

ADDERLEY MILL, CHEADLE



FLOOD RISK ASSESSMENT

VERSION 1.0

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Revision History

Version	Date	Amendments	Issued to
0.1	14/12/2015		
0.2	02/12/2019	FRA updated to suit proposed layout drawing and take account of current climate change allowances and flood risk requirements	Ken Wainman
1.0	24/09/2020	FRA report and surface water calculations updated to match amended site layout as per drawing 1487-08 (July 2020).	Chris Craven Ken Wainman Andy Bailey

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1.0 Introduction

This Flood Risk Assessment was prepared in December 2015 to investigate the potential redevelopment of the existing buildings at Adderley Mill, Trimpos, near Cheadle. It was updated in November 2019 to suit the proposed site layout and meet current Planning Practice Guidance on Flood Risk. The Flood Risk Assessment has now been updated to suit the latest proposed layout due to the relocation of the site entrance and the subsequent reduction in number of proposed dwellings on the site.

The National Planning Policy Framework requires a site-specific Flood Risk Assessment to be provided for all development in Flood Zones 2 and 3, including for change of use.

Development should only be allowed in areas at risk of flooding where it can be demonstrated that:

- a) within the site, the most vulnerable development is located in areas of lowest flood risk
- b) the development is appropriately flood resistant and resilient
- c) it incorporates sustainable drainage systems
- d) any residual risk can be safely managed
- e) safe access and escape routes are available

2.0 Site Location

Adderley Mill is located on the west side of Trimpos to the north of Cheadle, ST10 2NJ. The grid reference of the site is SJ 9910 4390. The site location plan is shown below with the site identified by the red circle.



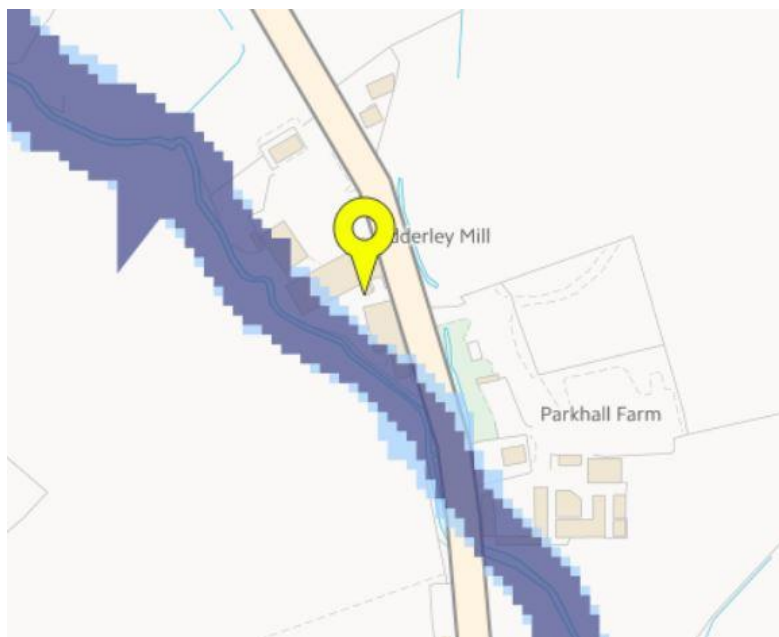
3.0 Site History and Development Proposals

The site currently houses two fairly extensive large brick buildings and a concrete yard area extending to the watercourse. Part of one of the existing buildings is currently used as a workshop. Access to the site is via a driveway off Trimpos between the two buildings. The current use of the existing buildings is less vulnerable. Planning permission is being sought to demolish the existing buildings and build 4 new 2-storey dwellings with a new site access off Trimpos. Redevelopment of the site to residential land use would change the land use classification to more vulnerable.

4.0 Flood Risk

4.1 River Tean

The River Tean flows along the western boundary of the site. The river is an ordinary watercourse at this location and the Environment Agency does not have any flood level information for this area. There are no flood defences in the vicinity of the site. The Environment Agency's flood map of the area is shown below.



The flood map shows the site to lie predominantly in Flood Zone 1, with areas of Flood Zones 2 and 3 along the line of the watercourse on the western side of the site. The River Tean flows in open channel along the site boundary and there are no flood defences. The watercourse is culverted under the road downstream of the site. A tributary joins the River Tean between the downstream end of the site and the culvert under the road. Photos of the site and watercourse are included in Appendix F.

