



ENVIRONMENTAL CONSULTING, SOFTWARE & TRAINING

FLOOD RISK ASSESSMENT

Site Address

Land North of Star Road
Caversham
Reading
RG4 5BE

Client

Idrees Baig
Virya Capital

Date

14/07/2025



CONSULTING GEO-ENVIRONMENTAL ENGINEERS AND SCIENTISTS

Phase 1 Contaminated Land Desk Studies, Geo-Environmental Site Investigations, Environmental Due Diligence, Flood Risk Assessments, Surface Water Management Strategies (SuDS), Ecology, Noise and Air Quality Assessments, Environmental Management Systems, GIS & Data Management Systems

1 Document Control



FLOOD RISK ASSESSMENT



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3 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
RBC	Reading Borough Council
SWMP	Surface Water Management Plan
SFRA	Strategic Flood Risk Assessment
CDA	Critical Drainage Area
AEP	Annual Exceedance Probability
CC	Climate Change
SuDS	Sustainable Urban 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

4 Disclaimer

This report and any information or advice which it contains, is provided by STM Environmental Consultants Ltd (STM) and can only be used and relied upon by Idrees Baig of Virya Capital (Client). Any party other than the Client using or placing reliance upon any information contained in this report, do so at their own risk.

STM has exercised such professional skill, care and diligence as may reasonably be expected of a properly qualified and competent consultant when undertaking works of this nature. However, STM gives no warranty, representation or assurance as to the accuracy or completeness of any information, assessments or evaluations presented within this report.

5 Executive Summary

SECTION	SUMMARY
Location	Land North of Star Road, Caversham, Reading, RG4 5BE Grid Reference: 472409, 174838
Area	610m ²
Proposed Development	Construction of 4no. new dwelling houses.
Flood Zone	The site is located in Flood Zone 3a.
Topography	The topographic survey indicates that the ground level of the site ranges from 36.51mAOD (northwest) to 36.91mAOD (southwest).
Sequential and Exception Tests	Please see accompanying report SEQ – 2025 – 000002. From the information reviewed, it is considered that the proposed development passes the Sequential and Exception Tests and should be viewed positively by the council.
Main Sources of Flooding	The River Thames, 552m south of the site, and onsite surface water flooding associated with heavy rainfall.
Flood Defences	EA mapping shows that the site benefits from high ground along both banks of both the Berry Brook and the River Thames.
Records of Historic Flooding	8no. fluvial, 51.no – 100no. sewer and 2no. groundwater flood incidents were identified within the vicinity of the site. Only 2no. fluvial events impacted the site.
Fluvial (River) and Tidal (Sea) Flood Risk	High – During the 5% AEP, the proposed development remains dry. During the 1% AEP + 31% CC, the proposed development witnesses flood depths of up to 1.16m to a level of 37.70mAOD. During the 0.1% AEP, the proposed main building witnesses flood depths of up to 1.24m to a level of 37.78mAOD.
Pluvial (Surface Water) Flood Risk	High – During the Present Day (2025) and Climate Change (2040 – 2060) events, the site is at 'Medium' and 'High' risk, respectively, of witnessing flood depths of up to 0.2m. The location of the proposed development is at 'Medium' risk of witnessing flood depths of 0.2m for both events.
Flood Risk from Artificial (Canals and Reservoirs) Sources	Low - OS mapping revealed that there are 2no. significant reservoirs (Whiteknights Lake and Longwater Lake) within 5km of the site. EA mapping indicates that the site is located in an area that is at risk of flooding when there is also flooding from rivers. The LLFA indicates that the risk of reservoir flooding is residual.
Groundwater Flood Risk	Medium – BGS mapping indicates that the site has potential for groundwater flooding to occur at the surface to the very north of the site and that the groundwater depth may be approximately less than 3mbgl.
Development Impacts on Local Flood Risk	The development will increase the impermeable and built-up area of the site by 390m ² and 282m ² , respectively, it will displace flood waters during the 1% AEP + 31% CC fluvial event.
Proposed Flood Risk Mitigation Measures	• The FFL will be raised 300mm above the flood level to 38.00mAOD; • Construction will utilise flood resistant materials and services will be placed as high as practicable to reduce impact of flooding; • Occupants will sign up for EA Emergency Flood Warning Direct Service; • Safe refuge is available in the upper floors of the building which are accessible via an internal staircase; • Underfloor voids will be implemented to minimise the flood plain displacement; • CFS on a level for level basis is not possible on site due to existing ground levels.
Surface Water Management (SuDS)	SuDS would reduce current surface water run off rates and given the size of the site (610m ²), there is potential for implementation. Consideration should be given to rainwater butts, rainwater harvesting, permeable paving, rain gardens or attenuation storage tanks where possible.

6 Introduction

STM Environmental Consultants Limited (STM) were appointed by Idrees Baig of Virya Capital (Client) to provide a Flood Risk Assessment (FRA) at a site located at Land North of Star Road, Caversham, Reading, RG4 5BE.

7 Development Proposal

The FRA is required to support a planning application for the construction of 4no. new dwelling houses.

Further details including drawings of the development plans are available in [Appendix 2](#).

8 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.

9 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.

10 Legislative and Policy Context

10.1 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.

10.2 Policy Context

The National Planning Policy Framework (NPPF) sets out the Government's economic, environmental and social planning policies for England. The policies set out in this framework apply to the preparation of local and neighbourhood plans and to decisions on planning applications.

The latest version of the NPPF can be view online [here](#). The below text it extracted from the online document from paragraphs 170 – 186.

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.

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.

All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

-  Applying the sequential test and then, if necessary, the exception test as set out below;
-  Safeguarding land from development that is required, or likely to be required, for current or future flood management;
-  Using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management); and
-  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.

A sequential risk-based approach should also be taken to individual applications in areas known to be at risk now or in future from any form of flooding, by following the steps set out below.

Within this context the aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. 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 test should be used in areas known to be at risk now or in the future from any form of flooding, except in situations where a site-specific flood risk assessment demonstrates that no built development within the site boundary, including access or escape routes, land raising or other potentially vulnerable elements, would be located on an area that would be at risk of flooding from any source, now and in the future (having regard to potential changes in flood risk).

Applications for some minor development and changes of use ⁽⁶²⁾ should also not be subject to the sequential test, nor the exception test set out below, but should still meet the requirements for site-specific flood risk assessments set out in footnote ⁽⁶³⁾.

Having applied the sequential test, if it is not possible for development to be located in areas 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 Annex 3.

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. To pass the exception test 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.

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

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.

Paragraph 181 of the National Planning Policy Framework (NPPF) states that:

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 (See Note 1)
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
-  the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;
-  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.

Paragraph 182 states that:

Applications which could affect drainage on or around the site should incorporate sustainable drainage systems to control flow rates and reduce volumes of runoff, and which are proportionate to the nature and scale of the proposal. These should provide multifunctional benefits wherever possible, through facilitating improvements in water quality and biodiversity, as well as benefits for amenity. Sustainable drainage systems provided as part of proposals for major development should:

-  a) take account of advice from the Lead Local Flood Authority;
-  b) have appropriate proposed minimum operational standards; and
-  c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development.

A major development is defined as:

-  a residential development: 10 dwellings or more or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known
-  a non-residential development: provision of a building or buildings where the total floor space to be created is 1000 square metres or more or where the floor area is not yet known, a site area of 1 hectare or more.

Coastal Change

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.

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.

- 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 ⁽⁶⁴⁾.

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.

Footnote 62 - This includes householder development, small non-residential extensions (with a footprint of less than 250m²) 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.

Footnote 63 - 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.

Footnote 64 - As required by the Marine and Coastal Access Act 2009.

10.2.1 Local Planning Policy – Reading Borough Council

EN18: FLOODING AND SUSTAINABLE DRAINAGE SYSTEMS

Development will be directed to areas at lowest risk of flooding in the first instance, following the Sequential and Exceptions Test set out in the NPPF, and taking into account the effects of climate change. It will consider flooding from all sources, including fluvial, surface water, groundwater and sewer flooding. Where development

in areas at risk of flooding is necessary, it will not reduce the capacity of the flood plain to store floodwater, impede the flow of floodwater or in any way increase the risks to life and property arising from flooding. Wherever possible, development should be designed to reduce flood risk, both on- and off-site.

All major developments⁶³ must incorporate sustainable drainage systems (SuDS) as appropriate and in line with the Government's Technical Standards⁶⁴. Smaller schemes are encouraged to incorporate SuDS, where possible. Runoff rates should aim to reflect greenfield conditions and, in any case, must be no greater than the existing conditions of the site. Schemes should ensure that the movement of water through vertical infiltration as well as horizontal run-off does not worsen contamination effects. Wherever possible, SuDS provision should maximise ecological benefits, link into the existing Green Network, incorporate tree planting and landscaping and avoid damage to existing significant trees, including through changes to the site hydrology. All new developments in areas of flood risk should give priority to SuDS.

⁶³10 or more dwellings or equivalent non-residential or mixed developments

⁶⁴Sustainable drainage systems non-statutory technical standards
<https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards>

10.3 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.

11 Site Description and Environmental Characteristics

11.1 Site Location and Area

The site is located at Land North of Star Road, Caversham, Reading, RG4 5BE and is centred at national grid reference 472409, 174838. The site has an area of 610m².

A site location map and aerial photo are shown below. Photographs of the site are available in [Appendix 1](#).

11.2 Site Access

The site is accessed via Star Road.

11.3 Local Planning Authority

The site falls within the jurisdiction of Reading Borough Council (RBC) in terms of the planning process.

11.4 Lead Local Flood Authority

RBC is also the Lead Local Flood Authority (LLFA).

11.5 Flood Zone

For planning purposes, the site is located in Flood Zone 3a as defined by the EA and LLFA. The maps of the Flood Zones are available in [Appendix 5](#).

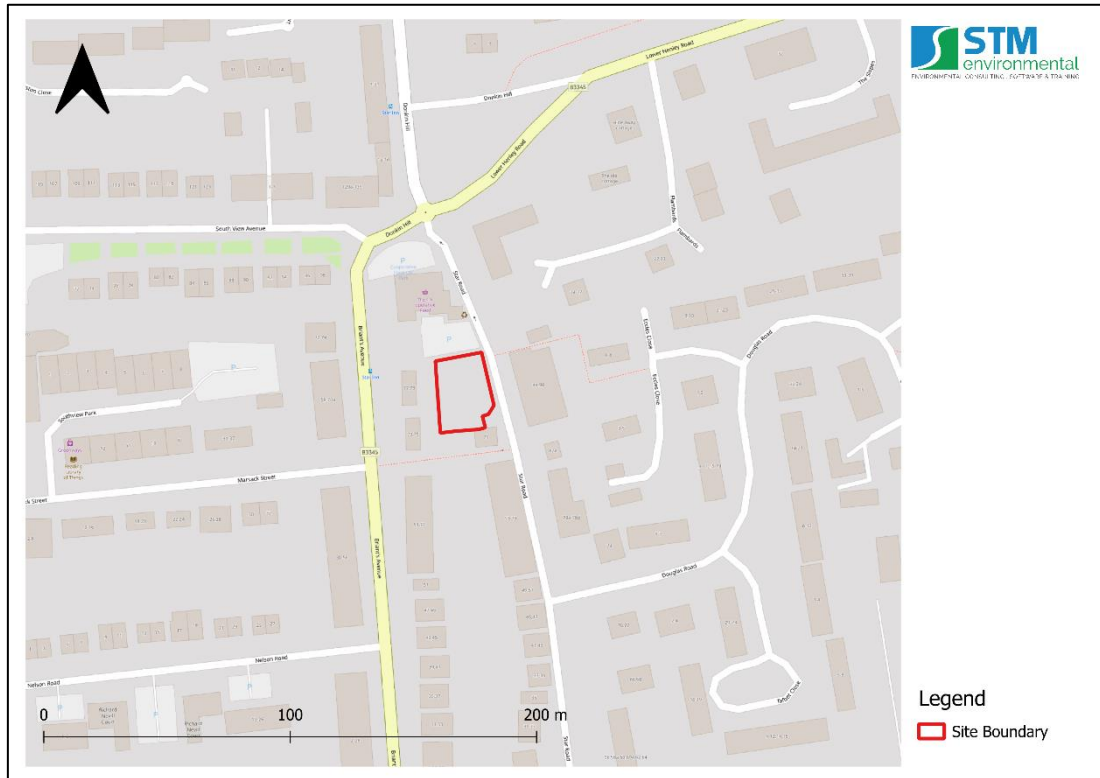


Figure 1 Site Location Map



Figure 2 Site Aerial Map

11.6 Site and Surrounding Land Uses

11.6.1 Site Current Land Use

The site is currently used a vacant plot of land.

11.6.2 Surrounding Land Uses

A description of the current and surrounding land uses of the site is given in Table 1.

Table 1 Summary of surrounding land uses

Boundary	Land Use Description	
	Immediately Adjacent (Within 0 – 25m)	General Local Area (Within 25 – 250m)
Northern	Car Park, Commercial (The Co-operative)	Road, Residential
Eastern	Road (Star Road), Residential	Road, Residential, Parkland
Southern	Residential	Residential
Western	Residential	Road, Residential, Library, Pharmacy

11.7 Hydrology

The nearest main watercourse is a culverted section of the Berry Brook located approximately 223m northeast of the site. A map of the nearby hydrological features is present in [Appendix 2](#).

The River Thames is also located 552m south of the site.

11.8 Geology

Data from the British Geological Survey indicates that the underlying superficial geology is characterised as Langley Silt Member (Unlithified Clay and Silt). The underlying bedrock geology is characterized as Undifferentiated Seaford Chalk Formation and New Haven Chalk Formation (Chalk).

11.9 Hydrogeology

The site lies upon an ‘Unproductive’ superficial aquifer and a ‘Principal’ bedrock aquifer.

[Appendix 3](#) provides BGS mapping showing the hydrogeology at the site location.

11.10 Topography

A LIDAR DTM map showing the topography of the site and surrounding area is available in [Appendix 3](#).

LiDAR DTM mapping indicates that there is an overall change in topography of 0.62m within the red line boundary. The topography increases from a low of 36.63mAOD, toward the northwest corner of the site, to a high of 37.24mAOD, toward the proposed 79 Star Road.

A topographic survey has been conducted and is also available in [Appendix 3](#). The survey indicates that the ground level increases from a low of 36.51mAOD, toward the northwest corner of the site, to a high of 36.91mAOD, toward the southwest corner of the site. The ground level of the proposed dwellings ranges from a low of 36.54mAOD, to the north of the site, and 36.83mAOD, to the south of the site.

The difference between the LiDAR DTM and topographic survey ground levels ranges between 330mm and 120mm.

As the topographic survey is more recent and site-specific, those ground level values will be used in this report.

12 The Sequential and Exception Tests

12.1 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.

Based on Government Guidance, Minor Development means:

-  development of an existing dwellinghouse, or development within the curtilage of a dwellinghouse, for any purpose incidental to the enjoyment of the dwellinghouse
-  an extension to an existing building used for non-domestic purposes where the floor space created by the development does not exceed 250 square metres
-  alterations to an existing building which do not increase the size of the building

With regard to residential and commercial developments, major development, as defined by the Town and Country Planning (Development Management Procedure) means one or more of the following:

-  Providing 10 or more dwellinghouses defined in article 2 of the DMPO or, where the number of dwellinghouses is not known, the site area is 0.5 hectares or more;
-  Providing a building or buildings where the floor space to be created by the development will be 1,000 square metres or more;
-  Development on a site of 1 hectare or more;
-  The winning and working of minerals or the use of land for mineral - working deposits;
-  Waste development

When development is exempt from the sequential test:

Development is exempt from the sequential test if it is a:

-  householder development like residential extensions, conservatories or loft conversions
-  small non-domestic extensions with a footprint of less than 250 square metres

- change of use (except changes of use to a caravan, camping or chalet site, or to a mobile home or park home site)

Development is also exempt from the sequential test if it is a development on a site allocated in the development plan through the sequential test and:

- the proposal is consistent with site's allocated use
- there have been no significant changes to the known level of flood risk to the site, now or in the future, which would have affected the outcome of the test

You may not need a sequential test if development can be laid out so that only elements such as public open space, biodiversity and amenity areas are located in areas at risk of any source of current or future flooding.

Please see accompanying report SEQ – 2025 – 000002. From the information reviewed, is considered that the proposed development passes the Sequential Test and should be viewed positively by the council.

12.2 The Exception Test

Where the Sequential Test is undertaken and alternative sites of lower flood risk are not available, then the proposed development may require an Exception Test in order 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 should be demonstrated that:

- development that has to be in a flood risk area will provide wider sustainability benefits to the community that outweigh flood risk; and

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.

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	X	Exception Test required	✓	✓
Zone 3b	Exception Test required	X	X	X	✓

Key:

✓ Development is appropriate

X Development should not be permitted.

Please see accompanying report SEQ – 2025 – 000002. From the information reviewed, is considered that the proposed development passes the Exception Test and should be viewed positively by the council.

13 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.

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

13.1.1 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.

13.1.2 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;

Functional flood plain

- Flood zone 3b (definition specific to the LLFA). Less than a 1 in 20 (5%) annual probability of fluvial and/or tidal flooding.
- This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters.

Functional floodplain will normally comprise:

- land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).
- 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)

13.1.3 Main Potential Sources of Local Fluvial Flooding

The nearest potential source of fluvial flooding to the site is considered to be the River Thames.

13.1.4 Records of Historic Fluvial Flooding Incidents

The EA's historic and recorded flood outline map indicates that there has been historic flooding at or in the vicinity of the site. A total of 7no. events were identified including March 1947, November 1974, August 1977, December 2000, January 2003, July 2007 and Winter 2013/2014 when the channel capacity was exceeded. Only the March 1974 event impacted the site. Copies of these maps are available in [Appendix 4](#).

Inspection of the LLFA's Level 1 SFRA reflects the same events as those above. However, an additional event taking place in November 2012 when the River Thames burst its banks was also identified. The site was not impacted.

13.1.5 Designated Fluvial Flood Risk Zone for the Site

The site is considered to be located within Flood Zone 3a as defined by the Environment Agency and the LLFA indicating that it has a greater than 1 in 100 (1%) annual probability of fluvial flooding.

13.1.6 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.

13.1.7 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. |

13.1.8 Potential Sources of Tidal Flooding

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

13.1.9 Flood Defences

The EA's flood defence map, which is available in [Appendix 7](#), shows that the site benefits from high ground along both banks of both the Berry Brook and the River Thames.

13.1.10 Peak River Flow Climate Change Allowances

The EA's [climate change allowances for peak river flow](#) maps show that the site is considered to be in the Thames and South Chilterns Management Catchment. The climate change allowances for this catchment are available in [Appendix 11](#).

In flood zones 2 or 3a for:

-  essential infrastructure – use the higher central allowance
-  highly vulnerable – use central allowance (development should not be permitted in flood zone 3a)
-  more vulnerable – use the central allowance
-  less vulnerable – use the central allowance
-  water compatible – use the central allowance

In flood zone 3b for:

-  essential infrastructure – use the higher central allowance
-  highly vulnerable – development should not be permitted
-  more vulnerable – development should not be permitted
-  less vulnerable – development should not be permitted
-  water compatible – use the central allowance

The central allowance for 'more vulnerable' developments indicates that a climate change allowance of 31% should be used.

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

The EA Product 6 dataset which is presented in [Appendix 11](#) provides modelled flood levels and flows for model node points close to the site. These are summarised in Table 3 below.

Table 3 EA modelled expected flood depths (m) and levels (mAOD) for different scenarios

Thames (Pangbourne to Sonning) 2019 - Topographic Survey Corrected														
Node	Easting	Northing	Topography (mAOD)		5% AEP		1% AEP		1% AEP + 31% CC		1% AEP + 35% CC		0.1% AEP	
			LiDAR DTM	Survey	Depth (m)*	Level (mAOD)	Depth (m)*	Level (mAOD)	Depth (m)*	Level (mAOD)**	Depth (m)*	Level (mAOD)	Depth (m)*	Level (mAOD)
1	472405	174852	36.78	36.54	-	-	0.91	37.45	1.16	37.70	1.20	37.74	1.24	37.78
2	472410	174853	36.75	36.60	-	-	0.85	37.45	1.10	37.70	1.14	37.74	1.18	37.78
3	472406	174849	36.84	36.59	-	-	0.86	37.45	1.11	37.70	1.15	37.74	1.19	37.78
4	472409	174849	36.84	36.70	-	-	0.75	37.45	1.00	37.70	1.04	37.74	1.08	37.78
5	472413	174848	36.90	36.76	-	-	0.69	37.45	0.94	37.70	0.98	37.74	1.02	37.78
6	472409	174845	37.01	36.74	-	-	0.71	37.45	0.96	37.70	1.00	37.74	1.04	37.78
7	472412	174844	36.93	36.83	-	-	0.62	37.45	0.87	37.70	0.91	37.74	0.95	37.78
8	472414	174843	36.90	36.70	-	-	0.75	37.45	1.00	37.70	1.04	37.74	1.08	37.78
9	472408	174840	37.11	36.79	-	-	0.66	37.45	0.91	37.70	0.95	37.74	0.99	37.78
10	472407	174838	36.99	36.70	-	-	0.75	37.45	1.00	37.70	1.04	37.74	1.08	37.78
11	472408	174835	37.06	36.71	-	-	0.74	37.45	0.99	37.70	1.03	37.74	1.07	37.78
12	472416	174835	36.94	36.80	-	-	0.65	37.45	0.90	37.70	0.94	37.74	0.98	37.78
13	472412	174833	37.08	36.81	-	-	0.64	37.45	0.89	37.70	0.93	37.74	0.97	37.78
14	472412	174832	36.99	36.76	-	-	0.69	37.45	0.94	37.70	0.98	37.74	1.02	37.78
15	472409	174830	36.98	36.71	-	-	0.74	37.45	0.99	37.70	1.03	37.74	1.07	37.78
16	472408	174827	37.02	36.74	-	-	0.71	37.45	0.96	37.70	1.00	37.74	1.04	37.78
17	472413	174828	36.91	36.70	-	-	0.75	37.45	1.00	37.70	1.04	37.74	1.08	37.78
18	472411	174827	36.91	36.70	-	-	0.75	37.45	1.00	37.70	1.04	37.74	1.08	37.78

* Depth = Flood Level – Survey Level

** 1% AEP + 31% AEP = (((1% AEP + 35% Level) – (1% AEP Level) / 35) * 31) + 1% AEP Level

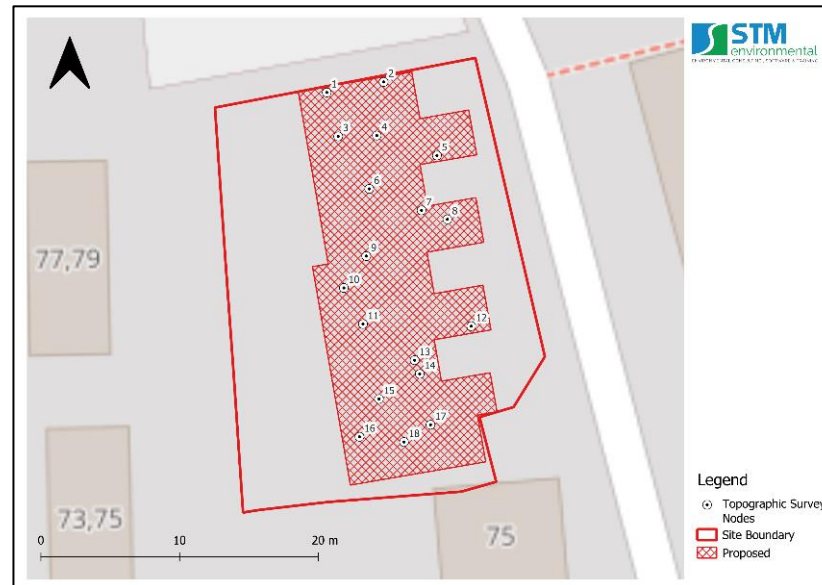


Figure 3 Topographic survey ground level nodes location map

During the 5% AEP, the proposed development remains dry.

