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WADDOW VIEW
CLITHEROE

FLOOD RISK ASSESSMENT

For
The Huntroyde Estate
And
Clitheroe Auction Mart Co Ltd
And
Mr John Taylor, Ms Sarah Howard and Ms Samantha Howard

JULY 2014

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WADDOW VIEW,
CLITHEROE
FLOOD RISK ASSESSMENT

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EXECUTIVE SUMMARY

This report was commissioned by The Huntroyde Estate, Clitheroe Auction Mart Co Ltd, Mr John Taylor, Ms Sarah Howard and Ms Samantha Howard referred to hereafter as 'the client' to support an outline planning application for the construction of a residential development complete with estate roads, external works, footpaths, car parking, external lighting, landscaping, boundary walls, fencing, external services and drainage.

This Flood Risk Assessment is an updated version of a previous assessment (Ref: Betts Associates: SEA14 FRA) prepared to support a previous application (planning ref: 3/2012/0854) which was rejected, principally due to highways issues. No adverse comments were made from either the Environment Agency, United Utilities or the Local Planning Authority with regards to the previous Flood Risk Assessment therefore this assessment only provides brief updates to the previous assessment and allows for an updated planning layout.

The proposed development site is approximately 9.200ha (hectares) in size and is located exclusively within Flood Zone 1 according to the Environment Agency's Flood Mapping Data. The National Planning Policy Framework (NPPF) requires that all planning applications for development proposals that exceed 1 hectare be accompanied by a Flood Risk Assessment.

The development is 'residential' in its nature and as such is classified as 'more vulnerable' in Table 1: Flood Risk Vulnerability Classification within the Technical Guidance to the NPPF. Table 2: Flood Risk Vulnerability and Flood Zone 'Compatibility' within the NPPF confirms that this type of land use is appropriate for Flood Zone 1, providing there no increase in flood risk elsewhere due to the proposals.

This Flood Risk Assessment has reviewed all sources of flood risk to both the proposed development and to the existing adjacent development as a result of the proposals, including; fluvial, tidal, pluvial, groundwater, sewers and flooding from artificial sources.

The small watercourse crossing site was hydraulically modelled to confirm it posed a low flood risk to the development area in accordance with the Environment Agency's requirements.

An Internet based search for flooding events did not recall any historical flooding to the immediate site area, pre-development enquiries with the EA, the LPA and UU also failed to highlight any historical flooding events specific to the development site. Consultation with various interested parties furthermore failed to highlight any historical flooding in or adjacent to the proposed development area.

Local residents have highlighted an existing highway drainage issue where Waddington Road passes under the Railway, although this presents little risk to the proposed development there is potentially scope to assist in alleviating this offsite issue as part of the development proposals, however viability will require additional investigation and detailed design.

The development is accessible for emergency access and egress during times of extreme flooding as the 100 year floodplain does not extend into the proposed development area.

As a result of the relatively low flood risk from all of the sources reviewed, the principle focus of this report is on the effective management of surface water drainage.

Based on the ground conditions identified by the BGS and NSRI Soilscapes Data, it can be considered that infiltration is unlikely to provide a viable drainage solution for surface water run-off generated by the proposed development site, in terms of infiltration characteristics. Infiltration should not be discounted as a complete or partial drainage solution until testing has been carried out in accordance with BRE365 to determine whether any infiltration solution can be applied in specific areas of site thought to be most suitable.

The primary option for surface water disposal is via infiltration, if discharge of the surface water via infiltration is not viable and discharge is proposed to the watercourse bisecting site. Flows will need to be restricted to the mean annual flood, QBar, calculated to be 33.1l/s, due to the nature of the proposals. Consents will be required for works affecting the Ordinary Watercourse and approval of discharge rates will be required.

A flow restriction will be most likely in the form of a Hydrobrake® or similar approved flow control device.

The restricted flow generates a storage requirement during the extreme storm events. The resultant storage requirement for the annual return period storm event with a restricted discharge rate of 33.1l/s, based on an impermeable area of 2.760ha is approximately between 165cu.m and 377cu.m. For the 1 in 100 year return period storm event with a 30% allowance for climate change with a restricted discharge rate of 33.1l/s (QBAR), is approximately between 1670cu.m and 2671cu.m.

The foul water flows generated by the proposed development site are suggested to discharge to the existing public combined sewer (675mm dia.) crossing the southern corner of site.

The proposed onsite surface water drainage system will need to be sized to prevent overland run-off from storm events up to and including the 100 year return period storm event with a 30% allowance for climate change.

This report has been prepared in consultation with the relevant interested parties (including the Environment Agency) and incorporates their comments where possible.

The Flood Risk Assessment is considered to be commensurate with the development proposals and in summary, the development can be considered appropriate in accordance with the NPPF.

CONTENTS

Figures & Tables

Specialist Software

- Flood Estimation Handbook FEH CD-ROM (v.3.0) – Determination of Catchment Descriptors and depths of rainfall.
- MicroDrainage WinDES (v.14.1) – Calculation of Greenfield run-off rates IH124/ICP-SUDS, Greenfield run-off volumes, rates of rainfall and stormwater storage estimates.

Abbreviations & Acronyms

AEP	Annual Exceedance Probability	mAOD	Metres Above Ordnance Datum
BGL	Below Ground Level	NGR	National Grid Reference
BGS	British Geological Survey	NPPF	National Planning Policy Framework
CC	Climate Change	NSRI	National Soil Resources Institute
CDA	Critical Drainage Area	OS	Ordnance Survey
EA	Environment Agency	PFRA	Preliminary Flood Risk Assessment
FEH	Flood Estimation Handbook	PPS	Planning Policy Statement
FRA	Flood Risk Assessment	QSE	Quick Storage Estimate
FRMSR	Flood Risk Management Strategy Report	QBAR	Mean Annual Flood
FZ	Flood Zone	RVBC	Ribble Valley Borough Council
Ha	Hectare	SFRA	Strategic Flood Risk Assessment
IDB	Internal Drainage Board	SuDS	Sustainable Urban Drainage Systems
LLFA	Lead Local Flood Authority	TWL	Top Water Level
LDP	Local Development Plan	UKCIP	United Kingdom Climate Impacts Programme
LPA	Local Planning Authority	UU	United Utilities
LCC	Lancashire County Council		

1.0 INTRODUCTION

1.1 Planning Policy Context

1.1.1 All forms of flooding and their impact on the natural and built environment are material planning considerations. The National Planning Policy Framework (NPPF) sets out the Government's objectives for the planning system, and how planning should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change.

1.1.2 Government policy with respect to development in flood risk areas is contained within the NPPF and the supporting Technical Guidance (refer to extracts in Appendix F).

1.1.3 The development proposals are over 1 hectare therefore require a Flood Risk Assessment be completed in accordance with NPPF to review all sources of flood risk both to and from the proposed development.

1.1.4 This Flood Risk Assessment is an updated version of a previous assessment (Ref: Betts Associates: SEA14 FRA) prepared to support a previous application (planning ref: 3/2012/0854) which was rejected, principally due to highways issues. No adverse comments were made from either the Environment Agency, United Utilities or the Local Planning Authority with regards to the previous Flood Risk Assessment therefore this assessment only provides brief updates to the previous assessment and allows for an updated planning layout.

1.1.5 The development is 'residential' in its nature and as such is classified as 'more vulnerable' in Table 1: Flood Risk Vulnerability Classification within the Technical Guidance to the National Planning Policy Framework. Table 2: Flood Risk Vulnerability and Flood Zone 'Compatibility' within the NPPF confirms that this type of land use is appropriate for Flood Zone 1, providing there no increase in flood risk elsewhere due to the proposals.

1.2 Site Context

1.2.1 This report was commissioned by the client to support an outline planning application for the construction of a residential development complete with estate roads, external works, footpaths, car parking, external lighting, landscaping, boundary walls, fencing, external services and drainage.

1.2.2 The proposed development site is located on predominantly undeveloped land to the south-east of the River Ribble and west of the B6478 (Waddington Rd, Clitheroe), referred to as 'Waddow View'. A plan showing the development proposals can be viewed in Appendix C.

1.3 Consultation

1.3.1 The preparation of this report has been undertaken in consultation with the following interested parties; Ribble Valley Borough Council (RVBC), the Environment Agency (EA) and United Utilities (UU).

1.3.2 The Local Planning Authority (LPA), Ribble Valley Borough Council (RVBC) has been consulted as part of the preparation of this report; who also acts as the Lead Local Flood Authority (LLFA). The NPPF advises that the LPA should consult with the Environment Agency who will provide advice and guidance on flood issues at a strategic level and in relation to planning applications.

1.3.3 The Environment Agency was contacted to discuss the nature and extent of information to be provided in this Flood Risk Assessment and for any background knowledge of flood risk specific to the site (correspondence is included in Appendix D).

1.3.4 United Utilities Developer Services were contacted to discuss whether UU have any historical flooding issues in the area or any background knowledge on flood risk specific to the site (correspondence is included in Appendix G).

1.3.5 Ribble Valley Borough Council (RVBC) and Lancashire County Council (LCC) were contacted to discuss the nature and extent of information to be provided in this FRA and for any background knowledge of flood risk specific to the site.

2.0 EXISTING SITE LOCATION

2.1 Location

2.1.1 The site is located just off Milton Avenue, Clitheroe. The Ordnance Survey National Grid Reference (OS NGR) for the site is 374096 (Easting), 442181 (Northing) and the nearest postcode is BB7 2HX. The site location plan is shown in Appendix A. The total development site is approximately 9.200ha in size and is edge in red in Figure 1 below.

2.1.2 The site is predominantly undeveloped; it is accessed via Milton Avenue, Back Commons (runs along a portion of the southern boundary) and Waddington Road (to the northern corner of the site). It is currently open grassed fields, levels slope gently from northwest to southeast. Existing mature trees line the eastern site border, and hedgerows line the northern, southern and western borders.

