



**BASEMENT IMPACT ASSESSMENT
FOR THE PROPOSED DEVELOPMENT
AT HIGHGATE SCHOOL
MSC 4PHASE DEVELOPMENT**

**Bishopswood Road
London, N6 4PB**

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CONTENTS

1.	Introduction	3
2.	Stage 1 – Screening	4
	2.1 Location of the project	4
	2.2 Characteristics of the Project	4
	2.3 Physical Form of the Development	5
	2.4 Mitigation Measures Being Considered	5
	2.5 Characteristics of Potential Impacts	6
	2.6 Screening Process	7
	2.7 Summary	8
3.	Stage 2 – Scoping	9
	3.1 Potential Impacts of the Proposed Scheme	9
	3.2 Summary	9
4.	Stage 3 - Site Investigation & Study	10
5.	Stage 4 - Impact Assessment & Conclusion	10
	5.1 Existing vs Proposed	10
	5.2 Site Attributes & Features Affected	10
	5.3 Conclusion	10
Appendix A	Mapping Data	11
Appendix B	PJCE Preliminary drawings	35
Appendix C	Borehole Data from investigations	43

1.0 Introduction

Pringuer-James Consulting Engineers (PJCE) were appointed by Highgate School as the structural engineers to prepare a Basement Impact Assessment (BIA) to be submitted with the planning submission package for the proposed MSC 4Phase development at Bishopswood Road, London, N6 4PB. The report has been compiled on behalf of Highgate School and shall be for the private and confidential use of the client for whom the report is undertaken and should not be reproduced in whole or in part or relied upon by third parties for any use without our express written authority.

The BIA has been prepared in accordance with the current format set-out by London Borough of Haringey Planning Department (LB Haringey) in the document: Basement development guidance note, in conjunction with the North London Strategic Flood Risk Assessment prepared by Mouchel dated 2008 and the Level 2 Strategic Flood Risk Assessment prepared by JBA Consulting dated 2015. Based on the Basement development guidance note, the new basements within the proposed developments have been classed Type 4, thus requiring a Basement Impact Assessment.

There are three critical criteria identified in the application which must be considered and dealt with in each assessment carried out for a proposed basement development. The defining criteria are as follows:-

- I) Subterranean Flow
- II) Land Stability
- III) Surface Flow & Flooding

This BIA document is set out with four stages indicated. Firstly, the initial screening process which leads to stage two, the scoping process, whereby relevant issues are identified for the site and their subsequent potential impacts. The third stage of the process involves gathering of site specific data by various means of a desk study and site investigation. From this the relevant information is obtained to enable an accurate assessment of the potential impacts of any issues identified in the first two stages.

Following the site investigation report carried out by Soil Consultants Ltd. dated 2016 and the subsequent further investigations carried out in 2019, the fourth stage of the BIA involves an analysis of the information gathered and a site-specific assessment is made on the potential impact of the proposed development. If the potential impacts identified are found to have an adverse risk to the existing site, the surrounding properties and/or the extended area, then a series of measures to mitigate against any negative impact are outlined for the project.

The assessment is then submitted as part of the planning package for the project to enable LB Haringey to make an informed decision on the overall planning submission.

This report presents an outline structural scheme for the construction of the new subterranean structure and proposed alterations to the lower & ground floor plates. Any changes to the superstructure fall outside this report, but a brief summary is included to assist with the understanding of the complete structural scheme.

The report is based on the current design and discussions with the architect (Edward Toovey Architects) and other consultants mentioned in the report. It should be read in conjunction with the information submitted at this stage by all other consultants, for information purposes.

2.0 Stage 1 - Screening

2.1 Location of the Project

The site is located at the South-Western edge of Haringey along the Eastern side of Bishopswood road and is part of the overall campus of the school. The site is approx. rectangular in shape and measures approximately 130m x 57m. The existing buildings consist of The Fives courts building dating back to the early twentieth century, The Pool Hall block and Squash Courts, both completed in 1969 and the Sports Hall together with a single storey link structure forming the main entrance along Bishopswood road with the aid of a foot bridge, added to the south in 1989.

The surrounding area consists of double storey residential properties and other Highgate School buildings.

2.2 Characteristics of the Project

The existing property is slightly sloped, partly grassed and paved areas. Historically the buildings have only been used for sports related purposes only.

The existing Pool Hall block consists of lightweight roof panels supported on long spanning steel castella roof rafters, which bear on steel columns. The pitched roof to the North is a traditional timber raftered construction. The internal floors, spectator galleries and staircase are of in-situ reinforced concrete construction, supported on steel beams encased in concrete, bearing on load bearing brickwork walls. Brickwork walls also form the East and West gable walls of the main pool area. The entire superstructure transfers the loads to the ground below via ground beams/pile caps over a grid of piles. The pool and surrounding slab structures were formed using in-situ RC construction, bearing directly onto the ground below.

The existing Fives Courts were constructed using load bearing brickwork walls and pitched roofs with steel trusses, most likely bearing on traditional strip foundations, with ground bearing slabs forming the courts. The existing Squash Courts have load bearing brickwork walls with an in-situ RC flat roof. Considering the time of construction, it can be assumed that the foundations are most likely made up of in-situ RC ground beams spanning over a grid of piles.

The existing Sports Hall has duo pitched steel roof trusses supporting lightweight profiled steel sheeting. The trusses bear on masonry diaphragm walls via an in-situ RC ring beam at the top. The flat roofs, the intermediate floors and the staircases were built in-situ, bearing on load bearing brickwork walls and piers. The entire superstructure is supported over and in-situ RC raft, with solid concrete strip foundations to the East, but the floor of the main sports hall is an in-situ RC ground bearing slab. To the West and the South, in-situ RC walls hold back the elevated ground levels.

2No. basements are proposed. The first will form the new Fives Courts to the South (Phase 2A), directly adjacent to the existing Sports Hall, with a maximum depth of approx. 4.0m deep. The second will form the new Sports Hall to the North (Phase 2B), directly adjacent to the existing Pool Hall Block, with a maximum depth of approx. 5.5m deep from existing ground level. (NB. All depths were measured from the highest ground level down to the underside of the proposed structural slabs).

Both basements will be formed with contiguous piled walls with internal in-situ RC lining walls, except for that the Southern edge of the new Fives Courts, which will be formed with in-situ RC retaining walls. Both will be constructed and detailed to transfer the new building loads to the substrata below.

As mentioned previously, any changes to the superstructure fall outside this report, but a brief summary is included to assist with the understanding of the complete structural scheme.

The new Fives Courts (Phase 2A) are proposed with load bearing brickwork walls, which double as dividing walls between the playing courts. Exposed lightweight trussed steel frames bearing on the brickwork walls form the roof over, with lightweight roof cladding panels. The new Sports Hall (Phase 2B) is proposed as a steel framed structure, with RC slabs on corrugated metal sheeting to form each floor slab, except the flat roof above the gym and the lower pitched roof to the North, which will be formed with timber joists/rafters. The main roof at high level is proposed with a lightweight space frame structure spanning above the entire playing areas. Stability of the structure will be achieved with braced frames in key locations, on full height.

