Appendix E: Flood Risk Assessment

Flood Risk Assessment for Planning

Prepared for:
LMB Geosolutions Ltd

December 2016

Location:
Former Spiritualist Temple
Rochester Square
London
NW1 9RY

Our reference:
86812-LMB-RochesterSq

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Application:	Mixed-use redevelopment
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Key Facts

Flood Risk Posed:

- The site is situated within Flood Zone 1 when using the Environment Agency Flood Map for Planning (Rivers and Sea).
- The EA Surface Water Flood Map suggests that the site lies in close proximity to an area of "High" to "Medium" risk of flooding from surface water.
- The risk of flooding posed to the site by fluvial, tidal, groundwater, and sewer surcharge flooding would appear to be negligible / low.

Flood Risk Management:

- It is recommended that the ground floor level, and basement entry thresholds are raised 300mm above adjacent ground levels.

Introduction

Unda Consulting Limited have been appointed by LMB Geosolutions Ltd (hereinafter referred to as "the applicant") to undertake a Site Specific Flood Risk Assessment (FRA) for Planning at Former Spiritualist Temple, Rochester Square, London NW1 9RY (hereinafter referred to as "the site"). The FRA has been undertaken in accordance with the National Planning Policy Framework (NPPF) March 2012 and the associated technical guidance.

The site appears to be located within Flood Zone 1 as defined by the Environment Agency (EA) on their Flood Map for Planning. Under the National Planning Policy Framework (NPPF), a FRA is required if a proposed development:

- includes building or engineering works in Flood Zone 2 or 3;
- includes building or engineering works on land classified by the Environment Agency as having critical drainage problem;
- changes the use of land or buildings in a location at risk of flooding from rivers or the sea, or with critical drainage problems;
- changes the use of land or buildings in a way that increases the flood vulnerability of the development where it may be subject to other sources of flooding;
- is larger than 1 hectare.

Given that your proposed development is located in Flood Zone 1 (Low Risk of flooding from rivers or the sea), you would not normally require a FRA under the NPPF. However, it is understood that the sit falls within an area at potential risk of surface water flooding. The assessment should demonstrate to the Local Planning Authority (LPA) and EA how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its potential users.

The objectives of a FRA to support a planning application are to establish:

- whether the proposed development is likely to be affected by current or future flooding from any source;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate.

Existing Situation

Site Usage:

The site is currently occupied by a former place of worship.

No detailed existing site plans are available.

Topography:

The site is situated 3.87km to the north east of the River Thames. LiDAR remotely sensed digital elevation data suggests that the topography on site ranges between approximately 30.60mAOD and 31.40mAOD.

Figure 1: Aerial view of the site and immediate surrounding area (Source: emapsite)

Geography and Soil:

The British Geological Survey (BGS) Map indicates that the bedrock underlying the site is London Clay - a clay and silt derived sedimentary bedrock formed 34 to 56 million years ago.

The soil type in the area taken from the UKSO Website is prequaternary marine/estuarine clay/silt (relatively deep clay and silt) which tends to be of relatively low permeability, but can be variable depending on the mix of clays and silts. With soil conditions such as these, it would be essential that this value is checked through trial pit infiltration tests on site prior to any final detailed drainage design requiring infiltration is carried out.

