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Transportation Planning : Infrastructure Design

Flood Risk Assessment & Outline Drainage Strategy

Blythe Bridge Road, Caverswall

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EXECUTIVE SUMMARY

The Flood Risk Assessment (FRA) has reviewed all sources of flood risk to both the proposed development and to the existing adjacent properties as a result of the development proposals, including fluvial, tidal, pluvial, groundwater, sewers and flooding from artificial sources.

The proposed development is considered low vulnerability development in Flood Zone 1 and is at low risk of flooding.

The proposed development is located on greenfield land and is outside of any groundwater protection zone.

The Drainage Strategy in Sections 5.0 and 6.0 provides options for the drainage of the proposed development in accordance with the National and Local requirements.

The preferred method for disposal of surface water is via infiltration subject to confirmation of infiltration testing to confirm suitability. Should discharge via infiltration prove to be impracticable then a positive drainage connection to the local drainage network will be required. Severn Trent Water sewer records do not indicate the presence of any surface water of combined sewers in the vicinity. However, a number of road gullies were noted during the site walkover which would indicate a potential highway drainage network which could be utilised pending further investigations and agreement with the Lead Local Flood Authority.

Further investigations would be required prior to undertaking detailed design to determine both the infiltration potential for the development and details of all drainage within the vicinity.

Foul water is intended to be discharged unrestricted to the existing public foul sewer system located in Blythe Bridge Road, subject to agreement with Severn Trent Water. It is understood that the sewer is located at an invert depth of approximately 1.5m which may prove too shallow to achieve a gravity connection. A waste water pumping station could therefore be potentially required to serve the development which would be offered for adoption to Severn Trent Water.

1.0 INTRODUCTION

1.1 Appointment

SCP has been commissioned by David Rowley via CTD Architects to provide a site specific Flood Risk Assessment and Outline Drainage Strategy to support a planning application for a new residential development situated at Blythe Bridge Road, Caverswall.

1.2 Proposed Development

The planning application proposes residential development comprises of 12 plots with associated hard and soft landscaping works across a total site area of approximately 1.0 hectares (ha).

The site is currently undeveloped greenfield land. The proposed development will have an approximate impermeable area of 0.40ha with a permeable area of 0.60ha for soft landscaping, assuming the site is 40% impermeable.

1.3 Objective of Strategy

The objective of the strategy is to undertake a Flood Risk Assessment in accordance with the National Planning Policy Framework and to set out the Outline Drainage Strategy for the development.

This report therefore assesses flood risk to the site and any impact on flood risk to other land because of the development proposals. Where required, flood risk mitigation measures have been proposed and are set out in the Outline Drainage Strategy.

The report also provides information and presents proposals relating to the following:

The existing surface water drainage systems within and in the vicinity of the site;

- Proposed surface water flows;
- Proposed surface water discharge points;
- Proposed surface water storage volumes;
- Proposed attenuation methods;
- Constraints imposed by the regulatory bodies, including the Environment Agency, the local water and highway authorities.

In accordance with the National Planning Policy Framework the drainage strategy takes account of climate change over the longer term of the development and gives priority to the use of sustainable drainage systems.

1.4 Flood and Water Management Act 2010

This strategy has been prepared in consultation with regulatory bodies and third parties. The views advice and recommendations provided by the regulatory bodies and third parties represent their current standards and procedures.

It should be noted that these standards and procedures are being reviewed by the respective regulatory bodies and third parties against the requirements imposed by the Flood and Water Management Act 2010. The advice and recommendations provided may change when associated regulations have been issued in order to implement the full scope of the Act.

The Flood and Water Management Act 2010 received Royal Assent on 8th April 2010. This Act provides duties on the Environment Agency, Local Authorities, Developers and other bodies to manage flood risks. The Act has significant planning and design implications for Developers.

