Donald Insall Associates
Chartered Architects and Historic Building Consultants

Broadfield Park Slopes ('The Slopes'), Rochdale

Design & Access Statement Appendix: Volume II

For Rochdale Development Agency

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Contact information

Caroline Drake
E: Caroline.drake@insall-architects.co.uk
Tel: 01244 350 063

Chester Studio
Bridgegate House, 5 Bridge Place
Chester, CH1 1SA

www.donaldinsallassociates.co.uk

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Appendix A
Geological Investigations

18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT
UK

Telephone: +44 (0)1442 437500
Fax: +44 (0)1442 437550
www.rsk.co.uk

Our Ref: 372700-L01 (01)

20th December 2022

Price & Myers
Beehive Lofts,
Jersey Street
Manchester
M4 6JG

For the attention of Will York

Dear Will,

RE: BROADFIELD PARK SLOPES, ROCHDALE – SURFACE WATER SAMPLING

1. INTRODUCTION

On the instructions of Price and Myers, on behalf of Rochdale Development Agency (the Client), RSK Environment Limited (RSK) has carried out surface water sampling at Broadfield Park Slopes, The Esplanade, Rochdale, OL16 1AQ.

The site comprises Broadfield Park Slopes ("the Slopes"), a section of the Grade-II listed Victorian-era Broadfield Park which is located adjacent south of the Victorian Grade-I listed Rochdale Town Hall (the "Town Hall") in the centre of Rochdale, Greater Manchester.

The Slopes and the adjacent Town Hall are currently subject to an ongoing regeneration project which aspires to return the site to its former status as a vibrant public space; including improvements to access, creating safe and desirable landscaped areas, restoring views between the surrounding historic buildings and rectifying drainage issues.

As part of the project, it is understood that consideration is being given to the reinstatement of Packer Spout as a public amenity. To enable this option to be considered in further detail, RSK was commissioned to undertake preliminary surface water sampling to provide an indicative assessment of the water quality.

2. LIMITATIONS

The comments given in this report and the opinions expressed are based on the conditions encountered during the site work and on the results of tests made in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that groundwater levels

flows may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised.

This report should be considered in the light of any changes in legislation, statutory requirement or industry practices that have occurred following the date of issue.

This report is subject RSK's service constraints given in Appendix A.

3. PREVIOUS REPORTS

The following reports detailing previous works at and within the immediate vicinity of the site were made available for review:

- Geotechnical & Environmental Associates Limited (GEA), "Desk Study and Ground Investigation Report: Rochdale Town Hall, The Esplanade, Rochdale, OL16 1AZ", ref.: J19177, dated November 2019
- Ambellia Consultancy, "Initial Hydrology Report: Rochdale Town Hall, The Esplanade, Rochdale, OL16 1AZ", rev.: 00, dated September 2021
- Ambellia Consultancy, "Report on April 2022 RTH Slopes Water Flow Investigations: Rochdale Town Hall, The Esplanade, Rochdale, OL16 1AZ", rev.: 00, May 2022
- Ambellia Consultancy, "Interim Report, Park Slopes Water Flow Investigations: Rochdale Town Hall, The Esplanade, Rochdale, OL16 1AZ", rev.: 00, June 2022

In addition, RSK has previously undertaken geotechnical desk study and intrusive investigation at the Broadfield Park Slopes site:

- RSK, Geotechnical Desk Study – Broadfield Park Slopes, The Esplanade, Rochdale, OL16 1A, report reference 372700-01 (00) dated October 2022.
- RSK, Ground Investigation Report – Broadfield Park Slopes, The Esplanade, Rochdale, OL16 1A, report reference 372700-02 (00) dated November 2022.

The above reports should be considered in conjunction with this letter report.

4. SITE DESCRIPTION AND SURFACE WATER SETTING

The Slopes cover an area of approximately 0.97Ha, ranging in elevation from 142.12m above Ordnance Datum (AOD) adjacent to St. Chad's Church in the south, to 121.24m AOD at the boundary with the Town Hall car park in the north. A plan showing the location of the site is presented as **Figure 1**.

Vegetation on the slopes was poorly maintained and had become heavily overgrown in recent years. The site has recently been subject to an extensive programme of vegetation clearance, undertaken by the contractor as part of the enabling works for the regeneration project, leaving the

surface of the slope generally covered with scrub vegetation, which has re-established following the recent clearance works.

The nearest offsite surface watercourse is the River Roch, which flows in a southwesterly direction 30m to the north of the site. It is culverted approximately 6m below ground level, where it flows parallel with The Esplanade (i.e. immediately north of the Town Hall), however flows in an open channel at either end of the culvert.

Grade-II* listed St. Chad's Church sits on a plateau at the top of the Slopes and is retained at an elevation of approximately 141.78m AOD. Runoff from the church yard at St. Chad's is channelled via a masonry surface drain which runs beneath the church yard retaining wall and onto the Slopes, where it currently collects to form a pond (elevation approximately 130.88m AOD). Wetland vegetation is established around the margin of the pond suggesting that this is a permanent feature.

Packer Spout, a semi-oval shaped stone reservoir, is present in the east of the Slopes. Packer Spout was originally constructed in 1760 to collect spring water before distributing it to buildings in Packer Street, Fleece Street, and Church Lane.

Investigations undertaken by Ambellia (2021, 2022a, 2022b) have established the presence of 2no. spring lines within the current study site, which sit within the granular superficial aquifer (Glaciofluvial Sand and Gravel) at elevations of approximately 131m and 127m AOD respectively.

Water issuing from the spring lines, along with runoff from the above catchment areas (St. Chad's Church yard and Parsonnage House), is channelled downslope by various different mechanisms. The site has been subject to an extensive and complicated history of water management, and a variety of different drainage systems have been used, all of which are understood to remain, though in varying states of disrepair.

A detailed inspection of the existing drainage systems is outside the scope of this report, and the drainage and water management systems within the slopes are the subject of an ongoing assessment by Ambellia, as described at length in the reports listed in Section 3.

5. GROUNDWATER

RSK have recently undertaken an intrusive investigation of the site, as reported in Ground Investigation Report, ref.: 372700-02 (00), November 2022.

Within the Ground Investigation Report the site was zoned on the basis of the spatial variation in ground conditions and topography encountered.

Within Zone A (Ground Model 1), groundwater springs are absent, considered to be due to the absence of cohesive units within the slope. However, groundwater is present at approximately 120 m AOD at the toe of the slope, rising to ~121.50 mAOD in line with the crest of the slope, and is

inferred to continue rising southward to an elevation of ~132 m AOD, following the local topography and consistent with the findings of borehole CP01.

Within Zones B and C (Ground Model 2) two groundwater spring lines are noted within the Glaciofluvial Deposits at around 132 m and 125 mAOD. Groundwater is present at approximately 120 m AOD at the toe of the slope, rising to ~132 mAOD within the upper portion of the slope (coincident with the reported level of spring line) and is considered to remain at around this elevation to approximately in line with the crest of the slope (in line with borehole CP01). It is inferred to continue rising southward to an elevation of ~135 mAOD, following the local topography.

Groundwater within the Pennine Coal Measures may be taken as being at approximately 109.85 m AOD based on the highest groundwater strike in this stratum results of the GEA investigation for all ground models.

6. SURFACE WATER SAMPLING

Two surface water samples (SW1 and SW2) were taken by RSK on the 7th September 2022 at the locations shown in **Figure 2**. The sampling locations were specified by Ambellia prior to RSK's attendance at the site.

Collection of a third sample (SW3) was attempted from a manhole within the grounds of Partnership House but this was found to be dry.

Samples were collected in containers appropriate to the anticipated testing suite required. The containers were filled to capacity and placed in a cool box to minimise volatilisation and dispatched to the laboratory in cool boxes under chain of custody documentation.

Chemical testing undertaken on water samples obtained is presented in **Table 1** with the laboratory testing results contained in Appendix B.

Table 1 Summary of chemical testing of water samples

Sample type	Tests undertaken	No. of tests
Surface water	Dissolved metals (Al, Ca, Fe, Mg, Sb, As, B, Cd, Mn, Cr, Cu, Na, Pb, Ni, Se, Hg)	2
	pH and sulphur (SO4)	2
	Dissolved Solids	2
	Total Coliform & E. Coli	2
	Ammonia	2
	Nitrite, Nitrate, Chloride, Total Oxidised Nitrogen (NO3)	2
	Volatile Petroleum Hydrocarbon (VPH) and Extractable Petroleum Hydrocarbon (EPH)	2

	Polycyclic Aromatic Hydrocarbon (PAH)	2*
	Hardness	2

*The results for Polycyclic Aromatic Hydrocarbons (PAHs) in sample SW1 fell outside the laboratories QC check and the sample was sent back for repeat analysis.

7. GEO-ENVIRONMENTAL ASSESSMENT

7.1 Introduction

As noted in Section 1 of this report, the Slopes and the adjacent Town Hall are currently subject to an ongoing regeneration project which aspires to return the site to its former status as a vibrant public space. As part of the project it is understood that consideration is being given to the reinstatement of Packer Spout as a public amenity. To enable this option to be considered in further detail, RSK was commissioned to undertake preliminary surface water sampling to provide an indicative assessment of the water quality.

At this stage, a limited scope of sampling and assessment has been undertaken (i.e. 2no. samples). It should therefore be appreciated that the comments made within this report are of a preliminary nature, and that although the findings may be used to inform an initial appraisal of potential options and constraints, further sampling and analysis would be required to provide a more detailed examination of the water quality, should the reinstatement of Packer Spout proceed.

7.2 Assessment

On the basis of the potential future use of the water supply as a public amenity, there is the potential for a complete pollutant linkage via direct contact or ingestion of impacted water, intentional or otherwise.

The analytical results for the two water samples have therefore been directly assessed against Drinking Water Standards (DWS). The Generic Assessment Criteria (GAC) for DWS have been presented in **Appendix C**.

The results of the direct comparisson undertaken indicate a number of exceedances above the assessment criteria, as summarised in Table 2 below.

Table 2 Summary of surface water GQRA results

Determinand	GAC (DWS) (µg/l)	Surface water exceedances (sampling location and concentration µg/l)
Total Coliform presumptive	0	SW1 (29) & SW2 (>100)
Total Coliforms confirmed	0	SW1 (29) & SW2 (>100)
E.coli presumptive	0	SW2 (>100)

Determinand	GAC (DWS) (µg/l)	Surface water exceedances (sampling location and concentration µg/l)
E. coli confirmed	0	SW2 (>100)
Total Iron	200	SW2 (1330)
Total Lead	10	SW2 (33.5)
pH	6.5 to 9.5	SW1 (6.37)

From the above, it can be seen that Total Coliforms and E. Coli were detected in sample SW2 and Total Coliforms were detected in sample SW1. Sample SW2 also had elevated metal concentrations (iron and lead) in excess of the DWS. The pH of SW1 also fell marginally short of the required DWS range.

Based on the limited testing undertaken to date, the presence of Total Coliform, E. coli and heavy metals indicate that the sampled waters do not comprise a suitable drinking water resource without prior treatment.

On the basis of the above results, consideration should be given to management of the up-slope water system to determine whether improvements to the water quality can be made. Further consideration may otherwise be given to the use of Packer Spout for resources other than drinking water. Following a review of the potential options, it is recommended that further testing of the water sources to determine any trends in long term water quality is undertaken.

Yours sincerely,

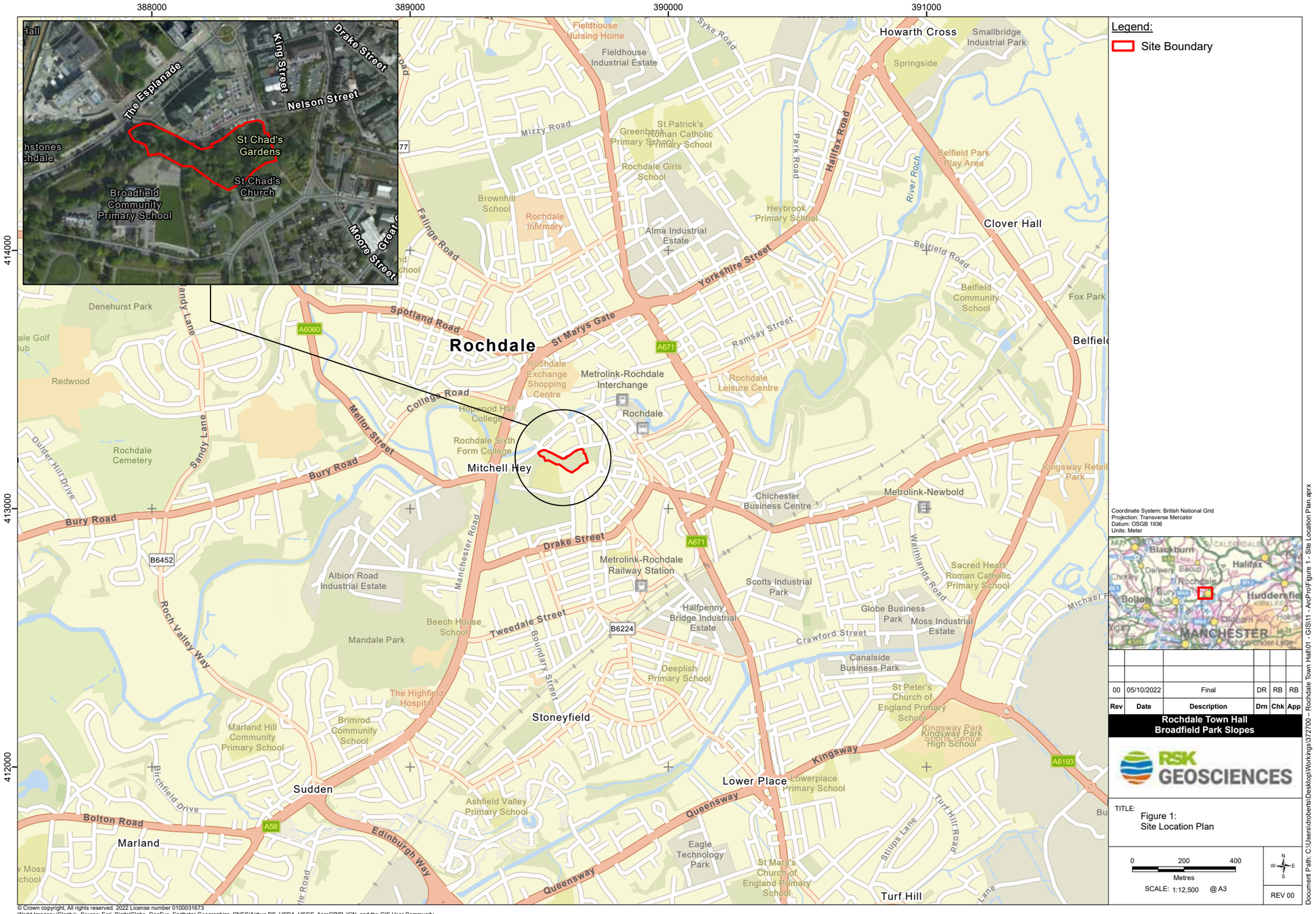
Claire Siberry
Senior Geotechnical Engineer

Rowan Brown
Principal Geotechnical Engineer

Encl.

Figure 1	Site location plan
Figure 2	Exploratory hole location plan
Appendix A	Service Constraints
Appendix B	Laboratory Certificates for Surface Water Analysis
Appendix C	Generic Assessment Criteria for Controlled Waters

FIGURES



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RSK	**SAMPLING LOCATION PLAN**	**Client:**	Rochdale Development Agency	**Figure No:**	2
		Site:	Broadfield Park Slopes, Rochdale	**Job No:**	372700
		Scale:	NTS	**Source:**	Dwg 30217-SK-CIV-01 P01

APPENDIX A
Service Constraints

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for Rochdale Development Agency (the "Client") in accordance with the terms of a contract between RSK and the Client, dated 31st August 2022. The Services were performed by RSK with the reasonable skill and care ordinarily exercised by an environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the Client.

2. Other than that, expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed in writing, the Services were performed by RSK exclusively for the purposes of the Client. RSK is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the Client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the Client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas, persistent, bioaccumulative or toxic chemicals (including PFAS compounds) or other radioactive or hazardous materials, unless specifically identified in the Services.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a visual inspection of the site together with RSK's interpretation of information, including documentation, obtained from third parties and from the Client on the history and usage of the site, unless specifically identified in the Services or accreditation system (such as UKAS ISO 17020:2012 clause 7.1.6):

    a. The Services were based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely.

    b. The Services were limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the visual inspection.

    c. The Services did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services.

    RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the Client and RSK.

8. The intrusive environmental site investigation aspects of the Services are a limited sampling of the site at pre-determined locations based on the known historic / operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the properties of the materials adjacent and local conditions, together with the position of any current structures and underground utilities and facilities, and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters (as stipulated in the scope between the client and RSK, based on an understanding of the available operational and historical information) and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

10. The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows, may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised.

11. Asbestos is often observed to be present in soils in discrete areas. Whilst asbestos-containing materials may have been locally encountered during the fieldworks or supporting laboratory analysis, the history of brownfield and demolition sites indicates that asbestos fibres may be present more widely in soils and aggregates, which could be encountered during more extensive ground works.

12. Unless stated otherwise, only preliminary geotechnical recommendations are presented in this report and these should be verified in a Geotechnical Design Report, once proposed construction and structural design proposals are confirmed.

APPENDIX B

Laboratory Certificates for Surface Water Analysis

ALS Environmental Ltd
Torrington Avenue
Coventry
CV4 9GU

T: +44 (0)24 7642 1213
F: +44 (0)24 7685 6575
www.alsenvironmental.co.uk

Ms Siberry
RSK Geosciences
18 Frogmore Road
Hertfordshire
Hemel Hempstead HP3 9RT

28 September 2022

Test Report: COV/2369621/2022

Dear Ms Siberry

Analysis of your sample(s) submitted on 07 September 2022 is now complete and we have pleasure in enclosing the appropriate test report(s).

An invoice for the analysis carried out will be sent under separate cover.

Should you have any queries regarding this report(s) or any part of our service, please contact Customer Services on +44 (0)24 7642 1213 who will be happy to discuss your requirements.

If you would like to arrange any further analysis, please contact Customer Services. To arrange container delivery or sample collection, please call the Couriers Department directly on 024 7685 6562.

Thank you for using ALS Environmental Ltd and we look forward to receiving your next samples.

Yours Sincerely,

Signed: Elizabeth Parker.

Name: E. Parker

Title: Potable Micro Team Leader

UKAS TESTING 1314 | bsi ISO 14001 Environmental Management CERTIFIED EMS675527 | ISO 45001 Occupational Health and Safety Management CERTIFIED OHS 542058 | MCERTS

This communication has been sent to you by ALS Environmental Ltd. Registered in England and Wales. Registration No.02148934. Registered Office: ALS Environmental Limited, Torrington Avenue, Coventry, CV4 9GU.

Report Summary

UKAS TESTING 1314

Ms Claire Siberry
RSK Geosciences
18 Frogmore Road
Hertfordshire
Hemel Hempstead
HP3 9RT

Date of Issue: **28 September 2022**

Report Number: **COV/2369621/2022** Issue **1** This issue replaces all previous issues

Number of Samples included in this report **2**

Job Received: **07 September 2022**

Number of Test Results included in this report **122**

Analysis Commenced: **08 September 2022**

Signed: Elizabeth Parker.

Name: **E. Parker** Date: **28 September 2022**

Title: **Potable Micro Team Leader**

ALS Environmental Ltd was not responsible for sampling unless otherwise stated.

Information on the methods of analysis and performance characteristics are available on request.
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. The results relate only to the items tested and where relevant sampled.
Tests marked 'Not UKAS Accredited' in this Report/Certificate are not included in the UKAS Accreditation Schedule for our laboratory.
This test report is not a statement of conformity to any specification or standard.

This communication has been sent to you by ALS Environmental Ltd. Registered in England and Wales. Registration No. 02148934. Registered Office: ALS Environmental Limited, Torrington Avenue, Coventry, CV4 9GU.
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Certificate of Analysis

UKAS TESTING 1314

Report Number: **COV/2369621/2022** Issue **1**
Laboratory Number **22007132** Sample **1** of **2**

Sample Source: **RSK Geosciences**
Sample Point Description: **Drinking Water**
Sample Description: **SW1**
Sample Matrix: **Drinking Water**

Sample Date: **07 September 2022** Sample Received **07 September 2022** Analysis Complete: **28 September 2022**

Test Description	Result	Units	Limit	Accreditation		Method
EPH >C10 - C44	<10	ug/l		Y	Cov	GEO46
VPH/EPH >C5 - C44	<10	ug/l		N	Cov	GEO45/GEO46
Aromatic VPH/EPH >C5 - C44	<10	ug/l		N	Cov	GEO45/GEO46
Aliphatic VPH/EPH >C5 - C44	<10	ug/l		N	Cov	GEO45/GEO46
Hydrogen ion (pH)	6.37	pH units	6.5 to 9.5	Y	Wak	WPC8
Ammonium ammonia+ammonium ion	<0.010	mg/l	0.5	Y	Wak	WPC64
Nitrite as NO2	<0.003	mg/l	0.5	Y	Wak	WPC64
Nitrate as NO3	17.0	mg/l	50	Y	Wak	WPC64
Chloride as Cl	17.1	mg/l	250	Y	Wak	WPC64
Aluminium, Total as Al	<6.90	ug/l	200	Y	Wak	WPC12/49
Calcium, Total as Ca	24.8	mg/l		Y	Wak	WPC12/49
Iron, Total as Fe	145	ug/l	200	Y	Wak	WPC12/49
Magnesium, Total as Mg	1.46	mg/l		Y	Wak	WPC12/49
Manganese, Total as Mn	26.8	ug/l	50	Y	Wak	WPC12/49
Sodium, Total as Na	13.2	mg/l	200	Y	Wak	WPC12/49
Antimony, Total as Sb	0.16	ug/l	5	Y	Wak	WPC15
Arsenic, Total as As	0.23	ug/l	10	Y	Wak	WPC15
Cadmium, Total as Cd	0.04	ug/l	5	Y	Wak	WPC15
Chromium, Total as Cr	<0.18	ug/l	50	Y	Wak	WPC15
Nickel, Total as Ni	1.50	ug/l	20	Y	Wak	WPC15
Selenium, Total as Se	0.86	ug/l	10	Y	Wak	WPC15
Mercury, Total as Hg	<0.06	ug/l	1	Y	Wak	WPC21
Solids, Dissolved 180 Deg C	104	mg/l	1500	Y	Wak	WPC25
Benzo(b)fluoranthene	Analyst Comment	ng/l		Y	Wak	WPC27
Benzo(k)fluoranthene	Analyst Comment	ng/l		Y	Wak	WPC27
Benzo(ghi)perylene	Analyst Comment	ng/l		Y	Wak	WPC27
Benzo(a)pyrene	Analyst Comment	ng/l	10	Y	Wak	WPC27
Fluoranthene	Analyst Comment	ng/l		Y	Wak	WPC27
Indeno(1,2,3cd)pyrene	Analyst Comment	ng/l		Y	Wak	WPC27
Total PAHs 4 Constituents	Analyst Comment	ug/l	0.1	Y	Wak	WPC27
Hardness, Total as CaCO3	67.9	mg/l		Y	Wak	WPC12/49
PAH Total ug/l	Analyst Comment	ug/l		N	Wak	WPC27
Total Oxidised Nitrogen as NO3	17.0	mg/l	50	Y	Wak	WPC64
Boron, Total as B	<0.0320	mg/l	1.0	Y	Wak	WPC12/49

Certificate of Analysis

UKAS TESTING 1314

Report Number: **COV/2369621/2022** Issue **1**
Laboratory Number **22007132** Sample **1** of **2**

Sample Source: **RSK Geosciences**
Sample Point Description: **Drinking Water**
Sample Description: **SW1**
Sample Matrix: **Drinking Water**

Sample Date: **07 September 2022** Sample Received **07 September 2022** Analysis Complete: **28 September 2022**

Test Description	Result	Units	Limit	Accreditation		Method
Copper, Total as Cu	0.69	ug/l	2000	Y	Wak	WPC15
Lead, Total as Pb	0.16	ug/l	10	Y	Wak	WPC15
Sulphur, Total as SO4	18.3	mg/l	250	Y	Wak	WPC12/49
Aliphatic EPH >C35 - C44	<10	ug/l		N	Cov	GEO46
Aliphatic EPH >C10 - C44	<10	ug/l		Y	Cov	GEO46
Aromatic EPH >C10 - C12	<10	ug/l		Y	Cov	GEO46
Aromatic EPH >C12 - C16	<10	ug/l		Y	Cov	GEO46
Aromatic EPH >C16 - C21	<10	ug/l		Y	Cov	GEO46
Aromatic EPH >C21 - C35	<10	ug/l		N	Cov	GEO46
Aromatic EPH >C35 - C44	<10	ug/l		N	Cov	GEO46
VPH >C5 - C10	<10	ug/l		N	Cov	GEO45
Aliphatic VPH >C5 - C6	<10	ug/l		N	Cov	GEO45
Aliphatic VPH >C6 - C8	<10	ug/l		N	Cov	GEO45
Aliphatic VPH >C5 - C10	<10	ug/l		N	Cov	GEO45
Aromatic VPH >C5 - C7	<10	ug/l		N	Cov	GEO45
Aromatic VPH >C7 - C8	<10	ug/l		N	Cov	GEO45
Aromatic VPH >C8 - C10	<10	ug/l		N	Cov	GEO45
Aromatic VPH >C5 - C10	<10	ug/l		N	Cov	GEO45
Aliphatic EPH >C10 - C12	<10	ug/l		Y	Cov	GEO46
Aliphatic EPH >C12 - C16	<10	ug/l		Y	Cov	GEO46
Aromatic EPH >C10 - C44	<10	ug/l		Y	Cov	GEO46
Aliphatic EPH >C16 - C35	<10	ug/l		N	Cov	GEO46
Aliphatic VPH >C8 - 10	<10	ug/l		N	Cov	GEO45
Total Coliforms confirmed	29	cfu/100ml	0	Y	Cov	W10
Escherichia coli confirmed	0	cfu/100ml	0	Y	Cov	W10
Total Coliform presump	29	cfu/100ml	0	Y	Cov	W10
E.coli presumptive	0	cfu/100ml	0	Y	Cov	W10

Analyst Comments for 22007132: {/*}pH result confirmed with a repeat result of 6.35.
WPC27 - PAH - Sample sent back for repeat analysis due to Internal standard recovery failure. however no sample remaining for further analysis.{*/} Total coliforms identified as Serratia fonticola, Buttiauxella species, Kluyvera species, Lelliottia amnigena.

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: CHE = Chester(CH5 3US), COV = Coventry(CV4 9GU), OTT = Otterbourne(SO21 2RU), S = Subcontracted, TRB = Subcontracted to Trowbridge(BA14 0XD), WAK = Wakefield(WF5 9TG),
F = Data supplied by customer.
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

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Certificate of Analysis

UKAS TESTING 1314

Report Number: **COV/2369621/2022** Issue **1**
Laboratory Number **22007133** Sample **2** of **2**

Sample Source: **RSK Geosciences**
Sample Point Description: **Drinking Water**
Sample Description: **SW2**
Sample Matrix: **Drinking Water**

Sample Date: **07 September 2022** Sample Received **07 September 2022** Analysis Complete: **28 September 2022**

Test Description	Result	Units	Limit	Accreditation		Method
EPH >C10 - C44	<10	ug/l		Y	Cov	GEO46
VPH/EPH >C5 - C44	<10	ug/l		N	Cov	GEO45/GEO46
Aromatic VPH/EPH >C5 - C44	<10	ug/l		N	Cov	GEO45/GEO46
Aliphatic VPH/EPH >C5 - C44	<10	ug/l		N	Cov	GEO45/GEO46
Hydrogen ion (pH)	6.93	pH units	6.5 to 9.5	Y	Wak	WPC8
Ammonium ammonia+ammonium ion	<0.010	mg/l	0.5	Y	Wak	WPC64
Nitrite as NO2	<0.003	mg/l	0.5	Y	Wak	WPC64
Nitrate as NO3	11.0	mg/l	50	Y	Wak	WPC64
Chloride as Cl	18.3	mg/l	250	Y	Wak	WPC64
Aluminium, Total as Al	294	ug/l	200	Y	Wak	WPC12/49
Calcium, Total as Ca	26.6	mg/l		Y	Wak	WPC12/49
Iron, Total as Fe	1330	ug/l	200	Y	Wak	WPC12/49
Magnesium, Total as Mg	1.78	mg/l		Y	Wak	WPC12/49
Manganese, Total as Mn	35.4	ug/l	50	Y	Wak	WPC12/49
Sodium, Total as Na	18.2	mg/l	200	Y	Wak	WPC12/49
Antimony, Total as Sb	0.22	ug/l	5	Y	Wak	WPC15
Arsenic, Total as As	1.55	ug/l	10	Y	Wak	WPC15
Cadmium, Total as Cd	0.07	ug/l	5	Y	Wak	WPC15
Chromium, Total as Cr	0.49	ug/l	50	Y	Wak	WPC15
Nickel, Total as Ni	1.74	ug/l	20	Y	Wak	WPC15
Selenium, Total as Se	0.96	ug/l	10	Y	Wak	WPC15
Mercury, Total as Hg	<0.06	ug/l	1	Y	Wak	WPC21
Solids, Dissolved 180 Deg C	145	mg/l	1500	Y	Wak	WPC25
Benzo(b)fluoranthene	1.02	ng/l		Y	Wak	WPC27
Benzo(k)fluoranthene	0.85	ng/l		Y	Wak	WPC27
Benzo(ghi)perylene	0.72	ng/l		Y	Wak	WPC27
Benzo(a)pyrene	1.33	ng/l	10	Y	Wak	WPC27
Fluoranthene	1.48	ng/l		Y	Wak	WPC27
Indeno(1,2,3cd)pyrene	1.19	ng/l		Y	Wak	WPC27
Total PAHs 4 Constituents	0.004	ug/l	0.1	Y	Wak	WPC27
Hardness, Total as CaCO3	73.7	mg/l		Y	Wak	WPC12/49
PAH Total ug/l	0.007	ug/l		N	Wak	WPC27
Total Oxidised Nitrogen as NO3	11.0	mg/l	50	Y	Wak	WPC64
Boron, Total as B	<0.0320	mg/l	1.0	Y	Wak	WPC12/49

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UKAS TESTING 1314

Report Number: **COV/2369621/2022** Issue **1**
Laboratory Number **22007133** Sample **2** of **2**

Sample Source: **RSK Geosciences**
Sample Point Description: **Drinking Water**
Sample Description: **SW2**
Sample Matrix: **Drinking Water**

Sample Date: **07 September 2022** Sample Received **07 September 2022** Analysis Complete: **28 September 2022**

Test Description	Result	Units	Limit	Accreditation		Method
Copper, Total as Cu	8.6	ug/l	2000	Y	Wak	WPC15
Lead, Total as Pb	33.5	ug/l	10	Y	Wak	WPC15
Sulphur, Total as SO4	27.8	mg/l	250	Y	Wak	WPC12/49
Aliphatic EPH >C35 - C44	<10	ug/l		N	Cov	GEO46
Aliphatic EPH >C10 - C44	<10	ug/l		Y	Cov	GEO46
Aromatic EPH >C10 - C12	<10	ug/l		Y	Cov	GEO46
Aromatic EPH >C12 - C16	<10	ug/l		Y	Cov	GEO46
Aromatic EPH >C16 - C21	<10	ug/l		Y	Cov	GEO46
Aromatic EPH >C21 - C35	<10	ug/l		N	Cov	GEO46
Aromatic EPH >C35 - C44	<10	ug/l		N	Cov	GEO46
VPH >C5 - C10	<10	ug/l		N	Cov	GEO45
Aliphatic VPH >C5 - C6	<10	ug/l		N	Cov	GEO45
Aliphatic VPH >C6 - C8	<10	ug/l		N	Cov	GEO45
Aliphatic VPH >C5 - C10	<10	ug/l		N	Cov	GEO45
Aromatic VPH >C5 - C7	<10	ug/l		N	Cov	GEO45
Aromatic VPH >C7 - C8	<10	ug/l		N	Cov	GEO45
Aromatic VPH >C8 - C10	<10	ug/l		N	Cov	GEO45
Aromatic VPH >C5 - C10	<10	ug/l		N	Cov	GEO45
Aliphatic EPH >C10 - C12	<10	ug/l		Y	Cov	GEO46
Aliphatic EPH >C12 - C16	<10	ug/l		Y	Cov	GEO46
Aromatic EPH >C10 - C44	<10	ug/l		Y	Cov	GEO46
Aliphatic EPH >C16 - C35	<10	ug/l		N	Cov	GEO46
Aliphatic VPH >C8 - 10	<10	ug/l		N	Cov	GEO45
Total Coliforms confirmed	>100	cfu/100ml	0	Y	Cov	W10
Escherichia coli confirmed	>100	cfu/100ml	0	Y	Cov	W10
Total Coliform presump	>100	cfu/100ml	0	Y	Cov	W10
E.coli presumptive	>100	cfu/100ml	0	Y	Cov	W10

Analyst Comments for 22007133: Confirmation process not been carried out for coliforms due to nature of the sample. Confirmation process not been carried out for coliforms due to nature of the sample. {/*}Pb result confirmed by 33.6ug/l
Al result confirmed by 276ug/l
Fe result confirmed by 1340ug/l{*/}

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: CHE = Chester(CH5 3US), COV = Coventry(CV4 9GU), OTT = Otterbourne(SO21 2RU), S = Subcontracted, TRB = Subcontracted to Trowbridge(BA14 0XD), WAK = Wakefield(WF5 9TG),
F = Data supplied by customer.
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

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Signed: Elizabeth Parker. Name: **E. Parker** Date: **28 September 2022**
Title: **Potable Micro Team Leader**

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Coventry
CV4 9GU

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www.alsenvironmental.co.uk

Ms Siberry
RSK Geosciences
18 Frogmore Road
Hertfordshire
Hemel Hempstead HP3 9RT

28 September 2022

Test Report: COV/2369621/2022

Dear Ms Siberry

Analysis of your sample(s) submitted on 07 September 2022 is now complete and we have pleasure in enclosing the appropriate test report(s).

An invoice for the analysis carried out will be sent under separate cover.

Should you have any queries regarding this report(s) or any part of our service, please contact Customer Services on +44 (0)24 7642 1213 who will be happy to discuss your requirements.

If you would like to arrange any further analysis, please contact Customer Services. To arrange container delivery or sample collection, please call the Couriers Department directly on 024 7685 6562.

Thank you for using ALS Environmental Ltd and we look forward to receiving your next samples.

Yours Sincerely,

Signed: Elizabeth Parker.

Name: E. Parker

Title: Potable Micro Team Leader

1314 EMS675527 OHS 542058

This communication has been sent to you by ALS Environmental Ltd. Registered in England and Wales. Registration No.02148934. Registered Office: ALS Environmental Limited, Torrington Avenue, Coventry, CV4 9GU.

Report Summary

ANALYSED BY

Ms Claire Siberry
RSK Geosciences
18 Frogmore Road
Hertfordshire
Hemel Hempstead
HP3 9RT

1314

Date of Issue: **28 September 2022**

Report Number: **COV/2369621/2022** Issue **1** This issue replaces all previous issues

Job Description: Drinking Waters Testing

Job Location: 18 FROGMORE RD. HP2 9RT

Number of Samples included in this report **2**

Job Received: **07 September 2022**

Number of Test Results included in this report **122**

Analysis Commenced: **08 September 2022**

Signed: Elizabeth Parker.

Name: **E. Parker** Date: **28 September 2022**

Title: **Potable Micro Team Leader**

ALS Environmental Ltd was not responsible for sampling unless otherwise stated.

Information on the methods of analysis and performance characteristics are available on request.
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. The results relate only to the items tested and where relevant sampled.
Tests marked 'Not UKAS Accredited' in this Report/Certificate are not included in the UKAS Accreditation Schedule for our laboratory.
This test report is not a statement of conformity to any specification or standard.

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ANALYSED BY

UKAS TESTING 1314

Report Number:	**COV/2369621/2022**		Issue	**1**
Laboratory Number:	**22007132**		Sample	**1** of **2**
Sample Source:	**RSK Geosciences**			
Sample Point Description:	**Drinking Water**			
Sample Description:	**SW1**			
Sample Matrix:	**Drinking Water**			
Sample Date/Time:	**07 September 2022**	**12:00**		
Sample Received:	**07 September 2022**			
Analysis Complete:	**28 September 2022**			

Test Description	Result	Units	Analysis Date	Accreditation		Method
Hardness, Total as CaCO3	67.9	mg/l	08/09/2022	Y	Wak	WPC12/49
PAH Total ug/l	Analyst Com	ug/l	28/09/2022	N	Wak	WPC27
Sulphur, Total as SO4	18.3	mg/l	08/09/2022	Y	Wak	WPC12/49
Total Coliform presump	29	cfu/100ml	09/09/2022	Y	Cov	W10
Total Coliforms confirmed	29	cfu/100ml	09/09/2022	Y	Cov	W10
E.coli presumptive	0	cfu/100ml	09/09/2022	Y	Cov	W10
Escherichia coli confirmed	0	cfu/100ml	09/09/2022	Y	Cov	W10
Aluminium, Total as Al	<6.90	ug/l	08/09/2022	Y	Wak	WPC12/49
Calcium, Total as Ca	24.8	mg/l	08/09/2022	Y	Wak	WPC12/49
Iron, Total as Fe	145	ug/l	08/09/2022	Y	Wak	WPC12/49
Magnesium, Total as Mg	1.46	mg/l	08/09/2022	Y	Wak	WPC12/49
Antimony, Total as Sb	0.16	ug/l	08/09/2022	Y	Wak	WPC15
Arsenic, Total as As	0.23	ug/l	08/09/2022	Y	Wak	WPC15
Boron, Total as B	<0.0320	mg/l	08/09/2022	Y	Wak	WPC12/49
Manganese, Total as Mn	26.8	ug/l	08/09/2022	Y	Wak	WPC12/49
Cadmium, Total as Cd	0.04	ug/l	08/09/2022	Y	Wak	WPC15
Chromium, Total as Cr	<0.18	ug/l	08/09/2022	Y	Wak	WPC15
Sodium, Total as Na	13.2	mg/l	08/09/2022	Y	Wak	WPC12/49
Copper, Total as Cu	0.69	ug/l	08/09/2022	Y	Wak	WPC15
Lead, Total as Pb	0.16	ug/l	08/09/2022	Y	Wak	WPC15
Nickel, Total as Ni	1.50	ug/l	08/09/2022	Y	Wak	WPC15
Selenium, Total as Se	0.86	ug/l	08/09/2022	Y	Wak	WPC15
Hydrogen ion (pH)	6.37	pH units	08/09/2022	Y	Wak	WPC8

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UKAS TESTING 1314

Report Number:	**COV/2369621/2022**		Issue	**1**
Laboratory Number:	**22007132**		Sample	**1** of **2**
Sample Source:	**RSK Geosciences**			
Sample Point Description:	**Drinking Water**			
Sample Description:	**SW1**			
Sample Matrix:	**Drinking Water**			
Sample Date/Time:	**07 September 2022**	**12:00**		
Sample Received:	**07 September 2022**			
Analysis Complete:	**28 September 2022**			

Test Description	Result	Units	Analysis Date	Accreditation		Method
Solids, Dissolved 180 Deg C	104	mg/l	09/09/2022	Y	Wak	WPC25
Ammonium ammonia+ammonium ion	<0.010	mg/l	08/09/2022	Y	Wak	WPC64
Nitrite as NO2	<0.003	mg/l	08/09/2022	Y	Wak	WPC64
Nitrate as NO3	17.0	mg/l	08/09/2022	Y	Wak	WPC64
Chloride as Cl	17.1	mg/l	08/09/2022	Y	Wak	WPC64
Total Oxidised Nitrogen as NO3	17.0	mg/l	08/09/2022	Y	Wak	WPC64
Mercury, Total as Hg	<0.06	ug/l	08/09/2022	Y	Wak	WPC21
Aliphatic VPH >C5 - C6	<10	ug/l	16/09/2022	N	Cov	GEO45
Aliphatic VPH >C6 - C8	<10	ug/l	16/09/2022	N	Cov	GEO45
Aliphatic VPH >C8 - 10	<10	ug/l	16/09/2022	N	Cov	GEO45
Aliphatic VPH >C5 - C10	<10	ug/l	16/09/2022	N	Cov	GEO45
Aromatic VPH >C5 - C7	<10	ug/l	16/09/2022	N	Cov	GEO45
Aromatic VPH >C7 - C8	<10	ug/l	16/09/2022	N	Cov	GEO45
Aromatic VPH >C8 - C10	<10	ug/l	16/09/2022	N	Cov	GEO45
Aromatic VPH >C5 - C10	<10	ug/l	16/09/2022	N	Cov	GEO45
VPH >C5 - C10	<10	ug/l	16/09/2022	N	Cov	GEO45
Aliphatic EPH >C10 - C12	<10	ug/l	14/09/2022	Y	Cov	GEO46
Aliphatic EPH >C12 - C16	<10	ug/l	14/09/2022	Y	Cov	GEO46
Aliphatic EPH >C16 - C35	<10	ug/l	14/09/2022	N	Cov	GEO46
Aliphatic EPH >C35 - C44	<10	ug/l	14/09/2022	N	Cov	GEO46
Aliphatic EPH >C10 - C44	<10	ug/l	14/09/2022	Y	Cov	GEO46
Aromatic EPH >C10 - C12	<10	ug/l	14/09/2022	Y	Cov	GEO46
Aromatic EPH >C12 - C16	<10	ug/l	14/09/2022	Y	Cov	GEO46
Aromatic EPH >C16 - C21	<10	ug/l	14/09/2022	Y	Cov	GEO46

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Report Number:	**COV/2369621/2022**		Issue	**1**
Laboratory Number:	**22007132**		Sample	**1** of **2**
Sample Source:	**RSK Geosciences**			
Sample Point Description:	**Drinking Water**			
Sample Description:	**SW1**			
Sample Matrix:	**Drinking Water**			
Sample Date/Time:	**07 September 2022**	**12:00**		
Sample Received:	**07 September 2022**			
Analysis Complete:	**28 September 2022**			

Test Description	Result	Units	Analysis Date	Accreditation		Method
Aromatic EPH >C21 - C35	<10	ug/l	14/09/2022	N	Cov	GEO46
Aromatic EPH >C35 - C44	<10	ug/l	14/09/2022	N	Cov	GEO46
Aromatic EPH >C10 - C44	<10	ug/l	14/09/2022	Y	Cov	GEO46
EPH >C10 - C44	<10	ug/l	14/09/2022	Y	Cov	GEO46
Aliphatic VPH/EPH >C5 - C44	<10	ug/l	16/09/2022	N	Cov	GEO45/GEO46
Aromatic VPH/EPH >C5 - C44	<10	ug/l	16/09/2022	N	Cov	GEO45/GEO46
VPH/EPH >C5 - C44	<10	ug/l	16/09/2022	N	Cov	GEO45/GEO46
Benzo(b)fluoranthene	Analyst Com	ng/l	28/09/2022	Y	Wak	WPC27
Benzo(k)fluoranthene	Analyst Com	ng/l	28/09/2022	Y	Wak	WPC27
Benzo(ghi)perylene	Analyst Com	ng/l	28/09/2022	Y	Wak	WPC27
Benzo(a)pyrene	Analyst Com	ng/l	28/09/2022	Y	Wak	WPC27
Fluoranthene	Analyst Com	ng/l	28/09/2022	Y	Wak	WPC27
Indeno(1,2,3cd)pyrene	Analyst Com	ng/l	28/09/2022	Y	Wak	WPC27
Total PAHs 4 Constituents	Analyst Com	ug/l	28/09/2022	Y	Wak	WPC27

Analyst Comments for 22007132: {/*}pH result confirmed with a repeat result of 6.35.
WPC27 - PAH - Sample sent back for repeat analysis due to Internal standard recovery failure. however no sample remaining for further analysis.{*/} Total coliforms identified as Serratia fonticola, Buttiauxella species, Kluyvera species, Lelliottia amnigena.

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: CHE = Chester(CH5 3US), COV = Coventry(CV4 9GU), OTT = Otterbourne(SO21 2RU), S = Subcontracted, TRB = Subcontracted to Trowbridge(BA14 0XD), WAK = Wakefield(WF5 9TG),
F = Data supplied by customer.
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

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Signed: Elizabeth Parker.

Name: **E. Parker** Date: **28 September 2022**

Title: **Potable Micro Team Leader**

Certificate of Analysis

ANALYSED BY

UKAS TESTING 1314

Report Number:	**COV/2369621/2022**		Issue	**1**
Laboratory Number:	**22007133**		Sample	**2** of **2**
Sample Source:	**RSK Geosciences**			
Sample Point Description:	**Drinking Water**			
Sample Description:	**SW2**			
Sample Matrix:	**Drinking Water**			
Sample Date/Time:	**07 September 2022**	**11:30**		
Sample Received:	**07 September 2022**			
Analysis Complete:	**28 September 2022**			

Test Description	Result	Units	Analysis Date	Accreditation		Method
Hardness, Total as CaCO3	73.7	mg/l	08/09/2022	Y	Wak	WPC12/49
PAH Total ug/l	0.007	ug/l	21/09/2022	N	Wak	WPC27
Sulphur, Total as SO4	27.8	mg/l	08/09/2022	Y	Wak	WPC12/49
Total Coliform presump	>100	cfu/100ml	09/09/2022	Y	Cov	W10
Total Coliforms confirmed	>100	cfu/100ml	09/09/2022	Y	Cov	W10
E.coli presumptive	>100	cfu/100ml	09/09/2022	Y	Cov	W10
Escherichia coli confirmed	>100	cfu/100ml	09/09/2022	Y	Cov	W10
Aluminium, Total as Al	294	ug/l	08/09/2022	Y	Wak	WPC12/49
Calcium, Total as Ca	26.6	mg/l	08/09/2022	Y	Wak	WPC12/49
Iron, Total as Fe	1330	ug/l	09/09/2022	Y	Wak	WPC12/49
Magnesium, Total as Mg	1.78	mg/l	08/09/2022	Y	Wak	WPC12/49
Antimony, Total as Sb	0.22	ug/l	08/09/2022	Y	Wak	WPC15
Arsenic, Total as As	1.55	ug/l	08/09/2022	Y	Wak	WPC15
Boron, Total as B	<0.0320	mg/l	08/09/2022	Y	Wak	WPC12/49
Manganese, Total as Mn	35.4	ug/l	08/09/2022	Y	Wak	WPC12/49
Cadmium, Total as Cd	0.07	ug/l	08/09/2022	Y	Wak	WPC15
Chromium, Total as Cr	0.49	ug/l	08/09/2022	Y	Wak	WPC15
Sodium, Total as Na	18.2	mg/l	08/09/2022	Y	Wak	WPC12/49
Copper, Total as Cu	8.6	ug/l	08/09/2022	Y	Wak	WPC15
Lead, Total as Pb	33.5	ug/l	09/09/2022	Y	Wak	WPC15
Nickel, Total as Ni	1.74	ug/l	08/09/2022	Y	Wak	WPC15
Selenium, Total as Se	0.96	ug/l	08/09/2022	Y	Wak	WPC15
Hydrogen ion (pH)	6.93	pH units	08/09/2022	Y	Wak	WPC8

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Report Number:	**COV/2369621/2022**		Issue	**1**
Laboratory Number:	**22007133**		Sample	**2** of **2**
Sample Source:	**RSK Geosciences**			
Sample Point Description:	**Drinking Water**			
Sample Description:	**SW2**			
Sample Matrix:	**Drinking Water**			
Sample Date/Time:	**07 September 2022**	**11:30**		
Sample Received:	**07 September 2022**			
Analysis Complete:	**28 September 2022**			

Test Description	Result	Units	Analysis Date	Accreditation		Method
Solids, Dissolved 180 Deg C	145	mg/l	09/09/2022	Y	Wak	WPC25
Ammonium ammonia+ammonium ion	<0.010	mg/l	08/09/2022	Y	Wak	WPC64
Nitrite as NO2	<0.003	mg/l	08/09/2022	Y	Wak	WPC64
Nitrate as NO3	11.0	mg/l	08/09/2022	Y	Wak	WPC64
Chloride as Cl	18.3	mg/l	08/09/2022	Y	Wak	WPC64
Total Oxidised Nitrogen as NO3	11.0	mg/l	08/09/2022	Y	Wak	WPC64
Mercury, Total as Hg	<0.06	ug/l	08/09/2022	Y	Wak	WPC21
Aliphatic VPH >C5 - C6	<10	ug/l	16/09/2022	N	Cov	GEO45
Aliphatic VPH >C6 - C8	<10	ug/l	16/09/2022	N	Cov	GEO45
Aliphatic VPH >C8 - 10	<10	ug/l	16/09/2022	N	Cov	GEO45
Aliphatic VPH >C5 - C10	<10	ug/l	16/09/2022	N	Cov	GEO45
Aromatic VPH >C5 - C7	<10	ug/l	16/09/2022	N	Cov	GEO45
Aromatic VPH >C7 - C8	<10	ug/l	16/09/2022	N	Cov	GEO45
Aromatic VPH >C8 - C10	<10	ug/l	16/09/2022	N	Cov	GEO45
Aromatic VPH >C5 - C10	<10	ug/l	16/09/2022	N	Cov	GEO45
VPH >C5 - C10	<10	ug/l	16/09/2022	N	Cov	GEO45
Aliphatic EPH >C10 - C12	<10	ug/l	14/09/2022	Y	Cov	GEO46
Aliphatic EPH >C12 - C16	<10	ug/l	14/09/2022	Y	Cov	GEO46
Aliphatic EPH >C16 - C35	<10	ug/l	14/09/2022	N	Cov	GEO46
Aliphatic EPH >C35 - C44	<10	ug/l	14/09/2022	N	Cov	GEO46
Aliphatic EPH >C10 - C44	<10	ug/l	14/09/2022	Y	Cov	GEO46
Aromatic EPH >C10 - C12	<10	ug/l	14/09/2022	Y	Cov	GEO46
Aromatic EPH >C12 - C16	<10	ug/l	14/09/2022	Y	Cov	GEO46
Aromatic EPH >C16 - C21	<10	ug/l	14/09/2022	Y	Cov	GEO46

ALS Environmental Ltd
Torrington Avenue, Coventry, CV4 9GU
Tel:+44 (0)24 7642 1213 Fax:+44 (0)24 7685 6575

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ANALYSED BY

UKAS TESTING 1314

ALS

Report Number:	**COV/2369621/2022**		Issue	**1**
Laboratory Number:	**22007133**		Sample	**2** of **2**
Sample Source:	**RSK Geosciences**			
Sample Point Description:	**Drinking Water**			
Sample Description:	**SW2**			
Sample Matrix:	**Drinking Water**			
Sample Date/Time:	**07 September 2022**	**11:30**		
Sample Received:	**07 September 2022**			
Analysis Complete:	**28 September 2022**			

Test Description	Result	Units	Analysis Date	Accreditation		Method
Aromatic EPH >C21 - C35	<10	ug/l	14/09/2022	N	Cov	GEO46
Aromatic EPH >C35 - C44	<10	ug/l	14/09/2022	N	Cov	GEO46
Aromatic EPH >C10 - C44	<10	ug/l	14/09/2022	Y	Cov	GEO46
EPH >C10 - C44	<10	ug/l	14/09/2022	Y	Cov	GEO46
Aliphatic VPH/EPH >C5 - C44	<10	ug/l	16/09/2022	N	Cov	GEO45/GEO46
Aromatic VPH/EPH >C5 - C44	<10	ug/l	16/09/2022	N	Cov	GEO45/GEO46
VPH/EPH >C5 - C44	<10	ug/l	16/09/2022	N	Cov	GEO45/GEO46
Benzo(b)fluoranthene	1.02	ng/l	21/09/2022	Y	Wak	WPC27
Benzo(k)fluoranthene	0.85	ng/l	21/09/2022	Y	Wak	WPC27
Benzo(ghi)perylene	0.72	ng/l	21/09/2022	Y	Wak	WPC27
Benzo(a)pyrene	1.33	ng/l	21/09/2022	Y	Wak	WPC27
Fluoranthene	1.48	ng/l	21/09/2022	Y	Wak	WPC27
Indeno(1,2,3cd)pyrene	1.19	ng/l	21/09/2022	Y	Wak	WPC27
Total PAHs 4 Constituents	0.004	ug/l	21/09/2022	Y	Wak	WPC27

Analyst Comments for 22007133: Confirmation process not been carried out for coliforms due to nature of the sample. Confirmation process not been carried out for coliforms due to nature of the sample. {/*}Pb result confirmed by 33.6ug/l
Al result confirmed by 276ug/l
Fe result confirmed by 1340ug/l{*/}

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: CHE = Chester(CH5 3US), COV = Coventry(CV4 9GU), OTT = Otterbourne(SO21 2RU), S = Subcontracted, TRB = Subcontracted to Trowbridge(BA14 0XD), WAK = Wakefield(WF5 9TG),
F = Data supplied by customer.
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

ALS Environmental Ltd
Torrington Avenue, Coventry, CV4 9GU
Tel:+44 (0)24 7642 1213 Fax:+44 (0)24 7685 6575

Signed: Elizabeth Parker.

