Land West of Hatfield, Hatfield.

Flood Risk Assessment & Drainage Statement

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1.0 Introduction

This Flood Risk Assessment has been prepared on behalf of Arlington, in support of planning application for the proposed development of undeveloped greenbelt land West of Hatfield Business Park, Hatfield.

Hatfield Business Park is located west of Hatfield town centre directly beyond the A1001 and A1(M) between junction 3 and junction 4. It is accessed off the A1001 Comet Way to the north and A1057 to the south.

The site approximate ordinance grid reference is E520348, N209062. A site location plan is included within Appendix A.

The total site area is 67.53Ha of undeveloped area and it is proposed that approx. 20.21Ha (30%) of that area will be hard landscaping. Drawing 12011 / 104 within appendix A provides a breakdown of permeable / impermeable site areas.

The Business Park is currently well established and occupied by a number of commercial and industrial businesses. It is also located adjacent to a well established residential development.

This assessment has been prepared following the guidance set out in National Planning Policy Framework (NPPF) [1] and Planning Practice Guidance (PPG2).

Further guidance has been obtained from:

- EA/DEFRA R&D document W5-74/A/TR/1 “Preliminary rainfall runoff for new developments” Revision D, including figures 2.1 & 2.2.
- “Interim National Procedures” point 3, 10.2 & 10.3
- The Suds Manual (ciria c697)
- “interim Code of Practice for Sustainable Drainage Systems 2004” (ICOP SUDS)

[1] National Planning Policy Framework, July 2018, Department for Communities & Local Government

[2] Planning Practice Guidance, March 2014 Department for Communities & Local Government

2.0 Existing Site

2.1 Site Location and Receiving Watercourse / River

The existing greenbelt site is currently soft landscaped and covered in grass – there are no drained hard landscaped areas at present or any form of land drainage.

The adjacent Hatfield Business Park development has a park wide infrastructure foul and surface water drainage system that was implemented as part of the redevelopment of the historic Hatfield Aerodrome site during the late 1990's early 2000's.

The Business Park drainage system has been designed to cater for all future plot developments at the business park and has previously been signed-off and approved by the local authority and The Environment Agency.

The existing surface water system generally comprises of a network of oversized sewers located beneath the main infrastructure spine roads to the business park.

Flows from the sewers are discharged to the Ellenbrook receiving watercourse and are controlled / limited by an existing storm water pumping station.

Further attenuation volume is also provided by a series of off-line balancing ponds that are located adjacent to the Ellenbrook Watercourse.

2.2 Topography

The topography of the site is such that there is a fall from the northeast towards the southwest for the northern part of the site, southwest towards south east for the middle part and southwest towards east for the southern part of the site.

Drawings 12011 / 100 - 101 within Appendix A indicates the existing levels at the site. Currently site topographical levels range from between 75.50 to 80.70m AOD approximately.

2.3 Description of Catchment

From investigation of the current Environment Agency floodplain maps and the 'Level 1 and 2 Strategic Flood Risk Assessment' (SFRA) report carried out by JBA consulting back in December 2015 it appears that the majority of existing site is not within a recognised floodplain area and as such are categorised as in Flood Zone 1. See drawing 12011/103 within appendix A.

The detailed SFRA has identified a section of the site adjacent to the existing watercourse is located within a floodplain area and is categorized as in Flood Zone 2 & 3. We can see that 9% of the site area is covered by Flood Zone 2 and <5% of the site is covered by Flood Zone 3 with the majority of the site shown to be located within Flood Zone 1.

Detailed flood maps from contained with the SFRA show that the anticipated depth of flooding to be expected within Flood Zone 1 / 2 range between 0 – 500mm. A copy of the maps are included within Appendix A.

According to the flood maps within SFRA report the proposed site is not at risk of groundwater flooding as the susceptibility to ground water flooding is <25%.

Desk study flood maps have identified that there might be a potential risk of flooding from artificial sources to the northwest section of the site. The identified source of this flooding is reported to be the gravel pits which are located to the west of the site. Refer to extract map from the SFRA within Appendix A.

Ground water source protection maps have identified the proposed area is within a recognized groundwater source protection zone.

See drawing 12011 / 103 and extracts from the SFRA report within Appendix A.

The existing Business Park is currently served by a local foul and surface water sewer systems, drawing 12192 / 108 & 109 within Appendix B illustrates their layouts in relation to the business park.