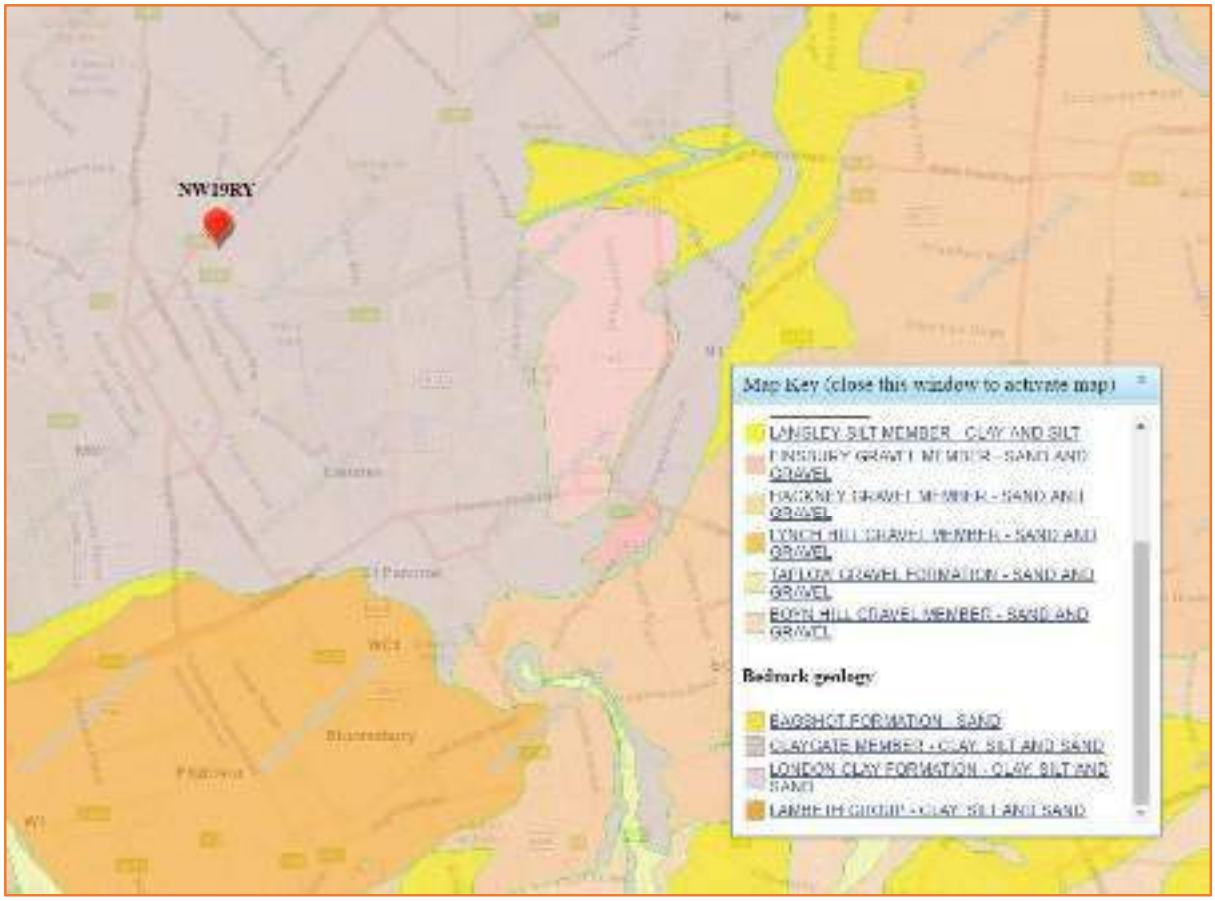


Figure 2: Local geology (Source: BGS)

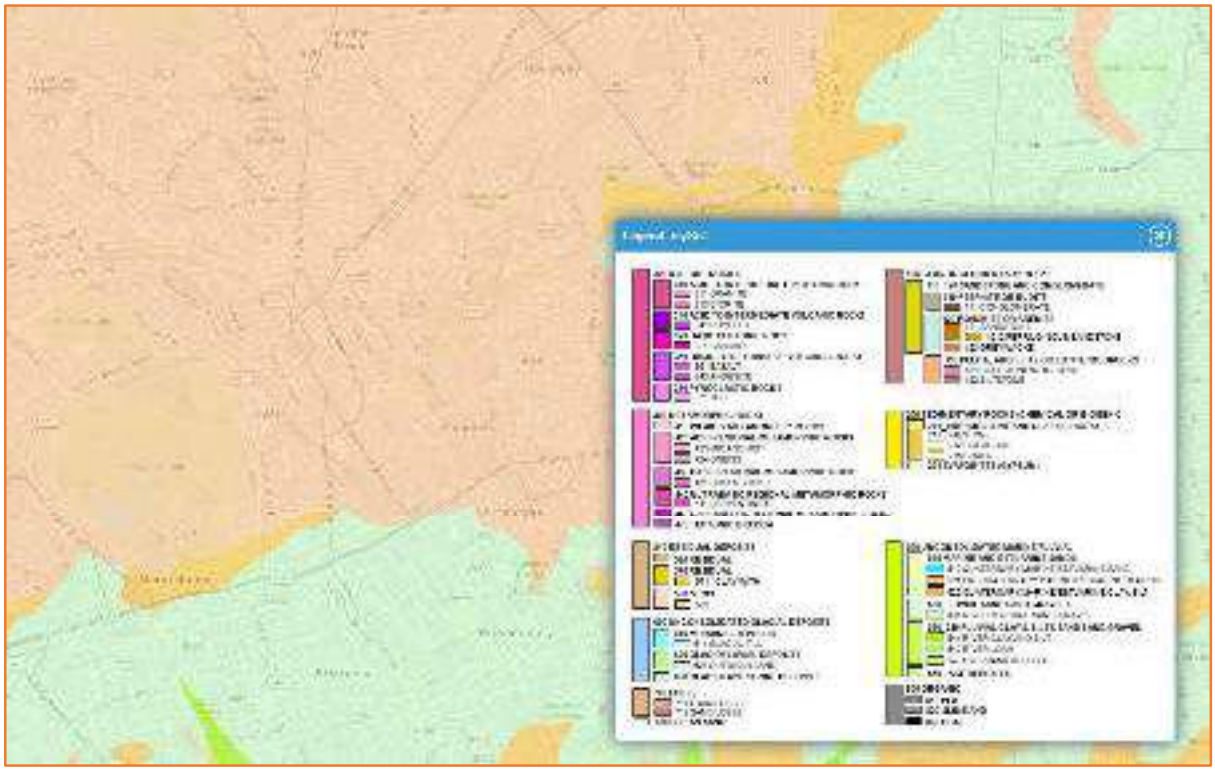


Figure 3: Local soil types (Source: UKSO)

Hydrology:

The site is situated 3.87km to the north east of the River Thames.

Greenfield runoff rates have been calculated using Microdrainage software, using ICP SUDS runoff estimation methods. See Appendix C.

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	0.041	Urban	0.000
SAAR (mm)	613	Region Number	Region 6

Results	l/s
QBAR Rural	0.2
QBAR Urban	0.2
Q100 years	0.5
Q1 year	0.1
Q30 years	0.3
Q100 years	0.5

As per the newly published climate change allowances (February 2016) for anticipated changes in extreme rainfall intensity in small and urban catchments, the upper end (40% increase) peak rainfall intensity allowances should be assessed to understand the impact of climate change. The increase in peak rainfall intensity has been assessed by increasing the SAAR (Standard average annual rainfall in mm) value in the calculations.

Proposed Development

The proposed planning application is for the cemotion of the existing place of worship, and construction of a mixed use development.

Indicative proposed plans are provided in Appendix A. No detailed plans were available.

