FLOOD RISK AND DRAINAGE SOLUTIONS

NPPF Flood Risk Assessment

Land at Whitcher Wells, North of Dunsop Bridge

Report No: 2019-025-B

Client: Mr John Ibison

Date: 13/08/2019

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Contract

This report describes work commissioned by Shelley Coffey of Rural Solutions on behalf of Mr John Ibison dated 30th May 2019. Chris Vose of Flood Risk and Drainage Solutions carried out the work.

Disclaimer

This document has been prepared solely as a Flood Risk Assessment for Mr John Ibison. Flood Risk and Drainage Solutions accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

Executive Summary

Flood Risk and Drainage Solutions have been appointed by Shelley Coffey of Rural Solutions on behalf of Mr John Ibison to provide a Flood Risk Assessment in support of a planning application for a small glamping site on land at Whitcher Wells north of the village of Dunsop Bridge.

The application site currently comprises of a fish hatchery building, 2No small outbuildings, water tank, access track and grassed open space, located on land to the west of Whitendale Road, approximately 2.1km north of the village of Dunsop Bridge.

Using the topographical survey provided, site levels generally slope from west to east, ranging from 163.000m AOD along the west boundary, down to 147.000m AOD along the east boundary.

Two small natural channels/watercourses flow through the site, one through the north extent flowing in an easterly direction. The other is formed by three channels that merge into one flowing in a southerly direction out of the south east boundary.

Another channel/watercourse is located approximately 10m east of the site where it flows parallel along the west of the River Dunsop in a southerly direction, ultimately discharging into the River Dunsop approximately 300m south of the site.

Development proposals comprise of retention and alterations to the fish hatchery, removal of the small outbuilding, large outbuilding to be converted into managers accommodation, alteration of the water tank with the incorporation of a green roof and the erection of 4No timber camping pods with associated soft/hard landscaping areas.

The site is shown to be situated within Flood Zone 1 of the Environment Agency Flood Map and therefore has a low risk of fluvial flooding.

An assessment has concluded that the primary flood risk at the proposed development is from surface water flow routes that pass through the site.

Pluvial Flow Routes

The application site is located midway up a steep hill surrounded by a large expanse of rural green space, with a number of channelised topographical depressions which convey surface water runoff into the larger watercourses, in this instance the River Dunsop located approximately 85m east of the site.

Following evaluation of pluvial flooding it is concluded that even during the low risk event i.e. the 1000 year return period the anticipated flood depths within the channels/watercourses will be less than 300mm. Due to the steep nature of the topography flows will remain over 0.25m/s during all events.

The proposed timber camping pods have been located within the topographical high points of the site, so to remain outside of the areas affected by surface water flow routes

Providing that the timber camping pods are elevated a minimum of 300mm above existing ground levels the risk of pluvial flooding can be suitably managed.

Surface Water and Foul Drainage

At present the site comprises of green open space and 4No buildings, due to the size of the buildings engineering judgement suggests that surface water is not positively drained and therefore discharges onto the ground, where it makes its way into the channels/watercourse within the site.

Following a non-intrusive desk top study infiltration at the site is not considered to be feasible, a review of Soilscape maps identifies the site to be located on land which is considered to be *'Very acid loamy upland soils with a wet peaty surface'.*

Taking the above into consideration the use of large soakaways at the proposed development is not considered to be feasible.

The proposed development comprises of retention of the fish hatchery, small outbuilding and tank, which the erection of 4No small timber camping pods each with a roof area of 18m^2. All access roads are to be constructed using gravel/permeable material. Therefore, the total increase in impermeable area is considered to be 72m^2

Due to the scale and nature of the development, restricting discharge rates would result in an aperture that would be extremely small and become blocked on a regular basis. As such attenuation is not considered to be feasible at the proposed development site.

However, the development proposals do provide a planting buffer around the car parking area, this area could be utilised as a rain garden to slow down the time of concentration into the watercourse.

The proposed managers accommodation and tank will incorporate green roofs, which will mimic greenfield runoff and offset some of the volume of the new timber cabins.

Furthermore, the access road and car parking areas will be covered by gravel/ permeable coverings and will therefore not require any positive drainage infrastructure.

Flows resulting from the 4No proposed timber camping pods have been directed into a rainwater garden near the proposed car parking area, prior to a piped outlet, which will ultimately discharge into the channels/watercourse onsite.

The rain garden will help to slow down the time of concentration of surface water entering into the channel/watercourse.

Land Drainage Consent will be required from the LLFA prior to constructing any structure within 5m of the banks of the watercourse, this includes outfall structures.

Due to the lack of available public sewers within the vicinity of the application site foul flows from the site will have to be managed within a Package Treatment Plant, which would ideally be positioned within the car parking area to the south east.

A Package Treatment Plant should be sufficiently sized to cope with flows from the expected occupancy of the proposed development by a suitable supplier, to be specified by the client.

The Package Treatment Plant may require Consent to Discharge from the Environment Agency prior to construction of the outfall structure into the watercourse/channel within the centre of the site.

In order to facilitate dilution of effluent the Preliminary Drainage Strategy shows the outlet of the Package Treatment Plant connected to the surface water outfall.

Consent to Discharge will be required to allow effluent to discharge into the ordinary watercourse prior to connecting.

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1.0 Introduction

1.1 Terms of Reference

Flood Risk and Drainage Solutions have been appointed by Shelley Coffey of Rural Solutions on behalf of Mr John Ibison to provide a Flood Risk Assessment in support of a planning application for a small glamping site on land at Whitcher Wells in Clitheroe, Lancashire.

The site is shown to be situated within Flood Zone 1 of the Environment Agency Flood Map and therefore has a low risk of fluvial flooding.

It is usual for the Environment Agency to raise an objection to development applications within the floodplain, or Zones 2 and 3 of the flood map, until the issue of flood risk has been properly evaluated. The Agency will also object to developments where the total site area is in excess of 1 Hectare until suitable consideration has been given to the management of surface water runoff.

1.2 Objectives

The objective of this assessment is to evaluate the following issues in regard to flood risk at the application site.

- Suitability of the proposed development in accordance with current planning policy.
- Identify the risk to both the proposed development and people from all forms of flooding.
- Provide a preliminary assessment of foul and surface water management.
- Increasing the risk of flooding elsewhere e.g. surface water flows and flood routing.
- Recommendation of appropriate measures to mitigate against flooding both within the proposed development, and neighbouring land and property.

1.3 Data Sources

This assessment is based on desk-top study of information from the following sources:

- National Planning Policy Framework (2018)
- Planning Practice Guidance at www.gov.uk
- Building Regulations Approved Document H
- Environment Agency Flood Mapping
- Ribble Valley Borough Council Level 1 Strategic Flood Risk Assessment April 2017
- Ribble Valley District Flood Report February 2017
- British Geological Society – Historic Borehole Logs
- Cranfield University's Soilscape Viewer
- CIRIA C697 The SUDS Manual
- Chronology of British Hydrological Events (Dundee University)
- R&D Technical Report FD2320/TR2 (2005)

2.0 Planning Policy Context

2.1 Approach to the Assessment

An initial assessment indicates that the primary flood risk at the proposed development is from surface water flow routes that pass through the application site.

Consideration has also been given to the site flooding from secondary sources such as fluvial, groundwater; artificial water bodies; infrastructure failure and ponding.

The requirements for flood risk assessments are generally as set out in the 'Technical Guidance to the National Planning Policy Framework', updated in July 2018; and in more detail from the Environment Agency's 'Standing Advice on Flood Risk' available from www.gov.uk.

2.2 National Planning Policy Framework (NPPF)

The information provided in the flood risk assessment should be credible and fit for purpose.

Site-specific flood risk assessments should always be proportionate to the degree of flood risk and make optimum use of information already available, including information in a Strategic Flood Risk Assessment for the area, and the interactive flood risk maps available on the Environment Agency's website.

A flood risk assessment should also be appropriate to the scale, nature and location of the development.

2.2.1 Site Specific Flood Risk Assessment Checklist

The following checklist has been extracted from Flood Risk & Coastal Change Section available from www.gov.uk , updated in July 2018.

1. Development site and location

Provide a description of the site you are proposing to develop, including, or making reference to, a location map which clearly indicates the development site.

A. Where is the development site located? (e.g. postal address or national grid reference)
B. What is the current use of the site? (e.g. undeveloped land, housing, shops, offices)
C. Which Flood Zone (for river or sea flooding) is the site within? (i.e. Flood Zone 1, Flood Zone 2, Flood Zone 3).

Check the Flood Map for Planning (Rivers and Sea) and the Strategic Flood Risk Assessment for the area available from the local planning authority.

2. Development proposals

Provide a general summary of the development proposals, including, or making reference to, an existing block plan and a proposed block plan, where appropriate.

A. What are the development proposal(s) for this site? Will this involve a change of use of the site and, if so, what will that change be?
B. In terms of vulnerability to flooding, what is the vulnerability classification of the proposed development?
C. What is the expected or estimated lifetime of the proposed development likely to be? (E.g. less than 20 years, 20-50 years, 50-100 years?).

3. Sequential test

For developments in flood zones 2 or 3 only.

(If the development site is wholly within flood zone 1, this section can be skipped - go to section 4).

Describe how the sequential test has been applied to the development (if required, and as set out in paragraphs 101-104 of the National Planning Policy Framework); and provide the evidence to demonstrate how the requirements of the test have been met.

See paragraph 033 of the NPPF guidance for further information. (It is recommended that the Developer or Agent contacts the LPA to confirm whether the sequential test should be applied and to ensure the appropriate level of information is provided).

A. What other locations with a lower risk of flooding have you considered for the proposed development?
B. If you have not considered any other locations, what are the reasons for this?

C. Explain why you consider the development cannot reasonably be located within an area with the lowest probability of flooding (flood zone 1); and, if your chosen site is within flood zone 3, explain why you consider the development cannot reasonably be located in flood zone 2.
D. As well as flood risk from rivers or the sea, have you taken account of the risk from any other sources of flooding in selecting the location for the development?

Exception test

Provide the evidence to support certain development proposals in flood zones 2 or 3 if, following application of the sequential test, it is appropriate to apply the exception test, as set out in paragraphs 102-104 of the National Planning Policy Framework.

It is advisable to contact the local planning authority to confirm whether the exception test needs to be applied and to ensure the appropriate level of information is provided.

A. Would the proposed development provide wider sustainability benefits to the community? If so, could these benefits be considered to outweigh the flood risk to and from the proposed development?

B. How can it be demonstrated that the proposed development will remain safe over its lifetime without increasing flood risk elsewhere?
C. Will it be possible to for the development to reduce flood risk overall (e.g. through the provision of improved drainage)?

4. Climate Change

How is flood risk at the site likely to be affected by climate change? (The local planning authority's Strategic Flood Risk Assessment should have taken this into account). Further advice on how to take account of the impacts of climate change in flood risk assessments is available from the Environment Agency.

5. Site specific flood risk

Describe the risk of flooding to and from the proposed development over its expected lifetime, including appropriate allowances for the impacts of climate change. It would be helpful to include any evidence, such as maps and level surveys of the site, flood datasets (e.g. flood levels, depths and/or velocities) and any other relevant data, which can be acquired through consultation with the Environment Agency, the lead local flood authority for the area, or any other relevant flood risk management authority. Alternatively, you may consider undertaking or commissioning your own assessment of flood risk, using methods such as computer flood modelling.

A. What is/ are the main source(s) of flood risk to the site? (E.g. tidal/sea, fluvial or rivers, surface water, groundwater, other?). You should consider the flood mapping available from the Environment Agency, the Strategic Flood Risk Assessment for the area, historic flooding records and any other relevant and available information.
B. What is the probability of the site flooding, taking account of the maps of flood risk available from the Environment Agency, the local planning authority's Strategic Flood Risk Assessment and any further flood risk information?

