BETTS HYDRO
CONSULTING ENGINEERS

NO.128-132 GRAFTON ROAD
LONDON

FLOOD RISK ASSESSMENT

For

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EXECUTIVE SUMMARY

This Flood Risk Assessment has been prepared to support a planning application for the residential development on an existing brownfield site off Grafton Road in London. The site is located within Flood Zone 1 and considered to be at low flood risk from fluvial and tidal flood sources based on the Environment Agency Flood Mapping. The proposals are residential in nature and classified as more vulnerable. Planning Practice Guidance confirms that 'more vulnerable' development is suitable to be located within Flood Zone 1 providing there is no increased flood risk elsewhere as a result of the proposals. Consultations with the Environment Agency, Thames Water and the London Borough of Camden have been undertaken as part of this assessment and have confirmed there are no records of historical flooding at the proposed development site. Review of the available flood mapping and publications including the London Borough of Camden's Strategic Flood Risk Assessment has been carried out as part of this assessment.

This assessment has not identified any significant flood risks to the development site from the sources reviewed including fluvial, tidal, surface water, overland flow, groundwater, reservoirs, canals or the sewer network. The potential flood risks identified to neighbouring areas are either from residual sources or can be sufficiently catered for through implementation of the mitigation measures proposed as part of this assessment. The mitigation measures proposed as part of this assessment have been noted in full in Section 4.7. To summarise these are to ensure appropriate levels design takes place to allow overland flows to continue as they would at present without increasing flood risk to the newly proposed building and basement. Appropriate resilience measures should be put in place for the basement level to ensure that during exceedance events run-off from the ground floor levels cannot direct into the low-level terraces and cause a flood risk.

It is also advised that an appropriate surface water management regime to be incorporated onsite to ensure that the proposals do not increase flood risks elsewhere. In accordance with national and local policy, the surface water run-off options have been assessed in compliance with the sustainable drainage hierarchy. Based on the information published online, infiltration is not considered to be a feasible surface water management option due to the cohesive underlying ground conditions.

The alternative option as there are no watercourses in proximity of site, is to mimic the existing surface water management regime onsite and discharge surface water flows to the public sewer network. further investigation is recommended to ascertain the location and condition of the existing drainage infrastructure serving the site. The proposals will be to offer betterment on the existing brownfield situation where practical and detailed drainage design will be required to confirm the strategy. Formal consents for works to the public sewer network will be required from TW and early discussion is recommended.

This Flood Risk Assessment has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The report is commensurate with the scale and nature of the development proposals and in summary, the development can be considered appropriate in accordance with the Planning Practice Guidance.

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Figures & Tables

Specialist Software

- Flood Estimation Handbook FEH CD-ROM (v.3.0) – Determination of Catchment Descriptors and depths of rainfall.

Abbreviations & Acronyms

AEP	Annual Exceedance Probability
BGL	Below Ground Level
BGS	British Geological Survey
CC	Climate Change
CRT	Canal and River Trust
CSAI	Cranfield Soil and Agrifood Institute
EA	Environment Agency
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
LBCAM	The London Borough or Camden
mAOD	Metres Above Ordnance Datum
NGR	National Grid Reference
NPPF	National Planning Policy Framework
NSRI	National Soil Resources Institute
OS	Ordnance Survey
PPG	Planning Practice Guidance
QSE	Quick Storage Estimate
QBAR	Mean Annual Flood
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Urban Drainage Systems
TW	Thames Water
TWL	Top Water Level

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1.0 INTRODUCTION

1.1 Planning Policy Context

1.1.1 All forms of flooding and their impact on the natural and built environment are material planning considerations. The National Planning Policy Framework (NPPF) sets out the Government's objectives for the planning system, and how planning should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change. Government policy with respect to development in flood risk areas is contained within the NPPF and the supporting Planning Practice Guidance (PPG) (refer to extracts in Appendix A).

1.1.2 The London Borough of Camden have their own planning guidance document that details the policy and requirements for supporting new development, consisting of basement proposals through the planning process. The specific guidance document is referred to as 'Basements and Lightwells Planning Guidance Document – CPG4'. This document has been appended with other Local Planning Authority correspondence.

1.1.3 For new development including basements within the London Borough of Camden there is a requirement for a Basement Impact Assessment to be undertaken, a small aspect of this relates to the potential hydrological and surface water flow implications of new development. A Screening and Scoping assessment has already been carried out prior to this Flood Risk Assessment by Kaya Consulting (dated 14th September 2017), this determined that a full Flood Risk Assessment would be required to support the planning application and the separate Basement Impact Assessment (being completed by others). This FRA has therefore been completed to support the proposals through the planning application.

1.1.4 A Flood Risk Assessment and Drainage Management Strategy (FRA&DMS) has been completed in accordance with NPPF/PPG to review all sources of flood risk both to and from the proposed development. The report also considers the most appropriate drainage options including the implementation of Sustainable Drainage Systems (SuDS) in line with national policy.

1.1.5 The proposals are solely 'residential' in nature and as such is classified as 'more vulnerable' in Table 2: Flood Risk Vulnerability Classification, within the Planning Practice Guidance. The PPG confirms that this type of land-use is appropriate for Flood Zone 1, providing there is no increase in flood risk elsewhere.

1.2 Site Context

1.2.1 This FRA&DMS has been prepared to support an application for residential development on an existing brownfield site off Grafton Road in London. The development proposals are for the demolition of the existing 2-storey commercially occupied building and the construction of a 6-storey residential building (including basement).

1.2.2 The site is located within 1km of the nearest identified watercourse, this and all other potential sources of flood risk will be considered within this assessment including the potential risk from fluvial and surface water flooding associated with these sources.

1.3 Consultation

1.3.1 The preparation of this report has been undertaken in consultations with the following interested parties; the Environment Agency (EA), Thames Water (TW) and The London Borough of Camden (LBCAM). Consultation responses can be seen in Appendix B, C and D respectively. The NPPF advises that the BC should consult with the EA who will provide advice and guidance on flood issues at a strategic level and in relation to planning applications.

2.0 SITE LOCATION

2.1 Location

2.1.1 The development site is located off Grafton Road in Camden, London. The Ordnance Survey National Grid Reference (OS NGR) for the site is E: 528476, N: 185062 and the nearest postcode is NW5 4BA (see location plan in Appendix E). The total site covers 260sq.m and is edged in red in Figure 1. The site currently compromises of a two-storey commercial building located off Grafton Road (Nos. 128-130). To the west of site is a single storey commercial building and to the east is a three-storey residential dwelling. These properties back onto Spring Place as illustrated in Figure 1.

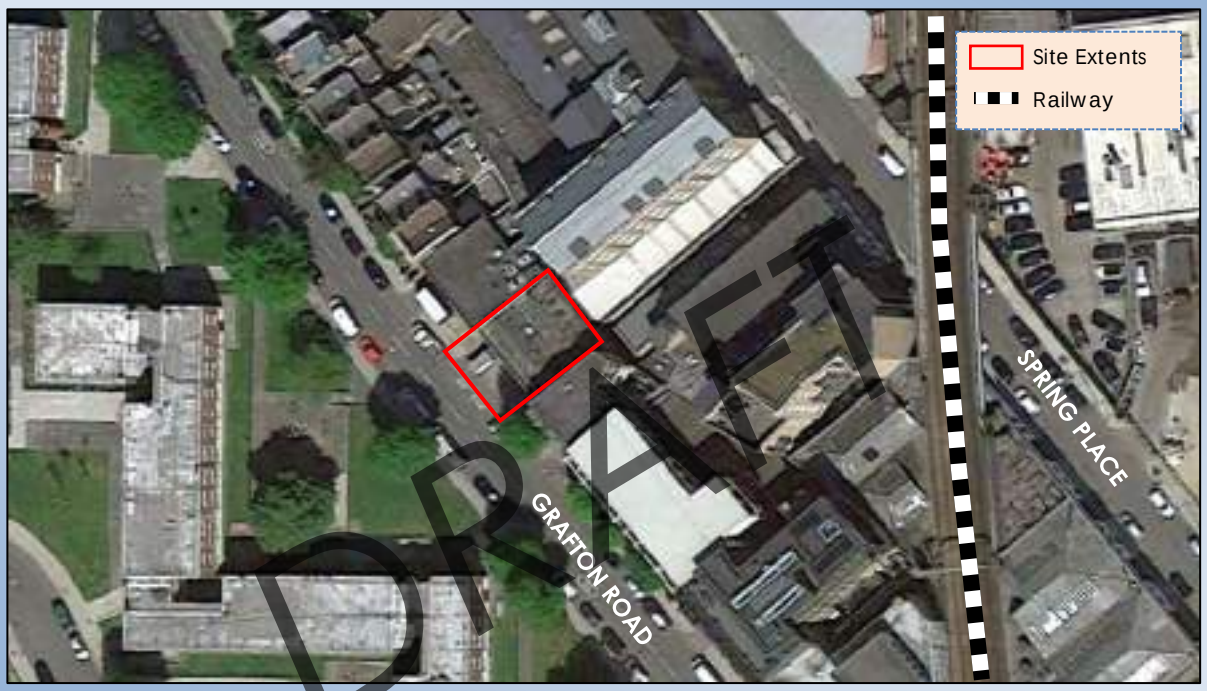

Figure 1: Aerial Photograph of Site (Google Maps, 2019)

2.2 Existing and Historical Land Use

2.2.1 This assessment has concluded that the site is brownfield at present and used for commercial purposes. The site is located within Kentish Town approximately 200m to the north of Talacre Gardens. Historically this area is thought to have been developed for commercial/industrial purposes, given its close links to the railway to the east. No other historical uses have been identified as part of this assessment.

3.0 DEVELOPMENT PROPOSALS

3.1 Nature of the development

3.1.1 This assessment is to support a planning application for the change of use of an existing commercial development. The proposals are for the demolition of the existing building and erection of a 6-storey building (including basement) comprising of 9 self-contained flats, as illustrated in Figure 2a. The proposals will be complete with terraces with vertical gardens at the rear and front of the building create private outdoor spaces.

Figure 2a: Street Scene Illustration (Joseph Boniface Architects Ltd, 2019)

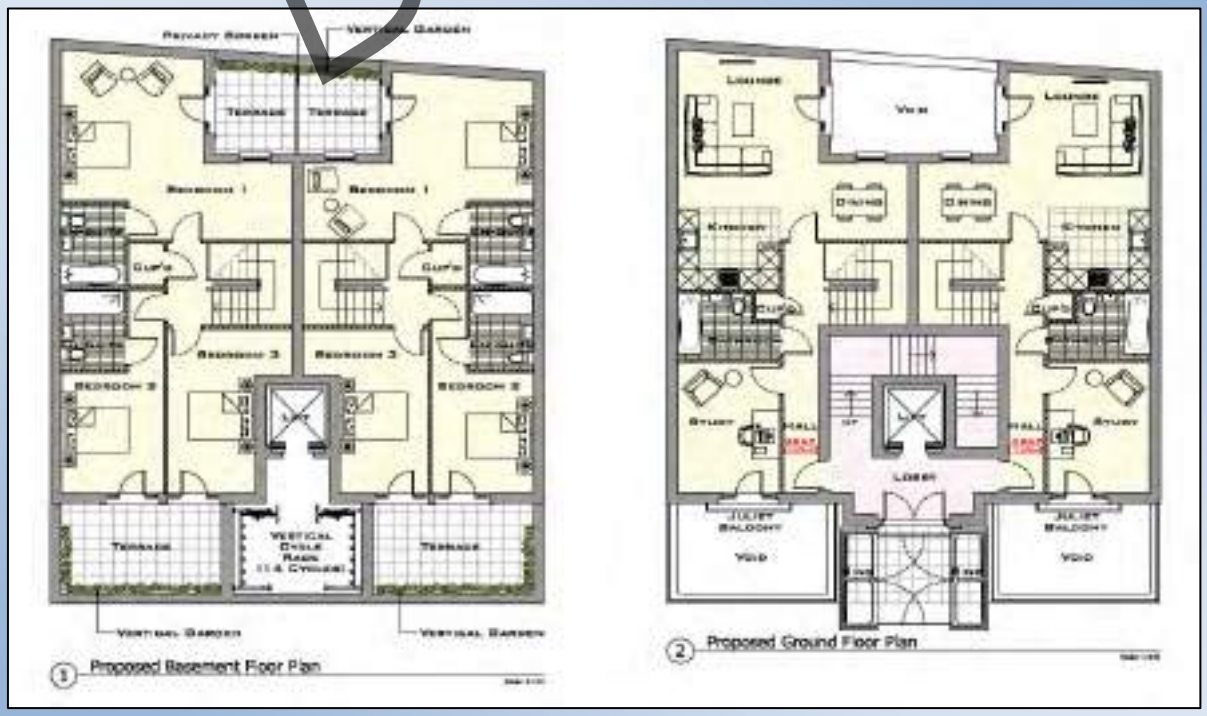

Figure 2b: Internal Site Layouts (Joseph Boniface Architects Ltd, 2019)

3.1.2 The development proposals are for the construction of a 6-storey building which includes a new basement level to accommodate 9no. mew self-contained apartments (Appendix F for full plans). The basement and ground floor will consist of 2no. maisonette 3-bedroomed flats, as illustrated in Figure 2b. The first, second and third floors will have 2no. 2-bedroomed flats, with the final (fourth) floor will have a penthouse, 3-bedroomed apartment with private amenity space. The proposals will occupy the entire site extents and there will be no external communal landscaping areas, each flat will have their own individual amenity area either paved terrace (basement and penthouse levels) or balconies.

3.1.3 The total site covers 260sq.m, is currently developed and therefore 100% impermeable. Due to the nature and scale of the development, the impermeable areas of the site will remain like the existing. As the existing site currently has a formal surface water drainage regime present to manage run-off generated the proposal would be to mimic the existing situation where practical and manage surface water run-off to ensure no increase in surface water flood risk will result from the development. A surface water management strategy has been developed and is discussed in Section 5.0 of this assessment.

4.0 SOURCES OF FLOOD RISK

4.1 Fluvial and Tidal Flood Risk

4.1.1 Information relating to flood risk at the site has been obtained from the Environment Agency and from the Gov.uk website. An extract of the EA's Flood Zone Map for Planning is shown in Figure 3, which illustrates that the site is located solely within Flood Zone 1. Flood Zone 1 is an area at little or no flood risk from rivers and/or the sea, as defined by the EA.

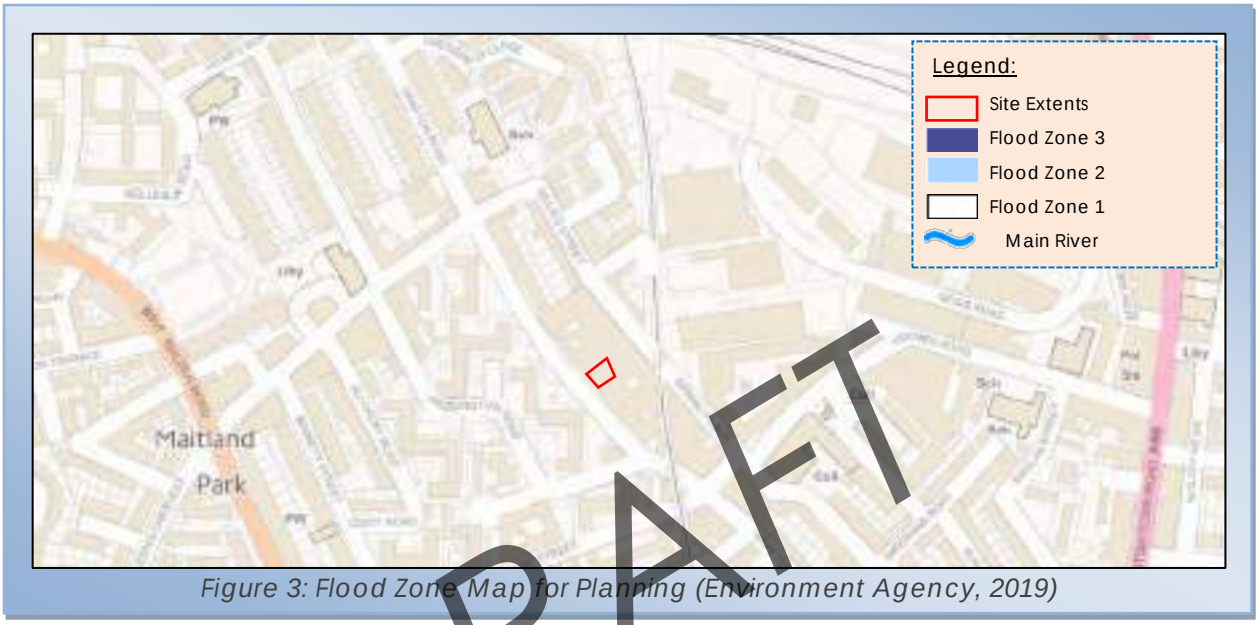

Figure 3: Flood Zone Map for Planning (Environment Agency, 2019)

4.1.2 The nearest Main River to the site is the River Thames located 5km to the south-east of site, the other Main Rivers are the River Brent located 8.5km to the west of the site and the River Lea, 9km to the east. The flood risk to site associated with the Main River network is considered to be very low, as represented on the available flood mapping. This low flood risk is due to a combination of factors including the distance between site and the watercourses, the catchment characteristics and the natural/man-made conveyance routes away from the site location.

4.1.3 Other than the Main River network the London Borough of Camden has limited fluvial features, records state that the during the 19th Century many of the natural watercourse located within London were lost from the natural landscape and either culverted beneath the urban development or diverted. Some research has been carried out as part of this assessment to consider based on the available mapping where the nearest 'lost rivers' might be located.

4.1.4 Recent mapping has identified the predicted routes that historically London's Lost Rivers might have taken, this mapping has been overlaid with the site location to estimate the location of the nearest lost watercourse. Figure 4 confirms the site is located between two tributaries of the River Fleet which historically flowed from the Hampstead Heath inland waterbodies to the north of the site, in a southerly direction through Camden Town and Clerkenwell to outfall into the River Thames over 5km from the site.

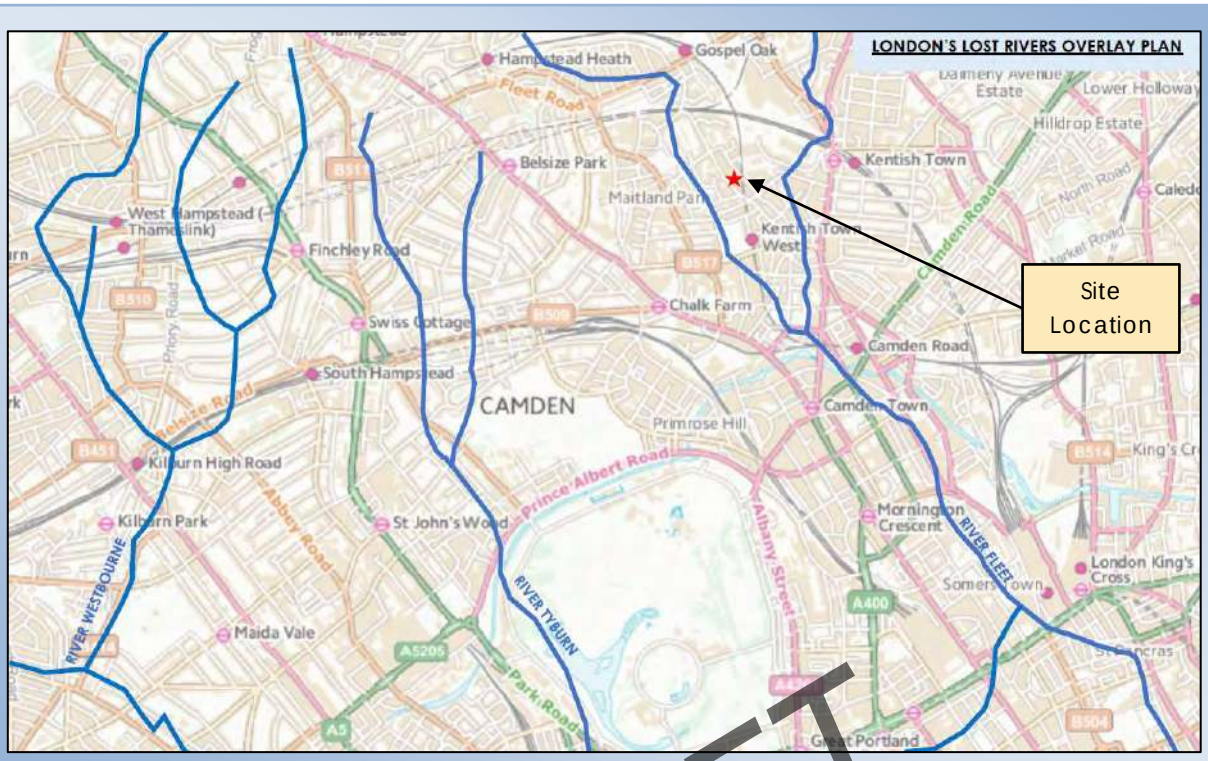

Figure 4: Historic River Route Overlay Map (Betts Hydro, 2019)

4.1.5 Although the River Fleet historically conveyed flows from the upstream reservoirs in Heampstead Heath to the River Thames, this network has now been culverted and forms one of the largest underground networks within the London boroughs. The River Fleet was incorporated into the Fleet Trunk Sewer managed and maintained by Thames Water Utilities Ltd. (TWUL) as confirmed in the London Borough of Camden's Strategic Flood Risk Assessment (SFRA). The SFRA confirms that the nearest culverted network runs south approximately 200m to the east of the site. the risk to the site from fluvial sources is concluded to be very low as identified in the SFRA and supporting EA flood risk mapping.

4.2 Tidal Flood Risk

4.2.1 The Coastline and Thames Estuary are located over 60km east of the development site. Due to the distance from the coast, the associated tidal flood risk is 'very low'. This is supported by the Environment Agency's Flood Zone Map for Planning which shows the site to be located within Flood Zone 1 and is therefore at no tidal flood risk (Figure 3).

4.3 Surface Water Flood Risk

4.3.1 Surface water flooding occurs when rainwater is unable to drain away through the normal drainage systems or soak into the ground but lies on or flows over the ground instead. The risk associated with surface water run-off is indicated by the long-term flood mapping (extract shown in Figure 5). The site is shown to be at 'very low' risk from surface water flooding, as illustrated in Figure 5. Grafton Road (adjacent to site) is however shown to be at 'low' to 'medium' risk.

4.3.2 In terms of the potential depths of flooding along Grafton Road, these potentially range up to 300mm along the stretch of highway directly adjacent to the site. The predicted velocities are shown to be less than 0.25m/s, based on the long-term government mapping. It is important that appropriate levels design be carried out at the interface of the development and Grafton Road to ensure no increased surface water flood risks result to the site or to others.

Figure 5: Surface Water Flood Map Extract (GOV.UK, 2019)

4.3.3 The London Borough of Camden's Strategic Flood Risk Assessment (SFRA), has been reviewed and this confirms what is shown in the EA's surface water flood risk mapping. The site remains flood free in the key rainfall events and Grafton Road is shown to be susceptible to surface water flooding in the low risk event (1 in 1000yr) and medium risk event (1 in 100yr).

4.3.4 In order to mitigate any potential for surface water flood risks to increase as a result of the development, it is advised that an appropriate formal surface water management regime to be incorporated onsite. It is also advised that finished ground floor levels are raised above the external levels (following any re-grade of the site) to provide safe overland flood routes for excess surface water run-off should exceedance of the drainage infrastructure occur.

4.3.5 As the proposals include for a new basement level appropriate measures should be incorporated at ground flood level to protect from any overland flows routing into the basement dwellings. This can be achieved by incorporating low level walling at ground floor level, surrounding any exterior voids from ground floor level, down to the basement levels. Low level walls will assist with preventing run-off overland from Grafton Road, directly down to basement level.

4.3.6 The volume and rate of overland flow from land can be exacerbated if development increases the percentage of impermeable area, in the case of the development proposals there will be no increase in impermeable area as a result of the development. Any overland flows generated by the development must be carefully

controlled as the volume and rate of overland flow from land can be exacerbated if development increases the percentage of impermeable area. Safe avenues directing overland flow away from the proposed and existing adjacent development is advised.

Pluvial (Overland run-off) Flood Risk

4.3.7 Intense rainfall that is unable to soak into the ground or enter drainage systems can run-off land and result in flooding. Local topography and the land-use can have a strong influence on the direction and depth of flow. The proposed development site is surrounded by urban development, as such there is little likelihood of pluvial flow impacting the site directly. Any flows directing towards the site area are likely to relate to surface water run-off, particularly overland flows from exceedance in the existing drainage infrastructure serving the impermeable areas.

Sewer Flood Risk

4.3.8 In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water known as 'combined sewers'. Foul water flooding often occurs in areas prone to overland flow and can result when the sewer is overwhelmed by heavy rainfall and will continue until the water drains away. Thames Water records indicate that there have been no incidents of flooding in the site area, as a result of surcharging public sewers (refer to Appendix C for correspondence).

4.4 Groundwater Flood Risk

4.4.1 High groundwater levels are usually the key source of groundwater flooding, which occurs when excess water emerges at the grounds surface (or within manmade underground structures such as basements). Groundwater flooding is often more insistent than surface water flooding and would typically last for weeks/months rather than days meaning the result to property is often more severe.

4.4.2 In general terms groundwater flooding can occur from three main sources:

- If groundwater levels are naturally close to the surface, then this can present a flood risk during times of intense rainfall. No groundwater flood risks have however been identified during consultation with the various interested parties nor following review of The London Borough of Camden key Flood Risk Publications.
- Seepage and percolation occur where embankments above ground level hold water. In these cases, water travels through the embankment material and emerges on the opposite side of the embankment. At present there are no reported problems with groundwater flooding.
- Groundwater recovery / rebound occurs where the water table has been artificially depressed by abstraction. When the abstraction stops the water, table makes a recovery to its original level. There is the potential for groundwater flooding in low lying areas where groundwater levels have been depressed below their pre-pumping conditions, where these were at or close to ground level. As with the seepage scenario the likelihood of flooding from this source is low.

4.4.3 The London Borough of Camden's Strategic Flood Risk Assessment does not suggest that the site is susceptible to groundwater related flooding. The mapping within the SFRA indicates the location of recorded incidents of groundwater flooding, however, the SFRA report considers the available records only and is not particularly

comprehensive or reliable. The SFRA shows the nearest recorded groundwater flooding occurred over 800m to the north-west of the site, no historical groundwater flooding of the site has been identified within the SFRA or as part of consultations with the various interested parties.

4.4.4 Although the site is not susceptible to groundwater flooding based on the information reviewed, the proposals are for a new basement level. Where at all feasible the proposed basement level would be raised above the natural water table level, in the event where groundwater flooding is experienced during the construction of the basement level, then appropriate mitigation techniques including cavity drainage should be implemented.

4.5 Artificial Sources of Flood Risk

4.5.1 National policy states that an FRA should consider the potential risks from a variety of other flood sources including artificial sources (such as risks from reservoirs and canals).

Reservoirs

4.5.2 The EA recognises reservoirs as bodies of water over 25,000cu.m and the long-term flood mapping is included in Appendix B, which shows the extent of flooding associated with reservoirs does not impact the site or the neighbouring areas (Figure 6). The flood risk associated with reservoirs to the proposals would therefore be low. There are no other waterbodies (ponds/lakes) nearer to site which would pose a potential flood risk.

