

F Potential growth areas

The following tables provide a summary of information relating to flood risk for locations identified as potential strategic growth areas. Appendix F has been prepared based on the most up-to-date information concerning the proposed growth areas, at the time of preparing this SFRA. It also contains information on one additional area, where major development is planned.

Each table is supported by corresponding interactive maps. These maps can be found by using the Appendix F Index Map and clicking on the corresponding square in the map. The interactive map for the area will then open in a separate PDF. The table also lists which maps relate to the proposed growth area.

The supplied information relating to the proposed growth areas did not provide a defined boundary. Therefore, the interactive maps have a buffer, to cover the proposed growth areas and immediate surrounding land.

F.1 AREA 1: Northern Gateway

Proposed growth area (Northern Gateway)
<p>The proposed growth area is centred around the northern parts of the A42 and M1 in North West Leicestershire District and Charnwood Borough.</p> <p>The interactive maps ref: SFRA_F01 and SFRA_F02 relate to this proposed growth area.</p>
Fluvial Flood Risk
<p>The main fluvial flood risks to the proposed growth area are associated with the Black Brook, the Grace Dieu Brook, the Westmeadow Brook and the Diseworth Brook. However, the Flood Zones are narrow and confined throughout much of the proposed growth area. Flood Zones are comparatively wider at the confluence of the Black Brook and Grace Dieu Brook.</p> <p>Flood Zone 3b has not been identified along the watercourses in the proposed growth area. Further modelling may be required to identify Flood Zone 3b and the impacts of climate change, as part of site-specific Flood Risk Assessments.</p> <p>There are several, un-named watercourses in the proposed growth area which are not included in the Environment Agency's Flood Zone 2 and 3 coverage. These watercourses primarily drain towards the Diseworth Brook, the Westmeadow Brook and the Black Brook, as well as an un-named watercourse to the west of the proposed growth area. Fluvial flood risk may be from one or more of these watercourses. Further modelling and investigation may be required to identify the Flood Zone coverage of these watercourses and the impacts of climate change, as part of site-specific Flood Risk Assessments.</p> <p>Notably, an un-named watercourse is shown to lead from East Midlands Airport towards the Diseworth Brook and has no Flood Zone coverage. Further modelling and investigation may be required to identify the Flood Zone coverage of these watercourses, if there is any significant interaction with the surface water network (e.g. around East Midlands Airport) and the impacts of climate change as part of a site-specific Flood Risk Assessment.</p> <p>In the proposed growth area, the Grace Dieu Brook is classed as a Main River. The Black Brook is classified as a Main River from downstream of Blackbrook Reservoir. All other watercourses in the proposed growth area are classified as ordinary watercourses.</p>

Surface Water Flood Risk
<p>The mapping shows surface water flood risk in the proposed growth area generally follows similar flow paths to watercourses. Due to the steep topography, much of the overland flow is directed towards low lying areas in the valleys of the watercourses and consequently, limited surface water ponding is shown outside of these valleys.</p> <p>One flow path follows a valley, from Harborough Pit Farm towards the Grace Dieu Brook. Another surface water flow route follows the flow path of an un-named watercourse, which leads from Spring Burrow Lodge in North West Leicestershire District. This flow path does not follow the route shown in the Detailed River Network (DRN) for its entire length; south of Fishpool Grange, it diverts and flows towards the Black Brook further downstream.</p> <p>Within the western part of Shepshed, covered by the proposed growth area, surface water is shown to pond on some of the local roads during in the 3.3% AEP event.</p> <p>Surface water is also shown to pond in isolated areas, on the higher ground, during the 0.1% AEP event. The mapping shows a notable area of surface water ponding, around the A512 and a place called “Ringing Hill” on the OS mapping, during the 0.1% AEP event.</p>
Groundwater Flood Risk
<p>The AStGW flooding mapping indicates that much of the proposed growth area is either within the <25% category or within the $\geq 25\%$ <50% category. Areas within the $\geq 25\%$ <50% category are found along the flow path of the Diseworth Brook (particularly in Diseworth), the Black Brook and the Grace Dieu Brook. Certain areas along the flow paths of the Black Brook and Grace Dieu Brook are also within the $\geq 50\%$ <75% category.</p>
Reservoir Flood Risk
<p>The proposed growth area is shown to be at risk of flooding if the EMA Gimbro Ponds, the Central East Area Balancing Pond and / or the Blackbrook Reservoir were to fail. The EMA Gimbro Pond is located within the proposed growth area, the Central East Area Balancing Pond is located at East Midlands Airport and the Blackbrook Reservoir is located immediately upstream of the proposed growth area, partially within North West Leicestershire District. The consideration of the residual risk posed by these reservoirs should be considered as part of site-specific Flood Risk Assessments. Considering the proximity of these reservoirs to the proposed growth area, there would be very limited time, if any, to respond to a reservoir breach.</p>
Flood risk from other sources
<p>There are no canals in the proposed growth area.</p> <p>The Water and Sewerage Company which covers this proposed growth area is Severn Trent Water. The 2014 Charnwood Borough SFRA Update used Severn Trent Water’s DG5 register; according to this, Shepshed is prone to sewer flooding.</p> <p>Two records of sewer flooding have been recorded at the LE12 9 post-code area (Shepshed) in Severn Trent Water’s risk register.</p>
Previous and known flooding issues
<p>There are two historical flood records at Diseworth, recorded in November 2000 and November 2012. The November 2012 event was considered a result of fluvial flooding from the Diseworth Brook. One flood event was recorded at Belton in 1987.</p> <p>There are two historical flood records at Shepshed, recorded in August 2012 and June 2016. The records were taken from Fire and Rescue data and the source of flooding and magnitude of the event were not stated. Thus, these records may be isolated incidents.</p> <p>The proposed growth area is located within the 1977 flood extent of the Black Brook, in the Environment Agency’s Historic Flood Map.</p>

Changes to flood risk in the future

Climate change is likely to:

- Increase storm intensities.
- Climate change may increase the depth, velocity or hazard of fluvial flooding
- Climate change may also increase the extent, depth and frequency of surface water flooding

Where detailed hydraulic models were supplied for use in the assessment, climate change modelling for the watercourses in study area was undertaken based on the new climate change guidance. Appendix H for the SFRA provides details on the detailed models used in the assessment. There is no climate change modelling covering watercourses within the proposed growth area. Developers should develop detailed hydraulic models as part of a site-specific Flood Risk Assessment and include climate change in the assessment.