In order to determine more accurate flood outlines for the site, a hydrological assessment has been carried out and topographical survey of the site, including cross-sections of the River Tean, has been obtained. A Hec-Ras model has been built using the topographic survey and cross-sections of the watercourse to predict the flood levels at the site. The topographic survey is included in Appendix B. The hydrological assessment and details of the hydraulic modelling are included in Appendices C and D.

Current planning guidelines requires the higher central and upper climate change allowances of 30% to 50% to be considered for more vulnerable development in Flood Zone 3 in the Humber basin for the period 2070 – 2115. The central and higher central climate change allowances of 20% to 30% need to be considered for more vulnerable development in Flood Zone 2.

The updated flow estimates for the watercourses, derived using the FEH statistical method and NRFA v8 peak flow data, are shown in the following table.

Return period	River Tean flow (m³/s)	Whole catchment flow including tributary(m³/s)
1 in 10 years	5.2	6.3
1 in 25 years	6.6	8.1
1 in 50 years	7.9	9.6
1 in 100 years	9.5	11.5
100 yr + 20% cc	11.4	13.8
100 yr + 30% cc	12.4	15.0
100 yr + 50% cc	14.3	17.3
1 in 1000 years	16.0	20.4

These flows were used in a steady state Hec-Ras hydraulic model constructed from the surveyed cross-sections of the River Tean. Details of the hydraulic modelling are included in Appendix D. The flood outlines derived from the flood level estimates for the site are included in Appendix E. The modelled flood levels at cross sections 6, 5 and 4, along the length of the site, are shown in the following table.

Return period	Water level at CS 6 (m AOD)	Water level at CS 5 (m AOD)	Water level at CS 4 (m AOD)
25 year	157.86	157.77	157.27
100 year	157.91	157.98	157.33
100 year +20% cc	158.13	158.12	157.46
100 year +30% cc	158.19	158.19	157.53
100 year +50% cc	158.32	158.32	157.65
1000 year	158.43	158.43	157.75

The predicted 1 in 25 year water level is shown to be just below the top of the left bank of the River Tean along the reach of the site. The 1 in 50 year flood event will just start to spill on to the site, affecting a small area of the concrete yard but not reaching the existing buildings. The 1 in 100 year flood event extends up to the west side of the northern building and extends on to the yard between cross sections 6 and 4. The floor level of the existing northern building is 138.36m, 40mm above the 100 year flood level with 50% climate change allowance. The 100 year flood event with 30% climate change allowance and the 1000 year flood event both extend further on to the concrete yard area but do not reach the southern building. Ground levels behind the wall along the left bank at the downstream end of the site are higher than the predicted flood levels in the River Tean.

The sensitivity checks on the model showed that an increase in Manning's n would increase the predicted water levels by 160mm at the upstream end of the site and 100mm at the downstream end of the site in the 100 year flood event. In the 100 year

event with 30% climate change allowance, the increase in water level would be 70mm at the upstream end of the site (RS6) and 20mm at the downstream end of the site (RS4).

In the blockage scenarios of the culvert downstream of the site, the most significant increases in water level occurred in the more frequent flood events. In the 100 year event, the water level increased by 0.4m and the 100 year plus 30% cc water level increased by 0.22m at the downstream end of the site (RS4) with a 50% blockage of the culvert. The blockage scenario results will be taken in to account when setting the recommended finished floor levels.

