H+H Drainage
Tremayne, Mortimer's Cross, Herefordshire HR6 9TG
Phone: 0845 2008421. Mobile: 07837 628764

Surface and Foul Water Drainage Strategy

The Proposed dwellings at Lower Hengoed, Gladestry Powys, HR5 3PL

19th March 2022

Prepared by Alex Taysum-Hunter

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Registered in England & Wales, Registration number 7357577

SUMMARY OF REPORT

The purpose of the work is to demonstrate that foul and surface water drainage arrangements comply with Core Strategy of Powys Council, Natural England and National Planning Policy Framework.

The site is located near to the Wernol Brook, which makes up part of the River Arrow Catchment. Although the River Arrow feeds the River Lugg, the River Arrow is not a Special Area of Conservation (SAC).

The key outcomes of the work are to ensure that surface water and foul water from the proposed development do not have an adverse effect on the Wernol Brook, Gladestry Brook, the River Arrow or the surrounding area. Wherever possible, the proposed works must improve the immediate environment and enhance the surrounding habitat.

This report outlines the design of the surface water and foul water strategy, including sewage treatment plants, drainage fields, attenuation and soak-aways.

Outline of Foul and Surface Water Strategy

Foul and surface water at the site are to be managed separately. Surface water runoff is to be managed by the methods outlined in the Surface Water Drainage Strategy and Foul water is to be managed by the methods outlined in the Foul Water Drainage Strategy.

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Site Location and conditions

Lower Hengoed Barn, Lower Hengoed, Gladestry, Powys HR5 3PL

SO 22632 53375

X (Easting): 322632
Y(Northing): 253375

Latitude: 52.173191
Longitude: -3.1327584

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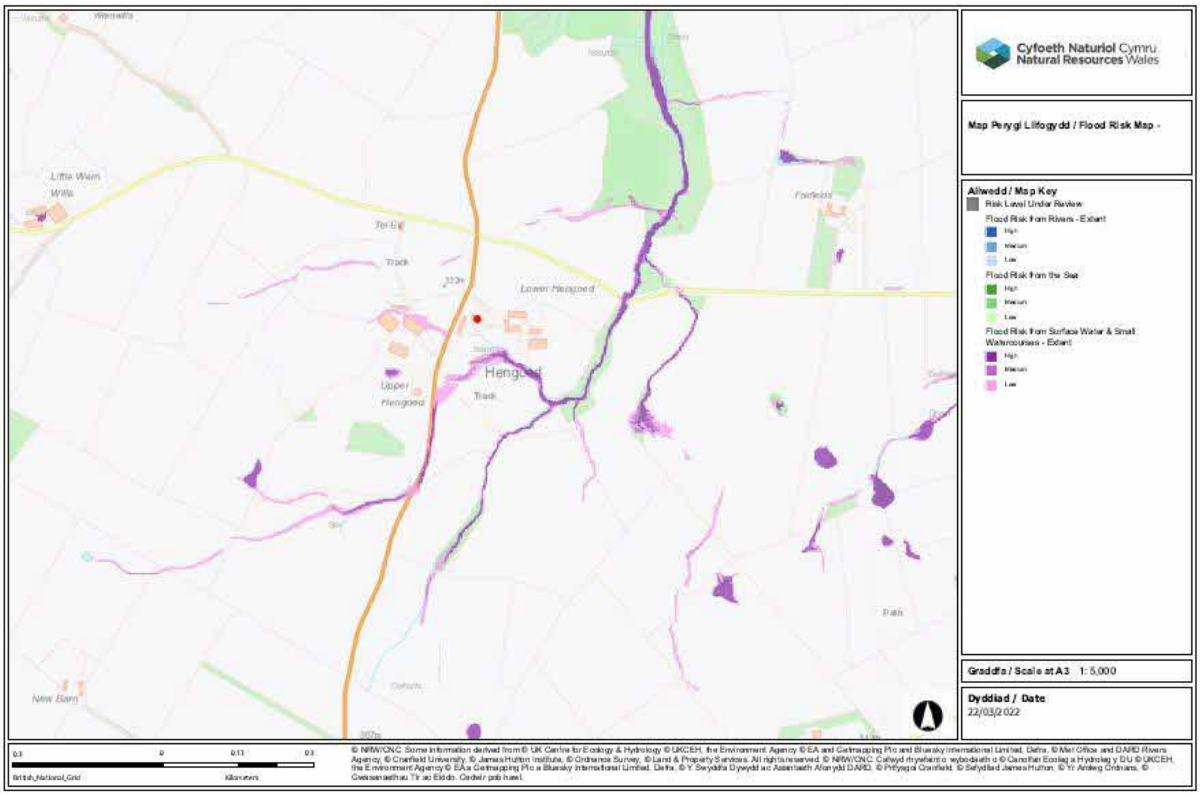
The percolation and infiltration test areas are laid to pasture and are grazed by a sheep.

As can be seen below, there is no recorded fluvial flooding at this site. However, there is historic or surface water flooding. The fluvial and surface water flooding does not affect Lower Hengoed Barn due to the topography of the area. Noting the topography and the historic surface water flooding, the percolation tests were completed on higher ground.



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As noted, the percolation tests were completed on higher ground; thus, avoiding any localised surface water flooding. The two test areas are primarily level.

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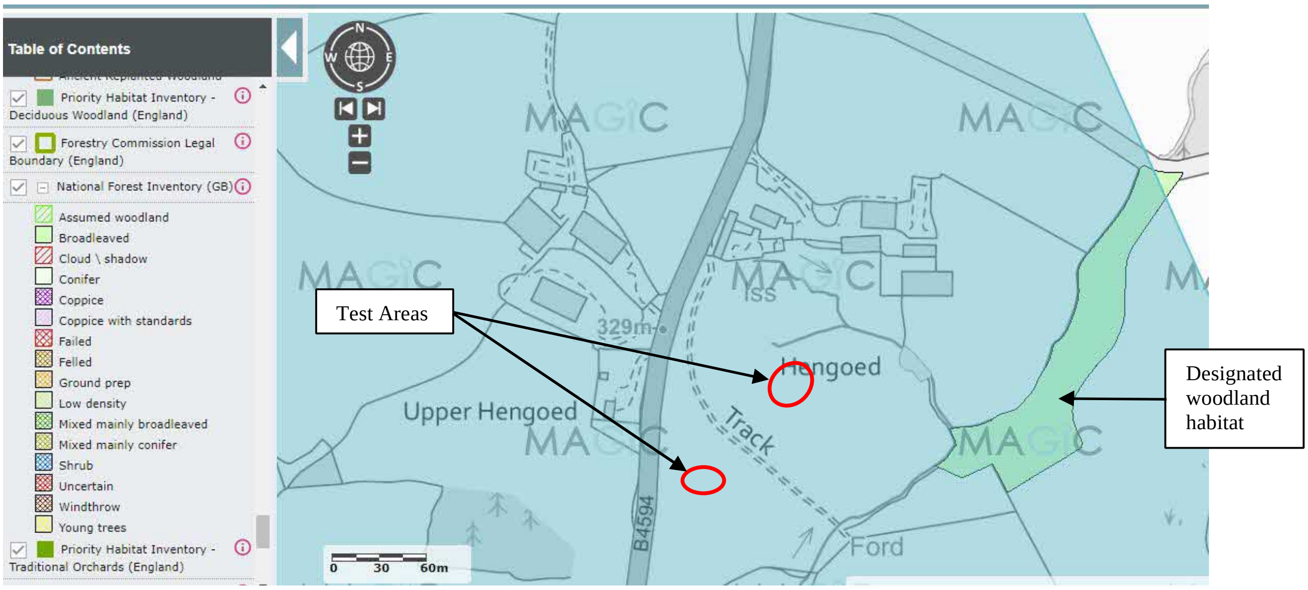
As shown in the map below, there are no Priority Habitats shown within 50m of the site or the percolation test areas.

