Weetwood

Development • Planning • Environment

LAND AT ALDHAM BRIDGE, WOMBWELL

FLOOD RISK ASSESSMENT

Final Report v1.2

April 2016

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1 INTRODUCTION

1.1 PURPOSE OF REPORT

Weetwood Services Ltd ('Weetwood') has been instructed by Riseholm Investments Ltd to undertake a Flood Risk Assessment (FRA) for the proposed redevelopment of a site at Wombwell, Barnsley.

The FRA has been undertaken in accordance with the requirements of the National Planning Policy Framework (NPPF) and supporting Planning Practice Guidance.

1.2 STRUCTURE OF THE REPORT

The report is structured as follows:

Section 1 Introduction and report structure

Section 2 Presents national and local flood risk and drainage planning policy

Section 3 Provides background information relating to the development site, the development proposals, ground conditions and existing site access arrangements

Section 4 Assesses the potential sources of flooding to the development site

Section 5 Presents flood risk mitigation measures based on the findings of the assessment

Section 6 Addresses the effect of the proposed development on surface water runoff and presents an illustrative surface water drainage scheme to ensure that surface water runoff is sustainably managed and flood risk is not increased elsewhere.

Section 7 Presents a summary of key findings

Section 8 Presents the recommendations

2 PLANNING POLICY AND GUIDANCE

2.1 NATIONAL PLANNING POLICY

The aim of the NPPF is to ensure that flood risk is taken into account at all stages in the planning process and is appropriately addressed.

2.1.1 Sequential Test

Paragraph 100 of the NPPF states that *'inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk but where development is necessary, making it safe without increasing flood risk elsewhere*'.

This policy is implemented through the application of the flood risk Sequential Test which aims to steer new development to areas with the lowest probability of flooding.

2.2 LOCAL PLANNING POLICY AND GUIDANCE

Barnsley Metropolitan Borough Council (MBC) Local Development Framework Core Strategy was adopted in September 2010. The following policies have been used to inform the FRA:

CSP 4 Flood Risk states the extent and impact of flooding will be reduced by:

- Requiring all development proposals on Brownfield Sites to reduce surface water run-off by at least 30% and development on Greenfield sites to maintain or reduce existing run-off rates.
- Requiring development proposals to use SuDS in accordance with policy CSP 3 SuDS.
- Using flood resilient design in areas of high flood risk.

CSP 3 SuDS states:

- Only in exceptional circumstances, where it can be demonstrated that all types of SuDS are impractical, will other drainage management systems be permitted.
- Planning applications must include an assessment to show that SuDS will work and be maintained. Measures should be taken to avoid water contamination and safeguard groundwater supply.
- Developers will be required to contribute to the maintenance of SuDS.

2.3 ENVIRONMENTAL PERMIT FOR FLOOD RISK ACTIVITIES

An Environmental Permit for Flood Risk Activities may be required from the Environment Agency (EA) for work:

- In, under, over or near a main river (including where the river is in a culvert)
- On or near a flood defence on a main river
- In the flood plain of a main river
- On or near a sea

Further information can be found at:
www.gov.uk/guidance/flood-risk-activities-environmental-permits

2.4 RELEVANT DOCUMENTS

The FRA has been informed by the following documents:

- Strategic Flood Risk Assessment (SFRA), Barnsley MBC, September 2010
- Preliminary Flood Risk Assessment (PFRA), Barnsley MBC, July 2011

3 SITE DETAILS AND PROPOSED DEVELOPMENT

3.1 SITE LOCATION

The approximately 0.52 hectare (ha) site is located at Aldham Bridge, Wombwell at Ordnance Survey (OS) National Grid Reference SE 386 044, as shown in **Figure 1**.

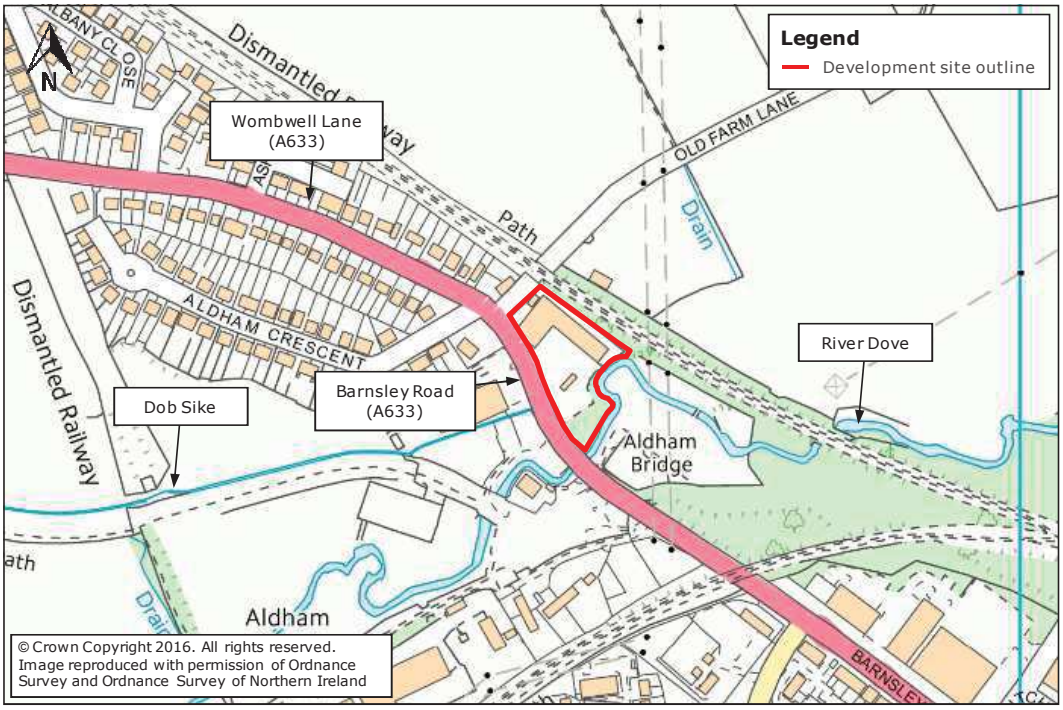

Figure 1: Site Location

3.2 EXISTING AND PROPOSED DEVELOPMENT

The existing site is partially occupied by retail units (total GEA 910 m^2), a hand car wash and areas of hardstanding. Part of the remainder of the site was previously occupied by a petrol filling station with associated kiosk, canopy and forecourt.

The proposals (**Appendix A**) entail the demolition of the existing buildings and canopy, and the development of three retail units (total GEA 1397 m^2) adjacent to the north-east boundary, together with associated car parking and access. Access to the site will remain via Barnsley Road along the south-western boundary of the site.

The NPPF Planning Practice Guidance classifies retail development as 'less vulnerable' land use.

3.3 WATERBODIES IN THE VICINITY OF THE SITE

The River Dove flows in a predominantly easterly direction adjacent to the south-east of the site. The river flows beneath Barnsley Road at Aldham Bridge to the south of the site before meandering around the south-east portion of the site (**Figure 1**). The river outfalls to the River Dearne approximately 3.7 km east of the site. The River Dove is designated a Main River from Barnsley Road. Upstream of the Barnsley Road the river is designated as an Ordinary Watercourse.

Dob Sike is a left bank tributary of the River Dove located to the west of the site (**Figure 1**), and flows in an easterly direction towards a culvert beneath Barnsley Road, approximately 40 m north-west of the River Dove. Dob Sike flows into the River Dove adjacent to the south of the site. The watercourse is approximately 2.2 km in length.

OS mapping indicates the presence of a small drainage ditch to the north-east of the site; a raised railway line runs between the site and the drain.

3.4 SITE LEVELS

A topographic survey of the site has been undertaken by Site and Survey Services and is provided in **Appendix B**.

The site slopes from south-east to west from 37.34 metres Above Ordnance Datum (m AOD) to 35.83 m AOD as shown in **Figure 2**.