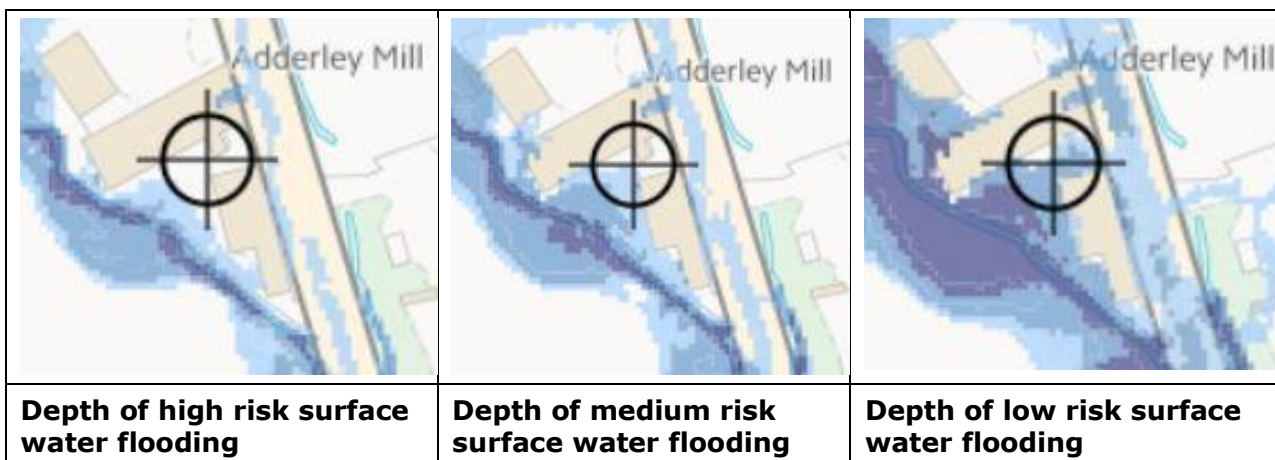
4.1.1 Flood zone compatibility

The site is shown to lie in Flood Zones 1, 2 and 3. Location of the proposed new dwellings on the higher ground in Flood Zone 1 is appropriate for the more vulnerable land use in accordance with Table 3 of the Planning Practice Guidance on Flood Risk and Coastal Change. Flood mitigation measures are proposed in Section 4.5 to manage and minimise the fluvial flood risks to the site.

4.2 Other potential sources of flooding

4.2.1 Surface water flood risk

The extracts from the Environment Agency's Surface Water Flood Map, included below, show that a small area near the north east corner of the site and part of the concrete yard is expected to be affected by high risk of surface water flooding (with greater than 1 in 30 chance of occurrence in any one year). This depth of high risk surface water flooding is shown to be up to 300mm deep.



The predicted area of medium risk surface water flooding (with between 1 in 30 and 1 in 100 chance of occurrence in any one year) is more extensive than the high risk flooding, covering most of the yard area outside the buildings. The area nearest the buildings is shown to be up to 300mm deep and the area closest to the watercourse is shown to be between 300mm and 900mm deep. The source of the surface water flooding on to the site is generally from the River Tean. In the low risk surface water flood event (with between 1 in 100 and 1 in 1000 chance of occurrence in any one year), the extent of flooding is similar to the medium risk event, but the depth of flooding is over 900mm deep near the River Tean and between 300 and 900mm deep elsewhere, including at the existing site entrance.

Some of the surface water flooding appears to originate from the tributary to the north east of Trimpos and is shown to cross the road upstream of the site rather than following the watercourse channel on the east side of Trimpos even in the high frequency rainfall event. No surface water flooding is shown along the line of the watercourse which

suggests that surface water flood map is not representative of this area. Some surface water flooding would be expected from the tributary on Trimpos in the lower frequency rainfall events.

The small area of surface water flooding near the north east corner is thought to be due to surface water being trapped on between the existing buildings where the ground level is lower than the road. Closure of the existing site entrance will reduce the low risk of surface water entering the site from the road and demolition of the existing buildings will remove the risk of surface water being trapped between the buildings at the north end of the site.

Surface water runoff from Trimpos will generally run down the road to the low point to the south of the culvert under the road, approximately 100m downstream of the site. The surface water will then flow overland into the fields to east of the road before joining the watercourse. Surface water could run down the proposed new site access from Trimpos, as the road levels fall towards the site as well as to the south.

Surface water runoff from Trimpos will flow down the site access towards the River Tean but will be intercepted by the proposed drainage channel on the west side of the site access before it reaches the watercourse. Design exceedance flows in the site access would discharge to the watercourse once the depth of surface water flooding exceeds the level of the kerbs. Some surface water runoff from the yard or overland flow could potentially get trapped behind the wall at the south end of the site. However, the wall is not very high compared to the existing ground levels on site and will start overtopping at 157.98m.

The surface water flooding at the site generally occurs on the lower ground near the watercourse. Locating the new dwellings on land in Flood Zone 1 will ensure that the dwellings are at low risk of surface water flooding and will not increase the risk of flooding elsewhere. Flood mitigation measures are proposed in Section 4.5 to minimise the residual surface water flood risk from potential overland flows.

4.2.2 Risk of flooding from artificial water bodies

The Environment Agency's map of Risk of Flooding from Reservoirs shows that the site is not at risk of flooding from reservoirs. No other artificial sources of flooding have been noted in the area and therefore the flood risk from artificial sources is considered to be low.