There is a designated woodland to the East of the test areas, but this is more than 50m away from the test areas.



There are no SPZ1 or SPZ2 areas highlighted within 500m of this site.

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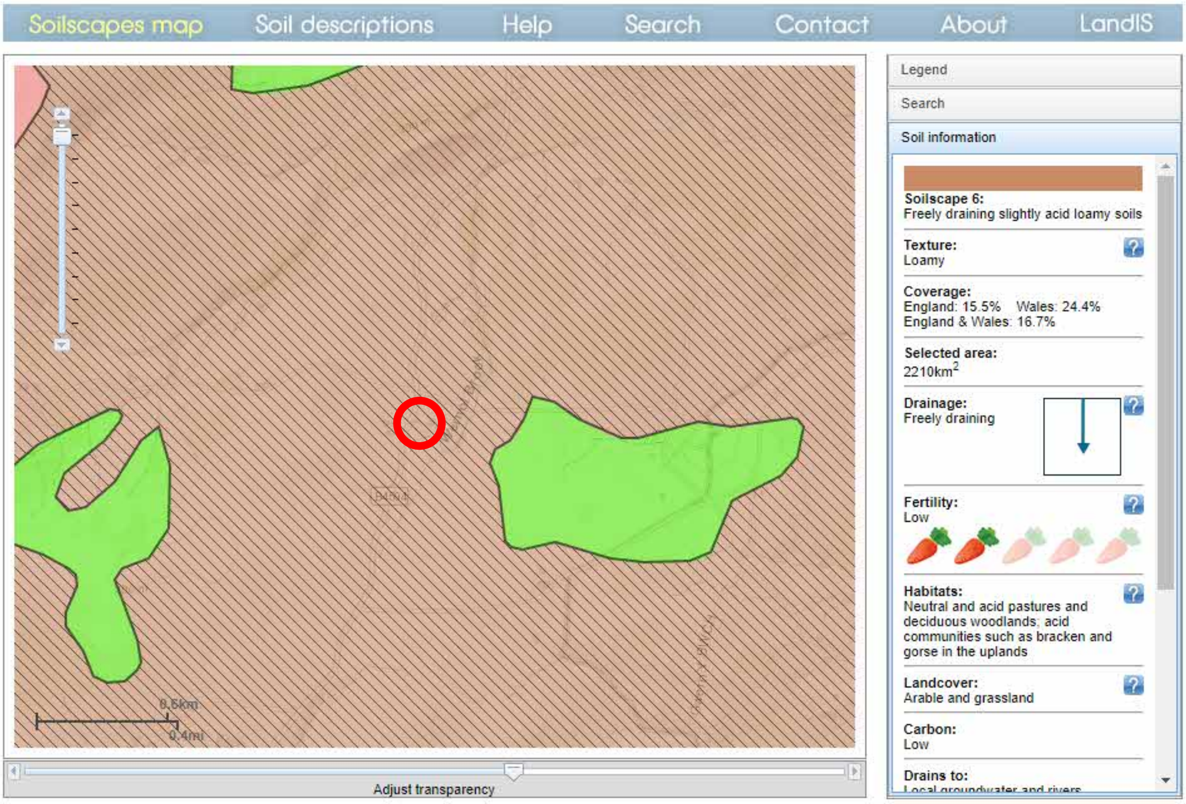
As can be seen below, the Soilscape Mapping provided by Cranfield University on behalf of DEFRA shows that the site of the proposed development falls on HOST soil class 6, which is described as "Freely drainage slightly acid loamy soils".



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Natural Resources Wales General Binding Rules

As specified in the General Binding Rules: *'If any part of the building(s) your treatment plant serves is within 30 metres of a public sewer, the Natural Resource Wales (NRW) will not allow you to start a new discharge from a sewage treatment plant under the general binding rules.*

If you are building a development of more than one property, this distance must be multiplied by the number of properties, eg if there are 3 properties then the distance will be 3 x 30 metres = 90 metres.

If there is a good reason why you can't connect to the sewer (eg there is a river or a hill in the way) then you must apply for a permit so that NRW can decide whether to allow you to use a sewage treatment plant instead.'

The proposed development is for two dwellings. Using the NRW parameter, we can see that a Public Foul Sewer within 60m (2 x 30m = 60m) would be considered the favoured option.

We can confirm that there is no Public Foul Sewer within 60m of the proposed site.

Considering the location and general site conditions, the development is unable to connect to the Public Foul Sewer and so a private off-mains foul drainage system is the preferred solution.

Ground testing and on-site investigation

Site investigations were undertaken on the 17th March 2022.

Initially, a ground water level assessment trial hole (GWLA) was excavated to a depth of 1.8m below local ground level. The GWLA showed that there was local ground water at a depth of 1.7m below ground level.

The GWLA trial hole also showed that the local topsoil type is clayish loam to a depth of 350mm. Beneath the topsoil is a clayish subsoil with shales rock deposits; this subsoil continued for the full extent of the excavation.

Ground water at approximately 1.7m below ground level.

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Percolation tests

Six percolation test holes were excavated in accordance with BS.6297. The test holes were filled with test water and the results were recorded. These results are shown in the following spreadsheets.

P1

P2

P3

P4

P5

P6

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Site Name: Lower Hengoed

Date: 17/03/2022

Weather conditions: Dry

Hole reference	Hole Depth	Water Drop	Time (secs)	Av. Drop
1				
Test 1	750mm	55	86400	15
Test 2				
Test 3				
			Hole Average:	1570

Hole reference	Hole Depth	Water Drop	Time (secs)	Av. Drop
2				
Test 1	GL	200	18000	90
Test 2	GL	200	17100	85.5
Test 3	GL	200	18600	93
			Hole Average:	89.5

Hole reference	Hole Depth	Water Drop	Time (secs)	Av. Drop
3				
Test 1	750mm	30	86400	2880
Test 2				
Test 3				
			Hole Average:	2880

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Hole reference	Hole Depth	Water Drop	Time (secs)	Av. Drop
4				
Test 1	GL	200	11100	55.5
Test 2	GL	200	12600	63
Test 3	GL	200	13500	67.5
			Hole Average:	62

Hole reference	Hole Depth	Water Drop	Time (secs)	Av. Drop
5				
Test 1	GL	200	8100	40.5
Test 2	GL	200	10800	54
Test 3	GL	200	11700	58.5
			Hole Average:	51

Hole reference	Hole Depth	Water Drop	Time (secs)	Av. Drop
6				
Test 1	GL	200	26100	130.5
Test 2	GL	200	25200	126
Test 3	GL			
			Hole Average:	128.25

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Calculation of soak-away (Summary & Calculation sheet)

Site Name: Lower Hengoed

Date: 17/03/2022

Weather conditions: Dry

Average calculation

Hole reference	Depth below ground		Average time
1	750mm		1570.00
2	GL		89.50
3	750mm		2880.00
4	GL		62
5	GL		51.00
6	GL		128.25
7			-
8			-
9			-
		Vp:	**67.50**

Assumed maximum population: 10pe 2x dwellings

Method of treatment: Package Sewage Treatment Plant
Standard of treatment: Secondary
GBR factor: 0.2

ASSUMED POPULATION X AVERAGE TIME X FACTOR A =

10 x 67.50 x 0.20 = 135.00

Minimum Drainage Field (Sewage treatment) : 135m^2

As can be seen from the previous results, the percolation tests demonstrate that the local soils would allow a drainage mound to work. However, a drainage field (tests at 750mm) is unlikely to be sufficient.