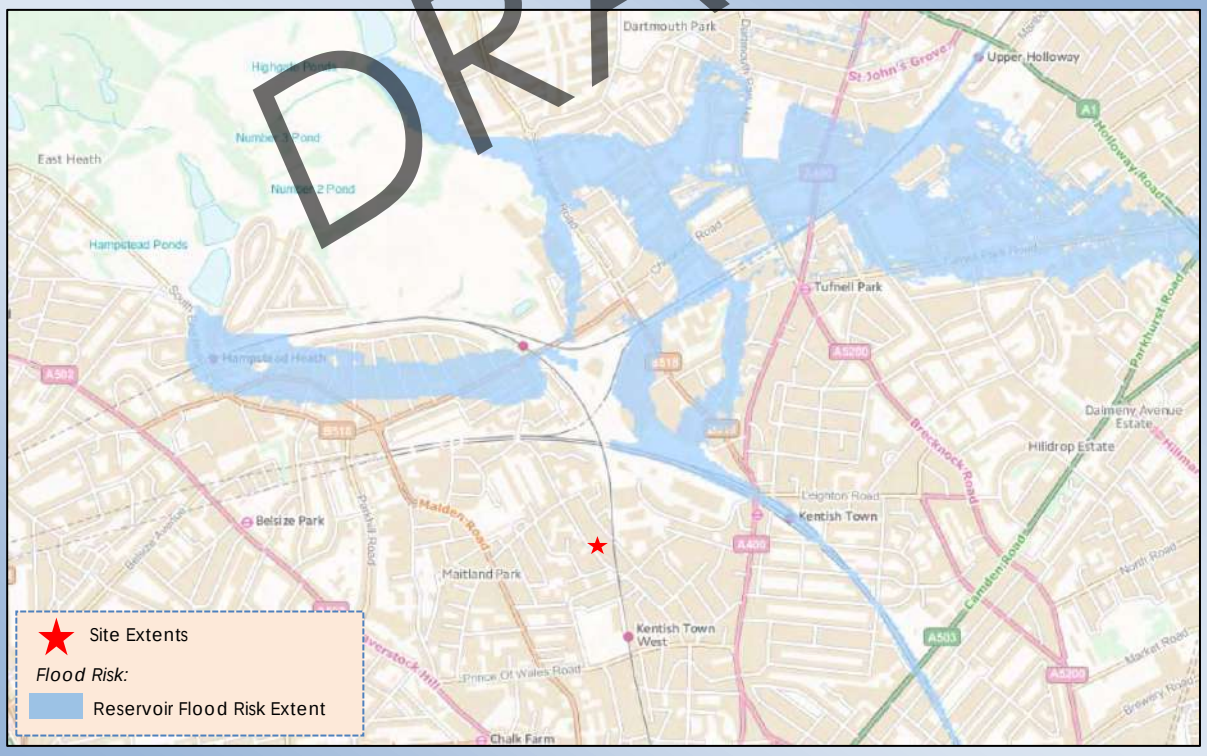

Figure 6: Flood Risk Extent Associated with Reservoirs (GOV.UK, 2019)

4.5.3 The London Borough of Camden's Strategic Flood Risk Assessment identifies that the nearest reservoirs to be within Hampstead Heath, over 1.5km to the north-west of the

site. Three of these large ponds within Hampstead Heath are raised reservoirs, under the Reservoirs Act 1975.

4.5.4 The Hampstead Heath Ponds Project was initiated in 2012, the SFRA notes that this project is currently being implemented and once completed will reduce the potential flood risk from failure in one of these major bodies of water. The Hampstead Ponds connect to the sewer network downstream and routing inspection and maintenance is carried out when necessary. The City of London Corporation has also developed a onsite emergency response plan associated with failure of one of the Hampstead Heath Ponds, thus the vulnerability to this residual risk is reduced further.

Canals

4.5.5 The nearest canal to site is the Regents Canal located 950m to the south off site. The canal contains a significant number of Locks within the borough and flows through highly urban areas of London. The canal is well-managed and maintained by its asset manager (Canals and Rivers Trust). The SFRA identifies that CR&T have set standards and documentations for asset inspection, these procedures ensure that all canal assets are managed appropriately.

4.5.6 The SFRA identifies that the Regents Canal is controlled by a series of locks and gates, this allows flood risk to be managed more effectively. No historical flooding has been identified near to the development site as a result of canal failure. Given the topographical differences between the site and the canal and its proximity from the site the associated flood risks are low, this is confirmed in the SFRA.

4.6 Historical and Anecdotal Flooding Information

4.6.1 An internet-based search for flooding did not identify any historical flooding directly to site, however historical flood events have been identified to the wider Camden Borough. Review of the London Borough of Camden's Strategic and Preliminary Flood Risk Assessments have been carried out, these publications have identified there have been no recorded floods in the Camden Borough since 2002 (extracts in Appendix I).

4.6.2 Consultations have been undertaken with the Environment Agency, Thames Water and The London Borough or Camden Council. These consultations have not been able to identify any historical flood risk to the development site or the wider Camden area (see correspondence is in Appendix B, C and D respectively).

4.7 Flood Risk Mitigation Measures & Residual Risks

4.7.1 The site is located within Flood Zone 1 and considered to be at little risk of fluvial/tidal flooding. To observe a conservative approach, however mitigation measures have been proposed below to safeguard the development with regards to other potential sources of flood risk. These mitigation measures also consider the uncertainties of climate change in accordance with the revised NPPF (2018) and the PPG.

Mitigation Measures

4.7.2 Any overland flows generated by the development must be carefully controlled. Safe avenues directing overland flow way from any existing and proposed buildings are

advised. It is also advised that finished ground floor levels are raised above the external levels (following any re-grade of the site) to provide safe overland flood routes for excess surface water run-off should exceedance of the drainage infrastructure occur.

4.7.3 As the proposals include for a new basement level appropriate measures should be incorporated at ground flood level to protect from any overland flows routing into the basement dwellings. This can be achieved by incorporating low level walling at ground floor level, surrounding any exterior voids from ground floor level, down to the basement levels. Low level walls will assist with preventing run-off overland from Grafton Road, directly down to basement level.

4.7.4 Although the site is not susceptible to groundwater flooding based on the information reviewed, the proposals are for a new basement level. Where at all feasible the proposed basement level would be raised above the natural water table level, in the event where groundwater flooding is experienced during the construction of the basement level, then appropriate mitigation techniques including cavity drainage should be implemented.

4.7.5 In order to mitigate any potential for surface water flood risks to increase as a result of the development, it is advised that an appropriate formal surface water management regime to be incorporated onsite. To minimise the flood risk to the neighbouring properties it is recommended that the surface water run-off generated by the proposals be managed effectively with the peak rates of run-off being restricted to the equivalent of the pre-development situation (with betterment where required).

Residual Risks

4.7.6 If an extreme rainfall event exceeds the design criteria for the drainage system it is likely that there will be some overland flows that are unable to enter the system, it is important that these potential overland flows are catered for within the development site if the capacity of the drainage system is exceeded.

5.0 SURFACE WATER MANAGEMENT

5.1 Pre-Development Surface Water Run-off

5.1.1 The total site covers 260sq.m, the current development on the site consists of an existing building and small amount of external hardstanding to the front. The site is understood to have a positive means of dealing with the surface water run-off currently generated by the roof area and adjacent small hardstanding areas. It is likely that the existing surface run-off discharges to the public sewer network given the cohesive ground conditions in this area and the lack of watercourse in proximity. We have assumed that there will be public sewer infrastructure located within Grafton Road however, further investigation is recommended to ascertain the location and condition of the existing drainage infrastructure serving the site.

5.1.2 As the site is development it is 100% impermeable at present. The peak rates of run-off generated by the existing impermeable areas onsite, have been calculated for the peak events below using the Modified Rational Method, as noted in Table 1 (full details Appendix J).

Brownfield Area	Run-Off Rates			
	1 In 1 Year	1 In 30 Year	1 In 100 Year	50mm/hr
0.026ha	1.4l/s	3.0l/s	4.2l/s	3.6l/s

Table 1: Pre-Development Brownfield Surface Water Run-Off Rates (Betts Hydro, 2019)

5.2 Post Development Surface Water Run-Off

5.2.1 The proposals are to demolish the existing building onsite and construct a new building to a similar footprint extent (albeit greater density), therefore there will be no increase in impermeable areas as a result of the development. The proposals would be to reduce the impermeable nature of any proposed external patio/terrace areas to provide betterment on the existing situation although due to the small areas where pervious surfaces could be incorporated it is likely that the run-off rates generated by the proposed impermeable areas will remain the same as existing.

Impermeable Area	Run-Off Rates			
	1 In 1 Yr	1 In 30 Yr	1 In 100 Yr	1 In 100 Yr + 40%CC
0.026ha	1.4l/s	3.0l/s	4.2l/s	5.8l/s

Table 2: Post-Development Un-Restricted Run-Off Rates (Betts Hydro, 2019)

5.2.2 The unrestricted post-development run-off rates generated by the proposed impermeable areas have been detailed in Table 2 (for comparison with the existing situation in Table 1). The proposals will be to restrict the rate of discharge from the development to mimic a pre-development situation, with betterment where practical. The full drainage strategy is included in the subsequent sections of this chapter.

5.2.3 Due to the scale and nature of the development SuDS are unlikely to be feasible to reduce the volume of run-off generated by the proposed development onsite, there may be the potential to utilised techniques such as rainwater harvesting and waterbutts. Although given the scale and extent of the proposals in relation to the total site there will be limited external areas where SuDS can be used.

5.3 Methods of Surface Water Management

5.3.1 At present the proposed development site covers 260sq.m and is 100% impermeable, the impermeable areas will remain the same post-development. There are three methods that have been reviewed for the management and discharge of surface water. These may be applied individually or collectively to form a complete strategy and should be applied in the order of priority listed below:

- Discharge via infiltration
- Discharge to watercourse
- Discharge to public sewerage system

Discharge via Infiltration

5.3.2 Any impermeable areas that can drain to soakaway or an alternative method of infiltration would significantly improve the sustainability of any surface water systems. Due to the current land-use onsite, infiltration rates at the site have not been confirmed. This section of the report has therefore referred to the published online datasets available.

5.3.3 The Cranfield Soil and AgriFood Institute (CSAI), Soilscapes viewer identifies the soil to be slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils. The British Geology Survey (BGS) published mapping data indicates that the bedrock geology consists of London Clay Formation (clay, silt and sand). Furthermore, the underlying soil factor is also shown to be high (0.47%) suggesting that there would be naturally high rates of run-off generated in these areas due to the lack of availability for natural infiltration.

5.3.4 Based on the ground conditions published online, infiltration is not considered to be a feasible surface water management option for the development proposals, due to the cohesive underlying ground conditions. It is understood that the existing building is already served by formal drainage infrastructure that discharges to the nearby sewer network. The proposals will be to adopt a similar approach for the proposed development and utilise the existing surface water drainage mechanisms serving the site.

Discharge to Watercourse

5.3.5 The next outfall in the sustainable drainage hierarchy should be to discharge to the watercourse, there are however no watercourses within proximity of site which would be practical for a surface water connection from the site. given that the site is already catered for by existing drainage infrastructure and that no changes to the impermeable areas will likely result from the proposal there are no proposals to alter the existing drainage outfall from the site.

Discharge to Sewer Network

5.3.6 Th sustainable drainage hierarchy suggests that discharge to the public sewer network will be acceptable when the more primary options have been investigated. It is likely that the existing surface run-off discharges to the public sewer network given the cohesive ground conditions in this area and the lack of watercourse in proximity. We have assumed that there will be public sewer infrastructure located within Grafton Road however, further investigation is recommended to ascertain the location and condition of the existing drainage infrastructure serving the site.

5.3.7 Given the nature and scale of development proposed, the proposed surface water management regime will mimic the pre-development situation and continue to discharge to the public sewer network. The proposals will be to offer betterment on the existing brownfield situation where practical and detailed drainage design will be required to confirm the strategy. Formal consents for works to the public sewer network will be required from TW and early discussion is recommended.

5.3.8 In accordance with the SuDS Manual (CIRIA) and the Non-Technical Standards for SuDS (March 2015) all sites should endeavour to achieve as close to pre-development greenfield rates as is viable. The guidance however notes that it is not always feasible to restrict a brownfield development to greenfield equivalent and in these cases, it is acceptable to offer betterment on the pre-development brownfield rates as an alternative.

5.3.9 In terms of discharge rates from the proposed development betterment on the existing brownfield rate should be applied is proposed. The betterment should be applied to the most restrictive of either;

- The existing brownfield rate generated by the impermeable areas onsite in the 50mm/hr event.
- Or the capacity/flow through the existing outgoing connection(s) from the site to the point of outfall.

The capacity/conveyance rate within the existing outgoing connection from site is not confirmed at present therefore further investigation is recommended. Given the scale of development and size of the site the rate of run-off generated by the impermeable areas onsite is lower than the minimum restriction rate typically accepted from a design perspective. The rate of discharge from the site to the sewer will therefore likely be restricted to 5l/s.

5.3.10 Restricting the rate of discharge will generate a stormwater storage requirement in the extreme storm events. The stormwater storage figures quoted in Table 3 (Appendix L) are estimates only based on the current proposals and the detailed design will determine with accuracy the stormwater storage requirements following a more detailed review of levels and the proposed layout.

Impermeable Area (ha)	1 In 1 Year	1 In 30 Year	1 In 100 Year + 40% CC
Restricted Run-Off Rate	5l/s	5l/s	5l/s
Estimated Stormwater Storage Volume	0cu.m-0.6cu.m	0.8cu.m-4.1cu.m	5cu.m-10cu.m

Table 3: Estimated Stormwater Storage Requirements (Betts Hydro, 2019)

5.3.11 The proposed onsite surface water drainage system will need to be sized to contain the exceedance from storm events up to and including the 1 in 100yr return period storm event with a 40% allowance for climate change being contained onsite.

6.0 FOUL WATER MANAGEMENT

6.1 The site is understood to have a positive means of dealing with the foul water run-off currently generated by the site. It is likely that the existing foul water discharges to the public sewer network and we have assumed that there is public sewer infrastructure located within Grafton Road. Further investigation is recommended to ascertain the location and condition of the existing drainage infrastructure serving the site.

6.2 The proposals will be to adopt a similar approach for the proposed development and utilise the existing foul water drainage mechanisms serving the site to deal with flows generated by the new dwellings. There will likely be an increase in flows generated given the increase in the no. of units onsite however detailed drainage design will confirm the specific requirement and design. Consents and relevant agreements will be required from TW prior to commencement of works. Early consultation with TW is recommended to identify any additional constraints and if a new connection is required, their preferred point(s) of connection.

7.0 SUMMARY AND CONCLUSIONS

7.1 This Flood Risk Assessment has been prepared to support a planning application for the residential development on an existing brownfield site off Grafton Road in London. The development proposals are for the demolition of the existing 2-storey commercially occupied building and the construction of a 6-storey residential building (including basement). The total site covers 0.026ha and is 100% impermeable at present.

7.2 The site is located within Flood Zone 1 and considered to be at low flood risk from fluvial and tidal flood sources based on the Environment Agency Flood Mapping. The proposals are residential in nature and classified as more vulnerable. Planning Practice Guidance confirms that 'more vulnerable' development is suitable to be located within Flood Zone 1 providing there is no increased flood risk elsewhere as a result of the proposals.

7.3 Consultations with the Environment Agency, Thames Water and the London Borough of Camden have been undertaken as part of this assessment and have confirmed there are no records of historical flooding at the proposed development site. Review of the available flood mapping and publications including the London Borough of Camden's Strategic Flood Risk Assessment has been carried out as part of this assessment.

7.4 This assessment has not identified any significant flood risks to the development site from the sources reviewed including fluvial, tidal, surface water, overland flow, groundwater, reservoirs, canals or the sewer network. The potential flood risks identified to neighbouring areas are either from residual sources or can be sufficiently catered for through implementation of the mitigation measures proposed as part of this assessment.

7.5 The mitigation measures proposed as part of this assessment have been noted in full in Section 4.7. To summarise these are to ensure appropriate levels design takes place to allow overland flows to continue as they would at present without increasing flood risk to the newly proposed building and basement. Appropriate resilience measures should be put in place for the basement level to ensure that during exceedance events run-off from the ground floor levels cannot direct into the low-level terraces and cause a flood risk.

7.6 It is also advised that an appropriate surface water management regime to be incorporated onsite to ensure that the proposals do not increase flood risks elsewhere. In accordance with national and local policy, the surface water run-off options have been assessed in compliance with the sustainable drainage hierarchy. Based on the information published online, infiltration is not considered to be a feasible surface water management option due to the cohesive underlying ground conditions.

7.7 The alternative option as there are no watercourses in proximity of site, is to mimic the existing surface water management regime onsite and discharge surface water flows to the public sewer network. further investigation is recommended to ascertain the location and condition of the existing drainage infrastructure serving the site. Formal

consents for works to the public sewer network will be required from TW and early discussion is recommended.

7.8 The proposals will be to offer betterment on the existing brownfield situation where practical and detailed drainage design will be required to confirm the strategy. The proposed onsite surface water drainage system will need to be sized to contain exceedance from storm events up to and including the 1 in 100yr return period storm event with a 40% allowance for climate change being contained onsite.

7.9 This Flood Risk Assessment has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The report is commensurate with the scale and nature of the development proposals and in summary, the development can be considered appropriate in accordance with the Planning Practice Guidance.

8.0 RECOMMENDATIONS

8.1 Any overland flows generated by the development must be carefully controlled. Safe avenues directing overland flow way from any existing and proposed buildings are advised. It is also advised that finished ground floor levels are raised above the external levels (following any re-grade of the site) to provide safe overland flood routes for excess surface water run-off should exceedance of the drainage infrastructure occur.

8.2 As the proposals include for a new basement level appropriate measures should be incorporated at ground flood level to protect from any overland flows routing into the basement dwellings. This can be achieved by incorporating low level walling at ground floor level, surrounding any exterior voids from ground floor level, down to the basement levels. Low level walls will assist with preventing run-off overland from Grafton Road, directly down to basement level.

8.3 Although the site is not susceptible to groundwater flooding based on the information reviewed, the proposals are for a new basement level. Where at all feasible the proposed basement level would be raised above the natural water table level, in the event where groundwater flooding is experienced during the construction of the basement level, then appropriate mitigation techniques including cavity drainage should be implemented.

8.4 In order to mitigate any potential for surface water flood risks to increase as a result of the development, it is advised that an appropriate formal surface water management regime to be incorporated onsite. To minimise the flood risk to the neighbouring properties it is recommended that the surface water run-off generated by the proposals be managed effectively with the peak rates of run-off being restricted to the equivalent of the pre-development situation (with betterment where required).

8.5 As with any drainage system blockages within either the foul or surface water system have the potential to cause flooding or disruption. It is important that should any drainage systems not be offered for adoption to either the Water Company or the Local Authority then an appropriate maintenance regime should be scheduled with a suitably qualified management company for these private drainage systems.

8.6 If an extreme rainfall event exceeds the design criteria for the drainage system it is likely that there will be some overland flows that are unable to enter the system, it is important that these potential overland flows are catered for within the development site if the capacity of the drainage system is exceeded.

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Environment Agency – www.environment-agency.gov.uk/
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Flood London – http://www.floodlondon.com/
Google Maps – http://maps.google.co.uk/
Streetmap – http://www.streetmap.co.uk/

APPENDIX A: NPPF & PPG EXTRACTS

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14. Meeting the challenge of climate change, flooding and coastal change

148. The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.

Planning for climate change

149. Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures[48]. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

150. New development should be planned for in ways that:

a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and

b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

151. To help increase the use and supply of renewable and low carbon energy and heat, plans should:

a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

[48] In line with the objectives and provisions of the Climate Change Act 2008.

152. Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

153. In determining planning applications, local planning authorities should expect new development to:

a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and

b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

154. When determining planning applications for renewable and low carbon development, local planning authorities should:

a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and

b) approve the application if its impacts are (or can be made) acceptable[49]. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

Planning and flood risk

155. Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

156. Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.

157. All plans should apply a sequential, risk-based approach to the location of development – taking into account the current and future impacts of climate change

[49] Except for applications for the repowering of existing wind turbines, a proposed wind energy development involving one or more turbines should not be considered acceptable unless it is in an area identified as suitable for wind energy development in the development plan; and, following consultation, it can be demonstrated that the planning impacts identified by the affected local community have been fully addressed and the proposal has their backing.

– so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

a) applying the sequential test and then, if necessary, the exception test as set out below;

b) safeguarding land from development that is required, or likely to be required, for current or future flood management;

c) using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques); and

d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.

158. The aim of the sequential test is to steer new development to areas with the lowest risk of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

159. If it is not possible for development to be located in zones with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in national planning guidance.

160. The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. For the exception test to be passed it should be demonstrated that:

a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

b) the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

161. Both elements of the exception test should be satisfied for development to be allocated or permitted.

162. Where planning applications come forward on sites allocated in the development plan through the sequential test, applicants need not apply the sequential test again. However, the exception test may need to be reapplied if relevant aspects of the proposal had not been considered when the test was applied at the plan-making stage, or if more recent information about existing or potential flood risk should be taken into account.

163. When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment[50]. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;

b) the development is appropriately flood resistant and resilient;

c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;

d) any residual risk can be safely managed; and

e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

164. Applications for some minor development and changes of use[51] should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 50.

165. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a) take account of advice from the lead local flood authority;

b) have appropriate proposed minimum operational standards;

c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and

d) where possible, provide multifunctional benefits.

Coastal change

166. In coastal areas, planning policies and decisions should take account of the UK Marine Policy Statement and marine plans. Integrated Coastal Zone Management should be pursued across local authority and land/sea boundaries, to ensure effective alignment of the terrestrial and marine planning regimes.

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[50] A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

[51] This includes householder development, small non-residential extensions (with a footprint of less than 250m^2) and changes of use; except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the sequential and exception tests should be applied as appropriate.

167. Plans should reduce risk from coastal change by avoiding inappropriate development in vulnerable areas and not exacerbating the impacts of physical changes to the coast. They should identify as a Coastal Change Management Area any area likely to be affected by physical changes to the coast, and:

a) be clear as to what development will be appropriate in such areas and in what circumstances; and

b) make provision for development and infrastructure that needs to be relocated away from Coastal Change Management Areas.

168. Development in a Coastal Change Management Area will be appropriate only where it is demonstrated that:

a) it will be safe over its planned lifetime and not have an unacceptable impact on coastal change;

b) the character of the coast including designations is not compromised;

c) the development provides wider sustainability benefits; and

d) the development does not hinder the creation and maintenance of a continuous signed and managed route around the coast[52].

169. Local planning authorities should limit the planned lifetime of development in a Coastal Change Management Area through temporary permission and restoration conditions, where this is necessary to reduce a potentially unacceptable level of future risk to people and the development.

[52] As required by the Marine and Coastal Access Act 2009.

Revision date: 06 03 2014

What should be considered if bringing forward a Neighbourhood Development Order/Community Right to Build Order in an area at risk of flooding?

The general approach and requirements for site-specific flood risk assessments should be applied to developments in areas at risk of flooding to be permitted by Neighbourhood Development/ Community Right to Build Orders. This means that for any development proposals:

- in Flood Zone 2 or 3;
- or of at least 1 hectare;
- or in an area that has critical drainage problems (as notified to the local planning authority by the Environment Agency);
- or that may be subject to other sources of flood risk;

a site-specific flood risk assessment should support the draft Order. The flood risk assessment checklist may be helpful in this respect.

Where the neighbourhood planning area is in Flood Zone 2 or 3, or is in an area with critical drainage problems, advice on the scope of the flood risk assessment required should be sought from the Environment Agency. Where the area may be subject to other sources of flooding, it may be helpful to consult other bodies involved in flood risk management, as appropriate.

Where a Neighbourhood Development/Community Right to Build Order is under consideration for a site/area in Flood Zone 2 or 3, which has not been allocated in the development plan through the Sequential Test, and if necessary the Exception Test, it will be necessary for those proposing the development, in having regard to the National Planning Policy Framework's policies on flood risk, to demonstrate why the development cannot reasonably be located in areas of lower flood risk.

In all cases where new development is proposed, the sequential approach to locating development in areas of lower flood risk should still be applied within a neighbourhood planning area.

Neighbourhood Development/Community Right to Build Orders that propose new development that would be;

- contrary to the flood risk vulnerability and flood zone compatibility table (Table 3), or;
- within areas at risk of flooding where sequential testing shows there to be places at lower flood risk which are suitable and reasonably available for the development proposed,

should not be considered appropriate, having regard to the national policies on development and flood risk.

Paragraph: 064 Reference ID: 7-064-20140306

Revision date: 06 03 2014

Flood Zone and flood risk tables

- Table 1: Flood Zones
- Table 2: Flood risk vulnerability classification
- Table 3: Flood risk vulnerability and flood zone 'compatibility'

Table 1: Flood Zones

These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. They are shown on the Environment Agency's Flood Map for Planning (Rivers and Sea (https://flood-map-for-planning.service.gov.uk/)), available on the Environment Agency's web site, as indicated in the table below.

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.(Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

Note: The Flood Zones shown on the Environment Agency's Flood Map for Planning (Rivers and Sea) do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding. Reference should therefore also be made to the Strategic Flood Risk Assessment when considering location and potential future flood risks to developments and land uses.

Paragraph: 065 Reference ID: 7-065-20140306

Revision date: 06 03 2014

Table 2: Flood risk vulnerability classification

Essential infrastructure

- Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk.
- Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood.
- Wind turbines.

Highly vulnerable

- Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding.
- Emergency dispersal points.
- Basement dwellings.
- Caravans, mobile homes and park homes intended for permanent residential use.
- Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').

More vulnerable

- Hospitals
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non–residential uses for health services, nurseries and educational establishments.
- Landfill* and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

Less vulnerable

- Police, ambulance and fire stations which are not required to be operational during flooding.
- Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill* and hazardous waste facilities).
- Minerals working and processing (except for sand and gravel working).
- Water treatment works which do not need to remain operational during times of flood.
- Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.

Water-compatible development

- Flood control infrastructure.
- Water transmission infrastructure and pumping stations.
- Sewage transmission infrastructure and pumping stations.
- Sand and gravel working.
- Docks, marinas and wharves.
- Navigation facilities.
- Ministry of Defence defence installations.
- Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.
- Water-based recreation (excluding sleeping accommodation).
- Lifeguard and coastguard stations.
- Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.
- Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

" * " Landfill is as defined in Schedule 10 of the Environmental Permitting (England and Wales) Regulations 2010 (http://www.legislation.gov.uk/uksi/2010/675/schedule/10/made).

Paragraph: 066 Reference ID: 7-066-20140306

Revision date: 06 03 2014

Table 3: Flood risk vulnerability and flood zone 'compatibility'

Table 3: flood risk vulnerability and flood zone ‘compatibility'
(https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/575184/Table_3_-_Flood_risk_vulnerability_and_flood_zone__compatibility_.pdf) (PDF, 58.1KB, 1 page)

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Notes to table 3:

- This table does not show the application of the Sequential Test which should be applied first to guide development to Flood Zone 1, then Zone 2, and then Zone 3; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea;
- The Sequential and Exception Tests do not need to be applied to minor developments and changes of use, except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site;
- Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.

† In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

” * “ In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows and not increase flood risk elsewhere.

Paragraph: 067 Reference ID: 7-067-20140306

Revision date: 06 03 2014

Site-specific flood risk assessment: Checklist

1 - Development site and location

You can use this section to describe the site you are proposing to develop. It would be helpful to include, or make reference to, a location map which clearly indicates the development site.

a. Where is the development site located? (eg postal address or national grid reference)

b. What is the current use of the site? (eg undeveloped land, housing, shops, offices)

c. Which Flood Zone (for river or sea flooding) is the site within? (ie Flood Zone 1, Flood Zone 2, Flood Zone 3). As a first step, you should check the Flood Map for Planning (http://apps.environment-agency.gov.uk/wiyby/37837.aspx) (Rivers and Sea). It is also a good idea to check the Strategic Flood Risk Assessment for the area available from the local planning authority.

