Barratt Homes Manchester

Flood Risk Assessment and Drainage Appraisal

Land off Chipping Lane, Longridge, Preston, PR3 2NA

880500 R1 (0)

APRIL 2014

RSK

RSK GENERAL NOTES

Project No.: 880500-R1 (0)

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK LDE.

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1 INTRODUCTION

RSK Land and Development Engineering Ltd were commissioned by Barratt Homes Manchester to carry out a flood risk assessment in support of a planning application for a residential development for a site off Chipping Lane, Longridge, Lancashire.

The assessment has been prepared in accordance with National Planning Policy Framework (NPPF) (Ref. 1) and its accompanying guidance document (Ref. 2), the Interim Code of Practice for Sustainable Drainage (Ref. 3) and BS 8533-2011 Assessing and managing flood risk in development Code of practice (Ref. 4), with site-specific advice from the Environment Agency, the Local Planning Authority and the Client.

The NPPF sets out the criteria for development and flood risk by stating that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. The key definitions are:

- "areas at risk of flooding" means land within Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems and which has been notified to the local planning authority by the Environment Agency
- "flood risk" means risk from all sources of flooding - including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

For this site, the key aspects that require the assessment are:

- the Environment Agency's indicative flood map (**Figure 1**) shows that the site is located within Flood Zone 1. Although the flood risk to the site is minimal the site is over 1Ha in size, therefore a flood risk and outline drainage assessment is required.

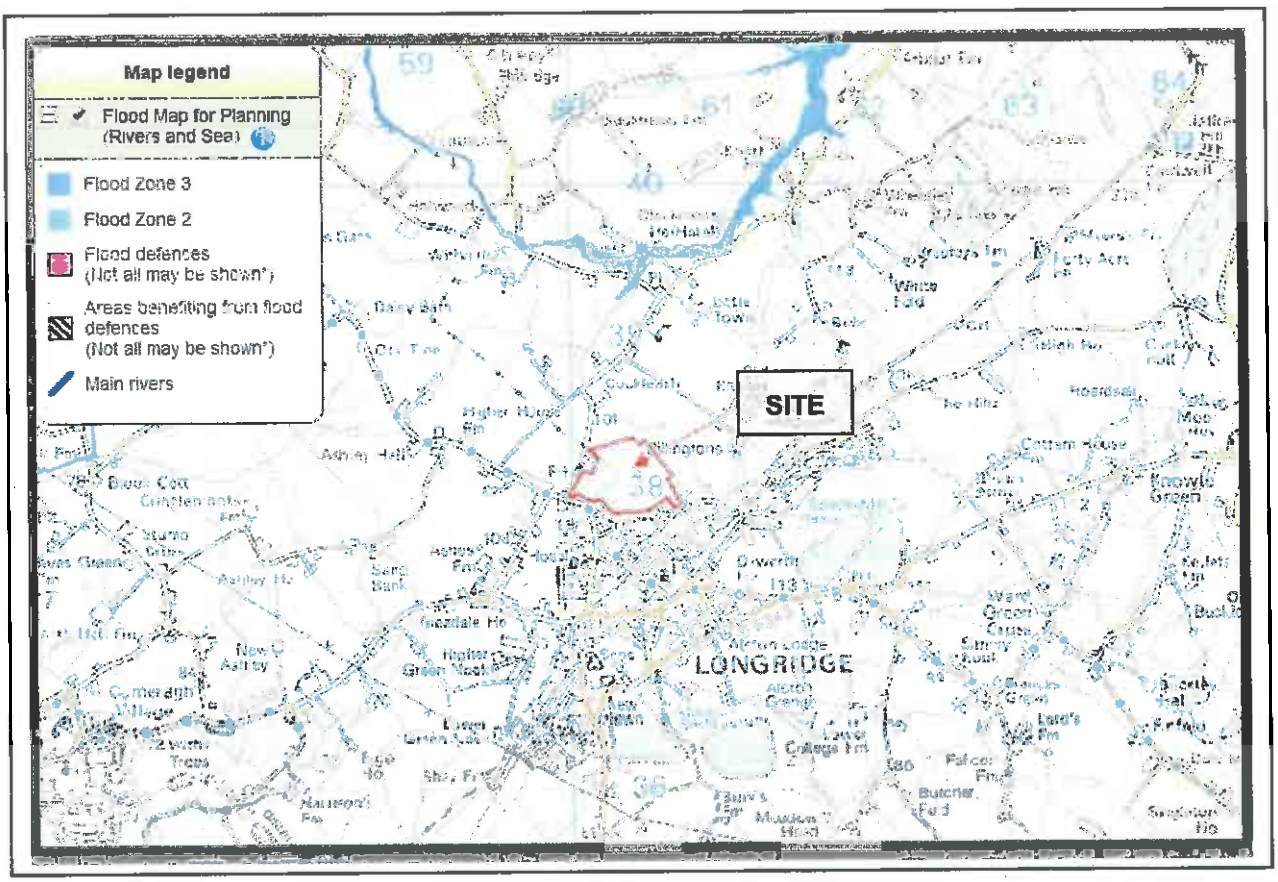

Figure 1: Environment Agency flood zone map (March 2014)

2 CONTEXT AND SCOPE OF WORKS

A key element of project development is to prepare a Flood Risk Assessment to establish the risk associated with site and to propose suitable mitigation, if required to reduce the risk to a more acceptable level.

The scope of work relating to a flood risk assessment is based on the guidance provided in Section 10 of NPPF (Ref. 1) and its accompanying guidance (Ref. 2).

A site-specific flood risk assessment must demonstrate that the site will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. The scope of this assessment therefore comprises of the following elements:

- to obtain information on the hydrology and hydrological regime in and around the site
- to obtain the views of the Environment Agency including scope, location and impacts
- to determine the extent of any new flooding provision and the influence on the site
- to review site surface water drainage based on the proposed layout. To determine the extent of infrastructure required
- to review architect plans and planning information and other studies to determine the existing site conditions
- to assess the impact on the site from climate change effects and anticipated increases in rainfall over a 100 year period for residential uses
- preparation of a report including calculations and summaries of the source information and elements reviewed.

