

Client Focused Professional Service Provider.



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SUDS STRATEGY REPORT.

REFSKFD:00260522.

Prepared 1 5th November 2021

FDL Consultants Ltd (FDL) have been commissioned to prepare a SUDS Strategy Assessment Report of the proposed development site, in order to provide the Local Planning Authority with information on the proposed development and the implementation of sustainable underground drainage system that will be site specific..

1.0 Sustainable Drainage Assessment

Site Address:

Lletty Cariard located as the Site Adjacent to 24 Curwen Close

Pontryhydyfen, Neath SA12 9UT

Site Location and Description. The 0.055 ha site is located at approximate National Grid Reference 278785E, 195365N, in the hamlet of Efail-Fâch around 1.5 km to the north of Pontrhydyfen and is currently derelict land. It is proposed to develop the site with semi-detached residential properties. The site is situated between existing residential properties at the end of a cul-de-sac, and slopes from 95.5 to 86.5 m AOD, east to west.

Grid Reference

278785E	195365N
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Report Prepared for :

Mrs Amanda Boucher,

Lletty Cariard, Curwen Close, Pontrhydyfen, Neath

SA12 9UT

Date: November 2021

Report Status: FINAL

Site Area: 0.055 HA

Reference: SKFD:00260522



The proposed Sustainable Drainage Scheme (SuDS) strategy is comprised of rainwater harvesting for non-potage use, garden water butts, permeable paving, filter beds to a attenuated grate cell , which will attenuate 9m3+ prior to discharge via a flow control chamber under connection to the Dwr Cymru Welsh water network out fall which is located to the South West utilising a Asset holders agreement with the Neighbouring property (prior to construction) .

2.0 EXECUTIVE SUMMARY

This report assesses the feasibility of a range of Sustainable Drainage Scheme (SuDS) options in support of the Site development process. A SuDS strategy is proposed to ensure surface water runoff can be managed effectively over the lifetime of the development.

SuDS SUITABILITY

Risk	Issue	Result
DISCHARGE LOCATION	What is the infiltration potential at the Site?	MODERATE/HIGH
	What is the potential to discharge to surface water features?	HIGH
	What is the potential to discharge to sewers?	LOW
	What is the potential to discharge to highway drains?	LOW
FLOODING	What is the fluvial flood risk at the Site?	VERY LOW
	What is the pluvial flood risk at the Site?	VERY LOW
	What is the groundwater flood risk at the Site?	VERY LOW
POLLUTION	Is the groundwater a protected resource?	NO
	Is the surface water feature a protected resource?	NO

Summary of existing and proposed development

The Site is currently a vacant infill site within an existing established development of mixed housing. Development proposal comprise the construction of a pair of 3 bedroomed semidetached homes. The topography of the existing site will be utilised in the proposed design. This requires a retaining wall and the required parking spaces. These will require the installation of permeable paving at the upper level and crated cell attenuation within the lower garden. Infiltration trenches will be utilised to transfer surplus storm water from catchment to the crate cell area. At each structure this infiltration trench will commence from a sump chamber to support the maintenance plan.

Summary of discharge route

FDL1511 001 (Source: <https://geosmartinfo.co>) Indicates the Site has moderate high potential for infiltration, primarily due to the high permeability of the underlying geology. Infiltration to

ground is therefore likely to be feasible. There is a surface of clay material FDL SI SI excludes the use of traditional soakaways to discharge water from site. Discharging all water at priority level 3 is therefore proposed using on site connections for both surface water and Foul.

FDL1511 002 NRW mapping indicates a surface water feature is located within 60 m south Westerly of the Site. However due to topography direct discharge into this feature should not be considered.

The regulated drainage and water search included in Appendix A confirms the Site is located within 10 m of the public sewer network a provision is included within deeds for discharge to a chamber positioned within No24 (noted in FDL AB 1021 005 Topographic Survey RED ARROW). However due to the gradient discharging to this sewer from the proposed development is not considered to be desirable. According to the topographic survey , highway gullies are located in front of the site, indicating the presence of the highway drainage network. The strategy of this development however is to manage the parking and pathway areas within the site curtilage by means of permeable grass cell units and brick paving for pathways. Roof run off will be managed by means of harvest for non-potage use within the dwelling, water butts for garden care and filter drain and crated attenuation.

Run off rate and attenuation requirements

Discharging via infiltration requires 8m³ of attenuation to be provided to ensure there is no flooding as a result of the development in all storm events up to and including the 1 in 100 year (6 hour storm) including a 40% allowance for climate change. This volume is subject to the results of infiltration testing and would ensure runoff is not increased above the Greenfield scenario. Discharging off-Site would require 8m³ of attenuation to be provided to ensure there is no flooding within the development in all storm events up to and including the 1 in 100 year including a 40% allowance for climate change. This volume is subject to the discharge rate being restricted to 2 l/s. prior to discharge via a flow control chamber under connection to the Dwr Cymru Welsh water network out fall which is located to the South West utilising a “Asset holders agreement” with the Neighbouring property (prior to construction)

Proposed SuDs strategy

Suds features comprised of rainwater harvesting butt, permeable paving , filter drains and a crated attenuation area are proposed to attenuate a minimum of 9 m³ of surface water runoff. The SuDs features would provide some water quality benefits (interception and filtration) prior to non-potage use within the home. Focused infiltration features should be sited at least 5m from building foundations and 2-3m from adjacent highways. The proposed SuDs strategy would ensure surface water runoff is stored on Site in SuDS features for the 1 in 100 year event including a 40% allowance for climate change and will not cause

flooding to the proposed development in accordance with DEFRA's non-statutory technical standards (DEFRA, 2015).

SuDS & drainage network maintenance

The management and maintenance of the SuDS features, in line with the details and schedules outlined in Section 11 of this report, will be undertaken by contractors appointed by the owners and occupiers of the new residential buildings. These will be included within the dwellings CDM file which will be provided to the properties end user. This will include but not limited to the periodic cleaning of the catch pits noted within the Site plan FDL AB 1021 003 attached, along with flow monitoring.

Recommendations / Next steps

Where site investigation confirms the underlying ground conditions are clayey, the condition and capacity of the surface watercourse should be confirmed and permission to discharge should be obtained from the Environment Agency along with required asset holder agreements with neighbouring properties.

3.0 PROPOSED STRATEGY

The most suitable SuDs options are outlined below and a SuDs strategy schematic is shown overleaf. Supporting information is provided in subsequent sections.

