BAYNHAM MEIKLE

Consulting Civil and Structural Engineers

ARC Oxford

Plot 4200

Flood Risk Assessment & Drainage Strategy

Project Ref: **13520**

Report Ref: **R101**

Revision 1.2

September 2023

Client

Advanced Research Clusters GP Limited (ARC)

BAYNHAM MEIKLE

Consulting Civil and Structural Engineers

REPORT STATUS

Client	Advanced Research Clusters GP Limited (ARC)
Project Title	ARC Oxford – Plot 4200
Report Type	Flood Risk Assessment & Drainage Strategy Report
Report Number	R101

Revision	Revised by	Approved by	Date
1.0	Marcel Richards – Assistant Engineer	Narinder Bangar – Director	02/11/2023
1.1	Marcel Richards – Assistant Engineer	Narinder Bangar – Director	23/11/2023
1.2	Marcel Richards – Assistant Engineer	Narinder Bangar – Director	02/02/2024

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Table of Contents

1 Introduction

Baynham Meikle Partnership Limited has been commissioned on behalf of Advanced Research Clusters GP Limited (ARC) to prepare a Flood Risk Assessment and Drainage Strategy to support the planning application for the development of a new laboratory-enabled office building with associated infrastructure.

The site is located in Cowley and accessed off John Smith Drive. The development area is approximately 1.283 hectares in total and the Ordnance Survey Grid reference is E454750, N203802. A site location plan is included in Appendix A.

It is a requirement for planning applications to consider the potential risk of flooding to the proposed development over its expected lifetime and any possible impacts on flood risk elsewhere in terms of its effects on flood flows and runoff.

This Flood Risk Assessment has been prepared following guidance set out in the National Planning Policy Framework (NPPF) and is undertaken in consultation with other relevant bodies.

The following aspects of flood risk that have been addressed within this report are:

- The area liable to flooding.
- The probability of flooding occurring now and over time.
- The extent and standard of existing flood defences and their effectiveness over time.
- The rates of flow likely to be involved.
- The likelihood of impacts on other areas, properties, and habitats.
- The effects of climate change which currently requires designs to include 1 in 100-year rainfall events with a climate change allowance as per the latest Environment Agency's guidance.
- The nature and current expected lifetime of the development proposed and the extent to which it is designed to deal with flood risk.

Further guidance has been obtained from:

- The SuDs Manual V6 (CIRIA c753).
- "Interim Code of Practice for Sustainable Drainage Systems 2004" (ICOP SUDS).
- "Interim National Procedures" point 3, 10.2 & 10.3.
- Oxfordshire County Council and Oxford City Council
- Strategic Flood Risk Assessment for this area.

2 Existing Site

2.1 Site Location

The development site is situated in Cowley and is accessed off John Smith Drive, with the nearest postcode being OX4 2RU. The Ordnance Survey National Grid reference to the centre of the site is E454750, N203802. A site location plan can be found in Appendix A. The site occupies an approximate area of 1.283 ha. The neighbouring land use is as follows:

North The site is bound to the north by employment uses.

East The site is bound to the east by John Smith Drive beyond which lie employment uses.

South The site is bound to the south by employment uses.

West The site is bound to the west by a residential area.

2.2 Topography

The existing site is currently developed and consists of 7 office units. The site is relatively flat with engineered falls incorporated into the existing design. Existing levels in the northwest circa 71.900 AOD and existing levels in the southeast circa 70.700 AOD.

A topographical survey can be found in Appendix A.

2.3 Existing Ground Conditions

The Plot 4200 Phase 1 & 2 Geo-environmental & Geotechnical Site investigation conducted by RSK Geosciences (report ref: 252995-R02 (00), dated December 2023) to get an understanding of the ground geology. Records show that the site is underlain by a variable thickness of made ground over weathered Beckley Sand Member with Beckley Sand Member encountered at depth. Figure 1 shows a summary of the encountered strata during testing. Full extracts of the RSK Geoscience Report can be found in Appendix E.

Two soakaway tests were also conducted on site by RSK of which locations are shown within RSK Geosciences (Report ref: 252995-R02 (00)). RSK have labelled these soakaway pits as TPSA01 and TPSA02 with a summary of the infiltration rates shown on Table 1 below.

Soakaway Test Pit	Geological unit	Test 2
TPSA01	Weathered Beckley Sand Member	1.40×10^{-5} m/s
TPSA02	Weathered Beckley Sand Member	2.23×10^{-5} m/s

Table 1. Summary of Soakaway Test Results

Stratum	Exploratory holes encountered	Depth to top of stratum m bgl	Proven thickness (m)
Made ground	WS01 – WS04, WS06, WS10, BH01, BH03, TT02, TT03, TT03a, TT04, TT04a, TPSA01, TPSA02, CBR02, CBR05, and CBR07 to CBR09	0.00 – 0.50	Up to 2.50
Topsoil	WS05, WS06, BH02, CBR03.	0.00	Up to 0.70
Weathered Beckley Sand Member	WS01 – WS07, WS10, BH01 – BH03	0.45 – 2.50	Up to 3.59
Beckley Sand Member	BH01 – BH03	3.70 - 4.50	Up to 10.92

Figure 2 Summary of encountered strata (Ref: 252995 R02 (00))

2.4 Aquifer Designation

An extract from the geographic information map (Figure & Figure) provided by Natural England indicates that the site is located on a superficial drift aquifer that is classified as unproductive. These are generally unable to provide useable water supplies and are unlikely to have surface water and wetland ecosystems dependant on them.

Figure 3 indicates that the site is located on a bedrock aquifer that is defined as Secondary A bedrock. These aquifers can support local useable water supplies and may have an important contribution towards base flow to rivers.