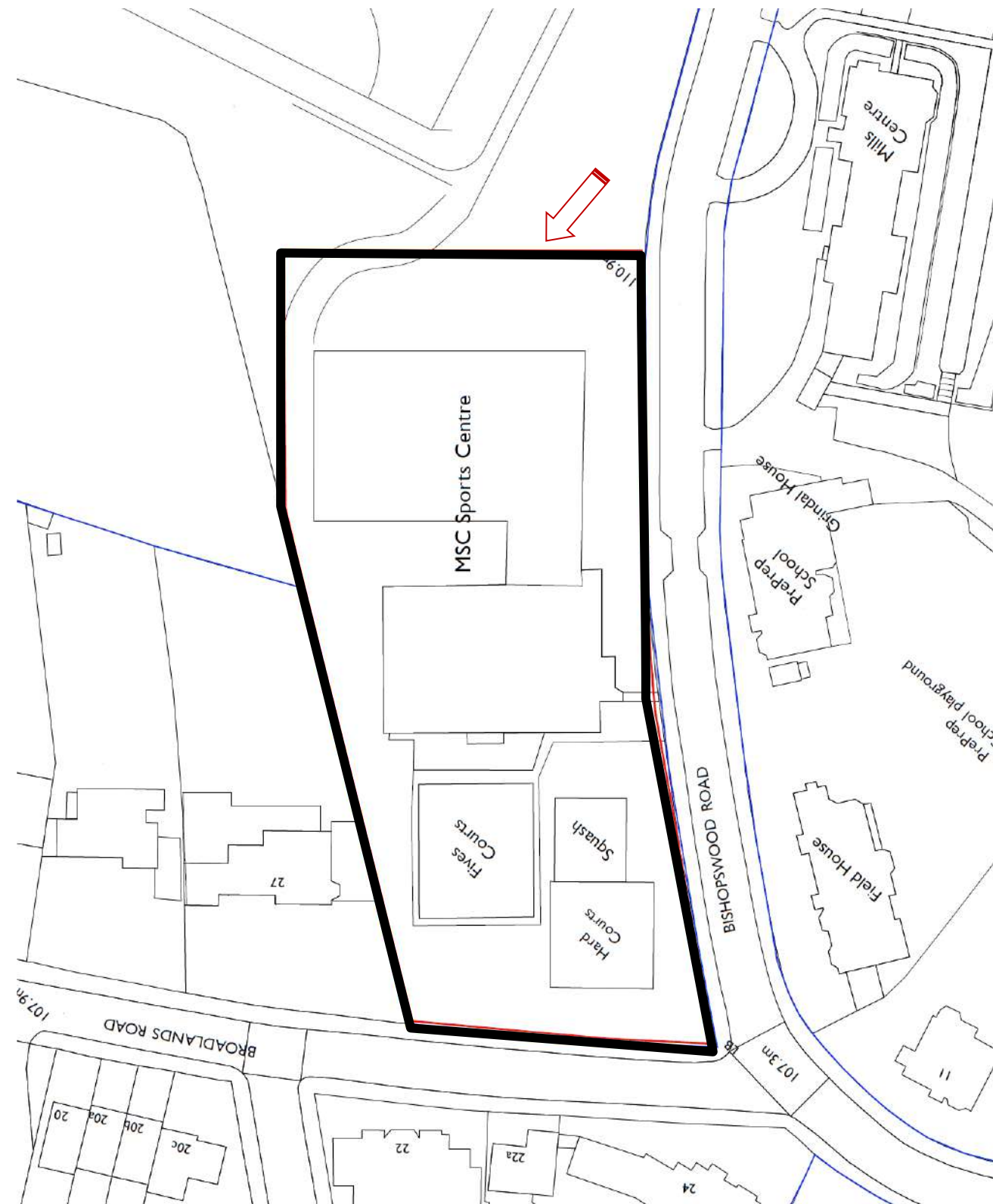


Fig 1 – Existing Site Location Map

Preliminary structural details are attached as part of the appendices which outline the proposed construction details to facilitate the installation of the new basement structure.

2.3 Physical Form of the Development

As outlined at point 2.2, 2No. basements are proposed, both under the large majority of the footprint of the proposed developments.

The basement under the Fives Courts (Phase 2A) will be built using cantilevered contiguous piled walls along the East and West ends, tied at the top with an in-situ RC capping beam and with an inner in-situ RC lining wall, together with an in-situ RC retaining wall along the Southern end. No retaining structures are required along the North end, because the existing Sports Hall will form the North end. The base will be formed with an in-situ RC raft under the entire footprint, which will support the entire superstructure and will also provide stability against overturning and sliding for the RC retaining walls.

The Basement under the New Sports Hall (Phase 2B) will be built using cantilevered contiguous piled walls along the East and West ends, tied at the top with an in-situ RC capping beam and with an inner in-situ RC lining wall. The basement slab will all be ground bearing rafts. The perimeter load bearing columns and beams (of timber or steel) of the intermediate floor slabs of the superstructure will be supported on the capping beams of the contiguous piled walls. The internal load bearing beams will be supported on columns bearing onto the ground bearing raft. Tension piles will be provided to restrict the buoyancy of basement box in accidental saturated soil conditions.

To the Northern and Western sides, the entire development is stepped back from Broadlands and Bishopswood roads. On the Southern side, it retains open grounds which form playing fields. On the Eastern side, it is stepped back from a sports ground belonging to Highgate School and from a neighbouring residential property (27 Broadlands road).

2.4 Mitigation Measures Being Considered

As with any development involving the construction of a basement, the proposed construction methods and programme of works must be chosen once appropriate levels of consideration are given to the inherent risks associated with excavation, and more specifically in this case, excavation in close proximity to existing buildings and their foundations.

Given the close proximity of the adjacent building along the East and of the roads to the North and West boundaries, the proposed development has been designed to limit the risk of adverse impact to the adjacent properties. This has been achieved by proposing the use of contiguous piled retaining walls along the length of the adjacent properties. These walls will also provide support to the excavation in the temporary condition and support the structure above as well. These walls will be designed to act as cantilevered retaining walls in both temporary and permanent conditions. These will be designed and detailed to transfer the building loads to the substrata, by others.

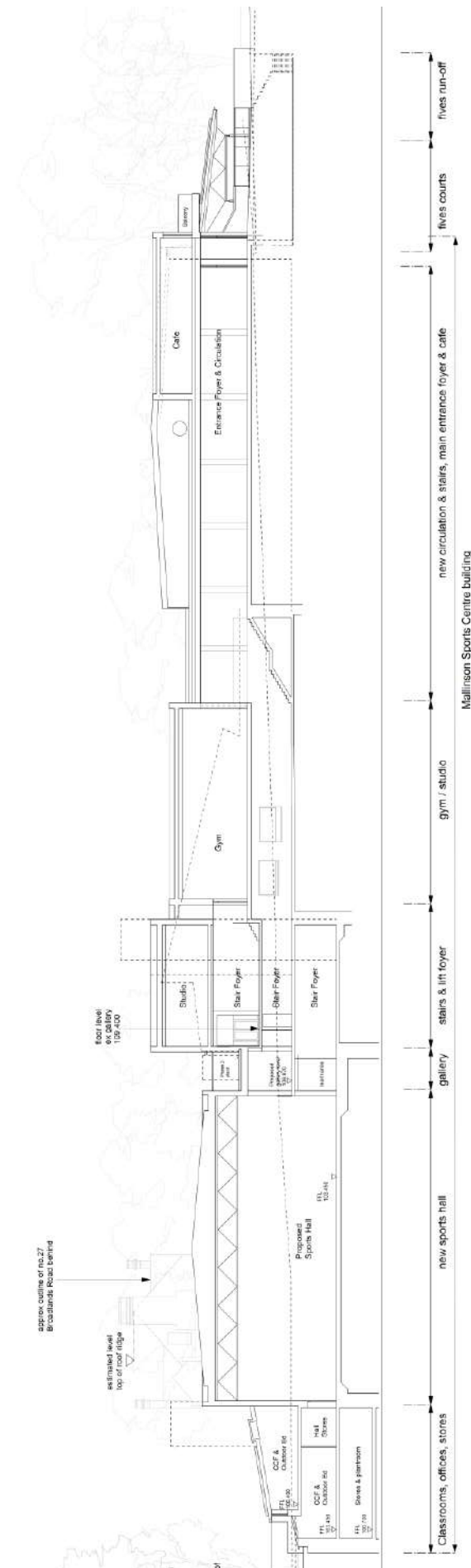


Fig 2 - Proposed Longitudinal Section

2.5 Characteristics of Potential Impacts

2.5.1 Subterranean (Groundwater Flow)

North London is almost entirely underlain by London Clay formation which overlays a significant chalk aquifer. The London Clay layer varies in thickness from less than 10m near the Lee Valley to over 100m in the areas of higher ground in Camden and Barnet. The clay layer is almost entirely impermeable which has a considerable impact on lead times of fluvial flows in many of the watercourses, especially when combined with intense urban development. The upstream catchment in the River Lee comprises a predominantly chalk soil, which results in increased permeability and slower response times in the watercourse. In places the London Clay layer is overlain by deposits of gravel and silts. This is most predominant in the Lee Valley and East of Hackney where alluvium deposits form the River Lee are in evidence. There are also notable outcrops of gravels and silts further to the West of Enfield, Stanmore gravels in Barnet and gravel outcrops on Hampstead Heath. These gravel and silt deposits are much more permeable than the underlying clay layer and flooding can occur at the edges of these deposits and outcrops when the groundwater percolating through the permeable layer meets the impermeable clay layer, causing the water to flow out at surface level, appearing as small as springs. The Lee Valley consists of a layer of gravels and silts deposited by the river within its natural flood plain that cover a layer of London Clay. Silts and gravels are also found in smaller quantities along the flood plains of other main rivers in the area, which include the River Brent, Dollis Brook, Silk Stream, Salmons Brook, Pymmes Brook and the river Ching. The Lee Valley is the lowest lying area within North London and is therefore susceptible to groundwater flooding. Groundwater levels in shallow deposits in the Lee Valley are hydraulically linked to the watercourses through the alluvium deposits and may be responsive to rainfall events and the corresponding increases in fluvial flows. However, for the major aquifer, the chalk, this is not always true. During prolonged rainfall events, the groundwater table may experience a relatively short term rise which could cause localised flooding incidents. Further to the West of Lee Valley, within Enfield there are a number of drift deposits silts and sands. A small number of groundwater flooding incidents are known to have occurred in the vicinity of these deposits. Hampstead Heath lies on a silty sandy layer on top of the London Clay. During rainfall events water drains through the sands before reaching the impermeable layer beneath, causing the formation of springs which feed the Highgate Ponds and form the source of the River Fleet. In the Finchley and Hendon are to the North of Hampstead, a Till, chalky sandy clay and gravel outcrop lies on the surface that may lead to a localised groundwater flooding, although there is no history of groundwater flooding in this location.

The ground conditions in Haringey vary from sandy clay in the Highgate Area (where there are areas where the sub strata is more sandy than clay) through to the more common brown clay in Muswell Hill and Crouch End. In area of Wood Green and Turnpike Lane there are areas of filled ground to a depth of approx. 1.00m deep, where upon a strata becomes clay. Clay subsoil than continues further East until Tottenham High Road, where gravel content starts to appear in the clay, and continues to increase East towards the River Lea. To the South towards South Tottenham, there are again large areas of filled ground.

Where a high groundwater table is found the possible effects of excavating for a basement include altering the water table levels and/or diverting the existing flow paths. The effect of these changes needs to be taken into consideration in the early planning stages of a development to ensure that adverse effects are accounted for and wherever possible designed out of the proposed development.