C. Are you aware of any other sources of flooding that may affect the site?
D. What is the expected depth and level for the design flood? See paragraph 055 of the NPPF guidance for information on what is meant by a "design flood". If possible, flood levels should be presented in metres above Ordnance Datum (i.e., the height above average sea level).
E. Are properties expected to flood internally in the design flood and to what depth? Internal flood depths should be provided in metres.
F. How will the development be made safe from flooding and the impacts of climate change, for its lifetime? Further information can be found in paragraphs 054 and 059 (including on the use of flood resilience and resistance measures) of the NPPF guidance.
G. How will you ensure that the development and any measures to protect the site from flooding will not cause any increase in flood risk off-site and elsewhere? Have you taken into account the impacts of climate change, over the expected lifetime of the development? (e.g. providing compensatory flood storage which has been agreed with the Environment Agency).
H. Are there any opportunities offered by the development to reduce the causes and impacts of flooding?

6. Surface water management*

Describe the existing and proposed surface water management arrangements at the site using sustainable drainage systems wherever appropriate, to ensure there is no increase in flood risk to others off-site.

A. What are the existing surface water drainage arrangements for the site?
B. If known, what (approximately) are the existing rates and volumes of surface water run-off generated by the site?
C. What are the proposals for managing and discharging surface water from the site, including any measures for restricting discharge rates? For major developments (e.g. of ten or more homes or major commercial developments), and for all developments in areas at risk of flooding, sustainable drainage systems should be used, unless demonstrated to be inappropriate.
D. How will you prevent run-off from the completed development causing an impact elsewhere?
E. Where applicable, what are the plans for the ongoing operation and/or maintenance of the surface water drainage systems?

7. Occupants and users of the development

Provide a summary of the numbers of future occupants and users of the new development; the likely future pattern of occupancy and use; and proposed measures for protecting more vulnerable people from flooding.

A. Will the development proposals increase the overall number of occupants and/or people using the building or land, compared with the current use? If this is the case, by approximately how many will the number(s) increase?
B. Will the proposals change the nature or times of occupation or use, such that it may affect the degree of flood risk to these people? If this is the case, describe the extent of the change.
C. Where appropriate, are you able to demonstrate how the occupants and users that may be more vulnerable to the impact of flooding (e.g., residents who will sleep in the building; people with health or mobility issues; etc.,) will be located primarily in the parts of the building and site that are at lowest risk of flooding? If not, are there any overriding reasons why this approach is not being followed?

8. Residual risk

Describe any residual risks that remain after the flood risk management and mitigation measures are implemented, and to explain how these risks can be managed to keep the users of the development safe over its lifetime.

A. What flood related risks will remain after the flood risk management and mitigation measures have been implemented?
B. How, and by whom, will these risks be managed over the lifetime of the development? (e.g., putting in place flood warning and evacuation plans).

9. Flood risk assessment credentials

Provide details of the author and date of the flood risk assessment.

A. Who has undertaken the flood risk assessment?
B. When was the flood risk assessment completed?

Other considerations

* Managing surface water

The site-specific flood risk assessment will need to show how surface water runoff generated by the developed site will be managed. In some cases, it may be advisable to detail the surface water management for the proposed development in a separate drainage strategy or plan. You may like to discuss this approach with the lead local flood authority.

Surface water drainage elements of major planning applications (e.g., of ten or more homes) are reviewed by the lead local flood authority for the area. As a result, there may be specific issues or local policies, for example the Local Flood Risk Management Strategy or Surface Water Management Plan, that will need to be considered when assessing and managing surface water matters.

It is advisable to contact the appropriate lead local flood authority prior to completing the surface water drainage section of the flood risk assessment, to ensure that the relevant matters are covered in sufficient detail.
Proximity to Main Rivers

If the development of the site involves any activity within specified distances of main rivers, a flood risk activity permit may be required in addition to planning permission.

For non-tidal main rivers, a flood risk activity permit may be required if the development of the site is within 8 metres of a river, flood defence structure or culvert.

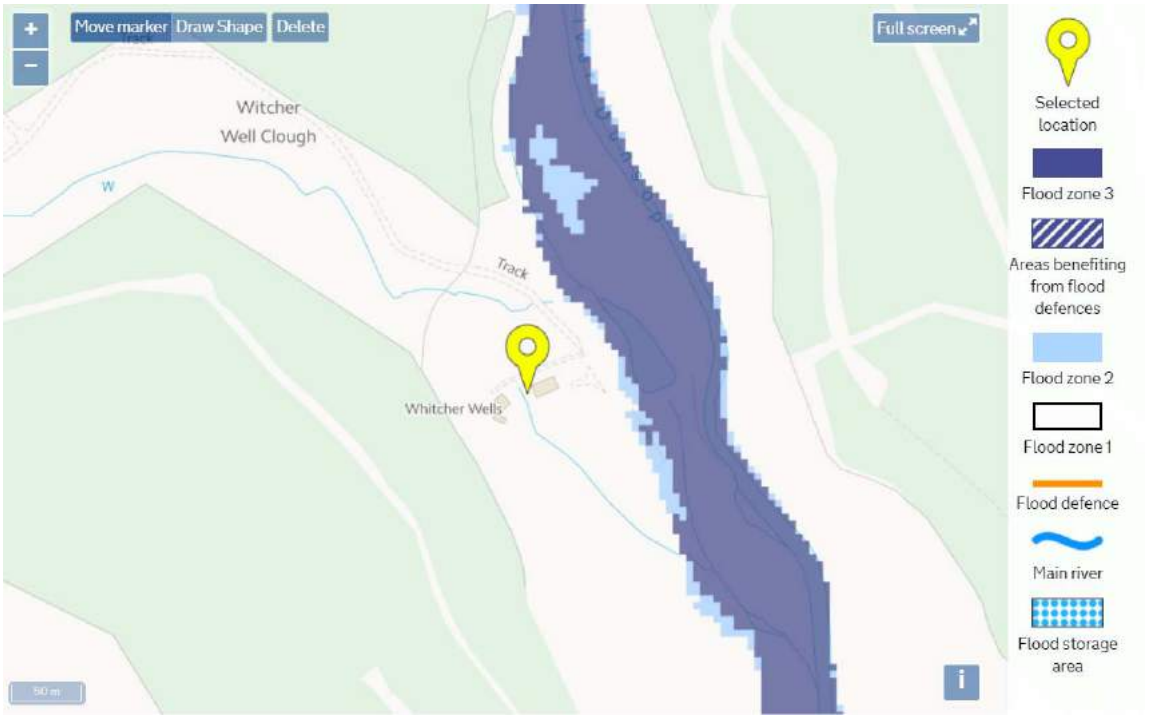
For tidal main rivers, a flood risk activity permit may be required if the development of the site is within 16 metres of a river, flood defence structure or culvert.

Details on obtaining a Flood Risk Activity Permit are available from the Environment Agency.

2.2.2 Sources of Flooding

- Rivers (fluvial): Flooding occurs when flow within river channels exceeds capacity; and the type of flood event experienced e.g. flash flooding; depends upon the characteristics of the river catchment.
- The Sea (tidal): Flooding at low lying coastline and tidal estuaries is caused by storm surges and high tides; with overtopping and breach failure of sea defences possible during extreme storm events.
- Pluvial (surface flooding or overland flows): Heavy rainfall, which is unable to soak away via infiltration or enter drainage systems can flow overland, resulting in localised flooding. Topography generally influences the direction and depth of flooding caused by this mechanism.
- Groundwater: Caused when ground water levels rise to the surface; and is most likely to occur in low lying areas underlain by aquifers.
- Sewers and drains: Generally occurs in more urban areas; where sewers and drains are overwhelmed by heavy rainfall or blocked pipes and gullies.
- Artificial Sources (reservoirs, canals, lakes and ponds): Reservoir and canal flooding may occur as a result of capacity exceedance or structural failure.

Figure 2.1: The Environment Agency Flood Map



Source: www.gov.uk

2.2.3 Flood Zones

- Flood Zone 1: Low probability (less than 1 in 1000 year (<0.1% AEP) annual probability of river or sea flooding in any year.
- Flood Zone 2: Medium probability (between 1 in 100 year (1.0% AEP) and 1 in 1000 year (0.1% AEP) annual probability of river flooding; or between 1 in 200 year (0.2% AEP) and 1 in 1000 year (0.1% AEP) annual probability of sea flooding in any year).
- Flood Zone 3a: High probability (1 in 100 year (1.0% AEP) or greater annual probability of river flooding in any year or 1 in 200 year (0.5% AEP) or greater annual probability of sea flooding in any year).
- Flood Zone 3b: This zone comprises land where water has to flow or be stored in times of flood. Land which would flood with an annual probability of 1 in 20 (5% AEP), or is designed to flood in an extreme flood (0.1%) should provide a starting point for discussions to identify functional floodplain.

2.2.4 Vulnerability of Different Development Types

- Essential Infrastructure: Transport infrastructure (railways and motorways etc...); utility infrastructure (primary sub-stations, water treatment facilities; power stations; and wind turbines).
- Water Compatible Development: Flood control infrastructure; water and sewage infrastructure; navigation facilities.
- Highly Vulnerable: Emergency services; basement dwellings; mobile home parks; industrial or other facilities requiring hazardous substance consent.
- More Vulnerable: Hospitals; residential dwellings; educational facilities; landfill sites caravan and camping sites.
- Less Vulnerable: Commercial premises; emergency services not required during a flood; agricultural land.

2.2.5 Sequential & Exceptions Test

As set out in the National Planning Policy Framework, the aim of the Sequential Test is to steer new development to areas at the lowest probability of flooding.

The Flood Zones are the starting point for the sequential approach.

Due to the proposed development being located within Flood Zone 1 it is not considered necessary to apply the Sequential and Exceptions Tests.

2.2.6 Climate Change

The NPPF requires the application of climate change over the lifetime of a development. As of 19th February 2016 the Technical Guidance for NPPF has updated the climate change allowances based on the river basin district. The climate change allowance for the North West basin district is tabulated below:

Table 1: North West Climate Change Allowances[1]

Parameter	Allowance Category	2010 - 2039	2040 - 2059	2060 - 2069	2070 - 2115
Peak Rainfall Intensity	Upper end	+ 10%	+ 20%	+ 40%	
	Central	+ 5%	+ 10%	+ 20%	
Peak River Flow	Upper end	+ 20%	+ 35%		+ 70%
	Higher Central	+ 20%	+ 30%		+ 35%
	Central	+ 15%	+ 25%		+ 30%

The selection of climate change allowance should be chosen appropriate to the expected lifespan of the proposed development.

The development is anticipated to have a lifespan approximating less than 100 years; and as such an additional 20% should be applied to peak rainfall intensities to assess the range of impact for this development.

Due to the development being less vulnerable and located within Flood Zone 1 there is no requirement to apply climate change to peak river flow.

[1] Extracted from Tables 1-4 of the Technical Guidance for flood risk assessments: Climate change allowances Document (February 2016)

3.0 Details of the Site

3.1 Site Details

Table 2: Development Location

Site Name:	Land at Whitcher Wells
Purpose of Development:	Holiday Camping Pods
Existing Land Use:	Greenfield
OS NGR:	SD651521
Country:	England
County:	Lancashire
Local Planning Authority:	Ribble Valley Borough Council
Internal Drainage Board:	Not Applicable
Other Authority (e.g. British Waterways/ Harbour Authority)	Not Applicable

Location Plan:

Source: Google

3.2 Site Description

The application site currently comprises of a fish hatchery building, 2No small outbuildings, water tank, access track and grassed open space, located on land to the west of Whitendale Road, approximately 2.1km north of the village of Dunsop Bridge.

