STM environmental

ENVIRONMENTAL CONSULTING , SOFTWARE & TRAINING

FLOOD RISK ASSESSMENT

Site Address

296 West End Road
Ruislip
HA4 6LS

Client

Vipin Dholakia

Date

12/02/2021

1 Document Control

FLOOD RISK ASSESSMENT

Site Address:	296 West End Road Ruislip HA4 6LS
National Grid Reference:	510053, 186035
STM Reference:	FRA – 2020 – 000118
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Prepared for:	Vipin Dholakia
Date:	12/02/2021
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Contents

2 Abbreviations

Abbreviation	Description
STM	STM Environmental Consultants Limited
BGS	British Geological Survey
EA	Environment Agency
OS	Ordnance Survey of Great Britain
FRA	Flood Risk Assessment
NPPF	National Planning Policy Framework
FWD	Floodline Warning Direct
FRMS	Flood Risk Management Strategy
LBH	London Borough of Hillingdon
SWMP	Surface Water Management Plan
SFRA	Strategic Flood Risk Assessment
CDA	Critical Drainage Area
SuDS	Sustainable Drainage Systems
GWSPZ	Groundwater Source Protection Zone
LLFA	Lead Local Flood Authority
mbgl	metres below ground level
DCLG	Department for Communities and Local Government
PPGPS	Planning practice guidance and Planning system

3 Disclaimer

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4 Executive Summary

Location	296 West End Road Ruislip HA4 6LS Grid reference: 510053, 186035
Proposed Development	Single storey rear extension to an existing shop.
Flood Zone	Flood zone 2.
Topography	The average ground level of the site at the proposed development is 36.63mAOD.
Sequential and Exception Tests	Development is minor and less vulnerable so Sequential and Exception Tests should not be required. LLFA to decide.
Main Sources of Flooding	Surface water flooding.
Flood Defences	No flood defences identified as part of the EA data.
Records of Historic Flooding	The EA data indicates the site has not been affected by any historic flood events.
Fluvial (River) and Tidal (Sea) Flood Risk	Low – The site is not impacted by any of the 1 in 100-year flood events including the 25% and 70% climate change allowances. The site is expected to flood to depths of 0.36m during the 1 in 1000-year event.
Pluvial (Surface Water) Flood Risk	Medium - the site experiences flooding during the 1 in 100 and 1000-year flood events. Maximum depths are 600mm for the 100yr event and 900mm for the 1000yr event.
Flood Risk from Artificial (Canals and Reservoirs) Sources	Low – No significant artificial sources identified. Not within the long-term reservoir flood risk zone.
Groundwater Flood Risk	Low –The site is not susceptible to groundwater flooding.
Development Impacts on Local Flood Risk	As the development will not significantly alter the site impermeable area, it is considered unlikely that it will have a significant impact upon surface water runoff rates.
Proposed Flood Risk Mitigation Measures	• Finished floor levels will be set to the maximum 100-year surface water flood level of 600mm above ground level; • Underfloor voids will be implemented to minimize any loss in flood storage; • Construction will utilise flood resistant materials and services will be placed as high as practicable to reduce the impact of flooding; • Occupants will sign up for EA Emergency Flood Warning Direct Service; • Safe egress to flood zone 1 is a 3-minute walk away and safe refuge is available on upper floors.
Surface Water Management (SuDS)	SuDS would reduce current surface water runoff rates however given the small size of the site (144m^2), there is limited potential for implementation. Consideration should be given to rainwater harvesting and permeable paving where possible.

Conclusions	Based on the information reviewed and taking into account the proposed mitigation measures, it is considered that the overall flood risk of the property is medium and the development is unlikely to have a significant impact on local flood risk.

5 Introduction

STM Environmental Consultants Limited (STM) has been appointed by Vipin Dholakia (Client) to provide a Flood Risk Assessment (FRA) at a site located at 296 West End Road, Ruislip, HA4 6LS.

6 Development Proposal

The FRA is required to support a planning application to support a planning application for a single storey rear extension to an existing shop.

Further details including drawings of the development plans are available in Appendix 2.

7 Report Aims and Objectives

The purpose of this report is to establish the flood risk to the site from all potential sources and, where possible, to propose suitable mitigation methods to reduce any risks to an acceptable level. It aims to make an assessment of whether the development will be safe for its lifetime, taking into account climate change and the vulnerability of its users, without increasing flood risk elsewhere.

The FRA assesses flood risk to the site from tidal, fluvial, surface water, groundwater, sewers and artificial sources. The FRA has been produced in accordance with the National Planning Policy Framework (NPPF) and its supporting guidance.

8 Summary of Data Review Undertaken

The following research has been undertaken as part of the FRA:

- Desktop assessment of topographical, hydrological and hydrogeological settings through review of the information sourced from the British Geological Survey (BGS), the Environment Agency (EA) and the Ordnance Survey (OS);
- Review of publicly available flood risk mapping provided by the EA;
- Review of the Preliminary Flood Risk Assessment (PFRA) and Level 1 Strategic Flood Risk Assessment (SFRA) produced by the LLFA outlining flood risk from various sources within the borough.

9 Legislative and Policy Context

9.1 Legislative Context

The Flood and Water Management Act was introduced in 2010. The Act defines the role of lead local flood authority (LLFA) for an area. All LLFA are required to develop, maintain, apply and monitor a strategy for local flood risk management in its area, called “local flood risk management strategy”.

Alongside the Act, Flood Risk Regulations (2009) outline the roles and responsibilities of the various authorities, which include preparing Flood Risk Management Plans and identifying how significant flood risks are to be mitigated.

9.2 Policy Context

9.2.1 National Planning Policy Framework (NPPF)

The NPPF sets out the government’s planning policies for England and how these are expected to be applied. It also provides a set of guidelines and philosophy with which local planning authorities (LPAs) can build their own unique policies to appropriately regulate development within their jurisdictions.

Section 14 entitled “Meeting the challenge of climate change, flooding and coastal change” deals specifically with flood risk. Among other things it states that LPAs should try to ensure that “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”. It further states that when determining planning application, LPAs should “ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. 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:

- 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;
- development is appropriately flood resilient and resistant;
- it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
- any residual risk can be safely managed; and
- safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

Applications for minor development and changes of use 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.

Footnote 50 states: “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."

The NPPF also lays out requirements for how LPAs should deal with planning applications in coastal areas. They should ensure that should they "reduce risk from coastal change by avoiding inappropriate development in vulnerable areas or adding to the impacts of physical changes to the coast."

Developments in Coastal Change Management Areas should only be considered appropriate where it is demonstrated that:

- it will be safe over its planned lifetime and will not have an unacceptable impact on coastal change;
- the character of the coast including designations is not compromised;
- the development provides wider sustainability benefits;
- the development does not hinder the creation and maintenance of a continuous signed and managed route around the coast.

9.2.2 Local Planning Policy

London Borough of Hillingdon addresses flood risk management and development in Policy EM6 of their local plan. It is summarised below.

The Council will require new development to be directed away from Flood Zones 2 and 3 in accordance with the principles of the National Planning Policy Framework (NPPF). The subsequent Hillingdon Local Plan: Part 2 -Site Specific Allocations LDD will be subjected to the Sequential Test in accordance with the NPPF.

Sites will only be allocated within Flood Zones 2 or 3 where there are overriding issues that outweigh flood risk. In these instances, policy criteria will be set requiring future applicants of these sites to demonstrate that flood risk can be suitably mitigated. The Council will require all development across the borough to use sustainable urban

drainage systems (SUDS) unless demonstrated that it is not viable. The Council will encourage SUDS to be linked to water efficiency methods.

The Council may require developer contributions to guarantee the long-term maintenance and performance of SUDS is to an appropriate standard.

9.3 EA Standing Advice on Flood Risk

The Environment Agency's standing advice lays out the process that must be followed when carrying out flood risk assessments for developments.

Flood risk assessments are required for developments within one of the flood zones. This includes developments:

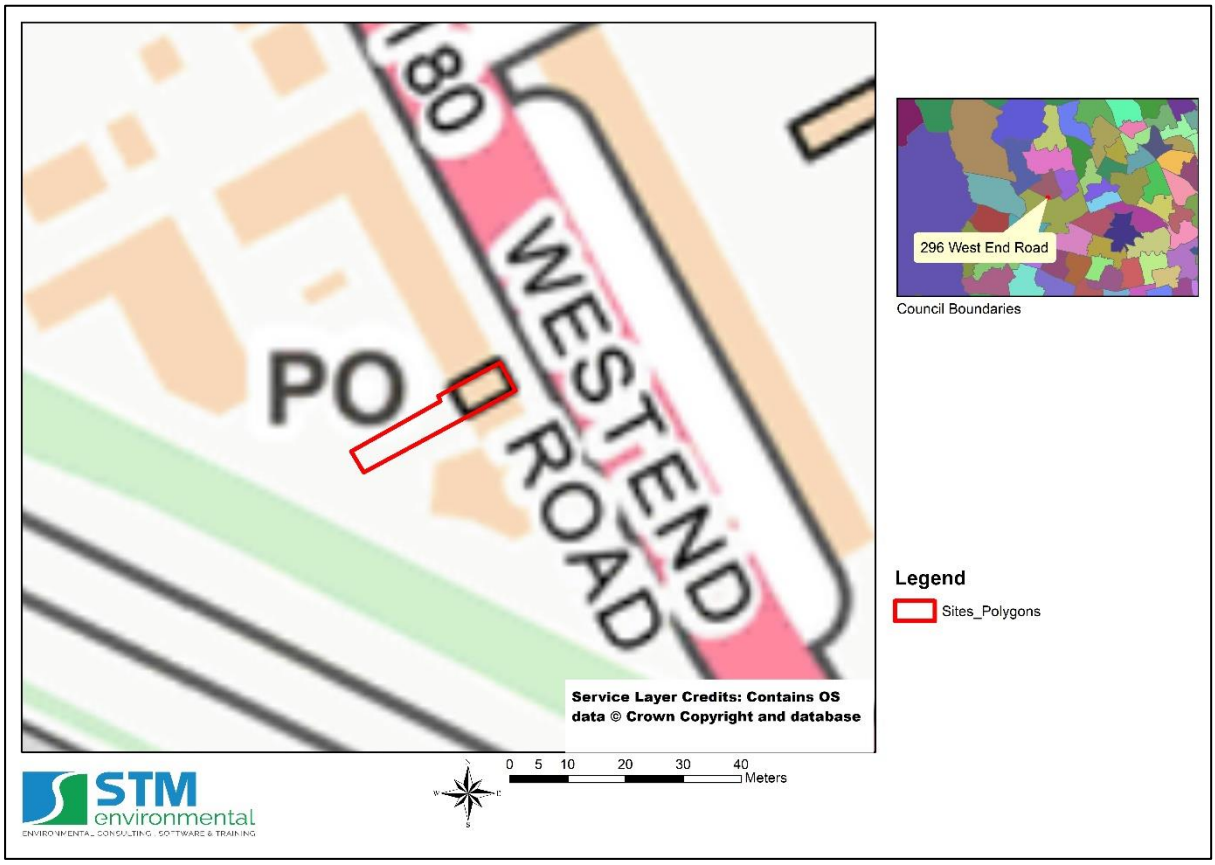
- in flood zone 2 or 3 including minor development and change of use more than 1 hectare (ha) in flood zone 1;
- less than 1 ha in flood zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs);
- in an area within flood zone 1 which has critical drainage problems as notified by the Environment Agency.

10 Site Description and Environmental Characteristics

10.1 Site Location and Area

The site is located at 296 West End Road, Ruislip, HA4 6LS. It is centred at national grid reference 510053, 186035. The site has an area of 144m^2.

A site location map and aerial photo are shown below. Photographs of the site are available in Appendix 1.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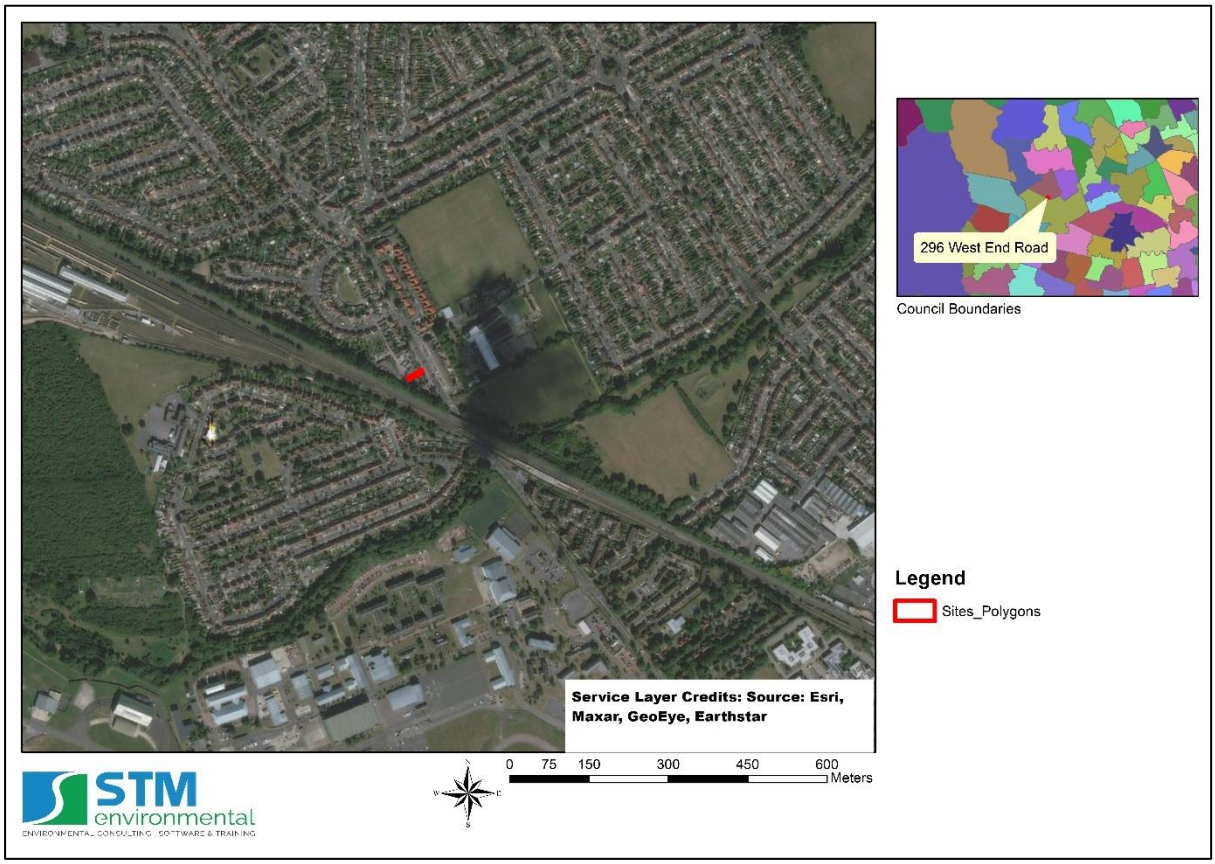
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296 West End Road
Council Boundaries
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10.2 Site Access

The site is accessed via West End Road.

10.3 Local Planning Authority

The site falls within the jurisdiction of London Borough of Hillingdon in terms of the planning process.

10.4 Lead Local Flood Authority

London Borough of Hillingdon is also the Lead Local Flood Authority (LLFA).

10.5 Flood Zone

For planning purposes, the site is located in Flood Zone 2 as defined by the EA and LLFA.

10.6 Site and Surrounding Land Uses

10.6.1 Site Current Land Use

The site is currently used as a commercial property.

10.6.2 Surrounding Land Uses

A description of current land uses surrounding the boundaries of the site is given below in

Table 1 below.

Table 1: Summary of surrounding land uses

Boundary	Land Use Description	
	Immediately Adjacent (within 0 – 25m)	General Local Area (i.e. within 25 - 250m)
Northern	Commercial/Residential	Commercial/Residential
Eastern	Commercial/Residential	Ruislip Gardens
Southern	Commercial/Residential	Commercial/Residential

Western	Commercial/Residential	Commercial/Residential

10.7 Hydrology

The nearest main watercourse is the Yeading Brook which is located 100m to the South.

10.8 Geology

Data from the British Geological Survey indicates that there are no underlying superficial deposits. The bedrock geology is characterized as London Clay Formation and Woolwich and Reading Beds formation.

10.9 Hydrogeology

The site lies upon an Unproductive and Secondary A bedrock aquifer.

Appendix 3 provides BGS mapping showing the hydrogeology at the site location.

10.10 Topography

The average ground level of the site at the proposed development is 36.63mAOD. A LIDAR map showing the topology of the site and surrounding area is available in Appendix 3.

A topographic survey has not been conducted.