The use of these sewers is discussed later on in this report.

2.4 Geology

Survey work has been carried out by RSK in July 2020 which confirmed that the site is underlain by topsoil or a variable thickness of localised made ground over Lowestoft Formation.

The underlying Lewes Nodular Chalk was not encountered during the investigation due to the limited depth of boreholes, and the difficulty in penetrating the (presumed) base of the Lowestoft Formation.

The borehole investigations from the report revealed the following general strata formation:

Topsoil was encountered at depths generally 0.1 to 0.3m (TP023 up to 0.9mBGL), the topsoil comprised a typically brown, slightly gravely, sandy clay, or in some areas a sand, with a gravel content of chert and occasionally mudstone.

Made Ground was encountered at depths between 0.1 to 2.9m bgl which comprised:

Trial pits TP002, 007 & 009 in the north of the site comprised of gravelly, sandy clay, or gravelly, clayey sand, with rare fragments of asphalt and ash in addition to the more typical chert gravel.

Trial pits TP030, 036-038, and 043-044, clustered in the centre of the site which comprised a gravelly, sandy clay, or gravelly, clayey sand, with brick, tile and rarely concrete, plastic and wood.

Trial pit TP040 in the west of the site which comprised a slightly sandy, slightly gravelly clay, with gravels of asphalt and chert.

The remaining trial pits containing made ground are TP047, 053, 056-059 and CP002-003, all of which are located in the south of the site and comprised gravelly, sandy clay with gravel of mudstone, chert, brick and occasional concrete.

Lowestoft Formation was proven to depths of at least 14.35m bgl and comprised variably cohesive and granular beds. Typically the stratum was found to be a slightly sandy, slightly gravelly clay, but was occasionally noted to be a slightly gravelly clayey sand. Rarely slightly clayey, sandy gravels or fine to coarse sands were noted, although these more granular fractions were less prevalent.

Extracts of the borehole investigation logs are included within Appendix D of this report.

The above borehole logs information confirmed that the site is underlain by low permeability cohesive soil layer up to 5.3m bgl with permeable granular soil underneath it and another layer of stiff clay (Lowestoft Formation) under that.

The report also states that the permeable granular soil layer (between two cohesive soil layers) may be contaminated, therefore, it has been proposed that the new on site drainage will be constructed above this layer in order to avoid further contamination of the soil and groundwater.

It has been confirmed that due to low permeability clays the infiltration techniques are not suitable for this site, also, due to infiltration from surface though to the underlying aquifer, specifically the contaminated groundwater present within the granular Lowestoft Formation are considered to be a significant risk presented by the potential development of the site. It is understood that while the bromate and bromide contamination within the underlying aquifer has not originated on site, its concentration within groundwater is directly affected by disturbance and increased flow. As such the development has the potential to concentrate flows of water to specific areas of the site such as the attenuation basins. Water would then drain through these at a significantly high rate causing increased mobility of the contamination present.

3 Proposed Site

3.1 Description of development

The proposed site area will comprise of residential developments, care home, local centre, primary school, allotments and soft landscaped areas.

Allowances will also be made for the introduction of new soft landscaping schemes that respect the proposed development layouts and where possible are integrated into the proposed surface water drainage proposals for the development.

Proposed site levels will be set such that they try to (where possible) follow the contours of the existing site so as to minimise the requirement for any retaining walls and also adhere to highway design standards. Building levels will be raised where possible to afford the new development with additional flood protection if required.

Proposed development levels will also be set such that they try to minimise any surface water flooding from the new development drainage network and ensure that should any flooding occur it is controlled and kept within the new development demise and not effect neighbouring properties or highway land.

Proposed development levels will also need to respect any future earthworks operations in relation to the development to try and balance cut and fill quantities thus re-using as much of the on site material as possible minimising cart away and import.

4 Drainage Strategy

4.1 Development Phasing

A development phasing plan has been prepared by the Architect that illustrates four likely phases for the project.

It is proposed that the proposed drainage strategy is aligned with these phases to ensure the adequate drainage infrastructure is in place and that sufficient drainage attenuation is available.

4.2 Existing Drainage

It's believed that the sites are currently not positively drained and as such any rainfall permeates naturally into the ground over the course of any rainfall event.

