

SITE 5A, WREXHAM

Drainage Strategy Report

Clywedog Road South, Wrexham, LL13 9XS

Final Report

S5A-BML-XX-XX-RP-C-0501

Monday, 11th July 2022

BarnsleyMarshall Limited

1 Birch Court
Blackpole East
Worcester
WR3 8SG

Tel 01905 330 550

Web barnsleymarshall.co.uk

Company Registered in England No. 4926185

Contents Amendment Record

This report has been issued and amended as follows:

Revision	Description	Issued by	Checked by	Date
P03	Amended section 3.8 to include Onsite Foul Treatment Plant	R. Abbott	A. Mavhunga	2022-07-11
P02	Final Report	R. Abbott	A. Mavhunga	2022-06-03
P01	First Issue for Planning Approval	M. Richards	A. Mavhunga.	2021-09-17

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 Risk Assessment & SuDS Drainage Strategy for the proposed development of 1 industrial unit on 3.0Ha of land off Clywedog Road South, Wrexham, postcode LL13 9XS.

The report provides a SuDS-based surface water drainage strategy for the proposed development based on Government and local authority guidance with regard to flood risk and sustainable drainage. The report also shows how foul drainage will be managed.

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 Drainage Strategy Report

In April 2015, the Government made changes to the National Planning Policy Framework which made Sustainable Urban Drainage Systems (SUDS) a material consideration in the determination of planning applications for new developments. This report has therefore been produced to support the Planning Application in accordance with the Town and Country Planning Order 2015.

The Strategy reviews the following information:

- Design and Construction Guidance Version 1 - Oct 2019
- Part H of the Building Regulations: Drainage and waste disposal
- BE EN12056 Part 2 Gravity Drainage Systems Inside Buildings
- Technical Advice Note 15: Development and Flood Risk (TAN15)
- CIRIA Report C753 SUDS Manual 2016.
- BS EN 752:2008 Drain and sewer systems outside buildings.

- BS 8582:2013, Code of Practice for surface water management for development sites.
- BS 8533:2011, Assessing and managing flood risk in development – Code of practice.
- CIRIA C635 Designing for exceedance in urban drainage - good practice
- Flood Estimation Handbook (FEH) /Flood Studies Report (FSR) methods.
- Institute of Hydrology (IH) Reports No. 124.
- Environmental Agency (EA) / Department for Environment, Food and Rural Affairs (DEFRA) recommendations.
- Floods and Water Management Act 2010

2. Existing Site Details

2.1 Location and Description

The proposed development is located off Clywedog Road South, Fen Drayton, Wrexham, LL13 9XS. The site is approximately 3.6km east of Wrexham city centre and is located in the South West area of Wrexham Industrial Estate. An unnamed stream / large ditch borders the north-east edge of the site flowing in a north-easterly direction. The watercourse is a tributary to the Redwither Brook that drains into River Clywedog, located approximately 530m to the South of the site. Another unnamed stream / large ditch borders the south east of the site, flowing in a south-westerly direction. The watercourse is a tributary to the River Clywedog. The site is currently a greenfield site that can be accessed from Clywedog Road South, 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, 2021-09-16, 1200hrs)

2.2 Topography

The site generally slopes north-to-south towards the existing ditch and River Clywedog. The north-western corner of the site has an existing level of 37.500mAOD, and the southmost tip of the site has an existing level of 34.500mAOD, giving a fall of 3m over a distance of 320m, which approximates to a 1% longitudinal fall.

Two ditches border the site one along the south eastern edge and the other along the north eastern edge.

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

2.3 Existing Watercourses

An unnamed stream / large ditch borders the north-east edge of the site flowing in a north-easterly direction. The watercourse is a tributary to the Redwither Brook that drains into River Clywedog, located approximately 530m to the south of the site. Another unnamed stream / large ditch borders the south east of the site, flowing in a south-westerly direction. The watercourse is a tributary to the River Clywedog.

2.4 Existing Public Drainage

There are no adopted sewers on site; the nearest existing public drainage are two Welsh Water combined public sewers and a DN150 surface water sewer (starting from the north-west corner of the site and flowing north-east) along Clywedog Road South on the western edge of the site,

From the provided Welsh Water sewer maps (refer to **Appendix G**), it can be seen that the two existing sewers are situated in the centre of Clywedog Road South.

The postcode of the site falls within a region supplied by Dwr Cymru Welsh Water.

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 the nearest boreholes logs dated April 1981 with references SJ34NE70 (Grid Reference: Easting:337070, Northing:348890) located to the south and SJ34NE69 (Grid Reference: Easting:337140, Northing:349060) are located close to the eastern edge of the site, and gave the information on **Table 1**.

