

KINGMOOR, WREXHAM

Flood Consequence Assessment Report

Bryn Lane, Bowling Bank, Wrexham, LL13 9UT

Preliminary Report

KSW-BML-XX-XX-RP-C-0500

TUESDAY, 04TH APRIL, 2023

BarnsleyMarshall Limited

1 Birch Court
Blackpole East
Worcester
WR3 8SG

Tel 01905 330 550
Web barnsleymarshall.co.uk

Company Registered in England No. 4926185

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Barnsley Marshall Limited have prepared this report in accordance with the instructions of their client, FI Real Estate Management, for their sole and specific use. Any other persons who use any information contained herein do so at their own risk.

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1. Introduction

1.1 Project Background

Barnsley Marshall Ltd was appointed by FI Real Estate Management to provide a Flood Consequences Assessment & SuDS Drainage Strategy for the proposed development of 3 industrial units and an ecological area on 25.42Ha of land off Bryn Lane, Wrexham postcode LL13 9UT.

The report provides an assessment of flood risk from various sources on the proposed development based on Government and local authority guidance with regard to flood risk assessments.

The report is based on currently available information and preliminary discussions.

Proposals contained or forming part of this report represent the design intent and may be subject to alteration or adjustment in completing the detailed design for this project. Where such adjustments are undertaken as part of the detailed design and are deemed a material deviation from the intent contained in this document, prior approval shall be obtained from the relevant authority in advance of commencing such works.

Where the proposed works to which this report refers are undertaken more than twelve months following the issue of this report, Barnsley Marshall shall reserve the right to re-validate the findings and conclusions by undertaking appropriate further investigations at no cost to Barnsley Marshall.

1.2 Scope of Flood Risk Assessment

The assessment is to be undertaken in accordance with the standing advice and requirements of the Planning Policy Wales – Technical Advice Note - 15 (TAN 15) Development and Flood Risk as outlined in the Communities and Local Government Planning Policy Guidance to the Planning Policy Wales and Sustainable Drainage (SuDS) Statutory Guidance - Wales.

The 25.42Ha development site is off Bryn Lane in Wrexham, with this road and existing industrial offices on the west, an existing housing community on the east, and NU Instruments on the north. Following scrutiny of the Natural Resources Wales Flood Maps it has been identified that the existing site lies within an area classified as Flood Zone A or B in accordance with TAN15 (Flood Zone 1 in accordance with Environment Agency Flood Maps) indicating that the risk of flooding from rivers and sea is low, with an Annual Exceedance Probability of flooding of less than 0.1%. The assessment has been undertaken in accordance with the standing advice and requirements of the Natural Resources Wales for Flood Risk Assessments as outlined in TAN 15.

The assessment has:

- Investigated all potential risks of current or future flooding to the site
- Considered the impact the development may have elsewhere with regards to flooding risk
- Considered design proposals to mitigate any potential risk of flooding determined to be present
- Determine any constraints to be imposed on the development layout or drainage systems

2. Existing Site Details

2.1 Location and Description

The proposed development is located off Bryn Lane, Bowling Bank, Wrexham, LL13 9UT. The site is approximately 6.0km east of Wrexham city centre and is located in the North East area of Wrexham Industrial Estate. The site is bounded by existing conveyance ditches/watercourses along the western, northern and eastern sides of the site, which combine at the north-eastern corner of the site then flows in a north-easterly direction to River Dee approximately 3.1km from the site. The site is primarily a greenfield site, with some existing truck parking that can be accessed from Bryn Lane, refer to **Figure 1**.

Refer to **Appendix A** for the site location plan and proposed masterplan.



Figure 1: Development Site showing site boundary in red

(Source: Google Maps, 2022-07-26, 1300hrs)

2.2 Topography

The site generally slopes from south-west to the north-east towards the existing ditches. The southwestern corner of the site has an existing level of 28.51mAOD, and the north-eastern corner of the site has an existing level of 25.69mAOD, giving a fall of 2.82m over a distance of 600m, which approximates to a 0.47% longitudinal fall.

Two ditches border the site; one along the western and northern edge and the other along the eastern edge.

Refer to **Appendix B** for the site topography.

2.3 Existing Watercourses

The site is bounded by existing conveyance ditches/watercourses along the western, northern and eastern sides of the site, which combine at the north-eastern corner of the site then flows in a north-easterly direction to River Dee approximately 3.1km from the site. The site also has three exiting small ponds, which show no inflow or outflow to the watercourses mentioned above.

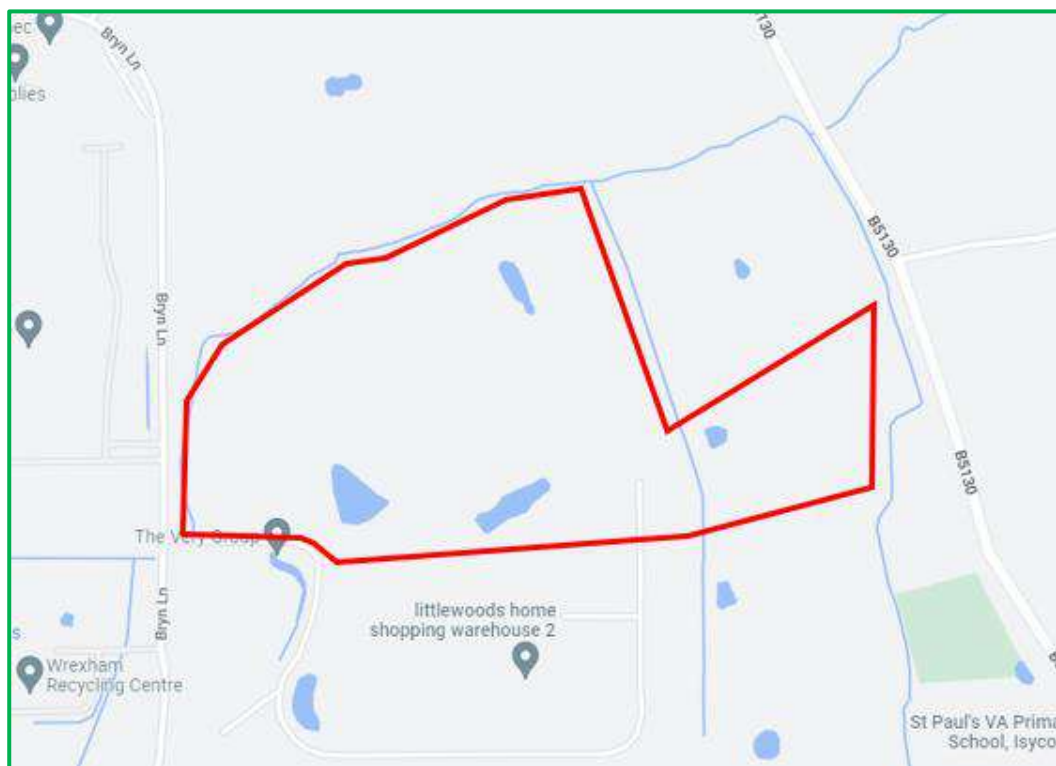


Figure 2: Rivers and Ponds within Site Extents

(Source: Google Maps, Accessed on 2022-07-26, 1640hrs)

2.4 Existing Public Drainage

There are no adopted sewers on site; the nearest existing public drainage is a Welsh Water combined public sewer and a DN150 surface water sewer (starting from the north-west corner of the site and flowing north-east) along Bryn Lane to the east of the site. From the provided Welsh Water sewer maps (refer to **Appendix C**), it can be seen that the two existing sewers are situated in the centre of Bryn Lane.

2.5 Existing Private Drainage

There is no existing private drainage on site. A detailed CCTV & Drainage Survey shall be commissioned to determine whether sewers are on site, and propose remedial works if required to ensure continuity of the sewers during and after construction.

2.6 Site Geology

No Ground Investigation Survey had been carried out at the time this report was compiled. A search on British Geological Survey online showed that there are six boreholes within the site boundary, these are listed in Table 1, with their grid references and the ID numbers used within Appendix D. Other borehole locations around the site are shown in **Figure 3**.

Table 2: Boreholes within the site and their information

ID	Eastings	Northings	ID within Appendix D
SJ35SE47	339240	350210	S5
SJ35SE48	339240	350330	S7
SJ35SE51	339240	350500	S8
SJ35SE50	339360	350580	S9
SJ35SE49	339450	350420	S10
SJ35SE46	339450	350210	S6

A copy of the borehole results is contained in **Appendix D**.

The soil profile from the two boreholes indicate that the soil is predominantly clay for depths of 15m from the surface and would not support drainage via infiltration. However due to the dated nature of the boreholes, BRE Digest 365 Soakaway Tests shall be conducted at a number of locations across the site, and if infiltration is found to be possible, the proposed Geo-cellular Storage Tank and Ponds shall be designed as infiltration features, and the controlled outflows to the ditches shall be reduced, or if infiltration is good enough, there shall be no outfall from the ponds to the existing ditches.

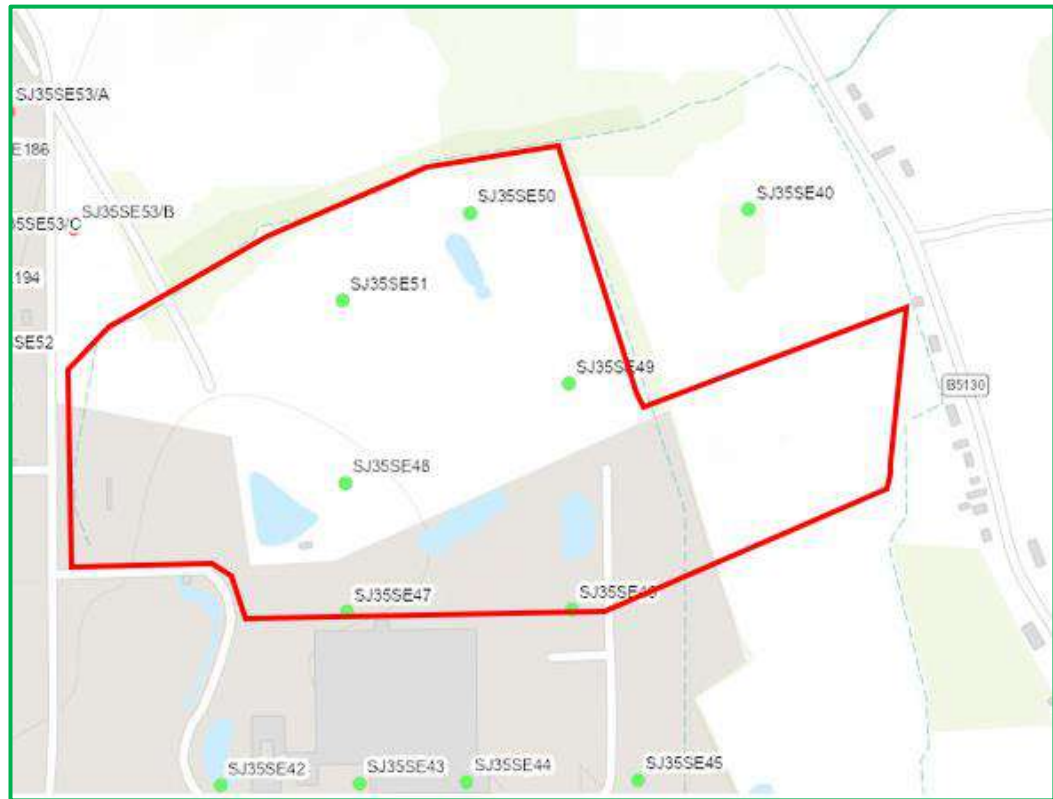


Figure 3: Historic Borehole Locations

(Source: British Geological Survey, Accessed on 2022-07-26, 1645hrs)

3. Policy and Guidance

3.1 Planning Policy Wales (PPW), Welsh Assembly Government (WAG), March 2002

Land use planning policies of the Welsh Assembly Government are set out in Planning Policy Wales (PPW). The main purpose of PPW is to reconcile the needs of development and conservation, securing economy, efficiency, and amenity in the use of land, protecting natural resources and the historic environment, thereby contributing to sustainable development.

