



NHS Property Services

**Proposed Redevelopment of Former Clitheroe
Hospital, Chatburn Road, Clitheroe, Lancashire**

Flood Risk and Foul Drainage Assessment

December 2016

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Flood Risk Assessment and Foul Drainage Assessment



Report Control

REPORT Flood Risk and Foul Drainage Assessment

Project: Proposed Redevelopment of Former Clitheroe Hospital, Chatburn Road, Clitheroe, Lancashire

Client: NHS Property Services

Job Number: A094939


File Origin: \\LEEDS2\Data\Projects\A090001-A095000\A094939\reports\FRA\Clitheroe FRDA Dec 16.doc

Document Checking:

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Issue	Date	Status	Checked for Issue
1	14/12/16	First Issue	
2			
3			
4			

Flood Risk Assessment and Foul Drainage Assessment



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1 INTRODUCTION

1.1 PURPOSE OF THE REPORT

NHS Property Services has commissioned WYG Engineering Ltd to undertake a Flood Risk and Foul Drainage Assessment (FRDA) in respect of the proposed retirement residential development on a 1.97 ha site at the site of the former Clitheroe Community Hospital, off Chatburn Road, Clitheroe, Lancashire. This report has been prepared to accompany the outline planning application for the development.

1.2 PROPOSED DEVELOPMENT

The proposed development is to consist of up to 50 residential units comprising a mix of 2, 3, 4 and 5 bedroom units together with associated landscaping and infrastructure.

The application site is currently occupied by buildings associated with the former Clitheroe Community Hospital and its existing associated infrastructure, thus the site is regarded as a brownfield development.

The proposed development is classified as "More Vulnerable" in accordance with Table 2 of the PPG - Flood Risk & Coastal Change (PPG).

A copy of the Indicative Masterplan is contained in Appendix A.

1.3 REQUIREMENT FOR FLOOD RISK ASSESSMENT

According to flood risk mapping provided by the EA, the site is located entirely within Flood Zone 1: i.e. land assessed as having an annual probability of river or sea flooding less than 1 in 1000 (<0.1% Annual Exceedance Probability (AEP)) in any one year. However, as the application site is in excess of one hectare, in accordance with the Planning Practice Guidelines (Flood Risk & Coastal Change), a Flood Risk Assessment is required to support the outline planning application.

1.4 SCOPE OF THE FLOOD RISK ASSESMENT

The FRA will be undertaken in accordance with the guidelines of the Environment Agency Flood Risk Assessment (FRA) Guidance Note 1.

The FRA will assess the existing flood risk to the site and establish a management regime for surface water runoff from the site such that flood risk to adjoining areas is not exacerbated. If not managed properly, surface water runoff from the site could potentially lead to increases in flood risk to other areas or the development itself.

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In line with the PPG, the FRA will also consider other potential sources of flood risk, such as sewers, overland flow routes, groundwater flooding, reservoir flooding, and minor watercourses not shown on EA flood map.

As the planning application is only an outline application then an outline surface water drainage strategy will be included in which potential measures for draining surface water will be discussed, and this will have a specific focus on implementing Sustainable Drainage Systems (SUDs) strategies. The strategy will provide only an outline strategy, which will be developed in detail during the subsequent reserved matters planning stage for the application.

1.5 FOUL DRAINAGE ASSESSMENT

The Foul Drainage Assessment will review the existing foul water drainage systems within and adjacent to the development site and identify the peak flows from the proposed development. The assessment will also identify points of connection to the public sewer system via a pre development application to United Utilities in relation to the proposed peak foul flows from the development.

1.6 LIMITATIONS OF THIS REPORT

This report has been prepared by WYG Engineering on behalf of the NHS Properties with the scope of the report as described in Section 1.2 above and the particular instructions and requirements. It is not intended for and should not be relied on by any third party and no responsibility is undertaken to any third party.

WYG Engineering accepts no duty or responsibility (including in negligence) to any party other than the NHS Property Services and disclaims all liability of any nature whatsoever to any such party in respect of this report.

This report cannot be reproduced without WYG's written consent.

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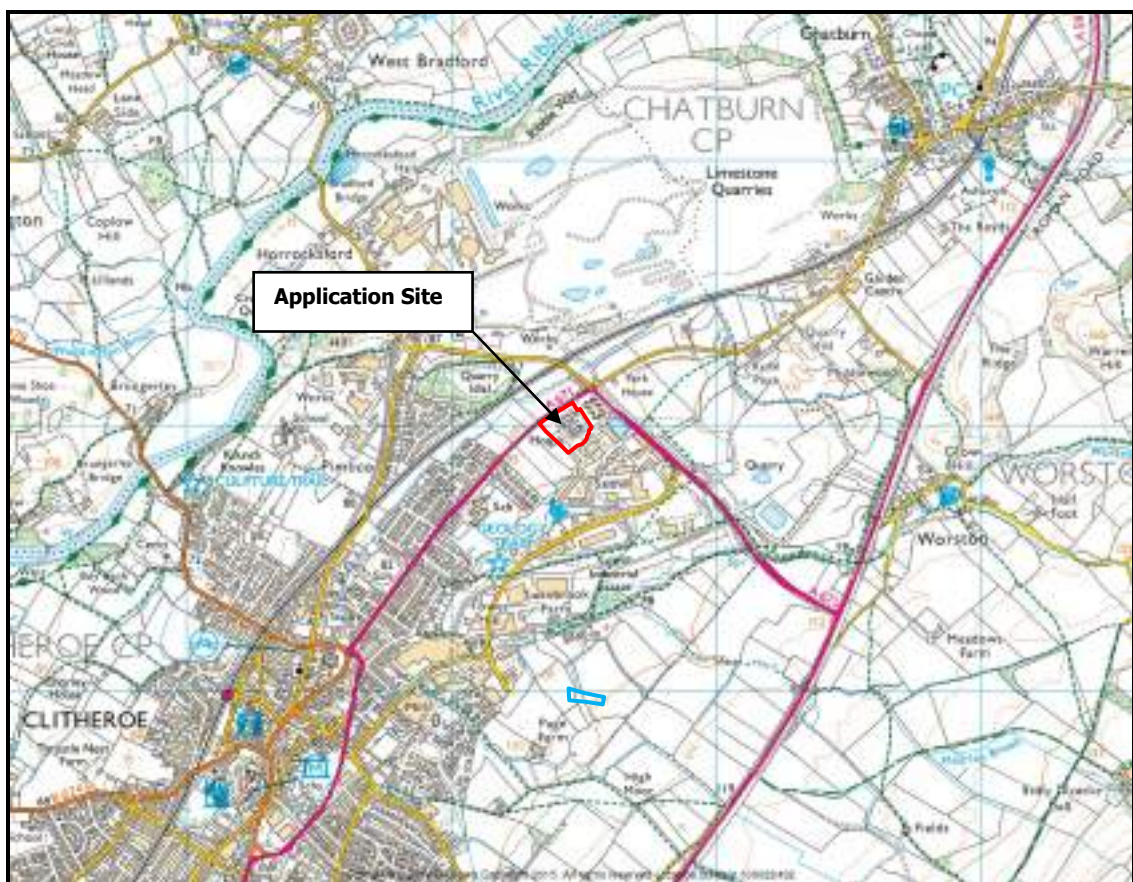


2 SITE DESCRIPTION

2.1 EXISTING SITE

The application site covers an area of 1.97 ha and is located off Chatburn Road, Clitheroe, Lancashire, as shown in Figure 1 and Figure 2 below. The postcode and grid reference of the site are BB7 1QJ and SD 75456 43013 respectively.

Figure 1 – Site Location¹



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Figure 2 – Site Plan



The application site is currently defined as a combination of greenfield and brownfield.

The application site is located in the north eastern outskirts of Clitheroe. It is bounded to the northwest by Chatburn Road, beyond which is greenfield land, to the southwest by scrub land, to the southeast by a business park, and to the northeast by the new Clitheroe Hospital.

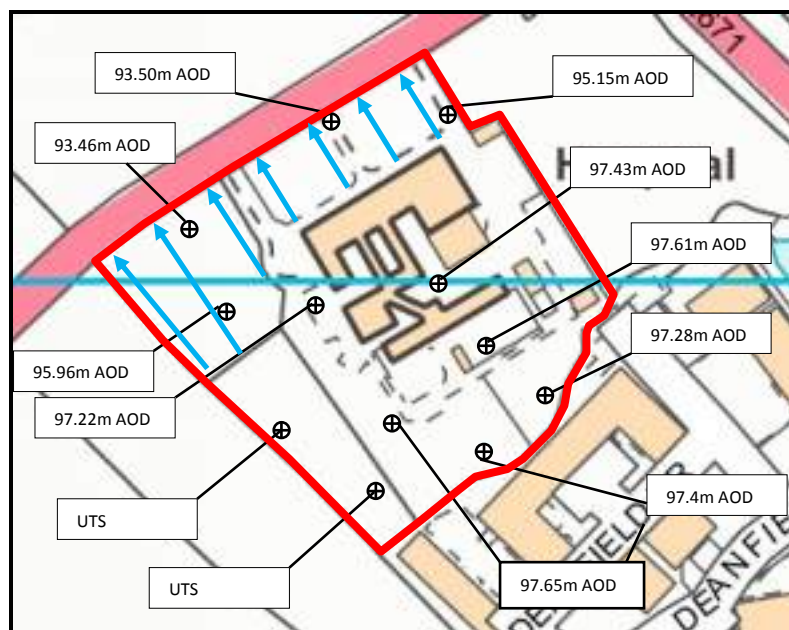
A topographic survey undertaken in September 2015 and this indicated that the highest point of the site was located near the south eastern corner of the site next to one of the existing buildings at a level of 98.08m AOD, and the lowest point lies near the north western boundary of the application site at a level of 93.46m AOD. The land on which the existing buildings are located is predominantly level, and the land fronting Chatburn Road falls towards the highway. Figure 3 below shows the direction of slopes across the application site, as well as the high and low points.