3 SITE DESCRIPTION

3.1 Site location and description

Longridge is a town in the borough of Ribble Valley in Lancashire. It is situated 8 miles (13 km) north-east of the city of Preston.

The site is located immediately north of Longridge Town and adjacent to Chipping Lane. The overall site is approximately 23.7Ha in size and is Greenfield land. The site is located at National Grid reference 360025E 438067N (SD60025 38067) and is shown in **Figure 2** below.

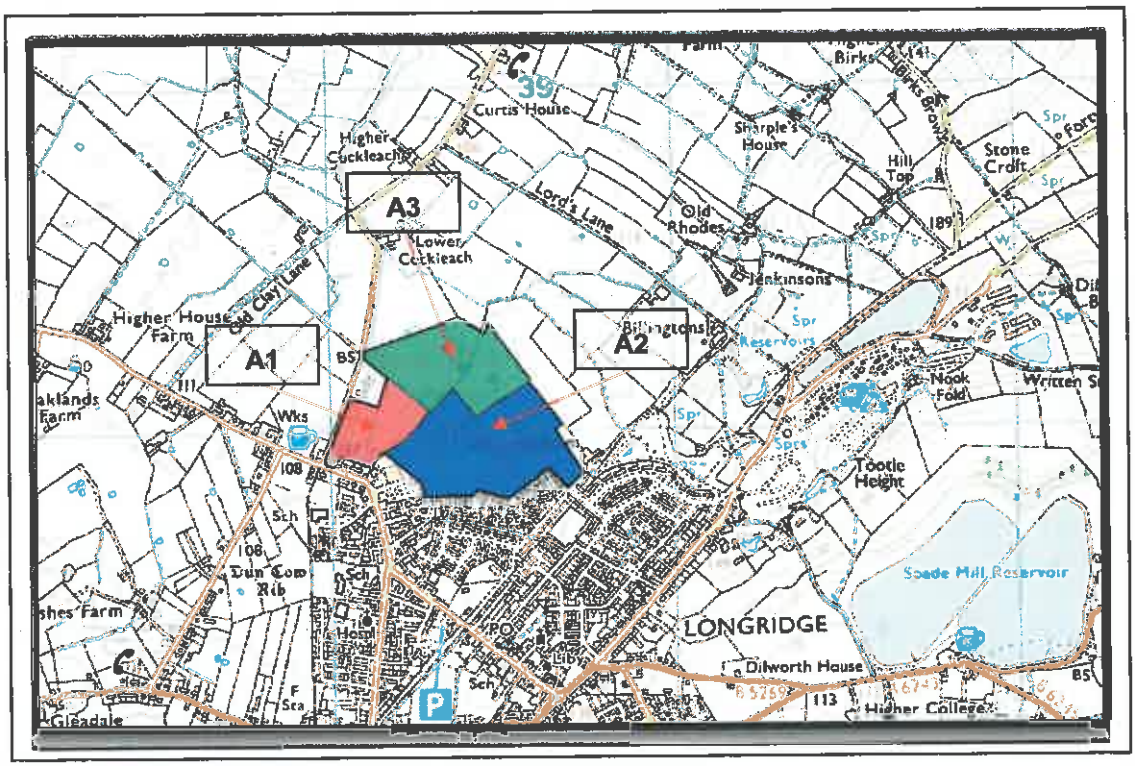

Figure 2: Site location map (March 2014)

The site is bounded to the:

- north by agricultural fields, approximately 240m from the proposed dwellings there is an 'non main river' Higgin Brook flowing in a north westerly direction. Beyond is more Greenfield land
- east by agricultural land including an unnamed ditch approximately 140m from the most easterly edge of the site. Higher Road is located 550m from the site with Dilworth Upper Reservoir 750m from site and Spade Mill Reservoirs 2 and 1 situated slightly south east of the site approximately 1km away
- south by Longridge Town and Alston Reservoirs 2 and 1 located approximately 800m from the most southerly point of site

- west by Chipping Lane running alongside the western length of the site with farmland beyond.

3.2 Outline proposals

The proposed development for the site consists of outline planning permission for the provision of circa 500 dwellings, including affordable housing, new vehicular, pedestrian and emergency accesses, on-site landscaping, public open space and ecological enhancement measures.

The site is being managed as a hybrid development and is segregated into three separate plots with only two of the plots requiring planning permission. The view is to develop the site in phases. The initial phase of the development is identified as A1 as shown on Figure 2, and is approximately 3.9Ha in size. Detailed planning permission is being sought in this area for approximately 106 residential dwellings. The second phase of the development (area A2) of the site is approximately 12Ha and is seeking outline planning permission for approximately 394 residential units. The remainder of the site (area A3) is approximately 7.8Ha in size and will remain as open grassland and amenity area.

A copy of the proposed plan can be found in **Appendix B**.

3.3 Source protection zone

The entire site is not located within a Source Protection Zone, according to the Environment Agency's latest groundwater designation maps.

3.4 Geology

According to the British Geological Survey the site and the surrounding area consists mainly of two types of bedrock, Bowland Shale formation comprising of mudstone and siltstone and Pendleside Sandstone Member comprising of sandstone. Sedimentary Bedrock formed approximately 313 to 335 million years ago in the Carboniferous Period. The local environment was previously dominated by open seas with pelagite deposits and sub-aqueous slopes.

3.5 General topography

The extensive topographical survey of the site shows the ground to fall approximately 20m in height over 730m in distance, falling in a north westerly direction. The most south easterly part of the site has ground levels of 122.08mAOD and falls away towards the cricket ground with the lowest ground levels of the site being 101.67mAOD in the North West corner of the site. A copy of the existing site topographical survey is located in **Appendix C**.

3.6 Surrounding hydrology

The site is located immediately north of Longridge Town which is situated in a rural setting. Longridge sits just outside of the boundary of the Forest of Bowland Area Of Natural Beauty which reaches heights of approximately 500mAOD.

