Balcap Re Limited

Land to the rear of 159-163 Kings Cross Road – FLOOD RISK ASSESSMENT and SURFACE WATER STRATEGY

Job No: 1676

Date: 10/03/2017

Parmarbrook | 345 Old Street, London EC1V 9L | tel 020 7839 3999 | www.parmarbrook.com

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		Date 10.03.17
Prepared by		
MG		
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VB		
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Revision:		
-	**10.03.17**	**Formal Issue**

Abbreviations

AOD - Above Ordnance Datum

CDA - Critical Drainage Area

EA - Environment Agency

FRA - Flood Risk Assessment

FFL - Finished Floor Level

NPPF - National Planning Policy Framework

SFRA - Strategic Flood Risk Assessment

SUDS - Sustainable Drainage Systems

SWMP - Surface Water Management Plan

1.0 Introduction

Parmarbrook were commissioned to undertake a Flood Risk Assessment (FRA) for the subject called 'Land to the rear of 159-163 Kings Cross Road, WC1X 9BN'.

The Flood Risk Assessment is intended to support the associated planning application to the Local Authority and relevant statutory bodies. The information and strategies contained in this report aim to identify and highlight flood risk to the development and elsewhere as a result of the development. Proposed mitigation measures are also presented subsequent to this analysis. The following non-exhaustive strategic and local documents were reviewed:

- National Planning Policy Framework (NPPF)
- Camden Strategic Flood Risk Assessment (SFRA)
- Camden Surface Water Management Plan (SWMP)
- Site Investigation Reports
- Topographical Information
- EA Flood Maps

As part of this report a site visit was carried out to identify any existing watercourses, drainage routes and associated constraints not obvious from the relevant documentation available.

2.0 Site Description and Context

2.1 Site Description and Location

The site is located in the London Borough of Camden, approximately 340 m east of King's Cross St Pancras Railway and London Underground station, and 860 m west of Angel London Underground station. The site is located behind properties that front onto King's Cross Road to the northeast and Britannia Street to the northwest. It is bounded by a communal courtyard area that is accessed by apartments that front onto the aforementioned roads and Wicklow Street to the south. The site's National Grid Reference is TQ306829 and is circa 1.05 hectares in area.

