MUCKLOW & HARRIS
CONSULTING CIVIL & STRUCTURAL ENGINEERS

Studio 313 Scott House, Custard Factory, Gibb Street, Digbeth, Birmingham, B9 4AA

Flood Risk Assessment and Drainage Strategy

Land Adjacent to Boleyn Road, Rubery

for

Capita

Job No: 20131	**Flood Risk Assessment and Drainage Strategy** **Land Adjacent to Boleyn Road**

Revision	Date of issue	Comments	Prepared By
*	24.03.21	First Issue	RAA

Should you have any queries relating to this document please contact:

Riaz Alam
Mucklow & Harris Ltd

T: 0121 771 0845
E: r.alam@mucklowandharris.co.uk

MUCKLOW & HARRIS
CONSULTING CIVIL & STRUCTURAL ENGINEERS

Studio 313 Scott House, Custard Factory, Gibb Street, Digbeth, Birmingham, B9 4AA

Contents

MUCKLOW & HARRIS
CONSULTING CIVIL & STRUCTURAL ENGINEERS

Studio 313 Scott House, Custard Factory, Gibb Street, Digbeth, Birmingham, B9 4AA

1.0 Introduction

1.1 Mucklow & Harris Limited have been commissioned by Capita to prepare a Flood Risk Assessment and Drainage Strategy for a residential development on land adjacent to Boleyn Road, in order to submit an outline planning application to Birmingham City Council.

1.2 The Flood Risk Assessment will address the requirements of the National Planning Policy Framework (NPPF) by looking at the risks from all possible sources of flooding. This report follows government and local guidance on development and flood risk and is undertaken in consultation with the relevant bodies.

1.3 It is a requirement for development applications to consider the potential risk of flooding to the proposed development over its expected lifetime and any possible impacts on flood risk elsewhere in terms of its effects on flood flows and run off.

The following aspects of flood risk should be addressed in all planning applications in flood risk areas:

a. The area liable to flooding.
b. The probability of flooding occurring now and over time.
c. The extent and standard of existing flood defences and their effectiveness over time.
d. The rates of flow likely to be involved.
e. The likelihood of impacts to other areas, properties and habitats.
f. The effects of climate change which currently requires designs to include 1 in 100-year rainfall events including an allowance for 30% climate change allowance.
g. The nature and current expected lifetime of the development proposed and the extent to which it is designed to deal with flood risk.

1.4 The Drainage Strategy will establish the hydrological context of the existing site and provide an approximate assessment of permeable and impermeable areas within the current site and associated greenfield run off rates. It will also describe how the development will be drained to address the requirements of a full planning application.

1.5 The Proposed development is for 71 no. two, three and four bed units with new adoptable access roads, associated parking bays and landscaped areas.

1.6. From April 2015, Lead Local Flood Authority (LLFA) is a statutory consultee for planning applications in relation to surface water drainage, requiring that all planning applications are accompanied by a sustainable Drainage Strategy. The aim of the Sustainable Drainage Strategy is to identify water management measures including sustainable drainage system (SuDS) to provide surface water runoff reduction and treatment.

1.7 Once submitted for planning and subject to the approval of this strategy by Birmingham City Council and their respective consultants including the Local Lead Flood Engineer (LLFE), this strategy will set the design parameters for future detailed design and construction of all the surface and foul water drainage including sustainable drainage facilities and infrastructure.

2.0 Site Location and Description

2.1 The site comprises of a parcel of land that is located south of Boleyn Road in Rubery, South West of Birmingham city centre, approximately 12km. The Ordnance Survey National Grid reference for the site is E398633, N278723. The nearest postcode is B45 0NL. The location plan can be found in Appendix 1.

2.2 The site is irregular in shape and covers an area of approximately 2.3Ha.

2.3 The site comprises an open, unoccupied field, which was once part of the playing fields of Holly Hill Church School and Balaam Wood School. The land has now been fenced off from the school playing fields. There is one dominant tree to the centre of the field, with small trees and shrubs along the Northern, Southern and Western Boundary.

2.4 The sites neighbouring land uses are summarised below:

- To the North: Boleyn Road, beyond this, further fields
- To the South: Residential properties
- To the East: Playing fields of Holly Hill Church School and Balaam Wood School
- To the West: Boleyn Road, beyond this, further fields

2.5 The site can be accessed immediately off Boleyn Road to the west.

2.6 The site generally falls from the north to the south by approximately 3.5m. A copy of the topographical survey can be found in Appendix A2.