During the 1% AEP, the proposed development witnesses flood depths of up to 0.91m to a level of 37.45mAOD.

During the 1% AEP + 31% CC, the proposed development witnesses flood depths of up to 1.16m to a level of 37.70mAOD.

During the 0.1% AEP, the proposed main building witnesses flood depths of up to 1.24m to a level of 37.78mAOD.

13.1.12 Long Term Fluvial/Tidal 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 9](#) indicate that the long-term risk from fluvial flooding to the site is 'Medium' during the Present Day (2025) event and 'High' during the Climate Change (2036 – 2069) event.

13.2 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.

13.2.1 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 upstream 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.

13.2.2 Main Potential Sources of Local Pluvial Flooding

The main potential source of pluvial flooding to the site is considered to be surface water ponding and flooding associated with heavy rainfall.

13.2.3 Records of Historic Pluvial Flooding Incidents

Examination of the LLFA's Level 1 SFRA revealed no evidence 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](#).

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

An examination of OS mapping and the EA's mapping revealed that there are 2 no. significant reservoirs within 5km of the site. These include Whiteknights Lake 2.89m southeast of site and Longwater Lake 4.94km southeast of site.

The EA's reservoir flood risk map indicates that the site is located in an area that is at risk of flooding when there is also flooding from rivers.

The LLFA's Level 1 SFRA indicates that the risk of reservoir flooding is residual.

13.2.5 Sewer Flooding

Examination of the LLFA's Level 1 SFRA revealed that the site is located with the RG4 5 postcode area which has witnessed between 51no. to 100no. sewer flood incidents as of February 2016.

A map showing recorded incidents of sewer flooding is available in [Appendix 4](#).

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

Mapping of the predicted extent and depth of surface water flooding for the Present Day (2025) and with Climate Change (2040 – 2060) events provided by the EA are available in [Appendix 6](#).

- | |
|---|
|  High - greater than or equal to 1 in 30 (3.3%) chance of flooding in any year |
|  Medium – Less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) chance of flooding in any given year |
|  Low – Less than 1 in 100 (1%) but greater than or equal to 1 in 1000 (0.1%) chance of flooding in any given year |

During the Present Day (2025) event, the site and proposed development is at 'Medium' risk of witnessing flood depths of up to 0.2m.

During the Climate Change (2040 – 2060) event, the site and proposed development is at 'High' risk of witnessing flood depths of up to 0.2m, the proposed development is at 'Medium' risk of witnessing flood depths of 0.2m and the site is at 'Medium' risk of witnessing flood depths of up to 0.3m.

13.2.7 Long Term Surface Water Flood Risk

The EA's [long term flood risk maps](#) which are available in [Appendix 9](#) indicate that the long term risk of flooding from surface water is considered to be 'Low' during the Present Day (2025) event and 'Medium' during the Climate Change (2040 – 2060) event.

13.3 Groundwater Flood Risk

Groundwater flooding occurs when water rises from an underlying aquifer (i.e. at the location of a spring) to such a level where it intersects the ground surface and inundates the surrounding land. Groundwater flooding tends to occur after long 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.

13.3.1 Historic Records of Groundwater Flooding

Examination of the LLFA's Level 1 SFRA revealed 2no. records of groundwater flooding, between 2000 and 2001, within 500m of the site. Neither event is known to have impacted the site.

A map showing the locations of historic groundwater flooding incidents is available in [Appendix 4](#).

13.3.2 Susceptibility to Groundwater Flooding

The Groundwater Flood Susceptibility Map provided by BGS and presented in [Appendix 10](#) indicates that the site has potential for groundwater flooding to occur at the surface to the very north of the site whilst there is no information for the rest of the site. The Groundwater Depth map also provided by BGS indicates that the groundwater level may be approximately less than 3mbgl.

13.4 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 to the local planning authority by the Environment Agency”.

No information regarding Critical Drainage Areas was provided by RBC. Therefore, it is assumed that the site is not located within a Critical Drainage Area.

14 Potential Impacts of the Development on Local Flood Risk

14.1 Changes to Impermeable Area and Building Footprint

Changes in ground cover arising from the development are presented in Table 4 and Table 5 below.

Table 4 Existing and proposed site ground cover

	Impermeable Area (m ²)	Permeable Area (m ²)	Total Area (m ²)
Existing	0	610	610
Proposed	390	220	610

Table 5 Break down of existing and proposed site uses

Use	Existing (m ²)	Proposed (m ²)	Difference (m ²)
Building	0	282	282
Hard Standing	0	108	108
Soft Landscaping	610	220	-390
Total	610	610	-

The proposed development will increase the impermeable area of the site by 390m².

As such, it is considered likely that it will impact upon flood flow rates, as it is impacted by the 1% AEP + 31% CC modelled fluvial event and the Climate Change (2040 – 2060) modelled pluvial event.

This increase in impermeable area is also likely to increase surface water runoff rates without mitigation measures being introduced.

14.2 Impacts on Flood Storage and Flood Flow Routes

As the development will increase the site's built-up area by 282m², it will have an impact on local flood storage and alter flood flow pathways.

Further information is provided in [Section 15.2.5](#).

15 Flood Risk Mitigation Measures

15.1 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 6 below to reduce surface water discharges from the site.

Table 6 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.

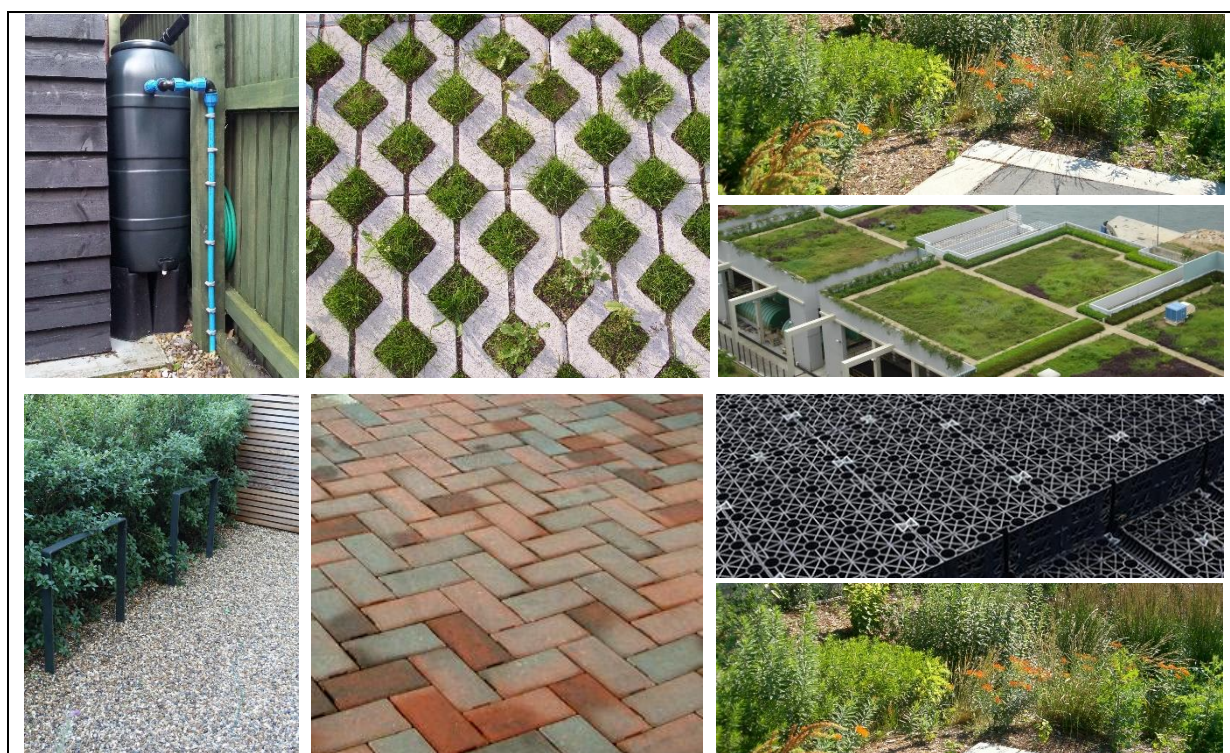


Figure 4 Surface water storage facilities and potential SuDS features - rainwater harvesting, on-site tank storage, rain garden soak-away and green roofs. (Source: UK SuDS Manual)

Given the nature of the development and the size of the site, it is considered that there are opportunities for implementing SuDS. Measures such as rainwater butts, rainwater

harvesting, permeable paving, rain gardens or attenuation storage tanks should be considered.

A full SuDS strategy is outside the scope of works of this FRA.

15.2 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.

15.2.1 Finished Floor Levels

Advice for Vulnerable Developments;

The EA's Standing Advice states that the Finished Floor Level of any vulnerable development should be set at whichever is highest, 600 millimetres (mm) above the;

	Average ground level of the site	36.91mAOD
	Ground level of the access road(s) next to your building	36.88mAOD
	Fluvial - 1 in 100 AEP + Climate Change;	37.70mAOD
	Tidal - 1 in 200 AEP + Climate Change;	NA

This can be reduced to 300mm if there is a high level of certainty about your estimated flood level. If there is a particularly high level of uncertainty it may need to be increased.

Table 7 FFL Requirements

	Level (mAOD)	Level + 600mm (mAOD)	Possible	Reason
Average Ground	36.91	37.51	No	Not the highest level
Roadway/s	36.88	37.48		
Estimate Flood Level (River)	37.70	38.30	No	Building restrictions

During the 1% AEP + 31% CC, the site floods to a maximum level of 37.70mAOD.

The FFL will be raised 300mm above the flood level to 38.00mAOD.

If you cannot raise floor levels to meet the minimum requirement, you will need to:

-  raise them as much as possible
-  consider moving vulnerable uses to upper floors
-  include extra flood resistance and resilience measures
-  Internal flooding of new vulnerable development like residential dwellings is unlikely to be considered appropriately flood resistant and resilient.

If you cannot raise the floor levels in this way, you will also need to include extra flood resistance and resilience measures. These measures should protect the property to at least 600mm above the estimated flood level.

15.2.2 Resilience Construction Measures

Flood water can put pressure on buildings, causing structural issues. If your design aims to keep out a depth of more than 600mm of water, you should get advice from a structural engineer.

Only use resistance measures that will not cause structural stability issues during flooding. It may not be possible to safely exclude the full estimated flood level. If this is the case, you will need to exclude it to the structural limit then allow additional water to flow through the property.

The design should be appropriately flood resistant and resilient by:

-  You should also use construction materials that have low permeability up to at least the same height as finished floor levels;
-  Using flood resistant materials that have low permeability to at least 600mm above the estimated flood level;

-  Making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level;
-  Using flood resilient materials (for example lime plaster) to at least 600mm above the estimated flood level;
-  Raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level;
-  Making it easy for water to drain away after flooding such as installing a sump and a pump;
-  Making sure there is access to all spaces to enable drying and cleaning;
-  Making sure that soil pipes are protected from back-flow such as by using non-return valves.

15.2.3 Water Exclusion

There are two main strategies, whose applicability is dependent on the water depth the property is subjected to and the potential for structural damage it may cause.

-  Water Exclusion (Flood Resistance) Strategy - should be employed where predicted flood depths are less than 0.3m and are likely to be for short duration. Emphasis is placed on minimising water entry and giving occupants time to relocate ground floor contents, maintaining structural integrity, and on using materials and construction techniques to facilitate drying and cleaning;
-  Water Entry (Flood Resilience) Strategy - Flood resilience measures are designed to allow water in but to limit damage and allow rapid re-occupancy. Resilience measures should be employed where flood depths are greater than 0.6m and where it is likely that structural damage will occur due to excessive water pressure.

When taking into account the proposed finished floor level raising and underfloor voids, the indicative flood depths are less than 0.3m in extreme scenarios and as such both the exclusion and entry strategies may be considered applicable for this site. The underfloor voids will allow for water entry whilst water exclusion measures will be adopted above the voids to 0.6m above the FFL.

Water Exclusion Strategy:

There are a range of flood protection devices/methods that can be used in the Water Exclusion Strategy including:

-  Using materials and construction with low permeability;
-  Raising thresholds and finished floor levels (e.g. porches with higher thresholds than main entrance);
-  Flood gates with waterproof seals;
-  Sump and pump for floodwater to remove waste water faster than it enters;
-  Door guards and airbrick covers.

Water Entry Strategy:

There are a range of options for implementing the Water Entry Strategy including:

-  Use materials with either good drying and cleaning properties, or, sacrificial materials that can easily be replaced;
-  Designing for water to drain away;
-  Designing access to all spaces to permit drying and cleaning;
-  Raising the level of electric wiring, appliances and utility metres (0.1m above flood level);
-  Ground supported floors with concrete slabs coated with impermeable membrane;
-  Plastic water resistant internal doors.

15.2.4 Flood resilience design and measures

Flood resilience design and measures that may be implemented are outlined below. Water-resistant and resilient materials that should be utilized throughout 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, 250 mm 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 fells and surface water drainage.

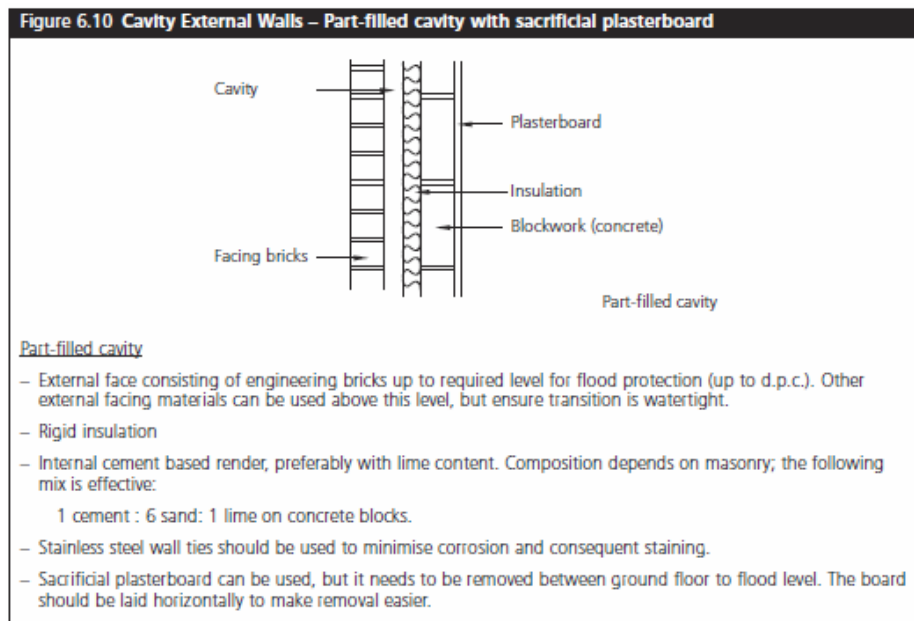


Figure 5 Cavity External Walls

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.

15.2.5 Compensatory Flood Storage (CFS)

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.

Where proposed development results in a change in building footprint, the developer must ensure that it does not impact upon the ability of the floodplain to store water, and should seek opportunities to provide a betterment with respect to floodplain storage.

Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain must be provided to ensure that the total volume of the floodplain storage is not reduced. The requirement for no loss of floodplain storage means that it is not possible to modify ground levels on sites which lie completely within the floodplain (when viewed in isolation), as there is no land available for lowering to bring it into the floodplain. It is possible to provide off-site compensation within the local area e.g. on a neighbouring or adjacent site, or indirect compensation, by lowering land already within the floodplain, however, this would be subject to detailed investigations and agreement with the Environment Agency to demonstrate (using an appropriate flood model where necessary) that the proposals would improve and not worsen the existing flooding situation or could be used in combination with other measures to limit the impact on floodplain storage.

The use of under-floor voids with adequate openings beneath the raised finished floor levels can be considered for developments in Flood Zones 2 and 3. They are generally considered to provide indirect compensation or mitigation, but not true compensation for loss of floodplain storage.

Should it not be possible to achieve all the level for level compensation required, the Environment Agency may consider that the remainder be provided through the use of under-floor voids instead. The amount of level for level compensation would need to be maximised and 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 the 1% annual probability (1 in 100-year) plus climate change flood level. By setting finished floor levels at 300mm above the design flood level, there is usually enough space provision for voids below. 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.

During the 1% AEP + 31% AEP, the proposed development has the potential to displace up to 253.8m³.

Table 8 Flood water displacement calculation with no mitigation implemented

Flood Water Displacement - No Mitigation			
Displacement	Area (m ²)	Depth (m)	Displacement (m ³)
4no. Terraced dwellings	282	0.9	253.8

However, due to the size and topography of the site, CFS on a level for level basis was not possible. Therefore, underfloor voids will be implemented.

Table 9 Flood water displacement calculation with mitigation implemented (i.e. the inclusion of voids)

Flood Water Displacement - With Mitigation			
Displacement	Area (m ²)	Depth (m)	Displacement (m ³)
Walls	28	0.9	25.52

When considering construction materials below the flood level, the development will displace a total of 25.52m³ of flood waters.

16 Emergency Plan

16.1.1 Assessment of Danger to People

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 13](#).

The EA Product 6 data indicates that the maximum Flood Hazard Rating (HR) score is 1.68, which constitutes flood waters which are 'Danger for Most'. The flood hazard rating would therefore be 'Significant'.

16.1.2 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.

16.1.3 Access and Safe Egress

Egress to Flood Zone 1 is available by a 5-minute walk north to Henley Road / A4155. Directions of this route are presented in [Appendix 12](#).

16.1.4 Safe Refuge

The proposed development will have internal connections to upper floors in the property which will act to provide sufficient safe refuge in the event of an extreme flood event.

17 References

1. Communities and Local Government - National Planning Policy Framework NPPF, July, 2021.
2. Communities and Local Government - Planning Practice Guidance: Flood Risk and Coastal Change, Updated 06 March 2014.
3. Reading Borough Council, Peter Brett – Reading Borough Council Strategic Flood Risk Assessment, June 2017.
4. Reading Borough Council – Reading Borough Local Plan, Adopted November 2019.
5. CIRIA, Defra, Environment Agency – UK SuDS Manual, 2015.

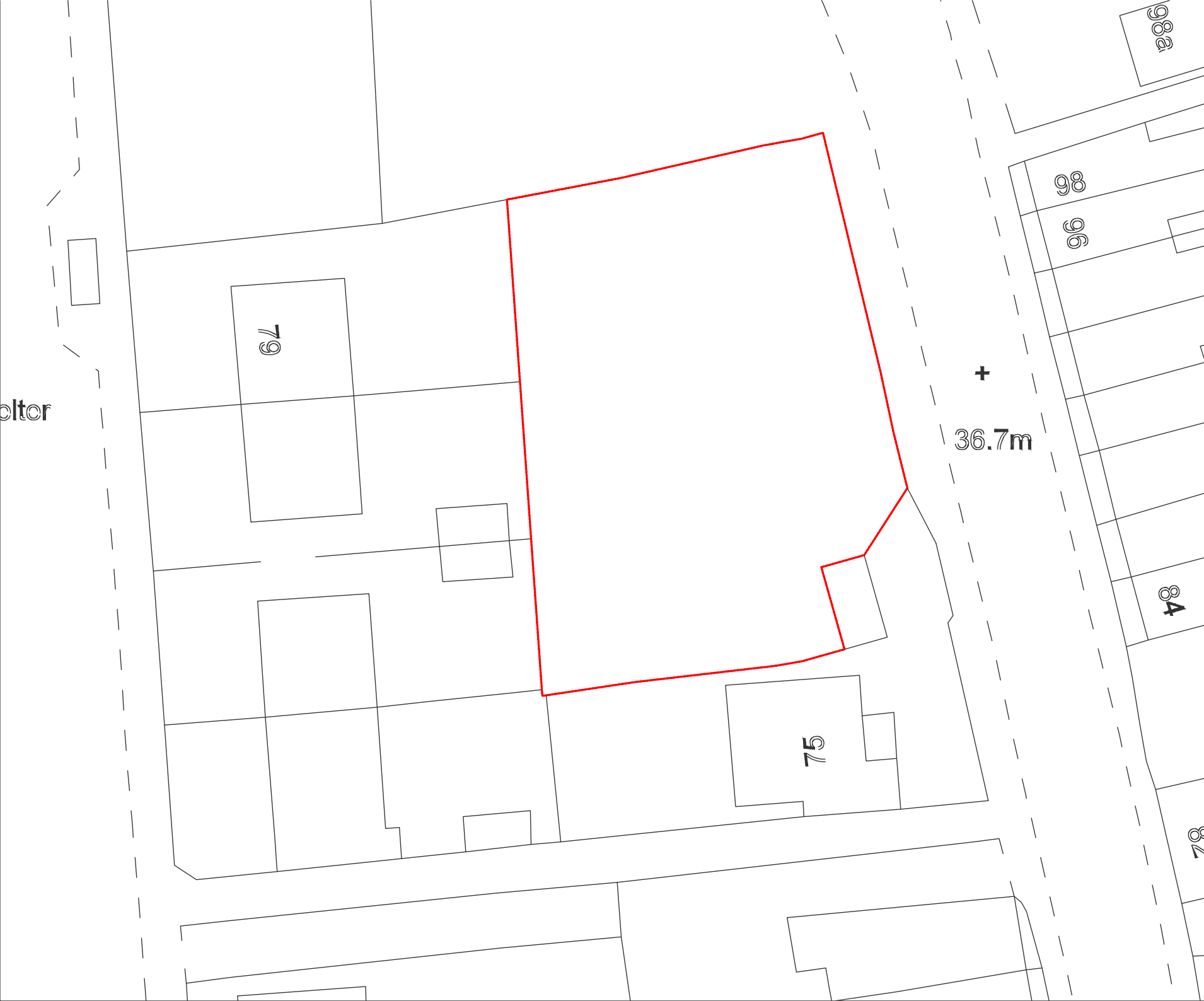
18 Appendices

18.1 Appendix 1 – Site Photographs



18.2 Appendix 2 – Development Plans

See next page.