As such, the Vp of 67.5 has been calculated using the results highlighted in green.

BRE Digest 365 Infiltration Tests.

One infiltration test hole was excavated in line with BRE Digest 365. This test hole was excavated to a depth of 1500mm below ground level, 500mm wide and 1500mm long, in the location shown on the associated plan.

As can be seen in the following plan, the infiltration test hole was excavated near to the proposed barn conversion and downhill. As can be seen below, ground water was found at a depth of 650mm below ground level.

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The infiltration test hole was filled with water and the water drop was recorded; the results are shown in the following calculations spreadsheet.

As can be seen in the following calculation sheet, the BRE Digest 365 calculations cannot be made as the infiltration test hole did not drain sufficiently.

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	Lower Hengoed Barn			
			Revision	
	Job No:		Page:	C/01
Section:	Prepared By:	Alex Hunter	Date:	19/03/2022

ALTERNATIVE SOAKAWAY SIZES			
	trench soakaways		
width of trench *[mm]*:	450	600	2000
required trench length *[m]*:	#DIV/0!	#DIV/0!	#DIV/0!
	ring soakaways		
diameter of ring *[mm]*:	900	1200	1350
required pit diameter *[m]*:	N/A	N/A	N/A

** Based on effective depth and number of pits as in Soakaway Data table*

SUMMARY OF CALCULATIONS		
critical design rainfall duration 't_{crit}' =	#DIV/0!	*min*
required storage volume 'V_{req}' =	#DIV/0!	m^3
provided storage volume 'V_{prov}' =	123.50	m^3
utilisation factor =	**#DIV/0!**	***#DIV/0!***
required time to discharge 50% 't_{50}' =	#DIV/0!	*hours*
utilisation factor =	**#DIV/0!**	***#DIV/0!***

#DIV/0!

GENERAL DATA	
site location:	England and Wales
soakaway type:	geocellular units (?)
impermeable area drained to soakaway 'A' *[m^2]* =	175
60 min rainfall depth of 5 year return period 'R' *[mm]* =	20 (?)
M5-60 to M5-2d rainfall ratio 'r' =	0.50
allowance for climate change:	40%

SOAKAWAY DATA	
soakaway width 'W' [m] =	10.00
soakaway length 'L' [m] =	10.00
total depth from ground level 'D_b' *[m]* =	1.50
depth to drain invert level 'D_d' *[m]* =	0.20
soakaway effective depth 'D_{eff}' *[m]* =	1.30
free volume in infill aggregate *[%]* =	95 (?)

SOIL INFILTRATION DATA	
allowance for infiltration through soakaway base:	20% (?)
available on-site infiltration test results:	(●) Yes ( ) No (?)
use soakage trial pit table below	
internal surface area of trial pit 'a_{p50}' [m^2] =	3.53
storage volume between 75-25% 'V_p' [m^3] =	0.52
time for water to fall from 75-25% 't_p' [min] =	#DIV/0!
soil infiltration rate 'f' [m/s] =	#DIV/0!

SOAKAGE TRIAL PIT DATA (?)	
soakage trial pit width 'W_t' *[m]* =	0.50
soakage trial pit length 'L_t' *[m]* =	1.60
total depth from ground level 'D_{tb}' *[m]* =	1.50
depth to pipe invert level 'D_{tp}' *[m]* =	0.20
soakage trial pit effective depth 'D_{teff}' *[m]* =	1.30
free volume in infill aggregate *[%]* =	100 (?)

NOTE: faces of excavation assumed to be vertical

REQUIRED STORAGE CAPACITY PER RAINFALL DURATION (?)

rainfall duration *[min]*	rainfall factor Z1	M5-D rainfalls *[mm]*	M10-D			M30-D			M100-D			outflow from soakaway [m^3]	required storage [m^3]
			Z2	rainfalls *[mm]*	inflow *[m^3]*	Z2	rainfalls *[mm]*	inflow *[m^3]*	Z2	rainfalls *[mm]*	inflow *[m^3]*		
5	0.39	7.80	1.21	13.18	2.31	1.46	15.97	2.79	1.86	20.28	3.55	#DIV/0!	#DIV/0!
10	0.54	10.80	1.22	18.49	3.24	1.50	22.62	3.96	1.92	29.07	5.09	#DIV/0!	#DIV/0!
15	0.65	13.00	1.23	22.42	3.92	1.51	27.52	4.82	1.96	35.64	6.24	#DIV/0!	#DIV/0!
30	0.82	16.40	1.24	28.47	4.98	1.53	35.16	6.15	2.00	45.95	8.04	#DIV/0!	#DIV/0!
60	1.00	20.00	1.24	34.72	6.08	1.54	43.21	7.56	2.03	56.84	9.95	#DIV/0!	#DIV/0!
120	1.19	23.80	1.24	41.32	7.23	1.54	51.17	8.95	2.01	67.13	11.75	#DIV/0!	#DIV/0!
240	1.38	27.60	1.23	47.51	8.31	1.52	58.85	10.30	1.99	76.86	13.45	#DIV/0!	#DIV/0!
360	1.51	30.20	1.22	51.56	9.02	1.51	63.94	11.19	1.97	83.22	14.56	#DIV/0!	#DIV/0!
600	1.68	33.60	1.21	56.88	9.95	1.50	70.40	12.32	1.94	91.31	15.98	#DIV/0!	#DIV/0!
1440	2.03	40.60	1.19	67.57	11.82	1.46	83.21	14.56	1.89	107.15	18.75	#DIV/0!	#DIV/0!

** Z2 is growth factor from M5 rainfalls*

Invalid measurements. Click the grey question mark below to see what measurements are required. Also refer to BRE 365 for details.

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS (?)

	water level measurement N°:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Soakage Trial 1	time *[min]* =	0	60	120	180	240	300	360	420	1440										
	depth to water *[m]* =	0.20	0.43	0.55	0.58	0.59	0.60	0.61	0.61	0.66										
Soakage Trial 2	time *[min]* =																			
	depth to water *[m]* =																			
Soakage Trial 3	time *[min]* =																			
	depth to water *[m]* =																			

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N.A.D.C. National Association Drainage Contractors

