



Flood Consequence Assessment & Drainage Strategy

Low Secure Unit and Residential
Development
Mold Road,
Wrexham,
LL11 4AF

03rd November 2017

Ref: 8/1547

Prepared on Behalf of:

CLA Architects
Unit 17 Connect Business Village,
24 Derby Road,
Liverpool
L5 9PR

Clancy Consulting Limited
Queens House
123-129 Queens Road
Norwich
NR3 1PL

t: +44 (0)1603 305190
e: enquiries@clancy.co.uk
www.clancy.co.uk

FLOOD CONSEQUENCE ASSESSMENT AND DRAINAGE STRATEGY
Low Secure Unit and Residential Development, 24 Derby Road, Liverpool

Report Reference: 8/1547

Prepared for: CLA Architects

Prepared by: Clancy Consulting Limited
Queens House
Queens Road
Norwich
NR1 3PL

Revision List

REVISION	REASON FOR ISSUE	DATE OF ISSUE
A	1 st Issue	3 rd September 2017

Prepared by: **Jack Cozens**
Civil Engineering Technician
for and on behalf of CLANCY CONSULTING LTD

Checked by: **Jyoti Goyal**
Senior Civil Engineer M.Eng, B.Eng (Civil)
for and on behalf of CLANCY CONSULTING LTD

Approved by: **Greg Scott B.Eng.(Hons), C.Eng., M.I.Struct.E**
Director
for and on behalf of CLANCY CONSULTING LTD

CAVEAT

This document has been prepared for the titled project, or named part thereof, and should not be relied upon or used for any other project or part as the case may be, without an independent check being made on it. Clancy Consulting shall not be liable for the consequences of using this document other than for the purpose for which it was commissioned, and any user and any other person using or relying on this document for such other purpose, agrees and will be such use or reliance be taken to confirm this agreement to indemnify Clancy Consulting for all loss or damage resulting therefrom

TABLE OF CONTENTS

1.0	INTRODUCTION.....	4
2.0	STRUCTURE OF THE REPORT	8
3.0	SITE DESCRIPTION.....	9
4.0	FLOOD POTENTIAL	12
5.0	DRAINAGE	22
6.0	PLANNING POLICY WALES AND LOCAL POLICY	27
7.0	FOUL WATER STRATEGY	28
8.0	CONCLUSIONS AND RECOMMENDATIONS	29

TABLE OF FIGURES

Figure 1 - Zone Description Table (PPW TAN 15).....	5
Figure 2 – River Flood Mapping (Natural Resources Wales).....	6
Figure 3 - Development and Flood Risk Advice Map (Natural Resources Wales)	7
Figure 4 - Site Location Plan (Google Maps).....	9
Figure 5 - Proposed GA Plan (CLA Architects)	10
Figure 6 - Historic Flood Map (Natural Resources Wales).....	12
Figure 7: Flooding from surface water (Natural resources Wales).....	14
Figure 8: Flooding from Reservoirs	15
Figure 9: GPR Survey (Dom Latham Ltd)	17
Figure 10: Green roof provision on the first floor plan	20
Figure 11: Soakaway trench.....	22

APPENDICES

Appendix A	Topographical survey Welsh water asset plans
Appendix B	Calculations
Appendix C	Proposed Drainage Scheme

1.0 INTRODUCTION

1.1 General

- 1.1.1 This report has been prepared on instructions received from CLA Architects.
- 1.1.2 This report relates to the proposed development for a planning application at Mold Road, Wrexham for some new secure units and regular residential properties.
- 1.1.3 This report sets out the results of a flood consequence assessment and drainage strategy required by the Local Planning Authority in support of the planning application for this development. The assessment has been carried out in accordance with the general principals set out in Welsh Assembly Planning Policy TAN 15 2013 and the updates of 2015.
- 1.1.4 This report is prepared solely for the benefit of the Client. This report may not be assigned without prior written permission from Clancy Consulting.

1.2 Background Information

- 1.2.1 In 2004 Planning Policy Wales (PPW) published the Technical Advice Note 15: Development and Flood Risk (TAN15) The general approach of PPW, supported by the TAN, is to advise caution in respect of new development in areas at high risk of flooding by setting out a precautionary framework to guide planning decisions.

The aim of the precautionary framework is, in order of preference, to: -

- Direct new development away from those areas which are at high risk of flooding
- Where development has to be considered in high risk areas (Zone C) only those developments determined by the planning authority to be justified in that location will be permitted. A full summary of what TAN 15 requires as justification and the acceptability criteria can be found on the following webpage <http://gov.wales/docs/desh/publications/140109-summary-of-what-tan15-requires-en.pdf>

The operation of the precautionary framework is governed by: -

- A development advice map containing three zones (A, B and C with subdivision into C1 & C2) which should be used to trigger the appropriate planning testes as set out in sections 6 & 7 and appendix 1 of TAN 15
- Definitions of vulnerable development and advice on permissible uses in relation to the location of development and the consequences of flooding.

- 1.2.3 The following zones as defined by the TAN15 Section 4 Development Advice Maps describe the composition and use of these zones to control and manage development.

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.

Figure 1 - Zone Description Table (PPW TAN 15)

- 1.2.4 Natural Resources Wales, a body formed by the Welsh Government in April 2013, took over the functions previously carried out by the Environment Agency in Wales. The Welsh Flood Zones have been produced using a flood model known as JFLOW. JFLOW has been used to produce the 1% (1 in 100 year) and the 0.1% (1 in 1000 year) flood outlines. The Environment Agency acknowledges that the JFLOW method is generalised and does not take flood defences into consideration. As such, the flood outlines produced by JFLOW can only be taken as a rough guide, showing where more detailed flood risk assessments are required.

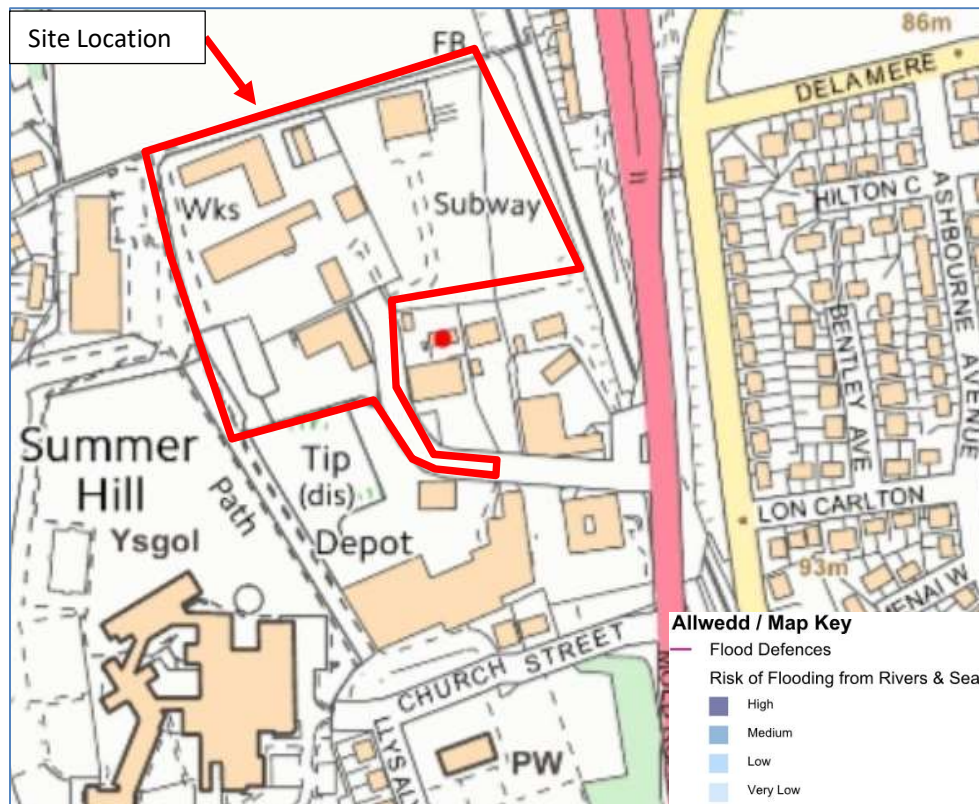


Figure 2 – River Flood Mapping (Natural Resources Wales)

- 1.2.5 Natural Resources Wales Flood Risk Map indicated in Figure 2 shows that the site is in a very low risk area.

