

Huntingdonshire Integrated Water Management Study Appendix G

Catchment-level assessment of Cumulative Impacts of Development on Flood Risk

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1 Introduction

Cumulative impacts are defined as the effects of past, current and future activities on the environment. The below assessment is a catchment based approach, which indicates potential cumulative impacts on the Huntingdonshire District Council (HDC) study are. These cumulative impacts may be negative, such as development leading to an increase in the existing level of flood risk within a catchment. They may also be positive, such as effective surface water management within a development site helping to alleviate existing flooding issues within a catchment.

To understand the impact of future development on flood risk in Huntingdonshire, historic flood risk data has been compared with potential changes in developed area within each river catchment defined within the Water Framework Directive (WFD). This identifies the catchments where development may have the greatest impact on flood risk, and therefore where further assessment would be required within a site-specific Flood Risk Assessment (FRA).

Where catchments have been identified as sensitive to the cumulative impact of development, the assessment concludes with potential strategic planning policy suggestions to manage the risk.

2 Method

2.1 Cumulative impact assessment

2.1.1 Cumulative impact of development: assessing existing and future development scenarios

To ensure that the strategic policies of the Local Plan consider the impact of any future development on areas susceptible to flooding, the potential development pressures during the Local Plan period need to be considered. The cumulative impact of development on the water supply and wastewater infrastructure is considered within the Stage 1 Water Cycle Study (WCS).

The impact of development is assessed by establishing a growth scenario of development already committed prior to the Local Plan, as well as the potential future development pressures during the Local Plan period.

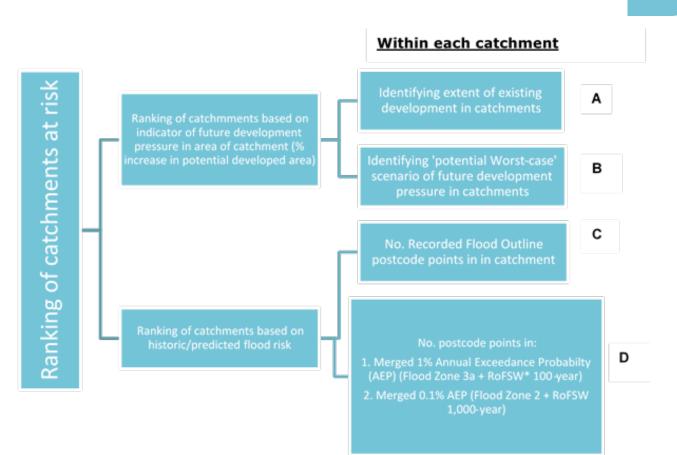
It should be noted that the inclusion of potential future development pressures makes the scoring method sensitive to future change, should any larger sites be removed, or additional sites come forward. However, it provides the best possible indication of development pressure across Huntingdonshire at the time of assessment.

The assessment is undertaken on a river catchment scale, using catchments defined by the Water Framework Directive (WFD). Several of the WFD catchments assessed within the cumulative impact assessment cross administrative boundaries into neighbouring districts. To account for this in the study, all neighbouring councils were contacted to provide information of future development within their administrative area. The councils are:

- City of Peterborough Council
- North Northamptonshire Council
- Bedford Borough Council
- Central Bedfordshire Council
- South Cambridgeshire District Council
- East Cambridgeshire District Council
- Fenland District Council

The site data received from these councils was combined with that of Huntingdonshire District Council to understand the risk to each WFD catchment, based upon potential future growth.

The approach to understanding the catchments most influenced by the cumulative impact of development is conceptualised in Figure 2-1.



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*Risk of Flooding from Surface Water (RoFSW)

Figure 2-1 Overview of the method used in the Cumulative Impacts Assessment

A. Existing development scenario

To understand the level of existing development within the study area, the 2022 residential and non-residential committed development sites for Huntingdonshire and the neighbouring authorities were used. The data describes areas of ongoing or committed development in Huntingdonshire and each of the neighbouring authorities, which represented the existing development area within each catchment. It should be noted that site commitment polygon data was not available for Peterborough, North Northamptonshire and Bedford. Caution should be taken with the results **for** catchments shared between HDC and these authority areas as results may be skewed.

B. Indicator of Development pressure

To understand which catchments within Huntingdonshire are likely to experience the greatest pressure for future growth, all sites which were either allocated or preferred for allocation within the Local Plan for Huntingdonshire and the neighbouring authorities were analysed.

