

Proposed Bungalow

**Rear of 66 George Street, Wombwell, Darfield,
Barnsley, South Yorkshire S73 0DS**

Flood Risk Assessment

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Executive Summary

UK Flood Risk Consultants has been commissioned to prepare this Flood Risk Assessment (FRA) in support of a proposal consisting of erection of a new detached bungalow at the rear of 66 George Street, Wombwell, Darfield, Barnsley, South Yorkshire S73 0DS.

The main sources of information to undertake flood risk assessment is the flood maps and data of the Environment Agency and the past flood study reports of the Local Authority.

The proposed development is categorised as 'more vulnerable' development.

The site is located in close proximity to the River Dove with the risk of fluvial flooding. The historic flood maps show that there were some flooding events in the River Dove such as in 2007, Autumn 2000 and 1947 however the site is located outside of the flood extents of these events.

The Environment Agency's flood map indicates that a small part of the site is located within the Flood Zone 2 (medium probability flooding). The majority of the site is located in Flood Zone 1 (low probability flooding). The majority of the site is located outside the risk zone with a small area falling within 'low' flood risk zone.

The Environment Agency's modelling data indicated that the site level is higher than the modelled water levels for a range of return period event including the 1 in 100 year event. The risk of flooding to the site is therefore low.

The flood risk from other sources including surface water, underground water, sewer and reservoir is 'low'.

It is recommended that flood resilient measures are used in the development to manage the residual risk, reduce the damage and clean up.

It is proposed that the finished floor level will be set 600mm above the 1 in 100 year annual probability (1%) water level which is 25.559mAOD. Therefore, it is proposed that the finished floor level will be set minimum of 26.159mAOD. The elevation of the existing ground is 25.899mAOD. This means the proposed finished floor level will be 260mm above the existing ground level.

As part of the site is located within a flood zone area, it will be necessary to make sure that the residents are fully aware of the flood risk and flood warning and evacuation during an extreme event. If necessary, during a flood event the first floor will provide a safe haven for the residents. The access to the Flood Zone 1 will be provided via Henry Street towards George Street. This safe area is located at a walking distance from the site.

The surface runoff from the site will be mitigated by implementing appropriate Sustainable Drainage Systems (SuDS). It is proposed that the surface runoff will be improved by implementing rainwater harvesting and soakaway.

This report demonstrates with appropriate mitigations the proposal will be safe, in terms of flood risk, for its design life and will not impose any flood risk elsewhere.

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Abbreviations

Abbreviation	Definition
AOD	Above Ordnance Datum
DEFRA	Department for Environment, Food, and Rural Affairs
EA	Environment Agency
FRA	Flood Risk Assessment
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
SFRA	Strategic Flood Risk Assessment
PFRA	Preliminary Flood Risk Assessment
SuDS	Sustainable Drainage Systems

1.0 Introduction

1.1. Terms of Reference

UK Flood Risk Consultants has been commissioned to prepare this Flood Risk Assessment (FRA) in support of a proposal consisting of erection of a new detached bungalow at the rear of 66 George Street, Wombwell, Darfield, Barnsley, South Yorkshire S73 0DS.

The National Planning Policy Framework requires a Flood Risk Assessment to be carried out to ensure flood risk to the proposed development is considered as well as the impact the development will have elsewhere on people and property.

This FRA has been prepared in accordance with the Environment Agency's Flood Risk Assessment (FRA) Guidance Note 3 and best practices in flood risk management.

1.2. FRA Requirements

It is a requirement for development applications to consider the potential risk of flooding to a proposed development over its expected lifetime and any possible impacts on flood risk elsewhere, in terms of its effects on flood flows and runoff.

Where appropriate, the following aspects of flood risk should be addressed in all planning applications in flood risk areas:

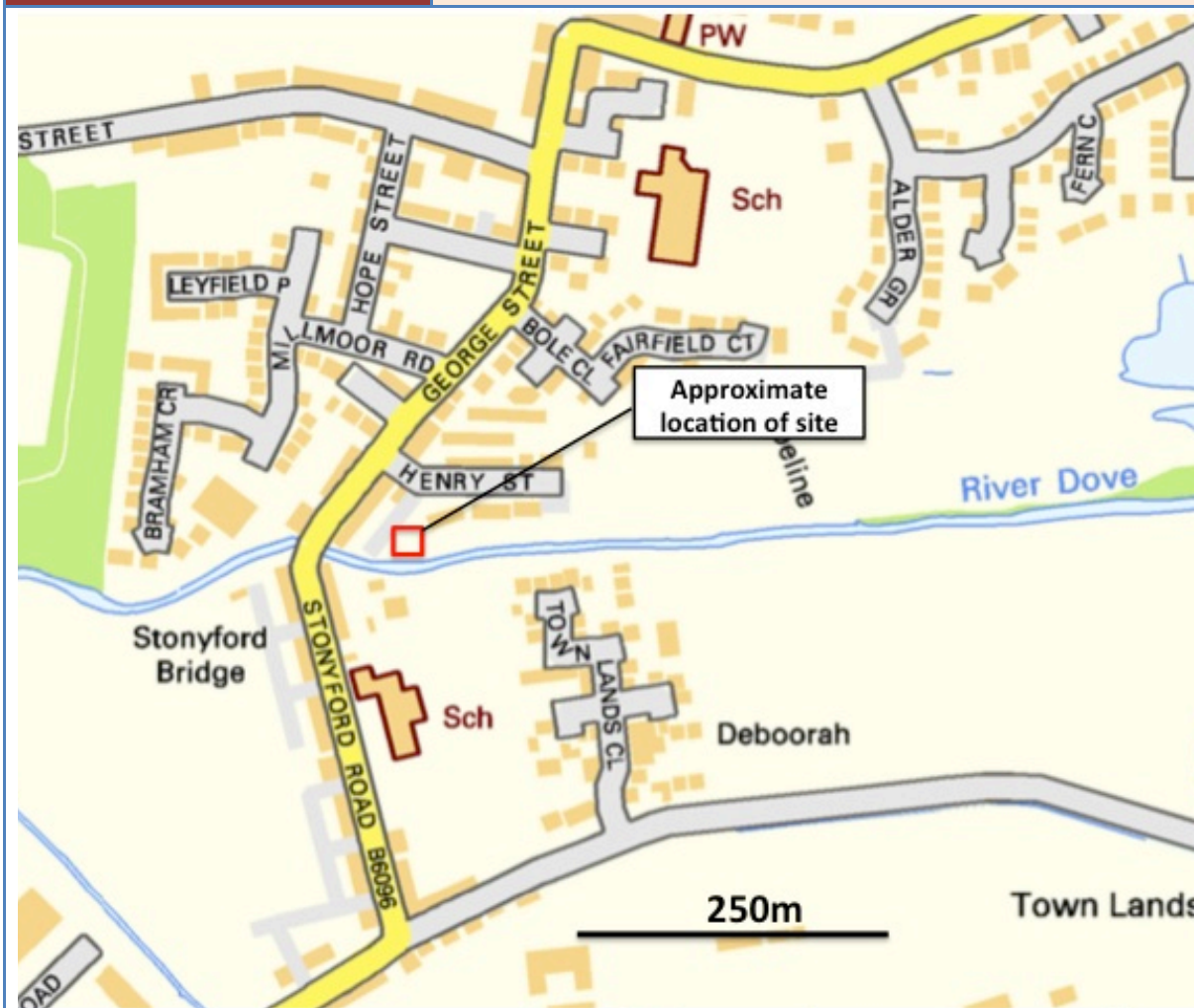
- The area liable to flooding.
- The probability of flooding occurring now and over time.
- The extent and standard of existing flood defences and their effectiveness over time.
- The likely depth of flooding.
- The rates of flow likely to be involved.
- The likelihood of impacts to other areas, properties and habitats.
- The effects of climate change.
- The nature and currently expected lifetime of the development proposed and the extent to which it is designed to deal with flood risk.