2 - Development proposals

APPENDIX B: EA INFORMATION & CORRESPONDENCE

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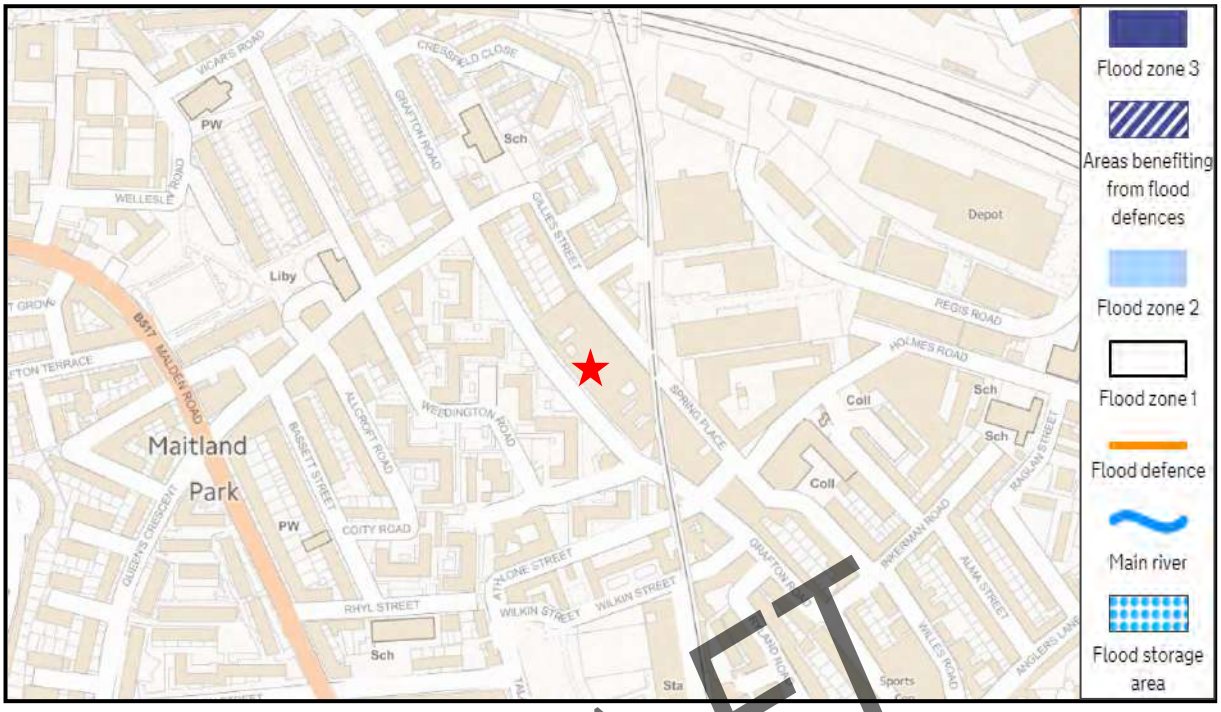
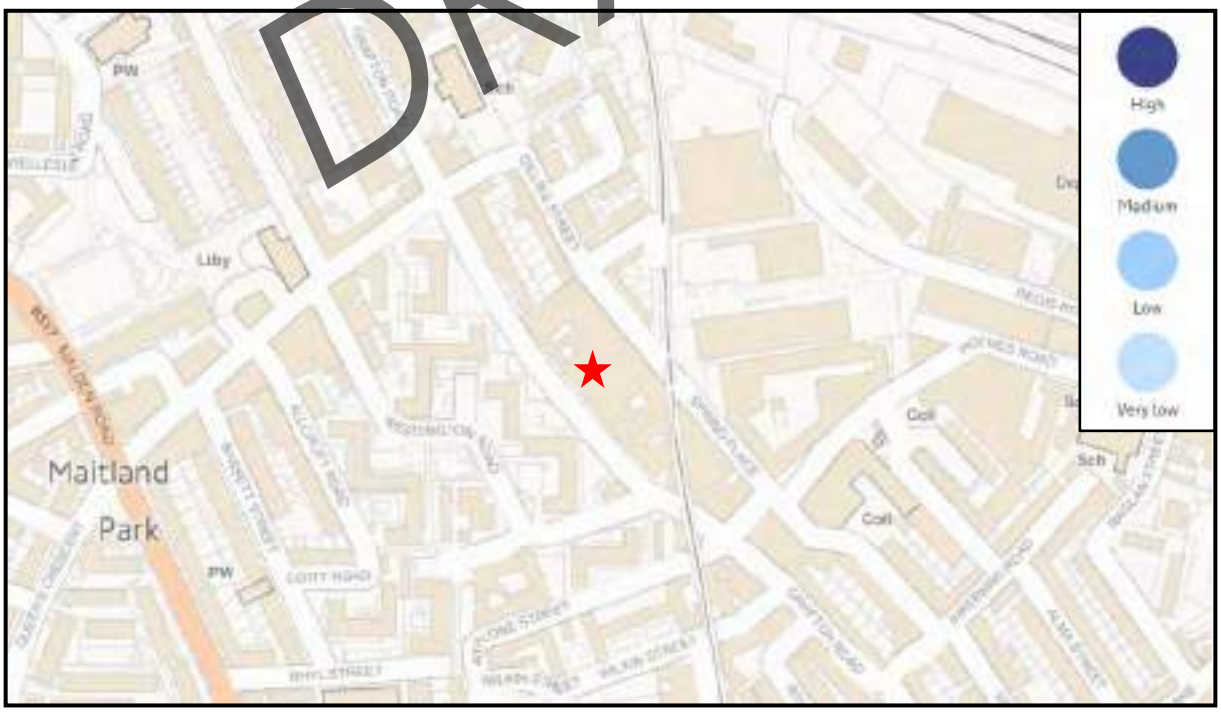
NATIONAL FLOOD MAPPING

BETTS HYDRO
CONSULTING ENGINEERS

Flood Map for Planning



Long Term Flood Risk – Rivers or Sea



NATIONAL FLOOD MAPPING

BETTS HYDRO
CONSULTING ENGINEERS

Long Term Flood Risk – Surface Water

Long Term Flood Risk - Reservoirs

Megan Berry

From: NET Enquiries <HNLenquiries@environment-agency.gov.uk>
Sent: 27 February 2019 13:31
To: Megan Berry
Subject: HNL118080/AS - Enquiry regarding 128-130 Grafton Road, London NW5 4BA

Dear Ms Berry

Thank you for your request dated 14 February 2019 for Environment Agency data.

The information on Flood Zones in the area relating to 128-130 Grafton Road, London NW5 4BA is as follows:

The property is in an area located within Flood Zone 1 shown on our Flood Map for Planning (Rivers and Sea).

Note - This information relates to the area that the above named site is in and is not specific to the property/proposed development itself.

Because this site does not fall within an area at risk of flooding from rivers or the sea, we do not hold any detailed flood modelling data that would impact your site. As such we are unable to provide a flood risk product.

We do not hold records of historic flood events from rivers and/or the sea affecting the area local to this site. However, please be aware that this does not necessarily mean that flooding has not occurred here in the past, as our records are not comprehensive.

If you have requested this information to help inform a development proposal, then you should note the information on GOV.UK on the use of Environment Agency Information for Flood Risk Assessments

https://www.gov.uk/planning-applications-assessing-flood-risk
https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

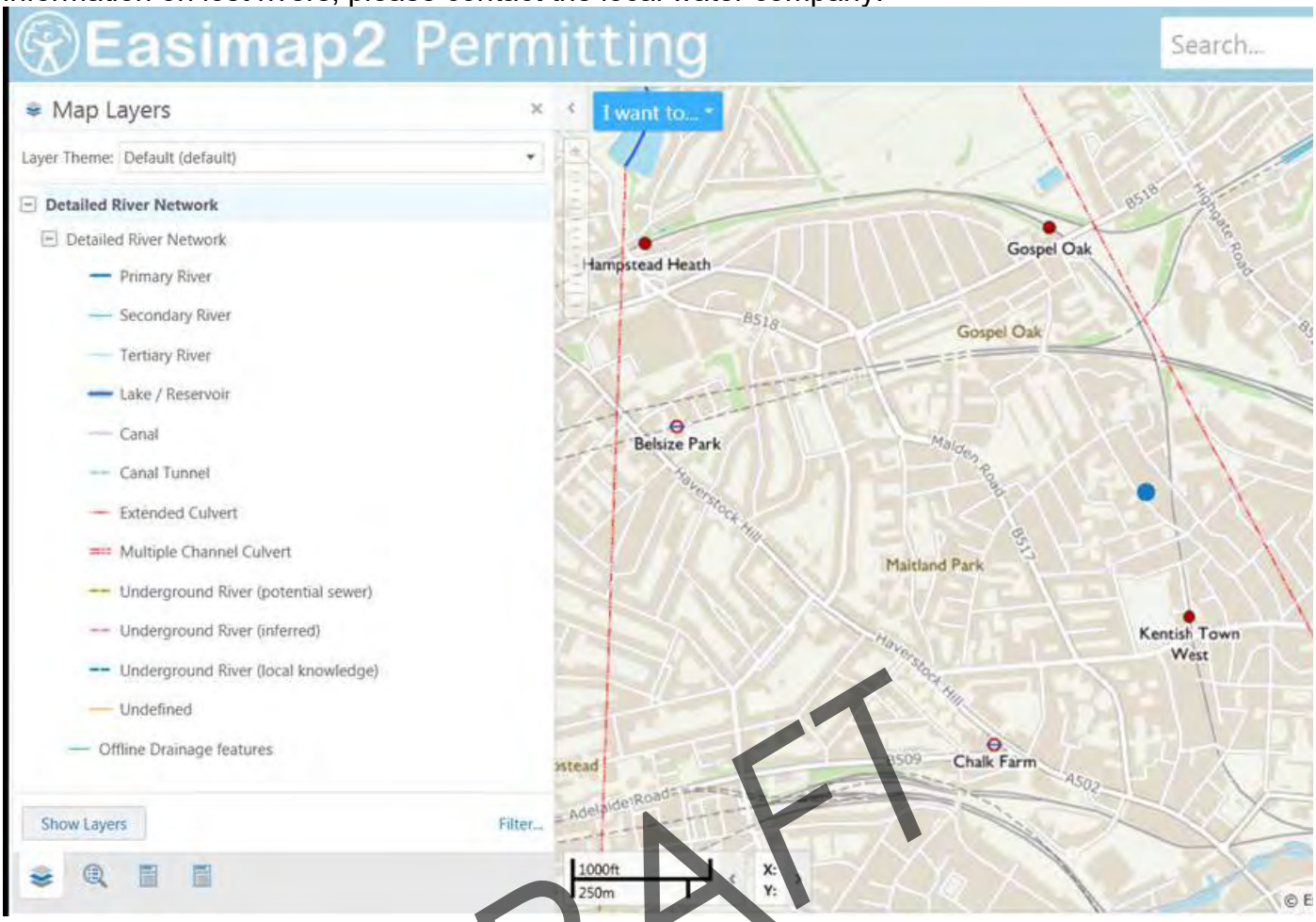
This address is within 20m of an area at Medium risk of surface water flooding.
Following the Flood and Water Management Act 2010, Lead Local Flood Authorities are responsible for the management of groundwater and surface water flooding. They also maintain a register of property flooding incidents. You may want to seek further advice from the LLFA London Borough of Camden.

You can also view and print surface water flood maps online at:
http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=ufmfsw#x=357683&y=355134&scale=2

This information is provided subject to the Open Government Licence, which you should read.

We respond to requests for recorded information that we hold under the Freedom of Information Act 2000 (FOIA) and the associated Environmental Information Regulations 2004 (EIR).

The screen shot below shows the sites proximity to the nearest culverted watercourses. For any information on lost rivers, please contact the local water company.



Data Available Online

Many of our flood datasets are available online:

- **You can view and download flood risk maps from our website at:** http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=floodmap#x=357683&y=355134&scale=2
- **Flood Map For Planning** (Flood Zone 2, Flood Zone 3 ,Flood Storage Areas, Flood Defences, Areas Benefiting from Defences)
- Risk of Flooding from Rivers and Sea
- Historic Flood Map
- Current Flood Warnings
- Open data

I hope that we have correctly interpreted your request. If you are not satisfied with our response to your request for information you can contact us within 2 calendar months to ask for our decision to be reviewed.

I hope this proves to be of help to you however if you have any further queries please feel free to contact me directly.

Kind regards

Annette Smith

Customers and Engagement Officer
Environment Agency, Hertfordshire and North London
Alchemy, Bessemer Road, Welwyn Garden City, Hertfordshire, AL7 1HE
Tel: 0203 025 8975

My usual working hours are 9.30am to 16.30pm, Tuesdays and Thursdays, and 9.30am to 14.30pm Wednesdays.

Did you know that the Environment Agency publishes most of its data via www.data.gov.uk? Using this site you can search for our data alongside other environmental data providers from the Defra Network and local authorities.

We are now **Hertfordshire and North London Area**
Our new email address for requests for information is HNLenquiries@environment-agency.gov.uk.
But don't worry, any emails you send to our old address will still reach us.

Environment Agency

Our website has moved. Find us at http://www.gov.uk/environment-agency

protect invest improve — Planning for the future of water — FLOODS DESTROY BE PREPARED

From: Megan Berry [mailto:meganberry@betts-associates.co.uk]
Sent: 14 February 2019 11:09
To: NET Enquiries <HNLenquiries@environment-agency.gov.uk>
Subject: Fluvial Flood Risk and Historical Flooding - Product 4

F.A.O Flood Risk, Drainage and/or Planning department

Please forward to the correct department/ office

Good Afternoon,

128-130 Grafton Road, London.

We have been instructed to undertake a flood risk assessment and drainage management strategy for the site above (see location plan attached). It would also be extremely helpful and

valuable to our work if you could please provide us with any information you may have regarding the flood risk of any culverts or 'lost rivers' within this area surrounding site. In addition, any historical flooding information that could be provided would also be helpful to include within our assessment.

If there are any other specific requirements that you require in a scope of works for this site please can you advise at this stage so that it can be fully incorporated into the proposals at an early stage. Please do not hesitate to contact me on the details below to discuss further should you require additional information or clarification.

Kind Regards

Megan Berry BSc(Hons) GradCIWEM
Graduate Flood Risk Analyst

BETTS HYDRO
Consulting Engineers

Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY
Chester +44 (0)1244 289041

meganberry@betts-associates.co.uk
www.betts-associates.co.uk

CIVIL | STRUCTURAL | GEO-ENVIRONMENTAL | HYDROLOGY | FLOOD RISK MANAGEMENT
SUDS | STRUCTURAL SURVEYS | PARTY WALL DUTIES | INFILTRATION | GEOTECHNICAL

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APPENDIX C: TW CORRESPONDENCE

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Megan Berry

From: onlinecustomers@thameswater.co.uk
Sent: 21 February 2019 20:21
To: Megan Berry
Subject: Your ref: N/A Our ref: 1031370
Attachments: 1031370-Sewer Flooding History Enquiry-1003184.pdf

Importance: High

Dear Customer

OSS/12/1031370.
Your Reference: N/A.
Site Address Supplied: 128-130 Grafton Road, London, .

Thank you for placing your order with Thames Water Property Searches. Please see the attached file for further details regarding your case.

Yours faithfully

Customer Service Team
Thames Water Property Searches

Thames Water Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13
(T) 0845 070 9148 (E) OnlineCustomers@thameswater.co.uk (W) www.thameswater-propertysearches.co.uk

Sewer Flooding
History Enquiry

Property Searches

Betts Associates Limited
Sealand Sealand
Welsh Road

Search address supplied	128-130 Grafton Road London
Your reference	N/A
Our reference	SFH/SFH Standard/2019_3956079
Received date	**20 February 2019**
Search date	**21 February 2019**

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0845 070 9148

Sewer Flooding
History Enquiry

Search address supplied: 128-130 Grafton Road,London

This search is recommended to check for any sewer flooding in a specific address or area

TWUL, trading as Property Searches, are responsible in respect of the following:-

(i) any negligent or incorrect entry in the records searched;

(ii) any negligent or incorrect interpretation of the records searched;

(iii) and any negligent or incorrect recording of that interpretation in the search report

(iv) compensation payments

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0845 070 9148

Sewer Flooding
History Enquiry

Thames Water Property Searches

History of Sewer Flooding

Is the requested address or area at risk of flooding due to overloaded public sewers?

The flooding records held by Thames Water indicate that there have been no incidents of flooding in the requested area as a result of surcharging public sewers.

For your guidance:

- A sewer is "overloaded" when the flow from a storm is unable to pass through it due to a permanent problem (e.g. flat gradient, small diameter). Flooding as a result of temporary problems such as blockages, siltation, collapses and equipment or operational failures are excluded.
- "Internal flooding" from public sewers is defined as flooding, which enters a building or passes below a suspended floor. For reporting purposes, buildings are restricted to those normally occupied and used for residential, public, commercial, business or industrial purposes.
- "At Risk" properties are those that the water company is required to include in the Regulatory Register that is presented annually to the Director General of Water Services. These are defined as properties that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system more frequently than the relevant reference period (either once or twice in ten years) as determined by the Company's reporting procedure.
- Flooding as a result of storm events proven to be exceptional and beyond the reference period of one in ten years are not included on the At Risk Register.
- Properties may be at risk of flooding but not included on the Register where flooding incidents have not been reported to the Company.
- Public Sewers are defined as those for which the Company holds statutory responsibility under the Water Industry Act 1991.
- It should be noted that flooding can occur from private sewers and drains which are not the responsibility of the Company. This report excludes flooding from private sewers and drains and the Company makes no comment upon this matter.
- For further information please contact Thames Water on Tel: 0800 316 9800 or website www.thameswater.co.uk

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0845 070 9148

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APPENDIX D: LPA/LLFA CORRESPONDENCE

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Megan Berry

From: Megan Berry
Sent: 14 February 2019 11:05
To: 'greencamden@camden.gov.uk'
Subject: Flood Risk Information
Attachments: LOCATION PLAN.pdf

F.A.O Flood Risk, Drainage and/or Planning department

Please forward to the correct department/ office

Good Afternoon,

128-130 Grafton Road, London.

We have been instructed to undertake a flood risk assessment and drainage management strategy for the site above (see location plan attached). It would also be extremely helpful and valuable to our work if you could please provide us with any information you may have regarding the flood risk of any culverts or 'lost rivers' within this area surrounding site that may pose a risk to site. In addition, any historical flooding information that could be provided would also be helpful to include within our assessment.

If there are any other specific requirements that you require in a scope of works for this site please can you advise at this stage so that it can be fully incorporated into the proposals at an early stage. Please do not hesitate to contact me on the details below to discuss further should you require additional information or clarification.

Kind Regards

Megan Berry BSc(Hons) GradCIWEM
Graduate Flood Risk Analyst

BETTS HYDRO
Consulting Engineers

Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY
Chester +44 (0)1244 289041

meganberry@betts-associates.co.uk
www.betts-associates.co.uk

CIVIL | STRUCTURAL | GEO-ENVIRONMENTAL | HYDROLOGY | FLOOD RISK MANAGEMENT
SUDS | STRUCTURAL SURVEYS | PARTY WALL DUTIES | INFILTRATION | GEOTECHNICAL

APPENDIX E: LOCATION PLAN

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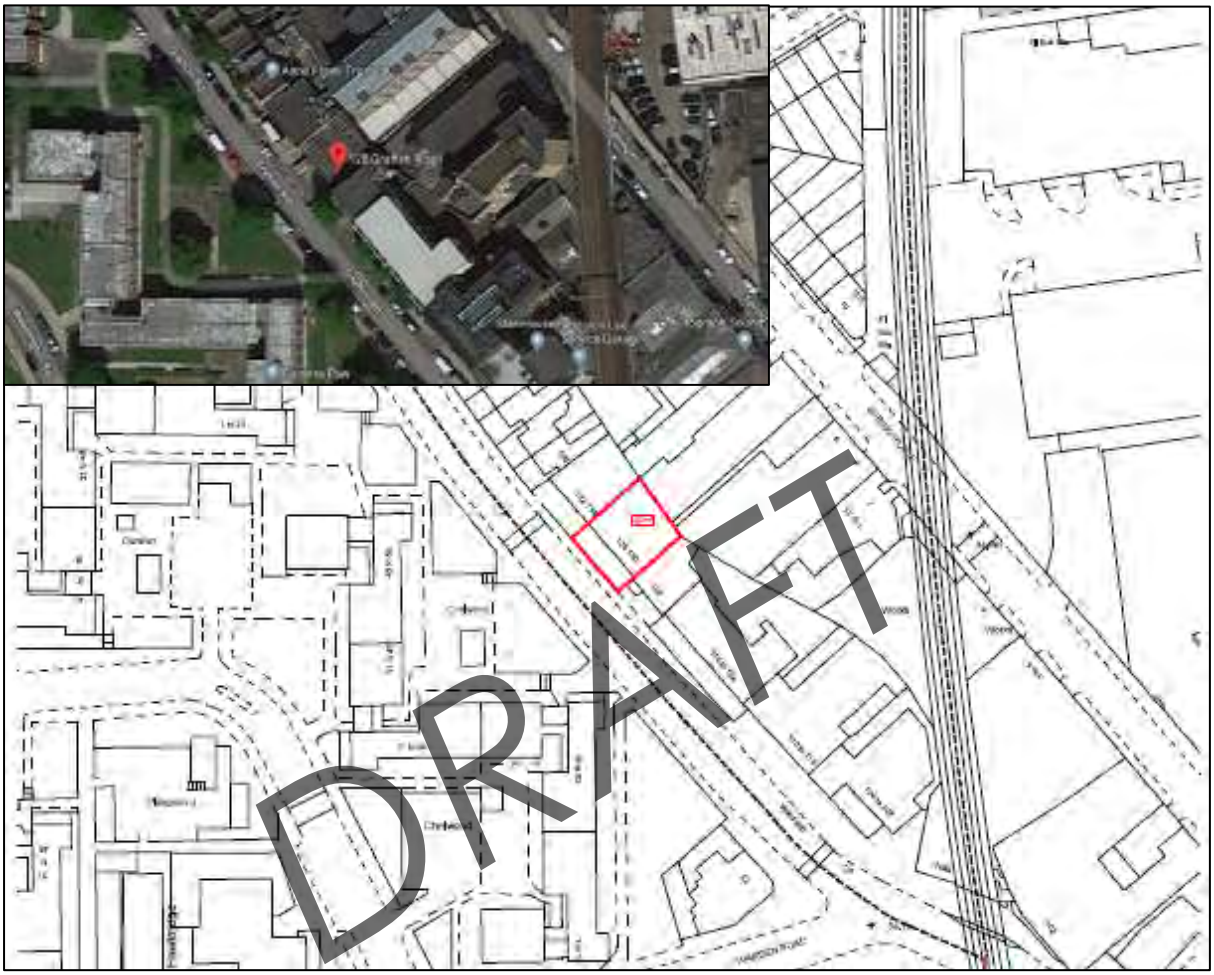
LOCATION PLAN

128-130 Grafton Road, London



OS X (Eastings)	528476
OS Y (Northings)	185062
Nearest Post Code	NW5 4BA
Lat (WGS84)	N51:32:59 (51.549830)
Long (WGS84)	W0:08:54 (-0.148455)
Lat,Long	51.549830,-0.148455
Nat Grid	TQ284850 / TQ2847685062
mX	-16525
mY	6685650

APPENDIX F: PROPOSED PLANNING LAYOUT

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128-130 Grafton Road

Kentish Town, London

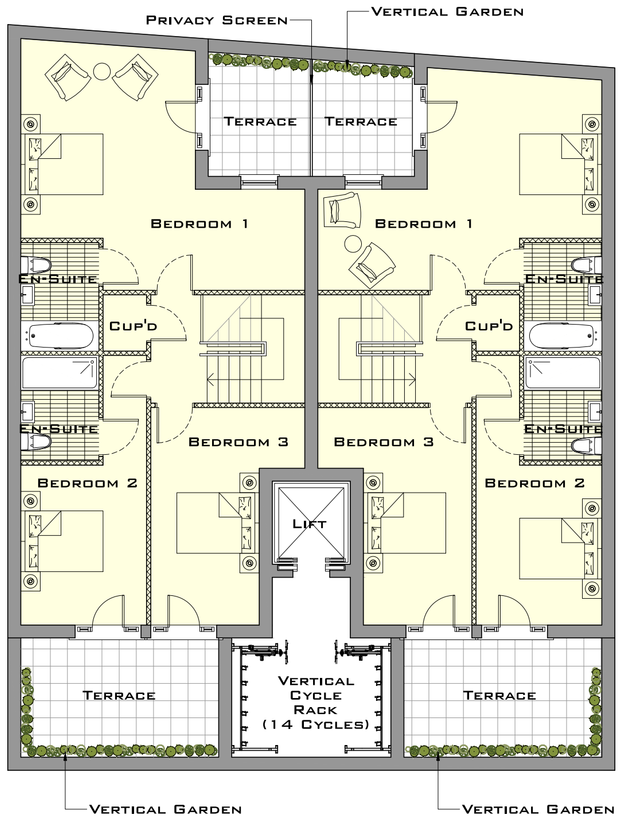
1 Proposed Site Plan

Scale: 1:100

Project	Drawing number: 05
128–130 GRAFTON ROAD, KENTISH TOWN	
Date: 25.07.2017	PROPOSED SITE LOCATION PLAN
Scale: 1:100 @ A1	