Using the topographical survey provided, site levels generally slope from west to east, ranging from 163.000m AOD along the west boundary, down to 147.000m AOD along the east boundary.

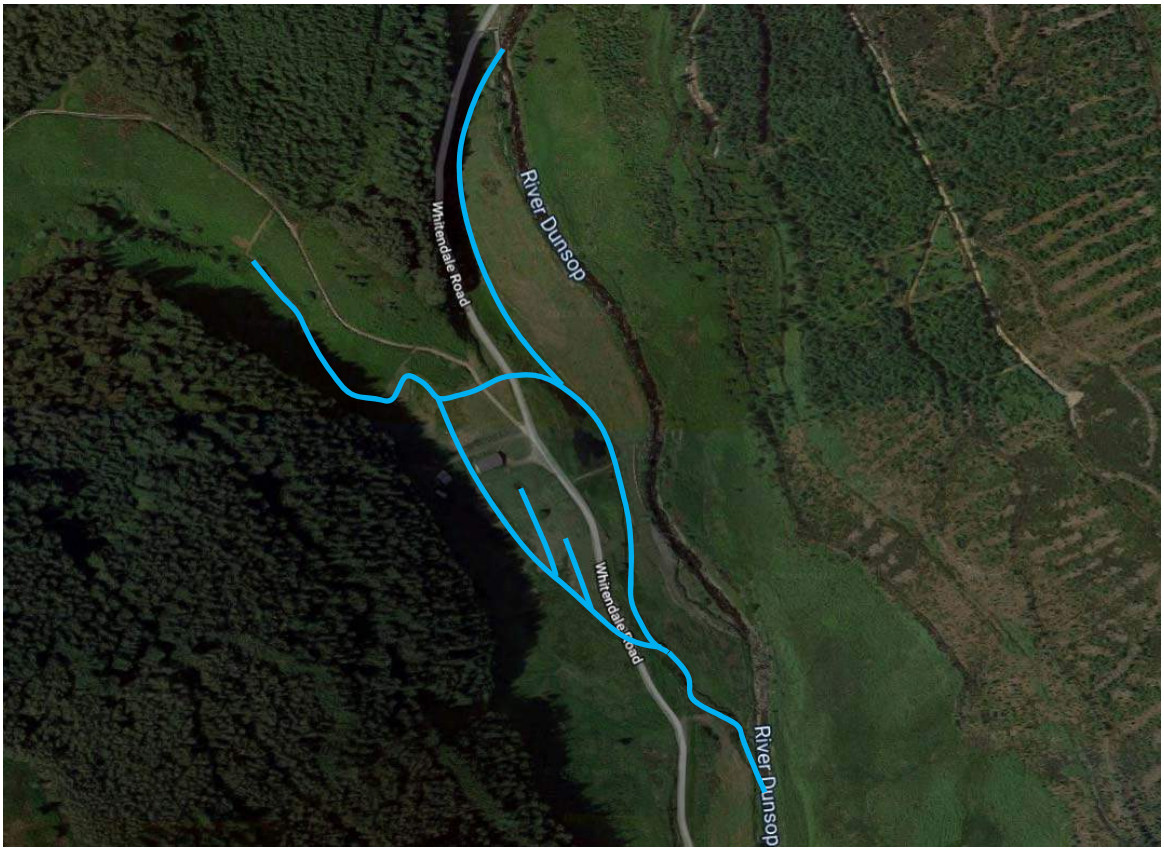
Two small natural channels/watercourses flow through the site, one through the north extent flowing in an easterly direction. The other is formed by three channels that merge into one flowing in a southerly direction out of the south east boundary.

Another channel/watercourse is located approximately 10m east of the site where it flows parallel along the west of the River Dunsop in a southerly direction, ultimately discharging into the River Dunsop approximately 300m south of the site.

Due to the steep nature of the watercourses which travers the site, the risk of flood water backing up the channels is considered to be low.

In accordance with the EA Flood Map the nearest fluvial flood risk is considered to be the River Dunsop, located approximately 85m east if the application site. However, the edge of Flood Zones 2 and 3 does not encroach the application site, therefore the site is wholly located within Flood Zone 1.

Figure 3.1: Location of Watercourses/Channels



Source: Google

Table 3: Boundaries

North	Directly north of the site is a large wooded area, beyond which is an expanse of rural green open space.
East	Directly east is the site Whitendale Road, beyond which is an area of grassland before the River Dunsop located approximately 85m east.
South	Directly south of the site is an area of rural green open space and large wooded area.
West	Directly west of the site is a large wooded area, beyond which is a vast expanse of rural green open space.

3.3 Proposed Development Details

Development proposals comprise of retention and alterations to the fish hatchery, removal of the small outbuilding, large outbuilding to be converted into managers accommodation, alteration of the water tank with the incorporation of a green roof and the erection of 4No timber camping pods with associated soft/hard landscaping areas.

Figure 3.2: Development Proposals

Source: Rural Solutions

4.0 Historic Flooding

4.1 Internet Search

An internet search did not find any reported flood records associated either at or within the vicinity of the application site.

4.2 Ribble Valley Borough Council SFRA April 2017

The Strategic Flood Risk Assessment (SFRA) was undertaken by Ribble Valley Borough Council and was completed in April 2017.

Section 4.4 Table 1 Major Historical Floods Recorded in the Ribble Catchment and RVBC Communities Worst Hit does not identify any incidents within Dunsop Bridge.

5.0 Initial Evaluation of Flood Risk

5.1 The Environment Agency Flood Map

The Environment Agency Flood Map illustrated within Figure 2.1, confirms that proposed development site is located in Flood Zone 1.

The definition for each of the flood zones highlighted above is provided for reference within Section 2.2.3 of this report.

5.2 Sources of Flooding

Table 4: Possible Flooding Mechanisms

Source/Pathway	Significant?	Comment/Reason
Fluvial	No	Flood Zone 1
Canal	No	Not Applicable
Tidal/Coastal	No	Not Applicable
Reservoir	No	EA Map shows that the site is not affected by reservoir flooding.
Pluvial (urban drainage)	No	Site is less than 1 Hectare
Groundwater	No	SFRA states that groundwater flooding within the area is not considered to be a significant risk
Surface Water Flooding	Yes	Surface water flow routes travers through the site
Overland Flow	Yes	Possible overland flow associated with surface water flooding.
Blockage	No	Not Applicable
Infrastructure failure	No	Not Applicable
Rainfall Ponding	No	No areas of ponding identified within the boundary of the site.

From the initial assessment it is concluded that the primary source of flood risk will be from surface water flow routes that pass through the site.

Fluvial: Dunsop Bridge

Dunsop Bridge is located approximately 85m east of the site and is considered to be an Ordinary Watercourse at this location.

The redline boundary of the application site is located within close proximity to Flood Zone 3, however it does not encroach the redline boundary.

The EA do not possess any modelled flood levels for the River Dunsop at this location, as such a comparison could not be undertaken. However, the location of the proposed timber camping pods is at least 10m west of the edge of Flood Zones 2 and 3 and wholly located within Flood Zone 1. Therefore, the fluvial flood risk associated with the River Dunsop is considered to be low.

Two small watercourses travers through the site which ultimately flow into an unnamed watercourse that flows parallel to the west of Dunsop Bridge.

Due to the steep nature of the channels/watercourse which travers through the application site the risk associated with flows backing up and affecting the proposed development is considered to be low. Therefore, the flood risk associated with the tributaries is considered to be pluvial rather than fluvial in nature.

The pluvial flooding mechanism associated with two watercourses which travers the site will be evaluated in further detail within Section 6 of this report.

Groundwater

Section 4.2.9 of the Ribble Valley Borough Councils SFRA states the following in relation to groundwater flooding:

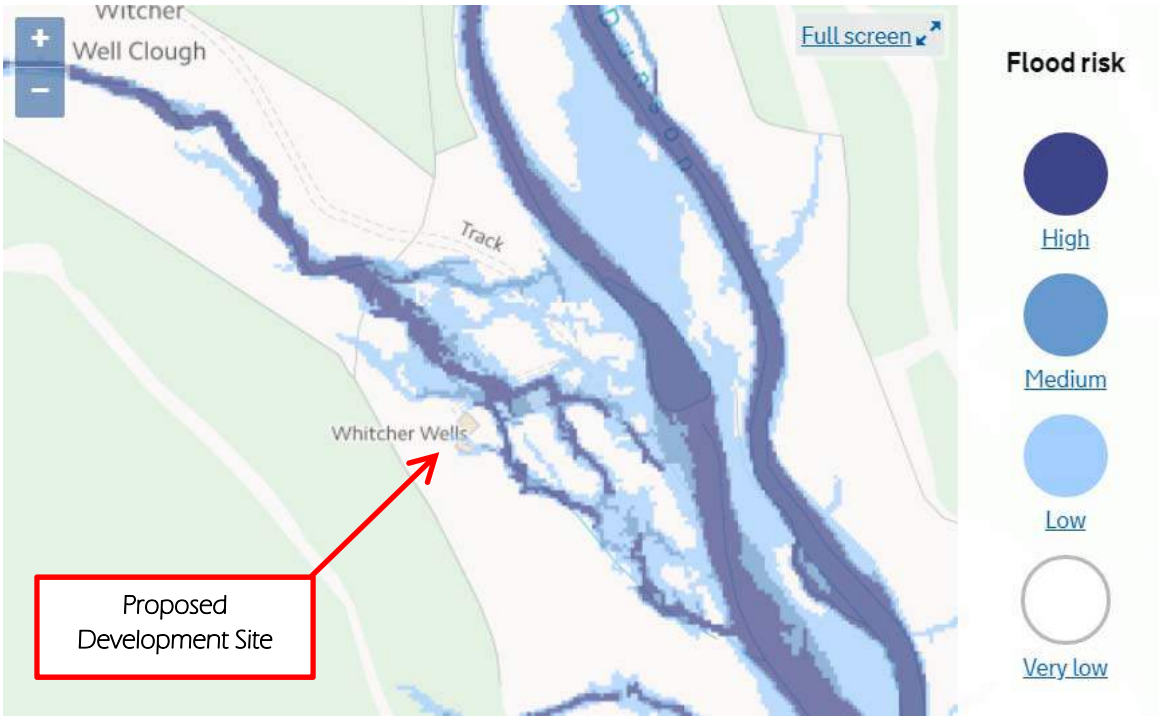
'Following consultation with the EA, no evidence of groundwater flooding in the area has been identified. While no risk has been demonstrated, this is not to say that unrecorded groundwater flooding events may have taken place or that groundwater flooding may not occur in the future, but using the best available information they are not considered to be a significant risk at this time.'

Due to the steep nature of the application site the risk associated with groundwater flooding is considered to be low.

Surface Water Flooding

The Environment Agency's Surface Water Flood Map identifies that the application site has a high risk associated with pluvial (surface water) flooding.

Figure 5.1: Environment Agency Surface Water Flood Map



Source: www.gov.uk

- High risk means that each year this area has a chance of flooding of greater than 3.3%. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

The channels/watercourses which travers through the boundary of the site are considered to provide conveyance routes during times of high rainfall resulting in varying depths across the site.

Taking the above into consideration the risk associated with pluvial flooding requires further evaluation, which has been undertaken within Section 6 of this report.

