Oriel

Flood Risk Assessment and Drainage Strategy

May 2021

File: ORL-INF-XX-XX-RP-PL-240-Flood Risk Assessment and Drainage Strategy

Revision 1.0

Oriel
Creating the centre for advancing eye health

Moorfields Eye Hospital NHS Foundation Trust

NHS

Moorfields Eye Charity

UCL INSTITUTE OF OPHTHALMOLOGY

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CONTACTS

Applicant:
Moorfields Eye Hospital NHS Foundation Trust
62 City Road
London EC1V 2PD
T: +44 (0)20 7253 3411
W: www.moorfields.nhs.uk

UCL Institute of Ophthalmology
Bidborough House
38-50 Bidborough Street
London WC1H 9BT
T: +44 (0) 20 7679 2000
W: www.ucl.ac.uk/ioo/

Moorfields Eye Charity
Kemp House
152-160 City Road
London EC1V 2NX
T: +44 (0)20 7566 2565
W: www.moorfieldseyecharity.org.uk

Development Manager:
Moorfields Eye Hospital NHS Foundation Trust
62 City Road
London EC1V 2PD
T: +44 (0)20 7501 0688
W: www.moorfields.nhs.uk

Project Manager:
AECOM
Aldgate Tower,
2 Leman Street
London E1 8FA
T: +44 (0)20 7061 7000
W: www.aecom.com

Lead Designer & Multi-Disciplinary Design Team including Specialists:
AECOM
Aldgate Tower
2 Leman Street
London E1 8FA
T: +44 (0)20 7061 7000
W: www.aecom.com

Lead Architect:
Penoyre & Prasad
The White Chapel Building
10 Whitechapel High Street
London, E1 8QS
T: +44 (0)20 7250 3477
W: penoyreprasad.com

Interiors / Landscape Architect:
White Arkitekter
Östgötagatan 100
Box 4700
11692 Stockholm
T: +46 8 402 25 00
W: whitearkitekter.com

Environmental Consultant:
AECOM
Aldgate Tower,
2 Leman Street
London E1 8FA
T: +44 (0)20 7834 7267
W: www.aecom.com

Planning Consultant:
JLL
30 Warwick Street
London W1B 5NH
T: +44 (0) 207 493 4933
W: www.jll.co.uk

Heritage & Townscape:
KM Heritage
72 Pymer's Mead
London SE21 8NJ
T: +44(0) 20 8670 9057
W: www.kmheritage.com

Wind Microclimate
BRE
Watford
Hertfordshire
WD25 9XX
T: +44(0) 333 321 8811
W: www.bregroup.com

Moorfields Eye Hospital NHS Foundation Trust
NHS
Moorfields Eye Charity
UCL INSTITUTE OF OPHTHALMOLOGY

Oriel
Creating the centre for advancing eye health

CONTACTS

Rights of Light:
GIA
The Whitehouse
Belvedere Road
LondonSE1 8GA
T: +44 (0)20 7202 1400
W: www.gia.uk.com

Public Affairs Consultant:
London Communication Agency
8th Floor
Berkshire House
168-173 High Holborn
London WC1V 7AA
T: +44 (0) 20 7612 8480
W: www.londoncommunications.co.uk

Client Accessibility Adviser:
Buro Happold
17 Newman Street
London W1T 1PD
T: +44 (0)2079 279 700
W: www.burohappold.com

Legal advisor:
CMS LLP
Cannon Place
78 Cannon Street
London EC4N 6A
T: +44 (0)20 7367 3000
W: cms.law/en/gbr

Cost Consultant:
Gardiner & Theobald LLP
10 South Crescent
London WC1E 7BD
T: +44 (0)20 3597 1000
W: www.gardiner.com

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C/M/S/ Law . Tax

Oriel
Flood Risk Assessment and Drainage Strategy

Prepared for:

Moorfields Eye Hospital NHS Foundation Trust
UCL Institute of Ophthalmology
Moorfields Eye Charity

Prepared by:

AECOM Limited

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Acronyms

Acronym	Description
AEP	Annual Probability of Exceedance
AOD	Above Ordnance Datum
EA	Environment Agency
FFL	Finished Floor Level
FRA	Flood Risk Assessment
DS	Drainage Strategy
FRADS	Flood Risk Assessment and Drainage Strategy
ha	Hectare
Qbar	Mean annual flood flow rate (approx. 2.3 year)
LBC	London Borough of Camden
LLFA	Lead Local Flood Authority (i.e. LBC)
m	metres
mAOD	metres Above Ordnance Datum
m^2	square metres
NPPF	National Planning Policy Framework
SFRA	Strategic Flood Risk Assessment
LFRZ	Local Flood Risk Zone
SuDS	Sustainable urban Drainage System
TWUL	Thames Water Utilities Limited

1 Introduction

1.1 Background

1.1.1 Moorfields Eye Hospital NHS Foundation Trust, on behalf of Oriel[1], have commissioned AECOM to prepare a site-specific Flood Risk Assessment and Drainage Strategy (FRADS) to accompany a detailed planning application for a new facility that would allow the existing Moorfields Eye Hospital (Moorfields at City Road) and University College London (UCL) Institute of Ophthalmology (IoO) services at Bath Street to relocate into a single building at the existing St. Pancras Hospital site (hereafter referred to as the 'Proposed Development').

1.1.2 The Proposed Development will be located at part of the existing St. Pancras Hospital site within the London Borough of Camden (LBC) (hereafter referred to as the 'Site').

1.1.3 The Proposed Development comprises a single building, between seven and ten storeys in height (including Ground Level and Lower Ground Level, as well as plant at Roof Level), as well as provision of public realm at ground level, blue badge parking, and a vehicular drop off point along St Pancras Way. The building is arranged around a central atrium and connection space. There is also a roof terrace on the Sixth Floor Level on the southwestern corners of the building.

1.1.4 Together with providing the details of a site-specific Flood Risk Assessment (FRA), this document describes the drainage design and strategy for disposal of both foul and surface water arising from the Proposed Development, recognising the legislative and policy requirements of the National Planning Policy Framework (NPPF) (Ref. 1), the adopted London Plan (Ref. 2),the Lead Local Flood Authority (LLFA), the Environment Agency and Thames Water.

1.1.5 This FRADS was first submitted with the Planning Application for the Proposed Development in October 2020. Sections 3, 4, 5 and 8 and relevant appendices have been updated to respond to comments received from the LLFA. The updates to the assessment are as a result of a clarification relating to the area of the Proposed Development boundary and adoption of the new London Plan in March 2021.

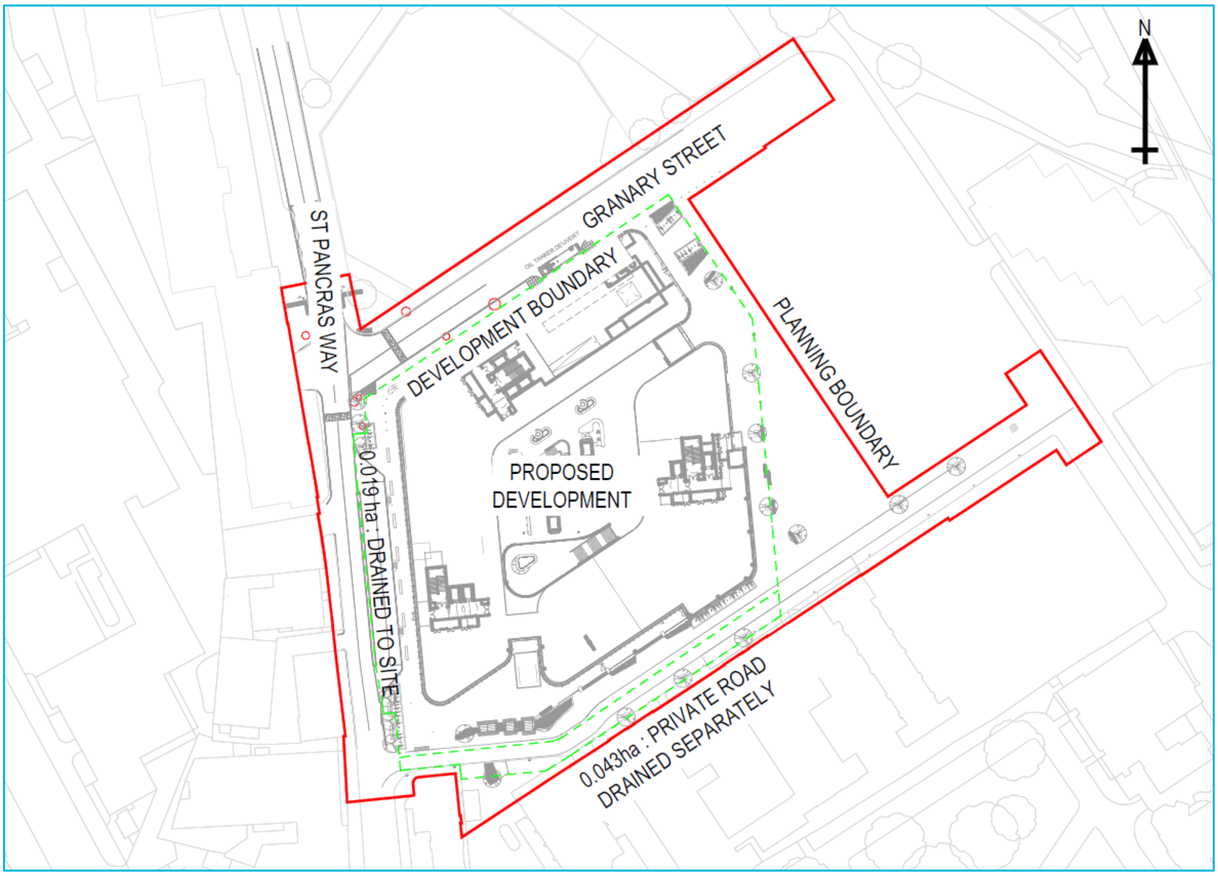
1.2 Site Location

1.2.1 The Site is located on the north-west part of the existing St Pancras Hospital site and is bounded to the west by St Pancras Way and to the north by Granary Street and is centred at National Grid Reference TQ 29689 83612 (see Appendix A for a drawing of the Site).

[1] Oriel is a joint venture between Moorfields Eye Hospital NHS Foundation Trust, UCL Institute of Ophthalmology and Moorfields Eye Charity.

1.2.2 An internal access road is located to the south of the Site. Further south and to the east lie the remainder of the St Pancras Hospital site. The Site covers an area of approximately 1.33 hectares (ha) and includes the proposed building area together with the surrounding public roads and shared private access spaces, as shown in red and referred to as the Planning Boundary in Figure 1-1 below. The proposed building and immediate associated external areas cover an area of 0.828 ha and are defined by the Proposed Development boundary, edged in green, and shown in Figure 1-1. This includes 0.043 ha to the south of the building which is within the two defined boundaries but treated separately for drainage purposes as the road will also be used by the curtilages to the south of the road. The area of 0.828 ha also includes 0.019 ha along St Pancras Way within the proposed layby which currently drains to St Pancras Way but will be re-routed through the Site proposed drainage network.

Figure 1-1 Site location and boundary of the proposed building



2 Flood Risk Assessment Methodology

2.1 Source-Pathway-Receptor Model

2.1.1 The approach undertaken for the FRA is based on the Source-Pathway-Receptor model. The Source-Pathway-Receptor model firstly identifies the causes or 'sources' of flooding to and from a development. The identification is based on a review of available information such as mapping, local conditions and consideration of the effects of climate change. The nature and likely extent of flooding arising from any one source is considered, e.g. whether such flooding is likely to be localised or widespread. As well as flooding from more obvious sources such as rivers and the sea, FRAs include an assessment of other sources of flooding as required in the NPPF (Ref. 1), including groundwater flooding, flooding from overland flow flooding and flooding from artificial sources.

2.1.2 The presence of a flood source does not always imply a risk. For example, the presence of a sewer does not necessarily increase the risk of flooding unless the sewer is local to the site and ground levels encourage surcharged water to accumulate. The exposure pathway or 'flooding mechanism' determines whether there is a risk of exposure to a flood source.

2.1.3 The identification of flooding pathways is typically undertaken by considering the local and site topography, the proximity of the flood source to the receptor and the potential flood conveyance routes local to the site. For more detailed assessments hydrological or hydraulic modelling may be required to quantify the flood risk and identify specific pathways, for the particular flood source.

2.1.4 If a flooding mechanism is considered not to be present, then the risk from the flood source is considered to be very low/ negligible.

2.2 Assessment of Flood Risk to Receptors

2.2.1 If a flood source and flooding pathway are identified, the assessment of the flood risk to the receptor is determined by combining the probability of the flood event occurring with the severity of impact (or consequences) if the flood event were to occur. Receptors include any people or buildings within the range of the flood source, which are connected to the source by a pathway.

2.2.2 The probability of a flood event occurring is usually determined from historical records of events, available modelling information and the design standard and condition of any infrastructure associated with the flood source. For more detailed assessments, hydrological or hydraulic modelling may be used to determine the frequency of flood events occurring, for a particular flood source.

2.2.3 The potential severity of the impact is determined by considering a combination of the type of flood source, the flood mechanisms identified, the layout and design of the proposed receptor and the vulnerability of the receptor.

2.2.4 The FRA approach undertaken involves a desk-based review of available information to establish:

- Likely flooding sources;
- Potential flooding pathways (mechanisms of flooding);
- Probability of a flood event occurring; and,
- Severity of impact of a flood event for the site.

2.2.5 In summary, for there to be a flood risk all the elements of the Source-Pathway-Receptor model must be present. Furthermore, effective mitigation can be provided to reduce the magnitude of flood risk by removing one element of the model. For example, by removing the pathway, defending against the flood source, incorporating flood management or flood resilient measures into building receptors, or providing safe access and egress and flood evacuation plans for human receptors.

2.3 Aims and Objectives

2.3.1 The aim of this report is to identify the flood risk associated with each potential flood source and, where required, identify appropriate measures that could be used to mitigate any significant risk as well as provide a strategy to implement a suitable drainage solution to complement the FRADS.

2.3.2 In order to achieve the above, the following objectives will be met, to:

- Identify all potential sources of flooding and determine whether potential pathways exist which may cause a flood risk to the Proposed Development;
- Determine whether the Proposed Development will increase flood risk elsewhere;
- Establish existing surface water runoff rates;
- Determine the surface water management requirements for the wider site in keeping with the principles of current planning policy;
- Where required, propose mitigation measures to reduce the flood risk posed to, or arising from the site post-development;
- Provide a suitable surface and foul water drainage strategy to meet the requirements of the NPPF and Local Policy.

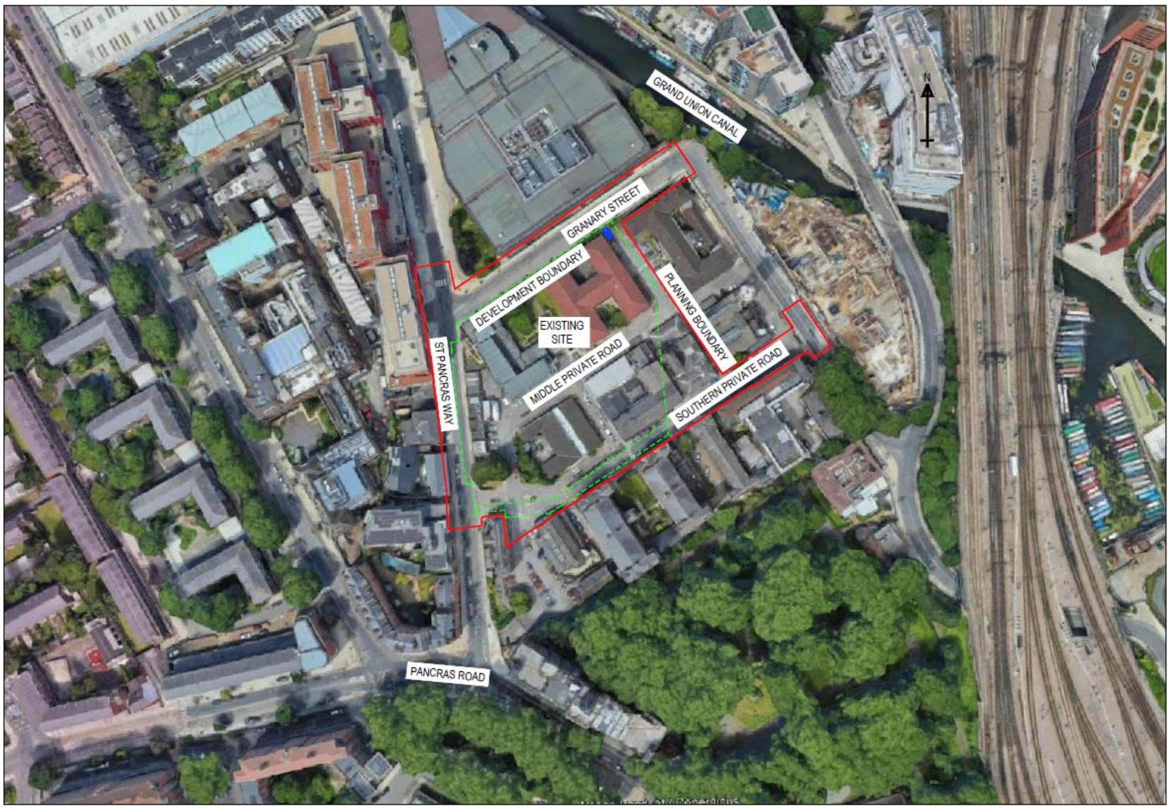
3 Existing Site Description

3.1 Site Description

3.1.1 The Site is located in a heavily urbanised area and is currently occupied predominantly by existing buildings which form part of the St Pancras Hospital site, comprising the Bloomsbury Day Centre, Ash House, the Post Room, Jules Thorn Day Centre, The Camley Centre (Estates and Facilities Building) and the Kitchen Building.

3.1.2 Surrounding the buildings are areas of hardstanding and roads, with small isolated landscaped areas (see Figure 3-1 below).

Figure 3-1 Existing site description and access routes



3.2 Topography

3.2.1 Existing ground levels on the Site generally fall from north east to south west, with the high point being 23.00m AOD in the north east of the Site and a low point of 19.09m AOD to the south west. A topographic survey of the Site is provided in Appendix A.

3.2.2 Where the Site extends further north along Granary Street, stopping immediately south west of the bend on Granary Street, topographical levels for this area are not available. However, Ordnance Survey map information suggests a level of approximately 23.60m AOD at this location, confirming the trend shown on the topographical survey information for the remainder of the Site, that the ground levels carry on rising north-east of the Site.

3.3 Geology

3.3.1 Published records (Ref. 3) show that the geology below the Site comprises the London Clay Formation to a depth of 30m, underlain by the Harwich Formation (when present), Lambert Group, Thanet Formation and then the White Chalk Subgroup.

3.3.2 Figure 3-2 below shows the published geological map of the area and the location of archived boreholes from the Phase 1 Geotechnical and Geoenvironmental Desk Study report (that have been used to develop the Site ground model. The ground model (Figure 3-3) is indicatively represented displaying graphical information and three of the boreholes used for ground model development. The Phase 1 Geotechnical and Geoenvironmental Desk Study report is submitted with the planning application.

Figure 3-2 Geological map

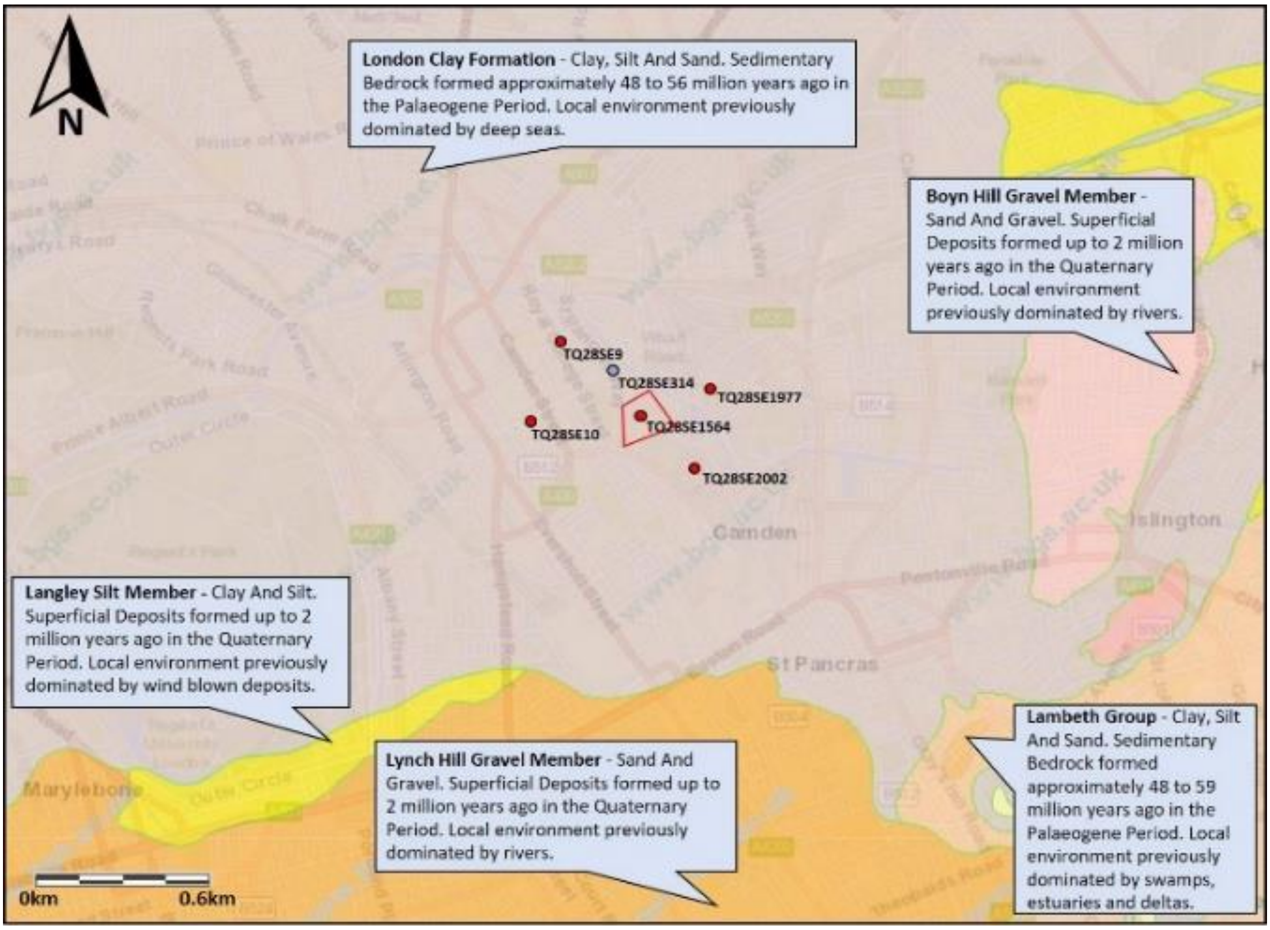
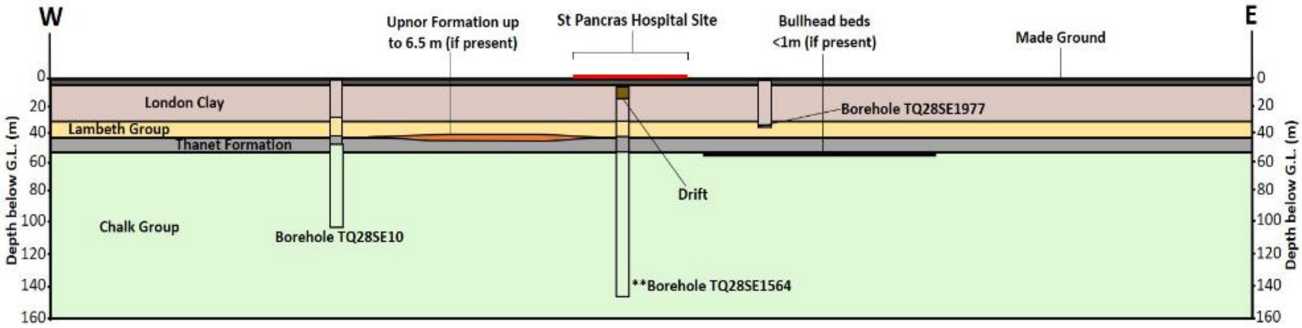


Figure 3-3 Site ground model



This cross section is only a schematic diagram, and therefore, the geology represented here is not indicative of the exact geology in the region. Borehole data has been overlain to show how the ground conditions may change from place to place. The closest deep boreholes to the E-W cross-section passing through borehole TQ28SE1564 were selected.

*** The borehole TQ28SE1564 was created for a pumping station, and therefore, the log was not taken from ground level. There is no evidence provided to suggest the exact depth below ground level where the borehole log was started. Therefore, the borehole shown is only in an approximate location relative to the ground level.*

3.3.3 The Phase 1 Geotechnical and Geo-environmental Desk Study surmised that the ground conditions are unlikely to be suitable for the use of infiltration devices.

