East Staffordshire Borough Council

Proposed Residential Development
Off Pennycroft Lane
Uttoxeter
Staffordshire

Flood Risk Assessment

Prepared by EWE Associates Ltd
Draft Rev0 September 2012

EWE Associates Ltd
Windy Ridge Barn
Thealby Lane
Winterton
Scunthorpe
North Lincolnshire
DN15 9TG
t: 0845 8377783
M: 07875 972270
e: lea.favill@eweassociates.com

CLIENT DETAILS

East Staffordshire Borough Council

The Maltsters
Wetmore Road
Burton upon Trent
Staffordshire
DE14 1LS

FAO Ranbir Sahota

CONTRACT

This report describes work commissioned by East Staffordshire Borough Council following written instruction dated 31st August 2012. East Staffordshire Borough Council is referred to as the Client and their representative for the contract was Ranbir Sahota. Lea Favill of EWE Associates Ltd carried out the work.

Date: 25th September 2012

Prepared by: …… ……Lea Favill
Director

REVISION HISTORY

Draft Report Rev0 issued 25th September 2012
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EXECUTIVE SUMMARY

The proposed development site is located to the north east of Uttoxeter, Staffordshire. The site is located to the west of the Dove Way and to the east of the A52 Cheadle Road. The site is currently used as a waste facility adjacent to the residential/commercial area off Pennycroft Lane. This section of the site has the Uttoxeter Brook meandering through in a west to east direction eventually discharging under the Dove Way via a large box culvert.

The site covers a total area of approximately 1.473 hectares. Ground levels within the developable site boundary vary from 79.10mOD located in the centre of the site adjacent to the Uttoxeter Brook, up to 85.05mOD located adjacent to Pennycroft Lane. The site generally slopes from the boundaries of the site towards the Uttoxeter Brook within the centre of the site. As such, any runoff within the site is likely to drain in this direction towards the Uttoxeter Brook. The existing site is predominantly paved, as such, is considered to be partially impermeable.

A preliminary proposal for the development is to construct a residential development. It is proposed that 35 residential dwellings are constructed and associated drives and access roads. The impermeable area of the proposed development will be reduced following the completion of the development; hence, the overall surface water runoff from the site will also be reduced.

The development site lies within Zone 1 of the Environment Agency Flood Map (version 2.8.2), being the zone with risk of 1 in 1,000 year (0.1% AEP) or less for river flooding.

The River Dove is located to the east of the site. The 1 in 100 year plus climate change flood level has been estimated at between 75.90mOD and 76.40mOD. The 1 in 1,000 year flood level has been estimated at between 76.45mOD and 76.64mOD.

The lowest ground level within the sites is 79.10mOD. As such during the 1 in 100 year plus climate change and the 1 in 1,000 year events the water level would be at least 2.46m below the lowest ground level within the site.

The Uttoxeter Brook flows through the centre of the site. Tabulated below are the modelled flood levels during the 1 in 100 year plus climate change flood event for the Uttoxeter Brook within the site.

Node reference	Retaining Wall Level (mOD)	Estimated 1 in 100 year +CC flood level (mOD)	Comments
2806	84.00	81.33	No flooding
2806_01	81.50	81.13	No flooding
2806_02	81.20	81.10	No flooding
2806_03	81.20	81.10	No flooding
2733	81.10	81.10	No flooding

The existing site slopes from all sides down to the lower Uttoxeter Brook. As such, the majority of the site is a considerable distance above the bank top level of the Uttoxeter Brook.

In order to comply with the Environment Agency's requirements, it is recommended that the internal finished floor level of the proposed buildings which are residential in nature, are set at a minimum of 600mm above the 1 in 100 year plus climate change flood level at the site. Therefore, based on the 1 in 100 year plus climate change flood level varying from 81.10mOD at the downstream end of the site up to 81.33mOD at the upstream end of the site the minimum internal ground floor level for the buildings should vary between 81.70mOD and 81.96mOD relative to the Uttoxeter Brook.

It is therefore considered that applying a 600mm freeboard to the 100 year plus climate change flood level for internal ground floor levels would ensure that if the downstream culvert did become blocked the internal floor level would be elevate sufficiently to ensure that the building remained dry and operational.

It is also recommended that the internal floor level is elevated at least 150mm above the finished external ground level to ensure that any localised flooding doesn't enter the new buildings.

Dry emergency access and egress is essential for the proposed residential development during extreme flood events. The dwellings and road ways will be elevated above the 1 in 1,000 year flood level thus ensuring that whole of the developed area within the site is within flood zone 1, low risk.

As such, dry access from the site will be available for pedestrians to the south west into the existing residential area off Pennycroft Lane which is presently within flood zone 1, low risk. Dry access will also be available onto Dove Way to the north east of the site.

Consideration has been given to the hierarchy for surface water disposal which recommends the SUDs approach which includes infiltration as the first tier. It is considered that infiltration drainage will be impractical solution for the site due to shallow ground water levels, made ground and contaminated ground.

However, other SUDs techniques can be used within the site and they have been considered. The second tier is to discharge to a watercourse and therefore the Uttoxeter Brook within the centre of the site is a viable option for the development.

It is considered that following the development there will be an increase in impermeable area and subsequently runoff from the site as the existing site is 57% impermeable. The impermeable area will be reduced to approximately 50% following the development.

Using WInDes Source Control software developed by Microdrainage the required attenuation has been calculated for the 1 in 100 year plus climate change (30%) event. The site was spilt into two separate areas with all areas discharging into the Uttoxeter Brook at a combined peak runoff rate of 70.6 l/s. It is proposed that 240m³ of storage is provided in the form of oversized pipes.

In conclusion there is a low risk of fluvial flooding from the Uttoxeter Brook. Incorporation of sustainable urban drainage systems should be considered where practically possible to mitigate against flooding caused by surface water runoff. Consultation must also be undertaken with the relevant water authority to establish agreements regarding the allowable peak discharges into the Uttoxeter Brook.

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1. INTRODUCTION

Terms of Reference

This report was commissioned to supplement a planning application for a proposed residential development off Pennycroft Lane within Uttoxeter, Staffordshire. The site is of a reasonable size and is presently accessed from off Pennycroft Lane. The location of the site is shown on Table 2-1.

The development site lies within Zone 1 of the Environment Agency Flood Map (version 2.8.2), being the zone with risk of 1 in 1,000 year (0.1% AEP) or less for river flooding, however is, greater than 1 hectare.

It is usual for the Agency to raise an objection to development applications within the floodplain or Zone 2 or 3 of the flood map until the question of flood risk has been properly evaluated. The Agency will also object to developments where the total site area is in excess of 1 hectare until suitable consideration has been given to surface water runoff.

Approach to the Assessment

As there are three potential sources of flood risk – the River Dove, Uttoxeter Brook and surface water runoff – it is necessary to determine flood water levels at the site for the desired return periods emanating from these sources.

The River Tean/River Dove is located to the north and east of the site. In line with the site the river is open channel. Directly upstream of the site the river passes under the A50 bypass before flowing south across the lowland area between Uttoxeter and Doveridge. The river is considered to be Main River and as such the responsibility for flood defence and land drainage lies with the Environment Agency.

The Environment Agency has been approached for modelled flood data for the river. The Environment Agency has modelled flood data which may assist in predicting the design flood level for the river adjacent to the proposed development site.

The Uttoxeter Brook meanders through the site in a north easterly direction eventually discharging into the River Dove to the east of the site. The brook is considered to be Main River and as such the responsibility for flood defence and land drainage lies with the Environment Agency.

The Environment Agency has been approached for modelled flood data for the river. The Environment Agency has modelled flood data which may assist in predicting the design flood level for the river adjacent to the proposed development site.

East Staffordshire Borough Council has completed a level 1 and level 2 Strategic Flood Risk Assessment (SFRA) for the district. The SFRA was completed by Haskoning UK Ltd with the level 1 being completed during February 2008 and the level 2 during August 2008. The SFRA has been referred to in this report, however, there a very few site specific references within the report.

The proposed development is an impermeable site. It is considered that the impermeable area within the site will be reduced following the proposed development. However, this assessment will consider the existing discharge routes from the site. An initial drainage strategy will be developed based on the existing data available. There is a site specific site investigation report available completed by BWB Consulting on behalf of East Staffordshire Borough Council during 2010.

A walk over of the site was conducted by Mr Lea Favill, Principal Engineer on 18th September 2012; during the visit a photograph survey of the site was undertaken. A topographical survey completed by Greenhatch Group, drawing 17438_OGL dated August 2012 was commissioned by EWE Associates Ltd. The survey has been calibrated to GPS.

The requirements for flood risk assessments are generally as set out in NPPF and technical guidance. The detail and complexity of the study required should be appropriate to the scale and potential impact of the development. For the purposes of this study, the following have been considered:-

- Available information on historical flooding in the area.

- Site level information.
- Details of structures, which may influence hydraulics of the watercourse and consideration of the effect of blockage of structures.
- Estimates of design levels, equivalent to a 200-year (coastal/tidal) and a 100-year (fluvial) return period flood event.
- Allowances for increased flows resulting from the effects of climate change.
- Allowances for sea level rise resulting from the effects of climate change.

Assess the existing runoff characteristics and the potential impact the proposed development will have on the runoff.

Further guidance is also provided in the CIRIA Research Project 624 "Development and Flood Risk: Guidance for the Construction Industry".

Application of Sequential & Exceptions Test

The proposed residential development site lies within Zone 1 of the Environment Agency Flood Map (version 2.8.2), being the zone with risk of less than 1 in 1,000 year (0.1% AEP) for river flooding. The site is located within an area adjacent to existing residential development. The proposed development is residential, as such, is considered to be "more vulnerable" respectively according to NPPF as shown below in Table 1-1.

