Government Property Agency

AtkinsRéalis



MANCHESTER DIGITAL CAMPUS

Drainage Strategy for Planning

NOVEMBER 2024

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1. Introduction

Atkins has been commissioned by Government Property Agency to prepare a Drainage Strategy to inform a Planning submission for a proposed new commercial development (the "Proposed Development") at Manchester (the "Site").

This Drainage Strategy has been prepared in accordance with the National Planning Policy Framework (NPPF)[1] and associated Planning Practice Guidance[2].

2. Background Information

2.1 United Utilities

United Utilities (UU) is the water distribution and sewerage company in Manchester. There are two UU Sewers that run within the Northern and Southern boundary of the site. Discussions and consultations have taken place with UU, and an application for a sewer diversion has been submitted to initiate dialogue with UU regarding the possibility of diverting or abandoning the current UU sewers on the site. A summary of the conversation has been provided below:

- For the Northern Sewer: This combined sewer is a deep and large diameter sewer running from northwest to northeast of the site which has been fully surveyed. If a 3-meter distance is maintained from the centreline of the sewer to any part of the building and structure, and piled foundations are utilised, thereby avoiding any surcharge to the sewer, compliance with both UU and Building Control requirements is achieved. In such a case, no diversion or formal easement arrangement would be necessary.
- For the Southern Sewer: According to UU records, this combined sewer is deep and of a large diameter crossing part of the site before leaving the site onto Great Ancoats Street and is assumed not to be serving the surrounding area or properties. There are no access chambers (at least at ground level) and previous CCTV surveys have failed to access the sewer on the site. UU will not assume this sewer is abandoned until it is proven to have no live connections. Further investigations of this sewer will take place and the sewer will either be diverted, or if proven abandoned capped off and removed.
- Shooters Brook – UU suggested that the culvert passing adjacent to the site was of riparian ownership and later became adopted on Store Street further downstream. Despite surface water eventually entering the UU sewerage system, it initially enters a culvert controlled by Manchester City Council (MCC) who are the Lead Local Flood Authority (LLFA), and who should be approached in the first instance.

2.2 Manchester City Council

The LLFA, MCC have been contacted regarding the potential to discharge surface water flows into the Culverted watercourse 'Shooters Brook'. Their response has been summarised below:

- The Shooters Brook is a culverted ordinary watercourse, not a public sewer therefore it is not regulated by UU. All approvals in relation to this asset (such as discharge rate, connection, diversions) are regulated by the LLFA. An applicant would need to apply for and obtain Land Drainage Consent approval from the LLFA prior to works on the asset.

[1] National Planning Policy Framework, December 2023, Department for Communities and Local Government
[2] National Planning Practice Guidance, September 2023, Department for Communities and Local Government

- The culvert appears to be outside of the Site boundary; a proposed offsite connection would need to be supported by evidence of same ownership/3rd party agreements.
- The LLFA requires that all new discharge connections to ordinary watercourses achieve greenfield runoff rates. This criteria cannot be relaxed. Proposed greenfield rates must be supported by survey & assessments to show the asset is fit to receive the proposed flow in terms of capacity and condition. The proposed rates must also have due consideration of the standard return periods; MCC would not accept a 1:100-year greenfield discharge rate being applied to lower return periods.
- The only circumstance in which a relaxation of discharge rate could be considered (brownfield run off rates) is if survey proves that areas of the existing site drain via existing connections into the culverted ordinary watercourse. In such a case, in order for a relaxation to be considered by the LLFA, detailed calculations of the existing rate into the culvert (derived from the existing network) would need to be provided for consideration, along with survey & assessment providing evidence of capacity/condition as outlined above.
- Shooters Brook has been subject to multiple attempts at surveying by CCTV and by other means, however there is no safe access, and the culvert is not in a condition allowing a successful survey. It is therefore not known if an appropriate assessment can be obtained.

