Force Foundations Ltd.
(Basement Force)

Royal Borough of Kensington and Chelsea Basements Policy

Hydrologic Review of Basements, Publication Planning Policy

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1 Introduction

The report documents a review of the Royal Borough of Kensington and Chelsea's (RBKC's) Basements Publication Planning Policy by Ove Arup and Partners Ltd. (Arup). The report focuses only on the potential hydrological and hydrogeological impacts of the proposed policy and therefore should not be considered to be a comprehensive review of the proposed policy. In particular, structural impacts related to the proposed policy are outside the scope of this project.

This report was funded by a commission from Force Foundations Ltd. (Basement Force) as part of the defined scope of work and agreement between Arup and Force Foundation Ltd, Arup has performed an impartial and unbiased assessment of the proposed RBKC policy and supporting documentation.

The purpose of the report is as follows:

- Review the proposed policy and supporting documents with respect to potential hydrological and hydrogeological impacts both locally and across the Borough;
- Review the technical appropriateness of the proposed policy in order to evaluate if proposed policies are technically reasonable; and
- Provide recommendations to improve the policy such that the policy is more protective of environmental resources.

This report is organized in the following sections:

- Section 2: Description of RBKC including geology and hydrogeology;
- Section 4: Review of the Draft Policy;
- Section 5: Hydrological assessment of Draft Policy; and
- Section 6: Conclusions and recommendations.

2 Royal Borough of Kensington and Chelsea

2.1 General information

The RBKC extends from the River Thames at Chelsea Embankment in the south, past Hyde Park which lies to the east, up to Kensal Green in the north. RBKC is busy and densely populated, and is home to a wide spectrum of socio-economic groups. The following statistics summarise key facts and figures (Arup, 2008):

- Land area: 12.13 square kilometres
- Population: 196,000
- Population density: 16,175 per square kilometre *(densest in the UK)*
- Average size of household: 2 per property
- Proportion of private households: 78%
- Proportion of social housing tenants on housing benefit: 66%

- Proportion of incomes above £60k: 16.6% *(highest in the UK)*
- Proportion of school children eligible for free school meals: 40%
- Number of listed buildings: more than 4,000
- Proportion of land designated as Conservation Areas: 70%

The building stock within the Borough is as diverse as its population. Across the Borough are areas occupied by terraced properties, semi-detached properties, detached properties, garden squares, and blocks of flats. In some parts of the Borough, buildings are close to their neighbours, and in other areas individual properties are set within larger grounds. Some districts include a greater proportion of commercial buildings, including office blocks. Much of the older building stock in the Borough is of traditional masonry-type construction, although the newer, multi-storey structures and apartment blocks are typically built of reinforced concrete.

2.2 Soil and Geology

The sequence of soil and rock layers that lie beneath the topsoil in the Borough are, shallowest first:

- Superficial geology:
  - Made Ground, including archaeological remnants in places
  - River Terrace Deposits, Alluvium, Brickearth (*largely absent in the northern portion of the Borough*)
- Solid geology:
  - London Clay
  - Lambeth Group (comprising mixed layers of clays and sands)
  - Thanet Formation (a dense sand)
  - Chalk rock.

Of most relevance to basement developments in the Borough are the soil layers that lie nearest to the ground surface. Figure 1 provides a distribution of shallow soils. The near-surface geology across the Borough can generally be separated into two distinct zones:

- In the north, the near-surface outcropping stratum is the **London Clay**;
- In the south, the near-surface outcropping stratum is mainly the **River Terrace Deposits (RTDs)**. This gravelly soil is underlain by London Clay.

There is much local natural variation in the details of the geology across the Borough, however the north/south divide between the clay and gravel is the key geological feature most relevant to the discussion of subterranean development in the Borough (Figure 1). This is because the majority of basement applications are for locations either in the Notting Hill area dominated by London Clay or RTDs or the Chelsea area dominated by RTDs (Arup, 2008).

Below the London Clay, the deeper geological strata that lie beneath the Borough are essentially similar across the whole district, albeit with some local variations in elevation. Due to the thickness of the London Clay (50m to 70m) and its relative impermeability, deeper strata are of little relevance to residential basement developments in the Borough and are not considered further.

Appendix A provides greater detail of the geological conditions in the Borough.

2.3 Hydrogeology

The groundwater regime across the Borough is generally characterised by two distinct aquifers ("water tables"), which are separated by the essentially impermeable London Clay:

- The Upper Aquifer is perched water sitting in gravelly soils that overlie the London Clay; and
- The Lower Aquifer is found within the sandy soils and chalk located deep below the London Clay. In the Borough, the Lower Aquifer is confined by the London Clay.

For basements in the Borough, the **Upper Aquifer** is more relevant. This is the water table that would be encountered when digging a basement, and against which the basement has to be designed structurally, and waterproofed for. It is also the groundwater table in which, potentially, flow patterns could be interrupted or altered by the presence of basements. In general, the "natural" trend in groundwater flow directions within the Upper Aquifer would originally have tended to be towards the historic waterways (Counter's Creek and the Westbourne) that previously formed the main tributaries of the Thames in this part of London. In the southern part of the Borough, groundwater flow is directly to the River Thames. While, the urbanisation of London has likely altered these natural trends, the alluvial deposits associated with the historic waterways still act to draw groundwater. The Westbourne is now contained within the Ranelagh sewer, and the Creek is carried within the Counter's Creek sewer (Arup, 2008).

In the northern portion of the Borough, where the RTDs are not present, the Upper Aquifer is not present, as the shallow London Clay is relatively impermeable. In this part of the Borough, groundwater is initially found much deeper and is associated with the confined Lower Aquifer.

An important element of the hydrogeologic cycle is the interaction between rainfall and urban leakage (from sewers and water mains) and the underlying aquifers. This interaction is known as recharge when aquifers are replenished from surface waters. Generally rainfall is deposited on the ground surface where it either infiltrates into the soil or runs-off as a surface flow. Once rainwater infiltrates it can either be evaporated, be transpired by plants or recharge underlying aquifers. If no aquifer is present, or if the soil is too impermeable to allow hydraulic communication to the aquifer then there is no significant recharge.

With respect to drainage conditions, the RTDs are relatively permeable materials and will allow water movement. Thus rain water and urban leakage will move vertically and horizontally through the RTDs and perch on the underlying London Clay. The London Clay is relatively impermeable and will only allow limited water movement. Thus water does not move vertically through the clay to deeper strata or aquifers.

2.4 Typical residential basement projects

Basement projects are highly variable and can range in size, depth, percentage of garden coverage, and location. Basements can be constructed beneath the building, front garden, back garden, or some combination of all three. The majority of residential basement projects are located within the Notting Hill and Chelsea areas (Arup, 2008).

3 Review of Draft Policy

3.1 Policy Background

The RBKC Council (Council) as part of a review of its 2010 Core Strategy is developing a bespoke policy on basements. The policy is currently in its proposed publication draft and the draft is currently in an eight week public consultation period. The public consultation period is scheduled to end on 3 September 2013.

As a result of an increase in basement construction projects in the Borough, a Supplementary Planning Document (SPD) was enacted in 2009. In December 2010, the Council adopted its Core Strategy. This Core Strategy, which included elements of the earlier Borough policy, also included the following:

- Policy on “New Buildings, Extensions, and Modifications to Existing Buildings” (Part (g) of Policy CL2);
- Policy on “Climate Change” (Part (c) of Policy CE1;
- Policy on “Flooding” (Part a) of Policy CE2); and
- Policy on “Heritage Assets – Conservation Areas and Historic Spaces” (Policy CL3).

The SPD, while predating the Core Strategy is still considered to be a relevant policy document (ABA, 2013). However the SPD is also under review and amendments are planned for later in 2013.

Appendix B provides a review of the London Plan as well as summaries of the review reports by Arup in 2008 and Alan Baxter and Associates (ABA) in 2013. Both review reports were prepared on behalf of the Borough. The Arup 2008 report was an initial scoping study which highlighted key issues relevant to subterranean developments. The ABA 2013 report provided an evaluation of the key issues documented in Arup’s 2008 report in addition to other issues raised between 2008 and 2013. The London Plan and review reports provide context and background for the current draft version of the basement policy.

The draft policy is separated into two sections: 1) Reasoned Justification and 2) Proposed Policy. The Reasoned Justification section provides supporting text to the actual policy. The following provides Arup’s review and comment of sections relevant to potential hydrological and hydrogeological impacts. Appendix C provides a brief summary of the draft policy.

3.2 Proposed policy

The proposed policy provides specific criteria to be adhered to (with some exceptions for large, comprehensively planned developments). From a hydrological and hydrogeological perspective, most of the criteria are reasonable. However, of note, is the following criterion "a" of the policy:

"Basement development should not exceed a maximum of 50% of each garden"

Arup Comment: After reviewing the supporting documentation provided in the proposed policy and the ABA 2013 report, it is unclear what the technical basis for the 50% limitation is. The only information which provides any quantitative limitation of basement size is the rules of thumb provided in the ABA 2013 report. However, as indicated in Appendix B, Section B4.5, no technical basis has been provided for the ABA's rules of thumb.

