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ES Appendix 14.1 - Flood Risk Assessment

Authored by Expedition

November 2025

THE CROWN ESTATE

East Hemel

East Hemel,

The Crown Estate

Flood Risk Assessment

EHUK-EXP-XXX-XXX-RP-C-0300

November 2025 – For Outline Planning

expedition

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00	01/08/2025	Draft for review	L Lester	A Garman	F Labbé
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Contents

1 Introduction

This Flood Risk Assessment (FRA) has been prepared to accompany an Outline Planning Application for the East Hemel (EH development). The Site comprises 354.55 hectares (ha) of land to the east of Hemel Hempstead. The Outline application is seeking consent for the following:

> *"Outline application for: urban extension comprising two new neighbourhoods and a new employment zone. The development to include new dwellings (including affordable housing and specialist accommodation for older people); new employment and industrial floorspace and ancillary facilities, a sports hub and Sports Pitches; green infrastructure and landscaping works*
>
> *(to include a country park, formal and informal open space, amenity space, Suitable Alternative Natural Greenspace, managed woodland, ecological areas); early years, nursery, primary and secondary education facilities; local centre uses (to include retail, community and employment uses; health and fitness, gym and other cultural and recreational uses; medical centre; transport mobility hubs; drainage works (including foul and surface water drainage infrastructure); ancillary infrastructure works; vehicular and active travel infrastructure; improvements to the Nickey Line and delivery of a proportion of the Hemel Garden Communities Green Loop; land for Gypsy and Traveller pitches; provision of an active travel bridge over the A414; safeguarded land for M1 Junction 8 improvements; ground remodelling, acoustic bund, engineering and demolition works. All matters reserved save for access from the A414/Green Lane junction and access from the B487/ Hemel Hempstead Road (Redbourn Road)".*

The Proposed Development forms part of the Hemel Garden Communities (HGC) programme. This is an ambitious proposal which will transform and grow Hemel Hempstead and create attractive, sustainable new neighbourhoods to its north and east by 2050.

The HGC Programme area covers the town of Hemel Hempstead, within the borough of Dacorum, as well as proposed growth areas straddling both Dacorum and St Albans districts to the north and east of the town and wider movement routes beyond. The partnership is working to develop a strategic approach to ensure the homes, employment opportunities and new infrastructure bring positive transformative to the whole town of Hemel Hempstead and the wider area.

This FRA should be read in conjunction with the proposed Drainage Strategy (included in Appendix 14.2 of the Water Resources and Flood Risk ES Chapter) that forms part of this planning application.

The structure of this FRA follows the checklist included in the National Policy Guidance (NPG) on Flood Risk and Coastal Change [1].

2 Development Site and Location

2.1 Where is the development site located?

The development site (the 'Site') shown in Figure 1 is located 1.7km east of Hemel Hempstead and directly west of the M1 Motorway, with the approximate centre at National Grid reference 509066 208141 as shown in Figure 1 below.

Figure 1: Site Location Plan

The Site covers an area of approximately 354.55ha and is sub-divided into four areas (Figure 2):

- East Hemel (EH) North, comprising the area of the Site within draft SADC Local Plan allocation H2 East Hemel Hempstead (North). This comprises the part of the Site to the north of Punchbowl Lane and south of the B487 Hemel Hempstead Road;

- EH Central, comprising the area of the Site within draft SADC Local Plan allocation H3 East Hemel Hempstead (Central). This comprises the part of the Site to the south of Punchbowl Lane and to the north of the A414;
- EH South, comprising the area of the Site within draft SADC Local Plan allocation H4 East Hemel Hempstead (South). This comprises the part of the Site to the south of the A414 and north of the A4147 St Albans Road; and
- EH East, comprising the land to the east of the M1 motorway

2.2 What is the current use of the site?

The Site is largely undeveloped and comprises of several irregular shaped agricultural fields, with some fields used for pasture (including grazing horses). Much of the Site is bordered by the M1 motorway to the east, the B487 Hemel Hempstead Road (Redbourn Road) to the north, urban areas of Hemel Hempstead to the west (including the neighbourhoods of Spencer's Park and Leverstock Green and Maylands Industrial Estate) and the A4147 Hemel Hempstead Road to the south.

The is cut (east-west) by the Nickey Line (a disused railway line that now forms a long-distance footpath and cycle way), Punchbowl Lane, Hogg End Lane and the A414 Breakspear Way.

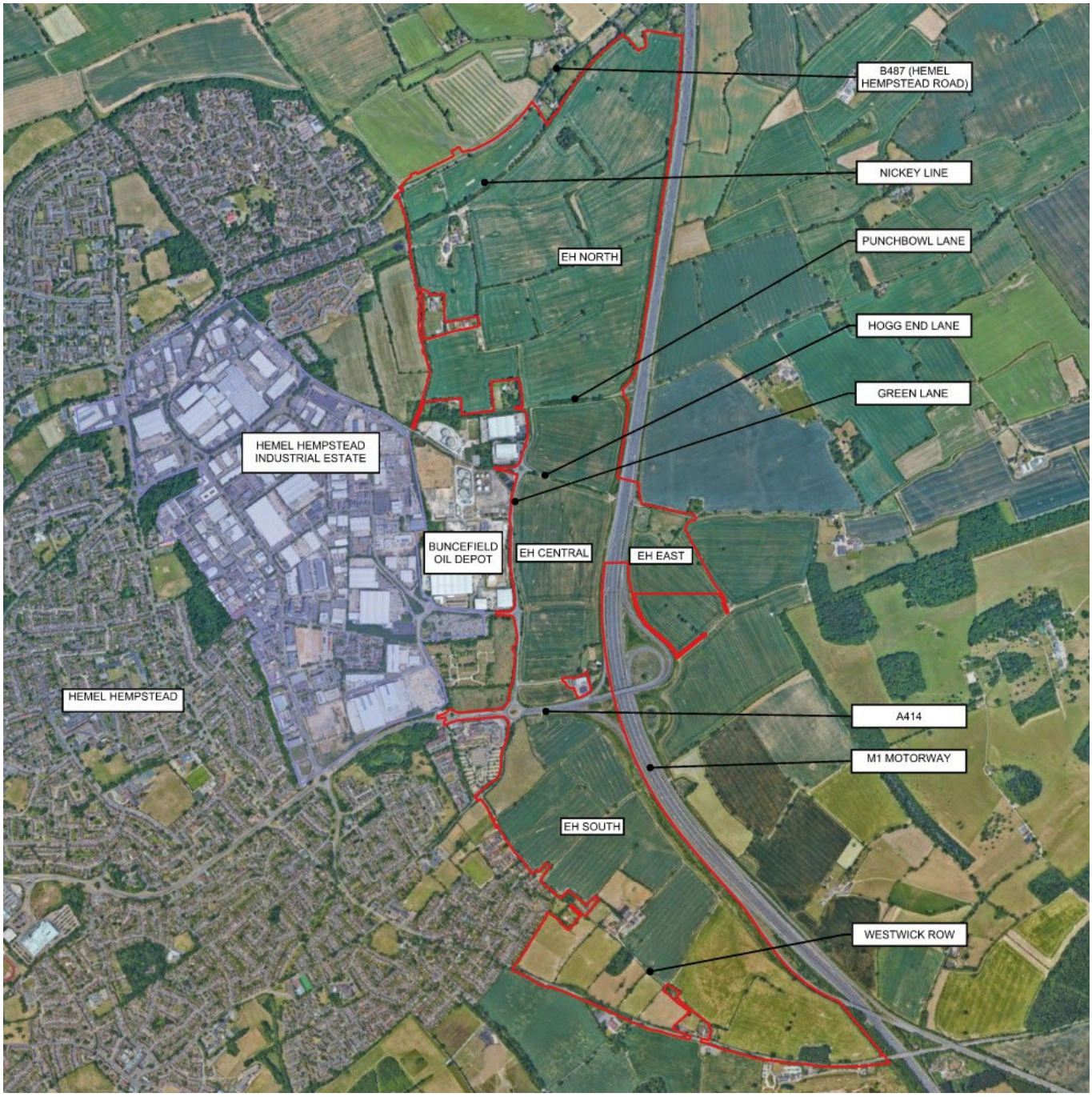

Figure 2: Subdivision of the Site and key roads

A detailed topographical survey was undertaken in 2014 and 2019 by Wardell Armstrong and Kings Land Surveyors (Appendix A of the Drainage Strategy in Appendix 14.2 of the Water Resources and Flood Risk ES Chapter). The pre-development site levels can be summarised as follows:

- The EH North area generally falls from the south to the north towards the B487 with levels between 134mAOD and 106mAOD. The southern part of EH North between Punchbowl Lane and Hogg End Lane slopes to the south, with levels between 134 and 128mAOD.
- The EH Central area slopes in two directions with the high point of approximately 137mAOD near the Green Lane roundabout down to 124mAOD in the north and 128mAOD in the south.

- The EH South area, slopes between 130mAOD to 126mAOD in the south-east through a low-lying valley running diagonally towards the M1 motorway. At the lowest point, the valley is approximately 111mAOD.
- The EH East area immediately to the east of the M1, has a high point of approximately 136mAOD and falls to the north, east and south. The approximate lowest point is at 124mAOD.