4.2.3 Risk of flooding from groundwater

The AECOM 2015 Update to the Staffordshire Moorlands Level 1 Strategic Flood Risk Assessment (SFRA) indicates that there are no historic records of property flooding from groundwater sources within Staffordshire Moorlands District Council catchment area.

Figure 8 in Appendix B of the SFRA shows the future susceptibility of the area to groundwater emergence to be 25 -50% in the 1km square area covering the site. The Landis Soils Map shows this area to the west of Cheadle to have slowly permeable loamy and clayey with impeded drainage.

The 2011 Royal Haskoning Staffordshire County Council Preliminary Flood Risk Assessment (PFRA) notes that there are limited records of groundwater flooding occurrences in Staffordshire. Where groundwater flooding has occurred, it is usually recorded in combination with multiple other sources of flooding after periods of sustained rainfall.

The site may therefore be susceptible to groundwater emergence in the future. The proposed new dwellings will not have basements and the site layout, levels and drainage

system will need to be designed to ensure that any emerging groundwater drains away from the new dwellings and off the site towards the river in order to minimise the flood risk from possible future groundwater emergence. The proposed mitigation measures to minimise the flood risk to the proposed new dwellings from possible future groundwater are detailed in Section 4.5.

4.2.4 Risk of flooding from sewers

Sewer flooding generally results in localised short-term flooding when the design capacity of sewers is exceeded. Flooding can also occur as a result of blockage, poor maintenance or structural failure. The Figure 4 in Appendix B of the 2015 SFRA Update does not show any recorded incidences of sewer flooding in the area.

Sewer flooding could occur through surcharge of the existing sewers of the adjacent or nearby properties or from the proposed new sewers for the dwellings when the capacity of the sewer system is exceeded. The proposed mitigation measures detailed in Section 4.5 should help to ensure that the flood risk from possible surcharge of sewers is minimised.

4.3 Previous Flood History

The current owners are not aware of any historic flooding of the site and have not experienced any flooding in the 15 years that they have owned the site. The UK river levels website shows that the gauge at Adderley at the Trimpos road bridge which records daily maximum and minimum river levels, has exceeded 1m 4 times in last 4 years. The peak recorded level is 1.43m on 28 March 2016. The photos in Appendix F indicate that this level is about the soffit level of the culvert under the road. The second highest level was 1.162m on 31 July 2019. The owners of the site have advised that they have not experienced flooding on the site when these peak water levels have occurred.

The Staffordshire County Council PFRA shows no flooding at Adderley Mill on the maps of areas affected by flooding in Autumn 2000, August 2004, Summer 2007 and October 2010. The June 2016 Flood Investigation Report does not have any record of flooding at the site in that event.

Staffordshire County Council has a historic record of flooding from multiple sources at the junction of Godleybarn Lane and Birchenfields Lane, approximately 750m upstream of the site, but no record of flooding at the site.

4.4 Safe Access and Egress

Safe dry pedestrian access will be available from all of the proposed new dwellings as they will all be located in Flood Zone 1. Access and parking for all of the dwellings will all lie in Flood Zone 1 with access on to Trimpos. The proposed new access rises up to the main road, Trimpos, which is also in Flood Zone 1.

Surface water flooding on Trimpos is likely to be short in duration and therefore it is recommended that residents avoid walking or driving through flood water and wait until the water recedes.

There is an existing flood warning system in place for the River Tean at Adderley that covers Adderley Mill and Parkhall Farm. Residents of the proposed new development should sign up to receive flood warnings so that they can be aware of the potential risk of flooding in the area.

4.5 Proposed Flood Mitigation Measures

The 4 proposed new dwellings are 2 storey houses with sleeping accommodation at 1st floor level. The properties will not have basements. The fluvial flood risk to the site will be managed and minimised by locating all of the dwellings in Flood Zone 1 above the 1000 year flood level. The site access will be located in Flood Zone 1. The garden of Plot 4 will be located in Flood Zones 1 and 2. All other gardens will be located in Flood Zone 1. There will be no development in Flood Zone 3.

The finished floor levels of the new dwellings should be set 600mm above the 100 year flood level with 30% climate change allowance and 300mm above the 1000 year flood level to ensure that the dwellings are at low risk of fluvial flooding for their lifetime. In order to minimise the flood risk from other sources, appropriate site layout, ground levels and drainage design should ensure that overland flows are directed away from the new dwellings to follow the natural path to the watercourse. In addition to the recommended finished floor levels above, the ground floor levels of the dwellings should be set at least 150mm above the external ground level to minimise the risk of flooding from all sources. Flood resistant construction should be used up to the finished floor level of the new dwellings.

