



Flood Risk Assessment

Rear of Delamere Road, Hayes

22-094-001 Rev -

December 2022



Charles & Associates

Document Control Sheet

Project Name:	Rear of Delamere Road, Hayes
Project Number:	22-094
Report Title:	Flood Risk Assessment
Report Number:	001

Rev	Issue Purpose	Author	Checked	Reviewed	Approved	Date
-	Draft	SC	TSH	SC	GAC	Dec 22

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Executive Summary

This Flood Risk Assessment (FRA) has been prepared by Charles & Associates Consulting Engineers Ltd. (C&A), on behalf of Sulinder Singh, in support of a planning application for 9 dwellings at the site known as 'Rear of Delamere Road, Hayes'.

The proposed residential development lies predominantly within Flood Zone 2, the risk of flooding from all sources is assessed to be medium and the safety of people is considered acceptable for all foreseeable flooding events. Finished floor levels elevated to at least 300mm above flooding levels will be implemented to assure no habitable room flooding will take place.

All forms of flooding have been assessed and a drainage management strategy for surface water has been implemented which will provide an improved surface water drainage regime and flood risk profile. Consequently, this will, reduce surface water run-off flows from the site, for storm return periods up to the 1 in 100year event, plus an allowance for the detrimental effects of climate change.

An emergency evacuation plan will be developed due to the sites location within Flood Zone 2 should the development gain planning permission.

Due to the positive outcome of these assessments, there is no reason why the site should not continue through the planning process and be approved for residential development in respect of flood risk and surface water drainage.

1 Introduction

1.1 Introduction

- 1.1.1 This Flood Risk Assessment (FRA) has been prepared by Charles & Associates Consulting Engineers Ltd. (C&A), on behalf of Sulinder Singh, in support of a detailed planning application for a site known as Land to the rear of 12 to 26 Delamere Road, Hayes hereafter referred to as “the site”.
- 1.1.2 This FRA will form part of a detailed planning application and includes a surface water drainage strategy and accompanying calculations. The submission is to be made by Woolf Bond Planning to Hillingdon London Borough Council (HLBC).
- 1.1.3 This FRA will form a part of a detailed planning application and includes a preliminary surface water drainage strategy and accompanying calculations. The submission is to be made by Woolf Bond Planning to Hillingdon London Borough Council (HLBC).

1.2 Purpose

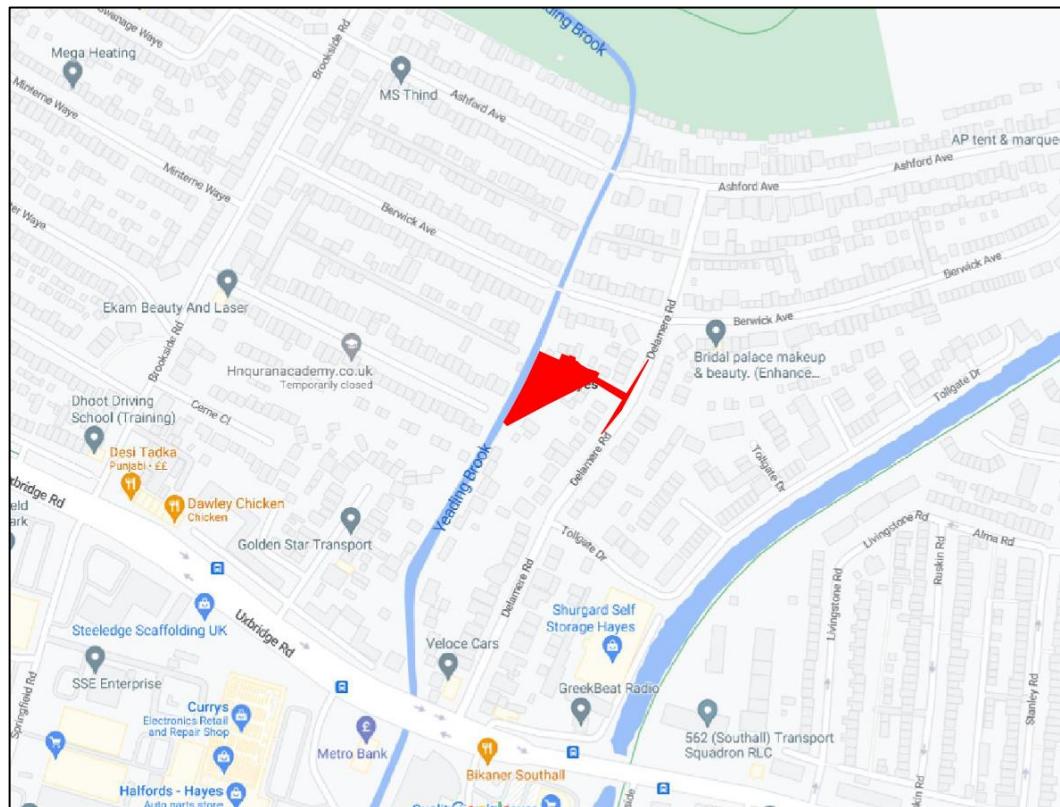
- 1.2.1 The detailed planning application seeks permission for the construction of 9 residential dwellings and associated site access and parking provision. This FRA has been prepared as a means of demonstrating that flooding and drainage issues would not constrain the development of the site or have any adverse effects on existing drainage networks. It also confirms that the site will conform to the recently published non statutory national standards for sustainable drainage systems (SuDS) and the local requirements set out by Hillingdon London Borough Council (HLBC) as the Lead Local Flood Authority (LLFA).
- 1.2.2 In terms of surface water drainage and potential for flooding, it examines the site's suitability in respect of planning policy and physical characteristics in order to allow suggested solutions to deal with drainage following development, thus ensuring the site is drained in a sustainable manner whilst not impacting the surrounding area.
- 1.2.3 The provisions of the National Planning Policy Framework (NPPF) have been considered in preparing this Flood Risk Assessment, together with The Flood & Water Management Act 2010. In addition, attention has also been paid to the National Planning Practice Guidance (NPPG) and policies within HLBC's SuDS Design Guidance, Local Planning Policies, Flood Risk Management Strategy, Surface Water Management Plan, and the West London Strategic Flood Risk Assessment (SFRA). The surface water drainage strategy (SuDS scheme) will be designed to conform to non-statutory Technical Guidance for a detailed planning application and the CIRIA SuDS Manual.

2 Site Location & Details

2.1 Site Location

- 2.1.1 The site is located to the west of Delamere Road, Hayes. Approximately 1km northwest of Southall Centre. The site's location is highlighted in red on the figure below.

Figure 2.1: Site Location

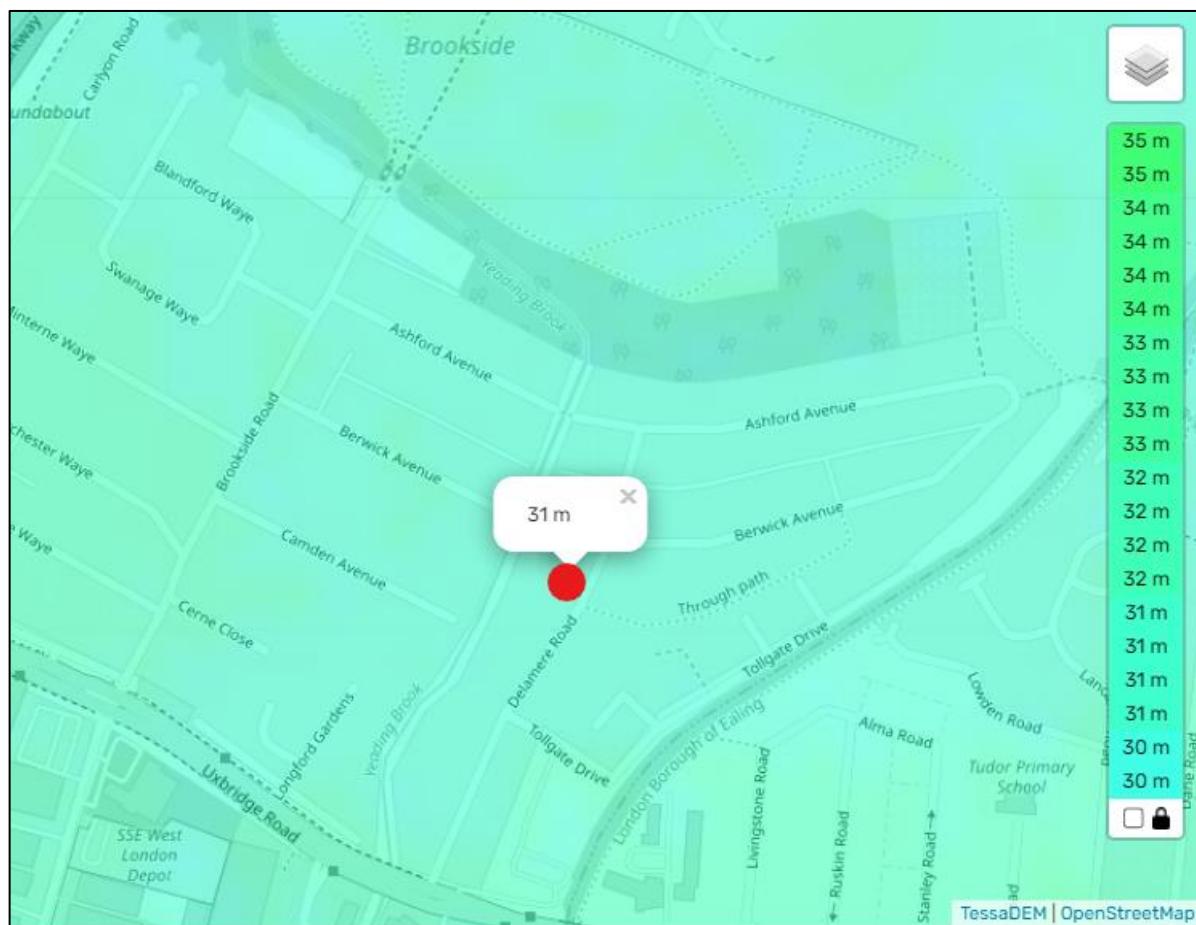


- 2.1.2 The site is bounded by neighbouring dwellings to the north, south and east, and to the west by the Yeading Brook. Beyond the existing dwellings to the east there is Delamere Road where access to the site is currently taken from.
- 2.1.3 The existing site is currently used as a scrap yard and storage for various materials and can be considered as brownfield. Access is taken from Delamere Road via an existing access road.
- 2.1.4 The entire site within the redline boundary is 0.18ha. The approximate Ordnance Survey (OS) grid reference for the site is TQ 11746 80890. The nearest post code is UB4 0NL.

2.2 Topography & Existing Drainage

2.2.1 Topographic information has been obtained from 'Topographic Map' which indicates site levels via LIDAR mapping. The site is indicated as predominantly flat with a level of 31.00m AOD. Although it is assumed that the site naturally falls in a westerly direction towards the 'Yeading Brook River' to aid drainage from the site via overland flow paths. An extract from the 'Topographic Map' is included within **Figure 2.2**.

Figure 2.2: Topographic Map



2.2.2 Is it assumed that the site currently has no formal or informal drainage network. Surface water flows from the site are assumed to flow overland across the site into Yeading Brook on the western side of the site.

As the site is currently developed it will be considered a brown field site in planning and flood risk terms.

2.3 Geology

2.3.1 Published geological data from British Geological Survey (BGS) indicates that the site is underlain by Langley Silt Member formed of Clay and Silt. These areas are further underlain by bedrock deposits of London Clay Formation consisting of Clay, Silt and Sand. Refer to **Figure 2-2 & 2-3** for British Geological Society mapping.