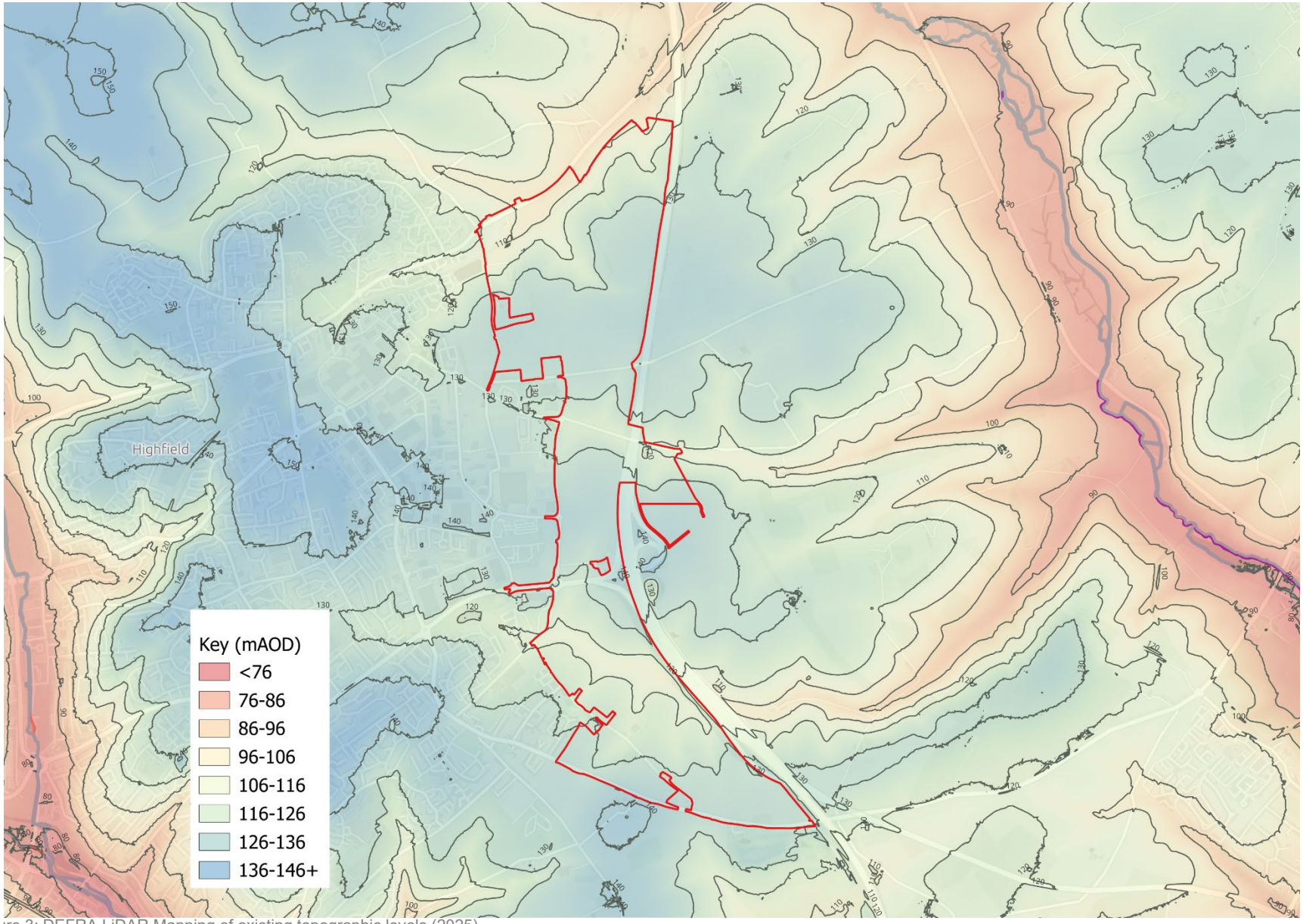

Figure 3: DEFRA LiDAR Mapping of existing topographic levels (2025)

The levels of the M1 slope down to the north from approximately 134mAOD to 106mAOD where it approaches the B487 (Redbourn Road/Hemel Hempstead Road).

The A414 bisects the central part of the site from east-west. This forms the 'boundary' between EH Central and EH South with levels between 128mAOD in the west to approximately 141mAOD in the east where it connects to the Junction 8 of the M1.

The B487 (Redbourn Road/Hemel Hempstead Road) runs parallel to the northern boundary of EH North. The B487 is a complement to the major highway and A-roads within and around the Site providing a link between Hemel Hempstead and Redbourn. The levels slope down towards the east and range approximately between 121mAOD to 104mAOD.

Green Lane is located immediately to the west of the site of EH Central. Green Lane is a local route which slopes down towards the north with levels between 138mAOD and 127mAOD.

Punchbowl Lane is located within EH Central, forming the 'boundary' between EH Central and EH North. This road goes underneath the M1 via an underpass with levels sloping down from approximately 132mAOD in the west at Green Lane to 130mAOD in the eastern boundary of the Site.

Hogg End Lane is located within EH Central and serves as a local connection between the residential and light industrial area in the west and the agricultural land in the east. This road goes underneath the M1 via an underpass with levels sloping down from approximately 126mAOD at the roundabout to 121mAOD at the eastern boundary of the Site.

The Nickey Line bisects the site from east-to-west within the EH North area. This track slopes down to the east from approximately 114mAOD at the western edge of the boundary to 105mAOD in the east of the Site.

Westwick Row bisects EH South from northeast to southeast and serves as a local connection between the A4147 and the A414 roundabout. There is a local highpoint of approximately 128mAOD near 'The Orchard' property, approximately within the upper third of the road. Westwick Row slopes down either side of this local point. Levels in the north of Westwick Row are approximately 118mAOD and 122mAOD in the south.

A4147 forms the boundary of EH South and connects the residential and light industrial areas to the west of the Site to the communities in the east. The A4147 slopes down to the east from approximately 134mAOD from the southwestern boundary of the Site to 131mAOD at the eastern edge approaching the M1.

2.3 Which Flood Zone is the site within?

The Environment Agency (EA) flood map shows that the site falls in Flood Zone 1 (outside of the 1:1000-year fluvial flood envelope, with an annual probability of flooding of less than 0.1%, Figure 4).

The South-West Herts Strategic Flood Risk Assessment (SFRA, 2019) [2] also shows the site is in Flood Zone 1. The relevant SFRA maps are shown in Appendix B.

According to the National Planning Policy Framework (NPPF) [3] and NPG [1], residential-led and commercial developments are permitted within Flood Zone 1.

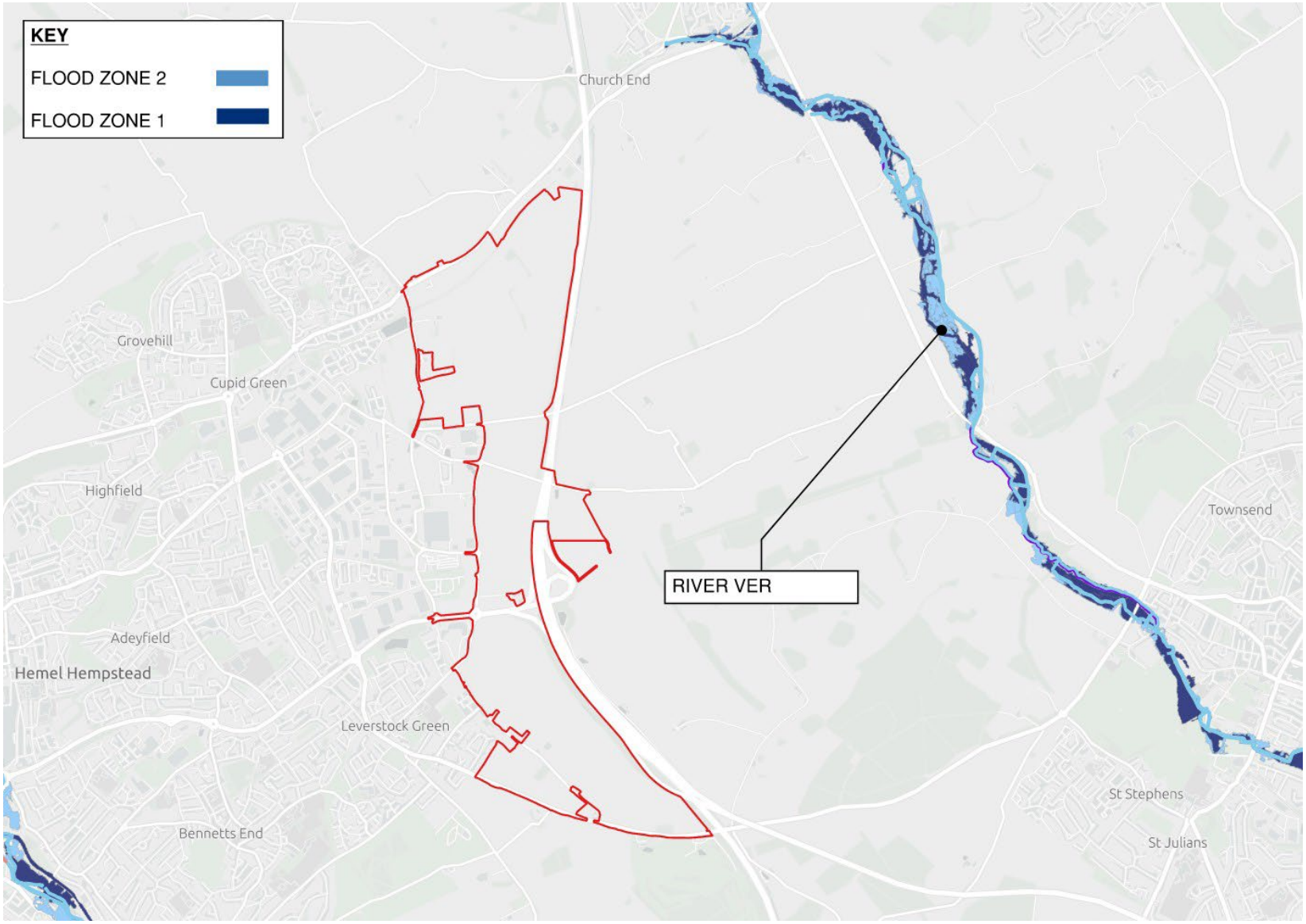

Figure 4: Flood Risk Zones [4]

3 Development Proposals

3.1 What are the development proposal(s) for this site? Will this involve a change of use of the site and, if so, what will that change be?

