Darton Park, Barnsley, South Yorkshire, S75 5LZ

NPPF: Flood Risk Assessment

For Rogers Geotechnical Services

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Darton Park, Barnsley, South Yorkshire, S75 5LZ	
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Client	Rogers Geotechnical Services
Status	Final
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EXECUTIVE SUMMARY

A car park and access road would be expected to remain dry in all but the most extreme conditions. Providing the recommendations made in this FRA are instigated, flood risk from all sources would be minimised, the consequences of flooding are acceptable, and the development would be in accordance with the requirements of the NPPF.

The adoption of a SuDS Strategy for the site represents an enhancement from the current conditions as the current surface water runoff from the site is uncontrolled, untreated, unmanaged and unmitigated. The SuDS Strategy will reduce the risk of flooding to the site and off-site locations.

This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The development should not therefore be precluded on the grounds of flood risk.

1.0 INTRODUCTION

1.1 Background

This Flood Risk Assessment (FRA) has been prepared by KRS Environmental Limited at the request of Rogers Geotechnical Services to support a planning application for the proposed development of a car park at Darton Park, Barnsley, South Yorkshire, S75 5LZ. This FRA includes an assessment of the existing and proposed surface water drainage of the site.

This FRA has been carried out in accordance with guidance contained in the National Planning Policy Framework (NPPF)[1] and associated Planning Practice Guidance[2]. This FRA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout the lifetime, taking climate change into account.

It is recognised that developments which are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. The development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues.

1.2 National Planning Policy Framework (NPPF)

One of the key aims of the NPPF is to ensure that flood risk is taken into account at all stages of the planning process; to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest risk.

It advises that where new development is exceptionally necessary in areas of higher risk, this should be safe, without increasing flood risk elsewhere, and where possible, reduce flood risk overall. A risk-based approach is adopted at stages of the planning process, applying a source pathway receptor model to planning and flood risk. To demonstrate this, an FRA is required and should include:

- whether a proposed development is likely to be affected by current or future flooding from all source;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- if necessary, provide the evidence to the Local Planning Authority (LPA) that the Sequential Test can be applied; and
- whether the development will be safe and pass part c) of the Exception Test if this is appropriate.

1.3 Report Structure

This FRA has the following report structure:

- Section 2 describes the location area and the existing and proposed development;

[1] Department for Communities and Local Government (2019) National Planning Policy Framework.
[2] Communities and Local Government (2014) Planning Practice Guidance - Flood Risk and Coastal Change.

- Section 3 outlines the flood risk to the existing and proposed development;
- Section 4 details the proposed surface water drainage for the site and assesses the potential impacts of the proposed development on surface water drainage;
- Section 5 outlines mitigation measures to reduce the overall level of flood risk;
- Section 6 details the sequential and exception tests; and
- Section 7 presents a summary and conclusions.

2.0 LOCATION & DEVELOPMENT DESCRIPTION

2.1 Site Location

The site is located at Darton Park, Barnsley, South Yorkshire, S75 5LZ (see Figure 1). The National Grid Reference (NGR) of the site is 431211, 409960.

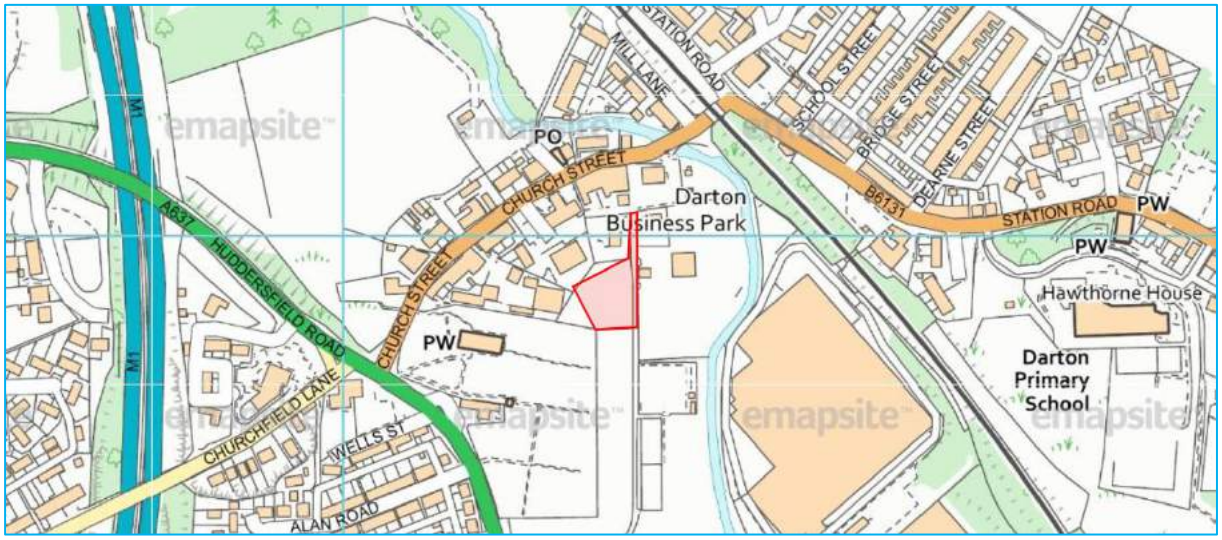

Figure 1 - Site Location

2.2 Existing Development

The site is part of Darton Park and includes an existing access road.

2.3 Proposed Development

It is understood that the proposals are to develop a car park and access road (see Appendix 1). Further details with regard to the proposed development can be found in the accompanying information submitted with the planning application.

2.4 Ground Levels

The site currently consists of a relatively flat area, the Environment Agency LiDAR 25cm resolution Digital Terrain Model (DTM) shows that the site has a ground level of 58.00 metres Above Ordnance Datum (mAOD).

2.5 Catchment Hydrology

The River Dearne is located approximately 200m to the east of the site and the Cawthorne Dike joins the River Dearne approximately 1km to the south of the site. There are no other watercourses evident either on, or within the vicinity of the site.

2.6 Ground Conditions

The British Geological Survey (BGS) map shows that the superficial deposits consist of Alluvium - clay, silt, sand and gravel. Superficial deposits formed up to 2 million years ago in the Quaternary Period in a local environment previously dominated by rivers. The bedrock deposits consist of the Haigh Moor Rock - sandstone. Sedimentary bedrock formed approximately 315 to 318 million years ago in the Carboniferous Period in a local environment previously dominated by rivers.

Information from the National Soil Resources Institute[3] details the site area as being situated on loamy and clayey floodplain soils with naturally high groundwater

2.7 Groundwater

The bedrock and superficial deposits are designated as Secondary A Aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

2.8 Source Protection Zone

The site is not located within an Environment Agency Source Protection Zone.

2.9 Permeability / Infiltration Rate

In determining the future surface runoff from the site, the potential of using infiltration devices has been considered. An overview of the general ground conditions may be used to gauge if there is potential for their application, infiltration devices may work at the site.

If an infiltration system is proposed, it is recommended that a series of infiltration/soakaway tests are carried out on site to BRE Digest 365 Guidelines to confirm the assumptions made in the calculations. Such work is beyond the scope of this FRA but should be undertaken to inform the detailed drainage strategy for the site.

[3] https://www.landis.org.uk/soilscapes/

3.0 FLOOD RISK

3.1 Sources of Flooding

All sources of flooding have been considered, these are: fluvial (river) flooding, tidal (coastal) flooding, groundwater flooding, surface water (pluvial) flooding, sewer flooding and flooding from artificial drainage systems/infrastructure failure.

3.2 Environment Agency Data

Information regarding the current flood risk at the application site, local flood defences and flood water levels has been obtained from the Environment Agency (see Appendix 2).

3.3 Barnsley Metropolitan Borough Council

Barnsley Metropolitan Borough Council is the Local Panning Authority (LPA) and the Lead Local Flood Authority (LLFA) and has responsibilities for 'local flood risk', which includes surface runoff, groundwater and ordinary watercourses. Planning guidance written by Barnsley Metropolitan Borough Council regarding flood risk was consulted to assess the mitigation policies in place. In particular, Barnsley Metropolitan Borough Council Level 1 Strategic Flood Risk Assessment (SFRA), the Preliminary Flood Risk Assessment (PFRA) (including the 2017 Addendum) and the Local Flood Risk Management Strategy (LFRMS).

3.4 Historic Flooding

The Environment Agency has confirmed that the site historically flooded during the March 1947, Autumn 2000 and June 2007 flood events (see Figure 2). The 2000 flood event resulted from heavy rainfall caused the overtopping of the River Dearne at Darton.

With regard to the June 2007 flood event the Barnsley PFRA states:

"Barnsley was affected by heavy and sustained rainfall which continued for a 10-day period leading up to the first flood which started early in the morning of Friday 15th June 2007. In total there were 352 properties flooded and many of these neighbourhoods which had not experienced flooding before and were poorly prepared for responding to flooding. During the two flooding events of 15th and 25th June 2007 approximately four times the seasonal average rainfall for the area was experienced. During a 24 hour period between June 14th and 15th a total of 118mm was recorded at a local weather station, with 68mm recorded in the north-west of the borough at Cannon Hall, Cawthorne. The intense rainfall continued during the days leading up to the 25th June when a further 80mm was recorded at Cannon Hall, this additional rain fell onto ground which was already saturated."

The June 2007 flood event had a water level of 57.80mAOD within the vicinity of the site, the site ground level is 58.00mAOD therefore, it is not clear if the site actually flooded during the June 2007 flood event as the ground levels are located above the recorded water level. The Barnsley Metropolitan Borough Council PFRA references a few small scale flooding events historically within the Darton area. The PFRA states that the impact of these events was relatively small scale.

There are no other records of anecdotal information of flooding at the site. The British Hydrological Society "Chronology of British Hydrological Events" has no information on flooding within the vicinity of the site. No other historical records of flooding for the site have been recorded.