3. Site Description

3.1 Location

The Site is approximately 2.98 ha. (Site Location boundary) and comprises of vacant brownfield land, comprised mostly of hardstanding. There are existing trees / shrubs on the Site, mostly congregated on the southern, western, and northern boundaries. There is a significant level change across the Site, descending from the north to the southern extent at Great Ancoats Street. The Site has a main vehicular access point off Great Ancoats Street to the south.

The Site is bounded to the south-west by Great Ancoats Street and to the south-east the rest of the historic central retail park and Old Mill Street. The north-western boundary is formed by the Rochdale Canal. New Islington Marina is a section of canal that links the Rochdale Canal to the Ashton Canal and is located to the east.



Figure 3-1 Site location plan (not to scale)

3.2 Topography

A topographical survey has been undertaken by Survey Operations (drawing number MGS46696-UT-Rev E; date: 29th September 2023).
The topography within the Site is such that ground levels fall from the northwest to southeast. The levels in the northwest of the site have levels of approximately 49.6mAOD and fall to the southeast with levels of approximately 46.6mAOD. There are a number of retaining walls on the southern and western boundary of the site, that accommodate the level differences that were created to enable the former development of the Site. In general, ground levels fall into the Site from the surrounding land.

3.3 Land Use

3.3.1 Historic

An examination of old maps from the 2000, show the Site to contain dense urban housing with some industrial buildings and sites relating to the nearby canals. Over time the Site was progressively redeveloped with old buildings either demolished or repurposed. By 1981 the Site was largely cleared of development with mapping from 1989 showing it to be occupied by the Central Retail Park. This was present until the late 2010's when the buildings are shown to have been demolished.

3.3.2 Current

The Site is disused in its current condition. The former retail park buildings have been demolished to ground level with floor slabs, the surrounding carpark, and service yard areas remaining.

3.4 Ground Conditions

3.4.1 Soils

According to Soilscapes[3], the natural soils on the Site are described as *slowly permeable seasonally wet acid loamy and clayey soils*.

3.4.2 Made Ground

The Ground Investigation Report[4] reveals that Made Ground has been identified as being present across the Site. The Made Ground consists of brick and concrete to depths of 0.7m bgl while between approximately 0.15m and 2.0m below ground level comprise clayey, sandy gravel and gravelly sand.

[3] Soilscapes, www.landis.org.uk/soilscapes/
[4] Ground Investigation Report – Appendix 12.2

3.4.3 Geology

3.4.3.1 Superficial Deposits

According to the Ground Investigation Report, the superficial deposits underlying the Site are described as Glacial Till consisting of gravelly and sandy gravelly clay. This stratum has been shown to extend to a maximum depth of approximately 24.5.0m below ground level.

3.4.3.2 Bedrock

The Ground Investigation Report and the British Geological Survey identify the bedrock beneath the Site to be sandstone (Chester Formation) which is present at depths varying between 24.5m and 39.0m below ground level.

3.4.3.3 Contamination

Due to the historic use of the Site and the presence of Made Ground, there is a likelihood that contamination is present. Further details are provided within the Ground Investigation Report however to summarise, the potential contaminants include Asbestos, Heavy Metals, PAHSs, Fuels and Ground gases due to the sites historical activities including; factorise, corporation yards, timber yards and retail park.

3.5 Water Environment

3.5.1 Drainage

3.5.1.1 Land Drainage

There is no evidence available of any land drainage systems being present within the Site. If any land drainage is encountered during construction, it must be reconnected and/or diverted to ensure continuity of drainage post-development.

3.5.1.2 Private Drainage

The Site is currently served by a private surface and foul water drainage system. It is believed that these discharge into the public sewerage network within Old Mill Street at the eastern end of the Site.

The topographical survey carried out indicates there is existing foul drainage present within the site boundary, possibly serving the historic retail buildings that have now been demolished and shows that the site previously connected foul flows into the combined sewers present on the site.

3.5.1.3 Public Sewerage

According to United Utilities (UU) sewer records for the Site and the surrounding areas, there are public sewers both within and surrounding the Site. A 900mm diameter combined sewer runs along the north-east boundary of the Site in a south-easternly path towards a 1500mm diameter combined sewer that runs into Old Mill Street. A second 700mm diameter combined sewer located within the site's northwestern boundary flows in a south-east direction with the diameter increasing from 700mm to 760mm.