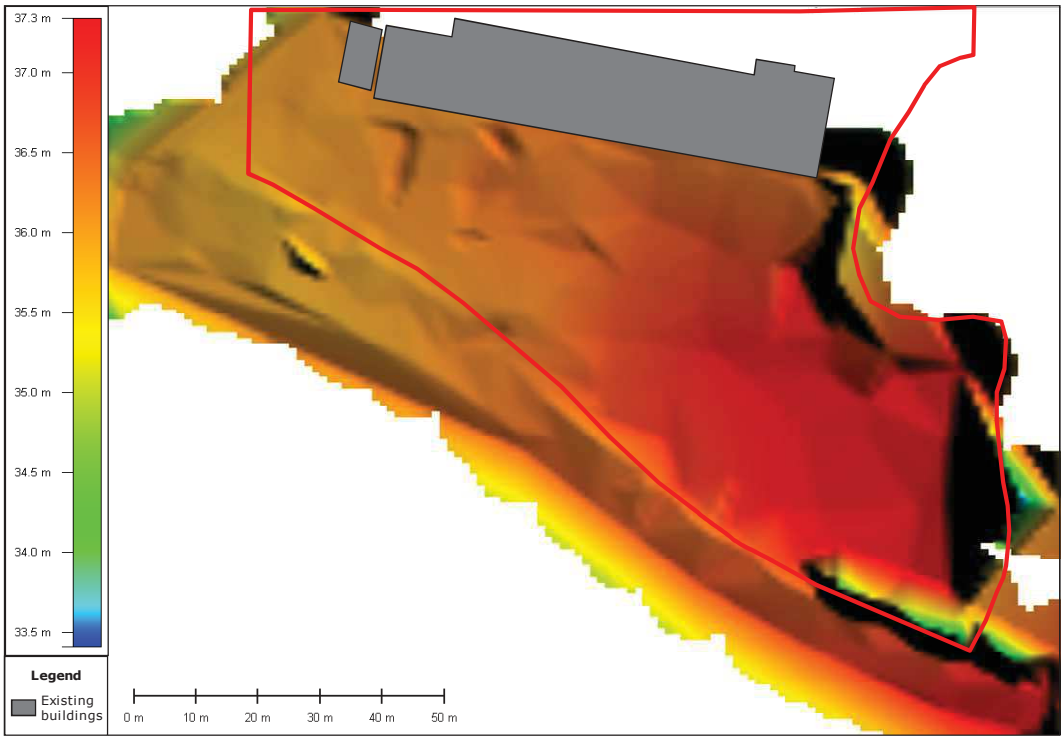

Figure 2: Digital Elevation Model

3.5 GROUND CONDITIONS

According to the Soilscapes maps produced by the National Soils Research Institute[1], soil conditions at the site and within the surrounding area are described as 'loamy and clayey soils'.

British Geological Survey (BGS) mapping indicates superficial deposits of alluvium (clay and silt) to be present at the site, underlain by sandstone bedrock of the Oaks Rock formation.

[1] Soilscapes www.landis.org.uk/soilscapes/

4 REVIEW OF FLOOD RISK

4.1 FLOOD ZONE DESIGNATION

Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. The NPPF Planning Practice Guidance defines Flood Zones as follows:

- **Flood Zone 1: Low Probability**. Land having a less than 1 in 1,000 annual probability of river or sea flooding.
- **Flood Zone 2: Medium Probability**. 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.
- **Flood Zone 3a: High Probability**. Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.
- **Flood Zone 3b: The Functional Floodplain**. 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 Flood Zones are shown on the EA Flood Map for Planning (Rivers and Sea). The Planning Practice Guidance states that the Zones shown on the EA Flood Map do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding.

According to the EA Flood Map for Planning (Rivers and Sea) (**Figure 3**) the site is located in Flood Zone 3 (approximately 75%) and Flood Zone 2 (approximately 25%).

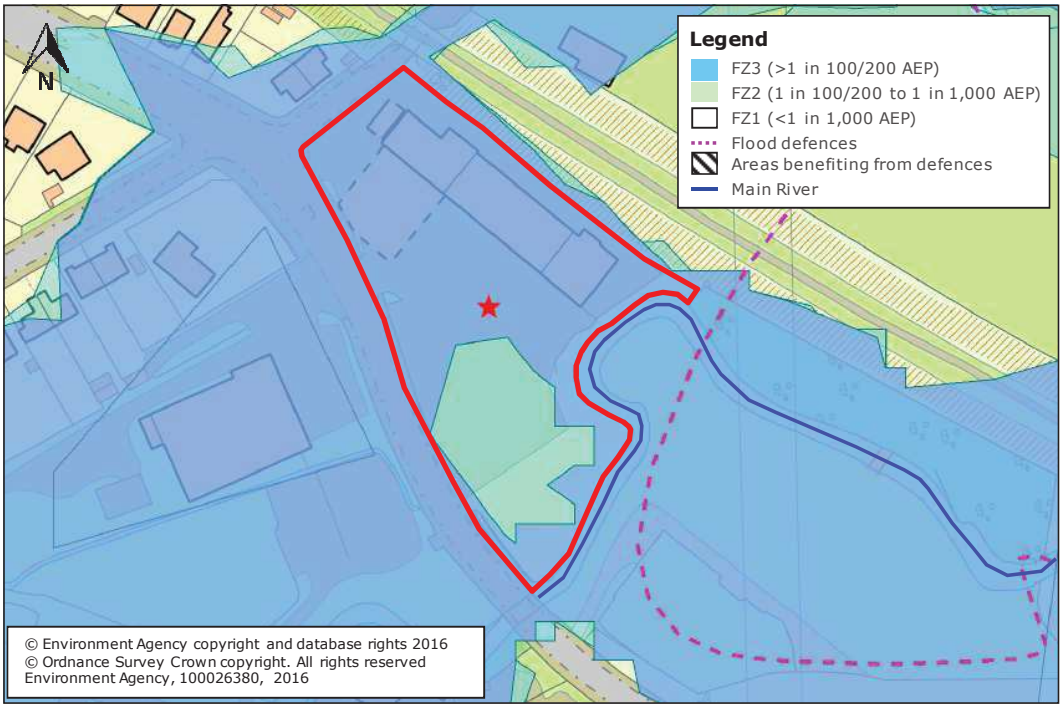

Figure 3: Environment Agency Flood Map for Planning (Rivers & Sea)

Map 6 of the SFRA[2] indicates the site is not located within the functional floodplain. The flood zone categorisation of the site is thus Flood Zone 3a.

4.2 SEQUENTIAL TEST

The Sequential Test has been addressed by ID Planning Ltd in consultation with Barnsley MBC. The proposed development would provide part replacement and part new retail floorspace in this location. The ID Planning 'Sequential Assessment' highlights that in retail policy terms the application site is out of centre. It is therefore necessary under the NPPF (paragraph 24) to carry out a sequential assessment in the retail policy context which examines whether there are any suitable or available sites within or on the edge of Wombwell District Centre which could accommodate the proposed development. In policy terms other 'out of centre' locations are not sequentially preferable. The findings of ID Planning's assessment are set out in a separate report and demonstrate there are no sequentially preferable sites.

4.3 HISTORICAL RECORDS OF FLOODING

According to the EA Flood History Map (**Figure 4**) the site does not have any records of flooding. However, land to the south-west region of the site including the A633 Barnsley Road was flooded during the 2007 flood event.