From a planning perspective, it is understandable that the Borough would want to create a policy which ensures that the soil infiltration capacity throughout the Borough is not reduced beyond a critical level. Any specified limitation in basement size should take into account cumulative impacts and not just the impacts to the project site area. However, a policy which is not grounded with sound scientific reasoning may be easily challenged. This would undermine the effect of putting such a policy into place. In addition, instituting such a limitation may further preclude engineering designs which improve local hydrologic conditions. An example is described in Section 4.2 below.

3.3 Reasoned justification

Section 34.3.54 states that "Retaining at least half of each garden will… allow water to drain through the 'Upper Aquifer'". This section references the ABA 2013 report.

Arup Comment: The ABA report provides only "rules of thumb" on percentage of garden to be retained to allow sufficient drainage. No data from a detailed technical evaluation or source of the "rules of thumb" have been provided. Thus it is unclear how technically relevant the 50% limitation is. Under certain conditions, this limitation may be overly conservative, and in some conditions this limitation may not be conservative enough.

Section 34.3.55 states that the unexcavated garden area needs to be in a single area. If to the rear, it should normally be at the end of garden where it will be adjacent to similar areas in other plots allowing for better drainage.

Arup Comment: Policy related to basements should be based on technically appropriate requirements (such as surface water storage and drainage requirements) and should require assessment to include neighbouring conditions in addition to site-specific conditions. While Section 34.3.55 may generally be reasonable, it does not address the need to evaluate proposals with respect to conditions at adjacent plots, groundwater flow, and surface water storage and drainage.

Section 34.3.68 states that Policy CE 2 of the Core Strategy requires surface water run-off to be managed as close to its source as possible. Sustainable Urban Drainage Schemes (SUDs) related to basement developments should include a minimum of one metre of a suitably drained permeable soil above any basement. Other measures may also be required.

Arup Comment: Run-off and sewer discharge volumes can be significantly impacted by basement projects. However engineering designs can be used to improve drainage conditions thereby reducing run-off and sewer impacts. Therefore, this is an area where the Borough has an opportunity to put into place policies which serve to improve overall conditions. This would be of particular benefit in the northern portion of the Borough where the outcropped London Clay creates poor drainage conditions which are subject to significant discharges to the combined sewer system.

Section 34.3.71 states that ground and hydrological conditions must be thoroughly investigated. The developer must demonstrate that the works can be carried out whilst safeguarding structural integrity.

Arup Comment: This is an important requirement for any successful development plan. Further, the policy should explicitly state that competent professionals be employed to perform these evaluations and investigations.

4 Hydrologic Evaluation of Potential Impacts

4.1 Potential groundwater impacts

The potential impact of subterranean developments on groundwater levels and groundwater flows is a subject of concern for many people in the Borough. The scale and extent of such impacts will be specific to a particular site and its immediate surroundings, and will depend on a combination of factors acting together such as soil types, the nature of existing and proposed development and the existing ground water flow patterns in and around the area of the site.

In general, where the Upper Aquifer is present (such as in the southern portion of the Borough) groundwater will usually find an alternative route when it meets an underground obstruction and static groundwater will re-distribute itself. It is therefore likely that, in general, the effect of a new basement on groundwater levels will be relatively small. However both groundwater levels and groundwater flows are factors that basement design engineers and contractors should take into account in their work, as each affects the technical design and practical construction of a basement. In addition, the impacts of temporary works must be assessed including how the project transitions from temporary to permanent works (i.e. what temporary alterations are left in place).

Excavations in the RTDs which do not completely penetrate the RTDs are not likely to adversely affect groundwater flow. Since the RTDs are dominated by gravels, the material has a relatively large capacity for flow due to its high relative permeability. Thus groundwater will have the ability to move around and below the remaining RTD volume. Figure 2 is adapted from an evaluation performed by Arup in 2010 for the Borough of Camden. Figure 2 illustrates conceptual impacts of basements on groundwater flow (Arup, 2010). In the extreme case where successive basements cut off the RTDs (such as in a line of houses) groundwater migration will likely move through the surrounding network of RTDs located beneath streets (Arup, 2008). Clearly cumulative impacts of multiple developments can increase the risk of adversely altering hydrogeologic conditions.

In the northern portion of the Borough where the Upper Aquifer is not present, groundwater flow and mounding impacts will not be an issue. However basements founded in clay should consider potential issue of hydraulic uplift due to pore pressure within the London Clay. Also hydrological impacts related to soil infiltration capacity will be an issue and is discussed in Section 4.2.

Groundwater can potentially flow out of RTDs over the top of the London Clay causing local flooding. This condition is generally constrained to the Notting Hill area where outcropped RTDs are adjacent to outcropped London Clay. There is the potential that basement developments could exacerbate this flooding risk. Thus basement developments in this area should evaluate potential impacts of this phenomenon.

Regardless of the anticipated low impacts of groundwater, an assessment of potential impacts should be performed by competent and experienced professionals as part of the planning application. The assessment should conform to guidance provided by the Borough. Potential risks found in the assessment should be properly mitigated and managed.

At a minimum, a detailed assessment should evaluate the following:

- Existing groundwater and hydrogeologic conditions ("baseline" condition);
- Potential post-development groundwater and hydrogeologic conditions;
- Risk to nearby and adjacent structures due to groundwater level and pore pressure increases;
- Risk of flooding and/or water ingress to the basement structure and nearby/adjacent structures;
- Impacts of pore pressures on the basement structure; and
- Impacts of local conditions such as sloped topography, flood risks associated with the River Thames, and site-specific geology and hydrogeology.

Further details on an approach to properly assess the hydrogeologic environment are beyond the scope of this review. The ABA 2013 report provides a discussion of assessment methodologies. In addition, Arup developed a Basement Impact Assessment methodology for the Borough of Camden which could be adapted to the RBKC (Arup, 2010).

4.2 Qualitative hydrological assessment of proposed policy

The main hydrological issue related to basement developments is the potential impact to storm water management and drainage. This section evaluates whether there is a relationship between storm water management and the proposed policy to limit residential basements to '*not exceed a maximum of 50% of each garden*'

It is understood that the '50% rule' has been proposed by RBKC based on a wide range of factors including advice given by ABA. The advice given has been extracted below from their Residential Basement Study Report, dated March 2013.

> *Where the near surface subsoil is gravel, water that falls on gardens will be held in the topsoil and by the vegetation and then drain through to the gravel and into the Upper Aquifer. When a basement is built, water falling on the topsoil above it needs to be channelled or directed to an unbuilt area of the garden, so that it can enter the ground and find its way into the gravel*

and down into the Upper Aquifer. As a rule of thumb, 25% of the garden area is likely to be sufficient to enable this to happen. On this basis a new basement should not occupy more than 75% of the area of a garden.

Where the near surface subsoil is clay, water that falls on gardens will be held in the topsoil and by the vegetation. It will drain through the topsoil until it reaches the clay, which will act as a barrier to the vertical flow of water. Some water will be absorbed by the clay surface. On sites with falls, water will gradually flow down any slope within the topsoil. The topsoil and ground will be waterlogged until the water evaporates or is absorbed by the underlying clay and dries out. To enable the clay subsoil to absorb some of the rainwater, a proportion of the garden should not be built under and on clay sites this might be between 25% and 50%. On this basis a new basement should not occupy more than between 50% and 75% of the area of a garden on clay sites.

For the purposes of this report, we are not considering basements in Flood Zone 2 and 3 as defined by the Environment Agency. Basements in these locations within RBKC are subject to Policy CE2.

4.2.1 Description of a Typical Site

For the purposes of this qualitative hydrological evaluation, a typical site will be used as the basis of assessment and discussion. Figure 3 illustrates the typical layout and section of a site being considered under Policy CL7. This can be described as follows:

- Narrow plot with the residential house at the front and a back garden.
- The boundary of the site follows the extent of the back garden.
- The proposal to be considered would typically involve a basement extension to the property below the garden area.
- The garden is considered to be a lawn or landscaped area that enables natural infiltration of surface water.
- Projects are located either on London Clay or on RTDs. These are the main geotechnical conditions for the Borough as described in Section 2.2.
- Neighbouring properties have similar scale gardens to the side of the site and there is a garden backing onto the site.
- Neighbouring properties have sufficient drainage typical to the area.
- The back garden of the site does not drain to the local public surface water sewer. The only means of discharge is through natural infiltration.

4.2.2 Storm Water Management Objectives

In order to frame the discussion on storm water management, a set of objectives have been defined that generally summarise the current policy on how storm water should be managed.

