Weetwood
Development • Planning • Environment

LAND OFF WREXHAM ROAD, ABERMORDDU

SURFACE WATER DRAINAGE STRATEGY

Final Report v1.2

November 2017

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Report Title:	**Land off Wrexham Road, Abermorddu** Surface Water Drainage Strategy Final Report v1.2
Client:	The Clark Estate
Date of Issue:	8 November 2017

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1 INTRODUCTION

1.1 PURPOSE OF REPORT

Weetwood Services Ltd ('Weetwood') has been instructed by The Clark Estate to undertake a Surface Water Drainage Strategy (SWDS) for the proposed development of land off Wrexham Road, Abermorddu.

This SWDS has been prepared in accordance with the requirements of Technical Advice Note 15 (TAN15): Development and Flood Risk.

1.2 STRUCTURE OF THE REPORT

The report is structured as follows:

Section 1 Introduction and report structure

Section 2 Presents national and local flood risk and drainage planning policy

Section 3 Provides background information relating to the development site, the development proposals, ground conditions and existing site access arrangements

Section 4 Addresses the effect of the proposed development on surface water runoff and presents an illustrative surface water drainage scheme to ensure that surface water runoff is sustainably managed and flood risk is not increased elsewhere.

Section 5 Presents a summary of key findings

2 SITE DETAILS AND PROPOSED DEVELOPMENT

2.1 SITE LOCATION

The site is located west of Wrexham Road at Ordnance Survey National Grid Reference SJ 307 566, as shown in **Figure 1**. The site is approximately 3.45 hectares (ha) in area.

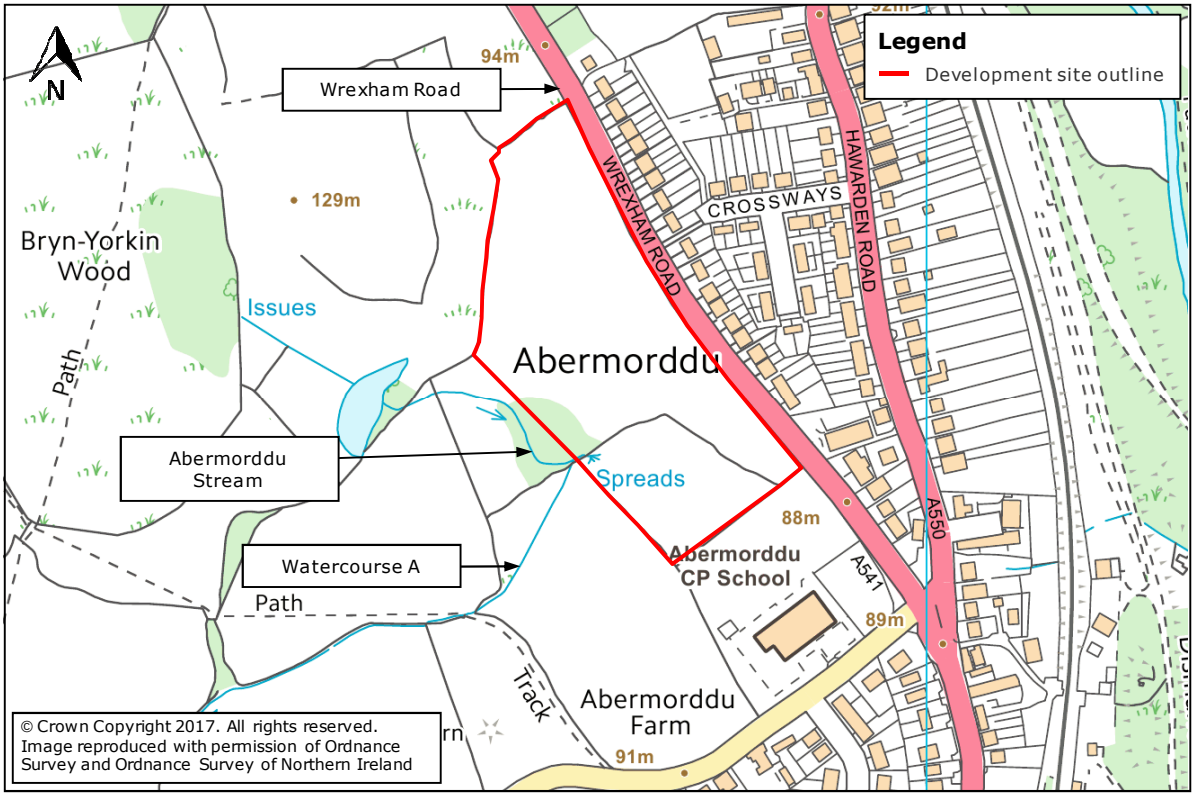

Figure 1: Site Location

2.2 EXISTING AND PROPOSED DEVELOPMENT

The existing site consists of undeveloped (greenfield) land.

The proposals are for the construction of approximately 80 residential properties (**Appendix A**).

TAN15 classifies residential development as *'highly vulnerable'* land use[1].

2.3 WATERBODIES IN THE VICINITY OF THE SITE

Abermorddu Stream flows in a predominantly south-easterly direction through the site. This is fed by an ordinary watercourse ('Watercourse A') which merges with Abermorddu Stream adjacent to the site's south-western boundary.

Abermorddu Stream and Watercourse A are each classified as an 'ordinary watercourse'.