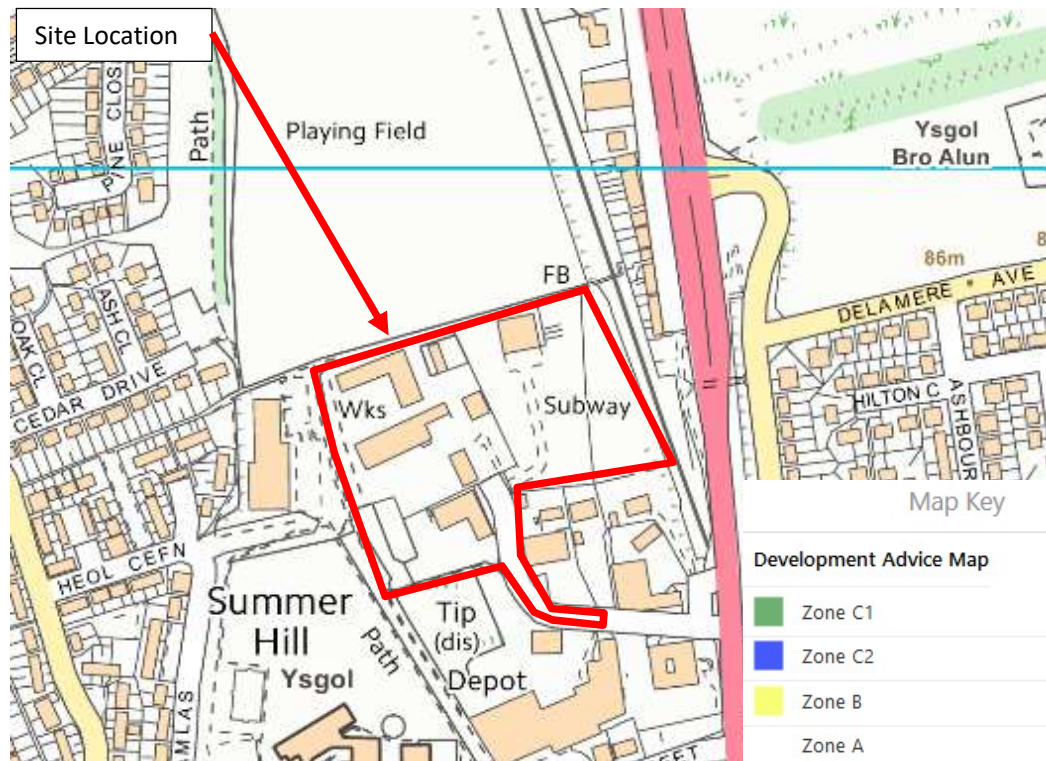


Figure 3 - Development and Flood Risk Advice Map (Natural Resources Wales)

- 1.2.6 TAN 15 Development and Flood Risk Advice Map indicated in Figure 3 shows that the site is in Zone A.

2.0 STRUCTURE OF THE REPORT

- 2.1 The report has been structured to follow the general principles set out in the Planning Policy Wales Technical Advice Note 15 (TAN 15 Development and Flood Risk) published in July 2004 with updates in January 2015.
- 2.2 The methodology for this Flood risk and drainage Assessment has comprised a desktop study and liaison with the Natural Resources Wales (NRW) and Welsh Water developer services. Reference has also been made to relevant plans including plans showing the location of local sewers.
- 2.3 Sources of information
- Flood maps from the NRW published on line
 - Data supplied by the NRW under the Freedom of Information Act
 - Wrexham Local Flood Risk Management Strategy
 - British Geological Survey
 - Welsh Water asset plan
 - Welsh Planning Policy TAN 15
 - Geo-Environmental appraisal report (10/1014/001)

3.0 SITE DESCRIPTION

3.1 Location

3.1.1 The site is located as detailed as below.

OS X (Eastings)	331548
OS Y (Northings)	353820
Nearest Post Code	LL11 4AF
Lat (WGS84)	N53:04:38 (53.077201)
Long (WGS84)	W3:01:24 (-3.023252)
LR	SJ315538 / SJ3154853820
mX	-336546
mY	6963107



Figure 4 - Site Location Plan (Google Maps)

3.1.2 The overall site is approximately 22,000m² and comprises of multiple warehouse units.

3.1.3 The existing roof area, car parking and rear paved area are, assumed to be the main impermeable areas which are positively drained. There are other small footpaths which drain to the soft landscaping. The existing impermeable area is 14,212m² which represents approximately 56.9% of the total site area.

3.2 Development Proposals

3.2.1 The proposal is to redevelop part of the site to give a low secure accommodation building with adjacent regular residential properties.

3.2.2 The proposal will decrease the impermeable area to 10,031m² which represents approximately 40.2% of the total site area, a decrease on the existing impermeable area by approximately 16.7%.



Figure 5 - Proposed GA Plan (CLA Architects)

The total proposed areas for the general housing & low-cost unit housing sites shall be as follows:

Low secure unit housing:

Roof area: 2500m²

Hardstanding: 6500m²

Total impermeable area of the site: 8,000m²

Total area of the site: 12,000m²

General housing site:

Roof area: 1750m²

Hardstanding: 2750m²

Total impermeable area of the site: 4,500m²

Total area of the site: 10,000m²

4.0 FLOOD POTENTIAL

4.1 Development Proposal

- 4.1.1 The proposed development is a residential development and the TAN15 classification of this development is Zone A, areas considered to be at little or no risk of fluvial/coastal flooding.

4.2 Potential for Flooding

- 4.2.1 The site is located within 1km of the River Alyn.
- 4.2.2 There are therefore four potential sources of flooding at the site which will be addressed in more detail in this report, i.e.
- (i) From surface water overland flow off site.
 - (ii) From high groundwater levels.
 - (iii) From artificial sources such as reservoirs.
 - (iv) From the surcharging of drains or sewers on the site.

4.3 Existing Historical Flooding Information

- 4.3.1 From the data available from Natural Resources Wales, the coloured areas indicated on the Historic Flood Map in Figure 6 shows that the area is not known to have flooded in the past. The records have come from a number of evidence sources including Natural Resources Wales, its predecessors or other risk Management Authorities. They may show flooding from rivers, the sea or surface water.

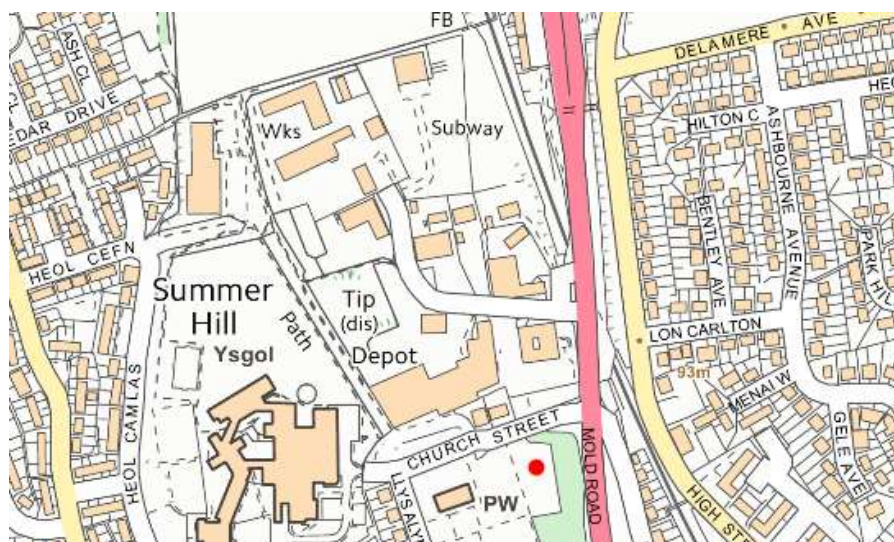


Figure 6 - Historic Flood Map (Natural Resources Wales)

4.4 Flood Risk Probabilities

(i) *Flooding from Surface Water – Overland flow*

- 4.4.1 The site is currently partly developed with the existing buildings and car parking areas.
- 4.4.2 There is always a risk that drainage may become blocked during a flood event or does not have the capacity to discharge an extreme rainfall event. The building FFL has been designed to be slightly raised as compared to the surrounding paved and landscaped areas. This shall provide protection to the building from discharge through overland flow routes and prevent water ingress.
- 4.4.3 During extreme rainfall events or due to poor drainage gully maintenance there will be times when gully capacity is exceeded which will lead to surface flow within the surrounding roads. Figure 7 shows Natural Resources Wales Surface Water Flood Map, this shows minimal surface water flooding near the proposed development.

(ii) *Flooding from Groundwater*

- 4.4.5 The 1: 50,000 British Geological Survey (BGS) scale map for the area indicates that the site is underlain by superficial Glaciofluvial Sheet Deposits of sand and gravel with solid strata comprising sandstone of the Cefn Rock Sandstone Formation.

There are three historical BGS borehole records located 50m to the west, 50m to the south west and 90m to the north. These boreholes identified localised clay to a depth of 2.2m underlain by medium dense to dense clayey sand and sandstone to 5.2m below ground level. The data available for the borehole records on the BGS website states that all of the boreholes did not strike groundwater.

Clancy Consulting's Site Investigation team conducted multiple boreholes on the proposed site to a depth of 5.45m, of which groundwater was encountered multiple times between depths of 0.4m and 2.0m. the depths were generally deeper within the centre of the site where some boreholes reached a depth of 5.45m but did not encounter any groundwater. Refer to Geo-Environmental appraisal report (10/1014/001) for details.

