

J ROBERTS DESIGN LTD

**Lowfield Farm
Lowfield Road
Rotherham**

FLOOD RISK ASSESSMENT

Client

Mr D White

1714 / August 2018

COPYRIGHT
THIS DOCUMENT MUST NOT BE COPIED OR
REPRODUCED WITHOUT THE PRIOR
PERMISSION OF J ROBERTS DESIGN LIMITED

CONTENTS

1	EXECUTIVE SUMMARY	2
1.1	Location and Type of Development	2
1.2	Flood Zone	2
1.3	Probability of Flooding	2
1.4	Flood Risk Management Measures	3
1.5	Off Site Impacts	3
1.6	Residual Risks	4
1.7	Conclusion	4
2	INTRODUCTION	5
3	DEVELOPMENT AND SITE LOCATION	5
3.1	Site Description	5
3.2	Site Location	6
3.3	Classification of Vulnerability	6
3.4	Flood Zone Classification	6
3.5	Local Development Plan	6
3.6	Sequential and Exceptions Test	7
4	DEFINITION OF THE FLOOD HAZARD	7
4.1	The River Deame	8
4.2	The Crane Well Dike	9
4.3	Flooding from Land	9
4.4	Flooding from Sewers	9
4.5	Flooding from Ground Water	10
5	THE PROBABILITY OF FLOODING	11
5.1	Probability of Flooding	11
5.2	Surface Water Discharge	12
6	CLIMATE CHANGE AFFECT	13
7	FLOOD RISK MEASURES	13
8	OFF SITE IMPACTS	15
8.1	Increase of Flood Risk Elsewhere	15
8.2	Management of Remaining Risks Over Lifetime of Development	15
9	RESIDUAL RISKS	15
9.1	Remaining Flood Risks After Implementation of Protection measures	15
9.2	Management of Remaining Risks Over the Lifetime of Development	16

1 EXECUTIVE SUMMARY

1.1 Location and Type of Development

- 1.1.1 This Flood Risk Assessment has been prepared in support of a new residential development, on land which was formally Lowfield Farm, Lowfield Road, Bolton Upon Dearne, Rotherham. This assessment has been undertaken in accordance with the National Planning Policy Framework (NPPF).
- 1.1.2 The site is located to the East end of Lowfield Road, on the outskirts of Bolton upon Dearne, some 10km north east from the centre of Rotherham. The development site is within Barnsley Metropolitan Borough Council (BMBC). The proposed development is bounded by residential properties to the South and South West. The North and Eastern Boundary's comprise agricultural fields. The Ordnance Survey grid reference for the site is 446094E, 402622N.
- 1.1.3 No defined residential development has been provided.
- 1.1.4 The watercourses near the site are the River Dearne and Lowfield lakes to the South, and Crane Well Dike to the North.

1.2 Flood Zone

- 1.2.1 The Environment Agency data shows the lower half of the site to be located within Flood Zone 2.
- 1.2.2 Barnsley and Rotherham MBC's Strategic Flood Risk Assessments (SFRA) locates the development just outside Flood Zone 2.

1.3 Probability of Flooding

- 1.3.1 The Environment Agency information flood history records show that the River Dearne flooded in 2007. The flood waters are shown to encroach on to the Northern lower half of the development site.
- 1.3.2 The 'Main River' closest to the site is the River Dearne which is indicated upon the Environment Agency's Flood Map. The river has raised earth embankments which are maintained and monitored by the Environment Agency.
- 1.3.3 The next closest watercourse to the proposed development is the Crane Well Dike some 190m away at the point closest to the site. The Dike is shown to have flooded at the same time as the River Dearne, which is likely to be due to the river flooding. The dike is considered as tertiary by the Danvm Drainage Commission.
- 1.3.4 Bolton upon Dearne and the surrounding area is protected by raised flood defence embankments and high ground on the River Dearne. The embankments local to the site provide protection from a predicted 1 in 50 year flood event which is below the national standard. The high ground local to the site provide protection from a predicted 1 in 30 year flood event which is below the national standard.

- 1.3.5 Overtopping of the River Dearne flood defences would take place primarily over the lower South bank in the first instance, into the functional flood plain to the south of the proposed development. Further rising of water levels would cause overtopping of the earth embankment flood defences on the Northern bank of the River Dearne and the Northern functional flood plain to flood.
- 1.3.6 The drainage ditches in the vicinity of the site are largely managed by the Danvm Drainage Commission and only have records of overtopping when the River Dearne overtopped and flooded in 2007. Should high intensity rainfall occur it is likely the drains will be temporarily inundated and largely the surface water will be accommodated within the channel, however in the event of overtopping occurring it will be shallow and localised to the ditches and drains. The site is considered to be at risk of flooding from local watercourses and from local drains and sewers.

1.4 Flood Risk Management Measures

- 1.4.1 Levels will be fixed to ensure flood water flows away rather than towards the buildings.
- 1.4.2 The proposed development is classified in the 'More Vulnerable' category of NPPF Table 2. Flood resilient construction in the lower parts of the structures should be considered where appropriate, in accordance with the document "Improving the Flood Performance of New Buildings – Flood Resilient Construction" (ISBN 9781 85946 2874).
- 1.4.3 It is proposed that the Finished Floor Level (FFL) of the new dwellings is 17.6m Above Ordnance Datum (AOD). This level will provide a minimum flood resilience of at least 600mm above the existing ground levels and above the maximum 1 in 200 year flood level from the River Dearne.

1.5 Off Site Impacts

- 1.5.1 The development proposal will increase the impermeable area of the site which will be managed by SuDs.
- 1.5.2 It is recommended that the surface water discharge from the site be via soakaways and other infiltration systems where possible. However, the prevailing ground conditions are thought to be sandy Clays of low permeability. Should infiltration systems not be viable for the site following testing, the surface water should be attenuated within the site and discharged at a controlled rate of 5L/s (or as agreed with Yorkshire Water, the IDB and local water authority) into a public sewer manhole to the north of the site. The public sewer discharges directly into the Crane Well Dike and currently serves the neighbouring housing estate to the west of the proposed development.
- 1.5.3 The controlled discharge will minimise the effect on any increase in flood water levels within the Crane Well Dike and active flood plain downstream. A 5L/s discharge is the minimum recommended to minimise blockages within the flow control manhole.

1.6 Residual Risks

- 1.6.1 It is inevitable that rare and extreme rainfall events will involve volumes of water that exceed the design standard of the surface water drainage which will lead to temporary surface ponding around the site. The final site levels proposed dwellings will be fixed so that in extreme conditions surface water flows away from them towards low lying landscaping. This will ensure to reduce the flood risk to the development during extreme rainfall events.
- 1.6.2 In extreme events it is possible the River Dearne and Crane Well Dike may overtop their banks. The topography of the wider surrounding is low lying this will act to dissipate the flood waters over large lower lying areas. The flood water will both spread and rise slowly allowing for warnings to be received and action taken. It is to be noted the Southern bank of the river Dearne is lower and land to both banks of the River act as the functional flood plain. With the Southern bank being lower than the embankments the southern bank would overtop first.
- 1.6.3 Access to the proposed development will be via Lowfield Farm Close. Should flooding of the area surrounding the site occur, access and egress of the site should remain available to allow evacuation from the site to higher land in Bolton upon Dearne should it be necessary.
- 1.6.4 In the event of flooding preventing the access or egress from the site then refuge should be taken on the first floor of the dwelling.
- 1.6.5 The proposed development should be registered with the Environment Agency Flood Warning Scheme.
- 1.6.6 The residual risks should be managed by the designers and the construction team for the development, who should ensure that its design and construction incorporates the more detailed points and recommendations contained within this assessment.

1.7 Conclusion

- 1.7.1 This report has identified that the main flood risk to the development is from overtopping of the River Dearne's North bank flood defences or overtopping arising from the Crane Well Dike watercourse. The defences of the area local to the site are rated as in 'Fair' and 'Good' condition according to the EA. The defences are monitored and maintained by the Environment Agency.
- 1.7.2 The finished floor levels of 17.6mAOD have been set 600mm above the lowest ground level and above the highest modelled 1 in 200 flood level within the River Dearne.
- 1.7.3 The Flood Risk Assessment concludes that the proposed development is appropriate for this location.

2 INTRODUCTION

This report aims to assess the risk of flooding for the development of a residential site located at Lowfield Farm, Lowfield Road, Bolton upon Dearne, Rotherham.

The assessment has been undertaken in accordance with the National Planning Policy Framework (NPPF). It has used information of the existing topography, existing surface water drainage systems, and historical flood records

Relevant information was also sought from the local authority, Environment Agency (EA) and the Shiregroup of IDB's. Possible sources of flooding will be identified and a careful evaluation will be carried out to determine the level of risk they each pose to the development. The effect of climate change will also be taken into consideration, as well as the off-site impact caused, if any, by the proposed development.

Should a risk of flooding be of significance, the report will aim to provide measures to minimise the impact upon the development throughout its design life, as well as the local area, and to protect against the threat to life.

3 DEVELOPMENT AND SITE LOCATION

3.1 Site Description

- 3.1.1 The development proposal is for a residential development. A detailed layout for the site is not yet available, however the total site area is 0.52Ha.
- 3.1.2 The proposed development site is a former farm yard comprising various agricultural buildings which have been demolished.
- 3.1.3 The site is accessed via a public road to the west of the development.
- 3.1.4 The general levels of the site range from 20.7 to 16.6 metres Above Ordnance Datum (mAOD). The topography varies across the site, but there is a general fall in the north east direction. The lowest level of the site is located to the north east corner of the proposed development plot (see Existing Levels Plan in **Appendix B**).

3.2 Site Location

- 3.2.1 The site is located on Lowfield Road , Bolton upon Dearne, some 10 km north east from the centre of Rotherham (see site location plan in **Appendix C**). The development site is within Barsley Metropolitan Borough Council (BMBC). The proposed development is bounded by residential properties and agricultural farm land. The Ordnance Survey grid reference for the site is 446094E, 402622N (see Site Location Plan in **Appendix C**).

3.3 Classification of Vulnerability

- 3.3.1 Table 2 of the Technical guidance to the NPPF, the classification of the proposed development is in the 'More Vulnerable' category.

3.4 Flood Zone Classification

- 3.4.1 The Environment Agency's flood map (see Environment Agency information in **Appendix D**), the development site is located within Flood Zone 2: Medium Risk (Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.)
- 3.4.2 Barnsley and Rotherham Council's Strategic Flood Risk Assessment locates the development within Flood Zone 1 for the majority of the site: Low Risk (Land having a less than 1 in 1,000 annual probability of river or sea flooding.) with the northern end of the site in Flood Zone 2. (Refer to **Appendix E**)

3.5 Local Development Plan

- 3.5.1 The site is located within a residential area of Bolton upon Dearne, and is located to the side of a small housing estate to the Eastern side of Bolton upon Dearne.
- 3.5.2 The site is currently considered to be developed as the site is considered as brown field having previously being the site of a former farm yard with associated agricultural buildings which have been demolished.
- 3.5.3 RMBC's Local Development Framework (LDF): Core Strategy document, makes clear that there is a growing demand for housing development, but that RMBC is aiming to minimise loss of countryside and take advantage of sustainable locations.
- 3.5.4 The development site is not located within a 'Housing Allocation' area, although as in fill development is considered to be consistent with the aims of Barnsley Council LDF.

3.6 Sequential and Exceptions Test

- 3.6.1 The development proposed is for the construction of residential dwellings. The development is categorised as 'More Vulnerable'.
- 3.6.2 The Environment Agency categorise the site within Flood Zone 2 as such Table 3 of the Technical Guidance to the NPPF a Sequential Test and Exceptions Test are not required.
- 3.6.3 The Eastern edges of Bolton upon Dearne are largely located in Flood Zone 2, with limited areas located in lower flood zone categories.
- 3.6.4 The development site is located to the East of Bolton upon Dearne and would be a benefit to the local area by adding additional housing, whilst also providing additional customers for the local economy. It is considered that the proposed development meets the requirements of the Exceptions Test.

4 DEFINITION OF THE FLOOD HAZARD

The sources of flooding that could potentially affect the site are; -

- Flooding from water courses
 - The River Dearne
 - The Crane Will Dike
- Flooding from land
- Flooding from sewers
- Flooding from ground water

4.1 The River Dearne

- 4.1.1 It is considered that fluvial flooding represents the worst case scenario rather than tidal flooding, and therefore fluvial flooding is considered over tidal flooding.
- 4.1.2 The development site is located some 500m to the North of the River Dearne at its nearest point. Bolton upon Dearne falls within the River Dearne catchment. The River Dearne has raised flood defences that protect large areas of low lying land in Bolton upon Dearne. The defences located closest to the site are recorded in the asset tables as being in condition grade 2 - 3 (Good - fair condition). The defences are mainly of earth embankments that provide protection for a 1 in 50 year storm event which does not meet the national standard.
- 4.1.3 The EA information (**Appendix D**) also included modelled water level results for various defended storm events of the River Dearne. Table 1 below details a summary of the information most relevant to the site.

Table 1; Defended modelled results of the River Dearne at the points closest to the site, and associated asset information.

Node Point	Asset ID	South Bank level (mAOD)	North Bank level (mAOD)	100YR Level (mAOD)	150YR Level (mAOD)	200YR Level (mAOD)
DRN01_5795	214728	16.260	15.850	16.03	16.49	16.95
DRN01_5544	214008	14.650	15.275	15.95	16.39	16.87
DRN01_5292		14.080	14.024	15.92	16.37	16.85

- 4.1.4 The sample data of the Environment Agency's modelled results of the River Dearne, for a 1 in 200 year storm event the risk of overtopping is high.
- 4.1.5 In the event the River Dearne overtops, the flood water would initially overtop the lower South bank, and the natural gradient of the land would result in water spreading in an Easterly direction across agricultural fields within the Flood Storage Areas. If river levels continue to rise the embankments on the north bank would overtop causing the functional flood plane to flood. Due to the topography of the agricultural land the water would spread in an easterly direction.

4.2 The Crane Well Dike

- 4.2.1 The Crane Well Dike is situated some 190m to the proposed development site at its closest point.
- 4.2.2 The dike forms part of the drainage ditch network in the interests of the Shires IDB, predominantly the Danvm Drainage Commission.
- 4.2.3 The Crane Well Dike is recorded to have flooded in 2007. This is likely to have been caused by the River Dearne over topping its defences at the same time and the ensuing flood enveloping the flood plain.
- 4.2.4 Crane Well Dike is considered as tertiary by the Danvm Drainage Commission. Therefore it is not considered as imperative to the drainage of the surrounding agricultural land, as such maintenance may only take place every 5 years.
- 4.2.5 The Crane Well Dike is unlikely to pose a direct risk to the development.