3.0 Site Development Proposals

3.1 At the time of preparing this report, the proposals are for a residential development with the potential for 59 No. two, three and four bed houses and 12 No. two bed apartments. The site will also comprise associated adoptable access road, driveways and soft landscaping including private garden areas.

3.2 A site development plan can be found in Appendix A3.

4.0 Existing Drainage

4.1 Severn Trent Water Limited has been contacted and a copy of the Development Enquiry and response can be found in Appendix A4.

4.2 **Private Drainage**

4.2.1 The site has never been developed; therefore we do not anticipate any existing private drainage within the site.

4.2.2 Since 1 October 2011 many private sewers have been transferred into the ownership of Severn Trent Water Limited as public sewers, where two or more properties in separate ownership are served by those sewers. Most of these former private sewers will not be shown on the public sewer records, therefore a full site survey should be carried out prior to any layout design or construction works to identify where these sewers may be and to avoid later delays and possible added costs.

4.3 **Foul Water Drainage**

4.3.1 There is an existing 225mmØ public foul water sewer, south of the site within Dorset Close, approximate depth 3.0 to 5.0m.

4.4 **Surface Water Drainage**

4.4.1 There is an existing 450mmØ public surface water sewer, south of the site within Dorset Close, approximate depth 3.0 to 5.0m.

5.0 Planning Policy and Flood Risk

5.1 The National Planning Policy Framework (NPPF) sets out the legislative process for how planning applications are assessed for suitability and the policies to be followed by all sites being brought forward for development. Any development application that lies in Flood Zone 1 that is larger than 1 hectare in size, must be accompanied by a site-specific Flood Risk Assessment.

5.2 A Flood Risk Assessment is required for all new developments in Flood Zone 2 and 3 or in an area within Flood Zone 1, which has critical drainage problems and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding. The Environment Agency and Local Authority flood map shows the site to be within Flood Risk Zone 1 with the site of having less than 0.1% or 1 in 1000 chance of flooding – This means that the proposed development has a low probability of flooding. The design of the development layout should incorporate sustainable drainage measures.

5.3 Applicable Planning Policy

5.3.1 Technical Guidance to the National Planning Policy Framework (NPPF) deals specifically with development planning zones. The main study requirement is to identify the flood zones and vulnerability classification relevant to the proposed residential development, based upon an assessment of current and future conditions.

5.4 Planning Zones

5.4.1 The overall aim should be to steer new developments to Flood Zone 1. Where there is no reasonably available site in Flood Zone 1, local planning authorities allowing land in local plans or in determining planning applications for development at any location should consider the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 be considered, considering the flood risk vulnerability of land uses and applying the Exception Test if required.

Table 5.1 – NPPF/Flood Zones

The table below shows how flood zones relate to a sequential planning response. There are advisory notes placed upon the type of development.

Zone 1: Low Probability	
Definition This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding (<0.1%).	**Appropriate Uses** All uses of land are appropriate in this zone. **FRA requirements** For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment. This need only be brief unless the factors above or other local considerations require particular attention. **Policy Aims** In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond, through the layout and form of the development and the appropriate application of sustainable drainage systems.
Zone 2: Medium Probability	
Definition This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%-0.1%) in any year.	**Appropriate Uses** Essential infrastructure and the water compatible, less vulnerable and more vulnerable uses as set out in table 2 are appropriate in this zone. The highly vulnerable uses are only appropriate in this zone if the Exception Test is passed. **FRA Requirements** All development proposals in this zone

	should be accompanied by a flood risk assessment. **Policy Aims** In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area, through the layout and form of the development and the appropriate application of sustainable drainage systems.