The main areas affecting Developers are:

- Lead Local Flood Authority (LLFA) to adopt sustainable urban drainage systems (SUDS). The LLFA may be either a Unitary or County Council;
- Approval fees and non-performance bonds to be standardised;
- A National Standard for SUDS design, construction, maintenance and operation to be issued. This guidance will emphasise the preference for surface SUDS features and the need to incorporate green corridors into the masterplan. A DRAFT version of this document was issued for consultation in December 2011. The final version was expected to be issued in 2014 however, DEFRA reported a delay and to date have not advised when the revised issue date is likely to be.
- Changes to the rights to connect to sewers will restrict automatic connection rights to only Section 104 sewer schemes or approved SUDS schemes constructed to a new national sewer or new SUDS standard respectively;
- Two options for the SUDS approval process. Either directly to the SUDS Approval Body or as a combined application to the Planning Authority as part of the Planning Application.

2.0 EXISTING SITE

2.1 Site Location

The site is located on Blythe Bridge Road in Caverswall on the outskirts of Stoke-on-Trent (to the west).

An approximate postcode for the site is ST11 9ED OS Co-ordinates 395284E, 342744N.

A site location plan can be found in Appendix A.

2.2 Site Description

Area		The gross site area is approximately 1.0 hectares.
Existing Surfacing		The site is greenfield and has no hardstanding. A tree lined drainage ditch is present along the approximate centre of the site (east to west) which terminates at a localised depression immediately adjacent to the western boundary.
General Topography		The site is relatively level with a steady fall from the eastern boundary of the site to the west
Current Use		The site is currently pasturable land.
Boundaries	**North**	Blythe Bridge Road which leads to Caverswall; the local village which comprises a small residential community with local amenities
	East	Multiple farmlands with associated properties i.e. barns, stables and farmhouses
	South	Blythe Bridge Road which leads to Blythe Bridge village; there are a few residential and farm properties in between
	West	A few residential properties, farmlands and the city of Stoke-on Trent is situated 2km westwards
Access	**Vehicular**	Gated accesses to the site are located in the north western and southern extents of the site
	Pedestrian	There is a footpath along Blythe Bridge Road which serves as local access between the villages of Caverswall and Blythe Bridge

2.3 Topography

A topographic survey of the site has been provided by CTD Architects. The topography of the site generally slopes from north east to south west at a relatively constant gradient. At the north east corner levels are recorded at 190.24m AOD with levels in the region of 183.65m AOD to the south west immediately adjacent to Blythe Bridge Road.

2.4 Geology

Information regarding the geology of the site has been obtained from the Sub Surface Midlands Desk Study Technical Report (Ref: M3171).

The document suggests that the site is underlain directly by cohesive glacial drift deposits (Devensian Till, Diamicton) which are in turn underlain by bedrock.

Cohesive glacial drift deposits generally comprise sandy silty clays with variable gravel, cobbles and boulders and with horizons of sand and/or gravel.

2.5 Hydrogeology and Hydrology

The superficial/ drift deposits underlying the site and its immediate surrounding area comprise cohesive glacial drift which are indicated to be a Secondary (undifferentiated) aquifer. The bedrock underlying most of the site comprise mudstones of the Mercia Mudstone Group which are indicated to be a Secondary B aquifer whilst the bedrock underlying the north north western margin if the site and the land beyond comprises sandstones with conglomerates which are indicated to be a Principal aquifer.

Principal aquifers are layers of rock or drift deposits that have high intergranular and/ or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/ or river base flow on a strategic scale.

Secondary B aquifers are predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.

2.6 Groundwater Protection Zones

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 the Environment Agency occasionally applies, to a groundwater source.

The proposed development site is identified by the EA as being partially located within a SPZ3 Total Catchment.

The EA define the SPZ3 Source Catchment Protection Zone as the total area needed to support the abstraction or discharge from the protected groundwater source. The shape and size of the zone is controlled by natural hydrogeological conditions as well as the operation of the groundwater abstractions.

Within the SPZs the EA seek to restrict certain potentially polluting activities, with the most onerous restrictions applied to Zone 1.

The development of the site would be undertaken in a manner to ensure that no contamination of groundwater occurred.

2.7 Existing Public Sewers

Severn Trent Water sewer records (Appendix H) indicate that there is a public foul water sewer situated west of the site along Blythe Bridge Road. This is shown as 150mm diameter and flows southward before turning east and crossing the adjacent private field.

No other public sewers are shown in the vicinity of the site.