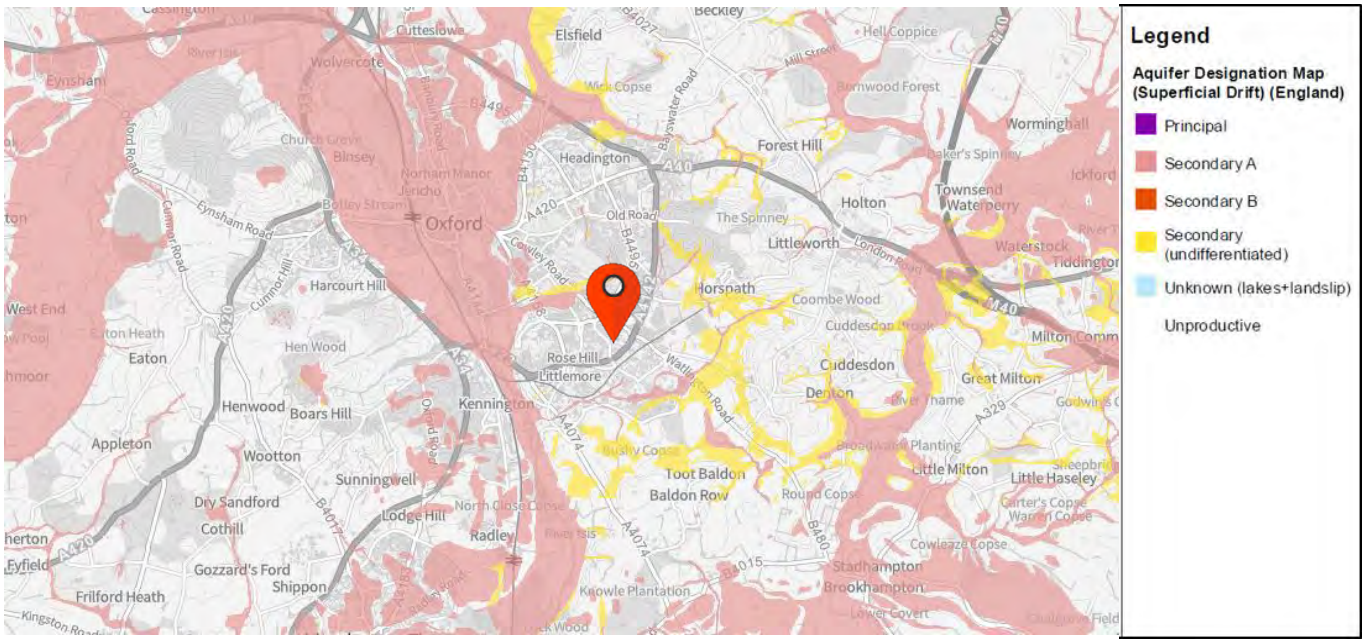


Figure 2. Aquifer Superficial Drift designation map

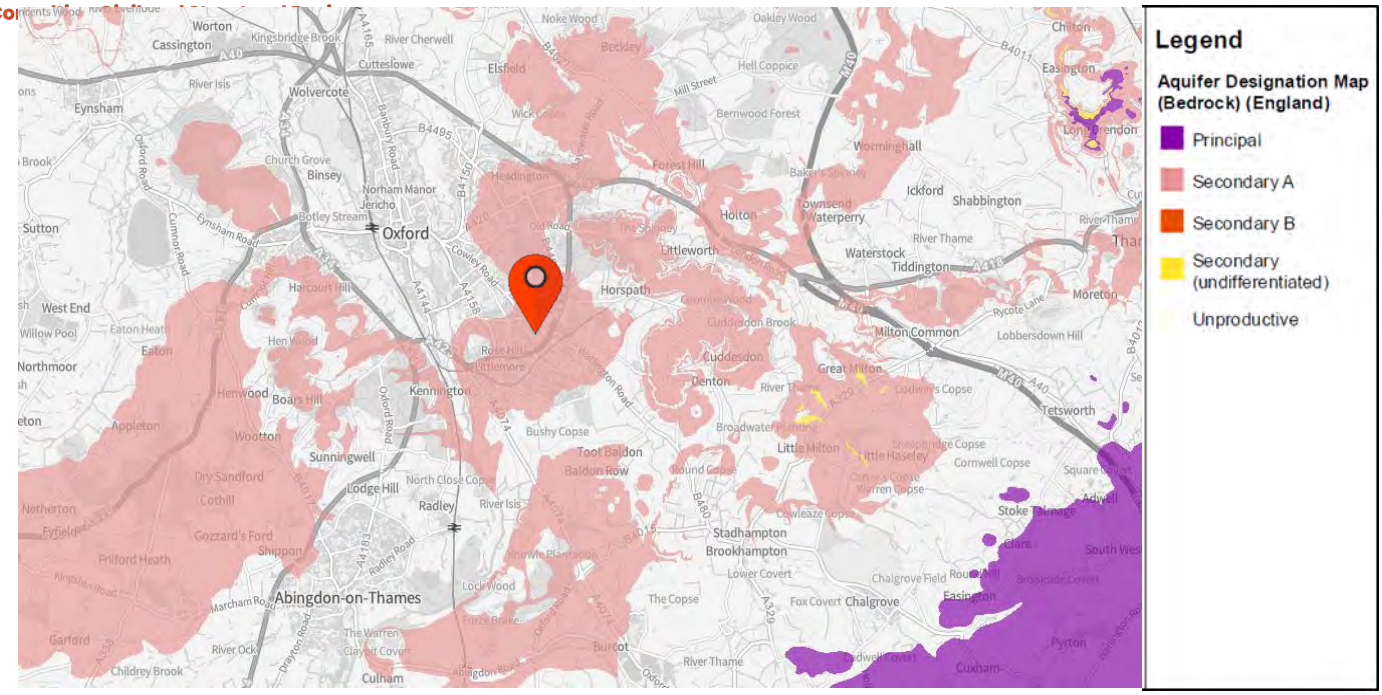


Figure 3. Aquifer Bedrock designation map

2.5 Site Specific Flood Risks

This section reviews the possible sources of flooding relevant for the site and assesses the impacts both on the development itself and on other areas as a result of the proposed development.

The Environment Agency is responsible for the provision of information pertaining to flood risk from tidal and main watercourses throughout England and Wales. The EA provides an online information service through its flood map data. An extract from the flood map is given in Figure 4 which indicates that the proposed site is in Flood Zone 1. The EA identifies Flood Zone 1 as land having a less than 1 in 1,000 annual probability of river or sea flooding.

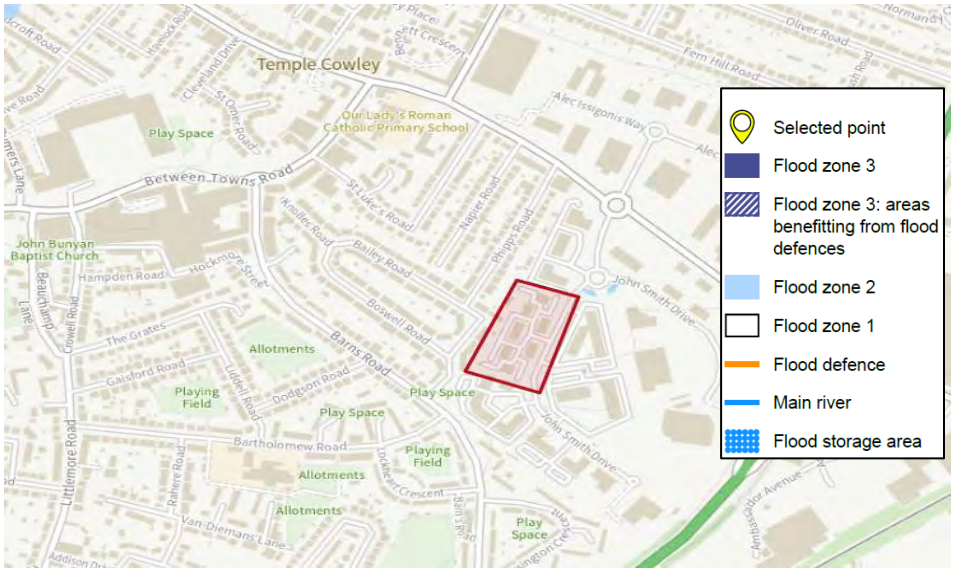


Figure 4. EA's Flood map for planning

2.5.1 Tidal/Fluvial Flooding

Tidal/Fluvial flooding occurs when sea levels rise and flow into a water course causing the water table levels to rise or water levels rise as a result of high or intense rainfall flowing into a watercourse, resulting in water courses overflowing their banks.

Sea (Tidal) Flooding – The proposed sites are not located in the vicinity of the coast and is therefore not at risk of flooding due to tidal flows.

River (Fluvial) Flooding – The proposed sites are not located adjacent to any river. Therefore, there is no risk of flooding from fluvial flows.

From Figure , the EA depicts the site is in a very low risk area. Meaning, each year this area has a chance of flooding less than 1 in 1,000 (0.1%) from tidal and fluvial flows.

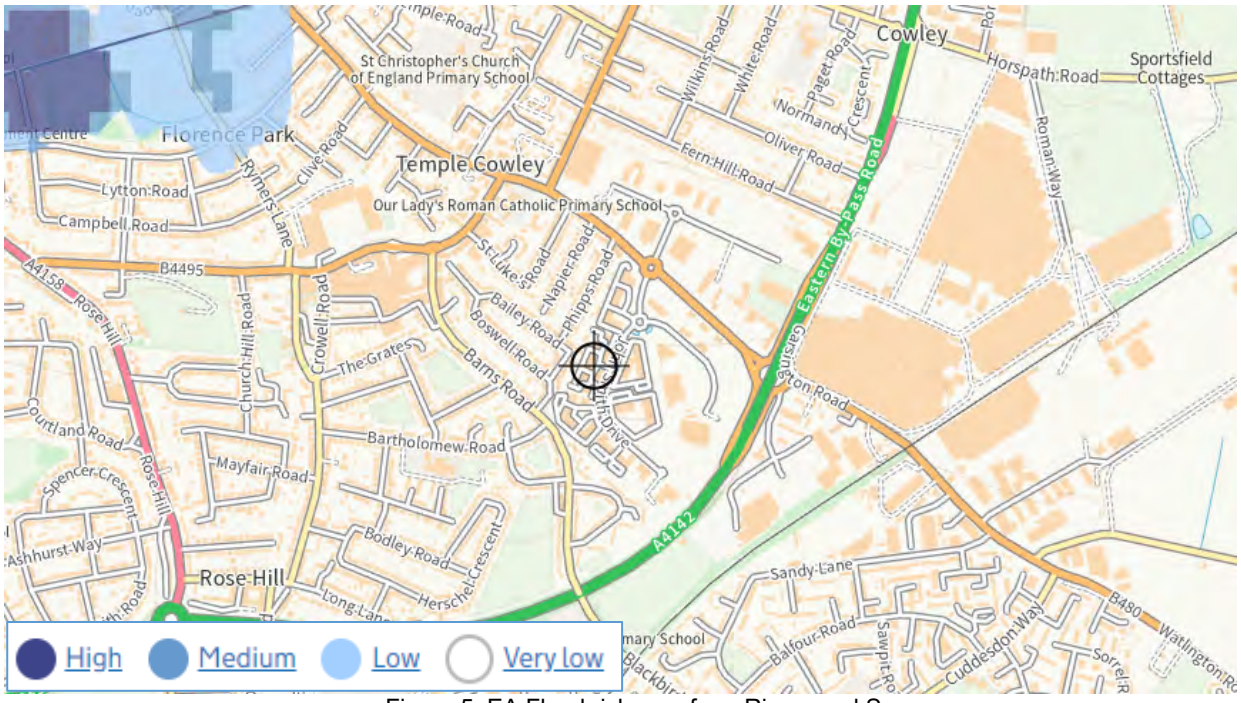


Figure 5. EA Flood risk map form Rivers and Sea

2.5.2 Surface Water Flooding (Pluvial Flooding)

Surface water flooding can occur when heavy rainfall overwhelms the local drainage network and also depends on existing ground levels, rainfall and the local drainage network. The EA website contains mapping of areas believed vulnerable to surface water flooding. An extract from the flood map is given in Figure . This shows that the site is in a low flood risk area, meaning that each year this area has a chance of pluvial flooding of between 0.1% and 1%. This considers the effect of any flood defences in the area.