A copy of the Topographic Survey for the site is contained within Appendix B.

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Figure 3 – Existing Site Levels and Approximate Falls within the Application Sites



2.2 EXISTING DRAINAGE

2.2.1 Main Rivers

The nearest main river to the application site (as listed on the EA Flood Map for Planning) is an unnamed watercourse located approximately 110m to the north west of the site which flows in a south westerly direction and is a tributary of Mearley Brook.

2.2.2 Ordinary and Manmade Watercourses

The nearest ordinary watercourse to the site is located 90m north of the application site, and becomes Mearley Brook as it flows west to the north east of the application site and flows north into the un named watercourse described in Section 2.2.1

2.2.3 Sewers

United Utilities Sewers

Inspection of the United Utilities (UU) Sewer Records have identified a 225mm diameter surface water sewer to the east of the application site draining through the new Clitheroe Community Hospital to the east of the site in a north westerly direction. The records indicate that this discharges into the watercourse to the northwest of the application site, and recent drainage survey supports this. A 225mm diameter combined sewer (also confirmed through a drainage survey) is located to the southwest of the application site, and drains in a north westerly direction, connecting to a 225mm diameter combined sewer draining in a south westerly direction along Chatburn Road.

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A copy of the sewer records received from UU is contained in Appendix C.

Private Sewers

A drainage survey was undertaken to identify how the existing site is drained and this indicated that the application site is drained by a combined system discharging into a 150mm diameter combined sewer located within Chatburn Road which drains to the south west along Chatburn Road eventually discharging into United Utilities combined sewer mentioned above.

In addition, it would appear that there is also a highway drain located within the footway of Chatburn Road which also drains south west along Chatburn Road and discharges into the United Utilities 225mm diameter combined sewer. However, several of the manholes along the line of the sewer were surcharged and will require cleaning out in order to validate the line and connection of the sewer.

A copy of the drainage survey results is contained within Appendix D.

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3 FLOOD RISK

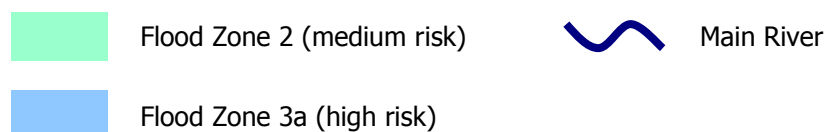
3.1 FLUVIAL FLOOD RISK

Fluvial flood risk is the risk arising from rivers and watercourses.

3.1.1 Environment Agency Data Review – Fluvial Flooding

According to Flood Risk Mapping for Planning obtained from the EA website (see Figure 4 below), the site is located entirely within Flood Zone 1, outside the extent of the 0.1% AEP (1 in 1000) risk of flooding from a major river in any one year. As the site is located in Flood Zone 1, it is considered to be at low risk of flooding from fluvial sources.

Figure 4 - Environment Agency Flood Map for Planning (downloaded 8th December 2016)



Since the application site is located within Flood Zone 1, it is not required to issue a pre development consultation to the Environment Agency as responsibility for flood risk is now covered by the Lead Local Flood Authority for the area, this being Lancashire County Council.

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3.1.2 Lancashire County Council Lead Local Flood Authority - Consultation

A consultation was issued to LCC LLFA to identify any Flood Risk and Drainage issues that are required to be addressed within this FRDA and are relevant to the proposed development. No response has yet been received, but once it has, it will be issued as a Flood Risk Addendum note.

3.1.3 Ribble Valley Borough Council - Consultation

A consultation was also issued to Ribble Valley Borough Council to identify any Flood Risk and Drainage issues that are required to be addressed within this FRDA and are relevant to the proposed development. In their response, RVBC recommended contacting the EA and Lancashire County Council for more information.

3.1.4 Ribble Valley Borough Council - Strategic Flood Risk Assessment 2010 (SFRA)

A review of the Ribble Valley Borough Council SFRA (dated May 2010) was undertaken to identify any flood risks associated with the application site that are required to be considered in providing flood mitigation and establishing an adequate surface water drainage strategy.

- a) Map 1 of the SFRA confirms that the application site lies in Flood Zone 1. This is shown in Appendix E.
- b) The SFRA provides no evidence that the application site is at risk of surface water flooding.
- c) The SFRA does not indicate that the application site has suffered from sewer flooding historically.
- d) Map 1 indicates that the application site has not been affected by any historical flooding events.
- e) The SFRA states that groundwater is not considered to be a significant flood risk in the RVBC area.

3.1.5 Lancashire County Council - Preliminary Flood Risk Assessment (PFRA)

A review of the Lancashire County Council Preliminary Flood Risk Assessment dated August 2011 does not highlight any flooding events in Clitheroe and no additional specific flood risks to the site were identified within this document.

3.2 SEWER FLOODING

Neither the SFRA nor the PFRA indicated any specific records of sewer flooding affecting the site; therefore, the risk of sewer flooding to the application site is considered low.

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3.3 SURFACE WATER FLOODING

Surface water flooding occurs where high rainfall events exceed the drainage capacity in an area (i.e. sewer system and/or watercourse), leading to flooding.

An extract of the Environment Agency's Risk of Surface Water Flooding map is shown below in Figure 5.

Figure 5 - Extract from the Environment Agency's Risk of Flooding Surface Water Map



Figure 5 indicates that the application site is at very low risk of surface water flooding, with isolated parts of the site at low risk of surface water flooding. This is presumed to be a result of isolated low lying areas of the land. The SFRA and PFRA show no evidence that the application site has suffered from surface water flooding. The risk of surface water flooding to the application site is therefore concluded to be low.

3.4 RUN OFF FROM OVERLAND SOURCES

3.4.1 Assessment of Existing Overland Flows into the Site

The land to the north west and east falls away from the application site, and the land to the south is a development assumed to be drained to a 1 in 30 year standard, therefore the application site is not considered to be at any risk of overland flooding.

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3.5 GROUND WATER

3.5.1 Groundwater Source Protection Zone

A review of the EA's Ground Water Source Protection Zone (GWSPZ) map for the development site location shows that the site is not located within a Groundwater Source Protection Zone.

The EA Groundwater Vulnerability maps indicate that the application site is located in a Major Aquifer Low Groundwater Vulnerability Zone.

3.5.2 Groundwater

BGS Maps

Based on the BGS maps, the application site is underlain by superficial deposits of Till – Devensian – Diamicton. The underlying bedrock is composed of Limestone Formation and Hodder Mudstone Formation.

Infiltration is unlikely to be viable given the low permeability of Till, however a full ground investigation including infiltration testing and groundwater monitoring, as well as a Preliminary Risk Assessment (to assess contamination), should be undertaken in support of the future reserved matters planning application to confirm whether or not infiltration would be feasible.

The SFRA does not indicate any recorded instances of groundwater flooding affecting the application site nor the adjacent area, therefore it is concluded that the risk of groundwater flooding affecting the application site is low.

3.6 RESERVOIR FLOODING

Although the probability of a catastrophic dam failure is considered to be extremely low, the consequence of such an event would be severe. A review of the EA online 'Risk of Flooding from Reservoirs' identified that the application site is not located within a zone at risk of reservoir flooding.

3.7 SUMMARY OF FLOOD RISK

3.7.1 Overview of Flood Risk

Based on the above it can be seen that the application site is considered to be at low risk of flooding from fluvial sources, and at low risk of flooding from surface water, overland sources, sewers, groundwater, and reservoir failure.

It will be essential to ensure that no increase in flooding occurs downstream of the site as a result of the development and this matter is discussed in more detail within Chapter 4.

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4 DEVELOPMENT PROPOSALS

4.1 PROPOSED DEVELOPMENT

The proposed development is to consist of up to 50 residential units comprising a mix of 2, 3, 4 and 5 bedroom units together with associated landscaping and infrastructure.

The application site is currently occupied by derelict buildings associated with the former Clitheroe Community Hospital and its existing associated infrastructure, thus the site is regarded as a brownfield development.

The proposed development is classified as "More Vulnerable" in accordance with Table 2 of the PPG - Flood Risk & Coastal Change (PPG).

A copy of the Indicative Masterplan is contained in Appendix A.

4.2 SEQUENTIAL TEST

One of the aims of the PPG is to steer development away from zones of high flood risk towards Flood Zone 1. According to Table 2 of the PPG (Flood Risk & Coastal Change), the development is classified as 'More Vulnerable', and given that the application site is located entirely in Flood Zone 1, according to the current EA Flood Map for Planning, the proposed development elements are all considered appropriate in flood risk terms.