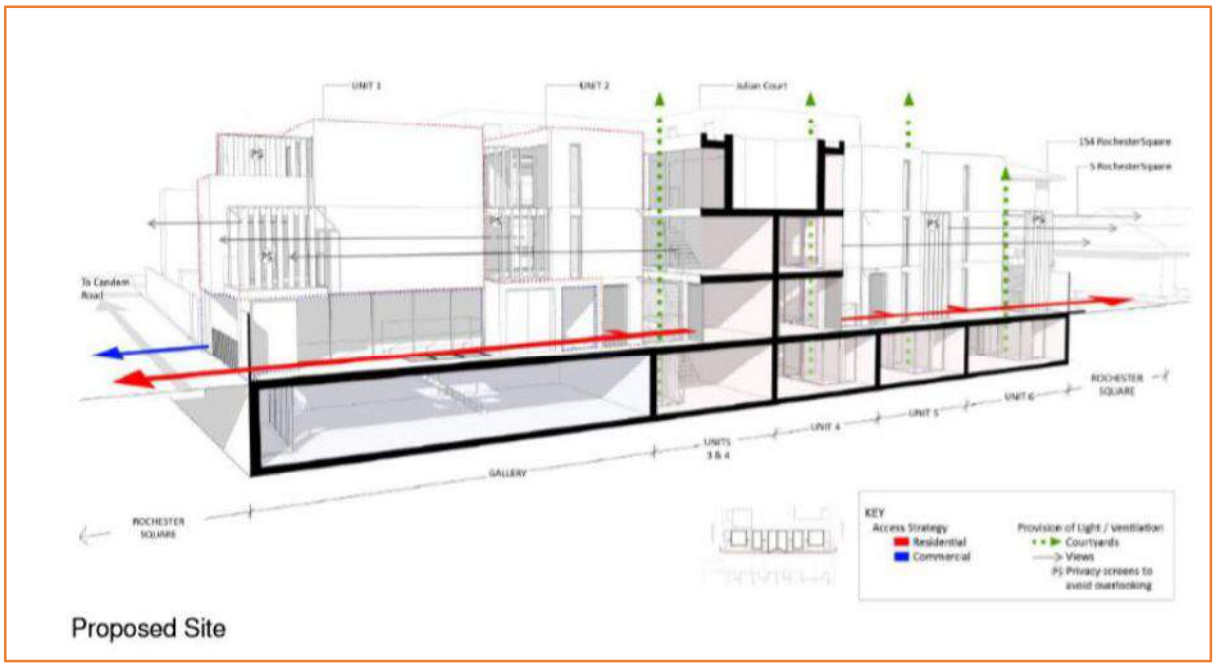


Figure 4: Indicative proposed section (Source: LMB Geosolutions)

Assessment of Flood Risk

Flood Zones:

Within planning, 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), available on the Environment Agency's web site.

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. (_and 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)

Table 2: Flood Zones

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.

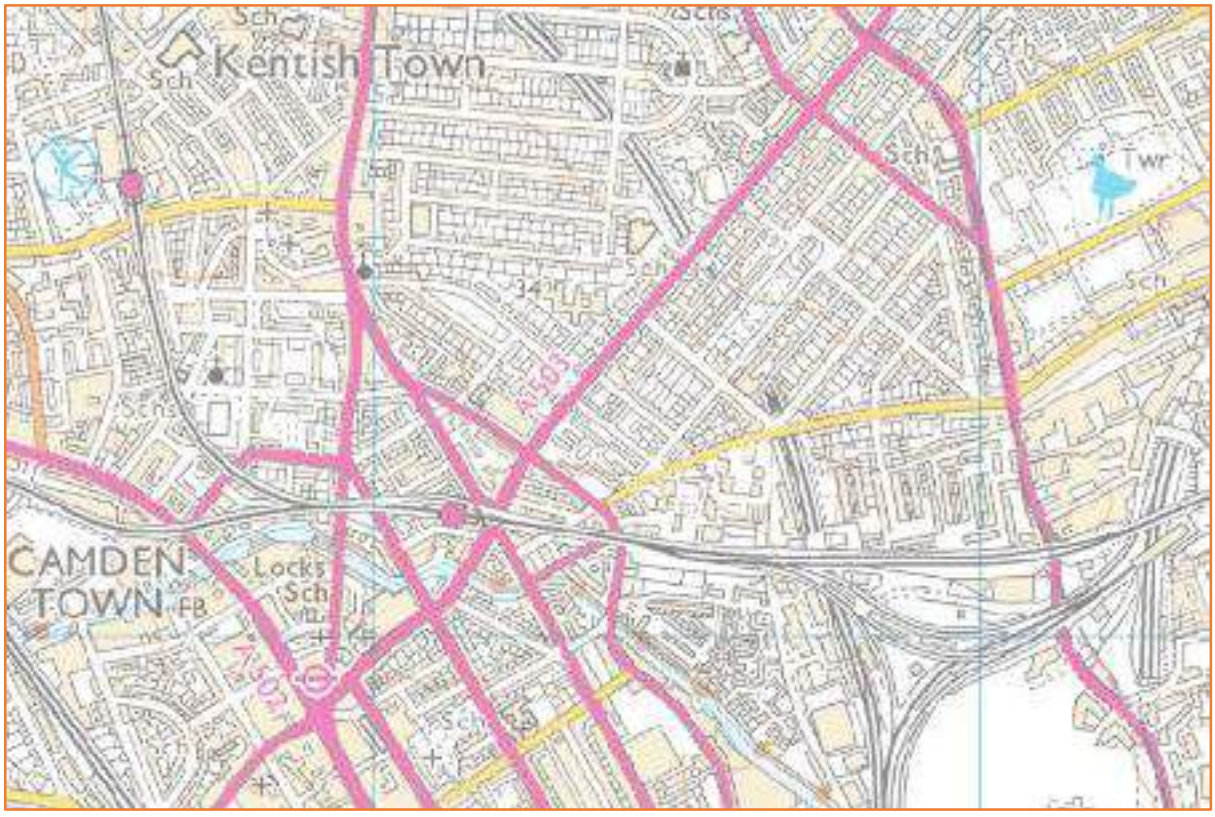


Figure 5: Environment Agency Flood Map for Planning (Rivers and Sea) (Source: EA)

The site is located within Flood Zone 1 (Low Probability), which means it is defined as land having a less than 1:1000 annual probability of river or sea flooding.

However, the site is located within an area at potential risk of surface water flooding, and as such the planning application submitted is required to be accompanied by a FRA which shows that the development can be achieved in a sustainable manner, with an overall reduction of flood risk to the site and surrounding area.