Current flood risk management infrastructure

Watercourses in the proposed growth area are undefended.

A Property Level Flood Protection scheme is proposed for Diseworth under Leicestershire County Council's Local Flood Risk Management Strategy and as listed in the February 2017 Environment Agency Flood and Coastal Erosion Risk Management (FCERM) Programme.

The proposed growth area is partially covered by the Environment Agency Flood Alert Areas:

- River Trent in Derbyshire
- Lower River Soar in Leicestershire
- Loughborough Urban Watercourses.

The proposed growth area is not covered by an Environment Agency Flood Warning Area.

Potential for future flood risk management

The potential growth area covers primarily rural land and a few urban settlements including Diseworth and parts of Shepshed. The mapping shows that:

- Many of the watercourses in the proposed growth area flow towards the Diseworth Brook; this brook flows through the centre of Diseworth.
- Parts of Diseworth are at risk of flooding from fluvial and / or surface water sources.
- The Black Brook joins the Grace Dieu Brook at their confluence to the north-east of the proposed growth area; the Grace Dieu Brook then flows into Loughborough.
- The northern part of Shepshed is at risk of flooding from fluvial sources and Loughborough is at risk from several sources, notably surface water for which there have been several recorded flood events attributed to this source.

Diseworth is proposed to have a Property Level Flood Protection Scheme.

Development in the potential growth area could provide opportunities to implement strategic solutions to improve flood risk in this area and downstream in Loughborough. One measure is the use of SuDS techniques, to ensure post-development runoff rates are at a manageable and appropriate level and to reduce the risk of development increasing flood risk downstream. Another measure is the creation of a flood storage area, to hold back flows and reduce the volume of water entering the Grace Dieu Brook.

Strategic flood risk opportunities in this area may require cross-boundary partnership working with North West Leicestershire District Council and Charnwood Borough Council.

Miscellaneous site information

- The proposed growth area is:
 - not located within a Groundwater Source Protection Zone;
 - nearly entirely located within a Surface Water Nitrate Vulnerability Zone (proposed 2017 Nitrate Vulnerability Zone, ref S309),
 - is partially located within a Groundwater Nitrate Vulnerability Zone (proposed 2017 Nitrate Vulnerability Zone, ref G34); and,
 - is partially located within the sub-regional GI network.
- There are two historic landfill sites in the proposed growth area, located north and south of Diseworth and adjacent to watercourses. There is a further historic landfill site; to the north of Shepshed and adjacent to the Black Brook. If development is located near / on the historic landfill sites, this could have implications for the suitability of certain types of SuDS techniques.
- The Diseworth Brook in the proposed growth area, does not have a WFD overall status. The Black Brook (referred to in the WFD dataset as the Black Brook from its source to the Grace Dieu Brook) has a moderate WFD overall status. The Grace Dieu Brook (referred to in the WFD dataset as the Grace Dieu Brook from its source to the Black Brook) has a poor WFD overall status. The Westmeadow Brook (contained within the Long Whatton Brook Catchment in the WFD dataset) has a moderate overall status. It is important that development in the proposed growth area aim to take positive measures to conform to the WFD, which can be impacted because of development, for example in terms of 'deterioration' in ecological status or potential. Development should consider the quality of the water that is released from sites and the impact it may have on the water quality on any receiving waterbodies. Opportunities to improve the status of watercourses, particularly along the Grace Dieu Brook, should also be considered.

F.2 AREA 2: Southern Gateway

Proposed growth area (Southern Gateway)
<p>The proposed growth area includes land both to the east and west of Hinckley.</p> <p>The interactive maps ref: SFRA_F05 and SFRA_06 relate to this proposed growth area.</p>
Fluvial Flood Risk
<p>The main fluvial flood risks to the proposed growth area are associated with the Sence Brook and its tributaries (e.g. the Tweed River), the Battling Brook / Harrow Brook, the Sketchley Brook and an un-named watercourse which flows to the Thurlaston Brook. The Flood Zones of these watercourses are narrow and confined throughout much of the proposed growth area, with exception of the Sketchley Brook through Hinkley, where Flood Zones are comparatively wider.</p> <p>Within the proposed growth area, Flood Zone 3b has not been identified along the Sence Brook and tributaries or the un-named watercourse which flows to the Thurlaston Brook. Further modelling may be required to identify or verify Flood Zone 3b and the impacts of climate change, as part of site-specific Flood Risk Assessments.</p> <p>There are several, un-named watercourses in the proposed growth area which are not included in the Environment Agency's Flood Zone 2 and 3 coverage. These watercourses primarily drain either away from the peripheries / suburbs of Hinckley, towards the Sence Brook, Thurlaston Brook and River Soar or towards Hinckley town centre and to the Battling Brook / Harrow Brook and Sketchley Brook. Further modelling and investigation may be required to identify the Flood Zone coverage of these watercourses and the impacts of climate change as part of site-specific Flood Risk Assessments.</p> <p>There may be interaction with these watercourses and the Ashby Canal. This should be considered as part of site-specific Flood Risk Assessments.</p> <p>The Sence Brook is classified as a Main River from around 441796, 297888. Upstream, it is named as the Tweed River and is classified as an ordinary watercourse. The Battling Brook is classified as an ordinary watercourse until the Brodick Road bridge; downstream of the road bridge the watercourse is known as the Harrow Brook and is classified as a Main River. The Sketchley Brook is classified as a Main River from around 442127, 292827; upstream, it is classified as an ordinary watercourse. All other watercourses in the proposed growth area are classified as ordinary watercourses.</p>
Surface Water Flood Risk
<p>The mapping shows surface water flood risk in the proposed growth area generally follows similar flow paths to watercourses, particularly the Sence Brook and its tributaries and the Battling Brook / Harrow Brook and the Sketchley Brook which flow through Hinckley. In the 3.3% AEP event, the risk is largely confined to these flow paths, with isolated areas of ponding on open spaces and local roads in Hinckley. In the 1% AEP event the risk is still largely confined to these flow paths, although surface water is shown to affect parts to Stoke Golding and a number of local roads throughout Hinckley are affected by surface water flooding. In the 0.1% AEP event, the mapping appears to show surface water runoff from areas of high ground, towards the flow paths of the watercourses. There are several flow paths, with quite wide surface water extents, leading to the watercourses within the proposed growth area and presenting a risk to existing property in the area.</p>
Groundwater Flood Risk
<p>The AStGW flooding mapping indicates that the proposed growth area is largely within the <25% category. Areas with increased susceptibilities (i.e. within the $\geq 25\%$ <50% category) are associated with the flow paths of watercourses. Small parts of the proposed growth area are within the $\geq 50\%$ <75% category; these areas tend to be underlain by a Secondary A aquifer (superficial deposits designation).</p>