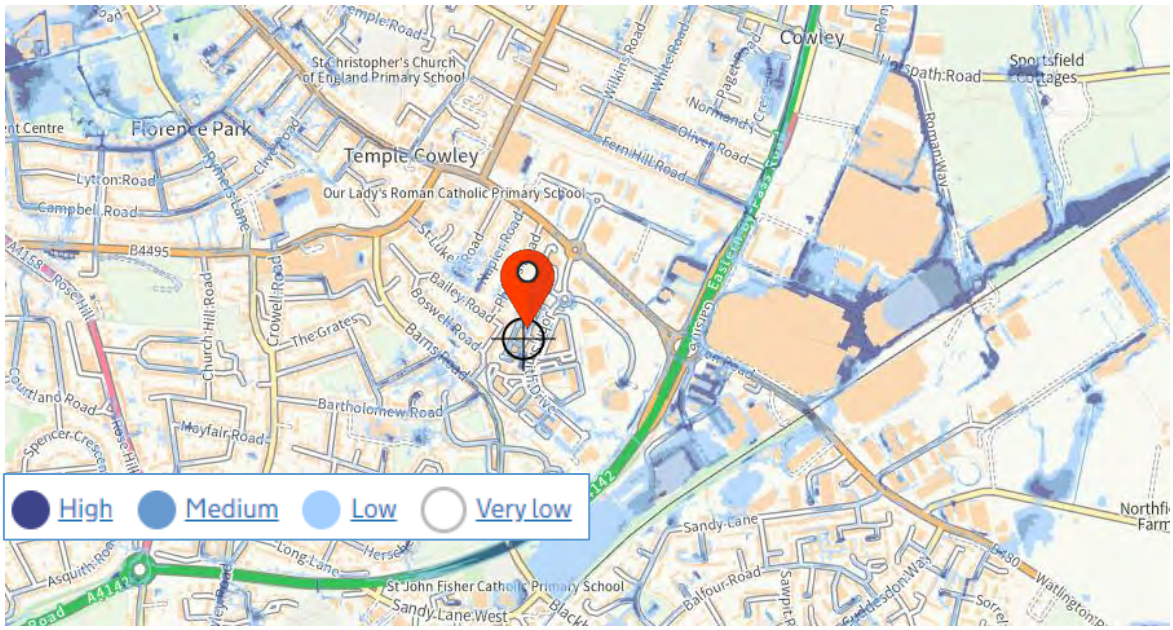


Figure 6. EA Flood risk map from Surface water

2.5.3 Historic Flooding

An extract from the Oxfordshire City Centre Level 1 SFRA indicates that numerous historical flood events have been recorded from the river Thames. The most recent floods recorded date back to winter 2003 and summer 2007 where extensive areas of the district were affected by widescale flooding as a result of several intensive rainfall events. The SFRA does not define which areas were most affected during this event, therefore it cannot be understood whether the site location was affected. There are no further recordings of historical flooding at the site beyond this date.

2.5.4 Sewer Flooding

An extract from Oxfordshire City Council Level 1 SFRA is included in Appendix B and indicates that the level of risk posed by sewer flooding within the vicinity of this development is low. The records provided show flood incidents on a postcode basis which indicates 0 surface water flooding and 1 foul water incidents have occurred within the vicinity of this development.

2.5.5 Groundwater Flooding

An extract from the Oxfordshire City Council Level 1 SFRA is included in Appendix B. Groundwater floods were mentioned within the SFRA, however it has been stated that there are locations within the district that are affected by high water tables. An extract from the geographic information map is show in Figure 7 and indicated that the site location is classified as high risk.

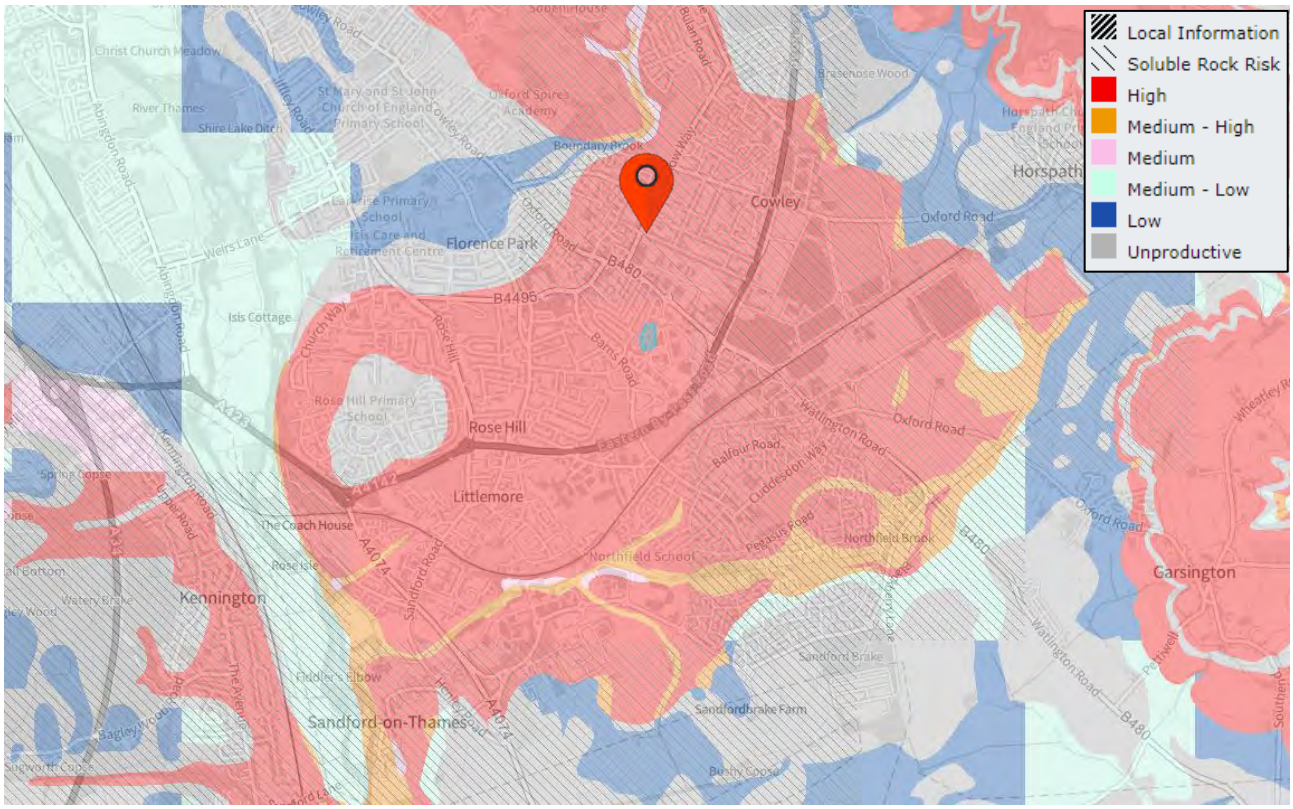


Figure 7. Groundwater Vulnerability Map

2.6 Source Protection Zone

The EA have defined Source Protection Zones (SPZs) for 2000 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 closer the activity, the greater the risk. The maps show three main zones (inner which is buffered around the abstraction point, outer and total catchment) and a fourth zone of special interest.

The zones are used in conjunction with the EA's Groundwater Protection Policy to set up pollution prevention measures in areas which are at a higher risk, and to monitor the activities of potential polluters nearby.

As shown in Figure 8. EA Source protection zones, the proposed development is not near or within any source protection zone.

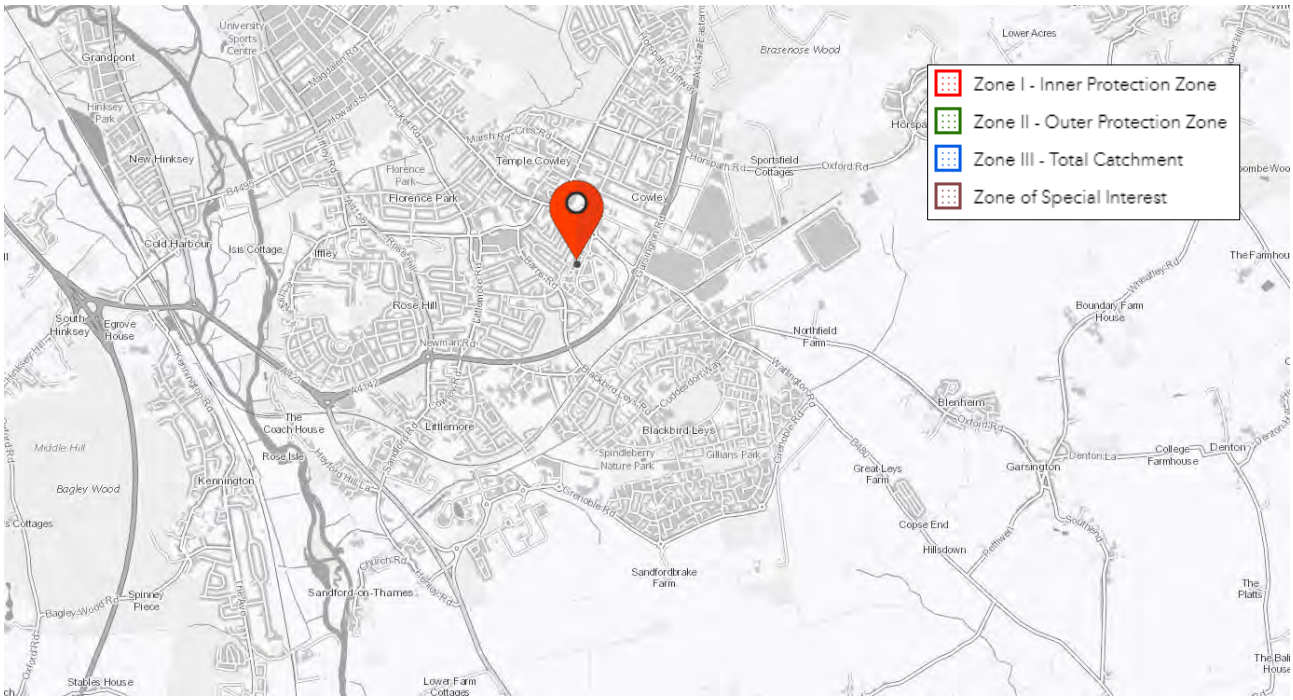


Figure 8. EA Source protection zones

3 Proposed Site

3.1 Description of development

The current site is classed as brownfield. The current proposed application is to demolish 7 existing office buildings to be redeveloped to provide a single laboratory – enabled office building with associated infrastructure.