6.0 Quantitative Flood Risk Assessment

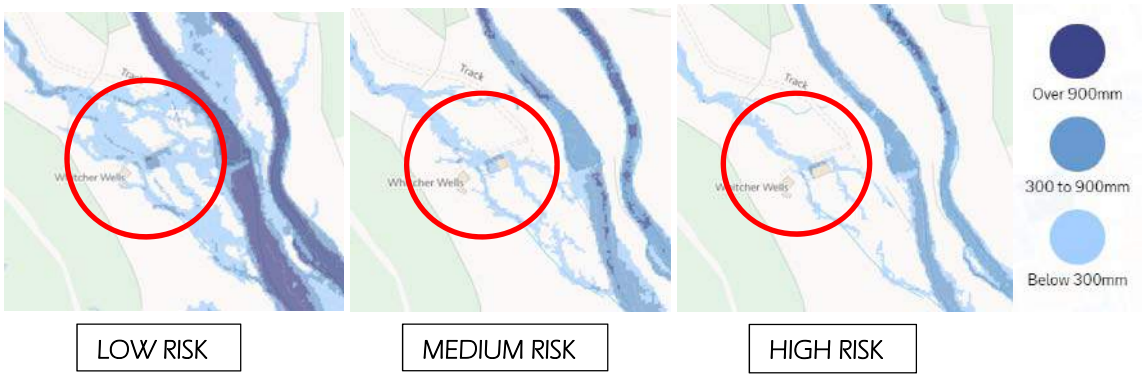
6.1 Pluvial / Overland Flow

6.1.1 General

The area surrounding the proposed development site suffers from pluvial flooding, due to the scale and nature of surface water flooding it would be difficult to pin point the specific reason as to why this occurs.

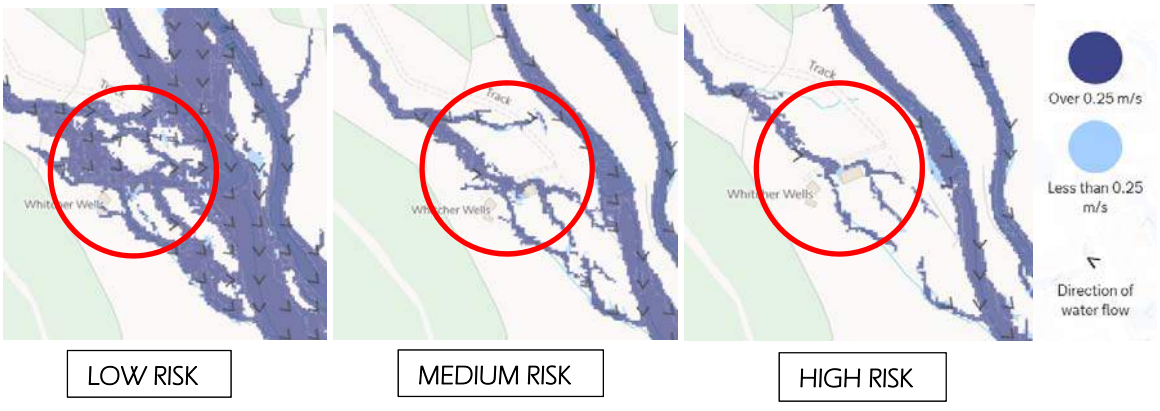
The application site is located midway up a steep hill surrounded by a large expanse of rural green space, with a number of channelised topographical depressions which convey surface water runoff into the larger watercourses, in this instance the River Dunsop located approximately 85m east of the site.

Figure 6.1: Environment Agency Surface Water Flood Depth



Source: www.gov.uk

Figure 6.2: Environment Agency Surface Water Flood Velocity



Source: www.gov.uk

Evaluation has been undertaken to determine flood depths and velocities within the curtilage of the redline boundary of the proposed development, this is shown below for a range of events.

6.1.2 Low Risk Event

During the low risk event (1:1000 year) the depths and velocities at the site are identified below:

- Depth = Less than 300mm
- Velocity = Over 0.25m/s

6.1.3 Medium Risk Event

During the medium risk event (1:100 year) the magnitude of flooding has reduced compared to the low risk even, the depths and velocities are identified below:

- Depth = Less than 300mm
- Velocity = Over 0.25m/s

6.1.4 High Risk Event

During the high-risk event (1:30 year) the magnitude of flooding has reduced compared to the medium risk even, the depths and velocities are identified below:

- Depth = Less than 300mm
- Velocity = Over 0.25m/s

6.1.5 Pluvial: Conclusion

Following evaluation of pluvial flooding it is concluded that even during the low risk event i.e. the 1000 year return period the anticipated flood depths within the channels/watercourses will be less than 300mm. Due to the steep nature of the topography flows will remain over 0.25m/s during all events.

The proposed timber lodges have been located within the topographical high points of the site, so to remain outside of the areas affected by surface water flow routes

Providing that the timber lodges are elevated sufficiently as described within Section 7.0 of this report, the risk of pluvial flooding can be suitably managed.

6.2 Surface Water Runoff

6.2.1 General

At present the site comprises of fish hatchery, 2No outbuildings and green open space. Due to the size of the buildings engineering judgement suggests that surface water is not positively drained and therefore discharges onto the ground, where it makes its way into the channels/watercourse within the site.

6.2.2 Existing Sewers

At the time of writing no sewer records where available, however due to its rural nature it is anticipated that there will be no public sewers within the vicinity of the site.

6.2.3 Surface Water Drainage Hierarchy

The hierarchy for disposal of surface water from new developments is outlined within the Building Regulations Approved Document H and specifies the following methods in order of preference:

- Infiltration via soakaway or other suitable infiltration device
- Discharge to watercourse
- Discharge to public surface water sewer
- Discharge to public combined sewer

Infiltration

Following a non-intrusive desk top study infiltration at the site is not considered to be feasible, a review of Soilscape maps identifies the site to be located on land which is considered to be *'Very acid loamy upland soils with a wet peaty surface'.*

The above is evident by the sheer volume of small channels/watercourses within the surround area which convey flows to the larger watercourses.

Taking the above into consideration the use of large soakaways at the proposed development is not considered to be feasible.

Watercourse

Within the application site there are a number of small channels/watercourses which would be more suitable than disposal of surface water via infiltration methods.

As such it is recommended that surface water resulting from the proposed development should be directed to watercourse.

6.2.4 Sustainable Urban Drainage Systems (SUDS)

SUDS act to reduce the impact of surface water runoff from the development by limiting runoff volumes and rates from leaving the site.

The proposed development comprises of retention of 3No of the structures and the erection of 4No small timber cabins each with a roof area of 18m^2, all access roads are to be constructed of gravel/permeable material. Therefore, the total increase in impermeable area is considered to be 72m^2.

Due to the scale and nature of the development, restricting discharge rates would result in an aperture that would be extremely small and become blocked on a regular basis. As such attenuation is not considered to be feasible at the proposed development site.

However, the development proposals do provide a planting buffer around the car parking area, this area could be utilised as a rain garden to slow down the time of concentration into the watercourse.

Furthermore, green roofs are proposed on the outbuilding and the tank which are being retained. This will offset some of the runoff from the roof areas of the proposed timber cabins.

Green Roofs

Green roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover/landscaping. The roof is likely to consist of an impermeable layer, a susbstrate or growing medium and a drainage layer (although not all green roofs require a drainage layer).

Green roofs are designed to intercept and retain precipitation, reducing the volume of runoff and attenuating peak flows.

Rain Gardens

A rain garden is a shallow area of ground or dip which receives run-off from roofs and other hard surfaces. It is planted with plants that can stand waterlogging for up to 48 hours at a time. In this instance the water from the rain garden will be piped out rather than infiltrating through the underlying ground.

More drought-tolerant plants are used towards the edges. Storm water fills the depression and then drains. Rain gardens should be planted up with native vegetation that is happy with occasional inundations.

The basics of how to make a rain garden

Use stakes and string to create the shape you want. Kidney-shaped can work well.

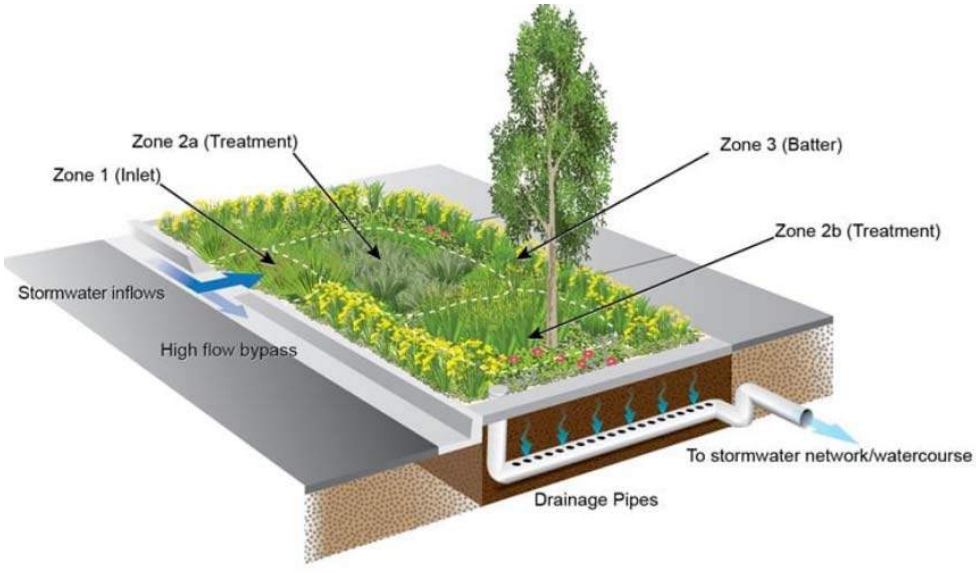
- Remove any vegetation. In a grassed areas you may find using a herbicide to kill the grass first will make it easier to dig the turf up
- As you dig, aim for a saucer shape, with a flat base and ensure levels are correct
- The soil you dig out can be used to make the berm (the lip or bund on three sides)

- The berm will keep the water in the rain garden, so has to be well-compacted, around 30cm (1ft) wide and 10cm (6in) in height
- Leave a notch in the berm, with a gravel-filled channel for the water to exit into a conventional drainage system
- If the area is sloping, the top end will require more digging out then the lower end. The spoil form the top end can be used to fill in at the lower end to make the rain garden level
- Incorporate organic matter into the excavated soil to improve soil structure and then backfill to the original level. Leaf mould, homemade compost, soil conditioner or well-rotted manure are all suitable media
- The soil should be not be compacted

Figure 6.3: Typical Example of a Green Roof

Source: Organic Roof

Figure 6.4: Typical Example of a Rain Garden



Source: Watersensative

6.2.5 Restricted Discharge Rate

Restricting flows from a drained roof area of 72m^2 is not considered to be feasible, due to the size of the aperture required within a flow control device being less than 50mm. Doing so would result in blockage due to debris and siltation, ultimately increasing the flood risk at the application site.

6.2.6 Preliminary Drainage Strategy

The buildings which are currently onsite will not be included within the proposed drainage strategy, as only the fish hatchery and tank will be retained, both of which will incorporate green roofs which mimicking greenfield runoff.

Furthermore, the access road and car parking areas will be covered by gravel/ permeable coverings and will therefore not require any positive drainage infrastructure.

Therefore, flows resulting from the 4No proposed timber cabins will be directed into a rainwater garden near the proposed car parking area, prior to a piped outlet, which will ultimately discharge into the channels/watercourse onsite.

The rain garden will help to slow down the time of concentration of surface water entering into the channels.

The CIRIA Rain Garden Guide and Preliminary Drainage Strategy have been included as an appendix within this report.

6.2.7 Maintenance

It is anticipated that the proposed drainage network will remain private and therefore the land/property owner will be responsible for maintaining all the drainage elements.

6.3 Foul

Due to the lack of available public sewers within the vicinity of the application site foul flows from the site will have to be managed within a Package Treatment Plant, which would ideally be positioned within the car parking area to the south east.

A Package Treatment Plant should be sufficiently sized to cope with flows from the expected occupancy of the proposed development by a suitable supplier, to be specified by the client.

7.0 Mitigation Measures

7.1 Finished Development Levels

Finished floor levels of all the new timber cabins should be elevated a minimum of 300mm above existing ground levels so not to become affected by surface water flow routes which travers the site.