Zone 3a: High Probability	
Definition This zone comprises land assessed as having between a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.	**Appropriate Uses** The water compatible and less vulnerable uses of land (table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. The more vulnerable uses and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood. **FRA requirements** All development proposals in this zone should be accompanied by a flood risk assessment. **Policy Aims** In this zone, developers and local authorities should seek opportunities to: • Reduce the overall level of flood risk in the area, through the layout and form of the development and the appropriate application of sustainable drainage systems. • Relocate existing development to land in zones with a lower probability of flooding. • Create space for flooding to occur by

	restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Zone 3b: Functional Floodplain	
Definition This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments, areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.	**Appropriate Uses** Only the water-compatible uses and the essential infrastructure listed in table 2 that has to be there should be permitted in this zone. It should be designed and constructed to: • Remain operational and safe for users in times of flood. • Result in no net loss of floodplain storage. • Not impede water flows. • Not increase flood risk elsewhere. Essential infrastructure in this zone should pass the exception test. **FRA Requirements** All development proposals in this zone should be accompanied by a flood risk assessment. **Policy Aims** In this zone, developers and local authorities should seek opportunities to: • Reduce the overall level of flood risk in the area, through the layout and form of the development and the appropriate application of sustainable drainage systems. • Relocate existing development to land with a lower probability of flooding.

Table 5.2 – Flood Risk Vulnerability Classification

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations, grid and primary substations and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly Vulnerable	• Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent (where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations or need to be located in other high flood risk areas, in these instances the facilities should be classified as “essential infrastructure”).
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non-residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities and hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

Less Vulnerable	• Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non-residential institutions not included in "more vulnerable" and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewerage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water Compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewerage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigations facilities. • Ministry of Defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping

	accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Note:

1. This classification is based partly on DEFRA/Environment Agency research on Flood Risks to People (FD2321/TR2) and also on the need of some uses to keep functioning during flooding.

2. Buildings that combine a mixture of uses should be placed into the higher of the relevant classes of flood risk sensitivity. Developments that allow uses to be distributed over the site may fall within several classes of flood risk sensitivity.

3. The impact of a flood on the particular uses identified within this flood risk vulnerability classification will vary within each vulnerability class. Therefore, the flood risk management infrastructure and other risk mitigation measures needed to ensure the development is safe may differ between uses within a particular vulnerability classification.

MUCKLOW & HARRIS
CONSULTING CIVIL & STRUCTURAL ENGINEERS

Studio 313 Scott House, Custard Factory, Gibb Street, Digbeth, Birmingham, B9 4AA

Flood Risk Vulnerability and Flood Zone Compatibility

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

Key: ✓ Development is appropriate

× Development should not be permitted

Notes to table:

This table does not show:

a) The application of the "Sequential Test" which guides development to Flood Zone 1 first, then Zone 2 and then Zone 3.

b) Flood Risk Assessment requirements, or

c) The Policy aims for each flood zone.

5.5 Flood and Water Management Act 2010

5.5.1 The FWMA is a direct result of the recommendations made by Sir Michael Pitt, taken from his report on the severe flooding experienced across the country in 2007 and was given Royal Assent in April 2010. It provides for better, more comprehensive management of flood risk for people, homes and businesses, helps safeguard community groups from unaffordable rises in surface water drainage charges and protects water supplies to the consumer.

5.5.2 The Act is being implemented by a series of ministerial orders. Currently, orders have been commenced which:

- Require the EA to develop a national flood risk and coastal management strategy,
- Establish Lead Local Flood Risk and Coastal Management authorities,
- Establish Regional Flood Risk and Coastal Management Committees,
- Providing for changes to administration and financing of Flood Risk and Water Management.

5.5.3 However, the most significant change facilitated by the FWMA is the establishment of the Sustainable Drainage National Standards and the Sustainable Drainage Approval Bodies (SABs). The National Standards will prescribe how surface water management design will have to be approached during new development and redevelopment proposals, adopting sustainable methods and practices. The SABs who will sit within the Lead Local Authority will then be tasked with scrutinising proposed surface water management strategies and evaluating them in terms of their technical feasibility and sustainability credentials. The documentation related to commencement of this part of the Act was issued for consultation in December 2011 and ended on the 13th March 2012. The full commencement of this Act is still outstanding as are the release of the National Standards.

5.6 Planning Strategic Flood Risk Assessment

5.6.1 The Birmingham City Council, Level 1 and 2 Strategic Flood Risk Assessment (2012) has been reviewed.

5.6.2 The Council Flood Zone map shows the site to be within Flood Zone 1.

5.7 Information Source

5.7.1 The Environment Agency's website was checked to assess the potential risk to the site from flooding. An extract of the flood map is included in Appendix A5.

5.7.2 To review and identify sources of flooding, data has been obtained from Centremaps in the format of Groundsure Enviro Insight Report. The results of this report are reviewed and summarised as part of this chapter. Extracts of the report can be found in Appendix A6.

