Client:

STG

Carried out for:

Residential Development, Lairds Way, Penistone

Flood Risk and Drainage Strategy Study

Project No: 08.16005

Date: July 2016

Issue Status	Draft/ 01 *or* Final/ A	Initial & date		Initial & date		Initial & date
Report Author:	Final	JR 07/16				
Checked:	Final	RP 07/16				
Approved:	Final	RP 07/16				

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Adept Consulting Engineers Ltd - Registered in England No. 6029802

Contents

1 Introduction 3

2 Existing Site 4

3 Proposed Development 6

4 Proposed Drainage Strategy 7

5 Flood risk 8

6 Conclusions 10

Appendix A Location Plan

~~Appendix B Existing Drainage~~

Appendix C Proposed Development

Appendix D Consultation Responses

1 Introduction

1.1 Appointment

Adept Consulting Engineers Limited was appointed in July 2016 to undertake a Flood Risk Assessment and Drainage Strategy Study for the development of land for residential purposes at land of Lairds Way, Penistone

1.2 Scope

The scope of the study was to collate and review information from searches and consultation with the key flood risk and drainage bodies, identify flood risk and drainage constraints and potential mitigation measures. Detailed design of mitigation measures and the drainage systems did not form part of the scope and has not been undertaken at this stage.

1.3 Limitations

Preliminary calculations and a concept drainage design have been undertaken as part of this study. The preliminary calculations and concept design are based on the information and assumptions covered in this report at the time of preparation and provide a concept design for points of connection and general design parameters only.

The report is based on the interpretation and assessment of data provided by third parties. Adept Consulting Engineers Limited cannot guarantee the reliability of the third party information obtained. The conclusions and findings of the report may change if the third party data is subsequently amended or updated.

2 Existing site

2.1 Location

The site is located at grid reference **387230, 387470**. The nearest postcode is **S36 6HN**

.

A site location plan is in **Appendix A**.

2.2 Description

Table 2.2 Site description	
Total Site Area	14,000m2
Current Use	Fields
Topography	212.5-206m AOD towards the north-west with large retaining wall/slope on north-east boundary

2.3 Drainage

Public Sewers

Yorkshire Water sewer record plans show a 225mm diameter sewer running in Sheffield Road to the north of the site.

The law regarding responsibility for drains and sewers changed on the 1st October 2011. From this date the Government transferred the majority of drainage pipes that are either outside a property's boundary or are shared with other buildings to the sewage/water companies. The sewer records may not show all of the transferred sewers.

Private Drainage

The existing site is undrained and there are no known watercourses nearby. Lairds Way has surface water and foul water drains in Lairds Way which are not shown on Yorkshire Water plans. We understand that the foul sewer was adopted by Yorkshire Water as part of the private to public handover in 2011. The surface water drain remains private and is the responsibility of Barnsley Council

2.4 Ground Conditions

Site investigations have been carried out by which show the site to be underlain by extensive made ground over residual soils. The site was previously used for industrial purposes.

2.5 Flood Mapping - Environment Agency

The site is shown to be in Flood Zone 1 (1 in 200 year tidal) on the Environment Agency flood zone maps.

The Environment Agency surface water flood risk mapping shows no flooding on the site.

3 Proposed Development

3.1 Proposed Development

The proposed development consists of the construction of 36 residential properties with associated parking, access roads and landscaping.

4 Proposed Drainage Strategy

4.1 Surface Water

In accordance with the hierarchical approach, as contained within Section 3 of the building Regulations Part H, consideration of the use of SUDS has been considered and is unlikely to be feasible based on ground conditions encountered.

With no nearby watercourse we would propose to take surface water discharge to the surface water sewer in Lairds Way development at a rate of 5l/s as agreed with Yorkshire Water

In this scenario, surface water storage is to be provided for no flooding for up to the 1 in 30 year return period design storm and to retain flows on site so as not to increase flood risk for up to the 1 in 100 year plus climate change storm.

Using Windes Quick Storage estimate the following surface water storage volumes would be required.

1 in 1 year Discharge from site	5 l/s
1 in 30 year surface water storage	est 150 m3
1 in 100 year plus climate change surface water storage	est 283m3

The above figures and concept design and are based on an impermeable area of 4,800sq.m. The final configuration of the drainage and surface water storage would be determined at the detailed design stage.

