Planning Application Submission – February 2014

Flood Risk Assessment

Consultant: RSK LDE Ltd

Latchmere House – Scheme 1

Berkeley Homes (Central London) Ltd

Berkeley
Designed for life

Berkeley Homes (Central London) Ltd

Latchmere House – Scheme 1

Flood Risk and Drainage Assessment

132034 - R1(3) - FRA

DECEMBER 2013

RSK GENERAL NOTES

Project No.: 132034 - R1(3) - FRA

Site Name: Latchmere House – Scheme 1

Report Title: Flood Risk and Drainage Assessment

Client: Berkeley Homes (Central London) Ltd

Date: December 2013

Office: Hemel Hempstead

Status: Final

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Date:	17th December 2013	Date:	17th December 2013

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1 INTRODUCTION

RSK Land and Development Engineering Ltd were commissioned by Berkeley Homes (Central London) Ltd (the client) to carry out a Flood Risk Assessment (FRA) for Latchmere House, Richmond, TW10 5HH (the site). The assessment is in support of a planning submission for the redevelopment of the site from a former HM Prison to residential dwellings.

The development application has now been split into two schemes. This report addresses Scheme 1, which is for *"redevelopment of the Latchmere House site to provide 73 residential units, associated parking and landscaping, and retained access via Church Road."* Scheme 2 is addressed in an additional report with reference 132034-R2(0)-FRA.

The purpose of the FRA is to establish the flood risk associated with the proposed development and to propose suitable mitigation, if required, to reduce the risk to a more acceptable level.

The assessment has been prepared in accordance with the National Planning Policy Framework (NPPF) [(Ref. 1)] and its accompanying technical guidance document [(Ref. 2)], the Interim Code of Practice for Sustainable Drainage Systems (ICPSDS) [(Ref. 3)] and British Standards (BS) 8533-2011 Assessing and Managing Flood Risk in Development Code of Practice [(Ref. 4)], with site-specific advice and information from the Environment Agency (EA), the Local Planning Authority, the planners, the architects and the client.

The NPPF sets out the criteria for development and flood risk by stating that 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. The key definitions are:

- "Areas at risk of flooding" means land within Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems and which has been notified to the local planning authority by the EA.
- "Flood risk" means risk from all sources of flooding - including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

For this site, the key aspects that require the assessment are:

- The EA's indicative flood map shows that the site lies within Flood Zone 1 (low risk of tidal and fluvial flooding) outside the area of flooding associated with the River Thames to the west of the site boundary.
- A review of the impact of other sources of flooding associated with surface water, sewer and groundwater flooding.

- The site area is 3.5782ha and requires a surface water drainage assessment and strategy.

The comments given in this report and opinions expressed are subject to RSK Group Service Constraints provided in **Appendix A**.

2 CONTEXT AND SCOPE OF WORK

The scope of work relating to an FRA is based on the guidance provided in Section 10 of NPPF [(Ref. 1)] and its accompanying technical guidance [(Ref. 2)].

A site-specific FRA must demonstrate that the development will be safe for its lifetime (in this case 100 years for residential development) taking account of the vulnerability of its users without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. The scope of this assessment therefore comprises the following elements:

- To review plans, planning information and other studies to determine the existing site conditions;
- To obtain information on the hydrology and hydrological regime in and around the site;
- To obtain the views of the EA, including scope, location and impacts;
- To evaluate the flood risk to site from tidal, fluvial, surface water, groundwater and sewerage sources;
- To assess the impact on the site from climate change effects and anticipated increases in rainfall over a 100 year period for residential uses;
- To review site surface water drainage based on the proposed layout and to determine the extent of infrastructure required;
- To determine the extent of new flooding provision and the influence on the site;
- To review site foul water drainage and report on a drainage strategy to accommodate new development flows;
- To prepare a report including calculations and summaries of the source information and elements reviewed.

Appendix B of this report provides clarity of the scope of site-specific Flood Risk Assessment and includes extracts from NPPF technical guidance [(Ref. 2)], ICPSDS [(Ref. 3)] and BS 8533-2011 [(Ref. 4)].

3 SITE DESCRIPTION

3.1 Site Location

Site Name: Latchmere House and HM Remand Centre

Site Address: Church Road, Richmond, Surrey, TW10 5HH

Site National Grid Reference: 518510^{N}, 171310^{E}

The site is situated in a largely residential area to the west of Richmond Park and to the south of Ham Common. The site is located approximately 2.7 miles to the south of Richmond town centre and 1.8 miles to the north of Kingston town centre. The site spans the northern boundary of the Royal Borough of Kingston upon Thames and the south-eastern boundary of the London Borough of Richmond upon Thames.

Figure 1 shows a site location map.

3.2 Site Land Use

The site is a decommissioned Ministry of Justice prison, vacant since 2011. The total site area is 3.5782ha[1] and comprises Latchmere House – a locally listed 3-storey Victorian mansion house - a number of detached buildings, access roads, parking areas, hardstanding areas including a large 'parade ground' and soft landscaped areas.

Figure 2 shows the existing site layout and topographic survey.

The approximate land uses of the existing site are as follows:

Table 3.1: Existing Land Uses

Land Use	Existing Development (m^2)
Total Site Area	35,782
Building Footprint[2]	6,460 (18%)
Hardstanding	12,333 (34%)
Soft Landscaping	16,989 (48%)

[1] The total site area of 3.5782ha (35,782m^2) has been calculated based on the redline boundary provided by the architect (drawing BKH04_P_101_Rev. 1, dated 06.12.13). Note: This area does not include the separate area in the northwest of the site as illustrated in drawing BKH04_P_101_Rev.1 and subsequent Figures of this report as the footprint of this area is unknown and its small area is deemed insignificant to contribute to the surface water drainage strategy.

