Level 1 Strategic Flood Risk Assessment

Final Report

Colchester City Council

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Quality information

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Abbreviations

Acronym	Definition
AEP	Annual Exceedance Probability
AIMS	Asset Information Management System
AMP	Asset Management Plan
AOD	Above Ordnance Datum
AW	Anglian Water
BGS	British Geological Survey
CBC	Colchester Borough Council
CCC	Colchester City Council
CDA	Critical Drainage Area
CFMP	Catchment Flood Management Plan
ECC	Essex County Council
FAS	Flood Alleviation Scheme
FCERM	Flood and Coastal Erosion Risk Management
FRA	Flood Risk Assessment
FRR	Flood Risk Regulations
FSA	Flood Storage Area
FWMA	Flood and Water Management Act
IDB	Internal Drainage Board
IUD	Integrated Urban Drainage
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
LFRMS	Local Flood Risk Management Strategy
NPPF	National Planning Policy Framework
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
RBD	River Basin District
RBMP	River Basin Management Plan
RFCC	Regional Flood and Coastal Committee
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
SOP	Standard of Protection

SWMP	Surface Water Management Plan
SuDS	Sustainable Drainage Systems
WFD	Water Framework Directive
WWNP	Working with Natural Processes

Glossary of Terms

Glossary	Definition
1D Hydraulic Model	Hydraulic model which computes flow in a single dimension, suitable for representing systems with a defined flow direction such as river channels, pipes and culverts.
2D Hydraulic Model	Hydraulic model which computes flow in multiple dimensions, suitable for representing systems without a defined flow direction including topographic surfaces such as floodplains.
Asset Information Management System (AIMS)	Environment Agency database of assets associated with Main Rivers including defences, structures and channel types. Information regarding location, standard of service, dimensions and condition.
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
Attenuation	In the context of this report - the storing of water to reduce peak discharge of water.
Catchment Flood Management Plan	A high-level plan through which the Environment Agency works with their key decisionmakers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Critical Drainage Area	A discrete geographic area (usually a hydrological catchment) where multiple or interlinked sources of flood risk cause flooding during a severe rainfall event thereby affecting people, property or local infrastructure.
Coastal Change Management Area	An area identified in plans as likely to be affected by physical change to the shoreline through erosion, coastal landslip, permanent inundation or coastal accretion.
Culvert	A channel or pipe that carries water below the level of the ground.
Design Flood	A flood event of a given annual probability against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed. The design event is generally taken as; a 1% AEP fluvial flooding event plus an appropriate allowance for climate change, a 0.5% AEP tidal flooding event plus an appropriate allowance for climate change, or a 1% AEP surface water flooding event plus an appropriate allowance for climate change.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are ‘at risk’ of sewer flooding more frequently than once in 20 years.
Exception Test	The Exception Test should be applied following the application of the Sequential Test. Conditions need to be met before the Exception test can be applied.
Flood Defence	Infrastructure used to protect an area against floods, such as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Resilience	Measures that minimise water ingress and promotes fast drying and easy cleaning, to prevent any permanent damage.
Flood Resistant	Measures to prevent flood water entering a building or damaging its fabric. This has the same meaning as flood proof.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption). Areas at risk of flooding are those at risk of flooding from any source, now or in the future. Flood risk also accounts for the interactions between these different flood sources.

Glossary	Definition
Flood Storage Area	Natural or man-made areas that temporarily fill with water during periods of high river level, retaining a volume of water which is released back into the watercourse after the peak river flows have passed.
Flood Zone	Flood Zones show the probability of flooding, ignoring the presence of existing defences.
Fluvial	Relating to the actions, processes and behaviour of a watercourse (river or stream).
Freeboard	The difference between the design flood level and the finished floor level of a development or soffit level of a bridge/culvert.
Functional Floodplain	Land where water has to flow or be stored in times of flood.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Lead Local Flood Authority (LLFA)	As defined by the Flood and Water Management Act, in relation to an area in England, this means the unitary authority or where there is no unitary authority, the county council for the area, in this case Essex County Council (ECC).
Local Planning Authority (LPA)	Body that is responsible for controlling planning and development through the planning system.
Main River	Watercourse defined on a 'Main River Map' designated by Defra. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Ordinary Watercourse	A watercourse that does not form part of a Main River. This includes "all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows" according to the Land Drainage Act 1991.
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account.
Return Period	Also known as a recurrence interval is an estimate of the likelihood of an event, such as a flood to occur.
Risk	Risk is a factor of the probability or likelihood of an event occurring multiplied by consequence: Risk = Probability x Consequence. It is also referred to in this report in a more general sense.
Sequential Test	Aims to steer vulnerable development to areas of lowest flood risk.
Sewer Flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Surface Water	Flooding caused when intense rainfall exceeds the capacity of the drainage systems or when, during prolonged periods of wet weather, the soil is so saturated such that it cannot accept any more water.
Sustainable Drainage Systems (SuDS)	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
SuDS Approval Body (SAB)	An organisation within County Councils and Unitary Authorities specifically established to deal with the design, approval and adoption of sustainable urban drainage systems (SUDS) within any new development consisting of two or more properties.

1 Introduction

1.1 Background

AECOM has been commissioned by Colchester City Council (CCC) to prepare an updated Level 1 Strategic Flood Risk Assessment (SFRA). An SFRA is a live document which provides an overview of the risk of flooding from all sources in the planning authority area, taking into the account the impacts of climate change, as well as assessing the impact that land use changes and development in the area could have on flood risk.

The Colchester Borough Council (CBC) SFRA was previously published in 2016 and is now being updated following a number of changes in planning policy and improvements in available flood mapping and modelling datasets. This updated CCC SFRA has been prepared in line with the requirements of the National Planning Policy Framework (NPPF)[1], supporting Planning Practice Guidance (PPG)[2], and Environment Agency guidance 'How to prepare a Strategic Flood Risk Assessment'[3].

1.2 Stakeholders

Table 1-1 identifies the stakeholders that have been involved in the preparation of this SFRA, either directly through consultation or by providing publicly available data, and their roles and responsibilities with respect to flood risk management.

Table 1-1: Stakeholders

Stakeholder	Role/Responsibility
Local Planning Authority (LPA): Colchester City Council	Responsible for preparing Local Plans including flood risk policies and development allocations. Local Drainage Authority under the Land Drainage Act. Risk Management Authority (RMA) under the Flood and Water Management Act. Category 1 responder under the Civil Contingencies Act.
Environment Agency	Lead RMA for the management of fluvial and tidal flooding. Strategic role in setting the direction for managing risks through the national flood and coastal erosion risk management strategy for England, regulating activities that may affect the risk of flooding from main rivers, and to act as a statutory consultee to the planning system for certain types of applications.
Lead Local Flood Authority (LLFA): Essex County Council (ECC)	Lead RMA for the management of local sources of flooding (surface water, groundwater, Ordinary Watercourses). Responsibility to develop a Local Flood Risk Management Strategy (LFRMS), investigate flood incidents, maintain a register and record of flood risk management structures and features, regulate works in Ordinary Watercourses, and to act as a statutory consultee to the planning system.
Water and Sewerage Companies: Anglian Water	Responsible for public water supply and sewerage systems[4]. Statutory consultee for SuDS that connect to the public network. Required to co-operate and share flood risk information with the LLFA.
Natural England	The government's advisor for the natural environment in England. Responsible for providing guidance regarding land usage and environmental management.

[1] National Planning Policy Framework (NPPF): https://www.gov.uk/government/publications/national-planning-policy-framework--2 [Accessed January 2025].
[2] Planning Practice Guidance (PPG): https://www.gov.uk/government/collections/planning-practice-guidance [Accessed June 2024].
[3] 'How to prepare a Strategic Flood Risk Assessment': https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment [Accessed June 2024].
[4] Affinity Water also supply water to small parts of Colchester.

1.3 Objectives

The objectives of the SFRA are as follows:

- Assess and describe all potential sources of flooding, both now and in the future as a result of climate change, based on readily available datasets;
- Review existing coastal and river models to confirm whether these need to be updated with the latest climate change allowances;
- Identify areas of Flood Zone 3b functional floodplain (both now and in future) and define criteria for how functional floodplain is to be considered by CCC;
- Identify existing flood risk management measures as well as areas that need to be safeguarded for future flood risk management features and structures (where applicable), through reference to Environment Agency data;
- Provide information on the consideration of cumulative impacts of development and land-use change on the risk of flooding;
- Identify opportunities to reduce the causes and impacts of flooding;
- Provide guidance for applying the Sequential Test, informing the sustainability appraisal and developing flood risk policies in the preparation of the CCC Local Plan to ensure flood risk is fully taken into account when considering allocations;
- Provide recommendations of how to address flood risk in development;
- Provide a recommendation as to whether a Level 2 SFRA will be required;
- Determine the acceptability of flood risk in relation to emergency planning capability; and
- Demonstrate how the adaptation to climate change has been undertaken.

1.4 User Guide

It is anticipated that the SFRA will have a variety of end users, including LPA officers, developers, planning consultants, neighbourhood planning bodies, LLFAs, emergency planners and local resilience forums. This Section sets out the structure of the SFRA and describes how to use it (Table 1-2). It should be noted that Appendix A contains maps while Appendix B provides an overview of the hydraulic models used within the SFRA.

Table 1-2: SFRA User Guide

Section Name and No.	Content
1. Introduction	Explains the need for the study and the objectives. Provides a user guide and identifies who has been consulted and where data has been collected. Identifies when the SFRA may need to be updated in the future.
2. Legislation and Policy Framework	Provides an overview of the latest legislation and national and regional policies in relation to flood risk and coastal change.
3. Datasets and Methodologies	Identifies the datasets used to inform the SFRA and describes the approaches taken to use and update data as part of the SFRA.
4. Applying the Sequential Test	Describes how the Sequential Test should be applied using the SFRA.
5. Preparing Flood Risk Assessments	Describes how site-specific Flood Risk Assessments (FRAs) should be prepared.
6. Sources of flood risk and expected effects of climate change	Describes the local geology and hydrology in the study area, and assessment of the risk of flooding from all sources based on available datasets. Sets out the sources of information for assessing climate change impacts on flood risk within the CCC area.

Section Name and No.	Content
7. Cumulative impact of development and land use change	Describes the importance of considering cumulative impacts on flood risk within the catchment, and cross-boundary impacts on flood risk in catchments downstream, resulting from land-use change. Suggests actions that CCC and developers can take to mitigate cumulative impacts.
8. Flood Management and Defences	Describes flood defences and flood warning services within the district.
9. Opportunities to reduce the causes and impacts of flooding	Identifies opportunities to reduce the causes and impacts of flooding in the local area and land required for flood risk management purposes.
10. Recommendations of how to address flood risk in development	Provides guidance on the range of measures that could be considered as part of development in order to manage and mitigate flood risk. These measures should be considered when preparing a site-specific FRA.

1.5 Future monitoring and update

This SFRA should be reviewed when there are changes to:

- The predicted impacts of climate change on flood risk,
- Detailed flood modelling - such as from the Environment Agency or LLFA,
- Local Plans, spatial development strategies or relevant local development documents,
- Local flood management schemes,
- Flood Risk Management Plans (FRMPs),
- Shoreline Management Plans,
- Local Flood Risk Management Strategies (LFRMS), and,
- National planning policy or guidance, and legislation.

The SFRA should also be reviewed after a significant flood or coastal erosion event.

2 Legislation and Policy Framework

This Section provides a high level overview of the national and regional planning context for coastal change and flood risk management in the CCC SFRA study area.

2.1 National

2.1.1 National Planning Policy Framework

The NPPF sets out the government's planning policies for England and provides a framework within which LPAs can produce Local Plans to deliver sustainable development in the face of the challenges presented by climate change, flooding, and coastal change. The NPPF was last updated in December 2024.

The NPPF stipulates that Local Plans should be supported by SFRAs and should develop policies to manage flood risk from all sources, taking into the advice from the Environment Agency and other relevant risk management bodies such as LLFAs and Internal Drainage Boards (IDBs).

The Sequential and Exception Tests are established by the NPPF as the primary decision-making tools which LPAs should use to direct development to areas with the lowest risk of flooding wherever possible. This SFRA provides the basis for applying these tests. Further guidance on the application of these tests can be found in Section 4.

2.1.2 Planning Practice and Guidance 'Flood Risk and Coastal Change'

The PPG is a living document that supports the NPPF and is periodically updated. It was noted as part of consultation on the NPPF changes in December 2024, that the PPG is likely to be updated in the near future[5]. The 'Flood Risk and Coastal Change' PPG outlines how the risks associated with flooding and coastal change should be assessed and addressed, including clear guidance regarding the contents of SFRAs and the application of the Sequential and Exception Tests to the siting of proposed developments.

Specific PPG paragraphs are referenced throughout this document in the relevant sections.

2.1.3 National Flood and Coastal Erosion Risk Management Strategy for England

The National Flood and Coastal Erosion Risk Management (FCERM) Strategy[6] (2020) describes what needs to be done by all risk management authorities involved in flood and coastal erosion risk management for the benefit of people and places. The strategy sets out the long-term delivery objectives the nation should take over the next 10 to 30 years as well as the shorter term, practical measures risk management authorities should take working with partners and communities. The strategy's long-term vision is for *'a nation ready for, and resilient to, flooding and coastal change – today, tomorrow and to the year 2100'*. The strategy has 3 long-term ambitions which are:

1. Climate resilient places.
2. Today's growth and infrastructure resilient in tomorrow's climate.
3. A nation ready to respond and adapt to flooding and coastal change.

2.1.4 Flood and Water Management Act

The Flood and Water Management Act (FWMA)[7] (2010) aims to provide sustainable and consistent management of flooding in England and Wales. It defines the roles of RMAs as the bodies with flood risk related responsibilities. RMAs include the Environment Agency, IDBs, Water and Sewerage Companies and LLFAs. The FWMA designates

[5] Government response to the proposed reforms to the National Planning Policy Framework and other changes to the planning system consultation: https://www.gov.uk/government/consultations/proposed-reforms-to-the-national-planning-policy-framework-and-other-changes-to-the-planning-system/outcome/government-response-to-the-proposed-reforms-to-the-national-planning-policy-framework-and-other-changes-to-the-planning-system-consultation#the-future-of-planning-policy-and-plan-making [Accessed January 2025].
[6] National Flood and Coastal Erosion Risk Management Strategy (2020): https://assets.publishing.service.gov.uk/media/5f6b6da6e90e076c182d508d/023_15482_Environment_agency_digitalAW_Strategy.pdf [Accessed January 2025].
[7] Flood and Water Management Act (2010): https://www.legislation.gov.uk/ukpga/2010/29/contents [Accessed May 2024].

county councils and unitary authorities as the LLFAs. The LLFA for the CCC area is ECC who pursuant to the FWMA have the following responsibilities:

- Carry out work to manage flooding from local sources (surface water, groundwater, and Ordinary Watercourses),
- Prepare and maintain a LFRMS,
- Investigate significant local flood incidents and publish the results of these investigations,
- Maintain a register of flood risk assets,
- Regulate work on Ordinary Watercourses,
- Share information about flood risk,
- Perform a lead role in emergency planning and recovery after a flood event, and,
- Co-operate with other RMAs.