Name: **E. Parker** Date: **28 September 2022**

Title: **Potable Micro Team Leader**

ANALYST COMMENTS FOR REPORT COV/2369621/2022 Issue 1

This issue replaces all previous issues

Date of Issue: **28 September 2022**

Sample No	Analysis Comments
22007132	{/*}pH result confirmed with a repeat result of 6.35. WPC27 - PAH - Sample sent back for repeat analysis due to Internal standard recovery failure. however no sample remaining for further analysis.{*/} Total coliforms identified as Serratia fonticola, Buttiauxella species, Kluyvera species, Lelliottia amnigena.
22007133	Confirmation process not been carried out for coliforms due to nature of the sample. Confirmation process not been carried out for coliforms due to nature of the sample. {/*}Pb result confirmed by 33.6ug/l Al result confirmed by 276ug/l Fe result confirmed by 1340ug/l{*/}

Signed: Elizabeth Parker.

Name: **E. Parker** Date: **28 September 2022**

Title: **Potable Micro Team Leader**

DETERMINAND COMMENTS FOR REPORT COV/2369621/2022 ISSUE 1

Date of Issue: 28 September 2022

This issue replaces all previous issues

Sample No	Description	Determinand	Comments
22007132	SW1	Total PAHs 4 Constituents	{/*}WPC27 - PAH - Sample sent back for repeat analysis due to Internal standard recovery failure. however no sample remaining for further analysis.{*/}
22007132	SW1	PAH Total ug/l	{/*}WPC27 - PAH - Sample sent back for repeat analysis due to Internal standard recovery failure. however no sample remaining for further analysis.{*/}
22007132	SW1	Total Coliforms confirmed	Total coliforms identified as Serratia fonticola, Buttiauxella species, Kluyvera species, Lelliottia amnigena.
22007133	SW2	Total Coliforms confirmed	Confirmation process not been carried out for coliforms due to nature of the sample.
22007133	SW2	Total Coliform presump	Confirmation process not been carried out for coliforms due to nature of the sample.

Signed: Elizabeth Parker.

Name: **E. Parker** Date: **28 September 2022**

Title: **Potable Micro Team Leader**

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ALS Laboratories (UK) Limited
Torrington Avenue
Coventry
CV4 9GU

T: +44 (0)24 7642 1213
F: +44 (0)24 7685 6575
www.alsenvironmental.co.uk

Ms Siberry
RSK Geosciences
18 Frogmore Road
Hertfordshire
Hemel Hempstead HP3 9RT

20 December 2022

Test Report: COV/2371123/2022

Dear Ms Siberry

Analysis of your sample(s) submitted on 09 September 2022 is now complete and we have pleasure in enclosing the appropriate test report(s).

An invoice for the analysis carried out will be sent under separate cover.

Should you have any queries regarding this report(s) or any part of our service, please contact Customer Services on +44 (0)24 7642 1213 who will be happy to discuss your requirements.

If you would like to arrange any further analysis, please contact Customer Services. To arrange container delivery or sample collection, please call the Couriers Department directly on 024 7685 6562.

Thank you for using ALS Laboratories (UK) Limited and we look forward to receiving your next samples.

Yours Sincerely,

Signed:

Name: P. Patel

Title: Inorganics Chemistry Manager

1314 EMS675527 OHS 542058

This communication has been sent to you by ALS Laboratories (UK) Limited. Registered in England and Wales. Registration No.02391955. Registered Office: ALS Laboratories (UK) Limited, Torrington Avenue, Coventry, CV4 9GU.

Report Summary

UKAS TESTING 1314

Ms Claire Siberry
RSK Geosciences
18 Frogmore Road
Hertfordshire
Hemel Hempstead
HP3 9RT

Date of Issue: **11 October 2022**

Report Number: **COV/2371123/2022** Issue **1** This issue replaces all previous issues

Number of Samples included in this report **2**

Job Received: **09 September 2022**

Number of Test Results included in this report **25**

Analysis Commenced: **17 September 2022**

Signed:

Name: **P. Patel** Date: **11 October 2022**

Title: **Inorganics Chemistry Manager**

ALS Laboratories (UK) Limited was not responsible for sampling unless otherwise stated.

Information on the methods of analysis and performance characteristics are available on request.
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. The results relate only to the items tested and where relevant sampled.
Tests marked 'Not UKAS Accredited' in this Report/Certificate are not included in the UKAS Accreditation Schedule for our laboratory.
This test report is not a statement of conformity to any specification or standard.

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Certificate of Analysis

UKAS TESTING 1314

Report Number: **COV/2371123/2022** Issue **1**
Laboratory Number **22017647** Sample **1** of **2**

Sample Source: **RSK Geosciences**
Sample Point Description: **Drinking Water**
Sample Description: **SW 1**
Sample Matrix: **Drinking Water**

Sample Date: **09 September 2022** Sample Received **09 September 2022** Analysis Complete: **29 September 2022**

Test Description	Result	Units	Limit	Accreditation		Method
Benzo(b)fluoranthene	2.74	ng/l		Y	Wak	WPC27
Benzo(k)fluoranthene	1.57	ng/l		Y	Wak	WPC27
Benzo(ghi)perylene	2.18	ng/l		Y	Wak	WPC27
Benzo(a)pyrene	4.15	ng/l	10	Y	Wak	WPC27
Fluoranthene	5.33	ng/l		Y	Wak	WPC27
Indeno(1,2,3cd)pyrene	3.85	ng/l		Y	Wak	WPC27
Total PAHs 4 Constituents	0.01	ug/l	0.1	Y	Wak	WPC27
PAH Total ug/l	0.02	ug/l		N	Wak	WPC27
VPH >C5 - C10	<10	ug/l		N	Cov	GEO45
Aliphatic VPH >C5 - C6	<10	ug/l		N	Cov	GEO45
Aliphatic VPH >C6 - C8	<10	ug/l		N	Cov	GEO45
Aliphatic VPH >C5 - C10	<10	ug/l		N	Cov	GEO45
Aromatic VPH >C5 - C7	<10	ug/l		N	Cov	GEO45
Aromatic VPH >C7 - C8	<10	ug/l		N	Cov	GEO45
Aromatic VPH >C8 - C10	<10	ug/l		N	Cov	GEO45
Aromatic VPH >C5 - C10	<10	ug/l		N	Cov	GEO45
Aliphatic VPH >C8 - 10	<10	ug/l		N	Cov	GEO45

Analyst Comments for 22017647: No Analyst Comment

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: CHE = Chester(CH5 3US), COV = Coventry(CV4 9GU), OTT = Otterbourne(SO21 2RU), S = Subcontracted, TRB = Subcontracted to Trowbridge(BA14 0XD), WAK = Wakefield(WF5 9TG), F = Data supplied by customer.
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

Certificate of Analysis

UKAS TESTING 1314

Report Number: **COV/2371123/2022** Issue **1**
Laboratory Number **22017648** Sample **2** of **2**

Sample Source: **RSK Geosciences**
Sample Point Description: **Drinking Water**
Sample Description: **SW 2**
Sample Matrix: **Drinking Water**

Sample Date: **09 September 2022** Sample Received **09 September 2022** Analysis Complete: **29 September 2022**

Test Description	Result	Units	Limit	Accreditation		Method
Benzo(b)fluoranthene	<0.39	ng/l		Y	Wak	WPC27
Benzo(k)fluoranthene	1.08	ng/l		Y	Wak	WPC27
Benzo(ghi)perylene	<0.43	ng/l		Y	Wak	WPC27
Benzo(a)pyrene	<0.57	ng/l	10	Y	Wak	WPC27
Fluoranthene	<0.88	ng/l		Y	Wak	WPC27
Indeno(1,2,3cd)pyrene	<0.79	ng/l		Y	Wak	WPC27
Total PAHs 4 Constituents	0.001	ug/l	0.1	Y	Wak	WPC27
PAH Total ug/l	0.001	ug/l		N	Wak	WPC27

Analyst Comments for 22017648: No Analyst Comment

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: CHE = Chester(CH5 3US), COV = Coventry(CV4 9GU), OTT = Otterbourne(SO21 2RU), S = Subcontracted, TRB = Subcontracted to Trowbridge(BA14 0XD), WAK = Wakefield(WF5 9TG),
F = Data supplied by customer.
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

Signed: Name: **P. Patel** Date: **11 October 2022**
Title: **Inorganics Chemistry Manager**

ALS Laboratories (UK) Limited
Torrington Avenue, Coventry, CV4 9GU
Tel:+44 (0)24 7642 1213 Fax:+44 (0)24 7685 6575

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APPENDIX C

Generic Assessment Criteria for Controlled Waters

GENERIC ASSESSMENT CRITERIA FOR CONTROLLED WATERS

Protection of the water environment

The water environment in the United Kingdom is protected under a number of regulatory regimes. The relevant environmental regulator is consulted where there may be a risk that pollution of 'controlled waters' may occur or may have occurred in the past.

The term 'controlled waters' refers to coastal waters, inland freshwaters and groundwater. The EU Water Framework Directive (WFD) (2000/60/EC) is implemented via domestic regulations and guidance, covering aspects of groundwater and surface water protection as well as drinking water supply policy. Domestic legislation and guidance will vary across the United Kingdom. Therefore, the relevant legislation for England, Wales, Northern Ireland and Scotland should be reviewed, alongside guidance provided by the Environment Agency (EA), Natural Resource Wales (NRW), the Scottish Environmental Protection Agency (SEPA) or the Northern Ireland Environment Agency (NIEA), as appropriate.

The main objectives of the protection and remediation of groundwater under threat from land contamination are set out within "The Environment Agency's approach to groundwater protection", version 1.0 (March 2017)[(1)] and the associated guidance "Land contamination groundwater compliance points: quantitative risk assessments (March 2017)[(1a)] that have replaced the previous guidance document "Groundwater Principles and Practice (GP3)". When assessing risks to groundwater, the following need to be considered:

- Where pollutants have not yet entered groundwater, all necessary and reasonable measures must be taken to:
  - ***prevent*** *the input of* ***hazardous*** *substances into groundwater (see description of hazardous substances below)*
  - ***limit*** *the entry of other (non-hazardous) pollutants into groundwater to avoid pollution, deterioration in the status of groundwater bodies and to prevent sustained, upward trends in pollutant concentrations in groundwater.*
- Where pollutants have already entered groundwater, the priority is to take all necessary and reasonable measures to:
  - ***minimise*** *further entry of "contaminants" where there is a defined source*
  - ***limit the pollution*** *of groundwater or any effect on the status of the groundwater body from the future expansion of the 'plume', if necessary, by actively reducing its extent.*

Within the context of groundwater risk assessments on sites affected by land contamination, "reasonable" means feasible without involving disproportionate costs. What costs are "disproportionate" depends on site-specific circumstances, which may include:

- Considerations of technical feasibility such as identified by the remedial options appraisal, this may be due to the distribution or nature of the contamination and the available remedial methods to treat the identified contamination;
- Sustainability considerations.

DEFINITIONS AND SUBSTANCE CLASSIFICATIONS

Risks to surface waters:

When assessing risks to surface waters, the following list of definitions should be understood:

Priority substances (PS) are harmful substances originally identified under the Water Framework Directive (WFD) 2000/60/EC as substances 'presenting a significant risk to or via the aquatic environment' at a European level. Member States are required to incorporate the identified **PS** into their country-wide monitoring programmes. There are currently 33 **PS** defined within the Priority Substances Directive (2013/39/EU; Annex 1), with a further 12 additional substances due to come into force from 22 December 2018. Directive 2013/39/EU has been transposed into domestic legislation for England and Wales by The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

Under the umbrella of **PS**, there is a sub-set of substances identified as being "hazardous", and these are referred to as **Priority hazardous substances (PHS).** The list of **PHS** is defined at EU level within the Priority Substances Directive (2013/39/EU). The WFD defines hazardous substances as 'substances (or groups of substances) that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances that give rise to an equivalent level of concern.' There are currently **21 PHS** (previously 15 PHS, with a further 6 substances added in 22 December 2018).

There is also another group of substances defined at EU level and which are referred to as **other pollutants (OP)** in Directive 2013/39/EU**.** These are additional substances which although not **priority substances**, have EQS which are identical to those laid down in the legislation which applied prior to 13 January 2009 (Directive 2008/105/EU). The **OP** are listed along with the **priority substance (PS)** within the Priority Substances Directive (2013/39/EU),and their associated EQS are also listed therein. There are 6 **OP** defined within the Priority Substances Directive (2013/39/EU).

In addition to the EU level substances, there are also a group of pollutants defined at a Member State level, referred to as **Specific pollutants (SP)**. These substances are pollutants which are released in significant quantities into water bodies in each of the individual European Member States. Under the WFD, Member States are required to set their own EQS for these substances. An indicative list of **SP** is given in Annex VIII of the WFD. Many of the substances categorised as **SP** in the UK were formerly List 2 substances under the old Groundwater Directive (80/68/EEC). The **SP** are defined within Part 2 (Table 1) of The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

Risks to groundwater:

When assessing risks to groundwater, the following definitions should be understood:

Under the requirements of the Groundwater Daughter Directive (2006/118/EU), the UK has published a list of substances it considers to be **hazardous substances** with respect to groundwater. In their advisory capacity to the government, this list has been derived by the UK Joint Agencies Groundwater Directive Advisory Group (JAGDAG), of which the Environment Agency is a member. The latest JAGDAG list of **hazardous substances** was published in January 2019 and the Environment Agency will use the updated list of hazardous substances from this date for all new activities that may lead to the discharge of hazardous substances to groundwater. The list is extensive and can be found in full at:

https://www.wfduk.org/stakeholders/jagdag

Selecting the appropriate assessment criteria

When assessing the risks to controlled waters, various assessment criteria apply, depending on the nature of the assessment and the conceptual site model.

Where a surface water body is involved, then Environmental Quality Standards (EQS) are the relevant assessment criteria as they are designed to be protective of surface water ecology.

Where a public water supply or a Principal aquifer is involved, then the standards defined in The Water Supply (Water Quality) Regulations[(2)] are the primary source of assessment criteria. The Private Water Supplies Regulations[(3)] may also be applicable in some cases. For instances where there are no UK assessment criteria, then the World Health Organisation (WHO) drinking water guidelines[(4)] may be used.

This appendix presents the generic assessment criteria (GAC) that RSK considers suitable for assessing risks to controlled waters for our most commonly encountered determinants. A full list of EQS for England and Wales are included in The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

The RSK GAC for controlled waters are presented in **Table 1** and **Table 2**. In line with the Environment Agency's Remedial Targets Methodology, the GAC for controlled waters are termed 'target concentrations'.

The appropriate target concentrations should be selected with consideration to:

- the site conceptual model (i.e. the receptor at potential risk);
- whether the substance is already present in groundwater at the site;
- whether or not the substance is classified as a priority hazardous substance under the Priority Substances Directive (2013/39/EC) (see above), or as a hazardous substance according to the current list of JAGDAG determinations[(5)]; and
- background concentrations in the aquifer (if applicable).

It is important to remember that the WFD and Environment Agency guidance[(1 & 1a)] support a sustainable, risk-based approach be applied to groundwater contamination. Exceedance of any target concentration does not necessarily imply that an unacceptable risk exists or that remediation is inevitably required.

Target concentrations shaded in green are statutory values	Target concentrations shaded in orange are non-statutory values

Note: Units µg/l throughout (unless otherwise stated)

Table 1: Target concentrations for controlled waters (excluding TPH CWG fractions)

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Metals & other inorganics						
Hazardous substance	Specific pollutant	Arsenic	-	10[2]	50[6a]	25[6a]
Non-hazardous pollutant	Priority substance	Cadmium	0.1[7]	5[2]	≤0.08, 0.08, 0.09, 0.15, 0.25 [6b]	0.2[6a]
(Not determined)	-	Chromium (total)	-	50[2]	8.1 Sum values for chromium III and VI	-
(Not determined)	Specific pollutant	Chromium (III)	-	Use value for total chromium	4.7[6a]	-
Hazardous substance	Specific pollutant	Chromium (VI)			3.4[6a]	0.6[6a]

Controlledwaters_GAC_Rev15 E&W

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
(Not determined)	Specific pollutant	Copper	-	2,000[2]	1 bioavailable[6a]	3.76 dissolved, where DOC ≤1mg/l[6a] 3.76µg/l + (2.677µg/l x ((DOC/2) – 0.5µg/l)) dissolved, where DOC >1mg/l[6a]
Hazardous substance	Priority substance	Lead	-	10[2]	1.2 bioavailable[6a]	1.3[6a]
Hazardous substance	**Priority hazardous substance**	Mercury	0.01[7]	1[2]	0.07[6c]	0.07[6c]
Non-hazardous pollutant	Priority substance	Nickel	-	20[2]	4.0 bioavailable[6a]	8.6[6a]
Non-hazardous pollutant	-	Selenium	-	10[2]	-	-
Non-hazardous pollutant	Specific pollutant	Zinc	-	3,000[8]	10.9 bioavailable[6a]	6.8 dissolved [6a]
(Not determined)	Specific pollutant	Iron	-	200[2]	1000[6a]*1	1000[6a])*1
(Not determined)	Specific pollutant	Manganese	-	50[2] (0.05mg/l)	123 bioavailable[6a] (0.123mg/l)	-
(Not determined)	-	Aluminium	-	200[2]	-	-

Controlledwaters_GAC_Rev15 E&W

Substance classification		Determinant	Target concentrations (µg/l)			
			Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
Groundwater receptors[5]	Surface water receptors[6]				Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	**Priority hazardous substance**	Tributyltin compounds (Tributyltin-cation)	0.001[7]	-	0.0002[6a]	0.0002[6a]
(Not determined)	-	Sodium	-	200,000[2] (200 mg/l)	-	-
Non-hazardous pollutant	Specific pollutant	Cyanide (Hydrogen cyanide)	-	50[2] (0.05 mg/l)	1[6a] (0.001 mg/l)	1[6a] (0.001 mg/l)
Non-hazardous pollutant	-	Total ammoniacal nitrogen[$]	-	500[2] (0.5 mg/l) as NH_4 (472 expressed as NH_3; 389 expressed as N)	300[6f] (0.3 mg/l) as N (364 expressed as NH_3; 386 expressed as NH_4)	-
Non-hazardous pollutant	Specific pollutant	Ammonia un-ionised (equilibrium ratio calculated) (NH_3)	-	-	-	21[6a] (0.021 mg/l)
Non-hazardous pollutant	Specific pollutant	Chlorine	-	-	2[6a] (0.002 mg/l)	10[6d] (0.01 mg/l)
(Not determined)	-	Chloride	-	250,000[2] (250 mg/l)	-	-
(Not determined)	-	Sulphate	-	250,000[2] (250 mg/l)	-	-
(Not determined)	-	Nitrate (as NO_3)	-	50,000[2] (50 mg/l)	-	-

Controlledwaters_GAC_Rev15 E&W

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
(Not determined)	-	Nitrite (as NO_2)	-	500[2] (0.5 mg/l)	10[9] (0.01 mg/l)	-
Volatile organic compounds (VOC)						
Non-hazardous pollutant	Other pollutant	Tetrachloroethene (tetrachloroethylene; PCE)	0.1[7]	10[2] sum of TCE and PCE	10[6a]	10[6a]
Hazardous substance	Other pollutant	Trichloroethene (trichloroethylene; TCE)	0.1[7]		10[6a]	10[6a]
Hazardous substance *(1,1,2,2-tetra - choloroethane)*	Specific pollutant	Tetrachloroethane	-	-	140[6a]	-
Hazardous substance	Other pollutant	Carbon tetrachloride (tetrachloromethane)	0.1[7]	3.0[2]	12[6a]	12[6a]
Non-hazardous pollutant	Priority substance	1,2-Dichloroethane	1.0[7]	3.0[2]	10[6a]	10[6a]
Non-hazardous pollutant	-	1.2-Dichloroethene (DCE) sum of cis and trans	-	50.0[4]	-	-
Hazardous substance	-	Vinyl chloride (chloroethene, chloroethylene)	-	0.5[2]	-	-
Non-hazardous pollutant	Priority substance	Dichloromethane	-	20[4]	20[6a]	20[6a]

Controlledwaters_GAC_Rev15 E&W

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Non-hazardous pollutant	Priority substance	Trichlorobenzenes	0.01[7]	-	0.4[6a]	0.4[(6a]
Hazardous substance	Priority substance	Trichloromethane (Chloroform)	0.1[7]	100[2a] (sum of **trihalomethanes** – chloroform, bromform, dibromochloromethane, bromodichloromethane)	2.5[6a]	2.5[6a]
(Not determined)	-	Bromoform	-		-	-
(Not determined)	-	Dibromochloromethane	-		-	-
(Not determined)	-	Bromodichloromethane	-		-	-
Non-hazardous pollutant	**Priority hazardous substance**	Di(2-ethylhexyl) phthalate (bis(2-ethylhexyl) phthalate, DEHP)	-	8[4]	1.3[6a]	1.3[6a]
(Not determined)	Specific pollutant	Benzyl butyl phthalate	-	-	7.5[6a]	0.75[6e]
Hazardous substance	**Priority hazardous substance**	Hexachlorobutadiene (as a pesticide, but reported in a VOC suite)	0.005[7]	0.1[2]	0.6[6c]	0.6[6c]
Semi-volatile organic compounds (SVOC)						
(Not determined) *Not to be confused with acenaphthene, which is a hazardous substance*	-	Acenaphthylene (Aro EC12-EC16)	-	-	5.8[10]	
Hazardous substance	**Priority hazardous substance**	Anthracene (Aro EC16-EC21)	-	-	0.1[6a]	0.1[6a]

Controlledwaters_GAC_Rev15 E&W

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Non-hazardous pollutant	Priority substance	Naphthalene (Aro EC10-EC12)	-	-	2[6a]	2[6a]
Hazardous substance	Priority substance	Fluoranthene (Aro EC21-EC35) not used as an indicator for this EC band	-	-	0.0063[6a]	0.0063[6a]
Hazardous substance(s)	**Priority hazardous substance(s)**	Benzo(a)pyrene (Aro EC21-EC35)	-	0.01[2]	0.00017[6a]	0.00017[6a]
		Benzo(b)fluoranthene (Aro EC21-EC35)	-	0.1[2] sum of the concentration of the four specified compounds	No EQS for these substances. B(a)P should be used as the indicator compound instead.	
		Benzo(k)fluoranthene (Aro EC21-EC35)	-			
		Benzo(g,h,i)perylene (Aro EC21-EC35)	-			
		Indeno(1,2,3-cd) pyrene (Aro EC21-EC35)	-			
Non-hazardous pollutant	Specific pollutant	Phenol	-	-	7.7[6a]	7.7[6a]
Hazardous substance	Specific pollutant	2,4-Dichlorophenol	0.1[7]	-	4.2[6a]	0.42[6a]

Controlledwaters_GAC_Rev15 E&W

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	Priority substance	Pentachloro-phenol (PCP) (as a pesticide, but reported in an SVOC suite)	0.1[7]	0.1[2]	0.4[6a]	0.4[6a]
Petroleum hydrocarbons						
Hazardous substance	-	Total petroleum hydrocarbons	-	See Table 2 for individual (non-statutory) TPH CWG fractions with respect to drinking water receptors	See individual risk driving compounds (i.e. BTEX and PAH) for specific EQS	
Hazardous substance	Priority substance	Benzene (Aro EC5-EC7)	1[7]	1[2]	10[6a]	8[6a]
Hazardous substance	Specific pollutant	Toluene (Aro EC7-EC8)	4[7]	700[4]	74[6a]	74[6a]
Hazardous substance	-	Ethylbenzene (Aro EC8-EC10)	-	300[4]	300[11]	-
Hazardous substance	-	Xylenes (Aro EC8-EC10)	3[7]	500[4]	30[11]	-
Non-hazardous pollutant	-	Methyl tertiary butyl ether (MTBE)	-	15[12]	-	

Controlledwaters_GAC_Rev15 E&W

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Pesticides, fungicides, insecticides and herbicides						
(Not determined) – assume to be Hazardous Substance as per below	-	Total pesticides	-	0.5[2]	-	-
(Not determined) - assume to be Hazardous Substance as per below	-	Other individual pesticides (unless otherwise detailed below)	-	0.1[2]	-	-
Hazardous substance(s)	Other pollutant (Cyclodiene pesticides)	Aldrin	0.003[7]	0.03[2]	0.01[6a] (sum of all four)	0.005[6a] (sum of all four)
		Dieldrin	0.003[7]	0.03[2]		
		Endrin	0.003[7]	0.1[2b] ('other individual pesticide')		
		Isodrin*[2]	0.003[7]	0.1[2b] ('other individual pesticide')		
Hazardous substance	Other pollutant	DDT (total)	0.002[7]	0.1[2] ('other individual pesticide')	0.025[6a]	0.025[6a]
Hazardous substance	Specific pollutant	Carbendazim	-	0.1[2] ('other individual pesticide')	0.15[6a]	-

Controlledwaters_GAC_Rev15 E&W

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	Specific pollutant	Chlorothalonil	-	0.1[2] ('other individual pesticide')	0.035[6a]	-
Hazardous substance	Priority substance	Cypermethrin	-	0.1[2] ('other individual pesticide')	$8.0E^{-5}$[6a]	$8.0E^{-6}$[6a]
Hazardous substance	Specific pollutant	Dimethoate	0.01[7]	0.1[2] ('other individual pesticide')	0.48[6a]	0.48[6a]
(Not determined)	Specific pollutant	Glyphosate	-	0.1[2] ('other individual pesticide')	196[6a]	196[6a]
Hazardous substance	Specific pollutant	Linuron	-	0.1[2] ('other individual pesticide')	0.5[6a]	0.5[6a]
Non-hazardous pollutant	Specific pollutant	Mecoprop	0.04[7]	0.1[2] ('other individual pesticide')	18[6a]	18[6a]
Non-hazardous pollutant	Specific pollutant	Methiocarb	-	0.1[2] ('other individual pesticide')	0.01[6a]	-
Non-hazardous pollutant	Specific pollutant	Pendimethalin	-	0.1[2] ('other individual pesticide')	0.3[6a]	-

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	Specific pollutant	Permethrin	0.001[7]	0.1[2] ('other individual pesticide')	0.001[6a]	0.0002[6a]
Hazardous substance	Priority substance	Alachlor	-	0.1[2] ('other individual pesticide')	0.3[6a]	0.3[6a]
Hazardous substance	Priority substance	Atrazine	0.03[7]	100[4] ('other individual pesticide')	0.6[6a]	0.6[6a]
Hazardous substance	Priority substance	Diuron	-	0.1[2] ('other individual pesticide')	0.2[6a]	0.2[6a]
Hazardous substance	**Priority hazardous substance**	Endosulphan	0.005[7]	0.1[2] ('other individual pesticide')	0.005[6a]	0.0005[6a]
Non-hazardous pollutant	Priority substance	Isoproturon	-	0.1[2] ('other individual pesticide')	0.3[6a]	0.3[6a]
Hazardous substance	Priority substance	Simazine	0.03[7]	0.1[2] ('other individual pesticide')	1[6a]	1 [6a]
Hazardous substance	**Priority hazardous substance**	Trifluralin	0.01[7]	0.1[2] ('other individual pesticide')	0.03[6a]	0.03[6a]

Controlledwaters_GAC_Rev15 E&W

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	Priority substance	Dichlorvos	-	0.1[2] ('other individual pesticide')	$6.0E^{-4}$[6a]	$6.0E^{-5}$[6a]
Hazardous substance	Priority substance	Heptachlor and heptachlor epoxide	-	0.03[2]	$2.0E^{-7}$[6a]	$1.0E^{-08}$[6a]
Miscellaneous						
(Not determined)	Specific pollutant	Triclosan (antibacterial agent)	-	-	0.1[6a]	0.1[6a]
Hazardous substance	**Priority hazardous substance**	Perfluoro-octane sulfonic acid (and its derivatives) (PFOS)	-	-	$6.5E^{-4}$[6a]	$1.3E^{-4}$[6a]
Hazardous substance	**Priority hazardous substance**	Hexabromo cyclododecane (HBCDD)	-	-	0.0016[6a]	0.0008[6a]

Controlledwaters_GAC_Rev15 E&W

Substance classification		Determinant	Target concentrations (µg/l)			
			Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
Groundwater receptors[5]	Surface water receptors[6]				Freshwater	Transitional (estuaries) and coastal waters

Notes:

'-' A target concentration is not available.

$Please note that total ammonia (NH_4^+ and NH_3) is equivalent to ammoniacal nitrogen in laboratory reports

*1 Please note that although iron is listed in the 2015 Direction as 1.000 µg/l, the EQS remains at 1mg/l in Scotland and it is assumed this is an error and should read either 1,000 or 1000µg/l.

*2 Please note that although Isodrin is not listed in name within the group of "Cyclodiene pesticides" in Table 1 of Schedule 3 Part 3 of the 2015 Direction[6], the CAS number for Isodrin (465-73-6) **is** listed and therefore it is assumed that it has been missed off the named list of substances.

*3 Total petroleum hydrocarbons is used for consistency, but is an analytical method-defined measurement for a mixture of hydrocarbons subject to environmental analysis[11].

"Bioavailable" in relation to copper, zinc, nickel and manganese (but not lead) is the generic EQSbioavailable[6a] derived from the Metal Bioavailability Assessment Tool (M-BAT) developed by the Water Framework Directive UK Technical Advisory Group (WFDTAG). Exceedance of this value should prompt a site-specific assessment using the M-BAT with pH, DOC and Ca to derive a site-specific EQS termed the $PNEC_{dissolved}$. http://www.wfduk.org/resources/rivers-lakes-metal-bioavailability-assessment-tool-m-bat.

For zinc, if there is an exceedance of the EQSbioavailable in an initial GQRA, Tier 2 required that the EQS for zinc should also have the ambient background concentration of zinc added as well

Table 2: World Health Organization (WHO) guide values for TPH CWG fractions in drinking water[13] (as referenced in CL:AIRE, 2017[11])

TPH CWG fraction	WHO guide value for drinking water[13] (µg/l)
Aliphatic fractions:	
Aliphatic EC5-EC6	15,000
Aliphatic >EC6-EC8	15,000
Aliphatic >EC8-EC10	300
Aliphatic >EC10-EC12	300
Aliphatic >EC12-EC16	300
Aliphatic >EC16-EC21	-
Aliphatic >EC21-EC35	-
Aromatic fractions:	
Aromatic EC5-EC6	10 (benzene)
Aromatic >EC6-EC8	700 (toluene)
Aromatic >EC8-EC10	300 (ethyl benzene) 500 (xylenes)
Aromatic >EC10-EC12	90
Aromatic >EC12-EC16	90
Aromatic >EC16-EC21	90
Aromatic >EC21-EC35	90
Reference: World Health Organisation (WHO), 2008. Petroleum products in drinking-water. Background document for development of WHO guidelines for drinking water quality. WHO/SDE/WSH/05.08/123. World Health Organisation, Geneva[13].	

References

1. Environment Agency (2018), 'The Environment Agency's approach to groundwater protection', version 1.2, February 2018 (formerly contained within GP3). https://www.gov.uk/government/collections/groundwater-protection

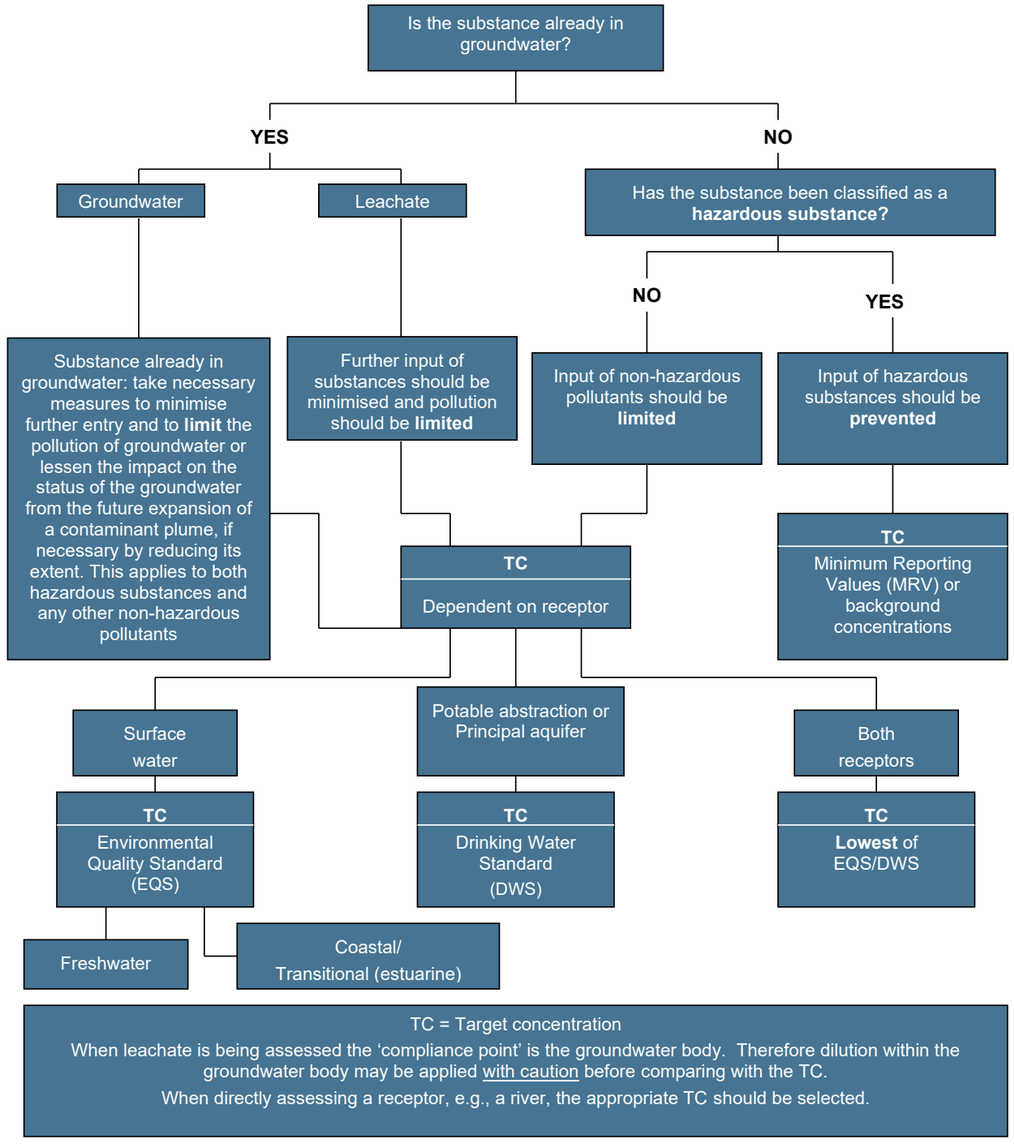
1a. Environment Agency (2017), 'Land contamination groundwater compliance points: quantitative risk assessments', March 2017 (formerly contained within GP3) [accessed 29 March 2017]. https://www.gov.uk/government/collections/groundwater-protection

2. The Water Supply (Water Quality) Regulations 2016 (SI 2016/619)
   - 2a. Sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane
   - 2b. Standard applies to individual pesticides except aldrin, dieldrin, heptachlor and heptachlor epoxide, for which a separate standard is defined.
3. The Private Water Supplies (England) Regulations 2016. SI 2016 / 618
4. WHO (2011), *Guidelines for drinking-water quality*, 4th edn
5. JAGDAG hazard substance determinations (January 2019): This list contains substances that are determined to be hazardous substances or non-hazardous pollutants for the purposes of the groundwater directive 2006/118/EC. https://www.wfduk.org/stakeholders/jagdag [accessed 1 February 2021]
   The absence of an assessment or substance from the list means an assessment has not been completed and is therefore presented as 'Not determined'. For further details on how substances are assessed, see the Joint Agencies Groundwater Directive Advisory Group (JAGDAG) 'Methodology for the determination of hazardous substances in groundwater for the purposes of the groundwater directive 2006/118/EC' which is available from the JAGDAG website. The methodology is a UK –wide framework that sets criteria for how to assess whether a substance is a hazardous substances in groundwater.
6. The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.
   - 6a. The EQS for these substances are based on a "long term mean" or an "annual average (AA)" EQS.
   - 6b. For cadmium and its compounds the EQS values vary depending on the hardness of the water as specified in five class categories (Class 1: < 40 mg CaCO3/l, Class 2: 40 to < 50 mg CaCO3/l, Class 3: 50 to < 100 mg CaCO3/l, Class 4: 100 to < 200 mg CaCO3/l and Class 5: ≥ 200 mg CaCO3/l).
   - 6c. The EQS for Mercury and hexachlorobutadiene are based on a "maximum acceptable concentration (MAC)" EQS in absence of an "annual average (AA)" EQS.
   - 6d. The EQS for chlorine in saltwater is based on the 95th percentile concentration of total residual oxidant, which refers to the sum of all oxidising agents existing in water, expressed as available chlorine.
   - 6e. The recommended saltwater standard is derived using a safety factor of 100. Where the standard is failed, it is recommended that supporting evidence of ecological damage should be obtained before committing to expensive action.
   - 6f. EQS for total ammonia is as per Schedule 3, Part 1, Table 7 of of the above directions. EQS applies to river types 1, 2 and 4 and 6 (namely upland and low alkalinity). The EQS for a lowland and high alkalinity rivers (types 3, 5 and 7) is 600µg/l (0.6mg/l).

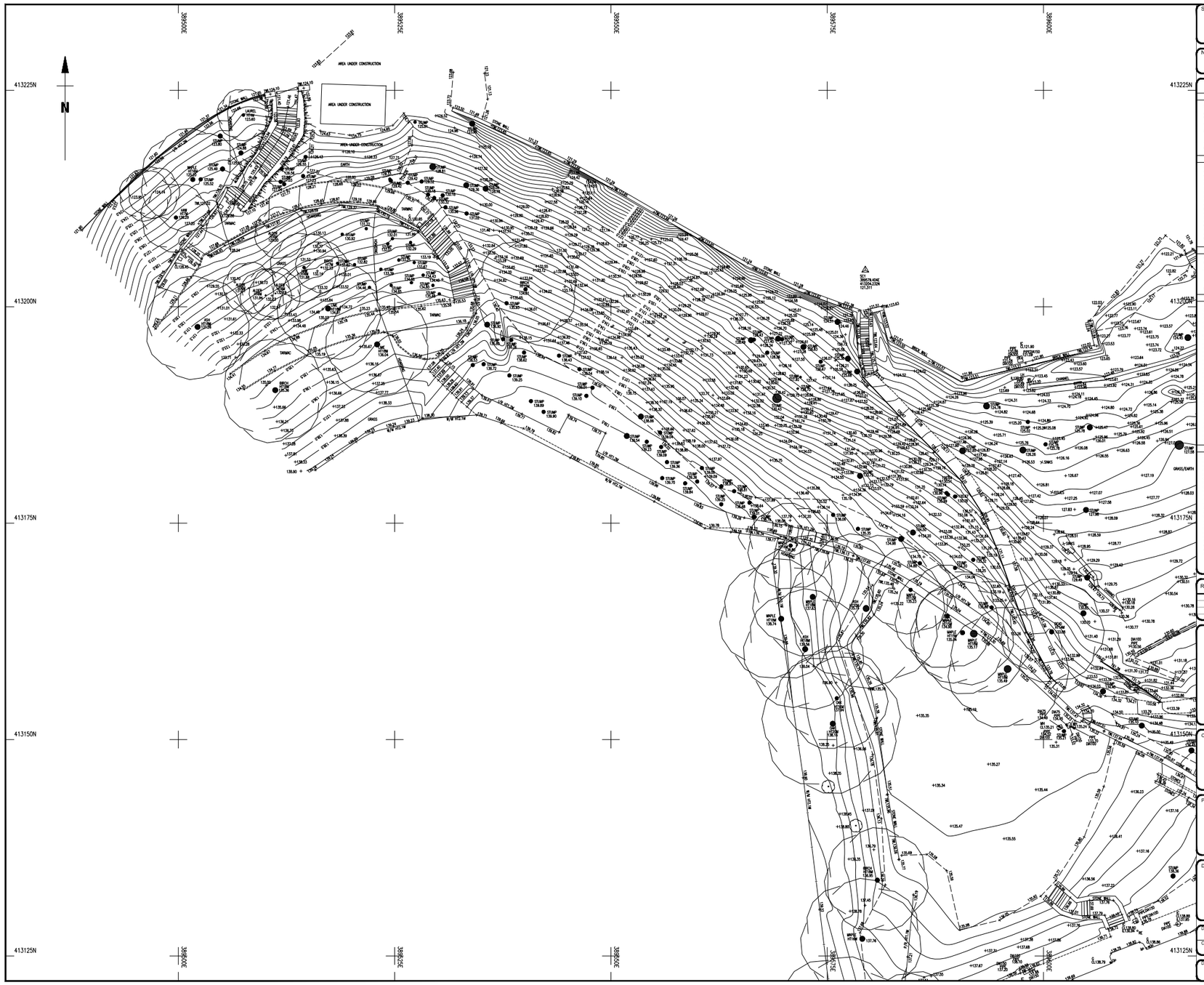
   Additional information on the Metal Bioavailability Assessment Tool (M-BAT) is available at http://www.wfduk.org/resources/rivers-lakes-metal-bioavailability-assessment-tool-m-bat

7. Minimum reporting values listed at https://www.gov.uk/government/publications/values-for-groundwater-risk-assessments/hazardous-substances-to-groundwater-minimum-reporting-values (updated 13 January 2017; accessed 29 March 2017). Note target concentration for xylenes is 3 µg/l each for o-xylene and m/p xylene as it may not be possible to separate m- and p-xylene; 135 tcb, 124 tcb, 123 tcb each to 0.01 µg/l)
8. The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996 (as amended). SI 1996 / 3001
9. Council Directive on the Quality of Fresh Waters Needing Protection or Improvement in Order to Support Fish Life (Freshwater Fish Directive) (78/659/EEC)
10. WRc plc (2002), R&D Technical Report P45.
11. CL:AIRE, 2017. Petroleum Hydrocarbons in Groundwater: Guidance on assessing petroleum hydrocarbons using existing hydrogeological risk assessment methodologies. V1.1.
12. Drinking Water Inspectorate (London, UK). Environmental Information Request on MTBE in drinking water. Ref. DWI 1/10/18; dated 28 November 2006. Value is based on the odour threshold for MTBE, which is lower than a health-based guideline value
13. World Health Organisation (WHO), 2008. Petroleum products in drinking-water. Background document for development of WHO guidelines for drinking water quality. WHO/SDE/WSH/05.08/123. World Health Organisation, Geneva. [accessed 29 March 2017] http://www.who.int/water_sanitation_health/dwq/chemicals/petroleumproducts_2add_june2008.pdf

FLOW CHART TO ASSIST WITH SELECTION OF TARGET CONCENTRATIONS



Appendix B
Topo Survey



Survey Notes

Grid: Local Plane Grid fixed to National Grid

Levels: OS Datum from GNSS positioning converted using the National Geoid Model OSGM15

Notes

Topographical Survey Legend

BUILDINGS AND WALLS

Building	
Building Open Sided	
Ruin	RUIN
Passage	P/W
Wall with Height	Wall HT.3m
Retaining Wall	R/W

FENCE STYLES AND DESCRIPTIONS

Close Boarded	C/B
Chestnut Paling	C/P
Chestnut Paling	C/P
Chainlink	C/L
Hoardrail	H/R
Intermediate	IRN
Post & Rails	P/R
Lattice Fence	L/F
Miscellaneous	Misc
Palisade	Pal.
Post & Chain	P/C
Post & Rail	P/R
Post & Wire	P/W
Post & Barbed Wire	P/W
Wire mesh	W/M
Stile	
Gate	
Fence Sleepyle	

ROADS

Kerbs	
Edge of Surfacing	
Pedestrian Crossing	PC
Track	Track
Footpath	FP

STREET FURNITURE

Belisha Beacon	● BB
Bus Stop	● BS
Cattle Grid	● CG
Cats Eye	● CE
Cost Chute	● CC
Closed Circuit TV	● CCTV
Drain	● DR
Electricity Pole	● EP
Flood Light	● FL
Flag Staff	● FS
Lamp Post	● LP
Letter Box	○ LB
Name Plate (street)	● NP
Mooring Post	● MP
Post for Mooring Post	● MP
Service Marker	● SM
Mile Stone	● MS
Post	● P
Parking Meter	● PM
Pedestrian Post	● PP
Reading Eye	● RE
Road Sign	● RS
Speed Camera	● S/CAM
Information Sign	● SIGN
Stop	● ST
Traffic Light	● TL
Telegraph Pole	● TP
Traffic Light Push Button Post	● TLP
Traffic Light Control	○ TLC/P
Control Box	□ C/BOX
British Telecom Box	□ BT. BOX
Electric Box	□ ELEC BOX
Gas Box	□ GAS BOX

INSPECTION CHAMBERS AND PIPES

Inspection Cover	IC
Inspection Cover (Elec)	IC/EL
Inspection Cover	IC
British Telecom Cover	BT
Inspection Cover (Comms)	IC/COM
Cable TV	CATV
Inspection Cover Traffic Signal	IC/TL
Cleanout	CO
Kerb Outlet	KO
Vent Pipe	● VP
Down Pipe	● DP
Drain Pipe	● DP
Rain Water Pipe	● RWP
Soil Pipe	● SP
Gas Pipe	● GAS PIPE
Gas Cap & lift cover	GAS
Stop Tap	● ST
Stop Valve	● SV
Lamphole	● LH
Hydrant	● HYD
Earth Rod	● ER
Gas Valve	● GV
Water Meter	● WM
Washout	● WO
Rodding Eye	● RE

GENERAL INFORMATION

Petrol Pump	PP
Basement Light	BL
Footbridge	FB
Dish Type Channel	FLOW
Slot Type Channel	FLOW
Grate Type Channel	FLOW
Textile Paving	T/C
Crash Barrier	C/BR
Column	COL
Obstruction	OTHR
Cattle Trough	C/T
Offset FB	● OF
Air Valve	● AV
Trough	TR
Chimney	CHY
Telephone Call Box	TCB

OVERHEAD FEATURES

Electricity Pylon	E.PYLON
Electricity	EL
Telephone	TEL

WATER FEATURES

Canal	Canal
Stream	Stream
Ditch	Ditch
Weir	Weir
Culvert	Culvert
Grip (Land Drain)	Grip
Spring	● SPR

RELIEF AND VEGETATION

Hedge	
Edge of wood/Bushes	
Stump	● STUMP
Individual Tree	
Slopes +3ft Height Greater than 1in	
Cliff Face	
Marsh	
Reeds	

LEVEL AND HEIGHT INFORMATION

Standard Spot Height	+ 123.45
Precision Spot Height	+ 123.456
Pad Level	+ 9.23.62
Water Level	+ 96.24.62
Suffit Level	+ 9.25.62
Threshold Level	+ 7426.68
Cover Level	+ 0.236.45
Invert Level	+ 0.236.45
Pipe Suffit Level	+ F63.0.00
Floor Level	+ F.6.00
Finished Floor Level	+ FFL6.00
Top of Tank Level	+ 117.00
Eaves Level	+ 6.2.00
Ridge Level	+ 9.2.00
Roof Hip Level	+ RHL8.50
Flat Roof Level	+ FR.7.00
Top of Canopy Level	+ TOP/C7.00
Underside of Canopy Level	+ SOF/C6.50
Window Head Level	+ WHL6.00
Window Sill Level	+ WSL4.50
Springing Level	+ SPL5.00
Arch Level	+ A.7.00
Cobb Level	+ CHFB.00
Top of Wall Level	+ TWL10.00
Underside of Beam Level	+ UBL7.00
General Height	+ H9.00

SURVEY INFORMATION SIGNS

Permanent Ground Marker	
O.S. Trig Station	
O.S. Bench Mark	

GEOTECHNICAL INFORMATION

Borehole	BH
Trial Pit	TP
Monitor /Rn	● MON
Probe Hole	● PH
Window Sample	● WS

Rev.	Date	Description

MALCOLM HUGHES
CHARTERED LAND SURVEYORS
65 Cross Street, Sale, Manchester
M33 7HF. Tel: 0161 905 1265
www.malcolmhughes.co.uk
survey@mhls.co.uk

