



FLOOD RISK ASSESSMENT
Hillingdon Hospital,
Additional Ward Buildings

Engineering, Design and
Surveying Consultants

from inception to completion

Prepared for: Nexus Planning Ltd
Ref: CV8190857/AQ/DW/007
Issue 3: 16 March 2020

Document History

Issue	Date	Description	Prepared By	Checked By
1	27 Sep 19	Issue 1	A Quigley	K Rayner
2	20 Dec 19	Issue 2	A Quigley	K Rayner
3	16 Mar 20	DRAFT	A Quigley	

Glanville

Glanville Consultants is a multi-disciplinary engineering, design and surveying consultancy with the following expertise:



Structural Engineering



Civil Engineering



Transport and Highways



Geomatics (Land Surveying)



Building Surveying



BIM

Cornerstone House
62 Foxhall Road
Didcot
Oxfordshire OX11 7AD

Offices also at:

3 Grovelands Business Centre
Boundary Way
Hemel Hempstead
Hertfordshire HP2 7TE

Telephone: 01235 515550

Telephone: 01442 835999

postbox@glanvillegroup.com
www.glanvillegroup.com

© Glanville Consultants Ltd. All rights reserved.

This report contains confidential information intended solely for the recipient. No part of this report may be copied, reproduced or stored electronically without prior written permission from Glanville Consultants Ltd. This report has been prepared in accordance with the commissioning brief and is for the client's exclusive use unless otherwise agreed in writing. Glanville Consultants Ltd does not accept liability for any use of this report, other than for the purposes for which it was originally prepared and provided. Third parties should not use or rely on the contents of this report without written permission from Glanville Consultants Ltd.

Contents

1.0	Introduction	1
2.0	Site Description	2
3.0	Planning Policy and Guidance	5
4.0	Sources of Potential Flooding	6
5.0	Flood Risk Assessment	8
6.0	Surface Water Drainage	10
7.0	Summary and Conclusions	17

Appendices

Appendix A:	Location Plan
Appendix B:	Development Proposal Drawings
Appendix C:	Topographical Survey
Appendix D:	Geological Mapping and Soilscape Mapping
Appendix E:	Drainage Survey
Appendix F:	Fluvial Flood Risk Mapping
Appendix G:	Surface Water Flood Risk Mapping
Appendix H:	Existing Run-off Rates
Appendix I:	Greenfield Run-off Rates
Appendix J:	MicroDrainage Calculations
Appendix K:	Proposed Surface Water Drainage Strategy

1.0 Introduction

- 1.1 This Flood Risk Assessment has been prepared by Glanville Consultants on behalf of Nexus Planning Ltd, in support of a planning application for the proposed additional ward buildings along with associated site infrastructure at Hillingdon Hospital, Uxbridge, UB8 3NN.
- 1.2 The purpose of this document is to assess the existing level of flood risk to the site and its surroundings within the context of the development proposals and to demonstrate a suitable drainage strategy for the disposal of surface water from the site.
- 1.3 This assessment has been prepared in accordance with the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG) to the NPPF. It has also been prepared with reference to West London Strategic Flood Risk Assessment (West London SFRA).
- 1.4 This report concludes that the development is not at an unacceptable risk of flooding and the site can be developed safely without increasing flood risk elsewhere, and therefore the development proposals comply with relevant planning policy concerning flood risk. The report demonstrates that suitable provision for the disposal of surface water from the proposed development is capable of being provided.

2.0 Site Description

Site Location

- 2.1 The site is located in Hillingdon, approximately 2km to the south-east of Uxbridge, and comprises part of the Hillingdon Hospital campus. The location of the site is shown on the plan included in Appendix A. The approximate centre of the site is located at Ordnance Survey National Grid reference 506816E 181776N.

Development proposals

- 2.2 The proposed development involves additional ward accommodation to replace non compliant ward accommodation within the 1960's Tower building, and elsewhere on the site. The new accommodation is located to the south of the AMU building and will be linked into the main service corridor that runs from north to south. Plans showing the proposed development are included in Appendix B.
- 2.3 The application comprises four elements:
- **1 A new three storey ward building** on the site of the existing Paediatric building. It will provide approximately 90 bed spaces, enabling much of the existing single storey Paediatric building that is suffering from subsidence to be demolished. Referred to as the Ward building South.
 - **2 A three storey ward building including a 28 bed Decant ward Building on the ground floor.** This will be constructed on the site of the approved Decant ward Building and will provide two additional floors above. They will provide clinical and medical support space to assist the decant process. This building is referred to as the Ward building North.
 - **3 Relocation of the existing Waste Compound** to make way for the new Ward building South and its car parking.
 - **4 Provision of 117 replacement car parking spaces**

Site Context

Topography

- 2.4 A topographical survey, carried out by Siteline Geomatic Surveyors (Ref: 712HH01/02, date: September 2019), along with a second survey provided by Nexus Planning Ltd, indicate that the additional ward buildings location area generally falls from a high point of approximately 37.90m AOD to the north, to a low point of approximately 35.01m AOD to the south of the Paediatric building, specifically within the protected trees area. While ground elevation from the proposed car parking area to the north-west, adjacent to Building 15, varies between approximately 39.41m AOD to the north and 38.05m AOD to the south. In relation to the proposed relocation area for the existing waste compound, ground elevations vary from 38.06m AOD to the north and 37.45m AOD to the south, adjacent to the internal road.
- 2.5 A copy of the topographical surveys are included in Appendix C.

Geological Mapping

- 2.6 Geological records published by the British Geological Survey (BGS) indicate the entire site is likely to be underlain by bedrock geology comprising clay, silt and sand from the London Clay Formation, as well as superficial deposits comprising sand and gravel from the Boyn Hill Gravel Member. Extracts from BGS mapping are included in Appendix D.

- 2.7 Soilscape mapping provided by Cranfield University on behalf of DEFRA shows that the site of the proposed development falls partly on HOST soil class 17 to the north, which is described as “Slowly permeable seasonally wet acid loamy and clayey soils” and soil class 22 to the south, which is described as “Loamy soils with naturally high groundwater”. An extract from Cranfield University “Soilscales” website is included in Appendix D.

Groundwater Vulnerability

- 2.8 The EA defines Source Protection Zones (SPZs) for groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The SPZs mapping indicates that the site is not located within an SPZ. However, Inner Zone (Zone 1) and Outer Zone (Zone 2) are located to the north of the Hillingdon Hospital campus.
- 2.9 A Nitrate Vulnerable Zone (NVZ) is a conservative designation for areas of land that drain to nitrate polluted waters or waters which could become polluted by nitrates. The NVZs mapping indicates that the site is not located within a Surface Water NVZ.
- 2.10 The EA defines Drinking Water Safeguard Zones (SgZs) for water sources used for public drinking water supply. SgZs are catchment areas that influence the water quality for their respective Drinking Water Protected Area (Surface Water), which are at risk of failing the drinking water protection objectives. The site is located within a SgZ (Surface Water).
- 2.11 The bedrock Aquifer Designation Map published by the EA indicates that the bedrock underlying the site is classed as an Unproductive Strata. Unproductive Aquifers are geological strata with low permeability that have negligible significance for water supply or river base flow.
- 2.12 The superficial Aquifer Designation Map published by the EA indicates that the superficial drift of the site is classed as a Secondary A Aquifer. Secondary A Aquifers are permeable strata capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers.

Existing Drainage Regime

- 2.13 A site drainage survey from Nexus Planning shows a network of both foul and surface water drains across the site that currently serves the Hillingdon Hospital campus.
- 2.14 Surface water drains, along with manholes S10 and S9, are located along the northern side of the proposed ‘Ward building North’ location, whereby run-off from the Nightingale Centre is collected and conveyed to the north-east. Surface water run-off from the existing car park within the proposed ‘Ward building North’ location, is currently intercepted via ACO drains, located along the centre and southern side, and conveyed to the south of this area. Foul water drains are currently situated around the proposed ‘Ward building North’, whereby sewage from the buildings located adjacent to this area are collected and conveyed accordingly.

-
- 2.15 Surface water drains and manholes are located along the north, south and eastern side of the exiting Paediatric ward building, whereby run-off from the roof area of the building, as well as part of the internal road located adjacent to the eastern side of the building, is currently collected and discharged at an unrestricted rate into the watercourse located along the south-eastern side of the site. Foul water drains are currently situated around the exiting Paediatric ward building, whereby sewage from the building is currently collected and conveyed accordingly.
- 2.16 A surface water drain is located across the proposed car parking area, adjacent to Building 15, running from Royal Lane, located to the north-west, to the southern side of Hillingdon Hospital campus. Foul flows from the disused building located within this area were formerly drained southwards via the existing foul drains located to the south-west. Furthermore, foul water drains are also located to the northern side of this area, whereby foul flows from part of the north and north-eastern side of the campus are collected and disposed into the public foul sewers in Royal Lane.
- 2.17 The current condition of the abovementioned drainage pipes and chambers, as well as the presence / allocation of the drains within the proposed relocation area for the existing waste compound, are unknown.
- 2.18 The site drainage survey is included in Appendix E.

3.0 Planning Policy and Guidance

- 3.1 Set out below is a summary of the national and local planning policy and guidance relating to flood risk and surface water management that are relevant to the development proposals.

National

- 3.2 At a national level, the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG) to the NPPF ensure 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 towards areas at lowest flood risk. The NPPF retains a risk based approach to the planning process and defines four Flood Zones to be used as the basis for applying the sequential test to consider a development in terms of Flood Risk Vulnerability Classifications, which define the type of development that is considered appropriate within each zone.
- 3.3 The NPPF establishes the Flood Zones as the starting point for assessment with the overarching aim to steer new development to areas with the lowest probability of flooding. The Flood Zones are defined as follows:
- Flood Zone 1 (Low Probability) comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).
 - Flood Zone 2 (Medium Probability) comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.
 - Flood Zone 3a (High Probability) comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
 - Flood Zone 3b (The Functional Floodplain) comprises land where water has to flow or be stored in times of flood.

Local Policy and Guidance

West London Strategic Flood Risk Assessment (SFRA) Level 1¹

- 3.4 The West London Boroughs of Barnet, Brent, Ealing, Harrow, Hillingdon and Hounslow have commissioned the production of a joint Level 1 SFRA. The overarching aim of this SFRA is to provide the evidence base for ensuring development is steered away from areas identified most at risk from various flood sources, reducing the risk of flooding to its residents and buildings.
- 3.5 The purpose of this Level 1 SFRA is to provide a strategic overview of all forms of flood risk throughout the study area, now and in the future. This document and associated mapping delivered as part of the SFRA, will be used as a evidence base by the Boroughs to inform the preparation of Local Plans, including the application of the sequential test to future site allocations.

¹ <http://westlondonsfra.london/>

4.0 Sources of Potential Flooding

- 4.1 Flood risk to the site has been considered from all likely sources of flooding, as defined in the NPPF and the Planning Practice Guidance to the NPPF. These include tidal, artificial sources (reservoir), fluvial, surface water, sewer and groundwater. The following paragraphs consider flood risk to the site from all of these sources.

Tidal

- 4.2 Given that there is no tidally influenced watercourse on or within the vicinity of the site, tidal flooding is not an issue that would prevent the development of the site.

Fluvial

- 4.3 The EA publishes its Flood Map for Planning on the GOV.UK website which shows the maximum extent of fluvial flooding. The mapping indicates that the site is located entirely within Flood Zone 1, beyond the limits of the 1 in 1,000 year fluvial flood event (<0.1%). It is therefore considered that the risk of fluvial flooding to the development is very low. An extract from the GOV.UK mapping is included within Appendix F.

Surface Water

- 4.4 The EA publishes a Flood Risk from Surface Water map on the GOV.UK website which indicates the predicted risk of surface water flooding in the event that rainwater does not drain away through normal drainage systems or soak into the ground. The mapping indicates that the majority of the site is at 'very low' risk of surface water flooding, with an annual probability of flooding of less than 1:1,000.
- 4.5 However, it is shown that the proposed 'Ward building North', the proposed relocation area for the existing waste compound, as well as the northern and southern side of the existing Paediatric ward building, are to be at 'medium' (between 1:30 and 1:100 annual probability) and 'low' (between 1:100 and 1:1,000 annual probability) risk of surface water flooding. While, reduced portions of the proposed car parking area, adjacent to Building 15, including the access road to the west of the site, which provides access to Royal Lane, are to be at 'low' risk of surface water flooding. The access road to the east of the site, which provides access to Colham Green Road is shown to be between 'low' to 'high' (greater than 1:30 annual probability) risk of surface water flooding.
- 4.6 An extract from the GOV.UK surface water flood map is included within Appendix G.

Reservoir

- 4.7 The Environment Agency (EA) publishes indicative mapping on the GOV.UK website which shows the maximum extent of reservoir flooding in the unlikely event that a reservoir should fail. The mapping indicates that the entire the site is located outside of a reservoir flood risk area. Therefore, reservoir flooding is not considered to be an issue that would prevent the development of the site for its intended end use.

Sewer

- 4.8 The West London SFRA includes data provided by Thames Water historical sewer flooding dataset. The West London SFRA indicates that no sewer flood incidents have been recorded within the Hillingdon Hospital campus. Therefore, sewer flooding is not considered to be an issue that would prevent the development of the site for its intended end use.

Groundwater

- 4.9 The West London SFRA states that the majority of the sub-region is underlain by Thames Group (also referred to as London Clay) bedrock, a composition of silty clay/mudstone, sandy silts and sandy clayey silts of marine origin, which corresponds with a geological unit with a low hydraulic conductivity, where water does not easily move through it.
- 4.10 The West London SFRA provides an Areas Susceptible to Groundwater Flooding map (AStGWf), from the EA, which is based on some information from the BGS maps and information on superficial deposits. The data was produced to annotate indicative Flood Risk Areas for PFRA studies and allows the LLFAs to determine whether they may be at risk of flooding from groundwater. The AStGWf map indicates that the risk of groundwater flooding at the site is more than 25% but less than 50% (i.e. $\geq 25\% < 50\%$).
- 4.11 The data shows the proportion of each 1km grid-square for which geological and hydrogeological conditions indicate that groundwater might emerge, it does not show the likelihood of groundwater flooding occurring, nor does it take account of the chance of flooding from groundwater rebound. This dataset covers a large area of land and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.
- 4.12 Furthermore, there is no anecdotal evidence to suggest that groundwater flooding has occurred on the site. It is therefore concluded that the risk of groundwater flooding is very low and is not considered to be an issue that would prevent the development of the site for its intended end use.

Historic Flooding

- 4.13 The West London SFRA includes historical flood records and indicates that no historical flood incidents have been recorded within Hillingdon Hospital campus.

Summary

- 4.14 With the exception of surface water flooding, the site is considered to be at very low risk from all sources of flooding examined.

5.0 Flood Risk Assessment

Fluvial

- 5.1 The NPPF encourages a sequential, risk-based approach to determine the suitability of land for development. This document advises that the development of sites within Flood Zone 1 should be given preference where available.
- 5.2 Table 2 of the Planning Practice Guidance to the NPPF categorises different types of development into five flood risk vulnerability classifications:
- Essential Infrastructure;
 - Highly Vulnerable;
 - More Vulnerable;
 - Less Vulnerable; and
 - Water Compatible Development.
- 5.3 The NPPF classifies hospitals as being 'More Vulnerable'. Table 3 of the PPG states that 'More Vulnerable' development is compatible with Flood Zones 1 and 2.
- 5.4 As discussed in Section 4 of this report, the entire site is located within Flood Zone 1. Table 3 of the PPG states that all uses are appropriate for Flood Zone 1. Therefore, the proposed development use is compatible with the flood zone of the site and developing the site for its intended purposes is considered appropriate in terms of flood risk. As such, no mitigation measures are required for fluvial flooding, and the Sequential Test and Exception Test are not required to be applied to this development.

Surface Water

- 5.5 The risk of surface water flooding to the majority of the site is 'very low', with an estimated annual probability of flooding occurring of less than 1 in 1,000. However, the proposed 'Ward building North', the proposed relocation area for the existing waste compound, as well as the northern and southern side of the existing Paediatric ward building, are to be at 'medium' (between 1:30 and 1:100 annual probability) and 'low' (between 1:100 and 1:1,000 annual probability) risk of surface water flooding. While, reduced portions of the proposed car parking area, adjacent to Building 15, including the access road to the west of the site, which provides access to Royal Lane, are to be at 'low' risk of surface water flooding.
- 5.6 The surface water flood risk areas within the proposed additional ward buildings location, the proposed relocation area for the existing waste compound, as well as the access road to the east, are associated with the watercourse located to the south-east of the site, where exceedances from the natural channel spill into the Hillingdon Hospital campus.

