



## **DRAINAGE STRATEGY**

ON  
**DEVELOPMENT OF RAILWAY CUTTING  
HORTON STREET, HECKMONDWIKE**

ON BEHALF OF  
**YORKDALES 2 LTD**

### **ARP ASSOCIATES**

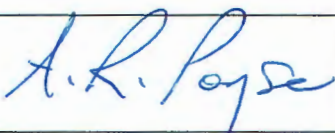


**CHARTERED CONSULTING ENGINEERS**

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**Drainage Strategy on Development of Railway Cutting, Horton Street, Heckmondwike**

**1471/01r2**

<b>Revision/Date</b>	<b>Initial Issue</b> <b>17<sup>th</sup> January 2018</b>	<b>Revision A</b>	<b>Revision B</b>	<b>Revision C</b>
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<b>Signature</b>				

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## **1.0 INTRODUCTION**

- 1.1 Yorkdales 2 Ltd is proposing to redevelop the site of the former Railway Cutting at Heckmondwike for new residential developments. A site location plan is presented in Appendix A. As part of the development appraisal, a Flood Risk Assessment Report was prepared by ARP Associates, under reference 1471/01r1 dated 10<sup>th</sup> November 2017.
- 1.2 In order to undertake further viability of the site and to supplement a Planning Application for the proposed development, it was decided that a Drainage Strategy should be prepared for both foul and surface water discharge from the proposed scheme.
- 1.3 ARP Associates have been appointed to review the Flood Risk Assessment and prepare a Drainage Strategy and agree the proposals with the Regulatory Authority.
- 1.4 The further consultations with the Regulatory Authorities and preparation of the report has been undertaken in November and December 2017.
- 1.5 The report has been initially prepared for the use and reliance of the Client only. The report shall not be relied upon or transferred to any other parties without the written agreement of ARP Associates. For the avoidance of any doubt, where ARP Associates enters into a letter of reliance for the benefit of a third party, that third party will be permitted to rely on the report. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party without ARP Associates consent.

## **2.0 FLOOD RISK ASSESSMENT**

- 2.1 Reference should be made to the Flood Risk Assessment Report, prepared by ARP Associates under reference 1471/01r1 dated 10<sup>th</sup> November 2017.
- 2.2 The report was based on consultations from the Environment Agency, Yorkshire Water, as Water Authority for the area, and Kirklees Council, as Land Drainage Authority for the area.
- 2.3 The Environment Agency confirmed that the site falls within Flood Zone 1 and that there was no flood history available from their records. Reference was made, however, to make allowance for climate change in accordance with the latest guidelines dated February 2016.
- 2.4 The consultation with the Water Authority confirmed that foul water could discharge to the 375mm diameter public combined sewer in Walkley Terrace adjacent to the southeastern corner of the site. However, in respect of surface water, the local public sewer network did not have any capacity to accept surface water from the proposal site and reference was made to culverted watercourses within the development. This would appear to be the obvious place for surface water disposal, if infiltration systems, as part of a Sustainable Drainage Assessment, were proved to be unsuitable.
- 2.5 The consultation with Kirklees Council identified that the site was subject to surface water flood risk due to the low lying nature of the cutting and that ponding upstream of Brunswick Street was around 1.2m in flat areas. This water flows through the site in the bottom of the cutting in a northwest to southeast direction during times of storm. An assessment of the catchment was recommended and properties will have to be significantly raised for safety within the development. The consultation did confirm that the British Geological Society data suggests that infiltration would be problematic and the Land Drainage Authority would accept that soakaways or other infiltration systems are unlikely to be appropriate. Therefore, it was recommended that a connection to watercourse should be explored with the nearest river being the River Spen approximately

500m to the south. It is likely that watercourse tributaries to the River are within the site boundaries or close by and it would be appropriate to investigate these to determine a suitable outfall for surface water discharge.

### **3.0 FURTHER CONSULTATIONS**

- 3.1 As a result of the information provided by Yorkshire Water and Kirklees Council, further consultations were undertaken to determine if connection to sewer would be acceptable. A copy of the e-mail correspondence with Yorkshire Water between the 9<sup>th</sup> and 30<sup>th</sup> November is presented in Appendix B for reference. This has identified watercourses to the north and south of the site as options for connection of surface water drainage and, only if these are unsuitable, would a discharge be acceptable to the 225mm diameter surface water sewer in Walkley Avenue?
- 3.2 It was identified that the water conduit on the Yorkshire Water plan was actually an overhead support for services and, therefore, there was no outfall for surface water drainage from the development at this location. However, the culverted watercourse which passes under the site in a northeast to southwest direction flowing along the back of houses on Horton Street before crossing the site is a suitable option for consideration with the Land Drainage Authority.
- 3.3 Consultation has since been undertaken with Kirklees Council, as Land Drainage Authority, and the copy correspondence, dated between the 1<sup>st</sup> and 5<sup>th</sup> December 2017, is presented in Appendix C for reference. In effect, the Land Drainage Authority would not have an objection to connecting to the culverted watercourse, but confirmed that this is deep and that this was blocked some time ago. It has also been identified that it is worth investigating a surface water culvert off Walkley Lane to the Greenway where a new pipe has been laid across to a ditch and, subject to investigation of all the systems in the vicinity to determine a suitable outfall, discharge of surface water at greenfield run-off rates would be acceptable for the development.