4.3 Flooding from Land

- 4.3.1 The topography of the surrounding land uphill of the development to the south west has a shallow fall in an easterly direction. The gradient on site is around 1 in 22 towards the north east corner of the site. Surface water flooding is likely to be contained within the highways and channelled into the local sewer network.
- 4.3.2 It is considered flooding from land is unlikely.

4.4 Flooding from Sewers

- 4.4.1 Existing Foul water sewers are located within Lowfield Farm Close at a depth of approximately 1.25m. (Refer to **Appendix F** for sewer plans and **Appendix B** for levels). The relative invert level would be around 18.94mAOD with cover level of 20.19mAOD. The foul water sewer connects to an existing combined sewer on the north side of the site with a depth of circa 2.1m within the Lowfield Farm Close. The combined sewer has an invert level of 18.68m within the road. Should the foul water sewer flood, overland flows would travel in a northerly direction towards the farm land. The proposed development should ensure the ground levels generally fall away from the dwellings to prevent localised sewers from flooding.

- 4.4.2 An existing surface water public sewer is present within Lowfield Farm Close, which then follows the western boundary of the site and discharges into the Crane Well Dike to the north via a headwall. The drainage within Lowfield Road consist of 900mm diameter pipes, whereby the sewers reduce to 225mm diameter at the corner of the existing turning head. Typically this would indicate attenuation has been provided for the adjacent development and the manhole where the pipe sizes reduce would contain a flow control device. Should the surface water sewer flood, overland flows would travel in a northerly direction towards the farm land and Crane Well Dike. The proposed development should ensure the ground levels generally fall away from the dwellings to prevent localised sewers from flooding.
- 4.4.3 The risk of sewer flooding is considered to be low.

4.5 Flooding from Ground Water

- 4.5.1 There are no known records of ground water flooding in the vicinity of the site.
- 4.5.2 The BGS confidence rating for the area is generally low.

5 THE PROBABILITY OF FLOODING

5.1 Probability of Flooding

- 5.1.1 According to the Environment Agency and Barnsley / Rotherham Strategic Flood Risk Assessment flood maps the site is located mostly within Flood Zone 2: Medium Risk (Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.)
- 5.1.2 The Environment Agency's response details there is one known historical flood event of the site, which occurred in 2007. The extent of flooding is shown to cover at least half of the development site. Based on the topographic survey levels this is thought to represent a flood level of 19.0m AOD.
- 5.1.3 Additional OS terrain levels were obtained for the larger area. The general ground levels fall to the north towards Crane Well Dike at around 1 in 20 to 1 in 30 gradient. From a comparison between the EA flood history map and OS terrain levels the flood levels appear to vary between 19m AOD and 16m AOD across the development site and the upstream end of Crane Well Dike (Refer to **Appendix B dwg 1714-SK1**). Due to the steep nature of the topography it is unlikely the flooding on site is the result of an extreme water level, but due to local shallow flood water as a result of water logged ground. It is known flood maps can vary in accuracy and based on the more detailed information the extent of the flood zone 2 boundary is expected to be closer to the north end of the proposed development than indicated.
- 5.1.4 The highest modelled flood level at chainage 5795 in the River Dearne closest to the site is 16.95m AOD for a 1 in 200 year event. At this level only the very end of the site would be affected by flooding, which would support the flood zone 2 extents in the SFRA's. Therefore, it is proposed to raise the finished floor levels 600mm above the lowest ground level and modelled flood level to give a minimum FFL of 17.6m AOD to allow for future increase in flood levels due to climate change above the 1 in 200 year model data.
- 5.1.5 From the river monitoring station at Adwick the maximum flood level in 2007 was 15.1m AOD. The EA modelled River level at change 3836U for a 1 in 150 year event is 14.9m AOD.
- 5.1.6 From the river monitoring station upstream of Bolton Bridge the maximum flood level in 2007 was 17.88m AOD. The EA modelled River level at change 6014U for a 1 in 150 year event is 18.1m AOD. The flood level upstream of Bolton Bridge would be expected to be at a higher level due to the weir at this location, plus the raised topography upstream and the viaduct presents a barrier to throttle to the flood water. At chainage 5795 adjacent to the sewage treatment works the 1 in 150 water level is 16.49m AOD, which confirms the reduction in water level downstream of the Bridge. Therefore a minimum floor level of 17.6m AOD would appear reasonable in comparison with this information.
- 5.1.7 The River Dearne's flood defences local to Burton upon Dearne do not meet the required national standard for the predicted 1 in 100 year storm event. The defences nearest to the site are recorded in the asset tables as being in condition grade 2 and 3 (good to fair condition).

- 5.1.8 Should overtopping occur it is likely to be over the South bank which is at a lower crest level than the Northern bank, which will enable flood water to enter into a functional flood plain away from the site. However, should river levels continue to rise the river would overtop the flood defence embankment on the Northern bank, which will enable flood water to enter a functional flood plane to the East of the proposed development.
- 5.1.9 It is considered likely that overtopping of the Crane Well Dike will occur during extreme events.
- 5.1.10 Should particularly high rainfall intensities take place, surface water ponding may occur in the vicinity of the site. Flood waters would be slow and gradual, surface water ponding would be for a short period and is not seen to be a significant risk to the development.

5.2 Surface and Foul Water Discharge

- 5.2.1 There are no buildings remaining on the site. The location and condition of any remaining drainage systems on site from the demolished buildings is unknown at this time.
- 5.2.2 The development is for new residential properties. There is no detailed scheme for the site at this time.
- 5.2.3 It is recommended that the surface water discharge from the site be via soakaways and other infiltration systems where possible. However, the prevailing ground conditions are thought to be sandy Clays of low permeability. Should infiltration systems not be viable for the site following testing, the surface water should be attenuated within the site and discharged at a controlled rate of 5L/s (or as agreed with Yorkshire Water, the IDB and local water authority) into a public sewer manhole to the north of the site. The public sewer discharges directly into the Crane Well Dike and currently serves the neighbouring housing estate to the west of the proposed development.
- 5.2.4 The connection manhole has a cover level of 17.34mAOD and an invert of 16.40mAOD. The outlet from the manhole is a 225mm diameter clay sewer. Based on the topography a gravity system is possible to connect to the sewer. The minimum recommended FFL is 17.6mAOD, however to contain the attenuation within the site and to have a gravity connection it is probable the site levels would have to be a minimum of 18.5mAOD, which would result in filling on the northern part of the development by up to 1m. At detailed design stage this will be assessed in more detail once a scheme has been developed.
- 5.2.5 Assuming 45% of the gross site is impermeable this would generate an area of 2340m² to be drained. With a discharge of 5L/s up to a 1 in 100 year event plus 30% climate change the approximate storage required would be in the order of 90m³. A full detailed assessment will be required to determine where and how this storage is to be provided.

- 5.2.6 In respect of the foul water connection a sewer is located within Lowfield Farm Close at a depth of approximately 1.25m. The relative invert level would be around 18.94mAOD with cover level of 20.19mAOD. The foul water sewer connects to an existing combined sewer on the north side of the site with a depth of circa 2.1m within the Lowfield Farm Close. The combined sewer has an invert level of 18.68m within the road. Based on typical gradients and the distance across the site the highest invert level of the drains at the north end of the development would be around a level of 19.8 – 20.2mAOD for a gravity system to be viable. As this would require the site to be raised by around 3m at the north end it is assumed an adoptable pumping station will be required. The minimum cover level for the pumping station (private or public) would also need to be 17.6mAOD to protect the compound from flooding.

6 CLIMATE CHANGE AFFECT

- 6.1.1 National Planning Policy Framework (Technical Guidance) (NPPF-TG) Table 5 suggests that a 20% increase in peak river flows will result from climate change in the period to 2115. The design model data provided is up to a 1 in 200 year event which estimates flooding to 2190, thus takes into account climate change beyond the required 2115 period.
- 6.1.2 A further 600mm allowance above the maximum predicted flood level provides increased allowance for future climate change and increase in peak river levels. This provides a minimum floor level of 17.6mAOD.
- 6.1.3 NPPF-TG suggests that a 30% increase in rainfall intensity will result from climate change in the period to 2115. Levels should be fixed so surfaces fall away from buildings or dwellings and any temporary surface water ponding does not pose a risk of flooding adjacent to the other nearby buildings. It is likely that Doncaster Council Drainage Team with Yorkshire Water will continue to monitor the Surface Water drainage network to mitigate any surface water flooding that may occur as a result. Whilst continual improvements to the land drainage systems and Crane Well Dike will be undertaken by the Danvm Drainage Commission (IDB).

7 FLOOD RISK MEASURES

- 7.1.1 The proposed development is deemed to be in the 'More Vulnerable' category of NPPF Table 2. Therefore flood resilient construction in the lower parts of the dwellings should be considered where appropriate, in accordance with the document "Improving the Flood Performance of New Buildings – Flood Resilient Construction" (ISBN 9781 85946 2874).
- 7.1.2 Such measures may include:-
- (a) All services to be routed in the ceiling void and brought down walls to terminate at least 0.6m above floor level.
 - (b) Water sensitive apparatus such as boilers, water heaters and their controllers, to be mounted at least 1.2m above ground floor level.
 - (c) Ground floor construction to be solid concrete slab with floor insulation to be water resistant.

(d) Wall insulation to be of a closed cell water resistant material up to at least 900mm above ground floor level.

(e) If brickwork is proposed, then up to at least 0.6m above ground floor level should be of a low porosity (e.g. engineering brick) in order to minimise water absorption.

(f) Where possible chipboard and Medium Density Fibreboard should be avoided within 900mm of ground floor level.

(g) Openings in walls are to be minimised below 900mm above floor level.

(h) The dwelling should be registered on the Environment Agency's Flood Warning scheme.

(i) The finished floor level (FFL) of the proposed dwellings is to be a minimum of 17.60 mAOD. This level will provide a minimum flood resilience of at least 600mm above the existing ground levels and the maximum 1 in 200 year flood level.

The above minimum floor level and construction details will ensure that flood risk at the site arising from the identified sources of flooding is minimized during the lifetime of the dwellings.

8 OFF SITE IMPACTS

8.1 Increase of Flood Risk Elsewhere

- 8.1.1 The development proposal will increase the impermeable area of the total site, managed this will have negligible impact upon areas elsewhere.

8.2 Management of Remaining Risks Over Lifetime of Development

- 8.2.1 At present the condition or location of any remaining drainage systems from the demolished buildings is unknown.
- 8.2.2 The proposed development should include a drainage design that incorporates Sustainable Drainage Systems (SuDs) where practical. Should infiltration structures not be viable, discharge into the Crane Well Dike is possible via a public sewer. The peak rate of 5L/s with on-site attenuation will need to be confirmed with Yorkshire Water, the IDB and LLFA as required. Such consideration will serve to reduce impact of the development upon the local area.
- 8.2.3 The new surface water sewers and attenuation storage is expected to be offered for adoption by Yorkshire Water. Thereby the drainage system will be maintained over the life of the development by a statutory authority. Should the system remain in private ownership a management company will be set up to maintain the system for the life of the development.

9 RESIDUAL RISKS

9.1 Remaining Flood Risks After Implementation of Protection measures

- 9.1.1 It is inevitable that rare and extreme rainfall events will involve volumes of water that exceed the design standard of the surface water drainage which will lead to temporary surface ponding around the site. The final site levels of the proposed dwelling will be fixed so that in extreme conditions surface water flows away from them towards low lying landscaping. This will ensure to reduce the flood risk to the development during extreme rainfall events.
- 9.1.2 In extreme events it is possible The River Dearne and Crane Well Dike may overtop its banks. The topography of the wider surrounding land rises from the River Dearne and Crane Well Dike towards the site. This will cause flood water to dissipate over large lower lying areas. The flood water will both spread and rise slowly allowing for warnings to be received and the necessary action taken.
- 9.1.3 Access to the proposed development will be via Lowfield Farm Close. Should flooding of the area surrounding the site occur, access and egress of the site should remain available to allow evacuation from the site to higher land in Bolton upon Dearne should it be necessary
- 9.1.4 Should the access or egress from the site not be possible then refuge should be made available on the first floor of any proposed dwellings.

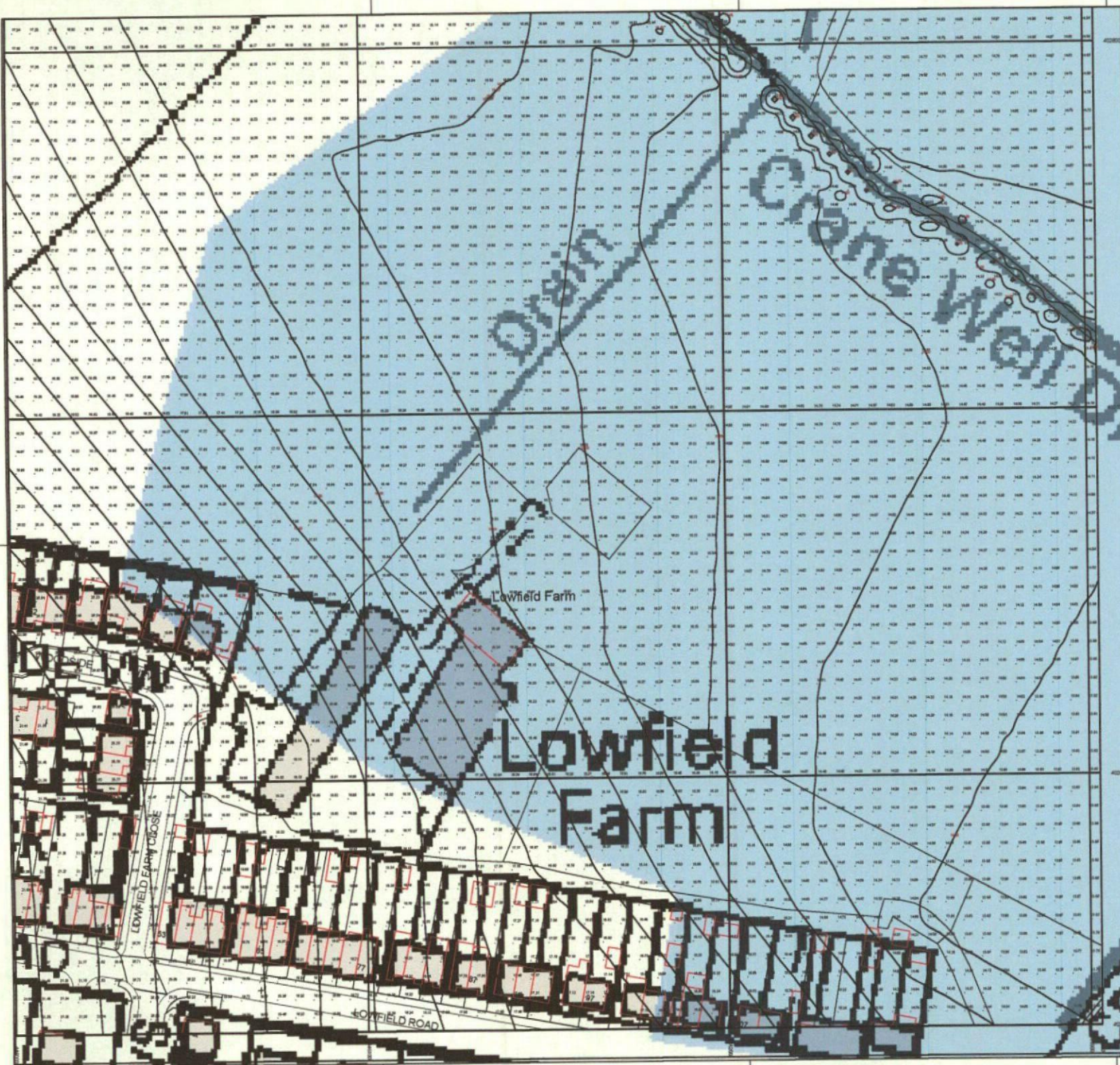
9.2 Management of Remaining Risks Over the Lifetime of Development

- 9.2.1 The residual risk should be managed by the designers and the construction team for the development, who should ensure that its design and construction incorporates the points and recommendations contained within this assessment.
- 9.2.2 The development should be registered for automated flood warnings from the Environment Agency as soon as the development is in use.