- 4.4.6 Based upon the desk study evidence above, **the risk of flooding due to ground water can be considered low for this proposed development.**

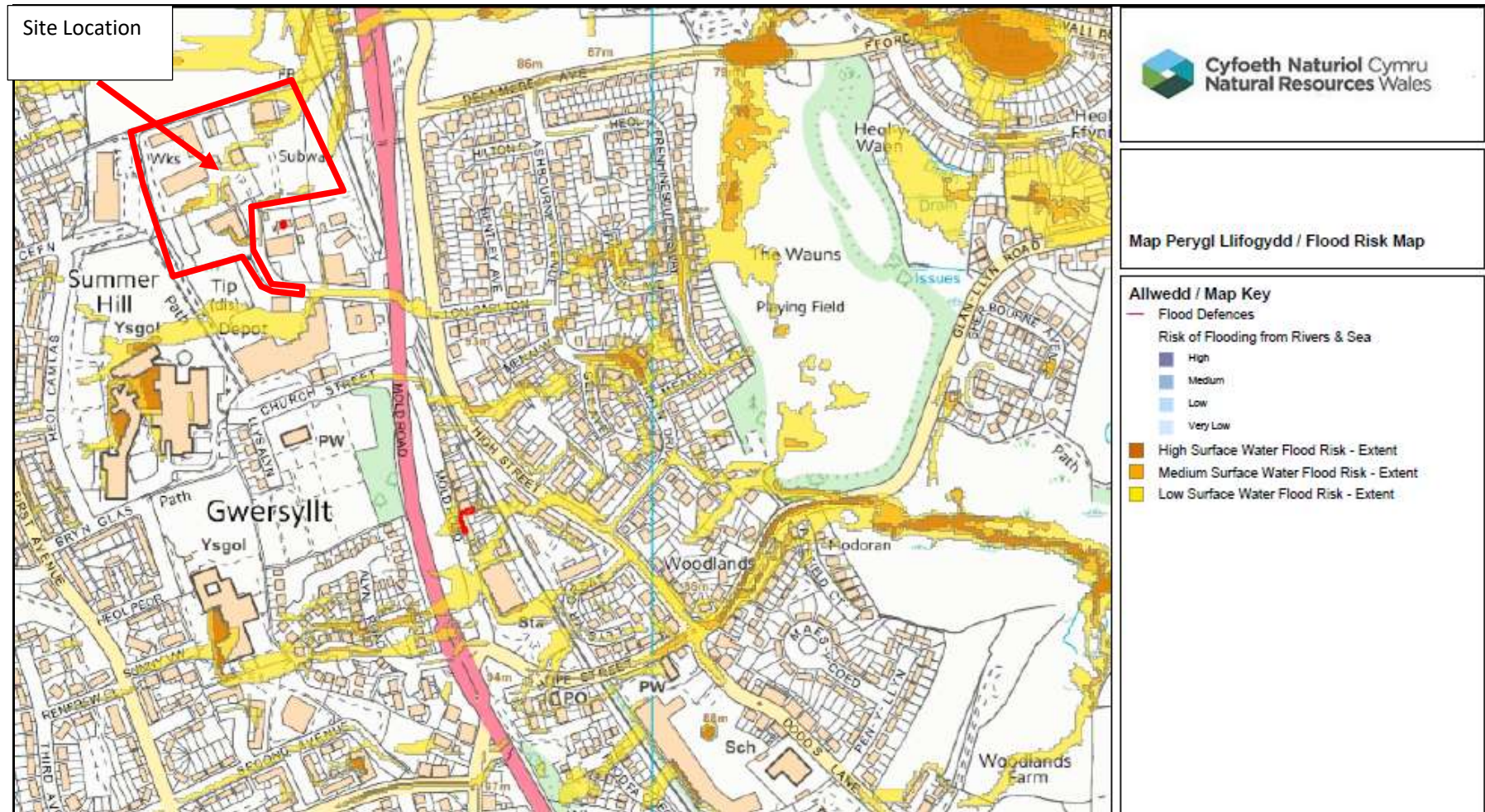


Figure 7: Flooding from surface water (Natural resources Wales)

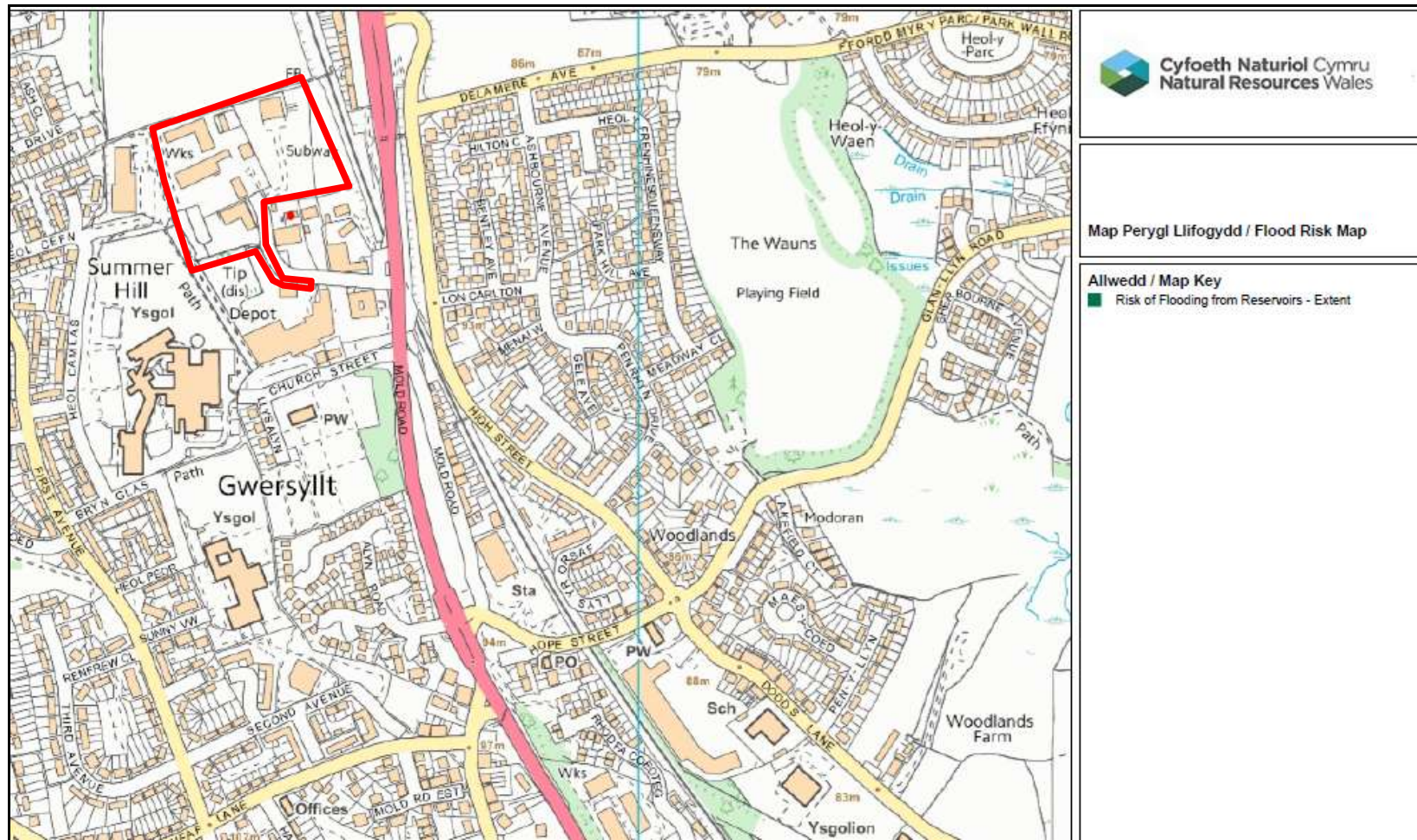


Figure 8: Flooding from Reservoirs

(iii) *Flooding from Artificial Sources - Reservoirs*

4.4.7 Artificial sources of flooding are potentially from man-made structures and infrastructure. Natural Resources Wales have modelled the potential effect of flooding from failures in retaining structures containing reservoirs. Please refer to Figure 8 above that indicates that our site has low risk from flooding from reservoirs.

4.4.8 It should be noted that reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs are inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in Wales, Natural resources Wales ensure that reservoirs are inspected regularly and essential safety work is carried out. **The risk of flooding from reservoirs at this site is extremely low.**

(iv) *Flooding from Drainage on site.*

4.4.9 Flooding could occur if the on-site drainage system becomes blocked of a rainfall event exceeds the design capacity. Details of the drainage system are discussed in Chapter 5.

5.0 DRAINAGE

5.1 Existing Drainage

- 5.1.1 The proposal is to further redevelop the site introducing new residential buildings including a low security unit. Consequently, there will be an increase in foul water flow rates discharged into the existing sewer. This is discussed further in section 7.0 foul water strategy.
- 5.1.2 The GPR survey performed by Dom Latham Ltd indicates that there are separate foul and surface water sewers (red arrowed line indicates foul water and blue arrowed line indicates the surface water) within the main site with foul water and some surface water then being drained together for when passing through the access road (green arrowed line indicates combined water).



Figure 9:GPR Survey (Dom Latham Ltd)

5.1.3 The existing foul water drainage is assumed to be collected on site into a below ground piped system and discharged into the Welsh Foul sewer located on Mold road.