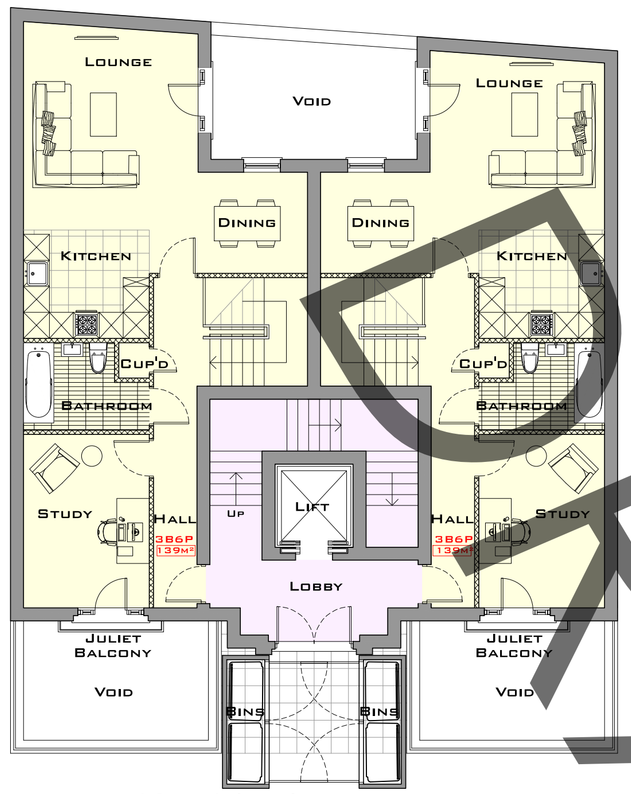
128-130 Grafton Road

Kentish Town, London



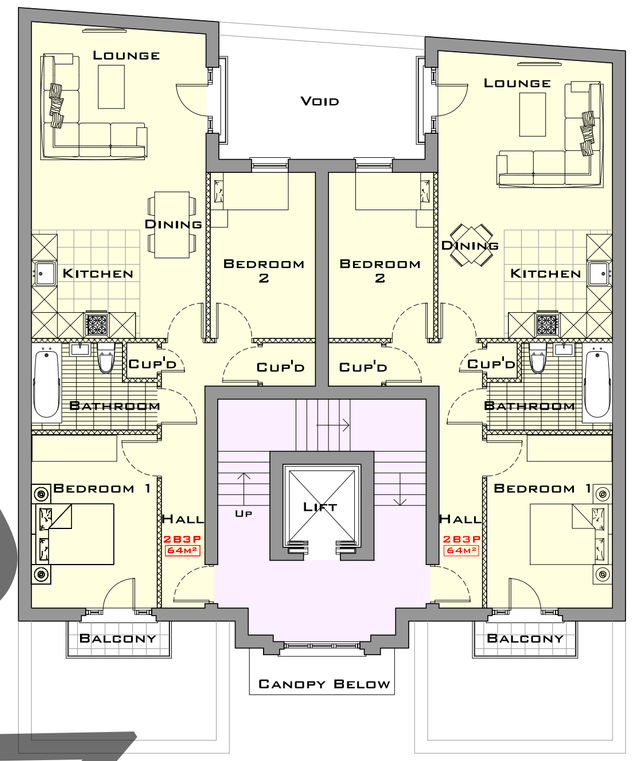
1 Proposed Basement Floor Plan

Scale: 1:100



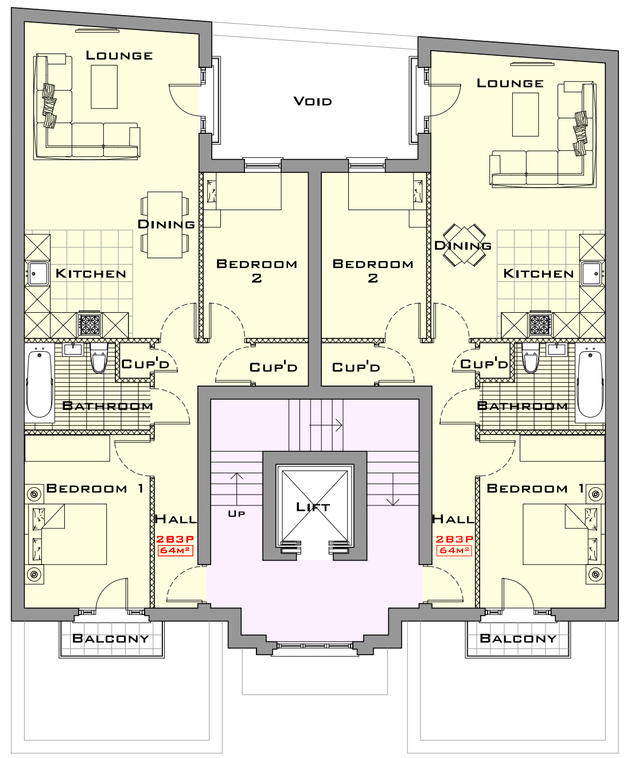
2 Proposed Ground Floor Plan

Scale: 1:100



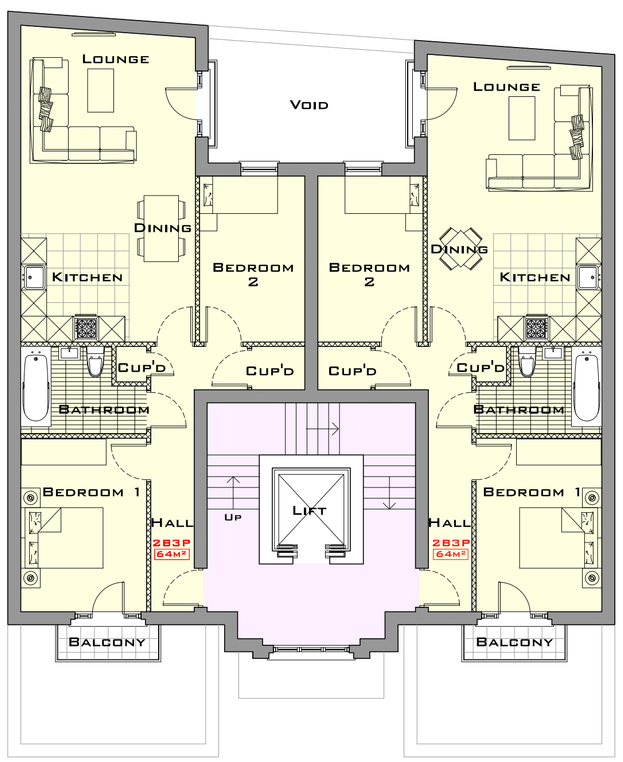
3 Proposed First Floor Plan

Scale: 1:100



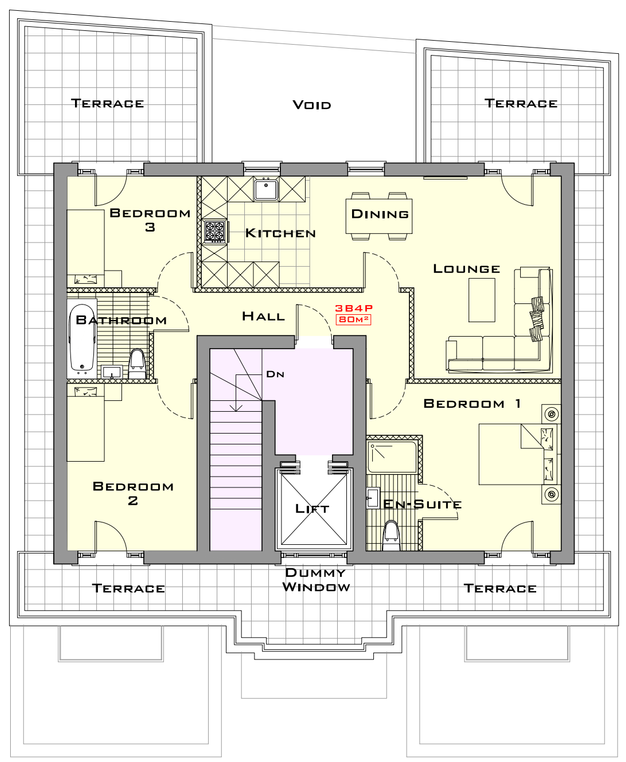
4 Proposed Second Floor Plan

Scale: 1:100



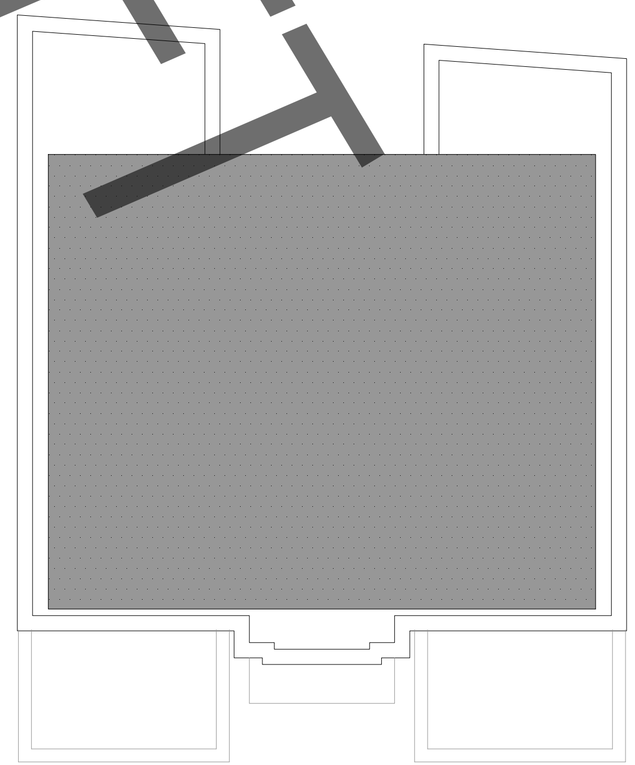
5 Proposed Third Floor Plan

Scale: 1:100



6 Proposed Penthouse Floor Plan

Scale: 1:100



7 Proposed Roof Plan

Scale: 1:100

scale 1:100

0 1 2 3 4 5 6 7 8 9 10 [m]

Project: 128–130 GRAFTON ROAD, KENTISH TOWN	Drawing number: 06
Date: 25.07.2017	PROPOSED PLANS
Scale: 1:100 @ A1	

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APPENDIX G: PFRA/SFRA PLANNING EXTRACTS

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Camden Planning Guidance

Basements and lightwells

CPG 4

London Borough of Camden

Camden

Surface flow and flooding

2.40 While nowhere in the borough is identified by the Environment Agency as being flood prone from rivers or the sea, there are still parts that are identified as being subject to localised flooding from surface water due to local soil conditions and topography. This is caused during times of heavy rainfall when the local combined sewer system is unable to deal with the volume and rate of flow. Flood Risk Assessment evidence suggests that areas of West Hampstead, Cricklewood and South Hampstead are at a higher risk of surface water floods. The relevant streets are broken down into 'primary areas' (those that have been affected by both major floods in 1975 and 2002) and 'secondary areas' (those that have been affected by one of the major floods) and these streets are listed on Page 29.

2.41 All applications for a basement extension within streets identified as either 'primary' or 'secondary' locations will be expected to include a Flood Risk Assessment with any application for a basement development, in line with the criteria set out in PPS25. In line with Development Policy DP27, the Council will not allow habitable rooms and other sensitive uses for self contained basement flats and other underground structures in areas at risk of flooding.

2.42 You should consider the flowchart below to determine whether you should proceed to the scoping stage of the Basement Impact Assessment and whether a Flood Risk Assessment should be undertaken as part of this. For surface flow and flooding issues the Basement Impact Assessment should be undertaken by a Hydrologist or a Civil Engineer specialising in flood risk management and surface water drainage, with either:

- The "CEng" (Chartered Engineer) qualification from the Engineering Council; or a Member of the Institution of Civil Engineers ("MICE); or
- The "C.WEM" (Chartered Water and Environmental Manager) qualification from the Chartered Institution of Water and Environmental Management.

2.43 Figure 14 within the Camden Geological, Hydrogeological and Hydrological Study identifies Hampstead Heath surface water catchments and drainage.

- do not place occupiers at risk or have any effects on the stability or bearing capacity of adjacent land generally.

Size of development

2.52 Often with basement development, the only visual features are lightwells and skylights, with the bulk of the development concealed wholly underground and away from any public view. However, just as overly large extensions above the ground level can dominate a building, contributing to the over-development of a site, an extension below ground can be of an inappropriate scale. There may be more flexibility with the scale of a development when it is proposed underground, but there are a number of factors that would mean basement development would be overdevelopment.

SKYLIGHT
A window, dome, or opening in the roof or ceiling, to admit natural light.

LIGHTWELL
An opening within or next to a building that allows natural light to reach basement windows, that would otherwise be obscured.

2.53 These include, for example, harm caused to any trees on or adjoining the site, where the development would restrict future planting and mature development of trees typical to the area, and any impact to the water environment. The permissible size of a basement development will therefore be guided by the characteristics of the site.

2.54 A basement development that is modest in size such that it does not extend beyond the footprint of the original building and is no deeper than one full storey below ground level (approximately 3 metres in depth) is often the most appropriate way to extend a building below ground, provided that the internal environment is fit for the intended purpose, and there is no impact to any trees on or adjoining the site, or to the water environment or land stability. Larger schemes (i.e. those consisting of two or more underground storeys) will be expected to provide evidence that the development does not harm the built and natural environment or local amenity.

2.55 Development Policy DP27 (Paragraph 27.6) states that the Council will not allow habitable rooms and other sensitive uses for self contained basement flats and other underground structures in areas at risk of flooding. Outside of these areas, where basement accommodation is to provide living space (possibly for staff), it will be subject to the same standards as other housing in terms of space, amenity and sunlight. Suitable access should also be provided to basement accommodation to allow for evacuation.

Conservation areas and listed buildings

2.56 Where the building is listed, new basement development or extensions to existing basement accommodation will require listed building consent, even if planning permission is not required. The acceptability of a

Water and flooding

8.51 Our built environment plays a significant role in the way water is consumed, distributed and disposed of. The way water is used in a building and the pollutants it picks up running across a site affect the quality of the water that reaches the combined storm water and sewer system. In addition, the location of a development, and any flood mitigation measures used, can have an impact on local and downstream surface water flooding. Camden is a Lead Local Flood Authority, which means the Council has responsibility for managing flood risk from surface water and groundwater in the borough.

8.52 Areas at risk of flooding in Camden are identified in the Council's Surface Water Management Plan and Strategic Flood Risk Assessment. These areas are shown on "Map 6: Historic flooding and Local Flood Risk Zones" on page 241.

8.53 Camden experienced significant flooding in 1975 and 2002 and the probability of such events recurring is likely to increase as a result of climate change. As noted in "Policy CC2 Adapting to climate change", flooding and drought are key risks which require mitigation and adaptation measures in the borough. Changes to our climate can also threaten the quantity and quality of our water supply. Such risks impact upon the health and wellbeing of Camden residents.

Policy CC3 Water and flooding

The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible.

We will require development to:

a. incorporate water efficiency measures;
b. avoid harm to the water environment and improve water quality;
c. consider the impact of development in areas at risk of flooding (including drainage);
d. incorporate flood resilient measures in areas prone to flooding;
e. utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and
f. not locate vulnerable development in flood-prone areas.

Where an assessment of flood risk is required, developments should consider surface water flooding in detail and groundwater flooding where applicable.

The Council will protect the borough's existing drinking water and foul water infrastructure, including the reservoirs at Barrow Hill, Hampstead Heath, Highgate and Kidderpore.

Water supply and quality

8.54 London has lower rainfall than the national average while having a very high population density. This combination of limited water resources and high demand has resulted in London being declared an area of serious water stress

and this trend is likely to be exacerbated by climate change. The Council will protect the borough's existing water infrastructure to ensure there is adequate supply, storage and foul water capability.

8.55 Developments must be designed to be water efficient. This can be achieved through the installation of water efficient fittings and appliances (which can help reduce energy consumption as well as water consumption) and by capturing and re-using rain water and grey water on-site. Residential developments will be expected to meet the requirement of 110 litres per person per day (including 5 litres for external water use). Refurbishments and other non-domestic development will be expected to meet BREEAM water efficiency credits. Major developments and high or intense water use developments, such as hotels, hostels and student housing, should include a grey water and rainwater harvesting system. Where such a system is not feasible or practical, developers must demonstrate to the Council's satisfaction that this is the case.

8.56 Camden has Groundwater Source Protection Zones (see "Map 6: Historic flooding and Local Flood Risk Zones" on page 241). The inner zone is located within the south west of Primrose Hill Park and the outer zone covers a section of South Hampstead from Prince Albert Road to Swiss Cottage. These zones are to signal that there are likely to be particular risks posed to the quality or quantity of water obtained, should certain activities take place nearby. These zones should be taken into account when considering the environmental impact of a development.

8.57 Water can pick up pollutants running across a site, which in turn enters our combined storm water and sewer system. Developments are required to utilise Sustainable Drainage Systems (SuDS), following the drainage hierarchy (see below), to ensure that development does not harm water quality.

Drainage hierarchy

1. store rainwater for later use
2. use infiltration techniques, such as porous surfaces in non-clay areas
3. attenuate rainwater in ponds or open water features for gradual release
4. attenuate rainwater by storing in tanks or sealed water features for gradual release
5. discharge rainwater direct to a watercourse
6. discharge rainwater to a surface water sewer/drain
7. discharge rainwater to the combined sewer

Areas at risk of flooding

8.58 The key flood risk to Camden is from surface water flooding. This arises following periods of intense rainfall when the volume and intensity of a rainfall event exceeds the capacity of the drainage system, resulting in localised flooding. Areas considered at risk from flooding are: Local Flood Risk Zones; and previously flooded streets (shown on "Map 6: Historic flooding and Local Flood Risk Zones"). Reference should also be made to Environment Agency surface water maps.

8.59 Thames Water identified that the south east of the borough discharges storm flow into the highly sensitive Counters Creek drainage catchment, where flooding to property already occurs. Changes in land use and rising population in

this catchment area has resulted in larger volumes of water entering the system. There are also twelve Local Flood Risk Zones (LFRZs) in Camden. LFRZs are defined as discrete areas of flooding that do not exceed the national criteria for a 'Flood Risk Area' but still affects houses, businesses or infrastructure (refer to "Map 6: Historic flooding and Local Flood Risk Zones" on page 241).

8.60 Camden also has a small risk of groundwater flooding, which takes two principal forms. The most common form of groundwater flooding in Camden is from 'perched' groundwater, water that becomes lodged between the top layer and the impermeable London clay layer. The risk of this type of flooding is difficult to model but has been recorded in parts of the borough, notably Kilburn, Fortune Green and West Hampstead, and will need to be considered and mitigated against in any new development. Aquifer based groundwater flooding is relatively rare in Camden, but it is possible in areas around Hampstead Heath and in the very south of the borough. This occurs when the water table rises due to prolonged heavy rain.

8.61 Development can have an impact on the water environment beyond the site where it takes place by altering the flow of water both above and below ground and changing where water is absorbed or rises to the surface. Changing water movements can alter soil conditions in the wider area. All developments should refer to the Council's Strategic Flood Risk Assessment (SFRA) to determine the likely impact the development will make to flood risk.

Site specific Flood Risk Assessments

8.62 Flood Risk Assessments (FRA) are carried out to identify the main flood risks to a development site, whether a development will increase flood risk, and recommendations for mitigating measures to reduce the impact of flooding at the site and surrounding area.

8.63 The Council will require Flood Risk Assessments for:

- all sites of 1 hectare or greater;
- all major planning applications in areas at high risk to flooding; and
- all basement development on streets identified as being at flood risk or in an area where historic underground watercourses are known to have been present, or in areas where there is an elevated risk of groundwater flooding.

8.64 A Flood Risk Assessment should identify how a development will be designed to cope with flooding and how the risk will be mitigated without increasing the risk elsewhere. Recommendations in the FRA will be secured by planning condition.

Mitigating flood risk

8.65 By decreasing the amount of permeable surfaces into which rainwater can be absorbed and by changing the direction of surface water flows, new development can increase stress on the drainage network and increase risk of flooding to properties downstream which were not previously at risk. Development located within areas at risk of flooding should not place additional pressure on the existing drainage infrastructure.

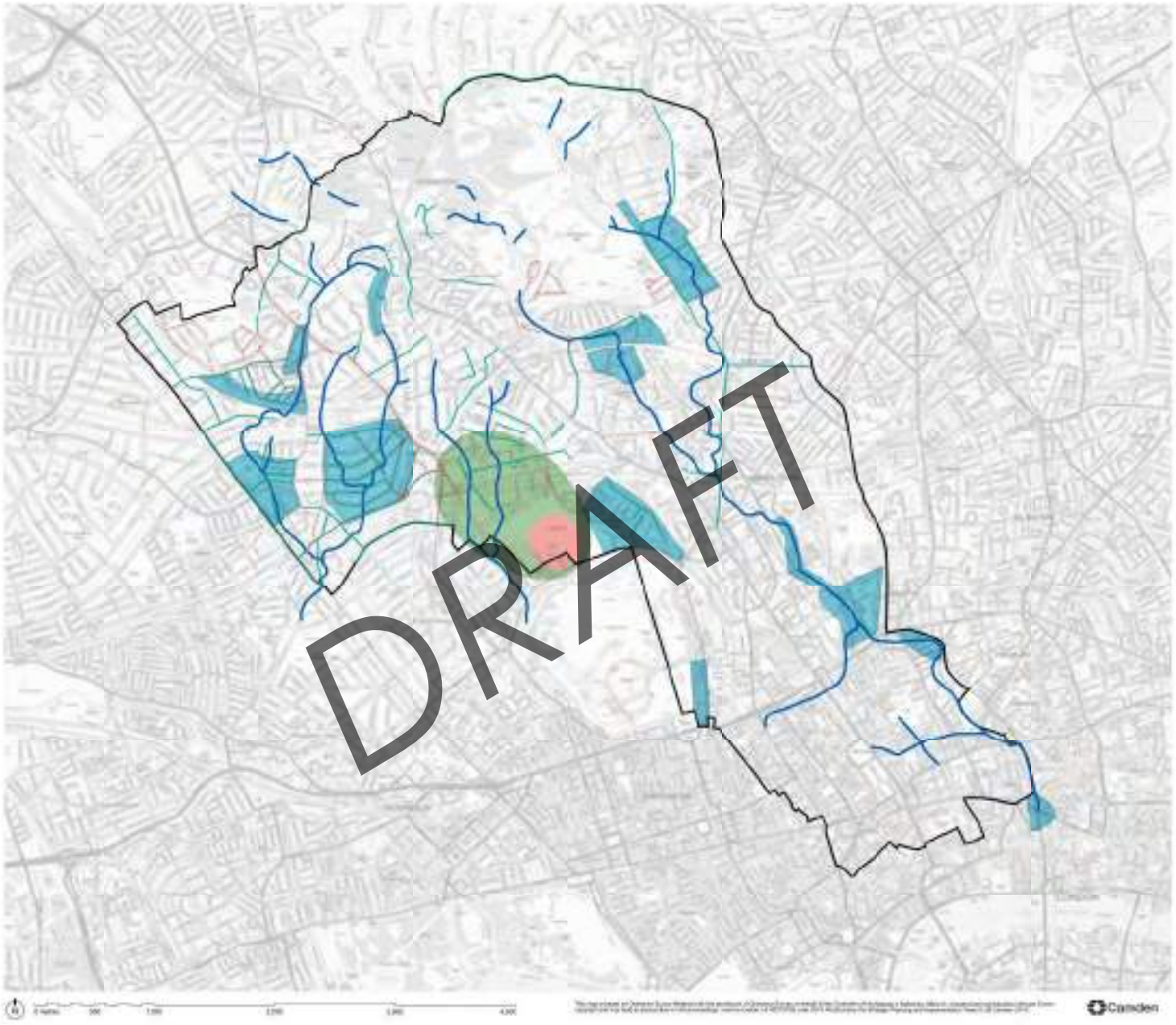
8.66 The Council will require developments to utilise Sustainable Drainage Systems (SuDS), to achieve greenfield run-off rates, unless demonstrated that this is not feasible. Surface water should be managed as close to its source as possible,

in line with the drainage hierarchy in the London Plan. Where it is not possible to achieve greenfield run-off rates it should be as close to this as possible (a greenfield run-off rate is one that reflects the natural rate of water run-off from a site before it was developed). Major developments will be required to constrain runoff volumes for a 1 in 100 year, 6 hour rainfall event, where feasible.

8.67 A drainage report should be submitted with all major applications, basement developments and other vulnerable development in areas identified at risk of flooding. This should include:

- identification of flood risk;
- assessment of existing run-off rates;
- calculation of greenfield run-off rates;
- identification of measures, in line with the drainage hierarchy, to reduce run-off rates; and
- calculation of proposed run-off rates.

Map 6: Historic flooding and Local Flood Risk Zones



8.68 Camden's Strategic Flood Risk Assessment includes information as to the suitability of SuDS in the borough and this should be used alongside other local information held by Camden and the Environment Agency. Where appropriate, SuDS measures will be secured by planning condition or by legal agreement. The Environment Agency published in 2016 updated climate change allowances including those for peak rainfall, which should be factored into any flood risk assessments.

8.69 Development should also demonstrate how it will mitigate the potential flooding of other properties. When determining the suitability of SuDS, vulnerability and the importance of local ecological resources, such as water quality and biodiversity should be considered.

Vulnerable development

8.70 Basements can affect the ability of the ground to absorb rain when soil is replaced by an impervious structure and can be particularly susceptible to flooding. The Council will not permit basement schemes which include habitable rooms and other sensitive uses for self-contained basement flats and other underground structures in areas prone to flooding ("Policy A5 Basements"). The Council shall require all new basement developments whether domestic or non-domestic to conduct a Basement Impact Assessment (please see "Policy A5 Basements") which considers both groundwater and surface water flooding. A Basement Impact Assessment (BIA) should demonstrate that the impacts of the proposed development are acceptable, or that appropriate mitigation measures will be adopted.

Regent's Canal

8.71 The Regent's Canal (which is a branch of the Grand Union Canal) runs through the centre of the borough. The Canal forms part of London's Blue Ribbon Network, which has its own set of policies within the London Plan. Please refer to "Policy A2 Open space" for further information on the value of Regent's Canal in Camden.

8.72 The quality of the Regents Canal is of 'moderate' status, it is not reaching 'good' as mitigation measures still need to be implemented. The Council will have regard to the Thames River Basin Management Plan which contains the actions needed to tackle the main issues of the water environment.

Air quality

8.73 Improving local air quality, mitigating the impact of development on air quality and reducing exposure to poor air quality in the borough is vital in safeguarding public health and the environment. The focus of Policy CC4 is to mitigate the impact of development on air quality and to ensure exposure to poor air quality is reduced in the borough.

8.74 It is recognised that parts of Camden have some of the poorest air quality levels in London and since 2000 the whole of the borough has been declared an Air Quality Management Area (AQMA) for both NO2 (Nitrogen Dioxide) and PM10 (Particulate Matter). Camden is also working to assess and address PM2.5 (the smallest fraction of particulate) because despite Camden meeting EU limit values for PM2.5, research suggests that particulates of this size have the worst health impacts. Air pollution is associated with a number of adverse health impacts, and it particularly affects the most vulnerable in society.

8.75 A key challenge is to make our local environment better by reducing air pollution. In addition to Policy CC4, this Plan also actively supports the improvement of air quality in Camden by:

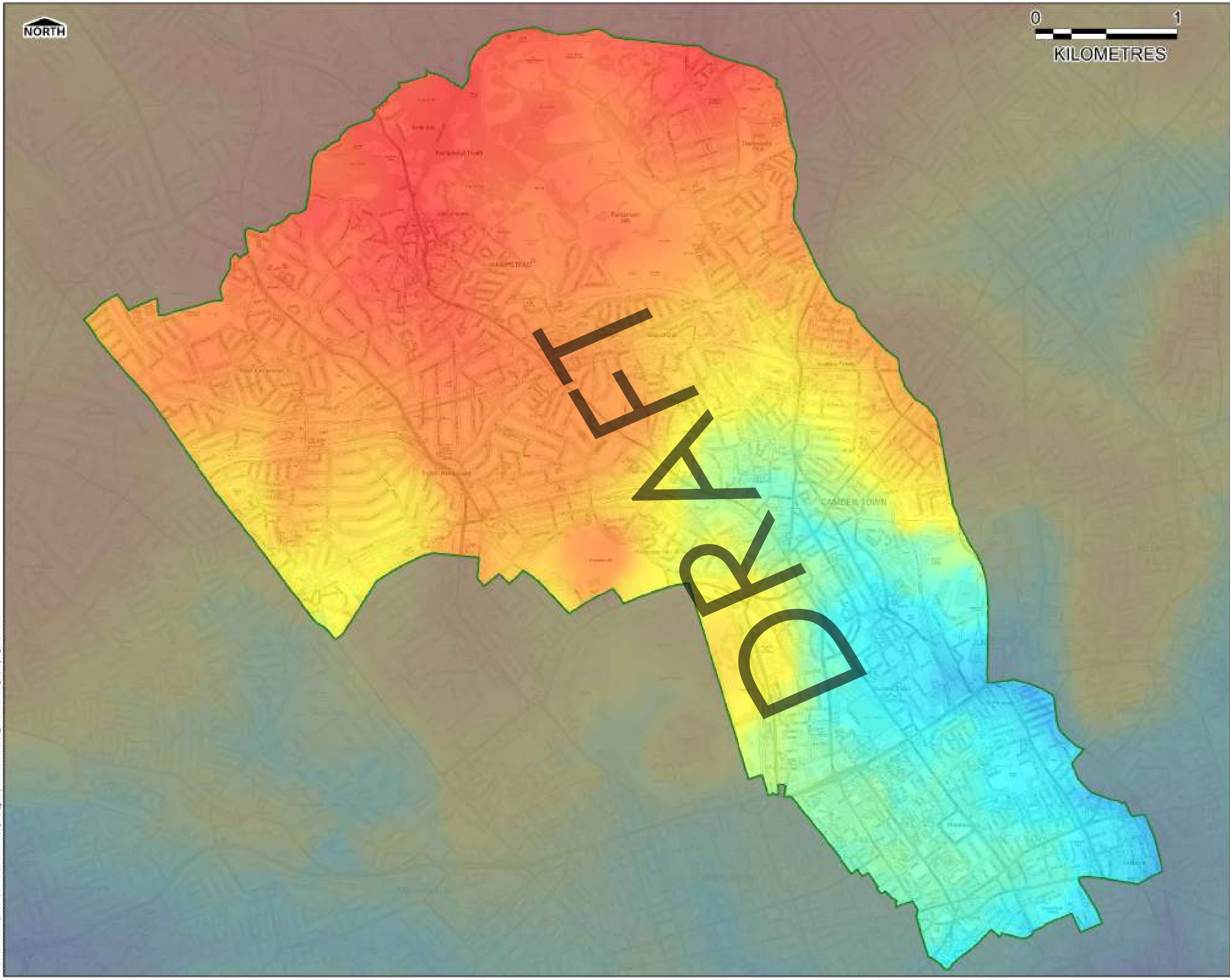
- requiring all new development in the borough to be 'car-free' (see "Policy T2 Parking and car-free development");
- maintaining and increasing green infrastructure (see "Policy A2 Open space");
- reducing emissions associated with new development (see "Policy CC1 Climate change mitigation"); and
- supporting and encouraging sensitive energy efficiency improvements to existing buildings (see "Policy CC1 Climate change mitigation").