APPENDIX A – Proposed Site Layout

NOT CURRENTLY AVAILABLE

APPENDIX B – Existing Site Levels



NOTES

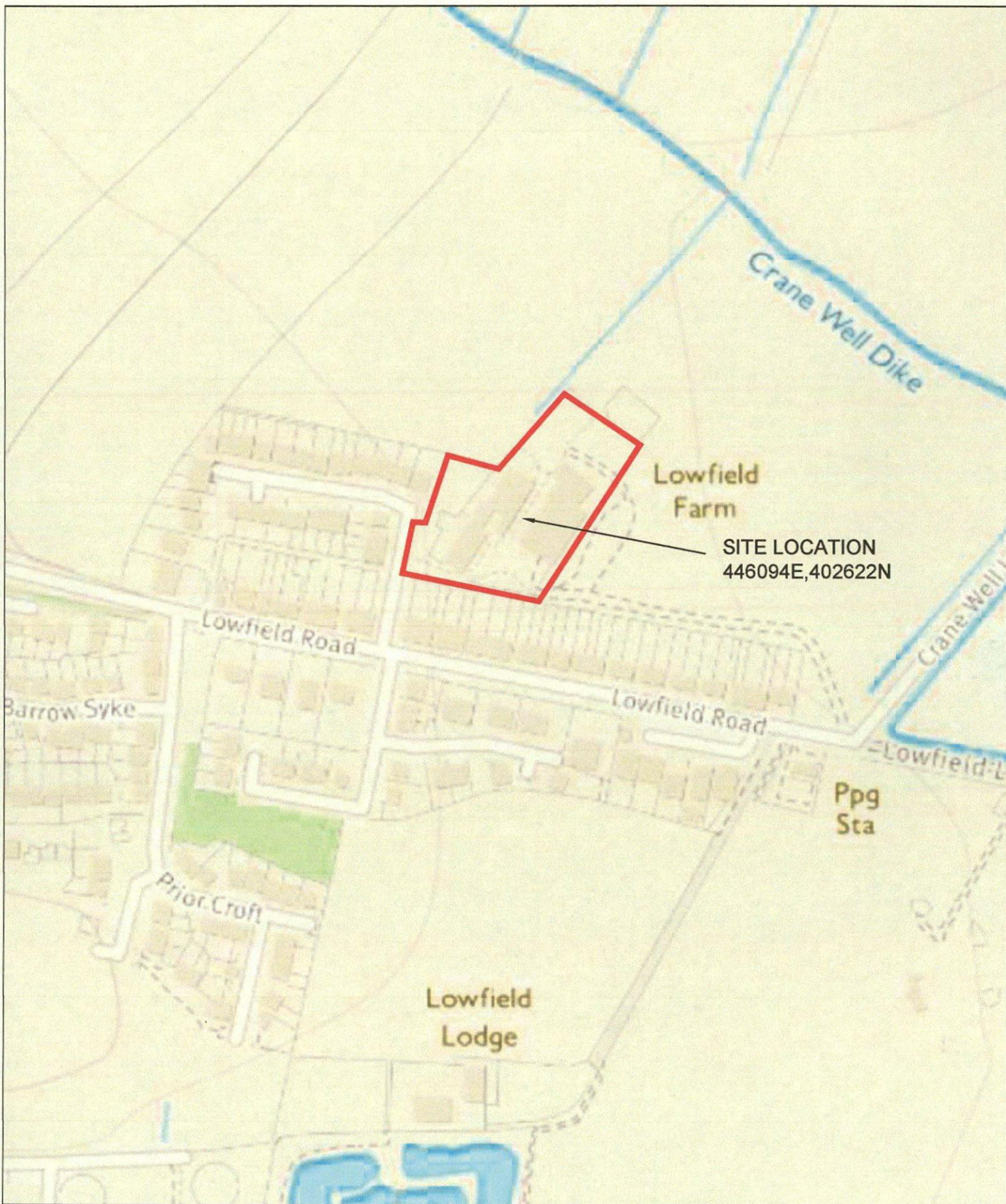
1. DO NOT SCALE - Use figured dimensions only.
2. All dimensions shown are in millimetres unless otherwise stated.
3. The Contractor is to verify all dimensions on site before commencing work or preparing shop drawings.
4. This drawing is to be read in conjunction with all Engineers and Architects drawings and specifications.

Series number: 148734

© Crown copyright and database right 2018
Ordnance Survey licence 100048607
Reproduction in whole or in part is prohibited
without the prior permission of Ordnance Survey

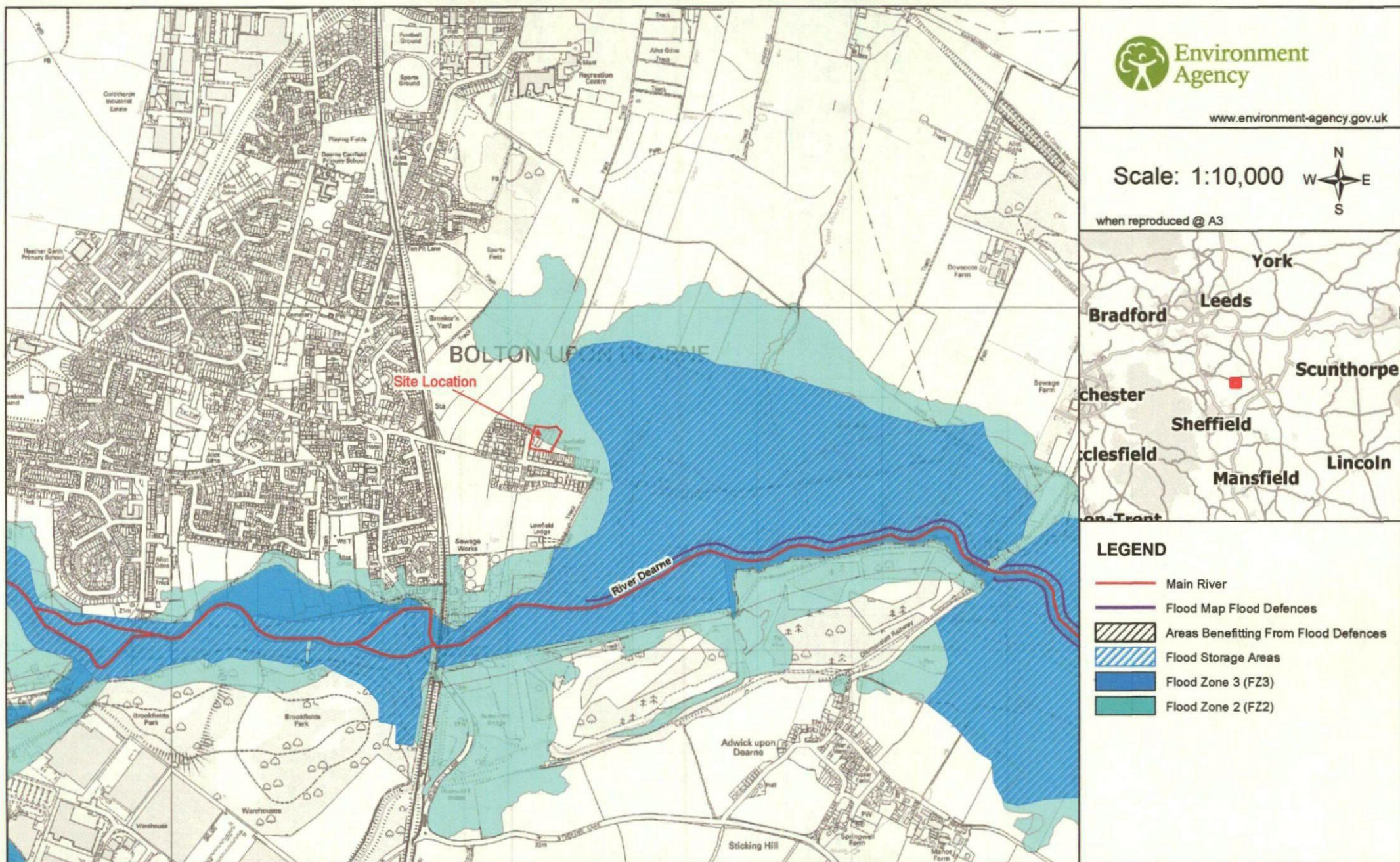
P1	PRELIMINARY ISSUE	JR	28.08.18		
Rev	Description	Dr	Ch	Date	
Client	Mr D White				
Project	Lowfield Farm, Lowfield Road Rotherham				
Title	Flood History Plan Overlay onto OS Level Data				
J ROBERTS DESIGN LTD		Sheet Size	A1	Scale	1:500
Tel: 01709 917154		Drawn	None	Drawing Number	1714-SK1
www.jrobertsdesign.co.uk		Checked		Rev	P1
		Approved			