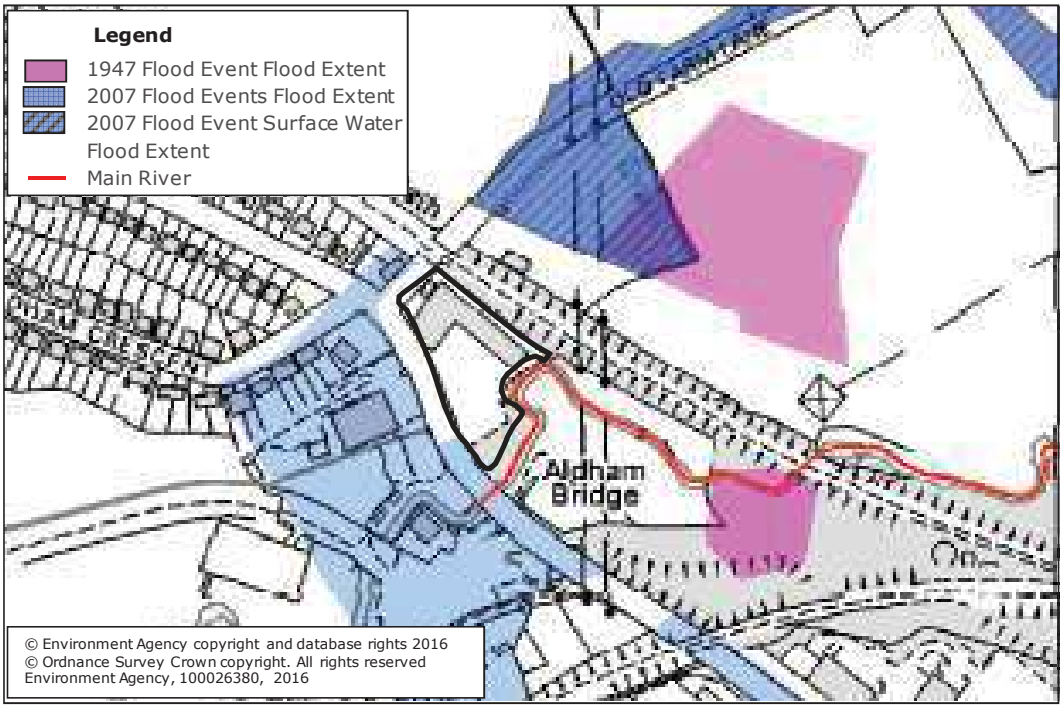

Figure 4: Environment Agency Flood History Map

The SFRA refers to the extents of four historical flood events (March 1947, January 1982, November 2000 and June 2007) within the Barnsley MBC area. It appears from Map 2 of the SFRA[3] that the site was not inundated during the June 2007 flood event.

[2] Barnsley SFRA General Map Study Area – Map 6 Functional Floodplain (FZ3b)
[3] Barnsley SFRA General Map Study Area – Map 2 Historical Flood Extents

The PFRA states the Aldham Bridge district was affected by two flooding events on 15th and 25th June 2007; the impact ranged from just a few inches to several feet of water flowing into properties, with many properties affected by contaminated flood waters. According to Appendix 2 Annex 3 of the PFRA the site was not recorded as a flooded property on the 2007 register.

4.4 FLUVIAL FLOOD RISK

According to the EA flood defence database, flood defences along the River Dove within the vicinity of the proposed site are either maintained channels or culverted channels.

To determine potential flood levels on site, modelled flood levels for the River Dove were provided by the EA. Unfortunately, no valid model output is available for the river reach alongside the site. Approximate flood levels have therefore been derived through a comparison between the EA Flood Map (**Figure 3**) and the topographic survey (**Figure 2**; **Appendix B**).

Based on this analysis, the peak flood level of the 1 in 100 year event has been estimated to be 37.0 m AOD. This level exceeds ground levels for a large proportion of the site and flooding of the site would be expected to occur during this design event.

The flood risk to the site will be mitigated through the implementation of the measures proposed in **Section 5** of this report.

4.5 FLOOD RISK FROM RESERVOIRS, CANALS AND OTHER ARTIFICIAL SOURCES

There are no canals located within the immediate vicinity of the site.

The EA Risk of Flooding from Reservoirs map (**Figure 5**) indicates that the north-western portion of the site is at potential risk of flooding from Worsbrough reservoir. However, as detailed on the EA website, reservoir flooding is extremely unlikely to happen as all large reservoirs are inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the EA ensures that all reservoirs are inspected regularly and essential safety work is carried out. In addition, the maximum extent of flooding from this source is within the fluvial flood extent of the River Dove.

As a result of the above, the measures proposed to mitigate fluvial flood risk from the River Dove (**Section 5**) will also mitigate against this potential source of flooding.

4.6 FLOOD RISK FROM GROUNDWATER

According to the BGS Groundwater Flooding Hazard map (**Figure 6**) the susceptibility to groundwater flooding is negligible. In addition, the site is extensively paved, and will remain so following redevelopment.

Based on the above, the risk of groundwater flooding is assessed to be very low. Any residual risk of flooding from this source will be mitigated through the implementation of the measures proposed in **Section 5** of this report.

Figure 5: Environment Agency Risk of Flooding from Reservoirs Map
(Source: EA website)

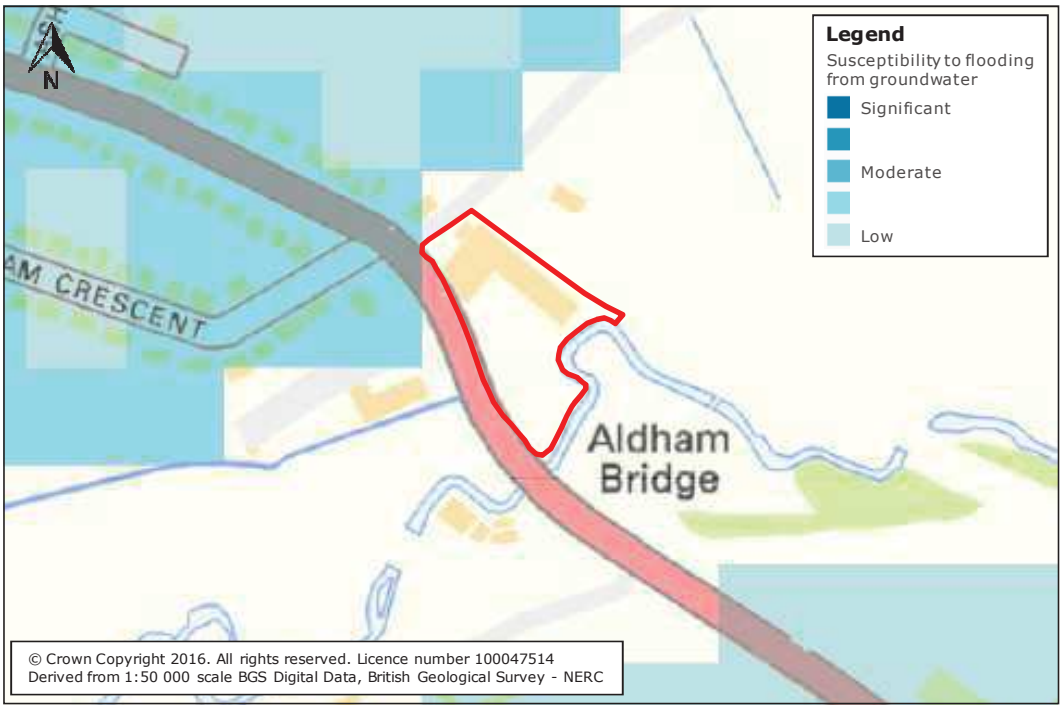

Figure 6: Groundwater Flooding Hazard Map
(Source: Findmaps)

4.7 FLOOD RISK FROM SURFACE WATER

Surface water flooding comprises pluvial flooding and flooding from sewers and highway drains and gullies.

The EA Risk of Flooding from Surface Water map (**Figure 7**) indicates that parts of the north-western portion of the site is at a low risk of flooding from surface water; these areas coincide with the low points within the site. The EA Surface Water Depth Low Chance of Occurring map indicates that maximum flood depths are between 300-900 mm. No retail units are proposed in these areas.

Barnsley MDC hold one record of sewer flooding within the vicinity of the site. The A633 Barnsley Road carriageway lowers beneath the railway bridge (Area A on **Figure 8**). This section of the A633 flooded twice during June 2007 and again in September 2008 and September 2009. Works have since been carried out to remove roots and blockages from the surface water drain between the railway bridge and the River Dove and no issues have been recorded since.

Barnsley MDC[4] has confirmed that flooding in Area B of **Figure 8** occurred in 2007 due to the collapse of a bridge adjacent to the former site of Darfield Main Colliery downstream from the site. This caused the River Dove to back up and overflow into Dob Sike.

Subsequently, Dob Sike overtopped causing flooding to the A633 Barnsley Road and properties on Aldham Crescent and Barnsley Road/Wombwell Lane. The flooding also inundated a Yorkshire Water pumping station on Wombwell Lane causing pump failure, thus leading to sewage flooding at this location. No issues have been recorded since.

