SC Structures Limited

14D Avenue Road, London, NW8 6BP

For

Metropolitan Basements Ltd

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

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APPENDICES

1. INTRODUCTION

1.1 SC Structures Ltd has been commissioned by Metropolitan Basements to undertake a Flood Risk Assessment (FRA) and Drainage Strategy for a proposed development at 14d Avenue Road, London, NW8 6BP.

1.2 The objective of this study was to undertake a Flood Risk Assessment in accordance with the National Planning Policy Framework (NPPF) and the accompanying Technical Guidance.

1.3 This study assesses:

- Flood risk to the site and the proposed development; and
- Any impact on flood risk to other land because of the development proposals.

1.4 This report is a holistic risk based assessment of potential flooding from possible sources, including fluvial, tidal, groundwater and surface water run-off. It also identifies and examines the residual flood risk to the proposed development and third party land.

1.5 The appraisal process comprised a desk study and data research.

1.6 Whilst completing the assessment, consideration has been given to the National Planning Policy Framework (NPPF), Planning Practice Guidance, British Standard 8533:2011, Assessing and Managing Flood Risk in Development, and British Standard 8582:2013 Code of Practice for Surface Water Management for Development Sites.

1.7 This report is based on the interpretation and assessment of data provided by third parties. SC Structures Ltd cannot be held responsible for the accuracy of the third party data and the conclusions and findings of this report may change if the data is amended or updated after the date of consultation.

2. POLICY CONTEXT

NATIONAL PLANNING POLICY FRAMEWORK (NPPF)

2.1 The NPPF was adopted in March 2012, superseding national planning policy statements and guidance. One of the overarching objectives of the NPPF is the encouragement of growth and acknowledgement that decision-makers should adopt a presumption in favour of sustainable development. Paragraph 14 of the document states:

> *"At the heart of the National Planning Policy Framework is a **presumption in favour of sustainable development**, which should be seen as a golden thread running through both plan-making and decision-taking.*
>
> *...*
>
> *For **decision-taking** this means:*
>
> > *approving development proposals that accord with the development plan without delay; and*
> >
> > *where the development plan is absent, silent or relevant policies are out of date, granting permission unless:*
> >
> > - *any adverse impacts of doing so would significantly and demonstrably outweigh the benefits, when assessed against the policies in this Framework taken as a whole; or*
> > - *specific policies in this Framework indicate development should be restricted"*

2.2 The Government expects the planning system to deliver the homes, business, infrastructure and thriving local places that the country needs, while protecting and enhancing the natural and historic environment. Paragraph 17 sets out the Core Planning Principles; it includes the requirement that planning should "proactively drive and support sustainable economic development to deliver the homes, business and industrial units, infrastructure and thriving local places that the country needs."

2.3 Section 10 of the NPPF seeks to address the issues of climate change, flooding and coastal change. In paragraph 100 it states: "Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere."

TECHNICAL GUIDANCE TO THE NATIONAL PLANNING POLICY FRAMEWORK

2.4 The Technical Guidance largely replicates the core components of Planning Policy Statement 25: Development and Flood Risk, most notably the Flood Zone definitions and flood risk vulnerability classifications for different land uses.

2.5 The assessment of flood risk is based on the definitions in Table 1 of the Technical Guidance of the NPPF. Table 1 includes the following:-

TABLE 1: FLOOD ZONES

Flood Zone 1	▪ as that which has a "low probability" of flooding. The definition provided in Table 1 is: *"This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%)."*
Flood Zone 2	▪ as that which has a "Medium Probability" of flooding. The definition provided in Table 1 is: *"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."*
Flood Zone 3a	▪ as that which has a "High Probability" of flooding. The definition provided in Table 1 is: *"This zone comprises land assessed as having 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."*
Flood Zone 3b	▪ as "the functional floodplain". The definition provided in Table 1 is: *"This zone comprises land where water has to flow or be stored in times of flood."*

2.6 Included within the "Policy aims" of Table 1 for Flood Zone 3a is reference to flood storage. This is not required in Flood Zone 2 but for Flood Zone 3a it is stated as follows:

> *"In this zone, developers and local authorities should seek opportunities to:*
>
> *...*
>
> > *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."*

2.7 The Environment Agency will often refer to this as flood compensation storage and require that the existing flood storage in the development area is maintained on a level-for-level basis. Typically they will ask for evidence that the volume available for flooding is the same at every 200mm horizontal slice post-development as it was pre-development up to the level of the 1 in 100 year flood, i.e. the extent of Flood Zone 3a.