Table 1. Proposed SuDs type, features, discharge location and rate restriction

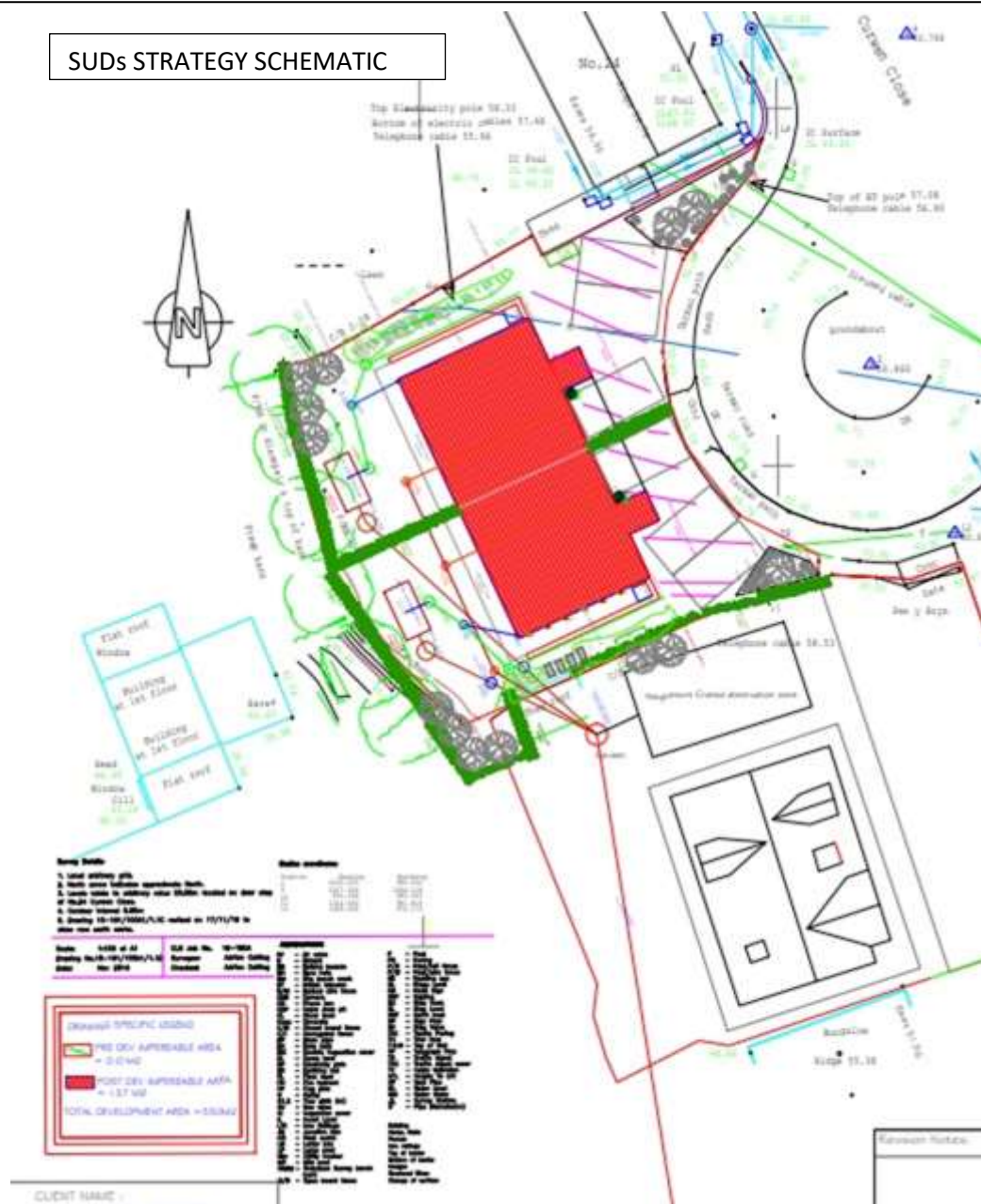
SUDS Type	Source control (Interception) and infiltration SuDs
Suds Feature	Rainwater Harvesting, Permeable paving and Soak away
Discharge location	Infiltration to ground

Table 2. Proposed SuDS sizing (dimensions) and attenuation volumes

Rain water harvesting	A rainwater harvesting butts should be established for the proposed development. In terms of attenuation storage within this SuDS scheme, volume of run-off which could be attenuated by Rainwater Harvesting has been considered within the Preliminary SuDS schematic. (Refer to PDF of UKSUDS.COM report attached.)
Permeable paving	A 148 m ² area of permeable paving (underlain with a Type 3 aggregate material) within the proposed driveway areas to a depth of 0.25 m, with a 30% porosity would result in c. 7.5 m ³ attenuation.
Crated area	2 separate crated s with a length of 3m, width of 1.5 m and depth of 1m within the rear gardens of the Site would result in c. 9 m ³ attenuation.
Total attenuation provided	9m ³
Total attenuation required	8 m ³
Free board storage provided	1m ³



SUDs STRATEGY SCHEMATIC



4.0 SITE ANALYSIS.

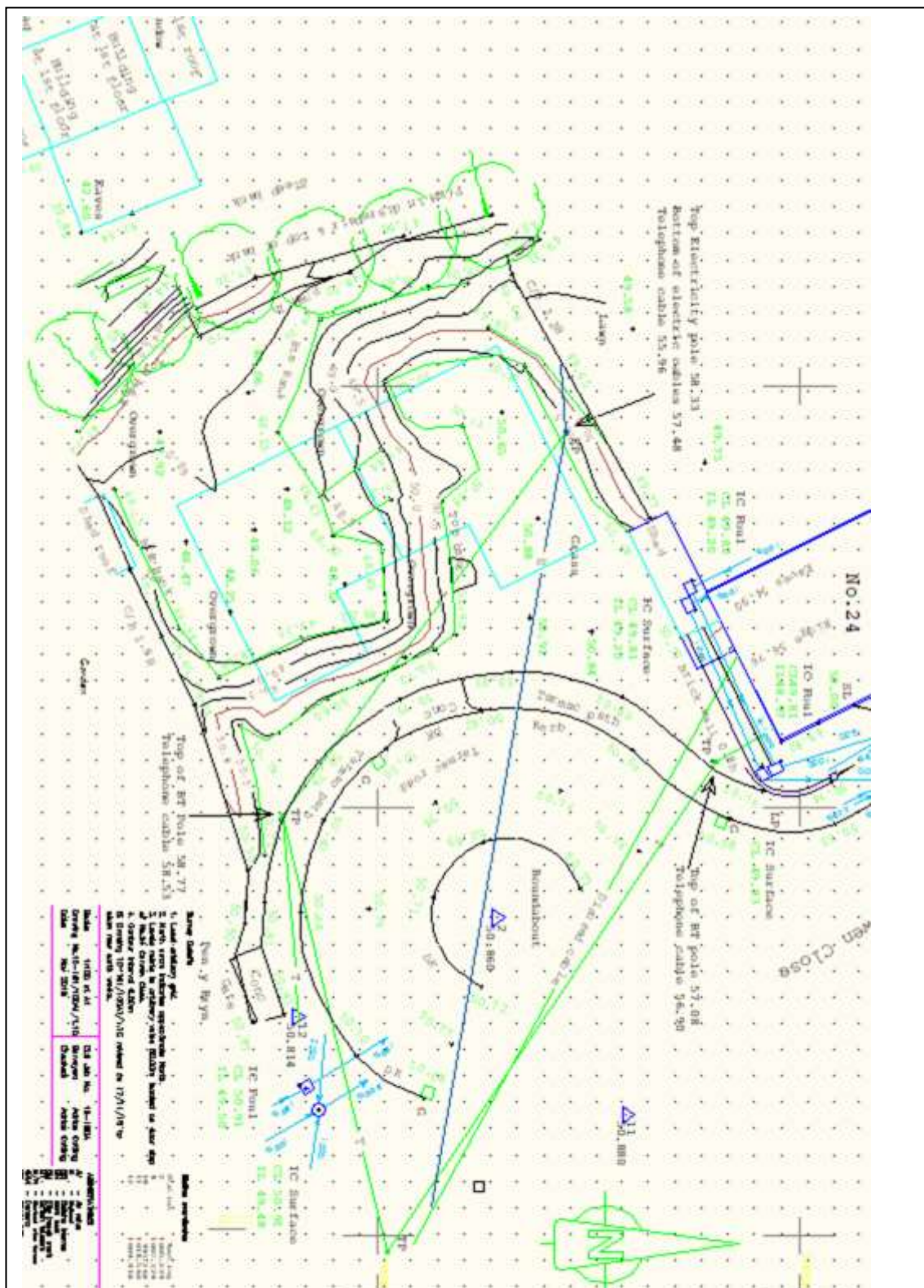




Brithdir Member - Sandstone. Sedimentary bedrock formed between 309.5 and 308 million years ago during the Carboniferous period

FDL's SuDs Infiltration Suitability Map screens the potential for infiltration drainage at the Site and indicates where further assessment is to be considered. The map combines information on the thickness and permeability of the underlying material and the depth to the high groundwater table. According to the map, there is a moderate to high potential for infiltration SuDs within the Site.