2.1.3 There is an existing derelict building located along the northern boundary. The surrounding area is predominantly residential to the north and south, fields to the west and a public car park to the east. A small stream bisects the site emerging from a culvert around the mid-point of the south eastern boundary and running north-northeast. A railway line is shown 100m south of site.

Figure 1: Aerial Photograph of site (Google Maps 2014)
Aerial view of the proposed development area (edged in red).

2.1.4 The site is bounded; to the north by undeveloped land and the B6478 (Waddington Rd), to the east lies development land in control of the developer and the developments of Clitheroe. To the south and west there is further undeveloped land, as indicated in Figure 1 (above).

2.2 Existing and Historical Land Use

2.2.1 The preparation of this report has identified that the proposed development site is predominantly undeveloped at present, with the exception of the small derelict barn structure located along the northern boundary. The total site area is approximately 9.200ha and is considered to be 100% pervious.

2.3 Topography

2.3.1 The topography varies through site however can generally be described as falling from the northwest to the southeast; levels range from approximately 80.5mAOD to 71.5mAOD. A topographical survey of the site has been undertaken and is included in Appendix B.

3.0 DEVELOPMENT PROPOSALS

3.1 Nature of the development

3.1.1 This outline planning application is for the construction of approximately 345 no. residential dwellings with private amenity areas, west of 'Milton Avenue' and south of the 'B6478', Clitheroe. The proposals include construction of an access road, footpaths, car parking, external works and lighting, landscaping, boundary walls and fencing, external services and drainage.

3.1.2 The pertinent planning drawings are included in Appendix C; an extract of the development proposals is shown in Figure 2 (below).

Figure 2: Planning Layout Extract (Bloor Homes 2013)

3.1.3 The total site area is approximately 9.200ha and is considered to be approximately 100% pervious at present. The proposed impermeable area of the total site will increase to approximately 2.760ha (30%) based on the pertinent planning layouts.

4.0 SOURCES OF FLOOD RISK

4.1 Fluvial & Tidal Flood Risk

4.1.1 Information relating to flood risk at the site has been obtained from the Environment Agency's (EA) website and online Flood Map, an extract of which is shown in Figure 3 (below).

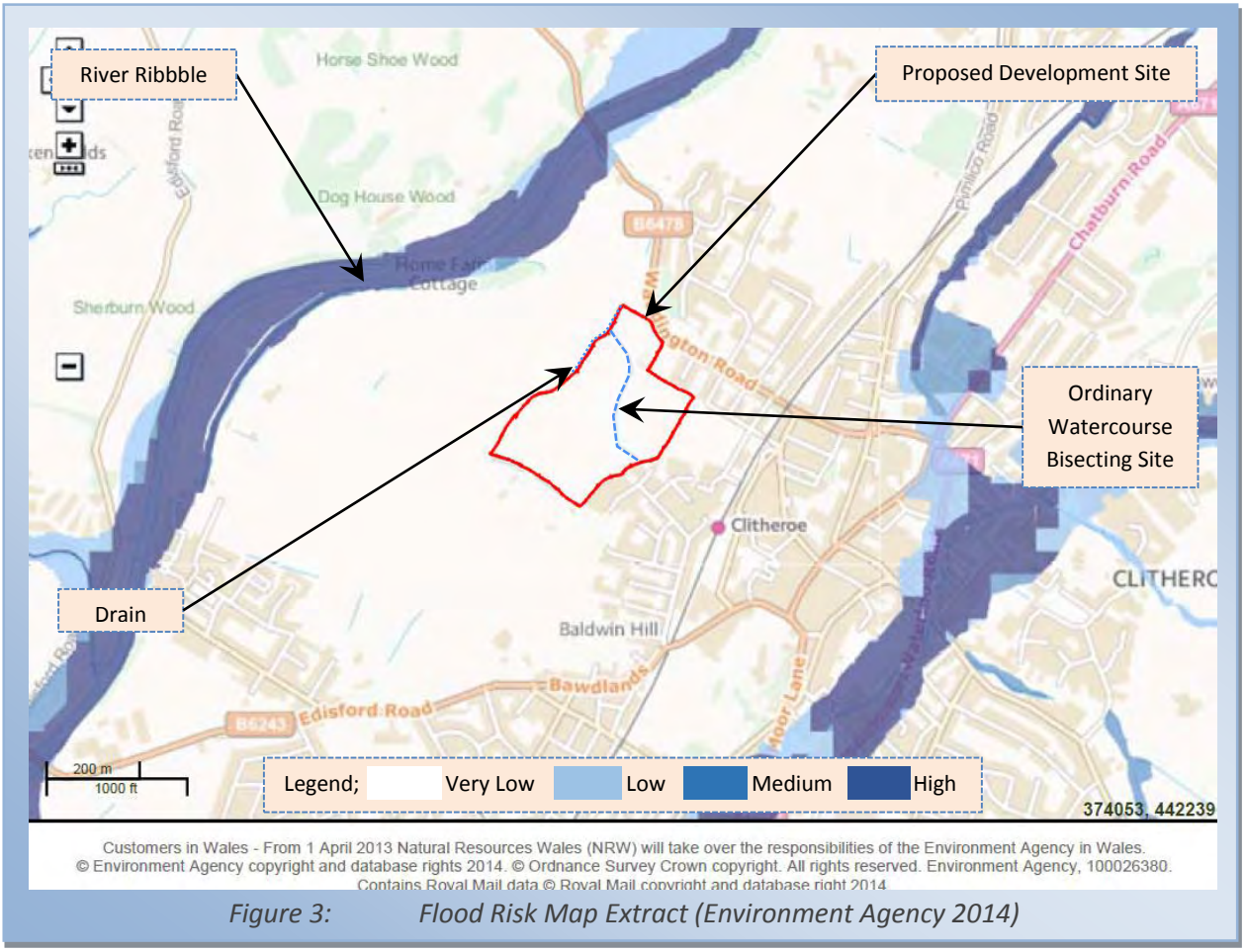


Figure 3: Flood Risk Map Extract (Environment Agency 2014)

Fluvial Flooding

4.1.2 The online EA Flood Map indicates that the proposed development area is considered to be at 'very low' risk from fluvial flooding, despite the Main River (River Ribble) being located less than approximately 0.3km north-west of the site boundary (represented by dark blue shading in Figure 3).

4.1.3 Historic maps suggest a watercourse that flowed along the eastern boundary, then the southern boundary before heading offsite in a west/northwest direction; however there was no evidence of a watercourse above ground along the eastern boundary. The watercourse is understood to run below ground (culverted) along the southern boundary.

4.1.4 It is understood that an ordinary watercourse (land-drain/ditch) is located on the north-western boundary of the proposed development site (indicated by the blue dotted line in Figure 3).

4.1.5 An ordinary watercourse (stream) is understood to bisect the site emerging from a culvert around the mid-point of the south eastern boundary and running north-northeast (indicated by the blue dashed line in Figure 3).

Figure 4: Photograph of Culvert Outfall along the South-Eastern Boundary.

4.1.6 The watercourse appears to be fed by a public surface water sewer (UUW asset) at UUW node ref. 1104 (900mm dia. pipe). The culvert (c.900mm dia.) discharges in to an open channel around the mid-point of the south-eastern boundary. A photograph of the outfall is shown in Figure 4 (above). The open channel watercourse flows west then north bisecting the development area (there are two existing culverted sections to allow access between fields).

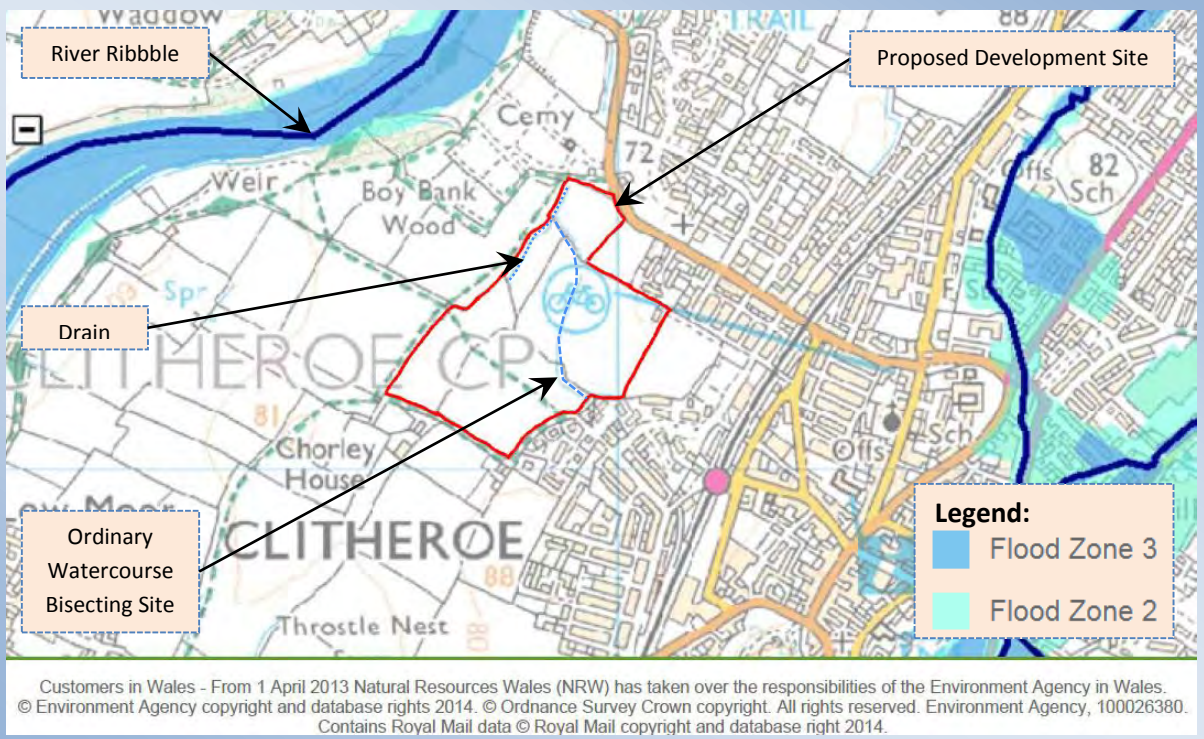


Figure 5: Flood Zone Map Extract (Environment Agency 2014)

4.1.7 The EA Flood Zone Map confirms that the proposed development site is located within an area identified as Flood Zone 1, as indicated in Figure 5 (preceding page) and therefore at little or no risk of fluvial and/or tidal flooding.

