

Location Plan



SITE LOCATION

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FACTUAL REPORT ON GROUND PRELIMINARY INVESTIGATION

PROPOSED DEVELOPMENT:

MALLINSON SPORTS CENTRE PHASE 2

HIGHGATE SCHOOL, BISHOPSWOOD ROAD, LONDON N6 4NY



Client: **HIGHGATE SCHOOL**
North Road, Highgate
London N6 4AY

Consulting Engineers: **PRINGUER-JAMES CONSULTING ENGINEERS**
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London SW19 4HE

Report ref: **10930/OS**

Date: **22nd February 2024**

FACTUAL REPORT ON PRELIMINARY GROUND INVESTIGATION**PROPOSED DEVELOPMENT:****MALLINSON SPORTS CENTRE PHASE 2****HIGHGATE SCHOOL, BISHOPSWOOD ROAD, LONDON N6 4NY****DOCUMENT ISSUE STATUS:**

Issue	Date	Description	Author	Checked/approved
Rev 0	22/02/2024	First issue	Oana Stanciu BSc, FSG	John Bartley BSc, MSc, FGS, CGeol

This investigation has been undertaken within the constraints of the client's instruction/contract, together with those set out in the 'General information, limitations and exceptions' section at the end of this report. The SCL 'Standard Terms of Appointment' are also included at the end of this report and these identify the contractual arrangements for the investigation. Conclusions or recommendations made in this report are limited to those which can be reasonably based upon the research and/or intrusive investigation work carried out. Any comments which rely on third-party information which has been provided to us are made in good faith and on the assumption that such information is accurate. SCL have not carried out independent validation of any third-party information.

Soil Consultants Ltd (SCL) has prepared this Report for the Client in accordance with the Terms of Appointment under which our services were performed. With respect to third parties, no other warranty, expressed or implied, is made as to the professional advice included in this Report or any other services provided by us. This Report may not be relied upon by any other party without the prior and express written agreement of SCL.

TABLE OF CONTENTS

1.0	Introduction	1
2.0	Site description	1
3.0	Exploratory work.....	2
3.1	Constraints of investigation.....	2
3.2	Dynamic sampler boreholes	2
4.0	Ground conditions	3

General Information, Limitations and Exceptions

Standard Terms of Appointment

APPENDIX

Fieldwork, in-situ testing and monitoring

- ✚ Foreword
- ✚ Standard Penetration Test results
- ✚ SPT hammer calibration certificates
- ✚ Window sample borehole records

Ground profiles

- ✚ Plot of SPT 'N' value versus depth
- ✚ Hand vane profile versus depth

Plans, drawings & photographs

- ✚ Site Plan
- ✚ Location Plan

1.0 INTRODUCTION

Consideration is being given to the construction of a new sports pitch which will be created by a cut and fill operation. In connection with the proposed works, Soil Consultants Ltd (SCL) were commissioned by Pringuer-James Consulting Engineers Ltd (PJCE), on behalf of the client, Highgate School, to carry out a preliminary ground investigation to identify the ground sequence and groundwater conditions. Previous ground investigations have been undertaken by SCL for the Mallinson Sports Centre buildings to the west of the current area of interest (Reports refs: 9916/JRCB, 22/02/16 and 9916A/MR, 06/02/19).

This report describes the intrusive investigation undertaken and provides a summary of the ground conditions encountered. Neither geotechnical nor environmental/contamination testing were requested within the specified scope of investigation.

2.0 SITE DESCRIPTION

A summary description of the site and its general setting is as follows:

Element	Description
Site location and setting	- The site is located in London Borough of Haringey, approximately 500m south from Highgate town centre - Development area is within the grounds of Mallinson Sports Centre, Highgate school - NGR 528020 , 187765
Site dimensions	The site is roughly rectangular in shape measuring – about 60m (NW-SE) x 50m (SE-NE)
Site boundaries	- The site is encircled by mature trees - Mallinson Sports Centre building and Bishopswood Road are present to the west - An all-weather sports pitch is present to the south of the site, beyond a line of mature trees and green areas - The rear gardens of residential properties which front onto Broadlands Road are present to the north - A copse of densely planted mature trees forms the eastern site boundary
Site description	The site comprises an open sloping grassed area
Topography and site levels	- Topographical information supplied (Randall Surveys LLP, Ref: 13849/JV/1, Jan 2016) - Spot levels indicate that the site slopes down gently to the west from a maximum of about +110mOD on the eastern boundary down to about +108mOD in the west

Element	Description
Existing vegetation within site and adjacent properties	 Mature trees on all boundaries including oak, sycamore willow and ash. Tree heights vary with the highest being about 18m tall

The current site features are shown on the Site Plan and Site Photographs which are included in the Appendix.

3.0 EXPLORATORY WORK

The ground investigation was carried out in February 2024 and is described below.

3.1 Constraints of investigation

At the time of the investigation a large proportion of the site area was waterlogged with pooled water on the ground surface. Due to the very soft nature of the ground, access was limited and it was not possible to undertake BH01 and BH02.

The investigation was carried out in accordance with the requirements of PJCE at the specified locations.

3.2 Dynamic sampler boreholes

Three dynamic sampler boreholes (BH03, BH04, BH05) were completed using operated equipment under the supervision of an experienced geo-environmental engineer. In-situ Standard Penetration Testing (SPT) were carried out at appropriate intervals. The hammer Energy Ratio (E_r) for the SPT equipment used was 64%; the relevant test certificate is appended.

4.0 GROUND CONDITIONS

Reference to published BGS data indicates that the site is underlain by the Claygate Member resting upon the London Clay. Beneath variable made ground/superficial soils, the investigation encountered an upper layer of essentially brown/grey mottled silty sandy clay overlying grey to dark grey clay silty sandy clay. For the purposes of this discussion, we have identified the upper mottled clay layer as the Claygate Member and the underlying darker clay as the London Clay. In fact, both of these sub-units are incorporated under the parent unit of the London Clay Formation.

Detailed descriptions of the soils are included on the appended borehole logs. A summary of the ground sequence is as follows:

Stratum	Depth to base	Description and properties
Topsoil	0.20m	➤ Dark brown clayey topsoil
Made ground	Between 0.35m and 0.40mbgl	➤ Dark brown silty sandy gravelly clay ➤ Variable amounts of brick, slate, clinker and ceramic tile fragments ➤ Assessed as being of soft consistency
Superficial Deposits	Between 1.00m and 1.20mbgl	➤ Orange/brown silty sandy gravelly clay ➤ Variable silt, sand and gravel content ➤ Occasional to frequent live rootlets ➤ Assessed as being of soft or firm consistency ➤ SPT N value of 10 indicates medium strength
Claygate Member	Between 2.70m and 3.50mbgl	➤ Brown, grey and orange silty sandy to very sandy clay ➤ Locally grades to clayey sand ➤ Locally laminated ➤ Assessed as soft to firm consistency ➤ SPT N values (between 9 and 14) and hand vane results generally indicate medium strength clay
London Clay	>5.45mbgl (extended below base of boreholes)	➤ Grey silty sandy to very sandy clay ➤ Locally grades to clayey sand ➤ Assessed as being of firm to stiff consistency ➤ SPT N values (between 15 and 20) indicate high strength clay
Groundwater:	➤ Encountered at 0.8mbgl within the inspection pit of BH03 ➤ Strata generally appeared 'damp' below about 1.20m ➤ End of drilling rest levels at depths of between 1.52m and 2.50mbgl	



GENERAL INFORMATION, LIMITATIONS AND EXCEPTIONS

Unless otherwise stated, our Report should be construed as being a Ground Investigation Report (GIR) as defined in BS EN1997-2. Our Report is not intended to be and should not be viewed or treated as a Geotechnical Design Report (GDR) as defined in EN1997-2. Any 'design' recommendations which are provided are for guidance only and are intended to allow the designer to assess the results and implications of our investigation/testing and to permit preliminary design of relevant elements of the proposed scheme.

The methods of investigation used have been chosen taking into account the constraints of the site including but not limited to access and space limitations. Where it has not been possible to reasonably use an EC7 compliant investigation technique we have adopted a practical technique to obtain indicative soil parameters and any interpretation is based upon our engineering experience and relevant published information.

The Report is issued on the condition that Soil Consultants Ltd will under no circumstances be liable for any loss arising directly or indirectly from ground conditions between the exploratory points which differ from those identified during our investigation. In addition, Soil Consultants Ltd will not be liable for any loss arising directly or indirectly from any opinion given on the possible configuration of strata between the exploratory points, below the maximum depth of the investigation or where site conditions have changed since the exploratory work; such opinions, where given, are for guidance only and no liability can be accepted as to their accuracy. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in using this Report. We will provide an indication of the strata configuration within the site based upon exploratory holes undertaken. Any strata boundaries shown will relate to the principal layers but it should be noted that these boundaries could be gradational and the depths identified would then not be definitive. The boundary depths/levels are given for guidance only.

Comments made relating to groundwater or ground-gas are based upon observations made during our investigation unless otherwise stated. Groundwater and ground-gas conditions may vary with time from those reported due to factors such as seasonal effects, atmospheric effects and and/or tidal conditions. We recommend that if monitoring installations have been included as part of our investigation, continued monitoring should be carried out to maximise the information gained.

Specific geotechnical features/hazards such as (but not limited to) areas of root-related desiccation and dissolution features in chalk/soluble rock can exist in discrete localised areas - there can be no certainty that any or all of such features/hazards have been located, sampled or identified. Where a risk is identified the designer should provide appropriate contingencies to mitigate the risk through additional exploratory work and/or an engineered solution.

Where a specific risk of ground dissolution features has been identified in our Report (anything above a 'low' risk rating), reference should be made to the local building control to establish whether there are any specific local requirements for foundation design and appropriate allowances should be incorporated into the design. If such a risk assessment was not within the scope of our investigation and where it is deemed that the ground sequence may give rise to such a risk (for example near-surface chalk strata) it is recommended that an appropriate assessment should be undertaken prior to design of foundations.

Where spread foundations are used, we recommend that all excavations are inspected and approved by suitably experienced personnel; appropriate inspection records should be kept. This should also apply to any structures which are in direct contact with the soil where the soil could have a detrimental effect on performance or integrity of the structure.

Ground contamination often exists in small discrete areas - there can be no certainty that any or all such areas have been located, sampled or identified.

The findings and opinions conveyed in this Report may be based on information from a variety of sources such as previous desk studies, investigations or chemical analyses. Soil Consultants Limited cannot and does not provide any guarantee as to the authenticity, accuracy or reliability of such information from third parties; such information has not been independently verified unless stated in our Report. No liability will be accepted for changes to the ground and groundwater conditions which occur post investigation.

Our Report is written in the context of an agreed scope of work between Soil Consultants Ltd and the Client and should not be used in any different context. In light of additional information becoming available, improved practices and changes in legislation, amendment or re-interpretation of the assessment or the Report in part or in whole may be necessary after its original publication.

Unless otherwise stated our investigation does not include an arboricultural survey, asbestos survey, ecological survey or flood risk assessment and these should be deemed to be outside the scope of our investigation.

We will identify tree and plant species if possible, but a suitably qualified arboriculturalist/botanist should be consulted to provide definitive identification.

Where reference to 'topsoil' is made, this should be construed as any turf (if present) plus any obvious organic-rich/humic layer of soil beneath, which may or may not contain roots/rootlets. Unless otherwise requested, we do not provide a detailed description, undertake sampling/testing for classification purposes or provide a specific classification. The thickness of the 'topsoil' identified on our exploratory hole records is indicative only and should not be used for detailed volume or site strip calculations.

STANDARD TERMS OF APPOINTMENT OF SOIL CONSULTANTS LTD FOR GEOTECHNICAL SERVICES

- 1 Unless previously withdrawn, our offer remains valid for a period of sixty days from date of offer. If an instruction is given after the sixty days we reserve the right to reasonably adjust any cost associated with the project to reflect any variance on the original offer. In placing an instruction to proceed with exploratory work, whether directly from the Client or Client's representative, the Client is deemed to have accepted our Terms of Appointment.
- 2 Our offer is on the basis that free, unhindered access and working conditions are available and that the investigation can be completed in one visit, if applicable. Delays beyond our control will incur additional charges. If additional works outside our offer are required to facilitate the investigation these will be advised and any costs will be passed on to the Client.
- 3 In our quotation we will provide an estimate of any mobilisation period following an instruction to proceed. This estimate will be accurate at the time of quotation, but it should be noted that the mobilisation period may vary at a later date due to factors such as sub-contractor availability and workload.
- 4 In commissioning this work, the Client has a responsibility for the health, safety and welfare of operatives invited to undertake work on their site. The Client shall indemnify us in respect of any failure to fulfil their obligations in connection with all relevant and current Health and Safety Regulations.
- 5 The methods of investigation used have been chosen taking into account the constraints of the site including but not limited to access, space and budgetary limitations. Where it has not been possible to reasonably use an EC7 compliant investigation technique, or where a non-compliant technique has been specified, we will adopt practical and appropriate techniques to obtain indicative soil parameters.
- 6 Unless otherwise stated, our Report should be construed as being a Ground Investigation Report (GIR) as defined in BS EN1997-2. Our Report is not intended to be and should not be viewed or treated as a Geotechnical Design Report (GDR) as defined in BS EN1997-2. Any interpretation which is provided is for guidance only and must not be regarded as design or design recommendation.
- 7 Where excavation is required as part of the exploratory work, the Client shall provide drawings or plans showing accurate and complete locations of all underground services and structures. In performing our service, we shall take reasonable precautions to avoid damage to underground services or structures. We will not be responsible for any damage caused to underground services or structures and will not be liable for any claims for damage, expenses arising or losses unless the location of all underground services or structures are accurately shown on drawings and those plans have been provided to us in good time prior to commencement of the exploratory work. Risk to the Client can be further reduced by undertaking a scan of the site using a specialist underground scanning service which would be intended to identify traceable services at shallow depth.
- 8 With some sites, especially those in certain areas of London and other large towns and cities, there may be a risk of unexploded ordnance (UXO) being present. Unless otherwise stated our offer is on the basis that the Client or their representative provides a preliminary UXO risk assessment for the site. It should be noted that if the site is deemed to be in an area of risk then further measures will be required. These would normally comprise either a more detailed risk assessment and/or specialist site attendance by an EOD engineer. These measures can be commissioned either by the Client or Soil Consultants Ltd. If the Client requires, we would be pleased to obtain a preliminary risk assessment at cost+10%.
- 9 The Client will supply a site plan (to a rational scale), an indication of the scope and type of the proposed development and an indication of any relevant structural loading information.
- 10 Should the Client terminate the contract after instruction, we reserve the right to recover costs associated to work carried out between the time of instruction and the point of termination. Cancellation fees, and material costs shall be charged at cost plus 20% (+VAT). Engineer/technician time shall be charged at £95+VAT per hour and principal consultant/director time shall be charged at £125+VAT per hour.