Fluvial / Tidal (River Thames):

The River Thames is predominantly tidal in the vicinity of the site. It flows west-east, and at its closest proximity lies approximately 3.87km to the south west of the site. It is defended to ar extremely high standard.

Flood defences:

London is defenced from tidal flooding from the River Thames to a high standard. These defences include the Thames Barrier. The Thames Barrier is one of the largest movable flood barriers in the world. The EA runs and maintains the Thames Barrier as well as London's other flood defences.

The Thames Barrier spans 520m across the River Thames near Woolwich, and it protects 125km^2 of central London from flooding caused by tidal surges. It has 10 steel gates that can be raised into position across the River Thames. When raised, the main gates stand 15m high, and 61.5m wide. Each main gate weighs 3,300 tonnes.

The barrier is closed under storm surge conditions to protect London from flooding from the sea. It may also be closed during periods of high flow over Teddington Weir to reduce the risk of river flooding in some areas of west London including Richmond and Twickenham.

The Thames Barrier will then remain closed over high water until the water level downstream of the Thames Barrier has reduced to the same level as upstream. This is a managed process to provide for different circumstances, and takes approximately 5 hours. The Thames Barrier is then opened, allowing the water upstream to flow out to sea with the outward-bound tide.

The EA has closed the Thames Barrier 174 times since it became operational in 1982 (correct as of March 2014). Of these closures, 87 were to protect against tidal flooding and 87 were to alleviate river flooding. The frequency of closures has increased over recent decades:

- In the 1980s there were 4 closures;
- In the 1990s there were 35 closures;
- In the 2000s there were 75 closures;
- In the 2010s there were 65 closures (as of March 2014).

In addition to the Thames Barrier, the site benefits from the presence of raised man-made flood defences either side of the main River Thames channel. These raised defences act to prevent direct inundation of the site and surrounding area during high tides and periods of high fluvial flow.

Due to the level of the topography on site, the risk of fluvial or tidal flooding is considered negligible.

Pluvial (Surface Water):

Pluvial flooding is the term used to describe flooding which occurs when intense, often short duration rainfall is unable to soak into the ground or to enter drainage systems and therefore runs over the land surface causing flooding. It is most likely to occur when soils are saturated (or baked hard) so that they cannot infiltrate any additional water or in urban areas where buildings tarmac and concrete prevent water soaking into the ground. The excess water can pond (collect) in low points and result in the development of flow pathways often along roads but also through built up areas and open spaces. This type of flooding is usually short lived and associated with heavy downpours of rain.

The potential volume of surface runoff in catchments is directly related to the size and shape of the catchment to that point. The amount of runoff is also a function of geology, slope, climate, rainfall, saturation, soil type, urbanisation and vegetation.

Pluvial flooding can occur in rural and urban areas, but usually causes more damage and disruption in the latter. Flood pathways include the land and water features over which floodwater flows. These pathways can include drainage channels, rail and road cuttings. Developments that include significant impermeable surfaces, such as roads and car parks may increase the volume and rate of surface water runoff.

Urban areas which are close to artificial drainage systems, or located at the bottom of hill slopes, or in valley bottoms and hollows, may be more prone to pluvial flooding. This may be the case in areas that are down slope of land that has a high runoff potential including impermeable areas and compacted ground.

Pluvial flooding can affect all forms of the built environment, including:

- Residential, commercial and industrial properties;
- Amenity and recreation facilities; and
- Infrastructure, such as roads and railways, electrical infrastructure, telecommunication systems and sewer systems.

This type of flooding is usually short-lived and may only last as long as the rainfall event. However occasionally flooding may persist in low-lying areas where ponding occurs. Due to the typically short duration, this type of flooding tends not to have consequences as serious as other forms of flooding, such as flooding from rivers; however it can still cause significant damage and disruption on a local scale.

The EA Surface Water Flood Map suggests that the site lies in close proximity to an area of "High" to "Medium" risk of flooding from surface water.

Figure 6: Extract from Environment Agency Surface Water Flood Map (Source: EA)

The detailed flood mapping below shows likely flood depths expected across the site during the 1:30, 1:100, and 1:1000 year pluvial flood events. High resolution mapping is provided within the report Appendix.

Figure 7: 1:30 year pluvial flood depth mapping (Source: EA)