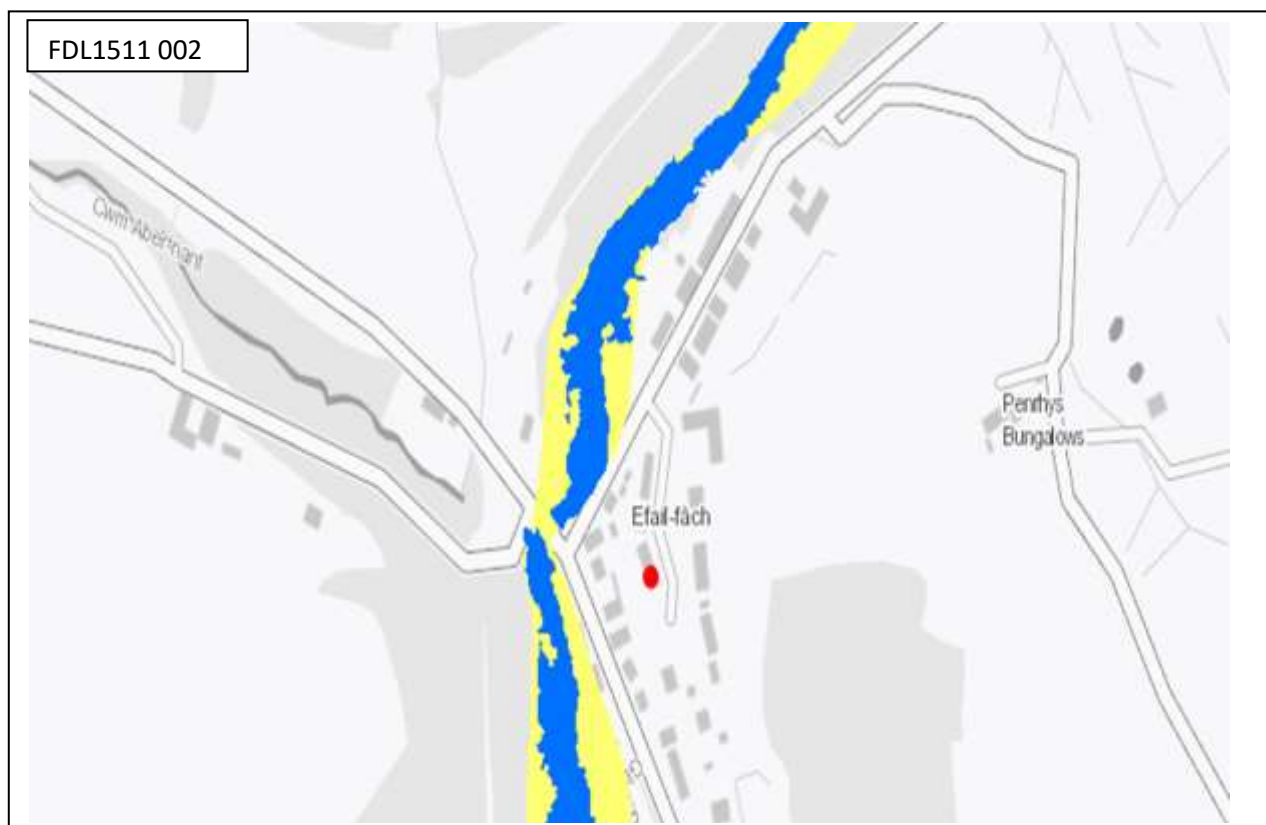
FDL AB 1021 005 TOPOGRAPHICAL SURVEY.



FDL have undertaken an assessment of the topography at the Site and within its vicinity, this survey shows a comparison between average ground levels on the Site with ground levels in

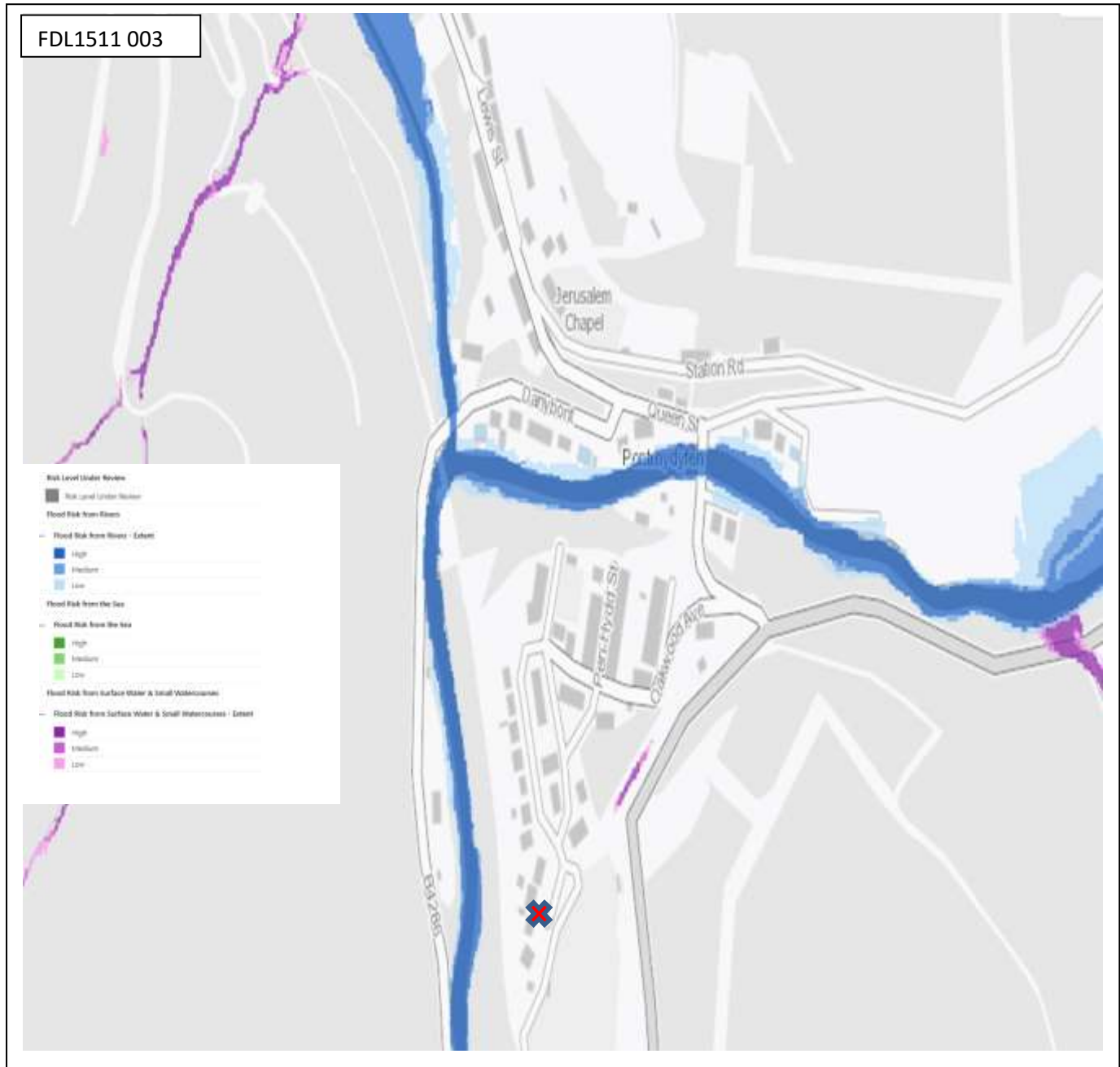
the surrounding area. The topographic data confirms the general level of the Site falls in a south westerly direction from 50.72 adjacent to highway and for a distance of circa only 2m then there is a sudden drop to 48.35 as a result of previous owners excavations, and as such not the natural topography of the location. From here for a distance of circa 16m the fall is gentle to 48.06 at the south, South Westerly boundary. From here again there is a significant drop due to a rock outcrop of some 8 plus meters to 39.88 . From the lower level there is clear evidence of rock face which is partially covered in vegetation. The boundary consists of a established Laurel hedge which is growing from the upper rock face over what is assumed to be soils deposited over years.