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- 11 The Report is issued on the condition that Soil Consultants Ltd will under no circumstances be liable for any loss arising directly or indirectly from ground conditions between the exploratory points which differ from those identified during the investigation. In addition Soil Consultants Ltd will not be liable for any loss arising directly or indirectly from any opinion given on the possible configuration of strata both between the exploratory points and/or below the maximum depth of the investigation; such opinions, where given, are for guidance only and no liability can be accepted as to their accuracy. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in using this Report.
- 12 We will provide an indication of the strata configuration within the site based upon exploratory holes undertaken. Any strata boundaries shown will relate to the principal layers but it should be noted that these boundaries could be gradational and the depths identified would then not be definitive. The boundary depths/levels are given for guidance only.
- 13 If and when instructed, an agreed number of contamination tests will be carried out to give an outline assessment of potential contaminants. In some circumstances it may be necessary to recommend further monitoring, contamination testing and assessment and the scope of this work would be agreed with the Client. Notwithstanding this additional scope, local regulatory authorities may have specific requirements which need to be addressed. Unless otherwise agreed or stated our reporting will constitute neither a Quantitative Risk Assessment nor a Remediation Statement or Strategy.
- 14 Our reports are counter-checked by one of our suitably qualified and experienced engineers/geologists.
- 15 Notwithstanding anything to the contrary contained in these terms, our liability under or in connection with these terms whether in contract or in tort, in negligence, for breach of statutory duty or otherwise (other than in respect of personal injury or death) shall not exceed the sum equivalent to ten times our contract fee or £100,000 whichever is less in the aggregate for geotechnical and environmental matters unless otherwise agreed.
- 16 Without prejudice to any other exclusion or limitation of liability, damages, loss, expense or costs our liability for any claim or claims under this agreement be further limited to such sum as it would be just and equitable for us to pay having regard to the extent of our responsibility for the loss or damage giving rise to such claim or claims ("the loss and damage") and on the assumptions that:
- (a) All other consultants, contractors, sub-contractors, project managers or advisers engaged in connection with the Project have provided contractual undertakings to the Client on terms no less onerous than those set out in the original contracts in respect of the carrying out of their obligations in connection with the Project; and
 - (b) There are no exclusions of or limitations of liability nor joint insurance or co-insurance provisions between the Client and any other party referred to in this clause and any such other party who is responsible to any extent for the loss and damage is contractually liable to the Client for the loss and damage; and
 - (c) All such other consultants, contractors, sub-contractors, project managers or advisers have paid to the Client such proportion of the loss or damage which it would be just and equitable for them to pay having regard to the extent of their responsibility for the loss and damage.
- 17 Further and notwithstanding anything to the contrary contained in this agreement and without prejudice to any provision in this agreement whereby liability is excluded or limited to a lesser amount, our liability under or in connection with this agreement whether in contract or in tort, in negligence, for breach of statutory duty or otherwise for any claim shall not exceed the amount, if any, recoverable by us by way of indemnity against the claim in question under professional indemnity insurance taken out by us and in force at the time that the claims or (if earlier) circumstances that may give rise to the claim is or are reported to the insurers in question. The limitation shall not apply if no such amount is recoverable due to us having been in breach of our obligations or the terms of any insurance maintained in accordance therewith or having failed to report any such claim or circumstances to the Insurers in question timeously.
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- 18 Whilst our investigation may include asbestos screening/quantification on selected samples, this must not be deemed to constitute a full asbestos survey or be taken as sufficient to definitively identify the presence or quantity of asbestos within or on the ground. We will not accept responsibility if asbestos is encountered during any subsequent construction or development works and in placing a contract with us the Client accepts this condition. Where the fabric of a building is to be disturbed, the Client shall provide an appropriate asbestos survey to us prior to exploratory work and make adequate provision to allow the implementation of sufficient and appropriate protective/remedial measures for the work to progress safely.
- 19 Where our report refers to 'topsoil', this should be construed as any turf (if present) plus any obvious organic rich/humic layer of soil beneath, which may or may not contain roots/rootlets. Unless otherwise requested, we do not provide a detailed description, undertake sampling/testing for classification purposes or provide a specific classification. The thickness of the 'topsoil' identified on our exploratory hole records is indicative only and should not be used for detailed volume or site strip calculations; if this type of classification is required, this should be identified to us at an early stage and the method of sampling, testing and classification agreed.
- 20 The Client agrees that they shall not bring any claim personally against any director/employee of Soil Consultants Ltd or consultant to us in respect of loss or damage suffered by the Client arising out of this contract.
- 21 Our appointment shall be under simple agreement and our liability under this contract or in tort shall be for a period of six years from date of appointment.
- 22 Our reports are non-assignable and are prepared for the benefit of the Client. No reliance can be assumed by others without written agreement from Soil Consultants Ltd. We will provide a letter of reliance at our discretion and this will be subject to payment of our fee, which will be 10% of contract value, subject to a minimum fee of £1,250 plus VAT. The terms of our letter of reliance are non-negotiable and the beneficiary should be aware that the information shall only apply to the scheme for which the report was originally produced and the original rights and benefits will apply.
- 23 A VAT invoice (at current rate) will be presented in respect of the work undertaken. Payment of our account is to be made within twenty-eight days of issue of our invoice unless otherwise agreed. On no account shall payment be on a 'pay-when-paid' basis. The information contained within our report remains the property of Soil Consultants Ltd and no reliance may be assumed by any party with an interest in the project until payment has been received in full. After one calendar month interest shall be chargeable at 10% above the Bank of England Rate and compensation claimed in accordance with 'Late Payments of Commercial Debts (Interest) Act 1998 and subsequent revisions. If the debt is referred to a debt collection agency then we have the right to recover associated fees under the terms of our contract.

APPENDIX**Fieldwork, in-situ testing and monitoring**

-  Foreword
-  Standard Penetration Test results
-  SPT hammer calibration certificates
-  Window sample borehole records

Ground profiles

-  Plot of SPT 'N' value versus depth
-  Hand vane profile versus depth

Plans, drawings & photographs

-  Site Plan
-  Location Plan

FOREWORD FOR DYNAMIC SAMPLER BOREHOLES (WINDOWLESS) - GUIDANCE NOTES

GENERAL

The borehole records are compiled from the driller's description of the strata encountered, an examination of the samples by our geotechnical engineer and the results of in-situ and laboratory tests. Based on these data, the report presents an opinion on the configuration of strata within the site. However, such reasonable assumptions are given for guidance only and no liability can be accepted for changes in conditions not revealed by the boreholes.

BORING METHODS

The dynamic sampler technique uses 1m long tubes containing a rigid plastic liner. These are driven into the ground by a falling hammer, then withdrawn and the liner removed. The borehole commences using a large diameter tube (usually 100mm) with each succeeding tube reducing usually by 10mm in diameter to assist the extraction of the tube from the ground. Thus, it is theoretically possible to obtain a total continuous sample of the soil for examination or testing. Casing can be utilised as required. The technique allows the ground conditions to be reasonably well established although disturbance of the ground is inevitable, particularly some "softening" of the upper zone of clay immediately beneath a granular soil. The presence of thin layers of different soils within a stratum may not always be detected.

GROUND WATER

The depth at which ground water was struck is entered on the borehole records. However, this observation may not indicate the true water level at that time. Due to the speed of boring and the relatively small diameter of the borehole, natural ground water may be present at a depth higher than the water strike. Moreover, ground water levels are subject to variations caused by changes in the local drainage conditions and by seasonal effects. When a moderate inflow of water does take place, boring is suspended for at least 10 minutes to enable a more accurate short-term water level to be achieved. An estimate of the rate of inflow is also given. This is a relative term and serves only as a guide to the probable flow of water into an excavation.

Further observations of the water level made during the progress of the borehole are shown including end of shift and overnight readings and the depth at which water was sealed off by the borehole casing, if applicable.

SAMPLES

Small disturbed samples can be recovered from the lining tubes for subsequent laboratory testing, including moisture content, index property tests and contamination analyses.

IN-SITU TESTING

Standard Penetration Test (SPT): this test is performed in accordance with the procedure given in BS EN ISO 22476-3:2005. The individual blow count record for each test is given on a separate table. The 'N' value is normally the number of blows to achieve a penetration of 0.3m following a seating distance of 0.15m and is quoted at the mid-depth of the test zone. However if a change of stratum occurs within the test zone then a revised 'N' value can be calculated to assess one layer in particular. In hard strata full penetration may not be obtained. The presence of groundwater and particularly Where groundwater can affect the test and the measured values may not represent the true in-situ density of the soil.

Hand Shear Vane: provides the shear strength of cohesive soils, values reported in kPa

Pocket Penetrometer: provides an estimate of the unconfined compression strength, values reported in kg/cm²

Mallinson Sports Centre Phase 2						Borehole No: BH03		
Highgate School, Bishopswood Road, London N6 4NY								
Client: Highgate School				Coordinates: 528008E, 187768N		Sheet 1 of 1		
Engineer: Pringuer-James Consulting Engineers Ltd				Ground Level: +109.10mOD		Report No: 10930/OS		
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)		Depth (m)	Level (m)			
BH commenced: 16/02/2024				0.20	108.90		Grass over dark brown, clayey, silty sandy TOPSOIL with occasional flint gravel and frequent live rootlets.	
				0.35	108.75		MADE GROUND: Soft to firm, dark brown, clayey silty slightly sandy gravelly clay. Gravel is angular to rounded, fine to coarse flint with brick, slate and clinker fragments. Frequent live rootlets.	
Water depth in inspection pit: 0.80m							Firm, orange mottled light orange grey, silty sandy slightly gravelly CLAY. Gravel is angular to rounded, fine to medium flint, locally coarse. Frequent live rootlets, occasional manganese staining and rare relict rootlets.	
Inspection pit to 1.00m	SPT/C	1.00	N=11	1.00	108.10		Soft to firm, orange brownish mottled grey silty, very sandy CLAY.	1
BH dia: 100mm reducing with depth	HV	1.50	30					
Strata appeared damp below about 1.20m	HV	1.80	35					
	SPT/C	2.00	N=11					2

Site & Location: Mallinson Sports Centre Phase 2 Highgate School, Bishopswood Road, London N6 4NY							Borehole No: BH05		
Client: Highgate School					Coordinates: 528038E, 187755N		Sheet 1 of 1		
Engineer: Pringuer-James Consulting Engineers Ltd					Ground Level: +110.00mOD		Report No: 10930/OS		
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation	
	Type	Depth (m)		Depth (m)	Level (m)				
BH commenced: 16/02/2024				0.20	109.80		Grass over dark brown, clayey, silty sandy TOPSOIL with occasional flint gravel and frequent live roots and rootlets.		
				0.40	109.60		MADE GROUND: Soft, dark brown, silty sandy gravelly clay. Gravel is angular to rounded, fine to coarse flint with brick, clinker and tile fragments. Frequent live roots and rootlets. Soft to firm, orange greyish, silty sandy gravelly CLAY. Gravel is angular to rounded, fine to coarse flint. Frequent live rootlets and rare live roots to 0.70m. Occasional relict rootlets and manganese staining.		
Inspection pit to 1.00m	SPT/C	1.00	N=11	1.00	109.00		Firm, orange mottled grey, silty slightly sandy to sandy CLAY with occasional partings of yellow orangish brown silt (possible iron weathering).		1
BH dia. 100mm reducing with depth	HV	1.80	55						
	HV	1.90	60						2
	SPT/C	2.00	N=9						
	HV	2.50	60				Between 2.40m and 2.85m, is grey brown mottled orange		
	HV	2.85	50	2.85	107.15				At 2.80m, rare claystone.
	SPT/C	3.00	N=16				Stiff, fissured, grey brownish, silty very sandy CLAY with occasional partings of light grey fine sand.		3
	SPT/C	4.00	N=16				Between 4.00m and 4.45m: grey silty sand (very damp).		4
	SPT/C	5.00	N=20				Below 4.60m, occasional partings of black pyritic fine sand.		5
BH complete: 16/02/2024				5.45	104.55	End of hole at 5.45m			6
BH depth: 5.45m									
Water at end of drilling: 2.5m									
Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet							Borehole type: Dynamic Sampler		
Remarks: Coordinates and ground level interpolated from Randall Surveys LLP drawing (Ref: 38489/JV/1, Jan 16)							Borehole No: BH05		

Site & Location	Mallinson Sports Centre Phase 2 Highgate School, Bishopswood Road, London N6 4NY	Report No:	10930/OS
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STANDARD PENETRATION TEST SUMMARY

BH ID	Depth (m)	Test type	N value (Note b)	Blow-counts and penetration						Casing depth (m)	Water depth (m)	Remarks
				Seating blows		Test blows						
BH03	1.00	C	N=11	2	2	2	3	3	3		Dry	
BH03	2.00	C	N=11	2	2	2	2	3	4		Dry	
BH03	3.00	C	N=14	3	3	3	3	4	4		Dry	
BH03	4.00	C	N=16	3	3	4	4	4	4		Dry	
BH03	5.00	C	N=16	3	3	4	4	4	4		Dry	
BH04	1.00	C	N=10	2	2	2	2	3	3		Dry	
BH04	2.00	C	N=14	2	3	3	3	4	4		Dry	
BH04	3.00	C	N=15	3	3	3	4	4	4		Dry	
BH04	4.00	C	N=19	4	4	4	5	5	5		Dry	
BH04	5.00	C	N=16	4	4	4	4	4	4		Dry	
BH05	1.00	C	N=11	2	2	2	3	3	3		Dry	
BH05	2.00	C	N=9	2	2	2	2	2	3		Dry	
BH05	3.00	C	N=16	3	3	4	4	4	4		Dry	
BH05	4.00	C	N=16	3	4	4	4	4	4		Dry	
BH05	5.00	C	N=20	4	4	5	5	5	5		Dry	

a) Standard Penetration Test : BS EN ISO 22476:2005 Part 3

b) Where full penetration was not achieved, the total test blow-counts are reported

c) Hammer Energy Ratio, Er = 64%

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Southern Testing
Unit 11
Charlwoods Road
East Grinstead
West Sussex
RH19 2HU

SPT Hammer Ref: DART312
Test Date: 03/11/2023
Report Date: 08/11/2023
File Name: DART312.spt
Test Operator: NPB

Instrumented Rod Data

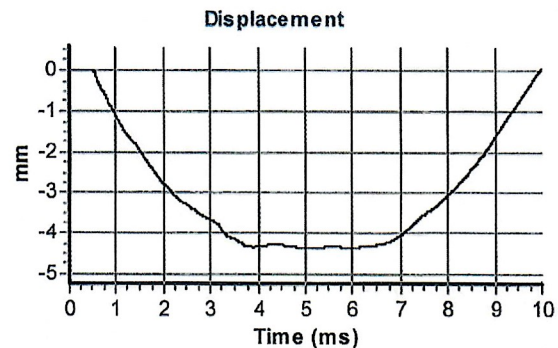
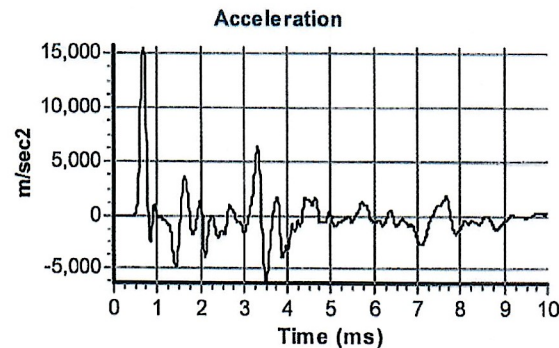
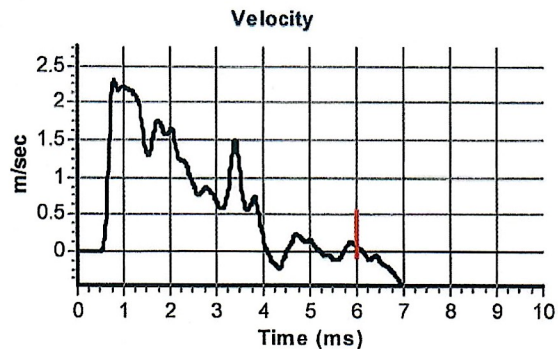
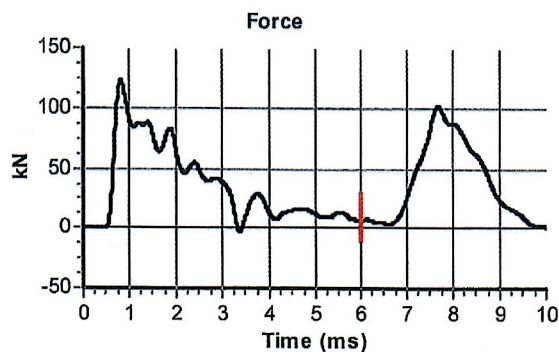
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.6
Assumed Modulus E_a (GPa): 208
Accelerometer No.1: 64786
Accelerometer No.2: 64789

SPT Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 14.7

Comments / Location

CHARLWOODS



Calculations

Area of Rod A (mm²): 983
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 302

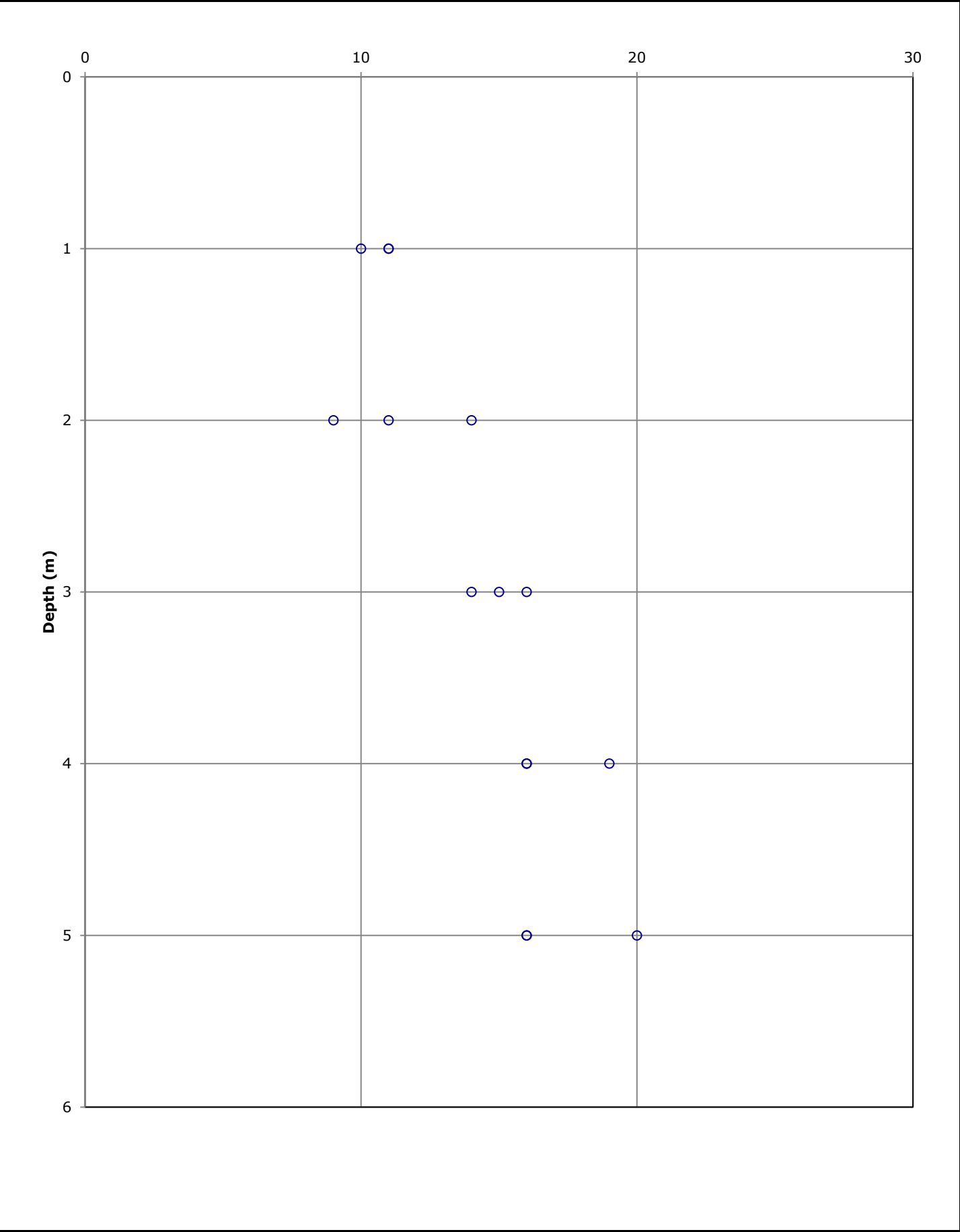
Energy Ratio E_r (%):