These adverse effects may include:-

- Forming alternative flow paths for the groundwater which may conflict with existing basements that have not been adequately protected against moisture;
- Altering existing groundwater levels locally and as a result possibly altering the soil properties of the local area. The altered soil properties may influence among other things, the existing slope stability and the soil bearing capacity.

2.5.2 Slope Stability

Generally:

Slope instability is affected by a number of contributory factors ranging from soil properties, land use, topography, landscape and human activities (e.g.: mining or drainage etc.). The excavation and construction of a basement can affect the slope stability of a site and the adjoining land or properties in a number of ways including:-

- Altering the soil properties such as, the moisture content, pore water pressure, consolidation and compaction levels, shear strength and bearing capacity of the soil.
- Requiring an element of pumping or dewatering of the site which can in some instances lead to the removal of “fines” in the existing soil, thus affecting the soil properties and interaction of the particles.
- Requiring the removal of existing vegetation, plants and/or trees from the site which are part of the system of groundwater extraction. This in turn may alter the groundwater levels which can affect the soil properties.
- Altering the natural state of the landscape or possibly involving works to previously disturbed or “worked” soil which could have an historic element of instability.

Beyond the Confines of the Site:

Possible effects of any basement construction must take into account the adjoining structures and their existing foundations, and any infrastructure in the area. The scale of proposed works will dictate the potential zone of influence of any works to be undertaken below ground.

During the construction stage of a project the local bearing capacity of the soil in the zone of influence for the works can be temporarily reduced. This is due to the removal of existing overburden pressures. Any project must allow for this reduction in pressure and undertake proper planning, design and execution of the excavation and any temporary works which would be required.

Additional effects which must be considered in the planning and design of a project are the inevitable ground movements which will be experienced. With any excavation there is a degree of ground movement which must be allowed for and this is generally done by specifying agreed design parameters for any soil retaining element of the works and incorporating in the construction sequence a suitable scheme for temporary works.

Once the construction stage of a project is complete possible effects which should be considered include the increased stiffness of the new foundations and also the possible increase in the loads transmitted to the bearing strata.

As part of the project any existing foundations within a site or adjoining the site may require upgrading to support the new building. Upgrading foundations along party wall lines can give rise to a variation in stiffness between old and new foundations which should be considered as part of the planning and design process.

In addition to the variation in stiffness of the foundations, a new or redeveloped building can lead to increased or redirected pressures on soil bearing strata. The effects of this should be catered for in any design with particular attention paid in areas where the primary soil is a clay-based material. This is due to the susceptibility of clay to experience swelling and contraction as moisture content varies. The issue of swelling and contraction can be minimized by excavating below the upper layers of soil which would be more sensitive to weather and moisture conditions.

2.5.3 Surface Flow & Flooding

Potential impacts on the surface flow and flooding characteristics in an area as a result of excavation for a basement can vary dependent on a site location and the existing drainage infrastructure which is required to cater for any runoff from a site.

Excavating directly affects the volume of soil below ground and depending on the type of material can affect the natural groundwater storage capacity of the soil. If this is reduced significantly it can cause an increase in the proportion of surface water runoff which needs to be catered for by the local drainage network.

Following on from the point above, with an increase in the volume of surface water runoff, there is an increased risk of overwhelming the local drainage network which may not have sufficient capacity to deal with the increased volumes. This in turn may raise the possibility of flooding properties down-gradient. As part of the planning and design of a project careful consideration should be given to the need to cater for any runoff generated by the development and if possible deal with it within the confines of the development site before finally letting any excess which cannot be catered for flow into the drainage network.

If a project causes an increase in the levels of runoff produced, and the increased volumes are not catered for, the possibility and frequency of flooding is increased. In areas which are already prone to flooding the effects of this must be examined and further analysis may need to be undertaken.

2.6 Screening Process

2.6.1 Subterranean Flow

Q1a: Is the site located directly above an aquifer? → **NO**

Referring to Maps 9, 11 and 12 of North London SFRA (see Appendix A) indicates that the underlying soil has no consolidated aquifers and thus would not be expected to contain any raised groundwater.

The boreholes and the supplementary window samples from the soil investigation show that the predominant soil condition is found to be a London Clay to a minimum of 20 m underlying approx. 1.00 m depth of made ground. There are no indications of a high water table or outcrops of permeable material in the immediate area, only localised shallow perched groundwater.

Q1b: Will the proposed works extend beneath the water table surface? → **NO**

The proposed basement depth is expected to be a maximum of 5.5m measured from the highest ground level. The boreholes and supplementary window samples carried out do not indicate the presence of a high groundwater table, however shallow perched groundwater can be expected on top of the London Clay.

Q2: Is the site within 100m of a watercourse, well (used/disused), or potential spring line? → **NO**

Referring to Maps 4, 9 and 11 of North London SFRA (see Appendix A) there are no watercourses, wells or potential springs within the vicinity of the proposed development. The nearest watercourse is Mutton Brook, which is situated approx. 1600m from the proposed development.

Q3: Is the site within the catchment of any pond chains? → **NO**

Referring to the Maps 9 and 11 of the SFRA (see Appendix A), there are no pond chains which coincide with the site location. The nearest ponds are the Highgate pond chains No. 2 and 3, which are situated approx. 300m from the proposed development.

Q4: Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas? → **NO**

At present the existing site has approx. an even green area to paved area distribution. The new developments will cover most of the areas, however green roofs will be provided above the entire development, substantially increasing the green areas.

Q5: As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)? → **NO**

The existing drainage system for the site is assumed to drain freely into the local authority drainage network. It is not anticipated that the proposed development will increase the levels discharged to the ground.

Q6: Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the lower ground floor) close to, or lower than, the mean water level in any local pond (not the pond chains on Hampstead Heath) or spring line? → **NO**

The lowest point of the proposed excavation will be approximately 5.5 metres measured from highest ground level. The site is not in close proximity to any local ponds.

2.6.2 Slope Stability

Q1: Does the existing site include slopes, natural or manmade, greater than 7 degrees (approximately 1 in 8)? → **NO**

The existing site has no significant gradient or falls. Topographical data available from existing site surveys suggests the site is relatively flat across the plan area (max. 4 degrees). Over the extended region the site is located in an area which is not noted as vulnerable to landslides or significant soil movements. The elevation of the extended area varies from approx. 105.5mOD to approx. 109.5mOD

Q2: Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8)? → **NO**

The site is not anticipated to require any major re-profiling to landscaping and the max. intended gradient and slopes to be 2 degrees.

Q3: Does the development neighbour land including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8)? → **NO**

Referring to Maps 1, 2 and 4 (see Appendix A), the nearest Underground station is Highgate Station, which is located approx. 800 m away from the proposed development. Therefore, there is no presence of any railway cuttings or indeed a slope in excess of 1 in 8.

Q4: Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8)? → **NO**

The site is set in a region with a relatively flat slope.

Q5: Is the London clay the shallowest strata at the site? → **NO**

The London Clay is the only definable strata at the site and is expected to go as far down as the underlying bedrock. Elements of the surrounding site have previously been used as residential areas and were found to have approximately 1.00 m of made ground. This was also highlighted by the boreholes and the supplementary window samples within the soil investigations.

Q6: Will any tree/s be felled as part of the proposed development and/or any works proposed within any tree protection zones where trees are to be retained? → **YES**

A Tree Constraints Report has been carried out by RJ Stephens Associates dated September 2018. This report outlines the number of trees and types that are to be felled, together with the root protection zones for the rest of the trees within the site. This information has been duly incorporated within the design of the new basements such that little to no works will encroach into the potential root protection zones.

Q7: Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site? → **UNKNOWN**

With the limited information available (no pre condition survey has been carried out to date on the existing buildings either within or adjacent to the site) the effects of seasonal shrink-swell subsidence cannot be accurately established.

Q8: Is the site within 100m of a watercourse or a potential spring line? → **NO**

Refer to Q2 of section 2.6.1 Subterranean Flow.

Q9: Is the site within an area of previously worked ground? → NO

The site is not considered to be within an area of previously worked ground. There is no indication that the area contains any worked ground.

Q10: Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction? → NO

Referring to Maps 9 and 11 of the SFRA (see Appendix A) indicates that the underlying soil has no consolidated aquifers. The boreholes do show only shallow perched water. This is consistent with the depth of made ground in the area. It is anticipated that there will be no requirement for any dewatering during the construction of the proposed basement.

Q11: Is the site within 50m of any ponds? → NO

Refer to Q3 of section 2.6.1 Subterranean Flow.

Q12: Is the site within 5m of a highway or pedestrian right of way? → YES

The proposed development is set back approximately 2.00 metres at its closest point from the nearest roadway and/or pedestrian right of way which is Bishopswood Road. This will remain fully usable until all works have been carried out.

Q13: Will the proposed development significantly increase the differential depth of foundations relative to neighbouring properties? → YES

To the north, the new Sports Hall (Phase 2B) is directly adjacent to the existing Pool Hall Block. Disregarding the first 2.00m of ground, the differential depth to the underside of the proposed basement slab will be approx. 3.50m (measured from highest ground level). To the East, the new basement of the Sports Hall (Phase 2B) will be set back approx. 4.50m from the face of the boundary fence wall. Considering the existing foundation are at approx. 1.00m BGL and a 45 degree dispersion angle, the underside of the lowest proposed basement slab will be outside of the dispersion angle, thus not resulting in any differential depths.