This analysis has been used as an indicator of areas likely to be subject to the greatest development pressure in future. This is the only spatial data indicator available at the time of preparing the assessment because definitive development areas have not yet been allocated within all Local Plans within the study area.

The data allows calculation of the overall area of sites within each catchment which are either proposed, or submitted to each Local Planning Authority to consider, for allocation within the Local Plan, illustrating the relative pressures on the catchments. This data is used, with the existing development extent, to identify catchments likely to be under the greatest pressure for development. The percentage total proposed area of development is calculated and ranked with the catchment with the highest proportion of growth ranked as '1'.

| Dataset | Coverage | Source of data | Use of data | |
|--|--|--|--|--|
| Data used to define | river catchments | | | |
| Catchment boundaries | Huntingdonshire study area | Water Framework Directive (WFD) catchments | Existing development / flood risk | |
| Data used to estimat | e future development | pressure | | |
| Huntingdonshire Committed Developments 2023 | Huntingdonshire study area | Huntingdonshire District Council | Existing development | |
| Sites received for consideration to allocate in Local Plan | Huntingdonshire study area | Huntingdonshire District Council | Indicator of relative development pressure | |
| Neighbouring authority Local Plan allocations and committed developments | Catchments covering the Huntingdonshire study area | the Huntingdonshire Greater | | |
| Data used to rank ca | tchments by flood risk | (| | |
| Merged 1 in 100- year flood extent (Flood Zone 3a and 1 in 100-year RoFSW extent) | Catchments covering the Huntingdonshire study area | Environment Agency (EA) | Potential fluvial and surface water flood risk | |
| Merged 1 in 1000- year flood extent (Flood Zone 2 and 1 in 1000-year RoFSW extent) | Catchments covering the Huntingdonshire study area | Environment Agency (EA) | Potential future fluvial and surface water flood risk | |
| Recorded Flood Outline (fluvial flood risk) | Catchments covering the Huntingdonshire study area | Environment Agency (EA) | Historic fluvial flooding | |

Table 2-1 Summary of datasets used within Cumulative Development Scenario

| Dataset | Coverage | Source of data | Use of data |
|---|--|----------------------------------|--|
| OS Code Point Open postcode points - plotted at the average co- ordinates representative of all individual addresses within a particular postcode | Catchments covering the Huntingdonshire study area | Ordnance Survey (Open source) | Proxy for number of properties at risk |

2.1.2 Cumulative impact of flood risk: assessment of flood risk

A composite flood risk score is derived for each catchment, by taking an average ranking of both recorded fluvial risk (historic incidents) and modelled (predicted) fluvial and surface water flood risk.

To understand the relative flood risk within the catchments, a ranking system is adopted, with the worst-case flood risk numbered '1'.

C. Historic flood risk

Data used in assessment:

- EA Recorded Flood Outline (number of property postcode points affected) flood extents mapped following flood events (largely relates to fluvial flooding). This is intersected with postcode points, to approximate the number of properties affected.
- D. Sensitivity to increases in flood flows

Data used in assessment:

- Present day risk: Merged fluvial and surface water 1 in 100-year (1% AEP) flood extent Flood Zone 3a and RoFSW 100-year (number of postcode points at risk within catchment).
- Future risk: Merged fluvial and surface water 1 in 1,000-year (0.1% AEP) flood extent Flood Zone 2 and RoFSW 1000-year (number of postcode points at risk within catchment).
- Postcode point data is used to identify properties within the Huntingdonshire study area.
- The postcode data is separately intersected with the Present day (1 in 1,000year) and Future (1 in 100-year) risk merged fluvial and surface water flood extents, to approximate the increase in the number of properties at risk of flooding. The flood extents are merged to prevent double counting of properties at risk where fluvial and surface water flood risks overlap.
- The difference between the Present and Future risk is then calculated and given as a percentage of the total number of OS Code Point Open points in the catchment. This gives an indication of which catchments are most sensitive to

increases in surface water runoff from upstream. For example, if there were 100 postcode points in a catchment, 15 within the 1 in 1,000-year merged flood extent and 5 within the 1 in 100-year merged flood extent, 10% of properties in that catchment are considered sensitive to increased flood risk.