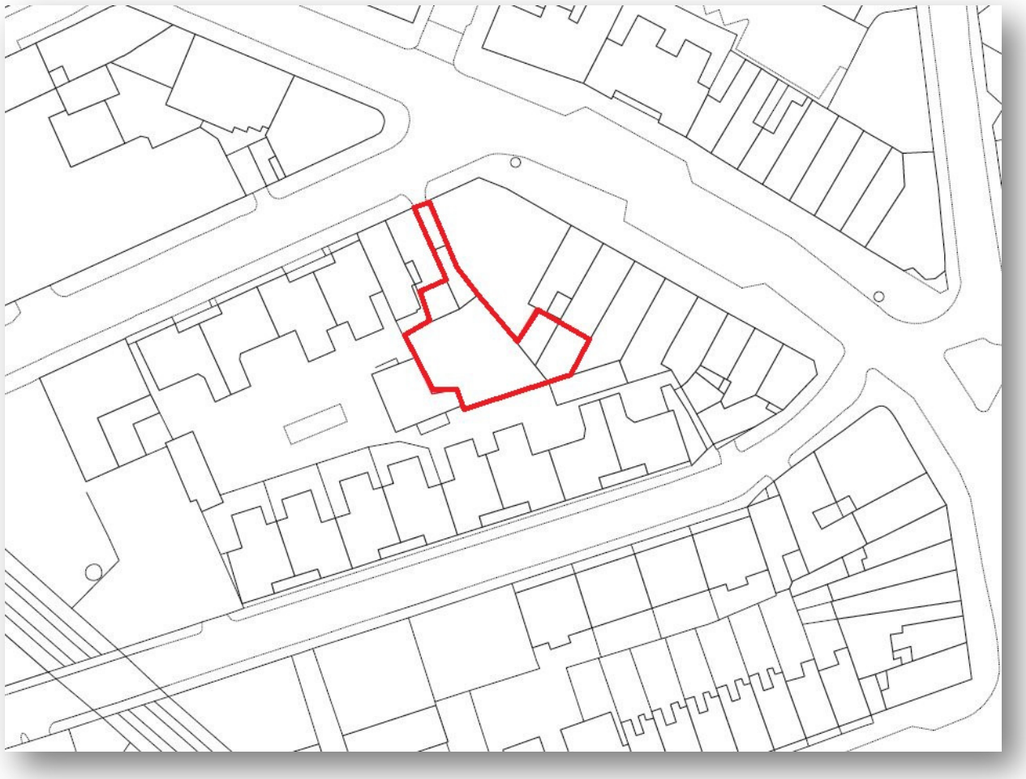

Figure 1.0 Site Location outlined in red.

The site is accessed from a vehicular access gate between No1 and No3 Britannia Street in the northeast. There are two-storeys above the access to site on Britannia Street although these are not accessible from the site.

Topography

A full topographical survey was carried out on site by 'Mobile CAD' in June 2016. The resultant survey shows a lowest site level of circa +14.096mAOD with the site falling towards Britannia Street which is at a level of circa +13.90mAOD.

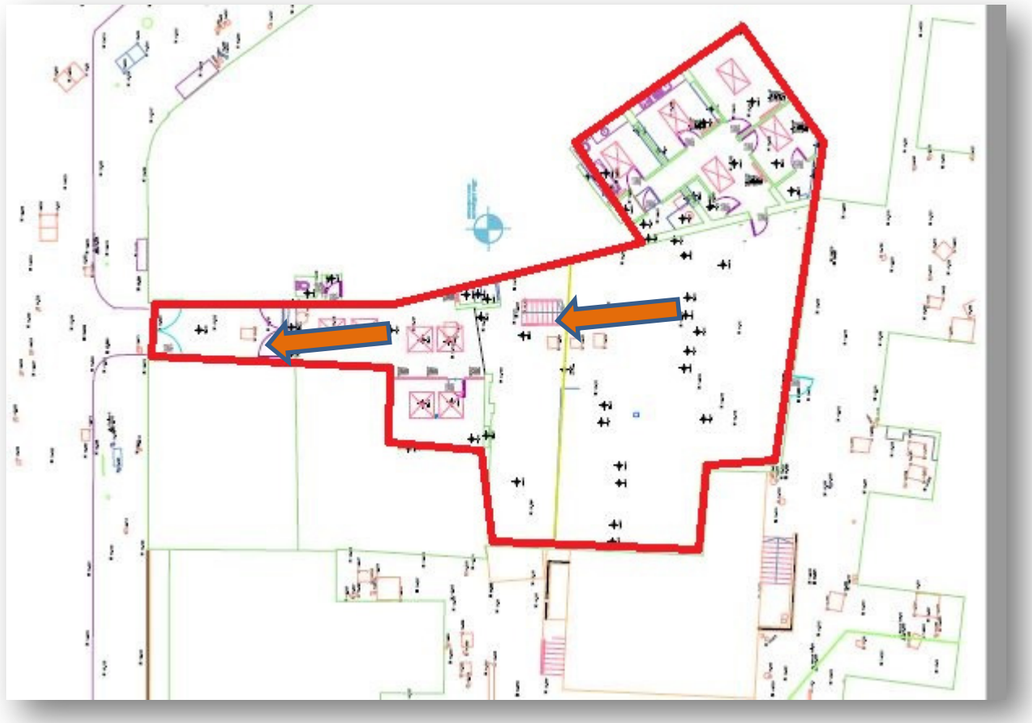

Figure 2.0 Site Topography with arrows showing site falls

Levels along Kings Cross Road fall in an easterly direction away from the site.