64

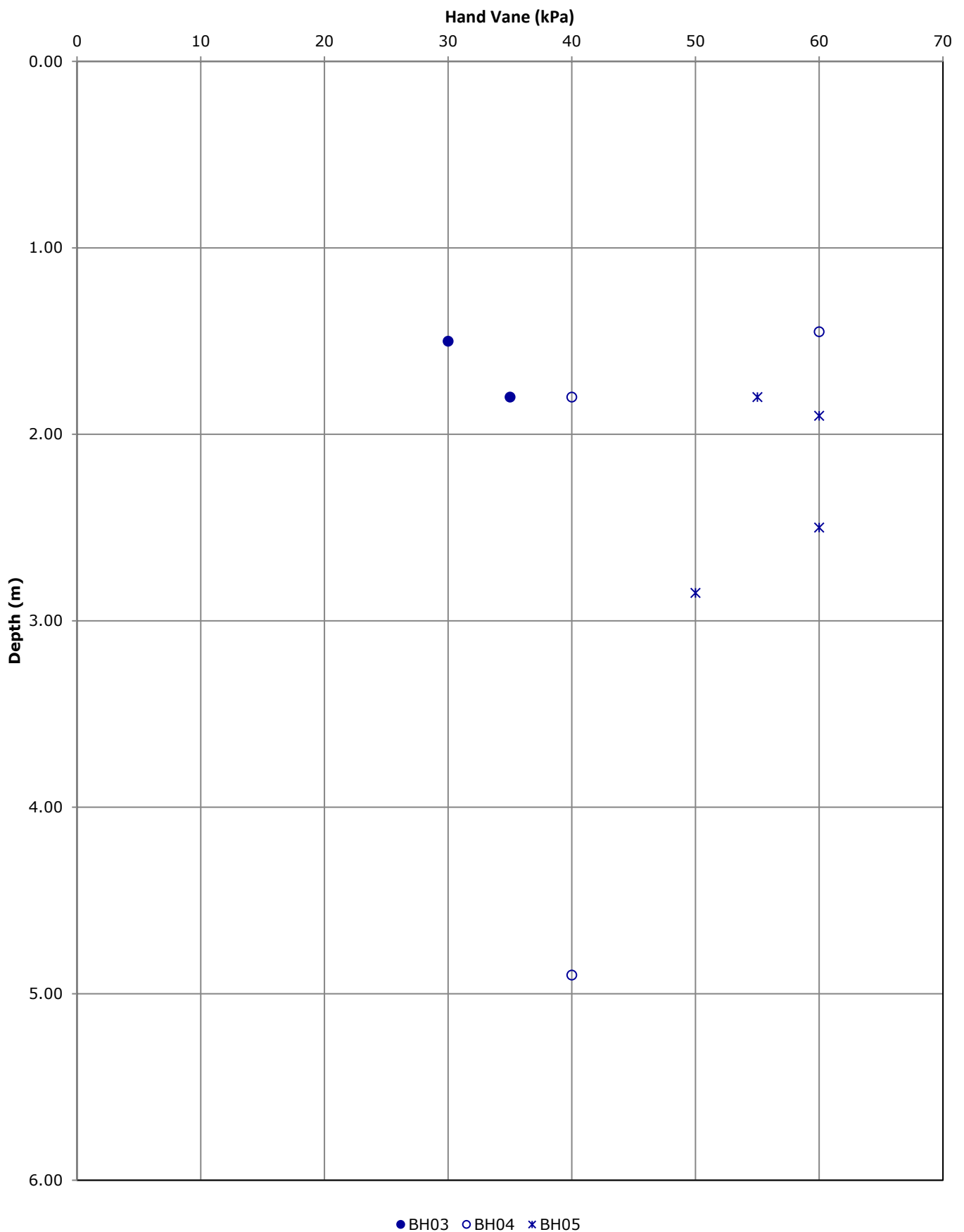
Signed: G Crane
Title: Technician

The recommended calibration interval is 12 months

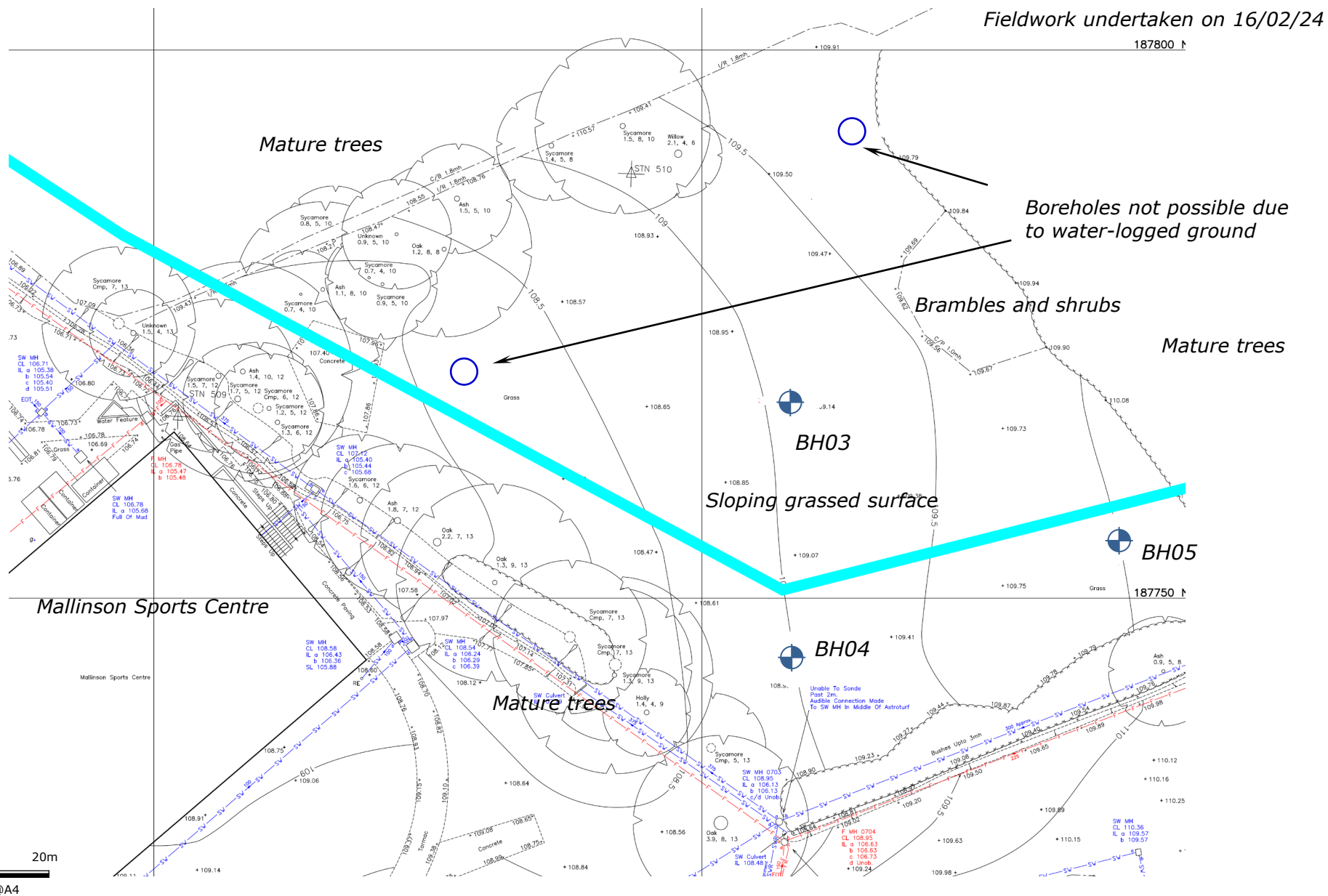
SPT-N vs depth



Hand Vane profile vs depth



Site Plan



Location Plan



SITE LOCATION

[Contains Ordnance Survey data © Crown copyright and database right 2024]

Head Office:

Chiltern House, Earl Howe Road, Holmer Green
High Wycombe, Bucks HP15 6QT
t: 01494 712494
e: mail@soilconsultants.co.uk

Harwich Office:

Haven House, Albemarle Street
Harwich, Essex CO12 3HL
t: 01255 241639
e: harwich@soilconsultants.co.uk

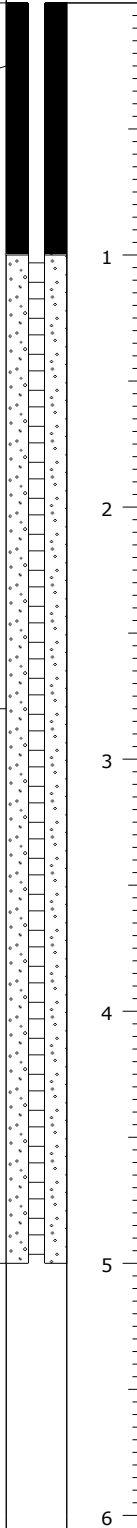
Site Plan – Water monitoring boreholes



Mallinson Sports Centre Highgate School, Bishopswood Road, London N6 4NY						Borehole No: BH101		
Client: Highgate School				Coordinates: 52887E, 187803N		Sheet 1 of 1		
Engineer: Pringuer-James Consulting Engineers Ltd				Ground Level: +105.70mOD		Report No: 10930/JRCE		
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)		Depth (m)	Level (m)			
BH commenced: 21/08/24	D	0.40		0.60	105.10		Grass underlain by MADE GROUND: dark brown slightly clayey, silty, slightly gravelly fine to medium sand. Gravel is mainly flint with occasional fragments of brick, asphalt and clinker. Occasional roots and rootlets	
BH dia: 100mm reducing with depth Inspection pit to 1.00m	D	0.90					'Stiff' becoming soft to firm friable orange brown and light grey mottled very silty, sandy, slightly gravelly CLAY. Gravel is rounded, fine flint. Occasional rootlets (Probably desiccated in upper levels)	
Water seepage at 2.00m	HV	1.20	58				Orange brown and light grey clayey, silty, very sandy GRAVEL grading to soft to firm silty sandy CLAY	
	HV	1.40	40				Soft to firm dark grey very silty sandy CLAY with occasional fine sand and silt partings	
	D	1.50	20					
	HV	1.60	20					
Water seepage at 4.10m				1.85	103.85		From 3.60m: rare white shell fossils.	
				2.10	103.60			
	HV	2.30	35					
	D	2.50	28					
	HV	2.50	28					
Water seepage at 4.10m								
	HV	3.40	65					
	D	3.50						
Water seepage at 4.10m								
	HV	3.80	65					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
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Water seepage at 4.10m								
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Water seepage at 4.10m								
	HV	4.90	68					
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Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					
	D	4.50						
	HV	4.60	66					
Water seepage at 4.10m								
	HV	4.90	68					

Mallinson Sports Centre							Borehole No: BH102	
Site & Location: Highgate School, Bishopswood Road, London N6 4NY								
Client: Highgate School					Coordinates: 527941E, 187764N		Sheet 1 of 1	
Engineer: Pringuer-James Consulting Engineers Ltd					Ground Level: +106.80mOD		Report No: 10930/JRCB	
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)		Depth (m)	Level (m)			
BH commenced: 21/08/24	D	0.20		0.10	106.70		Grass underlain by dark brown clayey, silty, very sandy, slightly gravelly TOPSOIL with rare brick fragments	
				0.35	106.45		MADE GROUND: dark grey brown clayey, silty, very sandy GRAVEL. Gravel is mainly flint with brick and concrete fragments	
	D	0.80					Soft locally firm orange brown and light grey mottled silty, sandy to very sandy, slightly gravelly CLAY with partings of silt and sand. Gravel is subangular to rounded, fine to coarse flint	
BH dia: 100mm reducing with depth	HV	1.00	25					1
Inspection pit to 1.00m	HV	1.20	20					
Water seepage at 1.50m	D	1.50					Between 1.40m and 1.60m: very gravelly	
	HV	1.60	25					
	HV	1.90	25					2
	HV	2.20	40					
	D	2.50						
	HV	2.50	45					
	HV	2.70	50					
				2.90	103.90		Firm to stiff friable dark grey, very silty, very sandy CLAY with frequent partings of sand and silt. Rare fossil shell fragments	3
	HV	3.30	75					
	D	3.50						
	HV	3.60	60					
	HV	3.80	52					
	HV	3.90	80					4
	HV	4.20	40					
Water seepage at between 4.00m and 5.00m	D	4.50						
	HV	4.70	60					

Mallinson Sports Centre							Borehole No: BH103	
Site & Location: Highgate School, Bishopswood Road, London N6 4NY								
Client: Highgate School					Coordinates: 527970E, 187775N		Sheet 1 of 1	
Engineer: Pringuer-James Consulting Engineers Ltd					Ground Level: +108.10mOD		Report No: 10930/JRCB	
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)		Depth (m)	Level (m)			
BH commenced: 21/08/24							Grass underlain by dark grey brown clayey, very silty, gravelly very sandy TOPSOIL with occasional brick and clinker fragments	
BH dia: 100mm reducing with depth Inspection pit to 1.00m	D	0.40		0.50	107.60			
	HV	0.70	64				Firm to stiff orange brown and light grey mottled silty, sandy to very sandy CLAY with occasional partings of fine sand. Rare to frequent rootlets observed to 1.60m (Possibly desiccated)	
	D	0.80						
	HV	0.90	62					
	HV	1.00	35					
	HV	1.10	40					
	HV	1.30	35					
	D	1.50						
	HV	1.50	35					
	HV	1.70	36					
	HV	1.90	32					

Mallinson Sports Centre							Borehole No: BH104	
Site & Location: Highgate School, Bishopswood Road, London N6 4NY								
Client: Highgate School					Coordinates: 528035E, 187765N		Sheet 1 of 1	
Engineer: Pringuer-James Consulting Engineers Ltd					Ground Level: +109.85mOD		Report No: 10930/JRCB	
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation
	Type	Depth (m)		Depth (m)	Level (m)			
BH commenced: 21/08/24	D	0.20		0.25	109.60		Grass underlain by dark brown clayey silty, very sandy slightly gravelly TOPSOIL with rare brick fragments. Frequent to occasional rootlets	
BH dia: 100mm reducing with depth Inspection pit to 1.00m	HV	0.70	85				Firm to stiff friable orange brown silty, sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse flint and sandstone. Occasional rootlets observed to 2.50m	
	D	0.80						
	HV	0.90	65					
	HV	1.20	58					
	HV	1.40	72					
	D	1.50						
	HV	1.60	64					
	HV	1.80	66					
	HV	2.00	48					
	HV	2.30	62					
	D	2.50						
	HV	2.70	52					
	HV	2.80	64	2.80	107.05		Firm to stiff, locally soft friable dark grey silty, very sandy CLAY with frequent fine sand partings	
	HV	3.00	75					
	HV	3.30	45					
HV	3.40	48						
D	3.50							
HV	3.70	58						
HV	4.00	25						
Water seepage between 4.00m to 5.00m	D	4.50						
BH complete: 21/08/24 - BH depth: 5.00m - water depth: dry (on completion)				5.00	104.85		End of hole at 5.00m	
Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet							Borehole type: Dynamic Sampler	
Remarks: a) Coordinates and ground levels obtained from Randall Surveys LLP drawing no 138489/JV/1 b) Monitoring pipe installed to 5.00m. Screened slotted section from 1.00m to 5.00m							Borehole No: BH104	



Site & Location	Mallinson Sports Centre Highgate School, Bishopswood Road, London N6 4PH	Report No: 10930/JRCB
--------------------	---	--

Results of groundwater monitoring

Date	BH ID	Ground level (mOD)	Pipe dia (mm)	GW depth (mbgl)	Depth to pipe base (mbgl)
08/08/24	WS02	106.7	35mm	1.74	4.80
	BH01	109.1	50mm	2.43	5.13
13/08/24	WS02	106.7	35mm	1.78	4.79
	BH01	109.1	50mm	2.46	5.14
21/08/24	WS02	106.7	35mm	1.75	4.90
	BH01	109.1	35mm	2.78	5.14
28/08/24	WS02	106.7	35mm	1.72	4.90
	BH01	109.1	50mm	2.48	5.14
	BH101	105.7	50mm	1.63	4.99
	BH102	106.8	50mm	1.26	4.94
	BH103	108.1	50mm	1.56	4.80
	BH104	109.85	50mm	1.66	4.83



Appendix D: Arboriculturist Letter



SJ Stephens Associates

ARBORICULTURAL, LANDSCAPE & MANAGEMENT CONSULTANTS

A-Squared Studio
One Westminster Bridge Road
London
SE1 7XW

Attn: Alex Corrigan

16th August 2024

Dear Alex,

**Re: Possible impact of tree removal relating to proposals for the Mallinson Sports Centre
and creation of a Flood Storage Basin at Highgate School**

The Tree Removal Plan attached shows tree removals proposed as part of this project.