[1] TAN15, Figure 2

2.4 GROUND CONDITIONS

British Geological Survey (BGS) borehole records[2] located approximately 120 m south-east of the site indicate that ground conditions within vicinity of the site may be variable, ranging from clays to gravels.

2.5 SITE LEVELS

A topographic survey of the site has been undertaken by Powers and Tiltman Ltd Land Surveyors and is provided in **Appendix B**. Site levels are generally shown to be in the region of 88.25 to 96.50 metres Above Ordnance Datum (m AOD), falling from north-west to south-east.

It should be noted that the lowest recorded site levels are located in the south-eastern corner of the site adjacent to Wrexham Road, which are approximately 200 mm lower than the lowest recorded point within Abermorddu Stream.

2.6 FLOOD ZONE DESIGNATION

Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. TAN15 defines flood zones as follows[3]:

- **Zone A.** Considered to be at little or no risk of fluvial or tidal/coastal flooding.
- **Zone B**. Areas know to have been flooded in the past evidenced by sedimentary deposits.
- **Zone C.** Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal). Zone C is subdivided into the following two zones:
  - **Zone C1.** Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.
  - **Zone C2.** Areas of the floodplain without significant flood defence infrastructure.

The Flood Zones are currently shown on the Natural Resources Wales (NRW) Flood Risk Map and do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding.

2.6.1 Development Advice Map

According to the latest Development Advice Map the site is located within Zone A (**Figure 2**).

[2] www.bgs.ac.uk/data/boreholescans/home.html, Ref: Sj35NW359, SJ35NW360
[3] TAN15, Figure 1

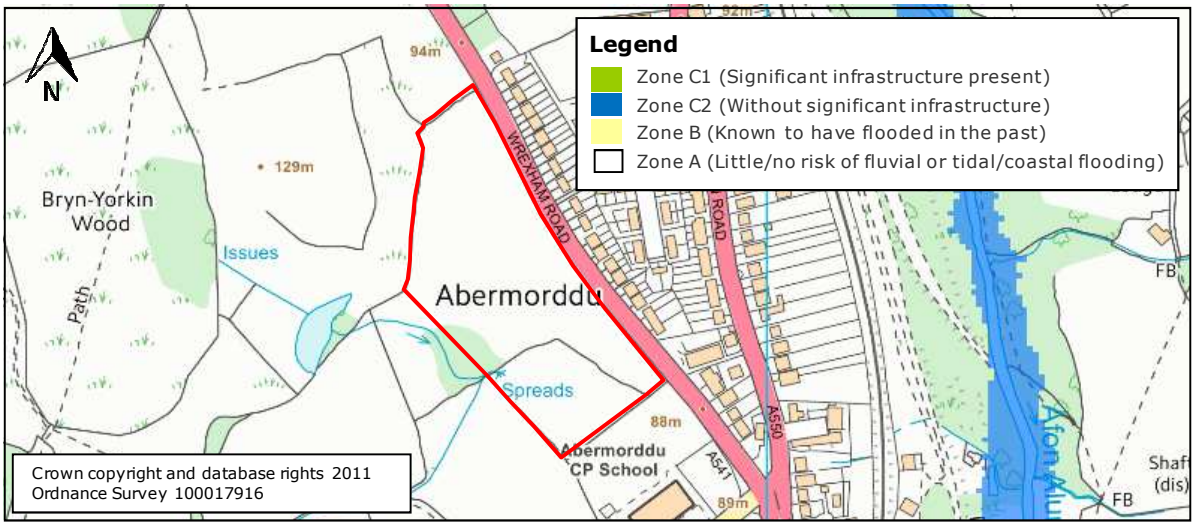

Figure 2: Development Advice Map
(Source: Welsh Government website)

2.6.2 Natural Resources Wales Flood Risk Map

According to the NRW Flood Risk Map (**Figure 3**) the site is located outside the 1 in 1,000 annual probability flood outline.

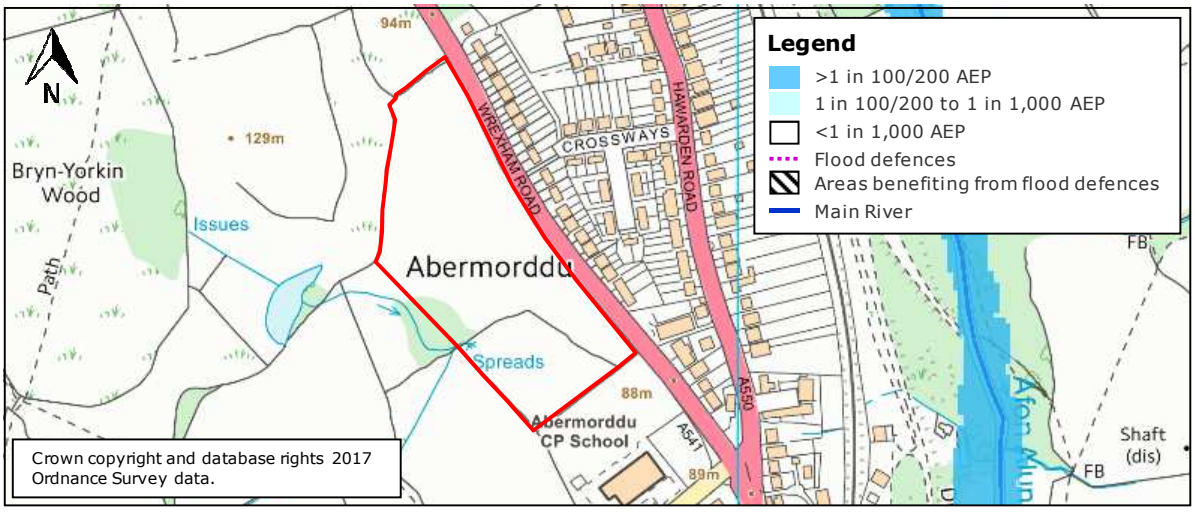

Figure 3: Natural Resources Wales Flood Risk Map
(Source: NRW website)