3.4 Hydrogeology

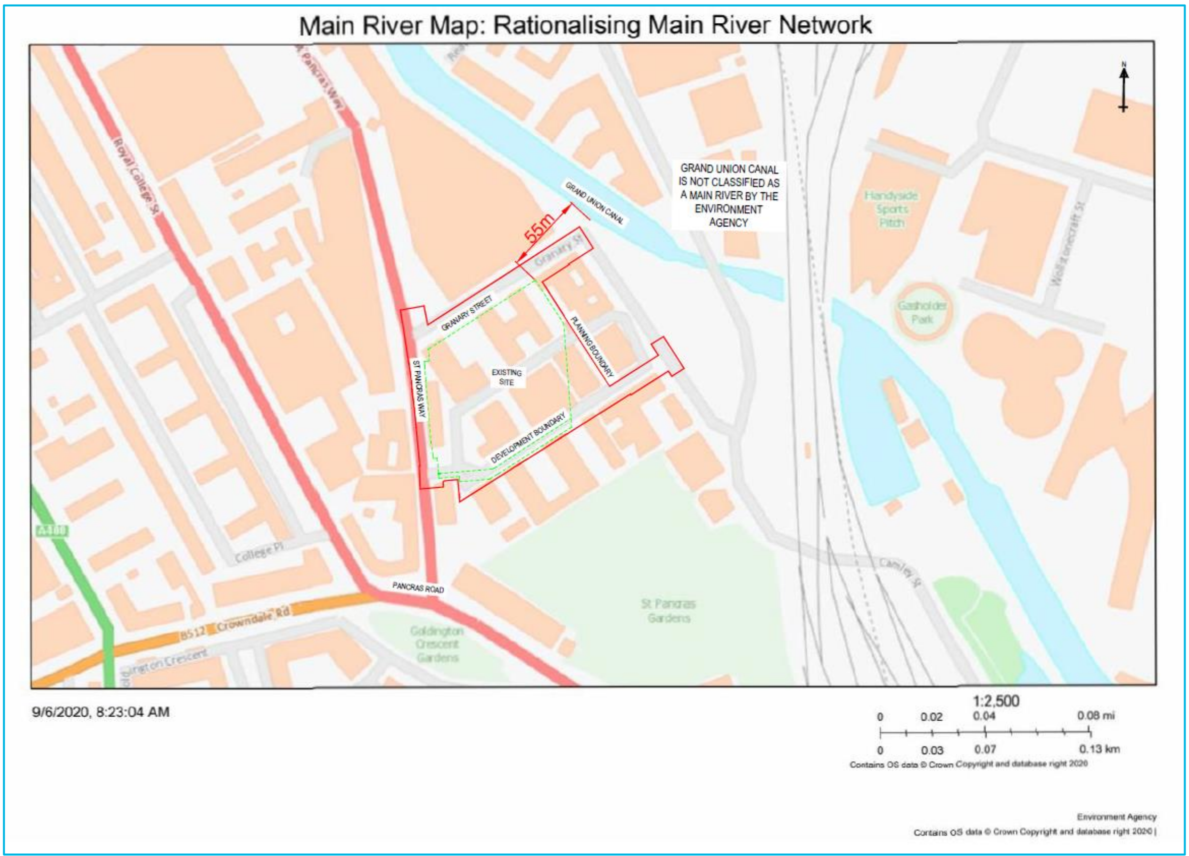
3.4.1 The London Clay Formation is classified as an Unproductive Strata. The presence of a significant thickness of London Clay means that groundwater resources present in the deeper Principal Aquifer are perceived to be at no risk from activities carried out on the Site. The Hydrogeological Map of England and Wales published by the BGS (Ref. 4) indicates that the groundwater level at the Site is -60m AOD.

3.5 Hydrology

3.5.1 The nearest watercourse to the Site is the Regent's Canal, an arm of the Grand Union Canal, which is located at the end of Granary Street, approximately 10m from the site boundary and 95m from the Proposed Development boundary. Regent's Canal is a manmade structure that is maintained by the Canal and River Trust.

3.5.2 The Regent's Canal is not classified as a Main River by the Environment Agency (Figure 3-4). The nearest Environment Agency Main River is the River Thames, located approximately 3 km to the south-south east of the Site.

Figure 3-4 Environment Agency Main River Map (Ref. 5)



3.6 Public Sewers

3.6.1 The results of the Thames Water Utilities Ltd (TWUL) Asset Locations Search can be found in Appendix B.

3.6.2 There is a TWUL combined water sewer running along the northern edge of Granary Street with DN150mm (no depth information available). This sewer flows from the north east corner of the Site in a south westerly direction to the north west corner where Granary Street meets St Pancras Way. The sewer then connects to a DN600mm sewer which then immediately outfalls to the 1118 x 762mm trunk sewer that extends along St Pancras Way.

3.6.3 The 1118 x 762mm trunk sewer that runs along St Pancras Way changes to a 1397 x 838mm sewer (manhole 6601 on TWUL records with invert level 14.88m AOD) immediately downstream of the connection from the DN600mm sewer and also accepts a connection from a DN300mm sewer on the north western corner of the Site. This DN300 sewer is shown to encroach on the north-western corner of the Site, however, is outside of the footprint of the proposed building.

3.6.4 The 1397 x 838mm trunk sewer also receives a connection from the Site at the south west corner in the form of a DN450mm sewer that is believed to be the combined surface and foul water connection point for drainage from the Site.

3.6.5 At the southern end of St Pancras Way, the 1397 x 838mm trunk sewer merges with the Fleet Sewer (Main Line) which varies in size from 2591 to 2642mm x 2260 to 2388mm. The invert level of the two large sewers is approximately 14.5m AOD.

3.6.6 Along the western boundary of the Site and within St Pancras Way, three existing gullies are located along the channel of the road to capture surface water runoff from the road as well as the adjacent public footways.

3.7 Existing Private Drainage Infrastructure

3.7.1 There are existing foul and surface water drainage networks running across the Site from east to west down two existing site access roads discharging into a main site drainage run to the west of the Site running from north to south. The existing Site drainage discharges into the wider St Pancras hospital site drainage network within the main access road and continues south before connecting into the Thames Water Public Sewers within St Pancras Way.

3.7.2 The private drainage network currently serving the existing buildings to be demolished on the Site will be abandoned in order to accommodate the proposed hospital building with any drainage upstream of the Site serving areas of the wider St Pancras Hospital to be diverted as required.

3.8 Existing Surface Water Discharge Rates

3.8.1 Existing surface water discharge rates from the area to be occupied by the Proposed Development has been calculated for the 1, 30 and 100 year events. These are summarised in Table 3-1 below. Existing runoff calculations are in Appendix C and were produced by constructing a simulated hydraulic model of the main pipes forming the existing drainage infrastructure as shown on the existing drainage drawings in Appendix D.

Table 3-1 Existing Surface Water Runoff

Return Period (years)	Existing Runoff (litres per second)
1 in 1	74.8
1 in 30	129.7
1 in 100	137.6

3.8.2 The simulated hydraulic model was created using Microdrainage Network tool (Ref. 6) of the existing site with a total drained area of 0.690 ha. This area has been calculated by removing the areas of the private road on the south side of the Site (0.043 ha) and the section of the emergency vehicle drop off layby to the west of the Site (0.019 ha) from the existing site impermeable area of 0.752 ha (which is shown on drawing ORL-ACM-ZZ-DR-C-050014 within Appendix D). The remaining area outside the Proposed Development boundary but within the planning boundary (1.33 ha minus 0.690 ha equals 0.640 ha) is comprised of public roads (St Pancras Way and Granary Street) and footpaths as well as private shared road which are anticipated to keep their existing surface water drainage regimes or be amended to suit the re-configuration works including relocation of gullies to meet low points. The remaining area includes part of the proposed emergency vehicle drop off area which will be drained to the site drainage network but has not been used to calculate existing drainage allowances as this area currently drains directly to the Thames Water network without passing through the private on-site drainage network. This approach has been chosen to provide a conservative assessment of the existing drainage discharge rate from the Site.

3.8.3 The results demonstrate that the existing system is able to contain the 1 year event although it surcharges the network in most modelled locations. However, the existing system is unable to cope with the 30 and 100 year events without flooding due to the discharge rates reaching and exceeding the capacity of the existing modelled outfall: a 225mm diameter pipe.

3.8.4 The outfall pipe is located near the south western corner of the Site and is understood to form part of the existing private infrastructure serving the existing Site and adjacent private access roads. Downstream of this pipe, the private network passes through a section of private 300mm diameter pipe, then a section of private 450mm diameter pipe before eventually connecting to the 1397 x 838mm TWUL sewer under St Pancras Way.

3.9 Greenfield Runoff Rates

3.9.1 The Rural Runoff estimation tool with Microdrainage was used to determine the greenfield runoff rates for the Proposed Development footprint (0.785 ha) to provide a basis of comparison to the proposed discharge rates. Table 3-2 shows the greenfield runoff rates obtained. Please see Appendix C for Greenfield Runoff calculations.

Table 3-2 Greenfield Runoff

Return Period (years)	Greenfield Runoff (litres per second)
1	2.4
Qbar	2.9
30	6.5
100	9.2

4 Proposed Development

4.1.1 Full planning permission is being sought for the Proposed Development.

4.1.2 Prior to commencement of construction of the Proposed Development, the existing buildings within the Site will be demolished.

4.1.3 The Proposed Development comprises a single building, which ranges from 7 to 10 storeys including Lower ground and Ground floor. The Proposed Development will comprise a mix of uses including clinical, research and education purposes, including accident and emergency (A&E) department, outpatients, operating theatres, research areas, education space, café and retail areas, facilities management, office space and plant space. Given the constrained nature of the Site, areas of soft landscaping within the Proposed Development would be limited and will include a roof terrace on the Sixth Floor Level.

4.1.4 The remaining land within Proposed Development but outside the footprint of the proposed building will generally be laid to hardstanding comprising primarily pedestrian footpaths, with elements of shared surfacing and planting appropriate for an urban setting.

4.1.5 The land outside of the Proposed Development boundary, but within the Site boundary for the planning application will mostly remain unchanged, except for the required highway amendments to ensure adequate access to the Proposed Development.

4.2 Proposed Drainage Strategy

4.2.1 The foul and surface water drainage strategy for the Proposed Development has been developed with reference to current best practice and requirements. The Proposed Development will be constructed with separate foul and surface water drainage networks which will only combine at the edge of the Proposed Development boundary in order to connect to the downstream private combined drains and eventually to the public sewers within St Pancras Way.

4.2.2 The proposed surface water drainage strategy is further described in Section 8 of this report.

4.3 Proposed Foul Water Drainage Strategy

4.3.1 It is proposed that foul water drainage from the Proposed Development will discharge largely via gravity into existing private combined water drains within the Site. This ultimately discharges into public sewers within St Pancras Way.

4.3.2 New foul water drains within the Proposed Development will be sized using the discharge unit method contained within BS EN 752 (Ref. 7) and the current Building Regulations requirements (Ref. 8). The system will be designed to flow not more than three-quarters full and will be laid at gradients that allow self-cleansing velocities to be achieved. The maximum design velocity within the system will be no greater than 3m/s.

4.3.3 All below ground foul drainage connections from toilet areas will be 150mm diameter to reduce the risk of blockages.

4.3.4 There is a requirement for vulcathene drainage in some areas due to the nature of chemicals used within laboratory areas. The extent of this is to be confirmed at the detailed design stage. It is currently unknown whether there is a requirement for radioactive waste disposal within the drainage system. However, if this is required, it would be drained to a separate tank and removed from site in order to prevent radioactive waste from entering the main drainage system, and in accordance with any necessary permits and/or licenses.

4.3.5 Internal manholes will be avoided wherever practicable. However, where used these will incorporate double seals, recessed and lockable covers, and be located in back of house areas and areas of low sensitivity.

4.4 Foul Water Discharge Rate

4.4.1 Details of the existing Site foul water drainage discharge rates are not available. Therefore, the following option has been used to estimate the likely discharge rate:

- Using Sewers For Adoption (Ref. 9), section B5.1 part 2(b) and by qualifying the existing Site as a having an unknown portion of normal and wet industry, an average flow rate of 0.7 l/s/ha is defined.
- The existing Site measures an area of 0.766 ha (building and private access roads only – this does not include the area of public and shared roads nor does it include the emergency vehicle drop off area).
- A peak factor of 6 can be applied to the average rate, to cater for the diurnal variations in flows expected from such sites.
- An allowance of 10% infiltration of surface water is included.
- The result is an estimated existing average flow rate of 3.54 l/s.

4.4.2 This compares favourably with existing combined water network on site which comprises pipes that are suitable to accommodate this flow rate, with spare capacity for the surface water element. See Appendix D for drawings showing the existing Site area and existing combined drainage networks.

4.4.3 The Proposed Development will cater for an undetermined number of users. However, the potable water demand has been estimated for the Proposed Development, which has been used to determine the proposed foul water flow from the Proposed Development.

- The estimated daily potable water demand of 116,180 l has been estimated by the MEP engineer on the project based on expected types of users within each part of the building.
- It is estimated that 80% of the potable water used in the Proposed Development is discharged to the foul system.
- A peak factor of 6 can be applied to the average rate, to cater for the diurnal variations in flows expected from such sites.
- An allowance of 10% infiltration of surface water is included.

- The result is an estimated proposed peak foul water flow rate of 7.10 l/s.
- This calculation shows an increase (7.10 minus 3.54 equals 3.56 l/s), which is an increase of almost 100% compared to the estimated existing discharge rate.

4.4.4 The proposed foul water drainage network will be designed to cater for this discharge rate.

4.4.5 Section 8 includes details of the proposed surface water network which, together with the proposed foul water discharge rate estimated in Section 4.4, will not exceed the capacity of the private drainage network downstream of the proposed connection point.

4.4.6 A Pre-development Enquiry application was submitted to Thames Water to identify if the increased foul water discharge rate can be accommodated in the downstream public network.. Thames Water has provided a response (see Appendix B) confirming that the proposed connection point and discharge rate is acceptable and that their downstream network will not require reinforcement in order to accept the increased foul water flow.

4.5 Foul Water from Food Preparation Areas

4.5.1 The Proposed Development does not include sufficient space to include underground centralised grease interception and removal units. Moreover, such underground systems tend not to be suitable for urban areas where external space is at a premium and maintenance operations of the underground units would result in disruption to the daily activities of the development as well as an odour nuisance to the surrounding area.

4.5.2 Therefore, it is proposed that all food preparation areas within the Proposed Development will include internal, above ground grease interception and disposal units that can be accessed and maintained locally.

4.6 Foul Water Drainage Adoption and Maintenance

4.6.1 The Proposed Development will be situated on private land and will only serve a single curtilage. Therefore, it will remain in private ownership and be maintained by an appropriate management company in perpetuity.

4.6.2 The connection of the proposed private foul water drainage network will be made on an existing section of private drainage within the Proposed Development boundary and will therefore require an indirect Section 106 application to Thames Water.

5 Planning Policy

5.1 Planning Policy Summary

5.1.1 Planning policy and guidance relevant to the Flood Risk Assessment and Drainage and Strategy for Proposed Development are outlined below.

5.2 The Flood and Water Management Act 2010

5.2.1 The Flood and Water Management Act 2010 (Ref. 10) implements the recommendations from Sir Michel Pitt's Review of the floods in 2007 (Ref. 11) and places a series of responsibilities on local authorities with the primary aim of improving flood risk management. The Act was also a response to the need to develop better resilience to climate change. It gives a new responsibility to the Environment Agency for developing a National Flood and Coastal Risk Management Strategy and to Lead Local Flood Authorities to coordinate flood risk management in their area.

5.3 The Flood Risk Regulations 2009

5.3.1 The Flood Risk Regulations 2009 (Ref. 12) transpose the European Commission (EC) Floods Directive (2007/60/EC) into domestic law in England and Wales and implements its provisions.

5.3.2 The key objective of the Floods Directive is to coordinate the assessment and management of flood risks within Member States. Specifically, it requires Lead Local Flooding Authorities (LLFAs) of Member States to assess if all watercourses and coast lines are at risk from flooding, map the flood extent and assets and humans at risk in these areas, and take adequate and coordinated measures to reduce this flood risk. In particular it places duties on the LLFAs to prepare a number of documents including:

- A Preliminary Flood Risk Assessment Report that identifies Flood Risk Areas that warrant further examination through the production of maps and management plans.
- Flood Hazard and Flood Risk Maps that summarise identified local flood risks and flood hazards within the Flood Risk Areas.
- Local Flood Risk Management Plans that set out the actions and measures that will be taken to manage identified flood risks within the Flood Risk Areas.

5.4 National Planning Policy Framework

5.4.1 The National Planning Policy Framework (NPPF) (Ref. 1), updated June 2019, states the following at paragraphs 163 and 165:

"163. When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment[2].

[2] A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at

Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
b) the development is appropriately flood resistant and resilient;
c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
d) any residual risk can be safely managed; and
e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan."

165. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:
a) take account of advice from the lead local flood authority;
b) have appropriate proposed minimum operational standards;
c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
d) where possible, provide multifunctional benefits."

5.4.2 This site-specific Flood Risk Assessment and Drainage Strategy has been prepared to address the requirements above and demonstrates the suitability of the Proposed Development to meet the requirements of the NPPF.

5.5 Flood Zone Definition

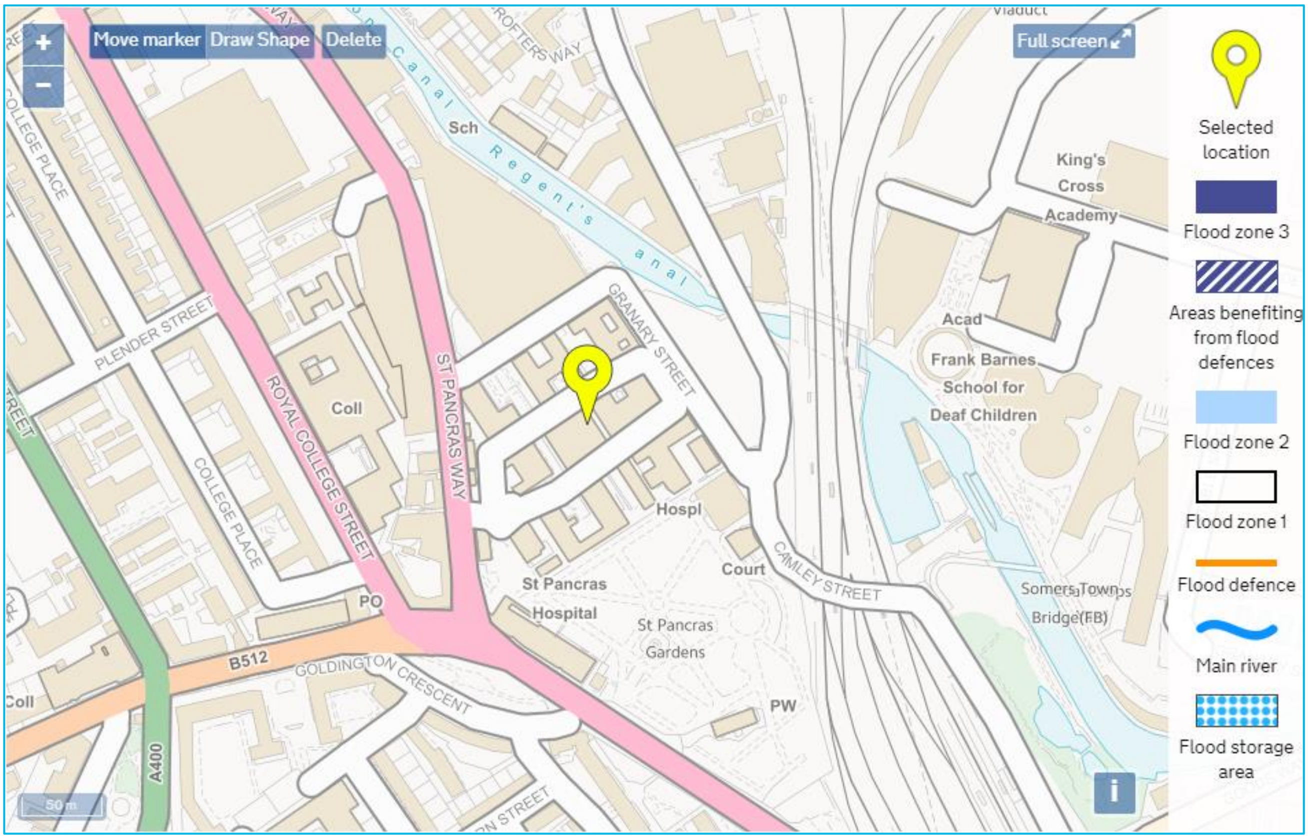
5.5.1 The Technical Guidance to the NPPF (Ref. 13) defines the flood risk zones that are published by the Environment Agency, which are as follows:

- Flood Zone 1 - the low probability zone which is defined as having a less than 0.1% (or 1 in 1000 year) probability of flooding each year;
- Flood Zone 2 – the medium probability zone which is defined as having between 0.1% and 1% (or between 1 in 1000 and 1 in 100 year) probability of fluvial flooding or between 0.1% and 0.5% (or between 1 in 1000 and 1 in 200 year) probability for flooding from the sea each year;
- Flood Zone 3a – the high probability zone which is defined as having a 1% or greater (or 1 in 100 or greater) probability of fluvial flooding, or a 0.5% or greater (1 in 200 or greater) probability of flooding from the sea each year; and
- Flood Zone 3b – Functional Floodplain which is defined as land where water has to flow or be stored in times of flood.

5.5.2 The Flood Zone classification for the Site is shown as Flood Zone 1 on the Environment Agency online maps: see Figure 5-1 below:

increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

Figure 5-1 Environment Agency Flood Zone Map (Ref. 5)



5.6 Sequential Test and Vulnerability Classification

5.6.1 The NPPF aims to ensure that flood risk is taken into account at all stages of the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas of highest risk. On a district-wide scale this is achieved through the application of the Sequential Test by the Local Planning Authority (LPA). The Sequential Test encourages LPAs to steer development to areas of lowest flood risk on a borough / district wide level and only develop in flood risk areas where absolutely necessary. The LPA should apply the Sequential Test based on information presented in their Strategic Flood Risk Assessment (SFRA).

5.6.2 The NPPF Sequential Test evaluates the risk of flooding, based on Environment Agency Flood Zones, against the vulnerability of a proposed development.

5.6.3 According to the Technical Guidance to the NPPF, the Proposed Development is classified as More Vulnerable.

Table 5-1 Flood Risk Vulnerability and Flood Zone Compatibility

Flood Risk Vulnerability classification (see Table D2)		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (see Table D.1)	Zone 1	✔	✔	✔	✔	✔
	Zone 2	✔	✔	Exception Test required	✔	✔
	Zone 3a	Exception Test required	✔	✗	Exception Test required	✔
	Zone 3b 'Functional Flood plain'	Exception Test required	✔	✗	✗	✗

5.6.4 More Vulnerable developments are appropriate in Flood Zone 1 and Flood Zone 2. An Exception Test is required for More Vulnerable developments in Flood Zone 3a areas and More Vulnerable developments are not appropriate for Flood Zone 3b areas.

5.6.5 The Site and Proposed Development are located entirely within Flood Zone 1. The Environment Agency Maps for Flooding which have been obtained to demonstrate the Flood Zone for the Site are included in Appendix E of this report. Therefore, the development classification (More Vulnerable) is considered to be suitable for this Flood Zone.

5.7 Thames: Catchment Flood Management Plan

5.7.1 The Thames Region Catchment Flood Management Plan (CFMP, Ref. 13) covers fluvial and non-tidal sections of the River Thames, i.e. the River Thames upstream of Teddington weir and tributaries of the River Thames (e.g. River Mole).

5.7.2 The Proposed Development is within Sub-area 9, 'London catchments', here the preferred policy option is 'Policy option 4: Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change'.

5.7.3 Climate change has been considered and accounted for within this FRADS.

5.8 London Plan 2021

5.8.1 Since submission of the FRADS in October 2020, the new London Plan has been adopted, in March 2021 (Ref. 2). The adopted London Plan contains a number of policies relevant to flood risk:

“<u>Policy SI 12 Flood risk management</u>

A. Current and expected flood risk from all sources (as defined in paragraph 9.12.2) across London should be managed in a sustainable and cost-effective way in collaboration with the Environment Agency, the Lead Local Flood Authorities, developers and infrastructure providers.

B. Development Plans should use the Mayor’s Regional Flood Risk Appraisal and their Strategic Flood Risk Assessment as well as Local Flood Risk Management Strategies, where necessary, to identify areas where particular and cumulative flood risk issues exist and develop actions and policy approaches aimed at reducing these risks. Boroughs should cooperate and jointly address cross-boundary flood risk issues including with authorities outside London.

C. Development proposals should ensure that flood risk is minimised and mitigated, and that residual risk is addressed. This should include, where possible, making space for water and aiming for development to be set back from the banks of watercourses.