The closest 'main river' is Turn Brook located 3.6km south of the site and is a tributary of the River Ribble located approximately 4km south of the site. The nearest river to the site highlighting flooding is the River Loud located 0.5km to the north of the site and is 'non main river' at its nearest point.

Within the site boundary there are two small ponded areas and some minor watercourses including the 'non main river' Higgin Brook and an unnamed watercourse which converge on site and flow in a north westerly direction. Higgin Brook and the unnamed watercourse will be utilised to accommodate surface water drainage from the development.

Although there are many more watercourses and ditches within a 5km radius of the site, there is no data to suggest any flooding history to the site from any of these sources. There are also a number of reservoirs and small ditches within a 3km radius of the site, all of which are considered to be a **low** source of flood risk.

4 LEGISLATION AND POLICY CONTEXT

4.1 National

Table 4.1: National policy context

Policy/Legislation name	Key Provisions
National Planning Policy Framework	The aims of planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall.

Table 4.2 National legislation

Policy/Legislation name	Key Provisions
Water Resources Act 1991	*Section 24* - The Environment Agency (EA) [now NRW] is empowered under this Act to maintain and improve the quality of 'controlled' waters *Section 85* - It is an offence to cause or knowingly permit pollution of controlled waters. *Section 88* - Discharge consents are required for discharges to controlled waters.
Flood and Water Management Act 2010	This legislation was formally ratified in April 2010 with the aim is to implementing the findings of the 2007 Pitt Review and co-ordinating control of drainage and flood issues. There are a number of increased responsibilities within the act that affect adoption of Sustainable Drainage Systems (SuDS) features and the role of the NRW to expand on the mapping data they provide. The implementation of SuDS features has many beneficial impacts on the treatment of surface water during remediation works.
Water Framework Directive (2000)	The Water Framework Directive (WFD) came in to force in 2000 and requires all inland and coastal waters to reach 'good' chemical and biological status by 2015. Flood risk management is unlikely to have a significant impact on chemical water quality except where maintenance works disturb sediment (such as de-silting) or where pollutants are mobilised from contaminated land by flood waters. The main impact of the WFD on flood risk management, both now and in the future, relates to the ecological quality of water bodies. Channel works, such as straightening and deepening, or flood risk management schemes that modify geomorphological processes can change river morphology. The WFD aims to protect conservation sites identified by the

Policy/Legislation name	Key Provisions
	EC Habitats Directive and Birds Directive that have water-related features, by designating them as 'protected sites'.

4.2 Local policy

Local policy ensures that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding and making development safe without increasing flood risk elsewhere and where possible, reducing flood risk.

Table 4.3: Local legislation and policy context

Policy/Legislation name	Key Provisions
South Ribble ENV20 - Environment Policy 20: Flood Risk	Development will not be permitted in areas liable to flooding and where it would itself increase the risk of flooding or interfere with the ability of agencies to carry out flood control works and maintenance or adversely affect the integrity and continuity of tidal or fluvial flood defences. Development may be considered acceptable provided that the Council is satisfied that suitable measures to mitigate any adverse impact of surface water run-off are included as an integral part of the development proposals.

5 SOURCE OF FLOOD RISK

In accordance with NPPF (Ref. 1) and advice from the Environment Agency, a prediction of the flood sources and levels is required along with the effects of climate change from the present for the design life of the development (in this case assumed to be 100 years). To consider these effects of climate change, NPPF Technical Guidance Table 5 recommends consideration of a 30% increase in rainfall intensity and 20% increase in peak river flows over this timeframe.

The flood risk elements that need to be considered for any site are defined in BS 8533 as the "Forms of Flooding" and are listed as:

- flooding from Rivers (fluvial flood risk)
- flooding from the Sea (tidal flood risk)
- flooding from the Land
- flooding from Groundwater
- flooding from Sewers (sewer and drain exceedance, pumping station failure etc)
- flooding from Reservoirs, Canals and other Artificial Structures.

5.1 Environment Agency flood zone map

The Environment Agency has produced Flood Zone Maps for much of England and Wales. The current displayed map is reproduced as **Figure 1.** The latest Flood Zone Map shows the site to be located within Flood Zone 1.

5.2 Flooding from rivers (fluvial flood risk)

There is no risk to the site from fluvial flooding (**see Figure 1**) as the site is situated in Flood Zone 1.

There is 'non main river' Higgin Brook and an unnamed watercourse and two ponds on the site and although there are many more watercourses and ditches within a 5km radius of the site, there is no data to suggest any flooding history to the site from any of these sources.

Higgin Brook is a 'non main river' which is a tributary of the River Loud located approximately 500m north of the site which is 'non main river' at its nearest point.

As noted above according to the Environment Agency flood map the site is located within Flood Zone 1 and therefore flood risk from fluvial sources can be considered **low**.

5.3 Flooding from the sea (tidal flood risk)

On the coast storm surges and high tides can threaten low lying coastal areas, and can sometimes be large and rapid enough to overtop defence works, causing significantly

more damage than river flooding. However, tidal flooding is not considered a risk, due to the inland location of the site.

5.4 Flooding from the land (overland pluvial flood risk)

If intense rain is unable to soak into the ground or be carried through manmade drainage systems, for a variety of reasons, it can run off over the surface causing localised floods before reaching a river or other watercourse (**see Figure 3**).

Generally, where there is impermeable surfacing or where the ground infiltration capacity is exceeded, surface water runoff will occur. Excess surface water flows from the site are believed to drain naturally to the local water features, either by overland flow or through infiltration.

Figure 3 below shows some minor areas of the site to be at risk from surface water flooding according to the Environment Agency surface water flood map. The areas shown as being at risk are the minor watercourses on site and the local natural drainage routes.

According to the Environmental Risk Management report (Ref 5), it has been identified that the site may be partially prone to pluvial flooding during an extreme event.