Source: National Resources Wales



FDL have undertaken an assessment of the EA groundwater Source Protection Zones (SPZ) within the vicinity of the Site. The Site is not within a SPZ, therefore, if applicable, infiltration to the ground is likely to be acceptable providing suitable mitigation measures are in place if required to prevent an impact on water quality from the proposed or historical land use. If hazards are identified, further consideration of the potential for any drainage system to cause pollution of groundwater is recommended. It is also recommended that the Local Authority and the EA are contacted to confirm the susceptibility of controlled water within the wider area.

Source: National Resources Wales



FDL have undertaken an assessment of the location of surface water features within the vicinity of the Site. The Pellenna River is located 55m south west of the Site and discharge to this watercourse is not feasible. Due to topography of the surrounding area the river is more than 8 m lower than the site and positioned across the B4287. Further analysis was undertaken by visiting the Site also by contacting the Local Council and the EA to confirm the presence, location and condition of other watercourses. There is both a foul and storm water discharge to the South west of the development and a agreement in principle is in place for the development to connect via a flow control chamber with a 20mm orifice restrict flow to 6l/s.

FDL have undertaken an assessment of the risk of flooding (FDL1511 003) from the rivers and the sea within the vicinity of the Site. Due to the elevated topography of the site it is deemed to be located at a negligible risk of flooding.

FDL have undertaken an assessment of the risk of flooding from groundwater sources(FDL1511 003). This was taken in view of aspects within the vicinity of the Site. The Site has a low risk of groundwater flooding. Therefore, SuDs design is considered unlikely are affected by flooding through the underlying geology. It was necessary that any SuDs are designed to operate in times when groundwater levels are high, so Site specific investigation was necessary to establish the depth to groundwater.

FDL have undertaken an assessment of the location of sewer features within the vicinity of the Site. A public surface water sewer is located within the established Curwen Close.

Further analysis of the connections and condition of the public surface water and foul drainage systems found that there are both Storm and Foul under Dwr Cymru Welsh water to the South West of the site, These would afford gravity fed outfall for Foul and subject to the afore mentioned flow control chamber the same for storm water. FDL have contacted Dwr Cymru Welsh water the drainage provider to confirm the presence, location and condition of these sewers. Consultation with the drainage provider in relation to the proposed foul sewer connection, and to gain permission to connect as required. Appendix Includes the planning pack received from DCWW. (To follow)

5.0 SITE IN CONTEXT.

Site information

The purpose of this report is to assess the potential for disposing of surface water through a sustainable drainage system (SuDs) for the site of Lletty Cariard, Curwen Close, Pontrhydyfen, Neath SA129UT (the Site). The Site is located in the hamlet of Efail-Fâch around 1.5 km to the north of Pontrhydyfen and is currently derelict land / green field.. Site plans and drawings are provided in the Appendix .

Site Visit

A walk of the Site and surrounding area was undertaken on the 15th November 2022 by Samuel Kingston. A summary of the findings are included below, with further detail available from other sections of the report, with photographs and a walkover pro-forma included in Appendix .

Ground Cover

The ground cover at the Site consists as follow. The site was purchased by the client in August of 2021 the site had been cleared and excavated by previous owners. The site remains clear of vegetation save for weeds. There is an existing Laurel hedge growing on the rock outcrop beyond the South Westerly boarder.

Topography

Refer to FDL AB 1021 005 within Appendix .This survey shows a comparison between average ground levels on the Site with ground levels in the surrounding area. The topographic data confirms the general level of the Site falls in a south westerly direction from 50.72 adjacent to highway and for a distance of circa only 2m then there is a sudden drop to 48.35 as a result of previous owners excavations, and as such not the natural topography of the location. From here for a distance of circa 16m the fall is gentle to 48.06 at the South, South Westerly boundary. From here a significant drop due to a rock outcrop of some 8 plus meters to 39.88 . From the lower level there is clear evidence of rock face which is partially covered in vegetation. The boundary consists of a established Laurel hedge which is growing from the upper rock face over what is assumed to be soils deposited over years.

On-site drainage

There is no onsite drainage .

Anecdotal evidence

The developer was present when the Site walkover was undertaken. It is understood the previous owner had excavated the site and was successful in achieving planning under reference P2018/0098 for a 3 storey dwelling. The site currently stands as was left with varying levels as recorded in the topographical survey. There is no knowledge locally of flooding of the site or the residential area of Curwen Close. The coal mining report and Risk assessment has raised no obstructions to development of the land. Report attached within Appendix.

Geology, permeability and thickness

British Geological Survey (BGS) national superficial and bedrock geology mapping confirms a number of different formations underlie the site and each formation may have a range of permeability.

Table 2. Site Geology

Geology present on site		Potentially permeable
Superficial geology	Till, Devensian - Diamicton	✓
Bedrock geology	Sandstone sedentary bedrock	✓



The permeability of the underlying material at the Site is likely to be relatively high and confirmation of the infiltration capacity has been calculated. SuDs are proposed directly into permeable superficial deposits. FDL PRE DEVELOPMENT RUN OFF ESTIMATE is attached within Appendix

Depth to groundwater

According to FDL investigation groundwater will be below the level of the Suds design at high water.



Ground conditions

A Site specific review of underlying ground conditions recommended to ensure focused infiltration does not cause ground instability as a result of landslide or collapse associated with dissolution or shallow mining. Hazards that were considered include soluble rocks, landslides, and compressible ground, and collapsible ground, shrink-swell clays, running sand and shallow mining. Crated cell attenuation should be a minimum of 5m away from the foundations of a building and local guidance may recommend a greater distance, such as 10m on some areas.

The confines of this development require the crate area to be long, deep and narrow to achieve this.

References CIRIA (2004). Sustainable drainage systems, hydraulic, structural and water quality advice. CIRIA Report C609. CIRIA (2007). The SuDS Manual. CIRIA Report C697. Water UK / WRc plc (2012). Sewers for Adoption (7th Edition) HR Wallingford. www.UKsuds.com

6.0 WATER QUALITY.

The Site does not lie within an SPZ. The infiltrated water quality should be of sufficient quality that it does not give rise to pollution of the underlying groundwater. Further consultation with the water company is unlikely to be required. Infiltration systems should not be used where there is a risk of contaminating groundwater by infiltrating polluted runoff or where receiving groundwater is particularly sensitive. The influence of surface runoff on water quality will depend on whether there is a source of contamination on Site and the sensitivity of the receiving environment, either groundwater or surface water. The intervening filter strip from source to receptor including mitigation and natural attenuation will determine the final impact. The impact of contaminants on the groundwater will be reduced by travel and natural attenuation through the unsaturated soil zone. A greater depth of unsaturated zone and the presence of significant clay and organic material will provide greater protection for the underlying groundwater. Rapid flow through fractures will provide less protection than intergranular flow around soil and rock particles.

7.0 NATIONAL & LOCAL POLICY CONTEXT.

National Guidance

CIRIA SuDs Manual (C753) (2015)

A development should utilise sustainable drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1. Use infiltration techniques, such as porous surfaces in non-clay areas,
2. Attenuate rainwater in ponds or open water features for gradual release,
3. Attenuate rainwater by storing in tanks or sealed water features for gradual release,
4. Discharge rainwater direct to a watercourse,
5. Discharge rainwater to a surface water sewer / drain,
6. Discharge rainwater to the combined sewer.

Defra - Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems (2015)

Peak Flow control

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

Volume control

Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never

exceed the runoff volume from the development site prior to redevelopment for that event. The runoff volume must be discharged at a rate that does not adversely affect flood risk. The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.

Ministry of Housing, Communities & Local Government – National Planning Practice Guidance: Flood risk assessments: climate change allowances (2014)

The Peak rainfall intensity allowances section provides advice on the increased rainfall effects on river levels and land and urban drainage systems. The anticipated changes in peak rainfall intensity in small catchments (less than 5 km²) and urban catchments are shown in Table 4. For large rural catchments use the alternative allowances defined for rivers. In order to understand the range of impact, both the central and upper end allowances should be assessed.