Table 1-1: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability classification		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b	Exception Test required	✓	×	×	×

✓ Development is appropriate

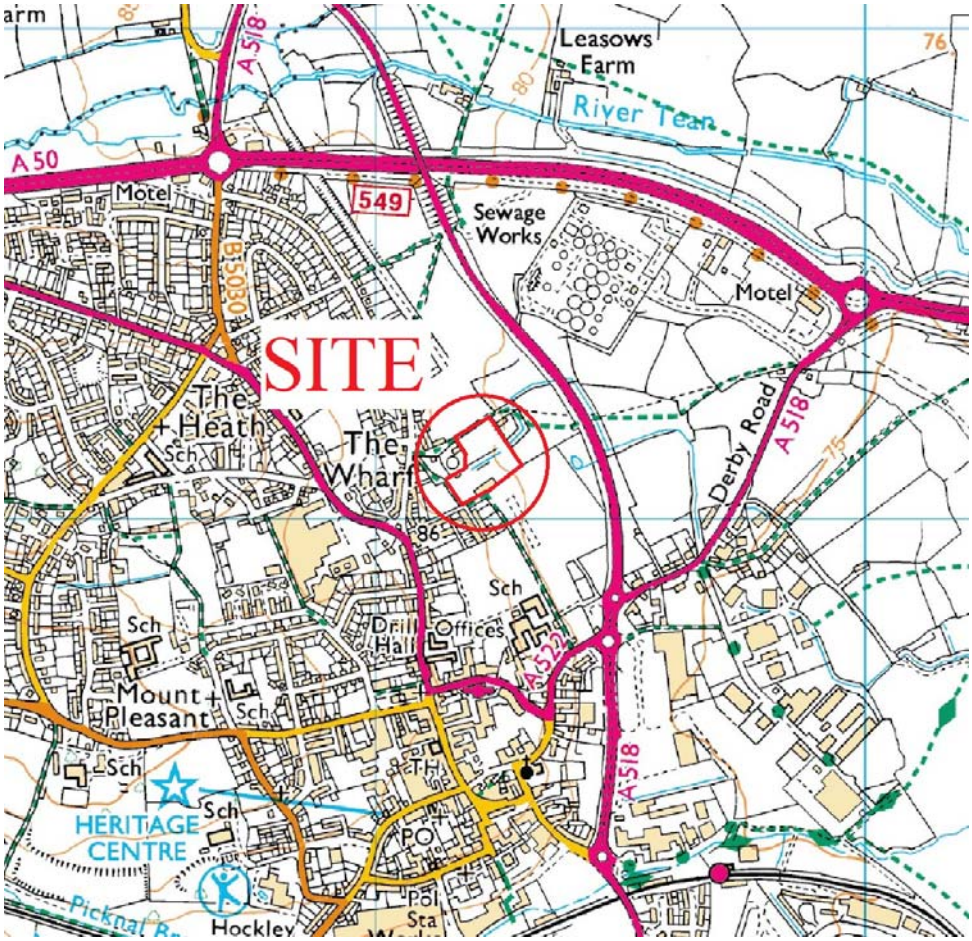
× Development should not be permitted

As the site is located within flood zone 1 low risk it is considered that a sequential and exceptions test will not be required for this development.

2. DETAILS OF THE SITE

Site Location

Table 2-1: Location Plan



Ordnance Survey Licence no.: WL1005160

Site Details

Table 2-2: Site Details

Site Name	Residential Development, Pennycroft Lane, Uttoxeter
Existing Land Use	Domestic waste facility
Proposed Development	Residential Development
Grid Reference	SK 09206 34100 centre of sites
County	Staffordshire
Local Planning Authority	East Staffordshire Borough Council
Internal Drainage Board	Not Applicable
Others	Not Applicable
Nearest Post Code	ST14 7QZ

Site Description

The proposed development site is located to the north east of Uttoxeter, Staffordshire. The site is located to the west of the Dove Way and to the east of the A52 Cheadle Road. The site is currently used as a waste facility adjacent to the residential/commercial area off Pennycroft Lane. This section of the site has the Uttoxeter Brook meandering through in a west to east direction eventually discharging under the Dove Way via a large box culvert.

Existing site levels are shown in the topographical survey in Appendix A of this report. Aerial photograph of the existing sites are shown below in Figure 2.1 which shows the existing use within the site relative to the residential area within Uttoxeter.

The site covers a total area of approximately 1.473 hectares. Ground levels within the developable site boundary vary from 79.10mOD located in the centre of the site adjacent to the Uttoxeter Brook, up to 85.05mOD located adjacent to Pennycroft Lane. The site generally slopes from the boundaries of the site towards the Uttoxeter Brook within the centre of the site. As such, any runoff within the site is likely to drain in this direction towards the Uttoxeter Brook. The existing site is predominantly paved, as such, is considered to be partially impermeable.

A preliminary proposal for the development is to construct a residential development. The proposed layout is provided at Appendix B of this report. It is proposed that 35 residential dwellings are constructed and associated drives and access roads. The impermeable area of the proposed development will be reduced following the completion of the development, hence, the overall surface water runoff from the site will also be reduced.

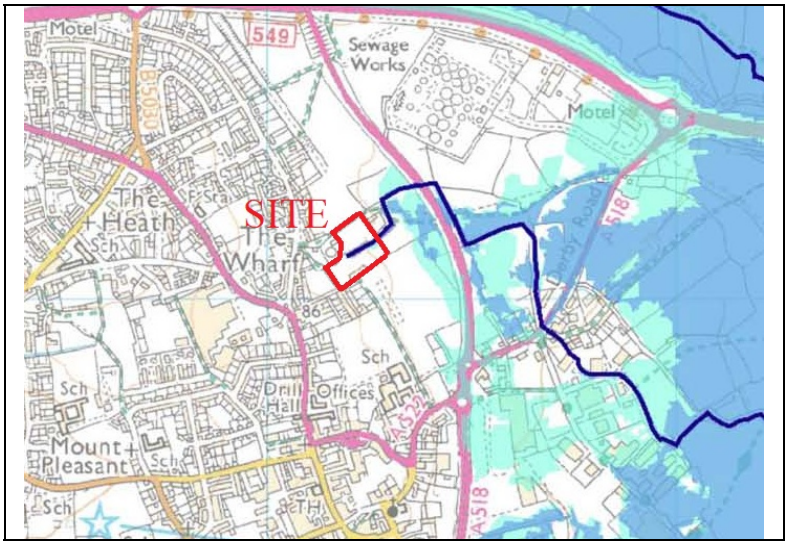
Site Photographs

Figure 2.1: Aerial Photograph of the Existing Site.

3. INITIAL ASSESSMENT

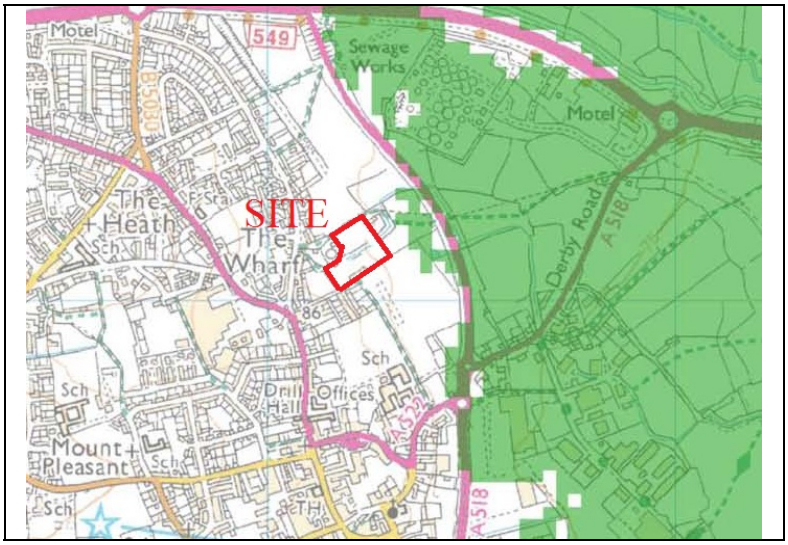
Environment Agency Flood Map

Figure 3.1: Environment Agency Flood Zones



Environment Agency Reservoir Flood Map

Figure 3.2: Environment Agency Reservoir Flood Map



Past Flooding History

A search on the British Hydrological Society Chronology of British Hydrological Events website[1] found no specific instances of flooding in the immediate vicinity of the proposed development or within the larger Uttoxeter area.

Undertaking an internet based search for flooding in the area found references to the River Dove and the River Tean flooding arable farmland within the Uttoxceter area. However, no specific instances of flooding within the immediate vicinity of the proposed development were found.

Environment Agency Flooding History

The Environment Agency provided no historical flood information close to the site.

SFRA Flooding History

The SFRA provided no historical flood information close to the site. There are thirteen references to flooding within the Uttoxeter area. The majority of these were incidents within the Picknall Brook and the River Dove.

Possible Flooding Mechanisms

As there are three potential sources of flood risk – the River Dove/River Tean, Uttoxeter Brook and surface water runoff – it is necessary to determine flood water levels at the site for the desired return periods emanating from these sources.

The River Tean is approximately 700m to the north of the site. The river is open channel with no flood defences adjacent and therefore overtopping will need to be considered. However, the A50 bypass is located between the site and the river which generally directs flood flows east towards the River Dove where the river flows beneath the A50 bypass. From here the site could potentially be flooded. As such consideration will be given to the River Dove flooding the site.

The River Dove is approximately 1400m to the east of the site. The river is open channel with no flood defences adjacent and therefore overtopping will need to be considered.

The Uttoxeter Brook meanders through the site. The brook is open channel with no flood defences adjacent and therefore overtopping will need to be considered.

The proposed development is greater than 1 hectare and as such, consideration will need to be given to potential flooding as a result of surface water runoff resulting from the proposed development. The proposed development will reduce the drained impermeable area and hence the overall surface water runoff from the site will also be reduced. However, consideration will need to be given to the existing drainage route and characteristics in order to evaluate the potential impact that surface water runoff from the site will have on the site and neighbouring land uses to inform the detailed drainage system design for the proposed development.

Due to the local topography, the site falls towards the Uttoxeter Brook. There is no significantly elevated land adjacent to the site which could result in overland flows being directed through the site. There are no significantly depressed areas which could encourage ponding and as such, these mechanisms will not be considered further for the purposes of this report.

Information on groundwater flooding is limited within the district. The site investigation report suggests that there is shallow ground water in the lower lying areas of the site. The following comment was extracted from the SFRA,

The Environment Agency's groundwater team was consulted and confirmed that there have been very few recorded incidences of groundwater flooding within East Staffordshire. The only events that have occurred are as a result of the cessation of the quarrying of gravel and sand in the area and thus the abstraction of water from the

[1] http://www.dundee.ac.uk/geography/cbhe/

pits. Once the abstraction machines were removed, the groundwater levels rose and filled some of the pits, hence the existence of the Branston Water Park. As a result of this, there has been one report regarding the occurrence of minor cellar flooding.

As such, the risk of flooding from ground water is considered to be low; however, the ground water level may influence the proposed drainage strategy within the site.

Severn Trent Water is the statutory water undertaker and is responsible for the public sewer systems within Uttoxeter area. Severn Trent Water maintains a register of historical sewer flooding events (DG5 Register) within the area. There are no report instances close to the development site.

4. FLOOD RISK ASSESSMENT

Requirements of the Environment Agency

The Environment Agency, as part of its development control procedures, generally require finished floor levels to be set above the 1% AEP plus climate change flood water level at the site. The development is residential in nature, as such it is considered that access and egress from the development site will be essential during times of extreme floods.

The Environment Agency will request that the runoff from the proposed development is restricted to the existing peak runoff rate. The existing site is considered to be 'brownfield development' hence a further 30% reduction will need to be applied to the estimated peak run off rate in order to accommodate climate change over the lifetime of the development. They will further insist that the proposed 1 in 2 year runoff can be maintained and also insist that the 1 in 30 year event is not allowed to flood the surface; hence the water must remain within the pipes, manholes, and storage systems. The 1 in 100 year plus climate change event will be allowed to flood the surface but flood water will not be permitted to enter any of the buildings within the site. The 1 in 100 year plus climate change flood must also be limited to the development boundary and must not be allowed to migrate to adjacent properties.