A copy of the site's layout plan can be found in Appendix C.

It has been estimated that the proposed development will have an impermeable area of 0.70ha and a permeable area of 0.57ha. These figures are subject to change slightly as the layout detail progresses.

The proposed site levels will be set such that they try to (where possible) follow the contours of the existing site so as to minimise the requirement for any retaining walls and also adhere to best practice and building regulation design standards.

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

4 Drainage Policy & Consultation

4.1 Drainage Authority

The local water authority is Thames Water. Thames Water has been contacted for information regarding the public storm and foul water sewers.

Section 5.116 gives the hierarchy of disposal. If draining to a watercourse a permit will be required from the E.A., LLFA or IDB.

4.2 Lead Local Flood Authority

The Lead Local Flood Authority (LLFA) is Oxfordshire County Council. Oxford City Council has a Strategic Flood Risk Assessment (SFRA) and Local Plan which define flooding and drainage requirements.

Key items within the SFRA are:

- An allowance needs to be made for the climate change over the life of the development for the 1 in 100-year event with an allowance for climate change as per the latest EA's guidance.
- Use of SuDS (where possible use of strategic SuDS should be made)
- Brownfield sites should seek to discharge surface water from the redeveloped site at Greenfield rates wherever possible. As a minimum, betterment should be offered (in terms of reduced runoff) for all redeveloped sites.
- 1 in 100-year attenuation of surface water, taking into account climate change.

4.3 Application of Flood Risk Policy

Based on the EA's flood maps it is possible to undertake an initial site flood risk compatibility assessment to ascertain whether the proposed development site is presently suitable for development by referring to the flood zone compatibility matrix (Table).

Table 2.Flood Risk Vulnerability and Flood Zone Compatibility

		Essential infrastructure	**Water compatible**	**Highly vulnerable**	**More vulnerable**	**Less vulnerable**
Flood Zones	**Zone 1**	√	√	√	√	√
	Zone 2	√	√	Exception Test required	√	√
	Zone 3a	Exception Test required	√	x	Exception Test required	√
	Zone 3b Functional Floodplain	Exception Test required	√	x	x	x

Key: √ - Development is appropriate

x - Development should not be permitted

Notes to table:

This table does not show:

- The application of the Sequential Test which guides development to Flood Zone 1 first, then Zone 2 and then Zone 3.
- Flood Risk Assessment requirements, or
- The Policy aims for each flood zone.

Table 3. Flood Risk Vulnerability Classification

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly Vulnerable	• Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent (where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations or need to be located in other high flood risk areas, in these instances the facilities should be classified as “essential infrastructure”).
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non-residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities and hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	• Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non-residential institutions not included in “more vulnerable” and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (expect landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Navigations facilities. • Ministry of Defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.
Water Compatible Development	• Water treatment works which do not need to remain operational during times of flood. • Sewerage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place). • Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewerage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves.

4.3.1 Sequential Test

The Sequential Test is intended to direct new development to an area of lowest probability of flood risk and ensure development is in the most appropriate flood zone.

As the development's extents of the site are within Flood Zone 1 and are Low Vulnerability in nature, the development can be considered appropriate for the proposed use, and therefore passes the Sequential Test.

4.3.2 Exception Test

The Exception Test is not required as the site is located within Flood Zone 1.

4.3.3 Flood Risk Assessment Summary & Mitigation Measures

Table contains a summary of the flood risks to the proposed site. Mitigation measures to address the identified risks are discussed below.

Table 4. Summary of Flood Risks

Flood Risk	**Risk Level**	**Action Required**
Tidal/Fluvial	Very Low	None
Surface Water	Low	None
Sewers	Medium	None
Groundwater	High	None
Artificial	N/A	None
Run-off	Low	Mitigation Required

5 Drainage Strategy

5.1 Hierarchy of Disposal

Generally, the aim should be to discharge surface water run-off as high up the following hierarchy of drainage options as reasonably practicable.

- Into the ground (infiltration)
- To a surface water body
- To a surface water sewer, highway drain, or other drainage systems
- To a combined sewer

5.1.1 Infiltration

As mentioned in section 2.3 of this report, the site is underlain by Weathered Beckley Sand Member. The presence of these materials indicate that infiltration can be considered a viable option of discharge. Infiltration tests were conducted during the investigation works and have produced an average discharge rate of 1.82 x 10^{-5} m/s. This infiltration rate confirms discharging surface water flows to ground via infiltration techniques is a viable strategy. Further testing is to be completed to confirm discharge rates at the proposed levels of the cellular soakaways.

An extract of the site investigation report can be found in Appendix E.

5.1.2 Water Body

There is no existing water body near the immediate vicinity of the site.

5.1.3 Surface Water Sewer/Combined Sewer

Records indicate there is existing public surface and foul water sewers running down Bailey Road into the Nash Court development and then reconnecting onto the public sewers beneath John Smith Drive. According to records, the foul drainage system is owned by Thames Water and currently serves the residential properties along Bailey Road and the existing development.

The current drainage system on site outfalls into the public drainage. A pre-planning enquiry would need to be submitted to confirm that outfall into the public drainage system is a viable means of discharge.

5.2 Sustainable Drainage

Potential SuDS techniques considered for the proposed site.

5.2.1 Rainwater harvesting

Rainwater harvesting (RWH) is the collection of rainwater runoff for use. Runoff can be collected from roofs and other impermeable areas, stored, treated (where required) and then used as a supply water for domestic, commercial and/or institutional properties.

The rainwater harvesting will be disproportionate in terms of cost and function in regards to the proposed development features (Toilet, sinks etc.) Therefore, rainwater harvesting has been disregarded

5.2.2 Green Roofs

Green roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover, over a drainage layer. They are designed to intercept and retain precipitation, reducing the volume of run-off and attenuating peak flows.

A green roof has been incorporated within the proposed drainage strategy.

5.2.3 Soakaways

Soakaways are square or circular excavations either filled with rubble or lined with brickwork, precast concrete or polyethylene rings/perforated storage structures surrounded by granular backfill. They can be grouped and linked together to drain large areas including highways. The supporting structure and backfill can be substituted by modular geo-cellular units. Soakaways provide storm water attenuation, storm water treatment and groundwater recharge.

Due to ground investigation results in the existing ground conditions of this report, infiltration has been deemed as a viable means of discharge.

5.2.4 Swales

Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate. They should promote low flow velocities to allow much of the suspended particulate load in the storm water runoff to settle out, thus providing effective pollutant removal. Roadside swales can replace conventional gullies and drainage pipes.

Swales cannot be incorporated into the landscape design due to space restrictions.

5.2.5 Pervious Pavements

Pervious pavements provide a pavement suitable for pedestrian and/or vehicular traffic while allowing rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored between infiltration to the ground, reused or discharged to a watercourse or other drainage system. Pavements with aggregate sub-bases can provide good water quality treatment.

Pervious surfaces have been incorporated into the design for car parking spaces.

5.2.6 Geo-cellular/Modular Systems

Modular plastic geo-cellular systems with a high void ratio can be used to create a below ground storage structure. Modular tanks can be used for runoff attenuation but require silt trap protection and a suitable means of access for cleaning and inspection.

A Geo-cellular system have been adopted on the proposed development.

5.2.7 Ponds/Infiltration Basin

Ponds can provide both storm water attenuation and treatment. They are designed to support emergent and submerged aquatic vegetation along their shoreline. Runoff from each rain event is detained and treated in the pool. The retention time promotes removal of silt through sedimentation and the opportunity for biological uptake mechanisms to reduce nutrient concentrations.

Due to the nature and lack of space with the development ponds and infiltration basin cannot be incorporated into the proposed drainage strategy.

5.3 Sustainable Drainage Maintenance

The various SuDS features will remain privately owned and be maintained by the developer. The exact details of this arrangement will be defined when future tenants are confirmed.

The SuDS operation and maintenance strategy will be in accordance with CIRIA C753 best practice, as tabled below:

Table 5. SuDS Operation and maintenance requirements

Monthly	Inspect upstream catchpits for silt and vortex control manhole for debris. Clean out if necessary, using vacuum tanker.
Every Six Months	Remove sediment from the inlet catchpit with a vacuum tanker twice a year as necessary, ideally at the start of Spring when general landscaping tidying up is carried out after winter damage and autumn leaf fall.
Annually	Annually inspect/check all sumps, inlets, outlets, vents to tanks to ensure that they are in good condition and operating as designed. Inspect distribution pipe by CCTV. If necessary clean out.
Remediation Inspection & tasks following significant storm events	Inspect upstream and downstream catchpits for silt and vortex control manhole for debris. Clean out as necessary using vacuum tanker.
Contingency plan details	Exceedance flows as defined in the Drainage Strategy Drawing.