Based on the above it can be shown that the development proposals comply with the requirements of Table 3 of the PPG (Flood Risk & Coastal Change) by locating all development within the Flood Zone 1 areas and therefore the Sequential Test is considered to have been passed and there is no requirement to apply the Exception Test.

4.3 REVIEW OF PLANNING POLICIES

Policy DME6: Water Management of the Ribble Valley Core Strategy states that:

- Development will not be permitted where the proposals would be at an unacceptable risk of flooding exacerbate flooding elsewhere. Applications for development should include appropriate measures for the conservation, protection and management of water such that development contributes to:
 - Preventing pollution of surface and / or groundwater
 - Reducing water consumption

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- Reducing the risk of surface water flooding (for example using SUDS)
- The council will also seek protection of watercourses for biodiversity value.
- All applications for planning permission should include details for surface water drainage and means of disposal based on SUDS principles. The use of the public sewer system is the least sustainable form of surface water drainage, therefore development proposals will be expected to investigate and identify more sustainable alternatives to help reduce the risk of surface water flooding and environmental impact.

4.4 DEVELOPMENT AND FLOOD RISK

4.4.1 Flood Risk to the Development

As discussed in Section 3.7.1, the site is considered to be at low risk of fluvial flooding, and at low risk of flooding from groundwater, sewer, overland flows, and reservoir failure. Additionally, in accordance with the requirements of the PPG and the NPPF, it is essential that the development of the site does not increase the risk of flooding off site.

4.4.2 Flood Risk Arising from the Development

The new development will result in the development of a part greenfield, part brownfield site in flood risk terms. In line with the requirements of the DEFRA Non Statutory Technical guidance on SUDs, the rate of surface water run off from the development site is to be restricted to the pre development greenfield rate of run off.

On site attenuation is therefore to be provided within the application site to ensure that the proposed surface water drainage system does not exacerbate flood risk outside of the extent of the proposed development for all storm events upto and including the 1 in 100 plus 30% allowance for climate change storm event.

4.5 ASSESSMENT OF PRE AND POST DEVELOPMENT AREAS

The application site covers an area of 1.97ha and is currently 43% impermeable.

In accordance with the requirements of the DEFRA Non Technical Standards for Sustainable Drainage, the post development discharge rate is to be based on the existing pre development greenfield discharge rate and therefore no allowance will be made for the existing surface water run off from the existing impermeable areas.

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In assessing the post development impermeable areas it has been assumed that 60% of the new development will be impermeable although this figure will be reviewed together with any subsequent calculations of the required attenuation volumes during the detailed drainage design following the preparation of a detailed site layout.

Table 1 below shows the pre and post development permeable and impermeable areas for the application site.

Table 1 – Pre and Post Development Areas for Application Site

Status	Impermeable Area (Ha)	Permeable Area (Ha)
Pre Development	0.86	1.11
Post Development	0.6	1.37

The above proposed post development impermeable areas have been adopted in assessing the preliminary on site attenuation volumes.

4.5.1 Existing Discharge Rates

The existing peak greenfield run off rate for the 1.11 ha permeable greenfield part of the site has been calculated using the ICP SUDs module of the Micro Drainage software package, with the peak run off per hectare for a number of key storm events summarised as follows:

- a) 1 in 1 year = 6.5 l/s/ha
- b) 1 in 30 year = 12.7 l/s/ha
- c) 1 in 100 year = 15.6 l/s/ha
- d) $Q_{bar} = 7.5$ l/s/ha

The above green field run off calculation is contained in Appendix F of this report.

The Q_{bar} value of 7.5 l/s/ha been adopted as the maximum post development discharge rate in assessing the required on site surface water attenuation, although this will be restricted to the proposed post development impermeable areas.

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4.5.2 Proposed Discharge Rates

It is proposed to discharge surface water run off from the impermeable areas of the site at existing green field rates in accordance with the requirements of the DEFRA Non Statutory Technical Standards for Sustainable Drainage.

Table 2 – Proposed Discharge Rates

Area (ha)	1.97
Post Development Impermeable Area (including 10% Urban Creep allowance)	0.66
Existing greenfield run off rate for site Qbar per hectare (l/s/ha)	7.5
Greenfield Run off rate (Qbar) for Total Site Post Development Impermeable Area (l/s)	4.95
Proposed Discharge Rate (l/s)	5.0

Although the calculated allowable discharge rate will be 4.95 l/s a minimum value of 5 l/s has been adopted as this is the lowest practical value for a flow control unit usually adopted to avoid any maintenance issues with the flow control outlet.

4.6 SURFACE WATER DRAINAGE STRATEGY

It is proposed to discharge surface water from the proposed 0.66 ha impermeable area of the site to the watercourse to the north of the site at the Q_{bar} greenfield run off rate of 5.0 l/s.

Initially, it is proposed to locate the on site detention ponds within the area of open space located adjacent Chatburn Road with a new gravity sewer being laid along Chatburn Road discharging into the existing outfall into the un named watercourse to the north of Chatburn Road. However, alternative locations or form of the detention ponds and the outfall route to the watercourse may need to be considered due to the presence of the existing retained trees within the site frontage and this should be reviewed as part of the reserved matters application.

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It will be necessary to provide attenuation storage to contain surface water run off from the 1 in 30 year storm event. This attenuation is proposed to be provided as SUDs features, such as detention ponds, swales, and permeable paving, which all may provide water quality and amenity benefits in addition to reducing downstream flood risk.

Further details regarding the potential SUDs features are shown in Chapter 5. Exceedance storage to contain surface water run off from all events up to and including the 1 in 100 year + climate change event can be provided within above ground depressions such as car parking areas, such that all exceedance run off is contained on site. If storage of exceedance surface water flows above ground is not acceptable, it is proposed to provide formal attenuation for all flows up to and including those as a result of the 1 in 100 year + climate change storm event.

If the use of SUDs options is identified as not being viable or reasonable¹ when compared to a similar system based on the minimum Building Regulation requirements, then the attenuation storage can be provided using an underground cellular attenuation tank or oversized pipework sized for the 1 in 30 year storm event.

It will be necessary to install a new sewer and outfall to the watercourse to the north of this site. This will require a legal agreement with the riparian owner of the watercourse and a Land Drainage Consent from the LLFA.

The proposed surface water drainage strategy is contained in Appendix G.

4.7 PROPOSED MITIGATION

4.7.1 Flood Risk due to Surface Water Runoff from the Site

In order to ensure that surface water runoff from the site does not cause an increase in flood risk, the management of runoff has been considered via a sequential approach, in line with Building Regulations. The following options for the disposal of surface water runoff were considered, in order of preference²:

- i) A soakaway or some other infiltration system;
- ii) A watercourse;
- iii) A sewer.

¹ Reasonable and “what is reasonably practical” is as set out within paragraphs 082,083,084 and 085 of the PPG (Flood Risk & Coastal Change) and compliance with the Technical Standards (i.e. DEFRA Non Statutory Technical Standards for Sustainable Drainage) will be regarded as not practical, if the cost of compliance exceeds the cost of compliance with Building Regulations (unless compliance is necessary where there is a risk of flooding requiring the development to be safe and to avoid flood risk elsewhere).

² Building Regulations H3(3), Rainwater drainage

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4.7.1.1 Discharge to soakaway

This is the preferred method for disposal of surface water run off, however, infiltration is considered unlikely to be feasible given that the underlying till tends to have poor permeability. A full ground investigation including infiltration testing and groundwater monitoring should be undertaken to confirm the feasibility of infiltration. Given the steep slopes to the north of the site, groundwater emergence of infiltrated water is a factor which would have to be considered.

4.7.1.2 Discharge to Watercourse

The proposed surface water drainage strategy seeks to discharge surface water from the proposed impermeable surfaces of the site to the watercourse to the north of the site at the existing greenfield run off rate. Attenuation SUDS components will be incorporated.

4.7.1.3 Discharge to Sewer

It is not proposed to discharge surface water to the sewer network and it should be noted that at present the existing site drains to the United Utilities combined sewer system and therefore the proposed surface water strategy will reduce the volume of surface water discharging to the sewer.

4.7.2 Assessment of Post Development Surface Water Attenuation Volumes

In order to provide an estimation of the future attenuation volumes required, a preliminary assessment using the Micro Drainage modelling programme has been undertaken.

Table 3 below provides a summary of the estimated attenuation storage volumes required for the application site based on the impermeable areas and proposed discharge as listed in Table 2.

Table 3 – Summary of Micro Drainage Quick Storage Calculations

	Impermeable area (ha)	Allowable discharge rate (l/s)	1 in 30 year storage (m ³)	Additional storage required to satisfy 1 in 100 (plus 30% CC) exceedance flows (m ³)	Total storage to satisfy 1 in 100 (plus 30% CC) exceedance flows (m ³)
Application Site	0.66	5	306	286	592

A copy of the preliminary Micro Drainage Quick Storage calculations is contained within Appendix H.

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It should be noted that the volumes indicated are preliminary and should be verified as part of the detailed scheme design once the detailed site layout and existing on site drainage has been established and the exact extent of the developed impermeable areas has been confirmed.