7.2 Consent to Discharge

The Package Treatment Plant may require Consent to Discharge from the Environment Agency prior to construction of the outfall structure into the watercourse/channel within the centre of the site.

In order to facilitate dilution of effluent the Preliminary Drainage Strategy shows the outlet of the Package Treatment Plant connected to the surface water outfall.

7.3 Land Drainage Consent

Any structures within 5m from the banks of the watercourse will require Land Drainage Consent from the Lead Local Flood Authority (Lancashire County Council), this will include the outfall structure for the surface water drainage network serving the site.

8.0 Conclusion

Pluvial Flow Routes

The application site is located midway up a steep hill surrounded by a large expanse of rural green space, with a number of channelised topographical depressions which convey surface water runoff into the larger watercourses, in this instance the River Dunsop located approximately 85m east of the site.

Following evaluation of pluvial flooding it is concluded that even during the low risk event i.e. the 1000 year return period the anticipated flood depths within the channels/watercourses will be less than 300mm. Due to the steep nature of the topography flows will remain over 0.25m/s during all events.

The proposed timber lodges have been located within the topographical high points of the site, so to remain outside of the areas affected by surface water flow routes

Providing that the timber lodges are elevated a minimum of **300mm above existing ground levels** the risk of pluvial flooding can be suitably managed.

Surface Water and Foul Drainage

Green roofs are proposed on the 2No buildings which are to be retained which will offset some of the volume resulting from the new timber cabins.

Flows resulting from the 4No proposed timber cabins have been directed into a rainwater garden near the proposed car parking area, prior to a piped outlet, which will ultimately discharge into the channels/watercourse onsite.

The rain garden will help to slow down the time of concentration of surface water entering into the channels.

Due to the lack of available public sewers within the vicinity of the application site foul flows from the site will have to be managed within a Package Treatment Plant, which would ideally be positioned within the car parking area to the south east.

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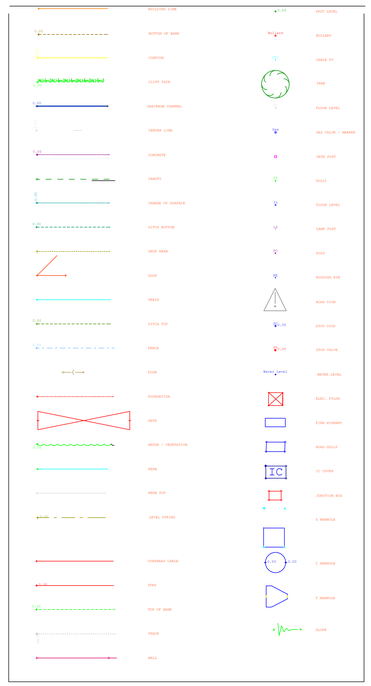
In order to facilitate dilution of effluent the Preliminary Drainage Strategy shows the outlet of the Package Treatment Plant connected to the surface water outfall.

APPENDICES

Appendix A: - Development Proposals


Proposed planted screen
Witcher Well Fish Hatchery
Proposed planted buffer
Existing outbuilding converted for use as manager's accommodation
Existing water tank roof lowered, existing mineral fibre sheet roof replaced with a green roof
Proposed access track
Existing track
Proposed access path
Proposed camping pod
Proposed planted buffer
Proposed visitor parking
Existing access
Access road
N
Scale 1:500
Meters
0 5 10 15 20 25

Appendix B: - Topographical Survey



NOTES

THIS SURVEY HAS BEEN ORIENTATED TO THE ORDNANCE SURVEY (O.S) NATIONAL GRID (OSGB36) VIR A GLOBAL POSITION SYSTEM (GPS) AND THE O.S ACTIVE NETWORK (SMARTNET)

A TRUE OSGB36 CO-ORDINATE HAS BEEN ESTABLISHED AROUND STN 1 AND STN 2 THE SURVEY HAS BEEN CORRELATED TO THESE 2 POINTS TO CREATE A TRUE O.S. BEARING FOR ANGLE ORIENTATION

ONLY DRAINAGE VISIBLE AT TIME OF SURVEY HAS BEEN ADDED

ALL DIMENSIONS SHOULD BE CHECKED ON SITE

SURVEY UNITS ARE IN METERS

SURVEY GRID = 50 METERS

Rev	Description	Date

PROPOSED DEVELOPMENT AT WHITENDALE ROAD DUNSOP BRIDGE

JOHN IBISON

TOPOGRAPHICAL SURVEY

050718/TOP

Drawn	G J Brookes
Date	JULY 2018
Scale	1:500@A0

G J BROOKES LTD
LAND SURVEYORS & SITE ENGINEERS

14 Joyce Avenue
Blackpool
Lancashire
FY4 4HL

TEL: 01253 766135
MOBILE: 07973 268024
E-MAIL: gjbrookesltd@hotmail.com

0m 10m 20m
SCALE BAR

Appendix C: - Preliminary Drainage Strategy

PRELIMINARY DRAINAGE STRATEGY

NOT TO SCALE

FOUL FROM THE PROPOSED NEW TIMBER LODGES TO BE DIRECTED TO A PACKAGE TREATMENT PLANT WHICH DISCHARGES CLEAN EFFLUENT INTO CHANNEL/WATERCOURSE

SURFACE WATER FROM THE NEW TIMBER LODGES TO BE DIRECTED INTO RAIN GARDEN BEFORE DISCHARGING INTO WATERCOURSE/CHANNEL

THE ROOF OF THE TANK AND MANAGERS ACCOMMODATION WILL BE COVERED IN GREEN ROOF

NOTE: PACKAGE TREATMENT PLANT TO BE SIZED TO ACCOUNT FOR OCCUPANCY

DISCHARGE OF EFFLUENT INTO WATERCOURSE/CHANNEL MAY REQUIRE A PERMIT TO DISCHARGE FROM THE EA PRIOR TO CONSTRUCTION

FRDS
FLOOD RISK AND DRAINAGE SOLUTIONS

KEY

- SURFACE WATER MH
- FOUL MH
- SURFACE WATER SEWER
- FOUL SEWER
- RAIN GARDEN
- SURFACE WATER OUTFALL
- PACKAGE TREATMENT PLANT
- GREEN ROOF

Appendix D: - CIRIA Rain Garden Guide

RAIN GARDEN GUIDE

Bob Bray, Dusty Gedge, Gary Grant & Lani Leuthvilay

Principal Sponsor's Foreword

Helen Newman
Head of Corporate Responsibility and Sustainability
Thames Water

Everyone can help address the impact of climate change without making major lifestyle changes. This guide shows how changing the way you manage your outside space can help reduce localised flooding whilst at the same time providing an enjoyable area for the benefit of both wildlife and people.

Providing rain gardens is part of a growing desire to have more sustainable drainage systems. Other current initiatives include installing a "green roof" on top of buildings in urban spaces and reducing the amount of non permeable surfacing for example in car parks.

Thames Water is pleased to sponsor this guide. Our organisation is in favour of driving changes to the way we manage outdoor spaces to benefit both customers and wildlife that exists within our catchment. We are actively working on a number of projects to provide alternative routes for rainwater, reducing the burden on overloaded sewers in parts of our area. We believe this can have a real impact in terms of reducing flooding from overloaded sewers and makes better use of the water collected. In particular, rainwater gardens provide an altogether healthier alternative to enjoying our outside spaces.

Contents

Statement of Support

Dave Wardle
London Environment Team Manager
Environment Agency

Water is a vital resource for people and wildlife. In the UK we expect to have enough water to meet our needs - having water readily available is something we often take for granted. Even in record breaking periods of prolonged summer rain, water is a precious resource, to be used and managed wisely.

The Environment Agency supports this guide which offers practical information on installing a small scale rain garden. It also reminds us how drains overwhelmed by a sudden downpour can affect water quality in the local river. Even one raing arden can make a small but positive difference in addressing localised flooding and the quality of the local water environment. Alongside other sustainable drainage systems and actions to tackle diffuse pollution, rain gardens can be an effective part of a bigger solution.

Front cover: Ashby Grove rain garden, north London | **Robert Bray Associates**

Above: Crocosmia | **Bob Gibbons**

What is a RAIN GARDEN?

In its simplest form, a rain garden is a shallow depression, with absorbent, yet free draining soil and planted with vegetation that can withstand occasional temporary flooding. Rain gardens are designed to mimic the natural water retention of undeveloped land and to reduce the volume of rainwater running off into drains from impervious areas and treat low level pollution. In this guide, we also suggest establishing rain gardens in planters, which can receive water from a downpipe.

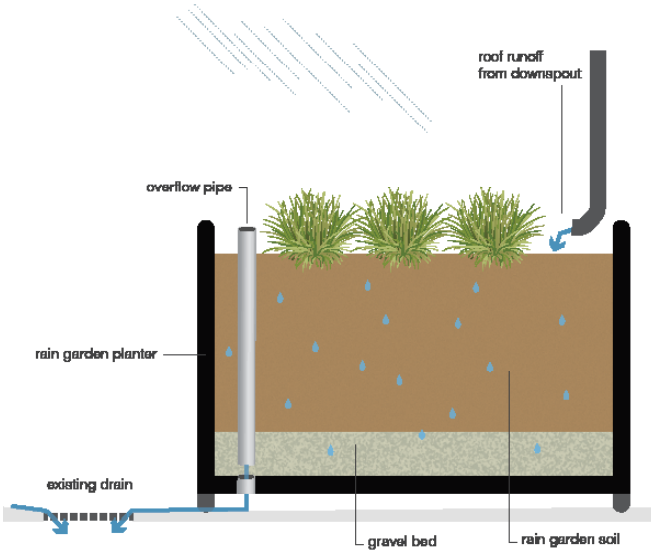
Rain gardens were first developed in the United States in the 1990s, where they have become increasingly popular. In the UK, the mimicking of natural drainage in urban areas is officially encouraged and known as Sustainable Drainage Systems (SuDS). This approach is part of a new philosophy to urban water management, developed in Australia, which is known as Water Sensitive Urban Design (WSUD).

The term rain garden is wide ranging and has been used to describe a number of different features (see Why Rain Gardens? below). However, for the purposes of this guide a rain garden is a simple intervention designed to receive rainwater which has come from a downpipe or a large domestic paved area. The rainwater enters the soil and drains away into the ground or is taken up by the plants and lost back to the air by a process known as evapotranspiration.

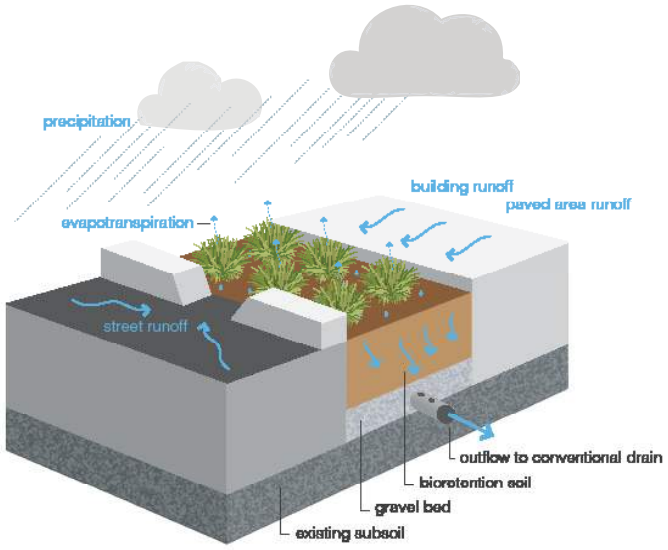
Rain gardens usually absorb all the rainwater that flows into them, but when they do fill up following particularly heavy rainfall, any excess water is redirected to the existing drains. These simple rain gardens do not require any redesign of the existing drainage system and can be installed wherever space permits (see Planning and Design below) and in most soil types.