D. Developments Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan. The Mayor will work with the Environment Agency and relevant local planning authorities, including authorities outside London, to safeguard an appropriate location for a new Thames Barrier.

E. Development proposals for utility services should be designed to remain operational under flood conditions and buildings should be designed for quick recovery following a flood.

F. Development proposals adjacent to flood defences will be required to protect the integrity of flood defences and allow access for future maintenance and upgrading. Unless exceptional circumstances are demonstrated for not doing so, development proposals should be set back from flood defences to allow for any foreseeable future maintenance and upgrades in a sustainable and cost-effective way.

G. Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat.

<u>Policy SI 13 Sustainable drainage</u>

A. Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water runoff outside these areas also need to be identified and addressed.

B. Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

1) rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)

2) rainwater infiltration to ground at or close to source

3) rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)

4) rainwater discharge direct to a watercourse (unless not appropriate)

5) controlled rainwater discharge to a surface water sewer or drain

6) controlled rainwater discharge to a combined sewer

C. Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.

D. Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation."

5.8.2 The drainage strategy for the Proposed Development has been progressed in a manner to demonstrate adherence to the hierarchy of discharge methods and will make use of SuDS features where possible to reduce runoff rates and volume in line with the requirements stated in London Plan adopted March 2021.

5.9 Camden Local Plan (2017)

5.9.1 Camden Local Plan (2017) (Ref. 17) contains a number of policies relevant to climate change and flood risk:

"Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

a. the protection of existing green spaces and promoting new appropriate green infrastructure;

b. not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;

c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and

d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy. Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Sustainable design and construction measures

The Council will promote and measure sustainable design and construction by:

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;

f. encourages new build residential development to use the Home Quality Mark and Passivhaus design standards; g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and

h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.

Policy CC3 Water and flooding

The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible.

We will require development to:

a. incorporate water efficiency measures;

b. avoid harm to the water environment and improve water quality;

c. consider the impact of development in areas at risk of flooding (including drainage);

d. incorporate flood resilient measures in areas prone to flooding;

e. utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and

f. not locate vulnerable development in flood-prone areas.

Where an assessment of flood risk is required, developments should consider surface water flooding in detail and groundwater flooding where applicable.

The Council will protect the borough's existing drinking water and foul water infrastructure, including the reservoirs at Barrow Hill, Hampstead Heath, Highgate and Kidderpore."

5.9.2 The drainage strategy for the Proposed Development has been progressed in a manner to demonstrate adherence to the hierarchy of discharge methods and will make use of SuDS features where possible to reduce runoff rates and volume in line with the requirements stated in Camden Local plan.

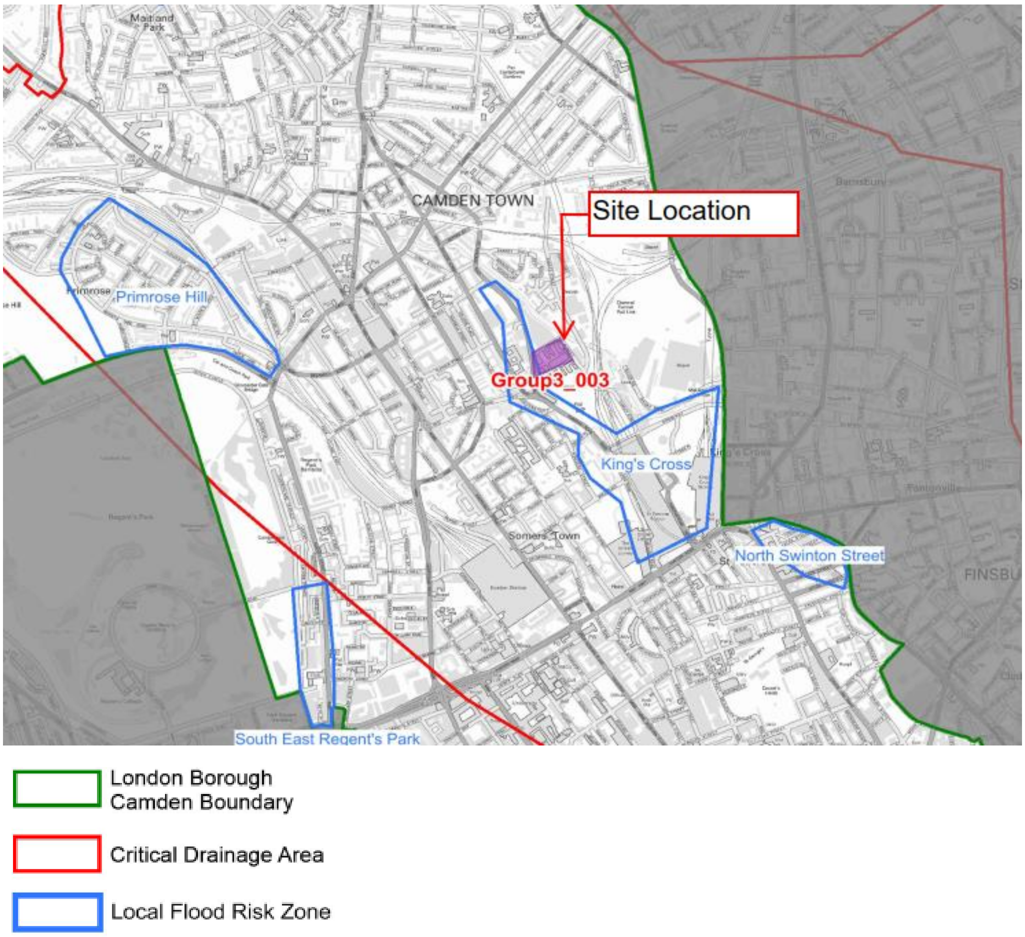
5.10 Camden Strategic Flood Risk Assessment (SFRA)

5.10.1 Camden SRFA (Ref. 16) provides a detailed assessment of the flood risk at the strategic development sites identified by the Council. In line with the SRFA, a Flood Risk Assessment *"is required for proposals of 1 hectare or greater in Flood Zone 1 and for new development (including minor development and change of use) in an area of Flood Zone 1 which has critical drainage problems. The majority of the borough is located within a Critical Drainage Area (CDA) as defined by the LB Camden Surface Water Management Plan (SWMP) and therefore LB Camden should consider requiring FRAs for all development located within Local Flood Risk Zones as defined by the SWMP."*

5.10.2 Due to the majority of the borough being located within a Critical Drainage Area as defined by the LBC SWMP, all opportunities should be taken during development to reduce existing runoff rates post-development. Policy 5.13 of the London Plan states that all development should aim to achieve greenfield runoff rates, and where this is not possible, runoff rates post-development should not exceed those pre-development, as per the NPPF. The SWMP Critical Drainage Areas and Local Flood Risk Zones, and the Environment Agency's updated Flood Map for Surface Water (uFMfSW) (now renamed Risk of Flooding from Surface Water (RoFSW)) dataset should be used as a starting point to indicate broad areas with a potential for surface water flood risk in the borough. In the absence of fluvial flood risk within the borough, a clear focus for new development should be a reduction in surface water runoff rates post-development, wherever practicable.

5.10.3 The Site area is 1.33ha and it sits within Critical Drainage Area (Ref: Group3_003 – see Figure 5-2). The Site borders the King's Cross Local Flood Risk Zone (see Figure 5-2 below) and for precautionary reasons the Site has been treated in a similar way to developments situated inside such a zone.

Figure 5-2 Critical Drainage Areas / Local Flood Risk Zones (Source: Camden Local Plan 2017 Ref. 17)



5.10.4 The SFRA states that "*suitable surface water mitigation measures are incorporated into any development plans in order to reduce and manage* *surface water flood risk to, and posed by the proposed development. This should ideally be achieved by incorporating SuDS*."

5.10.5 The SFRA recommends the adoption of mitigation measures and approaches within the SWMP as discussed in Section 5.11.

5.11 Camden Surface Water Management Plan (SWMP)

5.11.1 The Surface Water Management Plan (SWMP) (Ref. 18) is a non-statutory document which outlines the preferred surface water management strategy in the London Borough of Camden.

5.11.2 This document also establishes a long-term action plan to manage surface water and will influence future capital investment, maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.

5.11.3 The Site falls in Critical Drainage Area (CDA) Group3_003. The SWMP states that *"Measures in each CDA should be discussed and agreed in virtual site visits and workshops with the Borough and other stakeholders."*

5.11.4 Recommended Source Control options for LFRZ "*including Green Roofs, soakaways, swales, permeable paving, rainwater harvesting, detention basins, ponds and wetlands, partial or full disconnection of roof runoff from sewer system, and other 'source' measure".*

5.11.5 The Proposed Development will make use of permeable surfacing where possible and will provide a significant reduction in surface water discharge rate to reduce the burden on the downstream receiving sewers. Further details of the drainage strategy are included in Section 8.

5.12 Lead Local Flood Authority

5.12.1 Local Planning Authorities are responsible for the approval of sustainable drainage designs for all planning applications in consultation with the Lead Local Flood Authority (LLFA). LBC act as the LLFA for the Proposed Development and have produced a Pro-forma outlining their requirements. This Pro-forma has been completed and is included in Appendix F.

5.12.2 The Pro-forma demonstrates that the Proposed Development will meet the requirements of the LLFA by addressing the specific questions raised in the Pro-forma and providing details where needed.

5.13 The Environment Agency

5.13.1 The Environment Agency have defined the percentage of additional allowance for climate change for peak rainfall intensity in assessments of flood risk in small (less than $5km^2$) or urban drainage catchments.

5.13.2 Table 5-2 below indicates that the desired climate change allowance for the Proposed Development is 40% as an upper end allowance for a development with a design life which is expected to reach beyond 2070.

Table 5-2 Peak rainfall intensity allowance in small and urban catchments

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

5.13.3 The design of the drainage system for the Proposed Development should ensure there is no increase in the rate of runoff discharged from the Site for the upper end allowance.

5.13.4 The calculations within this FRADS demonstrate that the correct percentage for additional allowance for climate change has been used and therefore meet the requirements of the Environment Agency.

5.14 The SuDS Manual (CIRIA C753)

5.14.1 The SuDS Manual (CIRIA C753) (Ref. 19) is the most comprehensive industry SuDS guidance available in the UK. This guidance focuses on the cost-effective planning, design, construction, operation and maintenance of SuDS.

5.14.2 The SuDS Manual suggests a risk-based approach to SuDS selection based on land use, type and specific contaminants.

5.14.3 Table 26.1 of the SuDS Manual suggests a Simple Index Approach (SIA) for low risk developments, which includes the Proposed Development.

5.14.4 The SIA follows a three-step process, namely:

- Allocate suitable pollution hazard indices for the proposed land use (refer to CIRIA C753 Table 26.2).
- Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index (refer to CIRIA C753 Table 26.3).
- Where the discharge is to protect surface waters or groundwater, consider the need for a more precautionary approach.

5.14.5 Refer to Section 8.8 of this report which states the pollution hazards indices and the mitigation indices specific to the Proposed Development.

6 Flood Risk to the Proposed Development

6.1 Introduction

6.1.1 This section of the report identifies the existing risks to the Proposed Development from the different sources of flooding identified in the NPPF.

6.2 Flood Risk from Tidal Sources

6.2.1 Tidal sources of flooding include seas and estuaries. Flooding from these sources can occur through overtopping of defences, breaching of defences and wave action.

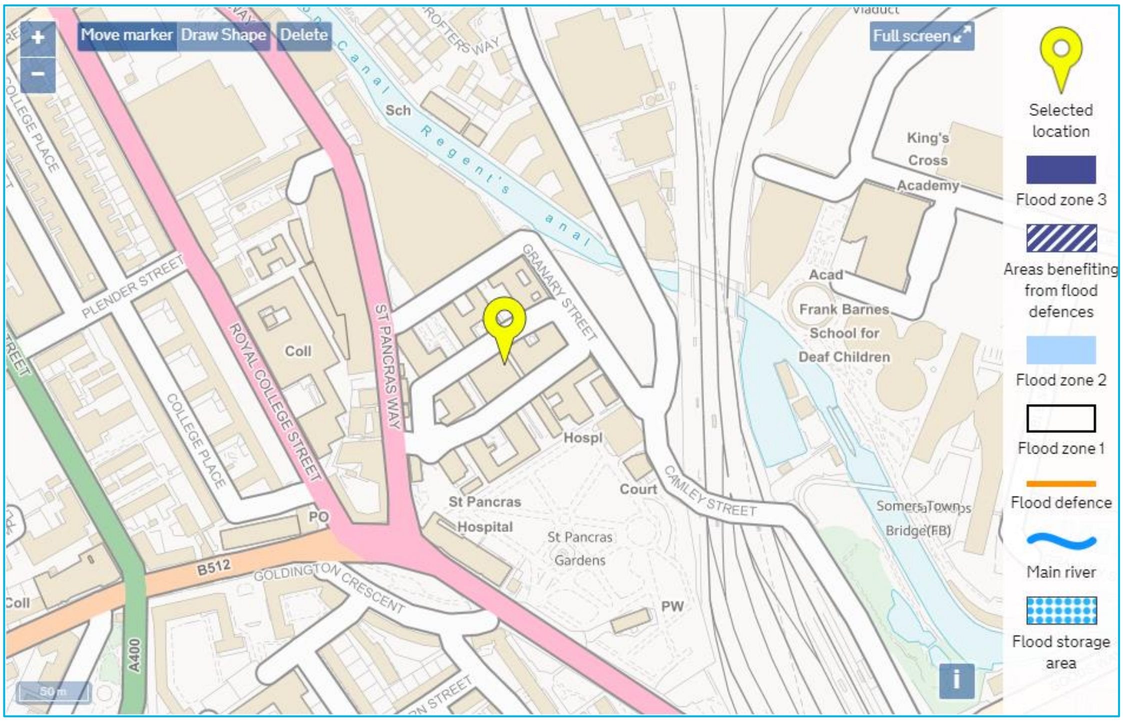
6.2.2 As the Site is located at over 19m AOD, there are no sources of tidal flooding within the vicinity; therefore, there is no flood risk from tidal sources.

6.3 Flood Risk from Fluvial Sources

6.3.1 Flooding from fluvial sources can occur through inundation of floodplains from watercourses; inundation of areas outside the floodplain due to the influence of bridges, embankments and other features that artificially raise water levels; overtopping of defences; breaching of defences; blockages of culverts; and blockages of flood channels, or flood corridors.

6.3.2 Regent's Canal is situated at the end of Granary Street to the north east of the northern tip of the Proposed Development. The Environment Agency Flood Map indicates that Regent's Canal has a risk of flooding of less than 0.1% (or 1 in 1000 year) probability each year (see Figure 6-1).

Figure 6-1 Environment Agency Flood Zone Map



6.3.3 There is a potential source of fluvial flooding present around the Site in the form of Regent's Canal. However, the canal has a low risk of flooding. In addition, the canal will be maintained in perpetuity by the Canal and River Trust and therefore is unlikely to suffer catastrophic failure of its banks that could lead to flooding of the Site.

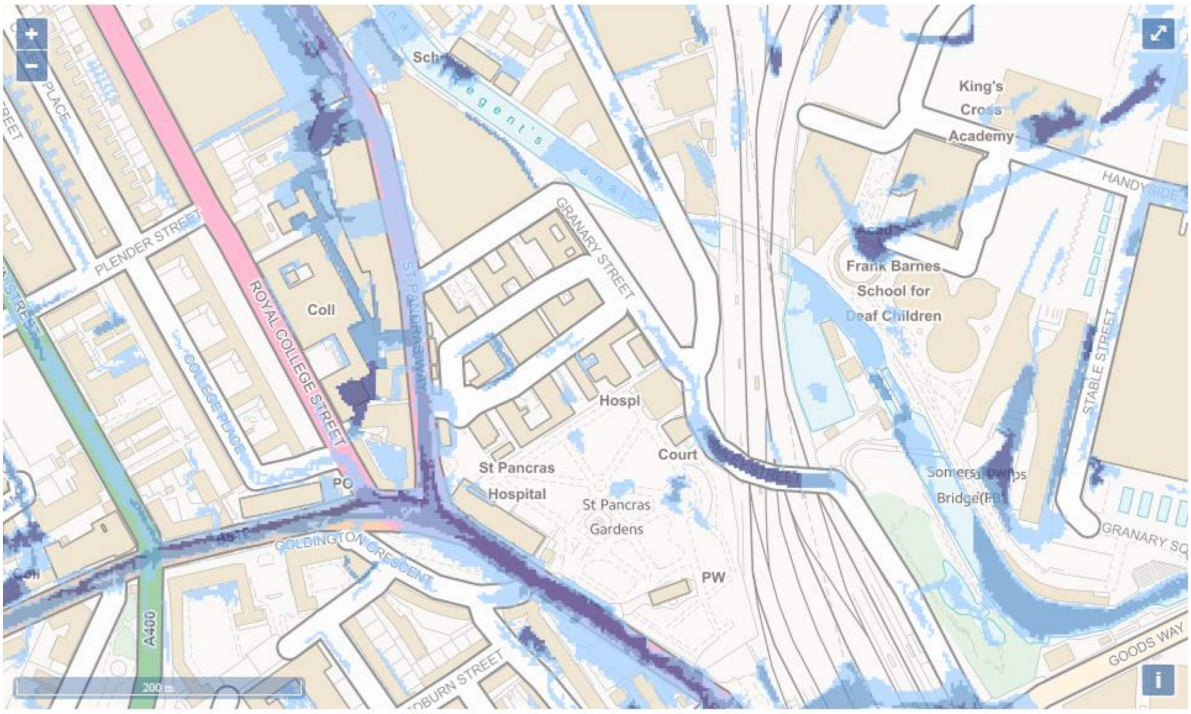
6.3.4 Therefore, the probability of fluvial flooding extending into the Site is considered to be low.

6.4 Flood Risk from Pluvial Flooding

6.4.1 Pluvial flooding occurs when rainfall cannot infiltrate the ground surface, or when intensity exceeds the infiltration capacity of the ground. Pluvial flooding can be evident in many forms and can range from deep ponding of surface water in low lying areas with poor drainage to fast flow via overland routes in heavily urbanised or steep catchments.

6.4.2 The Site is located within a highly urban area where overland flows would be primarily routed around buildings and via roads. The general fall across the land in the vicinity of the Site is from north east to south west. However, to the north of the Site lies Regent's Canal which acts as a barrier to any potential flow path from areas further north. In addition, all properties around the Site will include drainage systems that have been designed to capture surface runoff and direct it to the nearest sewer. The Environment Agency Surface Water flood map reproduced in Figure 6-2 below shows the extent of surface water flooding for the Site and surrounding area.

Figure 6-2 Environment Agency Surface Water Flooding Map (Ref. 21)



Extent of flooding from surface water

High Medium Low Very low Location you selected

6.4.3 The map reproduced in Figure 6-2 shows that significant surface water flooding can occur along St Pancras Way and smaller instances of flooding can occur within the southern parts of the Site.

6.4.4 The area to the south of the Site forms part of the Kings Cross Local Flood Risk Zone (see Figure 5-2 and Ref. 17). While the Site itself does not form part of this Local Flood Risk Zone, its proximity to the Zone suggests that it may require additional consideration to address the flooding issues that affect the Zone. The flooding shown in St Pancras Way is expected to be the main source of this risk.

6.4.5 There is a potential source of pluvial flooding to the Site from the urban catchments around the Site. In particular, the surface water flooding shown in St Pancras Way to the west of the Site is significant. However, St Pancras Way falls south towards Pancras Road which lies at topographical levels lower than the lowest point on the Site. The smaller instances of flooding within the Site are a result of the existing sub-standard drainage infrastructure which does not include any attenuation systems to cater for larger storm events. However, the surface water flooding is shown to be restricted to some limited parts of the Site where the topographical levels of the internal private roads result in low points that accumulate surface water runoff when the existing drainage infrastructure become overwhelmed.

6.4.6 The risk of flooding from pluvial sources at the Site is therefore considered to be medium.

6.5 Pluvial Flooding: Mitigation measures

6.5.1 The Proposed Development will be constructed in a manner to ensure that the finished floor level of the building will be set above the levels of the adjacent St Pancras Way.

6.5.2 The proposed on-site levels outside the proposed building footprint will be designed to fall away from the building in all cases, with linear drainage features located at the entrances to the building to provide an additional level of flood protection.

6.5.3 Where possible, pervious surfacing will be used to draw surface water to porous sub-base and to underground drainage systems to reduce the potential for failure of over-ground catchment systems (such as gullies) through blockages.

6.5.4 Section 8 of this FRADS provides details of the proposed surface water drainage infrastructure that will serve the Proposed Development to provide sufficient mitigation measures which will reduce the flood risk to the Proposed development from Pluvial Flooding to low.

6.6 Flood Risk from Sewers

6.6.1 Sewer flooding occurs when the sewer capacity becomes exceeded or where a blockage occurs causing the sewer to surcharge and flood.

6.6.2 A DN150mm combined sewer exists within Granary Street that receives flow from the area north of the Site as well as from the road itself. The road surface generally falls from east to west.

6.6.3 St Pancras Way contains a 1397 x 838mm combined sewer which flows in a southerly direction and passes along the western boundary of the Site.

6.6.4 Sources of flooding from sewers exist in the vicinity of the Site. The DN150mm combined sewer in Granary Street is located on the far side of the road from the Proposed Development and the fall along the road towards the west is such that any flooding from this pipe is likely to run west towards St Pancras Way rather than affect the Proposed Development.

6.6.5 The large combined sewer within St Pancras Way is also unlikely to adversely affect the Proposed Development as any flooding incidents from this sewer would flow south towards Pancras Road.

6.6.6 The risk of flooding from sewers at the Site is therefore considered to be low.

6.7 Flood Risk from Groundwater

6.7.1 Groundwater flooding can occur when groundwater levels rise above the surface of the site and infiltrate into the site via the ground surface.

6.7.2 The existing London Clay Formation is classified as an Unproductive Strata. The presence of a significant thickness of London Clay means that groundwater resources present in the deeper Principal Aquifer are perceived to be at no risk from activities carried out on site. The Hydrogeological Map of England and Wales published by the BGS indicates that the groundwater level at the site is -60m AOD. The presence of a thick clay sub-grade layer precludes the possibility of groundwater flooding by removing the potential flow path from more productive underground strata.

6.7.3 The groundwater level provided in the published ground investigation records demonstrates that the overall flood risk from groundwater on the Site is considered to be low.

6.7.4 The Envirocheck report obtained in April 2019, which is appended to the Phase 1 Geotechnical and Geoenvironmental Desk Study report submitted with the planning application states that there is no potential for flooding from groundwater on the Site.

6.8 Flood Risk from Artificial Sources

6.8.1 Artificial flood sources include raised channels such as canals or storage features such as ponds and reservoirs.

6.8.2 There are no ponds or other artificial sources near the Site except for Regent's Canal. The risk of flooding sources from Regent's Canal is assessed in Section 6.3 above.

6.8.3 There is no risk of flooding from artificial sources to the Site.

7 Residual Flood Risk

7.1.1 Table 7-1 below outlines the initial qualitative assessment of flood risk to the Proposed Development posed by the potential sources of flooding, the mechanisms for flooding and the likely consequences. It also includes a review of possible mitigation measures and the effect that the proposed mitigation measures are likely to have on the residual flood risk posed by the potential flood source.

Table 7-1 Summary of Existing and Residual Flood Risk to the Proposed Development

Flood Hazard	Flood Mechanism and Possible Consequence	Existing Assessment of Risk	Mitigation Measures	Residual Risk
Tidal	No tidal sources exist in the vicinity of the Site.	Very Low	No mitigation required.	Very Low
Fluvial / Tidal	Regent's Canal is close to the Site. However, this structure will be maintained in perpetuity by the Canal and River Trust and therefore is unlikely to breach its banks	Low	No mitigation required.	Low
Surface Water (Pluvial)	Parts of the Site are adjacent to areas that may allow surface water runoff to affect the Proposed Development and parts of the existing site including low lying areas that could be affected by accumulation of surface water runoff during larger storms	Medium	The proposed Surface Water Drainage Strategy will reduce the risks of surface water flooding.	Low
Surface Water and Foul Water offsite Sewers	The overall flood risk from sewers is low.	Low	No mitigation required.	Low

Flood Hazard	Flood Mechanism and Possible Consequence	Existing Assessment of Risk	Mitigation Measures	Residual Risk
Groundwater	The presence of a thick clay sub-grade layer precludes the possibility of groundwater flooding by removing the potential flow path from more productive underground strata. Therefore, the risk of flooding from this source is low.	Low	No mitigation required.	Low
Artificial Sources	There are no artificial sources in the vicinity of the Site other than Regent's Canal which has been dealt with above	Low	No mitigation required.	Low

8 Flood Risk from the Proposed Development

8.1 Proposed Surface Water Drainage Strategy

8.1.1 Within the Proposed Development boundary, the proposed building will result in an increase in impermeable area from 0.709 ha in the existing situation to 0.785 ha. The additional area will result in an increase in runoff rates unless steps are taken to amend the drainage regime to suit. The existing drainage network is unsuitable to meet the current standards required for surface water disposal for the Site.

