



FLOOD CONSEQUENCES ASSESSMENT
LAND EAST AND WEST OF BOTTOM ROAD,
SUMMERHILL LL11 4TS

PROPOSED RESIDENTIAL DEVELOPMENT

MAY 2017

JOB REFERENCE: 48048

Flood Risk Assessment

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1.0 Introduction

- 1.1 AAH Planning Consultants have been commissioned to provide a Flood Consequences Assessment (FCA) and outline drainage proposals in support of a proposed residential development on a 5.3 hectare plot of land located immediately to the east and west of Bottom Road, Summerhill, grid reference SJ 310 543.
- 1.2 Technical Advice Note 15 (TAN 15) identifies that an FCA report is required for developments in Flood Zones C1 and C2. In areas of Flood Zone B, site levels should be checked against the extreme flood outline for locally occurring watercourses. In Flood Zone A, fluvial/tidal flood risk need not be considered further, but consideration must be given to the consequences of increased runoff.
- 1.3 The site is in an area classified by Natural Resources Wales (NRW) as Flood Zone 1, under the jurisdiction of Wrexham County Borough Council and Welsh Water (Dŵr Cymru), each of whom have been consulted about the proposed development. It should be noted that Tan 15 refers to Flood Zones A, B and C, while the NRW websites refers to flood zones 1, 2 and 3 respectively.
- 1.4 This report concludes that in general terms the flood risk to the site is low and therefore no specific design restrictions should be placed on the development by the Statutory Consultees in this regard. An appraisal of the sustainable surface water drainage hierarchy contained within 'Sewers for Adoption 7th Edition' concludes that all surface water from the development will either be infiltrated in to the ground or discharged to the public sewer at a rate equivalent to that shed from the existing undeveloped site.
- 1.5 During the study, information was sought from:
- Wrexham County Borough Council
 - Natural Resources Wales (NRW)
 - British Geological Survey (BGS)
 - Landmark Envirocheck Report, April 2016

2.0 Existing Site

- 2.1 The site is located to the north of the settlement of Summerhill, and 5.5km northwest of Wrexham, in the administrative area of Wrexham County Borough Council. Access to the site is from Bottom Road and the A550 Mold Road, which lies 500m to the east.
- 2.2 The site is 5.3ha, approximately rectangular in plan, and is bounded to the west, north and south by agricultural land and to the south by the settlement of Summerhill. Farm steads and houses are sporadically positioned along Top and Bottom Roads, extending beyond the housing at Caer Haf and Summer Hill Park which back on to the site. The site is generally pasture land bordered by hedgerow and individual maturing trees. The land to the west extends towards a golf course (Moss Valley Golf Club) and east to the A550.

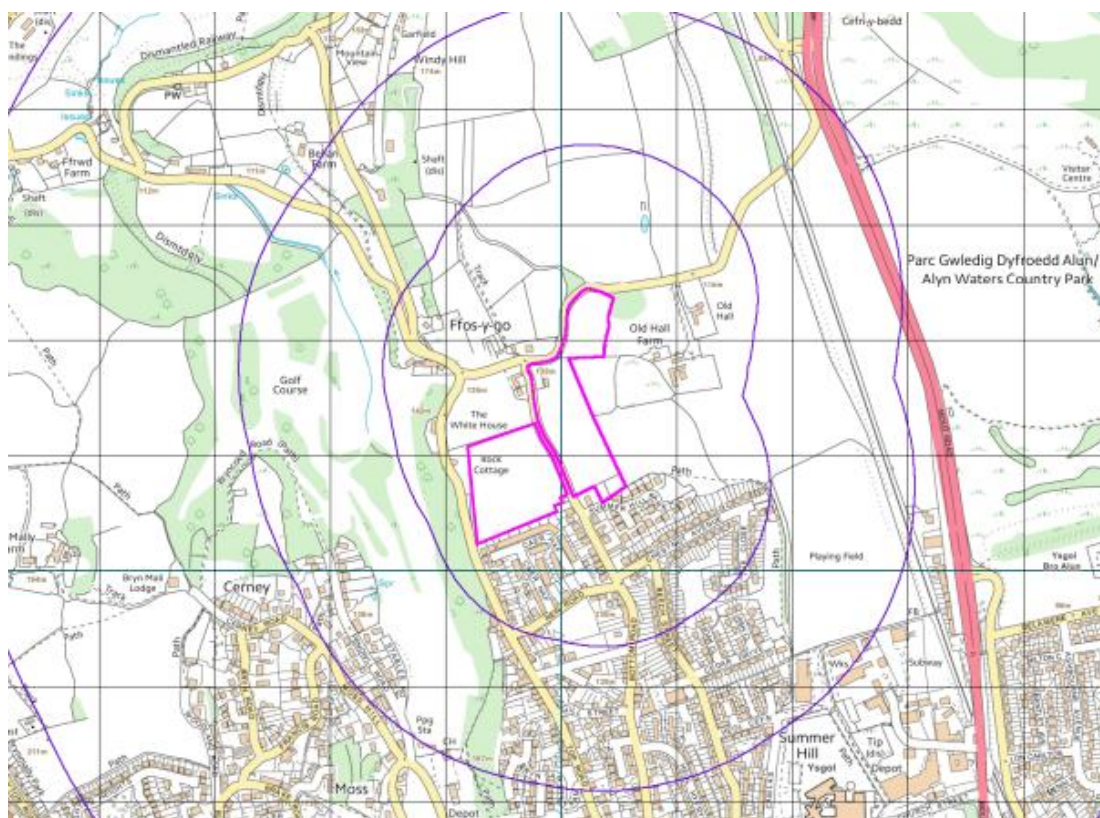


Figure 1 Site Location

- 2.3 There is currently no developed footprint within the area subject to planning consideration, and therefore no formal hardstanding associated with vehicular access, nor is it thought that there is any drainage infrastructure associated with the plot.

- 2.4 At the time of assessment a full topographic survey of the site was unavailable for scrutiny. OS Contour maps indicate that ground levels fall from approximately 140m Above Ordnance Datum (AOD) on Bottom Road to 120m AOD on the eastern site boundary.

3.0 Development Proposal

- 3.1 The site has an area of 5.3 hectares. It is proposed to develop the site to allow for a spacious arrangement with provision for landscaping to ensure that the proposal is in keeping with the existing character of Summerhill.
- 3.2 The proposed housing styles are also not yet fixed, but an appraisal of surrounding housing types would suggest that a mixture of 2, 3, and 4 bedroom two storey dwellings in detached, semi-detached and terrace dwellings would form the basis of the development.
- 3.3 In addition to the built form of each dwelling house, there would be areas of private hardstanding utilised for driveways and pedestrian/patio hardstanding. It is probable that these areas could be constructed from pervious hardstanding materials. Highways within the development would be built to an adoptable standard and in all probability have a traditional construction, thus forming part of the site impermeable/drain catchment area. For the purposes of this assessment it is anticipated that the built development on the site would be approximately 50% of the 5.3 ha developed area which equates to 2.6 ha.
- 3.4 Preference would be for surface water from the development to discharge to soakaways and infiltrate in to the ground, however where this is not possible then it will be necessary for these flows to connect to the public sewer. For sewer connection the calculated greenfield runoff rate will be used as the limiting discharge rate for the surface water sewer network design and attenuation storage estimates.
- 3.5 Large areas of the site which do not form part of the drained catchment would comprise private gardens and open community amenity space. At this stage it is anticipated that there will be some opportunities for the use of soft open Sustainable Drainage Systems (SuDS) on amenity space which would be most likely to comprise the lowest areas to the east of the development.

4.0 Flood Risk Assessment

Fluvial Flooding

- 4.1 Natural Resources Wales (NRW) Development Advice Maps (DAM) are based on the best available information considered sufficient to determine when flood risk issues need to be taken into account in planning future development. Three development advice zones are described on the maps, based on Environment Agency's extreme flood outlines (Zone C) and the British Geological Survey (BGS) drift data (Zone B).
- 4.2 The DAM shows that the site is designated at a strategic level as Flood Zone 1 and is therefore considered to be at a low risk of flooding from rivers and the sea. The annual probability of flooding (APF) to the site from fluvial and tidal flooding is quantified as less than 1 in 1000 years / 0.1%.

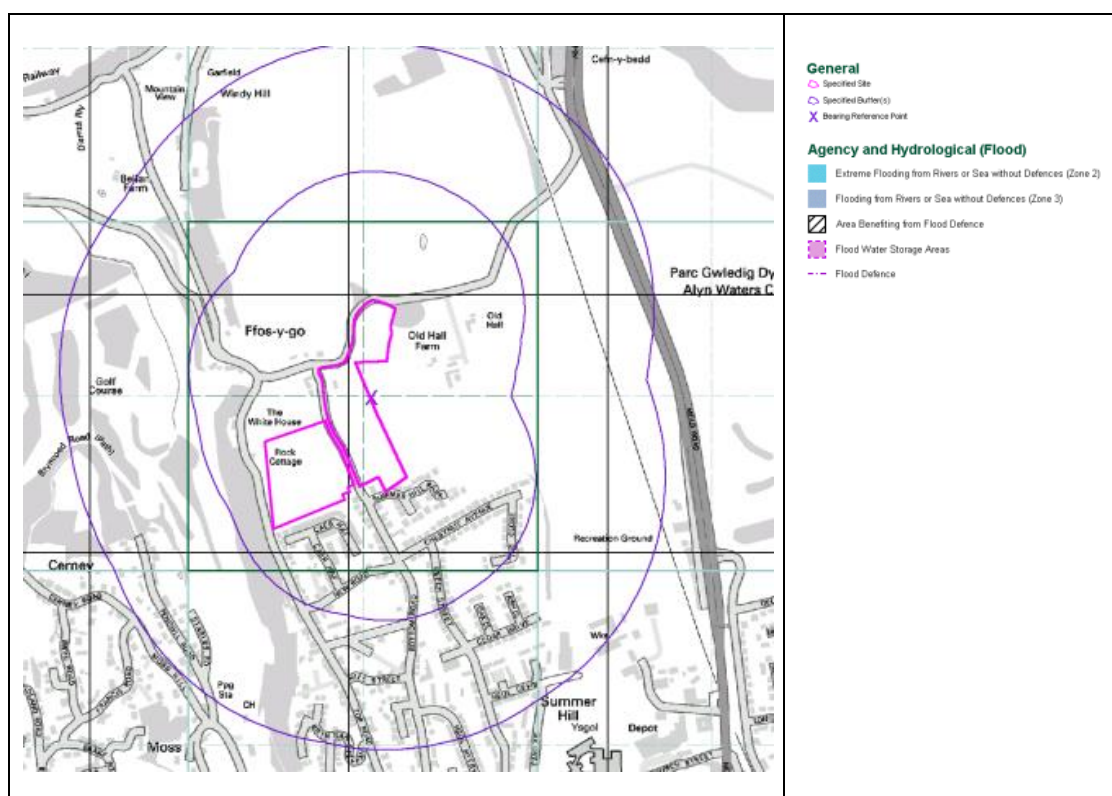


Figure 2 Natural Resources Wales Flood Risk Map

- 4.3 The River Alyn lies 980m to the east and poses no flood risk to the site. There is an additional unnamed tertiary watercourse 270m to the west of the site, which is not thought to pose any flood risk either.

Static/Artificial Watercourse Flood Risk

- 4.4 The NRW 'Risk of Flooding from Reservoirs' map indicates areas where peoples' lives would be in danger as a result of an uncontrolled release of water from a reservoir. In terms of the probability of occurrence, it is acknowledged that reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925 with all large reservoirs inspected and supervised by reservoir panel engineers. In this instance the site lies outside of the 'Risk of Flooding from Reservoirs' area.

Groundwater Flooding

- 4.5 Groundwater flooding is most commonly caused by rainfall which causes the groundwater table beneath a site to rise and to eventually exceed ground level. Groundwater flooding can also occur where the water table is sufficiently close to the site surface that it inundates subterranean development. Like other sources of flooding, groundwater flooding will be affected by increased rainfall attributable to climate change.
- 4.6 A desktop survey of mapped geological records has been undertaken as part of the Flood Risk Assessment process. Evaluation of the British Geological Survey (BGS) Geology of Britain Viewer shows the site has Bedrock of Cefn Rock sandstone, with superficial deposits of Glacial Till. No intrusive investigation has been undertaken for this study, but borehole records suggest (BGS ID: 154884) greyish brown to yellow brown sandy and stony clay to a depth of 2.8m over 0.9m of coarse and fine sandy gravel.
- 4.7 The sloping topography of the site, combined with the relatively small catchment upstream of the site and the free draining subsoils suggest that the groundwater table beneath the site will be relatively deep and stable and will not pose a risk of flooding to the site

Pluvial Flooding

- 4.8 Intense rainfall, particularly in urban areas, can create runoff which temporarily overwhelms the capacity of the local drainage systems. Under these conditions, localised 'flash' flooding can occur. In addition, surface water sewers can flood into foul sewers and overload both the surface water and combined sewer networks. This type of flooding is especially problematic when these systems become overloaded simultaneously.
- 4.9 The NRW flood map for surface water (FMfSW) is divided into areas with a very low, low, medium and high risk of surface water flooding. 'Very low' means that each year this area has a chance of flooding of less than 1 in 1000 (0.1%). 'Low' means that each year this area

has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%), 'Medium' means that each year this area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%) and 'High' means that each year this area has a chance of flooding of greater than 1 in 30 (3.3%).

- 4.10 Due to the low resolution of the FMfSW, it is not possible to accurately describe the extents of the denoted flood outlines in detail. In addition to this, it is also noted that this resource has significant inaccuracies due to the coarse nature of the topographic data upon which it is based. In general terms, the surface water flood map alone should not be used to assess flood risk on an individual site basis but used to consider catchment wide surface water flows (which will also be indicative of catchment wide pluvial flow), the surface water flood map does comprise a useful tool in determining the generalised flood risk to an area.