In relation to flood risk, PPW aims to minimise the risks posed by, or to, development on, or adjacent to land liable to flooding. PPW recognises that the impacts of future climate change effects should be considered when planning development in flood prone coastal areas and floodplains. The likely impact to frequency and severity of floods expected during the lifetime of development must be addressed. More detailed guidance relating to development and flood risk is provided in Technical Advice Note 15: Development and Flood Risk (TAN15).

3.2 Flood Zone Classification

TAN 15 Figure 1 describes the composition and use of flood zones to control and manage development. The figure enables identification of the amount of effort required to conduct flood risk assessment based on the flood zone in which the development falls. **Table 2** is a copy of TAN 15 Figure 1.

The 25.42Ha development site is off Bryn Lane in Wrexham, with this road and a food production plant to the west, an existing packaging factory to the south, and open land to the north and east. Following scrutiny of the Natural Resources Wales Flood Maps it has been identified that the existing site lies within an area classified as Flood Zone A or B in accordance with TAN15 (Flood Zone 1 in accordance with Environment Agency Flood Maps) indicating that the risk of flooding from rivers and sea is low, with an Annual Exceedance Probability of flooding of less than 0.1%.

Therefore, in accordance with TAN15, a Flood Risk Assessment (Flood Consequences Assessment) is not mandatory for this proposed development, but has been carried out as part of due diligence.

Table 2: Flood Zone Classification

Description of Zone		Use within the precautionary framework
Considered to be at little or no risk of fluvial or tidal/coastal flooding.	A	Used to indicate that justification test is not applicable and no need to consider flood risk further.
Areas known to have been flooded in the past evidenced by sedimentary deposits.	B	Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further.
Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal).	C	Used to indicate that flooding issues should be considered as an integral part of decision making by the application of the justification test including assessment of consequences.
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	C1	Used to indicate that development can take place subject to application of justification test, including acceptability of consequences.
Areas of the floodplain without significant flood defence infrastructure.	C2	Used to indicate that only less vulnerable development should be considered subject to application of justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered.

(Source: TAN 15 Figure 1)

3.3 Technical Advice Note 15: Development and Flood Risk (TAN15), Welsh Assembly Government (WAG), July 2004

The guidance in TAN 15 aims to direct new development away from areas of high flood risk. Where development in these areas can be justified, the guidance states that the risk of and consequences of flooding should be managed to an acceptable level.

TAN 15 guidance requires the assessment of consequence based on the consideration of whether flooding would be acceptable for the particular type of development under consideration. The justification test, as outlined in Section 6 of TAN 15, indicates that development can be justified if it can be demonstrated that:

- Its location in Zone C is necessary to assist, or be part of, a local authority regeneration initiative or a local authority strategy required to sustain an existing settlement, or,

- Its location in Zone C is necessary to contribute to key employment objectives supported by local authority and other key partners, to sustain an existing settlement or region; and,
- It concurs with the aims of PPW and meets the definition of previously developed land; and
- The potential consequences of a flooding event for the particular type of development have been considered and in terms of the criteria contained in Section 5 and 7 and Appendix 1 (TAN15) found to be acceptable.

TAN 15 states that any new development on the floodplain will generally result in additional flood risk. The guidance indicates that the main criteria for determining whether such a development is acceptable will depend on whether additional flood risk can be effectively managed. The guidance states that the objectives of the Flood Consequence Assessment are to develop a full appraisal of:

- The consequences of flooding on development;
- The consequences (i.e. overall impacts) of the development on flood risk elsewhere within the catchment for a range of potential flooding scenarios up to that flood having a probability of 0.1% and,
- The assessment can be used to establish whether appropriate mitigation measures can be incorporated within the design of the development to ensure that the development minimises risk to life, damage to property and disruption to people living and working on the site or elsewhere in the floodplain.

3.4 Flood Risk Vulnerability Classification

In accordance with TAN 15, particular flooding consequences may not be acceptable for particular types of development. For example, allowing residential development in areas which are subject to high risks of flooding can result in a traumatic impact on people's lives. The precautionary framework identifies the vulnerability of different land uses to flooding, and for this purpose, development has been subdivided into three categories in Figure 2. **Table 3** is a copy of TAN 15 Figure 2.

Table 3: Flood Vulnerability Classification

Development Category	Types
Emergency Services	Hospitals, ambulance stations, fire stations, police stations, coastguard stations, command centres, emergency depots and buildings used to provide emergency shelter in time of flood.
Highly vulnerable development	All residential premises (including hotels and caravan parks), public buildings (e.g. schools, libraries, leisure centres), especially vulnerable industrial development (e.g. power stations, chemical plants, incinerators), and waste disposal sites.
Less vulnerable development	General industrial, employment, commercial and retail development, transport and utilities infrastructure, car parks, mineral extraction sites and associated processing facilities, excluding waste disposal sites.

(Source: TAN 15 Figure 2)

3.5 Justifying the Development Location

In accordance with TAN 15, new developments should be directed away from Zone C and towards suitable land in Zone A, then towards Zone B. Table 4 outlines the planning requirements for developments within each zone. Specifically, Table 4 details that Zone A and Zone B developments do not require a Flood Consequence Assessment.

Table 4: Development Acceptability Criteria

DAM	Development Type (Section 5)	Planning Requirements (Section 4)	Acceptability Criteria (Section 7 & Appendix 1)	Development Advice (Section 5, 6, 7 & Appendix 1)
A	Emergency services Highly vulnerable development Less vulnerable development Other	- Justification test not applicable - Refer to surface water requirements	No increase in flooding elsewhere	No constraints relating to river or coastal flooding, other than to avoid increasing risk elsewhere.
B	Emergency services	- If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further. - Refer to surface water requirements	- Acceptable consequences for nature of use - Occupiers aware of flood risk - Escape/evacuation routes present - Effective flood warning provided - Flood emergency plans and procedures - Flood resistant design - No increase in flooding elsewhere	Generally suitable for most forms of development. Assessments, where required, are unlikely to identify consequences that cannot be overcome or managed to an acceptable level. It is unlikely, therefore, that these would result in a refusal of planning consent on the grounds of flooding.
	Highly vulnerable development		- Acceptable consequences for nature of use - Occupiers aware of flood risk - Escape/evacuation routes present - Effective flood warning provided - Flood emergency plans and procedures - No increase in flooding elsewhere	
DAM	Development Type (Section 5)	Planning Requirements (Section 4)	Acceptability Criteria (Section 7 & Appendix 1)	Development Advice (Section 5, 6, 7 & Appendix 1)
	Less vulnerable development		- Occupiers aware of flood risk - No increase in flooding elsewhere	
	Other	Refer to surface water requirements	No increase in flooding elsewhere	
CI	Emergency services Highly vulnerable development Less vulnerable development	- Application of justification test (section 6) , including acceptability of consequences (section 7 and appendix 1) - Refer to surface water requirements	- Acceptable consequences for nature of use - Flood defences adequate - Agreement for construction and maintenance costs secured - Occupiers aware of flood risk - Escape/evacuation routes present - Effective flood warning provided - Flood emergency plans and procedures - Flood resistant design - No increase in flooding elsewhere	Plan allocations and applications for all development can only proceed subject to justification in accordance with section 6 and acceptability of consequences in accordance with section 7 and Appendix 1.
	Other	- Application of acceptability of consequences (section 7 and appendix 1) - Refer to surface water requirements	- Acceptable consequences for nature of use - Occupiers aware of flood risk - Desirable if effective flood warning and evacuation routes/procedure provided depending on nature of proposal - No increase in flooding elsewhere	Plan allocations and applications for development should only be made if considered acceptable in accordance with section 7 and Appendix 1.

DAM	Development Type (Section 5)	Planning Requirements (Section 4)	Acceptability Criteria (Section 7 & Appendix 1)	Development Advice (Section 5, 6, 7 & Appendix 1)
C2	Emergency services Highly vulnerable development	The flooding consequences associated with Emergency Services and highly vulnerable development are not considered to be acceptable. Plan allocations should not be made for such development and planning applications not proposed.		
	Less vulnerable development	- Application of justification test (section 6) , including acceptability of consequences (section 7 and appendix 1) - Refer to surface water requirements	- Acceptable consequences for nature of use - Flood defences adequate - Agreement for construction and maintenance costs secured - Occupiers aware of flood risk - Escape/evacuation routes present - Effective flood warning provided - Flood emergency plans and procedures	Plan allocations or applications for less vulnerable development can only proceed subject to justification in accordance with section 6 and acceptability of consequences in accordance with section 7 and Appendix 1.
	Other	- Application of acceptability of consequences (section 7 and appendix 1) - Refer to surface water requirements	- Flood resistant design - No increase in flooding elsewhere - Acceptable consequences for nature of use - Occupiers aware of flood risk - Effective flood warning provided - No increase in flooding elsewhere	Plan allocations and applications for development should only be made if considered acceptable in accordance with section 7 and Appendix

(Source: TAN15 – Development and Flood Risk, accessed 2022/07/26 at 1720 hrs)

4. Development and Flood Risk

4.1 Proposed Development Vulnerability Classification

The 25.42Ha development site is off Bryn Lane in Bowling Bank, Wrexham. The site is bordered by greenfield land to the north and east, Bryn Lane and a large industrial factory to the west, and an industrial packaging unit to the south. Following scrutiny of the Natural Resources Wales Flood Maps it has been identified that the existing site lies within an area classified as Flood Zone A or B in accordance with TAN15 (Flood Zone 1 in accordance with Environment Agency Flood Maps) indicating that the risk of flooding from rivers and sea is low, with an Annual Exceedance Probability of flooding of less than 0.1%. The site is however

In accordance with TAN 15 Figure 2 (**Table 3** in this report), Kingmoor, Wrexham is a **Less Vulnerable Development**.