The 900mm diameter sewer is approximately 7m deep while the 700mm diameter sewer is of an unknown depth within the site boundary however further downstream, the sewer is approximately 7m deep.

The public sewers have associated easements that will restrict what can be constructed on or over them. The widths of these easements are up to 6.5m wide.

3.5.2 Watercourses

There are no open watercourses within the Site.

The Shooters Brook runs in a southerly direction in a 900mm diameter culvert adjacent to the eastern boundary of the Site. The culvert is approximately 8m deep below ground level.

The closest Main River is the River Medlock located approximately 700m south-east of the Site.

3.5.3 Waterbodies

There are no waterbodies located within the Site.

The Rochdale Canal is located immediately adjacent to the north-western boundary of the Site. This has a water level of approximately 40.0m AOD. The Ashton Canal is located approximately 150m to the south-east of the Site with the Ashton Canal Islington Branch extending from the Ashton Canal to a point immediately adjacent to the Site off Old Mill Street.

The Rochdale Canal and Ashton Canal are connected by New Islington Marina which is located approximately 70m from the north-eastern boundary of the Site. As there are no locks between the various sections of canal in the vicinity of the Site, they all have a common water level of 40.0m AOD.

3.5.4 Groundwater

According to Environment Agency mapping, the Site is not located within any groundwater Source Protection Zones. The superficial deposits underlying the Site are classified as a *Secondary (Undifferentiated)* aquifer. The bedrock underlying the site is designated a *Principal Aquifer*. The groundwater is identified as having medium vulnerability to pollution.

Intrusive investigations identified groundwater at depths between 1.9m and 5.0m below ground level. The Ground Investigation report indicates that the groundwater was recorded at depths as shallow as 0.5mbgl.

It is believed that this groundwater is perched groundwater rather than being representative of the water table associated with the Principal Aquifer.

4. Proposed Development

4.1 Description

The site is located within Flood Zone 1.

The proposed development is for of a new civil service office campus including:

- North Building comprising basement, ground plus seven floors of offices, plus enclosed and exposed rooftop plant up to 92.950 AOD;

- South Building comprising basement, ground floor commercial uses, cycle parking, and occupiable office floorspace, plus six floors of offices plus enclosed and exposed rooftop plant up to Level 90.100 AOD;
- Basement level accessible car parking of 50 spaces with access via Great Ancoats Street (plus 5 spaces associated with facilities management and operations);
- The creation of new areas of public realm, including improved frontage to Great Ancoats Street, a Canal Plaza adjacent to the Rochdale Canal, and a new boulevard between the two buildings.
- An area of private landscaping adjacent to the North Building enclosed by a boundary wall and a private garden adjacent to the east elevation of the South Building; and
- Associated servicing and access arrangements.

Primary vehicle access from Great Ancoats Street plus emergency vehicle access only via Hugh Oldham Way, connecting to Old Mill Street. The primary access allows transition into the undercroft situated alongside the building basements, where vehicle parking is available. There is no car parking at the ground floor level.

The podium above the undercroft parking area, and extending into the wider public realm areas, is proposed to consist of hardstanding and other landscape features such as trees and raised planters.

5. Surface Water Drainage Strategy

5.1 Existing Drainage Regime

This section describes the existing drainage regime for the Site. The Site in its current condition collects surface water via road gullies, as discussed in section 3.5.1.2, which discharges into the UU public sewers adjacent to the northern and eastern boundary of the Site. As the surface of the existing site comprises impermeable surfacing such as tarmac and concrete, it is assumed that no infiltration occurs.

The greenfield equivalent runoff rates have been calculated using IH124 Flood Estimation for Small Catchments with the ICP SUDS modifications as the Site has an area of less than 50ha. MicroDrainage Source Control was used to undertake the calculations using the following parameters:

- Area 2.1 ha (total site area)
- SAAR (Standard Annual Average Rainfall) 866 mm
- SOIL 0.450
- Urban 0.000
- Region 10

The calculation results are shown in Table 5-1.