[2] Note: The total existing building footprint does not include the existing garage (in the west of site) as the garage area partly falls outside of the redline boundary.

3.3 Site Topography

The site topographic survey was undertaken by Laser Surveys. A significant part of the site is relatively flat with an elevation varying between 8.50 and 9.50 metres above ordnance datum (m AOD). There is a gentle fall at the eastern end (to 7.90m AOD) and to the north (to 8.10m AOD).

3.4 Site Geology

Based on British Geological Survey (BGS) records for the area (BGS online mapping tool) there are underlying superficial deposits of Kempton Park Gravel. This is a relatively permeable layer of river terrace gravel deposits to depths of typically 6 metres below ground level (m bgl). The bedrock geology consists of the London Clay Formation.

Numerous BGS boreholes are noted in the area, the closest to site being boreholes TQ17SE210 Ham Common to the east and TQ17SE243 Parkgate Farm Housing Development 3 to the southeast. The borehole records indicate that water was struck at 1.52m bgl and 6.50m bgl respectively.

Listers Geotechnical Consultants carried out a site-specific Ground Investigation report in September 2012 (Ref. 5). Made Ground was encountered from ground level to a maximum depth of 1.10m bgl. Kempton Park Gravel, consisting of sand and gravel, was encountered beneath the Made Ground to the full depth of the investigation at a maximum depth of 6.00m bgl. The report states the following about contamination on site *"Nothing significant but contingency should be allowed for, for isolated pockets encountered during construction".*

3.5 Site Hydrogeology

Hydrogeological information has been obtained from the EA's online mapping service. Kempton Park Gravel is classified as a Secondary A Aquifer whilst London Clay is non-productive strata. The site does not lie within a Groundwater Source Protection Zone. The site lies in a Groundwater Vulnerability Zone (GVZ) rated Minor Aquifer High. The eastern site boundary borders a GVZ rated Major Aquifer Low.

Listers undertook permeability testing as part of the Ground Investigation (Ref. 5). The results indicate that the Secondary A Kempton Park Gravel Aquifer beneath the site has a 'very good' soil permeability in the order of $1x10^{-3}$m/s to $5x10^{-4}$m/s. **Table 3.2** provides the measured averages during permeability testing.

Table 3.2: Listers' Permeability Testing

Borehole Number	Average Permeability (m/s)	Permeability (m/hr)
CT15	1.57×10^{-3}	5.65
CT 5	8.30×10^{-4}	2.99
CT 4	5.83×10^{-4}	2.10
Average	**9.94×10^{-4}**	**3.58**

The average infiltration rate for the site is taken as 9.94x10-4m/s (3.5796m/hr).

Listers encountered groundwater at depths ranging from 3.00m bgl to 3.50m bgl. There are no groundwater abstraction licenses within 1000m of the site.

3.6 Site Hydrology

There is a small pond of approximately 29m^2 in the centre of the site to the north of the A Block.

There are numerous ponds and drains within Richmond Park to the east of the site as close as 150m. Ham Bottom ditch is located approximately 450m to the north of the site.

The River Thames is located approximately 700m to the southwest of the site, flowing in a north direction. The upstream tidal extent of the River Thames is at Teddington Weir, which is located approximately 1.8km to the northwest of the site.

Beverley Brook, a tributary of the Thames, is located approximately 3km to the east of the site. The River Crane, also a tributary of the Thames, is located approximately 4km to the northwest of the site.

Longford River, an artificial distributary waterway that diverts water from the River Colne in west London to Bushy Park (and subsequently to the Thames), is located approximately 3km to the southwest of the site.

4 DEVELOPMENT PROPOSALS

The proposed development with respect to the latest masterplan (drawing BKH04_P_101_Rev.1, dated 06.12.13 as presented as **Figure 3**) comprises the following:

- Retention and renovation of Latchmere House;
- 73 no. residential units including 7 apartments in Latchmere House;
- Associated gardens, car parking and garages;
- Access roads; and
- Areas of soft landscaping in the northeast and southeast.

Table 4.1 compares the approximate areas of land use types for the existing and proposed developments.

Table 4.1: Comparison of Existing and Proposed Site Land Uses

Land Uses	Existing Development (m^2)	Proposed Development (m^2)
Total Site Area	35,782	35,782
Building Footprint	6,460 (18%)	6,929 (19%)
Hardstanding	12,333 (34%)	8,940 (25%)
Soft Landscaping	16,989 (48%)	19,913 (56%)

Overall, the proposed development will result in a decrease in impermeable area by 2,924m^2 (8%).

5 LEGISLATION AND POLICY CONTEXT

5.1 National

Table 5.1: National Legislation and Policy Context

Legislation	Key Provisions
National Planning Policy Framework (2012)	The aims of planning policy on development and flood risk are to ensure 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 at highest risk. 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.
Flood and Water Management Act 2010	The Flood and Water Management Act aims to implement the findings of the 2007 Pitt Review and co-ordinate control of drainage and flood issues. There are a number of increased responsibilities within the Act that affect adoption of Sustainable Drainage Systems (SuDS) and the role of the EA to expand on the mapping data they provide. The implementation of SuDS features has many beneficial impacts on the treatment of surface water during remediation works.
Water Resources Act 1991	Section 24 - The EA is empowered under this Act to maintain and improve the quality of 'controlled' waters Section 85 - It is an offence to cause or knowingly permit pollution of controlled waters Section 88 - Discharge consents are required for discharges to controlled waters
Water Framework Directive (2000)	The Water Framework Directive (WFD) requires all inland and coastal waters to reach 'good' chemical and biological status by 2015. Flood risk management is unlikely to have a significant impact on chemical water quality except where maintenance works disturb sediment (such as de-silting) or where pollutants are mobilised from contaminated land by floodwaters. The main impact of the WFD on flood risk management, both now and in the future, relates to the ecological quality of water bodies. Channel works, such as straightening and deepening, or flood risk management schemes that modify geomorphological processes can change river morphology. The WFD aims to protect conservation sites identified by the EC Habitats Directive and Birds Directive that have water-related features, by designating them as 'protected sites'.