The Outline Planning Application is submitted in duplicate to St Albans City & District Council as the Local Planning Authority (LPA) for development falling within the District, and to Dacorum Borough Council as LPA for development falling within the Borough. The development components for which outline planning permission is sought (the Development) is as follows:

- All matters (Access, Appearance, Landscape, Layout and Scale) are reserved for future determination, save for access from the A414/Green Lane junction and access from the B487/ Hemel Hempstead (Redbourn Road). This application seeks Outline Planning Permission for:
- Up to 4,000 new dwellings (Class C3) including up to 640 elderly care / extra care units (Class C2 residential institutions) and 16 supported living units.
- Up to 190,600 sq.m of Employment Use including up to 54,500 sq.m Business and Research & Development (Class E(g)); and up to 104,250 sq.m Distribution (Class B8); and up to 31,850 sq.m Mixed Industrial Uses (Class B2 / Class E(g)(iii)).
- Three Primary Schools (Class F1) incorporating Early Years provision on sites of 2.03ha per 2FE school site, and 2.92ha per 3FE school site (up to 7.87ha in total).
- Secondary School (Class F1) for up to eight forms of entry on a site of not more than 10.78 hectares.
- Up to 2,000 sqm in total of Community Uses (Classes F1 and F2) including community centres and meeting places, library use, places of worship and other community facilities.
- Up to 2,300 sqm of health care services (Class E(e) including medical and dental services.
- Up to 18.8ha for a Sports Hub and Sports Pitches including up to 3,400 sqm in total of sports hub uses in Class E(d). Up to 775 sqm health and fitness, gym and other cultural and recreational uses in Class E(d).
- Up to 525 sqm nursery uses in Class E(f).
- Up to 76.8 ha of Suitable Alternative Natural Greenspace (SANG).
- Green infrastructure and landscape works to include a country park, formal and informal open space, including natural / semi-natural open space, parks & gardens, amenity space, managed woodland, ecology areas and links including mitigation works, green corridors, outdoor sports facilities including changing facilities, play areas, allotments and associated lighting and infrastructure.
- Mobility hubs.
- An active travel (pedestrian and cycle) bridge over the A414
- Vehicular and active travel access points and connections to the surrounding highway
- Vehicular and cycle parking including electric vehicle charging points.
- Pedestrian, cycle, equestrian, vehicle and bus routes, with associated bus stops, crossings, street furniture and lighting.

- Improvements to existing Public Rights of Way
- Improvements to the Nickey Line through the site. Delivery of the Hemel Garden Communities (HGC) Green Loop through the site.
- Land for up to 40 Gypsy and Traveller pitches.
- Safeguarded land for M1 Junction 8 improvements
- Engineering works including ground remodelling
- Creation of bunds (incorporating acoustic fencing) adjacent to the M1 motorway.
- Any necessary demolition of existing buildings.
- Retention of and improvements to listed buildings (subject to separate Listed Building Consent).
- Infrastructure works (comprising energy/utilities provision and diversions as necessary).
- Drainage works including foul drainage infrastructure, sustainable drainage systems and multi-function stormwater attenuation features

The Proposed Development is shown illustratively in Figure 5 and additional masterplan drawings are included in Appendix C.

The highways layout for the accesses from the A414/Green Lane and B487/Hemel Hempstead Road (Redbourn Road) are submitted at this stage for approval. Landscape and drainage detail will be conditioned for both these junctions.

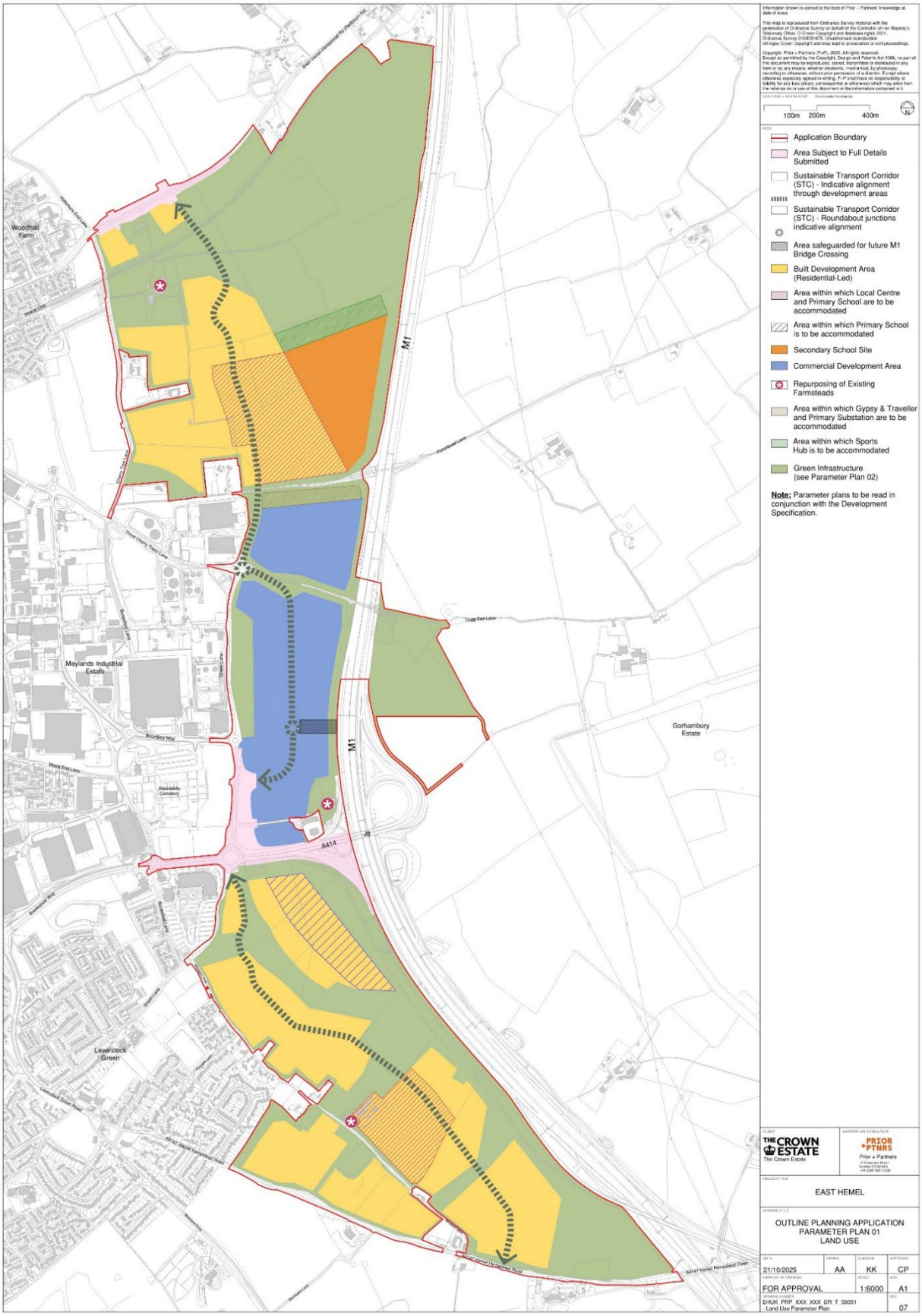

Figure 5: Land Use Parameter Plans

3.2 In terms of vulnerability to flooding, what is the vulnerability classification of the proposed development?

The residential development (principally located in EH North and South) are classed as ‘More Vulnerable’ in accordance with Table 2 of the NPPF (Annex 3) [3].

Commercial development (principally located in EH Central) is classed as ‘Less Vulnerable’ in accordance with Table 2 of the NPPF (Annex 3) [3].

A number of buildings within the residential areas are mixed-use, including retail, community centres, and sports hub mobility hubs. These are classed as ‘less vulnerable’ in accordance with Table 2 of the NPPF (Annex 3) [3].

The schools are classed as ’More Vulnerable’, in accordance with Table 2 of the NPPF (Annex 3) [3].

As such, the vulnerability classification of the Site as a whole is considered to be “More Vulnerable”.

3.3 What is the expected or estimated lifetime of the proposed development likely to be?

The residential element has an estimated lifetime of at least 100 years. The non-residential elements have an estimated lifetime of at least 60 years.

4 Sequential Test

In accordance with the NPPF [3] a Sequential Test must be applied by the local planning authority with regards to any proposed development of this scale concerning issues relating to flooding. As the Proposed Development is entirely in Flood Zone 1, with a very low risk of flooding, no alternative locations have been considered for the Proposed Development.

The Sequential Test is therefore considered passed and other sources of flood risk are discussed in Section 5.

5 Climate Change

5.1 How is flood risk at the site likely to be affected by climate change?

Climate change is predicted to increase mean rainfall intensities and fluvial flood levels.

The following climate change allowances have been considered as part of this flood risk assessment, in line with NPG and latest DEFRA mapping of climate change allowances for the Colne Management Catchment [5].

Residential areas (Catchment A, EH North, and Catchment C, EH South):

- 35% increase in rainfall intensities on the 1:30-year rainfall event (Upper End allowance to 2070s horizon); and
- 40% increase in rainfall intensities on the 1:100-year rainfall event (Upper End allowance to 2070s horizon)

Commercial area (Catchment B, EH Central):

- 25% increase in rainfall intensities on the 1:30-rainfall event (Central allowances to 2070s horizon)
- 25% increase in rainfall intensities on the 1:100-year rainfall event (Central allowance to 2070s horizon)

The Site, being in Flood Zone 1, is not impacted by increases in fluvial flows but will be impacted by the increase in rainfall over the 2070s horizon. In developing the surface water drainage strategy, the 35% and 40% climate change allowances on rainfall intensities have been considered for the respective storm events for residential areas (EH North and South). For the commercial area (EH Central), the 25% central allowances on rainfall intensities have been considered for the respective storm events.

6 Site Specific Flood Risk

6.1 What is/are the main source(s) of flood risk on the site?

A review of the main potential sources of flooding that could affect the development has been carried out, considering the key sources of flooding defined in the National Planning Policy Framework (NPPF) [3].

Relevant extracts from the latest SFRA (2019) are included in Appendix B.

6.1.1 Fluvial Flooding

The Site is located approximately 3km west of the River Ver, and 3.3km east of the River Gade. The Site is located within the catchment of the River Ver.

As shown in the flood map presented in Figure 3, the Site is located in Flood Zone 1 and therefore does not have a significant risk of fluvial flooding.

