10. Flood Risk and Drainage

Introduction

10.1 This chapter of the ES assesses the likely significant impacts of the Proposed Development with respect to Flood Risk. This Chapter also describes the methods used to assess the impacts; the baseline conditions currently existing at the Site and surrounding area; the mitigation measures required to prevent, reduce or offset any significant negative effects; and the likely residual impacts after these measures have been adopted.

10.2 This chapter only considers the potential impact that the development proposals will have on flood risk (and the associated mitigation and management of these impacts) as opposed to the risk posed to the development proposals by flooding. Clearly the risk posed to the development proposals is also a material planning consideration; however, this is considered within the separate flood risk assessment (provided at **Appendix 10.1**).

Policy Context

National Planning Policy

National Planning Policy Framework (2012)

10.3 The National Planning Policy Framework (NPPF) and the associated technical guidance sets out a framework for the consideration of flood risk through the planning process.

10.4 The NPPF states that Sequential Test should be used to steer new development to areas with the lowest probability of flooding (paragraph 101). This is typically interpreted to mean that development in flood zones 2 and 3 should only occur if the development passes the Sequential Test. The NPPF also indicates (footnote to paragraph 103) that a site specific flood risk assessment is required for all developments propose din flood zones 2 and 3 and any sites where the application boundary covers an area of greater than one hectare irrespective of the flood zoning.

Sequential Test

10.5 The Sequential Test as set out in NPPF (paragraph 101) requires decision makers to direct development to the lowest risk reasonably available site. In practice this typically means that where development is proposed in higher risk zones (i.e. 2 or 3) it is necessary to demonstrate that there are no reasonably available alternative sites. Where a site is partly or fully in flood zone 2 and 3 and no reasonably available alternative sites exist, this same process should be applied within the site.

10.6 Where development in flood zones 2 and 3 is shown to pass the Sequential Test, development can potentially occur subject to the development type / vulnerability being considered to be acceptable in the given flood zone. In addition the development layout and design must be informed by a site specific flood risk assessment that sets out how flood related risks and impacts will be managed.

Exception Test

10.7 The Exception Test as set out in NPPF (paragraph 103) exists to provide a mechanism through which a given class of development can exceptionally be permitted in a higher risk area than would otherwise normally be permitted. The test should however only be considered in situations where the Sequential Test has already been applied and passed.

10.8 The NPPF states that for the Exception Test to be passed:

"it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and

a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability."

Local Planning Policy

Adopted Development Plan

Staffordshire Moorlands Core Strategy (March 2014)

10.9 Policy 'SD3 - Pollution and Flood Risk' states that;

"Development proposed within the floodplain will be guided to first make use of areas at no or low risk of flooding before areas at higher risk, where this is viable or possible and compatible with other polices aimed at achieving a sustainable pattern of development. Development deemed acceptable within areas at risk of flooding due to national or other policies or other material considerations, must be subject to a flood risk assessment. Additionally, approved schemes must be designed and controlled to mitigate the effects of flooding on the site and the potential impact of the development on flooding elsewhere in the floodplain. In all cases, schemes will be determined after having considered both individual and cumulative impacts."

10.10 Policy 'C3 - Green Infrastructure' states that;

"The Council will, through partnership working with local communities, organisations, landowners and developers, develop an integrated network of high quality and multi-functional green infrastructure that will…….. mitigate the negative effects of climate change and maximise potential climate change benefits including effective flood risk and waterways management."

Assessment Methodology and Significance Criteria

10.11 In line with the risk based approach detailed by the Environment Agency and recommended elsewhere in industry guidance[22], the key to the classification flood impacts is based upon the consideration of:

- *"The sensitivity of the receptor – takes into account the nature or vulnerability of that receptor and its likely response to increased risk.*

22 Development and flood risk - guidance for the construction industry, FR/CP/102, CIRIA, 2004

- *The severity of the potential flood impact – takes into account the potential nature of the change in flood conditions that is likely to arise; and*

- *The probability of occurrence (i.e. likelihood) – takes into account the probability that a given impact will be realised when flooding occurs."*

Sensitivity of Receptor

10.12 When considering off site impacts there is a general assumption that all developments are highly sensitive. This assumption can, however, typically be relaxed when considering 'Water Compatible' development or undeveloped land. Given this, the Sensitivity of the Receptor is ranked as shown in Table **10.1**.