4.1.8 The EA confirmed they do not possess hydraulic modelling data for the 'ordinary' watercourse crossing site, therefore it was considered necessary to undertake a river modelling exercise to determine the floodplain extent for a variety of storm events. The method and scope of the modelling exercise was agreed with the EA and full details of the exercise are included in Section 5.0.

4.1.9 Review of the Flood Estimation Handbook (FEH) CD-ROM identifies the catchment to be 1.63km (sq.). Given the small nature of the catchment and the relative elevation of the proposed development site and surrounding areas; the flood risk from this source is considered to be 'low'.

Tidal Flooding

4.1.10 The coastline is located approximately 33km north-west of the proposed development site and the nearest estuary system (Lune Estuary) is located approximately 32km to the north-west of site. As such the associated risk from these sources is considered to be 'very low' as identified in the EA online Flood Map extract shown in Figure 3 (preceding page).

Flood Risk Vulnerability Classification and Flood Zone Compatibility

4.1.11 The development is considered to be solely 'residential' in nature (345 units) and as such is classified as 'more vulnerable' in Table 1: Flood Risk Vulnerability Classification within the Technical Guidance to the NPPF. The NPPF (Table 2: Flood Risk Vulnerability and Flood Zone 'Compatibility') confirms that this type of land-use is appropriate for development within Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

4.2 Surface Water Flood Risk

4.2.1 Surface water flooding occurs when rainwater is unable to drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

4.2.2 The risk associated with surface water run-off is indicated by the EA online mapping data (see Appendix D) as shown in Figure 6 (preceding page); it illustrates that the proposed development site is at varying risk from surface water flooding. The site is predominantly at 'Very Low' risk of surface water flooding, the area indicated on the EA map (light blue shading) bisecting the site indicates the potential for a 'low' risk from surface water flooding. This area identified as having a 'low' risk is associated with the location of the existing watercourse feature, where levels are naturally lower within the boundaries of site.

4.2.3 The other isolated areas indicated to be at 'Low' risk from surface water flooding are associated with the lowest points within site, where shallow informal channels currently exist aiding in the drainage of the undeveloped field. Following a re-grade of site (during the construction phase) the associated risk of surface water flooding in these isolated areas would be significantly reduced.

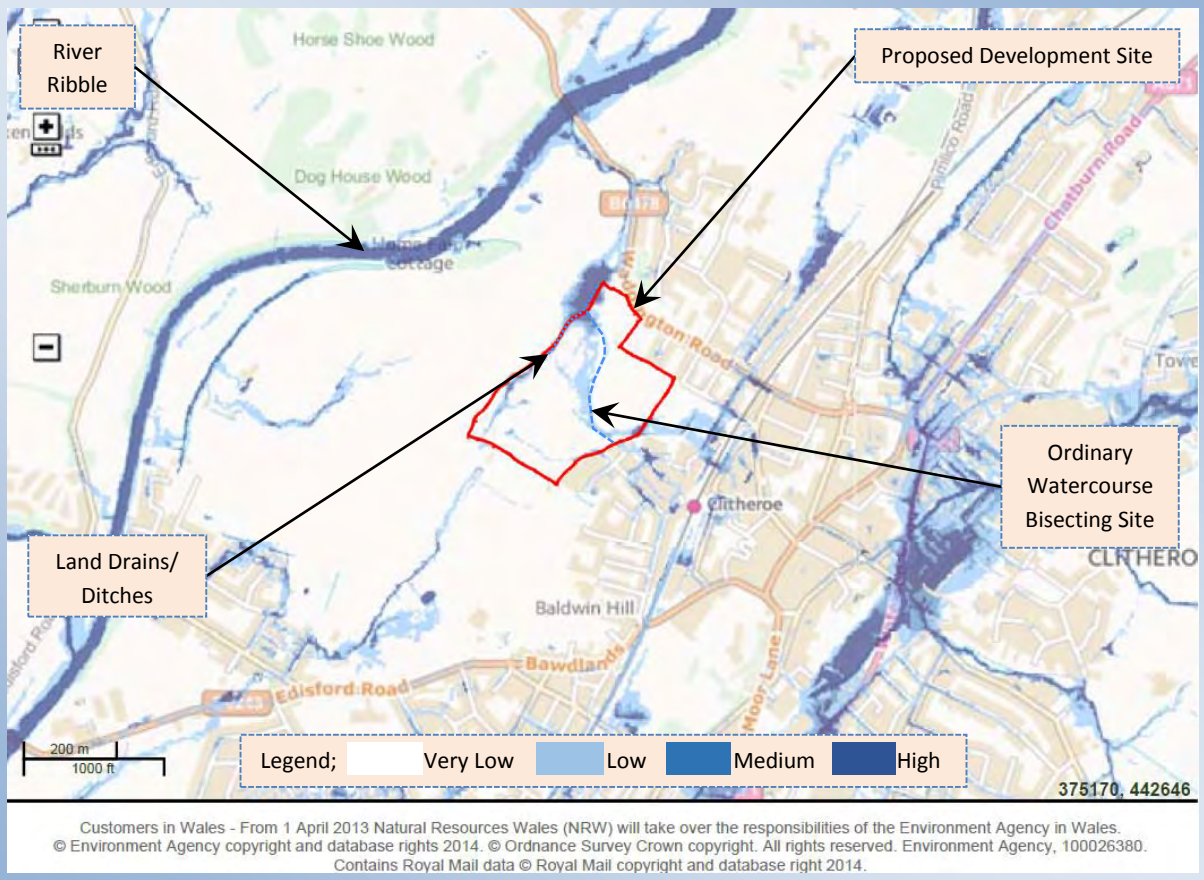


Figure 6: Surface Water Flood Map Extract (Environment Agency 2014)

4.2.4 The area indicated along the northern border of site (dark blue shading in Figure 6) as being at 'medium to high' risk of surface water flooding is associated with the confluence of the existing open watercourse feature and the boundary land-drain. This area is furthermore lower in comparison to the remainder of site which would account for the higher potential in this area of surface water flooding.

4.2.5 The EA provides estimates for potential surface water flood depths and velocities under key probability events; low, medium and high (chance of occurrence). The worst case scenario (low chance of occurrence) shows the potential depth of surface water flooding to be predominantly below 300mm in the areas discussed previously as being at most risk (low, medium and high).

4.2.6 The area indicated to be at high risk (Figure 6) along the northern corner, at the confluence of the ordinary watercourse and boundary land drain is indicated to have potential surface water flood depths higher than the remainder of site (approximately 300-900mm) due to the natural topography and existing land-use features, as indicated in Figure 7 (preceding page).

4.2.7 The EA data furthermore estimates surface water flows in the areas identified as at risk within the site to reach potential speeds of over 0.25m/s (during the low occurrence event), as indicated in Figure 8 (preceding page) by the dark blue shading.

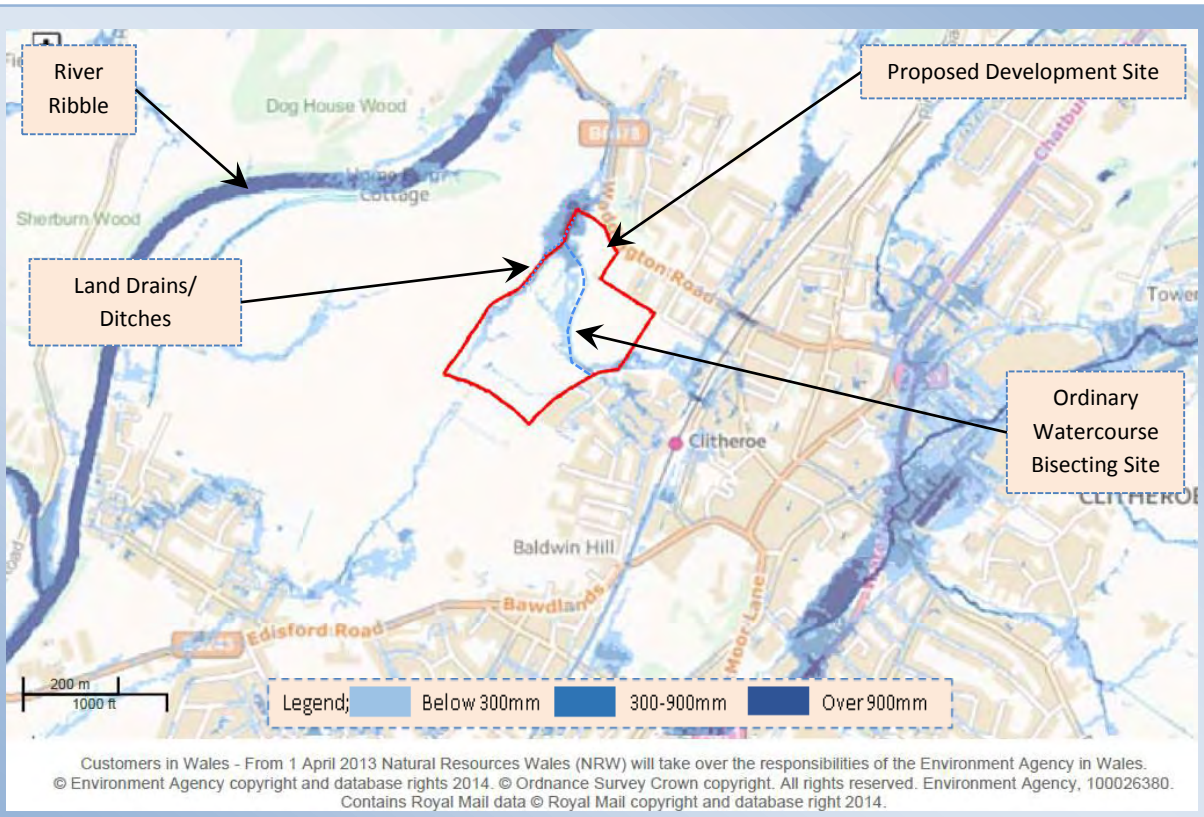


Figure 7: Surface Water Flood Depth Map Extract (Environment Agency 2014) (Based on a Low Chance of Occurrence Event)