2.8 The NPPF classifies the Flood Risk Vulnerability of various land uses in Table 2 (reproduced below). The More Vulnerable Classification encompasses usages such as hospitals and buildings used for dwellings. Less Vulnerable applies to buildings used for general industry, storage and distribution.

TABLE 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 and 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 for 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. ▪ Sewage 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. ▪ Sewage transmission infrastructure and pumping stations. ▪ Sand and gravel working. ▪ Docks, marinas and wharves.

	▪ Navigation facilities. ▪ Ministry of Defence 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.

2.9 The overall aim is to steer new development to Flood Zone 1. Where there are no reasonably available sites within Flood Zone 1, local planning authorities allocating land in local plans or determining planning applications for development at any particular location should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2, applying the Exception Test if required (see table below).

TABLE 3: FLOOD RISK VULNERABILITY AND FLOOD ZONE 'COMPATIBILITY'

Flood risk vulnerability classification		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable ***(residential)***	Less vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test Required	✓	✓
	Zone 3a	Exception Test Required	✓	✘	Exception Test Required	✓
	Zone 3b functional floodplain	Exception Test Required	✓	✘	✘	✘

✓ Development is appropriate
✘ Development should not be permitted

LONDON BOROUGH OF CAMDEN FLOOD RISK MANAGEMENT STRATEGY

2.10 The Flood Risk Management Strategy was produced by London Borough of Camden. The strategy has four key objectives:

1. To understand and explain the level of risk affecting the residents and businesses of Camden

2. To provide an action plan for areas at particular risk from surface water flooding

3. To highlight the actions that all partners, businesses and residents in Camden should be taking to manage flood risk

4. To take a sustainable and holistic approach to flood management, seeking to deliver wider environmental and social benefits.

LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT (SFRA)

2.11 London Borough of Camden Strategic Flood Risk Assessment (SFRA) was produced by URS in July 2014. This updated the 2008 and 2011 North London Strategic Flood Risk Assessments which were produced with by Mouchel (2008) and Halcrow (2011).

2.12 The London Borough of Camdenis required to carry out a Strategic Flood Risk Assessment (SFRA) for its area, which assesses the risk of flooding from all sources, now and in the future, taking account of the impacts of climate change.

2.13 The SFRA supports and informs the Local Plan, including the site allocations, by assessing the impact that land use changes and development in the area will have on flood risk. The SFRA provides the basis for applying the Sequential Test and Exception Test to development sites, thereby directing development away from areas at highest risk.

LONDON BOROUGH OF CAMDEN SURFACE WATER MANAGEMENT PAN (SWMP)

2.14 The Surface Water Management Pan was prepared produced by Halcrow in 2011.

2.15 In this context surface water flooding describes flooding from sewers, drains, groundwater, and runoff from land, small watercourses and ditches that occurs as a result of heavy rainfall.

2.16 The study forms part of the wider Drain London Tier 2 project, which involves the delivery of Surface Water Management Plans and Preliminary Flood Risk Assessments for each of the thirty two London Boroughs and the Corporation of City of London.

2.17 The SWMP builds on previous studies undertaken by the Borough and has been delivered using a four phase approach; Phase 1 – Preparation; Phase 2 – Risk Assessment; Phase 3 – Options; and Phase 4 – Implementation and Review.

3. DEVELOPMENT SITE DESCRIPTION

3.1 The development site is on a residential road within the London Borough of Camden (refer to **Appendix A**). The site is located at approximate grid reference TQ 27355 83526, at 14d Avenue Road, London, NW8 6BP.

3.2 The total area of the development site is in the region of 168 m^2 .

3.3 The proposed development comprises the formation of a basement beneath the garden and single storey living room with an extension to the northern side of the property.

3.4 The site slopes from north to south and lies approximately 38.4m above ordnance datum.

4. GEOLOGY & HYDROLOGY

4.1 The online British Geological Survey (BGS) maps indicate this site is not underlain by superficial deposits, the bedrock solid geology comprising the London Clay Formation. This is described as “clay and silt”.

4.2 The Fastrack Geotechnical Survey (FSI Ref: 10044) undertaken in August 2016 confirms the BGS mapping with a borehole noting the identified the Stratum set out in Table 4.1 (see **Appendix B** for full log). No ground water was encountered within the borehole.