- Surface water shall be managed to ensure that it is managed on site in line with building regulations and so neighbouring properties are not adversely affected.

- The natural groundwater regime should not be adversely affected. Groundwater shall be managed so that it is retained within the site and so neighbouring properties are not adversely affected by an increase in sub surface or surface flows of groundwater.
- Sustainable Urban Drainage Systems (SUDS) should be implemented where appropriate.

For the purposes of this report, we are assuming that off-site discharges to the public storm sewer are not acceptable because water authorities do not tend to accept land drainage into the combined sewer. Hence, we have not defined an objective for an off-site discharge rate. In reality however, some gardens will be connected to the surface water sewer system (likely to be old combined storm and foul sewers). Properties that do have a positive drainage connection will benefit because they will not have to rely solely on infiltration to discharge surface water.

4.2.3 Storm water Management Discussion

There are a wide range of factors that clearly support a limitation on the extent of basement construction across the Borough. However, when storm water management is considered in isolation, there are engineering solutions that can be considered to create the situation where a basement could be extended beyond the 50% rule and still comply with the objectives mentioned above in section 4.2.2. Large sites that are positioned in the RTDs for example, may be able to facilitate a larger basement extent and still manage to adequately infiltrate surface water. Whereas small sites located on London Clay will find it more difficult to encroach beyond the 50% rule and manage storm water through infiltration alone. Sites located on London Clay will likely discharge to the public sewer system. Therefore, engineering solutions will need to regulate storm water flows from the site such that the combined sewers are not overburdened during storm events.

To demonstrate this, we have illustrated three scenarios on Figure 4. The scenarios are as follows:

Scenario 1 – No basement – this is a typical small site as defined above in Section 3, the garden allows natural infiltration of surface water into the ground.

Scenario 2 – 50% rule – a typical small site where Policy CL7 is implemented. A permeable soil storage zone is provided above the basement slab to provide attenuation and a soakaway is provided in the garden area connected to the storage zone to enable a discharge to ground.

Scenario 3 – Maximum Basement Extents – This scenario illustrates a basement extension where the constraints imposed by storm drainage are at the limits of design. Again attenuation is provided in a permeable soil zone above the basement slab and a soakaway is provided in the garden space. However, there is only enough space to position a soakaway within the setback required by building control for properties and the site boundary.

Note that the three generalised scenarios (i.e. are not specific to where the Upper Aquifer is present or where the London Clay outcrops to the surface). Thus these scenarios assume that engineering measures are appropriate and suitable for the conditions in and around the site.

The above scenarios help to illustrate the following:

- Engineering methods are available which can be used to maintain or improve storm water storage and infiltration capacity within the site curtilage.
- A simple limitation of 50% may preclude innovative methods which improve overall drainage conditions within the Borough.
- There is a limit to the amount of garden which can be developed into a basement. To establish this limit, site specific assessment will be needed, a general rule cannot be applied.

4.2.4 Design Approach

Regardless of the basement size an applicant should undertake a site specific assessment to demonstrate that storm water can be managed appropriately. The following points describe the design methodology that should typically be followed in order to generate a storm water management strategy that meets the objectives described in Section 4.2.2. Please note that this methodology would be modified if the site is in Flood Zone 2 and 3 as defined by the Environment Agency. In this case, a formal Flood Risk Assessment (FRA) would be required in line with National Planning Policy Framework (2012).

Data collection

- Assess the existing site to obtain information on the existing storm water drainage system.
- Identify the local ground conditions in order to evaluate potential infiltration rates. This is likely to require physical site investigation work.
- Understand the ground levels to be in a position to look at overland flow routes.
- Obtain rainfall data for the site and make allowances for climate change in line with best practice guidance.
- If there is evidence of an offsite discharge route into a public sewer, consult with the local water authority on the allowable discharge rate.

Design

- Assess the performance of the existing drainage system and the potential to infiltrate on site. Identify existing infiltration rates and if appropriate, existing discharge rates to the local storm sewer. Then undertake a water balance across the site.
- Develop a drainage strategy that mimics the above discharge rates using appropriate form of SUDS where possible.
- Undertake an assessment of extreme rainfall events up to the 1 in 100 year annual probability event plus a factor for climate change to ensure surface water is managed on site and does not adversely affect neighbouring properties.
- If appropriate, gain agreement from the local water authority on the drainage strategy.

5 Conclusions and Recommendations

The Royal Borough of Kensington and Chelsea (RBKC) have produced a draft Basements Publication Planning Policy which is currently in its public consultation period (until 3 September 2013). Arup has performed a review of this policy focussing only on the potential hydrological and hydrogeological impacts of the proposed policy. This report was funded by a commission from Basement Force. As part of the defined scope of work and agreement between Arup and Force Foundation Ltd, Arup has performed an impartial and unbiased assessment of the proposed RBKC policy and supporting documentation.

There is only one significant groundwater system of relevance to the proposed policy, the perched water known as the Upper Aquifer. The Upper Aquifer is located within the RTDs and is perched on top of the underlying London Clay. The Upper Aquifer is only present in the southern portion of the Borough where the River Terrace Deposits are also present. The northern portion of the Borough is dominated by outcropping and largely impermeable London Clay. There is no Upper Aquifer in areas where the London Clay outcrops at the ground surface. There are other soil types present to a lesser extent within the Borough such as Alluvium and Brickearth. The near-surface geology across the Borough can generally be separated into two distinct zones:

- In the north, the near-surface soil layer is the **London Clay**;
- In the south, the near-surface soil layer is mainly the **River Terrace Deposits (RTDs)**. This gravelly soil is underlain by London Clay.

The current policy on basements is part of the Borough's Core Strategy and includes the 2009 Supplementary Planning Document (SPD). The SPD will likely be revised later in 2013 and will include guidance on performing Basement Impact Assessments. The Publication Planning draft of the revised Basement Policy will eventually be included within the Borough's Core Strategy. The basis for the policy is derived from reviews performed by Arup in 2008 and ABA in 2013. The policy contains two sections: 1) reasoned justification; and 2) policy criteria.

Generally the Publication Planning draft of the policy provides a reasonable policy to be implemented with respect to potential hydrological and hydrogeological impacts both locally and across the Borough. The most significant comments are related to the criterion which limits basement size to 50% of the garden plot where the remaining garden area is continuous. Based on our review, we have drawn the following conclusions:

- It is difficult to define a direct relationship between the 50% rule and the constraints posed from a hydrological perspective. Each site will have unique characteristics which would need thorough investigation if there is a desire to implement a bespoke drainage solution.
- Policy requirements should be tied to technically appropriate requirements which directly allow adequate groundwater flow, surface water, and drainage at the site and neighbouring areas. Generalised requirements may be useful, but should not limit good engineering practices that are demonstrably not worse than current conditions (where current conditions are satisfactory) or improve hydrologic and hydrogeologic conditions in the Borough.

- From a planning perspective, we can understand the desire to apply a standard rule that takes a conservative approach which ensures that the soil infiltration capacity throughout the Borough is not reduced beyond a critical level. However, it needs to be soundly based and technically justifiable.
- A policy not grounded with sound scientific reasoning may be easily challenged. This would undermine the effect of putting such a policy into place.
- Instituting such limitations may further preclude engineering designs that improve local hydrologic conditions.
- If there is a desire to extend beyond the 50% rule, the size of the site and the existing ground conditions will have a significant impact on the potential to implement engineering solutions.
- There may be some sites where the 50% rule is not conservative enough or where existing/adjacent developments could be impacted detrimentally. For example, a site where existing conditions do not provide adequate surface water storage, such as sites in outcropped London Clay areas. In these areas, engineering designs will be required to satisfy storage and discharge requirements for any basement proposals.
- In order to improve the sensitivity of existing policy with regards to hydrological performance of basement extensions, specific objectives such as those included in Section 4.2.2 could be adopted into the policy that require engineering solutions which are overall more effective and allow greater design flexibility. These engineering solutions should be subject to detailed assessment when discussed with statutory bodies such as Thames Water or the Environment Agency depending on location and details of proposal prior to planning approval.

We recommend that the policy be revised such that applications which are demonstrably not worse than current conditions (regardless of project size) and satisfy all other planning constraints (including demonstration that current conditions are satisfactory) be considered for approval. In addition, there should be an onus on the owner/developer that the development does not have an adverse impact on surface infiltration or groundwater conditions. Assessments should always consider the cumulative impacts to neighbouring areas.

6 References

[1] Alan Baxter and Associates (ABA), (2013). Royal Borough of Kensington and Chelsea, Residential Basement Study Report. Dated March 2013.

[2] Arup (2008). Royal Borough of Kensington & Chelsea, RBCK Town Planning Policy on Subterranean Development, Phase 1 – Scoping Study. Dated 13 November 2008.

[3] Arup (2010). Camden geological, hydrogeological and hydrological study, Guidance for subterranean development. Dated 18 November 2010.