2.2 Site Geology and Hydrogeology

A site specific Phase 1 ground investigation has been carried out by GEA Consultants in November 2016. The scope included intrusive works including a borehole, window samples and trial pits.

The works found that below a significant thickness of made ground, the London Clay Formation was encountered to the full depth of the investigation (15.00m). The made ground generally comprised dark brown and grey very silty sandy gravelly clay, sand and silt with cobbles, fragments of brick, concrete and pockets of ash, and extended to depths of 1.90m and 3.80m. The London Clay initially comprised firm fissured medium strength silty clay which extended to a depth of 4.90m.

Groundwater was encountered during drilling in Borehole No2, at a depth of 3.0m, and subsequent monitoring has measured the groundwater at depths of 2.6m and 5.0m.

The site is not located within a Source Protection Zone as defined by the Environmental Agency.

2.3 Existing Site Drainage

As the site is a Brownfield site there are existing drainage networks within the site. A CCTV Survey was carried out in order to identify the existing networks and outfalls. The survey works found that the site is served by an existing 150mmø combined drain which runs towards Britannia Road and outfalls into the existing 1372x838mm Combined Sewer which runs eastwards towards Kings Cross Road.

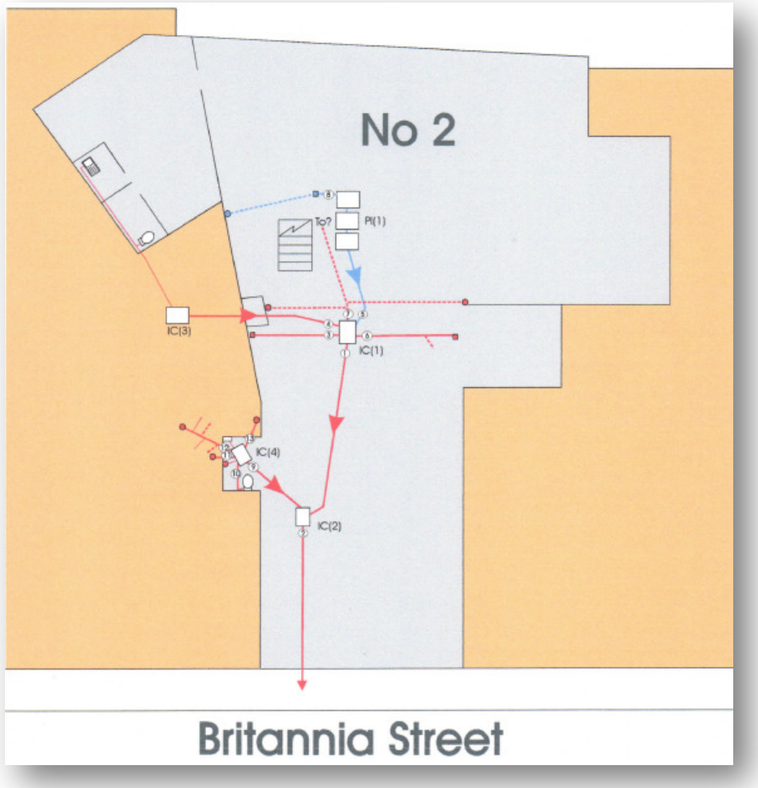

Figure 3.0 Existing Site Drainage

Please refer to Appendix C for Thames Water Sewer Records showing adjacent Public Sewers.

3.0 Development Proposals

3.1 Site Plan

The proposal will involve the demolition of the existing building and the construction of a 3 storey commercial office and gallery building plus a single storey basement which is within the proposed building footprint.

Figure 4.0 Development Site – Ground level

4.0 Assessment of Flood Risk

4.1 Flood Risk Sources

Potential sources of flooding that could pose a risk to a site are presented below in Table 1.0.