6.1.2 Tidal

The Site is not in proximity to any tidal estuary or the sea. Therefore, there is no risk of tidal flooding.

6.1.3 Pluvial and Sewer Flooding

In developed areas, where impermeable surfaces typically drain to sewers, pluvial flooding tends to occur as a result of sewer surcharging or poor drainage. Though the Site is currently undeveloped, it is abutted by development and existing assets including sewers and balancing ponds. Both pluvial and sewer flood risks are relevant and have therefore been considered in this FRA.

Pluvial Flooding

The EA surface water flood risk map (Figure 6) shows that there is a relatively low risk of flooding of surface water across the majority of the Site. The low-lying valleys, however, function as overland flow conveyance routes and are at risk of surface water flooding during intense rainfall events.

The Site is not formally developed, and mainly consists of agricultural fields, hedgerows and small woodlands and is therefore considered to be greenfield. It generally drains naturally via infiltration though during intense storms, excess rainfall runs off to the base of valleys creating temporary overland flow routes.

These flood events are shown in the EA surface water flooding map (with and without climate change effects), Figure 6 and Figure 7, and have been considered in the Drainage Strategy (Appendix 14.2 of the Water Resources ES Chapter) discussed in Section 7.0.

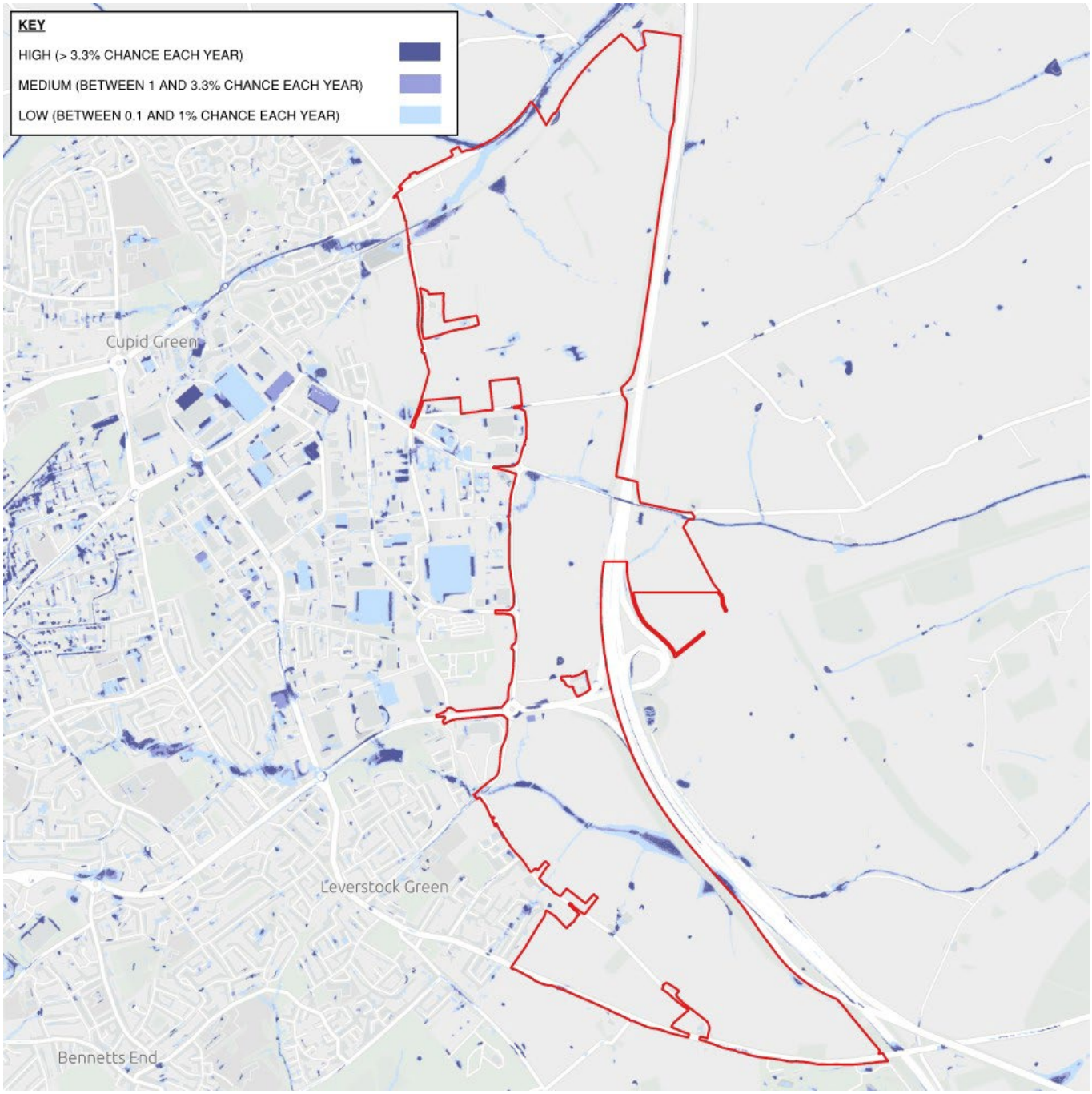

Figure 6: EA risk of surface water flooding without climate change effects [6]

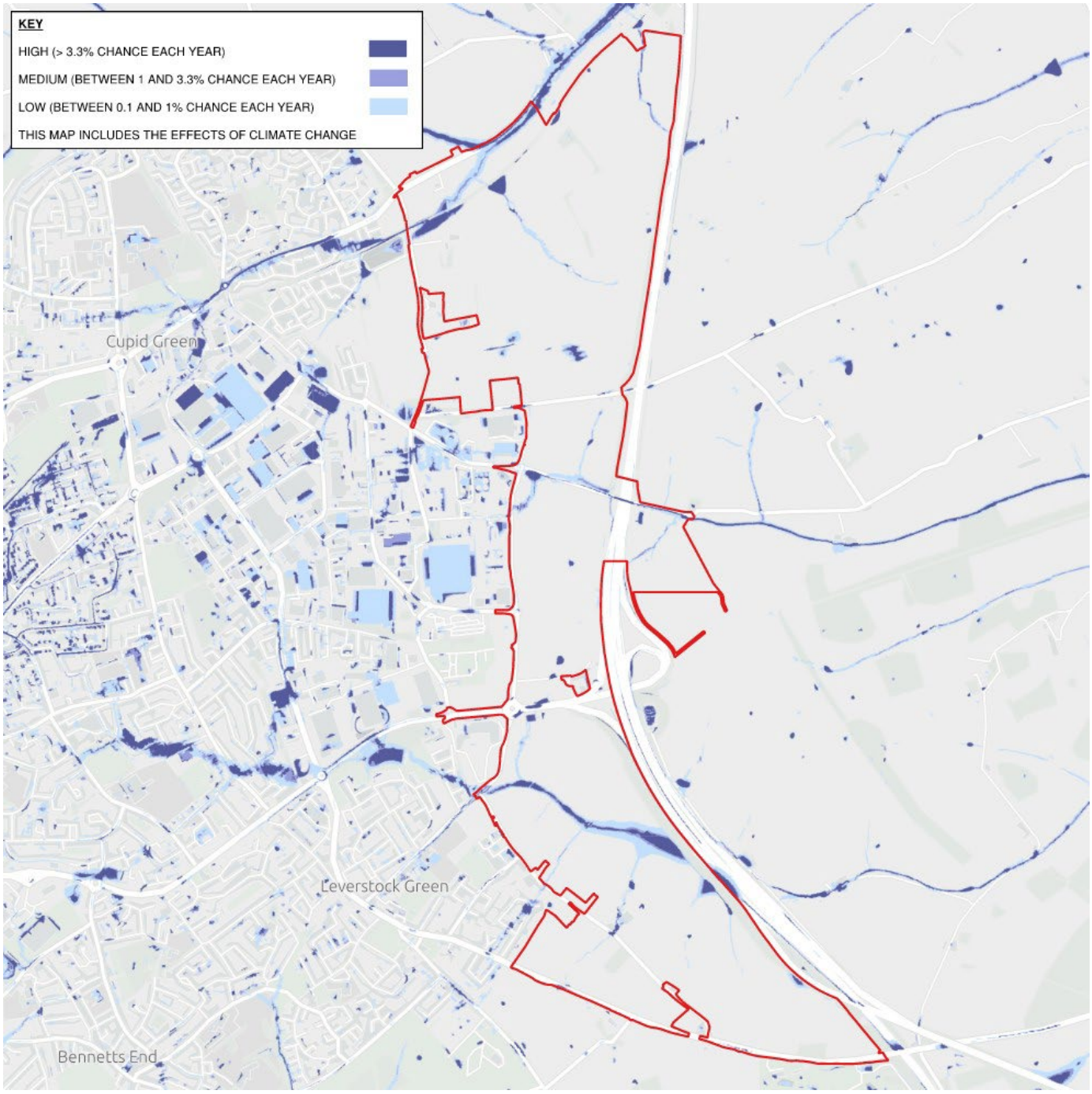

Figure 7: EA Risk of surface water flooding map with climate change effects [6]

Sewer Flooding

Thames Water records show a number of surface water sewers in the vicinity of the Site, as well as surface water attenuation ponds nearby. These are illustrated in Figure 8Figure 8.

In EH North, there is an existing 375mm diameter surface water sewer adjacent to the B487 (Redbourn Road/Hemel Hempstead Road) which connects to Redbourn Reservoir and is understood to discharge to the River Ver. There is also a 375mm diameter surface water sewer in Three Cherry Lane draining the caravan park. These sewers connect to an 875mm and then 1200mm diameter sewer which discharge to the Redbourn Reservoir.

In EH South, there is an existing 375mm diameter surface water sewer which bisects the Site. This connection drains the development to the west of the Site and passes beneath the M1 motorway, before discharging into the River Ver.

Surface water runoff from the M1 Motorway is currently managed through balancing ponds along the eastern side of the M1 Motorway adjacent to the Site. Surface water runoff from the A414 is managed through a local balancing pond to the south of the A414. These ponds are owned and managed by National Highways.