Table 5-1 - Existing greenfield equivalent surface water run-off rates

AEP*	Run-off flow (l/s)
100%	10.3
42.9% (QBAR)	11.8
3.3%	20.1
1%	24.6

* Annual exceedance probability

5.2 Proposed Outfall

In accordance with Design Construction Guidance (DCG) section A4.2, the surface water drainage proposals should fully explore the surface water hierarchy of connection, which can be summarised as follows:

- Surface water runoff is collected for re-use.
- Discharge into the ground via infiltration.
- Discharge to a watercourse or other surface water body.
- Discharge to a surface water sewer, highway drain or other drainage system.
- Discharge to a combined sewer.

Collection and reuse of surface water runoff will be explored in further detail as the design for the buildings progress, although this is expected to be achieved only for a small proportion of the total surface water runoff, from roof areas. There is potential for the proposed water feature to utilise the water collected from roofs rather than using potable water.

The ground under the site is considered to offer a poor potential for infiltration. The Flood Risk appraisal[5] and section 3.4.1 describes the composition of the natural soils on the Site as slowly permeable *seasonally wet acid loamy and clayey soil*. The report also indicates that there was some made ground present across the Site extending to depths of between approximately 0.15m and 2.0m below ground level. Disposal of the water to ground is, therefore currently not being considered at this stage but will be investigated as the design progresses to see if any use of this method could be made.

There is an opportunity to discharge surface water into the Shooters Brook culvert that runs adjacent to the site boundary. The depth of the culvert is of sufficient depth to achieve a gravity network however the outgoing pipe from the culvert is a 300mm diameter pipe which would reduce the system's capacity as this pipe essentially behaves like a flow control. There are no surface water sewers on the site. Surface water from the Proposed Development would ideally discharge to the Shooters Brook culvert. However, in the event that the discharge to the culvert is not viable due to capacity and condition issues, surface water will be discharged into the combined sewers. The surface and foul water will be kept separate until the point of discharge into the combined sewer. The combined sewers are a United Utilities public asset located within the Site.

5.3 Maximum Permitted Discharge Rate

In accordance with MCC requirements, detailed in Section 5.46 of the *Local Flood Risk Management Strategy*[6]*,* the maximum permitted discharge rate from the Proposed Development should be limited, if possible, '*to the greenfield equivalent runoff rate for the Site for all rainfall events up to and including the 1% AEP plus climate change event. If it is proven and demonstrated to be impractical to achieve this reduction in flow rate, a higher discharge rate can be used up to a maximum of the existing brownfield run-off rate with 50% betterment.'*

The greenfield equivalent run-off rates for the Site have been calculated and have been summarised in Section 5. Table 5-1 - Existing greenfield equivalent surface water run-off rates.

On this basis, the target maximum permitted discharge rate for the Proposed Development will be the existing run-off rates stated in Table 5-1 - Existing greenfield equivalent surface water run-off rates. If a complex flow control is used, the discharge rate for a particular rainfall event can be limited to the greenfield run-off rate for the

[5] Environmental Statement Volume 2 – Chapter 19 Water Resources and Flood Risk November 2024
[6] Manchester City Council Local Flood Risk Management Strategy 2014

same rainfall event. If a simple control is used, the discharge rate will be limited to the average annual greenfield rate (QBAR) for all rainfall events up to and including the 1% AEP plus climate change event (45% CC).

5.4 SuDS Selection

Sustainable Drainage Systems (SuDS) mimic the natural drainage processes to reduce the effect on the quality and quantity of run-off from developments and provide amenity and biodiversity benefits. A SuDS assessment has been carried out to identify the viable SuDS features that can be implemented in the drainage design.

The SuDS will be implemented to reduce the rate at which rainfall is discharged from the Site, provide necessary storage volumes and improving the quality of the receiving outfall. The necessary volume can be stored in the attenuation tanks under the concourse areas outside the building, basements and undercroft extents. There is also opportunity to utilise storage volumes available in tree pits and raised planters. The configuration of the tanks is dependent on the depth of the final outfall and the space available around the buildings, basements and undercroft.