Typical domestic rain garden, Ashby Grove, London | CIRIA

Other features that may be described as rain gardens include bioretention strips, swales and specially designed tree-pits, which may receive the often more polluted surface water run-off from roads and other paved areas. These features usually include gravel layers, engineering soils and perforated drains and are normally installed in the street. Advice on the planning and design of these and other similar installations is outside of the scope of this guide. For more information see the CIRIA website in the Resources section.



Rain garden planter



Street rain garden

Why RAIN GARDENS?

The extensive areas of sealed surfaces, including roofs, pavements and roads, in our towns and cities, cause problems. When it rains, water is normally directed straight to drains, which can be overwhelmed during storms. When this happens, localised flooding can occur, damaging property and blocking streets. In some cities where surface water drains and foul sewers are interconnected, sewage can find its way into watercourses and streets.

Even when flooding does not occur, runoff may wash oil, heavy metals and other pollutants into watercourses, damaging the plants and animals that live in aquatic environments. Sealed surfaces can also cause problems during warm weather. When the sun shines, more heat is absorbed, causing urban areas to be hotter than the surrounding countryside – a phenomenon known as the Urban Heat Island Effect.

These problems have become worse as our towns and cities have grown and are expected to be exacerbated by climate change, which is likely to bring about more frequent and heavier downpours and stronger heat waves. One of the most effective ways of tackling these problems and adapting to climate change is to increase the quantity and quality of vegetation and soils in our towns and cities. All the green spaces and other environmental features, which include parks, gardens, green roofs and street trees, which are collectively known as green infrastructure, combine to provide various benefits at minimal cost, which are often described as ecosystem services.

Rain gardens help our gardens to deal more effectively with rainfall, but they also filter and clean runoff. By providing more and more rain gardens, we will be able to reduce our risk of flooding and curb urban heat islands.

The many benefits of green infrastructure include:

- Reduced risk of flood
- Reduction in water, air and noise pollution
- Better health through stress reduction and more places to exercise
- Space to relax and play
- Habitat for wildlife and space for people to enjoy nature
- Environmental education
- Local food production

Rain gardens can also be planted to attract wildlife (see Planting below) and can reduce the cost of maintenance, for example, where frequently mown lawns are replaced. They can be easily combined with schemes to harvest rainwater. By increasing the amount of water entering the soil, rain gardens help to reduce the effects of drought and help gardens to thrive without the need for irrigation.

Rain gardens work well by bringing about many small incremental improvements, which cumulatively can bring about huge beneficial change – each project, however small, makes a significant contribution towards the overall goal of making the city greener.

Who is this GUIDE for?

The rain gardens described in this guide are relatively simple and straightforward, suitable for establishment anywhere where local conditions are suitable and an adjacent downpipe can be intercepted or water from a paved area redirected. This guide is intended to help the homeowner or property manager (or practical person working on behalf of others) to create a simple rain garden within their own property. Even in places without gardens, like many apartment blocks, offices or factories, there may be space to create container gardens or raised beds that receive water from downpipes and overflow into the drain. In some situations it may even be possible to remove paving or asphalt in order to create space for your rain garden.

We hope that this guide will encourage everyone to look for opportunities to establish rain gardens throughout our towns and cities. We should also consider how we can encourage managers of our parks and streets to restore more natural patterns of drainage in our neighbourhoods. For information on the various components of sustainable drainage systems and sources of professional advice see the Resources section at the end of this document or email us at: info@raingardens.info

Planning & Design

The first consideration is, if the rain garden overflows, where will the water go? This might be the existing drain, which the disconnected downpipe enters, but in some cases could be an alternative drain. If you are using the existing drain, you don't need to worry about drainage capacity, because the rain garden will be reducing the overall volume of water entering the drain. The rain garden will need to work in terms of levels, with the overflow point being higher than the receiving drain. If a suitable receiving drain cannot be identified, you should not proceed without taking professional advice.

You will usually site your rain garden in an existing flower bed or lawn. Rain gardens are usually situated some distance from buildings or site boundaries, although the exact location will depend on the local topography and available space. In order to reduce the likelihood of property damage to insignificant levels, authorities in the US recommend that rain gardens are situated at least 3m (10 feet) from any building. (Note that rain gardens as described here are not point soakaways as described under Part H of the Building Regulations. However, if your property is situated in an area with chalk or other material that could be adversely affected by localised increases in the flow of ground water you should contact your local authority Building Control Officer for advice). If a rain garden is based on a planter, it will normally be most convenient to place it below the downpipe and close to the receiving drain.

Most gardens slope away from buildings and It is usual to establish a rain garden on a gentle slope – the steeper it is, the more difficult it is to remodel the ground to create a level perimeter. Slopes of more than about 12% or 1:8 are difficult to work with and may require retaining structures. Seek professional advice if you would like to establish a rain garden on a steeper slope than this. The downpipe should feed into the head of the rain garden. If the garden is some distance from the downpipe, create a swale (a small, shallow channel) or use a pipe to take the water to the rain garden.

It is possible to locate a rain garden in the shade of large trees, however the range of plants that will thrive will be limited to those that are shade tolerant and there could be problems with tree roots, which are best left alone. When planning the location of your rain garden, consider how it will relate to other existing and planned features and how it will look from various viewpoints both inside and out.

We recommend that you undertake a simple percolation test before building your rain garden. Dig a hole at least 250mm deep, fill with water and let it drain. Fill the pit with water again. If it drains away at the rate of 50mm per hour or more you have suitable conditions for a rain garden. Water will not drain away quickly enough if the water table is at or very close to the surface or if the soil is composed of a heavy clay. The soil can be improved (see Construction section over the page), so it will usually be possible to work on sites with almost any soil type, although again, if you have any concerns about ground conditions in the local area, contact your local authority Building Control Officer for advice.

If your soil is clay it will require much more improvement than a light, sandy soil. If you are unsure of the soil type at your site, you can run this simple test: take a handful of damp soil and squeeze it in the palm of your hand. If it holds its shape at first but easily crumbles you have a loamy soil, which is ideal for a rain garden. If it falls apart as soon as you open your hand, it is a sandy soil, which is also suitable for a rain garden. If your sample holds its shape and stays intact it is a clay soil, which will need to be improved.

Before, during and after the installation of a rain garden at Kingsmead Way, Hackney, London, led by Groundwork London's Green Team and Sanctuary Housing, and planted up by local residents
| Groundwork London

The next step is to consider the size of the rain garden. The bigger the rain garden the better. Experienced 'rain gardeners' in the US suggest that rain gardens are between 3m and 5m wide, with the length adjusted to suit the slope and area available. Although a rain garden of any size may bring some benefits, if it is very small, it may overflow too frequently and may become waterlogged and less effective in reducing run-off rates.

To calculate the volume of water that your rain garden may be receiving, measure the size of the roof that drains into the downpipe that you will be intercepting and consider how much rain may fall during a particular downpour or period. The volume of water that the rain garden will be receiving in litres, equals the area of the roof (in square metres) multiplied by the rainfall (in millimetres).

A rain garden 150mm deep and 20% of the area of the area of the roof that it serves will be able to intercept all of the run-off from a typical summer storm where 10-15mm of rain might fall. Rain gardens on more permeable soils will be even more effective. Over the course of an average year, a rain garden of this size will intercept most of the rainfall that it receives, only overflowing after several days of persistent rainfall.

Construction

Once you have determined the location, size and shape of your rain garden, you should mark the outline on the ground with rope or hose (or if it has straight sides, with pegs and string). You can reduce the effort of digging up existing turf by covering it with dark plastic for a few weeks, until it has died off.

Dig out your rain garden to create a saucer shaped profile, to create a flat base for infiltration. You may place the spoil around the margins to create a level berm or lip. At the centre, the base of the excavation for a typical rain garden will be between 150mm and 450mm below original ground level. You can check that the perimeter lip is level by using a series of wooden stakes, parallel sided board and spirit level or, on larger excavations, a length of hosepipe filled with water.

The berm will hold back water during a storm so will need to be approximately 300mm in width, approximately 100mm high and well compacted. The amount of material in the berm will be greater on the lower part of the slope. Berms are usually tapered off so that they blend in with the adjoining garden.

In order to allow excess water to flow out of the rain garden in the direction of the drain, create a permeable channel through the berm in the required location by making a 150mm wide slot and filling this with gravel. The lower level of the outfall channel or pipe should be existing ground level. A shallow swale filled with gravel or pebbles can be created to channel the overflow towards the drain. In a similar way, if an inlet channel is required to direct water from the downpipe to the rain garden, this can be lined with clay and made with bricks, setts or pebbles (to ensure that the water reaches the rain garden and doesn't erode the soil).

Where a downpipe feeds water directly into a rain garden, stones or gravel should be used to dissipate the energy of the water and prevent heavy flows from washing away soil. Or alternatively, a pipe can be used to direct water to the rain garden.

You can redirect your downpipe towards the rain garden by adding bends and new sections or alternatively use a proprietary rainwater diverter of the type normally used to divert water from a downpipe to a water butt. The City of Toronto provides useful advice on the practicality of disconnecting downpipes (see Resources section on p10).

Once the rain garden is excavated to the required depth, the excavated soil should be improved to make it more water absorbent and free draining. The act of digging your soil will bring some improvement but it is also helpful to add organic matter. This could be in the form of your own home made compost, shredded paper, leaf mould, well-rotted bark or charcoal. If your soil is a heavy clay, the addition of sand, crushed brick, gravel, stones, as well as organic material will help.

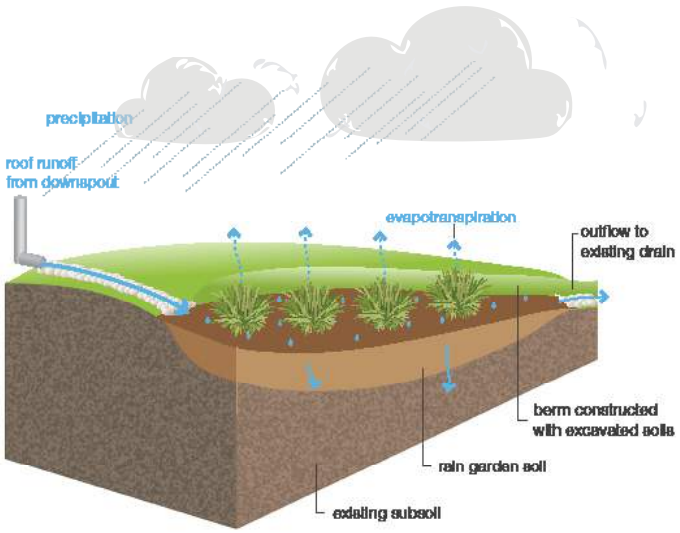
Once your soil has been well mixed with any improver, backfill the excavation to the original ground level. This should leave a freeboard between the original ground level and the surrounding berm, an area that may flood for a few hours following particularly heavy rain.

Rain gardens can be incorporated into conventional front gardens, keeping the ground permeable while allowing for car port and parking, as in this Hampton Court Flower Show Gold Medal winning design by Wendy Allen | Wendy Allen Designs

Rain gardens that are created using stone, concrete or metal planters should have a drainage hole near the base, which is close to the receiving drain. The bottom of the planter should be filled with stones and gravel to a depth of at least 50mm, with a 'fleece' over the gravel, and the remainder filled with a water absorbent and free draining soil. Avoid the use of clay and include plenty of organic material.

An overflow pipe, set at the height of the rim of the planter allows water to run straight to the base of the planter when the planter is saturated. Where the down-pipe empties into the planter, stones should be used to dissipate the energy of the falling water and prevent the soil being washed away.