Interpolating the flood levels between the cross sections, the recommended finished floor level of each plot is shown in the following table.

Plot	Proposed finished floor level (mAOD)	100 year + 30%cc WL and height to FFL (m)	1000 year WL and height to FFL (m)	100 year WL with 50% blockage of culvert and height to FFL (m)
1 (XS5)	159.1m	158.19m (+0.91m)	158.43m (+0.67m)	158.05m (+1.05m)
2 (XS4)	158.6m	157.53m (+1.07m)	157.75m (+0.85m)	157.73m (+0.87m)
3 (XS5)	158.8m	158.19m (+0.61m)	158.43m (+0.37m)	158.05m (+0.75m)
4 (XS6)	158.8m	158.19m (+0.61m)	158.43m (+0.37m)	157.97m (+0.83m)

The proposed finished floor levels in the table above are all above the recommended finished floor levels as they are all at least 600mm above the 100 year flood level with 30% climate change allowance, over 300mm above the 1000 year flood level and significantly higher than the predicted 100 year flood level with 50% blockage of the culvert under Trimpos. The proposed finished floor levels are also at least 150mm above the external ground levels.

There will be no raising of ground levels in Flood Zones 2 or 3 and consequently there will be no loss of floodplain. Compensatory flood storage will not be required for the proposed development. Removal of the existing buildings will widen the river corridor and will provide additional floodplain at the north end of the site.

Fencing in the floodplain will need to be post and rail fencing to ensure that there is no effect on the floodplain flows and no build-up of debris on the fencing that could raise water levels and cause flooding. The existing walls at the south end of the site will be retained.

The flood risks to the proposed development can therefore be mitigated and minimised and there will be no increase in flood risk elsewhere.

5.0 Drainage Strategy

The 3,174m² site is currently 83% impermeable, including 1283m² of impermeable roof area. There are only a few gutters on the existing buildings and the surface water runoff from the roofs currently discharges directly onto the ground and overland into the River Tean. Redevelopment of the site provides an opportunity to reduce the impermeable area on site, provide a green corridor along the river bank and improve the quality of the water discharging into the River Tean. The proposed new dwellings on Plots 1 to 4 will have a total footprint area of 507m², a 60% reduction in building footprint on site. Permeable paving is proposed for the 333m² of parking and access. The 241m² proposed vehicular access will be impermeable tarmac. The existing 538m² of permeable area on site will increase to 2,300m², increasing from 17% to 72% of the site area, based on a total new impermeable area of 874m².

The surface water runoff from the proposed new development must be managed through a sustainable drainage system to ensure no increase in surface water runoff from the site in order to ensure no increase in flood risk elsewhere. The significant reduction in impermeable area of the site, resulting in the decrease in the surface water runoff from the site, would provide an overall reduction in flood risk elsewhere and would also provide water quality benefits.

Current Planning Practice Guidance states that surface water runoff from new development should be discharged as high up the following hierarchy of drainage options as reasonably practicable:

- 1. Into the ground (infiltration)**
- 2. To a surface water body**
- 3. To a surface water sewer, highway drain or other drainage system**
- 4. To a combined sewer**

Infiltration would be the preferred option for dealing with surface water runoff from any development as close as possible to the source if ground conditions are suitable. However, the FSR WRAP map shows the site to lie in an area of soil type 4 with low winter rainfall acceptance potential. The Landis Soilscape website also shows the soils to be slowly permeable seasonally wet loamy and clayey soils and therefore infiltration is unlikely to be suitable for the site.

The table below considers the feasibility of different SuDS components within the proposed development.

Technique	Description	Feasibility
Rainwater harvesting	Rainwater storage system	Yes – Rainwater water harvesting or water butts for reuse of water in the gardens would be appropriate.
Porous and pervious surface materials	Green/Biodiversity roof	No – Use of a green/biodiversity roof would not be appropriate for this development.
	Pervious ground level surfacing	Yes – Any new parking, footpath or hard landscaped areas should be created with permeable surfacing or porous materials.