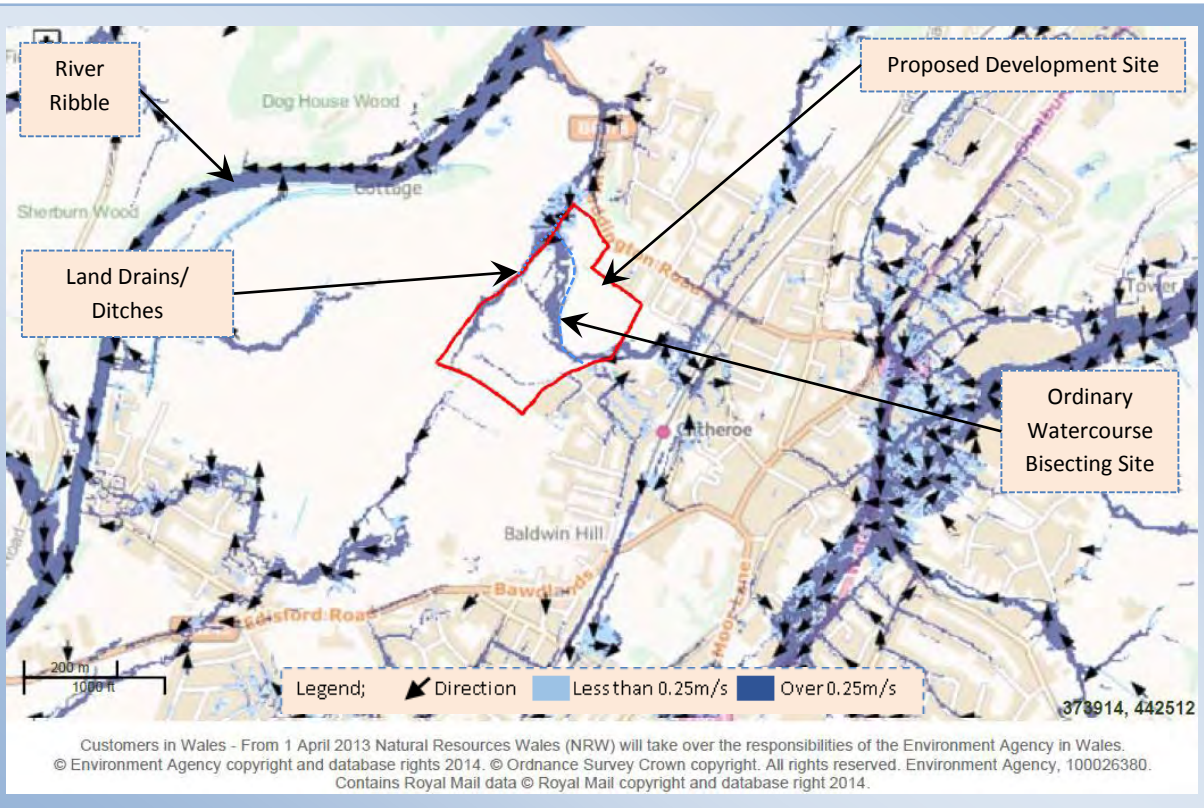


Figure 8: Surface Water Flood Velocity Map Extract (Environment Agency 2014). (Based on the Low Chance of Occurrence Event)

4.2.8 Surface water flood flows are generally predicted to encroach onto the site boundary along the northern corner (confluence of the watercourse features, as indicated in Figure 8 by arrows (above). There may be potential to intercept this oncoming flow at the boundary following a re-grade of site, through profiling and incorporating a formal interceptor ditch.

4.2.9 In order to mitigate potential surface water flood risk, it is advised that following a re-grade of the site, finished floor levels are raised above the external levels to allow overland flood routes for excess surface water run-off.

Pluvial (Overland run-off) Flood Risk

4.2.10 Intense rainfall that is unable to soak into the ground or enter drainage systems can run-off land and result in flooding. Local topography and the land use can have a strong influence on the direction and depth of flow. Large catchment areas are particularly prone to this type of flooding. The volume and rate of overland flow from land can be exacerbated if development increases the percentage of impermeable area.

4.2.11 The topography of the development and surrounding area means there is little likelihood of significant flows impacting on the proposed development or on land and property adjacent to the development. The only flows that are likely to be present on site are from direct rainfall on areas of hardstanding.

4.2.12 Any overland flows generated by the proposed development must be directed away from the adjacent existing residential properties on the boundaries; safe avenues of overland flow away from the proposed dwellings are advised.

Sewer Flood Risk

4.2.13 In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water known as ‘combined sewers’. Foul water flooding often occurs in areas prone to overland flow and can result when the sewer is overwhelmed by heavy rainfall and will continue until the water drains away. It can also occur when the sewer becomes blocked or is of inadequate capacity, this could lead to there being a high risk of internal property flooding with contaminated water.

4.2.14 United Utilities (UU) records identify a 675mm diameter combined public sewer crossing the site from around the mid-point along the south eastern boundary off Back Commons (UU MH Ref.9002) to the southern corner of site (UU MH Ref.8001). This system will need to be catered for within the proposed planning layout either in terms of an easement strip or a diversion; ideally under public highway to allow appropriate access to prevent blockages and minimise flood risk.

4.2.15 Consultation with United Utilities, has not identified any existing sewer flood risk issues or historical flooding of the immediate site area; see Appendix G for correspondence.

4.3 Groundwater Flood Risk

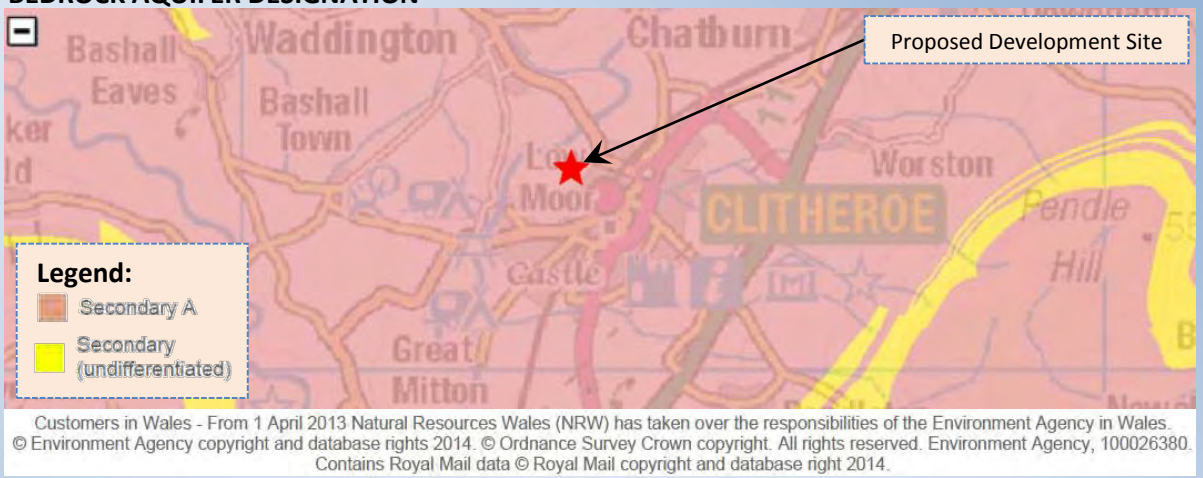
4.3.1 In general terms groundwater flooding can occur from three main sources: - raised water tables, seepage and percolation and groundwater recovery or rebound.

4.3.2 If groundwater levels are naturally close to the surface then this can present a flood risk during times of intense rainfall. No groundwater flood risk has been identified during consultation with the various interested parties.

4.3.3 Seepage and percolation occur where embankments above ground level hold water. In these cases water travels through the embankment material and emerges on the opposite side of the embankment. At present there are no reported problems with groundwater flooding.

4.3.4 Groundwater recovery / rebound occurs where the water table has been artificially depressed by abstraction. When the abstraction stops the water table makes a recovery to its original level. There is the potential for groundwater flooding in low lying areas where groundwater levels have been depressed below their pre-pumping conditions, where these were at or close to ground level. As with the seepage scenario the likelihood of flooding from this source is low.

BEDROCK AQUIFER DESIGNATION



SUPERFICIAL AQUIFER DESIGNATION

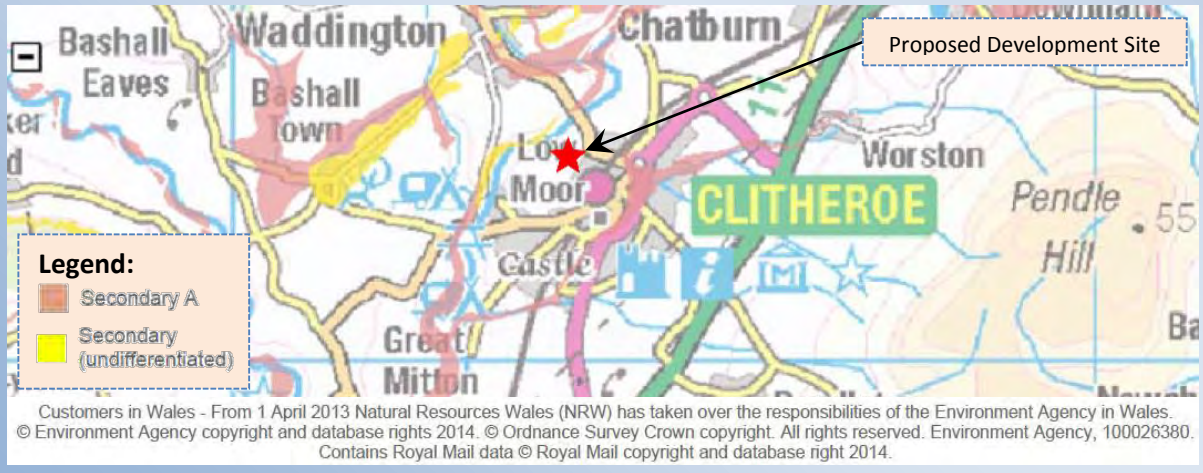


Figure 9: Bedrock and Superficial Aquifer Map Extract (Environment Agency 2014).