5.2 Regional Policy

The London Plan

The London Plan (July 2011) [Ref. 6] is the regional spatial strategic plan for London, setting out a fully integrated economic, environmental, transport and social framework for the development of London to 2031. The main policies relating to flood risk management in London are outlined in the **Table 5.2** below.

Table 5.2: The London Plan Policy Context

Policy Document	Key Provisions
London Plan	**Policy 5.12 Flood Risk Management** Development proposals must comply with the flood risk assessment and management requirements set out in PPS25 [now NPPF], the Thames Estuary 2100 (TE2100) Plan and Catchment Flood Management Plans (CFMP) over the lifetime of the development. Developments which are required to pass the Exceptions Test must address flood resilient design and emergency planning by demonstrating that: • the development will remain safe and operational under flood conditions • a strategy of safe evacuation and/or safely remaining in the building is followed under flood conditions • key services including electricity, water etc. will continue to be provided under flood conditions • buildings are designed for quick recovery following a flood.
	Policy 5.13 Sustainable Drainage Development should utilise sustainable drainage systems (SuDS), unless there are practical reasons for not doing so. Development should aim to achieve Greenfield runoff rates in line with the following drainage hierarchy: • store rainwater for re-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. Drainage should be designed and implemented in ways that also deliver other policy objectives of the London Plan, including water use efficiency and quality, biodiversity, amenity and recreation.
Supplementary Planning Guidance on Sustainable Design and Construction (May 2006) [Ref. 7]	**SPG 2.4.4 Water Pollution and Flooding** Essential Standard • Use of SuDS measures, wherever practical, to achieve 50% attenuation of the undeveloped site's surface water runoff at peak times

Policy Document	Key Provisions
	Mayor's Preferred Standard • Use of SuDS to achieve 100% attenuation of the undeveloped site's surface water runoff at peak times

5.3 Local Policy

London Borough of Kingston upon Thames Local Development Framework

The LDF superseded the Unitary Development Plan in 2012. Relevant policies contained within the DPDs are outlined in **Table 5.3** below.

Table 5.3: Local Development Framework Policy Context

Policy Document	Key Provisions
Core Strategy (April 2012) (Ref. 8)	**CS1 Climate Change Mitigation** Ensure that new development is designed and built to contribute to climate change mitigation by planning for increased flood risk.
	CS2 Climate Change Adaptation The Council will work in partnership with the EA and other stakeholders to address flooding from the River Thames and its tributaries and surface water flooding.
	DM1 Sustainable Design and Construction Standards Residential developments are encouraged to meet the Code for Sustainable Homes categories on surface water runoff.
	DM4 Water Management and Flood Risk A FRA is required for development within Flood Zone 1 of over 1ha. Development proposals should include SuDS, where possible, in line with the London Plan's drainage hierarchy. The development should also demontrate that there will be no adverse impacts on the quantity and quality of water resources. The development should take into account the impacts of climate change, the NPPF, the local Strategic Flood Risk Assessment (SFRA) and the Surface Water Management Plan (SWMP).

London Borough of Richmond upon Thames Local Development Framework

The Local Development Framework (LDF) superseded the Unitary Development Plan in 2011. The LDF incorporates a number of Local Development Plan Documents (DPDs). The DPDs, in conjunction with national planning policy and the London Plan, set out the strategy for managing development in the Borough. Relevant policies contained within the DPDs are outlined in **Table 5.3** below.

Table 5.3: Local Development Framework Policy Context

Policy Document	Key Provisions
Core Strategy (April 2009) (Ref. 9)	**CP1 Sustainable Development** Development will need to incorporate sustainable flood measures to protect vulnerable areas from flooding of the River Thames and its tributaries.
	CP3 Climate Change Development should be designed to take into account the future impacts of climate change.
Development Management Plan (November 2011) (Ref. 10)	**Policy DM SD 6: Flood Risk** Development will apply the Sequential Test and, if appropriate, the Exception Test. **Policy DM SD 7: Sustainable Drainage** Development will follow the drainage hierarchy when disposing of surface water and must utilise SuDS wherever practical. Any runoff must be reduced to Greenfield runoff rates wherever feasible. When discharging runoff to a public sewer, developers must check that capacity exists within the network. **Policy DM SD 9: Protecting Water Resources and Infrastructure** Developments must achieve a high standard of water efficiency.

6 SOURCES OF INFORMATION

6.1 Environment Agency

Flood Zone Map

The relevant guidance note from the Environment Agency is available online through the following link. The guidance note relevant to the site is Guidance Note 1, which relates to undertaking a FRA for sites greater than 1ha and including how the site will manage surface water runoff.

http://www.environment-agency.gov.uk/research/planning/93498.aspx

The EA do not have the detailed modelling to provide a Product 4 data set for the site area. The EA flood zone mapping service for England and Wales is available online at the following link:

http://www.environment-agency.gov.uk/homeandleisure/floods/

The latest EA flood map is presented as **Figure 4**. The site lies wholly within Flood Zone 1. Flood Zone 1 comprises land assessed as having less than a 1 in 1000 year annual probability of fluvial or tidal flooding (<0.1%) in any year. This places the site within an area of 'low' risk of fluvial and tidal flooding.

Pre-Application Enquiry

The EA confirmed that the site within Flood Zone 1, where the risk of flooding from rivers is classified as low. However, the FRA must consider surface water runoff and groundwater flooding.

The development should manage surface water runoff in line with the London Plan.