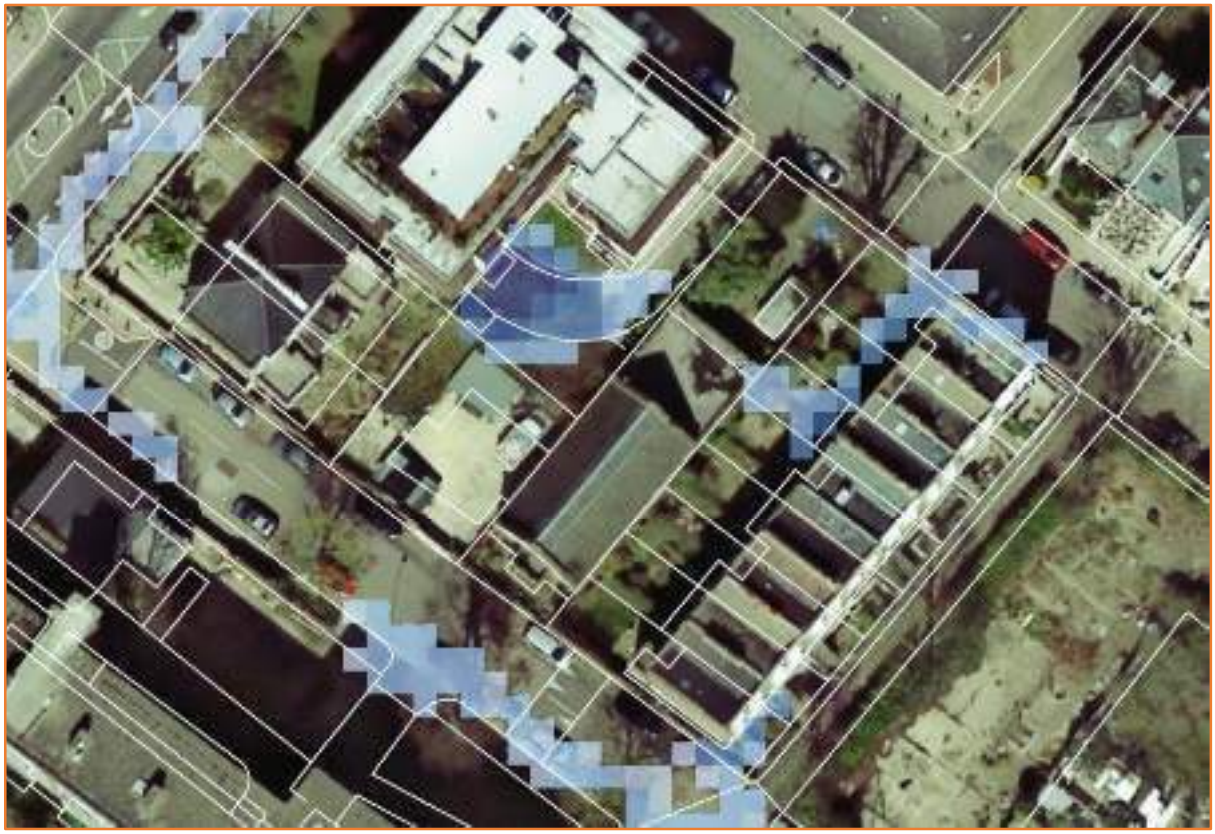


Figure 8: 1:100 year pluvial flood depth mapping (Source: EA)

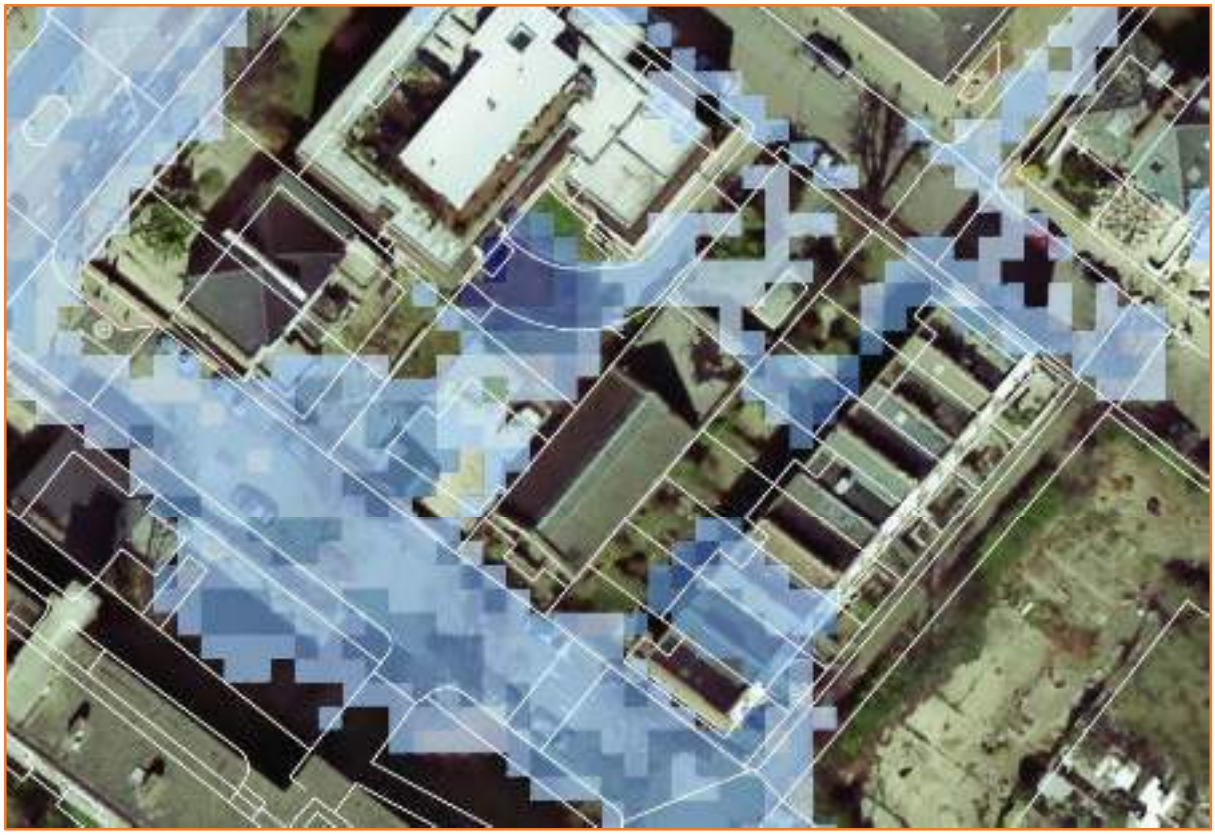


Figure 9: 1:1000 year pluvial flood depth mapping (Source: EA)

This mapping suggest that the site would be subject to a maximum depth of 300mm of pluvial floodwater during a 1:1000 year pluvial flood event.

Groundwater:

Groundwater flooding occurs as a result of water rising up from the underlying rocks or from water flowing from abnormal springs. This tends to occur after much longer periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. Groundwater tends to flow from areas where the ground level is high, to areas where the ground level is low. In low-lying areas the water table is usually at shallower depths anyway, but during very wet periods, with all the additional groundwater flowing towards these areas, the water table can rise up to the surface causing groundwater flooding.

Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). These may be extensive, regional aquifers, such as chalk or sandstone, or may be localised sands or river gravels in valley bottoms underlain by less permeable rocks. Groundwater flooding takes longer to dissipate because groundwater moves much more slowly than surface water and will take time to flow away underground.