[4] The Royal Borough of Kensington and Chelsea (RBKC), (2013). Basements, Publication Planning Policy, Partial Review of the Core Strategy. Dated July 2013.

Appendix A

Geology and Hydrogeology

Appendix A provides further information on the geology and hydrogeology of the RBKC. Figure 1 illustrates the distribution of shallow strata across the Borough

A1 Southern part of the Borough: River Terrace Deposits

The geology of the south is dominated by prehistoric flood plains of the 'ancestral' River Thames. It is blanketed by the River Terrace Deposits (RTDs) which comprise a complex mixture of sands, silts, gravels and clayey soils. These deposits were deposited during major flood events and would be partly eroded by the river before being buried by the next flood event. The RTDs in the borough are comprised by several different types of gravels known as the Boyne Hill Grave, Hackney Gravel, Kempton Park Gravel, Lynch Hill Gravel, and Taplow Gravel (Figure 1). In engineering terms, the River Terrace Deposits comprise a large-grained non-cohesive soil. This unit is permeable to water and groundwater located within the RTDs is known as the upper-aquifer. Groundwater tends to remain and migrate through the RTDs without percolating deeper through the largely impermeable London Clay.

A2 Northern part of the Borough: London Clay

Only in the northern portion of the Borough, does the London Clay outcrop at the surface, however the London Clay underlies the full footprint of the Borough. In the southern area, the London Clay is covered over by a blanket of River Terrace Deposits that is sufficiently thick in places such that excavations for basements would not encounter the London Clay.

London Clay is a brown or grey, firm, silty clay. The London Clay developed from a fine sediment that was gradually deposited on the seabed of a tropical sea that covered much of southeastern England between 55 and 52 million years ago. Although nowadays it is present at or near the ground surface, the London Clay has, during its geological history, been buried hundreds of metres below the ground surface. This overmantle material has since been completely eroded. However, its great weight acted to compress and stiffen the London Clay (it is termed an "overconsolidated clay"). In engineering terms, the London Clay is a fine-grained, cohesive soil. The design of foundations in the London Clay is governed by its cohesive, rather than frictional, properties.

The London Clay has a relatively low permeability to ground water. In essence, the London Clay presents an almost complete barrier to groundwater. In practice, this barrier is not complete: groundwater can permeate slowly through intact London Clay, and it can move more quickly along any fissures and cracks in the clay, and through localised zones that contain a higher proportion of silts or sands. However, even in the presence of fissures or silty zones, ground water flow rates in the London Clay are significantly slower than in the River Terrace Deposits.

The clayey minerals in the London Clay make it responsive chemically to water. Moisture present within the clay can bond chemically with particles of clay minerals, and cause the particles to swell. The well-known phenomenon of the seasonal swelling (in wet winters) and shrinkage (in dry summers) of London Clay is caused by this chemical bonding.

A3 Local shallow variations: Alluvium and Brickearth

Alluvium is very recently-formed soil (recent in geological time) made from sediments deposited by a river and is typically made up of a variety of materials, including fine particles of silt and clay and larger particles of sand and gravel. Alluvium is present in a narrow strip along the eastern edge of the Borough, corresponding to the course of the old river Westbourne. Alluvium is also present at Chelsea Creek, at the confluence of the old Counter's Creek with the Thames.

Brickearth was formed from a wind-blown dust that was deposited across Europe under extremely cold, dry conditions. It comprises very fine sand, silt and clay particles that are small enough to be carried on the wind. In RBKC, the brickearth is a River Brickearth ("Langley Silt"): the soil particles were picked up and carried by a river from wherever the wind originally deposited them, and then re-deposited by the river at their current location. The thickness of the brickearth layer in the Borough varies from 2m to 4 m. As its name suggests, brickearth was traditionally used to make bricks. It is not unusual to find that this commercially useful soil has been quarried and replaced with backfill .

A4 Upper Aquifer Groundwater Boundaries

Groundwater flow within the upper aquifer historically would have been bounded by the Counter Creek and Westbourne waterways on the west and east, respectively, and the River Thames in the South. The northern boundary is generally defined by the topographic rise in the area of Kensal Green. With the urbanisation of London, Counter's Creek is now carried within the Counter's Creek sewer and the Westbourne is now contained within the Ranelagh sewer (Arup, 2008). Thus groundwater boundaries between the eastern and western catchments are not as clearly defined.

A5 The Lower Aquifer

The Lower Aquifer of the London basin is now mainly present at depth within the Thanet Sand and Chalk. It is an important water resource for London and it is a protected aquifer. From the early C18th, abstraction from deep wells for drinking water and industrial uses caused the groundwater level in the Lower Aquifer to be artificially depressed. This trend continued until the mid-C20th, when industrial demand for water started to dwindle. From the mid-1960s, as the rate of abstraction of water needed by industry in London continued to fall, the groundwater level in the Lower Aquifer began to rise. In principle, if left unchecked, the rising groundwater could regain its natural, pre-industrial levels. In some parts of London, the pre-industrial water level was above ground surface (that is, artesian conditions). In the late 1990s, a long-term programme of dewatering called the "GARDIT" scheme was established by Thames Water Ltd in association with the Environment Agency in order to remedy the problem. This has started to arrest and reverse the trend of increasing groundwater levels in the Lower Aquifer. Environment Agency (EA) data issued in June 2007 indicates that the groundwater level in the Lower Aquifer across the Borough is being controlled by the ongoing de-watering scheme.

Appendix B

Background of Policy Development

B1 Borough Policy

The RBKC Council (Council) as part of a review of its 2010 Core Strategy is developing a bespoke policy on basements. The policy is currently in its Publication Policy draft and the draft document is currently in a eight week public consultation period. The public consultation period is scheduled to end on 3 September 2013.

The RBKC has previously had in place a Unitary Development Policy (UDP), which includes several policies related to subterranean development. As a result of an increase in basement construction projects in the Borough, a Supplementary Planning Document (SPD) was enacted in 2009. In December 2010, the Council adopted its Core Strategy. This Core Strategy, which included elements of the UDP, also included the following:

- Policy on "New Buildings, Extensions, and Modifications to Existing Buildings" (Part (g) of Policy CL2);
- Policy on "Climate Change" (Part (c) of Policy CE1;
- Policy on "Flooding" (Part a) of Policy CE2); and
- Policy on "Heritage Assets – Conservation Areas and Historic Spaces" (Policy CL3).

The SPD, while predating the Core Strategy is still considered to be a relevant policy document (ABA, 2013).

B2 The London Plan

The London Plan[1] updated in July 2011 has relevant policies related to basement construction as the design potentially impacts urban drainage and hydrogeology as summarised below:

Policy 3.5: Quality and design of housing developments

Developments should be of the highest quality and should enhance the quality of local places. The Plan supports development plan-led presumptions against development on back-gardens where locally justified by a sound local evidence base. Local approaches to the surfacing of front gardens should include the need for surfaces to be permeable, subject to permitted land development rights[2]

Policy 5.11: Green roofs and development site environs

[1] The London Plan refers to PPS25, which has now been superseded by the NPPF. However, technical guidance contained within PPS25 has been carried through to the NPPF.
[2] Environment Agency, Communities and Local Government (CLG) (2009). Guidance on Permeable Surfacing of Front Gardens.

Major development[3] proposals should be designed to include roof, wall and site planting, especially green roofs and walls where feasible, to deliver as many of the following objectives as possible:

- Sustainable urban drainage;
- Adaptation to climate change (i.e. aiding cooling); and
- Mitigation of climate change (i.e. aiding energy efficiency).

Policy 5.12: Flood risk management

The Mayor will work with all relevant agencies including the Environment Agency (EA) to address current and future flood issues and minimise risks in a sustainable and cost effective way.

Development proposals must comply with a Flood Risk Assessment (FRA) and management requirements set out in PPS25 over the lifetime of the development and have regard to measures proposed in Thames Estuary 2100 and Catchment Flood Management Plans.

Developments which are required to pass the PPS25 Exception Test will need to address flood resilient design and emergency planning by demonstrating that:

- The development will remain safe and operational under flood conditions;
- A strategy of either 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; and
- Buildings are designed for quick recovery following a flood.

Developments adjacent to flood defences will be required to protect the integrity of existing flood defences and wherever possible should aim to be set back from the banks of watercourses and those defences to allow their management, maintenance and upgrading to be undertaken in a sustainable and cost effective way.

Policy 5.13: Sustainable drainage

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

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

[3] Major developments are defined as: where 10 or more dwellings are to be constructed (or if number not given, area is more than 0.5hectares); where the floor space will be 1,000sq m or more for all other uses

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

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

Policy 5.14: Water quality and wastewater infrastructure

The Mayor will work in partnership with the boroughs, appropriate agencies within London and adjoining local planning authorities to:

- Ensure that London has adequate and appropriate wastewater infrastructure to meet the requirements placed upon it by population growth and climate change
- Protect and improve water quality having regard to the Thames River Basin Management Plan.