Figure 2.2: BGS – Superficial Deposits

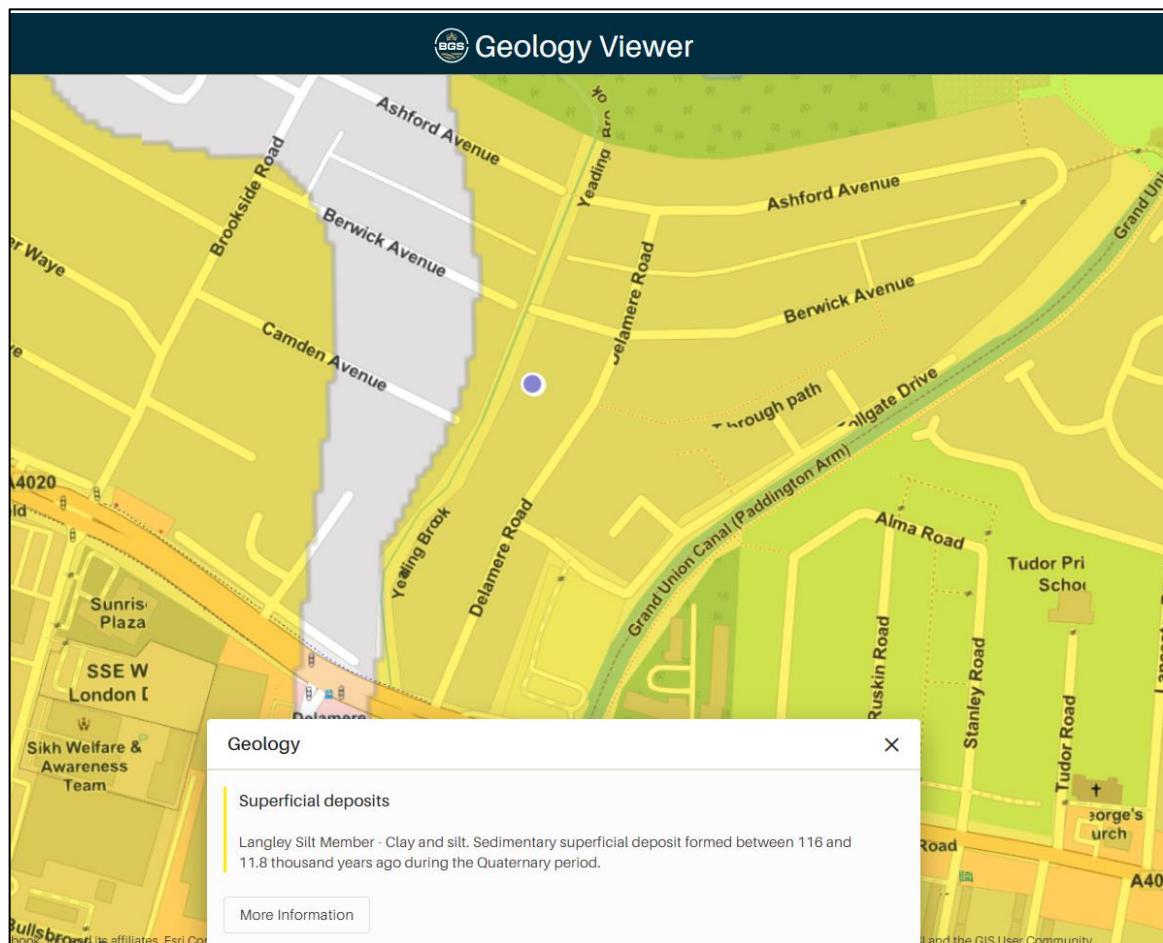
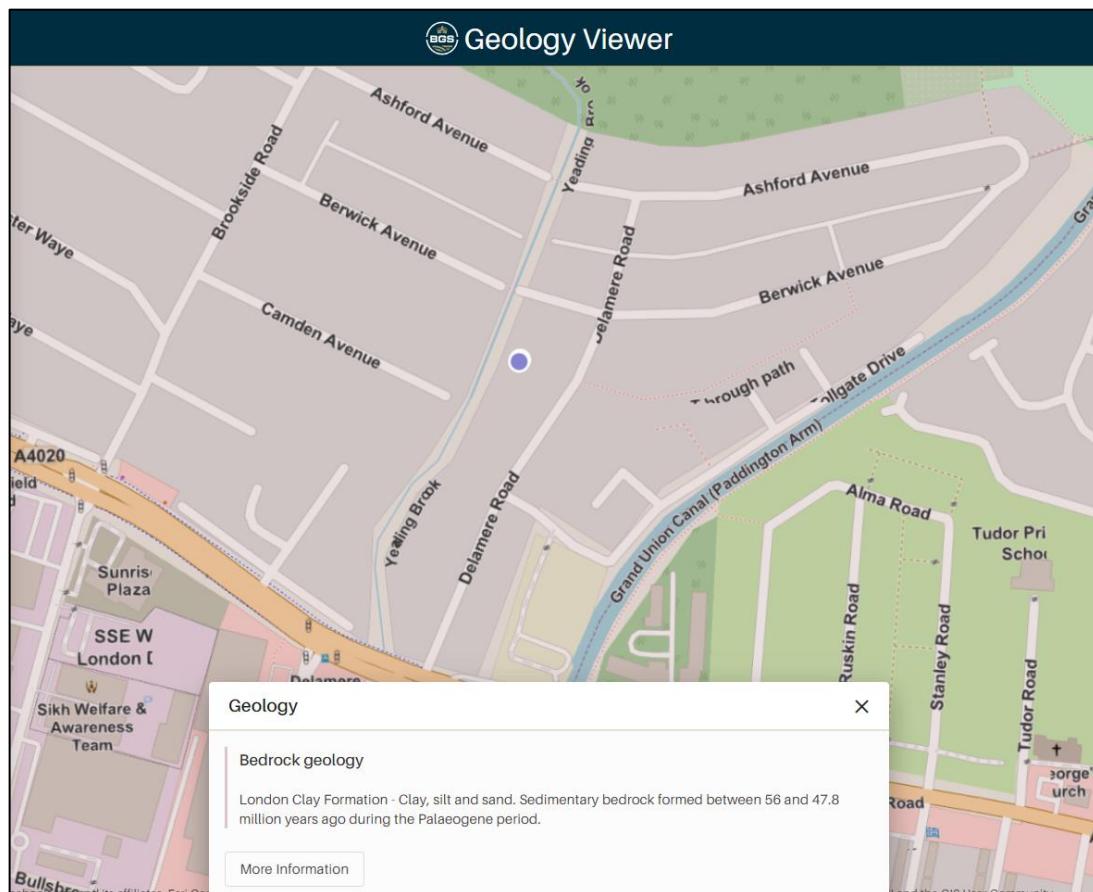
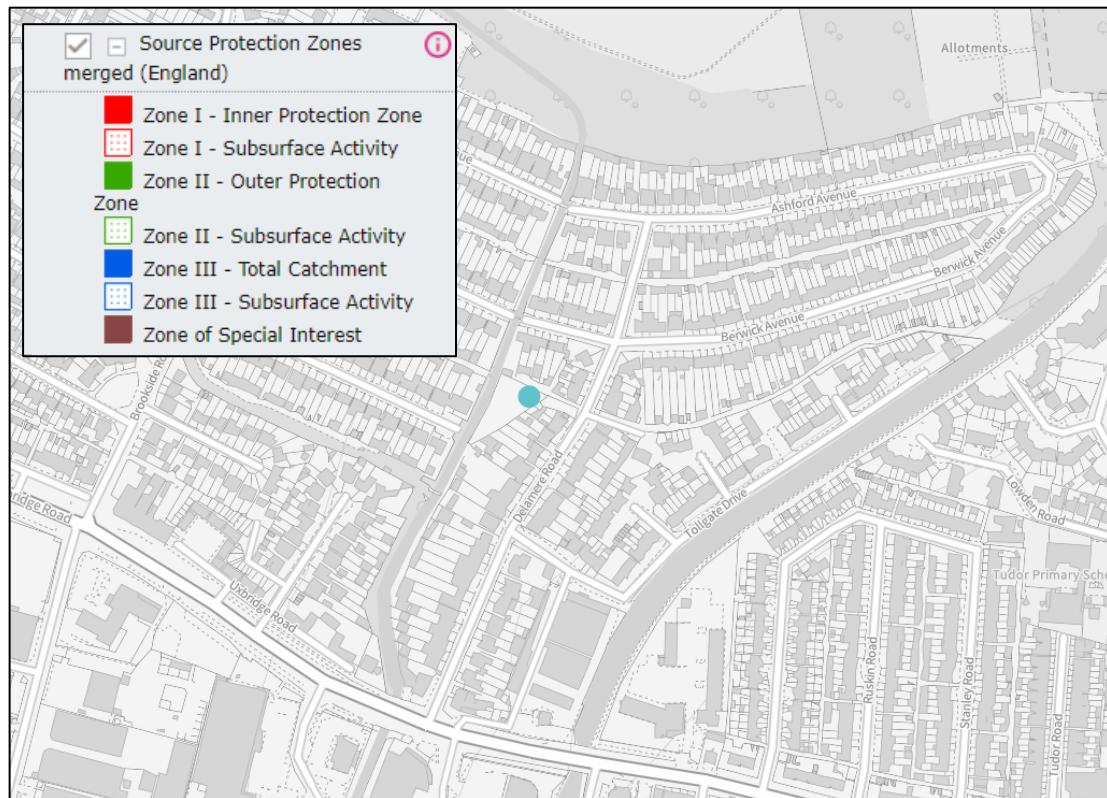


Figure 2.3: BGS – Bedrock Deposits

2.4 Groundwater

- 2.4.1 A review of the Department for Environment, Food & Rural Affairs (Defra) "Magic Map" confirms that the site is not located within a Groundwater Source Protection area. Refer to **Figure 2-4.**

Figure 2.4: Magic Map – Source Protection Zones

2.5 Development Proposals

- 2.5.1 The proposed development is a residential scheme for the construction of up to 9 dwellings, associated site access and parking provision as shown on the preliminary masterplan within **Appendix A**.
- 2.5.2 Is it intended that the proposed development would use the existing access off of Delamere Road to the east.
- 2.5.3 Surface water, disposal in the form of a Sustainable Urban Drainage System (SUDS) arrangement for the proposed development is discussed in **Section 7** of this report.

3 National Policy, Local Planning Policy & SuDS Guidance

3.1 National Planning Policy

3.1.1 NPPF sets out a robust approach to the Sequential Test and is intended to provide a rigorous understanding of flood risk. Its aim is to steer new development to areas at the lowest probability of flooding (i.e., Flood Zone 1). The Sequential Test would normally be completed by the Local Planning Authority (LPA) to inform the preparation of the Local Development Framework (LDF). The Sequential and Exception tests are discussed within **Section 5.8** of this report.

3.2 Local Policy and Guidance

3.2.1 The West London Strategic Flood Risk Assessment (WLSFRA) is a joint level 1 SFRA between the London Boroughs of Barnet, Brent, Ealing, Harrow, Hillingdon, and Hounslow. The primary objective of this SFRA is to provide a high-level overview of flood risk and identify areas of significant flood risk that need to be investigated in further stages of the regulations to manage future flooding. This SFRA relates to the same polices (5.12 & 5.13) as per below.