Policy CC4 Air quality

The Council will ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough.

The Council will take into account the impact of air quality when assessing development proposals, through the consideration of both the exposure of occupants to air pollution and the effect of the development on air quality. Consideration must be taken to the actions identified in the Council's Air Quality Action Plan.

Air Quality Assessments (AQAs) are required where development is likely to expose residents to high levels of air pollution. Where the AQA shows that a development would cause harm to air quality, the Council will not grant planning permission unless measures are adopted to mitigate the impact. Similarly, developments that introduce sensitive receptors (i.e. housing, schools) in locations of poor air quality will not be acceptable unless designed to mitigate the impact.



LEGEND

London Borough Camden Boundary

Topography (mAOD)

- -2 to 12
- 12 to 25
- 25 to 39
- 39 to 53
- 53 to 80
- 80 to 121
- 121 to 135

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Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: LB Camden Topography

Drawn	Checked	Approved	Date
CB	JS	MT	23/07/2014

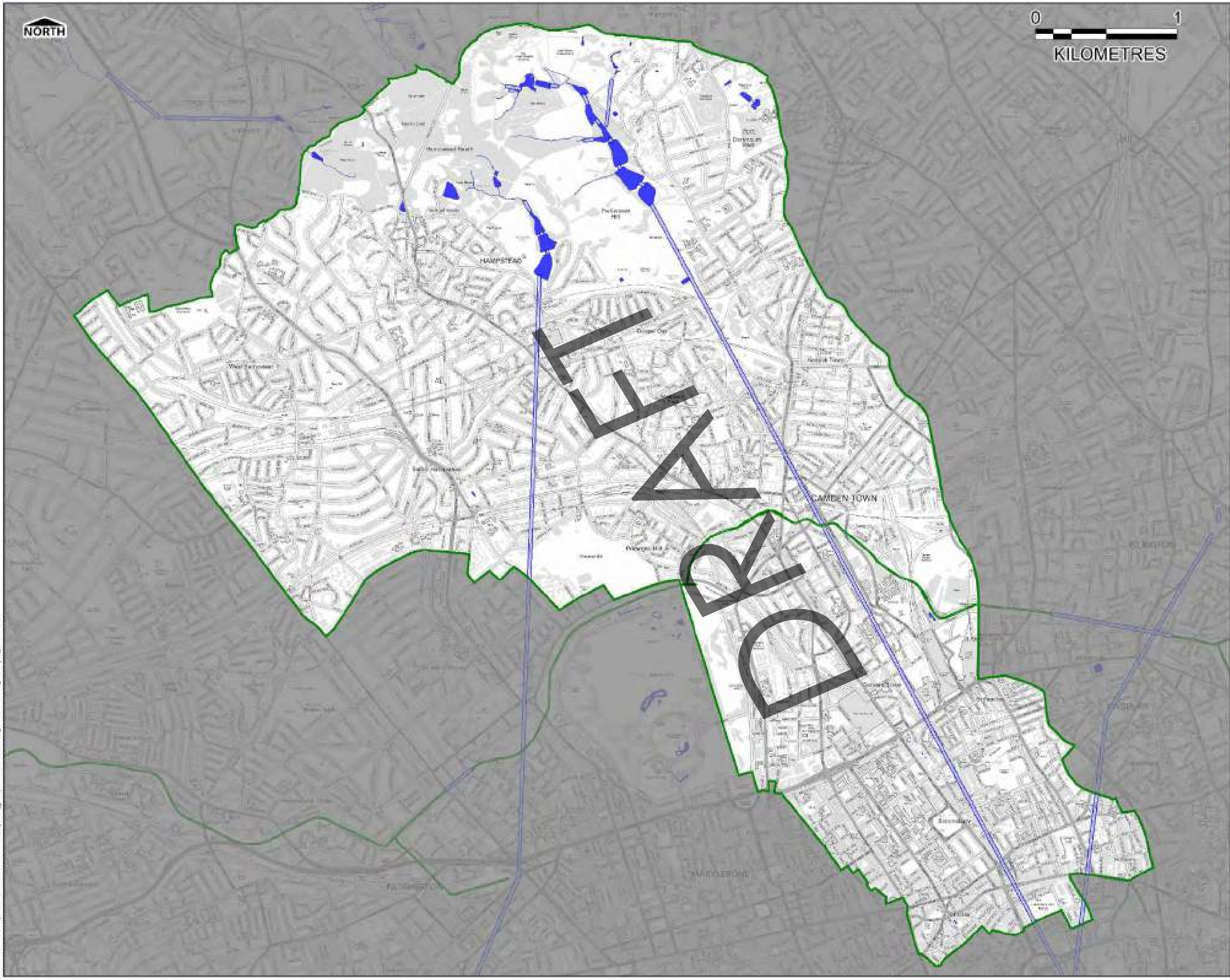
URS Internal Project No. 47070547

Scale at A3: 1:40,000

URS

Drawing Number: FIGURE 1

Rev: Rev 1



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LEGEND

- London Borough Camden Boundary
- Inland Waters
- Open Watercourse
- Culverted Watercourse
- Canal

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Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: LB Camden Surface Waterbodies

Drawn	Checked	Approved	Date
CB	JS	MT	23/07/2014

URS Internal Project No. 47070547 — Scale at A3: 1:40,000

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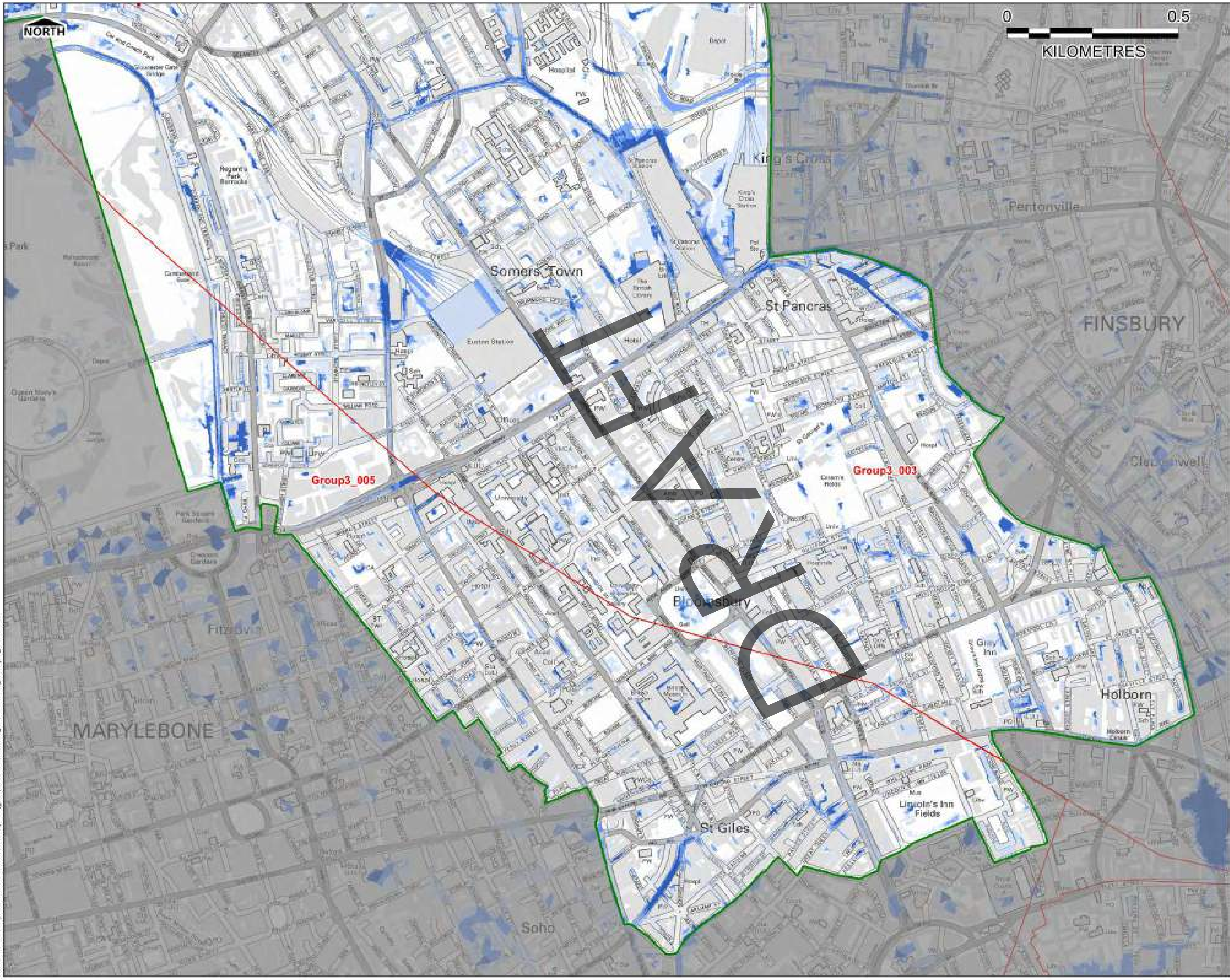
Drawing Number: FIGURE 2 — Rev 1



LEGEND

London Borough Camden Boundary

Critical Drainage Area

Risk of Flooding from Surface Water

High (1 in 30 year)

Medium (1 in 100 year)

Low (1 in 1000 year)

Very Low (<1 in 1000 year)

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Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: Updated Flood Maps for Surface Water Flooding (uFMfSW)

Drawn	Checked	Approved	Date
CB	JS	MT	23/07/2014

URS Internal Project No. 47070547 — Scale at A3 1:15,000

URS

Drawing Number: FIGURE 3 i — Rev 1

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LEGEND

- London Borough Camden Boundary
- Critical Drainage Area
- Flooded Streets (2002)
- Flooded Streets (1975)

LBC Historic SW Flooding Records
No. Properties affected
- 1
- 2

Risk of Flooding from Surface Water
- High (1 in 30 year)
- Medium (1 in 100 year)
- Low (1 in 1000 year)
- Very Low (<1 in 1000 year)

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: Updated Flood Maps for Surface Water Flooding (uFMfSW)

Drawn	Checked	Approved	Date
CB	JS	MT	03/07/2014

URS Internal Project No. 47070547 | Scale at A3 1:15,000

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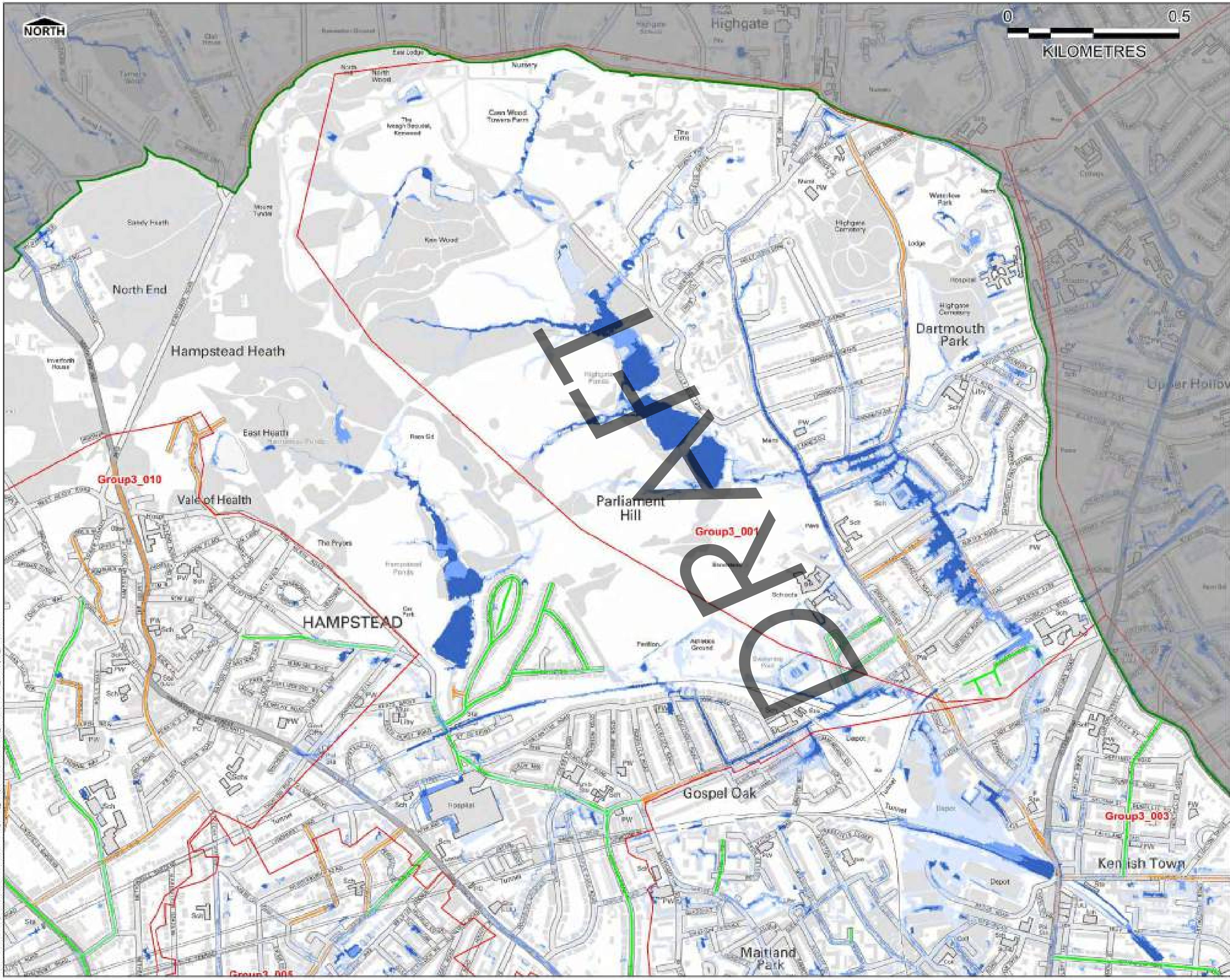
Drawing Number: FIGURE 3 ii | Rev 1



LEGEND

London Borough Camden Boundary

Critical Drainage Area

Flooded Streets (2002)

Flooded Streets (1975)

Risk of Flooding from Surface Water

High (1 in 30 year)

Medium (1 in 100 year)

Low (1 in 1000 year)

Very Low (<1 in 1000 year)

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

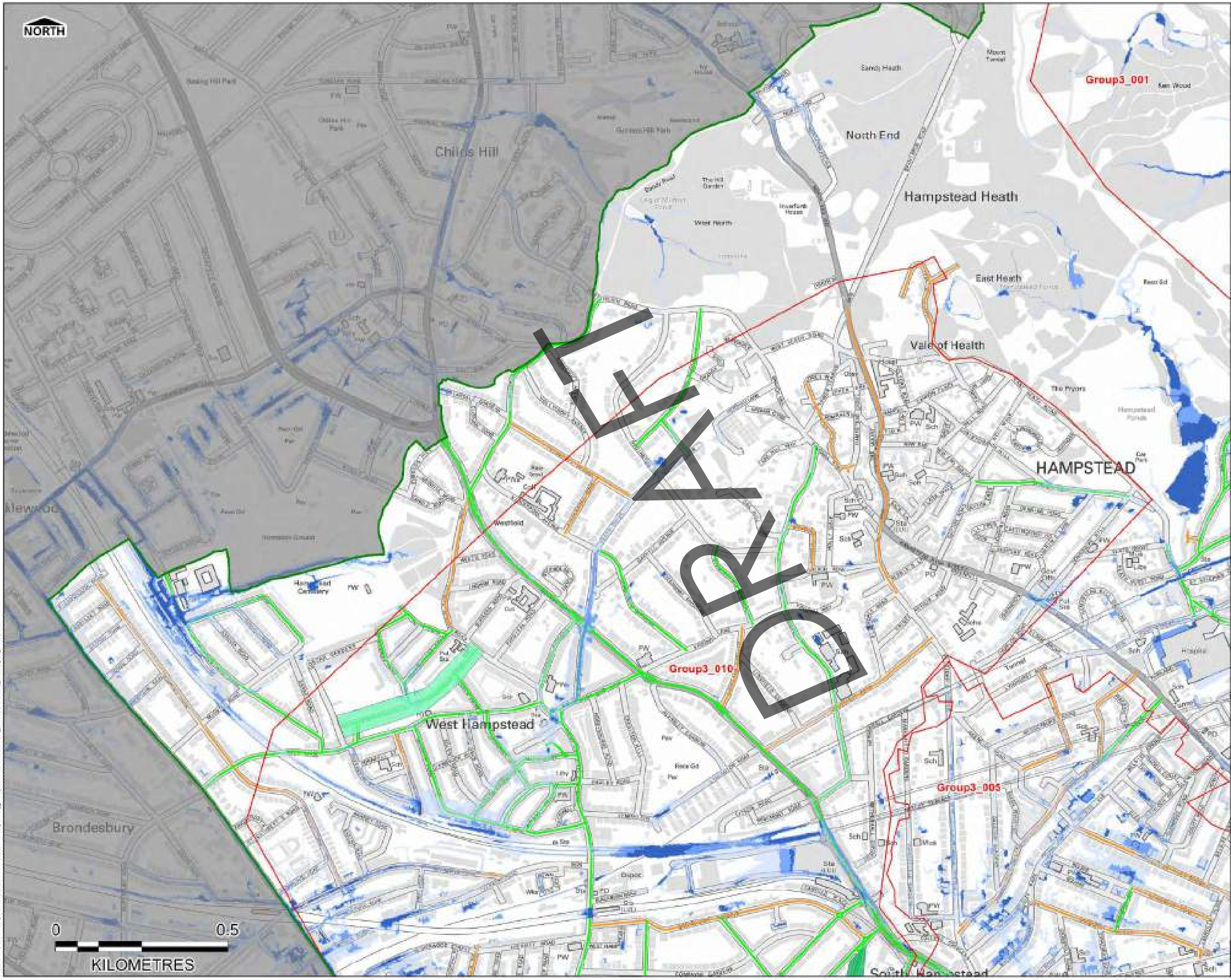
Drawing Title: Updated Flood Maps for Surface Water Flooding (uFMfSW)

Drawn	Checked	Approved	Date
CB	JS	MT	03/07/2014

URS Internal Project No.	Scale at A3
47070547	1:15,000

URS Infrastructure & Environment UK Limited

Drawing Number	Rev
FIGURE 3 iii	Rev 1



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LEGEND

- London Borough Camden Boundary
- Critical Drainage Area
- Flooded Streets (2002)
- Flooded Streets (1975)

LBC Historic SW Flooding Record No. Properties affected

- 1
- 2

Risk of Flooding from Surface Water

- High (1 in 30 year)
- Medium (1 in 100 year)
- Low (1 in 1000 year)
- Very Low (<1 in 1000 year)

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: Updated Flood Maps for Surface Water Flooding (uFMfSW)

Drawn	Checked	Approved	Date
CB	JS	MT	03/07/2014

URS Internal Project No. 47070547 | Scale at A3 1:15,000

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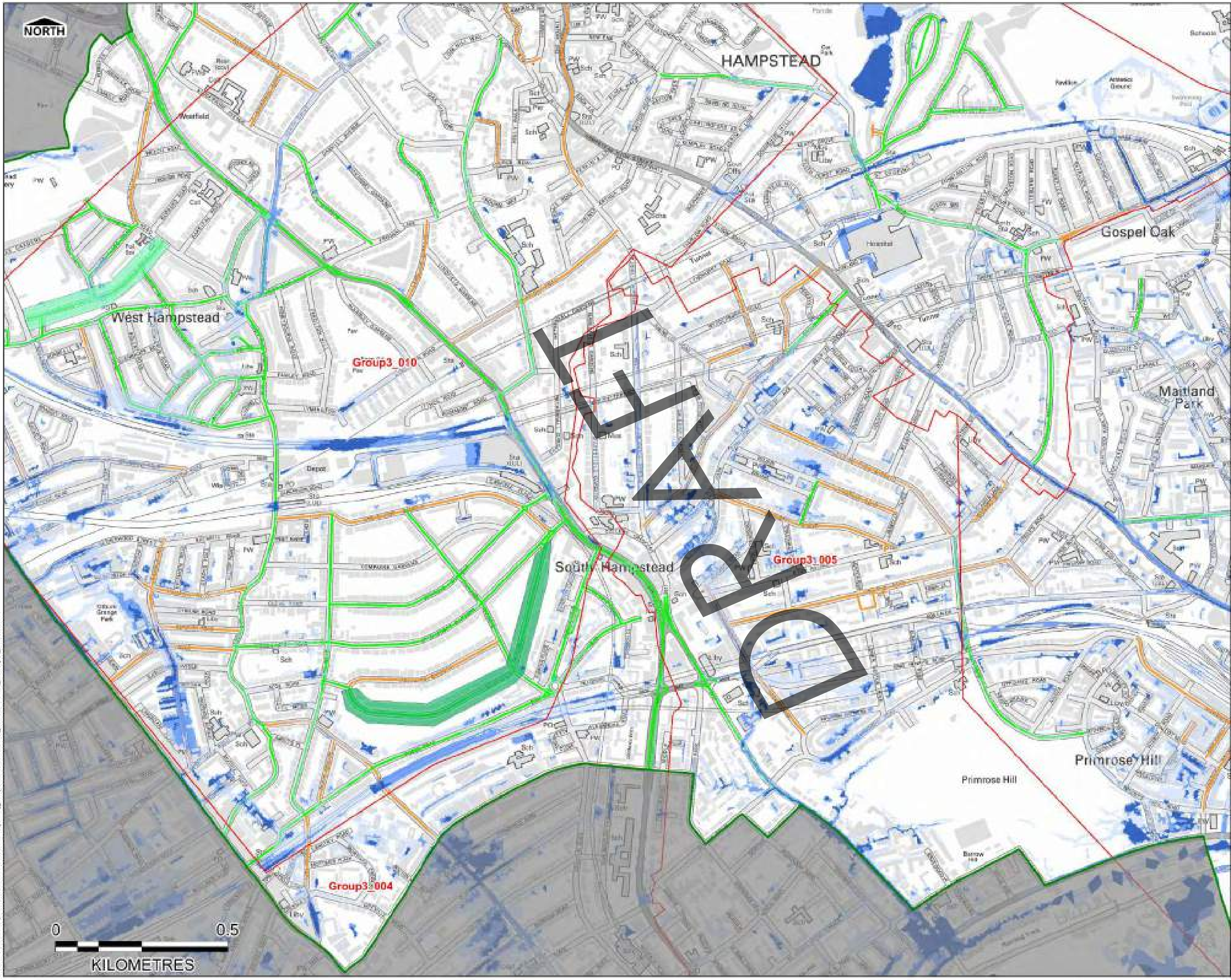
URS

Drawing Number: FIGURE 3 iv | Rev: Rev 1



LEGEND

- London Borough Camden Boundary
- Critical Drainage Area
- Flooded Streets (2002)
- Flooded Streets (1975)

LBC Historic SW Flooding Record No. Properties affected

- 1
- 2

Risk of Flooding from Surface Water

- High (1 in 30 year)
- Medium (1 in 100 year)
- Low (1 in 1000 year)
- Very Low (<1 in 1000 year)

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: Updated Flood Maps for Surface Water Flooding (uFMfSW)

Drawn	Checked	Approved	Date
CB	JS	MT	03/07/2014

URS Internal Project No. 47070547 — Scale at A3 1:15,000

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Drawing Number: FIGURE 3 v — Rev 1

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

LEGEND

London Borough Camden Boundary

Flood Hazard (m)

- >2.5 Extreme (Danger for all)
- 1.25 - 2.5 Significant (Danger for most)
- 0.75 - 1.25 Moderate (Danger for some)
- <0.75 Low (Caution)

Revision Details | By | Check | Date | Suffix

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: **Hazard: 1 in 1000 Year Flood Event**

Drawn	Checked	Approved	Date
CB	EY	MT	02/07/2014

URS Internal Project No.	Scale at A3
47070547	1:15,000

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Drawing Number: FIGURE 3 vi | Rev: Rev 1

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LEGEND

London Borough Camden Boundary

Flood Hazard (m)

- >2.5 Extreme (Danger for all)
- 1.25 - 2.5 Significant (Danger for most)
- 0.75 - 1.25 Moderate (Danger for some)
- <0.75 Low (Caution)

Revision Details | By | Check | Date | Suffix

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: **Hazard: 1 in 1000 Year Flood Event**

Drawn	Checked	Approved	Date
CB	EY	MT	02/07/2014

URS Internal Project No.	Scale at A3
47070547	1:15,000

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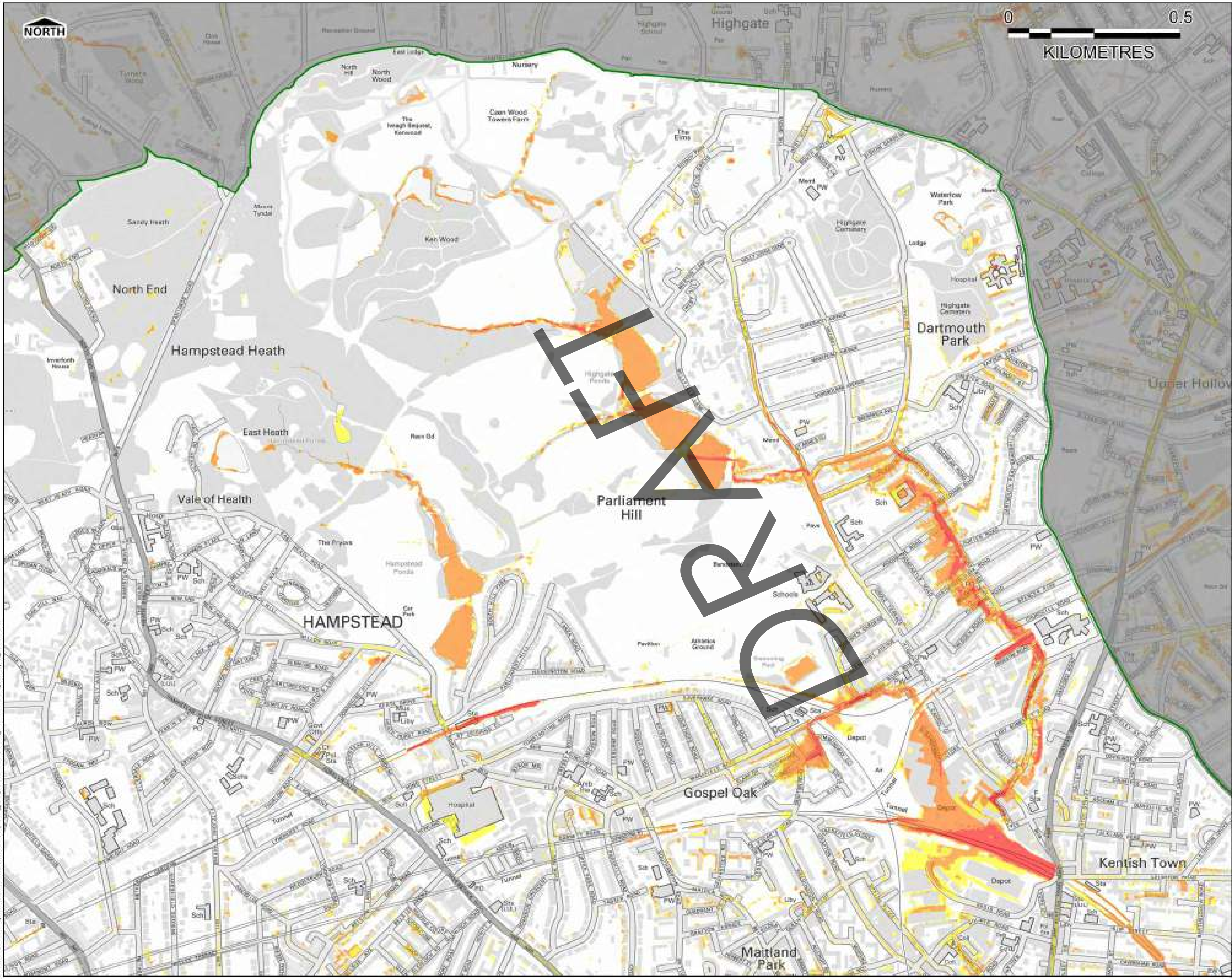
Drawing Number: **FIGURE 3 vii** | Rev: **Rev 1**