Complete correspondence is contained in **Appendix C**.

6.2 Relevant Studies

Relevant studies are summarised below with relevant flood risk sources presented in **Section 7**.

Strategic Flood Risk Assessments

Title: Royal Borough of Kingston upon Thames Strategic Flood Risk Assessment, Level 1 and 2, April 2011 (Ref. 11)

Title: London Borough of Richmond upon Thames Strategic Flood Risk Assessment, Level 1 Update, August 2010 (Ref. 12)

The principle aim of a SFRA is to map all forms of flood risk in the Borough in order to provide an evidence base to locate new development. The SFRA contains information and maps detailing flood sources and risks.

Relevant maps contained within the SFRAs can be found at the following links:

Kingston SFRA:

http://www.kingston.gov.uk/sfra_level1and2.pdf

Richmond SFRA:

http://www.richmond.gov.uk/home/environment/planning/planningpolicy/local_development_framework/local_development_framework_research/flood_risk_assessment.htm

Preliminary Flood Risk Assessment

Title: London Borough of Richmond upon Thames Preliminary Flood Risk Assessment, May 2011 (Ref. 13)

A Preliminary Flood Risk Assessment (PFRA) is the first part of the planning cycle for flood risk management as set out in the Flood Risk Regulations (2009), which implement the requirements of the European (EU) Floods Directive (2007). The EU Floods Directive aims to provide a consistent approach to managing flooding across Europe.

The PFRA considers local sources of flooding that the Lead Local Flood Authority is responsible for, including: ordinary watercourses; surface water; groundwater; and sewers where flooding is wholly or partially caused by rainwater or other precipitation entering or affecting the system. Information is gathered from existing sources on past floods and flood models to identify Flood Risk Areas. The PFRA forms part of the wider Drain London project.

Surface Water Management Plan

Title: London Borough of Richmond upon Thames and Royal Borough of Kingston upon Thames First Edition Surface Water Management Plan, August 2009 (Ref. 14)

Title: London Borough of Richmond upon Thames Surface Water Management Plan, July 2011 (Ref. 15)

A SWMP outlines a long-term action plan for the sustainable management of local surface water flood risk.

Catchment Flood Management Plan

Title: Thames Catchment Flood Management Plan, Summary Report, December 2009 *(Ref. 16)*

The CFMP gives an overview of the flood risk from inland sources across each river catchment and recommend ways of managing those risks now and over the next 50 to 100 years.

Thames Estuary 2100 Plan

Title: TE2100 Plan, November 2012 *(Ref. 17)*

The TE2100 Plan sets out the strategic direction for managing flood risk in the Thames estuary to the end of the century and beyond.

Other Planning Documents

Title: Latchmere House and HM Remand Centre Planning Brief, March 2013 *(Ref. 18)*

The Planning Brief was jointly prepared by Kingston and Richmond Boroughs' Councils to provide the prospective landowner with planning guidance. The Brief outlines relevant planning policy.

6.3 Drainage

Public Sewers

Sewer details have been referenced from sewer record plans obtained from Thames Water, as shown in **Appendix D**. All levels are quoted in metres Ordnance Newlyn Datum.

There are no public sewers within the site boundary. It appears that the site is served by separate foul and surface water systems. A foul sewer is located to the northeast of the site on Church Road whilst surface water sewer systems are located in residential areas to the south, east and west of the site.

A number of water supply mains are also located in the vicinity of the site.

A pre-development enquiry was sent to Thames Water ion February 2013, the response to which is also contained within **Appendix D**.

Private Drainage

Historical foul drainage maps indicate that the site buildings drain to the northeast.

Soakage tests carried out as part of Listers Ground Investigation report (Ref. 5) indicate it is probable that the surface water infiltrates into the ground via soakaways given the very good permeability of the underlying Kempton Park Gravel.

Internal Drainage Boards

There are no known Internal Drainage Boards covering the site area.

7 SOURCES OF FLOOD RISK

7.1 Criteria

In accordance with NPPF [(Ref. 1)] and advice from the EA, a prediction of the flood sources and levels is required along with the effects of climate change from the present to the design life of the development (100 years). To consider the effects of climate change, Table 5 of NPPF Technical Guidance [(Ref. 2)] recommends consideration of a 30% increase in rainfall intensity and 20% increase in peak river flows over the development's design life.

The flood risk elements that need to be considered for any site are defined in BS 8533-2011 [(Ref. 4)] as the "Forms of Flooding" and are listed as:

- Flooding from Rivers (fluvial flood risk)
- Flooding from the Sea (tidal flood risk)
- Flooding from the Land (surface water flood risk)
- Flooding from Groundwater
- Flooding from Sewers (sewer and drain exceedance, pumping station failure etc)
- Flooding from Reservoirs, Canals and other Artificial Structures.

The following section reviews each of these in respect of the site.

7.2 Fluvial Flood Risk

The EA flood map (**Figure 4**) shows the site to be located in Flood Zone 1, representing less than a 1 in 1000 year probability of flooding or 'low' flood risk from fluvial sources. The nearest Main River to the site, the River Thames, is located approximately 700m to the southwest of the site and thus is not deemed to represent a flood risk to the site.

Both Kingston and Richmond SFRAs confirm that the site lies in Flood Zone 1. Maps contained in these SFRAs indicate that neither the River Thames, River Crane nor Beverley Brook present a flood risk to the site. Richmond PFRA does not allude to any instances of fluvial flooding associated with ordinary watercourses in Richmond Park and Ham Common.

Within the TE2100 Plan, the site falls on the edge of Action Area 1, Policy Unit Richmond (Teddington to Kew). This area consists of a relatively narrow floodplain along the River Thames comprising largely residential properties and garden/parks. The fluvial flood risk associated with the River Thames is 1% per annum (Thames Barrier controlled). The flood depth in the event that the Barrier fails is up to 3m, which would not impact upon the site.