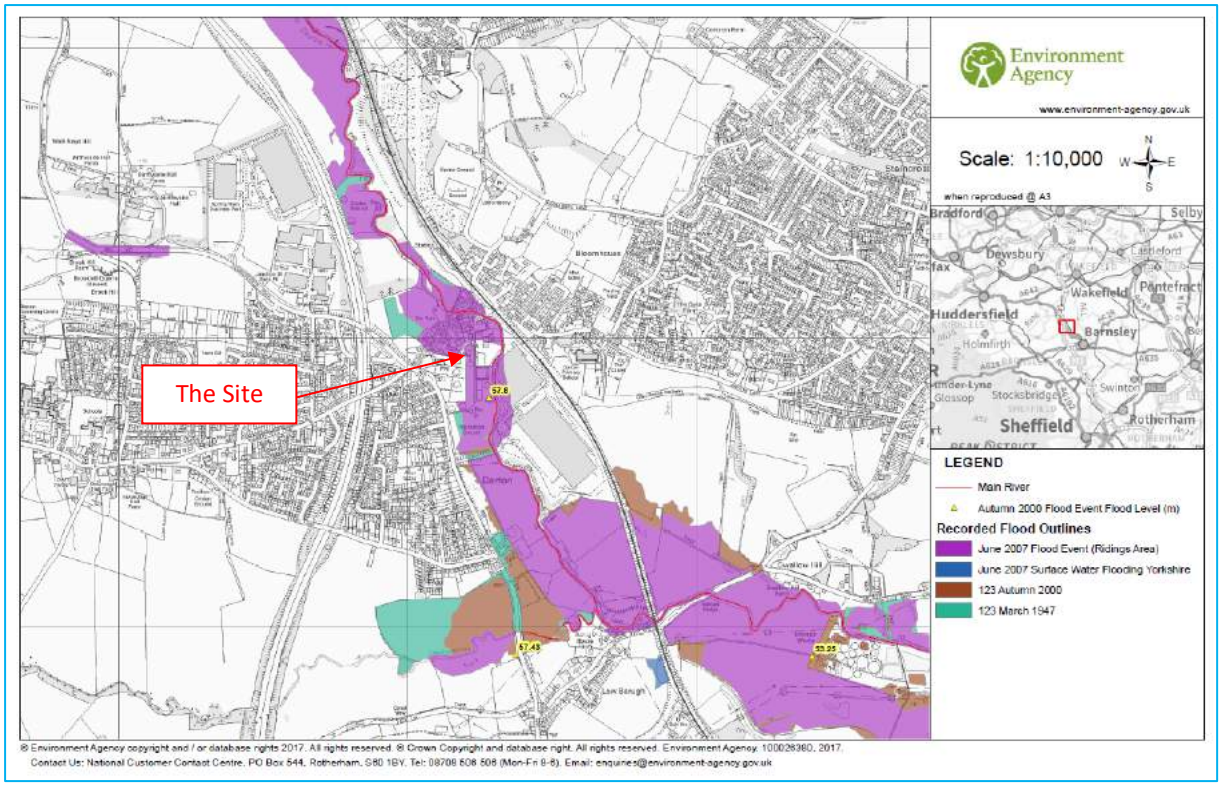

Figure 2 - Environment Agency Historic Flood Map

3.5 Existing and Planned Flood Defence Measures

The site is protected against flooding from the River Dearne (see Figure 3 and Table 1). These are privately maintained defences and provide a Standard of Protection (SoP) of 1 in 30 years. The defences are all raised, man-made and privately owned. However, the Environment Agency does undertake regular risk based visual inspections. The current condition grade for defences in the area is between 2 (good) and 3 (fair), on a scale of 1 (very good) to 5 (very poor).

This site is within an area benefiting from flood defences, as shown in Figure 3. Areas benefiting from flood defences are defined as those areas which benefit from formal flood defences specifically in the event of flooding from rivers with a 1% (1 in 100) chance in any given year or flooding from the sea with a 0.5% (1 in 200) chance in any given year. If the defences were not there, these areas would be flooded. An area of land may benefit from the presence of a flood defence even if the defence has overtopped, if the presence of the defence means that the flood water does not extend as far as it would if the defence were not there.

Further risk management measures are proposed to manage and reduce the overall flood risk at the site (see Section 5.0).

Table 1 - Flood Defences

Asset ID	Asset Maintainer	Type	Length (m)	Target Condition	Overall Condition
50217	Private	High Ground	3942.76	3	3
50852	Private	High Ground	764.23	3	2
172010	Private	High Ground	3208.53	3	2

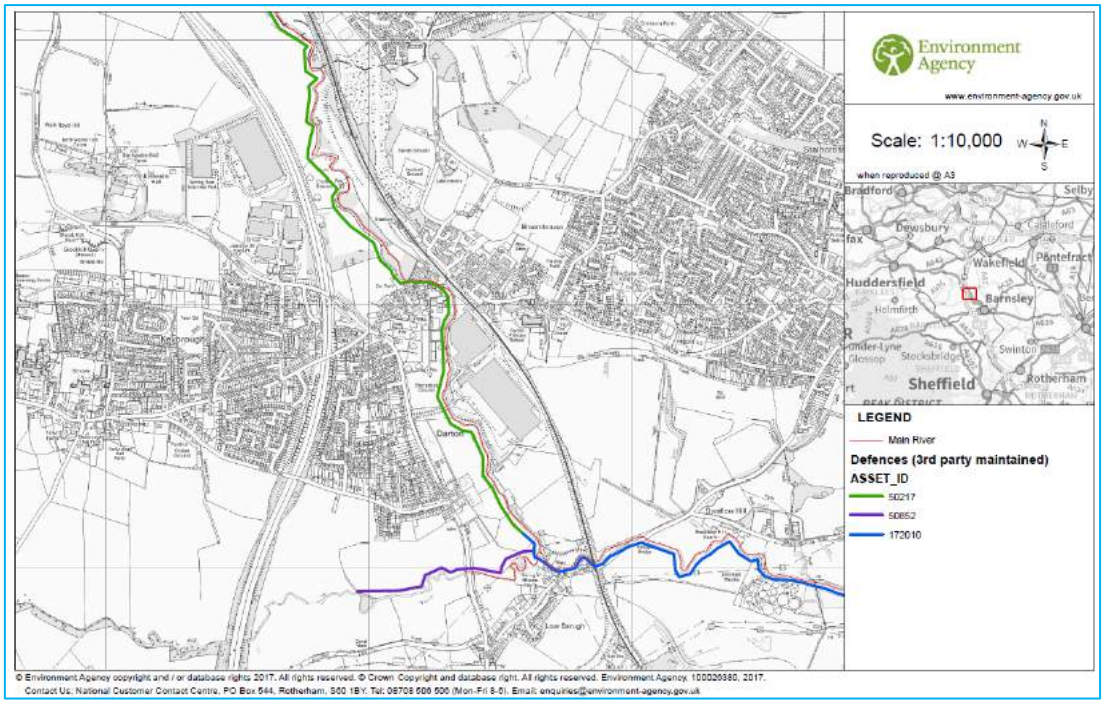

Figure 3 - Environment Agency Defences Map (3rd party maintained)

3.6 Environment Agency Flood Zones

A review of the Environment Agency's Flood Zones indicates that the site is located within Flood Zone 2 and therefore has a 'medium probability' of flooding with between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), in any year, as shown in Figure 4.

The Flood Zones are the current best information on the extent of the extremes of flooding from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development. They show the worst-case scenario. The flood outline shown on Figure 3 would only occur if the flood defences were to be overtopped/breached.

The Environment Agency Flood Zones and acceptable development types are explained in Table 2. Table 2 shows that most development types are generally acceptable in Flood Zone 2

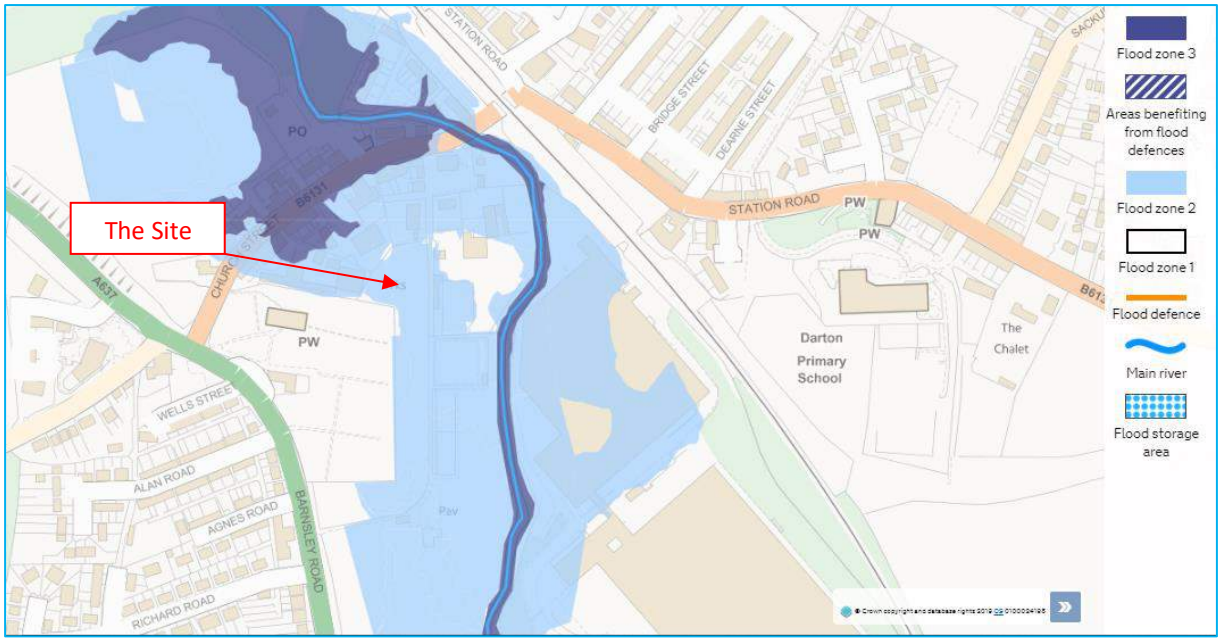

Figure 4 - Environment Agency Flood Zones

Table 2 - Environment Agency Flood Zones and Appropriate Land Use

Flood Zone	Probability	Explanation	Appropriate Land Use
Zone 1	Low	Less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)	All development types generally acceptable
Zone 2	Medium	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	Most development type are generally acceptable
Zone 3a	High	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 year	Some development types not acceptable
Zone 3b	'Functional Floodplain'	Land where water has to be flow or be stored in times of flood. SFRAs should identify this zone (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 LPA and the Environment Agency, including water conveyance routes)	Some development types not acceptable

3.7 Flood Risk Vulnerability

In the Planning Practice Guidance to the NPPF, appropriate uses have been identified for the Flood Zones. Applying the Flood Risk Vulnerability Classification in the Planning Practice Guidance to the NPPF, the proposed development of a car park is classified as 'less vulnerable'. The proposed development will not change the vulnerability of the site, the proposed development will not introduce a 'more vulnerable' use into the floodplain, the vulnerability of the site will not change. 'Less vulnerable' uses are appropriate within Flood Zone 2.

Table 3 - Flood Risk Vulnerability and Flood Zone 'Compatibility' as identified in Table 3 of the Planning Practice Guidance to the NPPF

Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
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.*

3.8 Climate Change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the NPPF recommends that the effects of climate change are incorporated into FRA. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the Flood risk assessments: climate change allowances guidance[4].

Table 4 shows the peak river flow climate change allowances by river basin district. There is reasonable level of certainty that the future impacts of climate change will lie somewhere between the central and upper allowances. The flood risk assessments: climate change allowances guidance recommends that for 'less vulnerable' uses in Flood Zone 2 that the central allowance be used. Therefore, the design flood level for the site is the 1 in 100 year (+20%) event water level.

Table 4 - Peak River Flow Allowances by River Basin District (use 1961 to 1990 baseline)

River basin district	Allowance category	2015 to 2039	2040 to 2059	2060 to 2115
Humber	Upper end	+20%	+30%	+50%
	High central	+15%	+20%	+30%
	Central	+10%	+15%	+20%

3.9 Fluvial (river) Flooding

The River Dearne is located approximately 200m to the east of the site therefore, the principal flood risk posed to the site is from fluvial flooding from the River Dearne. Table 5 shows the Environment Agency's in channel modelled water levels and the model node locations are shown in Figure 5. The modelled water levels have been compared to the ground of the site and areas within the vicinity of the site to assess the flood risk at the site in detail.

[4] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#high-allowances.