11 The Sequential and Exception Tests

11.1 The Sequential Test

The Sequential Test aims to steer developments and redevelopments to areas of lower flood risk. The test compares the proposed development site with other available sites, in terms of flood risk, to aid the steering process. The Sequential Test is not required if the proposed development is a minor development or if it involves a change

of use unless the development is a caravan, camping chalet, mobile home or park home site.

Minor development means:

- minor non-residential extensions: industrial/commercial/leisure etc extensions with a footprint less than 250 square metre.
- alterations: development that does not increase the size of buildings eg alterations to external appearance.
- householder development: For example; sheds, garages, games rooms etc within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling eg subdivision of houses into flats.

The development is considered to be minor and as such the Sequential Test should not be required by the LLFA.

11.2 The Exception Test

If alternative sites of lower flood risk are not available then the proposed development may require an Exception Test to be granted planning permission. Where the exception test is required, it should be applied as soon as possible to all local development document allocations for developments and all planning applications other than for minor developments. All three elements of the exception test have to be passed before development is allocated or permitted. For the exception test to be passed:

- It must demonstrate that the development provides wider sustainability benefits to the community that outweigh the flood risk, informed by an SFRA, where one has been prepared;
- The development should be on developed land or on previously developed land;

- A flood risk assessment must demonstrate that the development will be safe without increasing flood risk elsewhere, and where possible will reduce the overall flood risk.

The requirements for an Exception Test are given in Table 2 and are defined in terms of Flood Zone and development vulnerability classification.

Table 2: NPPF flood zone vulnerability compatibility (source: NPPF).

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	✗	Exception Test required	✓	✓
Zone 3b	Exception Test required	✗	✗	✗	✓

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Based on its scale and nature, the development is considered to be “less vulnerable”. As such the Exception Test should not be required by the LLFA.

12 Site Specific Flood Risk Analysis

The PFRA and Level 1 SFRA produced by the LLFA and maps from the EA provide information regarding historic flooding events and incidents as well as predictions of flood extents and depths during extreme rainfall events.

12.1 Fluvial (River) and Tidal (Sea) Flood Risk

12.1.1 Mechanisms for Fluvial Flooding

Fluvial, or river flooding, occurs when excessive rainfall over an extended period of time or heavy snow melt causes a river to exceed its capacity. The damage from a fluvial flood can be widespread as the overflow may affect downstream tributaries, overtopping defences and flooding nearby inhabited areas. Fluvial flooding consists of two main types:

- Overbank flooding – this occurs when water rises steadily and overflows over the edges of a river or stream;
- Flash flooding – this is characterized by an intense, high velocity torrent of water that occurs in an existing river channel with little to no notice. Flash floods are very dangerous and destructive not only because of the force of the water, but also the hurtling debris that is often swept up in the flow.

12.1.2 Definition of EA Modelled Fluvial Flood Risk Zones

Fluvial flood risk is assessed using flooding maps produced by the Environment Agency. These maps use available historic data and hydraulic modelling to define zones of flood risk. The maps allow a site to be defined in terms of its flood zone (e.g. 1, 2, 3) and in terms of the overall flood risk (very low, low, medium or high). It is important to note that existing flood defences are not taken into account within the models or the maps. The EA fluvial flood zones are defined as follows:

- Flood zone 1: Less than 1 in 1000 (0.1%) annual probability of flooding;

- Flood zone 2: Between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of flooding;
- Flood zone 3: Greater than 1 in 100 (1%) annual probability of fluvial flooding.

Flood zone 3 is split into two sub-categories (3a and 3b) by LLFAs depending on whether the land is considered to be a functional flood plain (i.e. an important storage area for flood waters in extreme events).

- Flood zone 3a: Greater than 1 in 100 (1%) annual probability of fluvial flooding and/or greater than 1 in 200 (0.5%) annual probability of tidal flooding;
- Flood zone 3b: Functional flood plain (definition specific to the LLFA). Less than a 1 in 20 (5%) annual probability of fluvial and/or tidal flooding.

12.1.3 Main Potential Sources of Local Fluvial Flooding

The nearest potential source of fluvial flooding to the site is considered to be the Yeading Brook.

12.1.4 Records of Historic Fluvial Flooding Incidents

The EA data has no records of floods impacting the site, there is one historic flood event from 1959 within 500m of the site.

12.1.5 Designated Fluvial Flood Risk Zone for the Site

The site is considered to be located within flood zone Flood Zone 2 as defined by the Environment Agency and the LLFA indicating that it has between 0.1% and 1% annual probability of fluvial flooding.

12.1.6 Mechanisms for Tidal Flooding

Tidal flooding may be described simply as the inundation of low-lying coastal areas by the sea, or the overtopping or breaching of sea defences. Tidal flooding may be caused by seasonal high tides, storm surges and where increase in water level above the astronomical tide level is created by strong on shore winds or by storm driven wave action.

12.1.7 Definition of EA Tidal Flood Risk Zones

As with fluvial flood risk, tidal flood risk is assessed using flooding maps produced by the Environment Agency. The difference is in the probability return periods used to define tidal flood zones. The EA tidal flood zones are defined as:

- Flood zone 1: Less than 1 in 1000 (0.1%) annual probability of flooding;
- Flood zone 2: Between 1 in 200 (0.5%) and 1 in 1000 (0.1%) annual probability of tidal flooding;
- Flood zone 3: Greater 1 in 200 (0.5%) annual probability of tidal flooding.

12.1.8 Potential Sources of Tidal Flooding

The area in which the site is located is considered unlikely to be affected by tidal flooding.

12.1.9 Flood Defences

No nearby flood defences are identified in the product 4 data.

12.1.10 Climate Change - EA Modelled Predictions of Fluvial and Tidal Flood Levels and Extents

The EA Product 4 dataset which is presented in Appendix 10 provides modelled flood levels and flows for model node points close to the site. These are summarised in the table below.

Table 4. EA data nodes and Annual Return Period and modelled flood depths (m)

	Annual Return Period				
Data Node	50 year	100 year	100 year+25%	100 year+70%	1000 year
YW901	35.82	35.85	35.94	36.08	36.23
YW902	36.02	36.06	36.18	36.38	36.99
YW903	36.35	36.41	36.54	36.74	37.36

The average ground level of the site is 36.63mAOD and the closest node to the site is YW902.

Given this information, the site is not expected to flood during the 1 in 100 year + 25% climate change event nor during the 1 in 100 + 70% climate change event. The site is expected to flood to depths of 0.36m during the 1 in 1000-year event.

12.1.11 Long Term Fluvial Flood Risk Considering Flood Defences

The EA's long term flood risk maps give an indication of the actual risk associated with flooding after taking into account the effect of any flood defences in the area. Copies of maps for the site which are available in Appendix 8 indicate that the long-term risk from fluvial flooding to the site is low.

12.2 Pluvial (Surface Water) Flood Risk

A pluvial, or surface water flood, is caused when heavy rainfall creates a flood event independent of an overflowing water body. Surface water flooding occurs when high intensity rainfall leads to run-off which flows over the ground surface, causing ponding in low-lying areas when the precipitation rate or overland flow rate is greater than the rate of infiltration, or return into watercourses. Surface water flooding can be exacerbated when the underlying soil and geology is saturated (as a result of prolonged precipitation or a high-water table) or when the drainage network has insufficient capacity.

12.2.1 Mechanisms of Pluvial Flooding

The chief mechanisms for surface water flooding can be divided into the following categories:

- Runoff from higher topography;
- Localised surface water runoff – as a result of localised ponding of surface water;

- Sewer Flooding – areas where extensive and deep surface water flooding is likely to be influenced by sewer flooding. Where the sewer network has reached capacity, and surcharged, this will exacerbate the flood risk in these areas;
- Low Lying Areas – areas such as underpasses, subways and lowered roads beneath railway lines are more susceptible to surface water flooding;
- Railway Cuttings –railway infrastructure cut into the natural geological formations can cause extra surface run off and pooling disrupting service and potentially affecting adjacent structures;
- Railway Embankments – discrete surface water flooding locations along the up-stream side of the raised network rail embankments where water flows are interrupted and ponding can occur;
- Failure of artificial sources (i.e. man-made structures) such as such as canals and reservoirs.

12.2.2 Main Potential Sources of Local Pluvial Flooding

The main potential source of pluvial flooding to the site is considered to be surface water ponding in the area.

12.2.3 Records of Historic Pluvial Flooding Incidents

Examination of the LLFA's Level 1 SFRA revealed no evidence of records of pluvial flooding on or in the vicinity of the site.

A map showing the location of surface water flooding incidents is available in Appendix 4 .

12.2.4 Surface Water Flood Risk from Artificial Sources (Reservoirs and Canals)

An examination of OS mapping and the EA's mapping revealed no indications of significant reservoirs or canals in the area of the site.

The EA's reservoir flood risk map indicates that the site does not lie within an area that is at risk of reservoir flooding.

12.2.5 Sewer Flooding

A map showing recorded incidents of sewer flooding is available in Appendix 4.

The LLFA records indicate that the site area has not experienced any sewer flooding events.

12.2.6 Climate Change - Modelled Predictions of Surface Water Run-off Flooding

Mapping of the predicted extent and depth of surface water flooding for the 1 in 100-year and 1 in 1000-year rainfall return periods provided by the EA are available in Appendix 6.

The location of the proposed development is exposed to surface water flooding during the 1 in 100 and 1 in 1000 AEP flooding events. The site remains dry during the 1 in 30-year event. During the 1 in 100 event the site floods between 150 and 600mm, the 1 in 1000 event floods between 300 and 900mm.

12.2.7 Long Term Surface Water Flood Risk

The EA's long term flood risk maps which are available in Appendix 8 indicate that the long-term risk of flooding from surface water is considered to be low to medium.

12.3 Risk of Flooding from Multiple Sources (ROFMS)

The Environment Agency provides a map which gives an indication the overall flood risk from fluvial, tidal and surface water sources considering the presence of river defences. This map indicates that there is between 0.1% and more than 3.3% chance of flooding at the site in any year. A copy of the map is presented in Appendix 8.

12.4 Groundwater Flood Risk

Groundwater flooding occurs when water rises from the underlying aquifer at the location of a spring – where the underlying impermeable geology meets the ground surface. This tends to occur after much longer periods of intense precipitation, in often low-lying areas where the water table is likely to be at a shallow depth. Groundwater flooding is known to occur in areas underlain by principal aquifers, although

increasingly it is also being associated with more localised floodplain sands and gravels. A high groundwater table also has the potential to exacerbate the risk of surface water and fluvial flooding by reducing rainfall infiltration capacity, and to increase the risk of sewer flooding through sewer/groundwater interactions.

12.4.1 Historic Records of Groundwater Flooding

The LLFA do not hold records of historic groundwater flooding in the SFRA.

12.4.2 Susceptibility to Groundwater Flooding

The Groundwater Flood Susceptibility Map provided by BGS, which is available in Appendix 9 indicates that the potential for groundwater flooding to occur at the surface does not exist. The Groundwater Depth map also provided by BGS indicates that the groundwater level may be at approximately more than 3 mbgl.

12.5 Critical Drainage Area

A Critical Drainage Area (CDA) may be defined as “a discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure”. A CDA is defined in the Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006 as “an area within Flood Zone 1 which has critical drainage problems and which has been notified HBC the local planning authority by the Environment Agency”.

The site is located within a Critical Drainage Area “Group1_018”.

13 Potential Impacts of the Development on Local Flood Risk

13.1 Impacts on Flood Storage

13.1.1 Changes to Impermeable Area and Building Footprint

Changes in ground cover arising from the development are presented in Table 3 below. The change to the impermeable area of the site is considered to be insignificant.

Table 3: Existing and proposed site ground cover.

	Impermeable Area (m^2)	Permeable Area (m^2)	Total Area (m^2)
Existing	130	14	144
Proposed	126	10	144

As the development will not significantly alter the site impermeable area, it is considered unlikely that it will impact upon surface water runoff rates.

However, as it will change the site's built-up area, it may impact upon local flood storage. Flood compensatory storage is discussed in Section 14.2.2 below.

13.2 Impacts on Flood Flow Routes

As the development does not involve the significant redesign of buildings at the site, it is unlikely to have a significant impact upon flood flow paths.

14 Flood Risk Mitigation Measures

14.1 SuDS

Planning practice guidance (PPG) which is prepared by the Ministry of Housing, Communities and Local Government (DCLG) states that developers and Local

Authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

As such, the developer has the option to implement a SuDS strategy in line with the drainage hierarchy as outlined in Table 5 below to reduce surface water discharges from the site.

Table 4: SuDs Options

- Store rainwater for later use;
- Use infiltration techniques, such as porous surfaces in non-clay areas;
- Attenuate rainwater in ponds or open water features for gradual release;
- Attenuate rainwater by storing in tanks or sealed water features for gradual release;
- Discharge directly to a water course;
- Discharge rainwater directly to a surface water sewer/drain;
- Discharge to a combined sewer.

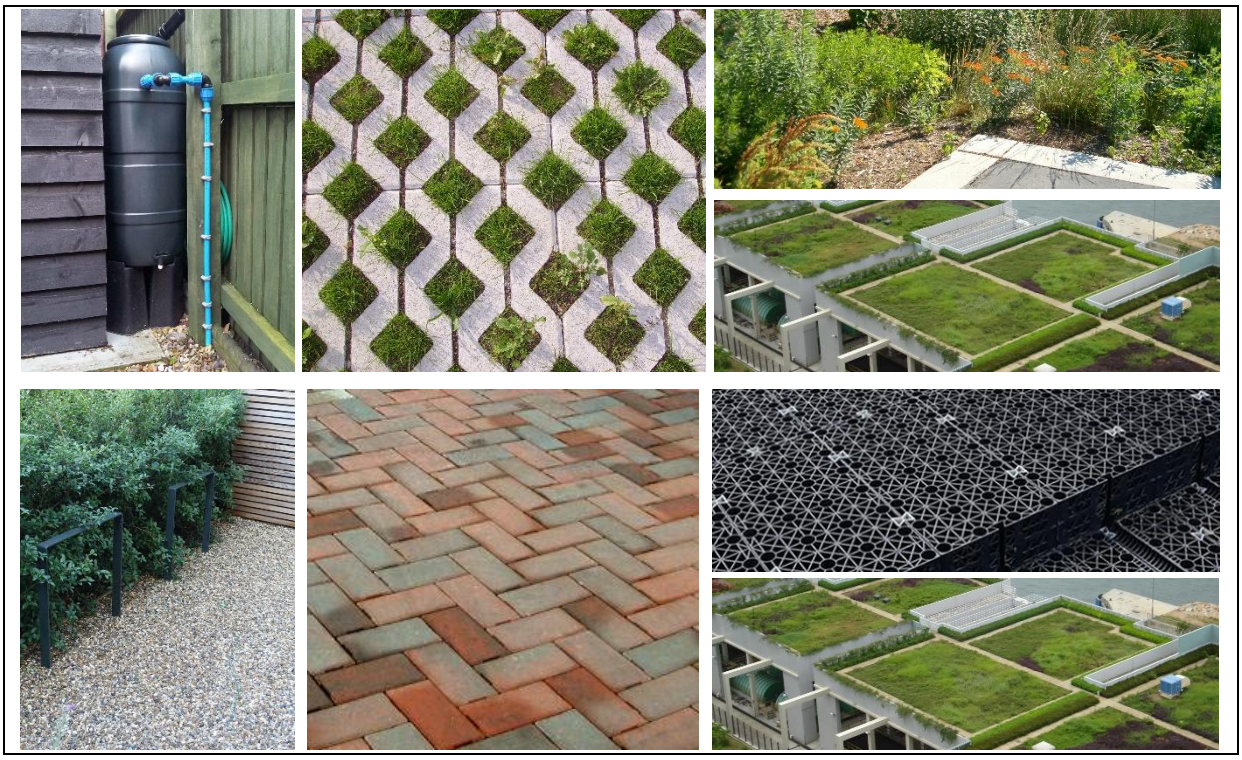


Figure 1: Surface water storage facilities and potential SuDS features - rainwater harvesting, on-site tank storage, rain garden soak-away and green roofs. (Source: UK SuDS Manual)

Given the nature of the development and the size of the site, it is considered that there are limited opportunities for implementing SuDS. Measures such as green roofs, rainwater harvesting, infiltration (soakaways, permeable paving, rain gardens) or attenuation storage tanks should be considered. If required the SuDS strategy will be detailed in a separate report as is outside the scope of works of this FRA.

14.2 Flood Resilience

Flood resilient construction uses methods and materials that reduce the impact from a flood, ensuring that structural integrity is maintained, and the drying out and cleaning required, following inundation and before reoccupation, is minimised.

14.2.1 Finished Floor Levels

The average ground level of site is 36.63mAOD.

The site does not experience any flooding during the 1 in 100-year event + 70% climate change.

However, in order to address surface water flood depths during the 1 in 100-year event, it is recommended finished floor levels are set to 600mm above ground level.