In accordance with TAN 15 Chapter 9: *Summary of Policy Requirements (refer to section 3.5)*, a Less Vulnerable Development in Flood Zone A is **acceptable with no constraints** relating to river or coastal flooding, other than to avoid increasing risk elsewhere, and the Justification Test is not applicable.

The following sections investigate the probability of flooding from various sources as a precautionary measure.

4.2 Flood Risk from Rivers and the Sea

The Natural Resources Wales Long Term Flood Map provides basic flood mapping data as a general guide to whether a site is at risk of flooding from various sources including rivers and seas for Flood Zoning classification.

This mapping indicates that the site is wholly located within an area with an undefended risk of flooding from rivers and the sea of less than 0.1% (or the 1 in 1000-year event), classified as Flood Zone 1 (Zone A in accordance to TAN 15). The development site is therefore at **Very Low Risk** of flooding from rivers and the sea.

4.3 Historic Flooding

There is no evidence or data to report any historic flooding within the site bounds. The site is bounded by existing conveyance ditches/watercourses along the western, northern and eastern sides of the site, which combine at the north-eastern corner of the site then flows in a north-easterly direction to River Dee approximately

3.1km from the site. The site itself falls from 28.51mAoD in the southwest, to 22.41mAoD in the west.

4.4 Flood Defences

There are no formal flood defences recorded on the Natural Resources Wales Flood Map in the immediate vicinity of the site. The site is also not indicated as being used for flood storage, therefore, the flood risk to the development from failed or breached flood defences is considered to be **Low Risk**.

4.5 Flooding induced by Climate Change

The nearest Flood Zone C (Flood Zone 2 in accordance with Natural Resources Wales Long Term Flood Map) is approximately 1.2km to the southwest of the site and is associated with the maximum flood extents of Redwither Brook. The ground levels at the flood extents caused by Redwither Brook (25.000mAOD) are approximately 3.5m lower than southwest most tip of the site which has an existing level of 28.51mAOD. The 3.5m level buffer should provide significant flood resilience of the site against flooding effects due to climate change. Flood risk to the development due to climate change effects is therefore considered to be **Low Risk**.

4.6 Flooding from Groundwater

There are six historical boreholes within the site on British Geological Survey maps. Both boreholes indicate a no groundwater to a depth of 15mbgl. The soil stratum shows clays down to a depth of 15mbgl without any detail on the underlying soil, refer to **section 2.6** of this report. This soil stratum, together with the existing ground slope towards the south, implies that any groundwater will be prevented from rising to the surface by the clay layer and forced to flow below ground towards the existing ditches and onwards to the River Dee. It is therefore unlikely that any seasonal rise in water table would result in surface flooding of the site, therefore the flood risk due to groundwater is **Low**.

4.7 Flooding from Adopted Sewers

There are no adopted sewers on site; the nearest existing public drainage is a DN150mm Welsh Water combined sewer approximately 150m south of the southwest corner of the site. Therefore, the flood risk due to adopted sewers is considered to be **Low**.

4.8 Flooding from Private Drainage

There is no existing private drainage on site. A detailed CCTV & Drainage Survey shall be commissioned to determine whether sewers are on site, and propose remedial works if required to ensure continuity of the sewers during and after construction.

4.9 Flooding from Surface Water and Small Watercourses

The Natural Resources Wales Flood Map was consulted to check the risk of site flooding from surface water and small watercourses; an extract from the map is presented in **Figure 5**. The figure indicates that after severe or prolonged storms especially during the wet season, runoff turns to accumulate within the conveyance ditches that run along the western, northern and eastern edges of the site, with the ditches running full for short periods, while the site may experience small amounts of flooding around the existing pools of surface water. Nevertheless, all finished floor levels shall be at **least 150mm above surrounding ground levels**. Flood risk to the development due to surface water is therefore considered to be **Low Risk**.



Figure 5: Flood Risk from Surface Water – Flood Extents

(Source: <https://maps.cyfoethnaturiolcymru.gov.uk/>, Accessed on 2022-07-26, 1150hrs)

4.10 Flooding from Reservoirs, Canals and Artificial Sources

The Natural Resources Wales Long Term Flood Map was consulted to check the risk of site flooding from reservoirs and it was found to be safe from such flooding effects because both the River Clywedog and the River Dee are in excess of 1km from the site (approximately 1.3km and 2.8km respectively). **Figure 6** shows the extents of the risk of reservoir flooding from the River Clywedog and River Dee.

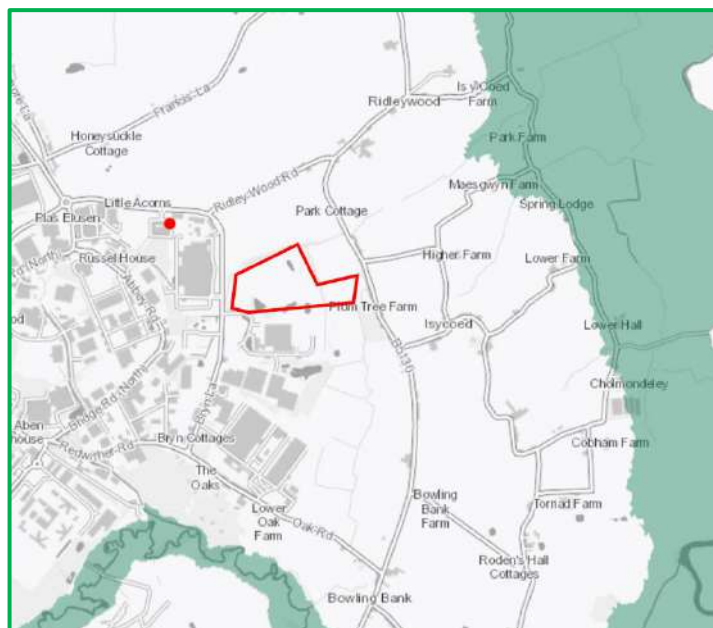


Figure 6: Flood Risk from Reservoirs – Flood Extents

(Source: <https://maps.cyfoethnaturiolcymru.gov.uk/>, Accessed on 2022-07-26, 1210hrs)

4.11 Overall Flood Risk

In accordance with TAN 15 Chapter 9: *Summary of Policy Requirements*, a Less Vulnerable Development in Flood Zone A is **acceptable** with 'no constraints relating to river or coastal flooding, other than to avoid increasing risk elsewhere', and the Justification Test is not applicable.

The site is therefore suitable for the type of development proposed.

5. Drainage Strategy

5.1 Recommended Surface Water Drainage Strategy

The proposed development has a plan area of 25.42Ha, with approximately 14.6ha being impermeable, and 10.7ha being reserved for an ecological zone. The IH124 method was used to estimate the greenfield runoff rates from the site since the site is less than 200Ha. *Because the site is also less than 50ha, the ICP SUDS tool in Micro-drainage Source Control module was used to calculate the greenfield runoff rates.* The tool uses the IH124 approach to calculate the greenfield runoff for 50ha, then linearly interpolate to get the flows for smaller catchments. The 1-year, 30-year, and 100-year Greenfield runoff rates were found to be 116.6 l/s, 233.6 l/s, and 288.8 l/s respectively, refer to **Appendix E**.

Qbar is 132.5 l/s for both rural and urban.

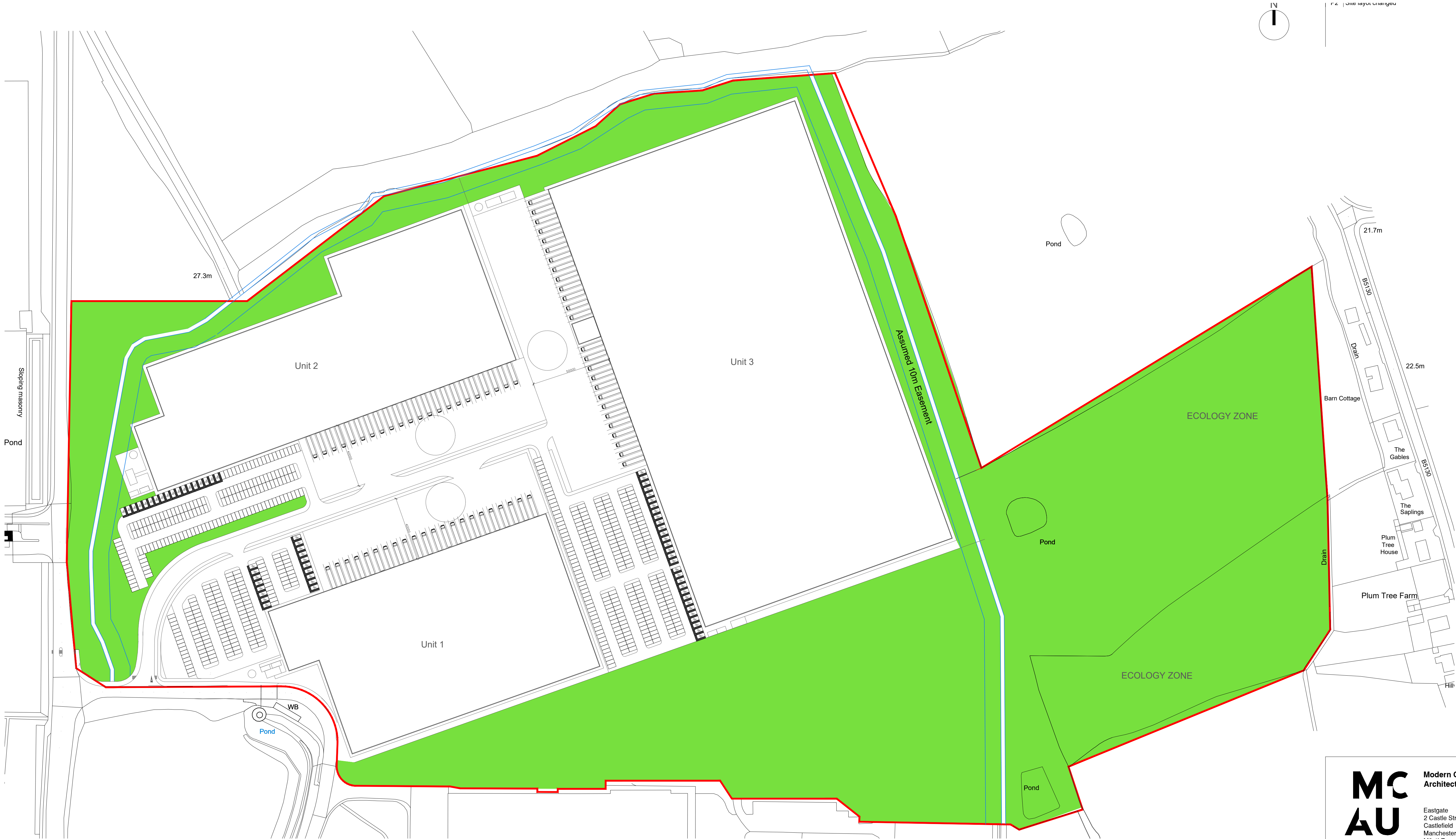
It is recommended that, to prevent increased flows post-development and offer an improvement to existing downstream flash flooding, runoff from the development shall be controlled to the 1-year Greenfield Runoff Rate of 116.6 l/s maximum for all storm events up to and including the 100-year + 40% CC storm event.