At present, ECC as LLFA is a statutory consultee to CCC for matters relating to surface water management in new development. When enacted, Schedule 3 of the FWMA would places a duty on the local authority, likely to be the LLFA, to become a SuDS Approval Body (SAB). Enactment of Schedule 3 would remove the automatic right to connect surface water to the public sewer network and will require all new development over a prescribed threshold (to be confirmed by secondary legislation) to use SuDS to manage surface water. In addition to the normal planning application process, developers would have to submit a SuDS application to the SAB, demonstrating compliance with National Standards. The SAB would approve applications (assuming they met all requirements) and then adopt the SuDS for the lifetime of the development, with responsibility for maintenance.

At the time of writing (September 2024), Schedule 3 has not been enacted. However, the Jenkins Review published in January 2023, made recommendations that Schedule 3 be enacted by Defra.

2.1.5 Flood Risk Regulations

The Flood Risk Regulations (FRR)[8] (2009) transpose the requirements of the EU Floods Directive 2007 into law in England. They outline the duties of LLFAs and the Environment Agency to produce PFRAs, flood risk maps displaying the flooding extents and hazards, and Flood Risk Management Plans (see Section 2.2 for further details). These FRR requirements are completed on a six-year cycle. The FRR will be revoked once the Retained EU Law Bill (Revocation and Reform) has been passed[9].

2.1.6 Environmental Permitting (England and Wales) Regulations

The Environmental Permitting (England and Wales) Regulations (2016)[10] stipulate the regulated activities for which a Flood Risk Activity Permit may be required when undertaken:

- in, under, over or near a Main River (including culverted sections);
- on or near a flood defence on a Main River;
- in the flood plain of a Main River; and/or
- on or near a sea defence.

Further guidance on obtaining an environmental permit is available from the Environment Agency[11].

[8] Flood Risk Regulations (2009): https://www.legislation.gov.uk/uksi/2009/3042/contents/made [Accessed June 2024].
[9] Retained EU Law Bill (Revocation and Reform): https://bills.parliament.uk/publications/51204/documents/3436 [Accessed June 2024].
[10] Environmental Permitting Regulations (2016): https://www.legislation.gov.uk/uksi/2016/1154/contents/made [Accessed June 2024].
[11] Environment Agency and Department for Environment, Food and Rural Affairs Flood risk activities environmental permits guidance: https://www.gov.uk/guidance/flood-risk-activities-environmental-permits [Accessed January 2025].

2.2 Regional

2.2.1 Shoreline Management Plans

SMPs form part of Defra's strategy for flood and coastal defences. They provide a large-scale assessment of risks associated with coastal change and present the policy framework to address these risks in a sustainable manner. The SMP policies defined by Defra are:

- Hold the line – maintain or upgrade the level of protection provided by defences,
- Advance the line – build new defences seaward of the existing defence line,
- Managed realignment – allowing retreat of the shoreline with management to control or limit the movement, and
- No active intervention – a decision not to invest in providing or maintaining defences.

The SMP relevant to the study area is the Essex and Suffolk SMP (2010)[12]. SMP areas have been further divided into frontages, each of which is has been assigned one of the four policies described above for three time periods; short term (0-20 years), medium term (20-50 years), and long-term (50-100 years). The short-term, medium-term, and long-term policies for each frontage in the LDC area are presented in Appendix A Figure 1. These polices for each time period and frontage were derived through reference to the SMP Mapping dataset[13]. The short-term, medium-term, and long-term policies for each coastal frontage section in the CCC area are presented in Table 2-1.

Table 2-1: SMP Policies for Coastal Frontages in and around the CCC area

Policy Unit	Short Term Policy (2005-2025)	Medium Term Policy (2025-2055)	Long Term Policy (2055-2105)
Point Clear Cliffs D1A1	No Active Intervention	No Active Intervention	No Active Intervention
St Osyth Stone Point D1A2	Hold the Line	Hold the Line	Hold the Line
St Osyth Creek to Point Clear Road 1 D1B1	Hold the Line	Managed realignment	Hold the Line
St Osyth Creek to Point Clear Road 2 D1B2	Hold the Line	Hold the Line	Hold the Line
St Osyth Creek North 1 D1B3	No Active Intervention	No Active Intervention	No Active Intervention
St Osyth Creek North 2 D1B4	Hold the Line	Hold the Line	Hold the Line
St Osyth Creek North 3 D1B5	No Active Intervention	No Active Intervention	No Active Intervention
Southern bank of Flag Creek D2A	Hold the Line	Hold the Line	Managed realignment
Creek at Bentley Country Park South D2B	No Active Intervention	No Active Intervention	No Active Intervention
Creek at Bentley Country Park North D3A	No Active Intervention	No Active Intervention	No Active Intervention
Northern bank of Flag Creek to Lower Farm D3B	Hold the Line	Hold the Line	Hold the Line
Northern bank of Flag Creek to Lower Farm D3C	Hold the Line	Managed realignment	Hold the Line
Brightlingsea 1 D4A	Hold the Line	Hold the Line	Hold the Line
Westmarsh Point to where the frontage meets the B1029 1 D5A	Hold the Line	Hold the Line	Hold the Line

[12] Essex and Suffolk Shoreline Management Plan (2010): https://environment.data.gov.uk/shoreline-planning/documents/SMP8%2Fessex%26southsuffolk%20smp%20final%202.4.pdf Accessed July 2024].
[13] Shoreline Management Plan Mapping; https://environment.data.gov.uk/dataset/8e383070-d465-11e4-b752-f0def148f590 [Accessed July 2024].

Policy Unit	Short Term Policy (2005-2025)	Medium Term Policy (2025-2055)	Long Term Policy (2055-2105)
Westmarsh Point to where the frontage meets the B1029 2 D5B	Hold the Line	Managed realignment	Hold the Line
Westmarsh Point to where the frontage meets the B1029 3 D5C	Hold the Line	Hold the Line	Hold the Line
Mill Dam D6A1	No Active Intervention	No Active Intervention	No Active Intervention
Alresford Creek North Bank to Ford Lane D6A2	Hold the Line	Hold the Line	Hold the Line
Ford Lane to Alresford Grange D6A3	No Active Intervention	No Active Intervention	No Active Intervention
B1029 to Wivenhoe D6B	Hold the Line	Managed realignment	Hold the Line
Colne Barrier D7	Hold the Line	Hold the Line	Hold the Line
Inner Colne west bank 1 D8A1	Hold the Line	Managed realignment	Hold the Line
Inner Colne west bank 2 D8A2	Hold the Line	Managed realignment	Hold the Line
Fingringhoe Wick D8B1	Managed realignment	Hold the Line	Hold the Line
Fingringhoe Wick to Pyefleet Channel D8B2	No Active Intervention	No Active Intervention	No Active Intervention
Langenhoe Hall Marsh D8C	Hold the Line	Hold the Line	Hold the Line
Landward Frontage E1	Hold the Line	Hold the Line	Hold the Line
East Mersea Cudmore Grove frontage E2A	No Active Intervention	No Active Intervention	No Active Intervention
East Mersea Fen Farm and Coopers Beach Holiday Park E2B	Hold the Line	Hold the Line	Hold the Line
East Mersea Rewsalls Farm E2C	Managed realignment	No Active Intervention	No Active Intervention
East Mersea Youth Camp embankment E2D	Hold the Line	Hold the Line	Hold the Line
East Mersea between Youth Camp to Waldergraves Caravan Park E2E	No Active Intervention	No Active Intervention	No Active Intervention
East Mersea Waldergraves Caravan Park defended E2F	Hold the Line	Hold the Line	Hold the Line
East Mersea Waldergraves Caravan Park undefended E2G	No Active Intervention	No Active Intervention	No Active Intervention
West Mersea 1 E3A	Hold the Line	Hold the Line	Hold the Line
West Mersea 2 E3B	No Active Intervention	No Active Intervention	No Active Intervention
West Mersea 3 E3C	Hold the Line	Hold the Line	Hold the Line
North Mersea (Strood Channel) E4A	Hold the Line	Managed realignment	Hold the Line
Pyefleet Inner Channel E4B	Hold the Line	Hold the Line	Hold the Line
Salcott Creek F2	Hold the Line	Hold the Line	Hold the Line

Policy Unit	Short Term Policy (2005-2025)	Medium Term Policy (2025-2055)	Long Term Policy (2055-2105)
Tollesbury F4	Hold the Line	Hold the Line	Hold the Line

2.2.2 River Basin Management Plans & Flood Risk Management Plans

Flood Risk Management Plans (FRMPs) explain the objectives and actions needed to manage flood risk at a national and local level in England. Under the FRR (2009), FRMPs must be reviewed by the Environment Agency and LLFAs every 6 years. The current FRMPs cover the period 2021-2027[14], and are separated into a part a[15], which provides an overview of national measures that apply to all river basin districts, and part b, which is composed of ten local flood risk management plans that outline the measures that apply to specific River Basin Districts. The entirety of the CCC area is covered by the Anglian RBD Flood Risk Management Plan 2021 to 2027.

River Basin Management Plans (RBMPs) are prepared in accordance with the Water Framework Directive (WFD) and they assess the pressure facing the water environment in River Basin Districts (RBD). Each RBMP comprises a collection of documents that describes the framework by which the quality of waterbodies will be protected or enhanced in each respective RBD.

Data tables and online interactive maps with information regarding the current conditions of, and pressures on, waterbodies within each RBD, are also provided. The entirety of the CCC area is covered by the Anglian RBD River Basin Management Plan (2022)[16].

Catchment Flood Management Plans (CFMPs) are high-level strategic plans providing an overview of flood risk across each river catchment. The Environment Agency use CFMPs to work with other decision makers to identify and agree long-term policies for sustainable flood risk management. The CCC area encompasses the North Essex CFMP (2009)[17]. The policies for those sub-areas within the North Essex CFMP that overlap with the CCC area are summarised in Table 2-2. Sub areas within the North Essex CFMP that do not fall within the CCC area have been excluded from Table 2-2.

Table 2-2: List of relevant CFMP sub-areas[17]

Sub Area	Preferred Policy
Lower Blackwater, Upper and Mid Tributaries and Mid Colne and Stour	Policy option 3: Areas of low to moderate flood risk where we are generally managing existing flood risk effectively.
Colchester	Policy option 4: Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change.
Blackwater and Chelmer, Upper Reaches and Coastal Streams	Policy option 2: Areas of low to moderate flood risk where we can generally reduce existing flood risk management actions.

Flood Risk Management Plans (FRMPs) explain the objectives and actions needed to manage flood risk at a national and local level in England. Under the FRR (2009), FRMPs must be reviewed by the Environment Agency and LLFAs every 6 years. The current FRMPs cover the period 2021-2027[18], and are separated into a part a[19], which provides an overview of national measures that apply to all river basin districts, and part b, which is composed

[14] Flood risk management plans 2021 to 2027: https://www.gov.uk/government/collections/flood-risk-management-plans-2021-to-2027 [Accessed June 2024].
[15] Flood risk management plans 2021 to 2027: national overview (part a): https://www.gov.uk/government/publications/flood-risk-management-plans-2021-to-2027-national-overview-part-a [Accessed June 2024].
[16] Anglian RBD River Basin Management Plan: https://www.gov.uk/guidance/anglian-river-basin-district-river-basin-management-plan-updated-2022 [Accessed June 2024].
[17] North Essex Catchment Flood Management Plan (2009): https://assets.publishing.service.gov.uk/media/5a74c2e9e5274a3f93b489a9/North_Essex_Catchment_Flood_Management_Plan.pdf [Accessed June 2024].
[18] Flood risk management plans 2021 to 2027: https://www.gov.uk/government/collections/flood-risk-management-plans-2021-to-2027 [Accessed June 2024].
[19] Flood risk management plans 2021 to 2027: national overview (part a): https://www.gov.uk/government/publications/flood-risk-management-plans-2021-to-2027-national-overview-part-a [Accessed June 2024].

of ten local flood risk management plans that outline the measures that apply to specific River Basin Districts. The entirety of the CCC area is covered by the Anglian RBD Flood Risk Management Plan 2021 to 2027.

2.3 Local Plan

2.3.1 Colchester Borough Local Plan

CCC's primary planning policy document is the Colchester Borough Local Plan[20] which was adopted in 2022 and will guide development in the CCC area up to 2033. Policy DM23: Flood Risk and Water Management stipulates that the impact and extent of flood risk within the CCC area will be achieved through the following measures:

- *"The Local Planning Authority will seek to direct development away from land at risk of flooding in accordance with the National Planning Policy Framework and the Planning Practice Guidance. Sites proposed for allocation in the Local Plan have been considered sequentially with respect to flood risk. The Sequential Test will be applied to planning applications for new sites coming forward that have not been allocated through the Plan. take a sequential approach to ensure most vulnerable uses are placed in the lowest risk areas.*

- *Development will only be supported where it can be demonstrated that the proposal meets flood management requirements in the NPPF, the PPG and policy DM23.*

- *Development proposals will be required to deliver or contribute to the delivery of flood defence/protection measures and/or flood mitigation measures to minimise the risk of increased flooding both within the development boundary and off-site in all flood zones and to ensure that the development remains safe throughout the life of the development. Proposals that include measures to enhance the flood resilience of new or renovated buildings will be encouraged, particularly in areas with a history of local flooding.*

- *Where proposals that require planning permission include driveways, hardstanding or paving, the use of permeable materials and landscaping will be sought to minimise the cumulative impacts of flooding from such developments.*

- *Developments will also be required to comply with the following as indicated in the Colchester Surface Water Management Plan."*

2.3.2 Essex Preliminary Flood Risk Assessment

Under the 2009 FRR all LLFAs are required to prepare a PFRA, as undertaken by ECC in 2011 with an addendum produced in 2017. The PFRA (2011)[21] provides a high-level overview of flood risk from local flood sources such as surface water, groundwater, and Ordinary Watercourses for which ECC are responsible. Information contained within the PFRA informed the development of the LFRMS and helped to identify areas that should be prioritised for Surface Water Management Plans (SWMPs). The Environment Agency has established a national methodology for identifying Flood Risk Areas, which refer to areas at risk with populations in excess of 30,000. PFRAs act as a screening exercise by which the Environment Agency's Flood Risk Areas can be revised and updated. The ECC PFRA concluded that one of the Environment Agency's existing Flood Risk Areas (Basildon) were located in Essex but not in the CCC LPA. The PFRA addendum concluded that there were 5 Flood Risk Areas in Essex, including one (Colchester) located within the CCC LPA.