5.1.4 It is assumed that part of the surface water on the site currently is being discharged through an existing soakaway on site.

5.2 Proposed Drainage

5.2.1 Surface Water Disposal Hierarchy

The disposal of surface water should be considered in the following order of priority;

1. Infiltration into the subsoil via soakaways or permeable paving.
2. Discharge to a water course or the sea.
3. Discharge to a surface water sewer.
4. Discharge to a combined sewer.

If it is not possible to discharge to a soakaway, then surface water should be controlled with the use of Sustainable Drainage Systems (SuDS) and considered using the SuDS Hierarchy.

5.2.2 SuDS Hierarchy

Most Sustainable	SUDS technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
↑	Living roofs	✓	✓	✓
	Basins and ponds	✓	✓	✓
	- Constructed wetlands			
	- Balancing ponds			
	- Detention basins			
↓	- Retention ponds			
	Filter strips and swales	✓	✓	✓
	Infiltration devices	✓	✓	✓
	- soakaways			
	- infiltration trenches and basins			
Least Sustainable	Permeable surfaces and filter drains	✓	✓	
	- gravelled areas			
	- solid paving blocks			
	- porous paviers			
	Tanked systems	✓		
	- over-sized pipes/tanks			
	- storms cells			

5.2.3 Disposal of Surface Water

Infiltration

From British Geological Survey information, soakaways could be viable within the superficial deposits of Glaciofluvial Sheet Deposits (Sand and Gravel).

Soakaway tests were carried out in the site investigation and the Infiltration rates obtained range from 5.8×10^{-6} to 4.5×10^{-7} at 2.0 – 2.1m depth. Soakaways could potentially be hence placed in gravel type material 2.0m below made ground.

It should also be noted that contamination in the form of hydrocarbons was found in some areas of the site. If soakaways are used, it shall be necessary to demonstrate that contamination shall not be released to the underlying aquifer.

There is an existing soakaway installed close to the drainage outfall on site assumed installed more than 2.0 m below ground. Further testing shall be undertaken at the detailed design phase of the project to establish the operational conditions of this to be used in future.

Based on the available information, soakaways have been designed for this site to drain the impermeable roof and hardstanding areas. These have been located in multiple locations around the site. Please refer to drainage strategy in Appendix C for details.

Additional geotechnical testing shall be undertaken in the detailed design phase of the project to establish infiltration of soil in deeper material. There is made ground encountered on this site from 1.0 -2.0 m below ground. Further monitoring is also being undertaken to establish the depth of ground water and its effect on the viability of soakaways to be designed for the site.

All measures such as extensive geotechnical contamination testing and ground water monitoring shall be undertaken to ascertain the potential of infiltration on the site.

If the results obtained from all the steps undertaken above reflect poor infiltration results on the site, a request for discharge into the public sewer at a controlled flow rate shall be made to Welsh water.

Water Couse

There are no watercourses within close vicinity of the site and this would entail crossing third party land.

Surface water Sewer

There are no existing surface water sewers near the site.

5.3.3 SuDS Strategy for proposed low secure units & general housing

Control at Source

One the most effective means of reducing surface water flows and run-off is to control the rainfall at source with the use of increased soft landscaping, green roofs and permeable paving.

It is usual practice for all paving to slope away from the building as any surface water which is unable to enter the below ground system will then collect on site within paved or landscaped areas.

Any new drainage should be designed in accordance with the building regulations to allow for easy access for maintenance and blockage clearance.

Any proposed drainage systems should be designed in line with SuDS contained in Planning Policy Wales (edition 5, November 2012) and TAN 15. It should be noted that any development requiring planning permission will also require a drainage approval as described in Flintshire Local Flood Risk Management Strategy section 7.2.2.9.

SuDS strategy

The impermeable area of the site has been reduced by 16.7% for the proposed development and this shall reduce the flow rates and the run-off volumes significantly.

Green Roofs

Green roofs have been provided for 300m² of the roof area which shall act as a ecologically sustainable option for provision of SuDS on this site. Provision of a green roof proves to be beneficial for the management of shorter more intense storms where and results in a slower flow rate of runoff from the roof.

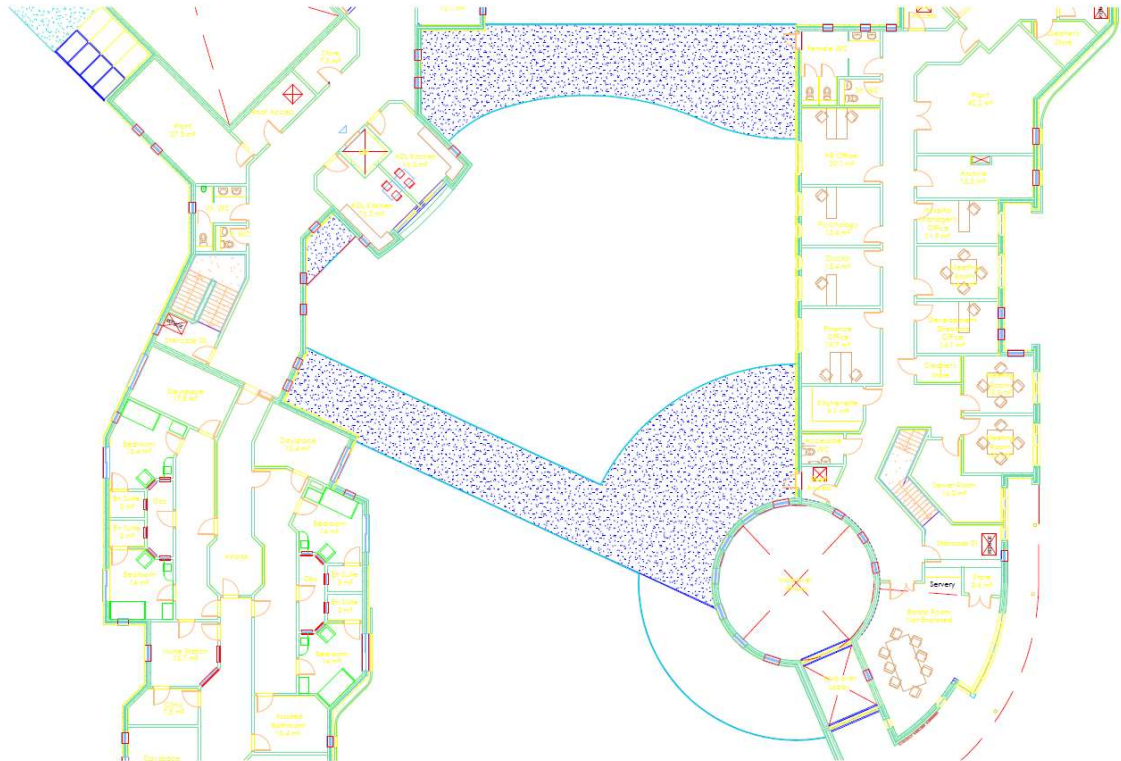


Figure 10: Green roof provision on the first floor plan

Ponds/ Basins.

There is insufficient space on site to provide an open basin/ pond.

Swales

Swales cannot be used as a SuDS solution for this site due to similar reasons for not being able to provide an open basin. There is insufficient space on site to provide a swale.

Soakaways

For an initial estimate of the space required for a critical event of 1 in 100 years with allowance for 30% climate control, the storage calculations carried out in Micro-drainage based on zero outflow shall be the following

Low secure unit (8000m²)- 1000 m³

General housing site (4500m²)- 741 m³.

Please refer to Appendix B for calculations.

Soakaway trench and infiltration basins shall be used for the discharge of surface water runoff into the insitu soil. A summary of the storage achieved through the provision of the above on the low-cost housing and the general housing site is provided below:

Low secure unit site:

Infiltration blanket:

Infiltration basins are rectangular or irregular polygon shaped basins provided in open spaces for collection of surface runoff from the structures and hardstanding around it and infiltrating it gradually into the ground. Please refer to Appendix A -Drainage strategy layout for the locations of the basins on the low-cost housing layout.

An area of 1800m² has been allocated for provision of infiltration blanket on the low-cost housing site. An average depth of 0.450m has been designed as per TEDDS calculations (attached in Appendix B) and this allows a total of 810m³ of storage.

The life span of the infiltration blanket may be increased by providing runoff pre-treatment, such as a filter strip, gully or sump pit to remove excessive solids. These shall be designed in the detailed design phase of the project on provision of more detailed information available for infiltration tests at specific areas on the site.

Infiltration trench:

Infiltration trenches are narrow excavated strips, filled with soakaway crates or stones designed to accept storm water runoff and allow water to exfiltrate into the surrounding soils from the bottom and sides of the trench.

A total of 495m² of area has been provided for trenches in the back gardens of houses. This shall be able to collect runoff from the roofs and the hardstanding around the house to dissipate it into the surrounding soil through lateral flow.

An average depth of 0.650m has been designed as per TEDDS calculations attached in appendix B and this allows a total of 321m³ of storage.

The total storage area provided using infiltration blanket and trenches is 1131m³.



