



Gatewen Road Residential Site,
New Broughton,
Wrexham

Flood Consequence Assessment &
Drainage Strategy

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Executive Summary

The proposal is for a development of 112 residential units with associated access and landscaping on greenfield land off Gatewen Road, Wrexham.

The information from the Technical Advice Note 15: Development and Flood Risk (TAN15) and Natural Resources Wales Flood Zones has determined that the site is located within Zone A, i.e. considered to be at little or no risk of fluvial or tidal/coastal flooding.

The site has been assessed against the requirements of Natural Resources Wales flood mapping and TAN15 Flood Risk Vulnerability and Flood Zone Compatibility matrix. Taking into consideration that the application is for a residential development (highly vulnerable development) in Zone A, the TAN15 Flood Risk Vulnerability and Zone Compatibility matrix indicates that this vulnerability would be appropriate within Zone A.

The British Geological Survey information indicates that the underlying geology of the site is Glaciofluvial Sheet Deposits, comprised of sand and gravel. Glacial Till underlies the southeastern part of the site. Cefn rock also underlies the site, comprised of sandstone, with the Pennine Lower Coal Measures Formation found in the east of the site and comprised of mudstone, siltstone and sandstone. Further infiltration testing indicated that soakaways are a viable SuDS technique for the discharge of surface water. There is an unnamed watercourse approximately 150m to the east of the site.

There are existing Dŵr Cymru Welsh Water Surface Water and Combined Water Sewers in the surrounding roads. Therefore, given the results of infiltration testing, surface water runoff from the proposed development site will discharge via soakaway. Attenuation will take the form of a geocellular soakaway. Given the undulating levels on the site, both surface water and foul drainage from the development may need to be pumped.

There is no residual flood risk from the development site to the surrounding district due to the restriction of surface water runoff prior to discharge. Therefore, the development does not increase the risk of flooding to other adjacent neighbourhoods. Out of chamber or gully flooding for the extreme 100 year plus climate change event may occur within the development site and is classed as exceedance flows. Flood water from this event will be where possible contained within the development site and directed away from the residential dwellings to the external hard and soft landscaped areas. Attenuation of surface water flows will take the form of attenuation pipes.

Foul water generated by the development will be discharged into the Dŵr Cymru Welsh Water Combined Sewer Network, the exact location is to be confirmed by Dŵr Cymru Welsh Water following their Hydraulic Modelling Assessment. The foul discharge does not present an increased flood risk to the surrounding district.

1.0 Introduction

- 1.1 Scott Hughes Design (SHD) has been appointed by Glyndwr University to prepare this Flood Consequence Assessment to support an outline planning submission for the proposed residential development with associated access, gardens and hard and soft landscaping on land off Gatewen Road, Wrexham. The assessment has been undertaken in line with Technical Advice Note 15: Development and Flood Risk (TAN15) and information from Natural Resources Wales.
- 1.2 This Flood Consequence Assessment (FCA) has been commissioned by Wrexham Glyndwr University and is specific to their interests in the development proposals as described by the Architectural plan in Appendix A. This report may not be assigned.
- 1.3 The report has been commissioned to identify any flood related issues associated with the proposed development and any likely constraints that could be imposed plus to consider the drainage strategy for it. The following issues have been suggested by Natural Resources Wales, Wrexham County Borough Council Preliminary Flood Risk Assessment & Management of Surface Water Guidance Document and subsequently addressed within this report:
- Identify available data relating to flood risk at the site.
 - Determine whether the site is at risk from flooding from all sources, including from breach or overtopping of any existing flood defences, surface water flooding and/or groundwater flooding.
 - Consider the flood risk from all other sources.
 - Determine the current surface water drainage regime and assess any potential increase in surface water runoff as a result of the proposed development.
 - Discuss Sustainable Drainage Systems (SuDS) as an option for reducing surface water flood risk.
 - Devise an appropriate outline surface water drainage strategy (including calculation where appropriate) to deal with any potential increase in surface water runoff and include for climate change.
 - Consider the recommendations of the Wrexham County Borough Council Preliminary Flood Risk Assessment (PFRA) and Wrexham County Borough Council Management of Surface Water Guidance Document.
 - Assess mitigation measures & off-site impacts and define any residual risks.

2.0 Development Description and Location

2.1 Site Location

The site is referenced in Table 1, and a site location map is provided in Appendix A.

Table 1: Site Referencing Information

Item	Brief Description
Site name	Gatewen Road Residential Site
Site address and location	Land of Gatewen Road, New Broughton, Wrexham, LL11 6UY
Council Area	Wrexham County Borough Council
Approximate Grid Reference	OS: 331248, 351632
General Locality	The proposed development site is located some 3.0km to the northwest of Wrexham Town Centre.

2.2 Existing site Description

- 2.2.1 The proposed development site is currently agricultural land with parcels of trees.
- 2.2.2 The site is bound by Gatewen Road to the south, residential properties border the site to the north, and east. The land sits adjacent to an existing Local Authority playground to the west.
- 2.2.3 Figure 1 below identifies the overall site location details. Topographical information indicates that the site is undulating, with falls in several directions. The highest level of approximately 120.44m AOD is located towards to southeast of the site and the lowest level of approximately 110.48m AOD is located in the southeast corner of the site.

Figure 1: Site Location



2.3 Development Proposals

- 2.3.1 As discussed in the earlier sections, the report is prepared to support an outline planning application for the proposed residential development at Gatewen Road, Wrexham. It is proposed that a development of 112 residential units including 28 affordable units is developed leaving a substantial amount of land for use by the community as public open space. As a result, the provision of public open space is above Planning Authority spatial standards. The total number of residential units on site has been dictated by Local Authority development density standards and equates to over 26 dwellings per hectare.

Within the proposed residential layout, public open space is distributed in various pockets with a large central area of space related to the retention of an existing mature tree cluster and topography change.

- 2.3.2 The site area is approximately 4.74ha.
- 2.3.3 The outline Site Layout as indicated in Appendix A provides details of the proposed development intent.

3.0 Planning Policy and Consultation

3.1 Planning Policy Framework

- 3.1.1 The Development Advice Map contained within Technical Advice Note 15: Development and Flood Risk (TAN15) and based on National Resources Wales Flood Zones has determined that the site is located within Zone A, i.e. considered to be at little or no risk of fluvial or tidal/coastal flooding (as shown in table 2 below).

Table 2: National Resources Wales Flood Zones

Natural Resources Wales Flood Zones		
Description	Zone	Notes
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.

Table 3: Natural Resources Wales Flood Zones

- 3.1.2 The proposed residential development is considered a “highly vulnerable development” in terms of flood risk. The TAN15 Flood Risk Vulnerability and Flood Zone Compatibility matrix indicates that a highly vulnerable development in Zone A is appropriate. A justification test is not requested for sites in Flood Zone A.

3.2 Preliminary Flood Risk Assessment (PFRA)

3.2.1 The Lead Local Flood Authority (LLFA) of Wrexham County Borough Council is required by the Flood Risk Regulations (2009) and EU Floods Directive 2007/60/EC to prepare a Preliminary Flood Risk Assessment (PFRA). PFRAs assess the risk associated with all types of flooding and provide the information required to identify the amount of development permitted in an area; how drainage systems in the area should function and also how risks in vulnerable areas can be reduced and/or mitigated. The purpose of the PFRA is to assess and map all known sources of flood risk including fluvial, surface water, sewer, groundwater and all impounded water bodies, taking into account future climate change predictions.

3.2.2 A summary of the main elements from the PFRA are detailed below. The full report can be obtained from the Wrexham County Borough Council website.

- PFRA provides a detailed understanding of flood risks across the borough from all sources.
- Surface Water flooding is the most prominent cause of flooding within the County Borough.
- The report identified no records of past groundwater flooding within the County Borough.
- There are no historic records of canal overtopping or flooding of a canal within the Borough.

3.3 Statutory Authority Correspondence

3.3.1 Wrexham County Borough Council confirmed that:

- Discharge rates and volumes are usually required to be limited to greenfield runoff rate, with on-site attenuation for all events up to the 1 in 100 year rainfall event plus climate change.
- The practicable minimum limit on the discharge rate from the site is 5l/s, using an appropriate vortex flow control device.
- The minimum size of pipe discharging from an attenuation device should be 150mm laid at a gradient not flatter than 1 in 150.
- An explanation as to how it is proposed to manage and fund the maintenance of the proposed system over the lifetime of the development should be provided. This should consider the requirement to ensure that access is physically possible for such maintenance works.

3.3.2 Owain George from Welsh Water confirmed that there are concerns over the capacity of the sewer downstream of Coronation Road. A Hydraulic Modelling Assessment will be required to confirm connection points; this can be conditioned.

3.3.3 Mr Neil Taunt, Senior Flood Management Officer, at Wrexham County Borough Council confirmed within his planning response that infiltration testing is to be carried out to confirm whether they are suitable.

4.0 Definition of Flood Hazard

4.1 Sources of information

TAN15 requires the developer to consider the impact of runoff generated by the proposed development onto the downstream catchment, and to assess the risk of runoff from the surrounding district impacting on the developments footprint. Furthermore, the report is to consider flood risk from all other sources. The following section defines the flood risk receptors and anticipated flood risk. Section 5 then discusses in further detail the probability of flooding and the likely impacts.

Table 3: Sources of information used in the identification of flood risk

Source of Information	Details
Natural Resources Wales	Flood Risk Map
Dŵr Cymru Welsh Water	Sewer Records
Historic Maps	From various websites

4.2 Flooding from Rivers (Fluvial)

- 4.2.1 There are no watercourses in close proximity to the site. The closest watercourse is an unnamed watercourse approximately 300m to the northeast of the site.
- 4.2.2 Figure 2 below locates the site boundary on the Natural Resources Wales flood risk map. It is clear from this that the red line area sits outside of the influence of flood water from any identified water body or river and is located within Flood Zone 1 i.e. land defined as having an annual probability of fluvial flooding of less than 1 in 1000 in any year (<0.1%).
- 4.2.3 Based on the available information, the site lies within Flood Zone 1 and is classified as Zone A. According to TAN15 Flood Risk Vulnerability and Flood Zone Compatibility Matrix, a justification test is not requested for sites in Flood Zone A. Therefore, there is no need to consider fluvial flood risk any further.

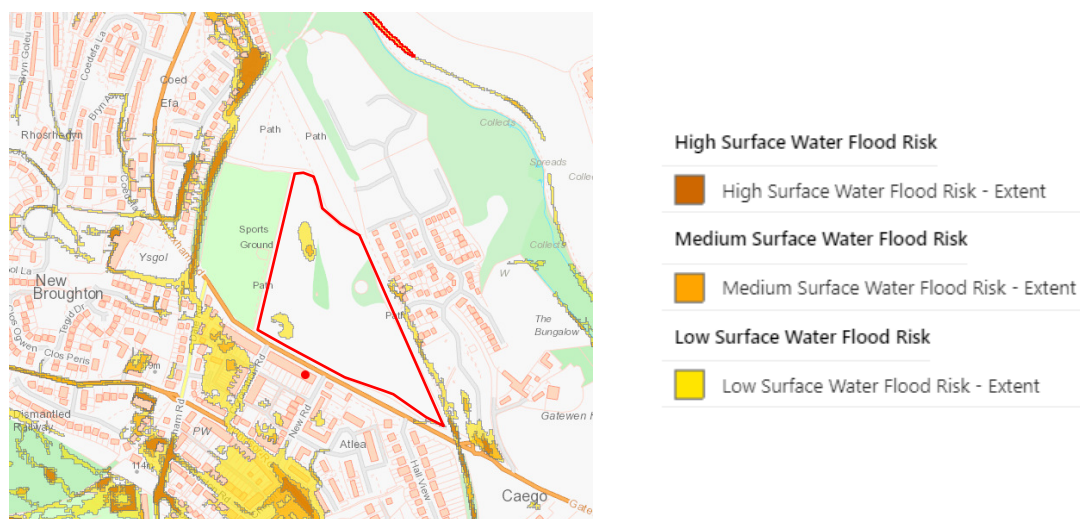
Figure 2 – Natural Resources Wales Risk of Flooding from Rivers & Sea Maps



4.3 Flooding From Land (Overland Flow)

- 4.3.1 The main development site topography is undulating. Surface water runoff from the surrounding area will be prevented from entering the site by the existing drainage associated with the surrounding residential developments and highways.
- 4.3.2 Furthermore, a review of the Natural Resources Wales Surface Water Flood Risk maps indicates that the site is predominantly at very low risk of flooding (see Figure 3 below). However, there are two areas that are shown as being at low risk, meaning that the area has a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%) and a small area at medium risk. The area at medium risk is associated with a topographical low point.