BRITISH WATER

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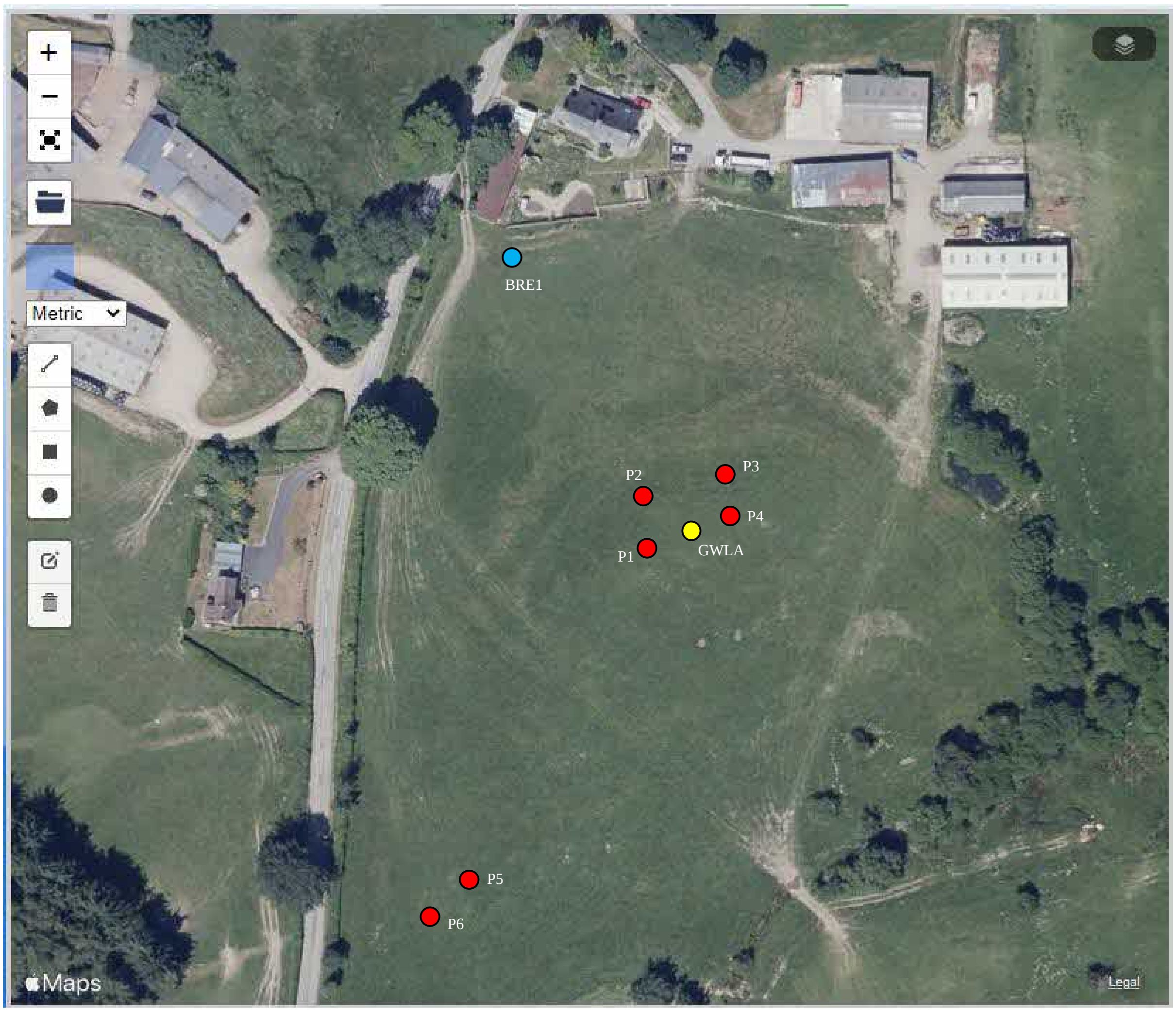
Location of test holes.



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<u>Surface Water Design</u>

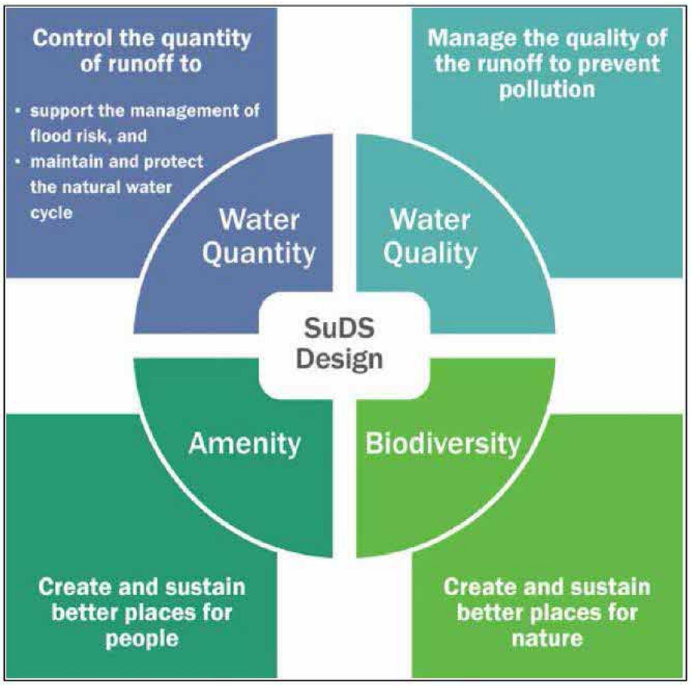
The site is a greenfield site, and the site is laid to pasture.

The primary concerns of any proposed surface water management are laid out in SuDS and should be considered to ensure minimal impact to the surrounding area.

Sustainable (urban) Drainage Systems
To satisfy the requirements of current best national surface water management guidance, SuDS are required to manage, attenuate and treat surface water runoff before discharging from the site.

Current best practice guidance relating to sustainable surface water management is outlined in the SuDS Manual (CIRIA, 2015) which provides details on the use of SuDS for managing surface water runoff.

There are four main categories of SuDS which are referred to as the 'four pillars of SuDS design' as shown below:



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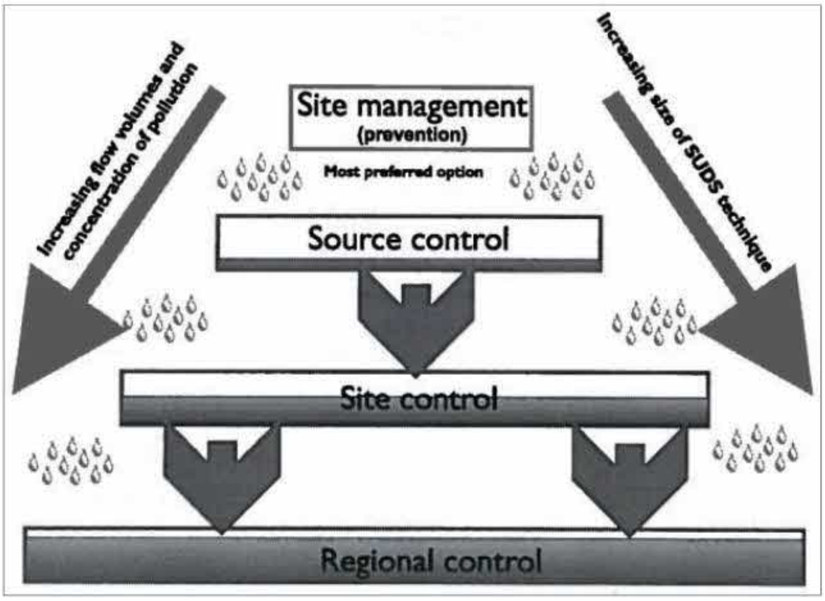
The SuDS Manual identifies a hierarchy of SuDS for managing runoff, which is commonly referred to as a 'management train':



SuDS Management Train

1. **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
2. **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting, permeable paving and green roofs).
3. **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one / several soakaways, below ground storage units or attenuation ponds for the whole site).
4. **Regional Control** – management of runoff from several sites, typically in a retention pond or wetland.

It is generally accepted that the implementation of SuDS as opposed to conventional drainage systems, provides a number of benefits by:

1. Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
2. Reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;
3. Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
4. Reducing potable water demand through rainwater harvesting;
5. Improving amenity through the provision of public open spaces and providing biodiversity and wildlife habitat enhancements; and
6. Replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

Proposed Surface Water Discharge Location(s)

In accordance with CIRIA Report C753, the hierarchy of preferred disposal options for surface water runoff from development sites is as follows:

1. Infiltration to Ground;
2. Discharge to Surface Waters; or
3. Discharge to Sewer.

Due to the high ground water level, it is unlikely that a surface water soak-away would be sufficient. Therefore, in line with CIRIA Report C753, the surface water from this development should be managed and discharged to surface water.

With reference to CIRIA C753, post development surface water runoff generated by the site (via building roofs, access roads and external car parking areas) is considered to have a 'very low' to 'low' *Pollution Hazard Level* as set out below:

Land Use	Pollution Hazard Level	Pollution Hazard Indices		
		Total Suspended Solids (TSS)	*Metals*	*Hydro-Carbons*
Residential Roofs	Very Low	0.2	0.2	0.05
Residential Car Parks	Low	0.5	0.4	0.4

Due to the low pollution hazard, we do not consider pollution to be a risk to the local environment at this site.