4.3.5 The EA's online mapping data for groundwater shows both the Bedrock and Superficial Aquifer designations as indicated in Figure 9 (preceding page). The bedrock aquifer designation for the site is shown in Figure 9 indicates the site is underlain by a 'Secondary A' aquifer (pink shading) and the site is not understood to be underlain superficial aquifers within the vicinity of the site (Figure 9).

4.3.6 No historical groundwater flooding of the site has been identified during consultation with the various interested parties; however setting Finished Floor Levels a minimum of 150mm above the external levels following any re-grade should mitigate any risk of flooding from this source.

4.4 Artificial Sources of Flood Risk

4.4.1 Figure 10 (below) shows an extract of the EA's online Reservoir flood map; Appendix D shows the EA's reservoir flood map in full.

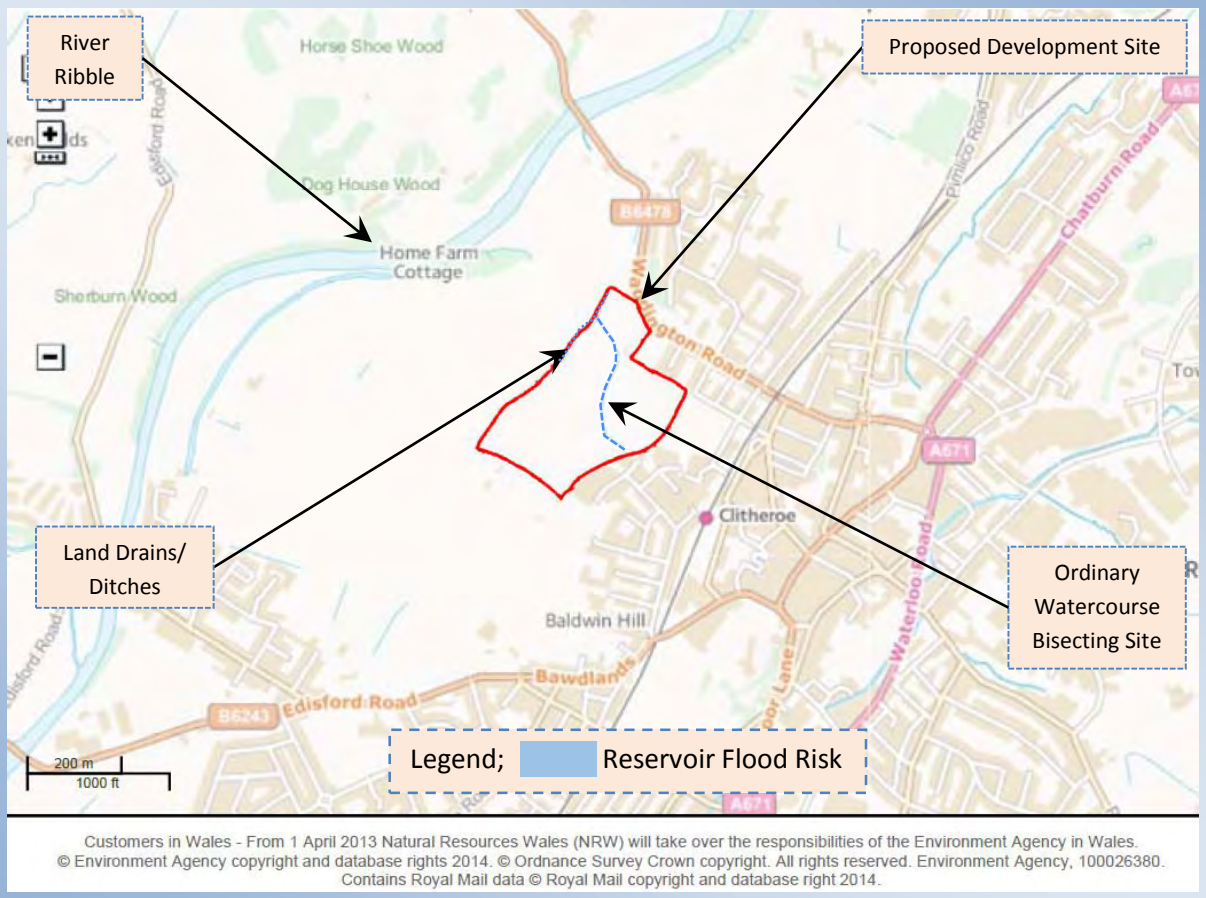


Figure 10: Reservoir Flood Map Extract (Environment Agency 2014)

Reservoirs

4.4.2 The EA recognises reservoirs as bodies of water over 25,000 cu.m, therefore there are no reservoirs within the vicinity of the proposed development site. Due to the site location relative to any artificial bodies of water such as reservoirs or canals the risk of flooding from this source is considered low.as indicated in Figure 10 (above).

Canals

4.4.3 The nearest identified canal to the proposed development site is the 'Leeds and Liverpool' canal, approximately 14.8km east of the site, as such the risk from this flood source is considered to be 'very low'.

4.5 Historical and Anecdotal Flooding Information

4.5.1 An internet based search for flooding events did not recall any historical flooding to the immediate development site area, including review of the Chronology of British Hydrological Events.

4.5.2 Consultation with various interested parties including United Utilities and the Environment Agency, failed to highlight any historical flooding to the immediate site area or the neighbouring areas. Review of the Ribble Catchment Flood Management Plan (CFMP) and the Ribble Borough Council Strategic Flood Risk Assessment (SFRA) furthermore failed to highlight any historical flooding of the proposed development of neighbouring areas (Appendix J for details)

4.5.3 Discussion with the Highway Department (Ribble Valley Borough Council), has highlighted some existing highway flooding issues off Milton Avenue; however these are considered a nuisance rather than a significant issue to the development. There may be an opportunity to provide some assistance in terms of flood alleviation to this area of highway but options will need to be evaluated during the detailed design of the drainage systems required to serve site.

4.5.4 The previous planning application identified some existing highway flooding issues (under the railway bridge) to the east of site. The proposed development is not understood to negatively impact on this system as the drainage is independent. The proposals may offer an opportunity to assist and potentially alleviate some of these offsite issues by providing an overflow from the existing highways system into the proposed onsite drainage system. The specifics will need to be determined in detail at the detailed design stage.

4.6 Flood Risk Mitigation Measures & Residual Risks

4.6.1 No specific flood risk mitigation measures are proposed as the development is located within Flood Zone 1.

Mitigation Measures

4.6.2 There is no requirement to set minimum Finished Floor Levels (FFL) as the proposed development is located outside of the floodplain, however it is advised that FFL be set ideally 600mm above the adjacent Q100 (1%AEP) TWL.

4.6.3 Setting Finished Floor Levels a minimum of 150mm above the external levels following any re-grade should mitigate any risk of flooding from a variety of sources, including groundwater and surface water run-off risks at the proposed development.

4.6.4 As with any development it is also advised that external levels fall away from property to minimise the flood risk from a variety of sources.

4.6.5 Overland flows generated by the proposed development must be carefully controlled; safe avenues of overland flow away from any existing and proposed buildings are advised.

4.6.6 To minimise the flood risk to the proposed dwellings and neighbouring property it is proposed that surface water run-off generated by the proposed development be managed effectively and ideally with the peak rates of run-off being restricted to the equivalent of the pre-development situation.

4.6.7 It is proposed that this be achieved using a Hydrobrake® flow control device with stormwater storage being provided to prevent overland run-off from leaving site for events up to and including the 100yr event with a 30% allowance for climate change.

Residual Risks

4.6.8 The development is accessible for emergency access and egress during times of extreme flooding as the floodplain does not extend into the proposed development.

4.6.9 The development and its drainage systems should be designed to cope with intense storm events up to and including the 100 year return period rainfall event with an allowance for Climate Change (CC), based on the design life of the proposed development this allowance for CC is in the form of a 30% increase in rainfall intensity.

4.6.10 If an extreme rainfall event exceeds the design criteria for the drainage system it is likely that there will be some overland flows that are unable to enter the system, it is important that these potential overland flows are catered for within the proposed planning layout in the event that the capacity of the drainage system is exceeded.

4.6.11 Any overland flows generated by the proposed development must be carefully controlled; safe avenues of overland flow away from the existing and proposed dwelling are advised.

4.6.12 As with any drainage system blockages within either the foul or surface water system have the potential to cause flooding or disruption. It is important that should any drainage systems not be offered for adoption to either the Water Company or the Local Authority then an appropriate maintenance regime should be scheduled with an appropriate management company for these private drainage systems.

5.0 FLUVIAL FLOOD MODELLING

5.1 Hydrological Modelling

5.1.1 This study has considered the; 1 in 1 year, 1 in 100 year, 1 in 100 year + 20% allowance for climate change and the 1 in 1000 year flood flows along the brook.

5.1.2 A small land drain running along the north western field boundary connects into the watercourse and for completeness has been included within the model.

5.1.3 Catchment descriptors were obtained from the FEH CD-ROM for the catchment upstream of the site. A catchment map and the catchment descriptors are provided in Appendix E. In addition to the natural catchment there are known to be public surface water sewers connecting into the watercourse; the catchment from these sewers has been determined and added to the natural catchment to determine the total flow estimates.