This FRA follows government guidance on development and flood risk (National Planning Policy Framework).

1.3. Site Details

Figure 1 - Summary of site details (Source: Streetmap)

Site name	Rear of 66 George Street, Wombwell, Darfield , Barnsley, South Yorkshire S73 0DS
Purpose of development	Erection of a new detached bungalow
Vulnerability of use (proposed)	More Vulnerable
Nearest water body	River Dove
OS NGR	440684,403784
Country	England (NPPF applies)
Local planning authority	Barnsley Metropolitan Borough Council
Other authorities	Environment Agency Yorkshire



1.4. Site Description

The site is located at the rear of 66 George Street, Wombwell, Darfield, Barnsley, South Yorkshire S73 0DS (Figure 2). The access to the site is via Henry Street off George Street. The surrounding area is predominantly residential. The site is located adjacent to the River Dove and has a flat topography. Further details on the existing building plans and layout have been given in Appendix A.

Figure 2 – The Site Location (Google Maps)



1.5. Development Proposals

The proposal consists of erection of a new detached bungalow. Further details on the proposal have been given in Appendix A.

2.0 Development and Flood Risk Policy

2.1. Planning Context

2.1.1. Applicable Planning Policy

The National Planning Policy Framework (NPPF) was issued by the Department for Communities and Local Government in March 2012. The NPPF deals specifically with development planning and flood risk using a sequential characterisation of risk based on planning zones and the Environment Agency Flood Map. The main study requirement is to identify the Flood Zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

2.1.2. Flood Zones

The Environment Agency has developed a Flood Map that shows the risk of flooding in England and Wales for different return period events. It should be noted that the Environment Agency's Flood Map is based on broad scale hydraulic modelling and is an indication of the potential flood risk to a site and the actual risk may differ. The Flood Zone Maps (without climate change) provide the information required by NPPF for planning purposes, as described in Section 3.2. The Flood Zones do not take account of the effect of flood defences.

2.1.3. Sequential and Exception Tests

The Sequential and Exception Tests should be applied when choosing the location of new development and the layout of the development site. The Sequential Test aims to promote development in areas with low flood risk. The Exception Test is used where no suitable development areas can be found in low risk areas, the risk of flooding is clearly outweighed by other sustainability factors, and the development will be safe for its lifetime, taking climate change into account.

2.1.4. Vulnerability and Flood Risk Assessment

The proposed development (i.e. residential use) is categorised as 'more vulnerable' development (Table 2). It should be ensured that all types of flood risk have been considered as part of the flood risk assessment:

'A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall'.

This FRA aims to demonstrate that the proposal will remain safe for its lifetime and not increase flood risk elsewhere.

2.2. NPPF Flood Zones

Table 1 shows how the Flood Zones relate to a sequential planning process.

Table 1 - NPPF Flood Zones and Requirements

Zone 1: Low Probability	
Land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).	Appropriate uses All uses of land are appropriate in this zone. FRA requirements For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. Policy aims Developers and local authorities should seek opportunities to reduce the overall level of flood risk through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
Zone 2: Medium Probability	
Land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.	Appropriate uses The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table 2 are appropriate in this zone. Highly vulnerable uses in Table 2 are only appropriate in this zone if the Exception Test is passed. FRA requirements All proposals in this zone should be accompanied by a FRA. Policy aims Developers and local authorities should seek opportunities to reduce the overall level of flood risk through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
Zone 3a: High Probability	
Land assessed as having a 1 in 100 or greater annual probability of river flooding (<1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any	Appropriate uses The water-compatible and less vulnerable uses of land in Table 2 are appropriate in this zone. The highly vulnerable uses (Table 2) should not be permitted in this zone.

year.	The more vulnerable and essential infrastructure uses in Table 2 should only be permitted in this zone if the Exception Test is passed. FRA requirements All proposals in this zone should be accompanied by a FRA. Policy aims Developers and local authorities should seek opportunities to: • reduce the overall level of flood risk through the layout and form of the development and the appropriate application of sustainable drainage techniques; • relocate existing development to land with a lower probability of flooding; • create space for flooding to occur by allocating and safeguarding open space for flood storage.
Zone 3b: Functional Floodplain	
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%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the local planning authority and the Environment Agency, including water conveyance routes).	Appropriate uses Only the water-compatible uses and the essential infrastructure listed in Table 2 that has to be there should be permitted. It should be designed and constructed to: • remain operational and safe for users in times of flood; • result in no net loss of floodplain storage; • not impede water flows; • not increase flood risk elsewhere. FRA requirements All proposals in this zone should be accompanied by a FRA. Policy aims In this zone, developers and local authorities should seek opportunities to: • reduce the overall level of flood risk through the layout and form of the development and the appropriate application of sustainable drainage techniques; • relocate existing development to land with a lower probability of flooding.