Accreditations

Client

Rochdale Development Agency
Number One Riverside, Smith Street
Rochdale OL16 1XU

Project

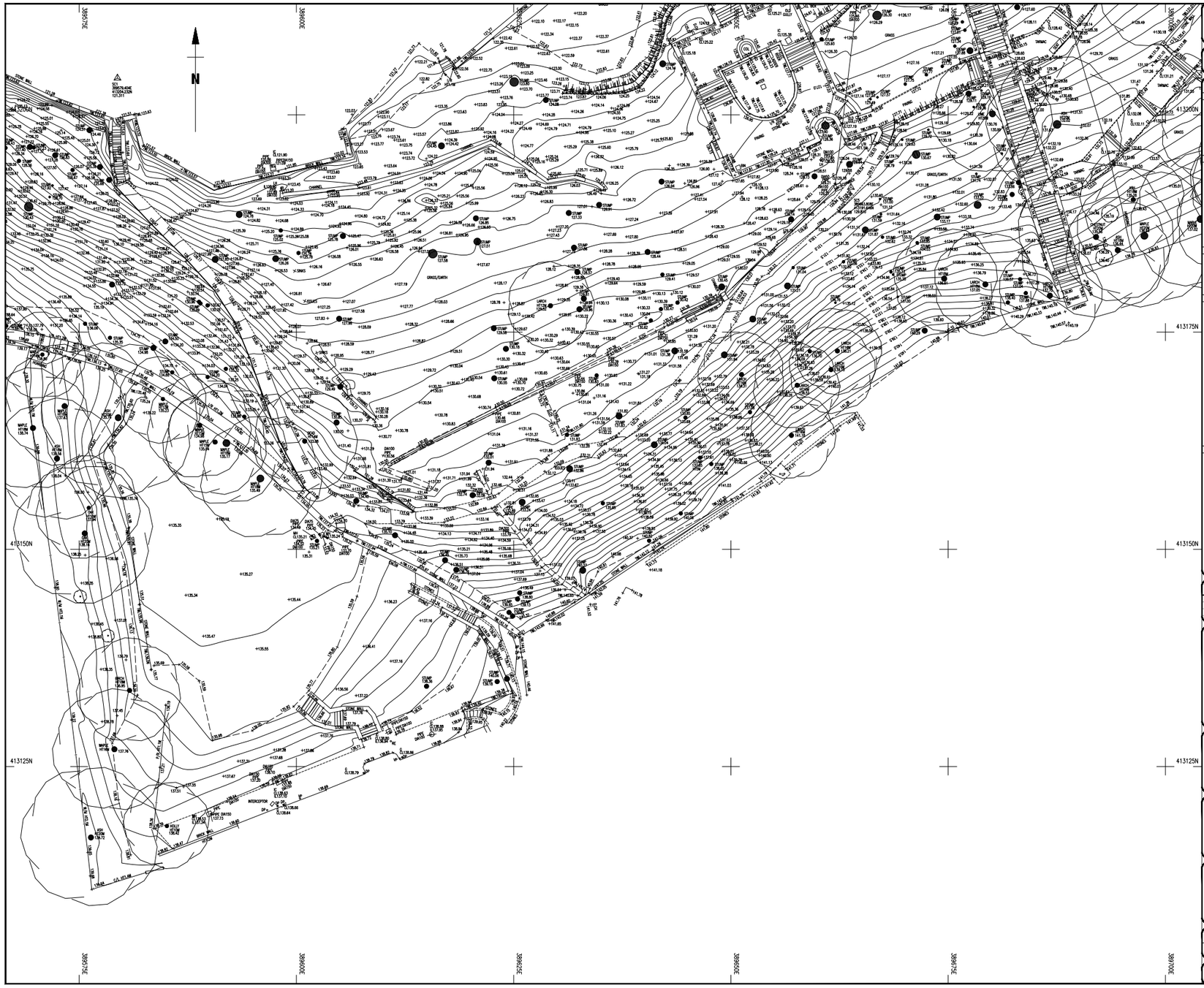
Broadfield Park Slopes
Rochdale Town Hall

Drawing Title

Topographical Survey
Sheet 1/3

Drawn By	IC 23/05/22	Survey Date	April 2022
Checked by	ED 24/05/22	Scale	A1@1:200

Drawing No	Revision
58612/1	



Survey Notes

Grid: Local Plane Grid fixed to National Grid

Levels: OS Datum from GNSS positioning converted using the National Geoid Model OSGM15

Notes

Topographical Survey Legend

BUILDINGS AND WALLS

Building
Building Open Sided
Ruin
Passage
Wall with Height — Wall 1.8/1.3m
Retaining Wall — R/W

FENCE STYLES AND DESCRIPTIONS

Close Boarded — C/B
Close Boarded — C/P
Creosoted Paling — C/P
Chainlink — C/L
Handrail — H/R
Intervision — VBS
Lattice Railings — L/R
Lattice — Lat
Miscellaneous — Misc
Palisade — PAL
Post & Chain — P/C
Post & Rail — P/R
Post & Wire — P/W
Post & Barbed Wire — B/W
Wire mesh — W/M
Stile — Stile
Gate — Gate
Fence Greetyle — GREY

ROADS

Kerbs
Edge of Surfacing
Pedestrian Crossing — PC
Track — TRACK
Footpath — FP

STREET FURNITURE

Belisha Beacon — BB
Bus Stop — BS
Cattle Grid — CG
Cats Eye — CE
Cast Chute — CC
Closed Circuit TV — CCTV
Drain — DR
Electricity Pole — EP
Flood Light — FL
Flag Staff — FS
Lamp Post — LP
Letter Box — LB
Name Plate (street) — NP
Name Plate (other) — NP
Mile Post or Marking Post — MP
Service Marker — SM
Mile Stone — MS
Post — P
Parking Meter — PM
Parking Post — PP
Redding Cap — RC
Road Sign — RS
Speed Camera — S/CAM
Intersection Sign — SIGN
Tap — TAP
Traffic Light — TL
Telegraph Pole — TP
Traffic Light Push Button Post — TLP
Traffic Light Control — TLC/U
Telephone — C/BOX
British Telecom Box — BT BOX
Electricity Box — EL BOX
Gas Box — Gas BOX

INSPECTION CHAMBERS AND PIPES

Inspection Cover — IC
Inspection Cover (Elec) — C/EL
Manhole — MH
British Telecom Cover — BT
Inspection Cover (Comms) — C/COM
Cable TV — C/CV
Inspection Cover Traffic Signals — C/TL
Gullies — GY
Kerb Outlet — KO
Vent Pipe — VP
Down Pipe — DP
Soil Water Pipe — SWP
Rain Water Pipe — RWP
Soil Pipe — SP
Gas Pipe — G-MPE
Unable to lift cover — U/L
Stop Tap — ST
Stop Valve — SV
Lamphole — LH
Lamp Post — LP
Kerb Rod — KR
Gas Valve — GV
Water Meter — WM
Washout — WO
Redding Eye — RE

GENERAL INFORMATION

Petrol Pump — PP
Basement Light — BL
Footbridge — FB
Dish Type Channel — D/C
Slot Type Channel — S/C
Grate Type Channel — G/C
Textile Posting — TXC
Crash Barrier — C/BR
Column — COL
Stanchion — STAN
Flag Pole — FP
Offset FB — OFB
Air Valve — AV
Trough — TR
Chimney — CHY
Telephone Call Box — TCB

OVERHEAD FEATURES

Electricity Pylon — E.PYLON
Electricity — EL
Telephone — TEL

WATER FEATURES

Canal — CANAL
Stream — STREAM
Ditch — DITCH
Weir — WEIR
Culvert — CUL
Drip (Land Drain) — DRAIN
Spring — SPR

RELIEF AND VEGETATION

Hedge
Edge of wood/Bushes
Stump — STUMP
Individual Tree
Shows with Height Greater than 1m
Cliff Face
Marsh
Reeds

LEVEL AND HEIGHT INFORMATION

Standard Spot Height — +123.45
Precision Spot Height — +123.456
Bed Level — BL23.62
Water Level — WL24.52
Soffit Level — SL25.62
Threshold Level — TL26.98
Cover Level — CL26.45
Invert Level — IL25.10
Pipe Soffit Level — PSL8.00
Floor Level — FL6.00
Finished Floor Level — FFL6.00
Top of Tank Level — TT5.00
Eaves Level — EL6.00
Ridge Level — RL8.00
Roof Hip Level — RHL8.50
Flat Roof Level — FRL7.00
Top of Canopy Level — TCP/CFL00
Underside of Canopy Level — UCP/CFL00
Window Sill Level — WSL6.00
Window Head Level — WHL8.00
Springing Level — SPL8.50
Arch Level — AL7.00
Cable Level — CHL8.50
Cable Height — CH2.00
Underside of Beam Level — UBL8.50
General Height — GH8.00

SURVEY INFORMATION SIGNS

Permanent Ground Marker
O.S. Trig Station
O.S. Bench Mark

GEOTECHNICAL INFORMATION

Borehole — BH
Trial Pit — TP
Western Pit — WPI
Probe Hole — PH
Window Sample — WS

Rev.	Date	Description

MALCOLM HUGHES
CHARTERED LAND SURVEYORS
65 Cross Street, Sale, Manchester
M33 7HF, Tel: 0161 905 1265
www.malcolmhughes.co.uk
survey@mhls.co.uk

Accreditations

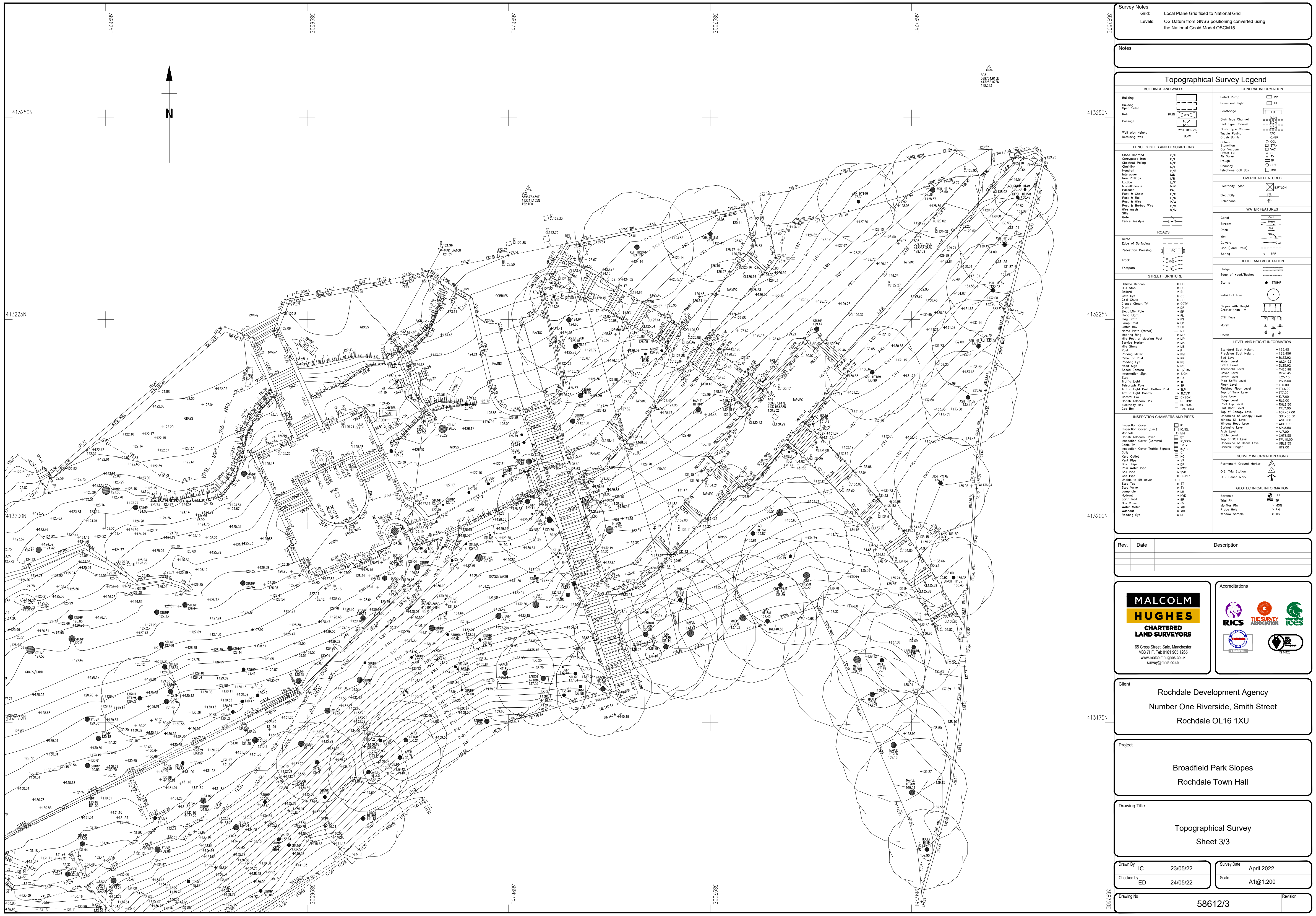
Client
Rochdale Development Agency
Number One Riverside, Smith Street
Rochdale OL16 1XU

Project
Broadfield Park Slopes
Rochdale Town Hall

Drawing Title
Topographical Survey
Sheet 2/3

Drawn By: IC	23/05/22	Survey Date	April 2022
Checked by: ED	24/05/22	Scale	A1@1:200

Drawing No: 58612/2 — Revision:



Survey Notes
Grid: Local Plane Grid fixed to National Grid
Levels: OS Datum from GNSS positioning converted using the National Geoid Model OSGM15
Notes
Topographical Survey Legend
BUILDINGS AND WALLS
GENERAL INFORMATION
FENCE STYLES AND DESCRIPTIONS
OVERHEAD FEATURES
WATER FEATURES
ROADS
RELIEF AND VEGETATION
STREET FURNITURE
LEVEL AND HEIGHT INFORMATION
INSPECTION CHAMBERS AND PIPES
SURVEY INFORMATION SIGNS
GEOTECHNICAL INFORMATION
Rev.
Date
Description
MALCOLM HUGHES
CHARTERED LAND SURVEYORS
65 Cross Street, Sale, Manchester
M33 7HF, Tel: 0161 905 1265
www.malcolmhughes.co.uk
survey@mhls.co.uk
Accreditations
Client
Rochdale Development Agency
Number One Riverside, Smith Street
Rochdale OL16 1XU
Project
Broadfield Park Slopes
Rochdale Town Hall
Drawing Title
Topographical Survey
Sheet 3/3
Drawn By IC 23/05/22
Checked by ED 24/05/22
Survey Date April 2022
Scale A1@1:200
Drawing No 58612/3
Revision

Appendix C
CCTV Drainage Survey

LAND SURVEYING
BUILDING SURVEYING
UNDERGROUND SURVEYING
SITE ENGINEERING
MONITORING

SURVEY SOLUTIONS
0845 040 5969
survey-solutions.co.uk

IPSWICH BRENTWOOD COVENTRY GLASGOW NORWICH NOTTINGHAM YEOVIL

CCTV Report

Project
Broadfield Slopes, The Esplanade,
Rochdale,

Survey Date
03/07/2023

Client
Price & Myers

Surveyor
OTM

Job Number
49962CCTV-02

Issue Date
10/07/2023

Checked by
JAD

Revision - Issue Date

chartered ICES
QMS ISO 9001 : 2008 REGISTERED
THE SURVEY ASSOCIATION FULL MEMBER
RICS

SURVEY SOLUTIONS

Survey Solutions
Nottingham
Nottinghamshire
Tel: 01773 714733, Fax:

Project-information

Project name:	Contract number:	Contact:	Date:
Broadfield Slopes	**49962**	**Steffan Rees**	**10/07/2023**

Client	**Price & Myers**
Contact:	**Steffan Rees**
Position:	**Civil Engineer**
Road	**37 Alfred Place**
Town	**London**
County	
Telephone:	**02045246770**
Fax:	
Mobile:	
E-Mail:	**srees@pricemyers.com**

Site	**Broadfield Slopes**
Contact:	**Steffan Rees**
Position:	**Civil Engineer**
Road	**The Esplanade**
Town	**Rochdale**
County	**Greater Manchester**
Telephone:	
Fax:	
Mobile:	
E-Mail:	

Contractor	**Survey Solutions**
Contact:	**Owain McDonald**
Position:	**Surveyor**
Road	**Farrington Way**
Town	**Nottingham**
County	**Nottinghamshire**
Telephone:	**01773 714733**
Fax:	
Mobile:	
E-Mail:	**Nottingham.office@survey-solutions.co.uk**

Price & Myers

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Survey Solutions
Nottingham
Nottinghamshire
Tel: 01773 714733, Fax:

Defect Grade Description

Project name:	Contract number:	Contact:	Date:
Broadfield Slopes	**49962**	**Steffan Rees**	**10/07/2023**

1:

Brick: No Structural Defects
Pipe: No Structural Defects

Acceptable Structural Condition

2:

Brick: Minor cracking, Surface mortar loss, Spalling slight, wear slight
Pipe: Circumfrential crack, Moderate joint defects, Spalling slight, Wear slight

Minor collapse risk in short term but potential for further deterioration

3:

Brick: Total mortorloss without other defects, single brick displaced, Deformation up to 5%, Spalling medium, Wear medium
Pipe: Fractures with deformation up tp 5%, Longitudinal cracking or mulitlpe cracking, Minor loss of level, More severe joint defects, Spalling medium, Wear medium

! Collapse unlikely in near future but future deterioration likely !

4:

Brick: Total mortorloss with deformation greater than 10%, Deformation up to 10% and fractured, Displaced/hanging brickwork, Small number of missing bricks
Pipe: Broken, Deformation up to 10% and broken,, Fractured with deformation 5 - 10%, Multiple fractures, Serious loss of level, spalling large, wear large

!! Collapse likely in foreseeable future !!

5:

Brick: Already Collapsed, Missing invert, Deformation over 10% and fractured, Displaced/hanging brickwork and deformation over 10%, Extensive missing bricks
Pipe: Already collapsed, Deformation over 10% and broken, Extensive areas of fabric missing, Fractured with deformation over 10%

!!! Collapsed or collapse imminent !!!

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SURVEY SOLUTIONS

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Nottinghamshire
Tel: 01773 714733, Fax:

Inspection report

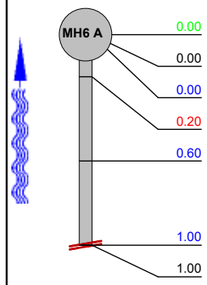
Date:	Job N°:	Weather:	Operator:	section number:	PLR:
10/07/2023	**49962**	**Heavy rain**		**1**	**MH6 A X**
Present:	Vehicle:	Camera:	Preset:	Cleaned: **No**	Grade:

Road:	**The Esplanade**	Division:		start MH:	**MH6 A**
Place:	**Broadfield Slopes**	District:		end MH:	
Location:		Tape No.:		Total length:	**1 m**

Purpose:	**Asset condition**	Shape/Size:	**Circular dia 100 mm**
Use:	**Surface water**	Material:	**Vitrified clay** Pipe length:
Catchment:		Lining:	
		Category:	

Comment:

Location details:



1:25 position	code	observation	counter	photo	grade
0.00	MH	Manhole Remark: MH6 A	00:00:00		(Constr) 0
0.00	ST	Start of Survey	00:00:00		(Misc) 0
0.00	WL	Water level, 0 % height/diameter	00:00:00		(Serv) 0
0.20	JDL	Joint displaced. Large	00:00:00	4_4a	(Struct) 2
0.60	LL	Line of Sewer deviates left	00:00:00		(Serv) 0
1.00	OB	Obstruction, 95 % height/diameter loss	00:00:00		(Serv) 2
1.00	SA	Survey abandoned, Remark: Unable to survey beyond obstruction.	00:00:00	7_7a	(Misc) 0

Structural Defects	Constructional Features
Service Defects	Miscellaneous Features

SURVEY SOLUTIONS

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Nottingham
Nottinghamshire
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Inspection photos

Place:	Road:	Date:	section number:	PLR:
Broadfield Slopes	**The Esplanade**	**10/07/2023**	**1**	**MH6 A X**

Photo: 4_4a, 00:00:00
0.2m, Joint displaced. Large

Photo: 7_7a, 00:00:00
1m, Survey abandoned, Remark: Unable to survey beyond obstruction.

SURVEY SOLUTIONS

Survey Solutions
Nottingham
Nottinghamshire
Tel: 01773 714733, Fax:

Inspection report

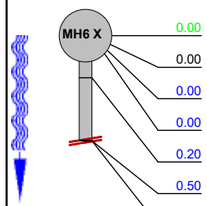
Date:	Job N°:	Weather:	Operator:	section number:	PLR:
10/07/2023	**49962**	**Heavy rain**		**2**	**MH6 X X**
Present:	Vehicle:	Camera:	Preset:	Cleaned: **No**	Grade:

Road:	**The Esplanade**	Division:		start MH:	**MH6 X**
Place:	**Broadfield Slopes**	District:		end MH:	
Location:		Tape No.:		Total length:	**0.5 m**

Purpose:	**Asset condition**	Shape/Size:	**Circular dia 100 mm**
Use:	**Surface water**	Material:	**Vitrified clay** Pipe length:
Catchment:		Lining:	
		Category:	

Comment:

Location details:



1:25 position	code	observation	counter	photo	grade
0.00	MH	Manhole Remark: MH6 X	00:00:00		(Constr) 0
0.00	ST	Start of Survey	00:00:00		(Misc) 0
0.00	WL	Water level, 0 % height/diameter	00:00:00		(Serv) 0
0.00	DES	Debris silt, 10 % cross-sectional area loss	00:00:00	11_4a	(Serv) 1
0.20	LR	Line of Sewer deviates right	00:00:00		(Serv) 0
0.50	OB	Obstruction, 95 % height/diameter loss	00:00:00	13_6a	(Serv) 2
0.50	SA	Survey abandoned, Remark: Unable to survey beyond obstruction.	00:00:00		(Misc) 0

Structural Defects	Constructional Features
Service Defects	Miscellaneous Features

SURVEY SOLUTIONS

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Nottinghamshire
Tel: 01773 714733, Fax:

Inspection photos

Place:	Road:	Date:	section number:	PLR:
Broadfield Slopes	**The Esplanade**	**10/07/2023**	**2**	**MH6 X X**

Photo: 11_4a, 00:00:00
0m, Debris silt, 10 % cross-sectional area loss

Photo: 13_6a, 00:00:00
0.5m, Obstruction, 95 % height/diameter loss

SURVEY SOLUTIONS

Survey Solutions
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Nottinghamshire
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Inspection report

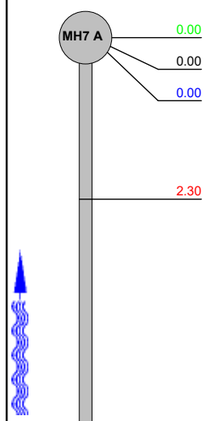
Date:	Job N°:	Weather:	Operator:	section number:	PLR:
10/07/2023	**49962**	**Heavy rain**		**3**	**MH7 A X**
Present:	Vehicle:	Camera:	Preset:	Cleaned: **No**	Grade:

Road:	**The Esplanade**	Division:		start MH:	**MH7 A**
Place:	**Broadfield Slopes**	District:		end MH:	
Location:		Tape No.:		Total length:	**9.1 m**

Purpose:	**Asset condition**	Shape/Size:	**Circular dia 100 mm**
Use:	**Surface water**	Material:	**Vitrified clay** Pipe length:
Catchment:		Lining:	
		Category:	

Comment:

Location details:



1:75	position		code	observation	counter	photo	grade
	0.00		MH	Manhole Remark: MH7 A	00:00:00		(Constr) 0
	0.00		ST	Start of Survey	00:00:00		(Misc) 0
	0.00		WL	Water level, 30 % height/diameter	00:00:00		(Serv) 0
	2.30		OJM	Open joint medium	00:00:00	3_4a	(Struct) 1
	7.40		CC	Circumferential Crack, from 05 to 02 o´clock	00:00:00	3_5a	(Struct) 2
	8.40	**S1**	RF	Fine Roots, Start	00:00:00	21_6a	(Serv) 1
	8.90	**F1**	RF	Fine Roots, Finish	00:00:00		(Serv) 1
	9.10		OB	Obstruction, 95 % height/diameter loss	00:00:00	23_8a	(Serv) 2
	9.10		SA	Survey abandoned, Remark: Unable to survey beyond obstruction.	00:00:00		(Misc) 0

Structural Defects	Constructional Features
Service Defects	Miscellaneous Features

Price & Myers

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Nottinghamshire
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Inspection photos

Place:	Road:	Date:	section number:	PLR:
Broadfield Slopes	**The Esplanade**	**10/07/2023**	**3**	**MH7 A X**

Photo: 3_4a, 00:00:00
2.3m, Open joint medium

Photo: 3_5a, 00:00:00
7.4m, Circumferential Crack, from 05 to 02 o´clock

Photo: 21_6a, 00:00:00
8.4m, Fine Roots, Start

Photo: 23_8a, 00:00:00
9.1m, Obstruction, 95 % height/diameter loss

Price & Myers

SURVEY SOLUTIONS

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Nottinghamshire
Tel: 01773 714733, Fax:

Inspection report

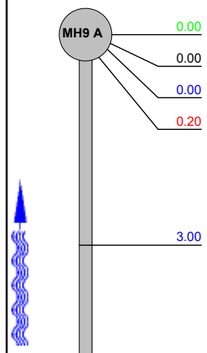
Date:	Job N°:	Weather:	Operator:	section number:	PLR:
10/07/2023	**49962**	**Heavy rain**		**4**	**MH9 A X**
Present:	Vehicle:	Camera:	Preset:	Cleaned: **No**	Grade:

Road:	**The Esplanade**	Division:		start MH:	**MH9 A**
Place:	**Broadfield Slopes**	District:		end MH:	
Location:		Tape No.:		Total length:	**7.2 m**

Purpose:	**Asset condition**	Shape/Size:	**Circular dia 100 mm**
Use:	**Surface water**	Material:	**Vitrified clay** Pipe length:
Catchment:		Lining:	
		Category:	

Comment:

Location details:



1:75	position	code	observation	counter	photo	grade
	0.00	MH	Manhole Remark: MH9 A	00:00:00		(Constr) 0
	0.00	ST	Start of Survey	00:00:00		(Misc) 0
	0.00	WL	Water level, 30 % height/diameter	00:00:00		(Serv) 0
	0.20	JDL	Joint displaced. Large	00:00:00	30_4a	(Struct) 2
	3.00	LR	Line of Sewer deviates right, Remark: Slight deviation.	00:00:00		(Serv) 0
	7.20	B	Sewer Broken, from 09 to 03 o´clock	00:00:00	32_6a	(Struct) 4
	7.20	SA	Survey abandoned, Remark: Unable to survey beyond broken sewer.	00:00:00		(Misc) 0

Structural Defects	Constructional Features
Service Defects	Miscellaneous Features

SURVEY SOLUTIONS

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Inspection photos

Place:	Road:	Date:	section number:	PLR:
Broadfield Slopes	**The Esplanade**	**10/07/2023**	**4**	**MH9 A X**

Photo: 30_4a, 00:00:00
0.2m, Joint displaced. Large

Photo: 32_6a, 00:00:00
7.2m, Sewer Broken, from 09 to 03 o´clock

SURVEY SOLUTIONS

Survey Solutions
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Nottinghamshire
Tel: 01773 714733, Fax:

Inspection report

Date:	Job N°:	Weather:	Operator:	section number:	PLR:
10/07/2023	**49962**	**Heavy rain**		**5**	**DR1 A X**
Present:	Vehicle:	Camera:	Preset:	Cleaned: **No**	Grade:

Road:	**The Esplanade**	Division:		start MH:	**DR1 A**
Place:	**Broadfield Slopes**	District:		end MH:	**MH9**
Location:		Tape No.:		Total length:	**4.2 m**

Purpose:	**Asset condition**	Shape/Size:	**Circular dia 100 mm**
Use:	**Surface water**	Material:	**Vitrified clay** Pipe length:
Catchment:		Lining:	
		Category:	

Comment:

Location details:

1:50	position	code	observation	counter	photo	grade
DR1 A	0.00	MH	Manhole Remark: DR1 A	00:00:00		(Constr) 0
	0.00	ST	Start of Survey	00:00:00		(Misc) 0
	0.00	WL	Water level, 0 % height/diameter	00:00:00		(Serv) 0
	0.60	LL	Line of Sewer deviates left, Remark: Slight deviation.	00:00:00		(Serv) 0
	0.80	LU	Line of Sewer deviates up	00:00:00		(Serv) 0
	0.80	LL	Line of Sewer deviates left, Remark: Slight deviation.	00:00:00		(Serv) 0
	1.50	JDL	Joint displaced. Large	00:00:00	5_7a	(Struct) 2
	1.50	LD	Line of Sewer deviates down	00:00:00		(Serv) 0
MH9	4.10	JN	Junction at 09 o´clock, dia 100 mm	00:00:00	5_9a	(Constr) 0
	4.20	FH	Finish Survey, Remark: MH9 reached.	00:00:00		(Misc) 0

Structural Defects	Constructional Features
Service Defects	Miscellaneous Features

SURVEY SOLUTIONS

Survey Solutions
Nottingham
Nottinghamshire
Tel: 01773 714733, Fax:

Inspection photos

Place:	Road:	Date:	section number:	PLR:
Broadfield Slopes	**The Esplanade**	**10/07/2023**	**5**	**DR1 A X**

Photo: 5_7a, 00:00:00
1.5m, Joint displaced. Large

Photo: 5_9a, 00:00:00
4.1m, Junction at 09 o´clock, dia 100 mm

SURVEY SOLUTIONS

Survey Solutions
Nottingham
Nottinghamshire
Tel: 01773 714733, Fax:

Inspection report

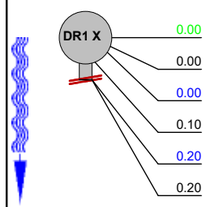
Date:	Job N°:	Weather:	Operator:	section number:	PLR:
10/07/2023	**49962**	**Heavy rain**		**6**	**DR1 X X**
Present:	Vehicle:	Camera:	Preset:	Cleaned: **No**	Grade:

Road:	**The Esplanade**	Division:		start MH:	**DR1 X**
Place:	**Broadfield Slopes**	District:		end MH:	
Location:		Tape No.:		Total length:	**0.2 m**

Purpose:	**Asset condition**	Shape/Size:	**Circular dia 100 mm**
Use:	**Surface water**	Material:	**Vitrified clay** Pipe length:
Catchment:		Lining:	
		Category:	

Comment:

Location details:



1:25	position	code	observation	counter	photo	grade
	0.00	MH	Manhole Remark: DR1 X	00:00:00		(Constr) 0
	0.00	ST	Start of Survey	00:00:00		(Misc) 0
	0.00	WL	Water level, 0 % height/diameter	00:00:00		(Serv) 0
	0.10	GP	General Condition photograph	00:00:00	54_4a	(Misc) 0
	0.20	LD	Line of Sewer deviates down	00:00:00		(Serv) 0
	0.20	SA	Survey abandoned, Remark: Unable to survey beyond deviation.	00:00:00		(Misc) 0

Structural Defects	Constructional Features
Service Defects	Miscellaneous Features

SURVEY SOLUTIONS

Survey Solutions
Nottingham
Nottinghamshire
Tel: 01773 714733, Fax:

Inspection photos

Place:	Road:	Date:	section number:	PLR:
Broadfield Slopes	**The Esplanade**	**10/07/2023**	**6**	**DR1 X X**

Photo: 54_4a, 00:00:00
0.1m, General Condition photograph

PAS 128: 2014 QUALITY LEVEL GUIDE

Q-LEVEL	DESCRIPTION	ACC	Q-LEVEL	DESCRIPTION
QL-D	Service positions taken from records.	Undefined	QL-B2	Horizontal & vertical location using only one geophysical technique.
QL-C	Visual evidence of service existence but unidentifiable by geophysical technology	Undefined	QL-B1	Horizontal & vertical location using multiple geophysical techniques
QL-B4	Undetectable service present shown as an assumed route (AR)	h: +/-300mm v: N/A	QL-A	Horizontal & vertical position verification by open excavation, manholes and/or inspection chambers.
QL-B3	Horizontal location by one geophysical technique but with none or poor depth information.			

DETECTION METHOD

IN ACCORDANCE WITH PAS 128: 2014 SURVEY TYPE B

DRAINAGE SURVEY
All accessible Manholes and Inspection chambers have had their respective covers lifted with pipe sizes, inverts, chamber sizes/types and service data recorded from ground level. All connections from DPs, Gullies, Drains, VP's, RE's and lampholes have been proven wherever possible using audible connections (AC) and/or sonde instrumentation where applicable. Where these methods have proved unsuccessful then assumed (AR) straight line connections will be shown.

CCTV DRAINAGE SURVEY
All accessible Manholes and Inspection chambers have had their respective covers lifted with pipe sizes, inverts, chamber sizes/type and service data recorded from ground level. Pipework has been traced, accessed and collected for post processing. Drainage layout, including manhole covers not located by topographical survey, may be taken from CCTV chainage and will be shown as indicative only.

Electricity
Elec cables will have been predominantly located using EML methodology with electronically derived depths shown. GPR techniques will be employed to achieve greater quality levels as required.

British Telecoms
BT cables will have been predominantly located using EML methodology with electronically derived depths shown. GPR techniques will be employed to achieve greater quality levels as required. Due to current laws and legislation protecting all BT apparatus, cabling can only be located remotely. We therefore compare all our telecom findings against record information to produce the final service layout. In some instances, where high amount of cable ducts are present, we may only be able to identify a linear centre peak signal rather than identifying all the individual duct positions. For further information regarding Telecoms apparatus, please contact Openreach directly.

Cable TV & Communications
CTV and/or Com cables will have been predominantly located using EML methodology with electronically derived depths shown. GPR techniques will be employed to achieve greater quality levels as required.

Fibre Optic
FO cables will have been predominantly located using GPR methodology. This is due to the materials used within fibre optic cabling. In some rare instances, tracer cabling or conductible non fibre optic cabling will be present within some or all ducting. When this is the case, both EML and GPR methodology will be combined to identify service network and achieve greater quality levels.

Lighting, Traffic Signals & Security Cables
LC, TS and/or Sec cables will have been predominantly located using EML methodology with electronically derived depths shown. GPR techniques will be employed to achieve greater quality levels as required.

Gas & Water Inc. Fuel Pipes and Hot Water Pipes
GM/GS and/or WM/WS pipe work will have been attempted and located using both EML & GPR methodology with electronically derived depths shown for the former and depths to crown levels shown for the latter.
When the Gas/Water pipe work is constructed using conductible materials, then we are able to employ multiple geophysical techniques to identify service network and achieve greater quality levels. When a non conductible material is used, GPR methodology will be employed to locate and plot the final service layout.

Ground Penetrating Radar
GPR methodology is used to identify and locate all non metallic, non conductible piping and cabling. We also employ GPR to obtain a greater accuracy levels on EML located services. The GPR has a greater success rate on pipe or service diameter upward of Ø63mm,C63mm, as size increments increase, so does the chance of detection. The GPR can produces varying results and as such, wouldn't be used as an independent utility surveying instrument.

Unidentified Traces
All UITs will have been predominantly located using EML methodology with electronically derived depths shown. GPR techniques will be employed to achieve greater quality levels as required. Every effort has been made to identify the service but in this instance, is not achievable. We recommend excavation work to determine identity and depth where applicable.

Scarring (QL-C)
Scarring has been identified on site with a potential of an undetectable service present.

Assumed Routes & Taken from Records (QL-B4/D)
Assumed routes (AR) are shown if there is evidence that a service exists but we are unable to trace it whilst on site. The surveyor will attempt to locate various risers/ics/valves/meters (service evidence) etc. around site area to successfully determine an assumed route between these points. If there is little evidence on site but they believe a service is still present, then a common sense approach to an assumed route shall be employed.

Taken from records (TFR) are service routes that are taken from STAT record plans or previous survey information and overlaid onto our drawings.

SURVEY RECOMMENDATIONS

LIST RECOMMENDATIONS TO IMPROVE SURVEY DATA

An up to date topographical survey drawing to overlay PAS utility information onto.

We recommend a PAS utility survey of the entire site to establish the position of underground services.

The areas of dense vegetation to be cleared to allow access if any of these areas are deemed critical or of high importance.

The sewers with high levels of silt or blockages to be jetted to extend the CCTV drainage survey, if any of these areas are deemed critical or of high importance.

We recommend full statutory record information be obtained to confirm site findings and to position undetectable which may be present.

Due to the geophysical nature of subsurface technology, we always recommend excavation works to be carried out within critical areas for verification and to eliminate the possibility of undetectable services present.

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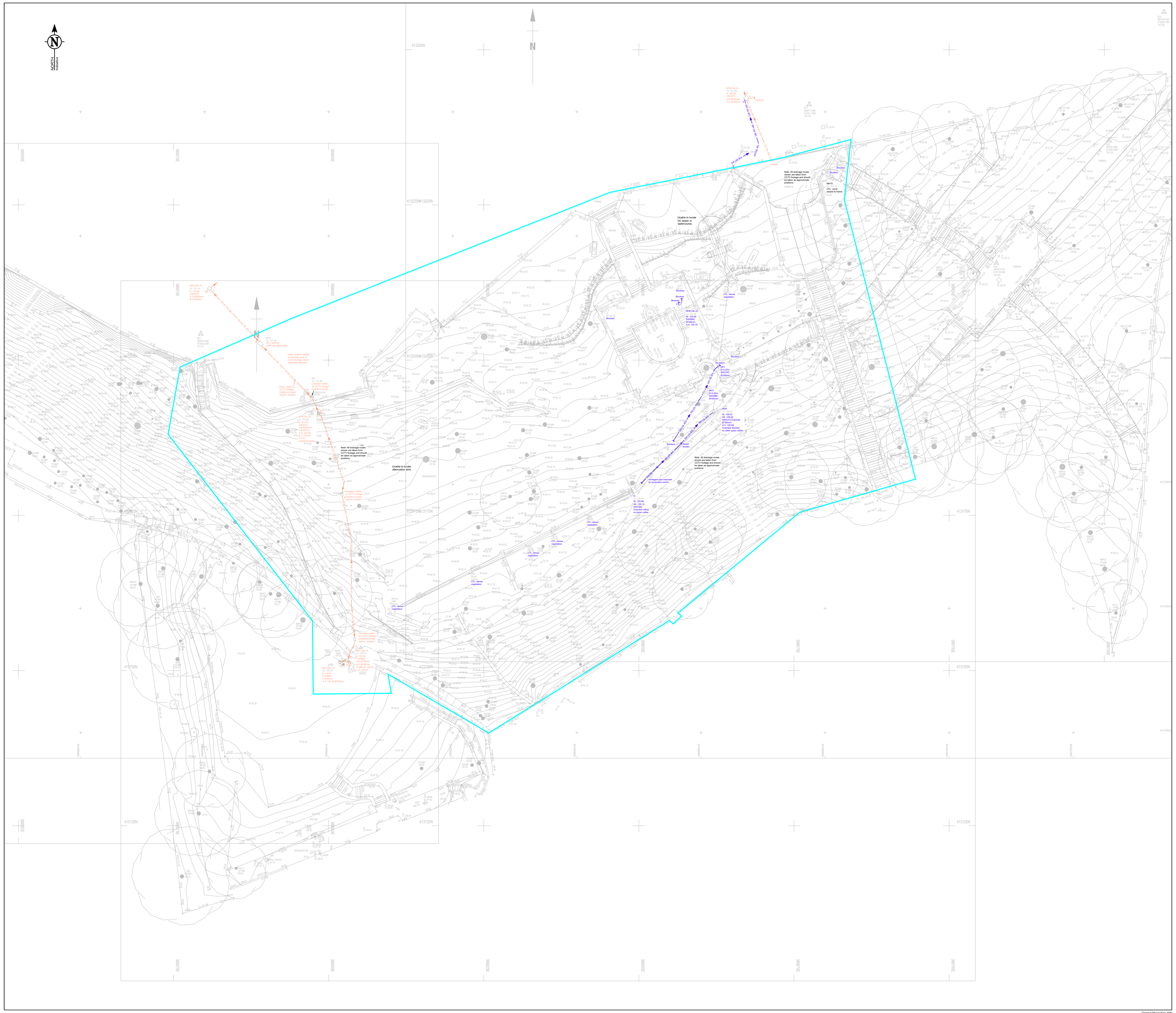

Original Sheet Size A0H

UTILITIES & UNDERGROUND INVESTIGATIONS

ABBREVIATIONS & SYMBOLS

1D 5C	1 Duct 5 Cables	DCr	Depth To Crown	RBC	Rectangular Brick Chamber
Ø	Diameter	DI	Depth To Invert	RCC	Rectangular Conc Chamber
AC	Audible Connection	DS	Depth To Silt	RE	Rodding Eye
AG	Above Ground	DTB	Depth To Base	SA	Survey Abandoned
AR	Assumed Route	DTW	Depth To Water	SL	Silt Level
BL	Base Level	DTS	Depth To Surcharge	SuL	Surcharge Level
CB	Concrete Benching	EBD	External Backdrop	TFR	Taken From Records
CBC	Circular Brick Chamber	EOT	End Of Trace	UTC	Unable To CCTV
CCC	Circular Conc Chamber	IBD	Internal Backdrop	UTDO	Unable To Determine Outfall
CL	Cover Level	IL	Invert Level	UTL	Unable To Lift
CPC	Circ Plastic Chamber	OH	Overhead	UTS	Unable To Survey
Cr/L	Crown Level	PDR	Poor Depth Response	UTT	Unable To Trace
CU	Camera Under Water	RB ●	Rest Bend	WL	Water Level

BT CABLE(S)
OVERHEAD BT CABLE(S)
COMMUNICATIONS CABLE(S)
CABLE TV CABLE(S)
EMPTY DUCT
ELECTRIC CABLE(S)
OVERHEAD ELECTRIC CABLE(S)
FIBREOPTIC CABLE(S)
FUEL PIPE(S)
GAS MAIN
GAS SERVICE
GROUND PENETRATING RADAR (GPR) TRACE
HOT WATER PIPE
LIGHTING CIRCUIT
OIL PIPE(S)
VISIBLE SCARRING
SECURITY CABLING
TELECOM CABLE(S)
TRAFFIC SIGNAL
UNIDENTIFIED SERVICE
UNIDENTIFIED TRACE
WATER MAIN
WATER SERVICE
COMBINED SEWER
COMBINED WATER RISING MAIN
EFFLUENT WATER
FOUL SEWER
FOUL WATER RISING MAIN
RISING MAIN
SURFACE WATER SEWER
SURFACE WATER RISING MAIN
INVESTIGATION EXTENTS

UTILITIES COMMENT BOX (GENERAL NOTES)
DEPTH TO SERVICE
AUDIBLE CONNECTION
SERVICE ABOVE GROUND
CAMERA UNDER WATER
SERVICE OVERHEAD

DRAWING NOTES

All below ground details shown have been identified from above ground without excavation. Survey Solution use electro-magnetic and/or ground penetrating radar (GPR) methods to investigate for underground utilities, services and features. Results using these methods are not infallible and we recommend trial excavations are carried out for verification of positions, depths and identification.

Any areas on the drawing where services or features have not been shown are not necessarily clear of services or features but are an indication that no items have been identified during our investigations. All reasonable care and normal good practice should still be employed during design and construction processes.

Certain types of services such as plastic or concrete pipes, some conduit and ducting where direct access can not be achieved for tracing may not be shown and alternative locating methods should be used.

Survey Solutions has used all reasonable care to research available service records but the completeness or use of the service records supplied to or by Survey Solutions cannot be guaranteed. Therefore Survey Solutions cannot be held responsible for any features annotated as 'taken from records' (TFR).

Depths obtained using electro-magnetic or GPR are effected by ground conditions and should be treated as indicative only. Electro-magnetic depths to utilities and services are generally taken to the centre of a feature, GPR depths to the top of a feature and drainage depth shown to inverts, unless otherwise indicated.

Drainage pipe sizes will be obtained without entering the chamber and therefore should be treated as approximate. Pipe dimensions which have not been obtained visually will be taken from records when available.

All services, drainage and utilities routes are assumed straight between access points, unless otherwise stated. The numbers of cables in runs will not be shown unless specifically requested. All services are below ground unless indicated.

Services, utilities and features may not have been surveyed if obstructed or not reasonably visible or accessible at the time of survey.

Survey Solutions accept no responsibility for the completeness or accuracy of either the topographical survey or base mapping on this project.

All critical dimensions and measurements should be checked and verified with any errors or discrepancies notified to Survey Solutions immediately. The accuracy of the digital data is the same as the plotting scale implies. All dimensions are in metres unless otherwise stated.

The contractor must check and verify all site and building dimensions, levels, utilities and drainage details and connections prior to commencing work.

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Do not scale from this drawing.

GENERAL SYNOPSIS

This survey has been carried out in accordance with PAS 128: 2014 & our version of the Royal Institution of Chartered Surveyors (RICS) specification for Measured Surveys of Land, Buildings and Utilities. Our survey extents have been agreed and confirmed with formal acceptance of 70208 from PRICE & MYERS. If you have any queries regarding the final services layout, please may we ask you to carefully read all the information within this title block in its entirety before continuing to do so.