The drainage system should be designed to make sure there is no increase in the rate of runoff discharged from the site for the upper end allowance. Where on-site flooding for the upper end allowance presents a significant flood hazard (for example, depths and velocities of surface water runoff cause a significant danger to people), you will need to take further mitigation measures to protect people and property (for example, raising finished floor levels). As a minimum, there should be no significant flood hazard to people from on-site flooding for the central allowance.

Local Policy

The Planning (Wales) Act 2015 introduced a statutory purpose for the planning system. Any statutory body carrying out a planning function must exercise those functions in accordance with the principles of sustainable development as defined in the Well-being of Future Generations Act 2015. The Well-being of Future Generations (Wales) Act 2015 places a duty on public bodies that they must carry out sustainable development. This means the process of improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the sustainable development principle, aimed at achieving the well-being goals. The use of SuDS is a way of helping to achieve sustainable development in both new and existing developments.

From January 7th 2019, all new developments of more than 1 house or where the construction area is of 100m² or more will require sustainable drainage to manage on-site surface water. Surface water drainage systems must be designed and built in accordance with mandatory standards for sustainable drainage published by Welsh Ministers.

These systems must be approved by the local authority acting in its SuDS Approving Body (SAB) role before construction work begins. The SAB will have a duty to adopt compliant systems so long as it is built and functions in accordance with the approved proposals, including any SAB conditions of approval.

The legislation referred

Schedule 3 of the Flood and Water Management Act (FWMA) 2010 requires surface water drainage for new developments to comply with mandatory National Standards for sustainable drainage (SuDS). The statutory standards will be published by Welsh Government in the autumn but in the meantime, we recommend that you refer to the [Non-Statutory Ministerial National Standards](#) and the [CIRIA 753: The SuDs Manual](#).

Schedule 3 to the FWMA 2010 also places a duty on local authorities as SuDS Approving Body to approve, adopt and maintain systems compliant with section 17 of the Schedule. For further information on the legislation, please go to the [Schedule 3 of the Flood & Water Management Act 2010](#).

8.0 Proposed SUDs Strategy.

Surface water runoff

The Non-Statutory Technical Guidance for SuDS (Defra, March 2015) states: “Where reasonably practicable, for Greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the Greenfield runoff volume for the same event. Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the Greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.”

Table 3. Change in impermeable area associated with the development

TOTAL SITE AREA =	550M2
Impermeable area (and as a percentage of the total area of the proposed development footprint of 137 m2)	
PRE DEVELOPMENT	POST DEVELOPMENT
0 M2	137 M2
Previous impermeable land use:	New impermeable land use:
None	Building Roof

See FDL AB 1021 010 & FDL AB 1021 011 attached.

“The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event’ and ‘flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development” (Defra, March 2015, non-statutory guidance).

Sustainable drainage systems

It is recommended the drainage system has the capacity to accommodate the 1 in 100 year event before flooding occurs. Drainage from areas outside the development footprint will continue to use the existing drainage arrangements. A surface water drainage strategy (summarised in Section 2 of this report) includes the following SuDS features to intercept, attenuate and treat surface water runoff.

Primary SuDS Strategy

Infiltration to ground is achievable at the Site, a storage volume of 9 m³ should be provided within SuDS features. This would ensure the attenuation of surface water runoff required to achieve Greenfield run off volumes for a 1 in 100 year (6 hour) storm event, including a 40% allowance for climate change. This would be in line with Defra - Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems (March, 2015)

Table 4. Proposed SuDS type, features, discharge location and rate restriction

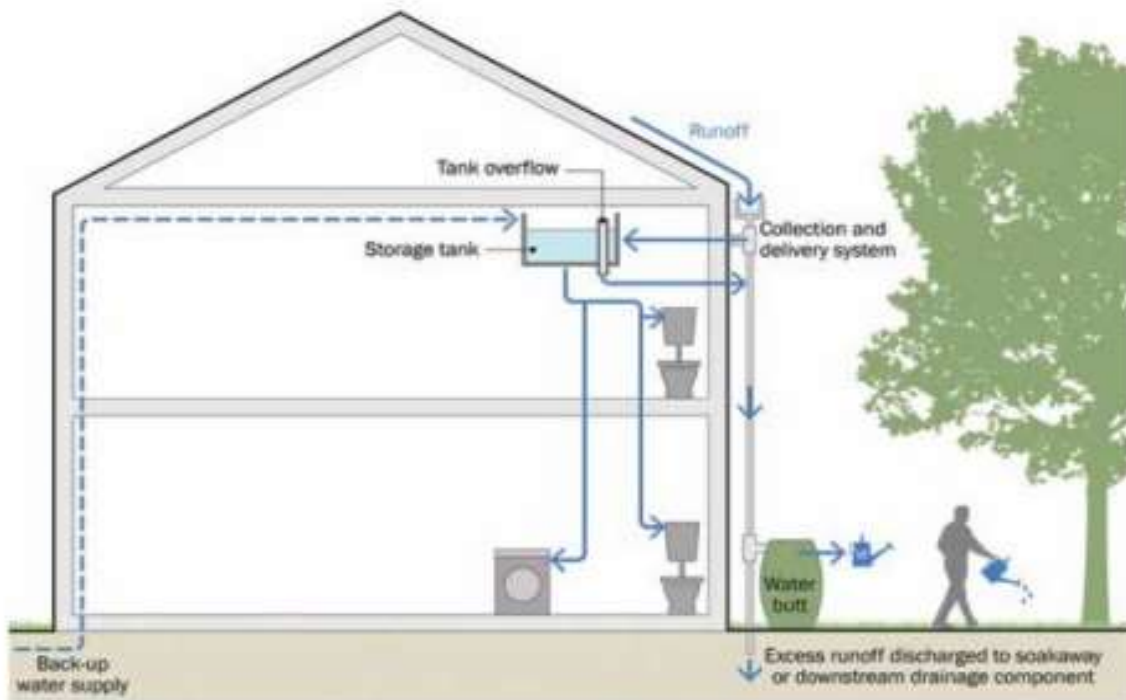
SuDS type	Source control (interception) and infiltration SuDS.
SuDS features	Infiltration to ground. Connection to Dwr Cymru Welsh Water Network via asset holder agreement
Discharge location	Infiltration to ground.

Table 5. Proposed SuDS sizing (dimensions) and attenuation volumes

Rainwater Harvesting	A rainwater harvesting butts should be established for the proposed development. In terms of attenuation storage within this SuDS scheme, volume of run-off which could be attenuated by Rainwater Harvesting has not been considered within the Preliminary SuDS schematic.
Permeable paving	A 148 m ² area of permeable paving (underlain with a Type 3 aggregate material) within the proposed driveway & path areas to a depth of 0.25 m, with a 30% porosity would result in c. 7.5 m ³ attenuation.
Crate Cell Attenuation	2 separate crated attenuation area with a length of 3m, width of 1.5 m and depth of 1m within the rear gardens of the Site would result in c. 9 m ³ attenuation.
Filter Strips	Storm water will be piped to minimum of 3m from Dwellings, from here to the pre cell catch pit filter strips will be utilised to allow some or all of the water to disperse into strata thus both slowing the velocity to the required cell crate area, and filtering sediment and pollutants
Total attenuation provided	9m ³
Total attenuation required	8m ³
Free board storage provided	1m ³

Rain water harvest

A rainwater harvesting butt per dwelling should be established for the proposed development. The run-off from the proposed development roof should be led into rainwater harvesting butts via rainwater downpipes and guttering to catch run-off from the dwellings roof. Overflow from the butts should be discharged into the storage system provided by the filter strips. Due to the relatively insignificant amounts of attenuation provided by rainwater harvesting tanks in this instance and the requirement to retain water for non-potable uses within the home have been calculated also such use as garden maintenance, the volume of run-off which could be attenuated by rainwater harvesting has **not been considered** within the report.