- 5.7 The Surface Water Flood Risk map from the West London Strategic Flood Risk Assessment show maximum surface water flood depths between 0.9m and 1.2m within the proposed car parking area, adjacent to the north of the proposed 'Ward building South', associated with 'low' (between 1:100 and 1:1,000 annual probability) risk of surface water flooding. Through assessment of the topographic survey, a maximum flood level of 37.75m AOD to the northern side of the proposed 'Ward building South' would appear to represent a robust assessment of potential surface water flood risk when considering appropriate mitigation measures. As such, it is proposed to establish the finished floor level (FFL) of the proposed 'Ward building South' at 38.05m AOD. This new building will be raised on columns or piers above the existing ground level. This FFL will be established 0.3m above the maximum likely surface water flood level within that location.
- 5.8 In relation to the 'Ward building North', the type of building construction proposed will also be naturally stilted and thus raise floor levels of the buildings above existing levels. According to the proposed elevation plans from Oxford Architects, included in Appendix B, the finished floor level (FFL) for the proposed 'Ward building North' will be established at 38.18m AOD, approximately between 0.65m and 1.2m above existing ground levels. This proposed FFL will coincide with the existing floor level of the Nightingale AMU building, adjacent to the north. This FFL will be established 0.43m above the maximum likely surface water flood level within that location.
- 5.9 Therefore, this permanent flood resistance measure for the abovementioned additional ward buildings will avoid the ingress of flood water into the building and the consequent fabric damages.
- 5.10 The proposed additional ward buildings will be built using piers/columns with a voided sub-floor elevated above existing ground levels, in order to allow free flow of floodwater to pass beneath the buildings from all directions. Given that the scheme will involve the removal of the existing Paediatric building, this proposed structural design for the replacement buildings will increase the ability of the site to store flood water and therefore reduce the existing flood risk on-site and elsewhere, by providing more floodplain storage in comparison with the current situation, as well as by establishing the FFL above the maximum likely surface water flood level.
- 5.11 Furthermore, the proposed surface water drainage strategy will offer protection against surface water flooding by providing a positive drainage system, which will intercept overland flows generated within the site. The drainage strategy will be designed to ensure that no flooding takes place up to and including the design rainfall event (1 in 100 year return period), with additional capacity within the system to allow for the potential future effects of climate change.
- 5.12 Therefore, after introducing an effective drainage strategy within the site, surface water flooding will not be an issue that would prevent or constrain the development of the site to any significant extent.

Other Sources

- 5.13 A review of sources of potential flooding in Section 4 of this assessment has concluded that there is a very low risk to the proposed development from all other sources of flooding examined. As such, no mitigation measures are necessary.

6.0 Surface Water Drainage

- 6.1 The PPG recommends that priority should be given to the use of Sustainable Drainage Systems (SuDS) as they are designed to control surface water run-off where it falls and mimic natural drainage characteristics as closely as possible. Source control techniques will be incorporated into the drainage strategy to ensure that surface water run-off is managed as close to source as possible. Sustainable drainage systems (SuDS) also provide opportunities for the following:
- Reducing the causes and impacts of flooding;
 - Removing pollutants from urban run-off at source; and
 - Combining water management and green space with benefits for amenity, recreation and wildlife.
- 6.2 SuDS encompass a wide range of drainage techniques intended to minimise the rate of discharge, volume and environmental impact of run-off and include:
- pervious pavements;
 - swales and basins;
 - green roofs and rainwater reuse;
 - infiltration trenches and filter drains; and
 - ponds and wetlands.
- 6.3 The Building Regulations part H3 stipulates that rainwater from roofs and paved areas is carried away from surface to discharge to one of the following, listed in order of priority:
- a) An adequate soakaway or some other adequate infiltration system; where that is not practical;
 - b) A watercourse; or, where that is not practical
 - c) A sewer.
- 6.4 Infiltration based techniques are the preferable sustainable option to manage surface water run-off. However, due to the impermeable nature of the soil within the site (see Section 2) infiltration is not considered to be a feasible method of disposal for surface water. Furthermore, due to the presence of drainage sewers currently serving the Hillingdon Hospital campus, it is therefore proposed that run-off is detained on site and released at an attenuated rate to the existing surface water drainage sewers.

Proposed Surface Water Drainage Strategy

- 6.5 The proposed strategy strives to utilise sustainable drainage techniques in accordance with the guidance described in CIRIA document C753 'The SuDs Manual' (2015) to accommodate run-off from all rainfall events up to and including the 1 in 100 year event, with a 40% allowance for climate change.
- 6.6 It is proposed that surface water run-off from the development site should be managed by using a combination of geo-cellular storage tanks and permeable pavements, prior discharging into the existing surface water sewers serving the Hillingdon Hospital campus.
- 6.7 The geo-cellular storage tanks will provide a 95% void volume in order to attenuate surface water flows with suitable outflow control. For the purposes of modelling, Polypipe Permavoid system PVPP150 (708mm x 354mm x 150mm deep) has been used to dimension the geo-cellular storage tanks.

- 6.8 The geo-cellular storage tanks would be subjected of load pressures due to the weight of the vehicles with a shallow cover. Therefore, a geo-cellular structural system with appropriate load bearing capacity is recommended as a surface water runoff storage medium. Permavoid system (PVPP150), provided by Polypipe², is a geo-cellular interlocking system designed for shallow groundwater storage or infiltration, to be used in place of traditional aggregate sub-base. The system has an exceptionally high compressive and tensile strength and bending resistance with a proprietary jointing system to create a horizontal structural 'raft' within the pavement that is ideal for the shallow attenuation of surface water. Permavoid is suitable for use in a range of applications including residential, industrial estates, car parks, sports pitches, roofs, basements, pedestrian areas and rainwater harvesting.
- 6.9 Polypipe states that in order to provide a suitable structural design, a 130 mm of minimum pavement thickness (CBR>2%) is recommended for 3 tonnes loading situation, in relation to private drives and car parks with height restrictions.

Proposed 'Ward Building North' Area

- 6.10 Run-off from the roof area of the proposed 'Ward Building North', as well as the proposed four disabled car parks adjacent to the Endoscopy department, will be collected and discharged into a geo-cellular storage tank located beneath the hardstanding area to the north-east of the proposed Ward building North, prior discharging into the existing surface water sewers serving the Hillingdon Hospital campus. The proposed outflow control will be established within a manhole located immediately downstream of the storage tank. The total impermeable area to be managed is approximately 997m².
- 6.11 The West London Strategic Flood Risk Assessment suggests that development on current brownfield sites should aim to achieve greenfield run-off rates where practical. Greenfield run-off rates have been calculated for the area of the site to be developed and in accordance with the methodology provided in DEFRA document "Interim Code of Practice for Sustainable Drainage Systems" (ICoPS) (July 2004). Results show a very low value related to the mean annual flood flow from the site (i.e. QBAR) of approximately 0.2l/s for the impermeable area of this side of the site.
- 6.12 The Modified Rational Method establishes that the existing discharge rate within the Ward building North area is approximately 19.4l/s, based on the existing brownfield area of 997m². Due to space constraints within this site, an approximate 49.5% reduction in existing run-off rate will be applied to the proposed surface water drainage strategy, reducing the total outflow to **9.8l/s**, which will be the maximum discharge rate from this development site. A calculation to establish the existing discharge rate is provided in Appendix H.
- 6.13 Results from MicroDrainage show that an attenuation storage tank with a base area of 47.4m² and 0.6m deep – 4 No Permavoid units, would be capable of managing run-off from the total impermeable surface area of 0.0997ha during the 1:100 year+40%CC rainfall event. The attenuation storage tank was shown to reach a maximum flood depth of 0.54m, associated with the critical storm duration of 30 min Winter storm. The invert level of the storage tank has been established at 0.75m below ground level.

² <https://www.polypipe.com/civils-and-infrastructure/permavoid-85150>

- 6.14 The design utilises a Hydro-Brake vortex flow control, in order to attenuate surface water run-off from the proposed development. Hydro-Brake Optimum® is a very robust low maintenance solution as it has no moving parts, nor does it require power – operating solely due to the flow of water through the unit. This flow control is accepted by a number of the UK Water Companies, Environment Agency and many Lead Local Flood Authorities (LLFA) for its accuracy of flow control and low maintenance requirements. To achieve the required outflow rates, as well as reduced the blockage risk, the unit selected has a 150mm orifice size (MD-SHE-0150-9800-0600-9800), but as it is located within a chamber with a sump, this dimension is not likely to give rise to any undue maintenance burden.
- 6.15 Attenuated outflow rates from this part of the development site will be restricted to 9.8l/s and discharged into the existing surface water manhole (S9), located adjacent to the proposed storage tank to the west, which currently serves the Hillingdon Hospital campus. The cover level of the storage tank has been established at 37.41m AOD, thereby the invert level of the tank is located approximately at 36.66m AOD. On this basis, a 150mm diameter outflow pipe with a longitudinal slope of 1:100, will convey the attenuated outflows from this site to the recorded surface water manhole S9 located to the west.

Proposed 'Ward Building South' Area

- 6.16 Run-off from the roof area of the proposed 'Ward Building South', and associated infrastructure including the decant plantroom, water tank, southern extension of the 'Ward building North', as well as the proposed car parking areas and internal road adjacent to the north of the proposed building, will be managed by using a voided sub-base layer, located beneath the proposed permeable car parking areas as attenuation storage prior discharging into the existing surface water sewers serving the Hillingdon Hospital campus. The total impermeable area to be managed is approximately 2,921m².
- 6.17 Greenfield run-off rates for the proposed 'Ward building South' area have also been calculated in accordance with the methodology provided in DEFRA document "Interim Code of Practice for Sustainable Drainage Systems" (ICoPS) (July 2004). Results show a very low QBAR value of approximately 0.5l/s for the total impermeable area of this side of the site. Greenfield run-off rates are shown in Appendix I.
- 6.18 The Modified Rational Method establishes that the existing discharge rate within the Ward building South area is approximately 56.9l/s, based on the existing brownfield area of 2,921m². Due to space constraints within this site, an approximate 78% reduction in existing run-off rate will be applied to the proposed surface water drainage strategy, reducing the total outflow to **12.5l/s**, which will be the maximum discharge rate from this development site. A calculation to establish the existing discharge rate is provided in Appendix H.
- 6.19 Results from MicroDrainage show that an attenuation storage with a base area of 478.7m² (i.e. associated with the proposed permeable car parking areas adjacent to the north of the building), 1.0m deep with a 30% void ratio would be capable of managing run-off from the total impermeable surface area of 0.292ha during the 1:100 year+40%CC rainfall event. The attenuation storage was shown to reach a maximum flood depth of 0.747m and a maximum volume of approximately 107.2m³, associated with the critical storm duration of 60 min Winter storm.
- 6.20 The design also utilises a Hydro-Brake vortex flow control, in order to attenuate surface water run-off from this section of the proposed development. To achieve the required outflow rates, as well as reduced the blockage risk, the unit selected has a 164mm orifice size (MD-SHE-0164-1250-0750-1250).

- 6.21 Attenuated outflow rates from this part of the development site will be restricted to 12.5l/s and discharged into the existing surface water manhole located between the eastern edge of the proposed 'Ward building South' and the western edge of the existing internal road to the south-east, which currently serves the Hillingdon Hospital campus. The drainage survey does not show any detail about the invert level of the existing manhole. However, due to the shallow invert level of the proposed attenuation storage, the disposal of attenuated outflows by gravity into the existing manhole should be feasible.

Proposed Car Parking Area (adjacent to Building 15)

- 6.22 Run-off from the proposed car parking area, adjacent to Building 15, site will be collected and discharged into a geo-cellular storage tank located beneath the hardstanding area at the same location as the building to be demolished. The total impermeable area to be managed is approximately 1,384m².
- 6.23 Greenfield run-off rates for the proposed car parking area, adjacent to Building 15, have also been calculated in accordance with the methodology provided in DEFRA document "Interim Code of Practice for Sustainable Drainage Systems" (ICoPS) (July 2004). Results show a very low QBAR value of approximately 0.2l/s for the total impermeable area of this side of the site. In order to restrict the attenuated outflow from the tank up to this level, it would be necessary to provide a considerable reduced orifice diameter and its corresponding blockage issues. Greenfield run-off rates are shown in Appendix I.
- 6.24 Therefore, attenuated outflow rates from the storage tank would be restricted to the practical value of 2l/s for the total impermeable area of 1,384m², as well as rainfall events up to 1 in 100 year with allowance for climate change.
- 6.25 Results from MicroDrainage show that an attenuation storage tank with a base area of 132.0m² (i.e. 11.0m wide x 12.0m long) and 0.6m deep – 4 No Permavoid units, would be capable of managing run-off from the total impermeable surface area of 0.139ha during the 1:100 year+40%CC rainfall event. The attenuation storage tank was shown to reach a maximum flood depth of 0.577m, associated with the critical storm duration of 240 min Winter storm. The invert level of the storage tank has been established at 0.75m below ground level.
- 6.26 The design also utilises a Hydro-Brake vortex flow control, in order to attenuate surface water run-off from this section of the proposed development. To achieve the required outflow rates, as well as reduced the blockage risk, the unit selected has a 73mm orifice size (MD-SHE-0073-2000-0600-2000).
- 6.27 Attenuated outflow rates from this part of the development will be restricted to 2.0l/s and discharged into the existing surface water sewer, running along the eastern side of the building to be demolished, via a new manhole.

Remaining Areas

- 6.28 The proposed four car parking spaces on the southern boundary of the site, as well as the proposed 9 spaces adjacent to the Waste Compound area, will be built on top of the existing hardstanding area, without increasing the current impermeable area. On this basis, surface water run-off from these areas will be managed via the existing surface water drains that currently serves the Hillingdon Hospital campus.

- 6.29 Run-off from the Waste Compound area will be collected through two proposed outlets connected to the existing foul water drains that currently serves the Hillingdon Hospital campus.

Summary

- 6.30 As a result of the development, flood risk will not increase either on-site or elsewhere.
- 6.31 The proposed surface water drainage strategy is in accordance with Building Regulations Part H where discharging run-off by attenuation to the existing surface water drainage system, which currently serves the Hillingdon Hospital campus, is the most appropriate drainage solution.
- 6.32 All new surface water drainage infrastructure will be designed in accordance with Sewers for Adoption, Building Regulations and best practice where appropriate.
- 6.33 Refer to Appendix J for the full hydraulic calculations for the surface water drainage strategy.
- 6.34 The proposed drainage strategy for the disposal of surface water is presented in Appendix K.

Sustainable Drainage Pollution Control and Maintenance

Pollution Control

- 6.35 Pollution control measures are designed to minimise the transmittal of any pollutants collected by run-off flowing over impermeable areas.
- 6.36 Table 26.2 of The SuDS Manual indicates the minimum treatment indices for contributing pollution hazards for different land use classifications. The treatment indices for the land uses proposed are shown in Table 1. In order to deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index. Table 2 indicates the SuDS mitigation indices for the permeable pavement.
- 6.37 The pollution indices in Table 1 should be compared with the mitigation indices in Table 2 and the following formulae applied:

$$\text{Total SuDS Mitigation Index} \geq \text{Pollution Hazards Index (for each contaminant type)}$$

$$\text{Total SuDS Mitigation Index} = 1^{\text{st}} \text{ Stage Mitigation Index} + 0.5 (2^{\text{nd}} \text{ Stage Mitigation Index})$$

- 6.38 For the proposed ward buildings, roof run-off has been assumed to have a low hazard potential and run-off from non-residential car parking with frequent change (eg hospitals, retail) has a medium hazard potential.
- 6.39 The proposed car parking areas will be constructed with permeable materials. From inspection of Table 2 and 3, it can be seen that permeable pavement in isolation is sufficient to mitigate pollution risk from commercial yard and delivery areas, non-residential car parking with frequent change, all roads except low traffic roads and trunk roads/motorways.
- 6.40 In addition, sediment sumps or catch pits should be included within the design immediately upstream of the SuDS features, which may thereby improve the quality of run-off to surface waters.