TABLE 4.1: FASTRACK GEOTECHNICAL SURVEY (FSI REF: 10044)

Depth (m)	Stratum Description and Observations
Ground level – 0.3	Paving Slab on to silty sandy MADE GROUND
0.3 – 0.45	Hardcore and Pebbles
0.45 – 0.8	GRAVEL
0.8 – 5.0	Mid brown orange CLAY containing grey mottle
End of Borehole at 5.0m	

4.3 BGS Borehole Data: TQ28SE1649 — TQ28SE1650 — 12 AVENUE ROAD, ST JOHNS WOOD 1A – Second Visit (approx. 31m to the south east of the site) also confirmed no Ground water being identified within the well boring down to 35m (see **Appendix B**).

4.4 The site is located within Outer zone (Zone 2) groundwater source protection zone as defined within the Environment Agency website. This zone is defined by a 400 day travel time from a point below the water table.

4.5 There are no watercourses in the direct vicinity of the development. The culverted River Tyburn is approximately 180m to the west and Regents Canal is 232m to the south of the proposed development. The closest open water body is the Boating Pond which is 735m to the south.

5. FLOOD RISK

5.1 The NPPF and the SFRA indentifies several potential sources of flooding that must be considered when assessing flood risk, these are considered below in the following order:-

- > Flooding from rivers (fluvial flooding)
- > Flooding from the sea (tidal flooding)
- > Flooding from land
- > Flooding from sewers
- > Flooding from groundwater, and
- > Flooding from reservoirs, canals, and other artificial sources.

5.2 A summary of the possible flood sources is set out in Table 5 below.

TABLE 5 – SUMMARY OF POSSIBILITY OF FLOODING FROM VARIOUS SOURCES

Source	Likelihood – Very Likely, Possible, Insignificant
Fluvial (River)	Insignificant
Coastal - Sea	N/A
Coastal - Estuarine	N/A
Pluvial / sheet run off	Possible
Sewer - SWS, FWS, CS, CSO	Possible
Groundwater	Insignificant
Dam breach	N/A
Canal	N/A
Water Main	Insignificant
Other sources	N/A

FLOODING FROM RIVERS (FLUVIAL FLOODING) & SEA (TIDAL FLOODING)

5.3 The indicative flood maps published by the Environment Agency (EA) identify that the entire site is outside an area at risk of fluvial/tidal flooding i.e. located in Flood Zone 1. Refer to **Appendix C** for the EA Flood Map Data.

5.4 The risk of flooding from both fluvial and tidal sources is considered to be low.

FLOODING FROM LAND & SEWERS

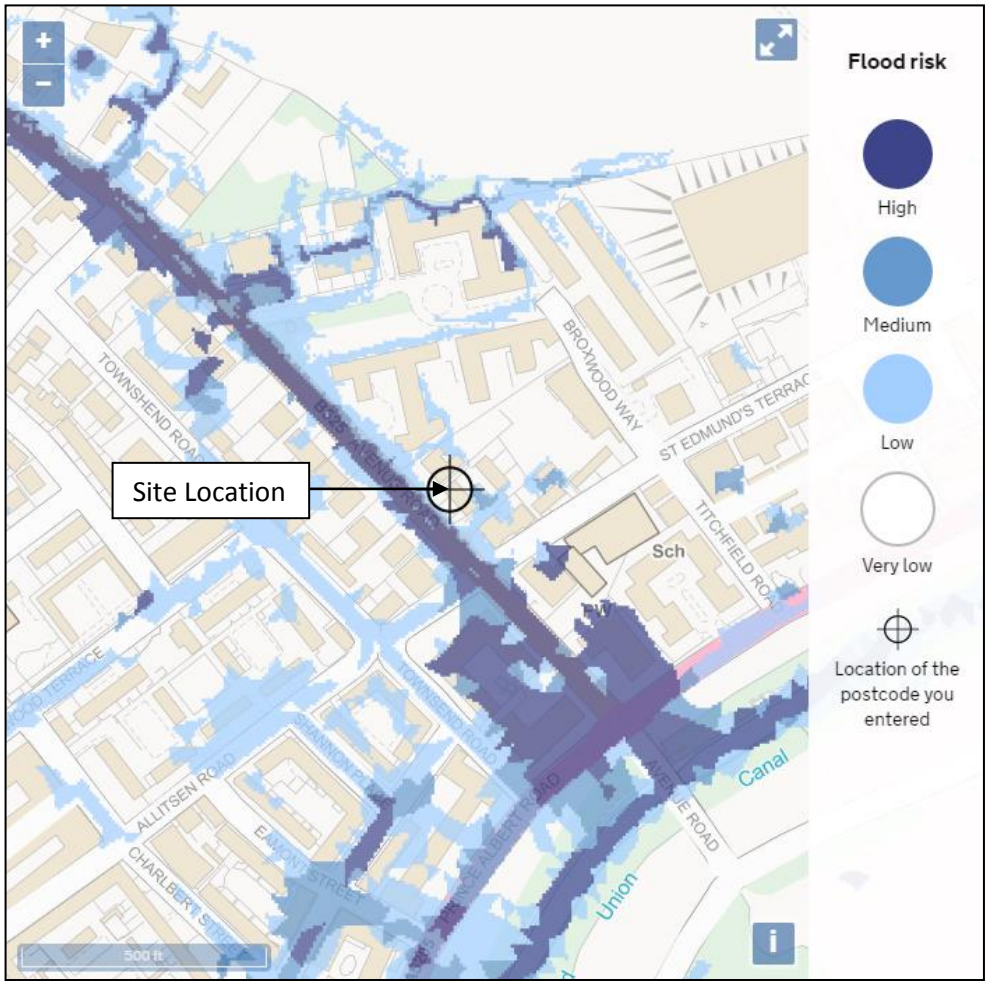
5.5 The Thames Water sewers indicate the existing site is served by combined sewer (see **Appendix D** for the full drainage records) Avenue Road – 1372mm x 914mm x running to the south east.