Notwithstanding the above, during the site walkover a number of highway drainage gullies were identified. It is not clear where these discharge to and discussions with the local authority have not provided any clarity regarding the presence of any highway drainage.

Further investigation will be required at detailed design stage to provide a clearer understanding of all drainage within the vicinity of the site.

2.8 Existing Private Drainage

At the time of writing this report, no information pertaining to the existing on-site drainage was available. However, given the sites current undeveloped nature it is unlikely that any piped drainage features are present. During the site visit an access chamber was located just within the site boundary off Blythe Bridge Road however, it is considered that this will be related potentially to existing electricity or communications apparatus.

The topographic survey identified a soakaway at the end of the existing land drainage ditch however, a site walkover could find no indication of any physical structure. It is therefore considered that the soakaway represents a depression and low point in the topography where runoff is allowed to infiltrate naturally.

Further investigation will be required at detailed design stage to provide a clearer understanding of all drainage within the vicinity of the site.

2.9 Watercourses, Land Drainage and other Waterbodies

Environment Agency river mapping suggests that the nearest water course to the site is the River Blithe which is located circa 500m the west. This is understood to be a designated secondary river and therefore falls within the Environment Agencies jurisdiction.

Within the site an existing drainage ditch is present which flows from north east to south west, dividing the site in two. A short section of this has been culverted with small diameter pipework to allow access between the two separate fields. As described above, the topographic survey identified a soakaway at the end of this ditch however it is considered that this is merely a depression in the topography rather than a formal drainage structure.

The drainage ditch extends beyond the site boundary to the east and therefore it will be necessary to maintain this connection within the proposed scheme. Any downstream connectivity beyond the western boundary could not be determined however, it is considered that the ditch terminates here and does not continue beyond the site limits.

2.10 Existing Flood Defences and Other Structures

There are no flood defences within close proximity to the proposed development site.

2.11 Historical Land Use

The site is undeveloped pasturable land and has had no other historical land use.

2.12 Historical Flood Records

The table on the next page, summarises the historical flood records obtained through consultation with the various bodies contacted as part of this study.

Information Source	Flood Records/Details
Environment Agency	The Environment Agency have confirmed that they hold no records of any historical flooding in the area and that the site is not within the current 'Extreme Flood Outline'.
Staffordshire County Council	Staffordshire County Council have confirmed that the site has no history of flooding. However, SCC expressed some concerns regarding the potential for overland flows from off-site impacting on the proposed development. These are addressed later in the report.

Severn Trent Water	At the time of writing a consultation response was awaited from Severn Trent Water and therefore details will be entered into the final version of this report when received.

2.13 Flood Mapping

EA Flood Zone Map

The Environment Agency Flood Zone Map indicates that the proposed development site is located in Flood Zone 1 (low risk).

This is land designated as having a less than 0.1% annual probability of flooding from rivers or the sea in any year (less than a 1 in 1000 annual probability of flooding).

Flood zone designation ignores the presence of any flood defences and only considers flooding from fluvial and tidal sources.

EA Reservoir Flood Map

The Environment Agency website does not locate the site within an area at risk from reservoir flooding.

British Geological Survey Flood Data

The British Geological Survey Flood Data Map indicates that the site contains no inland geological indicators of flooding and that the site has some potential for groundwater flooding of properties situated below ground level to occur.

3.0 DEVELOPMENT PROPOSALS

3.1 Nature of the Development

The proposed development comprises the construction of 12 residential houses and associated highway, footways and hardstanding.

A copy of the masterplan can be found in Appendix B.

The total area of the proposed development is approximately 1.0ha. With a proposed permeable area of approximately 0.60ha. This makes the proposed development 40% impermeable and represents an increase over the exiting site.

3.2 Proposed Levels

At the time of writing a site levels strategy was not available for the proposed development. However, it is anticipated that there will be no major changes in the existing site topography and therefore finished levels will remain broadly as existing with some levelling out of peaks and troughs as required to facilitate construction.