Source: NPPF Technical Guidance Table 1

Table 2 - Flood Risk Vulnerability Classification

Essential Infrastructure	Essential transport infrastructure and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
Highly Vulnerable	Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations and emergency dispersal points. Basement dwellings, caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent.
More Vulnerable	Hospitals, residential institutions such as residential care homes, children's homes, Social services homes, prisons and hostels. Buildings used for: dwelling houses, student halls of residence, drinking establishments, nightclubs, hotels and sites used for holiday or short-let caravans and camping. Non-residential uses for health services, nurseries and education. Landfill and waste management facilities for hazardous waste.
Less Vulnerable	Buildings used for shops, financial, professional and other services, restaurants and cafes, offices, industry, storage and distribution, and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill and hazardous waste facilities), minerals working and processing (except for sand and gravel). Water treatment plants and sewage treatment plants (if adequate pollution control measures are in place).
Water-compatible Development	Flood control infrastructure, water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel workings. Docks, marinas and wharves, navigation facilities. MOD defence installations. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location Water-based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation. Essential sleeping or residential accommodation for staff required by uses in this category, subject to a warning and evacuation plan.

Source: NPPF Technical Guidance Table 2

Table 3 - Flood Risk Vulnerability and Flood Zone 'compatibility'

Vulnerability Classification (Table 3)		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (Table 2)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test	✓	✓
	Zone 3a	Exception Test	✓	✗	Exception Test	✓
	Zone 3b	Exception Test	✓	✗	✗	✗

Source: NPPF Technical Guidance Table 3

Key:

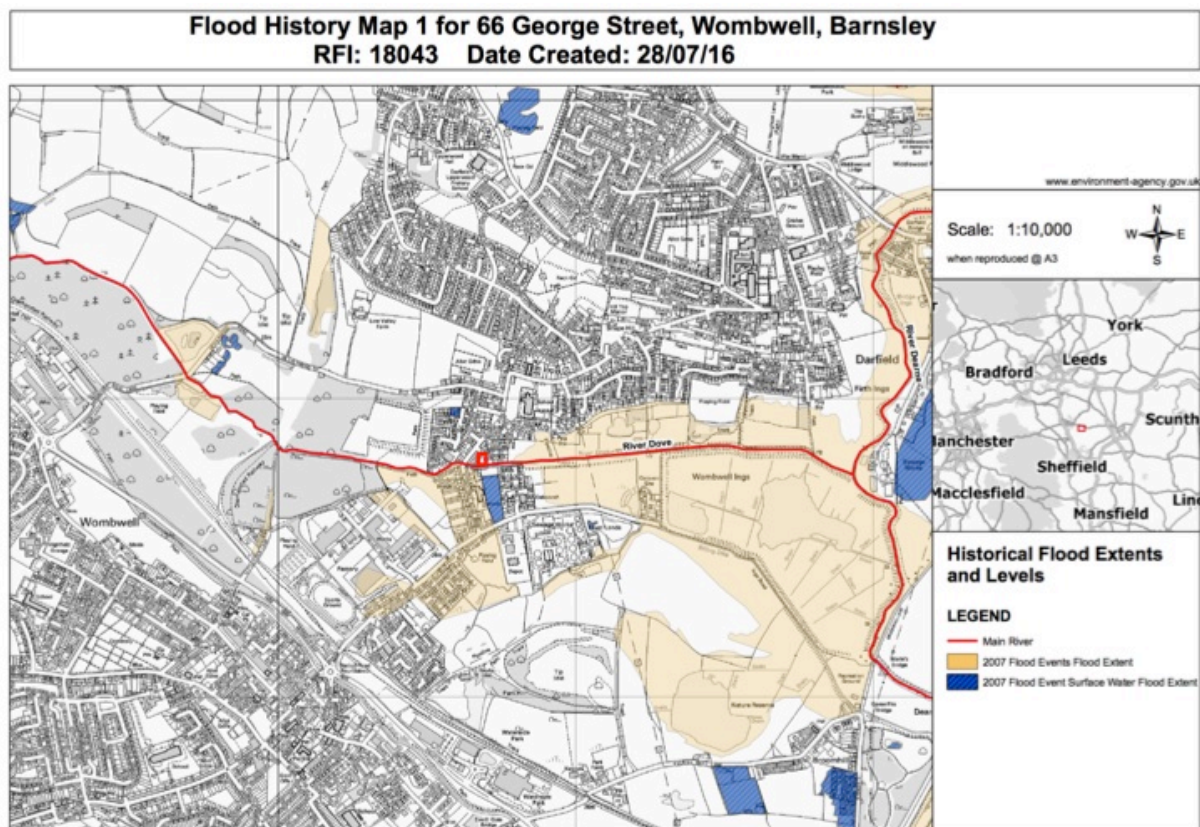
- ✓ Development is appropriate
- ✗ Development should not be permitted