3.2.2 The London Borough of Hillingdon as the LLFA produced a 'Local Flood Risk Management Strategy 2015'. This strategy contains various policies, supporting documentation and plans relating to flood risk as per below

3.2.3 Policy 5.12 Flood Risk Management of the 'Local Flood Risk Management Strategy 2015' and 'West London Strategic Flood Risk Assessment' states;

'This policy states that the Mayor will work with all relevant agencies, including the Environment Agency, to address current and future flood issues and minimise risks in a sustainable way.'

3.2.4 Policy 5.13 Sustainable Drainage of the 'Local Flood Risk Management Strategy 2015' and 'West London Strategic Flood Risk Assessment' states;

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

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

- *Discharge rainwater to a surface water sewer/drain and*
- *Discharge rainwater to the combined sewer'*

- 3.2.5 A Preliminary Flood Risk Assessment (PFRAH) was created in 2011 for Hillingdon aimed at providing a high-level overview of flood risk from all sources within the Borough, including consideration of surface water, groundwater, ordinary watercourses, and canals. This assessment indicates any historic flooding incidents, surface water flooding incidents, fluvial flooding incidents and sewer flooding incidents.
- 3.2.6 Hillingdon Borough Council have also prepared a Surface Water Management Plan A(SWMP) which is divided into two parts, the Evidence Base 2013, and the Options and Actions Plan 2014. This identifies critical drainage area, historic flooding records, groundwater flooding and future flood risk.
- 3.2.7 Hillingdon have also produced a SuDS Guidance and SuDS proforma document. This document sets out how the SuDS are to be designed and maintained.
- 3.2.8 All of these documents were referred to during preparation of this report in order to obtain advice and guidance on surface water management and design for the proposed site.
- 3.2.9 The use of Sustainable Drainage techniques for the attenuation and treatment of surface water runoff will be discussed in **Section 7.5** of this report, which will ensure that policies and guidance required under the National Planning Policies, the Flood & Surface Water Management Act 2010 and national SuDS Guidance, are all met and satisfied.

4 Definition of Flood Hazard

4.1.1 Flood Zones are defined in Table 1 of NPPF – Technical Guidance Document. The Flood Zones refer to the probability of flooding from rivers, the sea and tidal sources and ignore the presence of existing defences, because these can be breached, overtapped and may not be in existence for the lifetime of the development.

4.2 Sources of Flooding

4.2.1 NPPF identifies six potential sources of flooding that require investigation:

- Flooding from rivers or fluvial flooding;
- Flooding from the sea or tidal flooding;
- Flooding from land;
- Flooding from groundwater;
- Flooding from sewers; and
- Flooding from reservoirs, canals, and other artificial sources.

4.3 Flooding from Rivers or Fluvial Flooding

4.3.1 The Yeading Brook is located just off of the western boundary of the Site. During times of severe storm events, there is a possibility that water levels within the river could rise to cause flooding. Probability of flooding occurring on this site due to fluvial sources will be discussed in **Section 5.3** below.

4.4 Flooding from Sea or Tidal Flooding

- 4.4.1 Tidal flooding in general happens when there are exceptionally high tides due to storm surges. Storm surges are generally associated with increases in water levels due to the changes in atmospheric pressure and wind generated by storms.
- 4.4.2 The site is located within a low to medium flood risk area throughout the whole site due to the vicinity of the Yeading Brook.

4.5 Flooding from Land (Local Surface Water Flooding)

4.5.1 Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. Increased run-off from developed areas consisting of impermeable surfaces can increase overland flows. If the flow paths of these overland flows are not carefully considered during the detail design and planning stages, flooding from overland flows could occur. Probability of surface water flooding will be discussed within **Section 5.4** below.

4.6 Flooding from Sewers

4.6.1 Local urban drainage should be considered, as every drainage system has a design capacity, which at some point can be exceeded. Sewer and surface water flooding generally results in localised short-term flooding caused by intense rainfall events which overload the capacity of sewers or runs off adjacent land as sheet flow. Flooding can also occur as a result of blockage, poor maintenance, or structural failure.

4.7 Flooding from Groundwater

4.7.1 Groundwater flooding generally occurs when water levels in the ground rise above surface elevations. Severe storm events could cause groundwater levels to rise above ground level. Underlying geology is the principal factor that effects groundwater flooding. Groundwater flooding most commonly occurs in low lying areas which are underlain by permeable rocks or aquifers. Probability of groundwater flooding will be discussed within **Section 5.6** below.

4.8 Flooding from Reservoirs, Canals, and other Artificial Sources

4.8.1 The main cause for flooding from a reservoir would be a structural failure in the walls of the reservoir or some form of accident-causing significant damage to the structure of the reservoir. This is considered to be highly unlikely due to the difference in levels between the ground level onsite and the flood levels obtained within the EA Product 4 data.

5 Probability of Flooding

5.1 Flood Zone

5.1.1 Flood maps published by the EA and further information provided by the agency indicate that the site lies within 'Flood Zone 2', medium probability of flooding and comprises land assessed as having a 1% and 0.1% annual probability of river flooding and 0.1% annual probability of sea flooding. As defined by Table 1 of NPPF. A copy of the Flood Zone mapping is attached within **Appendix B**.

5.2 Vulnerability Classification

5.2.1 With reference to Table 2 of NPPF, the proposed residential dwellings would be considered as a 'More Vulnerable' land use. As noted above the site has a Flood Zone 2 classification. It is therefore considered suitable for residential development as set out in the NPPG guidance.

5.3 Flooding from Rivers or Fluvial Flooding

5.3.1 The site is located within the low to medium risk extent of flooding. This is due to the vicinity of the River Yeading Brook. There are no historic records of fluvial flooding on or adjacent to the site. A copy of the mapping is included within **Figure 5.3**.

Figure 5.3: EA– Fluvial Flood Mapping



- 5.3.2 Product 4 data was requested from the Environment Agency (EA) in December 2023. This mapping indicates flood outlines within the site. This is attached within **Appendix C**.
- 5.3.3 Reviewing the EA mapping data there are 2 nodes located within Yeading Brook to the north and south of the proposed site. These nodes are labelled Y731 and Y732u / Y732d. Furthermore, the data indicates that a small portion of the site is impacted by the 1 in 100 year + 70% climate change event.
- 5.3.4 Reviewing the node point data of Y731 and Y732u / Y732d the data indicates that flood water levels will rise to levels of between 28.25mAOD to 28.36mAOD for the 100year + 70% climate change event.
- 5.3.5 Referring to the lidar contours the site is at an approximate level of 31mAOD (over 2.5m above the flood levels in this area). This shows that fluvial flooding does not impact the site.
- 5.3.6 In line with the current climate change guidance, published in February 2016, a precautionary approach should apply to both the 35% and 70% increase in river flows to allow for climate change. The EA model has provided a 1:100 climate change (+35%) flood level of 28.25mAOD and a 1:100 climate change (+70%) flood level of 28.36mAOD.
- 5.3.7 Comparison of the modelled 1:100 year flood level, including an allowance for climate change (+35% and +70%), with assumed levels for the development area (approximately 31mAOD) confirm that the site is at least 2.64m clear of the flooding levels.

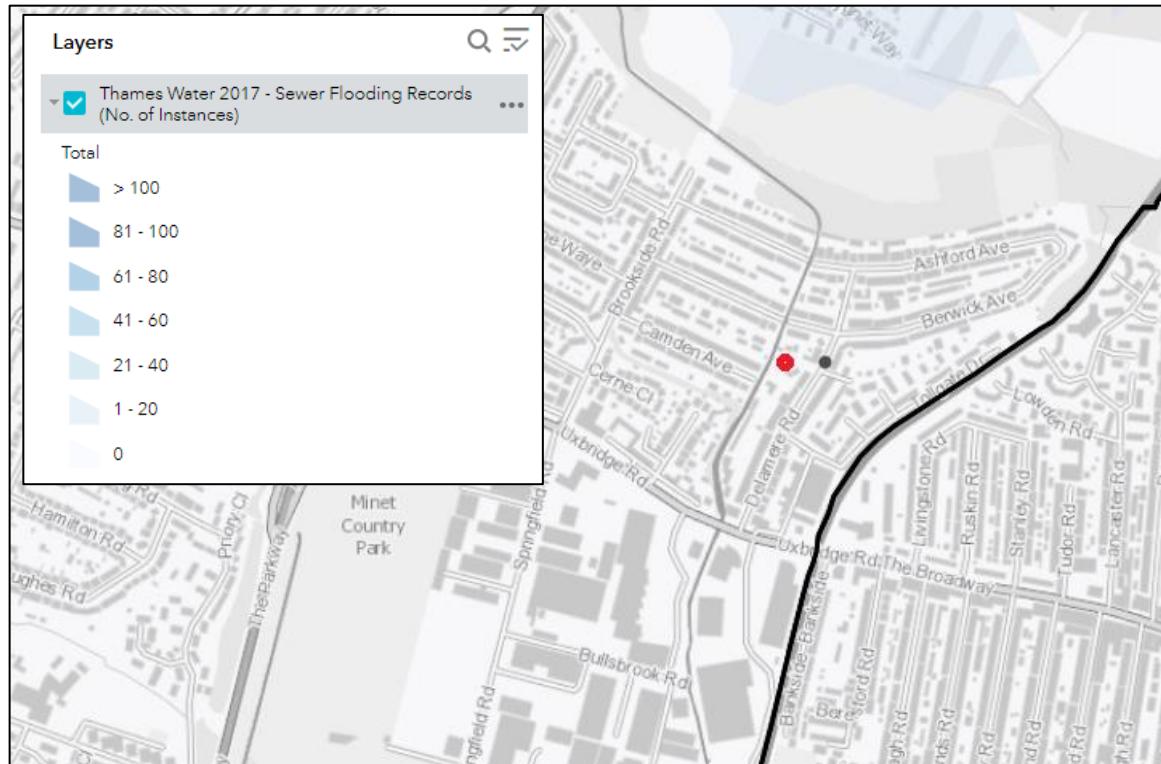
5.4 Flooding from Land (Surface water flooding)

- 5.4.1 The latest Environment Agency's surface water flood map for the site and surrounding area (**Figure 5-4**) shows flooding onsite and within Delamere Road. This flooding relates to the Yeading Brook that runs just off of the western site boundary. Through the introduction of a surface water strategy for the development surface water flows from the development will be restricted thus providing remediation of this surface water flooding. Therefore, the risk of surface water flooding on the site is assessed as medium.