5.1 Foul Water

A pre-development enquiry has been submitted to Yorkshire Water and foul water can drain to the foul sewer in Lairds Way, or the combined drain in Sheffield Road.

5 Flood Risk Sources and Extent

5.1 Summary

A summary of the sources and level of flood risk (negligible, low, medium or high) is given in Table 4.1 below.

Table 5.1 Summary of the Sources and Extent of Flood Risk	
Source	**Risk Level**
Fluvial	Very Low
Tidal - Coastal	Very Low
Surface Water / Pluvial	Low
Groundwater	Low
Surcharged Sewers	Low
Other Man Made Sources	Very Low

Further detail on the sources and level of flood risk is discussed in the paragraphs below.

5.2 Fluvial

The site is located in flood zone 1, i.e. at little or no risk.

5.3 Tidal

The site is not in an area at risk from tidal flooding.

5.4 Surface Water / Pluvial

Surface water flood risk mapping from the Environment Agency website shows risk from surface water flooding as low.

It is essential that building levels of the proposed development are set to ensure that the existing overland flow does not affect the buildings. In order to do this we recommend that the finished floor level of the plots is set at least 150mm above the surrounding ground levels to ensure safe passage of overland flows. Where this is not possible the effect of overland flow routes need to be considered to ensure buildings are not affected and floor levels should be set 150mm above surrounding areas.

5.5 Groundwater Flooding

Groundwater flooding is not expected to be an issue on this site.

5.6 Surcharged Sewers

We consider the likelihood of Surcharged Sewers to be low.

5.7 Other Man Made Sources

There are no man-made sources that we believe would cause a risk of flooding.

5.8 Climate Change

Based on a typical lifespan for this type of development of 100 years, the contingency allowances for climate change set out in Table 4 and 5 of the Technical Guidance to the NPPF, up to 2115 are for up to 15mm per year net sea level rises and a 30% increase in peak rainfall intensity.

The projections for the UK in relation to climate change are that the UK will experience more frequent short-duration, high-intensity rainfall and more frequent periods of long-duration rainfall of the type that has been responsible for the large flood events recently experienced in the UK.

6 Conclusions

6.1 Existing Drainage

The existing site is not currently drained.

6.2 Proposed Drainage Strategy

Ground conditions suggest that disposal surface water by infiltration is not possible.

In the absence of a nearby watercourse surface water is to discharge to the surface water drain in Lairds Way.

6.3 Flood Risk

The site is considered to be at a low risk of flooding from all sources. To mitigate against this risk we propose to ensure that the floor level of the units is set 150mm higher than surrounding areas to ensure overland flows follow the same topography as existing.

Appendices

A. Location Plan

Do Not Scale



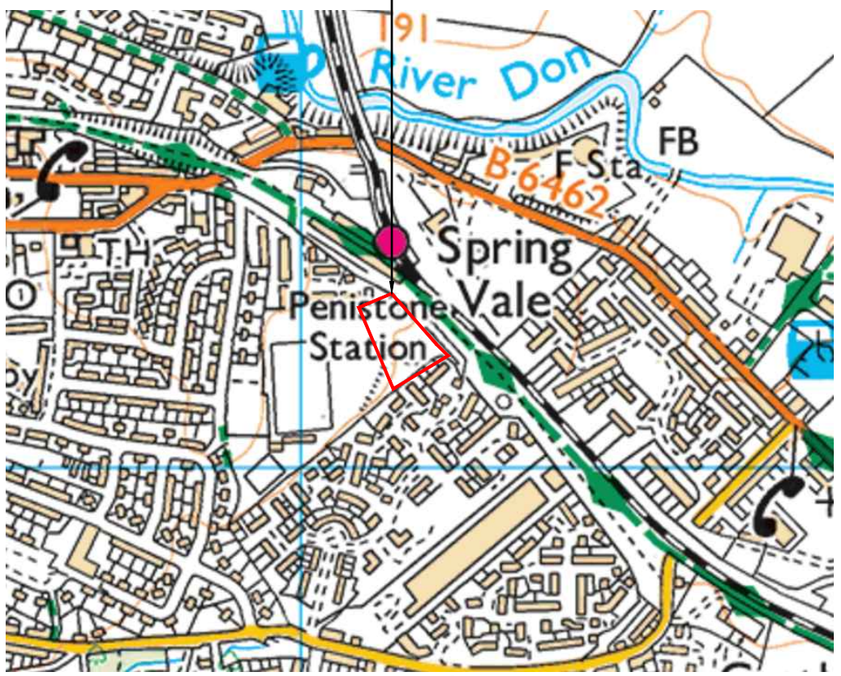
(Scale 1:5000)