With the previous information in mind, we can see that surface water from roofs will need to be managed and discharged to the local watercourse at no more than greenfield run-off rate.

As can be seen from the Natural Resources Wales flood map, there is a small watercourse to the Southwest of the barn in question. This small permanent spring-fed watercourse flows into the Wernol Brook.

As mentioned, any run-off (surface water) must be discharged to the local watercourse at no more than greenfield run off rate. It is generally accepted for small impermeable areas, that greenfield run off is no more than 2-litres/second.

The roof area of the proposed dwelling is 175m^2. Although this roof is existing, the rainwater goods are in a state of disrepair. As such, the existing roof water discharge is insufficient.

The following calculation sheet demonstrates that a flow management system, with a managed outflow of 2-litres/second (greenfield run off) would require a minimum of 4.44m^3 of attenuation when allowing an additional 40% for climate change and for a 1 in 100-year storm event.

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				Revision	
		Job No:		Page:	C/01
Section:	Attenuation	Prepared By:	Alex Hunter	Date:	23/03/2022

GENERAL DATA	
site location:	England and Wales
60 min rainfall depth of 5 year return period 'R' *[mm]* =	20
M5-60 to M5-2d rainfall ratio 'r' =	0.50
proposed discharge rate 'v_1' *[litre/s]* =	2.00
proposed discharge rate 'v_2' *[litre/s]* =	2.00
allowance for climate change:	40%

SUMMARY OF CALCULATIONS		
required storage volume for discharge rate 'v_1' =	**4.44**	m^3
required storage volume for discharge rate 'v_2' =	**3.55**	m^3

AREA DATA		impermeability *[%]*	effective area *[m^2]*
impermeable area 'A_1' *[m^2]* =	175	100.00	175
landscaping and/or green roof area 'A_2' *[m^2]* =	0	80.00	0
other partially permeable area 'A_3' *[m^2]* =	0	20.00	0
AREA DRAINED TO ATTENUATION TANK =			**175 m^2**

REQUIRED STORAGE VOLUME PER RAINFALL DURATION FOR DISCHARGE RATE v_1

rainfall duration *[min]*	rainfall factor Z1	M5-D rainfalls *[mm]*	M10-D			M50-D			M100-D			outflow from attenuation tank [m^3]	required storage *[m^3]*
			Z2	rainfalls *[mm]*	inflow *[m^3]*	Z2	rainfalls *[mm]*	inflow *[m^3]*	Z2	rainfalls *[mm]*	inflow *[m^3]*		
5	0.39	7.80	1.21	13.18	2.31	1.61	17.59	3.08	1.86	20.28	3.55	0.60	2.95
10	0.54	10.80	1.22	18.49	3.24	1.66	25.07	4.39	1.92	29.07	5.09	1.20	3.89
15	0.65	13.00	1.23	22.42	3.92	1.68	30.58	5.35	1.96	35.64	6.24	1.80	4.44
30	0.82	16.40	1.24	28.47	4.98	1.71	39.22	6.86	2.00	45.95	8.04	3.60	4.44
60	1.00	20.00	1.24	34.72	6.08	1.73	48.44	8.48	2.03	56.84	9.95	7.20	2.75
120	1.19	23.80	1.24	41.32	7.23	1.72	57.39	10.04	2.01	67.13	11.75	14.40	0.00
240	1.38	27.60	1.23	47.51	8.31	1.71	66.06	11.56	1.99	76.86	13.45	28.80	0.00
360	1.51	30.20	1.22	51.56	9.02	1.70	71.83	12.57	1.97	83.22	14.56	43.20	0.00
600	1.68	33.60	1.21	56.88	9.95	1.68	78.95	13.82	1.94	91.31	15.98	72.00	0.00
1440	2.03	40.60	1.19	67.57	11.82	1.64	93.01	16.28	1.89	107.15	18.75	172.80	0.00

** Z2 is a growth factor from M5 rainfalls*

REQUIRED STORAGE VOLUME PER RAINFALL DURATION FOR DISCHARGE RATE v_2

rainfall duration *[min]*	rainfall factor Z1	M5-D rainfalls *[mm]*	M10-D			M30-D			M50-D			outflow from attenuation tank [m^3]	required storage *[m^3]*
			Z2	rainfalls *[mm]*	inflow *[m^3]*	Z2	rainfalls *[mm]*	inflow *[m^3]*	Z2	rainfalls *[mm]*	inflow *[m^3]*		
5	0.39	7.80	1.21	13.18	2.31	1.46	15.97	2.79	1.61	17.59	3.08	0.60	2.48
10	0.54	10.80	1.22	18.49	3.24	1.50	22.62	3.96	1.66	25.07	4.39	1.20	3.19
15	0.65	13.00	1.23	22.42	3.92	1.51	27.52	4.82	1.68	30.58	5.35	1.80	3.55
30	0.82	16.40	1.24	28.47	4.98	1.53	35.16	6.15	1.71	39.22	6.86	3.60	3.26
60	1.00	20.00	1.24	34.72	6.08	1.54	43.21	7.56	1.73	48.44	8.48	7.20	1.28
120	1.19	23.80	1.24	41.32	7.23	1.54	51.17	8.95	1.72	57.39	10.04	14.40	0.00
240	1.38	27.60	1.23	47.51	8.31	1.52	58.85	10.30	1.71	66.06	11.56	28.80	0.00
360	1.51	30.20	1.22	51.56	9.02	1.51	63.94	11.19	1.70	71.83	12.57	43.20	0.00
600	1.68	33.60	1.21	56.88	9.95	1.50	70.40	12.32	1.68	78.95	13.82	72.00	0.00
1440	2.03	40.60	1.19	67.57	11.82	1.46	83.21	14.56	1.64	93.01	16.28	172.80	0.00

** Z2 is a growth factor from M5 rainfalls*

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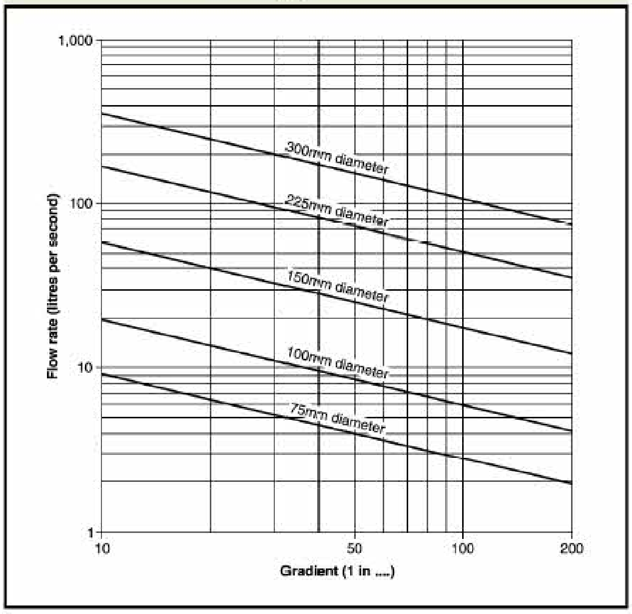
Noting the size of the required attenuation, we recommend that this is constructed from wrapped attenuation crates and is located down-slope of the proposed development.

In addition, the attenuated surface water would then be managed to a maximum flow rate of 2-litres/second.

Downstream of the attenuation, a smaller diameter drain should be installed. As can be seen from the following extract from Building Regulations, a 75mm diameter drain laid at a gradient of 1:100 has full discharge capacity of less than 2-litres/second.