6 Drainage Strategy – Surface Water

6.1 Proposed Surface Water Runoff Rate

Based on the Environment Agency Guidance for climate change published in February 2016, a climate change allowance of 20% should be considered with a sensitivity check carried out for 40%.

In accordance with the LLFA requirements, Brownfield sites should seek to discharge surface water from the redeveloped site at Greenfield rates wherever possible. As a minimum, betterment should be offered (in terms of reduced runoff) for all redeveloped sites. The total Qbar rate for the development is 4.7l/s.

A copy of the drainage plan can be found in Appendix C.

6.2 Proposed Attenuation Storage

Attenuation storage is provided to enable the runoff rate from the site into the receiving sewer to be limited to an acceptable rate to protect against flooding downstream. The estimate storage volume has been calculated using FSR hydrological zones and factor for FEH, climate change and hydrological region. Using a hydraulic modelling software, the total required attenuation for the proposed development is approximately 481m^3 in a 1 in 100 year plus 40% climate change event. The proposed attenuation is 114m^3 of proposed Geo-cellular tanks and 367m^3 within the pervious pavements.

6.3 Proposed Surface Water Drainage Strategy

Storm water discharging from the development will be attenuated and controlled using a hydrobrake with a maximum allowable discharge rate of 4.7 l/s for the 1-in-100 year event. The proposed development will follow the current flow of surface water and discharge into the existing water course southeast of the site.

For the 1 in 100 years plus climate change event should any flooding occur at the surface level this would be of no more than 100mm in depth and be contained safely within site, without risk to proposed or existing buildings. A copy of the proposed drainage strategy can be found in Appendix C.

7 Summary

The site lies within Flood Zone 1 and would provide a ‘less vulnerable’ end use within the Flood Risk Vulnerability Classification. Accordingly, the Sequential Test is passed and an Exception Test is not required. The Site is at ‘low risk’ of pluvial (surface water) flooding but at ‘high risk’ of groundwater flooding, although it does not lie near or within any Source Protection Zone.

Drainage is proposed to be directed into existing public sewer networks beneath John Smith Drive, subject to confirmations this is a viable means of discharge. It is not possible to direct discharge into an existing water body. Infiltration has been discounted at this stage, but subject to the results of further site investigations and infiltration tests, infiltration may be incorporated as a means of discharge.

A variety of SuDS features have been considered and incorporated within the design of the development. Surface water discharge will be attenuated by green roofs, pervious pavements and geo-cellular systems with a combined attenuation volume of approximately 481m^3 – equivalent to a 1 in 100 year plus 40% climate change event. This will lead to a discharged surface water rate equivalent to 4.7l/s.

Foul water is proposed to be discharged into the existing foul sewer system that follows the south western boundary of the Site.

Overall, the Proposed Development is not at any increased flood risk from the Site itself or adjacent developments, nor it would lead to increased flood risk elsewhere.

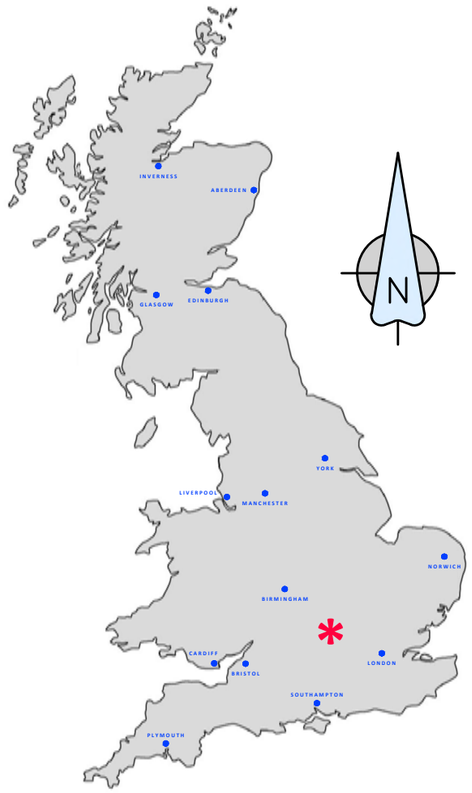
BAYNHAM MEIKLE
Consulting Civil and Structural Engineers

Appendix A – Existing Information

A.1 Site Location Plan

A.2 Topographical Survey

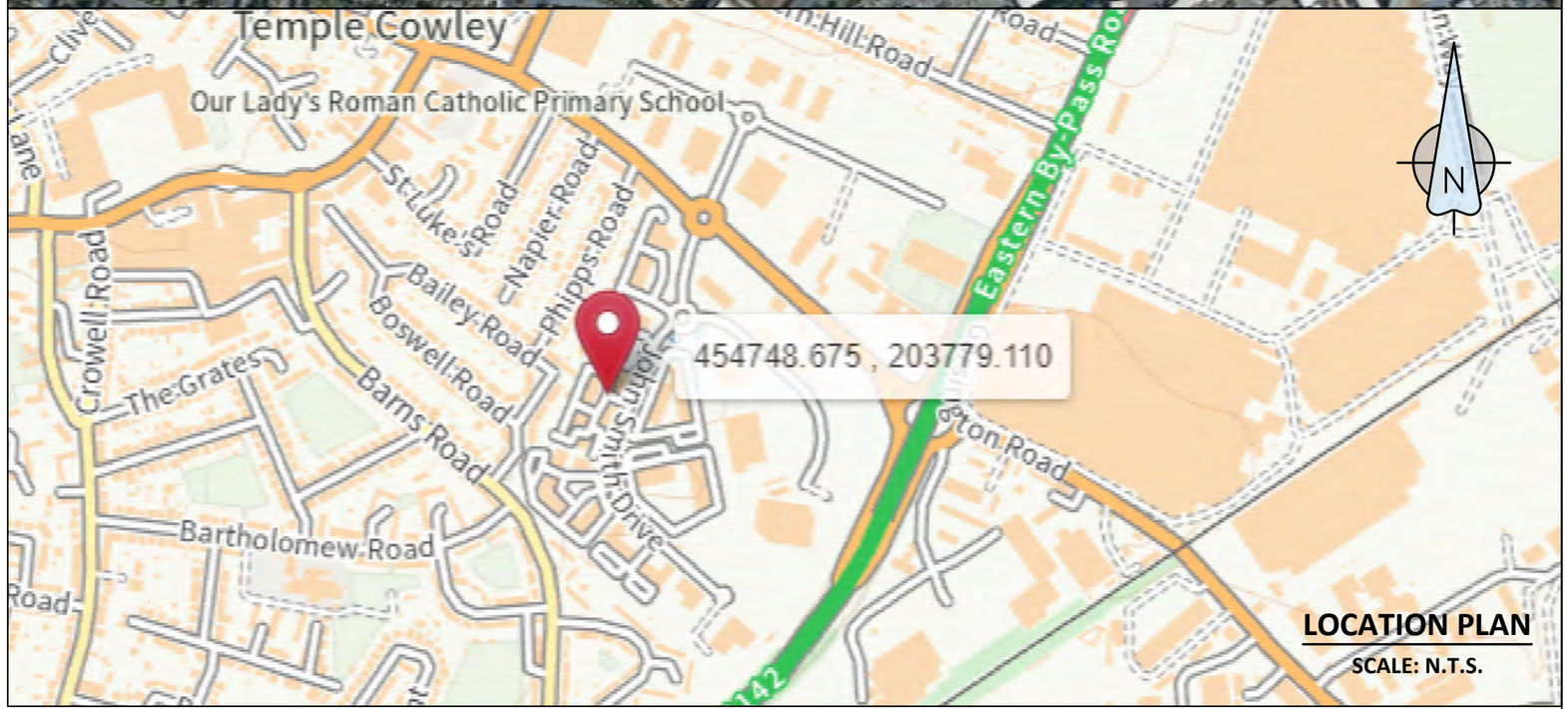
A.3 Constraints Plan



SITE DETAILS		
Address:	NASH COURT, OXFORD BUSINESS PARK, COWLEY, OXFORD	
Nearest Postcode:	OX4 2RU	
Grid Co-Ordinates:	E: 454748	N: 203779

SITE PLAN
SCALE: N.T.S.

Notes | A3



LOCATION PLAN
SCALE: N.T.S.

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CHECK: For the plan to be in scale, the above scale bar must measure correct, i.e. 100mm when printed.