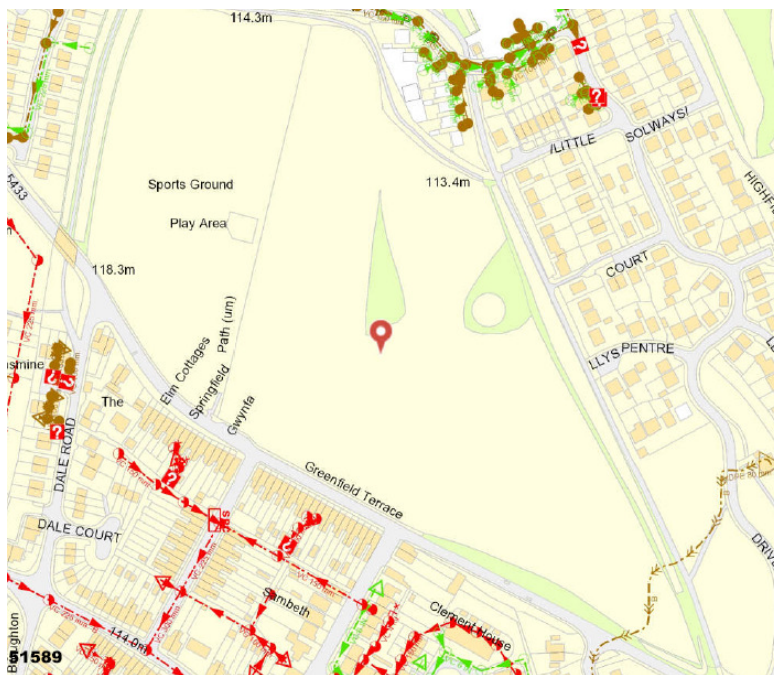
Figure 3 – Natural Resources Wales Surface Water Flood Risk Maps



4.4 Flooding from Sewers and Private Drainage

- 4.4.1 The Dŵr Cymru Welsh Water sewer records have been reviewed and confirm that are Surface Water, Foul and Combined Sewers in the surrounding residential estates. There is also a rising main that passes through the southeast of the site (to be confirmed following site surveys); if on site this main will need a 3m easement either side (See figure 4 below).
- 4.4.2 The extensive Dŵr Cymru Welsh Water adopted drainage network serving the surrounding urban district ensures that the development footprint is protected from the impact of both upstream and downstream runoff. It is speculated that complete protection may well exist beyond a storm event equivalent to the 30-year statistical event. Beyond this projection, there may be a small degree of peripheral 'Exceedance' flooding within the highway areas above the sewers. However, this is expected to be localised and restricted to the location of specific manhole covers located away from the development footprint. Thus flood risk to the site from sewers is diminished to acceptable levels.

Figure 4 – Dŵr Cymru Welsh Water Sewer Records Extract



4.5 Flooding from Groundwater

4.5.1 The British Geological Survey mapping indicates that the superficial geology of the site is Glaciofluvial Sheet Deposits, with an area of Glacial Till in the southeast. The bedrock geology of the site is comprised of Cefn Rock in the west and the Pennine Lower Coal Measures Formation in the east. According to the Environment Agencies Aquifer Designation Map, these are all classified as Secondary A Aquifers, comprised of permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. The PFRA identified no records of past groundwater flooding within the County Borough.

4.5.3 Based on the available information the risk of flooding from groundwater is considered to be low.

4.6 Flooding from Artificial Sources

4.6.1 There are no canals or reservoirs in close proximity to the red line area. Therefore the risk of flooding from artificial sources is low.

5.0 Assessment of Flood Risk on the Development Site (Probability)

5.1 Summary

Section 4 has defined the anticipated flood risks from all sources. Table 4 below considers each of the sources and defines in tabular format the Probability of Flood Risk associated to each and the likely impacts.

Below is a table summary of the flood risks associated with the development site.

Table 4 – Flood Risk Summary

Source	Flood Risk	Likely Impacts	Remarks
Tidal	Low	Low	The site is not tidally influenced.
Fluvial (Watercourse)	Low	Low	The site is in Zone A.
Surface (Overland Flood Flow)	Low	Low	The Natural Resources Wales flood maps show the majority of the site at very low risk of surface water flooding with two small areas at low risk and a small area at medium risk associated with a topographical low point.
Sewers	Low	Low	There is an existing rising main shown in the southeast of the site. The required WW easement will be applied to this rising main.
Groundwater	Low	Low	The site is at low risk of groundwater flooding.
Artificial Sources	Low	Low	There are no artificial sources in close proximity.

6.0 Outline Drainage Strategy

6.1 Existing Surface Water Runoff

- 6.1.1 The existing site is predominantly greenfield and greenfield runoff rates will apply as calculated in Table 5 below.

Table 5 – Existing Greenfield Runoff Rates

	Site Area (m ²)	1 Year (l/s)	Qbar (l/s)	30 Year (l/s)	100 year (l/s)
Open Land	47,400	10.9	12.3	21.8	26.9

6.2 Geology

- 6.2.1 The superficial geology of the site is Glaciofluvial Sheet Deposits, comprised of sand and gravel. Cohesive Glacial Till containing clays is found in the southeastern part of the site. The bedrock geology of the site is Cefn Rock, comprised of sandstone in the west of the site. The Pennine Lower Coal Measures Formation comprised of mudstone, siltstone and sandstone is found in the east of the site.
- 6.2.2 The underlying geology indicates that infiltration is a viable SuDS technique for the discharge of surface water, this has been confirmed with further infiltration testing (See Appendix F for further details).

6.3 Sustainable Drainage Systems

6.3.1 SuDS Objectives:

Sustainable drainage developed in line with the ideals of sustainable development is collectively referred to as Sustainable Drainage Systems (SuDS). At a particular site, these systems are designed both to manage the environmental risks resulting from the urban runoff and to contribute wherever possible to environmental enhancement. SuDS objectives are therefore to minimise the impacts from the development on the quantity and quality of the runoff and maximise amenity and biodiversity opportunities (CIRIA C753, 2015).

6.3.2 SuDS's Design Themes

A strong design theme is essential if the maximum aesthetic benefits are to be gained from the SuDS approach. At a more local scale the SuDS should link with the individuals plot structure, planting, public open space requirements and amenity areas, gaining multiple benefits from a limited area.

6.3.3 The SuDS Management Train

The 'Management Train Approach' should be central to the surface water drainage strategy of the proposed site. The main objective is treatment and control of runoff as near to the source as possible protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

1. **Prevention** – The use of good site design and housekeeping measures to prevent runoff and pollution and includes the use of rainwater reuse / harvesting.
2. **Source Controls** – Control of runoff at source or as close to source as possible (e.g. soakaways, green roofs, pervious pavements).
3. **Site Control** – Management of water in a local area and can include below ground storage / attenuation, detention basins, large infiltration devices.
4. **Regional Control** – Management of water from a site or various sites and can include wetlands and balancing ponds.

6.3.4 SuDS Site Constraints

SuDS techniques are suitable for all sites; therefore, an assessment of the existing site is required so that SuDS limitations can be determined.

- Land Use Characteristics: The size and type of the development plot allows a range of source control and site control SuDS devices to be considered both above and below ground.
- Site Characteristics: The underlying geology indicates that infiltration is a potentially viable SuDS technique, this has been confirmed by the results of further infiltration tests.
- Catchment Characteristics: The site is currently greenfield and greenfield runoff rates will apply.
- Environmental and Amenity Performance: Safety to all future users is paramount when including SuDS within the overall development and so best practice guidance will be incorporated so that these devices blend into the surrounding without the need for significant safety precautions. Maintenance plans will be prepared for all SuDS devices that are included.

6.3.5 SuDS Methods

Tables 6 and 7, below, provide an assessment of various above and below ground SuDS methods that can provide water quality treatment and management of flows to reduce runoff rates and volumes and whether they can be suitably incorporated at this development site. The purpose of this assessment is to set out options to be considered at the planning stage with consideration to time constraints, viability and lifetime maintenance of the development.

Table 6: Surface SuDS Methods

Method	Comment	Suitability for Development
Green Roofs	Can be used on suitable low-rise buildings to provide retention, attenuation and treatment of rainwater, and promotes evaporation and local biodiversity.	<u>Not suitable:</u> - Architectural proposals for the development and maintenance issues deem this unsuitable. - Additional costs of installation would have severe effect on viability of the development.
Water Butts	Plastic tanks placed at the base of rainwater down pipes to collect rainwater runoff from the roof areas.	<u>Suitable:</u> To be located at the base of downspouts. Subject to client approval.
Rainwater Harvesting	Rainwater harvesting reduces the total runoff volume from the developed site, and reduces treated water consumption.	<u>Not Suitable:</u> - Additional costs of installation would have severe effect on viability of the development. - The ability to restrict peak flow rates and short-term peak volumes is non-existent where a critical storm event occurs. - Running and maintenance costs would not be acceptable to the client or future residents.
Infiltration Options	Reduces total run off volume from the development.	<u>Suitable:</u> Infiltration tests confirmed suitability.
Permeable Surfacing (Infiltration)	- Reduces total run off volume from the development. - Can be used to enhance water quality.	<u>Suitable:</u> Infiltration tests confirmed suitability.
Permeable Surfacing (Standard)	- Can be used to enhance quality of runoff water. - Sub-base provides 'source' storage and reduces the volume of storage downstream. - The storage can be created with selection of the stone fill or use of plastic box stems.	<u>Suitable:</u> Infiltration tests confirmed suitability.

	Impermeable membrane at base of construction to prevent impact on pavement stability.	
Swales, basins and ponds	- Provide areas for above ground surface runoff storage. - Swales also allow filtering of particulate matter, improving water quality	<u>Suitable:</u> - The size of the development may allow for large above ground areas for surface water storage. - Dependent upon final development layout.
Bio-Retention	Collect and retain run-off to help improve water quality, prior to discharge in piped system on infiltration.	<u>Suitable:</u> - The size of the development may allow for large above ground areas for surface water storage. - Dependent upon final development layout.

Table 7: Sub-Surface SuDS Methods

Method	Comment	Suitability for Development
Geocellular Storage	- Suitable for sites with insufficient space for basins etc. - Suitable for sites where topography prevents the use of open basins etc. - Can be very effective infiltration devices subject to ground conditions.	<u>Suitable:</u> - The use of geocellular attenuation may be possible to retain excess storm water. - Cannot be used in Public Highways or adopted by WW.
Large Diameter Pipes, Culverts or Tanks	- Suitable for sites with insufficient space for basins etc. - Provide a volume of below ground storage with a high void ratio and good man entry provision to allow for future maintenance and cleaning. - Generally be suitable for adoption by the statutory water company (e.g. Dŵr Cymru Welsh Water).	<u>Suitable:</u> - The use of oversized pipes may be possible to retain excess storm water. - Used primarily on adopted drainage networks.

6.3.6 SuDS Hierarchal Approach

Based on the SuDS assessment in Tables 6 and 7, plus an assessment of the local site conditions, the SuDS hierarchal approach for discharge of surface water at the development site is considered in greater detail below.

Table 8: SuDS Hierarchal Approach

Method	Suitability	Suitability for Development
Infiltration to Ground	Yes	Infiltration testing confirmed that soakaways are a viable option for the site.
Connection to Watercourse	Yes	There is an unnamed watercourse approximately 300m to the east of the site.
Connection to Surface Water Sewer	No	There are other suitable options that would take precedence.
Connection to a Combined Sewer	No	There are other suitable options that would take precedence.

6.3.7 SuDS Design Philosophy

The SuDS assessment and hierarchal approach discussed in Tables 6, 7 and 8 above has defined the overall SuDS strategy. Thus, the SuDS philosophy for the main development site is the promotion of Source Control and Site Control techniques, to reduce the risk of both site and downstream flooding.

The following design philosophy is proposed:

- Surface water treatment using the 'Management Train' approach to remove and isolate contamination at all SuDS facilities prior to conveyance to the ground.
- Site control in the form of a geocellular soakaway in the west of the site.
- Infiltration testing confirmed that soakaways are a viable option.
- Aim to limit where possible the impermeable fraction of development.

6.4 Outline Surface Water Drainage Strategy

- 6.4.1 The outline strategy is to collect runoff from the roof and external areas and direct it to new below ground surface water drainage networks that will discharge via infiltration. Given the undulating nature of the topography, it is likely that some of the surface water drainage will need to be pumped.

