CAMBRIDGE ROAD ESTATE – PLANNING APPLICATION 20/02942/FUL

FLOOD RISK ASSESSMENT – APRIL 2021

UPDATED DOCUMENT

A revised flood risk assessment was issued in April 2021 and has not been subject to any revisions since.

Project Name:
Cambridge Road Estate
Kingston
KT1 3EF

Flood Risk Assessment

Date: 09th April 2021

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Signed on behalf of CTP	
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1.0 Executive Summary

1.1 CTP were instructed by Cambridge Road (RBK) LLP to prepare a Flood Risk Assessment (FRA) and Drainage Strategy to support the hybrid planning application for the whole of the proposed phased residential redevelopment of the existing Cambridge Road Estate, Kingston, KT1 3EF, including a detailed FRA for Phase 1.

1.2 The Flood Risk Assessment has been prepared in compliance with guidance given in the National Planning Policy Framework (NPPF) (February 2019) with the latest relevant Planning Practice Guidance.

1.3 Cambridge Road Estate is situated in Flood Zone 1. This means that the site has a 1 in 1000 or less chance of flooding in any given year due to rivers or seas. Hence, it has a very low risk of flooding from rivers or seas.

1.4 Environment Agency Flood Maps show the site has areas at risk from surface water flooding. The proposed drainage strategy and level appraisal will ensure that the proposal for Phase 1 will eliminate the risk of surface water flooding to the surrounding area.

1.5 The site does not lie within a groundwater source protection zone.

1.6 The site is not considered to be prone to groundwater flooding according to the British Geological Survey records.

1.7 The proposed surface runoff for Phase 1 will be controlled and appropriate SUDs techniques have been proposed to attenuate flows in order to discharge at approved rates. Therefore, the site is NOT considered to be at risk from surface water flooding.

1.8 In summary the overall Risk of Flooding due to all sources is considered to be low.

Masterplan Flood Risk Assessment

2.0 Brief and Introduction

2.1 CTP were instructed by Cambridge Road (RBK) LLP to provide a Flood Risk Assessment (FRA) in support of a hybrid planning application for the proposed phased residential redevelopment of the existing Cambridge Road Estate, Kingston, KT1 3EF, including a detailed FRA for Phase 1.

2.2 This report is split into two sections: i) site-wide FRA and ii) specific FRA and proposed Drainage Strategy to address the drainage (SuDs) proposals for the Phase 1 planning application.

2.3 In the preparation of the FRA, CTP liaised with Thames Water to seek pre-planning approval for the proposed drainage strategy enclosed in this report.

2.4 CTP has no responsibility to any other parties to whom this report may be circulated, in part or in full, and any such parties rely on the contents of this report solely at their own risk.

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3.0 Background

3.1 The initial resident engagement and feasibility options were undertaken from 2015 until 2017. From 2017, the masterplanning and further consultations were completed. This report is to support the hybrid planning application for the masterplan which will be submitted in 2020, coupled with a detailed FRA for Phase 1. **Phase 1 is split into two sub phases: Phase 1A and 1B.**

3.2 The masterplan area covers all phases including the ones which are not covered in detail in this FRA. These areas can be identified in drawing **503-PTA-MP-RF-DR-A-1201 PL02** Proposed Masterplan in Appendix B.

3.3 For further detail in relation to the background of the redevelopment of Cambridge Road Estate please refer to the Planning Statement, submitted with the planning application, prepared by Barton Willmore LLP.

4.0 Requirement for a Flood Risk Assessment

4.1 The National Planning Policy Framework specifies the requirement for a FRA and provides the framework for what a FRA should cover.

4.2 Although the site is located wholly within Flood Zone 1 (see Appendix D) as the area of Phase 1 is larger than 1 ha, the NPPF requires an FRA being undertaken to assess the sources of potential flooding in this area. The total area of the proposed masterplan redevelopment is 8.86 ha. The area of the proposed Phase 1 redevelopment is 2.21 ha within the masterplan area of 8.86 ha.

5.0 Existing Environmental Condition

5.1 The proposed development site is Located in the Royal Borough of Kingston upon Thames (RBK) in the area between Cambridge Road and Kingston Cemetery. With Hampden Road to the east and Portman Road to the West. These are major strategic routes to the proposed development. Access to the specific site is achievable through a series of main distributor roads.

5.2 Site Description and proposal – The Site Boundary is shown on the drainage strategy plan in Appendix C. All Buildings within the site boundary are to be demolished and the proposed development constructed in their place.

5.3 The total masterplan site area is 8.86 ha. Phase 1 site area is 2.21 ha.

5.4 Topography

5.4.1 The existing site is made up mostly of residential areas, highway land, footpaths and communal open spaces which is approximately 85% impermeable.

5.4.2 The site levels fall from east to west, with the lowest point being located in the north-western corner of the site. This can be seen on the topographical survey undertaken by Survey Solutions (Appendix G). The overall change in level across the site is approximately 7.5m.

5.4.3 There is a large change in level varying from 3m to 4m located in the centre of the site. The level difference is supported by a concrete retaining structure.

5.5 Existing Drainage

5.5.1 The drainage servicing the existing site is made up of foul and surface water sewers of various diameters that drain via gravity and are owned and maintained by Thames Water. Surface water enters the system via gully's and rain water pipes. It is assumed that the majority of the existing site is not attenuated and the unrestricted flow drains into the adopted system. This is due to the age of the site and the location of the infrastructure therefore, predating SUDs drainage design.