Table 5 - Modelled Water Levels (mAOD)

Node Reference	Return Period (yrs)							
	5	10	25	50	75	100	100 +20%	1000
DEAR01_06669	60.15	60.43	60.61	60.78	60.87	60.94	61.21	61.60
DEAR01_06471	59.85	60.24	60.42	60.59	60.68	60.75	61.03	61.37
DEAR01_06264	58.35	58.56	58.80	58.98	59.09	59.18	59.42	59.71
DEAR01_06087	57.66	58.85	58.08	58.25	58.35	58.44	58.65	59.05
DEAR01_05758	56.36	56.53	56.75	56.88	56.95	57.00	57.11	57.29
DEAR01_05592	56.29	56.45	56.66	56.79	56.86	56.92	57.06	57.42
DEAR01_05359	56.06	56.18	56.34	56.45	56.51	56.57	56.73	57.22
DEAR01_05216	55.75	55.82	55.96	56.07	56.15	56.25	56.47	57.13
CAWT01_316	56.32	56.41	56.50	56.56	56.59	56.63	56.69	57.09
CAWT01_145	55.95	56.05	56.17	56.27	56.32	56.40	56.56	57.14

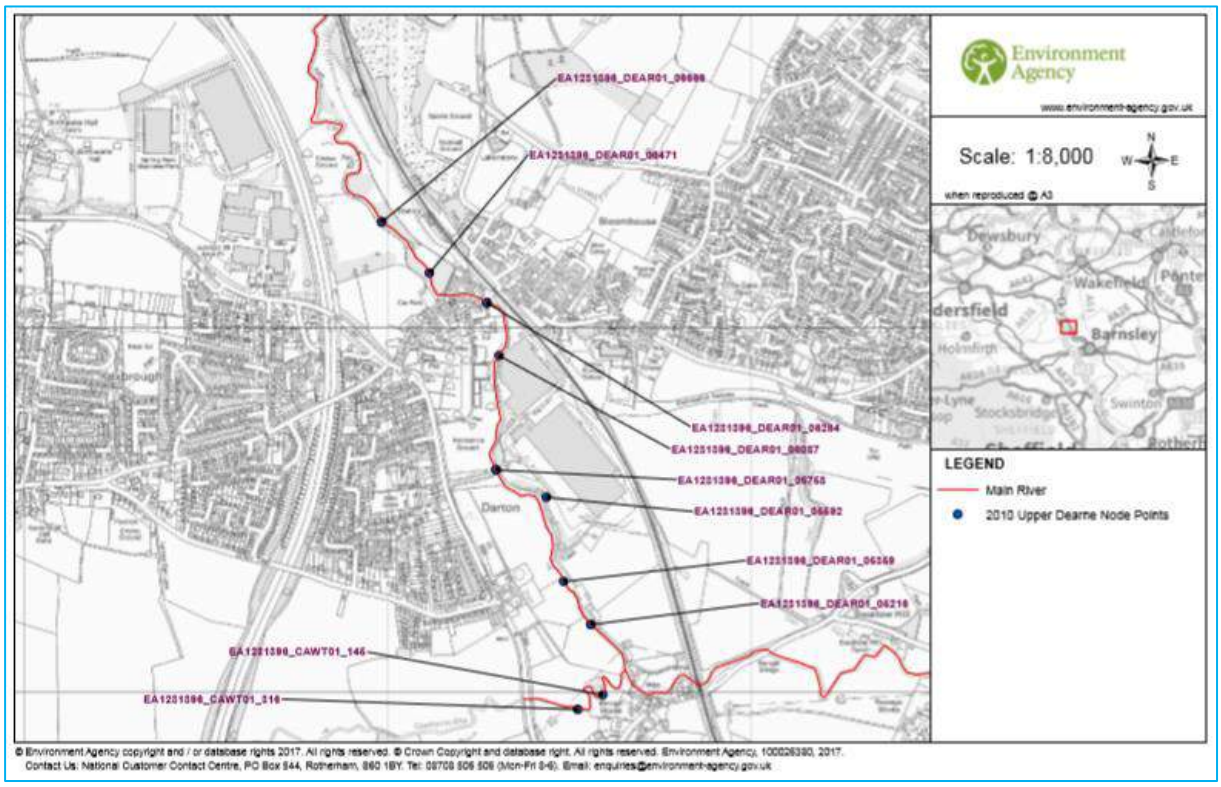

Figure 5 - Model Node Locations

The existing flood defences provide a SoP of 1 in 30 years therefore, the site would not be inundated with floodwater for all events up to and including the 1 in 30 year event. The site would be flood free during the 1 in 30 year event.

The Environment Agency Flood Zones shown in Figure 4 shows that the 1 in 100 year event is contained within the banks of the River Dearne to the east of the site, the river banks are only overtopped during the 1 in 100 year event to the north of the site. Between the site and the River Dearne to the north and east, the ground levels rise to a minimum of 59.00mAOD therefore, the site will not be inundated with floodwater for all events up to and including the 1 in 100 year (+20%) event.

The site will be flood free during the 1 in 100 year (+20%) event. Water levels have been modelled at 59.05mAOD during the 1 in 1000 year event, using node DEAR01_06087. Site ground levels are 58.00mAOD therefore, the site may be inundated with floodwater to a maximum depth of 1.05m during the 1 in 1000 year event.

The likelihood of a rapid river level rise and possible rapid inundation of urban areas posing a risk to life is considered to be minimal. The site is located within a low risk area where the onset of flooding is very gradual (many hours) as per Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2. The speed of inundation and rate of floodwater rise would be low.

Flood risk to the site from fluvial sources can be considered to be limited, as the site is located 200m away from the River Dearne. Any overbank flow would follow the contours of the surrounding area and would flow away from the site rather than flowing towards the site. The flood risk can also be considered to be limited due to the difference in elevations. The ground levels of the site are located a minimum of 1.00m above the normal water level of the River Dearne.

Therefore, the risk of fluvial flooding from the Longford Brook is considered to be of **medium significance**. The risk from this source will be further mitigated by using a number of risk management measures to manage and reduce the overall flood risk at the site (see Section 5.0).

3.10 Tidal (coastal) Flooding

The site is not located within the vicinity of tidal flooding sources and the risk of tidal flooding is considered to be **not significant**.

3.11 Groundwater Flooding

Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

Groundwater flooding tends to occur sporadically in both location and time. When groundwater flooding does occur, it tends to mostly affect low-lying areas, below surface infrastructure and buildings (for example, tunnels, basements and car parks) underlain by permeable rocks (aquifers). The risk from groundwater flooding is negligible. Therefore, the risk of flooding from groundwater flooding is considered to be **not significant**.

3.12 Surface Water (pluvial) Flooding

The site is situated near to large areas of poor permeability therefore; the site may be at risk of surface water flooding. Surface water flooding tends to occur sporadically in both location and time such surface water would tend to be confined to the streets around the development.

The Environment Agency Surface Water flood map shows that the majority of the site has a very low risk of surface water flooding with a chance of flooding of less than 1 in 1000 (0.1%) years however, a small proportion of the site has a low risk of surface water flooding (see Figure 6) with a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%) years. This may result in water depths of less than 300mm and is associated with low spots and areas of poor permeability. The risk of flooding from surface water flooding is considered to be of **low significance**. The risk from this source will be further mitigated by using a number of risk management measures to manage and reduce the overall flood risk at the site (see Section 5.0).

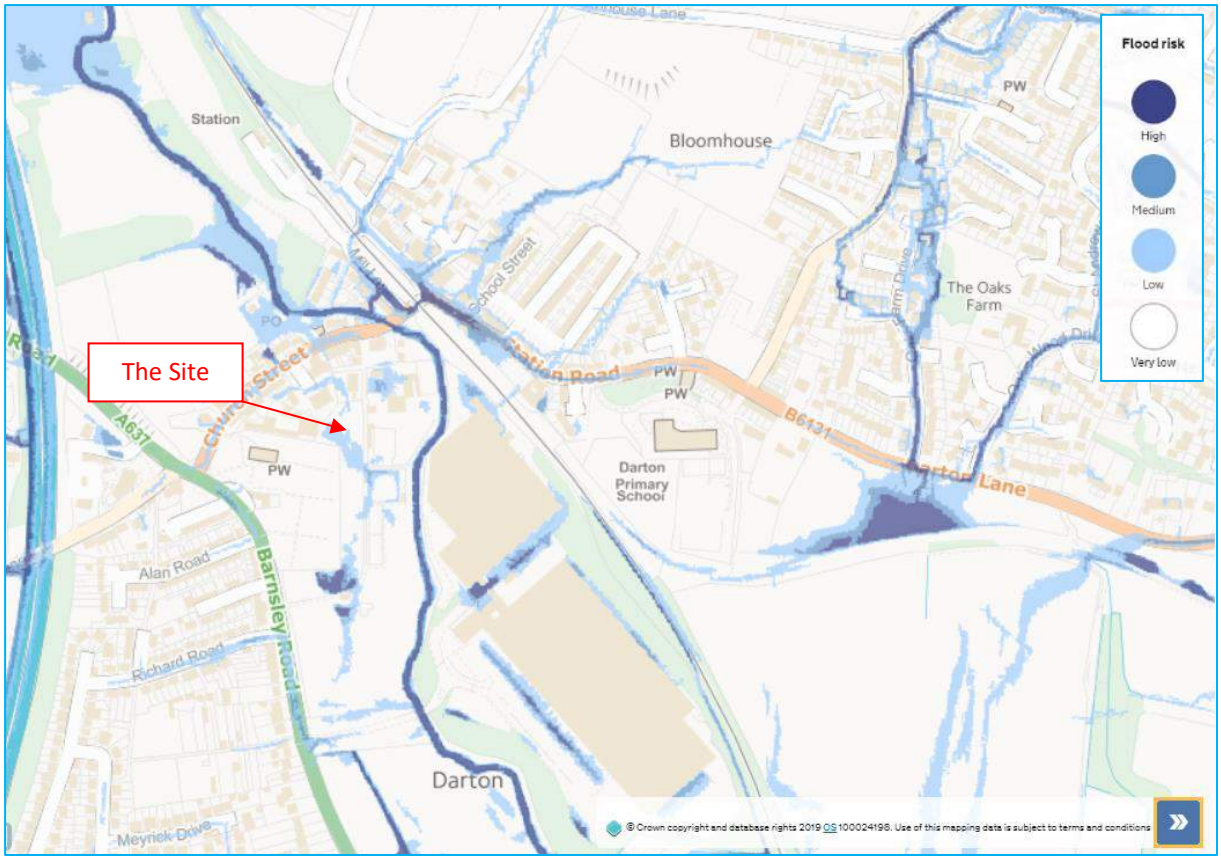

Figure 6 - Environment Agency Surface Water Flood Map

3.13 Sewer Flooding

Sewer flooding occurs when urban drainage networks become overwhelmed and maximum capacity is reached. This can occur if there is a blockage in the network causing water to back up behind it or if the sheer volume of water draining into the system is too great to be handled. Sewer flooding tends to occur sporadically in both location and time such flood flows would tend to be confined to the streets around the development.

There are existing sewers located within the vicinity of the site and these will inevitably have a limited capacity so in extreme conditions there would be surcharges, which may in turn cause flooding. Flood flows could also be generated by burst water mains, but these would tend to be of a restricted and much lower volume than weather generated events and so can be discounted for the purposes of this assessment.

Given the design parameters normally used for drainage design in recent times and allowing for some deterioration in the performance of the installed systems, which are likely to have been in place for many years, an appropriate flood risk probability from this source could be assumed to have a return period in the order of 1 in 10 to 1 in 20 years.

Therefore, the risk of flooding from sewer flooding is considered to be of **low significance**. The risk from this source will be further mitigated by using a number of risk management measures to manage and reduce the overall flood risk at the site (see Section 5.0).

3.14 Flooding from Artificial Drainage Systems/Infrastructure Failure

The site is located within the vicinity of Bretton Lake. Figure 7 shows that the site is at risk of flooding from reservoir failure. This map shows the largest area that might be flooded if a reservoir were to fail and release the water it holds.

The Environment Agency Reservoir flood map has been prepared for emergency planning purposes and for this reason they reflect a worst-case scenario. Since this is a prediction of a worst-case scenario, it's unlikely that any actual flood would be this large.

Reservoir flooding is extremely unlikely; reservoirs in the UK have a very good safety record. There has been no loss of life in the UK from reservoir flooding since 1925. Since then reservoir safety legislation has been introduced to make sure reservoirs are well maintained.

The hazard is well managed through effective legislation and it is unlikely that the impact zone downstream of these reservoirs should not allow the proposed development. Reservoir flooding poses a very low flood risk to the site. Therefore, the risk of flooding from reservoir flooding is considered to be not significant.