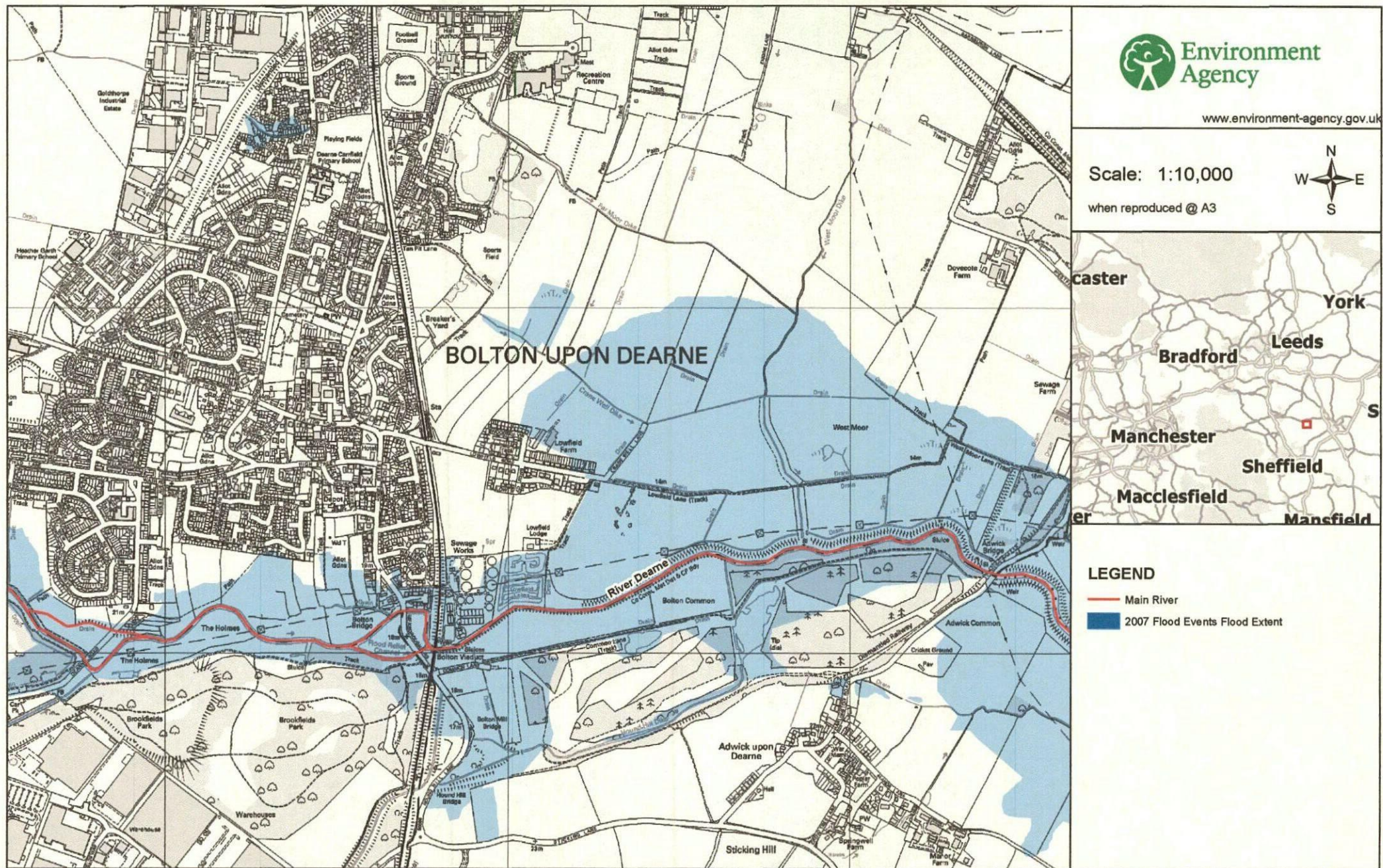
APPENDIX C – Site Location Plan

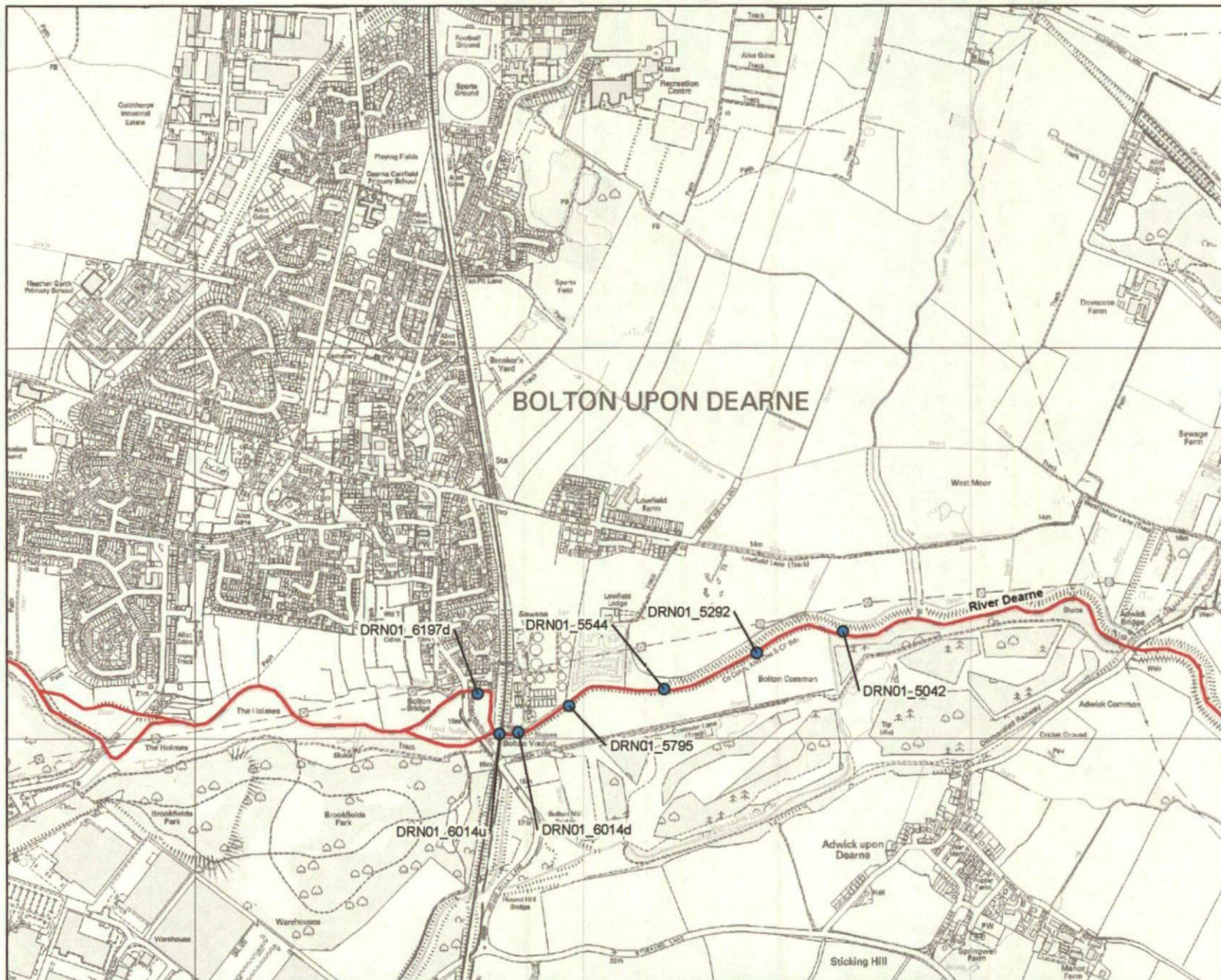


SITE LOCATION PLAN
SCALE 1:2500

APPENDIX D – Environment Agency Information







www.environment-agency.gov.uk

Scale: 1:10,000



when reproduced @ A3



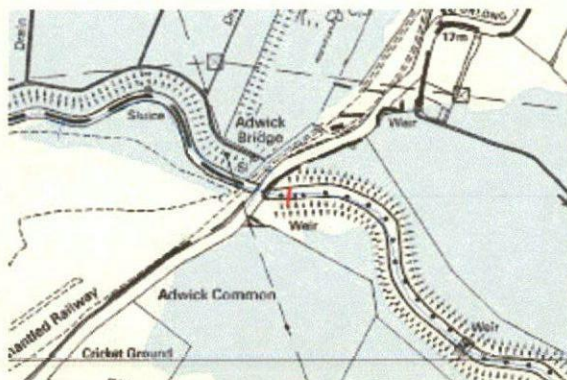
LEGEND

- Node Points selection
- Main River

River Don Results:

	25		50		75		100		150		200	
Node Label	Flow (m ³ /s)	Stage (mAOD)	Flow (m ³ /s)	Stage (mAOD)	Flow (m ³ /s)	Stage (mAOD)	Flow (m ³ /s)	Stage (mAOD)	Flow (m ³ /s)	Stage (mAOD)	Flow (m ³ /s)	Stage (mAOD)
DRN01_6197d	47.23	17.44	50.99	17.53	58.09	17.69	68.73	17.92	84.11	18.29	93.15	18.54
DRN01_6014u	47.22	17.29	51.94	17.39	58.38	17.53	68.72	17.74	84.11	18.12	93.14	18.37
DRN01_6014d	71.08	15.75	77.27	15.82	87.15	15.92	103.07	16.07	134.34	16.37	157.60	17.20
DRN01_5795	71.08	15.52	77.27	15.58	87.15	15.65	103.06	16.03	136.54	16.49	160.06	16.95
DRN01_5544	64.47	15.48	66.91	15.55	70.78	15.65	82.92	15.95	114.93	16.39	135.90	16.87
DRN01_5292	64.28	15.45	66.61	15.52	70.56	15.61	82.78	15.92	108.87	16.37	134.44	16.85
DRN01_5042	64.14	15.33	66.52	15.40	70.52	15.50	82.70	15.82	105.18	16.29	133.01	16.80

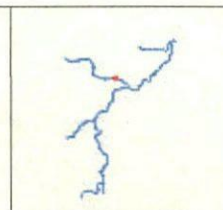
Location Plan



© Crown Copyright. All rights reserved. Environment Agency, 100020380, 2004

Cross Section References

River: DRN
Reach: 01
Chainage: 4168
Section Type: SECTION
OS NGR: SE 47455 02220
Survey Dwg Ref: N/A
Photograph Ref: DEAR_04168.JPG

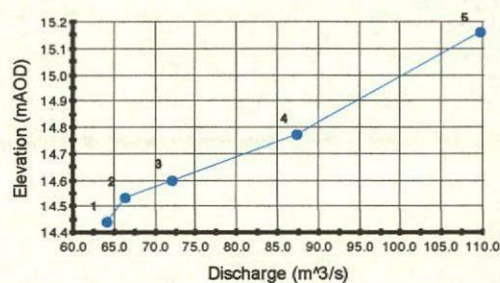


Next

Section D/s: 4035
Section U/s: 4210U



Rating Curve



Number represents model profile number

Summary of Results

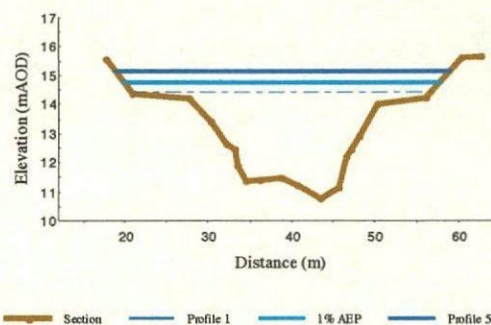
Profile No	AEP (%)	Flow (m³/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	64.1	14.442	1.20
2	2.00	66.4	14.537	1.22
3	1.33	72.1	14.601	1.26
4	1.00	87.2	14.775	1.29
5	0.67	109.5	15.160	1.32

Level of Left Bank 15.570 mAOD

Level of Right Bank 15.630 mAOD

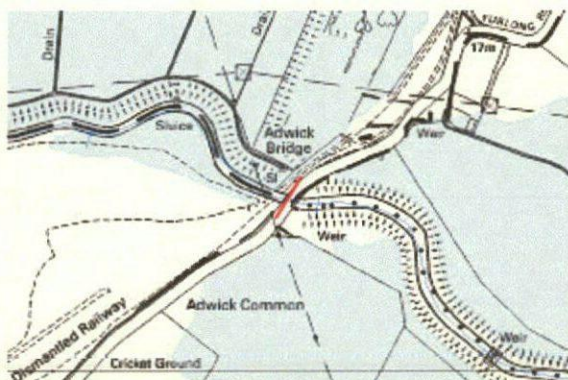
AEP: Annual Exceedance Probability = $1/T$, where T = Return Period (Years)

Cross Section Profile



DRN:01: CROSS SECTION NUMBER 4168

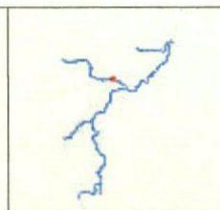
Location Plan



© Crown Copyright. All rights reserved. Environment Agency, 100020300, 2004

Cross Section References

River: DRN
Reach: 01
Chainage: 4210U
Section Type: BRIDGE, SECTION
OS NGR: SE 47416 02232
Survey Dwg Ref: N/A
Photograph Ref: DEAR_04210.JPG

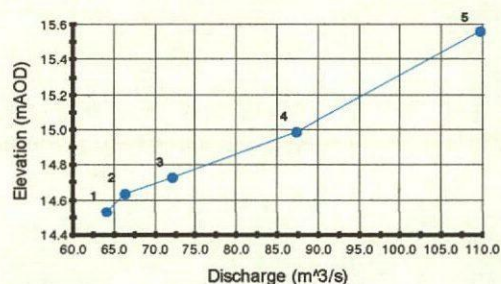


Next

Section D/s: 4168
Section U/s: 4539



Rating Curve



Number represents model profile number

Summary of Results

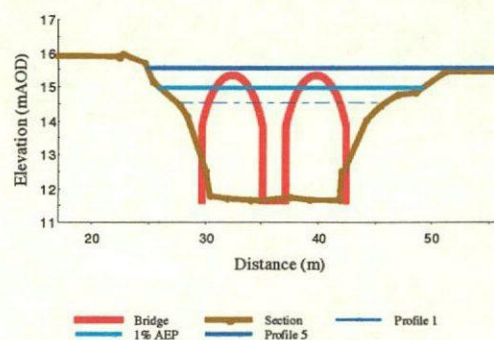
Profile No	AEP (%)	Flow (m³/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	64.1	14.537	1.66
2	2.00	66.4	14.640	1.69
3	1.33	72.1	14.733	1.72
4	1.00	87.2	14.991	1.76
5	0.67	109.5	15.559	1.78

Level of Left Bank 15.980 mAOD

Level of Right Bank 15.450 mAOD

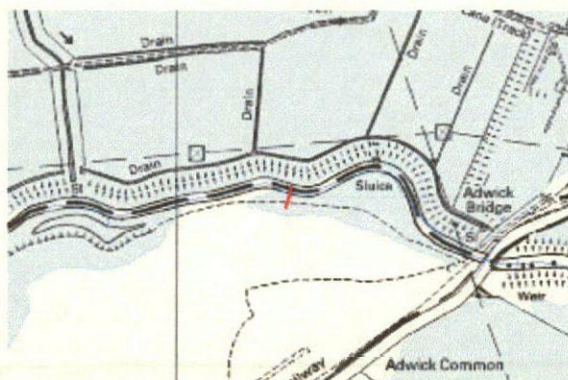
AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

Cross Section Profile



DRN: 01: CROSS SECTION NUMBER 4210U

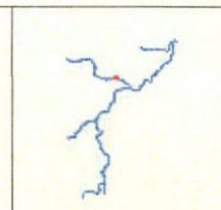
Location Plan



© Crown Copyright. All rights reserved. Environment Agency, 100000380, 2004

Cross Section References

River: DRN
Reach: 01
Chainage: 4539
Section Type: SECTION
OS NGR: SE 47150 02313
Survey Dwg Ref: N/A
Photograph Ref: DEAR_04539.JPG

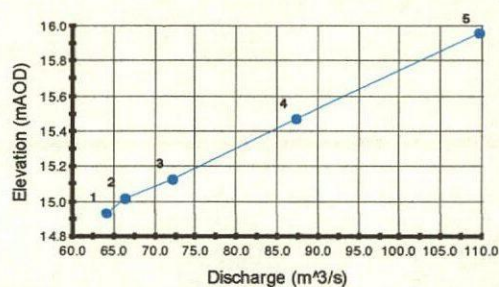


Next

Section D/s: 4210U
Section U/s: 4789U



Rating Curve



Number represents model profile number

Summary of Results

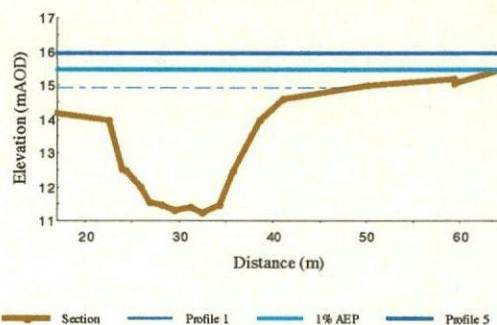
Profile No	AEP (%)	Flow (m³/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	64.1	14.937	1.19
2	2.00	66.4	15.022	1.20
3	1.33	72.2	15.131	1.20
4	1.00	87.2	15.473	1.20
5	0.67	109.5	15.958	1.21

Level of Left Bank 13.980 mAOD

Level of Right Bank 15.066 mAOD

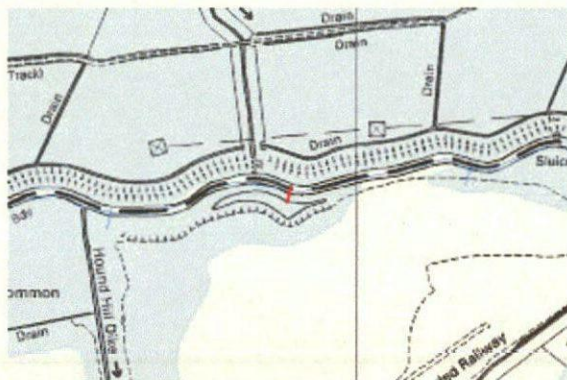
AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

Cross Section Profile



DRN: 01: CROSS SECTION NUMBER 4539

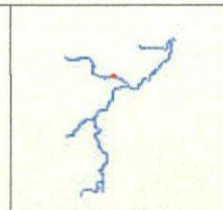
Location Plan



© Crown Copyright. All rights reserved. Environment Agency, 100020330, 2004

Cross Section References

River: DRN
Reach: 01
Chainage: 4789U
Section Type: SECTION
OS NGR: SE 46909 02284
Survey Dwg Ref: N/A
Photograph Ref: DEAR_04789.JPG

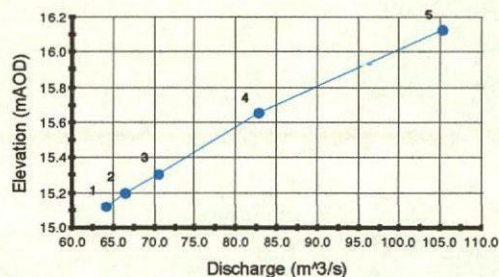


Next

Section D/s: 4539
Section U/s: 5042



Rating Curve



Number represents model profile number

Summary of Results

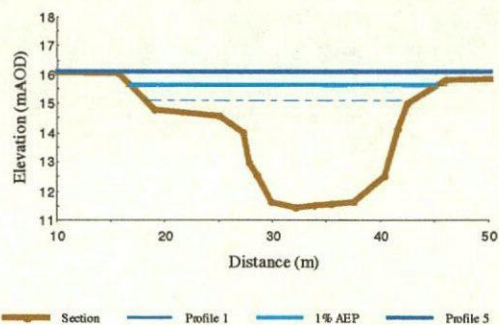
Profile No	AEP (%)	Flow (m³/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	64.1	15.124	1.27
2	2.00	66.5	15.203	1.28
3	1.33	70.5	15.310	1.28
4	1.00	82.7	15.658	1.28
5	0.67	105.1	16.127	1.29