The flood risk to the site will be mitigated through the implementation of the measures proposed in **Section 5** of this report and the surface water drainage strategy in **Section 5.5**.

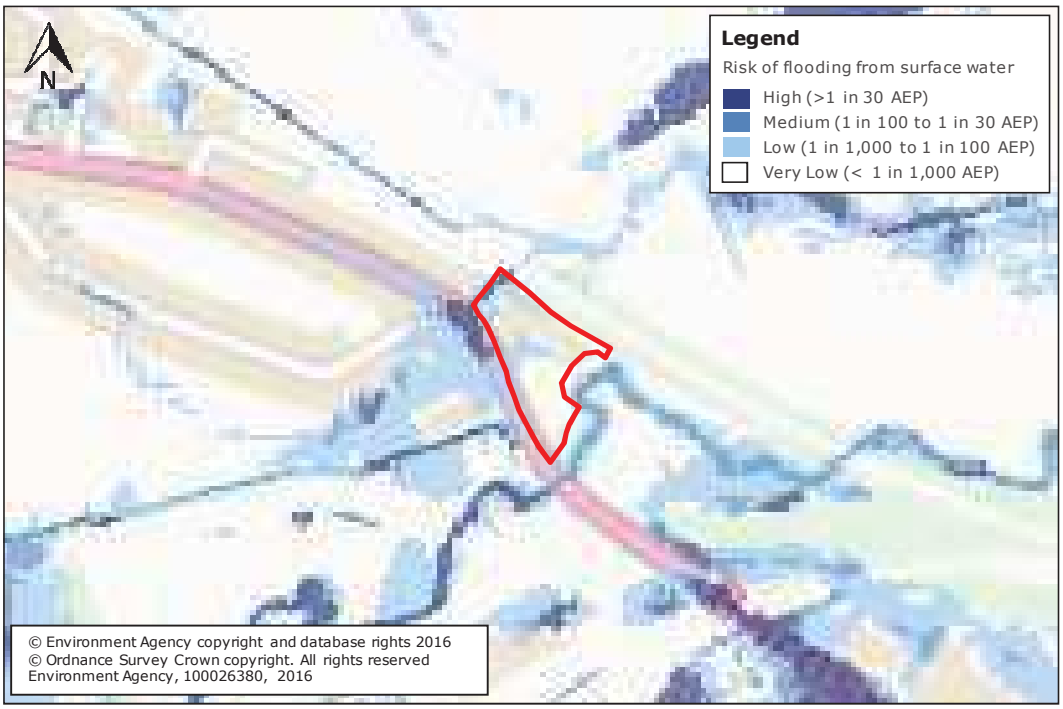

Figure 7: Environment Agency Risk of Flooding from Surface Water
(Source: EA website)

[4] Email response from Ian Grayson (Barnsley MDC) to Weetwood on 5 November 2013

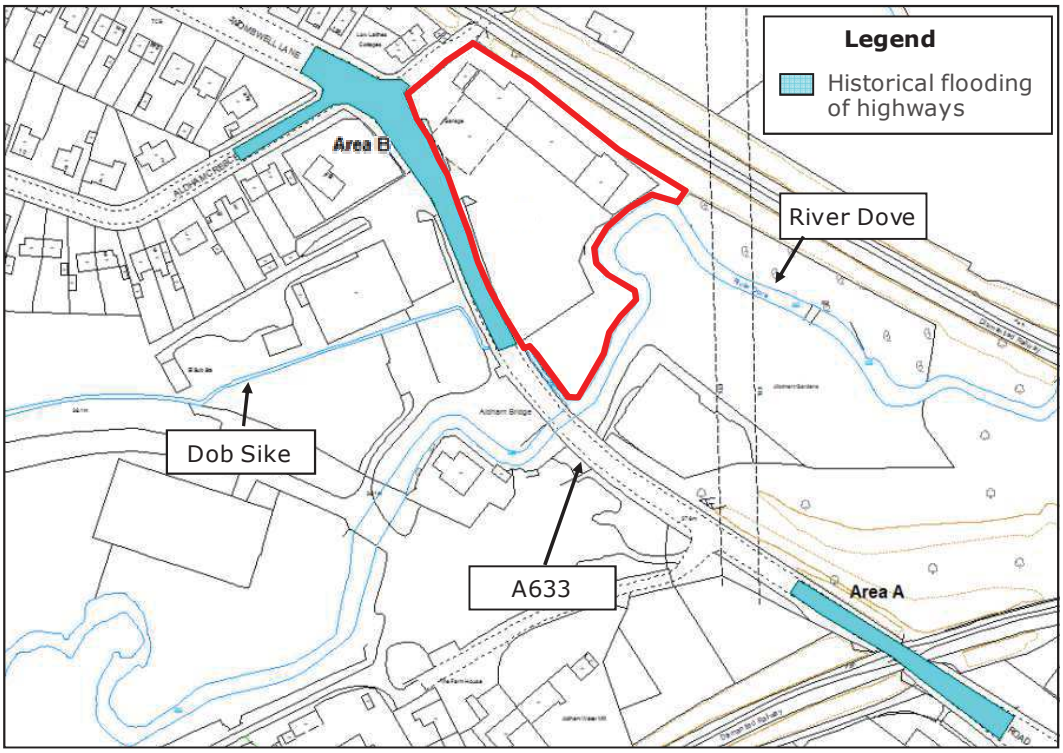

Figure 8: Local Flooding Map
(Source: Barnsley MBC)

5 FLOOD RISK MITIGATION MEASURES

The flood risk to the site from all sources will be mitigated through the implementation of the measures proposed within the following section of this report.

5.1 FINISHED FLOOR LEVELS

Finished floor levels (FFL) of new commercial units to be set at a minimum of 37.30 m AOD and not less than 300 mm above adjacent ground level. This would provide a freeboard of 300 mm above the 1 in 100 year flood water level.

This will enable any potential overland flows to be conveyed safely across the site without affecting property in accordance with the approach promoted by government policy[5].

5.2 FLOOD RESISTANT AND RESILIENT CONSTRUCTION

To provide additional mitigation, flood resilient construction techniques could be incorporated into the design of the buildings, in line with guidance provided in the Communities and Local Government Document, *'Improving the Flood Performance of New Buildings: Flood Resilient Construction'*[6].

These include design features and finish materials to minimise the entry of water and/or reduce the damage in the unlikely event of the development being inundated; including fitting electrical sockets and light fittings a minimum of 600 mm above FFL and locating water vulnerable equipment 300 mm above FFL.

5.3 FLOOD RISK ELSEWHERE

Any proposal to modify ground levels should to demonstrate that there is no increase in flood risk to the development itself, or to any existing buildings which are known to, or are likely to flood.

Developers must ensure there will be no loss of flood flow or flood storage capacity for floods up to the severity of the 1 in 100 annual probability fluvial event. Whilst not specified by the NPPF, the EA generally recommend that this should be the case over the lifetime of development (i.e. should take into account climate change).

Based on the estimated peak flood level for the 1 in 100 annual probability design event, it has been determined that the proposed development would result in a loss of approximately 330 m^3 of on-site flood storage.

On-site flood storage will be required to compensate for this loss and could be accommodated by lowering ground levels within the south-eastern corner of the site.

[5] Making Space for Water, Taking forward a new Government strategy for flood and coastal erosion risk management in England, March 2005, Dept for Environment, Food and Rural Affairs

[6] Improving the Flood Performance of New Buildings: Flood Resilient Construction. Department for Communities and Local Government. May 2007.

5.4 FLOOD PLAN

According to the EA Flood Warning Map (**Figure 9**), the site is included in the 'River Dove from Aldham Bridge to Low Valley including Wombwell Ings Caravan Site' flood warning area and the 'River Dearne Catchment' flood alert area.

It is recommended that a Flood Plan is prepared in consultation with Barnsley MBC Emergency Planners prior to occupation of the building. This should detail the existing flood risk to the site, the actions that should be taken to prepare for flooding and those necessary in the event of flooding.