TOPOGRAPHICAL/.DWG DRAWING INFORMATION
TOPOGRAPHICAL SURVEY DATE 24/05/2022

SURVEY TYPE	DESCRIPTION	EFFECT ON SURVEY RESULTS
TOPO	MALCOLM HUGHES	
OUTDATED		
OS		
NTS		

GENERAL SITE CONDITIONS
AVERAGE

ADDITIONAL INFORMATION	EFFECT ON SURVEY RESULTS

DESKTOP UTILITY RECORDS (PAS 128: 2014 SURVEY TYPE D)
PREREQUISITE FOR PAS 128: 2014 SURVEY TYPE B
COMMISSIONED: NO

UTILITY	AVAILABILITY	UTILITY COMPANY PROVIDER
SEWER	NO	N/A
WATER MAIN	NO	N/A
GAS MAIN	PUBLIC	CADENT GAS
TELECOM	PUBLIC	BRITISH TELECOMS
CABLE TV	NO	N/A
ELECTRICITY	NO	N/A
OIL PIPES	NO	N/A
OTHER	NO	N/A

REV	DESCRIPTION	DRAWN	CHECKED	APPR	SURVEY DATE
A	SITE SPECIFIC CCTV SURVEY.	OTM	JAD	DWR	03/07/2023

SURVEY SOLUTIONS

LAND SURVEYING
BUILDING SURVEYING
UNDERGROUND SURVEYING
SITE ENGINEERING
MONITORING

0845 040 5969
survey-solutions.co.uk

IPSWICH BEDFORD COVENTRY GLASGOW LONDON MANCHESTER NORWICH NOTTINGHAM YEOVIL

PROJECT TITLE: THE ESPLANADE, ROCHDALE, OL16 1AB				
DRAWING DETAIL: CCTV DRAINAGE SURVEY. SHEET 1 OF 1				
CLIENT: PRICE & MYERS				SCALE: 1:200
SURVEYOR: NB/TH	SURVEY DATE: 16/06/2023	CHECKED BY: TH/DR	APPROVED BY: DR	DWG STATUS: FINAL
DRAWING NUMBER: 49962MCUG-01			REVISION: A	ISSUE DATE: 26/06/2023

Project Details

Site Address	Broadfield Slopes
Town / City	Rochdale
Post Code	
Date	16-06-2023
Customer / Client	Price & Myers LLP

Manhole Report

MH (Node) Reference: MH1	**Date:** 16-06-2023

Location: MH1	**Location Type:** Difficult Access		
Function: Combined	**Node Type:** MH - Manhole	**Status:** PR - Private	
Latitude:	**Longitude:**	**Year Installed:** Z - Others	**Area Code:**

LEVELS	**Depth (m):**	**Cover Level (m):**	**Invert Level (m):**

COVER	**Shape:** C - Circular	**Hinged?** ☐	**Dimension 1:**
	Duty: Light	**Locked?** ☐	**Dimension 2:**

CHAMBER				
Construction: Brick	**Access:**	**Access Shaft?** ☐	**Reducing Slab?** ☐	**Landing Slab?** ☐
Chamber Dimensions	**Dimension 1 (Dia.):**	**Shaft Dimensions(if present)**		**Dimension 1 (Dia.):**
	Dimension 2:			**Dimension 2:**
Flow Depth (mm):		**Sluice Gate?** ☐	**Grating?** ☐	**Penstock?** ☐
Silt Depth (mm):		**Flap Valve?** ☐	**Headwall?** ☐	**Screens?** ☐
Surcharge Level (mm):		**Orifice?** ☐	**Flume?** ☐	**Weir?** ☐

Condition	Cover	Shaft	Step Irons/Ladders	Chamber	Benching	Half Channel
Good	☐	☐	☐	☐	☐	☐
Fair	☑	☑	☑	☑	☐	☐
Poor	☐	☐	☐	☐	☐	☐
Not Present	☐	☐	☐	☐	☐	☐

INCOMING PIPES

Letter	Upstream Ref.	Pipe Shape	Height (Dia.)		Width	Pipe Material	Lining Material	Depth (m)
A		Circular	100	x		VC - Vitrified Clay	Not present	1.62
B		Circular	150	x		VC - Vitrified Clay	Not present	
C		Circular	100	x		VC - Vitrified Clay	Not present	0.79

OUTGOING PIPES

Letter	Downstream Ref.	Pipe Shape	Height (Dia.)		Width	Pipe Material	Lining Material	Depth (m)
X		Circular	150	x		VC - Vitrified Clay	Not present	1.81

Evidence of misconnection? ☐

Manhole Images

Additional Notes and/or Recommendations

Manhole Report

MH (Node) Reference: MH2	**Date:** 16-06-2023

Location: MH2	**Location Type:** Difficult Access		
Function: Combined	**Node Type:** MH - Manhole	**Status:** PR - Private	
Latitude:	**Longitude:**	**Year Installed:**	**Area Code:**

LEVELS	**Depth (m):**	**Cover Level (m):**	**Invert Level (m):**

COVER	**Shape:** C - Circular	**Hinged?** ☐	**Dimension 1:**
	Duty: Light	**Locked?** ☐	**Dimension 2:**

CHAMBER

Construction: Brick	**Access:**	**Access Shaft?** ☐	**Reducing Slab?** ☐	**Landing Slab?** ☐
Chamber Dimensions	**Dimension 1 (Dia.):**	**Shaft Dimensions(if present)**		**Dimension 1 (Dia.):**
	Dimension 2:			**Dimension 2:**
Flow Depth (mm):		**Sluice Gate?** ☐	**Grating?** ☐	**Penstock?** ☐
Silt Depth (mm):0.8		**Flap Valve?** ☐	**Headwall?** ☐	**Screens?** ☐
Surcharge Level (mm):		**Orifice?** ☐	**Flume?** ☐	**Weir?** ☐

Condition	Cover	Shaft	Step Irons/Ladders	Chamber	Benching	Half Channel
Good	☐	☐	☐	☐	☐	☐
Fair	☐	☑	☐	☑	☐	☐
Poor	☑	☐	☐	☐	☐	☐
Not Present	☐	☐	☑	☐	☑	☑

INCOMING PIPES

Letter	Upstream Ref.	Pipe Shape	Height (Dia.)		Width	Pipe Material	Lining Material	Depth (m)
A		Circular	100	x		VC - Vitrified Clay	Not present	0.71
		Circular		x		VC - Vitrified Clay	Not present	

OUTGOING PIPES

Letter	Downstream Ref.	Pipe Shape	Height (Dia.)		Width	Pipe Material	Lining Material	Depth (m)
X		Circular	75	x		VC - Vitrified Clay	Not present	0.73

Evidence of misconnection? ☐

Manhole Images

Additional Notes and/or Recommendations

Manhole Report

MH (Node) Reference: MH3	**Date:** 16-06-2023

Location: MH3	**Location Type:** Difficult Access		
Function: Combined	**Node Type:** MH - Manhole	**Status:** PR - Private	
Latitude:	**Longitude:**	**Year Installed:**	**Area Code:**

LEVELS	**Depth (m):**	**Cover Level (m):**	**Invert Level (m):**

COVER	**Shape:** C - Circular	**Hinged?** ☑	**Dimension 1:**
	Duty: Heavy	**Locked?** ☐	**Dimension 2:**

CHAMBER

Construction:	**Access:**	**Access Shaft?** ☐	**Reducing Slab?** ☐	**Landing Slab?** ☐
Chamber Dimensions	**Dimension 1 (Dia.):**	**Shaft Dimensions(if present)**		**Dimension 1 (Dia.):**
	Dimension 2:			**Dimension 2:**
Flow Depth (mm):		**Sluice Gate?** ☐	**Grating?** ☐	**Penstock?** ☐
Silt Depth (mm):		**Flap Valve?** ☐	**Headwall?** ☐	**Screens?** ☐
Surcharge Level (mm):		**Orifice?** ☐	**Flume?** ☐	**Weir?** ☐

Condition	Cover	Shaft	Step Irons/Ladders	Chamber	Benching	Half Channel
Good	☐	☐	☐	☐	☐	☐
Fair	☑	☑	☐	☑	☐	☐
Poor	☐	☐	☐	☐	☐	☐
Not Present	☐	☐	☑	☐	☐	☐

INCOMING PIPES

Letter	Upstream Ref.	Pipe Shape	Height (Dia.)		Width	Pipe Material	Lining Material	Depth (m)
A		Circular	100	x		PVC - Polyvinyl Chloride	Not present	0.71
B		Circular	225	x		VC - Vitrified Clay	Not present	1.36

OUTGOING PIPES

Letter	Downstream Ref.	Pipe Shape	Height (Dia.)		Width	Pipe Material	Lining Material	Depth (m)
X		Circular	225	x		VC - Vitrified Clay	Not present	2.65

Evidence of misconnection? ☐

Manhole Images

Additional Notes and/or Recommendations

Manhole Report

MH (Node) Reference: MH5	**Date:** 16-06-2023

Location: MH5		**Location Type:** Road	
Function: Combined	**Node Type:** MH - Manhole		**Status:** PU - Public
Latitude:	**Longitude:**	**Year Installed:**	**Area Code:**

LEVELS	**Depth (m):**	**Cover Level (m):**	**Invert Level (m):**

COVER	**Shape:** C - Circular	**Hinged?** ☐	**Dimension 1:**
	Duty: Medium	**Locked?** ☐	**Dimension 2:**

CHAMBER				
Construction: Others	**Access:**	**Access Shaft?** ☐	**Reducing Slab?** ☐	**Landing Slab?** ☐
Chamber Dimensions	**Dimension 1 (Dia.):**	**Shaft Dimensions(if present)**		**Dimension 1 (Dia.):**
	Dimension 2:			**Dimension 2:**
Flow Depth (mm):		**Sluice Gate?** ☐	**Grating?** ☐	**Penstock?** ☐
Silt Depth (mm):		**Flap Valve?** ☐	**Headwall?** ☐	**Screens?** ☐
Surcharge Level (mm):		**Orifice?** ☐	**Flume?** ☐	**Weir?** ☐

Condition	Cover	Shaft	Step Irons/Ladders	Chamber	Benching	Half Channel
Good	☑	☑	☑	☑	☐	☐
Fair	☐	☐	☐	☐	☐	☐
Poor	☐	☐	☐	☐	☐	☐
Not Present	☐	☐	☐	☐	☐	☐

INCOMING PIPES

Letter	Upstream Ref.	Pipe Shape	Height (Dia.)		Width	Pipe Material	Lining Material	Depth (m)
A		Circular	300	x		VC - Vitrified Clay	Not present	

OUTGOING PIPES

Letter	Downstream Ref.	Pipe Shape	Height (Dia.)		Width	Pipe Material	Lining Material	Depth (m)
X		Circular	300	x		VC - Vitrified Clay	Not present	1.81

Evidence of misconnection? ☐

Manhole Images

Additional Notes and/or Recommendations

Manhole Report

MH (Node) Reference: MH4	**Date:** 16-06-2023

Location: MH4		**Location Type:** Road	
Function: Combined	**Node Type:** MH - Manhole		**Status:** PU - Public
Latitude:	**Longitude:**	**Year Installed:**	**Area Code:**

LEVELS	**Depth (m):**	**Cover Level (m):**	**Invert Level (m):**

COVER	**Shape:** C - Circular	**Hinged?** ☐	**Dimension 1:**
	Duty:	**Locked?** ☐	**Dimension 2:**

CHAMBER				
Construction:	**Access:**	**Access Shaft?** ☐	**Reducing Slab?** ☐	**Landing Slab?** ☐
Chamber Dimensions	**Dimension 1 (Dia.):**	**Shaft Dimensions(if present)**		**Dimension 1 (Dia.):**
	Dimension 2:			**Dimension 2:**
Flow Depth (mm):		**Sluice Gate?** ☐	**Grating?** ☐	**Penstock?** ☐
Silt Depth (mm):		**Flap Valve?** ☐	**Headwall?** ☐	**Screens?** ☐
Surcharge Level (mm):		**Orifice?** ☐	**Flume?** ☐	**Weir?** ☐

Condition	Cover	Shaft	Step Irons/Ladders	Chamber	Benching	Half Channel
Good	☐	☐	☐	☐	☐	☐
Fair	☐	☐	☐	☐	☐	☐
Poor	☐	☐	☐	☐	☐	☐
Not Present	☐	☐	☐	☐	☐	☐

INCOMING PIPES

Letter	Upstream Ref.	Pipe Shape	Height (Dia.)		Width	Pipe Material	Lining Material	Depth (m)
		Circular		x		VC - Vitrified Clay	Not present	

OUTGOING PIPES

Letter	Downstream Ref.	Pipe Shape	Height (Dia.)		Width	Pipe Material	Lining Material	Depth (m)
		Circular		x		VC - Vitrified Clay	Not present	

Evidence of misconnection? ☐

Manhole Images

Additional Notes and/or Recommendations

Manhole Report

MH (Node) Reference: MH6	**Date:** 16-06-2023

Location: MH6	**Location Type:** Footway		
Function: Combined	**Node Type:** MH - Manhole	**Status:** PU - Public	
Latitude:	**Longitude:**	**Year Installed:**	**Area Code:**

LEVELS	**Depth (m):**	**Cover Level (m):**	**Invert Level (m):**

COVER	**Shape:** C - Circular	**Hinged?** ☐	**Dimension 1:**
	Duty: Heavy	**Locked?** ☐	**Dimension 2:**

CHAMBER				
Construction: Plastic	**Access:**	**Access Shaft?** ☐	**Reducing Slab?** ☐	**Landing Slab?** ☐
Chamber Dimensions	**Dimension 1 (Dia.):**	**Shaft Dimensions(if present)**	**Dimension 1 (Dia.):**	
	Dimension 2:		**Dimension 2:**	
Flow Depth (mm):	**Sluice Gate?** ☐	**Grating?** ☐	**Penstock?** ☐	
Silt Depth (mm):	**Flap Valve?** ☐	**Headwall?** ☐	**Screens?** ☐	
Surcharge Level (mm):	**Orifice?** ☐	**Flume?** ☐	**Weir?** ☐	

Condition	Cover	Shaft	Step Irons/Ladders	Chamber	Benching	Half Channel
Good	☐	☐	☐	☐	☐	☐
Fair	☑	☑	☐	☑	☐	☐
Poor	☐	☐	☐	☐	☐	☐
Not Present	☐	☐	☑	☐	☐	☐

INCOMING PIPES

Letter	Upstream Ref.	Pipe Shape	Height (Dia.)		Width	Pipe Material	Lining Material	Depth (m)
A		Circular	100	x		VC - Vitrified Clay	Not present	
B		Circular	150	x		VC - Vitrified Clay	Not present	
C		Circular	100	x		VC - Vitrified Clay	Not present	

OUTGOING PIPES

Letter	Downstream Ref.	Pipe Shape	Height (Dia.)		Width	Pipe Material	Lining Material	Depth (m)
X		Circular	150	x		VC - Vitrified Clay	Not present	1.31

Evidence of misconnection? ☐

Manhole Images

Additional Notes and/or Recommendations

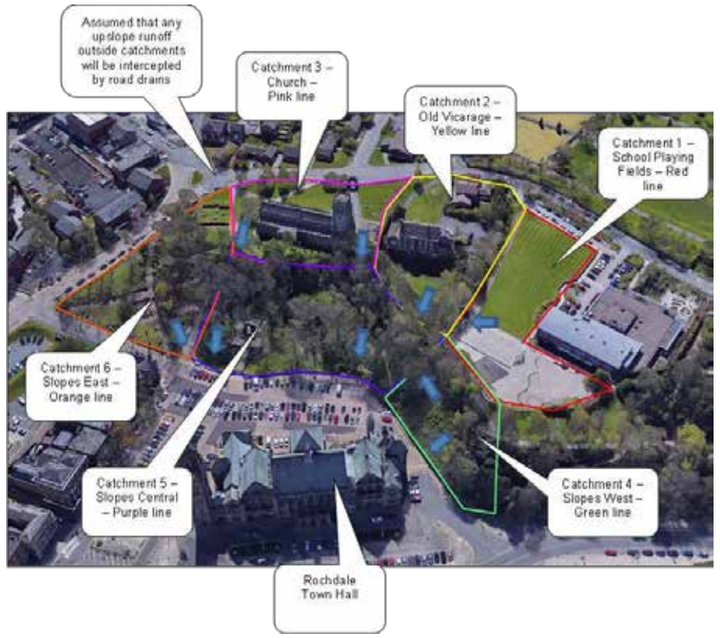
Appendix D
Hydrology

AMBELLIA CONSULTANCY

Rochdale Town Hall (RTH) Slopes Hydrology Studies

September 2021 to August 2022

Rochdale Town Hall
The Esplanade
Rochdale
OL16 1AB



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

AMBELLIA CONSULTANCY

Executive Summary

This report presents the results of the investigations (between September 2021 & August 2022) of the hydrology and hydrogeology of the slopes to the south of Rochdale Town Hall (RTH).

In parallel to the on-going restoration of the RTH grade 1 listed building, the slopes immediately to the south are to be restored and renovated to provide a multipurpose outdoor public space.

The main objectives of the hydrology and hydrogeology studies of the slopes were to

i) Investigate the evidence of the sources and evolution of the two historic water supply systems issuing from the slopes (Packer Spout water reservoir and Fulling Mill water supply) from their 18th Century origins to the present day
ii) Provide information to help to restore the two water supply systems and as a result improve the drainage of the slopes
iii) estimate the rates and volumes of runoff from 100 year return period storm events which may flow into the RTH drainage systems (which are currently being revised during the RTH restoration) as an aid to determining whether any additional flow attenuation structures may be required to avoid future flooding of RTH

It should be noted that as the slopes hydrology and hydrogeology studies have been based on a series of site visits and archive investigations, and that the observation, conclusions and recommendations in this final report supersede those in any previous Ambellia Consultancy reports relating to RTH.

This section presents the outline plan for restoring the two historic water supply systems on the slopes (Packer Spout and Fulling Mill) and for generally improving the slopes drainage and helping to avoid the overwhelming of the new RTH drainage during storm runoff conditions

The 6 slope runoff catchments defined for this report are shown in Fig. ExecSum.1.

Recommendations for the restoration of the Packer Spout Water Supply are listed in Fig. ExecSum.2.

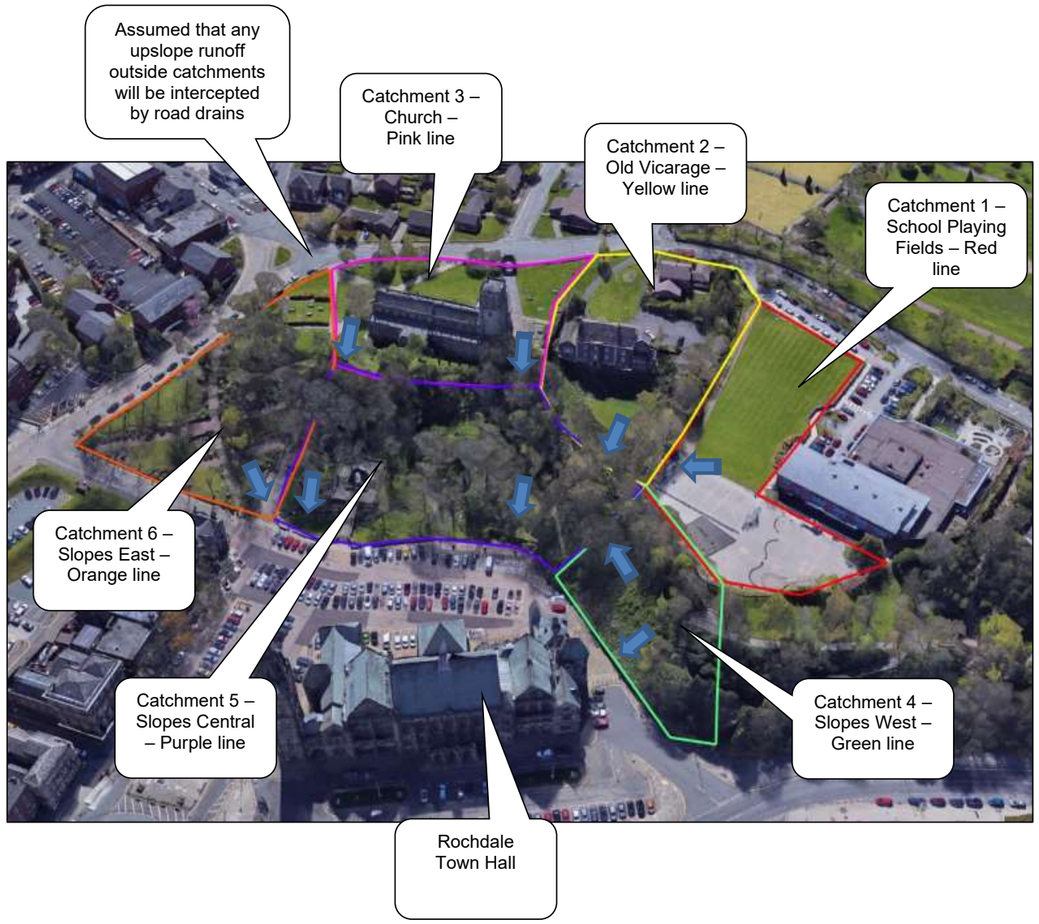
Recommendations for the restoration of the Fulling Mill Water Supply are listed in Fig. ExecSum.3.

A Summary of RTH Slopes Catchments drainage problems and recommendations for remedies are listed in Fig. ExecSum.4.

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

AMBELLIA CONSULTANCY

Fig. ExecSum.1
'3D' Aerial Photo Showing 6 Main Water Runoff Catchments for the RTH Slopes
(Blue arrows indicate main exit routes for runoff from catchments)



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

AMBELLIA CONSULTANCY

Fig. ExecSum.2
Recommendations for Restoration of the Packer Spout Water Supply

Item No.	Description
1	Restoring the catchpit for the main spring source so that sand is trapped in the catchpit and the spring water flows directly into half-round culvert and so removing the pond
2	Restoring the other 5 spring catchpits which can also act as sand/silt traps
3	Removing the back plastic pipes and other debris from the half round pipes
4	Refilling the round holes in the main west-east half-round culvert with lime mortar to stop water leaking to the slopes
5	Recovering the half-round culverts with the 90 cm natural stone slabs
6	Restoring the round brick sand/silt trap at the eastern end of the main half-round culvert
7	Restoring the stone culvert from the round brick chamber to the Packer Spout reservoir
8	Cleaning out the Packer Spout reservoir
9	Restoring the inflow and outflow controls for the Packer Spout reservoir
10	Laying new pipe from the Packer Spout Reservoir to the new RTH drainage to avoid current leaking drainage pipes
11	Determine if flow attenuation is required based on the relative flow capacity of the new RTH drainage compared with the slopes storm runoff rates.
12	Prepare maintenance plan including prevention of build-up of sand, silt and algae.

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. ExecSum.3
Recommendations for Restoration of the Fulling Mill Water Supply

Item No.	Description
1	Restoring the complete length of the stone culvert from the western side of St Chad's church to the underground brick chamber (which is 11 m from the base of the slope)
2	Restoring the system catchpits and culverts which is draining the lower spring line and channelling water to the underground brick chamber.
3	Determine if flow attenuation is required based on the relative flow capacity of the new RTH drainage compared with the slopes storm runoff rates.
4	Prepare maintenance plan

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. ExecSum.4
Summary of RTH Slopes Catchments Drainage Problems and Remedy Recommendations

Catchment No.	Catchment Name	Problems	Remedy
1	School Playing Fields	Possible uncontrolled runoff from the school playing fields is possibly reaching the RTH slopes via the vicarage garden	If confirmed, divert runoff away from RTH slopes or if required install flow attenuation prior to water reaching RTH slopes
2	Old Vicarage (Partnership House)	Foul water from vicarage probably reaching RTH slopes combined with runoff	If confirmed, connect vicarage to mains drains for install PWTP
		Possible uncontrolled runoff from the vicarage is reaching the RTH slopes via the vicarage garden	If confirmed, install flow attenuation if required prior to water reaching RTH slopes
3	Church	Foul water from church probably reaching RTH slopes combined with runoff	If confirmed, connect church to mains drains for install PWTP
		Uncontrolled runoff from the church is reaching the RTH slopes	Install flow attenuation if required at the base of the slopes
4	Slopes West	Unknown extent and condition of drains on these very steep slopes	Monitor drainage of catchment. Avoid damage to any drains during new planting
5	Slopes central	Blocked lateral field drains at base of slope	The lateral land drains at the base of the slope need to be replaced, with the land drain gravel covered by a permeable geotextile membrane to prevent silt blocking the land drain gravel.
			Runoff attenuation should be installed if required based on the relative flow capacity of the new RTH drainage compared with the slopes storm runoff rates.
6	Slopes East	Unknown extent and condition of drains on these very steep slopes	Investigate condition of significant drain for the surface runoff next to the base of the church steps
			Determine if storm runoff flow attenuation is required based on the relative flow capacity of the new RTH drainage compared with the slopes storm runoff rates.

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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14.0 Catchment 4 – Slopes West - RTH Drainage Considerations

15.0 Catchment 5 – Slopes Central - RTH Drainage Considerations

16.0 Catchment 6 – Slopes East - RTH Drainage Considerations

17.0 Summary of Conclusions & Recommendations

This study can only be used in relation to Rochdale Town Hall, The Esplanade, Rochdale, OL16 1AB. Dr. Robin Evans trading as Ambellia Consultancy retains the copyright of the report. This report was prepared with every possible effort to ensure that the work conforms to the accepted scientific practice. However, Dr. Robin Evans, trading as Ambellia Consultancy, makes no warranty, expressed or implied, and assumes no legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product or process disclosed. Dr. Robin Evans, trading as Ambellia Consultancy shall not be responsible for any consequential loss, howsoever caused, associated with the use of this study.

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Rochdale Town Hall (RTH) Slopes Hydrology Studies

September 2021 to August 2022

1.0 Introduction

This report presents the results of the investigations (between September 2021 & August 2022) of the hydrology and hydrogeology of the slopes to the south of Rochdale Town Hall (RTH).

In parallel to the on going restoration of the RTH grade 1 listed building, the slopes immediately to the south are to be restored and renovated to provide a multipurpose outdoor public space.

The main objectives of the hydrology and hydrogeology studies of the slopes were to

i) Investigate the evidence of the sources and evolution of the two historic water supply systems issuing from the slopes (Packer Spout water reservoir and Fulling Mill water supply) from their 18th Century origins to the present day
ii) Provide information to help to restore the two water supply systems and as a result improve the drainage of the slopes
iii) estimate the rates and volumes of runoff from 100 year return period storm events which may flow into the RTH drainage systems (which are currently being revised during the RTH restoration) as an aid to determining whether any additional flow attenuation structures may be required to avoid future flooding of RTH

It should be noted that as the slopes hydrology and hydrogeology studies have been based on a series of site visits and archive investigations, and that the observation, conclusions and recommendations in this final report supersede those in any previous Ambellia Consultancy reports relating to RTH.

A time line for the development to the 2 historical water supply systems on the slopes is presented in Fig. 1.1, along with a list of relevant sections in the report.

The Hydrogeological model for the 2 spring water sources on the slopes is shown in Fig. 1.2.

A summary of the area of the main storm water runoff catchments on the slopes is illustrated in Fig. 1.3.

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 1.1.
Summary of History of Water Use & Drainage on Broadfield Slopes to South of RTH and Main Relevant Report Sections

Year	Activity	Main relevant report sections
1754	Initial development of Packer Spout water supply with small reservoir/trough in front of Leyland House next to church steps	2
1760	Stone Reservoir built for Packer Spout spring on east side of slopes to supply water to Packer Street, Fleece Street, Church Street area	3
1764	Springs and runoff from St Chad's Church, vicarage and west side of slopes used to power fulling mill on glebe land below the slopes	4
1864	Glebe land is purchased to build Rochdale Town Hall & fulling mill is demolished	5
1871	Rochdale Town Hall is completed	5
Early 1870's	Water powered corn mill is built adjacent to Packer Spout reservoir using it as water source to power water turbine. Fulling mill water supply also possibly used for a second smaller mill	5
1934	Corn mill is demolished and landscaped gardens created. Spring and storm runoff flow diverted around Packer Spout reservoir to create small waterfall features prior to entering storm drains under Packer Street. Water has to pumped into Packer Spout to fill it. Fulling mill water drainage system is significantly damaged	6
1960's	Primary School built in western side of vicarage garden	11

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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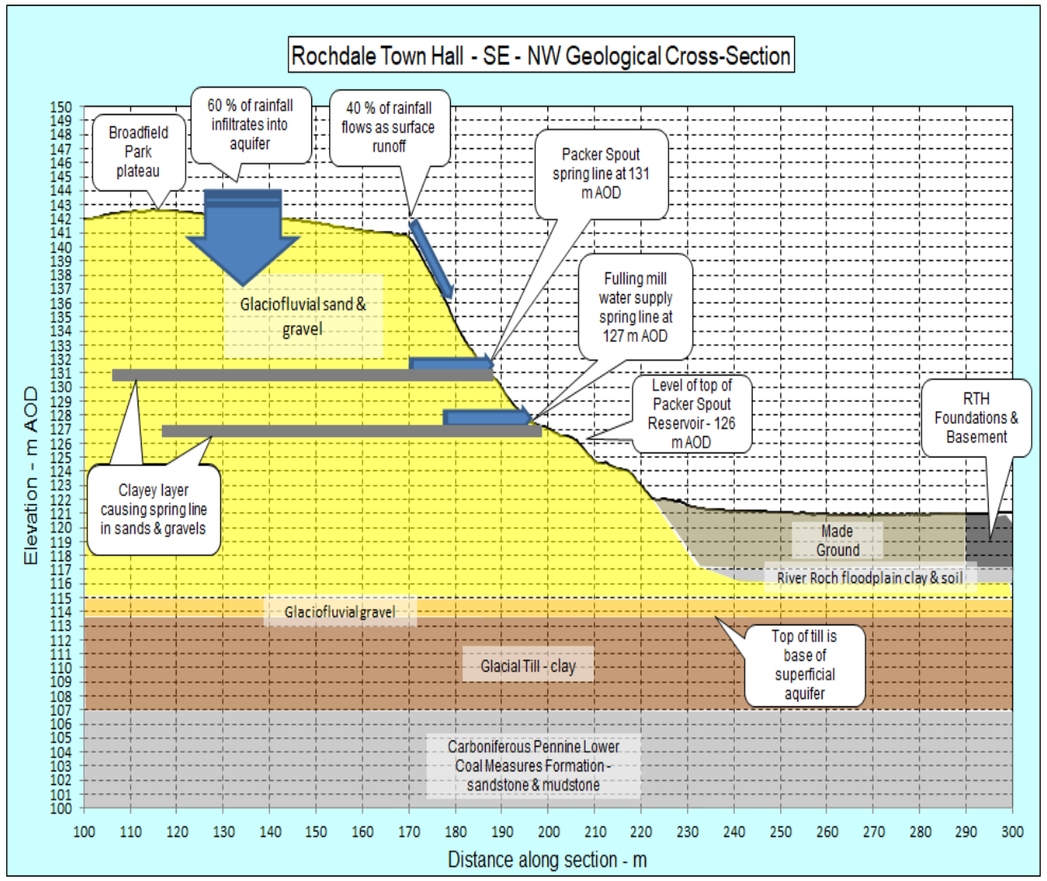
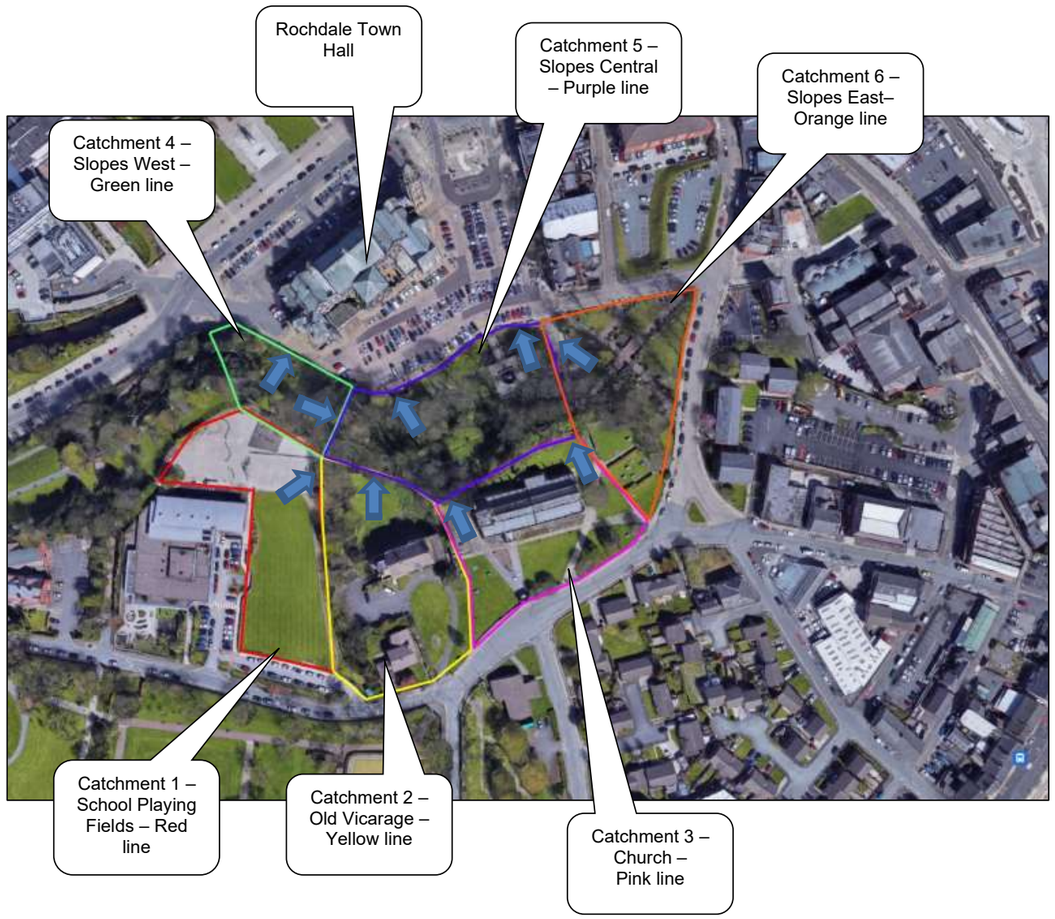
Figure 1.2
RTH SE-NW Geological Cross-Section



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 1.3
Aerial Photo Showing 6 Main Water Runoff Catchments for the RTH Slopes
(Blue arrows indicate main exit routes for runoff from catchments)



2.0 1754 Initial Development of the Packer Spout Spring Water Supply

Fig. 2.1 illustrates the original layout of the system of springs, spring catchpits and stone slab covered culverts which supplied water to the original Packer Spout trough in front of Leyland House which is believed to have been completed in 1754.

The springs feeding the original 1754 Packer Spout water trough were between 40 m and 75 m to the SW of the trough on the slopes area known as Leland Bank or Leylands Brow (Fig. 2.2).

Packer Spout, with its original publicly accessible water trough in front of Leyland House, was one of the first engineered water supplies in Rochdale (Fig. 2.3).

The original water trough was removed in 1927 when Leyland House was demolished, and the site is next to the Church Steps is now grassed over (Fig. 2.4).

Originally the main spring source, 75 m to the SW of the Leylands House trough, would have had catchpit similar to those at other spring sources supplying Packer Spout. The visible remnants of those catchpits indicate the presence of circular chambers which would have acted as sand/silt traps (Fig. 2.5).

To protect the spring water quality (and to prevent culvert blockages) there would have been no pond (Fig. 2.5) and the spring water would have flowed directly into the half-round culverts covered by stone slabs, as recreated in Fig. 2.6.

At the end of the half-round culvert section was a round brick chamber, which would have provided another sand/silt trap before the water flowed down a rectangular stone culvert to the water trough at Leylands House (Fig. 2.6).

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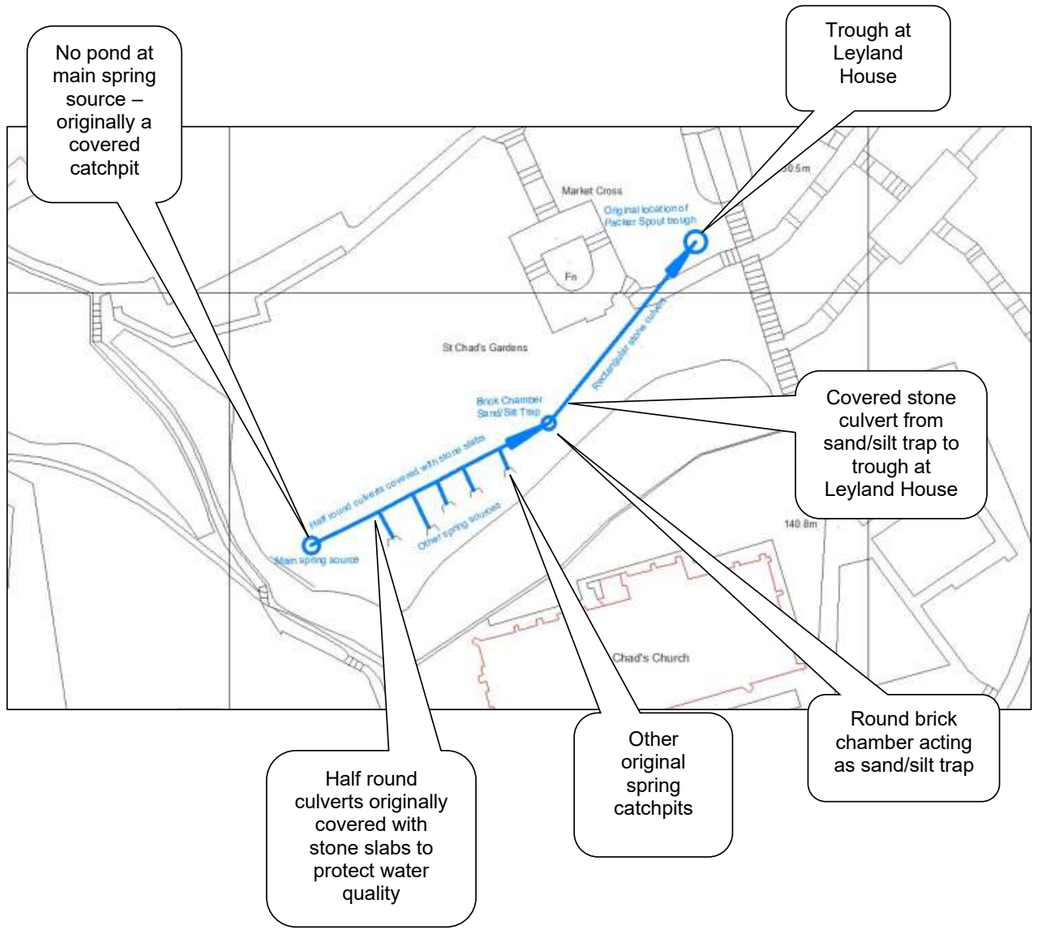
Fig. 2.1.
Packer Spout Arrangement Pre-1760



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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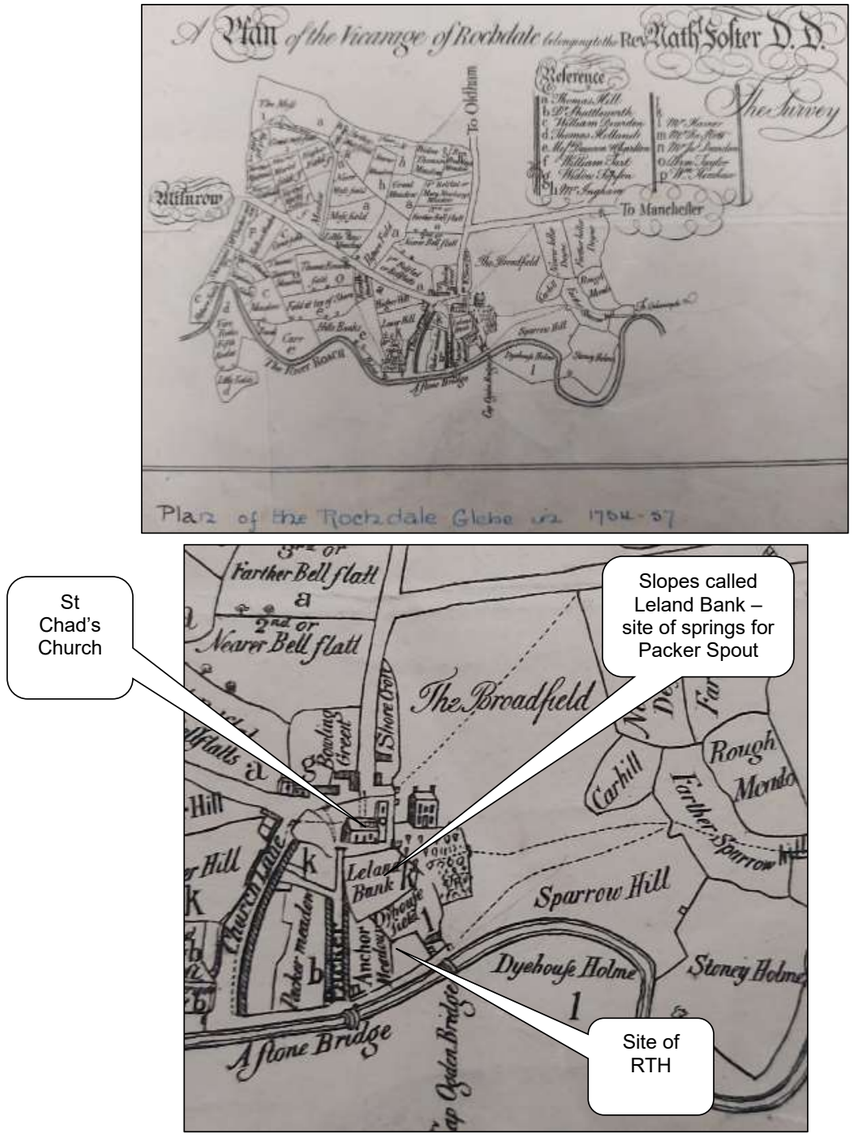
Fig. 2.2.
1754-1757 Rochdale Map Showing Leland Bank – Source of Packer Spout Springs



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
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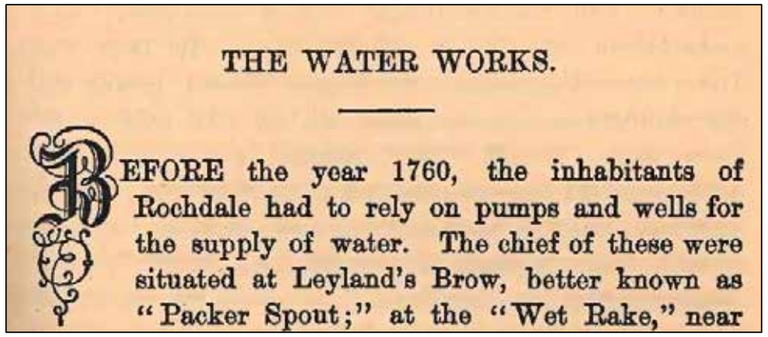
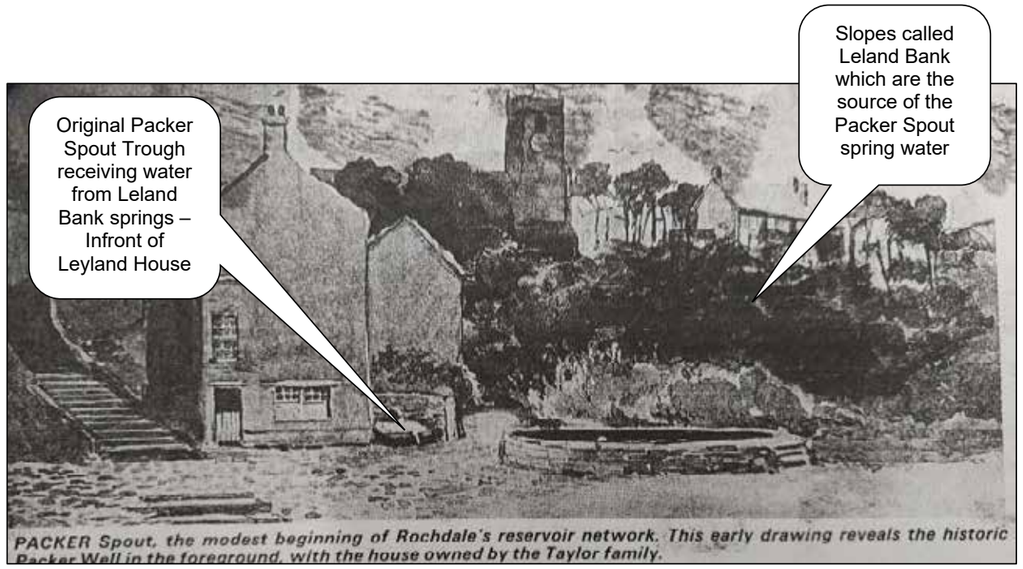
Fig. 2.3.
References to Packer Spout Prior to 1760



THE WATER WORKS.

BEFORE the year 1760, the inhabitants of Rochdale had to rely on pumps and wells for the supply of water. The chief of these were situated at Leyland's Brow, better known as "Packer Spout;" at the "Wet Rake," near



PACKER Spout, the modest beginning of Rochdale's reservoir network. This early drawing reveals the historic Packer Well in the foreground, with the house owned by the Taylor family.

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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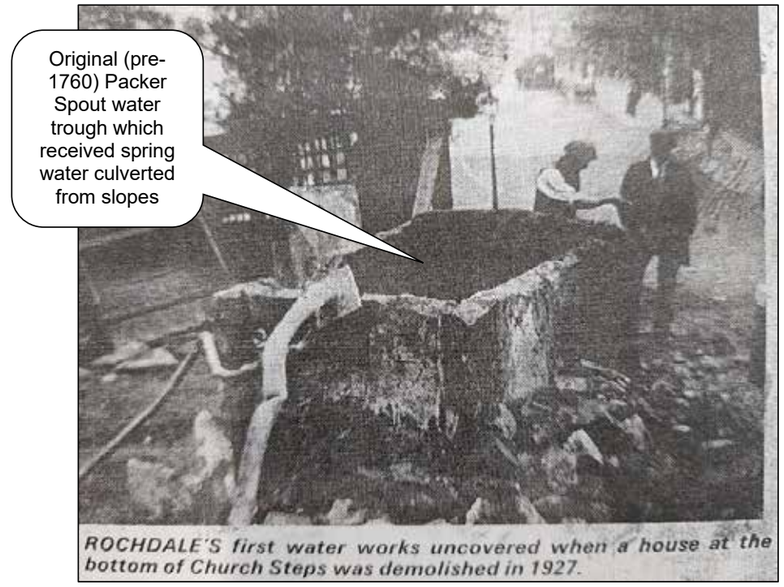
Fig. 2.4.
Original Packer Spout Trough Removed in 1927 when Leyland House was Demolished



ROCHDALE'S first water works uncovered when a house at the bottom of Church Steps was demolished in 1927.

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 2.5.
Main Spring Source Originally would Have had Covered Catchpit (i.e. No Pond)

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 2.6.
Example of How Half Round Culvert Section Would Have Been Covered by Stone Slabs & Round Brick Chamber Sand/Silt Trap Prior to Rectangular Stone Culvert Leading to Trough at Leyland House

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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3.0 1760 Construction of Larger Packer Spout Reservoir

In 1760 a larger stone reservoir was built about 20 m to the west of Leyland House with a capacity of about 70 m^3 (Fig. 3.1 & 3.2).

This required the re-routing of the stone culvert from the brick chamber sand/silt trap, however the rest of the water collection system remained the same.

As shown in Fig. 3.3, the original stone culvert is still in place at the inlet of the reservoir.

The draining of the Packer Spout reservoir in June & July 2022 did not reveal any water outlet pipes near the base of the reservoir.

This raises the possibility that the water outlet for the reservoir could have consisted of a cast iron pipe siphon system in the NE corner of the reservoir (Fig. 3.4).

Most of the siphon pipe system has now been lost due to corrosion. The inlet to the syphon pipe in the reservoir would have had a check valve, and stop valves at the highest point of the siphon pipe and at the outlet would have enabled the priming of the siphon.

The outflow from the siphon pipe (which would have been lower than the level of the inlet pipe in the reservoir) entered a distribution chamber accessible via a manhole cover in the paving at the NE corner of the reservoir (Fig. 3.5). Outlet pipes from the distribution chamber sent water to the streets below in Rochdale.

Once the siphon outlet was primed the whole water distribution system would have operated using gravity with a maximum head of about 7 m of water (10 psi).

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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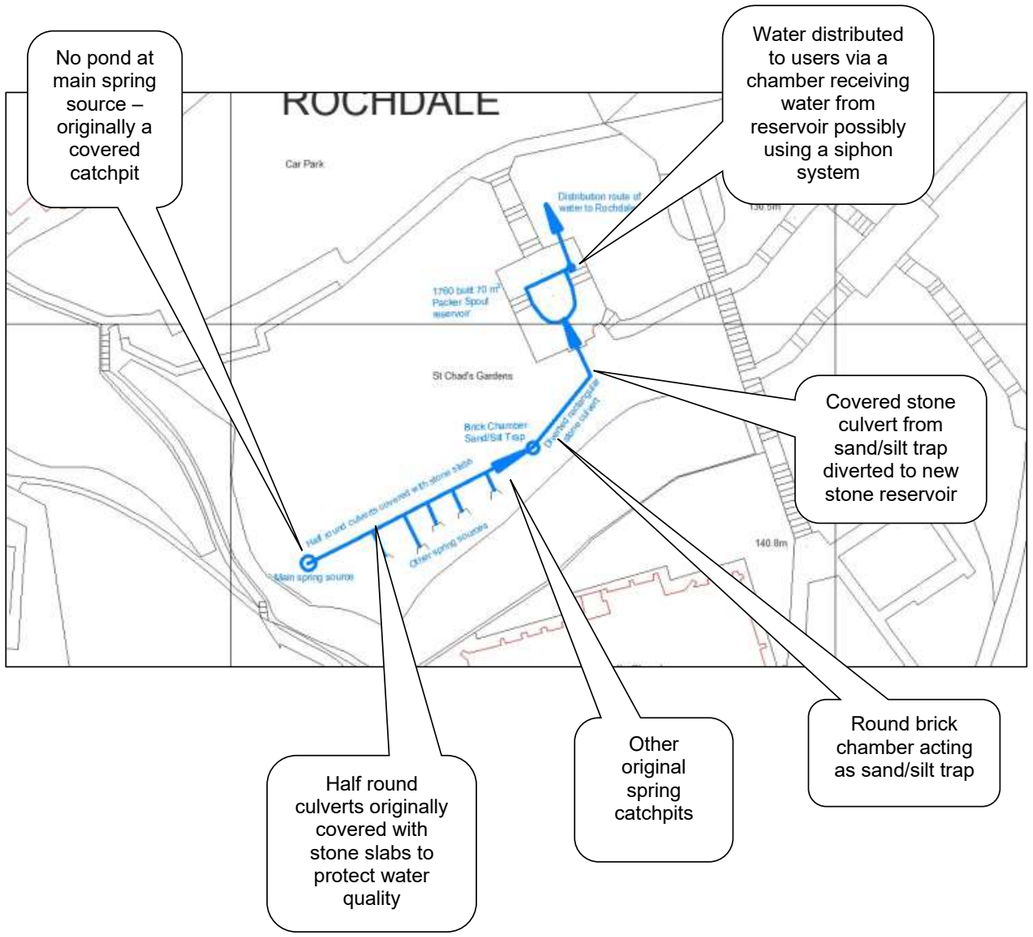
Fig. 3.1.
Packer Spout Arrangement With Larger 1760 Constructed Reservoir



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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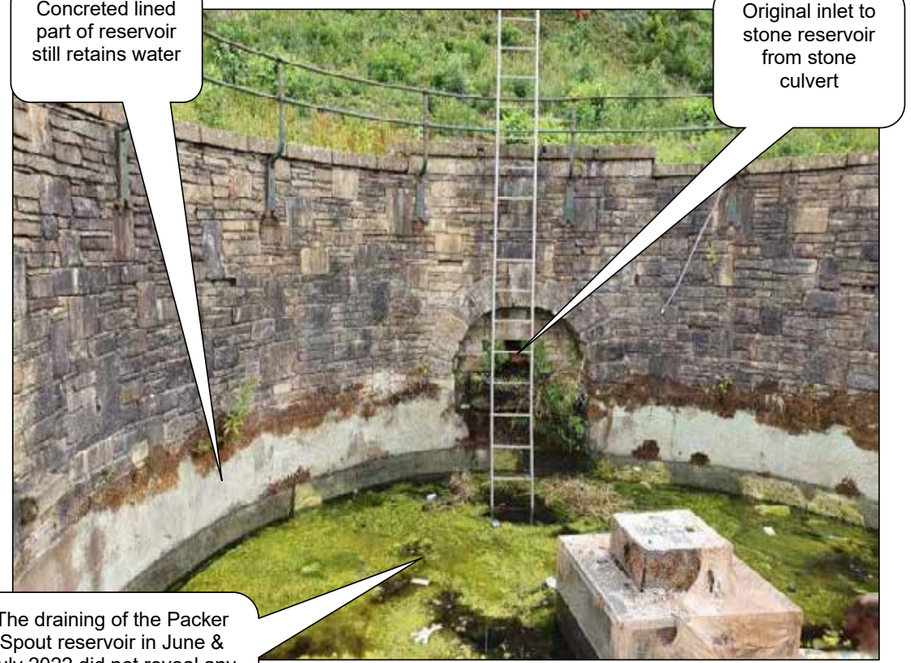
Fig. 3.2.
Larger Reservoir Constructed for Packer Spout in 1760

The first reservoir was constructed about the year 1760, by Messrs. Ralph and Samuel Taylor, and John Clegg. It is situated in Leyland's Brow, near the church steps, 25 feet above the centre of the town. Its low level confined the supply only to the inhabitants who resided in the lower parts of the town. However, its value in giving a supply of water inside the house led to the formation of a Water Works Company, who purchased it for an annuity of £80 per annum; and, in



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 3.3.
Details of Original Water Inlet to 1760 Stone Reservoir

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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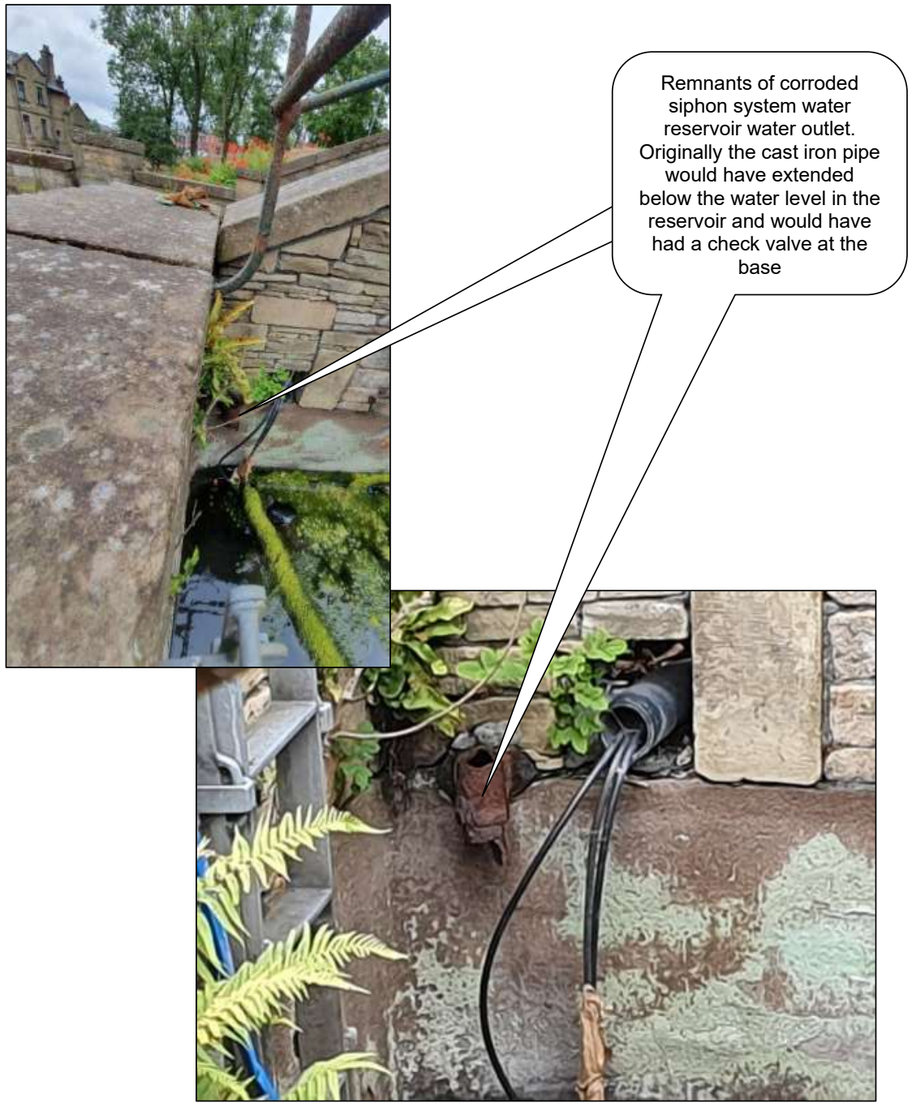
Fig. 3.4.
Details of Probable Original Siphon Water Outlet System for 1760 Stone Reservoir



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 3.5.
Details of Water Distribution Chamber Receiving Water from Siphon Outlet

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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4.0 1764 Construction of Water Supply for Fulling Mill & Dyehouse for the Processing of Woven Wool Fabrics

In 1764 the glebe land on which the Rochdale Town Hall (RTH) now stands was leased by the vicar to John Hamer, and a water supply was constructed to provide water to a fulling mill and dyehouse for the processing of woven woollen cloth (Fig. 4.1).