14.2.2 Flood displacement storage

All new development within Flood Zone 3 must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.

As the proposed development is located in flood zone 2 flood compensation storage is not required for fluvial flooding, however, due to the severity of surface water flooding the LLFA have requested flood compensation storage for the development.

The proposed extension measures 14m by 4.30m with a total area of 60.2m^2 and varying degrees of surface water flood depths.

38m^2 of the proposed development location is expected to flood to depths of between 150-300mm which results in a maximum of 11.4m^3 and a minimum of 5.7 m^3 of lost flood storage.

13m^2 of the proposed development area is expected to flood to depths of 300-600mm which gives a maximum of 7.8m^3 and a minimum of 3.9m^3 of lost flood storage.

The remaining 9.2m^2 of the proposed development area does not experience any surface water flood depths during the 1 in 100-year event. See appendix 12 with the extension area (in purple) overlayed with the 1 in 100-year Surface water flooding event predictions.

The total range of possible lost surface water flood storage associated with the development is between 9.6m^3 and 19.2m^3.

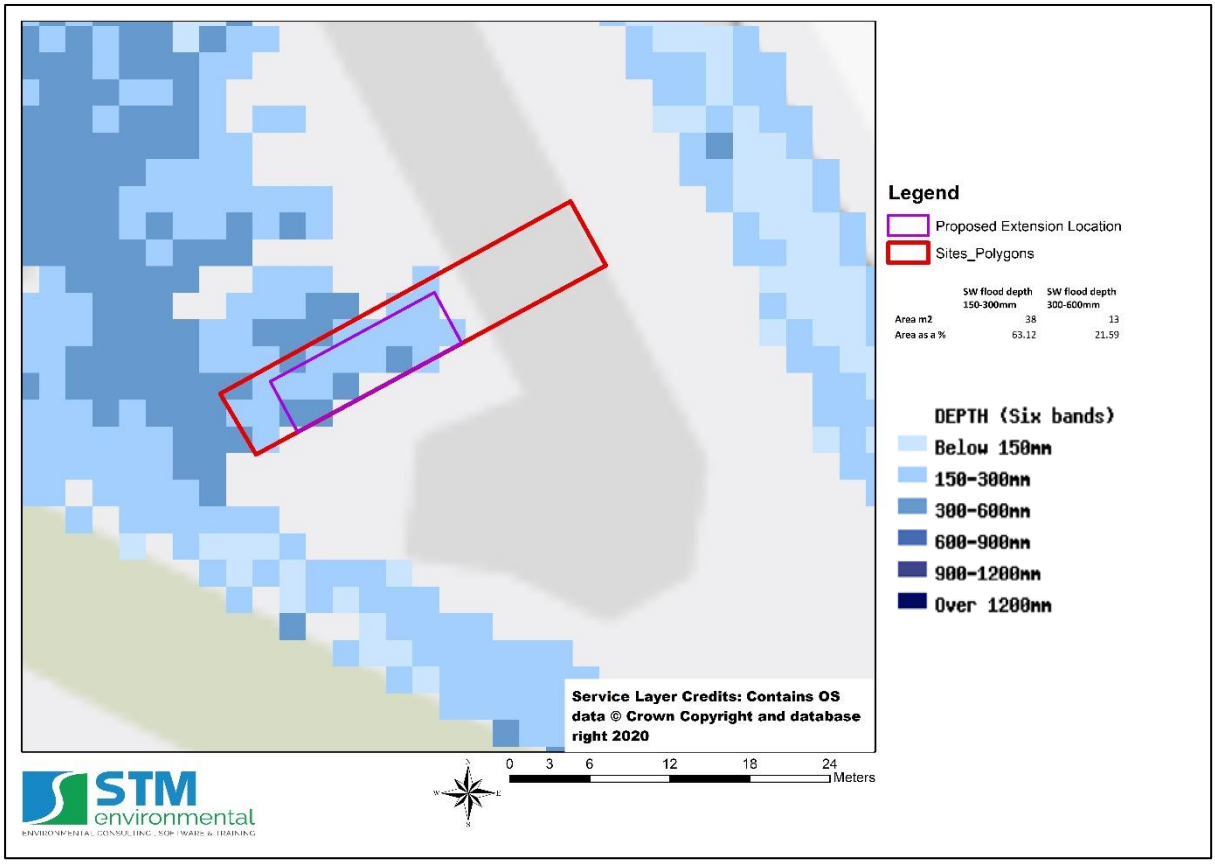
Given the considerable amount of potential flood storage displaced by the proposal, it is not considered feasible at the site to provide level for level compensation by lowering an area within the site itself. As the whole rear of the site would be impacted by flooding during the 1 in 100-year event, lowering an area to the rear of the proposed development would potentially lead to even greater flood depths at the site.

It is therefore recommended to raise finished floor levels and implement under floor voids in order to minimize any loss in flood storage.

As such, finished floor levels should be raised by 600mm above the current ground level and voids implemented underneath. As only ~22% of the extension location is expected to flood to depths of a maximum of 600mm, this level is considered appropriate to mitigate the lost flood storage from the proposed development.

Table 6 – Extension areas and predicted surface water flooding.

	Total Area	SW flood depth 150-300mm	SW flood depth 300-600mm
Area m^2	60.2	38	13
Area as a %	100	63.12	21.59



Any under-floor voids would need to be appropriately designed and kept clear to enable them to function effectively.

Ideally, void openings should be a minimum of 1m long and open from existing ground levels to at least to the 1% annual probability (1 in 100-year) plus climate change flood level. There should be a minimum of 1m of open void length per 5m length of wall. Void openings should be provided along all external walls of the proposed extension. If security is an issue, 10mm diameter vertical bars set at 100mm centres can be incorporated into the void openings.

14.2.3 Flood Resilience Measures

In terms of achieving resilience, there are two main strategies, whose applicability is dependent on the water depth the property is subjected to. These are:

- Water exclusion strategy - where emphasis is placed on minimising water entry whilst maintaining structural integrity, and on using materials and construction techniques to facilitate drying and cleaning. This strategy is favoured when low flood water depths are involved (not more than 0.3m);
- Water entry strategy - buildings are at significant risk of structural damage if there is a water level difference between outside and inside of about 0.6m or more. This strategy is therefore favoured when high flood water depths are involved (greater than 0.6m).

As flood depths less than 0.6m are predicted during the 1 in 100-year surface water event, the water exclusion strategy is the most applicable for this site.

Flood resilience design and measures that will be implemented are outlined below. Water-resistant and resilient materials will be utilized through the construction to minimize the flood risk and potential impacts.

Floor construction:

- Use of resilient flooring materials as ceramic tiles or stone floor finishes;
- Use of a concrete slab 150mm thick;
- Use of ceramic tiles or stone floor finishes is recommended;
- Maintain existing under floor ventilation by UPVC telescopic vents above 400 mm to external face of extension;
- Damp proof membrane of impermeable polythene at least 1200 gauge;
- Avoid the use of MDF carpentry.

Wall construction:

- Include in the external face of the extension a damp – proof course, 600mm above ground level, to prevent damp rising through the wall;
- Use rigid closed – cell material for insulation above the DPC;

- Spread hardcore over the site within the external walls of the building to such thickness as required to raise the finished surface of the site concrete. The hardcore should be spread until it is roughly level and rammed until it forms a compact bed for the oversite concrete. This hardcore bed will be 100 mm thick and composed by well compacted inert material, blinded with fine inert material.

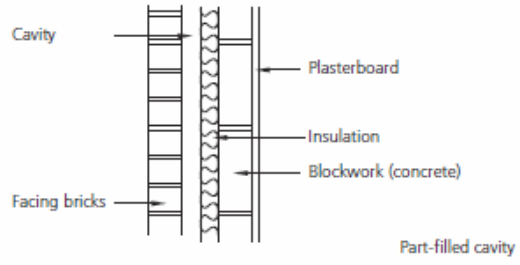
Doors:

- Seal doors around edges and openings. UPVC or composite material will be used with passive protection meaning that minimal intervention will be required in the event of flooding.

Underground drainage:

- Avoid use of metal for any underground piping;
- Use closed cell insulation for pipes that are below the predicted flood level;
- Provide non – return valves for the drainage system to prevent back water flow;
- Use UPVC or clay pipework for fouls and surface water drainage.

Figure 6.10 Cavity External Walls – Part-filled cavity with sacrificial plasterboard



Part-filled cavity

- External face consisting of engineering bricks up to required level for flood protection (up to d.p.c.). Other external facing materials can be used above this level, but ensure transition is watertight.
- Rigid insulation
- Internal cement based render, preferably with lime content. Composition depends on masonry; the following mix is effective:

  1 cement : 6 sand: 1 lime on concrete blocks.
- Stainless steel wall ties should be used to minimise corrosion and consequent staining.
- Sacrificial plasterboard can be used, but it needs to be removed between ground floor to flood level. The board should be laid horizontally to make removal easier.

As well as the above the following flood resilience features should be applied as part of the development:

- Electrical sockets should be installed above flood level for the ground floor;
- Utility services such as fuse boxes, meters, main cables, gas pipes, phone lines and sockets will be positioned as high as practicable;
- All external openings for pipes or vents below 400mm to be sealed around pipe or vent with expanding foam and mastic.

14.3 Emergency Plan

The dangers associated with flood water to people are possible injury and/or death. This can occur as a result of drowning or being carried along by the waters into hard objects or vice versa.

The risk to life is largely a function of the depth and velocity of the floodwater as it crosses the floodplain. Fast flowing deep water that contains debris would represent the greatest hazard.

The assessment of danger to people from walking in floodwater is described in the Flood Risks to People guidance documents (FD2321_TR1 and FD2321_TR2) by DEFRA/EA. Danger can be estimated by the simple formula:

$$HR = d \times (v + 0.5) + DF$$

where, HR = (flood) hazard rating; d = depth of flooding (m); v = velocity of floodwaters (m/sec); and DF = debris factor.
The scoring methodology and calculation matrix for this is summarised in Appendix 12.

During the modelled 1 in 1000-year flood event from the EA the site is expected to flood to depths of 0.36m, flood flows for the centre of the river are expected to be

17.80m/s during this time. As such, the final flood hazard ranking is 7.59 which indicates Extreme - danger for all.

It is key to note that the flood flow rates have been given for node point YW902 which is in the centre of the river and therefore the hazard ranking is for in channel flows rather than on site.

The site does not flood during the 1 in 100-year event with a 35% or 70% allowance for climate change and therefore its hazard ranking is 0.

The surface water flow rates for the 1 in 100-year AEP event site are presented in Appendix 6.

It displays the expected maximum flow rate for the site to be between 0.25 - 0.5m/s and the majority of the site has a ranking of less than 0.25m/s. Given the expected depths of 0.3 - 0.6m from the same event the expected flood hazard ranking for the site is between 1.375 and 1.6 signifying a between a class 1 and class 2 hazard ranking.

The surface water hazard map provided in Appendix 6 identifies the hazard ranking along the egress route which depicts a 0.50-0.75 hazard for the majority of the route along west end road with some portions of the route 0.75-1.25.

The use of a flood emergency plan is therefore sufficient for the proposed development, the proposed safe egress routes will also provide safe refuge to an area without surface water or fluvial flooding. The key elements of the emergency plan are described below.

14.3.1 EA Flood Warnings Direct Service Subscription

The occupants will subscribe to the EA Flood Warnings Direct Service which is a free service offered by the EA providing flood warnings direct to people by telephone,

mobile, email, SMS text message and fax. The EA aims to provide 2 hours' notice of flood, day or night, allowing timely evacuation of the site.

The agency operates a 24-hour telephone service on 0345 988 1188 that provides frequently updated flood warnings and associated floodplain information. In addition, this information can also be found at https://fwd.environment-agency.gov.uk/app/olr/home along with recommendations on what steps should be taken to prepare for floods, what to do when warnings are issued, and how best to cope with the aftermath of floods.

14.3.2 Access and Safe Egress

Access to and egress from the site is via Westend Road. LIDAR data indicates that the ground levels along Westend Road range from 36.7mAOD to 37.1mAOD.

Safe egress to Flood Zone 1 and an area without surface water flooding during the 1 in 100-year event is available by a 3-min walk North up Westend Road. Directions of this route are presented in Appendix 11 .

14.3.3 Safe Refuge

The proposed development is a commercial property with no residential accommodation and therefore safe refuge is not required.

15 Conclusions and Recommendations

This assessment has considered the potential risks to the application site associated with flooding from fluvial, tidal, surface water, artificial and groundwater sources and the potential impacts of climate change.

A review of LLFA's PFRA and SFRA as well as data provided by the EA was undertaken. The main findings of the review and assessment are provided below:

- The site is classified as a less vulnerable minor development and is therefore unlikely to require sequential and exception tests to be undertaken;
- The EA define the site as being within Flood Zone 2;
- No records of fluvial or artificial flooding incidents were identified at or in the vicinity of the site;
- The site is within a CDA. It is not in an area that has had a significant number of sewage flooding incidents;
- No records of groundwater flooding incidents were available at or in the vicinity of the site;
- The development will not result in a significant change in the impermeable area of the site and therefore unlikely to have a significant impact upon local flood risk;
- There is limited opportunity for implementing SuDS mitigation measures. Consideration should be given to use of permeable paving and rainwater harvesting;
- Flood resilient materials and construction methods will be used so as to ensure that the impacts of any potential flooding are minimised as much as possible;
- Occupants will subscribe to the EA Flood Warnings Direct Service;
- Safe egress routes to flood zone 1 are easily accessible;

Based on the information reviewed and taking into account the proposed mitigation measures, it is considered that the overall flood risk of the property is medium and the development is unlikely to have a significant impact on local flood risk.

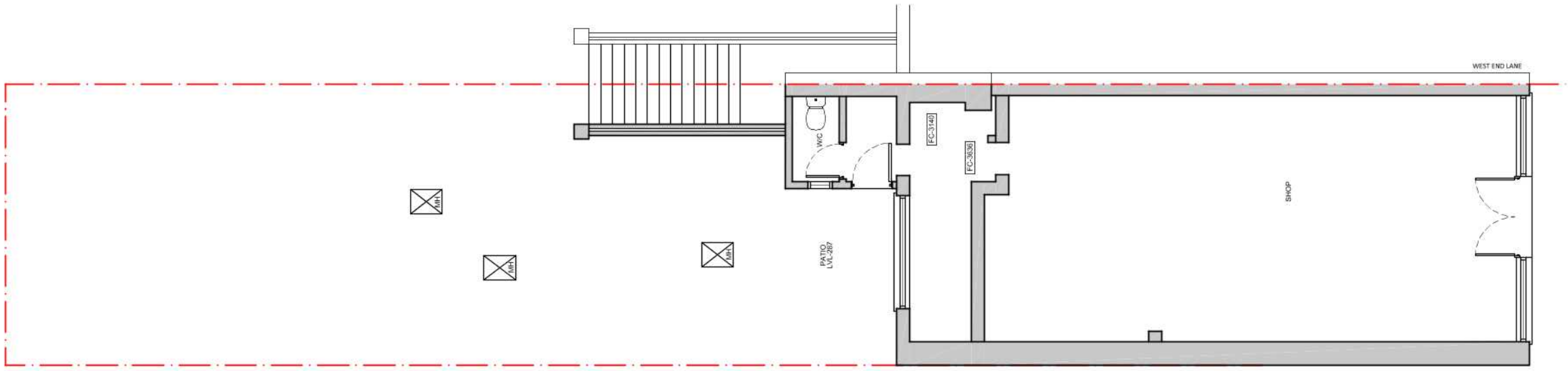
16 References

1. Communities and Local Government - National Planning Policy Framework NPPF, March 2012.
2. Communities and Local Government - Planning Practice Guidance: Flood Risk and Coastal Change, Updated 06 March 2014.
3. Strategic Flood Risk Assessment – London Borough of Hillingdon 2011
4. CIRIA, Defra, Environment Agency – UK Suds Manual, 2015.
5. Greater London Authority – London Sustainable Drainage Action Plan, 2015.
6. Google Maps accessed February 21.