Figure 11: Soakaway trench

General housing site:

A total impermeable area of 4500m² needs to be drained on the general housing site which shall require a storage of 741m³ as per calculations performed in Microdrainage.

Infiltration blanket:

An area of 1650m² has been allocated for provision of infiltration basins on the low-cost housing site. An average depth of 0.30m has been designed as per TEDDS calculations (attached in Appendix B) and this allows a total of 495m³ of storage.

Infiltration trench:

A total of 495m² of area has been provided for trenches in the back gardens of houses. This shall be able to collect runoff from the roofs and the hardstanding around the house to dissipate it into the surrounding soil through lateral flow.

An average depth of 0.500m has been designed as per TEDDS calculations attached in Appendix B and this allows a total of 250m³ of storage.

The total area provided with the use of the infiltration blanket and trenches shall be 745 m³.

SuDS TECHNICAL STANDARD REQUIREMENTS

5.1 Peak Flow

5.1.1 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer, or surface water body for the 1 in 1-year rainfall event and the 1 in 100-year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

5.1.2 Discharge flow rate controls.

Drainage will be designed for all storm events up to and including the 1 in 100-year event with a 30% allowance for climate change. This is based on information received from local guidance documents on flood risk assessments & drainage strategies by the Wales Council.

It is currently assumed that all surface water run off on site shall infiltrate with infiltration basins and trenches. Further detailed geotechnical testing shall be undertaken on the site in the detailed design phase of the project that shall ascertain if infiltration can work on this site. This shall include a review of infiltration rates, contamination and ground water levels at each soakaway location. If results do not confirm the design of soakaways on site then an application shall be made to Welsh water for discharge of run-off into the public sewer system at a controlled flow rate.

5.2 Volume Control

Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

The current assumption does not allow for any discharge of surface water into the public sewer system.

5.3 Flood Consequence within the Development

The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 100-year rainfall event plus climate change.

The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100-year rainfall event in any part of: a building or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.

The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall more than a 1 in 100-year rainfall event are managed in exceedance routes that minimise the risks to people and property.

The proposed building floor level has been set above the surrounding ground level to ensure that the surface flooding shall not enter the building. Below ground systems

have been designed to ensure that 100year + climate change events are retained below ground level

5.4 Structural Integrity

Components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development considering the requirement for reasonable levels of maintenance. The materials, including products, components, fittings or naturally occurring materials, which are specified by the designer, must be of a suitable nature and quality for their intended use.

The detailed design of the system and product selection for the storage and pipe solution will be made at the detailed design stage of the project when all the site constraints can be considered. There are numerous products available for storage of water below ground and care will be needed to ensure that the right product is chosen for the final loading conditions.

5.5 Designing for Maintenance considerations

Pumping should only be used to facilitate drainage for those parts of the site where it is not reasonably practicable to drain water by gravity.

No pumping shall be required for this site since there is no proposal for a basement and there is no expected requirement of removal of run-off from a constrained zone.

5.6 Construction

The mode of construction of any communication with an existing sewer or drainage system must be such that the making of the communication would not be prejudicial to the structural integrity and functionality of the sewerage or drainage system. Damage to the drainage system resulting from associated construction activities must be minimised and must be rectified before the drainage system is completed.

An application for connection and discharge into the public sewer system shall be made to Welsh water. This shall be required if infiltration results conducted through detailed geotechnical testing on site confirm the poor permeability of insitu soils.

6.0 PLANNING POLICY WALES AND LOCAL POLICY

6.1 Planning Policy Requirements

The proposed less vulnerable development has been classified as being effectively within Flood Zone A.

Planning Policy Wales T A N 1 5 considers this area developed and served by significant infrastructure, including flood defences.

Tan 15 explains that Zone A is used to indicate that the development can take place.

6.2 Residual Risks, Flood Mitigation, Resistance and Resilience of Proposed Building

6.2.1 The site has been shown to be at low to medium risk from all forms of flooding but it remains in a residual risk area as flood water could reach the site in the event of failure in the flood defences.

6.2.2 A secondary residual risk will be from failure of drainage systems on site. A detailed maintenance strategy and regime should be developed during the detailed design stage.

7.0 FOUL WATER STRATEGY

7.1 The information obtained from the Welsh water asset plans confirm that foul sewer is routed through a combined sewer network on site along the site access road which ties into the Welsh water public sewer on Mold road.

7.2 The actual daily flow discharged off the site is calculated using population numbers and the daily consumption in litres/person/day based on guidelines available in Code of practice for flows and loads-4. The total number of people expected on the site are 140 nos. The average daily flow is estimated to be 0.5 l/s.

7.3 A predevelopment enquiry shall be submitted to Welsh water to confirm the connection and discharge flow rate.

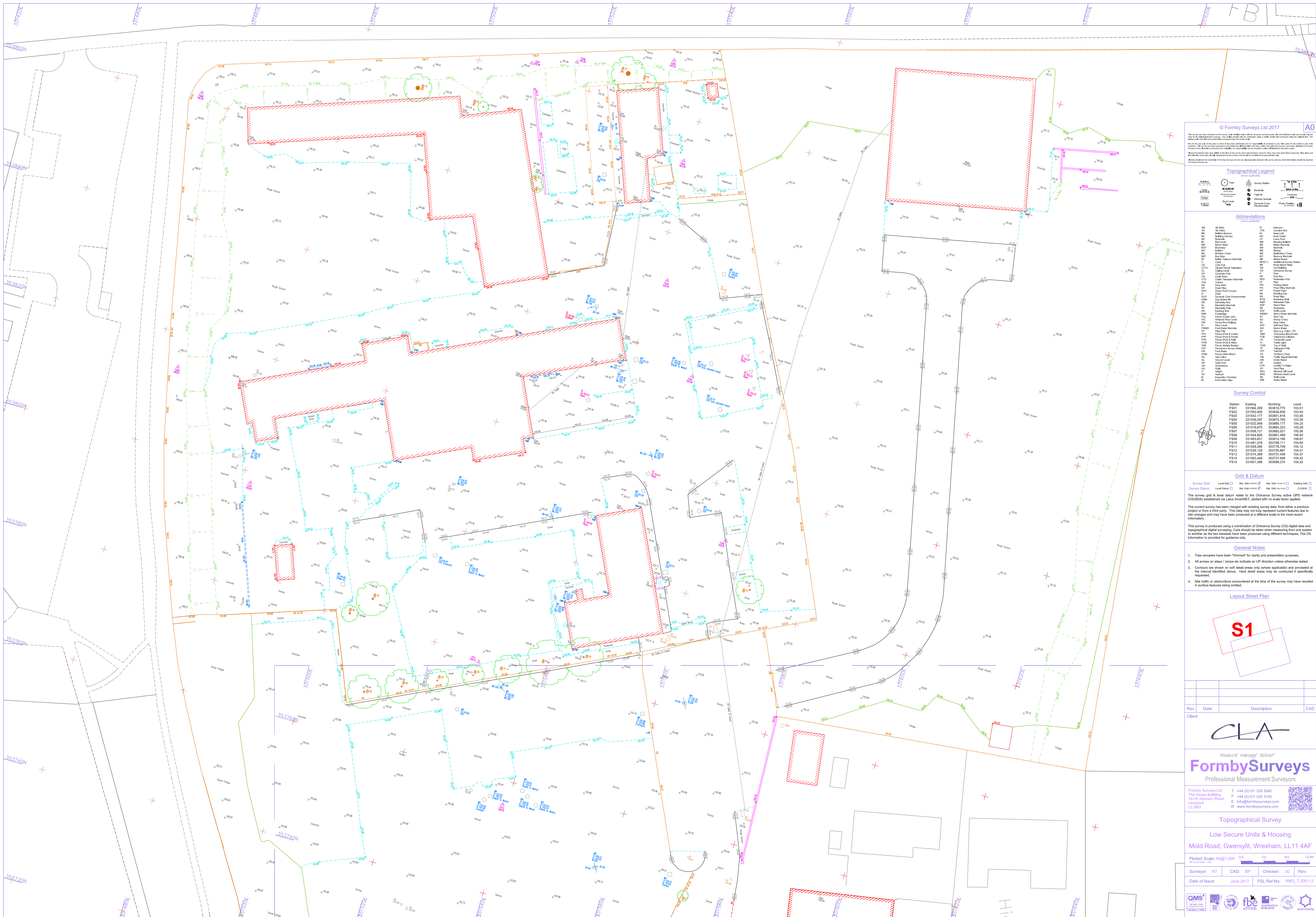
8.0 CONCLUSIONS AND RECOMMENDATIONS

- 8.1. This report gives details of the flood consequence assessment, which has been carried out for the proposed redevelopment of residential housing and the hospital at Mold road in Wrexham.
- 8.2 This flood consequence assessment report has demonstrated that the site is at low risk from all sources including surface water, ground water, and reservoirs.
- 8.3 The proposed development provides an opportunity to reduce local area flood risk by controlling surface water on site. Following the SuDS and water disposal hierarchy it has been determined that surface water shall be discharged using infiltration structures on site. The final viability of infiltration shall be ascertained through further geotechnical testing on site to be conducted at each proposed soakaway location in the detailed design phase of the project.
- 8.4 If infiltration results, high groundwater table or contamination which cannot be remediated is found to be prevalent on site, , a request shall be made to Welsh water for discharge into the public sewer on Mold road at a controlled flow rate.