4.7.3 Minimum Finished Floor Levels & Overland Flood Route

In setting the final external levels for the development it is important to ensure that if flows in exceedance of the 1 in 100 years plus 30% allowance for climate change storm event occur or a failure of the site surface water drainage system occurs, that suitable overland flood routes are provided within the development to ensure no localised flooding of the buildings occurs within the development.

It is therefore proposed to direct overland surface water flows to the tributary to Mearley Brook to the north of the application site, given that the site naturally drains in that direction. The site levels and layout will be set in order to maintain an overland surface water flood path through the development out to the tributary. Additionally, it is proposed that the finished floor levels of the new buildings are to be set 150mm above the average ground level, which will ensure that in the event of extensive overland flows, no flooding of the buildings will occur. Additionally, by installing a suitable surface water drainage system, this should deal with any potential surface water flooding issues on site.

4.8 RESIDUAL FLOOD RISK

If the above mitigation measures are provided as part of the development, it is considered that the primary residual failure would be as a result of some type of failure of the site drainage system during the life of the development. Regular, ongoing maintenance will therefore be required to ensure that the capacity of the system is maintained as it has been designed.

In addition, as discussed above there remains a residual risk of a storm event that exceeds the capacity of the drainage system, as events beyond the 1 in 100 year plus 30% allowance for climate change storm event will not be catered for explicitly.

4.9 FUTURE MAINTENANCE RESPONSIBILITIES

As it is anticipated that upon completion of the development the surface water sewers will be adopted under a Section 104 agreement with United Utilities, responsibility for the maintenance of the new surface water drainage systems will eventually be with United Utilities.

Maintenance and adoption of SUDs will be covered in Section **Error! Reference source not found..**

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5 SUDS

5.1.1 SuDS and Design Principles

It is proposed to incorporate a fully compliant SUDS strategy where economically viable³ in relation to the discharge of surface water drainage from the proposed development.

This section will also seek to identify some of the SUDS systems and techniques which are to be considered and reviewed as part of the proposed detailed surface water drainage design and subsequent planning application for the development site.

5.1.2 The SUDS Management Train

The overarching principles of a SUDS system are to minimise the impacts arising from the development on the quantity and quality of the development surface water run-off, whilst at the same time replicating the natural drainage from the site before development.

SUDS key objectives are to minimise the impacts from the development on the quantity and quality of run-off and to maximise amenity and biodiversity opportunities.

The accepted SUDS management train consists of three elements:

Source Control

- Water butts, green roofs, filter drains, pervious surfaces, swales, rain water harvesting

Site Control

- Swales, ponds, wetlands, infiltration devices

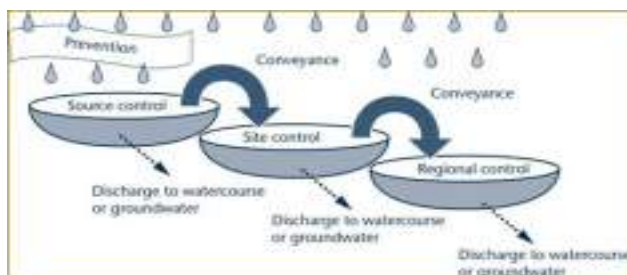
Regional Control

- Basins, ponds and wetlands
- Reservoirs

The following is an illustration of these principles and how they may be applied to a development via a SUDS Management Train.

³ Reasonable and “what is reasonably practical” is as set out within paragraphs 082,083,084 and 085 of the PPG (Flood Risk & Coastal Change) and compliance with the Technical Standards (i.e. DEFRA Non Statutory Technical Standards for Sustainable Drainage) will be regarded as not practical, if the cost of compliance exceeds the cost of compliance with Building Regulations (unless compliance is necessary where there is a risk of flooding requiring the development to be safe and to avoid flood risk elsewhere).

Flood Risk Assessment and Foul Drainage Assessment



Various methods are currently available for source, site and regional control. A review has been undertaken of how best the various systems and sub techniques could be incorporated into the proposed surface water management design and these are set out below:

Table 4 - Source Control Methods

Type of SUDS	Description	Applicability to the Site
Water butts	Small storage tanks on each individual housing plot	This is considered to be appropriate for this site.
Grey water recycling	Water collected from residential and commercial use and reused.	This is considered not to be appropriate for the site.
Rain water harvesting	Recycling of water from roofs and impermeable areas.	This may be appropriate for this site.
Green roofs	Vegetated roofs that reduce runoff and remove pollutants	This is considered not to be appropriate for the site.
Filter drains	Linear drains or trenches filled with granular material that allow infiltration to the surrounding ground	This is unlikely to work in an infiltration capacity, however it could be provided to provide water quality benefits.
Pervious surfaces	Surfaces that allow surface water inflow into underlying surfaces	The underlying ground is unlikely to allow infiltration, however these may still be suitable for providing an extra level of treatment and additional attenuation storage.
Swales	Vegetated channels to convey store and treat runoff.	This may be appropriate for this site as non infiltrative attenuation storage devices.
Local Shallow basins/ponds	Shallow areas of open space that temporarily hold water and collect silt	Detention ponds are being considered to provide on site attenuation, although the low permeability of the ground render their use in infiltration unlikely.

Flood Risk Assessment and Foul Drainage Assessment



Table 5 - Site Control Methods

Type of SUDS	Description	Applicability to the Site
Swales	Vegetated channels to convey, store and treat runoff.	The use of swales could be appropriate to convey water on the site as part of a site control system (non infiltrative).
Shallow basins/ponds/wetlands	Shallow areas of public open space that temporarily hold water and collect silt	This can be incorporated to provide surface water attenuation (non infiltrative)
Infiltration devices	Generally granular trenches or soakaways that store water and allow infiltration to the surrounding ground	Infiltration is likely to be unfeasible for this site.

As the proposed SUDS strategy will only be seeking to utilise source and site wide methods, regional methods have not been considered.

5.1.3 Proposed Surface Water Drainage Principles

The rate of run off is proposed to be limited to a greenfield run off rate of 5.0 l/s for the proposed 0.66 ha post development impermeable area. Within this site a variety of SUDS techniques can be adopted. Liaison with LCC will be necessary to confirm the adoptability of various proposed SUDs components.

As discussed in Chapter 4, the surface water drainage strategy seeks to dispose of surface water through discharge of surface water to the watercourse to the north of the site, using SUDs features to provide attenuation storage, for example detention ponds, swales and permeable paving. If SUDs are not feasible on site, attenuation storage can be provided through an underground lined attenuation tank.

Infiltration, subject to a full ground investigation, has been discounted due to the underlying ground listed by the BGS database as being underlain by till, which tends to have low permeability.

The individual elements of the site wide surface water drainage system are discussed in more detail below. Examples of the following SUDs components are contained in Appendix I.

5.1.4 Permeable Paving

Permeable Paving is a type of paving designed to allow run off to seep into its internal structure, and thus can provide an element of water attenuation. Permeable paving can be designed to discharge surface water to an on site sewer system, with an impermeable surround to prevent infiltration of water into the ground. Permeable paving may be suitable for car parking areas and will provide water quality benefits through surface water draining through the basal stone layer.

Flood Risk Assessment and Foul Drainage Assessment



5.1.5 Detention Ponds

Detention ponds (also known as detention basins) are dry basins that attenuate storm water run-off by providing temporary storage and controlled release of detained runoff. They are normally vegetated depressions (i.e. grass) that remain mainly dry, except during and immediately after storm events. The detention pond may also incorporate a small permanent pool of water at the outlet to prevent re-suspension of sediment particles by high intensity storms and to provide enhanced water quality treatment for frequent storm events.

Lined detention ponds may be provided with a depth of approximately 1.5m, and side slopes of approximately 1 in 3, and subject to the final design, may incorporate shallow ledges.

The ponds will be designed to incorporate a shallow dished section within the central part to allow low flows to drain to the outfall. At times of high rainfall the pond will fill up to provide the required attenuation and then drain down to maintain a grassed area for general amenity use.

In order to provide access for maintenance to the ponds inlet and outlet structures, vehicular access will be provided around the structure utilising a grass grid or similar pavement system.

5.1.6 Swales

Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can create low flow velocities so much of the suspended particulate load in the surface water run-off settles out, thus providing effective pollutant removal. While they can be designed to allow infiltration through the base, in this instance, swales will be lined to since infiltration is not likely to be feasible. The swales would be shallow (i.e. 1m deep) depressions with a grass finish.

5.1.7 Hydraulic Considerations

The attenuation storage volumes (in the form of attenuation tanks, soakaways, swales, or detention ponds) will be designed to provide adequate storage for storm events up to and including the 1 in 30 year event. Exceedance flows due to the 1 in 100 year + 30% CC event are proposed to be stored in parking areas and above ground depression. If this is not acceptable, then the attenuation storage volume will be sized to contain all events up to and including the 1 in 100 year + 30% CC event.

5.1.8 Water Quality Considerations

The SUDS design should seek to provide an appropriate management train of SUDS components to effectively mitigate the pollution risks associated with the different site users.

Flood Risk Assessment and Foul Drainage Assessment



Within this development, pollution from vehicle parking areas is one key driver in respect of pollutant risks to the off site watercourses downstream.