Infiltration Systems	Soakaways, shallow basins, rain gardens	Possible – Soakaways are unlikely to be suitable but raingardens with overflow into a storage system may be feasible
Conveyance Systems	Rills, swales, filter drains, open watercourse	Possible – There is limited scope for use of above ground conveyance systems to connect SuDS components within the site.
Storage Systems	Ponds, detention basins, wetlands	Possible – There is some scope for above ground attenuation systems in the gardens.
Treatment systems	Subsurface and surface structures designed to provide treatment through removal of contaminants	Yes – Appropriate treatment stages will be provided where necessary.

The 4 proposed new dwellings with gardens and permeable parking areas will reduce the impermeable area on site from 83% to 28%. Draining the surface water runoff from the new roof areas to a suitable sustainable drainage system will ensure that there is a decrease in surface water runoff from the site. The use of surface water attenuation, rainwater harvesting, water butts, rain gardens and permeable surfacing for patio and parking areas and footpaths would provide a suitable sustainable drainage system with water resources and biodiversity benefits.

If ground conditions are confirmed to be unsuitable for infiltration, then the surface water runoff from the site should be restricted to runoff rates as close as possible to the greenfield runoff rate for all return periods up to the 1 in 100 year rainfall event with climate change allowance. Discharge of the attenuated surface water runoff to the River Tean would be the next most appropriate drainage option if infiltration is not feasible.

Preliminary estimation of the greenfield runoff rate for the site has been made using the HR Wallingford UK SuDS calculator tool. The UK SuDS Tool report is included in Appendix G. The greenfield runoff rates for the 0.3174ha site using the UK SuDS Tool are shown in the table below.

RETURN PERIOD	GREENFIELD RUNOFF RATE (SOIL TYPE 4)
QBAR	2.0 l/s (6.2 l/s/ha)
1 in 1 year	1.6 l/s
1 in 30 years	4.0l/s
1 in 100 years	5.1 l/s

The modified rational method has been used to estimate the runoff from the existing impermeable areas on site. The estimated runoff rates are shown in the table on the following page assuming discharge from 2,636m² of impermeable area.

RETURN PERIOD	EXISTING SURFACE WATER RUNOFF RATE
1 in 30 years	89.6 l/s
1 in 100 years	117.2 l/s

As the proposed impermeable area (874m²) is only 28% of the existing impermeable area (2,636m²), no attenuation storage would be required to restrict the runoff to 28% of the existing runoff rate (32.8 l/s). Preliminary estimates of the volume of storage required to restrict the surface water runoff from 874m² of impermeable area to 5.1 l/s (the 100 year greenfield runoff rate) are shown in the table below. Climate change allowances of 20% and 40% have been used to consider the effects of possible increases in peak rainfall intensities until 2115.

STORAGE VOLUME ESTIMATION FOR SOIL TYPE 4	
20% cc	22 m ³
40% cc	29 m ³
IMPERMEABLE AREA	874m ²
DISCHARGE RATE	5.1 l/s

No attenuation storage would be required to restrict the surface water runoff from the proposed development to a third of the existing runoff rate. 22 - 29m³ of attenuation storage may be required to restrict the surface water runoff from 874m² of impermeable area to 5.1 l/s if attenuation to the greenfield runoff rate is required. Less attenuation storage will be required if some of the surface water runoff from the proposed new development roof areas is discharged to a rainwater harvesting system or to rain gardens. The storage volume estimates are indicative only at this stage. Use of permeable paving for the patio areas and footpaths and other SuDS components would reduce the volume of storage required.

The detailed drainage design will be carried out following granting of planning permission. The design of the drainage system will need to include a schedule of maintenance activities required to ensure the continued operation of the drainage system for the lifetime of the development. The maintenance activities required will be based on the recommendations of the CIRIA C753 SuDS Manual.

6.0 Recommendations

- Set finished floor levels to proposed levels in Section 4.5 and 150mm above existing ground level
- No raising of ground levels in Flood Zones 3 and 2
- Fencing in floodplain to be post and rail fencing
- Design sustainable drainage system to maximise the benefits as far as possible

7.0 Conclusion

The Hec-Ras model has shown that the proposed new dwellings and the site access will lie in Flood Zone 1 which is appropriate for the more vulnerable land use classification. The garden areas will lie in Flood Zones 1 and 2 which is sequentially appropriate for the land use. Flood mitigation measures have been proposed to ensure that the

proposed new dwellings and the occupiers are at low risk of flooding from all sources for their lifetime.

The proposed development will provide an overall reduction in flood risk elsewhere by reducing the surface water runoff from the existing site due to the significant reduction in impermeable area on site and the use of a sustainable drainage system.