During recent times there have been no reported incidents or formal records of any surface water flooding at the proposed development site.

Existing site levels across the development plots vary between approximately 75.50 to 80.70m AOD.

There is not believed to be any existing drains or sewers currently serving the development site.

4.3 Proposed Foul Water Drainage Strategy

It is proposed that the new foul sewers serving the development will discharge (by both gravity and pumps) into existing foul network at Albatross Way.

A formal development enquiry has been submitted to Thames Water in order that they can assess the capacity of their current receiving sewers. They have carried out a Sewer Impact study (a copy of which is included within Appendix D of this report) and concluded that their existing network does not have sufficient available capacity to take additional flows resulting from the proposed new development.

They have confirmed that some off site works to their sewers will be required in order to increase the capacity of the local system in the form of providing new on-line underground storage tank located within Albatross Way.

4.4 Proposed Surface Water Drainage Strategy

The current findings of the site investigations suggest that the prevailing ground conditions are such that clays will be encountered from depths of 0.1m and beyond.

The report also states that infiltration will not be suitable due to cohesive nature of the ground.

Also, infiltration into the ground will not be suitable due to an upper groundwater table located within granular portions of the Lowestoft Formation which is considered to be a significant risk for potential to concentrate flows of water to specific areas of the site which would then drain through the permeable strata causing increased mobility of the contamination. However, other SUDS features will be considered / used within the proposed drainage strategy which are discussed later within this report.

Ground water levels have been encountered at an elevation of approximately 71.6m AOD.

The above constraints should however not prohibit the incorporation of SUDS drainage techniques into the proposed drainage strategy.

A number of swales and ponds have been proposed within the proposed site area in order to provide required attenuation storage for surface water. These features will be above the permeable granular soil layer to ensure they are not affecting the groundwater within the permeable soil. Refer to drawing 12011 / 114 which identifies the existing levels of the permeable soil layer as well as proposed attenuation features.

To provide further source of treatment it is proposed that permeable car parking spaces are incorporated into the residential development scheme. This could be in the form of individual permeable parking spaces to each new dwelling or be incorporated into large communal car parking facilities.

It is proposed that the surface water will be directed to the new attenuation features mentioned above and eventually will discharge into existing ponds / watercourses at the boundaries to the site.

The resultant flow from the proposed developments will be restricted to green field run-off rates for 1 in 1, 30 and 100 year plus climate change storm events. To achieve this, flow control devices such as a hydrobrake will be incorporated into the proposed new drainage system.

In line with the above, green-field run-off calculations have been carried out:

Phase 1 (Drainage Network 1):

1 in 1 year = 10.9 l/s

1 in 30 years = 29.0 l/s

1 in 100 years = 40.8 l/s

Phase 2 (Overall)	Drainage Network 2	Drainage Network 3
1 in 1 year = 17.5 l/s	1 in 1 year = 8.3 l/s	1 in 1 year = 9.2 l/s
1 in 30 years = 46.6 l/s	1 in 30 years = 22.1 l/s	1 in 30 years = 24.5 l/s
1 in 100 years = 65.5 l/s	1 in 100 years = 31.3 l/s	1 in 100 years = 34.2 l/s

Phase 3 (Overall)	Drainage Network 4:
1 in 1 year = 35.0 l/s	1 in 1 year = 37.45 l/s
1 in 30 years = 93.3 l/s	1 in 30 years = 101.32 l/s
1 in 100 years = 131.3 l/s	1 in 100 years = 145.8 l/s

Phase 4 (Overall)	Drainage Network 5	Drainage Network 6
1 in 1 year = 40.6 l/s	1 in 1 year = 36.1 l/s	1 in 1 year = 2.05 l/s
1 in 30 years = 108.2 l/s	1 in 30 years = 97.83 l/s	1 in 30 years = 2.35 l/s
1 in 100 years = 152.3 l/s	1 in 100 years = 135.3 l/s	1 in 100 years = 2.5 l/s

We have used the above maximum discharge rates to initially approximate the volumes of attenuation storage required.

An allowance for the likely development soft landscaping / gardens has been taken with the impermeable area reduced by 40%.