- 6.4.2 The proposed drainage layout for the new development site will be designed in accordance with BS EN 752: 2008 and Building Regulations Part H guidance and Sewers for Adoption, i.e. up to the 30-year storm return period criterion and tested for the 1 in 100 year return period including a 40% increase to account for climate change to confirm that there is no flood risk to the buildings.
- 6.4.3 Flooding can occur on a local scale beyond the 30-year criterion due to runoff exceeding the capacity of the minor system during extreme events and it can only be addressed on a site-specific basis. Sewers for Adoption (SfA) 7th Edition (WRc, 2006) states that developments should be protected against flooding from extreme events (1 in 30 year) and that flood pathways are identified when the drainage system is exceeded.
- 6.4.4 In the case of this development, exceedance flows will be all those over and above the 30-year design criterion set by Sewers for Adoption guidance. Using storage within the external areas would be achievable and would direct flood water away from the residential buildings, with flows directed back into the surface water drainage network as water levels in the sewers receded. The exceedance flows and volumes can be calculated for the new development drainage layout. In the case of this development and due to the fall across the site, consideration will be given to make sure all water is controlled so that it does not impact on any adjoining properties.
- 6.4.5 Based on the infiltration results in Appendix F, a rate of 1.11×10^{-04} has been used to calculate the required volume for the geocellular soakaway. The outline attenuation volume in Appendix E has been derived using Microdrainage Source Control Software. The volumes identified are preliminary for this outline assessment and are likely to alter at detailed design stage.
- 6.4.6 Any future drainage calculations carried out as part of a site-wide drainage strategy or for the development layouts themselves must include the appropriate increase in rainfall to satisfy the future Climate Change allowances.

6.5 Pollution Control

- 6.5.1 Silt is to be prevented from entering the drainage system by the use of trapped gullies, channels with silt traps, French drains with silt traps or by the use of Sustainable Drainage techniques. If appropriate, oil separators in line with Pollution Prevention Guidance 3 (PPG 3) criteria will be provided (it is acknowledged that PPG 3 has been withdrawn, however as no replacement has been released it is still best practice guidance).

6.6 Foul Water Strategy

- 6.6.1 The outline foul water drainage strategy is to connect into the combined sewer network; the exact location is to be confirmed by Dŵr Cymru Welsh Water following their Hydraulic Modelling Assessment. There would be very limited increase in the foul water discharge rates generated by the new development.

7.0 Management Measures, Off Site Impacts and Residual Risk

7.1 Flood Risk Management Measures

- 7.1.1 The report has found the main development site to be at low risk of flooding from all sources.
- 7.1.2 The surface water drainage strategy for the new development site will be to discharge to ground. The new surface water networks will be designed in line with current British Standard and Sewers for Adoption Guidance up to the 100-year storm return period including an allowance for climate change. Beyond the 30-year criterion out of chamber flooding may occur and flood water will be directed away from the residential buildings to the external areas, where it will then be directed back into the drainage network as pipe water levels recede.
- 7.1.3 The use of SuDS in the form of Prevention and Site Control measures, with controlled (restricted) outflow, in line with the required reduction in runoff rates, will help to minimise the flood risk impact to the surrounding sewer networks.
- 7.1.4 There will be a site management health and safety document prepared in respect of the final development. This will include the required maintenance regime for the on-site drains and drainage facilities such as the channels, gullies, pipes, manholes and all SUDS facilities.
- 7.1.5 A new Management Company, the local Highway Authority and Dŵr Cymru Welsh Water will be responsible for site cleanliness, gully emptying and drain cleansing to ensure that the surface water drainage system will always operate at its maximum efficiency.
- 7.1.6 Should any flooding occur from the new sewers and drains it will be directed away from the residential buildings to external areas and soft landscaping areas.

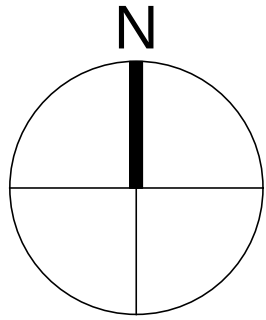
7.2 Off Site Impacts

- 7.2.1 Up to and including the 100-year plus increase in rainfall allowance due to climate change (CC) event, the report has justified that there is no risk of flooding.
- 7.2.2 The development footprint does not cross or cover any existing or declared future catchment flood defences. Consequently, the Applicant does not propose to augment or compromise any existing catchment defences.
- 7.2.3 By mimicking the pre-development peak runoff at its point of discharge by the inclusion of SuDS, this will reduce surface water flooding impact onto the downstream sewer network and satisfy site constraints.
- 7.2.4 As there is no flood displacement or increased rate of runoff as part of this proposal into the adjacent sewers, the proposed development will therefore not increase flood risk in its locality.

7.3 Residual Risk

- 7.3.1 With careful design of the drainage elements as described above there will be no residual flood-related risks that will remain after the development has been completed.
- 7.3.2 Flood risk to people and property can be managed but it can never be completely removed; a residual risk remains after flood management or mitigation measures have been put in place. The only known flood related risk that will remain will be the risk of out of manhole flooding within both the existing private and public sewer network beyond the 30 year design criterion. Should exceedance occur, out of chamber flood water will be directed to the external hard standing areas and roads but will not be a flood risk generator.

Appendix A – Architectural Site Layout



GENERAL NOTES:

DAY Architectural Ltd accepts no responsibility for any costs, losses or claims whatsoever arising from these drawings, specifications and related documents unless there is full compliance with the Client or any unauthorised user of the following:

- All boundaries, dimensions and levels are to be checked on site before construction and any discrepancies reported to the Architect / Designer.
- Partial Service: Any discrepancies with site or other information is to be advised to the Architect / Designer and direction and / or approval is to be sought before the implementation of the detail.
- Block and site plans are reproduced under license from the Ordnance Survey.
- Do not scale this drawing.
- For the purpose of coordination, all relevant parties must check this information prior to implementation and report any discrepancies to the Architect / Designer.

DRAWING NOTES:

P2	Issued for Planning	23.05.2019
STATUS	REVISION	DATE

CLIENT	Wrexham Glyndwr University	
PROJECT	Campus 2025	

DRAWING	Gatewen Road - Proposed Masterplan		
SCALE	1:1000	PAPER SIZE	A1
DATE	June 2018	DRAWN BY	LB
DRAWING No.	AL-00-001	REVISION	P2
		PROJECT No.	531-17-5
DRAWING STATUS			
PLANNING			
Information contained on this drawing is the sole copyright of DAY Architectural Ltd. and is not to be reproduced without their permission.			

DAY

ARCHITECTURAL LTD

DAY ARCHITECTURAL LTD.

61 BURLINGTON STREET

LIVERPOOL

L3 6LG

0151 203 9703, info@day-architectural.com, www.day-architectural.com

Appendix B – Topographical Survey

- | FENCE DESCRIPTIONS: | |
|---------------------|-----------------------|
| B/W: | BARRIED WIRE FENCE |
| C/B: | CLOSE BOARDED FENCE |
| C/L: | CHAIN LINK FENCE |
| C/P: | CHESTNUT PALING FENCE |
| CONC/P: | CONCRETE PANEL FENCE |
| I/R: | ROST PALING FENCE |
| P/W: | POST AND WIRE FENCE |
| P/C: | POST AND CHAIN FENCE |
| S/PAL: | STEEL PALISADE FENCE |
| S/B: | SAFETY BARRIER |
| I/PAL: | TIMBER PALISADE FENCE |

INFORMATION

PM SURVEYS UK

100% FREE

100% FREE

Day Architectural Ltd
2nd Floor Lancaster Building
77 Deansgate
Manchester

Tel: 01618 349703
Email: tony@day-architectural.com

Project No PMS18061	Sheet: A0 Scale: 1:200	Surveyed By:	AL
		Drawn By:	JW
PMS18061-01		Approved By:	PM
		Issued:	11/04/18

Appendix C – Statutory Authority Correspondence

From: Philip Forster
Sent: 09 October 2018 13:52
To: planning_admin
Subject: FW: P/2018/0674

[Flood officer response](#)

From: Philip Forster
Sent: 11 September 2018 10:13
To: planning_admin
Subject: FW: P/2018/0674

[Flood officer response](#)

From: Neil Taunt
Sent: 10 September 2018 11:50
To: Philip Forster
Subject: P/2018/0674

Hi Phil,

Thanks you for the recent consultation on the above application.

The site is identified as falling with DAM Zone A as defined within TAN15, there are also localised areas identified as being at risk of surface water flooding as defined on NRW's updated flood map for surface water.

I have reviewed the submitted Flood Consequence Assessment and Drainage Strategy and would request that additional information is submitted prior to the application being approved.

The outline drainage strategy indicates that surface waters will be managed by infiltration, but if this is not feasible due to local ground conditions then an attenuated discharge to a remote watercourse will be used. The strategy also suggests that due to the undulating nature of the site then pumping will be required. No connection to any existing surface water sewer is possible from the site.

I have significant concerns over the sustainability of the proposed scheme if it will be reliant on pumping to deliver a suitable solution. In addition it has not been demonstrated either that soakaway is a viable means of disposal for the site or that a connection to the remote watercourse through the neighbouring estate can be realised. The site would appear an ideal candidate for a more SuDS based solution to manage surface waters generated on site in accordance with the latest National Standards for Wales, but the intention appears to be for an underground based surface water management based solution. Prior to determination additional information should be submitted to demonstrate that there is a sustainable solution to surface water management on the site. The attached guidance note details the minimum requirements of an indicative drainage proposal that should be submitted to demonstrate that there is a viable solution – this must include confirmation that infiltration is viable (any percolation tests carried out in accordance with the latest BRE365 guidance).and if not that a route to the remote watercourse can be secured.

In the absence of this information it has not been demonstrated that surface water flood risk both to the development site and surrounding area can be sustainably managed into the future and I would request the application be refused.

In addition, the applicant should be made aware that the commencement of schedule 3 of the Flood and Water Management Act 2010 (the Act) was signed 1 May 2018. This will mean that from the 7 January 2019 any new

development that satisfy the criteria will require SuDS Approval Body (SAB) approval prior to the commencement of development. It is proposed to make transitional arrangements as follows:

- Existing sites and developments with planning permission granted or deemed to be granted (whether or not subject to any conditions as to a reserved matter – but see also below) or for which a valid application has been received but not determined by 7 January 2019, will not be required to apply for SAB approval.
- SAB approval will still be required if the planning permission was granted subject to a condition as to a reserved matter and an application for approval of the reserved matter is not made before 7 January 2020.

It is reasonable to assume that, if the development were to progress, and any associated drainage conditions not be discharged prior to the January 2020 date, then SAB approval would be required prior to the commencement of any works on site.

If you have any question on the above please let me know.

Many thanks

Neil

Neil Taunt MCIWEM C.WEM CEnv CSci

Uwch Swyddog Rheoli Llifogydd / Senior Flood Management Officer



01978 729734 / 07808 787632



Amgylchedd a Chynllunio, Cyngor Bwrdeistref Sirol Wrecsam, De Ffordd yr Abaty, Ystad Ddiwydiannol Wrecsam, Wrecsam LL13 9PW



Environment & Planning, Wrexham County Borough Council, Abbey Road South, Wrexham Industrial Estate, Wrexham LL13 9PW



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Ms Eleanor Dale
Scott Hughes Design
The Flint Glass Works
64 Jersey Street
Manchester
M4 6JW

Date: 04/06/2018
Our Ref: PPA0003118

Dear Ms Dale

Grid Ref: 331260 351581
Site Address: Site off Gatewen Road, Wrexham
Development: Residential development – 109 units

I refer to your pre-planning enquiry received relating to the above site, seeking our views on the capacity of our network of assets and infrastructure to accommodate your proposed development. Having reviewed the details submitted I can provide the following comments which should be taken into account within any future planning application for the development.

ASSET PROTECTION

The proposed development site is crossed by a public foul rising main sewer with the approximate position being marked on the attached Statutory Public Sewer Record. Under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times. No part of any building will be permitted within 3 metres either side of the centreline of the 80mm rising main sewer.

Our strong recommendation is that your site layout takes into account the location of the assets crossing the site and should be referred to in any master-planning exercises or site layout plans submitted as part of any subsequent planning application. Further information regarding Asset Protection is provided in the attached Advice & Guidance note.

SEWERAGE

The foul flows only from the proposed development can be accommodated within the public sewerage system. We advise that the flows should be taken to the foul sewer at or beyond manhole SJ31510102 which is located to the south of Strytybydden.