Q14: Is the site over (or within) the exclusion zone of any tunnels, e.g. railway lines? → NO

The site is located at approx. 800m from the underground lines, and there are no railway lines nearby. Thus, it is not expected that the site is over or within any exclusion zones for rail or underground infrastructure.

2.6.3 Surface Flow & Flooding**Q1: Is the site within the catchment of the any pond chains or rivers/watercourses? → NO**

Refer to Q2 and Q3 of section 2.6.1 Subterranean Flow.

Q2: As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route? → NO

The site and the proposed development will have extensive SuDS and attenuation measures incorporated to comply with agreed Haringey Council rates, thus keeping and even increasing its permeable capacities. The use of any existing local authority drainage systems will be maintained and so the proposed development will not materially change the surface water flows. Additionally, a new dam and attenuation area will be provided in adjacent land to reduce downstream flooding adjacent to the sports hall basement.

Q3: Will the proposed development result in a change in the proportion of hard surfaced / paved external areas? → NO

It is not anticipated that the proposed basement will result in a change in surface water generated.

Q4: Will the proposed development result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses? → NO

The existing site is serviced by a series of drainage sewers and channels which restrict the flow of surface water from the site to adjacent properties. This also ensures that all surface water generated is directed into the gravity fed drainage systems locally. The proposed development is not expected to generate any additional surface water and so is not expected to change the profile of inflows of surface water to adjacent properties or downstream watercourses.

Q5: Will the proposed development result in changes to the quality of surface water being received by adjacent properties or downstream watercourses? → NO

As per Q4, the proposed development will not have any effect on the surface water which will be generated and so will have no subsequent effect on the quality of the surface water received by adjacent properties or downstream watercourses.

Q6: Is the site in an area known to be at risk from surface water flooding or is it at risk from flooding, for example because the proposed development is below the static water level of a nearby surface water feature? → NO

An extensive Surface Water Modelling Report has been carried out by Edenvale Young Ltd., which concluded that the site is susceptible to surface water flooding, however mitigation measures were outlined, which will be incorporated. By incorporating these measures, the site will no longer be at risk from surface water flooding. This will be provided by a new dam and attenuation area in adjacent land to reduce downstream flooding adjacent to the sports hall basement.

2.7 Summary**2.7.1 Subterranean (Groundwater) Flow**

The screening process has not identified any issues of concern to be investigated further as part of this BIA.

2.7.2 Slope Stability

The screening process has identified two issues which are of initial concern as part of the planning process and should be examined further as part of the scoping process

1. History of seasonal shrink-swell subsidence in the local area.
2. Possible differential depth between foundations of adjacent structures

2.7.3 Surface Flow & Flooding

The screening process has not identified any issues of concern to be investigated further as part of this BIA.

3.0 Stage 2 - Scoping

3.1 Potential Impacts of the Proposed Scheme

3.1.1 Subterranean Flow

Not applicable.

3.1.2 Slope Stability

3.1.2.1 Seasonal Shrink-Swell Subsidence

The history of the seasonal shrink-swell ground movements in the local area is not readily known, although the clay-based nature of the underlying soil does point to the need to consider the cause and effects of shrink-swell movement in the proposed structural design.

There are a number of methods for dealing with possible ground movements which occur in clay soils. For areas of deep excavations, these can include the use of tension piles to counteract the anticipated hydrostatic pressures and/or the use of compressible material (e.g. Cordek) to reduce the build-up of hydrostatic pressure acting on the slab. In situations where a raft basement slab is used it is necessary to design the slab to resist the anticipated hydrostatic pressures.

In ground bearing RC strip foundation systems it is generally accepted that increasing the depth of a foundation below ground minimizes its susceptibility to the problems associated with the more frequent shrink-swell movement of clay soils due to freezing. A minimum depth of 1000mm is typically used for ground bearing foundations and is normally assumed to be below the level at which soil is susceptible to freezing and thawing.

The form of the foundations underlying the existing buildings adjacent to the excavation perimeter (typically stepped brickwork corbels), combined with their great depth to form the lower ground floor areas, allows us to presume that the problems that are inherent with shrink/swell of clay soils in shallow foundations are not applicable to the existing buildings on the site and would lead to the assumption that shrink-swell movements in the local area are currently not causing any undue deterioration in the buildings or boundaries.

For the proposed development, the building foundations are expected to comprise a suitably designed RC piles and ground bearing slabs at great depths, which are below the seasonal influence of trees. A suitably designed scheme of continuous contiguous piled walls is proposed to the perimeter of the new basement excavations.

3.1.2.2 Differential Depth Between Foundations

The proposed excavation levels for the project will encounter varying levels of foundation between adjacent properties and a maximum differential level of 5.50 m is expected between the new Sports Hall (Phase 2B) and the existing Pool Hall Block. The slope stability and soil condition within neighbouring sites and adjacent areas may be subject to various potential impacts as a result of the proposed development. These can be categorised relative to their scale and an appropriate risk factor assigned to each case.

Norther Boundary (Existing Pool Hall Block)

The existing Pool Hall Block is a double storey steel and brickwork building with piled foundations down to great depths below the existing ground floor level. On this basis, the expected differential depth between the existing foundations and the excavated depth of the proposed lower basement will be in the order of 3.50 m. Along the boundary it is proposed to construct a continuous contiguous piled wall.

The various impacts associated with the proposed works and a differential depth of foundation of 3.50 m may include:

Small scale: Risk – Average

A nominal degree of horizontal deflection in the temporary works scheme proposed would possibly result in a reduction in the passive pressure exerted by the temporary works on the retained material facilitating a reduction in shear pressure between the soil particles and a settlement of the soil material immediately beyond the line of excavation. This in turn would possibly lead to some settlement of the more heavily loaded foundations. The result of this would be some minor cracking of brittle elements in the adjacent building (i.e.: plastered blockwork and plasterboard clad timber partitions). The frequency and magnitude of expected cracking to the adjacent building would not be expected to compromise the overall stability of the building in any way or indeed the capacity of the structural elements which could be affected.

Medium scale: Risk - Low

Should the temporary works along the boundary be subject to an increased level of horizontal deflection it is expected that the potential impact would be somewhat similar to those outlined above in terms of cracking but would be more frequent and more prevalent in the adjacent boundary wall and its connecting elements.

Large Scale: Risk – Very Low

In the event of a more severe situation such as the complete or partial failure of the temporary works and therefore the excavated faces, it is possible that the bearing capacity of the underlying soil below would be reduced significantly. It is possible that a situation of this magnitude would result in

- Major cracking to primary structural elements bearing on the foundations with similar effects propagating throughout the secondary supported elements.
- Excessive subsidence below the foundation to the existing building. The consequences of this would be a reduction in the integrity of the building and/or foundations to unacceptable levels requiring large scale repair works or demolition.

3.1.3 Surface Flow & Flooding

Not applicable.

3.2 Summary

The proposed development is located in a region underlain by London Clay throughout. The potential impacts of the basement excavation have been assessed in relation to three screening flowcharts.

The scoping process has examined the particular areas which pose the highest risk for potential impact on the adjacent properties. Given the relatively shallow depth of the excavation and the proposed structure it is not expected that the works will present significant risk to any of the boundaries affected provided the works are carried out in the appropriate manner.

4.0 Stage 3 - Site Investigation & Study

A geotechnical site investigation with additional supplementary investigations has been carried out by Soil Consultants Ltd. The borehole logs and window samples are attached in Appendix C of this document. The findings of the boreholes and window samples confirm the that the underlying soil is London Clay and serve to back up the points raised as part of this BIA.

The subsoil has also been defined as unproductive in terms of groundwater and no evidence of water ingress was found during the site investigation.

The measurements also confirm the points made as part of this BIA.