Table 10.1: Sensitivity of receptor

Sensitivity of receptor	
High	All built developments unless mitigating circumstances exist, Key access routes
Moderate	Water compatible development, Other access routes
Low	Undeveloped Land

Severity of flood impact

10.13 To classify the severity of the potential flood impacts it is necessary to look at the nature and scale of the flood event. This includes, but is not confined to, the extent of flooding, the depth of flooding, the duration of flooding and the velocity of flood waters. For new developments the assessment is based on the likely post development situation, for off-site receptors it is based solely on the likely deterioration.

10.14 Given this, the severity of the potential flood impact is then ranked as shown below in **Table 10.2**.

Table 10.2: Severity of flood impact

Severity of flood impact	
Major	Any marked (>10%) increase in flood depth, flood flow velocity or flood duration. Any change in flood extent that impacts additional properties including access
Moderate	Any other measurable increase of flood depths, durations, flow velocities or extent.
Minor	Likely, but unquantifiable small increases of flood depths, durations, flow velocities or extent
Negligible	No likely increase in flood severity at any off site location

Probability of flood impact

10.15 Some impacts on the severity of flooding will clearly be realised whenever flooding occurs; however others are dependent upon multiple factors such a coincident flooding from two different sources and / or human actions or error. In these instances the significance of the potential flood impact should be accordingly reduced. This can be assessed in a number of ways; however often for complex and interrelated flood mechanisms a qualitative assessment based on professional judgement will be the most appropriate.

10.16 It should be noted that in many cases the probability of a given impact being realised will be high. This does not however mean that flooding is likely, but rather that the probability of the impact being realised when flooding occurs is high or indeed certain.

Table 10.3: Probability of flood impact

Probability of occurrence	
High	The impact is inevitable whenever a flood occurs and such a flood is likely to occur at some point over the development lifetime or construction period
Medium	Circumstances that would give rise to a potential impact will be in place for prolonged periods of the time. As such given the nature and frequency of flooding that could reasonably be expected to occur over the development lifetime or construction period, the flood impact could potentially be realised.
Low	Circumstances that would give rise to a potential impact will be in place for only short periods of the time and / or the flood impact will require two or more independent low probability events to coincide and as such it is unlikely that the impact will arise over the development lifetime or construction period.

Significance of potential flood impact

10.17 The severity of the flood impact and the sensitivity of the receptor are combined using a matrix (shown below – Table **10.4**) to determine the magnitude of the potential flood impact, if realised.

Table 10.4: Flood impact magnitude

Significance of Potential Hazard	Sensitivity of Receptor		
	Low	Moderate	High
Major	Moderate	Major	Major
Moderate	Minor	Moderate	Major
Minor	Minor	Minor	Moderate
Negligible	Negligible	Negligible	Negligible

10.18 This magnitude is then adjusted based on the assessment of probability using a secondary matrix (shown below – **Table 10.5**) to determine the significance of that flood impact.

Table 10.5: Flood impact significance

		Probability of flood impact		
		Low	Medium	High
Flood impact magnitude	Major	Minor	Moderate	High
	Moderate	Minor	Minor	Moderate
	Minor	Negligible	Minor	Minor
	Negligible	Negligible	Negligible	Negligible

10.19 Typically flood impacts that are assessed to be moderately or highly significant are deemed to be unacceptable whereas flood impacts that are considered to have a Minor or Negligible significance will not need any further mitigation or management for development to proceed.