5.5.2 Other than the consents required for the drainage currently being designed, there are no discharge consents close to the site.

5.6 Surface Water Quality

5.6.1 The closest watercourse to Cambridge Road Estate is the Hogsmill River located 300m south of the site. In addition, the River Thames is located approximately 1200m to the west of the site.

5.7 Hydrology

5.7.1 The Environment Agency's Flood maps enclosed in Appendix D shows that the site is entirely within Flood Zone 1. A site located within Flood Zone 1 has a probability of Flooding from rivers or seas of less than 1 in 1000 in any one year.

5.8 Geology and Hydrogeology

5.8.1 According to the Geo-Environmental Assessment done by IDOM Merebank, the geology of the site indicates that superficial deposits of Langley Silt Member are present beneath the west of the site. No superficial deposits are recorded across the remainder of the site. The Langley Silt Member comprises clay and silt. The underlying bedrock geology comprises the London Clay Formation.

5.8.2 Both the Langley Silt Member and the London Clay Formation are classified as Unproductive Strata. These will therefore act as aquitards preventing the infiltration of water.

5.8.3 Given the ground conditions, the underlying natural clay sub strata will have a very low permeability rate, as such it is not considered that any major infiltration drainage is a viable option.

5.8.4 The site is not considered to be prone to groundwater flooding according to the British Geological Survey records.

6.0 Surface Water Strategy and Risk of Flooding

6.1 This section of the report will assess the risk of flooding with regard to the whole masterplan area and proposed mitigation measures that could be taken to protect the area post development.

6.2 According to the Strategic FRA undertaken by the Royal Borough of Kingston upon Thames, the site does not lie in a Flood Hazard area. Please see the extract in Figure 1 below:

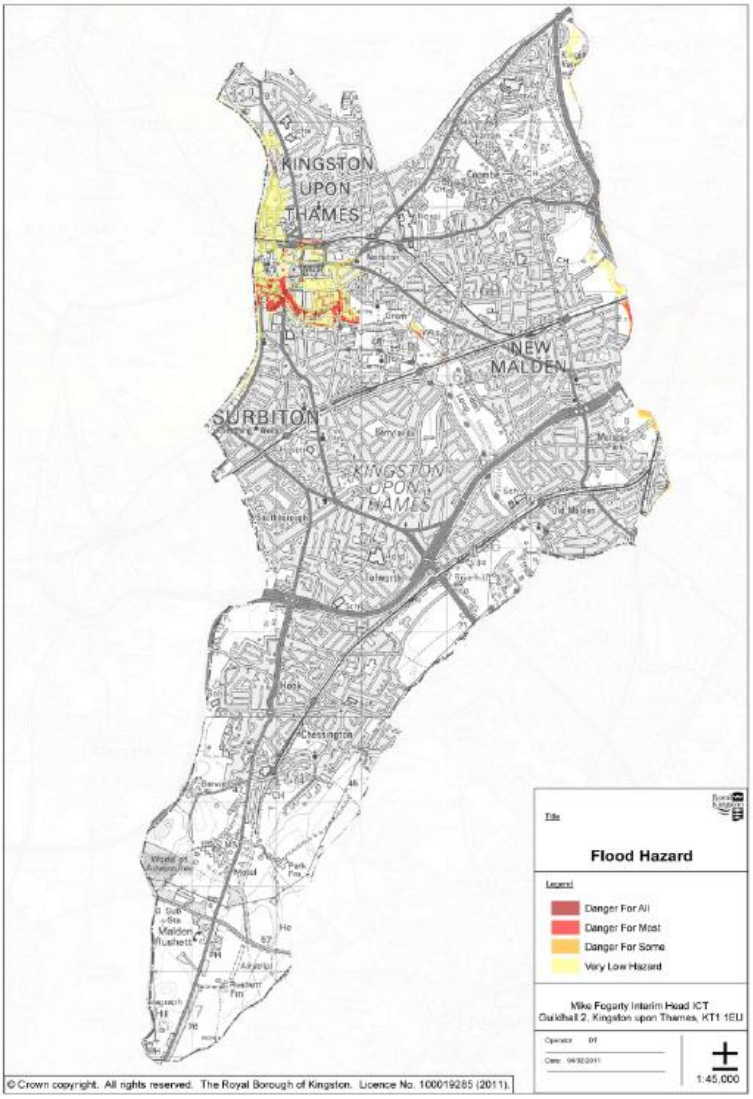

Figure 1: Extract from Strategic Flood Risk Assessment

6.3 Flooding from Rivers

6.3.1 The Flood Map provided in Appendix D shows the site is located within Flood Zone 1. This means that the site has a 1 in 1000 or less chance of flooding in any given year due to rivers or seas.

Therefore is a very low risk of flooding from Rivers.