5.1.4 The Revitalised FEH Rainfall Run-Off Method (ReFEH) was applied based on catchment descriptors. These are considered to represent conservative flow estimates (i.e. adopts the precautionary approach). The flows from the areas of hard-standing, roof areas and roads were determined by applying the rainfall characteristics from the FEH CD-ROM. The peak flow estimates are shown in Table 5.1 below; full details are shown in Appendix K.

Return Period (years)	Flow Ref.	Flow Estimate (m^3/s)
1 in 1	Q1	0.0724
1 in 100	Q100	0.2248
1 in 100 + 20% (CC)	Q100+20%CC	0.2896
1 in 1000	Q1000	0.3963

Table 5.1: Watercourse – ReFEH Flow Estimates

Return Period (years)	Flow Ref.	Flow Estimate (m^3/s)
1 in 1	Q1	0.0177
1 in 100	Q100	0.0423
1 in 100 + 20% (CC)	Q100+20%CC	0.0508
1 in 1000	Q1000	0.0618

Table 5.2: Land Drain – ReFEH Flow Estimates

5.2 Hydraulic Modelling

5.2.1 A steady state 1 dimensional model of the brook was developed using HEC-RAS v4.1 which solves the Energy Equation using the Standard Step Method.

5.2.2 A topographical survey of the site was undertaken and cross sections through the brook and adjacent land were recorded at approximately 10 metre centres upstream and downstream of the site in order to generate stable numerical solutions.

5.2.3 A schematic view of the modelled reach, profile and cross sections are shown in Appendix L/M.

5.2.4 Roughness coefficient allocation was based on information obtained during a site walkover survey in October 2011. The brook channel is relatively clean, with weeds and stones lower stages with more ineffective slopes and sections. As such the channel was assigned a roughness Manning's n value of 0.045. Beyond the main channel a Manning's n value of 0.045 has been applied.

5.2.5 The upstream and downstream boundary conditions were assumed normal depth, based on the average gradient through the study area the gradients are as follows: -

River Reach	Gradient (1 in x)	S
1 (watercourse)	308	0.003
2 (land drain)	146	0.007
3 (watercourse)	1012	0.001

Table 5.3: HEC-RAS Boundary Conditions

5.2.6 The hydraulic modelling results including; a schematic plan, a longitudinal profile, cross sections (indicating Top Water Levels (TWL) for all of the aforementioned storm events) are included in Appendix M.

5.2.7 The results indicate that an insignificant amount out of main channel flooding would occur; the extent of this flooding is indicated on the Flood Plain Plan in Appendix N.

5.2.8 There is no requirement to set minimum Finished Floor Levels (FFL) as the proposed development is located outside of the floodplain, however it is advised that FFL be set ideally 600mm above the adjacent Q100 (1%AEP) TWL.

5.3 Compensatory Flood Storage

5.3.1 There is no requirement for compensatory flood storage as there is no intention to raise the existing ground levels within the flood plain extents and the proposed development is located outside of the flood plain extent.

6.0 SURFACE WATER MANAGEMENT

6.1 Pre-Development Surface Water Run-off

6.1.1 The total site area is approximately 9.200ha and is considered to be approximately 100% pervious for the purposes of determining the existing rate of surface water run-off the site.

6.1.2 The surface water run-off rates have been calculated using the Modified Rational Method and the IH124 Greenfield run-off method, utilising rainfall catchment characteristics from the Flood Estimation Handbook (FEH), details of which are included Appendix E.

6.1.3 The peak rate of run-off generated by the total development during the annual return period event is calculated to be approximately 28.8l/s. The peak rate generated by the development during the 1 in 100 year return period event is calculated to be approximately 68.9l/s.

6.1.4 The mean annual flood, QBar is calculated to be 33.1l/s.

6.1.5 The approximate surface water run-off volume generated by the total site area based on the 1 in 100 year return period storm event is 217.6cu.m (Appendix H); estimated using the FEH rainfall catchment characteristics (6hr duration event).

6.2 Post-Development Surface Water Run-off

6.2.1 The residential nature of the development proposals means that there will be an increase in the impermeable areas of the site, resulting in an increase in both the volume and the peak rate of surface water run-off if flows are unrestricted.

6.2.2 The proposed impermeable area will increase to approximately 2.760ha, approximately 30% of the total development area.

6.2.3 Based on a rainfall rate of 50mm/hr (BRegs: Part H) the unrestricted run-off rate would be 383.3l/s.

6.2.4 Based on a rainfall rate of 10.2mm/hr (WinDES /FEH Data – 6hr winter peak rainfall intensity) the annual unrestricted run-off rate would be 78.2l/s.

6.2.5 The post-development surface water run-off volume generated by the impermeable site area based the 1 in 100 year return period event with a 30% allowance for Climate Change is 279.0cu.m.

6.2.6 The proposed impermeable area will generate significantly greater run-off than the existing total site area; if flows cannot be discharged via infiltration then they should be restricted to Greenfield run-off rates to compensate for the increase in run-off volume.

6.3 Sustainable Drainage Systems (SuDS)

6.3.1 In accordance with the NPPF, Sustainable Drainage Systems (SuDS) should be specified wherever possible to manage surface water. This in turn reduces the burden downstream on both watercourses and sewerage systems.

6.3.2 SuDS have the ability to address three core objectives; water quantity, water quality and amenity value. With the appropriate system specified, all three core objectives can be satisfied. Where possible, peak surface water discharge rates to watercourses and sewers should be reduced.

6.3.3 Preference should always be given to SuDS over the traditional methods of buried sewers wherever possible and practical. Opportunities should be taken to provide soft landscaping where at all possible on site to assist in minimising surface water run-off.

6.3.4 Runoff from car parking areas and roads could be conveyed through swales, permeable pavements and petrol interceptors to provide a degree of treatment before flows are carried to public sewers.

6.3.5 The exact type of SuDS will be determined at the detailed design stage.

6.4 Methods of Surface Water Management

6.4.1 At present the site is considered to be undeveloped, the total site area covers approximately 7.463ha and is considered to be 100% pervious.

6.4.2 The proposed impermeable area of the development is approximately 2.760ha, which accounts for approximately 30% of the total site area.

6.4.3 There are three methods that have been reviewed for the management and discharge of surface water detailed below; these may be applied individually or collectively to form a complete strategy. They should be applied in the order of priority listed below.

- Discharge via infiltration
- Discharge to watercourse
- Discharge to public sewerage system

6.5 Discharge via Infiltration

6.5.1 Any impermeable areas that can drain to soakaway or an alternative method of infiltration would significantly improve the sustainability of the surface water system and would help to minimise the amount of attenuation and storm water storage required.

6.5.2 The British Geology Survey (BGS) mapping data indicates that ground conditions are as follows:-

1:50 000 Scale Bedrock Geology Description: Clitheroe Limestone Formation And Hodder Mudstone Formation (Undifferentiated) - Mudstone. Sedimentary Bedrock formed approximately 334 to 344 million years ago in the Carboniferous Period.

Setting: Shallow Carbonate Seas. These rocks were formed in warm shallow seas with carbonate deposited on platform, shelf and slope areas; often rich in corals and shelly faunas. May include evaporites where seawater was trapped and salts concentrated by evaporation.

1:50 000 scale superficial deposits description: Till, Devensian - Diamicton. Superficial Deposits formed up to 2 million years ago in the Quaternary Period.

Setting: Ice Age Conditions. These rocks were formed in cold periods with Ice Age glaciers scouring the landscape and depositing moraines of till with outwash sand and gravel deposits from seasonal and post glacial meltwaters.

6.5.3 The Cranfield Soil and Agrifood Institute Soilscapes soil type viewer identifies the soils as; slowly permeable, seasonally wet, acid loamy and clayey soils. Drainage is considered likely to be impeded, the area is understood to freely drain to the local stream network.

6.5.4 Based upon the infiltration constraints identified above it is unlikely that infiltration drainage will be a suitable method of surface water discharge for the proposed development; however, infiltration should not be discounted as a complete or partial drainage solution until testing has been carried out in accordance with BRE365 to determine whether any infiltration solution can be applied in an specific areas of site thought to be most suitable.

6.5.5 If initial testing indicates infiltration may be viable then soakaway testing should be undertaken in specific locations where the use of soakaways is most likely, this is dependent upon the proposed planning layout and should be completed prior to the detailed design.

6.5.6 If it is ultimately proposed that the surface water arising from the proposed development is discharged via one or more infiltration solutions such as soakaways then the design standard will be no flooding for storm events up to and including the 100 year return period storm event in accordance with the 'The Suds Manual' (2007). The resultant storage volume depends on the infiltration rate and contributing impermeable area for each specific soakaway; this will be determined at the detailed design stage.

6.6 Discharge to a Watercourse

6.6.1 The Environment Agency's online mapping data is supported by various other publications in identifying the presence of a principal watercourse (River Ribble) located approximately 0.3km to the north-west of the proposed development site.

6.6.2 An ordinary watercourse (stream) is understood to bisect the site emerging from a culvert around the mid-point of the south eastern boundary and running north-northeast.

6.6.3 Due to the watercourse bisecting site this is the obvious method of discharging surface water flows generated by the proposed development. The watercourse and land drain that connects to the watercourse should be of sufficient depth to allow a suitable outfall with the necessary cover to any attenuation system.

6.6.4 Consents will be required from the LPA to discharge to the Ordinary Watercourse and approve discharge rates therefore early discussion is advised.

6.6.5 As a connection is proposed to a watercourse it is an EA requirement that the surface water drainage proposals cater for the 100 year return period storm event with a 30% allowance for climate change.

6.6.6 As an increase in the impermeable area is proposed (as the site is currently Greenfield) there will be an increase in the resultant volume of surface water run-off being generated compared to the pre-development scenario. This increase in surface water volume means that a discharge rate of QBar should be applied to the surface water flows.