- The assessment is an indicator of where local topography makes an area more sensitive to increases in flood risk. This may be due to any number of reasons, including climate change, new development etc. It is not an absolute figure or prediction of the impact that new development will have on flood risk.
- It should be noted that the Flood Zones represent flood risk from watercourses designated by the Environment Agency as Main Rivers, with a catchment area greater than 3km². There is no national dataset of flood risk mapping from smaller, ordinary watercourses. However, as the RoFSW mapping identifies the lowest points in the topography which includes the river floodplains, it can be used as a proxy to represent fluvial flood risk from ordinary watercourses. This approach has been used within the cumulative impacts assessment.

2.1.3 Assessment assumptions and limitations

Table 2-2 sets out the assumptions and limitations of the cumulative impacts assessment.

| Assessment aspect | Assumption made | Details of limitation in method | Justification |
|-------------------------|--|--|--|
| Development pressure | Assumption of housing density and impermeable areas | Where potential development densities were not known for the sites, it is assumed that 70% of the site area would contribute surface water runoff to the wider catchment. This takes into account a 30% allowance for landscaping and requirements for SuDS within sites, which lessens the impacts of new development. | With housing densities and proportions of undeveloped areas not known, the approach aims to provide a more realistic indication of site development in the growth scenario. |

Table 2-2 Assumptions and limitations of the assessment

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|---------|-------------------|
| ication | |

| Assessment aspect | Assumption made | Details of limitation in method | Justification |
|-------------------------|--|--|--|
| Development pressure | Current site use assumed to be greenfield (undeveloped) | The current use of the sites (e.g. greenfield/brownfield) is sometimes undefined. Brownfield sites are likely to have a less significant impact on flood risk as they have previously been developed. Therefore, in absence of this information, a 'worst case' assessment is produced, which assumes that all sites are greenfield (undeveloped), and may overestimate the risk within each catchment. | The assessment considers the 'worst case' development scenario, that all sites were greenfield (undeveloped) prior to growth. With the former land uses for each site not known, the approach overestimates the potential impact, but this is a precautionary approach. |
| Flood risk | Overlap between fluvial and surface water flood extents | The Risk of Flooding from Surface Water mapping identifies the lowest points in the landscape, and therefore low-lying river floodplains are also classified as being at surface water risk. This can lead to 'double counting' of flood risk. | To prevent double counting, the Flood Zone and Risk of Flooding from Surface Water datasets are merged, to create a composite flood risk layer, with any overlapping areas dissolved. |

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| Flood risk | Use of OS Code Point Open postcode point data to represent properties affected by historic/predicted flood risk | As postcode points represent the average location of all properties within a postcode area, there may be properties at the edges of a catchment or the study area which are counted within the neighbouring area, or not picked up at all. | The postcode points are an available open source dataset. Postcode area sizes are also relative to the density of properties in a location, providing better data coverage in areas where a greater number of properties were likely to be affected. |
|------------|--|---|--|

2.1.4 Ranking the results

The results are ranked for each of the above assessments and these rankings are combined to give an overall ranking. A Red Amber Green (RAG) rating is then applied to the catchments, with red being high risk, amber being medium risk, and green being low risk (as shown in Table 2-3).

| Dradiated flood risk | Potential growth ranking | | | | |
|---------------------------------|--------------------------|--------|-------------|--|--|
| Predicted flood risk ranking | High (0-7) | | Low (14-29) | | |
| High | High | High | Medium | | |
| Medium | High | Medium | Low | | |
| Low | Medium | Low | Low | | |

Specific policies are provided for each resulting risk category. Catchment-specific planning policy considerations are identified for the catchments where cumulative development is likely to have the greatest impact on flood risk to communities. The overall analysis provides context for further appropriate consideration of catchment-scale flood risk issues.

In addition to assessment at a Strategic Flood Risk Assessment (SFRA) level, it is recommended that site-specific Flood Risk Assessments (FRAs) are required to include consideration of the cumulative effects of the proposed development. It should be

demonstrated that flood risk downstream will not be made worse by the combination of effects from more than one development allocation.

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A map of the RAG rating for each catchment is shown in Figure 2-2 and a summary of the results is shown in Table 2-4, Table 2-5 and Table 2-6. Specific policies are provided for each resulting risk category.