6.4 Flooding from Reservoirs

6.4.1 There are no nearby reservoirs to the masterplan area and the Environment Agency map indicates that there is no flood risk from reservoirs to the site. Please see Figure 2 below:

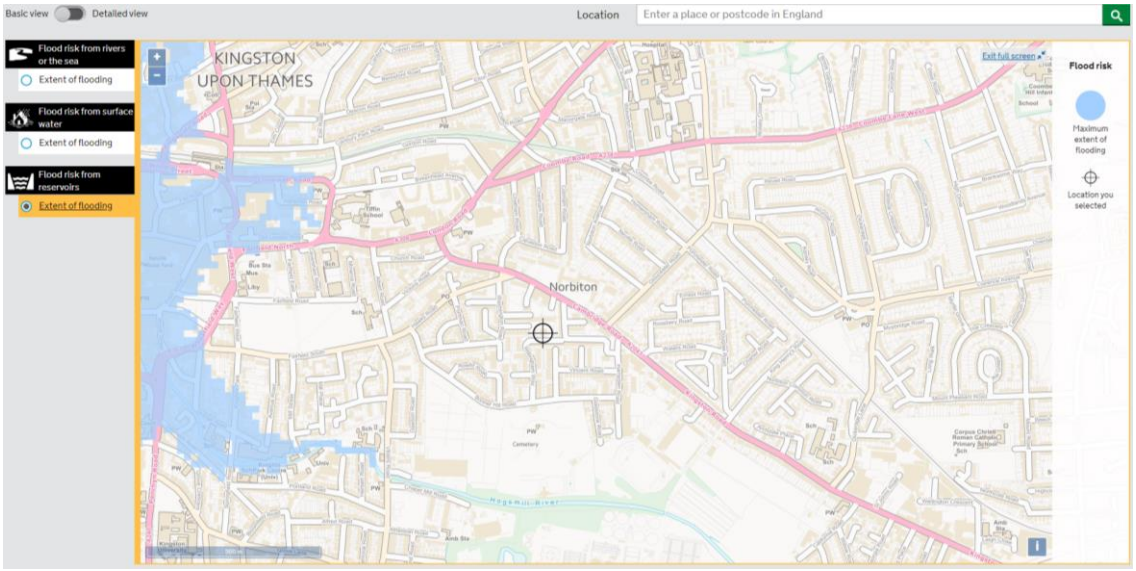

Figure 2 Extract from the Flood Risk Map on the website .GOV.uk

6.5 Groundwater Flooding

6.5.1 The risk of groundwater flooding to the total area of the masterplan is assessed as low risk according to the British Geological Survey records.

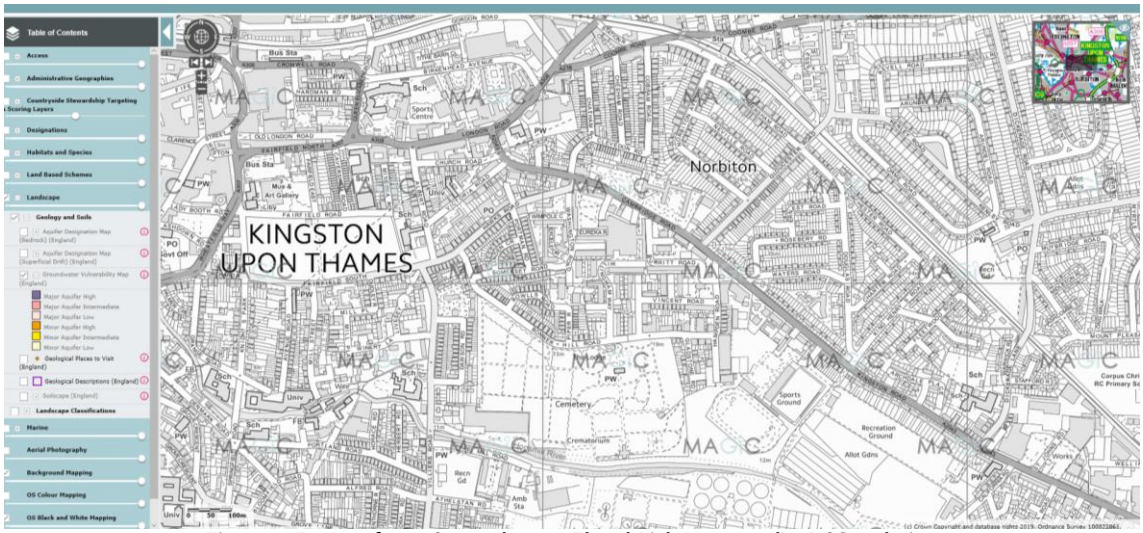

Figure 3 Extract from Groundwater Flood Risk Map on the BGS website.

6.6 Flooding from sewers

6.6.1 Thames Water is the statutory sewerage company for the area. Their network collects the surface water from the existing impermeable areas and the foul from the existing site.

6.6.2 Pre development capacity checks have been carried out for the site and confirmed that there is sufficient capacity for both foul and surface water discharges from the proposed development.

6.6.3 This is subject to the surface water flow rate being discharged at a controlled rate as agreed in principle with Thames Water. Please refer to the letter from Thames Water in Appendix F.

6.6.4 Therefore the risk of flooding from the sewers is low.

6.7 Flooding from tidal sources

6.7.1 The below environment agency map indicates the flood risk from tidal sources to the site.

The map indicates that there is no flood risk from tidal sources to the site.