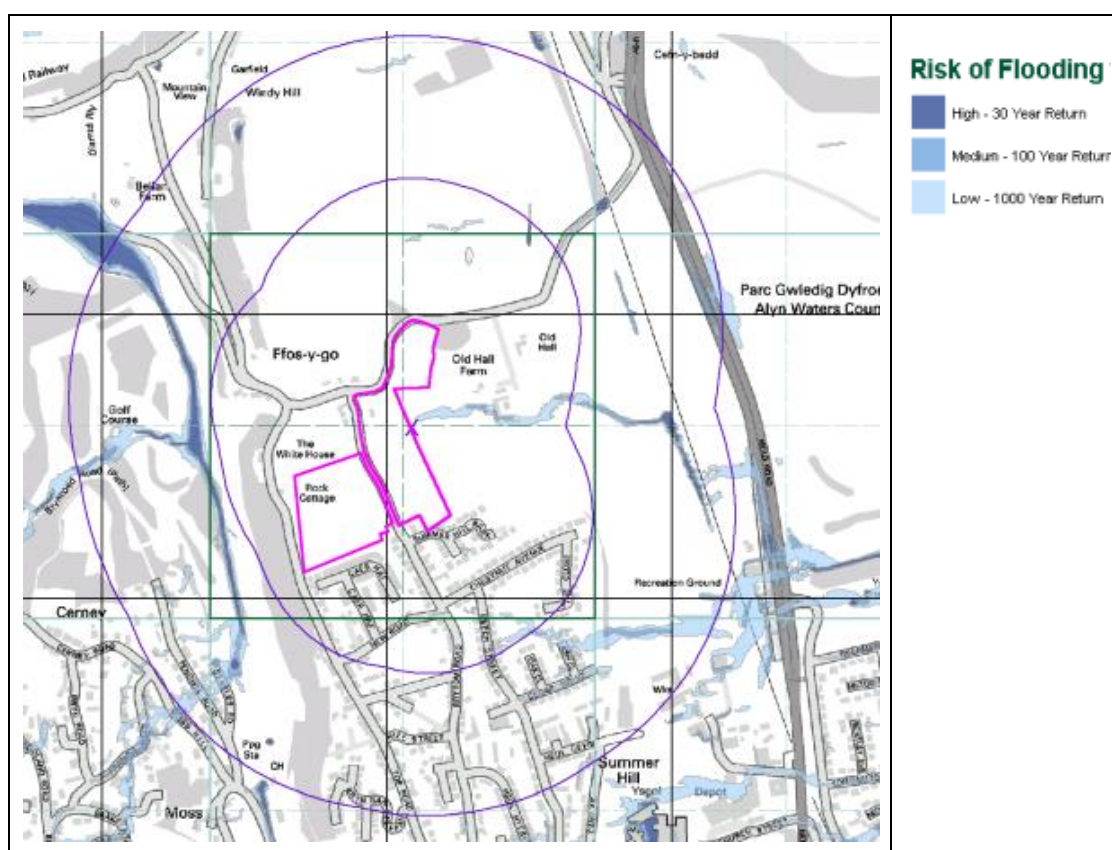


Figure 3 Natural Resources Wales Flood Risk Map for Surface Water

- 4.11 A rough appraisal of the flood map for surface water appears to show the site of the dwellings as being predominantly at a low risk of surface water flooding (1000 year return). The topography of the site suggests that rainfall will be shed to the west. A thin channel of

flood risk approaches the site from the west, but this is not thought to present a constraint to development.

- 4.12 With development of the site the standard percentage of rainfall runoff will increase. Although a comprehensive surface water drainage system will form part of the proposal to reduce and prevent overland flow, it should be noted that failure of such infrastructure could again see greater rates off of the site. Drainage system failure could be attributable to system blockage or following overwhelming rainfall which exceeds the finite design capacity of the system. Drainage system failure should be factored in to the detailed surface water drainage design for the site.
- 4.13 It is advised that the lowest areas are utilised as amenity space, whilst provision should also be made for notional sewer exceedance overland flow routes, perhaps along internal roadways.

5.0 Surface Water Drainage

- 5.1 At this stage the exact footprint of buildings on the site in the pre and post development stages remains unknown; however, it is accepted that there will be a significant increase in built footprint. This means that the sustainable management of surface water from the new dwelling is a fundamental point for consideration by the Lead Local Flood Authority during the planning consultation process.
- 5.2 In accordance with sustainable drainage principles, preference is for source control of runoff, where rainfall is captured at source and prevented from leaving a site by measures such as permeable pavements, rainwater harvesting systems and green roofs. Where rainfall cannot be entirely managed using source control measures the next most sustainable measures are for use of soakaways serving the entire positively drained site catchment, and then for discharge of surface water to a watercourse or public sewer in that order of preference. The use of infiltration techniques will depend upon the outcome of infiltration testing which will be required prior to detailed design.

Source Control - Pervious Pavements

- 5.3 There may be opportunities in the development to use pervious pavements as a means of surface water source control. It is anticipated that private driveways and parking areas will be created alongside and to the rear of the built units. Use of permeable block paving would

be a practical, attractive and sustainable means of surfacing external hardstanding areas and would reduce the footprint of positively drained surfaces within the proposed development.

Soakaways

- 5.4 A desktop survey of mapped geological records has been undertaken as part of the Flood Risk Assessment process. Evaluation of the British Geological Survey (BGS) Geology of Britain Viewer shows the site has Bedrock of Cefn Rock sandstone, with superficial deposits of Devensian Till. The closest borehole record with usable information (BGS ID: 154884) suggests greyish brown to yellow brown sandy and stony clay to a depth of 2.8m over 0.9m of coarse and fine sandy gravel.

Table 1 Borehole Scan			
LOG			
Geological classification	Lithology	Thickness m	Depth m
	Made ground, bricks and slag	0.7	0.7
Boulder Clay	Clay, greyish brown to yellow brown, sandy and stony	2.1	2.8
	Gravel, coarse and fine with well rounded medium sand	0.9	3.7
Coal Measures	Sandstone, dark grey, medium to fine grained, micaceous	1.1 +	4.8

- 5.5 Setting aside the made ground, which is specific to the location of the borehole 210m northeast of the site, the record suggests that infiltration may be viable, and this is supported by the lack of field drains in the vicinity of the site. The clay layer above the sand and gravel is described as having 'noticeable grains of coarse sand lightening to orange brown clay with pebbles' and 'yellow brown pebbly clay, v. broken up'. Beneath this there is a layer of clayey pebbly sand, over shattered rock sandstone. However, before the use of infiltration can be confirmed it will be necessary for onsite percolation testing to be undertaken to determine ground permeability.
- 5.6 Following percolation testing in November 2016, it has been agreed with Welsh Water that this is not a viable option. (see email correspondence in Appendices).

Discharge to a Watercourse/Sewer

- 5.7 As percolation testing has shown that the use of infiltration is not a viable means of surface water drainage then discharge to a watercourse will be the next most sustainable option. As there is no available watercourse (see email correspondence in Appendices), it would be

necessary to connect to the sewer system serving Summerhill Park. At this stage it is anticipated that connection of surface water to the sewer would be technically viable with attenuation to limit outflows to 5l/s, as agreed with Welsh Water (see email correspondence in Appendices).

Preliminary Drainage Proposals

- 5.8 Preliminary assessments of the requirements for storm drainage have been based on the following criteria:

Application Site Area (ha):	2.9		
Impermeable Area (ha):	1.5		
Sewer flood protection:	1 in 30 years		
Fluvial / Development flood protection:	1 in 100 years		
M5-60	18.0mm	SAAR	790
Ratio r	0.33	WRAP	1
Minimum cover to sewers (m):	1.2		
Minimum velocity (m/s):	1.0		
Pipe ks value (mm):	0.6mm		
Allowance for Climate Change:	30%		

Attenuation Storage Requirements

- 5.9 Assuming an impermeable area of 1.5 ha, a permeable area of 1.4 ha and a limiting discharge of 5 l/s, the 1 in 100 year plus 30% climate change storage volume is 862 m³, and the 1 in 30 year storage volume is 437 m³ (supporting calculations can be found in Appendix B).

Development Catchment

Total Developed Area (ha):	2.9
Total Impermeable Area (ha):	1.5
Design Flood	1 in 100 year + 30% CC

Attenuation Storage

Allowable Runoff (l/s)	5
Approx. Storage Volume (m ³):	862

- 5.10 Assuming an operating depth of 1.5m, the dimensions of the attenuation pond will therefore be: 30 * 25 * 1.2 = 900 m³. The surface water discharge from the site will require attenuation

by a flow control structure such as an orifice plate or vortex control device. Storm water storage will discharge to the watercourse to the south of the site. Detailed drainage design will determine the precise arrangement which will be fixed by reserved matters planning application, subject to approval of outline planning consent.

- 5.11 Surface water runoff from roofs, parking bays and the development access road will be collected by a combination of permeable paving areas, linear channels and trapped gullies, discharging into the main surface water sewer within the development road. Roof runoff will be collected by traditional roof guttering and downpipe systems where it will be discharged into the gravity storm system.
- 5.12 Any flood water that occurs as a result of surcharging of manholes within the system will be contained within the road limits by raised kerb edges and driveway entrance levels, where it will be temporarily stored until capacity returns within the drainage system. To mitigate the residual risk of overland flooding the design levels of hard paved and landscaped areas as part of the proposed design of the development will aim to contain and safely direct any flood flows to areas of the site to minimise flood risk and disruption to properties and residents.

Foul water drainage

- 5.13 Following the method outlined in Sewers for Adoption (7th Ed) the design flow rates for dwellings is 4000 l/dwelling per day, so the peak flow from the development of 160 dwellings would be $4000 * 160$ l/d, or 7.4l/s.
- 5.14 The minimum diameters for gravity foul sewers should be 150mm nominal internal diameter for more than ten properties (Sewers for Adoption 7th Ed). To provide a self-cleansing regime within gravity foul sewers, the minimum flow velocity should be 0.75m/sec at one third design flow, with a roughness value (k_s) for foul gravity sewer design of 1.5mm. Where this requirement cannot be met, the criterion would be considered to be satisfied if the 150 dia sewer is laid to a gradient not flatter than 1:150.
- 5.15 Following a foul sewage hydraulic study carried by Welsh Water, it has been confirmed that there is capacity within the sewerage system to connect this development.

6.0 Conclusions

- 6.1 The proposal is for the residential development of a 5.3 ha area of undeveloped land in Summerhill in Wrexham. Due to the nature of the residential land allocations process, the site layout and the number of dwelling houses are not fixed.
- 6.2 The proposed development site is restricted to NRW Flood Zone 1, the low fluvial and tidal flood risk area. Following an appraisal of topographic and geological records, and additional flood mapping resources, the site is also considered to have a low risk of flooding from surface water, sewers, groundwater and reservoirs. The proposed development is classified as 'Highly Vulnerable', and is therefore appropriate within flood zone 1 after completion of a satisfactory Flood Consequences Assessment in accordance with TAN15. The Justification Test should not need to be undertaken as part of this planning application.
- 6.3 Preference would be for infiltration of surface water from the proposed development to the ground via private soakaways or infiltration sustainable drainage measures serving the entire site. Where this is not viable, preference would be for connection to a local watercourse, or public sewer in that order of preference. Following infiltration testing, it has been agreed with Welsh Water that soakaways are not viable and that disposal of surface water runoff should be through connection to the public surface water sewer system within Chestnut Avenue (to the south of the site) at a rate not exceeding 5l/s. Attenuation would be provided with a total storage volume of 1855m³.
- 6.4 At this stage of the planning process it is proposed that a planning condition can be adopted to cover the detailed design of the surface water runoff from the site. It is proposed that the detailed drainage design of the final scheme would be secured by a planning condition attached to any planning permission granted and agreed with the Environment Agency, Welsh Water/Dŵr Cymru and the LPA prior to works commencing. In adopting these principles it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.
- 6.5 The flooding sources will be managed on the site by using a number of mitigation strategies to manage and reduce the overall flood risk at the site and will ensure the development will be safe. It is recommended that all properties are located above the back of the footway of the adjacent carriageway by 150mm to enable the full capacity of any secondary flood conveyance to be utilised. The Surface Water Management Strategy ensures that a

sustainable drainage solution can be achieved which reduces the flood risk posed by the surface water runoff from the site. The development of the layout should always consider that the site is potentially at risk from an extreme event and as such the implementation of flood resilience and resistance methods should be considered. Landscaped areas will include preferential flow paths that convey water away from buildings to mitigate local drainage system failure. Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas. An exceedance or blockage event of the sewers would not affect the proposed property because finished floor levels will be above surrounding ground levels, ensuring any exceedance flooding would not affect the building. Exceedance flows would be contained within the highways surrounding the buildings. The site and surrounding area is located within Flood Zone 1 and Zone A therefore a permanently safe and dry access can be maintained.