Table 1: Pollution Hazard Indices

Catchment Type	Pollution Hazard Level	Requirements for Discharge to surface waters	Pollution Hazard Indices		
			Suspended solids	Metals	Hydro-carbons
Other roofs (typically commercial/industrial roofs)	Low	Simple index approach	0.3	0.2	0.05
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retails), all roads except low traffic roads and trunk roads/motorways.	Medium		0.7	0.6	0.7

Table 2: SuDS Mitigation Indices

Type of SuDS	SuDS Mitigation Indices		
	Suspended solids	Metals	Hydro-carbons
Permeable pavement	0.7	0.6	0.7

Maintenance

- 6.41 All of the proposed SuDS will be the responsibility of and maintained by the management company.
- 6.42 Table 3 shows the maintenance schedule to manage the drainage features within the development.

Table 3: SuDS Maintenance Schedule

Drainage Feature	Inspection and Maintenance	Frequency
Flow control structure (Hydrobrake or similar) *	Inspect and remove any sediment / debris.	Annually
	Inspect flows controls and repair as necessary.	Occasional (as required)
Geocellular storage tank*	Ensure inlets and pre-treatment structures are clear and free of debris.	Annually
Hardstanding areas	Sweep regularly to prevent silt being washed off the surface.	Frequently
Permeable pavements	Brushing and vacuuming of surface to remove detrimental materials such as debris, dirt and sediment.	Annually
	Stabilise / mow adjacent verges and remove weeds from pavement surface.	Occasional (as required)
	Ensure paving dewaterers after rain and between storms: check joints for sedimentation; mechanically clean or jet wash and sweep surface free from silt, etc; refill joints with sealing grit.	As required
	Inspect and repair any rutting and cracked or broken blocks and replace lost jointing material.	Occasional (as required)
	Rehabilitate surface and upper substructure.	Occasional (every 10-15 years)

*Refer to manufacturer's guidance for specific maintenance instructions.

7.0 Summary and Conclusions

Summary

- 7.1 This Flood Risk Assessment has been prepared by Glanville Consultants on behalf of Nexus Planning Ltd, in support of a planning application for the proposed additional ward buildings along with associated site infrastructure at Hillingdon Hospital, Uxbridge, UB8 3NN.
- 7.2 This assessment has been prepared in accordance with the requirement of National Planning Policy Framework (NPPF), Planning Practice Guidance (PPG), flood risk and drainage guidance and with reference to the relevant Strategic Flood Risk Assessment.
- 7.3 The site is located entirely within Flood Zone 1, beyond the limits of the 1 in 1,000 year fluvial flood event (<0.1%), which is land at the lowest risk of fluvial flooding. With the exception of surface water flooding, the proposed development site is considered to be at very low risk from all sources.
- 7.4 The West London Strategic Flood Risk Assessment show maximum surface water flood depths between 0.9m and 1.2m within the proposed car parking area, adjacent to the north of the proposed 'Ward building South', associated with 'low' risk of surface water flooding. It has been assumed a maximum flood level of 37.75m AOD to the northern side of the proposed 'Ward building South'.
- 7.5 The finished floor level (FFL) of the proposed 'Ward building South' will be therefore established at 38.05m AOD. This new building will be raised on columns or piers above the existing ground level. This FFL will be established 0.3m above the maximum likely surface water flood level within that location.
- 7.6 In relation to the 'Ward building North', the type of building construction proposed will also be naturally stilted and thus raise floor levels of the buildings above existing levels. The finished floor level (FFL) for the proposed 'Ward building North' will be established at 38.18m AOD. This FFL will be established 0.43m above the maximum likely surface water flood level within that location.
- 7.7 Therefore, this permanent flood resistance measure for the proposed additional ward buildings will avoid the ingress of flood water into the building and the consequent fabric damages.
- 7.8 The proposed additional ward buildings will be built using piers and a voided sub-floor in order to allow free flow of floodwater to pass beneath the building from all directions. Given that the scheme will involve the removal of the existing Paediatric building, this proposed structural design for the replacement buildings will increase the ability of the site to store flood water and therefore reduce the existing flood risk on-site and elsewhere, by providing more floodplain storage in comparison with the current situation, as well as by establishing the FFL above the maximum likely surface water flood level.
- 7.9 The proposed surface water drainage strategy utilises sustainable drainage techniques. It employs the combination of geo-cellular storage tanks and permeable pavements to attenuate surface water run-off from the site prior discharging to the existing surface water drainage system that currently serves the Hillingdon Hospital campus.
- 7.10 The proposed surface water drainage scheme will provide storage for the 1 in 100 year plus 40% climate change event without flooding from surface water.

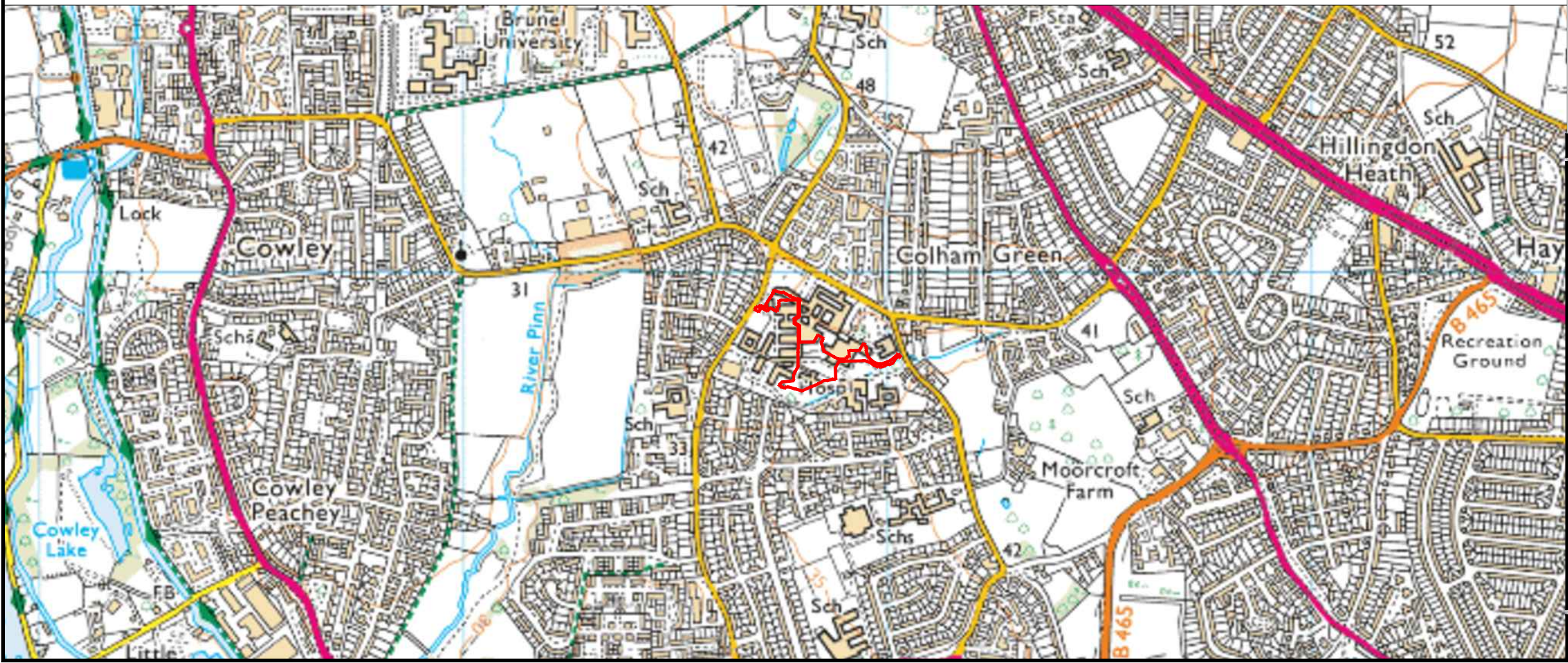
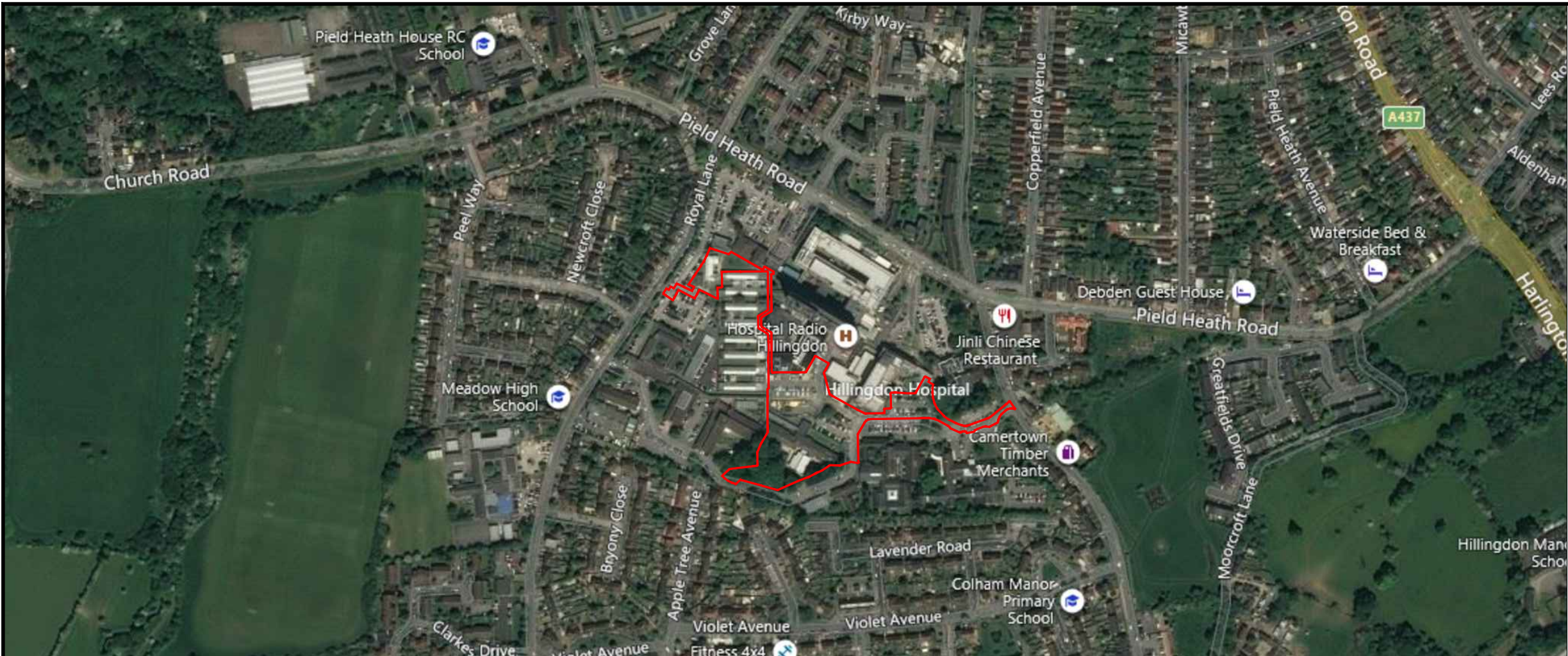
- 7.11 A maintenance plan has been proposed in order to ensure the proposed drainage features are maintained in perpetuity in accordance with the appropriate guidance and standards.
- 7.12 This report demonstrates that flood risk will not increase either on-site or elsewhere as a result of the development.
- 7.13 As well as allowing attenuation, the drainage strategy employed will also degrade pollutants, which thereby improve the quality of surface water to the watercourse.

Conclusion

- 7.14 In conclusion, this report has demonstrated that the proposed development:
- is in accordance with the National Planning Policy Framework;
 - will not be at an unacceptable risk from fluvial flooding or other sources;
 - will not increase flood risk elsewhere; and
 - will employ a surface water drainage strategy based on principles of sustainable drainage.
- 7.15 Therefore, the proposals are considered to fully comply with National, Regional and Local planning policy.

Appendices

Appendix A
Location Plan



NOTES

1. This drawing is to be read in conjunction with all other documents and specifications
2. Dimensions not to be scaled from drawing

LOCATION

Nearby postcode: UB8 3NN
Grid reference: Easting: 506811
Northings: 181791

KEY

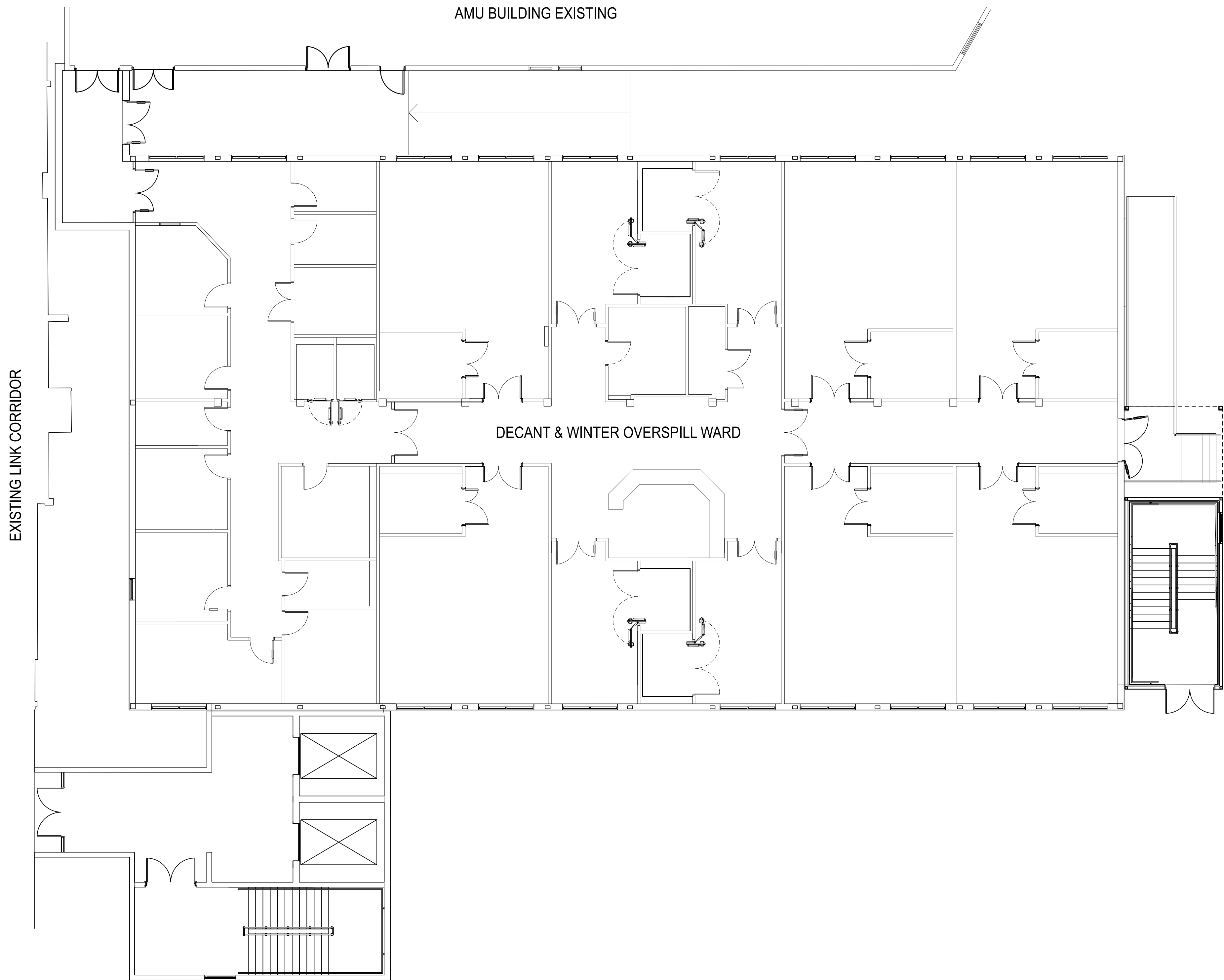
Approximate site boundary —



Rev.	Description	Date	Chkd
 Glanville Cornerstone House 62 Foxhall Road, Didcot Oxon, OX11 7AD Tel: (01235) 515550 Fax: (01235) 817799 postbox@glanvillegroup.com www.glanvillegroup.com			
Client :		Nexus Planning Ltd	
Project :		Hillingdon Hospital Uxbridge UB8 3NN	
Title :		Site Location Plan	
Project Engineer :		A.Quigley	Scale : NTS
Project Director :		K. Rayner	Date : March 2020
Status :		Preliminary	
Drawing No. CV8190857 - SK01			Rev -