Details of proposed SuDS-based drainage layout for the development are given in **KSW-BML-XX-XX-RP-C-0501 Drainage Strategy Report**.

APPENDICES

Appendix A

Site Location Plan and Masterplan



Total Site Area : 254,287 sqm
Total Ecology Area: 114,489 sqm
Ecology Zone as site percentage: 45% approx

Unit	Use	Ground Floor Area	Mezz Office Area (5%)	Storage Mezz Area (7.5%)	Unit Total Area
1	B8	17,187sqm / 185,000sqft	859sqm / 9,250sqft	1,289sqm / 13,875sqft	19,335sqm / 208,125sqft
2	B8	19,045sqm / 205,000sqft	952sqm / 10,250sqft	1,428sqm / 15,375sqft	21,425sqm / 230,625sqft
3	B8	46,451sqm / 500,000sqft	2,322sqm / 25,000sqft	3,483sqm / 37,500sqft	52,257sqm / 562,500sqft

Development Total	93,019sqm / 1,001,250sqft
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Unit	Parking Number
1	175 spaces including 18 accessible
2	183 spaces including 18 accessible
3	296 spaces including 30 accessible

MC

AU

Modern City

Architecture & Urbanism

Eastgate

2 Castle Street

Castlefield

Manchester

M3 4LZ

t: 0161 974 7203

e: info@mcau.co.uk

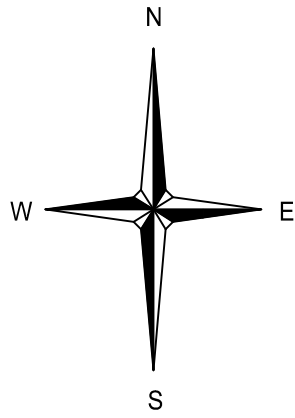
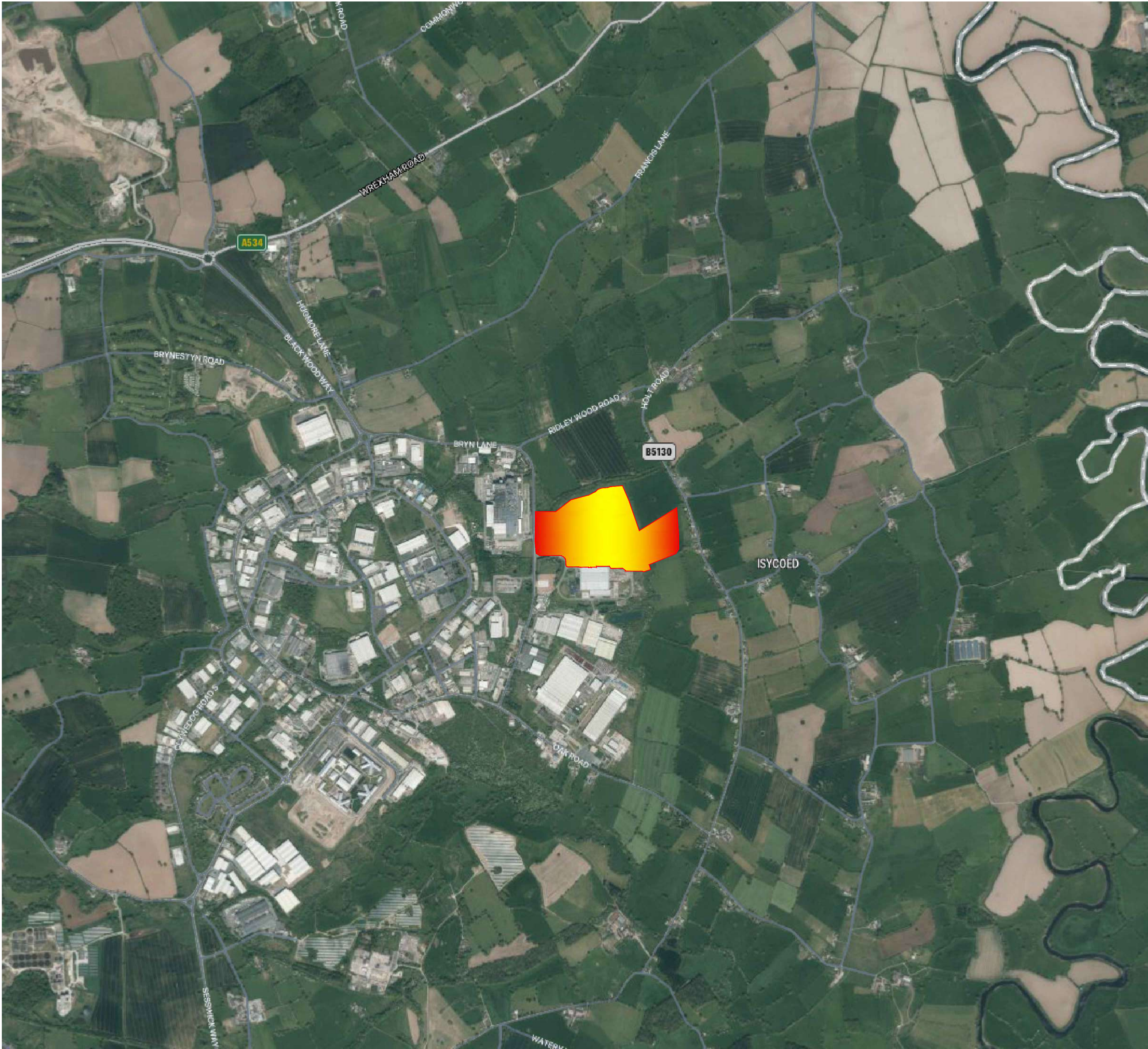
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Client
F.I. Real Estate Management

Project
Kingmoor Wrexham

Description
Proposed 3 Unit Site Plan

Status		
INFORMATION		
Scale	Drawn By	Date
1:1250@A1	PJ	AUG22
Job Number	Drawing Number	Revision
1204	02-001	P2



Safety, Health & Environmental Information:

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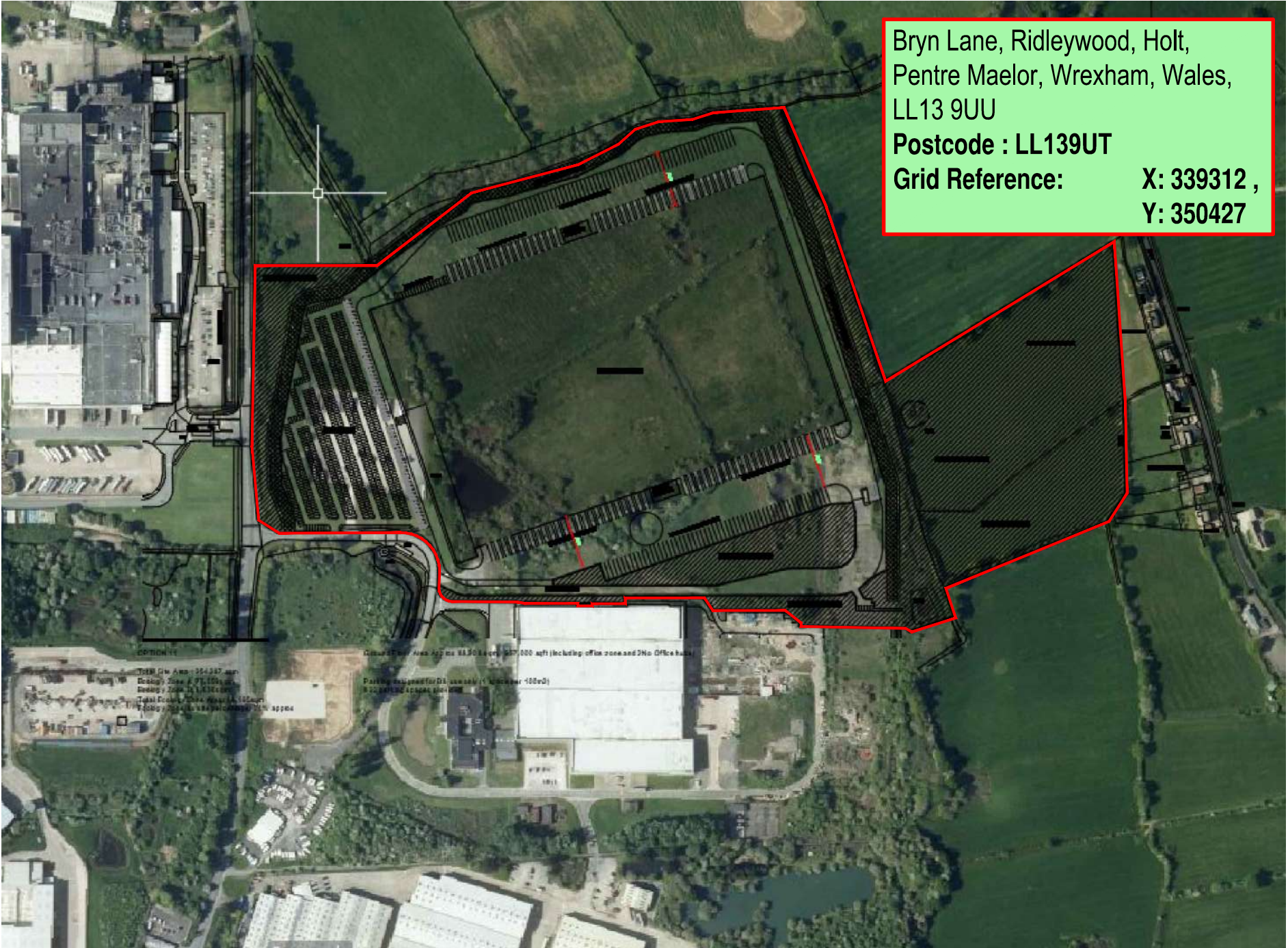
and described below:

Construction/Maintenance/Cleaning/Demolition

Refer to Drawing:

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2. All dimensions are in millimetres (mm), all levels in metres (m) unless noted otherwise.
3. Discrepancies or omissions are to be reported to the Engineer prior to work commencing.
4. Materials and workmanship are to comply in all respects with current British Standard Specifications, Codes of Practice, and Building Regulations Approved Documents.
5. The copyright of this drawing is vested in the Engineer and must not be copied or reproduced without written consent.
6. The Contractor is to check and verify all building and site dimensions, levels and sewer invert levels at connection points before work commences.
7. This drawing is to be read in conjunction with all relevant specifications and drawings issued by the Engineer, Architect and other Specialists.