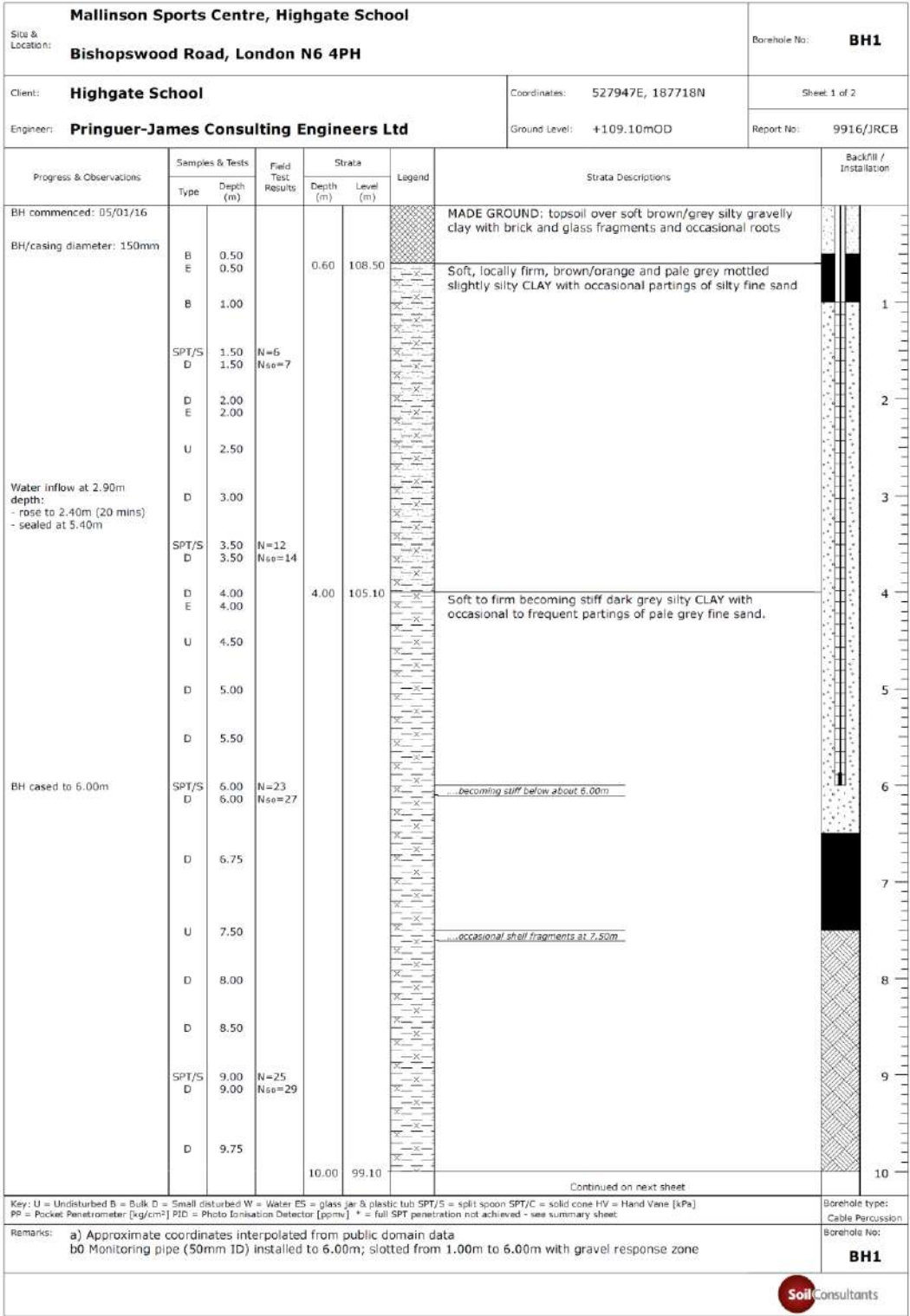


Fig 3 – Borehole extract

5.0 Stage 4 - Impact Assessment & Conclusion

5.1 Existing vs Proposed

The existing site is currently un-developed below ground level.

5.2 Site Attributes & Features Affected

5.2.1 Subterranean Flow

An analysis of site investigation and the additional supplementary investigation results together with the information obtained from various additional sources (British Geological Service, Environment Agency etc.) would indicate that the presence of groundwater in the area is minimal and thus the potential impacts to the groundwater as a result of the development would safely be considered negligible. This is based on a number of factors including, site location, the regional geology of the site, groundwater flows and groundwater source zones (see appendix A)

5.2.2 Slope Stability

The scope of the proposed works to the site may pose an increased risk of potential impacts during the construction process. This has been considered when deciding upon the proposed construction methods and sequence of works for the site. The result of this has been to propose the use of a continuous contiguous piled walls along the perimeters by means of a silent rig to minimize vibration. The piled walls will be designed as cantilevered in both permanent and temporary conditions with acceptable limiting deflection levels which will also help to reduce the risk of potential impacts on the adjacent properties.

5.2.3 Surface Flow & Flooding

The existing site has large areas of permeable surfaces and the construction works are anticipated to have negligible effects on the volume and quality of surface water generated by the redeveloped site due to the incorporation of extensive SuDS and attenuation measures.

Analysis of the available material in relation to flooding has indicated that the site is prone to flooding, however mitigation measures will be incorporated, which will completely de-risk the site, leading to the development not being in an area which is required to consider flooding as part of the basement construction.

5.3 Conclusion

The basement impact assessment for the development at Highgate School has been carried out in accordance with current guidelines provided by London Borough of Haringey Planning Department.

The three principle criteria identified by the department and which must be dealt with in each assessment include, subterranean (groundwater) flow, slope stability, and surface runoff and flooding.

At each stage of this assessment these three criteria have been considered and any requirements for each category have been incorporated into the projects proposed development scheme.

As a result of this assessment it is reasonable to conclude that the proposed basements will not be detrimental to the region in terms of groundwater, slope stability and surface flow and flooding.

Report prepared by: Thomas Fornvald
B Eng (Hons), M Eng
Update June 2022: Guy Brackenbury
BEng + MEng (Hons)

Report checked by: Sean Pringuer-James
MSc Eng, C Eng, Pr Eng, MICE, SAICE
Update June 2022: James Bishop
MEng, MStructe

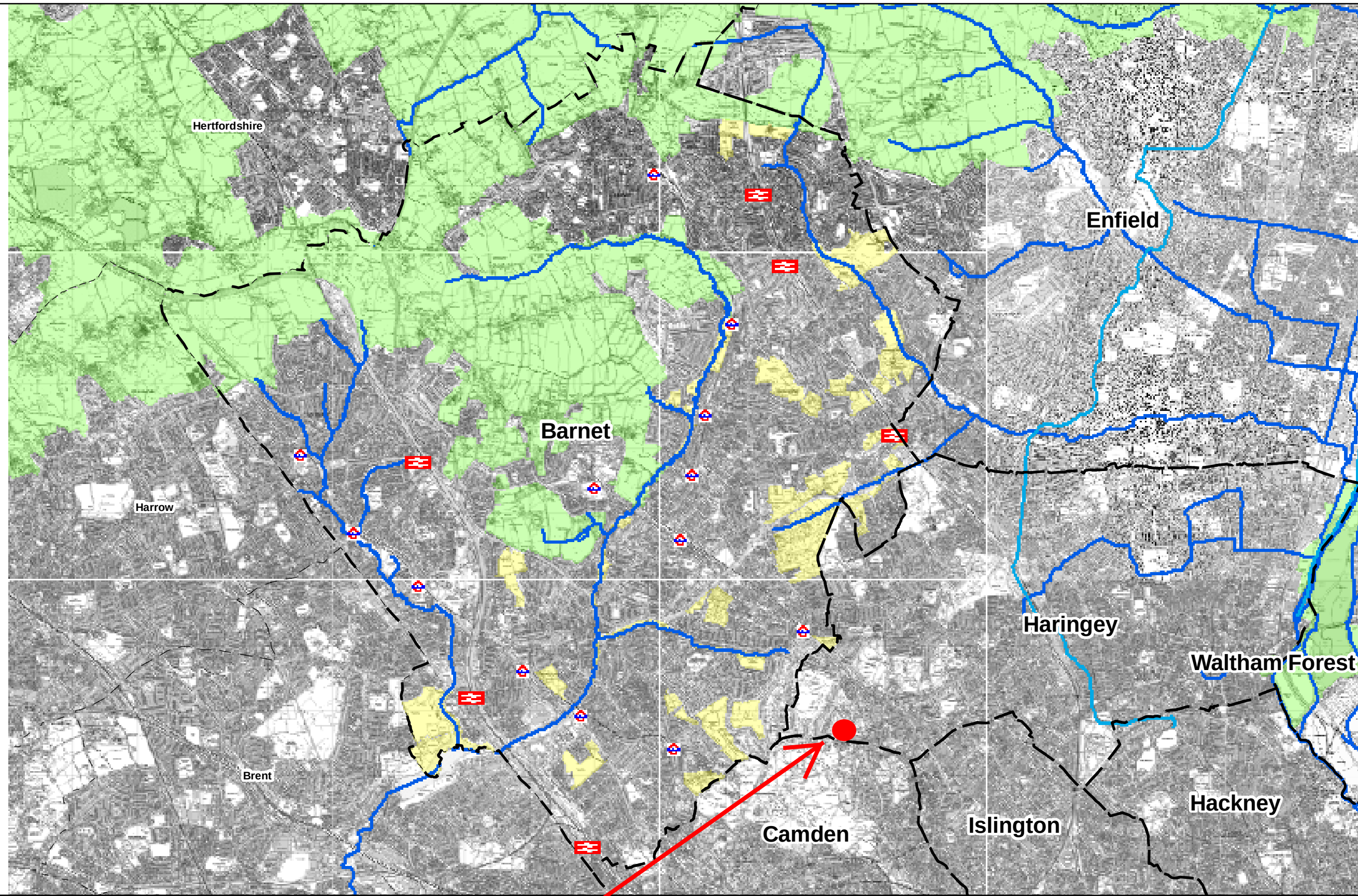
Date: March 2019

Revision: A (June 2022)

Appendix A

**Pringuer-James Consulting Engineers
Basement Impact Assessment**

Mapping Data



Legend

-  Borough Boundaries
-  Greenbelt
-  Canals
-  Metropolitan open land
-  Watercourses
-  Railway Station
-  Underground Station