As there is an issue with the storage capability of Rainwater Harvesting tanks, this method should have a fixed attenuation volume and a controlled outlet to discharge into the proposed infiltration feature. An overflow system will be required for implementation on the Site due to exceedance events (where the pumps fail or there is a blockage within the system / or the number of residents and subsequent water usage is reduced). Roof run-off is generally less polluted than run-off from road surfaces but can still generate pollutants such as sediments. Pollutants would be captured by the collection and filtration system and, by reducing the volume of run-off generated from the Site. Primary screening devices are used to prevent leaves and other debris from entering the butt and first flush devices can be designed to divert the first part of the rainfall away from the main storage tank and can pick up most of the dirt, debris and contaminants that collect on a residential roof.

Permeable Paving

Permeable paving is proposed for an area of the car park and pathways. Suitable aggregate materials (angular gravels with suitable grading as per CIRIA, 2015) will improve water quality due to their filtration capacity and usually work to a 30% porosity. A geotextile layer will be required for paving underlain by aggregate material to intercept silt/particles. Permeable pavements are multi-layered surfacing systems. The surface layer is constructed out of permeable material allowing infiltration of water through gaps along its surface. A geomembrane isolates stored water from the surrounding soil, especially in contaminated areas and a geotextile layer prevents clogging and damage to the geo-cellular modules. The geotextile layer works to intercept silt/particles flowing through the system via direct rainfall, or through vehicle use deposited onto the car park area and into the permeable

paving. The majority of silt would be trapped within the top 30mm of the joining material between the paving blocks. Rainfall flowing into the permeable paving directly from the development roof/rainwater butts would not contain enough volumes of silt and or particles to cause blockage so will be fed directly into underlying porous substrate via rainwater pipes. Downpipes from the development roofs/rainwater butts should extend through the paving for c.5 meters to divert roof run-off away from building foundations. Paving could also implement an impermeable liner close to the building or creating a separate compartment within the permeable sub-base close to the building to further divert attenuated water away from building foundations.

Permeable paving schematic.



Permeable paving schematic

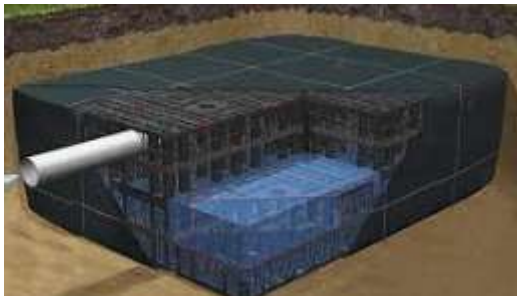


Plastic geo-cellular systems could also be used, which can increase the void space and therefore storage but do not allow filtration unless they are combined with aggregate material and/or permeable geotextiles which could increase their storage potential by up to 20%. Geocellular modules also have the added advantage of reducing the amount of aggregate sub base required, thus keeping costs lower. Void systems, such as permavoids, have a void ratio of 95% (i.e. for every 1 m³ there is 0.95 m³ of space available for water storage), which has been factored into the storage capacity calculations.

Crated Cell attenuation.

Attenuation cells, (also known as Storm Cells, Soak away Modules, and Storm Crates) are the modern equivalent of a soak away. They allow surface water to be stored in one location and gradually released back to the ground, a bit at a time, at a pace the ground can handle, rather than in one sudden deluge, as happens during a storm or downpour. In effect, the transfer of water from the surface to the ground is *attenuated*, is slowed down and stretched out over a longer period. If you dump 1,000 litres of water onto a patch of ground in one go, unless you're on sand or gravel, it's unlikely the ground will be able to absorb all that water instantly: attenuation cells work by taking all the water as fast as it's delivered, returning what it can to the ground as quickly as possible, but storing the surplus until the ground is ready and able to absorb it. Attenuation cells are specially manufactured, modular cells that provide lots of space (void space, as it's termed) within a cheap, lightweight structure that is capable of supporting quite significant loads when buried.

Crated cell attenuation schematic.



Discharge Route:

Infiltration to ground.

Exceedance Flow Route:

Where possible, exceedance flows should be directed away from buildings and into nonessential areas of the Site such as the car park. The SuDS system recommended for the Site should provide enough storage that this method would only be utilized during a worst case scenario. **In this site specific design** the over flow will be discharged to Dwr Cymru Welsh Waters network through a reduced flow chamber with a maximum orifice of 20mmDiam thus flow restricted to 6l/s.

Secondary SuDs strategy:

If infiltration to ground is not achievable at the site, an attenuation volume of 9m³ should be stored within lined SuDs features to accommodate the calculated 0.5 hour Critical Storm Duration for surface water discharge runoff, restricted to 2 l/s (DEFRA, 2015).

Table 5. Proposed SuDS type, features, discharge location and rate restriction

SuDS type	Source control (interception) and infiltration SuDS.
SuDS features	Permeable paving, filter strips, RW harvesting, attenuation cell Infiltration to ground. Connection to Dwr Cymru Welsh Water Network via asset holder agreement
Discharge location	Infiltration to ground / Overflow to Network
Discharge rate	6l/s

Table 6. Proposed SuDs sizing (dimensions) and attenuation volumes

Rainwater Harvesting	A rainwater harvesting butt should be established for the proposed development. In terms of attenuation storage within this SuDs scheme, volume of run-off which could be attenuated by Rainwater Harvesting has not been considered within the Preliminary SuDs schematic.
Crate Cell Attenuation	2 separate crated attenuation area with a length of 3m, width of 1.5 m and depth of 1m within the rear gardens of the Site would result in c. 9 m ³ attenuation.
Total Attenuation Provided	9m ³
Total Attenuation Required	8m ³
Freeboard Storage	1m ³

Hydrobrake

Flow control systems are required to reduce the runoff from the Site. These are usually a device used for controlling water flow into a connecting feature, such as a sewer, to a specific attenuation performance. The design consists of an intake, a volute and an outlet and the configuration is critical to ensure discharge control. For drainage areas which are less than 3 ha, outlet throttle diameters would have to be small (<150 diam) to achieve outflow rates which would result in blockage. For most SuDS features, a flow control device will comprise a fixed orifice or a throttle such as a short pipe

A Vortex Control

This is usually a self-activating vortex flow device which directs water into a volute to form a vortex. For the Site, rainwater down pipes from the development roof should drain directly into the attenuation feature to reduce infill from potential flood water.

A non-return flap

A non-return flap valve is also recommended for the outflow pipes to reduce the risk of backflow from the channel/sewer during a large scale rainfall event.

Discharge Route

Discharge of surface water runoff at 2 l/s via a hydro-brake or similar should be considered into the Rea Brook located south of the Site.

Exceedance Flow Route

Where possible, exceedance flows should be directed away from buildings and into nonessential areas of the Site such as the car park. The SuDS system recommended for the Site should provide enough storage that this method would only be utilized during a worst case scenario.

9.0 SuDs Maintenance.

Regular maintenance is essential to ensure effective operation of the SuDS features over the intended lifespan of the proposed development. The SuDS Manual (C753) (CIRIA, 2015) provides a maintenance schedule for SuDS with details of the necessary required actions as shown in the Table below.

Table 10. SuDs operation and recommended maintenance requirements

Asset type	Maintenance schedule (and frequency)
Rainwater Harvesting	Regular maintenance: • Inspection of tank for debris and sediment build up (annually and following poor performance). • Inspection of inlets, outlets, overflow areas, pumps and filters (annually and following poor performance). • Cleaning of tank, inlets, outlets, gutters, roof drain filters and withdrawal devices (annually or as required). Remedial actions: • Repair or overflow erosion damage or damage to tank and associated components (as required)
Permeable pavements	Regular maintenance: • Brushing and vacuuming (three times per year). • Trimming any roots and surrounding grass and weeds that may be causing blockages (annually or as required). Monitoring: • Initial inspection (monthly). Inspect for poor performance and inspection chambers (annually)
Crate Cell Attenuation	Regular maintenance: • Remove litter and debris pre entry catch pit (annually). Monitoring: • Inspect inlets, outlets and overflows for blockages (monthly)
Hydro Brake Flow Control	Low amounts of maintenance required as there are no moving parts within the Hydro-Brake® Flow Control. • Initial monthly inspection at the manhole once the construction phase is over. If blockages occur they normally do so at the intake. Hydro-Brake® Flow Controls are fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur. Inspection should be undertaken annually or when a storm event occurs.