The catchments rated as at high sensitivity to the cumulative impacts of development are:

- Abbotsley and Hen Brooks
- Ouse (Roxton to Earith)
- Alconbury and Brampton Brooks
- West Brook
- Marley Gap Brook
- Colmworth Brook
- Fen Drayton Drain

The catchments rated as medium sensitivity to the cumulative impacts of development are:

- Alconbury Brook
- Bury Brook
- Bourn Brook
- Diddington Brook
- Kym (and Til)
- Millbridge and Potton Brooks
- Middle Level

No growth or development was proposed in the following catchments. These catchments have been included in the cumulative impact assessment. However, they only represent sensitivity to flood risk and not growth:

- Pertenhall Brook
- Stanground Lode
- Counter Drain
- Nene Islip to tidal
- Ellington Brook
- Duloe Brook
- Stone Brook
- Thorpe Waterville Brook
- Hog Dyke
- Willow Brook (Nene)
- Kym
- Ellington Brook (Trib)
- Cock Brook
- Billing Brook
- Old Bedford River / River Delph

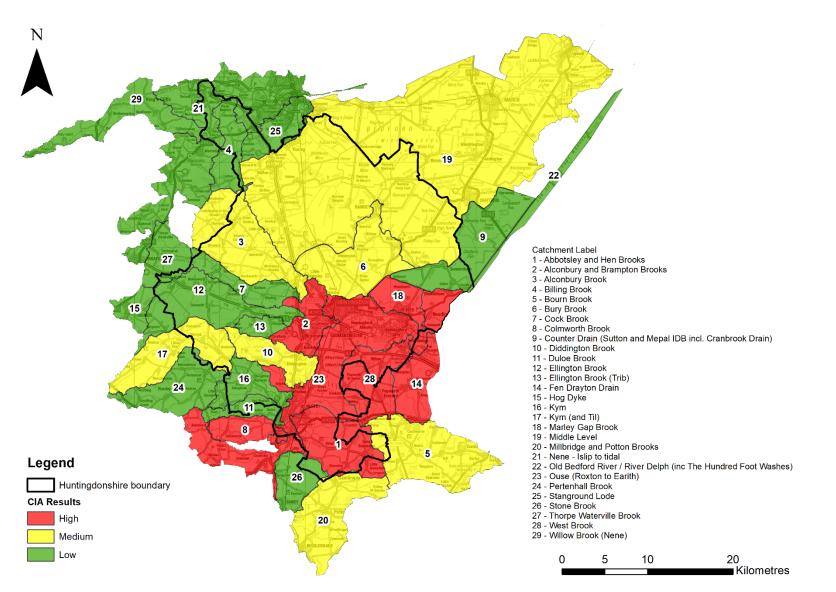


Figure 2-2 Sensitivity of catchments within and around Huntingdonshire to cumulative impacts

| Map label | Catchment Name | Drainage direction | Growth RAG score | % area of growth | Postcode points in historic flood outlines | % increase in properties at risk: 1 in 100 to 1 in 1,000- year flood extent | Flood Risk RAG score | Overall RAG score | Overall rank |
|--------------|--|---------------------------|------------------------|------------------------|--|---|----------------------------|-------------------------|-----------------|
| 1 | Abbotsley and Hen Brooks | Into Huntingdonshire | MEDIUM | 4.80% | 75 | 12.3% | HIGH | HIGH | 1 |
| 23 | Ouse (Roxton to Earith) | Out of Huntingdonshire | MEDIUM | 1.93% | 487 | 16.1% | HIGH | HIGH | 2 |
| 2 | Alconbury and Brampton Brooks | Into Huntingdonshire | HIGH | 9.14% | 7 | 11.7% | HIGH | HIGH | 3 |
| 28 | West Brook | Into Huntingdonshire | LOW | 0.91% | 15 | 6.2% | HIGH | HIGH | 4 |
| 18 | Marley Gap Brook | Out of Huntingdonshire | LOW | 0.47% | 14 | 8.2% | HIGH | HIGH | 5 |
| 8 | Colmworth Brook | Into Huntingdonshire | LOW | 0.14% | 10 | 9.3% | HIGH | HIGH | 6 |
| 14 | Fen Drayton Drain | Into Huntingdonshire | LOW | 0.68% | 4 | 3.9% | MEDIUM | HIGH | 7 |