P01	DH/AM	09/02/22	Preliminary Issue
Rev	By / Chkd	Date	Description

PRELIMINARY DRAWING
This drawing is not to be used for construction

Client



BarnsleyMarshall Limited
1 Birch Court
Blackpole East
Worcester
WR3 8SG

Tel: 01905 330550
Email: design@barnsleymarshall.co.uk
Web: www.barnsleymarshall.co.uk



Project

Kingmoor Site, Wrexham

Drawing

Site Location Plan

By	DH/AM	Date	09/02/2022
Drawing No.	KSW-BML-XX-XX-DR-C-0100		Revision P01
BML Job No.	1000-03		Status -

Drawing Scale at A1: N.T.S

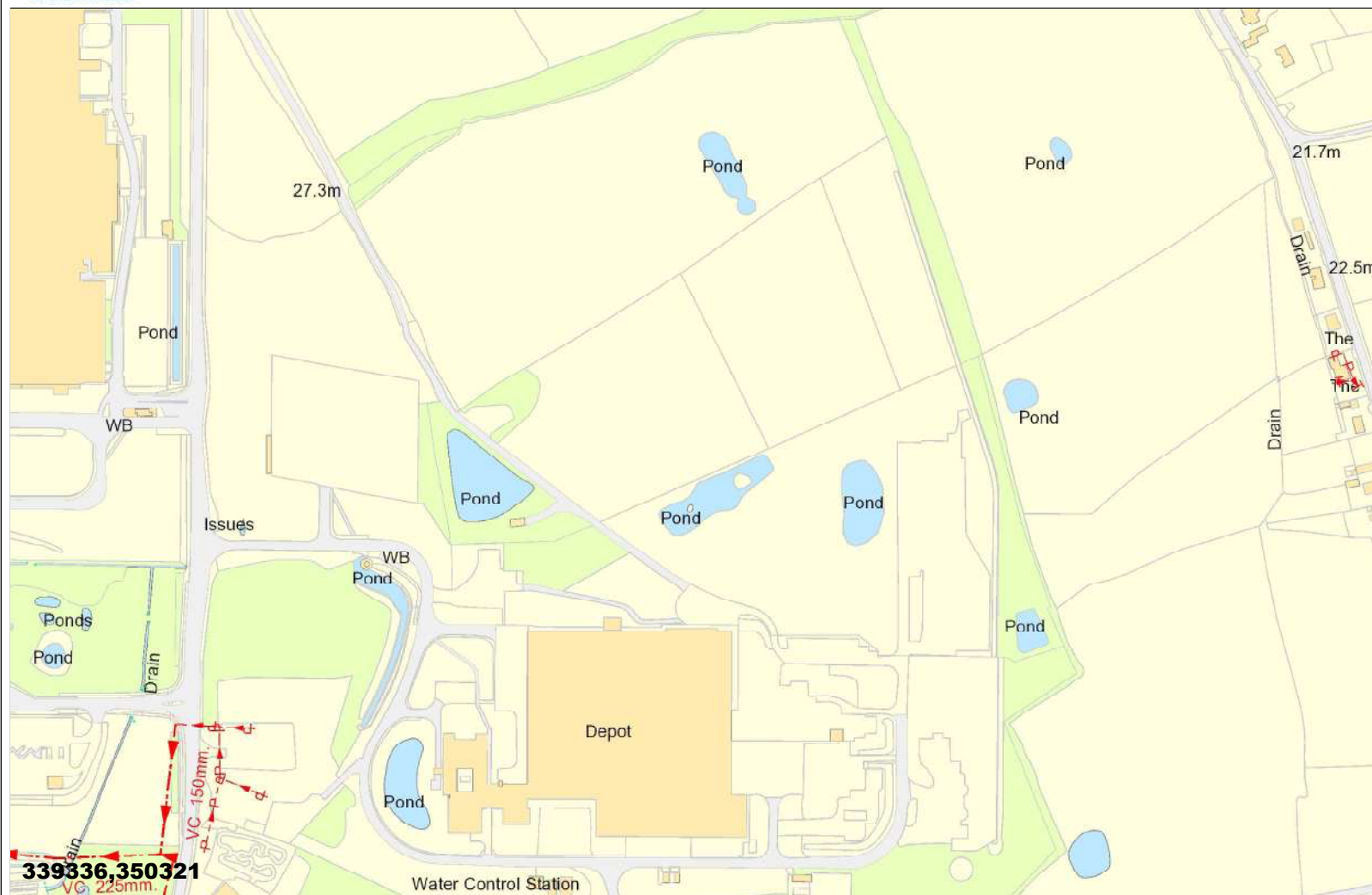
CAD Filename: C:\Users\DH\Documents\BML\BML-XX-XX-DR-C-0100.dwg

Appendix B

Site Topography

Appendix C

Welsh Water Sewer Maps



LEGEND

Clean Water

Sluice Val

Air Val, SINGLE

Tap

Pressure Reducing Valve

Meter

BULK Meter

FH

Cap

Existing Main

NON COMPANY

Sewerage External

Foul

Surface Water

Combined

Rising Main

Private

Treatment Works

Pumping Station

Special Purpose

Unknown End

Change, Combined Overflow

Outfall, FOUL

Lamp Hole, Foul

Private Sewer Transfer

Lateral Drain

Inspection Chamber

Dŵr Cymru Cyfyngedig ('the Company') gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus. The onus of locating apparatus before carrying out any excavations rests entirely on you. The information which is supplied by the Company, is done so in accordance with statutory requirements of sections 198 and 199 of the Water Industry Act 1991 which is based upon the best information available and, in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a water main, service pipe, sewer, lateral drain or disposal main and any associated apparatus laid before 1 September 1989, or, if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the Company's right to be compensated for any damage to its apparatus.

**EXACT LOCATION OF
ALL APPARATUS TO
BE DETERMINED ON
SITE**

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Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be Asbestos Cement (AC) or Pitch Fibre (PF). It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation

Appendix D

Site Geology

SJ 35 SE 40

3962 5058

North-west of Barn Farm, Isycoed 1st AD, 12.1

Surface level (+22.3 m) +73 ft

Water not struck

Shell and auger 8-in (203 mm) diameter

May 1977

Waste 18.0 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Boulder Clay	Clay, reddish brown, gleyed, stiff, slightly silty with occasional small subrounded clasts of quartzite, sandstone and igneous material	17.9 +	18.0

40 24

015 1536 (1159) 2000 1776

Institute of Geological Sciences

Sheet / of /

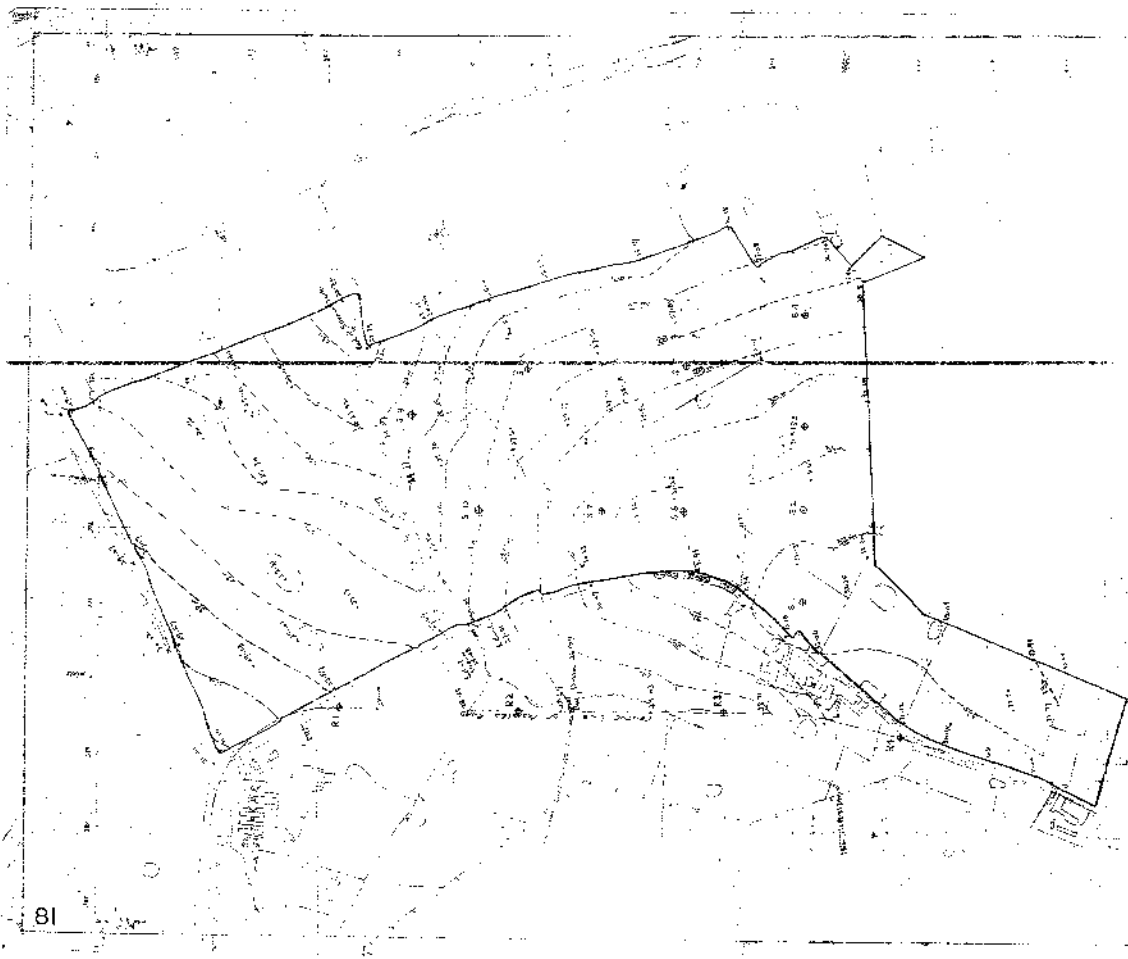
Borehole Reg No: ST 35 SE 24/40 Temp borehole No: 24 Nat Grid Ref: 3962 5058 Locality: NW of BARN FM 15KOE. Surface level: m O.D. (ft O.D.) Drilled by: STRATA SURVEYS LTD Drill type: SHELL Hole diameter: 8" Depth(s) bailed: Date started: Date finished: Recorded by: A.R. CLAYTON	Classification of ground	Thickness m	Nature
	WASTE	18.0	UPPER BOUNDER CLAY

Remarks

- | | | |
|--|--|---|
| Explanation
▽ Groundwater depth first encountered
a ▽ Morning water level
p ▽ Evening water level | — Casing depth
— Borehole depth
w Water sample | U ₁ sample; solid ornament
shows fraction recovered
Spot disturbed sample
Bulk sample
S.P.T. Standard Penetration Test |
|--|--|---|

Geological Classification	Description of Strata	Depth to Sample (m)	Sample Nos	Water level	Drilling and Casing progress
UPPER BOUNDER CLAY ("YOUNGER TILL")	CLAY, REDDISH BROWN, STIFF (CRUMBLY IN UPPER 1M), SLIGHTLY SILTY. OCCASIONAL POLISHED, SUBROUNDED IRENEOUS SANDSTONE & QUARTZITE GRAINS (OF 1/4-16mm SIZE) SOIL AT TOP 0.1m THICK. BIOTURBATED IE BLUE MOTTLE IN UPPER 1M. NO CHANGE WITH DEPTH.	18.00	=	=	=
	BOREHOLE COMPLETED AT 18m				

SJ 35 SE 42



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SHEFFIELD

Scale 1:2500

1 SITE UNC-LOC.
21 ROAD 10000.0

Scale 1:2500

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Scale 1:2500

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181

Note: Low level of water table
is indicated by dots.