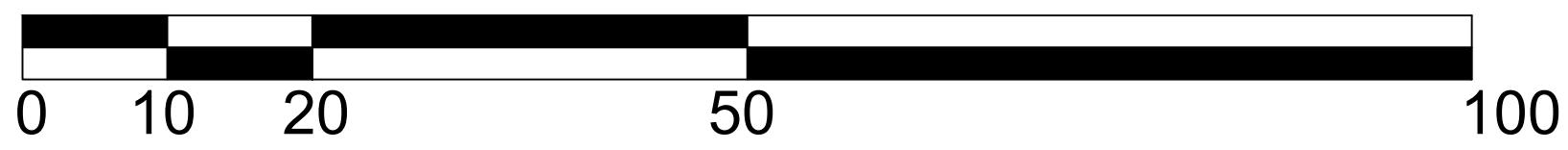
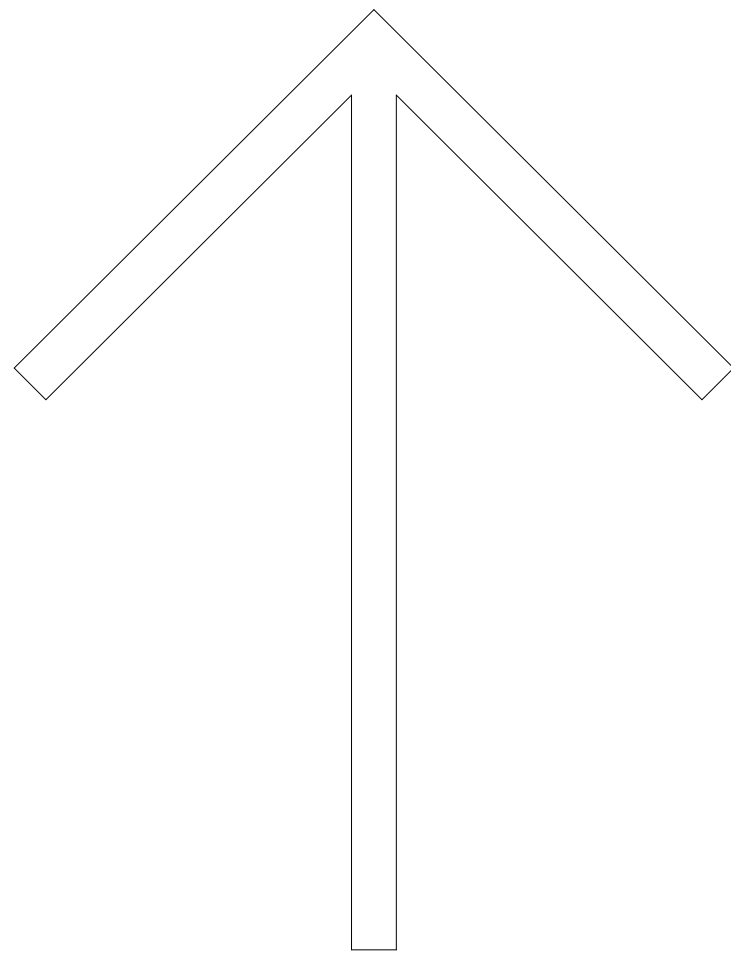
- 6.6 This FCA demonstrates that the site can be operated with minimal risk from flooding and will not increase flood risk elsewhere. The site should not therefore be precluded on the grounds of flood risk.

APPENDIX A

PROPOSED SITE LAYOUT



NORTH



SCALE BAR 1:500

KEY LEGEND

- Site Boundary
- Residential Garden Space
- Pavement
- Public Highway
- Public Open Space
- Trees/Vegetation
- Farm Fields
- Existing Private Curtilage
- Existing Building/Structure
- Proposed Building
- Pedestrian/Cycle Route

Site Area:
2.94 Hectares
7.26 Acres

Total Units:
59 Units

Note:
Please refer to HY Consulting
Access Plans for detailed
annotations.

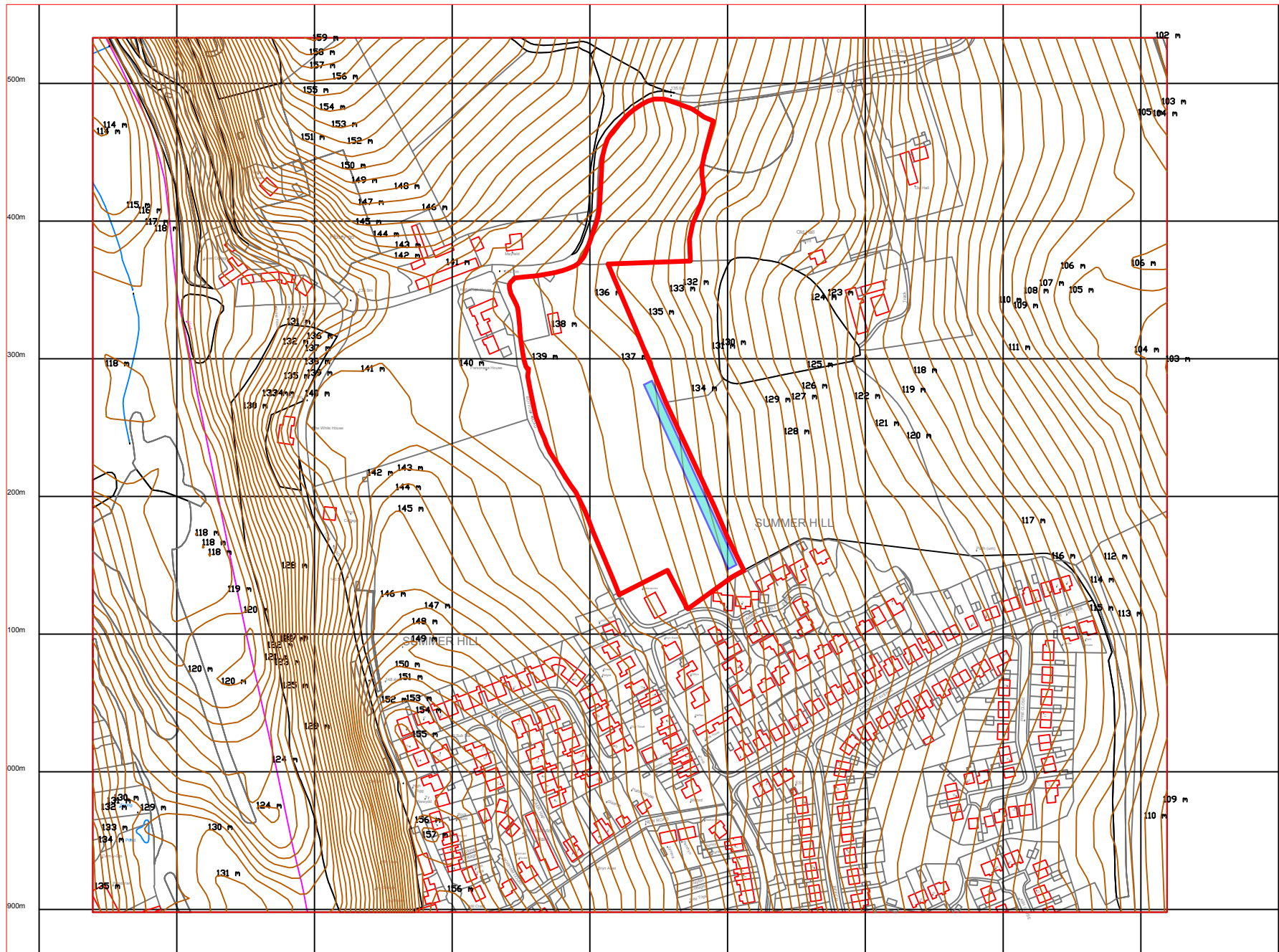


CLIENT: SitePlan UK

PROJECT: Land off Bottom Road, Summerhill, Wrexham

TITLE: Proposed Indicative Site Layout Plan

SCALE: 1:500 AD	DATE: 26/07/2016
DRAWN: RS	CHECKED: TG
CAL020216	04 D



A4 @ 1:100

APPENDIX B

INFILTRATION TEST RESULTS

Our Ref J3675/16/E
8th November 2016

AAH Planning Consultants,
2 Bar Lane,
York,
YO1 6JU

**Environmental
Geotechnical
Specialists**



For the attention of Mr Philip McAteer,

Dear Sir,

Ref: Bottom Road, Summerhill, Wrexham

We thank you for your request to undertake infiltration testing at the above mentioned site and take pleasure in enclosing the results of this work. The investigation was undertaken on the 1st November in accordance with your instruction to proceed. This letter describes the work undertaken, presents the data obtained and discusses the results of the tests.

Fieldworks

A total of six trialpits were excavated in order to undertake soakaway testing. The trialpits were excavated using an JCB 3CX digger at positions and depth determined by the RGS engineer. These positions are indicated on the attached site plan. The exposed soils were logged on site in general accordance with BS5930: 2015, and full descriptions are given on the trialpit records which are attached to this letter along with the soakaway test results.

At the elected test depths, the pit was trimmed and squared as much as practicable. Water was then pumped into the pit and the level monitored at timed intervals relative to a reference bar at ground level. These tests were conducted and calculated in general accordance with the method given by BRE Digest 365.

Once excavations were completed, the trialpit was carefully re-instated with the arisings. Whilst every care was taken during the infilling process, including compacting of the infill at regular intervals with the back acting arm of the excavator, it should be appreciated that some mounding of the surface may have resulted. Moreover, the infilled soils may be subjected to settlement over time, such that a depression in the surface may also occur. Therefore, the locations of any pits undertaken in this investigation should be conveyed to the current site user, as the mounds or depressions associated with the pits may present a risk to any current site operations.

GEOTECHNICAL
ENVIRONMENTAL



Rogers Geotechnical Services Ltd
Office 1 & 2 Barncliffe Business Park,
Near Bank, Shelley, Huddersfield, HD8 8LU

Telephone 0843 50 666 87
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Company No: 5130864

Geology

An examination of the 1: 50 000 scale Geological Survey map of the area¹ indicates that the site is underlain by Till. The map key indicates that this material is generally described as clays and sands with gravel deposited from seasonal and postglacial melt waters

Soakaway Tests

The results obtained from the soakaway tests are appended to this letter and are summarised below:

Table 1: Soakaway Test Results

Location	Soakage Area Dimensions (average) (m)	Test Depth (m)	Soil Description (Base of pit)	Infiltration Rate (m/sec)	Drainage Characteristics
TP1	1.60 x 0.30	1.70	Red mottled grey sandy gravelly CLAY.	n/a	Practically Impermeable
TP2	1.60 x 0.30	1.52	Orangish brown slightly sandy gravelly CLAY.	n/a	Practically Impermeable
TP3	1.80 x 0.30	1.30	Orangish brown gravelly SAND.	4.9×10^{-6} *	Poor/Good
TP4	1.60 x 0.30	1.34	Reddish brown sandy slightly gravelly Clay.	n/a	Practically Impermeable
TP5	1.60 x 0.30	1.30	Reddish brown sandy slightly gravelly CLAY.	1.9×10^{-9} *	Practically Impermeable
TP6	1.60 x 0.30	1.50	Reddish brown sandy slightly gravelly CLAY	n/a	Practically Impermeable

*Figures derived by extrapolation using in house methods.

Soakaway Tests Results

During the soakaway tests the water level did not achieve a fall from 75% to 25% of the effective depth of the storage volume within the trialpits. The tests, therefore, could not be completed within the scope of the method provided in BRE Digest 365 due to the poor soakage rate of the exposed soils.

Discussion

The soils encountered beneath the site were found to be typical of till deposits and comprised an unsorted mix of clay, silt, sand, gravel and cobbles. The soakage rates obtained during the investigation were found to be typical for this material. Although the infiltration rates obtained from position TP3 indicated poor to good drainage characteristics, the soils encountered at this location cannot be said to be

¹ Sheet 121, Solid with Drift, Wrexham.

typical across the entirety of the site and therefore could be considered to be an isolated lens of sands and gravels.

In this instance the recorded infiltration rates suggest that the soils have practically impermeable drainage characteristics. In light of the above, it is suggested that other forms of surface water drainage be considered.

References

Building Research Establishment (BRE) Digest 365, *Soakaway Design*, September 1991.

British Standards Institution (1999) BS5930: *Code of practice for site investigations*, B.S.I., London.

British Standards Institution (2007), Amendment No 1, BS5930: *Code of practice for site investigations*, B.S.I., London.

We trust that this information is of interest and should you have any other requirements do not hesitate to contact us.

For and on behalf of
Rogers Geotechnical Services Ltd,

Jim Irving BSc (Hons) UCL
Geotechnical Engineer



Trial Pit Log

Trialpit No

TP1

Sheet 1 of 1

Project Name: Bottom Road

Project No.
J3675/16/E

Co-ords: -
Level:

Date
01/11/2016

Location: Land off Bottom Lane, Summerhill, Wrexham, LL11 4TS

Dimensions (m):

1.6

Depth
1.70

0.3

Scale
1:50

Logged
JDMI

Client: AAH Planning Consultants.

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30			TOPSOIL. (Dark brown sandy organic CLAY. Abundant rootlets).	
	0.70	B					Firm to stiff orangish red mottled grey CLAY.	1
	1.40	B		1.50			Soft to firm red mottled grey sandy gravelly friable CLAY.	
				1.70			Gravel sub-angular to sub-rounded sub-spherical fine to coarse red sandstone.	2
							End of pit at 1.70 m	
								3
								4
								5
								6
								7
								8
								9
								10

Remarks: Trialpit soakaway.

Stability: Good.





Trial Pit Log

Trialpit No

TP2

Sheet 1 of 1

Project Name: Bottom Road

Project No.
J3675/16/E

Co-ords: -
Level:

Date
01/11/2016

Location: Land off Bottom Lane, Summerhill, Wrexham, LL11 4TS

Dimensions (m):

16

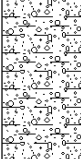
Scale
1:50

Client: AAH Planning Consultants.

Depth
1.52

0.3

Logged
JDMI

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.70	B		0.30			TOPSOIL. (Dark brown sandy organic CLAY. Occasional quarter and whole brick and abundant rootlets).	
	1.40	B		1.52			Firm to stiff light orangish brown mottled grey slightly sandy gravelly CLAY with rare cobbles. Gravel is angular to sub-rounded sub-cubic to rounded fine to coarse sandstone. Cobbles are sub-spherical medium sandstone.	1
							End of pit at 1.52 m	2
								3
								4
								5
								6
								7
								8
								9
								10

Remarks: Trialpit soakaway.

Stability: Good.