The proposed development will incorporate a suitable surface water drainage scheme and flood risk from this source is therefore considered **low**

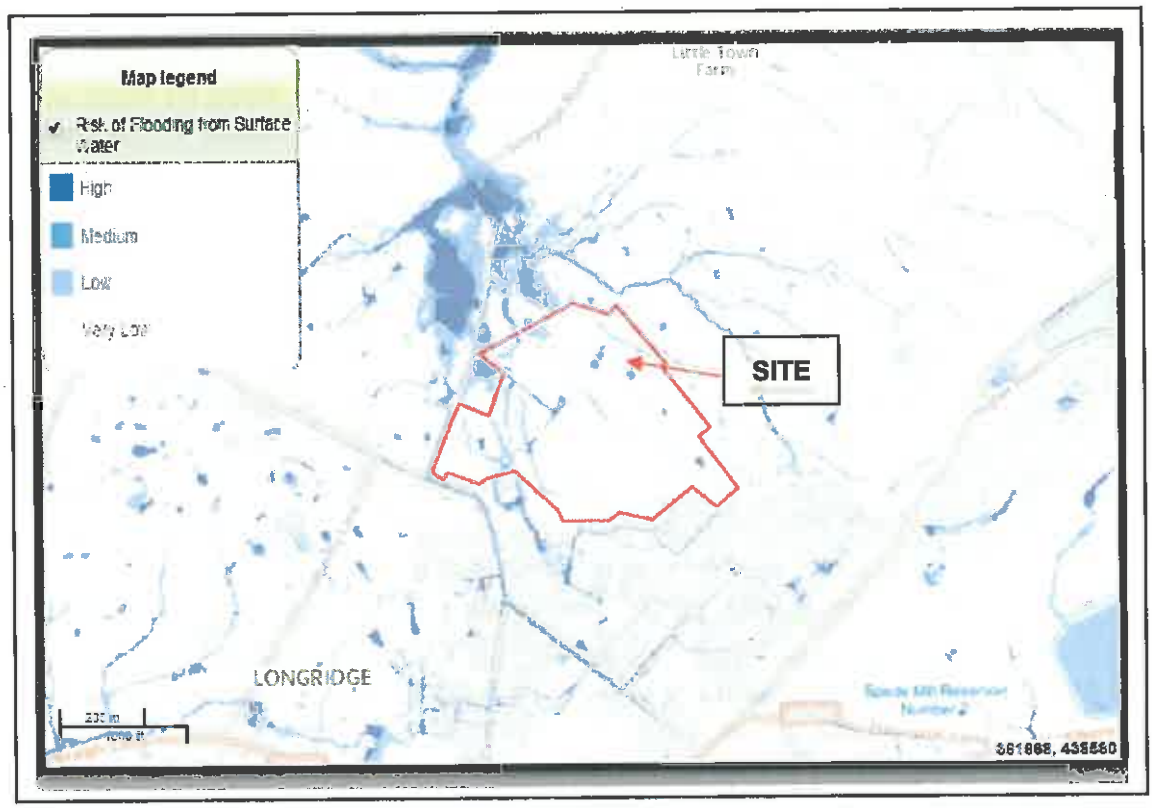

Figure 3: Surface water flood map (March 2014)

5.5 Flooding from groundwater

Groundwater flooding tends to occur after much longer periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. Groundwater tends to flow from areas where the ground level is high, to areas where the ground level is low. In low-lying areas the water table is usually at shallower depths anyway, but during very wet periods, with all the additional groundwater flowing towards these areas, the water table can rise up to the surface causing groundwater flooding.

Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). These may be extensive, regional aquifers, such as chalk or sandstone, or may be localised sands or river gravels in valley bottoms underlain by less permeable rocks. Groundwater flooding takes longer to dissipate because groundwater moves much more slowly than surface water and will take time to flow away underground.

The Ribble Valley Strategic Flood Risk Assessment (SFRA) (Ref 5) states that consultation with the Environment Agency has suggested that there are no known problems with flooding from groundwater within Longridge.

There is no subterranean development proposed with the residential dwellings, and therefore risk of flooding to the site from groundwater should be considered **low**.

5.6 Flooding from sewers

Flooding from artificial drainage systems occurs when flow entering a system, such as an urban storm water drainage system, exceeds its conveyance capacity, the system becomes blocked or it cannot discharge due to a high water level in the receiving watercourse. A sewer flood is often caused by surface water drains discharging into the combined sewer systems; sewer capacity is exceeded in large rainfall events causing the backing up of floodwaters within properties or discharging through manholes. Most adopted surface water drainage networks are designed to the criteria set out in Sewers for Adoption (Ref. 6). One of the design parameters is that sewer systems be designed such that no flooding of any part of the site occurs in a 1 in 30 year rainfall event. By definition a 1 in 100 year event would exceed the capacity of the surrounding sewer network as well as any proposed drainage.

Development has the potential to cause an increase in impermeable area, an associated increase in surface water runoff rates and volumes, and a consequent potential increase in downstream flood risk due to overloading of sewers, watercourses, culverts and other drainage infrastructure. According to United Utilities plans for the site, there is a pumping station located just off Thornfield Avenue which takes the foul waste from the residential estate to the south of the site. There is a 375mm diameter surface water pipe from Thornfield Avenue which flows in a north westerly direction across the site and discharges into Higgin Brook. Another surface water sewer is shown to lead from Redwood Drive towards the site and discharges to the unnamed watercourse on the site.

It is assumed that the sewers have been designed in accordance with best practice and therefore flood risk can be considered as **low**.

The other surface water sewer flows from Redwood Drive taking flow from the residential estate to the south of the site. It is assumed that the sewers have been designed to in accordance with best practice and therefore flood risk can be considered to be low.

There are no direct references within the Ribble Valley SFRA (Ref. 5) of sewer flooding affecting the site.

Surface water flooding must be considered within the design of the site, to ensure that any additional surface water and overland flows are managed correctly, to minimise flood risk to the site and the surrounding area. The proposed surface water network on the site should be designed to ensure exceedance of the network has been considered.

All new sewer infrastructure for the site will be designed to the latest best practice. Overall the flood risk from this source can be considered to be **low**.