Should a planning application be submitted for this development we will seek to control these points of communication via appropriate planning conditions and therefore recommend that any drainage layout or strategy submitted as part of your application takes this into account.

However, should you wish for an alternative connection point to be considered please provide further information to us in the form of a drainage strategy, preferably in advance of a planning application being submitted.

SURFACE WATER

With reference to the surface water flows from the proposed development, you are required to fully exhaust all technical options outlined under Sections 3.2 and 3.4 of Part H of the publication 'Building Regulations 2000; Disposal should be made through the hierarchical approach, preferring infiltration and, where infiltration is not possible, disposal to watercourses in liaison with the Land Drainage Authority and/or Natural Resources Wales. Please refer to further detailed advice relating to surface water management included in our attached Advice & Guidance note.

In addition, please note that no surface water, highway or land drainage run-off will be permitted to discharge directly or indirectly into the public sewerage system.

ADVISORY

The applicant may need to apply to Dwr Cymru / Welsh Water for any connection to the public sewer under S106 of the Water Industry Act 1991. If the connection to the public sewer network is either via a lateral drain (i.e. a drain which extends beyond the connecting property boundary) or via a new sewer (i.e. serves more than one property), it is now a mandatory requirement to first enter into a Section 104 Adoption Agreement (Water Industry Act 1991). The design of the sewers and lateral drains must also conform to the Welsh Ministers Standards for Gravity Foul Sewers and Lateral Drains, and conform with the publication "Sewers for Adoption"- 7th Edition. Further information can be obtained via the Developer Services pages of www.dwrcymru.com

Some public sewers and lateral drains may not be recorded on our maps of public sewers because they were originally privately owned and were transferred into public ownership by nature of the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011. The presence of such assets may affect your proposal. In order to assist us in dealing with the proposal we request that you contact our Operations Contact Centre on 0800 085 3968 to establish the location and status of the sewer. Under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times.

SEWAGE TREATMENT

No problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site.

I trust the above information is helpful and will assist you in forming water and drainage strategies that should accompany any future planning application. I also attach copies of our water and sewer extract plans for the area, and a copy of our Planning Guidance Note which provides further information on our



Welsh Water is owned by Glas Cymru – a 'not-for-profit' company.
Mae Dwr Cymru yn eiddo i Glas Cymru – cwmni 'nid-er-elw'.

We welcome correspondence in
Welsh and English

Dŵr Cymru Cyf, a limited company registered in
Wales no 2366777. Registered office: Pentwyn Road,
Nelson, Treharris, Mid Glamorgan CF46 6LY

Rydym yn croesawu gohebiaeth yn y
Gymraeg neu yn Saesneg

Dŵr Cymru Cyf, cwmni cyfyngedig wedi'i gofrestru yng
Nghymru rhif 2366777. Swyddfa gofrestredig: Heol Pentwyn
Nelson, Treharris, Morgannwg Ganol CF46 6LY.

approach to the planning process, making connections to our systems and ensuring any existing public assets or infrastructure located within new development sites are protected.

Please note that our response is based on the information provided in your enquiry and should the information change we reserve the right to make a new representation. Should you have any queries or wish to discuss any aspect of our response please do not hesitate to contact our dedicated team of planning officers, either on 0800 917 2652 or via email at developer.services@dwrcymru.com

Please quote our reference number in all communications and correspondence.

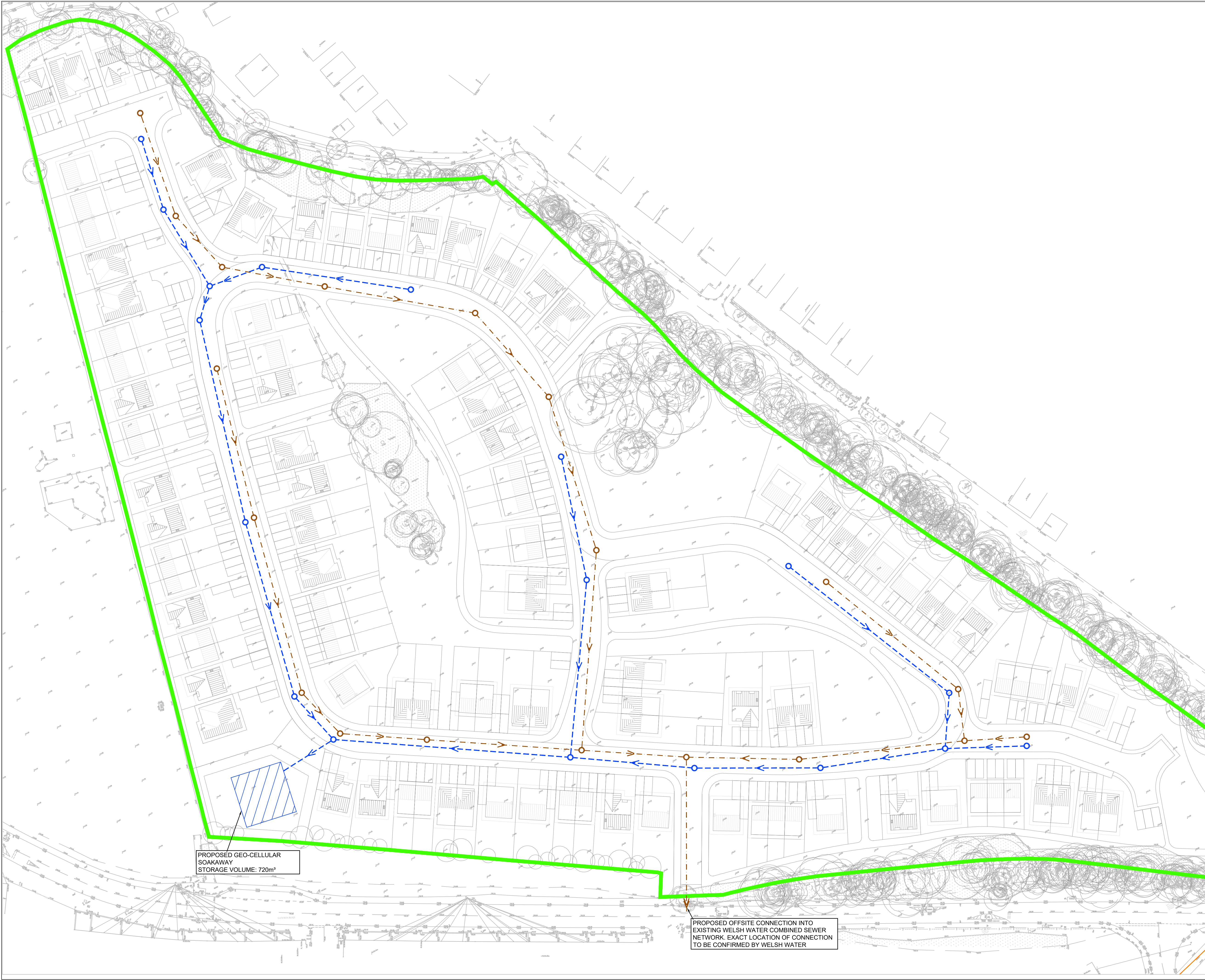
Yours faithfully,



Owain George
Planning Liaison Manager
Developer Services

Please Note that demands upon the water and sewerage systems change continually; consequently the information given above should be regarded as reliable for a maximum period of 12 months from the date of this letter.

Appendix D – Scott Hughes Design Drawings



GENERAL NOTES

- 1. DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL RELEVANT SPECIFICATIONS, ENGINEERS, ARCHITECTS & SERVICES DRAWINGS, INCLUDING APPROVED BUILDERS WORK DRAWINGS. CONTRACTOR TO NOTIFY ENGINEER OF DISCREPANCIES BETWEEN STRUCTURAL DRAWINGS AND SPECIFICATIONS OR OTHER DRAWINGS.
- 2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
- 3. DO NOT SCALE FROM THIS DRAWING. WORK TO DIMENSIONS OR CO-ORDINATES PROVIDED. ALL LEVELS ARE IN METRES AND ALL DIMENSIONS ARE IN MILLIMETRES, UNLESS OTHERWISE NOTED. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS, SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY.
- 4. INFORMATION CONTAINED ON THIS DRAWING IS SCHEME DESIGN ONLY AND REQUIRES FURTHER DETAILED DESIGN AND CO-ORDINATION WITH THE CONTRACTOR, DESIGN TEAM AND APPROPRIATE SUB-CONTRACTORS.

DRAINAGE KEY

- PROPOSED FW SEWER
- PROPOSED FW SEWER MANHOLE
- PROPOSED SW SEWER
- PROPOSED SW SEWER MANHOLE
- SITE BOUNDARY

P2	10.06.19	EJD	PG	LAYOUT UPDATED
P1	25.05.18	JS	PG	PRELIMINARY ISSUE
No	DATE	DRAWN	REV'D ENG.	AMENDMENT

STATUS	PURPOSE OF ISSUE
S2	FOR INFORMATION

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Scott Hughes Design Ltd.
The Flint Glass Works,
64 Jersey Street,
Manchester M4 6JW
t. 0161 605 0831
f. 0161 605 0832
e.mail@scotthughesdesign.co.uk
Reg No. 4899745

CLIENT	GLYNDWR UNIVERSITY		
PROJECT	GATEWEN ROAD, WREXHAM		
DRAFTER	JS	ENGINEER	PG
TITLE	PROPOSED DRAINAGE GA		
PROJECT REFERENCE: 3352			
SCALE	SHEET	DRAWING No	REV
1-500	A1	3352-SHD-00-ZZ-DR-C-0102	P2

Appendix E – Hydraulic Calculations

Scott Hughes Design Ltd		Page 1
The Flint Glass Works 64 Jersey Street Manchester M4 6JW	Gatewen Road Wrexham	
Date 07/06/2019 File	Designed by EJD Checked by PG	
Micro Drainage Source Control 2018.1		
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 1 Soil 0.300 Area (ha) 4.740 Urban 0.000 SAAR (mm) 950 Region Number Region 9 Results l/s QBAR Rural 12.3 QBAR Urban 12.3 Q1 year 10.9 Q1 year 10.9 Q30 years 21.8 Q100 years 26.9		
©1982-2018 Innovyze		