Trial Pit Log

Trialpit No

TP3

Sheet 1 of 1

Project Name: Bottom Road

Project No.
J3675/16/E

Co-ords: -
Level:

Date
01/11/2016

Location: Land off Bottom Lane, Summerhill, Wrexham, LL11 4TS

Dimensions
(m):

1.8

Depth
1.30

0.3



Scale
1:50

Logged
JDMI

Client: AAH Planning Consultants.

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.50	B		0.30			TOPSOIL. (Brown sandy organic CLAY. Abundant rootlets).	
	1.00	B					Orangish brown gravelly SAND with cobbles. Gravel is angular to sub-rounded sub-cubic and sub-spherical fine to coarse sandstone and quartz. Cobbles are sub-angular sub-cubic medium sandstone and quartz.	1
				1.30			End of pit at 1.30 m	2
								3
								4
								5
								6
								7
								8
								9
								10

Remarks: Trialpit soakaway.

Stability: Good.





Trial Pit Log

Trialpit No

TP4

Sheet 1 of 1

Project Name: Bottom Road

Project No.
J3675/16/E

Co-ords: -
Level:

Date
01/11/2016

Location: Land off Bottom Lane, Summerhill, Wrexham, LL11 4TS

Dimensions
(m):

1.6

Depth
1.34

0.3

Scale
1:50

Logged
JDMI

Client: AAH Planning Consultants.

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.50	B		0.30			TOPSOIL. (Brown sandy organic CLAY. Frequent rootlets).	
	1.00	B					Firm to stiff reddish brown sandy slightly gravelly friable CLAY with occasional cobbles. Gravel is sub-angular and sub- rounded sub-cubic and sub-spherical fine to coarse sandstone. Cobbles are angular to sub-rounded cubic and sub-spherical sandstone and quartz.	1
				1.34			End of pit at 1.34 m	2
								3
								4
								5
								6
								7
								8
								9
								10

Remarks: Trialpit soakaway.

Stability: Good.





Trial Pit Log

Trialpit No

TP5

Sheet 1 of 1

Project Name: Bottom Road

Project No.
J3675/16/E

Co-ords: -
Level:

Date
01/11/2016

Location: Land off Bottom Lane, Summerhill, Wrexham, LL11 4TS

Dimensions (m):

1.6

Depth
1.30

0.3

Scale
1:50

Logged
JDMI

Client: AAH Planning Consultants.

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30			TOPSOIL. (Brown sandy organic CLAY. Frequent rootlets).	
	0.60	B					Firm to stiff reddish brown sandy slightly gravelly friable CLAY with occasional cobbles. Gravel is sub-angular and sub- rounded sub-cubic and sub-spherical fine to coarse sandstone. Cobbles are angular to sub-rounded cubic and sub-spherical sandstone and quartz.	1
	1.20	B		1.30			End of pit at 1.30 m	2
								3
								4
								5
								6
								7
								8
								9
								10

Remarks: Trialpit soakaway.

Stability: Good.





Trial Pit Log

Trialpit No

TP6

Sheet 1 of 1

Project Name: Bottom Road

Project No.
J3675/16/E

Co-ords: -
Level:

Date
01/11/2016

Location: Land off Bottom Lane, Summerhill, Wrexham, LL11 4TS

Dimensions
(m):

1.6

Depth
1.50

0.3

Scale
1:50

Logged
JDMI

Client: AAH Planning Consultants.

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.60	B		0.30			TOPSOIL. (Brown sandy organic CLAY. Frequent rootlets).	
	1.20	B					Firm to stiff reddish brown sandy slightly gravelly friable CLAY with occasional cobbles. Gravel is sub-angular and sub- rounded sub-cubic and sub-spherical fine to coarse sandstone. Cobbles are angular to sub-rounded cubic and sub-spherical sandstone and quartz.	1
				1.50			End of pit at 1.50 m	2
								3
								4
								5
								6
								7
								8
								9
								10

Remarks: Trialpit soakaway.

Stability: Good.





Plan not to scale and investigation positions approximated from site operative's notes.

Title: **Investigation Location Plan**



Rogers Geotechnical Services Ltd

Site Name:

Bottom Road, Summerhill, Wrexham.

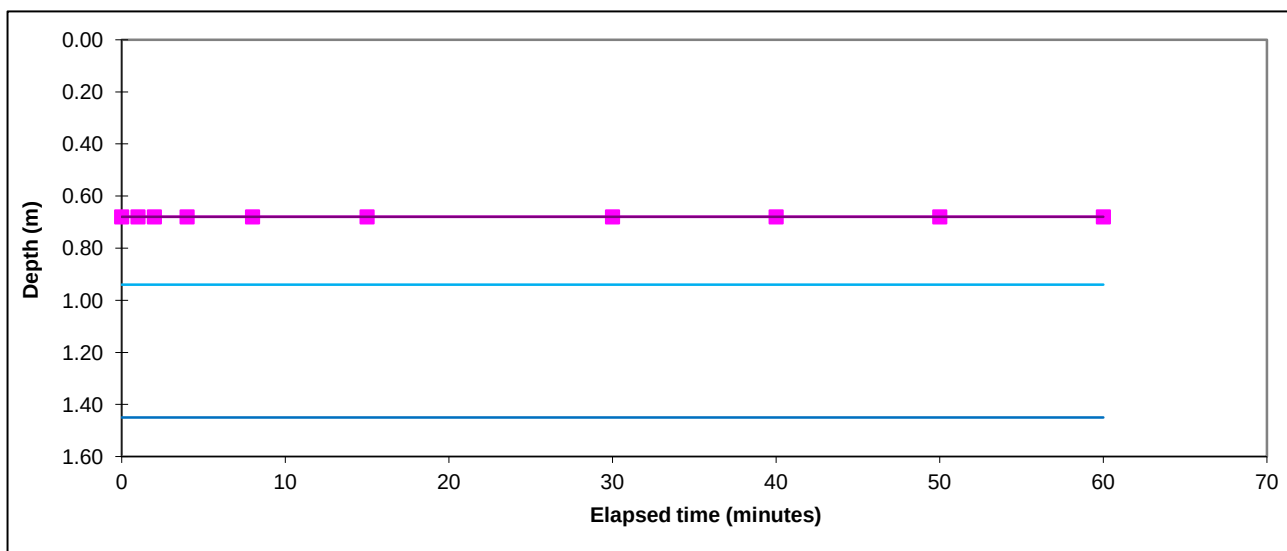
Job No:

J3675/16/E

Rogers Geotechnical Services Ltd

Soakaway Test

Trial Pit No:	TP1	Test No:	1	Date:	01/11/2016
Length (m):	1.600	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.70	Porosity of infill:	1	(assumed)	
	Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)	
	0	0.680			
	1	0.680			
	2	0.680			
	4	0.680			
	8	0.680			
	15	0.680			
	30	0.680			
	40	0.680			
	50	0.680			
	60	0.680			



Start water depth for analysis (mbgl):	0.68		
75% effective depth (mbgl):	0.94	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.19		
25% effective depth (mbgl):	1.45	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.70		

Volume outflow between 75% and 25% effective depth (m³):

Mean surface area of outflow (m²): 2.42

(side area at 50% effective depth + base area)

Time for outflow between 75% and 25% effective depth (mins):

Soil infiltration rate (m/s):	Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.
--------------------------------------	--

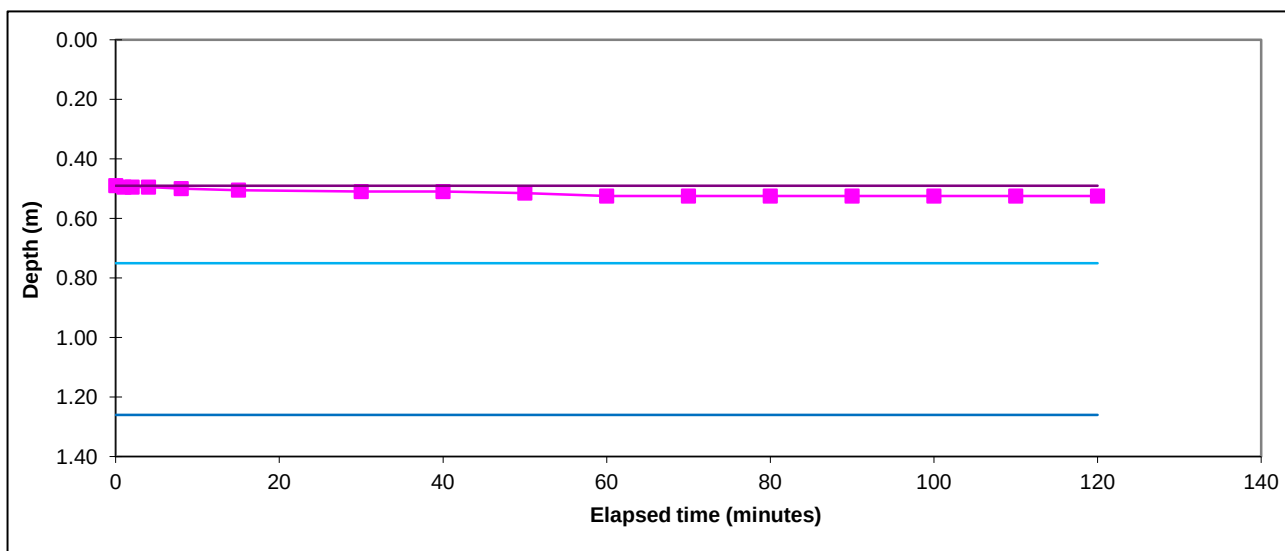
Remarks Results processed following BRE 365 (2007).

Client:	AAH Planning Consultants	Job No:
Site:	Bottom Road	J3675/16/E

Rogers Geotechnical Services Ltd

Soakaway Test

Trial Pit No:	TP2	Test No:	1	Date:	01/11/2016
Length (m):	1.600	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.52	Porosity of infill:	1	(assumed)	
	Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)	
	0	0.490	110	0.525	
	1	0.495	120	0.525	
	2	0.495			
	4	0.495			
	8	0.500			
	15	0.505			
	30	0.510			
	40	0.510			
	50	0.515			
	60	0.525			
	70	0.525			
	80	0.525			
	90	0.525			
	100	0.525			



Start water depth for analysis (mbgl):	0.49		
75% effective depth (mbgl):	0.75	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.01		
25% effective depth (mbgl):	1.26	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.52		

Volume outflow between 75% and 25% effective depth (m³):

Mean surface area of outflow (m²): 2.42

(side area at 50% effective depth + base area)

Time for outflow between 75% and 25% effective depth (mins):

Soil infiltration rate (m/s):	Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.
--------------------------------------	--

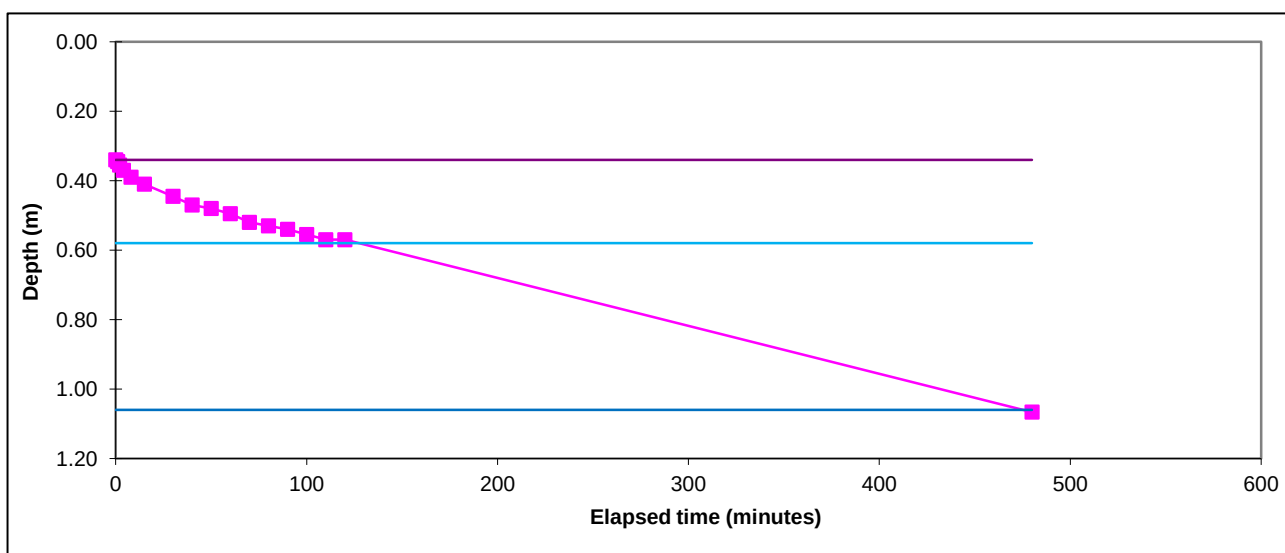
Remarks Results processed following BRE 365 (2007).