APPENDIX A

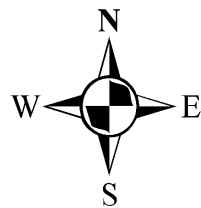
Existing Topographical plans

Welsh Water asset plans





Mold road, Wrexham



LEGEND(Representative of most common features)

- Waste network:
- | | | | |
|---|--|---|---|
|  | Foul chamber |  | Outfall |
|  | Surface water chamber |  | Lamphole |
|  | Combined chamber |  | Storm Overflow |
|  | Combined sewer overflow |  | Rising main |
|  | Special purpose chamber |  | Gravity sewer |
|  | Treatment works |  | Private sewer |
|  | Pumping station |  | Private sewer subject to Sect. 104 adoption agreement |
|  | Combined |  | Private Sewer Transfer |
|  | Surface Water |  | Lateral Drain |
|  | Foul |  | Inspection Chamber |
|  | Former S24 sewers (for indicative purposes only) | | |
- NB: Sewer symbol colour indicates the type.

Notes:

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

Dwr Cymru Cyf gives this information as to the position of its underground apparatus by way of general guidance only 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 and any onus of locating the apparatus before carrying out any excavations rests entirely on you. It must be understood that the furnishing of the information is entirely without prejudice to the provision of the New Roads and Streetworks Act 1991 and of the Company's right to be compensated for any damage to its apparatus.

Service pipes are not generally shown but their presence should be anticipated.

**EXACT LOCATIONS OF ALL APPARATUS
TO BE DETERMINED ON SITE.**

Reproduced by permission of Ordnance Survey on behalf of
HMSO. © Crown copyright and database right 2008.
All rights reserved.
Ordnance Survey License number 100019534.

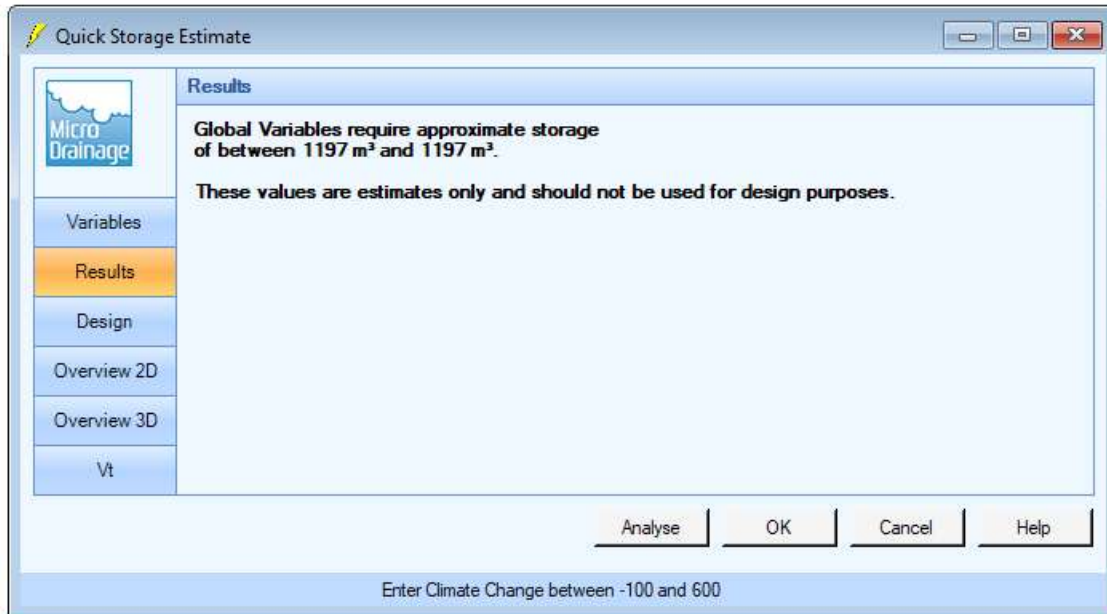
Map Ref: 331695,353669
Map scale: 1:2,500
Printed by: DT
Printed on: 09/08/2017

APPENDIX B

Calculations

Low Secure unit housing- Quick storage estimate

Calculations performed in Microdrainage



Quick Storage Estimate

Micro Drainage

Variables

Results

Design

Overview 2D

Overview 3D

Vt

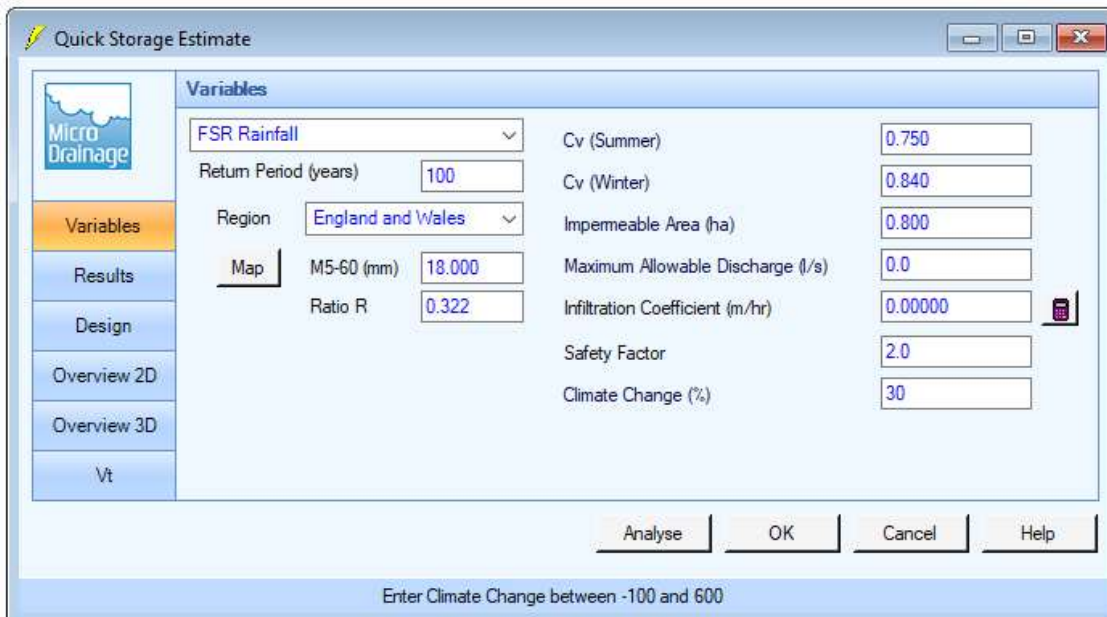
Results

Global Variables require approximate storage of between 1197 m³ and 1197 m³.

These values are estimates only and should not be used for design purposes.