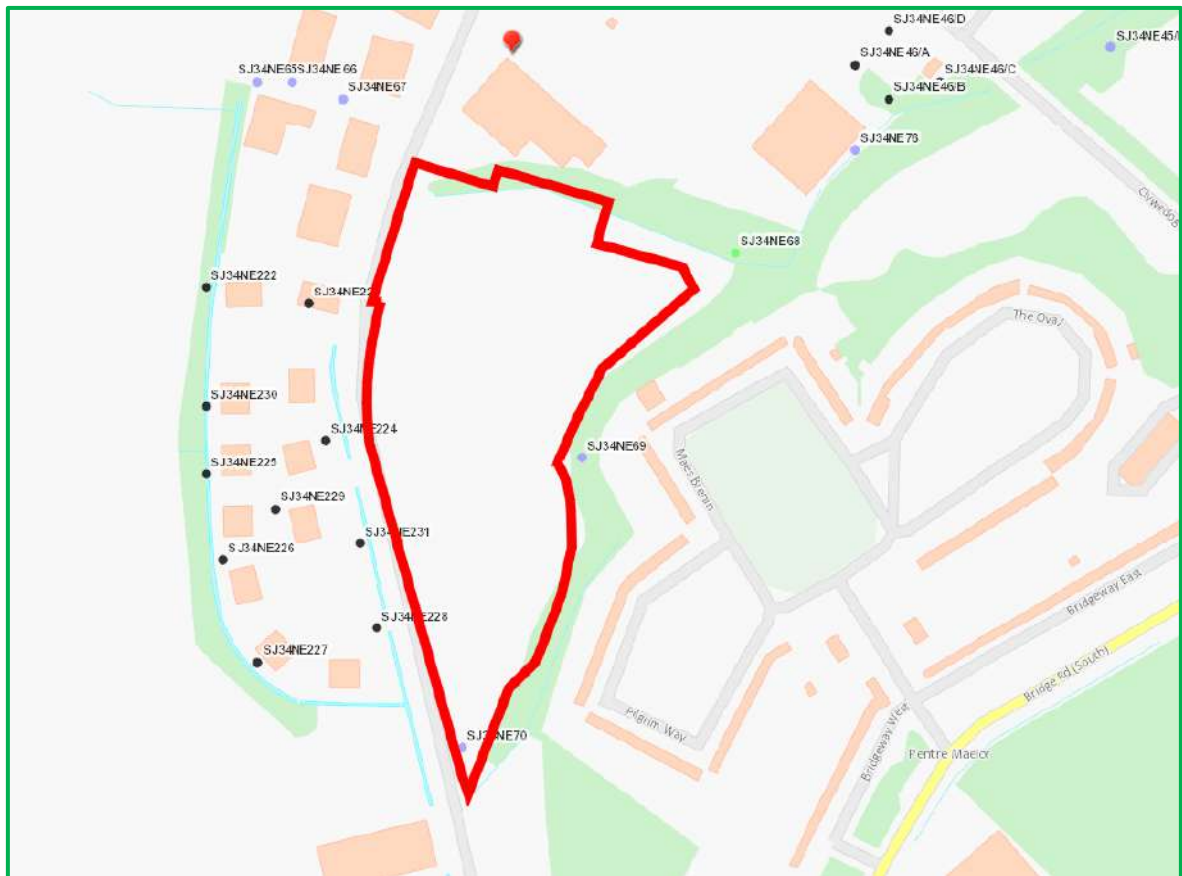
Table 1: Geological Information from BGS

From	To	Description
SJ34NE69		
Ground Level	0.75m below ground	Fill-Brown clay with traces of tree roots
0.75m below ground	4.5m below ground	Clay - brown with streaks of grey silt and occasional pebbles to 10mm. Firm to stiff
4.5m below ground	9.5m below ground (bottom of pit)	Silt – Brown with some fine-grained sand, saturated and soft
SJ34NE70		
Ground Level	0.5m below ground	Fill Brown clay, soft
0.5m below ground	3.0m below ground	Clay – Brown with streaks of grey silt. Firm to stiff with occasional sandy seams which are soft to firm
3.0m below ground	6.5m below ground (bottom of pit)	Silt – Brown, Sandy, saturated, soft

(Source: British Geological Survey, Accessed on 2021-09-16, 1600hrs)

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

The soil profile from the three boreholes indicate that the soil is predominantly clay for depths of more than 3m 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.



(Source: British Geological Survey, Accessed on 2021-09-16, 1600hrs)

3. Drainage Strategy

3.1 Key Principles of SuDS

Figure 3 gives the key design principles critical for the implementation of SuDS:

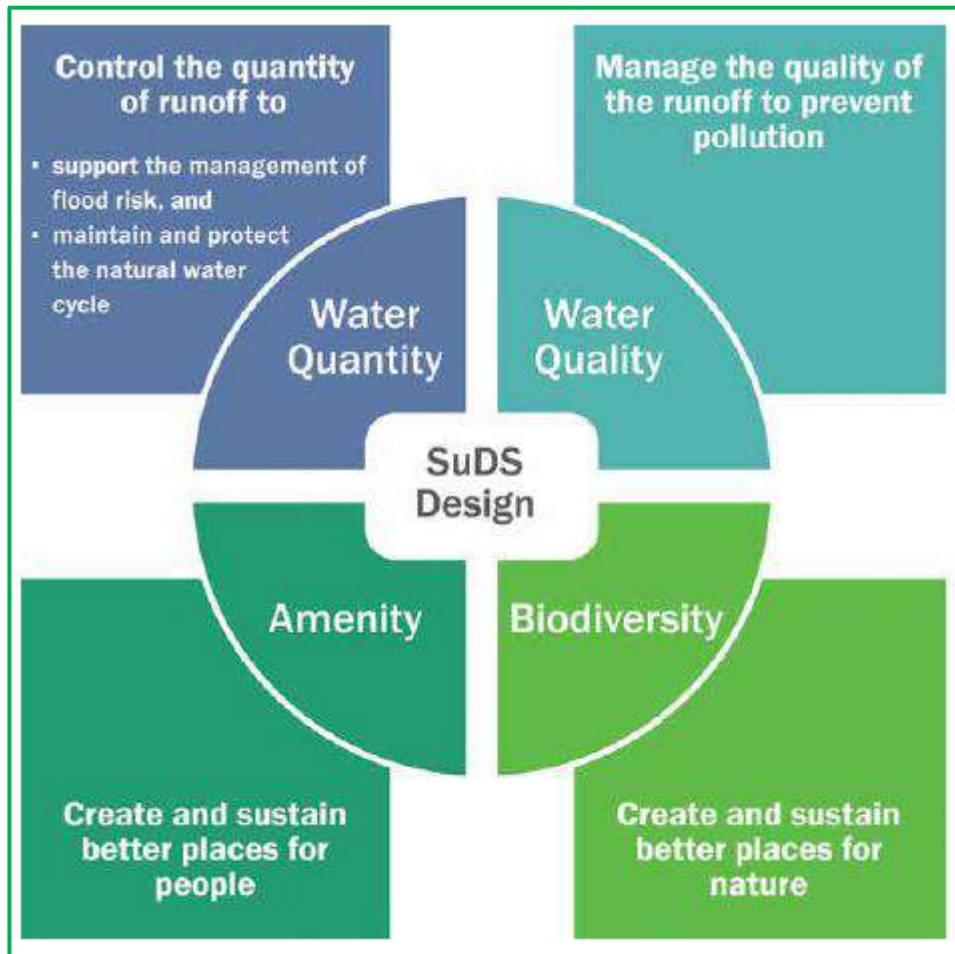


Figure 3: Four Main Categories of SuDS

(Source: CIRIA 753: The SuDS Manual)

Quantity Control : Achieved by controlling the quantity of surface water runoff reaching a watercourse, drainage system or sewer. Controlling runoff can aid in mitigating the risk of flooding. The benefits to quantity control include:

- Less surface water entering watercourses, thereby offsetting peak flows and reducing fluvial flood risk.
- Less surface water entering sewers, thereby freeing capacity and reducing flood risk
- Allows for adaption to climate change
- Allows for recharge of underground aquifer

Quality Control : Achieved by improving the quality of surface water reaching a watercourse, drainage system or sewer. The benefits to quality control include:

- Reduces of pollution levels in surface water bodies
- Protects groundwater resources from contamination
- Enables compliance with the Water Framework Directive

Biodiversity and Amenity Value : Achieved by introducing SuDS that enhance the existing biodiversity of the area and/or add amenity value to the community. The benefits include:

- Contributes to community health & wellbeing by providing green spaces with value in terms of landscape, recreation and walking routes
- Provides opportunities for multifunctional areas
- Provides wildlife habitat and ecological benefits
- Increases property values

These key design principles should be considered in all aspects of SuDS selection and design. All SuDS should aim to achieve **each of these principles**.

3.2 Discharge Hierarchy

Under the terms of Section H of the Building Regulations 2015, the SUDS Manual 2015 report C753, the disposal of surface water by means of soakaways should be considered as the primary method, refer to **Table 2**.

The main findings (refer to **section 2.6** of this report) were that drainage via infiltration is not feasible due to clay soils from the surface to depths of 4.5mbgl.

Table 2: Surface Water Discharge Hierarchy

Surface Water Discharge Hierarchy	
1	Reuse on site (i.e., rainwater harvesting)
2	Into the ground (infiltration)
3	To a surface water body
4	To a surface water sewer, highway drain, or another drainage system
5	To a combined sewer

3.3 Sustainable Drainage Systems Appraisal

A SuDS appraisal was conducted based on the SuDS hierarchy given in **Table 2**. **Table 3** gives the results of the appraisal.

Table 3: Scheme Appraisal of SuDS Drainage Features

SuDS Feature	Is feature suitable for the proposed site?	Comment
Soakaway	NO	Clay soils.
Green/Brown Roofs	NO	Proposed roofs too steep for green roofs, also a maintenance liability.
Filter Trench/Drain	YES	Proposed along the east side of the proposed building.
Swale	YES	Proposed along the north side of the proposed building
Permeable Paving	YES	Proposed for car parking bays
Infiltration Basin	NO	Clay soils.
Detention Basin	YES	Provided in the form of a Treatment & Attenuation Pond.
Bioretention System (Rain Garden / Stormwater Planters)	NO	Spatial constraints and layout make use of Bioretention Systems unsuitable.
Pond	YES	Provided in the form of a Treatment & Attenuation Pond.
Storage System: Geo-cellular or Tank	YES	Provided to store extra runoff that could not be accommodated by the pond.

Based on the selected SuDS features as per **Table 3**, the main SuDS features associated with the proposed drainage strategy are summarised below:

Permeable Pavement: Permeable pavement underlaid by a drainage blanket (5-20mm sub-base) wrapped in impermeable geo-membrane will allow runoff to undergo cleansing by the sand layer and sub-base. The permeable pavement shall be System C to BS 7533-13:2009 Figure 4, with an impermeable liner and collection pipe at the base of the sub-base.

Figure 4 gives a section through permeable pavement System C.

Figure 4. Typical section of no infiltration construction (System C)