5.8 Fluvial Flooding (from Rivers and the Sea)

5.8.1 The overall aim should be to steer new developments to Flood Zone 1. Where there is no reasonably available site in Flood Zone 1, local planning authorities allowing land in local plans or determining planning applications for development at any location should consider the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 be considered, considering the flood risk vulnerability of land uses and applying the exception test if required.

5.8.2 The site lies entirely within in Flood Zone 1, which is at low risk from flooding, with less than 0.1% or 1 in 100 chance of flooding from river and sea in any one year.

5.9 Historic Flooding

5.9.1 According to the Groundsure Enviro Insight report for the site, there are no reported historical flooding incidents within the site.

5.10 Surface Water (Pluvial) Flooding

5.10.1 Pluvial flooding results from rainfall generated overland flow before the runoff enters any watercourse or sewers or where the sewerage/drainage system and watercourses are overwhelmed and therefore unable to accept surface water.

5.10.2 Pluvial flooding is usually associated with high intensity rainfall events but may also occur with lower intensity rainfall where the ground is saturated, developed or

otherwise has low permeability which will result in overland flow and ponding within depressions.

5.10.3 Surface water flooding is limited to the south of the site. The majority of flooding is based on a 1 in 1000-year return period with depths ranging from between 0.1m to 0.3m.

5.11 **Flooding from Sewers and Drains**

5.11.1 Sewer flooding occurs when the capacity of the sewerage system is overwhelmed by heavy rainfall. This may be due to the sewer becoming blocked or having inadequate capacity resulting in flooding.

5.11.2 At the time of writing this report, there are no instances of sewers flooding within the site.

5.12 **Flooding from Groundwater**

5.12.1 According to the Groundsure Enviro Insight report and EA Flood Maps, the majority of the site is at low risk from ground water flooding. However, ¼ of the site towards the north is recorded to be at moderate risk from groundwater flooding.

5.13 **Flooding failure of infrastructure and/or artificial sources**

5.13.1 There are no artificial sources of water from reservoirs or canals that are recorded within the vicinity of the site which may influence the development; therefore, the site is considered at negligible risk from these sources.

5.13.2 There are existing surface water sewers close to the site which could lead to infrastructure failure and in turn lead to flooding, but this is unlikely to affect the site due to the site topography.

5.14 **Potential Flood Risk to the Site**

5.14.1 An appraisal was made of the site and surrounding areas to assess the potential risk of flooding at the site.

5.14.2 The proposed development is bound to the north and west by Boleyn Road, playing field to the east and residential properties to the south.

5.14.3 Boleyn Road falls east to west and then north to south west. The site falls from north to south by approximately 3m.

5.14.4 There is very little potential for flooding to occur from third party land.

6.0 Existing Ground Conditions

6.1 Patrick Parsons have prepared a Phase 1 Site Appraisal, dated March 2021. Below is a summary of its main findings.

6.2 **Site History**

The earliest reviewed mapping (1882) shows the site to be undeveloped in an agricultural landscape with minimal residential or industrial development. There is no significant development on site or any change to the site layout in subsequent mapping other than a drainage ditch marked in the centre of the site, and issues around 20m off the south east corner (1966).

6.3 **Geology**

The bedrock geology of the Aveley Member underlies the entire site comprising mudstones. There are superficial deposits across the northern part of the site which comprise of diamicton (boulder clay). Made ground is mapped approximately 120m to the east of the site but is not associated with any features seen of the OS mapping and worked ground is mapped of the south western corner of the site in the area of the former railway cutting. There are no BGS borehole records on site, however there are three in the surrounding area within 150m south and east of the site. All three boreholes suggest that the site is underlain by silty and sandy clay to a maximum depth of 1.50m begl. The shallow clays are underlain by interbedded sands, silts, and clays to a maximum depth of 4.50m begl. Sandstone and siltstone are encountered below 4.00m begl to 6.10m begl. Groundwater was recorded around 2m begl.

6.4 **Hydrogeology and Hydrology**

The site is underlain by the Aveley Member which is recorded to be a Secondary A Aquifer. The superficial deposits of the diamicton deposits that cover the northern end of the site are recorded as a Secondary (undifferentiated) Aquifer. The rest of the site is not covered by any superficial deposits. The site is approximately 180m north of the River Rea.