Scott Hughes Design Ltd				Page 1																																																																																																																																																																																																																			
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<u>Summary of Results for 30 year Return Period</u> Half Drain Time : 236 minutes. <table><thead><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr></thead><tbody><tr><td>15 min Summer</td><td>110.486</td><td>1.486</td><td>20.8</td><td>282.3</td><td>O K</td></tr><tr><td>30 min Summer</td><td>111.033</td><td>2.033</td><td>23.1</td><td>386.3</td><td>O K</td></tr><tr><td>60 min Summer</td><td>111.588</td><td>2.588</td><td>25.4</td><td>491.8</td><td>O K</td></tr><tr><td>120 min Summer</td><td>112.065</td><td>3.065</td><td>27.4</td><td>582.4</td><td>O K</td></tr><tr><td>180 min Summer</td><td>112.236</td><td>3.236</td><td>28.1</td><td>614.8</td><td>O K</td></tr><tr><td>240 min Summer</td><td>112.281</td><td>3.281</td><td>28.3</td><td>623.3</td><td>O K</td></tr><tr><td>360 min Summer</td><td>112.276</td><td>3.276</td><td>28.3</td><td>622.5</td><td>O K</td></tr><tr><td>480 min Summer</td><td>112.222</td><td>3.222</td><td>28.0</td><td>612.2</td><td>O K</td></tr><tr><td>600 min Summer</td><td>112.156</td><td>3.156</td><td>27.8</td><td>599.7</td><td>O K</td></tr><tr><td>720 min Summer</td><td>112.087</td><td>3.087</td><td>27.5</td><td>586.5</td><td>O K</td></tr><tr><td>960 min Summer</td><td>111.942</td><td>2.942</td><td>26.9</td><td>558.9</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>111.645</td><td>2.645</td><td>25.6</td><td>502.6</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>111.228</td><td>2.228</td><td>23.9</td><td>423.4</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>110.864</td><td>1.864</td><td>22.4</td><td>354.2</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>110.284</td><td>1.284</td><td>20.0</td><td>243.9</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>109.856</td><td>0.856</td><td>18.2</td><td>162.6</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>109.541</td><td>0.541</td><td>16.9</td><td>102.7</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>109.310</td><td>0.310</td><td>16.0</td><td>58.8</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>109.148</td><td>0.148</td><td>15.3</td><td>28.2</td><td>O K</td></tr><tr><td>15 min Winter</td><td>110.687</td><td>1.687</td><td>21.7</td><td>320.5</td><td>O K</td></tr></tbody></table> <table><thead><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Time-Peak (mins)</th></tr></thead><tbody><tr><td>15 min Summer</td><td>62.321</td><td>0.0</td><td>50</td></tr><tr><td>30 min Summer</td><td>42.358</td><td>0.0</td><td>61</td></tr><tr><td>60 min Summer</td><td>27.653</td><td>0.0</td><td>84</td></tr><tr><td>120 min Summer</td><td>17.544</td><td>0.0</td><td>132</td></tr><tr><td>180 min Summer</td><td>13.288</td><td>0.0</td><td>182</td></tr><tr><td>240 min Summer</td><td>10.851</td><td>0.0</td><td>218</td></tr><tr><td>360 min Summer</td><td>8.126</td><td>0.0</td><td>284</td></tr><tr><td>480 min Summer</td><td>6.616</td><td>0.0</td><td>352</td></tr><tr><td>600 min Summer</td><td>5.637</td><td>0.0</td><td>422</td></tr><tr><td>720 min Summer</td><td>4.943</td><td>0.0</td><td>490</td></tr><tr><td>960 min Summer</td><td>4.014</td><td>0.0</td><td>628</td></tr><tr><td>1440 min Summer</td><td>2.989</td><td>0.0</td><td>898</td></tr><tr><td>2160 min Summer</td><td>2.222</td><td>0.0</td><td>1292</td></tr><tr><td>2880 min Summer</td><td>1.799</td><td>0.0</td><td>1672</td></tr><tr><td>4320 min Summer</td><td>1.333</td><td>0.0</td><td>2412</td></tr><tr><td>5760 min Summer</td><td>1.077</td><td>0.0</td><td>3136</td></tr><tr><td>7200 min Summer</td><td>0.914</td><td>0.0</td><td>3840</td></tr><tr><td>8640 min Summer</td><td>0.799</td><td>0.0</td><td>4520</td></tr><tr><td>10080 min Summer</td><td>0.713</td><td>0.0</td><td>5176</td></tr><tr><td>15 min Winter</td><td>62.321</td><td>0.0</td><td>51</td></tr></tbody></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	110.486	1.486	20.8	282.3	O K	30 min Summer	111.033	2.033	23.1	386.3	O K	60 min Summer	111.588	2.588	25.4	491.8	O K	120 min Summer	112.065	3.065	27.4	582.4	O K	180 min Summer	112.236	3.236	28.1	614.8	O K	240 min Summer	112.281	3.281	28.3	623.3	O K	360 min Summer	112.276	3.276	28.3	622.5	O K	480 min Summer	112.222	3.222	28.0	612.2	O K	600 min Summer	112.156	3.156	27.8	599.7	O K	720 min Summer	112.087	3.087	27.5	586.5	O K	960 min Summer	111.942	2.942	26.9	558.9	O K	1440 min Summer	111.645	2.645	25.6	502.6	O K	2160 min Summer	111.228	2.228	23.9	423.4	O K	2880 min Summer	110.864	1.864	22.4	354.2	O K	4320 min Summer	110.284	1.284	20.0	243.9	O K	5760 min Summer	109.856	0.856	18.2	162.6	O K	7200 min Summer	109.541	0.541	16.9	102.7	O K	8640 min Summer	109.310	0.310	16.0	58.8	O K	10080 min Summer	109.148	0.148	15.3	28.2	O K	15 min Winter	110.687	1.687	21.7	320.5	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	62.321	0.0	50	30 min 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1440 min Summer	111.645	2.645	25.6	502.6	O K																																																																																																																																																																																																																		
2160 min Summer	111.228	2.228	23.9	423.4	O K																																																																																																																																																																																																																		
2880 min Summer	110.864	1.864	22.4	354.2	O K																																																																																																																																																																																																																		
4320 min Summer	110.284	1.284	20.0	243.9	O K																																																																																																																																																																																																																		
5760 min Summer	109.856	0.856	18.2	162.6	O K																																																																																																																																																																																																																		
7200 min Summer	109.541	0.541	16.9	102.7	O K																																																																																																																																																																																																																		
8640 min Summer	109.310	0.310	16.0	58.8	O K																																																																																																																																																																																																																		
10080 min Summer	109.148	0.148	15.3	28.2	O K																																																																																																																																																																																																																		
15 min Winter	110.687	1.687	21.7	320.5	O K																																																																																																																																																																																																																		
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																																				
15 min Summer	62.321	0.0	50																																																																																																																																																																																																																				
30 min Summer	42.358	0.0	61																																																																																																																																																																																																																				
60 min Summer	27.653	0.0	84																																																																																																																																																																																																																				
120 min Summer	17.544	0.0	132																																																																																																																																																																																																																				
180 min Summer	13.288	0.0	182																																																																																																																																																																																																																				
240 min Summer	10.851	0.0	218																																																																																																																																																																																																																				
360 min Summer	8.126	0.0	284																																																																																																																																																																																																																				
480 min Summer	6.616	0.0	352																																																																																																																																																																																																																				
600 min Summer	5.637	0.0	422																																																																																																																																																																																																																				
720 min Summer	4.943	0.0	490																																																																																																																																																																																																																				
960 min Summer	4.014	0.0	628																																																																																																																																																																																																																				
1440 min Summer	2.989	0.0	898																																																																																																																																																																																																																				
2160 min Summer	2.222	0.0	1292																																																																																																																																																																																																																				
2880 min Summer	1.799	0.0	1672																																																																																																																																																																																																																				
4320 min Summer	1.333	0.0	2412																																																																																																																																																																																																																				
5760 min Summer	1.077	0.0	3136																																																																																																																																																																																																																				
7200 min Summer	0.914	0.0	3840																																																																																																																																																																																																																				
8640 min Summer	0.799	0.0	4520																																																																																																																																																																																																																				
10080 min Summer	0.713	0.0	5176																																																																																																																																																																																																																				
15 min Winter	62.321	0.0	51																																																																																																																																																																																																																				
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Scott Hughes Design Ltd				Page 2	
The Flint Glass Works 64 Jersey Street Manchester M4 6JW		Gatewen Road Wrexham			
Date 07/06/2019 File 30YR SOAKAWAY.SRCX		Designed by EJD Checked by PG			
Micro Drainage		Source Control 2018.1			
<u>Summary of Results for 30 year Return Period</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	111.305	2.305	24.2	437.9	O K
60 min Winter	111.941	2.941	26.9	558.7	O K
120 min Winter	112.505	3.505	29.2	666.0	O K
180 min Winter	112.727	3.727	30.1	708.2	O K
240 min Winter	112.794	3.794	30.4	720.9	O K
360 min Winter	112.790	3.790	30.4	720.0	O K
480 min Winter	112.719	3.719	30.1	706.6	O K
600 min Winter	112.607	3.607	29.6	685.4	O K
720 min Winter	112.481	3.481	29.1	661.3	O K
960 min Winter	112.243	3.243	28.1	616.2	O K
1440 min Winter	111.776	2.776	26.2	527.5	O K
2160 min Winter	111.159	2.159	23.6	410.3	O K
2880 min Winter	110.653	1.653	21.5	314.1	O K
4320 min Winter	109.897	0.897	18.4	170.4	O K
5760 min Winter	109.386	0.386	16.3	73.3	O K
7200 min Winter	109.077	0.077	15.0	14.6	O K
8640 min Winter	109.045	0.045	13.5	8.6	O K
10080 min Winter	109.040	0.040	12.0	7.6	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	42.358	0.0	62		
60 min Winter	27.653	0.0	86		
120 min Winter	17.544	0.0	134		
180 min Winter	13.288	0.0	184		
240 min Winter	10.851	0.0	232		
360 min Winter	8.126	0.0	300		
480 min Winter	6.616	0.0	376		
600 min Winter	5.637	0.0	452		
720 min Winter	4.943	0.0	528		
960 min Winter	4.014	0.0	676		
1440 min Winter	2.989	0.0	958		
2160 min Winter	2.222	0.0	1364		
2880 min Winter	1.799	0.0	1756		
4320 min Winter	1.333	0.0	2500		
5760 min Winter	1.077	0.0	3192		
7200 min Winter	0.914	0.0	3768		
8640 min Winter	0.799	0.0	4360		
10080 min Winter	0.713	0.0	4976		
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The Flint Glass Works 64 Jersey Street Manchester M4 6JW	Gatewen Road Wrexham	
Date 07/06/2019 File 30YR SOAKAWAY.SRCX	Designed by EJD Checked by PG	
Micro Drainage		Source Control 2018.1

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.309	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.844

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)
0 4 0.285	12 16 0.285	24 28 0.284	36 40 0.284				
4 8 0.285	16 20 0.284	28 32 0.284					
8 12 0.285	20 24 0.284	32 36 0.284					

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The Flint Glass Works 64 Jersey Street Manchester M4 6JW	Gatewen Road Wrexham	
Date 07/06/2019 File 30YR SOAKAWAY.SRCX	Designed by EJD Checked by PG	
Micro Drainage Source Control 2018.1		

Model Details

Storage is Online Cover Level (m) 114.000

Cellular Storage Structure

Invert Level (m) 109.000 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.39600 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.39600

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	200.0	200.0	5.200	0.0	437.6
0.400	200.0	222.6	5.600	0.0	437.6
0.800	200.0	245.3	6.000	0.0	437.6
1.200	200.0	267.9	6.400	0.0	437.6
1.600	200.0	290.5	6.800	0.0	437.6
2.000	200.0	313.1	7.200	0.0	437.6
2.400	200.0	335.8	7.600	0.0	437.6
2.800	200.0	358.4	8.000	0.0	437.6
3.200	200.0	381.0	8.400	0.0	437.6
3.600	200.0	403.6	8.800	0.0	437.6
4.000	200.0	426.3	9.200	0.0	437.6
4.400	0.0	437.6	9.600	0.0	437.6
4.800	0.0	437.6	10.000	0.0	437.6

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Appendix F – Infiltration Test Results

OUR REF: A2813/19 18th February 2019

18th February 2019

Eleanor Dale
Scott Hughes Design
64 Jersey St
Manchester
M4 6JW

By Email (edale@scotthughesdesign.co.uk)

Dear Eleanor,

Infiltration Testing Letter Report
Wrexham University, Gatewen Road

Background

A site investigation has been commissioned by Scott Hughes Design on behalf of Wrexham University (the client), to examine ground conditions and soil infiltration rates at land off, Gatewen Road, Wrexham.

Reference

Earth Environmental and Geotechnical Ltd were commissioned by the client to undertake soakaway testing at the site, in accordance with BRE365.

Proposed Development

A proposed development plan was not available at the time of writing this report.

Fieldwork

The investigation comprised the excavation of five trial pits (TP01 to TP05) over the duration of a day, to depths between 1.90m and 2.30m by use of a JCB 3CX. Detailed exploratory hole logs can be found in Appendix A.

Each of the trial pits were used to carry out infiltration testing, with multiple tests carried out in each of pit, where possible.

The soil infiltration rate was calculated using the data collected from each test. The detailed testing results for these are presented in Appendix B with a summary in Table 1.

Sampling locations are shown overleaf in Figure 1.

Ground Conditions

The sequence of strata encountered was as follows:

- TOPSOIL
- CLAY
- SAND & GRAVEL (TP01 & TP05)

Detailed logs of the trial pits are presented in Appendix A.

**CONSULTING
ENGINEERS**

Geotechnical
Environmental
Ecology
Geology
Drainage
Mining

Earth Environmental &
Geotechnical Ltd
Houldsworth Mill Business
& Arts Centre
Houldsworth Street
Stockport
SK5 6DA

Tel: 0161 975 6088

www.earthenvironmental.co.uk
info@earthenvironmental.co.uk

ALSO AT:

Kingsbury House
Kingsbury Square
Melksham
Near Bath
SN12 6HL
Tel: 01225 434237

Albany House
14 Shute End
Wokingham, Berks
RG40 1BJ
Tel: 0845 2508100

Hudson House
8 Albany Street
Edinburgh,
EH1 3QB
Tel: 0131 5641789

Earth Environmental & Geotechnical
Ltd
Registered Office:
Mentor House, Ainsworth Street,
Blackburn, Lancashire, BB1 6AY
Registered in England
No: 8436152

Figure 1 Infiltration Testing Location Plan



Soakaway Testing

Each of the soakaway pits were excavated into natural strata and filled with water from a 9000 litre water bowser.

Due to the slow rate of infiltration observed across the site, the infiltration rates for the four tests; SA1-SA04 were unable to be calculated.