A group of trees will be removed to create a flood storage basin. The closest tree to properties on Broadlands Road is 59m from the closest house and 16m from a tennis court. At this distance there is no possibility of tree removals having any adverse effect on the properties.

Two trees on Bishopswood Road and a small cherry on Broadlands Road will be removed. With the roads separating the trees from adjacent properties, there is no possibility of tree removals having any adverse effect on the properties, which in any case are owned by the school rather than third parties.

If you require any further information, please get in touch.

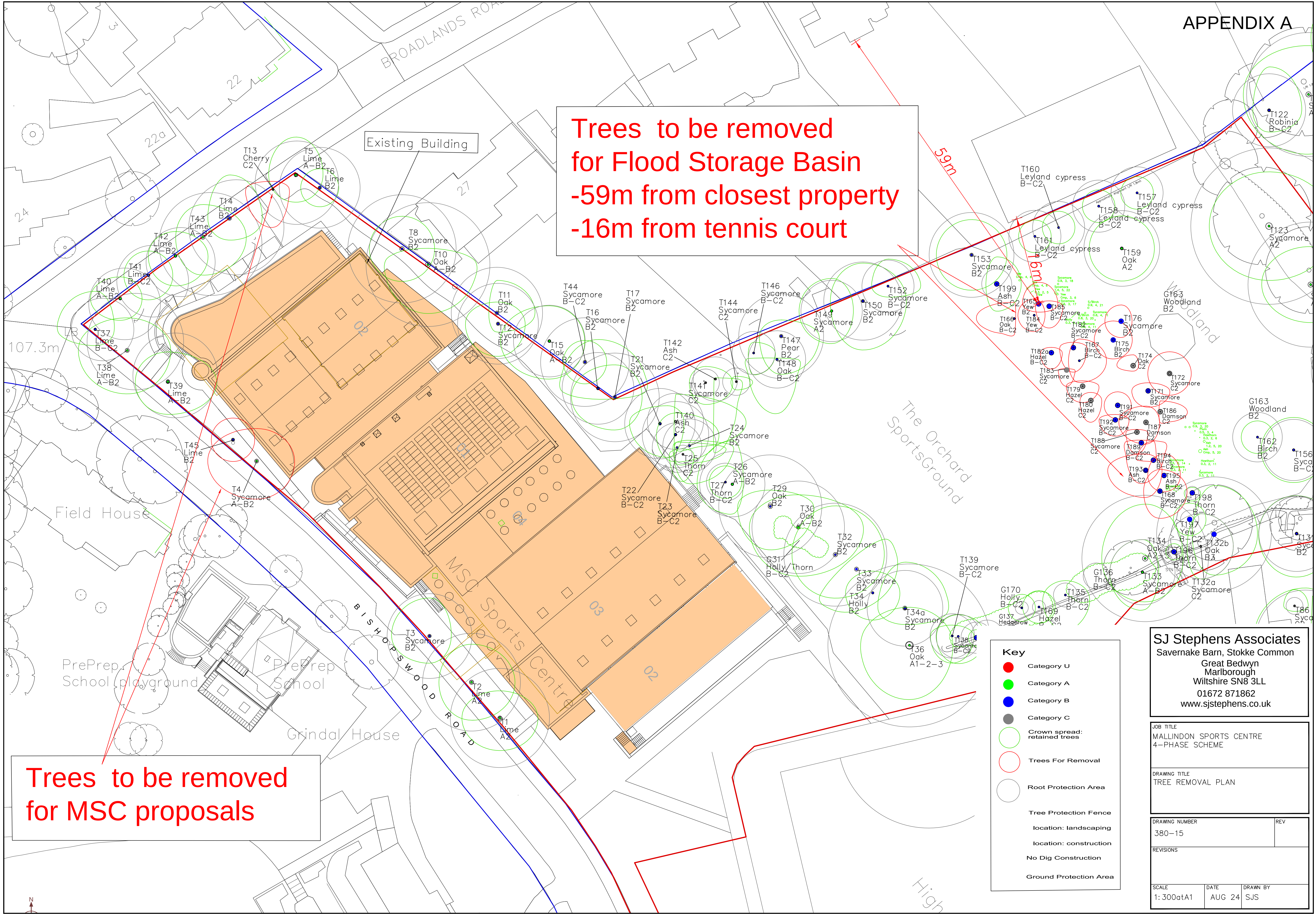
Yours sincerely,



Simon Stephens
Arboricultural Association Registered Consultant
MA Oxon, Dip Arb(RFS), MArborA. CEnv, MICF

Trees to be removed
for Flood Storage Basin
-59m from closest property
-16m from tennis court

Trees to be removed
for MSC proposals



SJ Stephens Associates
Savernake Barn, Stokke Common
Great Bedwyn
Marlborough
Wiltshire SN8 3LL
01672 871862
www.sjstephens.co.uk

JOB TITLE
MALLINDON SPORTS CENTRE
4-PHASE SCHEME

DRAWING TITLE
TREE REMOVAL PLAN

DRAWING NUMBER
380-15

REVISIONS

SCALE
1:300atA1

DATE
AUG 24

DRAWN BY
SJS



Appendix E: Flood Risk Assessment



Highgate School MSC 4-Phase

Flood Risk Assessment

Revision J

11 June 2024

HIGHGATE



WINNER
Design Innovator

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Document Control



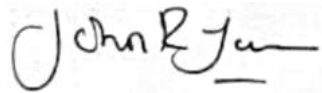
Project Name: Highgate School

Project Number: EY0753

Report Revision: J

Client: Capital Projects

Written by



11 June 2024

John Young

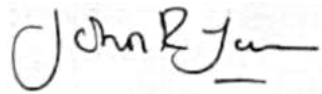
Checked by



11 June 2024

Alex Attwood

Approved by



11 June 2024

John Young

Revision	Issued to	Date
A	Capital Projects	10/12/18
B	Capital Projects	10/05/19
C	Capital Projects	11/09/19
D	Capital Projects	04/07/22
E	Capital Projects	26/10/22
F	Capital Projects	23/01/23
G	Capital Projects	29/01/24
H	Capital Projects	13/02/24
I	Capital Projects	24/05/24
I	Capital Projects	11/06/24

Contents

1	Introduction	1
1.1	General	1
1.2	Appendices	2
2	Development Proposals	4
3	Planning Policy	11
3.1	National Planning Policy	11
3.2	Strategic Flood Risk Assessment	12
4	Published Information	14
4.1	Ordnance Survey Mapping	14
4.2	Environment Agency Flood Risk Mapping	17
5	Hydraulic Modelling Surface Water Flood Risk	24
5.1	Model Build	24
5.2	Hydraulic Model Results	30
6	Conclusions and Recommendations	37
6.1	Conclusions	37
6.2	Recommendations	38
A	Topographic Survey	39
B	SWMP 1 in 100 year event + climate change flood depth map	40
C	Mapping from the SWMP showing sewer flooding incidents in Haringey	41
D	Mapping from the SWMP showing groundwater flooding incidents in Haringey	42

List of Figures

1.1	Location	2
1.2	Existing Site Layout	3
2.1	Proposed Mallinson Sports Centre	6
2.2	Existing Drainage Layout	7
2.3	Proposed Drainage Layout	8
2.4	Existing ditch to the rear of the existing Mallinson Sports Centre requiring clearance and improvement.	9
2.5	Existing swale to the east of the sports pitches requiring clearance and improvements to increase capacity.	9
2.6	Existing culvert to the rear of the rifle range requiring jetting.	10
2.7	Existing ditch to the rear of the rifle range requiring clearance and improvements to increase capacity.	10
3.1	SFRA Recommendation for Highgate School	13
4.1	1865 Ordnance Survey mapping (reproduced with the permission of the national library of Scotland)	15
4.2	1873 Ordnance Survey mapping (reproduced with the permission of the national library of Scotland)	16
4.3	1914 Ordnance Survey mapping (reproduced with the permission of the national library of Scotland)	16
4.4	Flood Risk for Planning	17
4.5	Surface Water Flood Risk (High 3.3% AEP)	18
4.6	Surface Water Flood Risk (Medium 1% AEP)	19
4.7	Surface Water Flood Risk (Low 0.1% AEP)	19
4.8	Reservoir Inundation	20
5.1	Coverage of different land-use classes to be assigned different roughness parameter values	25
5.2	Rainfall hyetograph for the 1 in 10yr, 1 in 30yr, 1 in 100yr, 1 in 1000yr, 1 in 100yr plus climate change allowances (20% and 40%) using a 3.5 hour storm duration	26
5.3	Coverage of different land-use classes to be assigned different roughness parameter values	28
5.4	Baseline case, maximum food depths: 1 in 100 year design event	32
5.5	Post development scenario, maximum food depths: 1 in 100 year design event	33

5.6	Baseline case, maximum food depths: 1 in 100 year design event + 40% climate change allowance	34
5.7	Post development scenario, maximum food depths: 1 in 100 year design event + 40% climate change allowance	35
5.8	Reference Points	36

List of Tables

2.1	Development Levels	4
3.1	Flood Zone and Vulnerability Compatibility	11
3.2	Climate Change Allowances for Rainfall	12
4.1	Surface Water Flood Depths	18
5.1	Roughness parameters applied to MasterMap classes	27
5.2	Model Results - Maximum Water Levels	31
5.3	Model Results - Maximum Water Depths	31

Glossary of Terms

- +CC - Return period inclusive for the predicted effects of Climate Change
- 1D - One-Dimensional
- 2D - Two-Dimensional
- AMAX - A series containing the peak flows recorded at a gauge from each year
- AOD - Above Ordnance Datum (0m sea level, Newlyn, UK)
- Channel Cross Section - profile view of a river channel, normally obtained by surveying a line across the watercourse
- Critical Storm - A storm that produces peak run off in the watershed
- Culvert - A device used to channel water, similar to a pipe though may be larger
- Defended - A scenario in which river defences are used
- FEH - Flood Estimation Handbook
- Fluvial - Referring to the processes associated with rivers and streams
- FRA - Flood Risk Assessment
- GIS - Geographic Information System
- Hydraulic Model - The mathematical process of analysing the interaction of water and the connected environment
- Hydrology - The calculation of catchment based flow rates
- Inflow - Source of water within a modelled domain
- FMP Software - One-Dimensional hydraulic model – Representation of watercourses
- FMP-TUFLOW - Hydraulic program that dynamically links FMP and TUFLOW (1D-2D)
- LiDAR - Light Detection And Ranging, remote sensing technology to measure distance typically used to obtain topographic data over a large area
- Outflow - The method by which water may leave a modelled area
- Overtopping - Where water has passed over a feature that might ordinarily prevent flow
- f100 - 1% annual probability fluvial event
- f1000 - 0.1% annual probability fluvial event
- f100CC - 1% annual probability fluvial event with an allowance for the predicted effects of climate change
- QMED - The median of the set of annual maximum flow data (AMAX)
- TUFLOW Software - Two-Dimensional hydraulic model – Representation of floodplain
- Undefined - A scenario in which river defences are ignored

1 Introduction

1.1 General

Edenvale Young Associates Ltd. were commissioned by Capital Projects to undertake a Flood Risk Assessment (FRA) in order to support the planning application relating to the Mallinson Sports Centre development in Highgate as shown in Figures 1.1 and 1.2.

The aim of the FRA is to assess the Pre and Post-development flood risk, explain the strategy for mitigating flood risk and not increase the flood risk to others. The scope of the FRA includes:

- Discussion on the the development proposals.
- A review of published data and mapping on Flood risk.
- National Planning Policy Framework (NPPF).
- A review of the Strategic Flood Risk Assessment for the area.
- Evaluation of Finished floor levels (FFLs).
- Analysis of third party impacts.
- Hydraulic modelling to evaluate the impact of climate change.
- Hydraulic modelling to evaluate Finished Floor Levels.
- The drainage strategy for the site

This flood risk assessment uses information from:

- The 'Haringey Council Strategic Flood Risk Assessment' (Level 2) (SFRA), 2015, JBA consulting
- 'London Borough of Haringey surface water management plan (SWMP)', 2011, Capita Symonds
- Flood map for planning online¹.

¹<https://flood-map-for-planning.service.gov.uk/>

Other sources, when used, are referenced appropriately.

Hydraulic modelling to determine surface water flood risks has been undertaken using an ESTRY-TUFLOW direct rainfall hydraulic model. The model has been run for Pre and Post development scenarios for the 1 in 100 year (1% AEP), 1 in 100 year (1% AEP) with an allowance of 40% climate change on rainfall.



Figure 1.1: Location

1.2 Appendices

The FRA should be read in conjunction with the following Appendices:

- Appendix A – Topographic Survey
- Appendix B – SWMP 1 in 100 year event + climate change flood depth map
- Appendix C – Mapping from the SWMP showing sewer flooding incidents in Haringey
- Appendix D – Mapping from the SWMP showing groundwater flooding incidents in Haringey

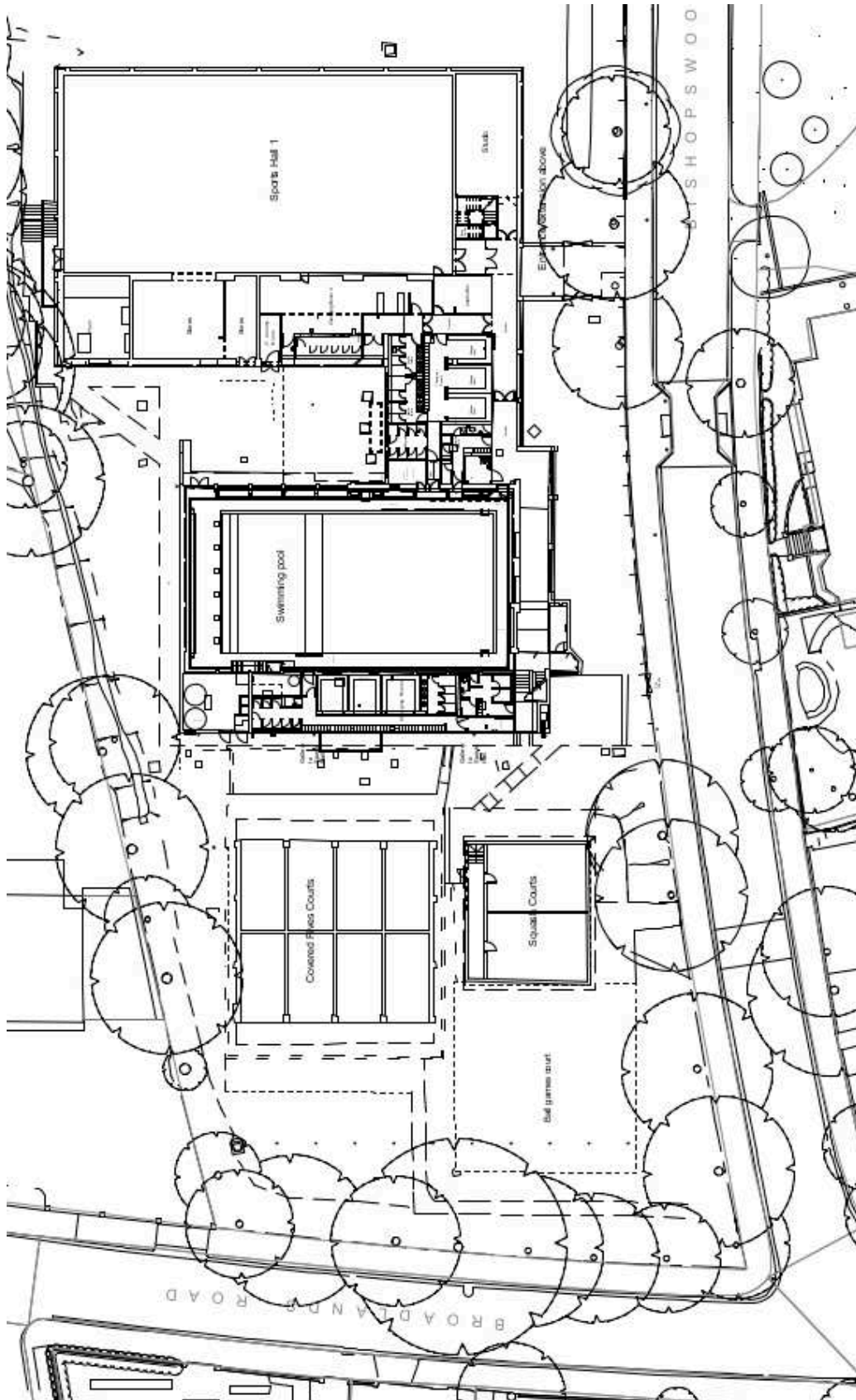


Figure 1.2: Existing Site Layout

2 Development Proposals

The proposed works comprises the development of a new sports hall adjacent to Broadlands Road and extension to the existing building to the south. The scope of development is shown in Figure 2.1. For a detailed description of the proposed development please refer to the Planning Statement. Proposals to mitigate the risk of surface water flooding to the site includes a flood retention basin to the east of the Mallinson Sports Centre and improvement works to existing swales within the site (see Figures 2.4 to 2.7 to ensure the functionality of the scheme.