Development proposals must ensure that adequate wastewater infrastructure capacity is available in tandem with development. Proposals that would benefit water quality, the delivery of the policies in this Plan and of the Thames River Basin Management Plan should be supported while those with adverse impacts should be refused.

Development proposals to upgrade London's sewage (including sludge) treatment capacity should be supported provided they utilise best available techniques and energy capture.

The development of the Thames Tideway Sewer Tunnels to address London's combined sewer overflows should be supported in principle.

B3 Arup 2008 scoping study

As part of the overall policy development, Arup provided a scoping study report in 2008 to the Council (Arup, 2008). The purpose of the scoping study was: "*to identify and assess the likely importance of factors and issues considered as being potentially relevant to policies on subterranean development in the Borough.*"

Arup's 2008 Scoping Study report provided eight conclusions summarised as follows:

1. Subterranean development in the Borough cannot be viewed in isolation from other planning issues, such as the protection of heritage structures, archaeology, and conservation areas; environmental protection; requirements for sustainable development; the need for provision of additional housing; the risk of flooding *etc*.
2. Previous policies dealt explicitly with subterranean developments in the Borough, but only in conservation areas (which occupy almost 70% of Borough). Thus revised policy should be comprehensive for the entire Borough.
3. The potential impact of subterranean developments on groundwater levels and groundwater flows is a subject of concern for many people in the Borough. The scale and extent of such impacts will be site-specific, and will

depend on a combination of factors acting together such as soil types, and the existing ground water flow patterns. In general, where the sub-surface conditions are not unusually adverse, groundwater will usually find an alternative route when it meets an underground obstruction and static groundwater will re-distribute itself. It is therefore likely that, in general, the effect of a new basement on groundwater levels will be relatively small. However both groundwater levels and groundwater flows are factors that basement design engineers and contractors should take into account in their work, as each affects the technical design and practical construction of a basement.

4. Concerns about the potential for structural damage if subterranean development works are not undertaken properly were also prominent in the public consultation. Subterranean development in a dense urban environment, especially basements built under existing structures, is significantly more challenging. In particular, there is a potential risk of damage to neighbouring structures and infrastructure if excessive ground movements occur around an ill-planned or poorly-implemented subterranean development. On the other hand, subterranean developments have been successfully achieved in London and elsewhere over many years. In general these successful projects have been undertaken by experienced, competent teams who recognised the potential hazards and mitigated against them.

5. Information gathered during the 2008 Arup study suggests that it is perhaps appropriate that different, stricter planning requirements and safeguards be considered for subterranean developments than for other types of building works in the Borough. If such a distinction were to be adopted, then the Borough should require that the “works” are performed by competent and experienced professionals. The “works” should be taken as encompassing the full spectrum of activities from project inception to completion. All stages in the works process are important and should be undertaken competently.

6. Design issues for subterranean developments under semi-detached or terraced properties that directly share a common party wall with neighbour(s) differ in several ways from fully-detached properties that are not close to other structures. There are engineering design issues specific to subterranean developments alongside such party walls; in addition to owner-occupiers’ natural concerns about noise, vibration and general inconvenience when their neighbours “have the builders in.” These engineering challenges can be successfully addressed and mitigated in practice, and would not necessarily preclude a subterranean development under a non-detached property, but it is appropriate for the Council to consider whether explicit additional policy provisions should be made.

7. The potential long-term impact of a subterranean development abutting a shared party wall tends to be more significant in clayey soils than in gravelly or sandy soils. The associated engineering challenges can be addressed and mitigated in practice, and should not necessarily preclude a subterranean development under these conditions, but it is appropriate for the Council to consider whether explicit additional provisions should be made in the planning requirements.

8. It should be understood that geologic maps are not necessarily definitive. Geologists have inferred mapped boundaries from available field data, and they gradually amend the boundary lines as more field data becomes available to them. If geologic maps are to be used for planning decisions, then it is recommended that decisions allow the latest available geological information to also be used.

B4 2013 ABA review study

In 2012, Alan Baxter and Associates (ABA) performed a review study on behalf of the Council (ABA, 2012). The ABA study built upon work initially performed by Arup in 2008 and included additional evaluations such as:

- The effect of subterranean developments on gardens, landscaped areas and trees, and the overall character and nature of the Borough green space; and
- Sustainability considerations and energy use.

Specifically relevant to this hydrologic review of the proposed RBKC policy, ABA provided a review and recommendations for, among other things:

- Groundwater issues;
- Flooding;
- Water ingress;
- Landscaping and trees; and
- Site coverage by basements built outside the footprint of a house.

The following summarises ABA's review and recommendations related to these relevant topics.

B4.1 Groundwater issues

Groundwater issues are only considered to be significant within the perched water of the Upper Aquifer where river terrace deposits (RTDs) consisting of gravels overlie the largely impermeable London Clay. ABA suggests that flow is significant only in sloped areas within the Borough such as in the Notting Hill area. Further, the presence of two historical water courses, Counter's Creek and River Westbourne, may create localised groundwater flow areas. Thus additional considerations should be given in these areas. In addition, houses located near the River Thames may need consideration with respect to tidal impacts from the River.

While groundwater levels are rising in the Lower Chalk Aquifer, groundwater levels within the Upper Aquifer are reasonably stable and only fluctuate as a result of season. In areas where the London Clay outcrops to the surface, there is generally no Upper Aquifer.

Basements constructed in clay should consider the potential for hydraulic uplift and should be designed to resist hydraulic forces.

Excavations in the RTDs which do not completely penetrate the RTDs are not likely to adversely affect groundwater flow. This is due to the ability of groundwater to move around and below the remaining RTD volume. In areas where the RTDs are completely penetrated or where successive numbers of basements are anticipated (such as in long terraces of houses) then an evaluation may be necessary to assess the impact to the Upper Aquifer. Engineering measures are available, such as engineered drainage, which can be used to mitigate potential issues.

Adding basements in areas where basements or lowered ground levels are present should be carefully evaluated. Basement constructions could increase local groundwater conditions causing nearby structures to become wet or impacting surface structures. Engineering solutions can be employed in the basement design to mitigate these issues.

In some areas within the Borough excessively perched groundwater can flow out of the soil onto the London Clay causing localised flooding. This condition is generally constrained to the Notting Hill area. Thus basement developments in this area should evaluate potential impacts of this phenomenon.

B4.2 Flooding

Flood risk areas in the Borough have been defined with respect to flooding from the River Thames, stormwater, and groundwater. Basements designed in these established areas should include assessments of flood risk. In addition, since the Borough sewer system is a combined storm water and sewer system, the potential exists for foul water to impact basements. Designs should include measures to reduce surface water discharges and methods to prevent water ingress.

B4.3 Water ingress

Basement construction projects should include designs to prohibit water ingress into the basement. Currently within the Borough there are a number of existing basements which experience flooding in the area of Counters Creek area due to overloaded drains.

B4.4 Landscaping and trees

All trees within conservation areas and trees with Tree Preservation Orders (TPOs) are protected and so must be considered during the design phase. In addition, British Standard 5837 (Trees in relation to design, demolition and construction) indicates that basements should not be constructed within a distance of twelve times the tree trunk diameter.

Aborculturists should be consulted for projects where trees exist or will be planted to ensure that conditions are appropriate for tree health. The final ground level and permeability should be kept as close as feasible to the existing conditions.

Basements which extend under trees or Root Protection Areas (RPAs) should not be permitted, even if technically feasible.

RBKC policy states that all new basements should include a 1m minimum of soil cover over the slab. This soil cover should allow for adequate drainage as well as allow for normal garden cultivation.

A minimum portion of a garden should be retained to “ensure that trees can be planted to replace existing species that die and also to provide a hydraulic connection between the surface and the perched water table…to maintain the current status quo with the groundwater regime”.

B4.5 Site coverage by basements built outside the footprint of a house

The basement size has to be limited outside the building footprint to:

a) Allow natural drainage from gardens by maintaining connectivity between the surface and Upper Aquifer or allowing rain water to infiltrate into the soil.

b) Allow for large tree and shrub planting to maintain the character of Borough green space.

Policy CE2 of the Borough’s Core Strategy requires the use of Sustainable Urban Drainage Systems (SUDS) or other methods to reduce the volume and intensity of run-off entering the combined sewer system. Thus water should be attenuated to less than or equivalent to existing conditions. Good practice in basement design should adopt these methods as a design principle.

In areas where the Upper Aquifer is present (i.e. where RTDs are present) water falling onto a property should find its way to the Upper Aquifer. ABA suggests a “rule of thumb” that a new basement should not occupy more than 75% of the garden area.