Appendix B

Development Proposal Drawings



WARD BUILDING NORTH
GROUND FLOOR PLAN

P3	Annotation amendments for Planning Application	5/3/20
P2	Planning Application	27/02/2020
P1	Issue for meeting	13/02/2020

Revision	Description	Date
----------	-------------	------

Partner	Drawn	Date Created
MB	GJHF	13/02/2020

Project
Construction of additional ward buildings at Hillingdon Hospital

Title
PROPOSED
GROUND FLOOR PLAN

Drawing Reference
19103-OA-A-B1-DR-3001-00

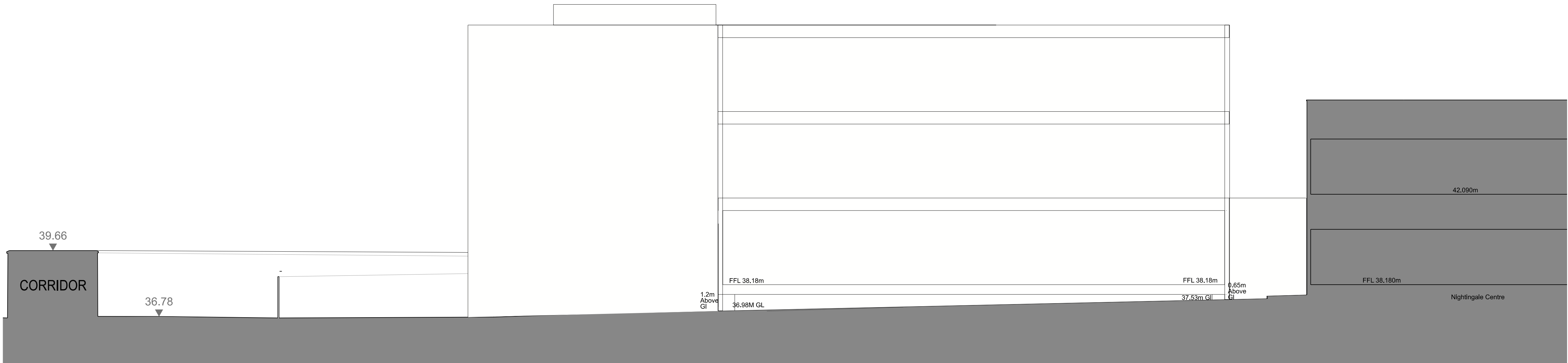
Proj Ref	Origin	Role	Zone	Type	Drawing No	Level
Drawing No	Revision	Status				
3001	P3	S0				

Scale
1:200 @ A1 & 1:400 @ A3

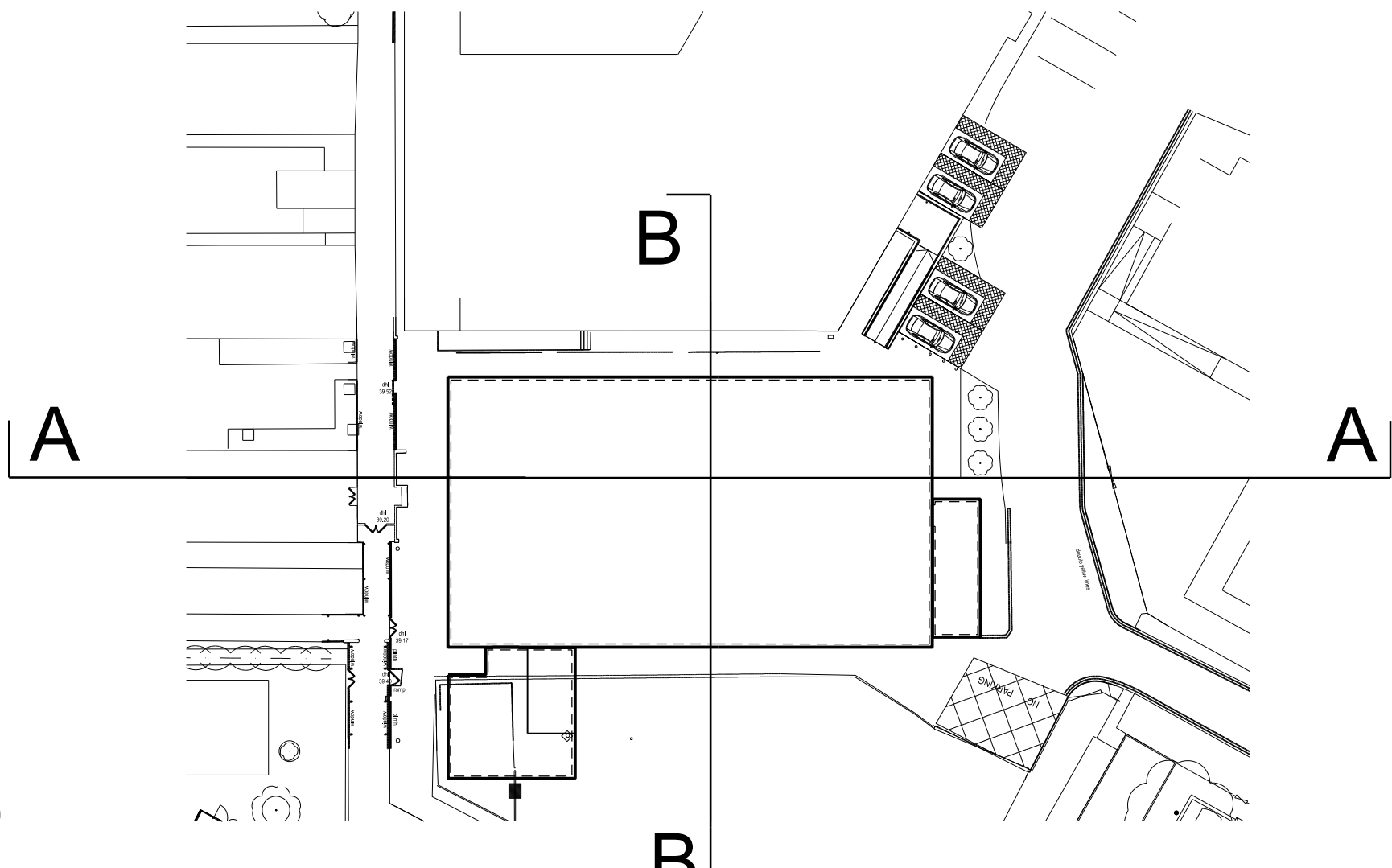




WARD BUILDING NORTH
SECTION AA



WARD BUILDING NORTH
SECTION BB



P3	Annotation amendments for Planning Application	5/3/20
P2	Planning Application	27/02/20
P1	Issue for meeting	20/02/20

Revision	Description	Date
----------	-------------	------

Partner	Drawn	Date Created
MB	GJHF	20/02/2020

Project
Construction of additional ward buildings at Hillingdon Hospital

Title
PROPOSED SITE SECTIONS AA & BB

Drawing Reference			
19103-OA-A-B1-DR-4003-00			
Proj Ref	Origin	Role	Zone
4003			
Drawing No	Revision	Status	
4003	P3	S0	

Scale
1:100 @ A1 & 1:200 @ A3

OXFORD ARCHITECTS
Bagley Croft, Hinksey Hill, Oxford, OX1 5BS
T. 01865 329100
The Workshop, 254 Southmead Road, Bristol, BS10 5EN
T. 0117 6681500
www.oxford-architects.com





KEY

Extent of new Waste Compound

New Assembly point and signage

Tree to be removed

P4	Re-issue for Planning following site meeting	04/03/20
P3	Planning	26/02/20
P2	Planning Issue	04.12.19
P1	First Issue	13.11.19

Revision	Description	Date
Partner MB	Drawn MB / GF	Date Created 13/11/2019

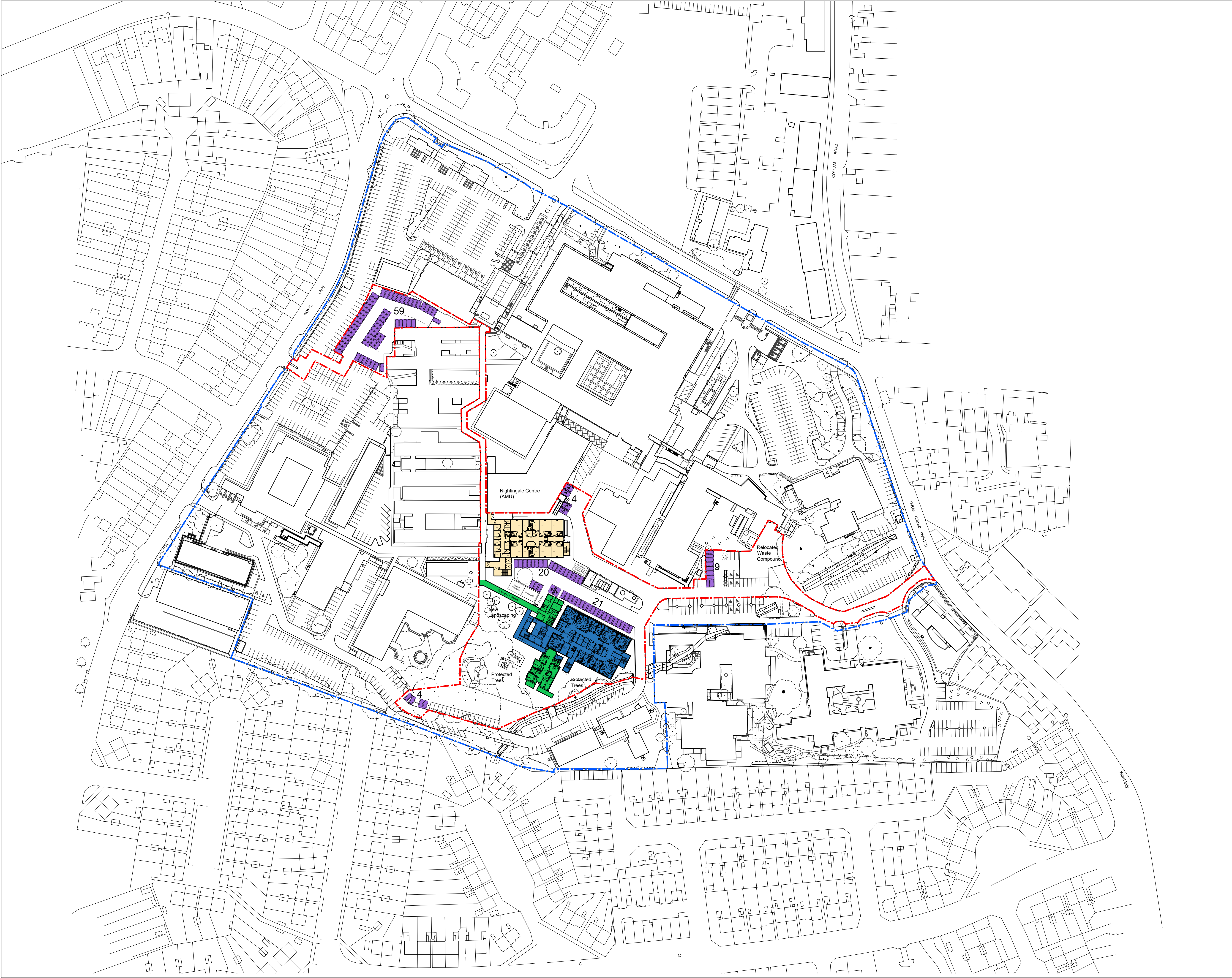
Project

Construction of additional ward buildings at Hillingdon Hospital

Title

New Waste Compound Area Proposed Site Plan

Drawing Reference	19131-OA-A-B1-DR-0002-00
Proj Ref	- Origin - Role - Zone - Type - Drawing No - Level
Drawing No	0002
Revision	P4
Status	S0
Scale	1:100 @ A1 & 1:200 @ A3



Notes:

- This drawing is copyright.
- Do not scale dimensions from this drawing.
- This drawing is to be read in conjunction with all other relevant drawings.
- All discrepancies on this drawing are to be reported to the architect.
- Do not modify any element of this drawing.
- Use drawing only for purpose(s) issued.

North Sign / Key Plan

The following external model files are included within this drawing:

-  Application Boundary
-  Land owned by the Hillingdon NHS Trust
-  Proposed Building including the Decant Ward Building (North)
-  Retained Buildings adjacent to the three storey Modular Building
-  Proposed Modular Ward Building (South)
-  Reprovided Replacement Parking

6	26.02.20	Final amendments for Planning Submission	AB	AB
5	18.02.20	Car parking reprovicion count updated Substation and water tank location updated Red line amended	AB	AB
4	13.02.20	Major updates for car parking reprovicion and decant layout	AB	AB
3	21.01.20	Minor amendments for planning	AB	AB
2	13.01.20	Car parking layout amended. New substation added	AB	NS
1	18.12.19	Context added and proposed building line amended.	LC	NS
Rev	Date	Revision Notes	Dn	Rv

Client / Contractor



www.ibigroup.com

Project
Hillingdon Hospital - Additional Ward Buildings

Drawing Title
PROPOSED SITE PLAN

Job Number 50598	Drawing Originated Date 04/11/2019	PAS 1192 Status Code -
Scale@A1 1:1000	Purpose FOR PLANNING	
Drawing Number 50598-IBI-WS-XX-DR-A-100-1000	Revision 6	

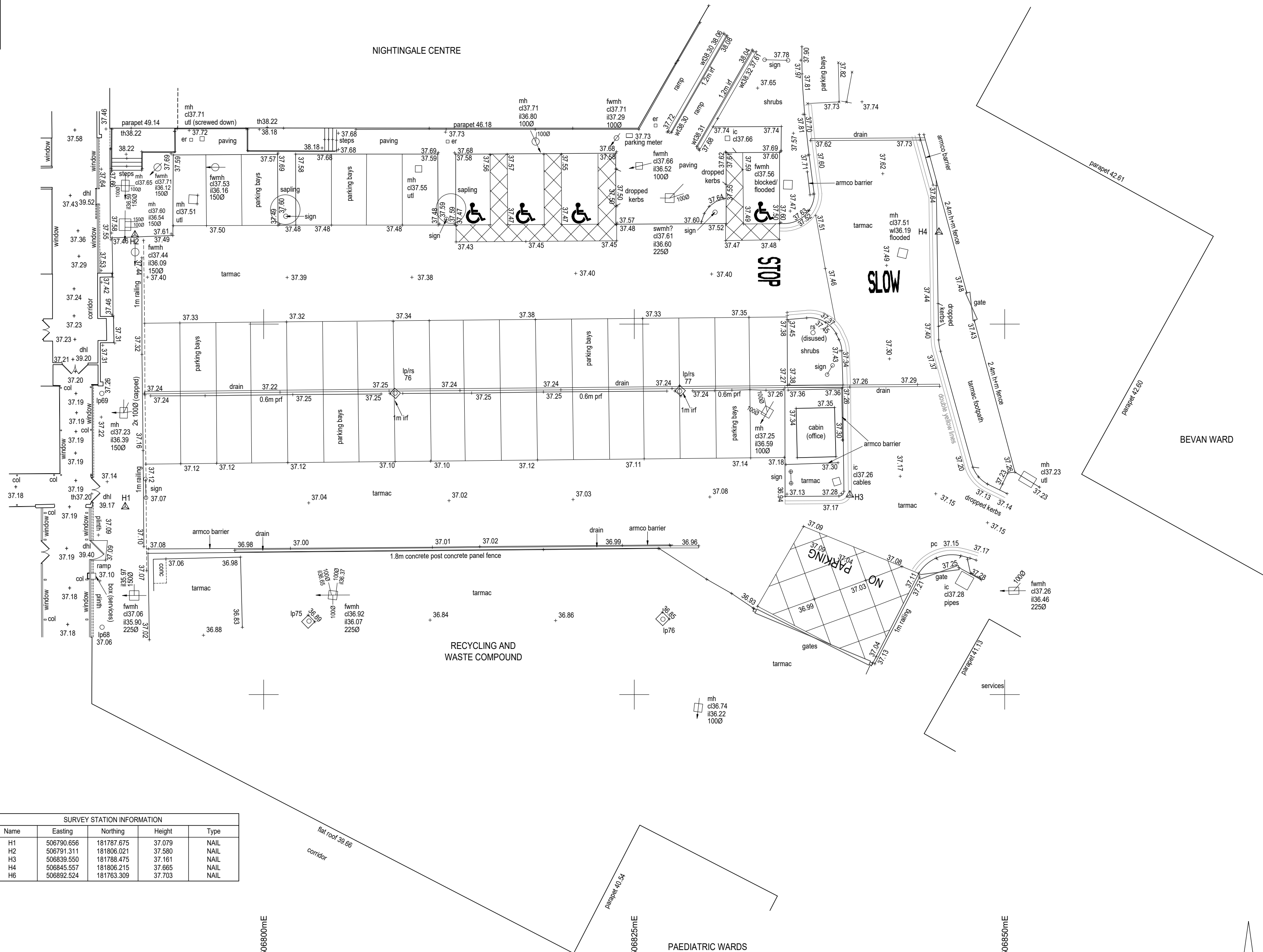
Appendix C

Topographical Survey

A	Ash
AL	Alder
AP	Apple
B	Beech
CB	Cedar
C	Copper Beech
CH	Cherry
CO	Cypress
E	Elm
EL	Elder
LU	Lucalyptus
F	Fir
FM	Fruit Maple
FZ	Fruit
H	Hazel
HC	Horse Chestnut
HO	Holm Oak
HW	Hawthorn
H	Holly
JM	Japanese Maple
LB	Laburnum
L	Line
LO	Locust Tree
L	Laurel
M	Maple
MG	Magnolia
O	Oak
P	Pine
PA	Palm
PL	Plane
PL	Plum
PO	Poplar
PP	Pissardii Plum
PR	Pear
R	Redwood
RD	Red Oak
RH	Rhododendron
R	Rowan
SB	Silver Birch
S	Sweet Chestnut
S	Scots Pine
S	Spruce
SY	Sycamore
U	Unidentified
W	Willow
WN	Walnut
Y	Yew