River Dove

The River Dove rises on the slopes of Axe Edge, close to the Leek to Buxton Road and runs southward for 45 miles to join the River Trent to the north of Burton Upon Trent. It is predominantly a rural river, flowing through Derbyshire and Staffordshire. The confluence with the River Tean is directly upstream of the A50 road bridge.

The River Dove is located approximately 1400m to the east of the site. In line with the site there are no flood defences which protect the site or Uttoxeter.

1 in 100 year flood event within the River Dove

The Environment Agency has provided modelled flood levels for the River Dove directly in line with the site. The data provided is shown at Appendix C of this report. It is considered that node references RD77D to RD75 which are in line with the site are the most representative. The 1 in 100 year flood level has been estimated at between 75.71mOD and 76.30mOD between these nodes.

The lowest ground level within the sites is 79.10mOD. As such, during the 1 in 100 year event the water level would be at least 2.8m below the lowest ground level within the site.

As such, during the 1 in 100 year flood event the site and its access route will not be flooded.

Increase in estimated flood level due to Climate Change

NPPF states that *'…Flood risk assessment should be carried out to the appropriate degree at all levels of the planning process, to assess the risks of all forms of flooding to and from development taking climate change into account. The future users of the development must not be placed in danger from flood hazards and should remain safe throughout the lifetime of the plan or proposed development and land use*.'

As part the proposed development is for a residential land use, consideration has therefore been given to take into account the potential effects of climate change over the next 100 years in accordance with NPPF. The Environment Agency provided an estimated 1 in 100 year plus climate change flood level in line with the site.

The data provided is shown at Appendix C of this report. It is considered that node references RD77D to RD75 which are in line with the site are the most representative. The 1 in 100 year plus climate change flood level has been estimated at between 75.90mOD and 76.40mOD between these nodes.

The lowest ground level within the sites is 79.1mOD. As such, during the 1 in 100 year event the water level would be at least 2.7m below the lowest ground level within the site. As such, during the 1 in 100 year plus climate change flood event the site and its access route will not be flooded.

Extreme 1 in 1,000 year flood event within the River Dove

The Environment Agency has provided modelled flood levels for the River Dove directly in line with the site. The data provided is shown at Appendix C of this report. It is considered that node references RD77D to RD75 which are in line with the site are the most representative. The 1 in 1,000 year flood level has been estimated at between 76.45mOD and 76.64mOD between these nodes.

The lowest ground level within the sites is 79.1mOD. As such, during the 1 in 1,000 year event the water level would be at least 2.46m below the lowest ground level within the site.

As such, during the 1 in 1,000 year flood event the site and its access route will not be flooded.

Uttoxeter Brook

Uttoxeter Brook rises within the centre of Uttoxeter and conveys flows north east towards the Dove Way where it turns south east towards the River Dove. The brook is generally shallow (1.5m maximum) with a narrow bed width (1.5m maximum) with steep sides. There are no flood defences or flood walls and as such relies upon the natural bank top for its defence. However, within the development site the brook is retained within a man made channel consisting of retaining walls on both left and right banks. The retaining walls do not extend above the natural ground level within the site.

1 in 100 year flood event within the Uttoxeter Brook

The Environment Agency have provided modelled flood levels for the Uttoxeter Brook from its upstream limit adjacent to Pennycroft Lane to downstream of Derby Road. The data provided is shown at Appendix D of this report.

It is considered that node references 2733 to 2806 which are in line with the site are the most representative. The 1 in 100 year flood level has been estimated at between 80.42mOD and 81.09mOD between these nodes. The flood levels for each section within the site have been tabulated below in Table 4-1.

Table 4-1: Uttoxeter Brook Estimated 1 in 100 year flood levels

Node reference	Retaining Wall Level (mOD)	Estimated 1 in 100 year flood level (mOD)	Comments
2806	84.00	81.09	No flooding
2806_01	81.50	80.52	No flooding
2806_02	81.20	80.42	No flooding
2806_03	81.20	80.42	No flooding
2733	81.10	80.42	No flooding

As such during the 1 in 100 year event the water level would be retained below the level of the retaining wall capping with a freeboard of at least 0.50m within the site.

As such during the 1 in 100 year flood event the site and its access route will not be flooded.

Increase in estimated flood level due to Climate Change

NPPF states that '*…Flood risk assessment should be carried out to the appropriate degree at all levels of the planning process, to assess the risks of all forms of flooding to and from development taking climate change into account. The future users of the development must not be placed in danger from flood hazards and should remain safe throughout the lifetime of the plan or proposed development and land use*.'

As the proposed development is for a residential land use, consideration has therefore been given to take into account the potential effects of climate change over the next 100 years in accordance with NPPF. The Environment Agency provided an estimated 1 in 100 year plus climate change flood level in line with the site.

It is considered that node references 2733 to 2806 which are in line with the site are the most representative. The 1 in 100 year plus climate change flood level has been estimated at between 80.91mOD and 81.19mOD between these nodes. The flood levels for each section within the site have been tabulated overleaf in Table 4-2.

Table 4-2: Uttoxeter Brook Estimated 1 in 100 year plus climate change flood levels

Node reference	Retaining Wall Level (mOD)	Estimated 1 in 100 year +CC flood level (mOD)	Comments
2806	84.00	81.19	No flooding
2806_01	81.50	80.93	No flooding
2806_02	81.20	80.91	No flooding
2806_03	81.20	80.91	No flooding
2733	81.10	80.91	No flooding

As such during the 1 in 100 year plus climate change event the water level would be retained below the level of the retaining wall capping with a freeboard of at least 0.29m within the site.

As such during the 1 in 100 year plus climate change flood event the site and its access route will not be flooded.

Extreme 1 in 1,000 year flood event within the Uttoxeter Brook

The Environment Agency has provided modelled flood levels for the Uttoxeter Brook from its upstream limit adjacent to Pennycroft Lane to downstream of Derby Road. The data provided is shown at Appendix D of this report.

It is considered that node references 2733 to 2806 which are in line with the site are the most representative. The 1 in 1,000 year extreme flood level has been estimated at between 81.10mOD and 81.33mOD between these nodes. The flood levels for each section within the site have been tabulated below in Table 4-3.

Table 4-3: Uttoxeter Brook Estimated 1 in 1,000 year extreme flood levels

Node reference	Retaining Wall Level (mOD)	Estimated 1 in 100 year +CC flood level (mOD)	Comments
2806	84.00	81.33	No flooding
2806_01	81.50	81.13	No flooding
2806_02	81.20	81.10	No flooding
2806_03	81.20	81.10	No flooding
2733	81.10	81.10	No flooding

As such during the 1 in 1,000 year extreme flood event the water level would be retained below the level of the retaining wall capping, however, at the downstream end of the site there would be no freeboard above the estimated flood level.

As such during the 1 in 1,000 year flood event the site and its access route will not be flooded.

Surface Water Runoff

Existing Development Site

The site includes two separate areas with the Uttoxeter Brook located between the two. Both areas are considered to be impermeable and are used for waste disposal and recycling. The combined area has been estimated at 1.473 hectares. There are several structures and buildings within the site and an extensive paved area. It has been estimated that there is 0.734 hectares of impermeable area within the site. As such, the existing site is considered to be 57% impermeable. There is formalised drainage within the site which appears to convey flows towards the Uttoxeter Brook.

During the day of the site inspection there was no signs of ground water or ponded water within the site.

Site investigation data is available for the development site which shows that the ground water level was encountered as high as 79.5mOD within the site. The report also shows the higher areas within the site are generally made ground over sands and gravels which suggest that the higher parts of the site may be suitable for infiltration drainage.

The Severn Trent Water sewer plan shows that the site is crossed by a gravity foul sewer which eventually discharge into the sewerage treatment works to the north east of the site. There are no surface water or combined sewers within the site.

Based on the above it is considered that the site will be able to practically discharge surface water to the Uttoxeter Brook by gravity. It is likely that some of the upper parts of the site will be able to discharge some runoff via infiltration. However, due to the presence of a ground water source and the level of contamination within the site it is assumed that infiltration drainage will not be acceptable in this site. It is assumed that the lower part of the site will not be able to practically discharge surface water drainage via infiltration due to the high ground water levels, the presence of made ground and alluvial clay.

The development is considered to be a 'brownfield' site, as such, the Environment Agency will require that the peak surface water runoff from the development is reduced by up to 30% following the development to accommodate for climate change over the lifetime of the development.

The runoff from the existing site has been calculated using the Modified Rational Method. The output from the spreadsheet is shown at Appendix E the estimated runoff from the site is shown below in Table 4-4 for various return periods based on an impermeable area of 0.834 hectares. Therefore applying a 30% reduction to the peak runoff of 96.22 l/s reduces the peak runoff from the site to 67.354 l/s.

Table 4-4: Modified Rational Method calculation for existing runoff

Return Period	Flow in litres per second (l/s)
1 in 2 year	96.22
1 in 30 year	228.93
1 in 100 year	335.13

For the purpose of this assessment the peak Greenfield discharge rate from the permabale parts of the site of 5 l/s/ha has been conservatively adopted. During a discussion with the Environment Agency Development Control Officer it was confirmed that this would be an appropriate discharge rate for the area. Any discharge from the site into the Uttoxeter Brook will require the consent of Environment Agency and as such they will also need to be approached to agree the discharge restriction from the site. Therefore, based on a Greenfield area of 0.6385 hectares the Greenfield contribution has been estimated at 3.2 l/s. For the purpose of this assessment the peak discharge rate from the site of 70.6 l/s (67.354 l/s + 3.2 l/s) has been conservatively adopted. Any discharge from

the site into the Uttoxeter Brook will require the consent of Environment Agency, as such, they will also need to be approached to agree the discharge restriction from the site.

Proposed Development Drainage Strategy

Due to the presence of elevated ground water within the lower parts of the site and made ground overlying Alluvial Clay it is considered that infiltration drainage is not a practical solution for the site. If soil permeabilities at the site are very low (less than 1 x 10^{-6} m/s) it will be impractical to rely on infiltration drainage to dispose of the stormwater runoff. As such, it will be necessary to adopt the discharge to the Uttoxeter Brook.

Due to the potential contamination of the ground water source only infiltration drainage has not been adopted for the site. As such the surface water drainage will be directed to a series of oversized pipes before discharging to the Uttoxeter Brook, which is located within the centre of the site, at a restricted runoff rate of 70.6 l/s.

The site has been split into areas 1 and 2 and is shown on the Drainage Strategy plan provided at Appendix F of this report.

Area 1 – Discharge to Uttoxeter Brook via oversized pipes

Area 1 which has an impermeable area of 0.3304 hectares, however, infiltration drainage is assumed to be impractical in this area and therefore a piped connection to the Uttoxeter Brook will be provided within the highway to discharge at the existing peak runoff rate. The increase in runoff will be attenuated by the introduction of an oversized pipe within the main highway. It is considered that both the pavement and roof drainage in this area will be directed to the oversized pipes.

