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environmental consultants

# PPS25: Flood Risk Assessment

## Barnsley College, Honeywell Site



May 2009

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'Experience and expertise working in union'

Enzygo Limited
STEP Business Centre
Wortley Road
Deepcar
Sheffield
S36 2UH

Tel: 0114 290 3677
Tel/Fax: 0114 290 3688
Email: mail@enzygo.com
www: www.enzygo.com

# PPS25: Flood Risk Assessment

# Barnsley College, Honeywell Site

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|---|---|
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| Site: | Honeywell Lane, Barnsley |
| For: | Barnsley College |
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| Author: | Keelan Serjeant, Senior Consultant |
| Reviewer: | Matt Travis, Director |

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# 1.0 INTRODUCTION

## 1.1 Background

At the request of Barnsley College, a Flood Risk Assessment (FRA) has been undertaken, in accordance with UK PPS25[1]: Development and Flood Risk, for the proposed development at Honeywell Lane, Barnsley, South Yorkshire (Drawing 1).

It is recognised that developments that are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. Current guidance on development and flood risk[2] identifies several key aims for a development to ensure that it is sustainable in flood risk terms. These aims are as follows:

- the development should not be at a significant risk of flooding and should not be susceptible to damage due to flooding;
- the development should not be exposed to flood risk such that the health, safety and welfare of the users of the development, or the population elsewhere, is threatened;
- normal operation of the development should not be susceptible to disruption as a result of flooding;
- safe access to and from the development should be possible during flood events;
- the development should not increase flood risk elsewhere;
- the development should not prevent safe maintenance of watercourses or maintenance and operation of flood defences;
- the development should not be associated with an onerous or difficult operation and maintenance regime to manage flood risk. The responsibility for any operation and maintenance required should be clearly defined;
- future users of the development should be made aware of any flood risk issues relating to the development;
- the development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues;
- the development should not lead to degradation of the environment; and

1 Communities and Local Government (2006) *Planning Policy Statement 25*: Development and Flood Risk (PPS25).

2 CIRIA (2004) Funders report CP/102 Development and Flood Risk – Guidance for the Construction Industry.

- the development should meet all of the above criteria for its entire lifetime, including consideration of the potential effects of climate change.

The FRA is undertaken with due consideration of these sustainability aims.

The key objectives of the FRA are:

- To assess the flood risk to the proposed development and to demonstrate the feasibility of appropriately designing the development such that any residual flood risk to the development and its users would be acceptable;
- To assess the potential impact of the proposed development on flood risk elsewhere and to demonstrate the feasibility of appropriately designing the development such that the development would not increase flood risk elsewhere; and
- To satisfy the requirements of national planning policy guidance which require FRAs to be submitted in support of planning applications.

## 1.2 Project Scope

In order to achieve the aims outlined above, a staged approach has been adopted in undertaking this FRA, in accordance with current best practice. A screening study has initially been undertaken to identify whether there are any potential sources of flooding at the site, which may warrant further consideration. Any potential flooding issues identified in the screening study have subsequently been considered in a scoping study. The aim of the scoping study is to review all available information and provide a qualitative assessment of the flood risk to the site and the impact of the site on flood risk elsewhere.

## 1.3 Report Structure

This FRA has the following report structure:

- Section 2 identifies the sources of information that have been consulted during the FRA;
- Section 3 describes the application area including the existing and proposed development;
- Section 4 outlines the flood risk to the existing and proposed development;
- Section 5 details the site drainage and any potential impacts of the proposed development on surface water drainage;
- Section 6 presents a summary and conclusions.

# 2.0 SOURCES OF INFORMATION

## 2.1 Sources of Information

General information regarding the site setting and hydrology of the application site has been obtained from OS Landranger Map 111: Sheffield and Doncaster. The National Grid Reference of the site is 434133 406877.

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

## 2.2 Discussion with Regulators

A wide range of regulators should be consulted when carrying out an FRA. These include the Environment Agency, the Local Planning Authority, and Sewage/Water Companies. Consultation and discussions with the relevant regulators have been undertaken during this FRA.

### 2.2.1 Environment Agency

Correspondence was held with Caroline Brannan, the Environment Agency's Development Control Technical Specialist for the area. Discussions were held with regard to the nature and scale of the development and required level of flood risk assessment. It has been confirmed that the site lies within Flood Zone 1 and therefore has a low probability of flooding with less than a 1 in 1000 year (<0.1% annual probability) of river or sea flooding. Therefore the only aspect of flooding to be considered is surface water drainage.

### 2.3.2 Barnsley Metropolitan District Council

Correspondence was held with Steve Kilner at Barnsley Council with regard to flood risk. The previous scheme had established the principal of discharging surface water to the public sewer in Honeywell Lane. The council would defer to Yorkshire Water regarding this matter.

### 2.3.3 Yorkshire Water

A 'desk top' study of the site was received from Yorkshire with regards to the surface water drainage strategy for the developed site. A sewerage plan of the site and surrounding area has been received from Yorkshire Water (see Appendix 1).

# 3.0 DESCRIPTION OF THE APPLICATION AREA

## 3.1 Site Location

The site is located to the south of Honeywell Lane in Barnsley, South Yorkshire. The site is bounded by two railway lines to the east and south with housing to the west and north (see Figure 1).

The site location is shown in Drawing 1, a topographical survey showing the current site layout is shown in Appendix 3 and the proposed layout is shown in Appendix 2.

Levels on site are variable with the lowest levels being found at the entrance to Honeywell Lane.



**Figure 1 - The Site**

### 3.2 Existing Development

The site is currently occupied by a number of college buildings, new sports centre, football pitch, tennis courts and open green areas (see Figures 2 and 3).

Site levels are variable, ranging from 84m AOD at the entrance on Honeywell Lane, rising up to 94m outside of the main college building, falling to around 91m in the car park of the sports hall.

### 3.3 Site Visit

A site visit was undertaken by Enzygo during April 2009. The majority of the site is used for college buildings, with a new sports hall, tennis courts and football pitch having been constructed on the eastern side of the site.



**Figure 2 - The Tennis Courts – Proposed area for 8 Housing Units**



**Figure 3 – Existing Main College Building**

### 3.4 Proposed Development

It is understood that the application will consist of the development of two principal residential areas totalling 63 units, and four B1 units with a floor space of 2460m$^2$. The housing units are split into two areas, with the central area accommodating 54 units and the eastern side of the access road accommodating 9 units.

The overall site covers an area of approximately 7.6 hectare, including the Belle Vue development with the proposed development footprints being as follows:

- Eight Housing Units – 0.24 Ha
- Fifty Housing Units – 1.57 Ha
- Business Park – 0.9 Ha

Further information with regards to the proposed development can be found in the accompanying Design and Access Statement.

# 4.0 FLOOD RISK

## 4.1 Potential Sources of Flooding – Level 1 Screening Study

All potential sources of flooding must be considered for any proposed development. A summary of the potential sources of flooding and a review of the potential risk posed by each source at the application site is presented in Table 1.

**Table 1 - Potential Risk Posed by Flooding Sources**

| Potential Source | Potential Flood Risk at Application Site? | Potential Source | Data Source |
|---|---|---|---|
| Fluvial flooding | No | River Dearne | Environment Agency |
| Tidal flooding | No | None reported | Environment Agency |
| Flooding from rising / high groundwater | Yes | Geology | BGS Map /Envirocheck Flood |
| Overland flow flooding | Yes | Pluvial | OS Map/Envirocheck Flood |
| Flooding from artificial drainage systems | No | None reported | ---- |
| Flooding due to infrastructure failure | No | None reported | ---- |

### 4.1.1 Fluvial Flooding Sources

The River Dearne is located to the east of the site. The Dearne's headwaters are upstream of Denby Dale, it flows through Clayton West, and Darton before passing through Barnsley (see Figure 4).

Drawing 2 illustrates the flood zones, flood defence locations in relation to the development site.

Relevant catchment descriptors and other information from the FEH CD-ROM v2.0 are shown in Table 2.




**Figure 4 - Upstream catchment as shown in the FEH CD-ROM v2.0**

**Table 2 - Relevant catchment descriptors and other information from the FEH CD-ROM v2.0**

| Catchment Descriptors | Value |
|---|---|
| AREA | 119.56 $km^2$ |
| $URBEXT_{1990}$ | 0.0649 |
| SAAR | 766 mm |
| BFIHOST | 0.539 |

### 4.1.2 Flooding from rising / high groundwater

The Environment Agency has not provided any details of groundwater levels in the area. Envirocheck Flood search indicates that the British Geological Survey (BGS) flood map shows that the area has characteristics which would make it prone to groundwater flooding (see Drawing 3).