Key Plan:

Scale: 1:100 @A3

Key:

General Notes:

Proposed Notes:

PLANNING ISSUE

Project Number: 25001

Date: February 2025

Scale: 1:200 @ A3

Project: Land North of Star Road, RG4 5BE

Drawing Title: Existing Site Plan

Drawing Title: 25001-PL140-A

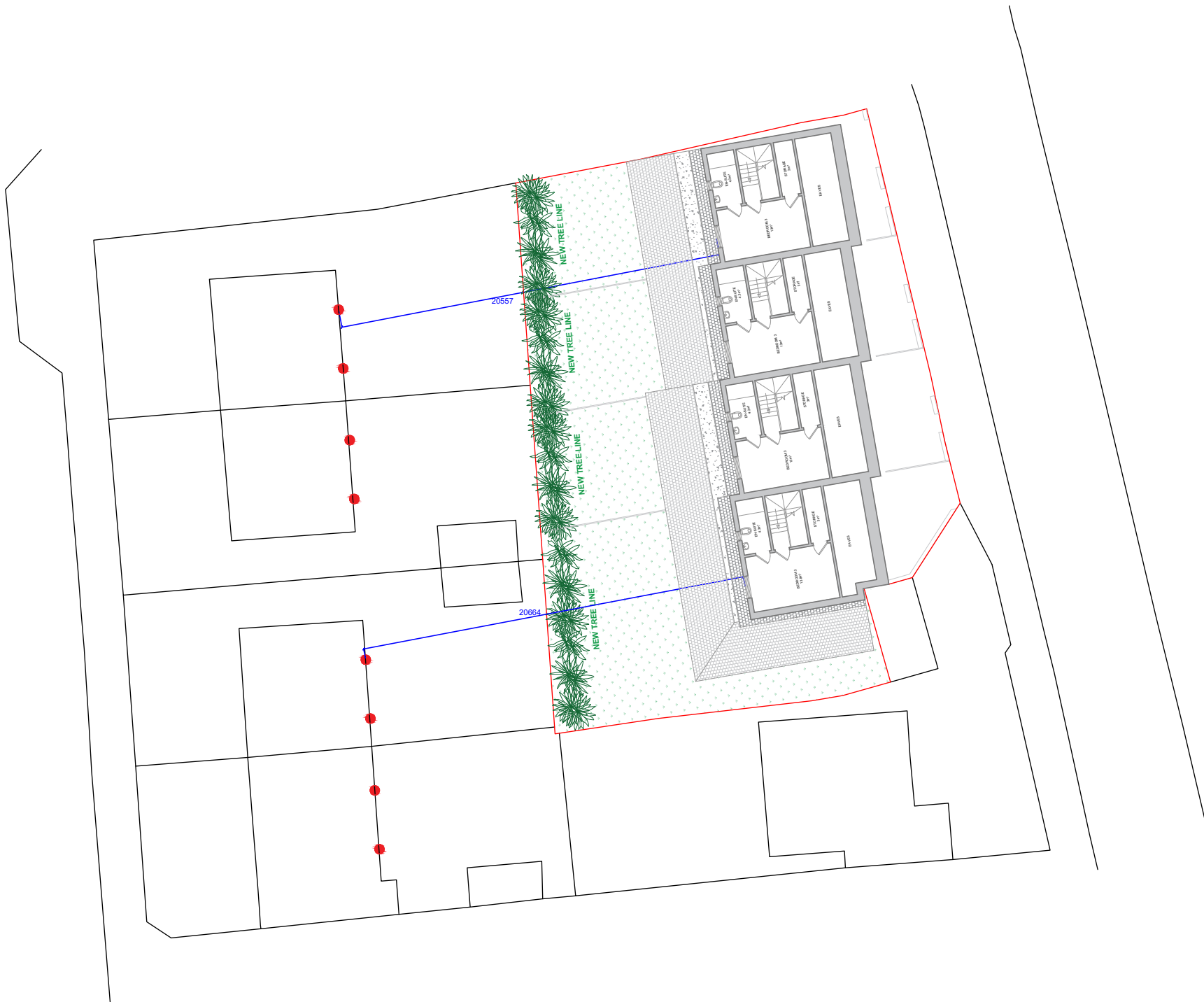
Drawn: IB Rev: A


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0m 2m 4m 6m 8m 10m



Key Plan:

Scale: 1:100 @A3

Key:

General Notes:

Proposed Notes:

PLANNING ISSUE

Project Number: 25001

Date: March 2025

Scale: 1:200 @ A3

Project: Land North of Star Road, RG4 5BE

Drawing Title: Proposed Site Plan

Drawing Title: 25001-PL240-A

Drawn: IB Rev: A

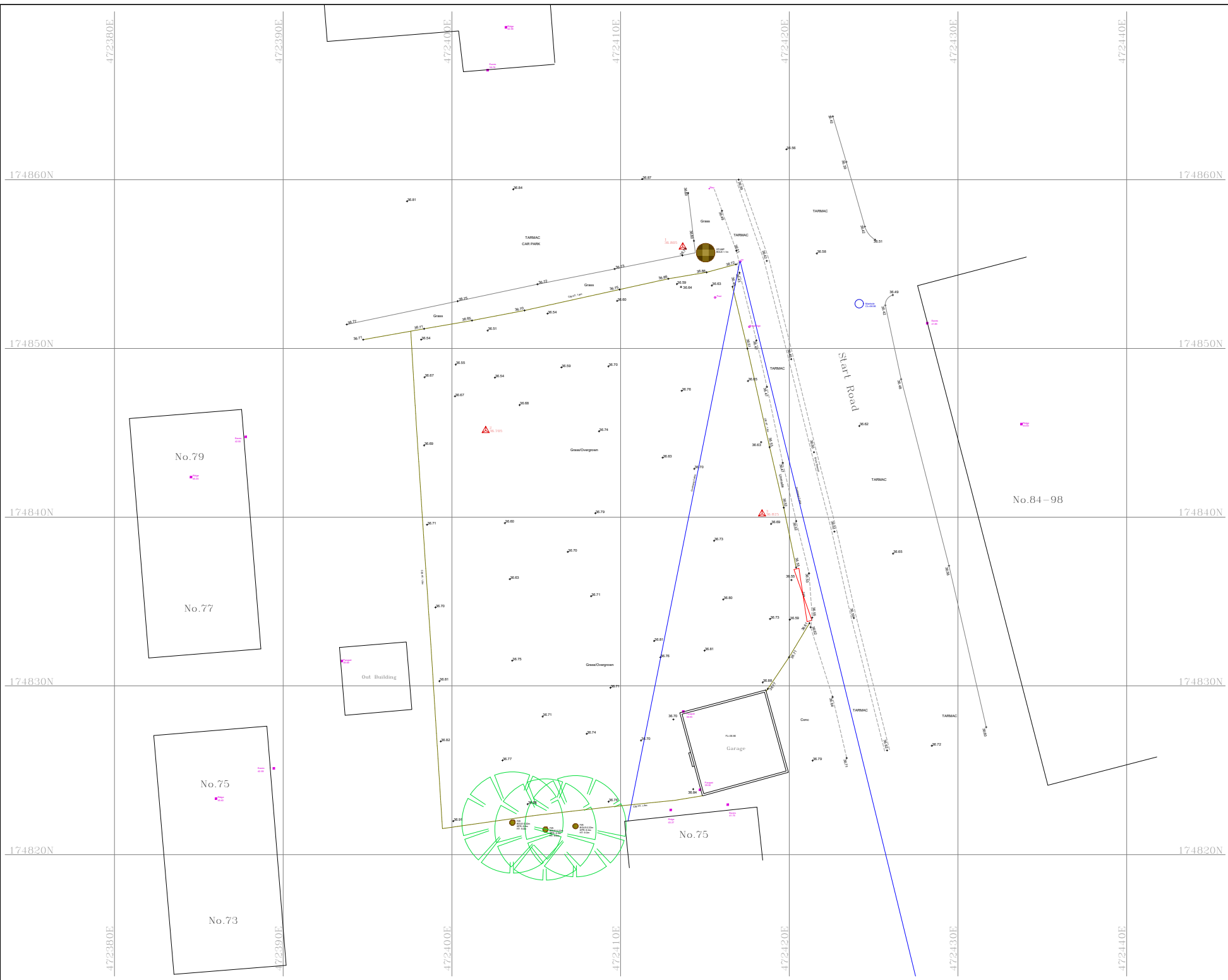


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0m 2m 4m 6m 8m 10m



Important Information:

Any Drainage that has been investigated should be checked against statutory records to confirm details before proceeding with any design work.

We advise that an arborologist be appointed to correctly determine the species and condition of all trees surveyed prior to any design work.

All information contained in this drawing (including digital data) should be checked and verified prior to any fabrication or construction.

Survey Legend

[illegible]

North:



Grid:

Grid: Survey is based on Ordnance Survey National Grid (OSGB36) sited centered on STN 2 with scale factor 1. Values have been derived via GPS using OS active network using the OSGM15 transformation and OSGM15 Geoid model.

Levelling: Ordnance Datum

Levelling

Drawing Title:
Topographical Survey

Site Address: Land North of 75 Star Road
RG4 5BE

Client:



Surveyor	MSM	Drawn By	MSM	Verified By	ATS	Date	27.01.20
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MIC No: MIC/MBS0107		Rev: 001
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Scale: 1:100m @ A1	Date: 27.01.2025
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PLOT NO	AREA	BEDROOMS	AMENITY
77 Star Road	126.8m ²	3B / 5P	100m ²
79 Star Road	110m ²	3B / 5P	39.5m ²
81 Star Road	107m ²	3B / 5P	42.6m ²
83 Star Road	103.6m ²	3B / 5P	40m ²

Key Plan:

Scale: 1:100 @A3

Key:

General Notes:

Proposed Notes:

AJune 2025

PLANNING ISSUE

Project Number:25001

Date:June 2025

Scale:1:100 @ A3

Project:Land North of Star Road, RG4 5BE

Drawing Title:Proposed Ground Floor Plans

Drawing Title:25001-PL200-A

Drawn:IBRev: A

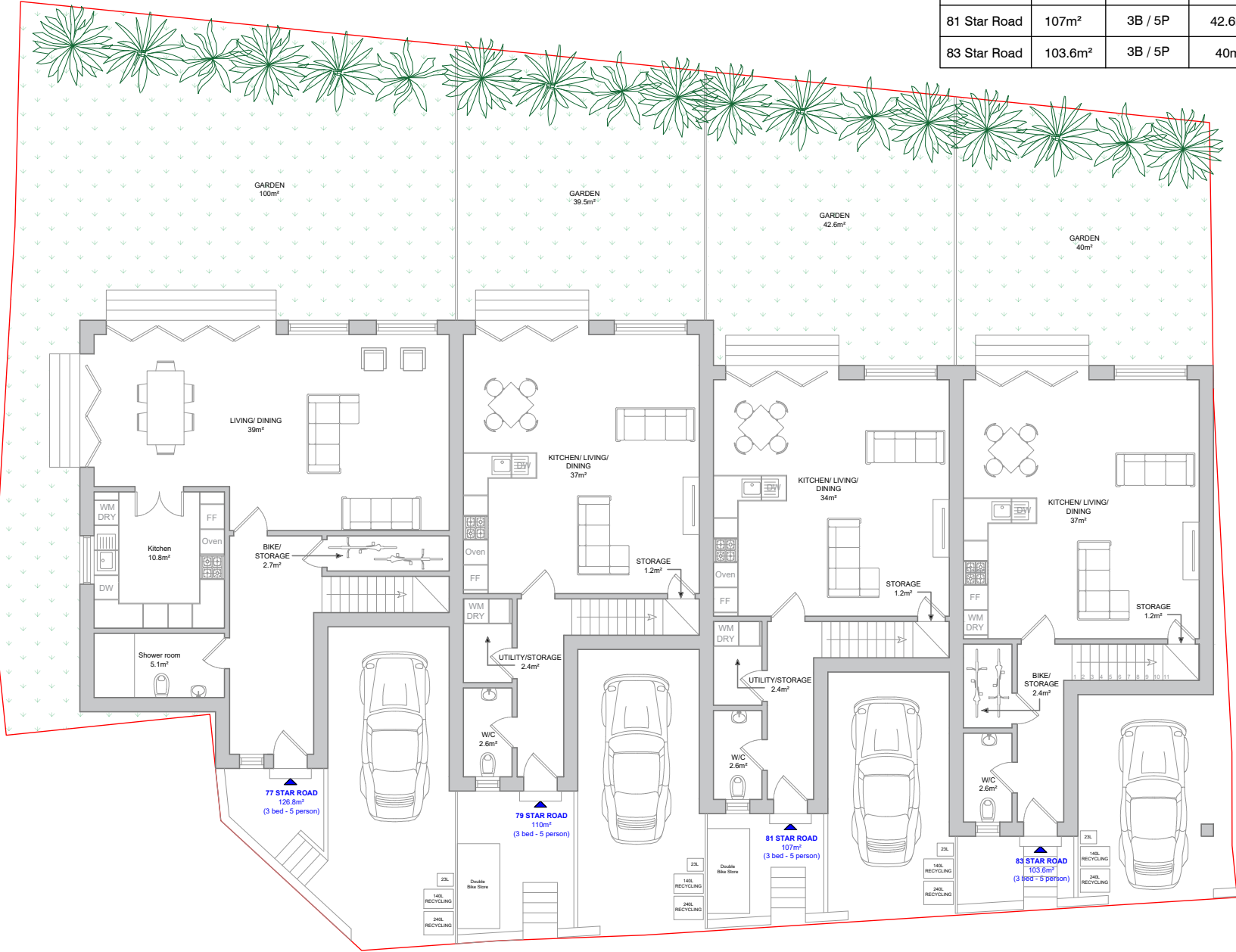

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N

0m1m2m3m4m5m



PLOT NO	AREA	BEDROOMS	AMENITY
77 Star Road	126.8m ²	3B / 5P	100m ²
79 Star Road	110m ²	3B / 5P	39.5m ²
81 Star Road	107m ²	3B / 5P	42.6m ²
83 Star Road	103.6m ²	3B / 5P	40m ²

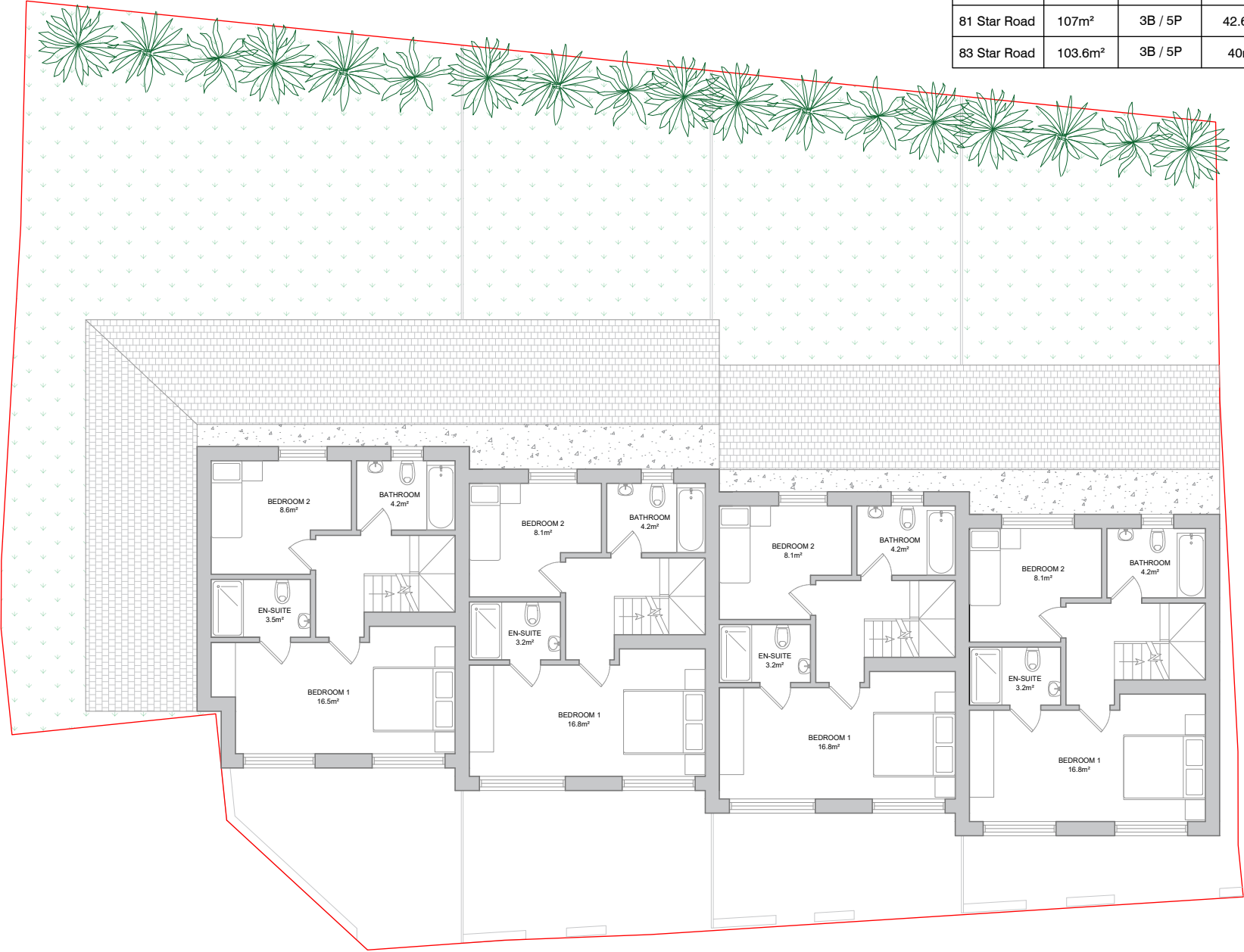
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Scale: 1:100 @A3

Key:

General Notes:

Proposed Notes:



AJune 2025

PLANNING ISSUE

Project Number:25001

Date:June 2025

Scale:1:100 @ A3

Project:Land North of Star Road, RG4 5BE

Drawing Title:Proposed First Floor Plans

Drawing Title:25001-PL201-A

Drawn:IBRev: A



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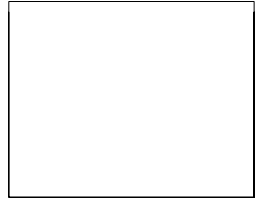
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N

0m1m2m3m4m5m

PLOT NO	AREA	BEDROOMS	AMENITY
77 Star Road	126.8m ²	3B / 5P	100m ²
79 Star Road	110m ²	3B / 5P	39.5m ²
81 Star Road	107m ²	3B / 5P	42.6m ²
83 Star Road	103.6m ²	3B / 5P	40m ²

Key Plan:



Scale: 1:100 @A3

Key:

General Notes:

Proposed Notes:

A June 2025

PLANNING ISSUE

Project Number: 25001

Date: June 2025

Scale: 1:100 @ A3

Project: Land North of Star Road, RG4 5BE

Drawing Title: Proposed Second Floor Plans

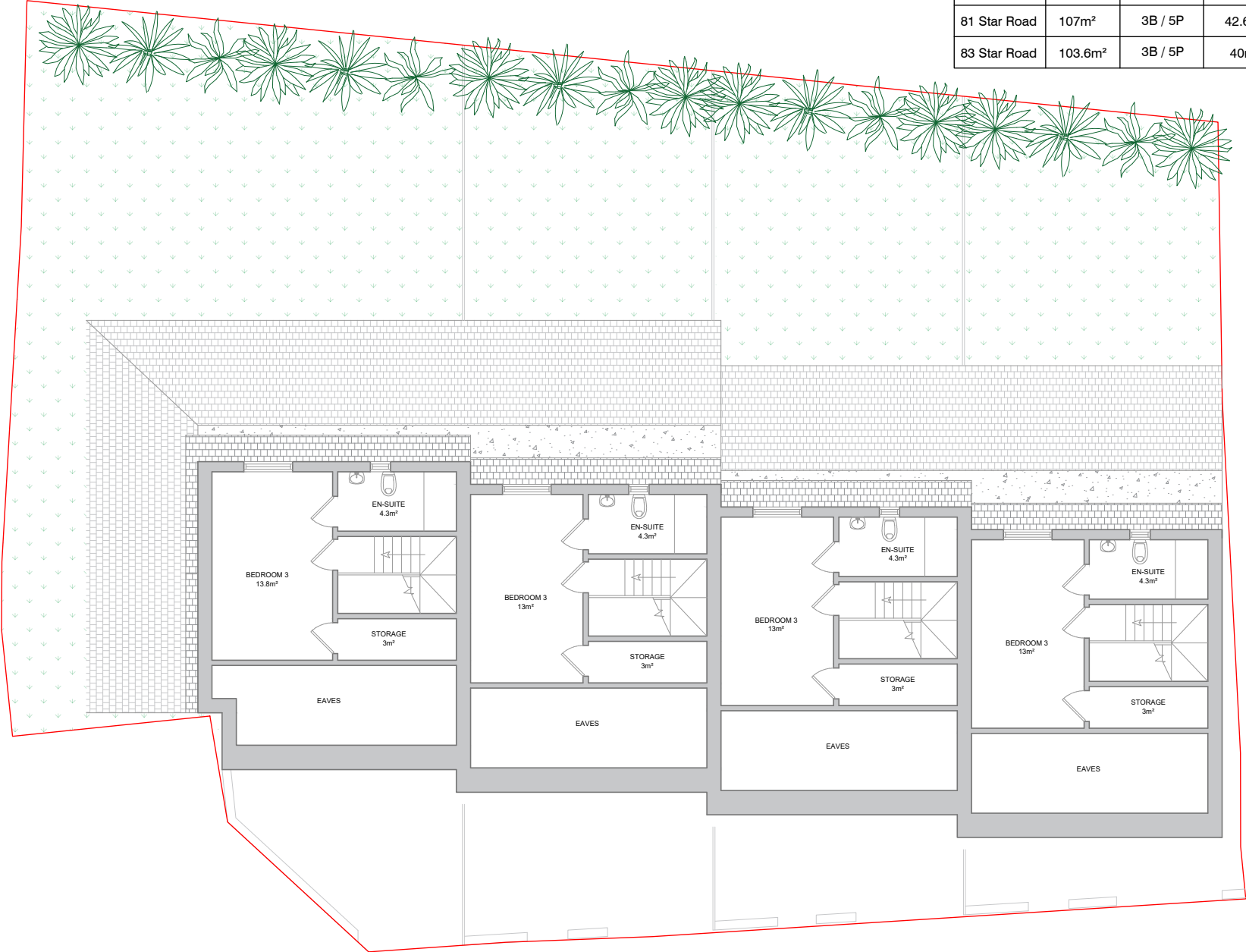
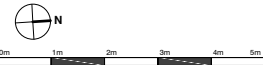
Drawing Title: 25001-PL202-A

Drawn: IB Rev: A

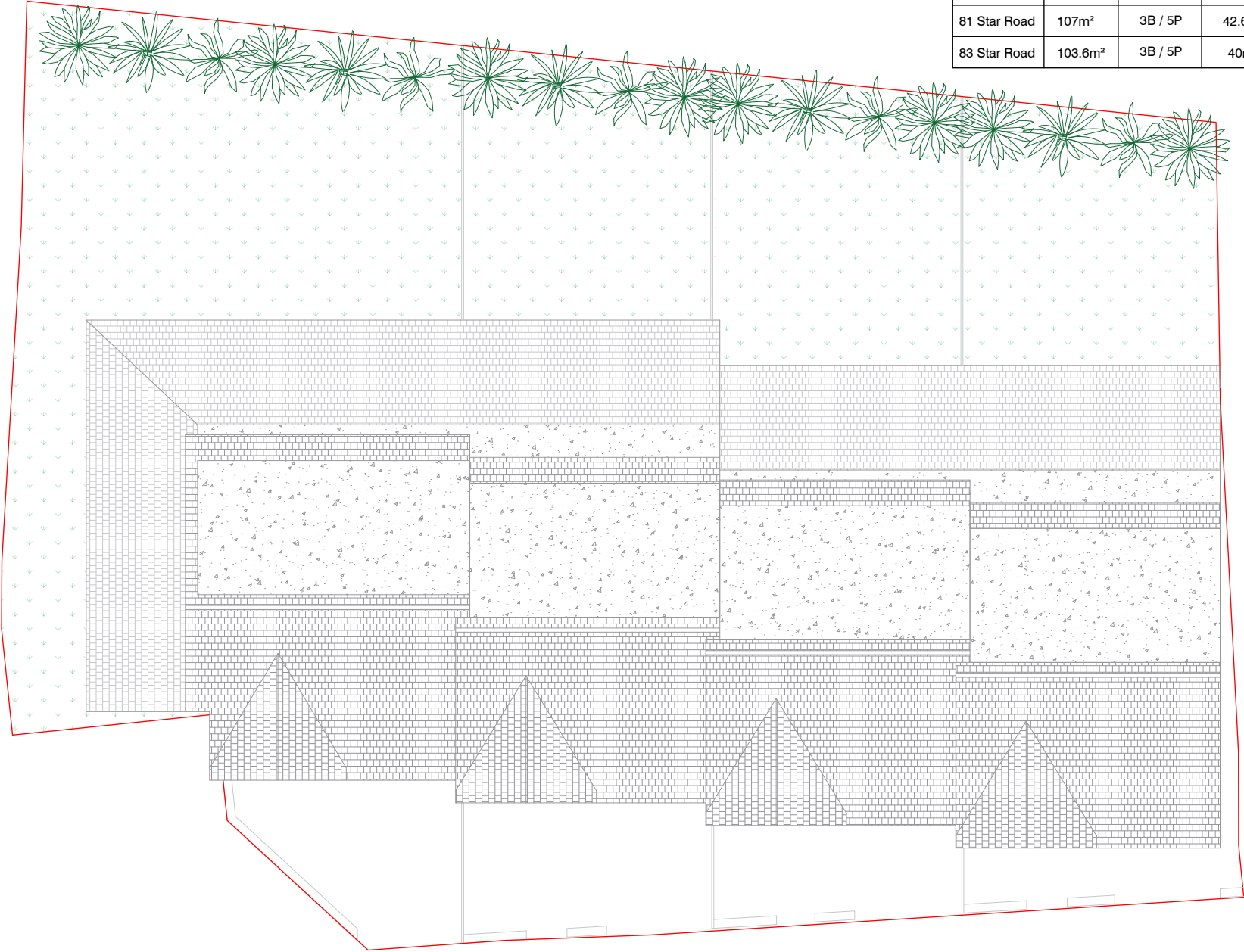


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PLOT NO	AREA	BEDROOMS	AMENITY
77 Star Road	126.8m ²	3B / 5P	100m ²
79 Star Road	110m ²	3B / 5P	39.5m ²
81 Star Road	107m ²	3B / 5P	42.6m ²
83 Star Road	103.6m ²	3B / 5P	40m ²



Key Plan:

Scale: 1:100 @A3

Key:

General Notes:

Proposed Notes:

A

June 2025

PLANNING ISSUE

Project Number: 25001

Date: June 2025

Scale: 1:100 @ A3

Project: Land North of Star Road, RG4 5BE

Drawing Title: Proposed Roof Plans

Drawing Title: 25001-PL203-A

Drawn: IB

Rev: A



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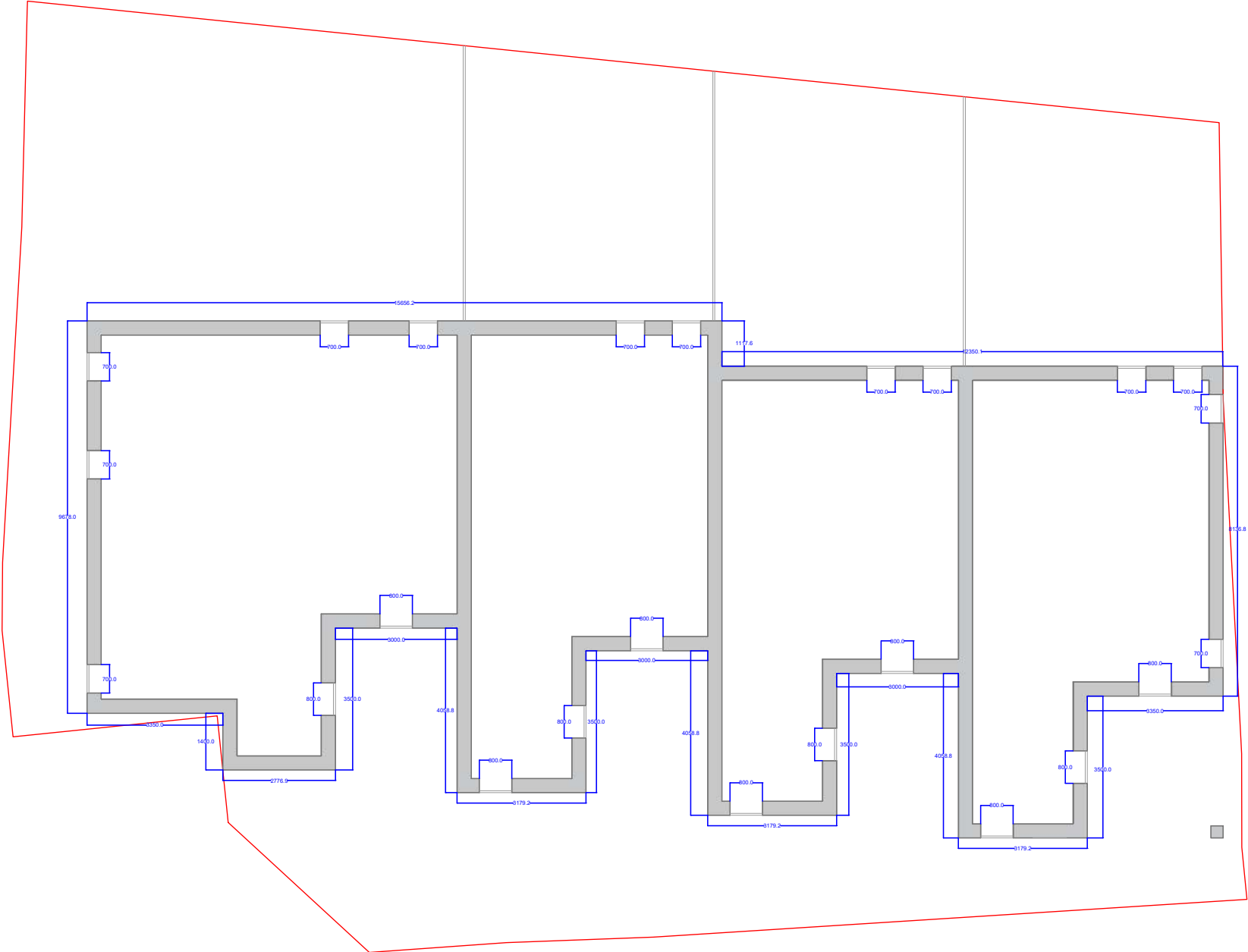
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 N

0m 1m 2m 3m 4m 5m

NB: Void openings to be from ground level to top of void



Key Plan:

Scale: 1:100 @A3

Key:

General Notes:

Proposed Notes:

A July 2025

PLANNING ISSUE

Project Number: 25001

Date: July 2025

Scale: 1:100 @ A3

Project: Land North of Star Road, RG4 5BE

Drawing Title: Proposed Lower Ground Floor

Drawing Title: 25001-PL204-A

Drawn: IB Rev: A


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 N

0m 1m 2m 3m 4m 5m



PROPOSED
FRONT ELEVATION

PROPOSED
FRONT ELEVATION



PROPOSED
REAR ELEVATION

PROPOSED
REAR ELEVATION

Key Plan:

Scale: 1:100 @A3

Key:

General Notes:

Proposed Notes:

A July 2025

PLANNING ISSUE

Project Number: 25001

Date: July 2025

Scale: 1:100 @ A3

Project: Land North of Star Road, RG4 5BE

Drawing Title: Proposed Elevations

Drawing Title: 25001-PL220-A

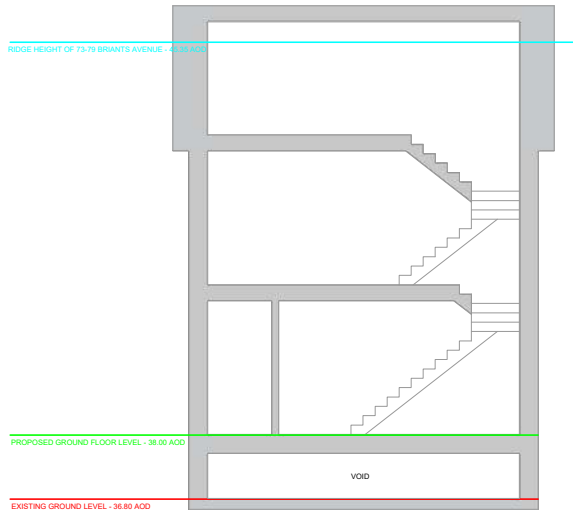
Drawn: IB Rev: A


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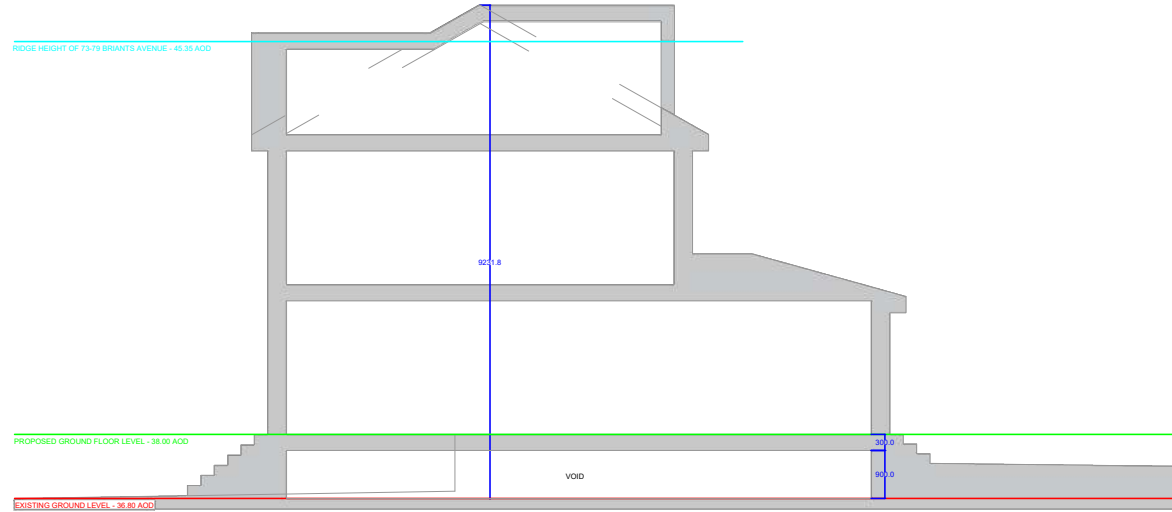
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0m 1m 2m 3m 4m 5m



PROPOSED TYPICAL
SECTION AA



PROPOSED TYPICAL
SECTION BB

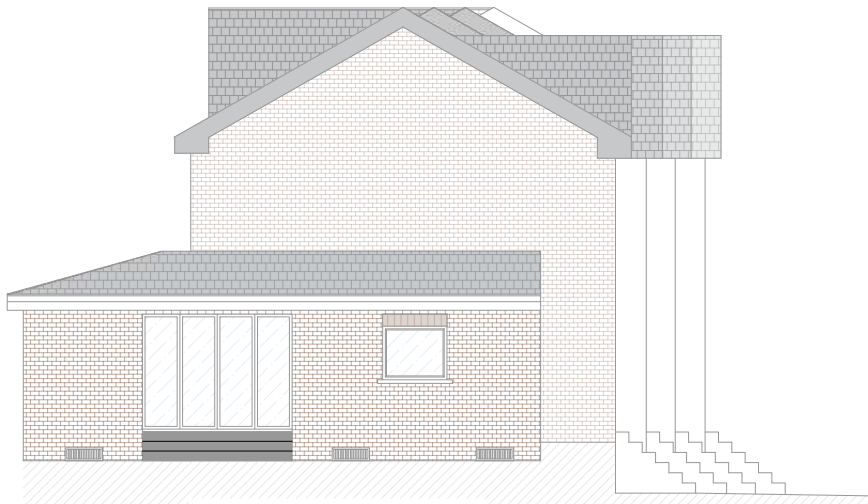
Key Plan:

Scale: 1:100 @A3

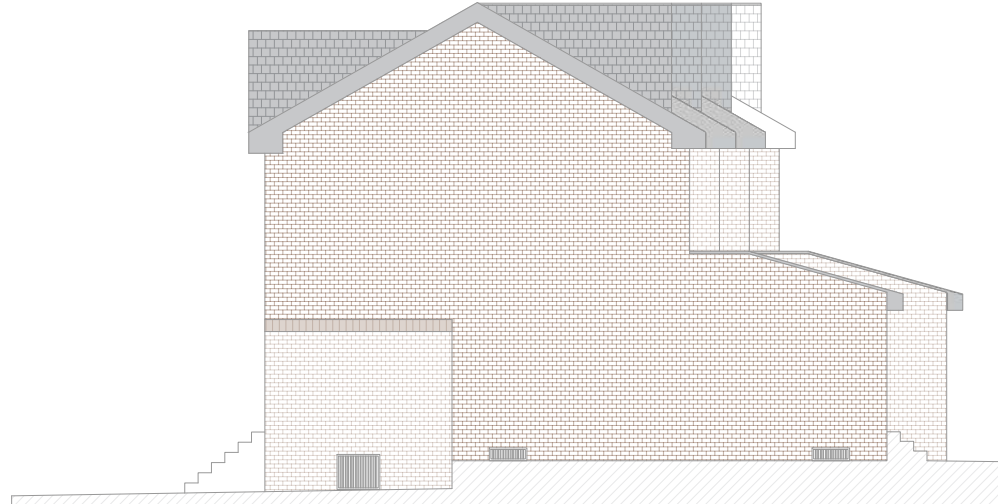
Key:

General Notes:

Proposed Notes:



PROPOSED
SOUTH FLANK ELEVATION



PROPOSED
NORTH FLANK ELEVATION

A June 2025

PLANNING ISSUE

Project Number: 25001

Date: June 2025

Scale: 1:100 @ A3

Project: Land North of Star Road, RG4 5BE

Drawing Title: Proposed Elevations & Section

Drawing Title: 25001-PL221-A

Drawn: IB Rev: A


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0m 1m 2m 3m 4m 5m

18.3 Appendix 3 – Environmental Characteristics

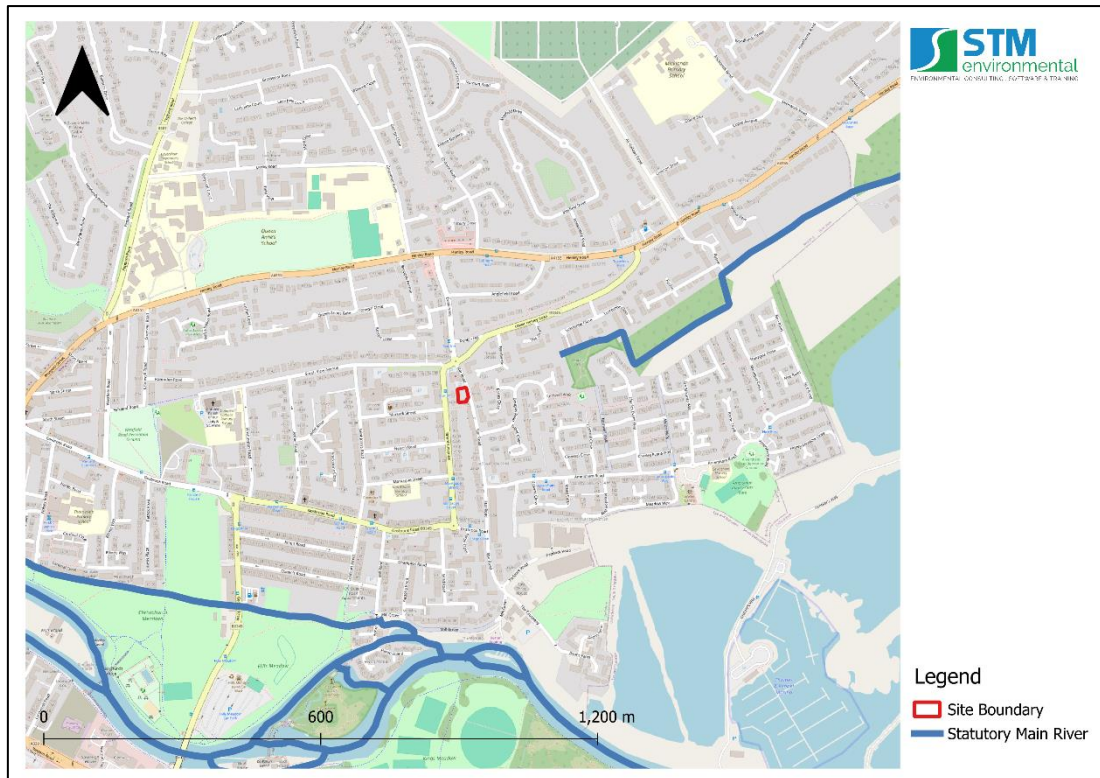
18.3.1 Superficial Hydrogeology Map



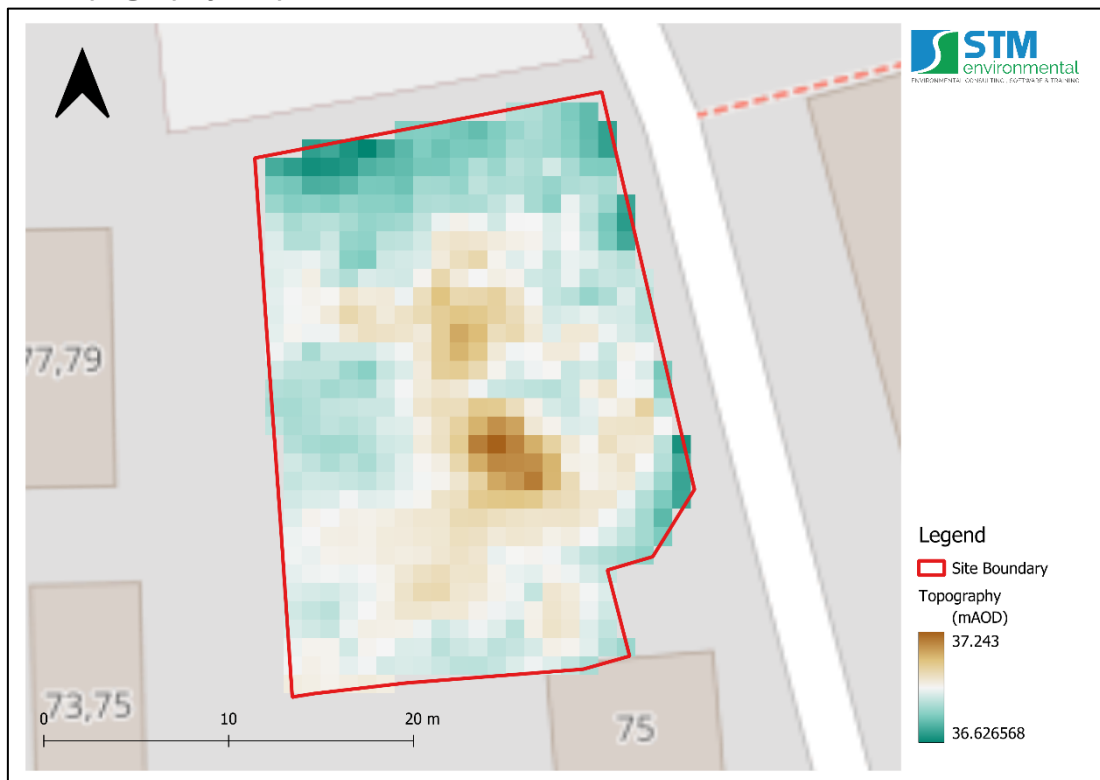
18.3.2 Bedrock Hydrogeology Map



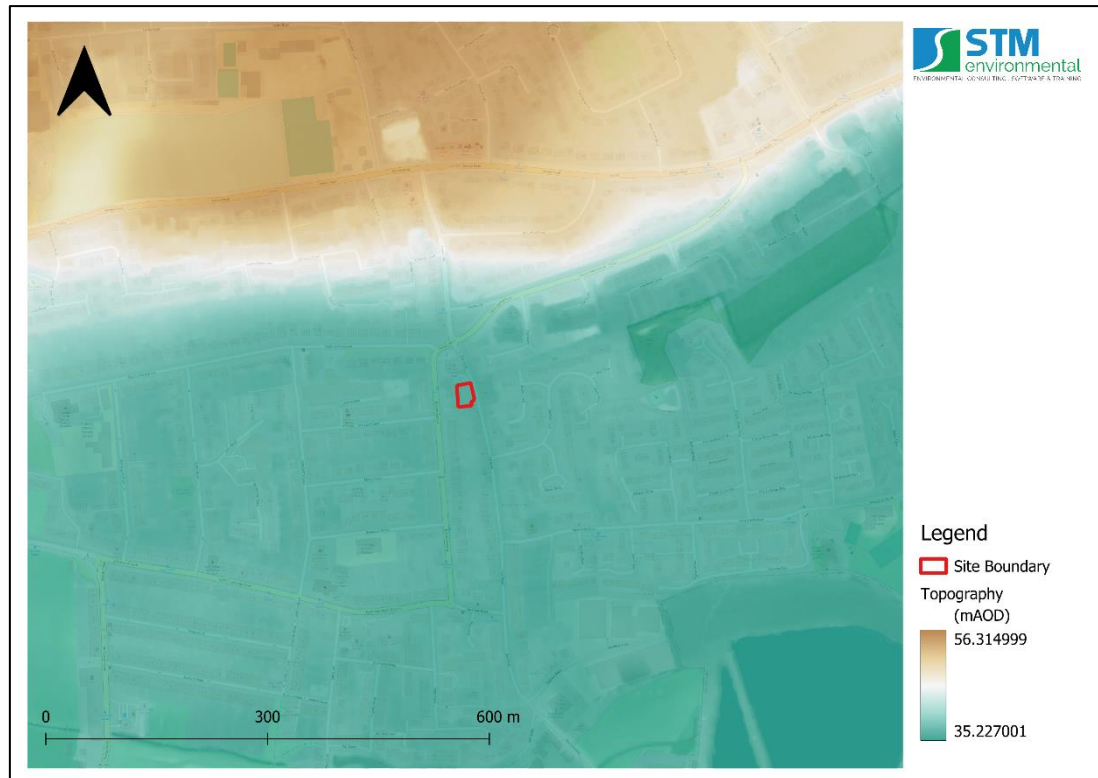
18.3.3 Hydrology Map



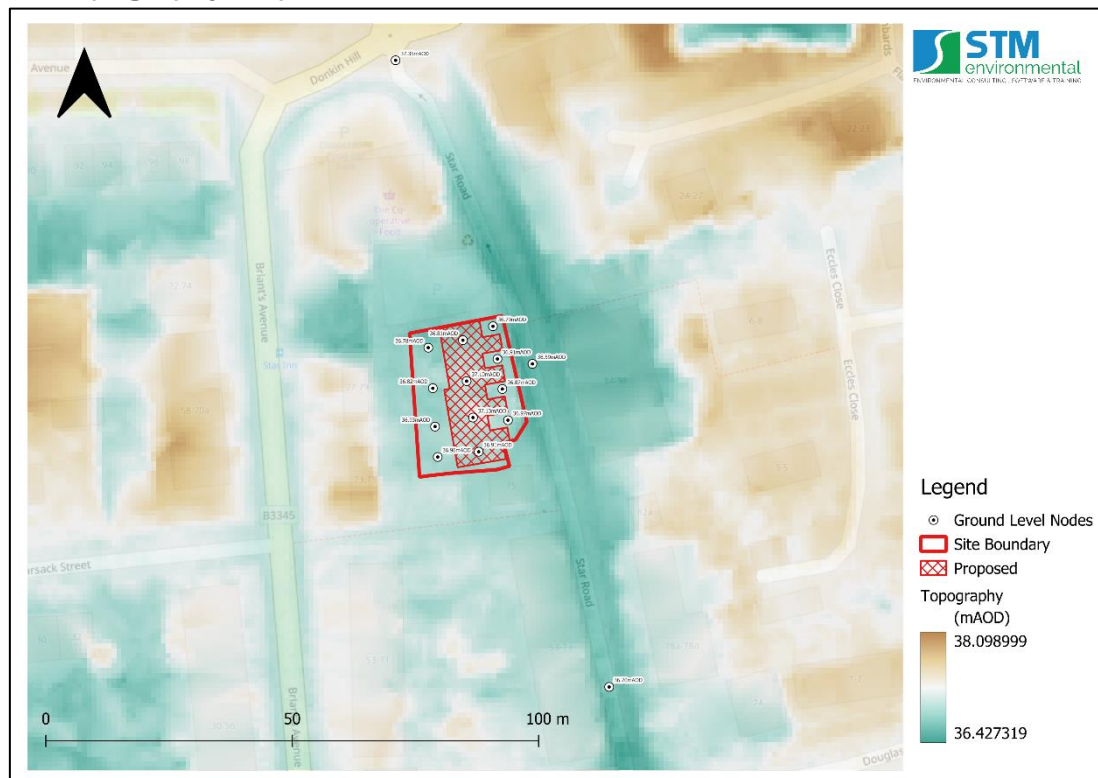
18.3.4 Topography Map – Site



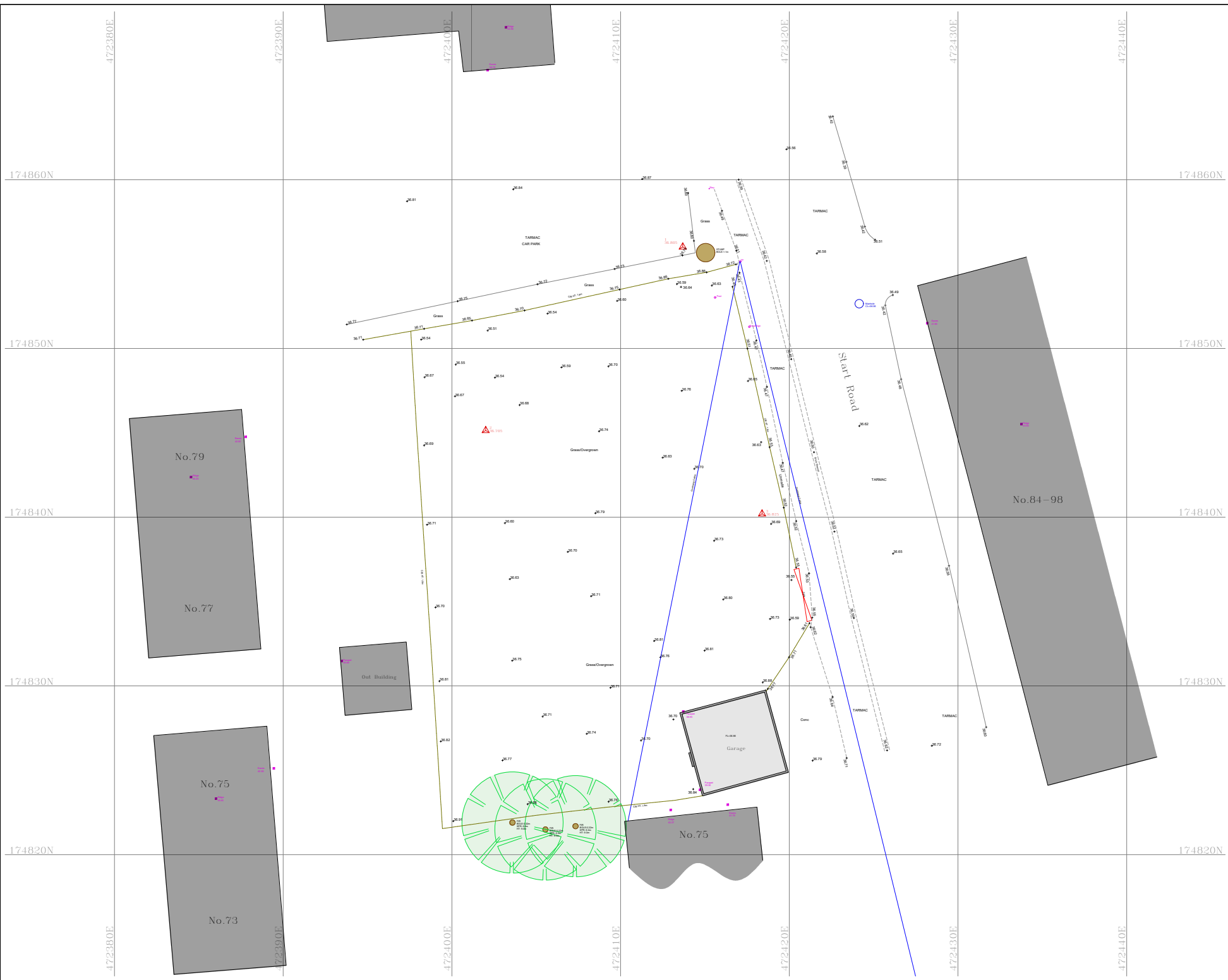
18.3.5 Topography Map – Area



18.3.6 Topography Map – Nodes



18.3.7 Topographic Survey
See next page.



Important Information:

Any Drainage that has been investigated should be checked against statutory records to confirm details before proceeding with any design work.

We advise that an arborologist be appointed to correctly determine the species and condition of all trees surveyed prior to any design work.

All information contained in this drawing (including digital data) should be checked and verified prior to any fabrication or construction.

Survey Legend

[illegible]

North:



Grid:

Grid: Survey is based on Ordnance Survey National Grid (OSBG36) site centered on STN 2 with scale factor 1. Values have been derived via GPS using OS active network using the OSGM15 transformation and OSGM15 Geoid model.

Levelling: Ordnance Datum

Levelling:

Drawing Title:	Topographical Survey
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Site Address: Land North of 75 Star Road
RG4 5BE

Client:



Surveyor	MSM	Drawn By	MSM	Verified By	ATS	Date	27.01.2025
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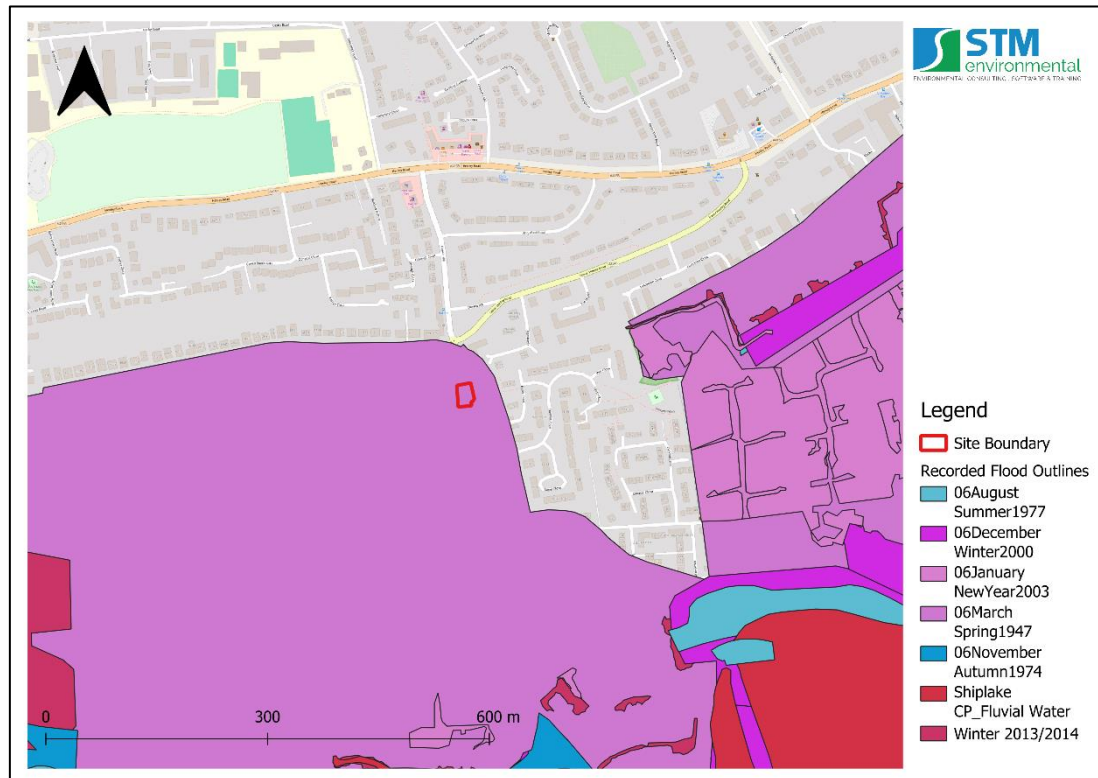
MIC No: MIC/MBS0107	Rev: 001
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Scale: 1:100m @ A1	Date: 27.01.2025
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18.4 Appendix 4 – Historical Flood Incident Maps

18.4.1 EA Historic and Recorded Flood Outlines



18.4.2 Map Recorded Historic Flooding

See next page.



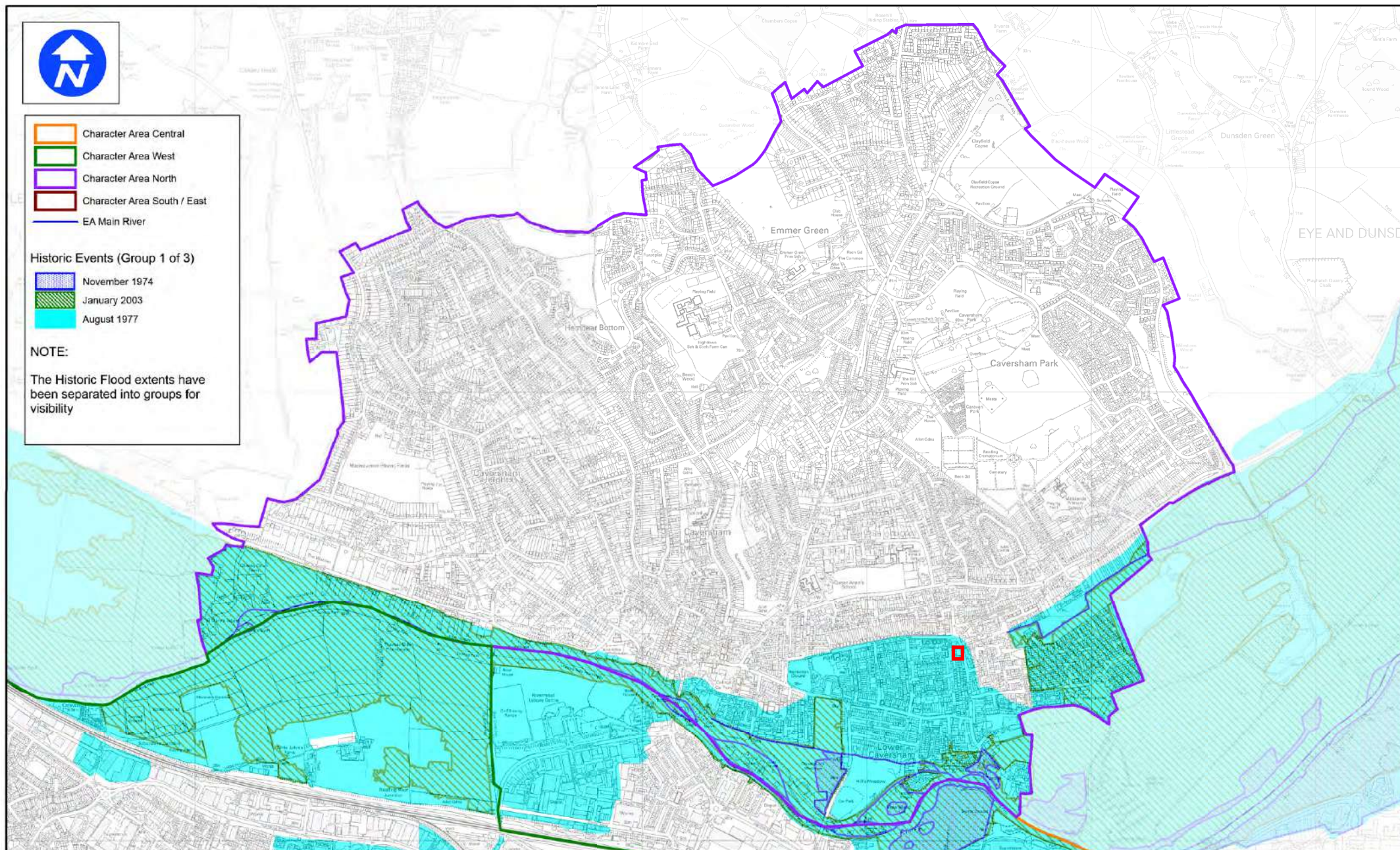
-  Character Area Central
-  Character Area West
-  Character Area North
-  Character Area South / East
-  EA Main River

Historic Events (Group 1 of 3)

-  November 1974
-  January 2003
-  August 1977

NOTE:

The Historic Flood extents have been separated into groups for visibility



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RBC SFRA

Character Area North
EA Historic Flood Map (map 1 of 3)

Date: 03/01/2017

Scale: NTS

Drawn By: SB Checked By: RF

Rev: -

Figure Number

Map F2_N1



-  Character Area Central
-  Character Area West
-  Character Area North
-  Character Area South / East
-  EA Main River

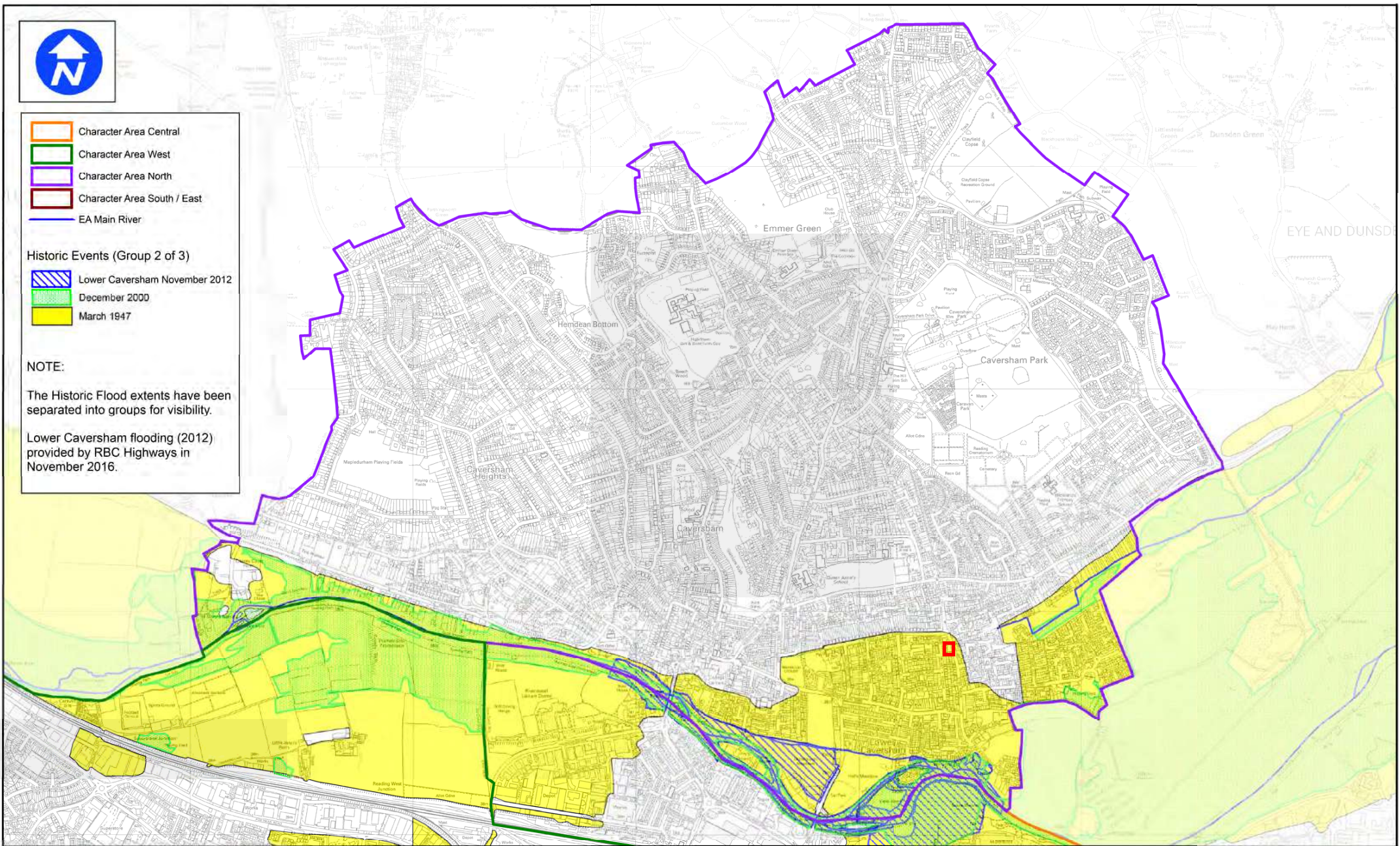
Historic Events (Group 2 of 3)

-  Lower Caversham November 2012
-  December 2000
-  March 1947

NOTE:

The Historic Flood extents have been separated into groups for visibility.