The existing peak runoff rate from the whole site (0.834 hectares) has been estimated at 70.6 l/s which included a 30% reduction for climate change. As such, the peak restricted runoff rate for area 1 has been estimated on an area pro-rata basis. As area 1 has an area of 0.3304 hectares the peak restriction has been estimated at 31.8 l/s.

It is considered that a hydro-brake or office plate will be required prior to discharging into the sewer connection to the brook to regulate the flow. A flapped outfall will need to be constructed adjacent to the Uttoxeter Brook.

An assessment of the required balance volume has been made assuming the post development impermeable area is 0.3304 hectares. Using WinDes Source Control software developed by Microdrainage the required attenuation has been calculated for the 1 in 100 year plus climate change (30%) event. The peak discharge was set at 31.8 l/s has been used for the storage calculations within the model.

Reference should be made to Appendix G where the calculation sheets are provided. The attenuation sizes have been tabulated below in Table 4-5.

Table 4-5: Modified Rational Method balance volume for Area 1

Return Period	Attenuation Proposed	Approx Volume (m^3)
1 in 100 year + CC	Oversized pipe 130m of 1m diameter pipe	$102m^3$

The proposed drainage strategy has been annotated onto the site layout drawing provided at Appendix F which clearly shows the points of discharge from area 1 and the area proposed for the oversized pipes.

Area 2 – Discharge to Uttoxeter Brook via oversized pipes

Area 2 which has an impermeable area of 0.4031 hectares, however, infiltration drainage is assumed to be impractical in this area and therefore a piped connection to the Uttoxeter Brook will be provided within the highway to discharge at the existing peak runoff rate. The increase in runoff will be attenuated by the introduction of an oversized pipe within the main highway. It is considered that both the pavement and roof drainage in this area will be directed to the oversized pipes.

The existing peak runoff rate from the whole site (0.834 hectares) has been estimated at 70.6 l/s which included a 30% reduction for climate change. As such, the peak restricted runoff rate for area 2 has been estimated on an area pro-rata basis. As area 2 has an area of 0.4031 hectares the peak restriction has been estimated at 38.8 l/s.

It is considered that a hydro-brake or office plate will be required prior to discharging into the sewer connection to the brook to regulate the flow. A flapped outfall will need to be constructed adjacent to the Uttoxeter Brook.

An assessment of the required balance volume has been made assuming the post development impermeable area is 0.4031 hectares. Using WinDes Source Control software developed by Microdrainage the required attenuation has been calculated for the 1 in 100 year plus climate change (30%) event. The peak discharge was set at 38.8 l/s has been used for the storage calculations within the model.

Reference should be made to Appendix H where the calculation sheets are provided. The attenuation sizes have been tabulated below in Table 4-6.

Table 4-6: Modified Rational Method balance volume for Area 2

Return Period	Attenuation Proposed	Approx Volume (m^3)
1 in 100 year + CC	Oversized pipe 176m of 1m diameter pipe	138m^3

The proposed drainage strategy has been annotated onto the site layout drawing provided at Appendix F which clearly shows the points of discharge from area 2 and the area proposed for the oversized pipes.

It is proposed that the attenuation will be provided in the form of a oversized pipes, designed in accordance with the recommendations of CIRIA C697. This is considered to be the most appropriate type of attenuation facility for a development of this type.

With regard to water quality considerations for the site, it is recommended that 1 treatment train is provided for building roofs and 2 treatment trains are provided for roads and hard-standing areas in line with CIRIA C697 recommendations. For the building roof, it is proposed to use trapped drainage outlets to provide 1 treatment train.

The proposed surface water solution for the site is below ground oversized pipes with a restricted rate of discharge to the Uttoxeter Brook.

The volume balance requirements should be recalculated during the detailed design stage to reflect the actual development proposal, agreed discharge rate and the extent of impermeable areas and runoff to be generated.

SUDS

The Environment Agency requires that adequate pollution control is incorporated into the proposed drainage system in order to prevent deterioration of the quality of the water environment. However, this is only applicable for surface water originating from access roads and communal parking areas, which needs to be passed through a petrol/oil interceptor or equivalent system prior to discharge into the existing surface water sewer or infiltration system. It is noted however, that this will not apply to surface water originating from roof drainage.

To reduce the impact of surface water runoff from the development in accordance with the requirements of the Environment Agency and Local Authority, the employment of SUDS techniques to limit runoff volumes and rates from the site are recommended. SUDS techniques can also be used to provide an appropriate level of treatment to the runoff.

It is normal practice to ensure that the 1 in 30 year event is maintained within the drainage system and the 1 in 100 year is permitted to flood the surface as long as there is no flooding to buildings and the flood volume is contained within the site boundary in specific areas proposed for this purpose.

The following section will provide some possible SUDS techniques which could be employed on the site to balance flows in excess of the 1 in 30 year event. SUDS techniques will also provide treatment to the runoff to remove a proportion of the pollution and protect the quality of the downstream watercourses. Following guidance from CIRIA Report C522 the following levels of treatment will be provided:

- • Roofs – 1 level
- • Driveways – 1 level
- • Roads and communal parking areas – 2 levels.

The level of treatment indicates the number of SUDS techniques that will be used to treat pollution. For example if two levels are required the runoff may enter a filter drain that leads to a basin or pond before outfall. It is recommended that source control techniques are used. In practice there will be little outflow from these techniques for a 1 in 2 year storm as most of the rainfall will be held within the system and will disperse via evapotranspiration. Further detail of the potential to use SUDS within this site it provided below within Table 4-7.

The precise combination of methods used will be dependent upon the site constraints identified at the final design stage.

Initial data suggests that it may be impractical use infiltration drainage within the site due to the presence of shallow ground water adjacent to the Uttoxeter Brook and within the lower parts of the site. However, due to the presence of a ground water source and the potential for contamination within the adjacent site it is recommended that the whole site drains to the adjacent Uttoxeter Brook at this stage.

The impermeable area within the site will be reducing from 57% to approximately 50% following development. There will therefore be a reduction in surface water runoff from the site when it is developed. It is considered that the site currently towards the Uttoxeter Brook within the confines of the site.

The development site is considered to be of a reasonable size with space set aside, in which to incorporate appropriate SUDs techniques. As such the following SUDS techniques shown below in Table 4-7 have been considered for use at this site.

Table 4-7: SUDS Techniques

SUDs Group	Suitability for Proposed Development
Retention	✓
Wetland	✖
Infiltration	✖
Filtration	✖
Detention	✓
Open Channel	✓
Source Control	✓

Foul Water Drainage

A developer enquiry has been submitted to Severn Trent Water (STW) with regards to a foul drainage discharge from the site into the STW sewer system. The comments provided by STW are provided at Appendix I of this report which clearly states that STW do not envisage any adverse impact on the existing system due to an additional flow from the proposed 35 dwellings.

The STW response also highlights two sewers which cross the site. The current proposal provides a potential easement area adjacent to the existing sewers.

5. MITIGATION MEASURES

Raising Floor Levels/Land Raising

The River Dove is located to the east of the site. The 1 in 100 year plus climate change flood level has been estimated at between 75.90mOD and 76.40mOD. The 1 in 1,000 year flood level has been estimated at between 76.45mOD and 76.64mOD.

The lowest ground level within the sites is 79.10mOD. As such during the 1 in 100 year plus climate change and the 1 in 1,000 year events the water level would be at least 2.46m below the lowest ground level within the site.

The Uttoxeter Brook flows through the centre of the site. Tabulated below in Table 5-1 are the modelled flood levels during the 1 in 100 year plus climate change flood event for the Uttoxeter Brook within the site.

Table 5-1: Water Levels at Key Locations during unobstructed flow for Uttoxeter Brook

Node reference	Retaining Wall Level (mOD)	Estimated 1 in 100 year +CC flood level (mOD)	Comments
2806	84.00	81.33	No flooding
2806_01	81.50	81.13	No flooding
2806_02	81.20	81.10	No flooding
2806_03	81.20	81.10	No flooding
2733	81.10	81.10	No flooding

The existing site slopes from all sides down to the lower Uttoxeter Brook. As such, the majority of the site is a considerable distance above the bank top level of the Uttoxeter Brook.

In order to comply with the Environment Agency's requirements, it is recommended that the internal finished floor level of the proposed buildings which are residential in nature, are set at a minimum of 600mm above the 1 in 100 year plus climate change flood level at the site. Therefore, based on the 1 in 100 year plus climate change flood level varying from 81.10mOD at the downstream end of the site up to 81.33mOD at the upstream end of the site the minimum internal ground floor level for the buildings should vary between 81.70mOD and 81.96mOD relative to the Uttoxeter Brook.

It is therefore considered that applying a 600mm freeboard to the 100 year plus climate change flood level for internal ground floor levels would ensure that if the downstream culvert did become blocked the internal floor level would be elevate sufficiently to ensure that the building remained dry and operational.

It is also recommended that the internal floor level is elevated at least 150mm above the finished external ground level to ensure that any localised flooding doesn't enter the new buildings.

Emergency Access & Egress

Dry emergency access and egress is essential for the proposed residential development during extreme flood events. The dwellings and road ways will be elevated above the 1 in 1,000 year flood level thus ensuring that whole of the developed area within the site is within flood zone 1, low risk.

As such, dry access from the site will be available for pedestrians to the south west into the existing residential area off Pennycroft Lane which is presently within flood zone 1, low risk. Dry access will also be available onto Dove Way to the north east of the site.

Surface Water Runoff Attenuation

Consideration has been given to the hierarchy for surface water disposal which recommends the SUDs approach which includes infiltration as the first tier. It is considered that infiltration drainage will be impractical solution for the site due to shallow ground water levels, made ground and contaminated ground.

However, other SUDs techniques can be used within the site and they have been considered. The second tier is to discharge to a watercourse and therefore the Uttoxeter Brook within the centre of the site is a viable option for the development.

It is considered that following the development there will be an increase in impermeable area and subsequently runoff from the site as the existing site is 57% impermeable. The impermeable area will be reduced to approximately 50% following the development.

Using WInDes Source Control software developed by Microdrainage the required attenuation has been calculated for the 1 in 100 year plus climate change (30%) event. The site was spilt into two separate areas with all areas discharging into the Uttoxeter Brook at a combined peak runoff rate of 70.6 l/s. The attenuation sizes have been tabulated below in Table 5-2.

Table 5-2: Modified Rational Method balance volumes during 1 in 100 year +CC event

Drainage Area	Proposed Attenuation Method	Approx Volume (m^3)
Area 1	Oversized pipe 130m of 1m diameter pipe	$102m^3$
Area 2	Oversized pipe 176m of 1m diameter pipe	$138m^3$
Total		$240m^3$

It is recommended that during the detailed phase of the development the following items are considered.