However, upon further investigation of the sites topography it is an elevated area about the surrounding area.

It is noted that the BGS flood map is to be used as a screening tool, and should not be used to inform planning decisions.

### 4.1.3 Overland flow flooding

Flooding from overland flow sources could pose a risk to the site due to its varying topography and the steepness of Honeywell Lane (see Drawing 4). The Pluvial flooding 100 year return period results indicate that Honeywell Lane in front of the site, directly before the railway line is susceptible to flooding. Since the proposed housing development (8 Units) would be higher than the road in this location, overland flow flooding has not been considered further within this FRA.

### 4.1.4 Flooding from Artifical Drainage Systems/Infrastructure Failure

There are various public combined sewers recorded crossing the site (see Appendix 3). However, these will be removed, replaced and re-located as agreed with Yorkshire Water. The new sewers have been designed to industry standards (e.g. Sewers for Adoption 6th Edition[3]) and will be located at least 3m away from the buildings, also, no records of flooding from this source have been provided by Yorkshire Water. Therefore, flooding from this source will not pose a flood risk to the development, flooding from this source has not been considered further within this FRA.

## 4.2 Environment Agency Flood Map

A review of the Environment Agency's flood maps indicates all of the site lies within Flood Zone 1 and therefore has a 'low probability' of fluvial and/or tidal flooding as shown in Drawing 3. With less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%) (see Drawing 2).

**Table 3 - Environment Agency Flood Zones and Appropriate Land use**

| Flood Zone | Probability | Explanation | Appropriate Land use |
|---|---|---|---|
| Zone 1 | Low | Less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%) | All development types generally acceptable |
| Zone 2 | Medium | Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% 0.1%) in any year | Most development type are generally acceptable |
| Zone 3a | High | A 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year | Some development types not acceptable |
| Zone 3b | 'Functional Floodplain' | Land where water has to be flow or be stored in times of flood. SFRAs should identify this zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%0 flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes) | Some development types not acceptable |

***Note:***

*The Flood Zones are the current best information on the extent of the extreme flood from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development.*

[3] Sewers for Adoption 6th Edition, WRc.

Within PPS25[4] development has been sub-divided into five categories. Applying the Flood Risk Vulnerability Classification in Table D.2 of PPS25, the development is classified as 'more vulnerable'.

In PPS25 (Table D.2 and 3) appropriate uses have been identified for the Flood Risk Zones. Table 4 of this report and Table D.1 of PPS25 states that 'more vulnerable' are appropriate within Flood Zone 1 after the completion of a satisfactory FRA.

**Table 4 - Flood Risk Vulnerability and Flood Zone 'Compatibility' as identified in Table D.3 of PPS25**

| Flood Risk Vulnerability classification (see Table D2 of PPS25) | Essential Infrastructure | Water Compatible | Highly Vulnerable | More Vulnerable | Less Vulnerable |
|---|---|---|---|---|---|
| Zone 1 | Yes | Yes | Yes | Yes | Yes |
| Zone 2 | Yes | Yes | Exception test required | Yes | Yes |
| Zone 3a | Exception test required | Yes | No | Exception test required | Yes |
| Zone 3b 'Functional Floodplain' | Exception test required | Yes | No | No | No |

***Key:***

*Yes: Development is appropriate, No: Development should not be permitted.*

### 4.3 Historic Flooding

The Barnsley Metropolitan District Council, the Environment Agency and client has stated that the area has not flooded in the past.

### 4.4 Existing and Planned Flood Defence Measures

The Environment Agency website confirms there are flood defences alongside the river Dearne at Barnsley.

### 4.5 Current and Developed Flood Risk

As noted in Section 4.2, the site lies within Flood Zone 1 and therefore has a 'low probability' of fluvial and/or tidal flooding as shown in Drawing 3. With less than 1 in 1000

[4] Communities and Local Government (2006) Planning Policy Statement 25: Development and Flood Risk (PPS25).

annual probability of river or sea flooding in any year (<0.1%). Developing the site does not change the flood zones.

Groundwater flooding, has been identified as a potential risk as detailed in section 4.1.3. However, the risk is not significant in this location due to the development sites topography and elevation. The development would not increase this risk

Flooding from overland flow has been identified as an off site risk on Honeywell Lane, adjacent to the railway bridge. The development of the site would not change this risk.

# 5.0 SITE DRAINAGE

## 5.1 Surface Water Drainage

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

## 5.2 Existing Drainage System

There are no public or combined sewers recorded crossing the site (see Appendix 1 and 2). However, precise details of the current drainage system, with regards to the drainage network is not available. It is understood that drainage currently discharges into Honeywell Lane adjacent to the current site entrance.

## 5.3 Current Runoff Rate

As noted in Section 3.2, the site is currently occupied by a number of buildings; therefore, the entire site comprises of permeable and impervious surfaces (see Figure 2). The site covers an area of approximately 7.6 hectare.

## 5.4 Post-Development Runoff Rate - Developed Site Drainage

As noted in Section 3.4, it is understood that the application will consist of the development of 63 residential units and four B1 units. The proposed site layout is shown in Appendix 3.

An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water attenuation requirements for the site. The assessment considers the impact of the site compared to current conditions. Therefore, the surface water attenuation requirement for the developed site can be determined and reviewed against existing arrangements.

In order to quantify any potential increase in surface water runoff, the Greenfield and pre-development runoff rate from the site must initially be determined. The rates of runoff have been determined using the current 'industry best practice' guidelines as outlined in the Interim Code of Practice for SUDS[5]. The recommended methodology for sites up to 50

[5] Office of the Deputy Prime Minister, National SUDS Working Group, July 2004, Interim Code of Practice for sustainable drainage systems.

hectares in area is the Institute of Hydrology Report 124 method (IoH124)[6]. The surface water runoff rates have been calculated using the Micro Drainage WinDes software suite.

This has been compared in Table 5, to the estimated rate of surface water runoff from the developed site, also calculated using the IoH124 method. The following parameters have been incorporated into the runoff calculations:

- Catchment Area: 7.6 hectare (from site development plans);
- Average Annual Rainfall (SAAR): 766mm/year;
- Soil: 0.45;
- Impermeable Areas:
    - Pre-development = 45%;
    - Post-development = 54%;
- Region No: 3.

In order to represent the change in runoff at the site as a result of the proposed development, and to ascertain the required attenuation volumes, the urban function within the IoH 124 method has been altered. It is preferable that the developed runoff rate is returned to the pre-development runoff rate, or Greenfield runoff rate (i.e. natural runoff rate). However, paragraph F10 of PPS25 Appendix F states that:

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

Following discussions with Yorkshire Water it has been agreed that surface water runoff from the developed site should not exceed 5l/s.

A review of Table 7 indicates that the proposed development, without adequate mitigation would result in increased discharges of storm water runoff.

[6] Institute of Hydrology (1994) Flood estimation for small catchments. Report no 124.

**Table 5 - Changes in the Site Runoff Characteristics**

| Annual Probability (Return Period, years) | Greenfield Runoff (l/s) | Pre-application Runoff (l/s) | Mitigated Post application Runoff (l/s) | Difference in Runoff (l/s) |
|---|---|---|---|---|
| 100% (1) | 67.1 | 74.8 | 5.0 | -68.9 |
| 50% (2) | 79.0 | 89.1 | 5.0 | -84.1 |
| 3.33% (30) | 125.0 | 137.1 | 5.0 | -132.1 |
| 1% (100) | 137.7 | 149.1 | 5.0 | -144.1 |
| 1% + Climate Change | 165.2 | 178.9 | 5.0 | -173.9 |

***Note:***

*20% added to rainfall data to account for long-term climate change as stated in PPS25. The 2 year, 30 year and 100 year annual probability events are of importance to the Water Companies and the Environment Agency when looking at sewage discharge and flood risk.*

## 5.6 Sustainable Drainage Options (SUDS)

Current guidance promotes sustainable water management through the use of SUDS. A range of SUDS options is described in Annex F of PPS25 and includes:

- Water butts
- Porous and pervious paving
- Rainwater harvesting
- Filter strips
- Wetland Areas
- Infiltration basins
- Detention basins
- Retention ponds
- Swales
- Green roofs

A hierarchy of techniques is identified[7]:

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

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

2. **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting).
3. **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site).
4. **Regional Control** – management of runoff from several sites, typically in a detention pond or wetland.

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

- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;
- improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- reducing potable water demand through rainwater harvesting;
- improving amenity through the provision of public open spaces and wildlife habitat; and
- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

## 5.7 Proposed Site Drainage - Attenuation

Storm water runoff from the new areas of development will be collected and attenuated in three separate facilities, designed to provide individual attenuation for each of the development areas (see Figure 6). Using the 5l/s discharge rate as provided by Yorkshire Water, this has been divided between the development areas and results in a discharge rate of 0.542 l/s/Ha.