BT	British Telecom
BOL	Bollard
CB	Control Box
CL	Cover Level
CCTV	Cable Television
CP	Corridor Hand Level
EP	Electricity Pole
FH	Fire Hydrant
SSV	Gas Stop Valve
HVC	Height
HL	High Voltage Cable
IL	Inspecting Cover
LP	Invert Level
LMH	Lamp Post
MW	Man-hole
MRK	Marker
MW	Monitoring Well
OB	Overhead
GB	Road Gully
PO	Post Box
PR	Pram Grassing
RNP	Road Name Plate
RNS	Road Sign
RNS	Soakaway
SV	Stay / Strut
SV	Stop Valve (Unidentified)
TCB	Telephone Box
TC	telecom
TH	Trial Hole
TL	Telegraph Pole
UTL	Unable to Lift
VP	Vent pipe
WM	Water Meter
WSV	Water Stop Valve

BWF	Barbed Wire Fence
CBF	Closed Board Fence
CP	Concrete Post
CPF	Chestnut Paling Fence
CWF	Chicken Wire Fence
IRF	Iron Railing Fence
PKF	Picket Fence
PRF	Post & Rail Fence
PWF	Post & Wire Fence
SCF	Security Fence
SP	Steel Post
WMF	Wire Mesh Fence
WPF	Wood Panel Fence



SURVEY STATION INFORMATION				
Name	Easting	Northing	Height	Type
H1	506790.656	181767.675	37.079	NAIL
H2	506791.311	181806.021	37.580	NAIL
H3	506839.550	181788.475	37.161	NAIL
H4	506845.557	181806.215	37.665	NAIL
H6	506892.524	181763.309	37.703	NAIL

NOTES

The survey grid has been related to OS National Grid using a flat earth projection and metric scale factor of 1, centred on Station H3. Levels are related to OS datum determined from the National GPS Network using OSGM15.

No assumptions should be made regarding the interconnection of manholes. Drainage details have been obtained from surface inspection and should be verified if of critical importance.

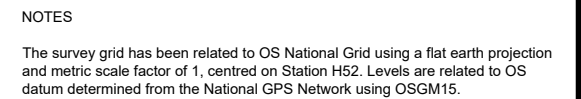
The position and height of adjacent buildings have been obtained using higher level reflectorless measurement and may not take account of single storey extensions or conservatories below the line of sight.

Geomatic Surveyors	 Unit E, Woodside 34 Parham Drive Eastleigh SO50 4NU t: 023 8081 1081 w: siteline.co.uk
NEXUS PLANNING	Client
HILLINGDON HOSPITAL FIELD HEATH ROAD LUXBRIDGE	Contract
SITE SURVEY AREA 1	Title
712HH01	Drawing Number
SEPTEMBER 2019	Date
1:200 (at A2)	Scale
MU/HB	Surveyor(s)

A	Ash
AL	Alder
AP	Apple
B	Beech
BO	Cedar
CB	Copper Beech
CH	Cherry
CM	Cypress
CO	elm
CU	Clder
E	Eucalyptus
EU	Fir
F	Field Maple
FM	Fruit
FR	Hazel
H	Horse Chestnut
HC	Holm Oak
HO	Hawthorn
HV	Holly
HY	Japanese Maple
LB	Laburnum
LM	Lime
LO	Locust Tree
LR	Laurel
M	Maple
MG	Magnolia
OK	Oak
P	Pine
PA	Palm
PL	Plane
PM	Plum
PO	Poplar
PP	Pissardii Plum
PR	Pear
R	Redwood
RD	Red Oak
RH	Rhododendron
RO	River Birch
SB	Silver Birch
SC	Sweet Chestnut
SP	Scots Pine
SU	Spruce
SY	Sycamore
U	Unidentified
WN	Willow
Y	Walnut
	Yew

BT	British Telecom
BOL	Bollard
CB	Control Box
CL	Cover Level
CTV	Cable Television
EL	Electric
FH	Fire Hydrant
GSV	Gas Stop Valve
H	Height
HVC	High Voltage Cable
IC	Inspection Cover
I	Invert Level
L	Lamp Post
MH	Man-Hole
MKR	Marker
MW	Monitoring Well
O/H	Overhead
GB	Ground Gully
PB	Post Box
PC	Pram Crossing
RNP	Road Name Plate
RS	Road Sign
S/A	Soakaway
ST	Stay / Strut
SV	Stop Valve (Unidentified)
TB	Telephone Box
TC	telecom
TH	Trial Hole
TC	Traffic Light
TP	Telegraph Pole
UTL	Unable to Lift
VP	Vent pipe
WM	Water Meter
WSV	Water Stop Valve

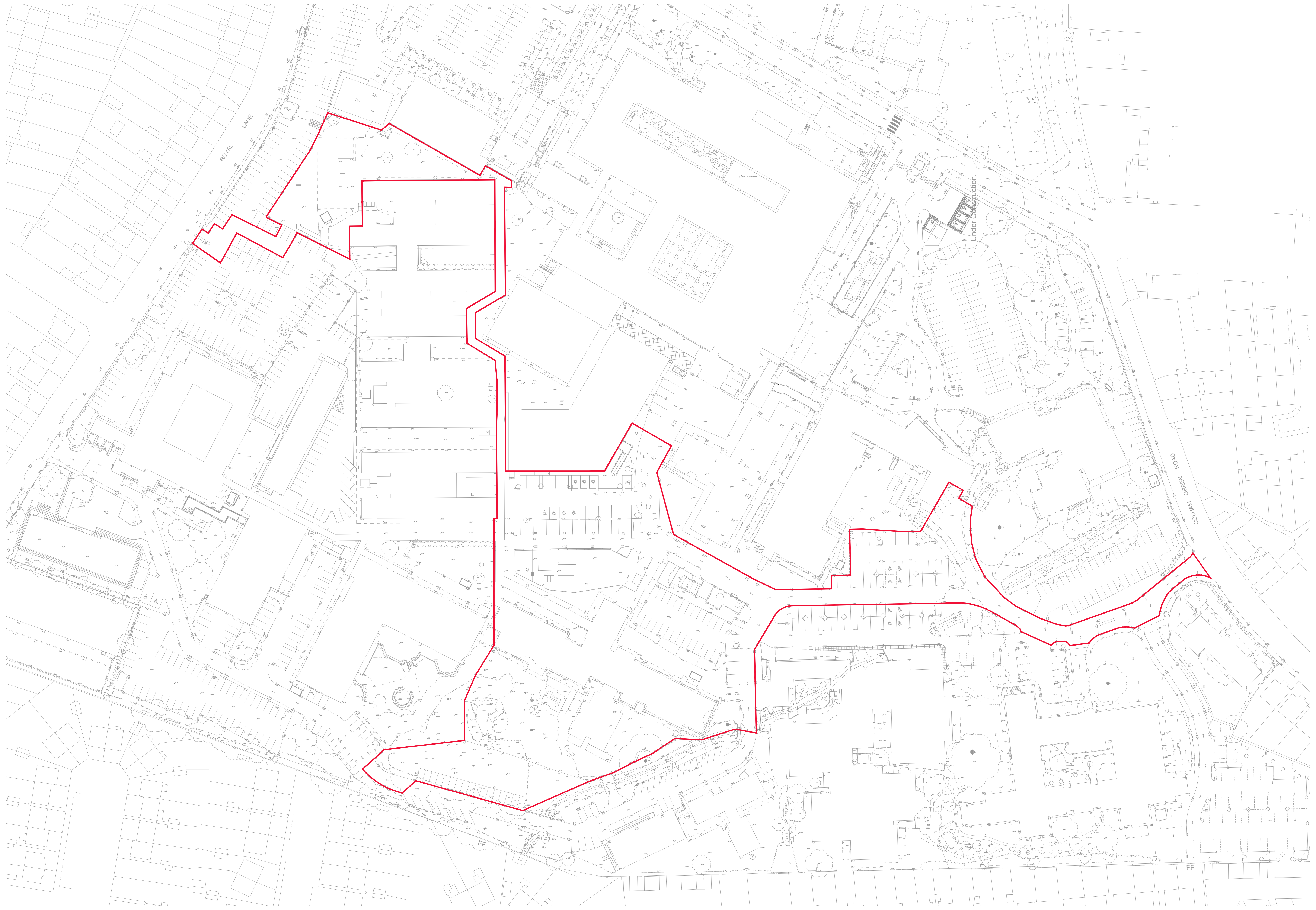
BWF	Barbed Wire Fence
CBF	Closed Board Fence
CP	Concrete Post
CPF	Chestnut Paling Fence
CWF	Chicken Wire Fence
IRF	Iron Railing Fence
PKF	Picket Fence
PRF	Post & Rail Fence
PWF	Post & Wire Fence
SCF	Security Fence
SP	Steel Post
WMF	Wire Mesh Fence
WPF	Wood Panel Fence



SURVEY STATION INFORMATION				
Name	Easting	Northing	Height	Type
H50	506734.733	181908.971	38.750	NAIL
H51	506736.028	181941.169	39.380	NAIL
H52	506734.734	181924.795	38.795	NAIL
H53	506719.109	181897.630	38.347	NAIL
H54	506712.644	181947.964	38.967	NAIL
H55	506701.853	181906.235	38.337	NAIL

t: 023 8081 1081
w: siteline.co.uk

JB	Surveyor(s)
----	-------------



ROYAL LANE

Under Construction.

COLHAM GREEN ROAD

FF

FF

Appendix D

Geological Mapping and Soilscape Mapping

KEY

Approximate site location

Bedrock Geology

London Clay Formation - Clay, Silt and Sand

Superficial Geology

Boyn Hill Gravel Member - Sand and Gravel



NOTES

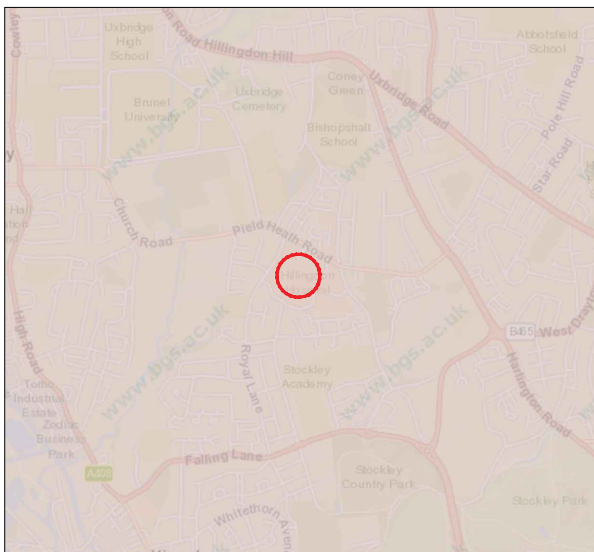
1. This drawing is to be read in conjunction with all other documents and specifications
2. Dimensions not to be scaled from drawing

Soilscapes Map

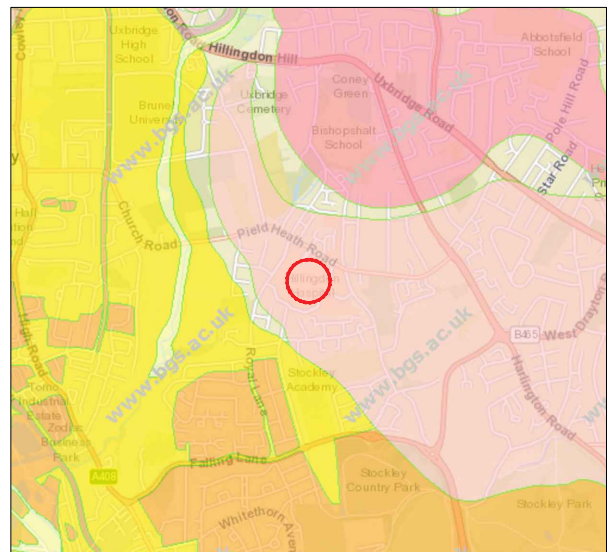
Slowly permeable seasonally wet acid loamy and clayey soils

Loamy soils with naturally high groundwater

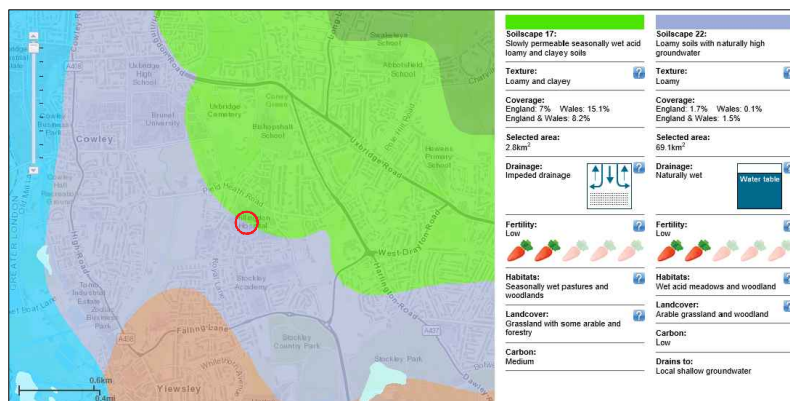
Bedrock Geology



Superficial Geology



Soilscapes Map_Cranfield University



Glanville

Cornerstone House
62 Foxhall Road, Didcot
Oxon, OX11 7AD

Tel: (01235) 515550 Fax: (01235) 817799
postbox@glanvillegroup.com www.glanvillegroup.com

Project :

Hillingdon Hospital, Uxbridge, UB8 3NN

Title :