5.7 Flooding from reservoirs, canals and other artificial structures

Reservoir flooding is also extremely unlikely. There has been no loss of life in the UK from reservoir flooding since 1925. Since then reservoir safety legislation has been introduced to ensure reservoirs are maintained.

The Environment Agency has recently published flood risk mapping (**Figure 4**) as a result of potential failure of reservoirs and artificial structures. The Environment Agency reservoir flood map shows the largest area that might be flooded if a reservoir were to fail and release the water it holds. Since this is a prediction of a worst-case scenario, it is unlikely that any actual flood would be this large.

Generally risk of dam failure on reservoirs is considered extremely low but failure could have major consequences, including loss of life. The Water Act 2003 introduced amendments to the Reservoirs Act 1975 which require the undertakers of large reservoirs to produce reservoir flood plans where directed by the Secretary of State (in England), where large reservoirs are those holding over 25,000 cubic metres of water above natural ground level. Smaller reservoirs are not covered by the Act but may still pose a significant risk. Reservoir flood plans became a legal requirement in 2009 and includes a map identifying the extent and severity of flooding resulting from an uncontrolled release of water. Therefore with ongoing flood assessments and statutory management plans prepared by the reservoir undertaker, the probability of a flood or breach event is very small. Any flood risk that exists from reservoir failure is therefore considered to be a residual risk. Due to the sensitive nature of the information contained within such risk assessments and the potential security issues however, they are treated as highly confidential and are unavailable for public use.

Given the level of monitoring of the structure, the risk of failure is considered to be **low**.

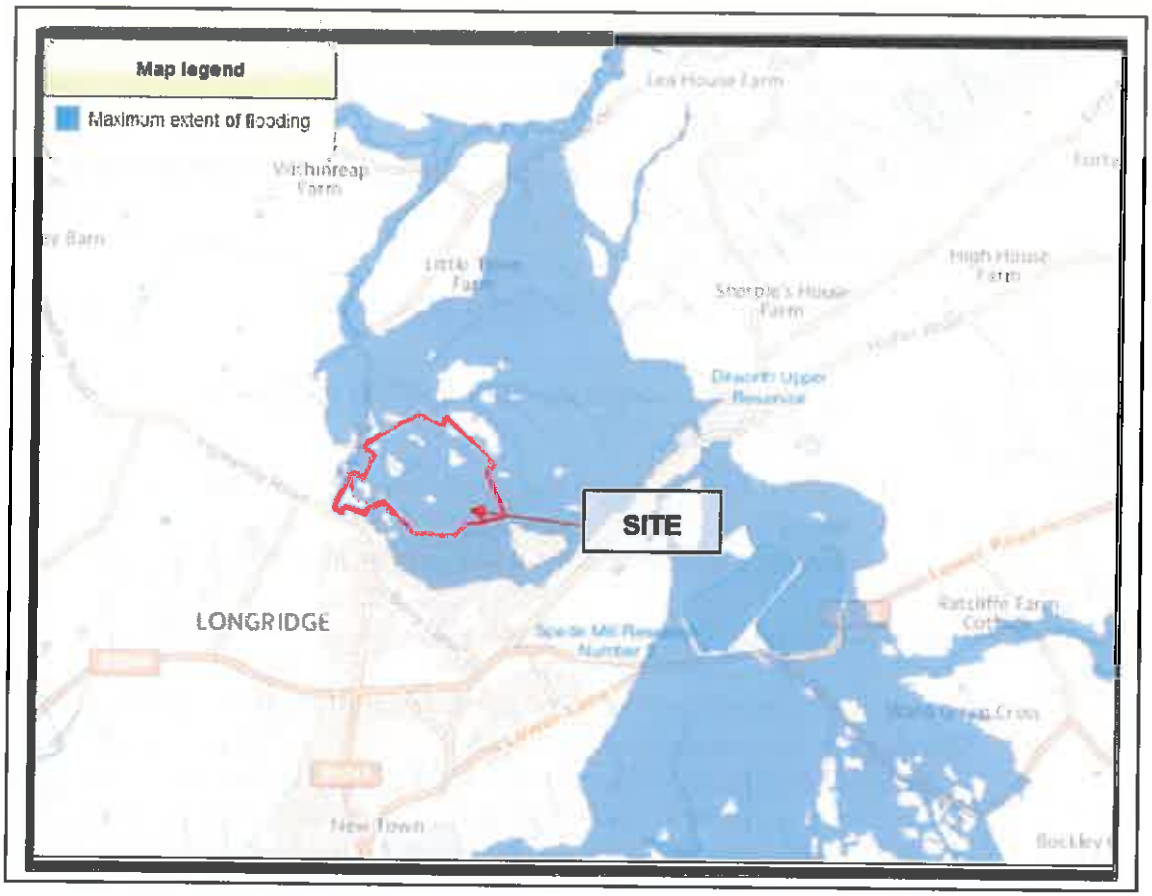

Figure 4: Risk of flooding from reservoirs map (March 2014)

5.8 Historic flooding

The Ribble Valley SFRA (Ref. 5) shows that the area of Longridge has not been affected by historical flooding events.

There are no direct references to flooding within the site boundary within these documents.

5.9 Climate change

Within the context of the existing flood risk at the site, and the requirements of the TGNPPF, climate change impacts from different flood sources have been considered alongside the present day scenario as described in Section 5.

As an overview; Climate change can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

In the North West River Basin District, wetter winters and more rain falling in wet spells may increase river flooding for rivers and tributaries. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers. Rising sea or river levels may increase local flood risk

inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

In accordance with the requirements of the NPPF the latest climate change predictions will be considered within this assessment.

Latest figures for the North West River Basin District (Ref. 7) show that if emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are:

- winter precipitation increases of around 18% (very likely to be between 2% and 39%)
- precipitation on the wettest day in winter up by around 16% (very unlikely to be more than 34%)
- relative sea levels are very likely to be up between 10cm and 40cm from 1990 levels (not including extra potential rises from polar ice sheet loss) peak river flows in a typical catchment likely to increase between 11% and 24%.