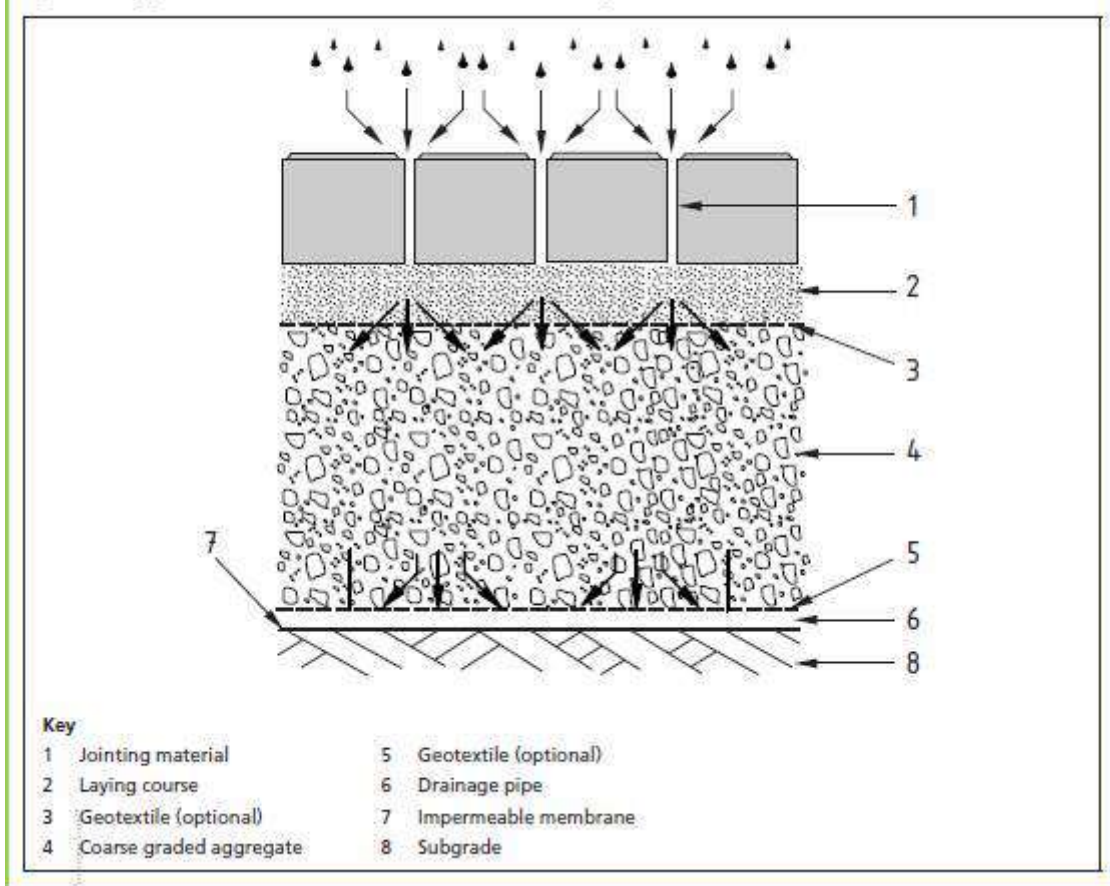


Figure 4: Permeable Pavement System C – for no infiltration

(Source: BS 7533-13:2009 Figure 4)

Flow Control Device: Runoff from the development to existing ditches shall be controlled to maximum 12.5 l/s for all storm events up to and including the 100-year + 40% CC storm event by two Hydro-brake Outflow Controls located at the downstream end of the proposed ponds, details of which are shown on plan layouts in **Appendix D**.

The SuDS Approval Body shall be consulted and fully briefed on the proposed drainage strategy so they can provide a formal Discharge Consent to the existing ditches.

Rigistorm Separate Catchpit: The catchpits with 450mm deep sumps have been strategically placed to capture debris and silt before the runoff reaches locations where it would be onerous to remove the silt.

Filter Drains: The proposed filter drains will have SHW Type B filter material (20-40mm stone) and be topped with 150mm top soil and lawn seeding to ensure that the filter drain will remain hidden from the surface. Filter Drains mimic the

hydrological behaviour of soft landscaping by allowing the water to permeate the filter material before reaching the perforated pipe at the base of the trench. This ensures filtration of the runoff prior to conveyance to attenuation devices downstream.

Ponds/Swales: Provide chemical treatment, and must have reeds and/or special grass (like Perennial Rye) to Landscape Architect's specification. The flora (planted grass/lawn/reeds) within the Pond/Swale areas absorb the pollutants via photosynthesis and reduce pollutant concentrations in the runoff. The microbial action of any fauna (bacteria/slugs) within the pond/swale areas also cause chemical cleansing of the runoff and enhance water quality. The ponds/swales also provide physical treatment via adsorption of suspended solids to the flora (grass/lawn/reeds).

3.4 Surface Water Drainage Strategy

The proposed development has a plan area of 3.019Ha. 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 12.9 l/s, 30.4 l/s, and 39.8 l/s respectively, refer to **Appendix E**.

Qbar is 15.5 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 12.9 l/s maximum for all storm events up to and including the 100-year + 40% CC storm event.

Figure 5 gives a summary of the proposed SuDS Drainage Strategy.

The SuDS Approval Body shall be consulted and fully briefed on the proposed drainage strategy so they can provide a formal Discharge Consent to the existing ditches before construction begins.