Level of Left Bank 15.840 mAOD

Level of Right Bank 14.734 mAOD

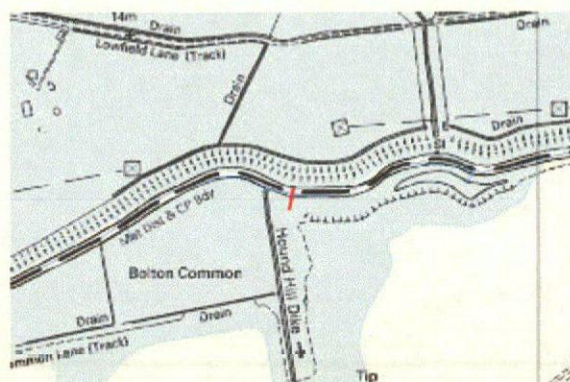
AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

Cross Section Profile



DRN: 01: CROSS SECTION NUMBER 4789U

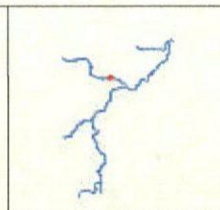
Location Plan



© Crown Copyright. All rights reserved. Environment Agency, 100020300, 2004

Cross Section References

River: DRN
Reach: 01
Chainage: 5042
Section Type: SECTION
OS NGR: SE 46669 02251
Survey Dwg Ref: N/A
Photograph Ref: DEAR_05042.JPG

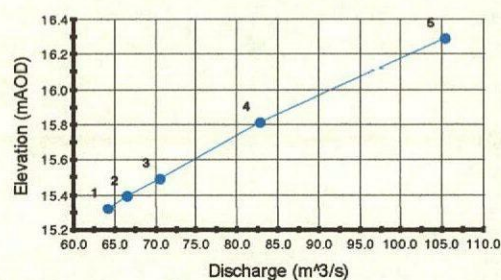


Next

Section D/s: 4789U
Section U/s: 5292



Rating Curve



Number represents model profile number

Summary of Results

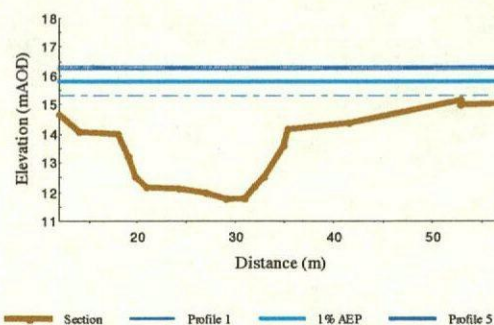
Profile No	AEP (%)	Flow (m³/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	64.1	15.326	0.95
2	2.00	66.5	15.400	0.96
3	1.33	70.5	15.499	0.96
4	1.00	82.7	15.818	0.96
5	0.67	105.2	16.292	0.96

Level of Left Bank 14.020 mAOD

Level of Right Bank 15.014 mAOD

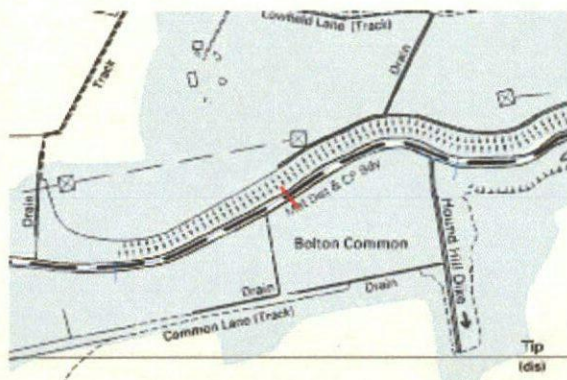
AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

Cross Section Profile



DRN: 01: CROSS SECTION NUMBER 5042

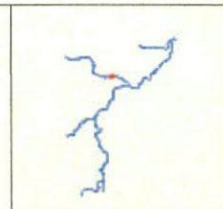
Location Plan



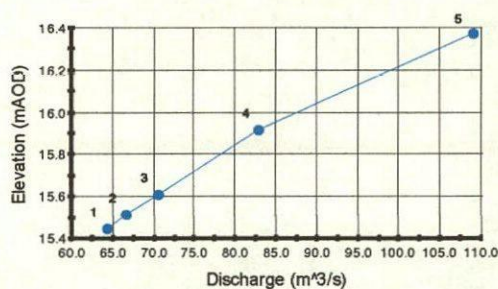
© Crown Copyright. All rights reserved. Environment Agency, 100020380, 2004

Cross Section References

River: DRN
Reach: 01
Chainage: 5292
Section Type: SECTION
OS NGR: SE 46446 02214
Survey Dwg Ref: N/A
Photograph Ref: DEAR_05292.JPG
Next
Section D/s: 5042
Section U/s: 5544



Rating Curve



Number represents model profile number

Summary of Results

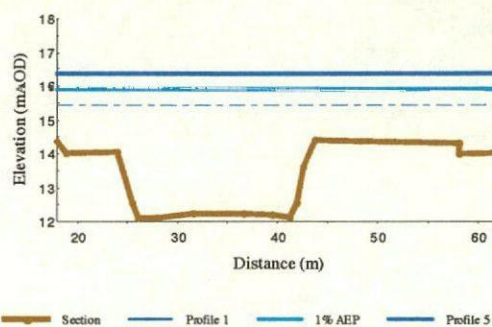
Profile No	AEP (%)	Flow (m³/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	64.3	15.450	0.74
2	2.00	66.6	15.519	0.74
3	1.33	70.6	15.614	0.74
4	1.00	82.8	15.919	0.74
5	0.67	108.9	16.372	0.74

Level of Left Bank 14.080 mAOD

Level of Right Bank 14.024 mAOD

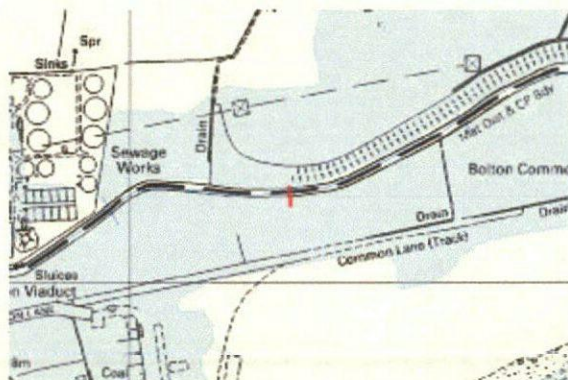
AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

Cross Section Profile



DRN: 01: CROSS SECTION NUMBER 5292

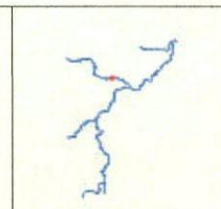
Location Plan



© Crown Copyright. All rights reserved. Environment Agency, 100020380, 2004

Cross Section References

River: DRN
Reach: 01
Chainage: 5544
Section Type: SECTION
OS NGR: SE 46213 02115
Survey Dwg Ref: N/A
Photograph Ref: DEAR_05544.JPG

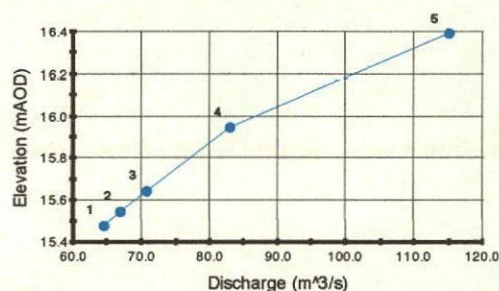


Next

Section D/s: 5292
Section U/s: 5795



Rating Curve



Number represents model profile number

Summary of Results

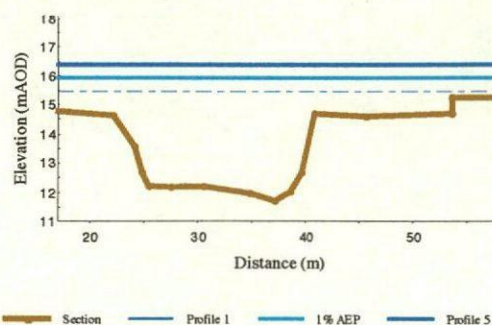
Profile No	AEP (%)	Flow (m³/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	64.5	15.481	0.97
2	2.00	66.9	15.550	0.98
3	1.33	70.8	15.647	0.99
4	1.00	82.9	15.948	1.00
5	0.67	114.9	16.391	1.01

Level of Left Bank 14.650 mAOD

Level of Right Bank 15.275 mAOD

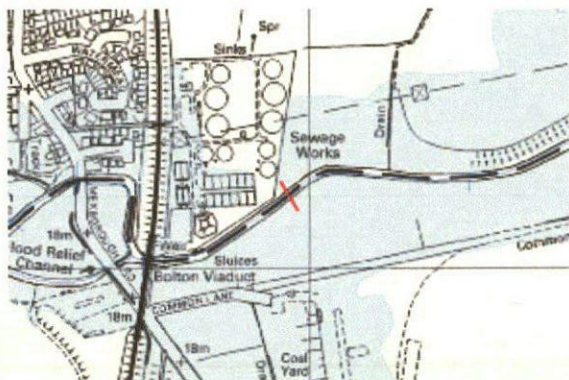
AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

Cross Section Profile



DRN: 01: CROSS SECTION NUMBER 5544

Location Plan



© Crown Copyright. All rights reserved. Environment Agency, 100020380, 2004

Cross Section References

River: DRN
Reach: 01
Chainage: 5795
Section Type: SECTION
OS NGR: SE 45973 02096
Survey Dwg Ref: N/A
Photograph Ref: DEAR_05795.JPG

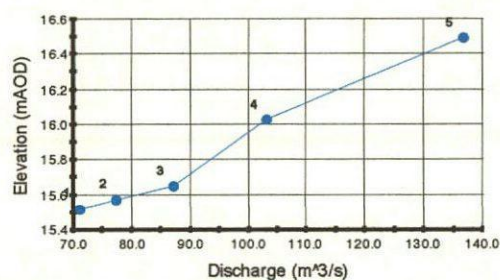


Next

Section D/s: 5544
Section U/s: 6014U



Rating Curve



Number represents model profile number

Summary of Results

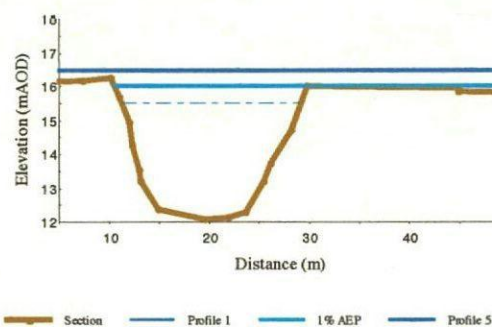
Profile No	AEP (%)	Flow (m³/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	71.1	15.521	1.57
2	2.00	77.3	15.576	1.65
3	1.33	87.2	15.654	1.78
4	1.00	103.1	16.031	1.89
5	0.67	136.5	16.493	1.90

Level of Left Bank 16.260 mAOD

Level of Right Bank 15.850 mAOD

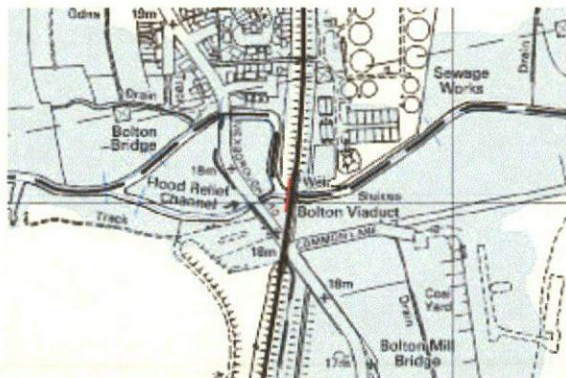
AEP: Annual Exceedance Probability = $1/T$, where T = Return Period (Years)

Cross Section Profile



DRN: 01: CROSS SECTION NUMBER 5795

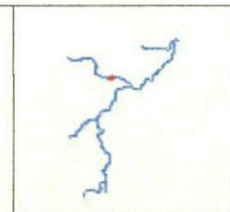
Location Plan



© Crown Copyright. All rights reserved. Environment Agency, 100020580, 2004

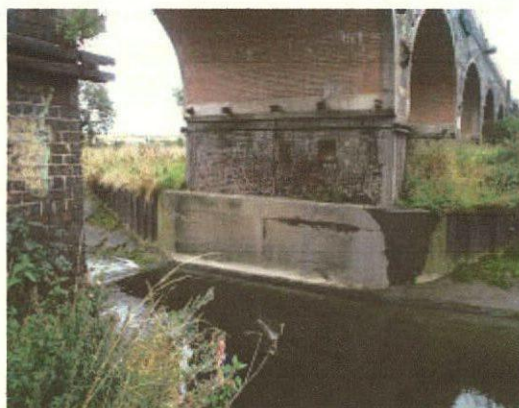
Cross Section References

River: DRN
Reach: 01
Chainage: 6014U
Section Type: SECTION
OS NGR: SE 45780 02011
Survey Dwg Ref: N/A
Photograph Ref: DEAR_06014.JPG

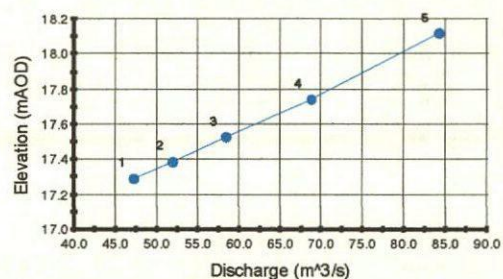


Next

Section D/s: 5795
Section U/s: 6197U



Rating Curve



Number represents model profile number

Summary of Results

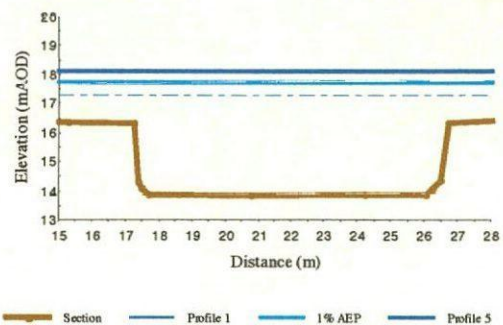
Profile No	AEP (%)	Flow (m³/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	47.2	17.295	0.96
2	2.00	51.9	17.390	0.96
3	1.33	58.4	17.532	0.96
4	1.00	68.7	17.744	0.96
5	0.67	84.1	18.117	0.96