No information has been provided to suggest that the site is susceptible to groundwater flooding.

Sewer Surcharge:

Sewer flooding occurs when the sewer network cannot cope with the volume of water that is entering it. It is often experienced during times of heavy rainfall when large amounts of surface water overwhelm the sewer network causing

flooding. Temporary problems such as blockages, siltation, collapses and equipment or operational failures can also result in sewer flooding.

All Water Companies have a statutory obligation to maintain a register of properties/areas which have reported records of flooding from the public sewerage system, and this is shown on the DG5 Flood Register. This includes records of flooding from foul sewers, combined sewers and surface water sewers which are deemed to be public and therefore maintained by the Water Company. The DG5 register records of flood incidents resulting in both internal property flooding and external flooding incidents. Once a property is identified on the DG5 register, water companies can typically put funding in place to address the issues and hence enable the property to be removed from the register. It should be noted that flooding from land drainage, highway drainage, rivers/watercourses and private sewers is not recorded within the register.

No information has been provided to suggest that the site is susceptible to sewer surcharge flooding.

Other Sources:

The site is situated outside of the maximum inundation extent on the EA Reservoir Inundation Map. The areas of risk are confined to the lower parts of the site immediately adjacent to the un-named drainage channel.

The EA also advise on their website that reservoir flooding is extremely unlikely. All major reservoirs have to be inspected by specialist dam and reservoir Engineers. These inspections are monitored and enforced by the EA themselves. The risk to the site from reservoir flooding is therefore minimal and is far lower than that relating to the potential for fluvial flooding to occur.

There do not appear to be any further artificial (man-made) sources of flood risk (such as raised canals) in the vicinity of the site.

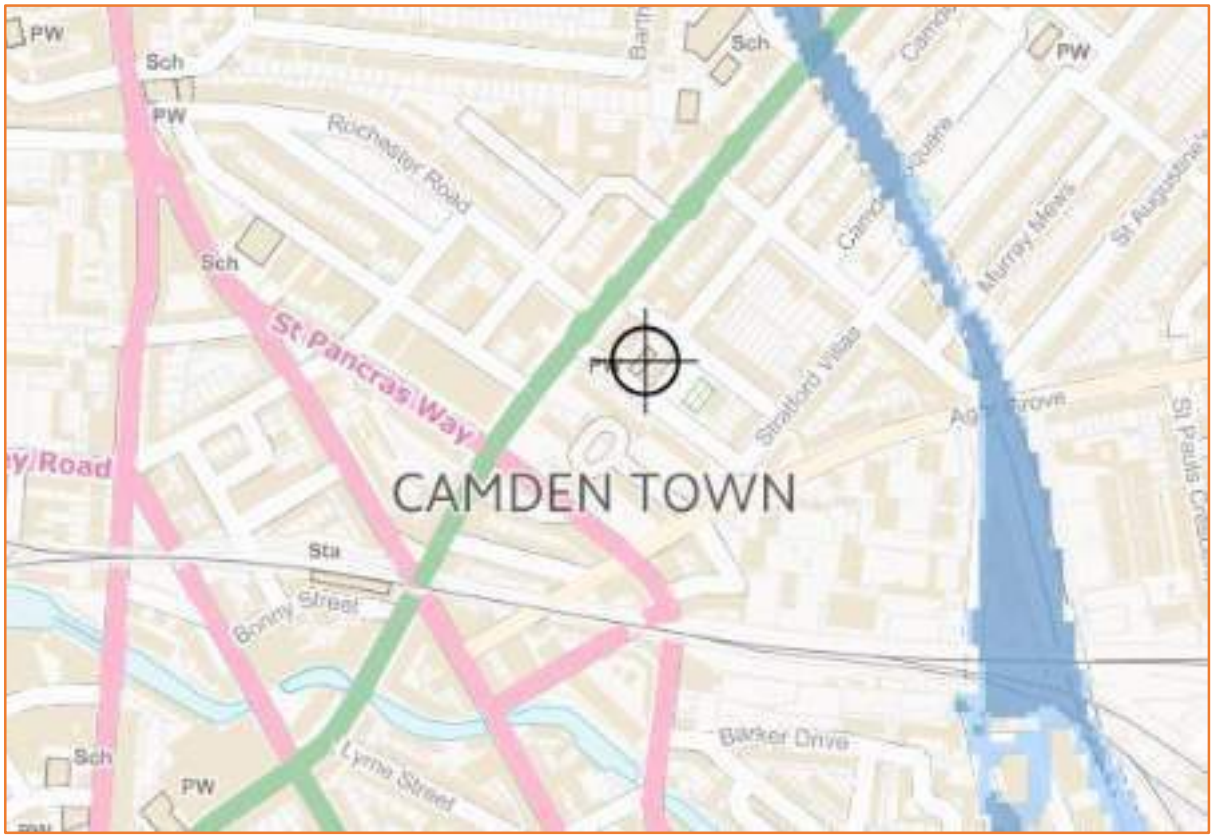


Figure 3: Extract from Environment Agency Risk of Flooding from Reservoirs Map

Flood Risk Management

Vulnerability to flooding:

The NPPF classifies property usage by vulnerability to flooding. The existing permitted site usage (place of worship) is classified as "less vulnerable" throughout. The proposal introduces additional residential properties. Post development, the site will become "more vulnerable" in part, with an intensification of usage.

EA Standing Advice:

The EA Standing Advice guidance is for domestic extensions and non-domestic extensions where the additional footprint created by the development does not exceed 250m^2. It should not be applied if an additional dwelling is being created, e.g. a self-contained annex or additional commercial unit.