The fulling process consists of the closing together of the threads of newly woven woollen fabric with the assistance of washing treatments and water powered mallets with the end purpose of producing a grease free cloth of the correct thickness for future use, including dying. The washing process involved the use of a number of different cleaning agents such as fuller's earth and stale urine. After mixing water and the cleaning agents together, the cloth was pounded by water powered fulling stocks or beaters (Fig. 4.1). Consequently, the water supply would have been vital to the fulling mill and dying operations.

The fulling mill water supply system was in operation at the same time as the Packer Spout system, and used different water sources to those supplying drinking water to the Packer Spout reservoir (Fig. 4.2).

The fulling mill water supply was provided by a combination of runoff from St Chad's Church, a lower spring line on the St Chad's Garden slopes and water supplies from the vicarage gardens to the SW (Fig. 4.2).

The water sources were culverted to an underground brick chamber which was probably used to store water and regulate the supply of water to the fulling mill.

Once used in the fulling mill, the water was culverted to the River Roach via the low lying glebe land on which the RTH was built.

The 1851 town map shows that the components of the fulling mill water supply were still in existence and where still channelling water to the River Roch (Fig. 4.3).

The stone culvert from St Chad's Church to the underground brick chamber still exists, however it has been covered with soil for part of its length and is blocked (Fig. 4.4).

The underground brick chamber still exists (Fig. 4.5), however the culverts which supplied spring water from the west and the east have become blocked (Fig. 4.6). As a result of this the lower spring line in St Chad's Garden is no longer drained and is a permanent bog.

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 4.1.
Extract from Book *Reminiscences of Rochdale* - 1764 Lease of Glebe Land Including Supply of Water for a Fulling Mill & Dyehouse & Example of a Water Powered Fulling Mill

the lease of the "House in the Wood" and adjoining land, dated 30th July, 1764. The house and its land represent the site of the present Town Hall. The lease, granted to John Hamer, Junr., a wealthy attorney, reveals the fact that this first Vicarage Act of 1764 only cost £150 to obtain! By the lease the Vicar let to John Hamer "The ancient messuage (then divided into several cottages) called 'The Wood' and the ancient dyehouse and the close of land called The Holme and Dyehouse Meadow and the use of the water which arises from the spring in Leylands Brow and from the spring in the basin in the Vicarage garden—and the Vicar reserves power to make a goit or tunnel under the road (now the Esplanadè) running along the south side of the River Roche. . . . for the purpose of conveying water from a fulling mill to be erected in a part of the glebe land then in possession of John Smith."

It may be here remarked that descendants of this same John Smith inter-married with the Royds, Entwisle, Newall and Walmsley families, that the fulling mill was the mill known in my childhood as "Bottom o' th' Lane Mill," and then occupied by Ogden Halliwell, and

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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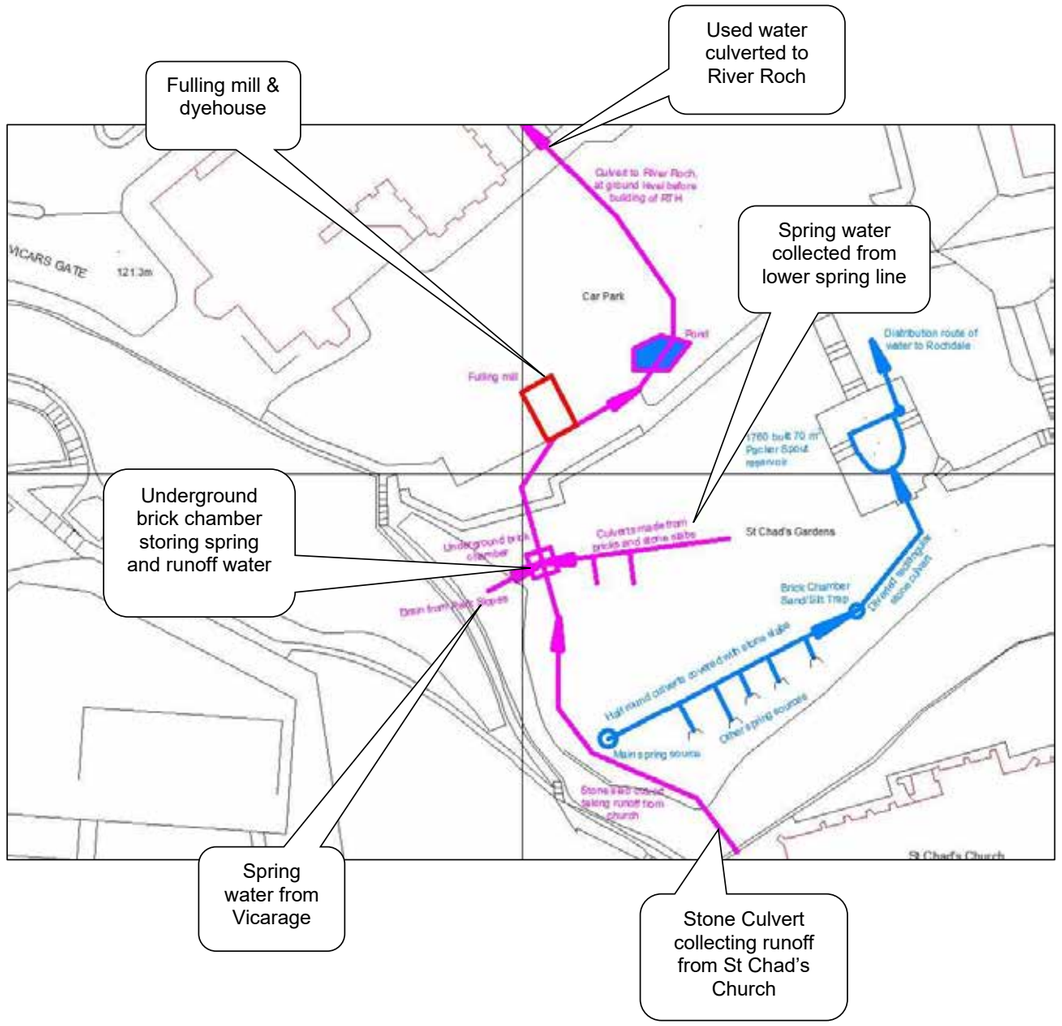
Fig. 4.2.
1764 Water Supply for Fulling Mill and Dyehouse (Purple Lines)
(Operating at Same Time as Packer Spout Drinking Water Supply)



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Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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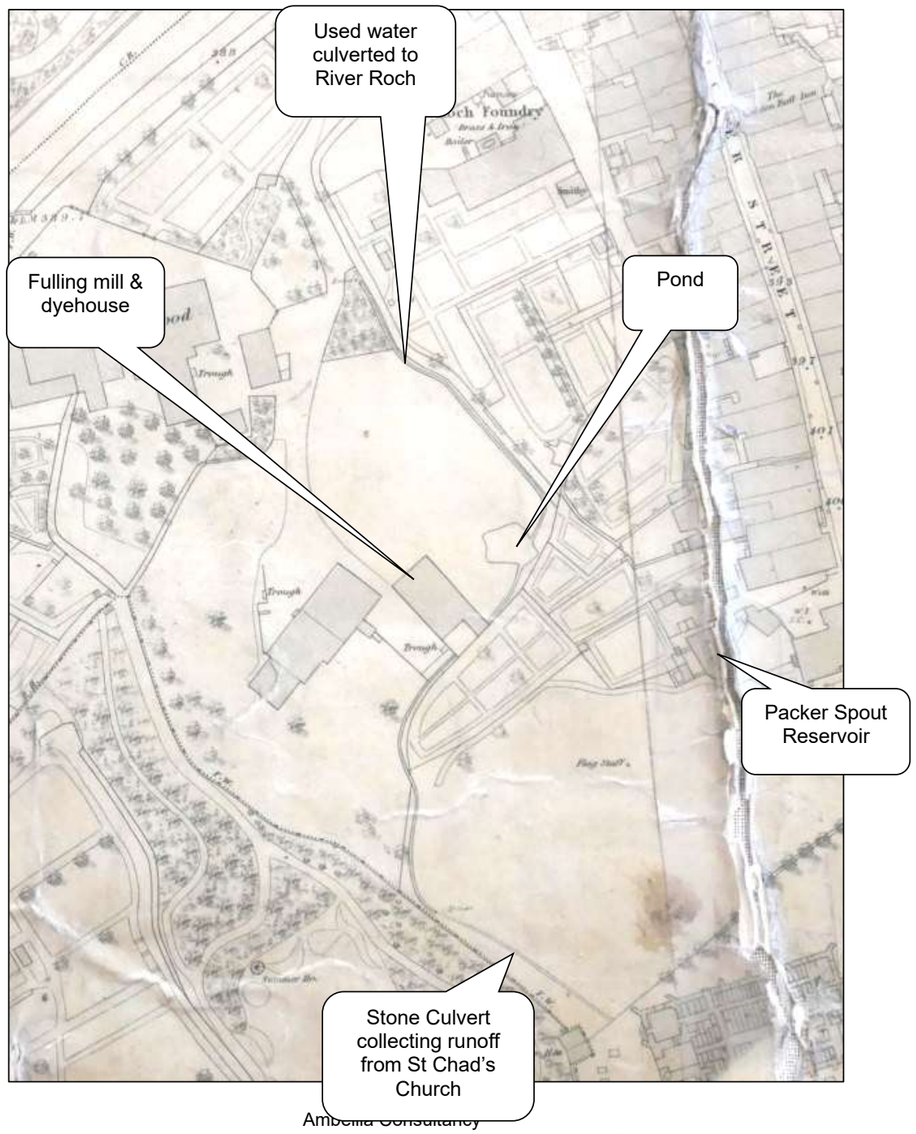
Fig. 4.3.
Extract from 1851 Town Map Showing Details of 1764 Water Supply
for Fulling Mill and Dyehouse



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
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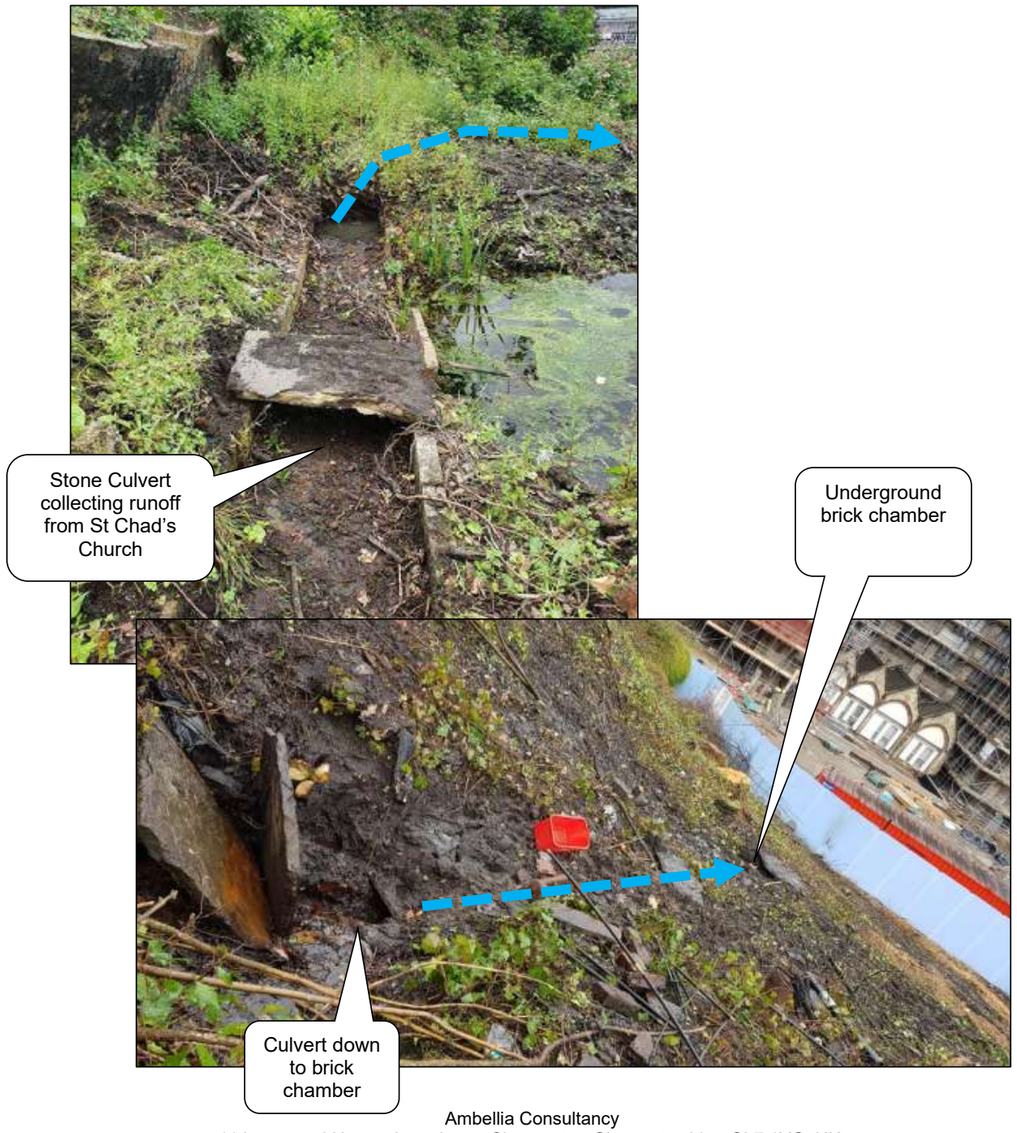
Fig. 4.4.
Details of Stone Culvert Leading from St Chad's Church to Underground Brick Chamber



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Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
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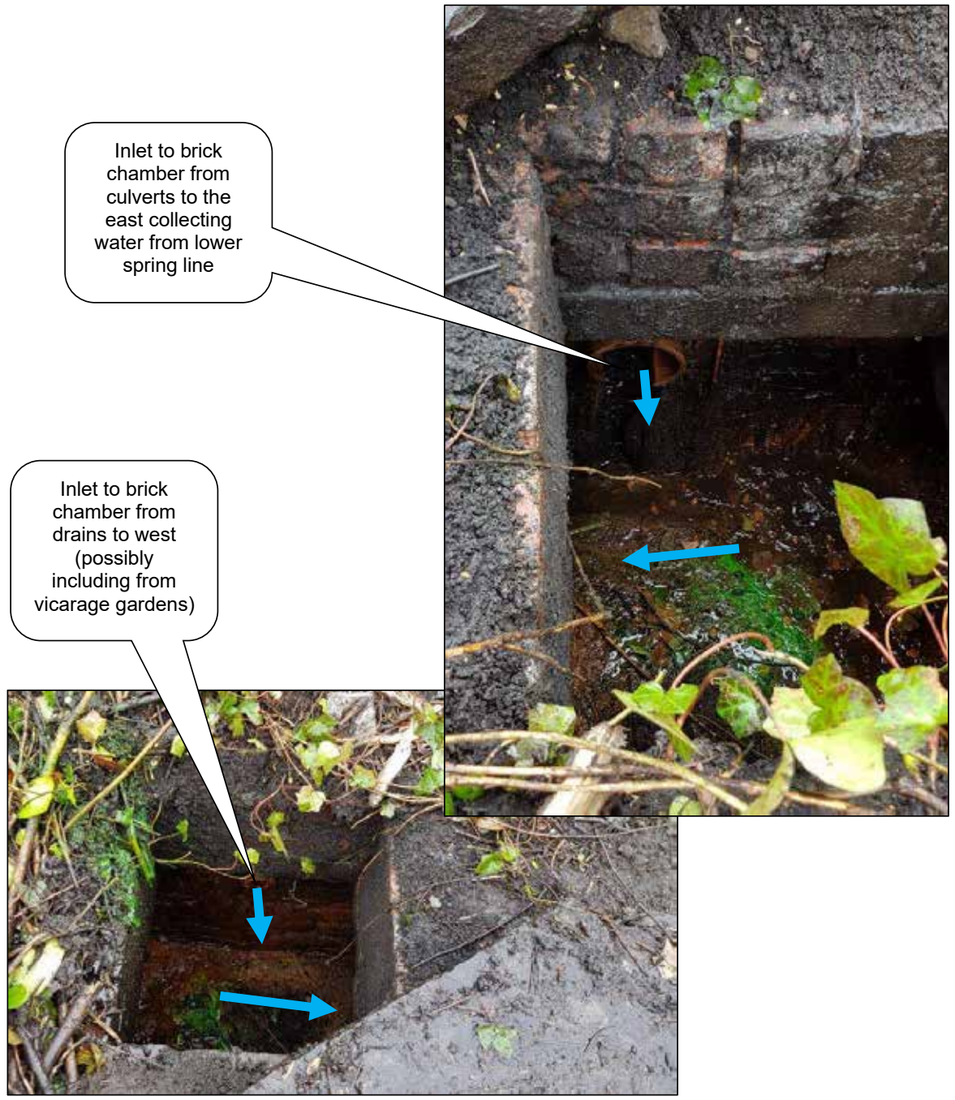
Fig. 4.5.
Details of Underground Brick Chamber with Drain Inlets to the West & East



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Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
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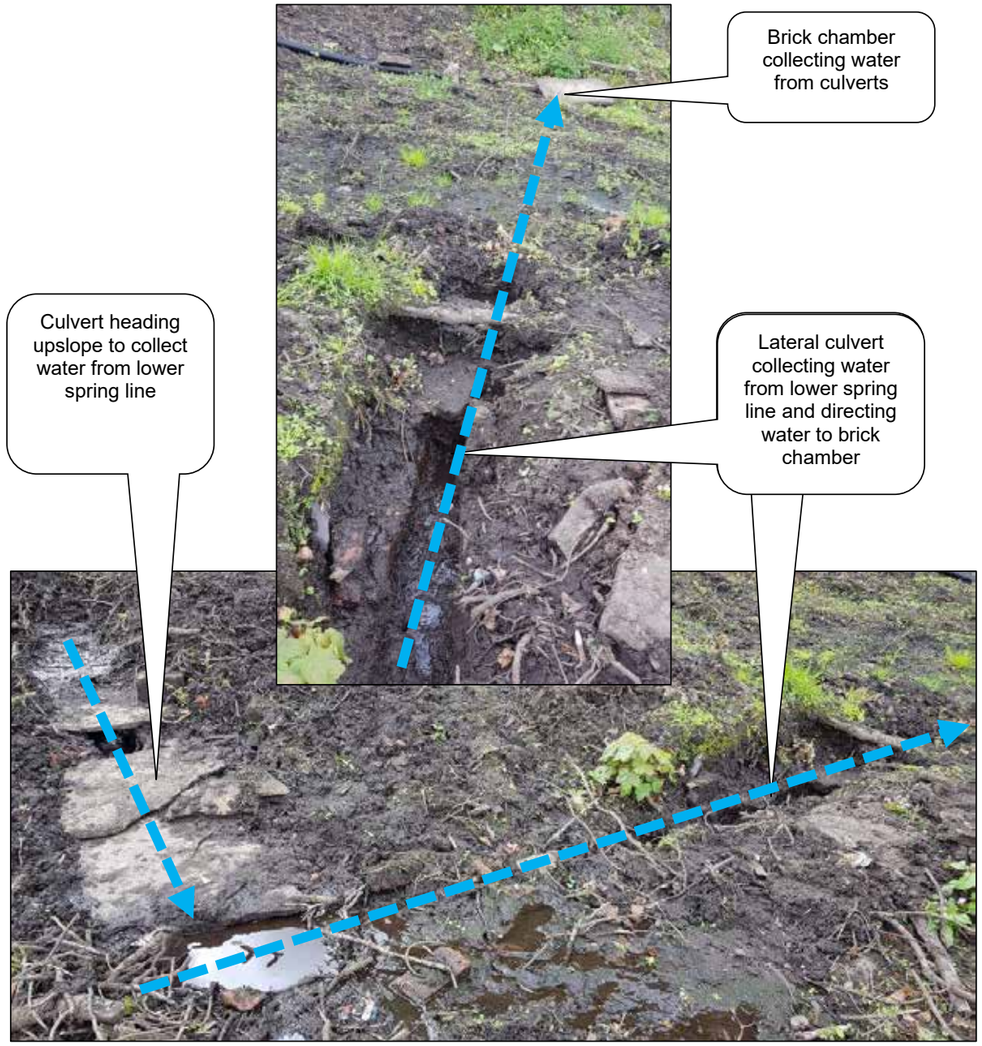
Fig. 4.6.
Details of Culverts Collecting Water from Lower Spring Line and Channelling it to Underground Brick Chamber



5.0 Changes to the Two Water Supply Systems Following Construction of the Rochdale Town Hall and the Central Corn Mill

In 1864 the glebe land including the Dyehouse Field, Anchor Meadow and the Wood Villa was purchased to build Rochdale Town Hall and the fulling mill is demolished.

By 1871 the construction of Rochdale Town Hall was completed (Fig. 5.1).

Also, in the early 1870's, a water powered central corn mill was built immediately to the north of the Packer Spout reservoir using it as water source to power water turbine (Figs. 5.2, 5.3 & 5.4).

The construction of the Rochdale Town Hall involved raising the ground level round the Town Hall by 4 m (Fig. 5.5).

It is probable that a second smaller water powered mill was built over the brick chamber of the fulling mill water supply (Fig. 5.5).

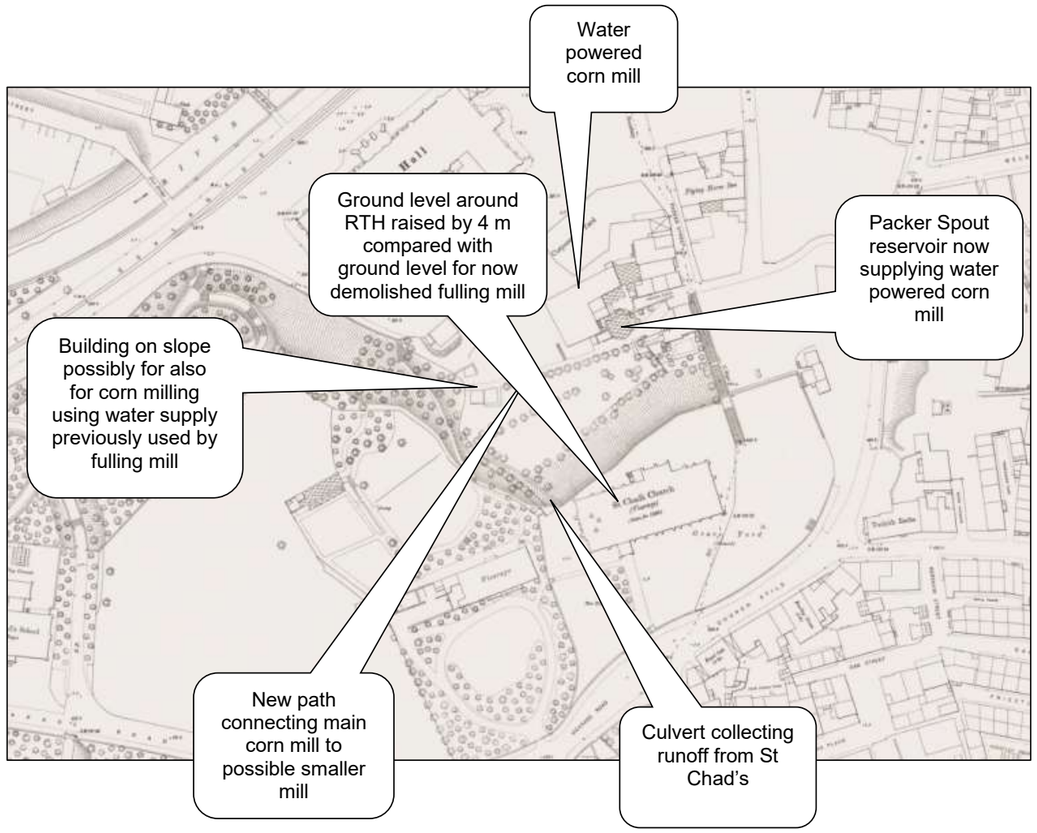
The changes to the use and routing of the Packer Spout and fulling mill water sources are summarised in Fig. 5.6.

The access chamber in Fig. 5.7 was probably for the culvert taking water away from the water turbine in the basement of the central corn mill to the River Roch via the eastern side of RTH.

A new 6" pipe was installed to take the fulling mill water supply to the River Roach via the western side of RTH (Fig. 5.8)

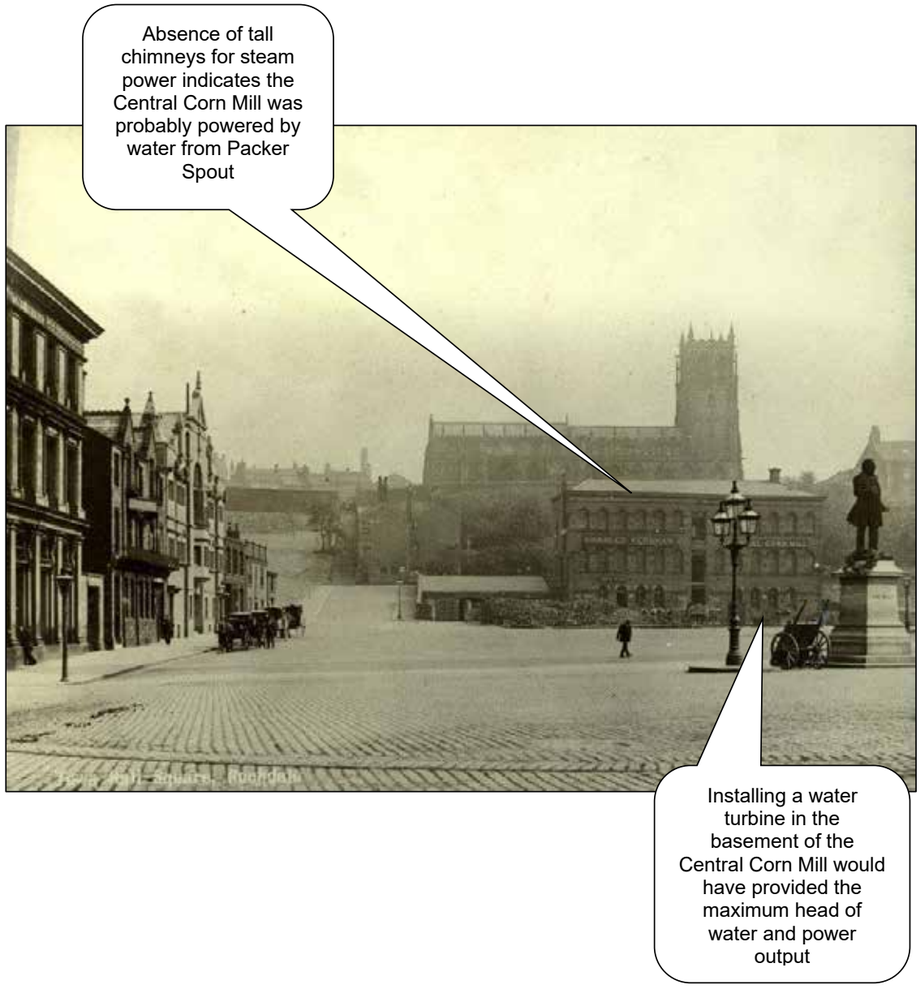
The *1876 As Built RTH Drainage and Sewers Plan* (Fig. 5.9) gives details of 2 deep manholes (which both go down to the original pre RTH ground level) which were probably parts of the new routes of Packer Spout and Old Fulling Mill water sources to the River Roch.

Figure 5.1
1910 Rochdale OS Town Map Following Construction of RTH and Central Corn Mill



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 5.2.
Photo of Water Powered Central Corn Mill



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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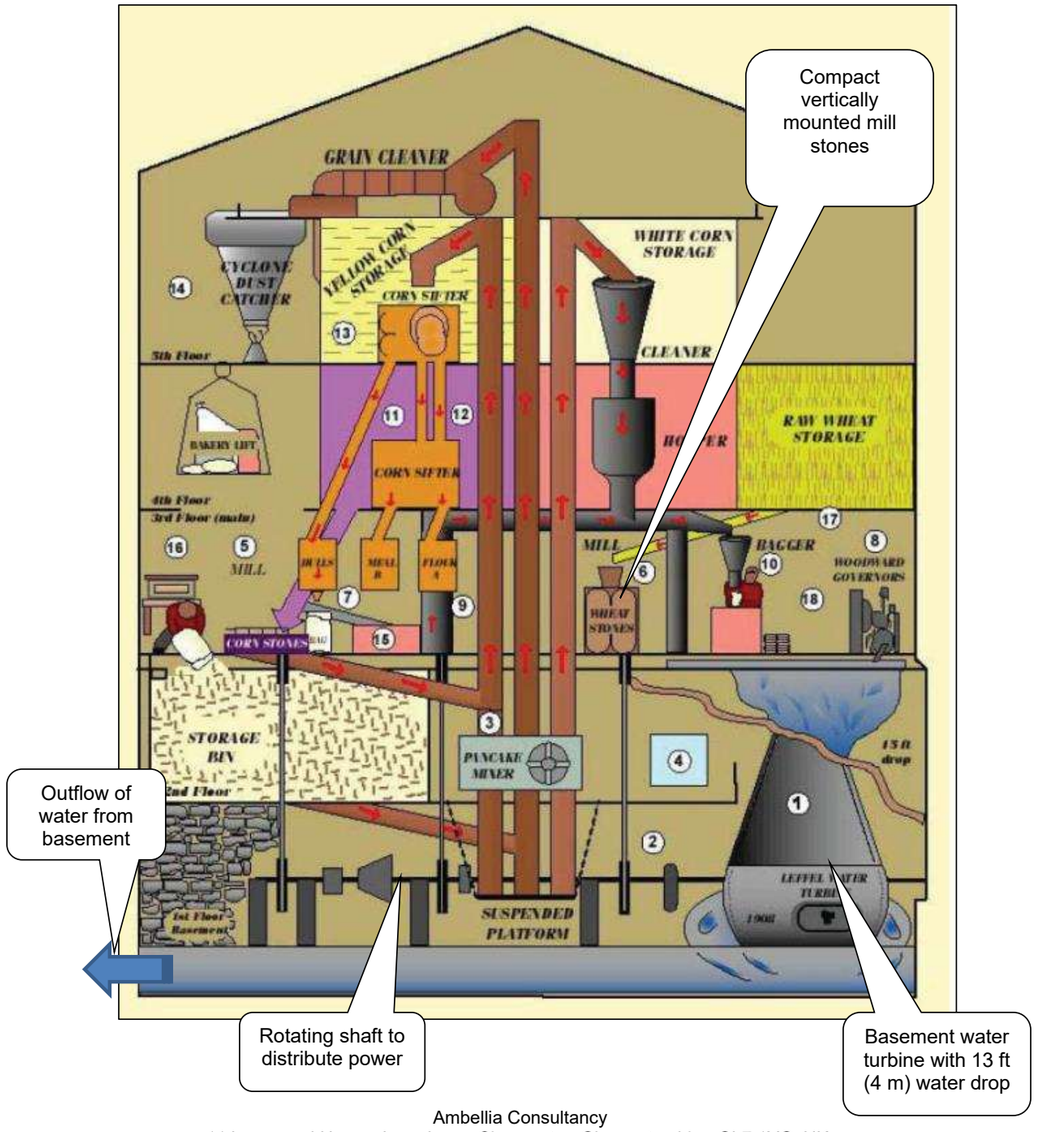
Figure 5.3
Example Layout of 1880s Corn Mill with Water Turbine in Basement



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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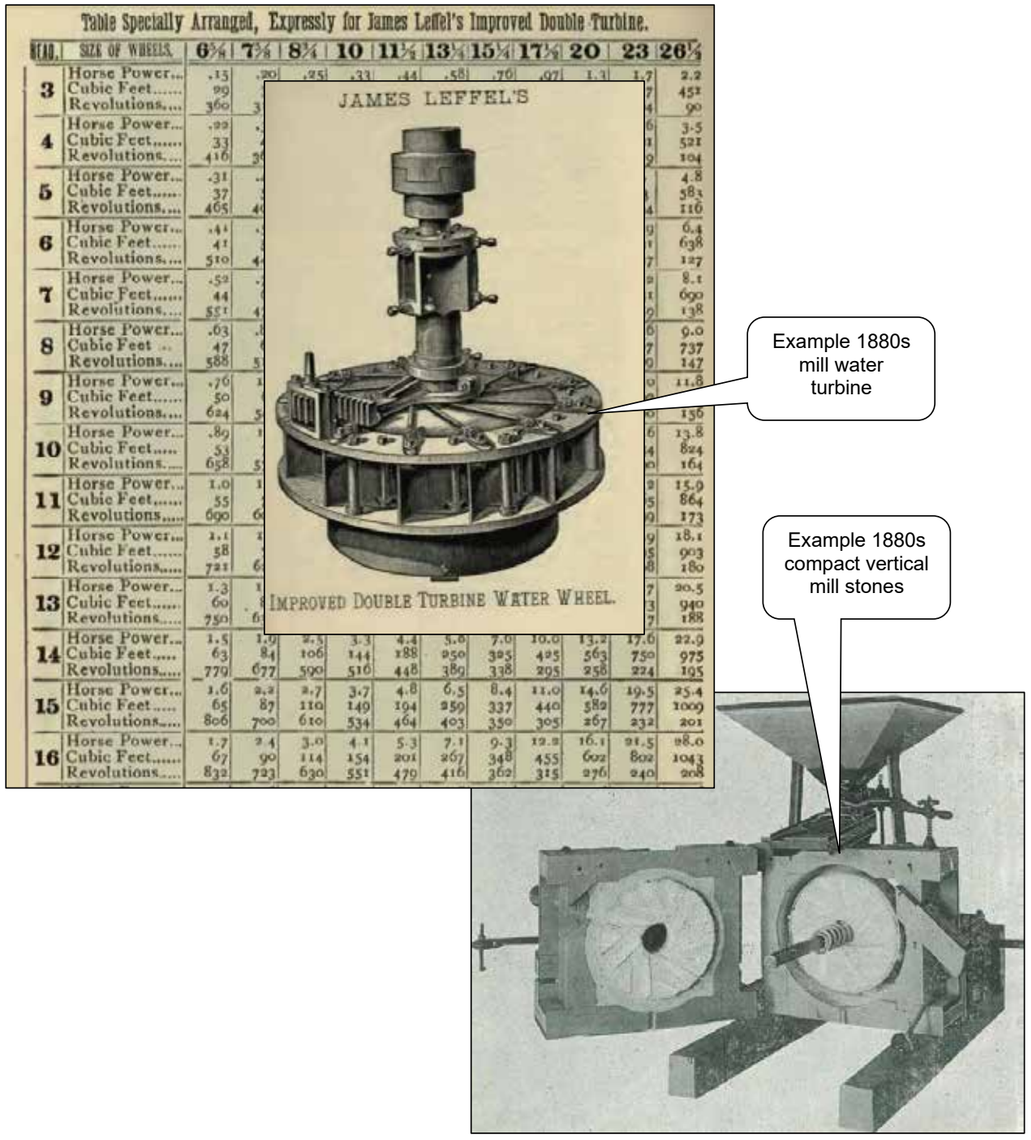
Figure 5.4
Details of 1880s Water Turbines and Compact Vertical Mill Stones



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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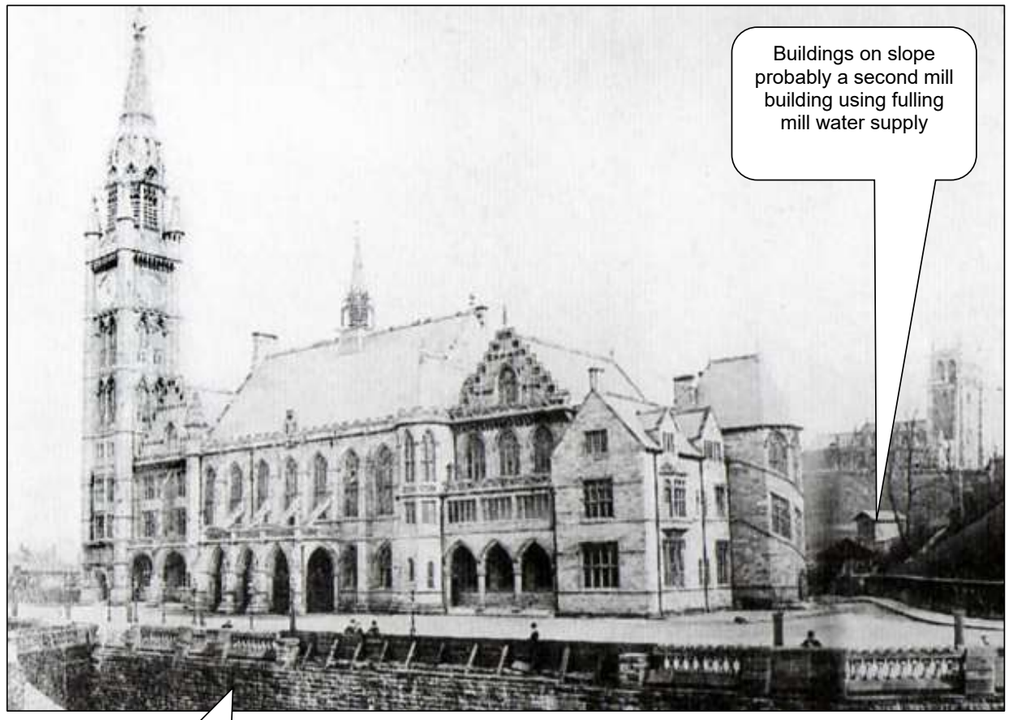
Figure 5.5
1874 Photo of Rochdale Town Hall Showing Possible Second Mill
(3 Years after Opening in 1871)



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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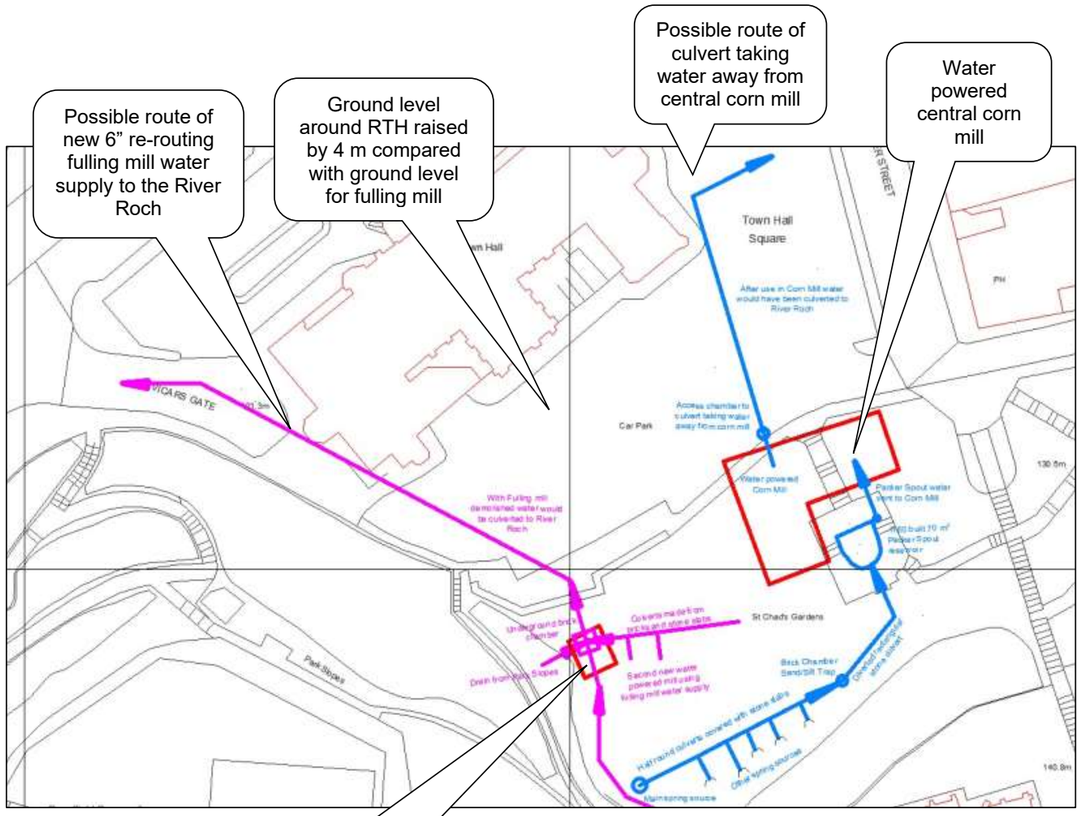
Fig. 5.6
Plan Showing Changes to the Two water Supply Systems Following Construction of Rochdale Town Hall, the Central Corn Mill and Possible Second Mill



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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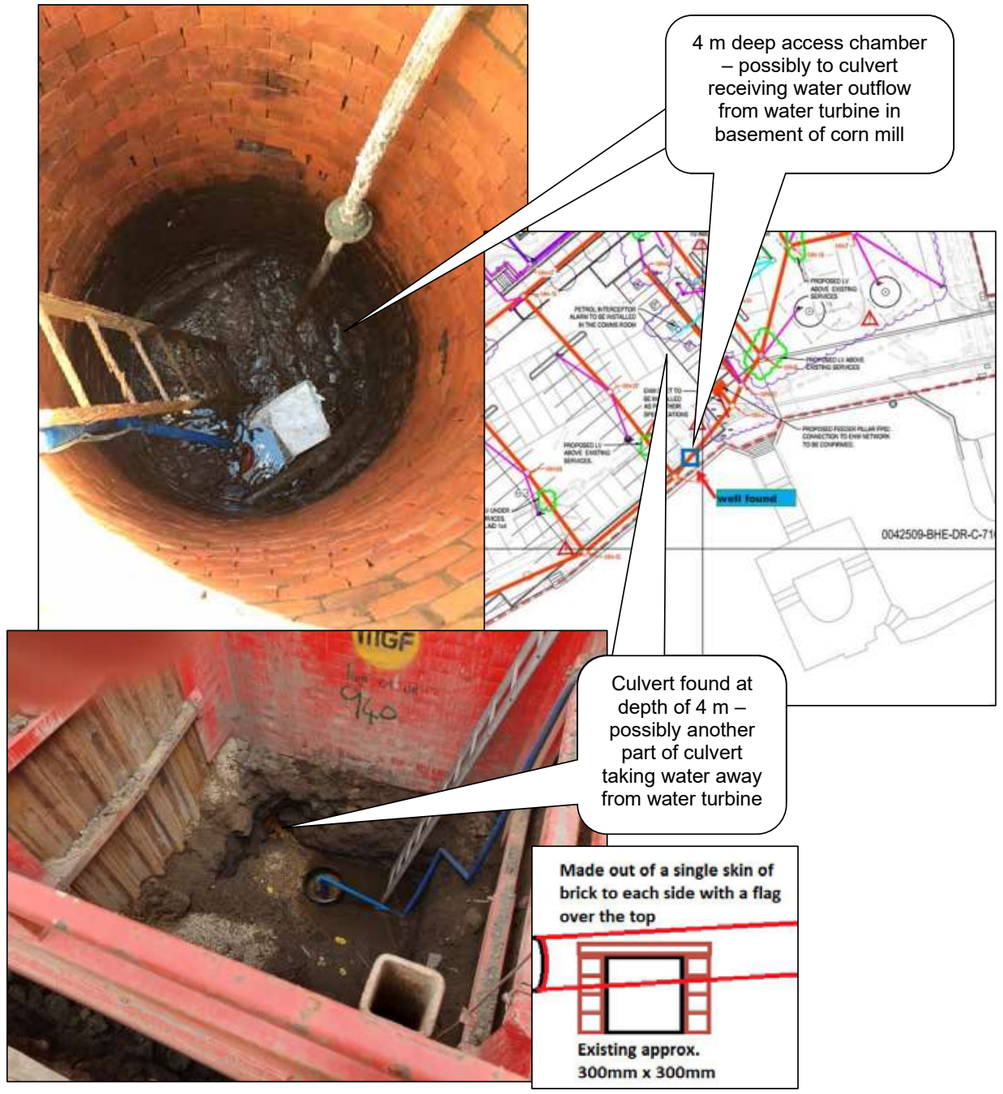
Figure 5.7
Possible Access Chamber to Culvert Taking Water Away from Basement Level Water Turbine in the Central Corn Mill



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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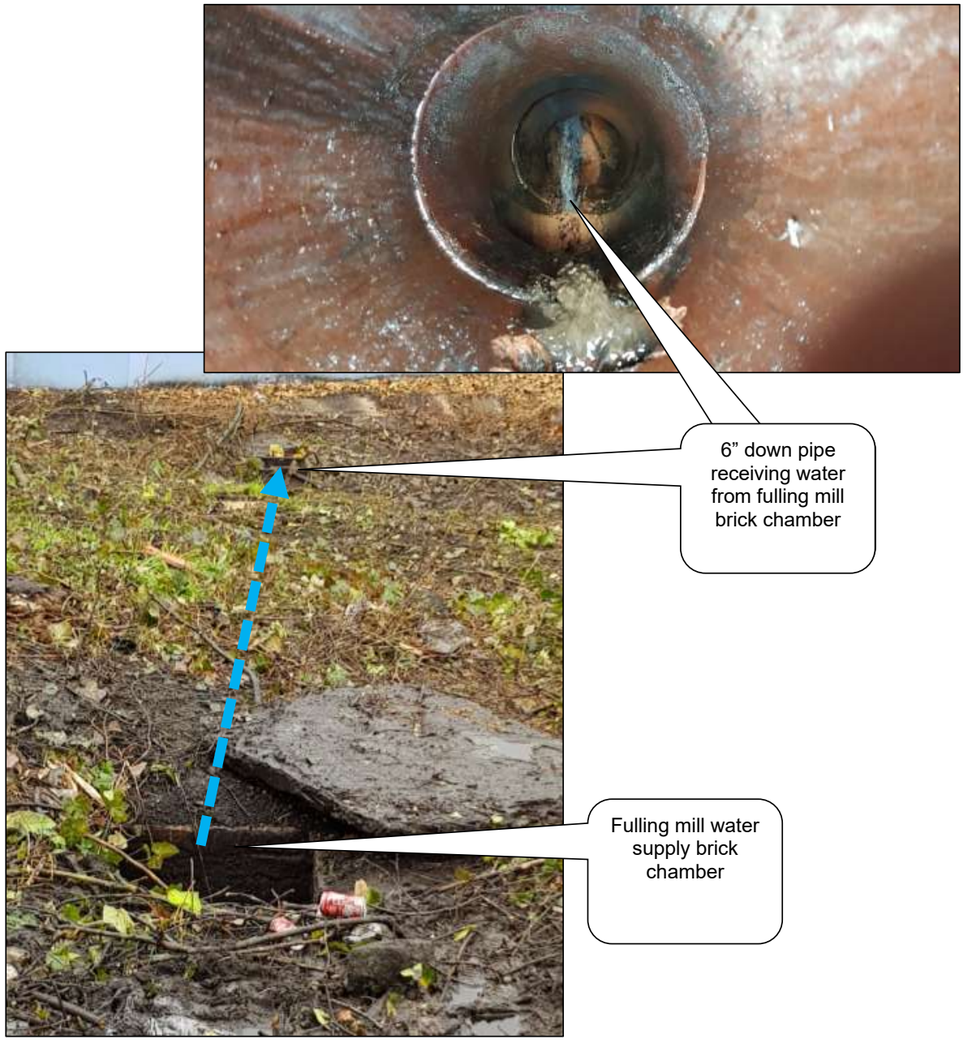
Figure 5.8
New 62 Pipe Re-Routing Fulling Mill Water Supply to the River Roch



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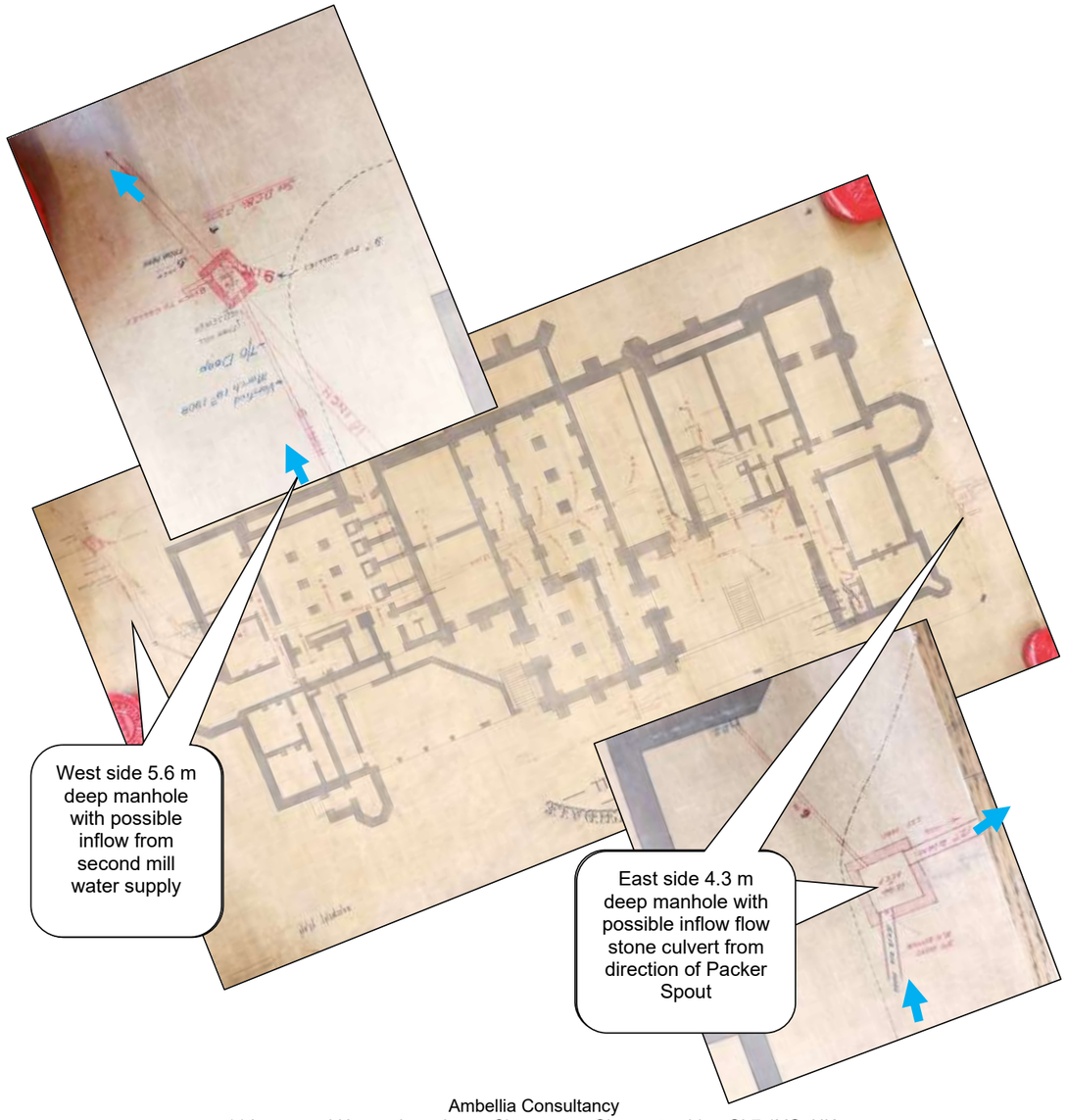
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 5.9
1876 As Built RTH Drainage & Sewers Plan Showing Parts of Routes of Packer Spout and Old Fulling Mill Water Sources to the River Roch



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

6.0 Changes to the Two Water Supply Systems Following the Demolition of the Central Corn Mill and Prior to Current RTH Restoration

When the Central Corn Mill (and other smaller mill building) were demolished in 1934, there was no longer any industrial need for both the Packer Spout and fulling mill water supply systems. As a result, the slopes to the south of RTH were redeveloped as municipal gardens (Figs.6.1).