Table 1 below provides a summary of each of the soakaway infiltration rate results.

Table 1 Soakaway Infiltration Rates

Location/Test	Infiltration Rate (m/s)
TP01/SA01	Infiltration too slow to calculate
TP02/SA02	Infiltration too slow to calculate
TP03/SA03	Infiltration too slow to calculate
TP04/SA04	Infiltration too slow to calculate
TP05/SA05	2.22E-04

Conclusions



Based on the results of the field testing, the natural strata are better suited for the installation of soakaway drainage in the area of TP05.

Please do not hesitate to contact me should there be any queries.

Yours sincerely,

Nigel Ramsumair

Operations Manager

For and on behalf of Earth Environmental & Geotechnical Ltd

*Enclosed: Appendix A Exploratory Hole Logs
Appendix B Infiltration Testing Results*



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& GEOTECHNICAL

EARTH ENVIRONMENTAL & GEOTECHNICAL
Houldsworth Mill Business & Arts Centre, Houldsworth Street,
Stockport, SK5 6DA
Tel: 0161 975 6088
Email: info@earthenvironmental.co.uk
Web: www.earthenvironmental.co.uk

TRIAL PIT LOG

Project Name: Wrexham University (Gatewen Road)

Date: 07/01/2019

Project No.: A2813/19

Client: Scott Hughes Design

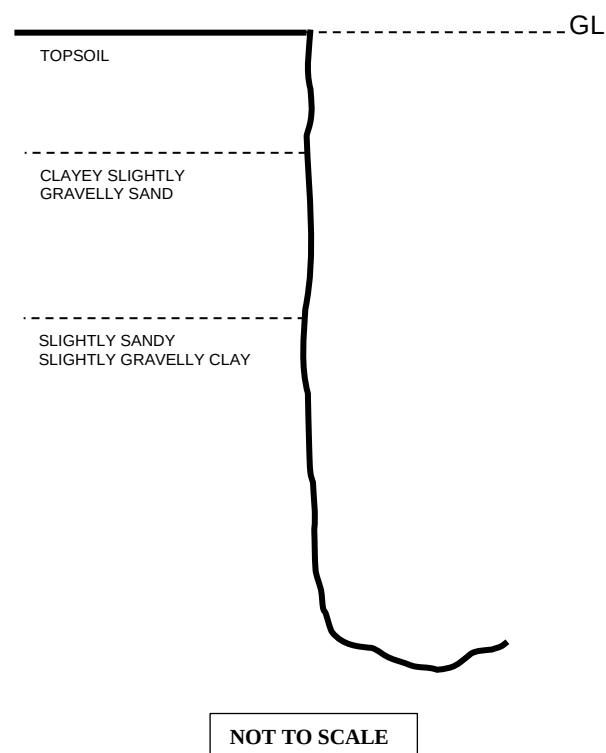
Hole Number: TP01

Logged By: J Cummins

Total Depth: 2.10m

Remarks:

Schematic Profile:



Legend	Depth (m)	Description
	0.00-0.30	Grass over brown clayey fine to coarse SAND. Abundant roots and rootlets. (TOPSOIL)
	0.30-1.40	Orangish brown clayey slightly gravelly fine to coarse SAND. Gravel is fine to coarse of quartz and mudstone.
	1.40-2.10	Soft orangish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse sub rounded of mudstone and quartz.
		Trial pit stable. No groundwater emergence.

Trial pit terminated at 2.10m.

Pictures:



Soakaway Pit 01: Internal view of excavation.



Soakaway Pit 01: Excavation spoil.



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Houldsworth Mill Business & Arts Centre, Houldsworth Street,
Stockport, SK5 6DA

Tel: 0161 975 6088
Email: info@earthenvironmental.co.uk
Web: www.earthenvironmental.co.uk

TRIAL PIT LOG

Project Name: Wrexham University (Gatewen Road)

Date: 07/01/2019

Project No.: A2813/19

Client: Scott Hughes Design

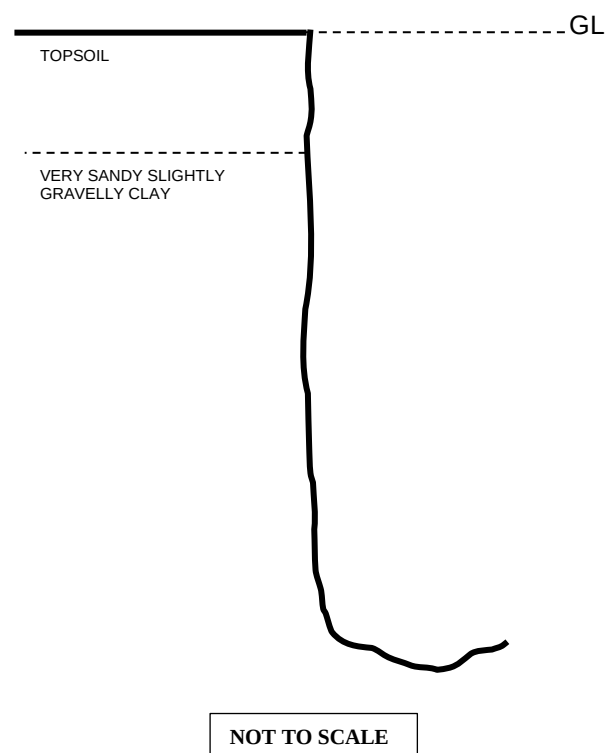
Hole Number: TP02

Logged By: J Cummins

Total Depth: 2.00m

Remarks:

Schematic Profile:



Legend	Depth (m)	Description
	0.00-0.30	Grass over brown clayey fine to coarse SAND. Abundant roots and rootlets. (TOPSOIL)
	0.30-2.00	Stiff orangish brown very sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse sub rounded of sandstone and quartz.
		Trial pit stable. No groundwater emergence.

Trial pit terminated at 2.00m.

Pictures:



Soakaway Pit 02: Internal view of excavation.



Soakaway Pit 02: Excavation spoil.



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Stockport, SK5 6DA

Tel: 0161 975 6088
Email: info@earthenvironmental.co.uk
Web: www.earthenvironmental.co.uk

TRIAL PIT LOG

Project Name: Wrexham University (Gatewen Road)

Date: 07/01/2019

Project No.: A2813/19

Client: Scott Hughes Design

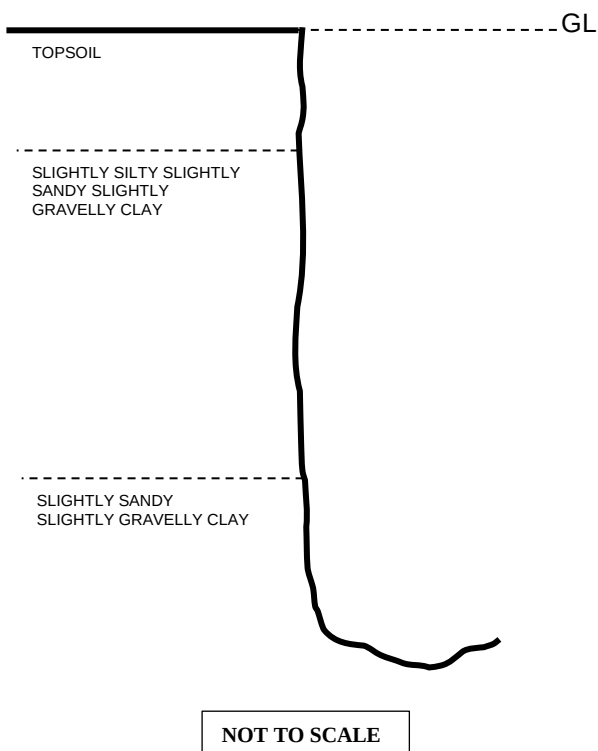
Hole Number: TP03

Logged By: J Cummins

Total Depth: 2.30m

Remarks: Water at base of Trial Pit

Schematic Profile:



Legend	Depth (m)	Description
	0.00-0.30	Grass over brown clayey fine to coarse SAND. Abundant roots and rootlets. (TOPSOIL)
	0.30-1.90	Soft orangish brown slightly silty slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subrounded of quartz and mudstone.
	1.90-2.30	Firm orange slightly sandy slightly gravelly CLAY. Sand is fine to coarse subrounded of mudstone, sandstone and quartz.
		Trial pit stable. Groundwater emergence at base of pit.

Trial pit terminated at 2.30m.

Pictures:



Soakaway Pit 03: Internal view of excavation.



Soakaway Pit 03: Excavation spoil.



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Houldsworth Mill Business & Arts Centre, Houldsworth Street,
Stockport, SK5 6DA

Tel: 0161 975 6088
Email: info@earthenvironmental.co.uk
Web: www.earthenvironmental.co.uk

TRIAL PIT LOG

Project Name: Wrexham University (Gatewen Road)

Date: 07/01/2019

Project No.: A2813/19

Client: Scott Hughes Design

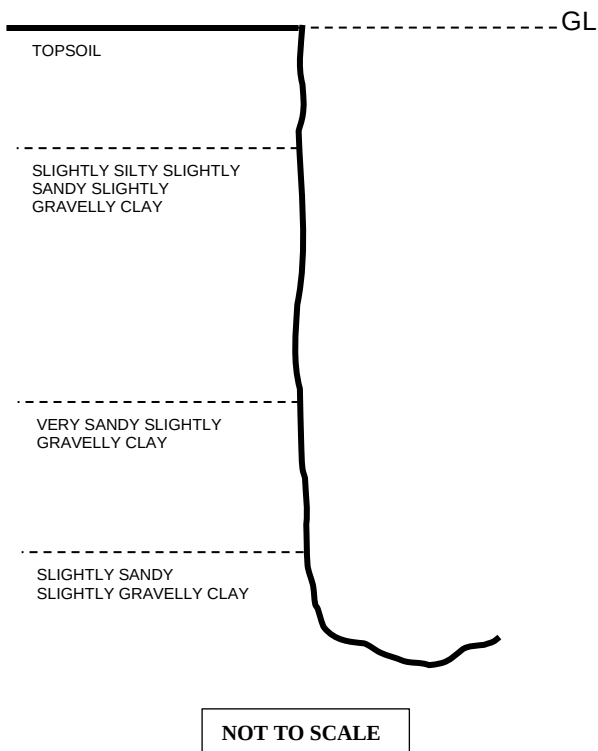
Hole Number: TP04

Logged By: J Cummins

Total Depth: 2.00m

Remarks:

Schematic Profile:



Legend	Depth (m)	Description
	0.00-0.30	Grass over brown clayey fine to coarse SAND. Abundant roots and rootlets. (TOPSOIL)
	0.30-1.10	Soft orangish brown slightly silty slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subrounded of quartz and mudstone.
	1.10-1.60	Firm yellowish brown very sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subrounded of mudstone and sandstone.
	1.60-2.00	Firm orange slightly sandy slightly gravelly CLAY. Sand is fine to coarse subrounded of mudstone, sandstone and quartz.
		Trial pit stable. No groundwater emergence.

Trial pit terminated at 2.00m.

Pictures:



Soakaway Pit 04: Internal view of excavation.



Soakaway Pit 04: Excavation spoil.



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Houldsworth Mill Business & Arts Centre, Houldsworth Street,
Stockport, SK5 6DA
Tel: 0161 975 6088
Email: info@earthenvironmental.co.uk
Web: www.earthenvironmental.co.uk

TRIAL PIT LOG

Project Name: Wrexham University (Gatewen Road)

Date: 07/01/2019

Project No.: A2813/19

Client: Scott Hughes Design

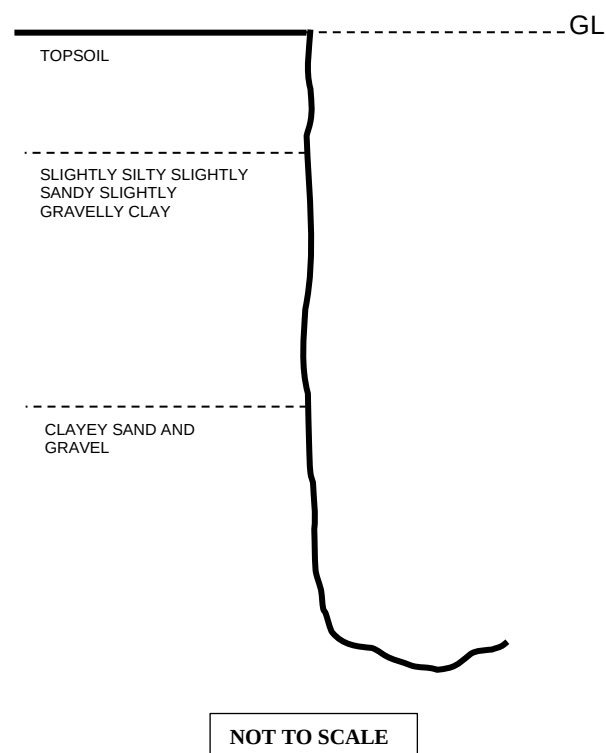
Hole Number: TP05

Logged By: J Cummins

Total Depth: 1.90m

Remarks:

Schematic Profile:



Legend	Depth (m)	Description
	0.00-0.30	Grass over brown clayey fine to coarse SAND. Abundant roots and rootlets. (TOPSOIL)
	0.30-1.10	Soft orangish brown slightly silty slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subrounded of quartz and mudstone.
	1.10-1.90	Orange slightly clayey SAND and GRAVEL. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of mudstone, sandstone, quartz and carbonaceous fragments. Occasional cobbles of quartz and sandstone.
		Trial pit unstable. No groundwater emergence.