Analyse OK Cancel Help

Enter Climate Change between -100 and 600



Quick Storage Estimate

Micro Drainage

Variables

Results

Design

Overview 2D

Overview 3D

Vt

Variables

FSR Rainfall

Return Period (years) 100

Region England and Wales

Map

M5-60 (mm) 18.000

Ratio R 0.322

Cv (Summer) 0.750

Cv (Winter) 0.840

Impermeable Area (ha) 0.800

Maximum Allowable Discharge (l/s) 0.0

Infiltration Coefficient (m/hr) 0.00000

Safety Factor 2.0

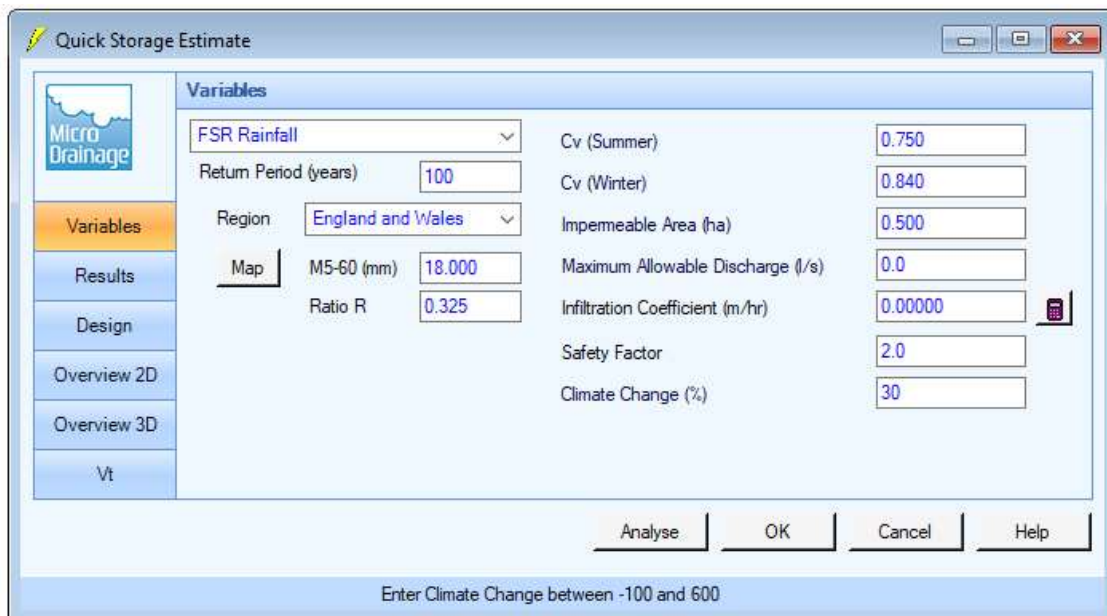
Climate Change (%) 30

Analyse OK Cancel Help

Enter Climate Change between -100 and 600

General Housing-Quick Storage Estimate

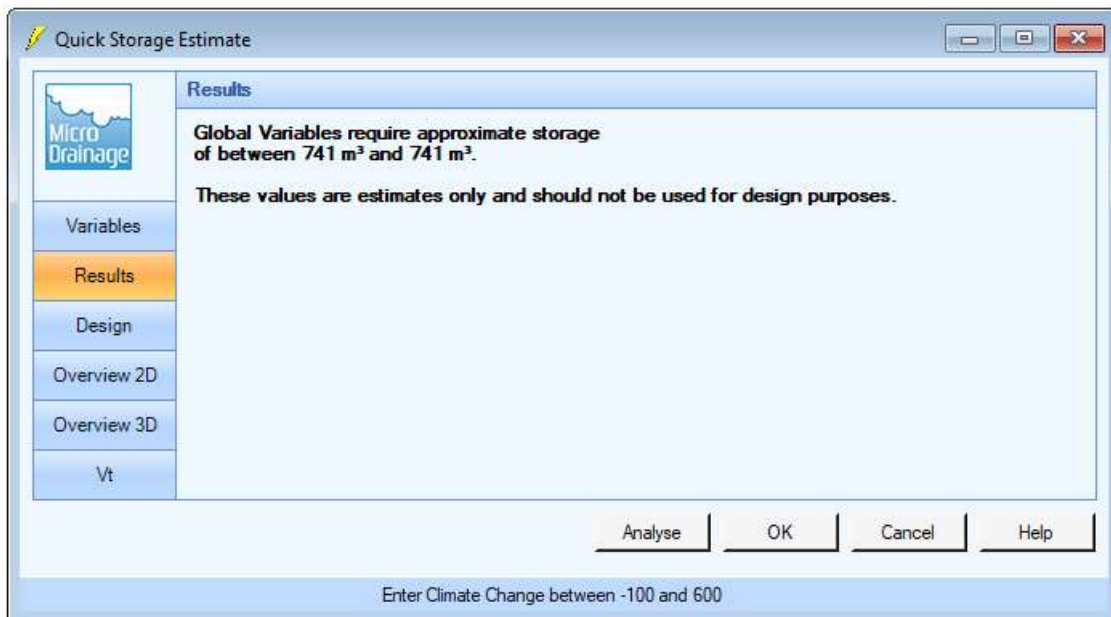
Calculations performed in Microdrainage



The screenshot shows the 'Variables' tab of the 'Quick Storage Estimate' window. The left sidebar contains a vertical menu with 'Variables' selected. The main area is divided into two columns. The left column contains a dropdown menu set to 'FSR Rainfall', a text box for 'Return Period (years)' with the value '100', a dropdown for 'Region' set to 'England and Wales', and a 'Map' button. The right column contains several input fields: 'Cv (Summer)' (0.750), 'Cv (Winter)' (0.840), 'Impervious Area (ha)' (0.500), 'Maximum Allowable Discharge (l/s)' (0.0), 'Infiltration Coefficient (m/hr)' (0.00000), 'Safety Factor' (2.0), and 'Climate Change (%)' (30). At the bottom, there are buttons for 'Analyse', 'OK', 'Cancel', and 'Help'. A status bar at the very bottom reads 'Enter Climate Change between -100 and 600'.

Variable	Value
FSR Rainfall	FSR Rainfall
Return Period (years)	100
Region	England and Wales
Map	Map
M5-60 (mm)	18.000
Ratio R	0.325
Cv (Summer)	0.750
Cv (Winter)	0.840
Impervious Area (ha)	0.500
Maximum Allowable Discharge (l/s)	0.0
Infiltration Coefficient (m/hr)	0.00000
Safety Factor	2.0
Climate Change (%)	30

Enter Climate Change between -100 and 600



The screenshot shows the 'Results' tab of the 'Quick Storage Estimate' window. The left sidebar has 'Results' selected. The main area displays the following text: 'Global Variables require approximate storage of between 741 m³ and 741 m³.' and 'These values are estimates only and should not be used for design purposes.' At the bottom, there are buttons for 'Analyse', 'OK', 'Cancel', and 'Help'. A status bar at the very bottom reads 'Enter Climate Change between -100 and 600'.

Global Variables require approximate storage of between 741 m³ and 741 m³.

These values are estimates only and should not be used for design purposes.

Enter Climate Change between -100 and 600



Clancy Consulting Ltd
Queens House,
123-129 Queens Road,
Norwich, NR1 3PL.

Project Wrexham Mold Road				Job no. 8/1547	
Calcs for Infiltration blanket sizing				Start page no./Revision 1	
Calcs by JG	Calcs date 30/10/2017	Checked by GS	Checked date 31/10/2017	Approved by GS	Approved date 31/10/2017

PLANE INFILTRATION SYSTEM DESIGN

In accordance with CIRIA C753 SUDS

Tedds calculation version 2.0.03

Design rainfall intensity

Location of catchment area Liverpool
Impermeable area drained to the system $A = 8000.0 \text{ m}^2$
Return period Period = 100 yr
Ratio 60 min to 2 day rainfall of 5 yr return period $r = 0.400$
5-year return period rainfall of 60 minutes duration $M5_{60\text{min}} = 19.0 \text{ mm}$
Increase of rainfall intensity due to global warming $p_{\text{climate}} = 30 \%$

Infiltration blanket details

Base area of blanket $A_b = 900.0 \text{ m}^2$
Porosity $n = 0.95$
Drainage ratio $R = A / A_b = 8.9$
Soil infiltration rate $f = 4.40 \times 10^{-6} \text{ m/s}$

Table equations

Rainfall intensity $i = M100 / D$
Minimum depth required (Eq. 25.1) $H = D / n \times (R \times i - f)$

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	100 year rainfall, M100 (mm)	Intensity, i (mm/hr)	Depth (mm)
5	0.37;	9.2;	1.89;	17.4;	209.29;	162;
10	0.52;	12.9;	1.96;	25.3;	151.77;	234;
15	0.63;	15.6;	2.00;	31.2;	124.84;	288;
30	0.80;	19.8;	2.03;	40.3;	80.51;	368;
60	1.00;	24.7;	2.01;	49.7;	49.68;	448;
120	1.21;	29.8;	1.97;	58.8;	29.38;	516;
240	1.45;	35.7;	1.92;	68.8;	17.19;	577;
360	1.60;	39.6;	1.89;	75.0;	12.50;	601;
600	1.79;	44.3;	1.86;	82.2;	8.22;	602;
1440	2.24;	55.3;	1.77;	98.1;	4.09;	518;

Min depth of blanket req'd $H_{\text{max}} = 602 \text{ mm}$

Time to empty blanket to half volume - Eq.25.6(1) $t_{s50} = n \times H_{\text{max}} / (2 \times f) = 18\text{hr } 3\text{min } 46\text{s}$

PASS - Infiltration system discharge time less than or equal to 24 hours

Project Wrexham housing				Job no. 8/1547	
Calcs for Soakaway trench sizing				Start page no./Revision 1	
Calcs by JG	Calcs date 01/11/2017	Checked by GS	Checked date 02/11/2017	Approved by GS	Approved date 02/11/2017

SOAKAWAY DESIGN

In accordance with BRE Digest 365 - Soakaway design

Tedds calculation version 2.0.03

Design rainfall intensity

Location of catchment area Liverpool
Impermeable area drained to the system $A = 630.0 \text{ m}^2$
Return period Period = 100 yr
Ratio 60 min to 2 day rainfall of 5 yr return period $r = 0.400$
5-year return period rainfall of 60 minutes duration $M5_{60\text{min}} = 19.0 \text{ mm}$
Increase of rainfall intensity due to global warming $p_{\text{climate}} = 0 \%$

Soakaway / infiltration trench details

Soakaway type Rectangular
Minimum depth of pit (below incoming invert) $d = 431 \text{ mm}$
Width of pit $w = 5000 \text{ mm}$
Length of pit $l = 100000 \text{ mm}$
Percentage free volume $V_{\text{free}} = 30 \%$
Soil infiltration rate $f = 4.40 \times 10^{-6} \text{ m/s}$
Wetted area of pit 50% full $a_{s50} = l \times d + w \times d = 45283565 \text{ mm}^2$

Table equations

Inflow (cl.3.3.1) $I = M100 \times A$
Outflow (cl.3.3.2) $O = a_{s50} \times f \times D$
Storage (cl.3.3.3) $S = I - O$