Client:	AAH Planning Consultants	Job No:	J3675/16/E
Site:	Bottom Road		

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Soakaway Test

Trial Pit No:	TP3	Test No:	1	Date:	01/11/2016
Length (m):	1.800	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.30	Porosity of infill:	1	(assumed)	
	Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)	
	0	0.340	110	0.570	
	1	0.345	120	0.570	
	2	0.355	480	1.066	
	4	0.370			
	8	0.390			
	15	0.410			
	30	0.445			
	40	0.470			
	50	0.480			
	60	0.495			
	70	0.520			
	80	0.530			
	90	0.540			
	100	0.555			



Start water depth for analysis (mbgl):	0.34		
75% effective depth (mbgl):	0.58	Elapsed time (mins):	127.3
50% effective depth (mbgl):	0.82		
25% effective depth (mbgl):	1.06	Elapsed time (mins):	475.6
Base of soakage zone (mbgl):	1.30		

Volume outflow between 75% and 25% effective depth (m ³):	0.259
Mean surface area of outflow (m ²):	2.56
(side area at 50% effective depth + base area)	
Time for outflow between 75% and 25% effective depth (mins):	348.3

Soil infiltration rate (m/s):	4.9E-6
--------------------------------------	---------------

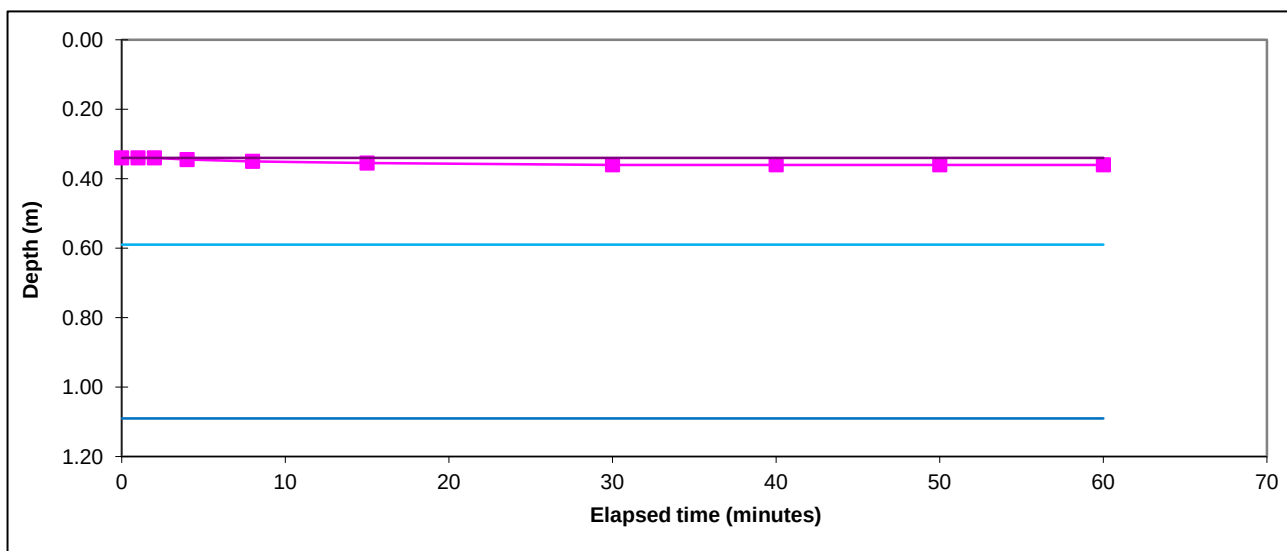
Remarks Results processed following BRE 365 (2007).
Results in italics gained by using in house meathod.

Client:	AAH Planning Consultants	Job No:
Site:	Bottom Road	J3675/16/E

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Soakaway Test

Trial Pit No:	TP4	Test No:	1	Date:	01/11/2016
Length (m):	1.600	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.34	Porosity of infill:	1	(assumed)	
	Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)	
	0	0.340			
	1	0.340			
	2	0.340			
	4	0.345			
	8	0.350			
	15	0.355			
	30	0.360			
	40	0.360			
	50	0.360			
	60	0.360			



Start water depth for analysis (mbgl):	0.34		
75% effective depth (mbgl):	0.59	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	0.84		
25% effective depth (mbgl):	1.09	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.34		

Volume outflow between 75% and 25% effective depth (m³):

Mean surface area of outflow (m²): 2.38

(side area at 50% effective depth + base area)

Time for outflow between 75% and 25% effective depth (mins):

Soil infiltration rate (m/s):	Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.
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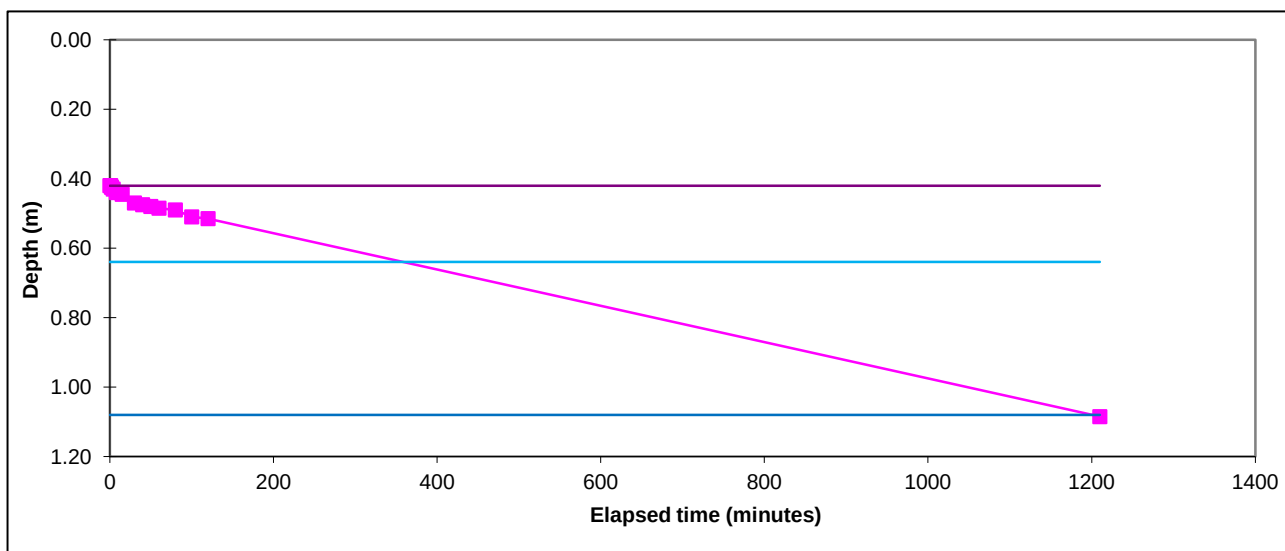
Remarks Results processed following BRE 365 (2007).

Client:	AAH Planning Consultants	Job No:	J3675/16/E
Site:	Bottom Road		

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Soakaway Test

Trial Pit No:	TP5	Test No:	1	Date:	01/11/2016
Length (m):	1.600	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.30	Porosity of infill:	1	(assumed)	
	Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)	
	0	0.420			
	1	0.420	120	0.515	
	2	0.425	<i>1210</i>	<i>1.085</i>	
	4	0.430			
	8	0.440			
	15	0.445			
	30	0.470			
	40	0.475			
	50	0.480			
	60	0.485			
	80	0.490			
	100	0.510			



Start water depth for analysis (mbgl):	0.42		
75% effective depth (mbgl):	0.64	Elapsed time (mins):	359.0
50% effective depth (mbgl):	0.86		
25% effective depth (mbgl):	1.08	Elapsed time (mins):	1200.4
Base of soakage zone (mbgl):	1.30		
Volume outflow between 75% and 25% effective depth (m ³):			0.211
Mean surface area of outflow (m ²):			2.15
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			841.4

Soil infiltration rate (m/s):	1.9E-6
--------------------------------------	---------------

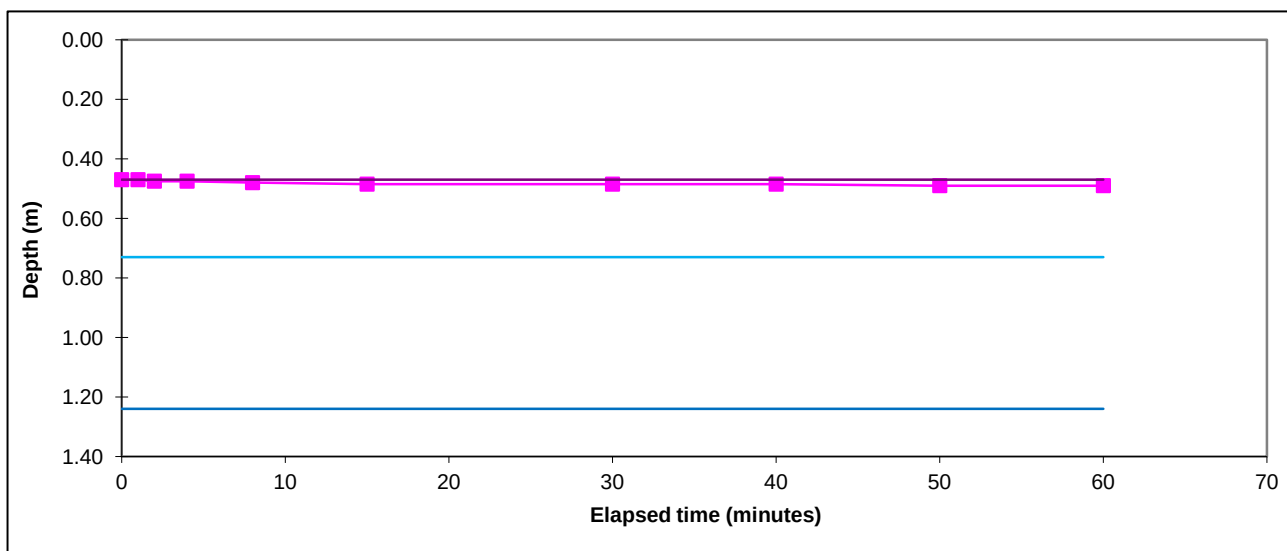
Remarks	Results processed following BRE 365 (2007). Results in italics gained by in house meathod.
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Client:	AAH Planning Consultants	Job No:
Site:	Bottom Road	J3675/16/E

Rogers Geotechnical Services Ltd

Soakaway Test

Trial Pit No:	TP6	Test No:	1	Date:	01/11/2016
Length (m):	1.600	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.50	Porosity of infill:	1	(assumed)	
	Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)	
	0	0.470			
	1	0.470			
	2	0.475			
	4	0.475			
	8	0.480			
	15	0.485			
	30	0.485			
	40	0.485			
	50	0.490			
	60	0.490			



Start water depth for analysis (mbgl):	0.47		
75% effective depth (mbgl):	0.73	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	0.99		
25% effective depth (mbgl):	1.24	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.50		

Volume outflow between 75% and 25% effective depth (m³):

Mean surface area of outflow (m²): 2.42

(side area at 50% effective depth + base area)

Time for outflow between 75% and 25% effective depth (mins):

Soil infiltration rate (m/s):	Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.
--------------------------------------	--

Remarks Results processed following BRE 365 (2007).

Client:	AAH Planning Consultants	Job No:	J3675/16/E
Site:	Bottom Road		

APPENDIX C

HYDRAULIC CALCULATIONS



MasterDrain
SW

AAH Planning Consultants

<http://www.aahplanning.com/>

2 Bar Lane,
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Tel: (01904) 780955
email: admin@aaahplanning.com

Job No. 48048	
Sheet no. 1	
Date 09/06/17	
By PMCA	Checked Reviewed

Project	
Title Peak flow storage calcs for Summerhill	

Data:-

FSR Hydrology:-

Location = Summerhill
M5-60 (mm) = 18
Soil index = 0.15
Return period = 100
UCWI = 84.9

Grid reference = SJ3154
r = 0.33
SAAR (mm/yr) = 790
WRAP = 1
Climate change = 30

- i) Well drained permeable sandy or loam soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts;
- ii) Earthy peat soils drained by dykes and pumps;
- iii) Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys.

Runoff factor (RF) = 33.0, calculated from:-

$$\text{Runoff factor} = (0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$$

where

$$\text{PIMP} = \frac{\text{Impervious Area} \times 100}{(\text{Impervious Area} + \text{Pervious Area})}$$

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 15000 m²
Total area (TA) = 29000 m²
Allowed discharge rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 14000 m²
Equiv area = 9570 m² (TA x RF)
Areal reduction factor = 0.967
Climate change factor = 30

Calculated data:-

Time to max = 868.0 mins
Rainfall at max = 6.69 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 862.1 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 13.00 mm/hr

Calculated storage volume = 807.0 m³
Allowed discharge rate = 5.000 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len	Ovoid	Len	Box culvert	Len
100	109786.6	1125	867.4	400 x 600	4789.4	500 x 500	3448.4
150	48794.0	1200	762.4	600 x 900	2085.4	500 x 750	2298.9
225	21686.2	1275	675.4	800 x 1200	1172.9	500 x 1000	1724.2
300	12198.5	1350	602.4			750 x 1000	1149.5
375	7807.0	1425	540.7			750 x 1200	957.9
450	5421.6	1500	487.9			750 x 1500	766.3
525	3983.2	1575	442.6			1000 x 1000	862.1
600	3049.6	1650	403.3			1000 x 1200	718.4
675	2409.6	1725	369.0			1000 x 1500	574.7
750	1951.8	1800	338.8			1000 x 1800	478.9
825	1613.0	1875	312.3			1000 x 2000	431.0
900	1355.4	1950	288.7			1500 x 1500	383.2
975	1154.9	2025	267.7			1500 x 1800	319.3
1050	995.8	2100	248.9			1500 x 2000	287.4



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Data:-

AAH Planning Consultants

<http://www.aahplanning.com/>

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Job No. 48048		
Sheet no. 2		
Date 09/06/17		
By PMCA	Checked	Reviewed