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LEGEND

London Borough Camden Boundary

Flood Hazard (m)

- >2.5 Extreme (Danger for all)
- 1.25 - 2.5 Significant (Danger for most)
- 0.75 - 1.25 Moderate (Danger for some)
- <0.75 Low (Caution)

Revision Details | By | Check | Date | Suffix

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: **Hazard: 1 in 1000 Year Flood Event**

Drawn	Checked	Approved	Date
CB	EY	MT	02/07/2014

URS Internal Project No.: 47070547 | Scale at A3: 1:15,000

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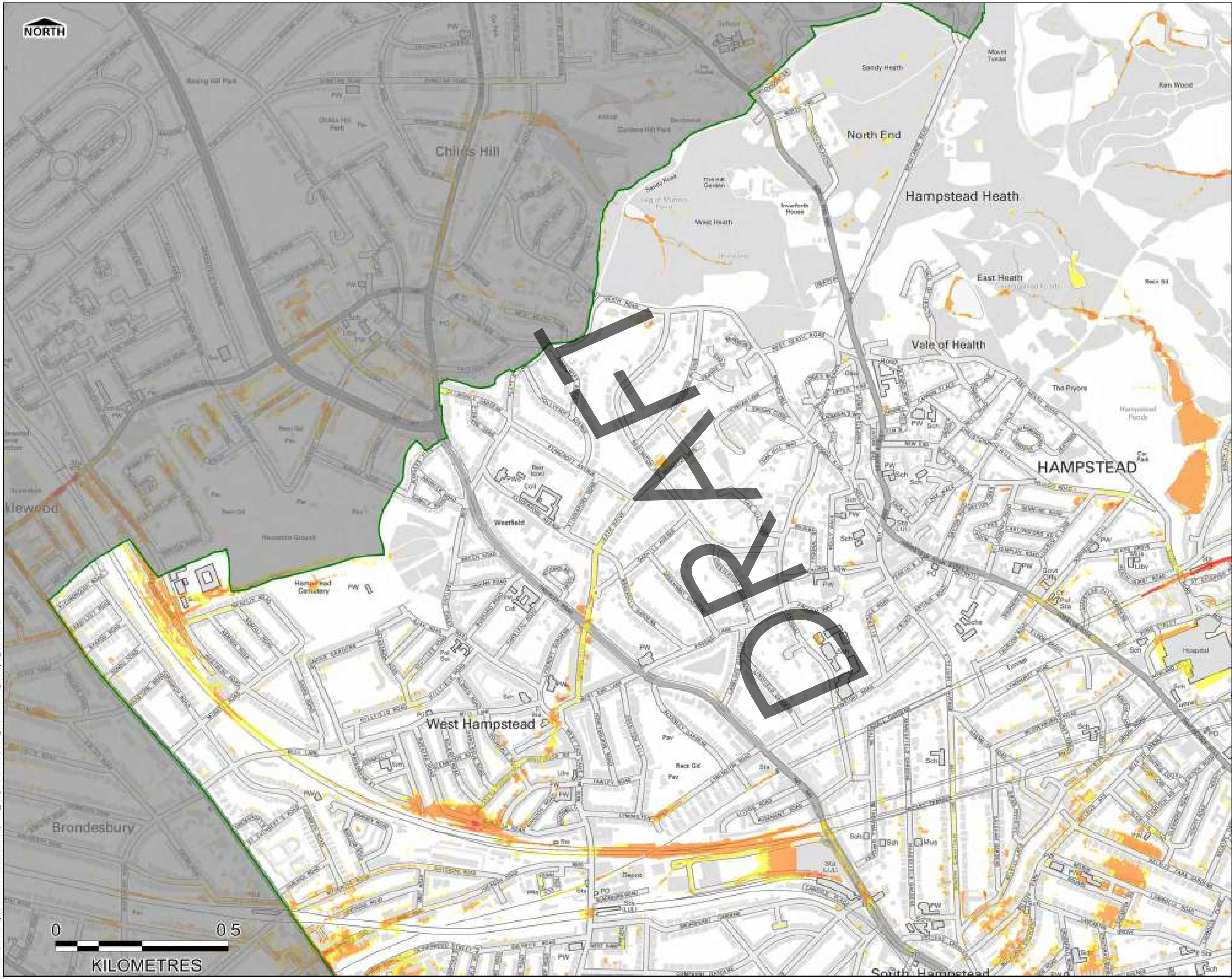
Drawing Number: FIGURE 3 viii | Rev: Rev 1



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LEGEND

London Borough Camden Boundary

Flood Hazard (m)

- >2.5 Extreme (Danger for all)
- 1.25 - 2.5 Significant (Danger for most)
- 0.75 - 1.25 Moderate (Danger for some)
- <0.75 Low (Caution)

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Revision Details | By | Check | Date | Suffix

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: **Hazard: 1 in 1000 Year Flood Event**

Drawn	Checked	Approved	Date
CB	EY	MT	02/07/2014

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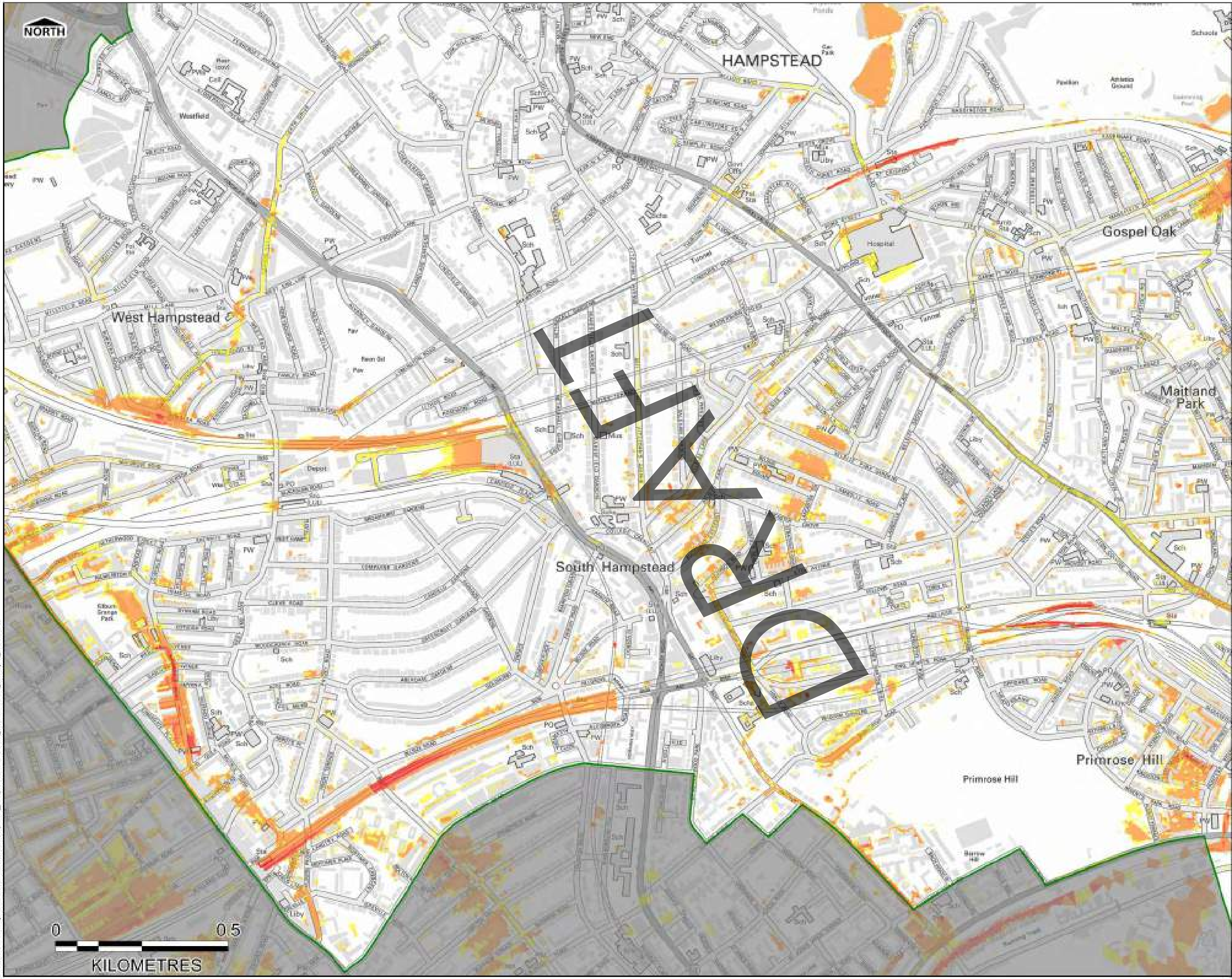
Drawing Number: **FIGURE 3 ix** | Rev: **Rev 1**



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Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: **Hazard: 1 in 1000 Year Flood Event**

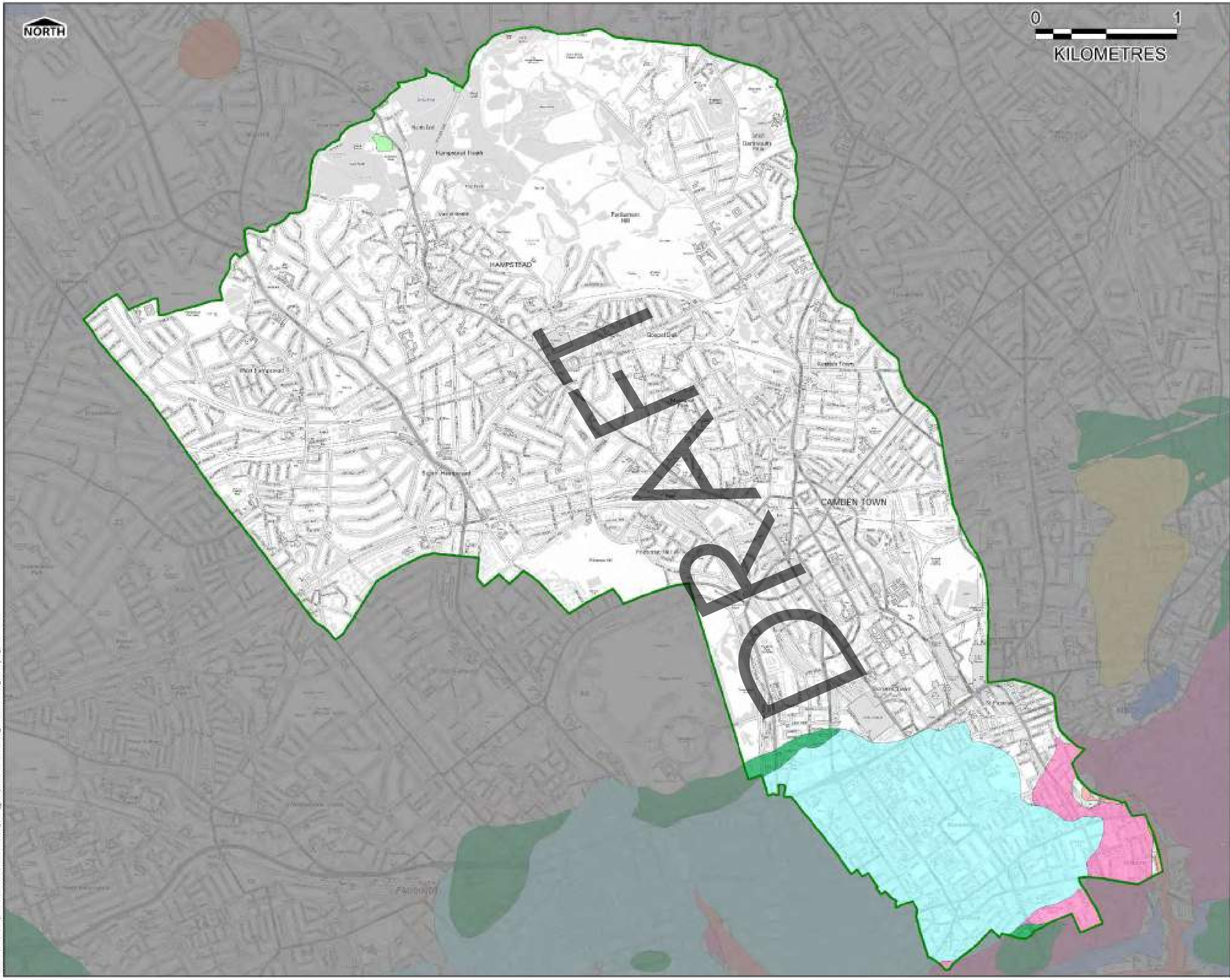
Drawn	Checked	Approved	Date
CB	EY	MT	02/07/2014

URS Internal Project No. 47070547 — Scale at A3 1:15,000

URS Infrastructure & Environment UK Limited

URS

Drawing Number: **FIGURE 3 x** — Rev: **Rev 1**



LEGEND

- London Borough Camden Boundary
- HACKNEY GRAVEL
- LANGLEY SILT
- LYNCH HILL GRAVEL
- STANMORE GRAVEL

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: British Geological Society Superficial Deposits Geology

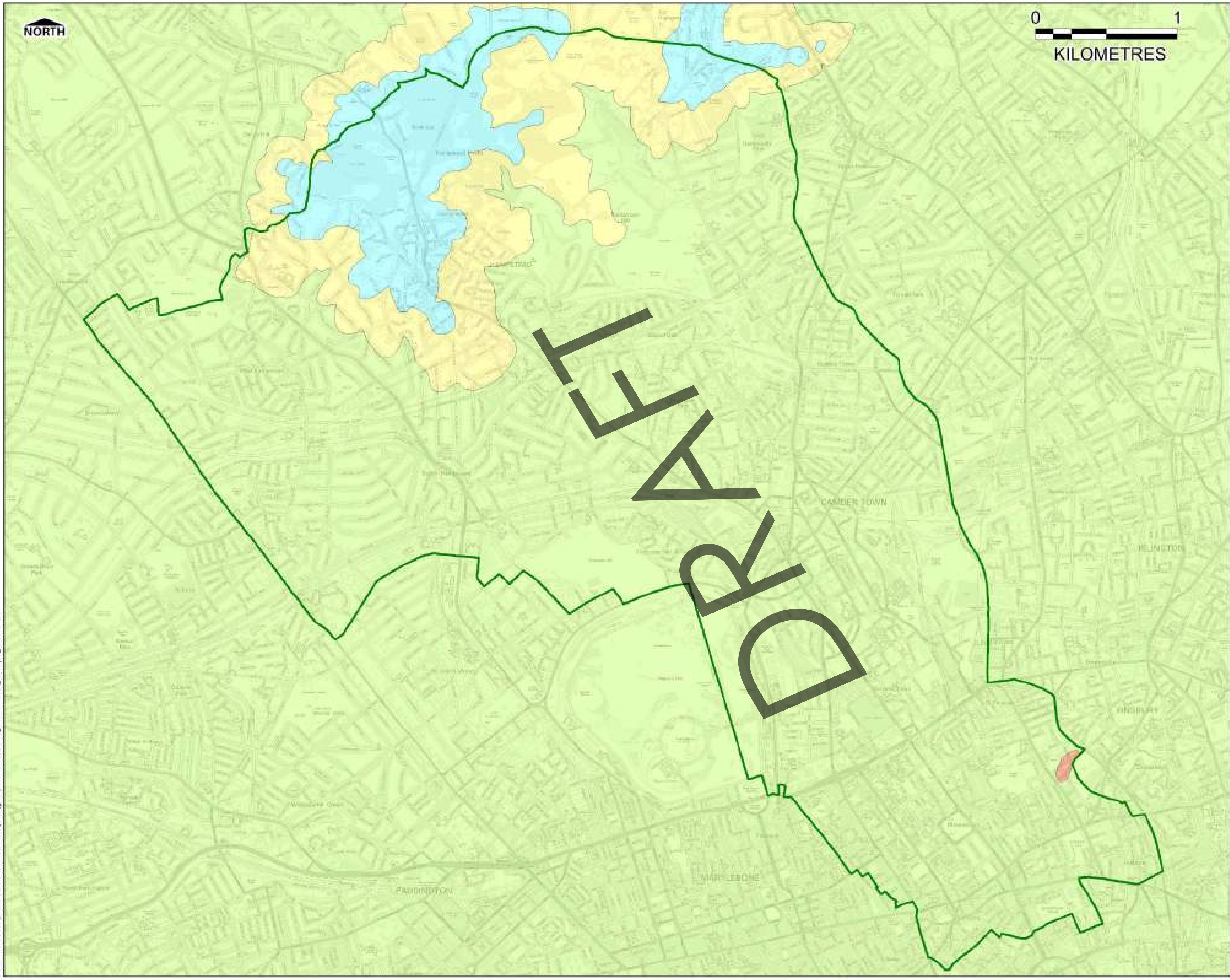
Drawn	Checked	Approved	Date
CB	JS	MT	29/07/2014

URS Internal Project No.	Scale at A3
47070547	1:40,000

URS

Drawing Number: FIGURE 4a

Rev 1



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LEGEND

- London Borough Camden Boundary
- Bagshot Formation
- Claygate Member
- Lambeth Group
- London Clay Formation

Revision Details | By | Check | Date | Suffix

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: British Geological Society Bedrock Geology

Drawn	Checked	Approved	Date
CB	JS	MT	23/07/2014

URS Internal Project No.	Scale at A3
47070547	1:40,000

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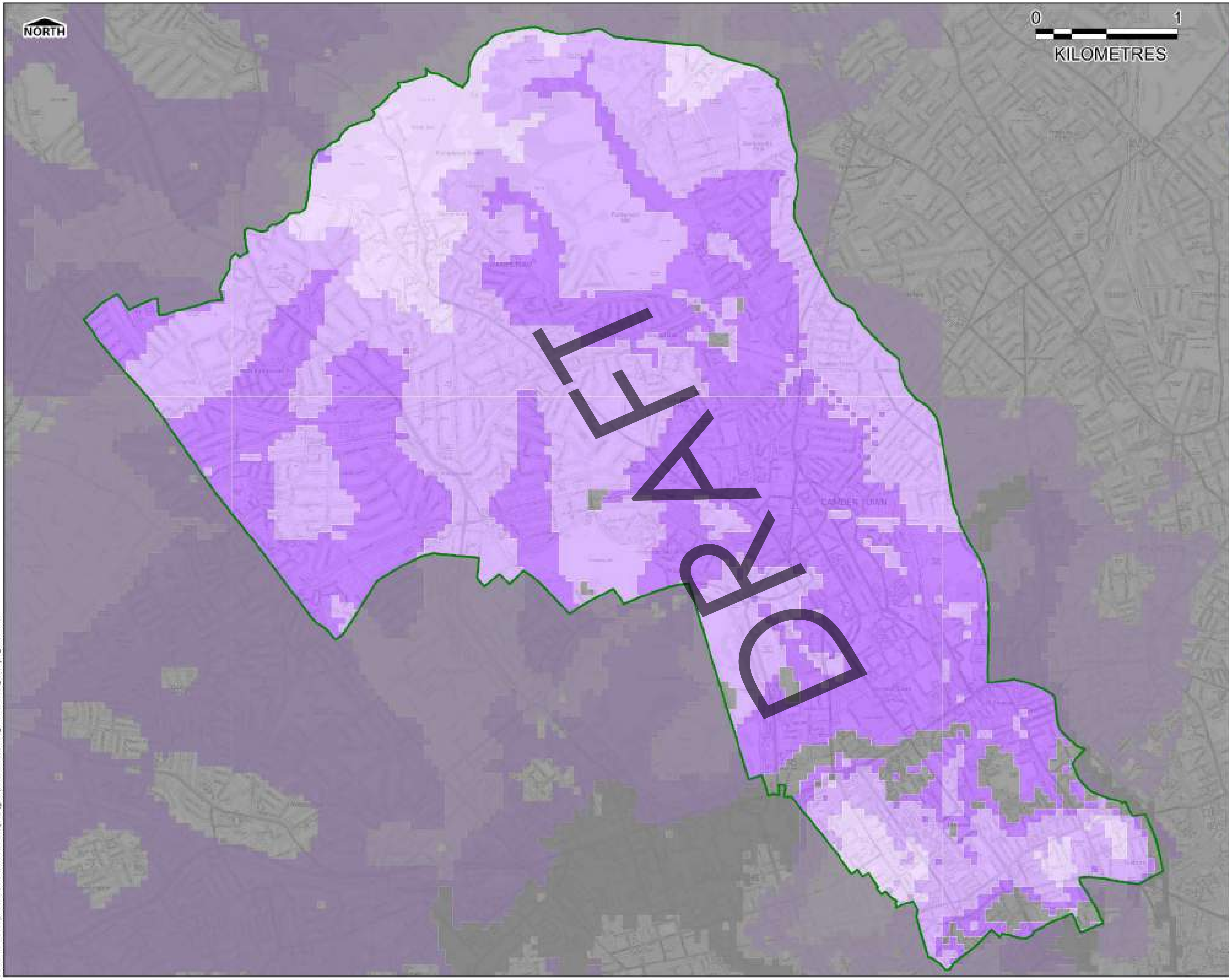
URS

Drawing Number: FIGURE4b

Rev: Rev 1



LEGEND

London Borough Camden Boundary

BGS Infiltration SuDS Map

Highly compatible for infiltration SuDS

Probably compatible for infiltration SuDS

Opportunities for bespoke infiltration SuDS

Very significant constraints are indicated

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Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: British Geological Society SuDS Drainage Potential

Drawn	Checked	Approved	Date
CB	JS	MT	29/07/2014

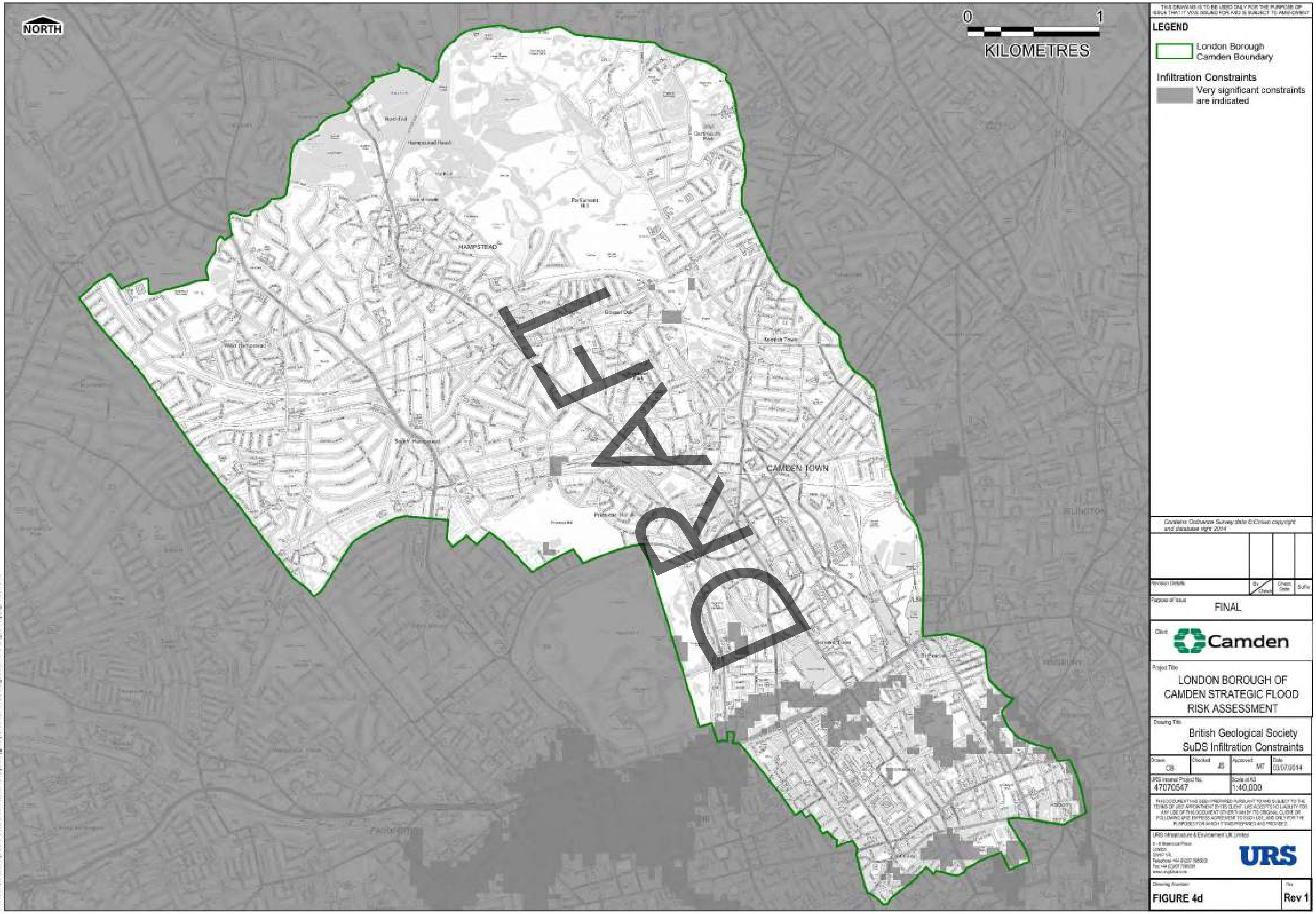
URS Internal Project No.: 47070547

Scale at A3: 1:40,000

URS

FIGURE 4c

Rev 1


NORTH
0
1
KILOMETRES
HAMPSTEAD
CAMDEN TOWN
DRAFT
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LEGEND
London Borough Camden Boundary
Infiltration Constraints
Very significant constraints are indicated
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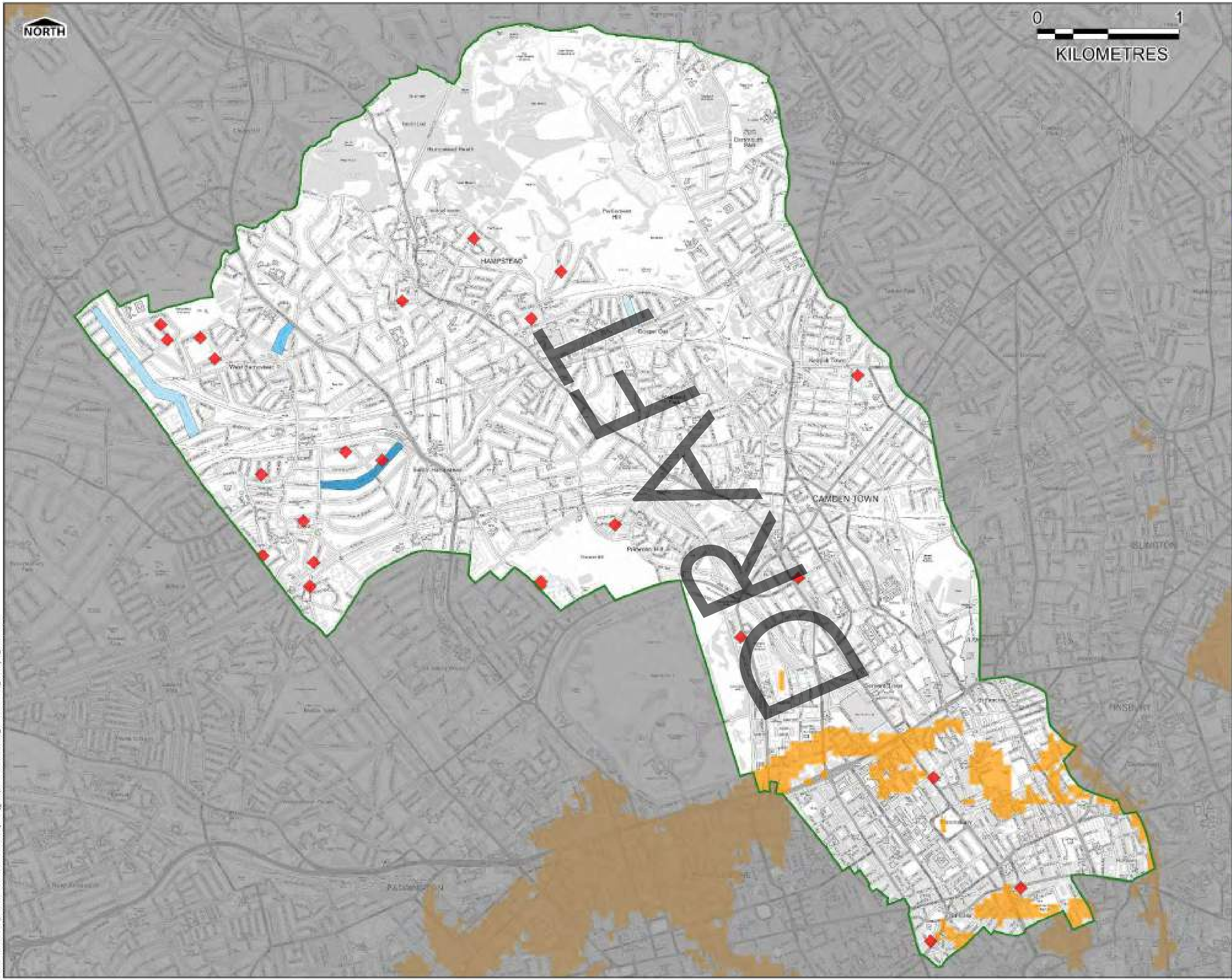
Revision Details
Purpose of Issue
FINAL
Client
Camden
Project Title
LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT
Drawing Title
British Geological Society SuDS Infiltration Constraints
Drawn CB
Checked JB
Approved MT
Date 03/07/2014
URS Internal Project No. 47070547
Scale at A3 1:40,000
URS
FIGURE 4d
Rev 1