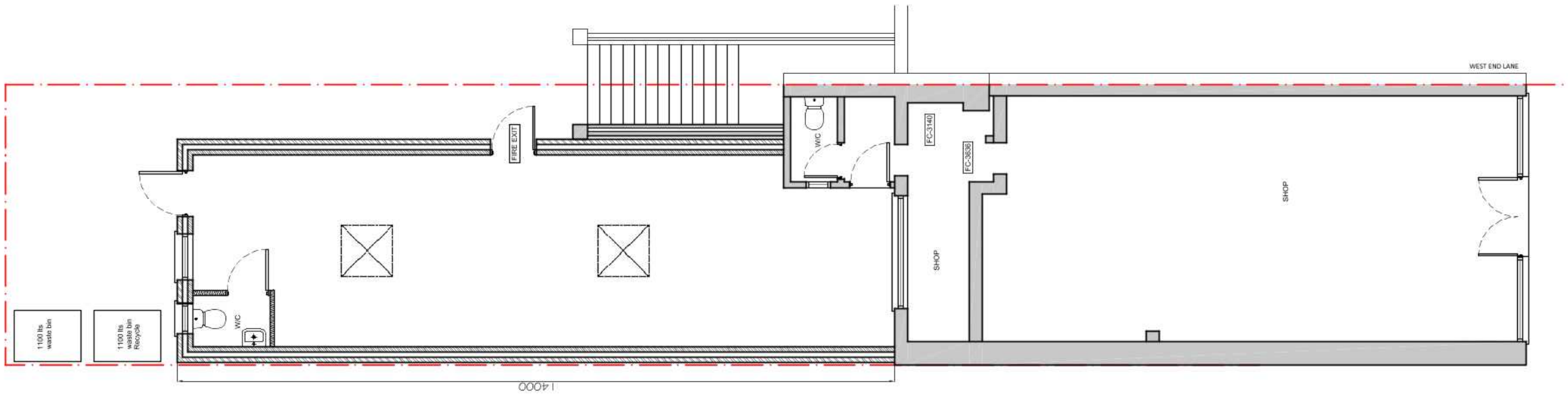
17 Appendices

17.1 Appendix 1 – Site Photographs

17.2 Appendix 2 – Development Plans



EXISTING GROUND FLOOR PLAN
SCALE 1:100



PROPOSED GROUND FLOOR PLAN
SCALE 1:100

SITE LOCATION PLAN
SCALE 1:1250

GENERAL NOTES

All dimensions, levels, sizes, positions and locations of particulars as indicated on drawings are to be verified by the appointed Contractor on site prior to engaging in works.
Any discrepancies must be reported to the Architect/Surveyor/Engineer or responsible person/s immediately.

No dimension to be scaled from the drawings for construction purposes unless otherwise indicated. All work is to comply with current Building Regulations.

Party Wall etc. Act 1996 would apply and contractor is to assure that no work is commenced until this formality is completed.

The sole purpose of this drawing is the procurement of Planning Permission and Building Regulation approval and work is NOT to commence before such approvals.

Where this drawing is used for the works, contractor should request at the time of tender, from the tenderer, full specification and schedule of work. To avoid any disputes, this schedule of works in conjuction with the drawings would be used to resolve matters.

Contractor to assure and satisfy himself that necessary Planning permission and Building Regulations are approved before tendering or commencement of works.

The competent person is to send to the local authority via the scheme provider) a self-certification certificate within 30 days of the electrical works' completion. The client must receive both a copy of the self certificate and a BS7671 Electrical Installation Test Certificate. (Reg. P1)

The Gas and Boiler installations will be carried out by a suitably qualified CORGI registered gas engineer or equal approved.

The Contractor is responsible for ensuring compliance with the CDM Regulations, and appropriate Health & Safety on site precautions.

PLANNING ISSUE

0 1m 2m 3m 4m 5m
Scale 1:100

0 1m 2m
Scale 1:50

REVISION	DESCRIPTION	BY	DATE
A	MINOR AMENDMENTS	DS	23-07-2020

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Architectural and Interior design services

33 Lloyd court
Pinner
HA5 IEF

Mo: 0044-0-7985433242
www.shahdesignsltd.co.uk
email:darshkas@shahdesignsltd.co.uk

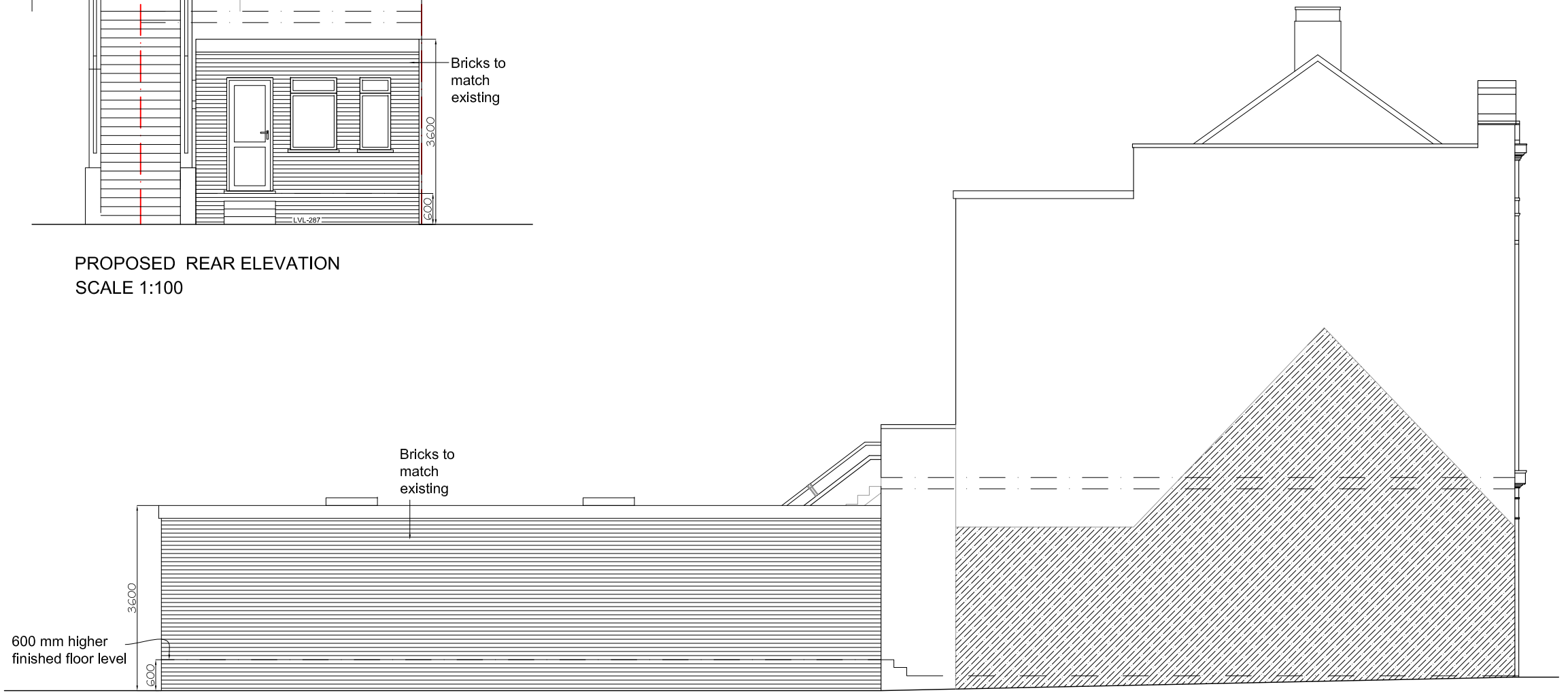
PROJECT
296 WEST END ROAD
RUISLIP
HA4 6LS

DRAWING TITLE
EXISTING AND PROPOSED GROUND FLOOR PLAN

DATE	DRAWN BY
22.07.2020	SD
SCALE 1:100 @ A3	CHECKED BY SD

DRAWING NO. SD2042(P)01–A REVISION

PROPOSED REAR ELEVATION
SCALE 1:100



PROPOSED SIDE ELEVATION (VIEW FROM NO. 295)
SCALE 1:100

GENERAL NOTES

All dimensions, levels, sizes, positions and locations of particulars as indicated on drawings are to be verified by the appointed Contractor on site prior to engaging in works.
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PLANNING ISSUE

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Scale 1:100

0 1m 2m
Scale 1:50

REVISION	DESCRIPTION	BY	DATE
B	MINOR AMENDMENTS	DS	29-01-2021
A	MINOR AMENDMENTS	DS	23-07-2020

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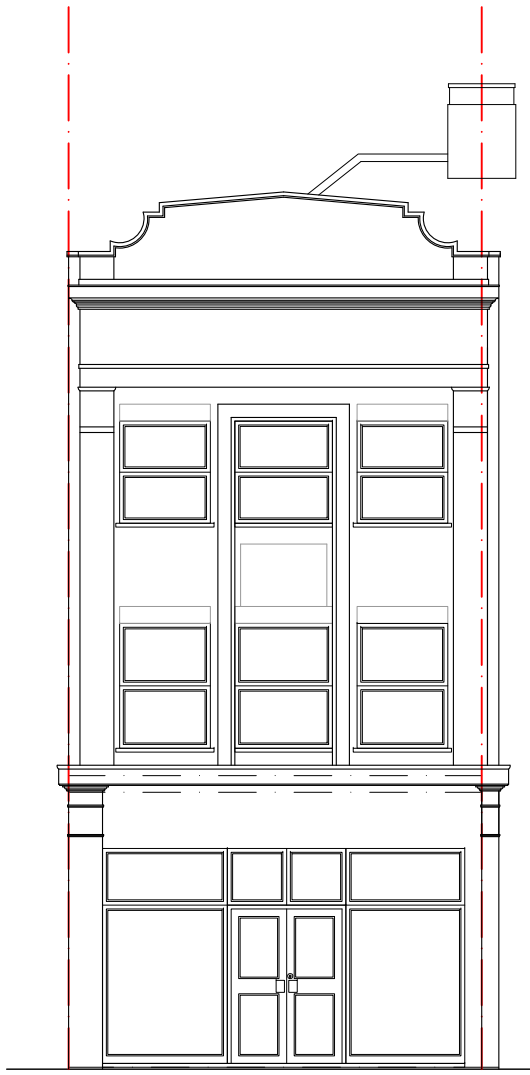
email:darshikas@shahdesignsltd.co.uk

PROJECT
296 WEST END ROAD
RUISLIP
HA4 6LS

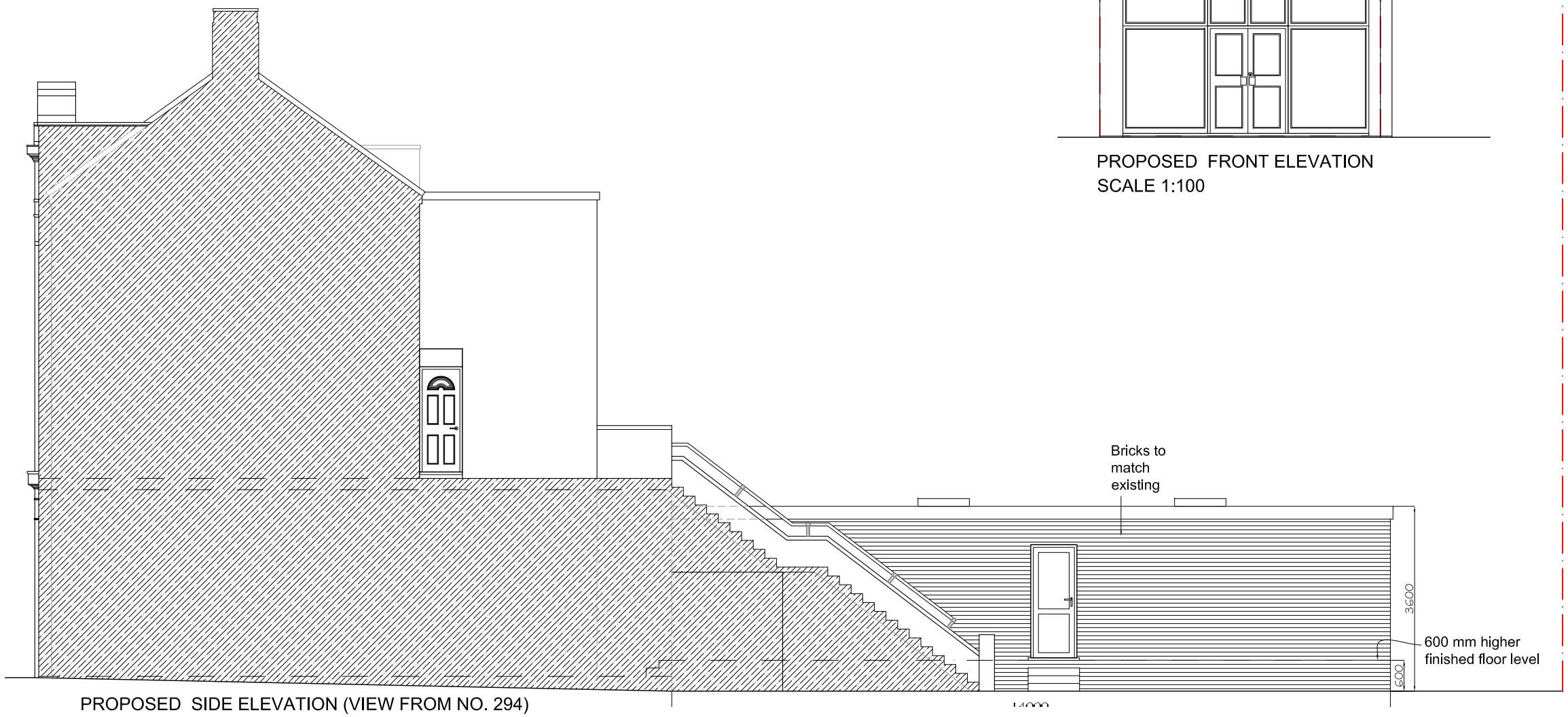
DRAWING TITLE
PROPOSED REAR AND SIDE ELEVATION

DATE 22.07.2020	DRAWN BY SD
SCALE 1:100 @ A3	CHECKED BY SD

DRAWING NO. SD2042(P)05–B
REVISION



PROPOSED FRONT ELEVATION
SCALE 1:100



PROPOSED SIDE ELEVATION (VIEW FROM NO. 294)
SCALE 1:100

GENERAL NOTES

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PLANNING ISSUE

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Scale 1:100

0 1m 2m
Scale 1:50

REVISION	DESCRIPTION	BY	DATE
B	MINOR AMENDMENTS	DS	29-01-2021
A	MINOR AMENDMENTS	DS	23-07-2020

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email:darshkas@shahdesignsltd.co.uk