There are no other nearby artificial water bodies, reservoirs, water channels and artificial drainage systems that could be considered a flood risk to the site. The risk of flooding from artificial drainage systems/infrastructure failure is considered to be **not significant**.

Figure 7 - Environment Agency Reservoir Flood Map

3.15 Effects of the Development on Flood Risk

The proposed development will have no impact on floodwater levels. The overall direction of the movement of water will be maintained within the developed site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed. The topography of the site will not be altered therefore; the overland flow routes will not be altered. The proposed development will allow floodwater to pass through the site with no effect on the conveyance routes.

3.16 Site Specific Flood Risk Assessment

A summary of the sources of flooding and a review of the risk posed by each source at the site is shown in Table 6.

Table 6 - Risk Posed by Flooding Sources

Sources of Flooding	Potential Flood Risk	Potential Source	Probability/Significance
Fluvial Flooding	Yes	River Dearne	Medium
Tidal Flooding	No	None Reported	None
Groundwater Flooding	No	None Reported	None
Surface Water Flooding	Yes	Low Spots / Poor Permeability	Low
Sewer Flooding	Yes	Local Sewers	Low
Flooding from Artificial Drainage Systems/Infrastructure Failure	Yes	Bretton Lake	None

The site is unlikely to flood except in extreme conditions. The primary, but unlikely, flood risk to the site is posed by fluvial flooding from the River Dearne. However, the flood defence measures identified are expected to afford the site significant protection from fluvial flooding. The existing flood defences provide a SoP of 1 in 30 years therefore, the site would not be inundated with floodwater for all events up to and including the 1 in 30 year event. The site would be flood free during the 1 in 30 year event.

The Environment Agency Flood Zones shows that the 1 in 100 year event is contained within the banks of the River Dearne to the east of the site, the river banks are only overtopped during the 1 in 100 year event to the north of the site. Between the site and the River Dearne to the north and east, the ground levels rise to a minimum of 59.00mAOD therefore, the site will not be inundated with floodwater for all events up to and including the 1 in 100 year (+20%) event. The site will be flood free during the 1 in 100 year (+20%) event. Water levels have been modelled at 59.05mAOD during the 1 in 1000 year event, using node DEAR01_06087. Site ground levels are 58.00mAOD therefore, the site may be inundated with floodwater to a maximum depth of 1.05m during the 1 in 1000 year event. Therefore, the risk of fluvial flooding from the Longford Brook is considered to be of **medium significance**. A number of secondary flooding sources has been identified which may pose a **low significant** risk to the site. These are:

- Surface Water Flooding
- Sewer Flooding

The proposed development is classified as ‘less vulnerable’, ‘less vulnerable’ uses are appropriate within Flood Zone 2. The flood risk at the site, will be further managed and mitigated by using a number of risk management techniques, and mitigation strategies to manage and reduce the overall flood risk at the site.

The proposed development will have no impact on floodwater levels. The overall direction of the movement of water will be maintained within the developed site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed. The topography of the site will not be altered therefore; the overland flow routes will not be altered. The proposed development will allow floodwater to pass through the site with no effect on the conveyance routes.

In conclusion, the flood risk to the site can be considered to be limited; the site is situated in Flood Zone 2, with a medium annual probability of flooding and from all sources. The site is unlikely to flood except in very extreme conditions.

4.0 SURFACE WATER DRAINAGE

4.1 Surface Water Management Overview

It is recognised that consideration of flood issues should not be confined to the floodplain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the development site. Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage.

A SuDS Strategy for the site proposals has been developed to manage and reduce the flood risk posed by the surface water runoff from the site. An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the site. The assessment considers the impact of the development compared to current conditions. Therefore, the surface water attenuation requirement for the developed site can be determined and reviewed against existing arrangements.

The requirement for managing surface water runoff from developments depends on the pre-developed nature of the site. If it is an undeveloped greenfield site, then the impact of the development will need to be mitigated so that the runoff from the site replicates the natural drainage characteristics of the pre-developed site. In the case of brownfield sites, drainage proposals will be measured against the existing performance of the site, although it is preferable for solutions to provide runoff characteristics that are similar to greenfield behaviour.

The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect.

It should be acknowledged that the satisfactory collection, control and discharge of surface water runoff are now a principle planning and design consideration. This is reflected in recently implemented guidance as well as the new Defra non-statutory technical standards for SuDS.

4.2 Climate change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the NPPF recommends that the effects of climate change are incorporated into Flood Risk Assessments. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the associated Planning Practice Guidance to the NPPF[5].

The recommended national precautionary sensitivity range for peak rainfall intensity are summarised in Table 7.

[5] Communities and Local Government (2014) Planning Practice Guidance - Flood Risk and Coastal Change.

Table 7 - Peak Rainfall Intensity Allowance in Small and Urban Catchment (use 1961 to 1990 baseline)

Parameter	2010 to 2039	2040 to 2059	2060 to 2115
Upper end	+10%	+20%	+40%
Central	5%	+10%	+20%

4.3 Opportunities for Discharge of Surface Water

There are three possible options to discharge the surface water runoff in accordance with requirement H3 of the Building Regulations, this hierarchy is also promoted within the NPPF. Rainwater shall discharge to one of the following, listed in order of priority:

- an adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable,
- a watercourse; or where that is not reasonably practicable,
- a sewer.

It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local runoff profile by using systems that can either attenuate runoff and reduce peak flow rates or positively impact on the existing surface water runoff.

4.3.1 Soakaway/Infiltration System

The general ground conditions suggest that the permeability and infiltration rate of the site will be moderate. Infiltration SuDS methods would not provide an adequate solution for the discharge of surface water runoff from the site. If an infiltration system is proposed, it is recommended that a series of infiltration/soakaway tests are carried out on site to BRE Digest 365 Guidelines to confirm the assumptions made in the calculations. Such work is beyond the scope of this FRA but should be undertaken to inform the detailed drainage strategy for the site.

4.3.2 Watercourse

Should infiltration be found to be unsuitable, the next option is discharge to a watercourse. There are no watercourses located within the vicinity of the site. Therefore, it would not be possible to discharge surface water runoff from the site into a watercourse.

4.3.3 Sewer

In the event that discharge of surface water via infiltration or discharge to a watercourse is deemed unsuitable, then discharge to a sewer would be possible. It is understood that there are public sewers located within the vicinity of the site. All surface water runoff that cannot be discharged via infiltration or to a watercourse will be managed on site and then discharged to the public sewers. Discharge to the public sewers would be at a restricted runoff rate.

It would be prudent to undertake further detailed surveys to verify the inverts, depth and arrangement of the existing public sewer. A gravity connection to the sewers would be made at a location/s adjacent to the site. If required, it should be confirmed with Yorkshire Water if they have the capacity to accept any discharge of surface water from the site. If so, it would be possible to discharge to the public sewers, at a point adjacent to the site. If required, this option should be explored further.

4.4 Surface Water Runoff Rates

An estimation of surface water runoff is required to permit effective site water management and prevent any increase in flood risk to off-site receptors. In accordance with The SuDS Manual, the Greenfield runoff from the site has been calculated using the IoH124 method. Table 8 shows the IoH 124 method Greenfield runoff rates for the site area of 0.13 hectares (ha) (see Appendix 3). QBAR has been calculated to be 0.24 litres/second.

The method used for calculating the runoff complies with the NPPF, as well as the new Defra non-statutory technical standards for SUDS and assumes that the excess runoff associated with the proposed development (plus an allowance for future climate change) will need to be managed by the proposed SUDS scheme.

Table 8 - IoH124 method Greenfield Runoff Rates

Rainfall Event	Runoff Rate (l/s)
1	0.20
QBAR (rural)	0.24
30	0.40
100	0.50

4.5 SuDS and Water Quality

Current guidance promotes sustainable water management through the use of SuDS. SuDS measures should be used to control the surface water runoff from the proposed development site therefore, managing the flood risk to the site and surrounding areas from surface water runoff.

A hierarchy of techniques is identified[6]:

1. **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).

2. **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting, permeable paving, soakaways and/or green roofs).

3. **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site, swales and/or infiltration trenches).

4. **Regional Control** – management of runoff from several sites, typically in a detention pond, basins, tanks and/or wetland.

It is generally accepted that the implementation of SuDS as opposed to conventional drainage systems, provides several benefits by:

- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;

- reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;

[6] CIRIA (2004) Report C609, Sustainable Drainage Systems – Hydraulic, Structural and Water Quality advice.

- improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- reducing potable water demand through rainwater harvesting;
- improving amenity through the provision of public open spaces and wildlife habitat; and
- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

The most appropriate attenuation system will need to satisfy three main characteristics, firstly, provide the required volume of storage, secondly, minimise the loss of developable land and thirdly, where possible provide local amenity.

The application of the SuDS Manual requires that the runoff from sites is not only restricted to meet the Greenfield runoff characteristics but also that SuDS systems are utilised to improve the quality of the runoff prior to outfall to watercourses. The SuDS Manual and Environment Agency guidance applies a sustainability hierarchy to the various types of SuDS systems, this is summarised in Table 9.

Table 9 - Sustainability Hierarchy

Most Sustainable	SUDS Technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife
	Living Roofs	✓	✓	✓
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration Devices - Soakaways	✓	✓	✓
	Permeable Surfaces and Filter Drains - Gravelled areas - Solid paving blocks - Permeable paving	✓	✓	
Least Sustainable	**Tanked systems** - Over-sized pipes/tanks - Cellular storage	✓		

Systems at the top of the hierarchy provide a combination of attenuation, treatment and ecology and are deemed the most sustainable options. There are always specific scenarios where systems are more suitable than others and at this stage it is not possible to guide the development towards a particular strategy.

In addition to the above hierarchy the SuDS Manual identifies the number of treatment trains or SuDS devices through which flow should pass from various point sources of runoff (see Table 10). This is designed to ensure that the receiving environments are not put at risk of pollution by new development therefore; accordingly, one treatment train will be used on this site.

The usual approach is to consider the 'SuDS train' where each of the above options are considered in turn until a suitable solution is found. Thus, source control techniques such as soakaways, rainwater

harvesting and/or infiltration trenches, if suitable on a site, are considered preferable to permeable conveyance and passive treatment systems such as tanks or ponds.

Table 10 - Number of Treatment Train Components (assuming effective pre-treatment is in place)

Runoff Catchment Characteristic	Receiving Watercourse Sensitivity		
	Low	Medium	High
Roof only	1	1	1
Residential roads Parking areas Commercial zones	2	2	3
Refuse collection Industrial areas Loading bays Lorry parks Highways	3	3	4

4.6 Proposed SuDS Strategy

The provision of suitable storage on site to mitigate the flood risk resulting from the development of the site will be a key factor in the evolution of the site development layout. The provision of large volumes of attenuation, as is likely in this case, can be achieved by a number of methods; however, not all systems can be assessed in direct comparison.

One of the aims of the NPPF is to provide not only flood risk mitigation but also to maximise additional gains such as improvements in runoff quality and provision of amenity and bio-diversity. Systems incorporating these features are often termed SUDS and it is the requirement of NPPF that these are considered as the primary means of collection, control and disposal for storm water as close to source as possible.

A series of infiltration/soakaway tests to BRE Digest 365 Guidelines should be undertaken to confirm whether infiltration methods will work at the site. Infiltration methods such as soakaways, permeable paving, swales etc. should be utilised wherever possible. The principle applied in the design of storage is to limit the discharge rate of surface water runoff from the developed site for events of similar frequency of occurrence to the same peak rate of runoff as that which takes place from a Greenfield site prior to development.