Consultation

10.20 The scoping response provided by Staffordshire Moorlands District Council, which was based upon responses by all statutory consultees including the Environment Agency, stated that;

"The site of the proposed development is shown on the Environment Agency's indicative flood maps to be located across Flood Zones 1, 2 and 3. As such a Flood Risk Assessment (FRA) will need to be produced taking into account the River Blithe and the ordinary watercourse. Sustainable urban drainage should form the basis of any surface water drainage plan/proposal including the provision of areas of open water on site."

10.21 The design of the proposed development and the nature of subsequent assessments are in line with this response.

Baseline Conditions

10.22 A flood risk assessment has been prepared to support the planning application and a full baseline description of the site, as relevant to flood risk, is contained within that report (**Appendix 10.1**).

10.23 The site is centred on national grid reference 397970 338970 and the red line boundary covers an area of approximately 15.58 ha. This area is split between the two proposed development areas (western plot [5.6 ha] and eastern plot [8.2 ha]) and land associated with access routes onto the site [1.2 ha].

10.24 The two development areas are situated on largely greenfield land to either side of the existing Blythe Business Park Industrial Estate. This in turn is located within the village of Cresswell. The River Blithe, which is the major point of focus for the flood risk assessment, forms the north-eastern site boundary for both development plots while a small tributary (Fulwood Tributary) of the river flows along the northern boundary of the eastern plot before confluencing with the river.

10.25 The topography locally is dominated by the River Blithe which runs along the base of a wide shallow valley orientated broadly from the west to the east. The two development plots are located immediately to the south of the river on the southern flank of this valley. Correspondingly levels are at their lowest adjacent to the river to the east (downstream) and then rise up gradually to the south and west.

10.26 In line with this topography the parts of the site to the south away from the channels are located in flood zone 1 indicating the probability of inundation is from the adjacent watercourses is low. This constitutes the large majority of the proposed development area. Land along the River Blithe and the Fulwood Tributary is however designated as being within flood zones 2 and 3a. While flooding in these areas is more possible the development has in general been set back from the watercourses such that only buildings proposed in flood zone 3a are the community centre and a security hut.

10.27 In 1981 a significant flood event occurred locally and large parts of the existing business park were inundated. Anecdotal reports indicate that although flooding was most severe to the north of the river on the existing business park, parts of the proposed development site are also likely to have been flooded during this event. Following the 1981 flood event the bridge within the business park where a blockage was believed to have occurred was removed. As such the impact today of an identical flood event is likely to be less severe.

10.28 Flood modelling was undertaken by Waterco in 2010 on behalf of the applicant and the outputs from this work were used as part of a successful challenge to the Environment Agency flood map in 2012. Subsequent to this (also in 2012) local residents commissioned RPS to undertake further flood modelling work. The current flood outlines shown on the Environment Agency flood map are based on this study however detailed outputs, including full explanations concerning the difference between this work and the earlier assessment, were not available to inform this assessment.

10.29 The flood modelling undertaken demonstrates that the probability of fluvial flooding across the majority of the site is low; however during a major flood low lying land along the River Blithe could be inundated. The extent of inundation could also be exacerbated by both climate change and any blockage that occur at the existing structures.

Predicted Significant Effects

Construction

10.30 The probability of a major flood occurring during the construction period is low; however there remains a potential for a period of high flows to occur and depending upon the severity of this event the land immediately adjacent to the river may become inundated. Construction related activities within the immediate vicinity of the channel do therefore

have the potential to result in adverse impacts should a flood event occur particularly in relation to;

- temporary changes in flood storage or conveyance that might arise from siting spoil heaps, excavations, or other temporary earth works in the floodplain; and
- mobilisation of materials / pollutants stored in close proximity to the watercourses and mobilisation of sediment in areas of un-vegetated worked ground in close proximity to the watercourses. Water pollution related issues are however considered separately in Chapter 11: Ground Conditions.

10.31 Temporary changes in land cover through the construction process associated with loss of vegetation and compaction of ground through plant movement could increase rates of runoff from the site. This in turn could contribute to flooding downstream of the site, although it should be noted that in isolation this effect would be small and the probability of a major flood event occurring during the construction phase is low.