Trial pit terminated at 1.90m.

Pictures:



Soakaway Pit 05: Internal view of excavation.



Soakaway Pit 05: Excavation spoil.



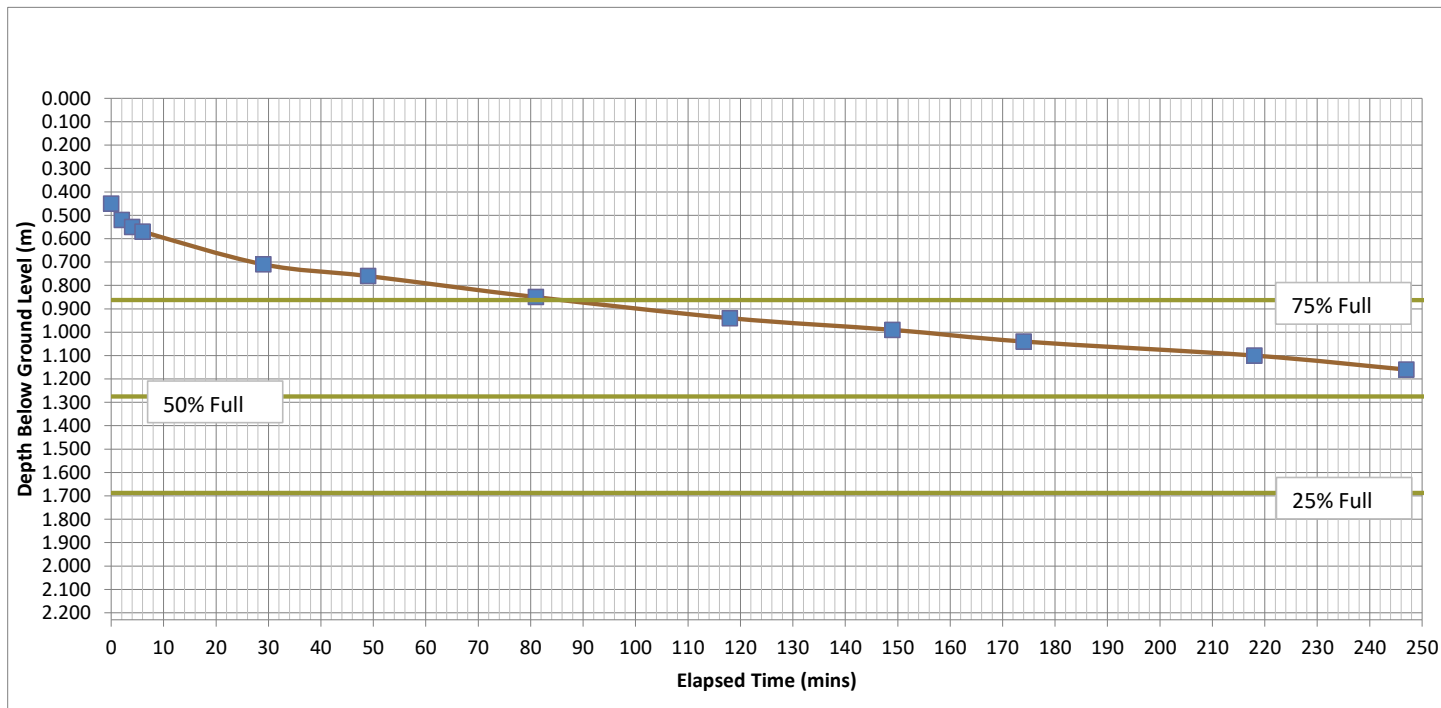
Tel / Fax: 0161 2824518
Web: www.earthenvironmental.co.uk
Email: adam@earthenvironmental.co.uk

(To: BRE 365 1991)

Job No:	A2813
Site:	Wrexham University (Gatewen Road)
Client:	Scott Hughes Design

Location Reference:
Date
Geology in test section
Depth to Base of Hole
Effective Depth
Hole width
Hole length
Depth to water at start of test below ground level
Depth to water at end of test below ground level
Effective storage depth to 75% full
(Depth below GL)
Effective storage depth to 50% full
(Depth below GL)
Effective storage depth to 25% full
(Depth below GL)
Height to 50% depth
Effective Storage Volume V_{p75-25}
Time tp_{25} at which water is 75% of effective depth (minutes)
Time tp_{25} at which water is 25% of effective depth (minutes)
Time for water level to fall between V_{p75-25}
Time for water level to fall between V_{p75-25}
Internal surface area of hole up to 50% depth including base
Soil Infiltration Rate, f

Assumes pit is not filled





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Email: adam@earthenvironmental.co.uk

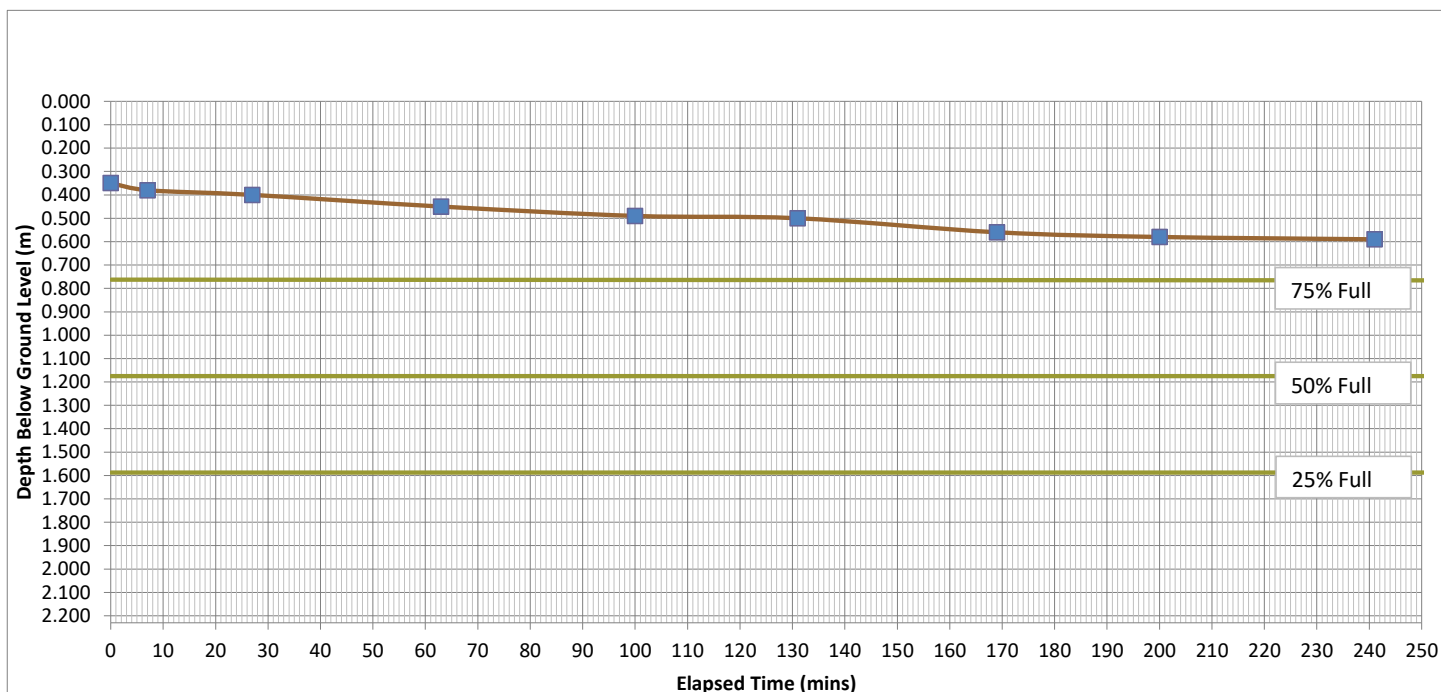
(To: BRE 365 1991)

Job No:	A2813
Site:	Wrexham University (Gatewen Road)
Client:	Scott Hughes Design

[illegible]

Location Reference:	SA02 - Test 1	
Date	07/01/2019	
Geology in test section	Clay	
Depth to Base of Hole	2	m
Effective Depth	1.65	m
Hole width	0.6	m
Hole length	1.7	m
Depth to water at start of test below ground level	0.35	m
Depth to water at end of test below ground level	0.59	m
Effective storage depth to 75% full	1.24	m
(Depth below GL)	0.76	m
Effective storage depth to 50% full	0.83	m
(Depth below GL)	1.18	m
Effective storage depth to 25% full	0.41	m
(Depth below GL)	1.59	m
Height to 50% depth	0.825	m3
Effective Storage Volume Vp75-25	0.84	m3
Time tp25 at whivh water is 75% of effective depth (minutes)	N/A	mins
Time tp25 at whivh water is 25% of effective depth (minutes)	N/A	mins
Time for water level to fall between Vp75 -25	Infiltration too slow to calculate	mins
Time for water level to fall between Vp75 -25	Infiltration too slow to calculate	secs
Internal surface area of hole up to 50% depth including base	4.82	m2
Soil Infiltration Rate, f	Infiltration too slow to calculate	m/s

Assumes pit is not filled





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Email: adam@earthenvironmental.co.uk

(To: BRE 365 1991)

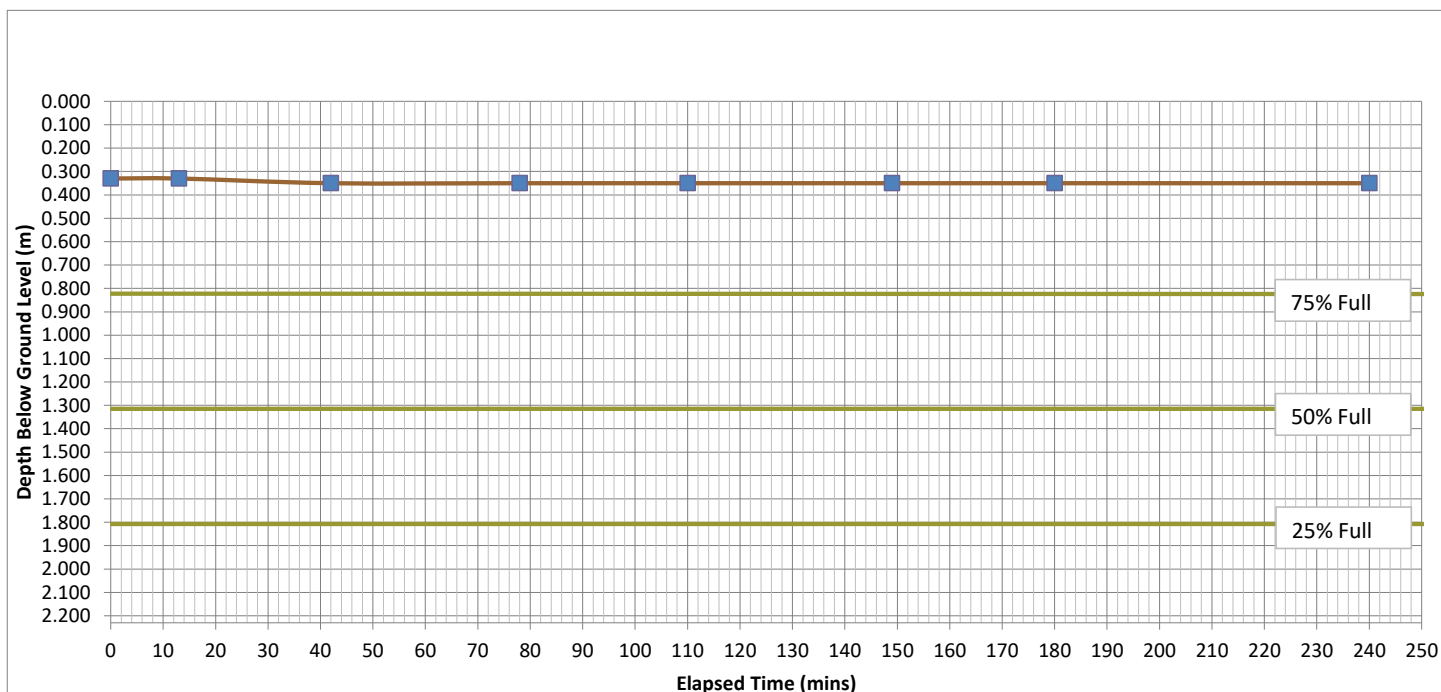
Job No:	A2813
Site:	Wrexham University (Gatewen Road)
Client:	Scott Hughes Design