Lower Caversham flooding (2012)
provided by RBC Highways in
November 2016.



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RBC SFRA

Character Area North
EA Historic Flood Map (map 2 of 3)

Date: 03/01/2017

Scale: NTS

Drawn By: SB Checked By: RF

Rev -

Figure Number

Map F2_N2



-  Character Area Central
-  Character Area West
-  Character Area North
-  Character Area South / East
-  EA Main River

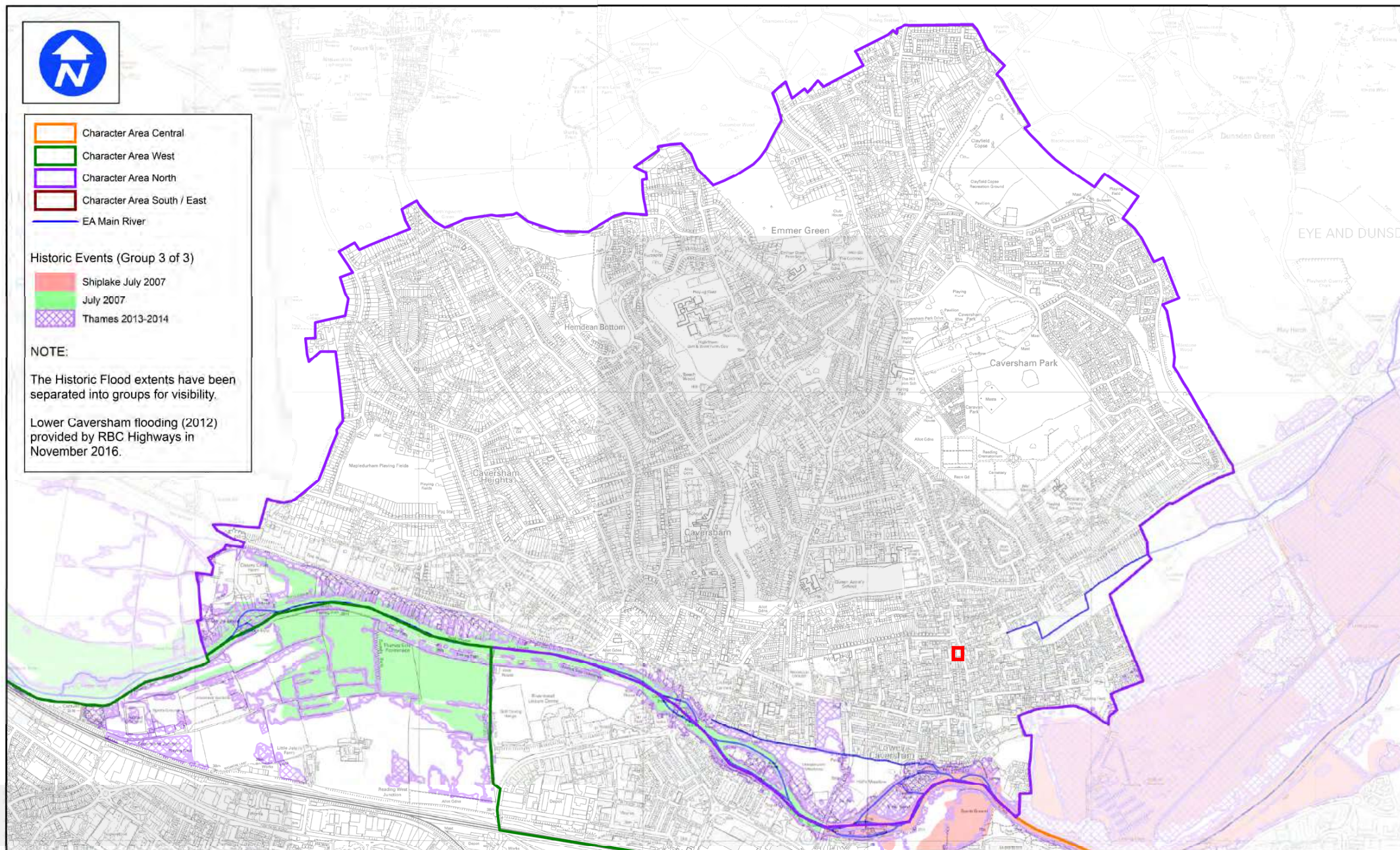
Historic Events (Group 3 of 3)

-  Shiplake July 2007
-  July 2007
-  Thames 2013-2014

NOTE:

The Historic Flood extents have been separated into groups for visibility.

Lower Caversham flooding (2012) provided by RBC Highways in November 2016.



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Plot: RBC SFRA 10
RBC
RBC

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RBC SFRA

Character Area North
EA Historic Flood Map (map 3 of 3)

Date: 09/03/2017

Scale: NTS

Drawn By: SB Checked By: RF

Rev: A

Figure Number

Map F2_N3



- Character Area Central
- Character Area West
- Character Area North
- Character Area South / East
- EA Main River

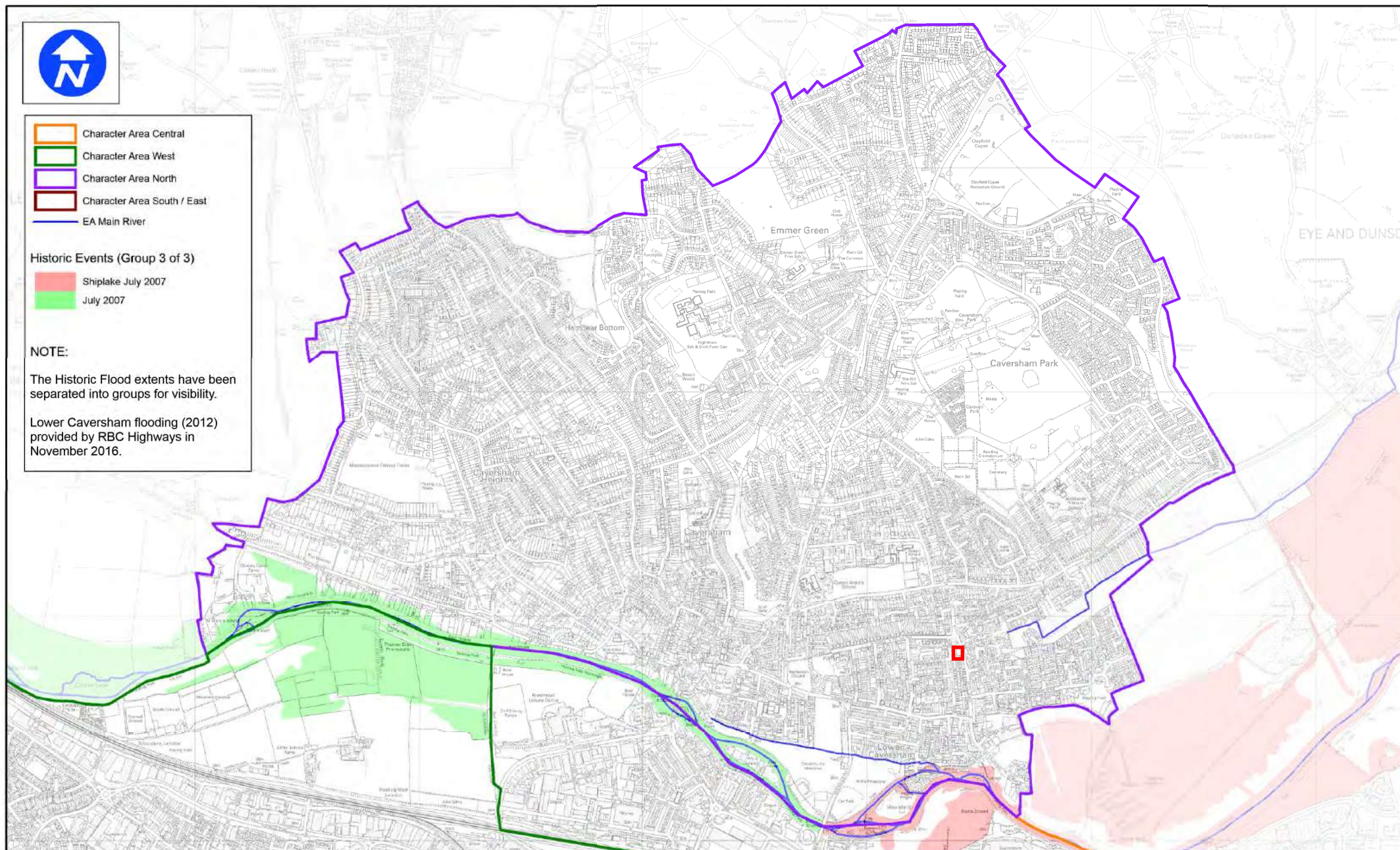
Historic Events (Group 3 of 3)

- Shiplake July 2007
- July 2007

NOTE:

The Historic Flood extents have been separated into groups for visibility.

Lower Caversham flooding (2012)
provided by RBC Highways in
November 2016.



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RBC SFRA

Character Area North
EA Historic Flood Map (map 3 of 3)

Date: 03/01/2017

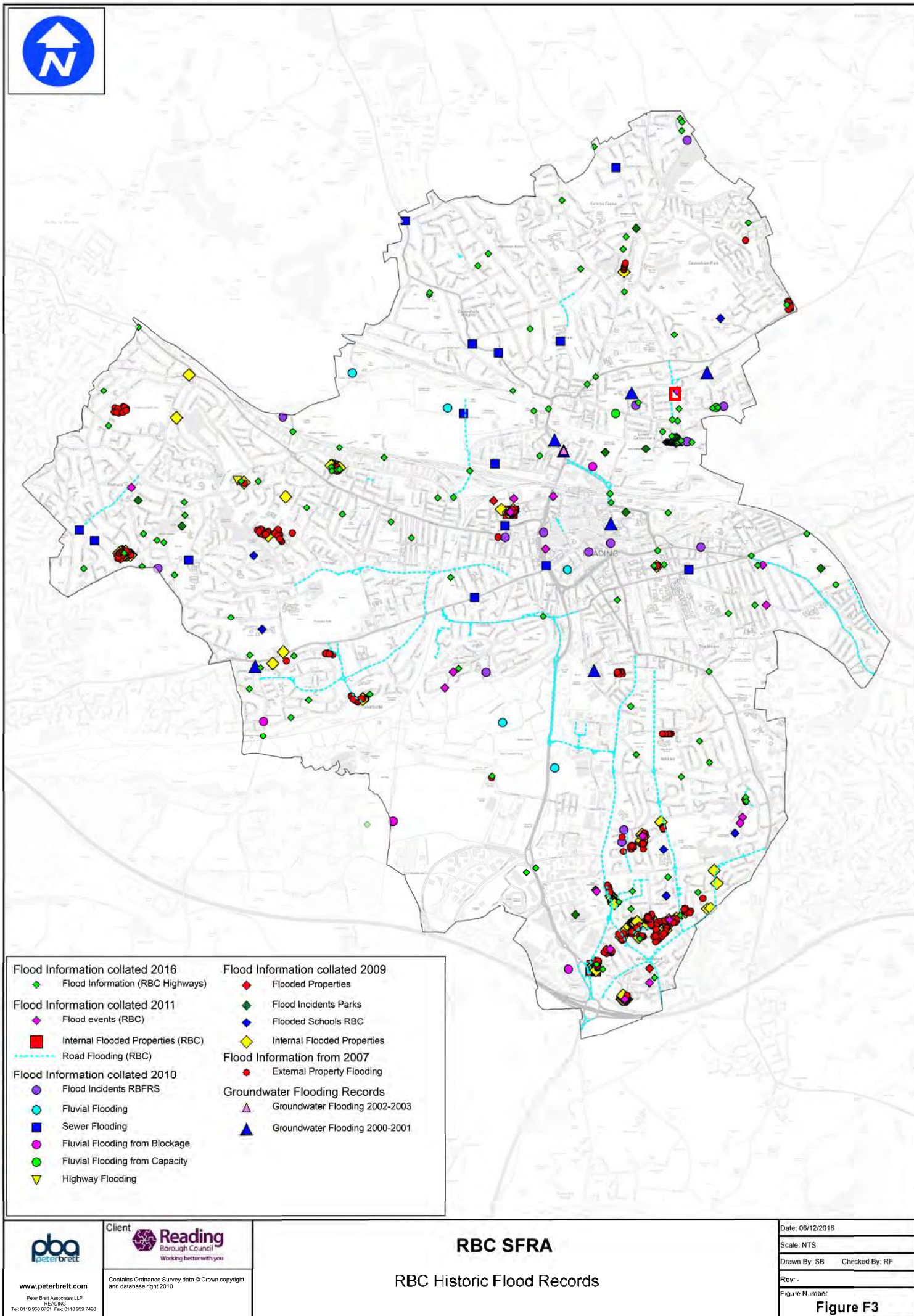
Scale: NTS

Drawn By: SB Checked By: RF

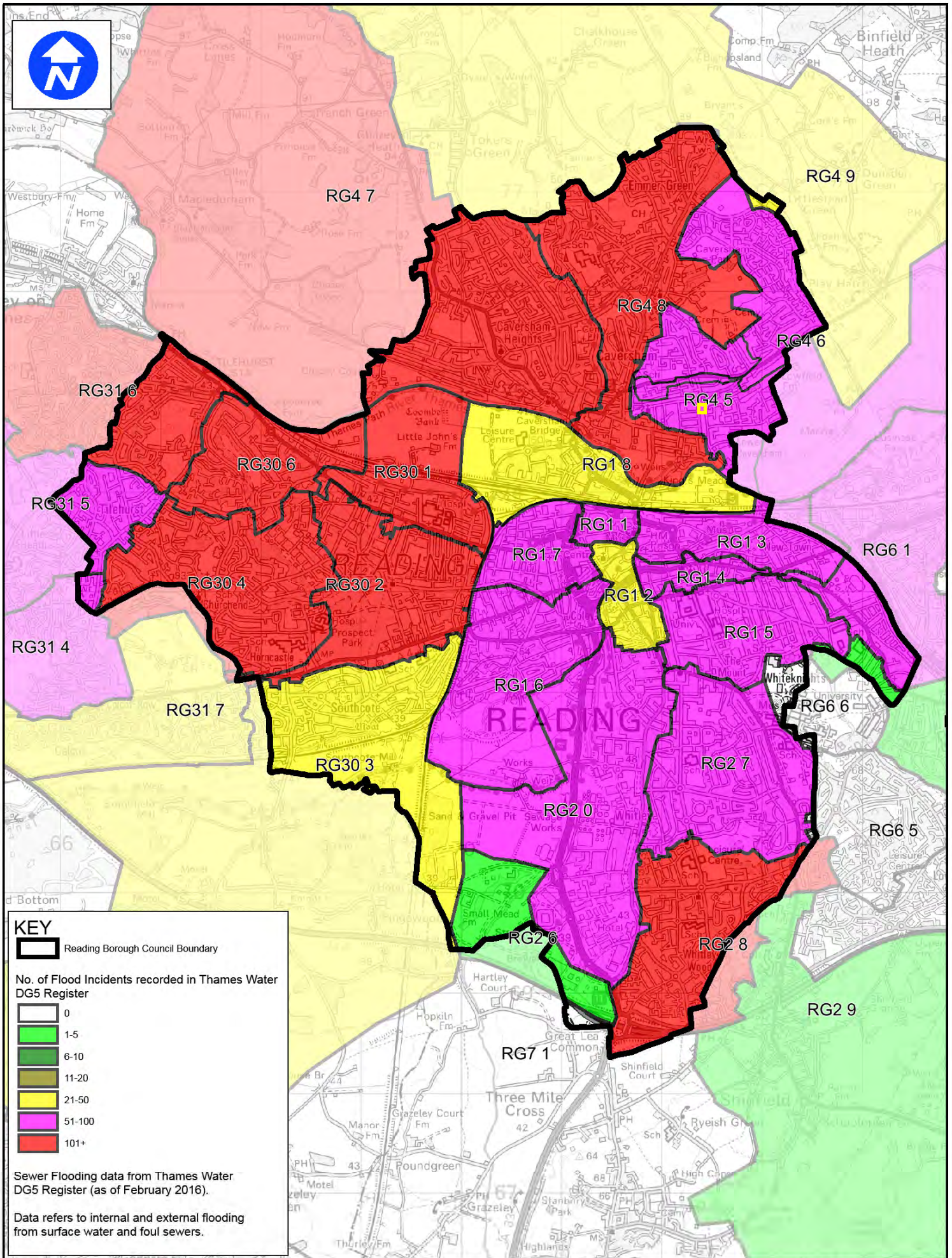
Rev: -

Figure Number

Map F2_N3



18.4.3 Map of Recorded Sewer Flooding
See next page.



KEY

Reading Borough Council Boundary

No. of Flood Incidents recorded in Thames Water DG5 Register

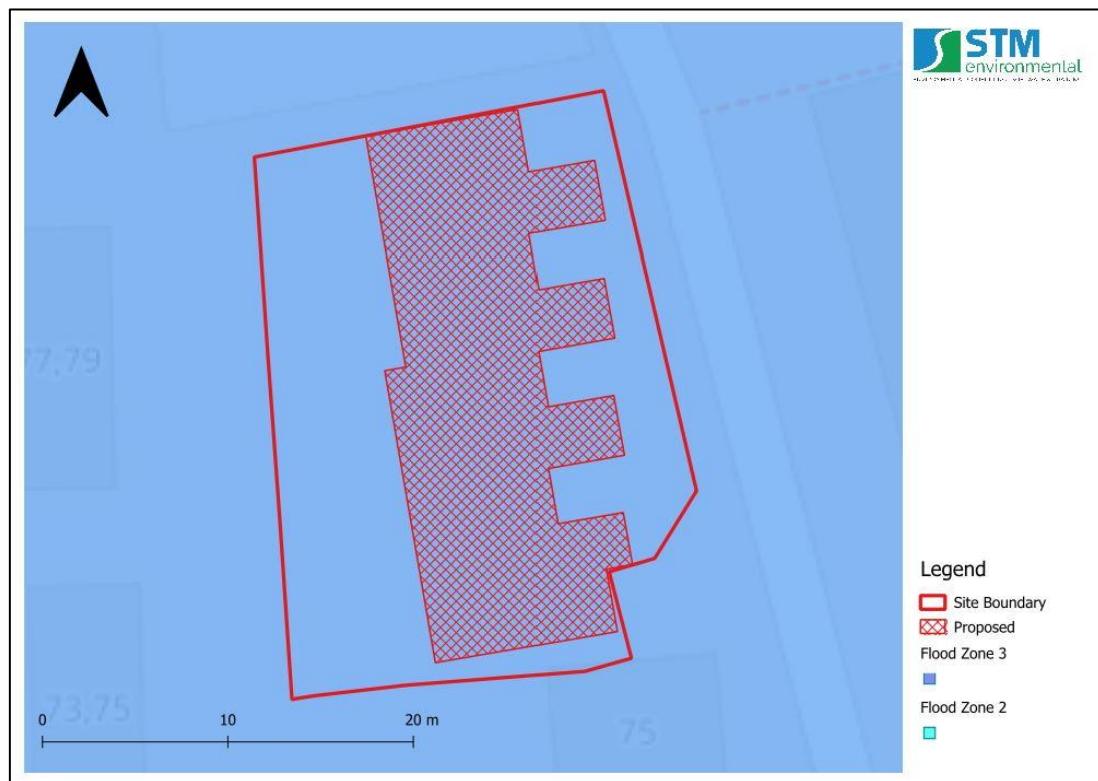
	0
	1-5
	6-10
	11-20
	21-50
	51-100
	101+

Sewer Flooding data from Thames Water DG5 Register (as of February 2016).

Data refers to internal and external flooding from surface water and foul sewers.

18.5 Appendix 5 - Flood Zone Maps

18.5.1 EA



18.5.2 LLFA

See next page.

- EA Main Rivers
- Flood Zone 1 (unshaded)
- Flood Zone 2
- Flood Zone 3a
- Flood Zone 3b (*refer to note)

Character Area North

Flood Zones as defined in Table 1 of the Planning Practice Guidance to the National Planning Policy Framework (NPPF).

Flood Zone 1 = 'Low Probability' - Land having a less than 1 in 1,000 (0.1%) annual probability of river or sea flooding.

Flood Zone 2 = 'Medium Probability' - Land having between a 1 in 100 (1%) and 1 in 1,000 (0.1%) annual probability of river flooding; or land having between a 1 in 200 (0.5%) and 1 in 1,000 (0.1%) annual probability of sea flooding.