Operation

10.32 Development in areas that would currently convey significant amounts of flood flow has the potential to alter flood dynamics locally by changing flood conveyance and thereby exacerbate flooding in areas both on and off the site. Development will however be set back at least 8 m from the top of the bank of the River Blithe and out of all areas where regular inundation and significant flood flow velocities are likely. As such the severity of such impacts is assessed to be negligible.

10.33 Any increase in land elevations within the floodplain will reduce the capacity of the floodplain to store water during a major flood event and this is likely to result in increased flood risk downstream. Some small changes in land levels will be necessary to create a level development platform for both the commercial / industrial buildings sited at the boundary of flood zones 2 and 3 and the community centre which is sited in flood zone 3. In addition, at the detailed design stage, options for lifting these building above the design flood elevation will be considered and if this option was selected the volume of flood storage lost would be greater unless mitigation was introduced.

10.34 The construction of the crossing over the Fulwood Tributary involves works to the channel of the watercourse and within the associated floodplain. This work will inevitably involve significant changes in the land form locally and if not undertaken carefully will have the potential to;

- alter the flood conveyance of that channel,
- alter the amount of channel / floodplain storage available, and
- provide a constriction / potential blockage point.

10.35 Any of these mechanisms would exacerbate flood risk both on site upstream of the structure and (to a small degree) downstream across the site and beyond.

10.36 The development site is currently mostly greenfield and following development the area of hard surfacing (i.e. roofs, car parks, yards and roads) will clearly be significantly

greater than is currently the case. Runoff from such areas of impermeable surfacing will be significantly higher than from an undeveloped site and as such the peak rates of discharge from the site into the River Blithe will be higher unless mitigation is introduced.

Table 10.6: Flood impact summary table prior to mitigation

	Potential Impact	Receptor	Sensitivity of Receptor	Severity of Potential Impact	Likelihood of Occurrence	Flood Impact Significance
Construction	Temporary alteration to / earthworks within areas of floodplain	Downstream developed areas	High	Minor	Medium	Minor
	Temporary changes in runoff rates associated with soil compaction and stripping of vegetation	Downstream developed areas	High	Moderate	Medium	Moderate
Operation	Changes in fluvial flood conveyance through buildings or earthworks in the floodplain	Adjacent / downstream developed areas	High	Negligible	High	Negligible
	Changes in flood storage from changes in land elevation within the floodplain	Downstream developed areas	High	Minor	High	Moderate
	Changes in flood flow dynamics associated with crossing over the Fulwood tributary	Onsite and downstream developed areas	High	Moderate	Medium	Moderate
		Onsite areas of landscaping upstream of structure	Low	Major	High	Moderate
	Changes in storm water runoff associated with the development	Downstream developed areas	High	Moderate	High	High

Mitigation Measures

Construction

10.37 Prior to construction, the principle contractor will prepare and agree with the EA and Staffordshire Moorlands District Council, a detailed Construction Environmental Management Plan (CEMP).

10.38 The CEMP will set out a broad range of specific measures that will be used during the construction works to avoid the potential for environmental harm. Specifically in terms of impacts associated with flooding the CEMP will;

- define areas within which spoil heaps and site compounds etc. will not be positioned and more generally where material storage will not occur. These areas will include all land within 20m of a watercourse and all land where there is a realistic potential for flooding to occur (flood zone 3).

- set out arrangements for the drainage of the site, and more generally managing storm water runoff, during the construction period. Where possible this will include construction of aspects of the final site drainage strategy in advance and using these to collect and control discharges from the site.

Operation

10.39 All changes of land elevation in areas defined as flood zone 3 will be accompanied by a detailed assessment of flood storage demonstrating how the proposals will ensure that flood storage is conserved (or increased) on a level for level basis up to the design flood elevation. This will be achieved by lowering land levels in specific areas of the car parking, services yard or landscaping associated with a given unit. In each case where such measures might be required the proposed site layout allows for small areas of additional land to be brought into the floodplain to achieve this purpose without resulting in wider problems to adjacent units of the site layout more generally. Following implantation of this mitigation the magnitude of the potential impact will be reduced to negligible (i.e. neutral / slightly beneficial).