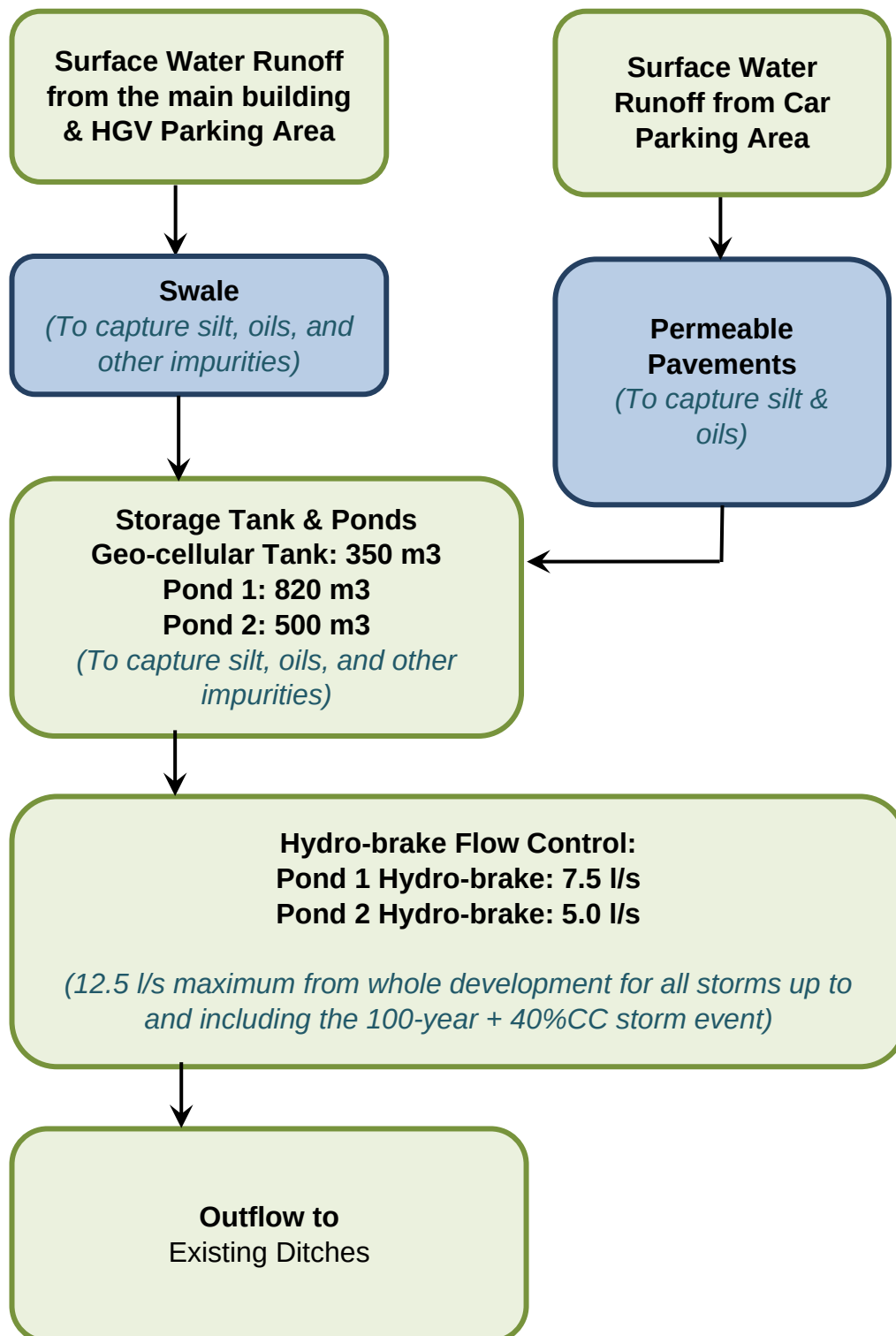


Figure 5: SuDS Drainage Strategy Summary

3.5 Pollution Control and Water Quality

The following pollution control devices have been proposed:

❖ **Permeable Pavement Areas:**

Treat pollutants from Parking Bays

Permeable pavement underlaid by a drainage blanket (5-20mm sub-base) wrapped in permeable geotextile will allow runoff to undergo filtration through the sand layer, sub-base and sub-grade before reaching the water table. Permeable Pavement is the primary Pollution Control feature for this SuDS scheme. Any spilled polycyclic aromatic hydrocarbons are filtered through the pavement layers before reaching the sub-grade. Refer to **Appendix D** for areas to receive permeable pavement and construction make-up.

❖ **Treatment Pond, Filter Drains & Swale:**

Treat effluent from whole site

Work as treatment plants for both dissolved and solid-bound pollutants. The flora (planted grass/lawn/reeds) within the pond/swale absorb the pollutants via photosynthesis and reduce the concentrations in the runoff. The reeds also provide physical treatment via adsorption of suspended soils to the flora (grass/lawn/reeds). Refer to **Appendix D** for pond and swale details.

❖ **Catchpit:**

Capture silt & debris

Catchpits have been strategically placed to capture debris and silt before the runoff reaches areas which would make it difficult to cleanse the system of the pollutants.

CIRIA report C753, The SuDS Manual, says on page 567 'To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type).'

Table 4 shows Table 26.2 of the SuDS Manual, which gives the pollution hazard indices for various land uses.

Table 4: Pollution hazard indices for different land use classifications

TABLE 26.2 Pollution hazard indices for different land use classifications				
Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways ¹	High	0.8 ²	0.8 ²	0.9 ²

Notes

- 1 Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).
- 2 These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

Table 5 shows Table 26.3 of the SuDS Manual, which gives indicative SuDS mitigation indices for discharges to surface waters.

Table 5: Indicative SuDS mitigation indices for discharges to surface waters

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters			
Type of SuDS component	Mitigation indices¹		
	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4 ²	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond ⁴	0.7 ³	0.7	0.5
Wetland	0.8 ³	0.8	0.8
Proprietary treatment systems ^{5,6}	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Notes

- 1 SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.
- 2 Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.
- 3 Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.
- 4 Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.
- 5 See **Chapter 14** for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: <http://tinyurl.com/qf7yuj7>
- 6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

Table 6 gives a summary analysis of the adequacy of the proposed SuDS drainage in addressing pollution control and water quality.