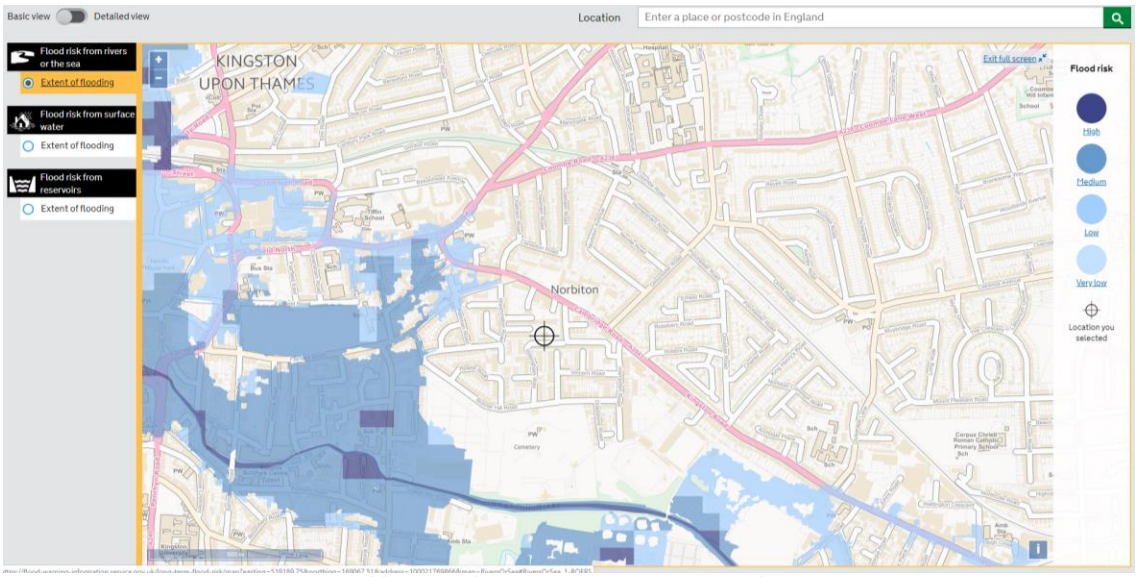

Figure 4 shows extent of flooding from Rivers and Seas taken from the website .GOV.uk

6.8 Flooding from Surface Water

6.8.1 The assessment of the Environment Agency's mapping facility indicates that the site lies within areas at risk from over land surface water flooding due to the topography across the site.

6.8.2 The proposed drainage strategy and level appraisal will ensure that the drainage proposals for the site will mitigate the risk of flooding to the site and will not pose an additional risk to the surrounding areas.

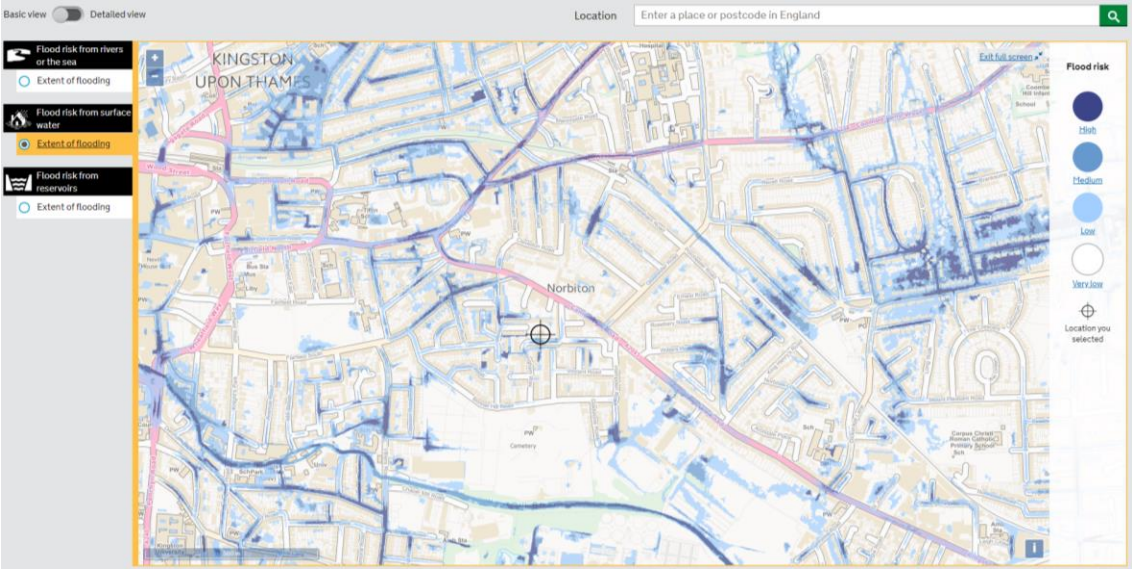

Figure 5 shows extent of flooding from surface water from .GOV.uk

6.9 The Sequential Test

6.9.1 The National Planning Policy Framework states that a Sequential Test should be carried out to validate that there are no sites, within the area where the development is located, which have a lower probability of flooding i.e. a lower classification of Flood Zone.

6.9.2 As the whole of the masterplan area is located within Flood Zone 1, this means that a better location with a lower flood risk is not possible and, therefore, the Sequential Test would be deemed to be passed and thus no exception test will be required.

6.9.3 The National Planning Policy Framework states that all sites located within Flood Zone 1 are appropriate for all types of use.