6.5 **Phase 1 Conceptual Model**

There are no significant potential sources of ground gases, such as landfills, recorded to be within influencing distance of the site. There is likely to be made ground across the southern half of the site, however, this is likely to have been derived from natural soils in the north. The BGS record made ground to the west of the site, however, there is no indication as to what activity this may have been associated with. Therefore, the risk of harmful ground gas impacting the proposed development is assessed as very low.

6.6 **Contamination and Remediation**

The risk of significant contamination being present at the site is considered very low.

6.7 **Geotechnical Considerations**

The ground conditions are likely to comprise cohesive and granular strata overlying the bedrock Aveley Member comprising siltstone and mudstones. There are some superficial strata in the very northern extent of the site made up of boulder clays and made ground is likely over the southern portion of the site.

Due to the anticipated presence of predominantly low permeability soils or made ground, it is considered unlikely that surface water disposal by the means of soakaway drainage will be feasible.

7.0 Sustainable Urban Drainage

7.1 Sustainable Urban Drainage Systems (SUDS)

7.1.1 Sustainable urban drainage systems (SUDS) involve the management of storm water from developments effectively, to reduce the impact of runoff both to the site in question and properties downstream and not to exacerbate existing problems. This is best achieved by using runoff as a resource by not increasing peak flows that will otherwise result from the development and by slowing and storing runoff to mimic, as closely as possible, the natural drainage run off and volumes from a site before development. Ensuring storm water runoff is treated so there is no detriment to water quality of the receiving watercourse is also fundamental.

7.1.2 Using a SUDS system may provide water quantity and quality control, as well as increased amenity value. Appropriately designed and maintained schemes may improve the sustainable water management at the site by:

- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream.
- Reducing the volume, rate of discharge and the frequency of water flowing directly to watercourses or sewers from the developed sites.
- Improving water quality compared with conventional surface water sewers by removing pollutants and/or reducing levels of pollutants.
- Allowing the development to adapt to the effects of climate change.
- Protecting groundwater resources from contamination.

7.2 The SUDS Approach

7.2.1 The design of SUDS should follow the “Management Train” as described in CIRIA 753 guidance. The aim of this is to consider an interconnected system of measures that combine effectively from where water falls to its eventual discharge or outfall, where practicable, controlling water as close to the source as possible by:

- Prevention (i.e., good housekeeping measures for individual properties).
- Source control including pervious infiltration systems.
- Conveyance systems that also provide flow and volume control as well as treatment.

- Larger and further downstream site control including storage systems.
- Treatment systems.

7.2.2 As an entire development is planned, the option of site control is available. However, where possible, it is desirable to control runoff at the source to reduce the size of any storage needed. Source control is the preferred option in any SUDS scheme and should be considered first. It involves controlling runoff at the source, by techniques including permeable pavements, etc.

7.2.3 There are many potential options using infiltration methods to lower the volume of water reaching the receiving watercourse. However, these options are not suitable where the infiltration capacity of the soil is low, where there is high water table and/or where ground contaminants might be mobilised.

7.2.4 The SUDS scheme must satisfy criteria for water quality and river protection, both during normal water levels and during flood conditions. In addition, an acceptably low level of site flooding frequency must be ensured and buildings must be designed to protect against flooding from the selected design storm event.

7.3 Potential SUDS Options on Site

7.3.1 The following represents our considered views on suitable SUDS options appropriate to this site. CIRIA C753 - The SUDS manual was initially consulted to examine the use of SUDS on this site in conjunction with the industry standard drainage hierarchy and the local guidance. It is the guidance that wherever possible, allowing for site conditions, for surface water to be managed as close to source as possible, as well as treated to achieve water quality improvements to surface water runoff from proposed developments.

7.4 Potential SUDS Techniques Considered for this Site

7.4.1 Below is a matrix of the feasibility of a range of SUD's techniques to identify which measures may be suitable for this site.