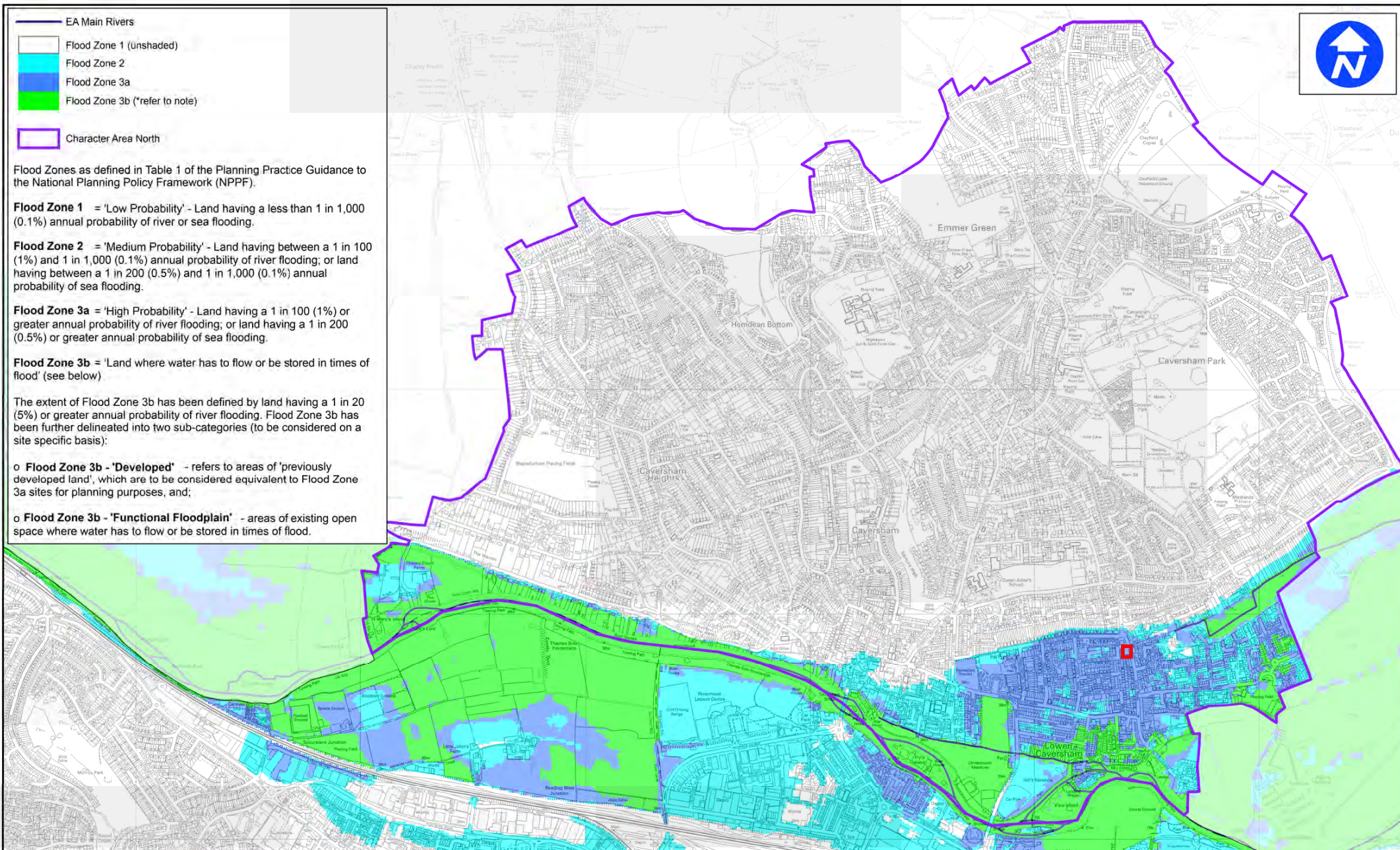
Flood Zone 3a = 'High Probability' - Land having a 1 in 100 (1%) or greater annual probability of river flooding; or land having a 1 in 200 (0.5%) or greater annual probability of sea flooding.

Flood Zone 3b = 'Land where water has to flow or be stored in times of flood' (see below)

The extent of Flood Zone 3b has been defined by land having a 1 in 20 (5%) or greater annual probability of river flooding. Flood Zone 3b has been further delineated into two sub-categories (to be considered on a site specific basis):

o **Flood Zone 3b - 'Developed'** - refers to areas of 'previously developed land', which are to be considered equivalent to Flood Zone 3a sites for planning purposes, and;

o **Flood Zone 3b - 'Functional Floodplain'** - areas of existing open space where water has to flow or be stored in times of flood.



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RBC SFRA

Character Area North
EA Flood Zone Map

Date: 07/06/2017

Scale: NTS

Drawn By: SB Checked By: RF

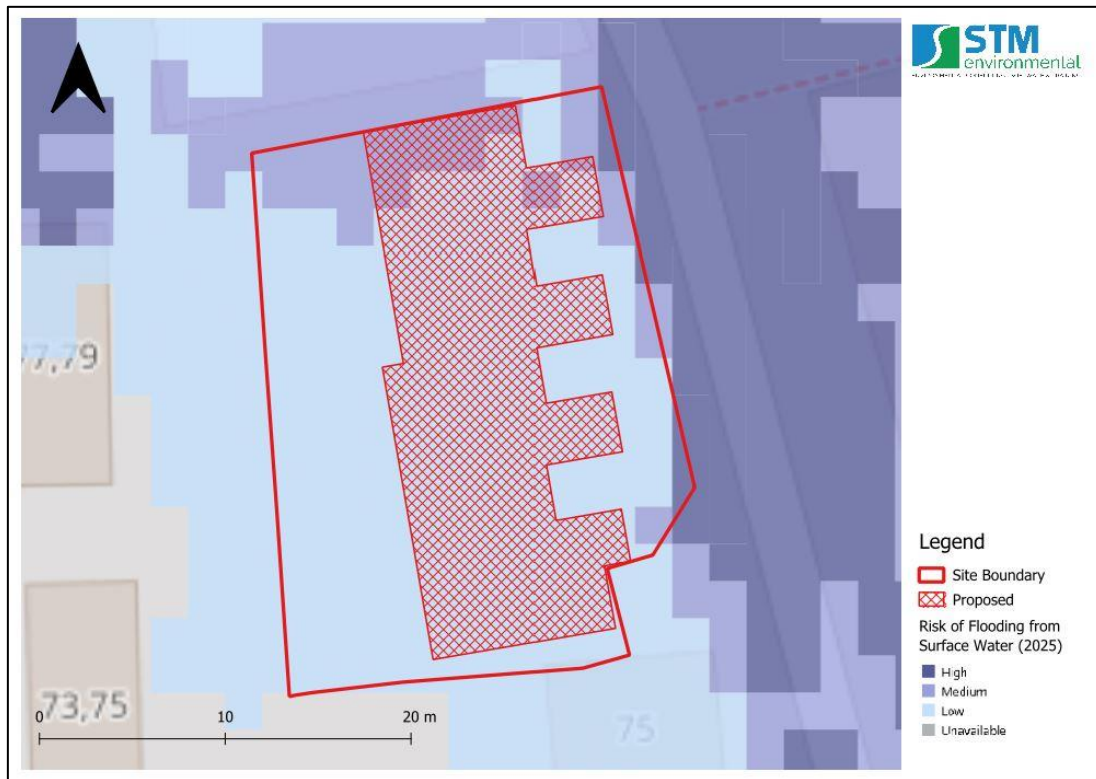
Rev: A

Figure Number

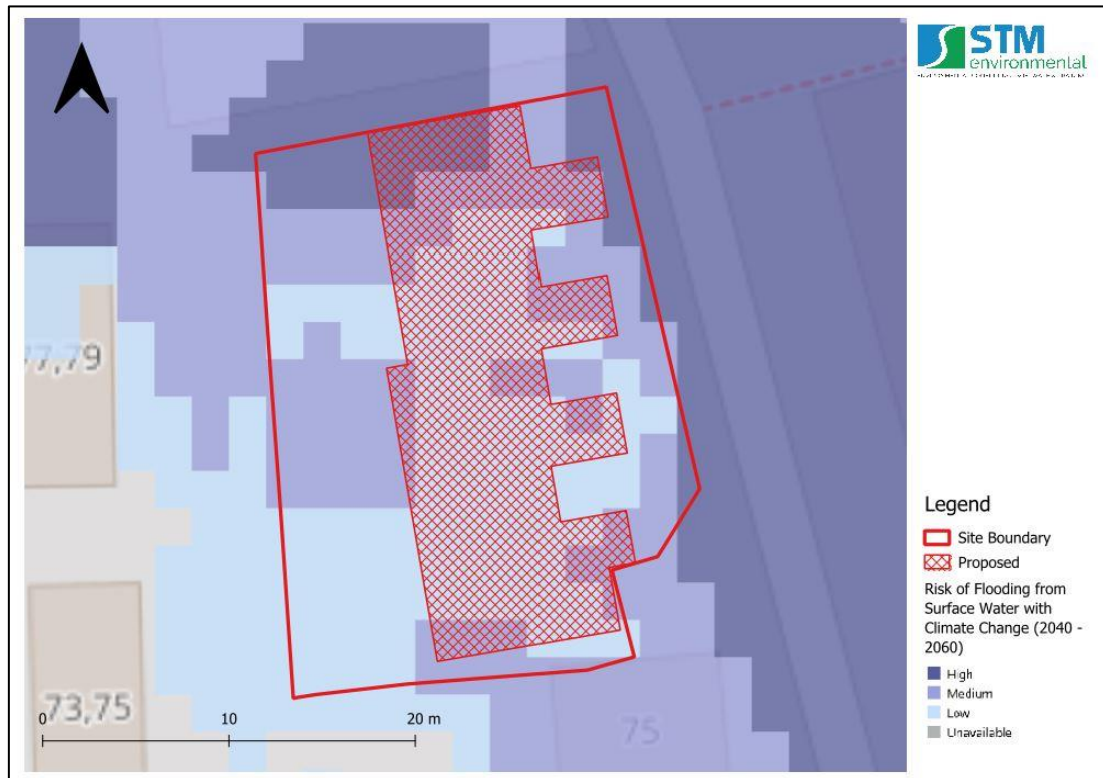
Map F4_N

18.6 Appendix 6 – Surface Water Flood Extent and Depth Maps

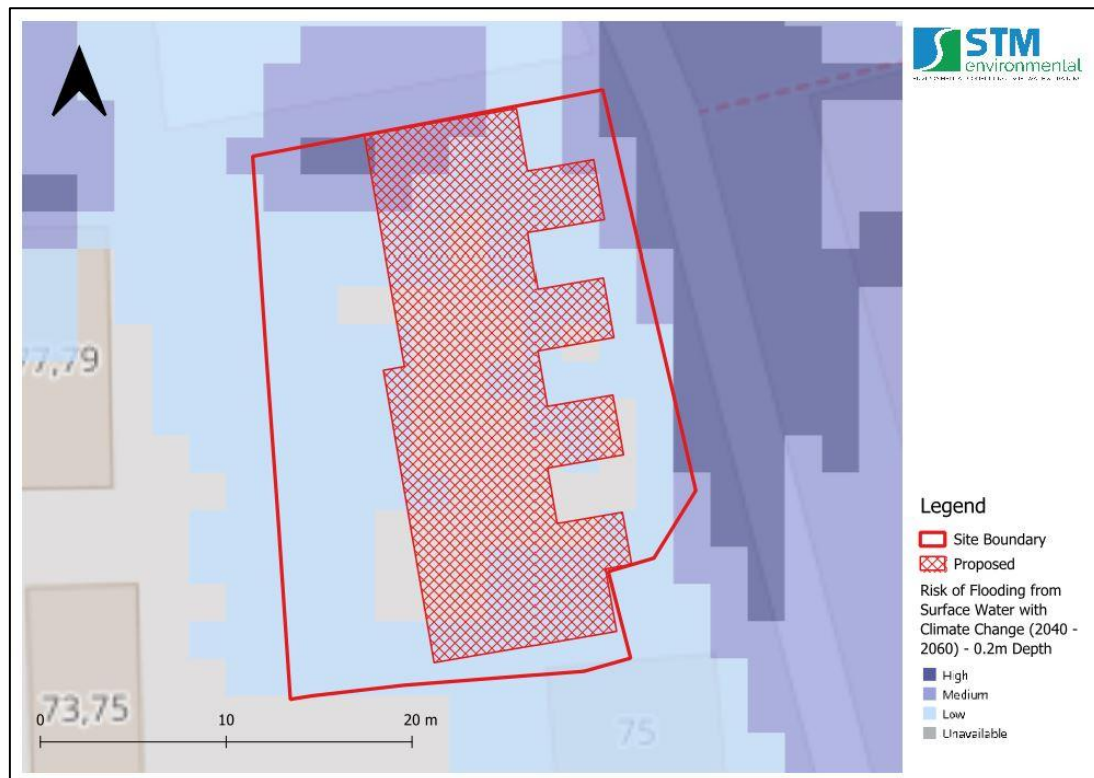
18.6.1 Predicted surface water flood depth for the Present Day (2025) – Up to 0.2m Depth (Source: EA, 2025).



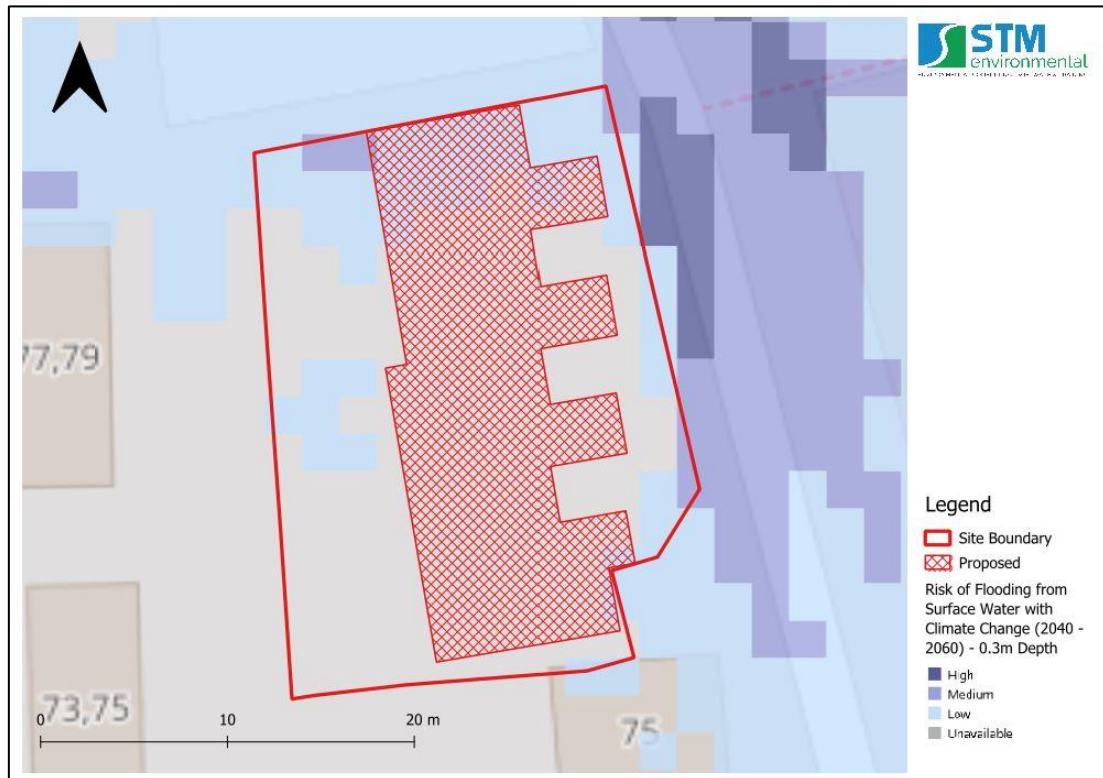
18.6.2 Predicted surface water flood depth with Climate Change (2040 – 2060) – Up to 0.2m Depth (Source: EA, 2025).



18.6.3 Predicted surface water flood depth with Climate Change (2040 – 2060) – 0.2m Depth (Source: EA, 2025).

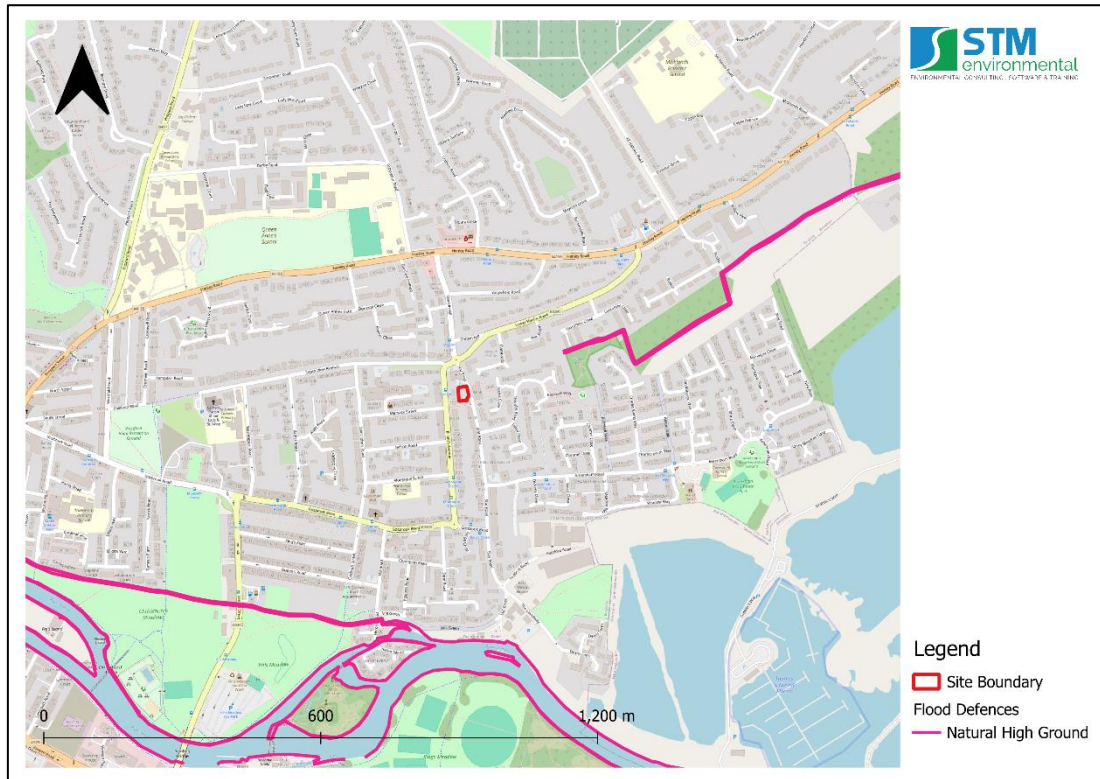


18.6.4 Predicted surface water flood depth with Climate Change (2040 – 2060) – 0.3m Depth (Source: EA, 2025).



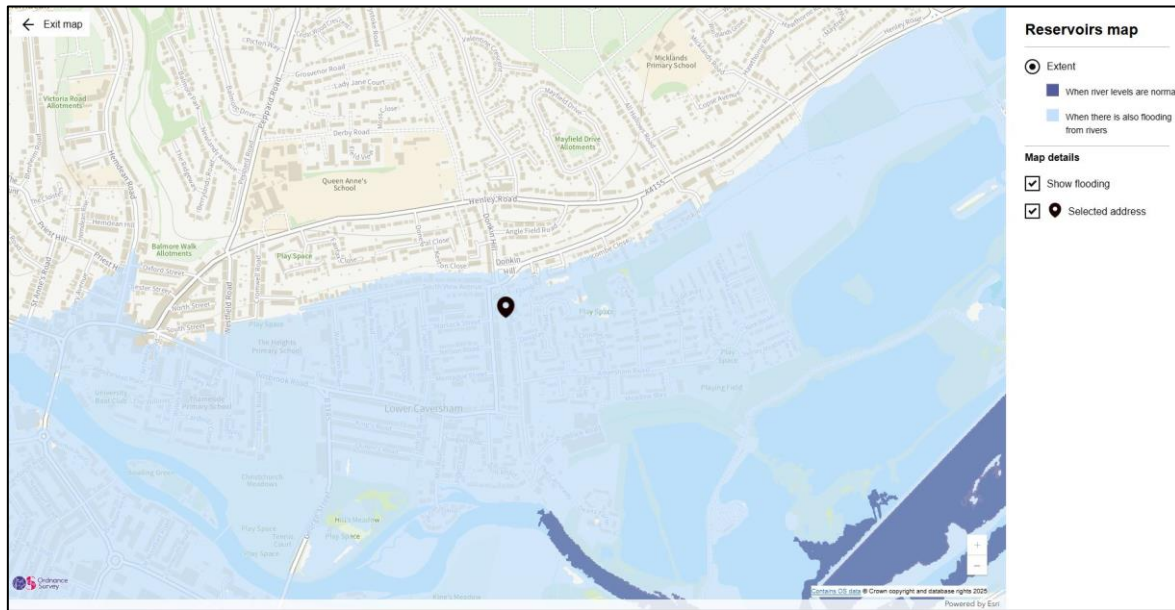
18.7 Appendix 7 – Flood Defence Mapping

18.7.1 EA flood defence map



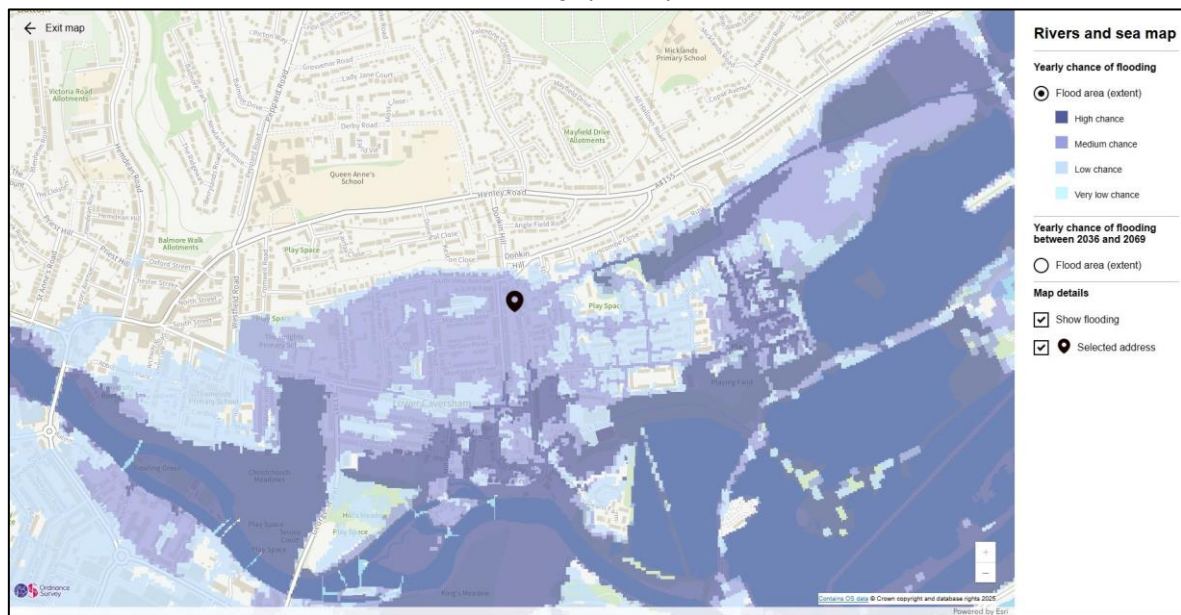
18.8 Appendix 8 – Risk of Flooding from Artificial Sources