6.10 Possible Mitigation Measures

6.10.1 Surface water runoff will be mitigated through the drainage strategy.

6.10.2 The surface water strategy will account for all storms up to a 1 in 100-year storm with 40% climate change as well as exceedance flows to manage the risk of surface water flooding. These flows will be attenuated and the discharge restricted to ensure that the flows within the local surface water system is reduced by removing unattenuated flows.

6.10.3 Although flooding from sewers is unlikely, Thames Water will be consulted throughout the design process.

6.10.4 The designs will be based on the overall drainage strategy, agreed with Thames Water.

6.11 Surface Water Drainage Strategy

6.11.1 As the site is located within the Greater London area, it is subject to complying with The London Plan. Policy 5.13 Sustainable Drainage states "Development should utilise sustainable 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:

1. **store rainwater for later use**
2. **use infiltration techniques, such as porous surfaces in non-clay areas**
3. **attenuate rainwater in ponds or open water features for gradual release**
4. **attenuate rainwater by storing in tanks or sealed water features for gradual release**
5. **discharge rainwater direct to a watercourse**
6. **discharge rainwater to a surface water sewer/drain**
7. **discharge rainwater to the combined sewer.**

6.11.2 CTP understand the importance of using SuDS in the use of drainage design to improve the quality of water and to provide attenuation of flows.

6.11.3 The proposed design will reduce the existing flows by means of attenuation and hydrobrake features. No previous reports of failure have been noted, therefore, by reducing the existing flow rates, the stress on the existing system has been reduced.

6.11.4 CTP have identified some existing public sewers that serve the existing areas of the Phase 1 development that will need to be abandoned. CCTV surveys prove there are no third-party flows entering these sections of pipe.

6.11.5 Based on the latest Masterplan area, the Greenfield Run-off rates for each storm event are as per the table below. From a previous area calculation, the rate agreed with Thames Water to be used is 43.4l/s. The proposed discharge rates below equate to significantly less than the existing brownfield discharge rates and therefore provide significant betterment to the area. The betterment will be quantified for each phase during the detail design processes. A copy of the calculations is located in Appendix H.

	Brownfield Runoff Rates l/s	Greenfield Runoff Rates l/s
Qbar Urban	48.8	13.1
Qbar 1 year storm event	41.4	11.1
Qbar 30 year storm event	84.7	29.7
Qbar 100 year storm event	97.7	41.8

6.11.6 Attenuation and other SuDS methods will be implemented to control the rate of runoff from the site to achieve the agreed discharge rates. The feasibility of each SuDS method is stated below.

6.11.7 It is recommended that a combination of the below is adopted to manage surface water runoff to provide a sustainable design. The proposed SuDS methods will subject to review at the planning stage for each Phase.

6.11.8 It is considered that infiltration methods do not seem to be feasible at this stage due to geo-environmental assessment.

SUDS Feasibility Matrix

Sustainable Level	SUDs Technique	Scheme Application
Most Sustainable	Living Roofs	Where viable for access and management living roofs in the form of green and brown roofs are to be introduced into the development.
	Basins & Ponds	Due to the sites topography, limited public green space, and associated restriction at ground level and anticipated densities of movements through the area, open water storage systems are deemed not a viable strategy for this development.
	Filter Strips & Swales	Due to the clay geology and associated lack of infiltration, strips and swales are not a viable strategy for this site.
	Infiltration Devices	Due to the clay geology infiltration is not a viable strategy for this development.
	Permeable Surfaces & Filter Drains	Permeable paving parking courts are to be used where viable within the private drainage systems.
Least Sustainable	Tanked Systems	Tanked systems are to be used in open spaces to provide further private attenuation systems.

6.11.9 With reference to Page 119 in Chapter 8 of the Landscape Architects Report Ref no: 503-PTA-MP-XX-RP-A-9001_Ch08_Landscape, the following hierarchy of suds features are considered in the design:

Drainage item	Incorporated (Yes or No)	Reasons
SUDS Hierarchy 1 Store Rainwater	Y	Rainwater harvested from buildings will be stored in water butts for use in irrigation of podium landscaping on a plot-by-plot basis.
SUDS Hierarchy 2 Infiltration Techniques	Y	The site is located over the Langley Silt Member which comprises clay and silt. The underlying bedrock geology comprises the London Clay Formation. Therefore it is a relatively impermeable soil. However where rainwater falls on soft landscaping, it will for the most part be used by the planting for self-irrigation. This applies to brown roofs as well as planted areas at ground floor and podium level. Rainwater will also be diverted below the root-balls of street tree pits to be used by the trees.
SUDS Hierarchy 3 Attenuate rainwater in ponds or open water features	Y	Using permeable pavements and channels, a combination of swales and rain gardens, rainwater will be attenuated in open water features to be held before evaporation or release into sewers at greenfield rates.
SUDs Hierarchy 4 Attenuate rainwater by storing in tanks or sealed water features for gradual release	Y	Where open water features are not appropriate or desirable in the landscaping strategy, for example where larger hard paved areas allow greater on street activity, crated storage will be buried below ground to be held before release into sewers at greenfield rates.
SUDs Hierarchy 5 Discharge rainwater direct to a watercourse	N	There is not a watercourse nearby.
SUDs Hierarchy 6 Discharge rainwater to a surface water sewer/drain	Y	Where surface water falls on an adopted street, it must be discharged directly into the surface water drainage network.
SUDs Hierarchy 7 Discharge rainwater to the combined sewer.	N	This is the existing solution and we are NOT increasing the surface water flow.