Client checklist

A drainage strategy has been recommended as suitable on the basis of the information provided. Prior to installation of the site drainage system it is recommended that the client carries out the following checks to confirm the development proposals. FDL would be able to support with any updates required to the drainage scheme, please contact us and we would be happy to provide you with a proposal to undertake the work.

Table 11. Potential SuDS limitations

Conditions in Non-Statutory Technical Standards (Defra, 2015), limitations to infiltration SuDs	Do these conditions arise at the site?
Is the surface runoff greater than the rate at which water can infiltrate into the ground?	
Is there an unacceptable risk of ground instability?	
Is there an unacceptable risk of mobilising contaminants?	
Is there an unacceptable risk of pollution to groundwater?	
Is there an unacceptable risk of groundwater flooding?	
Is the infiltration system going to create a high risk of groundwater leakage to the combined sewer?	

Table 12. SuDs design considerations

Confirm that potential flooding on site in excess of the design storm event and exceedance flow routes have been considered.	
Review options for the control of discharge rates (e.g. hydro brake).	
Confirm the owners/adopters of the drainage system. Consider management options for multiple owners.	
Is there an unacceptable risk of pollution to groundwater?	
Is there an unacceptable risk of groundwater flooding?	
Is the infiltration system going to create a high risk of groundwater leakage to the combined sewer?	
Review access and way leave requirements.	
Review maintenance requirements.	

Health and safety considerations for SuDs

FDL reports may include outline strategies or designs to support with development plans.

Any drawings or advice provided do not comprise any form of detailed design.

Implementation of any conceptual scheme options may constitute ‘Construction Work’ as defined by CDM Regulations (2015). The CDM Regulations place specific Health and Safety duties on those commissioning, planning and undertaking construction works. If you are uncertain what this means you should seek the advice of your architect, builder or other competent professional. FDL does not provide health and safety advisory services but we are required to advise you of your general responsibilities under CDM Please remember that detailed design work should be undertaken by a competent professional who might be your engineer, architect, builder or another competent party.

10 Methodology and limitations of study.

This report assesses the feasibility of infiltration SuDs and alternative drainage strategies in support of the Site development process. From April 6th 2015 SuDs are regulated by Local Planning Authorities and will be required under law for major developments in all cases unless demonstrated to be inappropriate. What is considered appropriate in terms of costs and benefits by the Planning Authority will vary depending on local planning policy, and Site setting. The Lead Local Flood Authority will require information as a statutory consultee on major planning applications with surface water drainage implications. The National Planning Policy Framework requires that new developments in areas at risk of flooding should give priority to the use of SuDs and demonstrate that the proposed development does not increase flood risk downstream to third parties.

How was the suitability of SuDs estimated for the Site?

There are a range of SuDs options available to provide effective surface water management that intercept and store excess runoff. When considering these options, the destination of the runoff should be assessed using the order of preference outlined in the Building Regulations Part H document (HM Government, 2010) and Defra's National Standards for SuDs (2015):

1. Discharge to the ground;
2. Discharge to a surface water body;
3. Discharge to a surface water sewer;
4. Discharge to a local highway drain;
5. Discharge to a combined sewer.

Data sets relating to each of the potential discharge options have been analysed to assess the feasibility of each option according to the hierarchy set out above. Hydrogeological characteristics for the Site are assessed in conjunction with the occurrence of SPZ's to assess infiltration suitability. The Site has been screened to determine whether flood risk from groundwater, surface water, fluvial or coastal sources may constrain SuDs. The distance to surface water bodies and sewers has been reviewed gauge whether these provide alternative options.

FDL Infiltration Suitability Maps

The FDL SuDs Infiltration Suitability Maps screens the suitability for infiltration drainage in different parts of the Site and indicates where further assessment is recommended. In

producing the SuDs Infiltration Suitability Map used data from the British Geological Survey on groundwater levels, geology and permeability to screen for areas where infiltration SuDS may be suitable. The map classifies areas into 3 categories of High, Medium and Low suitability for infiltration SuDS. This can then be used in conjunction with additional data on Site constraints to give recommendations for SuDS design and further investigation. The primary constraint on infiltration potential is the minimum permeability of the underlying material and in some cases the range in permeability may be considerable, ranging down to low. The map classifies these areas as moderate infiltration suitability requiring further investigation. In cases where the thickness of the receiving permeable horizon is less than 1.5 meters then additional Site investigation is recommended. If the Site is at risk of groundwater flooding for up to the 1% annual occurrence the map classifies these areas as moderate infiltration suitability requiring further investigation. FDL SuDS Infiltration Suitability Map is a national screening tool for infiltration SuDS techniques but a Site specific assessment should be used before final detailed design is undertaken.

How is the suitability to discharge to sewers and watercourses calculated?

The suitability to discharge to sewers and watercourses has been calculated using the distance from the Site to both. For example, where the Site is within 50m of a surface water body. Discharge to surface water is potentially appropriate subject to land access arrangements and a feasibility assessment. Where the Site is within 50m of a sewer, discharge to sewer is potentially appropriate subject to land access arrangements and a feasibility assessment. The utility company should be contacted to agree connection feasibility and sewer capacity

What is a Source Protection Zone?

The Environment Agency have defined Source Protection Zones (SPZs) for 2000 groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. The maps show three main zones (inner, outer and total catchment) and a fourth zone of special interest, which is occasionally applied. The zones are used to set up pollution prevention measures in areas which are at a higher risk. The shape and size of a zone depends on the condition of the ground, how the groundwater is removed, and other environmental factors. Inner zone (Zone 1) is defined as the 50 day travel time from any point below the water table to the source (minimum radius of 50 metres). Outer zone (Zone 2) is defined by a 400 day travel time. Total catchment (Zone 3) is defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source.

How was surface water runoff estimated from the site?

In accordance with The SuDs Manual (C753) (CIRIA, 2015), the Greenfield runoff from the Site has been calculated using the Ioh124 method and is assumed representative of the runoff generated on the undeveloped surfaces that are affected by the proposed development. The method used for calculating the runoff complies with the NPPF (DGLC, 2014). For the impermeable surfaces, it has been assumed that 100% runoff will occur (calculations provided in Appendix A). Rainfall data is derived from the Flood Estimation Handbook (FEH) CD-ROM, developed by NERC (2009). Only areas affected by the proposed development are considered in the flow and volume calculations. Permeable areas that remain unchanged are not included in the calculations as it is assumed these will not be actively drained and attenuated.

What is the peak discharge rate?

An estimation of peak runoff flow rate and volume is required to calculate infiltration, storage and discharge requirements. The peak discharge rate is the maximum flow rate at which surface water runoff leaves the site during a particular storm event, without considering the impact of any mitigation such as storage, infiltration or flow control. Proposed discharge rates (with mitigation) should be no greater than existing rates for all corresponding storm events. If all drainage is to infiltration there will be no discharge off site. Discharging all flow from site at the existing 1 in 100 event would increase flood risk during smaller events. Flow restriction is generally required to limit the final discharge from site during all events as a basic minimum to the green field QBAR rate. A more complex flow restriction which varies the final discharge rate from the site depending on the storm event will reduce the volume of storage required on site. Drainage to infiltration SuDS is subtracted from the total discharge off site to achieve a beneficial net affect

What is the total discharge volume?