4.0 SOURCES OF FLOOD RISK

Source	Likelihood
Fluvial	Low
Coastal - Sea	Not Applicable
Coastal - Estuarine	Not Applicable
Pluvial	Low
Sewer – SWS, FWS, CS, CSO	Low
Groundwater	Low
Other Sources	Low

4.1 Fluvial Flood Risk

Information relating to flood risk at the site has been obtained via an Envirocheck Flood Screening Report.

Examination of the Flood Maps show that the site is located within an area classified as Flood Zone 1 and the risk of flooding from Rivers or the Sea is considered to be 'low'.

River Blithe is local to the proposed site and it is understood that it falls under the jurisdiction of the Environment Agency.

Data obtained from the Environment Agency has revealed mean daily levels for the River Blithe, in the range of 169m AOD. Given the lowest existing level on site is in the region of 183m then it can be considered that there is no risk of the development being affected by fluvial flooding associated with this river.

The Environment Agency have advised that the site is not within the current 'Extreme Flood Outline' and that they have no record of any historic flooding in the area.

Staffordshire County Council have also confirmed that they hold no records of fluvial flooding in the area.

Taking the above into consideration, it is considered that the risk from fluvial flooding to the site is low.

4.2 Pluvial Flood Risk

Pluvial flooding is defined as flooding resulting from rainfall-generated overland flow, before runoff enters any watercourse or sewer.

It is usually associated with high intensity rainfall events but can also occur with low intensity rainfall or melting snow where ground is saturated, frozen, developed or otherwise has low permeability resulting in

overland flow and ponding in depressions in the topography. Large catchment areas are particularly prone to this type of flooding.

Surface water flood maps can be found in Appendix C. They demonstrate that even after a 1 in 1000 year rainfall event the site is not prone to flooding. However this mapping will be based on coarse level data and can be considered indicative only.

The topography of the site and surrounding area means that there is little likelihood of significant flows impacting on the proposed development or on land and property adjacent to the development. The topography to the east of the site drains towards the development but any runoff here is collected by the land drainage ditch. It is intended that this ditch will be maintained and provision made for these flows within the site. Furthermore, consideration will be given for the introduction of additional cut-off ditches or trenches to reduce the impact of potential overland flows and to ensure there are no off-site impacts. The only flows that are therefore likely to be present on site are from direct rainfall on areas of hardstanding.

The proposed new development will be served by a new surface water drainage network and underground/ surface attenuation which will be designed to accommodate surface water flows within the site for up to and including the 100 year plus climate change storm event.

Taking the above into consideration, the risk of flooding to the site from surface water is considered to be low.

4.3 Sewer Flood Risk

At the time of writing a consultation response was awaited from Severn Trent Water and therefore confirmation is still sought with respect to records of public sewer flooding to properties in the vicinity of the site. However, given the topography of the site and surrounding area it is considered unlikely that flooding from surcharged public sewers could impact on the proposed development.

The proposed site surface water drainage system will be design to maintain the surface water flows below ground for up to and including the 1 in 30 year return period as a minimum. Flows above this and up to the 100 year plus climate change event will be retained safely within the site on the surface.

Taking the above into consideration and pending a satisfactory response from Severn Trent Water, it is considered that the risk of flooding to the site from surcharged sewers is low.

4.4 Groundwater Flood Risk

In general terms groundwater flooding can occur from three main sources, raised water tables, seepage and percolation, and groundwater recovery or rebound.

If groundwater levels are naturally close to the surface then this can present a flood risk during intense rainfall. Having reviewed groundwater flood maps from Environment Agency and the British Geological

Survey it indicates that the site contains no inland geological indicators of flooding and that the site has limited potential for groundwater flooding to occur.

An intrusive investigation should be undertaken at detailed design stage to establish exact ground water levels. However, based on the available information at this stage it is considered that the likelihood of flooding from this source is low.

4.5 Flooding from Other Sources

Non-natural or artificial sources of flooding can include reservoirs, lakes and canals etc.

No other potential sources of flood risk have been identified in the vicinity of the site.

4.6 Historical and Anecdotal Flooding Information

An internet based search for flooding events did not recall any historical flooding in the immediate vicinity. Pre-development enquiries with various interested parties are awaiting a response and details will be entered into the final version of this report when received.