The details of attenuation and parameters used in the calculations are outlined below:

- Development Area: 2.71Ha;
- Discharge Rate: 5l/s
- Impermeable area: 54%
- 100 year FEH rainfall plus 20% for climate change.

**Table 6: - Simulated Required Storage Volumes and Outflow Rates**

| Location | Maximum Simulated Storage Volume ($m^3$) | Maximum Simulated Discharge ($m^3s^{-1}$) | Top of Pond/Tank Level (mAOD) | Pond Invert Level (mAOD) |
|---|---|---|---|---|
| B1 Office Units | 180 | 0.0165 | 92.5 | 91.5 |
| 50 Units | 400 | 0.0172 | 93.0 | 92.0 |
| Eight Units - Final Discharge to SW Sewer | 540 | 0.0380 | 83.0 | 81.5 |
| | **1,120** | **0.03 (3l/s)** | | |

Table 6 demonstrates that in order to restrict runoff from the developed areas to 5l/s, storage in the order of 1,120$m^3$ would be required.

It is currently envisaged that three attenuation features will be required on site in order to provide the attenuation. The B1 office units and 63 residential units will be drained to two ponds, which have been designed with the based 300mm below the invert level in order for the ponds to remain wet and provide ecological habitat.

Further details with regard to the pond are provided within the accompanying Ecology and Landscape report.

The final attenuation feature prior to discharge offsite, will attenuate runoff from the 8 residential units at the entrance to the site. This attenuation feature is envisaged to be a combination of permeable paving and a tank to provide final attenuation before discharge off site into the public surface water sewer on Honeywell Lane.

Adoptable sewers will be designed and constructed in accordance with 'Sewers for Adoption 6th Edition. Drawing 5 provides an indicative drainage layout depicting storage areas, and outline pipe locations.

# 6.0 SUMMARY AND CONCLUSION

This report presents an FRA, in accordance with UK PPS25: Development and Flood Risk, to support a reserved matters planning application for the development at Honeywell Lane, Barnsley, South Yorkshire.

The FRA has demonstrated the following:

- The entire site lies within Flood Zone 1 and therefore has a 'low probability' of fluvial and/or tidal flooding as shown in Drawing 2. With less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
- The re-development of B1 offices and Residential Houses is classified as 'more vulnerable'.
- 'More vulnerable' uses are appropriate in Flood Zone 1.

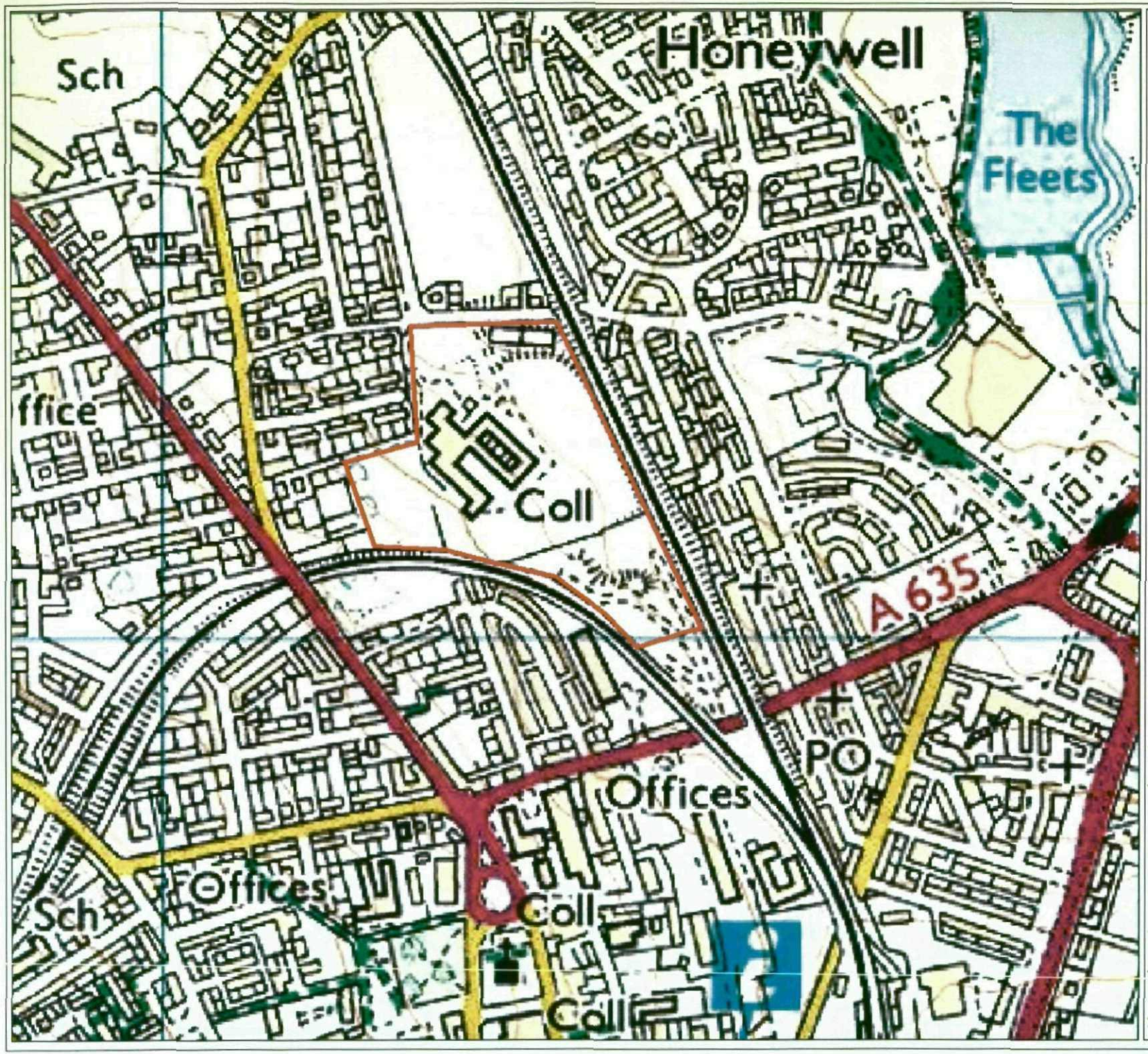
In addition, the assessment has considered the potential impact of the proposed development on surface water runoff rates. Appropriate mitigation measures to attenuate surface water have been presented. Current guidance promotes sustainable water management through the use of SUDS. The report and calculations demonstrate that in order to restrict runoff from the developed areas to 5l/s, storage in the order of 1,120m$^3$ would be required.

It is currently envisaged that three attenuation features will be required on site in order to provide the attenuation. The B1 office units and 50 residential units will be drained to two ponds, which have been designed with based 300mm below the invert level in order for the ponds to remain wet and provide ecological habitat.

The final attenuation feature prior to discharge offsite, will attenuate runoff from the eight residential units at the entrance to the site. This attenuation feature is envisaged to be a combination of permeable paving and a tank to provide final attenuation before discharge off site into the public surface water sewer on Honeywell Lane.

Attenuation to 5 l/s results in a *net reduction* of storm water by 132l/s for a 100 year storm and 62l/s for a 1 year storm. Therefore **the development of the site does not increase its flood risk and provides positive benefits by reducing flood risk in the surrounding area** by the increased level of attenuation provided.

Therefore this FRA demonstrates that the proposed development would be operated without being at risk from flooding or increasing flood risk elsewhere and is compliant with the requirements of PPS25. The development should not therefore be precluded on the grounds of flood risk.