Levels within the new development have been set to mitigate the risk of internal flooding to the building based on the results of the hydraulic modelling which is discussed later in this document. The Sports Centre will be tanked and protected by a high threshold at the entrance to the building. The tanking will be concealed by the outer skin of brickwork of the insulated cavity construction. In addition, ground levels between Broadlands Road and the Sports Centre will be set to 106.00mAOD. There is a proposed extra gully to help drain this area.

The proposed levels are summarised in Table 2.1.

Location	m AOD
Northern entrance threshold to Sports Hall	107.00
Window sills	107.00
Tanking to all the walls from lower basement	107.00
Reception and offices	106.15
Sports hall	103.45
Ground levels between Broadlands Road and MSC	106.00
Retention basin invert	107.00
Retention crest	109.50

Table 2.1: Development Levels

The existing site layout is shown in Figure 2.2. Surface water flows across the site in north-westerly direction towards Broadlands Road where it discharges into an existing Thames Water Sewer which runs along the road before turning northwards (See Appendix A). Further details of surface water flood risk are found in Section 4.2.3.

The proposed drainage layout is shown in Figure 2.3. The retention basin which is shown in PJCE's drawing (L2834-PJC-XX-GR-DR-C-700 01) connects to the existing but improved ditches to the east and discharges into an exiting Thames Water surface water sewer which flows north towards Broadlands Road. The attenuation basin has been designed and position to:

- Take into account the root of existing trees in the Orchard area of the site and thus minimise the damage to the trees in the area.
- Remain generally dry and form a recreational area for students..
- Accommodate the storage volume associated with a 1 in 100 year rainfall event in conjunction with a 40% climate change rainfall event.
- Accommodate exceedance flows through the inclusion of a lowered spillway which discharges into the existing ditch. The spillway will comprise a reinforced grass embankment to ensure the geotechnical stability of the embankment during an overtopping event.

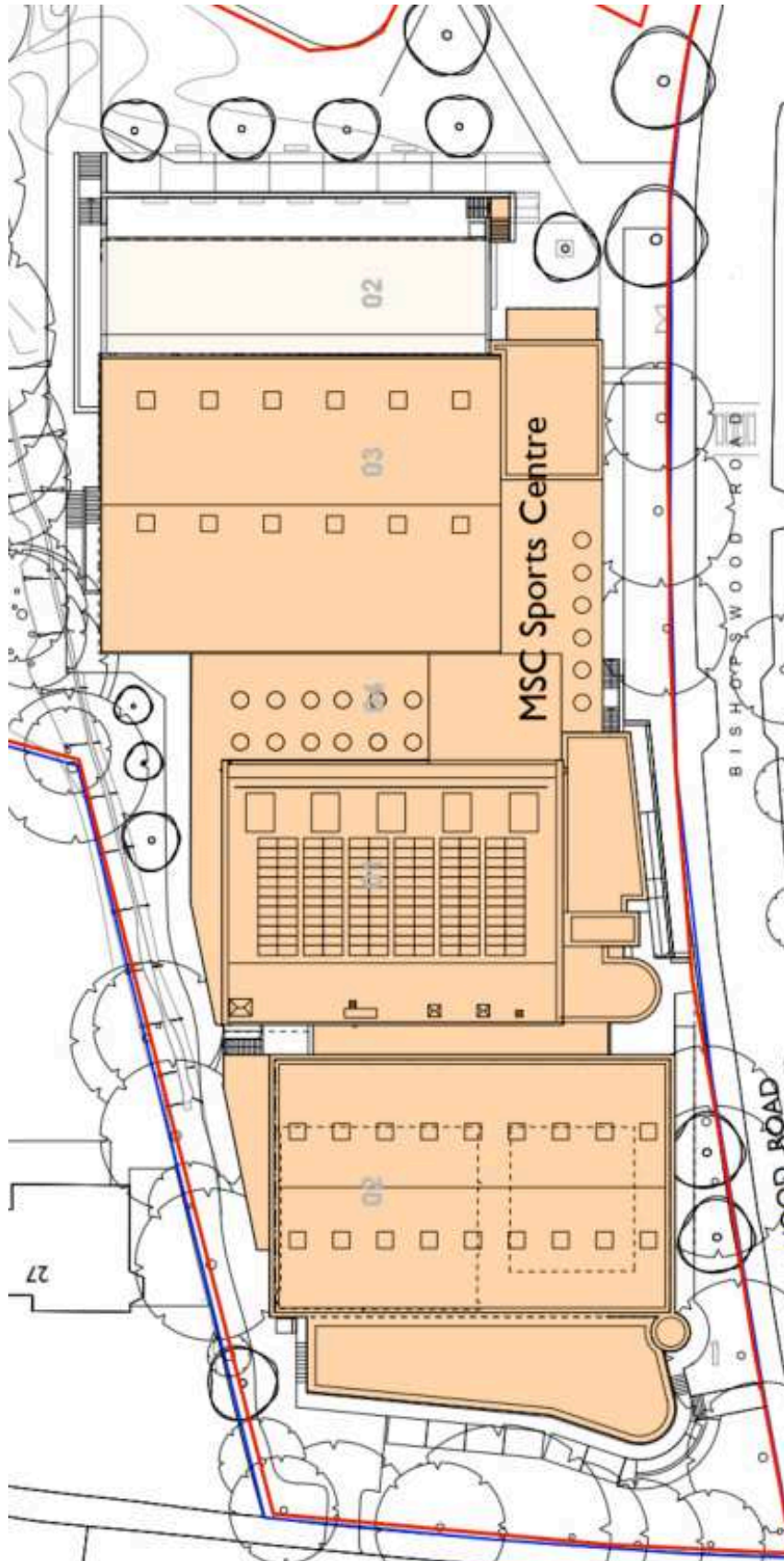


Figure 2.1: Proposed Mallinson Sports Centre

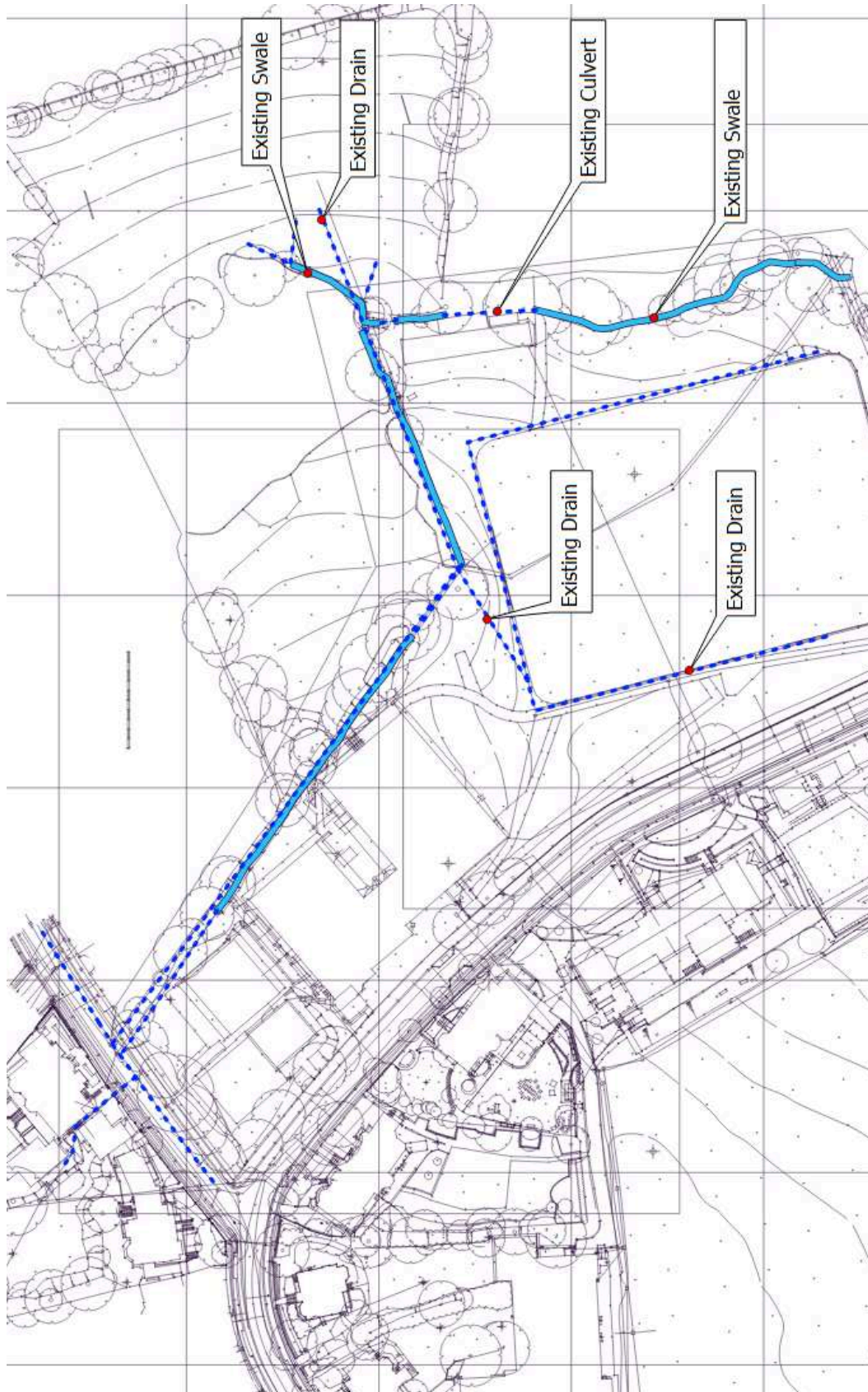


Figure 2.2: Existing Drainage Layout

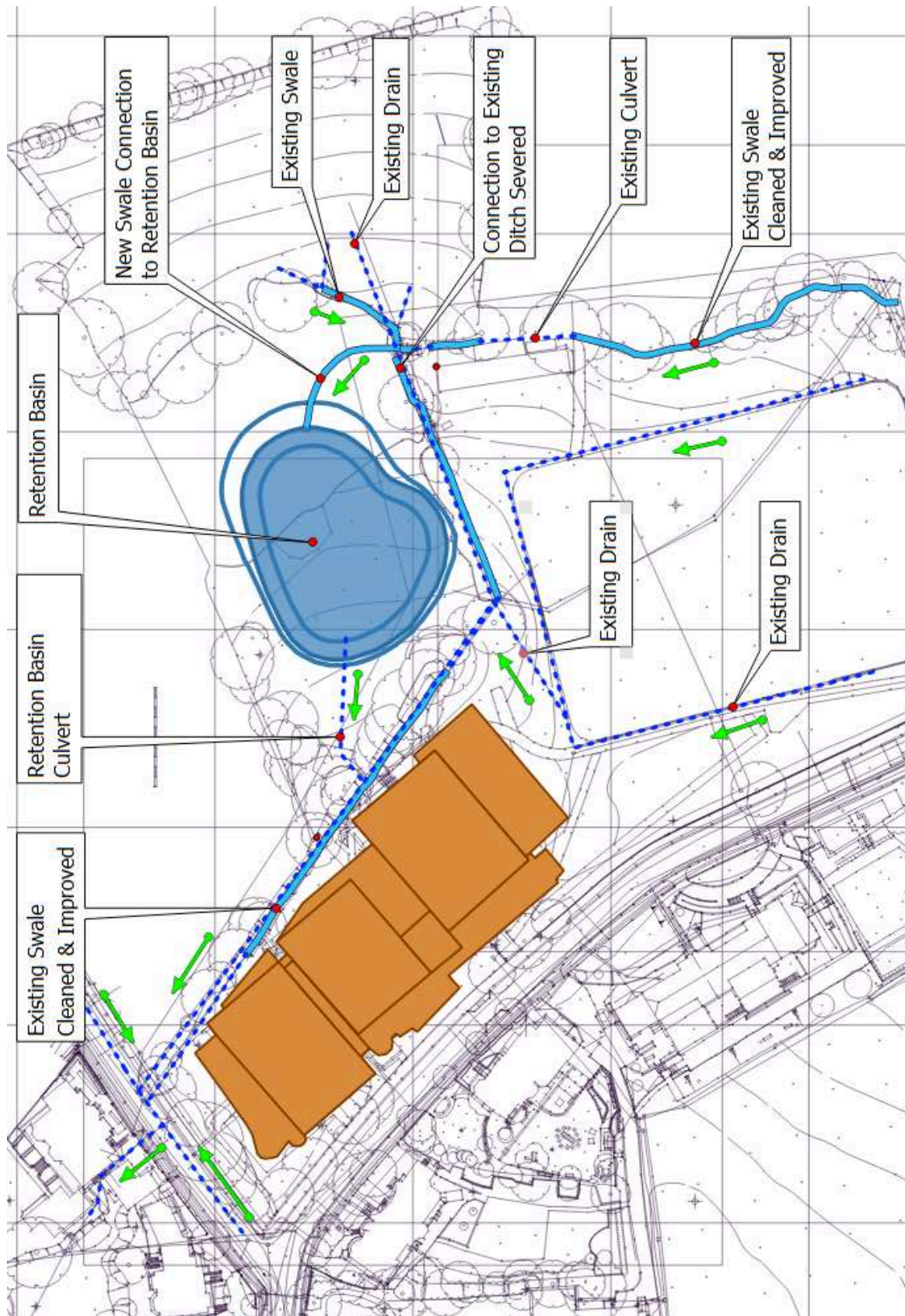


Figure 2.3: Proposed Drainage Layout



Figure 2.4: Existing ditch to the rear of the existing Mallinson Sports Centre requiring clearance and improvement.



Figure 2.5: Existing swale to the east of the sports pitches requiring clearance and improvements to increase capacity.



Figure 2.6: Existing culvert to the rear of the rifle range requiring jetting.



Figure 2.7: Existing ditch to the rear of the rifle range requiring clearance and improvements to increase capacity.

3 Planning Policy

3.1 National Planning Policy

3.1.1 Introduction

The National Planning Policy Framework (NPPF) clauses 159 to 169 details the policy associated with flooding with clause 161 giving the sequential, risk-based approach for managing flood risk. This includes:

- Sequential Testing - Clause 162
- Exception Testing - Clauses 163 to 165

These issues are discussed in more detail in subsequent sections.

3.1.2 The Sequential Test

The NPPF Sequential Test is used to, where possible, steer development to sites at a lesser risk of flooding. Given that the development site is located in the current EA flood zone 1, it does not apply to this development.

3.1.3 The Exception Test

Table 3 of the Flood Risk and Coastal Change Guidance (reproduced as Table 3.1) shows whether a particular type of development (i.e vulnerability) is compatible with the flood zone in which it is located. As noted above, the is located in Flood Zone 1 and considered to be ". Table 3 confirms that:

- development is appropriate development in Flood Zone 1.
- There is no requirement for an Exception Test.

Flood Zone	Essential Infrastruct	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Comp Vulnerable
Zone 1	Yes	Yes	Yes	Yes	Yes
Zone 2	Yes	Exception Test	Yes	Yes	Yes
Zone 3a	Exception Test	No	Exception Test	Yes	Yes
Zone 3b	Exception Test*	No	No	No	Yes*

Table 3.1: Flood Zone and Vulnerability Compatibility

3.1.4 Climate Change

Table 1 of the The Technical Guidance for Flood Risk Assessments - Climate Change Allowances gives the rainfall climate change allowances applicable to the development. Table 3.2 gives the climate change allowances for rainfall:

Climate Change Allowance	Percentage
Central 2070s	25%
Upper End 2070s	40%

Table 3.2: Climate Change Allowances for Rainfall

3.2 Strategic Flood Risk Assessment

3.2.1 Overview

A Level 2 Strategic Flood Risk Assessment (SFRA) for Haringey Council was completed in February 2015, to refine information of the probability of flooding, taking other various sources of flooding and the impacts of climate change into account. The over-arching principles (Section 9.1), that all proposed developments should follow according to the SFRA are outlined below:

- *"In line with the NPPF guidance and evidence from the LB of Haringey Level 2 SFRA development proposals should:*
- *show development not at risk of flooding or is compatible with the residual risk;*
- *not increase flood risk elsewhere, taking into account the impacts of climate change;*
- *not increase surface water peak flow rates or runoff volumes above green field levels including an allowance for climate change, as this would result in an increased flood risk to the receiving catchments;*
- *not increase the risk of groundwater flooding elsewhere or change the hydrogeological regime of the area;*
- *the location of basement development should be carefully considered within the LB of Haringey and attention should be paid to all sources of flood risk early within the planning process for new development (including the impact of potential future subterranean works that fall under permitted development);*
- *wherever possible use the opportunities offered by new development to reduce flood risk within the site and elsewhere; and*
- *ensure that where new development is necessary in areas of flood risk (in exceptional circumstances); it is made safe from flooding for the lifetime of the development, taking into account the impacts of climate change. This includes consideration of the potential effect of residual risks."*

3.2.2 Finished Floor Levels

There are no recommendations for finished floor levels in either the SFRA or SWMP. As discussed above 3, surface water flooding is the governing flood risk to the site. However, as guidelines for surface water are not mentioned in the standing advice, finished levels have been based on providing freeboard to the 1 in 100 year + 40% climate change.