4.7 Flood Risk Vulnerability Classification

The proposed development is residential and can be considered to be classified as 'less vulnerable' within *Table 2: Flood Risk Vulnerability Classification* of the NPPF. Therefore this type of development would be wholly appropriate for Flood Zone 1.

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	×	×	×

Key: ✓ Development is appropriate.
× Development should not be permitted.

Table 1 - NPPF Flood Risk Vulnerability Classification

5.0 SURFACE WATER MANAGEMENT

5.1 Introduction

The National Planning Policy Framework (NPPF) and accompanying Technical Guidance indicate surface water run-off should be controlled as near to its source as possible through a sustainable drainage approach to surface water management.

Consideration should therefore firstly be given to using sustainable urban drainage (SUDS) techniques including soakaways, infiltration trenches, permeable pavements, grassed swales, ponds and wetlands to reduce flood risk by attenuating the rate and quantity of surface water run-off from a site. This approach can also offer other benefits in terms of promoting groundwater recharge, water quality improvement and amenity enhancements. Approved document Part H of the Building Regulations (2000) sets out a hierarchy for the disposal of surface water which encourages a SUDS approach.

5.2 Climate Change

There are indications that the climate in the UK is changing significantly and it is widely believed that the nature of climate change will vary greatly by region. Current expert opinion indicates the likelihood that future climate change would produce more frequent short duration and high intensity rainfall events with the addition of more frequent periods of long duration rainfall.

The NPPF Technical Guidance Table 5 states that the recommended national precautionary sensitivity ranges for increase of peak rainfall intensity is 30% until 2115. However, The Environment Agency issued new advice which updated previous climate change allowances outlined in the NPPF. Table 2 below shows anticipated changes in extreme rainfall intensity in small and urban catchments. For Flood Risk Assessments and Strategic Flood Risk Assessments, The Environment Agency recommend both the central and upper end allowances are assessed to understand the range of impact.

Table 2 peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

The Lead Local Flood Authority has requested use of the 40% increase in peak rainfall for the purpose of surface water drainage design and assessment of exceedance flow pathways. This will therefore result in

an increase in the storage volumes required to meet planning policy, and greater consideration will need to be given to overland flow routes within the development layout.

5.3 Pre-development Surface Water Runoff

For the purposes of determining the existing rate of surface water runoff the site is considered to be permeable greenfield. Therefore for this exercise the total area of the application site is 1.0 ha will be considered 100% permeable.

The runoff rates from the permeable (Greenfield) areas of the site have been calculated using the HR Wallingford Sustainable Drainage Tool (http://www.uksuds.com/greenfieldrunoff_js.htm) which utilises the Institute of Hydrology Report 124 Method.

The **IH124** publication provides the essential design elements for determining the estimated Greenfield runoff rate which is based on the site area, soil type, and average annual rainfall, which is influenced by the location of the site within the United Kingdom. This methodology is recommended within R&D Technical Report W5-074/A/TR/1 'Preliminary Rainfall Runoff Management for Developments'(2012).

The IOH 124 equation to calculate runoff is:

$$Q_{bar} = 0.00108.^{0.89}.SAAR^{1.17}.SOIL^{2.17}$$

Where:

Q_{bar} = Mean Annual Flood (m^3/s). A return period in the region of 2.3 years.

SAAR = Standard Average Annual Rainfall (mm)

A = Area (ha) of the catchment.

SOIL = Soil index value obtained from soil maps in the Flood Studies Report or the WRAP map of the Wallingford Procedure.

The SAAR value for the site and soil value were obtained automatically through the HR Wallingford website. The analysis for determining the peak Greenfield discharge rate uses 50ha in the formula and linearly interpolates the flow rate value based on the ratio of the development to 50ha (Interim Code of Practice for Sustainable Urban Drainage Systems, 2004).

The table below summarises the existing Greenfield runoff rates generated by the site for a range of storm return periods.

Site Area (ha)	Q_{bar} (L/s)	Q_1 (L/s)	Q_{30} (L/s)	Q_{100} (L/s)	$Q_{100+40\%}$ (L/s)
1.00	7.96	6.61	15.92	20.46	28.64

A summary of these calculations can be found in Appendix D.