SUDS Feasibility Matrix		
Technique	*Physical Constraints*	*Feasibility*
Permeable pavement	Ideally requires a level site – good infiltration and no contamination	Possible, subject to soakaway testing
Permeable Car Park with underground storage	Permeable blocks; impermeable membrane liner; geotextiles; crushed stone; engineered sub-base storage.	Suitable – permeable paving strips on parking bays with tanked system
Green roofs	Roof slope for proposed buildings will preclude their use; flat roofs are ideal; also known as brown roofs and garden roofs.	Not provided
Bio-retention – shallow landscaped infiltration areas	Primarily used to remove pollutants from runoff and due to their shallow nature are not as effective at run-off attenuation as other SUDS techniques.	Not provided
Soakaways and infiltration trenches	Require infiltration rates of 1 x 10^{-6} m/s or greater. Shallow soakaways or infiltration trenches could be required where groundwater is shallow. Ground contamination may	Possible, subject to soakaway testing

	be an issue.	
Grassed filter strips – wide gently sloping areas of grass or other vegetation	Normally used to treat polluted run-off from car parks or roads. Not as effective at run-off attenuation as other SUDS techniques.	Not provided
Infiltration basins/swales	Area widely applicable for attenuation and treatment of surface run-off by infiltration into the ground. Require slope of no more than 4-10% and can act as a substitute for soakaways where groundwater is shallow – need to consider the impact these techniques have on local groundwater. Ground contamination may be an issue.	To be reviewed in Detail Design
Non-infiltration swales	Used in the same concept as carrier ditches or storage bunds.	Not provided
Filter drains	These are normally used adjacent to areas of car parking or roads and convey run-off via flow through an engineered substrate (normally gravel).	Not provided
Balancing ponds	These are permanent ponds that provide storage above the resting water level in the pond. Are appropriate for most sites but require suitable space. Require impermeable soils or can be lined.	To be reviewed in Detail Design

Rainwater harvesting	The collection and recycling of rainwater to be used for washing machines, irrigation and particularly for this site, ideal for vehicle washing.	Not Provided
Bio-retention Tree Pits	They filter out litter, oil and other pollutants washed from the street.	Not Provided

7.4 **SUDS Techniques Considered for this Site**.

7.4.1 **Rainwater Harvesting**

Rainwater from roofs can be stored and reused. If designed appropriately, the systems can also be used to reduce the rates and volumes of runoff.
Can provide a good source of water supply and reduce annual surface water runoff.

To be considered in detail design. Empirical evidence gathered from developers has indicated that there are significant maintenance issues associated with these facilities. Not Recommended.

7.4.2 **Discharge to a Surface Water Body**

Discharge to a surface water body would be discharging into an existing water course, canal, river or body of water such as lake or pond. Discharging to an ordinary watercourse requires approval from LLFA, whereas discharge to a main river will require approval from the Environment Agency, discharge to a canal will require approval from Canal and River Trust.

Not Recommended. Due to the site location, discharging to a Surface Water Body is not possible. No discharge opportunity available.

7.4.3 **Discharge to a combined sewer, Highway Drain or other drainage system**

Discharge to a combined water sewer, highway drain or other drainage system was historically the more conventional way of dealing with surface water before SUDs became a requirement through legislation and Planning Policy.

Recommended – existing public sewers are local to the site.

7.4.4 **Green Roofs**

Green roofs comprise a multilayered system that covers the roof of a building or podium structure with vegetation cover, over a drainage layer. They are designed to intercept and retain precipitation, reducing the volume of runoff and attenuating peak flows.

Cost to the structure can be considerable, suitable for shallow pitch roofs and poor maintenance will leave it looking unsightly.

Not feasible for residential properties.

7.4.5 **Swales**

Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate. They should promote low flow velocities to allow much of the suspended particulate load in the storm water runoff to settle out, thus providing effective pollutant removal. Roadside swales can replace conventional gullies and drainage pipes.

To be reviewed in Detailed Design, however, sufficient land to be put aside for a reasonable sized swale.

7.4.6 **Pervious Pavements**

Pervious pavements provide a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored between infiltration to the ground, reuse or discharge to a watercourse or other drainage system. Pavements with aggregate subbases can provide good water quality treatment.

The use of permeable paving for parking bays can be used as a stone subbase not only stores and slows down the rate of discharge, but also raises the water quality.

Recommended for inclusion on private drives and shared private driveways but must be tanked (should soakaway tests prove unsuccessful).

7.4.7 Geocellular/Modular Systems

Modular plastic geocellular systems with a high void ratio that can be used to create a below ground storage structure. Modular tanks can be used for runoff attenuation but requires silt trap protection and a suitable means of access for cleaning and inspection.