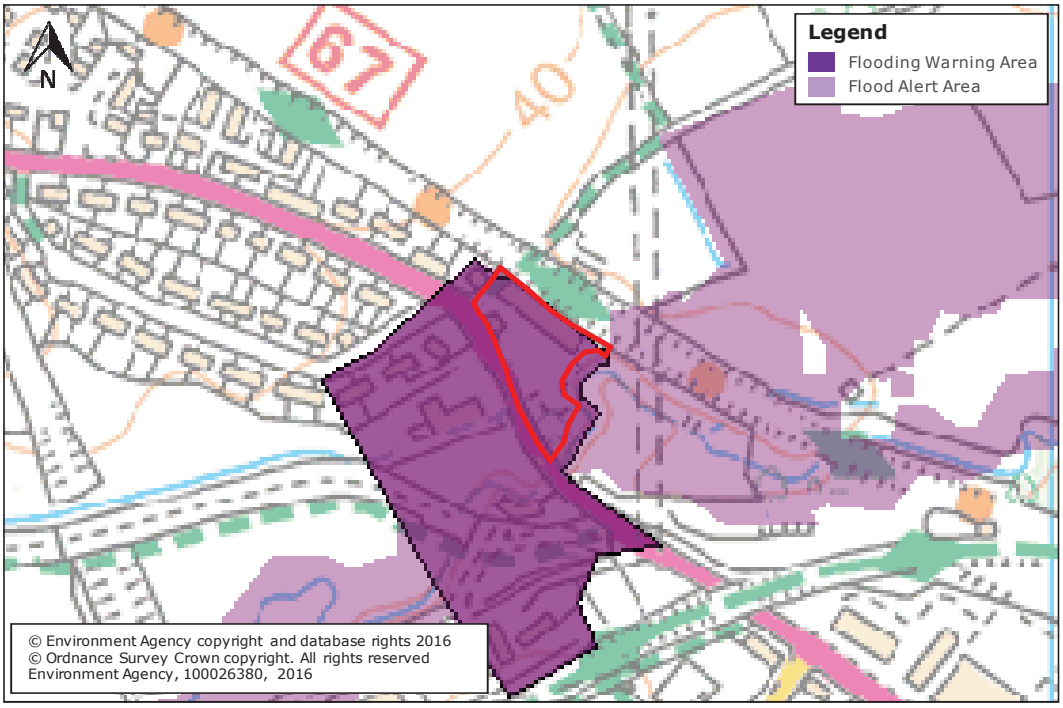

Figure 9: Environment Agency Flood Warning Areas
(Source: EA website)

5.5 ENVIRONMENTAL PERMIT FOR FLOOD RISK ACTIVITIES

It is proposed to provide a minimum 8m undeveloped buffer strip adjacent to UW1 and UW2 for maintenance purposes and to offer ecological benefit.

6 SURFACE WATER MANAGEMENT

6.1 REQUIREMENTS FOR SUSTAINABLE DRAINAGE SYSTEMS

Planning applications for major developments[7] are required[8] to provide Sustainable Drainage Systems (SuDS) for the management of surface water runoff, unless demonstrated to be inappropriate[9] or disproportionately expensive.

SuDS aim to mimic natural drainage and can achieve multiple objectives such as removing pollutants from urban runoff at source, controlling surface water runoff from developments, and ensuring that flood risk is not increased downstream. Combining water management with green space can provide amenity and biodiversity enhancement.

In considering a development that includes a sustainable drainage system, the local planning authority will want to be satisfied that the proposed minimum standards of operation are appropriate and that there are clear arrangements in place for ongoing maintenance. Technical standards[10] have been published by Defra in relation to the design, construction and operation of sustainable drainage systems.

6.2 SITE BACKGROUND

The existing site is 0.520 ha of which 0.459 ha is impermeable. The impermeable area is expected to decrease to 0.442 ha post redevelopment.

There is a formal system of surface water drainage comprising pipes and channels which discharge into the 225 mm public combined sewer (Yorkshire Water, YW) adjacent to Low Laithes Cottages via an interceptor (**Appendix C**).

The 225 mm sewer discharges into a combined pumping station (PS) a short distance downstream of the site. There is likely to be an overflow at the PS with a spill into the river to accommodate fluctuations in flow rates during rainfall as well as an emergency overflow in case of pump breakdown.

There is also a 525 mm diameter public surface water sewer located in Wombwell Lane adjacent the site which outfalls to the river a short distance downstream. However, there is no existing connection between the site drainage system and this public surface water sewer.

6.3 EXISTING SURFACE WATER RUNOFF

The Modified Rational Method[11] has been used to calculate existing site runoff rates.

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7 Developments of 10 dwellings or more; or equivalent non-residential or mixed development (as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010)

8 Written Statement (HCWS161) made by the Secretary of State for Communities and Local Government (Mr Eric Pickles) on 18 December 2014

9 Paragraph 082 (Reference ID: 7-082-20150323) of the Planning Practice Guidance outlines how a sustainable drainage system might be judged to be inappropriate

10 Non-Statutory Technical Standards for Sustainable Drainage Systems, Defra, March 2015

11 The Wallingford Procedure, Volume 4, 1981

The SUDS Tool website suggests Soil Type 2 but an investigation of Soilscapes suggests soils at the site are slowly permeable and naturally wet (as would be expected from a site adjacent to a watercourse). As such, Soil Type 4 has been used in the analysis.

The calculated flow rates from the impermeable surfaces (using a time of entry of 4 minutes and a time of flow of 2 minutes) are as follows:

- 1 year – 63.9 l/s
- 2 year – 82.3 l/s
- 30 year – 152.6 l/s
- 100 year – 193.9 l/s

No levels are provided on the YW sewer records. However, a gradient of 1/31 would be required on the 225 mm public combined sewer to convey a flow of 82.3 l/s.

The 525 mm diameter public surface water sewer located in Wombwell Lane would have a capacity of 430 l/sec based on a pipe gradient of 1/100.

6.4 POST DEVELOPMENT SURFACE WATER MANAGEMENT OPTIONS

6.4.1 Disposal of Surface Water

In accordance with the NPPF Planning Practice Guidance[12], surface water runoff should be disposed of according to the following hierarchy:

1. Into the ground (infiltration)
2. To a surface water body
3. To a surface water sewer, highway drain, or another drainage system
4. To a combined sewer

As stated in **Section 5.3**, the existing surface water drainage system serving the site connects in to a pubic combined sewer.

To provide a more sustainable approach, we propose the following:

- That the existing connection to the combined sewer is removed
- A new connection to the 525 mm diameter public surface water sewer is made
- The peak runoff rate is reduced by 50% compared to existing (i.e. 41.1 l/s compared to the current 1 in 2 year flow rate of 82.3 l/s)

The drainage system for the proposed site will be designed to manage flows in up to the 1 in 100 year event including an allowance for climate change.

This solution would provide significant environmental benefit, since it would reduce the number of unsatisfactory intermittent discharges to the River Dove from the combined sewer and pumping station overflows, reduce the loading on the receiving wastewater treatment works and reduce the energy consumption associated with pumping and treatment.

6.4.2 Storage Calculations

In order to restrict runoff rates, attenuation storage will be provided.

[12] Paragraph 080, Reference ID: 7-080-20150323

The surface water storage facilities described have been modelled using the Detailed Design module of MicroDrainage Source Control. The parameters used in the storage calculation along with the MicroDrainage Source Control output results are presented in **Appendix D**.

The required storage volume has been based on a post development impermeable area of 0.442 ha (i.e. a percentage impermeable percentage, PIMP of 85%), sized to store the 1 in 100 year storm event including a 30% increase in rainfall intensity in order to allow for climate change in accordance with the NPPF[13].

The modelling indicates that a storage volume of 106 m^3 would be required.

6.4.3 Summary

The purpose of this FRA is to demonstrate that a surface water drainage strategy is feasible for the site given the development proposals and the land available.

The proposals demonstrate that peak runoff rates will be significantly reduced through the use of attenuation storage.

In addition, it is proposed to alter the existing arrangements so that surface water runoff discharges from the site to the public surface water sewer rather than the public combined sewer as is currently the case, thereby providing significant environmental benefits.