PROJECT
296 WEST END ROAD
RUISLIP
HA4 6LS

DRAWING TITLE
PROPOSED FRONT AND SIDE EXTENSION

DATE	DRAWN BY
22.07.2020	SD
SCALE 1:100 @ A3	CHECKED BY SD

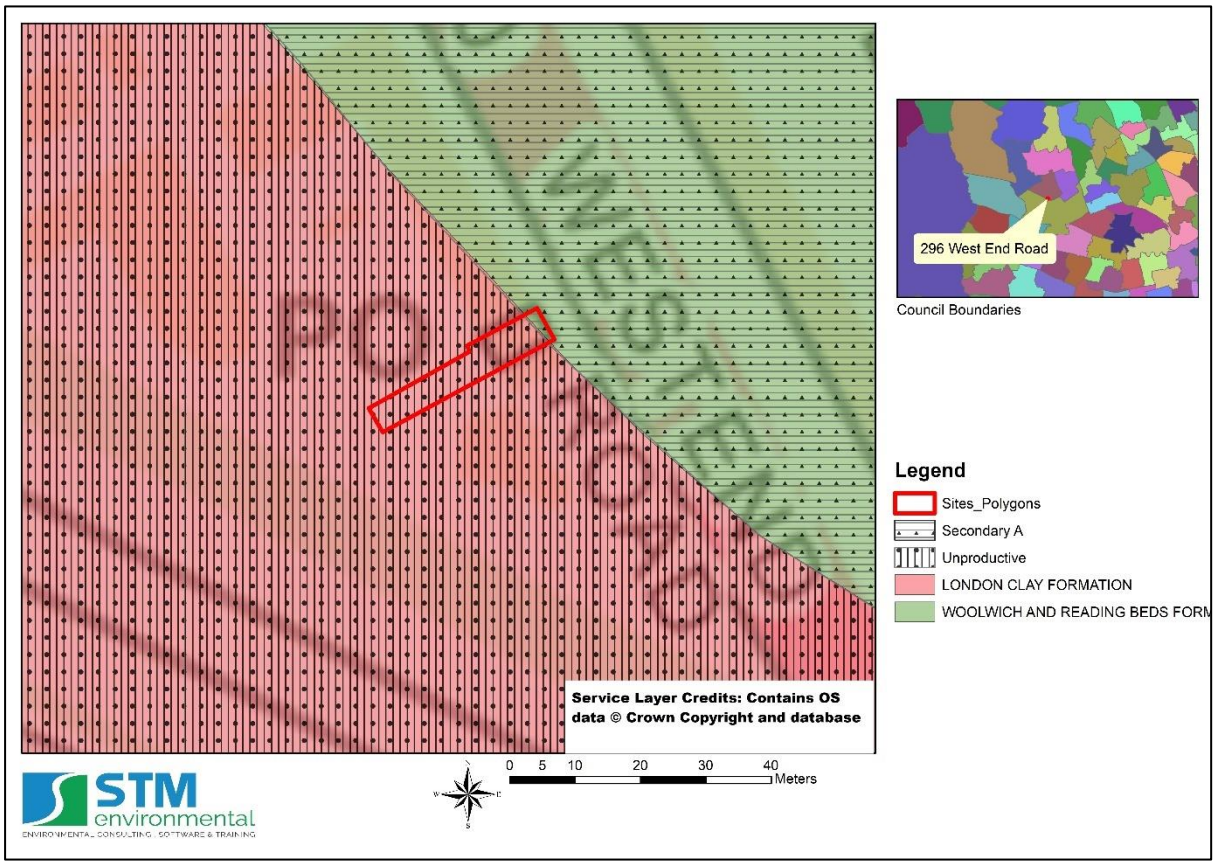
DRAWING NO. SD2042(P)04–B
REVISION

17.3 Appendix 3 – Environmental Characteristics

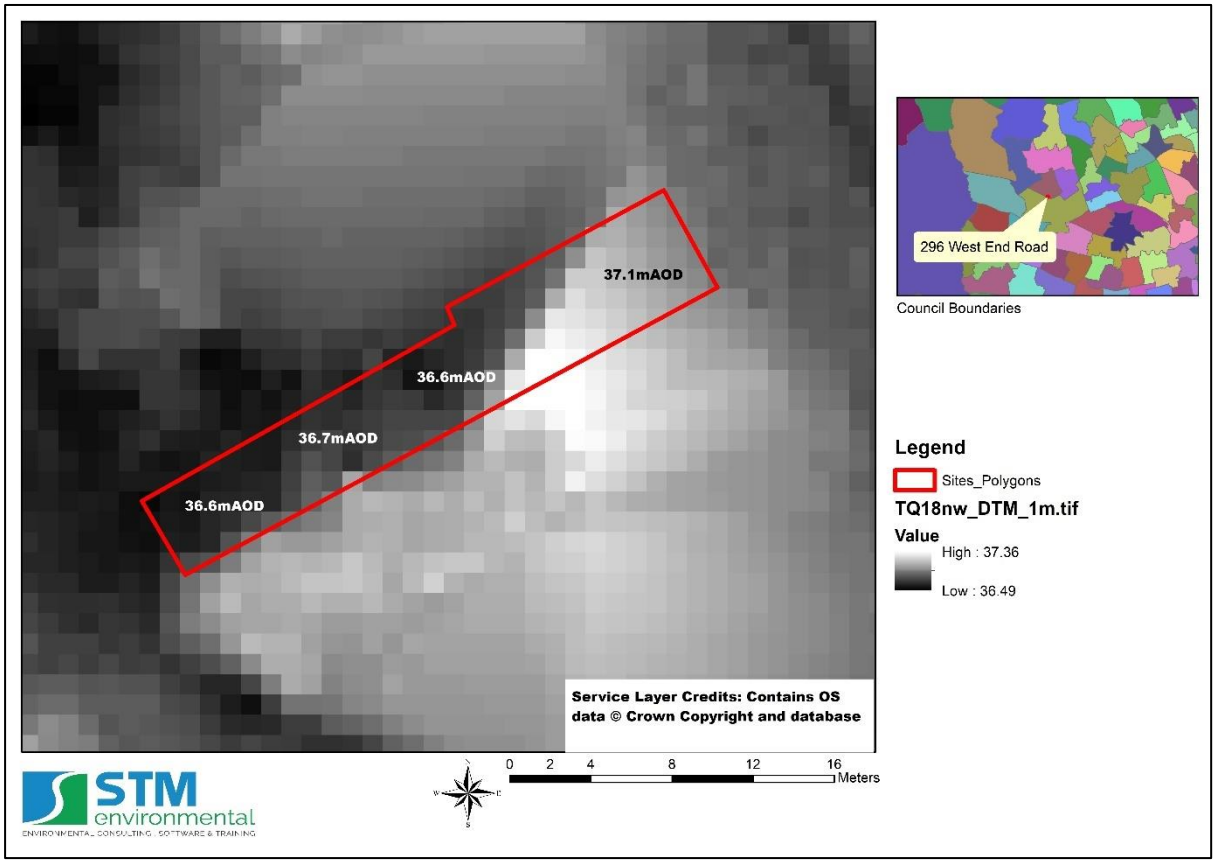
17.3.1 Superficial Hydrogeology Map

No Superficial deposits. Left intentionally blank.

17.3.2 Bedrock Hydrogeology Map



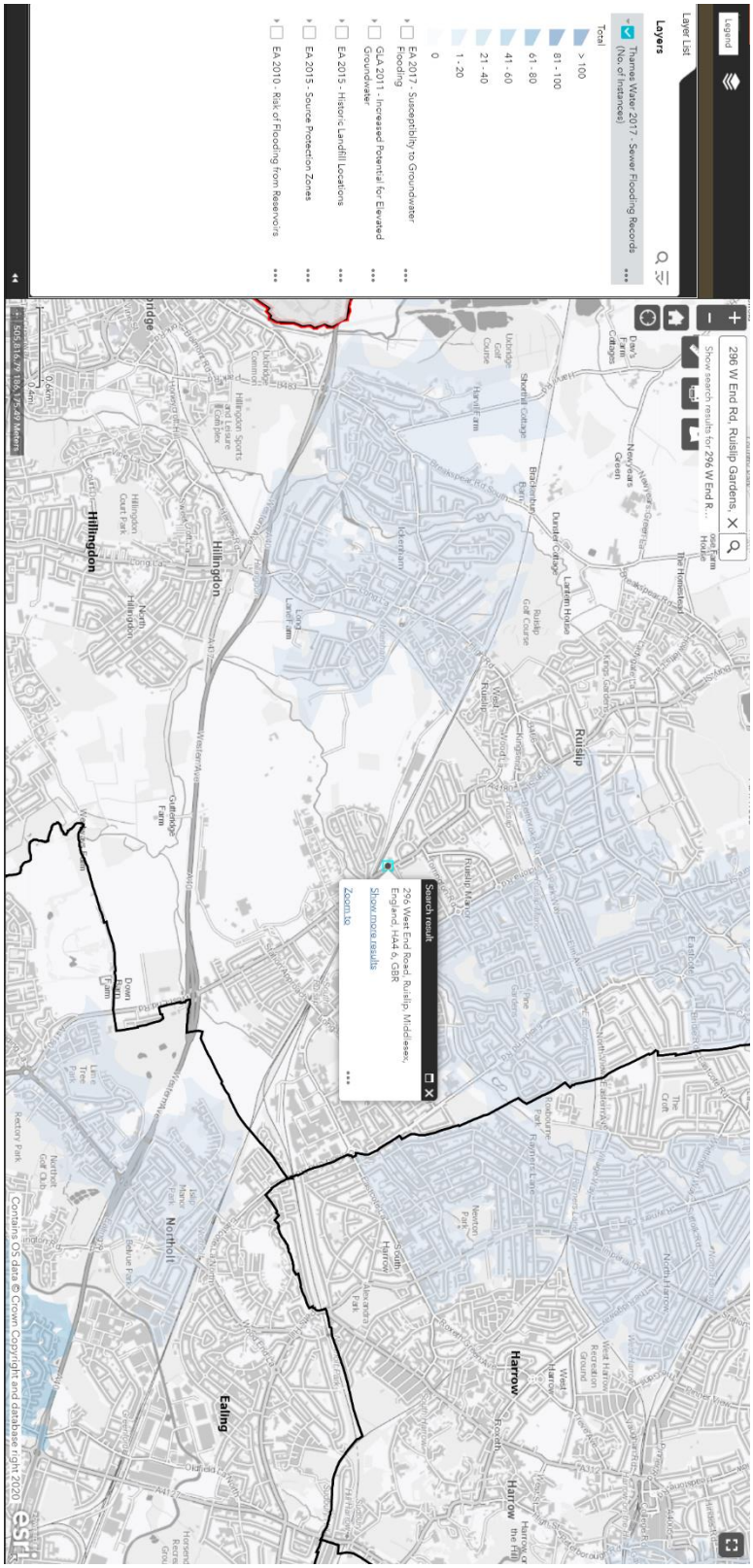
17.3.3 Topology Map



17.4 Appendix 4 – Historical Flood Incident Maps

17.4.1 EA Historic Flood Outlines

17.4.2 Map Recorded Sewer Flooding



17.4.3 Map of Recorded Groundwater Flooding

Not available in LLFA SFRA.

17.4.4 Map of LLFA Recorded Fluvial Flooding

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Main River
- Ordinary Watercourse
- Culverted Watercourse (Main River)
- Permanent Water Bodies
- Fluvial Flooding Incidents
- Historic Fluvial Flood Outline
- Environment Agency Flood Zone 3
- Environment Agency Flood Zone 2

Notes

1. Environment Agency Flood Zone 3 represents a 1% AEP flood event.
2. Environment Agency Flood Zone 2 represents a 0.1% AEP flood event.

London Borough of Hillingdon

HILLINGDON LONDON

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:40,000	08/04/2011	R.MOORE	P.HLINOVSKY

Environment Agency Flood Map and Fluvial Flooding Incidents

Consultants
CAPITA SYMONDS Flood Risk Management
Scott Wilson
Capita Symonds
Level Seven,
52 Grosvenor Gardens,
Belgravia,
London
SW1W 0AU

Drain London Programme Board Members

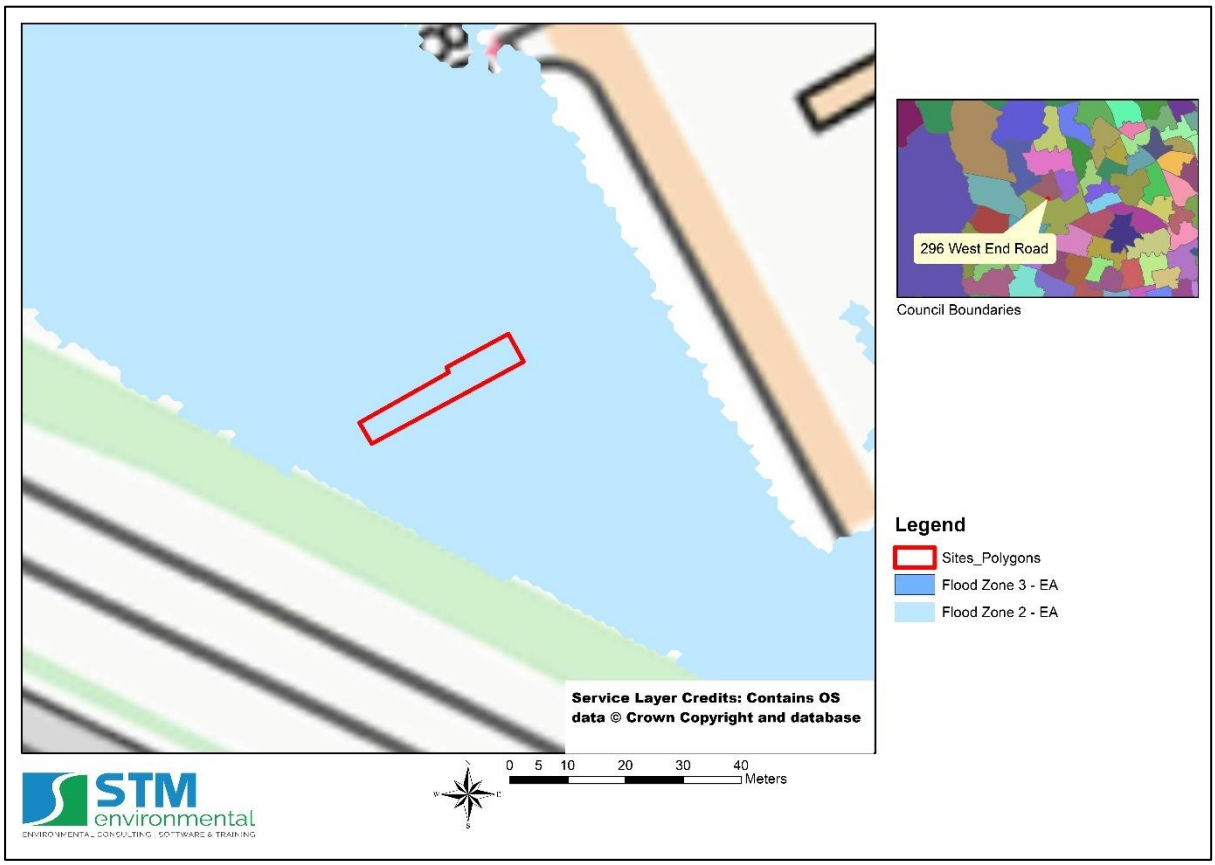
Environment Agency · Thames Water · LONDON COUNCILS · GREATER LONDON AUTHORITY

FIGURE 7.1

0 0.25 0.5 1 1.5 2 Kilometres

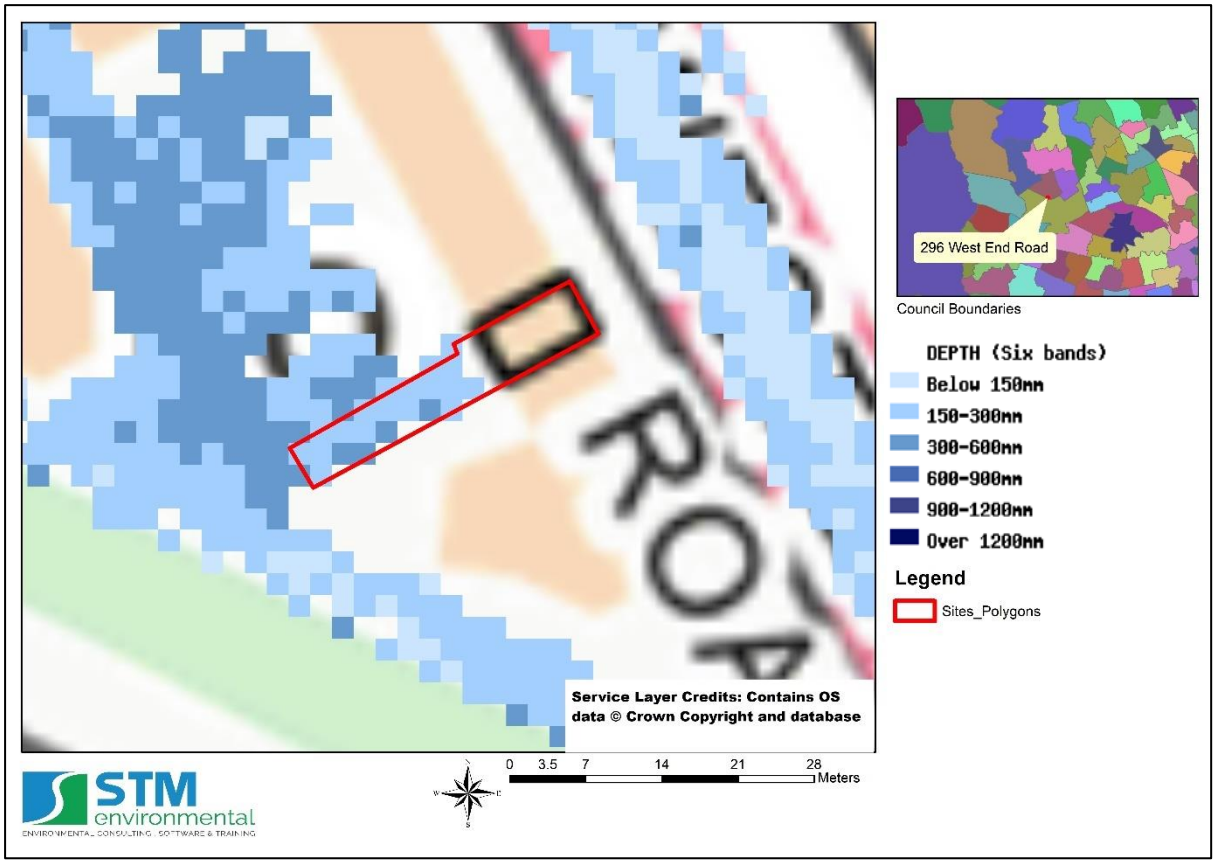
Filepath: L:\Environment\zwet\CS046913_DrainLondon_Tier2\Group1\ARC\mxds\GP1_Hillingdon_Fig7.1_EAFloodMap_FlvIncidents.mxd