Flood Source	Mechanism	Site Impact
Tidal/fluvial (River Thames)	Extreme flood water levels which result in overtopping/breach of river defences	Flood waters entering buildings via thresholds and other openings. Flooding of external areas etc.
Surface Water Run-off from Heavy Storm Events	Surcharging/inundating of existing drainage networks with overland flows to site.	Flood water entering site from adjacent highways/paved areas. Affecting basements and/or external areas
Groundwater	Rising groundwater within underlying aquifers	Rising groundwater levels could affect basements if pathway available

Table 1.0 Flood Risk Sources

4.2 Tidal/Fluvial Flooding

The EA Flood Hazard maps also show that the site is not at risk from tidal/fluvial flooding and is in Flood Zone 1 – low risk. Sites within Flood Zone 1 are classified as having less than a 1 in 1,000 annual probability of sea or river flooding (<0.1%).

From this information it can be assumed that there is a low risk from Tidal/Fluvial flooding to the proposed development. It can also be seen that the subject site is not in a flood plain and there are no floodwater paths over the site. As such the development will not increase the risk from Tidal/Fluvial flooding to other sites within the area.

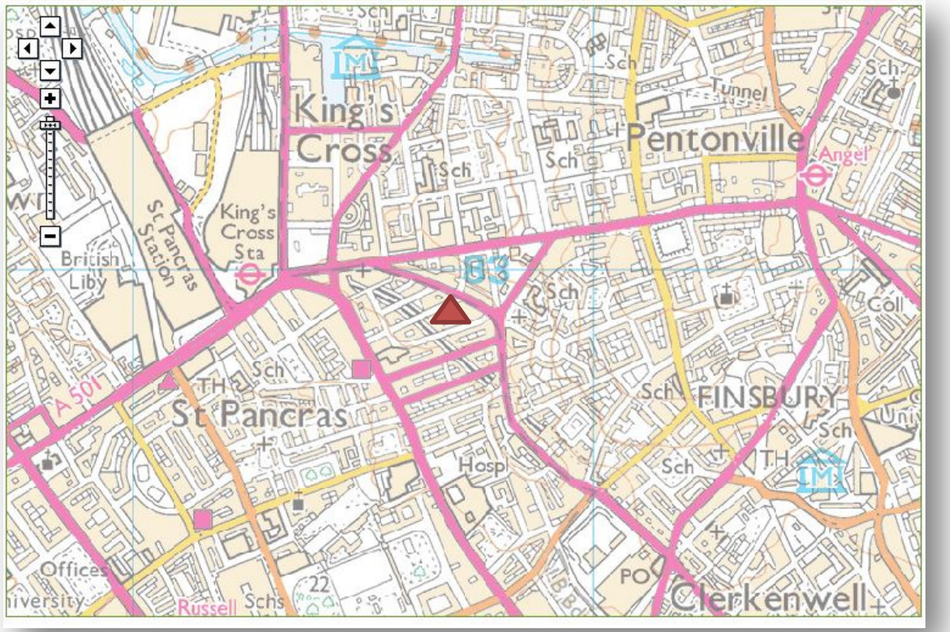

Figure 5.0 EA Tidal/Fluvial Flood Risk Zone Map – Site highlighted in red

4.2.1 Mitigation Measures

The subject site is at low risk from Tidal/Fluvial flooding and a development on the site would not increase the flood risk elsewhere. As such no mitigation methods are proposed in terms of Tidal/Fluvial.

4.3 Surface Water Flooding

Surface water flooding can occur during intense storm rainfall events which can overwhelm existing drainage infrastructure leading to overland flows. Due to the presence of robust flood defences dealing with Tidal/Fluvial Flooding, surface water flooding can be considered the more probable cause of flooding within the area.

A review of the LB of Camden Strategic Flood Risk Assessment (SFRA) indicates that the site is located within the "Group3_003"Critical Drainage Area, although the SFRA acknowledges that most of the Borough is located within a CDA. A CDA is defined as:

"A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones (LFRZ) during severe weather thereby affecting people, property or local infrastructure."