2.3.3 Essex County Council Local Flood Risk Management Strategy

The ECC LFRMS (2018)[22] sets out how ECC carries out its flood risk responsibilities that are a statutory requirement of the Flood and Water Management Act 2010. The key objectives to guide local focus and progress in Essex are as follows:

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[20] Colchester Borough Local Plan (2022): https://cbccrmdata.blob.core.windows.net/noteattachment/CBC-null-section-2-local-plan-update-Colchester%20Borough%20Council%20Local%20Plan%202017-2033%20Section%202%20Final.pdf [Accessed June 2024]

[21] Essex County Council Preliminary Flood Risk Assessment (2011 and 2017): https://www.rochford.gov.uk/sites/default/files/2022-11/evibase_98eb49.pdf and https://assets.publishing.service.gov.uk/media/5acb7d7040f0b64ff0e69396/PFRA_Essex_County_Council_2017.pdf [Accessed May 2024].

[22] Essex County Council Local Flood Risk Management Strategy (2018): https://flood.essex.gov.uk/media/1293/essex-local-flood-risk-management-strategy.pdf [Accessed June 2024]

1. *"To provide a clear explanation of everyone's responsibilities.*
2. *To make sure people understand their risk of flooding and think about how we communicate this.*
3. *To explain how we assess flood risk in Essex and then prioritise the work we do.*
4. *To clearly set out our work so that communities and businesses can make decisions about how they also manage flood risk.*
5. *To ensure that planning decisions properly consider flooding and the future impact of any development.*
6. *To state how we share information and work with other authorities.*
7. *To ensure that emergency plans and responses to flood incidents are effective and that communities are prepared for flooding.*
8. *To encourage innovative new thinking, considering community needs, while working with the existing natural and built environment.*
9. *To highlight where further detailed information and legislation regarding flooding can be found."*

2.3.4 The Sustainable Drainage Systems Design Guide for Essex

The Sustainable Drainage Systems Design Guide for Essex was produced in 2020[23] as a guide for use by developers, designers and consultants who are seeking guidance on the LLFAs standards for the design of sustainable surface water drainage in Essex. It provides guidance on the planning, design and delivery of attractive and high-quality SuDS schemes which should offer multiple benefits to the environment and community alike.

[23] Essex County Council The Sustainable Drainage Systems Design Guide for Essex (2020) https://www.essexdesignguide.co.uk/suds [Accessed June 2024]

3 Datasets and Methodologies

SFRAs rely on a large number of datasets and information from a range of stakeholder organisations. This section describes the datasets that have been obtained and the methods that have been applied to assess the risk from all sources of flooding across the study area.

3.1 Risk of Flooding from Rivers

Flooding from rivers occurs when water levels rise higher than bank levels, causing floodwater to spill across adjacent land (floodplain). The main reasons for water levels rising in rivers are:

- Intense or prolonged rainfall causing runoff rates and flows to increase in rivers, exceeding the capacity of the channel. This can be exacerbated by wet conditions and where there is significant groundwater base flow.
- Constrictions in the river channel causing floodwater to back up.
- Constrictions preventing discharge at the outlet of the river e.g. locked flood gates or tide-locking at high tide.

To assess flooding from rivers the datasets described in Table 3-1 have been used. It should be noted that the Flood Map for Planning and the Risk of Flooding from Rivers and Sea datasets are expected to be updated in early 2025 upon completion of the NaFRA2 project. This will combine local mapping with a new national model to produce improved mapped outputs and metadata. As a result of this, some of the published mapping will differ from the currently available local modelling at the time of writing (September 2024).

Table 3-1: Datasets for river flooding

Datasets	Notes	Data source
OS Open River	GIS shapefile which provides a high level overview of watercourses. Contains over 144,000km of water bodies and watercourses. These include freshwater rivers, tidal estuaries, and canals.	Ordnance Survey free download: https://www.ordnancesurvey.co.uk/business-government/products/open-map-rivers
Catchment boundaries	GIS shapefiles obtained from the Catchment Data Explorer have been used to identify the river basin districts, management catchments in the CCC SFRA project area.	Environment Agency Catchment Data Explorer: https://environment.data.gov.uk/catchment-planning
Flood Zone 2 and Flood Zone 3a	GIS shapefiles which identify the probability of fluvial and tidal flooding, ignoring the presence of defences as mapped on the Environment Agency Flood Map for Planning (rivers and sea). Flood Zone 1: Land having a less than 0.1% annual exceedance probability (AEP) of fluvial or tidal flooding. Flood Zone 2: Land having between a 1% and 0.1% AEP of fluvial flooding, or land having between a 0.5% and 0.1% AEP of tidal flooding. Flood Zone 3a: Land having a 1% or greater AEP of fluvial flooding, or land having a 0.5% or greater AEP of tidal flooding.	Defra Data Services Platform: https://environment.data.gov.uk/dataset/86ec354f-d465-11e4-b09e-f0def148f590 https://environment.data.gov.uk/dataset/87446770-d465-11e4-b97a-f0def148f590
AIMS Spatial Flood Defences	Contains the locations of flood defences currently owned, managed or inspected by the Environment Agency, including structures, buildings, earth banks, stone and concrete walls, and sheet-piling.	Defra Data Services Platform: https://environment.data.gov.uk/dataset/8e5be50f-d465-11e4-ba9a-f0def148f590
Reduction in Risk of Flooding from Rivers and Sea due to Defences	This dataset indicates where flood defences may reduce the risk of flooding from the rivers and the sea and has replaced the Areas Benefiting from Flood Defences dataset.	Defra Data Services Platform: https://environment.data.gov.uk/dataset/7b5cf457-6853-4b50-a812-b041d9da003a

Datasets	Notes	Data source
Recorded Flood Outlines	Contains all records of historic flooding from rivers, the sea, groundwater, and surface water since 1946. Takes account of the presence of defences, structures and other infrastructure that existed at the time of flooding. A companion Historic Flood Map contains a subset of these Recorded Flood Outlines which satisfy certain criteria.	Defra Data Services Platform: https://environment.data.gov.uk/dataset/8c75e700-d465-11e4-8b5b-f0def148f590

3.1.1 Hydraulic Models

On 13 June 2024, AECOM sent a data request to the Environment Agency for all hydraulic models situated within the CCC area. A high-level review of the received models has been undertaken, details of which are presented in the Hydraulic Model Review Report (Appendix B). Table 3-3 summarises the models that have been received, their extents and whether they have been used in the SFRA.

3.1.2 Functional Floodplain

The SFRA should identify areas of Flood Zone 3b functional floodplain, which is defined in the NPPF as land where water from rivers or the sea has to flow or be stored in times of flood.

The PPG sets out that functional floodplain will normally comprise:

- Land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or
- Land that is designed to flood (such as flood attenuations scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).

The PPG also states that the identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. For the purposes of council-wide mapping for this SFRA, Flood Zone 3b has been defined based on the 3.3% AEP event where this data exists from available models, further details on how Flood Zone 3b has been defined is available in Section 10.3. This has been undertaken to facilitate the Sequential Test application, but it should be noted that the mapped extents provided in this SFRA can (and should) be revisited if local modelling or site-specific assessments provide new evidence around local circumstances.

The majority of the flood models provided for the SFRA include flood extents for the 3.3% AEP event. The only exceptions are Birch Brook and Salary Brook. For these watercourses it was agreed with the Environment Agency that a conservative approach would be applied where a more extreme event would be considered i.e. the 1.33% AEP event or the 2% AEP event. Flood Zone 3b has not been able to be defined for part of the River Colne between East Street in Colchester and Wivenhoe due to missing modelling results. Therefore, any development coming forward within this area would need to undertake site-specific hydraulic modelling to confirm the Flood Zone 3b extent.

3.1.3 Impact of climate change on peak river flow

It is anticipated that climate change will increase the frequency, extent and impact of flooding, as reflected in peak river flows. For example, wetter winters and more intense rainfall may increase fluvial flooding and surface water runoff. SFRAs should consider the risk of flooding from rivers in the future as a result of the impact of climate change on rainfall patterns and peak river flows. The Environment Agency sets out the current guidance[24] on the climate change allowances that should be applied, with peak river flow allowances provided by management catchments. Management catchments are sub-catchments of RBDs. The CCC study area comprises a single river basin district (Anglian) and one management catchment (Combined Essex Management Catchment).

The Environment Agency's peak river flow allowances are based on percentiles. A percentile describes the proportion of possible scenarios that fall below an allowance level.

[24] Flood Risk Assessments: climate change allowances: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances [Accessed June 2024].

- Central Allowance is based on the 50th percentile.
- Higher Central Allowance is based on the 75th percentile.
- Upper End Allowance is based on the 95th percentile.

An allowance based on the 50th percentile is exceeded by 50% of the projections in the range. At the 70th percentile it is exceeded by 30%. At the 95th percentile it is exceeded by 5%. These allowances (increases) are provided, in the form of figures for the total potential change anticipated, for three climate change periods:

- The '2020s' (2015 to 2039).
- The '2050s' (2040 to 2069).
- The '2080s' (2070 to 2115).

The time period that should be applied in the appraisal of a proposed development is contingent upon the expected lifetime of the development. A minimum of 100 years should be considered for a residential development, whereas the lifetime of a non-residential development should be determined on a case-by-case basis.

The Environment Agency's climate change guidance stipulates that SFRAs should assess both the Central and Higher Central allowances. The Higher Central allowance should be applied to developments classified as Essential Infrastructure in Flood Zones 2, 3a, and 3b, whereas the Central allowance should be applied for all other development categories in Flood Zones 2 and 3a. There should also be consideration of the H++ scenario where deemed applicable i.e. if significant development is being proposed within areas considered to be at risk from fluvial sources or for Nationally Significant Infrastructure Projects (NSIP).

Table 3-2 provides the Central and Higher Central peak river flow allowances for the Combined Essex Management Catchment. For the CCC area, the central and higher central allowances for the 2080s epoch are 25% and 38% respectively.

Table 3-2: Peak river flow allowances for Combined Essex Management Catchment (based on 1981 to 2000 baseline)[25]

Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper End	27%	37%	72%
Higher Central	13%	16%	38%
Central	7%	8%	25%

Table 3-3 summarises the models that have been received and how they have been used in the SFRA. The majority of the flood models provided have simulated the 1% AEP +25% and +35% to represent climate change. The +25% climate change simulation is consistent with the central allowance. The +35% climate change simulation is 3% lower than the higher central allowance. This was discussed with the Environment Agency and it was agreed that given the modelled allowance is within 3% of the allowance specified within the guidance, there would be no need to re-simulate the models and this would be acceptable for use within the SFRA. There are two models (Birch Brook and Salary Brook) where climate change allowances are not in line with the current guidance. It was agreed for these two watercourses that a surrogate would be used i.e. Flood Zone 2.

It should be noted that for the watercourses where no modelled data was available i.e. Layer Brook, Roman River and Domsey Brook, a conservative approach has been applied where Flood Zone 3a has been used to define Flood Zone 3b and Flood Zone 2 has been as a surrogate for the climate change scenarios.

[25] Combined Essex Management Catchment Peak River Flow Allowances: https://environment.data.gov.uk/hydrology/climate-change-allowances/river-flow?mgmtcatid=3018 [Accessed June 2024].

Table 3-3: Hydraulic models for the CCC study area

Model	Date	Coverage	Flood Zone 3b (3.33% AEP)	Climate Change Allowances	Used within Level 1 SFRA?
Birch Brook	2006	Birch Brook near Rowhedge	N	+20%, +30%	Yes – 1.33% AEP to map FZ3b. 1% AEP +30% climate change used to map the central allowance and Flood Zone 2 used to map the higher central allowance
Salary Brook	2015	Salary Brook from Ardleigh to River Colne at University of Essex Colchester Campus	Y	+20%	Yes – 3.33% AEP to map FZ3b. Flood Zone 2 used to map the central and higher central allowance
Virley Brook	2016	Virley Brook, Virley Brook North Arm and Virley Hall Brook at Salcott	N	+25%, +35%, +65%	Yes - 2% AEP to map FZ3b. 1% AEP +25% climate change used to map the central allowance and 1% AEP +35% used to map the higher central allowance
River Blackwater	2017	Middle section from Braintree to Witham. Located outside of CCC boundary	Y	+20%	No – watercourse and flood extents located outside of the CCC boundary
St Botolphs Brook	2018	St Botolphs Brook / Black Brook from Horkesley Heath to River Colne	Y	+25%, +35%, +65%	Yes – 3.33% AEP to map FZ3b. 1% AEP +25% climate change used to map the central allowance and 1% AEP +35% used to map the higher central allowance
Lower Stour	2019	Lower Stour flows along CCC's northern boundary	Y	+25%, +35%, +65%	Yes – 3.33% AEP to map FZ3b. 1% AEP +25% climate change used to map the central allowance and 1% AEP +35% used to map the higher central allowance
River Colne	2019	River Colne from Great Yeldham (outside of the CCC boundary) to the tidal limit of the River Colne at East Mills in Colchester	Y	+25%, +35%, +65%	Yes – 3.33% AEP to map FZ3b. 1% AEP +25% climate change used to map the central allowance and 1% AEP +35% used to map the higher central allowance

3.2 Risk of Flooding from the Sea

Tidal sources of flooding include seas and estuaries, and tidal flooding is generally caused by the combination of storm surges and astronomical tides. Some of the datasets described in Table 3-1 have been used in the assessment of flooding from tidal sources, including 'Flood Zones and Reduction in Risk of Flooding from Rivers and Sea due to defences'.