5.4 Post-development Surface Water Runoff

The existing site is greenfield with no impermeable hardstanding. The current development proposals will lead to a reduction in this greenfield area by approximately 40% through the introduction of buildings and areas of hardstanding.

Site Area (ha)	Impermeable Area (ha)	Permeable Area (ha)
1.0	0.40	0.60

The industry standard Modified Rational Method has been used in the calculation of runoff rates from proposed hardstanding areas. Rainfall intensity data was obtained from Microdrainage and a standard runoff coefficient of 0.9 was applied to the areas assessed to be permeable.

The table below summarises the proposed peak flow rates generated by the development for a range of storm return periods. It is assumed that runoff from all landscaped (permeable) areas will infiltrate and not contribute to the proposed drainage network.

Impermeable Area (ha)	Q_1 (L/s)	Q_{30} (L/s)	Q_{100} (L/s)	$Q_{100+40\%}$ (L/s)
0.40	24.04	59.11	77.18	108.05

5.5 Proposed Restricted Discharge Rates

If infiltration drainage is proven to not be a suitable method of surface water disposal for the development, a positive drainage connection to either the public sewer system or nearby watercourse will be required. To comply with local and national drainage and planning policy, discharge from the development would be restricted to the existing greenfield runoff rate, Q_{bar}, which has been calculated at **7.96 litres per second**.

This would ensure that surface water runoff from the proposed development does not exceed the existing scenario and a betterment is provided for larger return periods.

5.6 Methods of Surface Water Management

At present the planning application site is greenfield and is considered to be 100% permeable. This figure will decrease following the proposed development to approximately 60% due to addition of buildings and impermeable hardstanding.

There are three methods that have been reviewed for the management and discharge of surface water for the site which are detailed below; these may be applied individually or collectively to form a complete strategy. They should be applied in the order of priority as listed.

- Discharge via infiltration;
- Discharge to watercourse;
- Discharge to public sewerage system.

5.7 Discharge via Infiltration

Any impermeable areas that can drain to a soakaway or an alternative method of infiltration would significantly improve the sustainability of any surface water systems.

No intrusive investigation has been carried out for the site to date. However, based on the underlying geology it is considered that infiltration would potentially be a suitable method of surface water disposal. Soakaway testing should be carried out in accordance with BRE365 to determine whether any infiltration solution can potentially be applied as a feasible method of surface water management.

If favourable infiltration rates are returned from the site investigation, further design work should be undertaken to establish resultant storage volumes. It is anticipated that storage could be provided in an attenuation pond or dry detention basin to the north of the proposed site access road. The existing ditch from off-site will need to be maintained and any storage facility will also need to consider this additional run-off.

5.8 Discharge to a Watercourse

As indicated earlier in this report, the nearest watercourse to the site is believed to be the River Blithe, which is located to the west of the site. The location of the watercourse is approximately 500m away. Any connection to this watercourse would require significant off-site works along busy vehicular routes and/ or through third party land, therefore on this basis this option has not been considered further.

5.9 Discharge to a Public Sewer

Based on the sewerage plans supplied by Severn Trent Water, it is considered that a connection to the existing public sewer network is not feasible as there are no surface or combined sewers identified in the vicinity.

A site walkover highlighted a number of existing road gullies along Blythe Bridge Road which indicates the presence of potential highway drainage which could be utilised as a point of connection for surface water discharge should infiltration prove not to be feasible.

Any discharge would need to be agreed with the Lead Local Flood Authority and it is anticipated that the site would be restricted to a greenfield runoff rate of 7.96 l/s.

Further investigation work will be required at detailed design stage to confirm the presence of all existing drainage in the vicinity of the site and appropriate discussions held with the local authority.

5.10 Attenuation Requirements

The proposed restricted discharge rate and calculated post-development runoff rates generate a storage requirement during periods of intense rainfall.

The Microdrainage 'Quick Storage Estimate' module has been used to estimate the storage volume required for both a 1 in 30 year and 1 in 100 year storm event plus a 40% allowance for climate change. These volumes are detailed in the table below and are based on the assumption that no infiltration is possible and all surface water discharge will be to the local highway drainage network.