6.11.10 The SuDS features will cater for surface water run-off by storing and then attenuating for the design storm event of 1 in 100 years + 40% climate change.

6.11.11 The existing site's underground drainage networks consist of separate foul and surface water sewers. The proposed drainage scheme provides separate foul and surface water flows and will control the proposed flows by reducing the peak flows with the existing network.

6.11.12 The risk of overall flooding from the existing sewers will also be reduced due to the attenuation of the surface water flows to the existing sewers, by the adoption of the above SuDS Hierarchy i.e. brown roofs, swales, tanked permeable paving areas and proprietary modular storage crates.

6.11.13 The location and integration of these SuDS features will be provided in the site-specific flood risk assessment for each sub-Phase when more detailed information is available to undertake the design.

7.0 Foul Drainage strategy

7.1 The existing properties in this area currently discharge their foul drainage into the extensive network of foul sewers around the existing Cambridge Road Estate.

7.2 The proposed development in the masterplan area will result in an increase in foul flows into the system due to an increase in the number of dwellings.

7.3 However CTP has liaised with Thames Water with regards to the increased discharge from the proposed development and a Thames Water capacity check was undertaken to assess the impact of the additional foul flows. Thames Water have confirmed that there is sufficient capacity in the existing public sewer to accommodate the proposed development. Refer to the Thames Water correspondence letter in Appendix F.

8.0 Conclusions

8.1 The whole of proposed masterplan development is located in Flood Zone 1. Therefore, the Sequential Approach was been followed for the all areas of the masterplan as the site is located in the lowest area of flood risk.

8.2 Therefore an Exception is not required as all uses are deemed acceptable in a Flood Zone 1.

8.3 Any increase in surface water runoff will be controlled by adopting the proposed drainage strategy during detailed design. This will ensure that any risk of flooding to surrounding areas will be mitigated.

8.4 Overall the level of flood risk in the overall masterplan area is considered to be low.

Phase 1 Site Specific Flood Risk Assessment

9.0 Introduction

9.1 This section of the report provides the specific FRA and outlines the proposed Drainage Strategy for Phase 1 which will support the full planning application.

9.2 Phase 1 is situated within the north-central portion of the Masterplan area and is shown on the location drawing in Appendix C.

10.0 Existing Environmental Condition

10.1 Phase 1 is located at the north-central part of the Masterplan area. There are two independent areas to Phase 1, which will be referred to as the Phase 1 northern site and Phase 1 southern site in this report. The main access routes to the site are via Washington Road and Bonner Hill Road.

10.2 The site area for Phase 1 is 2.21 ha.

10.3 Topography

10.3.1 The Phase 1 northern site falls from north to south. Levels range from approximately 11.7m AOD in the north to approximately 9.8m in the south. The approximate overall gradient of the site is 1:60 with localised areas of steeper and shallower gradients. There is a distinct change in levels on the eastern edge of the site that is supported by a retaining wall. The level difference at this location is approximately 1.5m.

10.3.2 The Phase 1 southern site falls from south-east corner to north-west corner. Levels range from approximately 13.4m AOD in the south-east corner to approximately 10.9m in the north-west corner. The approximate overall gradient of the site is 1:50 with localised areas of steeper and shallower gradients

10.3.3 The existing site currently contains residential and commercial premises, which are to be demolished to enable for the proposed development.

10.4 Existing Drainage

10.4.1 Thames Water sewer records for the site and surrounding areas have been obtained. These records indicate that the existing drainage network consists of separate foul and surface water gravity fed systems which, following the topography of the site, fall from East to West.

10.4.2 Due to the layout of the exiting drainage, the phasing of the development will have a significant impact on the amount of diversionary works needed. With the chosen phasing plan, the location of Phase 1 means that a considerable amount of the larger and more intrusive drainage works can be completed early on in construction. Completing the main drainage works in the initial phases (Phase 1 and 2) will simplify construction of the later phases.

10.4.3 An inspection chamber condition survey report has been carried out by SurvaTec Limited. This information confirms that there are separate surface water and foul water networks serving the site. The report has not been included in this document due to the size of the file, but is available if required issued upon request.

10.4.4 Both the surface and foul water networks follow accessible routes through the site, with the majority of the adoptable drainage laid beneath the existing roads.

10.4.5 Not all of the cover and invert levels for the existing drainage are known. However, the inspection chamber survey report indicates that drainage is laid at varying depths ranging from 1m up to 5m.

10.5 Surface Water

10.5.1 The existing surface water drainage consists of smaller diameter pipes (225mmØ and 300mmØ) in the East of the whole Masterplan site which increase in size as the system moves towards the West of the site.

10.5.2 There are two large surface water sewers to the West of the whole Masterplan site of 535mmØ and 600mmØ. Thames Water sewer records indicate that both of these sewers discharge into the network in Cambridge Road flowing westwards. Please refer to the proposed drawings **A6424-1550-P1 Proposed Phase 1A Drainage Layout and A6424-1551-P1 Proposed Phase 1B Drainage Layout** enclosed in Appendix E.