In accordance with Table 3.3 of The SUDS Manual, the required number of treatment train components required for the development is two.

Reviewing the SUDS options, set out within Section 5.4, it can be demonstrated that at least two levels of treatment may be possible with these being provided by the following systems:

- a) Permeable Paving
- b) Swales with Basal Stone Layer

It is recommended that the future detailed surface water drainage design for the development site should provide at least two levels of treatment in respect of water quality where possible. Although possible options have been stated above, alternative SUDS options may also be considered during the detailed design stage which achieves the same water quality objective.

Provided that the above two levels of treatment are provided then there should be no reduction in the overall water quality within the existing watercourses, however consideration should also be made as to the overall water quality objectives of the existing watercourses in particular any downstream ecologically sensitive areas (e.g. SSSI) that may be affected by a change in the water quality regime of the existing downstream watercourses.

5.1.9 Future SUDS Maintenance Responsibilities

It is anticipated that future SUDS maintenance will be undertaken by a private management company with each property owner contributing to the maintenance of the SUDS features and this requirement will be included within the title registration of the property.

As part of the future reserved matters application, a full inspection and operation manual will be provided setting out the proposed schedule of inspection and maintenance and who will be responsible for executing these elements.

Flood Risk Assessment and Foul Drainage Assessment



6 FOUL DRAINAGE ASSESSMENT

6.1 EXISTING FOUL DRAINAGE

As stated within Section 2.2.3 the existing site is drained by a combined system which in turn drains into a 150mm diameter combined sewer draining west along Chatburn Road which in turn discharges into the existing 225mm diameter combined sewer located to the west of the site within Chatburn Road.

A copy of the sewer records received from UU is contained in Appendix C.

6.2 PROPOSED POST DEVELOPMENT FLOWS

The application site is to consist of up to 50 residential units. Based on a peak flow of 0.0462 l/s per residential unit (refer to Sewers for Adoption 6th Edition), the peak foul flow has been assessed as being 2.3 l/s. It is proposed to discharge foul flows from the application site to the existing 225mm diameter combined sewer located in Chatburn Road, as shown in Appendix G.

6.3 UNITED UTILITIES WATER PRE DEVELOPMENT ENQUIRY

A pre development application enquiry has been submitted to United Utilities to confirm the point of connection and that there is adequate capacity within the receiving wastewater network. In their response, UU stated that

- Foul will be allowed to drain to the public combined / foul sewer network, with the preferred discharge point being the 225mm diameter foul sewer in Chatburn Road at an unrestricted rate.
- Surface water from the site should drain either to a soakaway or directly to a watercourse. Discharge rates and consents must be agreed with all interested parties.
- Although UU may agree discharge points and rates in principle, it will be necessary to apply for a formal sewer connection so that UU can assess the method of construction, health and safety requirements, and to ultimately inspect the connection when it is made.
- Adoption is assessed based on Sewer for Adoption 6th Edition.

The consultation issued and the response is contained in Appendix J.

Flood Risk Assessment and Foul Drainage Assessment



7 CONSENTS REQUIRED

7.1 SECTION 106 WATER INDUSTRY ACT 1991

Any new connection to the United Utilities public sewer system will require a Section 106 application under the Water Industry Act 1991.

7.2 SECTION 104 OF THE WATER INDUSTRY ACT

The foul and surface water system within the proposed development is to be constructed to adoptable standards such that it can at a future date be adopted by United Utilities. As such, the proposed foul and surface water sewers will be subject to an agreement under S104 of the Water Industry Act 1991.

7.3 LAND DRAINAGE CONSENT

In respect to the construction of the new surface water outfall into the existing watercourse it will be necessary to obtain a Land Drainage Consent from the LLFA and also consent will also be required in relation to the proposed discharge rate of 5 l/s from the riparian owner of the watercourse.

8 CONCLUSIONS & RECOMMENDATIONS

This report has identified the following conclusions:

- The development site is shown on the EA Statutory Flood Maps for Planning as being entirely within Flood Zone 1.
- The proposed development is to consist of up to 50 new residential units together with associated infrastructure and landscaping on the 1.97 ha brownfield site
- The proposed development is classified as 'More Vulnerable'.
- The highest point of the site is located near the south eastern corner of the site next to one of the existing buildings at a level of 98.08m AOD, and the lowest point lies near the north western boundary of the application site at a level of 93.46m AOD.
- The nearest main river to the application site (as listed on the EA Flood Map for Planning) is an unnamed watercourse located approximately 110m to the north west of the site which flows in a south westerly direction and is a tributary of Mearley Brook.
- The nearest ordinary watercourse to the site is located 90m north of the application site, and becomes Mearley Brook as it flows west to the north east of the application site and flows north into the un named watercourse described above.
- There are no historical records of any flooding within the application site.
- The application site is considered to be at low risk of flooding from fluvial sources, and at low risk of flooding from ordinary watercourses, sewer flooding, overland flooding, groundwater sources, and reservoir failure.
- The application site is underlain by superficial deposits of till, and a bedrock of Limestone. The site is not located within a Groundwater Source Protection Zone. The application site is located in a Major Aquifer Low Groundwater Vulnerability Zone.
- The existing Q_{bar} rate of discharge per hectare is estimated to be 7.5 l/s.
- It is proposed to discharge surface water run off from the estimated 0.66 ha post development impermeable area (including a 10% allowance for urban creep) at a rate of 5 l/s.
- It is proposed to dispose of surface water run off from the site to the tributary to Mearley Brook to the north east.
- It is proposed to provide attenuation in form of SUDs components, for example attenuation ponds, swales, and permeable paving. However, if it is not reasonable and viable when compared against meeting the drainage requirements of the Building Regulations to provide attenuation in this form, it could be provided using underground attenuation storage structures such as below ground cellular tanks or oversized pipework.
- It is proposed to provide formal attenuation storage of 306m³ to store run off from the 1 in 30 year storm event, with 286m³ additional storage to be provided as in above ground storage areas for

Flood Risk Assessment and Foul Drainage Assessment



exceedance events up to and including the 1 in 100 year + climate change event. If due to the proposed site levels this is not feasible, it is proposed to provide formal attenuation storage of 592m³ for all events up to and including the 1 in 100 year + climate change event.

- It is proposed to discharge foul flows to the existing 150mm diameter sewer draining along Chatburn Road. The peak foul flow rate has been calculated to be 2.3 l/s.
- A pre development enquiry has been submitted to UU. UU's response stated that foul can discharge to the existing combined sewer in Chatburn Road, and that surface water should either drain to a soakaway or directly to a watercourse.

Based on the above, the following recommendations are made:

- A detailed site specific site investigation study should be undertaken to confirm the ground conditions and undertake permeability testing and groundwater monitoring where the ground conditions permit to validate the possible use of SUDs infiltration techniques.
- Finished Floor Levels of the new buildings are to be set at 150mm above the average ground level to ensure that in the event of exceedance events causing overland flows within the development, no flooding of the properties will occur.
- The site is to be graded such that overland flows proceed through the site towards the watercourse to the north east of the site.
- The attenuation volumes should be reassessed as part of the detailed drainage design.
- The detailed surface water drainage design shall review options to maximise the use of SUDS techniques and improve the water quality of the surface water runoff prior to discharging into the attenuation ponds.
- On completion, a regular inspection & maintenance regime will be provided together with details of who will be responsible for the inspection and maintenance of the proposed SUDs components.
- A legal agreement should be obtained with the riparian owner in order to discharge to the watercourse
- A Land Drainage Consent from the LLFA will be necessary in order to discharge to the watercourse.

Flood Risk Assessment and Foul Drainage Assessment










Appendix A Built Form Masterplan



HOUSING MIX

2 bed:	12 (24%)
3 bed:	20 (40%)
4 bed:	14 (28%)
5 bed:	4 (8%)
Total:	50

KEY

-  Indicative housing
-  Existing trees
-  New tree planting
-  New Lin hedge
-  Tarmacked private drive
-  Adoptable road
-  Black paving

NHS Property Services Ltd

**Land South of Chatburn Road,
Clitheroe**

Built Form Masterplan

DATE: 06.12.2016

SCALE: 1:1250 @ A4

DRAWN BY / REVIEWED BY: MC / LW

PROJECT NO: A094939 DRAWING NO: A094939-01 REVISION: -

WYG Group

creative minds safe hands



WYG

Rowe House, 10 East Parade, Harrogate, HG1 5LT
Tel: +44 (0)1423 857 510
Email: info@wyg.com www.wyg.com

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- 2. THIS DRAWING IS TO BE CHECKED WITH ALL OTHER RELEVANT DRAWINGS
- 3. ANY DISCREPANCIES CHECK WITH WYG, IF IN DOUBT ASK
- 4. DRAWINGS TO BE USED FOR PURPOSES OF THE SCHEME AND NOTED ON PLAN

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Flood Risk Assessment and Foul Drainage Assessment