Reservoir Flood Risk
<p>The proposed growth area is not shown to be in an area at risk of flooding from a reservoir failure.</p>
Flood risk from other sources
<p>The Ashby Canal flows through the proposed growth area. Canal and River Trust data indicates that there have been two over-topping incidents around Stoke Golding. The description provided in the dataset indicates that there may be a critical point on this canal at Stoke Golding where overtopping during heavy rainfall events occurs. No other incidents were recorded in the proposed growth area. There remains a residual risk, should the canal breach or fail. The residual risk posed by the Canal should be considered as part of site-specific Flood Risk Assessments.</p> <p>The Water and Sewerage Company which covers this proposed growth area is Severn Trent Water. Severn Trent Water's risk register indicates that parts of Hinckley have experienced sewer flooding on a number of occasions. Three incidents have been recorded in the register, at the CV13 6 post-code area (Stoke Golding).</p>
Previous and known flooding issues
<p>No historical records of flooding in the proposed growth area have been found in this assessment.</p> <p>The proposed growth area is not located within the Environment Agency's Historic Flood Map.</p>
Changes to flood risk in the future
<p>Climate change is likely to:</p> <ul style="list-style-type: none"> • Increase storm intensities. • Climate change may increase the depth, velocity or hazard of fluvial flooding • Climate change may also increase the extent, depth and frequency of surface water flooding <p>Where detailed hydraulic models were supplied for use in the assessment, climate change modelling for the watercourses in study area was undertaken based on the new climate change guidance. Appendix H for the SFRA provides details on the detailed models used in the assessment.</p> <p>The detailed models of the Battling Brook / Harrow Brook and the Sketchley Brook, through Hinckley, are relatively insensitive to increased flows due to climate change; extents do not increase significantly based on the climate change allowance used. This is also the case for the River Soar headwaters and tributaries, on the south-eastern and eastern peripheries of Hinckley. However, it is important to note that although the flood extent may not increase noticeably on some watercourses, the flood depth, velocity and hazard may increase compared to the 1% AEP current day event.</p> <p>There is no climate change modelling covering all other watercourses within the proposed growth area. Developers should develop detailed hydraulic models as part of a site-specific Flood Risk Assessment and include climate change in the assessment.</p>
Current flood risk management infrastructure
<p>Watercourses in the proposed growth area are undefended.</p> <p>The proposed growth area is partially covered by the Environment Agency Flood Alert Areas:</p> <ul style="list-style-type: none"> • River Anker and River Sence • Upper Soar Catchment <p>The proposed growth area is not covered by an Environment Agency Flood Warning Area.</p>

Potential for future flood risk management

The potential growth area covers primarily rural land and extends into the urban settlements, including parts of Stoke Golding and Hinckley. It also covers rural settlements such as Higham on the Hill, Elmsethorpe and several farms. The mapping shows that many of the watercourses in the proposed growth area primarily drain either away from the peripheries / suburbs of Hinckley, towards the Sence Brook, Thurlaston Brook and River Soar or towards Hinckley town centre and to the Battling Brook / Harrow Brook and Sketchley Brook.

Whilst the Flood Zones of watercourses in the proposed growth area are relatively narrow and do not present a significant fluvial flood risk to properties, the surface water mapping indicates that local roads and properties, particularly in Hinckley, are at surface water risk.

Development in the potential growth area could provide opportunities to implement strategic solutions to improve flood risk in this area. One measure is the use of SuDS techniques, to ensure post-development runoff rates are at a manageable and appropriate level and to reduce the risk of development increasing flood risk downstream.

Miscellaneous site information

- The proposed growth area is:
 - not located within a Groundwater Source Protection Zone;
 - entirely located within a Surface Water Nitrate Vulnerability Zone (proposed 2017 Nitrate Vulnerability Zone, ref S308 and S309); and,
 - not located within the sub-regional GI network.
- There are no historic landfill sites in the proposed growth area.
- All watercourses in the proposed growth area do not have a WFD overall status.

There are six historic landfill sites within Hinckley. If development is located near / on these historic landfill sites, this could have implications for the suitability of certain types of SuDS techniques.

The Sketchley Brook (referred to as the Sketchley Brook from its source to the River Anker in the WFD dataset) has a moderate overall WFD status. The Soar Brook (referred to as the Soar Brook from its source to the River Soar) also has a moderate overall WFD status. It is important that development in the proposed growth area aim to take positive measures to conform to the WFD, which can be impacted because of development, for example in terms of 'deterioration' in ecological status or potential. Development should consider the quality of the water that is released from sites and the impact it may have on the water quality on any receiving waterbodies. Opportunities to improve the status of watercourses should also be considered. All other watercourses in the proposed growth area do not have a WFD overall status.