Table 2-4 Results of cumulative impacts assessment (High Overall Rank)

| Map label | Catchment Name | Drainage direction | Growth RAG score | % area of growth | Postcode points in historic flood outlines | % increase in properties at risk: 1 in 100 to 1 in 1,000- year flood extent | Flood Risk RAG score | Overall RAG score | Overall rank |
|--------------|------------------------------------|---------------------------|------------------------|------------------------|--|---|----------------------------|-------------------------|-----------------|
| 3 | Alconbury Brook | Into Huntingdonshire | LOW | 0.64% | 20 | 0% | LOW | MEDIUM | 8 |
| 6 | Bury Brook | Into Huntingdonshire | HIGH | 8.67% | 0 | 2.6% | MEDIUM | MEDIUM | 9 |
| 5 | Bourn Brook | Out of Huntingdonshire | MEDIUM | 4.75% | 4 | 1.5% | LOW | MEDIUM | 10 |
| 10 | Diddington Brook | Into Huntingdonshire | LOW | 0.4% | 4 | 2.7% | MEDIUM | MEDIUM | 11 |
| 17 | Kym (and Til) | Into Huntingdonshire | LOW | 0.26% | 1 | 5.3% | HIGH | MEDIUM | 12 |
| 20 | Millbridge and Potton Brooks | Out of Huntingdonshire | MEDIUM | 4.5% | 0 | 2.5% | MEDIUM | MEDIUM | 13 |
| 19 | Middle Level | Out of Huntingdonshire | LOW | 0.94% | 0 | 2.9% | MEDIUM | MEDIUM | 14 |

Table 2-5 Results of cumulative impacts assessment (Medium Overall Rank)

| Map label | Catchment Name | Drainage direction | Growth RAG score | % area of growth | Postcode points in historic flood outlines | % increase in properties at risk: 1 in 100 to 1 in 1,000- year flood extent | Flood Risk RAG score | Overall RAG score | Overall rank |
|--------------|-------------------------------|---------------------------|------------------------|------------------------|--|---|----------------------------|-------------------------|-----------------|
| 24 | Pertenhall Brook | Into Huntingdonshire | LOW | 0% | 3 | 7% | MEDIUM | LOW | 15 |
| 25 | Stanground Lode | Out of Huntingdonshire | LOW | 0.15% | 3 | 4.3% | LOW | LOW | 16 |
| 9 | Counter Drain | Out of Huntingdonshire | MEDIUM | 1.39% | 0 | 1.2% | LOW | LOW | 17 |
| 21 | Nene - Islip to Tidal | Into Huntingdonshire | LOW | 0.11% | 66 | 3.2% | MEDIUM | LOW | 18 |
| 12 | Ellington Brook | Into Huntingdonshire | LOW | 0.36% | 2 | 1.9% | LOW | LOW | 19 |
| 11 | Duloe Brook | Into Huntingdonshire | LOW | 0.04% | 8 | 0% | LOW | LOW | 20 |
| 26 | Stone Brook | Out of Huntingdonshire | LOW | 0.55% | 0 | 0% | LOW | LOW | 21 |
| 27 | Thorpe Waterville Brook | Out of Huntingdonshire | LOW | 0% | 0 | 4% | LOW | LOW | 22 |
| 15 | Hog Dyke | Out of Huntingdonshire | LOW | 0% | 1 | 3.3% | LOW | LOW | 23 |

Table 2-6 Results of cumulative impacts assessment (Low Overall Rank)

| Catchment Name | Drainage direction | Growth RAG score | % area of growth | Postcode points in historic flood outlines | % increase in properties at risk: 1 in 100 to 1 in 1,000- year flood extent | Flood Risk RAG score | Overall RAG score | Overall rank |
|------------------------------|---------------------------|------------------------|------------------------|--|---|----------------------------|-------------------------|-----------------|
| Willow Brook (Nene) | Into Huntingdonshire | LOW | 0% | 0 | 3.7% | LOW | LOW | 24 |
| Kym | Into Huntingdonshire | LOW | 0.34% | 0 | 0% | LOW | LOW | 25 |
| Ellington Brook (Trib) | Into Huntingdonshire | LOW | 0.15% | 0 | 0% | LOW | LOW | 26 |
| Cock Brook | Into Huntingdonshire | LOW | 0.13% | 0 | 0% | LOW | LOW | 27 |
| Billing Brook | Out of Huntingdonshire | LOW | 0.07% | 0 | 0% | LOW | LOW | 28 |

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Old Bedford Out of

Huntingdonshire

2.1.5 Planning policy considerations

Catchment-specific planning policy considerations have been identified for the catchments where cumulative development is likely to have the greatest impact on flood risk to communities.