According to CIRIA C753, Table 4.3, the Proposed Development has a *low* pollution hazard level. Where run-off is to be discharged to surface waters, the *Simple Index Approach* has been used to assess the water quality management requirements for the proposed development.

According to CIRIA C753, Table 26.2, the *low* pollution hazard levels for the Proposed Development translate to the pollution hazard indices set out in Table 5-2.

Table 5-2 - Development pollution hazard indices

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Low Traffic Roads (Fire Escape Route)	Low	0.5	0.4	0.4
Roofs (Commercial)	Low	0.3	0.2	0.05

The parameters for the initial selection of SuDS components for this site using CIRIA C697 Table 5.4, reproduced in **Appendix A**, are as follows:

- Soils — Impermeable (as infiltration is not viable)
- Area draining to a single SuDS component — 0 - 2ha
- Minimum depth to water table — >1m
- Site slope — 0 - 5%
- Available head — 1 - 2m
- Available space — Low

Based on this initial selection process, the following SuDS techniques are identified as being potentially suitable for the Proposed Development:

- Sub-surface storage
- Pocket wetland
- Perimeter sand filter
- Filter trench/drain
- Green roof
- Rainwater Harvesting
- Permeable paving

The subsurface storage is anticipated to provide the primary surface water storage within the Proposed Development. This will take the form of storage tanks located underneath the hardstanding areas outside the proposed building, undercroft and basement extents.

Wetlands require either a continuous through-flow of water or consistently high groundwater levels and a large amount of space. There is very little space available for wetlands on the site hence pocket wetlands are not considered to be a viable SuDS technique for this Site.

Perimeter sand filters are not proposed due to lack of suitable areas to position them within the layout of the Proposed Development.

Filter trenches/drains are considered suitable to allow water treatment to be provided for the low traffic access roads. Levels will need to be refined in order to collect run off from the road effectively.

The Proposed Development will not incorporate a green roof at this stage as these are not compatible with the building structure type of the new offices. This can be explored at later stages when the proposed building designs develop.

Rainwater Harvesting has not been proposed however there is a potential at later design stages for rainwater harvesting due to the BREEAM aspirations for the development. At this stage rainwater harvesting has not been considered.

Permeable paving is not proposed for use within the car parking spaces as these are within the undercroft below ground. There is opportunity for this to be used within the fire access road however this will be explored at later stages.

A Proprietary treatment system such as an oil interceptor has been proposed for providing water treatment to the roofs of the proposed buildings and the low traffic access road. The pollution mitigation indices for these SuDS components are set out in Table 5-3 as follows (CIRIA C753, Table 26.3).

Tree planters are also being proposed for the development, these planters can help to reduce pollution by capturing sediments, nutrients, and other pollutants carried by stormwater runoff. The tree pits and planters may be incorporated with the drainage to provide additional water treatment or as standalone features.

Table 5-3 - Pollution mitigation indices for selected SuDS components

SuDS component	Total suspended solids (TSS)	Metals	Hydrocarbons
Sub-surface storage	0.0	0.0	0.0
Filter trench/drain (Low Traffic Road)	0.4	0.4	0.4
Proprietary Treatment System (Roofs)	0.8	0.6	0.9

Source: CIRIA C753**Error! Bookmark not defined.**, Table 26.3 and 26.4 (extract)

Table 5-4 demonstrates the water treatment performance of the proposed configuration of SuDS features within the surface water drainage strategy. This includes the pollution mitigation indices for a proprietary system provided by a supplier.