Legend

Site Boundary

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THIS DRAWING IS NOT TO BE SCALED ALL DIMENSIONS TO BE CHECKED ON SITE DISCREPENCIES, AMBIGUITIES AND/OR OMISSIONS BETWEEN THIS DRAWING AND INFORMATION GIVEN ELSEWHERE MUST BE REPORTED IMMEDIATELY TO THIS OFFICE FOR CLARIFICATION BEFORE PROCEEDING

PROJECT: Barnsley College

TITLE: Site Location

SCALE: 1:2,500

DRAWN BY: KS

DATE: April 2009

CHECKED: MT

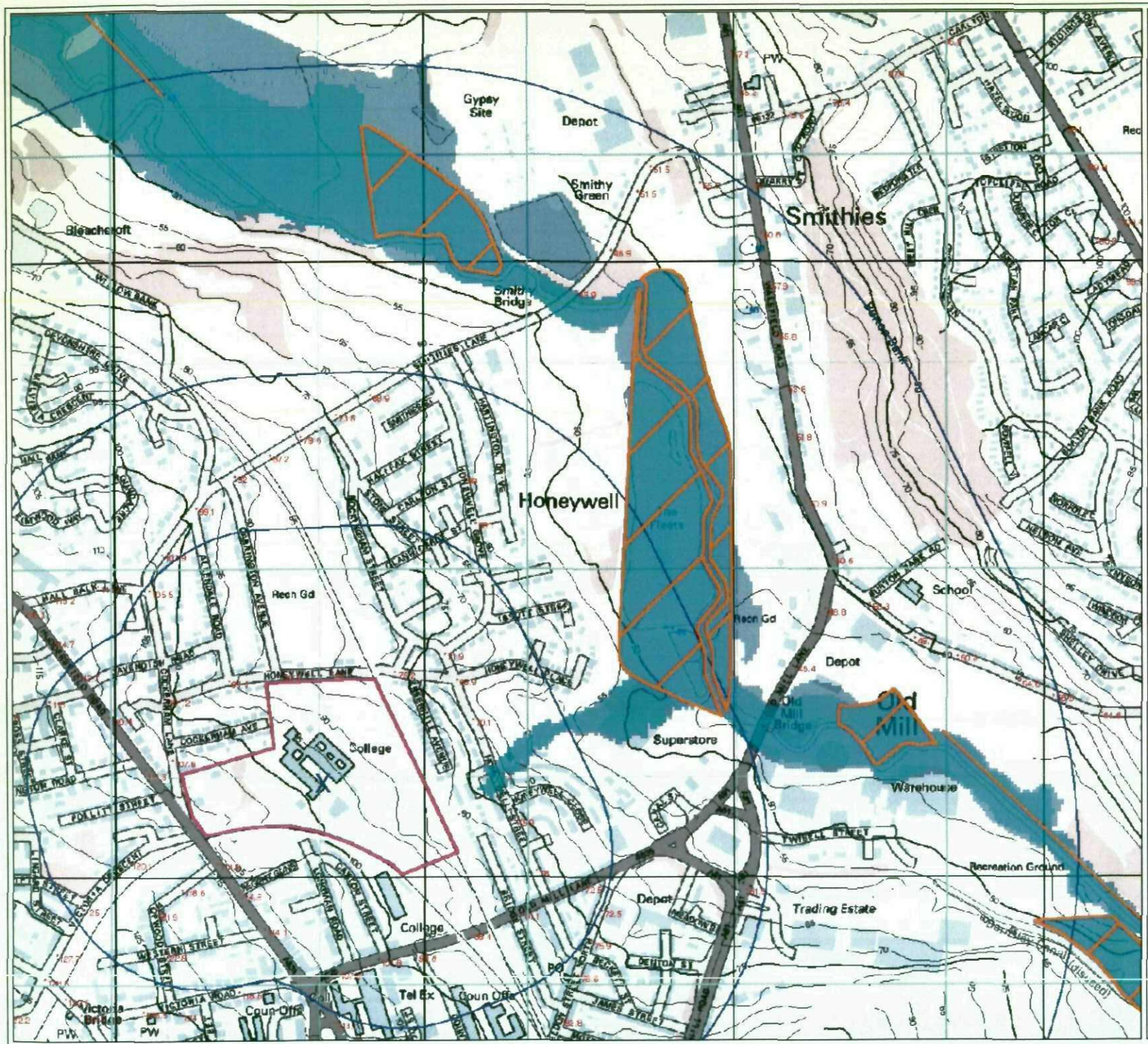
MAPINFO FILE: Projects\SHF.115.001\Drawings

PROJECT NUMBER: SHF.115.001

DRAWING NUMBER: Drawing 1

REV: A

CRPS




## EA Flood Data Map (1:10,000)

**General**

- Specified Site
- Specified Buffer(s)
- Boreline Reference Point

**Environment Agency Flood Data**

- Extreme Flooding from Rivers or Sea without Defences (Zone 3)
- Flooding from Rivers or Sea without Defences (Zone 2)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

**Contours** (height in metres)

Standard Contour — Spot Height

Index Contour — Air Height

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Wortley Road
Deepcar
Sheffield
S36 2UH

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PROJECT: Barnsley College

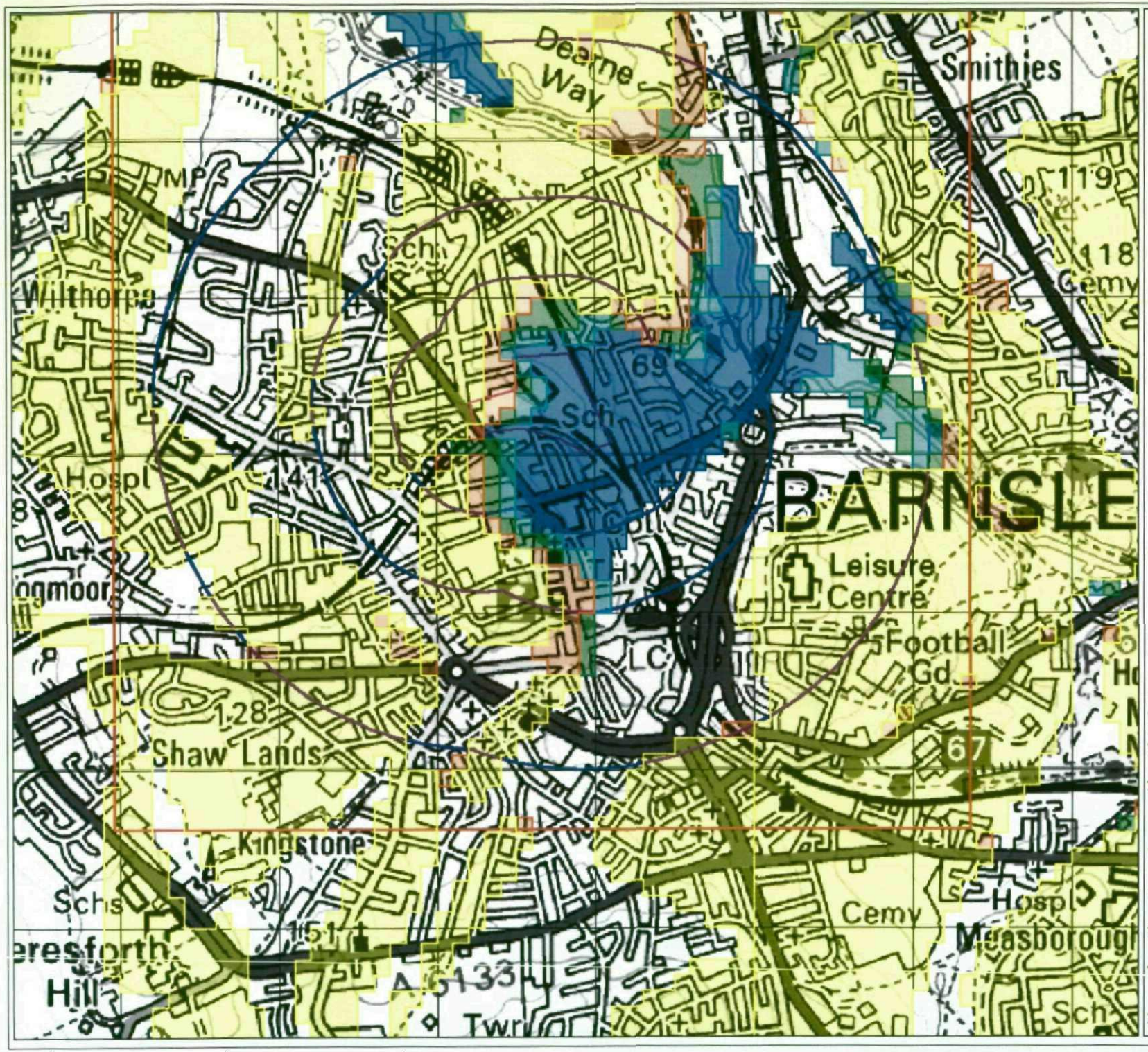
TITLE: Environment Agency Flood Information

| SCALE | DRAWN BY |
|---|---|
| 1:2,500 | KS |
| **DATE** | **CHECKED** |
| April 2009 | MT |

MAP INFO FILE: Projects\SHF.115.001\Drawings

| PROJECT NUMBER | DRAWING NUMBER | REV |
|---|---|---|
| SHF.115.001 | Drawing 2 | A |

CRS:




## General

Specified Site | Specified Buffer

Slice | Map ID

## BGS Groundwater Flooding

- High Susceptibility
- Moderately High Susceptibility
- Moderate Susceptibility
- Low Susceptibility
- Negligible Susceptibility

enzygo

STEP Business Centre
Wortley Road
Deepcar
Sheffield
S36 2UH

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PROJECT: Barnsley College

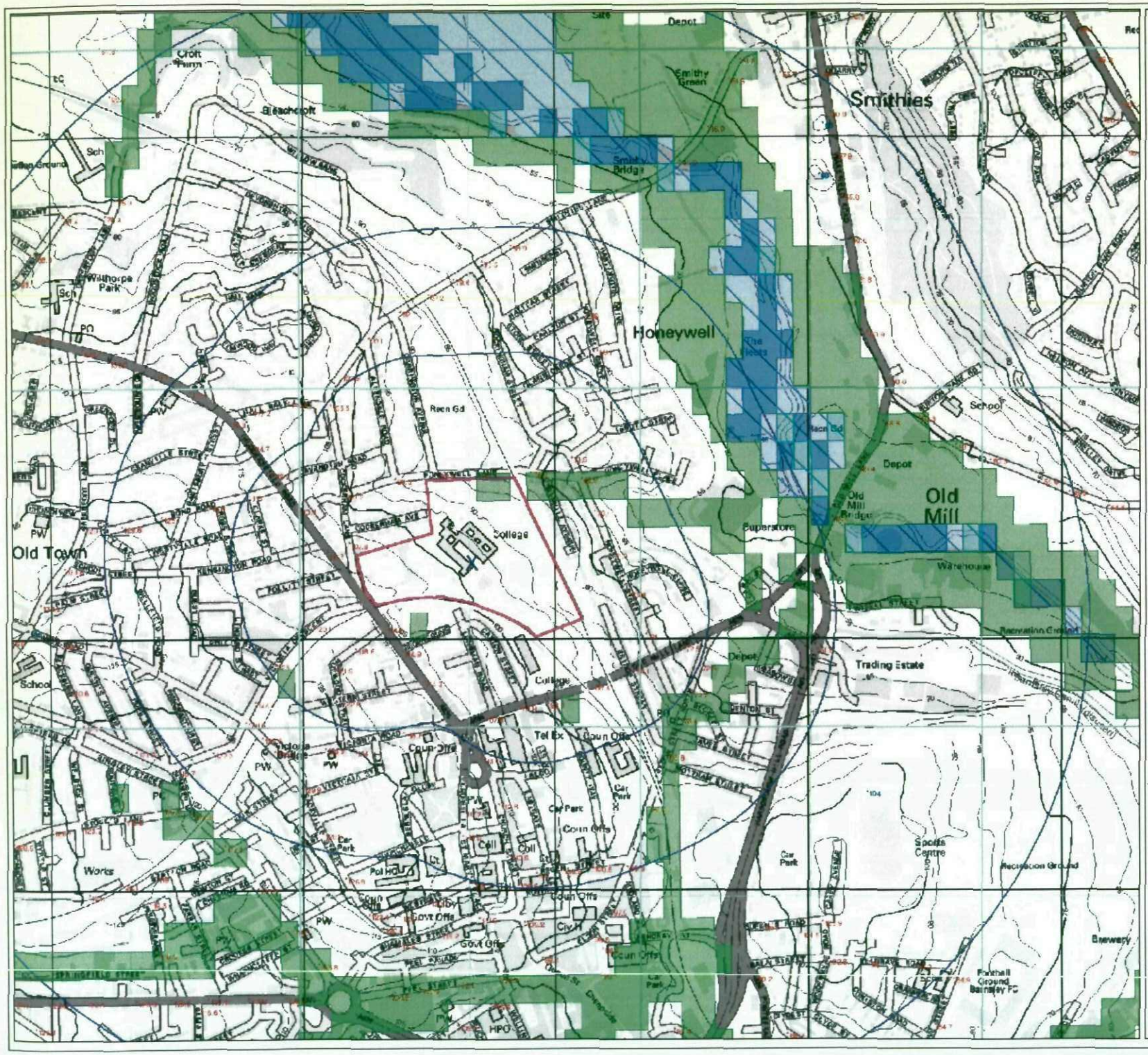
TITLE: Groundwater Flooding

| SCALE | DRAWN BY |
|---|---|
| 1:2,500 | KS |
| DATE | CHECKED |
| April 2009 | MT |

MAPINFO FILE: Projects\SHF.115.001\Drawings

| PROJECT NUMBER | DRAWING NUMBER | REV |
|---|---|---|
| SHF.115.001 | Drawing 3 | A |

CRS:




## General

Specified Site

Specified Address

Bearing Reference Point

## RMS 100 year Return Flood Data

| Flood Depth (mm) | Defended Flood | Undefended Flood | Fluvial Flood (Flood Depth) |
|---|---|---|---|
| 0 - 200 | | | |
| 201 - 500 | | | |
| 501 - 2000 | | | |
| 2001 + | | | |

Flood Type

## Contours (height in metres)

Standard Contour — Spot Height

Index Contour — Air Height

enzygo

STEP Business Centre
Worsley Road
Deepcar
Sheffield
S36 2UH

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PROJECT: Barnsley College

TITLE: Pluvial Flooding

| SCALE | DRAWN BY |
|---|---|
| 1:2,500 | KS |

| DATE | CHECKED |
|---|---|
| April 2009 | MT |

MAPINFO FILE: Projects\SHF.115.001\Drawings

| PROJECT NUMBER | DRAWING NUMBER | REV |
|---|---|---|
| SHF.115.001 | Drawing 4 | A |

CRP6




Legend

- Pipe
- Attenuation Feature

enzygo

STEP Business Centre
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Deepcar
Sheffield
S36 2UH

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PROJECT
Barnsley College

TITLE
Indicative Drainage and Storage Layout

| SCALE | DRAWN BY |
|---|---|
| nts | KS |
| DATE | CHECKED |
| April 2009 | MT |

MAPINFO FILE
Projects\SHF.115.001\Drawings

| PROJECT NUMBER | DRAWING NUMBER | REV |
|---|---|---|
| SHF.115.001 | Drawing 5 | A |

CRPS

# APPENDIX 1

## Yorkshire Water Correspondence

YorkshireWater

Land & Planning
Yorkshire Water Services Ltd
PO Box 500
Western House
Western Way
Halifax Road
Bradford
BD6 2LZ

Tel: (01274) 691111
Fax: (01274) 692643

For telephone enquiries ring:
Z Fayyaz on (01274) 692072

Assistant Director
Planning and Transportation
Barnsley Metropolitan Borough Council
Central Offices
Kendray Street
Barnsley
S70 2TN

Your Ref: B/05/1507/BA
Our Ref: F006911

13th September 2005

Dear Sir/Madam,

**Barnsley College, Honeywell Campus, Honeywell Lane, Barnsley - Proposed Mixed Use Development of Residential, Offices & Relocation of College Sports Hall & Tennis Courts**

Thank you for consulting Yorkshire Water regarding the above proposed development. We have the following comments:

If planning permission is to be granted, the following planning conditions are recommended:

**Unless otherwise agreed in writing by the local planning authority, no building or other obstruction shall be located over or within 3.0 (three) metres either side of the centre line of the water main, which crosses the site.**
**(In order to allow sufficient access for maintenance and repair work at all times.)**

**The site shall be developed with separate systems of drainage for foul and surface water on and off site.**
**(In the interest of satisfactory and sustainable drainage.)**

***No piped discharge of surface water from the application site shall take place until works to* provide a satisfactory outfall for surface water have been completed in accordance with details to be submitted to and approved by the local planning authority before development commences.**
**(To ensure that the site is properly drained and surface water is not discharged to the foul sewerage system which will prevent overloading.)**

**No development shall take place until details of the proposed means of disposal of foul and surface water drainage, including details of any balancing works and off-site works, have been submitted to and approved by the local planning authority.**
**(To ensure that the development can be properly drained.)**

**Unless otherwise approved in writing by the local planning authority, no buildings shall be occupied or brought into use prior to completion of the approved foul drainage works.**
**(To ensure that no foul water discharges take place until proper provision has been made for its disposal.)**



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UTILITY INDUSTRY ACHIEVEMENT AWARDS
Awarded for excellence

c) Where applicable, it is imperative that surface water run-off from the forecourt of petrol stations, areas used for the delivery of fuel, areas used for and immediately adjacent to vehicle washing facilities and/or other similar areas where detergent is likely to be used is not discharged to any *public surface water sewer network. Surface water from such areas should pass through an oil,* petrol and grit interceptor/separator of adequate design before discharge to the public foul or combined sewer network. A trade effluent consent - that may be conditional and, amongst other things, place a restriction on the rate of discharge to public sewer - may be required for such discharges. The developer is advised to contact Yorkshire Water's Industrial Waste Section (telephone 0845 1242429) about any such proposal.

d) If any discharge of foul water from kitchens and/or food preparation areas of any restaurants and/or canteens etc. is indicated, it should pass through a fat and grease trap of adequate design before any discharge to the public sewer network.