New Proposed Development
Lairns Way
Penistone
South Yorkshire
S36 6HN

Easting: 425061
Northing: 403198



(Scale NTS)



(Scale 1:7500)

DESIGN REVIEW

Review by:	Check by:

Residual hazards:

1. For general notes refer to drawing 002.

DRAWING NOTES

Date	Revision	By	Chkd	Rev
28.04.16	Initial Issue	JR	CB	P1

ADEPT
Civil and Structural Consulting Engineers
Engineering Better Solutions Together

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Web www.adeptcsce.com

14 Festoon Rooms, Sunny Bank Mill
Farlsey, Leeds, LS28 5UJ

Project
Lairns Way, Penistone

Title
Location Plan

Client
Strategic Team Group

Scale @ A3	Drawn	Chk
As Shown	JR	CB

Date	Status
April 2016	Preliminary

Drg. No.	Rev.
08.16005/190	P1

B. Proposed Development

Do Not Scale

Ambulance Station

Fire Station

SHEFFIELD ROAD

Proposed Attenuation FP McCann Storm Store to provide 283m³ (internal dimensions 7.5mx17.5mx2.125m deep) of storage for the 1in100yr storm event + 30% climate change. To be installed and vented fully in accordance with manufactures specification

Flow control fitted to manhole S9 to restrict flows to 5 l/s

1500 @ 1in32

300Ø @ 1in100

Small Trees & Bushes

Plot 01 375 S/O

Plot 02 375 S/O

Plot 03 375 S/O

Plot 04 375 S/O

Plot 05 375 S/O

Plot 06 375 S/O

Plot 07 265 S/R

Plot 08 265 S/R

Plot 09 265 S/O

Plot 10 384

Plot 11 384

Plot 12 384

Plot 13 384

Plot 14 4124 (Show Home)

Plot 33 384

Plot 34 384

Plot 35 384

Plot 36 384

Plot 32 4124

Plot 31 384

Plot 30 384

Plot 29 4124

Plot 28 4124

Plot 27 384

Plot 26 384

Plot 25 384

Plot 24 384

Plot 23 384

Plot 22 4118

Plot 21 384

Plot 20 384

Plot 19 4118

Plot 18 4118

Top of Bank

Existing landscape and foliage to be retained.

Existing trees & shubs to be cut back

Existing Lamp post

Lairds Way

Extent of existing highway to be made good where necessary

Existing footpath retained.

New highway to be adopted by Local Highway Planning Authority.

Private Drive

3000 @ 1in200

3000 @ 1in144

S1 S2 S3 S4 S5 S6 S7 S8 S9 S100 S101 S103 S105 S106 S107 S109

EX 1 EX 2 EX 3 EX 4 EX 5 EX 6

DESIGN REVIEW

Design review by:		Checked by:	

Residual hazards:

1. For general notes refer to drawing 002.

DRAWING NOTES

Health, Safety & Environmental Notes

Date	Initial Issue	By	chk	P1
Date	Revision	By	Chkd	Rev

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85 Tottenham Court Road London, W1T 4TQ - Tel: 020 3287 6677

Project
Lairds Way, Pensitone

Title
Proposed Drainage Layout

Client
Strategic Team Group

Scale @ A1	1:250	Drawn	CB	Checked	RP
Date	July 2016	Status	Preliminary		
Drg. No.	08.16005/101	Rev.	P1		

L:\adept_projects\08_Strategic Team Group\08.16005 - Lairds Way, Pensitone\01-WIP\Drawings\08.16005 - 1001 P1 Proposed Drainage.dwg, 7/26/2016 12:11 PM,

C. Consultation Responses

BARNSLEY
Metropolitan Borough Council

Operational Services
Assistant Director: P. Castle
PO Box 601, Barnsley, S70 9FA

F.a.o. Kieron Dunn
Development Control,
Planning and Transportation

2016/ENQ/00243
12th April 2016

Application Number 2016/ENQ/00243
Residential development (pre-app major)
Land off Lairds Way, Penistone

Kieron,

The Council have no records of any culverted or open watercourses crossing the site indicated on the attached plan.