8.1.2 Therefore, the Proposed Development will include a dedicated surface water drainage network that will integrate a system of SuDS features. The proposed SuDS system will be designed to ensure that the peak discharge rates from all storms up to an including the 100 year event plus 40% climate change will not exceed the proposed discharge rates set within this FRADS. This will ensure that flood risk from the Proposed Development to the surrounding areas is kept low.

8.1.3 The proposed runoff from the Proposed Development will be limited to a value as close to the greenfield runoff rate as reasonably practicable. Due to the nature of the Proposed Development, with very limited area outside the footprint of the proposed building and foundations and existing highways, there is limited space available to accommodate attenuation storage while maintaining a gravity outfall. Due to this, estimated attenuation volumes have been calculated for a range of discharge rates as summarised in Table 8-1 Greenfield Runoff Rates and Discharge Rates below.

8.1.4 The LBC Drainage Pro Forma in Appendix F identifies that where greenfield is not achievable, a minimum of 50% improvement on the existing 100 year event discharge rate should be targeted, and where possible exceeded.

Table 8-1 Greenfield Runoff Rates and Discharge Rates

	Discharge Rate	Attenuation Volume Estimate
Greenfield Runoff	2.9l/s	536 - 695m^3
Existing 1 in 100	137.6l/s	113 - 249m^3
50% Reduction	68.8l/s	194 - 321m^3
90% Reduction	13.8l/s	366 - 494m^3
85% Reduction	20.6l/s	321 - 448m^3

8.1.5 The volumes shown in Table 8-1 have been derived from Quick Storage Estimates tool within Microdrainage hydraulic modelling software based on the proposed drained area and the various discharge rates presented. These are provided as preliminary estimates for comparison purposes only. The attenuation rates proposed for this development are described further in the sections below to suit the site-specific spatial constraints.

8.1.6 Due to the small amount of space available and limited potential depth, a reduction of 85% is proposed as the lowest reasonable discharge rate from the Proposed Development. A further reduction is built into the calculation by draining the 0.019ha space that forms the emergency vehicle drop off area outside the Development Boundary. This additional area is to be drained through the proposed site drainage network without an increase in the discharge rate to provide a more conservative approach to drainage design.

8.1.7 Subsequently, a detailed hydraulic model was constructed using the Network tool within Microdrainage hydraulic modelling software to confirm that the proposed volume of attenuation was sufficient to achieve the desired rate of discharge. Details and results of the proposed surface water network model are included in Appendix G.

8.1.8 While the model includes sufficient attenuation within the underground cellular storage tanks to cater for the required storage volume, additional volume is also included in the form of permeable surfacing. However, this volume is only partially relied upon at this stage as it may be reduced by the need to provide services in the spaces where the permeable paving is shown.

8.2 Proposed Discharge Rates

8.2.1 The proposed discharge rates will therefore be as shown in the table below (Table 8-2). These are equivalent to 85% reduction compared to the existing rates calculated in Table 3-2.

Table 8-2 Proposed Discharge Rates

Return Period (years)	Proposed Discharge Rates (litres per second)
1	11.2
30	19.5
100	20.6

8.3 SuDS Selection

8.3.1 The selection of appropriate SuDS features has been undertaken by considering the local ground conditions and land use at the Site. A review of the suitability of SuDs features for the Proposed Development is presented in Table 8-3 below.

Table 8-3 Environment Agency SuDS Hierarchy

Suds Feature	Suitability for Proposed Development
Living/Green Roofs	This will be provided where practical during detailed design. However, it is likely that this form of SuDS will be unsuitable due to the need for the roof areas of the proposed building to cater for the significant density of MEP plant to serve the hospital.
Constructed Wetlands/Retention Pond	Unsuitable due to the spatial constraints of the site and the urban setting
Detention Basins	Unsuitable due to the spatial constraints of the site
Filter Strips and Swales	Unsuitable due to the spatial constraints of the site and the urban setting

Suds Feature	Suitability for Proposed Development
Soakaways	Unsuitable due to the nature of the underlying sub-soil: low infiltration potential
Infiltration Trenches	Unsuitable due to the nature of the underlying sub-soil: low infiltration potential
Gravelled Areas	Unsuitable due to the urban setting
Permeable Surfacing	Proposed within the few external spaces outside the proposed building footprint but within the Proposed Development boundary
Oversized pipes/ cellular storage crates	Cellular storage crates can be accommodated under the external spaces outside the proposed building footprint but within the Proposed Development boundary

8.4 Attenuation Storage: Porous Surfacing

8.4.1 Permeable surfacing will be provided on all external areas within the Proposed Development boundary where open space is available. The surfacing will be underlain by a porous sub-base construction of suitable thickness to accommodate the required volume of storage for the specific drained area.

8.4.2 Where possible the porous sub-base will be deepened to provide additional storage so that adjacent areas can be drained to the system. This may include roof areas which will be connected by means of diffuser crates to ensure that the runoff does not displace the sub-base material and cause un-due pavement subsidence.

8.4.3 The porous sub-base will be lined with an impermeable membrane to remove the potential for sub-grade softening and pavement failure. This will also ensure that the sub-base and underground drainage network behave as a tank network to maximise attenuation volume.

8.4.4 Where the Proposed Development finished surface levels will exceed gradients of 1:40, baffles may be necessary within the porous sub-base to restrict flow along the sub-base and compartmentalise the material to maximise attenuation volume.

8.4.5 The proposed area of porous surfacing is shown on drawings within Appendix D. It is proposed that the minimum conservative volume of attenuation within the porous surfacing will be 65m^3. However, an area of 720m^2 of porous surfacing is shown on the proposed drawings which may be able to achieve 130m^3 of storage, subject to installation depth, location of proposed services and the use of underground baffles, which may affect the available space for porous sub-base storage.

8.5 Attenuation Storage: Cellular Storage Crates

8.5.1 To accommodate the large volumes of storage required to achieve the significant reduction in surface water runoff described in this FRADS, cellular storage crates will be installed within the external areas of the Proposed Development where space is available. These units will be wrapped in impermeable membranes to act as storage devices coupled with perforated pipes that will only allow water to enter the crates during high flow events.

8.5.2 The cellular storage crates will be installed with cognisance of the adjacent foundations, the proposed services and the expected traffic loads in each area.

8.5.3 The proposed extent of cellular storage attenuation tanks is shown on drawings within Appendix D. It is proposed that the minimum volume of tank storage will be 280m^3.

8.6 Surface Water Outfall

8.6.1 The proposed surface water network will be terminated by a chamber housing a flow control unit that will ensure that surface water is not discharged from the Proposed Development at rates larger than those specified in this FRADS. The chamber outlet will then connect to the on-site private existing combined network which eventually flows to the Thames Water sewer within St Pancras Way.

8.7 Exceedance Flow Paths Design

8.7.1 In the event that the system fails due to an exceedance event (over and above a 1 in 100 year storm + 40% climate change allowance), damage or insufficient maintenance, external finished levels will be designed in order to ensure that the Proposed Development as well as the surrounding buildings are protected from flooding. Levels will be designed to fall away from entrances and towards areas of low sensitivity within the Proposed Development while taking care not to increase the risk of flooding to buildings surrounding the Site.

8.7.2 A drawing is included in Appendix D to show the potential exceedance flow routes around the proposed building. The drawing demonstrates that, while flow routes within the site boundary will be changed by the Proposed Development through the construction of a single large building compared to the arrangement of multiple existing smaller buildings, the wider flow routes for the surrounding existing retained roads remain unchanged.

8.8 Surface Water Treatment – Quality of Runoff

8.8.1 From the above review of SuDS features that can be practically implemented into the design, the following mitigation indices have been attributed to each SuDS feature which is to be integrated in the Proposed Development, as shown in Table 8-4 below (extract reproduced from Table 26.3 in the SuDS Manual).

Table 8-4 SuDS Mitigation Indices to be Implemented at the Proposed Development for Discharges to Surface Water Sewers

Type of SuDS Components	TSS	Metals	Liquid Hydrocarbons
Permeable Pavement	0.7	0.6	0.7
Proprietary treatment systems[1,2]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1-year event, for inflow concentrations relevant to the contributing drainage area.		

Notes:

1. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff.
2. SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

8.8.2 Overall the above is considered acceptable as the mitigation indices shown in Table 8-4 are greater than or equal to the pollution indices shown in Ciria C753 (Ref. 17).

8.9 Surface Water Drainage Adoption and Maintenance

8.9.1 The Proposed Development will be situated on private land and will only serve a single curtilage. Therefore, it will remain in private ownership and be maintained by an appropriate management company in perpetuity.

8.9.2 The connection of the proposed private surface water drainage network will be made on an existing section of private drainage within the Proposed Development boundary and will therefore require an indirect Section 106 application to Thames Water.

8.9.3 The details below are provided as outline maintenance guidance and are supplemented by the details included in Ciria C753 – The SuDS Manual (reproduced in Table 8-5 and Table 8-6). However, it is expected that the management company appointed to maintain the proposed drainage network will prepare an Operations and Maintenance Manual specifically for the Proposed Development that will include details of all items used to construct the system, including materials used, suppliers' details and manufacturers' suggested maintenance regimes.

- Drainage Channels: Inspections should be frequent and regular, depending on local conditions. However, these will be at least annually. Inspections should include gratings, covers including their locking bolts, sumps and sump buckets, exposed concrete surrounds and adjacent paving.
- Gullies: Inspections should be frequent and regular depending on local conditions. At this time inspect all gullies for damage and clean out

sumps. Any petrol/oil spillages should be cleaned up as soon as possible.

- Channels: After removal of gratings and/or inspection covers, channels should be flushed with water or high pressure jetting (Do not use boiling water or cleaning agents). All surfaces and joints should be checked and repaired as necessary. Empty all silt buckets and clean out sump/gully and connections. Replace bucket and gratings ensuring they are correctly fitted.
- Below Ground Manholes and Drainage: Manholes and catchpit inspections should be frequent and regular, depending on local conditions, but at least annually. The drainage system should be cleaned / jetted as necessary. Full CCTV inspection of drainage runs should be carried out every 5 years or as required to suit instances of blockage.
- Attenuation Tanks: Cellular storage attenuation tanks are sealed systems only reachable by water via the perforations in the pipes feeding them. Therefore, access and maintenance are not required to the tanks themselves. However, jetting of the perforated pipes feeding the tanks should be completed regularly: at least every two years (or following large storm events/ blockages) to ensure continued satisfactory operation of the perforations. Inspection of the finished surfacing above the tanks should be carried out monthly for 6 months following installation to detect early signs of subsidence if impermeable membranes become punctured.

Table 8-5 Extract of SuDs Manual (Ciria C753) – Pervious Pavements

TABLE 20.15 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 8-6 Extract of SuDs Manual (Ciria C753) – Attenuation Storage Tanks

TABLE 21.3 Operation and maintenance requirements for attenuation storage tanks

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

9 Conclusions

9.1.1 The conclusions of the FRA can be summarised as follows:

- The Proposed Development is categorised as “more vulnerable”.
- The Site is located in Flood Zone 1.
- There is no flood risk from tidal sources.
- The probability of fluvial flooding extending into the Site is considered to be low.
- Prior to the introduction of the mitigation measures the risk of flooding from pluvial sources is therefore considered to be Medium. However, the mitigation measures allow this flood risk to be reduced to low.
- The risk of flooding from sewers is therefore considered to be low.
- Based on published mapping the groundwater level at the Site demonstrates that the overall flood risk from groundwater on the Site is considered to be low.
- There is no risk of flooding from artificial sources to the Site.

9.1.2 The conclusions of the Drainage Strategy can be summarised as follows:

- A new separate foul water network will be provided to cater for the needs of the Proposed Development.
- An indirect Section 106 application will be made to TWUL for the new discharge regime.
- A new separate surface water network will be provided to cater for the needs of the Proposed Development.
- The surface water network will reduce the peak discharge rates from all storms up to the 100 year event plus 40% climate change to rates no greater than 15% of the estimated existing Site discharge rates (85% reduction) through the provision of a minimum of 65m^3 of permeable surfacing storage and 280m^3 of underground cellular storage tanks.
- SuDS features will be employed where possible within the Proposed Development to reduce runoff rates and provide an element of water quality enhancement prior to offsite discharge.

10 References

Ref. 1 Ministry of Housing, Communities and Local Government (MHCLG), (2019); National Planning Policy Framework (NPPF). UK Government, (2010); The Flood and Water Management Act

https://www.legislation.gov.uk/ukpga/2010/29/contents

Ref. 2 Greater London Authority, (2021); London Plan adopted March 2021

Ref. 3 British Geological Survey (2006) Geology of the country around North London, sheet 256 (England and Wales), 1:50,000.

Ref. 4 British Geological Survey Geoindex Onshore online geological mapping: http://mapapps2.bgs.ac.uk/geoindex/home.html. Accessed July 2020

Ref. 5 Environment Agency Flood Maps for Planning: https://flood-map-for-planning.service.gov.uk/

Ref. 6 Microdrainage hydraulic modelling software by Innovyze:

https://www.innovyze.com/en-us/products/microdrainage

Ref. 7 BS EN 752:2017 Drain and sewer systems outside buildings - sewer system management

Ref. 8 Building Regulations Approved Document H - Drainage and Waste Disposal (2015 edition)

Ref. 9 Sewers For Adoption 7th Edition, A design and Construction Guide for Developers, August 2012.

Ref. 10 Her Majesty's Stationery Office, Flood and Water Management Act 2010

Ref. 11 Pitt Review: Lessons Learned from the 2007 floods (archived on 2 Jul 2020)

Ref. 12 Her Majesty's Stationery Office, (2009); The Flood Risk Regulations

https://www.legislation.gov.uk/uksi/2009/3042/contents/made

Ref. 13 Communities and Local Government, (2012) Technical Guidance to the National Planning Policy Framework

Ref. 14 UK Government, (2009) Thames: Catchment flood management plan (CFMP)

https://www.gov.uk/government/publications/thames-catchment-flood-management-plan

Ref. 15 Environmental Agency, Thames Estuary TE2100 Plan (updated 29 May 2020). https://www.gov.uk/government/publications/thames-estuary-2100-te2100/thames-estuary-2100-te2100

Ref. 16 London's 33 Lead Local Flood Authorities (LLFAs), (April 2019); London Sustainable Drainage Proforma

Ref. 17 Camden Council, (2017); Camden Local Plan

Ref. 18 Camden Council, (July 2014); Camden Strategic Flood Risk Assessment

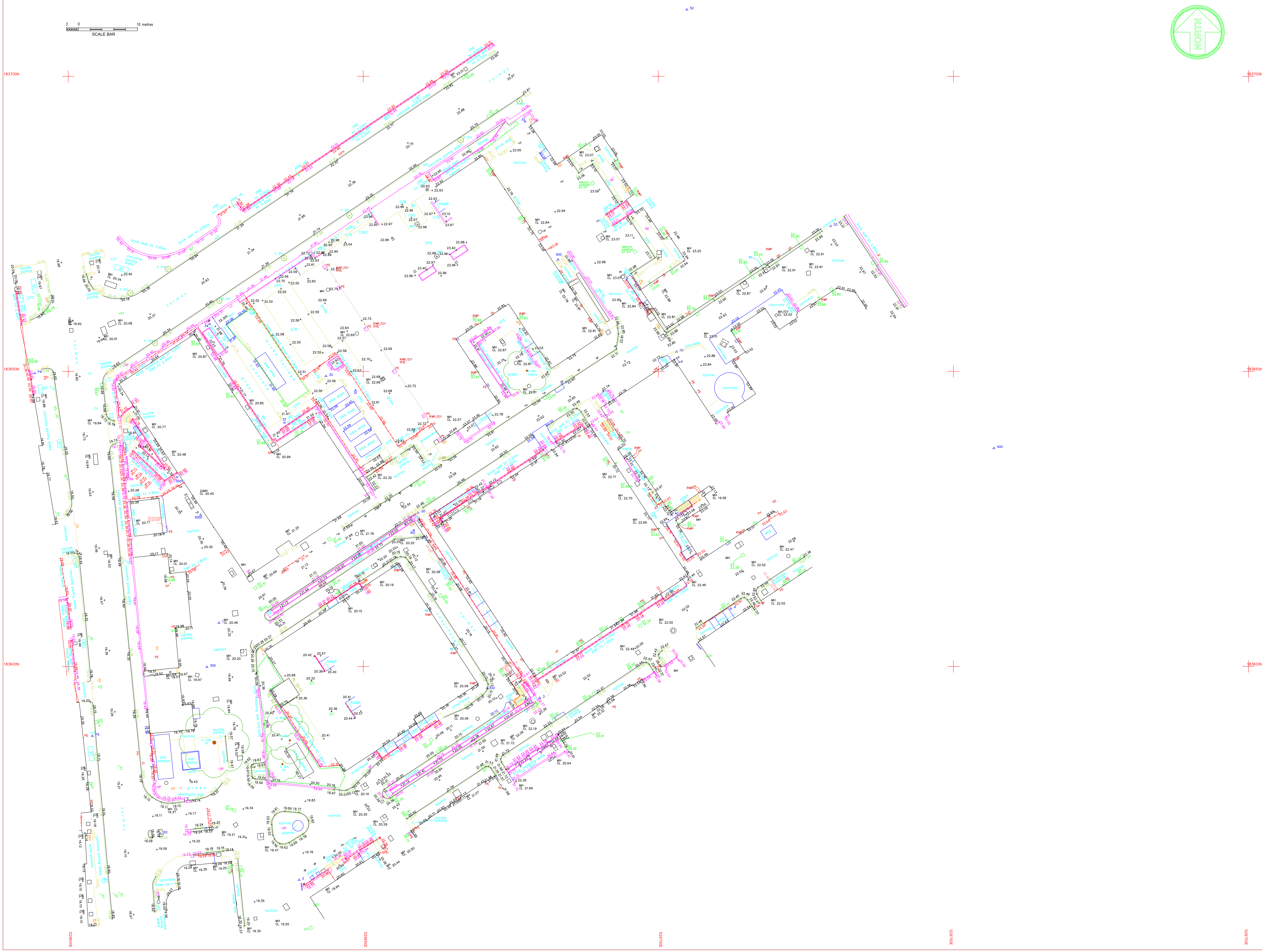
Ref. 19 Halcrow (2011) Drain London, London Borough of Camden Surface Water Management Plan

Ref. 20 CIRIA report C753 The SuDS Manual

Ref. 21 Environment Agency Surface Water Flood Maps:

https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?easting=529678&northing=183626&map=RiversOrSea

Appendix A Site Plan and Topographic Survey



Co-ordinate Table			
Station	Easting	Northing	Level
1	529625.545	183607.397	20.332
2	529639.130	183563.833	19.766
3	529679.890	183594.666	22.323
4	529712.280	183609.800	22.546
5	529683.667	183647.941	22.684
20	529615.639	183571.660	19.301
30	529659.281	183626.047	22.434
40	529702.246	183625.676	22.709
50	529703.091	183653.343	22.792
300	529623.499	183599.912	20.026
301	529658.549	183623.089	20.336
302	529670.990	183596.327	20.231
3000	529622.446	183625.682	20.413
3001	529618.423	183632.089	20.405
P3	529703.073	183725.791	23.637
P4	529594.320	183649.692	19.924
P5	529604.098	183588.220	19.296

GPS Note:
This survey is related to OSGB36(15) coordinate system by GPS 'rapid static' methods. No scale factor has been applied to the survey information. All horizontal distances taken from this drawing are ground distances.

Every effort has been made to confirm tree species on site, yet it is advised to confirm these details with an arborist before proceeding with any design.

Revision	Description	Date

LEGEND

Survey control station
Building
Banking
Gate (single)
Fence
Gate (double)
Contour 22.50
Wall bkwl
Tree Spread and Girth shown to scale
Ordnance Survey Value 15.37m

Abbreviations

Belisha Beacon	BB	Pipe	PE
Bollard	BD	Road Sign	RS
Borehole	BH	Rodding Eye	RE
British Telecom Box	BTB	Service Marker	MK
BT Inspection Cover	BT	Sign Post	SP
Concrete Paving Slabs	CPS	Sluice Valve	SV
Cable Television Cover	CTV	Stop Tap	ST
Electricity Cable Pit	EC	Stop Cock	SC
Electricity Pole	EP	Telegraph Pole	TP
Earth Rod	ER	Telephone Call Box	TCB
Fire Hydrant	FH	Traffic Light	TL
Flag Staff	FS	Unsurfaced	U\S
Gas Valve	GV	Vent Pipe	VP
Gate Post	GP	Water Meter	WM
Gully	GY	Eaves Level	EL
Inspection Cover	IC	Ridge Level	RL
Kerb Outlet	KO	Roof Level	RFL
Lamp Post	LP	Soffit Level	SFL
Manhole	MH	Threshold Level	THL
Marker Post	MK	Parapet Wall Level	PWL
Parking Meter	PM	Finished Floor Level	FFL
Post	P		
Retaining Wall	RTW	Cover Level	CL
Barbed Wire Fence	BWF	Invert Level	IL
Close Boarded Fence	CBF	No Visible Connection	NVC
Chainlink Fence	CLF	Unable to Lift	UTL
Chestnut Paling Fence	CPF	Surface Water	SW
Post and Chain Fence	PCF	Foul Water	FW
Post and Rail Fence	PRF	Brick Retaining Wall	BRTW
Post and Wire Fence	PWF	Flower Bed	F\B
Wooden Panel Fence	WPF	Shrub Bed	S\B

terrain
Land and Architectural Surveyors
Terrain Surveys Ltd
Bridge Chambers
28a High Street
Welwyn
Herts
AL6 9EQ
Tel 01438 841300
Fax 01438 841301
enquiries@terrainsurveys.co.uk
www.terrainsurveys.co.uk
THE SURVEY ASSOCIATION

Client
ROYAL FREE LONDON NHS FOUNDATION TRUST

Project
ST PANCRAS HOSPITAL, ST PANCRAS WAY, LONDON, NW1 0PE

Title
TOPOGRAPHICAL SURVEY

Drawn by	Checked by
HB	PG
Scale 1:200@A0	Date NOV 2018

Drawing Number TS18–464T\1 — Revision –

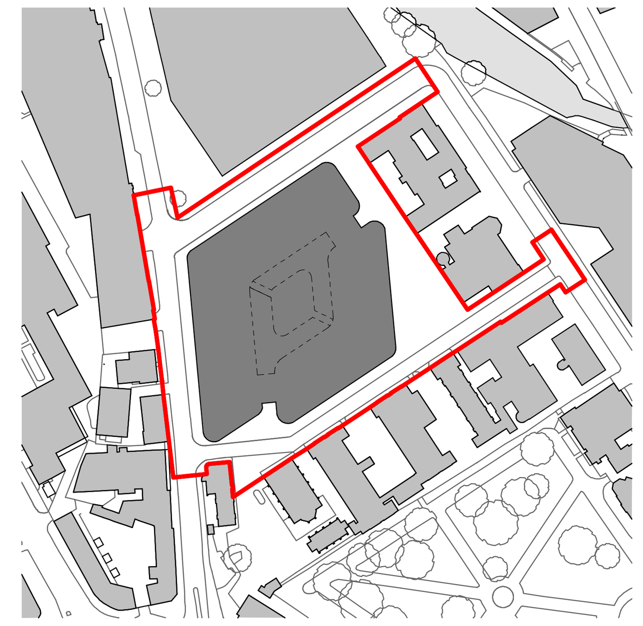
Sheet 1 of 1

All levels related to Ordnance Survey active GPS network, at survey station 30.

Value 22.434m

Lower Ground Floor Plan

SCALE: 1 : 200



Dimensions are to be verified on site prior to construction

Penoyre & Prasad are a trading division of Perkins & Will UK Ltd.