In addition to assessment at a SFRA level, it is recommended that site-specific FRAs are required to include consideration of the cumulative effects of the proposed development. It should be demonstrated that flood risk downstream will not be made worse by the combination of effects from more than one development allocation.

1. Considerations for all developments in Huntingdonshire

- Developments should seek betterment of existing flood risks both within the site and in surrounding areas. As a minimum, developments must meet national and local standards for Flood Risk Assessments and Surface Water Drainage Strategies. By looking at flood risks beyond the site boundary, developers should be encouraged to implement sustainable solutions which manage flood risk.
- New settlement areas should be accompanied by an overall Surface Water Drainage Strategy. This should cover:
 - How the cumulative impacts of potential peak rates and volumes of surface water runoff from development sites would impact on the peak flows, duration of flooding and timing of flood peaks on receiving watercourses. This should be used to develop and implement appropriate drainage sub-catchments for the management of surface water, as well as specific runoff rate and volume requirements for each phase of the development.
 - The risk of flooding from all sources, including for rainfall events greater than the design standard of the surface water drainage system should be taken into account. This is to ensure there is no flood risk to new properties and that exceedance flows in extreme events are safely routed around those properties.
 - The consideration of how SuDS, natural flood management techniques, green infrastructure and green-blue corridors can be designed into the development master plan to facilitate drainage flood risk management. As well as managing the quantity of water, they should also ensure the wider benefits of biodiversity, amenity, water quality and recreation are realised.
 - Based on the above, a drainage phasing plan aligned with the SuDS train method should be developed. Firstly, it should consider how water can be infiltrated / stored at a plot level, then conveyed through the site. It should also identify any regional storage needs at a settlement level.
 - The provision of drainage shall be based on the drainage phasing plan, to ensure adequate drainage is provided implemented throughout the lifetime of the development. This includes provision of adequate drainage during the



construction phase, to manage the risk of flooding, erosion and pollution during construction.

- Huntingdonshire District Council (as LPA), Cambridgeshire County Council (as LLFA), IDBs within HDC and the Environment Agency should be consulted during the development of the Surface Water Drainage Strategy.
- In upland and rural areas of the catchments, Natural Flood Management (NFM) techniques, such as woodland planting and earth bunds, can be used to slow down and store flood waters upstream of settlements.
- In urban and suburban locations, SuDS should be integrated into the site design, to manage the existing surface water flow paths on the site and to help mitigate the flood risks to downstream communities.
- Successive minor developments have the potential to significantly impact on existing surface water and flood risk issues, particularly as the LLFA is not currently consulted on these applications. Therefore, planning policy for minor developments should support existing Huntingdonshire Council guidance on the reduction of existing runoff rates, through the use of SuDS.
- Any development within the fluvial floodplain (i.e. Flood Zones 3b, 3a and 2) should provide suitable flood compensation storage, in consultation with the Environment Agency, to avoid a net loss in floodplain storage.
- The LLFA and other Risk Management Authorities (RMAs) should use the information in the SFRA to inform a long term pipeline of flood alleviation studies and schemes to determine where further developer contributions on / off site would be beneficial.

2. Planning considerations for medium sensitivity catchments

All new developments (other than minor extensions) in these catchments should:

- Incorporate SuDS and provide details of adoption, ongoing maintenance and management, in line with the Cambridgeshire SuDS Guidance. Preference will be given to above ground, vegetated SuDS, which contribute to the conservation and enhancement of biodiversity and green infrastructure in Huntingdonshire.
- Developments in these areas should be incentivised to provide wider betterment by being requested to demonstrate in site specific Flood Risk Assessments and Surface Water Drainage Strategies what measures can be put in place to contribute to a reduction in flood risk downstream. This may either be through provision of additional storage on site e.g. through oversized SuDS, natural flood management techniques, green infrastructure and green-blue corridors and/or by providing a Partnership Funding contribution towards a wider community scheme.
- Both greenfield and brownfield developments are to aim to achieve greenfield runoff rates and volumes in their post-development state.
- Surface Water Management Plans should be developed as required.