I am not aware of any flooding issues associated with the site, and would confirm that to my knowledge it is not affected by any flood plains from major watercourses in the area

The developer's attention is drawn to the following:

Given the size and type of the proposed development, full and comprehensive Sustainable Drainage System (SuDS) design details are required as an integral part of the planning application pack..

There should be no increase in surface water runoff from the new development. PPS25 recognises that the management of flood risk is not simply restricted to flood plains and that a catchment-wide approach should be employed.

There are public sewers adjacent the site. The developer should contact Yorkshire Water if they wish to discharge to these sewers to discuss allowable discharge rates.

Any balancing facility should be designed to accommodate a 1 in 30 year flow from the site below ground and a 1 in 100 year flow retained within the site (including an allowance of 30% for climate change), without causing any flooding to buildings.

There are alternatives to conventional storage for the control of surface water run-off that are favoured by the authority where ground conditions are suitable. Sustainable Urban Drainage techniques (SUD's) tackle surface water run-off problems at source using features such as soakaways, permeable pavements, grassed swales, infiltration trenches, ponds and wetlands to attenuate flood peak flows, produce water quality improvements and environmental enhancements.

The authority seeks to promote the use of SUD's techniques to this site and the authority expects the developer of the site to submit detailed investigations such that the use of SUD's has been fully explored.

As the Site area is greater than 1 Ha then a flood risk assessment in accordance with NPPF is required to be submitted with any planning application

Regards

Ian Grayson
Senior Engineer – Drainage and Highways
Network Resilience and Asset Management

Richard Parker

From: Chris.Roberts@yorkshirewater.co.uk on behalf of Technical_Sewerage@yorkshirewater.co.uk
Sent: 05 July 2016 09:39
To: Richard Parker
Subject: Lairds Way, Penistone - Pre-Planning Sewerage Enquiry on R167709

Dear Richard,

After reviewing your email I can agree to a maximum surface water discharge of 5 l/s to the surface water sewer in Lairds Way. Please note the public sewer network is for domestic sewage purposes. This generally means foul water for domestic purposes and, where a suitable surface water or combined sewer is available, surface water from the roofs of buildings together with surface water from paved areas of land appurtenant to those buildings. Land and highway drainage have no right of connection to the public sewer network. No land drainage to be connected/discharged to public sewer.

Regards

Chris Roberts
Sewerage Technical Team

|---------->
| From: |
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>----------|
|Richard Parker <richard.parker@adeptcsce.com> |
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|---------->
| To: |
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>----------|
|"Technical_Sewerage@yorkshirewater.co.uk" <Technical_Sewerage@yorkshirewater.co.uk>, "Chris.Roberts@yorkshirewater.co.uk" |
|<Chris.Roberts@yorkshirewater.co.uk>, |
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| Date: |
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|04/07/2016 14:46 |
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|---------->
| Subject: |
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|RE: Lairds Way, Penistone - Pre-Planning Sewerage Enquiry on R167709
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Chris

Many thanks for your response.

Please note that we are not connecting into the combined sewer in Sheffield Road but the surface water drain in Lairds Way. Admittedly this discharges to the combined system downstream.

The surface water sewer to the east lies approximately 10m lower than the development site and the back gardens of the houses on Westacre have retaining walls and gardens with limited access which will make the route extremely difficult. The approved layout on site also has no space for an easement through the east of the site. The route will also require requisition.

Would you reconsider the discharge to the surface water drain in Lairds Way and is there anything we can do to agree this?