However, the flood risk posed by Abermorddu Stream is not likely to be accurately represented on the aforementioned flood maps due to its small catchment size. A hydraulic modelling report[4] and Flood Consequences Assessment (FCA)[5] has been undertaken by Waterco which quantifies the flood risk posed by this source. The findings of the Waterco report have been used to inform this SWDS.

[4] Wrexham Road, Abermorddu Hydraulic Modelling Report, ref: w3246-170429-HMR. Waterco Consultants, April 2017

[5] Wrexham Road, Abermorddu Flood Consequences Assessment, ref: w3246-170419-FCA. Waterco Consultants, April 2017

3 SURFACE WATER MANAGEMENT

3.1 REQUIREMENTS FOR SURFACE WATER MANAGEMENT

TAN15 provides an overview of the requirements for the management of surface water to ensure that development does not increase flood risk at the site or elsewhere.

Paragraph 8.3 of TAN15 states "*…the aim should be for new development not to create additional run-off when compared with the undeveloped situation, and for redevelopment to reduce runoff where possible. It is accepted that there may be practical difficulties in achieving this aim".*

3.2 DISPOSAL OF SURFACE WATER

Building Regulations Approved Document Part H sets out a hierarchy of preferred methods for the disposal of surface water runoff. Disposal by infiltration is preferred, followed by disposal to a watercourse, with disposal to a public sewer the least preferred option[6].

As stated in **Section 2.4**, based on BGS borehole records ground conditions may vary from clays to gravels within the locality. In the absence of any such site-specific information it is currently unclear whether infiltration will be feasible at the site. It is therefore assumed for the purposes of this report that infiltration would not be feasible. BRE Digest 365 infiltration testing should be undertaken at the detailed design stage to confirm this.

Discharging to Abermorddu Stream would be the next preferred option. However, review of the topographic survey indicates that it may not be feasible to discharge the entire site into the watercourse via gravity.

The proposed strategy therefore has two outfall locations:

- All land that can gravitate to Abermorddu Stream would discharge into the watercourse.
- For the residual land, in the absence of any other receptors, discharge to the public sewerage system would be the final option. Dŵr Cymru Welsh Water's (DCWW) public sewer records indicate a 150 mm diameter combined sewer located in Wrexham Road, east of the site, which surface water could be discharged to following development.

3.3 SITE AREAS

The site has been divided into two indicative sub-catchments in order to facilitate surface water drainage (**Figure 4**). The assumed impermeable area within each sub-catchment has been calculated based on a conservative percentage impermeable (PIMP) area of 65%, which should allow for flexibility during the detailed design stage.

Based on the above, the assumed impermeable area for each sub-catchment is provided in **Table 1**.