The flood risk from fluvial sources is **low**.

7.3 Tidal Flood Risk

The site is located in Flood Zone 1, representing less than a 1 in 1000 year probability of flooding or 'low' flood risk from tidal sources. The tidal extent of the River Thames is at Teddington Weir, which is located approximately 1.8km to the northwest of the site.

According to the TE2100 Plan, the number of properties at risk of tidal flooding from the tidal Thames is small. The tidal flood risk is 0.1% per annum (Thames Barrier controlled). The flood depth in the event that the Barrier fails is up to 2m, which would not impact upon the site.

The recommended flood risk management policy for Richmond policy unit is P3 - to continue with existing or alternative actions to manage flood risk. The existing flood risk management system comprises the Thames Barrier, secondary defences along the Thames frontage and flood forecasting/warning. There are no fluvial-specific defences but the tidal defences provide a degree of fluvial protection. The area is also covered by the Thames Landscape Strategy Hampton to Kew.

The site itself does not fall within a priority evacuation/refuge area and neither does property in the site area contain building resilience/resistance as part of TE2100 Plan.

The flood risk from tidal sources is **low**.

7.4 Surface Water Flood Risk

Intense rainfall can create conditions where the local infiltration and drainage capacity is insufficient to cope with the volume of water and so water flows overland. Surface water flooding can also occur due to a reduction in the capacity of a drainage system due to some form of blockage.

The topography of the site indicates that any excess surface water on the site would drain to the areas of lower ground in the east (7.90m AOD) and to the north (8.10m AOD). The wider area in Kingston Borough is largely located at a lower ground level. In Richmond Borough, Richmond Park falls towards the site, however it is likely that surface water would be retained within the Park.

There are no records of historical surface water flood events on the site or surrounding site area. The site does not lie within a Critical Drainage Area, however Richmond SFRA 'Areas Susceptible to Surface Water Flooding' map indicates that the site lies within an area with 'intermediate susceptibility' to surface water flooding. Richmond PFRA maps model a 0.1-0.25m and 0.5-1.0m depth of surface water flooding in the south of the site during a 1 in 100 year and 1 in 200 year rainfall event respectively. These events both equate accordingly to a 'moderate (danger for some)' surface water flood hazard. According to Kingston SFRA, there is a risk of surface water flooding to the southwest of the site during a 1 in 30 year storm event.

The predicted affects of climate change - more intense summer rainfall events and higher winter rainfall - could increase the risk of surface water flooding.

The surface water flood risk to the site is considered to be **low**/**moderate**.

7.5 Flooding from Groundwater

Groundwater flooding occurs when the water held underground rises to a level where it breaks the surface in areas away from usual channels and drainage pathways. Groundwater flooding typically occurs following long periods of sustained intense rainfall and is typically associated with low-lying areas underlain by permeable aquifers.

There is evidence (based on SFRA maps) of groundwater flooding associated with superficial deposits of gravels approximately 2km to the north of the site. Evidence of historical groundwater flooding in Kingston Borough is relatively limited.

Climate change could increase the risk of groundwater flooding as a result of increased precipitation filtering into the groundwater body. If winter rainfall becomes more frequent and heavier, groundwater levels may increase. Higher winter recharge may however be balanced by lower recharge during the predicted hotter and drier summers. This is less likely to cause a significant change to flood risk than from other sources, since groundwater flow is not as confined. It is probable that any locally perched aquifers may be more affected, but these are likely to be isolated. The change in flood risk is likely to be low.

The groundwater flood risk to the site is considered to be **low**.

7.6 Flooding from Sewers

Flood events occur when the capacity of a sewer is exceeded either due to a blockage in the sewer system or excess surface water runoff entering the system. Richmond and Kingston is generally served by separate foul and surface water sewer networks. The sewers are typically designed to accommodate up to a 1 in 30 year rainfall event, however, according to Richmond SWMP, Thames Water informed the London Borough of Richmond upon Thames Scrutiny Task Group (created to provide a report into the 2007 flood event) that the sewer system across the Borough is only designed to accommodate a 1 in 10 or 1 in 15 year storm event.

There were 11-20 sewer flood records in Richmond (according to Thames Water DG5 register as of June 2010) and 39 overloaded sewers in Kingston (according to Thames Water DG5 register as of August 2009) however details of the locations are not available.

The impact of climate change is likely to be negative regarding flooding from sewers. Increased rainfall and more frequent flooding put existing sewer and drainage systems under additional pressure resulting in the potential for more frequent surcharging and potential flooding. This would increase the frequency of local sewer flooding but not significant in terms of the proposed development.

The risk of groundwater flooding is considered to be **low**.

7.7 Flooding from Reservoirs, Canals and Artificial Structures

Flood events can occur from a sudden release of large volumes of water from reservoirs, canals and artificial structures. The EA Reservoir flooding map is

reproduced as **Figure 5**. The map indicates that the site is not at risk from reservoir flooding. The nearest areas at risk of reservoir flooding are approximately 900m to the north and 600m to the southwest of the site.

Reservoirs can be managed over time, controlling inflow/outflow of water and therefore there is the capacity to control the effects of climate change. Increased rainfall has the potential to increase base flow, but this should be minimal. It is unlikely that there will be a substantial change to the risk of flooding for this site.

There are no canals in the site area. The small pond on the existing site will not be retained as part of the development proposals. A number of ponds and drainage ditches are located in Ham Common and Richmond Park however given their small size and distance from site these are considered to present a low risk to the site.

The risk of flooding from the above sources is considered to be **low**.