F.3 Area 3: A46 Growth Corridor

Proposed growth corridor (A46 Growth Corridor)
<p>The proposed growth corridor is located from Syston to the east of Leicester towards the Southern Gateway and the A5.</p> <p>The interactive maps ref: SFRA_F08, SFRA_F09, SFRA_F10, SFRA_F11 and SFRA_F12, SFRA_F13 relate to this proposed growth corridor.</p>
Fluvial Flood Risk
<p>Due to the size of the proposed growth corridor, a number of watercourses present a fluvial flood risk. The watercourses which present a risk to the proposed growth corridor include:</p> <ul style="list-style-type: none"> • The lower reaches of the River Wreake and its tributaries including the Gaddesby Brook, the Queniborough Brook and the Barkby Brook • The River Sence and its tributaries including the Kilby Brook, the Burton Brook and un-named watercourses • The Melton, Thurnby, Wash, Whestone and Cosby Brooks • The upper reaches of the River Soar and its tributaries • A number of un-named watercourses throughout the A46 growth corridor. <p>The majority of these watercourses drain towards the Leicester City Principal Urban Area and the River Soar or towards the River Sence and Great Glen.</p> <p>The Flood Zones east of Leicester City and within the proposed growth corridor are narrow, as these are the upper reaches and headwaters of largely ordinary watercourses, which are draining from higher ground, towards the River Soar in Leicester. However, at confluences, the Flood Zones can be comparatively wider within the proposed growth corridor e.g. the Barkby Brook confluence with its tributary and along the River Soar confluences with its tributaries. The Flood Zones of the River Sence and River Soar are also comparatively wider within the proposed growth corridor. The lower reaches of the River Wreake may just encroach within the proposed growth corridor.</p> <p>Within the proposed growth corridor, Flood Zone 3b has been identified for the River Wreake, the Queniborough Brook, part of the Barkby Brook, part of the Thurnby Brook, part of the Bushby Brook, part of the Wash Brook, part of the River Sence, part of the Whestone Brook, part of the Cosby Book, the River Soar, the Broughton Astley Brook and for a number of the un-named tributaries of the upper reaches of the River Soar. Further modelling may be required to identify Flood Zone 3b and the impacts of climate change, as part of site-specific Flood Risk Assessments.</p> <p>There are several, un-named watercourses in the proposed growth corridor which are not included in the Environment Agency's Flood Zone 2 and 3 coverage. These watercourses are found throughout the proposed growth corridor. Further modelling and investigation may be required to identify the Flood Zone coverage of these watercourses and the impacts of climate change as part of site-specific Flood Risk Assessments.</p> <p>There may be interaction with the River Sence and its tributaries with the Grand Union Canal. This should be considered as part of site-specific Flood Risk Assessments.</p> <p>A number of watercourses within the study area are partly classified as Main River and partly classified as ordinary watercourses:</p> <ul style="list-style-type: none"> • The Queniborough Brook is classified as Main River from around Croxton Road (465278, 312008); upstream, it is classified as an ordinary watercourse. • The Barkby Brook is classified as Main River from where it enters Syston; upstream, it is classified as an ordinary watercourse. • The Thurnby Brook is classified as an ordinary watercourse until it reaches Thurnby, where it is then classified as a Main River. • The River Sence is classified as an ordinary watercourse until it reaches Great Glen, where it is then classified as a Main River. • The Kilby Brook is classified as an ordinary watercourse until downstream of Main Street in

Kilby, where it is then classified as a Main River.

- The Cosby Brook is classified as a Main River from where it enters Cosby; upstream, it is classified as an ordinary watercourse.
- The Soar Brook is classified as an ordinary watercourse through Hinckley and Bosworth borough. In Blaby district, the Soar Brook forms the River Soar which is classified as a Main River.

The River Wreake is classified as a Main River where it flows near the proposed growth corridor. The Broughton Astley Brook is classified as a Main River throughout the proposed growth corridor. All other watercourses in the proposed growth corridor are classified as ordinary watercourses.

Surface Water Flood Risk

The mapping shows surface water flood risk in the proposed growth corridor generally follows similar flow paths to watercourses.

In the 3.3% AEP and 1% AEP events the risk is largely confined to these flow paths with isolated areas of ponding in open spaces and along local roads in urban areas. Smaller flow paths in natural dry valleys start to form during the 1% AEP event, largely in areas of high ground and leading towards the flow paths of watercourses.

In the 0.1% AEP event, the surface water extents are quite wide and present a risk to existing properties. Many of the smaller flow paths which started to form during the 1% AEP event are now prominent flow routes. Much of the proposed growth corridor is at risk from surface water during the 0.1% AEP event.

Groundwater Flood Risk

The AStGW flooding mapping indicates that the proposed growth corridor has a variable susceptibility to groundwater. Areas more susceptible to groundwater (i.e. within the $\geq 50\%$ <75% category or within the >75% category) tend to be found along the flow paths of watercourses, notably towards:

- the River Wreake and its tributaries to the north of the proposed growth corridor
- the middle and lower reaches of the River Sence and its tributaries
- south and south-west of the River Sence, along the remainder of the growth corridor, towards the A5 – this is associated with the River Soar and its tributaries.

To the east of Leicester, the proposed growth corridor is generally has a lower susceptibility to groundwater (i.e. within <25% category or within the $\geq 25\%$ <50% category). This tends to be associated with areas of higher ground.

Reservoir Flood Risk

The proposed growth corridor is not shown to be in an area at risk of flooding from a reservoir failure.

Flood risk from other sources

The Grand Union Canal flows through a part of the proposed growth corridor, towards the Oadby and Wigston borough and Blaby district administrative boundary. Canal and River Trust data has recorded one incident of over-topping of the Grand Union Canal in July 2007, at a farmer's field in Wistow Park. The accompanying description indicated that the cause of flooding was due to 24 hours of heavy rain. The residual risk posed by the Canal should be considered as part of site-specific Flood Risk Assessments.

The Water and Sewerage Company which covers this proposed growth area is Severn Trent Water. Severn Trent Water's risk register indicates that urban areas have experienced sewer flooding on occasion, throughout the proposed growth corridor.

Previous and known flooding issues

A number of flood incidents have been recorded throughout the proposed growth corridor. The settlements affected include Syston, Thurnby, Scraftoft, Keyham, Great Glen, Wistow, Newton Harcourt, land north of Kilby, Oadby, Sharnford, Broughton Astley and Countesthorpe. The sources of flooding are from a combination of fluvial, surface water and insufficient capacity of the drainage network. However, it is not known whether these historical flood events directly affected the proposed growth corridor.

The proposed growth corridor is partially located within the 1947 flood extents of the River Sence and Queniborough Brook flood extents, the 1977 flood extents of the Cosby Brook and the Broughton Astley Brook, the 1992 flood extent of the Barkby Brook and the 1993 flood extent of the Croft Brook in the Environment Agency's Historic Flood Map.

Changes to flood risk in the future

Climate change is likely to:

- Increase storm intensities.
- Climate change may increase the depth, velocity or hazard of fluvial flooding
- Climate change may also increase the extent, depth and frequency of surface water flooding

Where detailed hydraulic models were supplied for use in the assessment, climate change modelling for the watercourses in study area was undertaken based on the new climate change guidance. Appendix H for the SFRA provides details on the detailed models used in the assessment.