Therefore, by installing an outfall drain of 75mm diameter at a gradient of 1:100, the managed flow rate can be achieved without the installation of a flow management chamber.

Diagram 3 **Discharge capacities of rainwater drains running full**



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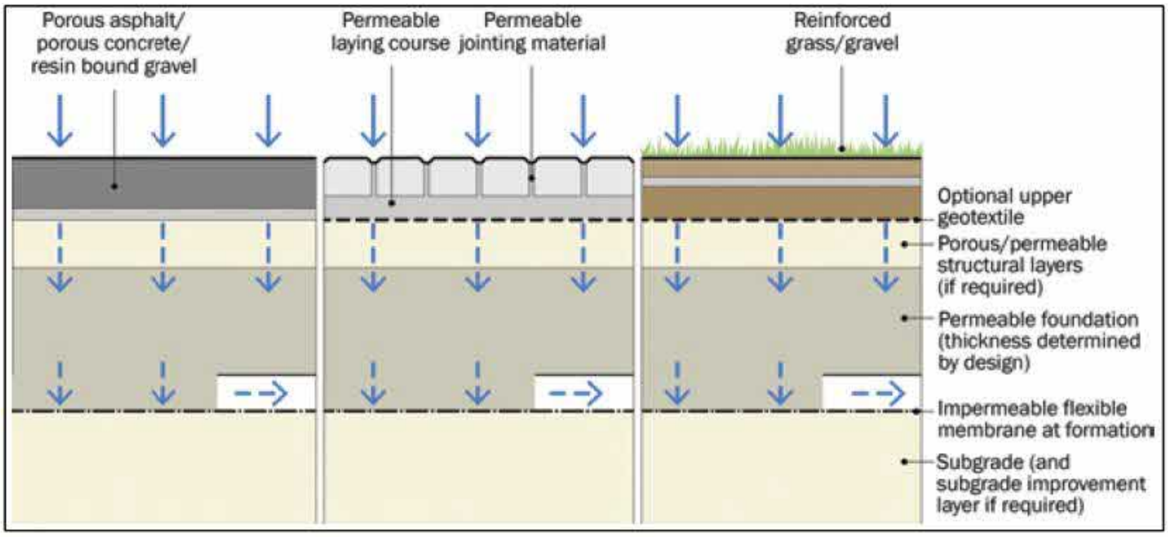
In addition to the impermeable roof area, a new driveway and hardstanding area is to be installed.

As demonstrated by the recent infiltration test, the upper soils were found to be permeable. With this in mind, it would be beneficial to lay the proposed hardstandings as permeable surfaces so as to facilitate infiltration wherever possible.

Where hardstanding areas are laid, SuDS recommends the use of non-infiltration systems where appropriate. As shown below, there are many ways of designing such permeable paths, hardstandings and driveways:



The installation of permeable hardstanding areas would reduce surface water run-off and would reduce the run-off of pollutants and detritus.

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Surface Water Disposal Conclusion.

Considering SuDS and the specifics of this site, we can confirm that the resulting surface water run-off should be managed as follows:

Roof water from the proposed barn conversion should be piped by gutters and rainwater goods to underground drainage.

The roof water should be piped to a catchpit in order to reduce debris entering the attenuation system.

At least $4.44m^3$ of attenuation should be constructed from wrapped attenuation crates.

A 75mm diameter discharge drain should be laid with a gradient of less than 1:100 so as to manage the flow to less than 2-litres/second.

The discharge pipe should be laid to the local permanent watercourse within the boundary of the property.

The drainage system should be maintained; this includes regular cleaning of the catchpit.

The proposed driveway and paths should be constructed as permeable surfaces.

All surface water drainage should be installed downslope of the new development.

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Foul Water / Sewage Treatment System Design

Using the following flow diagram, the site can be assessed:

As can be seen from the flow diagram, the favoured option would be to connect the foul drainage system to the **local Public Sewer**. However, as previously mentioned, there is no available Public foul Sewer near to this site. Therefore, connection to the local Public Foul Sewer is not possible at this site.

Following the flow diagram, a septic tank or packaged sewage treatment plant would be favoured with a discharge to ground. However, the percolation tests demonstrate that a drainage mound would be required due to the poor porosity value of the local soils at 750mm below ground level.

In addition, due to the local flooding and high ground water, the drainage mound would need to be installed on high ground at least 100m away from the proposed barn conversion. As such, a pumped system would be required.

Considering the above points, the installation of a packaged sewage treatment plant with a discharge to surface water would have a number of benefits:

1. By discharging to surface water, a gravity system can be used. This reduces power consumption and the potential for failure.
2. A discharge to surface water has a smaller installation carbon footprint.
3. A discharge to surface water has a lower impact/disruption on the local environment.
4. A discharge to surface water has a lower visual impact than a drainage mound.

The River Arrow is not an SAC or SSSI and has no nutrient issues highlighted. As such, there is no restriction on such a surface water discharge.

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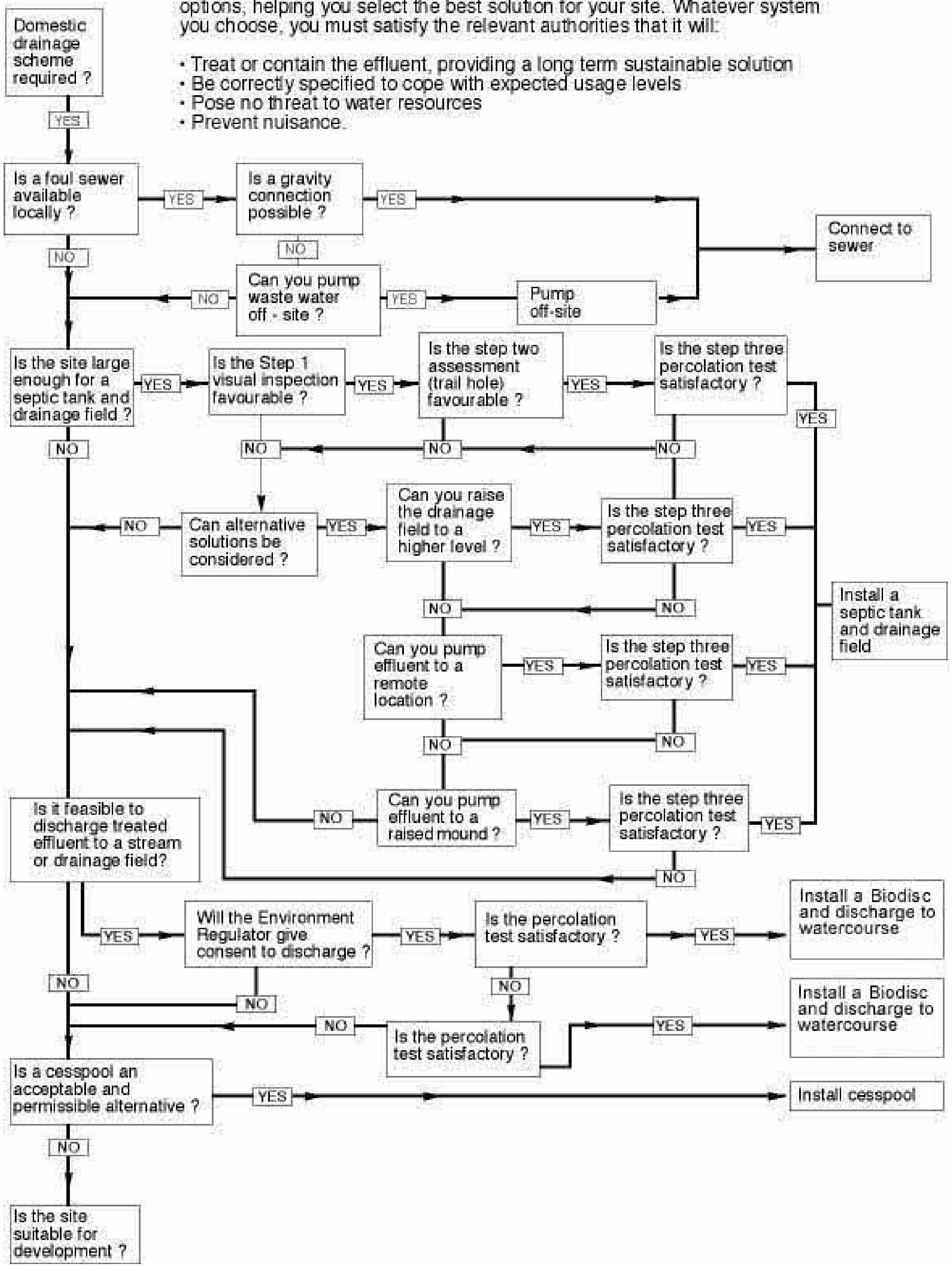
Site assessment and system selection