Once you have filled your rain garden with the improved soil, it is ready to plant!!



Section of a typical domestic rain garden

Ashby Grove rain garden, north London | CIRIA

Planting

Your rain garden is designed to slow surface water run-off and improve water quality. However it is a garden feature and should work for you in terms of the overall design of your property. Like any garden, there is range of possible planting styles: your rain garden might have ornamental, low maintenance ground cover, designed to provide a habitat for wildlife or quirky, perhaps, with stone, gravels or even sculpture – the choice is yours. The English cottage, American prairie or ornamental grass styles are particularly well suited to rain gardens. In larger planters, you may be able to grow fruit and vegetables.

When choosing plants you may want to consider height, colour and flowering period. Taller plants tend to be situated at the centre of the garden and shorter ones around the edges, so that all can be seen and so that deeper-rooted plants can benefit from the deeper soil in the middle of the bed. By grouping plants of various size and texture you will be able to create an interesting looking garden even when few flowers are in bloom. If you wish to create habitat for wildlife, plant native species or plants that are known to attract insects like bees and butterflies and other wildlife. For further information on plants for pollinators see the Royal Horticultural Society's list, and for general advice on wildlife gardening see the Wild About Gardens website (see the Resources section).

It is recommended that your rain garden is planted with a wide range of species in order to create a densely vegetated, stable and thriving bed with dense and thick root systems which will thrive without frequent maintenance. A typical rain garden is planted with about 10 species planted in 2 to 3 clumps per square metre. By planting several species, you will be creating a rain garden that can still succeed even if one or two species do not thrive. A typical planting density is 6-10 plants per square metre, but you may wish to vary this, depending on the size and nature of the plants chosen.

Bugle, *Ajuga reptans* | Bob Gibbons

Plant the rain garden with nursery-grown stock. Good results have been achieved with one or two year old plugs or potted plants, which have a strong root system. Before you plant, it is advisable to have a good idea of what goes where, by preparing a planting plan. Excavate a hole for each plant about twice the size of the root ball, place the plant in the hole and press the soil firmly around the roots. The stem should be at the same level relative to the ground as it was in the growing container. Once the garden is planted, you may consider spreading bark mulch across bare soil to suppress weed growth.

Yellow flag iris, *Iris pseudocorus* | Bob Gibbons

The perimeter berm can be seeded with a general purpose wildflower grassland mix, which can be left to grow, or mown as required, in order to match the adjacent garden. Unless it rains, plants should be watered during establishment. During hot weather, the soil loses about 3 litres per square metre per day by evaporation, so it is advisable to replace this if possible. Once established, the plants will not need to be watered unless the weather has been exceptionally dry. Plants can be planted anytime during the growing season, as long as they are watered. If watering is difficult, it may be advisable to plant in autumn.

A very wide range of plants can be planted in rain gardens, however you should avoid using plants that do not withstand occasional flooding - for example species which are usually associated with dry Mediterranean style gardens, like Lavender. Other plants to avoid include those susceptible to root rot including Azalea, Juniper and Chinese privet.

The frequency that the rain garden is inundated will depend on the size of the rain garden and the weather, so it is important to keep an eye on the rain garden, replace any failures and adjust the planting palette to suit the actual conditions. A selection of suggested plants is included in the table. There are many others that will be suitable which are not listed, so feel free to experiment and apply your own plant knowledge if you are a keen gardener. If you have success or notice problems with particular species, please let us know at: www.raingardens.info.

Planting Suggestions

Common name	Scientific name	Habit	Sunlight and Aspect	Origin
Guelder rose	*Viburnum opulus*	Perennial shrub	Any	Native. Flowers attract insects and berries are eaten by birds.
Dogwood	*Cornus sanguinea*	Perennial shrub	Any	Native. Leaves are larval food for vase bearer moth and berries eaten by birds. Often planted for attractive winter stems.
Culvers root	*Veronicastrum virginicum*	Herbaceous perennial	Full sun or partial shade	Non-native. Tall with long terminal blue flower spikes. On the RHS 'plants for pollinators' list.
Aster	*Aster spp.*	Herbaceous perennial	Full sun or partial shade	Non-native. Often late flowering. Clump forming. Several species on the RHS 'plants for pollinators' list.
Black eyed susan	*Rudbeckia birta*	Herbaceous annual or biennial	Full sun or partial shade	Non-native. Spectacular yellow and black flowers. On RHS 'plants for pollinators' list.
Stinking hellebore	*Helleborus foetidus*	Herbaceous perennial	Full sun or partial shade	Native. Winter flowers.
Montbretia	*Crocosmia spp.*	Deciduous rhizomatous perennial	Partial shade	Naturalised. Red flowers. Thrives in most conditions.
Bugle	*Ajuga reptans*	Rhizomatous perennial	Partial shade	Native. Low growing and will form a mat.
Columbine	*Aquilegia spp.*	Herbaceous perennial	Full sun or partial shade	Non-native. Clump forming with tall flower spikes. On RHS 'plants for pollinators' list.
Inula	*Inula hookeri*	Herbaceous perennial	Partial shade	Tall clump forming with yellow flowers. On RHS 'plants for pollinators' list.
Hemp agrimony	*Eupatorium cannabinum*	Herbaceous perennial	Full sun or partial shade	Native. Sub-shrubs with pink flowers.
Bellflower	*Campanula glomerata*	Herbaceous perennial	Full sun or partial shade	Native. Clumps bearing violet-blue bell shaped flowers.
Sneezeweed	*Helenium sp.*	Herbaceous perennial	Full sun	Non-native. Clump forming with red flowers. On RHS 'plants for pollinators' list.
Lesser periwinkle	*Vinca minor*	Perennial sub-shrub	Any	Non-native. Ground cover with blue flowers.
Elephants ear	*Bergenia sp.*	Rhizomatous perennial	Full sun or partial shade	Non-native. Large leaves and pink flowers.
Plantain lilies	*Hosta spp.*	Herbaceous perennial	Part shade	Non-native. Attractive light coloured flowers.
Yellow flag	*Iris pseudocorus*	Rhizomatous perennial	Full sun or partial shade	Native. Likely to prefer wetter areas near inlet.
Siberian flag	*Iris sibirica*	Rhizomatous perennial	Full sun or partial shade	Non-native. Blue flowers. Prefers moist but well drained soil.
Garlic and onions	*Allium spp.*	Bulbous perennials	Full sun	Non-native. On RHS 'plants for pollinators' list.
Soft rush	*Juncus effusus*	Evergreen perennial	Full sun or partial shade	Native. Form tussocks – likely to prefer wetter areas.
Pendulous sedge	*Carex pendula*	Rhizomatous perennial	Full sun or partial shade	Native. Nodding flower spikes. Likely to prefer wetter areas near inlet.
Zebra grass	*Miscanthis sinensis*	Perennial, deciduous grass	Full sun	Non-native. Tussock forming ornamental grass with silky flowers.
Switch grass	*Panicum virgatum*	Deciduous perennial grass	Full sun	Non-native. Tussock forming ornamental grass.
Royal fern	*Osmunda regalis*	Deciduous fern	Any	Native. Large clump-forming plants.
Male fern	*Dryopteris felix-mas*	Deciduous or evergreen fern	Partial shade or full shade	Native. Large shuttlecock-like form.
Broad buckler fern	*Dryopteris dilatata*	Deciduous or evergreen fern	Partial shade or full shade	Native. Large shuttlecock-like form.

Maintenance

Occasional weeding may be required during the first two years of the life of the rain garden. Remove by hand any weeds, ensuring that you remove the whole plant, including the roots. As the plants in the beds mature, they will fill in any gaps and suppress weed growth.

During winter, you may want to remove any dead or untidy plants, although it is good to leave some dead stems and seed heads for wildlife.

Regular mowing is not required, but the bed may benefit from cutting occasionally. If required, cutting can be undertaken in late summer or autumn with a scythe or strimmer with particularly tough material cut by hand with secateurs. Remove cut material for composting.

Rain garden, Hampton Court Flower Show | Wendy Allen Designs

Resources

This **Rain Garden Guide** is available for free download at the associated website:
www.raingardens.info

Low Impact Development
www.lowimpactdevelopment.org

Sustainable drainage systems
www.ciria.com/suds

Water sensitive urban design
www.wsud.melbournewater.com.au

London and the Urban Heat Island Effect
www.london.gov.uk/lccp/ourclimate/overheating.jsp

Defra Green Infrastructure Partnership
www.defra.gov.uk/environment/natural/green-infrastructure

Natural England on green infrastructure
www.naturalengland.org.uk/ourwork/planningtransport-localgov/greeninfrastructure/default.aspx

UK National Ecosystem Assessment
www.uknea.unep-wcmc.org

Regional climates: Meteorological Office
www.metoffice.gov.uk/climate/uk/regional

Soil and water
www.noble.org/ag/soils/soilwaterrelationships/index.htm

Building Regulations Part H – Drainage (Amended 2010)
www.planningportal.gov.uk/buildingregulations/approveddocuments/parth/approved

Disconnecting downpipes
www.toronto.ca/water/protecting_quality/downspout.htm

Depave Movement
www.depave.org

How to check levels using a hose
www.factsfacts.com/MyHomeRepair/WaterLevel.htm

Planting sources
www.rhs.org.uk/Gardening/Sustainable-gardening/pdfs/RHS_Pollinators_PlantList

www.wildaboutgardens.org.uk

Acknowledgements

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Championing the ecological adaptation of the built environment for a biodiverse, healthy and resilient future, through training, advocacy and research.

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Above: Hemp agrimony | **Bob Gibbons**

Back cover: Highway rain garden, Portland Oregon US | **Dusty Gedge**

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United Nations Decade on Biodiversity

Appendix E: - Example of Package Treatment Plants

Wastewater **Solutions**

BioDisc®

WASTEWATER SOLUTIONS

PREMIUM SEWAGE TREATMENT PLANT FOR DOMESTIC USE
FROM THE MARKET LEADERS IN WASTEWATER TREATMENT.

Kingspan Klargester

60 YEARS OF EXPERTISE

Kingspan Klargester
For over 60 years, Kingspan Klargester has designed and manufactured innovative ways to treat, pump, separate and recycle wastewater. We pioneered the world's first GRP septic tank and the patented RBC (Rotational Biological Contactor) BioDisc® wastewater treatment system – leading change in our sector and setting industry standards around the world.

As established global market leaders, we offer a diverse range of innovative and 100% compliant wastewater treatment solutions for domestic, commercial and industrial applications. We give you relevant advice and support throughout the wastewater treatment purchasing process based on our in-depth local knowledge and expertise.

WORLD LEADER
in quality wastewater management solutions

The Wastewater Management Experts
Kingspan Klargester are the wastewater management experts with over 60 years of innovation and knowledge. Our mission is to design and manufacture premium tried and tested wastewater management solutions on a global scale whilst offering one of the largest and most technologically advanced wastewater ranges available.

Operating in 85 countries worldwide, we offer a global distribution network backed by experienced sales and technical teams. Our support teams provide focused customer service from delivery scheduling to consultancy and installation guidance. We give you the confidence of support over the lifetime of the product and beyond.

85
COUNTRIES
WORLDWIDE

BioDisc®

Kingspan Klargester BioDisc® wastewater treatment plant
Our Kingspan Klargester BioDisc® sewage treatment range benefits from a wealth of industry experience and knowledge that allowed us to bring to market the first Rotational Biological Contactor treatment system over 40 years ago.

The patented BioDisc® is engineered to treat wastewater to the highest level of standards. In terms of ongoing service and maintenance, it offers one of the best returns on investment compared to other treatment processes. Each BioDisc® is designed to ensure 100% compliance with industry requirements, including national and international regulations such as BS EN12256.

The aim of BioDisc® is simple – quality product and quality customer service for total peace of mind.