In general, the results show that the models are relatively insensitive to increased flows due to climate change; extents do not increase significantly based on the climate change allowance used. However, it is important to note that although the flood extent may not increase noticeably on some watercourses, the flood depth, velocity and hazard may increase compared to the 1% AEP current day event.

Where there is no climate change modelling covering watercourses within the proposed growth corridor or where alternative approaches were used to map climate change extents (i.e. where the 0.1% outline was used as a surrogate for the Upper End extent), developers should develop detailed hydraulic models as part of a site-specific Flood Risk Assessment and include climate change in the assessment. Appendix H lists the detailed hydraulic models supplied and run for climate change in this assessment.

Current flood risk management infrastructure

The following defences are located within the proposed growth corridor:

- There is an embankment, located along the Thurnby Brook, behind Fernvale Primary School. However, the design and current standard of protection is recorded as 0.
- At Great Glen there are a series of embankments. Several of the defences have a 1:100-year design standard of protection. However, in places the current standard of protection is far lower than the design standard of protection.
- Along the Cosby Brook around Broughton Road / Chapel Lane in Cosby. The design and actual standard of protection varies.
- Along the River Soar, north of Sunny Dale. The design and actual standard of protection varies.

However, much of the proposed growth corridor is undefended.

Sharnford has an existing Property Level Flood Protection Scheme.

Natural Flood Management options along the River Sence are being investigated.

The proposed growth corridor is covered by three Environment Agency Flood Alert Areas: the River Wreak in Leicestershire, the Upper Soar Catchment and the River Sence in Leicestershire. The proposed growth corridor is covered by three Environment Agency Flood Warning Areas: the River Sence at Great Glen, the River Soar at Croft and the River Soar at Shanford including Croft Mill. The proposed growth corridor just encroaches on one other Environment Agency

Flood Warning Area: the Whetstone Brook at Whetstone.

Potential for future flood risk management

Whilst much of the land is undeveloped, the proposed growth corridor also covers or partially covers several urban settlements. Many watercourses flow through the proposed growth corridor and towards the Leicester City Principal Urban Area or towards the River Sence and Great Glen. Leicester and Great Glen have a well-documented history of flooding from fluvial, surface water and sewer sources. The mapping also shows that parts of Leicester and Great Glen are at risk of flooding from fluvial and / or surface water sources.

As such, development in the proposed growth corridor covers could provide opportunities to implement strategic solutions, to improve flood risk in the area and in downstream locations, notably in Leicester City.

Natural Flood Management (NFM) options are already being investigated along the River Sence by the Trent Rivers Trust and its partners. The Environment Agency are also reviewing NFM measures in this proposed growth corridor, to reduce the flood risk downstream in Leicester. However, if development were to be built in this proposed growth corridor, NFM may not be the most suitable option to reduce flood risk and other measures, such as flood defences, may be more appropriate. The commissioning authorities should liaise with the Trent Rivers Trust and the Environment Agency to discuss what NFM options have been identified and to assess the feasibility of implementing these measures at the potential growth corridor. If NFM measures are not considered to be a viable option, other flood alleviation options should be considered e.g. flood defences.

Another measure which could be considered in the proposed growth corridor is the development of flood storage areas on the upper reaches of watercourses such as

- the Barkby Brook (its tributary), to hold back flows and reduce the volume of water continuing downstream, through Syston.
- the upper reaches of the River Sence, to hold back flows and reduce the volume of water continuing downstream, through Great Glen
- the Soar Brook and its tributaries, to hold back flows and reduce the volume of water continuing downstream into the River Soar, through Sharnford
- the upper reaches of the Whetstone Brook, to hold back flows and reduce the volume of water continuing downstream, through Whetstone.

Another measure is the use of SuDS techniques, to ensure post-development runoff rates are at a manageable and appropriate level and to reduce the risk of development increasing flood risk downstream.

Strategic flood risk opportunities in this area may require cross-boundary partnership working with Charnwood Borough Council, Harborough District Council, Leicester City Council, Oadby and Wigston Borough Council and Blaby District Council.

Miscellaneous site information

- The proposed growth corridor is:
 - not located within a Groundwater Source Protection Zone;
 - entirely located within a Surface Water Nitrate Vulnerability Zone (proposed 2017 Nitrate Vulnerability Zone, ref S309); and,
 - is partially located within the sub-regional GI network.
- There are a number of historic landfill sites scattered across the proposed growth corridor:
 - One is located immediately west and south-west of the Ridgemere Lane and Barkby Road / Queniborough Road junction.
 - One is located off Covert Lane, east of Scraptoft and near Quorn Villa.
 - One is located in Thurnby.
 - Two are located in Oadby.
 - Seven are clustered between Green acres and Wigston Harcourt
 - Four are located around Cosby and Countesthorpe
 - One is located at the M1 / A426 interchange to Holt Lane
 - Five are located in Stoney Stanton
 - Two are located east of Sapcote
 - One is located at Mill on the Soar
 - Two are located at / near Aston Flamville
 - One is located off the B4114 Coventry Road, south of Sharnford

If development is located near / on a historic landfill site, this could have implications for the suitability of certain types of SuDS techniques.

- For watercourses where the WFD overall status has been recorded, nearly all of these have a moderate overall status, with exception of the Burton Brook (referred to as the Burton Brook from its source to the River Sence in the WFD dataset) which has a poor overall WFD status. The watercourses in the proposed growth corridor do not have a WFD overall status. It is important that development in the proposed growth corridor aim to take positive measures to conform to the WFD, which can be impacted because of development, for example in terms of 'deterioration' in ecological status or potential. Development should consider the quality of the water that is released from sites and the impact it may have on the water quality on any receiving waterbodies. Opportunities to improve the status of watercourses should also be considered, particularly along the Burton Brook. All other watercourses in the proposed growth corridor do not have a WFD overall status.