Project Title
NASH COURT REDEVELOPMENT

Drawing Title
SITE LOCATION PLAN

Drawing Status
For Information

BM Ref	Scale @ A3	Drawn by	Checked by	Project Eng	Drawing Number	Revision
13520	1 : —	M.R.	J.H.	J.H.	**13520_100**	**—**

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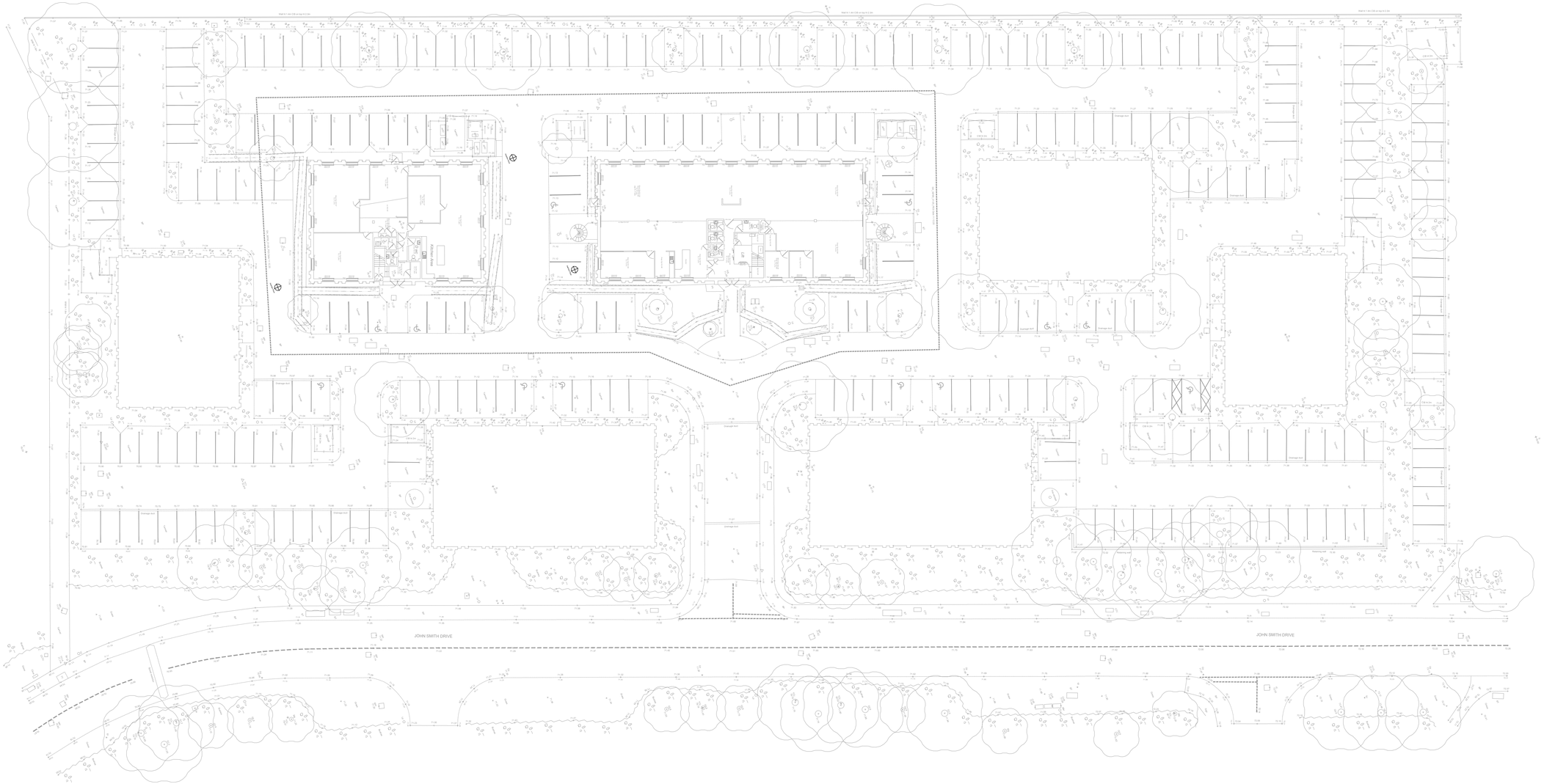
Rev	Date	Description	By	Chkd
A	01/08/2023	First Issue.	M.R.	J.H.

Revision Schedule



Notes

A0

1. Topographical Survey carried out by **Macgregor Smith**, Drawing No.:
   - **05879 4200 - Topographical Survey Plan** (Dated **19/05/2023**).
2. Do not scale from this drawing. All dimensions must be checked & verified on-site. If in doubt ask.
3. The Contractor is to check & verify all dimensions & levels before any work is started on-site.
4. Existing site survey works have been carried out by others & no guarantee can be given by Baynham Meikle for their accuracy.
5. Any discrepancies noted on-site are to be reported to Baynham Meikle immediately.
6. This drawing is to be read in conjunction with all relevant Architects', Engineers' and other Specialists' drawings & specifications.
7. For existing ground conditions, refer to Site Investigation reports.

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0 mm 10 mm 20 mm 30 mm 40 mm 50 mm 60 mm 70 mm 80 mm 90 mm 100 mm

CHECK: For the plan to be in scale, the above scale bar must measure correct, i.e. 100mm when printed.

Rev	Date	Description	By	Chkd
A	10/08/2023	First Issue	M.R.	N.S.B.

Revision Schedule

Drawing Status

For Information

Project Title

NASH COURT REDEVELOPMENT

Drawing Title

TOPOGRAPHICAL SURVEY PLAN

Drawing Number: **13520_101**

Revision: **A**

BM Ref	Scale @ A0	Drawn by	Checked by	Project Eng
13520	1 : 200	M.R.	J.H.	N.S.B.

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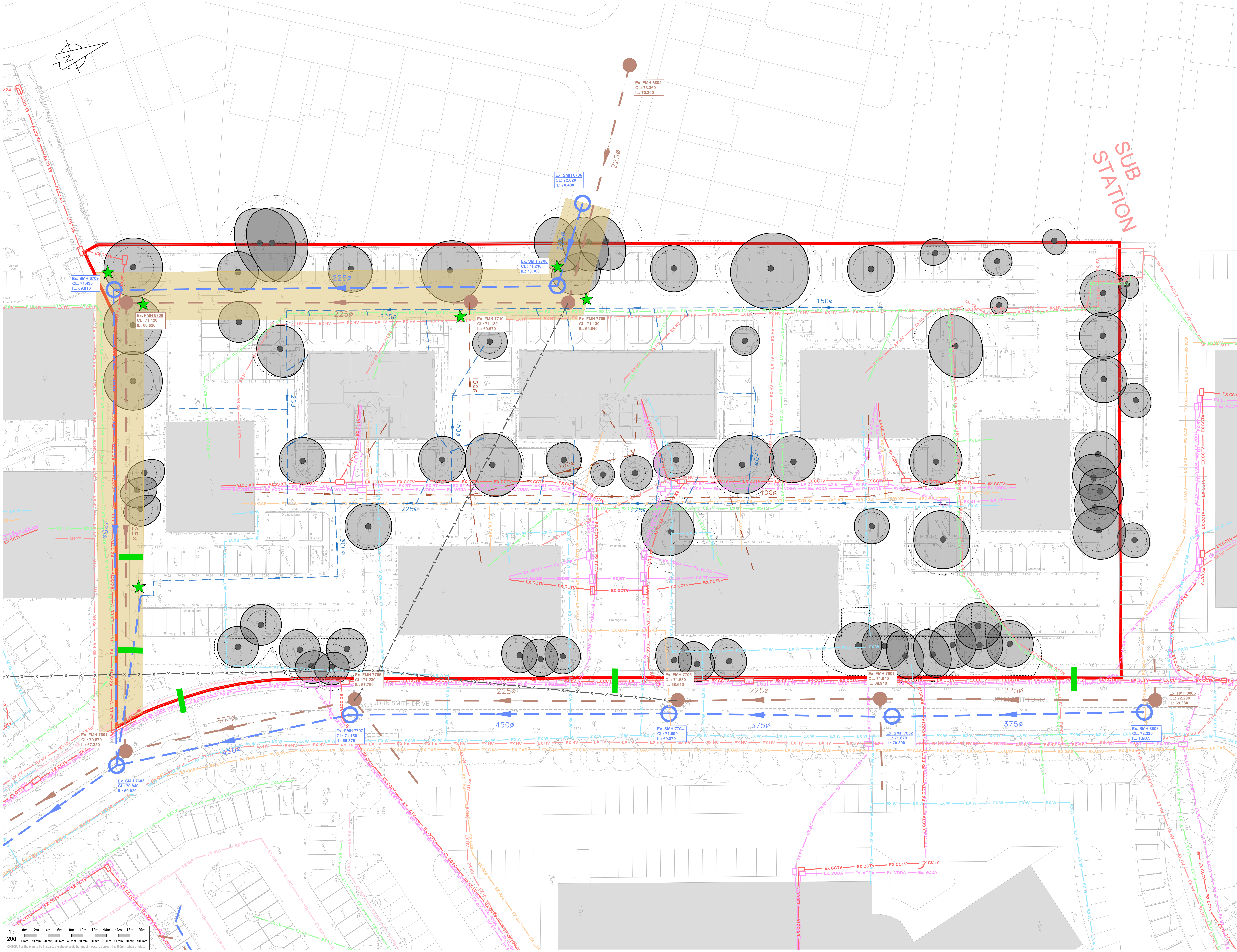

Notes

A0

1. Do not scale from this drawing. All dimensions must be checked & verified on-site. If in doubt ask.
2. The Contractor is to check & verify all dimensions & levels before any work is started on-site.
3. Existing site survey works have been carried out by others & no guarantee can be given by Baynham Meikle for their accuracy.
4. Any discrepancies noted on-site are to be reported to Baynham Meikle immediately.
5. This drawing is to be read in conjunction with all relevant Architects', Engineers' and other Specialists' drawings & specifications.
6. For existing ground conditions, refer to Site Investigation reports.