The changes to the two water supply systems are summarised in the plan in Fig. 6.2. Unfortunately, this redevelopment resulted in significant damage to the slopes drainage.

With respect to the Packer Spout water supply system, at the main spring source the catchpit was removed and a pond created. The stone slab covers were also removed from the half-round culverts (Fig. 6.3). This allowed sand and plant debris to enter the culverts resulting in blockages and overflowing of the culverts. Packer Spout spring water supply drains appear on post 1930's OS maps because they are now visible due to the removal of the stone slab covers

Other spring catchpits were broken or covered with soil and the half-round culverts from those catchpits had the cover slabs removed, black plastic perforated pipes installed and were covered with soil, all resulting in impeded drainage (Fig. 6.4).

Water flow was diverted away from, and to the east of the Packer Spout reservoir (via a concrete ring chamber silt trap) enroute to cascades using 10 cm diameter plastic pipe which is easily blocked (Figs. 6.5, 6.6 & 6.7). The drain holes at base of upper cascade take water to Packer Street Drains, however dye tracing has indicated that the water is also leaking to old culverts near RTH basement.

Concerning the fulling mill water supply, the stone culvert leading from St Chad's Church to the underground brick chamber was covered with soil and blocked, resulting in the runoff water entering the Packer Spout culverts and not reaching the underground brick chamber (Fig. 6.8).

The downslope and lateral culverts collecting water from the lower spring line and channelling it to the underground brick chamber were also covered with soil and consequently blocked, resulting in permanently boggy ground along (Fig. 6.9).

To compensate for the impeded drainage, a field drain was installed at the base of the slope to the west of the Packer Spout reservoir to collect runoff and send it to the top of down pipe which receives water From underground brick chamber (Fig. 6.10).

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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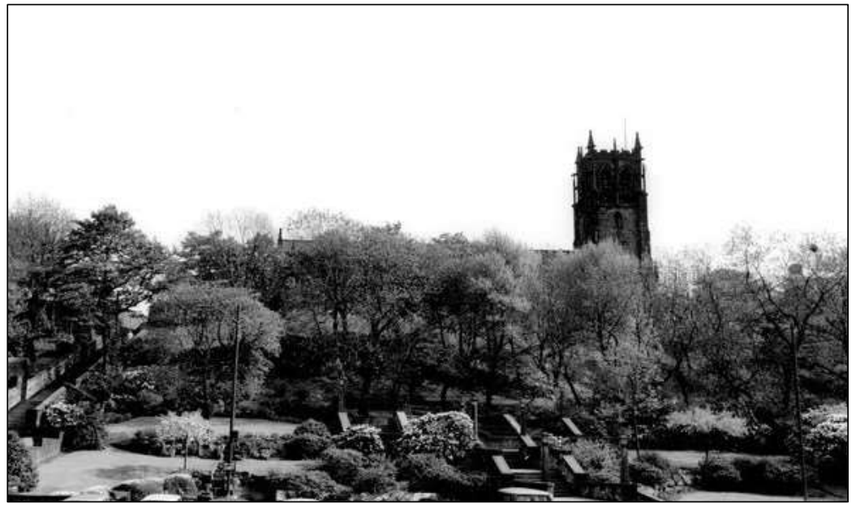
Fig. 6.1
Photos of Conversion of Slopes to Landscaped Gardens after Demolition of Mill Buildings



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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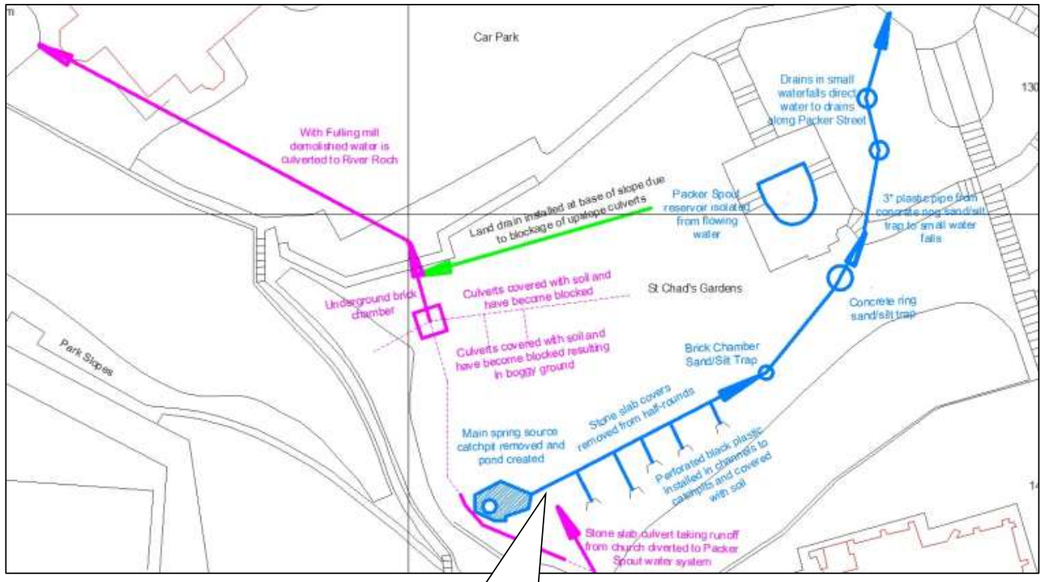
Figure 6.2
Summary of Changes to Slopes Water Supply Systems and Drainage Following Demolition of Central Corn Mill in 1934



Packer Spout spring water supply drains appear on post 1930's OS maps because they are now visible due to the removal of the stone slab covers

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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 6.3
At Main Spring Source for Packer Spout the Spring Catchpit was Removed and Pond Created - Stone Slab Covers Removed from Half-Round Culverts

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Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Figure 6.4
Packer Spout Top Spring Line Catchpits Broken or Covered With Soil – Half-Round Culverts from Catchpits Have Cover Slabs Removed, Black Plastic Perforated Pipes installed and Are Covered with Soil Resulting In Impeded Drainage

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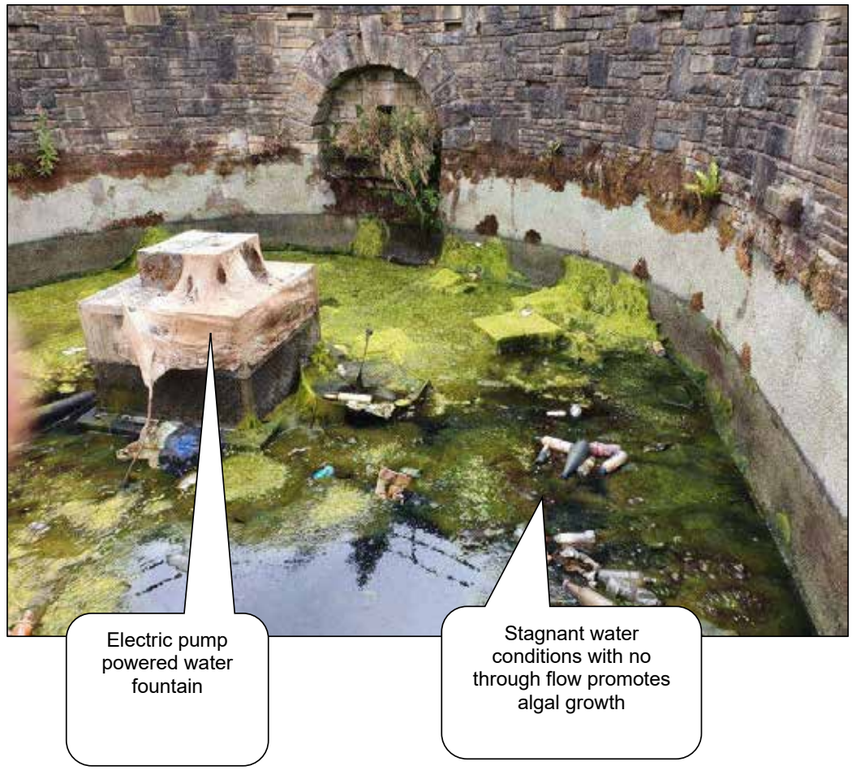
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 6.5
Packer Spout Reservoir No Longer Has Water Flowing Into It – Spring Water Diverted to the East to the Water Falls/Cascades



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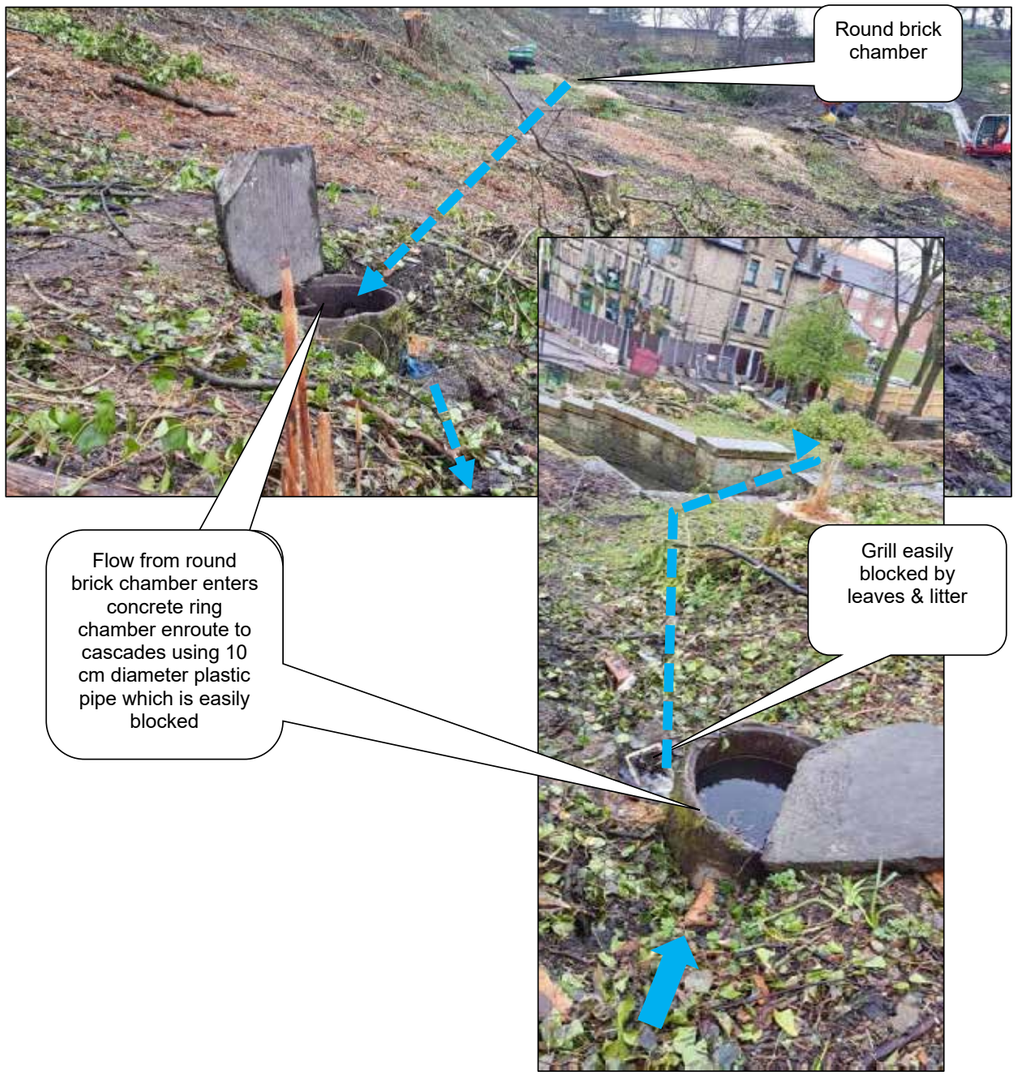
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 6.6
Water Flow Diverted to East of Packer Spout Reservoir
Flow from Round Brick Chamber enters Concrete Ring Chamber Silt Trap Enroute to Cascades Using 10 cm Diameter Plastic Pipe Which is Easily Blocked



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Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 6.7
Location of Drains at Base of Upper & Lower Cascades Taking Water to Packer Street Drains – Water From Cascades Known to be Leaking Water to Old Culverts near RTH Basement as Shown by Dye Tests

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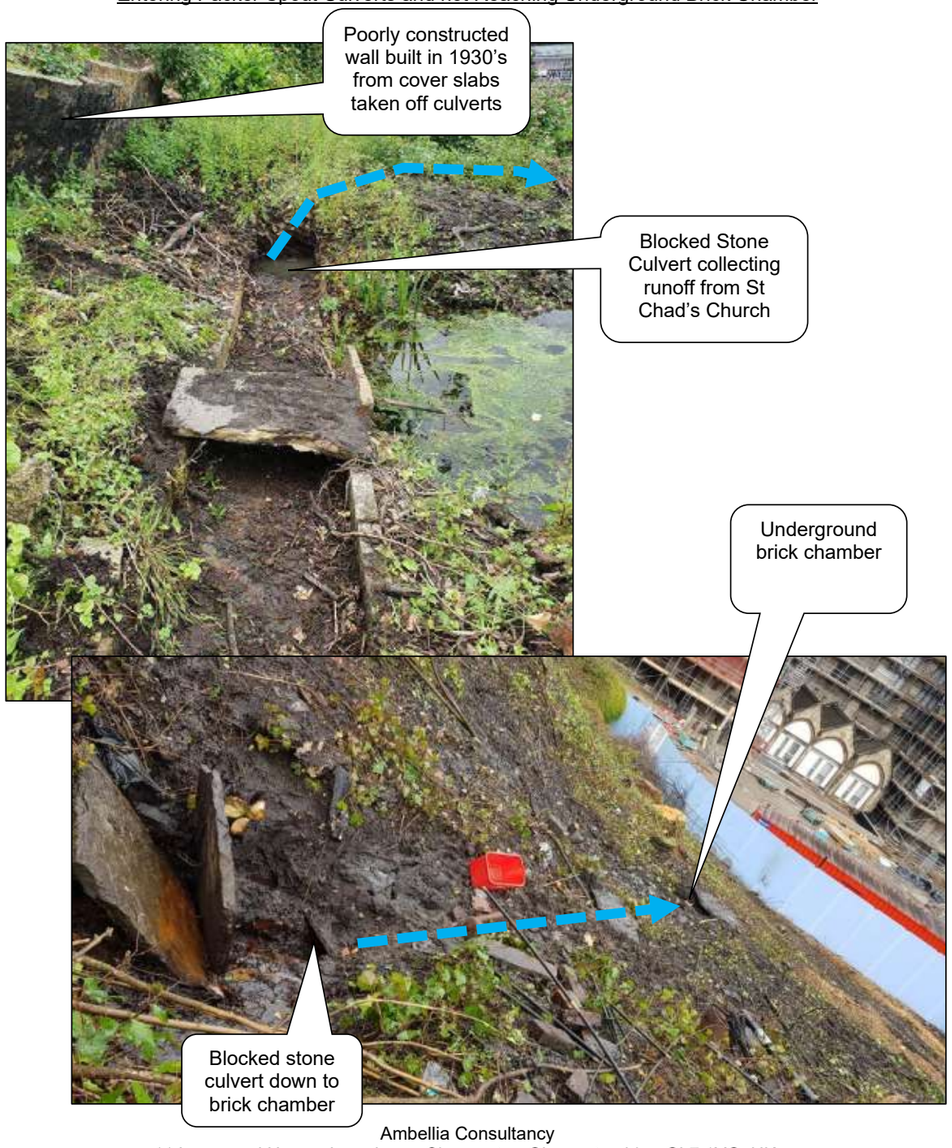
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 6.8.
Stone Culvert Leading from St Chad's Church to Underground Brick Chamber Covered with Soil and Blocked Resulting in Water Entering Packer Spout Culverts and not Reaching Underground Brick Chamber



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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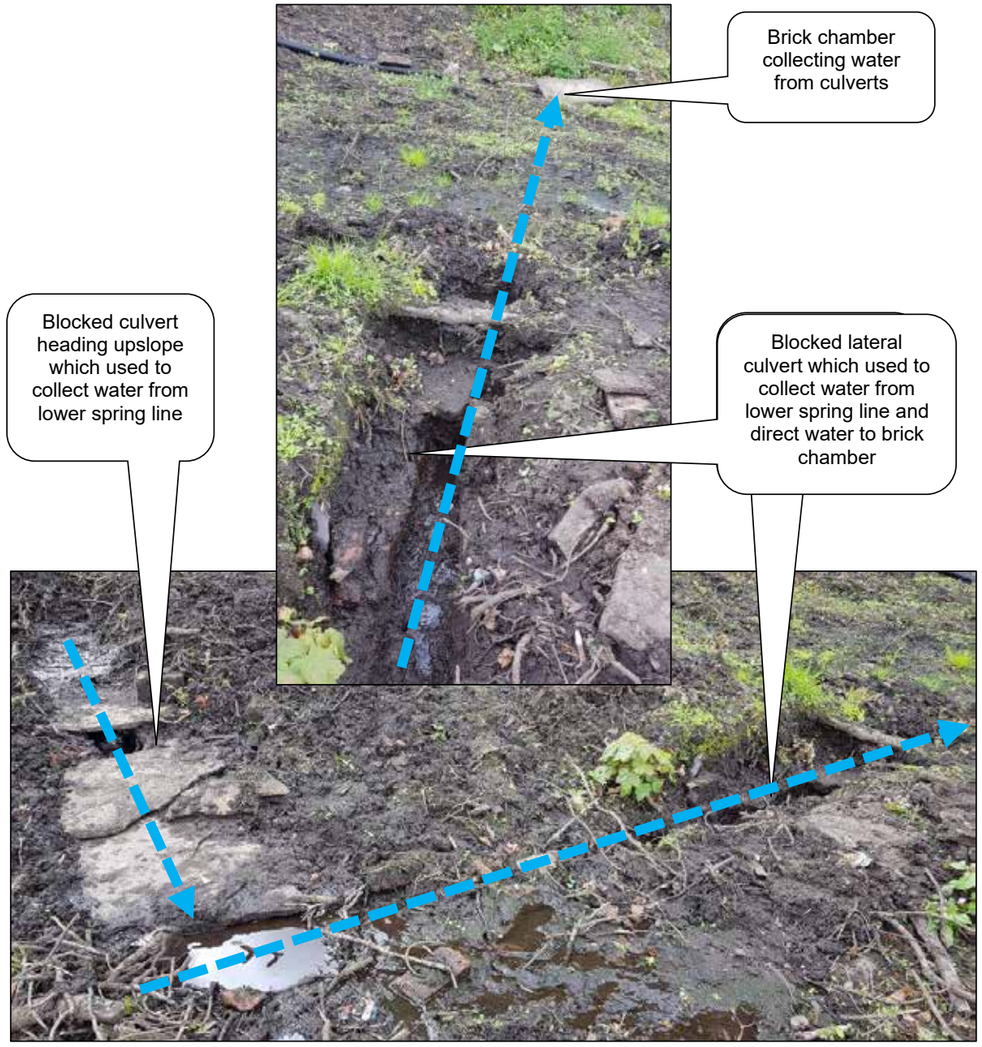
Fig. 6.9.
Culverts Collecting Water from Lower Spring Line and Channelling it to Underground Brick Chamber Covered with Soil and Blocked



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 6.10
Field Drain Installed at Base of Slope to West of Packer Spout Reservoir to Collect Runoff – Field Drain Enters top of Down Pipe which Receives Water From Underground Brick Chamber

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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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7.0 Impact of March/April 2022 Tree Clearance on Slope Drainage

As part of the RTH Slopes Project, trees clearance was undertaken in March and April 2022.

The slopes tree clearance caused some unavoidable problems with the existing slopes drainage, primarily due to the exposure of the unvegetated slopes resulting in the mobilisation of silt.

The trench of gravel of the field drain at the base of the slope became blocked with silt resulting in water flowing over the top of the field drain and over the retaining wall (Fig. 7.1).

The gravel of the field drain became rapidly blocked with silt due to the absence of a geotextile membrane above the top of the gravel layer which would have prevented the silt ingress. As a result of the blockage of the field drain, no water was flowing along the black perforated pipe within the field drain (Fig. 7.1).

Yellow perforated filed drain pipes leading down to the base of slope field drain were also broken during the slopes clearance which would have resulted in more drainage problems and more silt laden surface runoff blocking the field drain at the base of the slope (Fig. 7.2).

Silt and shredded wood also accumulated in the half-round surface drainage pipes at the top of the slopes, causing blockage of the buried pipes leading to the water cascades, which resulted in surface flow towards the RTH (Fig. 7.3).

To prevent the surface runoff reaching RTH and causing problems with work on the area surrounding RTH, remedial action had to be taken on the slopes drainage in April 2022 as described in Section 8.

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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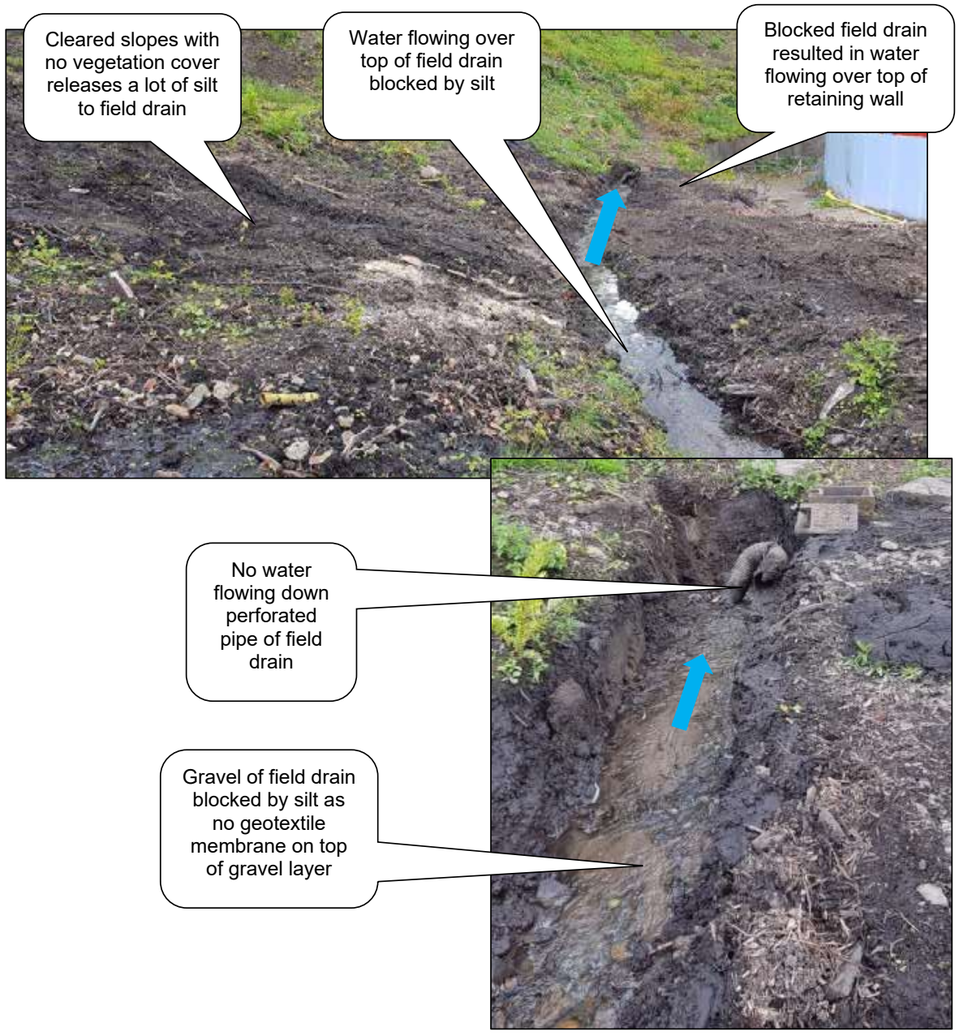
Fig. 7.1
Blocked Field Drain at Base of Slope –
(Due to Silt Generated by Slope Clearance & Absence of Geotextile Membrane at Top of Field Drain)



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 7.2
Broken Yellow Field Drain Pipes above Field Drain at Base of Slope

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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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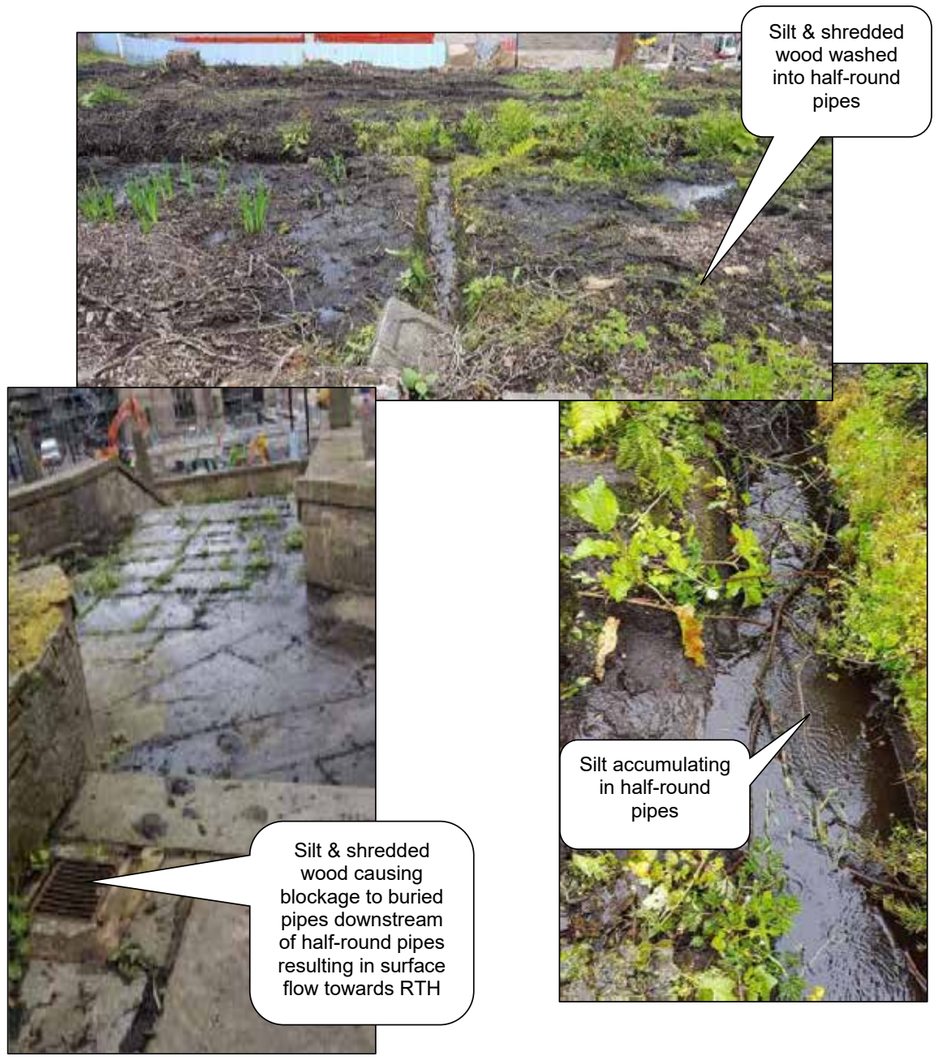
Fig. 7.3
Silt and Shredded Wood Washed into Top Slope Half Round Pipes Causing
Blockage of Downstream Buried Pipes Resulting in Surface Flow Towards RTH



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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8.0 Remedial Action on Slope Drainage to Prevent Surface Runoff Reaching RTH

As discussed in Section 7, the March/April 2022 slopes tree clearance caused problems with the existing slopes drainage primarily due to the exposure of the unvegetated slopes resulting in the mobilisation of silt.

The remedial actions taken to help prevent runoff reaching the level ground to the south of RTH are listed below.

It is emphasised that these remedial actions are only intended to be short term, prior to the redesign of the slopes' drainage.

New drainage should be installed as soon as possible to control water flows and the accumulation of silt.

The outfall of the blocked field drain at the base of slope was excavated so that water can now flow directly into the drains connected to the new RTH drains (Fig. 8.1).

The trench connected to the field drain at the base of the slope was extended to the east to intercept surface runoff from higher up the slopes which may occur due to, for example, storms and blocked pipes leading to the cascades (Fig. 8.2).

The pond below the vicarage gardens was deepened and widened to retain more water and the pond outfall was directed (using a temporary surface black plastic pipe) to the brick chamber on the eastern side of the slopes, which is connected to the new RTH drainage, (Fig. 8.3).

The half-round pipes at the top of the slopes were dammed at their mid-point to send as much water as possible to the pond – thus avoiding blockage prone pipes leading to cascades (Fig. 8.4).

The water reaching the concrete ring silt trap above Packer Spout was diverted to the trench leading to the lower slope field drain, again to prevent water flowing down the blockage prone pipes leading to cascades (Fig. 8.5).

The photo in Fig. 8.6. presents a summary of the remedial temporary drainage changes implemented to try and prevent surface water flow to the RTH and to help start the drying out process of the slopes.

The requirement for these remedial drainage works restricted the time available for the original planned activities such as the hand-digging of the original spring water collection drainage systems.

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 8.1
Outfall of Blocked Field Drain at Base of Slope Excavated so Water Can Flow Directly into Drains Connected to New RTH Drains – Avoiding Water Flowing Over Retaining Wall

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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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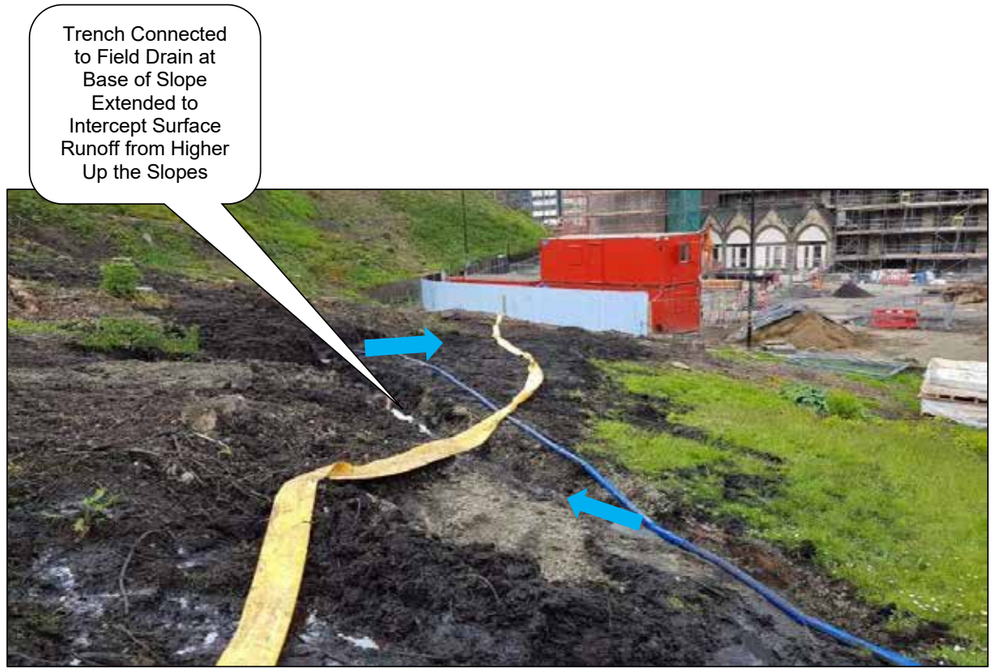
Fig. 8.2
Trench Connected to Field Drain at Base of Slope Extended to Intercept Surface Runoff from Higher Up the Slopes (Due to e.g., storms and blocked pipes)



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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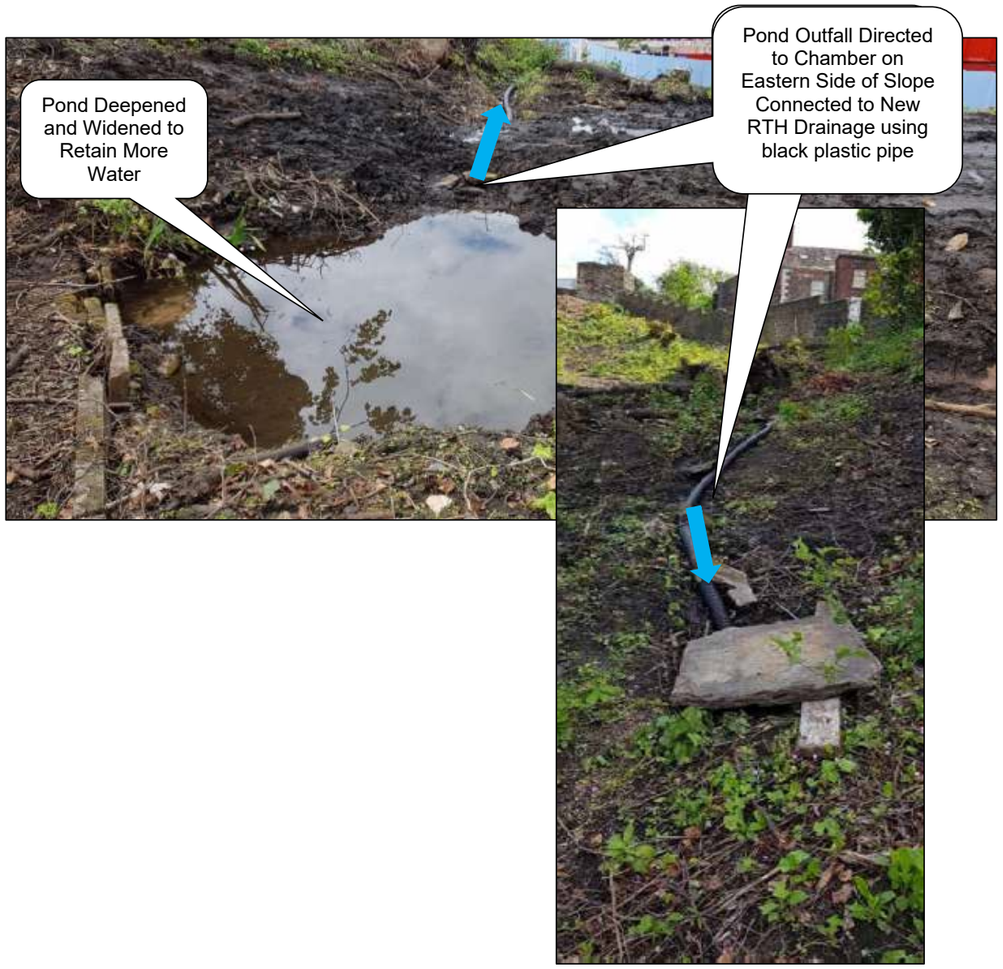
Fig. 8.3
Pond Deepened and Widened to Retain More Water and Pond Outfall Directed to Chamber on Eastern Side of Slope Connected to New RTH Drainage



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 8.4
Half-Round Pipes at Top of Slopes Dammed at Mid-Point

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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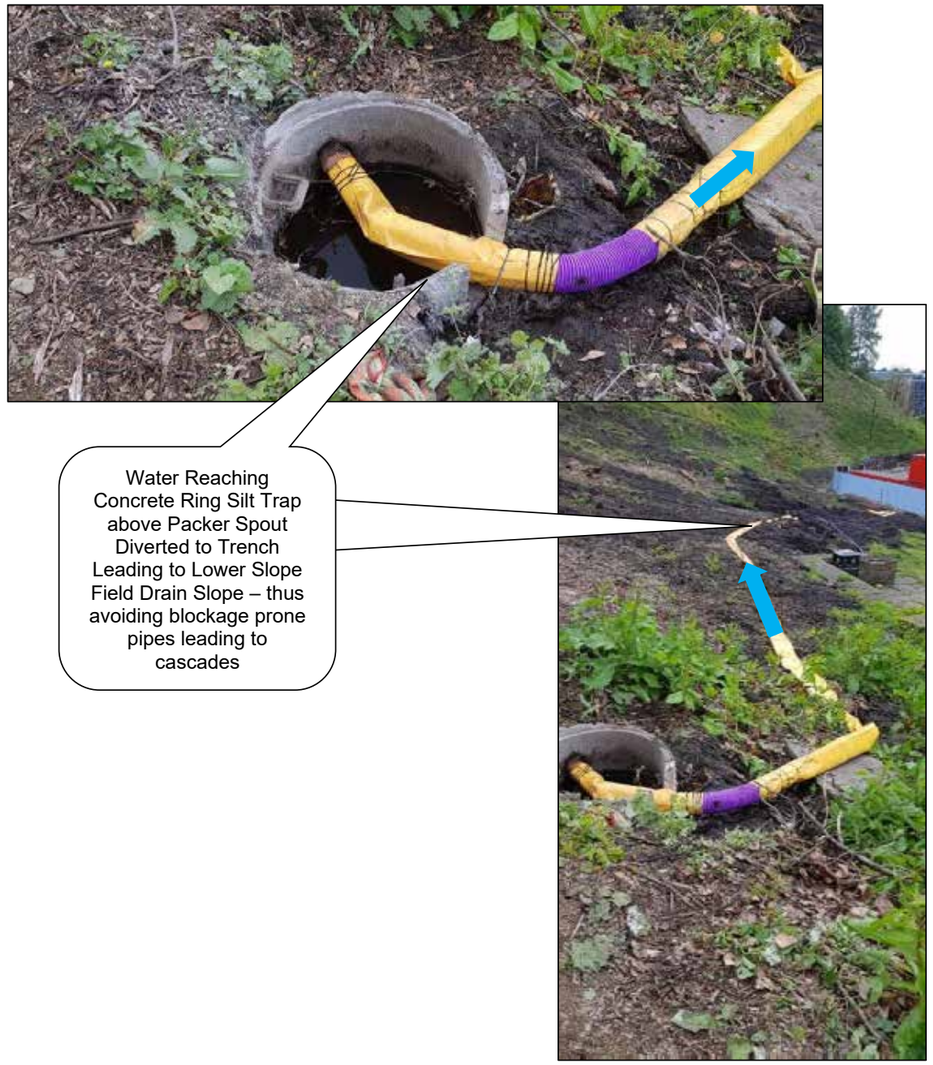
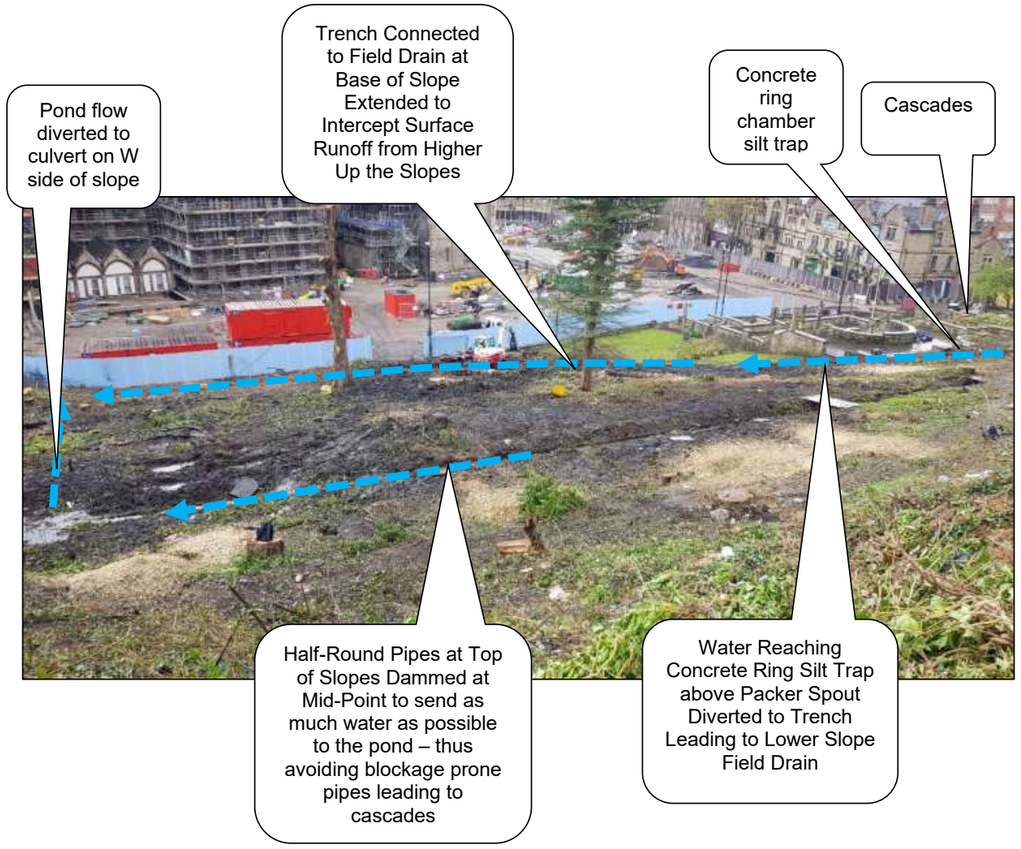
Fig. 8.5
Water Reaching Concrete Ring Silt Trap above Packer Spout Diverted to Trench Leading to Lower Slope Field Drain Slope



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 8.6
Photo of Summary of Remedial Temporary Drainage Changes to Prevent Surface Water Flow to the RTH



9.0 Hydrogeological Model for the Springs Water Flows for the Packer Spout and Fulling Mill Water Systems Flows

This section summaries the hydrogeological model developed for the superficial glaciofluvial sand and gravel aquifer which outcrops at the site and is the source of the spring water issuing from the slopes to the south of RTH. Also included are estimates of the main Packer Spout spring flow rate during June & July 2022 based on data logger water level recordings.

The surface superficial geology in the vicinity of the site is illustrated in Fig 9.1. The key to the colour coding of the superficial geology is shown in Fig. 9.2. A '3D' Representation of the Superficial Geology in the Vicinity of the Site is presented in Fig. 9.3. Superficial geology refers to the glacial and fluvio-glacial deposits left after the retreat of the glaciers and ice sheets associated with the last ice age, and landslip.

The site is on an extensive area of Devensian glaciofluvial sheet deposits which are comprised of sands & gravels interbedded with clay layers and were deposited by large rivers fed by meltwater from retreating glaciers (Fig. 9.4)

At the base of the sands and gravels is a layer of glacial till clay. Till is deposited directly beneath a glacier as it melts and is the material ground down by the abrasive movement of the glacier over the bedrock. As the glaciers retreated further the till deposits would have been eroded and sorted in size by the rivers of flowing meltwater which deposited the overlying glaciofluvial sand and gravels and interbedded layers of clay (Fig. 9.5).

A geological log for a borehole drilled adjacent to RTH shows the different layers of superficial deposits (Fig. 9.6). The Lidar DTM data contour map, with the two spring lines plotted is presented in Fig. 9.7, and was used to help plot a N-S geological section through the superficial Devensian glaciofluvial sand & gravel sheet aquifer (Fig. 9.8).

The glaciofluvial sands and gravels are shown to have a thickness of about 30 m underneath the Broadfield Park plateau, which is at an elevation of about 142 m AOD. At the base of the slope, at 121 m AOD, the thickness of the sands and gravels is about 4 m underneath about 4 m of made ground around the foundations and basement of the RTH. The 4 m of made ground indicates that the ground level at the RTH before its construction was at about 177 m AOD. The clayey soil at that original ground level still appears to be in place and probably represent deposits on the floodplain prior to the building of RTH.

Spring lines emerge at elevations where a high permeability sand and gravel is underlain by relatively thin clayey layers. The two spring lines are estimated to be at 131 m AOD (for the Packer Spout water supply) and at 127 m AOD (for the Fulling Mill water supply) (Fig. 9.8).

The Devensian glaciofluvial sand & gravel sheet deposits at the site (which have a thickness of about 30 m below the Broadfield Park plateau) are classified as a Secondary A aquifer (Figs. 9.9 & 9.10).

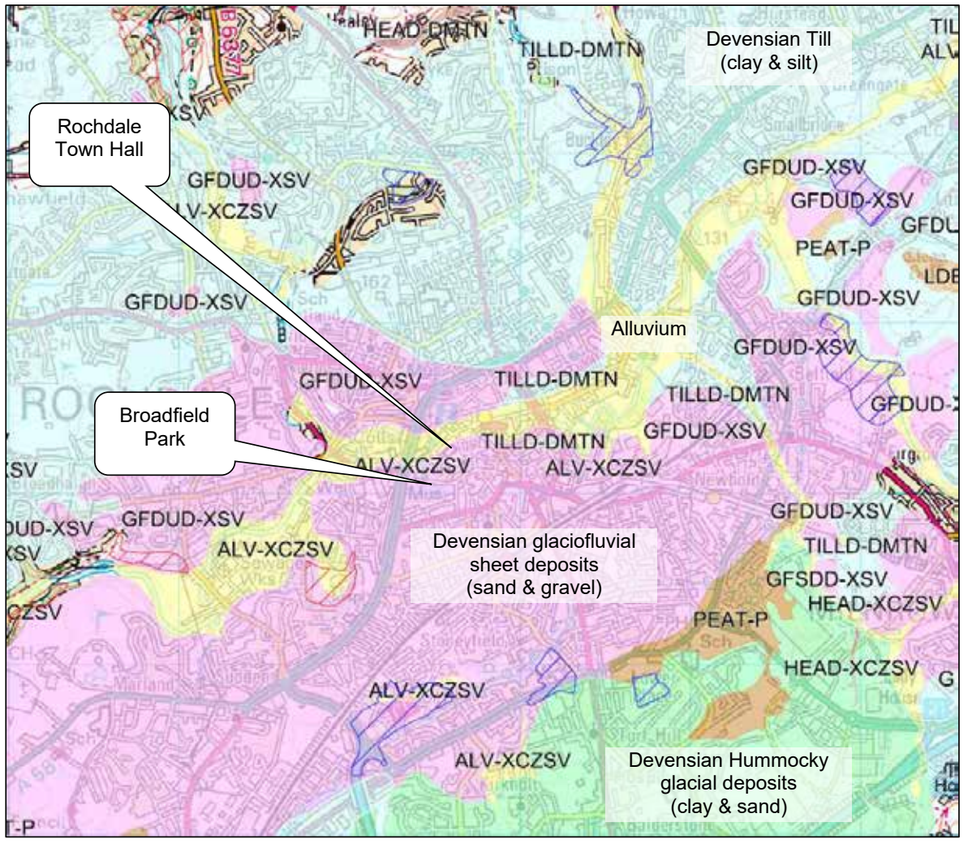
Secondary A aquifers have permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

Data logger water level measurements indicated that the main spring source for the Packer Spout water supply had a flow rate of between 1 l/s and 8 l/s (Fig. 9.11).

This flow rate is in general agreement with the ReFH2 estimated of base flow for a 10.24 ha catchment area of the Broadfield Park plateau to the south of RTH (Fig. 9.12).