Permissible Discharge (L/s)	Impermeable Area (ha)	Q_{30} Volume (m^3)	$Q_{100+40\%}$ Volume (m^3)
7.96	0.397	113	249

These volumes are indicative only and are subject to confirmation at detailed design stage. Should the site discharge via infiltration, further calculations will be required to ascertain the resultant storage volumes pending receipt of appropriate BRE 365 test results.

Given the proposed location for the attenuation facility and the topography of the site it is likely that no surface storage will be feasible as it would be difficult to retain within the development.

Appendix F contains the calculation summary.

5.11 Outline Surface Water Drainage Strategy

As described above, the hierarchy for surface water disposal, as set out in Part H of the Building Regulations indicates that priority should be given to the use of infiltration systems; second priority to discharge to a watercourse and third priority to discharge to the public sewer.

The general principle of the surface water drainage strategy for this site, is to collect the runoff from the roof areas and then convey this to a grey water storage tank located within the curtilage of each plot. An overflow system will also be provided which will convey excess storm water into a detention basin where it will be allowed to infiltrate naturally as per the existing site regime.

It is intended that both the private driveways and access road will comprise permeable surfacing and will be allowed to infiltrate at source. An overflow to the proposed detention basin will also be provided to cater for extreme storm events.

Should the above prove not to be feasible as a result of poor infiltration rates, then a direct connection will be required to the local highway drainage network which is assumed to be located in Blythe Bridge Road pending further investigation work to confirm details. Discharge would be restricted to the existing rate of greenfield runoff subject to approval with the Lead Local flood Authority.

The proposed discharge rate generates an attenuation requirement due to the increase of impermeable area. As described above, it is proposed to accommodate this requirement via a combination of both above and below ground attenuation storage.

The site itself is relatively constrained with respect to a suitable location for any attenuation facility. It is currently proposed to construct a dry detention basin or attenuation pond immediately adjacent to the site access road where runoff would be allowed to infiltrate naturally, as shown on SCP drawing 16328/SK02.

The existing ditch which enters the site from the east will need to be considered within the drainage scheme. It is therefore intended that this will be culverted along its existing alignment and discharged into the proposed attenuation facility. Consent would be required for culverting this ditch from the Local Authority under Section 23 of the Lane Drainage Act of 1991 however, it is considered that this would be acceptable.

There is the potential that each plot could be served by individual soakaways and permeable pavements with the larger soakaway/ attenuation facility servicing the adoptable carriageway areas only. This would be subject to detailed design and discussions with the local authority. If this was chosen as a solution then the proposed surface water drainage would need to be maintained as highway drainage by the Local Authority as Severn Trent Water would not adopt this. Discussions would also need to be held with the local authority regarding adoption of the attenuation facility.

A drawing highlighting indicative attenuation areas and point of connection for the development can be found in Appendix G.

6.0 FOUL WATER MANGEMENT

6.1 Introduction

It is proposed to install a new foul water drainage system to serve the development which will connect into the public foul sewer network situated on Blythe Bridge Road.

Where possible, any existing connections from the site will be maintained subject to further investigation work on-site to confirm suitability.

The foul water system will be designed and constructed in accordance with the current Building Regulations, BS EN:752 drainage and sewer systems outside buildings, the local authority building control specifications and requirements, Sewers for Adoption 7th Edition and the Civil Engineering Specification for the Water Industry 7th Edition.

6.2 Foul Water Capacity and Point of Connection

As described above, where possible existing connection points to the public sewer network will be maintained. However, a new connection(s) to the public foul sewer adjacent to the site on Blythe Bridge Road will be required subject to agreement with Severn Trent Water.

The estimated Dry Weather Flow (DWF) generated by the proposed development site has been calculated at 0.55 l/s. This is based on the requirement of 4000 litres per dwelling per day in accordance with Sewers for Adoption 7th Edition.

This flow rate represents an increase on the existing foul water historically discharged from the site. A pre-development enquiry will need to be submitted to Severn Trent Water to confirm available capacity within the public sewer network for the additional flow and agree points of connection.