5.10 Watercourse access / easement

Under the terms of the Water Resources Act 1991, the prior consent of the Environment Agency is required for any proposed works or structures, in, under, over or within 8 metres of the top of the bank of any watercourse, designated 'main river' or 'non main river'. An easement 10 metres has been incorporated into the proposal and is evident within **Appendix B.** Clarification should be sought from the Local Authority / Environment Agency with regarding the bylaws to non main rivers.

5.11 Flood risk summary

From the Environment Agency flood maps, the site is located within Flood Zone 1, suggesting that the site is **not** at risk of flooding from fluvial and / or tidal sources.

Flooding from pluvial sources can be considered **low** following the implementation of a suitable surface water scheme.

As outlined in the above sections, flood risk to the proposed development from all other sources is considered **low**.

6 SURFACE WATER DRAINAGE STRATEGY

6.1 Pre-development situation

The existing site is undeveloped and comprises entirely of permeable land. For the range of annual flow rate probabilities up to and including the one per cent annual exceedence probability (1 in 100 years) event, including an appropriate allowance for climate change, the developed rate of run-off should be no greater than the existing rate of run-off for the same event.

The entirety of the site can be classified as greenfield land, and as such is not served by a formal surface water management scheme. Any precipitation falling on this area will either naturally infiltrate or run-off in the form of surface or subsurface run-off. Therefore, it is essential that the rate of runoff generated as a result of any future development should either remain the same as the existing discharge rate or be reduced. Preferably the discharge rate should be restricted to near the pre-development rate if possible, by combining the use of SuDS onsite where feasible.

In terms of estimating the potential runoff from the site, the pro-rata IOH method has been used based on a greenfield site. The results are highlighted in Table 6.1 (**Appendix D**) details the WinDes Calculations sheet.

Table 6.1: IoH surface water runoff calculations

Return Period	Peak flow Area A1	Peak flow Area A2
Greenfield (undeveloped – urban extent 0.00 Ha)		
$QBAR_{URBAN}$	36.4 l/sec	112.6 l/sec
1 in 1 year peak flow	31.6 l/sec	97.9 l/sec
1 in 30 year peak flow	61.6 l/sec	190.8 l/sec
1 in 100 year peak flow	75.6 l/sec	234.1 l/sec

6.2 Off site discharge

An order of preference exists for drainage receptors. Infiltration drainage should be used where possible. Where this is not possible, or does not provide sufficient capacity, attenuated discharge to watercourses should be sought. Only where neither of these two options are available should discharge to sewers be considered.

6.2.1 Infiltration

Further investigation should be carried out to assess whether discharge to the ground, or infiltration, may be a possible drainage solution for this site; however the effectiveness of infiltration is completely dependent on the physical conditions at the site. Potential obstacles include:

Local Variations In Permeability Preventing Infiltration - This testing should be undertaken in line with the guidance contained in BRE 365 (Ref. 11) or CIRIA R156 (Ref. 12) and the results used to firstly check feasibility and secondly to size the necessary infiltration features.

Shallow Groundwater Table - For infiltration drainage devices Building Regulation approved document H2 states that these, "should not be built in ground where the water table reaches the bottom of the device at any time of the year".

Source Protection Zones - As discussed in Section 3, the site is not located in a source protection zone. If the local ground conditions prove suitable, water could be infiltrated to the ground in a number of different ways (provided suitable treatment options are incorporated into the design), including discharge to infiltration trenches, retention ponds designed to infiltrate water or more laterally extensive systems constructed beneath roadways.

6.3 Discharge to watercourse

Discharging surface water from the proposed site to Higgin Brook and the unnamed watercourses located on site is a viable drainage option for the site, subject to confirmation from the Local Authority and Environment Agency. The preferred option would be for all the surface water from Area 1 to discharge into Higgin Brook on site and the Area 2 to discharge into the unnamed watercourse most central to the site. Both watercourses merge on site and converge on site (there on the watercourse is known as Higgin brook. A more detailed description of the drainage plan for the site is shown in the RSK Drainage Appraisal (880500 10-01 and 880500 10 -02 (**Appendix E**)) for the site. The watercourses are classed as 'Non Main River' and are under the jurisdiction of the Local Authority with guidance from the Environment Agency. Discharge to this watercourse will be limited to QBAR run-off rates in line with the Ribble Valley Borough Council local plan, for the developed (impermeable) area.

6.4 Discharge to sewer

If either of the above two options are not suitable for the site then connection to sewer may be required. Further discussions should be undertaken with the Sewerage Undertaker to determine the most suitable point of connection and any discharge rates.

6.5 Post-development situation

The proposed site does not currently have any formal points of surface water discharge, it is therefore assumed that any rainfall will either naturally infiltrate, or more likely due to the gradient of the site leave in a form of surface or subsurface runoff to the watercourses on the site.

Subject to agreement from the LLFA discharging at a restricted rate, surface water runoff from the site to the watercourses within the site boundary is the most feasible drainage option.

Following the above, a combination of SuDS and hard engineering techniques will be provided discharging surface water runoff from the site to the watercourses within the site boundary at a rate which does not exceed the pre-development runoff rates.

Further details on the proposed attenuation features and drainage infrastructure for the site are detailed within the RSK drainage appraisal 880500 10-01 and 880500 10-02 (**Appendix E**).

6.6 Sustainable drainage options

In order to define the proposed post-development drainage solution, the use of sustainable drainage systems for surface water management and the disposal of surface water run-off, has been considered in this assessment. The options available, based upon guidance given in the CIRIA publication 'The SUDS Manual' (Ref. 14), are summarised in Table 6.2, and 6.3 below. The suitability of each SuDS feature on this site is also commented upon in this table as indicated on the masterplan.