3.2.3 Sustainable Drainage Systems (SuDS)

Further requirements are that:

- Surface water discharge from proposed development sites should mimic that of a present day green field site, up to and including a 1 in 100 year critical storm event including an allowance for climate change. Green field run-off rates should be maintained irrespective of whether the site falls within an area designated as being effected by flood risk from any source.
- It is critical that the on site drainage models should demonstrate that there is no increased flood risk to third parties.
- Use SuDS measures wherever practical and achieve 50% attenuation of undeveloped site's surface water run-off at peak times.

The SFRA also contains suggestions for Highgate School in the form of "Green infrastructure", which would be covered by suitable SuDS measures Figure 3.1.

HDA01	Highgate School, Highgate Wood, St Luke's Hospital	• Green Infrastructure at Highgate School • Habitat creation in Highgate Wood • Green Infrastructure at St Lukes Hospital, green roofs
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Figure 3.1: SFRA Recommendation for Highgate School

4 Published Information

4.1 Ordnance Survey Mapping

Historic mapping for Highgate indicates that there are two small watercourse which flow northwards through the site. The first is along the eastern boundary of the school site and this channel still exists as a small ditch. The second originally flowed from the orchard area northwards towards Springfield House. The ditch to the east of the Sports Buildings is potentially the only remaining section of open watercourse.

It unlikely that there were watercress meadows on, or adjacent to, the school site. Watercress requires a constant supply of preferably fresh flowing water, and this is not the case given the small size of the watercourses. The area identified by the Highgate Society as possible watercress pasture (i.e the parallel rows) is more likely to be orchards or nurseries which the 1865 mapping tends to suggest is the case (see Figures 4.1 and 4.2).

Indeed, the 1895, 1914 (see Figure 4.3) and 1938 mapping includes reference a nursery to the south-east of the school. The fact that the area within the school is referred to as the orchard may also be an historical remnant. British History Online (see below) also suggests that the primary agricultural industry in the Highgate was orchards and nurseries.

In 1865, the area around the present-day location of the school was rural with open fields (probably pasture) to the north and the cricket ground to the south (see Figure 4.1). It is well understood principle that urbanisation increases the rate and volume of run-off and reduces infiltration to ground. This is particularly true of the immediate area around the Sports Hall.

To the north and west, the site is bounded by roads which are serviced by a highway drainage network. In addition, there is a culvert under Broadlands Road from the site which conveys water from the ditch to the east of existing buildings to a storm sewer to the north of the highway. The watercourse of which this was originally mapped in 1865 has been lost. In addition, there are buildings, fences and walls which all have an impact on surface water run-off and infiltration.

British History Online

"At Highgate a nursery which had existed in 1804 became that of William Cutbush; in 1881 the firm had 4 a. at Highgate, where it remained until 1918, 20 a. at Barnet, and 7 a. at Finchley. (fn. 114) A nursery in Wightman Road, Harringay, included a vinery, cucumber- and peach-houses, and glass forcingpits in 1885; it too had gone by 1894. (fn. 115) In 1880 there were at least two other nurseries at Hornsey and four at Highgate (fn. 116) and in 1887 there were 17½ a. of nurseries and orchards. The area shrank from 5 a. of small fruit in 1897 to 1 a. in 1907, (fn. 117) but there were still 4 holdings in 1947, 2 with small areas of glass-houses and 3 with small frames. (fn. 118) In 1887 the local board opened its own nurseries at Irish Corner with 4 glass-houses to supply the isolation hospital and public gardens. (fn. 119) The nurseries had been considerably enlarged by 1963 (fn. 120) and survived in 1976."

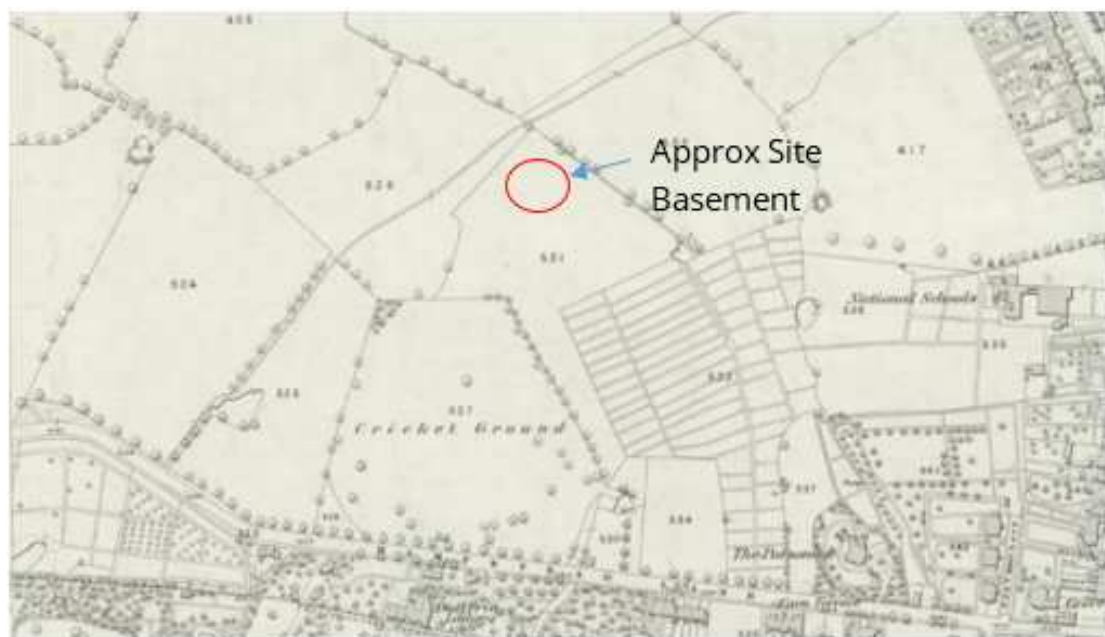


Figure 4.1: 1865 Ordnance Survey mapping (reproduced with the permission of the national library of Scotland)



Figure 4.2: 1873 Ordnance Survey mapping (reproduced with the permission of the national library of Scotland)

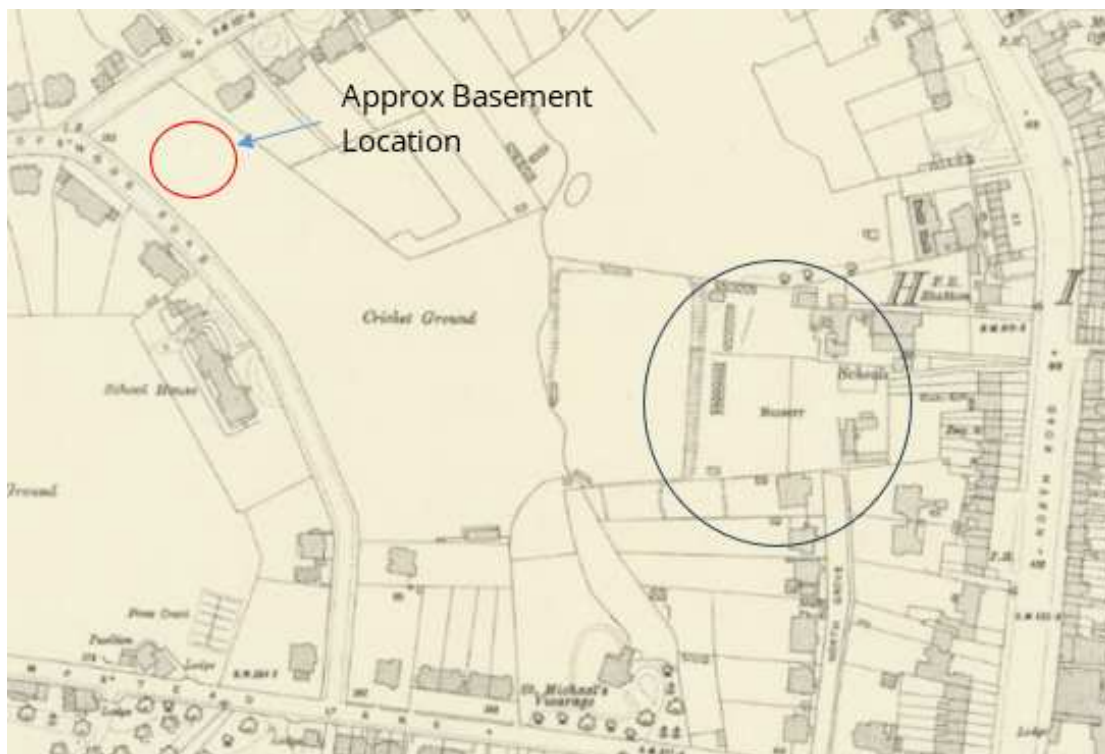


Figure 4.3: 1914 Ordnance Survey mapping (reproduced with the permission of the national library of Scotland)

4.2 Environment Agency Flood Risk Mapping

4.2.1 Flood Zone Classification

Figure 4.4 show the flood zone classification for the . The mapping has been extracted from the UK Government's flood map for planning¹ and confirms that the development is within Flood Zone 1.

4.2.2 Rivers and Seas

A copy of the "long term flood risk mapping" shown on the UK government website² is shown in Figure 4.4. This shows the extent of flooding on the - adjacent to the site. The development is deemed to be at a Low risk of fluvial flooding.



Figure 4.4: Flood Risk for Planning

4.2.3 Surface Water Flood Risk

Surface water flooding occurs following intense rainfall events, when water is unable to infiltrate the ground or cannot discharge to a watercourse. The Environment Agency mapping shows that the site is not at significant risk of surface water flooding. Accordingly it is considered that surface water flood risk is not an issue. It should also be noted that the drainage design for the development is reported elsewhere.

Figures 4.5 to 4.7 show the surface water flood risk to the site which have been downloaded from the UK Government website (<https://flood-warning-information.service.gov.uk/long-term-flood-risk>). The mapping gives flood depths on the site for high, medium and low risks which are quantified in Table 4.1.

¹<https://flood-map-for-planning.service.gov.uk/>

²<https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>

Importantly it should be recognised that the depths shown on the figures reflect the existing surface water flood risk and not surface water flood risk to the proposed sports facilities. The predicted depth of surface water is considered to present a flood risk to the sports facilities which will be raised above the maximum surface water level.

The low risk scenario shows a clear flood route from the south east flowing across the site, where water then appears to pond behind Broadlands Road before spilling over the road. This mapping does not take into account culverts under the road which is the reason why water builds up behind the road causing the flooding shown on the figures.

The surface water flood maps presented are very broad scale and it is considered that they do not represent the true nature of flooding to the site. Accordingly site specific hydraulic modelling has been undertaken to determine more accurate flood depths and extents.

Risk	Depth
Low Risk	over 0.9m
Medium Risk	over 0.9m
High Risk	over 0.9m

Table 4.1: Surface Water Flood Depths

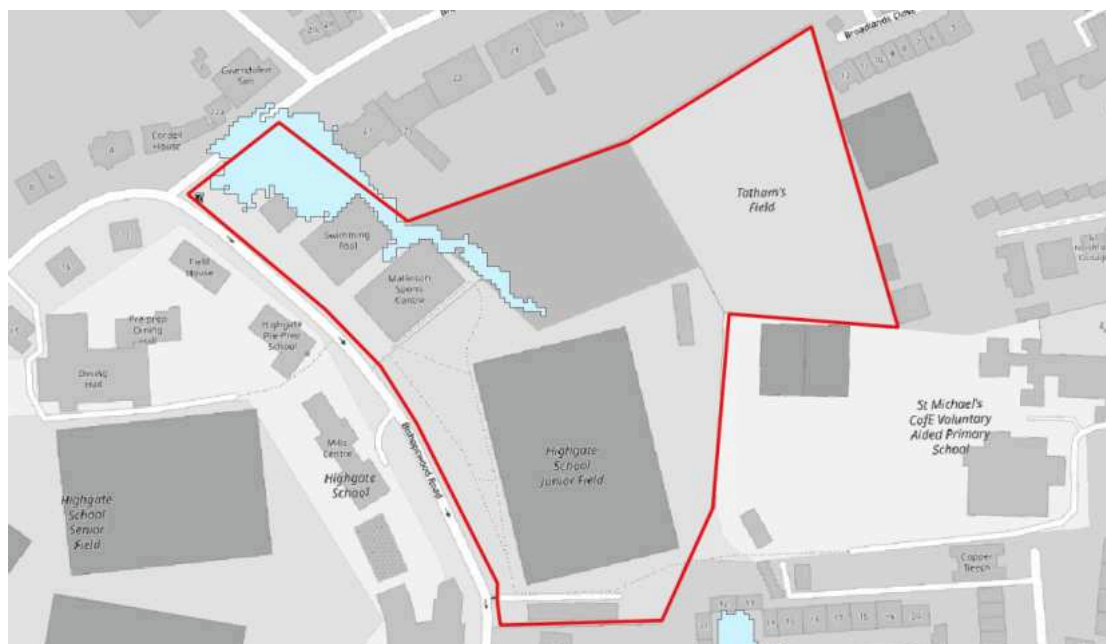


Figure 4.5: Surface Water Flood Risk (High 3.3% AEP)

4.2.4 Reservoirs

A copy of the Reservoir Inundation mapping is shown in Figure 4.8. There are no issues associated with reservoir inundation.



Figure 4.6: Surface Water Flood Risk (Medium 1% AEP)



Figure 4.7: Surface Water Flood Risk (Low 0.1% AEP)

4.2.5 Sewer Flooding

The SWMP mapping (Appendix C) has not identified a specific sewer flooding issue in the vicinity of the site. The area 'N6 4', which the site is located within is recorded as having '1 to 5' sewer flooding records. Other areas within the borough are recorded as having between '21 to 50' sewer flooding records so sewer flooding incidents at our site can be considered low.

However, as the SFRA mapping is very broad scale, it does not offer strong



Figure 4.8: Reservoir Inundation

conclusions regarding risk of flooding from sewers.

4.2.6 Groundwater Flooding

British Geological Survey (BGS) mapping³ has recorded no superficial deposits. The geology of the Highgate area is characterised by the Claygate Member which overlies the London Clay Formation. The British Geological Survey (BGS) notes that the Claygate Member is a deposit formed by CLAY, silt and sand (please note that the use of capitals follows geotechnical convention to identify the predominant material within a sample of soil). The Claygate Member is a sedimentary bedrock formed between 56 and 47.8 million years ago during the Palaeogene period. It is comprised of dark grey clays with sand laminae, passing up into thin alternations of clays, silts and fine-grained sand, with beds of bioturbated silt.

The British Geological Survey (BGS) possesses a record of boreholes within the UK. According to this record, boreholes (TQ28NE4111, TQ28NE412 and TQ28NE413) are available in the vicinity of the site, approx. 250m away, to the East on Bishopswood Road. The Borehole logs, from 2006, indicate the ground is all clay and remarks include 'water seepages throughout'. Groundwater flooding usually occurs in more permeable strata such as chalk, so the risk for groundwater flooding in clay is considered low.

The SWMP mapping (Appendix D) shows two potential incidents have occurred near to the site. However the disclaimer states that *"Incident records shown are generally unconfirmed and may include issues such as water main bursts or non-groundwater related problems."*

³<http://mapapps.bgs.ac.uk/geologyofbritain3d/index.html?>

The proposed new sports hall is partly below ground level, however with suitable tanking and an entrance threshold level above the potential surface water flood level, this should mitigate some risk of development.

Four boreholes were sunk on the site by Soil Consultants Ltd. Two boreholes (WS1 and WS2 both 5.45m deep) were positioned to the north of the Sports Centre in the area between the existing Fives Court and Broadlands Road. Two further boreholes (WS3 - 5.45m deep and WS4 - 5.0m deep) were sunk to the south of the existing Sports Centre in the area between the all-weather pitches and the existing buildings. Borehole WS3 is approximately 45m from the centre of the Orchard where the attenuation pond will be sited. The borehole logs are included as Annex A.

All boreholes confirm the presence of "Made Ground" (brick concrete etc) overlying CLAY with interstitial silts, gravel and sand. These findings agree with the BGS geological classification of the geological setting; i.e. the Claygate Member. The London Clay Formation was detected in the boreholes at 105m to 106mOD in east of the site falling to approximately 102m AOD to 103m AOD in the west. The finished floor level of the Sports Hall basement will be 103.45m AOD. Accordingly, the excavation for the Sport Hall will be within the Claygate Member but will penetrate into the underlying London Clay Formation.