F.4 AREA 4: Melton Mowbray

Proposed growth area (Melton Mowbray)
<p>The proposed growth area is centred on the eastern part of Melton Mowbray, in Melton borough. The interactive map ref: SFRA_F04 relates to this proposed growth area.</p>
Fluvial Flood Risk
<p>The River Wreake and Thorpe Brook presents the main fluvial flood risk to the proposed growth area, particularly around the confluence of the two watercourses where the Flood Zones are comparatively wide. The Thorpe Brook may flood independently of the River Wreake and / or if their peaks coincide, flooding could be from both watercourses in the proposed growth area. An un-named brook to the south of the proposed growth area, which flows to the Burton Brook, also presents a fluvial flood risk to the proposed growth area.</p> <p>There are several, un-named watercourses in the proposed growth area which are not included in the Environment Agency's Flood Zone 2 and 3 coverage. These watercourses primarily drain towards the River Wreake. Further modelling and investigation may be required to identify the Flood Zone coverage of these watercourses and the impacts of climate change as part of site-specific Flood Risk Assessments.</p> <p>The River Wreake is classed as a Main River in the proposed growth area. The Thorpe Brook is classed as a Main River from 476674 320370. Upstream, it is classified as an ordinary watercourse. All other watercourses in the proposed growth area, are classified as ordinary watercourses.</p>
Surface Water Flood Risk
<p>The mapping shows surface water flood risk in the proposed growth area generally follows similar flow paths to watercourses, particularly the River Wreake and the Thorpe Brook. The risk is predominantly confined to these flow paths during the 3.3% AEP event. Surface water starts to pond on local roads in Melton Mowbray during the 1% AEP event. In the 0.1% AEP event, there are several overland flow paths along normal dry valleys in the proposed growth area. Due to the nature of the topography, there is little surface water ponding shown on the mapping in hillside areas to the south of Melton Mowbray and north of Melton Mowbray; the mapping indicates that it is more likely that there will be surface water runoff from these areas, entering local watercourses.</p>
Groundwater Flood Risk
<p>The AStGW flooding mapping indicates that the proposed growth area is within the <25% category and the $\geq 25\%$ <50% category.</p>
Reservoir Flood Risk
<p>The proposed growth area is shown to be at risk of flooding if the Stapleford Lake, the Brentingby Flood Storage Reservoir and / or the Scalford Brook Reservoir were to fail. The consideration of the residual risk posed by these reservoirs should be considered as part of site-specific Flood Risk Assessments. Considering the proximity of these reservoirs to the proposed growth area, there would be very limited time, if any, to respond to a reservoir breach.</p>
Flood risk from other sources
<p>There are no canals in the proposed growth area. However, the 2015 SFRA for Melton Mowbray notes that Melton Mowbray flooded from a canal in 2001.</p> <p>The Water and Sewerage Company which covers this proposed growth area is Severn Trent Water. Severn Trent Water's risk register shows several records of sewer flooding across Melton Mowbray and indicates that sewer flooding has historically occurred quite frequently in the town.</p>

Previous and known flooding issues

Historically, Melton borough has a well-documented history of flooding from fluvial and surface water sources and has a recorded incident of groundwater flooding through hillside fissures.

There is also a record of flooding in Thorpe Arnold. However, this record was taken from Fire and Rescue data and the source of flooding and magnitude of the event were not stated. Thus, this record may be an isolated incident.

The Scalford Brook which flows into Melton Mowbray, is known to have flooded in 1947, 1969 and 1975.

The 2014 Melton SFRA identified recorded incidents of groundwater flooding in Melton Mowbray, following the egression of groundwater through hillside fissures and the generation of overland flow.

Whilst the historic records listed above either affected Melton Mowbray or Thorpe Arnold, it is not known if these events affected the proposed growth area.

The proposed growth area is located within the 1977, 1998 and 2000 flood extents of the River Wreake in the Environment Agency's Historic Flood Map.

Changes to flood risk in the future

Climate change is likely to:

- Increase storm intensities.
- Climate change may increase the depth, velocity or hazard of fluvial flooding
- Climate change may also increase the extent, depth and frequency of surface water flooding

Where detailed hydraulic models were supplied for use in the assessment, climate change modelling for the watercourses in study area was undertaken based on the new climate change guidance. Appendix H for the SFRA provides details on the detailed models used in the assessment.

The detailed model of the River Wreake is relatively sensitive to increased flows due to climate change; extents are shown to increase within the proposed growth area, as higher climate change allowances are applied. By comparison the detailed model of the Thorpe Brook and un-named tributary of the River Wreake, are relatively insensitive to increased flows due to climate change; extents do not increase significantly based on the climate change allowance used. However, it is important to note that although the flood extent may not increase noticeably on some watercourses, the flood depth, velocity and hazard may increase compared to the 1% AEP current day event.

There is no climate change modelling covering the remaining, un-named watercourses within the proposed growth area. Developers should develop detailed hydraulic models as part of a site-specific Flood Risk Assessment and include climate change in the assessment.

Current flood risk management infrastructure

There are two defences shown in the Environment Agency's Raised Flood Defences dataset, located along the Thorpe Brook at Melton Mowbray. The design standard of protection is recorded as 0. However, one embankment is recorded to have a current standard of protection of 1:100-years.

There are existing Flood Alleviation Schemes along the River Wreake, reducing the fluvial flood risk to Melton Mowbray.

The proposed growth area is partially covered by an Environment Agency's Flood Alert Area: the River Wreake in Leicestershire. It is also partially covered by an Environment Agency's Flood Warning Area: River Wreake at Melton Mowbray.

Potential for future flood risk management

The potential growth area is centred on Melton Mowbray and covers a mixture of urban and undeveloped land. Many watercourses which flow through the proposed growth area join the River Wreake at their confluences in and around Melton Mowbray. Asfordby is also located downstream of Melton Mowbray. The mapping shows Asfordby to be at risk from fluvial and surface water sources.

There have already been investments in flood alleviation schemes for Melton Mowbray. There are also several flood storage areas along the River Wreake and a flood storage area on the Scafford Brook. Therefore, the creation of further flood storage areas may not be practical in this case.

Melton Mowbray has a well-documented history of surface water flooding; any increases in surface water runoff following development in the proposed growth area must be managed accordingly, to reduce the risk of increasing flooding downstream in Melton Mowbray. Further, any potential discharge points from SuDS into the watercourses needs to consider the impact of any additional discharge. There are several flood storage areas associated with Flood Alleviation Schemes; additional discharge could contribute to excess flow entering flood storage areas and could risk water exceeding the design capacity more quickly, thereby reducing their effectiveness.