6.6.7 A flow restriction will be most likely in the form of a Hydrobrake® or similar approved flow control device.

6.6.8 The restricted flow generates a storage requirement during periods of intense rainfall. The storage requirement for the 1 in 1 year return period storm event with a restricted discharge rate of 33.1l/s, based on an impermeable area of 2.760ha and FEH catchment characteristics, is approximately between 165cu.m and 377cu.m (Appendix I).

6.6.9 The storage requirement for the 1 in 100 year return period storm event plus 30% allowance for Climate Change with a restricted discharge rate of 33.1l/s, based on an impermeable area of 2.760ha and FEH catchment characteristics, is approximately between 1670cu.m and 2671cu.m (Appendix I).

6.6.10 This may provide a full or partial solution for the discharge of surface water run-off generated by the proposed development, detailed design will need to confirm feasibility of the proposed strategy, prior to approval.

6.7 Discharge to a Public Sewer

6.7.1 United Utilities have identified a 675mm diameter combined public sewer crossing the site from around the mid-point along the south eastern boundary off Back Commons (UU MH Ref.9002) to the southern corner of site (UU MH Ref.8001).

6.7.2 There is no intention of discharging surface water flows to the public sewer system in light of the close proximity to the watercourse.

6.8 Climate Change

6.8.1 There are indications that the climate in the UK is changing significantly and it is widely believed that the nature of climate change will vary greatly by region. Current expert opinion indicates the likelihood that future climate change would produce more frequent short duration and high intensity rainfall events with the addition of more frequent periods of long duration rainfall.

6.8.2 The NPPF Technical Guidance Table 5 states that the recommended national precautionary sensitivity ranges for increase of peak rainfall intensity is 30% until 2115. It is widely believed that the impact of climate change means there is likely to be a long term increase in the average sea levels, with an expectation that sea levels will rise gradually.

6.8.3 An increase in flood water levels means that future flooding events will occur more frequently and will have a greater impact. Any increase in the level of flood risk to the proposed development from climate change is likely to be related to the increase in rainfall intensity and duration and its impact upon the surface water drainage system.

6.8.5 Climate Change should be accounted for within the design and it is recommended that an increase in peak rainfall intensity of 30% is allowed for.

7.0 FOUL WATER MANAGEMENT

7.1 There are no existing foul water flows generated by the site.

7.2 Consultation with United Utilities has identified a 675mm diameter combined public sewer crossing the site from around the mid-point along the south eastern boundary off Back Commons (UU MH Ref.9002) to the southern corner of site (UU MH Ref.8001).

7.3 A copy of the UU sewer records and correspondence is included in Appendix G.

7.4 This 675mm (dia.) combined public sewer would provide a point of connection for the foul water flows generated by the development; however the feasibility of making a connection would depend on levels.

7.5 It may be necessary to provide a foul water pumping station to serve site and pump via a rising main back up to the system crossing site; this will need to be determined at the design stage.

7.6 Based on the proposals for the construction of approximately 345no. residential units the approximate peak foul water flows generated by the development are 16.0l/s. This is based on 4000 litres per dwelling per 24 hours; the guidance contained within Sewers for Adoption (SfA).

7.7 A detailed design will be required to confirm feasibility based on the topographic levels following more detailed investigation, further discussion with United Utilities will be required to confirm the strategy.

8.0 SUMMARY AND CONCLUSIONS

8.1 The Flood Risk Assessment has been prepared to support a planning application for the construction of approximately 345no. dwellings as part of a residential development, complete with estate roads, private access roads, external works, footpaths, car parking, external lighting, landscaping, boundary walls, fencing, external services and drainage.

8.2 The proposed development site lies solely within Flood Zone 1 and is approximately 9.200ha; the NPPF requires that all planning applications for development proposals that exceed 1 hectare be accompanied by a Flood Risk Assessment.

8.3 The development is solely 'residential' in its nature and as such is classified as 'more vulnerable' based on guidance within the NPPF (Table 2), this is considered an appropriate land-use within Flood Zone 1; providing there is no increase in flood risk elsewhere as a result of the proposals.

8.4 This Flood Risk Assessment has reviewed all sources of flood risk to both the proposed development and to the existing adjacent development as a result of the proposals, including; fluvial, tidal, pluvial, groundwater, sewers and flooding from artificial sources.

8.5 An Internet based search for flooding events did not recall any historical flooding in the immediate site area. The pre-development enquiries with the EA also failed to highlight any historical flooding events specific to the development site.

8.6 Local residents have highlighted an existing highway drainage issue where Waddington Road passes under the Railway, although this presents little risk to the proposed development there is potentially scope to assist in alleviating this offsite issue as part of the development proposals, however viability will require additional investigation and detailed design.

8.7 The development is accessible for emergency access and egress during times of extreme flooding as the 100 year floodplain does not extend into the proposed development area.

8.8 As a result of the relatively low flood risk from all of the sources reviewed, the principle focus of this report is on the effective management of surface water drainage.

8.9 Based on the ground conditions identified by the BGS and NSRI Soilscapes Data, it can be considered that infiltration is unlikely to provide a viable drainage solution for surface water run-off generated by the proposed development site, in terms of infiltration characteristics.

8.10 Infiltration should not be discounted as a complete or partial drainage solution until testing has been carried out in accordance with BRE365 to determine whether any infiltration solution can be applied in specific areas of site thought to be most suitable. Soakaway testing should be undertaken in specific locations where the use is most likely.

8.11 It is proposed that the surface water run-off generated by the development proposals discharge to ground via soakaways if feasible, however it is more likely that a practical solution will be to discharge to the Ordinary Watercourse bisecting site

8.12 Consents will be required for works affecting the Ordinary Watercourse and approval of discharge rates will be required, therefore early discussion is advised.

8.13 It will be necessary to restrict the surface water discharge generated by the development proposals to the pre-development greenfield rates of run-off (QBAR), due to the nature of the proposals. The Greenfield run-off rates have been calculated using the IH124/ICP-SUDS method based on the catchment characteristics of the site obtained from the FEH CD-ROM (v3.0). The mean annual peak rate of run-off QBar is calculated to be 33.1l/s.

8.14 A flow restriction will be most likely in the form of a Hydrobrake® or similar approved flow control device.

8.15 The restricted flow generates a storage requirement during the extreme storm events. The resultant storage requirement for the annual return period storm event with a restricted discharge rate of 33.1l/s, based on an impermeable area of 2.760ha is approximately between 165cu.m and 377cu.m. For the 1 in 100 year return period storm event with a 30% allowance for climate change with a restricted discharge rate of 33.1l/s (QBAR), is approximately between 1670cu.m and 2671cu.m.

8.16 The foul water flows generated by the proposed development site are suggested to discharge to the existing public combined sewer (675mm dia.) crossing the southern corner of site.

8.17 The proposed onsite surface water drainage system will need to be sized to prevent overland run-off from storm events up to and including the 100 year return period storm event with a 30% allowance for climate change.

8.18 If an extreme rainfall event exceeds the design criteria for the drainage system it is likely that there will be some overland flows that are unable to enter the system, it is important that these potential overland flows are catered for within the proposed planning layout in the event that the capacity of the drainage system is exceeded.

8.19 As with any drainage system blockages within either the foul or surface water sewer systems have the potential to cause flooding or disruption. It is important that should any drainage systems not be offered for adoption to either the Water Company or the Local Authority then an appropriate maintenance regime be scheduled with an appropriate management company for these private drainage systems.

8.20 The Flood Risk Assessment is considered to be commensurate with the development proposals and in summary, the development can be considered appropriate in accordance with the NPPF.

9.0 RECOMMENDATIONS

9.1 The development and its drainage systems should be designed to cope with intense storm events up to and including the 100 year return period rainfall event with an allowance for Climate Change (CC).

9.2 Opportunities should be taken to provide soft landscaping where at all possible on site to assist in minimising surface water run-off. Added benefits include biodiversity and visual enhancements.

9.3 If an infiltration drainage solution cannot be provided for the surface water system proposed to serve the development, then discharge of surface water to the watercourse crossing site should be restricted to a maximum rate of QBar, calculated to be 33.1l/s.

9.4 It is important that should any drainage systems not be offered for adoption to either the Water Company or the Local Authority then an appropriate maintenance regime be scheduled with an appropriate management company for these private drainage systems.

9.5 Any overland flows generated by the proposed development must be directed away from any neighbouring development; safe avenues of overland flow away from the proposed dwellings are advised.

9.6 Foul water flows are to be discharged to the combined public sewer crossing the southern corner of the site; a pumped solution may be required to serve the whole development area.

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Chronology of British Hydrological Events – www.dundee.ac.uk/
CIRIA – http://www.ciria.org/
Cranfield University – http://www.landis.org.uk/soilscapes/
Environment Agency – www.environment-agency.gov.uk/
FloodProBE – http://www.floodprobe.eu/
Flood Forum – http://www.floodforum.org.uk/
Flood London – http://www.floodlondon.com/
Flood Resilience Group – http://www.floodresiliencegroup.org/frg/
Google Maps – http://maps.google.co.uk/
Lancashire County Council – http://www.lancashire.gov.uk/home/2010/classic/index.asp
London Resilience – http://www.londonprepared.gov.uk/
Ribble Valley Borough Council – http://www.ribblevalley.gov.uk/
Streetmap – http://www.streetmap.co.uk/
US Army Corps of Engineers – http://www.hec.usace.army.mil/software/hec-ras/
United Utilities - http://www.unitedutilities.com/default.aspx
Watertight International – http://www.watertightinternational.com/

APPENDIX A: LOCATION PLAN

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LOCATION PLAN
WADDOW VIEW, CLITHEROE

OS X (Eastings)	374096
OS Y (Northings)	442181
Nearest Post Code	BB7 2HX
Lat (WGS84)	N53:52:31 (53.875177)
Long (WGS84)	W2:23:44 (-2.395478)
LR	SD740421
mX	-266663
mY	7112013