The following historic surface water flood events have been recorded near to the Site:

- Leverstock Green to the southwest of the Site has had a number of historic flood events (2016 and 2020), understood to originate from the Marchmont Pond. Thames Water are responsible for managing the Marchmont Pond and are aware of these flooding incidents (Appendix D). The last recorded flood event associated with Marchmont Pond was October 2020, during Storm Alex, where the nearby Kings Copse development recorded significant flooding. It is understood that this was a 1:99-year storm event where the valve within the Marchmont Pond was left open, which exacerbated downstream flooding. No recent flooding has been recorded since the valve has been closed.
- Engagement with TW has confirmed there has been flooding originating from Redbourn Reservoir along the B487 (Appendix D). Furthermore, anecdotal evidence following public engagement sessions have indicated flooding along the B487 and is believed to arising from the surcharge of the sewer system. The flooding along the B487 could therefore be related to sewer capacity issues of the existing 375mm diameter pipeline connecting the reservoir to the outfall at the River Ver. Thames Water is investigating this further with Hertfordshire County Council (HCC) LLFA. There are no other specific records of sewer flooding incidents near or within the Site. The South-West Herts SFRA (2019) [4] does not mention any historic sewer flooding events.

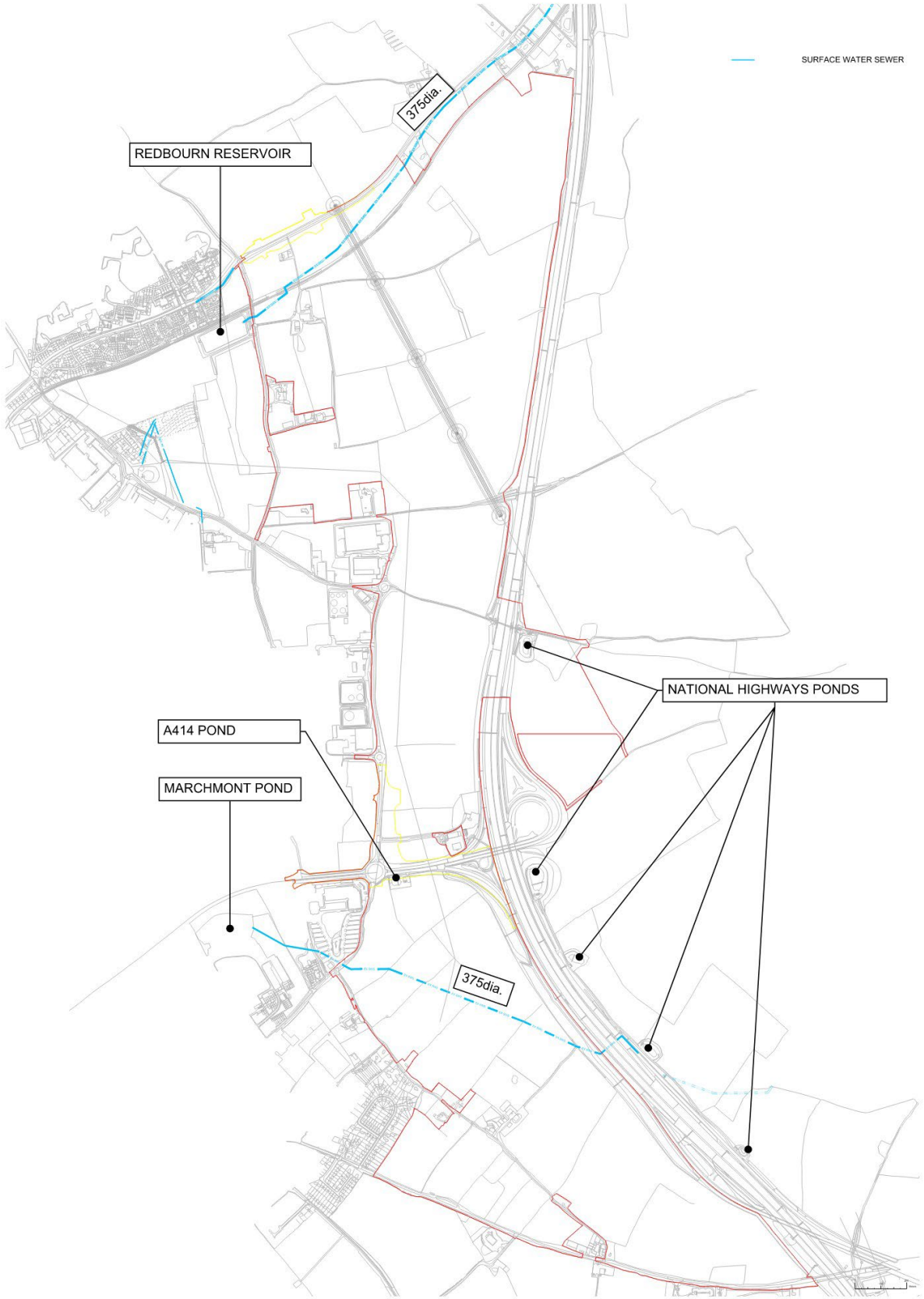

Figure 8: Existing surface water network

6.1.4 Groundwater

The Site is generally found to be underlain by Lewes Nodular and Seaford Chalks with superficial Clay-with-Flints as per British Geological Society (BGS) Mapping [7] and historic investigations undertaken by Wardell Armstrong in 2014 and 2017 to support previous proposals.

The South-West Herts Level 1 SFRA (2019) notes that within the wider South-West Hertfordshire there have been several incidents of groundwater flooding. This tended to be within the eroded chalk valleys, notably within the Chilterns in the winter of 2000/2001, with areas in the northeast of St Albans affected. It is also noted that the upper reaches of the River Ver catchment (Markyate) had groundwater flooding recorded in 2014.

The historic groundwater flooding records detailed in the SFRA indicate that groundwater flooding is mostly around the Tring Reservoirs, the Chilterns and Markyate; all of which are several miles outside of the Site boundary. The SFRA further confirms that there is further localised risk of groundwater flooding within areas of permeable sand and gravel deposits, however these are also not present within the Site boundary.

Geotechnical site investigations have been carried out on the Site. This includes geophysical investigation in 2014, groundwater investigation in 2017 and more recently investigations in 2019 and 2025. This also includes infiltration testing completed May 2025 (Appendix J of the Drainage Strategy in Appendix 14.2 of the Water Resources and Flood Risk ES Chapter).

A review and synthesis of historic investigations undertaken by A-Squared to support the Ground Conditions and Contamination Scoping Opinion (Appendix E) also notes that BGS mapping indicates the risk of groundwater flooding is either low or negligible across the Site.

Groundwater levels identified in previous investigations and synthesised by A-Squared (Appendix E) indicate that levels range from 84.56mAOD to 96.27mAOD with the groundwater depth generally increasing to the south and east. Contouring of groundwater elevations identified an easterly groundwater flow in the north and centre of the Site and a southeasterly flow in EH South.

Due to the relatively low groundwater levels and relatively low permeability of the superficial ground conditions, the risk of groundwater flooding is considered to be low.

6.1.5 Water Infrastructure

The risk of flooding from reservoirs is considered to be very low across most of the Site as per the EA ‘Reservoir Flood Map’ [8] but there is localised risk associated with Redbourn Reservoir to the northwest of EH North, as illustrated in Figure 9Figure 9 9.

The risk associated with Redbourn Reservoir is confirmed by the South-West Herts SFRA (2019) [4] which defines a possible route of flooding from nearby reservoirs. Whilst the region at greatest risk (around the Tring reservoirs) is beyond the Site extents, the proximity to the Marchmont Pond and Redbourn Reservoirs brings some localised risk of reservoir flooding to the southern and northern parts of the site, respectively.

Marchmont Pond, located to west of EH South, has not been identified in the SFRA and EA mapping as this is not defined as a reservoir. This Thames Water balancing pond has been noted to be associated with flood risk when the pond is breached and/or fails (described in section 6.1.3).

Redbourn Reservoir is included in the EA and the SFRA mapping (included in Figure 9 9 and Appendix E, respectively). Both maps indicate a localised risk associated with the Redbourn Reservoir being breached or failing. The risk of flooding from reservoir breach is currently limited to localised natural surface water conveyance landscape areas though anecdotal evidence, discussed in Section 6.13, suggests the existing surface water network may be surcharging and flooding the B487. This is being investigated by Thames Water and HCC LLFA.

As outlined in the SFRA, all reservoirs are managed and maintained by Thames Water with dedicated emergency planning teams, response plans and mitigated by regular inspection and supervision by a reservoir panel engineer. The overall risk to the Proposed Development is therefore considered to be managed and low.