Figure 5.4: EA– Surface Water Flood Mapping

5.5 Sewer Flooding

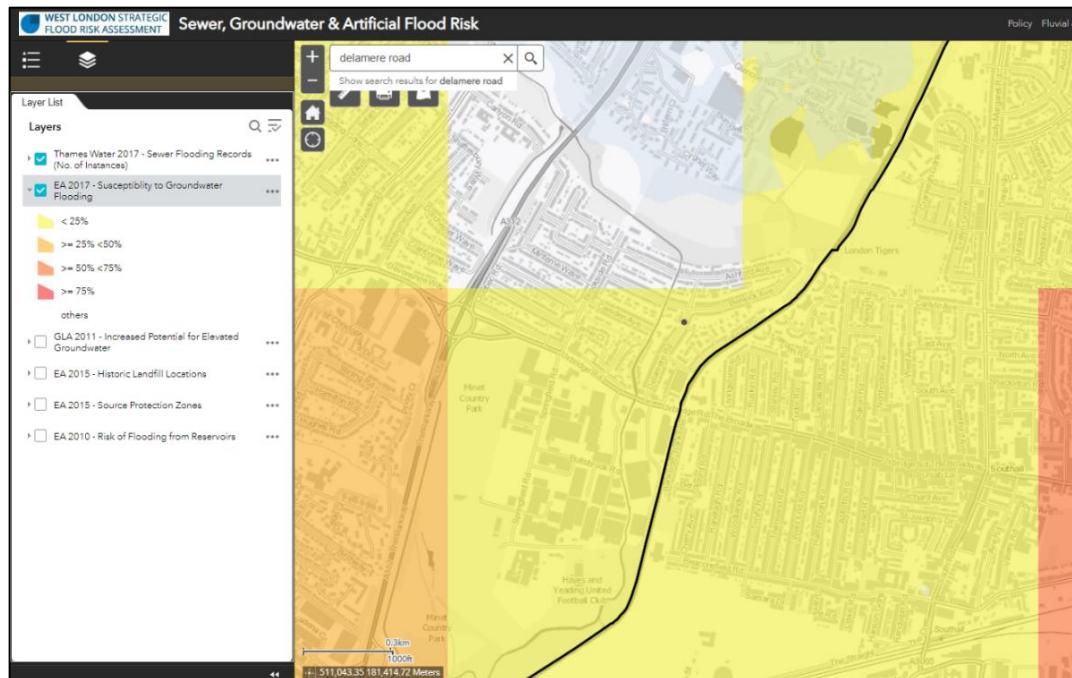
- 5.5.1 Thames Water is responsible for managing the sewer network in and around the proposed development area. There are no sewers located within the proposed development boundary. Therefore, the probability of flooding from a failure in the existing sewers is assessed as low.
- 5.5.2 The WLSFRA mapping indicates that no historic sewer flooding has taken place within the site as per **Figure 4-6**.

Figure 5.5: SFRA – Historic Sewer Flooding

5.6 Flooding from Groundwater

- 5.6.1 The site does not fall within a groundwater source protection zone area. It is underlain by a principal aquifer.
- 5.6.2 No records of groundwater flooding have been identified within the SFRA although the site is susceptible of an up to 25% chance of groundwater flooding. A copy of the SFRA mapping is shown within **Figure 5-6**.

Figure 5.6: SFRA – Groundwater Susceptibility Mapping



5.7 Flooding from Reservoirs

5.7.1 Reservoir flood maps are available from the EA government website and in this case show the site can suffer from onsite flooding from reservoirs. Refer to **Figure 5-7 to 5-8** for mapping.

Figure 5.7: EA – Extent of Reservoir Flooding

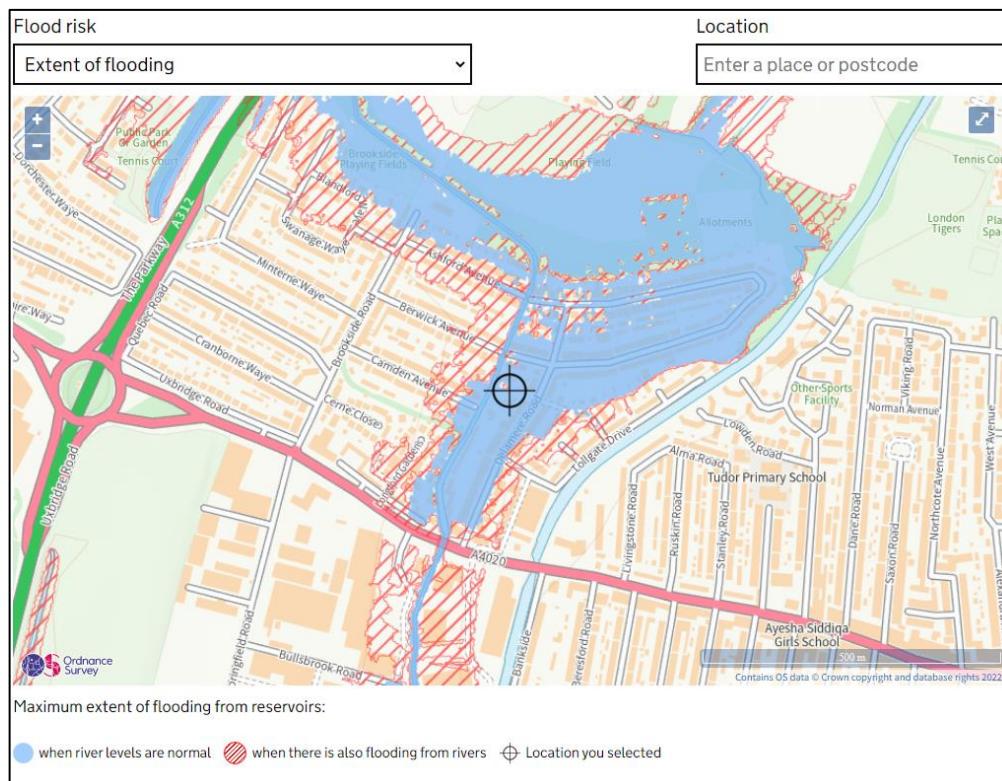
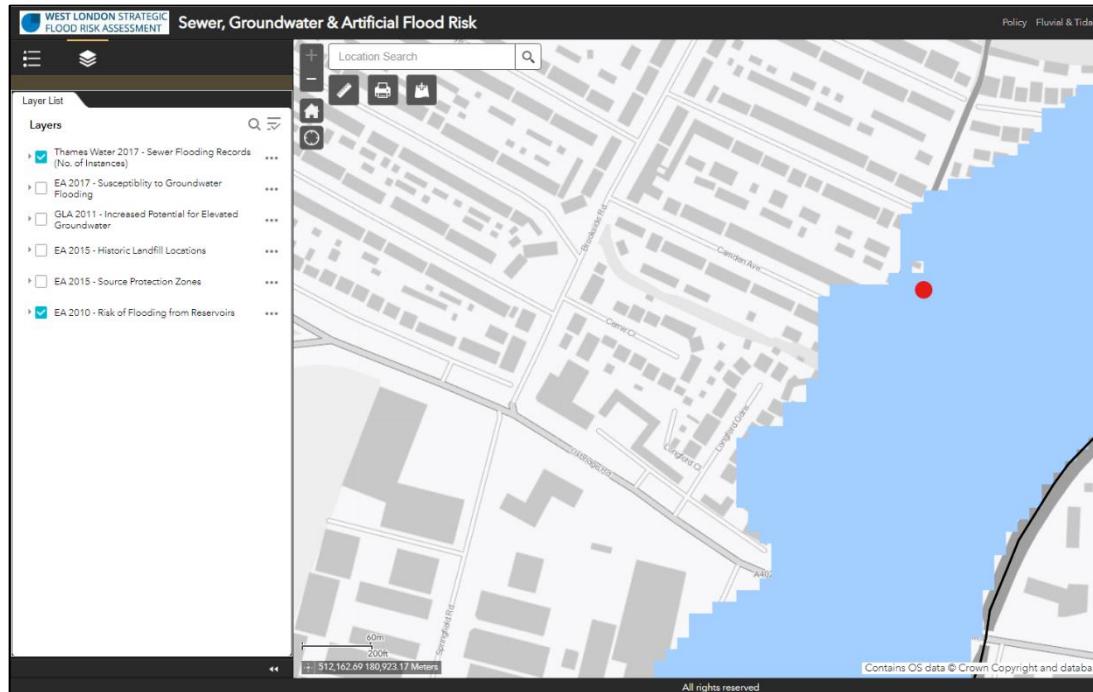


Figure 5.8: SFRA – Extent of Reservoir Flooding

5.8 Sequential and Exception Test

- 5.8.1 The sequential test aims to ensure that development does not take place in area at high risk of flooding when appropriate areas of lower risk are available.
- 5.8.2 The proposed development is located in Flood Zone 2 and is at low to medium risk of flooding from other sources. As the site is within Flood Zone 2, it is therefore required to undertake the sequential test.
- 5.8.3 The proposed development is a residential scheme, and therefore, can be classified as 'More Vulnerable' to risk of flooding. It is consistent with the appropriate uses, as outlined in the NPPF. Effect of Climate Change

Table 5.8: Flood Risk Vulnerability and Flood Zone 'Compatibility'

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	✓	✓

Flood Zones	Flood Risk Vulnerability Classification				
	Exception Test Required	X	X	X	✓
Zone 3b					

5.8.4 The Using the above table, the proposed application is considered to be suitable within Flood Zone 2.

5.8.5 The sequential and exception tests do not need to be applied to minor developments (0.5ha) and changes of use. This development is classed as a minor development due to the site area totalling 0.18ha and under 10 dwellings (major).

6 Effect of Climate Change

6.1 Climate Change

- 6.1.1 Based on the most recent advice on climate change reported in NPPG, peak rainfall intensity, sea level, peak river flow, offshore wind speed and extreme wave heights are all expected to increase in the future. It is recommended that considerations for future climate change are included in Flood Risk Assessments for proposed developments.
- 6.1.2 In February 2016, the Environment Agency (EA) published new guidance on how to use climate change allowances in flood risk assessments and drainage strategies. It is recommended that designs accommodate the 1 in 100-year storm with a 20% allowance for climate change and an additional analysis is undertaken to understand the flooding implications for a greater climate change allowance of 40%.
- 6.1.3 Under the WLSFRA it is proposed that the site is to be modelled at 1 in 100 year + 40% climate change.

7 Surface Water Management Proposal

7.1 Development Proposal

7.1.1 The proposed development is a residential scheme for the construction of 9 dwellings and associated site access and parking provision as shown on the preliminary Masterplan (Appendix A).

7.2 Proposed Drainage

7.2.1 A comprehensive sustainable drainage system will be implemented to prevent runoff from this development increasing flood risk to other areas. This will be fully detailed at the detail drainage design stage of the proposed development, although an indicative strategy to demonstrate that SuDS can be delivered is described below.

7.2.2 There are a number of options available to impose surface water restrictions on proposed development plots such as attenuation ponds, oversized sewers, below ground storage tanks, pervious paving, infiltration systems etc. Approved document Part H (Ref 10) sets out a hierarchy for surface water disposal, which encourages a sustainable approach.

- An adequate soakaway or some other adequate infiltration system, or where that is not reasonably practicable;
- A Watercourse, or where that is not reasonably practicable;
- to a surface water sewer, highway drain, or other drainage system;
- to a combined sewer.

7.2.3 As described in **Section 2.3** above, a desktop investigation has been undertaken. The results of which suggest infiltration is not feasible due to the geology onsite.

7.3 Proposed and Existing Run- off Rates

7.3.1 Under current conditions, there is no formal drainage system in place for the site. Precipitation falling on the existing ground currently disperses through a combination of evaporation, transpiration, run-off from largely impermeable soil and geology. Excess rainfall drains diffusely across the surface of the site in a westerly direction towards the Yeading Brook.

7.3.2 Current government guidance advises that the post-development rate of runoff should be no greater than the pre-developed rate with the same rainfall event.

7.3.3 As per the existing site runoff, the site will be draining to the watercourse (Yeading Brook River) at a maximum discharge of 0.2l/s (QBAR).

7.3.4 It is therefore proposed that the 'post development' discharge rates will be restricted to 0.2l/s, for all storm events up to and including the critical 1% AEP (1 in 100-year return period) storm event incorporating the impacts of climate change allowances (applied as a 40% uplift in peak rainfall intensity) for the lifetime of the development (assessed as being 100 years).

7.4 Surface Water Networks

7.4.1 A comprehensive sustainable drainage system has been developed which will be implemented to prevent runoff from the development increasing flood risk to other areas. This will be fully detailed at the detailed construction drainage design stage of the proposed development, although a strategy to demonstrate that SuDS can be delivered in accordance with the Council's and LLFA's requirements is described below.