The site is also located in the "North Swinton Street Local Flood Risk Zone". Local flood risk zones are defined as:

"discrete areas of flooding that do not exceed the national criteria for a "Flood Risk Area' but still affect houses, businesses or infrastructure. A LFRZ is defined as the actual spatial extent of predicted flooding in a single location."

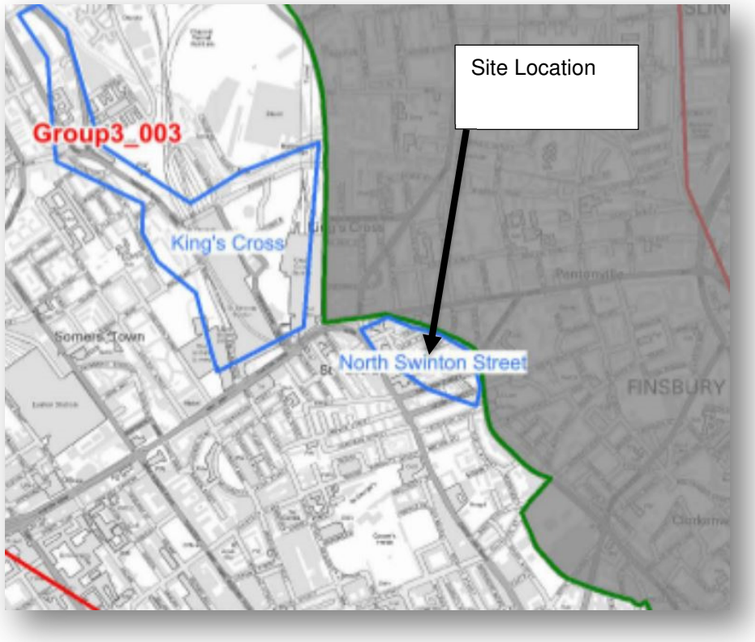

Figure 6.0 Map Extract from SFRA showing site in CDA and LFRZ

It is evident that surface water flooding in this area is the main risk of surface water flooding and contributing factor towards the area being in a LFRZ. Detailed surface water modelling carried out for the area show that the highways in the vicinity of the site suffer from varying degrees of surface water flooding as highlighted in Figure 8.0.

Kings Cross Road shows high flood risk in terms of surface water, however, the development site itself is classed as low risk and has its entrance off Britannia Street away from areas of high flood risk. Topographical information shows that levels fall away from the site on Kings Cross Road and that a raised pedestrian table forms a physical barrier between the surface water flooding on Kings Cross Road and Britannia Road – see sketch ref: 1676_SKD01 contained in Appendix D for extract from Topographical Survey.

Figure 7.0 Raised Table forming barrier to surface water flow from Kings Cross Road