1180/24/1-1/10-10-1
REINFORCEMENT EXPANSION
LOCALITY OF SITE INVESTIGATION
BOREHOLES

51 SITE BOREHOLE.
51 ROAD BOREHOLE.

CHD 1/10/10

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FARNHAM, SURREY.

SJ 35 SE 42

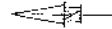
5

CED : 02/50
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 APPROXIMATE BOUNDARIES
 OF THE DISTRICT
 OF THE DISTRICT

1 SITE UNCL-OLC
 21 ROAD BORD-OLC

Scale 1:2500

Topographical Features
 of the District
 of the District



Scale 1:2500
 1 SITE UNCL-OLC
 21 ROAD BORD-OLC

81



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[SJ35SE BJ 47.]

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Note: Low level of water table
is shown in diagram.



1180/24-1/10-10-1
REINFORCEMENT EXPANSION
LOCALITY OF SITE INVESTIGATION
BOREHOLES

51 SITE BOREHOLE.
51 ROAD BOREHOLE.

CHD 1/10-10-1

CHARLES ANDREWS & SONS
CONSULTING ENGINEERS
44 BROOKLANDS ROAD,
FARNHAM, CHESHIRE.

BOREHOLE	DEPTH METRES	APPARENT CONE-RESISTANCE	ANGLE OF BEARING RESISTANCE	NATURAL MOISTURE	FIELD DRY DENSITY (100% WET)	LEVEL
S1	1.00	2820	0°	20.4	1.06	32.20
S1	2.00	2760	0°	20.0	1.06	
S1	3.00	2650	0°	21.1	1.06	
S1	4.00	3060	0°	18.8	1.10	
S1	5.00	1610	0°	20.1	1.05	
S1	6.00	1430	0°	27.3	1.07	
S2	1.00	2680	0°	16.8	1.05	31.50
S2	2.00	2680	0°	21.2	1.06	
S2	3.00	1850	0°	20.7	1.08	
S2	4.00	2530	0°	21.1	1.05	
S2	5.00	2270	0°	21.8	1.06	
S2	6.00	2260	0°	19.8	1.10	
S3	1.00	2050	0°	25.4	1.08	30.50
S3	2.00	1470	0°	20.2	1.08	
S3	3.00	2060	0°	21.5	1.06	
S3	4.00	2530	0°	21.5	1.05	
S3	5.00	2070	0°	18.1	1.12	
S3	6.00	1750	0°	20.7	1.08	
S3	7.00	1540	0°	21.5	1.06	
S3	8.00	3470	0°	23.5	1.06	
S3	9.00	12700	0°	13.0	1.08	
S3	10.00	6210	0°	17.3	1.18	
S3	11.00	3520	0°	20.1	1.07	28.20
S3	12.00	3380	0°	10.0	1.06	
S3	13.00	3980	0°	10.7	1.03	
S3	14.00	3030	0°	20.3	1.14	
S3	15.00	1750	0°	22.1	1.10	
S6	1.00	6750	0°	14.5	1.14	31.30
S6	2.00	4330	0°	13.1	1.10	
S6	3.00	1740	0°	17.8	1.05	
S6	4.00	2870	0°	20.0	1.07	
S6	5.00	7700	0°	7.5	1.14	
S6	6.00	1820	0°	17.8	1.06	30.60
S6	7.00	2640	0°	22.7	1.05	
S6	8.00	1560	0°	18.2	1.08	
S8	1.00	5660	0°	16.3	1.12	27.25
S8	2.00	4230	0°	10.5	1.07	
S8	3.00	2520	0°	21.4	1.06	
S8	4.00	1440	0°	22.0	1.06	
S8	5.00	3630	0°	19.2	1.09	
S8	6.00	4600	0°	21.1	1.07	24.50
S8	7.00	3500	0°	21.0	1.06	
S8	8.00	3460	0°	21.3	1.06	
S8	9.00	3170	0°	20.1	1.08	
S10	1.00	4350	0°	17.5	1.13	26.90
S10	2.00	4060	0°	21.3	1.05	
S10	3.00	2620	0°	21.8	1.05	
S10	4.00	2500	0°	20.3	1.06	



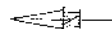
BOREHOLES

S1 S5 S7 S9 S10

VERY STIFF SANDY	1
MOTTLED CLAY	1
VERY STIFF SANDY	1
BROWN CLAY	1
FIRM STIFF GREY UNMOTTLED	1
SILTY CLAY WITH SLIGHT	1
SAND TRACES	1
STIFF BROWN GREY BOULDER	0.15
CLAY	0.15
VERY STIFF BROWN SILTY	0.15
BOULDER CLAY	0.15
VERY STIFF BROWN GREY	0.15
SILTY CLAY	0.15
VERY STIFF BROWN SILTY	0.15
BOULDER CLAY WITH	0.15
OCCASIONAL TRACES OF	0.15
GREY & REDDISH BROWN	0.15
POLYNETS	0.15

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classrooms are V-shapes relative
to Opponent's positions

181

Note: Low level of water table
is indicated by dots.



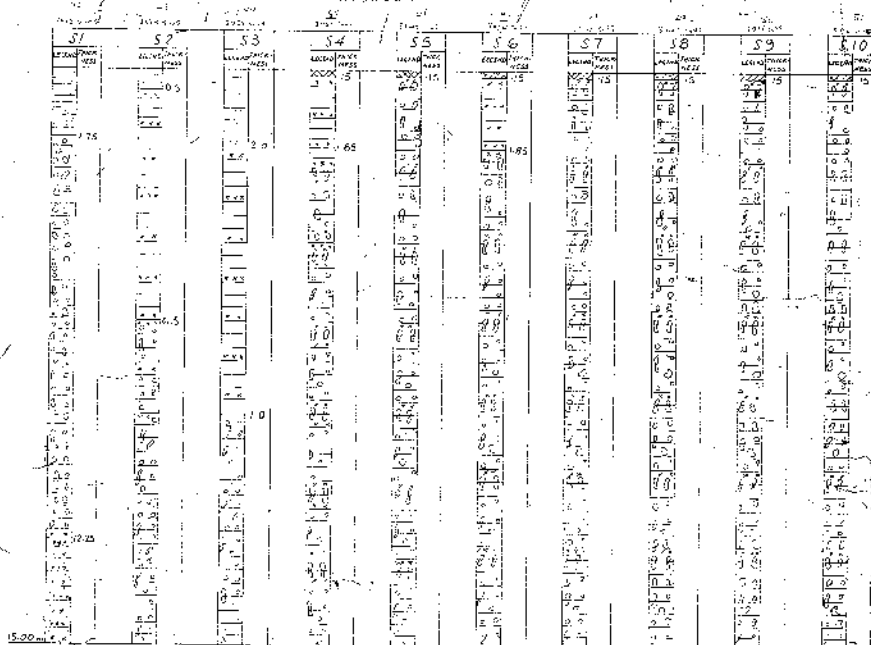
1180/24-1/10-10-1
REINFORCEMENT EXPANSION
LOCALITY OF SITE INVESTIGATION
BOREHOLES

51 SITE BOREHOLE.
51 ROAD BOREHOLE.

CHD 1/10-10-1

CHARLES ANDREWS & SONS
CONSULTING ENGINEERS
44 BROOKLANDS ROAD,
FARNHAM, CHESHIRE.

BOREHOLE	DEPTH METRES	APPARENT CONE-RESISTANCE	ANGLE OF BEARING RESISTANCE	NATURAL MOISTURE	FIELD DRY DENSITY (Mg/m ³)	LEVEL
S1	1.00	2820	0°	20.4	1.06	32.20
"	2.00	2760	0°	20.0	1.06	
"	3.00	2650	0°	21.1	1.06	
"	4.00	3060	0°	18.8	1.10	
"	5.00	1610	0°	20.1	1.05	
"	6.00	1430	0°	27.3	1.07	
S2	1.00	2680	0°	16.8	1.05	31.50
"	2.00	2680	0°	21.2	1.06	
"	3.00	1850	0°	20.7	1.08	
"	4.00	2530	0°	21.1	1.08	
"	5.00	2270	0°	21.8	1.06	
"	6.00	2260	0°	19.8	1.10	
S3	1.00	2050	0°	20.4	1.06	30.50
"	2.00	1470	0°	20.4	1.06	
"	3.00	2060	0°	20.2	1.08	
"	4.00	2530	0°	21.2	1.06	
"	5.00	2680	0°	21.6	1.06	29.50
"	6.00	2070	0°	18.1	1.12	
"	7.00	2540	0°	20.7	1.08	
"	8.00	2750	0°	21.5	1.06	
"	9.00	3470	0°	19.5	1.06	
"	10.00	3270	0°	19.5	1.08	
S4	1.00	2610	0°	17.3	1.18	28.20
"	2.00	3320	0°	20.1	1.07	
"	3.00	3380	0°	20.1	1.06	
"	4.00	3380	0°	10.7	1.03	
"	5.00	3090	0°	20.3	1.14	
"	6.00	1770	0°	22.2	1.10	
S5	1.00	2750	0°	14.5	1.14	31.30
"	2.00	2330	0°	15.1	1.10	
"	3.00	2740	0°	17.8	1.05	
"	4.00	2870	0°	20.0	1.07	
"	5.00	2700	0°	7.5	1.14	
"	6.00	1820	0°	17.8	1.06	30.60
"	7.00	2640	0°	22.7	1.05	
"	8.00	2560	0°	16.3	1.08	
S6	1.00	5660	0°	16.3	1.12	
"	2.00	4230	0°	10.8	1.07	27.25
"	3.00	2520	0°	21.4	1.06	
"	4.00	2440	0°	22.0	1.06	
"	5.00	3630	0°	19.2	1.10	
"	6.00	4600	0°	21.1	1.07	24.50
"	7.00	3500	0°	21.0	1.06	
"	8.00	3460	0°	21.3	1.06	
"	9.00	3120	0°	20.1	1.08	
"	10.00	4350	0°	17.5	1.13	
S10	1.00	4060	0°	21.3	1.05	26.90
"	2.00	2620	0°	21.8	1.05	
"	3.00	2500	0°	20.2	1.06	