Highgate School MSC 4
Phase Development

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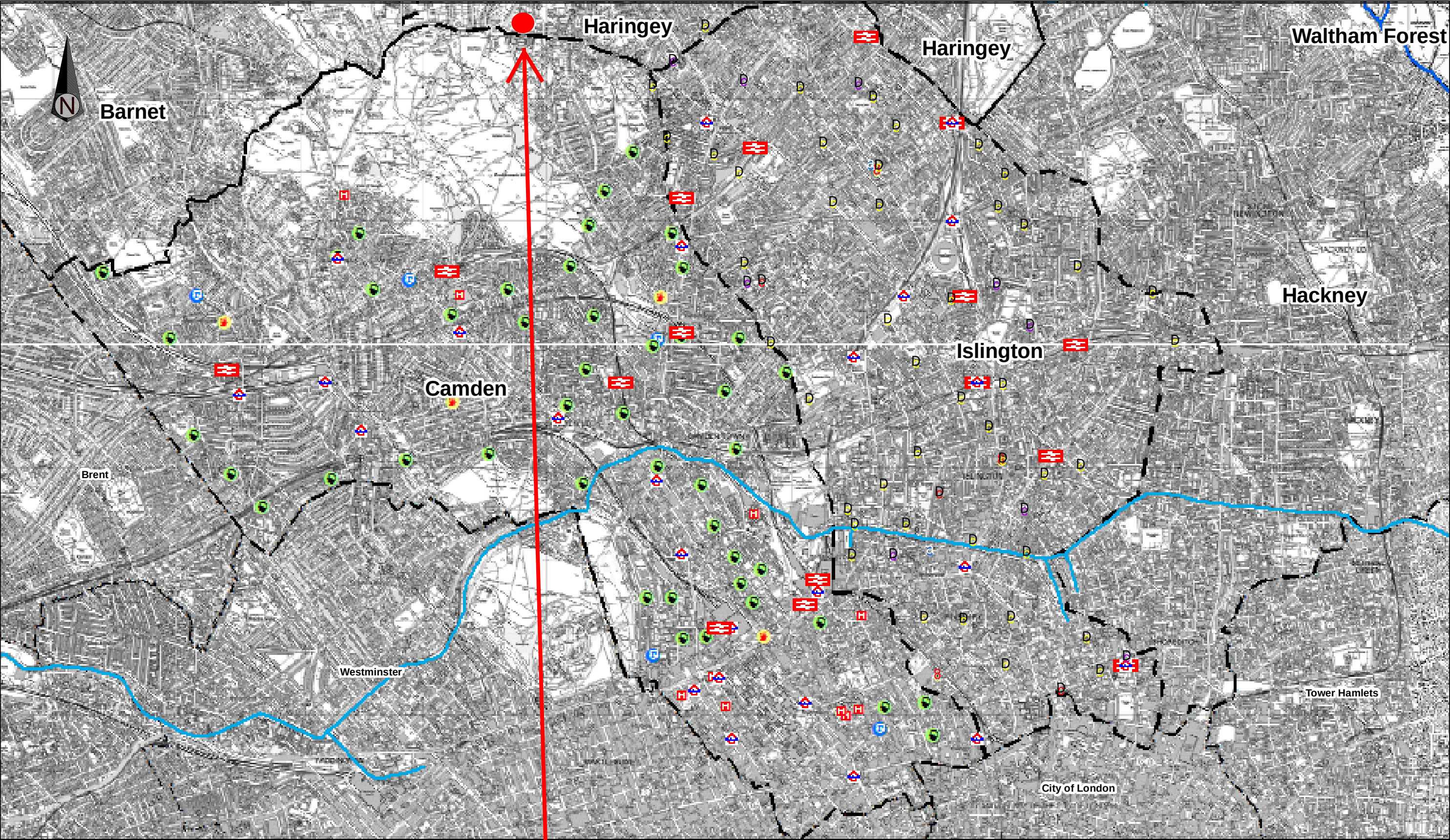
Data Origin
Rail station and underground data gathered by Mouchel. Remaining data provided by LB Barnet.

mouchel 

Purpose Information

Drawn	SL	Chkd	KR	Appvd	FP
Date	07/08/08	Date	07/08/08	Date	08/08/08
Draft		Scale (at A3 size)		Issuing Office	
Issue	●	1:60,000		Telephone	0121 355 8949

Client		North London Waste Plan			
Project		North London Strategic Flood Risk Assessment			
Drawing Title		Map 1: Barnet Study Area			
		Issuing Office		Drawing Number	
		Sutton Coldfield		722586/001	
		Telephone		0121 355 8949	
				Rev	
				B	



Legend

- | | |
|---------------------|----------------------|
| D Schools | P Hospital |
| D Special Schools | Underground Stations |
| D Primary Schools | Railway Stations |
| D Secondary Schools | Canals |
| c Police Station | Watercourses |
| 8 Fire Station | Borough Boundaries |

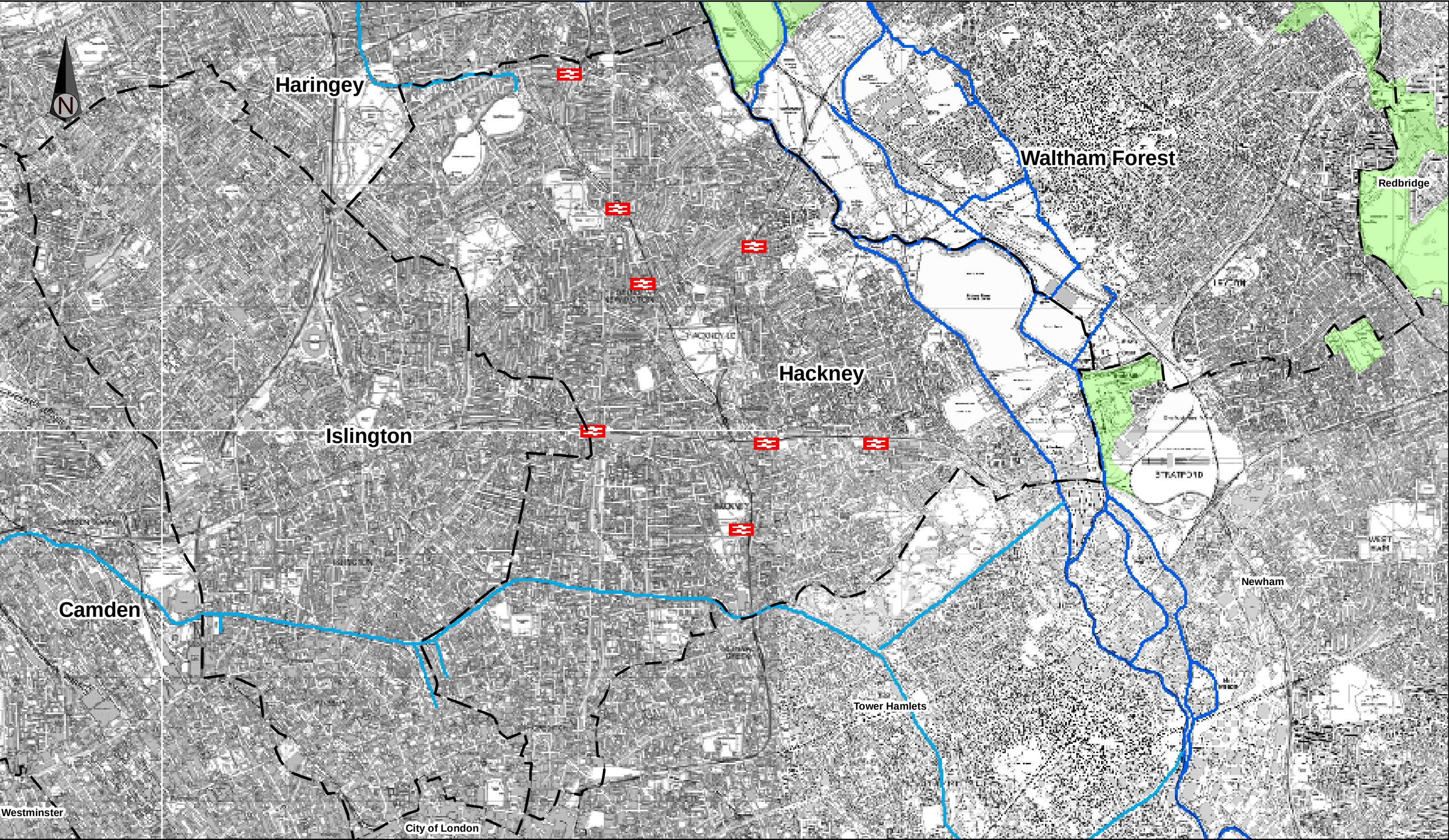
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Data Origin
Rail station and underground data gathered by Mouchel. Remaining data provided by LB Camden.