[13] NPPF Technical Guidance, Table 5

7 SUMMARY

There are proposals for the redevelopment of a site located at Aldham Bridge, Wombwell. The proposals entail the demolition of the existing buildings and canopy, and the development of three retail units (total GEA 1397 m^2) adjacent to the north-east boundary, together with associated car parking and access.

According to the EA flood map the proposed development site is located within the 1 in 100 year and 1 in 1000 year flood outlines and is therefore defined as being situated within Flood Zone 3 and Flood Zone 2 under the NPPF.

The Sequential Test has been carried out by ID Planning Ltd and has identified that there are no sequentially preferable retail sites within or on the edge of Wombwell District Centre which could accommodate the proposed development. The assessment is separately reported.

The principal source of flood risk to the site is from the River Dove and Dob Sike (i.e. fluvial flood risk).

Measures have been proposed to mitigate flood risk in order to ensure the development remains safe throughout its lifetime.

Access and egress to the developed site will be provided via Barnsley Road (A633).

Approximately 330 m^3 of compensatory flood storage would need to be provided on-site to offset the loss of storage due to the redevelopment of the site.

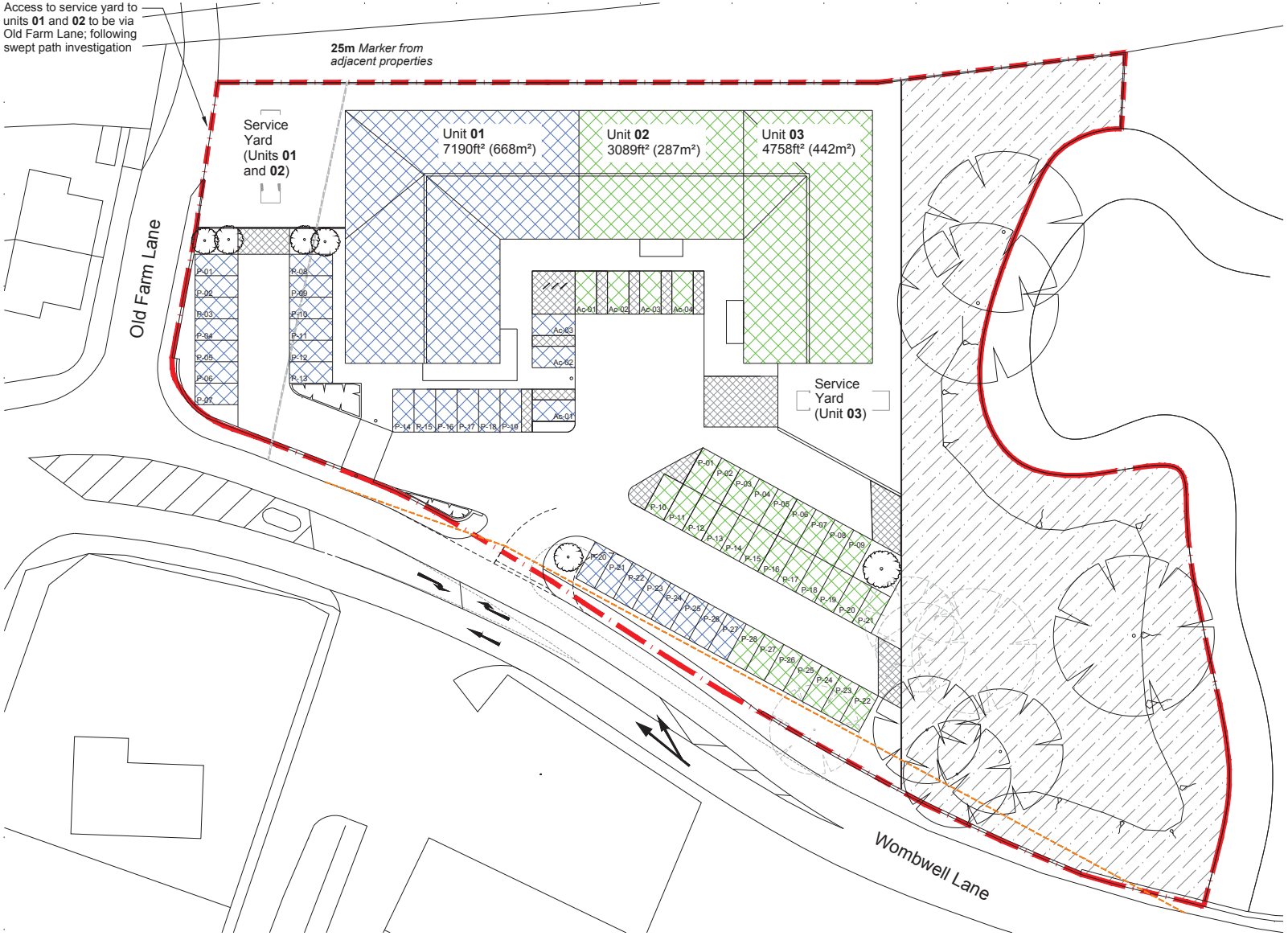
This FRA demonstrates that surface water runoff from the developed site can be sustainably managed in accordance with the NPPF and Technical Guidance, and local policy.

8 RECOMMENDATIONS

This FRA has demonstrated that the proposed development may be completed without conflicting with the requirements of the NPPF and supporting Technical Guidance subject to the following:

- Finished floor levels to be set at a minimum of 37.30 m AOD and not less than 300 mm above adjacent ground level.
- Flood Warning Plan to be developed in consultation with Barnsley MBC.
- Compensatory flood storage to be provided in accordance with the principles set out in this report.
- The detailed drainage design, developed in accordance with the principles set down in this FRA, should be submitted to and approved by the local planning authority prior to the commencement of development

APPENDIX A:	Development Proposals



N

Unit 01 - food retail
7190ft² (668m²)

Parking:

Parking bays	27
Acc. bays	03
	30 Total

Unit 02 - non-food retail
3089ft² (287m²)

Unit 03 - non-food retail
4758ft² (442m²)
(or combined 7847ft² (729m²) Unit)

Parking:

Parking bays	28
Acc. bays	04
	32 Total

(Site total car parking **62** spaces)

Trees

- Existing trees retained
- Existing TPO trees (T4, T5, T6, T7) permission obtained for removal
- Indicative new trees proposed
- Denotes increased buffer as requested to form strip between River Dove and the remainder of the site
- Denotes site boundary
- 2.4m x 90m visibility splay