- The proposed surface water drainage system should be modelled using Micro Drainage WinDes or similar. The model should be used to analysis the possibility that the design for surface water may fail or becomes block and as such should design a backup plan. Overland floodwater should be routed away from vulnerable areas. Acceptable depths and rates of flow are contained in EA and Defra document FD2320/TR2 “Flood Risk Assessment Guidance for New Development Phase 2”.

- The maintenance and adoption regimes for all elements of the development should be considered for the lifetime of the development.

- Consenting will be required from the Environment Agency for any connections/outfalls into the Uttoxeter Brook.

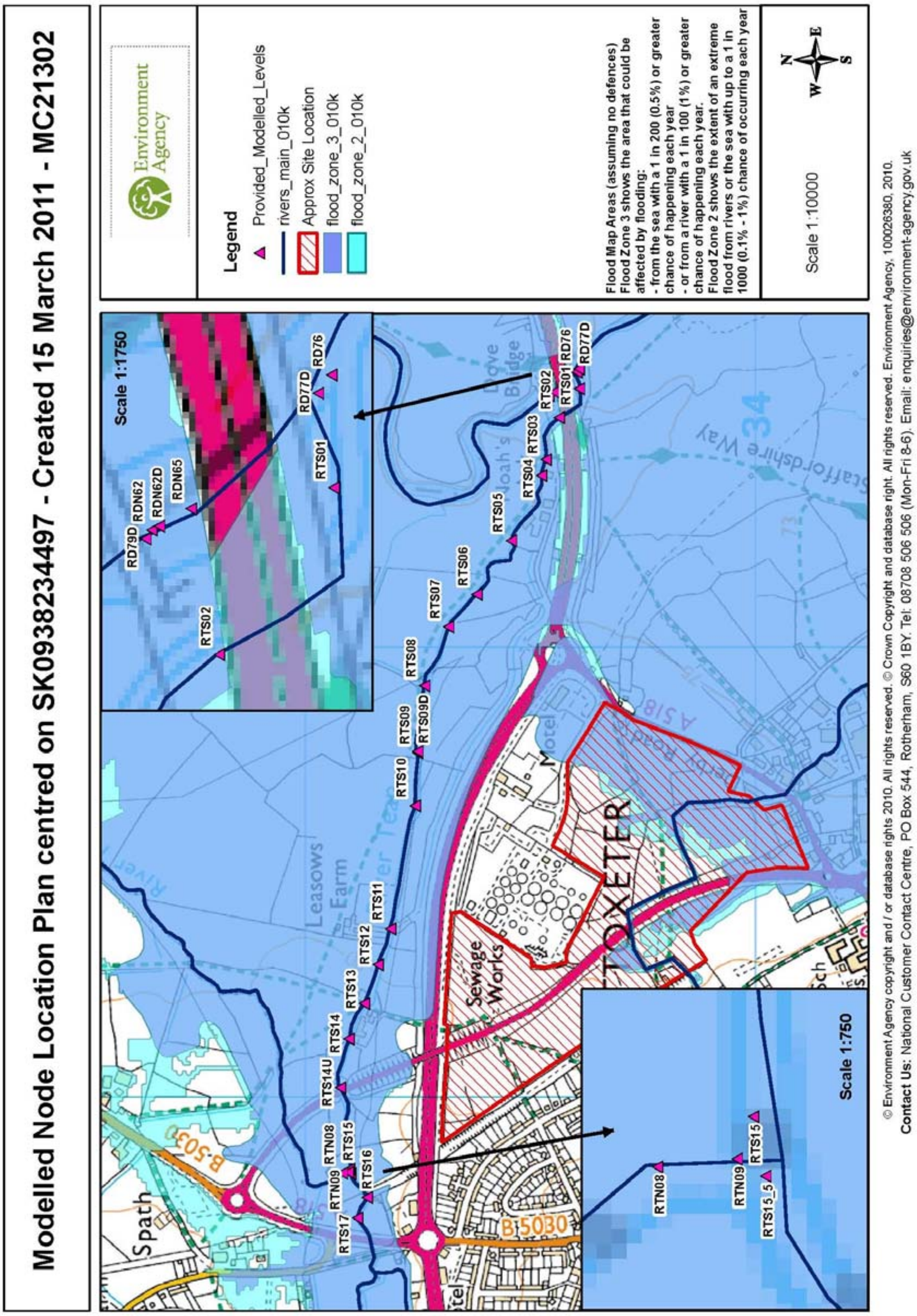
6. CONCLUSION

In conclusion there is a low risk of fluvial flooding from the Uttoxeter Brook. Incorporation of sustainable urban drainage systems should be considered where practically possible to mitigate against flooding caused by surface water runoff. Consultation must also be undertaken with the relevant water authority to establish agreements regarding the allowable peak discharges into the Uttoxeter Brook.

Appendix A: - Existing Ground Levels

Appendix B: - Proposed Layout

Appendix C: - River Dove Environment Agency Flood Data


Modelled Node Location Plan centred on SK0938234497 - Created 15 March 2011 - MC21302
Environment Agency
Legend
Provided_Modelled_Levels
rivers_main_010k
Approx Site Location
flood_zone_3_010k
flood_zone_2_010k
Flood Map Areas (assuming no defences)
Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 1 in 200 (0.5%) or greater chance of happening each year
- or from a river with a 1 in 100 (1%) or greater chance of happening each year.
Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 (0.1% - 1%) chance of occurring each year
Scale 1:10000
Scale 1:1750
Scale 1:750
UTTOXETER
Sewage Works
Leasows Farm
Spath
B5030
A518
Staffordshire Way
Dove Bridge
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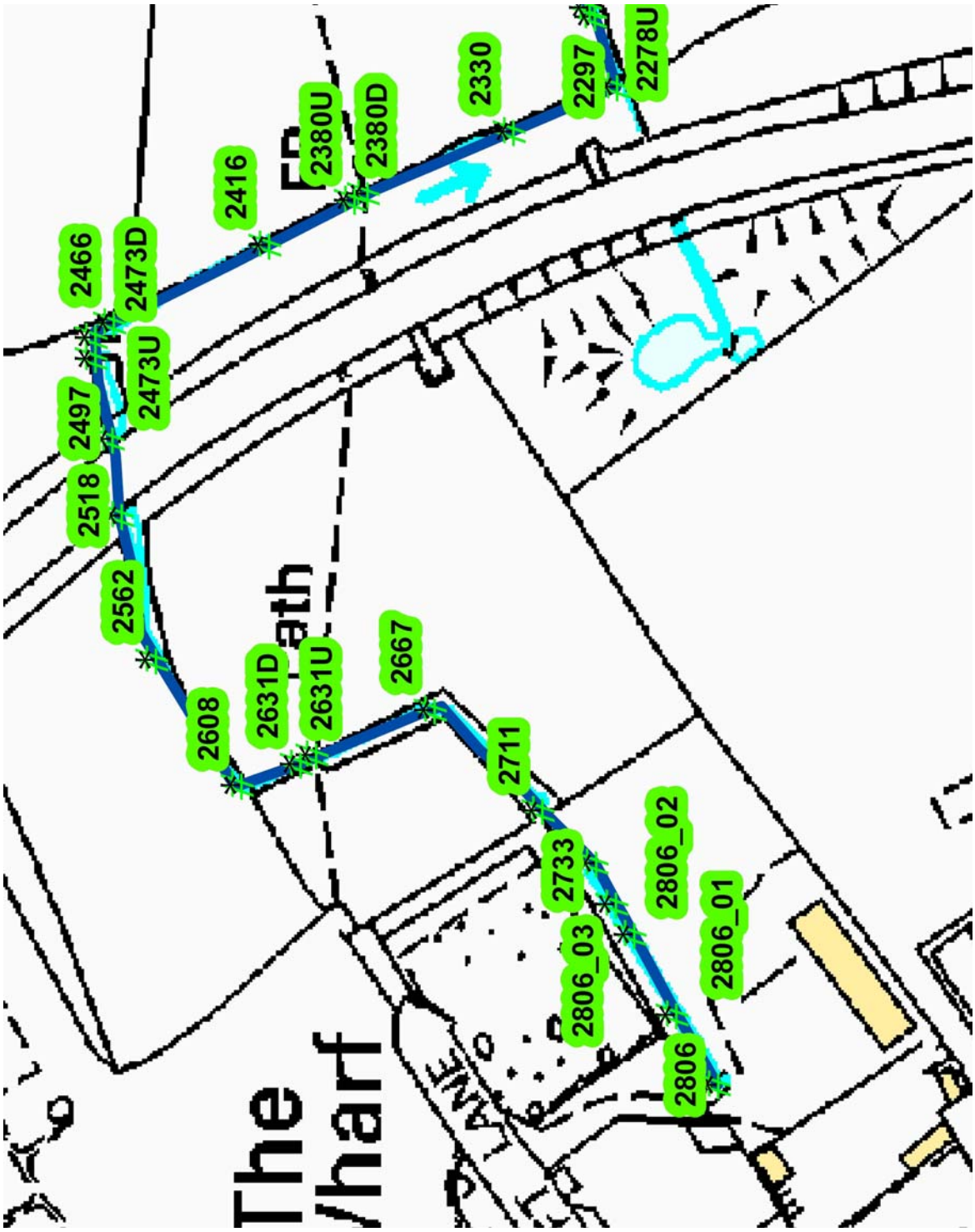
Modelled Levels - MC21302