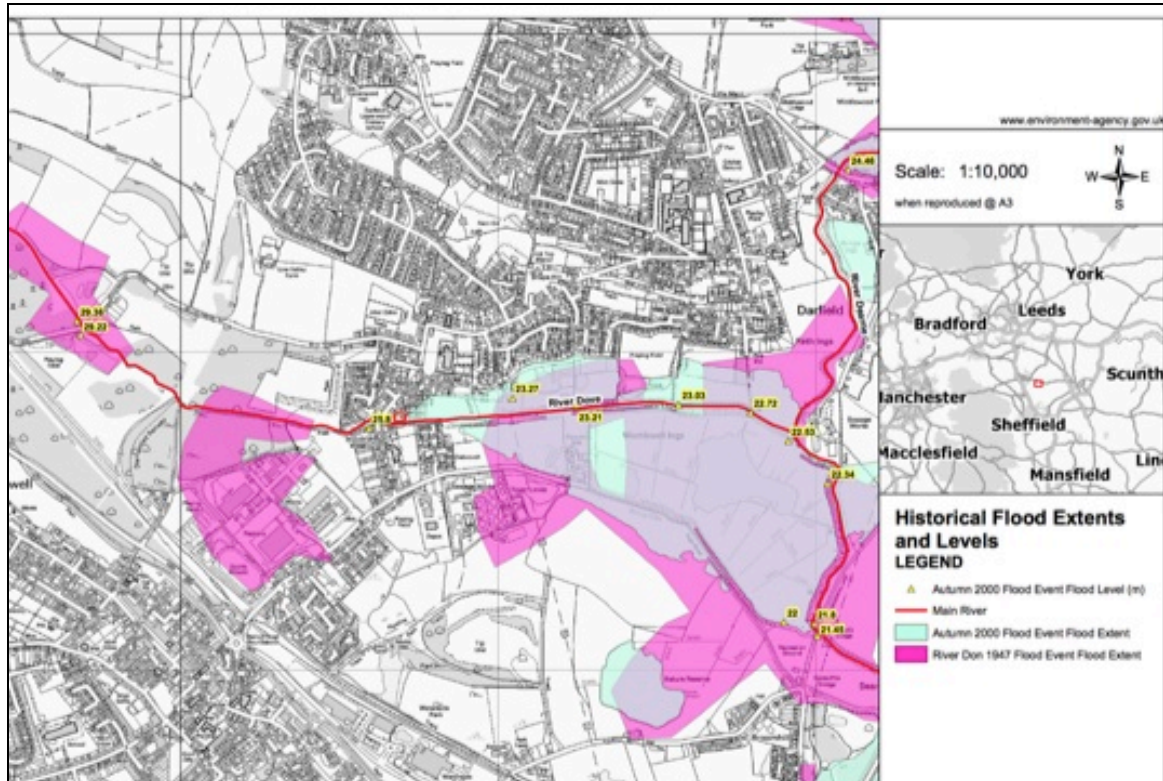
3.0 Assessment of Flood Risk

3.1. Flood History

The Barnsley Metropolitan Borough Council's Preliminary Flood Risk Assessment, July 2011 (PFRA) has provided a brief summary of the historical flooding events within the borough. The PFRA reported that the borough experienced some flooding from different sources in the past however the scale of these events was local. There were no records of flooding at the site. In addition, information on the flooding history was obtained from the Environment Agency (Appendix B). The historic flood maps in Figure 3 below show that there were some flooding events in the River Dove such as in 2007, Autumn 2000 and 1947 however the site is located outside of the flood extents of these events.

Figure 3 - Environment Agency's Historic Flood Map





3.2. Fluvial Flood Risk

The site is located in close proximity to the River Dove with the risk of fluvial flooding. The Environment Agency's Flood Map around the site is shown in Figure 4 which shows that a small part of the site is located within the Flood Zone 2 (medium probability flooding). The majority of the site is located in Flood Zone 1 (low probability flooding). The Flood Zone 2 is defined as the land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any year. The flood map also shows that the site is located in an area not benefiting from any flood defences. Figure 5 shows the majority of the site is located outside the risk zone with a small area falling in 'low' flood risk zone.

Figure 4 - Environment Agency's Flood Map

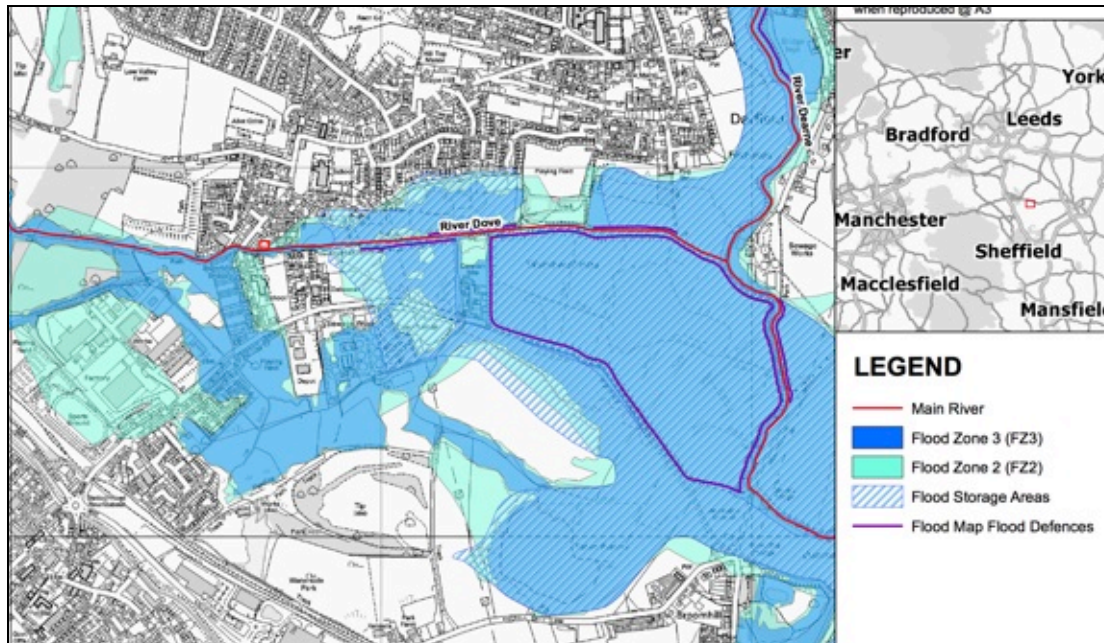
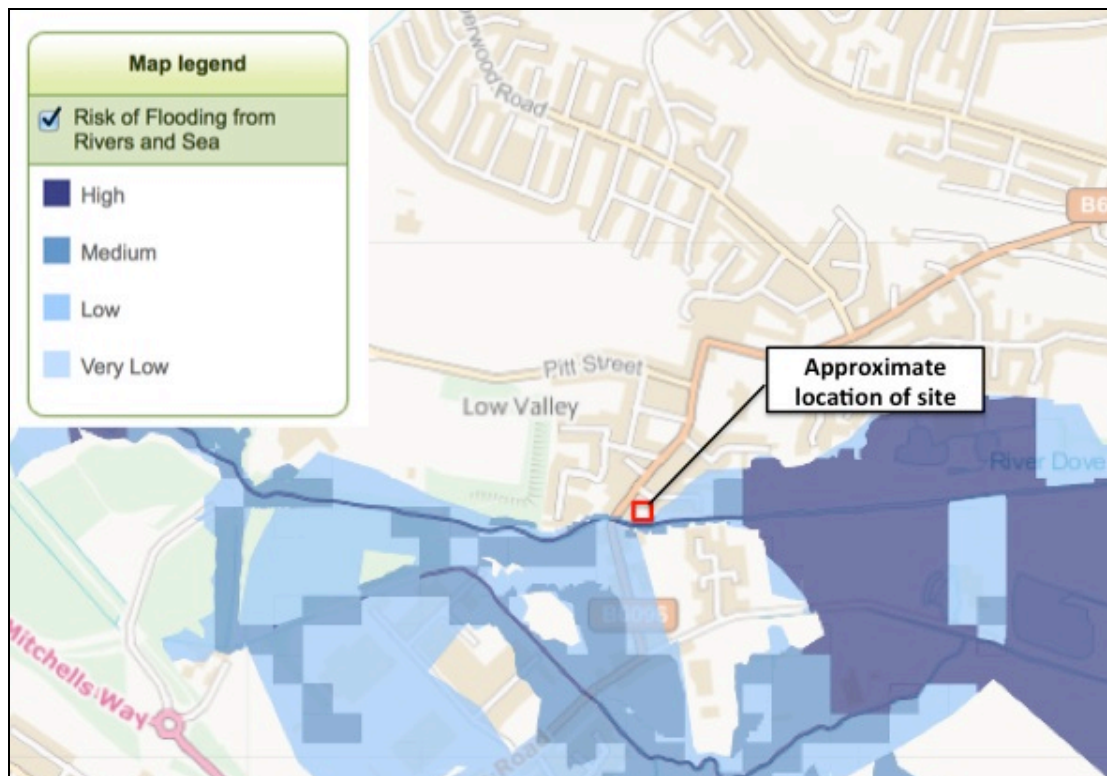