3.2.1 Impact of climate change on sea level rise

LPAs are encouraged to make allowances for climate change in Local Plans to help minimise vulnerability and provide resilience to flooding. Current guidance on the climate change allowances that should be applied are set out by the Environment Agency[26]. There are a range of allowances for each RBD and epoch for sea level rise. The allowances for the Anglian RBD are included in Table 3-4.

Table 3-4: Sea level allowances in the Anglian RBD for each epoch in mm for each year (based on 1981 to 2000 baseline) – the total sea level rise for each epoch is in brackets

Area of England	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Anglian	Higher Central	5.8 (203)	8.7 (261)	11.6 (348)	13.0 (390)	1.20
Anglian	Upper End	7.0 (245)	11.3 (339)	15.8 (474)	18.1 (543)	1.60

The Environment Agency guidance stipulates that SFRAs and FRAs should assess both the Higher Central and Upper End allowances for sea level rise. There should also be consideration of the H++ scenario where deemed applicable i.e. if significant development is being proposed within areas considered to be at risk from tidal sources or for NSIPs.

Table 3-5 summarises the models that have been received and how they have been used in the SFRA. The River Colne and River Blackwater Tidal model provides tidal flood extents for present day and in the future with consideration of sea level rise. The allowances and methods used within this are however out of date as they use allowances from UKCP09 and the NPPF. However, this is the only tidal information available, and it was therefore agreed with the Environment Agency that these extents would be used; any development sites proposed within these areas would need to undertake additional modelling as part of any site-specific assessment to fully understand the tidal impact with an appropriate allowance for climate change.

Table 3-5: Tidal models for CCC study area

Model	Date	Coverage	Flood Zone 3b (3.33% AEP)	Climate Change Allowances	Used within Level 1 SFRA?
River Colne and River Blackwater (tidal)	2017	Colne and Blackwater estuary from Sales Point to Clacton-on-Sea	Y	Medium emission 95th percentile UKCP09 (2115). SLR 0.75m. Medium emission 95th percentile NPPF (2115). SLR 1.11m.	Yes - 3.33% AEP to map FZ3b. Medium emission 95th percentile NPPF (2115) used to map future climate change impact. The 2125 Higher Central Anglian sea level rise climate change allowance is approximately the same as the 2115 sea level rise climate change allowance used in the 2017 model and is therefore an appropriate surrogate.

[26] Anglian Sea Level Allowances: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#sea-level-allowances [Accessed July 2024].

3.3 Risk of Flooding from Surface Water

Overland flow and surface water flooding typically arise following periods of intense rainfall, often of short duration, which is unable to soak into the ground or enter drainage systems. It can run quickly off land and result in localised flooding. It can be difficult to provide a detailed representation of such localised flooding in a strategic-scale document.

The PPG states that an SFRA should identify areas at risk from surface water flooding and drainage issues, taking account of the surface water flood risk published by the Environment Agency as well other available information. The Environment Agency has undertaken modelling of surface water flood risk at a national scale and produced mapping identifying those areas at risk of surface water flooding during three annual probability events: 3.3% AEP (1 in 30 year), 1% AEP (1 in 100 year) and 0.1% AEP (1 in 1000 year). The extents of the latest version of the mapping have been made available for the Level 1 SFRA as GIS layers. This mapping is referred to as 'Risk of Flooding from Surface Water' (RoFSW) and is also available online on the Long Term Flood Risk Map[27].

As part of the Colchester Town Surface Water Management Plan (SWMP)[28] (2013), surface water modelling was undertaken to aid the identification of Critical Drainage Areas (CDA) within the City of Colchester. An update to the SWMP was undertaken in 2018[29] which updated the CDAs and associated action plan. As this modelling only covers a small area of the Colchester Borough and the modelling outputs were shown to be similar to the RoFSW, the RoFSW has been used to assess surface water flood risk in this SFRA.

The RoFSW mapping provides all relevant stakeholders, such as the Environment Agency, LPAs, and the public with access to information on surface water flood risk which is consistent across England and Wales. The modelling helps the Environment Agency take a strategic overview of flooding and assists LLFAs in their duties relating to management of surface water flood risk.

For the purposes of this SFRA, the mapping allows an improved understanding of areas within the study area which may have a surface water flood risk. It should be noted that this national mapping has the following limitations:

- Use of a single drainage rate for all urban areas,
- It does not show the susceptibility of individual properties to surface water flooding,
- The mapping has significant limitations for use in flat catchments,
- No explicit modelling of the interaction between the surface water network, the sewer systems, and watercourses,
- In a number of areas, modelling has not been validated due to a lack of surface water flood records, and,
- As with all models, the RoFSW mapping is affected by a lack of, or inaccuracies in, available data.

It should be noted that a new RoFSW map is expected to be published in early 2025 as part of the NaFRA2 project.

3.3.1 Impact of climate change on peak rainfall intensity

Climate change is predicted to result in wetter winters and increased summer storm intensity in the future. This will lead to an increased volume of water entering land and urban drainage systems, consequently resulting in surface water flooding.

LPAs are encouraged to make allowances for climate change in Local Plans to help minimise vulnerability and provide resilience to flooding. Table 3-6 shows the peak rainfall intensity allowance the Combined Essex Management Catchment. The specific allowance to be used depends on the development, as well as its development lifetime. Current guidance on the climate change allowances that should be applied are set out by

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[27] Environment Agency Flood Risk for Surface Water Map: https://www.gov.uk/check-long-term-flood-risk [Accessed May 2024].
[28] Essex County Council and Colchester Borough Council Colchester Town Surface Water Management Plan (2013): https://cbccrmdata.blob.core.windows.net/noteattachment/CBC-Local-Plan-Colchester-Town-Centre-Surface-Water-Management-Plan-EBC%204.62%20Colchester_Surface%20Water%20Management%20Plan%20Jul%202013.pdf [Accessed September 2024].
[29] Essex County Council Revised CDAs (2018): https://cbccrmdata.blob.core.windows.net/noteattachment/CBC-Local-Plan-Colchester-Surface-Water-Management-Plan---Maps-EBC%204.64%20Surface%20Water%20Management%20Plan%20(Maps).pdf [Accessed January 2025].

the Environment Agency[30]. The Environment Agency advises that the peak rainfall allowances should only be used for surface water flood mapping in small catchments (under $5km^2$), urbanised drainage catchments, and for site-scale applications.

Table 3-6: Peak rainfall intensity allowance in small catchments (less than $5km^2$) or urban drainage catchments for Combined Essex Management Catchment (based on a 1981 to 2000 baseline)[31]

AEP	Epoch 2050s (2022-2060) or 2070s (2061-2125)	Central Allowance	Upper End Allowance
3.3%	'2050s'	20%	35%
	'2070s'	20%	35%
1%	'2050s'	20%	45%
	'2070s'	25%	40%

The guidance advocates for the utilisation of the Upper End allowances for both the 1% (1 in 100 year) and 3.3% (1 in 30 year) AEP events when assessing the impacts of climate change on surface water flood risk within SFRAs. For site-specific assessments, developers should use the 2050s epoch for development with a lifetime up to 2060 and the 2070s epoch for development with a lifetime between 2061 and 2125.

3.4 Risk of Flooding from Groundwater

Groundwater flooding usually occurs in low lying areas underlain by permeable rock and aquifers that allow groundwater to rise to the surface through the permeable subsoil following long periods of wet weather. Low lying areas may be more susceptible to groundwater flooding because the water table is usually at a much shallower depth and groundwater paths tend to travel from high to low ground. There are many mechanisms associated with groundwater flooding which are linked to high groundwater levels and can be broadly classified as:

- Direct contribution to channel flow – where the river channel intersects the water table and groundwater enters the streambed increasing water levels and causing flooding,
- Springs erupting at the surface,
- Exceptionally large flows from perennial springs or large flows from intermittent or dormant springs, and,
- Rise of typically high groundwater levels to extreme levels in response to prolonged extreme rainfall.

The main impacts of groundwater flooding are:

- Flooding of basements of buildings below ground level – in the mildest case this may involve seepage of small volumes of water through walls, temporary loss of services etc. In more extreme cases larger volumes may lead to the catastrophic loss of stored items and failure of structural integrity.
- Overflowing of sewers and drains – surcharging of drainage networks can lead to overland flows causing significant but localised damage to property. Sewer surcharging can lead to inundation of property by polluted water. Note: it is complex to separate this flooding from other sources, notably surface water, or sewer flooding.
- Flooding of buried services or other assets below ground level – prolonged inundation of buried services can lead to interruption and disruption of supply.
- Inundation of roads, commercial, residential and amenity areas – inundation of grassed areas can be inconvenient; however, the inundation of hard-standing areas can lead to structural damage and the disruption of commercial activity. Inundation of agricultural land for long durations can have financial consequences.

[30] Environment Agency Peak River Flow Allowances: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#peak-river-flow-allowances [Accessed May 2024].
[31] Combined Essex Management Catchment peak rainfall allowances: https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall?mgmtcatid=3018 [Accessed June 2024].

- Flooding of ground floors of buildings above ground level – can be disruptive and may result in structural damage. In addition, typically a groundwater flood event will have a long duration (when compared to other flood sources) which adds to the disruptive nature of the flood event.

The British Geological Survey (BGS) has produced the first national dataset on groundwater flooding, covering England, Wales and Scotland. The dataset can be used to identify areas where geological and hydrogeological information indicates that groundwater flooding may occur and where groundwater may come close to the ground surface. The dataset doesn't provide any information on the depth to which groundwater flooding occurs or the likelihood of the occurrence of an event of a particular magnitude. Where aquifers were present, areas were separated into 50m by 50m cells, each of which was assigned to one of three classes. Outside of these areas, the rock types were not considered prone to groundwater flooding.

The three classification categories utilised in the BGS's 'Groundwater Flooding' dataset were as follows:

A: Limited potential for groundwater flooding to occur.

B: Potential for groundwater flooding of property situated below ground level.

C: Potential for groundwater flooding to occur at the surface.

According to the BGS user guide[32], the dataset is intended for regional or national planning purposes and should be supplemented by a range of other relevant information to inform land-use planning decisions. It might also be used in conjunction with a large number of other factors, e.g. records of previous incidence of groundwater flooding, rainfall, property type, and land drainage information, to establish relative, but not absolute, risk of groundwater flooding at a resolution of greater than a few hundred metres. The data should not be used on its own to make planning decisions at any scale, and, in particular, should not be used to inform planning decisions at the site scale. The data cannot be used on its own to indicate risk of groundwater flooding. Any depth to water table data is likely to be more suitable for site-scale decisions.

3.4.1 Impact of climate change on groundwater flooding

Groundwater flooding occurs primarily as a response to extended periods of rain. With climate change bringing wetter winters, an increased risk of groundwater flooding may be seen. However, the complex relationship between rainfall, recharge, groundwater storage and flow make the response to climate change uncertain.

3.5 Risk of Flooding from Sewers

During heavy rainfall, flooding from the sewer system may occur if:

- The rainfall event exceeds the capacity of the sewer system/drainage system: New sewer systems are typically designed and constructed to accommodate 3.3% AEP (1 in 30 year) rainfall events, or greater. Older sewer systems have a variable design standard. Therefore, rainfall events with an annual probability less than 3.3% would be expected to result in surcharging of some of the sewer system. While sewerage undertakers recognise the impact that more extreme rainfall events may have, it is not cost beneficial to construct sewers that could accommodate every extreme rainfall event.
- The system becomes blocked by debris or sediment: Over time there is potential that road gullies and drains become blocked from fallen leaves, build-up of sediment and debris without sufficient maintenance (e.g. litter).
- The system surcharges due to poor maintenance of outfall flap valves: Flooding from sewers can occur where outfall flap valves are not maintained or become faulty, especially in areas close to tidal rivers, where the level of the land (and sewer soffit levels and manhole levels) lie below the maximum tide level.
- The system surcharges due to high water levels in receiving waterbodies: There is potential for surface water outlets to become submerged due to high river or tide levels. Once storage capacity within the sewer system itself is exceeded, the water will overflow into streets and potentially into houses. This can be exacerbated by defective flap valves, allowing tidal water to potentially surcharge to street level, or to occupy storage in the sewer network that would normally be available to surface water volumes.

[32] British Geological Survey (BGS) Groundwater Flooding User Guide: https://www.bgs.ac.uk/datasets/groundwater-flooding/ [Accessed May 2024].

Within urban areas, rainwater is frequently drained into sewers conveying both surface and foul water known as 'combined sewers'. As a result, sewer flooding events where 'combined sewers' are particularly prevalent may be more frequent and associated with the potential contamination of floodwater by foul effluent.

3.5.1 Impact of climate change on sewer flooding

Climate change is anticipated to increase the potential risk from sewer flooding as summer storms become more intense and winter storms more prolonged. This combination is likely to increase the pressure on the existing efficiency of sewer systems, thereby reducing their design standard and leading to more frequent localised flooding incidents. There is likely to be longer durations of tide-locking to surface water sewer gravity outfalls where these discharge to tidal rivers. Any sewer flooding that may occur could be exacerbated as a result of surface water runoff during extreme rainfall events.

Water companies continue to monitor the risk of sewer flooding and put plans in place to manage the risk, as required, based on their business plan and priorities. The LPAs can work with Anglian Water to identify flooding hotspots and locations of known sewer capacity issues where risk could be exacerbated. Water companies prioritise investment for potential flood alleviation schemes depending on the severity and frequency of flooding, but this can only be identified where affected property owners report the incident to the water company.

3.6 Risk of Flooding from Reservoirs

The failure of a reservoir has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The PPG encourages LPAs to identify any impounded reservoirs and evaluate how they might modify the existing flood risk in the event of a flood in the catchment it is located within, and / or whether emergency draw-down of the reservoir will add to the extent of flooding. Areas at risk of reservoir flooding are presented on the Environment Agency's Long Term Flood Risk Map[33]. Datasets showing the flood extents for all large, raised reservoirs in the event of their failure are available. Two flood extents are provided for each reservoir denoting the "dry day" scenario[34] during which river levels are normal, and the "wet day" scenario[35] during which local rivers have already overflowed their banks.

The dataset represents the prediction of a credible worst case scenario, although its improbable that any actual flood would be this large. The dataset gives no indication of the likelihood or probability of reservoir flooding. Flood extents are not provided for smaller reservoirs (i.e. those with a volume below the threshold of 25,000m^3) or for reservoirs registered following the onset of the modelling programme beginning in October 2016. There is an ongoing Reservoir Safety Reform Programme which may bring reservoirs capable of holding 10,000m^3 – 25,000 m^3 above ground level into a new hazard classification[36]. This may have a bearing on some small embanked lakes in Colchester (Bourne Pond, Blyth Pond and Distillery Pond and High Woods Country Park and lakes to north of Rectory Hill, Wivenhoe).