10.5.3 It is highly unlikely that there is any form of attenuation present within the existing surface water network. It is assumed that run off is discharged at an uncontrolled rate directly into the sewer running along Cambridge Road/Hawks Road.

10.6 Foul Water

10.6.1 Similar to the surface water drainage, the foul system starts towards the East of the site and falls towards the West of the site, with the pipe sizes increasing from 150mmØ up to 300mmØ.

10.6.2 Foul water discharges from the site in two locations. One sewer discharges in the North-West corner of the site into a 525mmØ foul sewer running along Cambridge Road. The other sewer discharges from the site via drainage in Somerset Road flowing westwards.

10.7 Hydrology

10.7.1 The Environment Agency's Flood map enclosed in Appendix D shows that the site is entirely within Flood Zone 1. A site located within Flood Zone 1 has a probability of Flooding from rivers or seas of less than 1 in 1000 in any one year.

10.8 Geology

10.8.1 According to the Geo-Environmental Assessment done by IDOM Merebrook, the geology of the site indicates that superficial deposits of Langley Silt Member are present beneath the west of the site. No superficial deposits are recorded across the remainder of the site. The Langley Silt Member comprises clay and silt. The underlying bedrock geology comprises the London Clay Formation.

10.8.2 Both the Langley Silt Member and the London Clay Formation are classified as Unproductive Strata. These will therefore act as aquitards which will restrict the infiltration of water.

10.8.3 Hence this underlying natural clay sub strata will have a very low permeability rate and thus it is considered that using infiltration methods for drainage is not a viable option.

10.8.4 The site is not considered to be prone to groundwater flooding according to the British Geological Survey records.

11.0 Flood Risk and Surface Water Strategy

11.1 The whole of Phase 1 is located in Flood Zone 1 which means the site has an annual probability of less than 1 in 1000 to flood from fluvial sources. Thus, the site has a very low risk from fluvial flooding. Due to the site being located within Flood Zone 1, the site fulfils requirements of the National Planning Policy Framework and therefore, a Sequential Test is deemed to be passed.

11.2 Due to its topography, the site has a low risk of surface water flooding. Measures will be introduced to reduce the risk of flooding from sewers by attenuating surface water runoff and restricting the discharge. This in turn, will reduce unattenuated flows from the public sewer system reducing the risk of flooding from sewers to Phase 1 and to surrounding areas.

11.3 The proposed drainage strategy and proposed levels will ensure that the proposals reduce the existing risk of flooding and do not pose any additional risk to the surrounding areas.

11.4 Phase 1 is outside of the potential groundwater flood zone, therefore the risk of groundwater flooding to the development is assessed to be a low risk.

Surface Water Strategy

11.5 The following Suds Feasibility matrix has been produced for the site:

SUDS Feasibility Matrix

Sustainable Level	SUDs Technique	Scheme Application
Most Sustainable	Living Roofs	Where viable for access and management living roofs in the form of green and brown roofs are to be introduced into the development.
	Basins & Ponds	Due to the sites topography, limited public green space, and associated restriction at ground level and anticipated densities of movements through the area, open water storage systems are deemed not a viable strategy for this development.
	Filter Strips & Swales	Due to the clay geology and associated lack of infiltration, strips and swales are not a viable strategy for this site.
	Infiltration Devices	Due to the clay geology infiltration is not a viable strategy for this development.
	Permeable Surfaces & Filter Drains	Permeable paving parking courts are to be used where viable within the private drainage systems.
Least Sustainable	Tanked Systems	Tanked systems are to be used in open spaces to provide further private attenuation systems.

11.6 There are existing public and private sewers within the proposed building footprints, but CCTV survey information confirms that these pipes do not serve any third-party flows and therefore can be abandoned as shown in the proposed drainage strategy for Phase 1.

11.7 **With reference to Page 166 in Chapter 7 of the Landscape Architects Report Ref no: 503-PTA-MP-XX-RP-A-9002_Ch07_Landscape Design, the following hierarchy of suds features are proposed in the design for Phase 1A and 1B:**

Drainage item	Incorporated (Yes or No)	Reasons
SUDS Hierarchy 1 Store Rainwater	Y	Rainwater harvested from the building roofs and first floor gardens will be stored in water butts for use in irrigation of podium landscaping. Plot C will have a central tank within the courtyard. Plot E will have a central tank integrated in the podium car park which will recirculate rainwater back into the podiums for irrigation of the podium gardens.
SUDS Hierarchy 2 Infiltration Techniques	Y	The site is located over the Langley Silt Member which comprises clay and silt. The underlying bedrock geology comprises the London Clay Formation. Therefore it is a relatively impermeable soil. However where rainwater falls on soft landscaping, it will for the most part be used by the planting for self-irrigation. This applies to brown roofs as well as planted areas at ground floor and podium level. Rainwater will also be diverted below the root-balls of street tree pits to be used by the trees.
SUDS Hierarchy 3 Attenuate rainwater in ponds or open water features	Y	Where rainwater falls on soft landscaping or permeable paving areas it will be captured and attenuated, partially to be used by the planting for self-irrigation with the remaining being gradually released into the network. This applies to green and brown roofs, podium gardens, soft planting at ground floor, tree pits and paving to parking bays. Crated storage is also provided adjacent to Plot C for attenuation.
SUDs Hierarchy 4 Attenuate rainwater by storing in tanks or sealed water features for gradual release	Y	Where open water features are not appropriate or desirable in the landscaping strategy, for example where larger hard paved areas allow greater on street activity, crated storage will be buried below ground to be held before release into sewers at greenfield rates.
SUDs Hierarchy 5 Discharge rainwater direct to a watercourse	N	There is not a watercourse nearby.
SUDs Hierarchy 6	Y	Where surface water falls on an adopted

Discharge rainwater to a surface water sewer/drain		street, it must be discharged directly into the surface water drainage network.
SUDs Hierarchy 7 Discharge rainwater to the combined sewer.	N	This is the existing solution and we are NOT increasing the surface water flow.