Figure 5. Environment Agency's Flood Risk Map



3.3. Modelled Water `Levels

Information on modelled water levels was obtained from the Environment Agency (Appendix B). The site-specific modelled flood levels at the proposed development site have been taken from River Dove Model. The location map showing the model nodes near the site are shown in Figure 6 below. The map shows that the nearest model node from the site is 'DOVE01_1328d'. The modelled water levels near the site are summarised in Table 4 below. The data shows that the 1 in 100 year water level at this node is 25.559mAOD.

Figure 6. Model Node Location Map

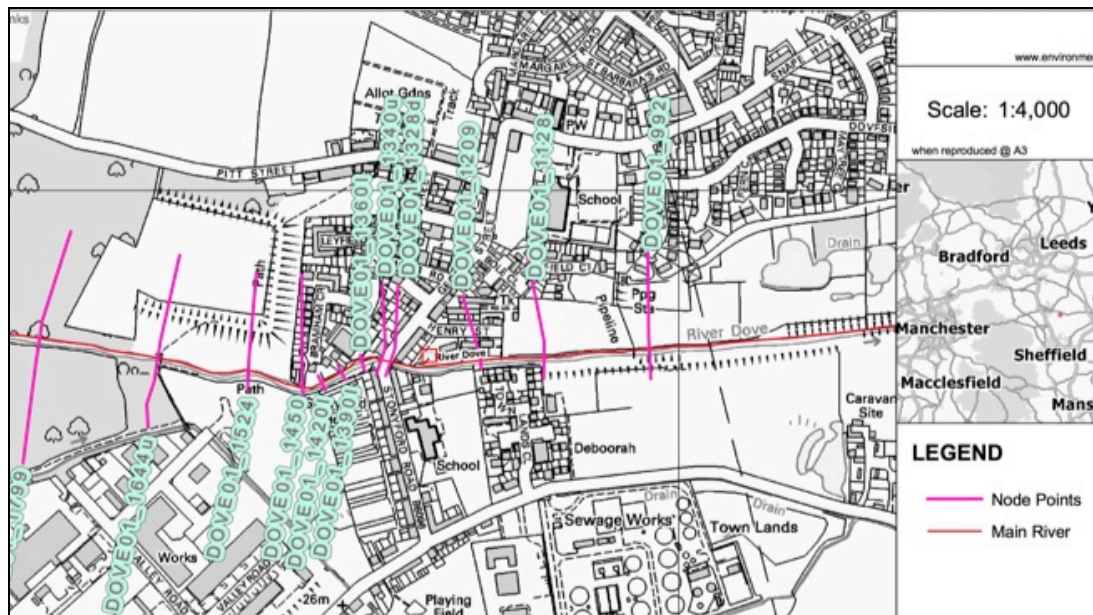


Table 4 –Modelled Water Levels

Events	Modelled levels, mAOD
20% AEP	25.359
10% AEP	25.390
2% AEP	25.518
1.33% AEP	25.543
1% AEP	25.559

Comparison of Modelled Water Levels and Site Levels

The modelled water levels have been compared with the existing site levels (Table 5). The site levels have been derived from the topographic map (Appendix A). The general elevation of the site is 25.899mAOD. Table 5 shows that the site level is higher than the modelled water levels for a range of return period event. The risk of flooding to the site is therefore low.

Table 5 – Comparison of modelled water levels against the site levels

Events	Modelled levels, mAOD	Site Level, mAOD	Potential flood depth, m
20% AEP	25.359	25.899	No flooding
10% AEP	25.390	25.899	No flooding
2% AEP	25.518	25.899	No flooding
1.33% AEP	25.543	25.899	No flooding
1% AEP	25.559	25.899	No flooding

3.4. Tidal Flood Risk

The River Dove is not influenced by tidal waves at this location. The risk of tidal flooding will therefore be low.

3.5. Flood Risk from Artificial Water Bodies

There are no known flood risks from this source.

3.6. Reservoir Flood Risk

According to the Environment Agency's reservoir flood map, the proposed development site is located outside of the maximum extent of flooding from reservoir (Figure 7). According to the Environment Agency, the reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency ensure that reservoirs are inspected regularly and essential safety work is carried out.

Figure 7. Environment Agency's Reservoir Flood Extent Map



3.7. Groundwater flooding

Groundwater flooding usually occurs following a prolonged period of low intensity rainfall. Predicting groundwater flooding is often complex as groundwater levels are heavily influenced by the underlying geology and the topography and geology of the surrounding catchment areas. Groundwater flooding can occur following extended periods of heavy rainfall (either local or within the aquifer catchment area) and can occur many hours or even days after the precipitation has finished and can remain in-situ for long periods of time. Other factors that can influence groundwater levels include reduced abstraction rates or changes to underground flows.

Groundwater flooding is difficult to apportion as groundwater flooding usually occurs in combination with pluvial and fluvial flooding. As groundwater flooding occurs in low-lying areas, basements of residential housing and commercial buildings are usually impacted by this type of flooding. However, according to the PFRA, no records of historical flooding in this area have been found.

Evidence of historical groundwater flooding within the PFRA is very limited, however it is important to recognise that the risk of groundwater flooding is highly variable and heavily dependent upon local conditions at any particular time. The future risk from this source is more uncertain than surface water as the climate change predictions indicate that although

sea levels will rise, thus possibly raising groundwater levels, overall summer rainfall will decrease, therefore having a long-term effect of lowering the groundwater levels. However, long periods of wet weather are predicted to increase: these are the type of weather patterns that can cause groundwater flooding to occur. According to the information available from the landowner, there were no records of any groundwater flooding incidents around the site. Based on these evidences and information, it is reasonable to consider that the risk of groundwater flooding to the site is low.

3.8. Surface Water Flood Risk

When the infiltration capacity of land or the drainage capacity of a local sewer network is exceeded, excess rainwater flows overland; this water will collect in topographic depressions and at obstructions, and can inundate development downslope. The severity of the rainfall event, the degree of saturation of the soil before the event, the permeability of soils and geology, hill slope steepness and the intensity of land use all contribute to and affect the severity of overland flow.