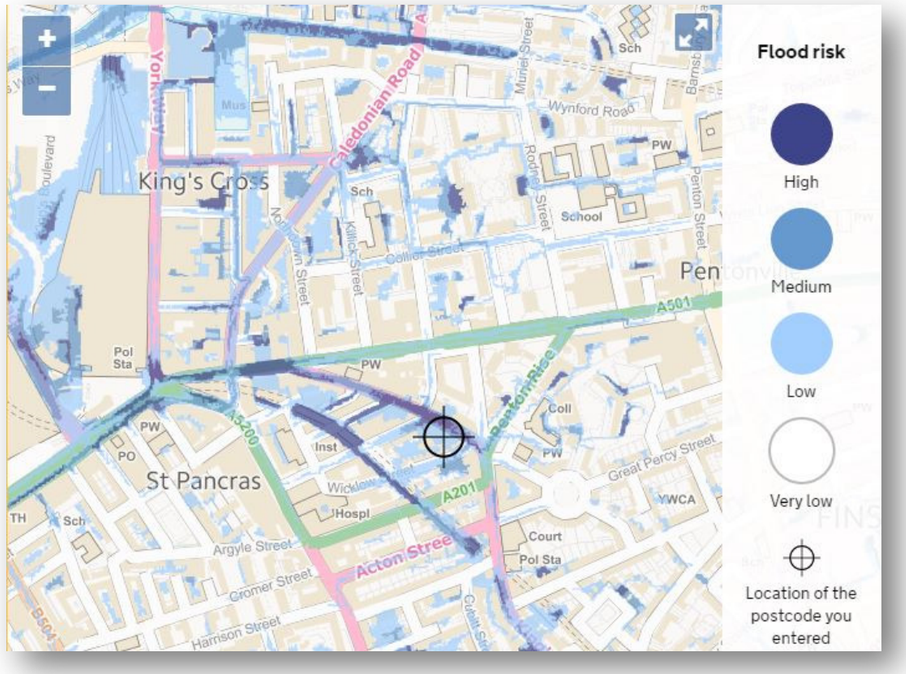

Figure 8.0 Surface Water Flood Maps showing Low Flood Risk

There is no evidence that the site flooded during the 1975 or 2002 floods which affected large areas of the Borough. The 1975 was the heaviest and most concentrated rainfall event since records began for this part of Camden, with 150mm falling in two and a half hours. The drainage capacity of drain pipes, road gullies and sewers was unable to cope with the volume of surface water runoff involved. The 2002 flood was less severe but still saw 60mm fall in just under an hour during the evening of 7th August 2002. This rainfall event had a 1% chance of happening in any year or 1 in 100year return period.

If flooding were to occur as a result of an extreme storm it is likely that any flood water will be contained within the kerb upstands of the highways and should not have an effect on the proposed site. This is further developed in Section 4.3.1.

4.3.1 Mitigation Measures

In order to mitigate against possible surface water flooding on Britannia Street, the development will propose raising the level at the site threshold above the adjacent highway in order to introduce a watershed which will prevent any surface water flooding entering the site as shown in sketch ref: 1676_SKD02 contained in Appendix D. ACO channels or similar will be positioned along the entrance of the development to ensure any surface water flows are intercepted before reaching any buildings thresholds.

The proposed development will also not increase impermeable areas on site and so will not increase peak surface water run-off rates from the development site. The development plans will also incorporate new soft landscaping within the development on terraces and roof levels. This will reduce peak run-off rates through attenuation and evapotranspiration when compared to existing.
Other SUDS measures will also be incorporated into the development to reduce the peak run-off rates to the Public Sewer running in Britannia Street. This is further discussed in Section 5.0 of this report.

4.4 Groundwater

As well as the flood risk posed by surface water run-off, other sources of potential flood risk require investigation including groundwater. The risk of flooding from groundwater can occur when groundwater levels rise above surface levels affecting low lying areas and/or basement levels.

As shown below which has been taken from the SFRA indicates that the site is not located within an area that is at risk from ground water flooding.

Figure 9.0 Map showing areas of high Groundwater susceptibility – site highlighted in blue

In addition, site investigation works carried out on site has indicated standing water at depths of 5.0m and 2.6m in 2 of the completed boreholes, with these thought to be localised areas of perched groundwater.

The report also states that "any groundwater flow within the London Clay will be at a very slow rate, due to its negligible permeability. The permeability will be predominantly secondary, through fissures in the clay. Published data indicates the horizontal permeability of the London Clay to generally range between 1 x 10-11 m/s and 1 x 10-9 m/s."

4.4.1 Mitigation Measures

Significant inflows of water are not expected to be encountered during the works for the proposed development. Any perched groundwater flows should easily flow around the basement and hence the proposal should not have a significant effect on groundwater flow paths. Relevant basement measures such as a cavity drainage system will be incorporated as a form of mitigation.

5.0 Surface Water Management Plan

5.1 Existing Surface Water Flows

As previously highlighted, the subject site is an existing Brownfield site with an existing drainage network outfalling, uncontrolled to the Public Sewers.

No surface water attenuation is currently provided on site.