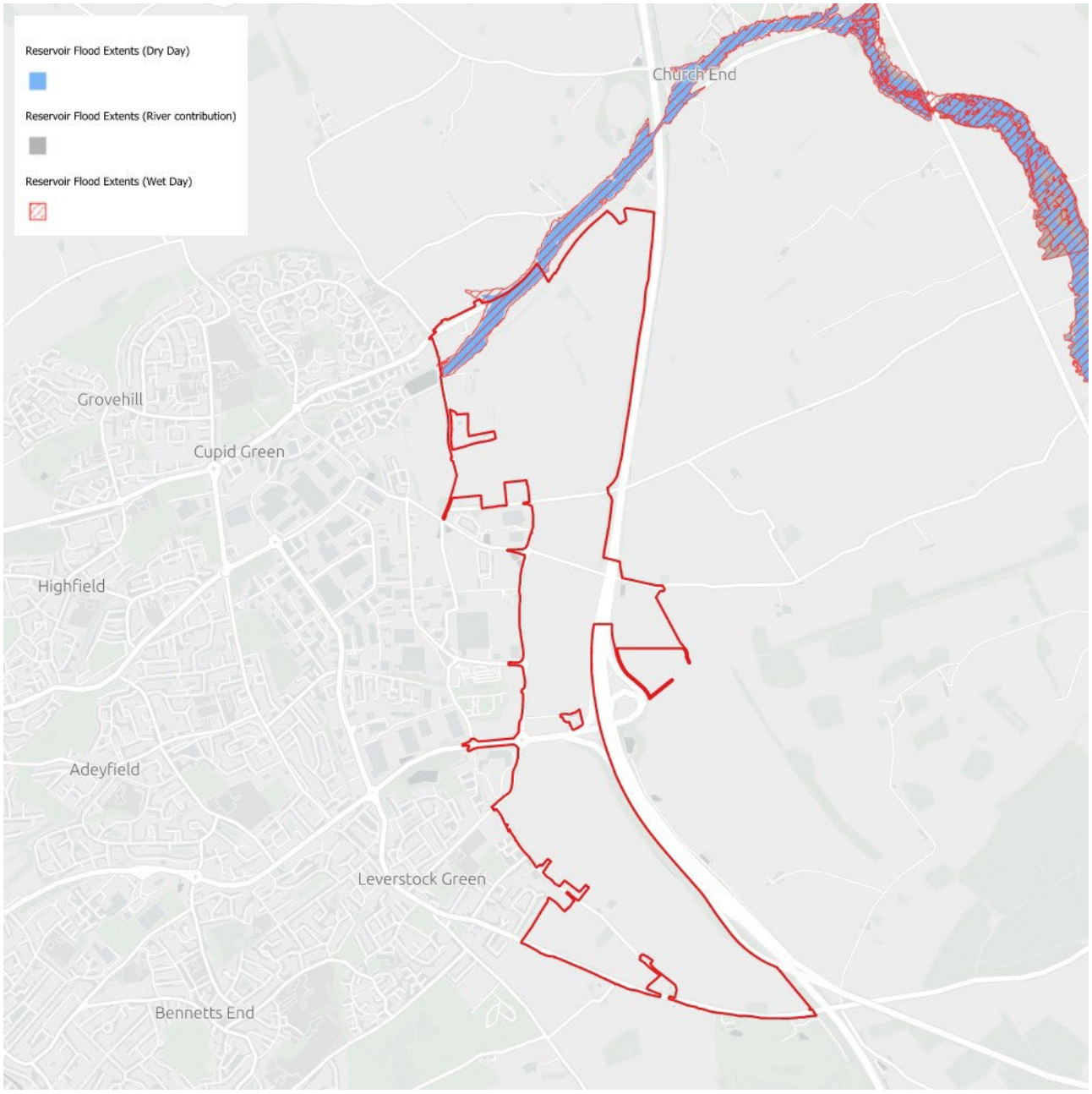

Figure 9 9: EA Risk of Flooding from Reservoir Map [8]

6.1.6 Conclusions

The Site is not subject to fluvial or tidal flooding given the distance from any river or sea. Further, given the depth of the groundwater and geology, the Site is not considered to be at risk of groundwater flooding. The Site is, however, subject to pluvial and sewer flood risks, as well as localised reservoir flood risk.

The Site is subject to pluvial flooding in the valleys, which function as overland flow conveyance paths, particularly in intense storms. The risk of flooding will be managed by the measures set out in Section 7.0 through the development of a sustainable drainage strategy (Appendix 14.2 of the Water Resources and Flood Risk ES Chapter).

Flooding from existing sewers is considered to be low risk and the impact of the Proposed Development on the existing sewer system will be managed by measures set out in Section 7.0 through the development of a sustainable drainage strategy (Appendix 14.2 of the Water Resources and Flood Risk ES Chapter) in alignment with guidance from HCC LLFA and Thames Water.

The localised risk of flooding in the north of EH North associated with Redbourn Reservoir and the possible surcharging of the existing system is being investigated further by HCC LLFA and Thames Water. Flood risk arising from the reservoir will be managed by measures set out in Section 7.0 through the development of a sustainable drainage strategy (Appendix 14.2 of the Water Resources and Flood Risk ES Chapter). Likewise, the risks associated with Marchmont Pond, although not a reservoir, will be managed through the sustainable drainage strategy.

6.2 What is the probability of the site flooding?

As stated, the Site is located within Flood Zone 1 with an annual probability of fluvial flooding less than 0.1%.

As discussed in Section 6.1, however, there are localised risks of surface water flooding across the Site associated with intense storms as well as reservoirs and sewers. The risk of surface water flooding, presented in Figure 6, is contained within the low-lying valleys for both the 1:30 and 1:100-events. With the effect of climate change, presented in Figure 7, the risk remains in the low-lying valleys for all events. The risk of surface water flooding from intense storm events is therefore contained within the low-lying valleys.

For storm events greater than 1:30, sewer flood events will contribute to the probable extents of flooding. The extents will, however, remain in the low-lying valleys given the Site's topography.

Similarly, should the Redbourn Reservoir or Marchmont Ponds be breached, the existing infrastructure will contribute to the extent of flooding within the low-lying valleys, as was the case in October 2020 where the Marchmont Pond had an open valve which resulted in surcharging the downstream surface water sewer system (see Section 6.1.3).

The valve at Marchmont Pond has since been closed, and the risk of breach associated with both Marchmont Pond and Redbourn Reservoir is considered low, as defined in Section 6.1.5.

The high flood risk (greater than 3.3% per year) is therefore localised to low-lying, undeveloped valleys which contain the extents whilst the majority of the Site is considered to be at a very low risk.

6.3 Are you aware of any other sources of flooding that may affect the site?

No other sources of flood risk have been identified.

6.4 What is the expected depth and level for the design flood?

As stated in Section 6.2, the Site is generally at low risk of flooding but does have localised risk of flooding associated with intense storm events, sewer surcharge and reservoirs/ponds.

Flood risk and depth mapping from the EA [6] indicates a range of possible flood depths within the low-lying valleys with the deepest in the southern valley in EH South near the M1 motorway and in the local depression beside the Nickey Line in EH North. The maximum depth at the lowest point of the southern valley is 1.2m for the 1:100-event (between 1% and 3.3% probability). Generally, the southern valley has a flood depth between 0.3 and 0.6m in the 1:100-event.

Similarly, the maximum depth at the northern depression beside the Nickey Line is 1.2m for the 1:30-event (greater than 3.3% probability). This maximum condition is illustrated in Figure 10. The majority of the low-lying areas subject to surface water flooding are generally at a low probability (between 0.1% and 1%) of having depths between 0.2 and 0.3m.

The effect of climate change increases the flooded extents of the low-lying valleys, as illustrated in Figures 5 and 6. It also increases the probability of having a maximum depth of 1.2m in the lowest point of the southern valley to greater than 3.3% (i.e., 1:30-event). The northern low point beside the Nickey Line remains likely in the 1:30-event though with slightly increased extents.

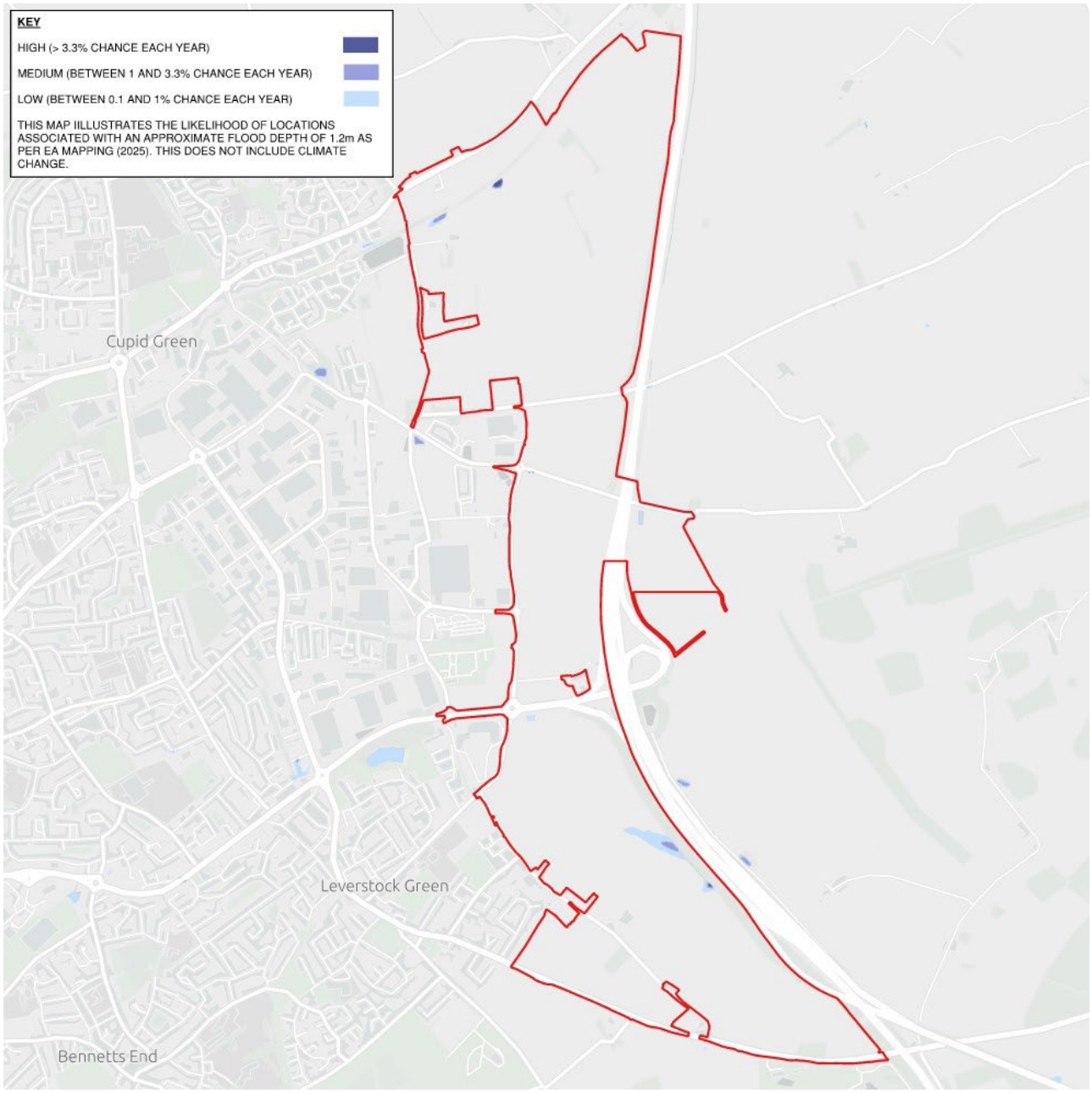

Figure 10: EA risk of surface water flooding resulting in 1.2m flood depth mapping without climate change

6.5 Are properties expected to flood internally in the design flood and to what depth?

The Proposed Development buildings have been sited away from the low-lying valleys subject to surface water, sewer, and reservoir flood risk (i.e., low-lying areas are to remain undeveloped/open space). It is proposed that all generated runoff up to the 1:100 + cc storm event will be contained within the low-lying valleys away from the Proposed Development. This is described further in Section 7.0 and the Drainage Strategy (Appendix 14.2 of the Water Resources and Flood Risk ES Chapter). Therefore, there is no significant risk of flooding for properties.