BOREHOLES

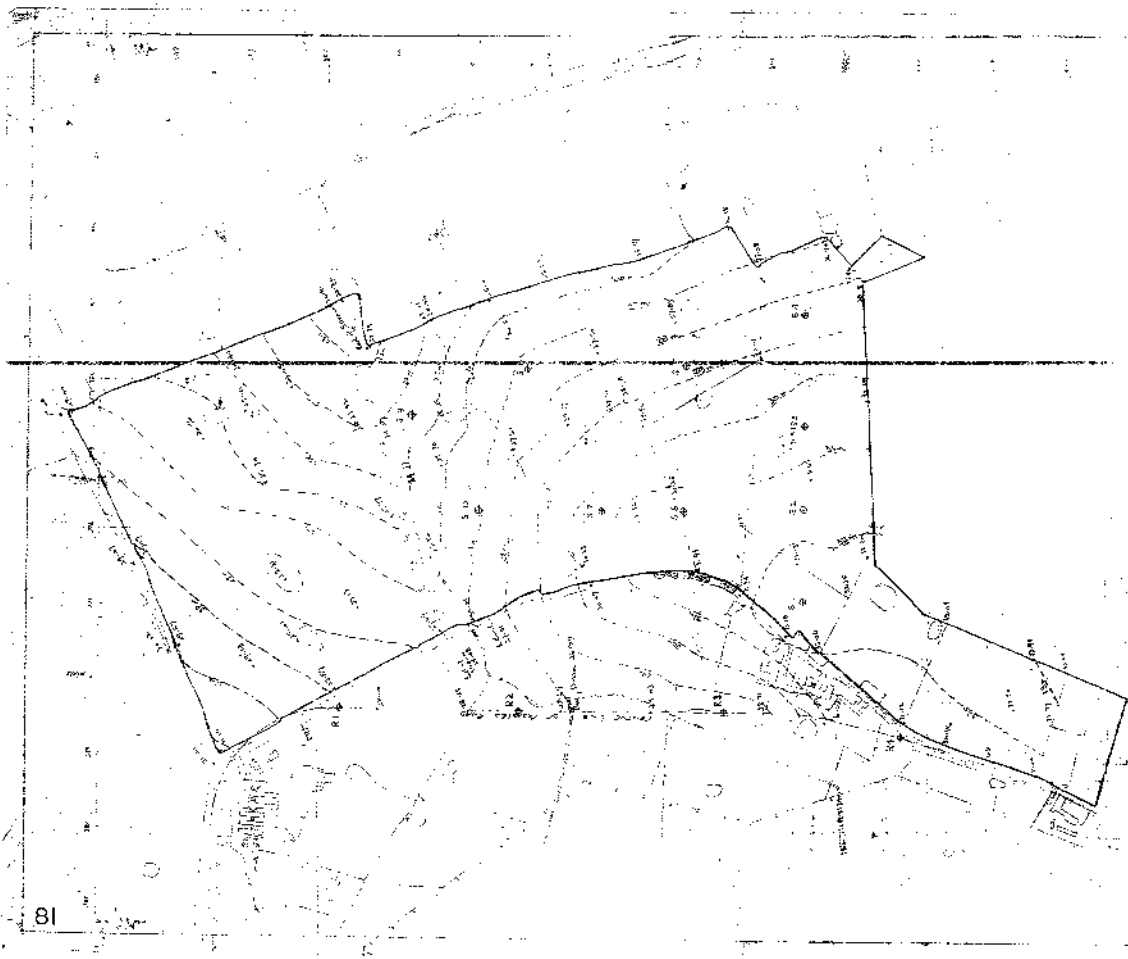
S1 S5 S7 S9 S10

VERY STIFF SANDY	1
MOTTLED CLAY	1
VERY STIFF SANDY	1
BROWN CLAY	1
FIRM STIFF GREY UNMOTTLED	1
SILTY CLAY WITH SLIGHT	1
SAND TRACES	1
STIFF BROWN GREY BOULDER	0.15
CLAY	0.15
VERY STIFF BROWN SILTY	0.15
BOULDER CLAY	0.15
VERY STIFF BROWN GREY	0.15
SILTY CLAY	0.15
VERY STIFF BROWN SILTY	0.15
BOULDER CLAY WITH	0.15
OCCASIONAL TRACES OF	0.15
GREY & REDDISH BROWN	0.15
POLYNETS	0.15

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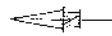
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Printed: P. J. (Scale 1:500) Date: 10/10/01

SJ 35 SE 42



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Scale 1:2500



Scale 1:2500
1 inch = 2500 feet
1 cm = 2500 cm

1 SITE UNC-LOC.
21 ROAD 10000-10000

Scale 1:2500

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[SJ35SE BJ 49.]

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Note: Low level of water table
is indicated by the



180/24-1/10-10-1
REINFORCEMENT EXPANSION
LOCALITY OF SITE INVESTIGATION
BOREHOLES

51 SITE BOREHOLE.
51 ROAD BOREHOLE.

CHD 1/2/10

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BOREHOLE	DEPTH METRES	APPARENT CONE-SHAPE	ANGLE OF BEARING RESISTANCE	NATURAL MOISTURE	FIELD DRY DENSITY (100% WET)	LEVEL
S1	1.00	2820	0°	20.4	1.06	32.20
S1	2.00	2760	0°	20.0	1.06	
S1	3.00	2650	0°	21.1	1.06	
S1	4.00	2660	0°	18.8	1.06	
S1	5.00	2610	0°	20.1	1.06	
S1	6.00	2590	0°	21.3	1.06	
S1	7.00	2580	0°	16.8	1.06	31.50
S1	8.00	2530	0°	21.3	1.06	
S1	9.00	2530	0°	20.7	1.06	
S1	10.00	2520	0°	21.1	1.06	
S1	11.00	2520	0°	21.8	1.06	
S1	12.00	2520	0°	19.8	1.06	30.50
S1	13.00	2470	0°	20.4	1.06	
S1	14.00	2460	0°	20.2	1.06	
S1	15.00	2530	0°	21.3	1.06	
S1	16.00	2580	0°	21.6	1.06	29.50
S1	17.00	2570	0°	18.1	1.06	
S1	18.00	2540	0°	20.7	1.06	
S1	19.00	2540	0°	21.5	1.06	
S1	20.00	2510	0°	19.5	1.06	
S1	21.00	2470	0°	19.0	1.06	28.20
S1	22.00	2420	0°	17.3	1.06	
S1	23.00	3380	0°	20.1	1.06	
S1	24.00	3380	0°	10.7	1.06	
S1	25.00	3380	0°	10.7	1.06	
S1	26.00	3380	0°	20.3	1.06	
S1	27.00	3380	0°	22.2	1.06	
S1	28.00	3380	0°	16.5	1.06	31.30
S1	29.00	3330	0°	15.1	1.06	
S1	30.00	3330	0°	17.8	1.06	
S1	31.00	3330	0°	20.0	1.06	
S1	32.00	3330	0°	7.5	1.06	30.60
S1	33.00	3330	0°	22.7	1.06	
S1	34.00	3330	0°	16.3	1.06	
S1	35.00	3330	0°	16.3	1.06	
S1	36.00	3330	0°	10.5	1.06	27.25
S1	37.00	3330	0°	21.4	1.06	
S1	38.00	3330	0°	22.0	1.06	
S1	39.00	3330	0°	19.5	1.06	24.50
S1	40.00	3330	0°	21.3	1.06	
S1	41.00	3330	0°	21.0	1.06	
S1	42.00	3330	0°	21.3	1.06	
S1	43.00	3330	0°	20.1	1.06	26.90
S1	44.00	3330	0°	21.3	1.06	
S1	45.00	3330	0°	21.8	1.06	
S1	46.00	3330	0°	20.3	1.06	



BOREHOLES

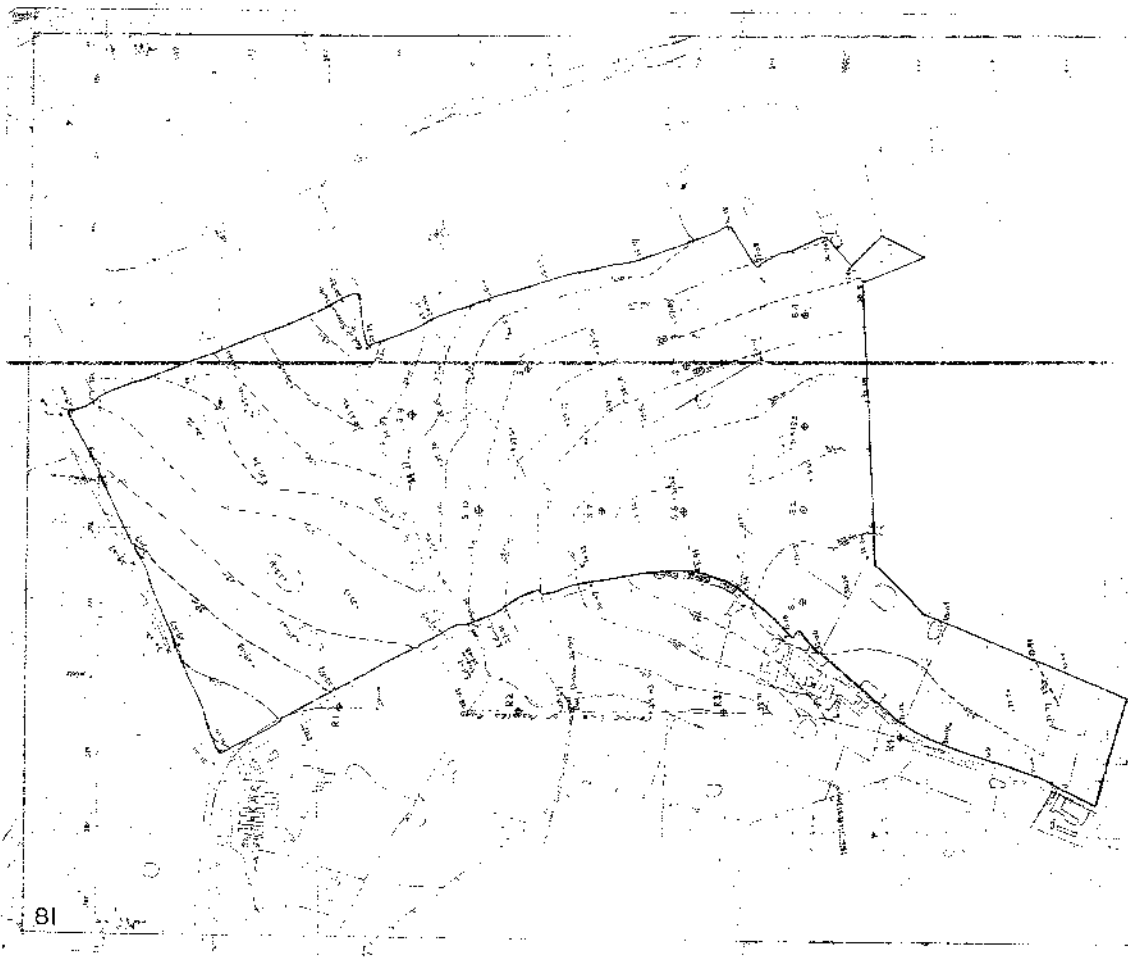
SCALE 1:500

S1 35 4

VERY STIFF SANDY	1
MOTTLED CLAY	1
VERY STIFF SANDY	1
BROWN CLAY	1
FIRM STIFF GREY UNMOTTLED	1
SILTY CLAY WITH SLIGHT	1
SAND TRACES	1
STIFF BROWN GREY BOULDER	0.15
CLAY	0.15
VERY STIFF BROWN SILTY	0.15
BOULDER CLAY	0.15
VERY STIFF BROWN GREY	0.15
SILTY CLAY	0.15
VERY STIFF BROWN SILTY	0.15
BOULDER CLAY WITH	0.15
OCCASIONAL TRACES OF	0.15
GREY & REDDISH BROWN	0.15
POLYNETS	0.15

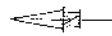
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100, FIBBERGATE, LONDON E.C. 4

SJ 35 SE 42



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SHEFFIELD
SHEFFIELD

Scale 1:2500



Scale 1:2500
1 inch = 1250 feet
1 centimetre = 25 metres

Site UNC-01
Road 10000 E

Scale 1:2500

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SHEFFIELD
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Note: Low level of water table
is indicated by dots.