Off-Site Impacts:

Fluvial floodplain storage:

The NPPF requires that where development is proposed in undefended areas of floodplain, which lie outside of the functional floodplain, the implications of ground raising operations for flood risk elsewhere needs to be considered. Raising existing ground levels may reduce the capacity of the floodplain to accommodate floodwater and increase the risk of flooding by either increasing the depth of flooding to existing properties at risk or by extending the floodplain to cover properties normally outside of the floodplain. Flood storage capacity can be maintained by lowering ground levels either within the curtilage of the development or elsewhere in the floodplain, in order to maintain at least the same volume of flood storage capacity within the floodplain.

In undefended tidal areas, raising ground levels is unlikely to impact on maximum tidal levels so the provision of compensatory storage should not be necessary.

For development in a defended flood risk area, the impact on residual flood risk to other properties needs to be considered. New development behind flood defences can increase the residual risk of flooding if the flood defences are breached or overtopped by changing the conveyance of the flow paths or by displacing flood water elsewhere. If the potential impact on residual risk is unacceptable then mitigation should be provided.

The application site is situated within Flood Zone 1. Post development, there will be no loss of fluvial floodplain storage.

Surface Water Drainage:

The EA Risk of Flooding from Surface Water Map suggests that the site lies in close proximity to an area of "Medium" to "High" risk of flooding from surface water.

Accordingly, it is recommended that the ground floor level, and basement entry thresholds are raised 300mm above adjacent ground levels.

Sequential and Exception Test

The Sequential Test aims to ensure that development does not take place in areas at high risk of flooding when appropriate areas of lower risk are reasonably available. The site is situated in Flood Zone 1 when using the Environment Agency Flood Map for Planning (Rivers and Sea). Post development, the site will become "more vulnerable", as the proposal includes residential properties.

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a	Exception Test required	X	Exception Test required	✓	✓
Zone 3b	Exception Test required	X	X	X	✓

Table 4: Flood risk vulnerability and flood zone 'compatibility'

Using the table about, the proposed application is considered to be suitable within Flood Zone 1. The Sequential and Exception Tests do not need to be applied to minor developments and changes of use.

Conclusion

Unda Consulting Limited have been appointed by LMB Geosolutions Ltd to undertake a Site Specific Flood Risk Assessment (FRA) for Planning at Former Spiritualist Temple, Rochester Square, London NW1 9RY. The FRA has been undertaken in accordance with the National Planning Policy Framework (NPPF) March 2012 and the associated technical guidance.

The proposed planning application is for the cemotion of the existing place of worship, and construction of a mixed use development. The existing permitted site usage (place of worship) is classified as "less vulnerable" throughout. The proposal introduces additional residential properties. Post development, the site will become "more vulnerable" in part, with an intensification of usage.

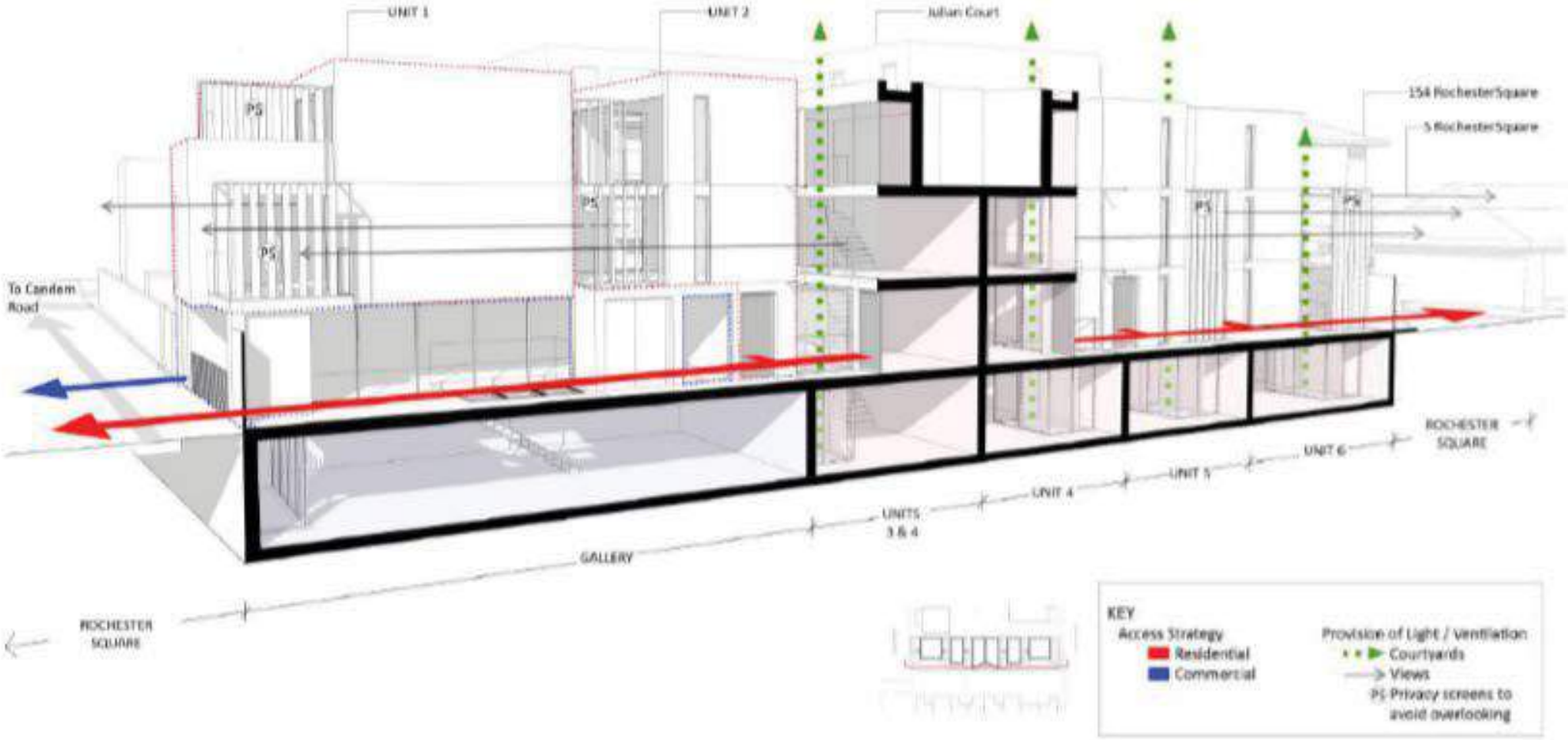
The site is located within Flood Zone 1 (Low Risk) as defined by the Environment Agency (EA) on their Flood Map for Planning, but falls within an area at potential risk of surface water flooding.