17.5 Appendix 5 - EA Flood Zone Map

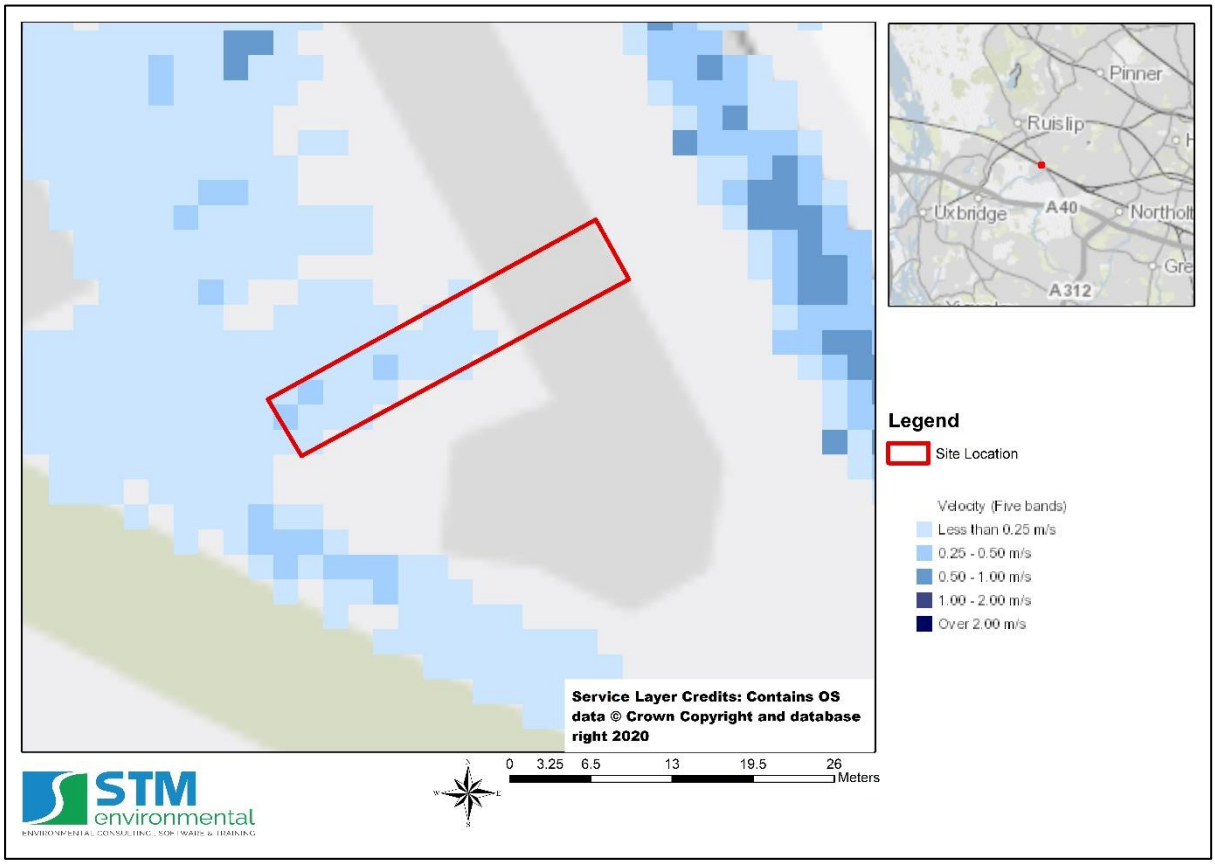


17.6 Appendix 6 – Surface Water Flood Extent and Depth Maps

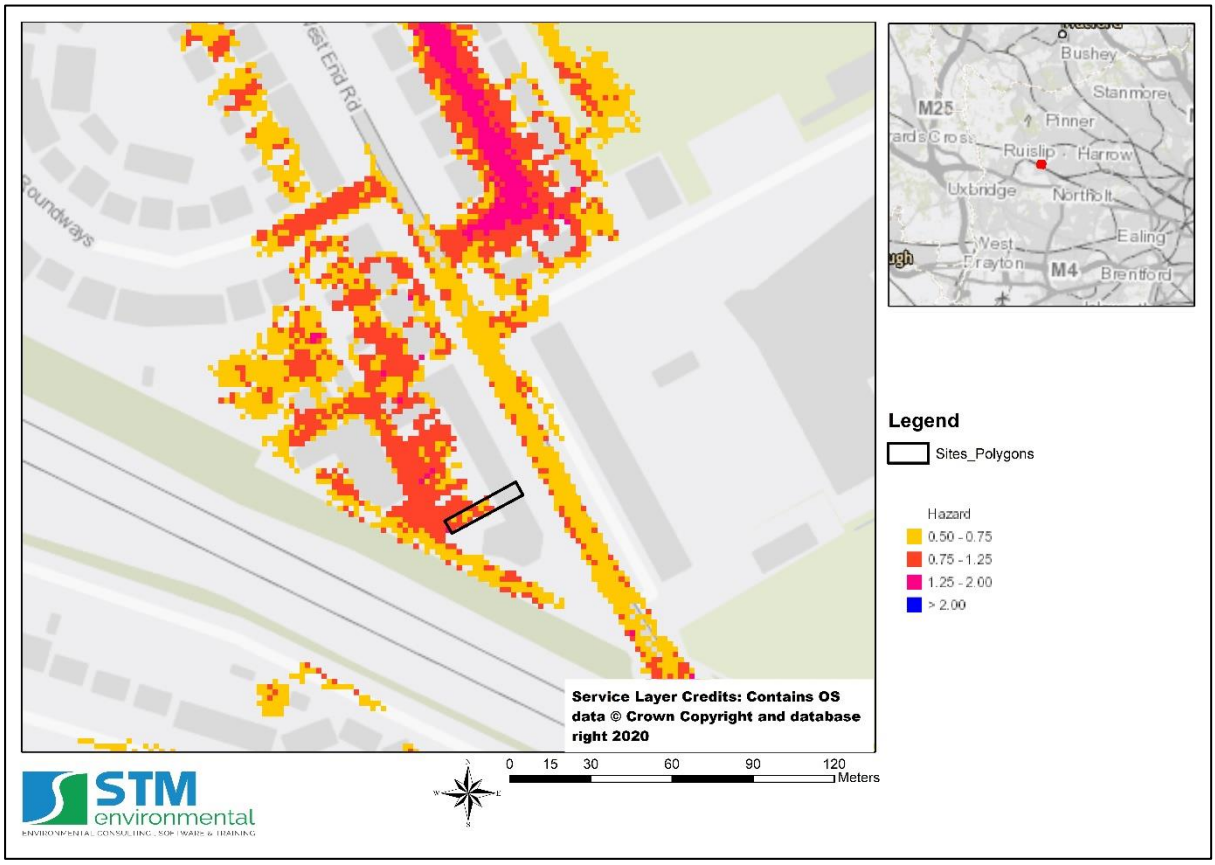
17.6.1 Map showing surface water flood depths for the 1 in 100-year rainfall return period (Source: EA, 2020).



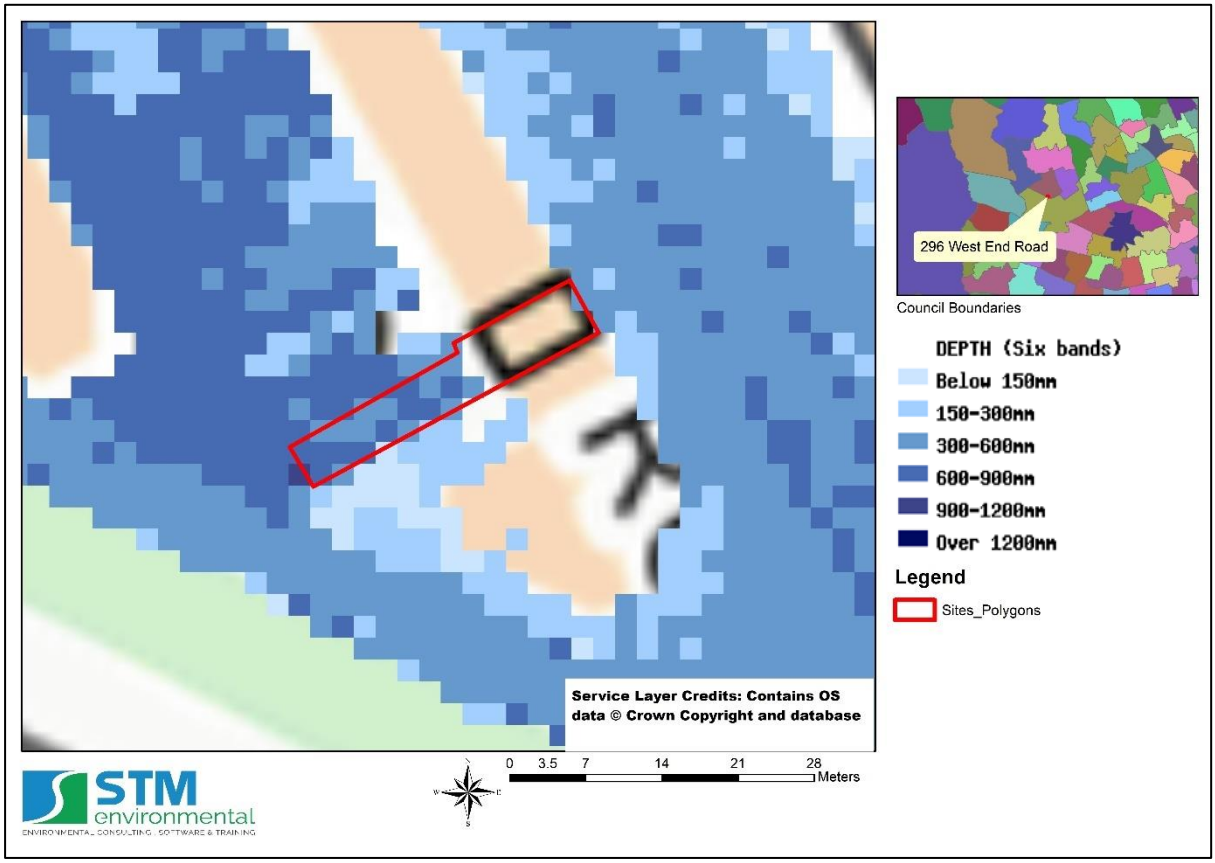
17.6.2 Predicted surface water flood flow rates for the 1 in 100-year return period (Source: EA, 2020).



17.6.3 Predicted surface water flood hazard rates for the 1 in 100-year return period (Source: EA, 2020).



17.6.4 Predicted surface water flood depth for the 1 in 1000-year return period (Source: EA, 2020).

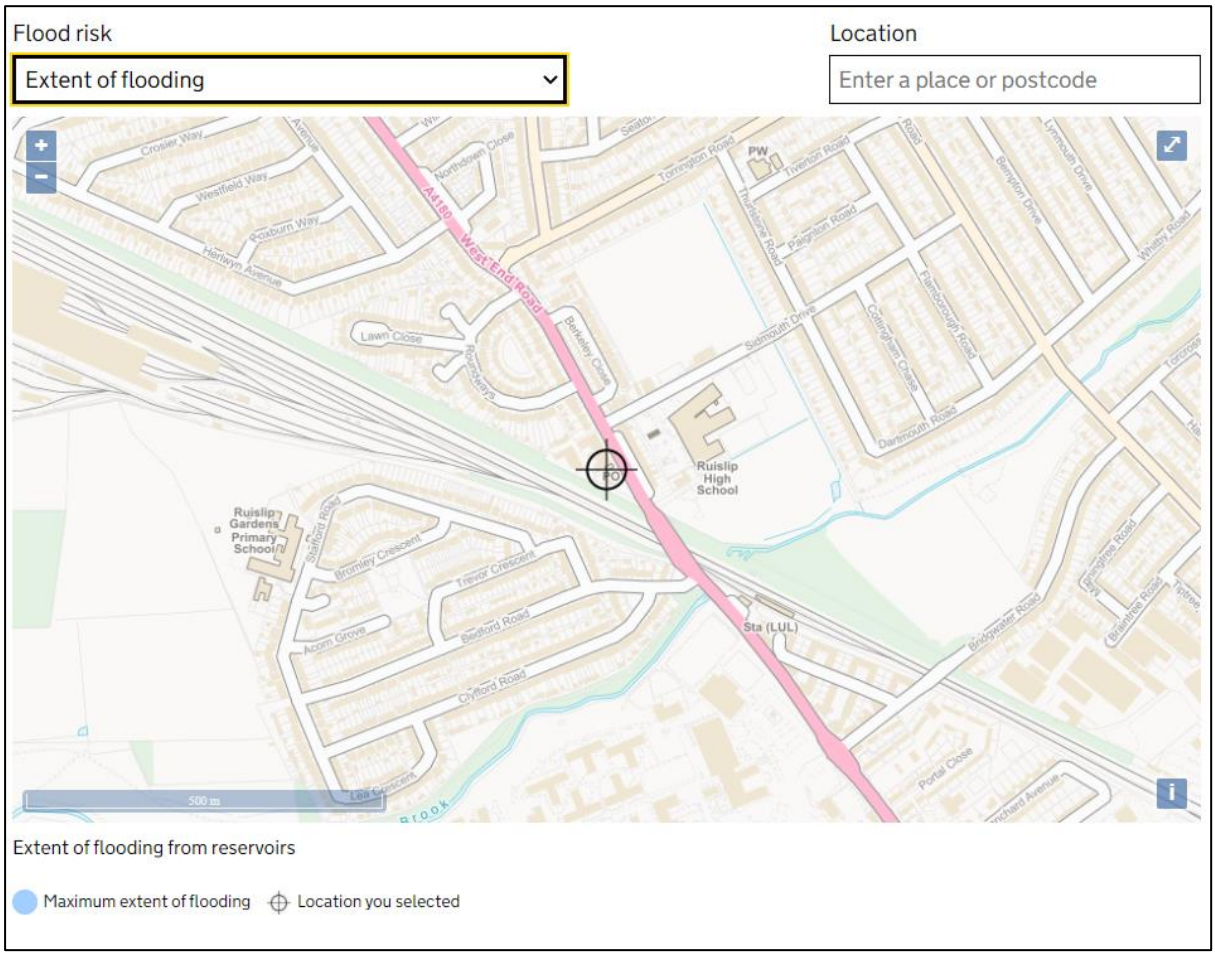


17.7 Appendix 7 –Flood Defence and Reservoir Flood Risk Maps

17.7.1 EA Map showing areas benefitting from flood defences

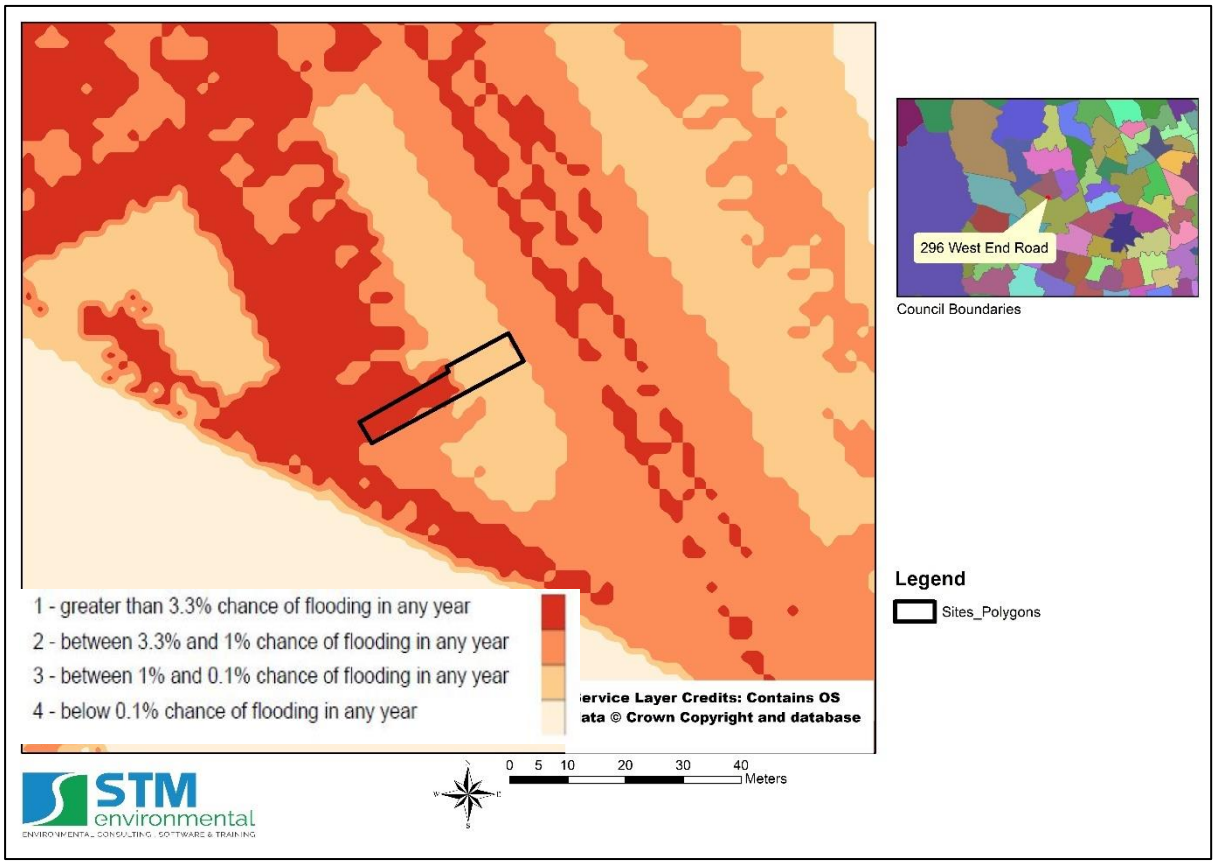
No flood defences identified in the EA product 4 data.