Best regards,

Richard Parker B.Eng (Hons)
Director
For and on behalf of Adept Consulting Engineers Ltd

Mob: 07951 824366

Email I inbox@adeptcsce.com Web I www.adeptcsce.com

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-----Original Message-----
From: Chris.Roberts@yorkshirewater.co.uk [mailto:Chris.Roberts@yorkshirewater.co.uk] On Behalf Of Technical_Sewerage@yorkshirewater.co.uk
Sent: 24 June 2016 13:27
To: Richard Parker <richard.parker@adeptcsce.com>
Subject: Re: Lairds Way, Penistone - Pre-Planning Sewerage Enquiry on R167709

Dear Richard,

Thank you for your email.

I can accept that soakaways will not be feasible on your development .

1. We have no available records of the private sewer in Lairds Way and I cannot find any information as to why they were not adopted.

2. I will agree to a maximum site discharge of 5 l/s to the 225 mm surface water sewer in Westacre to the east of the site. I will not agree a surface water connection to the 225 mm combined sewer in Sheffield Road.

Regards

Chris Roberts
Sewerage Technical Team

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| From: |
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|Chris Roberts/Water Business Unit/YWS/Yorkshire Water
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|---------->
| To: |
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|technical.sewerage@yorkshirewater.co.uk,
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|---------->
| Date: |
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|13/06/2016 07:48
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| Subject: |
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|Lairds Way, Penistone - Pre-Planning Sewerage Enquiry on R167709
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>----------|

Link to R167709

----- Forwarded by Chris Roberts/Water Business Unit/YWS/Yorkshire Water on 13/06/2016 07:47 -----
|---------->
| From: |
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|Richard Parker <richard.parker@adeptcsce.com>
|
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|---------->
| To: |
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|"Chris.Roberts@yorkshirewater.co.uk"
<Chris.Roberts@yorkshirewater.co.uk>,
|
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|---------->
| Cc: |
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|James Robinson <james.robinson@adeptcsce.com>, "'Lindsay Rich'"
<LindsayRich@strategicteamgroup.com>
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| Date: |
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|10/06/2016 12:38
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| Subject: |
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|RE: Lairds Way, Penistone - Pre-Planning Sewerage Enquiry on R167709
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Chris

Thank you for your response on the above site. We have now investigated options for surface water disposal and have attached a copy of the site investigation report along with correspondence from Barnsley Council. You will note on p28 of the report that soakaways are not considered a suitable method of draining the site. Derek Bell from Barnsley Council has also confirmed that there are no nearby watercourse.

With this in mind we have undertaken a survey of the drains in Lairds Way which show a foul and surface water drain which connect before discharging to the combined sewer in Sheffield Road.

Firstly, are you aware of a reason why the sewers in Lairds Way were not adopted as it appears to have been the intention.

Secondly, will you permit a surface water discharge to the surface water drain running in Lairds Way at 5l/s. If this is granted we will need to ensure that the existing drainage in Lairds Way is adopted. Please can you advise what needs to be done here. You may have some historic records from when the road was built or do we need a Section 102 Agreement.

I look forward to hearing from you.

Best regards,

Richard Parker B.Eng (Hons)
Director
For and on behalf of Adept Consulting Engineers Ltd

Mob: 07951 824366

Email I inbox@adeptcsce.com Web I www.adeptcsce.com

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-----Original Message-----
From: Chris.Roberts@yorkshirewater.co.uk [mailto:Chris.Roberts@yorkshirewater.co.uk] On Behalf Of Technical_Sewerage@yorkshirewater.co.uk
Sent: 13 May 2016 14:57
To: James Robinson <james.robinson@adeptcsce.com>
Subject: Lairds Way, Penistone - Pre-Planning Sewerage Enquiry on R167709

Dear Mr Robinson,

Please find my response below.

(See attached file: LAIRDS.pdf)(See attached file: roberts4_rad149D4.PNG)

If I can be of any further assistance please contact me on 03451 20 84 82.