The size of the infiltration storage should be such that the proposed development has the capacity to accommodate the 1 in 100 year rainfall event including a 40% increase in rainfall intensity that is predicted to occur as a result of climate change.

The objective of this SuDS Strategy is to ensure that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the site. At this stage a detailed surface water drainage design has not been undertaken, however it is necessary to demonstrate that the surface water from the proposed development can be discharged safety and sustainably. The SuDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the site.
- No increase in flooding to people or property off-site as a result of the development.
- No surface water flooding of the site.

- The proposals take into account a 40% increase in rainfall intensity due to climate change during the next 100 years which is the lifetime of the development

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. The SuDS Strategy will take the form of:

- Permeable surfaces used on the footways/road.
- Porous paving of /car parking areas.
- If required, permeable conveyance features - infiltration trenches, swales, filter strips.
- For larger events in other areas such as car parking and landscaping, provided that it will not cause damage or prevent access.

For all development, both the Building Regulations and NPPF promote a hierarchical approach to surface water management. This approach has been adopted within this SuDS Strategy with infiltration being utilised wherever possible.

The size of the infiltration storage should be such that the proposed development has the capacity to accommodate the 1 in 100 year rainfall event including a 40% increase in rainfall intensity that is predicted to occur as a result of climate change. Consequently, all areas drained should be designed to accommodate a 100 year (+40% climate change) storm event. The remainder of the site that is not formally drained, i.e. landscaped areas, will be permeable (grass). The majority of rainwater falling on these areas will soak into the ground. Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas.

These methods will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this site. The adoption of a SuDS Strategy for the site represents an enhancement from the current conditions as the current surface water runoff from the site is uncontrolled, untreated, unmanaged and unmitigated. The SuDS Strategy will reduce the risk of flooding to the site and off-site locations.

In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

4.7 Designing for Local Drainage System Failure

When considering residual risk, it is necessary to make predictions as to the impacts of a storm event that exceeds the design event, or the impact of a failure of the local drainage system. The SuDS Strategy applies a safe and sustainable approach to discharging rainfall runoff from the site and this reduces the risk of flooding however, it is not possible to completely remove the risk. This section of the FRA is therefore associated with the way the residual risk is managed.

As part of the SuDS Strategy it must be demonstrated that the flooding of property would not occur in the event of local drainage system failure and/or design exceedance. It is not economically viable or sustainable to build a drainage system that can accommodate the most extreme events. Consequently, the capacity of the drainage system may be exceeded on rare occasions, with excess water flowing above ground[7].

[7] CIRIA (2006) Designing for exceedance in urban drainage – good practice.

The attenuation requirements have been designed to accommodate the 1 in 100 year storm event plus climate change (+40%). The design of the site layout provides an opportunity to manage this local drainage system failure/exceedance flow and ensure that indiscriminate flooding of property does not occur.

There will not be an extensive sewerage network on the proposed development site and therefore it is very unlikely that a catastrophic failure would occur. Exceedance flows would be contained within the highways of the site and would flow to the lower ground levels where the landscaped areas are located. It is not considered that there is an increased risk to the properties on the site or located adjacent to the site.

In particular, the landscaped areas will include preferential flow paths that convey water away from buildings. Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas.

When considering the impacts of a storm event that exceeds the 1 in 100 year (+40%) event, there is safety factor, even under the design event conditions. Consequently, if this event were to be exceeded there is additional capacity with the system to accommodate this (i.e. within the manholes, pipes etc.). If this freeboard was to be exceeded the consequences would be similar, if not less than for the local drainage system failure. Consequently, the impact of an exceedance event is not considered to represent any significant flood hazard.

The above manages and mitigates the flood risk from surface water runoff to the proposed properties from surface water runoff generated by the site development and to offsite locations as well the risk from surface water runoff generated offsite.

5.0 RISK MANAGEMENT

5.1 Introduction

The flood risk at this location is considered suitable for 'less vulnerable' developments within the NPPF. In this flood zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development and the use of flood mitigation measures.

A number of techniques and mitigation strategies to manage and reduce the overall flood risk in the area will be used. This will ensure the development will be safe and there is:

- Minimal risk to life;
- Minimal disruption to people living and working in the area;
- Minimal potential damage to property;
- Minimal impact of the proposed development on flood risk generally; and;
- Minimal disruption to natural heritage.

5.2 Ground Levels

The proposed ground levels will be no lower than existing.

5.3 Flood Warning

The site is located in a flood risk area therefore; the site will participate in the Environment Agency flood warning telephone service. The site will register contact details with the Environment Agency' Flood Warnings Service (Floodline 0345 988 1188) in order to receive Flood Warnings for the area.

The Environment Agency operate a free flood warning service providing alerts by phone, text or email when flooding is anticipated providing an opportunity for home owners to take necessary precautions, giving enough time for the building to be safely evacuated and mitigation measures to be put in place.

All occupants/visitors of the site will be made aware of the Environment Agency Floodline telephone number (Call Floodline on 0345 988 1188 to get more information) and the three Flood Warning Codes and their meaning.

The Environment Agency uses three Flood Warnings Codes. They can be issued in any order, usually ending with an 'all clear'. They are issued by the Environment Agency through their website and Floodline. The flood warning will be passed onto the visitors and occupants of the site verbally, by telephone and/or in person. It will be ensured that everyone receives the flood warnings when required.

5.4 Flood Warning and Evacuation Plan

A Flood Warning and Evacuation Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed. The Flood Plan is a 'living' document and therefore should be periodically reviewed and updated to provide advice and guidance in the event of an extreme flood. The Flood Plan will therefore reduce the vulnerability of the site users to flooding and makes them aware of the mechanisms of flooding at the property.

Flood warning signs should be displayed prominently in and around the car park, clearly stating the potential flood risk. It is essential that responsibility for car park closure and evacuation is suitably delegated, for example, to a flood warden for the site, and that all relevant staff members are made aware of closure and evacuation procedures. Provided a clear and suitable emergency and closure plan is developed and communicated effectively to staff and car park users, the flood risk at the site should not present a risk to people or the car park.

5.5 Safe Access and Egress Route

The NPPF requires that, where required, safe access and escape is available to/from new developments in flood risk areas. Access routes should be such that occupants can safely access in design flood conditions. These routes must also provide the emergency services with access to the development during a flood event and enable flood defence authorities to carry out any necessary duties during the period of flood.

A safe access and egress route, including emergency access can be maintained for vehicles and/or by foot via the access road to the north of the site and then via Station Road to the north east. The site is located within Flood Zone 2 and would not be inundated with floodwater for all events up to and including the 1 in 100 year (+20%) event. Station Road to the north east is hwon to be located within Flood Zone 1 and therefore, has less than a 1 in 1000 annual probability of river flooding in any year (<0.1%). The site is located within a low risk area where the onset of flooding is very gradual (many hours) as per Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2. The debris will be limited due to the low water depths, as per the guidance in Flood Risks to People, FD2321/TR1.

Therefore, safe access and egress can be maintained for all events up to and including the 1 in 100 year (+20%) event in accordance with the NPPF and Environment Agency Guidance.

5.6 Flooding Consequences

The mitigation measures detailed above show that the flood risk can be effectively managed and therefore the consequences of flooding are acceptable. The chance of flooding each year is low each year. This takes into account the effect of any flood defences that may be located within the vicinity of the site as well the mitigation measures.

6.0 SEQUENTIAL APPROACH

6.1 Sequential Test

The risk-based Sequential Test in accordance with the NPPF aims to steer new development to areas at the lowest probability of flooding (i.e. Flood Zone 1). It is impractical to suggest that there are more suitable locations for this development elsewhere. The site is currently an access road and park, the site is the only site in the ownership of the client and therefore the only site available to them to develop. The cost of buying a similar site and the cost to construct a similar development would make it uneconomical.

The proposed development is ancillary infrastructure to the existing use of the site as a park. The proposed use will improve and formalise the existing use of the site. The proposed development is essential for the growth and development of Darton Park. Therefore, the location of the proposed development on the site is a necessary function of this ancillary infrastructure. The site proposals cannot be located in another site elsewhere they have to be located at this site which has existing facilities.

The site proposals remain consistent with the relevant planning policies and are not at odds with the current use of the site and can only enhance and preserve the employment base which currently exists. The site is situated within a long established park. The wider area surrounding the proposed development site is affected by a very similar, and in many cases, higher risk of flooding. The application is for a new, suitable flood-resilient design. The exposure of people and property will be minimised.

The development proposals should therefore be considered by the LPA to satisfy the Sequential Test as set out in the NPPF.

6.2 Exception Test

Applications for 'less vulnerable' uses located within Flood Zone 2 are not subject to the Exception Test as confirmed within Table 3 of this report and Table 3 of the Planning Practice Guidance to the NPPF. Therefore, the Exception Test will not need to be undertaken as part of this planning application.

7.0 SUMMARY AND CONCLUSIONS

7.1 Introduction

This report presents an FRA in accordance with the NPPF for the proposed development at Darton Park, Barnsley, South Yorkshire, S75 5LZ

This FRA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout the lifetime, taking climate change into account.

7.2 Flood Risk

The site is unlikely to flood except in extreme conditions. The primary, but unlikely, flood risk to the site is posed by fluvial flooding from the River Dearne. However, the flood defence measures identified are expected to afford the site significant protection from fluvial flooding. The existing flood defences provide a SoP of 1 in 30 years therefore, the site would not be inundated with floodwater for all events up to and including the 1 in 30 year event. The site would be flood free during the 1 in 30 year event.

The Environment Agency Flood Zones shows that the 1 in 100 year event is contained within the banks of the River Dearne to the east of the site, the river banks are only overtopped during the 1 in 100 year event to the north of the site. Between the site and the River Dearne to the north and east, the ground levels rise to a minimum of 59.00mAOD therefore, the site will not be inundated with floodwater for all events up to and including the 1 in 100 year (+20%) event. The site will be flood free during the 1 in 100 year (+20%) event. Water levels have been modelled at 59.05mAOD during the 1 in 1000 year event, using node DEAR01_06087. Site ground levels are 58.00mAOD therefore, the site may be inundated with floodwater to a maximum depth of 1.05m during the 1 in 1000 year event. Therefore, the risk of fluvial flooding from the Longford Brook is considered to be of **medium significance**. A number of secondary flooding sources has been identified which may pose a **low significant** risk to the site. These are:

- Surface Water Flooding
- Sewer Flooding

The proposed development is classified as ‘less vulnerable’, ‘less vulnerable’ uses are appropriate within Flood Zone 2. The flood risk at the site, will be further managed and mitigated by using a number of risk management techniques, and mitigation strategies to manage and reduce the overall flood risk at the site.

The proposed development will have no impact on floodwater levels. The overall direction of the movement of water will be maintained within the developed site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed. The topography of the site will not be altered therefore; the overland flow routes will not be altered. The proposed development will allow floodwater to pass through the site with no effect on the conveyance routes.

7.3 SuDS Strategy

The SuDS Strategy ensures that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the site. At this stage a detailed surface water drainage design has not been undertaken, however it is

necessary to demonstrate that the surface water from the proposed development can be discharged safety and sustainably. The SuDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the site.
- No increase in flooding to people or property off-site as a result of the development.
- No surface water flooding of the site.
- The proposals take into account a 40% increase in rainfall intensity due to climate change during the next 100 years which is the lifetime of the development

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. The SuDS Strategy will take the form of:

- Permeable surfaces used on the footways/road.
- Porous paving of /car parking areas.
- If required, permeable conveyance features - infiltration trenches, swales, filter strips.
- For larger events in other areas such as car parking and landscaping, provided that it will not cause damage or prevent access.

For all development, both the Building Regulations and NPPF promote a hierarchical approach to surface water management. This approach has been adopted within this SuDS Strategy with infiltration being utilised wherever possible.