17.7.2 Reservoir Flood Risk Map

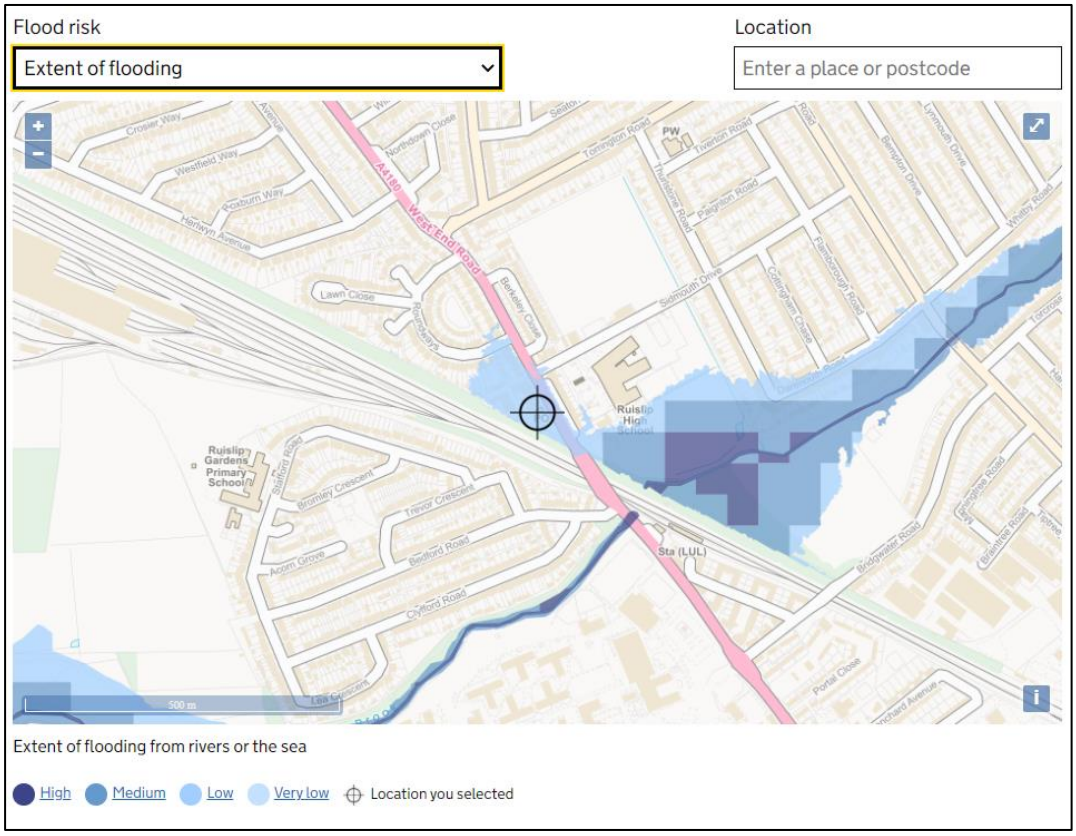


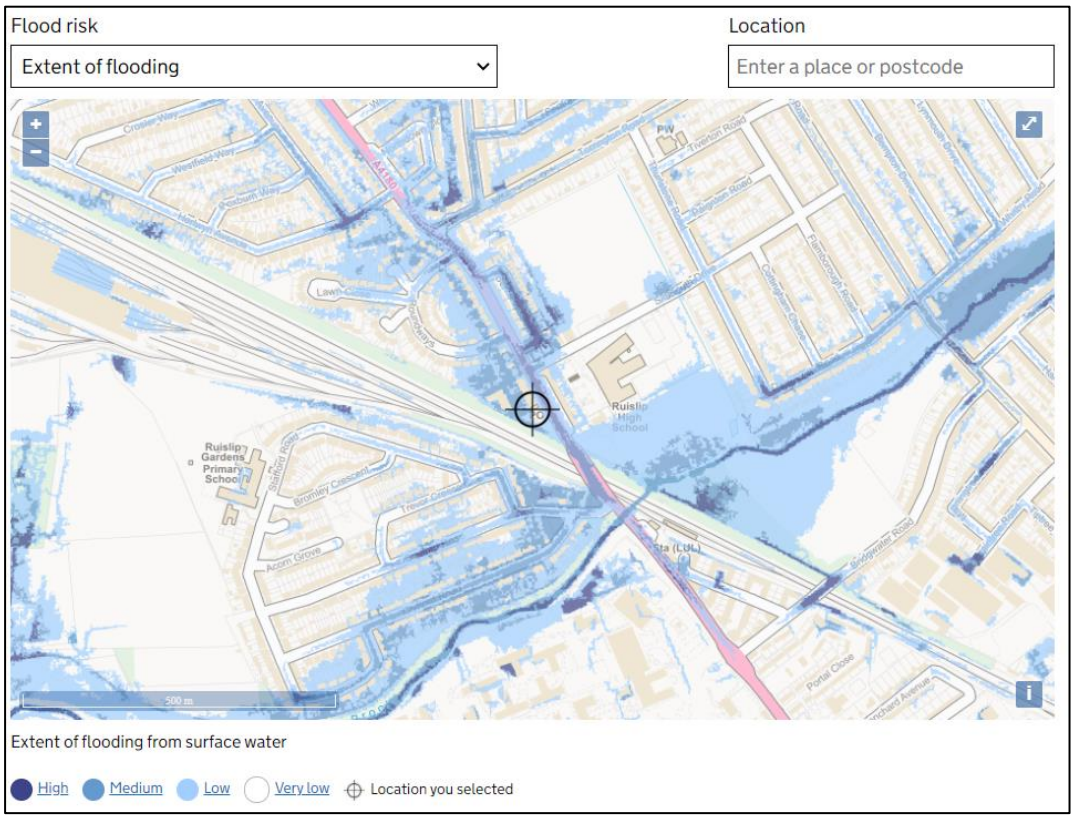
17.8 Appendix 8 – Flood Risk Maps

17.8.1 Risk of Flooding from Multiple Sources Map

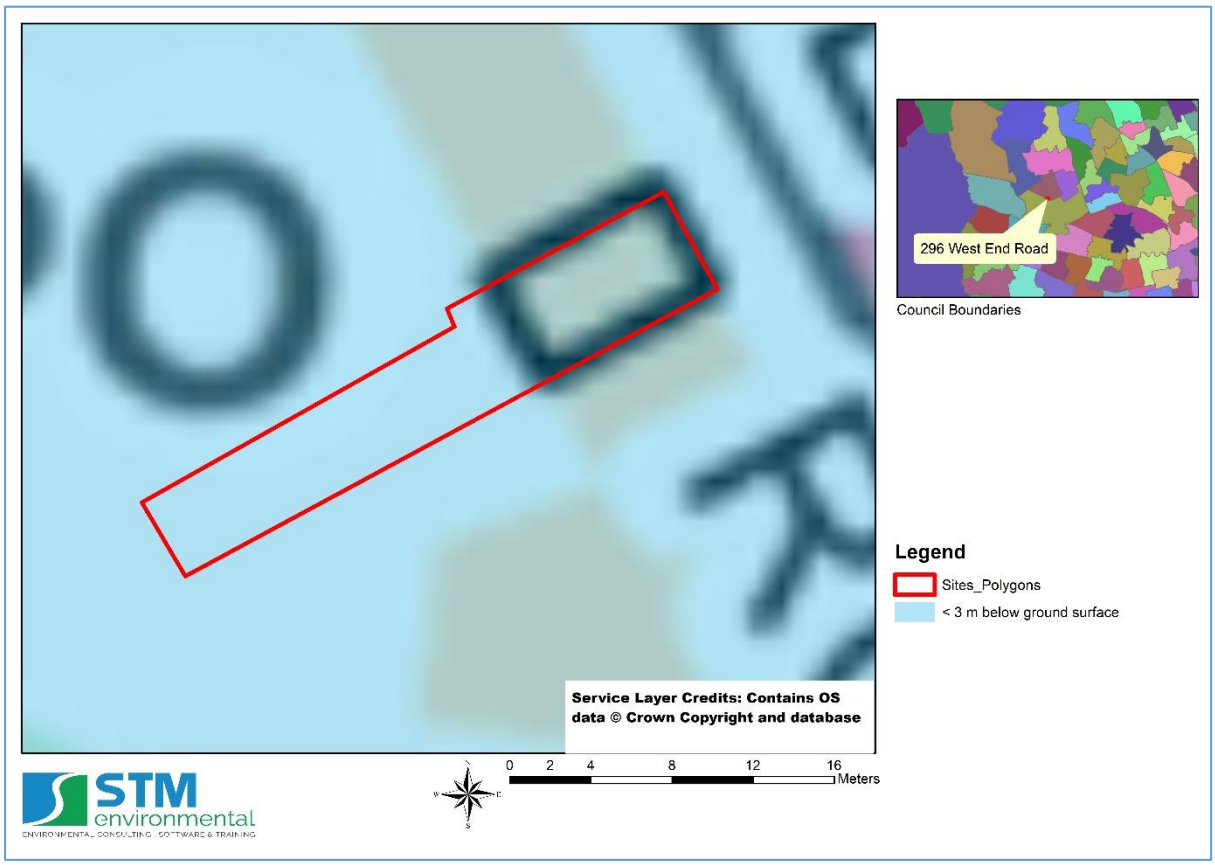


17.8.2 Long Term Flood Risk Maps



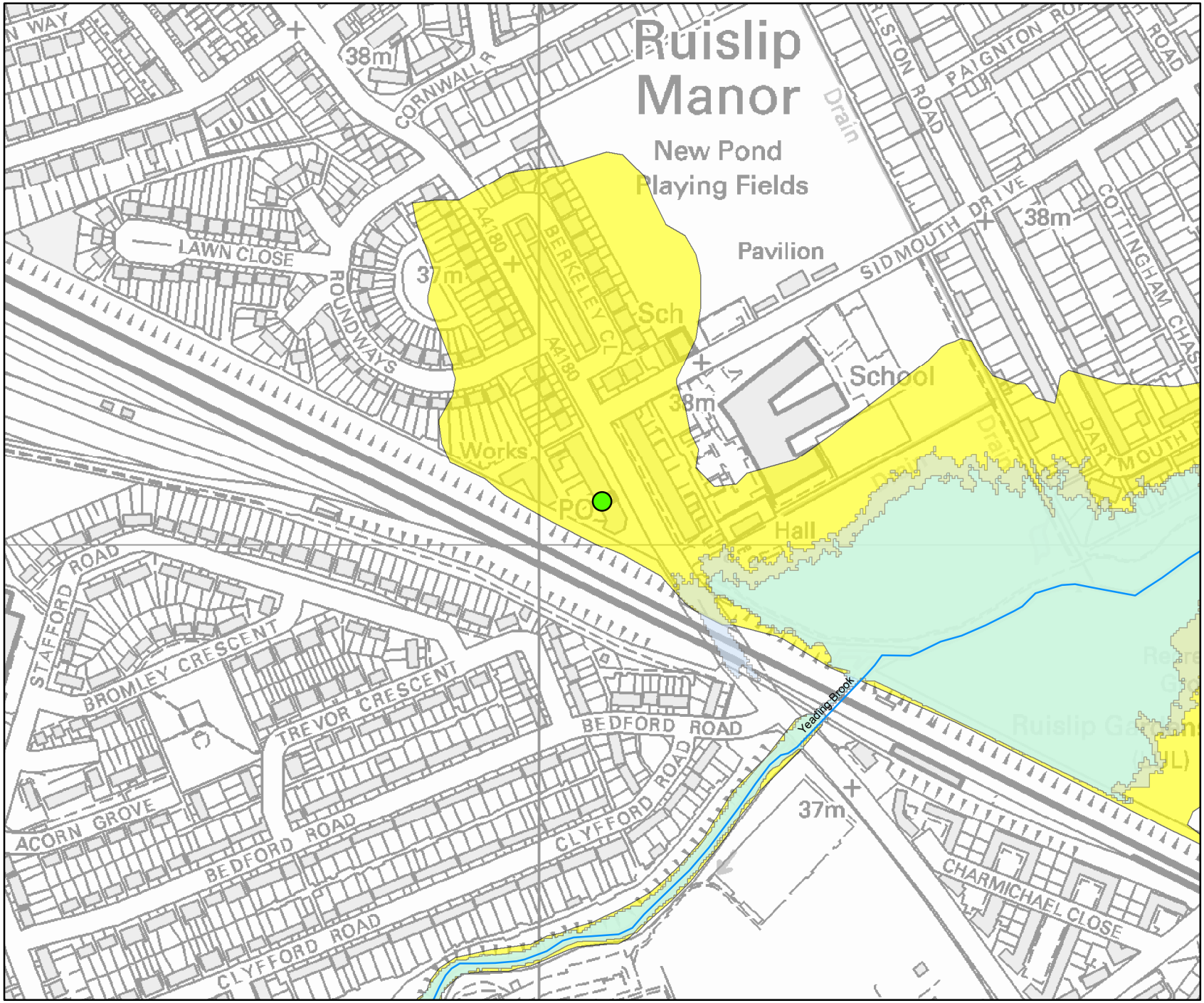


17.9 Appendix 9 – Groundwater Flood Susceptibility Map



17.10 Appendix 10 - EA Product 4 (Detailed Flood Risk) Data

Detailed FRA centred on: 296 West End Road, Ruislip, HA4 6LS - 19/10/2020 - HNL 189421 NR



Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 60 120 240
Metres

Legend

- Main Rivers
- Site location

Defended Flood Outlines

- 1 in 100+30% (*CC) Defended
- 1 in 100+70% (*CC) Defended
- 1 in 1000 (0.1%) Defended

The data in this map has been extracted from the River Crane Mapping Study (Halcrow 2008).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites withinthe catchment.
Modelled outlines take into account catchment wide defences.
Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence. https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

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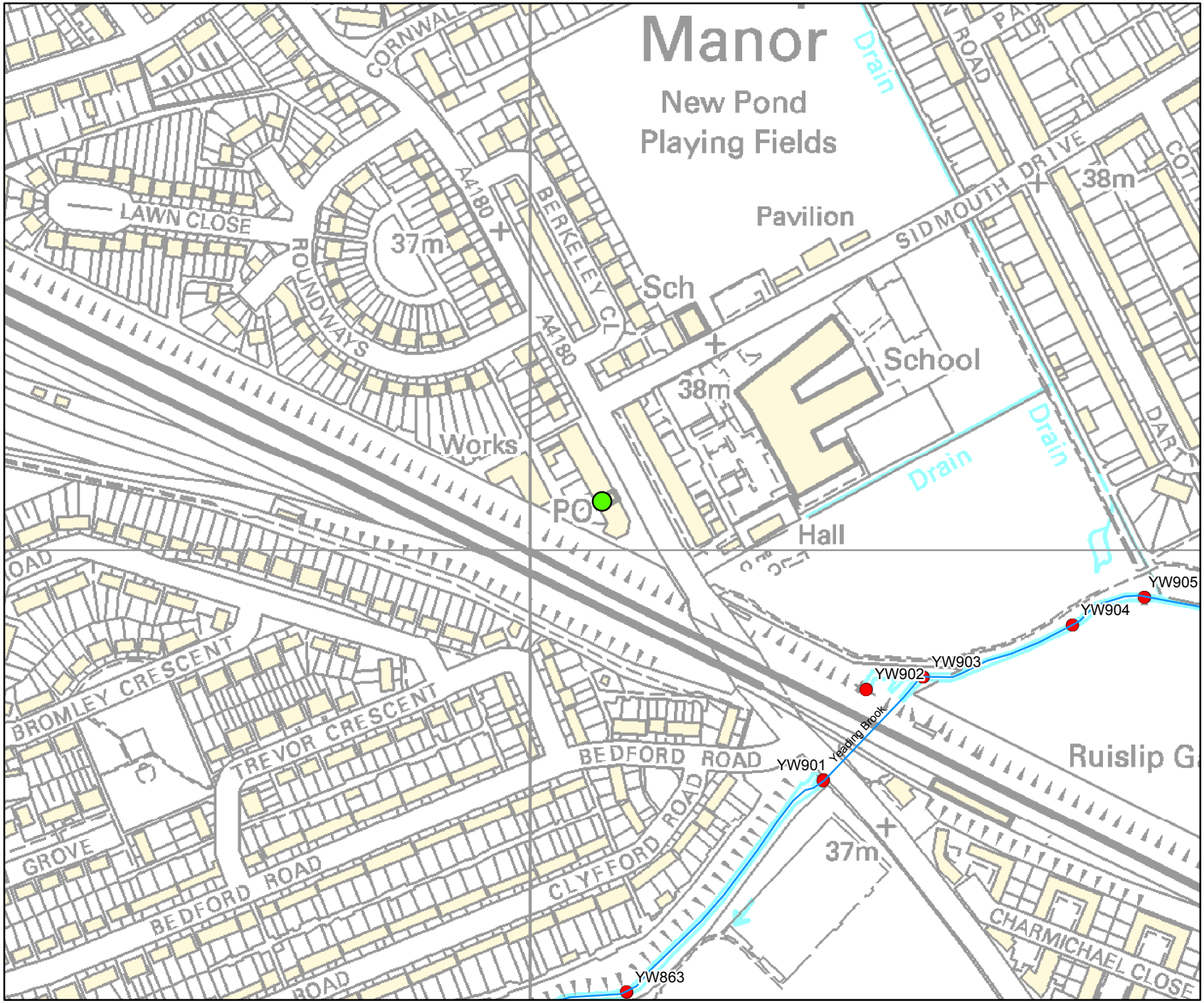
Detailed FRA centred on: 296 West End Road, Ruislip, HA4 6LS - 19/10/2020 - HNL 189421 NR



Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 50 100 200
Metres

Legend

- Main Rivers
- Site location

1D Node Results

- Node Results

The data in this map has been extracted from the River Crane Mapping Study (Halcrow 2008).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites withinthe catchment.
Modelled outlines take into account catchment wide defences.

Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

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Environment Agency ref: HNL 189421 NR

The following information has been extracted from the River Crane Mapping Study (Halcrow 2008)

Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.

https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Caution:
The modelled flood levels and extents are appropriate for catchment wide strategic flood risk mapping. However, for more detailed flood risk assessment it is recommended that each of the underlying flood mapping, hydraulic modelling and hydrological assumptions are re-evaluated to determine the appropriateness in a more detailed analysis.

All flood levels are given in metres Above Ordnance Datum (mAOD)
All flows are given in cubic metres per second (cumecs)

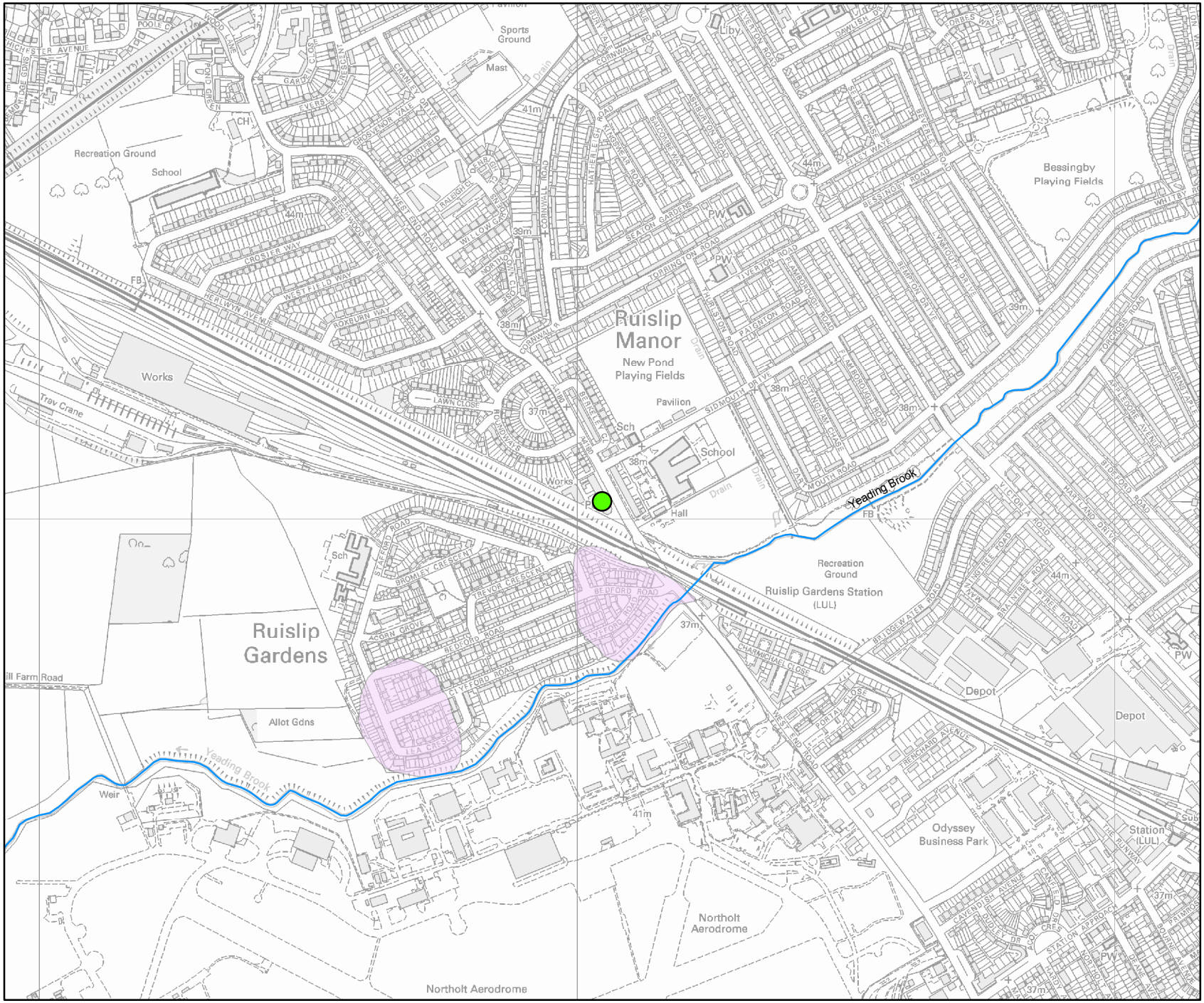
MODELLED FLOOD LEVEL

			Return Period									
Node Label	**Easting**	**Northing**	**5 yr**	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**100yr + 20%**	**100yr + 25%**	**100yr + 35%**	**100yr + 70%**	**1000yr**
YW905	510400	185965	36.00	36.15	36.29	36.37	36.43	36.53	36.56	36.60	36.74	37.36
YW904	510353	185951	35.96	36.12	36.30	36.36	36.42	36.52	36.55	36.60	36.74	37.36
YW903	510255	185914	35.92	36.10	36.28	36.35	36.41	36.52	36.54	36.59	36.74	37.36
YW902	510219	185909	35.72	35.84	35.97	36.02	36.06	36.16	36.18	36.22	36.38	36.99
YW901	510192	185849	35.58	35.68	35.78	35.82	35.85	35.92	35.94	35.97	36.08	36.23
YW863	510061	185716	34.71	34.85	34.97	35.02	35.06	35.14	35.16	35.19	35.30	35.73

MODELLED FLOWS

			Return Period									
Node Label	**Easting**	**Northing**	**5 yr**	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**100yr + 20%**	**100yr + 25%**	**100yr + 35%**	**100yr + 70%**	**1000yr**
YW905	510400	185965	4.26	5.25	6.61	7.27	7.78	8.78	9.01	9.45	10.96	19.18
YW904	510353	185951	4.26	5.25	6.52	7.11	7.59	8.54	8.78	9.22	10.58	18.53
YW903	510255	185914	4.26	5.22	6.35	6.89	7.36	8.27	8.52	8.97	10.30	17.82
YW902	510219	185909	4.26	5.23	6.37	6.91	7.38	8.29	8.54	8.99	10.33	17.80
YW901	510192	185849	4.26	5.23	6.38	6.92	7.38	8.30	8.54	9.00	10.34	17.80
YW863	510061	185716	5.27	6.40	7.67	8.17	8.62	9.60	9.84	10.28	11.79	19.62

Historic Flood Map centred on: 296 West End Road, Ruislip, HA4 6LS - 19/10/2020 - HNL 189421 NR



Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 150 300 600

Metres

Legend

- Main Rivers
- Site location

Flood Event Outlines

- 1959

The historic flood event outlines are based on a combination of anecdotal evidence, Environment Agency staff observations and survey.
Our historic flood event outlines do not provide a definitive record of flooding.
It is possible that there will be an absence of datain places where we have not been able to record the extent of flooding.
It is also possible for errors occur in the digitisation of historic records of flooding.

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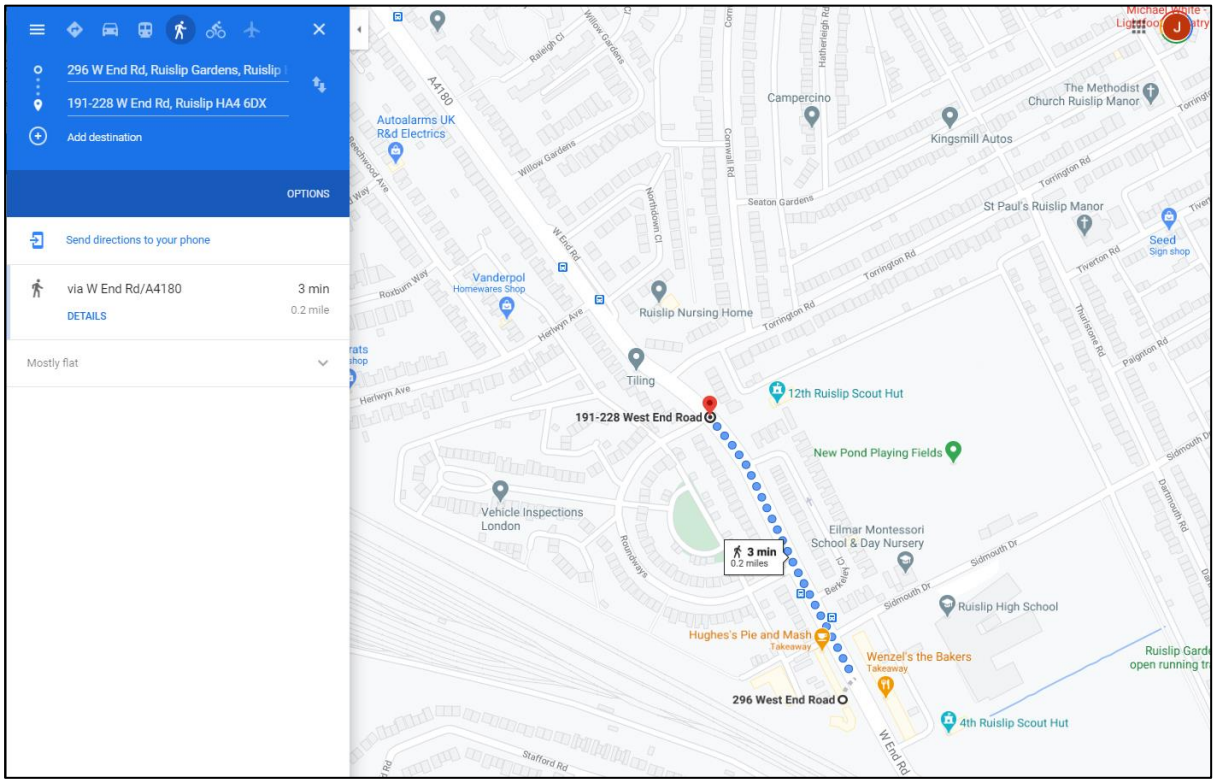
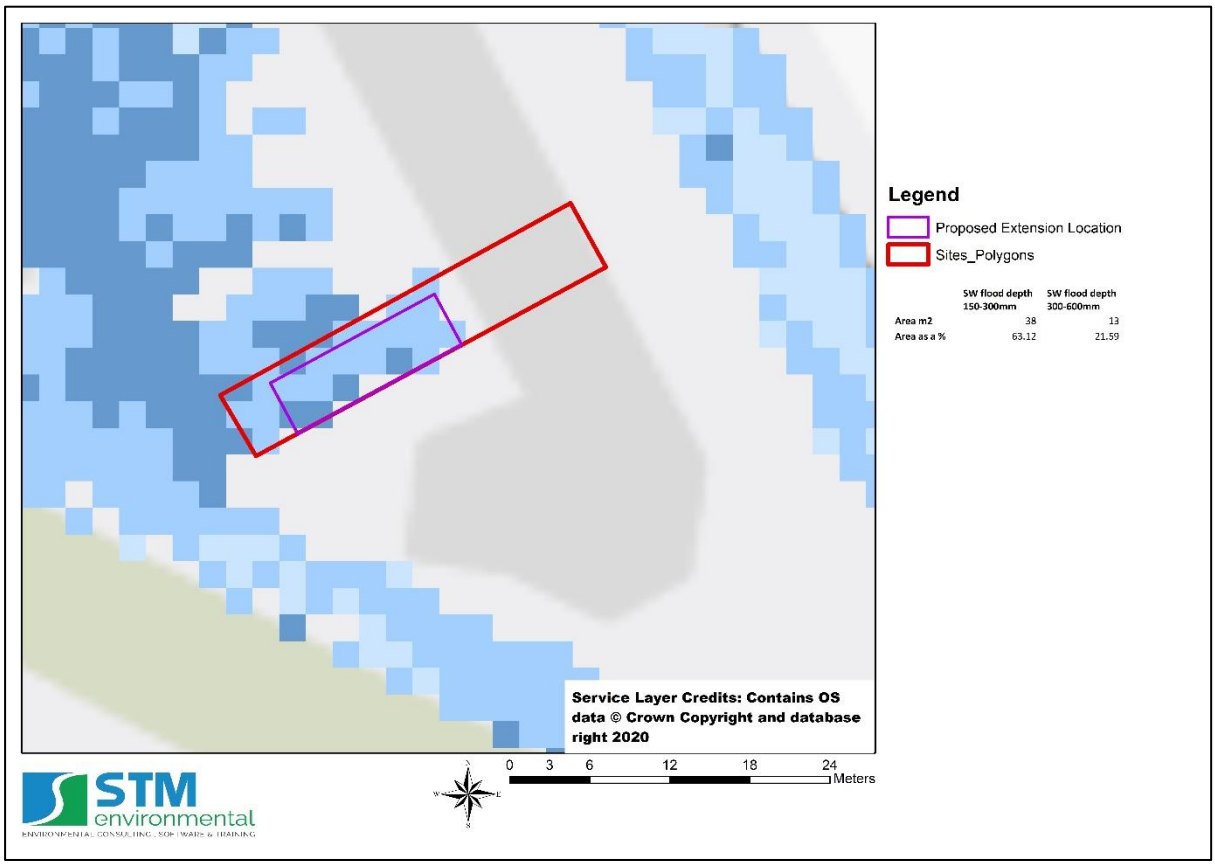
17.11 Appendix 11 – Safe Egress to Flood Zone 1 for surface water and fluvial flooding Map



17.12 Appendix 12 – Flood Compensation Storage



17.13 Appendix 12 – Calculation of Flood Hazard Rating

Table 5: Flood Hazard Rating Scores – based on DF score of 0

Velocity	Depth									
	0.25	**0.50**	**0.75**	**1.00**	**1.25**	**1.50**	**1.75**	**2.0**	**2.25**	**2.50**
0.0	0.13	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.25
0.5	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
1.0	0.38	0.75	1.13	1.50	1.88	2.25	2.63	3.00	3.38	3.75
1.5	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
2.0	0.63	1.25	1.88	2.50	3.13	3.75	4.38	5.00	5.63	6.25
2.5	0.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50
3.0	0.88	1.75	2.63	3.50	4.38	5.25	6.13	7.00	7.88	8.75
3.5	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
4.0	1.13	2.25	3.38	4.50	5.63	6.75	7.88	9.00	10.13	11.25
4.5	1.25	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50
5.0	1.38	2.75	4.13	5.50	6.88	8.25	9.63	11.00	12.38	13.75

Table 6: Summary of Scores

	Score From	Score To	Flood Hazard	Description
	<0.75	0.75	Low	Exercise Caution
Class 1	0.75	1.5	Moderate	Danger for some
Class 2	1.5	2.5	Significant	Danger for most
Class 3	2.5	20.0	Extreme	Danger for all

Table 7: Values for Debris Factor for different flood depths

Depths	Pasture/Arable Land	Woodland	Urban
0 to 0.25	0	0	0
0.25 to 0.75	0.5	1	1
d>0.75 and/or v > 2	0.5	1	1

- The “danger to some” category includes vulnerable groups such as children, the elderly and infirm. “Danger: Flood zone with deep or fast
- flowing water”
- The “danger to most” category includes the general public.

- The danger to all category includes the emergency services.

A flood emergency plan is considered to be an acceptable way of managing flood risk where the flood hazard has been given a “very low hazard” rating. In some instances, flood emergency plans may also be acceptable where the rating is “danger for some”. However, it is unlikely to be an acceptable way of managing residual flood risk where the hazard to people classification is “danger for most” or “danger for all”.