The EA Surface Water Flood Map suggests that the site lies in close proximity to an area of "High" to "Medium" risk of flooding from surface water. Detailed flood mapping from the EA shows likely flood depths expected across the site during the 1:30, 1:100, and 1:1000 year pluvial flood events. This mapping suggest that the site would be subject to a maximum depth of 300mm of pluvial floodwater during a 1:1000 year pluvial flood event.

Accordingly, it is recommended that the ground floor level, and basement entry thresholds are raised 300mm above adjacent ground levels.

Appendix A

Page 19: Indicative proposed section.



Proposed Site

Appendix B

Pages 21 to 23: EA pluvial flood modelling.

1:30 year pluvial flood depths

Over 900mm

300 to 900mm

Below 300mm

N

5 0 5 10 15 20 m

1:100 year pluvial flood depths

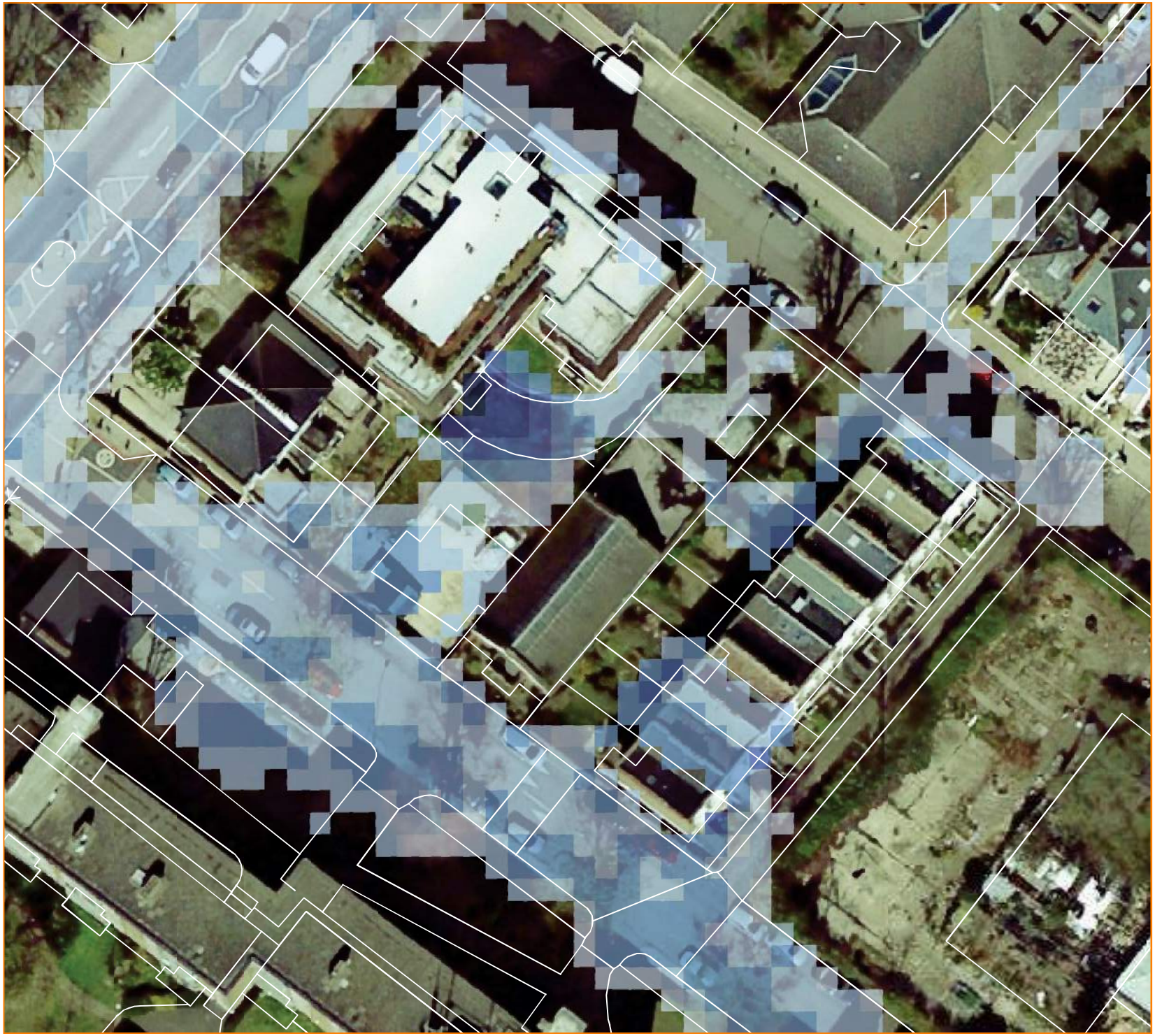
Over 900mm

300 to 900mm

Below 300mm

N

5 0 5 10 15 20 m



1:1000 year pluvial flood depths

Over 900mm

300 to 900mm

Below 300mm

N

5 0 5 10 15 20 m

Appendix C

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	0.041	Urban	0.000
SAAR (mm)	613	Region Number	Region 6

Results l/s

QBAR Rural	0.2
QBAR Urban	0.2
Q100 years	0.5
Q1 year	0.1
Q30 years	0.3
Q100 years	0.5