Regards

Chris Roberts
Sewerage Technical Team

|---------->
| From: |
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>----------|

|James Robinson <james.robinson@adeptcsce.com>
|

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|---------->
| To: |
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>----------|

|"technical.sewerage@yorkshirewater.co.uk"
<technical.sewerage@yorkshirewater.co.uk>,
"planning.sewerage@yorkshirewater.co.uk" |
|<planning.sewerage@yorkshirewater.co.uk>,
|

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|---------->
| Cc: |
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|Richard Parker <richard.parker@adeptcsce.com>
|

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| Date: |
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|29/04/2016 08:47
|

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|---------->
| Subject: |
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|Pre-Development Enquiry - Lairns Way, Penistone
|

>----------|

To who it may concern,

Please find attached our request for a pre-planning sewerage enquiry along with suitable information.

Best regards,

James Robinson

Apprentice Technician

For and on behalf of Adept Consulting Engineers Ltd

Tel: 0113 2394518

cid:image002.png@01CE8A19.4BBA0220

Email Sig Without IStructE Rev A

Email I inbox@adeptcsce.com Web I www.adeptcsce.com

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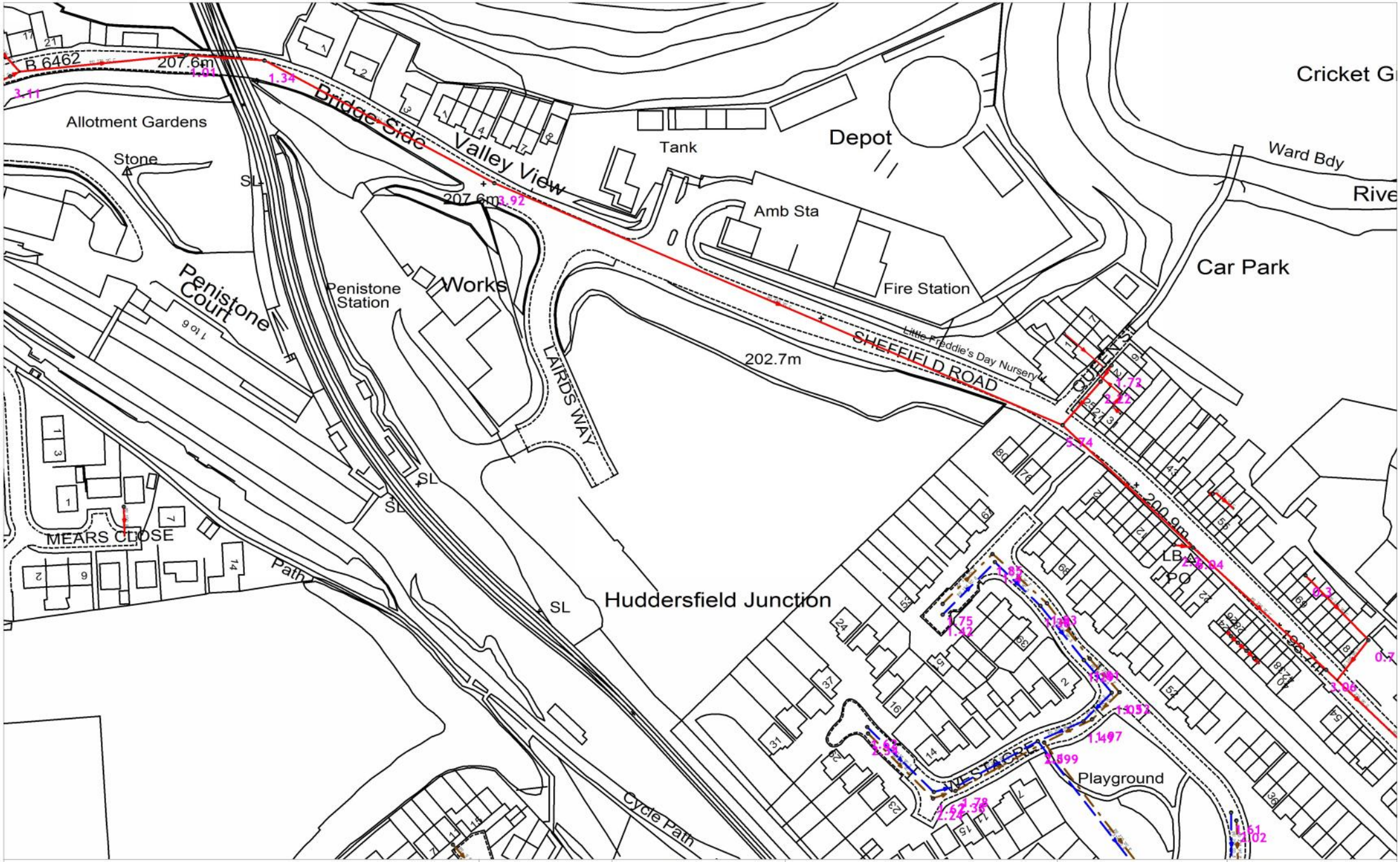
Click here to report this email as spam.
(See attached file: image001.png)(See attached file: image004.png)(See attached file: 08.16005 - 190P1 Location Plan.pdf)(See attached file:
08.16005 - Pre Development Enquiry.pdf)(See attached file: 2121.121.010H - Site Layout.pdf)