Although the impacts emanating from the breach of a large, raised reservoir could be severe, large-raised reservoirs are carefully monitored and maintained across England in line with the provisions of the Reservoirs Act 1975[37], and consequently, the risk of reservoir failure is very low.

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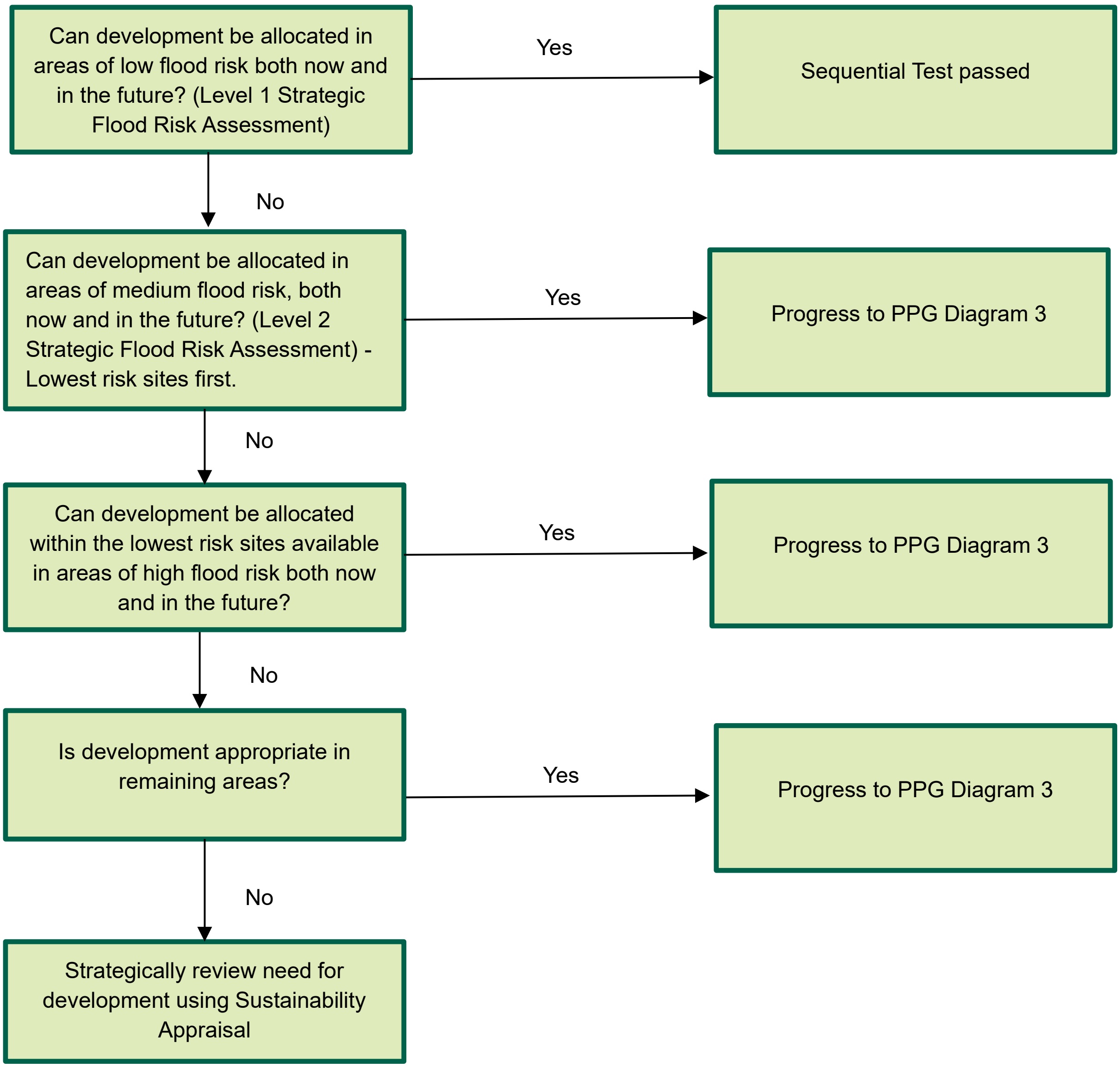
[33] Environment Agency Risk of Reservoir Flooding: https://www.gov.uk/check-long-term-flood-risk [Accessed June 2024].
[34] Reservoir Flood Extents Dry Day National: https://environment.data.gov.uk/dataset/c66ee97f-49d2-454e-9a19-d48a47bd22ad [Accessed June 2024].
[35] Reservoir Flood Extents Wet Day National: https://environment.data.gov.uk/dataset/d81646cf-37e5-4e71-bbcf-b7d5b9ca3a1c [Accessed June 2024].
[36] https://consult.environment-agency.gov.uk/solent-and-south-downs/reservoir-safety-reform-programme/#:~:text=The%20Reservoir%20Safety%20Review%20recommended,assessments%20and%20reservoir%20management%20plans [Accessed January 2025].
[37] Reservoirs Act 1975: https://www.legislation.gov.uk/ukpga/1975/23 [Accessed June 2024].

4 Applying the Sequential and Exception Tests

4.1 Sequential Test

The Sequential Test is a decision-making tool designed to ensure that development is steered away from areas at risk of flooding, and that areas with little or no risk of flooding (from any source) are developed in preference to areas at higher risk. When preparing a Local Plan, the LPA should demonstrate that a range of site allocations have been considered, using the SFRA to apply the Sequential and Exception Tests where necessary. The Sequential Test should be applied to the whole LPA area to increase the likelihood of allocating development in areas not at risk of flooding. The sequential approach can be applied at all levels and scales of the planning process, both between and within Flood Zones. All opportunities to locate new developments (except Water Compatible developments) in reasonably available areas of little or no flood risk should be explored, prior to any decision to locate them in areas of higher risk. Figure 4-1 illustrates the approach for applying the Sequential Test that CCC should adopt in the allocation of sites as part of the preparation of the Local Plan. This has been reproduced from Diagram 2 of the PPG.

Figure 4-1: Applying the Sequential Test in the preparation of a Local Plan (PPG Diagram 2)



The NPPF acknowledges that some areas may also be at risk of flooding from sources other than fluvial. All sources must be considered when planning for new development including flooding from land or surface water runoff, groundwater, sewers, and artificial sources. If a location is recorded as having experienced repeated flooding from the same source this should be acknowledged within the Sequential Test. Guidance on application of the Sequential Test is available in Paragraphs 27 – 29 of the PPG.

Ultimately, after applying the Sequential Test, CCC needs to be satisfied in all cases that the proposed development would be safe and not lead to increased flood risk elsewhere. This needs to be demonstrated within an FRA and is necessary regardless of whether the Exception Test is required.

Appendix A Figure 9 provides a map of flood risk layers to inform application of the Sequential Test.

4.1.1 Sequential Test Exemptions

It should be noted that the according to the PPG and Paragraph 175 of the NPPF that the Sequential Test does not need to be applied in situations where a site-specific flood risk assessment demonstrates that no built development within the site boundary, including access or escape routes, land raising or other potentially vulnerable elements, would be located on an area that would be at risk of flooding from any source, now and in the future. Paragraph 176 of the NPPF also notes that the Sequential Test does not need to be applied in the following circumstances:

- The site has been allocated for development and subject to the test at the plan making stage (provided the proposed development is consistent with the use for which the site was allocated and provided there have been no significant changes to the known level of flood risk to the site, now or in the future which would have affected the outcome of the test).
- The site is in an area at low risk from all sources of flooding, unless the Strategic Flood Risk Assessment, or other information, indicates there may be a risk of flooding in the future.
- The application is for a development type that is exempt from the test, as specified in footnote 62 of the NPPF. This includes:
    - Householder development,
    - Small non-residential extensions (with a footprint of less than 250m^2),
    - Changes of use; except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the Sequential and Exception tests should be applied as appropriate.

4.2 Exception Test

Following the application of the Sequential Test it may be concluded that there are no reasonable available alternative sites in areas of lower risk, and in some cases the Exception Test may be required.

Table 4-1 (reproduced from PPG Table 2) identifies when the Exception Test is required, based on the Flood Zone and the vulnerability classification of the proposed development, as defined in Table 2 of the PPG.

Table 4-1: Flood risk vulnerability and Flood Zone 'incompatibility'[38]

Flood Zone	Flood risk vulnerability classification				
	Essential Infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a	Exception Test required†	✗	Exception Test required	✓	✓
Zone 3b*	Exception Test required*	✗	✗	✗	✓*

Notes:
✓ = Exception Test not required
✗ = Development should not be permitted
†In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.
**In Flood Zone 3b (functional floodplain) essential infrastructure that has passed the Exception Test, and water-compatible uses, should be designed and constructed to:*

- *remain operational and safe for users in times of flood*
- *result in no net loss of floodplain storage*
- *not impede water flows and not increase flood risk elsewhere*

As set out in paragraph 178 of the NPPF, the application of the Exception Test should be informed by a strategic or site-specific FRA, depending on whether it is being applied during plan production or at the application stage. To pass the exception test it should be demonstrated that:

(a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

(b) the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Both elements of the Exception Test should be satisfied for development to be allocated or permitted.

In order to fulfil Part 1 of the Exception Test, the sustainability framework set out in CCC's Sustainability Appraisal (SA) Environmental report[39] should be used to assess each potential development site. The sustainability framework includes a list of objectives and indicators which can be employed to appraise the sustainability of a proposed development.

In order to address Part 2, a site-specific FRA should be prepared for the proposed development that demonstrates how the site will be safe. Consideration should be made of the following as appropriate:

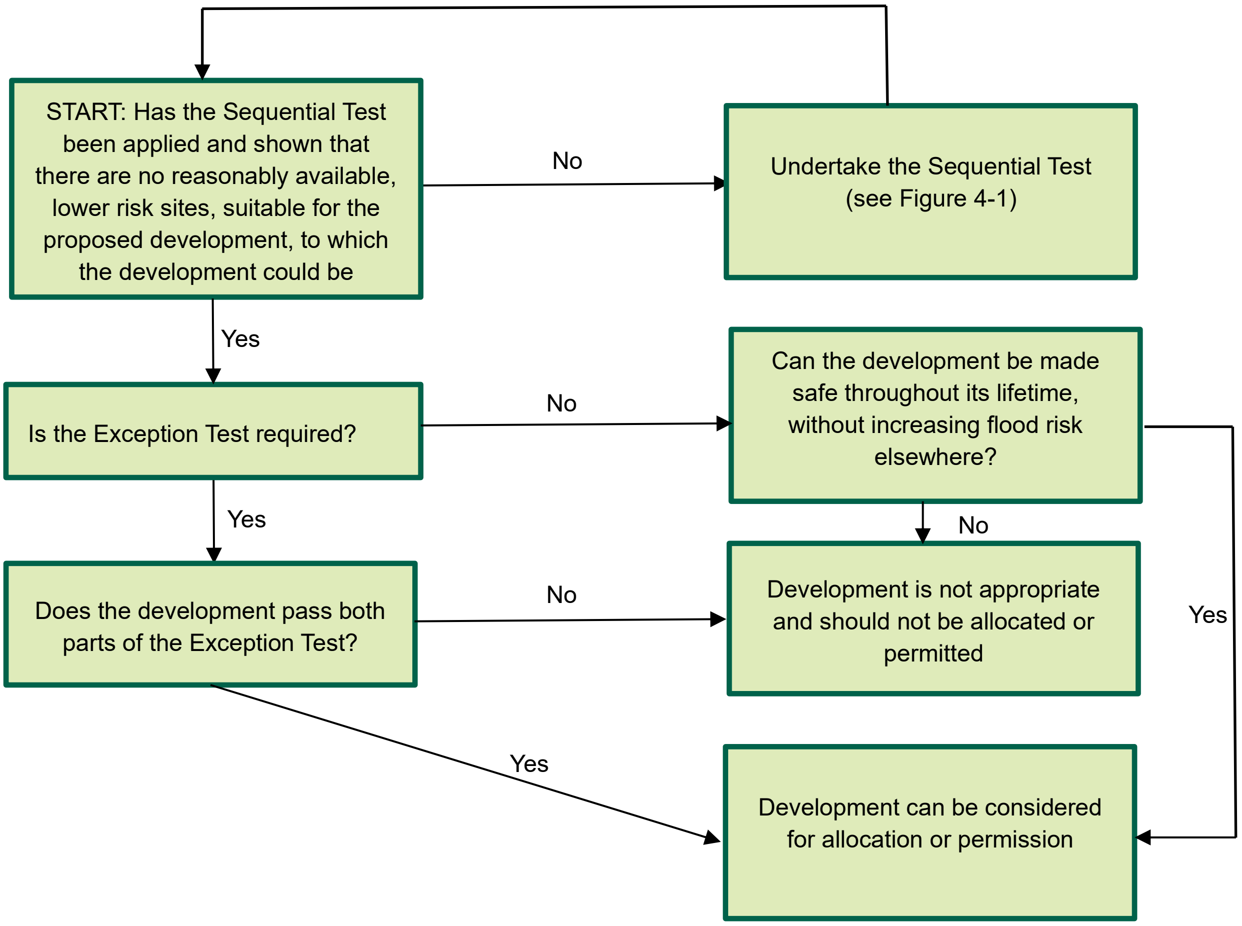
- Applying a sequential approach within the site layout.
- Development design to manage and reduce flooding.
- Safe access and egress.
- Design of flood defence infrastructure.
- Operation and maintenance.

[38] Planning Practice Guidance Table 2 Flood Risk Vulnerability and Flood Zone incompatibility: https://www.gov.uk/guidance/flood-risk-and-coastal-change#table2 [Accessed June 2024].
[39] Colchester Borough Council Sustainability Appraisal Environmental Report: https://cbccrmdata.blob.core.windows.net/noteattachment/Final%20Sustainability%20Apprasial%20Part%202%20Colchester%20Local%20Plan%20July%202016.pdf [Accessed June 2024].

- Flood warning and evacuation procedures.
- Funding or maintenance arrangements for implementing measures.

Figure 4-2 (reproduced from PPG Diagram 3) sets out how the Exception Test should be applied in the preparation of a Local Plan.