5.6 The SWMP identified the area is within the Group 5_003 critical drainage area see **Appendix C.**

5.7 No specific instances of historical flooding were identified at the proposed development.

5.8 The surface water flooding was modelled by the EA, the model identified areas that may experience ponding during each of a 1 in 30 year and 1 in 1000 year return period storm. Surface water flooding is presented within the SFRA, and is included in **Appendix C**. The site itself has been designated as very low risk.

FIGURE 5 – ENVIRONMENT AGENCY - RISK OF FLOODING FROM SURFACE WATER



5.9 Review of the mapping indicates the proposed development would not experience surface water flooding. However, Avenue Road would act as an exceedance flow route during the extreme event and it would be prudent that any drainage strategy for the proposed development be mindful of the risk of this flow path.

FLOODING FROM GROUNDWATER

5.10 In areas with an increased potential for groundwater, basements of buildings below ground level, buried surfaces and other assets held below ground level are vulnerable to flooding from groundwater. This can also lead to inundation of roads, commercial, residential and amenity areas as well as flooding of ground floors of buildings above ground level and overflowing of sewers and drain.

5.11 The SWMP considers the overall risk of Groundwater flooding to be a relatively low risk in the London Borough of Camden.

5.12 The onsite borehole to 5m recorded no ground water. Further review of the BGS borehole logs within the vicinity of the proposed development did not record any ground water strikes – see **Section 4 Geology & Hydrology** and **Appendix B**.

5.13 The SFRA sets out area susceptible to ground water flooding (see Appendix C); the closest area to the site is 1.9km to the south east. The SFRA does include Environment Agency records which indicate two incidence 215m to the northwest of the site, no details are given on the incidence and it is often noted that surface water flooding is miss-classified as ground water flooding.

WATER MAINS

5.14 Consultation with Thames Water identified that their records indicate a two 125mm HPPE water main and three trunk mains within Avenue Road. If these mains were to experience a leak it is unlikely it would affect the site, but flow in a north south direction similar to the surface water mapping.

5.15 Water Main records are contained in Appendix D of this report.

FLOODING FROM RESERVOIRS, CANALS & OTHER ARTIFICIAL SOURCES

5.16 Environment Agency Reservoir Flood Mapping shows no flooding from reservoir failure in the site area. The closest reservoir flooding occurs to the west, approximately 2.1 km from the proposed development site to the north.

6. THE SEQUENTIAL TEST

6.1 The Sequential Test, within the National Planning Policy Framework, aims to steer all new developments to areas at the lowest risk of flooding and to ensure that the development type proposed is appropriate by reference to the flood risk.

6.2 The proposed site is solely location within Flood Zone 1 (based on Environment Agency modelled flood levels) and therefore satisfies the requirement of the sequential test.

THE EXCEPTION TEST

6.3 Table 2 of the Flood Risk and Coastal Change Chapter of the Planning Practice Guidance (2015) classes different types of development depending upon their vulnerability. It classes residential developments as ‘more vulnerable’.

6.4 Table 3 of the Flood Risk and Coastal Change Chapter of the Planning Practice Guidance (2015) shows that ‘more vulnerable’ land uses are acceptable in Flood Zone 1.