Table 5-4 - Proposed SuDS configuration

Land use	Pollution hazard indices	SuDS feature	Pollution mitigation indices

	TSS	Metals	Hydrocarbons		TSS	Metals	Hydrocarbons
Low Traffic Road	0.5	0.4	0.4	Filter trench/drain	0.4	0.4	0.4
				Proprietary Treatment System	0.8	0.6	0.9
				Total	0.8	0.7	0.85
Roofs (Commercial)	0.3	0.2	0.05	Proprietary Treatment System	0.8	0.6	0.9

5.5 Proposed Strategy

Based on the proposed development layout plans, and as worst case, the site has been calculated as having a 100% impermeable area. It is proposed that the surface water drainage system will comprise a conventional pipe network, alongside SuDS components.

A Hydrobrake flow control is proposed to be used prior to the outfall into the existing network, limiting the flow to the maximum permitted flow rate for the Site. At detailed design stage, use of a complex flow control with be explored so that the discharge rate for a particular rainfall event can be limited to the greenfield run-off rate for the same rainfall event.

The storage has been designed to provide the necessary flow attenuation for all rainfall events up to and including the 1% AEP + 45% climate change event. The required storage volume for the site has been determined using MicroDrainage Quick Storage Estimate, a total storage volume of approximately $1800\mathrm{m}^3$. These tanks have been divided into three tanks due to the available space within the proposed development special constraints. The depth of the attenuation has been assumed as 2m deep, attenuation tanks exhibit a lack of lateral strength, and will require a structural evaluation to establish their maximum depth capacity.

Run off from the undercroft access road is proposed to be treated by filter drains/trenches while an oil interceptor will treat run off from the roofs of each building. The oil interceptor has been located at the end of the proposed drainage system to allow water treatment of all catchment areas before discharging surface water to the existing system.

Surface water flows are expected to enter the undercroft via vehicles and although these flows are minimal, they are likely to be polluted. It is expected that drainage channels will be present at the entrance of the undercroft to collect surface water. It is then proposed that these flows will discharge to the proposed foul drainage system.

5.6 Adoption & Maintenance

The proposed surface water drainage systems will be owned and maintained by Government Property Agency as part of their regular maintenance regime for the existing systems within the Site.

6. Foul Water Drainage

6.1 Foul Water Flow Rates

The proposed site consists of two office buildings with a total of 4337 people at 100% occupancy, the peak foul water flow rate generated from the building will be 34.3 l/s (based on 57 litres per person per day, 12 core hours per day and 6 x dry weather flow (DWF)).

6.2 Proposed Outfall

As mentioned in Public Sewerage 3.5.1.3 United Utilities sewer records indicate a number of public combined sewers crossing the site. These combined sewers within the site are of a sufficient depth to allow for a gravity connection. Due to existing combined sewer locations outside the site boundary, a connection into the existing combined 900mm sewer on the northeastern boundary of the site has been determined as a suitable point of connection.

6.3 Proposed Strategy

It is proposed that foul water flows within the Proposed Development will be conveyed via a gravity pipe network. The pipe network will consist of pipes laid at gradients that enable self-cleansing flow velocities to be achieved in accordance with the Design and Construction Guidance and Building Regulations Part H. The surface water volumes from ‘wet’ cars entering the undercroft are expected to be low and will be picked up by the foul drainage. This is subject to detailed design.

6.4 Adoption & Maintenance

It is anticipated that the proposed foul water drainage system will remain private and will be maintained by the Government Property Agency.

7. Conclusions & Recommendations

7.1 Conclusions

The Site comprises of vacant brownfield land, comprised mostly of hardstanding. There is a significant level change across the Site, descending from the north to the southern extent at Great Ancoats Street. The Site has a main vehicular access point off Great Ancoats Street to the south. The former retail park buildings have been demolished to ground level with floor slabs, the surrounding carpark and service yard areas remaining.

The Proposed Development comprises of two new office buildings with associated car parking in an undercroft, and public realm areas and landscape areas for pedestrian and building access. An emergency fire tender route also runs around the site.

The public realm and landscape areas consist of a mixture of hardstanding and softworks features such as trees and raised planters. Based on the proposed development layout plans, poor potential for infiltration, and as worst case, the site has been calculated as having a 100% impermeable area.