		Return Periods (yrs) Levels (mAOD)									
		Undefended	Defended								
NodePoint	Reference	1:100_UD	1:20_D	1:50_D	1:75_D	1:100_D	1:100_cc_D	1:200_D	1:1000_D	X	Y
RD79A	River Dove Flood Risk Mapping Study 2009	77.40	76.90	77.18	77.30	77.40	77.78	77.76	78.48	410550	334471
RD79D		76.98	76.60	76.82	76.91	76.98	77.27	77.26	77.87	410556	334464
RDN62		76.93	76.57	76.78	76.86	76.93	77.21	77.20	77.75	410559	334462
RDN62D		76.67	76.33	76.53	76.61	76.67	76.94	76.93	77.47	410561	334459
RDN65		76.56	76.24	76.42	76.50	76.56	76.78	76.77	77.23	410567	334447
RD77D		76.30	76.07	76.21	76.26	76.30	76.40	76.39	76.64	410612	334397
RD76		76.19	75.96	76.09	76.15	76.19	76.27	76.27	76.42	410619	334392
RD75		75.71	75.50	75.62	75.67	75.71	75.90	75.89	76.45	410764	334212
RTS17		83.76	83.42	83.62	83.70	83.76	83.90	83.89	83.96	408732	334884
RTS16		83.10	82.94	83.06	83.08	83.10	83.16	83.15	83.20	408779	334863
RTS15_5		82.68	82.51	82.60	82.65	82.67	82.70	82.70	82.75	408831	334899
RTS15		82.54	82.42	82.47	82.51	82.54	82.59	82.58	82.64	408841	334901
RTS14		80.95	80.83	80.90	80.93	80.95	81.02	81.00	81.12	409130	334904
RTS13		80.39	80.32	80.36	80.38	80.39	80.43	80.42	80.50	409209	334869
RTS12		79.86	79.80	79.84	79.85	79.86	79.90	79.90	79.97	409296	334838
RTS11		79.46	79.41	79.44	79.45	79.46	79.51	79.50	79.57	409375	334810
RTS10		78.20	78.17	78.19	78.19	78.20	78.26	78.25	78.76	409649	334756
RTS09		77.84	77.78	77.80	77.82	77.84	78.10	78.09	78.74	409766	334750
RTS09D		77.83	77.77	77.80	77.81	77.83	78.09	78.08	78.73	409770	334751
RTS08		77.71	77.30	77.52	77.62	77.71	78.07	78.05	78.72	409915	334735
RTS07		77.70	77.25	77.50	77.61	77.70	78.06	78.04	78.71	410046	334682
RTS06		77.68	77.21	77.48	77.59	77.68	78.04	78.03	78.70	410119	334619
RTS05		77.67	77.19	77.47	77.58	77.67	78.04	78.02	78.70	410238	334542
RTS04		77.63	77.14	77.42	77.53	77.63	78.00	77.99	78.72	410382	334475
RTS03		77.62	77.12	77.41	77.52	77.62	78.00	77.98	78.64	410418	334465
RTS02		75.80	75.75	75.77	75.78	75.80	75.81	75.81	76.21	410511	334436
RTS01		76.30	76.07	76.21	76.26	76.30	76.40	76.39	76.64	410576	334391
RTN09		82.62	82.43	82.54	82.59	82.62	82.66	82.65	82.72	408834	334904
RTN08		82.55	82.35	82.47	82.52	82.55	82.58	82.58	82.65	408833	334917
RTS14U		81.45	81.37	81.42	81.44	81.45	81.49	81.48	81.56	409022	334922
RD72		73.37	73.33	73.35	73.36	73.36	73.39	73.39	73.46	411511	333301
RD71		72.95	72.82	72.89	72.92	72.95	73.03	73.03	73.28	411253	333049
RD70		72.65	72.49	72.59	72.62	72.65	72.74	72.74	72.99	411187	332657
RD74		74.90	74.79	74.86	74.88	74.90	74.96	74.96	75.10	411119	333975
RD73		74.11	74.03	74.08	74.10	74.11	74.17	74.17	74.30	411342	333731
RD74D		74.83	74.73	74.79	74.81	74.83	74.89	74.89	75.02	411116	333965

Appendix D: - Uttoxeter Brook Environment Agency Flood Data



Modelled Levels - 15/DE

	Return Periods (yrs) Modelled Levels (mAOD)							
	Defended							Undefended
Node Point	1:20yr	1:50yr	1:75yr	1:100yr	1:100yr+cc	1:200yr	1:1000yr	1:100yr
2806	81.03	81.07	81.08	81.09	81.19	81.18	81.33	81.09
2806_01	80.28	80.38	80.43	80.52	80.93	80.90	81.13	80.52
2806_02	79.70	80.06	80.25	80.42	80.91	80.88	81.10	80.42
2806_03	79.67	80.05	80.25	80.42	80.91	80.88	81.10	80.42
2733	79.66	80.05	80.24	80.42	80.91	80.88	81.10	80.42
2711	78.76	78.85	78.88	78.90	78.96	78.95	79.09	78.90
2667	78.55	78.67	78.71	78.73	78.77	78.76	78.81	78.73
2631U	78.34	78.52	78.57	78.59	78.65	78.64	78.72	78.59
2631D	78.20	78.29	78.31	78.32	78.35	78.34	78.39	78.32
2608	77.81	77.89	77.91	77.92	77.95	77.95	77.99	77.92
2562	77.41	77.49	77.52	77.53	77.56	77.56	77.61	77.53
2518	77.33	77.41	77.43	77.44	77.47	77.47	77.52	77.44
2497	77.31	77.36	77.39	77.39	77.41	77.41	77.44	77.39
2473U	77.24	77.28	77.30	77.30	77.31	77.31	77.33	77.30
2473D	77.24	77.28	77.30	77.30	77.31	77.31	77.33	77.30
2466	77.23	77.26	77.28	77.28	77.29	77.29	77.30	77.28
2416	77.21	77.24	77.26	77.26	77.26	77.26	77.26	77.26
2380U	77.00	77.10	77.14	77.15	77.16	77.15	77.17	77.14
2380D	76.98	77.06	77.09	77.09	77.11	77.10	77.12	77.09
2330	76.68	76.71	76.73	76.73	76.73	76.73	76.74	76.73
2297	76.60	76.63	76.65	76.65	76.66	76.66	76.66	76.65
2278U	76.56	76.59	76.60	76.61	76.61	76.61	76.62	76.61
2278D	76.47	76.49	76.50	76.51	76.51	76.51	76.52	76.51
2248	76.40	76.42	76.43	76.43	76.44	76.44	76.45	76.43
2217	76.35	76.37	76.38	76.38	76.39	76.39	76.40	76.38
2182	76.30	76.32	76.33	76.34	76.34	76.34	76.35	76.34
2143	76.21	76.23	76.24	76.24	76.24	76.24	76.25	76.24
2093	76.12	76.14	76.14	76.14	76.15	76.15	76.15	76.15
2049	76.08	76.10	76.11	76.11	76.11	76.11	76.11	76.11
2014	76.05	76.08	76.09	76.09	76.09	76.09	76.09	76.09
1975U	75.92	75.94	75.96	75.97	75.97	75.97	75.99	75.97
1975D	75.80	75.83	75.85	75.86	75.86	75.86	75.87	75.86
1917	75.35	75.41	75.42	75.43	75.44	75.44	75.46	75.43
1738	75.17	75.22	75.23	75.24	75.24	75.24	75.26	75.24
1684	74.98	75.05	75.06	75.07	75.07	75.07	75.09	75.07

Appendix E: - Modified Rational Runoff Calculation

Modified Rational Method

Length (m)	71	m
Area (ha)	0.834	Ha
Max Height	85.1	mAOD
Min Height	80.7	mAOD
DeltaH	4.3	
Slope (%)	6.07	
Te (mins)	8.00	mins
ARF	0.997	
SAAR	758.000	mm
UCWI	78	mm
PIMP	100.0	%
SOIL	0.40	
Percentage Runoff PR	78.28	
DEEPSTOR	0.30	

Cv	0.78284	
Cr	1.3	
allowable outflow		
2 year	96.22	l/s

Return Period flood 2 years
Post Development Rainfall 2 years

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)
0.13	0.005	5.3	5.4	40.8	96.2	115.3
0.25	0.010	6.83	7.0	27.3	64.5	77.3
0.5	0.021	8.91	9.1	17.8	42.1	50.4
0.75	0.031	10.4	10.6	13.9	32.7	39.2
1	0.042	11.6	11.8	11.6	27.4	32.8
1.25	0.052	12.61	12.8	10.1	23.8	28.5
1.5	0.063	13.51	13.7	9.0	21.3	25.5
1.75	0.073	14.32	14.6	8.2	19.3	23.2
2	0.083	15.05	15.3	7.5	17.8	21.3
2.25	0.094	15.73	16.0	7.0	16.5	19.8
2.5	0.104	16.36	16.6	6.5	15.4	18.5
2.75	0.115	16.96	17.3	6.2	14.6	17.4
3	0.125	17.52	17.8	5.8	13.8	16.5
3.25	0.135	18.05	18.4	5.6	13.1	15.7
3.5	0.146	18.56	18.9	5.3	12.5	15.0
3.75	0.156	19.04	19.4	5.1	12.0	14.4
4	0.167	19.51	19.9	4.9	11.5	13.8
4.25	0.177	19.95	20.3	4.7	11.1	13.3

Modified Rational Method

Length (m)	71	m
Area (ha)	0.834	Ha
Max Height	85.1	mAOD
Min Height	80.7	mAOD
DeltaH	4.3	
Slope (%)	6.07	
Te (mins)	8.00	mins
ARF	0.997	
SAAR	758.000	mm
UCWI	78	mm
PIMP	100.0	%
SOIL	0.40	
Percentage Runoff PR	78.28	
DEEPSTOR	0.30	

Cv	0.78284	
Cr	1.3	
allowable outflow		
30 year	228.93	l/s

Return Period flood 30 years
Post Development Rainfall 60 years

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)
0.2	0.008	19.4	19.7	97.0	228.9	274.4
0.25	0.010	23.36	23.8	93.4	220.5	264.4
0.5	0.021	28.31	28.8	56.6	133.6	160.2
0.75	0.031	31.63	32.2	42.2	99.5	119.3
1	0.042	34.21	34.8	34.2	80.7	96.8
1.25	0.052	36.34	37.0	29.1	68.6	82.3
1.5	0.063	38.18	38.9	25.5	60.1	72.0
1.75	0.073	39.8	40.5	22.7	53.7	64.3
2	0.083	41.26	42.0	20.6	48.7	58.4
2.25	0.094	42.58	43.3	18.9	44.7	53.5
2.5	0.104	43.8	44.6	17.5	41.3	49.6
2.75	0.115	44.94	45.7	16.3	38.6	46.2
3	0.125	46	46.8	15.3	36.2	43.4
3.25	0.135	46.99	47.8	14.5	34.1	40.9
3.5	0.146	47.93	48.8	13.7	32.3	38.7
3.75	0.156	48.83	49.7	13.0	30.7	36.8
4	0.167	49.67	50.5	12.4	29.3	35.1
4.25	0.177	50.48	51.4	11.9	28.0	33.6

Modified Rational Method

Length (m)	71	m
Area (ha)	0.834	Ha
Max Height	85.1	mAOD
Min Height	80.7	mAOD
DeltaH	4.3	
Slope (%)	6.07	
Te (mins)	8.00	mins
ARF	0.997	
SAAR	758.000	mm
UCWI	78	mm
PIMP	100.0	%
SOIL	0.40	
Percentage Runoff PR	78.28	
DEEPSTOR	0.30	

Cv	0.78284	
Cr	1.3	
allowable outflow		
100 year	335.13	l/s

Return Period flood 100 years
Post Development Rainfall 140 years

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)
0.2	0.008	28.4	28.9	142.0	335.1	401.7
0.25	0.010	33.48	34.1	133.9	316.1	378.9
0.5	0.021	39.71	40.4	79.4	187.4	224.7
0.75	0.031	43.82	44.6	58.4	137.9	165.3
1	0.042	46.97	47.8	47.0	110.9	132.9
1.25	0.052	49.56	50.4	39.6	93.6	112.2
1.5	0.063	51.77	52.7	34.5	81.5	97.6
1.75	0.073	53.71	54.7	30.7	72.4	86.8
2	0.083	55.44	56.4	27.7	65.4	78.4
2.25	0.094	57.01	58.0	25.3	59.8	71.7
2.5	0.104	58.46	59.5	23.4	55.2	66.2
2.75	0.115	59.79	60.8	21.7	51.3	61.5
3	0.125	61.04	62.1	20.3	48.0	57.6
3.25	0.135	62.2	63.3	19.1	45.2	54.1
3.5	0.146	63.3	64.4	18.1	42.7	51.2
3.75	0.156	64.34	65.5	17.2	40.5	48.5
4	0.167	65.33	66.5	16.3	38.5	46.2
4.25	0.177	66.27	67.4	15.6	36.8	44.1