In areas where the London Clay outcrops at the ground surface, water falling onto the surface should be managed. ABA suggests that a new basement should occupy between 50 and 75% of the garden area. They reason that water which falls onto a site will be retained within the topsoil until it drains to the top of the clay where the clay will act as a vertical barrier. While some water will be absorbed by the clay, most will remain within the topsoil where it will either evaporate, be transpired, or flow to a drainage system (where a significant slope exists).

Groundwater conditions should be managed such that an increase in subsurface or surface water flows from groundwater does not adversely impact neighbouring properties.

Appendix C

Summary of Proposed Policy

C1 Summary of Proposed "Reasoned Justification"

The "Reasoned Justification" section provides supporting text to the actual policy and is intended to be included into the Core Strategy as Section 3 of Chapter 34. Section 3 within Chapter 34 includes the following:

- Section 34.3.46 provides a basement definition;
- Section 34.3.47 provides a rationale for the construction of basements to add extra accommodation and the need for a policy to provide appropriate rules.
- Section 34.3.48 provides a rationale to restrict basement size to reduce construction impacts to neighbours, which have been heightened due to significant rise in basement applications between 2010 and 2012;
- Section 34.3.49 states the high impact of basement construction on neighbours.
- Section 34.3.50 provides a rationale for the Council to consider that careful control is required over the scale, form and extent of basements.
- Section 34.3.51 states that this policy restricts the extent of basement exaction under gardens to no more than half the garden and depth of excavation to a single storey in most cases. The extent will be measured as gross external area (GEA).
- Section 34.3.52 states how restricting the size of basements will help to protect residential living conditions in the Borough, including the health and well-being of residents.
- Section 34.3.53 states how embodied carbon[3] in basements is almost three times the amount of embodied carbon in an above ground development per square metre due to the extensive use of concrete and steel.
- Section 34.3.54 states that at least half of a garden should remain basement-free to enable flexibility in planting, including major trees. This will also allow water to drain through to the Upper Aquifer. The section also sites London Plan, the Mayor of London's Housing SPG, and the National Planning Policy Framework as guidance for the Borough's proposed policy.
- Section 34.3.55 states that the unexcavated area of the garden should be a single area, adjacent to similar areas in other plots, allowing for better drainage and planting.
- Section 34.3.56 states that basements should be limited to a single storey to avoid greater structural risks and complexities.
- Section 34.3.57 provides a definition for a 'single storey' and includes some allowances for swimming pools.
- Section 34.3.58 states that greater coverage and depth may be allowed for larger comprehensively planned sites.
- Section 34.3.59 states that basement developments will be reduced to a single "one-off" scheme.

- Section 34.3.60 states that a full tree survey and tree protection proposal for the construction phase must accompany developments which are likely to impact either on-site or nearby trees.
- Section 34.3.61 states that the significance of heritage assets needs to be identified so that it is not harmed.
- Section 34.3.62 states that the special architectural or historic interest of listed buildings goes beyond appearance and includes the hierarchy of the historic floor levels. Therefore basements under listed buildings are resisted by the policy
- Section 34.3.63 states that foundations are part of the historic integrity of a listed building. Therefore basements under gardens of listed buildings are resisted by this policy unless the basement can be built without large modifications to the foundations.
- Section 34.3.64 states that basements should preserve or enhance the character of the conservation area. Externally visible elements such as light wells and railings have a bearing on the character.
- Section 34.3.65 states that archaeological remains must not be threatened by a development, either directly or indirectly.
- Section 34.3.66 states that impact of basements on non-designated heritage assets must be assessed on their merits to avoid any harm to their significance.
- Section 34.3.67 states that the visual impact from visible elements must be minimised. Light pollution to neighbours should be avoided. Externally visible elements should not be allowed in areas where they are not already an acceptable feature of the local streetscape.
- Section 34.3.68 states that Policy CE 2 of the Core Strategy requires surface water run-off to be managed as close to its source as possible. A minimum of one metre of suitably drained permeable soil above any basement is noted to be beneficial for both drainage and for plants. Other SUDS measures may also be required.
- Section 34.3.69 notes that carbon emissions for basement developments are greater than above ground developments. A BREEAM methodology is used as a proxy across the whole dwelling or commercial development to the which the basement relates. For residential developments, the standard is BREEAM Domestic Refurbishment “very good” including a minimum standard of “excellent” in the energy section and a minimum of 80% credits in the waste category. For non-residential developments, the standard is BREEAM “very good”.
- Section 34.3.70 states that construction related nuisances (traffic, noise, dust, and vibration) should be kept to acceptable levels taking the cumulative impacts of other developments in account.
- Section 34.3.71 states that the ground and hydrological conditions must be thoroughly investigated. The developer must demonstrate that the works can be carried out whilst safeguarding structural integrity. Minimising damage means limiting damage to an adjoining building to Category 1.
- Section 34.3.72 states that all basements should be fitted with a ‘positive pumped device’ or technological equivalent. In addition, a ‘non-return valve’ is not acceptable.

- Section 34.3.73 states that applicants are strongly advised to discuss proposals with neighbours and others affected, commence party wall negotiations, and discuss with the Council before a planning application submittal. This includes discussion of traffic plans.

C2 Proposed Policy

The proposed basement policy will become Policy CL7 of the Core Strategy. The policy is stated exactly as follows:

All basements must be designed, constructed and completed to the highest standard and quality.

Basement development should:

a. not exceed a maximum of 50% of each garden. The unaffected garden must be in a single area and where relevant should form a continuous area with other neighbouring gardens. Exceptions may be made on large comprehensively planned sites;

b. not comprise more than one storey. Exceptions may be made on large comprehensively planned sites;

c. not be built under an existing basement;

d. not cause loss, damage or long term threat to trees of townscape or amenity value;

e. not cause harm to the significance of heritage assets;

f. not involve excavation underneath a listed building (including pavement vaults) or any garden of a listed building, except for gardens on large sites where the basement would not involve extensive modification to the foundation of the listed building by being substantially separate from the listed building;

g. not introduce light wells and railings to the front or side of the property unless they are already an established and positive feature of the local streetscape;

h. maintain and take opportunities to improve the character or appearance of the building, garden or wider area, with external elements such as light wells, roof lights, plant and means of escape being sensitively designed and discreetly sited;

i. include a sustainable urban drainage scheme (SUDs), including a minimum of one metre of permeable soil above any part of the basement beneath a garden. Where the character of the gardens within an urban block is small paved courtyards SUDs may be provided in other ways;

j. ensure that any new building which includes a basement, and any existing dwelling or commercial property related to a new basement, is adapted to a high level of performance in respect of energy, waste and water to be verified at pre-assessment stage and after construction has been completed;

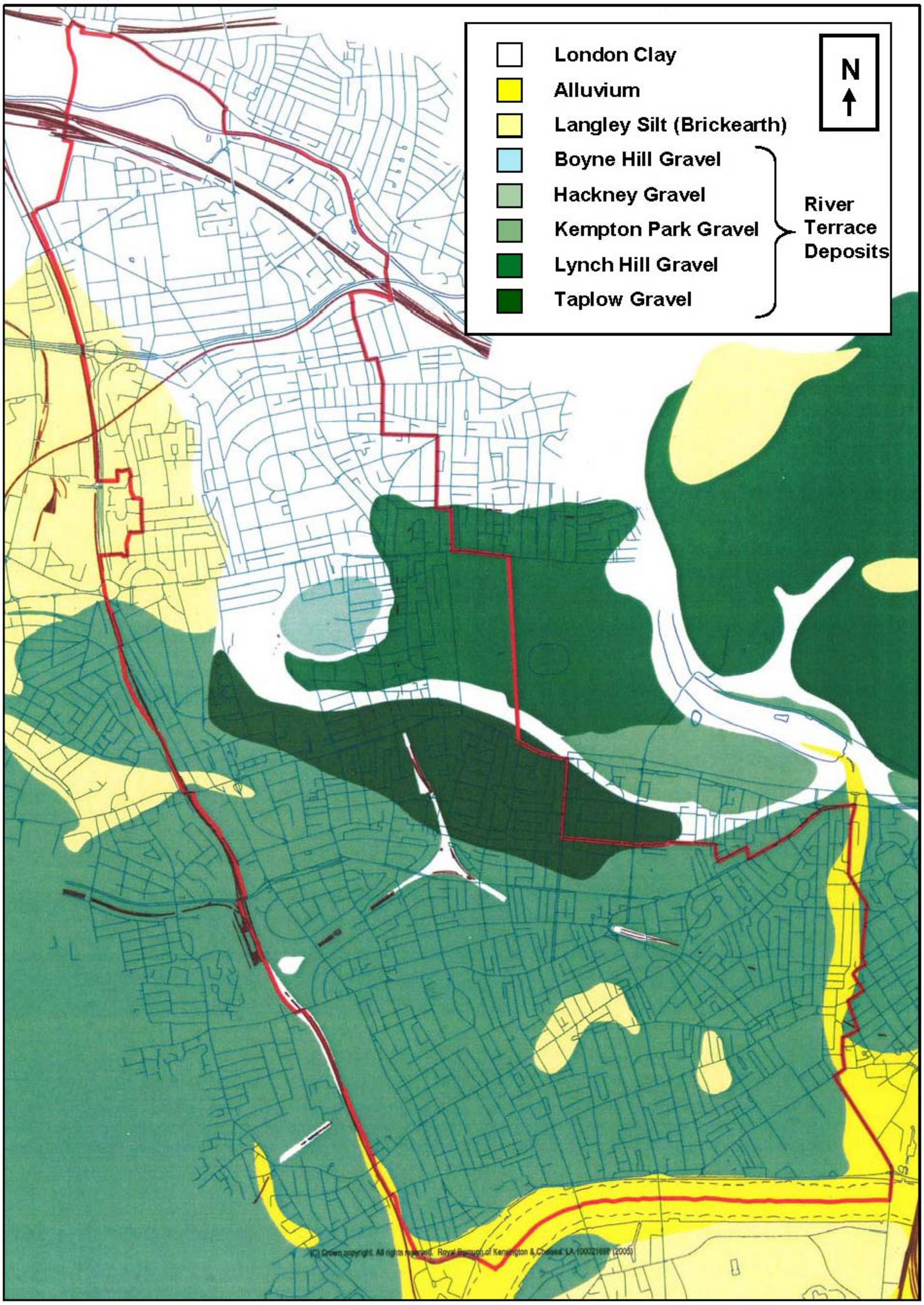
k. ensure that traffic and construction activity does not harm pedestrian, cycle, vehicular and road safety, affect bus or other transport operations (e.g. cycle hire), significantly increase traffic congestion, nor place unreasonable inconvenience on the day to day life of those living, working and visiting nearby;