7. SURFACE WATER MANAGEMENT - POLICY CONTEXT

NATIONAL PLANNING POLICY FRAMEWORK (NPPF) – MARCH 2012

7.1 The Extracts from applicable national planning policy documents are set out below.

7.2 The National Planning Policy Framework (NPPF) supersedes Planning Policy Statement 23 (Planning and Pollution Control) and Planning Policy Statement 25 (Development and Flood Risk) and associated Practice Guide.

7.3 The NPPF ensures that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest flood risk.

7.4 Where new development is exceptionally necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and, where possible, reducing flood risk overall.

SUSTAINABLE DRAINAGE SYSTEMS WRITTEN STATEMENT HCWS161 (DECEMBER 2014)

7.5 The Secretary of State for Communities and Local Government laid a Written Ministerial Statement in the House of Commons on 18 December 2014 setting out changes to planning that will apply for major development from 6 April 2015. This confirms that in considering planning applications, local planning authorities should consult the relevant Lead Local Flood Authority on the management of surface water; satisfy themselves that the proposed minimum standards of operation are appropriate and ensure through the use of planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

7.6 Therefore, from 6 April 2015 local planning policies and decisions on planning applications relating to major development are required to ensure that sustainable drainage systems (SuDS) are used for the management of surface water.

7.7 Major development is development involving any one or more of the following:

- The winning and working of minerals or the use of land for mineral-working deposits;
- Waste development;

- The provision of 10 dwellings or more;
- The provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more; or
- Development carried out on a site having an area of 1 hectare or more.

DEFRA SUSTAINABLE DRAINAGE SYSTEMS NON-STATUTORY TECHNICAL STANDARDS FOR SUSTAINABLE DRAINAGE SYSTEMS (MARCH 2015)

7.8 This document sets out non-statutory technical standards for sustainable drainage systems. It should be used in conjunction with the National Planning Policy Framework and Planning Practice Guidance.

7.9 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

7.10 Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

7.11 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with the above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

7.12 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.

7.13 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.

7.14 The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.

BRITISH STANDARD 8582:2013 CODE OF PRACTICE FOR SURFACE WATER MANAGEMENT FOR DEVELOPMENT SITES (NOVEMBER 2013)

7.15 In the absence of specific local guidance on the management of surface water run-off, BS 8582 should be considered as best practice guidance for the development of surface water drainage strategies for new development sites.

LONDON BOROUGH OF CAMDEN - CAMDEN GEOLOGICAL, HYDROGEOLOGICAL AND HYDROLOGICAL STUDY: GUIDANCE FOR SUBTERRANEAN DEVELOPMENT

7.16 The study was undertaken by Arup in 2008 and was been carried out with the objective of providing the Borough with technical guidance to assist them in ensuring that developers are meeting the requirements of DP27.

LONDON BOROUGH OF CAMDEN - ADVICE NOTE ON CONTENTS OF A SURFACE WATER DRAINAGE STATEMENT

7.17 The purpose of this advice note is to set out what information should be included in Surface Water Drainage Statement. Within Camden, SuDS systems must be designed in accordance with London Plan policy 5.13.

LONDON PLAN (2015), POLICY 5.13 - POLICY - PLANNING DECISIONS

7.18 A Development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

- Store rainwater for later use
- Use infiltration techniques, such as porous surfaces in non-clay areas
- Attenuate rainwater in ponds or open water features for gradual release
- Attenuate rainwater by storing in tanks or sealed water features for gradual release
- Discharge rainwater direct to a watercourse

- Discharge rainwater to a surface water sewer/drain
- Discharge rainwater to the combined sewer.

7.19 Drainage should be designed and implemented in ways that deliver other policy objectives of this Plan, including water use efficiency and quality, biodiversity, amenity and recreation.

LDF preparation

7.20 B Within LDFs boroughs should, in line with the Flood and Water Management Act 2010, utilise Surface Water Management Plans to identify areas where there are particular surface water management issues and develop actions and policy approaches aimed at reducing these risks.

CLIMATE CHANGE

7.21 The Climate Change Adaptation Sub-Committee Progress Report 2014, increased flood risk is the greatest threat to the UK from climate change. Models of the climate system suggest floods of the type experienced in England and Wales in autumn 2000, and between December 2013 and February 2014, have become more likely as a consequence of increased concentrations of greenhouse gases in the atmosphere.

7.22 More frequent short-duration, high intensity rainfall and more frequent periods of long-duration rainfall could be expected. Sea levels are also expected to continue to rise.