0 10 20 30 40 50m

1:500

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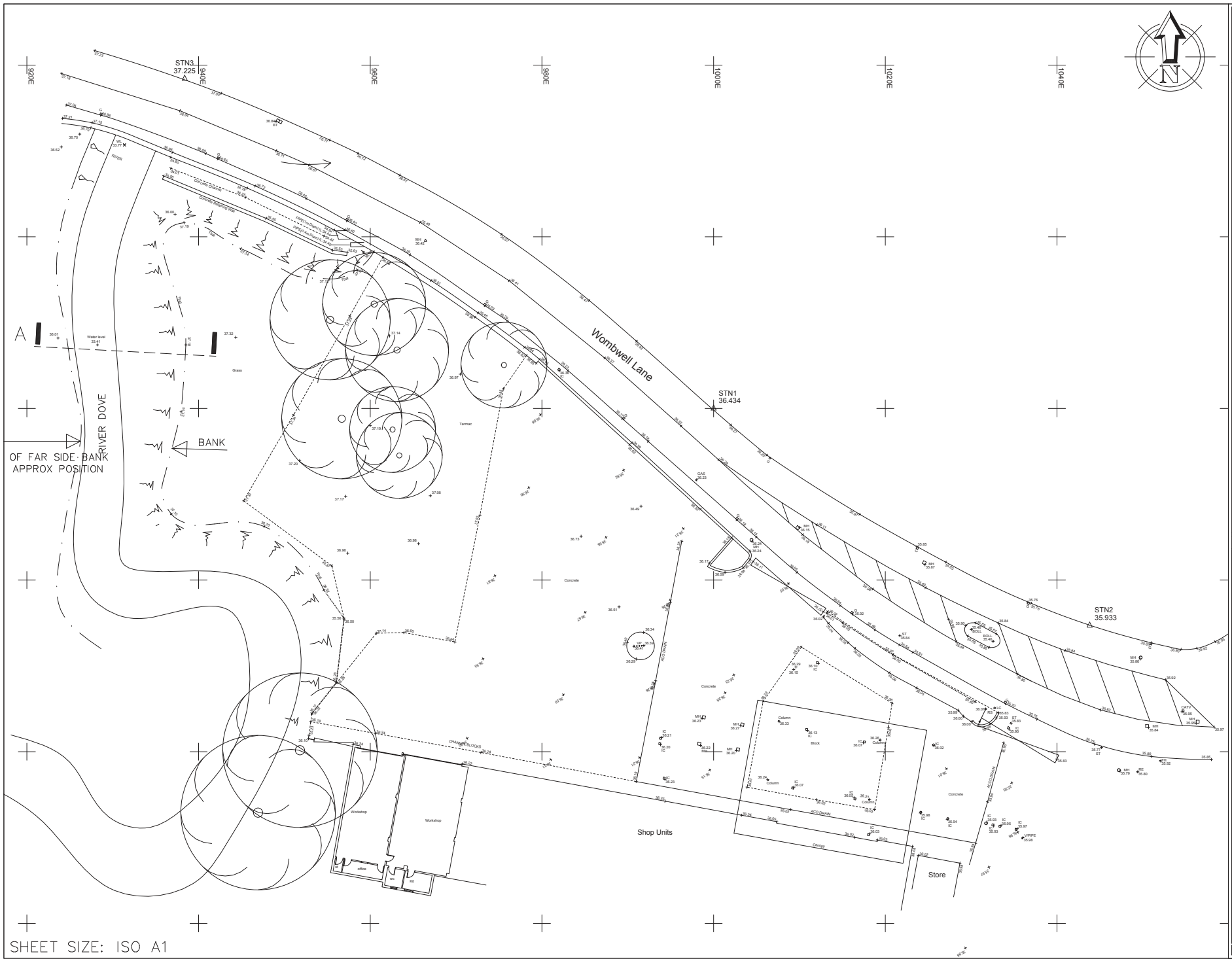
REV	DATE	DESCRIPTION	DRN	CHK

PROJECT TITLE: ALDHAM BRIDGE, WOMBWELL LANE BARNSLEY				
DRAWING TITLE: SKETCH PROPOSAL 04				
DRAWING PURPOSE: PRELIMINARY				
DRAWN / CHECKED: CY / CY	DATE: JAN 16	SCALE: 1:500 @ A3		
JOB No: 3RI1	DRAWING No: sk04	STATUS: --	REVISION: -	

APPENDIX B:	Topographic Survey



SHEET SIZE: ISO A1

NOTES:

Survey to Local Grid and OS Level datum, oriented Aprrox Grid North, originating at STN1. Level Reduced from 100.00m (original value) to 36.434m AOD using GNNS positioning.

Kerblines (surveyed at channel level)
Edge of surface, top of kerb, material change etc.
Buildings
Walls– Bk/wl Brick wall
St/wl Stone wall
Bl/wl Block wall
Co/wl Concrete wall
Ds/wl Dry stone wall
Hedgerows
Extents of Bushes, Canopies, Scrub, Foliage
Fences Bw/fe Barbed wire
Cb/fe Close boarded
Cp/fe Concrete Panel
Ir/fe Iron Railings
Mr/fe Metal Palisade
Pa/fe Timber Palisade fence
Pw/fe Post & Wire
Pr/fe Post & Rail
Pm/fe Post & Mesh
Tp/fe Timber Panel
TBAT Top of batter
BBAT Bottom of batter
Pipe Exposed Pipe/Drain
OH/** Overhead Cables-OH/BT Telecom' OH/EL Electricity
Gate
52.47 Spot level
Tree
Multi trunk from ground level
Tree Stump
STN Survey Control Station

AC	Access cover/chamber/Miscellaneous	SVMK	Stop Valve Marker
BB	Bellaha beacon	SVP	Soil vent pipe
B	Bollard	SP	Spring
BIG	Block inlet Gully	ST	Stop tap
BIN	Litter bin	STAY	Cable stay
BSTP	Bus stop	SV	Stop valve
BT	British Telecom IC	TM	Triangular manhole
CTV	Cable Television cover (small)	TCB	Telephone call box
DRAIN	Drain	TC	Telecom's chamber
ECAB	Electrical Cabinet	TL	Traffic light
ELEC	Electrical IC	TSC	Traffic signal control cover
EP	Elec. pole	TP	Telegraph pole
ER	Earth Rod	VP	Vent pipe
FLTS	Floodlight	WM	Water meter
FP	Flagpole	WO	Wash out
GP	Gate post	UTL	Unable to Lift
G	Gully		
GAS	Gas valve		
FH	Fire Hydrant		
FHMK	Fire Hydrant Marker		
IC	Inspection Cover	BL 33.58	Bed level
KO	Kerb outlet	IC 32.56	Cover level
LB	Letter box	FFL 36.52	Floor level
LC	Lamp column	IL 36.59	Invert level
LHOLE	Lamp Hole	SL 37.54	Soffit level
Mkr	Utility marker	THRESH	Threshold level
MY	Mercury Telecom IC	WL 36.24	Water level
MH	Manhole cover	Eaves	Eaves level
PM	Parking meter	Ridge	Ridge level
P	Post		
PP	Petrol pump		
RE	Reading eye		
RP	Reflector post		
RS	Road sign		
RWP	Rain water pipe		

REVISIONS

	9/11/13	

SURVEY SITE SERVICES

Survey and Site Services LLP
York Hub Popeshead Court Offices Peter Lane
York YO1 8SU
Tel: 01226 289177 Mob: 07919031290 / 07919031289
Website: www.surveysite.co.uk Email: mail@surveysite.co.uk
Brian Meggitt MRICS and Mr Hugh Morris CEng MICE
Registered in England and Wales partnership No OC309029