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 9.1
Superficial Geology in the Vicinity of the Site



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Figure 9.2
Key to Superficial Geology

KEY TO SUPERFICIAL GEOLOGY

Map Colour	LEX Code	Rock Name	Rock Type	Max Age (Period)
	ALV-XCZSV	Alluvium	Clay, Silt, Sand And Gravel	Quaternary
	HMGDD-DMTN	Hummocky (Moundy) Glacial Deposits, Devensian	Diamicton	Quaternary
	TILLD-DMTN	Till, Devensian	Diamicton	Quaternary
	GFDUD-XSV	Glaciofluvial Deposits, Devensian	Sand And Gravel	Quaternary
	GFSDD-XSV	Glaciofluvial Sheet Deposits, Devensian	Sand And Gravel	Quaternary
	LDE-C	Lacustrine Deposits	Clay	Quaternary
	HEAD-XCZSV	Head	Clay, Silt, Sand And Gravel	Quaternary
	HEAD-DMTN	Head	Diamicton	Quaternary
	PEAT-P	Peat	Peat	Quaternary

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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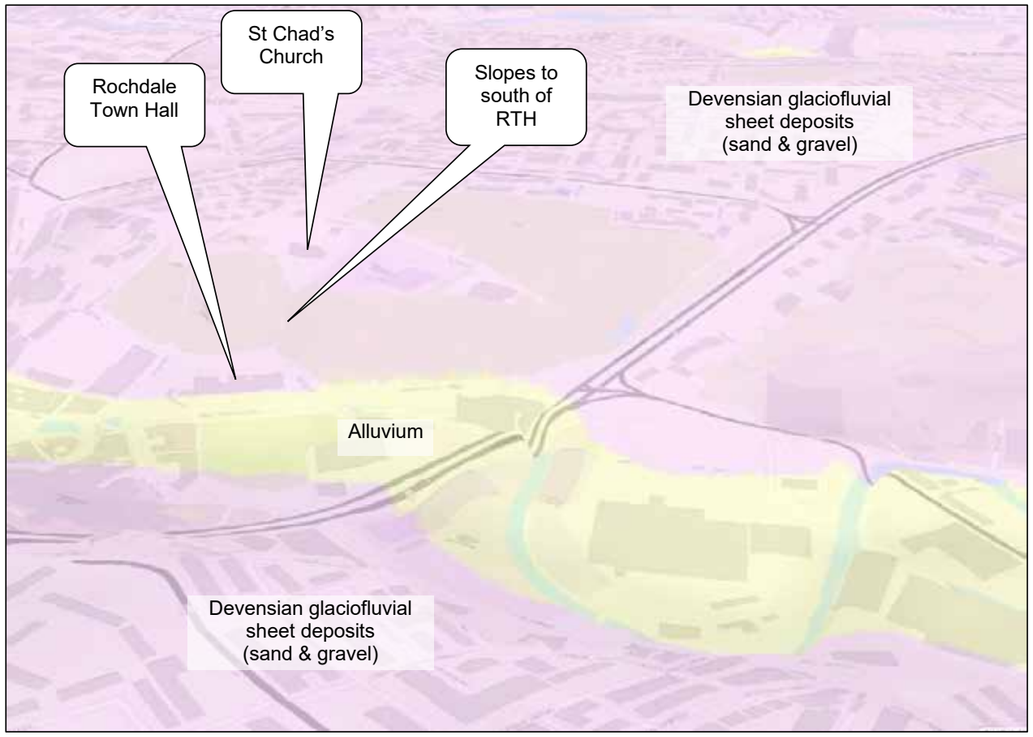
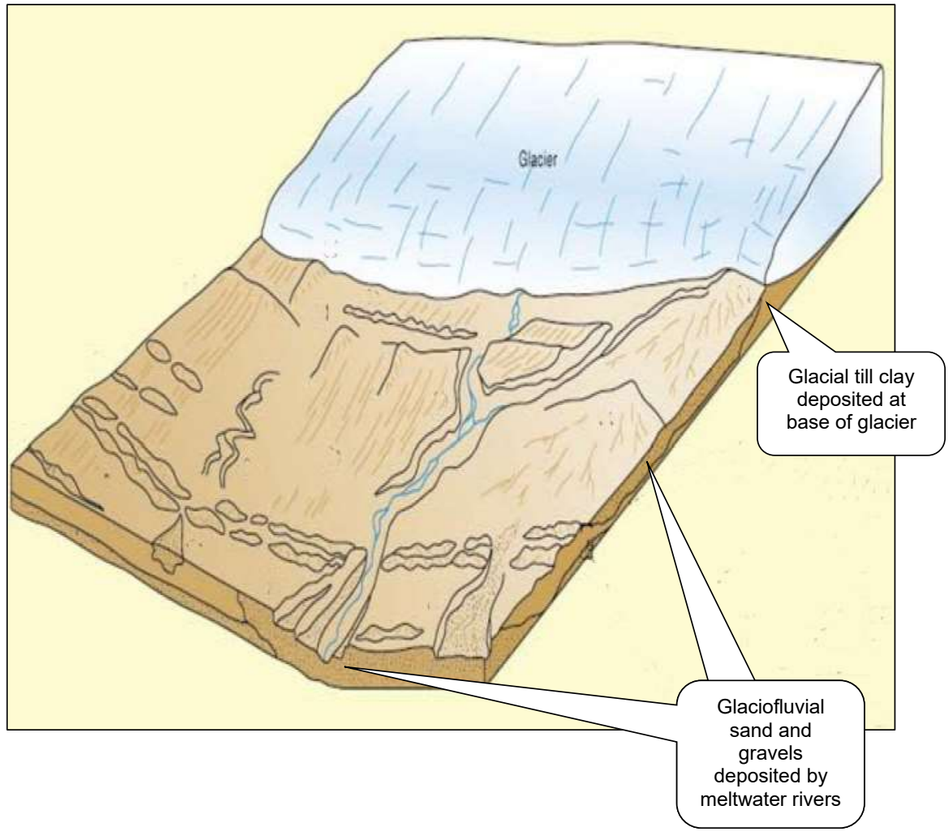
Figure 9.3
'3D' Representation of the Superficial Geology in the Vicinity of the Site



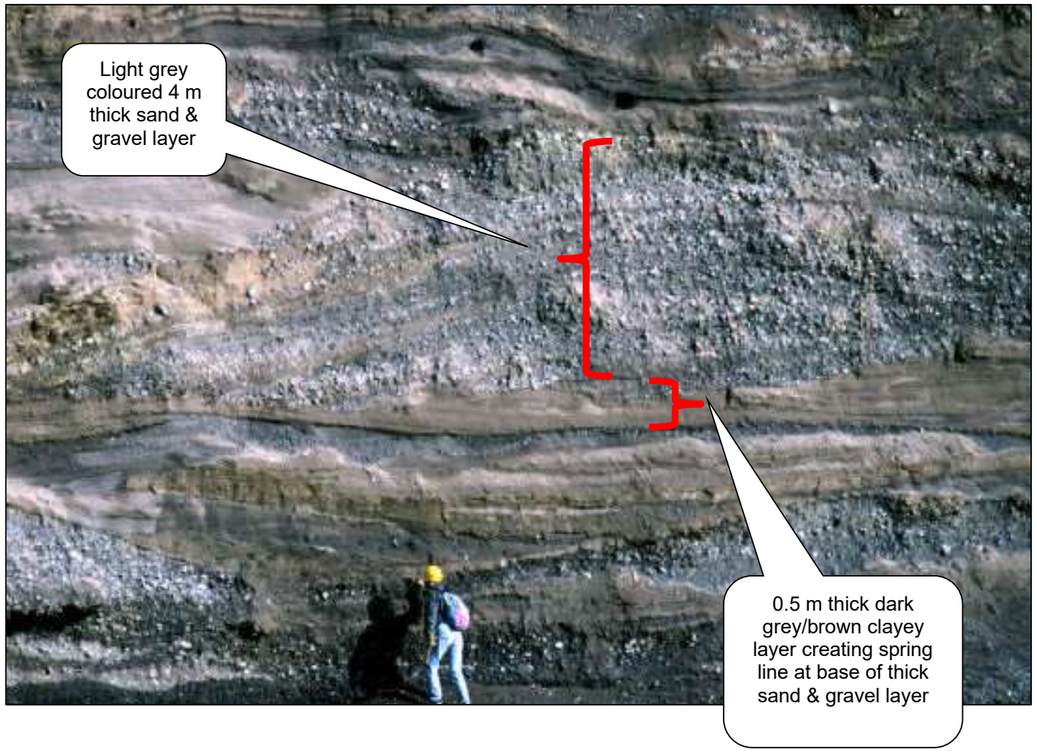
Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 9.4
Schematic Sedimentological Log for Glacial Sediments below Broadfield Park



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 9.5
Example Image of Glaciofluvial Sands & Gravels Interbedded with Clayey Layers



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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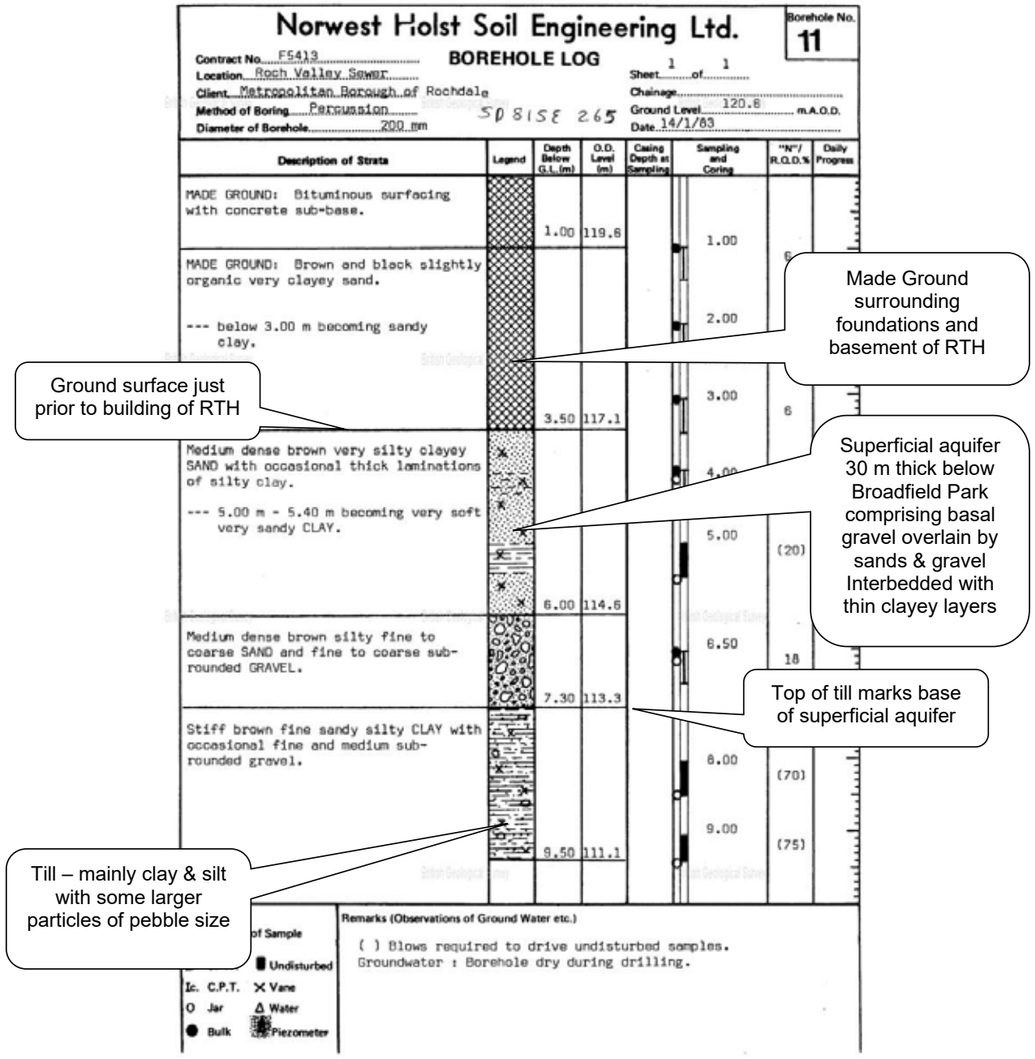
Figure 9.6
Geological Log for Borehole 13 m to NW of RTH



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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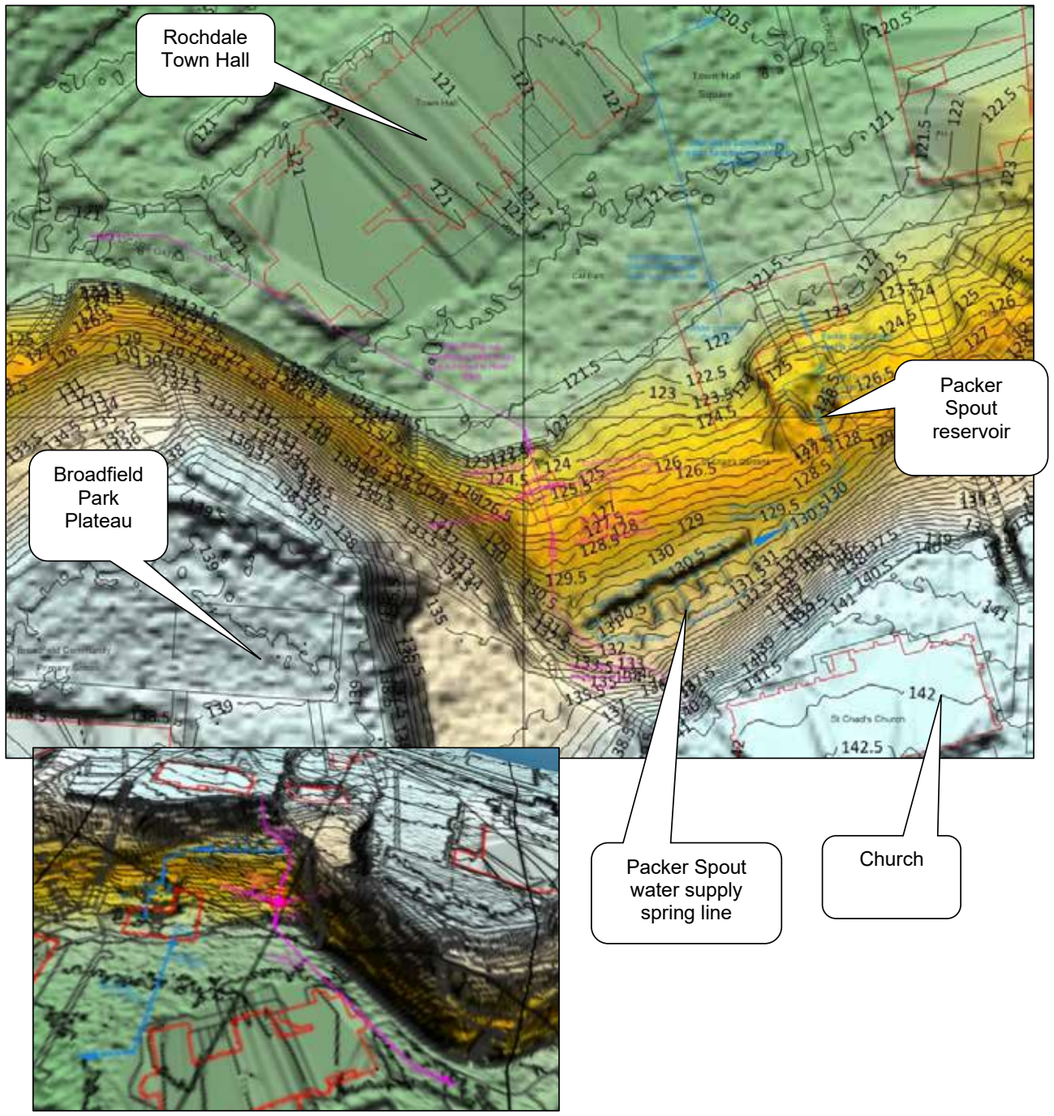
Figure 9.7
Lidar DTM Contour Plots Showing Spring Lines and Water Supply Systems Arrangements Following Construction of Central Corn Mill



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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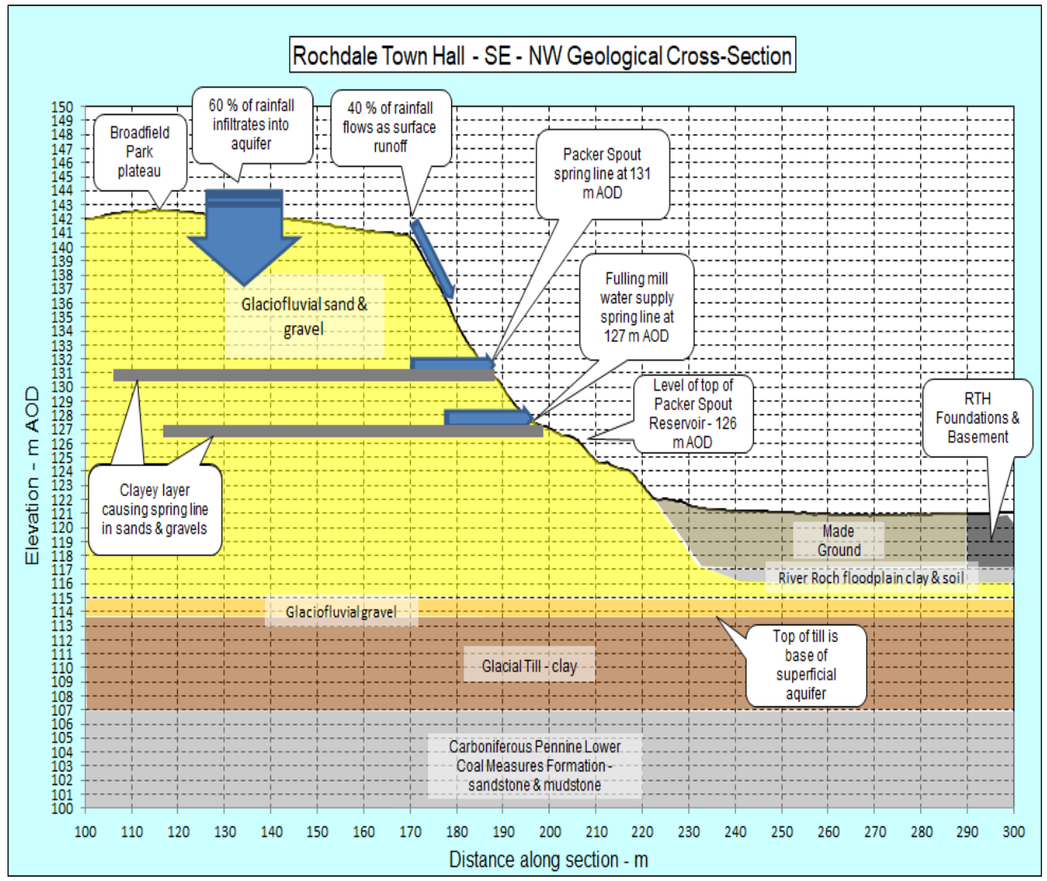
Figure 9.8
RTH SE-NW Geological Cross-Section



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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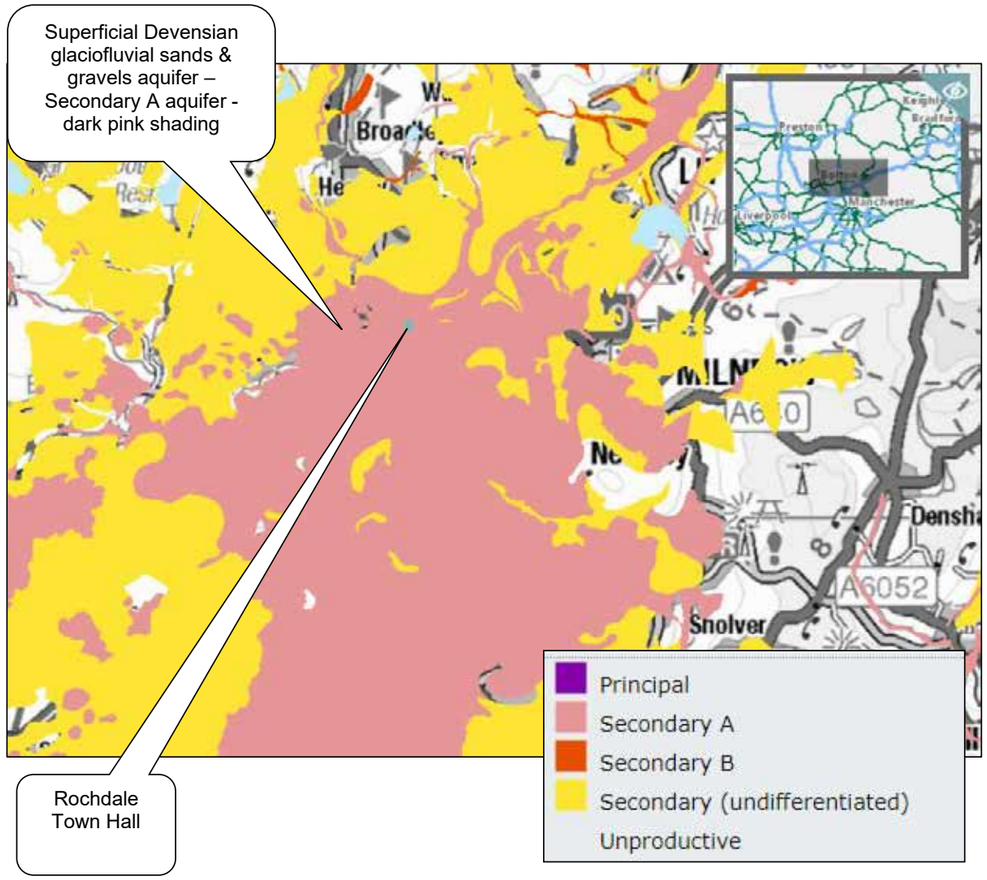
Fig. 9.9.
Superficial Deposits Aquifer Classification Map



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Figure 9.10
Aquifer Classification Descriptions

Principal Aquifers

These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary Aquifers

These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types:

Secondary A - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers;

Secondary B - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.

Secondary Undifferentiated - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

Unproductive Strata

These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Note: Only the principal and secondary aquifers are displayed as coloured areas on the maps.
All uncoloured areas on the bedrock designation map will be unproductive strata.

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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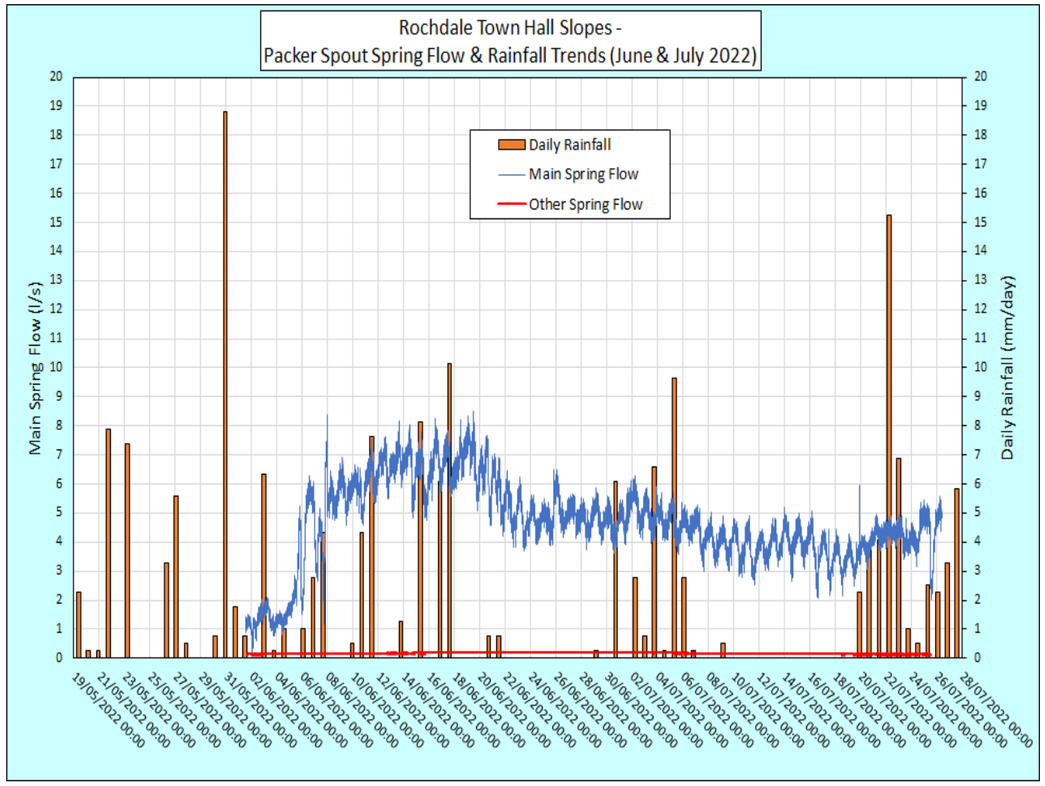
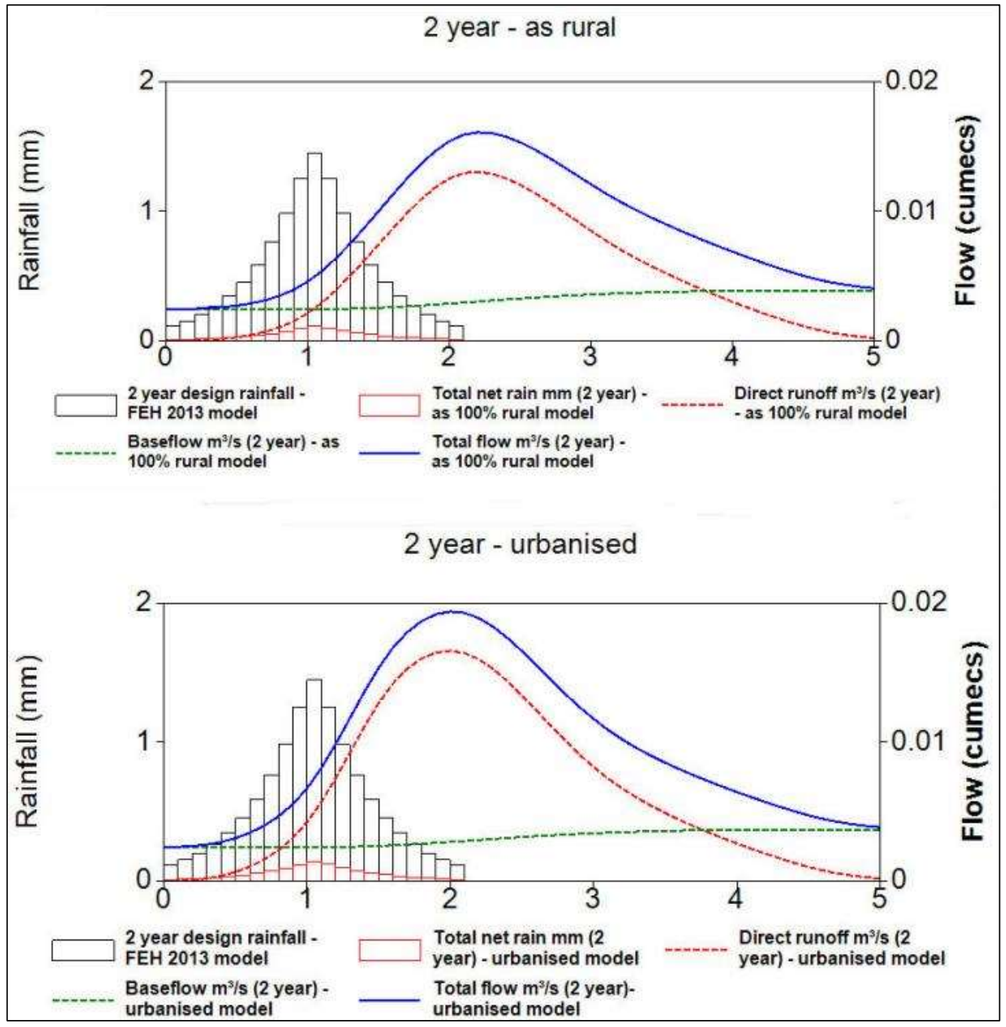
Figure 9.11
Daily Rainfall and Packer Spout Main Spring Source Flow Rates for June & July 2022 Based on Datalogger Water Levels



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 9.12
ReFH2 Estimate of Base Flow for the RTH 10.24 ha Catchment Area above RTH



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

10.0 Summary of Slopes Catchments & 100 Year Return Period Storm Runoff Rates and Volumes

In addition to the flow from springs, surface runoff will also flow off the slopes towards RTH. This runoff will have to be managed by the water drainage system surrounding RTH to avoid those drains being overwhelmed.

For each of the slopes' catchments from which runoff could flow towards RTH and into the drains surrounding it the current 100 year storm event runoff rates and volumes have been calculated to help determine whether the existing drainage systems can cope with the flows or whether additional flow attenuation should be installed such as cellular storage. It should be noted that the design of additional attenuation structures should also consider a 40% increase in storm intensity due to climate change.

Based on Lidar data contour and watershed maps the Broadfield Park slopes to the south of Rochdale Town Hall (RTH) have been divided into 6 main catchments (Figs. 10.1 to 10.5). The 6 catchments have been named

1 School Playing Fields
2 Old Vicarage
3 Church
4 Slopes West
5 Slopes Central
6 Slopes East

In defining the area of the catchments, it has been assumed that existing road drains will intercept any upslope runoff outside the catchments. The blue arrows in Figs. 10.1 & 10.3 indicate the main possible exit routes for runoff from the catchments.

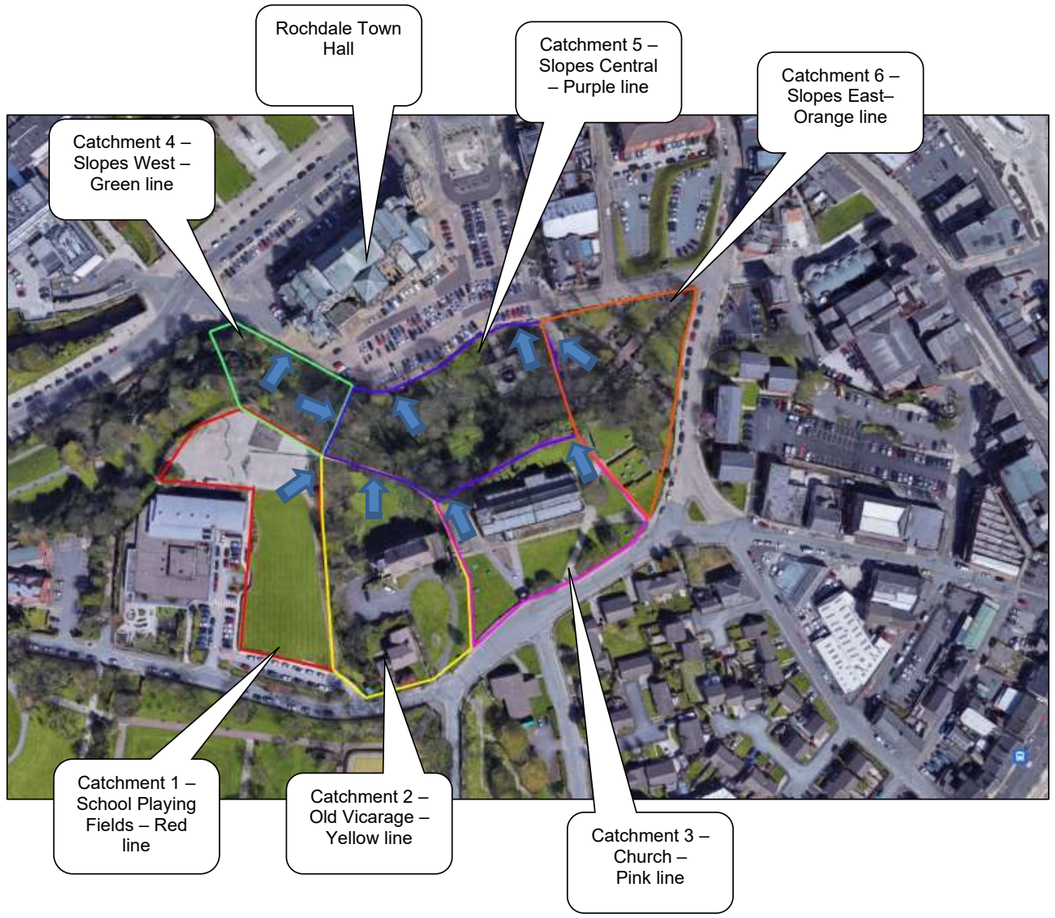
Details of the catchments including total area, the proportion of the surface area which is made up by impermeable surfaces, 100 year storm peak runoff volume and flow rate and the % of rainfall flowing as surface runoff are listed in Fig. 10.5. Example calculations of 100 year storm peak runoff volume and flow rate and the % of rainfall flowing as surface runoff are presented in Figs. 10.6 and 10.7.

On average about 41% of the volume of the 100 year storm event rainfall is expected to flow as surface runoff. The estimated current 100 year storm event runoff rates varied from 1.1 l/s to 4.0 l/s. Future 100 year storm event runoffs are expected to be significantly higher.

Later Sections discuss the slopes catchments in more detail and factors which need to be considered when controlling runoff from the catchments to RTH.

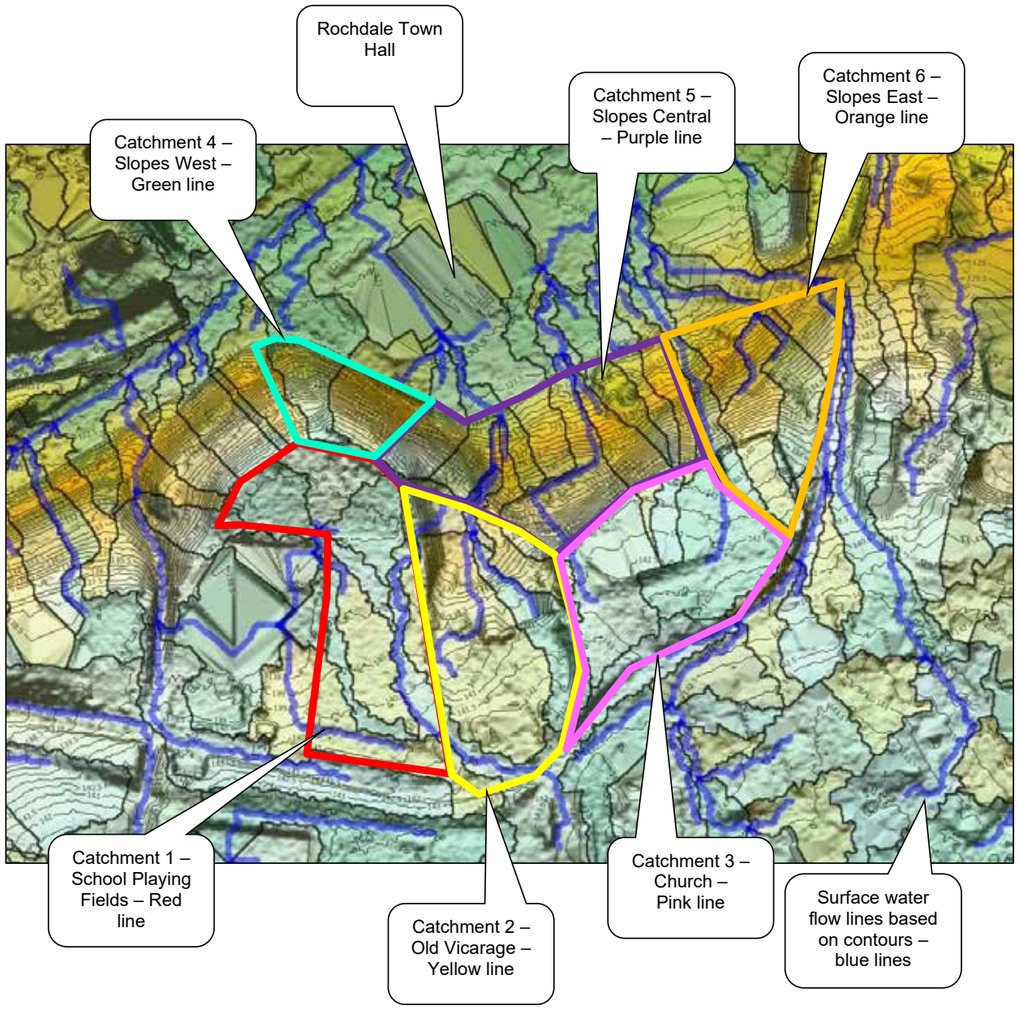
Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 10.1
Aerial Photo Showing 6 Main Water Runoff Catchments for the RTH Slopes
(Blue arrows indicate main exit routes for runoff from catchments)



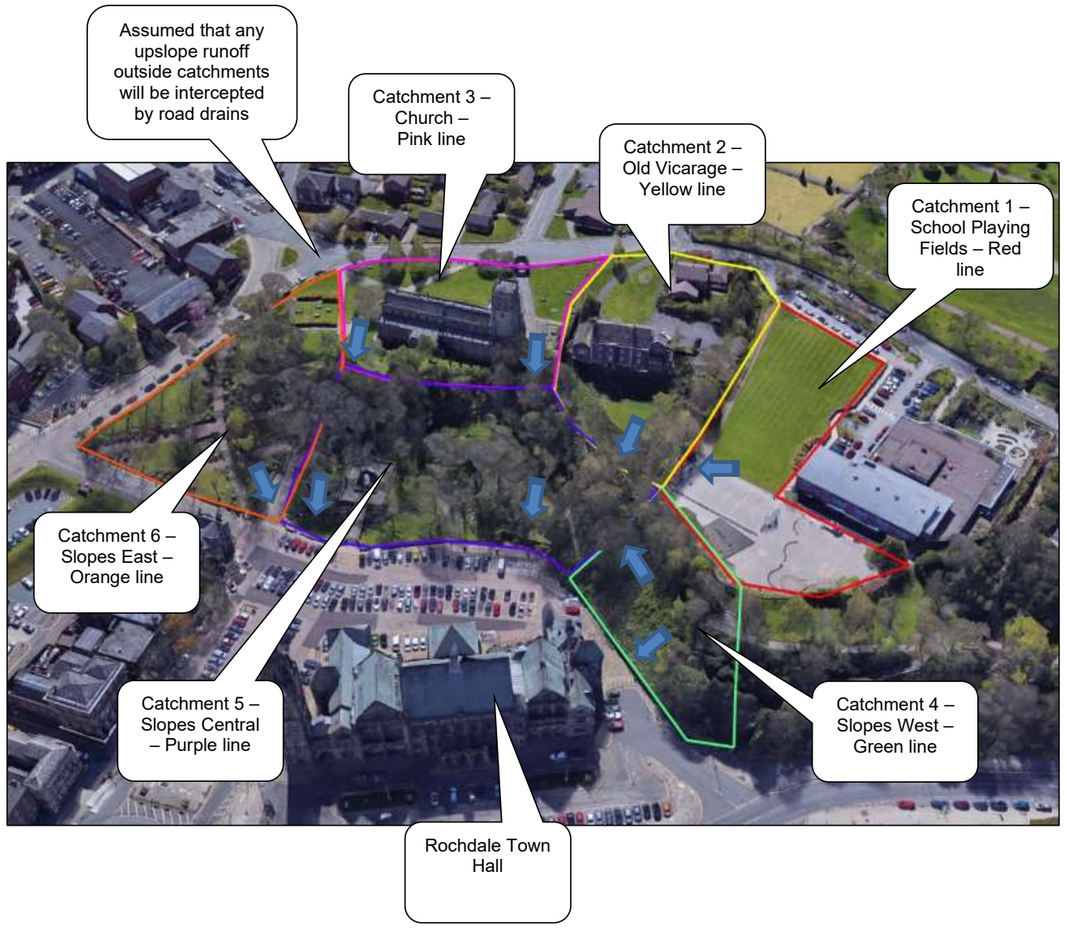
Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 10.2
Lidar Contour & Water Flowline Plot Showing 6 Main Water Runoff Catchments for the RTH Slopes



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 10.3
'3D' Aerial Photo Showing 6 Main Water Runoff Catchments for the RTH Slopes
(Blue arrows indicate main exit routes for runoff from catchments)



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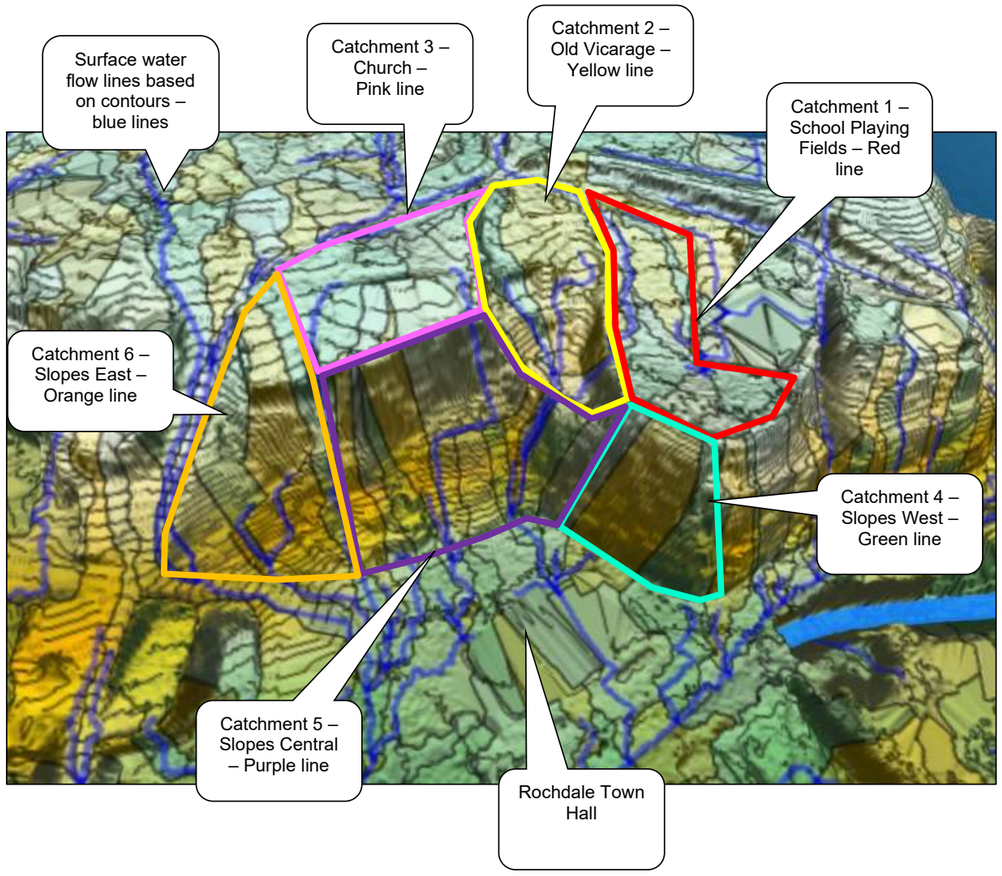
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 10.4
'3D' Lidar Contour & Water Flowline Plot Showing 6 Main Water Runoff Catchments for the RTH Slopes



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 10.5
Details of Catchments Including Total Area, Impermeable Surfaces Proportion, 100 Year Storm Peak Runoff Volume & Flow Rate & % of Rainfall Flowing as Surface Runoff

Catchment No.	Catchment Name	Total Area (m^2)	Impermeable Area (m^2)	Impermeable Area (fraction)	Current 100 years storm event runoff rate (l/s)	Current 100 year storm event runoff volume (m^3)	% of 100 year storm rainfall flowing as surface runoff
1	School Playing Fields	4751	1774	0.373	2.8	201.3	44.0
2	Old Vicarage	5723	1394	0.244	3.7	227.7	41.4
3	Church	4855	2275	0.469	4.0	214.9	46.0
4	Slopes West	2131	45	0.021	1.1	75.3	36.8
5	Slopes Central	5719	307	0.054	2.9	206.0	37.4
6	Slopes East	4476	1056	0.236	2.8	177.6	41.2

Figure 10.6
Example Calculation of Catchment 100 Year Storm Event Runoff Rate

Ambellia Consultancy		Page 1
11 Longwood House Love Lane Cirencester, Clos, GL7 1YG	Catchment 3 - Church Rochdale Town Hall Slopes Rochdale, OL16 1AB	Micro Drainage
Date 28/04/2022 18:49 File RTH Catch 3 church.SRCX	Designed by Dr. R. Evans Checked by	
Innovyze	Source Control 2020.1.3	

ICP SUDS Mean Annual Flood

Input

Return Period (years) 10 Soil 0.300
Area (ha) 0.486 Urban 0.469
SAAR (mm) 856 Region Number Region 10

Results	l/s
QBAR Rural	1.1
QBAR Urban	2.3
Q10 years	3.1
Q1 year	2.0
Q30 years	3.5
Q100 years	4.0

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Figure 10.7
Example Calculation of Catchment 100 Year Storm Event Runoff Volume

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11 Longwood House Love Lane Cirencester, Clos, GL7 1YG	Catchment 3 - Church Rochdale Town Hall Slopes Rochdale, OL16 1AB	Micro Drainage
Date 28/04/2022 15:11 File RTH Catch 3 church.SRCX	Designed by Dr. R. Evans Checked by	
Innovyze	Source Control 2020.1.3	

Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	960
FEH Rainfall Version	1999
Site Location	GB 382150 163150 ST 82150 63150
C (1km)	-0.023
D1 (1km)	0.388
D2 (1km)	0.382
D3 (1km)	0.208
E (1km)	0.278
F (1km)	2.507
Areal Reduction Factor	1.00
Area (ha)	0.486
SAAR (mm)	856
CWI	120.055
SPR Host	30.000
URBEXT (1990)	0.4660

Results

Percentage Runoff (%)	45.97
Greenfield Runoff Volume (m^3)	214.944

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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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11.0 Slopes Catchments 1 – School Playing Fields - RTH Drainage Considerations

As discussed in Section 12, catchment 1 is the playgrounds area of the school which has a surface area 4,751 m^2,

The 1926 aerial photo (Fig. 11.1) shows the area of the catchments prior to the building of the school on the western side of the vicarage gardens.

It is possible that the runoff from the school playgrounds could follow the route of the original site drainage into the remaining part of the vicarage gardens (Fig. 11.2).

The silt trap manhole in the vicarage garden next to garden gate receives runoff from the direction of Catchment 1 (School playing fields) and so could potentially be receiving runoff from Catchment 1 (Figs. 11.3).

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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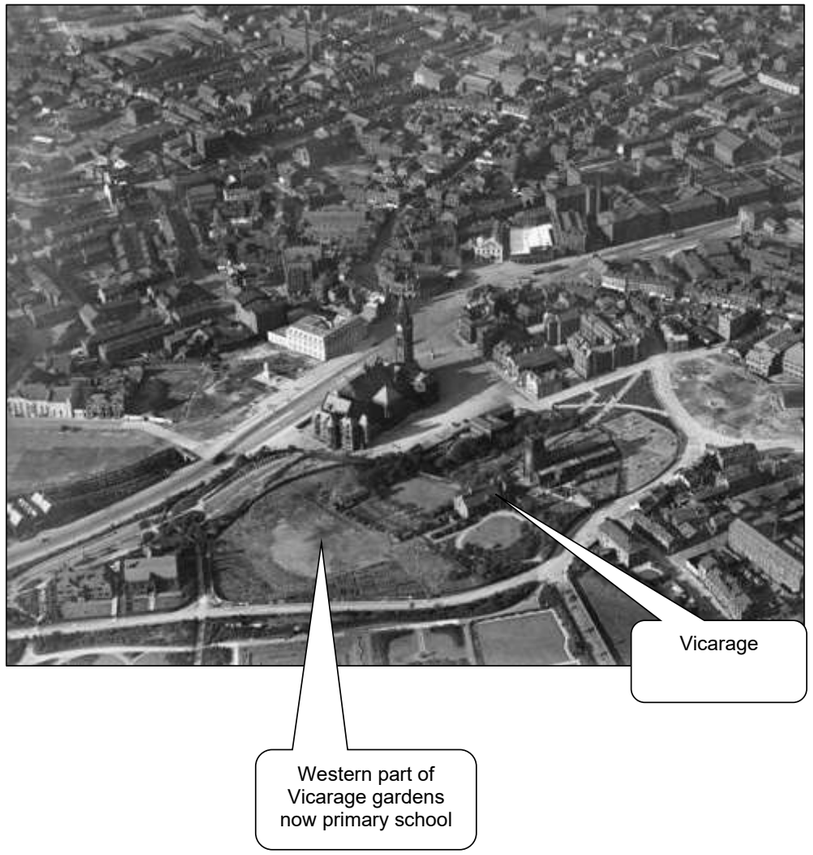
Fig. 11.1

1926 Aerial Photo Showing Catchment 1 in Vicarage Gardens Before Building of Primary School



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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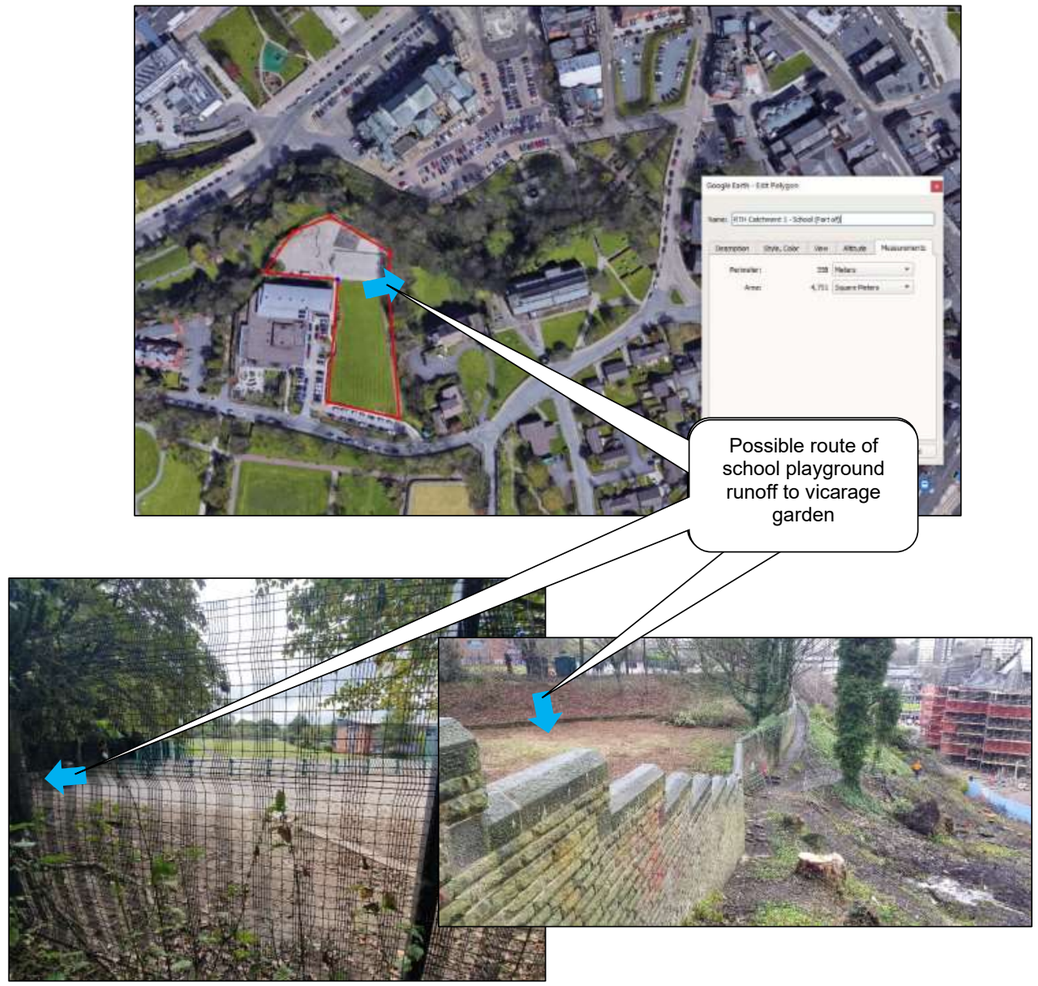
Fig. 11.2

Catchment 1 - Grassed & Hard Standing Playground Areas Could Still Possibly Drain to Vicarage Garden as per Original Drainage Before Construction of School



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 11.3
Manhole Next to Garden Gate Receiving Runoff from Direction of Catchment 1 (School Playing Fields)

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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

12.0 Catchment 2 – Old Vicarage (now Partnership House) - RTH Drainage Considerations

Catchment 2 is the remaining part of the old vicarage with a surface area of 5,723 m^2 (Fig. 12.1).

The manhole in the vicarage garden next to garden gate (which leads to the slopes) receives runoff from the direction of Catchment 1 (School playing fields) and Catchment 2 (Vicarage) and discharges it to the Slopes (Fig. 12.2).

Dye tracer tests indicated that the water leaving the manhole in the Vicarage garden entered the slopes drainage system at, or below, the level of the underground brick chamber, which was originally part of the fulling mill water supply system (See Fig. 4.2).

Consequently, it is not thought that the outflow from the vicarage garden manhole enters the Packer Spout spring water supply.

The walkover investigations of drainage from the church and the old vicarage to the slopes revealed that it is highly probable that foul water from the church and the vicarage is being discharged to the slopes via the manhole adjacent to the gate in the wall. Fig. 12.3 shows the probable route of foul water from church to the slopes via a manhole in the vicarage gardens. The church website confirms that the church has toilet facilities (Fig. 12.4). The location of a possible septic tank or cesspit in church yard to the west of the church is also shown in Fig. 12.4.

It is possible that the 2 manholes in the terrace immediately to the north of the old vicarage are receiving combined foul water and roof runoff from vicarage and then discharging to the slopes via the same manhole receiving the foul water from the church (Fig. 12.5).

The extent of the treatment of the vicarage foul water is not known. It is not known if there is a septic tank or cesspit in the vicarage gardens.

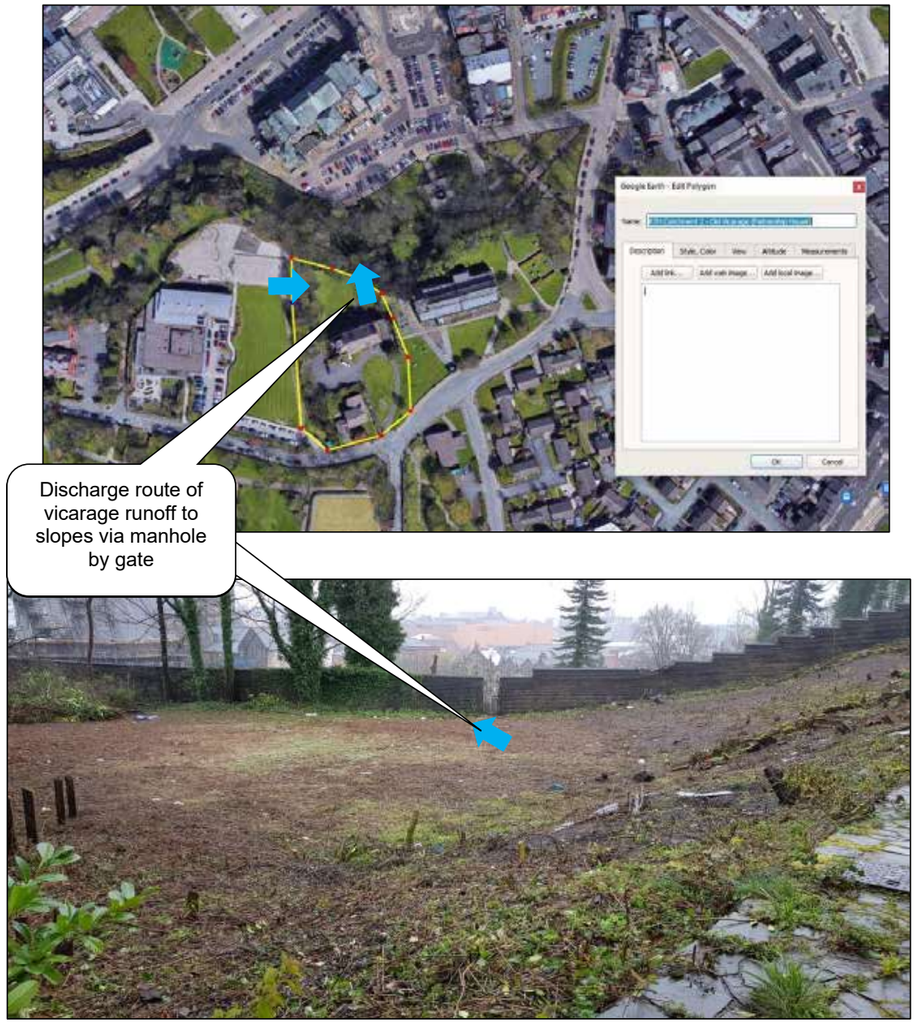
Information needs to be obtained on the foul water management and treatment for the church and the vicarage.