Figure 4-2: Applying the Exception Test in the preparation of a Local Plan (PPG Diagram 3)



4.3 Impact of development on flood risk elsewhere

When allocating land for development, consideration must be given to the potential for development to impact flood risk elsewhere. The increase in impermeable surfaces and resulting increase in runoff increases the chances of surface water flooding if suitable mitigation measures, such as SuDS, are not put in place. Additionally, the increase in runoff may result in more flow entering watercourses, increasing the risk of fluvial flooding downstream.

Consideration must also be given to the potential impact of the loss of floodplain as a result of development. The effect of the loss of floodplain storage should be assessed both at the development and elsewhere within the catchment and, if required, the scale and scope of appropriate mitigation should be identified.

While the increase in runoff, or loss in floodplain storage, from individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe without appropriate mitigation measures. This must be considered at the planning application and development design stages and the appropriate mitigation measures undertaken, within an appropriate FRA, to ensure flood risk is not exacerbated, and in many cases the development should provide betterment when flood risk is considered. Maintenance and upkeep for mitigation measures, such as SuDS, must be set out as part of a site-specific drainage strategy and management funding for the lifetime of the development must be agreed.

Where the Sequential and the Exception Tests have been applied as necessary and not met, development should not be allowed.

5 Preparing Flood Risk Assessments

5.1 What is an FRA?

A site-specific FRA is a report conducted by, or on behalf of, a developer to assess the flood risk from all sources to and from a development, and to demonstrate how the proposed development will be designed so that it remains safe over its lifetime, and not increase flood risk elsewhere. An FRA must be prepared by a suitably qualified and experienced person and must contain all the information needed to allow CCC to satisfy itself that the requirements have been met.

According to paragraph 181 of the NPPF, development should only be allowed in areas at risk of flooding where, in the light of an FRA, it can be demonstrated that:

- Within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
- The development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;
- It incorporates SuDS, unless there is clear evidence that this would be inappropriate;
- Any residual risk can be safely managed; and
- Safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

5.2 When is an FRA required?

According to footnote 63 of the NPPF a site-specific FRA is required in the following circumstances:

- Proposals for all developments in Flood Zones 2 and 3.
- Proposals of 1 hectare or greater in Flood Zone 1.
- Proposals for development in an area within which has critical drainage problems (as identified by the Environment Agency).
- Proposals in Flood Zone 1 where land is identified in an SFRA as being at increased flood risk in the future.
- Proposals for the change of use to a more vulnerable class on land that may be subject to other sources of flooding.

The Colchester Borough Local Plan[20] also notes that *small sites (less than 1ha) in Flood Zone 1 that are surrounded by Flood Zone 2 or 3 land, i.e., dry islands, are likely to be treated in the same way as the surrounding land. Each area will have its unique characteristics and a site-specific Flood Risk Assessment may be required even for those sites less than 1ha to ensure that safe access / egress exists for the development and that residents are safe during the duration of the flood period.*

5.3 What needs to be addressed in an FRA?

The PPG states that the objectives of a site-specific FRA are to establish:

- Whether a proposed development is likely to be affected by current or future flooding from any source.
- Whether it will increase flood risk elsewhere.
- Whether the measures proposed to manage these effects and risks are appropriate.
- The evidence for the local planning authority to apply (if necessary) the Sequential Test.
- Whether the development will be safe and pass the Exception Test, if applicable.

5.4 How detailed should an FRA be?

The PPG stipulates that site-specific FRAs should be proportionate to the scale and nature of the development, to the severity of flood risk, to the development's vulnerability classification, and to the status of the site in relation to the Sequential and Exception Test.

The report should employ readily available information such as the mapping presented within the LPA's SFRA and on the Environment Agency's website. In some cases, additional hydraulic modelling or detailed calculations may need to be undertaken. For example, an extension to an existing house (for which planning permission is required) which would not significantly increase the number of people in an area of flood risk, would typically need a less detailed assessment than a new development comprising a greater number of houses, such as an apartment block. Likewise, CCC may require a more detailed assessment at a location where the flood risk is greater, such as the execution of site-specific hydraulic modelling to precisely determine the level of flood risk to and from the site both pre and post-development, and to appraise the effectiveness of any proposed mitigation measures.

The Environment Agency provides standing advice for FRAs[40] which should be followed for all development classed as[41]:

- a minor extension (household extensions or non-domestic extensions less than 250m^2) in Flood Zone 2 or 3.
- 'more vulnerable' development in Flood Zone 2 (except for landfill or waste facility sites, caravan or camping sites).
- 'less vulnerable' development in Flood Zone 2 (except for agriculture and forestry, waste treatment, mineral processing, and water and sewage treatment).
- 'water compatible' development in Flood Zone 2.
- a change of use into one of these vulnerable categories or into the water compatible category.

The Environment Agency's standing advice stipulates that the following information should be included in an FRA:

- site address.
- a description of the development.
- an assessment of the flood risk from all sources of flooding for the development, plus an allowance for climate change.
- the estimated flood level for the development, taking into account the impacts of climate change over its lifetime.
- details of the finished floor levels.
- details of the flood resistance and resilience plans.
- any supporting plans and drawings.

The estimated flood level is the maximum anticipated depth of flooding on a development site in a 1% AEP (1 in 100 year) fluvial event (plus an allowance for climate change) or in a 0.5% AEP (1 in 200 year) tidal event (plus an allowance for climate change).

For all developments involving surface water drainage in flood risk areas and major developments involving surface water drainage, SuDS must be provided unless clear evidence detailing their unsuitability is provided to the LPA. The management of surface water, including the provision of SuDS, should be outlined in an FRA, or in a separate surface water drainage strategy.

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[40] Preparing a flood risk assessment standing advice: https://www.gov.uk/guidance/flood-risk-assessment-standing-advice#standing-advice-for-vulnerable-developments [Accessed June 2024].
[41] Flood risk assessments if you're applying for planning permission: https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications [Accessed June 2024].

Environment Agency Data Requests

The Environment Agency offers a series of 'products' for obtaining flood risk information suitable for informing the preparation of site-specific FRAs as described on their website: https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications.

- Product 1: contains a flood map, including Flood Zones, defences, statutory main river designations and water storage areas.
- Product 4: contains a detailed FRA map, including detailed flood data, flood defence locations and attributes, data on past flood events, modelled flood levels and extents, and flood defence breach hazard information if available.
- Product 5: contains the flood modelling and hydrology reports for the specific hydraulic model.
- Product 6: contains the model output data so the applicant can interrogate the data to inform the FRA.
- Product 7: comprises the hydraulic model.
- Product 8: contains flood defences breach hazard information. This allows the residual risk associated with defence breach to be assessed and is important for the consideration of mitigation if the site benefits from flood defences.

Modelling of Ordinary Watercourses

It should be noted that the scope of hydraulic modelling studies undertaken by the Environment Agency typically covers flooding associated with Main Rivers, and therefore Ordinary Watercourses that form tributaries to the Main Rivers may not always be included in the model.

Where a proposed development site is in close proximity to an Ordinary Watercourse the LLFA and/or local authority should be contacted to see whether any modelling data exists (on the assumption that this has not been considered by the Environment Agency). If either no hydraulic modelling exists, or the available modelling is considered to provide very conservative estimates of flood extents (due to the use of national generalised modelling such as JFLOW), applicants may need to prepare a hydraulic model to enable more accurate assessment of the probability of flooding associated with the watercourse and to inform the site-specific FRA. The requirements of this should first be discussed with the LLFA and the Environment Agency. If required, modelling should be carried out in line with industry standards and in agreement with the Environment Agency and ECC (as the LLFA).

Where a watercourse exists on, under, or adjacent to a property, the owner of that property is classified as a riparian owner. A 'watercourse' here is defined as any natural or artificial channel above or below ground through which water flows, such as a river, brook, ditch, gill or stream (which may be piped or culverted in sections). The responsibilities of riparian owners include:

- The clearance of silt and debris, including rubbish, from a watercourse
- The management of vegetation within the channel
- Ensuring the flow of water within the watercourse is not obstructed

Riparian owners have the right to protect their property from flooding or their land from erosion. However, riparian owners must not:

- Dispose of waste such as grass cuttings into the watercourse
- Fill in, obstruct, bridge, or pipe the watercourse without obtaining consent

Further information in relation to riparian ownership can be viewed on the ECC website[42] and on the GOV.UK website[43].

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[42] Essex County Council Guide to ordinary watercourse maintenance: https://flood.essex.gov.uk/media/1289/essex-county-council-ordinary-watercourse-maintenance-guide.pdf [Accessed June 2024].
[43] Environment Agency Owning a watercourse guidance: https://www.gov.uk/guidance/owning-a-watercourse [Accessed January 2025].

5.5 Pre-application advice

At all stages, CCC, and where necessary the Environment Agency, ECC and/or the statutory water undertaker, may need to be consulted to ensure the FRA provides the necessary information to fulfil the requirements for planning applications.

The Environment Agency, ECC and CCC each offer pre-application advice services which should be utilised to discuss particular requirements for specific applications.

- CCC: https://www.colchester.gov.uk/info/cbc-article/?catid=pre-app-advice-planning&id=KA-01221.
- ECC: https://www.essex.gov.uk/planning-land-and-recycling/planning-and-development/our-role-planning/planning-pre-application.
- Environment Agency: https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion.

The following government guidance sets out when LPAs should consult with the Environment Agency on planning applications: https://www.gov.uk/flood-risk-assessment-local-planning-authorities and https://www.gov.uk/guidance/consultation-and-pre-decision-matters.

6 Sources of flood risk and expected effects of climate change

This Section provides a description of the local geology and hydrology in the study area, and an assessment of the risk of flooding from all sources based on available datasets.

6.1 Topography

Appendix A, Figure 2 displays the topography throughout the CCC area. This figure shows the Light Detection and Radar (LiDAR) dataset for CCC, which has a spatial resolution of 1m and contains digital elevation data derived from surveys carried out between 2000 and 2022.

In general, lower elevations are situated around the channels of Main Rivers throughout the area including the River Colne, Roman River and River Stour, and in the south of the Borough around Mersea Island in the estuarine locations, where elevations are as low as -2m Above Ordnance Datum (mAOD). Higher elevations are present throughout the remaining areas of the Borough where elevations reach up to around 70mAOD.

6.2 Geology

The bedrock and superficial geology of the CCC area is presented in Appendix A Figure 3 and Appendix A Figure 4 respectively.

The Thames Group and London Clay Formation cover the CCC area. The London Clay Formation is the uppermost-sub-unit of the Thames Group. These geology types consist of clay, silt and sand. There are also small areas of Thanet Formation and Lambeth Group (clay, silt and sand), and Red Crag Formation (sand). There are superficial deposits across the borough including Cover Sand and Lowesoft Formation located mainly inland. Alluvium and River Terrace Deposits are present in and around the river valleys and Intertidal deposits are located around Mersea Island and along the River Colne where it is tidally influenced.

6.3 Hydrology

The principal watercourses and associated catchments are shown in Appendix A Figure 5 and described in Table 6-1. The primary river systems in the CCC area are the River Blackwater and the River Colne.

The River Colne originates in Great Yeldham located to the north-west of Colchester. The river flows south-east and enters the Colchester Borough to the north-west of the city of Colchester. The river continues south until it converges with the Blackwater Estuary at the southern boundary of the Borough. The River Colne is tidally influenced. The Normal Tide Limit of the River Colne is located approximately at the Riverside Place bridge, approximately 1km to the east of the centre of Colchester. The River Colne has several tributaries within the Colchester Borough including the Roman River, Porters Brook, Salary Brook and St Botolph's Brook.

The River Blackwater rises as the River Pant to the east of Saffron Walden in Uttlesford and flows south-east through Braintree and Maldon and into the Blackwater Estuary which forms the southern border of Colchester. The River Blackwater is tidally influenced. The Normal Tide Limit of the River Blackwater is located in Maldon near the Blackwater Trading Estate.

Table 6-1: Watercourses in the CCC area

Watercourse	Classification	Tidal (Y/N)	Description
River Blackwater	Main River	Y	21km long Main River that rises outside of the CCC area near Saffron Walden and flows in a south easterly direction until it discharges into the Blackwater Estuary near Tollesbury (TM 00483 10610). The Normal Tide Limit is located in outside of the CC area in Maldon near the Blackwater Trading Estate (TL 85866 07517).

Watercourse	Classification	Tidal (Y/N)	Description
River Colne	Main River	Y	62km long Main River that rises outside of the CCC area in Great Yaldham and flows in a south easterly direction through the centre of the city of Colchester and discharges into the Blackwater Estuary near Brightlingsea at the southern border of CCC area (TM 07767 15717). The Normal Tide Limit is located at the Riverside Place bridge (TM 00682 25428).
Roman River	Main River	Y	19.5km long Main River that rises to the west of Great Tey (TL 86635 25154) and flows in an easterly direction to its confluence with the River Colne near Wivenhoe (TM 03536 21368). The river is located entirely within the CCC area with its catchment primarily rural. The river is tidally influenced with its Normal Tide Limit located where the river flows beneath the B2035 (TM 01120 20397).
Layer Brook	Main River/Ordinary Watercourse	N	15km long river which rises as an Ordinary Watercourse to the south of Tiptree (TL 89471 14770) and flows in an easterly direction. It becomes Main River approximately 1.5km east of the source and continues in an easterly direction to its confluence with the Roman River near Berechurch (TL 99652 20180). The river is located entirely within the CCC area with its catchment primarily rural. The river flows through the Abberton Reservoir during its course.
Salary Brook	Main River	N	15km long Main River that rises outside of the CCC area in Ardleigh (TM 05152 29857) and flows in a south westerly direction to its confluence with the River Colne near Wivenhoe Park (TM 02160 23890). The catchment is primarily rural and runs along the western border of the city of Colchester.
St Botolphs Brook	Main River	N	6km long Main River that rises in Great Horkesley (TL 97537 30640) that flows in a southerly direction to its confluence with the River Colne in West Bergholt (TL 96191 26210). The river is located entirely within the CCC area with its catchment primarily rural.
Birch Brook	Main River	N	1km long Main River that rises in Rowhedge (TM 02317 22687) that flows in an easterly direction to its confluence with the River Colne at TM 03080 22523. The river is located entirely within the CCC area with its catchment being rural.
River Stour	Main River	Y	76km long Main River that rises outside of the CCC area in Cambridgeshire and flows in an easterly direction along the northern border of the CCC area until it discharges into the sea approximately 13km to the east of the CCC border. The Normal Tide Limit is located where the river flows beneath the A137 (TM 09947 32689).
Virley Brook	Main River	Y	5.5km long Main River that rises near Salcott (TL 94316 13806) and flows in an easterly direction to its confluence with the Blackwater Estuary. The river is located entirely within the CCC area with its catchment being rural and estuarine in nature. The Normal Tide Limit is located in Salcott (TL 95169 13700).
Domsey Brook	Main River	N	7.5km Main River which rises on the Braintree/Colchester border (TL 89526 22074) and flows in a south westerly direction to its confluence with the River Blackwater (TL 86814 18835) in the Braintree LPA area.
Porters Brook	Main River	N	1km long Main River in Parsons Heath which rises immediately south of the railway running through Colchester (TM 01563 26423) and flows in a south westerly direction to its confluence with the River Colne (TM 01307 24978). The river is entirely within the CCC area with its catchment being in the urban area of Parsons Heath.
Wivenhoe Town Drain	Ordinary Watercourse	N	0.6km long Ordinary Watercourse rising just south of Brook Street in Wivenhoe (TM 04043 21530) and flows in an easterly direction to its confluence with a network of land drains to the south east of Wivenhoe (TM 04310 21456) which ultimately discharges into the River Colne. The river is entirely within the CCC area with its catchment being primarily urban.