3. Planning considerations for higher sensitivity catchments

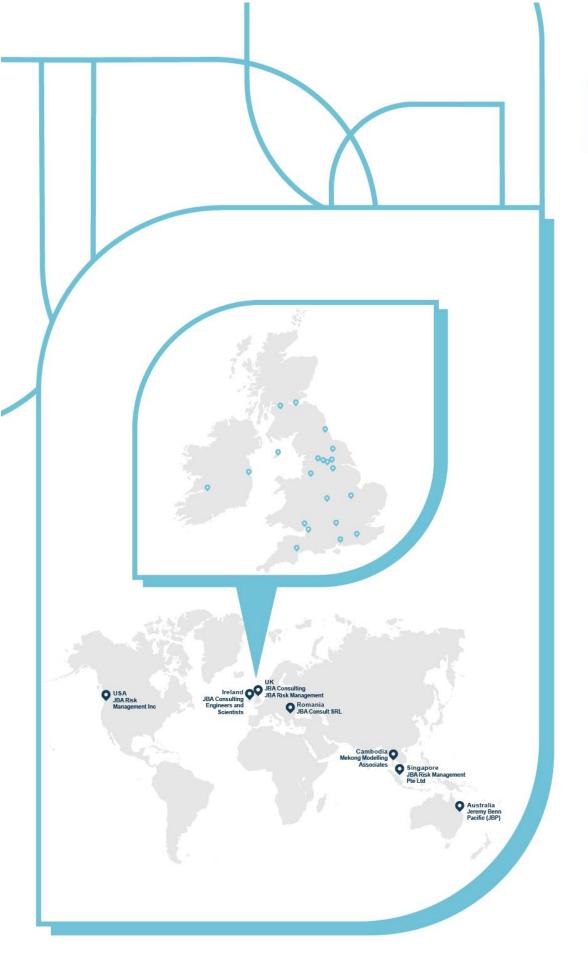
All new development (other than minor extensions) in these catchments:

- National and local flood risk planning policy must be stringently applied within these areas, with flood risk from all sources given the appropriate priority, particularly when applying the Sequential and Exception Tests.
- Both greenfield and brownfield developments to achieve 20% betterment over pre-development greenfield runoff peak flows¹ and volumes² in their post-development state, to counter cumulative impacts of development within the catchment.
- A Surface Water Drainage Strategy should be required for all developments in these catchments, regardless of development size. This would mean that a site-specific Flood Risk Assessment would be required for all developments, regardless of their size.
- The Environment Agency (EA) may designate higher sensitivity catchments as critical drainage areas as required. If a critical drainage area is identified, the Local Planning Authority (LPA) (supported by the Lead Local Flood Authority (LLFA)) should draft a policy within their Local Plan to manage flood risk from local sources in these catchments with critical drainage problems.
- For larger sites and strategic developments (e.g. new settlements and urban extensions):
 - The LLFA, Environment Agency and LPA should be consulted at preapplication stage.
 - The FRA should examine the cumulative impacts of proposed peak surface water runoff rates and volumes from across the site on the peak flows, duration of flooding and timing of flood peaks in receiving watercourses. This should include the impact of other developments within the WFD catchment, if appropriate, as advised by the LPA/LLFA.
 - A Surface Water Drainage Masterplan should be developed and implement appropriate drainage sub-catchments for the management of surface water, with specific runoff rate and volume requirements set for each sub-catchment, in line with the SuDS management train.
- Particular attention should be given to limiting runoff volumes to greenfield volume, with long-term storage to be provided where required. The timing of runoff released from the development site will need to be assessed against peak flow timings on the receiving watercourse, to ensure that discharges do not have a detrimental impact on downstream flood risk.
 - The timing of flows released from the development site will need to be assessed in the context of peak flows on the receiving watercourse.

¹ For the 1 in 1 year rainfall event and the 1 in 100 year rainfall event 2 For the 1 in 100 year, 6 hour rainfall event



- Every opportunity should be taken to infiltrate and/or store water at a plot level.
- Longer-term measures for managing flood risk should be considered, including river restoration and contributions to pipeline flood alleviation schemes.
- Where development sites receive runoff from, or drain towards, neighbouring authorities, the LPA should work closely with neighbouring LPAs and the LLFA to develop complementary Local Planning Policies on cumulative flood risk and sustainable drainage.





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