If required, steps should be taken to rectify any inadequacies in the current foul water treatment by connecting the church and the vicarage to the mains sewer or installing package water treatment plants.

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 6.3

Catchment 2 – Old Vicarage Discharging Runoff (& Probably Foul Water) to Slopes Via Manhole by Gate



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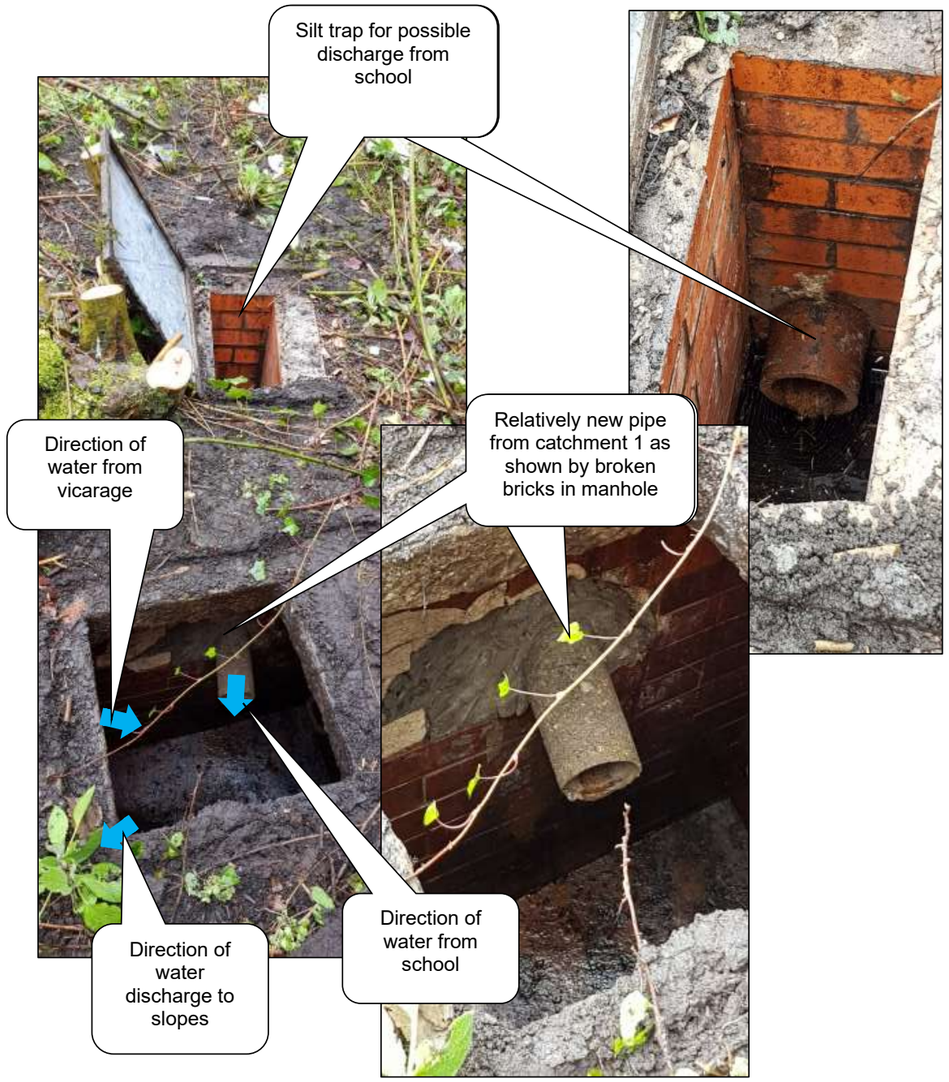
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 12.2

Manhole Next to Garden Gate Receiving Runoff from Catchment 1 (School playing fields) and Catchment 2 (Vicarage) and then Discharging to the Slopes



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
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Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 12.3

Probable Route of Foul Water from Church to the Slopes Via Vicarage Gardens

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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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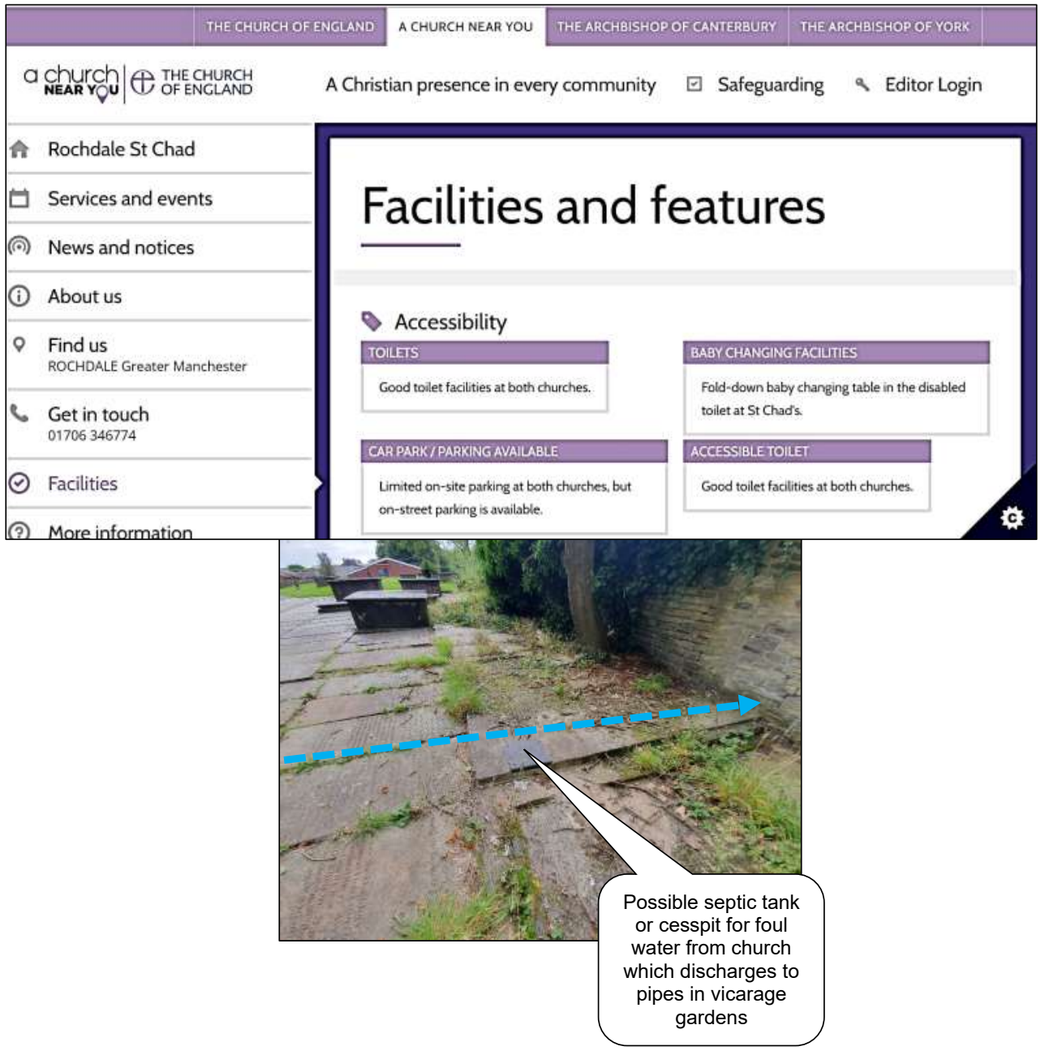
Fig. 12.4

Confirmation St Chad's Church has Toilets and Possible Septic Tank or Cesspit in Church Yard to the West of the Church



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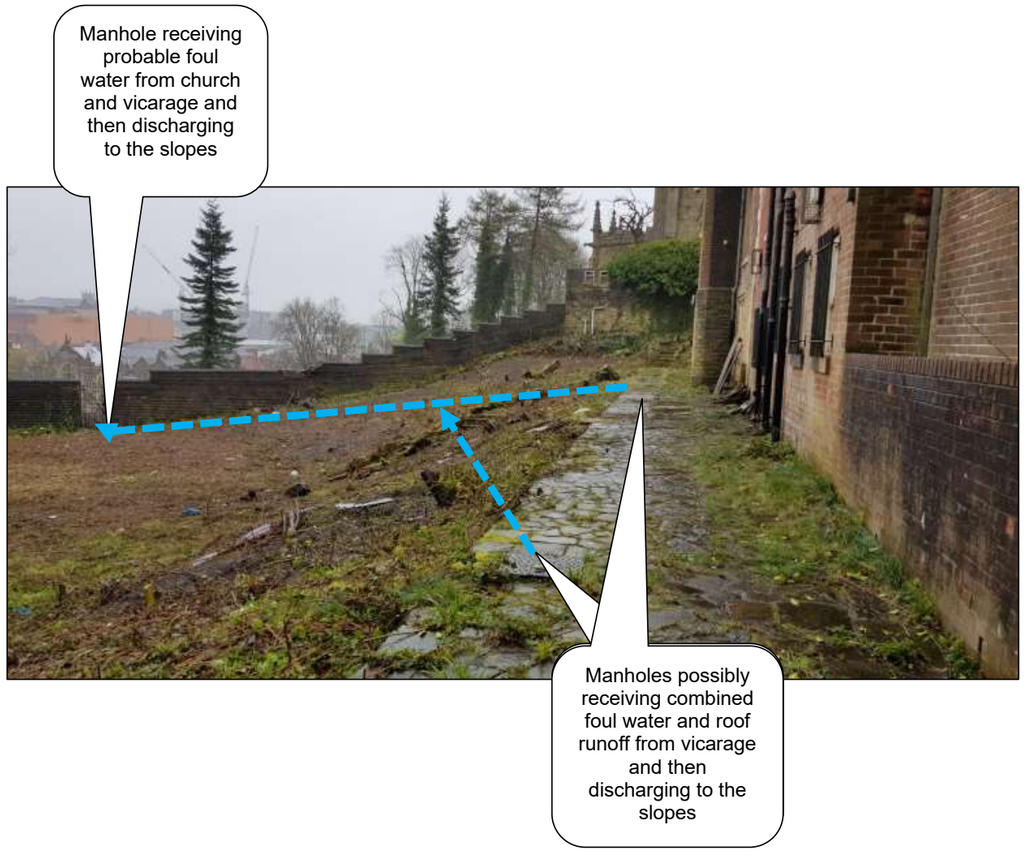
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 12.5

Manholes Possibly Receiving Combined Foul Water and Roof Runoff from Vicarage and then Discharging to the Slopes



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

13.0 Catchment 3 – St Chad's Church - RTH Drainage Considerations

Catchment 3 is St Chad's church and church yard, which has a surface area 4,855 m^2 (Fig. 13.1)

Runoff from the church roof and paved church yard is discharged both to the west and east of the of the church (Figs 13.1 & 13.2).

On the western side of the church, an open channel discharges runoff into the pond and open channel of the Packer Spout water supply (Fig. 13.2).

On the eastern side of the church, the runoff is directed into the drains at the top of the church steps (Fig. 13.3).

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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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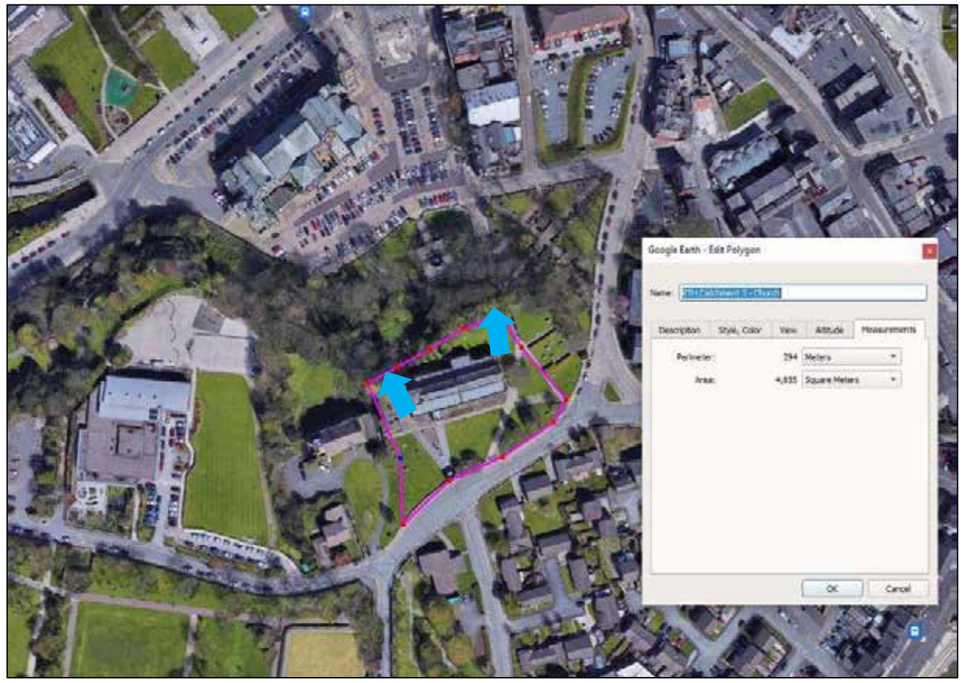
Fig. 13.1
Catchment 3 – Church Discharging Runoff to Slopes to the West and East of St Chad's Church



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Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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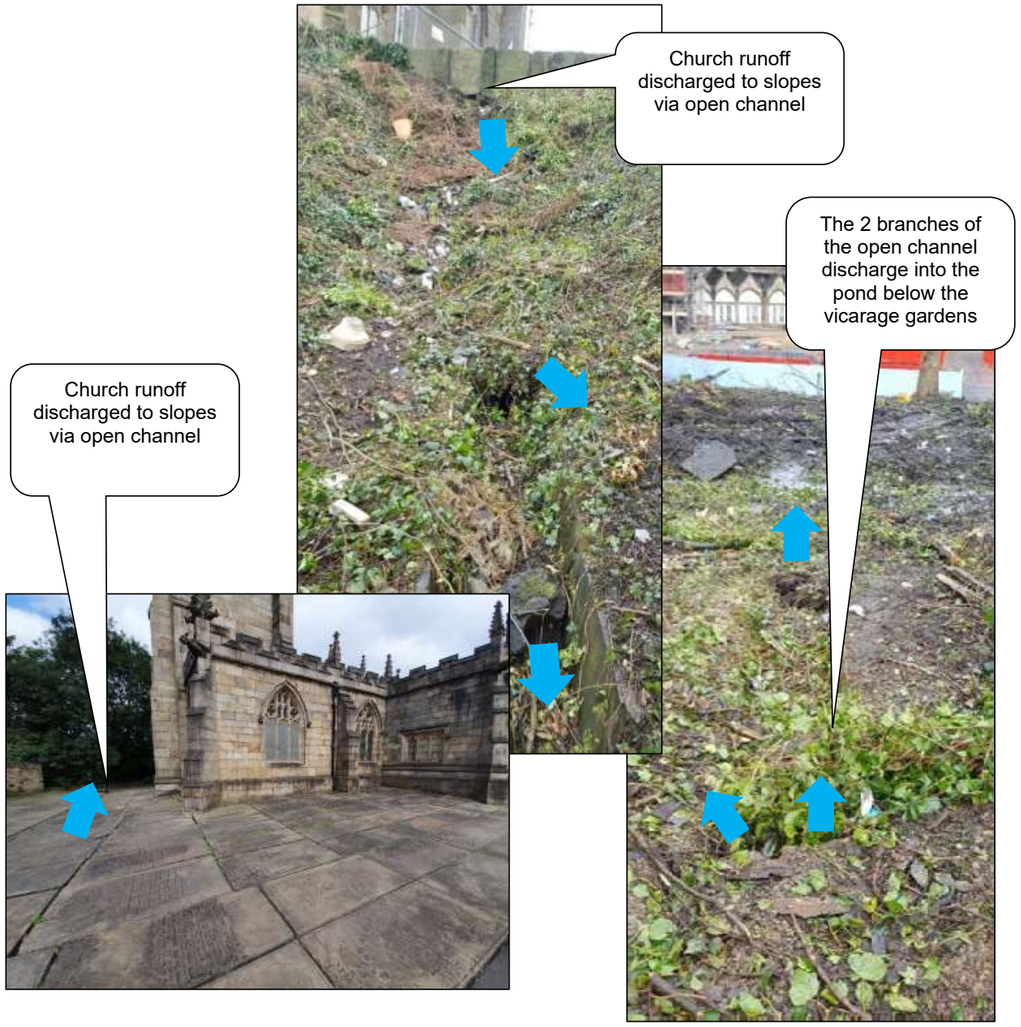
Fig. 13.2
West Side of Church Discharging Runoff to Slopes Via Open Channel to Packer Spout Water Supply – Open Channel Splits into Two Channels Halfway Down Slope



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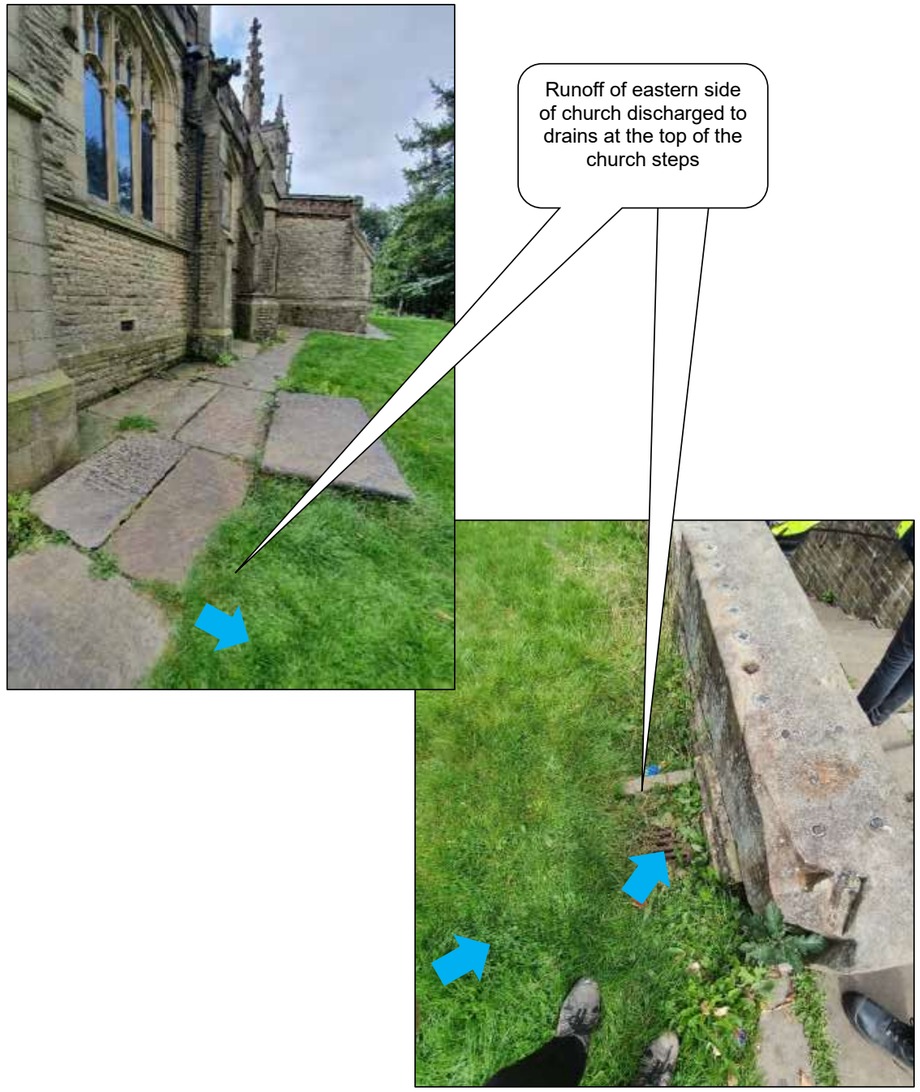
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 13.3
Church Discharging Runoff to Slopes Via Open Channel to Pond Below Vicarage Gardens – Open Channel Splits into Two Channels Halfway Down Slope



14.0 Catchment 4 – Slopes West - RTH Drainage Considerations

Catchment 4 is the steep western side of the slopes (Slopes West) which has a surface area 2,131 m^2 (Fig. 14.1)

Part of the Slopes West runoff is drained to the culvert and underground brick chamber on west side of Slopes Central (catchment 5) (Fig. 14.2).

Some Slopes West runoff to flows to behind the retaining wall to west of RTH where seep holes release build-ups of water (Fig. 14.3).

Any new planting on the slopes should not disturb the existing drainage.

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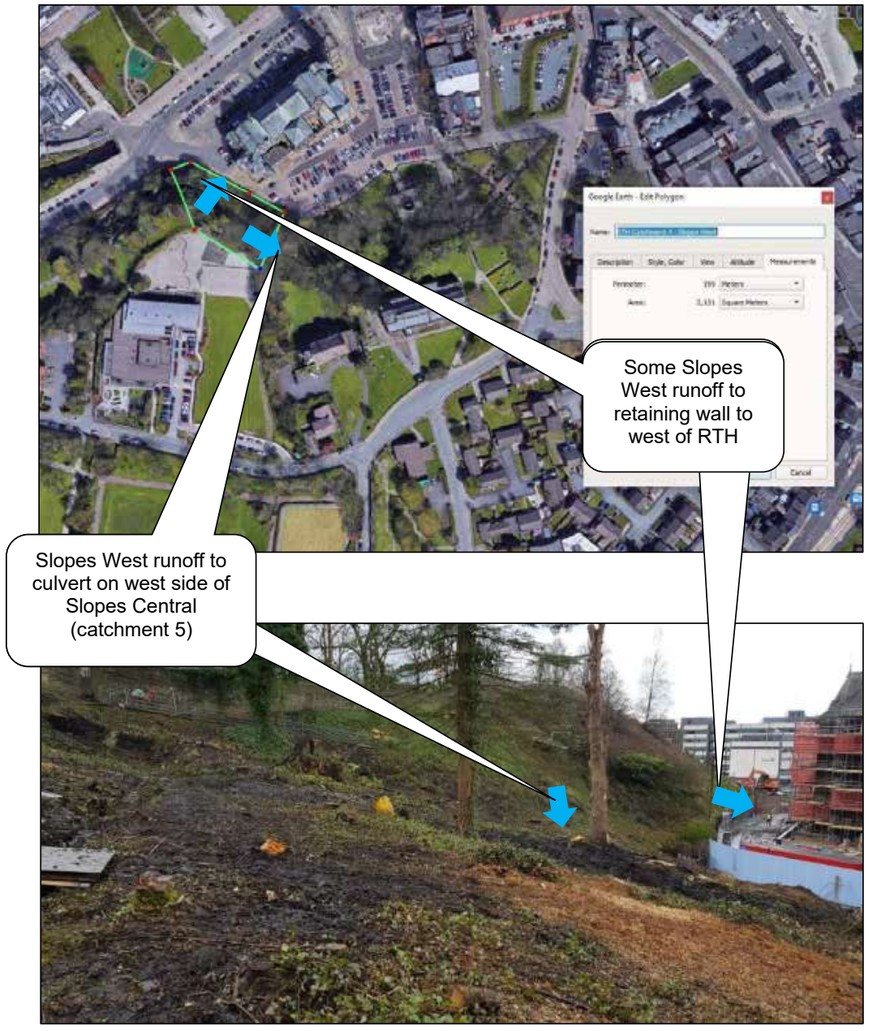
Fig. 14.1
Catchment 4 – Slopes West



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 14.2
Catchment 4 – Slopes West runoff to culvert and underground brick chamber on west side of Slopes Central (catchment 5)

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Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Fig. 14.3
Catchment 4 – Some Slopes West runoff to retaining wall to west of RTH

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15.0 Catchment 5 – Slopes Central - RTH Drainage Considerations

Catchment 5 is the Slopes Central which has a surface area 5,719 m^2 (Fig. 15.1). The evolution of the Slopes Central drainage in relation to the development of the two water supplies for, respectively, Packer Spout and the Fulling Mill since the mid-18th Century has been documented in Sections 2 to 5 of this report.

The recent state of the two water systems following the demolition of the Central Corn Mill in the 1930's, and the tree clearance in March and April 2002, has been discussed in Sections 6, 7 & 8. The hydrogeological model for the spring flows is presented in Section 9.

With the dual objectives of restoring the main historical features of the two water supply systems and improving the slopes drainage in general, the key recommended actions are discussed below.

The lateral land drains at the base of the slope need to be replaced, with the land drain gravel covered by a permeable geotextile membrane to prevent silt blocking the land drain gravel. Runoff attenuation should be installed if required based on the relative flow capacity of the new RTH drainage compared with the slopes storm runoff rates.

The key considerations regarding the Packer Spout water supply system are

i) Restoring the catchpit for the main spring source so that sand is trapped in the catchpit and the spring water flows directly into half-round culvert and so removing the pond
ii) Restoring the other 5 spring catchpits which can also act as sand/silt traps
iii) Removing the back plastic pipes and other debris from the half round pipes
iv) Refilling the round holes in the main west-east half-round culvert with lime mortar to stop water leaking to the slopes
v) Recovering the half-round culverts with the 90 cm natural stone slabs
vi) Restoring the round brick sand/silt trap at the eastern end of the main half-round culvert
vii) Restoring the stone culvert from the round brick chamber to the Packer Spout reservoir
viii) Cleaning out the Packer Spout reservoir
ix) Restoring the inflow and outflow controls for the Packer Spout reservoir
x) Laying new pipe from the Packer Spout Reservoir to the new RTH drainage to avoid current leaking drainage pipes
xi) Determine if flow attenuation is required based on the relative flow capacity of the new RTH drainage compared with the slopes storm runoff rates.
xii) Prepare maintenance plan including prevention of build-up of sand, silt and algae.

The key considerations regarding the Fulling Mill water supply system are

i) Restoring the complete length of the stone culvert from the western side of St Chad's church to the underground brick chamber (which is 11 m from the base of the slope)
ii) Restoring the system catchpits and culverts which is draining the lower spring line and channelling water to the underground brick chamber.
iii) Determine if flow attenuation is required based on the relative flow capacity of the new RTH drainage compared with the slopes storm runoff rates.
iv) Prepare maintenance plan

An example flood attenuation structure design for a cellular storage structure at the base of the western side of the central slopes catchment is presented in Fig 15.2.

The cellular storage structure (6 m wide * 20 m long * 2 m deep) was been designed on the basis of receiving 100 year storm flow (+40% for climate change) from a catchment area of 0.33 hectares. The maximum allowable discharge rate from the cellular storage was set at 5 l/s. The design calculations are shown in Fig. 15.3 confirming that the cellular storage would retain the storm flows (status OK).

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 15.1
Catchment 5 – Slopes Central

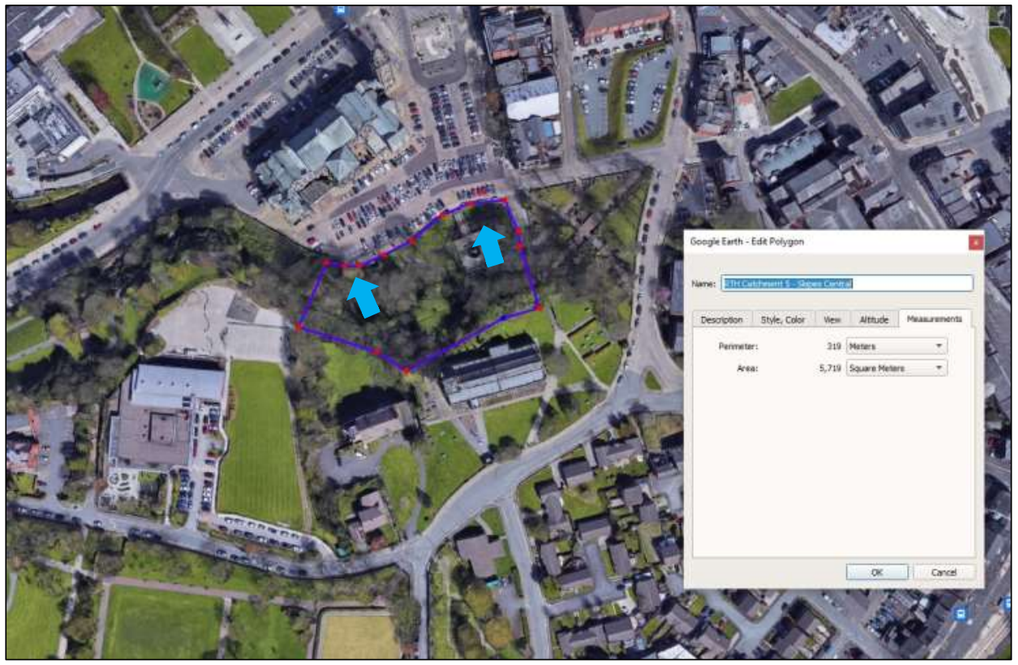

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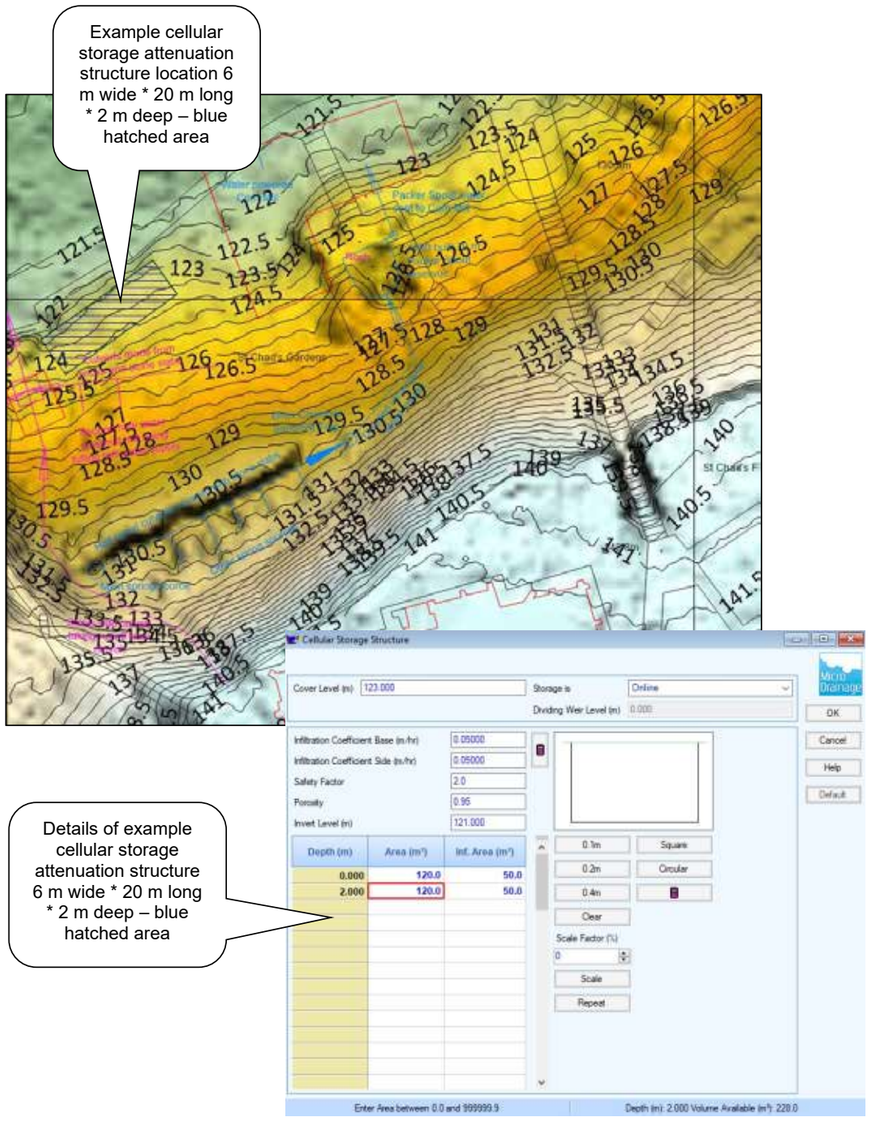
Figure 15.2
Example Cellular Storage Attenuation Structure Location & Dimensions



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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Figure 15.3
Summary of Design Calculations for Cellular Storage

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11 Longwood House Love Lane Cirencester, Clos, GL7 1YG	Cellular Storage Rochdale Town Hall Slopes Rochdale, OL16 1AB	Micro Drainage
Date 22/08/2022 12:57 File CHURCH SLOPES COMBINED....	Designed by Dr R Evans Checked by	
Innovyze	Source Control 2020.1.3	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 345 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	121.864	0.864	0.3	4.0	4.3	98.5	O K
30 min Summer	122.033	1.033	0.3	4.1	4.4	117.8	O K
60 min Summer	122.212	1.212	0.3	4.4	4.7	138.2	O K
120 min Summer	122.375	1.375	0.3	4.6	5.0	156.7	O K
180 min Summer	122.444	1.444	0.3	4.7	5.1	164.6	O K
240 min Summer	122.470	1.470	0.3	4.8	5.1	167.6	O K
360 min Summer	122.479	1.479	0.3	4.8	5.1	168.6	O K
480 min Summer	122.472	1.472	0.3	4.8	5.1	167.8	O K
600 min Summer	122.458	1.458	0.3	4.8	5.1	166.2	O K
720 min Summer	122.439	1.439	0.3	4.7	5.1	164.1	O K
960 min Summer	122.392	1.392	0.3	4.7	5.0	158.7	O K
1440 min Summer	122.291	1.291	0.3	4.5	4.8	147.2	O K
2160 min Summer	122.138	1.138	0.3	4.2	4.6	129.7	O K
2880 min Summer	121.993	0.993	0.3	4.0	4.3	113.2	O K
4320 min Summer	121.556	0.556	0.3	4.0	4.3	63.3	O K
5760 min Summer	121.274	0.274	0.3	4.0	4.3	31.2	O K
7200 min Summer	121.159	0.159	0.3	3.7	4.1	18.1	O K
8640 min Summer	121.114	0.114	0.3	3.4	3.8	13.0	O K
10080 min Summer	121.097	0.097	0.3	3.0	3.3	11.1	O K
15 min Winter	121.971	0.971	0.3	4.0	4.3	110.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	166.901	0.0	103.2	26
30 min Summer	101.480	0.0	125.5	40
60 min Summer	61.702	0.0	152.7	68
120 min Summer	37.516	0.0	185.7	126
180 min Summer	28.043	0.0	208.2	182
240 min Summer	22.811	0.0	225.8	240
360 min Summer	17.051	0.0	253.2	300
480 min Summer	13.869	0.0	274.6	364
600 min Summer	11.817	0.0	292.5	432
720 min Summer	10.367	0.0	307.9	500
960 min Summer	8.418	0.0	333.4	642
1440 min Summer	6.277	0.0	372.8	918
2160 min Summer	4.681	0.0	417.1	1324
2880 min Summer	3.801	0.0	451.5	1732
4320 min Summer	2.641	0.0	470.6	2468
5760 min Summer	2.040	0.0	484.6	3064
7200 min Summer	1.670	0.0	495.8	3744
8640 min Summer	1.418	0.0	505.1	4408
10080 min Summer	1.234	0.0	513.2	5136
15 min Winter	166.901	0.0	115.6	26

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Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 15.3 (continued)
Summary of Design Calculations for Cellular Storage

Ambellia Consultancy		Page 2
11 Longwood House	Cellular Storage	
Love Lane	Rochdale Town Hall Slopes	
Cirencester, Clos, GL7 1YG	Rochdale, OL16 1AB	
Date 22/08/2022 12:57	Designed by Dr R Evans	
File CHURCH SLOPES COMBINED....	Checked by	
Innovyze	Source Control 2020.1.3	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	122.164	1.164	0.3	4.3	4.6	132.7	O K
60 min Winter	122.370	1.370	0.3	4.6	5.0	156.2	O K
120 min Winter	122.567	1.567	0.3	4.9	5.3	178.7	O K
180 min Winter	122.659	1.659	0.3	5.1	5.4	189.1	O K
240 min Winter	122.701	1.701	0.3	5.1	5.5	193.9	O K
360 min Winter	122.715	1.715	0.3	5.1	5.5	195.6	O K
480 min Winter	122.704	1.704	0.3	5.1	5.5	194.3	O K
600 min Winter	122.684	1.684	0.3	5.1	5.4	191.9	O K
720 min Winter	122.654	1.654	0.3	5.0	5.4	188.5	O K
960 min Winter	122.577	1.577	0.3	4.9	5.3	179.8	O K
1440 min Winter	122.412	1.412	0.3	4.7	5.0	160.9	O K
2160 min Winter	122.170	1.170	0.3	4.3	4.6	133.3	O K
2880 min Winter	121.948	0.948	0.3	4.0	4.3	108.1	O K
4320 min Winter	121.310	0.310	0.3	4.0	4.3	35.3	O K
5760 min Winter	121.124	0.124	0.3	3.5	3.9	14.2	O K
7200 min Winter	121.095	0.095	0.3	2.9	3.2	10.8	O K
8640 min Winter	121.081	0.081	0.3	2.4	2.8	9.2	O K
10080 min Winter	121.072	0.072	0.3	2.1	2.4	8.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	101.480	0.0	140.6	39
60 min Winter	61.702	0.0	171.0	68
120 min Winter	37.516	0.0	208.0	124
180 min Winter	28.043	0.0	233.2	180
240 min Winter	22.811	0.0	252.9	236
360 min Winter	17.051	0.0	283.6	338
480 min Winter	13.869	0.0	307.6	382
600 min Winter	11.817	0.0	327.6	460
720 min Winter	10.367	0.0	344.9	538
960 min Winter	8.418	0.0	373.4	692
1440 min Winter	6.277	0.0	417.6	990
2160 min Winter	4.681	0.0	467.1	1424
2880 min Winter	3.801	0.0	505.7	1848
4320 min Winter	2.641	0.0	527.1	2464
5760 min Winter	2.040	0.0	542.8	3000
7200 min Winter	1.670	0.0	555.3	3672
8640 min Winter	1.418	0.0	565.8	4408
10080 min Winter	1.234	0.0	574.7	5024

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Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 15.3 (continued)
Summary of Design Calculations for Attenuation Basin

Ambellia Consultancy		Page 3
11 Longwood House	Cellular Storage	
Love Lane	Rochdale Town Hall Slopes	
Cirencester, Clos, GL7 1YG	Rochdale, OL16 1AB	
Date 22/08/2022 12:57	Designed by Dr R Evans	
File CHURCH SLOPES COMBINED....	Checked by	
Innovyze	Source Control 2020.1.3	

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 382150 163150 ST 82150 63150
C (1km)	-0.023
D1 (1km)	0.388
D2 (1km)	0.382
D3 (1km)	0.208
E (1km)	0.278
F (1km)	2.507
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.330

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.110	4	8	0.110	8	12	0.110

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11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 15.3 (continued)
Summary of Design Calculations for Attenuation Basin

Ambellia Consultancy		Page 4
11 Longwood House Love Lane Cirencester, Clos, GL7 1YG	Cellular Storage Rochdale Town Hall Slopes Rochdale, OL16 1AB	Micro Drainage
Date 22/08/2022 12:57 File CHURCH SLOPES COMBINED....	Designed by Dr R Evans Checked by	
Innovyze	Source Control 2020.1.3	

Model Details

Storage is Online Cover Level (m) 123.000

Cellular Storage Structure

Invert Level (m) 121.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.05000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.05000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	120.0	50.0	2.000	120.0	50.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0095-4000-1000-4000
Design Head (m)	1.000
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	95
Invert Level (m)	121.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.0
Flush-Flo™	0.294	4.0
Kick-Flo®	0.629	3.2
Mean Flow over Head Range	-	3.5

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	3.0	1.200	4.3	3.000	6.7	7.000	10.0
0.200	3.9	1.400	4.7	3.500	7.2	7.500	10.3
0.300	4.0	1.600	5.0	4.000	7.6	8.000	10.6
0.400	3.9	1.800	5.3	4.500	8.1	8.500	10.9
0.500	3.8	2.000	5.5	5.000	8.5	9.000	11.2
0.600	3.4	2.200	5.8	5.500	8.9	9.500	11.5
0.800	3.6	2.400	6.0	6.000	9.3		
1.000	4.0	2.600	6.2	6.500	9.6		

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Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

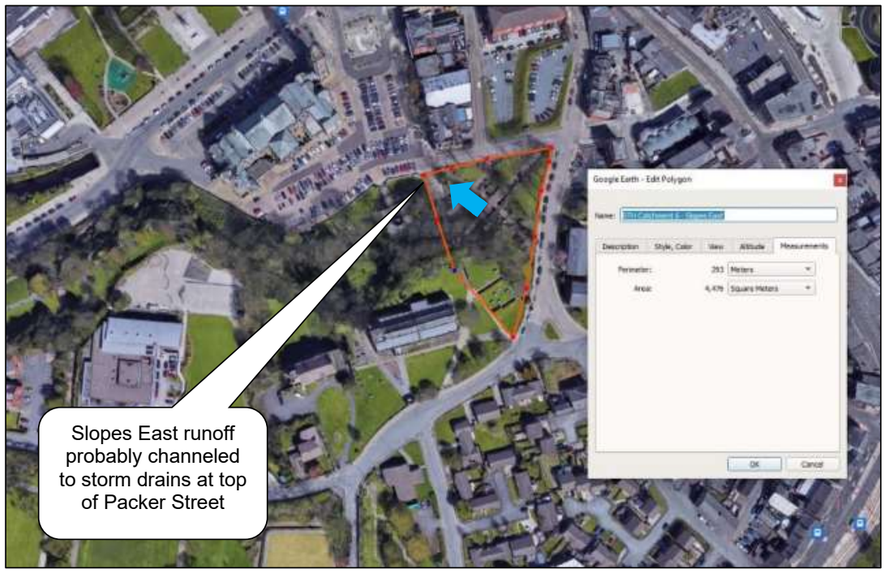
16.0 Catchment 6 – Slopes East - RTH Drainage Considerations

Catchment 6 is the Slopes East which has a surface area 4,476 m² (Fig. 16.1)

A significant drain for the surface runoff from the slopes east catchment is next to the base of the church steps (Fig. 16.1).

As previously mentioned for the other slopes catchments, it should be determined if storm runoff flow attenuation is required based on the relative flow capacity of the new RTH drainage compared with the slopes storm runoff rates.

Fig. 16.1
Catchment 6 – Slopes East



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Fig. 16.2
Significant Drain for Catchment 6 – Slopes East Next to Church Steps

17.0 Summary of Conclusions & Recommendations

This section presents the outline plan for restoring the two historic water supply systems on the slopes (Packer Spout and Fulling Mill) and for generally improving the slopes drainage and helping to avoid the overwhelming of the new RTH drainage during storm runoff conditions

The 6 slope runoff catchments defined for this report are shown in Fig. 17.1.

Recommendations for the restoration of the Packer Spout Water Supply are listed in Fig. 17.2.

Recommendations for the restoration of the Fulling Mill Water Supply are listed in Fig. 17.3.

A Summary of RTH Slopes Catchments drainage problems and recommendations for remedies are listed in Fig. 17.4.

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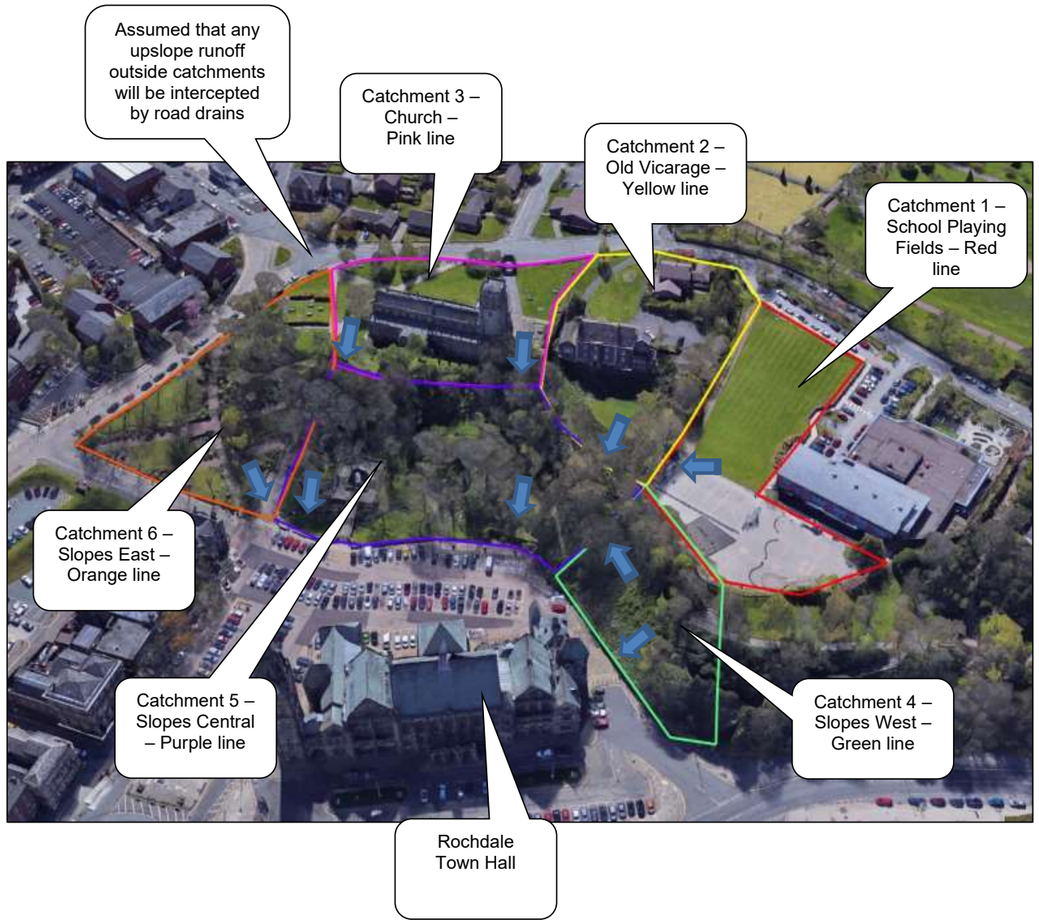
Figure 17.1
'3D' Aerial Photo Showing 6 Main Water Runoff Catchments for the RTH Slopes
(Blue arrows indicate main exit routes for runoff from catchments)



Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

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Figure 17.2
Recommendations for Restoration of the Packer Spout Water Supply

Item No.	Description
1	Restoring the catchpit for the main spring source so that sand is trapped in the catchpit and the spring water flows directly into half-round culvert and so removing the pond
2	Restoring the other 5 spring catchpits which can also act as sand/silt traps
3	Removing the back plastic pipes and other debris from the half round pipes
4	Refilling the round holes in the main west-east half-round culvert with lime mortar to stop water leaking to the slopes
5	Recovering the half-round culverts with the 90 cm natural stone slabs
6	Restoring the round brick sand/silt trap at the eastern end of the main half-round culvert
7	Restoring the stone culvert from the round brick chamber to the Packer Spout reservoir
8	Cleaning out the Packer Spout reservoir
9	Restoring the inflow and outflow controls for the Packer Spout reservoir
10	Laying new pipe from the Packer Spout Reservoir to the new RTH drainage to avoid current leaking drainage pipes
11	Determine if flow attenuation is required based on the relative flow capacity of the new RTH drainage compared with the slopes storm runoff rates.
12	Prepare maintenance plan including prevention of build-up of sand, silt and algae.

Ambellia Consultancy
11 Longwood House, Love Lane, Cirencester, Gloucestershire, GL7 1YG, UK.
Tel/Fax: +44-(0)1258-472365. Mobile: 07879-400343. E-mail. robinevans@ambellia.co.uk
Robin Evans, B.Sc., M.Sc., MBA, Ph.D.

Figure 17.3
Recommendations for Restoration of the Fulling Mill Water Supply

Item No.	Description
1	Restoring the complete length of the stone culvert from the western side of St Chad's church to the underground brick chamber (which is 11 m from the base of the slope)
2	Restoring the system catchpits and culverts which is draining the lower spring line and channelling water to the underground brick chamber.
3	Determine if flow attenuation is required based on the relative flow capacity of the new RTH drainage compared with the slopes storm runoff rates.
4	Prepare maintenance plan

Figure 17.4
Summary of RTH Slopes Catchments Drainage Problems and Remedy Recommendations

Catchment No.	Catchment Name	Problems	Remedy
1	School Playing Fields	Possible uncontrolled runoff from the school playing fields is possibly reaching the RTH slopes via the vicarage garden	If confirmed, divert runoff away from RTH slopes or if required install flow attenuation prior to water reaching RTH slopes
2	Old Vicarage (Partnership House)	Foul water from vicarage probably reaching RTH slopes combined with runoff	If confirmed, connect vicarage to mains drains for install PWTP
		Possible uncontrolled runoff from the vicarage is reaching the RTH slopes via the vicarage garden	If confirmed, install flow attenuation if required prior to water reaching RTH slopes
3	Church	Foul water from church probably reaching RTH slopes combined with runoff	If confirmed, connect church to mains drains for install PWTP
		Uncontrolled runoff from the church is reaching the RTH slopes	Install flow attenuation if required at the base of the slopes
4	Slopes West	Unknown extent and condition of drains on these very steep slopes	Monitor drainage of catchment. Avoid damage to any drains during new planting
5	Slopes central	Blocked lateral field drains at base of slope	The lateral land drains at the base of the slope need to be replaced, with the land drain gravel covered by a permeable geotextile membrane to prevent silt blocking the land drain gravel.
			Runoff attenuation should be installed if required based on the relative flow capacity of the new RTH drainage compared with the slopes storm runoff rates.
6	Slopes East	Unknown extent and condition of drains on these very steep slopes	Investigate condition of significant drain for the surface runoff next to the base of the church steps
			Determine if storm runoff flow attenuation is required based on the relative flow capacity of the new RTH drainage compared with the slopes storm runoff rates.

Donald Insall Associates
Chartered Architects and Historic Building Consultants