Level of Left Bank 16.332 mAOD

Level of Right Bank 16.342 mAOD

AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

Cross Section Profile



DRN: 01: CROSS SECTION NUMBER 6014U



www.environment-agency.gov.uk

Scale: 1:10,000



when reproduced @ A3



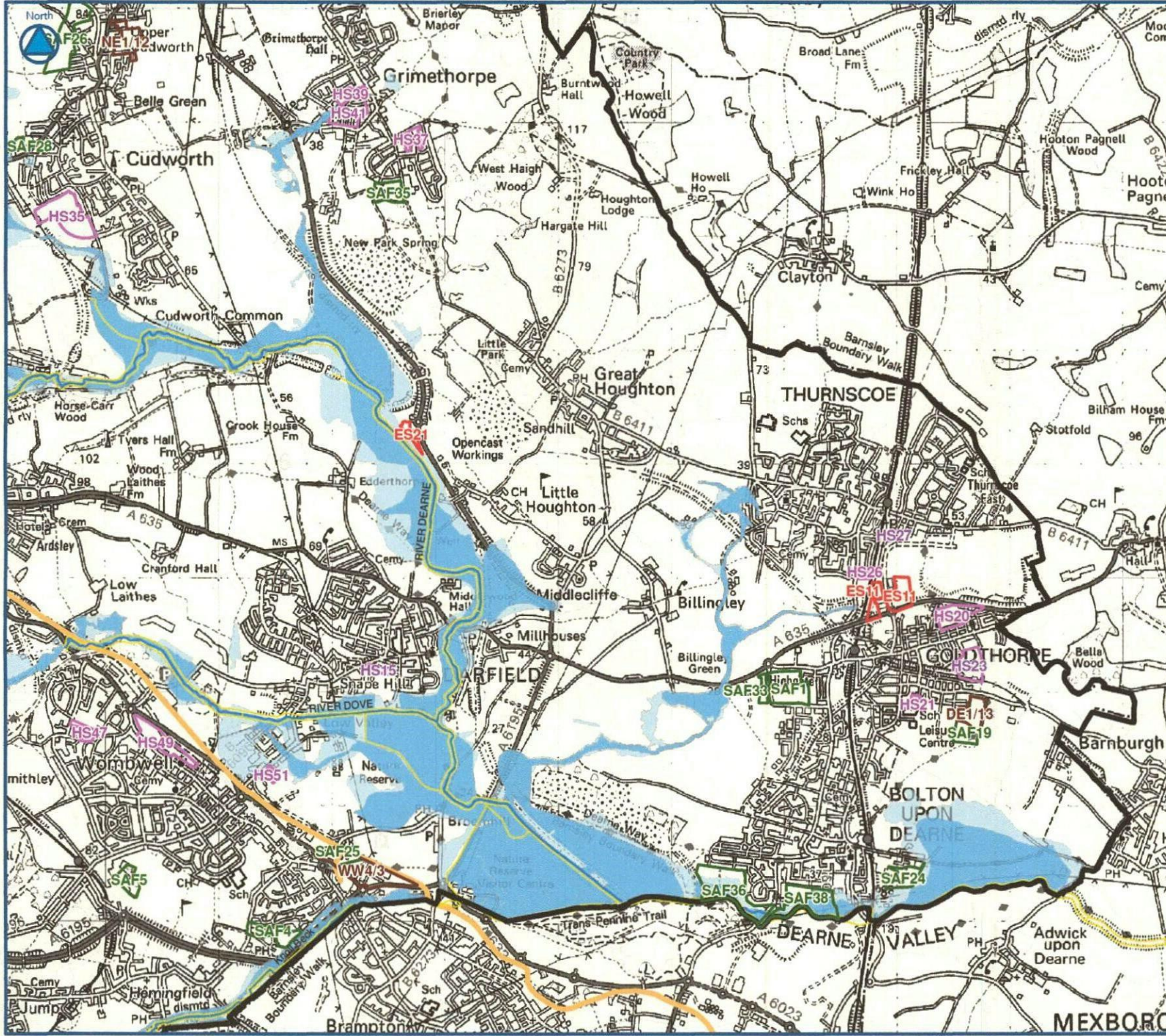
LEGEND

-  Main River
-  Structures
-  High Ground
-  Embankment

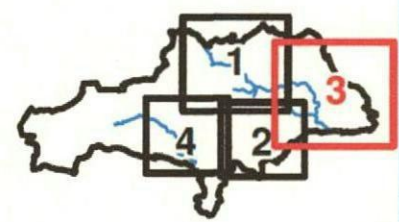
ASSET_ID	AIMS_SUB_T	DESCRIPTION	DESIGN_SOP	ASSET_MAIN	PROTECTION	TARGET_CON	OVERALL_CO
333898	weir			private	fluvial	9	2
214728	outfall			private	fluvial	9	3
276421	outfall			private	fluvial	9	3
214008	outfall			private	fluvial	9	2

ASSET ID	DESCRIPTIO	ASSET MAIN	AIMS SUB T	LENGTH	ACTUAL DCL	ACTUAL UCL	PROTECTION	TARGET CON	OVERALL CO	DESIGN SOP
445403	Adwick Spillway	environment agency	embankment	163.35			fluvial	3	3	
25730		environment agency	embankment	1325.11	15.95	15.36	fluvial	2	3	50
48853		private	high ground	1847.20			fluvial	3	2	30
25731		private	high ground	450.42			fluvial	3	4	50

APPENDIX E – Rotherham SFRA Information



KEYPLAN



LEGEND

1:32,596

- Barnsley MBC Boundary
- Defence
- Main River
- Possible route of restored canal
- Flood Zone 3
- Flood Zone 2

Proposed Development Sites

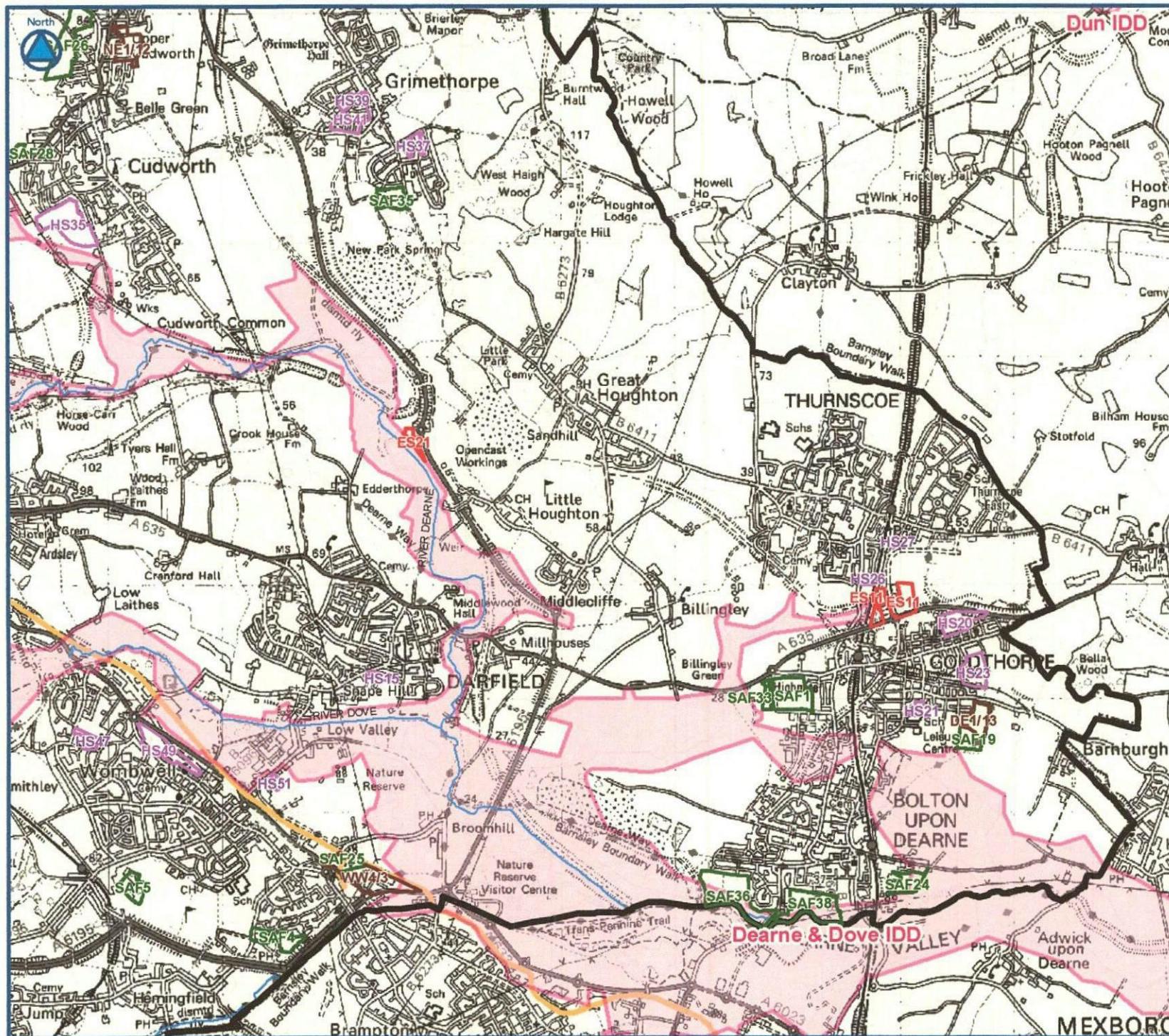
- Employment Sites
- Housing Sites
- UDP Sites
- Safeguarded Land

This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationary Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100022264 (2009)

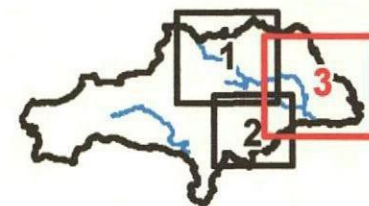


MAP A - 3

PROPOSED DEVELOPMENT SITES
AND FLOOD ZONES



KEYPLAN



LEGEND

1:32,596

- Barnsley MBC Boundary
- IDB Boundaries
- Main River
- Possible route of restored canal

Proposed Development Sites

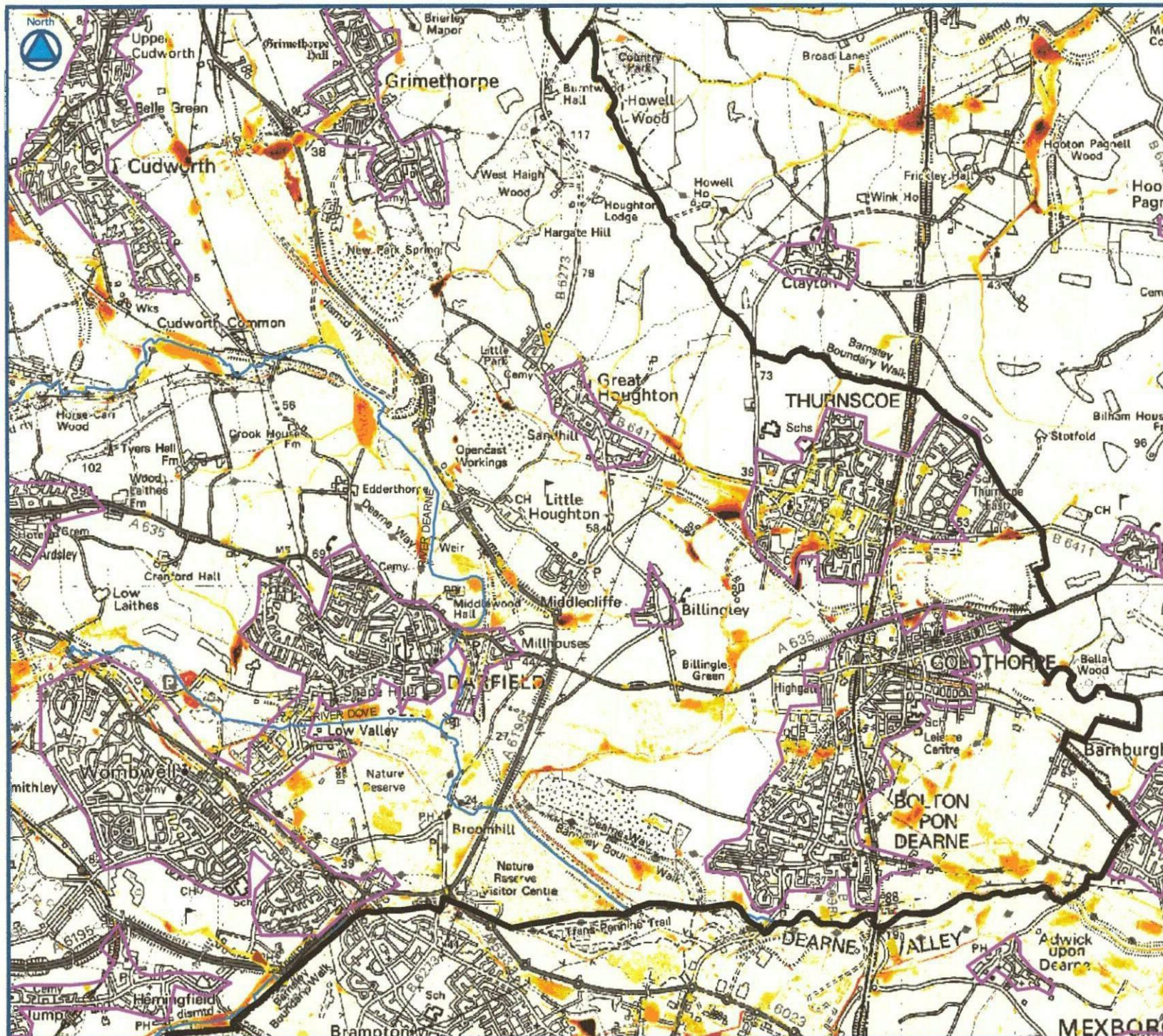
- Employment Sites
- Housing Sites
- UDP Sites
- Safeguarded Land

This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationary Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100022264 (2009)

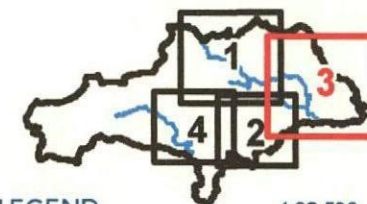


MAP B - 3

PROPOSED DEVELOPMENT SITES
AND IDB BOUNDARIES



KEYPLAN



LEGEND

1:32,596

- Barnsley MBC Boundary
- Urban Areas
- Main River
- Surface Water Flooding
- Flood Depth (m)**
 - 0.15 - 0.3
 - 0.3 - 0.5
 - 0.5 - 1
 - 1 - 1.5
 - 1 - 2
 - > 2