LEGEND

London Borough Camden Boundary

LBC Historic GW Flooding Record No. Properties affected

1
6
7
8

Increased Susceptibility to Elevated Groundwater

Environment Agency groundwater flood incidents

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

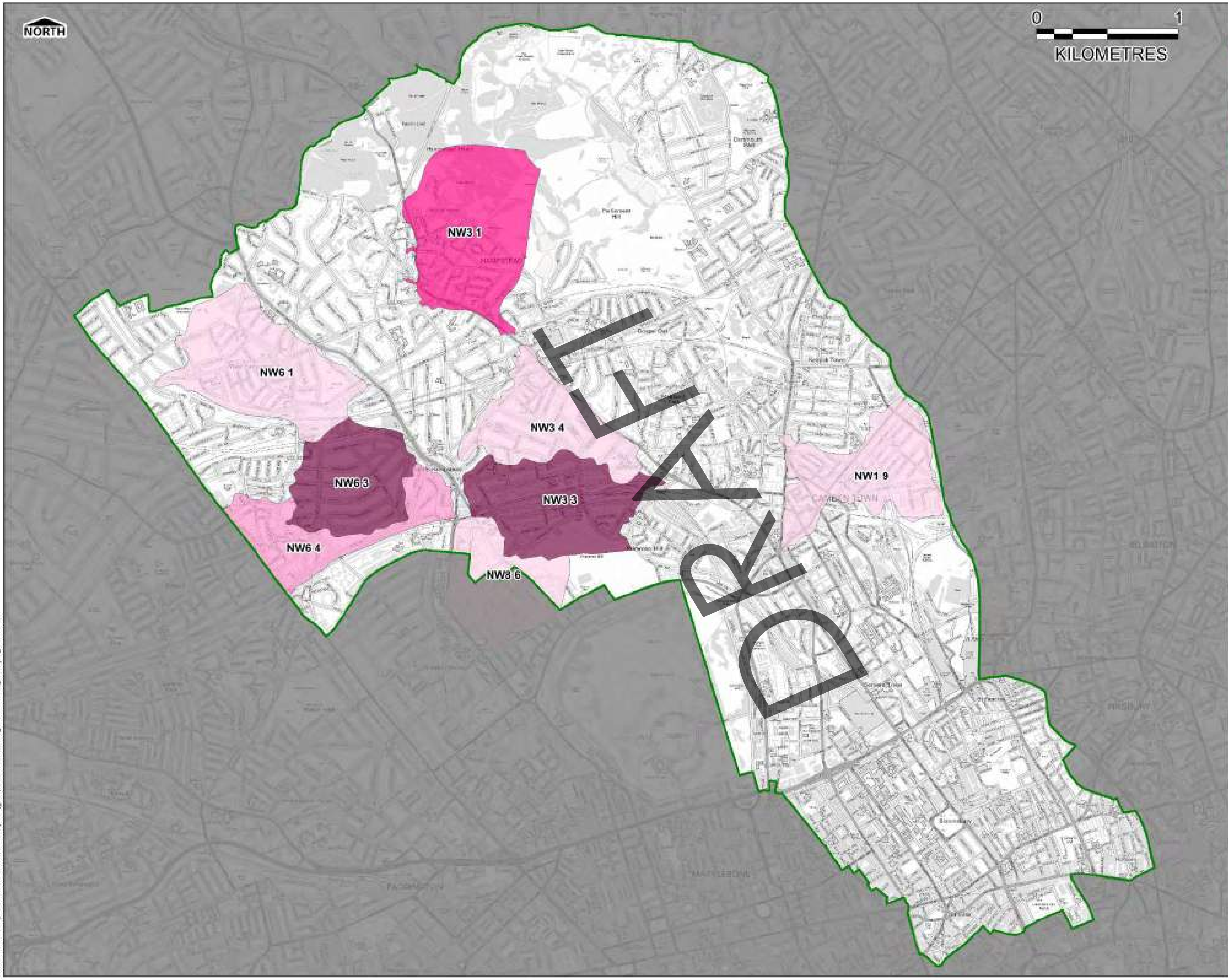
Drawing Title: Increased Susceptibility to Elevated Groundwater

Drawn	Checked	Approved	Date
CB	JS	MT	23/07/2014

URS Internal Project No.: 47070547 | Scale at A3: 1: 40,000

URS

Drawing Number: FIGURE 4e | Rev 1



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LEGEND

London Borough Camden Boundary

Internal Sewer Flooding
No. of Properties affected

- 1
- 2
- 4
- 8

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: DG5 Internal Sewer Flooding

Drawn	Checked	Approved	Date
CB	JS	MT	23/07/2014

URS Internal Project No. 47070547 | Scale at A3 1:40,000

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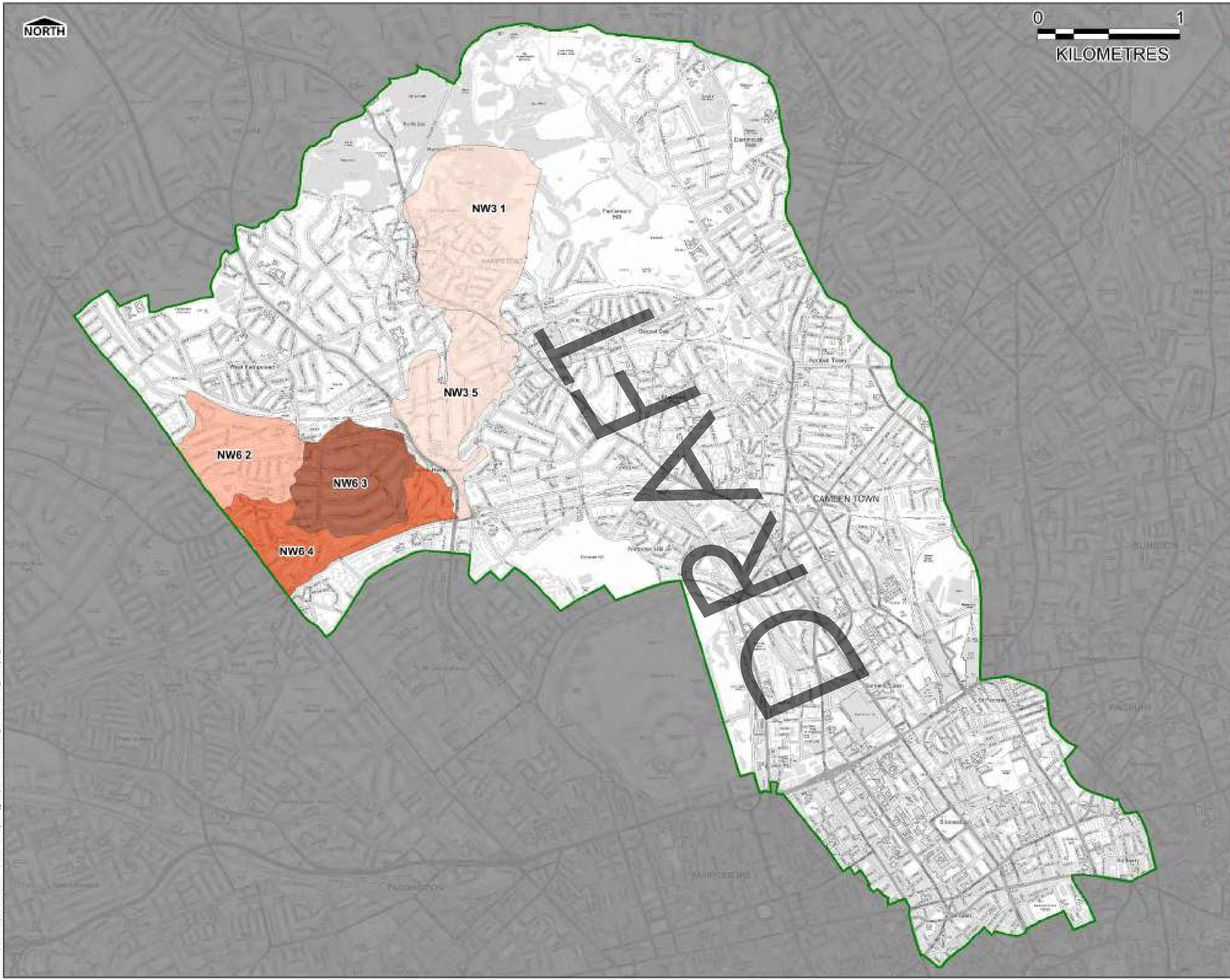
Drawing Number: FIGURE 5a | Rev: Rev 1



LEGEND

London Borough Camden Boundary

Exterior Sewer Flooding
No. of Properties affected

- 1
- 2
- 4
- 18

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: DG5 External Sewer Flooding

Drawn	Checked	Approved	Date
CB	JS	MT	03/07/2014

URS Internal Project No. 47070547 | Scale at A3 1:40,000

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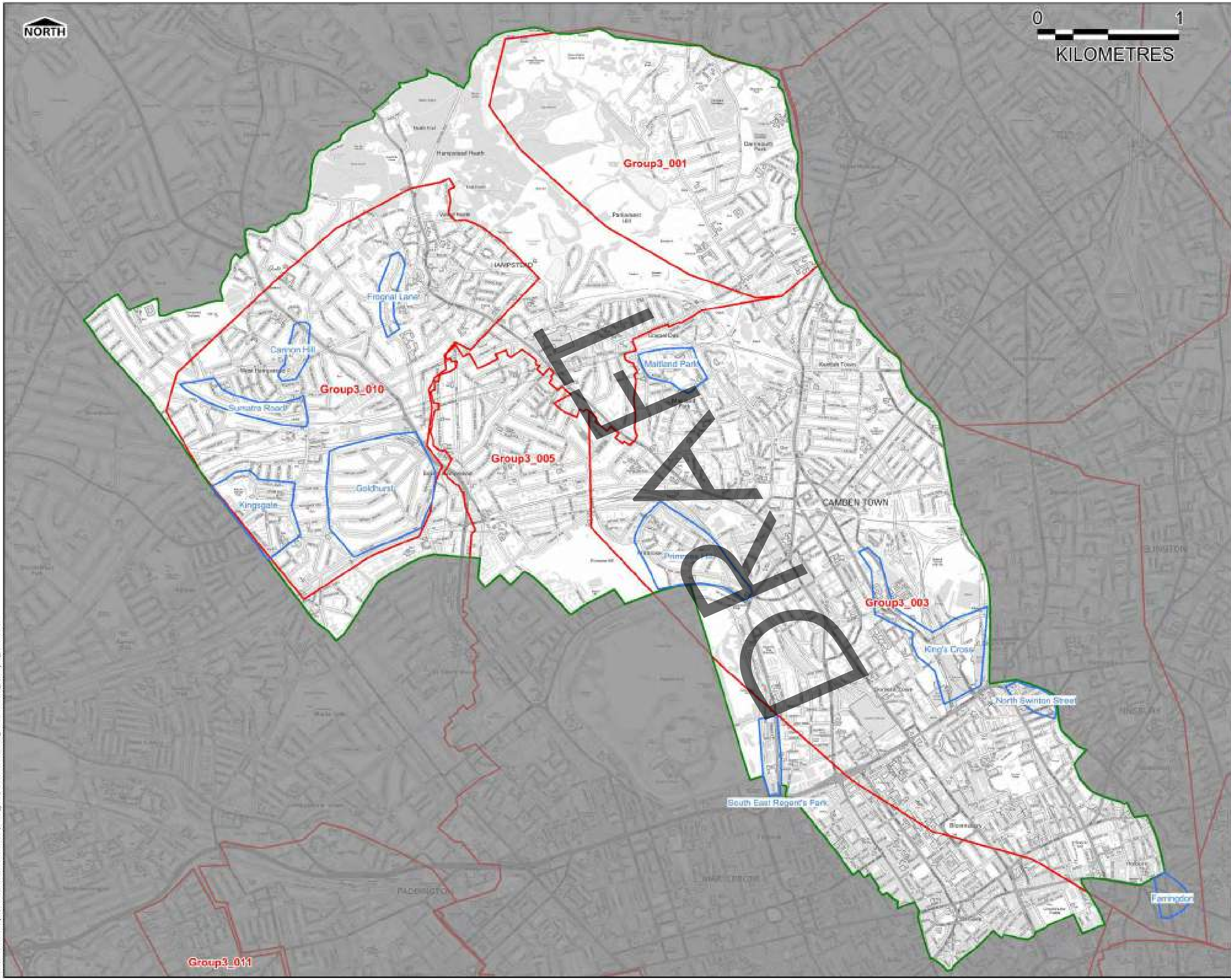
FIGURE 5b | Rev 1



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LEGEND

- London Borough Camden Boundary
- Critical Drainage Area
- Local Flood Risk Zone

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Revision Details | By | Check | Date | Suffix

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: Critical Drainage Areas / Local Flood Risk Zones

Drawn	Checked	Approved	Date
CB/EB	EY	MT	04/06/2014

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Drawing Number: FIGURE 6

Rev: Rev 2

Preliminary flood risk assessment: London Borough of Camden

This addendum by London Borough of Camden (2017) updates the council's preliminary flood risk assessment report published in 2011. Read the addendum in conjunction with the preliminary assessment report.

Addendum

The preliminary flood risk assessment (PFRA) and flood risk areas (FRAs) for London Borough of Camden were reviewed during 2017, using all relevant current flood risk data and information.

Camden's Strategic Flood Risk Assessment (SFRA) was published in 2014 and provides comprehensive information on the risk and consequences of flooding from all sources in the borough. The SFRA confirms the findings of the Preliminary Flood Risk Assessment.

Past flood risk

There have been no recorded floods in Camden since 2002.

Future flood risk

Future flood risk was assessed as part of the 2011 Preliminary Flood Risk Assessment using the London wide Drain London model. Camden then commissioned an update to this model which is referred to in Annex 2. The modelling approach involved expanding the underlying Thames Water model to enable better modelling of overland flows and the effect of direct rainfall on open space. Gullies were also simulated by increasing the flow co-efficient in and out of manholes from 0.5 to 0.8. The supplied Thames Water model was verified but not calibrated by Thames Water. The enhanced model did not materially or significantly alter the findings of the Drain London model but provided a framework for Initial Assessments various key flood risk locations.

The initial assessment work (also detailed in Annex 2) typically took the Enhanced Model and added more detailed site specific information, for example precise gully locations and curb heights. In all instances the level of flood risk decreased from the Drain London model suggesting that the former was overstating flood risk in Camden.

In addition to the enhanced modelling work, the City of London completed the Hampstead Heath dam restoration project in 2015/16. This project substantially increases the standard of protection to residents down-stream from the Heath reservoirs.

Flood risk areas (FRAs)

The following FRA has been identified for the purposes of the Flood Risk Regulations (2009) 2nd planning cycle:

- Greater London (includes the whole of Camden, as in the first cycle)

Other changes

The SFRA and local flood risk management strategy (LFRMS) have both been published since the 2011 PRFA. The FRMS in particular defines Camden's approach to its duties under the Flood and Water Management Act.

London Borough of Camden
December 2017

LIT 10868

CATEGORY ARCHIVES: LONDON’S LOST RIVERS

London’s lost rivers

Posted on **January 3, 2012**

As the growth of London took hold in the Victorian Era many of the Thames’ tributaries were covered up, forced underground or simply built over!

So here’s some of the lost rivers…

Beverley Brook
Rises at Cuddington Recreation Park in Worcester Park, Beverley Brook flows through Wimbledon Common, Richmond Park and Barnes and joins the Thames at Barn Elms, near Putney Bridge. Its name derives from the presence of the European beaver, extinct in Britain since the 16th century.

Black Ditch

Counter's Creek

Rises in Kensal Green and flowing south through Little Wormwood Scrubs, Olympia and Earls Court to Sands End, where it flows into the Thames, Counter's Creek can still sometimes be spotted by commuters on the westbound platform of West Brompton tube station, but only after heavy rainfall. Its tidal mouth is known as Chelsea Creek. Chelsea FC's football grounds is known erroneously as Stamford Bridge because of confusion between Counter's Creek and Stamford Brook.

River Effra

Derived from the Celtic word for torrent (compare, in Welsh, 'ffrydlif'), the Effra rises from multiple sources, among others in Crystal Palace and near Westow Hill, flowing under Half Moon Lane in North Dulwich, towards Herne Hill train station, from there towards Brixton's Coldharbour Lane, Brixton Road, on to Kennington and then ending in the Thames, near Vauxhall Bridge. In 1992, an arts project sparked a campaign to unearth the Effra.

River Falcon

The Falconbrook, or Falcon, springs on Tooting Bec Common, flows under Balham and enters the Thames at Battersea. It burst out of the pavement of Falcon Road (named after the stream) in Clapham Junction in July 2007 during floods that affected large parts of England.

River Fleet

There are two springs on Hampstead Heath, directed into two 18th century reservoirs (Highgate and Hampstead Ponds) thereafter combine to form London's largest underground river. The upper reaches were known as the hollow stream ('Holborn' in Anglo-Saxon, hence the name of that London area), its lower reaches as the Fleet (from Anglo-Saxon for 'estuary'). The Fleet flows under King's Cross, which was originally known as Battle Bridge, after a place where Queen Boudicca is reputed to have fought the Romans. It ends in the Thames under Blackfriars Bridge. The river gave its name to Fleet Street, which in turn became a collective term for the British press, as most newspapers had their offices there. It almost gave its name to a tube line, but since its opening coincided with the Queen's silver jubilee, the Fleet Line was named the Jubilee Line. On a quiet moment in front of the Coach and Horses pub in Ray Street, Farringdon, you can still hear the Fleet's flow through the grating. Another slightly more dangerous location for Fleet-spotting is the grid in the centre of Charterhouse Street where it joins Farringdon Road.

River Neckinger

Rising in Southwark, the Neckinger joins the Thames via St Saviour's Dock, where pirates were hanged in the 17th century. The river's name may derive from the term 'devil's neckcloth' (i.e. the noose). In the 19th century, the mouth of the Neckinger was known as Jacob's Island, a place of great poverty and squalor, described as the very capital of cholera and the Venice of drains. Charles Dickens lets one of his best-known characters, Bill Sykes (from Oliver Twist) meet a violent death in the mud of the Dock.

Parr's Ditch

River Peck

The Peck, springing in East Dulwich and running through Peckam, was enclosed in 1823. It can still be seen on the west side of Peckham Rye Park.

River Ravensbourne

The River Ravensbourne rises at Caesar's Well in Keston, flows through Bromley, Lewisham and Greenwich and is joined by several tributaries, among which the beautifully named River Quaggy (also known as Kyd Brook). It ends in the Thames in Greenwich Reach (also known as Deptford Creek), west of Greenwich proper. In 1580, Queen Elizabeth I knighted Francis Drake on board the Golden Hind in Deptford Creek after his circumnavigation of the globe.

Stamford Brook

Is the confluence of three smaller streams arising in West London, Stamford Brook flows into Hammersmith Creek before discharging into the Thames. Its name comes from 'stoney ford', and is remembered in Stamford Brook tube station. The stream was covered by 1900 and is now a sewer.

River Tyburn

Originates in South Hampstead, flowing through St James's Park and flowing into the Thames near Vauxhall Bridge in Pimlico, the Tyburn once branched to form the island of Thorney, the site of Westminster Abbey.

River Walbrook

This one starts in Finsbury, flowing straight through the middle of the most ancient part of the city and into the Thames at Cannon Street Railway Bridge, this river's name might derive from the fact that it flowed through or under the wall of Londinium, the Roman settlement on the site of present-day London. Legend has it that when London fell to the Saxons, these forced the original Celtic inhabitants to live on the east side of the river, while they lived on the west side of it – resulting in the still noticeable difference between London's affluent West End and a more working-class East End.

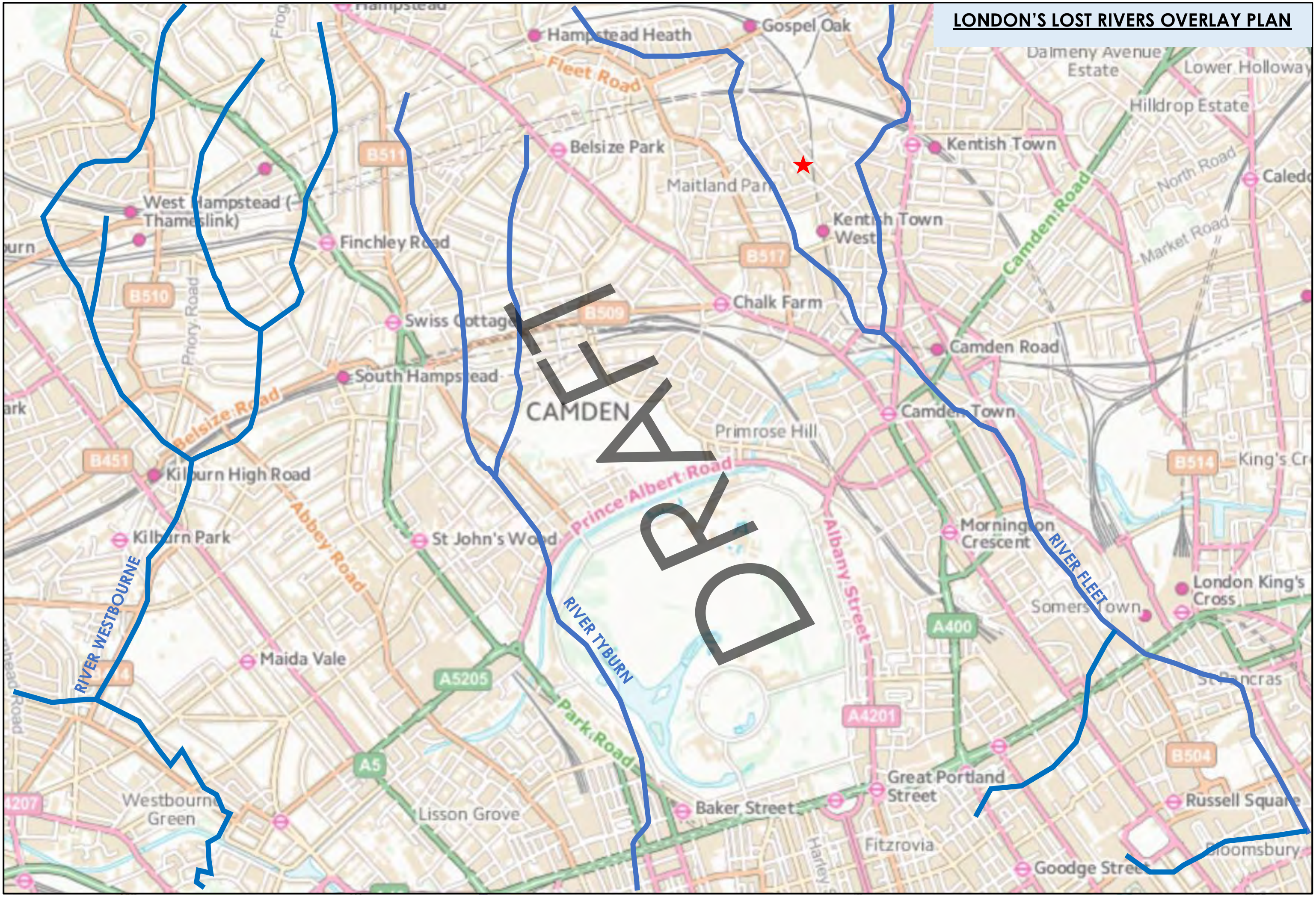
River Wandle

The River Wandle springs from two sources: one of the Waddon Ponds in Croydon and another at Carshalton Ponds. It flows through Sutton, Lambeth, Merton and finally Wandsworth, where it joins the Thames. Both Wandsworth and the Wandle get their names from Wendle, a Saxon who settled in the area. Exceptionally among London's 'lost' rivers, the Wandle is not subterranean for most of its length. Springing at Thornton Heath as the Norbury Brook, the river Graveney joins the Wandle near Summerstown.