l. ensure that construction impacts such as noise, vibration and dust are kept to acceptable levels for the duration of the works;

m. be designed to minimise damage to and safeguard the structural stability of the application building, nearby buildings and other infrastructure including London Underground tunnels and the highway;

n. be protected from sewer flooding through the installation of a suitable pumped device.

A specific policy requirement for basements is also contained in Policy CE2, Flooding.



Map produced by the Royal Borough of Kensington and Chelsea Planning Services Department using GGP 13/11/2006

NOT TO SCALE
ORIGINAL SCALE 1:25,000

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Issue	Date	By	Chkd	Appd
draft	250413	MC	GC	PM

Client: Force Foundations Ltd.

Job Title: Royal Borough of Kensington and Chelsea Basement Policy

Drawing Title: SHALLOW SOIL STRATA WHICH UNDERLIE GROUND SURFACE

Scale at A3

Plot ID

Drawing Status: ISSUE

Job No	Drawing No	Issue
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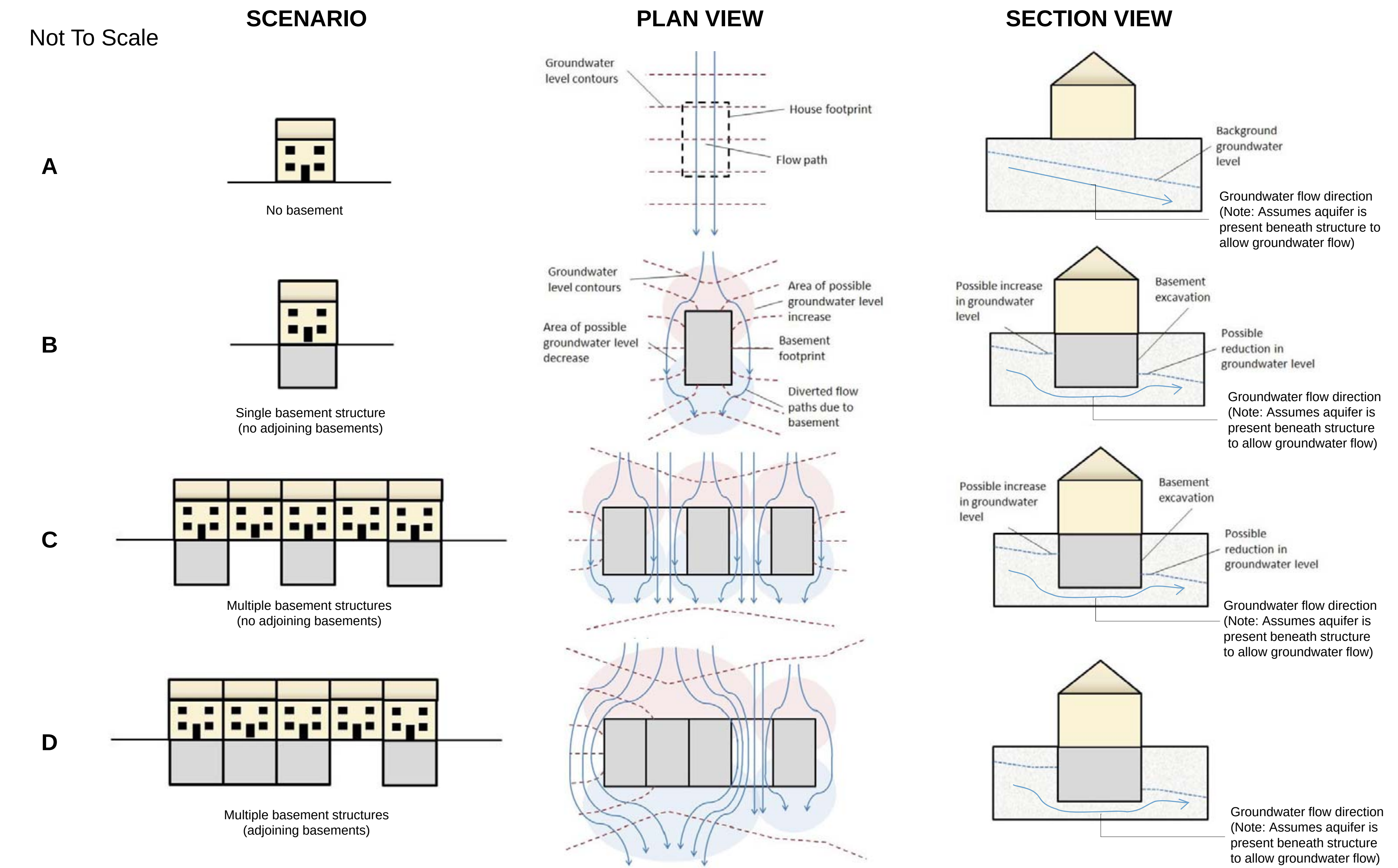

Adapted from Figure 23, Arup (2008). Camden geological, hydrogeological and hydrological study, Guidance for Subterranean development. Dated 18 November 2010.

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Issue	Date	By	Chkd	Appd
draft	130424	ER	SD	MD

Client: Force Foundations Ltd.

Job Title: Royal Borough of Kensington and Chelsea Basement Policy

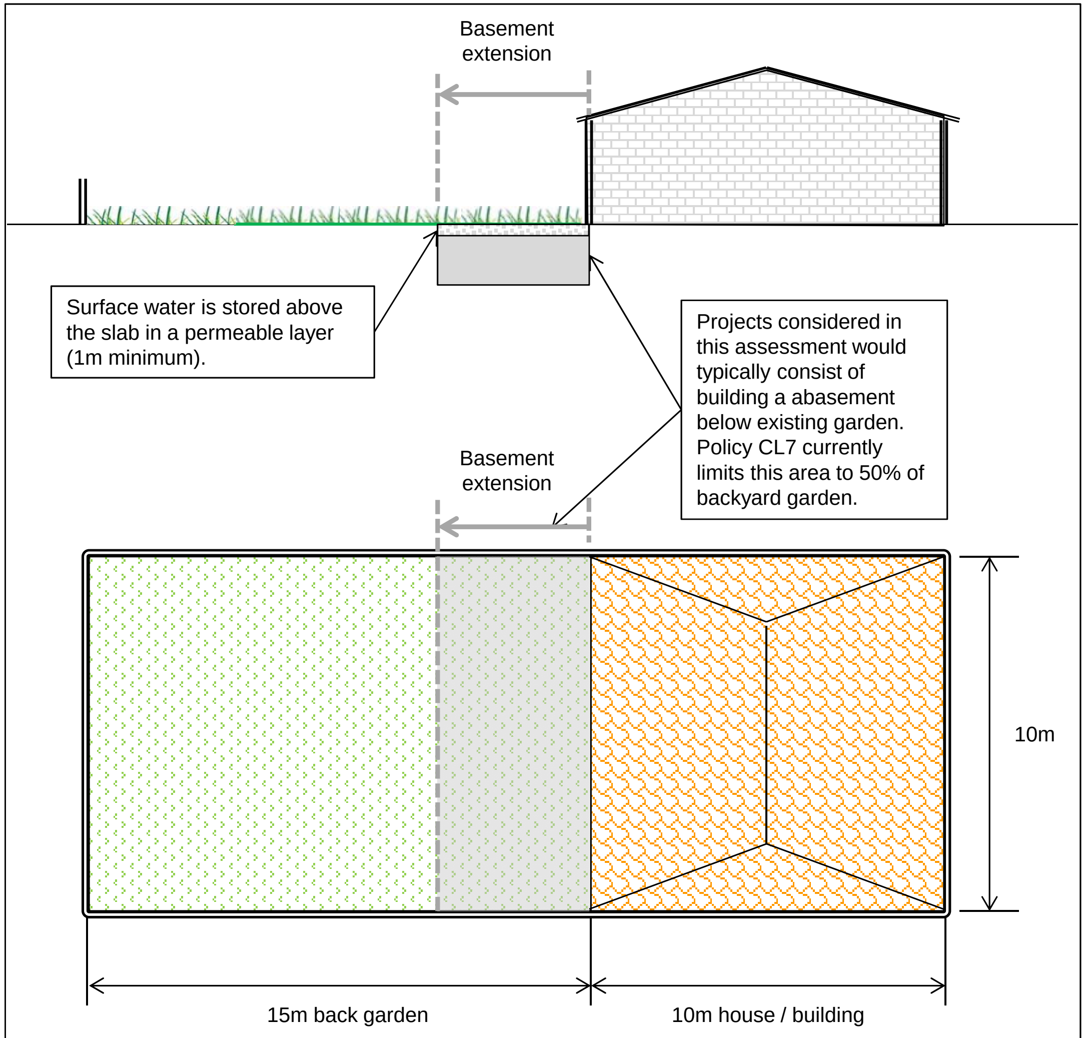
Drawing Title: ILLUSTRATED EFFECTS OF BASEMENTS ON GROUNDWATER FLOW