The Thorpe Brook flows in a straight line from Thorpe Road, to its confluence with the River Wreake, indicating it may be heavily modified in this area. There may be opportunities to re-naturalise the watercourse in this area, to introduce a more natural morphology, which could reduce the time to peak / rate of flow. Further, structures could be removed or alternated to increase watercourse capacity. However, the floodplain in this area is largely urbanised which may limit opportunities to re-naturalising the watercourse.

Miscellaneous site information

- The proposed growth area is:
 - not located within a Groundwater Source Protection Zone (there is a Groundwater Source Protection Zone located immediately west of the M1 area);
 - entirely located within a Surface Water Nitrate Vulnerability Zone (proposed 2017 Nitrate Vulnerability Zone, ref S309) and,
 - is partially located within the sub-regional GI network.
- There is one historic landfill site, located in Thorpe Arnold, in the M1 area. If development is located near / on this historic landfill site, this could have implications for the suitability of certain types of SuDS techniques.
- The Thorpe Brook Catchment has a moderate WFD overall status. The River Wreake (Eye) (referred to in the WFD dataset as the River Wreake (Eye) from Langham Brook to the River Soar) have a poor WFD overall status. It is important that development in the proposed growth area aim to take positive measures to conform to the WFD, which can be impacted because of development, for example in terms of 'deterioration' in ecological status or potential. Development should consider the quality of the water that is released from sites and the impact it may have on the water quality on any receiving waterbodies. Opportunities to improve the status of watercourses, particularly along the River Wreake (Eye), should also be considered.

F.5 AREA 5: Lutterworth

Proposed growth area (Lutterworth)
<p>The proposed growth area is centred on Lutterworth in Harborough District.</p> <p>The interactive map ref: SFRA_F07 relates to this proposed growth area.</p>
Fluvial Flood Risk
<p>The upper River Swift and its tributaries (un-named watercourses) present the main fluvial flood risk to the proposed growth area. The Flood Zones of these watercourses are narrow throughout much of this area.</p> <p>Flood Zone 3b has been identified along the River Swift, from downstream of the M1 road bridge, near junction 20; upstream of the bridge, Flood Zone 3b has not been identified. Flood Zone 3b has not been identified for any other watercourse in the proposed growth area. Further modelling may be required to identify or verify Flood Zone 3b and the impacts of climate change, as part of site-specific Flood Risk Assessments.</p> <p>There are a few, un-named watercourses in the proposed growth area which are not included in the Environment Agency's Flood Zone 2 and 3 coverage. These watercourses primarily drain towards the River Swift and its tributaries. Further modelling and investigation may be required to identify the Flood Zone coverage of these watercourses and the impacts of climate change as part of site-specific Flood Risk Assessments.</p> <p>The River Swift is classified as Main River downstream of the M1 road bridge, near junction 20; upstream of the bridge, the watercourse is classified as an ordinary watercourse. All watercourses in the proposed growth area are classified as ordinary watercourses.</p>
Surface Water Flood Risk
<p>The mapping shows surface water flood risk in the proposed growth area generally follows similar flow paths to watercourses. In the 3.3% AEP and 1% AEP events, the risk is largely confined to these flow paths, with isolated instances of surface water ponding on open spaces. Surface water ponding is also shown along local roads at Bitteswell, in the H3 area, during the 1% AEP event. In the 0.1% AEP event, the mapping indicates that surface water extents are quite wide along these flow paths.</p>
Groundwater Flood Risk
<p>The AStGW flooding mapping indicates that Lutterworth and areas covered by flow path of the River Swift are more susceptible to groundwater flooding and are either within the $\geq 25\%$ $< 50\%$ category, or the $\geq 50\%$ $< 75\%$ category. Immediately west of Lutterworth, the area is largely within $< 25\%$ category.</p>
Reservoir Flood Risk
<p>The proposed growth area is not shown to be in an area at risk of flooding from a reservoir failure.</p>
Flood risk from other sources
<p>There are no canals in the proposed growth area.</p> <p>The Water and Sewerage Company which covers this proposed growth area is Severn Trent Water. Severn Trent Water's risk register has recorded one incident of sewer flooding in the LE17 6 post-code area (Lutterworth).</p>

Previous and known flooding issues
<p>There are three records of flooding in Lutterworth. However, no historical records of flooding in the proposed growth area have been found in this assessment.</p> <p>Insufficient capacity of the drainage system following heavy rainfall events is a known issue in Lutterworth; the 2008 SFRA for Harborough District identified Lutterworth as a location with frequently historic sewer flooding. However, it is not known if these issues extend to surrounding land covered by the proposed growth area.</p> <p>The proposed growth area is partially located within the September 1992 flood extent of the River Swift in the Environment Agency’s Historic Flood Map.</p>
Changes to flood risk in the future
<p>Climate change is likely to:</p> <ul style="list-style-type: none"> • Increase storm intensities. • Climate change may increase the depth, velocity or hazard of fluvial flooding • Climate change may also increase the extent, depth and frequency of surface water flooding <p>Where detailed hydraulic models were supplied for use in the assessment, climate change modelling for the watercourses in the study area was undertaken based on the new climate change guidance. Appendix H for the SFRA provides details on the detailed models used in the assessment.</p> <p>The detailed model of the River Swift is relatively insensitive to increased flows due to climate change; extents do not increase significantly based on the climate change allowance used. However, it is important to note that although the flood extent may not increase noticeably on some watercourses, the flood depth, velocity and hazard may increase compared to the 1% AEP current day event.</p> <p>There is no climate change modelling covering all other watercourses within the proposed growth area. Developers should develop detailed hydraulic models as part of a site-specific Flood Risk Assessment and include climate change in the assessment.</p>
Current flood risk management infrastructure
<p>Watercourses in the proposed growth area are undefended.</p> <p>The proposed growth area is partially covered by an Environment Agency Flood Alert: Upper Avon, River Swift and Clay Coton Brook. The proposed growth area is not covered by a Flood Warning Area.</p>
Potential for future flood risk management
<p>The potential growth area covers primarily rural land, surrounding the urban settlement of Lutterworth. The mapping shows that many of the watercourses in the proposed growth area flow towards the River Swift and its tributaries; many of these watercourses flow around the outskirts of Lutterworth. Lutterworth has known surface water and sewer flooding issues.</p> <p>Development in the potential growth area could provide opportunities to implement strategic solutions to improve flood risk in this area and in Lutterworth. One measure could be to investigate whether the drainage network in Lutterworth contributes towards the surface water flood risk; if so, a developer contributor scheme could be established to help upgrade and improve the surface water network in Lutterworth.</p> <p>Another measure is the use of SuDS techniques, to ensure post-development runoff rates are at a manageable and appropriate level and to reduce the risk of development increasing flood risk downstream.</p>