Table 6: Mitigation versus hazard indices for proposed layouts

SuDS Drainage Layout	SuDS device/Land Use	TSS	Metals	Hydro-carbons	Remark
Permeable Pavement	Permeable Pavements	0.7	0.6	0.7	OK, SuDS element provides sufficient treatment.
	Cars Parking Area	0.5	0.4	0.4	
Filter Drains, Pond, and Swale	Filter Drains, Pond, and Swale	1.1	1.1	0.9	OK, SuDS element provides sufficient treatment.
	Buildings' Roofs & HGVs Parking Area	0.8	0.6	0.45	

3.6 Spillage Management

The probability of an oil spillage on this site is higher within the HGVs Parking Area, refer to proposed Masterplan. Should any accidental oil spillage take place, the effluent from the HGVs Parking Area flows into the proposed swale along the north side of the proposed building. A catchpit with Penstock located at the downstream end of the swale is sealed by lowering the penstock, thus containing the spillage to the swale. The oil can then be sucked up and the swale cleansed before opening the penstock. Use of the swale and Penstock Catchpit absolves the need for a Bypass Oil Interceptor.

Any minor spills within the Cars Parking Area will be treated by the Permeable Pavement as the runoff filters through the layers to the collection pipe at the bottom of the sub-base.

3.7 Exceedance Flows

Exceedance flows are those flows generated by flooding of part or all of the drainage scheme due to storm events in excess of the design storm event [100-year + 40% CC storm event]. Proposed Drainage hydraulic calculations (**Appendix E**) show that there shall be **no flooding on site** for all storm events up to and including the 100-year + 40% CC storm.

To check the effect of an extreme event and how flooding will be managed on site, a 1000-year 15-minute winter storm event was run in Micro-drainage and Flood Flow Analysis carried out using Alternate Direction Implicit and Fine Dynamic Time stepping.

The results of the analysis indicated that exceedance flood water will find its way to existing ditches on the south-east and south-west of the site and also to the proposed pond and ditch/swale on the north-west. This demonstrates that the proposed Poultry Sheds and outbuildings will be fairly resilient to flooding by virtue of their raised FFLs and efficient drainage system.

Refer to **Appendix F** for FloodFlow Analysis and plan layout showing flooding effects of a 250-year 15-minute winter storm event on site.

3.8 Foul Drainage Strategy

Foul drainage from the proposed building shall be collected by a proposed gravity foul drainage system to a proposed APEX Onsite Treatment Plant. The treatment plant has a phosphorous removal kiosk which ensures that treated effluent coming out of the plant has a phosphorous concentration less than or equal to 1.0 mg/l. It is proposed to discharge the treated effluent via a rising main to an existing Welsh Water public foul sewer along the south-western edge of the site. A connection to

the existing sewer shall be made via a new manhole, refer to plan layout drawing number S5A-BML-XX-XX-DR-C-0500 in **Appendix D**.

An S106 WIA Direct Connection consent shall be obtained before construction begins.

It is hoped that the response from Welsh Water will be similar to the one they gave for another scheme within Wrexham Industrial Estate as below:

'No problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site. We can advise that Five fords WwTW has a phosphate permit. This matter will need to be considered further by the local planning authority.'

3.9 Maintenance and Operation

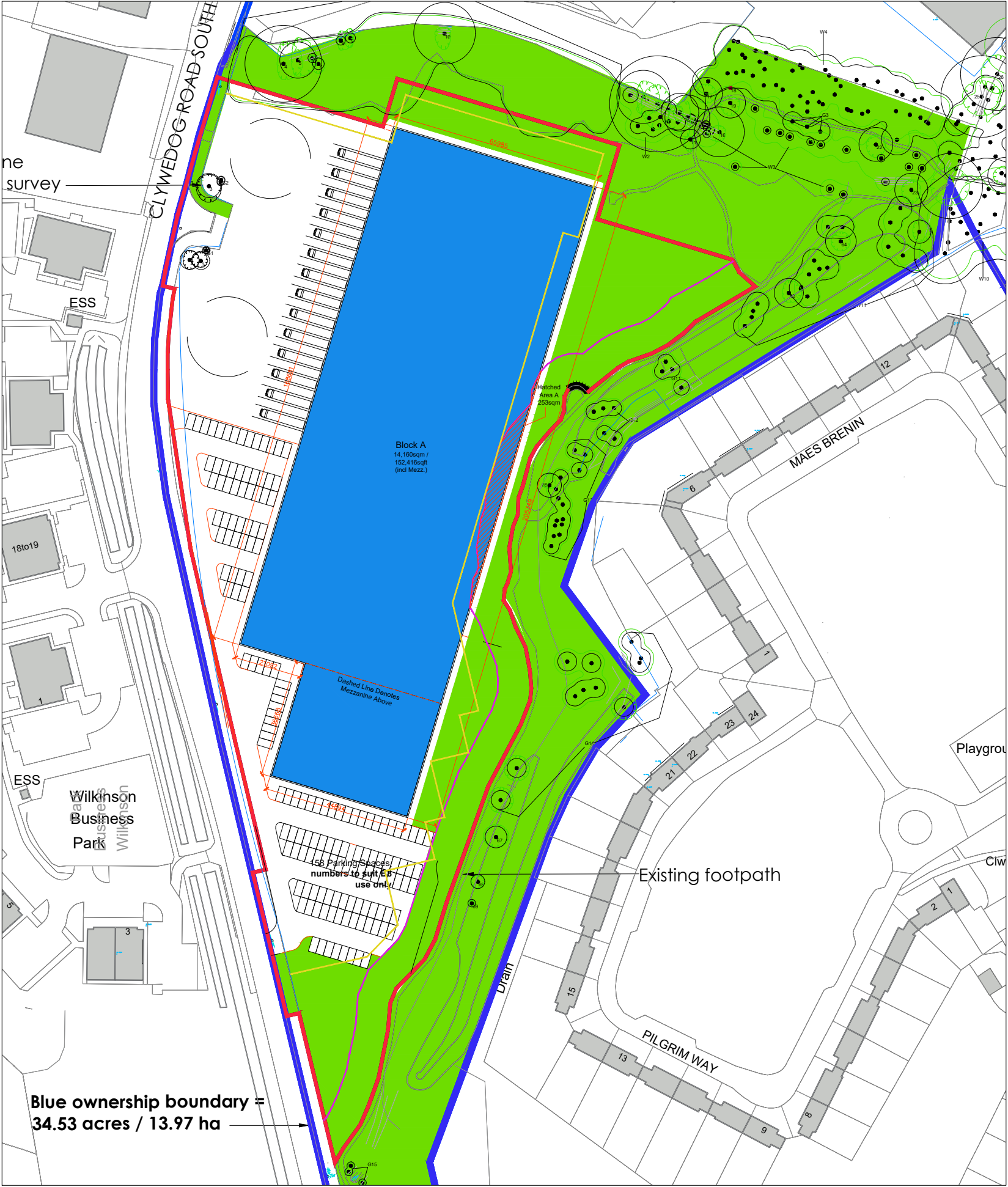
A SuDS Operation and Maintenance Manual has been produced and issued as a separate document from this report. The Manual shall be revised post-construction to suit as-built drainage (which should be in accordance with details approved at planning stage) and added to the Health and Safety File.