## 4.0 DRAINAGE STRATEGY

### Surface Water

- 4.1 It is accepted that the Geological Survey Map of Great Britain shows that the site is located on undifferentiated strata of the Lower Coal Measures with the upper stratum likely to be weathered to a cohesive material (clay). Therefore, the soil is likely to have poor infiltration characteristics and as the site will be infilled to a significant depth, soakaways on the site are likely to filter through the backfill and create potential problems around a culvert. Therefore, the use of soakaways has been discounted for development on the site.
- 4.2 It will be necessary to carry out an investigation of the known culverted watercourses through the development or in the adjacent land, but outfall to culverted watercourse is a solution which would be acceptable to the Regulatory Authorities.
- 4.3 The surface water discharge rate from the site shall be limited to 5l/s/ha and, based on a site area of 2.58ha, the proposed surface water discharge rate will be 12.9l/s.
- 4.4 For discharge of surface water to watercourse, it is necessary to attenuate the proposed development for a 1 in 30 year storm underground and show that a 1 in 100 year storm event plus 30% for climate change can be retained on site without causing flooding of buildings or third party land. Calculations, based on an assumed 50% impermeable area of the total site on completion showed that an attenuation volume of 324.7m<sup>3</sup> will be required for the 1 in 30 year storm and a 640.0m<sup>3</sup> volume for the 1 in 100 year storm plus 30% for climate change. If the attenuation is to be placed under the adopted highway, it is a requirement in the Kirklees area that a maximum 1.5m diameter pipe is acceptable. Therefore, to meet the necessary attenuation volume, 364m of the 1.5m diameter pipe is required. A copy of the calculations is presented in Appendix D.
- 4.5 A plan showing the approximate location of attenuation requirements, assuming an outfall to the culverted watercourse crossing the site to the north is presented in Appendix E.

### Foul Drainage

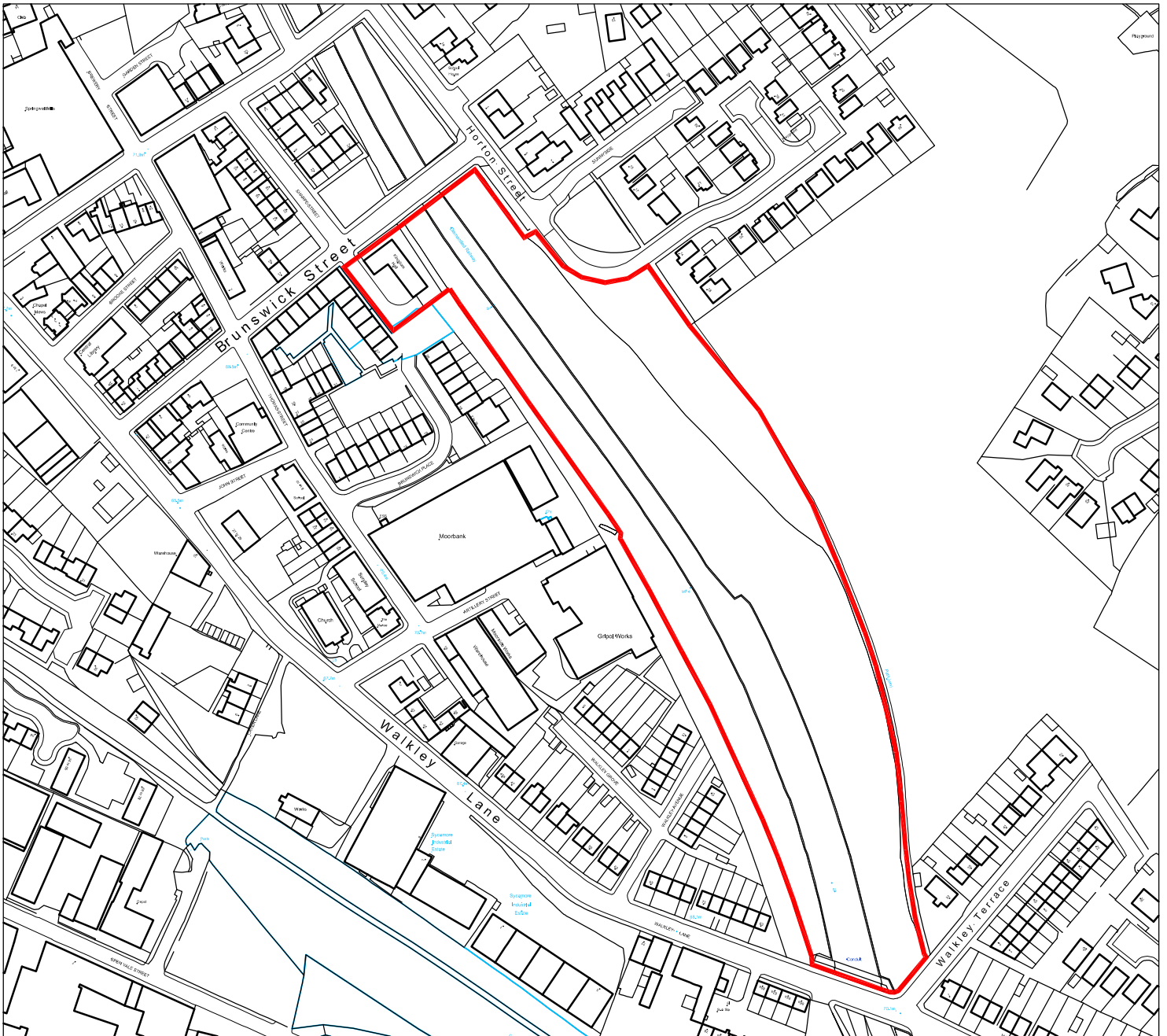
- 4.6 Foul drainage can discharge to the 375mm diameter public combined sewer in Walkley Terrace adjacent to the southeastern corner of the site. This outfall is shown on the plan presented in Appendix E.

## **5.0 SUMMARY**

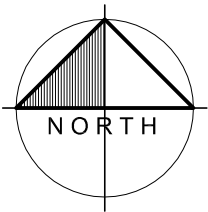
- 5.1 It is considered that the proposed development site will be unsuitable for soakaways or other infiltration drainage systems for surface water discharge.
- 5.2 There are culverted watercourses in the immediate vicinity of the site and a culvert crosses the site towards the north flowing from northeast to southwest along the back of houses to Horton Street before crossing the development under the former railway at depth. An investigation of the condition of the pipes will be required.
- 5.3 Surface water discharge will be restricted to greenfield run-off rate of 12.9l/s with outfall to a culverted watercourse.
- 5.4 Surface water will be attenuated on site for a 1 in 30 year storm in an underground system and the 1 in 100 year storm plus 30% allowance for climate change will be accommodated within the system without causing flooding to buildings or third party land.
- 5.5 Foul drainage will discharge to the 375mm diameter public combined sewer in Walkley Terrace adjacent to the southeastern corner of the site.