10.40 The crossing of the Fulwood Tributary will be designed as a free span structure across the channel with the bridge soffit set clear above the design flood level. This, and regular checks / clearance on the bridge and upstream channel will help prevent this structure acting as a point of constriction and blockage.

10.41 The final design of the Fulwood Tributary crossing will be subject to separate approval from the statutory drainage authority under the 1991 Land Drainage Act. The design developed for that application will be informed by flood modelling to ensure that the final design will not increase peak flood flows proceeding downstream and will not exacerbate the risk of flooding posed to any of the new or existing buildings.

10.42 The site drainage strategy set out within the flood risk assessment uses Sustainable Urban Drainage Systems (SUDS), consisting of source control measures (permeable paving) and surface attenuation (ponds and swales) to achieve the following flow objectives:

- no uncontrolled discharge from the drainage system up to a 1% AEP flood event including an allowance for changes in rainfall severity associated with climate change; and

- peak rates of runoff from the site following development to be no greater than would be expected for an equivalent greenfield site.

10.43 Given this and the removal of the impermeable cover associated with the existing building on the site the development proposals will result in a negligible (beneficial) impact on flood risk downstream.

Residual Effects

10.44 As set out in **Table 10.7** following implementation of the mitigation described in this chapter it is assessed that there will be no significant residual flood impact arising as a result of the development proposals.

Table 10.7: Flood impact summary table following mitigation

	Potential Impact	Receptor	Sensitivity of Receptor	Severity of Potential Impact	Likelihood of Occurrence	Flood Impact Significance	Mitigation
Construction	Temporary alteration to / earthworks within areas of floodplain	Downstream developed areas	High	Minor	Medium	Minor	Construction activities in floodplain controlled through CEMP
	Temporary changes in runoff rates associated with soil compaction and stripping of vegetation	Downstream developed areas	High	Minor	Medium	Minor	Construction phase drainage strategy delivered through CEMP
Operation	Changes in fluvial flood conveyance through buildings or earthworks in the floodplain	Adjacent / downstream developed areas	High	Negligible	High	Negligible	N/A
	Changes in flood storage from changes in land elevation within the floodplain	Downstream developed areas	High	Negligible	High	Negligible	Compensation storage provided on a level for level basis
	Changes in flood flow dynamics associated with crossing over the Fulwood tributary	Onsite and downstream developed areas	High	Negligible	Medium	Negligible	Free span bridge with elevated soffit plus ongoing management of channel / structure.
		Onsite area of landscaping upstream of structure	Minor	Moderate	High	Minor	
	Changes in storm water runoff associated with the development	Downstream developed areas	High	Negligible	High	Negligible	Implementation of storm water management strategy using SUDs and restricting runoff to greenfield rates

Cumulative Effects

10.45 Staffordshire Moorlands District Council has requested that the cumulative impacts of the proposed development and planning approval 08/09751/COU be assessed. Planning approval 08/09751/COU was granted in 2008 and was for change of use of the Former Indesit Works, Grindley Line, Blythe Bridge from B2 Industrial to B1, B2 and B8 land.

10.46 This application was not accompanied by a flood risk assessment. The site is however located in flood zone 1 and the proposals did not involve intensification of land use or other works that would be likely to give rise to significant changes in site runoff. Given this, the proposed change of use of the Former Indesit Works is highly unlikely to have given rise to any flood impacts and therefore there is no potential for cumulative impacts with the proposed development in relation to flood risk.

Summary

10.47 This chapter concludes that the development proposed can be delivered without resulting in an adverse impact on flood risk locally. Key issues relate to the design of buildings and infrastructure located within the floodplain and the management of storm water runoff from the site. A clear commitment to the provision of compensation storage on a level for level basis and the development of an outline drainage strategy which uses sustainable drainage systems to control runoff from the site to greenfield rates (i.e. at or below existing) will however ensure that these issues are adequately addressed.