[6] Building Regulations Approved Document H, Section 3 page 45

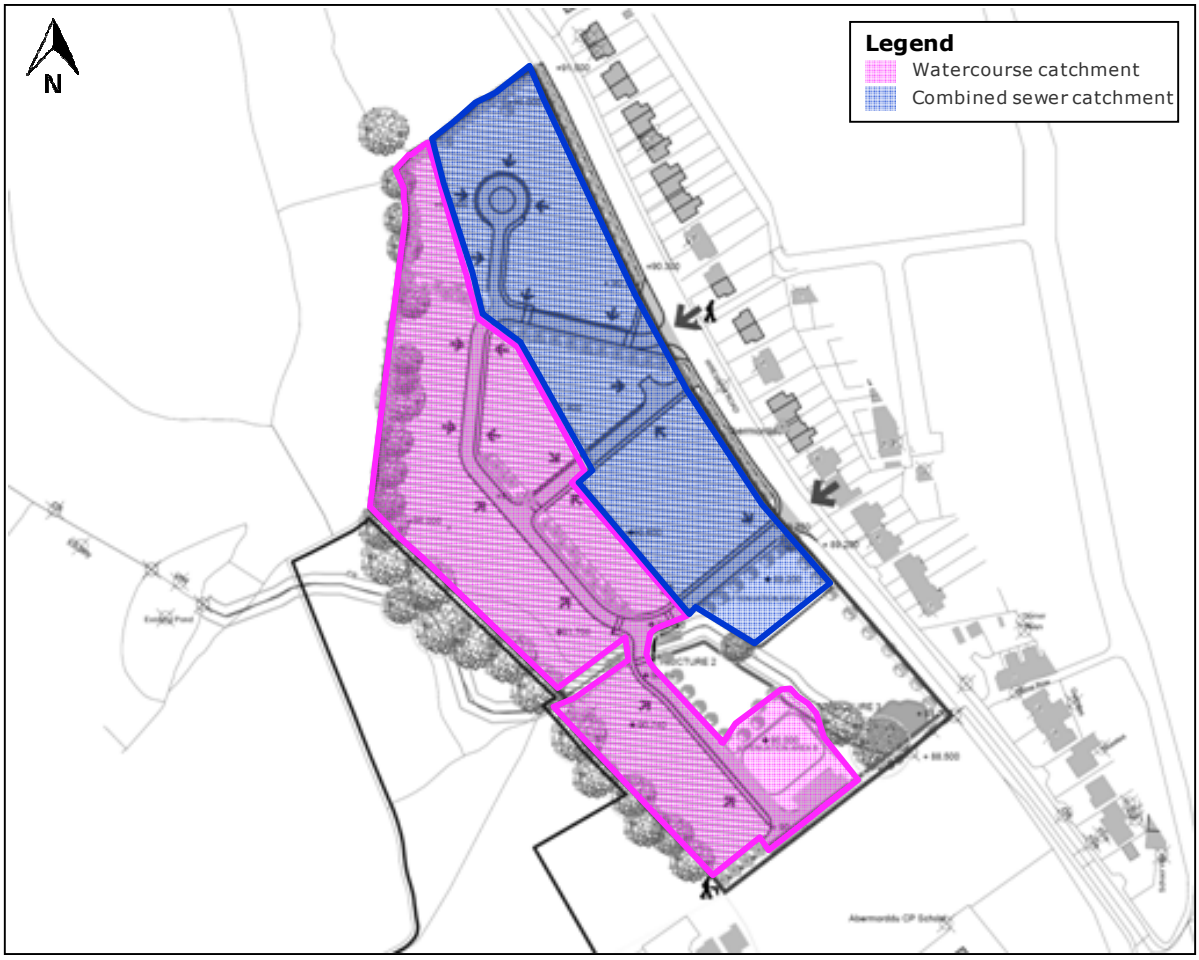

Figure 4: Indicative Surface Water Drainage Sub-catchments

Table 1: Assumed Sub-catchment Impermeable Areas

Sub-catchment	Area (ha)	Assumed impermeable area (ha)
Watercourse	1.64	0.96
Combined sewer	1.22	0.69

3.4 PEAK FLOW RATE

For greenfield sites, the peak runoff rate from the proposed development to any highway drain, sewer or surface water body for the 1 in 1 annual probability rainfall event and the 1 in 100 annual probability rainfall event should not exceed the peak greenfield runoff rate for the same event.

The site has a total area of 3.45 ha. The greenfield surface water runoff rate has been calculated using the ICP SUDS method within MicroDrainage (**Appendix C** and **Table 2**).

Table 2: Greenfield Runoff Rate

Annual probability of rainfall event	Greenfield Runoff Rate for 3.45 ha Site (l/s)
1 in 1	6.6
1 in 30	13.5
1 in 100	16.6

The proposed strategy has been designed to have two outfalls, both discharging at 5 l/s to Abermorddu Stream and the combined sewer respectively; this would result in a total discharge rate of 10 l/s for the site and should afford betterment over the existing greenfield runoff rates. Irrespective, discharge rates from each outfall are being limited to the lowest rate possible without risking blockage to the drainage system.

3.5 VOLUME CONTROL

Where reasonably practicable, for greenfield sites, the runoff volume from the proposed development to any highway drain, sewer or surface water body in the 1 in 100 annual probability, 6 hour rainfall event should not exceed the greenfield runoff volume for the same event.

Infiltration methods may not be suitable for disposing of surface water at the site (to be confirmed at the detailed design stage), and as discussed in **Section 3.4** runoff rates are to be restricted as far as is reasonably practicable. It is therefore considered that provision of long term storage should not be required at the developed site, and that the runoff rates outlined in **Section 3.4** will not adversely affect flood risk.

3.6 MANAGING SURFACE WATER WITHIN THE DEVELOPMENT

The surface water drainage system must be designed so that:

- Flooding does not occur on any part of the site for a 1 in 30 annual probability rainfall event, unless an area is designed to hold and/or convey water as part of the design;
- Flooding does not occur in any part of a building during a 1 in 100 annual probability event; and
- Flows resulting from rainfall in excess of a 1 in 100 annual probability rainfall event are managed in exceedance routes that minimise the risks to people and property, so far as is reasonably practicable.

The surface water storage facilities have been modelled using the Detailed Design module of MicroDrainage Source Control (**Appendix D**). The required storage volume has been sized to store the 1 in 100 annual probability rainfall event including a 30% increase in rainfall intensity in order to allow for climate change in accordance with DEFRA guidance[6].

3.6.1 Discharge to Watercourse

Assuming a peak discharge rate of 5 l/s and a design depth of 1.15 m, a total storage volume of 602.5 m^3 would be required.

The storage volume could be accommodated within a detention basin, with a surface area of 711.5 m², a depth of 1.3 m, which would fill to a depth of 1.15 m affording a 0.15 m freeboard.

The attenuation basin could be located in the southernmost part of the site. The basin would be located outside of the 1 in 1,000 annual probability flood outline derived through the hydraulic modelling study undertaken by Waterco.

The invert level of the basin would need to be set at a minimum of approximately 88.70 m AOD, in order to allow a gravity connection into Abermorddu Stream.

3.6.2 Discharge to Combined Sewer

Assuming a peak discharge rate of 5 l/s and a design depth of 1.0 m, a total storage volume of 386.6 m^3 would be required.

The storage volume could be accommodated within a detention basin, with an area of 569.0 m², a depth of 1.3 m, which would fill to a depth of 1.0 m affording a 0.3 m freeboard.