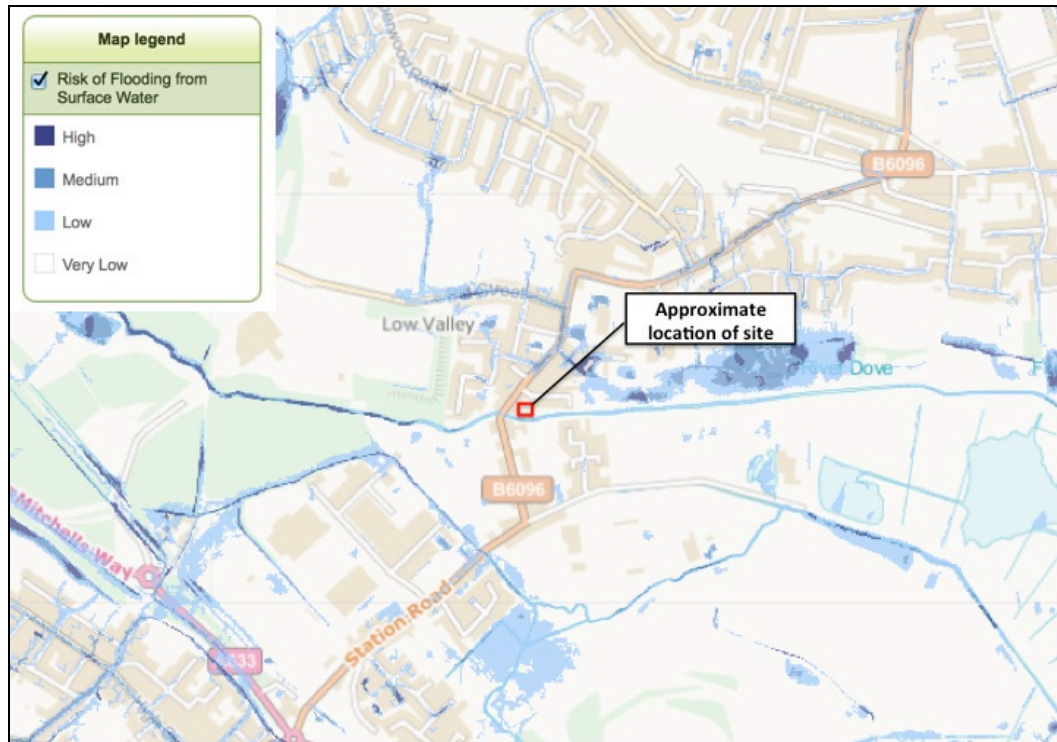
The Environment Agency most recent flood map for surface water published in December 2013 is freely available online at their website and can be used to see the approximate areas that would experience surface water flooding from a variety of rainfall return periods. The risk is categorised based on annual probability of occurrence. The different risk categories are displayed in Table 6 below.

Table 6 - Environment Agency's Surface Water Risk Categories

Environment Agency Surface Water Risk Category	Surface water flooding annual probability of occurrence
Very Low	Less than 0.1% (1 in 1000 years)
Low	Between 1% and 0.1% (1 in 100 years and 1 in 1000 years)
Medium	Between 1% and 3.3% (1 in 100 years and 1 in 30 years)
High	Greater than 3.3% (1 in 30 years)

The Environment Agency's surface water flood map (Figure 8) indicates that the risk of surface water flooding to the site is 'low'. The area around the site is heavily developed, overland flow typically tends to occur when surface water cannot enter overloaded drainage systems during significant rainfall events. There is therefore an inherent link between sewer flooding and overland flow/surface water flooding. According to the information obtained from the landowner, there were no records of any surface water flooding incidents around the site.

Figure 8 - Environment Agency's Surface Water Flood Map



3.9. Sewer flooding

Sewer flooding is often caused by excess surface water entering the drainage network causing sewers to surcharge. In lowland areas the topography results in dispersal over a wide area. Local flooding of this kind is often exacerbated by deficiencies in the local surface water drainage system, temporary blockages or saturated ground conditions. These can often be remedied through reactive management once they have been identified in a flooding event.

There were very limited information about sewer flooding incidents in the PFRA. According to the information available from the landowner, there were no sewer flooding incidents around the site.

It is important to note that previous sewer flood incidents or the lack thereof do not indicate the current or future risk to the site as upgrade work could have been carried out to alleviate any issues or conversely in areas that have not experienced sewer flooding incidents the local drainage infrastructure could deteriorate leading to future flooding.

3.10. Climate Change

The National Planning Policy Framework (NPPF) sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. NPPF

and supporting planning practice guidance on Flood Risk and Coastal Change explain when and how flood risk assessments should be used. This includes demonstrating how flood risk will be managed now and over the development's lifetime, taking climate change into account. Local planning authorities refer to this when preparing local plans and considering planning applications.

The Environment Agency released new climate change guidance for flood risk assessments on 19th February 2016 outlining the allowances for the impact of climate change on peak river flows, peak rainfall intensities, sea level rise, offshore wind speeds and extreme wave height. They are based on climate change projections and different scenarios of carbon dioxide (CO₂) emissions to the atmosphere. There are different allowances for different epochs or periods of time over the next century.

The range of allowances in Table 7 below is based on percentiles. A percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for peak flows fall below it and half fall above it. The central allowance is based on the 50th percentile, higher central is based on the 70th percentile and the upper end is based on the 90th percentile.

Table 7 - Peak river flow allowances by river basin district (use 1961 to 1990 baseline)

River basin district	Allowance category	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)
Northumbria	Upper end	20%	30%	50%
	Higher central	15%	20%	25%
	Central	10%	15%	20%
Humber	Upper end	20%	30%	50%
	Higher central	15%	20%	30%
	Central	10%	15%	20%
Anglian	Upper end	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%
South East	Upper end	25%	50%	105%
	Higher central	15%	30%	45%
	Central	10%	20%	35%
Thames	Upper end	25%	35%	70%
	Higher central	15%	25%	35%
	Central	10%	15%	25%
South West	Upper end	25%	40%	85%
	Higher central	20%	30%	40%
	Central	10%	20%	30%
Severn	Upper end	25%	40%	70%
	Higher central	15%	25%	35%

	Central	10%	20%	25%
Dee	Upper end	20%	30%	45%
	Higher central	15%	20%	25%
	Central	10%	15%	20%
North West	Upper end	20%	35%	70%
	Higher central	20%	30%	35%
	Central	15%	25%	30%
Solway	Upper end	20%	30%	60%
	Higher central	15%	25%	30%
	Central	10%	20%	25%
Tweed	Upper end	20%	25%	45%
	Higher central	15%	20%	25%
	Central	10%	15%	20%

Using peak river flow allowances for flood risk assessments

The guideline suggests to consider the flood zone and the appropriate flood risk vulnerability classification to decide which allowances applies to the development or plan.