The flow chart below gives an overview of the principal off-mains drainage options, helping you select the best solution for your site. Whatever system you choose, you must satisfy the relevant authorities that it will:

- Treat or contain the effluent, providing a long term sustainable solution
- Be correctly specified to cope with expected usage levels
- Pose no threat to water resources
- Prevent nuisance.



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Packaged Sewage Treatment Plant Design

As previously identified, the site lies within the River Arrow Catchment. Although there is currently no nutrient issue identified in the River Arrow, every effort should be made to prevent pollution and reduce discharges of nitrates and phosphates.

As specified by Natural Resources Wales, all package sewage treatment plants must conform to BSEN.12566.

There are a limited number of package sewage treatment plant manufacturers that can also offer a phosphate reduction system.

As can be seen below, Marsh Industries offer the Gem APS packaged sewage treatment plant with a tested phosphate reduction system. This installation can reduce the phosphate discharge level to below 0.9mg/L and can reduce nitrate to lower than 0.4mg/L.

Certificate

405.01C01

Marsh Industries Limited
Units 2-20 Addington Park Industrial Est., NN14 4AS Northants, United Kingdom

EN 12566-7, Annex A
Small wastewater treatment systems for up to 50 PT

Small wastewater treatment system Gem APS – (P & NH4-N)
APS - Aerated precipitation system

Test report PIA2021-T7-405525

Nominal organic daily load (influent)	0.01 kg BOD_5/d		
Nominal hydraulic daily load	0.9 m^3/d		
Material	GRP		
Treatment efficiency		Efficiency	Effluent
	COD	57.6 %	24 mg/l
	BOD_5	75.8 %	2 mg/l
	TN_b	11.5 %	18 mg/l
	NH_4-N	21.1 %	0.4 mg/l
	P_{tot}	83.7 %	0.9 mg/l
	SS	30.4 %	14 mg/l
Electrical consumption	0.1 kW h/d		
Number of desludging	1		

Tested by:

PIA – Prüfinstitut für Abwassertechnik GmbH
(PIA GmbH)
Hergenrather Weg 30
52074 Aachen, Germany

[redacted]

This document replaces neither the declaration of performance nor the CE marking.

Notified Body No.: 1739

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The new off-mains foul drainage system is to serve one 3-bedroom dwelling and one 2-bedroom dwelling. The domestic sewage discharge loading must be designed in line with British Water Flows and Loads 4.

5 Domestic housing

- A treatment system for a single house with **up to and including 3 bedrooms** shall be designed for a minimum population (P) of 5 people.
- The size of a treatment system for a single house with more than 3 bedrooms shall be designed by **adding 1 P** for **each additional bedroom** to the **minimum single house value of 5 P,** eg:
  - house with 3 bedrooms = **minimum 5 P system**
  - house with 4 bedrooms = **minimum 6 P system (5+1)**
  - house with 6 bedrooms = **minimum 8 P system (5+3).**
- For groups of small 1 and 2 bedroom houses or flats
  - flat with 1 bedroom = **allow 3 P**
  - flat with 2 bedrooms = **allow 4 P**
- A treatment system serving a group of houses shall be designed by adding together the P values for each house calculated independently, eg:
  - for a group of two houses (3 and 4 bedrooms, respectively) the system shall be for a minimum of 11 P (5+6)
- **If the calculated total P for a group of houses exceeds 12 P then some reduction may be made** to allow for the balancing effects on daily flow of a group of houses (round UP not down)
  - **Where the total is 13-25 P** multiply the total by 0.9 to give an adjusted P value, e.g. if there are four four-bedroom houses the total P will be 24 P (4 x 6) and the adjusted P will be 22 P (24 x 0.9 = 21.6)
  - **Where the total is 26-50 P** multiply the total by 0.8 to give an adjusted P value, e.g. if there are four three-bedroom houses and three four-bedroom houses the total P will be 38 P (4 x 5 and 3 x 6) and the adjusted P will be 31 P (38 x 0.8 = 30.4)
- Where there are larger groups of houses, the P should be estimated using both the expected total load and the flow, considering both peak and total flow
- These are minimum recommended population (P) loads, they should not be modified downwards, upward modification may be necessary because of particular characteristics of each property or groups of properties.
- The above assessments of population (P) should be used for both existing and new properties

As can be seen from the previous extract from British Water Flows & Loads 4, the population equivalence (design population) for a 3-bedroom dwelling is 5-pe, and the population equivalence (design population) for a 2-bedroom dwelling is also 5-pe.

With this in mind, the necessary foul drainage system must be design for a potential population of 10pe (population equivalence).

Noting the previous information, a new GEM APS packaged sewage treatment plant, manufactured by Marsh Industries, should be installed. This packaged sewage treatment plant should be installed to serve the design population of 10pe.

It should be noted that the proposed sewage treatment plant should be located at least 7m away from all habitable parts of any dwelling and within 30m of a tanker access hardstanding.

The resulting treated effluent should then be discharged to the permanent watercourse. The point of discharge should be downhill of the proposed dwellings and more than 10m away from the proposed dwellings in line with Natural Resources Wales guidelines.

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Foul Water Disposal Conclusion.

After considering the site location and geology, the on-site testing has shown that the site is suitable for an off-mains foul drainage system.

The evidence shows that the foul sewage treatment system should be designed as follows:

> The foul drainage must be kept separate to the surface water and roof water drainage system.
>
> The foul drainage from the proposed dwellings should be laid to a packaged sewage treatment plant sized for a minimum potential population of 10pe.
>
> A GEM APS packaged sewage treatment plant, manufactured by Marsh Industries should be installed in order to minimise phosphate and nutrient discharges.
>
> The packaged sewage treatment plant should be located at least 7m from the proposed (and existing) dwellings.
>
> The packaged sewage treatment plant should be located within 30m of a tanker access hardstanding.
>
> The resulting effluent should be discharged to the local permanent watercourse.
>
> The new equipment should be maintained in line with the Manufacturers Guidelines and the General Binding Rules.

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Natural Resources Wales Consent to Discharge

The total design discharge will be 1500-litres per day. The Natural Resources Wales General Binding Rules state that any discharge to surface water (a watercourse) of more than 5,000-litres per day will require a Consent to Discharge or Exemption Certificate. In addition, any discharge to ground (a drainage field/mound) of more than 2,000-litres per day will require a Consent to Discharge or Exemption Certificate.

A small sewage discharge (SSD) is a discharge of domestic sewage effluent of 2 cubic metres or less per day to ground from septic tanks or small sewage treatment plants, or 5 cubic meters or less per day to surface water from small sewage treatment plants

As this proposed dwelling has a design discharge of 1500-litres per day, a Consent to Discharge or Exemption Certificate will NOT be required from Natural Resources Wales.