8 PLANNING CONTEXT

8.1 Application of Planning Policy

Section 10 of NPPF [(Ref. 1)] includes measures specifically dealing with development planning and flood risk using a sequential characterisation of risk based on planning zones and the EA flood map. The main study requirement is to identify the flood zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

8.2 Land Use Vulnerability

NPPF Technical Guidance [(Ref. 2)] includes a list of appropriate land uses in each flood zone dependent on vulnerability to flooding. The tables are contained in **Appendix E** and Table 3 is reproduced as **Table 8.1** below.

Table 8.1: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	Appropriate	Appropriate	Appropriate	Appropriate	Appropriate
	Zone 2	Appropriate	Appropriate	Exception Test Required	Appropriate	Appropriate
	Zone 3a	Exception Test Required	Appropriate	Should not be permitted	Exception Test Required	Appropriate
	Zone 3b functional floodplain	Exception Test Required	Appropriate	Should not be permitted	Should not be permitted	Should not be permitted

The site's proposed residential development is classed as 'More Vulnerable' development. This classification of development is appropriate for areas within Flood Zone 1 subject to the implementation of an appropriate surface water drainage strategy. A surface water drainage strategy is considered in **Section 9**.

8.3 Sequential and Exception Tests

The Sequential Test is required at all stages of the planning process to steer new development to areas with the lowest probability of flooding (Flood Zone 1). As shown in **Table 8.1**, the proposed development is located in Flood Zone and passes the Sequential Test. The Exception Test - where there are no reasonably available sites for new development in Flood Zone 1 and development is subsequently proposed within Flood Zones 2 or 3a - is not applicable to the site.

9 SURFACE WATER DRAINAGE ASSESSMENT

9.1 Scope

NPPF and the London Plan state that SuDS should be considered wherever practical. Building Regulations Part H [(Ref. 19)] requires that the first choice of surface water disposal should be to discharge to an adequate soakaway or infiltration system, where practicable. If this is not reasonably practicable then discharge should be to a watercourse, the least favourable option then being to a sewer. Infiltration techniques should therefore be applied wherever they are appropriate.

In accordance with the London Plan, the surface water drainage strategy should seek to implement the SuDS hierarchy and aspire to achieve reductions in surface water runoff rates to Greenfield rates (Preferred Standard). As a minimum, the proposed surface water drainage strategy should achieve the Essential Standard set out in the London Plan to reduce runoff to 50% of existing rates if the Greenfield rate is not practicable.

As development will be located in Flood Zone 1 and is greater than 1ha in size, the EA requires such development to focus on the management of surface water runoff. This section discusses the potential quantitative effects of the development on both the risk of surface water flooding on-site and elsewhere within the catchment, as well as the type of potential SuDS features that could be incorporated as part of the masterplan.

9.2 Pre-Development Situation

The existing site is considered to consist of approximately 18,793m^2 (52%) impermeable land (see **Section 3.2**). It is assumed that all runoff from the site either infiltrates into the ground or enters the public surface water sewers to the south, east and west of the site (see **Section 6.3**). It is probable that the existing site drains into the ground since there is reference to soakaways on the on-site foul drainage plan.

In terms of the initial estimate of the potential runoff from the site, the pro-rata Institute of Hydrology (IoH) 124 method [(Ref. 20)] has been used to estimate the existing surface water runoff from the site. The results are shown in **Table 9.1** below. Additional information is contained in **Appendix F.**

Table 9.1: IoH Surface Water Runoff Calculations (existing hardstanding)

Return Period	Peak Flow (l/s)
QBAR urban	14.5
1 in 1 year peak flow	12.4
1 in 30 year peak flow	27.2
1 in 100 year peak flow	32.8

As a pre-developed site, an additional method of calculating the surface water runoff from impermeable areas is the Rational Method.

Rational Method:

$Q = C \times i \times A$

where C - is the runoff coefficient with a value of 0.95

i - is the design rainfall intensity which is at 0.014l/s/m^2 (14l/s/ha) from Part H of the Building Regulations (paragraph 3.8 Approved Document H3, 2010) (Ref. 19)

A - is the impermeable area (m^2)

$Q = 0.95 \times 0.014 \times 18{,}793$

Q = 249.95 l/s

This method assumes that all surface runoff is immediately directed into the public sewer network surrounding the site and therefore does not account for natural attenuation and possible infiltration across the site's permeable areas.

9.3 Limiting Discharge for Design

For the range of annual flow rate probabilities up to and including the 1 in 100 year event, including an appropriate allowance for climate change, the developed rate of runoff into a watercourse or other receiving water body should be no greater than the existing rate of runoff for the same event.

Due to the favourable ground conditions on site (see **Section 3.5**) there will be no off-site discharge, as all surface water will discharge to ground.

This also conforms with the Thames Water response contained within **Appendix D**, which states that the surrounding public surface water sewers are overloaded.

9.4 Sustainable Drainage Options

In order to define the proposed post-development drainage solution the use of SuDS for surface water management and the disposal of surface water runoff has been considered in this assessment. The options available are based upon guidance given in the CIRIA publication 'The SuDS Manual' (Ref. 21) and the London Plan (Ref. 6).

A SuDS system aims to mimic natural systems whereby water is held close to the source, then released slowly over time. This acts to both reduce peak discharge and to promote the settlement of sediment thereby improving the water quality of any resulting discharge. The final SuDS strategy for this site will be designed in line with the SuDS hierarchy as in Policy 5.13 Sustainable Drainage in the London Plan (see **Section 5.2**).

9.5 Post-Development Situation

9.5.1 Quick Store Estimates

To determine the approximate volume of attenuation storage that would be required on-site, the WinDes 'Quick Storage' calculation has been used undertaken for the two proposed catchments, based on a conservative total post-development impermeable area of approximately 15,869m^2 (~44%). An infiltration coefficient of 3.5796m/hr has been used. Full calculations can be found in **Appendix G.** This is an approximation of the storage requirement and as such provides a range of storage volumes. These volumes can be later revised at detail design stage by the introduction of specific flow control methods. A summary is shown in **Table 9.5** below.