Miscellaneous site information

- The proposed growth area is:
 - not located within a Groundwater Source Protection Zone;
 - entirely located within a Surface Water Nitrate Vulnerability Zone (proposed 2017 Nitrate Vulnerability Zone, ref S590); and,
 - not located within the sub-regional GI network.
- There are three historic landfill sites located around the peripheries of Lutterworth; one historical landfill site is located to the north of the town, near the M1. The remaining two historic landfill sites are located to the south-west of the town, south of the A4303.
- The River Swift (referred to in the WFD dataset as the River Swift from its sources to its confluence with the River Avon) has a moderate WFD overall status. It is important that development in the proposed growth area aim to take positive measures to conform to the WFD, which can be impacted because of development, for example in terms of 'deterioration' in ecological status or potential. Development should consider the quality of the water that is released from sites and the impact it may have on the water quality on any receiving waterbodies. Opportunities to improve the status of watercourses should also be considered. All other watercourses in the proposed growth area do not have a WFD overall status.

F.6 AREA 6: Six Hill

Area (Six Hills Development Site)
<p>The proposed development site is known as Six Hills and is located on a triangle of land between the A46 / A46006 interchange, the A46 / B676 interchange and the Six Hills Lane / A6006 cross roads.</p> <p>The interactive map ref: SFRA_F03 relates to this proposed development site.</p>
Fluvial Flood Risk
<p>The proposed development site is shown to be located in Flood Zone 1. However, the headwaters of the Kingston Brook and a number of un-named watercourses flow through the proposed development site which are not included in the Environment Agency's Flood Zone 2 and 3 coverage. As such, whilst the site is shown to be located in Flood Zone 1, these watercourses could present a flood risk. Further modelling and investigation may be required to identify the Flood Zone coverage and the impacts of climate change of these watercourses as part of a site-specific Flood Risk Assessment.</p> <p>All watercourses in the proposed development site are classified as ordinary watercourses.</p>
Surface Water Flood Risk
<p>The mapping shows surface water flood risk in the proposed development site generally follows similar flow paths to watercourses. In the 3.3% AEP and 1% AEP events, the risk is largely confined to these flow paths, with isolated instances of surface water ponding on open spaces. In the 0.1% AEP event, the mapping indicates that surface water extents are wider along these flow paths and that there is potential runoff from higher areas towards the flow paths of watercourses.</p>
Groundwater Flood Risk
<p>The AStGW flooding mapping indicates that the entire proposed development site falls within the <25% category, suggesting it is less susceptible to groundwater.</p>
Reservoir Flood Risk
<p>Much of the proposed development site is at risk of flooding if the Ragdale reservoir were to fail. The consideration of the residual risk posed by these reservoirs should be considered as part of site-specific Flood Risk Assessments. Considering the proximity of this reservoir to the proposed site, there would be very limited time, if any, to respond to a reservoir breach.</p>
Flood risk from other sources
<p>There are no canals in the proposed development site.</p> <p>There are lakes within the proposed development site. The connectivity of these lakes is unknown. The DRN suggests that these could be connected to nearby un-named watercourses. The risk posed by these lakes may need to be investigated as part of a site-specific Flood Risk Assessment.</p> <p>The Water and Sewerage Company which covers this proposed growth area is Severn Trent Water. Severn Trent Water's risk register has no records of sewer flooding at the proposed development site.</p>

Previous and known flooding issues
<p>The SFRA historic flood records did not show any instances of recorded flooding at the proposed development site; the proposed development site is not located within any extents shown in the Environment Agency's Historic Flood Map.</p>
Changes to flood risk in the future
<p>Climate change is likely to:</p> <ul style="list-style-type: none"> • Increase storm intensities. • Climate change may increase the depth, velocity or hazard of fluvial flooding • Climate change may also increase the extent, depth and frequency of surface water flooding <p>Where detailed hydraulic models were supplied for use in the assessment, climate change modelling for the watercourses in study area was undertaken based on the new climate change guidance. Appendix H for the SFRA provides details on the detailed models used in the assessment. There is no climate change modelling covering watercourses within the proposed development site. Developers should develop detailed hydraulic models as part of a site-specific Flood Risk Assessment and include climate change in the assessment.</p>
Current flood risk management infrastructure
<p>Watercourses in the proposed development site are undefended.</p> <p>The proposed development site is not covered by an Environment Agency Flood Alert or Warning Area.</p>
Potential for future flood risk management
<p>The proposed development site covers primarily rural land, with a few isolated properties. The site is not located immediate upstream of an urban settlement. The mapping shows that many of the watercourses in the proposed development site flow northwards, away from the site and continue through rural and primarily undeveloped land.</p> <p>There are limited urban areas downstream of the site and there is undeveloped floodplain downstream. The main opportunity to implement strategic solutions to improve flood risk in this area is through the use of SuDS techniques, to ensure post-development runoff rates are at a manageable and appropriate level and to reduce the risk of development increasing flood risk downstream.</p>
Miscellaneous site information
<ul style="list-style-type: none"> • The proposed development site is: <ul style="list-style-type: none"> ○ not located within a Groundwater Source Protection Zone; ○ entirely located within a Surface Water Nitrate Vulnerability Zone (proposed 2017 Nitrate Vulnerability Zone, ref S309); and, ○ not located within the sub-regional GI network. • There are no historic landfill sites in the proposed development site. • No overall WFD status has been recorded for watercourses which flow through the proposed development site. However, the Kingston Brook (referred to as the Kingston Brook catchment, tributary of the River Soar in the WFD dataset) has a poor overall WFD status. It is important that development in the site aims to take positive measures to conform to the WFD, which can be impacted because of development, for example in terms of 'deterioration' in ecological status or potential. Development should consider the quality of the water that is released from sites and the impact it may have on the water quality on any receiving waterbodies. Opportunities to improve the status of watercourses should also be considered, particularly along the Kingston Brook.