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	100 year rainfall, M100 (mm)	Inflow (m³)	Outflow (m³)	Storage required (m³)
5	0.37;	7.1;	1.84;	13.1;	8.22;	0.06;	8.16
10	0.52;	9.9;	1.91;	19.0;	11.96;	0.12;	11.84
15	0.63;	12.0;	1.94;	23.4;	14.73;	0.18;	14.55
30	0.80;	15.3;	1.99;	30.4;	19.16;	0.36;	18.80
60	1.00;	19.0;	2.02;	38.4;	24.20;	0.72;	23.49
120	1.21;	22.9;	2.02;	46.3;	29.15;	1.43;	27.72
240	1.45;	27.5;	1.99;	54.7;	34.46;	2.87;	31.59
360	1.60;	30.5;	1.97;	59.9;	37.74;	4.30;	33.43
600	1.79;	34.1;	1.94;	66.0;	41.59;	7.17;	34.42
1440	2.24;	42.6;	1.87;	79.6;	50.13;	17.22;	32.91

Required storage volume $S_{\text{req}} = 34.42 \text{ m}^3$

Soakaway storage volume $S_{\text{act}} = l \times d \times w \times V_{\text{free}} = 64.69 \text{ m}^3$

PASS - Soakaway storage volume

Time for emptying soakaway to half volume $t_{s50} = S_{\text{req}} \times 0.5 / (a_{s50} \times f) = 23\text{hr } 59\text{min } 35\text{s}$

PASS - Soakaway discharge time less than or equal to 24 hours

APPENDIX C

Drainage Strategy Layout

SOAKAWAY TRENCH
AREA- 495 M²

INFILTRATION
BLANKET
AREA- 1800M²

TOTAL AREA OF THE SITE - 12000 M2

3.0m high security fencing to all external resident amenity area

2.4 high existing security fence on top of banking to be retained together with dense shrub and tree planting

- Site boundary (Site Area 6.18 Acres)
- 2 Storey Low Secure Unit (with single storey elements)
- Soft landscaping, trees and grassed areas
- Banking
- Footpaths & maintenance access tracks
- Parking - standard
- Parking - disabled
- Main entrance
- Service entrance
- Existing level
- Proposed level

ME	Main Entrance
HAS	Hospital Admin Suite (First Floor)
CAU	Clinical Assessment Unit (Ground Floor)
S/K	Services Block/Kitchen
ATU	Assessment Treatment Unit (2 storey - 2No. 7 bed units)
LSU	Low Secure Unit (2 storey - 4No. 10 bed units)
SH	Sports Hall
KEY - EXTERNAL AMENITY AREAS	
CC	Central Landscaped Courtyard
AG	Amenity Garden (to resident unit day space)
FG	First Floor Unit Amenity Garden
A/HG	Amenity/Horticultural Garden
PG	Private Resident Garden

1. 14 Bed Assessment Treatment Unit arranged as 2No. 7 bed units.
2. 40 Bed Low Secure Accommodation arranged as 4No. 10 bed units.
3. Main reception.
4. Clinical and management administration units.
5. Resident facilities including cafe, activity rooms, gym, and sports hall. Includes external amenity spaces

	TYPE	PROVISIONS	NOTES
1.	Standard parking spaces	66	To provide for staff in 3rd shifts as part of 24 hours operation and visitors
2.	Disabled parking spaces	5	Close to main entrance
3.	Cycle parking spaces	10	Refer to Broxap Coventry Cantilever cycle shelter spec sheet
4.	Motor cycle parking spaces	4	Close to main entrance

**SECURE UNIT
ING APPLICATION**

**GENERAL HOUSING
OUTLINE PLANNING APPLICATION**

VER

MP 2.75

 10m^2 1.65 m²)Hillcrest
Garden

Hillcrest

Highfield

Willcroft

Site access from Mold Road

NEW FOUL ROUTING 150DIA PIPE

**NEW FOUL ROUTING
150DIA PIPE**

NEW MANHOLE

EXISTING MANHOLE IL-100.81

**EXISTING COMBINED
SEWER 375 DIA (INFO
RECEIVED FROM GPR
SURVEY.**

**EXISTING
WELSH WATER
FOUL SEWER
(INFO RECEIVED
FROM WELSH
WATER ASSET
PLAN.**

KEY - GENERAL

	Proposed Building 1 - 9 = Houses A-C = Apartment Blocks
	RS Refuse Store
	Parking Standard
	Disabled Parking
	Soft landscaped perimeter

REF	ACCOMMODATION	PARKING		
	TYPE	No. Houses/ Apartments	Provisions per Unit	No. provided (disabled include)
1 - 9	Detached & semi detached 3 - 4 bed houses	9	2	18
A	3 Storey apartment block 1 & 2 bed flats	9	1.5	13
B	3 Storey apartment block 1 & 2 bed flats	9	1.5	14
C	3 Storey apartment block 1 & 2 bed flats	9	1.5	14
Total Residential Units		36		
Total Parking				59 (includes 7N/d disabled)

The diagram illustrates two methods of water infiltration. The top section shows a 'SOAKAWAY TRENCH' consisting of a series of vertical yellow channels separated by orange soil, with a total area of 495 M². The bottom section shows an 'INFILTRATION BLANKET' with a blue and white interlocking brick pattern, with a total area of 1650 M².

SOAKAWAY TRENCH
AREA- 495 M²

INFILTRATION BLANKET
AREA- 1650M²

TOTAL AREA OF THE SITE- 10000 M2

88. Although a company's financial records are confidential, and not for release to
89 the public, they can be disclosed to the institution from the reporting to
90 the regulator. Any sensitive data received by the regulator

91 MATERIALS PROHIBITED

92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
279
280
281
282
283
284
285
286
287
288
289
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
352
353
354
355
356
357
358
359
360
361
362
363
364
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
399
400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
415
416
417
418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
438
439
440
441
442
443
444
445
446
447
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
468
469
470
471
472
473
474
475
476
477
478
479
480
481
482
483
484
485
486
487
488
489
490
491
492
493
494
495
496
497
498
499
500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564
565
566
567
568
569
570
571
572
573
574
575
576
577
578
579
580
581
582
583
584
585
586
587
588
589
590
591
592
593
594
595
596
597
598
599
600
601
602
603
604
605
606
607
608
609
610
611
612
613
614
615
616
617
618
619
620
621
622
623
624
625
626
627
628
629
630
631
632
633
634
635
636
637
638
639
640
641
642
643
644
645
646
647
648
649
650
651
652
653
654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700
701
702
703
704
705
706
707
708
709
710
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
726
727
728
729
730
731
732
733
734
735
736
737
738
739
740
741
742
743
744
745
746
747
748
749
750
751
752
753
754
755
756
757
758
759
760
761
762
763
764
765
766
767
768
769
770
771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
837
838
839
840
841
842
843
844
845
846
847
848
849
850
851
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888
889
890
891
892
893
894
895
896
897
8

1. Site Plan based on Topographical Survey
Ref. 9963_T received on 22.06.2017
2. All entry points off access road to existing
sites and businesses to be retained

1. Low Secure Unit site - 3.94 Acres
2. Housing site - 2.24 Acres

PREL

~~PLANNING APPLICATION~~

- | | | |
|---|---|----------|
| ② | 1. Site letters revised to suit new layout | |
| | 2. Retaining wall introduced | |
| | 3. Maintenance access path amended | |
| | 4. First Floor Unit garden & private garden sizes reduced | 20.10.20 |
| ② | 1. 3 No. First Floor Unit gardens maximised in size | |
| | 2. Highlighted staircases amended to suit larger gardens | |
| | 3. Car parking revised | 12.10.20 |
| ② | 1. Number of car parking spaces reduced | |
| | 2. Building repositioned to suit revised car parking | |
| | 3. Highlighted staircases amended | |
| | 4. First Floor unit amenity gardens extended | 04.10.20 |
| ② | 1. Revision notes added | 21.09.20 |
| | 1. General notes amended | |
| | 2. Highlighted car parking spaces reduced | |
| | 3. Highlighted staircases to SUUs amended | |
| | 4. First Floor unit amenity gardens extended | |
| | 5. Secure delivery compound introduced | |
| | 6. Hedging between site and neighbour introduced | |
| | 7. Hedging to outline of service path amended | |
| | 8. Security fencing amended | 01.09.20 |

REVISION DETAILS

- ☒ Preliminary
- ☐ For Approval
- ☐ Tender
- ☐ Construction

ASC Real Estate Investments Ltd.

PROJECT
Proposed Low Secure Units & Housing
Mold Road, Gwersyllt
Wrexham LL13 4AE

DRAWING TITLE

SCALE drawn by date

1:500@A1
DRAWING NO.

17-032-11



CLAA
Cindy Lofthouse Architects

T: 0151 207 4371 • **F:** 0151 207 7087

SITE PLAN - AS PROPOSED

SURFACE & FOUL WATER STRATEGY FOR LOW SECURE UNIT & GENERAL HOUSING AT MOLD ROAD, WREXHAM-SK001.