**APPENDIX A**

**SITE LOCATION PLAN**



Location Plan 1:2500 @ A4



Rev	Description	Date	By	App'd
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Client: **Ernest Gordon Ltd**

Project: **Residential Development  
 Disused Railway Cutting Heckmondwike**

Drawing Title: **LOCATION PLAN**

Project No.	Dwg No.	Rev.	Scale @ A4	Date.	By.
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Issue Status: **PLANNING**

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## **APPENDIX B**

### **YORKSHIRE WATER CONSULTATION**

**Allan Poyser**

---

**From:** Chris.Roberts@yorkshirewater.co.uk on behalf of technical.sewerage@yorkshirewater.co.uk  
**Sent:** Thursday 30 November, 2017 11:29 am  
**To:** Allan Poyser  
**Subject:** RE: 1471/01 RE: Disused Railway Cutting Off Walkley Lane Heckmondwike - Pre Planning Sewerage Enquiry On R713401  
**Attachments:** Untitled.png; YW plan highlighting Watercourse.pdf

Hi Allan,

I was referring to the watercourse to the north. The options are

1. The watercourse to the north
2. The water conduit to the south
3. The 225 mm SW sewer in Walkley Avenue subject to discounting the watercourse/conduit.

(See attached file: Untitled.png)

Kind Regards

Chris

```
|----->
| From:   |
|----->
>-----|
|Allan Poyser <AllanPoyser@arpassociates.co.uk>           |
>-----|
|----->
| To:     |
|----->
>-----|
|"technical.sewerage@yorkshirewater.co.uk" <technical.sewerage@yorkshirewater.co.uk>,
|
>-----|
|----->
| Cc:     |
|----->
>-----|
|Wayne Walker <WayneWalker@arpassociates.co.uk>           |
>-----|
|----->
| Date:   |
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>-----|
|18/11/2017 11:17                                         |
>-----|
|----->
| Subject: |
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>-----|

Thank you, Chris

I assume you are referring to the watercourse I have highlighted pink on your plan? I am not certain we can get to that location within Highway land, so would need a Requisition and you will appreciate the problems of discharge via a headwall in third party land. Do YW have any surface water sewers in close proximity to the watercourse where we could tap in just before the outfall?

Kind Regards

Allan Poyser  
0113 245 8498  
allanpoyser@arpassociates.co.uk

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[http://webdefence.global.blackspider.com/urlwrap/?q=AXicLcs9DslwDAbQT-I-LpQywMSPhMrMCazIIIHTprJDo16AA7GxcjI6MD89XNB-gdUH0Dhv9kymE\\_UcoktD1hTJpR7T6XZum-t9va13dYMszg\\_BcSSTIsoPOc5JO\\_NBpXAWXRI9O\\_icx0NVIVKIdWSz5MLC9mfg9QZ-1jUrmw&Z](http://webdefence.global.blackspider.com/urlwrap/?q=AXicLcs9DslwDAbQT-I-LpQywMSPhMrMCazIIIHTprJDo16AA7GxcjI6MD89XNB-gdUH0Dhv9kymE_UcoktD1hTJpR7T6XZum-t9va13dYMszg_BcSSTIsoPOc5JO_NBpXAWXRI9O_icx0NVIVKIdWSz5MLC9mfg9QZ-1jUrmw&Z)

5 & 6 Northwest Business Park, Servia Hill, Leeds LS6 2QH Pre-planning Geotechnical Civil Engineering Structural Engineering

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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: Friday 17 November, 2017 2:34pm

To: Allan Poyser

Subject: Fw: 1471/01 RE: Disused Railway Cutting Off Walkley Lane Heckmondwike - Pre Planning Sewerage Enquiry On R713401

Sorry forgot to add plan

(See attached file: roberts4\_rad66920.PNG)

----- Forwarded by Chris Roberts/Water Business Unit/YWS/Yorkshire Water on

17/11/2017 14:33 -----

From: Technical Sewerage  
To: Allan Poyser <AllanPoyser@arpassociates.co.uk>,  
Date: 17/11/2017 14:20  
Subject: Re: 1471/01 RE: Disused Railway Cutting Off Walkley Lane  
Heckmondwike - Pre  
Planning Sewerage Enquiry On R713401

Dear Allan,

Thank you for your email.

I have included a plan showing the watercourse that our surface waters ultimately enter. I would ask that you present this to Kirklees Council to see if this helps them identify the watercourses as under their authority.

I will accept that soakaways would not be feasible.

I would not agree to a surface water discharge to the combined sewer network.

If you can provide written evidence from Kirklees stating that the culverted watercourse and conduit are not under their ownership I may be open to agree a restricted surface water discharge from the site of 5 l/s to the 225 mm public surface water sewer in Walkley Lane.