Please refer to report **S5A-BML-XX-XX-RP-C-0502** SuDS Operation and Maintenance Manual for details of Owner and Maintainer of the assets, and recommended maintenance regime for the drainage assets.

APPENDICES

Appendix A

Site Location Plan and Masterplan



OPTION D- 1No Buildings (152K sqft)

Rev	Description	By	Date
C	Initial Issue	MC	17.08.20
D	Parking repositioned, Building size reduced	MC	31.08.21

Internal Areas
Ground Floor: 135K sqft
First Floor: 17K sqft

MC
AU

Modern City
Architecture & Urbanism

Eastgate
2 Castle Street
Castlefield
Manchester
M3 4LZ

t: 0161 974 7203
e: info@mcau.co.uk
www.mcau.co.uk

Client

FI REAL ESTATE MANAGEMENT

Project

Site 5
Wrexham

Description

Proposed Site plan
OPTION D

Status

DRAFT

Scale

N.T.S

Drawn By

PJ

Date

MAY21

Job Number

1200

Drawing Number

SK-001

Revision

D

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Safety, Health & Environmental Information:

In addition to the hazards and risks normally associated with the types of work detailed on this drawing, please note the significant hazards identified by symbols below.

 INDICATES A RESIDUAL RISK AS A WARNING

 INDICATES A RESIDUAL RISK FOR INFORMATION

and described below:

Construction/Maintenance/Cleaning/Demolition

Refer to Drawing:

General Notes:

1. Do not scale from this drawing.
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	31/08/21	Preliminary Issue
Rev	By / Chk'd	Date	Description

PRELIMINARY DRAWING
This drawing is not to be used for construction

Client

FI Real Estate Management

BarnsleyMarshall Limited
1 Birch Court
Blackpole East
Worcester
WR3 8SG

Tel: 01905 330559
Email: design@barnsleymarshall.co.uk
Web: www.barnsleymarshall.co.uk