5.2 Proposed Surface Water Flows

For new developments current policy advocates that Sustainable Drainage systems (SUDS) are incorporated in order to control surface water run-off from site at source. SUDS promotes the use of infiltration systems to allow surface water to drain back into the ground, thereby mimicking natural pre-development conditions. The Camden Surface Water Management Plan (SWMP) urges that developers be encouraged to demonstrate that their proposals will deliver a positive reduction in flood risk, whether that be by reducing the frequency or severity of flooding (for example, through the introduction of SuDS), or by reducing the impact that flooding may have on the community.

The proposed surface water strategy for the development site adheres to this policy by proposing to incorporate SUDS systems into the scheme which will reduce the peak run-off rate and volume from the development.

Infiltration systems such as soakaways etc are not feasible on site due to the close proximity of structural foundations and the presence of poor infiltrating London Clays. In this regard the site will incorporate an attenuation led SUDS strategy. This is achieved by specifying extensive green roofs within the site at 1st and 2nd floor levels (total area:157m^{2}) which will act as a source control measure during storm events.

Greenroofs are an effective way of reducing peak run-of rates for the majority of storms with previous research claiming that with a green roof you can expect no runoff for over 80% of the rainfall events experienced during a year. The storage provided in the drainage layer underneath a Green roof also provides attenuation volume during heavier storm events.

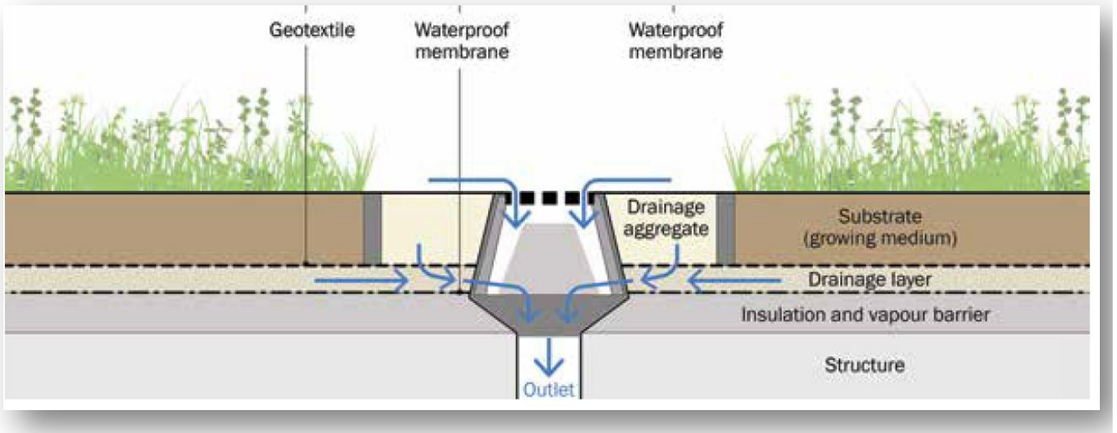

Figure 10.0 Illustration of Green Roof with outlet (*Source SUDS Manual*)

Due to the basement extents within the site, the development RWPs will need to be routed to the basement level where they will outfall to a surface water sump pump. This sump will be sized to provide storage for the surface water run-off with a controlled pump rate of circa 5l/s. The storage provided will be in accordance with Sewers for Adoption and will be sized at a rate of 125m³/ha of impermeable area draining to the pump as below:

- Total Area draining to Pump: 0.03ha
  - Storage Rate to be provided: 125m³/ha
    - Storage to be provided: 3.75 m³

This sump will provide attenuation of surface water flows by reducing the peak run-off rates to the receiving Sewers during storm events.

The combined effect of green roofs and surface water storage within the basement mean that the development will result in significant improvement in terms of surface water flows from the site when compared to existing. This complies with the guidance in the London Plan and reduces the risk of flooding both on and off site.

All proposed drainage networks will be designed to Building Regulations Part H with any SuDS designed and constructed in accordance with 'The SuDS Manual' taking into consideration all access, maintenance and safety issues.

All proposed drainage networks will be designed to Adoptable Standards in accordance with Thames Water requirements.