6.6 How will the development be made safe from flooding and the impacts of climate change, for its lifetime?

The developable areas will be situated outside of the areas where there is a higher risk of surface water flooding via overland flow conveyance, sewer flooding associated with surcharging and potential reservoir flooding Therefore, there will be no risk of flooding for the parts of the site where development is proposed.

The assessment has considered the potential impacts of climate change. As described in Section 7.0, the design of the surface water drainage system will consider the latest predictions for the effects of climate change on design rainfall intensities.

6.7 How will you ensure that the development and any measures to protect the site from flooding will not cause any increase in flood risk off-site and elsewhere? Have you considered the impacts from climate change, over the expected lifetime of the development?

EA mapping presented in previous sections indicates that during intense storms the low-lying valleys function as conveyance areas for overland surface water flows generated off-site during the major storm events.

The Proposed Development and associated drainage strategy has therefore been closely integrated with the existing landscape including overland flow routes with the Proposed Development sited outside of the low-lying valleys prone to pluvial, sewer and reservoir flooding. The existing overland flow routes are therefore safeguarded to ensure the Proposed Development does not exacerbate flooding off-site and elsewhere.

The Proposed Development's sustainable drainage network will be designed to ensure there is no surface water flooding for the 1:30 year event + cc% allowance for climate change and that surface water is contained for both the 1:100 + cc% climate change event. The climate change allowances are as per Section 5.1 for the different areas.

The Drainage Strategy (Appendix 14.2 of the Water Resources and Flood Risk ES Chapter) describes how the proposed surface water drainage system will be designed independent of overland flow routes so as not to increase flood risk on or off the site. The overland flow extents are contained within low-lying landscaped parts of the site, free of any buildings or development. As the sewer and reservoir flood extents are also constrained to the low-lying valleys, ensuring these overland flow routes remain unobstructed should also provide suitable mitigation of the risks associated with sewer surcharge and/or reservoir breach/failure.

To inform the arrangement of the dedicated overland flow route, we have extracted the flood depth and extents from the EA Risk of Surface Water Flooding (inclusive of climate change) dataset (2025) for the Site [6] . This is illustrated by Figure 11 and described further in the Drainage Strategy (Appendix 14.2 of the Water Resources and Flood Risk ES Chapter).

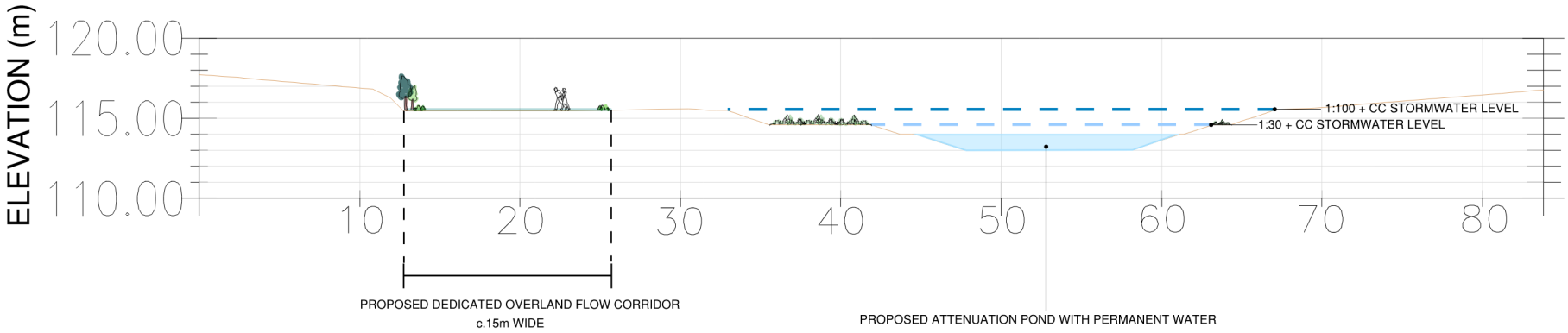

Figure 1111: Typical section through proposed pond and overland flow route

6.8 Are there any opportunities offered by the development to reduce the causes and impacts of flooding?

As discussed in Section 6.7, the Proposed Development will contain and manage 1:100+cc storm generated surface water flooding originating from outside the site which is currently unmanaged. These flood events occur from areas upstream of the site, and there are no further opportunities to reduce flooding to surrounding communities and facilities.

7 Surface Water Management

7.1 What are the existing surface water drainage arrangements for the site?

As discussed in Section 5 and illustrated in Figure 8Figure 8, there is limited surface water drainage infrastructure within the Site. There are no foul water sewers within the Site.

Currently the entire Site is greenfield and drains naturally via infiltration.

No significant existing pollution control measures and other stormwater attenuation are in place within the Site.

7.2 If known, what (approximately) are the existing rates and volumes of surface water run-off generated by the site?

As agreed with the LLFA (Appendix G of the Drainage Strategy in Appendix 14.2 of the Water Resources and Flood Risk ES Chapter), greenfield surface water runoff rates have been estimated using the ReFH2 method with soil characteristics as per LandIS Soil Report (Appendix F in the Drainage Strategy in Appendix 14.2 of the Water Resources and Flood Risk ES Chapter), specific to the Site, and FEH22 rainfall data. The rates have been determined for the three drainage catchments, namely:

- Catchment A – represents EH North
- Catchment B – represents EH Central
- Catchment C – represents EH South

The calculations are included in Appendix K of the Drainage Strategy (Appendix 14.2 of the Water Resources and Flood Risk ES Chapter). The resultant runoff rates (l/s) are as follows:

Table 1: Existing (greenfield) runoff rates

Storm Return Period	Runoff Rate (l/s)		
	Catchment A	Catchment B	Catchment C
1 in 30 years	207.8	342.6	428.3
1 in 100 years	263.9	432.6	540.0

As previously discussed, it is understood that surface water runoff currently generated within the Site largely infiltrates naturally with some localized ponding in the low-lying valleys. There is no evidence of any parts of the site discharging into surrounding Thames Water surface water sewers. The rates are therefore currently unrestricted.

7.3 What are the proposals for managing and discharging surface water from the site, including any measures for restricting discharge rates?

7.3.1 Strategic principles

The key strategic principles of the Drainage Strategy accompanying this planning application are described in the Sustainable Drainage Strategy and summarised below:

- Adopting the most sustainable disposal route for surface water drainage flows, in line the HCC LFRMS 2 and with the drainage hierarchy set out by the SUDS Manual CIRIA C753 .

- Flood resilience and no increase in flood risk off-site.
- Management of stormwater flows in efficient multi-function open water bodies integrated with green infrastructure, including permanent water to enhance biodiversity and amenity.
- Control runoff at source and maximise opportunities for enhancement of the landscape and biodiversity following best practice in line with The SuDS Manual (CIRIA C753)
- Control pollution to the water environment in line with the requirements of the SuDS Manual (CIRIA C753)
- Effective management and maintenance of the drainage infrastructure.
- Management of water levels in the proposed wetlands using smart weather-controlled technology to remove topping up requirements and maintain water quality.
- Harvesting of rainwater in a carbon and land efficient way using latest smart technology to reduce pressure on locally scarce water resources.

7.3.2 Overview of drainage system

The surface water drainage strategy is shown in Figure 121212 below, and described in detail in the Drainage Strategy (Appendix 14.2 of the Water Resources and Flood Risk ES Chapter). In summary, surface water runoff will be controlled and discharged to the River Ver via existing Thames Water Surface Water sewers.

This will contribute additional discharge to the existing Thames Water network, which has been agreed-in-principle with Thames Water though they have noted that reinforcing may be required following further detailed capacity studies (Appendix D).

An additional requisition route will be required from the east of the M1 to connect the drainage to the Thames Water network in the south.

On this basis, it is proposed to reuse of existing network of Thames Water sewers and outfalls to the River Ver, helping to minimise disruption to established riverine landscape, ecology and geomorphology.