1180/24-1/10-10-1
REINFORCEMENT EXPANSION
LOCALITY OF SITE INVESTIGATION
BOREHOLES

51 SITE BOREHOLE.
51 ROAD BOREHOLE.

CHD 1/10-10-1

CHARLES ANDREWS & SONS
CONSULTING ENGINEERS
44 BROOKLANDS ROAD,
FARNHAM, CHESHIRE.

BOREHOLE	DEPTH METRES	APPARENT CONE-RESISTANCE	ANGLE OF BEARING RESISTANCE	NATURAL MOISTURE	FIELD DRY DENSITY (Mg/m ³)	LEVEL
S1	1.00	2820	0°	20.4	1.06	32.20
S1	2.00	2760	0°	20.0	1.06	
S1	3.00	2650	0°	21.1	1.06	
S1	4.00	3060	0°	18.8	1.10	
S1	5.00	1610	0°	20.1	1.06	
S1	6.00	1430	0°	27.3	1.07	
S2	1.00	2680	0°	16.8	1.05	31.50
S2	2.00	2680	0°	21.2	1.06	
S2	3.00	1850	0°	20.7	1.08	
S2	4.00	2530	0°	21.1	1.06	
S2	5.00	2270	0°	21.8	1.06	
S2	6.00	2260	0°	19.8	1.10	
S3	1.00	2050	0°	25.4	1.08	30.50
S3	2.00	1470	0°	20.2	1.08	
S3	3.00	2060	0°	21.5	1.06	
S3	4.00	2530	0°	21.5	1.06	
S3	5.00	2070	0°	18.1	1.12	
S3	6.00	1750	0°	20.7	1.08	
S3	7.00	1540	0°	21.5	1.06	
S3	8.00	1410	0°	19.5	1.06	
S3	9.00	1270	0°	19.0	1.08	
S3	10.00	1240	0°	17.3	1.18	28.20
S3	11.00	3520	0°	20.1	1.06	
S3	12.00	3380	0°	10.7	1.06	
S3	13.00	3380	0°	10.7	1.06	
S3	14.00	3090	0°	20.3	1.14	
S3	15.00	1750	0°	22.2	1.10	
S6	1.00	2750	0°	14.5	1.14	31.30
S6	2.00	2330	0°	15.1	1.10	
S6	3.00	2740	0°	17.8	1.05	
S6	4.00	2870	0°	20.0	1.07	
S6	5.00	2700	0°	7.5	1.14	
S6	6.00	1820	0°	17.8	1.06	30.60
S6	7.00	2640	0°	22.7	1.05	
S6	8.00	2560	0°	18.2	1.08	
S8	1.00	5660	0°	16.3	1.12	
S8	2.00	4230	0°	10.5	1.07	27.25
S8	3.00	2520	0°	21.4	1.06	
S8	4.00	2440	0°	22.0	1.06	
S8	5.00	3630	0°	19.2	1.06	
S8	6.00	4600	0°	21.1	1.07	24.50
S8	7.00	3500	0°	21.0	1.06	
S8	8.00	3440	0°	21.3	1.06	
S8	9.00	3120	0°	20.1	1.08	
S10	1.00	4350	0°	17.5	1.13	26.90
S10	2.00	4060	0°	21.3	1.05	
S10	3.00	2620	0°	21.8	1.05	
S10	4.00	2500	0°	20.3	1.06	



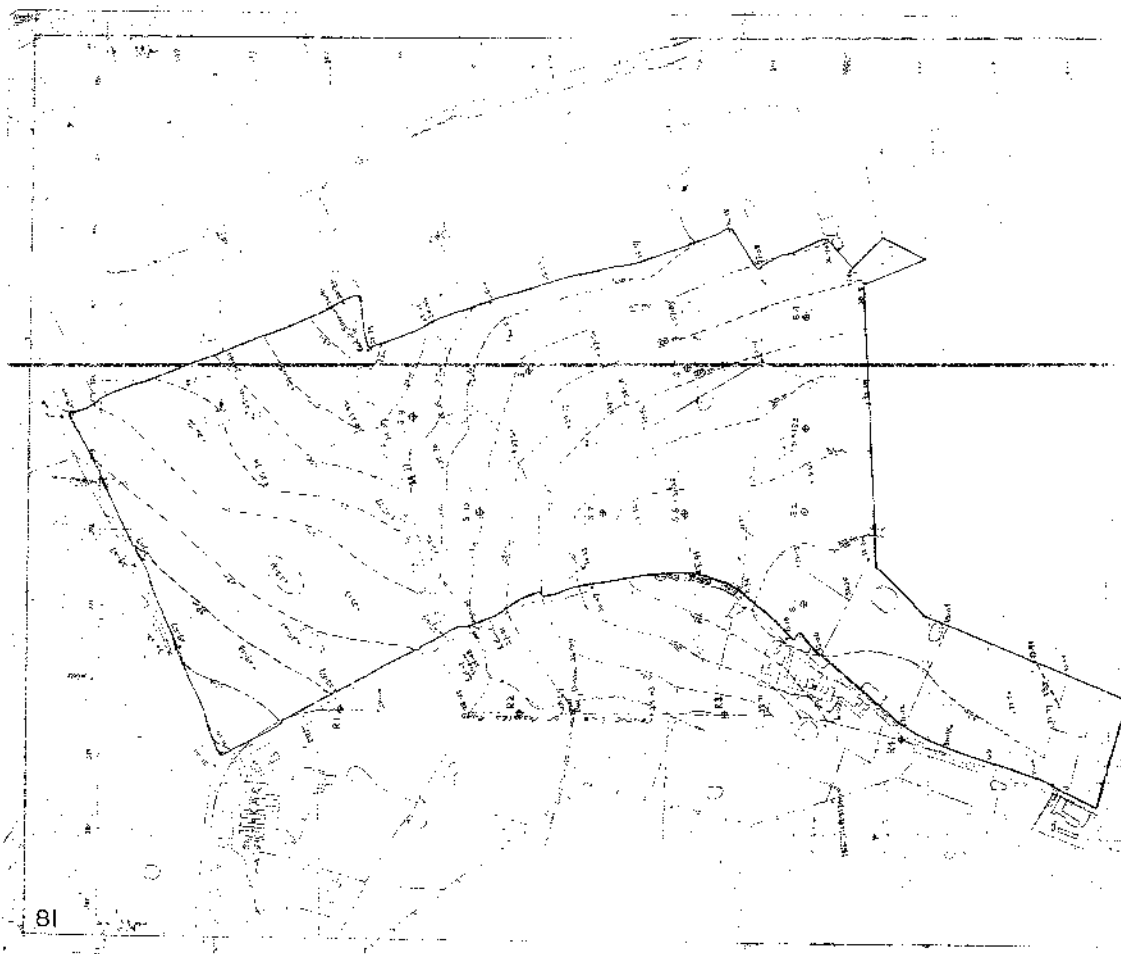
BOREHOLES

S1 S5 S7 S9 S10

VERY STIFF SANDY	1
MOTTLED CLAY	1
VERY STIFF SANDY	1
BROWN CLAY	1
FIRM STIFF GREY UNMOTTLED	1
SILTY CLAY WITH SLIGHT	1
SAND TRACES	1
STIFF BROWN GREY BOULDER	0.15
CLAY	0.15
VERY STIFF BROWN SILTY	0.15
BOULDER CLAY	0.15
VERY STIFF BROWN GREY	0.15
SILTY CLAY	0.15
VERY STIFF BROWN SILTY	0.15
BOULDER CLAY WITH	0.15
OCCASIONAL TRACES OF	0.15
GREY & REDDISH BROWN	0.15
POLYNETS	0.15

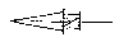
CHARLES ANDREWS & SONS LTD
Consulting Engineers
100, FIBBERGATE, LONDON E.C. 6
TELEPHONE: 01-404 1111
FAX: 01-404 1111
100, FIBBERGATE, LONDON E.C. 6
TELEPHONE: 01-404 1111
FAX: 01-404 1111
100, FIBBERGATE, LONDON E.C. 6
TELEPHONE: 01-404 1111
FAX: 01-404 1111

SJ 35 SE 42



BRITISH GEOLOGICAL SURVEY
EDINBURGH
LONDON
SHEFFIELD
SHEFFIELD

Scale 1:2500



Scale 1:2500
1 inch = 2500 feet
1 centimetre = 25 metres

1 SITE UNCLD.
21 ROAD 10000 E.

S.D. 1: 12.50

CHURCH PARISHES & SOVEREIGN
CONTRACTING RESEARCH
AND SURVEYING
SHEFFIELD

81

181



Note: Low level of water table
is indicated by the



1180/24-1/10-10-1
REINFORCEMENT EXPANSION
LOCALITY OF SITE INVESTIGATION
BOREHOLES

51 SITE BOREHOLE.
R1 ROAD BOREHOLE.

CHD 1/10-10-1

CHARLES ANDREWS & SONS
CONSULTING ENGINEERS
44 BROOKLANDS ROAD,
FARNHAM, CHESHIRE.

Appendix E

Greenfield Runoff Rate

Barnsley Marshall		Page 1												
1 Birch Court Blackpole East Worcester, WR3 8SG														
Date 26/07/2022 12:26 File	Designed by AlexMavhunga Checked by													
Innovyze	Source Control 2020.1.3													
<u>ICP SUDS Mean Annual Flood</u> Input <table> <tr> <td>Return Period (years)</td> <td>100</td> <td>Soil</td> <td>0.450</td> </tr> <tr> <td>Area (ha)</td> <td>25.420</td> <td>Urban</td> <td>0.000</td> </tr> <tr> <td>SAAR (mm)</td> <td>810</td> <td>Region Number</td> <td>Region 9</td> </tr> </table> Results l/s QBAR Rural 132.5 QBAR Urban 132.5 Q100 years 288.8 Q1 year 116.6 Q30 years 233.6 Q100 years 288.8			Return Period (years)	100	Soil	0.450	Area (ha)	25.420	Urban	0.000	SAAR (mm)	810	Region Number	Region 9
Return Period (years)	100	Soil	0.450											
Area (ha)	25.420	Urban	0.000											
SAAR (mm)	810	Region Number	Region 9											
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