The proposed surface water network will incorporate all relevant pollution control measures as required by NPPF and in accordance with EA requirements.

5.3 Maintenance Strategy for SUDS

The successful implementation and operation of a SuDS system depends on a robust and clear maintenance strategy being implemented. In this regard the following steps and measures should form an integral part of the site's proposed scheme.

It is envisaged that the site drainage will be maintained by the site's Management Company and will form part of the maintenance regime for the site.

Annual inspections of the proposed manholes and pumps will need to be carried out to ensure any blockages are cleared and full storage volume is being provided. Further maintenance proposals are specified in Figure 11.

Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (ie year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
	Post establishment, replace dead plants as required (where > 5% of coverage)	Annually (in autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly or as required
Remedial actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

Figure 11.0 SUDS Maintenance Strategy

6.0 Flood Warning Proposals

6.1 Flood Warning

The Environment Agency is responsible for monitoring flood events and for issuing warnings to people in properties and businesses at risk of flooding. In order to fulfill their responsibilities, the Environment Agency operates a coded warning system. This is a four stage warning system and each stage will trigger a set of procedures for various org anisations.

Flood Warning	Symbol	Meaning	General Advice
Flood Alert	 FLOOD ALERT	Flooding is possible Be prepared.	**General advice** • Be prepared to act on your flood plan. • Prepare a flood kit of essential items. • Monitor local water levels and the flood forecast on the Environment Agency website.
Flood Warning	 FLOOD WARNING	Flooding is expected. Immediate action required.	**General advice** • Move family, pets and valuables to a safe place • Turn off gas, electricity and water supplies if safe to do so. • Put flood protection equipment in place.
Severe Flood Warning	 SEVERE FLOOD WARNING	Severe flooding. Danger to life.	**General advice** • Stay in a safe place with a means of escape. • Be ready should you need to evacuate. • Co-operate with the emergency services. • Call 999 if you are in immediate danger.
Warnings no longer in force	• No further flooding is currently expected in your area. • Be careful. Flood water may still be around for several days. • If you've been flooded, ring your insurance company as soon as possible.		

Figure 12.0 – EA Flood Warning Types

The proposed development will be registered with the EA Flood Warning System, Floodline, and will receive notifications and or updates on potential flood events. The will allow the actions and procedures in the development's 'Flood Management Plan' to be triggered.

7.0 Flood Risk Policy

7.1 Sequential Test

The Sequential Test is the mechanism derived by the Environment Agency to steer new development to areas with a lower probability of flooding by analysing available land and flood vulnerability. The Sequential Test for the subject site is based on the information provided within the Camden SFRA. The aim of the Sequential Test is to steer new development to areas at the lowest probability of flooding (Zone 1).

The NPPF classifies developments according to their vulnerability. Five vulnerability classifications are defined as outlined below:

- Essential Infrastructure;
- Highly Vulnerable;
- More Vulnerable;
- Less Vulnerable, and
- Water Compatible.

The subject site is being developed within Flood Zone 1 and so is suitable for development use as defined by the NPPF.

The site also proposes to manage and reduce the surface water flood risk to the site and surrounding area by implementing a surface water strategy incorporating SUDS and associated measures to reduce flood risk.

In this regard the Sequential Test is considered to be passed.

7.2 Exception Test

As the site passes the Sequential Test, the application of the Exception Test is not required.

8.0 Summary and Recommendations

- There is low risk of flooding from Fluvial / Tidal sources and hence no mitigation measure will be required.
- There is low risk of flooding from surface water, any surface water flooding which may occur along the Highways in close proximity to the site is likely to be contained within kerb upstands of the highways and should not have an adverse effect on the proposed site.
- The use of a sedum green roof and associated SUDS has been incorporated within the proposal as a form of mitigation and will aid in reducing peak flows from site and provide a level of attenuation.
- There is no significant risk of flooding from groundwater with no evidence of significant groundwater flows through the impermeable clay layers
- Therefore, the development is deemed to be at low flood risk.