Table 6.2: SUDS Features and their Suitability on Site – Source Control

SUDS Group	Description	Location	Comment*	Used?
Source Control				
Rainwater harvesting	System to collect water from impermeable surfaces for use in non-potable water situations.	Individual Properties.	Rainwater harvesting not to be considered essential part of drainage strategy proposal	Possibly
Pervious pavements	Surfaces that allow water to soak into the ground or a gravel-filled base. Porous surface replaces traditional hard (impermeable) surfaces.	Shared surface zones and car parking areas	Permeable paving to be used in any redevelopment	Yes
Soakaways	Excavation or trench that can be filled with filter material. Can be made of pre-cast concrete or polyethylene rings/perforated storage structures that are then backfilled with granular material. Allows water to soak away into the ground.	Private gardens and communal soft landscaping	Feasibility subject to site-specific geotechnical survey.	Possibly
Subsurface Storage	Modular plastic systems that can be used to create below ground infiltration or storage.	Under car parks	Possible use as attenuation storage	Possibly

Table 6.3: SUDS Features and their Suitability on Site – Area Control

SUDS Group	Description	Location	Comment	Used?
Area Control				
Infiltration trench	Stone-filled trenches that allow water to soak into the ground, as close to where the rain lands as possible.	In gardens or public open space	Feasibility subject to site-specific geotechnical survey.	Possibly
Infiltration basin	A vegetated depression designed to store runoff and infiltrate it into the ground.	See above	Overflow capacity for larger storm events, feasibility subject to site-specific geotechnical survey.	Possibly
Bioretention	Depressions backfilled with a sand/soil mixture and planted with vegetation. Water enters through a vegetated surface and then trickles via a filter layer entering a perforated pipe at the bottom before being carefully transported downstream.	In gardens or public open space	Possible inclusion in soft landscaping providing additional amenity and enhance infiltration	Possibly
Filter strip	A vegetated area of gently sloping ground designed to drain water evenly off impermeable areas and filter out silt and other material.	Possible along edge of impermeable areas	Possibly may be included subject to detail design.	Yes
Filter trench/drain	Gravel filled trenches with a pipe with small holes installed in the bottom.	See above	See above	Possibly
Conveyance swale	Shallow vegetated swales that can run parallel to hard surfaces, allowing runoff to trickle down the side slopes and into the base of the component. Water is then transported in a controlled manner to another SuDS component or to a stream or river downstream.	Following overland flow route	Included as an overflow route for extreme storm events from development into attenuation areas	Yes
Enhanced dry swale (trench trough)	Open landscaped channels which can be vegetated, over filter medium and under-drained. Used to convey, attenuate and improve water quality.	See above	See above	Possibly
Detention Basin	Shallow vegetated depressions to control the amount and rate of runoff and some water quality improvement.	Potentially in public open space	To allow for overflow storage for extreme flood events	Yes

7 PLANNING CONTEXT

7.1 Application of planning policy

NPPF includes (Section 10) measures specifically dealing with development planning and flood risk using a sequential characterisation of risk based on planning zones and the Environment Agency Flood Map. The main study requirement is to identify the flood zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

Within NPPF Technical Guidance on flood risk each flood zone has a list of appropriate land uses dependent on vulnerability to flooding.

7.2 Land use vulnerability

From the NPPF Technical Guidance, a "Less Vulnerable" land use could be appropriate to Flood Zone 1 (High Probability of flooding at higher than 1 in 100 annual probability) with the "More Vulnerable" use only permitted if the exception test is passed. For a "More Vulnerable" class, development on this site could be appropriate within Flood Zone 2 (Medium Probability of flooding at less than 1 in 100 but higher than 1 in 1,000 annual probability).

In applying the sequential test, reference is made to the following table (reproduced from Table 3 contained within NPPF).

Table 7.1: Flood risk vulnerability and flood zone 'compatibility'

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	Appropriate	Appropriate	Appropriate	Appropriate	Appropriate
	Zone 2	Appropriate	Appropriate	Exception Test Required	Appropriate	Appropriate
	Zone 3a	Exception Test Required	Appropriate	Should not be permitted	Exception Test Required	Appropriate
	Zone 3b functional floodplain	Exception Test Required	Appropriate	Should not be permitted	Should not be permitted	Should not be permitted

The proposed development is classed as 'less vulnerable' and therefore appropriate for Flood Zone 1. All proposed development is located within Flood Zone 1 and therefore classified as an acceptable development for flood risk vulnerability.

7.3 Sequential test

The Sequential Test is required to assess flood risk and NPPF Technical Guidance recommends that the test be applied at all stages of the planning process to direct new development to areas with the lowest probability of flooding (Flood Zone 1).

According to NPPF, if there is no reasonably available site in Flood Zone 1, the flood vulnerability of the proposed development (see NPPF Technical Guidance Table 2) can be taken into account in locating development in Flood Zone 2 and then Flood Zone 3. Within each Flood Zone new development should be directed to sites at the lowest probability of flooding from all sources.

The development is situated within Flood Zone 1 and with reference to Table 7.1 above, the proposed development passes the Sequential Test.

8 CONCLUSIONS AND RECOMMENDATIONS

This flood risk assessment complies with the NPPF and its Technical Guidance and demonstrates that flood risk from all sources has been considered in the proposed developments. It is also consistence with the Local Planning Authority requirements with regard to flood risk.

The proposed development site lies in an area designated by the Environment Agency as Flood Zone 1. This means that the site has a less than 1 in 1000 annual probability of river flooding (<0.1%) in any year.

NPPF sets out a Sequential Test, which states that preference should be given to development located within Flood Zone 1. This flood risk assessment demonstrates that the requirements of the Sequential Test have been met, with the site's location within Flood Zone 1.

The site is currently a Greenfield site. The proposed development will alter the local impermeable area by an amount to be confirmed. The surface water runoff from the site is proposed to discharge into the Higgin Brook and the unnamed watercourse on site.

This flood risk assessment has concluded that:

- the site is not at risk of flooding from a fluvial event, and is far enough inland not to be at risk of any tidal flooding event
- flood risk from surface water is considered low at the site
- flood risk from other sources – groundwater, sewers, reservoirs and artificial sources – is demonstrated to be low
- the impact of the development on other forms of flooding is demonstrated to be low
- any increase in surface water runoff from the proposed development will be attenuated on site and discharged at pre-development rates to the unnamed watercourses on site, subject to approval from the local authority / Environment Agency
- overall, taking into account the above points, the development of the site should not be precluded on flood risk grounds.