Table 9.5: Summary of Required Attenuation Volumes

Flood Event	Approximate Storage (m^3)	
	Northern Catchment	Southern Catchment
1 in 30 year event	6 - 62	16. - 161
1 in 100 year event	7 - 81	20 - 212
1 in 100 year event + climate change	10 - 106	26 - 277

As previously mentioned in Section 3.5 and 9.3, no off-site discharge will occur. An infiltration rate of 9.94x10^{-4}m/s (3.5796m/hr) has been used in these calculations.

An approximate total storage volume of 62m^3 for the northern catchment and 161m^3 for the southern catchment, would be required for the site in order to contain all surface water runoff below ground within the site for up to the 1 in 30 year storm event. A total storage volume of 106m^3 for the northern catchment and 277m^3 for the southern catchment would be needed for a 1 in 100 year storm event plus a 30% allowance for climate change.

9.5.2 Proposed Drainage Strategy

Given the suitability of the ground conditions, all surface water on the developed site is discharged to ground via soakage features. The majority of runoff from roofs is discharged directly to individual trench soakaways within back gardens, which have been located at least 5m from any buildings. Due to the proposed site layout, it has not been possible to locate trench soakaways within all gardens and therefore some runoff from roofs will enter the network within the road system. Runoff from the roads will pass through permeable paving and swale features (for treatment purposes) before entering infiltration basins that will allow water to discharge to ground. The site has been split into two catchment areas with infiltration basins at the downstream end of both.

The strategy has been designed to accommodate the 1 in 30 year event below ground (northern catchment: approximately 78m^3, excess of 62m^3 and southern catchment: approximately 168m^3, excess of 161m^3). This will be accommodated within the individual trench soakaways for the buildings and permeable paving/geocellular storage beneath the infiltration basins to accommodate runoff from the roads.

For more extreme storm events, up to the 1 in 100 year plus 30% climate change event, runoff will be attenuated on site within the infiltration basins. A preliminary design of these basins indicate that they only have water above ground during these extreme events (more than 1 in 30 year event). Due to the site topography, the surface water drainage pipework will be up to 2m below ground level at the inlet to the basins and therefore these have been designed to fill the geocells and gravel trench before filling the basin (i.e. filled from below). The two basins have been designed in the Windes 'Source Control' as features to accommodate the 1 in 100 year plus climate change volume from the roads only. As there will be an overflow from the buildings for this larger storm event, the basins sizes have been increased to ensure that this extra volume can be accommodated in the basins and an approximate 280-300mm freeboard has been allowed for.

Groundwater levels have been measured at 3-3.5m bgl (Section 3.5) and the features have a preliminary design which provides at least a 1m buffer to the groundwater table.

It should be noted that the northern part of the main access road into the site is assumed to drain as per its existing arrangement, as no changes are proposed for this area. Therefore this impermeable area has not been included in the calculations.

An indicative proposed SuDS layout is shown as **Figure 6**. It should be noted that the inclusion and feasibility of the above outline proposals would need to be confirmed at the detailed design stage following a review of the final site layout.

9.6 Foul Water Drainage Strategy

Thames Water plans as contained within **Appendix D**, illustrate that there is an existing 150mm diameter foul sewer to the north east of the site skirts the near side of Church Road just outside the site boundary. This sewer gravitates eastwards to a pumping station a short distance downstream at the junction with Latchmere Lane. At manhole no 5401 on this run, the sewer depth is approximately 2.4 metres. This increases to 2.8 metres close to the pumping station.

Direct correspondence with Thames Water states *"there is adequate capacity in the sewer for your foul drainage proposals"* (see **Appendix D**). Therefore the proposed foul water strategy for this site connects into the existing public network.

According to surveys of the previously developed site, there appears to be an existing connection to the public network through the trees in the north of the site. Therefore, **Figure 7** illustrates an indicative foul water plan that utilises this existing connection. Detailed design of the foul water network is outside the scope of this report and will need to be developed during the detailed design stage.

10 CONCLUSIONS AND RECOMMENDATIONS

The conclusions and key recommendations from this FRA have been summarised in **Table 11** below.

Table 11: Flood Risk Assessment Summary

1.	**Development description and location**
1a	What type of development is proposed and where will it be located? • A 3.58ha residential development on the site of Latchmere House.
1b	What is its vulnerability classification? • Residential use is considered as 'More Vulnerable' in accordance with NPPF Technical Guidance.
1c	Is the proposed development consistent with the Local Development Documents? • The development will incorporate SuDS features in line with the London Plan and the LDF of both Kingston and Richmond Boroughs.
1d	Provide evidence that the Sequential Test or Exception Test has been applied in the selection of this site for this type of development? • The 'More Vulnerable' classified site is located within an area of low fluvial flood risk (Flood Zone 1) and is therefore considered appropriate in terms of flood risk and is deemed to satisfy the Sequential Test.
2.	**Definition of the flood hazard**
2a	What source of flooding could affect the site? • Surface water • Sewer flooding
2b	Describe how flooding could occur? • Overland flow and surcharge of sewers.
2c	What are the existing surface water drainage arrangements for the site? • The site is served by a private drainage network believed to connect to Thames Water foul and surface water sewers off-site.
3.	**Probability**
3a	Which flood zone is the site within? • Flood Zone 1
3b	If there is a Strategic Flood Risk Assessment covering this site, what does it show? • The site lies in both Kingston and Richmond Boroughs thus is covered in two SFRAs, both of which confirm that the site lies within Flood Zone 1. There have been no historical instances of fluvial, tidal, surface water, sewer or groundwater flooding on the site.