Based on the above the microdrodrainage quick storage estimates have been calculated to approximate following requirement for average volumes of storage to each phase:

	1 in 1 year	1 in 30 year	1 in 100 year + 40% climate change
Phase 1	231m3 – 356m3	518m3 – 733m3	1035m3 – 1420m3
Phase 2	413m3 – 631m3	920m3 – 1292m3	1829m3 – 2500m3
Phase 3	864m3 – 1318m3	1920m3 – 2696m3	3822m3 – 5203m3
Phase 4	440m3 – 710m3	1015m3 – 1508m3	2041m3 – 2943m3

These have been used for initial guidance on the size of the required storage volumes prior to subsequent calculations.

As discussed earlier in this report part of the northern section of the site has been identified as being within Flood zone 2 / 3.

To ensure there that the proposed new development site levels do not result in a loss in existing flood plain storage volumes we have suggested that the nett level change within the flood zone 2/3 area is zero. This is illustrated on drawing 12011/109 & 110 within Appendix B.

4.5 Windes Network Modelling

Windes / Microdrainage modelling software has been used to create a model of the proposed new surface water drainage schemes.

The porous block paving areas have been modelled into the simulation in the form of plain areas at this stage.

Also, allowance for balancing ponds and swales have been made to allow for their attenuation volumes.

Design files are included within Appendix C, with the networks illustrated on drawings 12011 / 109 – 112.

4.5.1 Design Analysis

We have carried out a full suite of storm simulations for each phase of the development for different return periods and durations. The results of the calculations are all appended to this report.

The storm return periods that have been simulated are:

1 in 1 year
1 in 30 year
1 in 100 year + 40% for climate change

Duration tested ranged between:
15 minutes through to 1440 minutes for both the winter and summer profiles.

The simulation results show that:

- No flooding is observed at the site from the 1 in 1 and 1 in 30 year return period.
- A relatively small level of flooding is observed within the 1 in 100 years plus climate change return period. This volume of controlled flooding should be containable within the development demise by carefully designing and setting the proposed development levels. A flood routing plan is included within appendix B of this report.

The critical storm events were noted as being:

Network 1 (Phase 1):
240 minute winter duration for the 1 in 100 year plus climate change with nominal level of flooding ranging from 2.643m3 – 75.403m3.

Network 2 (Phase 2):
240 minute winter duration for the 1 in 100 year plus climate change with nominal level of flooding ranging from 0.194m3 – 41.892m3.

Network 3 (Phase 2):
600 minute winter duration for the 1 in 100 year plus climate change with nominal level of flooding ranging from 38.176m3 – 81.910m3

Network 4 (Phase 3):
30 minute winter duration for the 1 in 100 year plus climate change with nominal level of flooding ranging from 0.180m3 – 38.349m3.

Network 5 (Phase 4):
30 minute winter duration for the 1 in 100 year plus climate change with nominal level of flooding ranging from 3.508 – 18.451m3.

Supporting calculations and proposed networks plan are included within appendix C.

4.6 PROPOSED SUDS MEASURES - SUMMARY

4.6.1 Ground Permeability (Soakaways)

The findings from the current ground investigation report confirmed low permeability rates at approximate $1.215x10^{-10}$ m/s.

As such the use of soakaway drainage techniques discharging water directly into the underlying strata will not be feasible.

This should however not prohibit the consideration of Sustainable drainage techniques to be incorporated into the proposed surface water drainage strategy. These are discussed further below.

4.6.2 Allowable Surface Flooding

Additional storage of peak storm water can be facilitated by allowing car-parking, access drives and soft landscaped areas to flood up to 100mm, provided this will not put the buildings, or neighbouring properties at risk of flooding. The proposed site levels should be set such that this is achieved, for the higher return period event of 1 in 100 year plus climate change.

4.6.3 Surface Water Swales and Pond Features

Given the development density we have the opportunity to incorporate surface water attenuation pond and swale features into the soft landscaping and drainage strategy such that they can contribute towards the surface water attenuation volume requirements.

These surface level feature (surrounded in impermeable membrane) will be strategically positioned to serve various parcels of proposed development incorporating drainage outfall connection points.

4.6.4 Rainwater Harvesting

Rainwater harvesting tanks could also be incorporated to receive rainwater from the roof of the proposed new building for reuse in specific areas.

4.6.5 Porous Paving

It is possible that new parking facilities could be made of permeable surfacing, comprising of an appropriate block paving construction and will be designed with a suitable tanked free draining subbase material that will enable surface water run-off to be attenuated. This will help attenuate peak design flows from future developments by utilising the volume available within the permeable stone (type 3 material with no fines) within the structural layers of the construction.