7.23 New EA guidance "Flood risk assessments: climate change allowances" issued on the 19th February 2016 provides up to date information on expected changes in rainfall, river flows and sea level rise as a consequence of climate change.

7.24 A key change from the previous guidance is that the climate change allowances for peak river flows now are shown as variable on a regional basis; allowance are also now based on percentiles, whereby a percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level (e.g. a 50% percentile means that the allowance has 50% chances of not being exceeded).

7.25 On this basis key allowances for peak river flows based on percentiles are:

- central allowance, - based on the 50th percentile
- higher central - based on the 70th percentile
- upper end - based on the 90th percentile

These allowances are detailed in Table 1 (Peak river flow allowances by river basin district) of the EA guidance.

7.26 As discussed in the EA Guidance, the choice of the appropriate allowance for peak river flow (e.g. central or higher central) should reflect the risk for the proposed development and therefore is linked to the expected hazard, vulnerability and resilience of the scheme; recommendations on the appropriate allowances to be considered are provided in the EA Guidance.

7.27 For peak rainfall the EA Guidance provides an upper end and central allowance depending on epoch; the guidance recommends assessing both the central and upper end allowances to understand the range of impact. These allowances are detailed in Table 2 (Peak rainfall intensity allowance in small and urban catchments) of the EA guidance.

7.28 For this proposed site, based on the new guidance residential development (considered "More Vulnerable" in flood risk terms) should be reviewed against the following new climate change allowances:

TABLE 7.1 – SUMMARY OF CLIMATE CHANGE FACTORS

Flood Criteria	Climate change Factor
Peak River Flow	25% for Flood Zone 1 locations
Peak Runoff	20% for minimum design with 40% for overall surface water management within the site

8. SURFACE WATER MANAGEMENT

EXISTING

8.1 The existing site is significantly impermeable aside from some grass and planting with the rear garden.

8.2 It is assumed all surface water that falls upon the existing site currently freely discharge to the combined Thames Water sewers in Avenue Road (See **Appendix D** for Thames Water sewer records). Table 8.1 sets out the results from indicative Micro Drainage modelling for the existing site (see **Appendix E**):

TABLE 8.1: BROWNFIELD RUNOFF RATES (ASSUMING 150MM PIPE PUBLIC SEWER CONNECTION)

Return Period	Flow rates (l/s)
1yr	1.6
30yr	4.0
100yr	5.2

PROPOSED

8.3 The following general principles shall be applied to the drainage design for the re-development.

- The system is to be designed such that surface water run-off generated from the proposals are contained within the development site. The design will cater for storm events up to a 1 in 100yr return period plus 40% to account for climate change
- The discharge from the development to the local sewer network shall be controlled to avoid exceeding the capacity of the sewer system, without detriment to the site use and not increasing the flood risk to the surrounding area.

TABLE 8.2: SUDS COMPONENT POTENTIAL

SUDS GROUP	TECHNIQUE	POSSIBLE LOCATION	COMMENT
Retention	Retention Pond	N/A	The urban nature of the development with no open areas means there is inadequate space to incorporate a pond.
	Subsurface storage	N/A	The urban nature of the development with no open areas means there is inadequate space to incorporate a Subsurface storage.
Wetland	Pond/Wetland	N/A	The urban nature of the development with minimal open space means there is inadequate space to incorporate a pond/wetland.
Infiltration	Infiltration trench	N/A	Soakaway are not viable due proximity to foundations/basement/clay soils
	Infiltration basin	N/A	Soakaway are not viable due proximity to foundations/basement/clay soils
	Soakaways	N/A	Soakaway are not viable due proximity to foundations/basement/clay soils
Open channels	Swales/Ditch	N/A	The urban nature of the development with minimal open space means there is inadequate space to incorporate a swale/ditch.
Source Control	Green roof	Over proposed basement	Green roofs mimic the effect of natural catchments providing both source control and attenuation
	Rain water harvesting	N/A	Does not contribute to critical flood risk.
	Pervious pavements	Hard standing areas/over proposed basement	Potential to integrate around the building where hard standing areas are proposed and would not pose a threat to the basement.

SURFACE WATER STRATEGY

8.4 The conceptual SuDS strategy for the Proposed Development has been derived using the principles outlined within the CIRIA SuDS Design Manual (C753) along with BS 8582:2013 – Code of Practice for Surface Water Management for Development Sites.

8.5 The conceptual surface water strategy is based on the current knowledge about the site. The scheme utilises the topography and natural site boundary conditions. No significant re-profiling of the site is proposed.