Project

Site 5a, Wrexham

Drawing

Site Location Plan

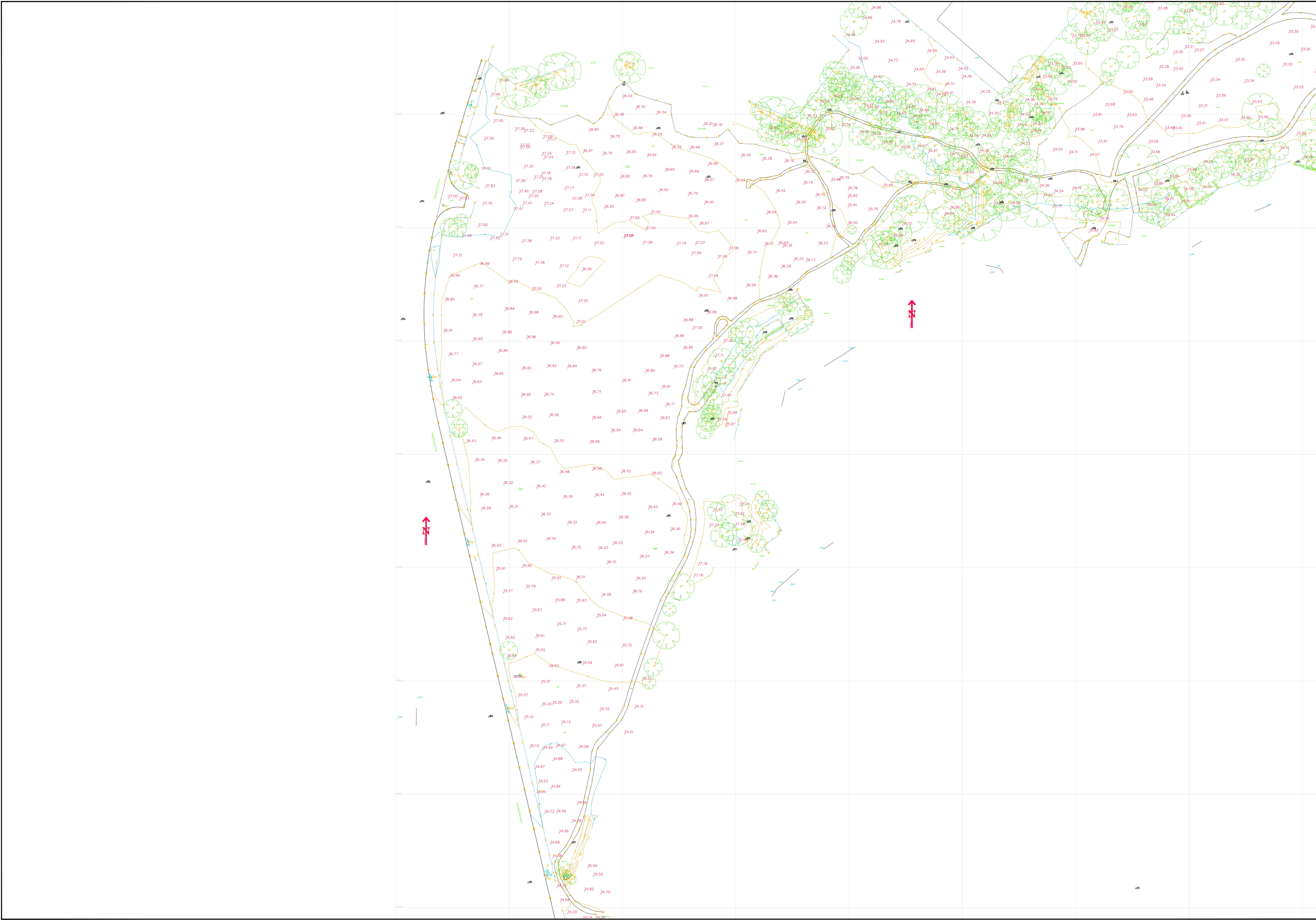
By/Chk'd	DH/AM	Date	31/08/2021
Drawing No.	Revision		
S5A-BML-XX-XX-DR-C-0100	P01		
BML Job No.	Status		
1000-02	-		

Drawing Scale at A1: N.T.S

CAD Filename: C:\Users\DH\Documents\BarnsleyMarshall\BML\Drawings\1000-02_Site Location Plan.dwg

Appendix B

Site Topography



Appendix C

Site Geology

PROJECT : PROPOSED SEWERLINE
LOCATION : WREXHAM INDUSTRIAL ESTATE
GROUND LEVEL :

ST 34 NE / 69
3714 4706

DIA. OF CASING : 154 mm to metres
mm to metres

TYPE OF BORING : Shell & Auger

SCALE OF LOG : 1:50

DATE DRILLED 03.12.81 - 5.00 m
04.12.81

SOIL LEVEL (Metres)	DEPTH OF CHANGE (Metres)	SOIL DESCRIPTION	SAMPLING		TEST RESULTS		LAB. TEST KEY	MOISTURE CONTENT AND PLOT OF ATTERBERG LIMITS				
			TYPE	DEPTH (Metres)	C kN/sqm	ϕ		PERCENT.				
								10	20	30	40	
	0.75	FILL - Brown clay with traces of tree roots	D	0.50								
		CLAY - Brown with streaks of grey silt and occasional pebbles to 10 mm. Firm to stiff	D	1.00								
			D	1.50								
			U 100									
			D	2.00								
			D	2.50								
			D	3.00								
			U 100									
			D	3.50								
			D	4.00								
	4.50	SILT - Brown with some fine grained sand, saturated, soft	D	4.50								
			U 100									
			D	5.00								
			D	5.50								
		('in running condition')	D	6.00								
			D	6.50								
			N 1									
			D	7.00								
			D	7.50								
			N 1									
			D	8.00								
			D	8.50								
			D	9.00								
			N 4									
	9.50		D	9.50								

GROUND WATER

Encountered at	3.50			4.20		
Casing at						
Quantity (est)	Trace			Moderate rate of inflow		
Final Level						

SHEET 10F 1
Borehole No 23.

PROJECT : PROPOSED SEWERLINE
 LOCATION : WREXHAM INDUSTRIAL ESTATE
 GROUND LEVEL :
 TYPE OF BORING : Shell & Auger
 SCALE OF LOG : 1:50

ST 34 NE/70
 3767 4889

DIA. OF CASING : 154 mm to metres
 mm to metres

DATE DRILLED 04.12.81 3.00 m
 07.12.81 5.00 m
 08.12.81

LEVEL (Metres)	DEPTH OF CHANGE (Metres)	SOIL DESCRIPTION	SAMPLING		TEST RESULTS		LAB TEST REF.	MOISTURE CONTENT AND PLOT OF ATTERBERG LIMITS PERCENT.				
			TYPE	DEPTH (Metres)	C kN/sqm	ϕ		10	20	30	40	
0.50	3.00	FILL - Brown clay, soft	D	0.50								
		CLAY - Brown with streaks of grey silt. Firm to stiff with occasional sandy seams which are soft to firm	U 100									
			D	1.00								
			D	1.50								
			U 100									
			D	2.00								
			D	2.50								
			D	3.00								
			U 100									
			D	3.50								
			D	4.00								
			N 7									
6.50		SILT - Brown, sandy, saturated, soft	D	4.50								
			D	5.00								
			D	5.50								
			D	6.00								
			N 7									
			D	6.50								

GROUND WATER

Encountered at	3.00					
Casing at	2.75					
Quantity (est)	Moderate rate of inflow					
Final Level						

SHEET 1 OF 1
 Borehole No 24.