This method of surface water interception / collection will also avoid the need to provide formal by-pass oil interceptor units as the stone media under the permeable block paving will naturally capture hydrocarbon contaminants.

4.6.6 Oversized Pipes

Surface water oversized pipes (existing and new) shall also be considered within the plot drainage strategies to provide an effective means of underground storage volume.

4.6.7 Surface Controls

Surface controls are to be incorporated onto the plot and infrastructure drainage systems to limit discharge rates to the previously prescribed values. These may take the form of Hydrobrakes or orifice plate controls.

4.6.8 Cellular Storage

Although cellular storage tanks do not provide any form of treatment they do provide a significantly higher void ratio than porous stone and as such could be considered for attenuation purposes. Their use could be considered in certain areas to further enhance underground attenuation volumes where surface level attenuation such as ponds/swales are not feasible.

4.6.9 Maintenance

The complete drainage system will have a detailed maintenance regime in place prior to occupation. This regime will involve an inspection after 3 and 6 months, and any maintenance required will be carried out. A further inspection will be carried out after 12 months, after which the maintenance schedule will be reviewed and adjusted to suit the circumstances and maintenance requirements of the development. In any case following severe storm events, the system will be inspected to ensure that all elements are performing satisfactorily.

Flood Risk Assessment

5.1 Existing Information on Flood Risk

5.1.1 Tidal/Coastal

Coastal flooding is not considered a risk at this development with the nearest coastline being approximately 120 kilometres away.

5.1.2 Groundwater

Groundwater flooding is not known to be an issue. The existing site has had no recorded problems with groundwater flooding.

5.1.3 Surface Water

There is no evidence to suggest that the site currently drains to the existing adopted surface water sewers in the vicinity. Discharge of flow from the development into the existing Ellenbrook watercourse is proposed and is to be approved by Environmental Agency / Thames Water.

5.1.4 Rivers / Watercourses

The Environment Agency publishes floodplain maps on the internet (http://www.environment-agency.gov.uk). These maps show the possible extent of fluvial flooding for the 1 in 100-year flood (that which would have a 1% probability of being exceeded each year) or the possible extent of tidal flooding to a 1 in 200 year event. A plan showing the extent of the flooding along the nearest marked Environment Agency marked watercourse is presented in the Appendix A.

The flood plans within Appendix A show that most of the development under consideration does not lie within an area of a recognised floodplain and as such is categorised as flood zone 1. However, a northern site area is recognized as Flood Zone 2 & 3.

Summary

Baynham Meikle Partnership has prepared this Flood Risk Assessment following the guidelines set out in National Planning Policy Framework (NPPF) [1] and Planning Practice Guidance (PPG) [2], to support the Outline Planning Application for the development of remaining land at Hatfield Business Park.

The Flood Risk Assessment may be summarised as follows:

- The Flood Maps have shown that the majority of the site is not identified to be at risk from fluvial flooding and does not form part of the functional floodplain apart from a small section to the north of the site.

- The proposed redevelopment will not generate any extra flow and will not exacerbate any flooding that may already occur within the vicinity of the site.

- The surface water runoff from the development site will be controlled such that the overall flow from the proposed new drainage network is no more than the previously existing greenfield run-off rates. This is to be achieved through flow attenuation and the use of SUDS techniques in the new design. The techniques proposed may include sub-surface storage in the way of oversized pipes, permeable paving and surface water attenuation ponds with flow being controlled by the use of Hydrobrakes and orifice plates.

- External areas of car-parking are to be allowed to temporarily flood by no more than 100mm in extreme storm events. Finished ground levels will be carefully considered and flood routing will be applied to ensure protection of proposed buildings and of adjacent landowners, in the event of extreme conditions.

- The water quality will also be improved through the use of SUDS drainage techniques such as permeable paving, swales and/or surface water attenuation ponds.

It can therefore be said that the proposed development drainage schemes will be designed such that there is no increase to the potential of any flooding occurring at the existing Business Park. This is mainly due to the peak runoff flows from the site being restricted to previously agreed rates for the site and adoption of recommended SUDS design techniques in line with the EA and CIRIA guidance.

APPENDICES