Whilst the preferred option is to utilise open, at-ground attenuation basins, these crates offer an efficient, cost-effective solution that can be located under parking areas.

Recommended, to be utilised as a storage system.

8 Surface Water discharge

8.1 Initially, it must be demonstrated that soakaways and other forms of infiltration are not feasible. At the time of writing this report, no permeability tests have been carried out.

8.2 Allowable levels of storm water discharge from the site to the public sewer system or watercourses are to be implemented after discussions with Severn Trent Water Limited and the Lead Local Flood Authority at Birmingham City Council.

8.3 Birmingham City Council provide the following guidance which is summarised below:

- All developments (greenfield and brownfield) surface water to be limited to greenfield run-off.
- Birmingham City Council, Lead Local Flood Authority promote the implementation of SUDS.
- Assessment on surface water flood risk and mitigation.
- To check if infiltration is viable and compliance with drainage hierarchy.
- Discharge to public sewers to be approved by Severn Trent Water Limited.
- Calculation will be based on 100 year plus 30% climate change.
- Finish floor levels should be designed to mitigate flood risk.

  Consideration should be given to exceedance flows.

8.4 Permeability tests for the for the site are pending. In the meantime, proposals are to have a surface water discharge from the site into the existing 450mmØ surface water sewer to the south of the site in Dorset Close.

8.5 The total discharge from the site is based on Q bar. Greenfield rates have been calculated using ICP SUDS based on the following:

Area = 2.32Ha
SAAR = 807mm
SPR = 0.47

Q bar	13.2 l/s
Q1	11.0 l/s
Q30	25.9 l/s
Q100	34.0 l/s

8.6 Based upon the proposals for the site, it has been estimated that the total impermeable contribution area is calculated at 1.05Ha.

8.7 Based upon an allowable discharge of 13.2 l/s, the table below lists the amount of attenuation required for any given return period.

Return Period	**Max Flow Rate**	**Attenuation Required**
2	13.0 l/s	127.3m³
30	13.1 l/s	270m³
100	13.1 l/s	381m³
100 + 30%	13.1 l/s	519.5m³

8.9 The surface water strategy and drainage calculations can be found in Appendix A7 and Appendix A8 respectively.

8.10 It is likely that oversized pipes in the adopted roads within the site will accommodate the 1 in 30-year storm event, restricted to Q bar with an adoptable Vortex flow control. The pipes will be offered for adoption to Severn Trent Water Limited under a section 104 agreement.

8.11 Private storage for the balance of the storage up to the 1 in 100-year event including an allowance of 30% for climate change will likely be in the form of cellular underground storage pond etc, within the site.

8.12 The development layout shall be designed to have a minimum impact on the existing sewers, with easement provided of 6m o/a for 225mmØ and 10m o/a for pipes over 225mm.

8.13 Flood routing is to be provided within the site to direct water in extreme storm events, above the 1 in 100 year + climate change, away from properties and towards the roads and/or landscaped areas. Flood routing can be provided by careful selection of floor levels, reshaping ground and utilising natural channels formed by the kerbs.

8.14 A separate surface water drainage system is to be provided within the site. There are existing sewers within the site.

8.15 The following SUDS features should be considered at detail design:

- Permeable Paving
- Water Butts
- Swales
- Ponds

8.16 The final storm connection would be made under a Section 106 Agreement with Severn Trent Water Limited.

8.17 Any required sewer diversions will be under a Section 185 Agreement with Severn Trent Water Limited.

9 Maintenance and Operational Considerations

9.1 Maintenances of SUDs features are important considerations to the effectiveness and design life of the drainage system as well as the SUDs features. In this development, all storm flows up to the 1 in 100-year flood event plus 40% climate change are accommodated within attenuation tanks in the private areas. Overland flow routing has been undertaken and the house floor levels set to ensure they are not at risk in such flood events.

9.2 Any other private areas or other drainage systems considered in the future would be the responsibility of the client or their management sub-contractors and consultation is underway to evidence the maintenance agreements required.

More details regarding the SUDS facilities incorporated in the site can be found in the table below.

SUDS Facility	Operation and Maintenance
Attenuation Tanks	Inspect after first storm Inspect /check inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed – annually Thereafter survey inside of tank for sediment build-up and remove as necessary - every 5 years or as required. (as outlined in Ciria report C753)
Silt Trap	Inspect six-monthly, empty every 12 months and after every major storm or local flood event.
Flow Control	Inspect every 12 months and following every major storm or local flood event.
Gullies (road)	Inspect per 6 months, empty every 12 months.