Water seepage into borehole WS1 and WS2 was noted at approximately 1.0m and 0.3m respectively and the site investigation report also notes that localised shallower inflows were observed in the 2016 trial pits at between 0.90m and 1.20m depth). However, groundwater was not encountered and both boreholes were dry at a depth of 5.45m (100.50m AOD). Similarly, seepage was detected in Boreholes WS3 at 2.2m depth commensurate with a sand 'lense' with groundwater at 3.5m depth (105.75m AOD). No seepage was recorded in WS 4, and groundwater was encountered at approximately 3.0m depth (106m AOD).

However, the presence of silt, sand and gravel within a predominantly clay media indicates that there is significant variation in the underlying ground conditions. Clay has a significantly lower permeability than cohesionless materials and overlying lenses of silt, sand or gravel within the soil matrix will result in perching of water.

The borehole logs confirm the presence of perched water commensurate with bands of silts, sands and gravel. Although there are no boreholes within the footprint of the basement, it is highly likely that the excavation for the basement will encounter lenses of silt, sand or gravel material within the clay matrix which perches water within the Claygate Member. During excavation, perched water will seep into the excavation and dewatering will be required to facilitate construction. The excavation of lenses containing perched water within basement is not considered to be significant in relation to the overall hydrogeological regime or sub-surface flows.

Where groundwater was encountered this was at a depth of 3m to 3.5m (105.75m AOD to 106m AOD). Importantly, it should be recognised that ground water in clay is not subject to rapid fluctuation due to rainfall or seasonal variation due to its low permeability. Given the slow rates of flow within the clay matrix, the absence of groundwater in boreholes WS1 and WS2 and the depth of groundwater in WS3 and WS4, it is highly unlikely that ground water levels and hence flows will be affected by the imposition of the foundations for the Sports Hall. There is no reason to suppose that ground water levels will rise or fall significantly or have an adverse impact at the existing ground level.

The existing level of the orchard is between 108.5m AOD and 109.0m AOD. The invert of the attenuation basin will be set at 107m AOD requiring an excavation of between 1m and 1.5m. On the assumption that borehole WS3 is representative of the ground conditions at the attenuation basin then the invert of the attenuation pond would be within the media described as orange brown and blue grey slightly silty gravelly CLAY / clayey GRAVEL. The borehole log notes that there is seeping water at approximately 107m AOD commensurate with a lens of cohesionless material and seepage into the basin may be possible. However, it must be emphasised that the underlying conditions in the basin may be at variance to WS3 and could be similar to WS4 where gravelly CLAY / clayey GRAVEL was not encountered in the borehole.

The detailed design of the attenuation basin, which will be a condition of planning, has not yet been undertaken and a trial pit / soak away test will be required as part of the detailed design to determine the nature and permeability of the soils within the basin. It is considered that two soakaway tests should be undertaken to a base level of 107m AOD. It is recommended that one test should be at a ground level of 108.5 m AOD and the second at 109m AOD. The soakaway excavation will confirm composition of the soils and the presence of perched water. The results of the soakaway test will be used for the design of the basin, and this will include the need for sub-surface drainage and or lining to ensure that the basin performs satisfactorily so that it can be used for sports and be functional as an occasional drainage basin.

Turning towards the hydrological characteristics of the area, the Highgate Society report refers to the 1865 Ordnance survey mapping. The report notes that the mapping shows the presence of numerous ponds and streams. It is highly likely that ponds were / are clay lined and fed by surface water run-off and shallow springs.

Indeed, the presence of isolated ponds, occasional watercourses, shallow springs and waterlogged ground is entirely consistent with a material dominated by clay incorporating silt, sand and gravel lenses. The mapping for 1896 only identifies two ponds within a radius of approximately 500m of the school but neither of these ponds exists today and have probably been infilled as noted by the Highgate Society report.

In summary:

- The Claygate Member overlying the London Clay Formation is predominantly clay but incorporates silt, sand and gravel lenses. Clay underlying porous material occurring within the Claygate Formation matrix allows water to be held

(or perched) at different levels above groundwater.

- The result of the boreholes sunk within the school grounds is consistent with the Claygate Member.
- The presence of isolated ponds, occasional watercourses, shallow springs and waterlogged ground in the Highgate area is entirely consistent with the underlying geology.
- The hydro-geological setting is not complex but there is local variation in the composition of materials including sand and gravel lenses within the clay matrix.
- The present-day hydrological environment is substantially different to 1865. The site and Highgate in general are serviced by highway drainage and storm sewer network. In addition, there are large areas of impermeable surfaces (roads, drives etc), buildings and walls which all have an impact on surface water run-off and infiltration. Accordingly, the relevance of the historic hydrological setting of 1865 is of limited value.

In conclusion, groundwater flooding at the site is considered a low risk.

5 Hydraulic Modelling Surface Water Flood Risk

5.1 Model Build

5.1.1 Available data

Existing modelling

No pre-existing modelling of this area is available for use, though the area is covered by the Environment Agency surface water flood mapping. A new model has been built from component data with no elements from previous models incorporated.

5.1.2 Elevation data

LiDAR data was obtained from the Environment Agency. For the study area 2m and 1m DTMs were available and 1m resolution was selected.

Topographic survey

Topographic survey was undertaken for the purposes of this study by Randall Surveys in 2016. The survey included information pertaining to surface water sewers, foul sewers and the topography of the site. This survey can be found in Error: Reference source not found.

MasterMap data

Land-use data in vector format was derived from the national coverage provided by Ordnance Survey MasterMap. This was supplied with sufficient coverage for the full model extent. See section 5.3 for further details.

Hydrological data

ReFH2.2 software was used in combination with the FEH web service in order to provide data for hydrological analysis. See section 4 for further details.

5.1.3 Hydrological analysis

Introduction

A hydrological assessment was undertaken for the Highgate catchment surrounding the development site shown in Figure 5.1. The rainfall boundary was set over the entire 2D model area, which has been configured to be larger than the FEH catchment area to ensure that any errors in the delineation of the FEH catchment are excluded.

Storm durations

The rainfall hyetograph shown in Figure 5.2 has been based on gross rainfall derived from the ReFH2 using DDF2013 data. The rainfall hyetograph shown is for the 1 in 10, 1 in 30, 1 in 100, 1 in 1000 as well as the 1 in 100 plus 20% and 40% climate change. Additionally, several storm durations were run, including 3.5 hour (which is the critical storm duration for the catchment), 4.5 hour and 5.5 hour durations (which is the critical storm drainage duration). This approach means that there is explicit representation of both storage and infiltration losses within the hydraulic model.

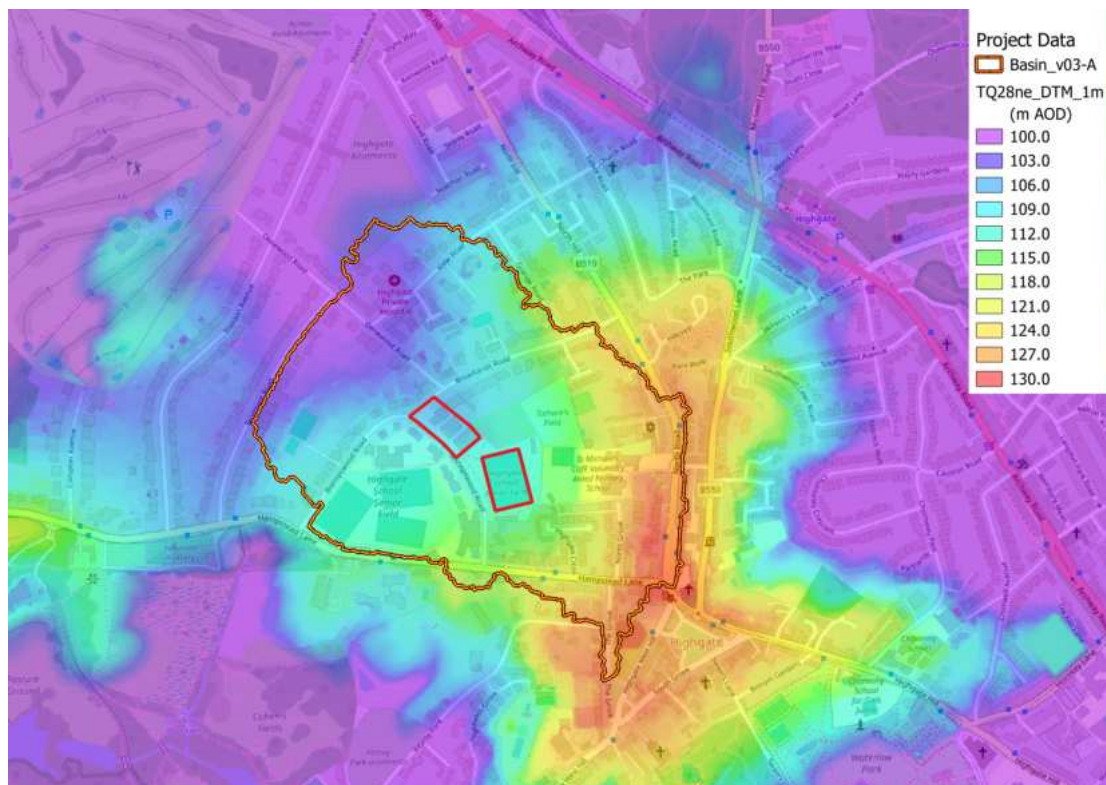


Figure 5.1: Coverage of different land-use classes to be assigned different roughness parameter values

5.1.4 Hydraulic simulation

Software

The scheme was modelled using the widely-adopted TUFLOW HPC software. TUFLOW has been in wide use in the UK for over 20 years and is a stable and extensively tested two-dimensional (2D) modelling package. It incorporates a one-dimensional (1D) model, ESTRY, for the simulation of surface water pipe network.

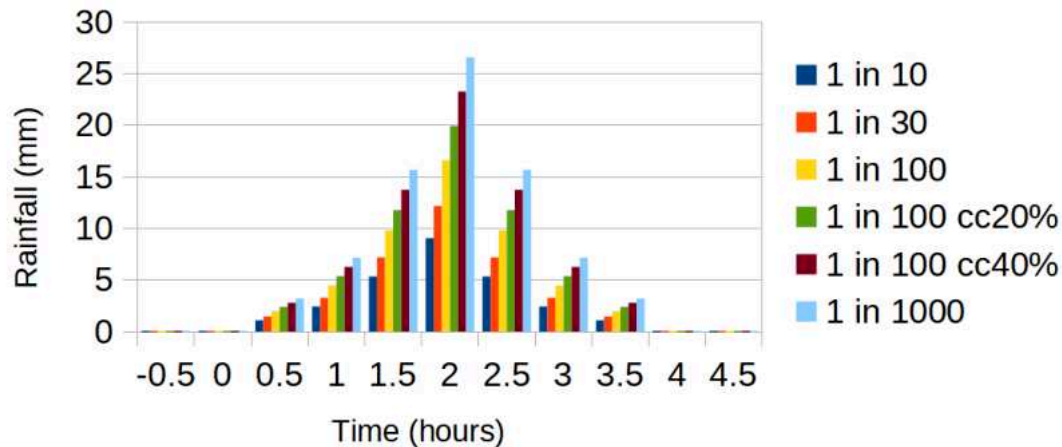


Figure 5.2: Rainfall hyetograph for the 1 in 10yr, 1 in 30yr, 1 in 100yr, 1 in 1000yr, 1 in 100yr plus climate change allowances (20% and 40%) using a 3.5 hour storm duration

The 1D and 2D solvers may be coupled and run simultaneously, exchanging data throughout the simulation, permitting utilisation of the strengths of both 1D (best for channels, structures and pipe networks) and 2D (best for floodplains and complex flood paths). One of the key advantages of the software is its use of standardised and open input and output formats (ASC, SHP, CSV, TXT). This means that model data can be both prepared and inspected/reviewed without a copy of the software and the data can be readily extracted and processed using other, unrelated programs. The latest version of the software was applied, specifically build 2024-03-AC-iSP-w64.

Terrain

The terrain has been represented using the 2D portion of the model, the wider floodplain is split into square elements referred to as 'cells'. The cell size should be small enough to represent flow routes with sufficient detail, however, larger cell sizes are favourable as increases to the number of cells also increases the computational effort in undertaking simulations (halving the cell size results in simulations taking approximately 8 times longer to run).

In this instance a 1m resolution was selected as there are fine detailed features that need representing in 2D and this still permits runs to complete in suitable time. The majority of elevations across the terrain were obtained by inspection of the LiDAR data. Figure 5.1 shows the Extent of LiDAR coverage around the modelled area. LiDAR was sufficiently recent and of sufficient quality that no further refinements were considered necessary.

Surface roughness

Roughness has been spatially assigned using MasterMap data, with different classes (also known as feature codes) being assigned different Manning's n roughness parameters (the industry standard parametrisation of roughness). The values selected are typical values for floodplains in the UK. Figure 5.3 shows the coverage of the different classes, while Table 5.1 below shows the roughness parameters applied to the different classes.

MasterMap class	Description	Manning's 'n' Roughness
10021	Buildings	1
10022	Buildings	1
10053	Land	0.08
10054	Land	0.02
10056	Land	0.05
10062	Buildings	0.1
10089	Water	0.03
10096	Land	0.055
10111	Land	0.1
10172	Roads	0.022
10123	Roads	0.022
10183	Roads	0.04
10193	Structures	0.055
10217	Land	0.08

Table 5.1: Roughness parameters applied to MasterMap classes

Surface permeability

Soils data has been based on the freely available European Soil Database¹. The Highgate catchment model extent falls under the soil category loam, this soil was specified using TUFLOW default values for the Green-Ampt Infiltration Method.

Surface water drainage

Surface water drainage features are included in this modelling including a pipe network with pits that allow transfer of water from cover levels of manholes to the surface water sewer network beneath. The network is based on the topographic survey. The pipe network has entrance and exit losses applied as recommended within the TUFLOW manual.

Boundary conditions - Inflows and outflows

The rainfall boundary was set over the entire 2D model area, which has been configured to be larger than the FEH catchment area to ensure that any errors in the delineation of the FEH catchment are excluded.

¹<https://esdac.jrc.ec.europa.eu/content/european-soil-database-v20-vector-and-attribute-data>



Figure 5.3: Coverage of different land-use classes to be assigned different roughness parameter values

Head/time boundaries have been applied at the downstream extent of both pipe exits that drain to the north west of the catchment in the 1D domain. The elevations of both of these boundaries have been set to be just above the soffit level of the pipes (9803a at 103.83mAOD and 8805 at 103.34mAOD). This allows representation of a full pipe as the downstream boundary condition, in order to provide a conservative estimate of flows on the site.

A head/flow boundary has been applied at the North-western boundary of the catchment to drain the flow as it will continue to flow down the slope. An average gradient was calculated and applied.

Initial conditions

The 2D domain starts completely dry and the 1D downstream water level boundaries have been set so the pipes are full.

Simulation parameters

All simulation parameters have been left at their default values. The model time-step has been set to be 0.5 seconds for the 2D domain and 0.25 seconds for the 1D domain. This is in-line with the TUFLOW manual recommendations on appropriate time-steps (which states that “2D time-step in seconds should be somewhere between 1/2 to 1/5 of the 2D cell size in metres” and the 1D time-step is recommended as being half that of the 2D domain in linked simulations).

Model sensitivity runs

In any modelling exercise there are associated uncertainties. Often it is desirable to calibrate/verify the model to observed data, in order to either refine the selected schematisation/parameters or to demonstrate that they produce reasonable results by showing fit to the observed data.

In this instance there is no observed data to fit for either calibration or verification. Instead, a number of sensitivities have been undertaken in order to assess the impact upon results that selecting different parameters or schematisation might have. It should be stressed that reasonable values and schematisation have been selected in all cases as the baseline case, in line with best practice; however, by adjusting these values a measure of confidence in the outputs might be obtained in the face of uncertainties.

Storm durations

The sensitivities applied in this model are to run different storm durations to see how this impacts upon the results of the model.

5.1.5 Modelled scenarios

Baseline model scenario

The baseline model is a representation of the existing school sports facilities. It includes all the parameters described in sections 4 and 5, with the existing sports centre facilities represented using finished floor levels based on the plan drawings.

Post development model scenario (Mallinson Sports Centre)

The post development model is a representation of the proposed sports facilities and proposed flood mitigation options. The model includes all the parameters with the proposed sports centre facilities represented using finished floor levels based on the architect's drawings (see Table 2.1).

Mitigation measures are shown in Figure 2.3 and includes the flood retention basin to the east of the Mallinson Sports Centre. The retention basin connects to the existing improved ditches to the east and discharges into an exiting ditch and surface water sewer which flows north towards Broadlands Road. In addition, the scheme includes improvement works to swales within the site to ensure the functionality of the drainage. Existing culverts will be jetted to remove site.

The model includes the Sports Centre which will be tanked and protected by a high threshold at the entrance to the building (107.00 m AOD). In addition, ground levels between Broadlands Road and the Sports Centre has been set to 106.00mAOD.

5.1.6 Model strengths and limitations

Strengths

The model has been built in line with current best practice, including undergoing model review. A range of sensitivities on storm duration have been undertaken to

assess the impact of changing such parameters to see if they have any significant effect on model results which could alter the conclusions of the study.