EXPERTISE

- With over 60 years' experience delivering high performance and reliable wastewater treatment systems worldwide, you can trust Kingspan Klargester.

PREMIUM

- BioDisc® is one of the only premium sewage treatment systems in the world to use the patented Rotating Biological Contactor technology. This ensures continued high performance and hassle-free sewage treatment.

SERVICE

- We pride ourselves on a quality customer experience from comprehensive on-site assessments to professional installation options and expert after sales care.

REQUEST A FREE SITE VISIT FROM OUR EXPERT TEAM.
klargester@kingspan.com
01 296 633 000

BioDisc®

PROTECTING YOUR HOME AND THE ENVIRONMENT

ULTIMATE RELIABILITY
GUARANTEEING
LONG TERM
PERFORMANCE

4 EASY STEPS TO THE PERFECT WASTEWATER TREATMENT SOLUTION

Step 1
Contact us and we'll arrange for a local Kingspan Klargester expert to visit your home for a full site assessment, should you need it.

Step 2
Our professional team will work with you to help choose the correct BioDisc® model.

Step 3
A Kingspan professional can be arranged to commission and activate your tank.

Step 4
We offer tailored service and maintenance packages for your BioDisc® treatment plant.

OVER 60 YEARS OF EXPERTISE

Kingspan Klargester

KEY BENEFITS

FREE NATIONWIDE HI-AB DELIVERY WITHIN 3 WORKING DAYS*
*Mainland UK only

In an increasingly regulated world with new Environment Agency and SEPA standards, it's more important than ever to choose a sewage treatment plant that delivers peace of mind by guaranteeing safe and reliable treatment of wastewater.

BioDisc® from Kingspan Klargester is built on the back of 60 years' experience and offers the following benefits:

LOW RUNNING COSTS
The robust patented design of the BioDisc® treatment plant offers complete peace of mind. With low running costs and minimal servicing and maintenance required, the BioDisc® is a high-quality lifetime investment that helps safeguard the health of you and your family.

FULLY COMPLIANT SOLUTION
BioDisc® is tested and certified to European standard EN 12566, the European standard for small treatment plants and was awarded its Performance Certificate by delivering high levels of pollution removal (up to 97.5%).
As a homeowner you can rest assured that the BioDisc® will operate optimally at all times, saving you time, money and hassle.

EXPERTISE AND KNOWLEDGE
BioDisc® is backed by 60 years' of expertise and technical knowledge. Our expert team is on hand to guide you on the best choice of sewage treatment system for your home.

60

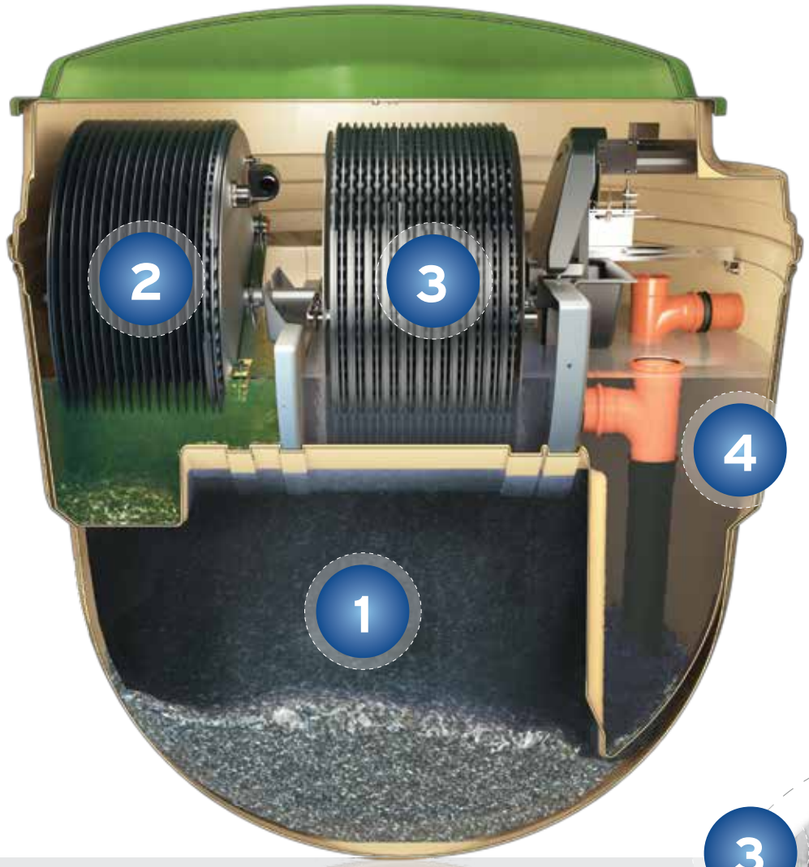
*Subject to stock levels and other conditions. Free delivery from our distribution hubs.

BioDisc®
HOW IT WORKS

The Rotational Biological Contactor (RBC) is central to the operation of each Kingspan Klargester BioDisc®. It supports a biologically active film or biomass onto which aerobic micro-organisms, naturally found in sewage, become established. Natural breakdown of sewage can then occur as described below.

UNIT SIZE	SINGLE HOUSE		MULTIPLE HOUSES	
	BA	BA-X	BB	BC
Population Equivalent	1 House up to 4 bedrooms	1 House up to 7 bedrooms	2 House up to 8 bedrooms	3 House up to 12 bedrooms
Overall diameter / Width (mm)	1995	1995	1995	2450
Standard drain inlet (mm)	750*	750*	750*	600†
Standard outlet (mm)	835	835	835	685
Depth from invert to base (mm)	1400	1400	1400	1820
Pipework Diameter (mm)	110	110	110	110
Sludge storage period (Approx)	12 Months	9 Months	6 Months	7 Months
Standard power supply	Single Phase	Single Phase	Single Phase	Single Phase
Motor rating	50W	50W	50W	75W
Weight (tonnes) standard units	0.388	0.418	0.418	0.650

* BA-BB 450/1250 † BC 11000



ROTATING BIOLOGICAL CONTACTOR (RBC)

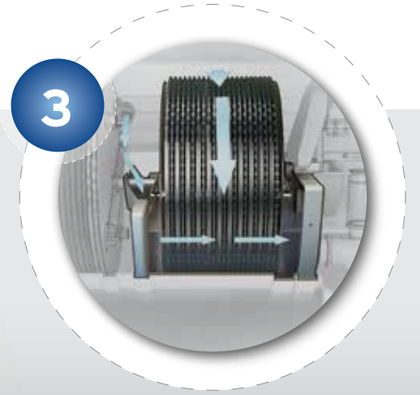
The RBC comprises banks of vacuum formed polypropylene media supported by a steel shaft. This is slowly rotated by a low energy consumption electric motor and drive assembly.

BioDisc® from Kingspan Klargester

For further technical information and videos on the BioDisc® treatment plant visit our website at **kingspanklargester.com**

PRIMARY SETTLEMENT TANK
Wastewater and sewage flows into the primary settlement tank where the large solids are retained for future removal.

FIRST STAGE BIOLOGICAL TREATMENT
The liquor and fine solids then flow into the Biological Treatment Zone 1 where the first stage of treatment occurs.



SECOND STAGE BIOLOGICAL TREATMENT
The liquor is then fed forward at a controlled rate into Biological Treatment Zone 2 for further cleaning.

FINAL SETTLEMENT TANK
The clean liquid passes into the final settlement tank where it can be discharged to ground or water course.

BioDisc®

CHOOSING THE CORRECT SEWAGE TREATMENT PLANT FOR YOUR HOME

At Kingspan Klargester we offer a full range of options and professional insight to help you choose the perfect sewage treatment plant for your home.

All our robust BioDisc® models cater for properties housing between 4-16 people. The premium BioDisc® sewage treatment system is available in four sizes for all types of domestic applications.

For single house applications we offer the BA and BAX models and, for multiple homes, the Kingspan Klargester BB and BC BioDisc® models are ideal.

Because various inlet and outlet options are available, we carry out a free comprehensive site assessment to ensure the correct system model and size for your home.

WHAT DETERMINES MY CHOICE OF SEWAGE TREATMENT PLANT?

The BioDisc® is technically engineered with high performance and quality in mind. Each component of the BioDisc® has been manufactured and chosen with care, to ensure continuous operation of a tried and tested wastewater treatment process.

What else do I need to consider when choosing my sewage treatment plant?

- **The size of treatment plant needed**
  We'll take you through the best practice guidelines from British Water's 'Flows and Loads' sizing criteria to help you make the correct choice.

- **Ground conditions around the plant**
  We'll establish whether it's a wet or dry site to determine the choice of backfill used on the tank.

- **Wastewater discharge options**
  With the new Environmental Agency regulations for domestic plants, it's now more important than ever to take responsibility for wastewater discharges.

- **Ground conditions around the plant**
  Kingspan Klargester offer a range of drain invert level options to match your site conditions.

BioDisc® from Kingspan Klargester

For further technical information and videos on the BioDisc® treatment plant visit our website at **kingspanklargester.com**

REED BEDS

Klargester BioDisc® treatment plants use a reed bed filtration process to further enhance the quality of the effluent migrating into drainage fields or a surrounding watercourse.

DESIGN
Advanced Patented design delivers superior performance
Pre-fabricated to ensure correct sizing
Modules designed with a hydraulic gradient across the length of the units
Performance tested in Germany to EN12566-3 in combination with a Part 3 plant
Modular system comprising of: · Two individual reed beds = single house application · Four individual reed beds = two house application
Adjustable outlet weir allows water level control
One piece GRP moulding installed flush to the ground
Reeds and GRP beds supplied. Washed pea gravel, 'growing' media by others (not included)
Effluent discharge is typically improved by at least 50%, providing reduced BOD and suspended solids
Provides rooting zone depth of 600mm (required by Phragmites Australis)

Benefits

- Tertiary treatment for new applications with tight discharge consents
- Satisfies new building regulations
- Improved effluent quality for existing works
- Very low maintenance
- Aesthetically pleasing and environmentally friendly
- Easy to install and maintain

CUSTOMER SUPPORT

We stand by the quality and performance of Kingspan Klargester products and our support doesn't stop once your tank is installed. We're on standby 24/7 with guidance on servicing and maintenance and offer tailored warranty options. Our trained professional support team is only a phone call away.

Peace of mind with extended warranty options
We offer an extended and tailored warranty or bond on your sewage treatment plant to suit your needs and budget. This cost effective package offers the benefits of scheduled maintenance inspections to ensure your system performs at optimum levels at all times.

Customer support when you need it
Our friendly local customer service team are on hand with professional advice. We operate a dedicated helpline on 01296 633 000 and a support email address for customers on klargester@kingspan.com

WE OFFER A FULL
2 YEAR GUARANTEE* ON OUR DOMESTIC **BioDisc®** TREATMENT PLANT.
* One year guarantee offered as standard on the domestic BioDisc model

Register for your extended two year guarantee at:
kingspanenviro.com/guarantee

Service and maintenance
We recommend that you service your BioDisc sewage treatment plant once a year. Under new Environment Agency regulations, it's now your responsibility to ensure smooth running of your plant. Our in house Service department offer a range of service packages including Gold, Silver and Bronze to cater for all homeowners' needs. To find out more about how you could benefit from a tailored service package from Kingspan, call us on **0844 846 0500** or email **helpingyou@kingspan.com.**

Contact your expert local Kingspan Klargester team today

Our experienced local Kingspan Klargester product experts are on hand with professional advice on all aspects of your sewage treatment system, including sizing and installation.

Book your no obligations site assessment from the global experts in wastewater treatment, Kingspan Klargester. Contact us today on **+44 (0) 1296 633 000.** You can also book your visit online at **Kingspanklargester.com**

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