It is proposed that the surface water drainage system will comprise a conventional gravity pipe network, alongside SuDS components. There is an opportunity to discharge surface water into the Shooters Brook culvert that runs adjacent to the site boundary. However, in the event that the discharge to the culvert is not viable due to capacity and condition issues, surface water will be discharged into the combined sewers. The surface and foul water will be kept separate until the point of discharge into the combined sewer. The combined sewers are a United Utilities public asset located within the Site.

A Hydrobrake flow control is proposed to be used prior to the outfall into the final outfall, limiting the flow to the maximum permitted flow rate for the Site. At detailed design stage, use of a complex flow control with be explored so that the discharge rate for a particular rainfall event can be limited to the greenfield run-off rate for the same rainfall event.

The storage has been designed to provide the necessary flow attenuation for all rainfall events up to and including the 1% AEP + 45% climate change event. The required storage volume for the site has been determined using MicroDrainage Quick Storage Estimate, a total storage volume of approximately $1800\mathrm{m}^3$. These tanks have been divided into three tanks due to the available space within the proposed development special constraints. The depth of the attenuation has been assumed as 2m deep, attenuation tanks exhibit a lack of lateral strength, and will require a structural evaluation to establish their maximum depth capacity.

Run off from the access road is proposed to be treated by filter drains/trenches while an oil interceptor will treat run off from the roofs of each building. The oil interceptor has been located at the end of the proposed drainage system to allow water treatment of all catchment areas before discharging surface water.

The proposed site consists of two office buildings with a total of 4337 people at 100% occupancy, the peak foul water flow rate generated from the building will be 34.3 l/s (based on 57 litres per person per day, 12 core hours per day and 6 x dry weather flow (DWF)).

It is proposed that foul water flows within the Proposed Development will be conveyed via a gravity pipe network. The pipe network will consist of pipes laid at gradients that enable self-cleansing flow velocities to be achieved in accordance with the Design and Construction Guidance and Building Regulations Part H. The surface water volumes from ‘wet’ cars entering the undercroft are expected to be low and will be picked up by the foul drainage. This is subject to detailed design.

7.2 Recommendations

- Detailed coordination with landscape proposals to finalise locations of SuDS features at next stage
- Further ground investigation to confirm infiltration.
- Conduct further investigations on the southern sewer to confirm whether a diversion or abandonment for the sewer is required.
- Location of proposed manholes are coordinated with structures to understand access for maintenance.
- Explore use of complex flow control so that the discharge rate for a particular rainfall event can be limited to the greenfield run-off rate for the same rainfall event, thus reducing storage requirements while achieving greenfield run off rates.
- Establish undercroft drainage strategy.

APPENDICES

Appendix A. SuDS Selection

The following tables are taken from CIRIA C697 The SuDS Manual (2007).

CIRIA C697, Table 5.2 Land Use Selection Matrix

SuDS group	Technique	Low density	Residential	Local roads	Commercial	Hotspots	Construction site	Brownfield	Contaminated land
Retention	Retention pond	Y	Y	Y_1	Y_2	Y_2	Y_3	Y	Y_2
	Subsurface storage	Y	Y	Y	Y	Y	Y_3	Y	Y
Wetland	Shallow wetland	Y	Y	Y_1	Y_2	Y_2	N	Y	Y_2
	Extended detention wetland	Y	Y	Y_1	Y_2	Y_2	N	Y	Y_2
	Pond/wetland	Y	Y	Y_1	Y_2	Y_2	N	Y	Y_2
	Pocket wetland	Y	Y	Y_1	Y_2	Y_2	N	Y	Y_2
	Submerged gravel wetland	Y	Y	Y_1	Y_2	Y_2	N	Y	Y_2
	Wetland channel	Y	Y	Y_1	Y_2	Y_2	N	Y	Y_2
Infiltration	Infiltration trench	Y	Y	Y_1	Y_2	N	N	Y	Y_4
	Infiltration basin	Y	Y	Y_1	Y_2	N	N	Y	Y_4
	Soakaway	Y	Y	Y_1	Y_2	N	N	Y	Y_4
Filtration	Surface sand filter	N	Y	Y_1	Y_2	Y_2	N	Y	Y_2
	Sub-surface sand filter	N	Y	Y_1	Y_2	Y_2	N	Y	Y_2
	Perimeter sand filter	N	N	Y_1	Y_2	Y_2	N	Y	Y_2
	Bioretention/filter strip	Y	Y	Y_1	Y_2	Y_2	N	Y	Y_2
	Filter trench	Y	Y	Y_1	Y_2	Y_2	N	Y	Y_2
Detention	Detention basin	Y	Y	Y_1	Y_2	$Y_{1,2}$	Y_3	Y	Y_2
Open channels	Conveyance swale	Y	Y	Y_1	Y_2	Y_2	Y_3	Y	Y_2
	Enhanced dry swale	Y	Y	Y_1	Y_2	Y_2	Y_3	Y	Y_2
	Enhanced wet swale	Y	Y	Y_1	Y_2	Y_1	Y_3	Y	Y_2
Source control	Green roof	Y	Y	N	Y_2	Y	N	Y	Y
	Rainwater harvesting	Y	Y	N	Y_2	N	N	Y	Y
	Permeable paving	Y	Y	N	Y_2	Y_1	N	Y	Y_2