Kind Regards

Chris Roberts  
Sewerage Technician  
Yorkshire Water

\*\*\* Please note, all correspondence must be sent to [technical.sewerage@yorkshirewater.co.uk](mailto:technical.sewerage@yorkshirewater.co.uk) and will be responded to within 10 working days \*\*\*

From: Allan Poyser <AllanPoyser@arpassociates.co.uk>  
To: "technical.sewerage@yorkshirewater.co.uk"  
<technical.sewerage@yorkshirewater.co.uk>,  
Cc: Wayne Walker <WayneWalker@arpassociates.co.uk>  
Date: 09/11/2017 17:39  
Subject: 1471/01 RE: Disused Railway Cutting Off Walkley Lane  
Heckmondwike - Pre  
Planning Sewerage Enquiry On R713401

Chris

Please see the attached correspondence regarding surface water discharge from the proposed development

Kind Regards

Allan Poyser  
0113 245 8498  
allanpoyser@arpassociates.co.uk

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[http://webdefence.global.blackspider.com/urlwrap/?q=AXicLcs9DslwDAbQT-I-bvgZgAnEUoITWMEiUdOmstNGvQAHYmPIZHRgfnq4of0Cmw-gaXEHJtOZeo7J56FoTuRzj\\_l6ah98Z7ffHbcORXwYoudEJIWUn3JZsnYWokrllrommjQEUsZz09RaiXVks-zjyvZn4PUGfu6eK-U&Z](http://webdefence.global.blackspider.com/urlwrap/?q=AXicLcs9DslwDAbQT-I-bvgZgAnEUoITWMEiUdOmstNGvQAHYmPIZHRgfnq4of0Cmw-gaXEHJtOZeo7J56FoTuRzj_l6ah98Z7ffHbcORXwYoudEJIWUn3JZsnYWokrllrommjQEUsZz09RaiXVks-zjyvZn4PUGfu6eK-U&Z)

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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: Sunday 1 October, 2017 12:49pm  
To: Allan Poyser  
Subject: Disused Railway Cutting Off Walkley Lane Heckmondwike - Pre Planning Sewerage Enquiry On R713401

Dear Mr Poyser,

Please find my response below.

(See attached file: WALK.pdf)(See attached file: roberts4\_radF0D88.PNG)

If I can be of any further assistance please contact me on 0345 1 20 84 82.

Regards

Chris Roberts  
Sewerage Technical Team

\*\*\* Please note, all correspondence must be sent to [technical.sewerage@yorkshirewater.co.uk](mailto:technical.sewerage@yorkshirewater.co.uk) and will be responded to within 10 working days \*\*\*

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

|Allan Poyser <[AllanPoyser@arpassociates.co.uk](mailto:AllanPoyser@arpassociates.co.uk)>  
|  
>-----|

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

|"technical.sewerage@yorkshirewater.co.uk"  
<[technical.sewerage@yorkshirewater.co.uk](mailto:technical.sewerage@yorkshirewater.co.uk)>,  
|  
>-----|

|----->  
| Date: |  
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|20/09/2017 11:25  
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| Subject: |  
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|1471/01 Railway Cutting, Heckmondwike  
|  
>-----|

EXTERNAL SOURCE - THINK BEFORE YOU CLICK

Dear Sirs

Please see the attached Pre-planning Sewerage Enquiry for the above site

Kind Regards

Allan Poyser

0113 245 8498

allanpoyser@arpassociates.co.uk

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cid:image001.jpg@01CE1C03.D2DEA7D0

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(See attached file: image001.png)(See attached file: PrePlanning\_Sewerage\_Enquiry.pdf)(See attached file: PL01 Location Plan.pdf)(See attached file: Proposed layout.pdf)

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<https://www.yorkshirewater.com/payment>

Find out about issues in your area

<https://www.yorkshirewater.com/inyourarea>

Save money on your utility bills and help conserve water by requesting a free water saving pack

<https://www.yorkshirewater.com/savewater>

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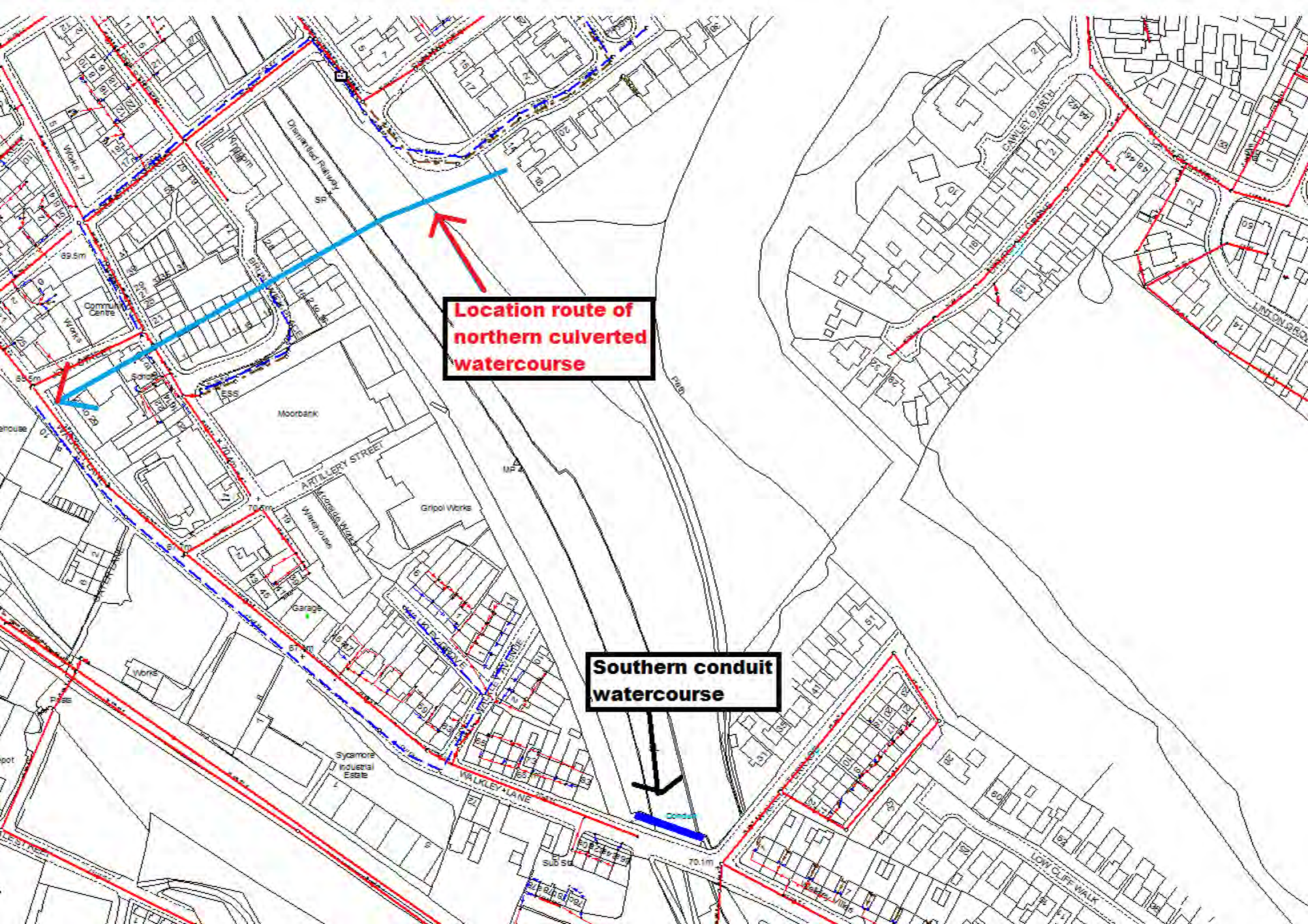
Registered Office Western House, Halifax Road, Bradford, BD6 2SZ Registered in England and Wales No 2366682

(See attached file: 14710111.pdf)

(See attached file: YW plan highlighting Watercourse.pdf)



421825 422867	Map Name SE2122NE	Title
	Yorkshire Water, PO Box 500, Hartley Road, Bradford BD6 2LZ Contact Name YorkMap Advisor C ROBERTS Contact Tel 87 2582	Notes