8.6 It is envisaged that the proposed development will not increase the existing runoff rates from the site as the impermeable area will not increase and much of the development is subterranean. That said it may be possible to discharge runoff via SuDS techniques (to provide treatment and source control), prior to discharge to the public sewer.

8.7 The requirement H3 of the Building Regulations 2010 states that the preferred hierarchy for disposal of surface water is:

1. Infiltration
2. Existing Watercourse
3. Existing sewer

8.8 Building Regulations stipulate that infiltration structures must be at least 5m from any building foundations; in this instance there is insufficient space to infiltrate and it is unlikely the London Clays will allow any significant infiltration rate if it were possible.

8.9 There are no watercourses within close proximity to the site and so it is proposed to discharge the surface water at a controlled rate into the combined Thames Water public sewer within Avenue Road. It is advised a survey is undertaken to confirm how the site currently discharges as it may be possible to utilise the existing pipe and minimise offsite works.

8.10 The proposed drainage strategy is provided on drawing **0018-1001 Drainage Strategy** (**Appendix F**).

8.11 The dense urban nature of the proposed development and the fact that it is largely subterranean make it difficult to retrofit SuDS and improve on the existing discharge.

8.12 If the levels permit on site there is potential to integrate a green roof and permeable paving above the basement

8.13 No contamination is expected from runoff from the proposed development, namely the roof areas and hard standing, as no car parking or uses that may produce hazardous materials are proposed on site.

8.14 It is proposed that following construction of the basement beneath the garden the existing patio is replaced with permeable paving the garden area is replaced with a green roof.

8.15 The permeable paving and green roofs will provide source control for the rainfall that falls directly on the surface. Green roofs and permeable can provide approx.5mm interception storage and reduce the total volume of runoff off from the development. Furthermore, they should provide attenuation storage within their sub-base.

8.16 Roof runoff from the rear of the property is to discharge via diffusers to the lined porous paving within the patio.

8.17 Micro Drainage modelling indicates the following runoff rates if a green roof and permeable paving were to be used over the new basement for the 1 in 100 year storm plus 40% allowance for climate change. **Appendix E** sets out the Micro Drainage modelling and analysis results.

TABLE 8.3: EXISTING & PROPOSED RUNOFF RATES

	Runoff Rate (l/s)			
	1	**30**	**100**	**100 + 40% CC**
Existing	1.6	4.0	5.2	N/A
Proposed	0.1	1.1	N/A	4.6

8.18 As identified the existing building is thought to discharge at 5.2 l/s. the introduction of the proposed SuDS and the fitting of a 100mm orifice plate on the outlet, even with an

additional 40% allowance for climate change, would reduce see the peak flow reduced to 4.6 l/s. The betterment is even more pronounced for the 1 year and 30 year return periods. This proposal would provide a sustainability benefit to the wider community. The utilisation of a green roof and permeable paving should also result in a reduction of the total runoff volume from proposed development.

8.19 The site may require a predevelopment enquiry application to Thames Water to determine if sufficient capacity within the network, although as the proposed development will provide betterment over the existing development it is anticipated this should not be a concern.

8.20 The proposed strategy is to provide gravity drained piped network where levels permit. A pump will be required to lift surface water from any cavity drainage system with the basement and any surface water that would accumulate within the light well.

8.21 If new connections to then Thames Water sewers are found to be necessary a section 106 Sewer Connection Agreement and offsite works will be required to connect into the sewer in Avenue Road.

8.22 It is generally accepted that a high proportion of the perceived failures of SuDS components are as a direct result of either poor quality workmanship at the installation stage or damage during construction. **Appendix G** set out the *Method Statement - Managing Surface Water during Construction*. This provides outline guidance and covers Pollution and sediment control, Access and storage areas, Skills and understanding, Infiltration system protection, Landscaping, Erosion control and Inspections. It is intended as an overview with further detail required following the detailed design of the sites drainage systems.

BASEMENT & FINISHED FLOOR LEVELS

8.23 The development is located entirely within Flood Zone 1; however the EA surface water flood risk mapping identified the Avenue Road (although not the property) to be at risk from surface water.

8.24 The basement will be utilised a gym, cinema, study and lounge with no space used as a bedroom or similar.

8.25 Walls and basements can be flooded by water entering from the ground floor level of the building or through the structure due to inadequate waterproofing measures. A sump should be provided to enable effective pumping out of floodwater, with an alarm system with a battery back-up. Basement walls should be designed to withstand the forces of hydrostatic pressure at all times – however it should be noted ground water was not identified by the onsite SI or other BGS borehole logs. New basements should be designed and constructed in accordance with BS 8102:2009 Code of practice for protection of below ground structures against water from the ground.