British Geological Survey & Soilscapes Mapping Extract

Project Engineer : A. Quigley

Scale : NTS

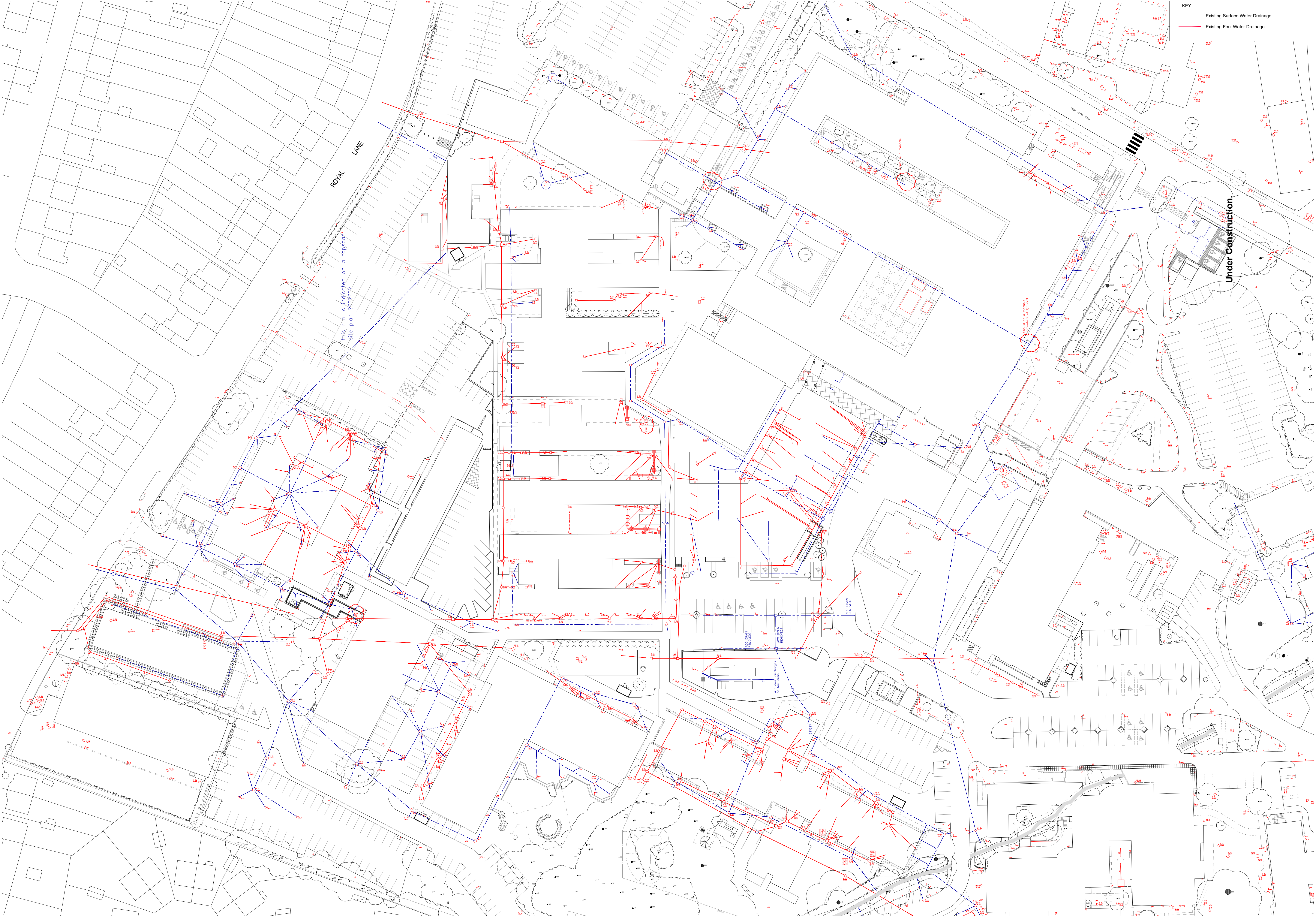
Project Director : K. Rayner

Date : Sept 2019

Drawing No. CV8190857 - SK02

Rev -

Appendix E
Drainage Survey



Appendix F

Fluvial Flood Risk Mapping

KEY



Flood Zone 2



Flood Zone 3

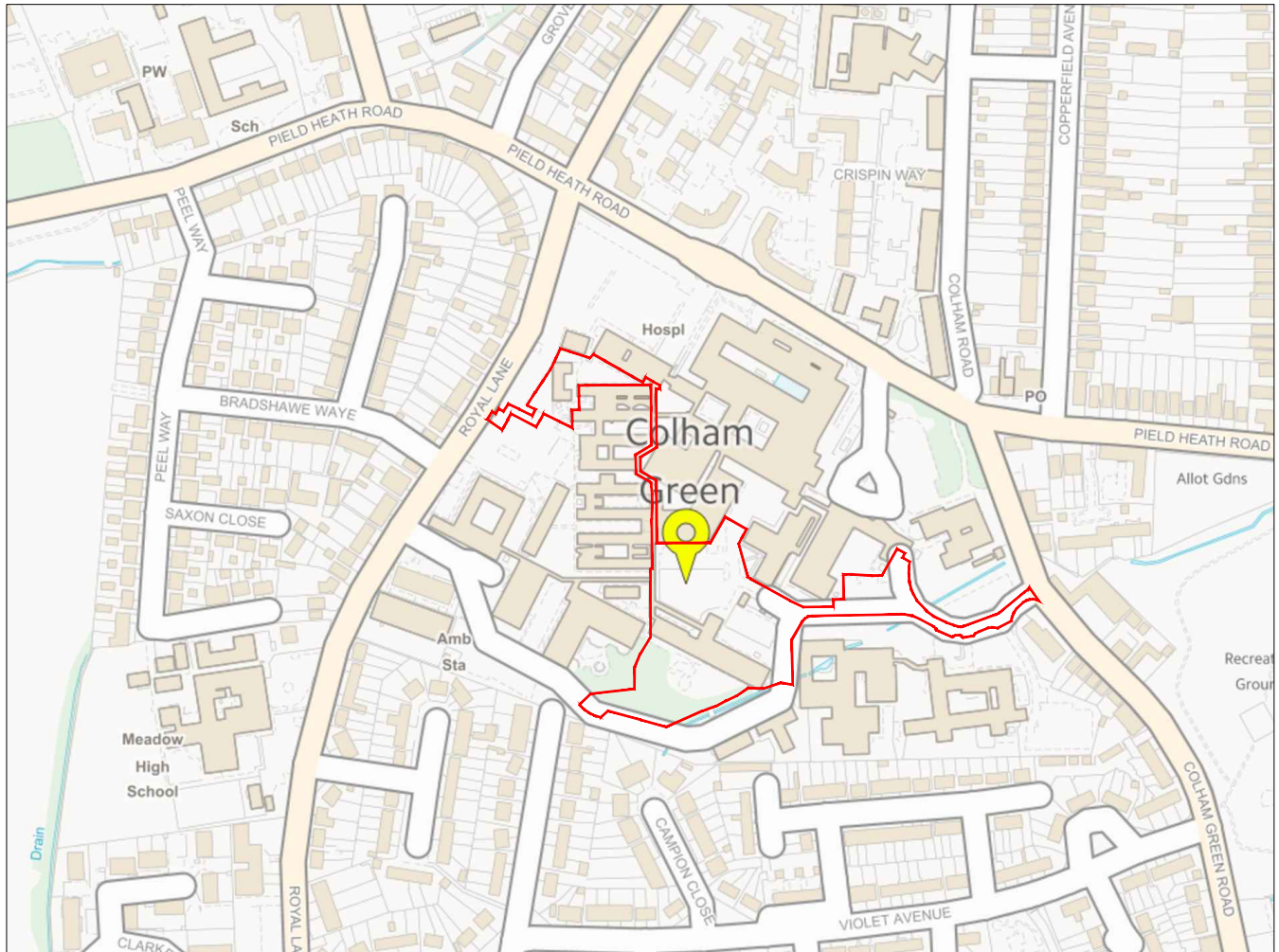


Approximate site boundary



NOTES

1. This drawing is to be read in conjunction with all other documents and specifications
2. Dimensions not to be scaled from drawing



Project :

Hillingdon Hospital, Uxbridge, UB8 3NN

Title :

Environment Agency Flood Zone Map

Project Engineer : A. Quigley

Scale : NTS

Project Director : K. Rayner

Date : March 2020

Drawing No. CV8190857 - SK03

Rev -

Appendix G

Surface Water Flood Risk Mapping

KEY



Low risk of surface water flooding



High risk of surface water flooding



Medium risk of surface water flooding

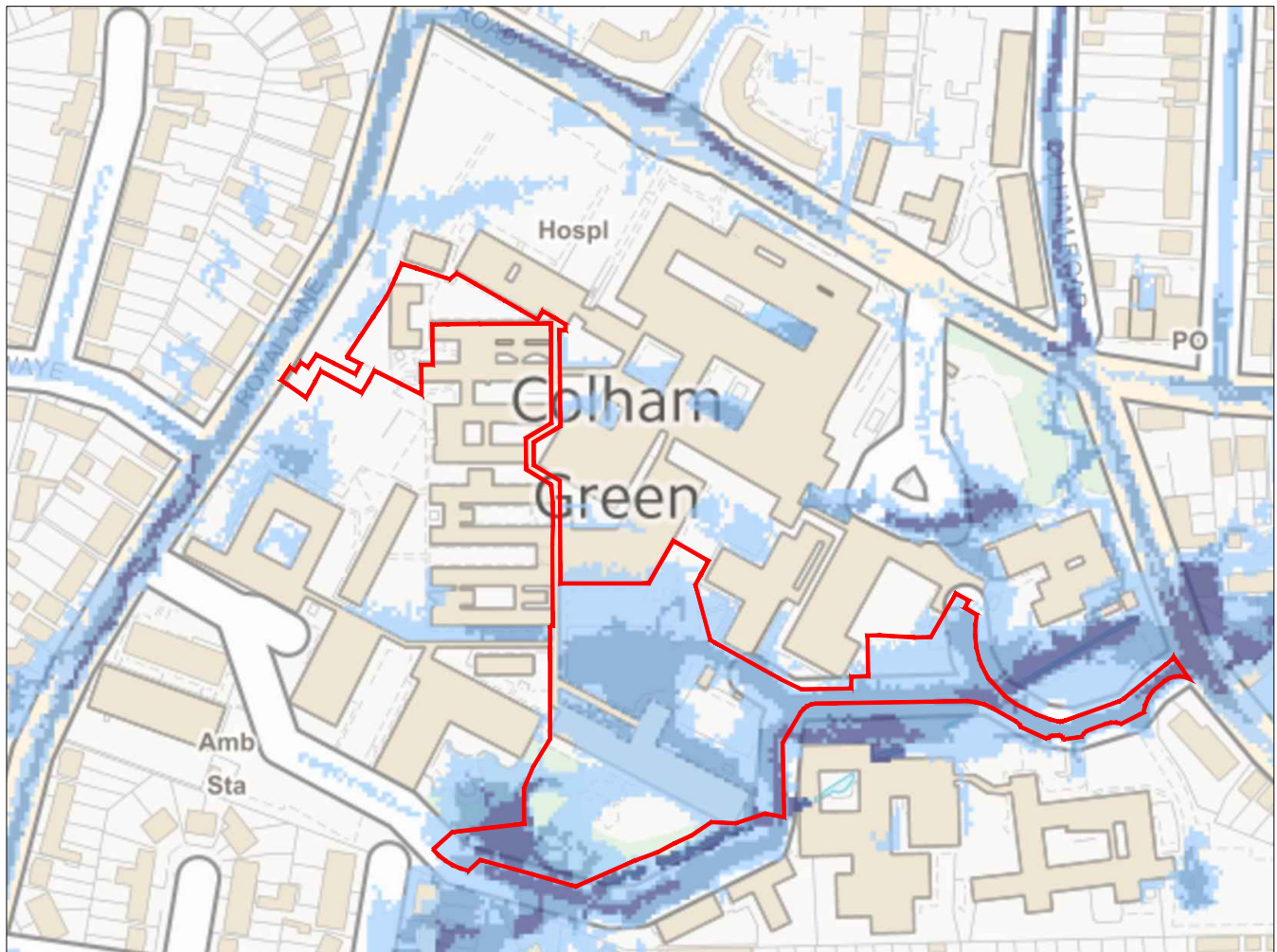


Approximate site boundary



NOTES

1. This drawing is to be read in conjunction with all other documents and specifications
2. Dimensions not to be scaled from drawing



Glanville

Cornerstone House
62 Foxhall Road, Didcot
Oxon, OX11 7AD

Tel: (01235) 515550 Fax: (01235) 817799
postbox@glanvillegroup.com www.glanvillegroup.com

Project :

Hillingdon Hospital, Uxbridge, UB8 3NN

Title :

Environment Agency Surface Water Flood Map

Project Engineer : A. Quigley

Scale : NTS

Project Director : K. Rayner

Date : March 2020

Drawing No. CV8190857 - SK04

Rev -

Appendix H

Existing Run-off Rates – Area 1

Job Title: <u>ADDITIONAL WARD BUILDINGS</u>	Job No: <u>8190857</u>	Date: <u>13.03.20</u>
Member/Location: <u>HILLINGDON HOSPITAL</u>	Sheet No: <u>1</u>	
Engineer: <u>A. GUILLEY</u>	Checked/Approved: <u>K. RAYNER</u>	Revision: <u>-</u>

<u>EXISTING DISCHARGE RATES</u>	<u>Ref.</u>
Impermeable Area of "Ward building North" area = $997 \text{ m}^2 \approx 0.0997 \text{ ha}$	Based on Arch layout
Impermeable Area of "Ward building South" area = $2,921 \text{ m}^2 \approx 0.2921 \text{ ha}$	
Discharge Rate ; $Q = 3.61 \times C_v \times i \times A$ where C_v = volumetric run-off coefficient = 1.0 i = rainfall intensity = 54 mm/hr	Modified Rational Method
$A = \begin{cases} \text{Contributing Area (North)} = 0.0997 \text{ ha} \\ \text{Contributing Area (South)} = 0.2921 \text{ ha} \end{cases}$	Building Regs H3 Pg 2.
Therefore	
$Q_{\text{NORTH}} = 3.61 \times 1.0 \times 54 \times 0.0997 = \underline{19.4 \text{ l/s}}$	
$Q_{\text{SOUTH}} = 3.61 \times 2.0 \times 54 \times 0.2921 = \underline{56.9 \text{ l/s}}$	

Appendix I

Greenfield Run-off Rates – Areas 2 & 3

Glanville Consultants		Page 1
Cornerstone House 62 Foxhall Road Didcot OX11 7AD		
Date 13/03/2020 13:04 File Geo-cellular storage tan...	Designed by AQuigley Checked by	
Innovyze Source Control 2018.1.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years) 2 SAAR (mm) 673 Urban 0.000
Area (ha) 0.138 Soil 0.300 Region Number Region 6

Results 1/s

QBAR Rural 0.2
QBAR Urban 0.2

Q2 years 0.2

Q1 year 0.2
Q30 years 0.5
Q100 years 0.8

©1982-2018 Innovyze

Glanville Consultants		Page 1
Cornerstone House 62 Foxhall Road Didcot OX11 7AD		
Date 13/03/2020 11:54 File Geo-cellular storage tan...	Designed by AQuigley Checked by	
Innovyze Source Control 2018.1.1		
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 2 SAAR (mm) 673 Urban 0.000 Area (ha) 0.100 Soil 0.300 Region Number Region 6 Results 1/s QBAR Rural 0.2 QBAR Urban 0.2 Q2 years 0.2 Q1 year 0.1 Q30 years 0.4 Q100 years 0.6		
©1982-2018 Innovyze		

Glanville Consultants		Page 1
Cornerstone House 62 Foxhall Road Didcot OX11 7AD		
Date 13/03/2020 11:55 File Geo-cellular storage tan...	Designed by AQuigley Checked by	
Innovyze	Source Control 2018.1.1	
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 2 SAAR (mm) 673 Urban 0.000 Area (ha) 0.292 Soil 0.300 Region Number Region 6 Results 1/s QBAR Rural 0.5 QBAR Urban 0.5 Q2 years 0.4 Q1 year 0.4 Q30 years 1.2 Q100 years 1.6		
©1982-2018 Innovyze		