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	Project		North London Strategic Flood Risk Assessment	
Purpose Information	Drawing Title		Map 2: Camden & Islington Study Area	
	Issuing Office		Sutton Coldfield	Drawing Number
Drawn SL	Chkd KR	Apprvd FP	722586/002	
Date 07/08/06	Date 07/08/06	Date 07/08/06	Telephone	0121 355 8949
Draft	Scale (at A3 size)		Rev B	
Issue	1:30,000			



- Legend**
- Borough Boundaries
 - Watercourses
 - Canals
 - Railway Station
 - Greenbelt

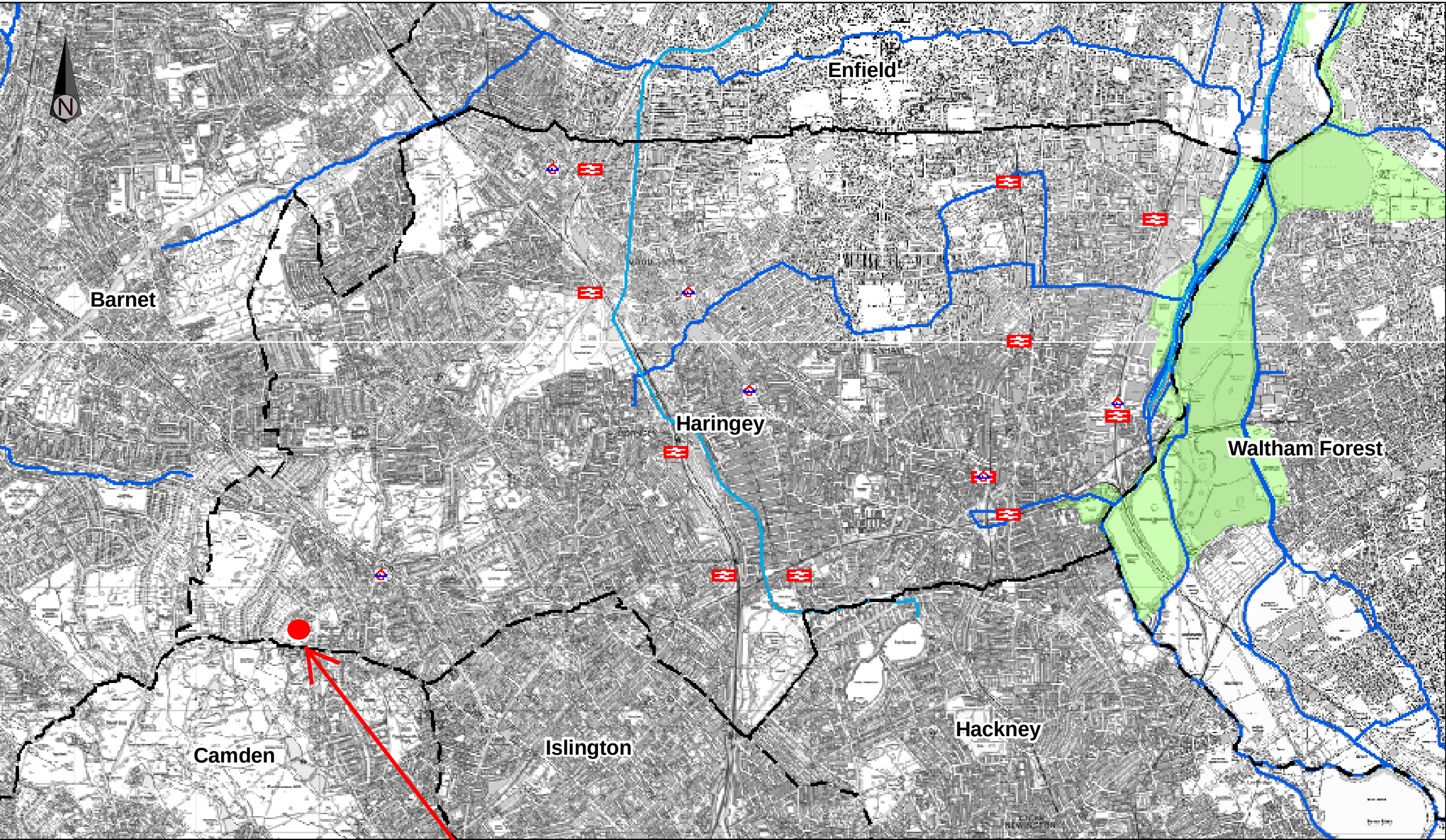
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Data Origin
Rail station data gathered by Mouchel.

mouchel						Client North London Waste Plan			
						Project North London Strategic Flood Risk Assessment			
Purpose Information						Drawing Title Map 3: Hackney Study Area			
Drawn	SL	Chkd	KR	Apprvd	FP				
Date	07/08/08	Date	07/08/08	Date	07/08/08				
Draft		Scale (at A3 size)		Issuing Office	Sutton Coldfield	Drawing Number		Rev	
Issue	●	1:30,000		Telephone	0121 355 8949	722586/003		B	



- Legend**
- Borough Boundaries
 - Watercourses
 - Canals
 - Underground Station
 - Railway Station
 - Greenbelt

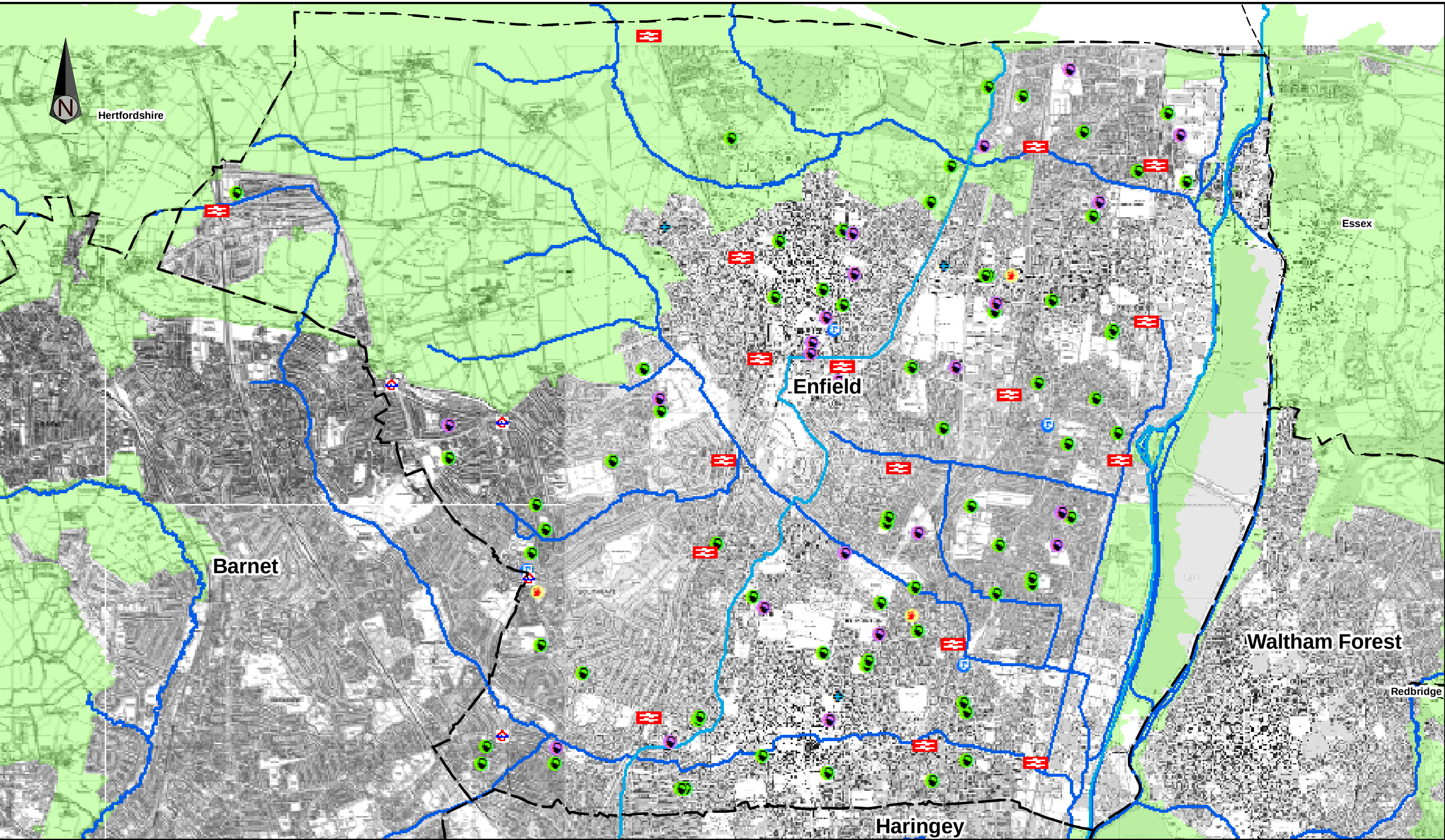
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Data Origin
Rail station and underground data gathered by Mouchel.