The attenuation basin could be located on land south of the southernmost access road. The basin would be located outside of the 1 in 1,000 annual probability flood outline derived through the hydraulic modelling study undertaken by Waterco.

The levels in vicinity of the proposed basin are currently in the region of 88.90 to 89.20 m AOD; a 1.3 m deep basin would have an invert level in the region of 87.90 m AOD. The DCWW combined sewer manhole cover (manhole node SJ30568601) has a cover level of 88.61; assuming a minimum 1.2 m cover above a 150 mm diameter pipe, the pipe invert level would be in the region of 87.26 m AOD. This should provide sufficient fall for the basin to connect to the public sewer system via a gravity connection.

3.6.3 Illustrative Surface Water Drainage Layout

Figure 5 provides an indicative surface water drainage layout for the site. Additional SuDS features, such as rainwater harvesting, permeable paving, bioretention areas, filter strips, swales or filter drains may be incorporated into the surface water drainage strategy at the detailed design stage.

The storage facilities have been sized to accommodate the entire storage requirements for the site. This is likely to be an overestimate as the storage capacity within the surface water conveyance system and other SuDS features has not been taken into account.

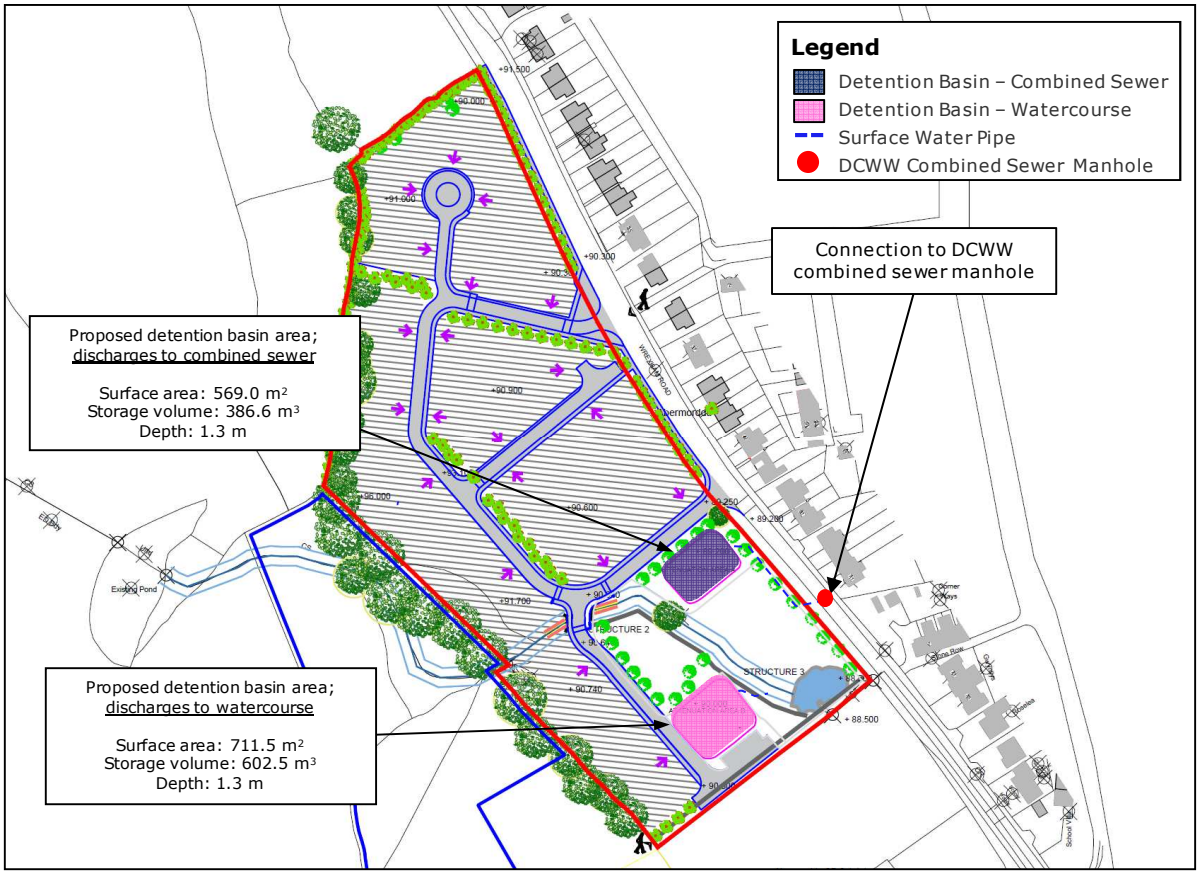

Figure 5: Indicative Surface Water Drainage Layout

3.6.4 Maintenance of SuDS

SuDS elements within the curtilage of residential dwellings would be the responsibility of the owner of the property.

The pipe network, designed to Sewers for Adoption (7th edition) standard, may be adopted by the sewerage undertaker.

SuDS in open spaces may be maintained by a management company.

3.7 SUMMARY

The purpose of this SWDS is to demonstrate that a surface water drainage strategy is feasible for the site given the development proposals and the land available. The proposals provide the opportunity for the inclusion of SuDS elements, ensuring that there will be no increase in surface water runoff from the proposed development. The storage calculations may be refined at the detailed design stage and a final decision made on the types of storage to be provided.