NOTE:

ALL EXISTING UTILITIES HAVE BEEN TAKEN FROM EXTERNAL SOURCES, AND THEIR ACCURACY CANNOT BE GUARANTEED BY BAYNHAM MEIKLE. THE PRECISE LOCATIONS, DEPTHS AND SIZES OF EXISTING UNDERGROUND UTILITIES WILL NEED TO BE CONFIRMED BEFORE ANY WORK IS STARTED ON-SITE. ANY REDUNDANT UTILITIES ENCOUNTERED ARE TO BE CONFIRMED DEAD VIA ON-SITE TESTING.

KEY:

- NASH COURT - SITE BOUNDARY.
- EXISTING PUBLIC STORM DRAINAGE.
- EXISTING PUBLIC FOUL DRAINAGE.
- EXISTING PRIVATE STORM DRAINAGE.
- EXISTING PRIVATE FOUL DRAINAGE.
- EX BT — EXISTING B.T. TELECOMS.
- Ex. VODA — EXISTING VODAFONE.
- EX CCTV — EXISTING C.C.T.V. / SECURITY.
- EX W — EXISTING WATER MAINS.
- EX GAS — EXISTING GAS MAINS.
- EX HV — EXISTING H.V. ELECTRICITY.
- EX LV — EXISTING L.V. ELECTRICITY.
- EX IRR — EXISTING IRRIGATION MAINS.
- EXISTING EASEMENTS.
- X — X — EXISTING REDUNDANT DRAINAGE.
- EXISTING TREE ROOT PROTECTION AREAS.
- LOCATION OF PROPOSED TRIAL TRENCHES (5 No. TOTAL).
- EXISTING MANHOLES TO BE INVESTIGATED (6 No. TOTAL).

Rev	Date	Description	By	Chkd
B	24/01/2024	Existing Services Records updated.	K.M.	N.S.B.
A	10/08/2023	First Issue.	M.R.	N.S.B.

Revision Schedule

Drawing Status

For Information

Project Title

ARC Oxford
Nash Court Redevelopment

Drawing Title

Existing Site Constraints Plan

Drawing Number: **13520-102**

Revision: **B**

BM Ref	Scale @ A0	Drawn by	Checked by	Project Eng
13520	1 : 200	M.R.	J.H.	N.S.B.

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Appendix B – EA & SFRA Information

B.1 SFRA: Flooding incidents and regulations extract

2.0 PHASE 1 – DESK RESEARCH

2.1 Summary

The purpose of the desk research phase of the SFRA is to identify and obtain information regarding flood risk. It is during this phase that existing knowledge has been collated with regards to the source and extent of flood risk, existing flood management measures and the land use and development opportunities within Oxford. It should be noted, however, that the flood risk in Oxford is dependent on factors upstream and downstream of Oxford within the Thames and Cherwell river catchments. Policies that other local authorities have in managing flood risk will influence flood risk in Oxford, the Joint Vale of White Horse and South Oxfordshire SFRA and the Joint Cherwell and West Oxfordshire SFRA have been reviewed to identify potential impacts of their activities to Oxford City

Consultations were undertaken with Oxford City Council, the Environment Agency, British Waterways, Thames Water and adjoining LPAs.

The information gathered during this phase is used to assess the potential extent and frequency of flood risk.

2.2 Flooding Sources

2.2.1 Fluvial

The primary source of flood risk in Oxford is fluvial flooding based on the number of properties at risk. Located at the confluence of the Rivers Cherwell and Thames, the city is vulnerable from both watercourses independently and, in wider flood events, concurrently.

The River Thames flows into the city from the North-West, passing through Wolvercote before entering the western side of the city centre. The River Cherwell flows into the city from the North-East, passing through Marston before entering the eastern side of the city centre. The flood plains of both of these watercourses consist of farm land and recreational area with few properties at risk.

The River Cherwell joins the River Thames south of the city centre, which then flows south through New Hinksey and out of the city boundary. In this area, the flood plain contains a number of housing estates which are known to have flooded in 2003.

Boundary Brook also joins the River Thames, south of New Hinksey, and the Environment Agency's Flood Zone Mapping suggests that there is flooding along its length. Historically flood events have shown a greater area of flooding than the flood zones due to the affect of structures on water levels within the watercourse. The Environment Agency have recently been undertaking modelling work to establish risk more accurately in this area.

The River Thames and the River Cherwell flow through wide, flat floodplain corridors upstream, through, and downstream of Oxford City. During times of high water, out-of-bank flow causes flooding across these low lying floodplains covering vast areas. This out of bank flow potentially impacts the urban areas of New Botley, Osney, New Hinksey, South Hinksey, Grandpont, Wolvercote, Summertown and New Marston.

Further flood risk is associated with Castle Mill Stream through the West End of Oxford, Boundary Brook through Florence Park and Temple Cowley, and Northfield Brook/Littlemore Brook through Blackbird Leys.

2.2.2 Surface Water Drainage

Surface water flooding as a result of sewer blockages, failure or insufficient capacity has the potential to contribute significant flood risk in urban areas. This is due to the rapid run off rates associated with urban land use and the volume of water that flows into the sewer systems in relatively short periods of time.

The sewerage undertaker for Oxford, Thames Water, holds records of flooding issues relating to surface and foul water sewers. Thames Water was consulted and provided the up to date information. The records provided show flood incidents on a postcode area basis during the last 10 year period. This data does not provide the specific location of each incident and is therefore of limited use for providing location specific information. This data is tabulated in Table 1 below and presented graphically in Appendix A.

Table 1: Thames Water Figures on Flooding from Sewers

Postcode	Properties flooded by surface water sewers in last ten years	Properties flooded by foul water sewers in the last ten years	Properties flooded by combined sewers in the last ten years	Total
OX1 2	1	0	0	1
OX2 0	1	6	0	7
OX2 6	0	2	1	3
OX2 8	0	1	0	1
OX4 3	0	1	0	1
OX4 4	0	1	0	1
OX4 6	0	1	0	1
OX4 7	0	1	0	1
Total	2	13	1	16

Of the 16 flood incidents recorded within the Thames Water data, 13 of these incidents were attributed to foul water flooding and therefore, it is assumed that the surface water flood risk from the surface water sewer network, as reported by Thames Water, within the city is low.

2.2.3 Canal Infrastructure

The Oxford Canal runs north south from Coventry to Oxford for approximately 77km before joining the River Thames between Jericho and New Osney. During the final 800m through Jericho the canal and Castle Mill Stream run parallel and in some places are within 5 metres of each other. There are no other canals within the city limits.

The Oxford Canal, Castle Mill Stream and River Thames are linked through a series of locks and spills which enable the management of canal water levels and boat passage between the canal and the river system.

Although British Waterways have not identified any historic occurrences of flood risk associated with the canal within Oxford City, the common assets between canal and river system and the proximity of the canal to the watercourses comprise a potential source of flooding.

The first is associated with the close proximity of the Canal and Castle Mill Stream directly upstream of Hythe Bridge Street which passes over the stream at the northern boundary of the West End area of Oxford. At this location, the two water bodies run parallel within 5m of each other with the water level of the canal approximately 1m above that in the stream. Should failure of the canal bank occur in this location subsequent water spill into Castle Mill Stream could potentially drain the canal as far as Wolvercote Lock (Lock 45) located a further 3.5km upstream.

Further potential for raised water levels in the Castle Mill Stream are associated with failure of the water level control assets located by the cricket ground in Jericho and directly upstream of Hythe Bridge Street. These controls are in the form of spills from the canal into the Castle Mill Stream. Failure of either of these control structures has the potential to raise water levels in Castle Mill Stream and subsequent flood risk through Oxford City centre.

The Oxford canal discontinues at Hythe Bridge Street. There is some interest however, in the possibility of extending the Oxford Canal into the Worcester Street car park.

2.2.4 Groundwater

Groundwater flooding issues do exist within the Thames Valley through Oxfordshire. The floodplain is situated above buried gravels which act as underground reservoirs, spilling into the floodplain when full. The majority of the sites where groundwater flood risk exists are in the low lying areas, also subject to fluvial flood risk.

The Environment Agency has worked with a number of parties, including the British Geological Survey (BGS) to investigate groundwater flooding. The BGS was contacted and enquiries made regarding this collaborative study, the specific aims and findings. Unfortunately, at the time of publishing no specific information was available for incorporation within the SFRA. The BGS did however provide a summary of the study outcomes. It found that the local ground water was linked to river flows and has an independent response to rainfall. A lack of reliable data was identified and a system of water level measurement points for future monitoring purposes was created. The study recognised groundwater as an important source of flooding in Oxford and the investigation into this source of flooding continues.

In addition to the work being undertaken by the BGS and the Environment Agency, a groundwater flooding register is held by the Environment Agency which identifies the locations and narration of specific groundwater flooding events.

The groundwater register contains 21 records of suspected ground water flooding which occurred between 2000 and 2003 inclusive and 2007 and 2009 inclusive. The locations of the incidents are spread throughout, and beyond in the case of 6 incidents, the extents of the Oxford City Boundary but clusters of incidents in the New Hinksey, Grandpont and Sunnymead areas and in the Oxford District area to the East of the city centre can be identified. The incident within the Environment Agency's groundwater records for Headington, north of hospital, has been confirmed to be a mains water leak rather than groundwater.

The type of incident reported is typically associated with cellar and sub floorboard flooding of property and the emergence of groundwater in gardens and garages. **Error! Reference source not found.** presents the information contained within this register.