Ongoing Maintenance

Once the sewage treatment system has been installed. It will need to be Commissioned and maintained.

H+H Drainage would be pleased to complete the initial Commissioning in line with Manufacturers Guidelines and The Environment Agency guidelines.

The installed equipment will require monthly 'maintenance checks' to be undertaken by the homeowner(s) or operator(s).

Sewage Treatment Plant:

The sewage treatment plant will require desludging at least 12-monthly; depending on usage. The frequency will depend on usage; H+H drainage will be able to measure the sludge density in order to initiate the correct desludging regime.

In accordance with the General Binding Rules, the sewage treatment plant will require maintenance in line with the Manufacturer's Guidelines. As British Water Accredited Engineers, H+H drainage will complete this maintenance annually.

In order to conform to the General Binding Rules and to ensure that the off-mains sewage system is maintained correctly, a maintenance agreement should be undertaken once the new system has been installed.

Following is a copy of such an example maintenance agreement.

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Annual Maintenance agreement

MAINTENANCE AND SERVICING OF SMALL WASTEWATER TREATMENT SYSTEMS (PACKAGE PLANTS) UP TO 50 POPULATION (PE) AND LARGER SYSTEMS UP TO 1000 PE.

Customer: ####################

Site Address: ##################

H+H Drainage herewith agree to complete a scheduled maintenance visit (in accordance with the manufacturer's instructions and British Water Guidelines) at ###### **MONTHLY** intervals on the following equipment:

1x ########## Sewage Treatment Plant

1x ########## Pumping station

H+H Drainage also agree to replace any minor parts (up to the value of **£50.00** excluding VAT) where necessary in order to maintain operations and prevent pollution. Where parts costs exceed £50.00 excluding VAT, H+H Drainage will first attain permission from you before fitting new parts. Any parts supplied/fitted are to be invoiced additionally.

H+H Drainage will complete and submit a maintenance record sheet for each visit completed, as specified in the General Binding Rules. In addition, H+H Drainage will retain a duplicate copy of each maintenance record sheet.

The Customer will provide a clean water supply and a 230-volt domestic power supply at the sewage treatment plant. In addition, the Customer will grant H+H Drainage access to the plant(s) when necessary.

Exemptions:

H+H Drainage cannot be held responsible for any failures of the sewage treatment plant. In addition, H+H Drainage cannot be held responsible for the standard of final effluent leaving the sewage treatment plant. In order to maintain a high standard of discharge effluent, we ask all users of the sewage treatment plant to follow the attached guidelines.

Further, we ask all users of the sewage treatment plant not to flush items or chemicals that may be dangerous to our operators and engineers.

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Where new parts are required, H+H Drainage cannot be held responsible for late deliveries or delays, although every effort will be made to order by express delivery where necessary

Payment Terms:

All invoices exclude VAT. (unless stated otherwise)

Invoices are due for payment within 14-days from the date of invoice.

Any price increases by H+H Drainage will be notified prior to on-site works.

Termination.

The Client will give at least 30-days' notice of termination.

H+H Drainage will give at least 30-days' notice of termination.

The Agreement

This document, hereto signed by both parties shall constitute the entire binding agreement between H+H Drainage and the Customer. The Customer represents that they are the owner of the sewage treatment plant(s), or joint owner, subject to this agreement.

'Please complete the necessary maintenance visits on the sewage treatment plant(s) as per this agreement and current pollution Law;

Signed (On behalf of the Customer):

Position:

Date:

Signed (on behalf of H+H Drainage):

Position:

Date:

H+H Drainage

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HOW TO KEEP YOUR SEWAGE TREATMENT PLANT RUNNING SWEETLY

Sewage treatment plants use colonies of live natural micro-organisms to break down pollutants in domestic sewage. Many chemicals found in the household can inhibit or kill these micro-organisms, particularly if used in excessive amounts.

Bear in mind that treatment plants serving a few houses do not have the benefit of dilution that occurs at a large sewage works. A bottle of bleach tipped down the toilet in Birmingham would be virtually lost amongst the millions of gallons of sewage arriving at city's treatment works; a bottle of bleach in a plant serving half a dozen houses could be a lethal dose.

If the micro-organisms are damaged, they will usually recover in time. But in the meanwhile, one of the more obvious symptoms is an unpleasant smell, so it is in residents' interest to avoid this.

Generally speaking, all common household cleaning fluids are acceptable, provided they are used in accordance with the makers' instructions and stipulated concentrations.

The following are some of the most common chemicals found in household situations. It is not an exhaustive list and the golden rule is "If in doubt - leave it out." Bear in mind too that it isn't only the toilet that is connected to the treatment plant; anything that goes down the sink, bath etc. also ends up there.

Washing machine and dishwasher detergents, washing up liquids:
Perfectly all right in normal concentrations and usage. Problems can occur if, for instance, you are washing the jerseys of the local rugby club's five teams! Excess amounts of biological detergent can affect the biomass development. So, if you have to do unusual amounts of clothes washing it would be a good idea to spread it over a few days.

Floor cleaners, disinfectants and bleaches:
These are safe to use in accordance with the makers recommendations and in the minimum necessary concentration. Do not pour neat disinfectant or bleach down the sink or outside gullies. If these are smelly it usually indicates a buildup of decaying material or a plumbing problem and should be dealt with accordingly.

Nappy disinfectants and bottle sterilizing fluids eg. Milton:
When disposing of the used fluid, ensure that it is well diluted with water. The easiest way of doing this is usually to flush it away down the toilet.

Waste disposal units:
These do not inhibit the micro-organisms, but, depending on use, they can present the treatment plant with considerable extra load. Much better to compost your vegetable peelings etc. - it's cheaper and environmentally friendly.

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Home beer and wine making.
This presents a similar problem to waste disposal units. The treatment plant has to work as hard to treat one pint of beer tipped down the drain as it does to treat all the normal waste produced by one person in 24 hours. See also the notes above regarding Sterilizing fluids.

THE FOLLOWING MUST NOT BE DISCHARGED INTO THE DRAINS OF EITHER A SEWAGE TREATMENT PLANT OR SEPTIC TANK.

Motor oil, grease, anti-freeze, brake fluid etc.
Motor oil and grease are basically fats. Fat build-up is the most common reason for treatment plant failure, while anti-freeze and brake fluid are poisonous to microscopic organisms.

Cooking oil and fat.
Fat build-up is the most common reason for treatment plant failure. The human body, cooking and washing all result in fats and oils being discharged into the treatment plant, so it is best to keep fats to a minimum where possible.

Weed-killers, insecticides, fungicides and other gardening chemicals.
Fluids that kill germs in the kitchen, bathroom or garden also kill useful germs in your sewage treatment plant.

Paint, thinners, white spirit, turpentine, creosote etc.
Medicines
Take unused medicines to a pharmacist for safe disposal.

Photographic developing fluids.

Nappies, sanitary towels, wipes, syringes, soft toys, tennis balls etc.
It may seem a bit obvious to say this, but it is amazing what gets flushed down the loo from time to time. Although such items are not directly damaging to the micro-organisms, they can cause problems, not the least of which is simple blockage of the drains.

Even so-called disposable nappies, flushable-wipes, thread, kitchen paper-towel and sanitary towels often do not degrade fully in the treatment plant and can lead to malfunction, so it is best to dispose of them by other means.

In an ideal world, only toilet tissue and human waste should be flushed!

Finally, it is now a legal requirement to ensure that your sewage treatment plant is maintained correctly. This includes regular desludging/emptying and an annual maintenance visit by a British Water Accredited Engineer.

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