River Westbourne

Flowing from Hampstead through Hyde Park onto Sloane Square and thence into the Thames, the River Westbourne has left its mark on London toponymy, mainly by the other names it has been called through the centuries: Kilburn, Bayswater, Serpentine, Bourne, Westburn Brook, Ranelagh and Ranelagh Sewer. Kilburn and Bayswater nowadays are well-known areas in

LONDON'S LOST RIVERS OVERLAY PLAN



APPENDIX H: SURFACE WATER RUN-OFF CALCULATIONS

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SURFACE WATER RUN-OFF CALCULATION SHEET

Development	128-130 Grafton Road, London
Project No.	HYD401

Revision	A	Completed by	KW
Date	03.04.2019	Checked by	RN

Areas

Total Site	0.026	ha	
Development Area[1]	0.026	ha	
Existing Impermeable	0.026	ha	
Existing Impermeable[2]	0.026	ha	100%
Existing Pervious	0.000	ha	
Existing Pervious[2]	0.000	ha	
Proposed total impermeable	0.026	ha	100%

Catchment Characteristics

SAAR	652	mm			
SPR	0.47				
BFI	0.182				
i_1	19.8	mm/hr	d_1	22.9	mm
i_{30}	41.8	mm/hr	d_{30}	64.0	mm
i_{100}	58.1	mm/hr	d_{100}	88.9	mm

Run-off Rates

Pre-development

Impermeable ------	1yr	1.4	l/s
	30yr	3.0	l/s
	100yr	4.2	l/s
	50mm/hr[3]	3.6	l/s
Pervious[4] ------	1yr	0.0	l/s
	30yr	0.0	l/s
	100yr	0.0	l/s
	QBar[5]	0.0	l/s
Total ------	1yr	1.4	l/s
	30yr	3.0	l/s
	100yr	4.2	l/s

Post-development (without control)

Impermeable[6] ------	1yr	1.4	l/s
	30yr	3.0	l/s
	100yr+40%CC	5.8	l/s

Volumes

Pre-development

Impermeable ------	1yr	0.6	cu.m
	30yr	1.7	cu.m
	100yr	2.3	cu.m
Pervious[4] ------	1yr	0.0	cu.m
	30yr	0.0	cu.m
	100yr	0.0	cu.m
Total ------	1yr	0.6	cu.m
	30yr	1.7	cu.m
	100yr	2.3	cu.m

Post-development

Impermeable[6] ------	1yr	0.6	cu.m
	30yr	1.7	cu.m
	100yr+40%CC	3.2	cu.m

Stormwater Storage Estimates

Based on Pre-Development Brownfield Situation

As the pre-development rates are below the minimum restricted rate typically accepted, the proposals will be to restrict the rate of run-off to no greater than 5l/s. This is the standard requirement accepted by the water and sewer authorities.

Microdrainage Quick Storage Estimates

Return Period	Rate		lower	upper	mean	
1yr	5.0	l/s	0	0.6	0.3	cu.m
30yr	5.0	l/s	0.8	4.1	2.45	cu.m
100yr+40%CC	5.0	l/s	5	10	7.5	cu.m

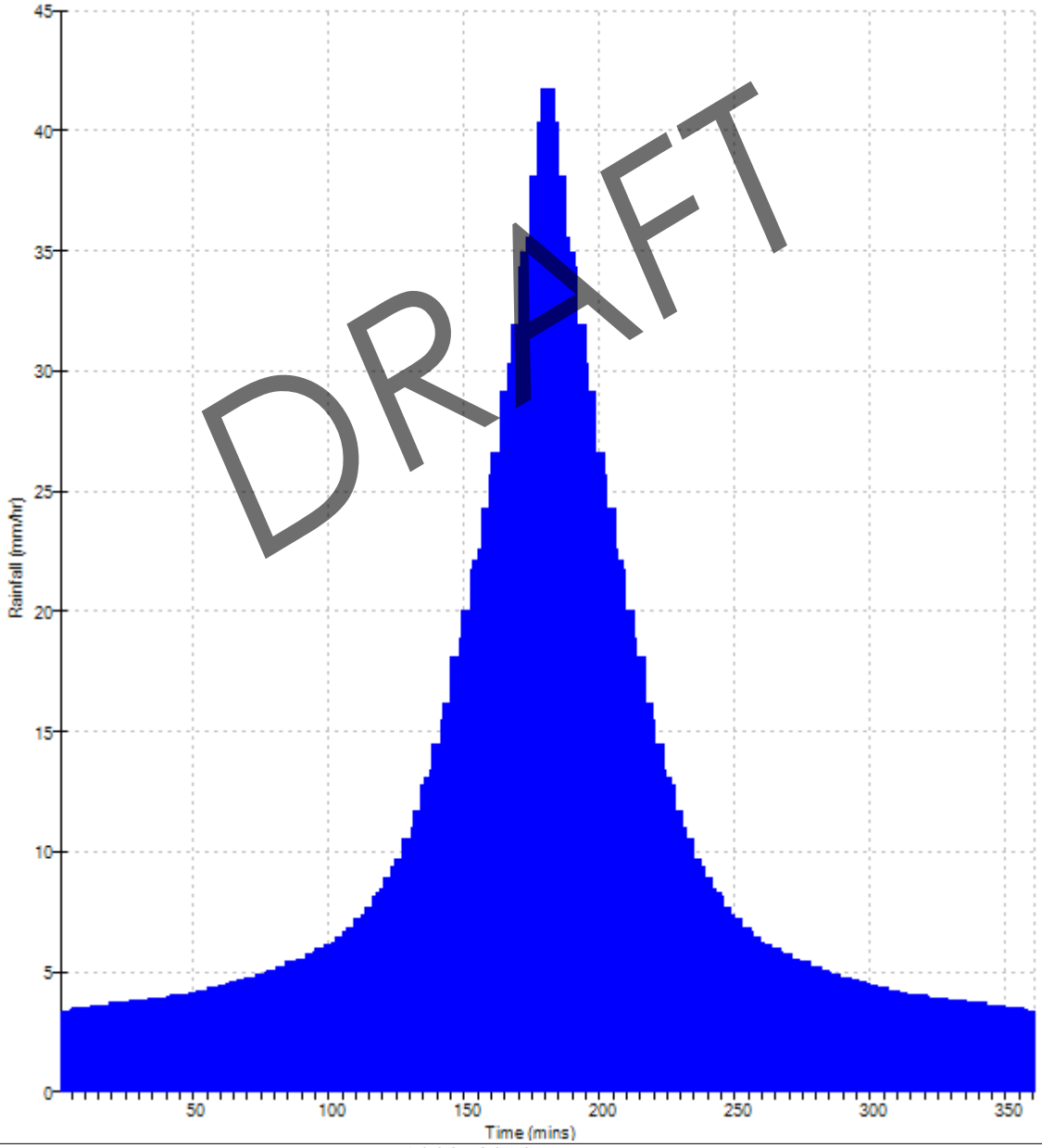
1/ The 'development area' removes areas of POS and/or landscaped areas of the wider site that are to remain as existing.
2/ On occasion the existing impermeable area cannot be evidenced to connect and a reduction is applied.
3/ 50mm/hr is used for BRegs calculations and often used by Water Companies when considering allowable post-development rates of discharge. (Rational Method)
4/ The Greenfield rates and of run-off have been calculated using the UK SUDS Calculator
5/ QBar is the estimated flood flow for the 2.33yr return period event and is often used as a post-development rate restriction.
6/ Post-development run-off is only considered from the impermeable area when the proposed post-development impermeable area >50% in accordance with the EA Guidance Preliminary rainfall runoff management for developments (W5-074/A/TR1/1 rev E (2012).

NB. The catchment characteristics are from the FEH catchment, the UK SUDS Calculator and Microdrainage.
NB. The rainfall intensities and depths are calculated for the 6hr duration rainfall event (peak summer intensity)

Rainfall profile

Storm duration (mins) 360

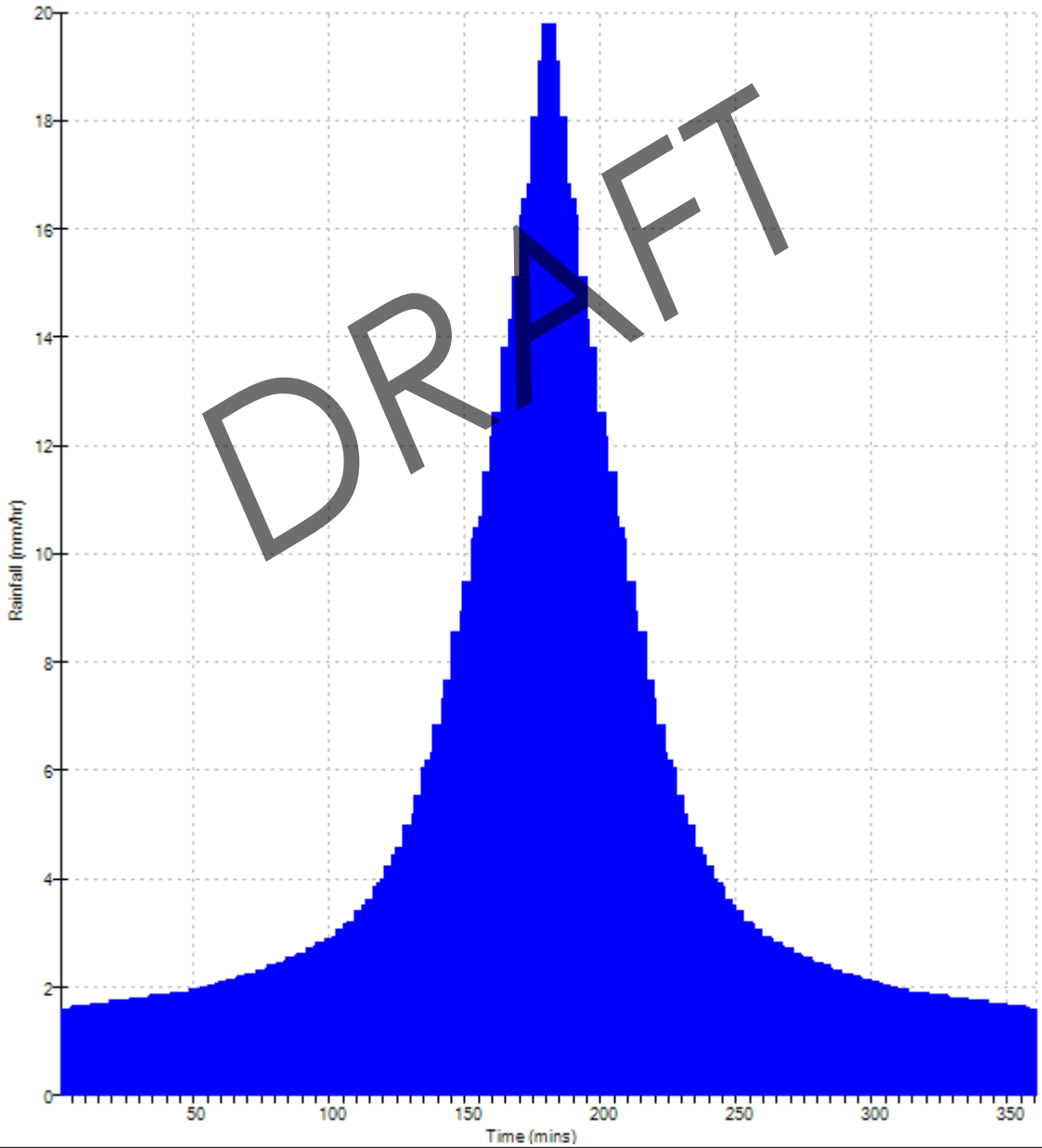
FEH Data	
FEH Rainfall Version	2013
Site Location GB	528509 185017
Data Type	Point
Peak Intensity (mm/hr)	41.786
Ave. Intensity (mm/hr)	10.660
Return Period (years)	30.0



Rainfall profile

Storm duration (mins) 360

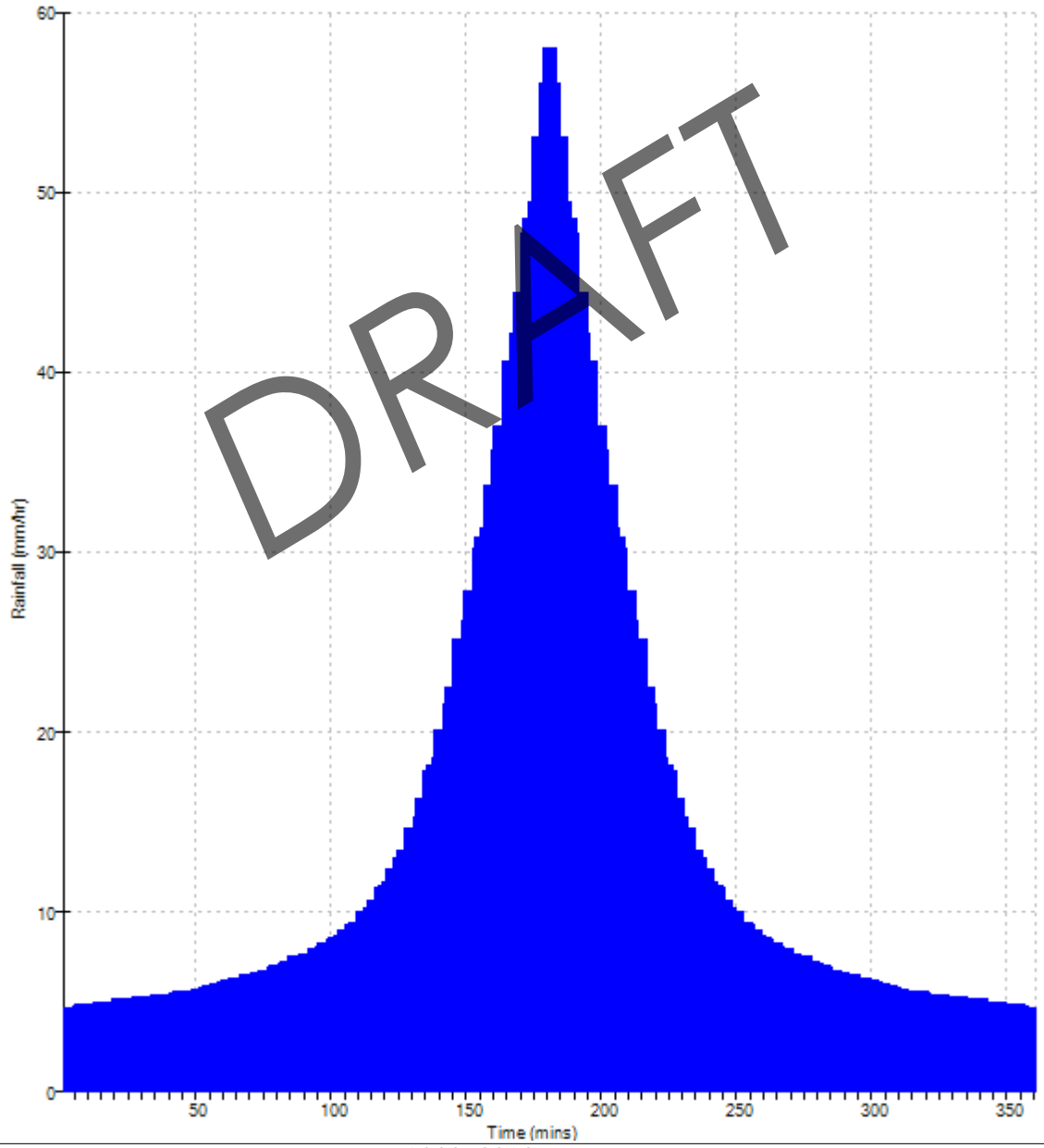
FEH Data	
FEH Rainfall Version	2013
Site Location GB	528509 185017
Data Type	Point
Peak Intensity (mm/hr)	19.783
Ave. Intensity (mm/hr)	5.047
Return Period (years)	2.0



Rainfall profile

Storm duration (mins) 360

FEH Data	
FEH Rainfall Version	2013
Site Location GB	528509 185017
Data Type	Point
Peak Intensity (mm/hr)	58.089
Ave. Intensity (mm/hr)	14.819
Return Period (years)	100.0



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APPENDIX I: STORMWATER STORAGE ESTIMATES

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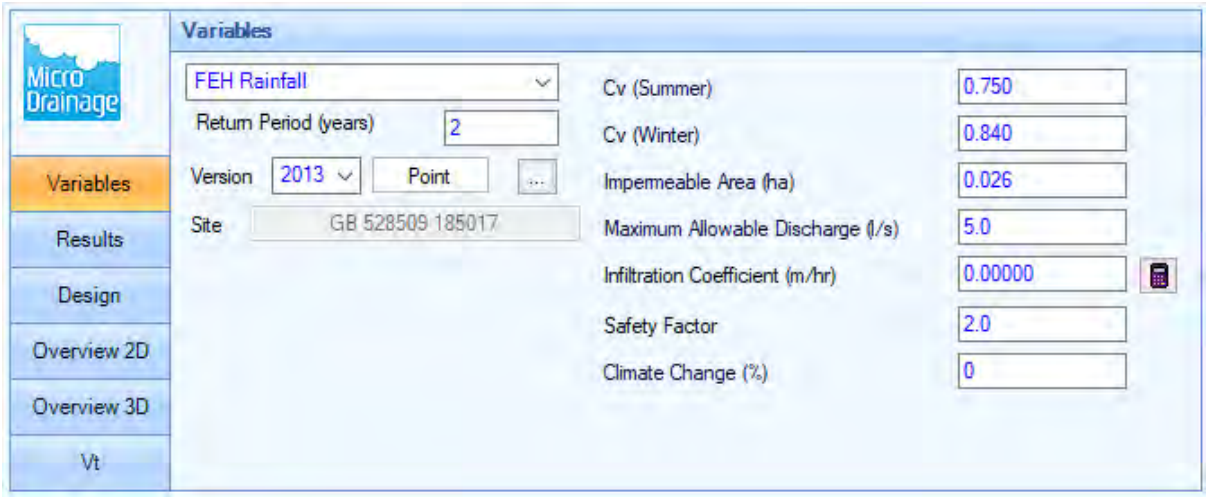
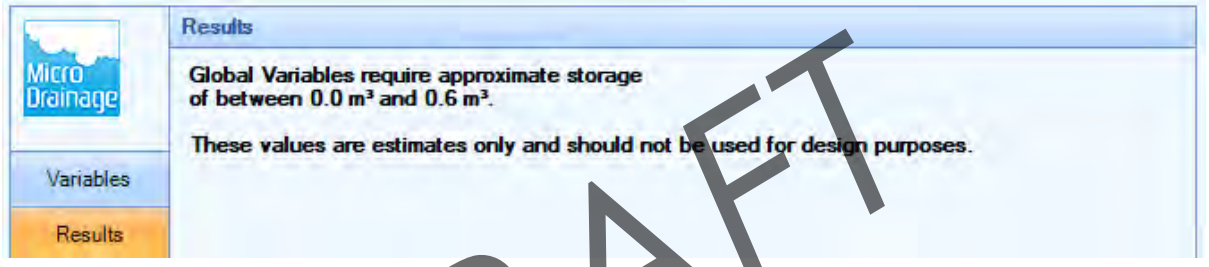
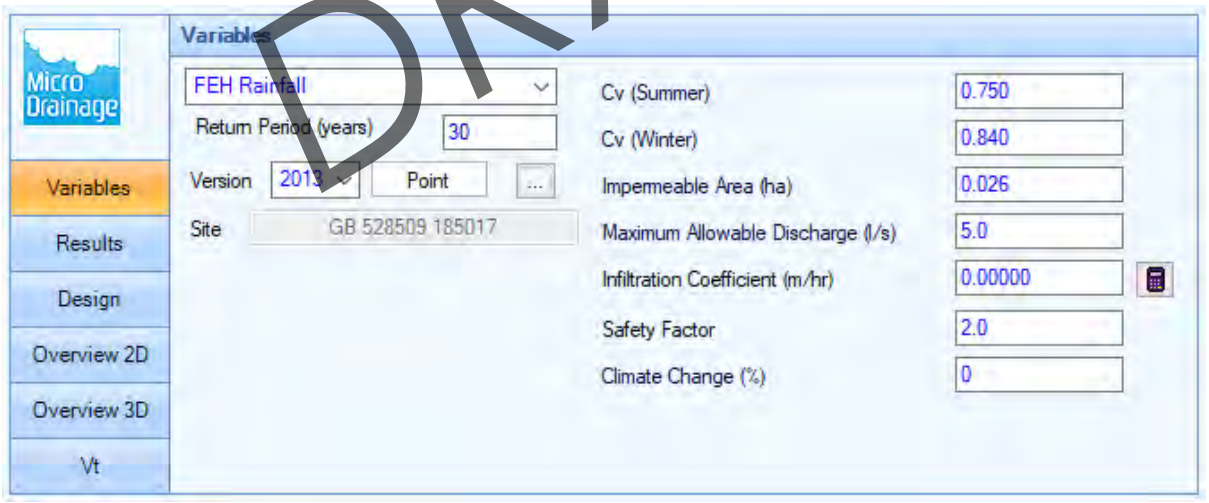
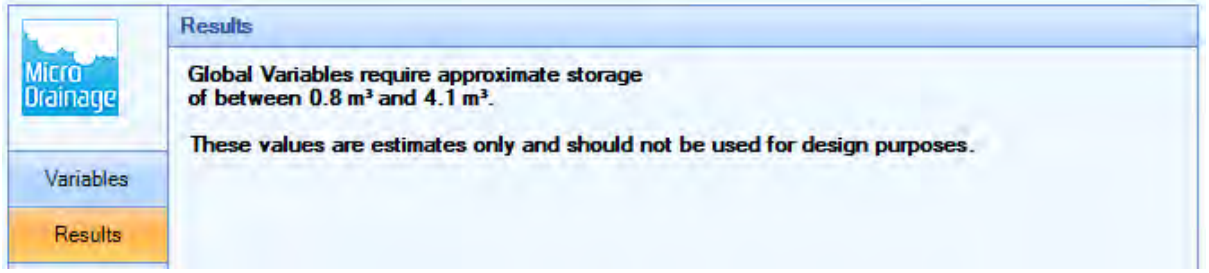
2 YEAR RETURN PERIOD STORM EVENT



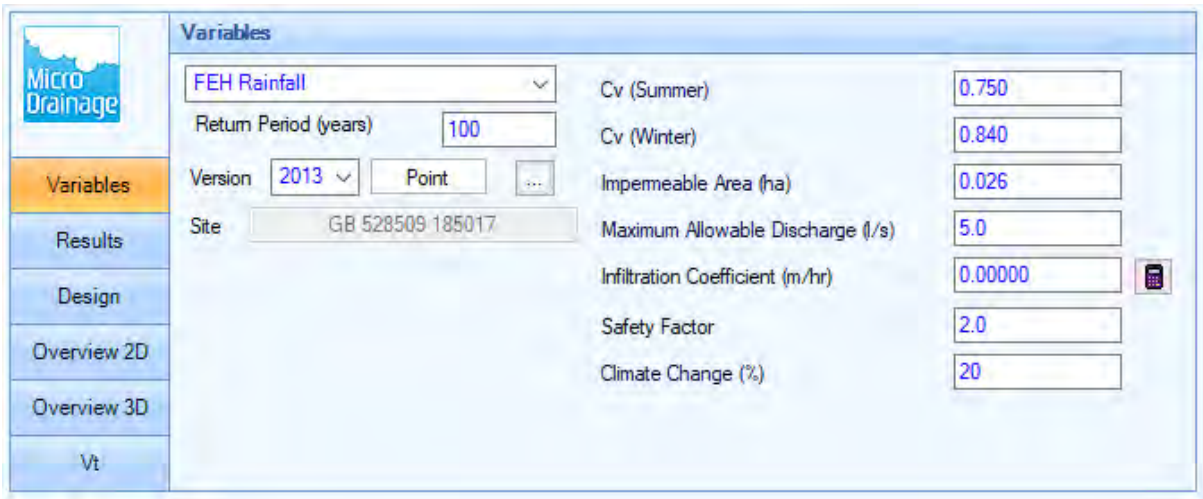


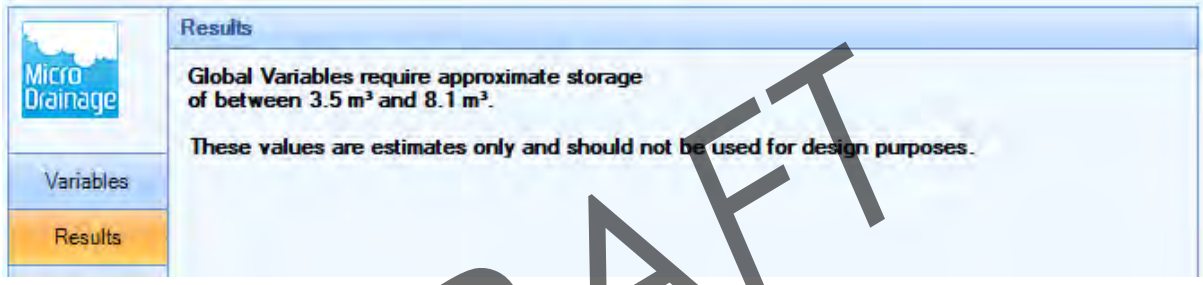
30 YEAR RETURN PERIOD STORM EVENT



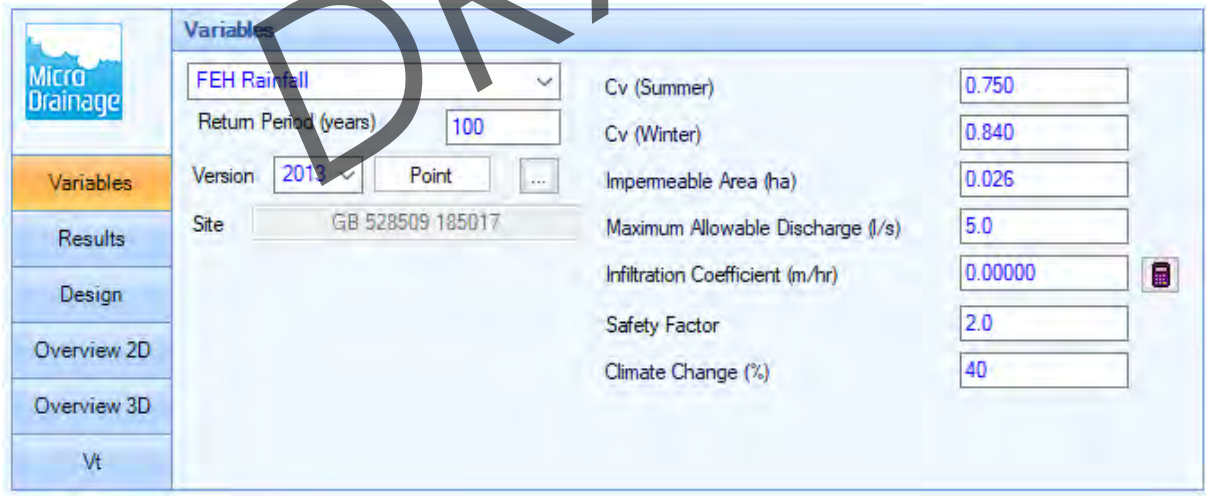


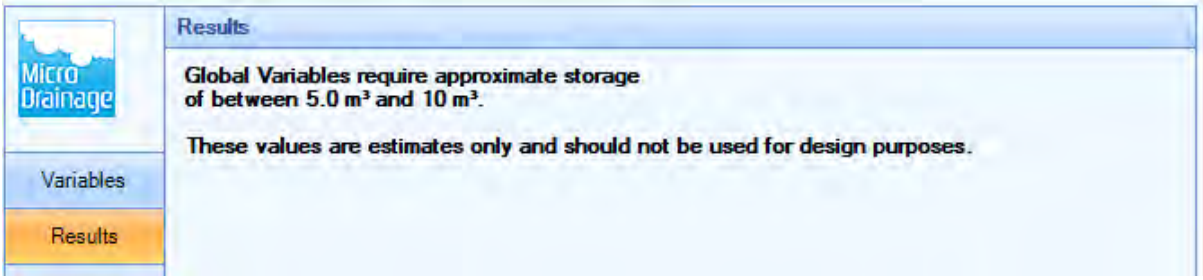
100 YEAR RETURN PERIOD STORM EVENT + 20% CLIMATE CHANGE





100 YEAR RETURN PERIOD STORM EVENT + 40% CLIMATE CHANGE





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APPENDIX J: NOTES OF LIMITATIONS

The data essentially comprised a study of available documented information from various sources together with discussions with relevant authorities and other interested parties. There may also be circumstances at the site that are not documented. The information reviewed is not exhaustive and has been accepted in good faith as providing representative and true data pertaining to site conditions. If additional information becomes available which might impact our conclusions, we request the opportunity to review the information, reassess the potential concerns and modify our opinion if warranted.

It should be noted that any risks identified in this report are perceived risks based on the available information.

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