The map coordinates within the register have been used to map the groundwater flooding incidents and is presented within Appendix B. The Strategic Locations for Development and sites identified within the West End are also shown to demonstrate that there are no recorded incidents of groundwater flooding at any of the site locations put forward by Oxford City Council for development.

The 3 groundwater incidents located within New Hinksey are all located within Flood Zone 3b, the incident in New Botley in Flood Zone 3a and the 2 incidents in the vicinity of Grandpont are located within Flood Zone 3a. The register reports that these 6 locations have underlying gravels, associated with the Thames floodplain, and therefore, the groundwater incidents reported are partially associated with fluvial flooding.

The 4 incidents reported immediately to the west of the Cherwell Thames confluence are within Flood Zone 1.

Table 2 suggests that they are located on gravels, normally associated with floodplain areas, and although these are within Flood Zone 1, the proximity to the Cherwell and Thames floodplains suggests that groundwater emergence at these sites are likely, at least in part, to be associated with periods of high water in the two rivers.

Of the remaining 5 incidents, 2 are located in Headington, 2 in Sunnymead and 1 in Iffley, all of which are located within Flood Zone 1.

Further information on Flood Zones is provided in section 4.3.4.

Table 2: The Groundwater Register (Source. The Environment Agency)

Call_No	Date_	NGR	Location	Geology	Problem
12	18/12/2000	SP5202804302	New Hinksey	Flood plain terrace gravels on Oxford Clay	Water under floorboard
53	10/04/2001	SP480050	North Hinksey	Corallian	New spring in garden - no further action reqd
70	05/08/2001	SP5250105410	University sports centre, east of city centre	Gravel Drift over Oxford Clay	Damp problem in cellar - occurred since last Autumn.
74	25/10/2001	SP525054	University sports centre, east of city centre		Flooding of ground level of split level properties.
82	05/06/2002	SP5570906288	New Headington	Whitchurch Sand	Dirty oily water in garden. Owner is concerned as there are septic tanks up the hill.
83	12/06/2002	SP4621504135	Cumnor	Corallian	No springs indicated in area. Flooding tends to happen after high rainfall - doesn't sound like groundwater then. Problem started in January after road resurfacing - water used to bubble through road
85	18/07/2002	SP4916805407	North Hinksey	Corallian / Oxford Clay Boundary	Water in back garden, building up for about 18 months. Pipes were installed 6 years but don't seem to have improved things. No springs marked but will tend to occur here due to geology.
89	07/01/2003	SP5167004644	New Hinksey	Gravels close to river	Water coming up under kitchen floor. Owner would like to prevent this from occurring again
90	09/01/2003	SP5131205164	Grandpont	Gravels close to river	Water under floor of property
102	23/01/2003	SP5129105397	Grandpont	River gravels	Flooded cellar related to high river levels
106	28/03/2003	SP 524 059	East of city centre	Gravels on clay	Flooding started on 15th October 2002 - tanking failed. Owner wants to prove it is from a student block quite close to the property - thinks it displaced groundwater. I said I couldn't comment too closely on this.
110	26/06/2003	SP5263605697	East of city centre	Oxford clay and adjacent to a small patch of glacial drift gravel	Flooding of cellar
113	19/08/2003	SP5396708200	Headington	Oxford Clay	Seepage in garden. TWUL have tested and said it is groundwater. Problem arose after stop tap on mains was moved.
117	02/12/2003	SP5174804521	New Hinksey	Gravel over Oxford Clay	Groundwater flooding under the floorboards during both the winter 2000/01 and New Year 2003 floods. He would like to buy a pump to stop the water rising during such events.
136	4/01/2007	206931, 455514	Headington	Ampthill Clay and Corallian	After rainfall water seeps through the floor of the building and have to bail it out. Worried about subsidence. OCC and TW also informed. Lives nr Spring Lane.
138	23/01/2007	204260, 452960	Oxford	Gravels/alluvium over Oxford Clay	Flooded basement, probably due to high GW levels in the gravels being unable to drain away
139	19/02/2007	211214, 456620	Beckley	Corallian (Beckley Sands & West Walton Fm)	Water appearing from under her house. Otmoor Lane ditch adjacent to house and springs 150m to the west. Probably natural cause

Call_No	Date_	NGR	Location	Geology	Problem
149	30/07/2007	206250, 449873	Oxford	sand and gravel over West Walton mudstone	Has water in his cellar (didn't ingress into house) would like to know if it's worth pumping out the cellar, or if it would just fill up again.
166	19/01/2008	204228, 451011	South Hinksey	Northmoor member sand and gravels over Oxford Clay	Internal puddles of water in the property. Probably groundwater. Occurred during the fluvial flood event in 2008.
174	12/05/2008	209603, 450523	to the Sand &	Sand & gravels (?) over Oxford Clay	Water-logged garden, thought to be due to poor drainage and the construction below ground. Photos on file
194	12/02/2009	209781, 450894	Oxford	Gravel on oxford clay	soakaway not soaking away. Probably just too much rain and snow melt.

It can be seen from the map in Appendix B that there are no reported incidents in the immediate vicinity of the development sites identified within the West End or the Strategic Locations for Development.

It is therefore concluded that, from the information available, the risk of groundwater flooding does not directly affect any of the proposed development sites. It is noted, however, that the gravels found in the ground beneath Oxford may be the cause of more flooding than has been reported to the Environment Agency. Therefore, more detailed investigation of groundwater flood risk may have to be undertaken as part of any site specific Flood Risk Assessments (FRA) for sites at which groundwater flooding is known to be an issue, or, for sites in locations that are reported to have high groundwater levels, including Greenfield and Brownfield sites.

Future site allocations will need to be assessed against the groundwater flooding information presented within this SFRA.

Further guidance on this issue is presented in Section 6.6.

2.2.5 Neighbouring, Upstream Authorities

When considering flood risk to Oxford City, it is important to recognise the potential impacts to local flooding issues as a result of development and planning policy within neighbouring upstream authorities. The SFRAs of neighbouring authorities have been reviewed as part of this SFRA.

Joint Cherwell District and West Oxfordshire SFRA
A joint Level 1 SFRA was undertaken for the Cherwell District Council and the West Oxfordshire District Council and was published in April 2009. The following sections summarise the development pressures which each of the districts face and the potential downstream impact to Oxford City.

The Cherwell District is located upstream of Oxford City on the River Cherwell, development in the District has the potential for downstream flood impacts to Oxford. The District's SFRA identifies that the main centres for employment type development are in the areas of Banbury and Bicester with the main residential growth areas being seen in Banbury, Bicester and Upper Heyford.

With West Oxfordshire, a significant proportion of the new business development has been concentrated within the larger service centres of Witney, Carterton and Chipping Norton with only a few small scale developments elsewhere. Similarly, housing development is to be targeted in the specific locations of Carterton, Chipping Norton, Eynsham, Woodstock and Witney where half the project developments are expected.

The upstream developments in Cherwell and West Oxfordshire, if left uncontrolled with no requirement to manage flood risk, could potentially have significant negative impacts to the level of risk faced by the residents of Oxford City. However, careful application of PPS25 through a partnered approach between the Environment Agency, the District's planning officers and the developers themselves, these risks can and should be mitigated. PPS25 requires that new developments do not increase the risk of flooding elsewhere. With this in mind, there should be no increased risk of flooding through Oxford as a result of these upstream developments.

Joint South Oxfordshire and Vale of White Horse SFRA
A joint Level 1 and 2 SFRA was undertaken by South Oxfordshire District Council and Vale of White Horse District Council and was published in 2009. The two Districts are predominantly downstream of Oxford although small areas of each to drain into the River Thames upstream of parts of Oxford City. The following sections summarise the development pressures which each of the districts face and the potential downstream impact to Oxford City.

Within South Oxfordshire, Didcot has been identified as the focus for major change with a potential further strategic new development south of Oxford. Development elsewhere will focus on Henley, Thame and Wallingford, with more limited change in and around the villages of Berinsfield, Benson, Chalgrove, Chinnor, Cholsey, Crowmarsh Gifford, Goring, Nettlebed, Sonning Common, Watlington, Wheatley and Woodcote. Development within these areas will not affect flood risk with Oxford.

Within the Vale of White Horse District, the Council's preferred locations for housing growth include Abingdon, Wantage & Grove, Botley, the western edges of Didcot and Faringdon. Employment development will be focused on Harwell Science and Innovation Campus, Milton Park, Wantage & Grove and Faringdon. None of these locations are upstream of Oxford City.

As reported within the SFRA, it is only the proposed developments in Botley, Vale of White Horse, that could potentially lead to increased flood risk in Oxford. However, careful application of PPS25 through a partnered approach between the Environment Agency, the District's planning officers and the developers themselves, these risks can and should be mitigated. PPS25 requires that new developments do not increase the risk of flooding elsewhere. With this in mind, there should be no increased risk of flooding through Oxford as a result of these upstream developments.

2.3 Recent Studies on Flood Risk

Several studies have recently been undertaken within the Thames catchments which have a relevance to the Oxford City SFRA. The main studies that are worth consideration Include:

The Environment Agency has undertaken hydraulic modelling studies within the Thames catchment, specifically through Oxford, which provides additional water level information to those first used to generate the original Flood Map. The Wolvercote hydraulic model (Wolvercote OX5B), developed by the Environment Agency, has been used to refine the previous Flood Map by the Environment Agency. This latest Flood Map has been used within this SFRA.