18.8.1 Reservoir Flood Risk Map

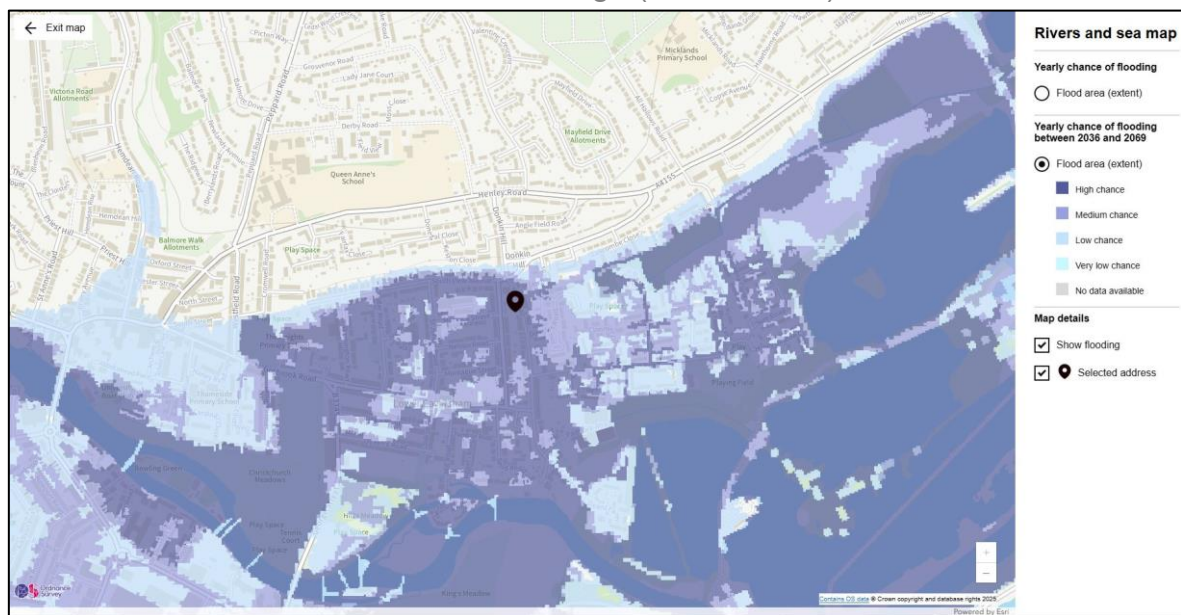


18.9 Appendix 9 – EA's Long Term Flood Risk Maps

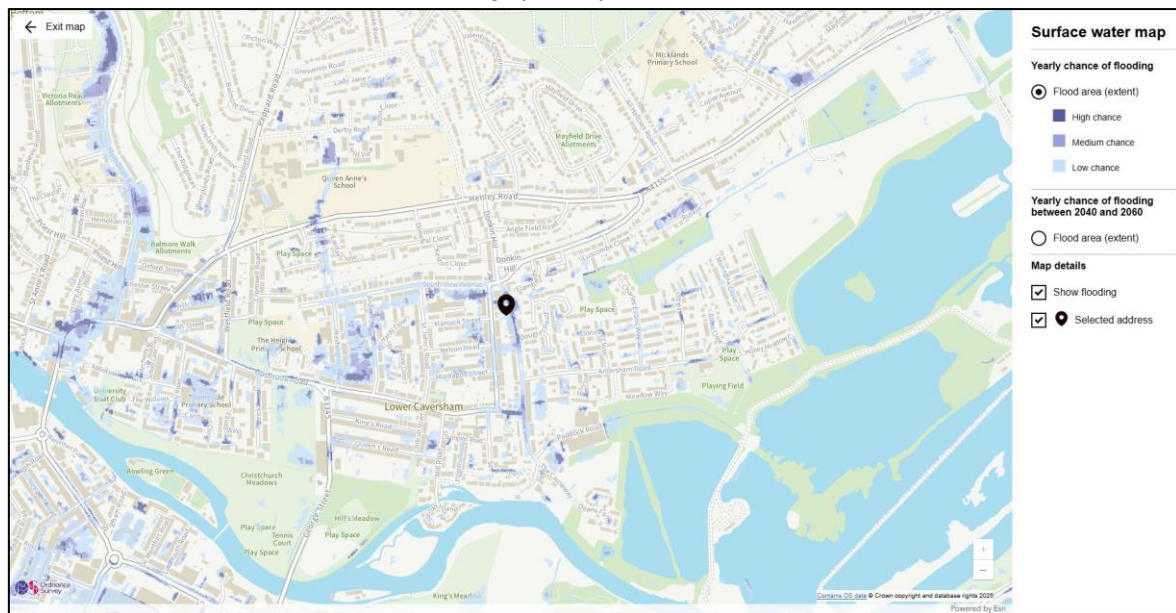
18.9.1 Rivers and the Sea – Present Day (2025)



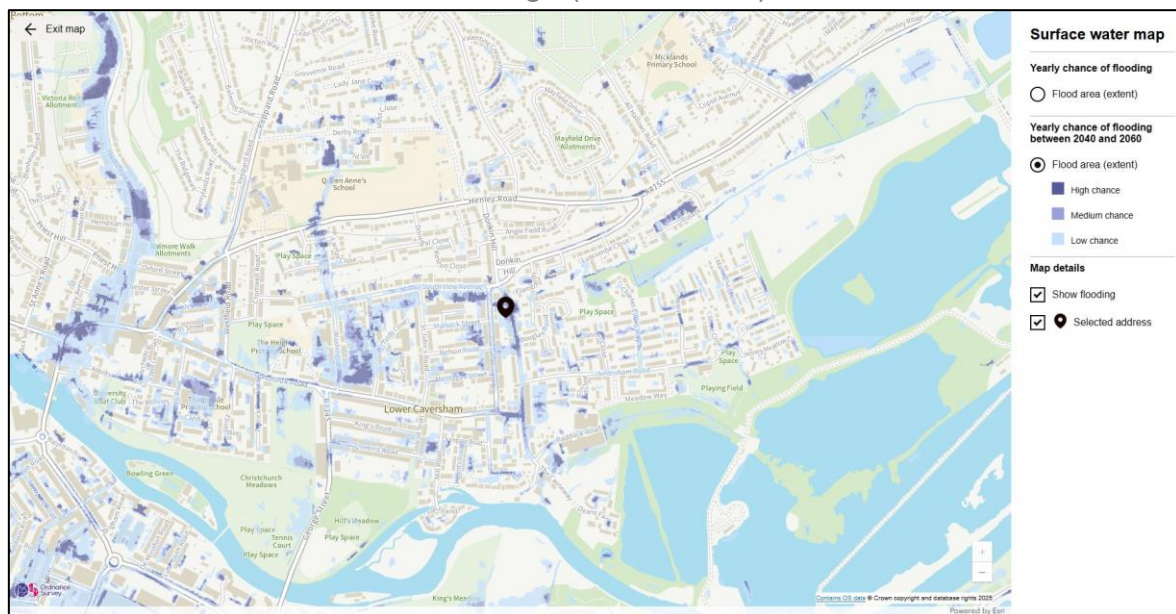
18.9.2 Rivers and the Sea – Climate Change (2036 – 2069)



18.9.3 Surface Water – Present Day (2025)



18.9.4 Surface Water – Climate Change (2040 – 2060)



18.10 Appendix 10 – Groundwater Flood Maps

18.10.1 Groundwater Flooding (Susceptibility) Map (BGS) and Potential Depth to the Groundwater Water Map (BGS)

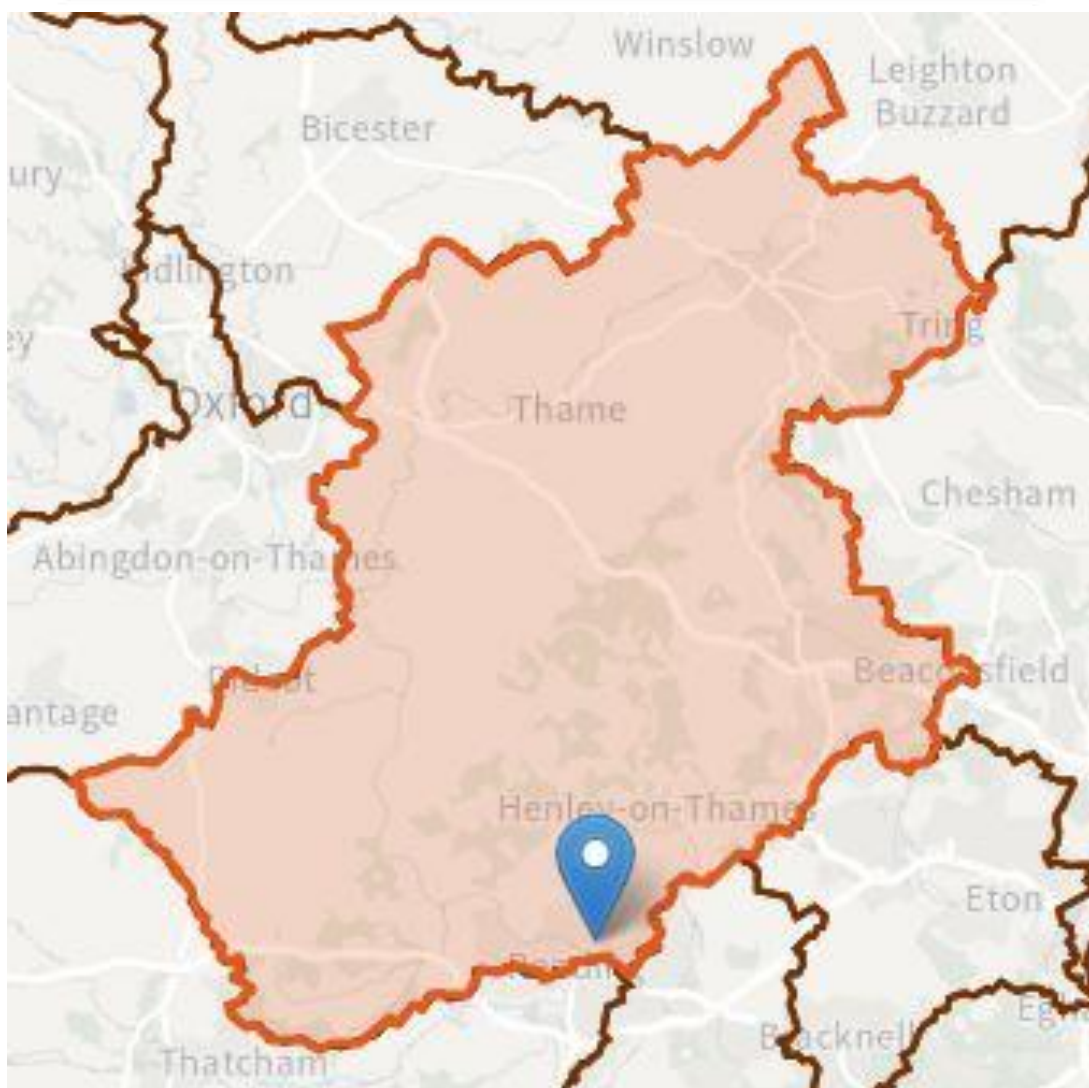


18.11 Appendix 11 - EA Product 6 (Detailed Flood Risk) Data

18.11.1 EA Climate Change Allowances for Peak River Flow

Thames and South Chilterns Management Catchment peak river flow allowances

	Central	Higher	Upper
2020s	12%	17%	30%
2050s	14%	22%	42%
2080s	31%	43%	76%



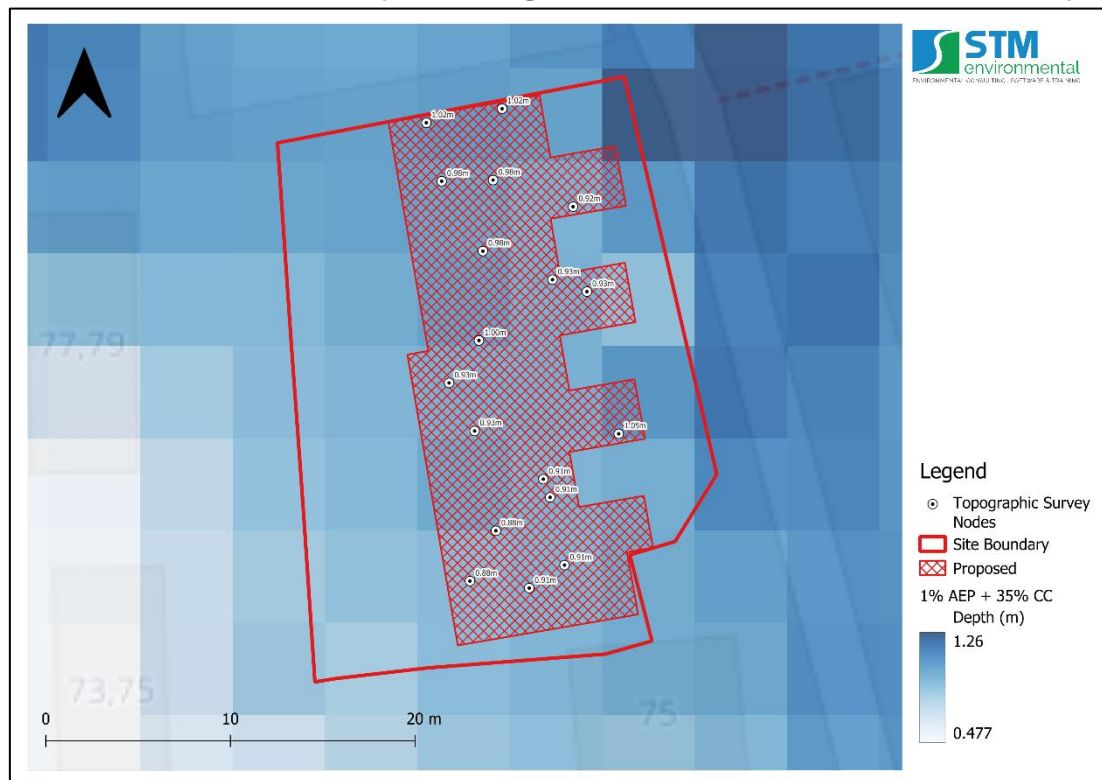
18.11.2 P6 Data

Thames (Pangbourne to Sonning) 2019 - Topographic													
Node	Easting	Northing	Topography (mAOD)			5% AEP		1% AEP		1% AEP + 35% CC		0.1% AEP	
			LiDAR DTM	Survey	EA Model	Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)
1	472405	174852	36.78	36.54	36.72	-	-	0.73	37.45	1.02	37.74	1.07	37.78
2	472410	174853	36.75	36.60	36.72	-	-	0.73	37.45	1.02	37.74	1.07	37.78
3	472406	174849	36.84	36.59	36.76	-	-	0.69	37.45	0.98	37.74	1.02	37.78
4	472409	174849	36.84	36.70	36.76	-	-	0.69	37.45	0.98	37.74	1.02	37.78
5	472413	174848	36.90	36.76	36.82	-	-	0.63	37.45	0.92	37.74	0.97	37.78
6	472409	174845	37.01	36.74	36.76	-	-	0.69	37.45	0.98	37.74	1.02	37.78
7	472412	174844	36.93	36.83	36.81	-	-	0.64	37.45	0.93	37.74	0.97	37.78
8	472414	174843	36.90	36.70	36.81	-	-	0.64	37.45	0.93	37.74	0.97	37.78
9	472408	174840	37.11	36.79	36.74	-	-	0.71	37.45	1.00	37.74	1.04	37.78
10	472407	174838	36.99	36.70	36.81	-	-	0.64	37.45	0.93	37.74	0.97	37.78
11	472408	174835	37.06	36.71	36.81	-	-	0.64	37.45	0.93	37.74	0.97	37.78
12	472416	174835	36.94	36.80	36.69	-	-	0.76	37.45	1.05	37.74	1.09	37.78
13	472412	174833	37.08	36.81	36.82	-	-	0.62	37.45	0.91	37.74	0.96	37.78
14	472412	174832	36.99	36.76	36.82	-	-	0.62	37.45	0.91	37.74	0.96	37.78
15	472409	174830	36.98	36.71	36.86	-	-	0.59	37.45	0.88	37.74	0.92	37.78
16	472408	174827	37.02	36.74	36.86	-	-	0.59	37.45	0.88	37.74	0.92	37.78
17	472413	174828	36.91	36.70	36.83	-	-	0.62	37.45	0.91	37.74	0.95	37.78
18	472411	174827	36.91	36.70	36.83	-	-	0.62	37.45	0.91	37.74	0.95	37.78

18.11.3 Node Location Map



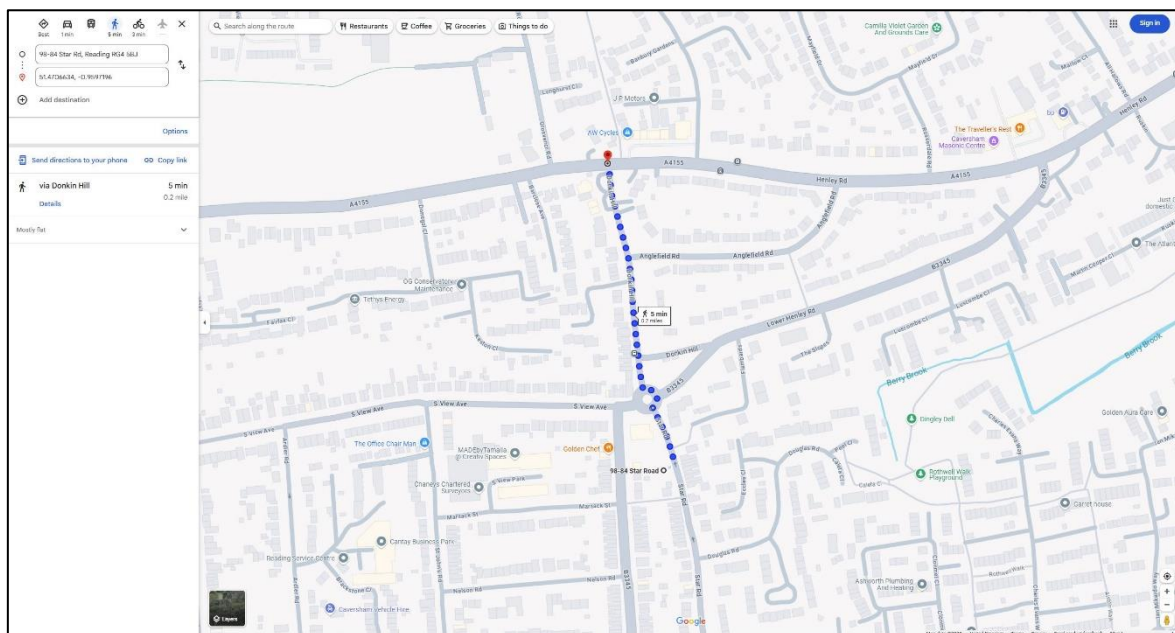
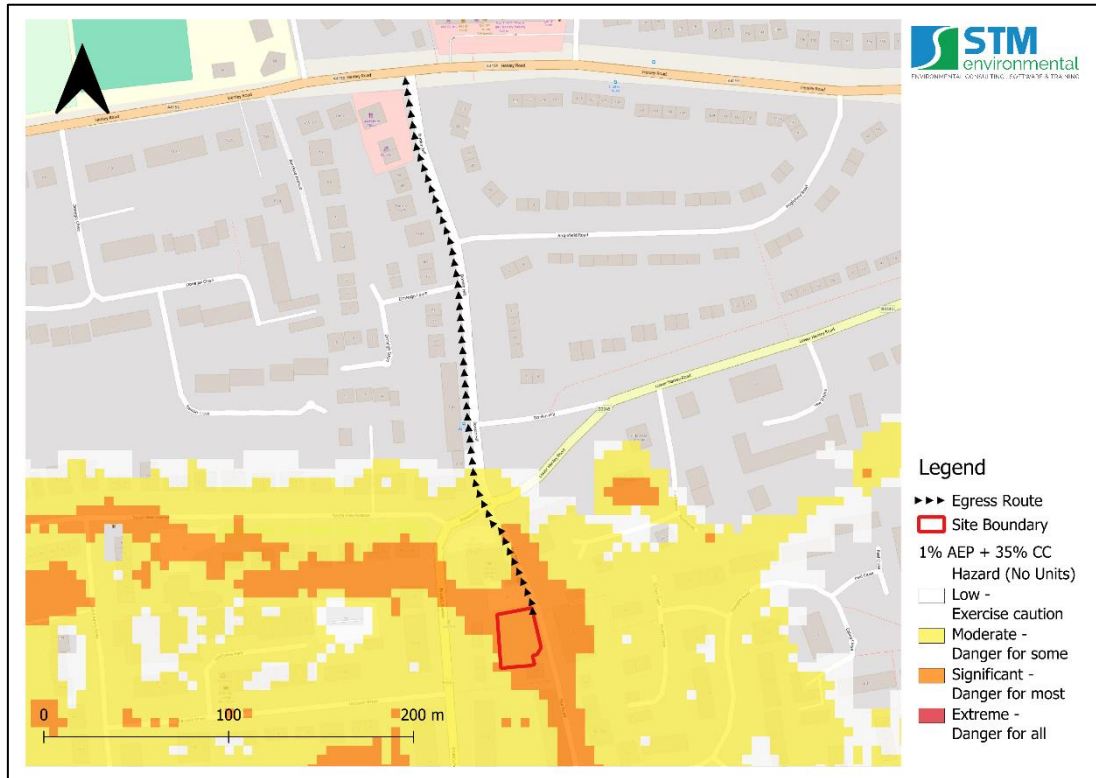
18.11.4 Fluvial Flood Depths during the 1% AEP + 35% CC Scenario Map



18.11.5 Hazard Rating During the 1% AEP + 35% CC Scenario Map



18.12 Appendix 12 – Egress to Flood Zone 1 Map



18.13 Appendix 13 – Calculation of Flood Hazard Rating

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

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

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”.