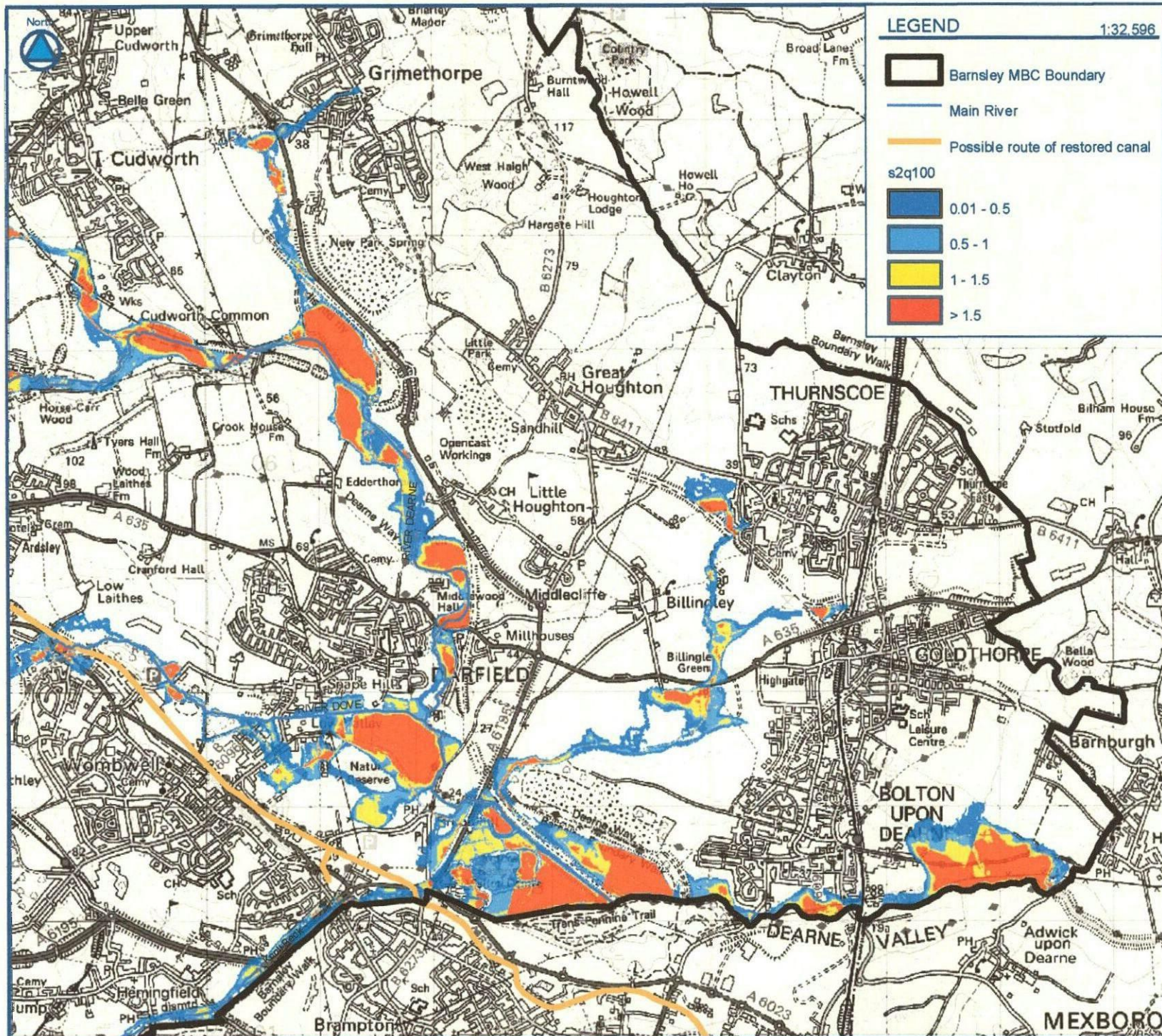
Note:
Please see Section 5.8 of the SFRA
for further details.

This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationary Office. © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100022264 (2008)

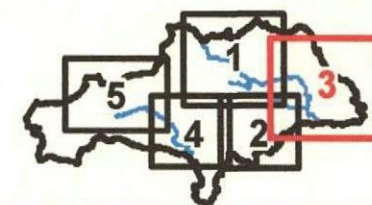


MAP C - 3

PLUVIAL FLOODING CAUSED BY
100YEAR RAINSTORM



KEYPLAN



Note:
This map shows the potential scale of flood inundation for a range of severe overtopping flood events and different standards of flood defence. They do not include the impact of a breach or failure of these defences.

Typical range of defence standards for the River Don and Dearne is to protect up to a 1 in 30year (3%) return period.

s2 = 1 in 2year Standard of Defence
q100 = 1 in 100year or 1% probability flood event.

This map should be considered in support of the Environment Agency Flood Zone Maps to aid the Sequential and Exception Tests. It should not be considered in isolation without reference to the other SFRA Flood Risk Maps.

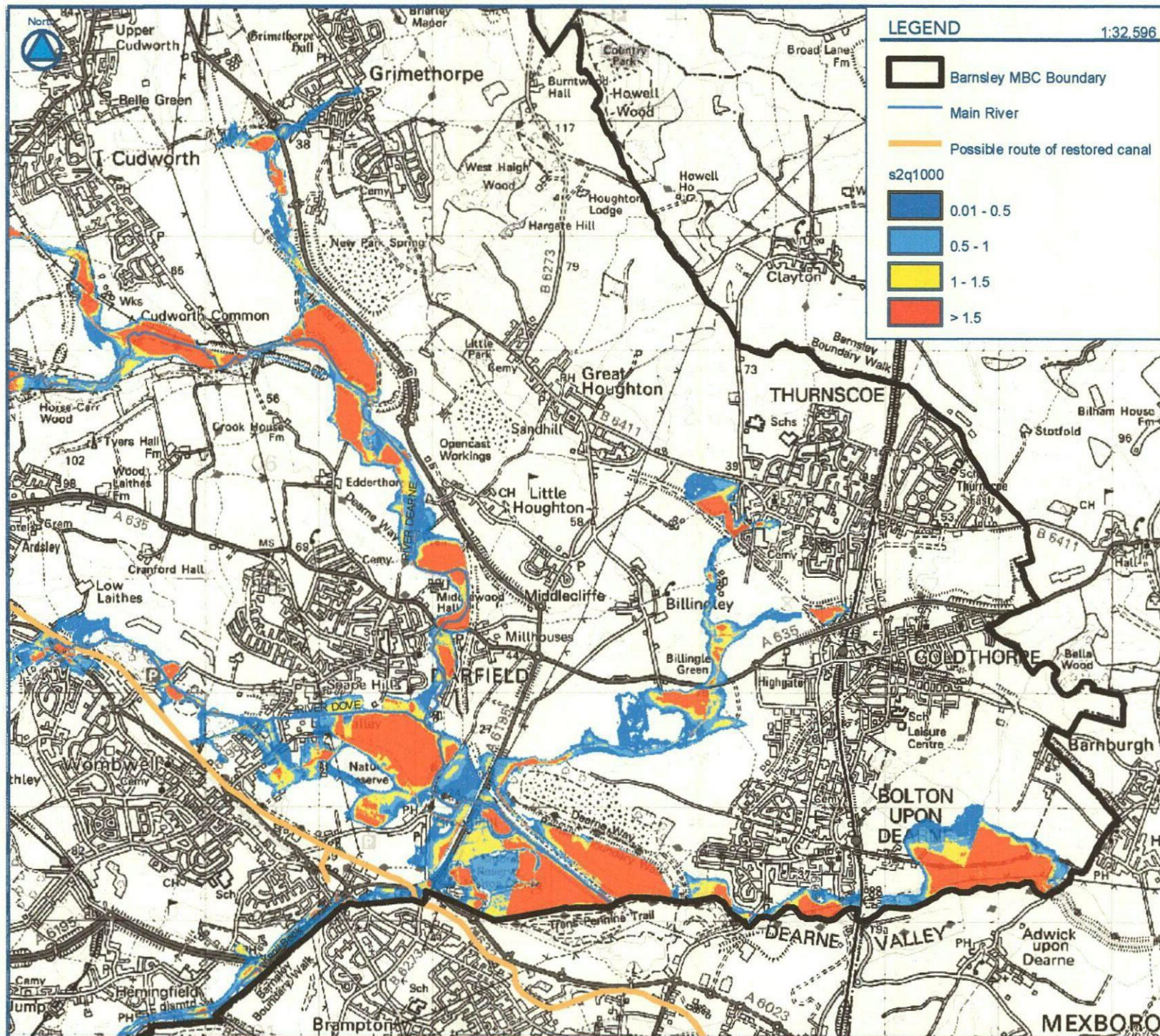
Please see the Section 6 of the SFRA for further details.

This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationary Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100022264 (2008)



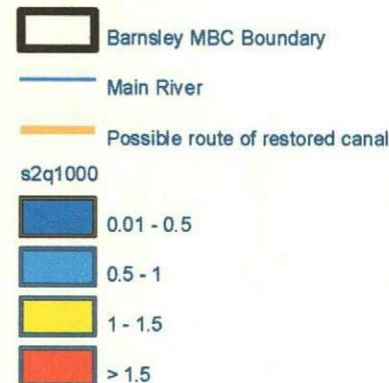
MAP D - 3

s2q100

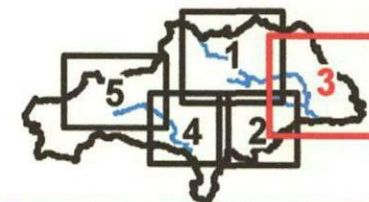


LEGEND

1:32,596



KEYPLAN



Note:
This map shows the potential scale of flood inundation for a range of severe overtopping flood events and different standards of flood defence. They do not include the impact of a breach or failure of these defences.

Typical range of defence standards for the River Don and Dearne is to protect up to a 1 in 30year (3%) return period.

s2 = 1 in 2year Standard of Defence
q1000 = 1 in 1000year or 0.1% probability flood event.

This map should be considered in support of the Environment Agency Flood Zone Maps to aid the Sequential and Exception Tests.

It should not be considered in isolation without reference to the other SFRA Flood Risk Maps.

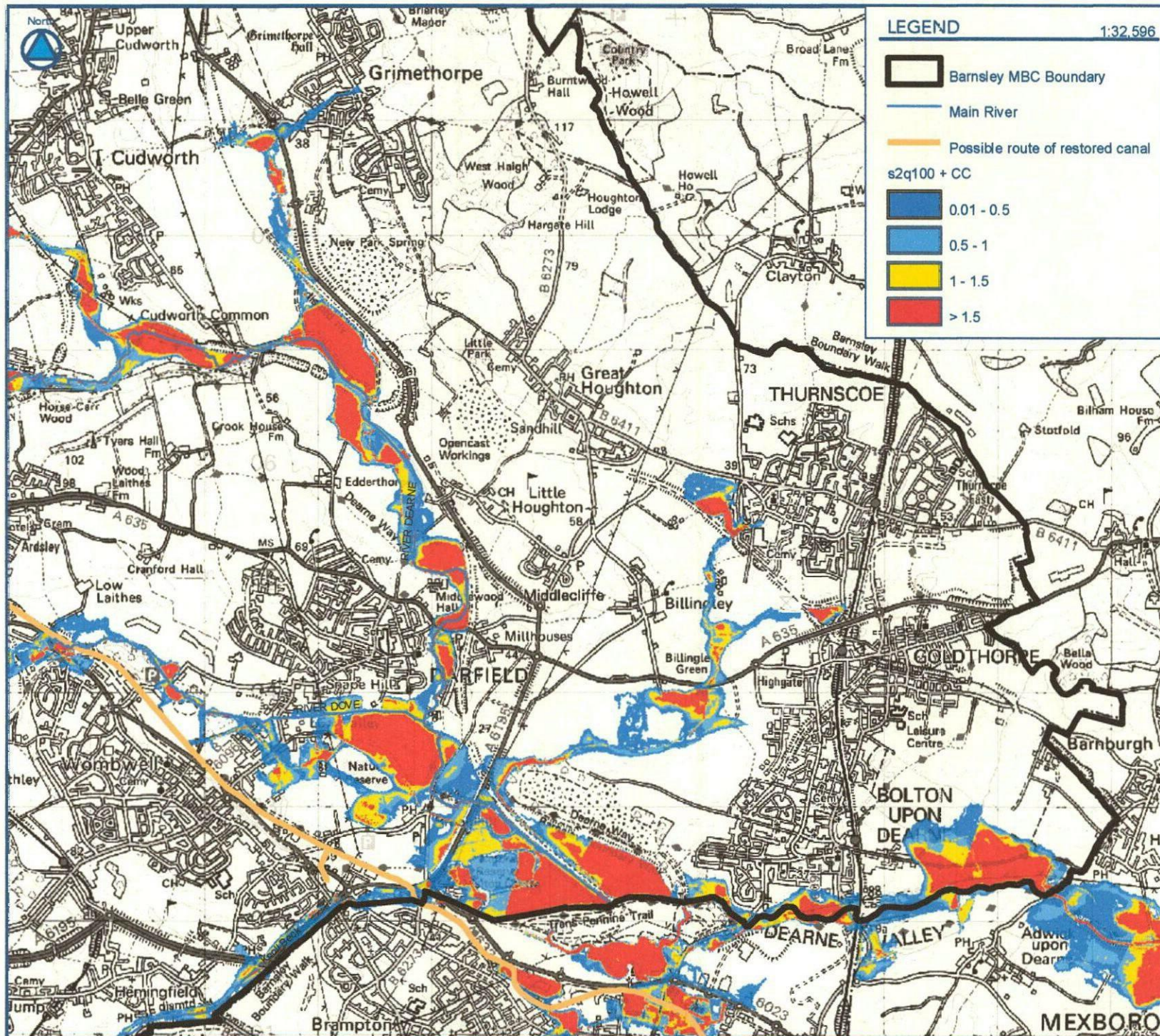
Please see the Section 6 of the SFRA for further details.

This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationary Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100022264 (2008)

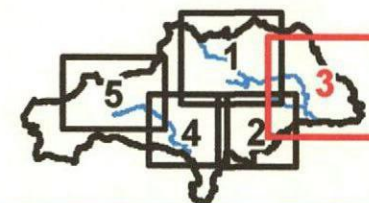


MAP E - 3

s2q1000



KEYPLAN



Note:
This map shows the potential scale of flood inundation for a range of severe overtopping flood events and different standards of flood defence. They do not include the impact of a breach or failure of these defences.

Typical range of defence standards for the River Don and Deane is to protect up to a 1 in 30year (3%) return period.

$s2 = 1$ in 2year Standard of Defence
 $q100 = 1$ in 100year or 1% probability flood event.

Climate Change scenario represents 20% increase of flood flow.

This map should be considered in support of the Environment Agency Flood Zone Maps to aid the Sequential and Exception Tests.

It should not be considered in isolation without reference to the other SFRA Flood Risk Maps.

Please see the Section 6 of the SFRA for further details.