In flood zone 2

Essential infrastructure – use the higher central and upper end to assess a range of allowances

Highly vulnerable – use the higher central and upper end to assess a range of allowances

More vulnerable – use the central and higher central to assess a range of allowances

Less vulnerable – use the central allowance

Water compatible – use none of the allowances

In flood zone 3a

Essential infrastructure – use the upper end allowance

Highly vulnerable – development should not be permitted

More vulnerable – use the higher central and upper end to assess a range of allowances

less vulnerable – use the central and higher central to assess a range of allowances

Water compatible – use the central allowance

In flood zone 3b

Essential infrastructure – use the upper end allowance

Highly vulnerable – development should not be permitted

More vulnerable – development should not be permitted

Less vulnerable – development should not be permitted

Water compatible – use the central allowance

The site is located within the Humber River Basin District. As the proposed development is categorised as 'more vulnerable' and is located in Flood Zone 3a, the guideline recommends to use the higher central and upper end to assess a range of allowances. The higher central and upper end allowances for the Humber River Basin District are 30% and 50% respectively for the period between 2070 and 2115. All of these allowances are greater than that currently used and incorporated into the Environment Agency's existing Fluvial Flood Model Levels. In order to account for the new climate change allowances, the models should be updated by incorporating the higher peak flow estimates with the higher central and upper end allowances.

4.0 Mitigation Measures

4.1. Recommended Finished Floor Levels

In order to afford a level of protection against flooding it is normally recommended that finished floor levels are set a nominal 300mm above the 1 in 100 year annual probability fluvial flood (1%) in any year (including an allowance for climate change). However, the information on the modelled water levels for the 1 in 100 year annual probability fluvial flood (1%) with climate change was not available. Therefore, it is proposed that the finished floor level will be set 600mm above the 1 in 100 year annual probability (1%) water level. The 1 in 100 year annual probability (1%) water level at the site is 25.559mAOD. Therefore, it is proposed that the finished floor level will be set minimum of 26.159mAOD. The elevation of the existing ground is 25.899mAOD (Appendix A). This means the proposed finished floor level is 260mm above the existing ground level.

4.2. Flood Resilient Measures

The following flood resilient measures will be implemented:

- All service entries will be sealed (e.g. with expanding foam or similar closed cell material).
- Pipework: Closed cell insulation will be used for pipes which are below the predicted flood level.
- Drainage services: Non-return valves will be used in the drainage system to prevent back-flow of diluted sewage in situations where there is an identified risk of the foul sewer surcharging. Maintenance of these valves is important to ensure their continued effectiveness.
- Water, electricity and gas meters will be located above predicted flood level.

- Electrical services: electrical sockets will be installed above flood level for ground floors to minimise damage to electrical services and allow speedy re-occupation. Electric ring mains should be installed at first floor level with drops to ground floor sockets and switches.
- Communications wiring: wiring for telephone, TV, Internet and other services will be protected by suitable insulation in the distribution ducts to prevent damage. Any proposed design solution for flood insulation on all potentially vulnerable wiring should be discussed with the relevant service providers.
- Engineering bricks (Classes A and B) will be used which has 'good' resilience in terms of water penetration, drying ability and retention of pre-flood dimensions and integrity.
- Building materials that are effective for a 'water exclusion strategy' will be used which include: engineering bricks, cement-based materials including water retaining concrete and dense stone.

4.3. Flood Warning and Evacuation

As part of the site is located within a flood zone area, it will be necessary to make sure that the residents are fully aware of the flood risk and flood warning and evacuation during an extreme event. If necessary, during a flood event the first floor will provide a safe haven for the residents.

4.3.1. Access and Egress

The access to the Flood Zone 1 will be provided via Henry Street towards George Street which are located outside of the extreme flood outlines. This safe area is located at a walking distance from the site.

4.3.2. Flood Warnings Direct

The Environment Agency operates a free flood warning service called Floodline Warnings Direct (FWD) which can give advance notice of when flooding is likely to happen and time to prepare for a flood event. Property owners on the proposed development site will be able to sign up to FWD online using the following channels (Table 8):

Table 8- Contacts for flood warning services

Channel	Details
Online	https://fwd.environment-agency.gov.uk/app/olr/register
Telephone	0345 988 1188

4.3.3. Flood Warning Service

The Environment Agency provides a Flood Warning Service throughout England and Wales in areas at risk of flooding from rivers or the sea. This is provided using up to date rainfall, river level and sea condition monitoring 24 hours a day to forecast the possibility of flooding.

If flooding is forecast, the Environment Agency will issue warnings using a set of three different warning types (Table 9). Many areas of England are covered by the full four stages of the Environment Agency's Flood Warning Service including the site (Figure 9). It is therefore advised that the residents of the property should utilise this service. The Environment Agency's Flood Warning target lead time; the time between a flood warning being issued and the onset of flooding is approximately two hours. Providing the Environment Agency can meet their target Flood Warning lead time, the occupants of the proposed development will have two hours to ensure that property is relocated to minimise risk and evacuation to safe locations can be carried out.