Scale at A3: NTS

Plot ID

Drawing Status: ISSUE

Job No	Drawing No	Issue
215579	Figure 2	1



TYPICAL DIMENSIONS OF PLOT AND INTERVENTION

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Issue	Date	By	Chkd	Appd
draft	130424	ER	SD	MD

Client: Force Foundations Ltd.

Job Title: Royal Borough of Kensington and Chelsea Basement Policy

Drawing Title: TYPICAL SITE DESCRIPTION

Scale at A3: NTS

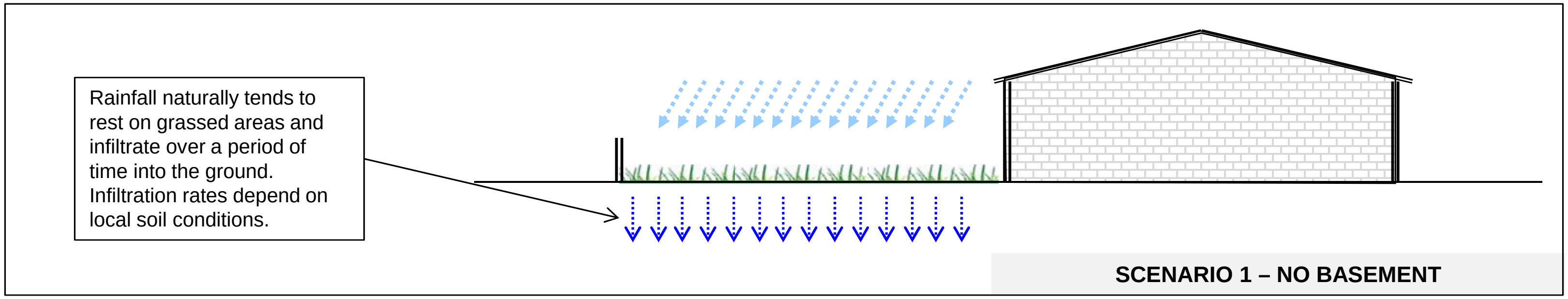
Plot ID

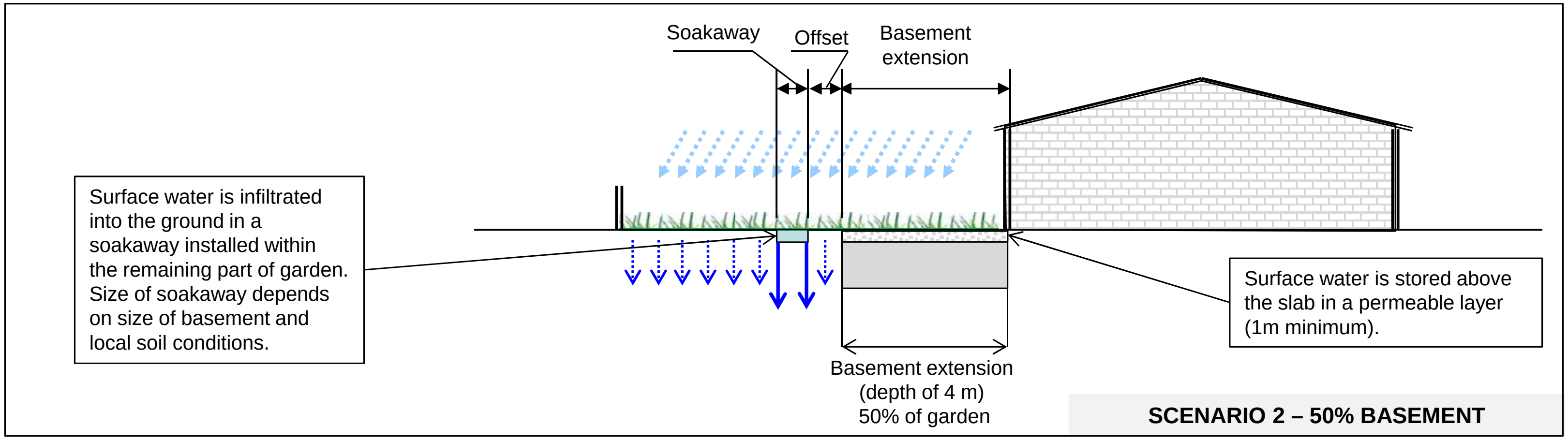
Drawing Status: ISSUE

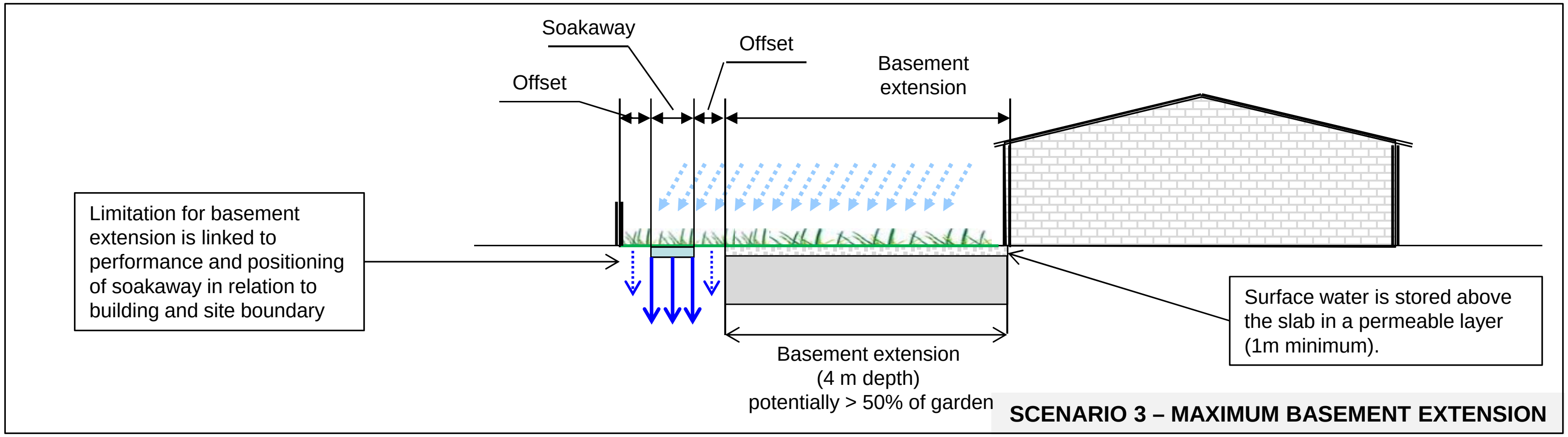
Job No: 215579

Drawing No: Figure 3

Issue: 1







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Issue	Date	By	Chkd	Appd
draft	130424	ER	SD	MD

Client: Force Foundations Ltd.

Job Title: Royal Borough of Kensington and Chelsea Basement Policy

Drawing Title: EXAMPLE STORMWATER MANAGEMENT STRATEGY

Scale at A3: NTS

Plot ID

Drawing Status: ISSUE

Job No: 215579 | Drawing No: Figure 4 | Issue: 1