7.4.2 HLBC set out a series of sustainable drainage principles in their Supplementary Requirements for Surface Water Drainage Proposals. These follow the hierarchy set out in the SuDS Manual, which must be considered when preparing any surface water drainage strategy. These require the following discharge hierarchy to be applied;

- Discharge into the ground (infiltration);
- Controlled discharge to a surface water body;
- Controlled discharge to a surface water sewer.

7.4.3 As described in **Section 2.3** above, due to the existing geology of the site and distance from the watercourse found within the desk study of the site, it is deemed the site is unsuitable for infiltration techniques.

7.5 Proposed SuDS

7.5.1 A Drainage Strategy has been developed and been attached within **Appendix D**.

7.5.2 Run off from the proposed development will be restricted to the 0.2l/s value as noted in **Section 7.3** above. This provides considerable betterment than occurs in the current situation, where run off during higher intensity storms can be much greater than these levels.

7.5.3 The attenuation required to restrict the runoff will be provided by a series of attenuation features including permeable paving and attenuation crates.

7.5.4 Private parking will have run off controlled at source through permeable paving. A small attenuation crate will be located in the southern corner of the Development which will provide storage for the development. From this a hydrobrake will restrict flows to 0.2 l/s before discharging into the Yeading Brook River on the western boundary.

- 7.5.5 SuDS guidance (CIRIA C753) recommends an inclusion of additional 10% impermeable area to account for potential future development (Urban creep). The current masterplan was used to assess the impermeable areas on the developed site and run off rates calculated on the basis of this layout, allowing an additional 10%.
- 7.5.6 As requested by HLBC SuDS Proforma/ Design Guide the drainage design allows for a 1 in 100 year storm event, plus a 40% allowance for climate change.
- 7.5.7 The preliminary SuDS system for the development has been designed in accordance with best practice SuDS guidance as set out in the SuDS Manual and also in accordance with WLSFRA's guidance, as LLFA.

7.6 Pollution Control Measures

- 7.6.1 Table 4.3 of the SuDS manual (C753) sets out minimum water quality requirements for discharges to receiving surface waters and groundwater. Roof areas of residential dwellings and driveways/low traffic roads have 'very low' and 'low' pollution risks, respectively. These will require at least one type of SuDS source/site control component to be implemented on site to provide the required treatment prior to discharge. It is intended that this will be a minimum design parameter for any future detailed design, however suggested treatment trains beyond this are set out below.
- 7.6.2 A comprehensive SuDS system will be incorporated into the masterplan to provide a 'treatment train' approach to maintain a high-water quality prior to discharging to the watercourse. Typical SuDS components that have been implemented on-site in the preliminary design, to reduce total suspended solids, heavy metals and hydrocarbons from the runoff and to provide the necessary water quality treatment are as follows:
- Roofs – All roof areas will include some pre-treatment to remove leaves and other roof debris at source. All roofs will reach Level 1 on the treatment train as a minimum, before discharging into the pipe system.
 - Communal car parking Areas – These areas will include source control pre-treatment such as porous paving and/or petrol/oil interceptors (which could be taken as an additional component on the treatment train). Two levels of treatment will be included as the minimum.

7.7 Flood Risk Management Measures

- 7.7.1 NPPG requires that the safety of people and the proposed development be considered against each source of flooding identified in **Section 5**.

- 7.7.2 The proposed development will not be at risk due to the proposed levels are to be above the flood levels indicated within the EA data.
- 7.7.3 A preliminary surface water drainage strategy incorporating SuDS has been proposed to manage the increase in run-off from the site over the lifetime of the development, such that it will not place properties at risk of surface water flooding.
- 7.7.4 The dwellings FFL's will be at a minimum of 300mm above the 1 in 100 year +70% CC flood modelling levels obtained from the product 4 data. This is to satisfy the NPPF. EA (Product 4 data) flooding maps are discussed within **Section 5** of the report. This shows that the existing ground levels of the site are 2.5m above the flood levels of the 1 in 100 year + 70% CC storm event.
- 7.7.5 The SuDS system will be maintained by a management company for the lifetime of the development, such that it will not place properties either on the site or elsewhere at an increased risk of surface water flooding. This complies with NPPF guidance and HLBC guidance.
- 7.7.6 The flood risk to the proposed development and surrounding area, as a consequence of the development is therefore considered to be low and no specific flood risk management measures will be required.
- 7.7.7 The NPPF requires a route of safe escape for all residents and users to be provided from new residential properties within Flood zone 3. Safe escape is usually defined as being within slow moving water no deeper than 25cm.
- 7.7.8 As the entire site is located within Flood Zone 2 and is situated at least 0.5m above the 1 in 100 + 70% allowance for climate change flood level, the entire site is completely dry at the design flood level therefor a safe escape plan is not required.

7.8 Microdrainage Storage Calculations

- 7.8.1 SuDS guidance (CIRIA C753) recommends an inclusion of additional 10% impermeable area to account for potential future development (Urban creep), which has been added to the calculation. The preliminary masterplan in **Appendix A** was used to assess the impermeable areas on the developed site. As this masterplan is further developed through the detailed design process run off calculations will be further refined. An analysis has also been undertaken using a 40% increase in rainfall intensity. This SuDS strategy will ensure that the surface water runoff from the future development will be attenuated within the development area and discharged into the Yeading Brook.

- 7.8.2 Calculations for the strategic SuDS that are located within **Appendix E** demonstrate that for the respective critical storm events of up to 1 in 100year return period plus a 40% allowance for climate change, the drainage system and storage of run off is contained within the storage features. There is also the potential to implement source control SuDS measures such as permeable paving, rainwater harvesting etc. locally to reduce the runoff entering the drainage system and also to provide pollution treatment at source. These will be considered during the detailed design stage.
- 7.8.3 The preliminary SuDS system for the development has been designed to accord with current HLBC guidance. This guidance will be followed should the site gain planning permission, when full final design details will be developed to release planning conditions and enable construction, including any potential updates resulting from changes to the masterplan.

8 Conclusions and Recommendations

8.1 Background

- 8.1.1 This report has been prepared to assess the implications of Flood Risk for the proposed development of land known as Rear of Delamere Road, Hayes. It is proposed to provide up to 9 residential dwellings together with associated amenity and open space provision, landscaping, and vehicle access.
- 8.1.2 The entire developable area of site lies in Flood Zone 2 'medium probability' flood area as defined by Table 1 of NPPG. The proposed residential development is considered as 'More Vulnerable' when utilising Table 2 of NPPG. The development being proposed is consistent with the appropriate uses for Flood Zone 2, as outlined in Table 3 of Planning Practice Guidance and therefore passes the sequential test.

8.2 Probability of Flooding

- 8.2.1 All potential sources of flood risk to and from the site, as listed in NPPF, have been assessed and the risks of flooding occurring have all been assessed as low. In assessing the flood risk, the impacts of climate change have been considered for the lifetime of the proposed development and are also considered acceptable.

8.3 Flood Risk Management

- 8.3.1 As the proposed residential development will lie predominantly within Flood Zone 2, the risk of flooding from all sources is assessed to be medium and the safety of people is considered acceptable for all foreseeable flooding events. Finished floor levels elevated to at least 300mm above flooding levels will be implemented to assure no dwelling flooding will take place.

8.4 Offsite Impacts

- 8.4.1 The Preliminary Surface Water Drainage Strategy set out in this assessment proposes management of surface water run-off from the development through the use of sustainable drainage techniques which will provide an improved surface water drainage regime and flood risk profile. Consequently, this will, reduce surface water run-off flows from the site, for storm return periods up to the 1 in 100year event, plus an allowance for the detrimental effects of climate change. The proposed development will not increase the risk of flooding elsewhere. The implementation of the SuDs schemes as proposed, is likely to reduce any existing risk of downstream flooding.

8.5 Recommendations

- 8.5.1 Due to the positive outcome of these assessments, there is no reason why the site should not continue through the planning process and be approved for residential development in respect of flood risk and surface water drainage.

Appendices

Appendix A Site Masterplan

SITE AREA: 0.1846 ha

ECOLOGICAL BUFFER ZONE: 125.50m²



LAND TO REAR OF 12-26 DELAMERE ROAD HAYES UB4 0NL

CD
A

Coventry Design Limited
River House, 14 Cherry Orchard
Road, Molesey
Surrey, KT8 1QZ.
+44 (0) 780 383 0015
info@coventrydesign.com
www.coventrydesign.com

Scale (1:500)

DRG No: 013442

02

SCALE: 1:500 @ A3
DATE: SEP 2022

PROJECT: Land to rear of 12-26 Delamere Road - UBN 0N
TITLE: Proposed site plan

PROJECT: Land to rear of 12
TITLE: Proposed site plan

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THIS DRAWING IS COPYRIGHT AND IT IS A BREACH OF
THAT COPYRIGHT FOR THEM TO BE USED IN WHOLE
OR PARTIALLY WITHOUT WRITTEN PERMISSION FROM
US IN ADVANCE. DO NOT SCALE. IF IN DOUBT ASK.

Appendix B EA – Flood Mapping

Flood map for planning

Your reference
22-094

Location (easting/northing)
511743/180879

Created
8 Dec 2022 14:57

Your selected location is in flood zone 2, an area with a medium probability of flooding.

This means:

- you must complete a flood risk assessment for development in this area
- you should follow the Environment Agency's standing advice for carrying out a flood risk assessment (see www.gov.uk/guidance/flood-risk-assessment-standing-advice)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Flood risk data is covered by the Open Government Licence which sets out the terms and conditions for using government data. <https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2022 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>



Environment
Agency

Flood map for planning

Your reference

22-094

Location (easting/northing)

511743/180879

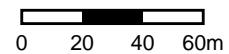
Scale

1:2500

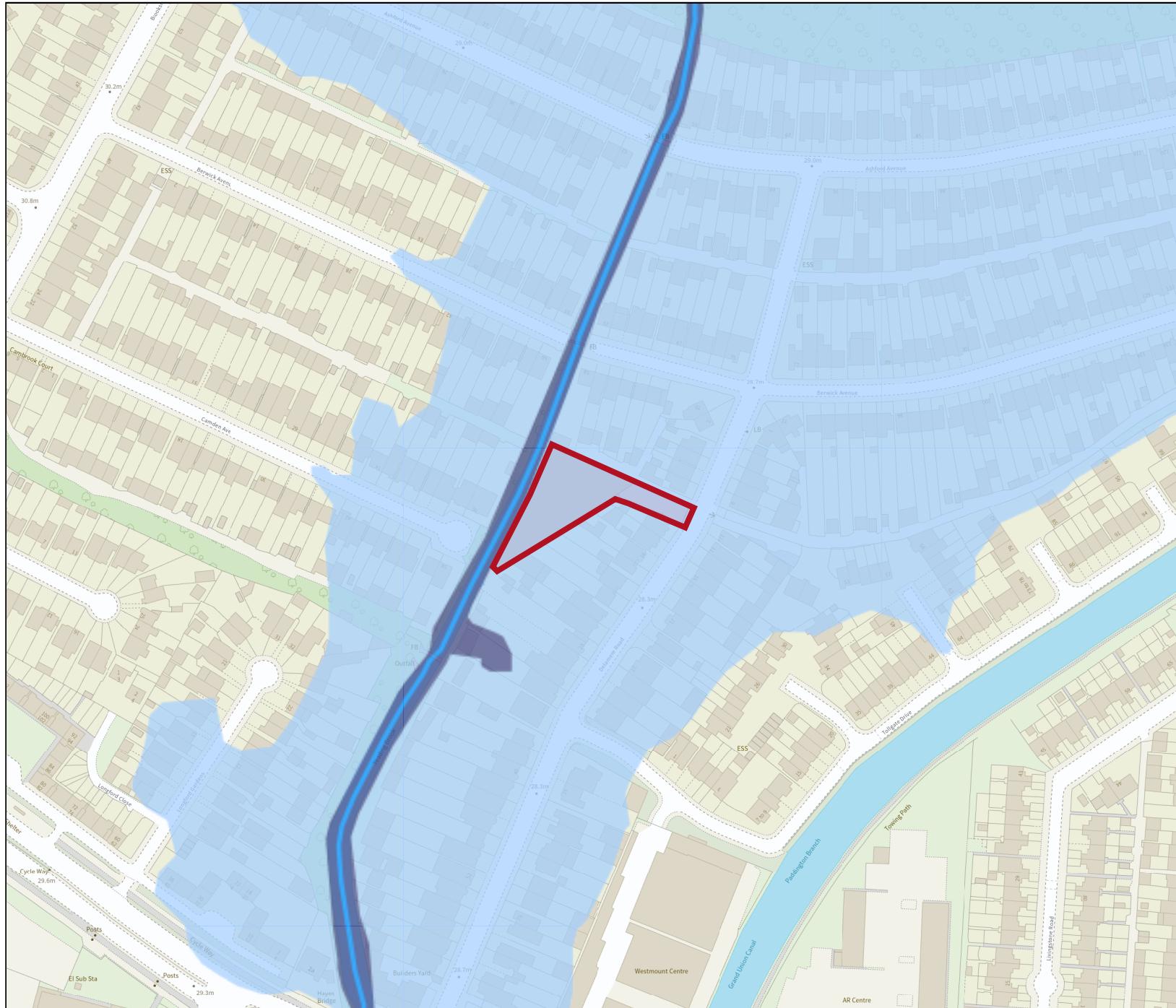
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8 Dec 2022 14:57