KEY

Development zone boundary

Area below ground level

Notes:

1. Refer to Landscape Architect's drawings for more detailed landscape proposals.

Rev	Date	Prep	Check	Description
P6	18.03.21	JG	KE	Planning Issue
P5	11.03.21	JG	KE	Planning Issue
P4	15.10.20	JG	KE	Updated for Planning Issue
P3	13.10.20	AR	KE	Development zone boundary updated; Issued for Planning
P2	25.09.20	NVA	KE	Planning Issue
P1	04.09.20	NVA	KE	Draft Planning Issue for Client Review

Aldgate Tower
2 Leman Street
London E1 8FA
United Kingdom
Tel: +44 (0) 20 7061 7000
www.aecom.com

The White Chapel Building
10 Whitechapel High Street
London E1 8QS

020 7250 3477
penoyreprasad.com

Client

Moorfields Eye Hospital and UCL Institute of Ophthalmology

Project

Oriel

Drawing Title

Proposed Lower Ground Floor Plan

Purpose of Issue

Planning

Status code: A1

Scale @ A1: 1:200

Drawing Number

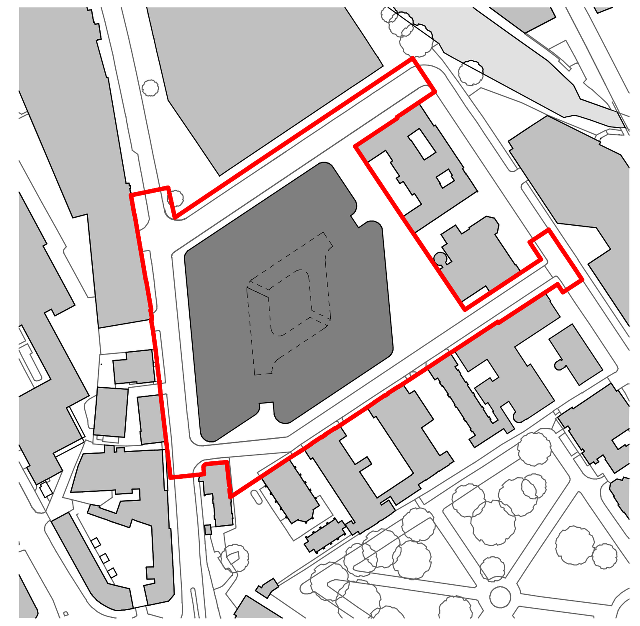
Project	Originator	Volume	Level	Type	Role	Number
ORL -	PPA -	XX -	LG -	DR -	A -	20241

Revision

P6

Ground Floor Plan
SCALE: 1 : 200

1:200m
0 2 10 20



KEY

Development zone boundary

Notes:

1. Refer to Landscape Architect's drawings for more detailed landscape proposals.

Rev	Date	Prep	Check	Description
P6	18.03.21	JG	KE	Planning Issue
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P1	04.09.20	NVA	KE	Draft Planning Issue for Client Review

Penoyre & Prasad

AECOM
Aldgate Tower
2 Leman Street
London E1 8FA
United Kingdom
Tel: +44 (0) 20 7061 7000
www.aecom.com

white

The White Chapel Building
10 Whitechapel High Street
London E1 8QS

020 7250 3477
penoyreprasad.com

Client

Moorfields Eye Hospital and UCL Institute of Ophthalmology

Project

Oriel

Drawing Title

Proposed Ground Floor Plan

Purpose of Issue

Planning

Status code: A1

Scale @ A1: 1:200

Drawing Number

Project	Originator	Volume	Level	Type	Role	Number
ORL	PPA	XX	GF	DR	A	20242

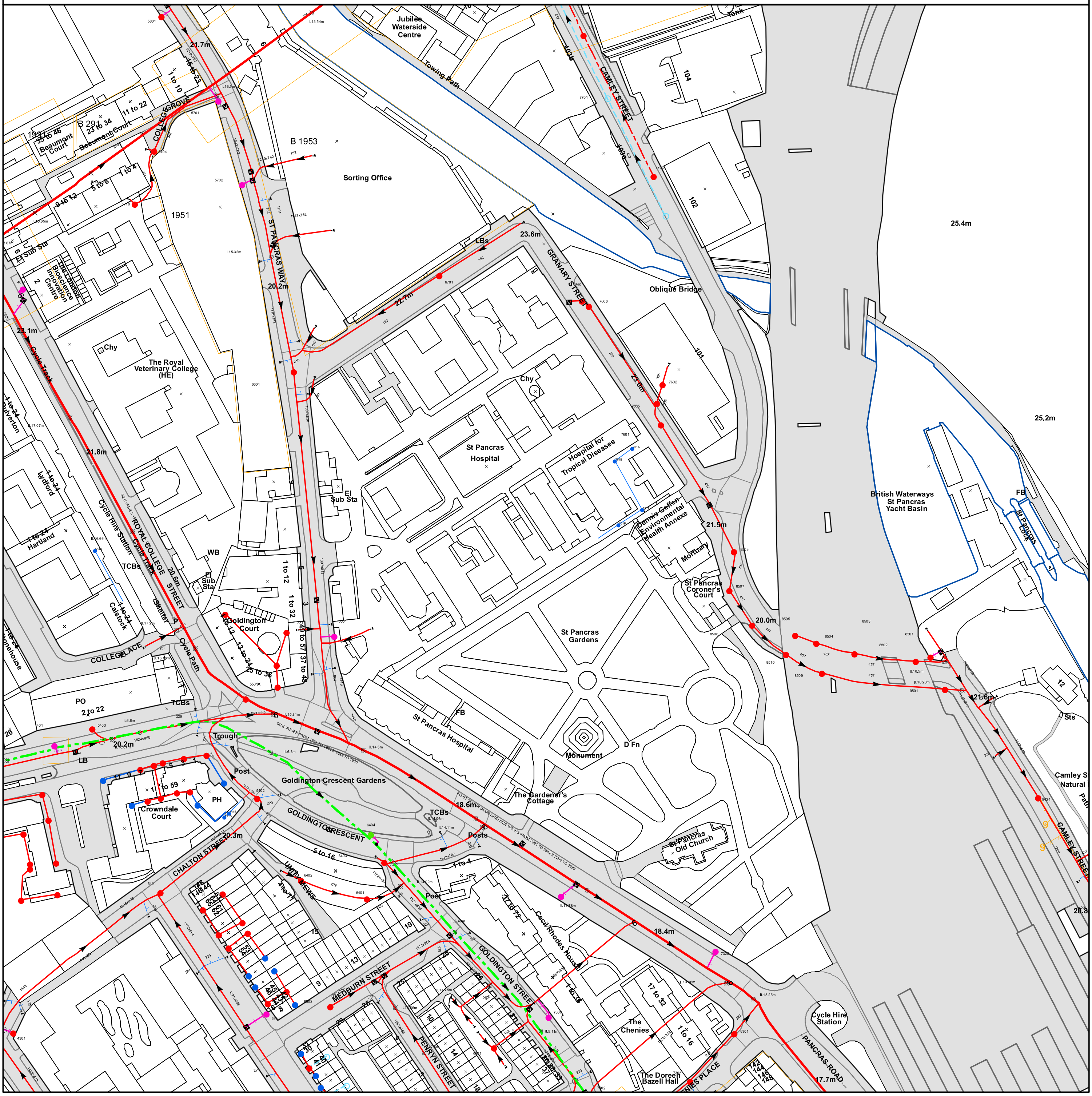
Revision

P6

Appendix B Public Sewer Records and pre-development capacity check

Based on the Ordnance Survey Map with the sanction of the Controller of H.M Stationary Office License Number 10019345

ALS/ALS Standard/2018_3913821



0 10 20 40 60 80
Meters

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified before any works are undertaken. Crown copyright Reserved

Scale: 1:1790
Width: 500m
Printed By: SAsirvat
Print Date: 22/11/2018
Map Centre: 529717,183574
Grid Reference: TQ2983NE

Comments:

Roddy Prayag

AECOM
Midpoint
Alencon Link
Basingstoke
RG21 7PP

Wastewater pre-planning
Our ref DS6081542

26 February 2021

Pre-planning enquiry: Confirmation of sufficient capacity

Site: Oriel Building MEH, St Pancras Way, London, NW1 0PE

Dear Roddy,

Thank you for providing information on your development.

Proposed site: Education Centre (210 people), Lab (100 people), Restaurant (800 people), Office (42 people), Hospital (1200 people), Hospital therapy and recovery (50 beds), Impermeable area : 8280m2
Proposed foul water discharge by gravity into combined water sewer downstream of manhole TQ29836601 via existing connection.
Proposed surface water discharge at 20.8 l/s for all storm events up to and including 1:100yr+40%CC into combined water sewer downstream of manhole TQ29836601 via an existing connection.

We have completed the assessment of the foul water flows and surface water run-off based on the information submitted in your application with the purpose of assessing sewerage capacity within the existing Thames Water sewer network.

Foul Water

If your proposals progress in line with the details you've provided, we're pleased to confirm that there will be sufficient sewerage capacity in the adjacent combined water sewer network to serve your development.

This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

You'll need to keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient capacity.

Surface Water

When developing a site, policy 5.13 of the London Plan and Policy 3.4 of the Supplementary Planning Guidance (Sustainable Design And Construction) states that every attempt should be made to use flow attenuation and SuDS/Storage to reduce the surface water discharge from the site as much as possible.

In accordance with the Building Act 2000 Clause H3.3, positive connection of surface water to a public sewer will only be consented when it can be demonstrated that the hierarchy of disposal methods have been examined and proven to be impracticable. Before we can consider your surface water needs, you'll need written approval from the lead local flood authority that you have followed the sequential approach to the disposal of surface water and considered all practical means.

The disposal hierarchy being:

1. store rainwater for later use.
2. use infiltration techniques where possible.
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.
8. discharge rainwater to the foul sewer

Where connection to the public sewerage network is still required to manage surface water flows, we will accept these flows at a discharge rate in line with CIRIA's best practice guide on SuDS or that stated within the sites planning approval.

If the above surface water hierarchy has been followed and if the flows are restricted to a total of 20.8 l/s, then Thames Water would not have any objections to the proposal.

Please see the attached 'Planning your wastewater' leaflet for additional information.

What happens next?

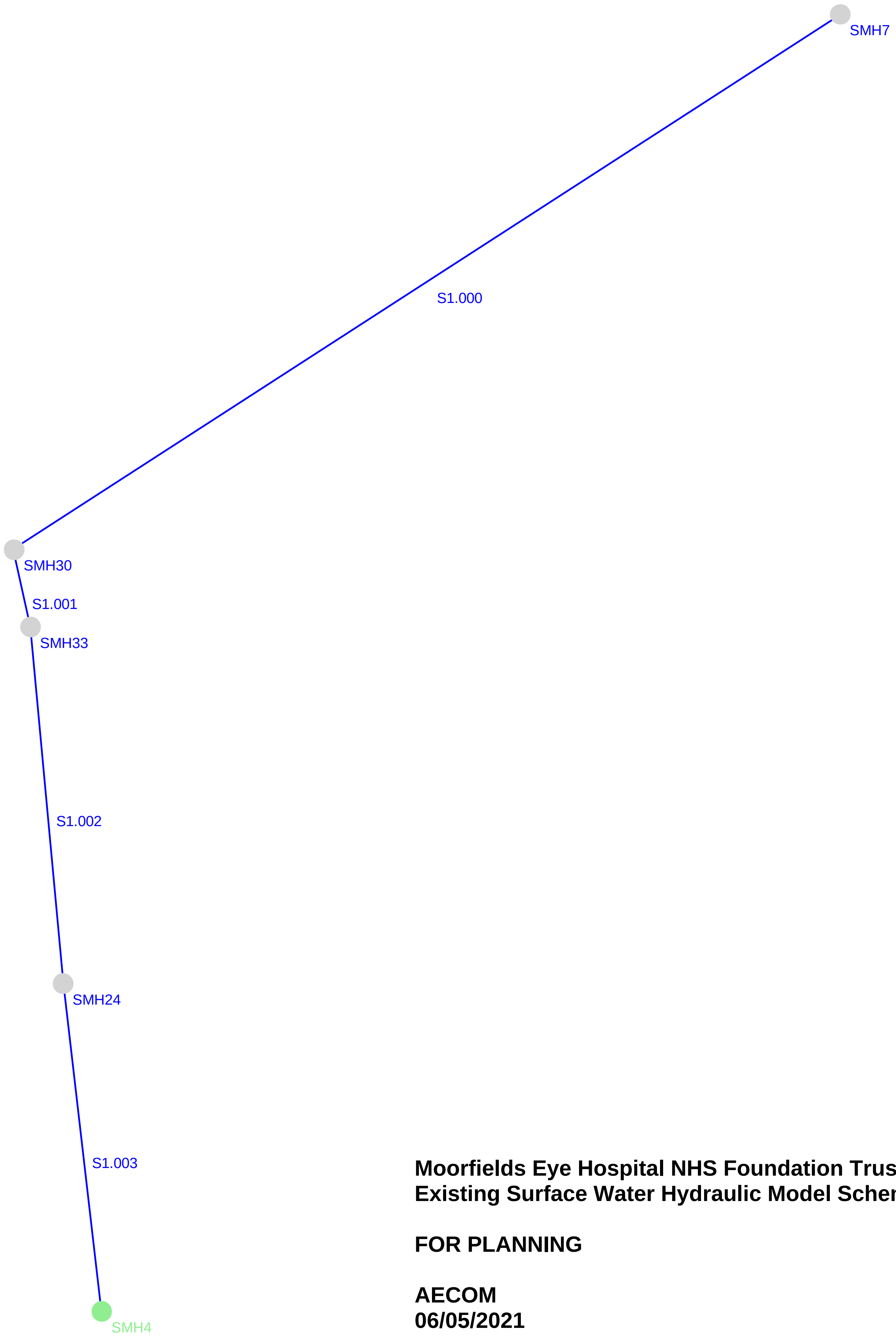
Please make sure you submit your connection application, giving us at least 21 days' notice of the date you wish to make your new connection/s.

If you have any further questions, please contact me on 0800 009 3921.

Kind Regards,

Hemlata Gurung
Developer Services – Technical Coordinator, Sewer Adoptions Team
Tel: 0800 009 3921
hemlata.gurung@thameswater.co.uk
Get advice on making your sewer connection correctly at connectright.org.uk
Clearwater Court, Vastern Road, Reading, RG1 8DB
Find us online at developers.thameswater.co.uk

Appendix C Existing Drainage Calculations



Moorfields Eye Hospital NHS Foundation Trust
Existing Surface Water Hydraulic Model Schematic

FOR PLANNING

AECOM
06/05/2021

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
SMH7	22.810	4.000	Open Manhole	1200	S1.000	18.810	225				
SMH30	20.460	3.000	Open Manhole	1200	S1.001	17.460	225	S1.000	17.460	225	
SMH33	20.200	2.780	Open Manhole	1200	S1.002	17.420	225	S1.001	17.420	225	
SMH24	19.470	2.450	Open Manhole	1200	S1.003	17.020	225	S1.002	17.020	225	
SMH4	19.480	2.900	Open Manhole	0		OUTFALL		S1.003	16.580	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SMH7	529700.595	183655.705	529700.595	183655.705	Required	
SMH30	529628.383	183608.940	529628.383	183608.940	Required	
SMH33	529629.836	183602.189	529629.836	183602.189	Required	
SMH24	529632.662	183571.039	529632.662	183571.039	Required	
SMH4	529636.049	183542.392			No Entry	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	SMH7	22.810	18.810	3.775	Open Manhole	1200
S1.001	o	225	SMH30	20.460	17.460	2.775	Open Manhole	1200
S1.002	o	225	SMH33	20.200	17.420	2.555	Open Manhole	1200
S1.003	o	225	SMH24	19.470	17.020	2.225	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	86.032	63.7	SMH30	20.460	17.460	2.775	Open Manhole	1200
S1.001	6.905	172.6	SMH33	20.200	17.420	2.555	Open Manhole	1200
S1.002	31.279	78.2	SMH24	19.470	17.020	2.225	Open Manhole	1200
S1.003	28.847	65.6	SMH4	19.480	16.580	2.675	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.300	0.300	0.300
1.001	-	-	100	0.200	0.200	0.200
1.002	-	-	100	0.095	0.095	0.095
1.003	-	-	100	0.095	0.095	0.095
				Total	Total	Total
				0.690	0.690	0.690

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.003	SMH4	19.480	16.580	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	21.000	Storm Duration (mins)	30
Ratio R	0.440		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	21.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.439	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	1, 2, 30, 100
Climate Change (%)	0, 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	SMH7	15 Winter	1	+0%	2/15 Summer	100/15 Summer			18.952	-0.083
S1.001	SMH30	15 Winter	1	+0%	1/15 Summer	30/15 Summer			18.220	0.535
S1.002	SMH33	15 Winter	1	+0%	1/15 Summer	30/15 Summer			18.054	0.409
S1.003	SMH24	15 Winter	1	+0%	1/15 Summer				17.484	0.239

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SMH7	0.000	0.69			43.7	OK	4
S1.001	SMH30	0.000	1.94			58.0	SURCHARGED	10
S1.002	SMH33	0.000	1.21			66.5	SURCHARGED	7
S1.003	SMH24	0.000	1.25			74.8	SURCHARGED	

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.439 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years) 1, 2, 30, 100
Climate Change (%) 0, 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	SMH7	15 Winter	2	+0%	2/15 Summer	100/15 Summer			19.342	0.307
S1.001	SMH30	15 Winter	2	+0%	1/15 Summer	30/15 Summer			18.747	1.062
S1.002	SMH33	15 Winter	2	+0%	1/15 Summer	30/15 Summer			18.530	0.885
S1.003	SMH24	15 Winter	2	+0%	1/15 Summer				17.746	0.501

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SMH7	0.000	0.78			49.9	SURCHARGED	4
S1.001	SMH30	0.000	2.21			66.0	SURCHARGED	10
S1.002	SMH33	0.000	1.40			76.9	SURCHARGED	7
S1.003	SMH24	0.000	1.47			87.9	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	21.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.439	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	1, 2, 30, 100
Climate Change (%)	0, 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	SMH7	15 Winter	30	+0%	2/15 Summer	100/15 Summer			22.776	3.741
S1.001	SMH30	15 Winter	30	+0%	1/15 Summer	30/15 Summer			20.470	2.785
S1.002	SMH33	15 Winter	30	+0%	1/15 Summer	30/15 Summer			20.200	2.555
S1.003	SMH24	15 Winter	30	+0%	1/15 Summer				18.912	1.667

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SMH7	0.000	1.25			79.7	FLOOD RISK	4
S1.001	SMH30	10.470	3.57			106.8	FLOOD	10
S1.002	SMH33	0.498	1.98			108.8	FLOOD	7
S1.003	SMH24	0.000	2.17			129.7	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.439 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years) 1, 2, 30, 100
Climate Change (%) 0, 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	SMH7	15 Winter	100	+0%	2/15 Summer	100/15 Summer			22.818	3.783
S1.001	SMH30	30 Winter	100	+0%	1/15 Summer	30/15 Summer			20.488	2.803
S1.002	SMH33	15 Winter	100	+0%	1/15 Summer	30/15 Summer			20.204	2.559
S1.003	SMH24	15 Winter	100	+0%	1/15 Summer				19.165	1.920

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SMH7	7.808	1.31			83.6	FLOOD	4
S1.001	SMH30	27.729	3.55			106.2	FLOOD	10
S1.002	SMH33	4.320	2.01			110.9	FLOOD	7
S1.003	SMH24	0.000	2.30			137.6	SURCHARGED	

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	SAAR (mm)	600	Urban	0.000
Area (ha)	0.785	Soil	0.450	Region Number	Region 6

Results	**l/s**
QBAR Rural	2.9
QBAR Urban	2.9
Q100 years	9.2
Q1 year	2.4
Q30 years	6.5
Q100 years	9.2

Appendix D Drainage Drawings

GENERAL NOTES

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DRAINAGE STRATEGY SUBJECT TO LOCAL AUTHORITY AND ENVIRONMENT AGENCY APPROVAL

GREASE CONTROL MEASURES TO BE PROVIDED LOCALLY ABOVE GROUND TO ALL FOOD PREPARATION AREAS AND TO BE WITHIN THE KITCHEN DESIGN SPECIALISTS REMIT.

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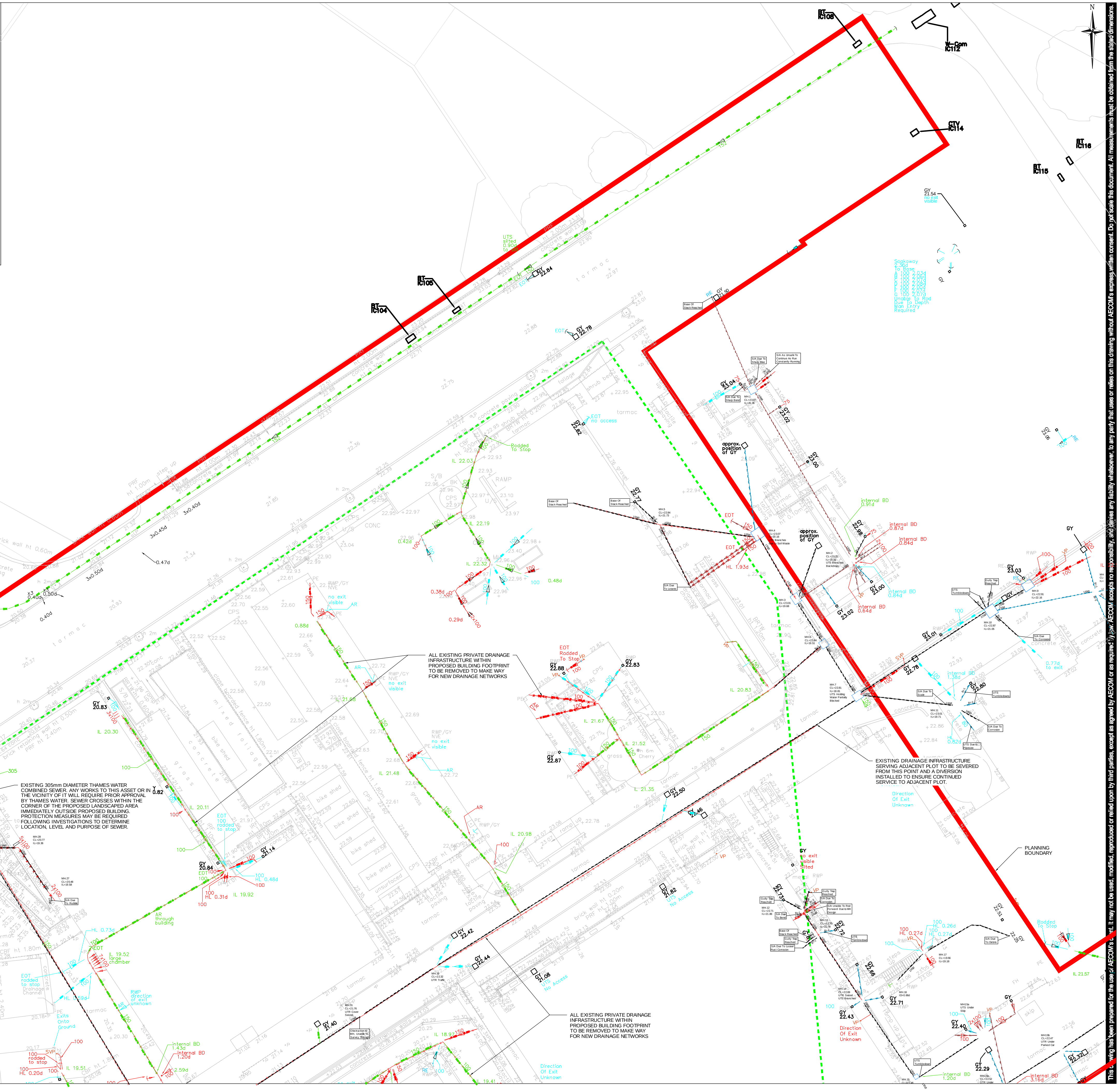
CLASS 1 FORECOURT SEPARATOR WITH HIGH LEVEL ALARM IN ACCORDANCE WITH PPG3 AND TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS SPECIFICATION. CONTRACTOR TO NOTE THAT ALARM REQUIRES POWER SUPPLY AND CABLING TO CONTROL PANEL. LOCATION TO BE CONFIRMED BY M&E ENGINEERS.



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Project

MOORFIELDS EYE HOSPITAL

Client

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Consultant

Aecom
Aecom House
63-77 Victoria Street
St Albans,Herts
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13. Where stacks are connected direct to drain, rodding access points are to be provided above finished floor level.
14. Construction of some sewers may involve deep excavations and working in hazardous confined space atmospheres.