9 REFERENCES

1. Communities and Local Government "National Planning Policy Framework" NPPF, March 2012.
2. Communities and Local Government "Technical Guidance to the National Planning Policy Framework", March 2012.
3. DEFRA "Interim Code of Practice for Sustainable Drainage Systems" National SUDS Working Group, July 2004.
4. BS 8533-2011 Assessing and managing flood risk in development Code of practice, November 2011.
5. Ribble Valley Strategic Flood Risk Assessment, May 2010.
6. WRC "Sewers for Adoption" 6th Edition, March 2006.
7. River Basin Management Plan, North West River Basin District, December 2009.
8. DTLR "Preparing for Floods Interim guidance for improving the flood resistance of domestic and small business properties" February 2002.
9. CIRIA "Development and Flood Risk guidance for the construction industry" C624, 2004.
10. Communities and Local Government "Improving the flood performance of new buildings – flood resilient construction", May 2007.
11. BRE 365.
12. CIRIA R156.

APPENDIX A
RSK SERVICE CONSTRAINTS

1. This report is carried out in connection with the report (together the "Services") were compiled and carried out by RSK LDE Ltd (RSK) for Barratt Homes Manchester in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable Civil Engineer at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

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

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

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

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

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

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

APPENDIX B
PROPOSED PLAN

Longridge, Bowland Meadows

House Type	Bed no.		No.	Sqft	Total Sqft	Percentage Split
Ber	3	Berwick	14	881	12334	13.21%
TBH	3	The Boat House	2	881	1762	1.65%
TCL	3	The Carpenters Lodge	13	935	12428	12.26%
Oak	4	Oakham	8	1002	8016	7.53%
TCH	4	The Cobblers House	2	1302	2604	1.69%
Bre	3	Brentwood	1	1161	1161	0.94%
Tav	4	Tavistock	2	1134	2260	1.85%
Hel	4	Helmsley	4	1108	4432	3.77%
Sam	4	Samerton	4	1170	4680	3.77%
Fow	4	Fowley	5	1155	5975	4.72%
Tho	4	Thornbury	2	1263	2408	1.86%
Gla	4	Glastonbury	4	1215	4852	3.77%
TGH	4	The Glen House	8	1243	9944	7.53%
Cam	4	Cambridge	4	1424	5696	3.77%
GKL	4	Game Keepers Lodge	1	1424	1424	0.94%
Affordables						
Ash	2	Ashford	13	634	8242	12.28%
RC	2	River Cottage	3	634	1902	2.83%
Bam	3	Bampton	14	737	10318	13.21%
TSC	3	The Sheppard Cottage	1	737	1474	1.89%
		Total	106		101338	100.00%


Paddock
Paddock
Paddock
Village Green
Village Green
Existing Cricket Ground
Mews
Square
Square
Square
Mews
Mews
Square
Mews
Circus
Crescent
Mews
Mews
Mews
e*SCAPE

APPENDIX C
TOPOGRAPHICAL SURVEY

APPENDIX D
WINDES CALCULATIONS

Spring Lodge 172 Chester Road Helsby Cheshire WA6 0AR	Longridge Area 1A Greenfield RO
Date April 2014 File	Designed by KP Checked by CW
Micro Drainage	Source Control 2013.1.1

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.500
Area (ha)	3.860	Urban	0.000
SAAR (mm)	1105	Region Number	Region 10

Results l/s

QBAR Rural	36.4
QBAR Urban	36.4
Q100 years	75.6
Q1 year	31.6
Q30 years	61.6
Q100 years	75.6

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.500
Area (ha)	11.950	Urban	0.000
SAAR (mm)	1105	Region Number	Region 10

Results l/s

QBAR Rural	112.6
QBAR Urban	112.6
Q100 years	234.1
Q1 year	97.9
Q30 years	190.8
Q100 years	234.1

APPENDIX E
DRAINAGE APPRAISAL DRAWINGS (880500 10-01 AND 880500 10-02)

Notes

1. This drawing is to be read in conjunction with all Architectural Drawings, Topographical Survey Drawings.
2. This drawing has been prepared Appraisal purposes only, and a detailed design must be carried out prior to construction.
3. Figures quoted next to manholes / inspection eyes are cover & invert level, to ordnance AOD.
4. Footpaths are to be laid with a crossfall to allow drainage to soft landscaped areas.
5. Where possible all drainage runs shall be kept a minimum of 4.0m from any existing tree that is to be retained.
6. All drainage designs subject to technical approval, no connections shall be made to any public sewers without written consent from the drainage authority.
7. The drainage made to from PCP overlays which have been traced and adapted to fit the topographical survey, RSK have no responsibility for the accuracy of the overlays.
8. Proposed ground levels have been altered to match with the drainage design.

Drainage Information

Total discharge rate for the proposed development is 140l/s which is 50% of greenfield Rate (Qbar).
Proposed pipe sizes and attenuation is based on 40% of the site area being impermeable
Existing ditches to be re-sited and reprofiled where necessary.

Drainage Legend

- Proposed foul water sewer and manhole
- Proposed surface water sewer and manhole
- Proposed foul water lateral and connection
- Proposed surface water lateral and connection

REFER TO RSK DRAWING 10-01 FOR CONTINUATION

RSK
LAND & DEVELOPMENT ENGINEERING LTD

Client: Barratt Homes

Project Title: Land Off Chipping Lane Longridge

Drawing Title: Engineering Appraisal Phase 1

Drawn	Date	Checked	Date	Approved	Date
MAR	Apr 14	CW	Apr 14	CB	Apr 14

Scale	Orig Size	Direction
1:500	A0	

Project No: 650500
Drawing No: 10-02
Rev: P1

PCL XL error
Error: IllegalOperatorSequence
Operator: LineRelPath
Position: 2973540