4 RECOMMENDATIONS

This SWDS has demonstrated that the proposed development may be completed without conflicting with the requirements of TAN15 subject to the following:

- The detailed drainage design, developed in accordance with the principles set down in this SWDS, should be submitted to and approved by the local planning authority prior to the commencement of development

APPENDIX A:	Development Proposals

KEY

- POS AND PLAY AREA
- STREAM WITH CLEAR ZONE
- PEDESTRIAN WAY
- EXISTING TREES RETAINED
- ROAD OVER STREAM CONCRETE BOX CULVERT INDICATIVE SIZE 1000 X 500 MM
- OVERHEAD POWER LINE
- GREEN LINK
- PLOT FRONTAGE
- VEHICLE ENTRANCE
- AREA REFERENCE
- PLANTING AND ATTENUATION AREA SURFACE WATER
- PROPOSED POND
- PROPOSED GABION BANK REINFORCEMENT TO INCREASE BED OF STREAM TO 1.5M, 10M EITHER SIDE OF STRUCTURE
- OTHER LAND IN OWNERSHIP SITE LIMITS
- + 89.200 PROPOSED LEVELS
- DEVELOPABLE AREA
- HIGHWAY & PEDESTRIAN

ARCHITECTS / URBAN DESIGNERS
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Web : www.tnw-architecture.co.uk

SCALEBAR: 0 20m 40m 60m 80m 100m 1:1000

REV:	DATE:	BY:	DESCRIPTION:
A	20/12/16	BWL	Flood storage area indicated and housing omitted in area "F"
B	6/02/17	BWL	Flood storage area indicated and housing altered to avoid flood plain
C	13/03/17	BWL	Flood storage and surface water area indicated and housing layout altered
D	06/04/17	BWL	Structure 2 proposal altered
E	06/04/17	BWL	Attenuation Areas Added and units reduced in numbers
F	17/07/17		Layout of parking and footway altered
G	29/08/17		Layout of entrance roads and housing layout to north
H	30/08/17		Amendment to green areas and turning head
I	06/10/17		Amendment turning head

CLIENT/PROJECT:
THE CLARK ESTATE

LAND AT ABERMORDDU

DRAWING TITLE:
INDICATIVE SITE PLAN

SCALE: 1:1000/250 1:2000/500@A3 A1
DATE: 17.10.17
DRAWN BY:
CHECKED BY:

NORTH: N

JOB/DRAWING NUMBER: 1610 :SK05
REVISION: I
STATUS: DRAFT

APPENDIX B:	Topographic Survey

Legend

AV	Air valve
BH	Borehole
BOL	Bollard
BT	British Telecom cover
CATV	Cable television cover
CL	Cover level
DPC	Damp proof coarsing level
Earth/ER	Earthing rod
ELEC	Electric cover
EP	Electricity pole
Fence I/R	Iron railing fence
Fence C/B	Closeboard fence
Fence C/P&P	Concrete post & panel fence
Fence Pa	Palisade fence
Fence P/W	Post and wire fence
Fence P/R	Post and rail fence
Fence P/P	Post and panel fence
FFL	Finished floor level
F/B	Flower bed
FH	Fire Hydrant
G	Gulley
GAS	Gas cover
IC	Inspection chamber
IL	Invert level
INV	Invert level
LP	Lamp post
LT	Light
MH	Manhole
Nynex	Telecommunications cover
OSBM	Ordnance Survey Bench Mark
PTM	Parking ticket machine
RE	Rodding eye
RS	Road sign
R/t wall	Retaining wall
SBX	Switch box
SP	Sign post
SPS	Safety playing surface
ST	Stop tap
SV	Service valve
TBM	Temporary Bench Mark
TP	Telegraph pole
TRP	Trial pit
TRL	Traffic light
W	Water cover
WL	Water level
WO	Wash out

SURVEY STATIONS

Name	Easting	Northing	Height
RC1	330786.217	356832.217	90.217
RC1A	330893.525	356676.626	88.693
RC2	330740.157	356779.492	91.243
RC3	330819.736	356626.013	90.420

KEY DIMENSIONS SHOULD BE CHECKED ON SITE BEFORE COMMENCEMENT OF ANY WORKS

NOTE

Grid and Levels
Related to OS
Via Active GPS Network

Amendments

	Date	Surveyor	Description of work

Powers & Tiltman Ltd
Land Surveyors

Meridian House
58/60 Hillside Road, Frodsham, Cheshire WA6 6AG
Tel: 01928 734473 Fax: 01928 735573
Email: mail@powerstiltman.co.uk
www.powerstiltman.co.uk

Wrexham Road
Abermorddu
Topographical Survey

Client : Fisher German

Surveyed By : RM	Date : 06/07/16	A0 @ 1:500
Drawn By : RM	Drawing No : 7558/01	
Checked By : MP	Amendment :	

APPENDIX C:	Greenfield Runoff Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	1.000	Urban	0.000
SAAR (mm)	818	Region Number	Region 9

Results l/s

QBAR Rural	2.2
QBAR Urban	2.2
Q100 years	4.8
Q1 year	1.9
Q30 years	3.9
Q100 years	4.8