11.8 Should the above solutions not be viable; the worst-case solution has been shown. The surface water runoff will be designed to collect via rainwater pipes and gully's and distributed through pipes and catch pit manholes into an attenuation crate system where the flow is controlled through attenuation tanks using flow control manholes. The combined outflow from the discharge points will discharge into various demarcation chambers and in turn into the public sewer system.

11.9 An attenuation crate system has been selected as the most appropriate due to several factors which discounted the use of other SuDS features. Large attenuation methods such as basins, ponds, wetlands, swales, and filter strips are not feasible due to the lack of available space on the Phase 1 site. Brown roofs and green roofs are proposed on some roofs. Infiltration devices such as soakaways cannot be utilised as the underlying geology to the site has a Clay strata which does not provide adequate soakage rates suitable for infiltration devices. Tanked permeable paving areas in the external car parking bays may been included in the proposed drainage design, which connect to the attenuation tanks before discharging at a controlled rate to the public sewer.

In accordance with the overall flow rates agreed with Thames Water in the masterplan drainage strategy, Phase 1 is required to limits its surface water discharge rate to 10 l/s (based on the size ratio of Phase 1 to the whole site).

Phase 1 is split into two areas A and B. Phase 1A has an area of 1.272 ha and is thus permitted to discharge at 6.0l/s. Phase 1B has an area of 0.878 ha and is thus permitted to discharge at 4.0 l/s.

In order to achieve these rates, using the Quick Storage Estimate method in Microdrainage Windes, Phase 1A will require a storage volume of between 821-1099m3 and Phase 1B will require a storage volume of between 571 – 765 m3. Please refer to Appendix H.

The storage volume stated above has been calculated for a design storm of 1 in 100 year + 40% climate change.

Therefore it is proposed to use the higher value calculated to provide a conservative design at this stage.

As some of the phases have limited space to accommodate the required attenuation, the overall scheme should be considered throughout the design

of the phased network. The large areas of open space within the proposed development will likely need to be utilised for large attenuation tanks. These tanks will be designed to accommodate the surface water discharge from all phases, which has been calculated as 4200 m^3 using the quick storage calculation on Microdrainage Windes. Please refer to Appendix H.

Phase 1 works will require replacing existing drainage that is located near to the point of discharge and thus drainage from later phases will be connected into them. Therefore the future phases and the discharges associated with them will have to be considered within the design of Phase 1.

Please refer to the proposed drainage strategy shown on drawings A6424-1500-P3 Proposed Masterplan Drainage Layout and A6424-1550-P1 Proposed Phase 1 Drainage Layout in Appendix E and the accompanying proposed drainage statement REF: A6424 – Cambridge Road Estate Phase 1 drainage statement.

12.0 Foul Water Drainage Strategy

12.1 The existing site discharges its foul water into the public foul drainage system.

12.2 Phase 1 will increase the foul flow to the public sewer due to the increased number of dwellings. Thames Water has confirmed that there is sufficient capacity in the existing system to accommodate the proposed increase in flow. Please refer to the letter from TW in Appendix F.

12.3 The connection to the existing foul network will require to be altered to accommodate the increase in pipe size required due to the increase in proposed flows. Indicative pipe sizes, which are subject to detailed design, are shown on drawing **A6424-1500-P4** Proposed Drainage Layout in Appendix E.

13.0 Conclusions

13.1 The proposed drainage strategy for Phase 1 will reduce the risk of flooding to existing neighbouring areas by attenuating the proposed flows from site.

13.2 Phase 1 is not at risk from fluvial flooding due to the site being situated in Flood Zone 1.

13.3 The surface runoff will be managed as the proposed SUDs techniques, based on the hierarchy described above, will attenuate the flows and will discharge at the agreed rate of 10.0 l/s. The site is considered to be at a low risk from surface water flooding, before and after the mitigation measures.

13.4 The site is not considered to be at risk of groundwater flooding according to the British Geological Survey records indicating that the risk to Phase 1 is low.

13.5 Phase 1 will increase the foul flow to the public sewer due to the increased number of dwellings. Thames Water has confirmed that there is sufficient capacity in the existing system to accommodate the proposed increase in flow. Please refer to the letter from TW in Appendix F.

13.6 It is concluded that Phase 1 is overall not at risk from flooding due to the proposed mitigation measures mentioned within this report and within the drainage strategy on drawings **A6424-1550-P1 Proposed Phase 1A Drainage Layout and A6424-1551-P1 Proposed Phase 1B Drainage Layout** enclosed in Appendix E.