Permeable Paving	Inspect after every major storm or local flood event. Re-grit joints every 12 months or if grit is washed away. Replace permeable stone media every 25 years
Ponds & Wetlands	Removing litter and debris monthly or required. Inspecting silt accumulation half yearly. Removing Vegetation (25%) annually.
Swale	Removing litter and debris monthly or as required. Inspect inlets half yearly.

Road Gullies – To be maintained by Birmingham City Council

Adoptable Sewers/Flow Control – To be maintained by Severn Trent Water Limited

A more detailed operational and maintenance document will be required at detailed design once all of the SUDS features have been identified.

10 Foul Water Discharge

10.1 An estimation of the foul flows has been provided in the table below, based on a Dry Weather Flow (DWF) of 3 with the number of occupants per house calculated using the development proposals plan in Appendix A3.

Size of Unit	Number of units	Flow (l/sec)
2, 3 and 4 bed properties and apartments	79	2.3

10.2 The proposed foul discharge rate from the development will be discussed with Severn Trent Water to gain their comment and/or approval.

10.3 It is suggested that an unrestricted foul water discharge should be provided subject LLFA and Severn Trent Water approval.

10.4 Proposals are for the foul water to discharge into the existing 225mmØ public foul sewer to the south of the site.

10.5 A separate foul water drainage system is to be provided within the site.

10.6 The development layout shall be designed to have a minimum impact on the existing sewers, with a 6m easements provided for the 225mmØ pipes and 10m for pipes over 225mmØ. Where this is not possible, a sewer diversion will be required with the route agreed with Severn Trent Water Limited.

10.7 All sewer diversions will be under a Section 185 Agreement with Severn Trent Water Limited.

10.8 The final outflow pipe, a gravity connection, will be adopted under a Section 104 Agreement with Severn Trent Water Limited.

10.9 A copy of the foul drainage strategy can be found in Appendix A7.

11 Conclusions

11.1 Guidelines set out by Severn Trent Water Limited and Lead Local Flood Authority have been considered to determine the foul and surface water strategy for this development.

11.2 Surface water will discharge into the existing Severn Trent Sewer with additional flows attenuated on site within the below ground cellular attenuation restricted to Qbar with a discharge rate of 13.2 l/s, subject to LLFA and Severn Trent Water Limited Approval.

11.3 A full implementation of the guidelines should be undertaken at detail design. Applying for section 106 and 104 to Severn Trent Water Limited and satisfying the guidelines set out by the Lead Local Flood Authority which include the implementation of SUDS, flood storage mitigation, flood routing, network calculations and detailed operational and maintenance manual.

11.4 Permeability tests are to be carried out on site to determine whether soakaway drainage would be a viable discharge method.

11.5 The use of sustainable urban drainage (SUDS) has been considered and can be incorporated within the design, with the use of porous paving will be implemented.

11.6 Foul water will discharge to existing public foul sewers at an unrestricted discharge rate subject to LLFA and Severn Trent Water Approval.

11.7 The site lies within Flood Zone 1, and it is not at risk from flooding.

A1 LOCATION PLAN

A2 TOPOGRAPHICAL SURVEY

A3 DEVELOPMENT PROPOSALS

MUCKLOW & HARRIS
CONSULTING CIVIL & STRUCTURAL ENGINEERS

Studio 313 Scott House, Custard Factory, Gibb Street, Digbeth, Birmingham, B9 4AA

A4 SEVERN TRENT WATER DEVELOPMENT ENQUIRY RESPONSE

A5 ENVIRONMENT AGENCY FLOOD MAPS

A6 FLOOD ZONE MAPS – GROUNDSURE REPORT

MUCKLOW & HARRIS
CONSULTING CIVIL & STRUCTURAL ENGINEERS

Studio 313 Scott House, Custard Factory, Gibb Street, Digbeth, Birmingham, B9 4AA

A7 FOUL/ SURFACE WATER STRATEGY

MUCKLOW & HARRIS
CONSULTING CIVIL & STRUCTURAL ENGINEERS

Studio 313 Scott House, Custard Factory, Gibb Street, Digbeth, Birmingham, B9 4AA

A8 SURFACE WATER STORAGE CALCULATIONS