APPENDIX D:	Surface Water Attenuation - Storage Volume Calculations

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.395	0.395	5.0	171.3	O K
30 min Summer	0.525	0.525	5.0	235.1	O K
60 min Summer	0.662	0.662	5.0	307.3	O K
120 min Summer	0.801	0.801	5.0	385.2	O K
180 min Summer	0.876	0.876	5.0	429.0	O K
240 min Summer	0.922	0.922	5.0	456.6	O K
360 min Summer	0.973	0.973	5.0	487.8	O K
480 min Summer	1.001	1.001	5.0	505.7	O K
600 min Summer	1.016	1.016	5.0	515.0	O K
720 min Summer	1.022	1.022	5.0	518.9	O K
960 min Summer	1.020	1.020	5.0	517.7	O K
1440 min Summer	1.004	1.004	5.0	507.7	O K
2160 min Summer	0.970	0.970	5.0	486.2	O K
2880 min Summer	0.931	0.931	5.0	462.3	O K
4320 min Summer	0.848	0.848	5.0	412.5	O K
5760 min Summer	0.757	0.757	5.0	360.0	O K
7200 min Summer	0.648	0.648	5.0	299.8	O K
8640 min Summer	0.551	0.551	5.0	248.4	O K
10080 min Summer	0.467	0.467	5.0	206.2	O K
15 min Winter	0.439	0.439	5.0	192.2	O K
30 min Winter	0.581	0.581	5.0	264.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	96.918	0.0	170.5	19
30 min Summer	67.029	0.0	236.2	34
60 min Summer	44.405	0.0	318.4	64
120 min Summer	28.487	0.0	408.6	124
180 min Summer	21.655	0.0	465.8	182
240 min Summer	17.694	0.0	507.3	242
360 min Summer	13.184	0.0	566.5	362
480 min Summer	10.704	0.0	612.4	482
600 min Summer	9.097	0.0	649.4	600
720 min Summer	7.960	0.0	680.1	720
960 min Summer	6.440	0.0	726.1	876
1440 min Summer	4.766	0.0	732.0	1114
2160 min Summer	3.518	0.0	912.6	1516
2880 min Summer	2.831	0.0	978.9	1932
4320 min Summer	2.079	0.0	1076.6	2768
5760 min Summer	1.668	0.0	1155.8	3584
7200 min Summer	1.408	0.0	1219.3	4328
8640 min Summer	1.226	0.0	1273.5	5016
10080 min Summer	1.090	0.0	1320.6	5744
15 min Winter	96.918	0.0	191.2	19
30 min Winter	67.029	0.0	264.4	33

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.732	0.732	5.0	345.9	O K
120 min Winter	0.884	0.884	5.0	434.0	O K
180 min Winter	0.967	0.967	5.0	484.4	O K
240 min Winter	1.019	1.019	5.0	516.7	O K
360 min Winter	1.078	1.078	5.0	554.7	O K
480 min Winter	1.113	1.113	5.0	577.9	O K
600 min Winter	1.134	1.134	5.0	591.6	O K
720 min Winter	1.145	1.145	5.0	599.1	O K
960 min Winter	1.150	1.150	5.0	602.5	O K
1440 min Winter	1.128	1.128	5.0	587.6	O K
2160 min Winter	1.084	1.084	5.0	558.7	O K
2880 min Winter	1.028	1.028	5.0	522.8	O K
4320 min Winter	0.903	0.903	5.0	445.5	O K
5760 min Winter	0.763	0.763	5.0	363.5	O K
7200 min Winter	0.584	0.584	5.0	265.9	O K
8640 min Winter	0.442	0.442	5.0	194.0	O K
10080 min Winter	0.331	0.331	5.0	141.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	44.405	0.0	356.7	62
120 min Winter	28.487	0.0	457.6	122
180 min Winter	21.655	0.0	521.5	180
240 min Winter	17.694	0.0	567.8	238
360 min Winter	13.184	0.0	633.4	356
480 min Winter	10.704	0.0	683.7	470
600 min Winter	9.097	0.0	722.9	584
720 min Winter	7.960	0.0	752.3	696
960 min Winter	6.440	0.0	769.7	914
1440 min Winter	4.766	0.0	745.4	1170
2160 min Winter	3.518	0.0	1022.0	1624
2880 min Winter	2.831	0.0	1096.2	2100
4320 min Winter	2.079	0.0	1204.1	2988
5760 min Winter	1.668	0.0	1294.5	3912
7200 min Winter	1.408	0.0	1365.7	4608
8640 min Winter	1.226	0.0	1426.6	5192
10080 min Winter	1.090	0.0	1479.6	5848

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.963

Time (mins) From:	To:	Area (ha)
0	4	0.963

Model Details

Storage is Online Cover Level (m) 1.300

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	390.5	1.000	628.9	1.300	711.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0103-5000-1150-5000
Design Head (m)	1.150
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.150	5.0
Flush-Flo™	0.340	5.0
Kick-Flo®	0.717	4.0
Mean Flow over Head Range	-	4.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.5	1.200	5.1	3.000	7.8	7.000	11.7
0.200	4.7	1.400	5.5	3.500	8.4	7.500	12.1
0.300	5.0	1.600	5.8	4.000	9.0	8.000	12.5
0.400	5.0	1.800	6.2	4.500	9.5	8.500	12.8
0.500	4.8	2.000	6.5	5.000	10.0	9.000	13.2
0.600	4.6	2.200	6.8	5.500	10.4	9.500	13.5
0.800	4.2	2.400	7.1	6.000	10.9		
1.000	4.7	2.600	7.3	6.500	11.3		

Suite 1 Park House
Broncoed Bus Park
Wrexham Rd Mold

Date 02/11/2017 15:33 | Designed by LucyRaven
File 2017-11-02 3428 Detenti... | Checked by
Micro Drainage | Source Control 2017.1.2