Appendix J

MicroDrainage Calculations

Glanville Consultants				Page 1			
Cornerstone Court 62 Foxhall Road Didcot OX11 7AD		8191013 Hillingon Hospital, Ward Attenuation Storage_Ward South					
Date 12/03/2020 11:41 File Permeable Pavement_Ward ...		Designed by A. Quigley Checked by					
Micro Drainage		Source Control 2018.1.1					
<u>Summary of Results for 100 year Return Period (+40%)</u>							
Half Drain Time : 78 minutes.							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.470	0.470	0.0	12.5	12.5	67.4	O K
30 min Summer	0.587	0.587	0.0	12.5	12.5	84.3	O K
60 min Summer	0.654	0.654	0.0	12.5	12.5	93.9	O K
120 min Summer	0.658	0.658	0.0	12.5	12.5	94.5	O K
180 min Summer	0.629	0.629	0.0	12.5	12.5	90.3	O K
240 min Summer	0.589	0.589	0.0	12.5	12.5	84.5	O K
360 min Summer	0.497	0.497	0.0	12.5	12.5	71.4	O K
480 min Summer	0.416	0.416	0.0	12.5	12.5	59.7	O K
600 min Summer	0.347	0.347	0.0	12.5	12.5	49.8	O K
720 min Summer	0.291	0.291	0.0	12.5	12.5	41.8	O K
960 min Summer	0.213	0.213	0.0	12.4	12.4	30.6	O K
1440 min Summer	0.153	0.153	0.0	10.7	10.7	22.0	O K
2160 min Summer	0.123	0.123	0.0	8.1	8.1	17.7	O K
2880 min Summer	0.107	0.107	0.0	6.5	6.5	15.3	O K
4320 min Summer	0.088	0.088	0.0	4.7	4.7	12.6	O K
5760 min Summer	0.077	0.077	0.0	3.7	3.7	11.0	O K
7200 min Summer	0.070	0.070	0.0	3.1	3.1	10.0	O K
8640 min Summer	0.064	0.064	0.0	2.7	2.7	9.2	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
15 min Summer	138.153	0.0	75.3	17			
30 min Summer	90.705	0.0	99.0	32			
60 min Summer	56.713	0.0	124.0	60			
120 min Summer	34.246	0.0	149.8	90			
180 min Summer	25.149	0.0	165.1	124			
240 min Summer	20.078	0.0	175.7	160			
360 min Summer	14.585	0.0	191.5	224			
480 min Summer	11.622	0.0	203.4	288			
600 min Summer	9.738	0.0	213.1	346			
720 min Summer	8.424	0.0	221.2	404			
960 min Summer	6.697	0.0	234.4	512			
1440 min Summer	4.839	0.0	254.0	738			
2160 min Summer	3.490	0.0	275.1	1104			
2880 min Summer	2.766	0.0	290.6	1468			
4320 min Summer	1.989	0.0	313.4	2200			
5760 min Summer	1.573	0.0	330.7	2936			
7200 min Summer	1.311	0.0	344.3	3648			
8640 min Summer	1.129	0.0	355.7	4360			
©1982-2018 Innovzye							

Glanville Consultants		Page 2					
Cornerstone Court 62 Foxhall Road Didcot OX11 7AD		8191013 Hillingon Hospital, Ward Attenuation Storage_Ward South					
Date 12/03/2020 11:41 File Permeable Pavement_Ward ...		Designed by A. Quigley Checked by					
Micro Drainage		Source Control 2018.1.1					
Summary of Results for 100 year Return Period (+40%)							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	0.060	0.060	0.0	2.4	2.4	8.6	O K
15 min Winter	0.532	0.532	0.0	12.5	12.5	76.4	O K
30 min Winter	0.665	0.665	0.0	12.5	12.5	95.5	O K
60 min Winter	0.747	0.747	0.0	12.5	12.5	107.2	Flood Risk
120 min Winter	0.745	0.745	0.0	12.5	12.5	107.0	Flood Risk
180 min Winter	0.703	0.703	0.0	12.5	12.5	100.9	Flood Risk
240 min Winter	0.645	0.645	0.0	12.5	12.5	92.6	O K
360 min Winter	0.508	0.508	0.0	12.5	12.5	72.9	O K
480 min Winter	0.382	0.382	0.0	12.5	12.5	54.9	O K
600 min Winter	0.285	0.285	0.0	12.5	12.5	40.9	O K
720 min Winter	0.216	0.216	0.0	12.4	12.4	31.1	O K
960 min Winter	0.159	0.159	0.0	11.1	11.1	22.8	O K
1440 min Winter	0.124	0.124	0.0	8.2	8.2	17.8	O K
2160 min Winter	0.101	0.101	0.0	6.0	6.0	14.5	O K
2880 min Winter	0.088	0.088	0.0	4.8	4.8	12.6	O K
4320 min Winter	0.073	0.073	0.0	3.4	3.4	10.5	O K
5760 min Winter	0.064	0.064	0.0	2.7	2.7	9.2	O K
7200 min Winter	0.058	0.058	0.0	2.3	2.3	8.3	O K
8640 min Winter	0.054	0.054	0.0	2.0	2.0	7.7	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
10080 min Summer	0.994	0.0	365.5	5080			
15 min Winter	138.153	0.0	84.4	17			
30 min Winter	90.705	0.0	110.9	31			
60 min Winter	56.713	0.0	138.9	58			
120 min Winter	34.246	0.0	167.8	96			
180 min Winter	25.149	0.0	184.9	134			
240 min Winter	20.078	0.0	196.8	172			
360 min Winter	14.585	0.0	214.5	244			
480 min Winter	11.622	0.0	227.9	304			
600 min Winter	9.738	0.0	238.7	358			
720 min Winter	8.424	0.0	247.8	410			
960 min Winter	6.697	0.0	262.6	508			
1440 min Winter	4.839	0.0	284.6	740			
2160 min Winter	3.490	0.0	308.1	1100			
2880 min Winter	2.766	0.0	325.5	1468			
4320 min Winter	1.989	0.0	351.0	2168			
5760 min Winter	1.573	0.0	370.4	2920			
7200 min Winter	1.311	0.0	385.7	3640			
8640 min Winter	1.129	0.0	398.5	4304			
©1982-2018 Innovyze							

Glanville Consultants		Page 4																														
Cornerstone Court 62 Foxhall Road Didcot OX11 7AD	8191013 Hillingon Hospital, Ward Attenuation Storage_Ward South																															
Date 12/03/2020 11:41 File Permeable Pavement_Ward ...	Designed by A. Quigley Checked by																															
Micro Drainage		Source Control 2018.1.1																														
<u>Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>20.000</td> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Ratio R</td> <td>0.400</td> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> <td>Climate Change %</td> <td>+40</td> </tr> </table> <u>Time Area Diagram</u> Total Area (ha) 0.292 <table> <tr> <th>Time (mins)</th> <th>Area</th> </tr> <tr> <th>From:</th> <th>To: (ha)</th> </tr> <tr> <td>0</td> <td>4 0.292</td> </tr> </table>			Rainfall Model	FSR	Winter Storms	Yes	Return Period (years)	100	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	20.000	Shortest Storm (mins)	15	Ratio R	0.400	Longest Storm (mins)	10080	Summer Storms	Yes	Climate Change %	+40	Time (mins)	Area	From:	To: (ha)	0	4 0.292
Rainfall Model	FSR	Winter Storms	Yes																													
Return Period (years)	100	Cv (Summer)	0.750																													
Region	England and Wales	Cv (Winter)	0.840																													
M5-60 (mm)	20.000	Shortest Storm (mins)	15																													
Ratio R	0.400	Longest Storm (mins)	10080																													
Summer Storms	Yes	Climate Change %	+40																													
Time (mins)	Area																															
From:	To: (ha)																															
0	4 0.292																															
©1982-2018 Innovyze																																

Glanville Consultants		Page 5
Cornerstone Court 62 Foxhall Road Didcot OX11 7AD	8191013 Hillingon Hospital, Ward Attenuation Storage_Ward South	
Date 12/03/2020 11:41 File Permeable Pavement_Ward ...	Designed by A. Quigley Checked by	
Micro Drainage Source Control 2018.1.1		

Model Details

Storage is Online Cover Level (m) 1.000

Cellular Storage Structure

Invert Level (m) 0.000 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.30
 Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	478.7	0.0	1.001	0.0	0.0
1.000	478.7	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0164-1250-0750-1250
 Design Head (m) 0.750
 Design Flow (l/s) 12.5
 Flush-Flo™ Calculated
 Objective Minimise upstream storage
 Application Surface
 Sump Available Yes
 Diameter (mm) 164
 Invert Level (m) 0.000
 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)	0.750	12.5	Kick-Flo®	0.553	10.8
Flush-Flo™	0.270	12.5	Mean Flow over Head Range	-	10.4

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)
0.100	5.9	1.200	15.6	3.000	24.2	7.000	36.4
0.200	12.3	1.400	16.8	3.500	26.0	7.500	37.6
0.300	12.4	1.600	17.9	4.000	27.8	8.000	38.6
0.400	12.2	1.800	18.9	4.500	29.4	8.500	39.8
0.500	11.6	2.000	19.9	5.000	30.9	9.000	41.0
0.600	11.2	2.200	20.8	5.500	32.4	9.500	42.1
0.800	12.9	2.400	21.7	6.000	33.7		
1.000	14.3	2.600	22.6	6.500	35.1		

©1982-2018 Innovyze

Glanville Consultants						Page 1	
Cornerstone Court 62 Foxhall Road Didcot OX11 7AD			8190857 Hillingdon Hospital, Ward Storage Tank_Car Park				
Date 12/03/2020 11:39 File Geo-cellular storage tan...			Designed by AQuigley Checked by				
Micro Drainage			Source Control 2018.1.1				
<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time : 316 minutes.							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	37.846	0.276	0.0	2.0	2.0	34.6	O K
30 min Summer	37.926	0.356	0.0	2.0	2.0	44.7	O K
60 min Summer	38.002	0.432	0.0	2.0	2.0	54.1	O K
120 min Summer	38.058	0.488	0.0	2.0	2.0	61.2	Flood Risk
180 min Summer	38.074	0.504	0.0	2.0	2.0	63.2	Flood Risk
240 min Summer	38.073	0.503	0.0	2.0	2.0	63.0	Flood Risk
360 min Summer	38.059	0.489	0.0	2.0	2.0	61.4	Flood Risk
480 min Summer	38.045	0.475	0.0	2.0	2.0	59.5	Flood Risk
600 min Summer	38.029	0.459	0.0	2.0	2.0	57.5	Flood Risk
720 min Summer	38.012	0.442	0.0	2.0	2.0	55.4	O K
960 min Summer	37.977	0.407	0.0	2.0	2.0	51.1	O K
1440 min Summer	37.903	0.333	0.0	2.0	2.0	41.7	O K
2160 min Summer	37.814	0.244	0.0	2.0	2.0	30.6	O K
2880 min Summer	37.749	0.179	0.0	2.0	2.0	22.4	O K
4320 min Summer	37.677	0.107	0.0	1.9	1.9	13.4	O K
5760 min Summer	37.653	0.083	0.0	1.7	1.7	10.4	O K
7200 min Summer	37.641	0.071	0.0	1.4	1.4	8.8	O K
8640 min Summer	37.633	0.063	0.0	1.3	1.3	7.8	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
15 min Summer	138.153	0.0	35.6	18			
30 min Summer	90.705	0.0	46.8	33			
60 min Summer	56.713	0.0	58.9	62			
120 min Summer	34.246	0.0	71.2	122			
180 min Summer	25.149	0.0	78.4	180			
240 min Summer	20.078	0.0	83.5	240			
360 min Summer	14.585	0.0	91.0	298			
480 min Summer	11.622	0.0	96.7	362			
600 min Summer	9.738	0.0	101.2	428			
720 min Summer	8.424	0.0	105.1	496			
960 min Summer	6.697	0.0	111.4	636			
1440 min Summer	4.839	0.0	120.7	894			
2160 min Summer	3.490	0.0	130.9	1256			
2880 min Summer	2.766	0.0	138.2	1612			
4320 min Summer	1.989	0.0	149.0	2252			
5760 min Summer	1.573	0.0	157.3	2944			
7200 min Summer	1.311	0.0	163.8	3672			
8640 min Summer	1.129	0.0	169.2	4408			
©1982-2018 Innovyze							

Glanville Consultants				Page 2			
Cornerstone Court 62 Foxhall Road Didcot OX11 7AD			8190857 Hillingdon Hospital, Ward Storage Tank_Car Park				
Date 12/03/2020 11:39 File Geo-cellular storage tan...			Designed by AQuigley Checked by				
Micro Drainage			Source Control 2018.1.1				
Summary of Results for 100 year Return Period (+40%)							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	37.627	0.057	0.0	1.1	1.1	7.2	O K
15 min Winter	37.880	0.310	0.0	2.0	2.0	38.9	O K
30 min Winter	37.972	0.402	0.0	2.0	2.0	50.4	O K
60 min Winter	38.057	0.487	0.0	2.0	2.0	61.1	Flood Risk
120 min Winter	38.123	0.553	0.0	2.0	2.0	69.4	Flood Risk
180 min Winter	38.145	0.575	0.0	2.0	2.0	72.1	Flood Risk
240 min Winter	38.147	0.577	0.0	2.0	2.0	72.4	Flood Risk
360 min Winter	38.132	0.562	0.0	2.0	2.0	70.5	Flood Risk
480 min Winter	38.112	0.542	0.0	2.0	2.0	68.0	Flood Risk
600 min Winter	38.092	0.522	0.0	2.0	2.0	65.4	Flood Risk
720 min Winter	38.069	0.499	0.0	2.0	2.0	62.6	Flood Risk
960 min Winter	38.020	0.450	0.0	2.0	2.0	56.5	Flood Risk
1440 min Winter	37.908	0.338	0.0	2.0	2.0	42.4	O K
2160 min Winter	37.776	0.206	0.0	2.0	2.0	25.9	O K
2880 min Winter	37.696	0.126	0.0	2.0	2.0	15.8	O K
4320 min Winter	37.648	0.078	0.0	1.6	1.6	9.8	O K
5760 min Winter	37.633	0.063	0.0	1.3	1.3	7.9	O K
7200 min Winter	37.625	0.055	0.0	1.1	1.1	6.9	O K
8640 min Winter	37.620	0.050	0.0	0.9	0.9	6.3	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
10080 min Summer	0.994	0.0	173.8	5136			
15 min Winter	138.153	0.0	39.9	18			
30 min Winter	90.705	0.0	52.4	33			
60 min Winter	56.713	0.0	66.0	62			
120 min Winter	34.246	0.0	79.7	120			
180 min Winter	25.149	0.0	87.8	176			
240 min Winter	20.078	0.0	93.5	232			
360 min Winter	14.585	0.0	101.9	336			
480 min Winter	11.622	0.0	108.3	380			
600 min Winter	9.738	0.0	113.4	458			
720 min Winter	8.424	0.0	117.7	534			
960 min Winter	6.697	0.0	124.8	690			
1440 min Winter	4.839	0.0	135.2	966			
2160 min Winter	3.490	0.0	146.6	1316			
2880 min Winter	2.766	0.0	154.8	1616			
4320 min Winter	1.989	0.0	166.9	2248			
5760 min Winter	1.573	0.0	176.2	2944			
7200 min Winter	1.311	0.0	183.5	3680			
8640 min Winter	1.129	0.0	189.6	4312			
©1982-2018 Innovyze							

Glanville Consultants		Page 4
Cornerstone Court 62 Foxhall Road Didcot OX11 7AD	8190857 Hillingdon Hospital, Ward Storage Tank_Car Park	
Date 12/03/2020 11:39 File Geo-cellular storage tan...	Designed by AQuigley Checked by	
Micro Drainage Source Control 2018.1.1		

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.139

	Time (mins)	Area
From:	To:	(ha)
	0	4 0.139

©1982-2018 Innovyze

Glanville Consultants		Page 5
Cornerstone Court 62 Foxhall Road Didcot OX11 7AD	8190857 Hillingdon Hospital, Ward Storage Tank_Car Park	
Date 12/03/2020 11:39 File Geo-cellular storage tan...	Designed by AQuigley Checked by	
Micro Drainage Source Control 2018.1.1		

Model Details

Storage is Online Cover Level (m) 38.320

Cellular Storage Structure

Invert Level (m) 37.570 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	132.0	0.0	0.601	0.0	0.0
0.600	132.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0073-2000-0600-2000
Design Head (m) 0.600
Design Flow (l/s) 2.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 73
Invert Level (m) 37.570
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	2.0	Kick-Flo®	0.397	1.7
Flush-Flo™	0.177	2.0	Mean Flow over Head Range	-	1.7

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)
0.100	1.9	1.200	2.7	3.000	4.2	7.000	6.3
0.200	2.0	1.400	2.9	3.500	4.5	7.500	6.5
0.300	1.9	1.600	3.1	4.000	4.8	8.000	6.7
0.400	1.7	1.800	3.3	4.500	5.1	8.500	6.9
0.500	1.8	2.000	3.5	5.000	5.3	9.000	7.1
0.600	2.0	2.200	3.6	5.500	5.6	9.500	7.3
0.800	2.3	2.400	3.8	6.000	5.8		
1.000	2.5	2.600	3.9	6.500	6.0		