Appendix F: - Drainage Strategy

Appendix G: - WinDes Calculation for Area 1

EWE Associates Ltd		Page 1
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		
Date 28/09/2012 13:54 File Area 1 - pipes.srcx	Designed By Lea Checked By	
Micro Drainage	Source Control W.12.4	

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m^3)	Status
15 min Summer	78.856	0.856	23.8	79.8	O K
30 min Summer	78.891	0.891	23.8	83.8	O K
60 min Summer	78.854	0.854	23.7	79.7	O K
120 min Summer	78.772	0.772	23.8	69.9	O K
180 min Summer	78.695	0.695	23.7	60.1	O K
240 min Summer	78.620	0.620	23.8	50.4	O K
360 min Summer	78.469	0.469	23.8	31.2	O K
480 min Summer	78.362	0.362	23.8	18.8	O K
600 min Summer	78.305	0.305	22.9	13.0	O K
720 min Summer	78.272	0.272	21.2	9.9	O K
960 min Summer	78.232	0.232	17.9	6.8	O K
1440 min Summer	78.189	0.189	13.4	4.2	O K
2160 min Summer	78.158	0.158	9.9	2.7	O K
2880 min Summer	78.140	0.140	7.9	2.0	O K
4320 min Summer	78.117	0.117	5.6	1.3	O K
5760 min Summer	78.103	0.103	4.4	1.0	O K
7200 min Summer	78.094	0.094	3.6	0.8	O K
8640 min Summer	78.087	0.087	3.1	0.7	O K
10080 min Summer	78.082	0.082	2.7	0.6	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	161.961	19
30 min Summer	95.610	31
60 min Summer	56.442	48
120 min Summer	33.319	84
180 min Summer	24.479	116
240 min Summer	19.669	150
360 min Summer	14.451	208
480 min Summer	11.611	260
600 min Summer	9.799	316
720 min Summer	8.531	374
960 min Summer	6.839	492
1440 min Summer	5.008	734
2160 min Summer	3.667	1100
2880 min Summer	2.940	1452
4320 min Summer	2.070	2192
5760 min Summer	1.614	2840
7200 min Summer	1.330	3672
8640 min Summer	1.136	4336
10080 min Summer	0.994	5000

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Windy Ridge Barn Thealby Lane Winterton DN15 9TG		
Date 28/09/2012 13:54	Designed By Lea	
File Area 1 - pipes.srcx	Checked By	
Micro Drainage	Source Control W.12.4	

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m^3)	Status
15 min Winter	78.962	0.962	23.8	91.1	O K
30 min Winter	79.032	1.032	23.8	96.8	O K
60 min Winter	78.977	0.977	23.8	92.4	O K
120 min Winter	78.843	0.843	23.7	78.4	O K
180 min Winter	78.719	0.719	23.8	63.2	O K
240 min Winter	78.594	0.594	23.8	47.0	O K
360 min Winter	78.363	0.363	23.8	18.9	O K
480 min Winter	78.279	0.279	21.6	10.5	O K
600 min Winter	78.241	0.241	18.7	7.4	O K
720 min Winter	78.217	0.217	16.5	5.8	O K
960 min Winter	78.188	0.188	13.3	4.1	O K
1440 min Winter	78.156	0.156	9.7	2.6	O K
2160 min Winter	78.132	0.132	7.2	1.8	O K
2880 min Winter	78.118	0.118	5.8	1.4	O K
4320 min Winter	78.100	0.100	4.1	0.9	O K
5760 min Winter	78.088	0.088	3.1	0.7	O K
7200 min Winter	78.081	0.081	2.6	0.6	O K
8640 min Winter	78.075	0.075	2.2	0.5	O K
10080 min Winter	78.071	0.071	1.9	0.4	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Winter	161.961	19
30 min Winter	95.610	31
60 min Winter	56.442	52
120 min Winter	33.319	90
180 min Winter	24.479	126
240 min Winter	19.669	160
360 min Winter	14.451	208
480 min Winter	11.611	258
600 min Winter	9.799	314
720 min Winter	8.531	372
960 min Winter	6.839	492
1440 min Winter	5.008	734
2160 min Winter	3.667	1080
2880 min Winter	2.940	1436
4320 min Winter	2.070	2180
5760 min Winter	1.614	2920
7200 min Winter	1.330	3568
8640 min Winter	1.136	4288
10080 min Winter	0.994	5104

EWE Associates Ltd		Page 3
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		
Date 28/09/2012 13:54 File Area 1 - pipes.srcx	Designed By Lea Checked By	
Micro Drainage	Source Control W.12.4	

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	409250 334050 SK 09250 34050
C (1km)	-0.029
D1 (1km)	0.373
D2 (1km)	0.365
D3 (1km)	0.268
E (1km)	0.303
F (1km)	2.377
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.330

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.200	4-8	0.130

EWE Associates Ltd		Page 4
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		
Date 28/09/2012 13:54 File Area 1 - pipes.srcx	Designed By Lea Checked By	
Micro Drainage	Source Control W.12.4	

Model Details

Storage is Online Cover Level (m) 80.000

Pipe Structure

Diameter (m) 1.000 Length (m) 130.000
Slope (1:X) 500.000 Invert Level (m) 78.000

Hydro-Brake® Outflow Control

Design Head (m) 2.000 Hydro-Brake® Type Md4 Invert Level (m) 78.000
Design Flow (l/s) 31.8 Diameter (mm) 170

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.1	1.200	24.7	3.000	39.0	7.000	59.6
0.200	14.6	1.400	26.6	3.500	42.1	7.500	61.7
0.300	22.7	1.600	28.5	4.000	45.0	8.000	63.7
0.400	23.3	1.800	30.2	4.500	47.8	8.500	65.7
0.500	21.0	2.000	31.8	5.000	50.4	9.000	67.6
0.600	19.7	2.200	33.4	5.500	52.8	9.500	69.4
0.800	20.5	2.400	34.9	6.000	55.2		
1.000	22.6	2.600	36.3	6.500	57.4		

Appendix H: - WinDes Calculation for Area 2

EWE Associates Ltd		Page 1
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		Micro Drainage
Date 28/09/2012 13:54 File Area 2 - pipes.srcx	Designed By Lea Checked By	
Micro Drainage	Source Control W.12.4	

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m^3)	Status
15 min Summer	78.833	0.833	30.2	96.5	O K
30 min Summer	78.863	0.863	30.2	101.4	O K
60 min Summer	78.830	0.830	30.2	96.0	O K
120 min Summer	78.754	0.754	30.2	83.2	O K
180 min Summer	78.679	0.679	30.2	70.3	O K
240 min Summer	78.604	0.604	30.2	57.3	O K
360 min Summer	78.464	0.464	30.2	34.3	O K
480 min Summer	78.374	0.374	30.1	21.3	O K
600 min Summer	78.323	0.323	28.4	15.0	O K
720 min Summer	78.289	0.289	26.1	11.5	O K
960 min Summer	78.248	0.248	21.9	8.0	O K
1440 min Summer	78.203	0.203	16.4	4.9	O K
2160 min Summer	78.170	0.170	12.1	3.2	O K
2880 min Summer	78.151	0.151	9.7	2.4	O K
4320 min Summer	78.126	0.126	6.8	1.6	O K
5760 min Summer	78.111	0.111	5.3	1.2	O K
7200 min Summer	78.102	0.102	4.4	1.0	O K
8640 min Summer	78.094	0.094	3.7	0.8	O K
10080 min Summer	78.089	0.089	3.3	0.7	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	161.961	19
30 min Summer	95.610	31
60 min Summer	56.442	50
120 min Summer	33.319	84
180 min Summer	24.479	116
240 min Summer	19.669	148
360 min Summer	14.451	206
480 min Summer	11.611	260
600 min Summer	9.799	316
720 min Summer	8.531	374
960 min Summer	6.839	492
1440 min Summer	5.008	734
2160 min Summer	3.667	1092
2880 min Summer	2.940	1452
4320 min Summer	2.070	2156
5760 min Summer	1.614	2848
7200 min Summer	1.330	3560
8640 min Summer	1.136	4272
10080 min Summer	0.994	5008

EWE Associates Ltd		Page 2
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		Micro Drainage
Date 28/09/2012 13:54	Designed By Lea	
File Area 2 - pipes.srcx	Checked By	
Micro Drainage	Source Control W.12.4	

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m^3)	Status
15 min Winter	78.922	0.922	30.2	110.4	O K
30 min Winter	78.971	0.971	30.2	117.5	O K
60 min Winter	78.931	0.931	30.1	111.8	O K
120 min Winter	78.813	0.813	30.1	93.2	O K
180 min Winter	78.693	0.693	30.2	72.7	O K
240 min Winter	78.566	0.566	30.2	50.9	O K
360 min Winter	78.371	0.371	30.0	20.9	O K
480 min Winter	78.295	0.295	26.6	12.1	O K
600 min Winter	78.257	0.257	22.9	8.7	O K
720 min Winter	78.233	0.233	20.1	6.8	O K
960 min Winter	78.202	0.202	16.2	4.9	O K
1440 min Winter	78.168	0.168	11.9	3.2	O K
2160 min Winter	78.143	0.143	8.8	2.1	O K
2880 min Winter	78.127	0.127	7.0	1.6	O K
4320 min Winter	78.107	0.107	4.9	1.1	O K
5760 min Winter	78.096	0.096	3.9	0.8	O K
7200 min Winter	78.087	0.087	3.2	0.7	O K
8640 min Winter	78.081	0.081	2.7	0.6	O K
10080 min Winter	78.077	0.077	2.4	0.5	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Winter	161.961	20
30 min Winter	95.610	32
60 min Winter	56.442	52
120 min Winter	33.319	90
180 min Winter	24.479	126
240 min Winter	19.669	158
360 min Winter	14.451	206
480 min Winter	11.611	258
600 min Winter	9.799	314
720 min Winter	8.531	372
960 min Winter	6.839	490
1440 min Winter	5.008	734
2160 min Winter	3.667	1092
2880 min Winter	2.940	1468
4320 min Winter	2.070	2184
5760 min Winter	1.614	2880
7200 min Winter	1.330	3672
8640 min Winter	1.136	4280
10080 min Winter	0.994	4968

EWE Associates Ltd		Page 3
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		
Date 28/09/2012 13:54 File Area 2 - pipes.srcx	Designed By Lea Checked By	
Micro Drainage	Source Control W.12.4	