Y: Yes N: No

[1] May require two treatment train stages, depending on type and intensity of road use and receiving water sensitivity.

[2] May require three treatment train stages, depending on receiving watercourse sensitivity.
[3] Will require draw-down and rehabilitation following construction activities, prior to use as a permanent drainage system.
[4] Providing designs prevent mobilisation of contamination.

CIRIA C697, Table 5.4 Site Characteristics Selection Matrix

SuDS group	Technique	Soils		Area draining to a single SuDS component		Minimum depth to water table		Site slope		Available head		Available space	
		Impermeable	Permeable	0 - 2ha	>2ha	0 - 1m	>1m	0 - 5%	>5%	0 - 1m	1 - 2m	Low	High
Retention	Retention pond	Y	Y[1]	Y	Y[5]	Y	Y	Y	Y	Y	Y	N	Y
	Subsurface storage	Y	Y	Y	Y[5]	Y	Y	Y	Y	Y	Y	Y	Y
Wetland	Shallow wetland	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y	N	Y
	Extended detention wetland	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y	N	Y
	Pond/wetland	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y	N	Y
	Pocket wetland	Y[2]	Y[4]	Y[4]	N	Y[2]	Y[2]	Y	N	Y	Y	Y	Y
	Submerged gravel wetland	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y	N	Y
	Wetland channel	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y	N	Y
Infiltration	Infiltration trench	N	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y
	Infiltration basin	N	Y	Y	Y[5]	N	Y	Y	Y	Y	N	N	Y
	Soakaway	N	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y
Filtration	Surface sand filter	Y	Y	Y	Y[5]	N	Y	Y	N	N	Y	N	Y
	Sub-surface sand filter	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	Y
	Perimeter sand filter	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y
	Bio-retention/filter strip	Y	Y	Y	N	N	Y	Y	N	Y	Y	N	Y
	Filter trench	Y	Y[1]	Y	N	N	Y	Y	N	Y	Y	Y	Y
Detention	Detention basin	Y	Y[1]	Y	Y[5]	N	Y	Y	Y	N	Y	N	Y
Open channels	Conveyance swale	Y	Y	Y	N	N	Y	Y	N[3]	Y	N	N	Y
	Enhanced dry swale	Y	Y	Y	N	N	Y	Y	N[3]	Y	N	N	Y
	Enhanced wet swale	Y[2]	Y[4]	Y	N	Y	Y	Y	N[3]	Y	N	N	Y
Source control	Green roof	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
	Rainwater harvesting	Y	Y	Y	N	Y	Y	Y	Y	Y			
	Permeable paving	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y

Y: Yes N: No

[1] With liner
[2] With surface baseflow
[3] Unless follows contours
[4] With liner and constant surface baseflow, or high ground water table

[5] Possible, but not recommended (implies appropriate management train not in place)
[6] Where high flows are diverted around SuDS component.

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