Appendix B Topographic Survey

Flood Risk Assessment and Foul Drainage Assessment



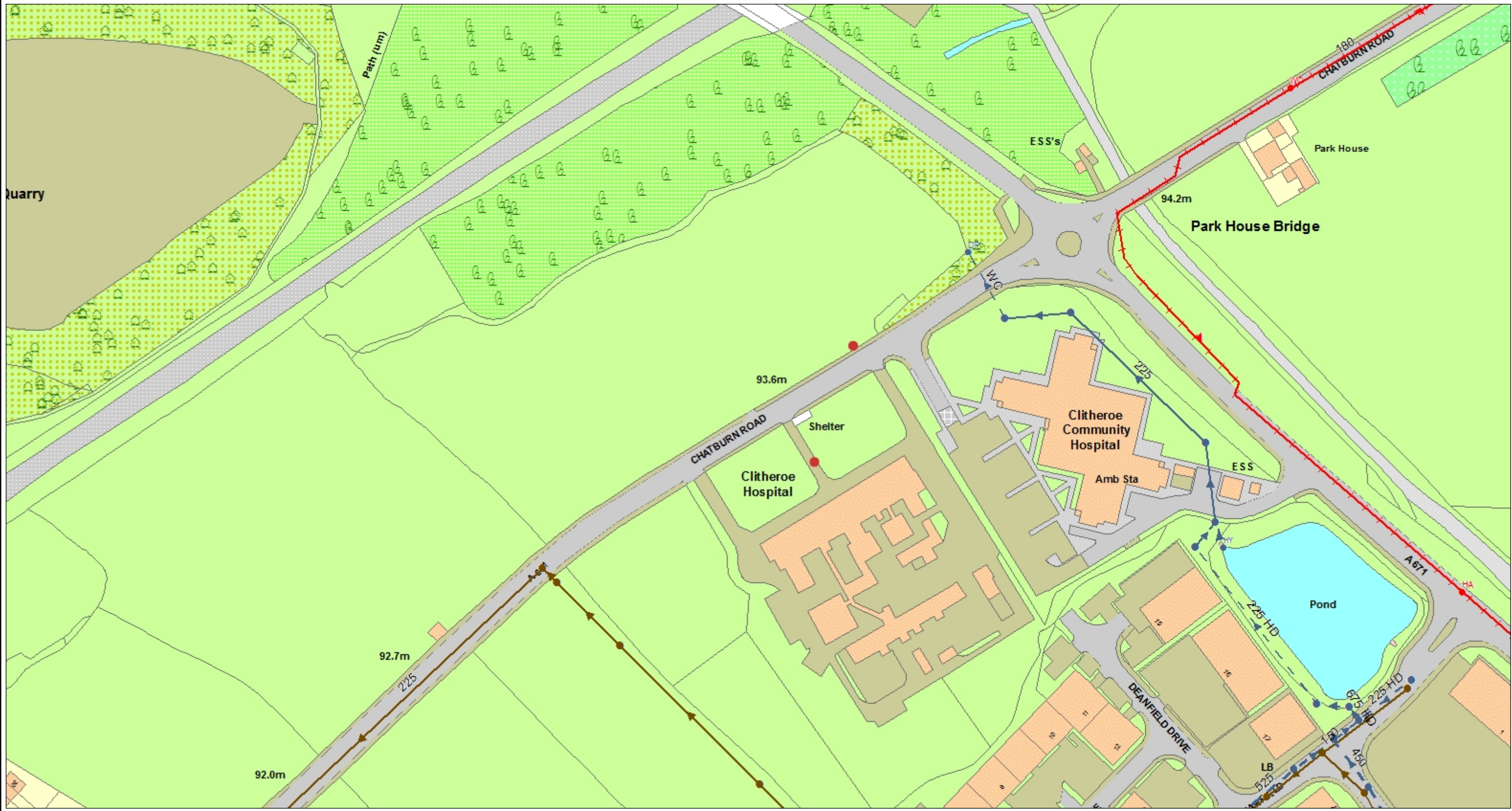
Appendix C UU Sewer Record

UU Maps for Safe Dig

Centre : X : 375409 Y : 443071

Date : 18/12/2015 09:58:24

Scale Approx : 1447.00000000004



Extract from maps of United Utilities' Underground Assets

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. The actual positions may be different from those shown on the plan and private service pipes may be shown by a blue broken line. United Utilities Water will not accept liability for any damage caused by the actual position being different from those shown.

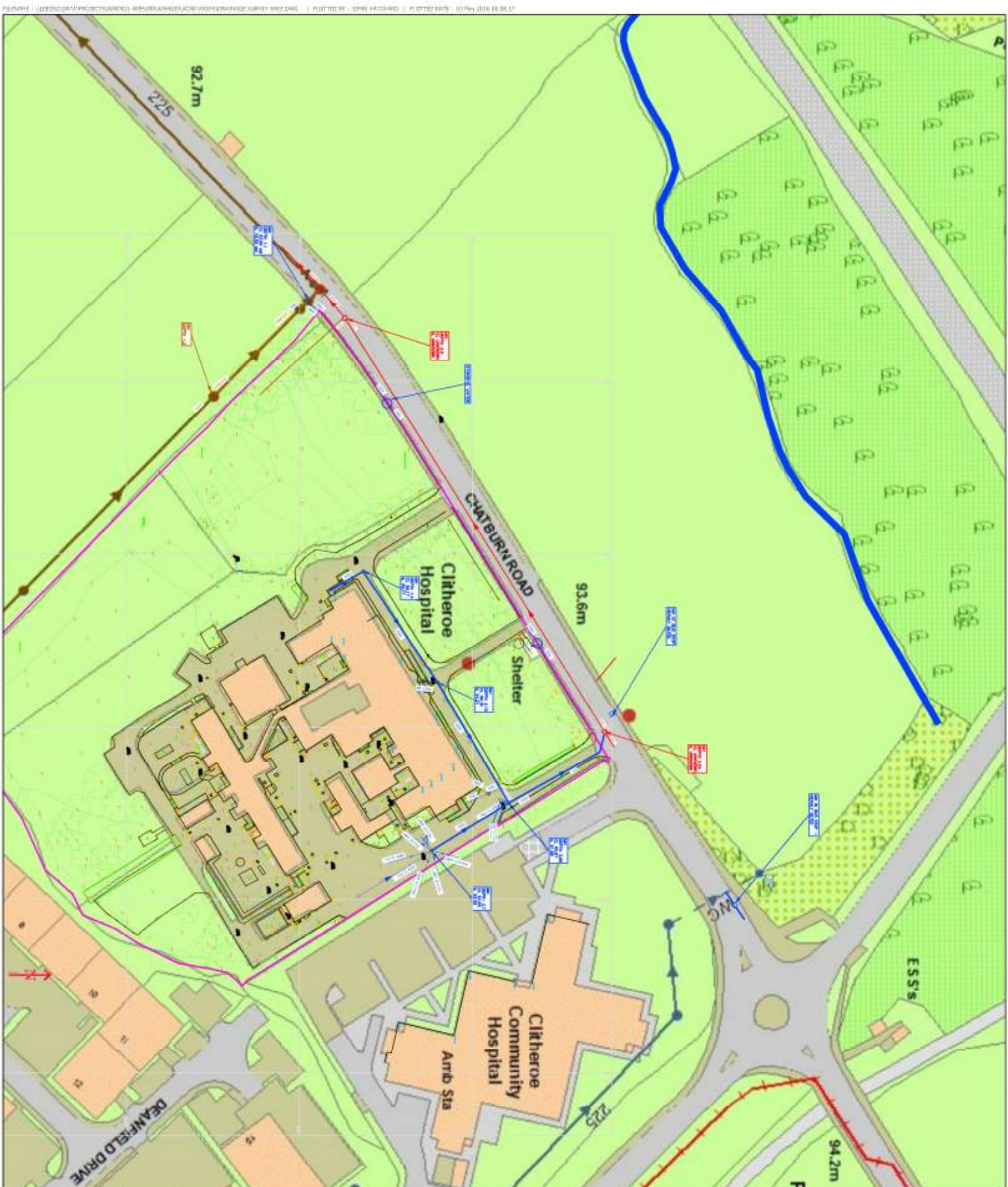
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Flood Risk Assessment and Foul Drainage Assessment



Appendix D Drainage Survey



KEY

- SITE BOUNDARY
- EXISTING SURVEYED SURFACE WATER SEWER
- EXISTING SURVEYED COMBINED SEWER

REV	DESCRIPTION	BY	CHK	DATE

ASPLDRAE CONSULTANTS
 HEATHCOTE
 LEEDS
 LS9 2JU
 TEL: +44 (0)113 278 7113
 FAX: +44 (0)113 278 2487
 e-mail: info@aspldrae.com