LEGEND

(red line)	Planning boundary
(green dashed line)	Building boundary ('Proposed Development' boundary as referenced in Flood Risk Assessment and Drainage Strategy Report)
(red dashed line)	Existing private foul water sewer
(cyan dashed line)	Existing private surface water sewer
(black dashed line)	Existing private combined sewer
(green dash-dot line)	Existing public combined sewer
-X-X-X-X-	Drainage to be abandoned

ISSUE/REVISION

Rev	Date	Description	Drn/Chk/Appr
P1.0	14/10/20	ISSUED FOR PLANNING: WIP	JW/AV/RP

Suitability Status

S4 - Suitable For Stage Approval

Project Number

60588325

Sheet Title

EXISTING FOUL AND SURFACE WATER LAYOUT SHEET 1 OF 2

Sheet Number

ORL-ACM-ZZ-00-DR-C-000001

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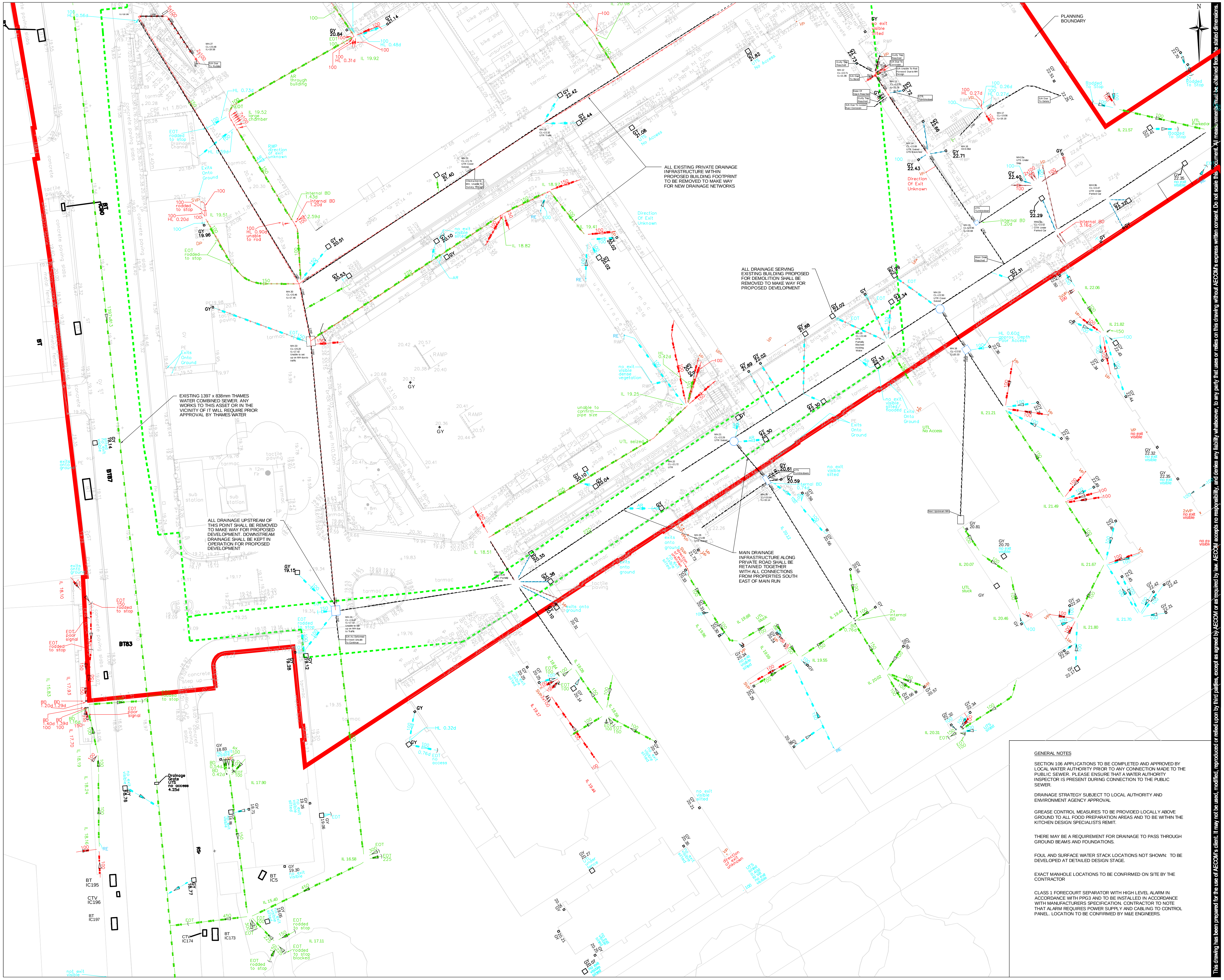

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LEGEND

- Planning boundary
- Building boundary ('Proposed Development' boundary as referenced in Flood Risk Assessment and Drainage Strategy Report)
- Existing private foul water sewer
- Existing private surface water sewer
- Existing private combined sewer
- Existing public combined sewer
- Drainage to be abandoned

ISSUE/REVISION

Rev	Date	Description	Drn/Chk/Appr
P1.0	14/10/20	ISSUED FOR PLANNING	JW/AV/RP

Suitability Status
S4 - Suitable For Stage Approval

Project Number
60588325

Sheet Title
EXISTING FOUL AND SURFACE WATER LAYOUT SHEET 2 OF 2

Sheet Number
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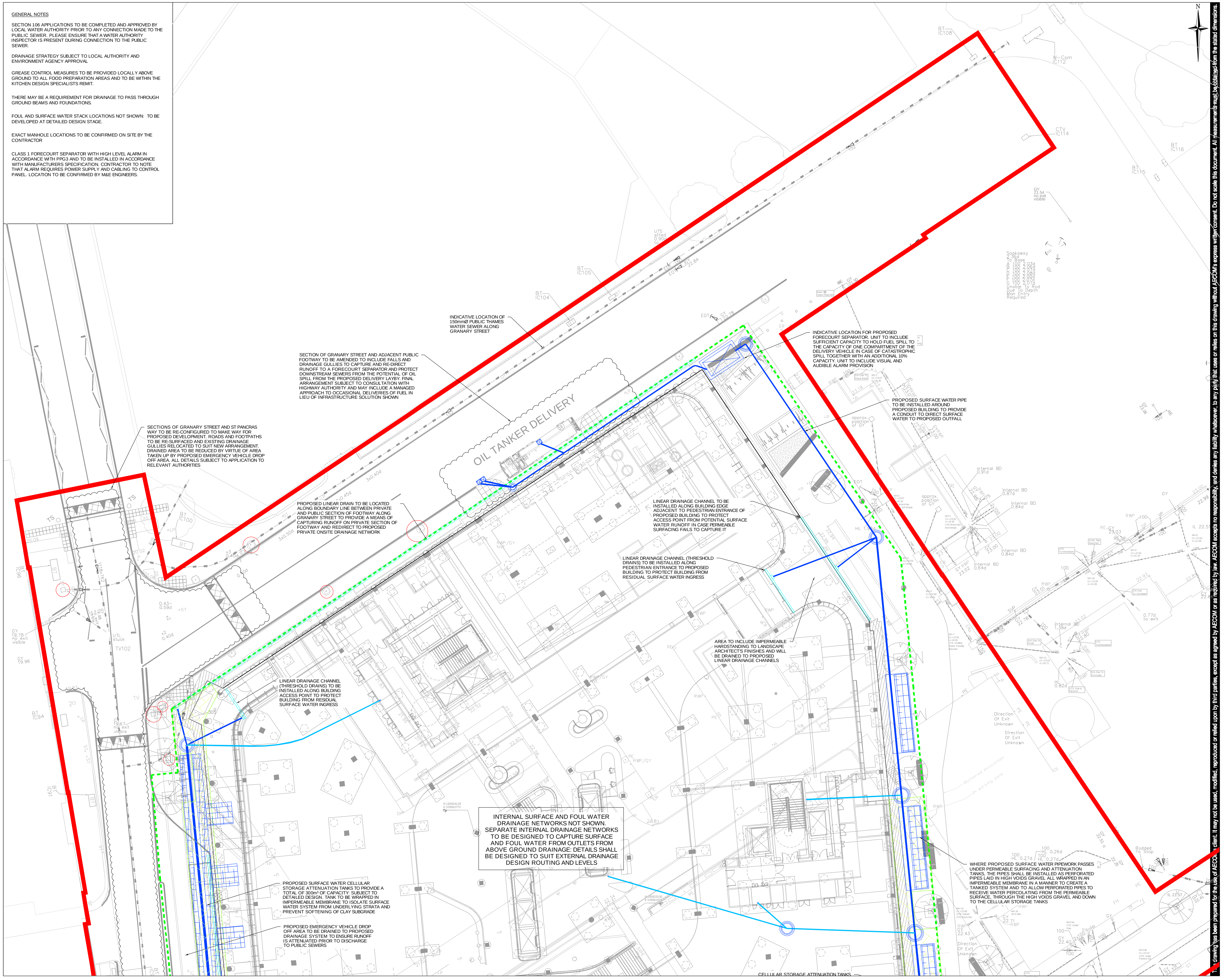

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LEGEND

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- Building boundary ('Proposed Development' boundary as referenced in Flood Risk Assessment and Drainage Strategy Report)
- Existing private foul water sewer
- Existing private surface water sewer
- Existing private combined sewer
- Existing public combined sewer
- Proposed private manhole
- Proposed private surface water pipe
- Proposed private linear drain
- Proposed private forecourt separator
- Proposed private permeable surfacing
- Proposed attenuation tank

ISSUE/REVISION

P1.0	14/10/20	ISSUED FOR PLANNING	JW/AV/RP
Rev	Date	Description	Drn/Chk/Appr

Suitability Status

S4 - Suitable For Stage Approval

Project Number

60588325

Sheet Title

PROPOSED FOUL AND SURFACE WATER LAYOUT
SHEET 1 OF 2

Sheet Number

ORL-ACM-ZZ-00-DR-C-010001

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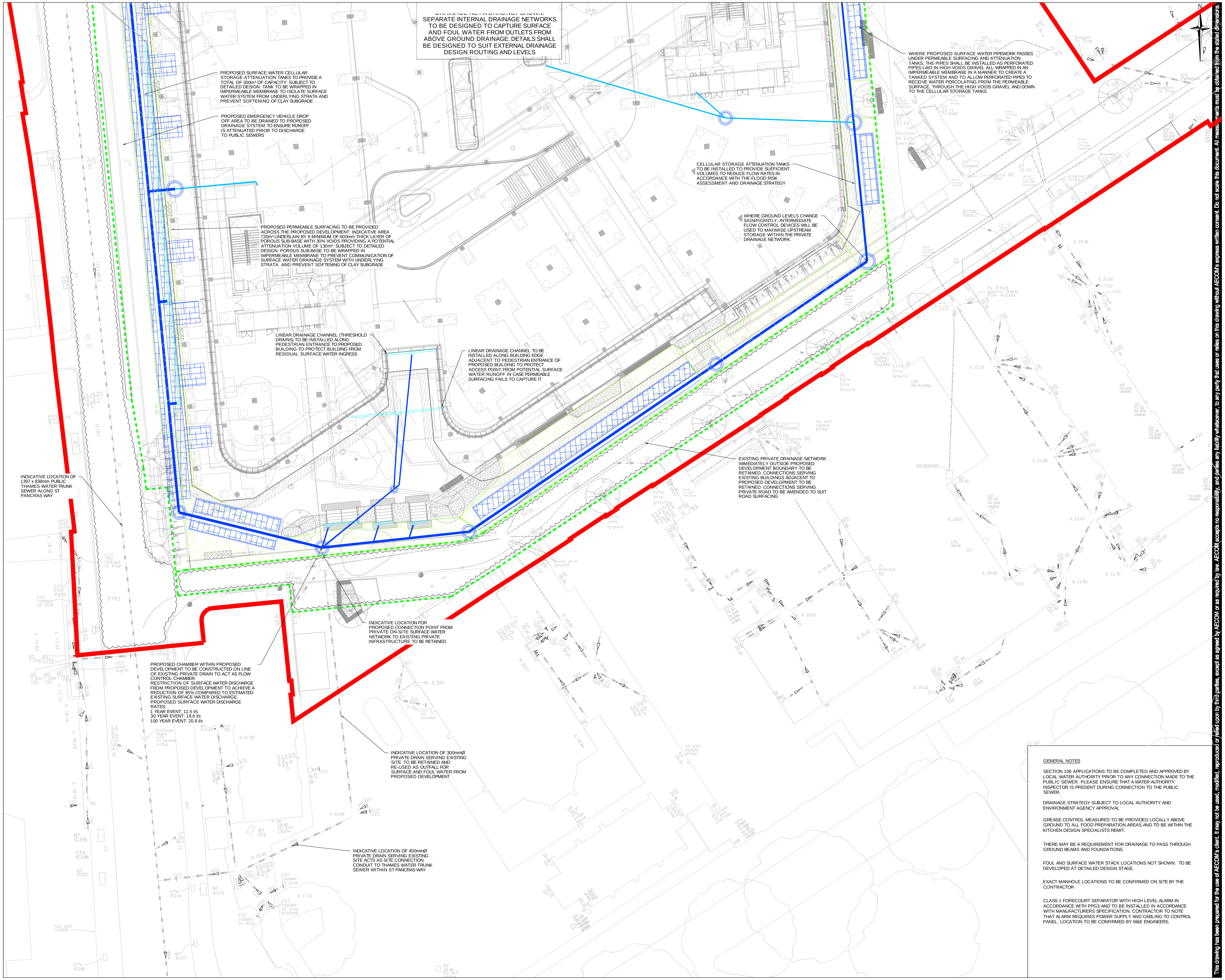

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3. All dimensions in millimetres unless shown otherwise.
4. Report any discrepancies to AECOM immediately and seek advice.
5. This drawing must be read in conjunction with all party drawings, specifications and schedules.
6. The contractor shall check levels & condition of all existing drainage prior to construction of any new drainage, unless otherwise agreed, to ensure the proposed design may be achieved.
7. Before any works commence reference should be made to the latest utilities mapping records for the locations of all existing services. AECOM accept no liability for any omissions or errors in these drawings and the contractor is deemed to have satisfied himself of the location of any services.
8. Contractor to allow for jet washing all lengths of sewers to be retained.
9. Manhole cover levels and orientation are to be coordinated with the landscape architects' drawings.
10. Adoptable drainage works to be in accordance with the water authorities association "Sewers for Adoption 8th edition".
11. All private drainage works to be in accordance with part H of the current building regulations, BS EN 752 and BS EN 12056.
12. The works described and specified on this drawing and associated drawings shall be undertaken in accordance with all current health and safety legislation. Reference shall also be made to the project health & safety plan prepared by the CDM coordinator for the project.
13. Where stacks are connected direct to drain, rodding access points are to be provided above finished floor level.
14. Construction of some sewers may involve deep excavations and working in hazardous confined space atmospheres.

LEGEND

- Planning boundary
- Building boundary ('Proposed Development' boundary as referenced in Flood Risk Assessment and Drainage Strategy Report)
- Existing private foul water sewer
- Existing private surface water sewer
- Existing private combined sewer
- Existing public combined sewer
- Proposed private manhole
- Proposed private surface water pipe
- Proposed private linear drain
- Proposed private forecourt separator
- Proposed private permeable surfacing
- Proposed attenuation tank

ISSUE/REVISION

P1.0	14/10/20	ISSUED FOR PLANNING	JW/AV/RP
Rev	Date	Description	Drn/Chk/Appr

Suitability Status
S4 - Suitable For Stage Approval

Project Number
60588325

Sheet Title
PROPOSED FOUL AND SURFACE WATER LAYOUT
SHEET 2 OF 2

Sheet Number
ORL-ACM-ZZ-00-DR-C-010002

Scale: 1:200 @A1 **Rev:** P1.0

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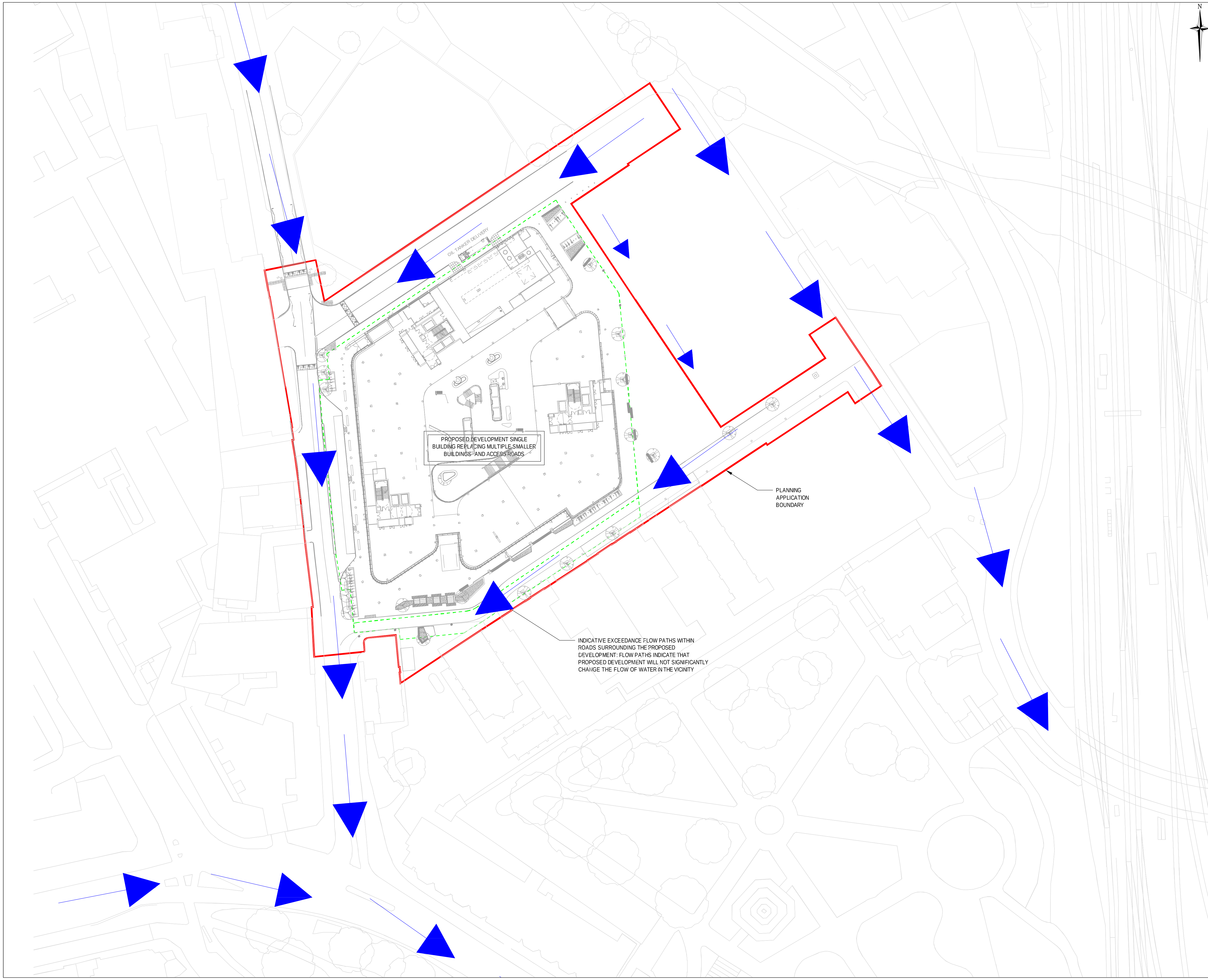

AECOM

Project

MOORFIELDS EYE HOSPITAL

Client

MOORFIELDS EYE HOSPITAL AND UCL INSTITUTE OF OPHTHALMOLOGY

Consultant

Aecom
Aecom House
63-77 Victoria Street
St Albans,Herts
AL1 3ER
United Kingdom
Tel +44 (0)1727 535000
www.aecom.com

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13. Where stacks are connected direct to drain, rodding access points are to be provided above finished floor level.
14. Construction of some sewers may involve deep excavations and working in hazardous confined space atmospheres.

LEGEND

- Site boundary
- Development boundary
- Indicative exceedance flow paths

ISSUE/REVISION

Rev	Date	Description	Drn/Chk/Appr
P01	16/10/20	ISSUED FOR PLANNING	JW/AV/RP

Purpose Of Issue

Project Number

60588325

Sheet Title

EXCEEDANCE FLOW PATH LAYOUT

Sheet Number

ORL-ACM-ZZ-00-DR-C-010005

Scale: 1:500 @A1 **Rev:** P1.0

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AECOM

Project

MOORFIELDS EYE HOSPITAL

Client

MOORFIELDS EYE HOSPITAL AND UCL INSTITUTE OF OPHTHALMOLOGY

Consultant

Aecom
Aecom House
63-77 Victoria Street
St Albans,Herts
AL1 3ER
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www.aecom.com

Notes

Legend

- BUILDING BOUNDARY
- TOTAL IMPERMEABLE AREA WITHIN PROPOSED DEVELOPMENT = 0.752 ha THIS INCLUDES 0.0434 ha COMPRISING THE PRIVATE ROAD SOUTH OF THE PROPOSED DEVELOPMENT
- TOTAL PERMEABLE AREA WITHIN PROPOSED DEVELOPMENT = 0.076 ha

TOTAL PROPOSED DEVELOPMENT AREA = 0.828 ha

- PLANNING APPLICATION BOUNDARY
- PUBLIC LAND WITHIN PLANNING BOUNDARY

ISSUE/REVISION

Rev	Date	Description	Drn/Chk/Appr
P1.0	14/10/20	ISSUED FOR PLANNING	JW/AV/RP

Suitability Status

S4 - Suitable For Stage Approval

Project Number

60588325

Sheet Title

EXISTING PERMEABLE AND IMPERMEABLE AREAS

Sheet Number

ORL-ACM-ZZ-00-DR-C-050014

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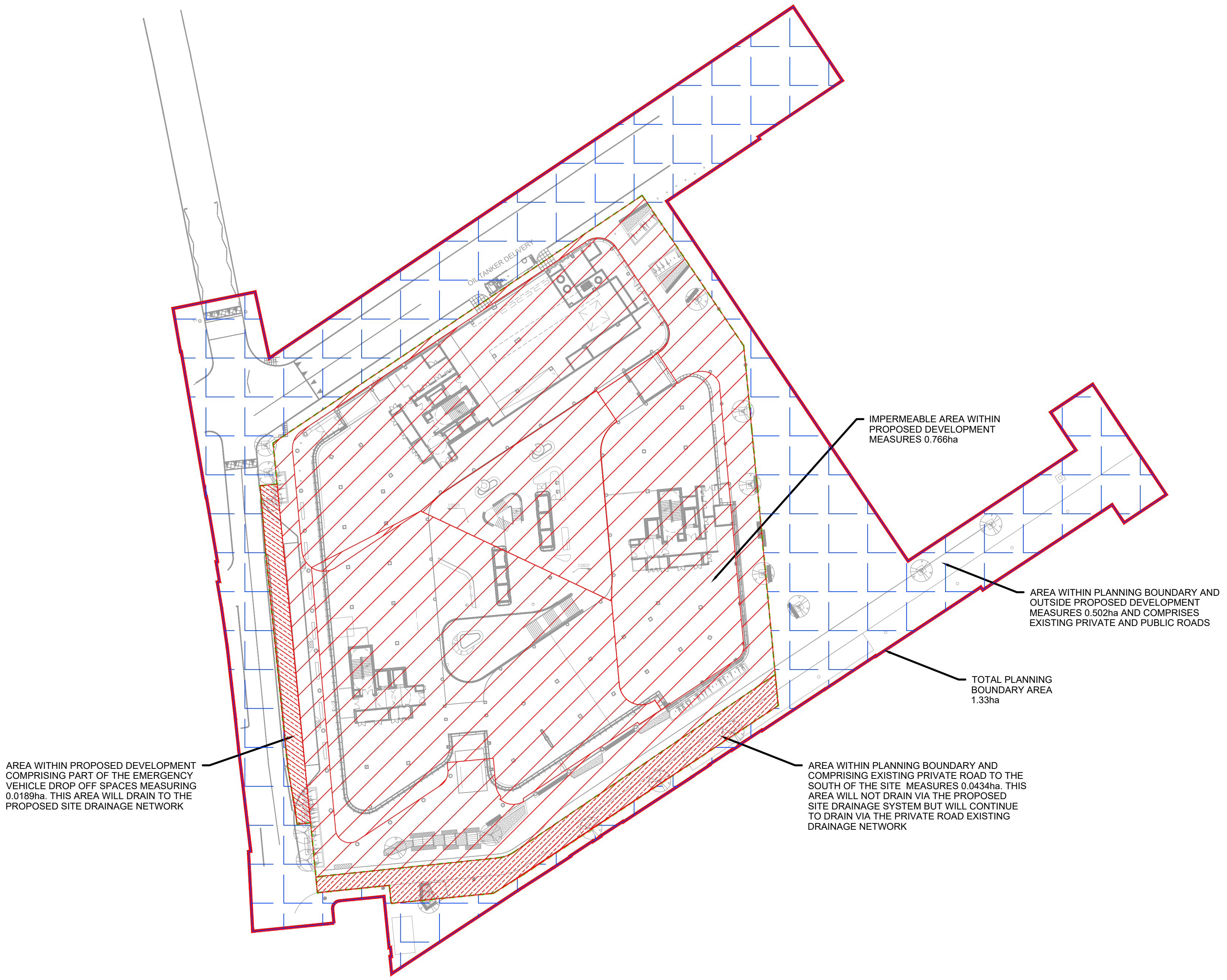

Project

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MOORFIELDS EYE HOSPITAL AND UCL INSTITUTE OF OPHTHALMOLOGY

Aecom House
63-77 Victoria Street
St Albans,Herts
AL1 3ER
United Kingdom
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www.aecom.com

Notes

Legend

BUILDING BOUNDARY

TOTAL IMPERMEABLE AREA TO BE DRAINED BY PROPOSED DRAINAGE NETWORK = 0.785 ha THIS INCLUDES 0.0189 ha FOR EMERGENCY VEHICLE DROP OFF AREA AND 0.766 FOR THE BUILDING AND PRIVATE FOOTPATHS

IMPERMEABLE AREA WITHIN PROPOSED DEVELOPMENT BOUNDARY AND TO BE DRAINED BY EXISTING NETWORK SOUTH OF THE SITE = 0.0434 ha

PROPOSED SITE PERMEABLE AREA = 0.000 Ha

TOTAL PROPOSED DEVELOPMENT AREA = 0.828 Ha

PLANNING APPLICATION BOUNDARY

PUBLIC LAND WITHIN PLANNING BOUNDARY

P2.0 06/05/21	AREA NOTE CLARIFIED	JW/AV/RP
P1.0 14/10/20	ISSUED FOR PLANNING	JW/AV/RP
		Drn/Chk/Appr

Suitability Status

S4 - Suitable For Stage Approval

Project Number

60588325

Sheet Title

PROPOSED PERMEABLE AND IMPERMEABLE AREAS

Sheet Number

ORL-ACM-ZZ-00-DR-C-050015

Scale: 1:500 @A1 **Rev:** P2.0

ISO A1 594mm x 841mm

Approved:

Checked:

Designer:

Project Management Initials:

Last saved by: RODDY.PRAYAG(2021-05-06) Last Plotted: 2021-05-06

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Appendix E Environment Agency Flood Map Report

Environment Agency

Flood map for planning

Your reference	Location (easting/northing)	Created
MEH	**529690/183627**	**6 Sep 2020 13:45**

Your selected location is in flood zone 1, an area with a low probability of flooding.