	Partial Key Full Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Depress = PD	<small>This plan is furnished as a general guide only and no liability is to be accepted by the provider. This plan must not be used for any other purpose without the prior written consent of the provider. The issue of property connections are shown.</small>
	Date Req: 17/11/2017, 13:58:23	Date Gen: 17/11/2017, 13:58:39
	Source: Sewer Network Encour	



**Location route of northern culverted watercourse**

**Southern conduit watercourse**

## **APPENDIX C**

### **LAND DRAINAGE AUTHORITY CONSULTATION**

## Allan Poyser

---

**From:** Paul Farndale <Paul.Farndale@kirklees.gov.uk>  
**Sent:** Tuesday 5 December, 2017 9:51 am  
**To:** Allan Poyser  
**Subject:** RE: 800/582 Disused Railway cutting, Heckmondwike

There is a manhole at the bottom of the path off Walkley Lane to the Greenway. This was blocked a while ago so a new pipe has been laid across to a ditch. This is worth investigating as to where it goes next as it could give you an outfall. There is the fish lake at a raised level at the other side. Plenty of water around....just need to research the outfalls.

Greenfield once we can confirm the outfalls.

PF

---

**From:** Allan Poyser [mailto:AllanPoyser@arpassociates.co.uk]  
**Sent:** 04 December 2017 16:08  
**To:** Paul Farndale  
**Subject:** RE: 800/582 Disused Railway cutting, Heckmondwike

Paul

Thank you for responding so promptly.

There is no above ground watercourse at the location shown so it must be culverted and I agree it must be deep. However, this is the only feasible outfall for SW (there is nothing to the south) so I will probably request a greenfield run-off to this culverted watercourse for the development. Would you have any objection to this as part of a Drainage Strategy to supplement a Planning Application?

Kind Regards

Allan Poyser  
0113 245 8498  
[allanpoyser@arpassociates.co.uk](mailto:allanpoyser@arpassociates.co.uk)



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---

**From:** Paul Farndale [<mailto:Paul.Farndale@kirklees.gov.uk>]  
**Sent:** Monday 4 December, 2017 3:54pm  
**To:** Allan Poyser  
**Subject:** RE: 800/582 Disused Railway cutting, Heckmondwike

Hello Allan,

Hope you are well.

We have the northern one on our maps and it will be from the same historical source as YW got it from as data was readily exchanged in the past. All we can say is that it is unverified given you have a hug cutting meaning we would have excessive depths on this system for it to be present in this location.

That said to the west of the cutting we do have various public surface water sewers connecting to it and some highway drains. Unless it is in an above ground supported structure (Pipe Bridge?)

The southern watercourse is a bit of a mystery. If we put the OS plans up it shades it grey as opposed to blue. Clicking on the line it simply states 'obstructing feature'.

Regards,

Paul Farndale  
Principal Engineer  
Flood Management & Drainage  
Investment & Regeneration Service  
Kirklees Council  
01484 221000

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**From:** Allan Poyser [<mailto:AllanPoyser@arpassociates.co.uk>]  
**Sent:** 01 December 2017 08:09  
**To:** Paul Farndale  
**Cc:** Wayne Walker  
**Subject:** RE: 800/582 Disused Railway cutting, Heckmondwike

Good Morning Paul

Since receiving your Consultation for the above project, I have revisited the site and been in negotiation with YW to determine a suitable outfall for surface water for the new development.

YW are stating that there is a culverted watercourse to the north ern side of the scheme crossing under the site from Horton Street. I have attached a plan from YW showing this pipe. Are you able to shed any light on this pipe and is it a culverted watercourse? You will appreciate the significance if it is a watercourse.

Please ignore the comment re a southern Conduit. This is an above ground "bridge" carrying services across the old railway.


Thank you in anticipation of your advice

Kind Regards

Allan Poyser  
0113 245 8498  
[allanpoyser@arpassociates.co.uk](mailto:allanpoyser@arpassociates.co.uk)