Spotted a leak?
If you spot a leak please report it immediately. Call us on 0800 57 3553 or go to
http://www.yorkshirewater.com/leaks

Get a free water saving pack
Don't forget to request your free water and energy saving pack, it could save you money on your utility bills and help you conserve water.
http://www.yorkshirewater.com/savewater

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Yorkshire Water Services Limited
Registered Office Western House, Halifax Road, Bradford, BD6 2SZ Registered in England and Wales No 2366682
(See attached file:
2016-ENQ-00243.docx)(See attached file: 08.16005 -
100P1 - Existing Drainage.pdf)(See attached file: 50233_R01 Penistone Geo-environmental Investigation Report (2) 12-12-2012.pdf)



425036 : 403127

Map Name : SE2403SE

Title

Notes

YorkshireWater

Yorkshire Water,
PO Box 500,
Halifax Road,
Bradford BD6 2LZ
Contact Name :
YorMap Advisor C ROBERTS
Contact Tel : 87 2582

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Partial Key

Foul Sewer = F
Combined Sewer = C
Surface Water Sewer = SW
Trade Sewer = TD
Partially Separate = PS

This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connections are shown.

Date Req : 13/05/2016, 14:51:10

Date Gen : 13/05/2016, 14:51:24

Source : Sewer Network Enquiry

UPN: Undefined

Originator: C ROBERTS, YorMap, 87 2582

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.732	0.732	4.0	97.4	O K
30 min Summer	1.007	1.007	4.0	133.9	O K
60 min Summer	1.299	1.299	4.0	172.8	O K
120 min Summer	1.576	1.576	4.3	209.7	O K
180 min Summer	1.701	1.701	4.5	226.2	O K
240 min Summer	1.768	1.768	4.6	235.1	O K
360 min Summer	1.824	1.824	4.6	242.7	O K
480 min Summer	1.830	1.830	4.6	243.4	O K
600 min Summer	1.824	1.824	4.6	242.6	O K
720 min Summer	1.811	1.811	4.6	240.8	O K
960 min Summer	1.773	1.773	4.6	235.8	O K
1440 min Summer	1.683	1.683	4.5	223.8	O K
2160 min Summer	1.540	1.540	4.3	204.9	O K
2880 min Summer	1.400	1.400	4.1	186.2	O K
4320 min Summer	1.144	1.144	4.0	152.1	O K
5760 min Summer	0.904	0.904	4.0	120.3	O K
7200 min Summer	0.606	0.606	4.0	80.6	O K
8640 min Summer	0.431	0.431	4.0	57.3	O K
10080 min Summer	0.318	0.318	3.9	42.3	O K
15 min Winter	0.825	0.825	4.0	109.7	O K
30 min Winter	1.133	1.133	4.0	150.6	O K
60 min Winter	1.465	1.465	4.2	194.8	O K
120 min Winter	1.786	1.786	4.6	237.6	O K
180 min Winter	1.937	1.937	4.8	257.6	O K
240 min Winter	2.023	2.023	4.9	269.1	O K
360 min Winter	2.108	2.108	4.9	280.4	Flood Risk
480 min Winter	2.128	2.128	5.0	283.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	114.824	0.0	101.1	26
30 min Summer	79.374	0.0	139.9	40
60 min Summer	52.391	0.0	185.2	70
120 min Summer	33.240	0.0	235.1	128
180 min Summer	24.972	0.0	264.9	186
240 min Summer	20.308	0.0	287.2	244
360 min Summer	15.158	0.0	321.6	360
480 min Summer	12.293	0.0	347.8	426
600 min Summer	10.437	0.0	369.1	488
720 min Summer	9.125	0.0	387.2	554
960 min Summer	7.372	0.0	417.0	686
1440 min Summer	5.444	0.0	461.8	966
2160 min Summer	4.009	0.0	510.7	1384
2880 min Summer	3.220	0.0	547.1	1792
4320 min Summer	2.367	0.0	602.9	2600
5760 min Summer	1.904	0.0	647.0	3408
7200 min Summer	1.609	0.0	683.4	4040
8640 min Summer	1.403	0.0	714.9	4672
10080 min Summer	1.250	0.0	742.8	5344
15 min Winter	114.824	0.0	113.3	26
30 min Winter	79.374	0.0	156.7	40
60 min Winter	52.391	0.0	207.5	68
120 min Winter	33.240	0.0	263.3	126
180 min Winter	24.972	0.0	296.7	182
240 min Winter	20.308	0.0	321.7	240
360 min Winter	15.158	0.0	360.2	352
480 min Winter	12.293	0.0	389.5	458