This means:

- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

Notes

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

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

Environment Agency

Flood map for planning

Your reference
MEH

Location (easting/northing)
529690/183627

Scale
1:2500

Created
6 Sep 2020 13:45

- Selected point
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Flood storage area

0 20 40 60m

Appendix F SuDS Pro-forma

Camden GREATER LONDON AUTHORITY LoDEG

1. Project & Site Details

Project / Site Name (including sub-catchment / stage / phase where appropriate)	Project Oriel, Moorfields Eye Hospital
Address & post code	St Pancras Way, London, NW1 0PE
OS Grid ref. (Easting, Northing)	E 529654 N 183642
LPA reference (if applicable)	
Brief description of proposed work	The proposed development comprises a single building, which ranges from 7 to 9 storeys, with a lower ground floor and a covered atrium
Total site Area	7850 m^2
Total existing impervious area	7520 m^2
Total proposed impervious area	7850 m^2
Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)?	no
Existing drainage connection type and location	Connected to Thames Water combined public sewer via private combined drainage network. See drawings with
Designer Name	Roddy Prayag
Designer Position	Principal Infrastructure Engineer
Designer Company	AECOM Ltd

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility

Superficial geology classification	Not available on BGS maps: not expected - brownfield site likely to have made ground over London Clay
Bedrock geology classification	London Clay
Site infiltration rate	m/s
Depth to groundwater level	m below ground level
Is infiltration feasible?	No

2b. Drainage Hierarchy

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

2c. Proposed Discharge Details

Proposed discharge location	ee drawings with Appendix E of FRADS fo
Has the owner/regulator of the discharge location been consulted?	Thames Water: results show Thames Wate

3. Drainage Strategy

3a. Discharge Rates & Required Storage				
	Greenfield (GF) runoff rate (l/s)	*Existing discharge rate (l/s)*	*Required storage for GF rate (m³)*	*Proposed discharge rate (l/s)*
Qbar	2.9			
1 in 1	2.4	74.8	97-143	11.2
1 in 30	6.5	129.7	208-284	19.5
1 in 100	9.2	137.6	266-358	20.6
1 in 100 + CC			408-542	20.6
Climate change allowance used		40%		
3b. Principal Method of Flow Control		Vortex flow control unit		

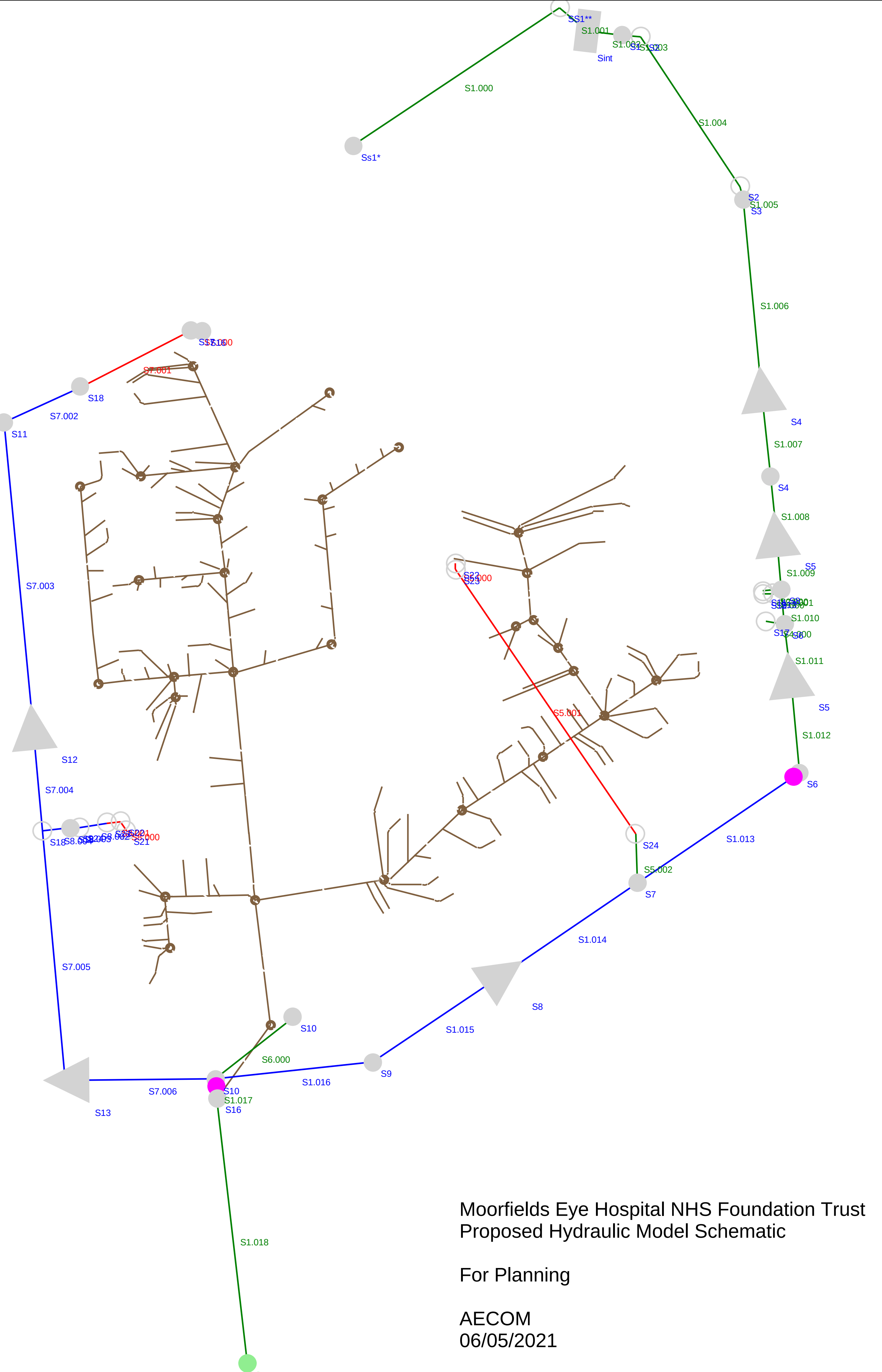
3c. Proposed SuDS Measures	*Catchment area (m²)*	*Plan area (m²)*	*Storage vol. (m³)*
Rainwater harvesting	0		0
Infiltration systems	0		0
Green roofs	0	0	0
Blue roofs	0	0	0
Filter strips	0	0	0
Filter drains	0	0	0
Bioretention / tree pits	0	0	0
Pervious pavements	720	720	130
Swales	0	0	0
Basins/ponds	0	0	0
Attenuation tanks	7560		280
Total	**8280**	**720**	**410**

4. Supporting Information

4a. Discharge & Drainage Strategy	*Page/section of drainage report*
Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	Desk Study details as shown in FRADS - section 3.3
Drainage hierarchy (2b)	etails shown in FRADS - section 8.
Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	Details shown in FRADS - section 8
Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Details shown in FRADS - section 8
Proposed SuDS measures & specifications (3b)	Details shown in FRADS - section 8

4b. Other Supporting Details	*Page/section of drainage report*
Detailed Development Layout	etails shown in FRADS - Appendix
Detailed drainage design drawings, including exceedance flow routes	etails shown in FRADS - Appendix
Detailed landscaping plans	See planning application
Maintenance strategy	etails shown in FRADS - section 8.
Demonstration of how the proposed SuDS measures improve:	
a) water quality of the runoff?	etails shown in FRADS - section 8.
b) biodiversity?	Details shown in FRADS - section 8
c) amenity?	Details shown in FRADS - section 8

Appendix G Proposed Drainage Calculations



Moorfields Eye Hospital NHS Foundation Trust
Proposed Hydraulic Model Schematic

For Planning

AECOM
06/05/2021

Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
S1.000	26.872	0.179	150.1	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit
S1.001	3.872	0.026	148.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit
S1.002	3.802	0.640	5.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit
S1.003	2.026	0.014	150.0	0.043	5.00	0.0	0.600	o	150	Pipe/Conduit
S1.004	19.396	0.129	150.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit
S1.005	1.504	0.011	136.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit
S1.006	20.548	0.137	150.0	0.081	0.00	0.0	0.600	o	225	Pipe/Conduit
S1.007	9.473	0.063	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
S1.008	6.235	0.042	150.0	0.053	0.00	0.0	0.600	o	225	Pipe/Conduit
S1.009	6.039	0.040	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
S2.000	2.000	0.000	0.0	0.000	5.00	0.0	0.600	o	200	Pipe/Conduit
S3.000	1.051	0.000	0.0	0.000	5.00	0.0	0.600	o	200	Pipe/Conduit
S3.001	1.000	0.000	0.0	0.000	0.00	0.0	0.600	o	200	Pipe/Conduit
S1.010	3.747	0.025	149.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
S4.000	2.075	0.000	0.0	0.000	5.00	0.0	0.600	o	200	Pipe/Conduit
S1.011	5.517	0.037	150.0	0.041	0.00	0.0	0.600	o	225	Pipe/Conduit
S1.012	10.624	0.069	154.7	0.010	0.00	0.0	0.600	o	225	Pipe/Conduit
S1.013	21.123	0.251	84.2	0.058	0.00	0.0	0.600	o	300	Pipe/Conduit
S5.000	0.666	0.000	0.0	0.000	5.00	0.0	0.600	o	90	Pipe/Conduit
S5.001	34.472	0.000	0.0	0.000	0.00	0.0	0.600	o	90	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
S1.000	21.200	0.000	0.0	0.82	14.5
S1.001	21.021	0.000	0.0	0.82	14.5
S1.002	20.945	0.000	0.0	4.16	73.6
S1.003	20.305	0.043	0.0	0.82	14.5
S1.004	20.291	0.043	0.0	0.82	14.5
S1.005	20.162	0.043	0.0	0.86	15.2
S1.006	20.076	0.124	0.0	1.07	42.4
S1.007	19.939	0.124	0.0	1.07	42.4
S1.008	19.876	0.177	0.0	1.07	42.4
S1.009	19.834	0.177	0.0	1.07	42.4
S2.000	20.794	0.000	0.0	0.00	0.0
S3.000	20.794	0.000	0.0	0.00	0.0
S3.001	20.794	0.000	0.0	0.00	0.0
S1.010	19.794	0.177	0.0	1.07	42.4
S4.000	20.769	0.000	0.0	0.00	0.0
S1.011	19.769	0.218	0.0	1.07	42.4
S1.012	19.732	0.228	0.0	1.05	41.7
S1.013	18.396	0.286	0.0	1.72	121.2
S5.000	18.750	0.000	0.0	0.00	0.0
S5.001	18.750	0.000	0.0	0.00	0.0

Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
S5.002	5.296	0.000	0.0	0.000	0.00	0.0	0.600	o	160	Pipe/Conduit
S1.014	17.539	0.175	100.2	0.057	0.00	0.0	0.600	o	300	Pipe/Conduit
S1.015	17.000	0.170	100.0	0.050	0.00	0.0	0.600	o	300	Pipe/Conduit
S1.016	17.072	0.213	80.0	0.004	0.00	0.0	0.600	o	300	Pipe/Conduit
S6.000	10.704	0.134	80.0	0.029	5.00	0.0	0.600	o	150	Pipe/Conduit
S7.000	1.227	0.000	0.0	0.000	5.00	0.0	0.600	o	125	Pipe/Conduit
S7.001	13.408	0.000	0.0	0.000	0.00	0.0	0.600	o	125	Pipe/Conduit
S7.002	9.092	0.103	88.3	0.000	0.00	0.0	0.600	o	250	Pipe/Conduit
S7.003	33.002	0.165	200.0	0.221	5.00	0.0	0.600	o	300	Pipe/Conduit
S7.004	11.286	0.056	200.0	0.122	0.00	0.0	0.600	o	300	Pipe/Conduit
S8.000	1.136	0.000	0.0	0.000	5.00	0.0	0.600	o	125	Pipe/Conduit
S8.001	1.482	0.000	0.0	0.000	0.00	0.0	0.600	o	125	Pipe/Conduit
S8.002	3.010	0.000	0.0	0.000	0.00	0.0	0.600	o	250	Pipe/Conduit
S8.003	1.000	0.248	4.0	0.000	0.00	0.0	0.600	o	250	Pipe/Conduit
S8.004	3.045	0.076	40.1	0.000	5.00	0.0	0.600	o	300	Pipe/Conduit
S7.005	27.048	0.136	198.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit
S7.006	16.159	0.065	248.6	0.016	0.00	0.0	0.600	o	300	Pipe/Conduit
S1.017	2.064	0.014	147.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
S1.018	28.789	0.290	99.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
S5.002	18.680	0.000	0.0	0.00	0.0
S1.014	18.145	0.343	0.0	1.57	111.0
S1.015	17.970	0.393	0.0	1.57	111.1
S1.016	17.800	0.397	0.0	1.76	124.4
S6.000	18.000	0.029	0.0	1.12	19.9
S7.000	18.750	0.000	0.0	0.00	0.0
S7.001	18.750	0.000	0.0	0.00	0.0
S7.002	18.625	0.000	0.0	1.49	73.1
S7.003	17.522	0.221	0.0	1.11	78.3
S7.004	17.357	0.343	0.0	1.11	78.3
S8.000	18.750	0.000	0.0	0.00	0.0
S8.001	18.750	0.000	0.0	0.00	0.0
S8.002	18.625	0.000	0.0	0.00	0.0
S8.003	18.625	0.000	0.0	7.02	344.5
S8.004	17.377	0.000	0.0	2.49	176.1
S7.005	17.301	0.343	0.0	1.11	78.5
S7.006	17.165	0.359	0.0	0.99	70.2
S1.017	17.034	0.785	0.0	1.07	42.7
S1.018	17.020	0.785	0.0	1.31	52.2

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
Ss1*	22.200	1.000	Open Manhole	600	S1.000	21.200	150				
SS1**	23.000	1.979	Junction		S1.001	21.021	150	S1.000	21.021	150	
Sint	23.000	2.055	Open Manhole	2520 x 4563	S1.002	20.945	150	S1.001	20.995	150	50
S1	23.000	2.695	Open Manhole	1200	S1.003	20.305	150	S1.002	20.305	150	
S2	23.035	2.744	Junction		S1.004	20.291	150	S1.003	20.291	150	
S2	23.070	2.908	Junction		S1.005	20.162	150	S1.004	20.162	150	
S3	23.140	3.064	Open Manhole	1200	S1.006	20.076	225	S1.005	20.151	150	
S4	23.330	3.391	Junction		S1.007	19.939	225	S1.006	19.939	225	
S4	23.165	3.289	Open Manhole	1200	S1.008	19.876	225	S1.007	19.876	225	
S5	23.000	3.166	Junction		S1.009	19.834	225	S1.008	19.834	225	
S11	23.000	2.206	Junction		S2.000	20.794	200				
S12	23.000	2.206	Junction		S3.000	20.794	200				
S13	23.000	2.206	Junction		S3.001	20.794	200	S3.000	20.794	200	
S8	22.925	3.131	Open Manhole	1500	S1.010	19.794	225	S1.009	19.794	225	
								S2.000	20.794	200	975
								S3.001	20.794	200	975
S17	22.925	2.156	Junction		S4.000	20.769	200				
S6	22.850	3.081	Open Manhole	1500	S1.011	19.769	225	S1.010	19.769	225	
								S4.000	20.769	200	975
S5	22.700	2.968	Junction		S1.012	19.732	225	S1.011	19.732	225	
S6	22.360	3.964	Open Manhole	1500	S1.013	18.396	300	S1.012	19.663	225	1192
S22	19.300	0.550	Junction		S5.000	18.750	90				
S23	19.300	0.550	Junction		S5.001	18.750	90	S5.000	18.750	90	
S24	19.300	0.620	Junction		S5.002	18.680	160	S5.001	18.750	90	
S7	22.170	4.025	Open Manhole	1200	S1.014	18.145	300	S1.013	18.145	300	
								S5.002	18.680	160	395
S8	21.070	3.100	Junction		S1.015	17.970	300	S1.014	17.970	300	
S9	20.180	2.380	Open Manhole	1200	S1.016	17.800	300	S1.015	17.800	300	
S10	19.300	1.300	Open Manhole	600	S6.000	18.000	150				
S16	19.300	0.550	Open Manhole	1200	S7.000	18.750	125				
S17	19.300	0.550	Open Manhole	1200	S7.001	18.750	125	S7.000	18.750	125	
S18	19.300	0.675	Open Manhole	1200	S7.002	18.625	250	S7.001	18.750	125	
S11	19.850	2.328	Open Manhole	1200	S7.003	17.522	300	S7.002	18.522	250	950
S12	19.400	2.043	Junction		S7.004	17.357	300	S7.003	17.357	300	
S21	19.300	0.550	Junction		S8.000	18.750	125				
S22	19.300	0.550	Junction		S8.001	18.750	125	S8.000	18.750	125	
S23	19.300	0.675	Junction		S8.002	18.625	250	S8.001	18.750	125	
S24	19.300	0.675	Junction		S8.003	18.625	250	S8.002	18.625	250	
S18	19.300	1.923	Open Manhole	1500	S8.004	17.377	300	S8.003	18.377	250	950
S18	19.260	1.959	Junction		S7.005	17.301	300	S7.004	17.301	300	
								S8.004	17.301	300	
S13	19.120	1.955	Open Manhole	1200	S7.006	17.165	300	S7.005	17.165	300	
S10	19.500	2.466	Open Manhole	1500	S1.017	17.034	225	S1.016	17.587	300	628
								S6.000	17.866	150	757

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
								S7.006	17.100	300	141
S16	19.470	2.450	Open Manhole	1200	S1.018	17.020	225	S1.017	17.020	225	
S	19.200	2.470	Open Manhole	0		OUTFALL		S1.018	16.730	225	

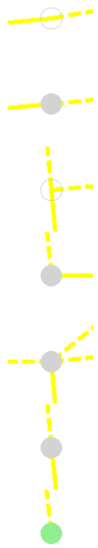
MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
Ss1*	529647.258	183674.014	529647.258	183674.014	Required	
SS1**	529669.574	183688.983			No Entry	
Sint	529672.498	183686.444	529672.498	183686.444	Required	
S1	529676.273	183685.983	529676.273	183685.983	Required	
S2	529678.293	183685.829			No Entry	
S2	529689.038	183669.681			No Entry	
S3	529689.362	183668.213	529689.362	183668.213	Required	
S4	529691.360	183647.762			No Entry	
S4	529692.281	183638.333	529692.281	183638.333	Required	
S5	529692.887	183632.128			No Entry	
S11	529691.483	183625.932			No Entry	
S12	529691.513	183625.618			No Entry	
S13	529692.559	183625.715			No Entry	
S8	529693.475	183626.117	529693.475	183626.117	Required	
S17	529691.785	183622.686			No Entry	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S6	529693.839	183622.388	529693.839	183622.388	Required	
S5	529694.375	183616.897			No Entry	
S6	529695.408	183606.324	529695.408	183606.324	Required	
S22	529658.313	183628.934			No Entry	
S23	529658.323	183628.268			No Entry	
S24	529677.687	183599.749			No Entry	
S7	529677.933	183594.459	529677.933	183594.459	Required	
S8	529663.423	183584.607			No Entry	
S9	529649.358	183575.057	529649.358	183575.057	Required	
S10	529640.690	183579.982	529640.690	183579.982	Required	
S16	529630.926	183654.004	529630.926	183654.004	Required	
S17	529629.702	183654.079	529629.702	183654.079	Required	
S18	529617.735	183648.033	529617.735	183648.033	Required	
S11	529609.510	183644.157	529609.510	183644.157	Required	
S12	529612.617	183611.302			No Entry	
S21	529622.704	183600.112			No Entry	
S22	529622.126	183601.090			No Entry	
S23	529620.650	183600.962			No Entry	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S24	529617.685	183600.442			No Entry	
S18	529616.689	183600.351	529616.689	183600.351	Required	
S18	529613.657	183600.064			No Entry	
S13	529616.225	183573.138	529616.225	183573.138	Required	
S10	529632.384	183573.230	529632.384	183573.230	Required	
S16	529632.574	183571.174	529632.574	183571.174	Required	
S	529635.804	183542.567			No Entry	



PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	150	Ss1*	22.200	21.200	0.850	Open Manhole	600
S1.001	o	150	SS1**	23.000	21.021	1.829	Junction	
S1.002	o	150	Sint	23.000	20.945	1.905	Open Manhole	2520 x 4563
S1.003	o	150	S1	23.000	20.305	2.545	Open Manhole	1200
S1.004	o	150	S2	23.035	20.291	2.594	Junction	
S1.005	o	150	S2	23.070	20.162	2.758	Junction	
S1.006	o	225	S3	23.140	20.076	2.839	Open Manhole	1200
S1.007	o	225	S4	23.330	19.939	3.166	Junction	
S1.008	o	225	S4	23.165	19.876	3.064	Open Manhole	1200
S1.009	o	225	S5	23.000	19.834	2.941	Junction	
S2.000	o	200	S11	23.000	20.794	2.006	Junction	
S3.000	o	200	S12	23.000	20.794	2.006	Junction	
S3.001	o	200	S13	23.000	20.794	2.006	Junction	
S1.010	o	225	S8	22.925	19.794	2.906	Open Manhole	1500
S4.000	o	200	S17	22.925	20.769	1.956	Junction	
S1.011	o	225	S6	22.850	19.769	2.856	Open Manhole	1500
S1.012	o	225	S5	22.700	19.732	2.743	Junction	
S1.013	o	300	S6	22.360	18.396	3.664	Open Manhole	1500
S5.000	o	90	S22	19.300	18.750	0.460	Junction	