Figure 9 - Environment Agency's Flood Warning Areas

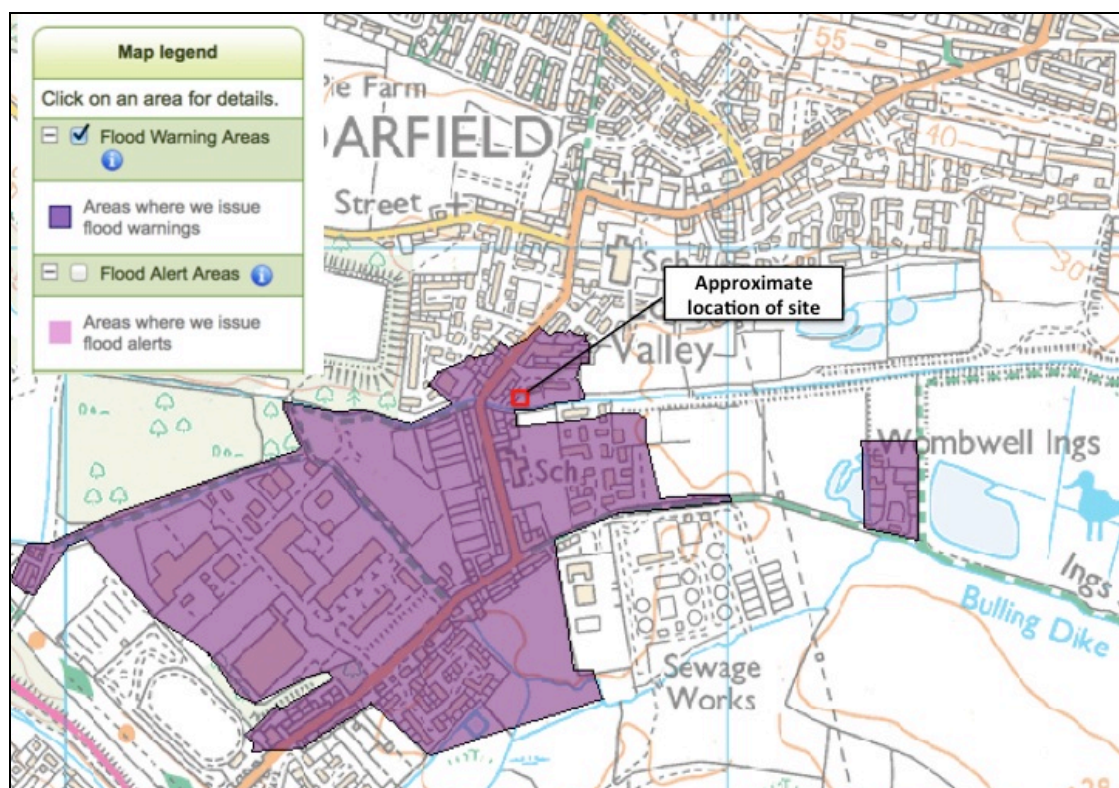


Table 9 - Environment Agency's Flood Warning Codes

Flood Warning Code	What it Means	What To Do
	Flooding is possible. Be prepared.	Be prepared to act on your flood plan. Prepare a flood kit of essential items. Monitor local water levels and the flood forecast on our website.

 FLOOD WARNING	Flooding is expected. Immediate action required.	Move family, pets and valuables to a safe place. Turn off gas, electricity and water supplies if safe to do so. Put flood protection equipment in place.
 SEVERE FLOOD WARNING	Severe flooding. Danger to life.	Stay in a safe place with a means of escape. Be ready should you need to evacuate from your home. Co-operate with the emergency services. Call 999 if you are in immediate danger.
Warnings no longer in force	No further flooding is currently expected in your area.	Be careful. Flood water may still be around for several days. If you've been flooded, ring your insurance company as soon as possible.

4.4. Surface Water Runoff Management

There will be an increase in the impermeable surface as a result of the proposed development. The surface runoff from the site will be improved by implementing appropriate Sustainable Drainage Systems (SuDS) which have been described in the section below.

4.4.1. Surface Water Drainage (SuDS) requirements

In order to improve the surface water runoff from the site, implementation of suitable Sustainable Drainage Systems (SuDS) have been proposed.

4.4.2. SuDS

Paragraph 1.3.2 from the SuDS manual (C697) discusses the SuDS 'management train' which is intended to mimic the natural catchment process as closely as possible. The hierarchy of techniques used to achieve the management train are shown in Table 10 below.

Table 10 Hierarchy of SuDS techniques

Technique	Description
Prevention	The use of good site design and housekeeping measures to prevent runoff and pollution (e.g. rainwater harvesting/reuse).
Source control	Control of runoff at or very near its source (e.g. soakaways, porous and pervious surfaces, green roofs).
Site control	Management of water in a local area or site (e.g. routing water to large soakaways, infiltration or detention basins)
Regional control	Management of runoff from a site or several sites (e.g. balancing ponds, wetlands).

There is an opportunity for the application of minimal SuDS techniques (Table 11):

Table 11 Feasible SuDS techniques for the site

Technique	Issues	Feasibility
Prevention Good site design and housekeeping/rainwater harvesting/infiltration devices/education.	Surface runoff can be improved by implementing rainwater harvesting using water butts.	Yes
Source Control Porous and pervious materials/soakaways/green roof/infiltration trenches/disconnect downpipes to drain to lawns or infiltrate to soakaway.	Soakaway will be utilised to dispose excess runoff from the site.	Yes
Site and Regional Control Infiltration/detention basins/balancing ponds/wetlands/underground storage/swales/retention ponds.	Balancing ponds and detention basins will not be feasible at the site.	No

5.0 Conclusion

The proposal consists of erection of a new detached bungalow at the rear of 66 George Street, Wombwell, Darfield, Barnsley, South Yorkshire S73 0DS.

The proposed development is categorised as 'more vulnerable' development.

The site is located in close proximity to the River Dove with the risk of fluvial flooding. The historic flood maps show that there were some flooding events in the River Dove such as in 2007, Autumn 2000 and 1947 however the site is located outside of the flood extents of these events.

The Environment Agency's flood map indicates that a small part of the site is located within the Flood Zone 2 (medium probability flooding). The majority of the site is located in Flood Zone 1 (low probability flooding). The majority of the site is located outside the risk zone with a small area falling within 'low' flood risk zone.

The Environment Agency's modelling data indicated that the site level is higher than the modelled water levels for a range of return period event including the 1 in 100 year event. The risk of flooding to the site is therefore low.

The flood risk from other sources including surface water, underground water, sewer and reservoir is 'low'.

It is recommended that flood resilient measures are used in the development to manage the residual risk, reduce the damage and clean up.

It is proposed that the finished floor level will be set 600mm above the 1 in 100 year annual probability (1%) water level which is 25.559mAOD. Therefore, it is proposed that the finished floor level will be set minimum of 26.159mAOD. The elevation of the existing ground is 25.899mAOD. This means the proposed finished floor level will be 260mm above the existing ground level.

As part of the site is located within a flood zone area, it will be necessary to make sure that the residents are fully aware of the flood risk and flood warning and evacuation during an extreme event. If necessary, during a flood event the first floor will provide a safe haven for the residents. The access to the Flood Zone 1 will be provided via Henry Street towards George Street. This safe area is located at a walking distance from the site.

The surface runoff from the site will be mitigated by implementing appropriate Sustainable Drainage Systems (SuDS). It is proposed that the surface runoff will be improved by implementing rainwater harvesting and soakaway.

This report demonstrates with appropriate mitigations the proposal will be safe, in terms of flood risk, for its design life and will not impose any flood risk elsewhere.

Appendix A Existing Site and Proposed Development Plans

Appendix B Environment Agency's Data and Information