Project			
Title	Peak flow storage calcs for Summerhill		

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
20	91.0	351.450	6.000	345.450
40	60.0	467.002	12.000	455.002
60	47.0	541.159	18.000	523.159
80	39.0	596.600	24.000	572.600
100	33.0	641.066	30.000	611.066
120	29.0	678.204	36.000	642.204
140	26.0	710.052	42.000	668.052
160	24.0	737.873	48.000	689.873
180	22.0	762.514	54.000	708.514
200	20.0	784.567	60.000	724.567
220	19.0	804.472	66.000	738.472
240	18.0	822.559	72.000	750.559
260	17.0	839.085	78.000	761.085
280	16.0	854.256	84.000	770.256
300	15.0	868.238	90.000	778.238
320	14.0	882.357	96.000	786.357
340	14.0	895.850	102.000	793.850
360	13.0	908.699	108.000	800.699
380	13.0	920.967	114.000	806.967
400	12.0	932.708	120.000	812.708
420	12.0	943.970	126.000	817.970
440	11.0	954.793	132.000	822.793
460	11.0	965.213	138.000	827.213
480	11.0	975.261	144.000	831.261
500	10.0	984.966	150.000	834.966
520	10.0	994.350	156.000	838.350
540	10.0	1003.438	162.000	841.438
560	9.0	1012.247	168.000	844.247
580	9.0	1020.796	174.000	846.796
600	9.0	1029.102	180.000	849.102
620	9.0	1037.178	186.000	851.178
640	8.0	1045.038	192.000	853.038
660	8.0	1052.694	198.000	854.694
680	8.0	1060.157	204.000	856.157
700	8.0	1067.438	210.000	857.438
720	8.0	1074.544	216.000	858.544
740	8.0	1081.487	222.000	859.487
760	7.0	1088.272	228.000	860.272
780	7.0	1094.909	234.000	860.909
800	7.0	1101.402	240.000	861.402
820	7.0	1107.760	246.000	861.760
840	7.0	1113.988	252.000	861.988
860	7.0	1120.092	258.000	862.092
880	7.0	1126.076	264.000	862.076
900	7.0	1131.945	270.000	861.945
920	6.0	1137.705	276.000	861.705
940	6.0	1143.360	282.000	861.360
960	6.0	1148.913	288.000	860.913
980	6.0	1154.368	294.000	860.368
1000	6.0	1159.730	300.000	859.730
1020	6.0	1165.000	306.000	859.000
1040	6.0	1170.183	312.000	858.183
1060	6.0	1175.282	318.000	857.282
1080	6.0	1180.299	324.000	856.299
1100	6.0	1185.238	330.000	855.238
1120	5.0	1190.100	336.000	854.100
1140	5.0	1194.889	342.000	852.889
1160	5.0	1199.606	348.000	851.606
1180	5.0	1204.254	354.000	850.254
1200	5.0	1208.835	360.000	848.835

Storage volume (m³) = 862.1 m³



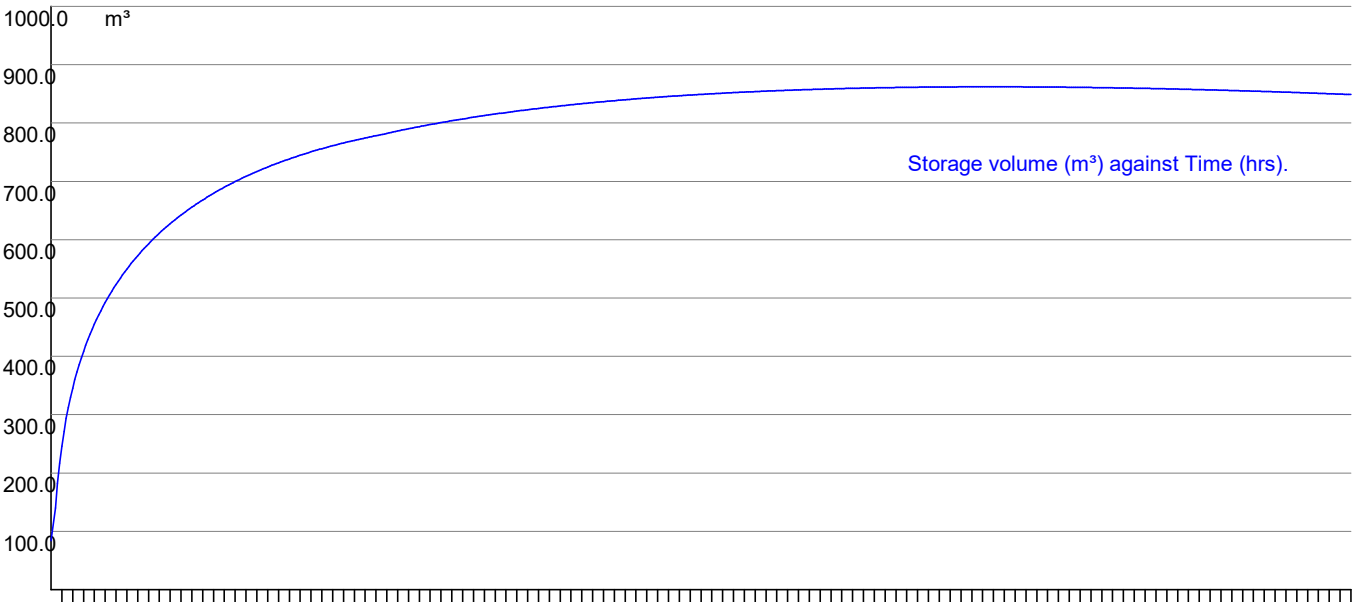
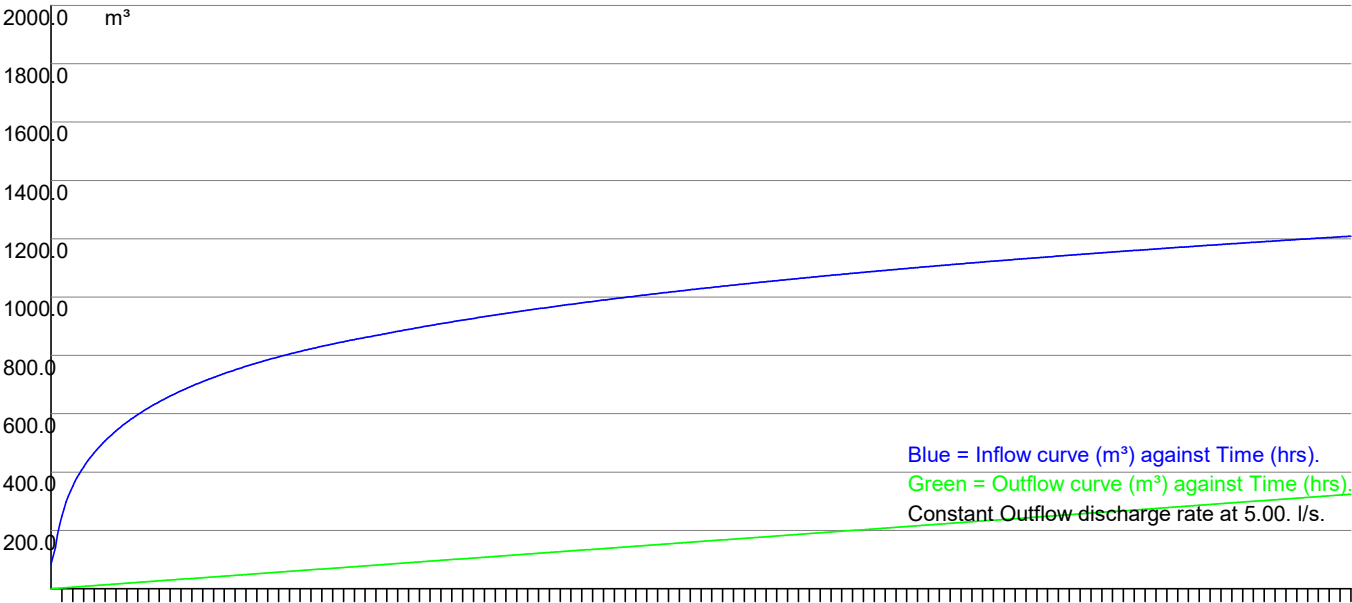
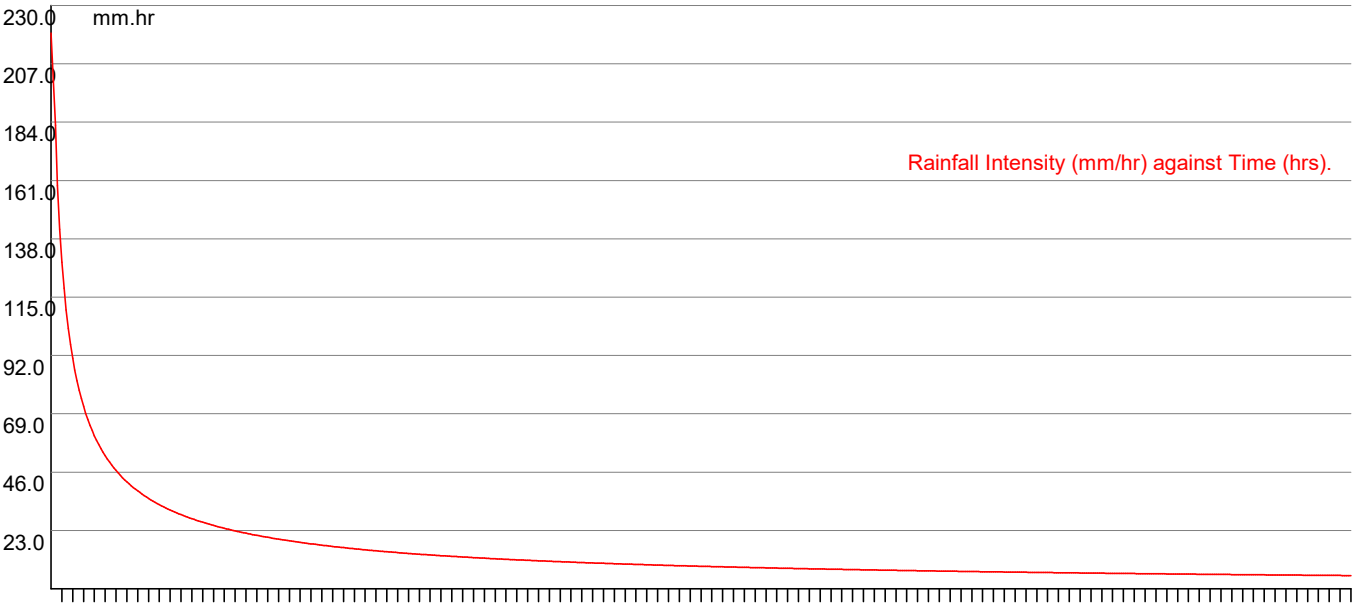
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Job No. 48048		
Sheet no. 3		
Date 09/06/17		
By PMCA	Checked	Reviewed

Project
Title **Peak flow storage calcs for Summerhill**





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Job No. 48048		
Sheet no. 4		
Date 09/06/17		
By PMCA	Checked	Reviewed

Project	By PMCA	Checked	Reviewed
Title Peak flow storage calcs for Summerhill			

Explanatory notes for Peak Flow Storage

- 1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
- 2) The balance is calculated from the inflow minus the outflow.
- 3) The storage volume is the maximum value of the balance curve.
- 4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
- 5) References to 'storm duration' relate only to the hydrograph method (qv).
- 6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

- 1) The user has the choice of Summer or Winter curves
- 2) The mean intensity varies with the duration of the storm curve
- 3) There are always 120 steps in the calculation process, irrespective of storm duration.
- 4) The balance is calculated from the inflow minus the outflow.
- 5) The storage volume is the sum of the balance values for each step.
- 6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.



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Job No.	48048		
Sheet no.	1		
Date	09/06/17		
By	PMCA	Checked	Reviewed

Project	
Title	Peak flow storage calcs for Summerhill

Data:-

FSR Hydrology:-

Location = Summerhill
M5-60 (mm) = 18
Soil index = 0.15
Return period = 30
UCWI = 84.9

Grid reference = SJ3154
r = 0.33
SAAR (mm/yr) = 790
WRAP = 1
Climate change = 0

- i) Well drained permeable sandy or loam soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts;
- ii) Earthy peat soils drained by dykes and pumps;
- iii) Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys.

Runoff factor (RF) = 33.0, calculated from:-

$$\text{Runoff factor} = (0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$$

where

PIMP = Impervious Area*100/(Impervious Area+Pervious Area)

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 15000 m²
Total area (TA) = 29000 m²
Allowed discharge rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 14000 m²
Equiv area = 9570 m² (TA x RF).
Areal reduction factor = 0.967
Climate change factor = 0

Calculated data:-

Time to max = 510.0 mins
Rainfall at max = 5.98 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 437.0 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 7.00 mm/hr

Calculated storage volume = 432.3 m³
Allowed discharge rate = 5.000 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len	Ovoid	Len	Box culvert	Len
100	55649.9	1125	439.7	400 x 600	2427.7	500 x 500	1748.0
150	24733.3	1200	386.5	600 x 900	1057.1	500 x 750	1165.3
225	10992.6	1275	342.3	800 x 1200	594.5	500 x 1000	874.0
300	6183.3	1350	305.3			750 x 1000	582.7
375	3957.3	1425	274.1			750 x 1200	485.5
450	2748.1	1500	247.3			750 x 1500	388.4
525	2019.0	1575	224.3			1000 x 1000	437.0
600	1545.8	1650	204.4			1000 x 1200	364.2
675	1221.4	1725	187.0			1000 x 1500	291.3
750	989.3	1800	171.8			1000 x 1800	242.8
825	817.6	1875	158.3			1000 x 2000	218.5
900	687.0	1950	146.4			1500 x 1500	194.2
975	585.4	2025	135.7			1500 x 1800	161.8
1050	504.8	2100	126.2			1500 x 2000	145.7



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Data:-

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Job No. 48048		
Sheet no. 2		
Date 09/06/17		
By PMCA	Checked	Reviewed