8.26 A Non-return valve to BS EN 13564-1, Anti-flooding devices for buildings – Part 1: Requirements, should be installed to prevent back-flow of sewage from the combined system.

8.27 The site has not been identified as at risk of groundwater flooding, however it would be prudent for the waterproofing strategy to the basement to be carefully considered to prevent water ingress, for example from a perched water table.

8.28 To reduce the existing risk from surface water through doors, windows and air vents the following options should be considered:

a) Doors

> Thresholds should be raised to be above the design flood level, while satisfying level access requirements. External doors and patio doors should conform to PAS 1188-1, Flood protection products.

> Glazing in the bottom 600 mm of external doors should be avoided.

> Hollow core timber internal doors should not be used where the predicted frequency of flooding is high, unless it is accepted they will be replaced after flooding.

b) Windows

> Standard window designs may be used when the flood depth is less than 600 mm, but frames should be sealed to the building fabric.

c) Air vents

> Proprietary air vents should be installed that automatically prevent water entry during a flood. Note that where a ventilator provides air for a fire or boiler, blockage can lead to carbon monoxide poisoning and care should be taken with such vents.

MAINTENANCE

8.29 To manage the effectiveness of the proposed drainage network, a robust maintenance regime in accordance with CIRIA C753 Section 22 will be implemented to maintain future performance of all SuDS and drainage components. This will include regular cleaning of the SuDS devices and any pre-treatment devices.

8.30 The outline SuDS Maintenance and Management Plan is set out in **Appendix H**. It is anticipated that the maintenance and management of the system will be the responsibility of a private management company set up by the developer.

FOUL STRATEGY

8.31 Foul Flows will discharge via gravity into the Thames Water public sewer within Avenue Road. As with the surface water, it is advised a survey is undertaken to confirm how the site currently discharges as it may be possible to utilise the existing pipe and minimise offsite works.

8.32 At present there is no shown requirement for a foul discharge from the basement. If plans were to change, foul flows from the basement will be pumped to ground level and be protected from sewer flooding through the installation of a suitable pumped device. 24 hours of storage should be provided within the basement in event of pump failure.

8.33 A Non-return valve to BS EN 13564-1, Anti-flooding devices for buildings – Part 1: Requirements, should be installed to prevent back-flow of sewage from the combined system.

8.34 A Section 106 Sewer Connection Agreement and offsite works may be required to connect into the sewer in Avenue Road.

9. CONCLUSIONS

9.1 This Flood Risk Assessment (FRA) has been commissioned by Metropolitan Basements for a development site located 14D Avenue Road, London NW8 6BP, as shown on the site location plan in **Appendix A**.

9.2 The development site is on a residential road within the Borough of Camden. The site is located at approximate grid reference TQ 27355 83526.

9.3 The proposed development comprises the formation of a basement beneath the garden and single storey living room with an extension to the northern side of the property

9.4 The risk of flooding of the proposed development, including the basement from rivers, surface water, seas, groundwater and reservoirs is considered to be very low.

9.5 No historical records were identified of surface water flooding at the property. Recommendations are made within the report regarding how the development could reduce the risk of flooding.

9.6 The Thames Water sewers indicate the existing site is served by sewers in Avenue Road and.

9.7 The development can accommodate within its boundaries and site constraints a surface water drainage network that can manage the 1 in 100 yr return period storm event plus a 40% allowance for climate change.

9.8 As the development is predominantly subterranean the possibilities to provide betterment on the existing discharge rates are minimal. The report does however provide proposals for a SuDS scheme (subject to review of levels) for the development that could provide source control, attenuation and controlled storm water discharge.

9.9 The proposed surface water drainage design principals set out in this document ensure that the development does not increase the risk of flooding to surrounding areas and could reduce the risk downstream through the provision of SuDS techniques and attenuation. The proposed robust system is designed to deal with the impacts of climate change.

9.10 The outline drainage strategy has been designed to accommodate surface water runoff from the development for all events including the critical 1 in 100 year + 40% climate change.

9.11 The proposed foul water drainage strategy will consist of traditional piped system and will then discharge offsite of the existing Thames Water sewer in Avenue Road.

9.12 The site is presented as sustainable in terms of flood risk and fully compliant with the criteria set out in NPPF.