The total discharge volume is calculated on the basis of the surface water runoff that has the potential to leave the site as a result of the assumed 6 hour duration design storm event. The runoff is related to the underlying soil conditions, impermeable cover, rainfall intensity and duration of the storm event. The total volume generated by the current site is compared to the potential total volume from the developed site (not taking into consideration any mitigation). The difference provides the minimum total volume that will need to be stored and infiltrated on site or released at a controlled rate. Guidance indicates that the total discharge volume should never exceed the runoff volume from the development site prior to redevelopment for that event and should be as close as is reasonably practicable to the Greenfield runoff volume.

11 Background SuDs Information

SuDs control surface water runoff close to where it falls. SuDs are designed to replicate, as closely as possible, the natural drainage from the Site before development to ensure that the flood risk downstream does not increase as a result of the Site being developed, and that the Site will have satisfactory drainage under current and likely future climatic conditions. SuDs provide opportunities to reduce the causes and impacts of flooding; remove pollutants from urban runoff at source; and combine water management with green space with benefits for amenity, recreation and wildlife. Government planning policy and planning decisions now include a presumption in favour of SuDS being used for all development Sites, unless they can be shown to be inappropriate.

Infiltration SuDs

Government policy for England & Wales is to introduce sustainable drainage systems (SuDS) via conditions in planning approvals. Guidance indicates that capturing rainfall runoff on site and infiltrating it into the ground (infiltration SuDs) is the preferred method for managing surface water without increasing flood risk downstream. The greatest benefit to general flood risk is if all runoff is infiltrated on site, however, this may not be feasible due to physical and economic constraints in which case infiltration may be considered as a part of an integrated drainage solution. The final design capacity for an infiltration SuDS system depends on the site constraints and the requirements of the individual Planning Authority and the Lead Local Flood Authority. The capacity of the ground to receive infiltration depends on the nature, thickness and permeability of the underlying material and the depth to the high groundwater table. The final proportion of the site drained by infiltration will depend on topography, outfall levels and a suitable drainage gradient. It is important to note that, even if the whole site cannot be drained by infiltration, the use of partial infiltration is encouraged, with the remainder of runoff discharged via other SuDS systems.

Types of infiltration SuDs

Infiltration components include infiltration trenches, soakaways, swales and infiltration basins without outlets, rain gardens and permeable pavements. These are used to capture surface water runoff and allow it to infiltrate (soak) and filter through to the subsoil layer, before returning it to the water table below. An infiltration trench is usually filled with permeable granular material and is designed to promote infiltration of surface water to the ground. An infiltration basin is a dry basin or depression designed to promote infiltration of surface water runoff into the ground. Soakaways are the most common type of infiltration device in the UK where drainage is often connected to over-sized square or rectangular, rubble-filled voids sited beneath lawns. According to the guidance in Building Research Establishment (BRE) Digest 365 (2007) a soak away must be able to discharge 50% of the

runoff generated during a 1 in 10 year storm event within 24 hours in readiness for subsequent storm flow. This is the basic threshold criteria for a soak away design and the internal surface area of the proposed soak away design options should be calculated on this basis by taking into account the soil infiltration rate for the Site. Developers need to ensure their design takes account of the construction, operation and maintenance requirements of both surface and subsurface components, allowing for any machinery access required.

SuDs maintenance and adoption

Regular maintenance is essential to ensure effective operation of the soak away(s) over the intended lifespan of the proposed development. A maintenance schedule for SuDs is required. Sewerage undertakers or Local Authorities may adopt SuDS and will require maintenance issues to be dealt with in accordance with their Management Plan. If the SuDS will not be adopted other provision is required with associated financial implications. Maintenance is a long-term obligation requiring the upkeep of all elements of the SuDS, including mechanical components (e.g. pumps), as well as inspections, regular maintenance and repair.

12 References and Glossary

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Glossary

Attenuation	Reduction of peak flow and increased duration of a flow event.
Combined sewer	A sewer designed to carry foul sewage and surface water in the same pipe.
Detention basin	A vegetated depression normally is dry except after storm events, constructed to store water temporarily to attenuate flows. May allow infiltration of water to the ground.
Evapotranspiration	The process by which the Earth's surface or soil loses moisture by evaporation of water and by uptake and then transpiration from plants.
FEH	Flood Estimation Handbook, produced by Centre for Ecology and Hydrology, Wallingford (formerly the Institute of Hydrology).
Filter drain or trench	A linear drain consisting of a trench filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water, but may also be designed to permit infiltration.

First flush	The initial runoff from a site or catchment following the start of a rainfall event. As runoff travels over a catchment it will collect or dissolve pollutants, and the “first flush” portion of the flow may be the most contaminated as a result. This is especially the case for intense storms and in small or more uniform catchments. In larger or more complex catchments pollution
Flood plain	Land adjacent to a watercourse that would be subject to repeated flooding under natural conditions (see Environment Agency’s Policy and practice for the protection of flood plains for a fuller definition).
Greenfield runoff	This is the surface water runoff regime from a site before development, or the existing site conditions for brownfield redevelopment sites.
Impermeable surface	An artificial non-porous surface that generates a surface water runoff after rainfall.
Permeability	A measure of the ease with which a fluid can flow through a porous medium. It depends on the physical properties of the medium, for example grain size, porosity and pore shape.
Runoff	Water flow over the ground surface to the drainage system. This occurs if the ground is impermeable, is saturated or if rainfall is particularly intense.

Sewerage undertaker	This is a collective term relating to the statutory undertaking of water companies that are responsible for sewerage and sewage disposal including surface water from roofs and yards of premises.
Soak away	A subsurface structure into which surface water is conveyed to allow infiltration into the ground. A subsurface structure into which surface water is conveyed to allow infiltration into the ground.
Treatment	Improving the quality of water by physical, chemical and/or biological means.

The terms included in this glossary have been taken from CIRIA (2015) guidance.

Data Sources

Aerial Photography	Contains Ordnance Survey data © Crown copyright and database right 2020 Blue-sky copyright and database rights 2020
Bedrock & Superficial Geology	Contains British Geological Survey materials © NERC 2020 Ordnance Survey data © Crown copyright and database right 2020
Flood Risk (RoFRS/Pluvial/Surface Water Features/SPZ)	Environment Agency copyright and database rights 2020 Ordnance Survey data © Crown copyright and database right 2020
Flood Risk (Groundwater) and SuDS infiltration suitability (SD50)	British Geological Survey materials © NERC 2020 Ordnance Survey data © Crown copyright and database right 2020

Sewer Location	Contains Ordnance Survey data © Crown copyright and database right 2020 Contains STL Regulated Drainage and Water Search data 2020
Topographic Data	OS LiDAR/EA Contains Ordnance Survey data © Crown copyright and database right 2020 Environment Agency copyright and database rights 2020

13 Appendices

- FDL SuDs pre planning application.
- FDL AB 1021 001 SITE LOCATION.
- FDL AB 1021 002 SITE LAYOUT.
- FDL AB 1021 003 SITE LANDSCAPE.
- FDL AB 1021 004 FLOOR PLANS.
- FDL AB 1021 005 FRONT & REAR ELEVATIONS.
- FDL AB 1021 006 SIDE ELEVATIONS.
- FDL AB 1021 009 PHOTO MONTAGE
- FDL AB 1021 010 PRE DEVELOPMENT IMPERMEABLE AREAS.
- FDL AB 1021 01 POST DEVELOPMENT IMPERMEABLE AREAS.
- NRW DEVELOPMENT MAP WITH SITE IDENTIFIED.
- NRW FLOOD AREAS MAP WITH SITE IDENTIFIED.
- PRE DEVELOPMENT RUN OFF ESTIMATION.
- NRW DEVELOPMENT MAP WITH SITE IDENTIFIED.
- SURFACE WATER STORAGE VOLUME ESTIMATION .
- NRW DEVELOPMENT MAP WITH SITE IDENTIFIED.
- ONLINE WORLD WEATHER / RAIN FALL AVERAGES NEATH.