Project	By PMCA	Checked	Reviewed
Title Peak flow storage calcs for Summerhill			

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
20	54.0	208.655	6.000	202.655
40	36.0	274.720	12.000	262.720
60	27.0	317.170	18.000	299.170
80	23.0	349.096	24.000	325.096
100	19.0	374.903	30.000	344.903
120	17.0	396.649	36.000	360.649
140	15.0	415.476	42.000	373.476
160	14.0	432.088	48.000	384.088
180	13.0	446.954	54.000	392.954
200	12.0	460.403	60.000	400.403
220	11.0	472.675	66.000	406.675
240	10.0	483.953	72.000	411.953
260	10.0	494.378	78.000	416.378
280	9.0	504.061	84.000	420.061
300	9.0	513.094	90.000	423.094
320	8.0	521.981	96.000	425.981
340	8.0	530.468	102.000	428.468
360	8.0	538.566	108.000	430.566
380	7.0	546.313	114.000	432.313
400	7.0	553.741	120.000	433.741
420	7.0	560.879	126.000	434.879
440	7.0	567.751	132.000	435.751
460	6.0	574.377	138.000	436.377
480	6.0	580.778	144.000	436.778
500	6.0	586.969	150.000	436.969
520	6.0	592.965	156.000	436.965
540	6.0	598.780	162.000	436.780
560	6.0	604.426	168.000	436.426
580	5.0	609.912	174.000	435.912
600	5.0	615.249	180.000	435.249
620	5.0	620.445	186.000	434.445
640	5.0	625.509	192.000	433.509
660	5.0	630.448	198.000	432.448
680	5.0	635.268	204.000	431.268
700	5.0	639.976	210.000	429.976
720	5.0	644.577	216.000	428.577
740	5.0	649.076	222.000	427.076
760	4.0	653.479	228.000	425.479
780	4.0	657.791	234.000	423.791
800	4.0	662.014	240.000	422.014
820	4.0	666.153	246.000	420.153
840	4.0	670.211	252.000	418.211
860	4.0	674.193	258.000	416.193
880	4.0	678.101	264.000	414.101
900	4.0	681.938	270.000	411.938
920	4.0	685.707	276.000	409.707
940	4.0	689.410	282.000	407.410
960	4.0	693.050	288.000	405.050
980	4.0	696.630	294.000	402.630
1000	4.0	700.151	300.000	400.151
1020	4.0	703.616	306.000	397.616
1040	4.0	707.026	312.000	395.026
1060	3.0	710.384	318.000	392.384
1080	3.0	713.691	324.000	389.691
1100	3.0	716.949	330.000	386.949
1120	3.0	720.159	336.000	384.159
1140	3.0	723.323	342.000	381.323
1160	3.0	726.443	348.000	378.443
1180	3.0	729.519	354.000	375.519
1200	3.0	732.553	360.000	372.553

Storage volume (m³) = 437.0 m³



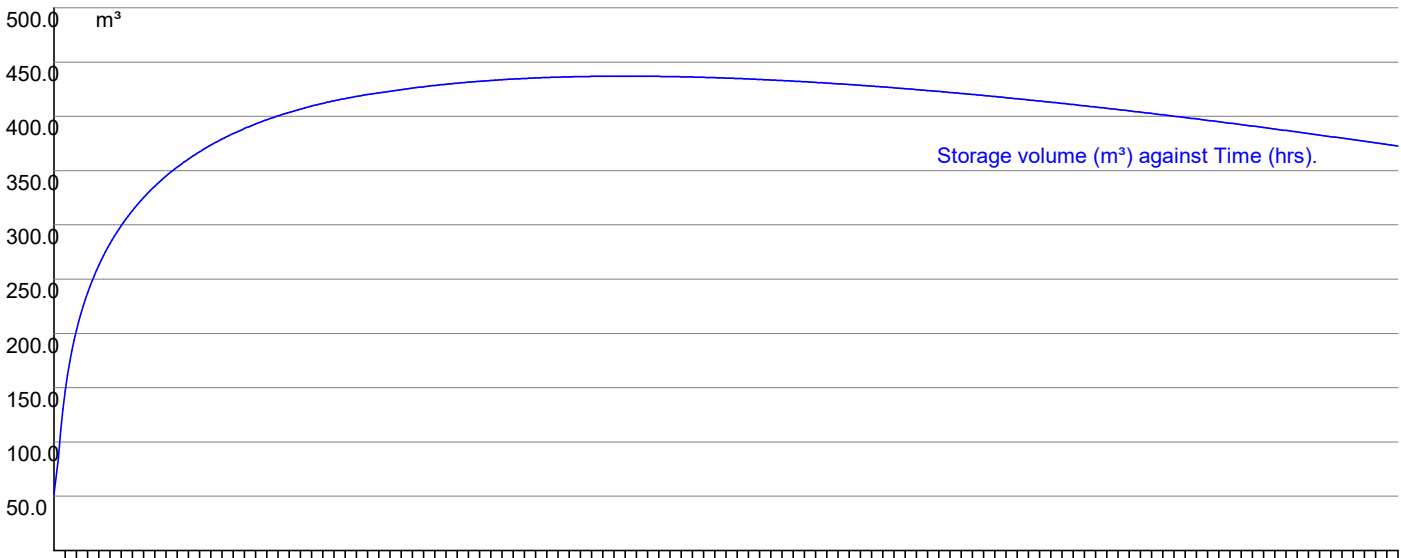
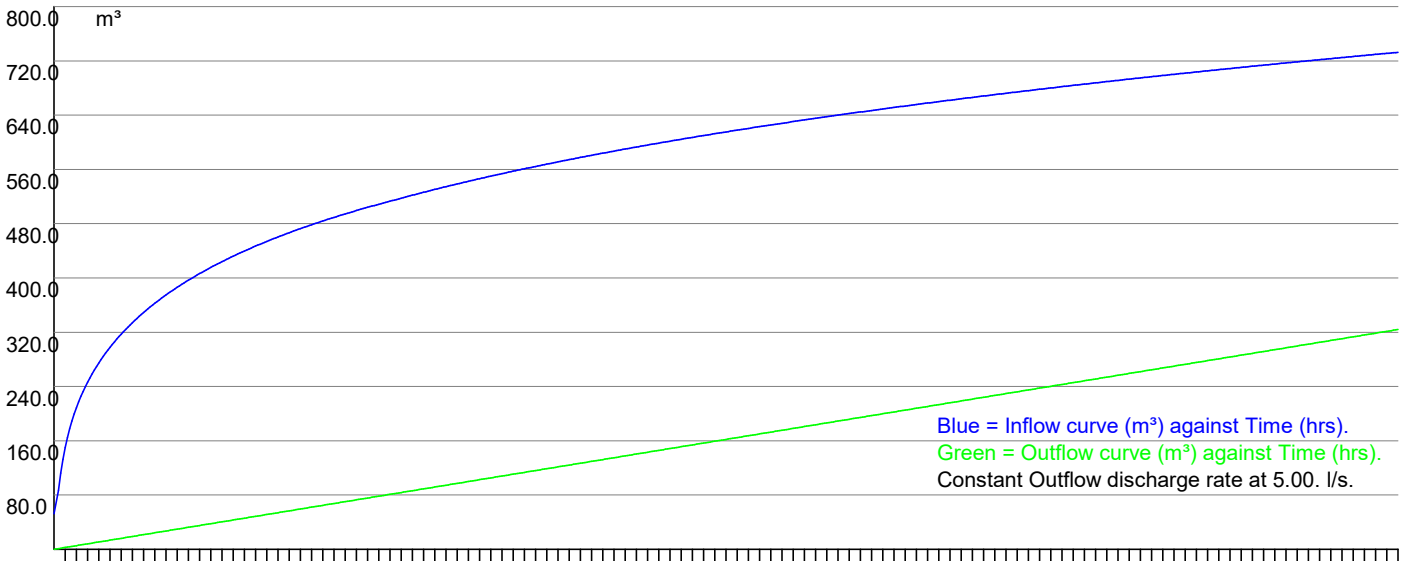
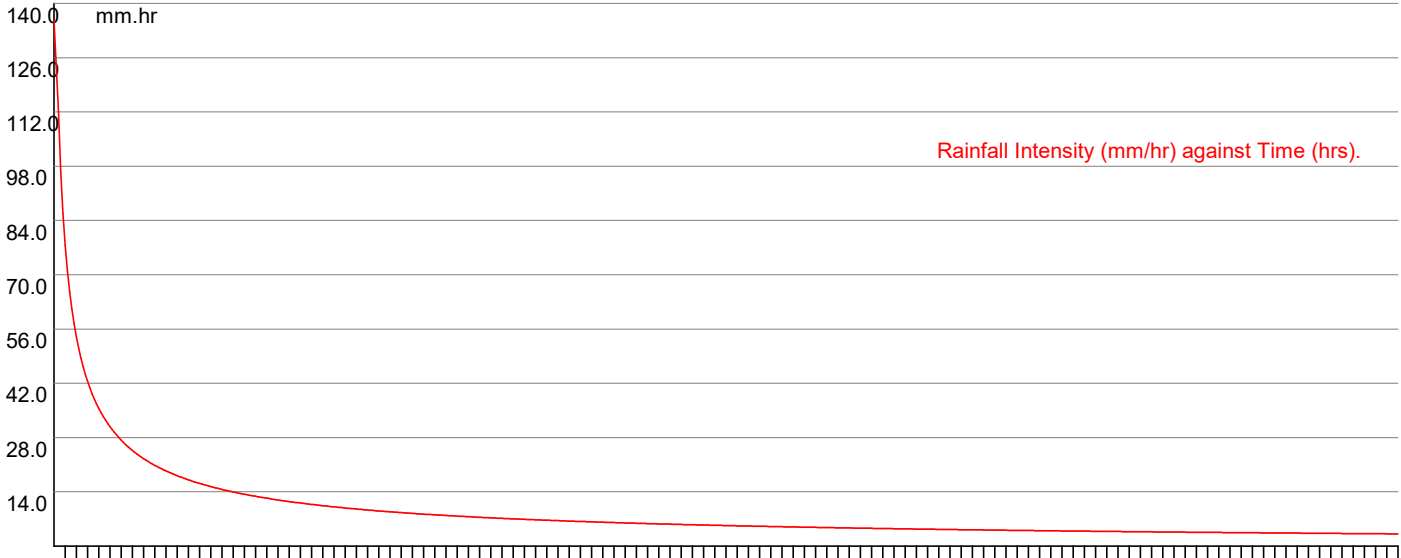
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Job No. 48048		
Sheet no. 3		
Date 09/06/17		
By PMCA	Checked	Reviewed

Project
Title **Peak flow storage calcs for Summerhill**





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Job No. 48048		
Sheet no. 4		
Date 09/06/17		
By PMCA	Checked	Reviewed

Project	By PMCA	Checked	Reviewed
Title Peak flow storage calcs for Summerhill			

Explanatory notes for Peak Flow Storage

- 1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
- 2) The balance is calculated from the inflow minus the outflow.
- 3) The storage volume is the maximum value of the balance curve.
- 4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
- 5) References to 'storm duration' relate only to the hydrograph method (qv).
- 6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

- 1) The user has the choice of Summer or Winter curves
- 2) The mean intensity varies with the duration of the storm curve
- 3) There are always 120 steps in the calculation process, irrespective of storm duration.
- 4) The balance is calculated from the inflow minus the outflow.
- 5) The storage volume is the sum of the balance values for each step.
- 6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.

APPENDIX D
CORRESPONDENCE

Philip Mcateer

From: Jones-Hughes Henry <Henry.Jones-Hughes@dwrcymru.com>
Sent: 08 May 2017 14:41
To: Philip Mcateer
Cc: Robert Walker
Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

Hi Philip

I can confirm that we will be able to agree to a discharge of surface water into the public surface water sewer at a rate not exceeding 5l/s.

Regards
Henry



Henry Jones-Hughes

Development Control Officer | Developer Services | Wholesale Business Services | Services Dwr Cymru Welsh Water

Linea | Cardiff | CF3 0LT | T: 0800 917 2652 | www.dwrcymru.com

Developer Services have an on-line service at www.dwrcymru.com. Here you can find all the services available, complete application forms and also make payments. If you have a quotation you can pay for this on-line or alternatively by telephoning 0800 917 2652 using a credit/debit card.

*We will respond to your email as soon as possible but you should allow up to **10 working days** to receive a response. For most of the services we offer we set out the timescales that we work to on our Developer Services section of our website. Just follow this link <http://www.dwrcymru.com/en/Developer-Services.aspx> and select the service you require where you will find more information and guidance notes which should assist you. If you cannot find the information you are looking for then please call us on 0800 917 2652 as we can normally deal with any questions you have during the call.*

If we've gone the extra mile to provide you with excellent service, let us know. You can nominate an individual or team for a Diolch award through our [website](#).

From: Philip Mcateer [mailto:philip.mcateer@aahplanning.com]
Sent: 08 May 2017 14:32
To: Jones-Hughes Henry <Henry.Jones-Hughes@dwrcymru.com>
Cc: Robert Walker <robert.walker@aahplanning.com>
Subject: Fw: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

***** External Mail *****

Good Afternoon Henry

Please see attached the correspondence between Welsh Water and Wrexham County Council of 15th February 2017. As there is an apparent contradiction between the first condition and your email to me (please see below) of 14th November last year, can you please clarify whether we are permitted to connect to the public surface water sewer system in Chestnut Avenue (to the South of the site) at a rate not exceeding 5l/s?

Kind Regards

Philip

From: Jones-Hughes Henry <Henry.Jones-Hughes@dwrcymru.com>
Sent: 19 December 2016 16:31
To: Philip Mcateer
Cc: Robert Walker
Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

Hi Philip

Im sorry for the delays in coming back to you. The networks operation team are still monitoring the network downstream of this site. They haven't been able to feed back to me any firm findings, this is because we are reliant on weather events to pick up on how the sewers perform and there are still discussions round what level of storm event flooding downstream from this site occurred at. The consultants we have are modelling the storm event to try to understand when the flooding occurred and as a result of what. This is trial and error at the moment and my expectations are that following further monitoring a report will outline the level of detriment that is occurring and during what storm event.