## **APPENDIX D**

### **SURFACE WATER DRAINAGE CALCULATIONS**

ARP Associates		Page 1
Northwest House Servia Hill Leeds LS6 2QH	Yorkdales 2 Ltd Railway Cutting, Heckmondwike 1471/01Prelim100yr+CC@12.9l/s	
Date 11-01-18 File 1471-01 preliminary Att...	Designed by ARP Checked by	
Elstree Computing Ltd		Source Control 2015.1

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


Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	101.008	1.008	12.8	0.0	12.8	267.1	O K
30 min Summer	101.173	1.173	12.8	0.0	12.8	353.6	O K
60 min Summer	101.343	1.343	12.8	0.0	12.8	440.8	O K
120 min Summer	101.506	1.506	12.8	0.0	12.8	516.0	O K
180 min Summer	101.579	1.579	12.8	0.0	12.8	545.0	O K
240 min Summer	101.603	1.603	12.8	0.0	12.8	553.7	O K
360 min Summer	101.588	1.588	12.8	0.0	12.8	548.1	O K
480 min Summer	101.547	1.547	12.8	0.0	12.8	532.7	O K
600 min Summer	101.512	1.512	12.8	0.0	12.8	518.8	O K
720 min Summer	101.482	1.482	12.8	0.0	12.8	505.9	O K
960 min Summer	101.428	1.428	12.8	0.0	12.8	481.3	O K
1440 min Summer	101.324	1.324	12.8	0.0	12.8	431.3	O K
2160 min Summer	101.157	1.157	12.8	0.0	12.8	345.1	O K
2880 min Summer	101.008	1.008	12.8	0.0	12.8	267.1	O K
4320 min Summer	100.763	0.763	12.8	0.0	12.8	147.0	O K
5760 min Summer	100.563	0.563	12.8	0.0	12.8	71.5	O K
7200 min Summer	100.403	0.403	12.4	0.0	12.4	32.1	O K
8640 min Summer	100.289	0.289	11.7	0.0	11.7	14.4	O K
10080 min Summer	100.208	0.208	10.7	0.0	10.7	6.4	O K
15 min Winter	101.072	1.072	12.8	0.0	12.8	300.9	O K
30 min Winter	101.262	1.262	12.8	0.0	12.8	399.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	115.731	0.0	279.9	0.0	23
30 min Summer	77.804	0.0	376.4	0.0	37
60 min Summer	49.937	0.0	483.1	0.0	68
120 min Summer	30.956	0.0	599.0	0.0	126
180 min Summer	23.058	0.0	669.3	0.0	186
240 min Summer	18.577	0.0	718.9	0.0	246
360 min Summer	13.656	0.0	792.7	0.0	364
480 min Summer	10.974	0.0	849.4	0.0	432
600 min Summer	9.254	0.0	895.3	0.0	492
720 min Summer	8.046	0.0	934.2	0.0	560
960 min Summer	6.447	0.0	998.0	0.0	688
1440 min Summer	4.709	0.0	1093.5	0.0	970
2160 min Summer	3.432	0.0	1195.4	0.0	1364
2880 min Summer	2.739	0.0	1271.8	0.0	1732
4320 min Summer	1.989	0.0	1385.3	0.0	2424
5760 min Summer	1.583	0.0	1470.2	0.0	3064
7200 min Summer	1.325	0.0	1538.3	0.0	3744
8640 min Summer	1.147	0.0	1597.8	0.0	4408
10080 min Summer	1.015	0.0	1650.2	0.0	5136
15 min Winter	115.731	0.0	313.5	0.0	22
30 min Winter	77.804	0.0	421.5	0.0	37

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	101.468	1.468	12.8	0.0	12.8	499.7	O K
120 min Winter	101.717	1.717	12.8	0.0	12.8	588.7	O K
180 min Winter	101.900	1.900	12.8	0.0	12.8	625.9	O K
240 min Winter	102.034	2.034	12.8	0.0	12.8	640.0	O K
360 min Winter	102.068	2.068	12.8	0.0	12.8	642.0	O K
480 min Winter	101.926	1.926	12.8	0.0	12.8	629.5	O K
600 min Winter	101.809	1.809	12.8	0.0	12.8	610.2	O K
720 min Winter	101.732	1.732	12.8	0.0	12.8	592.5	O K
960 min Winter	101.622	1.622	12.8	0.0	12.8	559.9	O K
1440 min Winter	101.442	1.442	12.8	0.0	12.8	488.0	O K
2160 min Winter	101.179	1.179	12.8	0.0	12.8	356.7	O K
2880 min Winter	100.943	0.943	12.8	0.0	12.8	233.7	O K
4320 min Winter	100.568	0.568	12.8	0.0	12.8	73.3	O K
5760 min Winter	100.300	0.300	11.8	0.0	11.8	15.7	O K
7200 min Winter	100.175	0.175	10.1	0.0	10.1	4.2	O K
8640 min Winter	100.147	0.147	8.7	0.0	8.7	2.8	O K
10080 min Winter	100.132	0.132	7.8	0.0	7.8	2.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
60 min Winter	49.937	0.0	541.1	0.0	66
120 min Winter	30.956	0.0	670.9	0.0	124
180 min Winter	23.058	0.0	749.6	0.0	182
240 min Winter	18.577	0.0	805.2	0.0	240
360 min Winter	13.656	0.0	887.9	0.0	350
480 min Winter	10.974	0.0	951.3	0.0	458
600 min Winter	9.254	0.0	1002.8	0.0	554
720 min Winter	8.046	0.0	1046.3	0.0	580
960 min Winter	6.447	0.0	1117.8	0.0	736
1440 min Winter	4.709	0.0	1224.7	0.0	1044
2160 min Winter	3.432	0.0	1338.9	0.0	1476
2880 min Winter	2.739	0.0	1424.4	0.0	1824
4320 min Winter	1.989	0.0	1551.6	0.0	2468
5760 min Winter	1.583	0.0	1646.5	0.0	3000
7200 min Winter	1.325	0.0	1722.9	0.0	3672
8640 min Winter	1.147	0.0	1789.5	0.0	4352
10080 min Winter	1.015	0.0	1848.2	0.0	5032

ARP Associates		Page 3
Northwest House Servia Hill Leeds LS6 2QH	Yorkdales 2 Ltd Railway Cutting, Heckmondwike 1471/01Prelim100yr+CC@12.9l/s	