PROJECT:
 PROPOSED RETIREMENT HOME ON
 LAND OFF CHATBURN ROAD
 CLITHEROE, LANCASHIRE

Drawing Title:
 OVERLAY OF INITIAL DRAINAGE SURVEY RESULTS
 WITH UU SEWER RECORDS AND TOPO SURVEY

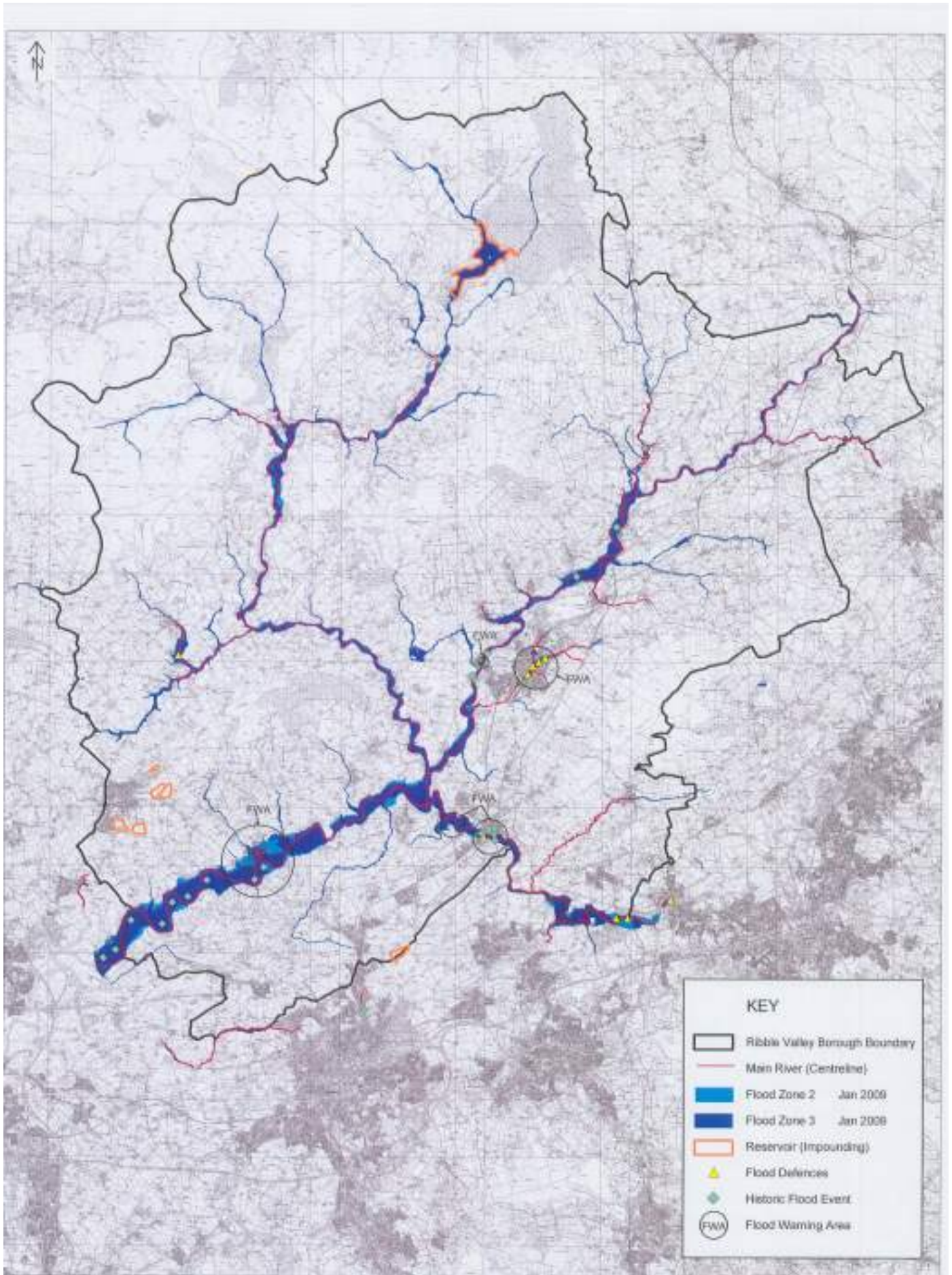
Scale: A3	Drawn: 21/08/15	Checked: SK-100	Approved: [Signature]	Date: [Date]
Project No: A091403	Office Type: 21	Drawing No: SK-100	Revision: [Blank]	

Flood Risk Assessment and Foul Drainage Assessment



Appendix E

SFRA Maps



MAP 1 RIBBLE VALLEY STRATEGIC FLOOD RISK ASSESSMENT

Scale: 1:115000

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Flood Risk Assessment and Foul Drainage Assessment



Appendix F Greenfield Run off Calculations

Arndale Court
Headingley
Leeds LS6 2UJ

Designed by simbi.hatchard



Date 25/04/2016 14:46
File

Checked by

Micro Drainage Source Control 2014.1

ICP SUDS Mean Annual Flood

Input

Return Period (years)	30	Soil	0.450
Area (ha)	1.000	Urban	0.000
SAAR (mm)	1104	Region Number	Region 10

Results 1/s

QBAR Rural 7.5
QBAR Urban 7.5

Q30 years 12.7

Q1 year 6.5
Q30 years 12.7
Q100 years 15.6

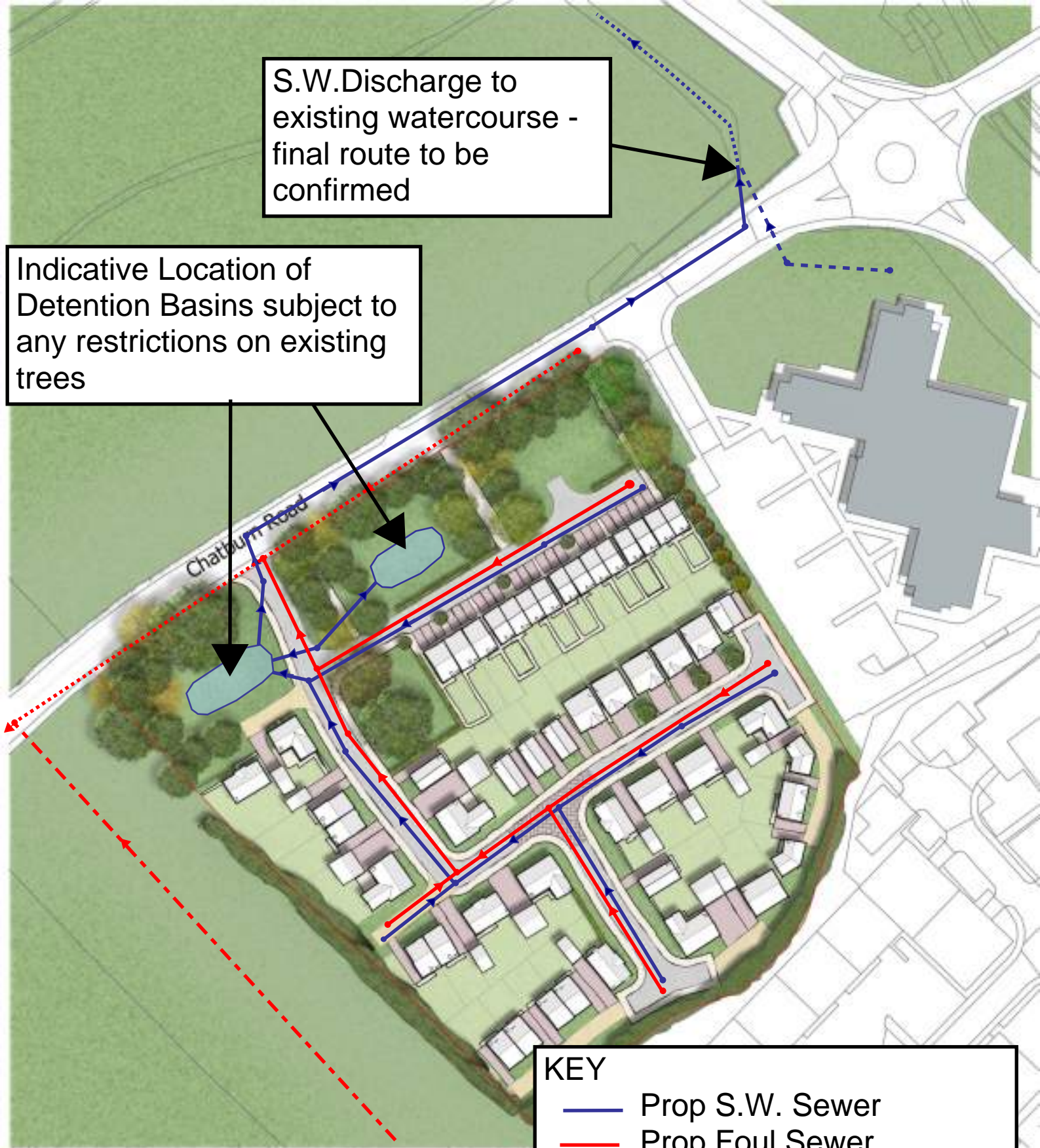
Flood Risk Assessment and Foul Drainage Assessment



Appendix G Proposed Drainage Strategy Plan

S.W. Discharge to existing watercourse - final route to be confirmed

Indicative Location of Detention Basins subject to any restrictions on existing trees



KEY

- Prop S.W. Sewer
- Prop Foul Sewer
- - - Ex S.W. Sewer
- Ex Foul Sewer
- Proposed Detention Pond

HOUSING MIX

2 bed:	12 (24%)
3 bed:	20 (40%)
4 bed:	14 (28%)
5 bed:	4 (8%)
Total:	50

NHS Property Services
Land South of Chattam Road
Clitheroe
 Built Form Masterplan
 DATE: 06.12.2016

KEY

- Indicative housing
- Existing trees
- New tree planting
- New L11 hedge
- Tarmacked private drive
- Adoptable road
- Black paving

PRELIMINARY DRAINAGE PLAN



Appendix H

Micro Drainage Quick Storage Calculations

Quick Storage Estimate

Variables

FSR Rainfall

Return Period (years): 30

Region: England and Wales

M5-60 (mm): 20.400

Ratio R: 0.255

Cv (Summer): 0.750

Cv (Winter): 0.840

Impemeable Area (ha): 0.660

Maximum Allowable Discharge (l/s): 5.0

Infiltration Coefficient (m/hr): 0.00000

Safety Factor: 2.0

Climate Change (%): 0

Buttons: Analyse, OK, Cancel, Help

Select required Rainfall Model from the list

1 in 30 year Quick Storage Design Criteria

Quick Storage Estimate

Results

Global Variables require approximate storage of between 224 m³ and 387 m³.