6.4 Historical Flooding

Information on previously recorded flood events is provided in this section. This information has been taken from data provided by ECC and the Environment Agency's Recorded Flood Outlines.

6.4.1 Fluvial and Tidal flooding

A number of relatively widespread fluvial flooding events have occurred within the study area. The Environment Agency's Recorded Flood Outlines dataset documents the following events, as seen in Appendix A Figure 6:

- February 1947 – The channel capacity of the River Colne, Roman River, St Botolphs Brook, Salary Brook, Domsey Brook was exceeded, causing floodplain inundation in numerous locations along the reaches.
- January/February 1953 – Tidal flooding of the River Blackwater, River Colne, Roman River and River Stour causing floodplain inundation in numerous locations along the reaches.
- September 1968 – Channel capacity of the River Stour exceeded, causing floodplain inundation along the River Stour at the northern border of the Colchester Borough.
- January 2009 – Channel capacity of the River Stour and Roman River exceeded, causing isolated areas of floodplain inundation along the reaches.
- December 2013 – Overtopping of flood defences of the River Colne and River Blackwater, causing isolated areas of flooding near Wivenhoe and West Mersea.

ECC provided a Flood Investigation Report for the Marks Tey[44] area in Colchester due to internal flooding of at least one property and one commercial premises on more than one occasion (2008 and 2009) and the gardens/outhouses of a large number of properties in the area, in addition to regular highway flooding of Mott's Lane, Godmans Lane and Wilson's Lane up until the 2013 winter. This investigation concluded that the flooding is likely due to the constricted nature of two ordinary watercourses which enter a sewer system within the Marks Tey area before opening back into an open channel. The condition of the majority of open sections of ordinary watercourse and at least one culvert within the investigation area is poor and should be cleared, cleansed and where applicable re-graded.

6.4.2 Surface Water Flooding

ECC provided a register detailing all recorded historic flooding events within CCC in the past 10 years. The most common source of historic flooding within this dataset is shown to be surface water. Appendix A, Figure 6 shows this dataset, with the areas that have experienced surface water flooding highlighted. It should be noted that records only appear where they have been reported to ECC, and as such they may not include all instances of surface water flooding. A large majority of recorded incidents are shown to have occurred within the urban areas of the CCC area including within the city of Colchester, Tiptree and West Mersea. Incidents within the more rural areas of the borough are predominantly located along roads.

The Marks Tey Flood Investigation Report identified that surface water flooding has been observed affecting property internally on a number of occasions and the highway network on a frequent basis.

There is a history of flooding affecting Haven Road in Colchester in the area where it is crossed by Distillery Lane. There is insufficient capacity for attenuation of the normal baseflow in the culverted Bourne Stream Ordinary Watercourse downstream of Distillery Pond at times when its outfall to the River Colne is tide-locked during normal spring tides. This results in frequent flooding of Haven Road near to its junction with Distillery Lane, regardless of whether it is raining or not. This issue is occasionally further exacerbated by defective operation of the tidal flap valve behind the outfall[45].

ECC provided a Flood Investigation Report for Haven Road and Distillery Pond[46] which has a long history of internal flooding to multiple properties. The most severe instance of recent flooding occurred in May 2016 and affected several properties. The area was identified in the Colchester SWMP as a CDA. The investigation concluded that the flooding was likely caused by the overflow system from Distillery Pond being over capacity and further stress

[44] ECC (2013) Flood Investigation Report Marks Tey – Wilson's Lane, Goodmans Lane, Mott's Lane, Coggeshall Road.
[45] Fenland Hydrotech (2013) Flooding in Haven Road Report for Colchester Borough Council.
[46] ECC (2016) Flood Investigation Report Haven Road & Distillery Pond.

on the system is likely to have been caused by the pumping of surface water from the new development in Albany Gardens to discharge into the pond. In addition to this, constrictions in the private system caused by the reducing culvert diameters downstream and the poor functioning of the flap valve allowing tidal waters to enter the sewer causes capacity and maintenance issues. The pond also overtopped and manhole chambers along the downstream culvert line overflowed in Autumn/Winter 2023/24 and flooding of a property occurred when the pond overflowed in 2017.

6.4.3 Sewer Flooding

Water companies are required to maintain a register of locations which are at risk of flooding due to hydraulic overloading of sewers (sewer pipe is too small or positioned at too shallow a gradient). The identification of these locations of previous flooding can inform LPAs of areas where additional development may have a significant impact on the capacity of the sewer system, and where water companies may need to prioritise investment in measures to improve the system's capacity to support proposed developments. However, it should be noted that historic incidents may have been addressed through water companies' asset management programmes and may no longer reflect an area where sewer incapacity is a problem or where flooding is probable.

Anglian Water has provided an extract from their DG5 Flood Register for the study area, which records historic internal and external sewer flooding events. Due to data protection requirements the data has not been provided at individual property level; rather the register comprises the number of properties within postcode district areas that have experienced flooding either internally or externally within the last 10 years (2014-2024). It should be noted that records only appear on the DG5 register where they have been reported to Anglian Water, and as such they may not include all instances of sewer flooding. Furthermore, given that Anglian Water target these areas for maintenance and improvements, areas that experienced flooding in the past may no longer be at greatest risk of flooding in the future.

Appendix A Figure 7 shows the number of sewer flooding incidents reported by Anglian Water over the last 10 years in each postcode district in the CCC study area. However, it should be noted that Anglian Water focus their efforts on removing properties from the DG5 register and therefore this information may not accurately represent those properties currently at risk. The figure shows that there is a high frequency of sewer flooding incidents in the CCC study area. 7 out of the 8 postcodes within the CCC area have experienced upwards of 150 sewer flooding incidents, with the postcodes occupying most of the borough boundary (CO5, CO6 and CO7), having experienced between 270 and 343 sewer flooding incidents.

6.5 Flood Mapping

6.5.1 Fluvial/Tidal Flooding

Appendix A Figure 8 shows Flood Zones 2 and 3 for the principal watercourses within the study area (see Table 3-1 for more information on Flood Zones). Areas of Flood Zones 2 and 3 are primarily confined to the channels and immediate floodplain surrounding the Main Rivers and ordinary watercourses throughout the catchment. An extensive area of Flood Zone 3 is concentrated in the estuarine locations around Mersea Island.

The Environment Agency's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset[47] shows that parts of the floodplain of the River Colne, Roman River, Salary Brook and the Blackwater Estuary have a reduced risk of fluvial flooding due to the presence of flood defences. The Colne Barrier was constructed to prevent tidal surge inundation of Wivenhoe and Colchester. This has significant impacts on fluvial flow in the Colne during tide locked conditions, where it can cause backing up of fluvial flow. More information regarding flood defences can be viewed in Section 8.1.

Future flood risk

Climate change is expected to increase the frequency, extent, and impact of flooding, as reflected in higher peak river flows. Wetter winters and more intense rainfall may increase fluvial flooding and surface water runoff and there may be increased storm intensity in summer. Rising sea levels at the Blackwater Estuary may also increase

[47] Reduction in Risk of Flooding from Rivers and Sea due to Defences: https://environment.data.gov.uk/dataset/7b5cf457-6853-4b50-a812-b041d9da003a [Accessed July 2024]

flood risk. Fluvial flood risk may also be increased in low lying areas close to tidal rivers as rising tidal levels will prolong tide locking durations at outfalls.

Appendix A Figure 10 provides the modelled extent of the combined fluvial and tidal climate change extent (central, 2115s) and Appendix A Figure 11 provides the modelled extent of the combined fluvial and tidal climate change extent (higher central, 2115s). As described within Section 3.1, a conservative approach has been taken where future flood risk has been represented by a merged maximum extent between Flood Zone 2 (0.1% AEP) and the available modelled climate change allowances.

Within Appendix A Figure 10 and Appendix A Figure 11, small increases are seen in flood extents along the watercourses in the study area when compared to present day (Appendix A Figure 8). There are small increases in flood extents when comparing the central (Appendix A Figure 10) and higher central (Appendix A Figure 11) food extents. Only one future modelled tidal flood extent was available as described in Section 3.1 therefore this extent has been mapped on both the central and higher central maps. Further assessment of future flood risk should be undertaken as part of site-specific assessments.

Appendix A Figure 12 provides the modelled extent of the combined fluvial and tidal 0.1% AEP climate change extent (higher central, 2115s) to indicate the potential future Flood Zone 2 extent. This shows small increases are seen in future Flood Zone 2 extents along the watercourses in the study area when compared to present day (Appendix A Figure 8).

Residual risk

Tidal flood defences along the River Colne protect the area from tidal flooding and prevent tidal waters utilising the natural flow paths and network of drainage channels within the Borough. In the event of a breach in the flood defences, the low-lying areas in the south of the Borough and drainage channels would provide pathways for floodwater into the greater floodplain area.

The Colchester Borough possesses extensive defences to manage flood risks from tidal inundation, including tidal defences walls in built-up areas such as the city of Colchester and Wivenhoe, earth embankments in more rural locations such as around Mersea Island, and the Colne Barrier at Wivenhoe.

The Colne Barrier protects areas upstream, in particular the city of Colchester from flooding caused by tidal surges. The barrier is 8m high and 130m wide, with a navigation opening of 30m. The main mechanism consists of two mitre gates that operate in a similar method to those used as locks on canals and rivers. The threshold levels for manning and operating the barrier are 3.1m AOD and 3.2m AOD respectively. There is therefore a residual risk of tidal flooding in the area upstream in the event of a failure of the Colne Barrier. Further assessment of the residual risk should be undertaken as part of site-specific assessments.

There are some areas of land in Colchester which lie lower than the operational trigger for the Colne Barrier (3.2m AOD) including Haven Road and Hawkins Road in the city of Colchester. Therefore, as noted in Section 6.4.2, there is a residual risk of flooding if outfall non-return valves fail or where surface water outfalls are tide-locked where there has been significant rainfall.

6.5.2 Functional Floodplain

Flood Zone 3b functional floodplain is defined as land where water has to flow or be stored in times of flooding. Flood Zone 3b will normally comprise land that would flood during a 3.3% AEP (1 in 30 year) event or greater in any year, with flood risk management features and structures operating effectively. In this SFRA, Flood Zone 3b has been defined as the defended 3.3% AEP event including existing buildings, to be used as an initial assessment for the purpose of Council wide mapping and Sequential Test application, that can be revisited if local modelling or site-specific assessments provide new evidence.

As described in Section 3.1, the majority of the flood models provided include flood extents for the 3.3% AEP event. The only exceptions are Birch Brook and Virley Brook. For these watercourses it was agreed with the Environment Agency that a conservative approach would be applied where a more extreme event would be considered i.e. the 1.33% AEP event or 2% AEP event. Appendix A Figure 13 displays the Flood Zone 3b extent across the study area and indicates that Flood Zone 3b is generally confined to the river channels. It is important to note that for part of the River Colne between East Street in Colchester and Wivenhoe Flood Zone 3b has not been able to be defined due to missing modelling results. Therefore, any development coming forward within this area would need to undertake site-specific hydraulic modelling to confirm the Flood Zone 3b extent.

The Environment Agency guidance ‘How to prepare a Strategic Flood Risk Assessment’[3] encourages the use of site-specific FRAs to determine whether a site is classified as functional floodplain. If sites are proposed for development in such areas in any of the LPA’s Local Plans, it may be necessary to undertake additional assessment (which may include hydraulic modelling) to map the location of the functional floodplain as part of a Level 2 SFRA.

Future Flood Risk

In line with the future flood risk of river flooding, the area of functional floodplain is expected to increase as a result of climate change. Consequently, Flood Zone 3b is expected to have a greater extent in the future.

6.5.3 Groundwater Flooding

The BGS dataset ‘Groundwater Flooding’ is mapped in Appendix A Figure 14. This map does not show the risk of groundwater flooding, rather it identifies areas where geological conditions could enable groundwater flooding to occur.

Appendix A Figure 14 identifies areas across Colchester as having ‘potential for groundwater flooding to occur at the surface’ with these areas generally associated with the floodplains of the watercourses and their tributaries across Colchester such as the River Colne, River Stour, Roman River, Layer Brook, and Blackwater Estuary. These areas include parts of the City of Colchester, Wivenhoe, Tiptree, Mersea Island, Dedham, and Langham.

There are also areas identified as having ‘potential for groundwater flooding of property situated below ground level’. These areas are mainly identified in the City of Colchester, with some areas also identified in Wivenhoe, Tiptree, Mersea Island, Langham, Dedham, and Great Horkesley.

Future Flood Risk

Most climate change models indicate an increased likelihood of drier summers, albeit with more intense rainfall when it occurs, and wetter winters. As groundwater flooding occurs primarily as a response to extended periods of rain during late autumn and early winter, there may be an increased risk of groundwater flooding arising from these changing rainfall patterns. However, the complex relationship between rainfall, recharge, groundwater storage and flow make the response to climate change uncertain. It is recommended that this figure should be updated once the groundwater dataset is updated.

6.5.4 Surface Water

The Environment Agency’s Risk of Flooding from Surface Water (RoFSW) dataset is presented in Appendix A Figure 15. This map shows that the risk of surface water flooding is concentrated around watercourses in the district, most notably the River Colne, Roman River, Layer Brook and the network of watercourses leading to the estuarine channels in the south of the CCC area. The risk of surface water flooding also increases markedly in urbanised areas, with this being most pronounced in the city of Colchester. The figure also displays CDAs and shows that there are 11 CDAs in the CCC area, most of which are concentrated in the city of Colchester and surrounding areas, and one in Wivenhoe.