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	26.872	150.1	SS1**	23.000	21.021	1.829	Junction	
S1.001	3.872	148.9	Sint	23.000	20.995	1.855	Open Manhole	2520 x 4563
S1.002	3.802	5.9	S1	23.000	20.305	2.545	Open Manhole	1200
S1.003	2.026	150.0	S2	23.035	20.291	2.594	Junction	
S1.004	19.396	150.0	S2	23.070	20.162	2.758	Junction	
S1.005	1.504	136.7	S3	23.140	20.151	2.839	Open Manhole	1200
S1.006	20.548	150.0	S4	23.330	19.939	3.166	Junction	
S1.007	9.473	150.0	S4	23.165	19.876	3.064	Open Manhole	1200
S1.008	6.235	150.0	S5	23.000	19.834	2.941	Junction	
S1.009	6.039	150.0	S8	22.925	19.794	2.906	Open Manhole	1500
S2.000	2.000	0.0	S8	22.925	20.794	1.931	Open Manhole	1500
S3.000	1.051	0.0	S13	23.000	20.794	2.006	Junction	
S3.001	1.000	0.0	S8	22.925	20.794	1.931	Open Manhole	1500
S1.010	3.747	149.9	S6	22.850	19.769	2.856	Open Manhole	1500
S4.000	2.075	0.0	S6	22.850	20.769	1.881	Open Manhole	1500
S1.011	5.517	150.0	S5	22.700	19.732	2.743	Junction	
S1.012	10.624	154.7	S6	22.360	19.663	2.472	Open Manhole	1500
S1.013	21.123	84.2	S7	22.170	18.145	3.725	Open Manhole	1200
S5.000	0.666	0.0	S23	19.300	18.750	0.460	Junction	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S5.001	o	90	S23	19.300	18.750	0.460	Junction	
S5.002	o	160	S24	19.300	18.680	0.460	Junction	
S1.014	o	300	S7	22.170	18.145	3.725	Open Manhole	1200
S1.015	o	300	S8	21.070	17.970	2.800	Junction	
S1.016	o	300	S9	20.180	17.800	2.080	Open Manhole	1200
S6.000	o	150	S10	19.300	18.000	1.150	Open Manhole	600
S7.000	o	125	S16	19.300	18.750	0.425	Open Manhole	1200
S7.001	o	125	S17	19.300	18.750	0.425	Open Manhole	1200
S7.002	o	250	S18	19.300	18.625	0.425	Open Manhole	1200
S7.003	o	300	S11	19.850	17.522	2.028	Open Manhole	1200
S7.004	o	300	S12	19.400	17.357	1.743	Junction	
S8.000	o	125	S21	19.300	18.750	0.425	Junction	
S8.001	o	125	S22	19.300	18.750	0.425	Junction	
S8.002	o	250	S23	19.300	18.625	0.425	Junction	
S8.003	o	250	S24	19.300	18.625	0.425	Junction	
S8.004	o	300	S18	19.300	17.377	1.623	Open Manhole	1500
S7.005	o	300	S18	19.260	17.301	1.659	Junction	
S7.006	o	300	S13	19.120	17.165	1.655	Open Manhole	1200
S1.017	o	225	S10	19.500	17.034	2.241	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S5.001	34.472	0.0	S24	19.300	18.750	0.460	Junction	
S5.002	5.296	0.0	S7	22.170	18.680	3.330	Open Manhole	1200
S1.014	17.539	100.2	S8	21.070	17.970	2.800	Junction	
S1.015	17.000	100.0	S9	20.180	17.800	2.080	Open Manhole	1200
S1.016	17.072	80.0	S10	19.500	17.587	1.613	Open Manhole	1500
S6.000	10.704	80.0	S10	19.500	17.866	1.484	Open Manhole	1500
S7.000	1.227	0.0	S17	19.300	18.750	0.425	Open Manhole	1200
S7.001	13.408	0.0	S18	19.300	18.750	0.425	Open Manhole	1200
S7.002	9.092	88.3	S11	19.850	18.522	1.078	Open Manhole	1200
S7.003	33.002	200.0	S12	19.400	17.357	1.743	Junction	
S7.004	11.286	200.0	S18	19.260	17.301	1.659	Junction	
S8.000	1.136	0.0	S22	19.300	18.750	0.425	Junction	
S8.001	1.482	0.0	S23	19.300	18.750	0.425	Junction	
S8.002	3.010	0.0	S24	19.300	18.625	0.425	Junction	
S8.003	1.000	4.0	S18	19.300	18.377	0.673	Open Manhole	1500
S8.004	3.045	40.1	S18	19.260	17.301	1.659	Junction	
S7.005	27.048	198.9	S13	19.120	17.165	1.655	Open Manhole	1200
S7.006	16.159	248.6	S10	19.500	17.100	2.100	Open Manhole	1500
S1.017	2.064	147.4	S16	19.470	17.020	2.225	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.018	o	225	S16	19.470	17.020	2.225	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.018	28.789	99.3	S	19.200	16.730	2.245	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.000	0.000	0.000
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.043	0.043	0.043
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.081	0.081	0.081
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.053	0.053	0.053
1.009	-	-	100	0.000	0.000	0.000
2.000	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.000	0.000	0.000
3.001	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
4.000	-	-	100	0.000	0.000	0.000
1.011	-	-	100	0.041	0.041	0.041
1.012	-	-	100	0.010	0.010	0.010
1.013	-	-	100	0.058	0.058	0.058
5.000	-	-	100	0.000	0.000	0.000
5.001	-	-	100	0.000	0.000	0.000
5.002	-	-	100	0.000	0.000	0.000
1.014	-	-	100	0.057	0.057	0.057
1.015	-	-	100	0.050	0.050	0.050
1.016	-	-	100	0.004	0.004	0.004
6.000	-	-	100	0.029	0.029	0.029
7.000	-	-	100	0.000	0.000	0.000
7.001	-	-	100	0.000	0.000	0.000
7.002	-	-	100	0.000	0.000	0.000
7.003	-	-	100	0.221	0.221	0.221
7.004	-	-	100	0.122	0.122	0.122
8.000	-	-	100	0.000	0.000	0.000
8.001	-	-	100	0.000	0.000	0.000
8.002	-	-	100	0.000	0.000	0.000
8.003	-	-	100	0.000	0.000	0.000
8.004	-	-	100	0.000	0.000	0.000
7.005	-	-	100	0.000	0.000	0.000
7.006	-	-	100	0.016	0.016	0.016
1.017	-	-	100	0.000	0.000	0.000
1.018	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.785	0.785	0.785

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.018	S	19.200	16.730	21.940	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	2	Number of Storage Structures	6	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	21.000	Storm Duration (mins)	30
Ratio R	0.440		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S6, DS/PN: S1.013, Volume (m³): 7.4

Unit Reference	MD-SHE-0122-1200-3900-1200
Design Head (m)	3.900
Design Flow (l/s)	12.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	122
Invert Level (m)	18.396
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	3.900	12.0	Kick-Flo®	1.097	6.6
Flush-Flo™	0.535	8.3	Mean Flow over Head Range	-	8.9

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	4.4	0.800	8.0	2.000	8.7	4.000	12.1	7.000	15.9
0.200	7.1	1.000	7.3	2.200	9.1	4.500	12.8	7.500	16.4
0.300	7.9	1.200	6.9	2.400	9.5	5.000	13.5	8.000	16.9
0.400	8.2	1.400	7.4	2.600	9.9	5.500	14.1	8.500	17.4
0.500	8.3	1.600	7.9	3.000	10.6	6.000	14.7	9.000	17.9
0.600	8.3	1.800	8.3	3.500	11.4	6.500	15.3	9.500	18.4

Complex Manhole: S10, DS/PN: S1.017, Volume (m³): 6.7

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0159-1120-0500-1120
Design Head (m)	0.500
Design Flow (l/s)	11.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	159
Invert Level (m)	17.034
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.500	11.2	Kick-Flo®	0.401	10.1
Flush-Flo™	0.235	11.2	Mean Flow over Head Range	-	8.8

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

Hydro-Brake® Optimum

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.7	0.800	14.0	2.000	21.6	4.000	30.2	7.000	39.6
0.200	11.1	1.000	15.5	2.200	22.6	4.500	32.0	7.500	41.0
0.300	11.0	1.200	16.9	2.400	23.6	5.000	33.6	8.000	42.3
0.400	10.1	1.400	18.2	2.600	24.5	5.500	35.0	8.500	43.7
0.500	11.2	1.600	19.4	3.000	26.3	6.000	36.6	9.000	44.9
0.600	12.2	1.800	20.6	3.500	28.3	6.500	38.1	9.500	46.2

Storage Structures for Storm

Complex Manhole: S4, DS/PN: S1.007

Cellular Storage

Invert Level (m) 20.234 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	13.5	0.0	2.000	13.5	0.0	2.001	0.0	0.0

Complex Manhole: S5, DS/PN: S1.009

Cellular Storage

Invert Level (m) 19.834 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	14.2	0.0	2.000	14.2	0.0	2.001	0.0	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	11.0
Max Percolation (l/s)	12.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	21.984	Cap Volume Depth (m)	0.600

Complex Manhole: S5, DS/PN: S1.012

Cellular Storage

Invert Level (m) 20.005 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	12.0	0.0	2.000	12.0	0.0	2.001	0.0	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.6
Membrane Percolation (mm/hr)	1000	Length (m)	17.8
Max Percolation (l/s)	22.7	Slope (1:X)	40.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	22.000	Cap Volume Depth (m)	0.600

Complex Manhole: S8, DS/PN: S1.015

Cellular Storage

Invert Level (m) 17.970 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	45.0	0.0	1.000	45.0	0.0	1.001	0.0	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	50.0
Max Percolation (l/s)	69.4	Slope (1:X)	20.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	19.970	Cap Volume Depth (m)	0.600

Complex Manhole: S12, DS/PN: S7.004

Cellular Storage

Invert Level (m) 17.284 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	165.0	0.0	1.000	165.0	0.0	1.001	0.0	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	53.0
Max Percolation (l/s)	58.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	18.284	Cap Volume Depth (m)	0.600

Complex Manhole: S13, DS/PN: S7.006

Cellular Storage

Invert Level (m) 17.186 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	13.5	0.0	1.000	13.5	0.0	1.001	0.0	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	21.7
Max Percolation (l/s)	36.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	35.306	Cap Volume Depth (m)	0.600

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.440 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	Ss1*	15 Summer	1	+0%	100/30 Summer				21.200	-0.150
S1.001	SS1**	15 Summer	1	+0%					21.021	-0.150
S1.002	Sint	15 Summer	1	+0%	100/15 Summer				20.945	-0.150
S1.003	S1	15 Winter	1	+0%	30/15 Summer				20.390	-0.065
S1.004	S2	15 Winter	1	+0%					20.362	-0.079
S1.005	S2	15 Winter	1	+0%					20.245	-0.067
S1.006	S3	15 Winter	1	+0%	30/15 Summer				20.180	-0.121
S1.007	S4	30 Winter	1	+0%	1/30 Winter				20.166	0.002
S1.008	S4	30 Winter	1	+0%	1/15 Winter				20.162	0.061
S1.009	S5	30 Winter	1	+0%	1/15 Summer				20.158	0.099
S2.000	S11	15 Summer	1	+0%					20.794	-0.200
S3.000	S12	15 Summer	1	+0%					20.794	-0.200
S3.001	S13	15 Summer	1	+0%					20.794	-0.200
S1.010	S8	30 Winter	1	+0%	1/15 Summer				20.154	0.135
S4.000	S17	15 Summer	1	+0%					20.769	-0.200
S1.011	S6	30 Winter	1	+0%	1/15 Summer				20.151	0.157
S1.012	S5	30 Winter	1	+0%	1/15 Summer				20.146	0.189
S1.013	S6	30 Winter	1	+0%	1/15 Summer				20.138	1.442
S5.000	S22	15 Summer	1	+0%					18.750	-0.090
S5.001	S23	15 Summer	1	+0%					18.750	-0.090
S5.002	S24	15 Summer	1	+0%					18.680	-0.160
S1.014	S7	15 Summer	1	+0%	100/60 Winter				18.225	-0.220
S1.015	S8	30 Winter	1	+0%	100/60 Summer				18.054	-0.216
S1.016	S9	30 Winter	1	+0%	100/15 Summer				17.884	-0.216
S6.000	S10	15 Winter	1	+0%	100/15 Summer				18.051	-0.099
S7.000	S16	15 Summer	1	+0%					18.750	-0.125
S7.001	S17	15 Summer	1	+0%					18.750	-0.125
S7.002	S18	15 Summer	1	+0%					18.625	-0.250
S7.003	S11	15 Winter	1	+0%	30/15 Summer				17.667	-0.155
S7.004	S12	180 Winter	1	+0%	30/15 Winter				17.539	-0.118

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	Ss1*	0.000	0.00			0.0	OK	
S1.001	SS1**	0.000	0.00			0.0	OK*	
S1.002	Sint	0.000	0.00			0.0	OK	
S1.003	S1	0.000	0.60			6.5	OK	
S1.004	S2	0.000	0.45			6.5	OK*	
S1.005	S2	0.000	0.59			6.4	OK*	
S1.006	S3	0.000	0.43			16.6	OK	
S1.007	S4	0.000	0.38		13	13.3	SURCHARGED*	
S1.008	S4	0.000	0.62			18.6	SURCHARGED	
S1.009	S5	0.000	0.52		19	15.5	SURCHARGED*	
S2.000	S11	0.000	0.00			0.0	OK*	
S3.000	S12	0.000	0.00			0.0	OK*	
S3.001	S13	0.000	0.00			0.0	OK*	
S1.010	S8	0.000	0.47			13.5	SURCHARGED	
S4.000	S17	0.000	0.00			0.0	OK*	
S1.011	S6	0.000	0.57			17.0	SURCHARGED	
S1.012	S5	0.000	0.44		13	16.3	SURCHARGED*	
S1.013	S6	0.000	0.08			8.3	SURCHARGED	
S5.000	S22	0.000	0.00			0.0	OK*	
S5.001	S23	0.000	0.00			0.0	OK*	
S5.002	S24	0.000	0.00			0.0	OK*	
S1.014	S7	0.000	0.16			15.1	OK	
S1.015	S8	0.000	0.18		46	18.1	OK*	
S1.016	S9	0.000	0.17			18.5	OK	
S6.000	S10	0.000	0.25			4.4	OK	
S7.000	S16	0.000	0.00			0.0	OK	
S7.001	S17	0.000	0.00			0.0	OK	
S7.002	S18	0.000	0.00			0.0	OK	
S7.003	S11	0.000	0.46			33.2	OK	
S7.004	S12	0.000	0.12		66	7.6	OK*	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S8.000	S21	15 Summer	1	+0%					18.750	-0.125	0.000
S8.001	S22	15 Summer	1	+0%					18.750	-0.125	0.000
S8.002	S23	15 Summer	1	+0%					18.625	-0.250	0.000
S8.003	S24	15 Summer	1	+0%					18.625	-0.250	0.000
S8.004	S18	180 Winter	1	+0%	30/15 Winter				17.539	-0.138	0.000
S7.005	S18	120 Winter	1	+0%					17.539	-0.062	0.000
S7.006	S13	120 Winter	1	+0%	1/30 Winter				17.538	0.073	0.000
S1.017	S10	120 Winter	1	+0%	1/15 Summer				17.550	0.291	0.000
S1.018	S16	720 Summer	1	+0%					17.093	-0.152	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S8.000	S21	0.00			0.0	OK*	
S8.001	S22	0.00			0.0	OK*	
S8.002	S23	0.00			0.0	OK*	
S8.003	S24	0.00			0.0	OK*	
S8.004	S18	0.00			0.1	OK	
S7.005	S18	0.11			9.0	OK*	
S7.006	S13	0.17		47	10.4	SURCHARGED	
S1.017	S10	0.39			11.2	SURCHARGED	
S1.018	S16	0.23			11.2	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.440 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	Ss1*	15 Summer	30	+0%	100/30 Summer				21.200	-0.150
S1.001	SS1**	15 Summer	30	+0%					21.021	-0.150
S1.002	Sint	15 Summer	30	+0%	100/15 Summer				20.945	-0.150
S1.003	S1	60 Winter	30	+0%	30/15 Summer				20.847	0.392
S1.004	S2	15 Summer	30	+0%					20.441	0.000
S1.005	S2	15 Summer	30	+0%					20.312	0.000
S1.006	S3	60 Winter	30	+0%	30/15 Summer				20.838	0.537
S1.007	S4	60 Winter	30	+0%	1/30 Winter				20.829	0.665
S1.008	S4	60 Winter	30	+0%	1/15 Winter				20.825	0.724
S1.009	S5	60 Winter	30	+0%	1/15 Summer				20.819	0.760
S2.000	S11	60 Winter	30	+0%					20.815	-0.179
S3.000	S12	60 Winter	30	+0%					20.815	-0.179
S3.001	S13	60 Winter	30	+0%					20.815	-0.179
S1.010	S8	60 Winter	30	+0%	1/15 Summer				20.815	0.796
S4.000	S17	60 Winter	30	+0%					20.812	-0.157
S1.011	S6	60 Winter	30	+0%	1/15 Summer				20.812	0.818
S1.012	S5	60 Winter	30	+0%	1/15 Summer				20.806	0.849
S1.013	S6	60 Winter	30	+0%	1/15 Summer				20.797	2.101
S5.000	S22	15 Summer	30	+0%					18.750	-0.090
S5.001	S23	15 Summer	30	+0%					18.750	-0.090
S5.002	S24	15 Summer	30	+0%					18.680	-0.160
S1.014	S7	15 Winter	30	+0%	100/60 Winter				18.263	-0.182
S1.015	S8	15 Winter	30	+0%	100/60 Summer				18.110	-0.160
S1.016	S9	180 Winter	30	+0%	100/15 Summer				17.982	-0.118
S6.000	S10	15 Winter	30	+0%	100/15 Summer				18.085	-0.065
S7.000	S16	15 Summer	30	+0%					18.750	-0.125
S7.001	S17	15 Summer	30	+0%					18.750	-0.125
S7.002	S18	15 Summer	30	+0%					18.625	-0.250
S7.003	S11	180 Winter	30	+0%	30/15 Summer				17.985	0.163
S7.004	S12	180 Winter	30	+0%	30/15 Winter				17.982	0.325

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	Ss1*	0.000	0.00			0.0	OK	
S1.001	SS1**	0.000	0.00			0.0	OK*	
S1.002	Sint	0.000	0.00			0.0	OK	
S1.003	S1	0.000	0.68			7.4	SURCHARGED	
S1.004	S2	0.000	0.80			11.6	SURCHARGED*	
S1.005	S2	0.000	0.99			10.8	SURCHARGED*	
S1.006	S3	0.000	0.48			18.3	SURCHARGED	
S1.007	S4	0.000	0.36		39	12.9	SURCHARGED*	
S1.008	S4	0.000	0.65			19.3	SURCHARGED	
S1.009	S5	0.000	0.39		57	11.6	SURCHARGED*	
S2.000	S11	0.000	0.00			0.1	OK*	
S3.000	S12	0.000	0.00			0.1	OK*	
S3.001	S13	0.000	0.01			0.2	OK*	
S1.010	S8	0.000	0.38			11.0	SURCHARGED	
S4.000	S17	0.000	0.01			0.1	OK*	
S1.011	S6	0.000	0.47			14.1	SURCHARGED	
S1.012	S5	0.000	0.39		48	14.4	SURCHARGED*	
S1.013	S6	0.000	0.09			9.5	SURCHARGED	
S5.000	S22	0.000	0.00			0.0	OK*	
S5.001	S23	0.000	0.00			0.0	OK*	
S5.002	S24	0.000	0.00			0.0	OK*	
S1.014	S7	0.000	0.33			31.1	OK	
S1.015	S8	0.000	0.44		9	45.7	OK*	
S1.016	S9	0.000	0.17			17.6	OK	
S6.000	S10	0.000	0.60			10.8	OK	
S7.000	S16	0.000	0.00			0.0	OK	
S7.001	S17	0.000	0.00			0.0	OK	
S7.002	S18	0.000	0.00			0.0	OK	
S7.003	S11	0.000	0.25			17.7	SURCHARGED	
S7.004	S12	0.000	0.18		127	11.0	SURCHARGED*	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S8.000	S21	15 Summer	30	+0%					18.750	-0.125	0.000
S8.001	S22	15 Summer	30	+0%					18.750	-0.125	0.000
S8.002	S23	15 Summer	30	+0%					18.625	-0.250	0.000
S8.003	S24	15 Summer	30	+0%					18.625	-0.250	0.000
S8.004	S18	180 Winter	30	+0%	30/15 Winter				17.980	0.303	0.000
S7.005	S18	15 Summer	30	+0%					17.601	0.000	0.000
S7.006	S13	180 Winter	30	+0%	1/30 Winter				17.976	0.511	0.000
S1.017	S10	180 Winter	30	+0%	1/15 Summer				17.972	0.713	0.000
S1.018	S16	180 Winter	30	+0%					17.104	-0.141	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S8.000	S21	0.00			0.0	OK*	
S8.001	S22	0.00			0.0	OK*	
S8.002	S23	0.00			0.0	OK*	
S8.003	S24	0.00			0.0	OK*	
S8.004	S18	0.01			0.4	SURCHARGED	
S7.005	S18	0.12			9.3	SURCHARGED*	
S7.006	S13	0.20		155	12.1	SURCHARGED	
S1.017	S10	0.50			14.5	SURCHARGED	
S1.018	S16	0.30			14.5	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.440 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	Ss1*	60 Winter	100	+40%	100/30 Summer				21.721	0.371
S1.001	SS1**	15 Summer	100	+40%					21.171	0.000
S1.002	Sint	60 Winter	100	+40%	100/15 Summer				21.721	0.626
S1.003	S1	60 Winter	100	+40%	30/15 Summer				21.723	1.268
S1.004	S2	15 Summer	100	+40%					20.441	0.000
S1.005	S2	15 Summer	100	+40%					20.312	0.000
S1.006	S3	60 Winter	100	+40%	30/15 Summer				21.714	1.413
S1.007	S4	60 Winter	100	+40%	1/30 Winter				21.704	1.540
S1.008	S4	60 Winter	100	+40%	1/15 Winter				21.699	1.598
S1.009	S5	60 Winter	100	+40%	1/15 Summer				21.693	1.634
S2.000	S11	15 Summer	100	+40%					20.994	0.000
S3.000	S12	15 Summer	100	+40%					20.994	0.000
S3.001	S13	15 Summer	100	+40%					20.994	0.000
S1.010	S8	60 Winter	100	+40%	1/15 Summer				21.689	1.670
S4.000	S17	15 Summer	100	+40%					20.969	0.000
S1.011	S6	60 Winter	100	+40%	1/15 Summer				21.685	1.691
S1.012	S5	60 Winter	100	+40%	1/15 Summer				21.678	1.721
S1.013	S6	60 Winter	100	+40%	1/15 Summer				21.667	2.971
S5.000	S22	180 Winter	100	+40%					18.755	-0.085
S5.001	S23	180 Winter	100	+40%					18.756	-0.084
S5.002	S24	180 Winter	100	+40%					18.758	-0.082
S1.014	S7	180 Winter	100	+40%	100/60 Winter				18.758	0.313
S1.015	S8	180 Winter	100	+40%	100/60 Summer				18.747	0.477
S1.016	S9	180 Winter	100	+40%	100/15 Summer				18.737	0.637
S6.000	S10	180 Winter	100	+40%	100/15 Summer				18.728	0.578
S7.000	S16	15 Summer	100	+40%					18.750	-0.125
S7.001	S17	15 Summer	100	+40%					18.750	-0.125
S7.002	S18	180 Winter	100	+40%					18.749	-0.126
S7.003	S11	180 Winter	100	+40%	30/15 Summer				18.749	0.927
S7.004	S12	180 Winter	100	+40%	30/15 Winter				18.743	1.086

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	Ss1*	0.000	0.00			0.0	SURCHARGED	
S1.001	SS1**	0.000	0.05			0.6	SURCHARGED*	
S1.002	Sint	0.000	0.04			2.1	SURCHARGED	
S1.003	S1	0.000	1.00			10.8	SURCHARGED	
S1.004	S2	0.000	0.94			13.6	SURCHARGED*	
S1.005	S2	0.000	0.88			9.5	SURCHARGED*	
S1.006	S3	0.000	0.84			32.3	SURCHARGED	
S1.007	S4	0.000	0.36		92	12.6	SURCHARGED*	
S1.008	S4	0.000	0.95			28.4	SURCHARGED	
S1.009	S5	0.000	0.37		109	11.1	SURCHARGED*	
S2.000	S11	0.000	0.01			0.2	SURCHARGED*	
S3.000	S12	0.000	0.01			0.2	SURCHARGED*	
S3.001	S13	0.000	0.02			0.3	SURCHARGED*	
S1.010	S8	0.000	0.38			11.0	SURCHARGED	
S4.000	S17	0.000	0.01			0.2	SURCHARGED*	
S1.011	S6	0.000	0.46			13.7	SURCHARGED	
S1.012	S5	0.000	0.37		101	13.6	SURCHARGED*	
S1.013	S6	0.000	0.10			11.0	SURCHARGED	
S5.000	S22	0.000	0.00			0.0	OK*	
S5.001	S23	0.000	0.00			0.0	OK*	
S5.002	S24	0.000	0.01			0.1	OK*	
S1.014	S7	0.000	0.19			18.3	SURCHARGED	
S1.015	S8	0.000	0.24		105	24.9	SURCHARGED*	
S1.016	S9	0.000	0.22			23.5	SURCHARGED	
S6.000	S10	0.000	0.24			4.3	SURCHARGED	
S7.000	S16	0.000	0.00			0.0	OK	
S7.001	S17	0.000	0.00			0.0	OK	
S7.002	S18	0.000	0.00			0.1	OK	
S7.003	S11	0.000	0.45			32.1	SURCHARGED	
S7.004	S12	0.000	0.19		251	11.7	SURCHARGED*	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S8.000	S21	15 Summer	100	+40%					18.750	-0.125	0.000
S8.001	S22	15 Summer	100	+40%					18.750	-0.125	0.000
S8.002	S23	180 Winter	100	+40%					18.739	-0.136	0.000
S8.003	S24	180 Winter	100	+40%					18.739	-0.136	0.000
S8.004	S18	180 Winter	100	+40%	30/15 Winter				18.739	1.062	0.000
S7.005	S18	15 Summer	100	+40%					17.601	0.000	0.000
S7.006	S13	180 Winter	100	+40%	1/30 Winter				18.733	1.268	0.000
S1.017	S10	180 Winter	100	+40%	1/15 Summer				18.726	1.467	0.000
S1.018	S16	180 Winter	100	+40%					17.119	-0.126	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S8.000	S21	0.00			0.0	OK*	
S8.001	S22	0.00			0.0	OK*	
S8.002	S23	0.00			0.1	OK*	
S8.003	S24	0.00			0.2	OK*	
S8.004	S18	0.01			0.4	SURCHARGED	
S7.005	S18	0.14			10.8	SURCHARGED*	
S7.006	S13	0.22		305	12.9	SURCHARGED	
S1.017	S10	0.68			19.5	SURCHARGED	
S1.018	S16	0.40			19.5	OK	

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