		Client North London Waste Plan			
		Project North London Strategic Flood Risk Assessment			
Purpose Information		Drawing Title Map 4: Haringey Study Area			
Drawn	SL	Chkd	KR	Apprvd	FP
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Draft		Scale (at A3 size)		Issuing Office	Sutton Coldfield
Issue	●	1:30,000		Telephone	0121 355 8949
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				722586/004	
				Rev	B



Legend

- Borough Boundaries
- Watercourses
- Canals
- Underground Station
- Railway Stations
- Ambulance Station
- Fire Station
- Police Station
- Primary School
- Secondary School
- Greenbelt

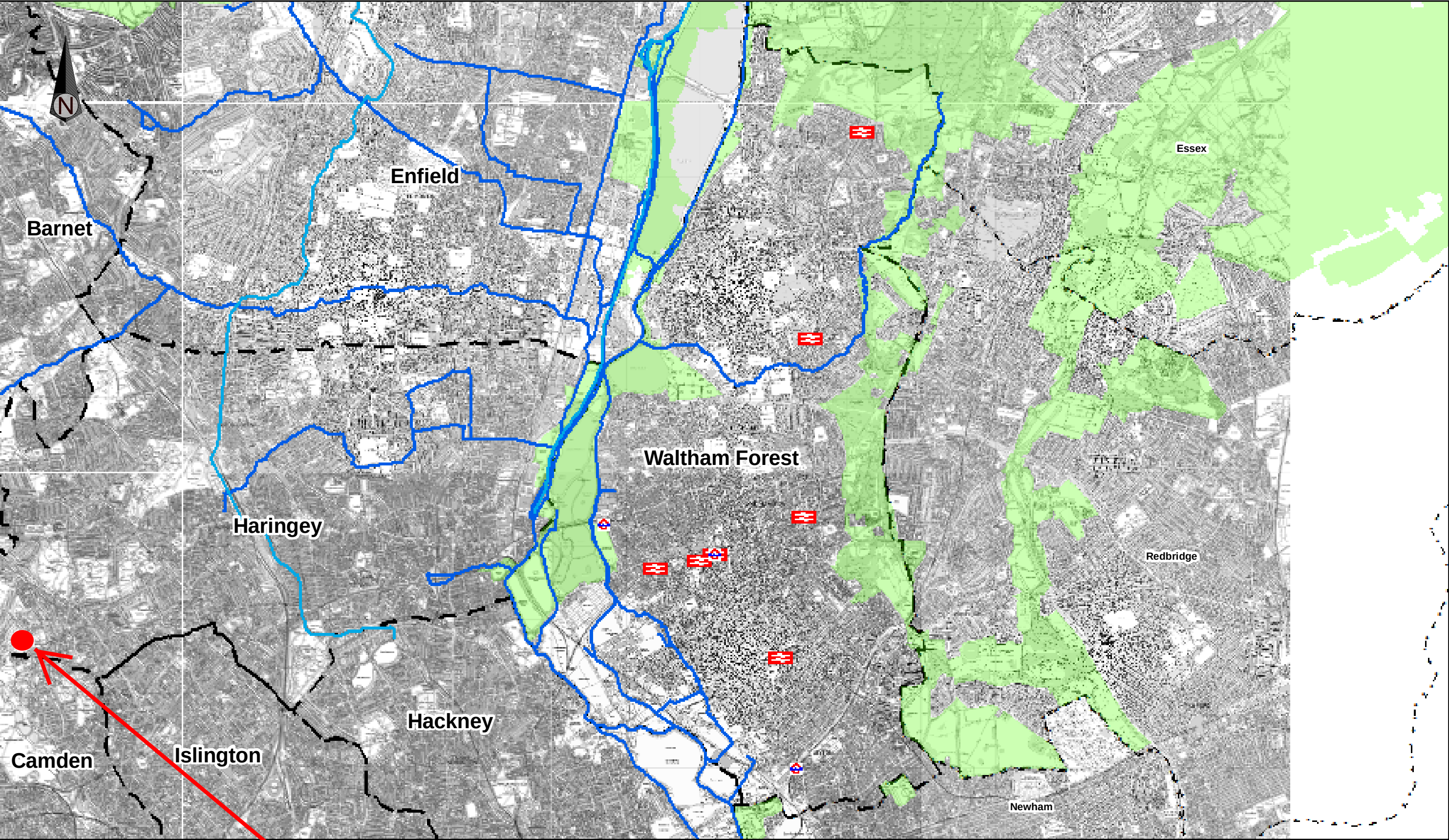
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Data Origin
Rail station data gathered by Mouchel. Remaining data provided by LB Enfield.

mouchel						Client			North London Waste Plan			
						Project			North London Strategic Flood Risk Assessment			
Purpose Information						Drawing Title Map 5: Enfield Study Area						
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Date	07/08/08	Date	07/08/08	Date	08/08/08							
Draft		Scale (at A3 size)				Issuing Office		Sutton Coldfield		Drawing Number		Rev B
Issue	●	1:40,000				Telephone		0121 355 8949		722586/005		



- Legend**
- Borough Boundaries
 - Watercourses
 - Canals
 - Underground Station
 - Railway Station
 - Greenbelt

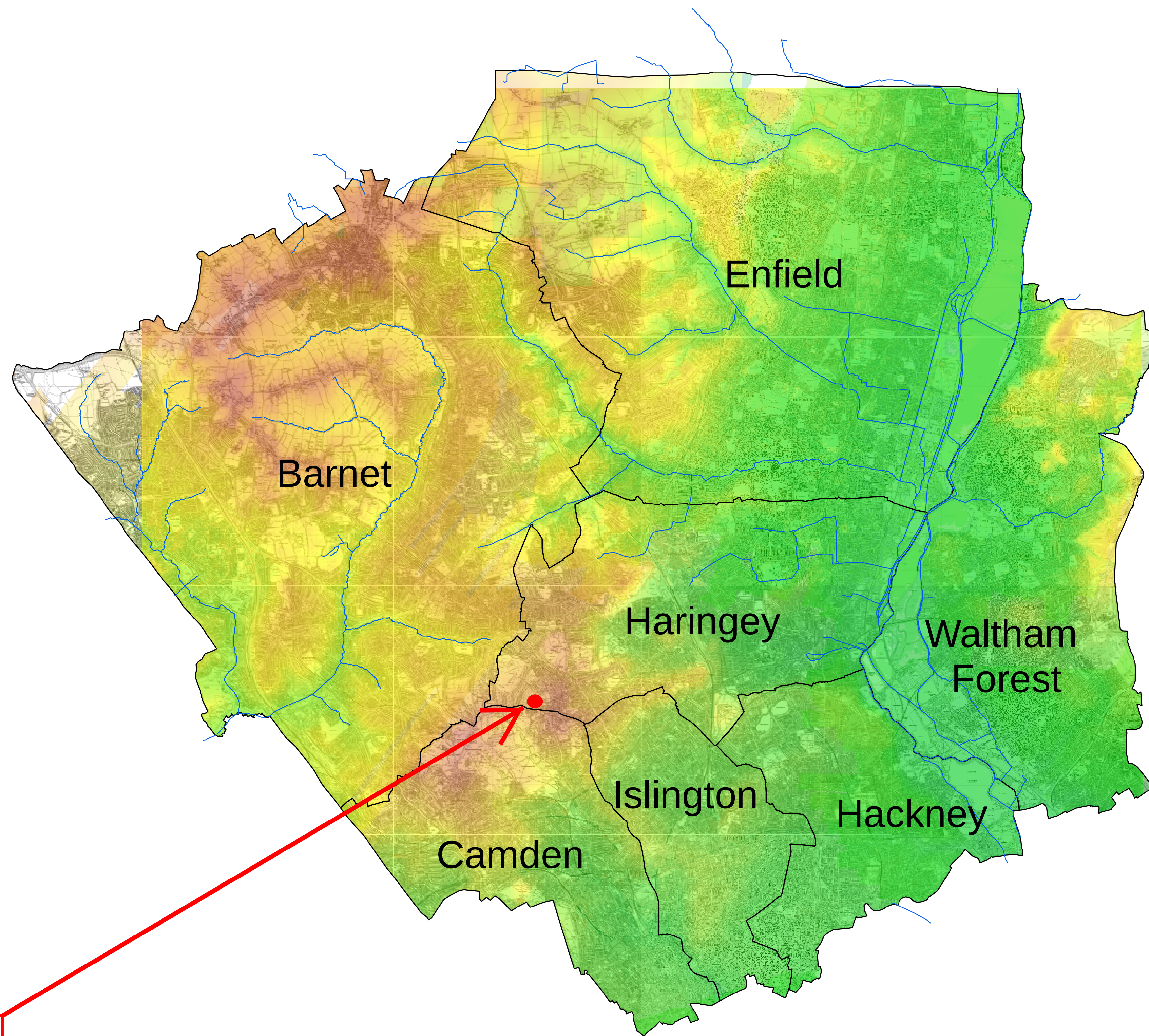
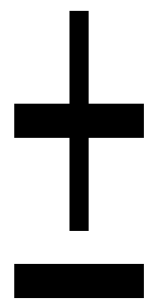
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Data Origin
Rail station data gathered by Mouchel. Remaining data provided by LB Waltham Forest

mouchel						Client North London Waste Plan			
						Project North London Strategic Flood Risk Assessment			
Purpose Information						Drawing Title Map 6: Waltham Forest Study Area			
Drawn	SL	Chkd	KR	Appvd	FP				
Date	07/08/08	Date	07/08/08	Date	08/08/08				
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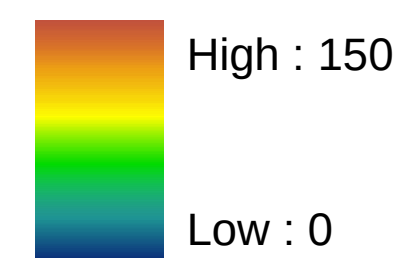
Highgate School
MSC 4 Phase
Development

Note: Appearance is subject to change
upon utilisation of OS Master Mapping

Legend

Non Main Rivers

Height in Metres



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Data Origin Lidar data from the EA and Nextmap DTM data provided by the LB when available.					

		Client North London Waste Plan			
		Project North London Strategic Flood Risk Assessment			
Purpose Information		Drawing Title Map 7: Study Area Lidar Topography Map			
Drawn	NV	Checked	KR	Approved	FP
Date	06/02/2016	Date	07/02/2016	Date	08/02/2016
Draft		Scale (at A1 size)		Issuing Office	Sutton Coldfield
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