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	409250 334050 SK 09250 34050
C (1km)	-0.029
D1 (1km)	0.373
D2 (1km)	0.365
D3 (1km)	0.268
E (1km)	0.303
F (1km)	2.377
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.403

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.200	4-8	0.200	8-12	0.003

EWE Associates Ltd		Page 4
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		
Date 28/09/2012 13:54 File Area 2 - pipes.srcx	Designed By Lea Checked By	
Micro Drainage	Source Control W.12.4	

Model Details

Storage is Online Cover Level (m) 80.000

Pipe Structure

Diameter (m) 1.000 Length (m) 176.000
Slope (1:X) 500.000 Invert Level (m) 78.000

Hydro-Brake® Outflow Control

Design Head (m) 2.000 Hydro-Brake® Type Md4 Invert Level (m) 78.000
Design Flow (l/s) 38.8 Diameter (mm) 187

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.3	1.200	29.9	3.000	47.2	7.000	72.1
0.200	16.0	1.400	32.2	3.500	51.0	7.500	74.6
0.300	27.0	1.600	34.5	4.000	54.5	8.000	77.1
0.400	30.2	1.800	36.6	4.500	57.8	8.500	79.4
0.500	28.0	2.000	38.5	5.000	60.9	9.000	81.8
0.600	25.6	2.200	40.4	5.500	63.9	9.500	84.0
0.800	25.3	2.400	42.2	6.000	66.7		
1.000	27.4	2.600	43.9	6.500	69.5		

Appendix I: - Severn Trent Water Information

SEVERN TRENT WATER

Severn Trent Water

East Staffordshire Borough Council
PO Box 8045
Burton Upon Trent
Staffordshire
DE14 9JG

Severn Trent Water Ltd
Regis Road
Wolverhampton
WV6 8RU

Tel: 01902 793871
Fax: 01902 793971

www.stwater.co.uk
net.dev.west@severntrent.co.uk

Contact: Dave Hadley

Your ref:
Our ref: WT31335

Fao Ranbir Sahota

04 September 2012

Dear Sirs,

Proposed Development at Pennycroft Lane, Uttoxeter, Staffordshire ST14 7BW

I refer to your Development Enquiry Request in respect of the above site. Please find enclosed the sewer records that are included in the fee together with the Supplementary Guidance Notes (SGN) referred to below.

Foul Water Drainage

The enclosed sewer record extract shows a 450mm diameter cast iron foul water sewer entering the site at manhole reference 1103. At manhole reference 1104, which is an overflow manhole, the sewers split into two 300mm diameter cast iron pipes. These continue across the site adjacent to the watercourse and leave the site at the eastern boundary as indicated diagrammatically on your sketch plan submitted.

For your information sewers of 300mm diameter up to 1000mm diameter have a 10.0 metres protected strip centred over them for which no building will be allowed to encroach. It is particularly important that the overflow manhole reference 1104 should be located in public land where it is easily accessible and not in the private garden of a property.

It is considered that the flow from 35 units will not have an adverse impact on the existing system. Any connections will be subject to formal S106 approval (see later). To note, there are no reported sewer flooding incidents in close proximity to the site.

Registered in England & Wales Registration No. 2366686
Registered Office: Severn Trent Centre, 2 St John's Street, Coventry CV1 2LZ
www.stwater.co.uk

SEVERN TRENT WATER

Severn Trent Water

Surface Water Drainage

The enclosed sewer record extract indicates a watercourse running through the middle of the site with 975mm and 375mm diameter surface water sewers connecting to this from the west. The above mentioned protected strips apply for these sewers. In the event that following comprehensive testing, it is demonstrated that soakaways would not be possible, evidence should be submitted. This would satisfy SGN1 (enclosed). As the site is effectively Greenfield a connection to the watercourse will then be necessary with flow rates in accordance with SGN3 at 5.0 l/s/ha or such other flow rate as directed by the Environment Agency or Local Authority Planning Department.

For any new connections (including the re-use of existing connections) to the public sewerage system, you will need to submit a Section 106 application form. Our New Connections department are responsible for handling all such enquiries and applications. To contact them for an application form and associated guidance notes please call 0800 7076600 or download from www.stwater.co.uk.

Please quote WT31335 in any future correspondence (including e-mails) with STW Limited. Please note that 'Development Enquiry' responses are only valid for 6 months from the date of this letter.

Yours sincerely

D J Hadley
Waste Water Services - Asset Protection (West)

Registered in England & Wales Registration No. 2366686
Registered Office: Severn Trent Centre, 2 St John's Street, Coventry CV1 2LZ
www.stwater.co.uk

SUPPLEMENTARY GUIDANCE NOTES

In 2006 the Government issued national advice in the form of "Planning Policy Statement 25: Development and Flood Risk" that seeks to reduce the impact of development on surface water runoff. This advice is generally followed by Local Authorities through both the Building Regulations (Approved Document H) and the imposition of appropriate planning conditions. Severn Trent welcomes this advice and supports such planning conditions that impose flow restrictions. It is considered that in accordance with current guidance disposal of storm runoff from the development should be dealt with as follows:

1. By soakage into the site's subsoil, subject to suitable ground soakage capacity and any contamination present. If ground soakage proves inadequate, evidence should be submitted to Severn Trent Water. The evidence should be either percolation test results or a statement from the SI consultant (extract from report or a supplementary letter) stating that soakaways would be ineffective. **A connection to public sewerage (existing or adoptable) would then be considered reasonable with flows as:**

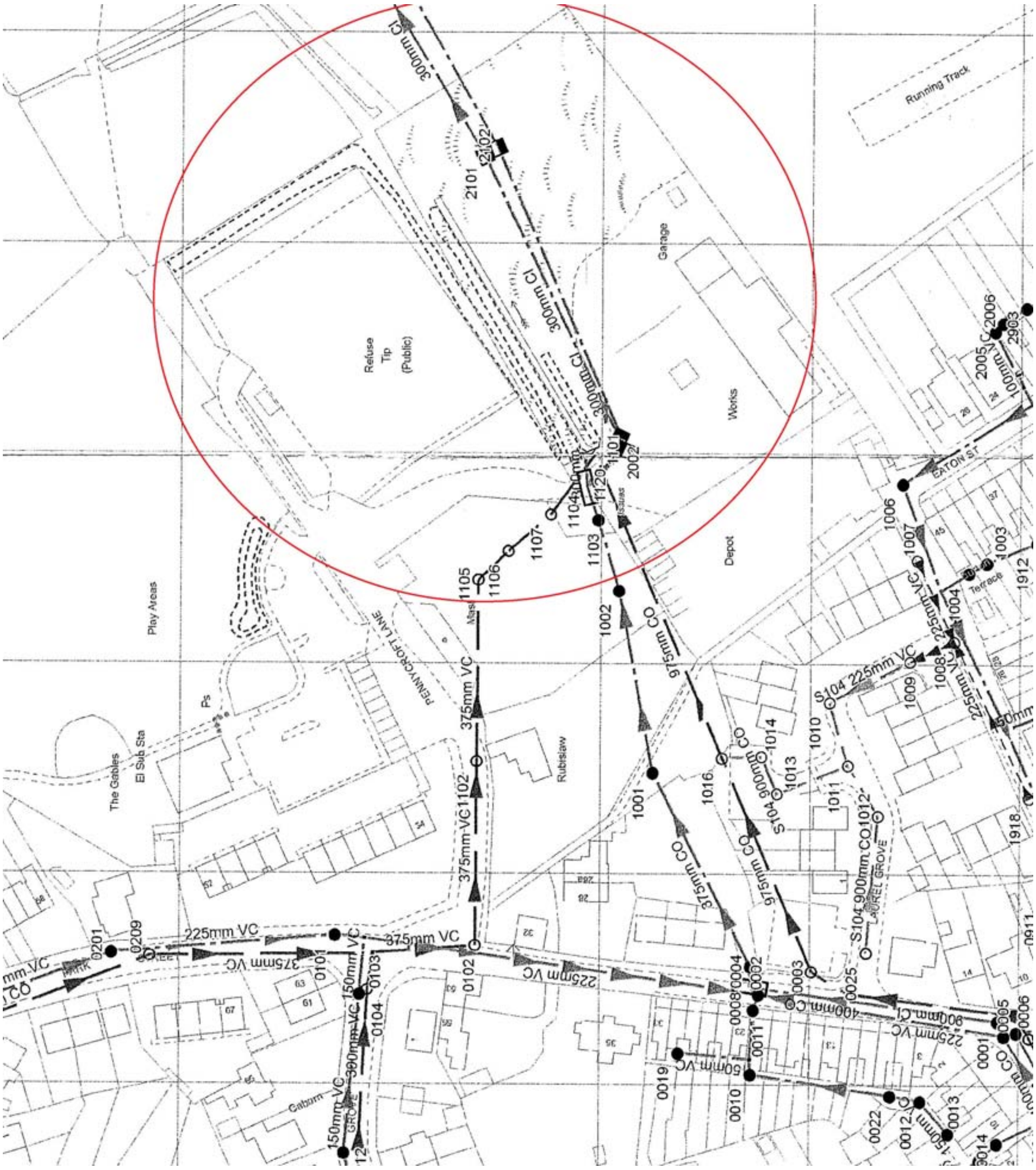
2. Brown field development site: If storm runoff from the existing development is connected to the public sewerage system, then peak storm flows from the proposed development up to that generated from the previous connected impermeable area may be connected to the network subject to the details of the existing storm connection arrangements being submitted to Severn Trent Water.

   For existing storm connections to the public foul sewerage system, any new storm connection to the public storm sewerage system (if available) should be limited to 5 litres/sec/ha (option A) OR a peak flow to be determined by the Company from its developer-funded hydraulic modelling of the public storm sewerage system (option B). The developer may choose either option. Existing flows should be assessed as the lower of $Q=2.78x50xA_{imp}$ l/s (A_{imp} ha) and the unsurcharged capacity of the outfall pipe(s).

   In addition to this restriction, for Brownfield developments, the Company would also suggest a reduction in surface water flow to the public sewerage systems of 20%. It should be noted that the Company would like to see any flow attenuation based on a 30 year critical duration storm design in accordance with 'Sewers for Adoption' current edition.

3. Green field development site: If the site is a green field development i.e. not involving any demolition of buildings or paved areas connected to the public sewerage system, then the storm runoff from the proposed development may be connected to the public sewerage system subject to peak storm flows (30 year design storm) being limited to a green field runoff of 5 litres/sec/ha (subject to a minimum of 5 litres/sec), applied to the gross area of the site, subject to sufficient capacity in the network.

17/07/2012 Version 1.5


Running Track
Refuse Tip (Public)
Garage
Works
Depot
Play Areas
Pennycroft Lane
Rubislaw
The Gables
El Sub Sta
Eaton St
300mm CI
975mm CO
375mm VC
225mm VC
375mm CO