This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationary Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100022264 (2009)



MAP H - 3

s2q100 + Climate Change

APPENDIX F – Yorkshire Water Sewer Plan

BOLTON UPON DEARNE



APPENDIX G – Glossary of Terms

GLOSSARY OF TERMS AND ABBREVIATIONS

Attenuation	Slowing down the rate of flow to prevent flooding and erosion, with a consequent increase in the duration of flow.
Balancing Pond	A pond designed to attenuate flows by storing runoff during peak periods and releasing the water after the flood peak has passed. The pond always contained water. Storage periods may not be long enough to improve water quality.
Catchment	A river catchment is the whole area which drains either naturally or with artificial assistance to a river. It includes the drainage channels, tributaries, floodplains and washlands associated with a river and an estuary where one is present.
Climate Change	Flood risk may increase due to environmental changes, and one of the key uncertainties in assessing flood risk at present is the extent to which climate is changing and may change in the future. NPPF Table 5 advocates a precautionary approach to deal with uncertainties of how climate change may affect sea levels, river flows and flood risk. Current best practice recommends allowing for a 10% increase in peak rainfall intensity and a 20% increase in peak river flow to 2055. Recommended allowances for net sea level rise in the East of England are 4mm/year to 2025 and then 8.5mm/year onwards to 2055.
Critical Ordinary Watercourse	Ordinary watercourses which the Environment Agency and other operating authorities agree are critical because they have the potential to put large numbers of people and property at risk from flooding.
Design flood level	the flood level to which defences or mitigation measures are designed. This is typically the 1% (1 in 100 year) flood level. More extensive flooding and higher levels due to more extreme conditions than the design event or as a result of obstructions of the watercourse may occur at any time.
Development	In accordance with the definitions given in Section 55 of Town and Country Planning Act 1990, with certain exceptions development means the carrying out of building, engineering, mining or other operations, in on over or under land or the making of any material change in use of any buildings or other land.
Drainage (land drainage)	The Water Resources Act 1991 (as amended by the Environment Act 1995) defines drainage as including: a) defence against water, including sea water; b) irrigation other than spray irrigation; c) warping d) the carrying on, for any purpose, of any other practice which involves management of the level of water in a watercourse.
Exception Test	If, following application of the Sequential Test (see below), it is not possible for proposed development to be located in zones of lower probability of flooding, the Exception Test can be applied as detailed in the NPPF. For the Exception Test to be passed the Flood Risk Assessment must demonstrate the proposed development provides wider sustainability benefits to the community that outweigh the estimated flood risk.
Flood Defence	Flood defence means the drainage of land (as defined above), and the provision of flood warning systems.
Flood Estimation Handbook (FEH)	The primary national guide to flood probability estimation in the UK, developed by CEH Wallingford. The use of the FEH ensures national consistency in estimating the probability of flooding, although users must be aware of the need to exercise good judgment and recognise the uncertainty inherent in flood estimation. Prediction of flood flows is not an exact science

and therefore the results of estimation cannot be guaranteed and the users make use of them at their own risk.

Flood return period/risk	The risk of flooding to floodplain areas and property is often described in terms of a return period. Statistical return periods relate to the long term average time interval between events of a particular magnitude. The 1 in 100 year return period flood has a one percent chance of occurring in any one year. i.e. the odds of it happening are one hundred to one. It does <u>not</u> mean that flooding of this magnitude will only occur once every 100 years.
Flood Zone Maps	These were produced by the Environment Agency after the 1998 and 2000 floods to improve public awareness of flood risk and updated in 2004 alongside the release of the new FRA guidance. The floodplain envelopes indicate where flooding from rivers, streams, watercourses or the sea is possible or has occurred, but ignore the presence of all flood defences such as embankments, pumping stations and walls, although the locations of flood defence structures are indicated. The maps therefore only give a general indication of potential areas at risk of flooding, generally based on either 1% probability assessments or historic flood levels. (www.environment-agency.gov.uk/subjects/flood/?lang=e)
Flooding	Inundation by river or sea water whether caused by inadequate or slow drainage, or by breaches or overtopping of banks or defences.
Floodplain	All land adjacent to a watercourse over which water flows in times of flood.
Fluvial Flooding	Is the process of flooding arising from a watercourse
Greenfield	Land which has not been developed.
Greenfield rate of run off	Rate of water flow which would occur over the ground surface of undeveloped land to the drainage system.
Hydrology	The study of water resources.
Main River	Watercourses shown as such on the statutory main river maps held by the Department for Environment, Flood and Rural Affairs. Main rivers are maintained by the Environment Agency and are generally larger arterial watercourses.
NPPF	National Planning Policy Framework and Technical Guidance published by Communities and Local Government in March 2012. Technical Guidance explains how flood risk should be considered at all stages of the planning and development process in order to reduce future damage to property and loss of life.
Ordinary Watercourses	Any watercourse that does not form part of Main River. Internal Drainage Boards maintain certain designated common watercourses within Internal Drainage Districts. Local Authorities maintain certain 'awarded' common watercourses and highway ditches outside Internal Drainage Districts. Generally, other common watercourses are the responsibility of riparian owners.
PAGN/FCDPAG	The DEFRA Flood Coastal Defence Project Appraisal Guidance (FCDPAG) documents provide advice on best practice for the appraisal of flood and coastal defence projects. A brief summary of these documents and the applicable standards (tables 6.1 & 6.2) are appended to this glossary.
Pluvial Flooding	Is the process of flooding arising from rainfall and associated surface water runoff.
Riparian	Relating to, or situated on the banks of a river or watercourse.

Runoff	Water flow over the ground surface to the drainage system. This occurs if the ground is impermeable or if permeable ground is saturated.
Sequential test	NPPF advocates that planners use a sequential test when considering land allocations for development to avoid flood risk where possible. Details of this test are summarised in the NPPF.
Soakaway	A subsurface structure into which surface water is conveyed, designed to promote infiltration.
Source Control	The control of runoff at or near to its source.
Storage Compensation	Due to the cumulative impacts of developments on the extent and function of the floodplain, the EA may require compensation storage to be provided at a site where a loss of storage in the floodplain occurs, irrespective of the negligible impacts of individual developments. In other words, an area of ground above the floodplain level must be found that can be excavated to compensate for the floodplain storage volume lost by the developing building area. In addition, the EA may insist that compensation is provided on a 'level-for-level' basis, i.e. providing compensation areas at the same level as where storage has been lost, so that there is a minimal impact on the flood patterns in the area.
SuDS	Sustainable Drainage Systems: A strategy, supported by a range of techniques, for dealing with surface water drainage that seeks to promote sustainable and environmentally beneficial or least damaging solutions. Developing a 'greenfield' site can significantly alter the way rainfall runs off the site. Impermeable areas such as tarmac mean that rainwater cannot infiltrate into the ground, and is instead channelled directly into rivers via drains and sewers. Flood risk may therefore be increased by the rapid flow of surface water run-off from developed areas into the watercourse. SuDS were developed initially with urban drainage in mind but the approach has broad application over all development drainage. SuDS techniques include Source Control.
Swale	A grass-lined channel designed to drain water from a site as well as controlling the flow and quality of the surface water.
Watercourse	Any natural or artificial channel which conveys surface water.
Wetland	A pond that has a high proportion of emergent vegetation in relation to open water that provides a variety of habitats.

NPPF Technical Guidance - The Sequential and

Exception Tests

3. As set out in the National Planning Policy Framework, the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. The flood zones (see table 1) are the starting point for this sequential approach. Zones 2 and 3 are shown on the flood map¹ with Flood Zone 1 being all the land falling outside Zones 2 and 3. These flood zones refer to the probability of sea and river flooding only, ignoring the presence of existing defences.
4. Strategic Flood Risk Assessments (see paragraphs 7-8) refine information on the probability of flooding, taking other sources of flooding and the impacts of climate change (see paragraphs 11-15) into account. They provide the basis for applying the Sequential Test, on the basis of the flood zones in table 1. Where table 1 indicates the need to apply the Exception Test (as set out in the National Planning Policy Framework), the scope of a Strategic Flood Risk Assessment will be widened to consider the impact of the flood risk management infrastructure on the frequency, impact, speed of onset, depth and velocity of flooding within the flood zones considering a range of flood risk management maintenance scenarios. Where a Strategic Flood Risk Assessment is not available, the Sequential Test will be based on the Environment Agency flood zones.
5. The overall aim should be to steer new development to Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, local planning authorities allocating land in local plans or determining planning applications for development at any particular location should take into account the flood risk vulnerability of land uses (see table 2) and consider reasonably available sites in Flood Zone 2, applying the Exception Test if required (see table 3). Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

¹ To access the flood map, see the Environment Agency's website at:
<http://www.environment-agency.gov.uk/homeandleisure/floods/default.aspx>

Table 1: Flood zones

(Note: These flood zones refer to the probability of river and sea flooding, ignoring the presence of defences)

Zone 1 - low probability Definition This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%). Appropriate uses All uses of land are appropriate in this zone. Flood risk assessment 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 flood risk assessment. This need only be brief unless the factors above or other local considerations require particular attention. Policy aims In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems². ² Sustainable drainage systems cover the whole range of sustainable approaches to surface drainage management. They are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible.
Zone 2 - medium probability Definition This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year. Appropriate uses Essential infrastructure and the water-compatible, less vulnerable and more vulnerable uses, as set out in table 2, are appropriate in this zone. The highly vulnerable uses are <i>only</i> appropriate in this zone if the Exception Test is passed. Flood risk assessment requirements All development proposals in this zone should be accompanied by a flood risk assessment. Policy aims In this 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 appropriate application of sustainable drainage systems.
Zone 3a - high probability Definition This zone comprises 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 year. Appropriate uses The water-compatible and less vulnerable uses of land (table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone.

The more vulnerable uses and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.

Flood risk assessment requirements

All development proposals in this zone should be accompanied by a flood risk assessment.

Policy aims

In this 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 appropriate application of sustainable drainage systems;
- relocate existing development to land in zones with a lower probability of flooding; and
- create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Zone 3b - the functional floodplain

Definition

This zone comprises land where water *has* to flow or be stored in times of flood.

Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But 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, should provide a starting point for consideration and discussions to identify the functional floodplain.

Appropriate uses

Only the water-compatible uses and the essential infrastructure listed in table 2 that has to be there should be permitted in this zone. 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; and
- not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

Flood risk assessment requirements

All development proposals in this zone should be accompanied by a flood risk assessment.

Policy aims

In this 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 appropriate application of sustainable drainage systems;
- relocate existing development to land with a lower probability of flooding.

Table 2: Flood risk vulnerability classification

Essential infrastructure • Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly vulnerable • Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use³. • Installations requiring hazardous substances consent⁴. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as "essential infrastructure")⁵.
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 and hotels. • Non-residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste⁶. • Sites used for holiday or short-let caravans and camping, <i>subject to a specific warning and evacuation plan</i>.⁷
Less vulnerable • Police, ambulance and fire stations which are <i>not</i> required to be operational during flooding. • Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non-residential institutions not included in "more vulnerable", 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 working). • Water treatment works which do <i>not</i> need to remain operational during times of flood. • Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water-compatible development • Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • Ministry of Defence 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 and essential facilities such as changing rooms.
- Essential ancillary sleeping or residential accommodation for staff required by uses in this category, *subject to a specific warning and evacuation plan.*

³ For any proposal involving a change of use of land to a caravan, camping or chalet site, or to a mobile home site or park home site, the Sequential and Exception Tests should be applied.

⁴ See Circular 04/00: *Planning controls for hazardous substances* (paragraph 18) at:

www.communities.gov.uk/publications/planningandbuilding/circularplanningcontrols

⁵ In considering any development proposal for such an installation, local planning authorities should have regard to planning policy on pollution in the National Planning Policy Framework.

⁶ For definition, see *Planning for Sustainable Waste Management: Companion Guide to Planning*

Policy Statement 10 at www.communities.gov.uk/publications/planningandbuilding/planningsustainable

⁷ See footnote 3.

⁸ See website for further details.

www.defra.gov.uk/science/ProjectData/DocumentLibrary/FD23203364TRP.pdf

Notes to table 2:

a. This classification is based partly on Department for Environment, Food and Rural Affairs and Environment Agency research on *Flood Risks to People (FD2321/TR2)*⁸ and also on the need of some uses to keep functioning during flooding.

b. Buildings that combine a mixture of uses should be placed into the higher of the relevant classes of flood risk sensitivity. Developments that allow uses to be distributed over the site may fall within several classes of flood risk sensitivity.

c. The impact of a flood on the particular uses identified within this flood risk vulnerability classification will vary within each vulnerability class. Therefore, the flood risk management infrastructure and other risk mitigation measures needed to ensure the development is safe may differ between uses within a particular vulnerability classification.

FCDPAG INDICATIVE STANDARDS OF PROTECTION

The DEFRA Flood and Coastal Defence Project Appraisal Guidance (FCDPAG) documents provide advice on best practice for the appraisal of flood and coastal defence projects. Volume 3: Economic Appraisal gives indicative standards for flood and coastal defence in England and Wales. The tables below are provided "as an aid to authorities to help in establishing the range of options to be considered, though they should not constrain the need to consider a full range of alternatives. They do not represent any entitlement to protection or minimum level to be achieved". Please refer to the FCDPAG documents at <http://www.defra.gov.uk/enviro/fcd/pubs/pagn/default.htm> for further information.

Table 6.1 Indicative standards of protection

Land use band	Indicative standards of protection				
	Fluvial		Coastal		
	Return period (years)	Annual probability of failure	Return period (years)	period	Annual probability of failure
A	50-200	0.005-0.02	100-300		0.003-0.01
B	25-100	0.01-0.04	50-200		0.005-0.02
C	5-50	0.02-0.20	10-100		0.01-0.10
D	1.25-10	0.10-0.80	2.5-20		0.05-0.40
E	<2.5	>0.40	<5		>0.20

The standards shown in Table 6.1 are determined by land use bands, as defined in Table 6.2 below.

Table 6.2 Description of Land Use Bands

Land use band	Indicative range of housing units (or equivalent) per km of coastline or single river bank	Description
A	>=50	Typically intensively developed urban areas at risk from flooding and/or erosion
B	>=25 to <50	Typically less intensive urban areas with some high-grade agricultural land and/or environmental assets of international importance requiring protection.
C	>=5 to <25	Typically large areas of high-grade agricultural land and/or environmental assets of national significance requiring protection with some properties also at risk, including caravans and temporary structures.
D	>=1.25 to <5	Typically mixed agricultural land with occasional, often agriculturally related, properties at risk. Agricultural land may be prone to flooding, water logging or coastal erosion. May also apply to environmental assets of local significance.
E	>0 to <1.25	Typically low-grade agricultural land, often grass, at risk from flooding, impeded land drainage or coastal erosion, with isolated agricultural or seasonally occupied properties at risk, or environmental assets at little risk from frequent inundation.