3c	What is the probability of the site flooding taking account of the contents of the SFRA of any further site-specific assessment? • Low
3d	What are the existing rates and volumes of runoff generated by the site? • IoH 124 calculations indicate existing discharge rates vary between 12.4 and 32.8l/s for return periods up to and including the 1 in 100 year plus climate change event. • The Rational Method indicates that the site currently generates 249.9l/s.
4.	**Climate Change**
4a	How is flood risk at the site likely to be affected by climate change? • Climate change will increase rainfall by 30%, which may result in increased surface water flooding. However, various design features could be incorporated into the site layout to mitigate against flooding from this source.
5.	**Detailed development proposals**
5a	Demonstrate, where appropriate, how land uses most sensitive to flood damage have been placed within the site that are at least risk of flooding. • The whole site is located within Flood Zone 1.
6.	**Flood risk management measures**
6a	How will the site be protected from flooding, including the potential of climate change, over the development's lifetime? • SuDS features have been outlined that can be designed to attenuate surface water up to the 1 in 100 year plus climate change event on site.
7.	**Off site impacts**
7a	How will it be ensured that the proposed development and the measures to protect the site from flooding will not increase flood risk elsewhere? • SuDS features should be adopted to ensure that surface water runoff from the site is managed.
8.	**Residual risks**
8a	What flood related risks will remain after the implementation of measures to protect the site from flooding? • Any blockage of sewers during extreme fluvial flood events.
8b	How, and by whom, will these risks be managed over the lifetime of the development? • Site management teams will maintain on-site private drains • Thames Water will manage public sewers • The EA will manage local Main Rivers.

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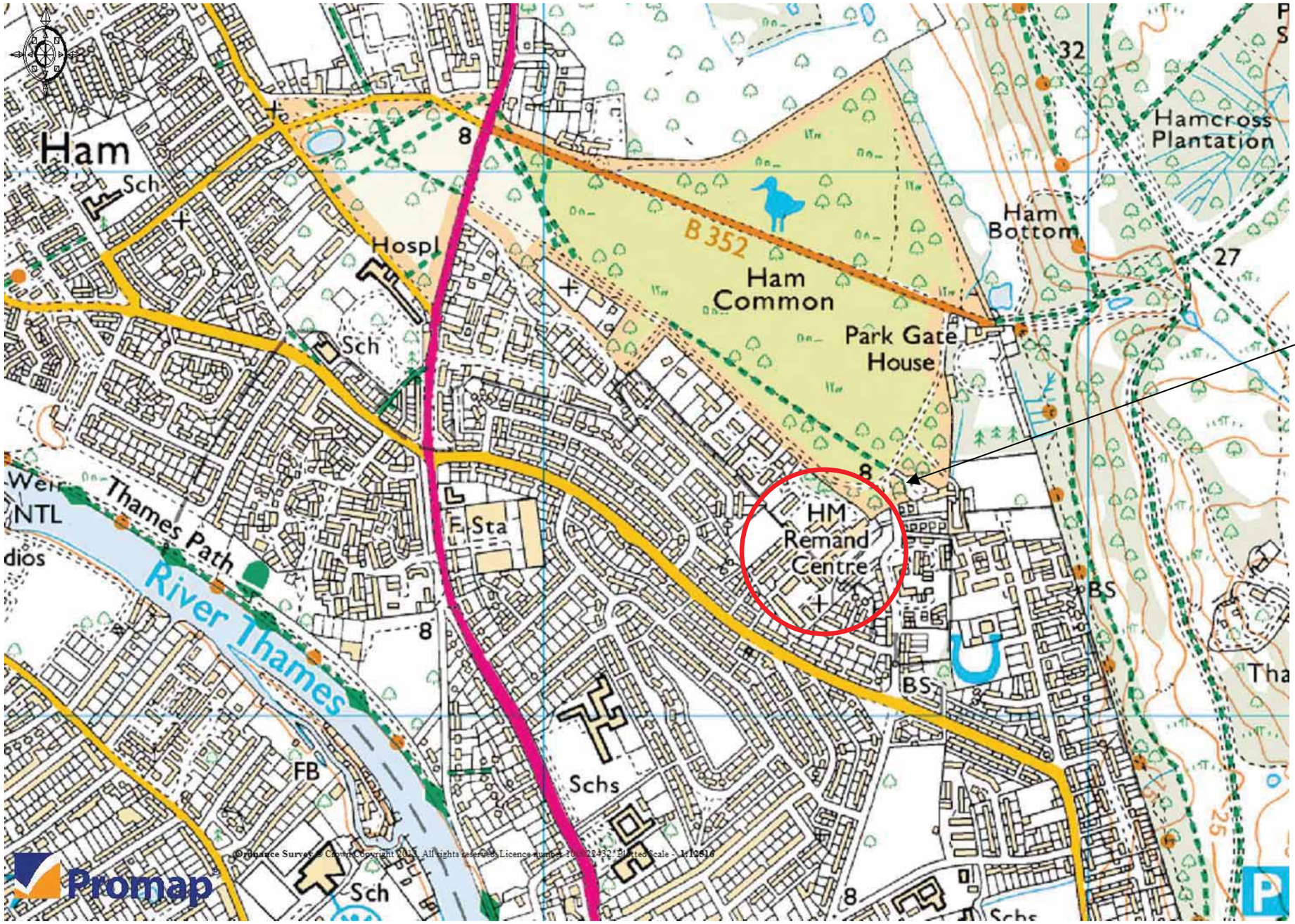
FIGURES



RSK	**SITE LOCATION PLAN**	**Client:**	Berkeley Homes (Central London) Ltd	**Figure No:**	1
		Site:	Latchmere House	**Job No:**	132034
		Scale:	NTS	**Source:**	Promap