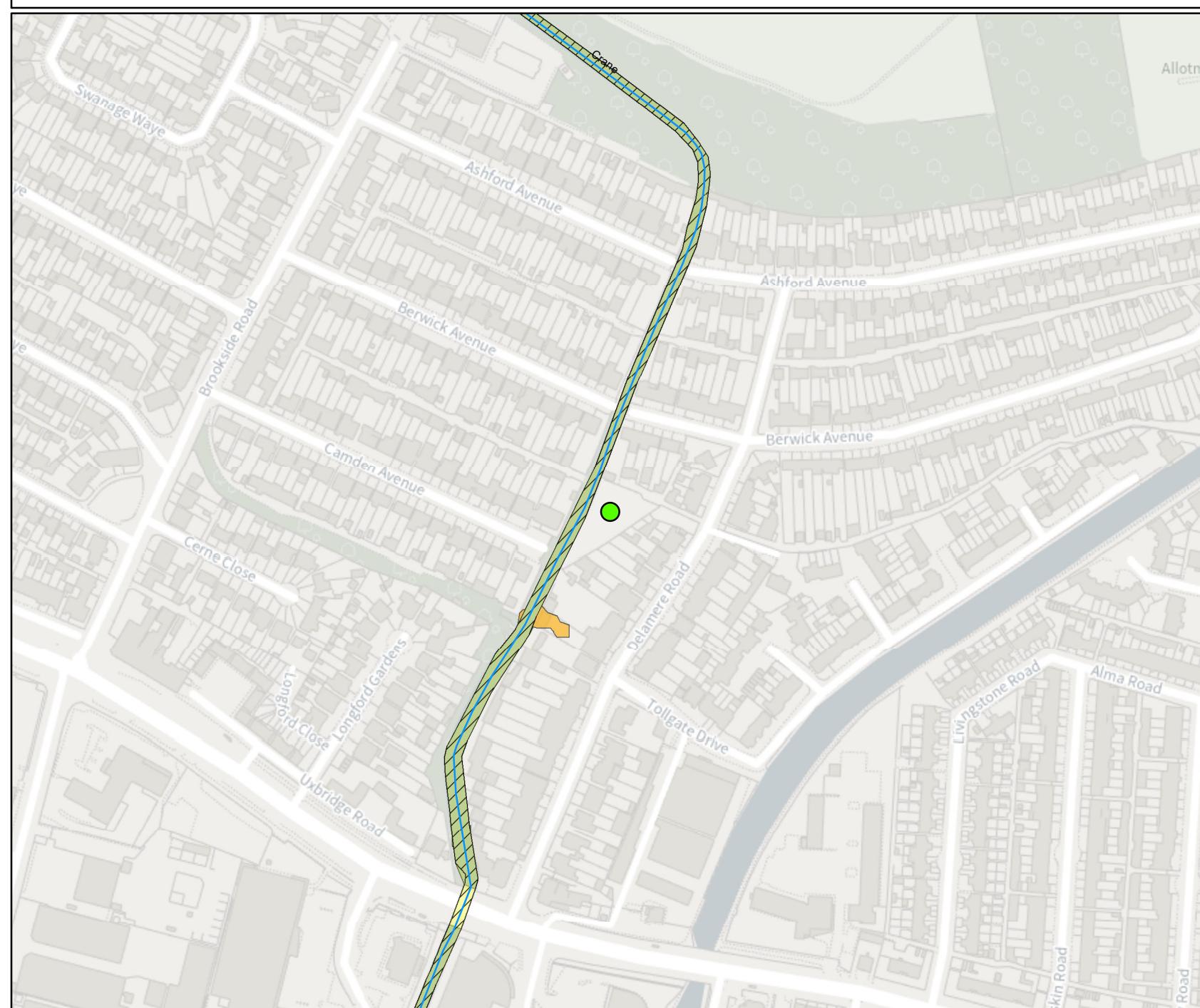
- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area



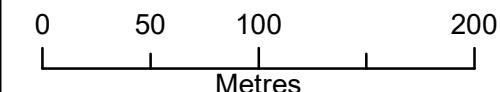
Page 2 of 2



Appendix C EA – Product 4 Data



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



Legend

- Main Rivers
- Site location

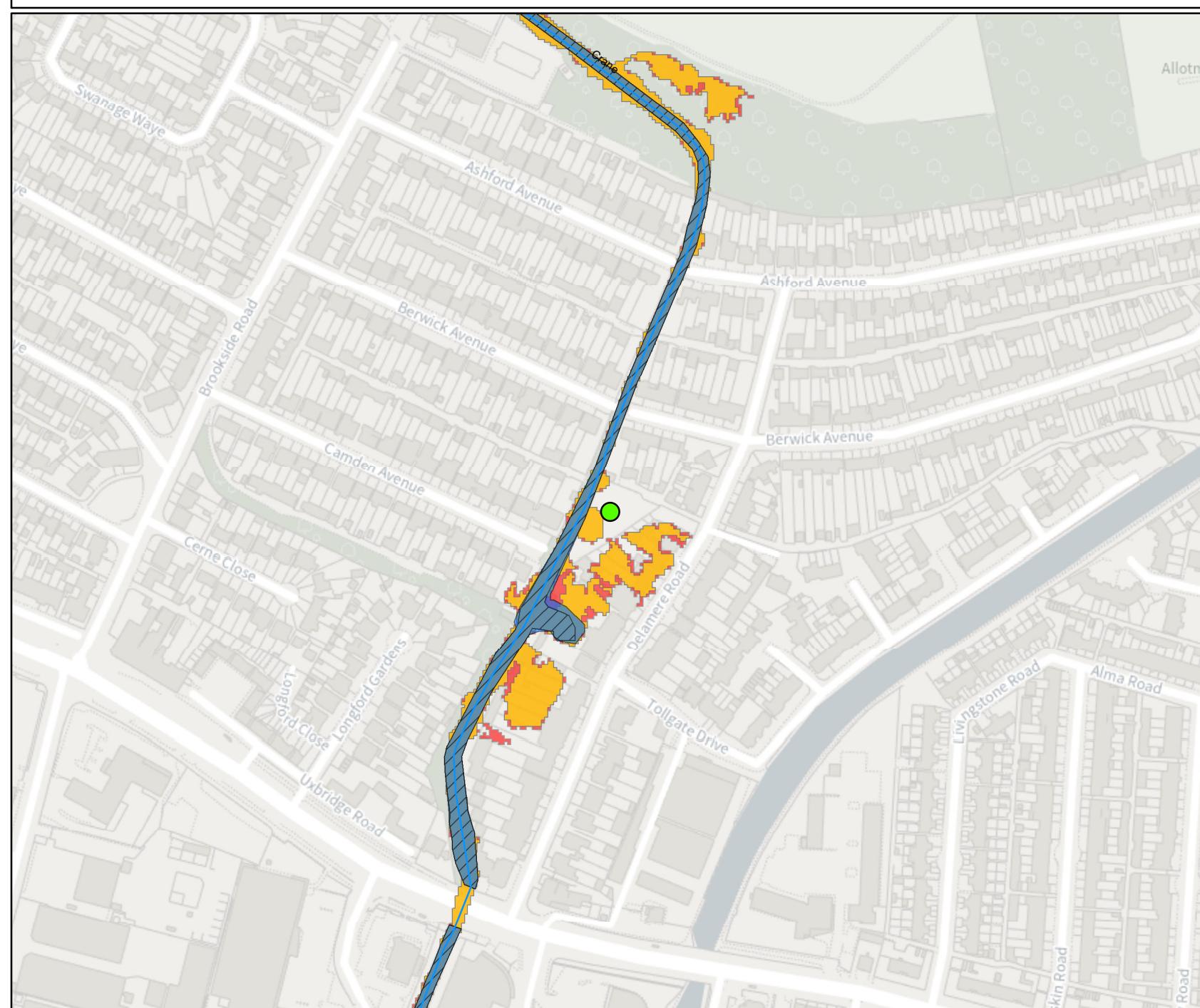
Defended Flood Outlines

- 1 in 5 (20%) Defended
- 1 in 10 (10%) Defended
- 1 in 20 (5%) Defended
- 1 in 50 (2%) Defended

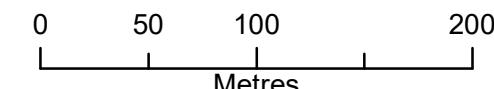
The data in this map has been extracted from the River Crane Mapping Study (Halcrow 2008). This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment. Modelled outlines take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