Unfortunately we will need more time in order to progress this investigation and, if im honest, it could be a number of months before we fully understand the situation. There are two options as I see it.

1. We wait for the outcome of our investigation. This will help to inform any decision we make on the development within the catchment
2. Your client models the network to identify a solution.

Regards
Henry



Henry Jones-Hughes
Development Control Officer | Developer Services | Dwr Cymru Welsh Water
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From: Philip Mcateer [<mailto:philip.mcateer@aahplanning.com>]
Sent: 19 December 2016 11:13
To: Jones-Hughes Henry <Henry.Jones-Hughes@dwrcymru.com>
Cc: Robert Walker <robert.walker@aahplanning.com>
Subject: FW: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

***** External Mail *****

Good Morning Henry

Are you able to respond to my earlier email (please see below) regarding the foul sewage hydraulic study for Summerhill?

Kind Regards

Philip

From: Philip Mcateer
Sent: 13 December 2016 08:19
To: 'Jones-Hughes Henry'

Cc: Robert Walker

Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

Good morning Henry

Can you please let me know if the foul sewerage hydraulic study for Summerhill has been completed yet? The last time we spoke you suggested we should expect some news about mid-December.

Many thanks

Philip

From: Jones-Hughes Henry [<mailto:Henry.Jones-Hughes@dwrcymru.com>]

Sent: 14 November 2016 11:29

To: Philip Mcateer

Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

Hi Philip

Thanks for clarifying this. I can agree to surface water discharging into the public surface water sewer system that us within Chestnut Avenue (to the South of the site). A rate not exceeding 5l/s into this public sewer would be permitted.

The new surface water sewer will have to be put forward to Welsh Water for adoption along with the foul sewers.

Regards

Henry



Henry Jones-Hughes

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From: Philip Mcateer [<mailto:philip.mcateer@aahplanning.com>]

Sent: 14 November 2016 10:15

To: Jones-Hughes Henry <Henry.Jones-Hughes@dwrcymru.com>

Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

***** External Mail *****

Good Morning Henry

Thank you for responding so promptly. I did inspect the water course when I visited the site in April, but unfortunately the best photo I have (please see attached) doesn't show the source, though it does show the slope and the ground cover above, viewed from the west. However, I attach a contour site plan which makes it clear that the site lies between 2m and 8m below the crest of the hill (approximately 141mAOD) that any drainage would have to cross to reach the watercourse, quite apart from the multiple land ownership issues.

The FEH website also makes this clear (please see below). The catchment of the watercourse lies to the west of the hill crest, our site to the east.



In view of this, I don't think that the water course is viable for surface water drainage.

Kind Regards

Philip

From: Jones-Hughes Henry [<mailto:Henry.Jones-Hughes@dwrcymru.com>]
Sent: 11 November 2016 10:09
To: Philip Mcateer
Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

Hi Philip

Thanks for sending this through. The watercourse you have identified looks to be the head of this watercourse system. Further investigation into this watercourse will be required. Whether there is any more to this watercourse upstream, whether this watercourse runs any closer to the development site? You would also need to look at the feasibility of a gravity connection to this watercourse (why it would be cost prohibitive to connect to this watercourse/any ownership issues with 3rd party land crossing/possible routes to the closest point of connection to this watercourse/levels. Etc...) It looks like the source of the watercourse is within the golf course but without a site visit this cannot be confirmed

Regards
 Henry



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From: Philip Mcateer [<mailto:philip.mcateer@aahplanning.com>]

Sent: 11 November 2016 09:51

To: Jones-Hughes Henry <Henry.Jones-Hughes@dwrcymru.com>

Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

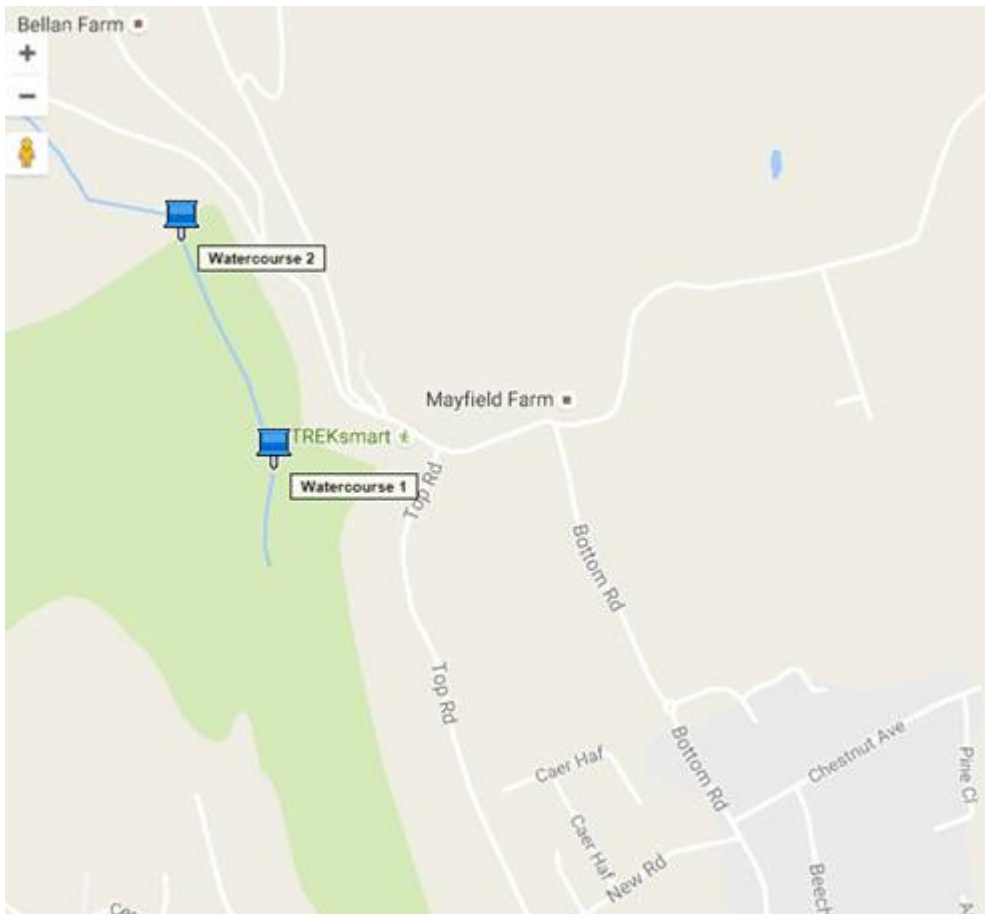
***** External Mail *****

Good Morning Henry

The investigations carried out thus far include:

- EA maps;
- Google and MAGIC maps;
- Envirocheck data searches (see below)
- Several site visits, with photographs (attached)

The Envirocheck searches reveal two watercourses in the vicinity of the site (Map ID 16 and 17), their locations are shown below – both lie well to the west of the site:



I also attach site photos: these show no field drains within the site (viewpoint 1, RHS) and no receiving drain to the east of the site (viewpoint 2, top).

I believe that should provide sufficient evidence of an absence of field drains, but would be happy to undertake further searches if you feel these are required?

Kind Regards

Philip

From: Jones-Hughes Henry [<mailto:Henry.Jones-Hughes@dwrcymru.com>]
Sent: 10 November 2016 09:12
To: Philip Mcateer
Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

Hi Philip

Thanks for sending this through. What investigation has been carried out to identify where the land currently drains to? Further investigation is required to identify this and whether there are any local watercourses/land drains that the development can connect into. Often this is a desktop study which is insufficient. On-site investigation will often reveal alternative options.

If all else fails we can look at agreeing a connection into the surface water sewer at a controlled greenfield run-off rate

Regards
Henry



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From: Philip Mcateer [<mailto:philip.mcateer@aahplanning.com>]
Sent: 10 November 2016 08:57
To: Jones-Hughes Henry <Henry.Jones-Hughes@dwrcymru.com>
Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

***** External Mail *****

Good morning Henry

We have recently carried out infiltration testing for this site, (please see attached) and this indicates that soakaways are not viable for the disposal of storm water runoff. Given this, could you advise please on whether a connection to Welsh Water sewers is an option, and if so whether a formal application is necessary at outline planning stage?

Kind Regards

Philip

From: Jones-Hughes Henry [<mailto:Henry.Jones-Hughes@dwrcymru.com>]
Sent: 07 September 2016 12:06
To: Philip Mcateer
Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

Hello Philip

Given that the development is likely to cause increased flooding within the local sewer network I would not be able to support the use of a condition until we have a clear understanding of what solutions might be available to resolve

the detriment that would be caused and until we know the cost of such a solution. The progression of a hydraulic modelling assessment (HMA) would enable us to move towards identifying a solution if one exists. A quote for a HMA can be obtained by paying a fee of £250 (excl VAT). This quote will provide a cost and programme for the actual HMA. A quote would usually take 1 month to prepare.

Drainage is a material planning consideration and if there is a fundamental issue with a connection into the sewer network then this should be addressed before any consent, outline or full, is given.

Regards

Henry



Henry Jones-Hughes

Development Control Officer | Developer Services | Dwr Cymru Welsh Water

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From: Philip Mcateer [<mailto:philip.mcateer@aahplanning.co.uk>]

Sent: 07 September 2016 11:32

To: Jones-Hughes Henry <Henry.Jones-Hughes@dwrcymru.com>

Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

***** External Mail *****

Hi Henry

I understand that the consultation response is looking for further information which would usually come forward in the detailed drainage design which would be normally required by a condition of planning consent.

As you'll know information sought by the local planning authority should be no more than necessary, having regard to the nature and scale of the development concerned. As outlined we believe that a scheme can be achieved and would be happy to suggest the following planning condition to finalise the details through a detailed drainage design:

The development hereby permitted shall not be commenced until such time as a scheme to dispose of foul and surface water, has been submitted to, and approved in writing by, the Local Planning Authority. The scheme shall be implemented as approved. Reason To prevent pollution of the water environment.

The commonly adopted planning condition suggested above would ensure that the consultation response is satisfactorily addressed whilst maintaining the Council's processing requirements in accordance with national planning policy.

Should this not be acceptable, I would be grateful if you could provide an indication of the likely cost for a Hydraulic Modelling Assessment of the local public sewerage network.

Kind Regards,

Philip

From: Jones-Hughes Henry [<mailto:Henry.Jones-Hughes@dwrcymru.com>]

Sent: 24 August 2016 13:44

To: Philip Mcateer

Cc: Robert Walker

Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

Hi Philip

The Barratt Case specifically related to the control offered under Section 106 of the Water Industry Act which relates to the right to communicate flows with the public sewer. The case determined that under this section anyone is afforded the right to connect to the public sewer with little direct control being available to the sewerage undertaker to prevent adverse consequences, e.g. flooding or pollution occurring.

The Court of Appeal judgement was supported by the Supreme Court and they solely concentrated on the statutory construction of Section 106 and this is what was determined by the respective courts.

The earlier Court of Appeal judgement which is endorsed by the Supreme Court goes further, when referring to where the control of a new communication to the public sewer rested, specifically where the communication was likely to or would result in flooding and pollution, Lord Justice Pill said *'the respondent (Welsh Water) can expect to have the protection in the planning process, as can the public interest'*.

To conclude, I would state that as a statutory consultee within the planning process, Welsh Water are able to offer guidance, object or support a planning application based on the capacity within the sewer network.

Regards
Henry



Henry Jones-Hughes

Development Control Officer | Developer Services | Dwr Cymru Welsh Water

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From: Philip Mcateer [<mailto:philip.mcateer@aahplanning.co.uk>]
Sent: 24 August 2016 13:30
To: Jones-Hughes Henry <Henry.Jones-Hughes@dwrcymru.com>
Cc: Robert Walker <robert.walker@aahplanning.com>
Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

***** External Mail *****

Dear Henry

Thank you for responding so promptly. I appreciate that we will need to proceed to a formal application through your preapplication enquiry service, in order to determine the most appropriate solution. However, I would be grateful if you could clarify whether, in principle, the Supreme Court decision in Barratt Homes v Welsh Water (2009) means that the developer has a right of connection into an existing public sewer under section 106 of the Water Industry Act 1991?

Many thanks

Philip

From: Jones-Hughes Henry [<mailto:Henry.Jones-Hughes@dwrcymru.com>]
Sent: 16 August 2016 11:57
To: philip.mcateer@aahplanning.com
Subject: RE: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

Dear Mr McAteer

Thank you for your enquiry. I would direct you to our pre application enquiry service which will enable us to advise on all aspects of drainage capacity.

<http://www.dwrcymru.com/en/Developer-Services/Pre-Planning.aspx>

My initial advice is that the public sewer network is at capacity so we would not at present be able to accommodate any additional foul flows within the network and a hydraulic modelling assessment would be required to identify solutions.

Given the above, surface water would not be allowed to connect into the public sewer

Regards
Henry



Henry Jones-Hughes

Development Control Officer | Developer Services | Dwr Cymru Welsh Water

PO Box 3146 | Cardiff | CF30 0EH | T: 0800 9172652 | F: 02920 740472 | Ext. 65813

If we've gone the extra mile to provide you with excellent service, let us know. You can nominate an individual or team for a Diolch award through our [website](#)

From: Philip McAteer [<mailto:philip.mcateer@aahplanning.com>]

Sent: 16 August 2016 10:25

To: services developer <developer.services@dwrcymru.com>

Subject: LAND EAST AND WEST OF BOTTOM ROAD, SUMMERHILL LL11 4TS

***** External Mail *****

Dear Sir or Madam

We have been commissioned to provide an outline drainage proposal in support of a proposed residential development on a 5.3 hectare plot of land located immediately to the east and west of Bottom Road, Summerhill, grid reference SJ 310 543.

27 Old Gloucester Street
London WC1N 3AX
+44 (0)207 419 5113

Fax: 0845 130 5075

www.aahplanning.com

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