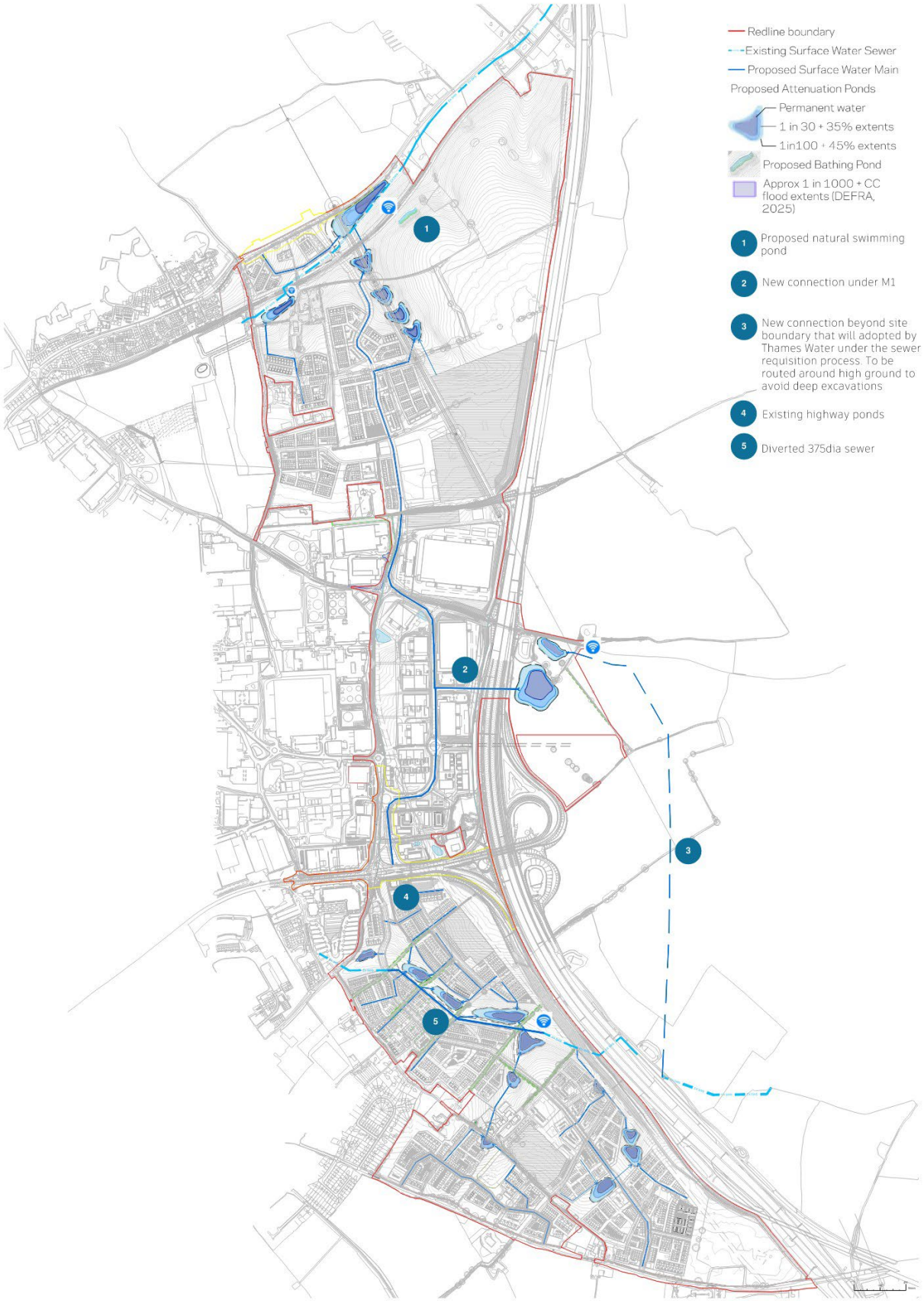

Figure 12: Surface water drainage strategy

The definition of the drainage catchments has been determined from proposed site levels and key infrastructure barriers such as the A414, Punchbowl Lane, Westwick Row and the Nickey Line. The proposed three large catchments, correlating to EH North, EH Central and EH South, are presented in the Drainage Strategy (Appendix 14.2 of the Water Resources and Flood Risk ES Chapter). For all catchments, source control measures and sustainable drainage design has been incorporated into the masterplan.

Across the Site, strategic attenuation ponds have been nestled in the landscape's valleys as primary source controls to manage most of the generated surface water runoff for up to the 1:100+cc event. The placement of the attenuation ponds is sensitive to the existing overland flow routes previously discussed in this FRA and will safeguard these overland flow routes within the landscaped valley. The proposed open water ponds will provide further pollution control and biodiversity enhancements before discharging attenuated surface water to the River Ver through the Thames Water network.

The primary system is supported through a secondary system of with generous soft landscape areas and maximisation of permeable paving for parking areas surrounding office and residential buildings. Raingardens and urban swales will be provided along streets to collect and treat road runoff at source and will contribute to achieving pollution control requirements.

7.3.3 Design criteria

The surface drainage system has been designed for:

- No surface water flooding for all events up to 1:30-year + 35% return period, in line with BS EN 752;
- No flooding of buildings and containment on site extreme events up to the 1:100-year return period, in line with NPPF [3].

The climate change allowances discussed in Section 5 have been applied to above design events.

7.3.4 Approach to attenuation

As agreed with the Lead Local Flood Authority (LLFA) and the EA, it is proposed to provide attenuation which restricts discharge during peak storm events as per Hertfordshire County Council (HCC) Local Flood Risk Management Strategy (LFRMS) 2 Policy 14 [10] and agreed with the LLFA (Appendix G of the Drainage Strategy in Appendix 14.2 of the Water Resources and Flood Risk ES Chapter). The Drainage Strategy has therefore been developed on the basis of applying 'complex control'. This involves achieving Policy 14 criteria by limiting peak discharge to:

- Peak greenfield runoff rate, for all discharge adding up to the 1:100 6-hour generated greenfield runoff, and
- 2l/s/ha for all discharge beyond this volume.

This is further described in Section 5 of the Drainage Strategy.

7.4 How will you prevent run-off from the completed development causing an impact elsewhere?

As described in the Drainage Strategy, all surface water drainage flows from the main site will be discharged to the River Ver at a controlled rate. Generated stormwater runoff will be attenuated within the sustainable drainage features, including the primary attenuation ponds, within the Site.

Events in exceedance of the 1:30 year design event and up to the 1:100 year with an allowance for climate change will be contained on the site, flooding areas of low sensitivity in a controlled manner, as outlined in Section 6.6.

Refer to Section 6.7 which describes the approach to ensuring the drainage strategy is designed to be independent of the overland flow conveyance routes, mitigating any risk of the proposed development causing any increase in flood risk elsewhere.

7.5 Where applicable, what are the plans for the ongoing operation and/or maintenance of the surface water drainage systems?

A maintenance and management plan has been developed to ensure that the performance of the drainage system is maintained over its entire design life. This has been based on guidance from the SUDS Manual (CIRIA C753) [10]. It covers all private elements of the system including raingardens, swales, wetlands (ponds), and drainage pipework. The maintenance plan is included in Appendix U of the Drainage Strategy in Appendix 14.2 of the Water Resources and Flood Risk ES Chapter.

8 Occupants and Users of the Development

8.1 Will the development proposals increase the overall number of occupants and/or people using the building or land, compared with current use?

The Site currently only includes local farm cottages associated with its use as agricultural land. There are no offices or commercial buildings. The proposed redevelopment of the Site will result in a significant number of residents and increased number of people coming to work within the new commercial area.

8.2 Will the proposals change the nature or times of occupation or use, such that it may affect the degree of flood risk to these people?

The proposed redevelopment of the Site will result in a significant number of residents, with 24-hour occupation of the Site.

8.3 Where appropriate, are you able to demonstrate how the occupants and users that may be more vulnerable to the impact of flooding will be located primarily in the parts of the building and site that are at lowest risk of flooding?

As discussed in previous sections, the Proposed Development is located within Flood Zone 1 and therefore at a very low risk of flooding. Surface water drainage will be managed in accordance with the principles described in Section 7 and Drainage Strategy in Appendix 14.2 of the Water Resources and Flood Risk ES Chapter, which includes siting the Proposed Development buildings outside of the low-lying valley overland flow routes and ensuring the retention of dedicated, unobstructed overland flow routes to mitigate the exposure of the risk of flooding from any of the sources discussed in Section 6.1.All occupants shall therefore be protected from flooding.

9 Exception Test

As stated previously, a large part of the site falls within Flood Zone 1 and therefore the Exception Test does not apply.

9.1 Would the proposed development provide wider sustainability benefits to the community? If so, could these benefits be considered to outweigh the flood risk to and from the proposed development?

The Site is within Flood Zone 1 and therefore does not require the Exception Test.

9.2 How can it be demonstrated that the proposed development will remain safe over its lifetime without increasing flood risk elsewhere?

Refer to Section 7.5.

9.3 Will it be possible for the development to reduce flood risk overall?

Refer to Section 6.8.

10 Residual Risk

10.1 What flood related risks will remain after the flood risk management and mitigation measures have been implemented?

The main residual risk of flooding is associated with a failure or exceedance of the Site's drainage system. The risk associated with failure of the drainage system will be mitigated by ensuring a robust and regular maintenance schedule in line with CIRIA 753 [9].

10.2 How, and by whom, will these risks be managed over the lifetime of the development?

The Proposed Development will manage flooding through sustainable drainage features, including the open water ponds and on-plot source controls such as raingardens and permeable paving. The sustainable drainage system has been designed for no surface water flooding up to the 1:30-year return period and no flooding of buildings with containment in dedicated areas of surface water for extreme events up to the 1:100-year period.

The features will all be managed and maintained over the entire design life to ensure efficacy. This will be undertaken by an appropriate appointed party described in future Reserved Matters Applications. Adoptable sewers and the outfall to the River Ver (outside of the Site) will be managed by Thames Water.

11 FRA Credentials

11.1 Who has undertaken the flood risk assessment?

This Flood Risk Assessment has been produced by Lauren Lester, a Civil Engineer at Expedition Engineering, and checked by Alex Garman, a Chartered Civil Engineer with the Institution of Civil Engineers (ICE) and Associate at Expedition Engineering. It has been reviewed by Fred Labbé, a chartered engineer and Director at Expedition Engineering.

11.2 When was the flood risk assessment completed?

This assessment was completed in July 2025.

12 Bibliography

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[9] Hertfordshire County Council, “Local Flood Risk Management Strategy 2 for Hertfordshire 2019-2029,” Hertfordshire County Council, 2019.

[10] CIRIA, “CIRIA SuDS Manual C753,” CIRIA, 2015.

[11] Hertfordshire County Council, “Local Flood Risk Management Strategy 2 2019-2029,” Hertfordshire County Council, 2018.

Appendix A: Omitted

Appendix B: SFRA Maps

Appendix C: Proposed Development Parameter Plans

Appendix D: Thames Water Engagement

Appendix E: Ground Condition and Contamination Scoping Opinion Chapter

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