©1982-2018 Innovyze

Glanville Consultants		Page 1																																																																																																																																																																																																																																																								
Cornerstone Court 62 Foxhall Road Didcot OX11 7AD		8190857 Hillingdon Hospital, Ward Storage Tank_Ward North																																																																																																																																																																																																																																																								
Date 12/03/2020 11:40 File Geo-cellular storage tan...		Designed by A. Quigley Checked by																																																																																																																																																																																																																																																								
Micro Drainage		Source Control 2018.1.1																																																																																																																																																																																																																																																								
<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time : 23 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Control (l/s)</th><th>Max E Outflow (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>37.078</td><td>0.418</td><td>0.0</td><td>9.8</td><td>9.8</td><td>18.8</td><td>O K</td></tr><tr><td>30 min Summer</td><td>37.128</td><td>0.468</td><td>0.0</td><td>9.8</td><td>9.8</td><td>21.1</td><td>Flood Risk</td></tr><tr><td>60 min Summer</td><td>37.122</td><td>0.462</td><td>0.0</td><td>9.8</td><td>9.8</td><td>20.8</td><td>Flood Risk</td></tr><tr><td>120 min Summer</td><td>37.040</td><td>0.380</td><td>0.0</td><td>9.8</td><td>9.8</td><td>17.1</td><td>O K</td></tr><tr><td>180 min Summer</td><td>36.947</td><td>0.287</td><td>0.0</td><td>9.8</td><td>9.8</td><td>12.9</td><td>O K</td></tr><tr><td>240 min Summer</td><td>36.871</td><td>0.211</td><td>0.0</td><td>9.8</td><td>9.8</td><td>9.5</td><td>O K</td></tr><tr><td>360 min Summer</td><td>36.778</td><td>0.118</td><td>0.0</td><td>9.7</td><td>9.7</td><td>5.3</td><td>O K</td></tr><tr><td>480 min Summer</td><td>36.744</td><td>0.084</td><td>0.0</td><td>8.7</td><td>8.7</td><td>3.8</td><td>O K</td></tr><tr><td>600 min Summer</td><td>36.727</td><td>0.067</td><td>0.0</td><td>7.6</td><td>7.6</td><td>3.0</td><td>O K</td></tr><tr><td>720 min Summer</td><td>36.715</td><td>0.055</td><td>0.0</td><td>6.6</td><td>6.6</td><td>2.5</td><td>O K</td></tr><tr><td>960 min Summer</td><td>36.700</td><td>0.040</td><td>0.0</td><td>5.4</td><td>5.4</td><td>1.8</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>36.682</td><td>0.022</td><td>0.0</td><td>3.9</td><td>3.9</td><td>1.0</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>36.669</td><td>0.009</td><td>0.0</td><td>2.9</td><td>2.9</td><td>0.4</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>36.660</td><td>0.000</td><td>0.0</td><td>2.3</td><td>2.3</td><td>0.0</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>36.660</td><td>0.000</td><td>0.0</td><td>1.6</td><td>1.6</td><td>0.0</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>36.660</td><td>0.000</td><td>0.0</td><td>1.3</td><td>1.3</td><td>0.0</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>36.660</td><td>0.000</td><td>0.0</td><td>1.1</td><td>1.1</td><td>0.0</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>36.660</td><td>0.000</td><td>0.0</td><td>0.9</td><td>0.9</td><td>0.0</td><td>O K</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>138.153</td><td>0.0</td><td>25.8</td><td>16</td></tr><tr><td>30 min Summer</td><td>90.705</td><td>0.0</td><td>34.0</td><td>26</td></tr><tr><td>60 min Summer</td><td>56.713</td><td>0.0</td><td>42.4</td><td>42</td></tr><tr><td>120 min Summer</td><td>34.246</td><td>0.0</td><td>51.2</td><td>76</td></tr><tr><td>180 min Summer</td><td>25.149</td><td>0.0</td><td>56.6</td><td>108</td></tr><tr><td>240 min Summer</td><td>20.078</td><td>0.0</td><td>60.2</td><td>136</td></tr><tr><td>360 min Summer</td><td>14.585</td><td>0.0</td><td>65.6</td><td>192</td></tr><tr><td>480 min Summer</td><td>11.622</td><td>0.0</td><td>69.7</td><td>250</td></tr><tr><td>600 min Summer</td><td>9.738</td><td>0.0</td><td>73.0</td><td>308</td></tr><tr><td>720 min Summer</td><td>8.424</td><td>0.0</td><td>75.8</td><td>368</td></tr><tr><td>960 min Summer</td><td>6.697</td><td>0.0</td><td>80.3</td><td>490</td></tr><tr><td>1440 min Summer</td><td>4.839</td><td>0.0</td><td>87.1</td><td>734</td></tr><tr><td>2160 min Summer</td><td>3.490</td><td>0.0</td><td>94.2</td><td>1096</td></tr><tr><td>2880 min Summer</td><td>2.766</td><td>0.0</td><td>99.6</td><td>1468</td></tr><tr><td>4320 min Summer</td><td>1.989</td><td>0.0</td><td>107.4</td><td>0</td></tr><tr><td>5760 min Summer</td><td>1.573</td><td>0.0</td><td>113.3</td><td>0</td></tr><tr><td>7200 min Summer</td><td>1.311</td><td>0.0</td><td>118.0</td><td>0</td></tr><tr><td>8640 min Summer</td><td>1.129</td><td>0.0</td><td>121.9</td><td>0</td></tr></table>				Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status	15 min Summer	37.078	0.418	0.0	9.8	9.8	18.8	O K	30 min Summer	37.128	0.468	0.0	9.8	9.8	21.1	Flood Risk	60 min Summer	37.122	0.462	0.0	9.8	9.8	20.8	Flood Risk	120 min Summer	37.040	0.380	0.0	9.8	9.8	17.1	O K	180 min Summer	36.947	0.287	0.0	9.8	9.8	12.9	O K	240 min Summer	36.871	0.211	0.0	9.8	9.8	9.5	O K	360 min Summer	36.778	0.118	0.0	9.7	9.7	5.3	O K	480 min Summer	36.744	0.084	0.0	8.7	8.7	3.8	O K	600 min Summer	36.727	0.067	0.0	7.6	7.6	3.0	O K	720 min Summer	36.715	0.055	0.0	6.6	6.6	2.5	O K	960 min Summer	36.700	0.040	0.0	5.4	5.4	1.8	O K	1440 min Summer	36.682	0.022	0.0	3.9	3.9	1.0	O K	2160 min Summer	36.669	0.009	0.0	2.9	2.9	0.4	O K	2880 min Summer	36.660	0.000	0.0	2.3	2.3	0.0	O K	4320 min Summer	36.660	0.000	0.0	1.6	1.6	0.0	O K	5760 min Summer	36.660	0.000	0.0	1.3	1.3	0.0	O K	7200 min Summer	36.660	0.000	0.0	1.1	1.1	0.0	O K	8640 min Summer	36.660	0.000	0.0	0.9	0.9	0.0	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	138.153	0.0	25.8	16	30 min Summer	90.705	0.0	34.0	26	60 min Summer	56.713	0.0	42.4	42	120 min Summer	34.246	0.0	51.2	76	180 min Summer	25.149	0.0	56.6	108	240 min Summer	20.078	0.0	60.2	136	360 min Summer	14.585	0.0	65.6	192	480 min Summer	11.622	0.0	69.7	250	600 min Summer	9.738	0.0	73.0	308	720 min Summer	8.424	0.0	75.8	368	960 min Summer	6.697	0.0	80.3	490	1440 min Summer	4.839	0.0	87.1	734	2160 min Summer	3.490	0.0	94.2	1096	2880 min Summer	2.766	0.0	99.6	1468	4320 min Summer	1.989	0.0	107.4	0	5760 min Summer	1.573	0.0	113.3	0	7200 min Summer	1.311	0.0	118.0	0	8640 min Summer	1.129	0.0	121.9	0
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																																																			
15 min Summer	37.078	0.418	0.0	9.8	9.8	18.8	O K																																																																																																																																																																																																																																																			
30 min Summer	37.128	0.468	0.0	9.8	9.8	21.1	Flood Risk																																																																																																																																																																																																																																																			
60 min Summer	37.122	0.462	0.0	9.8	9.8	20.8	Flood Risk																																																																																																																																																																																																																																																			
120 min Summer	37.040	0.380	0.0	9.8	9.8	17.1	O K																																																																																																																																																																																																																																																			
180 min Summer	36.947	0.287	0.0	9.8	9.8	12.9	O K																																																																																																																																																																																																																																																			
240 min Summer	36.871	0.211	0.0	9.8	9.8	9.5	O K																																																																																																																																																																																																																																																			
360 min Summer	36.778	0.118	0.0	9.7	9.7	5.3	O K																																																																																																																																																																																																																																																			
480 min Summer	36.744	0.084	0.0	8.7	8.7	3.8	O K																																																																																																																																																																																																																																																			
600 min Summer	36.727	0.067	0.0	7.6	7.6	3.0	O K																																																																																																																																																																																																																																																			
720 min Summer	36.715	0.055	0.0	6.6	6.6	2.5	O K																																																																																																																																																																																																																																																			
960 min Summer	36.700	0.040	0.0	5.4	5.4	1.8	O K																																																																																																																																																																																																																																																			
1440 min Summer	36.682	0.022	0.0	3.9	3.9	1.0	O K																																																																																																																																																																																																																																																			
2160 min Summer	36.669	0.009	0.0	2.9	2.9	0.4	O K																																																																																																																																																																																																																																																			
2880 min Summer	36.660	0.000	0.0	2.3	2.3	0.0	O K																																																																																																																																																																																																																																																			
4320 min Summer	36.660	0.000	0.0	1.6	1.6	0.0	O K																																																																																																																																																																																																																																																			
5760 min Summer	36.660	0.000	0.0	1.3	1.3	0.0	O K																																																																																																																																																																																																																																																			
7200 min Summer	36.660	0.000	0.0	1.1	1.1	0.0	O K																																																																																																																																																																																																																																																			
8640 min Summer	36.660	0.000	0.0	0.9	0.9	0.0	O K																																																																																																																																																																																																																																																			
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																																																																						
15 min Summer	138.153	0.0	25.8	16																																																																																																																																																																																																																																																						
30 min Summer	90.705	0.0	34.0	26																																																																																																																																																																																																																																																						
60 min Summer	56.713	0.0	42.4	42																																																																																																																																																																																																																																																						
120 min Summer	34.246	0.0	51.2	76																																																																																																																																																																																																																																																						
180 min Summer	25.149	0.0	56.6	108																																																																																																																																																																																																																																																						
240 min Summer	20.078	0.0	60.2	136																																																																																																																																																																																																																																																						
360 min Summer	14.585	0.0	65.6	192																																																																																																																																																																																																																																																						
480 min Summer	11.622	0.0	69.7	250																																																																																																																																																																																																																																																						
600 min Summer	9.738	0.0	73.0	308																																																																																																																																																																																																																																																						
720 min Summer	8.424	0.0	75.8	368																																																																																																																																																																																																																																																						
960 min Summer	6.697	0.0	80.3	490																																																																																																																																																																																																																																																						
1440 min Summer	4.839	0.0	87.1	734																																																																																																																																																																																																																																																						
2160 min Summer	3.490	0.0	94.2	1096																																																																																																																																																																																																																																																						
2880 min Summer	2.766	0.0	99.6	1468																																																																																																																																																																																																																																																						
4320 min Summer	1.989	0.0	107.4	0																																																																																																																																																																																																																																																						
5760 min Summer	1.573	0.0	113.3	0																																																																																																																																																																																																																																																						
7200 min Summer	1.311	0.0	118.0	0																																																																																																																																																																																																																																																						
8640 min Summer	1.129	0.0	121.9	0																																																																																																																																																																																																																																																						
©1982-2018 Innovyze																																																																																																																																																																																																																																																										

Glanville Consultants		Page 2					
Cornerstone Court 62 Foxhall Road Didcot OX11 7AD		8190857 Hillingdon Hospital, Ward Storage Tank_Ward North					
Date 12/03/2020 11:40 File Geo-cellular storage tan...		Designed by A. Quigley Checked by					
Micro Drainage		Source Control 2018.1.1					
Summary of Results for 100 year Return Period (+40%)							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	36.660	0.000	0.0	0.8	0.8	0.0	O K
15 min Winter	37.140	0.480	0.0	9.8	9.8	21.6	Flood Risk
30 min Winter	37.200	0.540	0.0	9.8	9.8	24.3	Flood Risk
60 min Winter	37.183	0.523	0.0	9.8	9.8	23.5	Flood Risk
120 min Winter	37.057	0.397	0.0	9.8	9.8	17.9	O K
180 min Winter	36.909	0.249	0.0	9.8	9.8	11.2	O K
240 min Winter	36.807	0.147	0.0	9.8	9.8	6.6	O K
360 min Winter	36.738	0.078	0.0	8.3	8.3	3.5	O K
480 min Winter	36.716	0.056	0.0	6.8	6.8	2.5	O K
600 min Winter	36.704	0.044	0.0	5.7	5.7	2.0	O K
720 min Winter	36.695	0.035	0.0	4.9	4.9	1.6	O K
960 min Winter	36.683	0.023	0.0	4.0	4.0	1.0	O K
1440 min Winter	36.669	0.009	0.0	2.9	2.9	0.4	O K
2160 min Winter	36.660	0.000	0.0	2.1	2.1	0.0	O K
2880 min Winter	36.660	0.000	0.0	1.6	1.6	0.0	O K
4320 min Winter	36.660	0.000	0.0	1.2	1.2	0.0	O K
5760 min Winter	36.660	0.000	0.0	0.9	0.9	0.0	O K
7200 min Winter	36.660	0.000	0.0	0.8	0.8	0.0	O K
8640 min Winter	36.660	0.000	0.0	0.7	0.7	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
10080 min Summer	0.994	0.0	125.3	0			
15 min Winter	138.153	0.0	29.0	16			
30 min Winter	90.705	0.0	38.1	27			
60 min Winter	56.713	0.0	47.5	46			
120 min Winter	34.246	0.0	57.6	84			
180 min Winter	25.149	0.0	63.4	114			
240 min Winter	20.078	0.0	67.4	140			
360 min Winter	14.585	0.0	73.5	190			
480 min Winter	11.622	0.0	78.1	250			
600 min Winter	9.738	0.0	81.8	308			
720 min Winter	8.424	0.0	84.9	368			
960 min Winter	6.697	0.0	90.0	488			
1440 min Winter	4.839	0.0	97.5	730			
2160 min Winter	3.490	0.0	105.6	0			
2880 min Winter	2.766	0.0	111.5	0			
4320 min Winter	1.989	0.0	120.3	0			
5760 min Winter	1.573	0.0	126.9	0			
7200 min Winter	1.311	0.0	132.1	0			
8640 min Winter	1.129	0.0	136.5	0			
©1982-2018 Innovyze							

Glanville Consultants		Page 4
Cornerstone Court 62 Foxhall Road Didcot OX11 7AD	8190857 Hillingdon Hospital, Ward Storage Tank_Ward North	
Date 12/03/2020 11:40 File Geo-cellular storage tan...	Designed by A. Quigley Checked by	
Micro Drainage Source Control 2018.1.1		

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.100

Time (mins)	Area
From:	To: (ha)
0	4 0.100

©1982-2018 Innovyze

Glanville Consultants		Page 5
Cornerstone Court 62 Foxhall Road Didcot OX11 7AD	8190857 Hillingdon Hospital, Ward Storage Tank_Ward North	
Date 12/03/2020 11:40 File Geo-cellular storage tan...	Designed by A. Quigley Checked by	
Micro Drainage Source Control 2018.1.1		

Model Details

Storage is Online Cover Level (m) 37.410

Cellular Storage Structure

Invert Level (m) 36.660 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	47.4	0.0	0.601	0.0	0.0
0.600	47.4	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0150-9800-0600-9800
Design Head (m) 0.600
Design Flow (l/s) 9.8
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 150
Invert Level (m) 36.600
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)	0.600	9.8	Kick-Flo®	0.455	8.6
Flush-Flo™	0.233	9.8	Mean Flow over Head Range	-	8.0

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)
0.100	5.4	1.200	13.6	3.000	21.0	7.000	31.5
0.200	9.8	1.400	14.6	3.500	22.6	7.500	32.7
0.300	9.7	1.600	15.6	4.000	24.1	8.000	33.7
0.400	9.2	1.800	16.5	4.500	25.5	8.500	34.8
0.500	9.0	2.000	17.3	5.000	26.9	9.000	35.8
0.600	9.8	2.200	18.1	5.500	28.1	9.500	36.8
0.800	11.2	2.400	18.9	6.000	29.3		
1.000	12.5	2.600	19.6	6.500	30.4		

©1982-2018 Innovyze