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
600 min Winter	2.115	2.115	5.0	281.2	Flood Risk
720 min Winter	2.098	2.098	4.9	279.0	O K
960 min Winter	2.049	2.049	4.9	272.5	O K
1440 min Winter	1.913	1.913	4.7	254.4	O K
2160 min Winter	1.691	1.691	4.5	224.9	O K
2880 min Winter	1.476	1.476	4.2	196.4	O K
4320 min Winter	1.087	1.087	4.0	144.5	O K
5760 min Winter	0.604	0.604	4.0	80.4	O K
7200 min Winter	0.331	0.331	3.9	44.0	O K
8640 min Winter	0.208	0.208	3.7	27.6	O K
10080 min Winter	0.146	0.146	3.4	19.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
600 min Winter	10.437	0.0	413.4	554
720 min Winter	9.125	0.0	433.6	578
960 min Winter	7.372	0.0	467.1	732
1440 min Winter	5.444	0.0	517.1	1042
2160 min Winter	4.009	0.0	572.0	1492
2880 min Winter	3.220	0.0	612.7	1932
4320 min Winter	2.367	0.0	675.3	2776
5760 min Winter	1.904	0.0	724.6	3464
7200 min Winter	1.609	0.0	765.4	4032
8640 min Winter	1.403	0.0	800.7	4592
10080 min Winter	1.250	0.0	832.0	5248

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.900	Shortest Storm (mins)	15
Ratio R	0.296	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.472

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.157	4	8	0.157	8	12	0.157

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Model Details

Storage is Online Cover Level (m) 2.400

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	133.0	2.150	133.0	4.800	0.0	7.200	0.0	9.600	0.0
0.400	133.0	2.151	0.0	5.200	0.0	7.600	0.0	10.000	0.0
0.800	133.0	3.200	0.0	5.600	0.0	8.000	0.0		
1.200	133.0	3.600	0.0	6.000	0.0	8.400	0.0		
1.600	133.0	4.000	0.0	6.400	0.0	8.800	0.0		
2.000	133.0	4.400	0.0	6.800	0.0	9.200	0.0		

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0090-5000-2150-5000
Design Head (m)	2.150
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	90
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.150	5.0	Kick-Flo®	0.805	3.2
Flush-Flo™	0.394	4.0	Mean Flow over Head Range	-	3.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	0.800	3.2	2.000	4.8	4.000	6.7	7.000	8.7
0.200	3.7	1.000	3.5	2.200	5.0	4.500	7.1	7.500	9.0
0.300	3.9	1.200	3.8	2.400	5.3	5.000	7.4	8.000	9.3
0.400	4.0	1.400	4.1	2.600	5.5	5.500	7.8	8.500	9.5
0.500	3.9	1.600	4.4	3.000	5.8	6.000	8.1	9.000	9.8
0.600	3.8	1.800	4.6	3.500	6.3	6.500	8.4	9.500	10.1

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