Produced by:
Partnerships & Strategic Overview,
Hertfordshire & North London



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



Legend

- Main Rivers
- Site location

Defended Flood Outlines

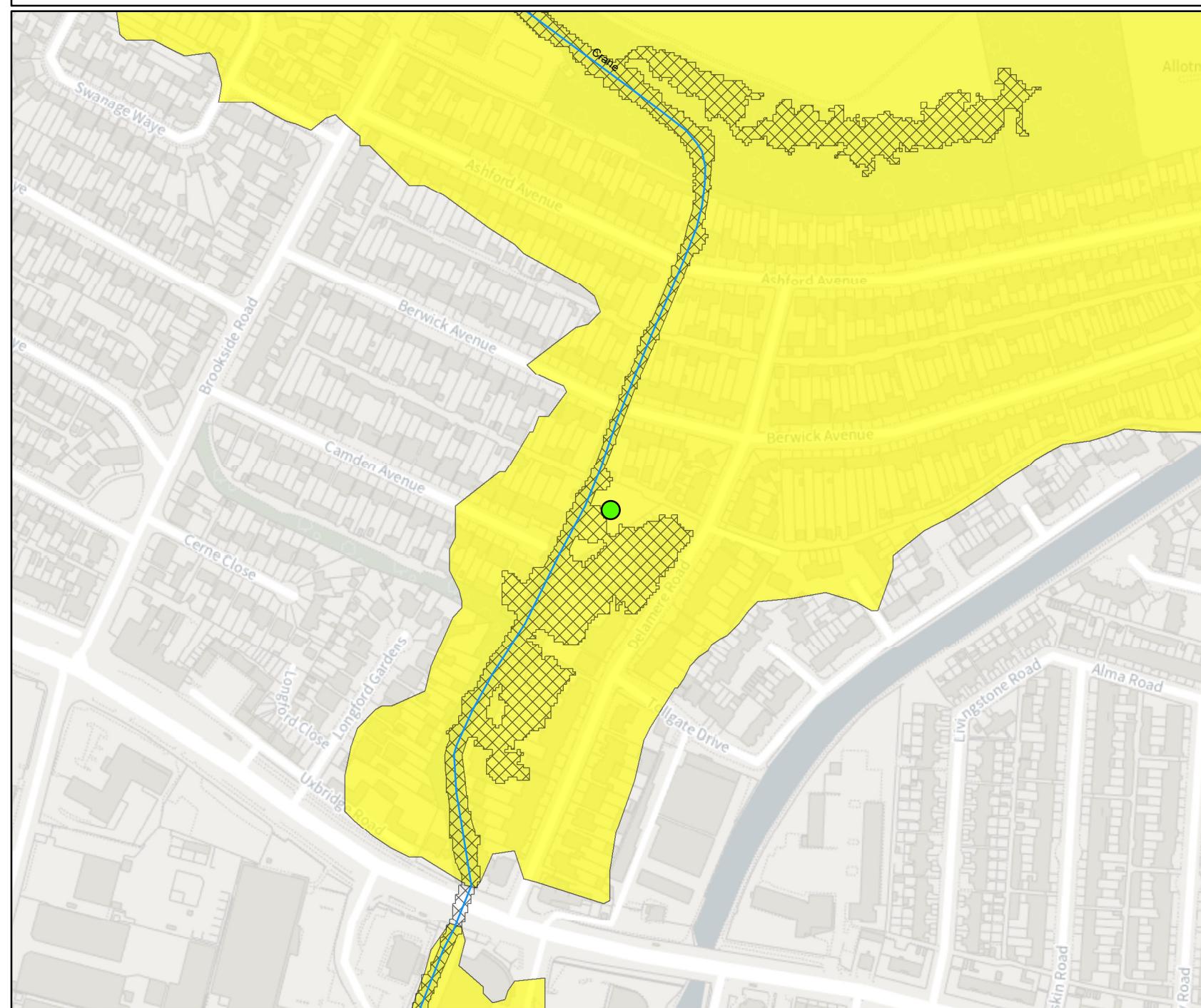
- 1 in 100 (1%) Defended
- 1 in 100+20% (*CC) Defended
- 1 in 100+25% (*CC) Defended
- 1 in 100+30% (*CC) Defended

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 within the catchment. Modelled outlines take into account catchment wide defences.

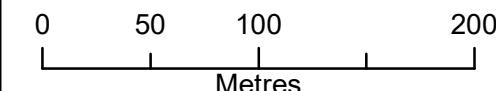
Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of 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: (Near) Delamere Road, Yeading, UB4 0NL- 20/12/2022 - HNL 292587 JH



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



Legend

- Main Rivers
- Site location

Defended Flood Outlines

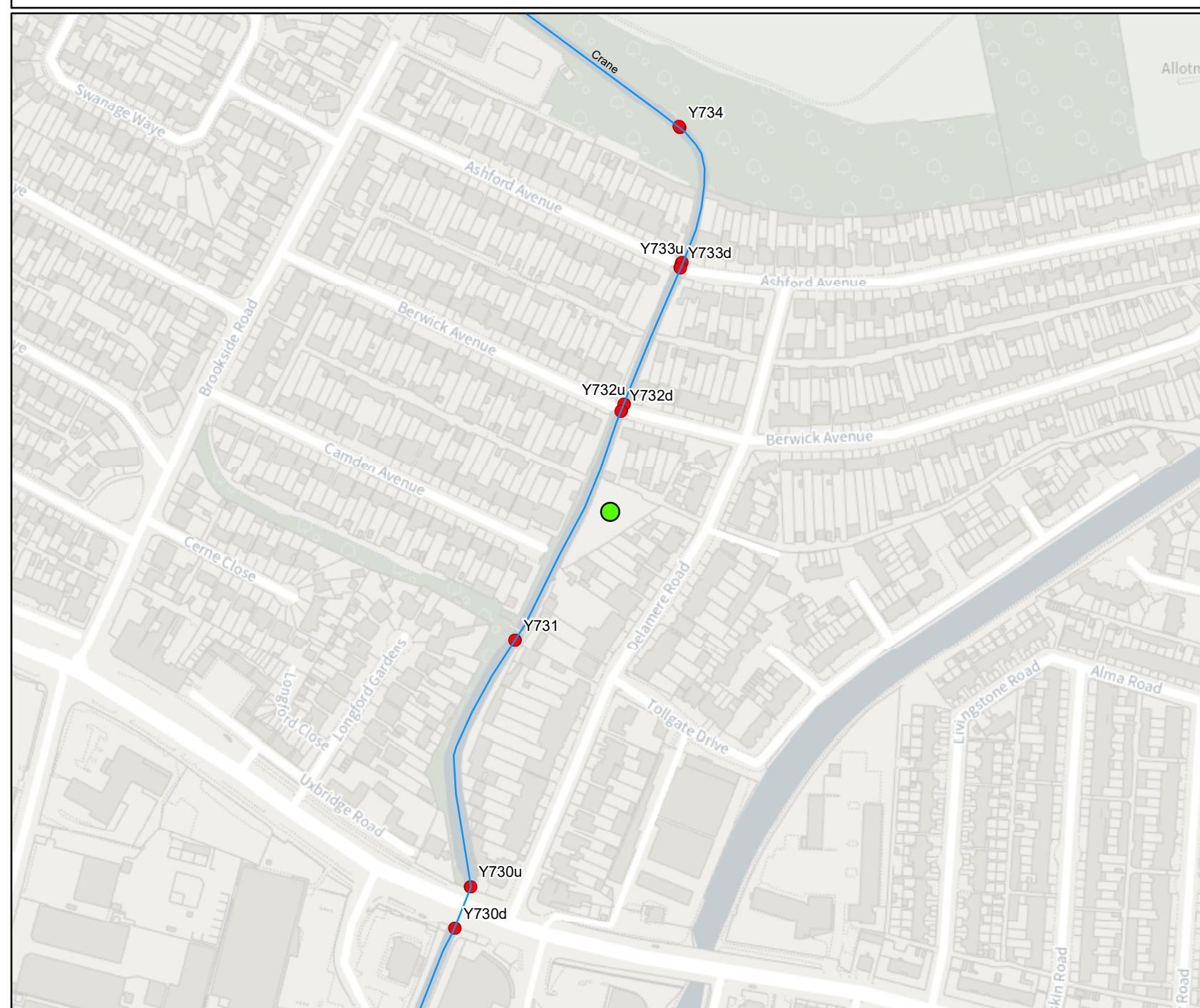
- 1 in 100+70% (*CC) Defended
- 1 in 1000 (0.1%) Defended

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 within the 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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Hertfordshire,
AL7 1HE



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 within the 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 292587 JH

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)

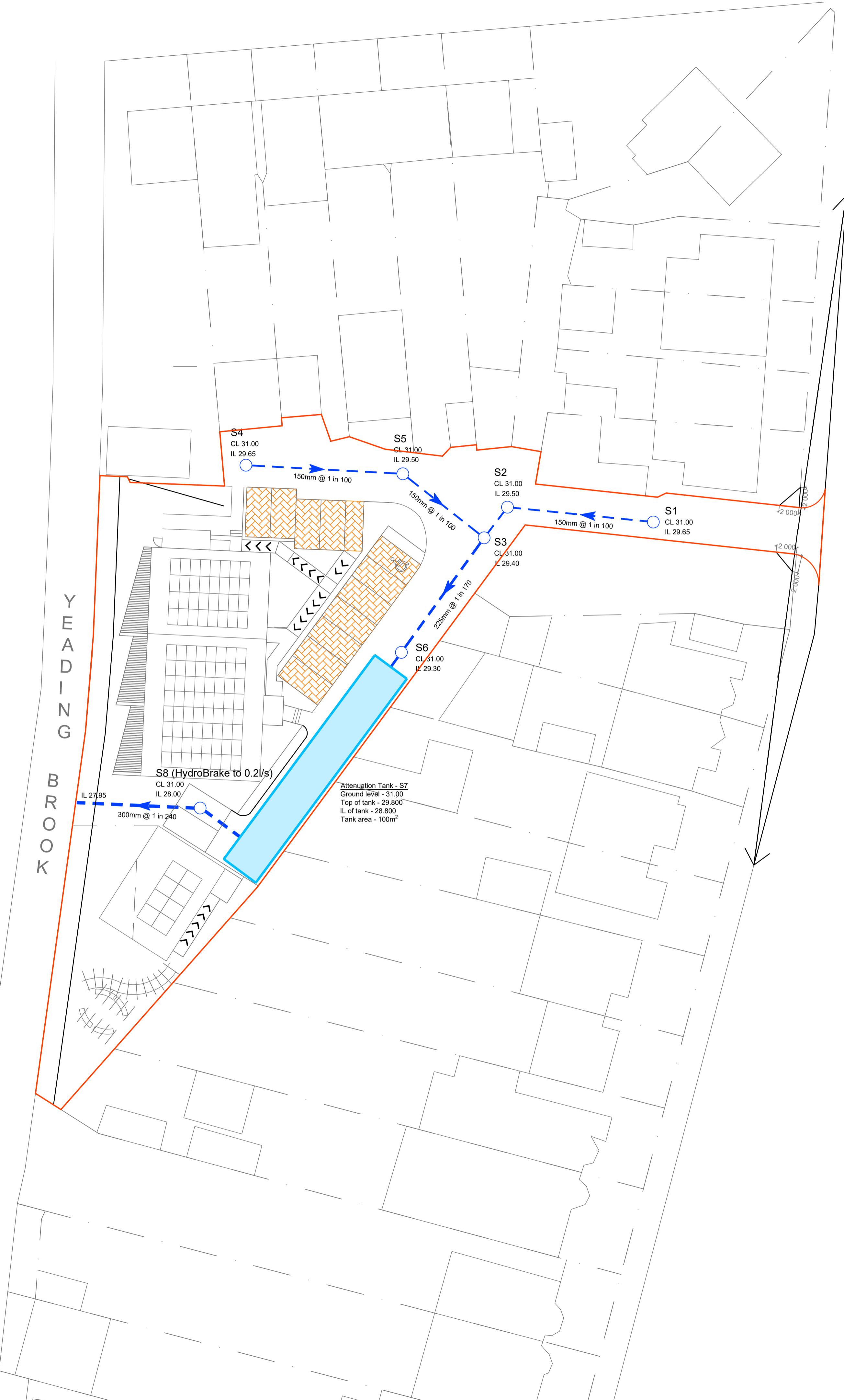
MODELLED FLOOD LEVEL

Node Label	Easting	Northing	Return Period									
			5 yr	10 yr	20 yr	50 yr	100 yr	100yr + 20%	100yr + 25%	100yr + 35%	100yr + 70%	1000yr
Y734	511774	181138	28.10	28.13	28.17	28.24	28.28	28.36	28.37	28.40	28.48	29.49
Y733u	511776	181049	28.02	28.06	28.10	28.17	28.23	28.31	28.32	28.35	28.45	29.49
Y733d	511774	181046	28.02	28.06	28.10	28.17	28.23	28.31	28.32	28.35	28.44	29.38
Y732u	511735	180957	27.90	27.93	27.97	28.05	28.10	28.19	28.21	28.25	28.36	29.38
Y732d	511734	180955	27.88	27.91	27.95	28.03	28.08	28.16	28.18	28.22	28.33	29.27
Y731	511669	180803	27.74	27.78	27.82	27.90	27.96	28.06	28.08	28.12	28.25	29.26
Y730u	511638	180644	27.61	27.65	27.70	27.79	27.85	27.95	27.97	28.01	28.15	29.19
Y730d	511629	180617	27.58	27.62	27.67	27.76	27.82	27.92	27.94	27.98	28.12	29.11