Date 11-01-18 File 1471-01 preliminary Att...	Designed by ARP Checked by	
Elstree Computing Ltd	Source Control 2015.1	


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)	19.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 1.290

<b>Time (mins) Area</b>			<b>Time (mins) Area</b>		
<b>From:</b>	<b>To:</b>	<b>(ha)</b>	<b>From:</b>	<b>To:</b>	<b>(ha)</b>
0	4	0.000	4	8	1.290

ARP Associates		Page 4
Northwest House Servia Hill Leeds LS6 2QH	Yorkdales 2 Ltd Railway Cutting, Heckmondwike 1471/01Prelim100yr+CC@12.9l/s	
Date 11-01-18 File 1471-01 preliminary Att...	Designed by ARP Checked by	
Elstree Computing Ltd		Source Control 2015.1

Model Details

Storage is Online Cover Level (m) 103.000

Pipe Structure

Diameter (m) 1.500 Length (m) 364.000  
Slope (1:X) 500.000 Invert Level (m) 100.000

Hydro-Brake Optimum® Outflow Control

Unit Reference MD-SHE-0147-1290-2088-1290  
Design Head (m) 2.088  
Design Flow (l/s) 12.9  
Flush-Flo™ Calculated  
Objective Minimise upstream storage  
Diameter (mm) 147  
Invert Level (m) 100.000  
Minimum Outlet Pipe Diameter (mm) 225  
Suggested Manhole Diameter (mm) 1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.088	12.8
Flush-Flo™	0.616	12.8
Kick-Flo®	1.266	10.1
Mean Flow over Head Range	-	11.2

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

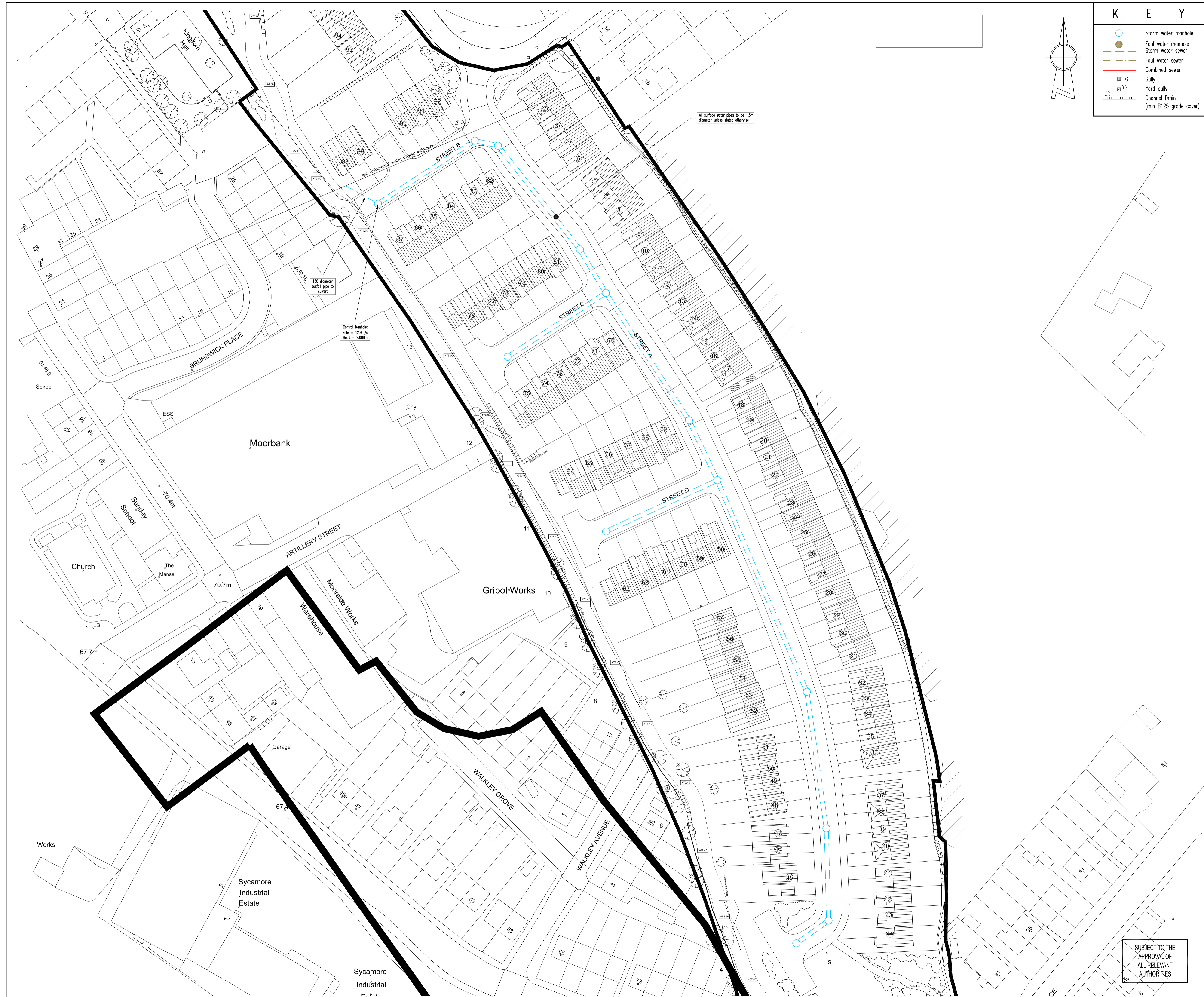
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.3	1.200	10.8	3.000	15.2	7.000	22.9
0.200	10.5	1.400	10.6	3.500	16.4	7.500	23.6
0.300	11.8	1.600	11.3	4.000	17.5	8.000	24.4
0.400	12.4	1.800	12.0	4.500	18.5	8.500	25.1
0.500	12.7	2.000	12.6	5.000	19.5	9.000	25.8
0.600	12.8	2.200	13.2	5.500	20.4	9.500	26.5
0.800	12.7	2.400	13.7	6.000	21.2		
1.000	12.1	2.600	14.2	6.500	22.1		

Weir Overflow Control

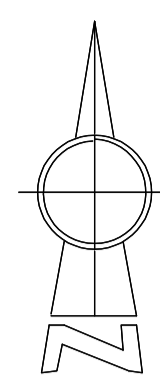
Discharge Coef 0.544 Width (m) 3.000 Invert Level (m) 102.088

**APPENDIX E**

**INDICATIVE DRAINAGE PROPOSAL**



KEY	
	Storm water manhole
	Foul water manhole
	Storm water sewer
	Foul water sewer
	Combined sewer
	Gully
	Yard gully
	Channel Drain (min B125 grade cover)



- ### NOTES
- For longitudinal sections refer to drawing 000/00/06.
  - No services are to be sited directly over, or within 1m of, an adoptable sewer or manhole.
  - Private drainage connections to adoptable sewers to be via 45° junction.
  - Off site manholes already built must have invert levels checked prior to connection to the off site drainage.
  - Any connections to existing sewers/manholes are to be supervised by Yorkshire Water.
  - All connections to proposed public sewers to be minimum 150mm#.
  - Any kind drain or water course on site to be diverted as not to pass under proposed buildings. Diversion to be approved and inspected on site by the Local Authority.

- #### Yorkshire Water General Notes
- All adoptable sewer works and material to be in accordance with "Sewers for Adoption" 6th Edition, the relevant British/European and Yorkshire Water's Standards/Requirements/Addendum to the Mechanical and Electrical Specification and Kitemarked.
  - Manhole covers shall have a clear opening of 600mm and shall be Class D400 to BS EN 124 with 150mm deep frames in highways.
  - Filled ground must be filled and consolidated under the supervision, and to the satisfaction, of Yorkshire Water before any sewer works are carried out.
  - Cover slabs must carry the BSI Kitemark or will be rejected by the Yorkshire Water inspector. Where the clear opening of the Kitemarked product is different to that of the cover and frame, a loading bearing slab should be fitted above the cover slab to bring the size down to 600x600mm for the Yorkshire Water specified cover size. Please refer to the Concrete Pipe Systems Association (CPSA), "Technical Bulletin" issued autumn 2004 for Kitemarked cover slab opening sizes.
  - The adoptable sewers should be a minimum of 1m and manholes 0.5m from kerb faces and service margins.
  - Sewers must have 5 metres clearance from trees and hedges, (please also refer to Figure 2.3 on page 33 in "Sewers for Adoption" 6th Edition for restrictions on tree planting adjacent to Sewers).