The sensitivity analyses show that storm duration is not a critical issue in terms of evaluating flood depths for the 3.5 hour, 4.5 hour and 5.5 hour rainfall events. The maximum change in depth in the site of interest is between a 3.5 hour and 5.5 hour simulation is less than 0.1m.

Limitations

The modelling simplifies the schematisation of the sports pitch and excludes the beneficial impact of below ground attenuation. This is considered conservative as it assumes that the flood storage volume is full at the commencement of the design event and has the effect of increasing run-off.

Certain surface water culverts / pipes shown on the topographic survey which are stated as being “assumed connection from records”. As no diameter or invert levels were recorded, the modelling has assumed their diameters as the same as any pipes they are connected to. As an example, modelled pipes SW8805 and SWSTN102d are assumed as being 0.45m in diameter (based on the known connecting pipes), with invert levels based on nearest known inverts.

5.2 Hydraulic Model Results

The hydraulic model has been constructed to assess surface water flooding at the existing sports facilities and for the proposed sports facilities.

Tables 5.2 and 5.3 and Figures 5.6 and 5.7 shows the results of the hydraulic modelling for the pre and post development scenarios associated with a 1 in 100 year rainfall event. Levels and depths are quoted at three key reference points as shown in Figure 5.8. Reference point 1 is at the northern end of the site which currently experiences the deepest depth of flooding within the model. Reference point 2 is within the retention basin and reference point 3 is on the sports pitches.

The modelling has demonstrated that the retention pond and other mitigation measures are effective at mitigating internal flooding of the school for the 1 in 100 year rainfall event plus 40% climate change allowance design event. The modelling also demonstrates that there is no adverse impact off site, with flood levels within the development area reduced by 0.34m at the northern end of the site. The depth within the retention basin is 1.52m AOD.

- The Mallinson Sports Centre is flood free in the 1 in 100 year design event + 40% climate change.
- There is a reduction in flood level and depth at reference point 1 of 0.34m.
- There is a reduction in flood level and depth to the north of Broadlands Road of approximately 0.15m.

- There is a freeboard of 0.41m to the threshold at the northern entrance of the Mallison Sports Centre to the 1 in 100 year rainfall event plus a 40% allowance for climate change.

Scenario	Year	Return Period Years	Pre-dev Level (m AOD)	Post-dev Level (m AOD)
Ref 1 (MSC North)	2125	1 in 100 + 40% cc	106.93	106.59
Ref 2 (Retention Basin)	2125	1 in 100 + 40% cc	-	109.02
Ref 3 (Sports Pitch)	2025	1 in 100	110.40	110.40

Table 5.2: Model Results - Maximum Water Levels

Scenario	Year	Return Period Years	Pre-dev Depth (m)	Post-dev Depth (m)
Ref 1 (MSC North)	2125	1 in 100 + 40% cc	1.26	0.59
Ref 2 (Retention Basin)	2125	1 in 100 + 40% cc	0.01	1.52
Ref 3 (Sports Pitch)	2025	1 in 100	0.11	0.11

Table 5.3: Model Results - Maximum Water Depths

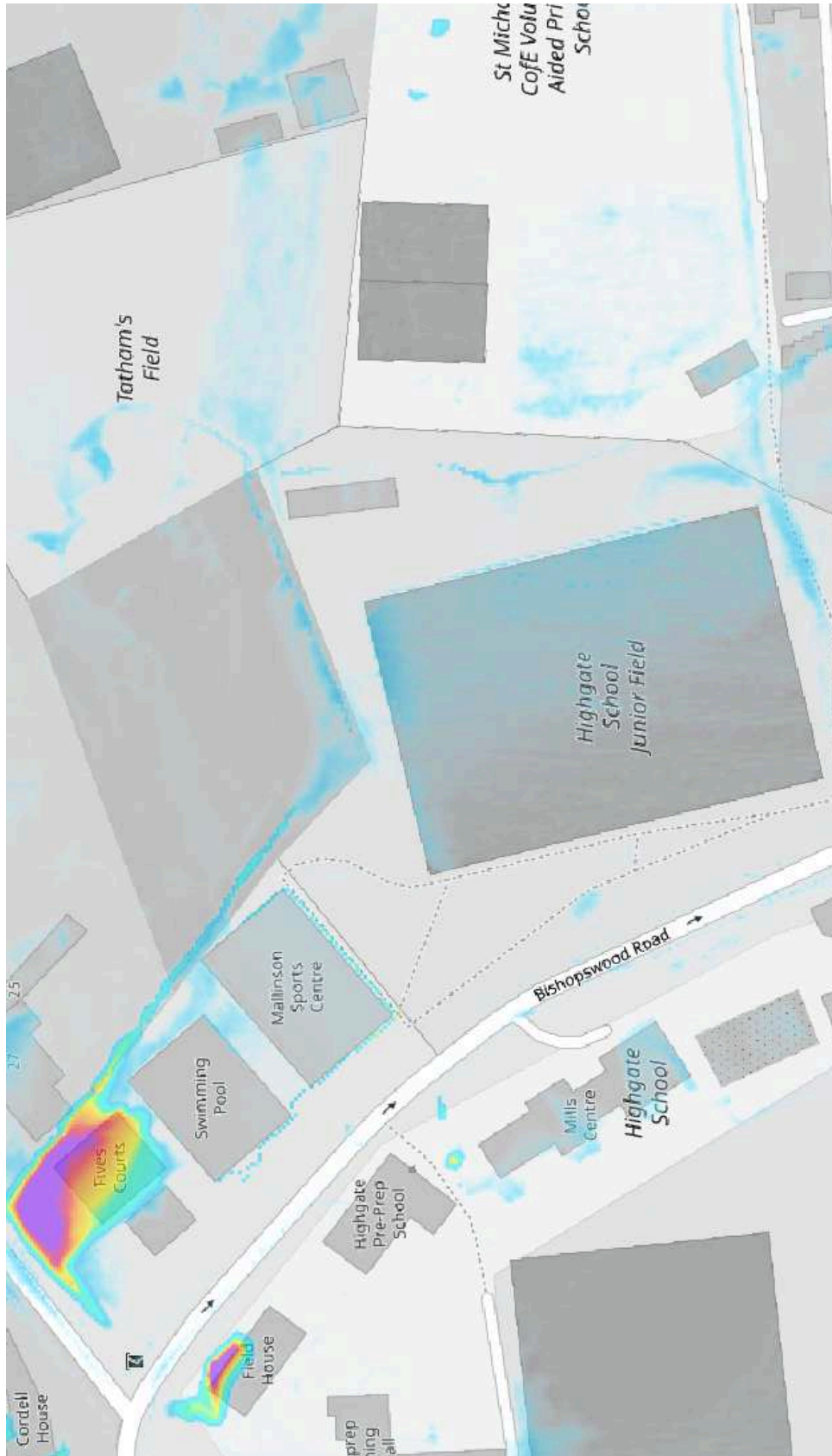


Figure 5.4: Baseline case, maximum flood depths: 1 in 100 year design event

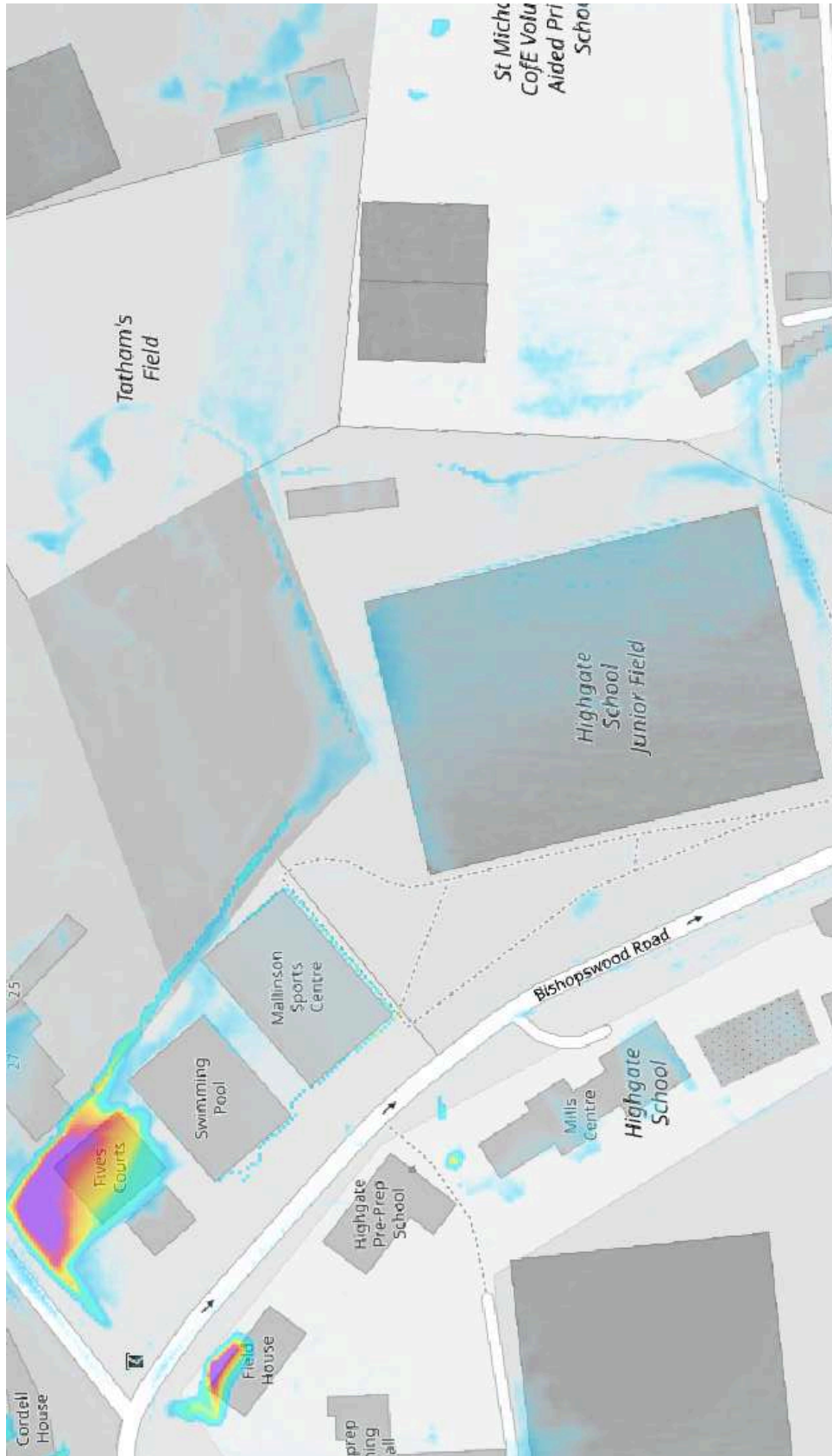


Figure 5.5: Post development scenario, maximum flood depths: 1 in 100 year design event



Figure 5.6: Baseline case, maximum flood depths: 1 in 100 year design event + 40% climate change allowance

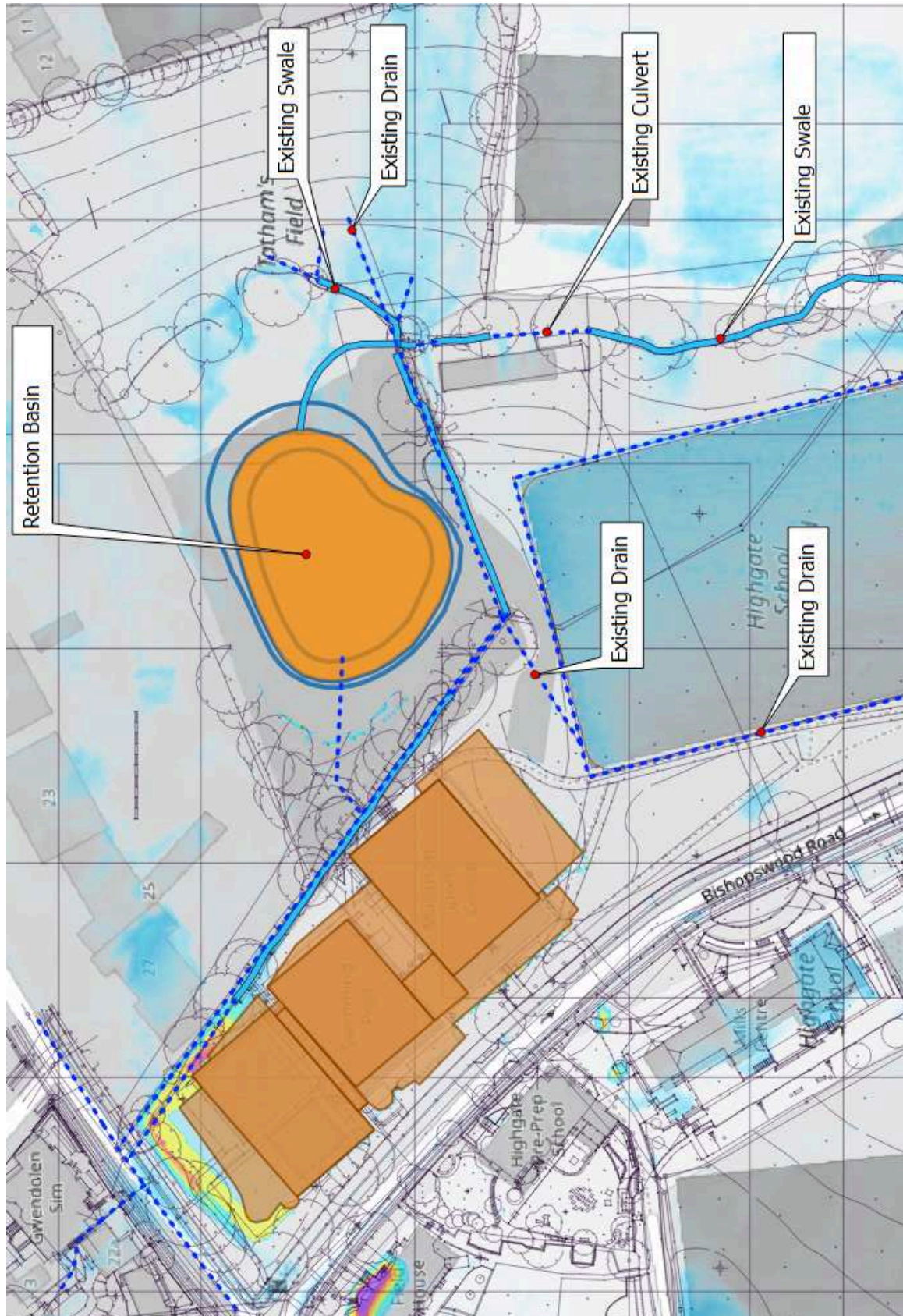


Figure 5.7: Post development scenario, maximum food depths: 1 in 100 year design event + 40% climate change allowance



Figure 5.8: Reference Points

6 Conclusions and Recommendations

6.1 Conclusions

Edenvale Young Associates were commissioned by Capital Projects to complete a Flood Risk Assessment for the construction of the Mallinson Sports Centre. The scope of works has included The FRA has includes an evaluation of published information, desktop analysis and hydraulic modelling to assess flood risk to the site.

The results of the modelling have been used to assess flood risk to the development. This includes consideration of:

- Post development finished floor and threshold levels.
- Pre and post development flood levels to assess third party impacts.

The following conclusions are made from the Flood Risk Assessment undertaken to assess the risk of flooding to the Mallinson Sports Centre redevelopment at Highgate school

- The proposed development lies in Flood Zone 1.
- The main flood risk posed to the site is surface water flooding.
- Other sources of flooding such as infrastructure flooding, surface water flooding and groundwater flooding have been reviewed but are considered low risk.
- Site specific hydraulic modelling has been undertaken as well as modelling of proposed flood mitigation measures.
- The Mallinson Sports Centre is flood free in the 1 in 100 year design event + 40% climate change.
- There is a reduction in flood level and depth at reference point 1 of 0.34m.
- There is a reduction in flood level and depth to the north of Broadlands Road of approximately 0.15m.
- There is a freeboard of 0.41m to the threshold at the northern entrance of the Mallinson Sports Centre.

6.2 Recommendations

It is recommended that:

- The door threshold to the Northern entrance to the Sports Hall shall be no less than 107.00m AOD
- The Sports Centre will be tanked to a level be no less than 107.00m AOD.
- Ground levels between Broadlands Road and the Sports Centre will be set to 106.00mAOD.
- An retention basin will be constructed to attenuate surface water run-off from the catchment.
- Flow control on the discharge from the retention basin will be restricted to ensure that the requirements of the SFRA are met.
- Existing ditches and swales will be cleaned and improved to ensure conveyance of syrface water flows through the site.
- Existing culverts and pipes conveying surface water will be cleaned of silt.
- Flood resilience measures should be adopted as part of the sports hall design, it is recommended that;
 - One-way valves should be installed in foul pipework to prevent sewage backing up into the development.
 - Suitable flood doors shall be installed at the entrance to the buildings.

A Topographic Survey

B SWMP 1 in 100 year event + climate change flood depth map

C Mapping from the SWMP showing sewer flooding incidents in Haringey

D Mapping from the SWMP showing groundwater flooding incidents in Haringey

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