5a) Trade effluent may only be discharged to sewer with the prior consent of Yorkshire Water. A trade effluent is any liquid, other than domestic sewage, which is wholly or partly produced in the course of any business. The Industrial Waste Manager should be contacted as soon as possible regarding the acceptability of any proposals which may involve a trade effluent (including vehicle wash-water) or contaminated surface water discharge.

b) The developer is advised to consult with Yorkshire Water's Industrial Waste Section (telephone 0845 1242429) on any proposal to discharge a trade effluent to the public sewer network.

**Surface water from vehicle parking and hardstanding areas shall be passed through an interceptor of adequate capacity prior to discharge. Roof drainage should not be passed through any interceptor.**
**(In the interest of satisfactory drainage.)**

**Water Supply**

OBSERVATIONS:

- A water main crosses the site as shown on the enclosed plan. The presence of the main may affect the layout of the site and therefore I consider it to be a material consideration in the determination of this application. The exact line of the main will have to be determined on site under Yorkshire Water Services supervision. It may be possible for the main to be diverted under s.185 of the Water Industry Act 1991. These works would be carried out at the developer's expense. The cost of these works may be prohibitive.

- The 2" water main may be affected. It is recommended that no obstruction encroaches within 3 metres on either side of the main i.e A protected strip width of 6 metres.

- A water supply can be provided under the terms of the Water Industry Act, 1991.

- For further information and advice, the Distribution Asset Manager should be contacted at the following address: The Water Business Unit (Distribution Assets South/South East), Thorncliffe Hall/Area Office, Newton Chambers Road, Thorncliffe Park, Chapeltown, Sheffield, South Yorkshire S35 2PQ.

**Waste Water**

OBSERVATIONS:

- Development of the site should take place with separate systems for foul and surface water drainage both on and off site.

- Foul water domestic waste may discharge to the public foul/combined water sewer recorded in Honeywell Lane, at a point approximately 15 metres from the site.

- Foul water domestic waste from kitchens and/or food preparation areas of any restaurants and/or canteens etc. should pass through a fat and grease trap of adequate design before any discharge to the public sewer network.

- The foul water discharge from the proposal to the public sewer network should be **restricted** - for example, if sewage pumping is required - so as not to exceed **6 (six) litres** per second.

- In the interests of good drainage a separate outfall should be provided for the disposal of surface water where possible concerning new buildings / hardstanding areas.

- Surface water may discharge to the public surface water sewer recorded in Honeywell Lane, at a point approximately 10 metres from the site, however, on-site storage/balancing - or some other means of attenuation - of the surface water will be required before any discharge to the public sewer network is permitted. The surface water discharge from the proposal to the public sewer network should be **restricted** so as not to exceed **5 (five)** litres per second.

- Surface water run-off from areas of communal vehicular parking and/or hardstanding etc. should pass through an oil, petrol and grit interceptor/separator of adequate design before any discharge. Roof water should not pass through the traditional 'stage' or full retention type of interceptor/separator. It is good drainage practice for any interceptor/separator to be located upstream of any on-site balancing, storage or other means of flow attenuation that may be required.

- An off-site foul and an off-site surface water drain may be required. These may be provided by the developer.

- From the information supplied, it is not possible to determine if the whole site will drain by gravity to the public sewer network. If the site, or part of it, will not drain by gravity, then it is likely that a sewage pumping station will be required to facilitate connection to the public sewer network.

- Furthermore, it is not possible to determine if the site is low-lying relative to the location(s) of the public sewer network. Amongst other things, where the ground level of a site or the level of any basement is below the ground level at the point where the drainage is to connect to a public sewer, the developer may have to take precautions to **prevent the risk of flooding** of the site from surcharge of the public sewer network. Such precautions may include raising the level of the site, having (a) pumped discharge(s) from the site and/or the installation of (a) anti-flooding valve(s).

- Land drainage must not be discharged to the public sewer network.

I attach some general information relating to drainage matters.

It is important that Yorkshire Water is informed of the local planning authority's decision on this application.

Please send me a copy of the decision notice.

Yours faithfully

**Stephanie Walden**
**Environmental Planning Manager**




434133 . 406877 | Map Name : SE3406NW | Title

Yorkshire Water,
PO Box 500,
Halifax Road,
Bradford BD6 2LZ
Contact Name :
MR Z FAYYAZ
Contact Tel : 01274 69264

Note:
Yws Ref No - Tec6111

| Partial Key | | |
|---|---|---|
| Water mains up to 4" in diameter | —— | The position and depths of apparatus shown on this plan are approximate only. The exact positions and depths should be obtained by excavation trial holes. |
| Water mains over 4" in diameter | —— | |
| Raw water mains | —— | |
| Private water mains | —— | Scale 1:2500 |

Based upon Ordnance Survey map data with the permission of the Controller of Her Majesty's Stationery Office, (c) Crown Copyright. Licence No. WU296581

Drg No : | Mains No :

Date Req : 13/09/2005, 15:08:18 | Date Gen : 13/09/2005, 15:08:22

Source :

UPN: WN/PLANNING/008435 Originator : Z FAYYAZ, Appraisals, 0127

YorkshireWater

**General Information**

1a) Yorkshire Water Services Limited is the Sewerage Undertaker for the area and responsible for the public sewer network together with any treatment and the disposal of the contents. The Sewerage Undertaker is not responsible for drains, private sewers, land drainage, watercourses or highway drainage.

b) Land drainage must not be discharged to the public sewer network.

c) The public sewer network - particularly the public surface water sewer network – could usually discharge to watercourse. Assuming that the Local Planning Authority is consulting with the relevant land drainage authorities, then these bodies may wish to comment on a development proposal that ultimately discharges surface water directly or indirectly to a watercourse.

2a) Where the ground level of a site or the level of any basement is below the ground level at the point where the drainage is to connect to a public sewer, the developer may have to take precautions to prevent the risk of flooding of the site from surcharge of the public sewer network. Such precautions may include raising the level of the site, having (a) pumped discharge(s) from the site and/or the installation of (a) anti-flooding valve(s).

b) Vehicular access, including large tankers, could be required at any time to any Yorkshire Water Services installations in the vicinity of the development site.

Where a sewage pumping station (SPS) is located in the vicinity of the site, there could be a loss of amenity for future residents/workers. In order to minimise the risk of odour, noise and nuisance, habitable buildings should not be located within 15 (fifteen metres) from an existing SPS. To reduce the visible impact of an installation, the erection (by the developer) of suitable screening is advised.