APPENDIX B: TOPOGRAPHIC SURVEY

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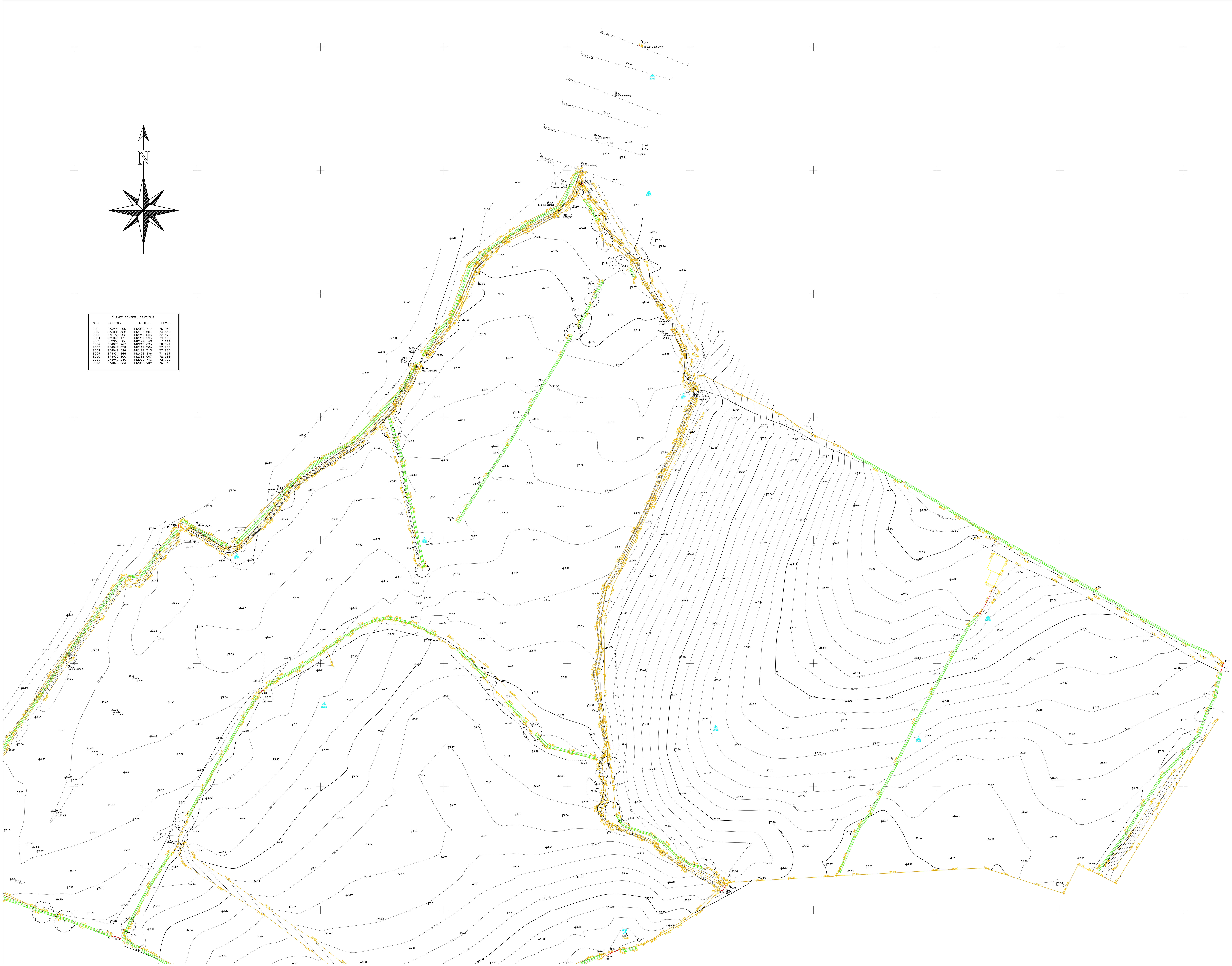

SURVEY CONTROL STATIONS			
STN	EASTING	NORTHING	LEVEL
2001	373923.606	442090.717	76.858
2002	373801.465	442183.504	73.558
2003	373765.952	442243.835	72.477
2004	373842.171	442250.335	73.108
2005	373960.306	442174.140	77.114
2006	374070.767	442218.696	78.741
2007	374042.578	442169.506	77.230
2008	374042.586	442169.513	77.230
2009	373934.666	442438.386	71.619
2010	373933.200	442391.067	72.192
2011	373947.246	442308.746	72.796
2012	373871.723	442069.989	76.843

LEGEND

CONTROL STATIONS
MANHOLE — MH CL 31.20
BUSH
TREE
DROP KERB
EMBANKMENT — TOP BANK / BOTTOM BANK
OVERHEAD ELECTRICITY LINE
OVERHEAD TELEPHONE LINE
FOOTPATH
FENCE
HEDGE
FOLIAGE
DITCH
VERGE
EXISTING BUILDING
MAIN CONTOUR — 50.00
CONTOUR — 49.50
SW SEWER
FW SEWER

AV	Air Valve
BH	Borehole
BD	Bollard
BM	Bench Mark
BS	Bus Stop
BT	BT Inspection Chamber
BL	Bed Level
CATV	Cable TV Cover
CL	Cover Level
C/L	Chain Link Fence
CP	Catch Pit
CPS	Concrete Paving Slab
ECB	Electricity Control Box
EH	Building Eaves Level
ER	Earthing Rod
FB	Flower Bed
FH	Fire Hydrant
FL	Floor Level
GH	Greenhouse
GP	Gate Post
GR	Grate
GV	Gas Valve
G	Gully
IC	Inspection Chamber
IL	Invert Level
KO	Kerb Outlet
JB	Junction Box
LP	Lamp Post
MH	Man Hole
MK	Marker Post
MS	Mile Stone Marker
NP	Street Name Plate
O/H	Overhead
P	Post
PB	Post Box
PI	Pipe
PM	Parking Meter
P/R	Post & Rail Fence
P/W	Post & Wire Fence
PYL	Electricity Pylon
RE	Rodding Eye
RH	Building Ridge Level
RSJ	Reinforced Steel Joist
R/W	Retaining Wall
RWP	Rainwater Pipe
SC	Stop Cock
SL	Soffit Level
SP	Sign Post
ST	Stop Tap
SV	Stop Valve
SY	Stay Wire
TOW	Top Of Wall Level
TH	Trial Hole
TL	Traffic Light
TP	Telegraph Pole
UTL	Unable To Lift
WM	Water Meter
WL	Water Level
VH	Building Valley Level

Disclaimer

Man Entry to sewers has not been undertaken. Depths, Pipesizes etc are measured from the ground. All sewers and inverts to be checked prior to any works commencing on site. Geomatic Surveys Limited are not resposible for manholes, services, information not surveyed which may have an impact on site development.

Boundaries shown are physical and may not represent legally conveyed ownership

Tree species have only been identified using basic identification techniques. For precise tree species identification, it is recommended that a qualified aboroculturist is used prior to tree removal.

REV	DATE	DESCRIPTION	BY	APP.
A	08.03.12	Culvert Pipe sizes and Openings confirmed on the drawing.	DCW	

Sheet Layout

Sheet 1
Sheet 2

Survey Information

The Survey is related to Ordnance Survey National Grid and Datum, using GPS.

Geomatic Surveys Ltd
LAND SURVEYORS AND CONSULTING ENGINEERS
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Client

BETTS ASSOCIATES

Project Title

WADDOW VIEW BACK COMMONS CLITHEROE

Drawing Title

TOPOGRAPHICAL SURVEY

Drawn	Checked	Surveyed Date
DCW	IRH	23/02/2012
Date	Scale	Sheet No.
27/02/2012	1:500 @ A0	SHEET 1 OF 2
Drg. No.	0911/Topo	Rev A

LEGEND

CONTROL STATIONS
MANHOLE — MH CL 31.20
BUSH
TREE
DROP KERB
TOP BANK
EMBANKMENT
BOTTOM BANK
OVERHEAD ELECTRICITY LINE
OVERHEAD TELEPHONE LINE
FOOTPATH
FENCE
HEDGE
FOLIAGE
DITCH
VERGE
EXISTING BUILDING
MAIN CONTOUR 50.00
CONTOUR 49.50
SW SEWER
FW SEWER

AV	Air Valve
BH	Borehole
BD	Bollard
BM	Bench Mark
BS	Bus Stop
BT	BT Inspection Chamber
BL	Bed Level
CATV	Cable TV Cover
CL	Cover Level
C/L	Chain Link Fence
CP	Catch Pit
CPS	Concrete Paving Slab
ECB	Electricity Control Box
EH	Building Eaves Level
ER	Earthing Rod
FB	Flower Bed
FH	Fire Hydrant
FL	Floor Level
GL	Greenhouse
GP	Gate Post
GR	Grate
GV	Gas Valve
G	Gully
IC	Inspection Chamber
IL	Invert Level
KO	Kerb Outlet
JB	Junction Box
LP	Lamp Post
MH	Man Hole
MK	Marker Post
MS	Mile Stone Marker
NP	Street Name Plate
O/H	Overhead
P	Post
PB	Post Box
PI	Pipe
PM	Parking Meter
P/R	Post & Rail Fence
P/W	Post & Wire Fence
PYL	Electricity Pylon
RE	Rodding Eye
RH	Building Ridge Level
RSJ	Reinforced steel Joist
R/W	Retaining Wall
RWP	Rainwater Pipe
SC	Stop Cock
SL	Soffit Level
SP	Sign Post
ST	Stop Tap
SV	Stop Valve
SY	Stay Wire
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Sheet Layout
Sheet 1
Sheet 2

Survey Information
The Survey is related to Ordnance Survey National Grid and Datum, using GPS.

Geomatic Surveys Ltd
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Client
BETTS ASSOCIATES

Project Title
WADDOW VIEW
BACK COMMONS
CLITHEROE

Drawing Title
TOPOGRAPHICAL SURVEY

Drawn	Checked	Surveyed Date
DCW	IRH	23/02/2012
Date	Scale	Sheet No.
27/02/2012	1:500 @ A0	SHEET 2 OF 2
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