These values are estimates only and should not be used for design purposes.

Buttons: Analyse, OK, Cancel, Help

Select required Rainfall Model from the list

1 in 30 year Quick Storage Results

Quick Storage Estimate

Micro Drainage

Variables

FSR Rainfall:

Return Period (years):

Region:

M5-60 (mm):

Ratio R:

Cv (Summer):

Cv (Winter):

Impemeable Area (ha):

Maximum Allowable Discharge (l/s):

Infiltration Coefficient (m/hr):

Safety Factor:

Climate Change (%):

Buttons: Analyse, OK, Cancel, Help

Enter Climate Change between -100 and 600

1 in 100 year + 30%% CC Quick Storage Design Criteria

Quick Storage Estimate

Micro Drainage

Results

Global Variables require approximate storage of between 460 m³ and 724 m³.

These values are estimates only and should not be used for design purposes.

Buttons: Analyse, OK, Cancel, Help

Enter Climate Change between -100 and 600

1 in 100 year + 30%% CC Quick Storage Results

Flood Risk Assessment and Foul Drainage Assessment



Appendix I Typical SUDs Details

Flood Risk Assessment



1 Typical Swale Details



Photo showing possible use of swales to discharge housing run off

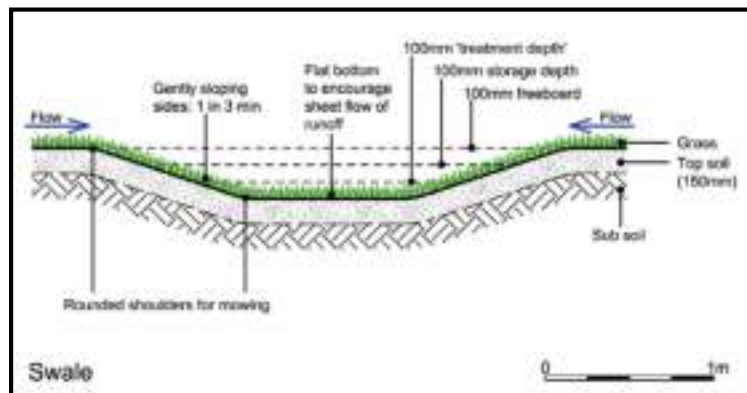


Photo showing typical swale located adjacent to highway

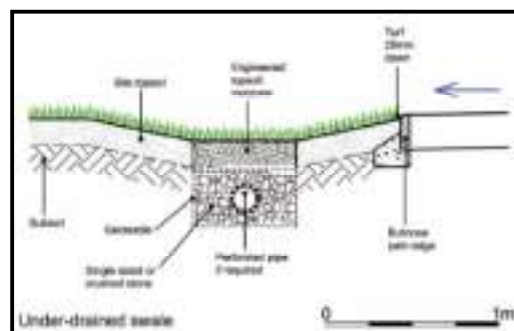
Flood Risk Assessment



Photo showing typical swale located within open space areas with footbridge.



Typical section through proposed swale.



Typical swale detail with infiltration trench at base

2 Typical Filter Strip Details



Photo showing edge of carriageway filter strip

3 Typical Edge of Carriageway Details

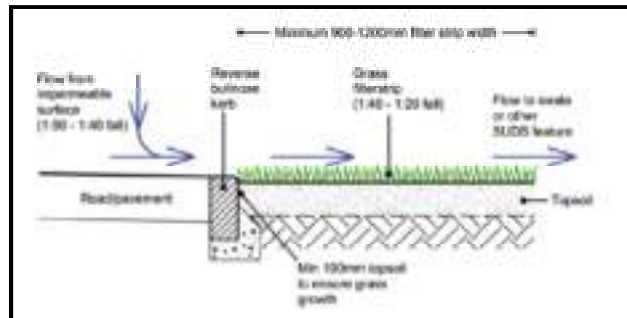


Photo showing edge of carriageway detail

Flood Risk Assessment



Photo showing gully into swale



Typical Detail showing edge of carriageway discharge to swale

4 Typical Detention Pond Details



Flood Risk Assessment and Foul Drainage Assessment



Appendix J

UU Pre Development Enquiry

tom.beavis

Subject: FW: DE2221 Clitheroe Hospital, Chatburn Road, Clitheroe, Ribble Valley due 31.05.2016
Attachments: GFRO.pdf; Outline Foul Drainage Strategy.pdf; Topo.pdf; Wastewater Predevelopment Enquiry Clitheroe.pdf

From: Perry, Graham [<mailto:Graham.Perry@uuplc.co.uk>]
Sent: 27 May 2016 15:37
To: simbi.hatchard
Subject: FW: DE2221 Clitheroe Hospital, Chatburn Road, Clitheroe, Ribble Valley due 31.05.2016

Dear Customer

We have carried out an assessment of your application which is based on the information provided; this pre development advice will be valid for 12 months

Foul

Foul will be allowed to drain to the public combined/ foul sewer network. Our preferred point of discharge would be to the 225mm foul sewer on Chatburn Rd at an unrestricted rate.

Surface Water

Surface water from this site should drain to either soak away or directly to watercourse. Discharge rates and consents must be discussed and agreed with all interested parties.

Connection Application

Although we may discuss and agree discharge points & rates in principle, please be aware that you will have to apply for a formal sewer connection. This is so that we can assess the method of construction, Health & Safety requirements and to ultimately inspect the connection when it is made. Details of the application process and the form itself can be obtained from our website by following the link below

<http://www.unitedutilities.com/connecting-public-sewer.aspx>

Sewer Adoption Agreement

You may wish to offer the proposed new sewers for adoption. United Utilities assess adoption application based on Sewers adoption 6th Edition and for any pumping stations our company addenda document. Please refer to link below to obtain further guidance and application pack:

<http://www.unitedutilities.com/sewer-adoption.aspx>

Please be aware that on site drainage must be designed in accordance with Building Regulations, National Planning Policy, and local flood authority guidelines, we would recommend that you speak and make suitable agreements with the relevant statutory bodies.

Regards

Graham Perry

Development Engineer
Developer Services and Planning
Business Operations

United Utilities

T: 01925 679405 (internal 79405)
E: graham.perry@uuplc.co.uk
unitedutilities.com

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From: Wastewater Developer Services
Sent: 11 May 2016 10:14
To: Perry, Graham <Graham.Perry@uuplc.co.uk>
Subject: DE2221 Clitheroe Hospital, Chatburn Road, Clitheroe, Ribble Valley due 31.05.2016

FYI petal

Regards,

Will Harrison BSc (Hons)
Technical Administrator
Developer Services & Planning
Operational Services
United Utilities

T : 01925 679319
E : Seweradoptions@uuplc.co.uk

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United Utilities Water Ltd. - Developer Services and Planning
Warrington North Wastewater Treatment Works
Barnard Street Off Old Liverpool Road
Gatewarth Industrial Estate
Warrington
WA5 1DS

From: simbi.hatchard [<mailto:simbi.hatchard@wyg.com>]
Sent: 09 May 2016 17:41
To: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Cc: tom.beavis <tom.beavis@wyg.com>
Subject: Pre Development Enquiry

Dear Sir / Madam,

Proposed Retirement Home on the former Clitheroe Hospital Site, Clitheroe, Lancashire BB7 1QJ
Grid Reference: SD 75456 43013

Pre Development Enquiry

Please find attached a Pre Development Enquiry for the above site, for both foul and surface water discharge.

It is proposed to discharge surface water to the watercourse to the north of the site. The current point of discharge for the existing development is understood to be to the 225mm diameter combined sewer located in Chatburn Road to the north of the site. We therefore are seeking to discharge to the watercourse via a requisitioned sewer (see the attached surface water drainage strategy).

Foul is proposed to be discharged into the Foul Manhole in Chatburn Road at a rate of 6.47 l/s, as shown in the Outline Foul Drainage Strategy.

I look forward to receiving your response.

Kind regards,

Simbi Hatchard

Flood Risk & Drainage Engineer

WYG

Arndale Court, Headingley, Leeds, West Yorkshire, LS6 2UJ

Tel: +44 113 219 2284

Fax: +44 113 278 3487

www.wyg.com

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WYG Engineering Limited. Registered in England number: 1959704. Registered Office: Arndale Court, Otley Road, Headingley, Leeds, West Yorkshire LS6 2UJ VAT No: 431-0326-08



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