[illegible]

Location Reference:
Date
Geology in test section
Depth to Base of Hole
Effective Depth
Hole width
Hole length
Depth to water at start of test below ground level
Depth to water at end of test below ground level
Effective storage depth to 75% full
(Depth below GL)
Effective storage depth to 50% full
(Depth below GL)
Effective storage depth to 25% full
(Depth below GL)
Height to 50% depth
Effective Storage Volume Vp75-25
Time tp25 at which water is 75% of effective depth (minutes)
Time tp25 at which water is 25% of effective depth (minutes)
Time for water level to fall between Vp75 -25
Time for water level to fall between Vp75 -25
Internal surface area of hole up to 50% depth including base
Soil Infiltration Rate, f

SA03 - Test 1	
07/01/2019	
Clay	
2.3	m
1.97	m
0.6	m
1.7	m
0.33	m
0.35	m
1.48	m
0.82	m
0.99	m
1.32	m
0.49	m
1.81	m
0.985	m3
1.00	m3
N/A	mins
N/A	mins
Infiltration too slow to calculate	mins
Infiltration too slow to calculate	secs
5.55	m2
Infiltration too slow to calculate	m/s

Assumes pit is not filled





Tel / Fax: 0161 2824518
Web: www.earthenvironmental.co.uk
Email: adam@earthenvironmental.co.uk

(To: BRE 365 1991)

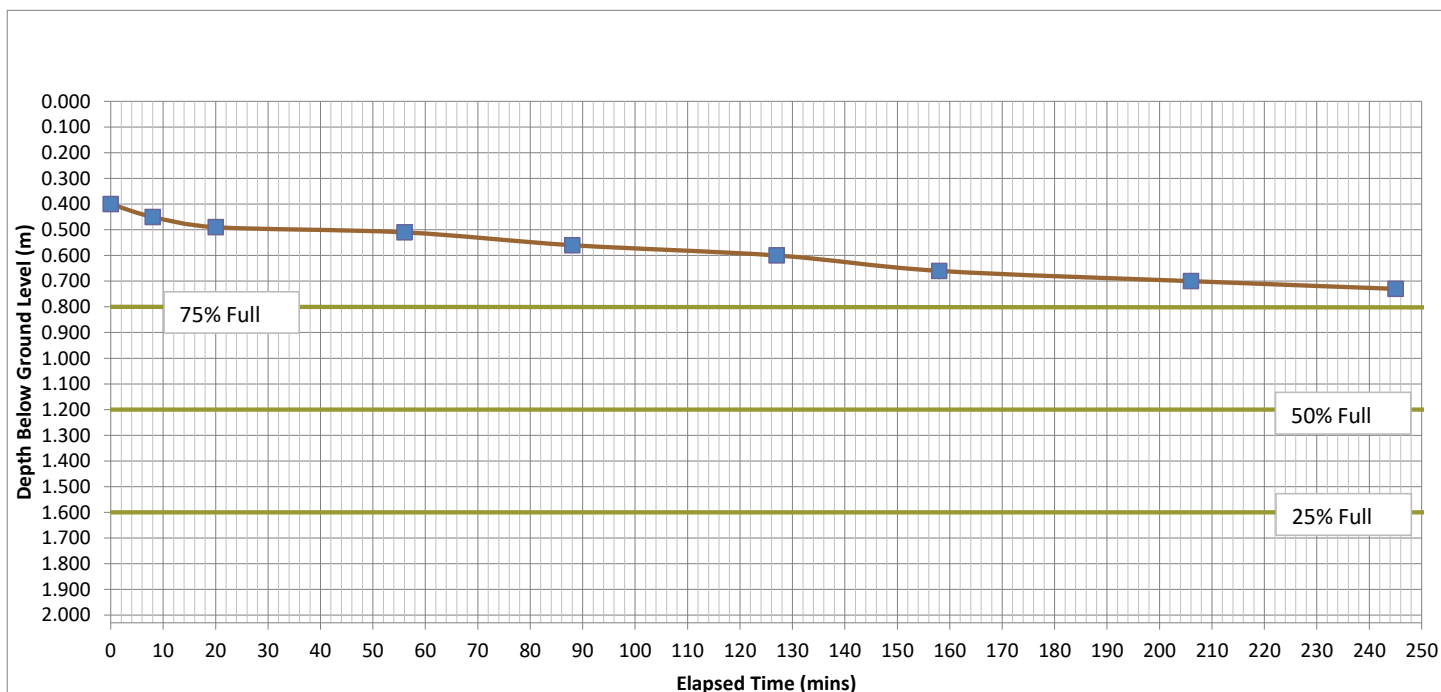
Job No:	A2813
Site:	Wrexham University (Gatewen Road)
Client:	Scott Hughes Design

[illegible]

Location Reference:
Date
Geology in test section
Depth to Base of Hole
Effective Depth
Hole width
Hole length
Depth to water at start of test below ground level
Depth to water at end of test below ground level
Effective storage depth to 75% full
(Depth below GL)
Effective storage depth to 50% full
(Depth below GL)
Effective storage depth to 25% full
(Depth below GL)
Height to 50% depth
Effective Storage Volume Vp75-25
Time tp25 at which water is 75% of effective depth (minutes)
Time tp25 at which water is 25% of effective depth (minutes)
Time for water level to fall between Vp75 -25
Time for water level to fall between Vp75 -25
Internal surface area of hole up to 50% depth including base
Soil Infiltration Rate, f

SA04 - Test 1	
07/01/2019	
Clay	
2.0	m
1.6	m
0.6	m
1.7	m
0.4	m
0.73	m
1.20	m
0.80	m
0.80	m
1.20	m
0.40	m
1.60	m
0.800	m3
0.82	m3
N/A	mins
N/A	mins
Infiltration too slow to calculate	mins
Infiltration too slow to calculate	secs
4.70	m2
Infiltration too slow to calculate	m/s

Assumes pit is not filled





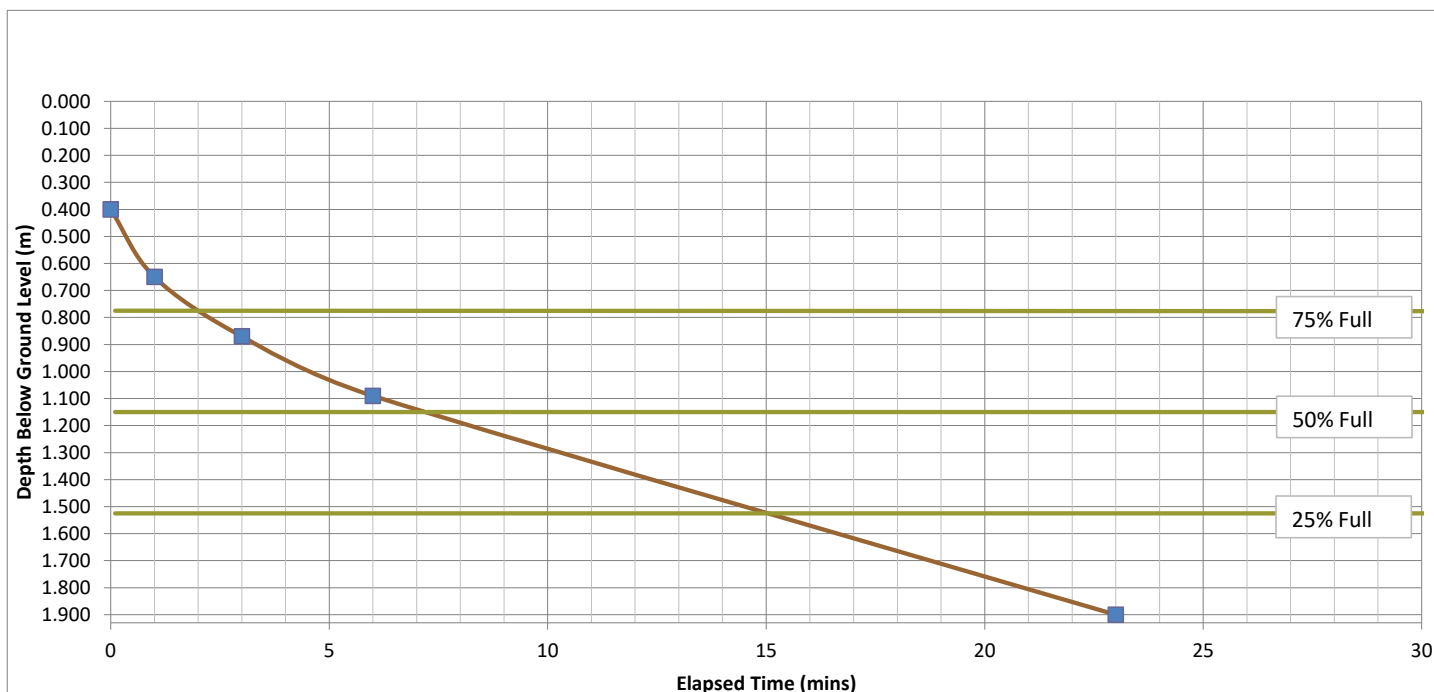
SOAKAWAY TEST

Job No:	A2813
Site:	Wrexham University (Gatewen Road)
Client:	Scott Hughes Design

[illegible]

Location Reference:	SA05 - Test 1	
Date	07/01/2019	
Geology in test section	Clay underlain by Sand & Gravel	
Depth to Base of Hole	1.9	m
Effective Depth	1.5	m
Hole width	0.6	m
Hole length	1.8	m
Depth to water at start of test below ground level	0.4	m
Depth to water at end of test below ground level	1.90	m
Effective storage depth to 75% full	1.13	m
(Depth below GL)	0.78	m
Effective storage depth to 50% full	0.75	m
(Depth below GL)	1.15	m
Effective storage depth to 25% full	0.38	m
(Depth below GL)	1.53	m
Height to 50% depth	0.750	m3
Effective Storage Volume Vp75-25	0.81	m3
Time tp25 at which water is 75% of effective depth (minutes)	2.00	mins
Time tp25 at which water is 25% of effective depth (minutes)	15.00	mins
Time for water level to fall between Vp75 -25	13	mins
Time for water level to fall between Vp75 -25	780	secs
Internal surface area of hole up to 50% depth including base	4.68	m2
Soil Infiltration Rate, f	2.22E-04	m/s

Assumes pit is not filled





SOAKAWAY TEST

Job No:	A2813
Site:	Wrexham University (Gatewen Road)
Client:	Scott Hughes Design

[illegible]

Location Reference:
Date
Geology in test section
Depth to Base of Hole
Effective Depth
Hole width
Hole length
Depth to water at start of test below ground level
Depth to water at end of test below ground level
Effective storage depth to 75% full
(Depth below GL)
Effective storage depth to 50% full
(Depth below GL)
Effective storage depth to 25% full
(Depth below GL)
Height to 50% depth
Effective Storage Volume Vp75-25
Time tp25 at which water is 75% of effective depth (minutes)
Time tp25 at which water is 25% of effective depth (minutes)
Time for water level to fall between Vp75 -25
Time for water level to fall between Vp75 -25
Internal surface area of hole up to 50% depth including base
Soil Infiltration Rate, f

SA05 - Test 3	
07/01/2019	
Clay underlain by Sand & Gravel	
1.9	m
1.5	m
0.6	m
1.8	m
0.4	m
1.90	m
1.13	m
0.78	m
0.75	m
1.15	m
0.38	m
1.53	m
0.750	m3
0.81	m3
6.00	mins
32.00	mins
26	mins
1560	secs
4.68	m2
1.11E-04	m/s

Assumes pit is not filled