The size of the infiltration storage should be such that the proposed development has the capacity to accommodate the 1 in 100 year rainfall event including a 40% increase in rainfall intensity that is predicted to occur as a result of climate change. Consequently, all areas drained should be designed to accommodate a 100 year (+40% climate change) storm event. The remainder of the site that is not formally drained, i.e. landscaped areas, will be permeable (grass). The majority of rainwater falling on these areas will soak into the ground. Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas.

These methods will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this site. The adoption of a SuDS Strategy for the site represents an enhancement from the current conditions as the current surface water runoff from the site is uncontrolled, untreated, unmanaged and unmitigated. The SuDS Strategy will reduce the risk of flooding to the site and off-site locations.

In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

7.4 Risk Management

The flooding sources will be managed on the site by using a number of mitigation strategies to manage and reduce the overall flood risk at the site and will ensure the development will be safe. Measures used:

Ground Levels: The proposed ground levels will be no lower than existing.

Flood Warning: The site is located in a flood risk area therefore; the site will participate in the Environment Agency flood warning telephone service.

Flood Warning and Evacuation Plan: A Flood Warning and Evacuation Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed.

Safe Access and Egress Route: A safe access and egress route, including emergency access can be maintained for vehicles and/or by foot via the access road to the north of the site and then via Station Road to the north east. The site is located within Flood Zone 2 and would not be inundated with floodwater for all events up to and including the 1 in 100 year (+20%) event. Station Road to the north east is shown to be located within Flood Zone 1 and therefore, has less than a 1 in 1000 annual probability of river flooding in any year (<0.1%). The site is located within a low risk area where the onset of flooding is very gradual (many hours) as per Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2. The debris will be limited due to the low water depths, as per the guidance in Flood Risks to People, FD2321/TR1.

Therefore, safe access and egress can be maintained for all events up to and including the 1 in 100 year (+20%) event in accordance with the NPPF and Environment Agency Guidance.

7.5 Sequential Approach

The development proposals should be considered by the LPA to satisfy the Sequential and Exception Tests as set out in the NPPF.

7.6 Conclusion

Table 11 summarises the probability and consequence of flooding for the site with and without mitigation measures.

In conclusion, a car park and access road, would be expected to remain dry in all but the most extreme conditions. Providing the recommendations made in this FRA are instigated, flood risk from all sources would be minimised, the consequences of flooding are acceptable, and the development would be in accordance with the requirements of the NPPF.

The adoption of a SuDS Strategy for the site represents an enhancement from the current conditions as the current surface water runoff from the site is uncontrolled, untreated, unmanaged and unmitigated. The SuDS Strategy will reduce the risk of flooding to the site and off-site locations.

This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The development should not therefore be precluded on the grounds of flood risk.

Table 11 - Probability and Consequences of all Sources of Flooding

Sources of Flooding	Potential Source	Probability	Consequence & Impact Without Mitigation	Consequence & Impact with Mitigation	Comment
Fluvial Flooding	River Dearne	Medium	Medium	Low	Mitigation measures used
Tidal Flooding	None Reported	None	Negligible	Negligible	None
Groundwater Flooding	None Reported	None	Negligible	Negligible	None
Surface Water Flooding	Poor Permeability	Low	Low	Negligible	Mitigation measures used
Sewer Flooding	Local Sewers	Low	Low	Negligible	Mitigation measures used
Flooding from Artificial Drainage Systems/Infrastructure Failure	None Reported	None	Negligible	Negligible	None

APPENDICES

APPENDIX 1 – Proposed Site Layout

Access to Church St.

Existing car park

Club

Existing field gate

Existing memorial plinth

C3/150 channel

Width varies

16.50m min.

6.00m min.

Gap in railing to be 1.5m min. width

Install birds mouth fencing in concrete foundation 300mm wide

A

A

LEGEND

- Existing tree - to be removed
- Existing fencing and field gate - to be removed
- Excavate existing road/car park to 230mm depth and reconstruct with Group 2 footway construction, comprising:-
  DBM 6mm aggregate surface course, 20mm thick,
  DBM 20mm aggregate binder course, 60mm thick,
  Type 1 granular sub-base, 150mm thick
- Excavate existing verge to 230mm depth and resurface with Group 2 footway construction, comprising:
  DBM 6mm aggregate surface course, 20mm thick,
  DBM 20mm aggregate binder course, 60mm thick,
  Type 1 granular sub-base, 150mm thick,
- Excavate existing road/footway to 80mm depth and resurface with Group 3 footway construction, comprising:-
  DBM 6mm aggregate surface course, 20mm thick,
  DBM 20mm aggregate binder course, 60mm thick
- Excavate existing grassed area to 400mm depth and resurface with Group 4 footway construction, comprising:-
  Bodpave 85 porous pavers (or equivalent) 50mm thick, infilled with selected gravel/angular aggregate (4-15mm dia.)
  Bedding layer of 4-15mm dia. angular gravel or crushed aggregate, 50mm thick,
  Geotextile "Terram 1500" or similar approved,
  Permeable/open graded reduced fines (Type 3) granular sub-base, 300mm thick,
  Tensar Triax TX160 geogrid (or similar approved)
- Area to be topsoiled and seeded
- Existing lamp column
- Proposed lamp column
- Proposed ducting for street lighting
- Proposed birdsmouth/kneerail fencing 700mm high

N

BARNSLEY
Metropolitan Borough Council

Project
DARTON PARK
PROPOSED CAR PARK

Scale 1/200

Drawn E.D.C.

Date DEC.2017

Checked

File PTP

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Drawing No. HD/DP/PCP/1/A

APPENDIX 2 – Environment Agency Data

2010 Upper Dearne Model Results - 117840										
	Return Period									
	5		10		25		50		75	
NodePointName	Level (mAOD)	Flow (m^3/s)	Level (mAOD)	Flow (m^3/s)	Level (mAOD)	Flow (m^3/s)	Level (mAOD)	Flow (m^3/s)	Level (mAOD)	Flow (m^3/s)
DEAR01_06669	60.15	23.34	60.43	28.42	60.61	35.11	60.78	40.62	60.87	43.82
DEAR01_06669	60.15	23.34	60.43	28.42	60.61	35.11	60.78	40.62	60.87	43.82
DEAR01_06471	59.85	23.5	60.24	28.56	60.42	35.3	60.59	39.9	60.68	42.31
DEAR01_06264	58.35	23.68	58.56	28.69	58.8	35.58	58.98	41.14	59.09	44.47
DEAR01_06264	58.35	23.68	58.56	28.69	58.8	35.58	58.98	41.14	59.09	44.47
DEAR01_06087	57.66	23.81	57.85	28.83	58.08	35.76	58.25	41.34	58.35	44.69
DEAR01_05758	56.36	24.04	56.53	29.06	56.75	36.05	56.88	41.65	56.95	45.01
DEAR01_05758	56.36	24.04	56.53	29.06	56.75	36.05	56.88	41.65	56.95	45.01
DEAR01_05592	56.29	24.08	56.45	29.1	56.66	35.97	56.79	40.75	56.86	43.36
DEAR01_05359	56.06	24.14	56.18	29.16	56.34	36.04	56.45	40.76	56.51	43.22
DEAR01_05216	55.75	23.13	55.82	26.49	55.96	30.38	56.07	32.79	56.15	33.76
DEAR01_05216	55.75	23.13	55.82	26.49	55.96	30.38	56.07	32.79	56.15	33.76
CAWT01_316	56.32	17.28	56.41	19.34	56.5	21.99	56.56	24.36	56.59	25.74
CAWT01_145	55.95	17.41	56.05	19.06	56.17	20.77	56.27	21.77	56.32	22.23

2010 Upper Dearne Model Results - 117840						
	Return Period					
	100		100+CC		1000	
NodePointName	Level (mAOD)	Flow (m^3/s)	Level (mAOD)	Flow (m^3/s)	Level (mAOD)	Flow (m^3/s)
DEAR01_06669	60.94	46.86	61.21	55.24	61.6	82.6
DEAR01_06669	60.94	46.86	61.21	55.24	61.6	82.6
DEAR01_06471	60.75	44.46	61.03	50.14	61.37	74.05
DEAR01_06264	59.18	47.54	59.42	55.89	59.71	83.72
DEAR01_06264	59.18	47.54	59.42	55.89	59.71	83.72
DEAR01_06087	58.44	47.77	58.65	56.19	59.05	78.75
DEAR01_05758	57	48.11	57.11	56.54	57.29	84.7
DEAR01_05758	57	48.11	57.11	56.54	57.29	84.7
DEAR01_05592	56.92	45.55	57.06	50.49	57.42	62.82
DEAR01_05359	56.57	45.21	56.73	49.37	57.22	57.59
DEAR01_05216	56.25	34.19	56.47	35.26	57.13	35.23
DEAR01_05216	56.25	34.19	56.47	35.26	57.13	35.23
CAWT01_316	56.63	27.94	56.69	31.26	57.09	37.88
CAWT01_145	56.4	22.93	56.56	23.6	57.14	24.24

RFI/2019/117840 Assets Map, centred on Darton Park, S75 5LZ
Date Created: 06/03/19

Environment Agency

www.environment-agency.gov.uk

Scale: 1:10,000

N W E S

when reproduced @ A3

LEGEND

Main River

Defences (3rd party maintained)