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.379	0.379	5.0	122.3	O K
30 min Summer	0.500	0.500	5.0	167.4	O K
60 min Summer	0.627	0.627	5.0	217.6	O K
120 min Summer	0.750	0.750	5.0	269.8	O K
180 min Summer	0.811	0.811	5.0	297.1	O K
240 min Summer	0.846	0.846	5.0	312.9	O K
360 min Summer	0.877	0.877	5.0	327.4	O K
480 min Summer	0.888	0.888	5.0	332.6	O K
600 min Summer	0.888	0.888	5.0	332.7	O K
720 min Summer	0.886	0.886	5.0	331.6	O K
960 min Summer	0.876	0.876	5.0	327.0	O K
1440 min Summer	0.848	0.848	5.0	313.9	O K
2160 min Summer	0.797	0.797	5.0	290.8	O K
2880 min Summer	0.742	0.742	5.0	266.5	O K
4320 min Summer	0.612	0.612	5.0	211.4	O K
5760 min Summer	0.476	0.476	5.0	158.1	O K
7200 min Summer	0.370	0.370	5.0	119.1	O K
8640 min Summer	0.288	0.288	5.0	90.2	O K
10080 min Summer	0.227	0.227	4.9	69.9	O K
15 min Winter	0.420	0.420	5.0	137.3	O K
30 min Winter	0.554	0.554	5.0	188.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	96.918	0.0	123.8	19
30 min Summer	67.029	0.0	171.7	33
60 min Summer	44.405	0.0	229.7	64
120 min Summer	28.487	0.0	294.9	122
180 min Summer	21.655	0.0	336.3	182
240 min Summer	17.694	0.0	366.4	242
360 min Summer	13.184	0.0	409.5	360
480 min Summer	10.704	0.0	443.3	480
600 min Summer	9.097	0.0	470.8	550
720 min Summer	7.960	0.0	494.3	608
960 min Summer	6.440	0.0	532.9	740
1440 min Summer	4.766	0.0	590.4	1008
2160 min Summer	3.518	0.0	657.4	1428
2880 min Summer	2.831	0.0	705.3	1844
4320 min Summer	2.079	0.0	776.7	2640
5760 min Summer	1.668	0.0	831.9	3344
7200 min Summer	1.408	0.0	877.6	4032
8640 min Summer	1.226	0.0	916.7	4672
10080 min Summer	1.090	0.0	950.8	5344
15 min Winter	96.918	0.0	138.8	18
30 min Winter	67.029	0.0	192.4	33

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.693	0.693	5.0	245.4	O K
120 min Winter	0.828	0.828	5.0	304.6	O K
180 min Winter	0.897	0.897	5.0	336.7	O K
240 min Winter	0.937	0.937	5.0	355.9	O K
360 min Winter	0.977	0.977	5.0	375.1	O K
480 min Winter	0.995	0.995	5.0	384.1	O K
600 min Winter	1.000	1.000	5.0	386.6	O K
720 min Winter	0.997	0.997	5.0	385.2	O K
960 min Winter	0.983	0.983	5.0	377.9	O K
1440 min Winter	0.945	0.945	5.0	359.7	O K
2160 min Winter	0.870	0.870	5.0	324.2	O K
2880 min Winter	0.787	0.787	5.0	286.2	O K
4320 min Winter	0.575	0.575	5.0	196.8	O K
5760 min Winter	0.375	0.375	5.0	120.9	O K
7200 min Winter	0.241	0.241	4.9	74.4	O K
8640 min Winter	0.163	0.163	4.7	49.3	O K
10080 min Winter	0.124	0.124	4.4	37.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	44.405	0.0	257.4	62
120 min Winter	28.487	0.0	330.3	120
180 min Winter	21.655	0.0	376.7	180
240 min Winter	17.694	0.0	410.4	238
360 min Winter	13.184	0.0	458.7	352
480 min Winter	10.704	0.0	496.4	464
600 min Winter	9.097	0.0	527.2	572
720 min Winter	7.960	0.0	553.4	678
960 min Winter	6.440	0.0	596.5	770
1440 min Winter	4.766	0.0	659.9	1082
2160 min Winter	3.518	0.0	736.3	1540
2880 min Winter	2.831	0.0	790.0	1992
4320 min Winter	2.079	0.0	870.1	2812
5760 min Winter	1.668	0.0	931.7	3464
7200 min Winter	1.408	0.0	983.0	4040
8640 min Winter	1.226	0.0	1026.8	4664
10080 min Winter	1.090	0.0	1065.2	5152

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.693

Time (mins) From:	To:	Area (ha)
0	4	0.693

Model Details

Storage is Online Cover Level (m) 1.300

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	287.0	1.000	495.4	1.300	569.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0105-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	105
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.0
Flush-Flo™	0.296	5.0
Kick-Flo®	0.637	4.1
Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.4	3.000	8.4	7.000	12.5
0.200	4.8	1.400	5.8	3.500	9.0	7.500	12.9
0.300	5.0	1.600	6.2	4.000	9.6	8.000	13.3
0.400	4.9	1.800	6.6	4.500	10.1	8.500	13.7
0.500	4.7	2.000	6.9	5.000	10.6	9.000	14.1
0.600	4.3	2.200	7.2	5.500	11.1	9.500	14.5
0.800	4.5	2.400	7.5	6.000	11.6		
1.000	5.0	2.600	7.8	6.500	12.1		

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