Client

Drawing Title

Topographical Survey
Original transformed to OS Levels

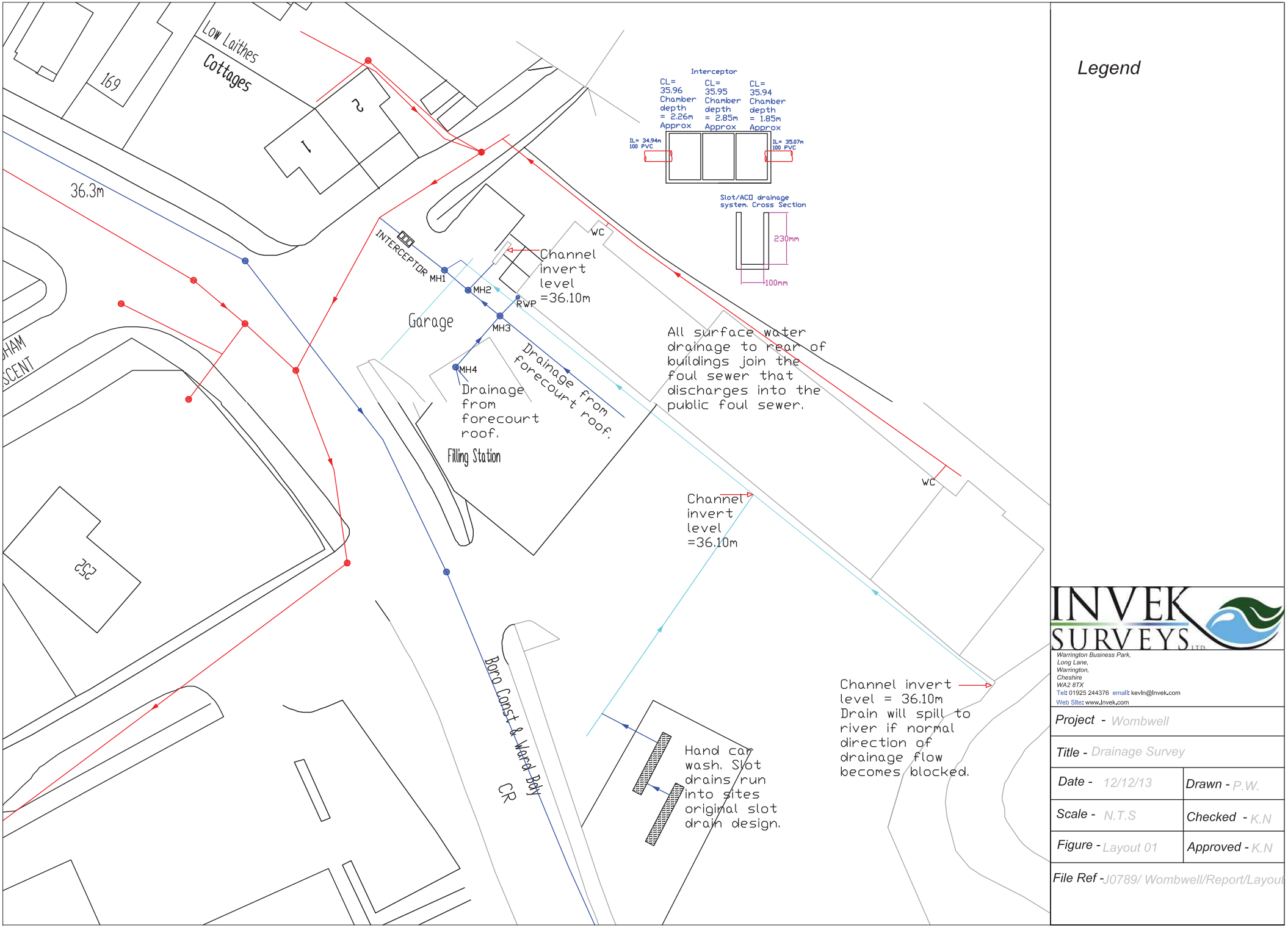
Site Address

Wombwell Lane Service Station

SCALE =1:200

Surveyed BSM	Processed BSM	Drawn BSM	Checked BSM
Drg.NoB119–S–1B		Date 11/11/2013	

APPENDIX C:	On-Site Drainage Survey



Legend

INVEK SURVEYS LTD

Warrington Business Park,
Long Lane,
Warrington,
Cheshire
WA2 8TX
Tel: 01925 244376 email: kevin@invek.com
Web Site: www.invek.com

Project - Wombwell	
Title - Drainage Survey	
Date - 12/12/13	Drawn - P.W.
Scale - N.T.S	Checked - K.N
Figure - Layout 01	Approved - K.N
File Ref - J0789/ Wombwell/Report/Layout	

APPENDIX D:	Surface Water Attenuation - Storage Volume Calculation

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.746	0.746	40.4	78.8	O K
30 min Summer	0.875	0.875	40.4	92.4	O K
60 min Summer	0.894	0.894	40.4	94.4	O K
120 min Summer	0.776	0.776	40.4	81.9	O K
180 min Summer	0.634	0.634	40.4	67.0	O K
240 min Summer	0.515	0.515	40.4	54.4	O K
360 min Summer	0.371	0.371	37.6	39.2	O K
480 min Summer	0.298	0.298	33.6	31.4	O K
600 min Summer	0.255	0.255	29.6	26.9	O K
720 min Summer	0.227	0.227	26.3	23.9	O K
960 min Summer	0.190	0.190	21.5	20.0	O K
1440 min Summer	0.150	0.150	16.0	15.8	O K
2160 min Summer	0.119	0.119	11.6	12.5	O K
2880 min Summer	0.101	0.101	9.3	10.7	O K
4320 min Summer	0.081	0.081	6.7	8.6	O K
5760 min Summer	0.069	0.069	5.3	7.3	O K
7200 min Summer	0.062	0.062	4.4	6.5	O K
8640 min Summer	0.056	0.056	3.8	5.9	O K
10080 min Summer	0.052	0.052	3.4	5.4	O K
15 min Winter	0.851	0.851	40.4	89.8	O K
30 min Winter	1.000	1.000	41.0	105.6	O K
60 min Winter	0.998	0.998	41.0	105.4	O K
120 min Winter	0.802	0.802	40.4	84.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	128.285	0.0	106.3	17
30 min Summer	84.226	0.0	139.6	27
60 min Summer	52.662	0.0	174.5	44
120 min Summer	31.800	0.0	210.8	78
180 min Summer	23.353	0.0	232.2	108
240 min Summer	18.644	0.0	247.2	138
360 min Summer	13.543	0.0	269.3	196
480 min Summer	10.792	0.0	286.2	254
600 min Summer	9.043	0.0	299.7	314
720 min Summer	7.823	0.0	311.1	372
960 min Summer	6.219	0.0	329.8	492
1440 min Summer	4.493	0.0	357.4	736
2160 min Summer	3.241	0.0	386.7	1100
2880 min Summer	2.568	0.0	408.6	1468
4320 min Summer	1.847	0.0	440.9	2184
5760 min Summer	1.461	0.0	464.8	2936
7200 min Summer	1.217	0.0	484.1	3648
8640 min Summer	1.048	0.0	500.2	4400
10080 min Summer	0.923	0.0	514.1	5120
15 min Winter	128.285	0.0	119.0	18
30 min Winter	84.226	0.0	156.3	29
60 min Winter	52.662	0.0	195.5	48
120 min Winter	31.800	0.0	236.1	84

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
180 min Winter	0.585	0.585	40.4	61.7	O K
240 min Winter	0.432	0.432	39.5	45.6	O K
360 min Winter	0.291	0.291	33.0	30.8	O K
480 min Winter	0.234	0.234	27.2	24.8	O K
600 min Winter	0.202	0.202	23.1	21.3	O K
720 min Winter	0.179	0.179	20.1	18.9	O K
960 min Winter	0.151	0.151	16.1	15.9	O K
1440 min Winter	0.119	0.119	11.7	12.6	O K
2160 min Winter	0.095	0.095	8.5	10.0	O K
2880 min Winter	0.081	0.081	6.7	8.6	O K
4320 min Winter	0.066	0.066	4.9	6.9	O K
5760 min Winter	0.056	0.056	3.8	5.9	O K
7200 min Winter	0.050	0.050	3.2	5.3	O K
8640 min Winter	0.046	0.046	2.8	4.8	O K
10080 min Winter	0.042	0.042	2.4	4.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180 min Winter	23.353	0.0	260.1	114
240 min Winter	18.644	0.0	276.9	142
360 min Winter	13.543	0.0	301.7	198
480 min Winter	10.792	0.0	320.5	256
600 min Winter	9.043	0.0	335.7	314
720 min Winter	7.823	0.0	348.5	374
960 min Winter	6.219	0.0	369.4	494
1440 min Winter	4.493	0.0	400.3	736
2160 min Winter	3.241	0.0	433.2	1100
2880 min Winter	2.568	0.0	457.6	1452
4320 min Winter	1.847	0.0	493.8	2196
5760 min Winter	1.461	0.0	520.6	2880
7200 min Winter	1.217	0.0	542.2	3632
8640 min Winter	1.048	0.0	560.2	4288
10080 min Winter	0.923	0.0	575.8	5096

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.442

Time From: (mins)	To: (mins)	Area (ha)	Time From: (mins)	To: (mins)	Area (ha)
0	4	0.295	4	8	0.147

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Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)
0.000	105.6

Hydro-Brake® Outflow Control

Design Head (m) 1.000 Hydro-Brake® Type Md5 SW Only Invert Level (m) 0.000
Design Flow (l/s) 41.2 Diameter (mm) 253

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.1	1.200	43.3	3.000	66.7	7.000	101.9
0.200	22.9	1.400	46.1	3.500	72.1	7.500	105.5
0.300	33.7	1.600	48.9	4.000	77.0	8.000	109.0
0.400	38.6	1.800	51.8	4.500	81.7	8.500	112.3
0.500	40.3	2.000	54.5	5.000	86.1	9.000	115.6
0.600	40.3	2.200	57.2	5.500	90.3	9.500	118.7
0.800	39.9	2.400	59.7	6.000	94.4		
1.000	41.0	2.600	62.1	6.500	98.2		

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