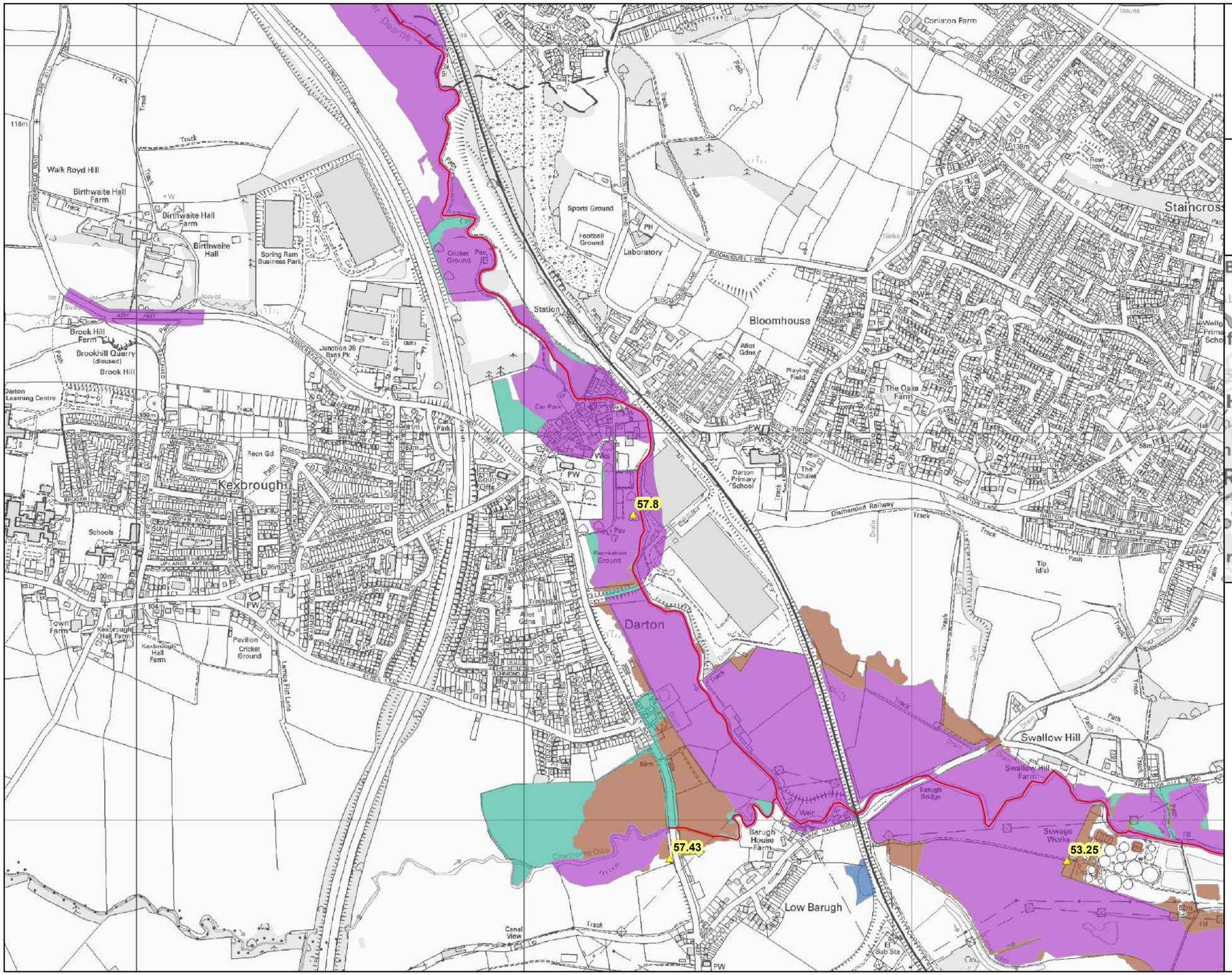
ASSET_ID

- 50217
- 50852
- 172010

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Defences (3rd Party Maintained) - 117840										
ASSET _ID	**DESCRIPTION**	**ASSET _MAIN**	**AIMS _SUB_T**	**LENGTH**	**ACTUAL _DCL**	**ACTUAL _UCL**	**PROTECTION**	**TARGET _CON**	**OVERALL _CO**	**DESIGN _SOP**
50217		private	high_ground	3942.76			fluvial	3	3	
50852		private	high_ground	764.23			fluvial	3	3	
172010		private	high_ground	3208.53			fluvial	3	2	

RFI/2019/117840 Flood History Map, centred on Darton Park, S75 5LZ
Date Created: 06/03/19



Environment Agency

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LEGEND

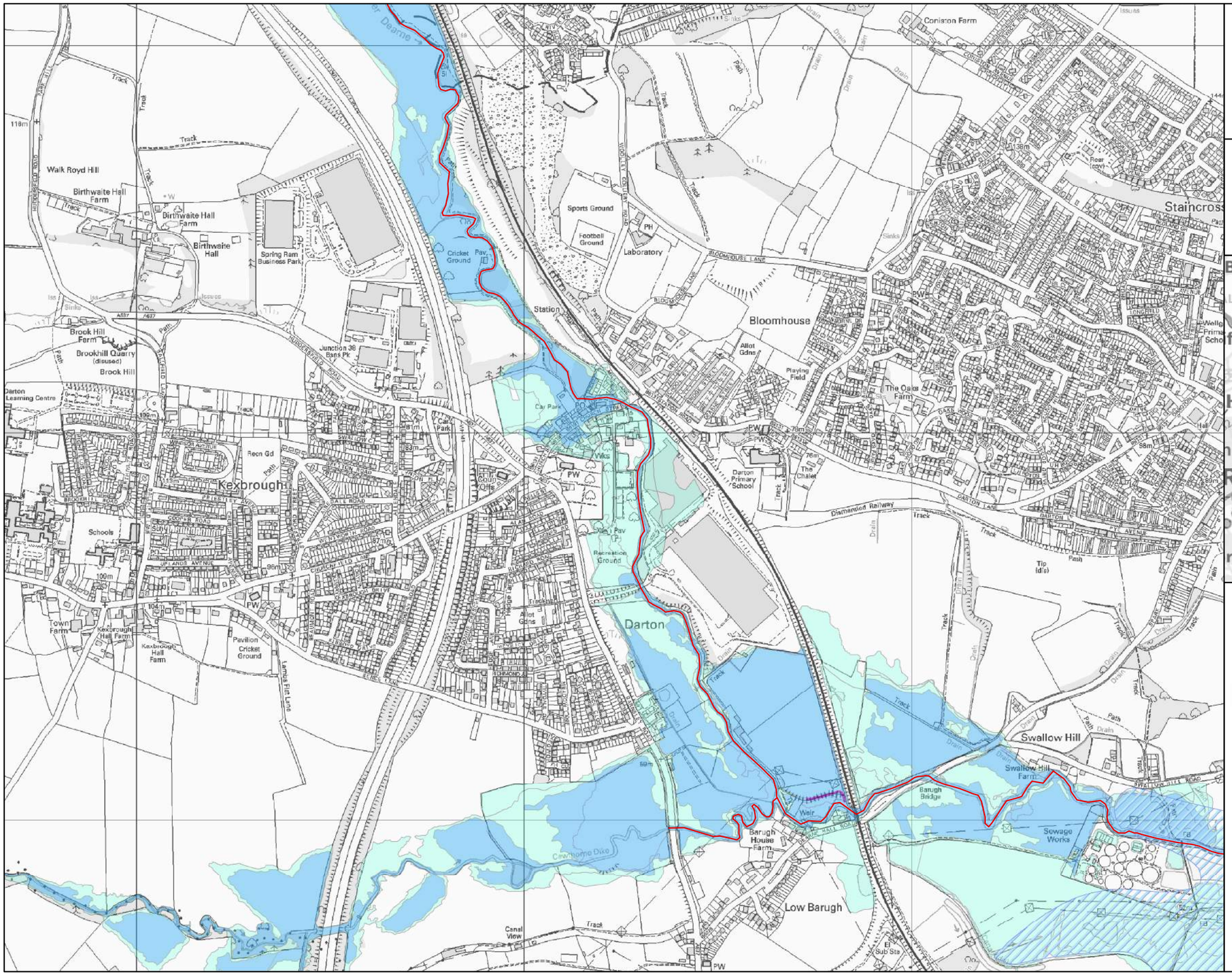
- Main River
- Autumn 2000 Flood Event Flood Level (m)

Recorded Flood Outlines

- June 2007 Flood Event (Ridings Area)
- June 2007 Surface Water Flooding Yorkshire
- 123 Autumn 2000
- 123 March 1947

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

RFI/2019/117840 Flood Map for Planning, centred on Darton Park, S75 5LZ
Date Created: 06/03/19



Environment Agency

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Scale: 1:10,000

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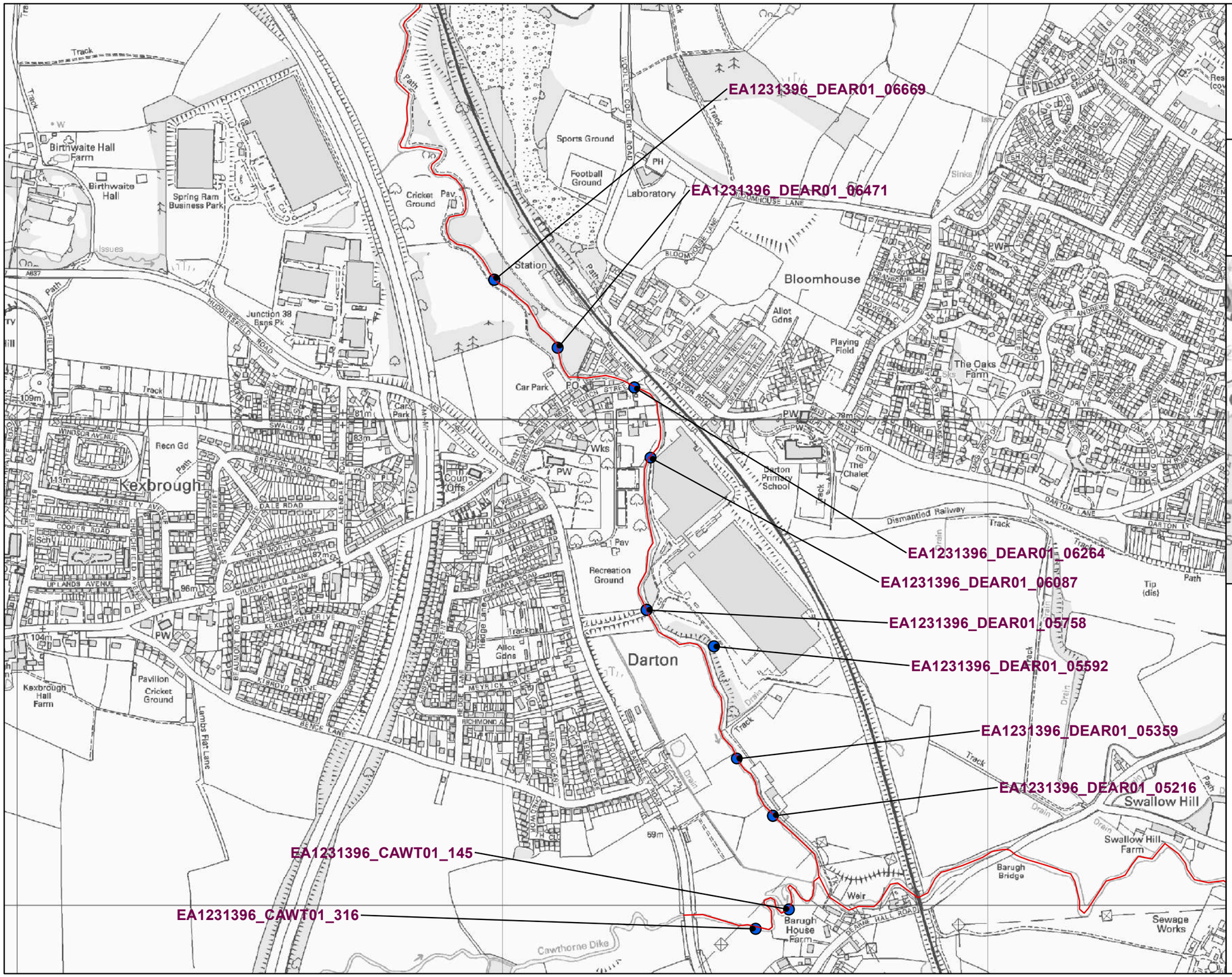
LEGEND

- Main River
- Flood Map Flood Defences
- Areas Benefitting From Flood Defences
- Flood Storage Areas
- Flood Zone 3 (FZ3)
- Flood Zone 2 (FZ2)

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

RFI/2019/117840 Node Points Map, centred on Darton Park, S75 5LZ
Date Created: 06/03/19



Environment Agency

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Scale: 1:8,000

when reproduced @ A3

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W E
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LEGEND

- Main River
- 2010 Upper Dearne Node Points

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

RFI

Ref:	*117840*	Completed by:	*SC*	Date due:	*21/03/2019*

The Flood Map for Planning

The Environment Agency provides the Flood Map (see enclosed extract).

What is the Flood Map for Planning?

The Flood Map for Planning provides information on flooding from rivers and the sea for England and Wales. The Flood Map also has information on flood defences and the areas benefiting from those flood defences.

The Flood Map for Planning shows the following:

1. Flood Zone 3 (dark blue area on the enclosed map): natural flood plain area that could be affected by flooding from rivers and/or the sea – not taking into account the presence of any flood defences
   - For flooding from rivers the map indicates the extent of a flood with a 1% (1 in 100) chance of happening each year;
   - For flooding from the sea the map shows the extent of a flood with a 0.5% (1 in 200) chance of happening each year.

2. Flood Zone 2 (light blue area): natural flood plain area that could be affected by flooding from rivers and/or the sea – not taking into account the presence of any flood defences. Flood Zone 2:
   - indicates the extent of a flood with a 0.1% (1 in 1000) chance of happening each year.
   - and/or indicates the greatest recorded historic flood, whichever is greater.

3. Flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, together with some natural or constructed entities which retain, store or channel water and which may protect against smaller floods.

4. Areas benefiting from flood defences - areas that benefit from the flood defences shown, in the event of a river flood with a 1% (1 in 100) chance of happening each year, or a flood from the sea with a 0.5% (1 in 200) chance of happening each year. If the defences were not there, these areas would flood.

Flood History

Flood History

See the attached map showing the flood history for this site. The extent of flooding, and/or flood level information is only shown for those watercourses surveyed after the flood. Other flooding may have occurred which is not shown. This is the best information currently available.

Please refer to the following table detailing the causes of those past floods.

Name	Comments	Start Date	End Date	Flood Source	Flood Cause	Source of data
123 March 1947	Extent digitised from large scale 1inch to 1mile map	19/03/1947	22/03/1947	Main River	Channel Capacity	Local Authority
123 March 1947	Extent digitised from large scale 1inch to 1mile map	19/03/1947	22/03/1947	Main River	Channel Capacity	Local Authority
123 March 1947	Extent digitised from large scale 1inch to 1mile map	19/03/1947	22/03/1947	Main River	Channel Capacity	Local Authority
123 Autumn 2000	start and end date do not relate to dates of flooding.	01/10/2000	30/11/2000	Main River	Unknown	Other
123 Autumn 2000	start and end date do not relate to dates of flooding.	01/10/2000	30/11/2000	Main River	Unknown	Other

Assets

Asset Location Map
Please find attached asset map(s) showing location of all (Agency and non Agency maintained) flood defences and channels.

Description of Works
See attached table with description of the defences and structures shown on the above drawing, including condition ratings, upstream and downstream crest levels, where available.

Risk of Flooding – Environment Agency Defences
The risk of flooding in this area is now reduced by the presence of flood defences that we maintain, but there still is a residual risk of flooding if these were to breach or be overtopped by a flood greater than that for which they were designed.

Risk of Flooding – Privately Maintained Defences
You will see that the Environment Agency does not maintain any of those defences. However we undertake regular risk based visual inspections. We do not hold design levels and have no height information on these defences or structures.

Asset Condition Ratings
The performance of a flood defence asset is recorded as the condition of the asset. Our asset inspectors subjectively assess the conditions of assets (during visual inspection site visits) with reference to a national standard template. Each asset is given a rating between one and five with one being very good condition and five being very poor. A condition rating of 3, or 'fair' is the minimal acceptable standard for a critical asset, such as a defence wall that protects properties. We are striving to improve all assets below 'fair' to an acceptable standard.

Asset inspections are done on average every six months, although some critical assets are assessed on a more regular basis. It is possible that adjacent assets are inspected on different dates, which may result in two assets of a similar state of repair having different condition ratings.

Condition ratings of assets may also be affected by the time of year the surveys are conducted, as vegetation may obscure the asset in the summer months, or accessibility may be an issue during winter months. These factors would not usually affect the recorded condition rating of an asset unless the asset is on a borderline between two ratings.

Asset Standard of Protection
Please note that the provided Design Standard of Protection is an estimate and should not be relied on. Please note that where available the defended flood extents provide more reliable information relating to the protection offered by the defence (i.e. at which return period the water levels are likely to overtop the defence). If available and required the defended flood extents can be provided on request.

Modelling

2010 Upper Dearne Study
See enclosed extracts from the Upper Dearne Flood Mapping Study produced by Halcrow Group Limited in May 2010.

Extracts consist of

- A spreadsheet showing the results for max stage and 0.1% (1 in 1000yr), 0.5% (1 in 200yr), 1% (1 in 100yr), 1% CC (1 in 100yr +climate change), 1.3% (1 in 75yr), 2% (1 in 50yr), 4% (1 in 25yr), 10% (1 in 10yr) and 20% (1 in 5yr) annual chance events.
- An associated map showing the location of the model node points.

Climate Change

Please note that new guidance on climate change allowances for Flood Risk Assessments has been published in February 2016. The new guidelines are available from:
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Bespoke Flood Risk Assessment (FRA) advice:

If the pre-application advice is required with regards the preparation of a site-specific Flood Risk Assessment, this can be requested via the Yorkshire Sustainable Places team (email: sp-yorkshire@environment-agency.gov.uk). Charges may apply for any advice that is provided, this currently stands at £100 per hour per person. The .gov.uk pages provide a good starting point on what to include within a site-specific Flood Risk Assessment and can be accessed via https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications. A site-specific Flood Risk Assessment will need to consider flood risks from all sources, including those associated with defence failure (e.g. breach) and accounting for the predicted impacts as a result of climate change. Please contact the Sustainable Places team if you require advice on how to include these within a Flood Risk Assessment.

Other

Surface Water Map

In partnership with Local Authorities, we publish Risk of flooding from surface water maps. These were updated in December 2013. If you would like a copy of the map for your area, please contact us again. Otherwise the map can be viewed online at : https://flood-warning-information.service.gov.uk/long-term-flood-risk/#x=438988&y=406600&scale=2

Surface Water Drainage

The Lead Local Flood Authority is the statutory consultee for planning matters relating to surface water drainage, therefore it is recommended they should be consulted separately regarding this.

Surface water discharge from new development should ideally 'mimic' the pre-development situation using a sustainable drainage system so that the flow and volume of water in watercourses is not increased.

A permit may be required, under the Environmental Permitting Regulations 2010 from the Environment Agency for any proposed works or structures in, under, over or within eight metres of a 'main river' (e.g. a new outfall). A permit is separate to and in addition to any planning permission granted. Further details and guidance are available on the GOV.UK website: https://www.gov.uk/guidance/flood-risk-activities-environmental-permits

Risk of Flooding from Reservoirs Map

Outlines and simplified depth and velocity maps can be viewed on our website:

https://flood-warning-information.service.gov.uk/long-term-flood-risk/#x=438988&y=406600&scale=2

Please, zoom into the location of interest, and then click on the inundated location for details. As a result a list of reservoirs will be provided with supporting information and a links to other data, such as estimated depths and speed of flooding, at the bottom of the result page.

A map showing the outlines can also be provided on request.

Flood Warning

The site is covered by a Flood Warning. To register to receive this service, you can call Floodline 24 hours a day on 0845 988 1188.

LIDAR Data

Please note that our LiDAR data is now available free of charge (Open Data) from http://environment.data.gov.uk/ds/survey/index.jsp#/survey (once zoomed to the relevant location the available LiDAR products will be listed below the map).

Two LIDAR products are available:

1. Tiled LIDAR data - The full tiled dataset consists of historic LIDAR data which has been gathered since 1998. For some areas we have carried out repeat surveys and data is available in a range of resolutions.
2. Composite LIDAR data - The composite dataset is derived from a combination of our full tiled dataset which has been merged and re-sampled to give the best possible spatial coverage.

Light Detection and Ranging (LIDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. This technique results in the production of an accurate, cost-effective terrain model suitable for assessing flood risk and other environmental applications.

The Environment Agency owns two LIDAR systems, which are installed in a survey aircraft along with its other operational remote sensing instruments.

The aircraft is positioned and navigated using Global Positioning System (GPS) corrected to known ground reference points. The aircraft typically flies at a height of about 800 metres above ground level and a scanning mirror allows a swath width of about 600 metres to be surveyed during a flight.

The Rights & Responsibilities of a Riverside Owner

The owner of property adjacent to a watercourse is usually deemed to be the riparian owner and, as such, has both riparian rights and responsibilities with regard to the watercourse within their ownership.

For more information on Rights and Responsibilities of a riverside owner, you can visit our website at:

https://www.gov.uk/guidance/owning-a-watercourse

Ordnance Survey Data
Under the terms of our licence agreement with the Ordnance Survey, we are unable to supply the OS data. Under this agreement we can only supply OS data to consultants/contractors carrying out work on our behalf.

Flood Portal

It's a new 'one-stop shop' web portal providing guidance and information on flood risk management in the UK. Arup have written and designed the site, in conjunction with CIRIA, the Local Government Association, the EA and Defra, primarily as a resource for local authority officers, flood risk management professionals, and others with an interest in flood risk. It's a part of the Capacity Building Strategy.http://www.local.gov.uk/floodportal

APPENDIX 3 – IoH 124 Method Calculations

MasterDrain
HY 10.03

KRS Environmental Limited.
www.krsenvironmental.com

3 Princes Square, Princes Street,
Montgomery
Powys, SY15 6PZ
Tel: 01686 668957 Mob: 07857 264 376
email: keelan@krsenvironmental.com

Job No.			
Sheet no.	1		
Date	02/04/19		
Project	Darton Park, Barnsley, S75 5LZ	By	Checked / Reviewed
Title	IoH 124 Method Calculations		

Hydrological Data:-

FSR Hydrology:-

Location = DARTON	Grid reference = SE3110
M5-60 (mm) = 18.8	r = 0.36
Soil runoff = 0.30	SAAR (mm/yr) = 700
WRAP = 2	Area = England & Wales
Hydrological area = 3	Hydrological zone = 8

Soil classification for WRAP type 2
i) Very permeable soils with shallow ground water;
ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils; (fragipan - a natural subsurface horizon having a higher bulk density than the solum above. Seemingly cemented when dry but showing moderate to weak brittleness when moist. The layer is low in organic matter, mottled and slowly or very slowly permeable to water. It is found in profiles of either cultivated or virgin soils but not in calcareous material).
iii) Moderately permeable soils, some with slowly permeable subsoils.

Design data:-

Area = 0.0013 Km² - 0.13 Ha - 1300 m²

Calculation method:-

Runoff is calculated from:-

$$Q_{BAR(rural)} = 0.00108\ AREA^{0.89} \cdot SAAR^{1.17} \cdot SOIL^{2.17}$$

where

AREA = Site area in Km²
SAAR = Standard Average Annual Rainfall (mm/yr)
SOIL = Soil value derived from Winter Rainfall Acceptance Potential
$Q_{BAR(rural)}$ = Runoff (cumecs)

$Q_{BAR(rural)}$ is then multiplied by a growth factor - GC(T) - for different storm return periods derived from EA publication W5-074/A.

Calculated data:-

For areas less than 50Ha, a modified calculation which multiplies the 50Ha runoff value by the ratio of the site area to 50Ha is used
Reducing factor used for these calculations is 0.003

Mean Annual Peak Flow $Q_{BAR(rural)}$ = 0.24 l/s

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MasterDrain
HY 10.03

Job No.			
Sheet no.	2		
Date	02/04/19		
Project	Darton Park, Barnsley, S75 5LZ	By	Checked / Reviewed
Title	IoH 124 Method Calculations		

Values for $Q_{BAR(rural)}$

Ret. per.	m³/hr	l/s	l/s/ha	Ret. per.	m³/hr	l/s	l/s/ha
1yr	0.725	0.201	1.549	100yr	1.791	0.498	3.827
2yr	0.802	0.223	1.713	100yr+20%	2.149	0.597	4.593
5yr	1.032	0.287	2.205	100yr+30%	2.328	0.647	4.975
10yr	1.237	0.344	2.643	200yr	2.047	0.569	4.374
30yr	1.433	0.398	3.062	200yr + 30%	2.661	0.739	5.686
50yr	1.621	0.450	3.463	500yr	2.328	0.647	4.975
				1000yr	2.593	0.720	5.540

Growth factors -

1yr	2yr	5yr	10yr	30yr	50yr	100yr	200yr	500yr	1000yr
0.85	0.94	1.21	1.45	1.68	1.90	2.10	2.40	2.73	3.04

The above is based on the Institute of Hydrology Report 124
to which you are referred for further details (see Sect 7).
Note that the 200 and above year growth curves were taken from W5-074.

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