At this stage it is anticipated that the additional flow will be acceptable and foul water can discharge without any restriction. However, this will need to be confirmed at the earliest opportunity. Furthermore, investigations will be required to establish exact invert levels, diameters and condition of the receiving sewer.

6.3 Gravity Drainage System

Based on available information, it is anticipated that a gravity connection to the public foul sewer network may be achievable. This is based the known invert for MH 2701 as indicated on Severn Trent Water sewer records. However, further investigation work will be required on-site to establish exact invert levels prior to the commencement of any detailed design or construction work. Should pumping be required then any pumping station will be designed in accordance with the current Building Regulations, British Standards and Sewers for Adoption 7th Edition all in consultation with Severn Trent Water.

7.0 MANAGEMENT MEASURES, OFF SITE IMPACTS AND RESIDUAL RISK

7.1 Flood Risk Management Measures

It is intended that surface water from the development will be discharged via infiltration as per the existing site regime.

Should this prove to be impracticable following infiltration testing carried out in accordance with BRE 365 then a positive drainage connection will be required. Based on a site walkover it is anticipated that a highway drainage network ay be present within Blythe Bridge Road which could potentially be used in the absence of any public surface or combined sewers. Further investigations would be required in advance of any detailed design or construction work to determine the location, level, capacity and condition of all drainage in the vicinity.

The proposed discharge rate will be restricted to match that of the existing greenfield runoff.

The use of site control measures, with controlled release of surface water either via infiltration or to the local drainage network will help to minimise the flood risk impact to the surrounding area.

Finished site levels will be engineered to provide positive drainage where required and prevent ponding. The accumulation of standing water would therefore not occur and thus not pose a risk.

Gradients of the hardstanding areas, where possible, will be designed to fall away from buildings such that any overland flow resulting from extreme events would be channelled away from entrances.

As the site and surrounding areas are located within Flood Zone 1, it is considered that access and egress should not be affected during flooding.

7.2 Off Site Impacts

To ensure that the proposed development will not increase flood risk elsewhere it is intended that the site will drain via infiltration as the existing site regime. Should this not be possible then surface water drainage discharge rates would be restricted. This restricted discharge in conjunction with surface water attenuation on site will mitigate against flood risk to other land.

By reducing the pre development peak runoff prior to its point of discharge, this will reduce the potential for surface water flooding on the downstream network.

7.3 Residual Risks

The development and its drainage system will be designed to cope with the intense storm events up to and included the 100 year return period rainfall event with an allowance for climate change (40%). If an extreme rainfall event exceeds the design criteria for the drainage network it is likely that there will be some overland flows that are unable to enter the system.

Any overland flows generated by the proposed development must be directed away from buildings and towards the highway network where it can follow natural flow paths.

8.0 SUMMARY

The proposed development comprises the construction of a 12 house residential development with associated hard and soft landscaping. A copy of the masterplan can be found in Appendix B.

The site is in an area identified as having a 'low' probability of flooding on the Environment Agency Flood Map and is located in Flood Zone 1.

NPPF requires that planning applications for development proposals of 1 hectare or greater in Flood Zone 1 should be accompanied by a Flood Risk Assessment.

The Flood Risk Assessment (FRA) has reviewed all sources of flood risk to both the proposed development and to existing adjacent developments as a result of the proposals, including fluvial, tidal, pluvial, groundwater, sewers and flooding from artificial sources.

The primary option for surface water disposal is via infiltration pending confirmation of suitability through testing in accordance with BRE 365.

Should infiltration not be suitable then it is proposed to discharge runoff to the local highway drainage network, pending further investigation work, at a restricted discharge rate of 7.96 l/s. Both the discharge rate and point of connection would be subject to formal agreement with the Lead Local Flood Authority.

Foul Water is proposed to be discharged unrestricted to the public combined sewer network, again this will be subject to agreement with Severn Trent Water and further investigation work to confirm invert levels, capacity and condition.

The development is accessible for emergency access and egress during times of extreme flooding as the flood plain does not extend into the area proposed for development.

The Flood Risk Assessment is considered to be commensurate with the development proposals and in summary, the development can be considered appropriate for Flood Zone 1 in accordance with the NPPF.