  - Sewers to be laid in Class "S" bedding (150mm granular bed and surround). Where depth of cover to top of the sewer is less than 1.2m in highways and verges (or less than 900mm in none vehicular access areas) then a concrete slab should be provided above the granular bed and surround.
  - Adoptable plastic sewer pipes to be BSI Kitemarked (Certified to WS 4-35-01 and BS/EN13476). Adoptable sewer pipes to be laid in maximum 3 metre lengths unless there is a specific operational need to lay longer.
  - Plastic channel sections, manholes are not acceptable and clayware is preferable. Plastic channels are difficult to set in concrete and a satisfactory finish cannot be obtained on the bedding.
  - The chamber size of manholes with more than one connection in them may need to be increased an increment to accommodate the connections and bends.
  - Yorkshire Water policy is not to accept type "C" brick manhole and 1050mm dia manhole rings. Instead it is preferred that you use a type "B" manhole with 1200mm dia or 1500mm dia rings, with the opening sited over the channel where depth of cover to pipe soffit is 1-1.5m.
  - Surface water and foul rising mains to be provided with marker tape above the rising mains.
  - If plastic pipes are to be used then the following should apply:
    - All adoptable sewers to be BSI Kitemark (certified to WS 4-35-01).
    - Bedding and backfill material to conform to the requirements of Water industry Specification 4-08-02 (Table A2)
  - Where plastic pipes are proposed for adoptable sewers, structural calculations for the plastic pipes and a site investigation report to prove that the ground condition is suitable for the plastic pipes are to be produced.
  - Where plastic pipes are installed into the ground prior to getting full technical approval, the developer must provide a CCTV survey of the prospectively adoptable sewers and a deformation test (Light-Line test) of the plastic pipes.
  - Demarcation chambers to be a min. 450mm# chamber for 100mm# foul & 150mm# surface water pipes up to 1.2m deep. For depths greater than 1.2m, restricted access opening to 350mm is required for safety reasons.
  - Maximum depth of demarcation chamber to be 2m, where depth exceeds 2m, manhole to be constructed as type B manhole.
  - Where a B125 cover and frame has been approved, this must not be coated in plastic and must have lifting eyes suitably sized to accommodate standard lifting keys. Screw down covers are not acceptable.
  - Yorkshire Water is not obliged to accept filter drain/land drainage runoff into the public sewer network or adoptable drainage system (directly or in-directly). An alternative method of disposal of the land drainage runoff will therefore be required and you will have to liaise with the Land Drainage Authority/Land Drainage Section with regard to the disposal of the filter drain/land drainage runoff is required.
  - Sulphate resisting cement (C20-DC2) and precast concrete products must be used or a laboratory report provided proving that such precautions are not necessary.
  - Strength of vitrified clay pipes (if used) to be 40KN/m for 100#, 40KN/m for 150#, 45KN/m for 225# and 72KN/m for 300#. All concrete pipes to be Class 120 concrete to EN 1916/BS 5911-1:2002.
  - All levels of existing drainage to be confirmed prior to work commencing on site.
  - The contractor must allow for any fee's required for road and sewer opening permits, sewer connections and make the appropriate applications.

Rev	By	Date	Revision	ARP	ARP
/	JMG	16.01.18	Issued for approval	ARP	ARP

**ARP ASSOCIATES**  
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ARP Associates is a trading division of ARP Geotechnical Ltd, a company registered in England and Wales with company number 3773813, whose registered office is at 5/6 Northwest Business Park, Servia Hill, Leeds LS6 2QH

TITLE  
**INDICATIVE DRAINAGE STRATEGY**

PROJECT  
**HORTON STREET, HECKMONDWIKE**

CLIENT  
**YORKDALES 2 LTD**

DRAWING STATUS  
**PRELIMINARY**

Scale	Date	Drawn
1:200 @ A1	JAN 18	JMG
	Chk.	ARP

Org. No.	Rev
1471/01/SK01	/

SUBJECT TO THE APPROVAL OF ALL RELEVANT AUTHORITIES