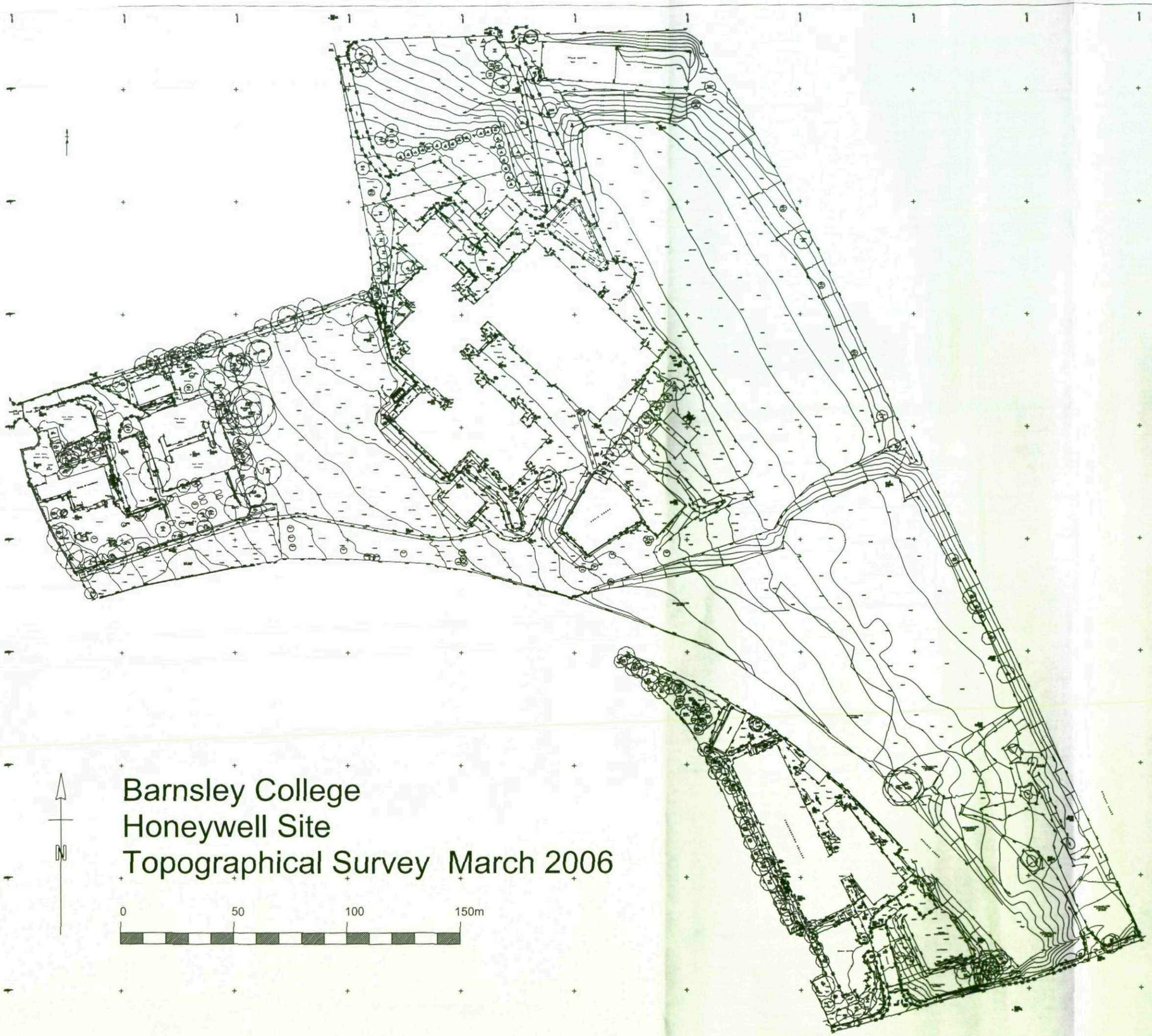
3a) An alternative method for surface water disposal could be Sustainable Drainage Systems (SuDS), for example the use of soakaways and/or permeable hardstanding:

b) The use of SuDS should be encouraged and the LPA's attention is drawn to PPG25. The developer and LPA are advised to seek comments on the suitability of SuDS from the appropriate authorities.

c) If soakaways are acceptable as an alternative method of drainage,this must be subject to testing and approval of the local Building Control Officer, for the curtilage drainage. The developer must contact the Highway Authority with regard to acceptability of highway drainage proposals.

4a) Where the proposal includes 40 or more vehicular parking spaces and/or hardstanding etc, surface water run-off should pass through an oil, petrol and grit interceptor/separator of adequate design before any discharge to the public sewer network. Roof water should not pass through the traditional 'stage' or full retention type of interceptor/separator.

b) It is good drainage practice for any interceptor/separator to be located upstream of any on-site balancing, storage or other means of flow attenuation that may be required.



Barnsley College
Honeywell Site
Topographical Survey March 2006

0 50 100 150m

# APPENDIX 2

## Topographical Survey showing the Current Layout

# APPENDIX 3

## Proposed Site Layout

Proposed Site Plan

Barnsley Honeywell Housing

Jefferson Sheard Architects

1:500@A0

4116

2005

01/05/2009

A

# APPENDIX 4

## WinDes MicroDrainage Calculations

*Cascade Storage Controls for 8 units finalq.src*

Tank/Pond Details

Invert Level (m) 81.500 Ground Level (m) 83.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.00 | 500.0 | 0.70 | 500.0 | 1.40 | 500.0 | 2.10 | 500.0 |
| 0.10 | 500.0 | 0.80 | 500.0 | 1.50 | 500.0 | 2.20 | 500.0 |
| 0.20 | 500.0 | 0.90 | 500.0 | 1.60 | 500.0 | 2.30 | 500.0 |
| 0.30 | 500.0 | 1.00 | 500.0 | 1.70 | 500.0 | 2.40 | 500.0 |
| 0.40 | 500.0 | 1.10 | 500.0 | 1.80 | 500.0 | 2.50 | 500.0 |
| 0.50 | 500.0 | 1.20 | 500.0 | 1.90 | 500.0 | | |
| 0.60 | 500.0 | 1.30 | 500.0 | 2.00 | 500.0 | | |

Hydro-Brake Outflow Control

Design Head (m) 2.000 Diameter (mm) 57
Design Flow (l/s) 5.0 Invert Level (m) 81.500
Hydro-Brake Type MD1

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.10 | 1.6 | 1.20 | 3.9 | 3.00 | 6.2 | 7.00 | 9.5 |
| 0.20 | 1.6 | 1.40 | 4.3 | 3.50 | 6.7 | 7.50 | 9.9 |
| 0.30 | 2.0 | 1.60 | 4.6 | 4.00 | 7.2 | 8.00 | 10.2 |
| 0.40 | 2.3 | 1.80 | 4.8 | 4.50 | 7.6 | 8.50 | 10.5 |
| 0.50 | 2.5 | 2.00 | 5.1 | 5.00 | 8.0 | 9.00 | 10.8 |
| 0.60 | 2.8 | 2.20 | 5.3 | 5.50 | 8.4 | 9.50 | 11.1 |
| 0.80 | 3.2 | 2.40 | 5.6 | 6.00 | 8.8 | | |
| 1.00 | 3.6 | 2.60 | 5.8 | 6.50 | 9.2 | | |

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Cascade Summary of Results for 56units_middleq.src

| Upstream Structures | Outflow To | Overflow To |
|---|---|---|
| (None) | (None) | 8 units_finalq.src |

| Storm Duration (mins) | Maximum Control (l/s) | Maximum Outflow (l/s) | Maximum Water Level (m OD) | Maximum Depth (m) | Maximum Volume ($m^3$) | Status |
|---|---|---|---|---|---|---|
| 15 Summer | 17.0 | 17.0 | 92.6113 | 0.6113 | 244.4 | O K |
| 30 Summer | 17.1 | 17.1 | 92.7278 | 0.7278 | 291.0 | O K |
| 60 Summer | 17.2 | 17.2 | 92.8413 | 0.8413 | 336.5 | O K |
| 120 Summer | 17.2 | 17.2 | 92.9248 | 0.9248 | 369.9 | O K |
| 180 Summer | 17.2 | 17.2 | 92.9373 | 0.9373 | 374.9 | O K |
| 240 Summer | 17.2 | 17.2 | 92.9193 | 0.9193 | 367.7 | O K |
| 360 Summer | 17.2 | 17.2 | 92.8838 | 0.8838 | 353.4 | O K |
| 480 Summer | 17.2 | 17.2 | 92.8503 | 0.8503 | 340.2 | O K |
| 600 Summer | 17.2 | 17.2 | 92.8168 | 0.8168 | 326.6 | O K |
| 720 Summer | 17.1 | 17.1 | 92.7818 | 0.7818 | 312.7 | O K |
| 960 Summer | 17.1 | 17.1 | 92.7303 | 0.7303 | 292.1 | O K |
| 1440 Summer | 17.0 | 17.0 | 92.6173 | 0.6173 | 246.9 | O K |
| 2160 Summer | 16.9 | 16.9 | 92.4517 | 0.4517 | 180.6 | O K |
| 2880 Summer | 16.8 | 16.8 | 92.3088 | 0.3087 | 123.5 | O K |
| 4320 Summer | 16.6 | 16.6 | 92.0568 | 0.0568 | 22.6 | O K |
| 5760 Summer | 15.3 | 15.3 | 92.0000 | 0.0000 | 0.0 | O K |
| 7200 Summer | 12.6 | 12.6 | 92.0000 | 0.0000 | 0.0 | O K |
| 8640 Summer | 10.7 | 10.7 | 92.0000 | 0.0000 | 0.0 | O K |

| Storm Duration (mins) | Rain (mm/hr) | Time-Peak (mins) |
|---|---|---|
| 15 Summer | 138.99 | 50 |
| 30 Summer | 83.16 | 62 |
| 60 Summer | 49.76 | 86 |
| 120 Summer | 29.77 | 134 |
| 180 Summer | 22.05 | 184 |
| 240 Summer | 17.81 | 224 |
| 360 Summer | 13.19 | 288 |
| 480 Summer | 10.66 | 356 |
| 600 Summer | 9.03 | 424 |
| 720 Summer | 7.89 | 492 |
| 960 Summer | 6.47 | 630 |
| 1440 Summer | 4.90 | 896 |
| 2160 Summer | 3.70 | 1280 |
| 2880 Summer | 3.04 | 1640 |
| 4320 Summer | 2.13 | 2284 |
| 5760 Summer | 1.65 | 0 |
| 7200 Summer | 1.36 | 0 |
| 8640 Summer | 1.16 | 0 |