MODELED FLOWS

Node Label	Easting	Northing	Return Period									
			5 yr	10 yr	20 yr	50 yr	100 yr	100yr + 20%	100yr + 25%	100yr + 35%	100yr + 70%	1000yr
Y734	511774	181138	7.11	7.29	7.47	7.68	7.80	8.11	8.19	8.35	8.81	24.93
Y733u	511776	181049	7.11	7.30	7.48	7.69	7.81	8.11	8.20	8.36	8.84	24.44
Y733d	511774	181046	7.11	7.30	7.48	7.69	7.81	8.11	8.20	8.36	8.84	24.44
Y732u	511735	180957	7.64	7.91	8.22	8.76	9.16	9.80	9.96	10.24	11.11	24.70
Y732d	511734	180955	7.64	7.91	8.22	8.76	9.16	9.80	9.96	10.24	11.11	24.70
Y731	511669	180803	7.64	7.92	8.23	8.76	9.16	9.78	9.92	10.18	10.97	24.46
Y730u	511638	180644	7.76	8.06	8.40	9.01	9.46	10.17	10.33	10.62	11.51	24.37
Y730d	511629	180617	7.76	8.06	8.40	9.01	9.46	10.17	10.33	10.62	11.51	24.37

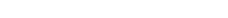
Appendix D Drainage Strategy



OTES

1. All dimensions are in metres unless stated otherwise.
2. Do not scale from this drawing. only written dimensions are to be used..
3. Location of sewers & lateral drains to be in accordance with the sewage sector guidance.
4. Cover levels indicated are nominal & may be adjusted to suit finished ground levels as necessary.
5. Topographical survey to be undertaken before finalisation of the drainage design.

Key

Site Boundary 

Proposed Drainage

Surface Water 

Attenuation Tank 

Permeable Paving 

Amendments	Drn	Chk	App	Date
	Charles & Associates			
<input checked="" type="checkbox"/> Issued by	<input type="checkbox"/>	Park House Park Farm East Malling Trust Estate Bradbourne Lane Aylesford Kent ME20 6SN 01732 448120		
Landmark House Station Road Berk Hampshire GU27 9HA 0126 630420	enquiries@c-a.uk.com www.c-a.uk.com			
o Title	Rear of Delamere Road, Hayes			
awing Title	Surface Water Drainage Strategy			
ent	Woolf Bond Planning			
ale 1:250 @ A1	Date Dec 2022	Designed SC		
awn SC	Checked GAC	Approved GAC		
o No 22-094	Drawing No 22-094-001			Rev -

Appendix E MicroDrainage Calculations

C & A Consulting Engineers Ltd Landmark House Station Road, Hook Hampshire RG27 9HA		Page 1
Date 21/12/2022 11:00 File	Designed by Scott Collis Checked by	
Innovyze		Source Control 2019.1

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	0.108	Urban	0.000
SAAR (mm)	644	Region Number	Region 6

Results 1/s

QBAR Rural 0.2
QBAR Urban 0.2

Q100 years 0.6

Q1 year 0.2
Q30 years 0.4
Q100 years 0.6

C & A Consulting Engineers Ltd							Page 1
Landmark House Station Road, Hook Hampshire RG27 9HA							
Date 21/12/2022 12:28		Designed by Scott Collis					
File 22-094 - SOURCE CONTROL...		Checked by					
Innovyze	Source Control 2019.1						



Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 3778 minutes.

Storm Event	Max Level	Max Depth	Max Infiltration	Max Control	Max Σ	Max Outflow	Max Volume	Status
	(m)	(m)	(l/s)	(l/s)	(l/s)	(l/s)	(m³)	
15 min Summer	29.095	0.295	0.0	0.2	0.2	28.0	0 K	
30 min Summer	29.186	0.386	0.0	0.2	0.2	36.6	0 K	
60 min Summer	29.278	0.478	0.0	0.2	0.2	45.4	0 K	
120 min Summer	29.371	0.571	0.0	0.2	0.2	54.2	0 K	
180 min Summer	29.422	0.622	0.0	0.2	0.2	59.1	0 K	
240 min Summer	29.456	0.656	0.0	0.2	0.2	62.3	0 K	
360 min Summer	29.503	0.703	0.0	0.2	0.2	66.8	0 K	
480 min Summer	29.535	0.735	0.0	0.2	0.2	69.8	0 K	
600 min Summer	29.558	0.758	0.0	0.2	0.2	72.0	0 K	
720 min Summer	29.575	0.775	0.0	0.2	0.2	73.6	0 K	
960 min Summer	29.598	0.798	0.0	0.2	0.2	75.8	0 K	
1440 min Summer	29.618	0.818	0.0	0.2	0.2	77.7	0 K	
2160 min Summer	29.615	0.815	0.0	0.2	0.2	77.4	0 K	
2880 min Summer	29.593	0.793	0.0	0.2	0.2	75.3	0 K	
4320 min Summer	29.541	0.741	0.0	0.2	0.2	70.4	0 K	
5760 min Summer	29.499	0.699	0.0	0.2	0.2	66.4	0 K	
7200 min Summer	29.464	0.664	0.0	0.2	0.2	63.1	0 K	
8640 min Summer	29.433	0.633	0.0	0.2	0.2	60.2	0 K	
10080 min Summer	29.404	0.604	0.0	0.2	0.2	57.4	0 K	
15 min Winter	29.131	0.331	0.0	0.2	0.2	31.4	0 K	

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
		(m³)	(m³)	
15 min Summer	139.755	0.0	14.6	27
30 min Summer	91.475	0.0	15.2	42
60 min Summer	57.005	0.0	30.4	72
120 min Summer	34.310	0.0	31.4	132
180 min Summer	25.153	0.0	31.9	190
240 min Summer	20.060	0.0	32.2	250
360 min Summer	14.548	0.0	32.7	370
480 min Summer	11.581	0.0	32.9	490
600 min Summer	9.696	0.0	33.1	608
720 min Summer	8.382	0.0	33.2	728
960 min Summer	6.656	0.0	33.2	966
1440 min Summer	4.803	0.0	33.0	1444
2160 min Summer	3.460	0.0	65.1	2164
2880 min Summer	2.739	0.0	64.7	2804
4320 min Summer	1.968	0.0	63.1	3460
5760 min Summer	1.555	0.0	120.2	4208
7200 min Summer	1.294	0.0	117.4	5040
8640 min Summer	1.114	0.0	113.6	5808
10080 min Summer	0.981	0.0	109.1	6656
15 min Winter	139.755	0.0	14.8	27

C & A Consulting Engineers Ltd Landmark House Station Road, Hook Hampshire RG27 9HA		Page 2
Date 21/12/2022 12:28 File 22-094 - SOURCE CONTROL...	Designed by Scott Collis Checked by	
Innovyze	Source Control 2019.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level	Max Depth	Max Infiltration	Max Control	Max Σ	Max Outflow	Max Volume	Status
	(m)	(m)	(l/s)	(l/s)	(l/s)	(l/s)	(m³)	
30 min Winter	29.232	0.432	0.0	0.2	0.2	41.1	0 K	
60 min Winter	29.337	0.537	0.0	0.2	0.2	51.0	0 K	
120 min Winter	29.441	0.641	0.0	0.2	0.2	60.9	0 K	
180 min Winter	29.500	0.700	0.0	0.2	0.2	66.5	0 K	
240 min Winter	29.539	0.739	0.0	0.2	0.2	70.2	0 K	
360 min Winter	29.592	0.792	0.0	0.2	0.2	75.3	0 K	
480 min Winter	29.630	0.830	0.0	0.2	0.2	78.8	0 K	
600 min Winter	29.657	0.857	0.0	0.2	0.2	81.4	0 K	
720 min Winter	29.678	0.878	0.0	0.2	0.2	83.4	0 K	
960 min Winter	29.707	0.907	0.0	0.2	0.2	86.2	0 K	
1440 min Winter	29.736	0.936	0.0	0.2	0.2	88.9	0 K	
2160 min Winter	29.744	0.944	0.0	0.2	0.2	89.7	0 K	
2880 min Winter	29.731	0.931	0.0	0.2	0.2	88.4	0 K	
4320 min Winter	29.678	0.878	0.0	0.2	0.2	83.4	0 K	
5760 min Winter	29.625	0.825	0.0	0.2	0.2	78.3	0 K	
7200 min Winter	29.575	0.775	0.0	0.2	0.2	73.6	0 K	
8640 min Winter	29.533	0.733	0.0	0.2	0.2	69.6	0 K	
10080 min Winter	29.491	0.691	0.0	0.2	0.2	65.7	0 K	

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
		(m³)	(m³)	
30 min Winter	91.475	0.0	15.4	41
60 min Winter	57.005	0.0	31.0	70
120 min Winter	34.310	0.0	32.1	130
180 min Winter	25.153	0.0	32.7	188
240 min Winter	20.060	0.0	33.0	246
360 min Winter	14.548	0.0	33.4	364
480 min Winter	11.581	0.0	33.7	482
600 min Winter	9.696	0.0	33.9	600
720 min Winter	8.382	0.0	34.0	718
960 min Winter	6.656	0.0	34.0	952
1440 min Winter	4.803	0.0	33.7	1416
2160 min Winter	3.460	0.0	66.9	2100
2880 min Winter	2.739	0.0	66.3	2768
4320 min Winter	1.968	0.0	64.2	3980
5760 min Winter	1.555	0.0	124.5	4496
7200 min Winter	1.294	0.0	122.3	5408
8640 min Winter	1.114	0.0	118.8	6320
10080 min Winter	0.981	0.0	114.5	7256

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.407	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.108

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From:	To:	(ha)	From:	To:	(ha)
0	4 0.036	4	8 0.036	8	12 0.036

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Model Details

Storage is Online Cover Level (m) 31.000

Cellular Storage Structure

Invert Level (m) 28.800 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
 Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	100.0	0.0	1.001	0.0	0.0
1.000	100.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0018-2000-1500-2000
 Design Head (m) 1.500
 Design Flow (l/s) 0.2
 Flush-Flo™ Calculated
 Objective Minimise upstream storage
 Application Surface
 Sump Available Yes
 Diameter (mm) 18
 Invert Level (m) 28.000
 Minimum Outlet Pipe Diameter (mm) 75
 Suggested Manhole Diameter (mm) 1200

Control Points Head (m) Flow (l/s)

Design Point (Calculated)	1.500	0.2
Flush-Flo™	0.075	0.1
Kick-Flo®	0.161	0.1
Mean Flow over Head Range	-	0.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)						
0.100	0.1	1.200	0.2	3.000	0.3	7.000	0.4
0.200	0.1	1.400	0.2	3.500	0.3	7.500	0.4
0.300	0.1	1.600	0.2	4.000	0.3	8.000	0.4
0.400	0.1	1.800	0.2	4.500	0.3	8.500	0.4
0.500	0.1	2.000	0.2	5.000	0.3	9.000	0.4
0.600	0.1	2.200	0.2	5.500	0.4	9.500	0.4
0.800	0.2	2.400	0.2	6.000	0.4		
1.000	0.2	2.600	0.3	6.500	0.4		



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