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Cascade Summary of Results for 56units_middleq.src

| Storm Duration (mins) | Maximum Control (l/s) | Maximum Outflow (l/s) | Maximum Water Level (m OD) | Maximum Depth (m) | Maximum Volume ($m^3$) | Status |
|---|---|---|---|---|---|---|
| 10080 Summer | 9.4 | 9.4 | 92.0000 | 0.0000 | 0.0 | O K |
| 15 Winter | 17.0 | 17.0 | 92.6113 | 0.6113 | 244.5 | O K |
| 30 Winter | 17.1 | 17.1 | 92.7283 | 0.7283 | 291.3 | O K |
| 60 Winter | 17.2 | 17.2 | 92.8433 | 0.8433 | 337.3 | O K |
| 120 Winter | 17.2 | 17.2 | 92.9303 | 0.9303 | 372.0 | O K |
| 180 Winter | 17.2 | 17.2 | 92.9463 | 0.9463 | 378.4 | O K |
| 240 Winter | 17.2 | 17.2 | 92.9298 | 0.9298 | 371.8 | O K |
| 360 Winter | 17.2 | 17.2 | 92.8773 | 0.8773 | 350.9 | O K |
| 480 Winter | 17.2 | 17.2 | 92.8268 | 0.8268 | 330.7 | O K |
| 600 Winter | 17.1 | 17.1 | 92.7718 | 0.7718 | 308.8 | O K |
| 720 Winter | 17.1 | 17.1 | 92.7148 | 0.7148 | 285.8 | O K |
| 960 Winter | 17.0 | 17.0 | 92.6203 | 0.6203 | 248.1 | O K |
| 1440 Winter | 16.9 | 16.9 | 92.4322 | 0.4322 | 172.8 | O K |
| 2160 Winter | 16.7 | 16.7 | 92.1938 | 0.1937 | 77.5 | O K |
| 2880 Winter | 16.6 | 16.6 | 92.0363 | 0.0362 | 14.4 | O K |
| 4320 Winter | 12.7 | 12.7 | 92.0000 | 0.0000 | 0.0 | O K |
| 5760 Winter | 9.9 | 9.9 | 92.0000 | 0.0000 | 0.0 | O K |
| 7200 Winter | 8.1 | 8.1 | 92.0000 | 0.0000 | 0.0 | O K |
| 8640 Winter | 6.9 | 6.9 | 92.0000 | 0.0000 | 0.0 | O K |
| 10080 Winter | 6.0 | 6.0 | 92.0000 | 0.0000 | 0.0 | O K |

| Storm Duration (mins) | Rain (mm/hr) | Time-Peak (mins) |
|---|---|---|
| 10080 Summer | 1.01 | 0 |
| 15 Winter | 138.99 | 51 |
| 30 Winter | 83.16 | 62 |
| 60 Winter | 49.76 | 86 |
| 120 Winter | 29.77 | 134 |
| 180 Winter | 22.05 | 184 |
| 240 Winter | 17.81 | 234 |
| 360 Winter | 13.19 | 300 |
| 480 Winter | 10.66 | 376 |
| 600 Winter | 9.03 | 452 |
| 720 Winter | 7.89 | 524 |
| 960 Winter | 6.47 | 668 |
| 1440 Winter | 4.90 | 938 |
| 2160 Winter | 3.70 | 1296 |
| 2880 Winter | 3.04 | 1588 |
| 4320 Winter | 2.13 | 0 |
| 5760 Winter | 1.65 | 0 |
| 7200 Winter | 1.36 | 0 |
| 8640 Winter | 1.16 | 0 |
| 10080 Winter | 1.01 | 0 |

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## Cascade Rainfall Details for 56units_middleq.src

| | |
|---|---|
| Region | FEH Rainfall Model |
| Return Period (years) | 100 |
| Site Location | GB 435000 407300 SE 35000 07300 |
| C (1km) | -0.025 |
| D1 (1km) | 0.374 |
| D2 (1km) | 0.426 |
| D3 (1km) | 0.239 |
| E (1km) | 0.298 |
| F (1km) | 2.354 |
| Cv (Summer) | 0.540 |
| Cv (Winter) | 0.540 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 10080 |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Climate Change % | +20 |

## Time / Area Diagram

Total Area (ha) = 1.570

| Time from: | (mins) to: | Area (ha) | Time from: | (mins) to: | Area (ha) | Time from: | (mins) to: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.157 | 16 | 20 | 0.157 | 32 | 36 | 0.157 |
| 4 | 8 | 0.157 | 20 | 24 | 0.157 | 36 | 40 | 0.157 |
| 8 | 12 | 0.157 | 24 | 28 | 0.157 | | | |
| 12 | 16 | 0.157 | 28 | 32 | 0.157 | | | |

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Cascade Storage Controls for 56units_middleq.src

Tank/Pond Details

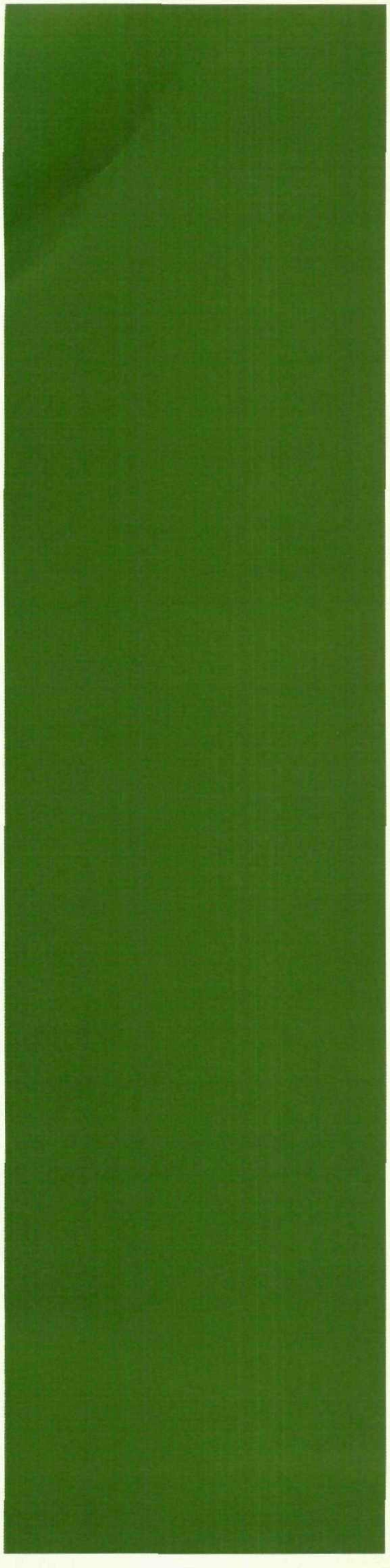
Invert Level (m) 92.000 Ground Level (m) 93.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.00 | 400.0 | 0.70 | 400.0 | 1.40 | 400.0 | 2.10 | 400.0 |
| 0.10 | 400.0 | 0.80 | 400.0 | 1.50 | 400.0 | 2.20 | 400.0 |
| 0.20 | 400.0 | 0.90 | 400.0 | 1.60 | 400.0 | 2.30 | 400.0 |
| 0.30 | 400.0 | 1.00 | 400.0 | 1.70 | 400.0 | 2.40 | 400.0 |
| 0.40 | 400.0 | 1.10 | 400.0 | 1.80 | 400.0 | 2.50 | 400.0 |
| 0.50 | 400.0 | 1.20 | 400.0 | 1.90 | 400.0 | | |
| 0.60 | 400.0 | 1.30 | 400.0 | 2.00 | 400.0 | | |

Pipe Outflow Control

| | | | |
|---|---|---|---|
| Pipe Diameter (m) | 0.100 | Entry Loss Coef | 0.500 |
| Slope (1:x) | 14.3 | Coef of Contraction | 0.600 |
| Length (m) | 150.000 | Invert Level (m) | 91.000 |
| Roughness (mm) | 0.600 | | |

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enzygo
environmental consultants

BRISTOL
The Smithy
Woodend Lane, Cromhall
Gloucestershire GL12 8AA
Tel: +44(0) 1454 269 237
Fax: +44(0) 1454 269 760

SHEFFIELD
STEP Business Park
Wortley Road, Deepcar,
Sheffield S36 2UH
Tel: +44(0)114 290 3677
Fax: +44(0)114 290 3688
www.enzygo.com