Future flood risk

Section 3.2 describes the impact of climate change on surface water flood risk and summarises the peak rainfall intensity climate change allowances for the study area which range from 20% - 45% depending on the specific location and epoch under consideration.

Climate change must be considered in evaluating the flood risk from all sources, including surface water. The RoFSW does not include a specific scenario to determine the impact of climate change on the risk of surface water flooding and it is not within the scope of this SFRA to undertake widespread surface water modelling to apply all the allowances within the guidance. However, a range of three annual probability events have been modelled within the RoFSW, 3.3%, 1% and 0.1%, and therefore it is possible to use with caution the 0.1% outline as a proxy dataset to provide an indication of the implications of climate change.

It is also important to note that surface water flood risk may be increased in low lying areas close to tidal rivers as rising tidal levels will prolong tide locking durations at outfalls.

6.5.5 Reservoir Flooding

12 Reservoir Act registered impoundments with the potential to cause flooding within the CCC area have been identified, which are presented in Table 6-2.

Table 6-2: List of Reservoir Act registered impoundments with the potential to cause flooding within CCC

Name	Location	Grid Reference	Flood Risk in CCC?
Halstead Flood Alleviation Reservoir	Halstead (outside of CCC)	TL 80922 31271	Flooding is largely restricted in both the 'dry day' and 'wet day' scenarios to the valley of the River Colne. There are several vulnerable receptors in Halstead.
Gosfield Lake	Gosfield (outside of CCC)	TL 77620 29183	Flooding is restricted in both the 'dry day' and 'wet day' scenarios to the valley of the Bourne Brook. There are no vulnerable receptors within the affected area.
Preston's Lake	South of Pebmarsh (outside of CCC)	TL 85450 32057	Flooding is largely restricted in both the 'dry day' and 'wet day' scenarios to the valley of the River Peb. There are no vulnerable receptors present in the CCC area.
Brick Kiln Reservoir	West Bergholt	TL 97522 28654	Flooding is restricted in both the 'dry day' and 'wet day' scenarios to the valley of the St Bolotoph's Brook. There are no vulnerable receptors within the affected area.
Abberton Reservoir	Layer de la Haye	TL 98780 19734	Flooding is restricted to the east of the reservoir in both the 'dry day' and 'wet day' scenarios to the valley of the Roman River. There are some vulnerable receptors within the affected area, particurarly in Rowhedge. Flooding to the south of the reservoir is present with a few isolated vulnerable resceptors present.
Abberton Central and Western Arm	Layer de la Haye	TL 96165 17206	Flooding is largely restricted in both the 'dry day' and 'wet day' scenarios to the valley around the Abberton Central and Western Arm. Flooding to the south of the reservoir is present with some vulnerable receptors present in Little Wigborough.
Bockingham Hall	Bockingham Hall Farm, nr Copford Green	TL 93060 21890	Flooding occurs to the east of the reservoir, a few isolated vulnerable receptors are present.
Ardleigh	Ardleigh (outside of CCC)	TM 03487 28024	Flooding is largely restricted in both the 'dry day' and 'wet day' scenarios to the valley of the Salary Brook. Some vulnerable receptors are present in Greenstead.
Park Lane 1 (ID122)	South of Langham	TM 02191 30466	Flooding occurs downstream of the reservoir with a few isolated vulnerable receptors present within the CCC area.
Wick Lane Reservoir	Ardleigh (outside of CCC)	TM 04142 29398	Flooding is largely restricted in both the 'dry day' and 'wet day' scenarios to the valley of the Salary Brook. There are a few isolated vulnerable receptors present within the CCC area.
Langham Raw Water	Near Langham	TM 02220 34070	Flooding is largely restricted in both the 'dry day' and 'wet day' scenarios to the valley of the River Stour. Some vulnerable receptors are present within the CCC area.
Thorington Street	Thorrington Street (outside of CCC)	TM 01214 35096	Flooding is largely restricted in both the 'dry day' and 'wet day' scenarios to the valley of the River Stour. Some vulnerable receptors are present within the CCC area.

Appendix A Figure 16 shows the potential extent of flooding in the unlikely event of a failure of these reservoirs when river levels are normal ('dry' day scenario) and when rivers have already overtopped their banks ('wet' day scenario). The mapping shows that the area at risk generally follows the floodplains and valleys of the River Colne, River Stour, Roman River and Salary Brook, with a large proportion of flooding occurring regardless of the river levels.

7 Cumulative impact of development and land use change

This Section describes the importance of considering cumulative impacts on flood risk as a result of development and land use change.

7.1 Cumulative impact assessment

The NPPF states that strategic policies should be informed by an SFRA and should consider cumulative impacts in, or affecting, local areas susceptible to flooding and take account of advice from the Environment Agency and other relevant flood risk management authorities. The 'How to prepare a Strategic Flood Risk Assessment' guidance[3] also states that an SFRA should include as assessment of the cumulative impacts of development and land-use change which should include any impact expected from:

- Strategically planned development;
- Windfall development;
- Permitted development; and
- Significant changes in land use, such as paving over domestic gardens or reforestation of uplands.

Development, or the cumulative impacts of development, may result in an increase in flood risk elsewhere as a result of impacts such as the loss of floodplain storage, deflection or constriction of flood flow routes and/or through inadequate management of surface water.

Where flood storage from any source of flooding is to be lost as a result of development, on-site level for level, volume for volume compensatory storage for the 1% AEP flood event accounting for the predicted impacts of climate change over the lifetime of the development, should be provided. Where it is not possible to provide compensatory storage on site, it may be acceptable to provide off-site if it is hydraulically and hydrologically linked. More information is provided in Section 9.3.1.

Identification of those areas where changes in land use could potentially increase surface water runoff rates and volumes can strategically aid spatial planning in avoiding areas where significant mitigation of surface water runoff following development may be required. The provision of multifunctional sustainable drainage systems, natural flood management and green infrastructure can also make a valuable contribution to mitigating the cumulative impacts of development on flood risk.

Whilst individual development with appropriate site mitigation measures should not result in measurable local effects with respect to hydrology and flood risk, the cumulative effects of multiple development may be more severe at downstream locations in the catchment. Locations where there are existing flood risk issues will be particularly sensitive to cumulative effects.

The cumulative impact should be considered throughout the planning process, from the allocation of sites within the Local Plan, to the planning application and development design stages.

7.2 Cross boundary considerations

Many of the catchments within the CCC area cross borders between LPA administrative areas, such that future development in another LPA could impact flood risk in the CCC area, and vice versa. It is important that LPAs work together and take a catchment-wide approach when considering the wider impacts of any proposed development.

Three of the River Colne's tributaries rise near Stambourne Green, Birdbrook and Cornish Hall End within the Braintree LPA before converging in Great Yeldham and flowing south-east into the Colchester LPA area where the River Colne discharges into the Blackwater Estuary to the south of the Colchester LPA area. Developments in the Braintree LPA area could have an impact downstream on flood risk in the CCC area.

The River Blackwater rises as the River Pant to the east of Saffron Walden in the Uttlesford LPA and flows south-east through the Braintree LPA and Maldon LPA areas and into the Blackwater Estuary to the south of the Colchester LPA area. Developments in the Braintree LPA and Maldon LPA areas could have an impact downstream on flood risk in the CCC area.

The River Stour rises near Balsham in the South Cambridgeshire LPA and flows east through the West Suffolk LPA, along the border of the Babergh LPA and Colchester LPA, and along the border of the Babergh LPA and Tendring LPA before discharging into the Colne Estuary. Developments in the South Cambridgeshire LPA, West Suffolk LPA and Babergh LPA areas could have an impact downstream on flood risk in the CCC area. Developments in the Colchester LPA area could have a downstream impact on the Tendring LPA and Babergh LPA areas.

As a result, any new development will need to produce a site-specific assessment inclusive of a Surface Water Drainage Strategy which ensures that flood risk will not increase to third parties as a result of the proposed development.

8 Flood Management and Defences

This Section provides information on existing flood management and flood defence measures present across the Study Area.

8.1 Defences

There are several flood defences present within the CCC area which are mapped in Appendix A Figure 9. The following details regarding flood management and defences within the CCC area were extracted from the Environment Agency's Asset Information Management System (AIMS) dataset:

- Embankments are present around Mersea Island, along the River Colne in some locations and along the Roman River on both banks from Mersea Road until the confluence with the River Colne. These provide a Standard of Protection of between 100% AEP (1 in 1 year) and 20% AEP (1 in 50 year) events and are considered to be in 'Poor', 'Fair' and 'Good' condition.

- There is an engineered high ground defence located near to St James' Primary School in the city of Colchester to provide protection from an unnamed ditch running adjacent to the school playing field.

- Natural high ground is located along all of the watercourses listed in Table 6-1, including the key watercourses of the River Colne, River Blackwater and Roman River.

- There is a section of flood wall located along the River Colne near Hythe Station Road providing some protection to the industrial state adjacent to the River Colne.

- There is also a section of embankment adjacent to the north side of the River Colne at the western end of Castle Park providing some protection to the areas of Causton Road up to North Station Road. This provides a Standard of Protection up to the 1% AEP (1 in 100 year) event and is considered to be in 'Fair' condition.

- There is also a section of embankment on the south side of the River Colne through Castle Park providing some protection to the Riverside Estate and to properties to the east of Castle Park. This is maintained by Colchester City Council and provides a Standard of Protection up to the 0.1% AEP (1 in 1000 year) event.

- There is a flood storage embankment in the open space adjacent to Salary Brook upstream of St Andrew's Avenue.

- The Colne Barrier at Wivenhoe protects areas upstream, in particular the city of Colchester from flooding caused by tidal surges. This provides a Standard of Protection up to the 0.1% AEP (1 in 1000 year) event and is considered to be in 'Good' condition.

8.2 Flood Warning Service

The Environment Agency operates a Flood Warning Service[48] in respect to Main River (and tidal) flooding across England. Three different codes are issued depending on the type of flooding forecasted:

- Flood Alert – Flooding is possible, be prepared.
- Flood Warning – Flooding is expected, immediate action is required.
- Severe Flood Warning – Severe flooding, danger to life.

The Environment Agency's website offers up-to-date flood information, monitoring information of river and sea levels and latest flood risk forecast, as well as a page to sign up to warnings by phone, text, email, or fax.

There are 11 Flood Warning Areas in the CCC area which are shown in Appendix A Figure 17 including:

- The Essex coast at East Mersea;

[48] Environment Agency Flood Warning Service: https://check-for-flooding.service.gov.uk/ [Accessed June 2024].

- The Essex coast at West Mersea, including The Strood and surrounding marshland;
- Salcott cum Virley;
- The River Colne from Halstead to Lexden;
- Riverside properties on the River Colne in Colchester;
- The River Colne, through Colchester;
- The tidal River Colne from Brightlingsea to Wivenhoe;
- The tidal River Colne upstream of the Colne Barrier;
- The River Stour from Sudbury to Boxted;
- The River Stour from Boxted to Dedham; and
- The River Stour upstream of Cattawade Barrage to Dedham.

The Environment Agency publishes ‘Water situation: area monthly reports for England’[49] for each of its areas. These reports identify monthly rainfall, soil moisture deficit, river flows, groundwater levels and reservoir levels. The Environment Agency also publishes ‘Groundwater situation’[50] reports which provide the latest update on monitored groundwater levels and whether there are any groundwater alerts or warnings in force. These reports will give an indication as to when groundwater levels may be high and groundwater flooding may be imminent.

The Environment Agency also provide a targeted groundwater flood warning service through issue of groundwater “Flood Alerts” for specific locations and communities. According to the Environment Agency’s Hydrometric Monitoring Points dataset[51], there are currently six groundwater monitoring stations within the CCC area:

- Great Tey;
- Chappel Viaduct;
- Bures Water Tower;
- Pops Bridge Gt Horkesle;
- Dedham; and
- Middle Harling Fen.

8.3 Residual Risk

The risk of flooding from rivers and the sea can never be fully mitigated, and there will always be a residual risk of flooding that will remain after measures have been implemented to protect an area or a particular site from flooding. This residual risk is associated with a number of potential risk factors including (but not limited to):

- a flooding event that exceeds that for which the flood risk management measures have been designed e.g. flood levels above the designed defence crest level,
- the structural deterioration of flood defence structures (including informal structures acting as a flood defence) over time resulting in a defence breach,
- blockage of key defence/conveyance structures,
- the occurrence of large, unpredictable cliff falls, and/or
- general uncertainties inherent in the prediction of flooding.

The modelling of flood flows and flood levels is not an exact science, therefore there are inherent uncertainties in the prediction of flood levels used in the assessment of flood risk. While the Flood Map for Planning Flood Zones provide a relatively robust depiction of flood risk for specific conditions all modelling requires the making of core

[49] Water situation: area monthly reports for England 2022: https://www.gov.uk/government/publications/water-situation-local-area-reports [Accessed May 2024].
[50] Groundwater situation reports: https://www.gov.uk/government/collections/groundwater-current-status-and-flood-risk [Accessed May 2024].
[51] Environment Agency Hydrometric Monitoring Points: https://www.data.gov.uk/dataset/0bac3947-c632-47eb-83d5-fff7f1911537/hydrometric-monitoring-points [Accessed May 2024].

assumptions and the use of empirical estimations relating to (for example) rainfall distribution and catchment response. No residual modelling (breach or overtopping of defences or structural blockages) has been undertaken as part of this SFRA. This should be included as part of a site-specific FRA, or a Level 2 SFRA, should development be located in an area where residual flood risk is considered to be an issue.

Steps should be taken to manage these residual risks through the use of flood warning and evacuation procedures, as described in Section 10.

9 Opportunities to reduce the causes and impacts of flooding

This Section identifies opportunities to reduce the causes and impacts of flooding in the local area and land required for flood risk management purposes.

9.1 Maintenance of watercourses

9.1.1 Main Rivers

The Environment Agency is likely to seek an 8m wide undeveloped easement alongside Main Rivers for maintenance purposes and is likely to also ask developers to explore opportunities for riverside restoration as part of any development.

Under Section 109 of the Water Resources Act 1991 and/or Environment Agency Byelaws, some works within 8m of any statutory Main River, flood defence or culvert (16m if it is a tidal Main River or defence structure) requires Environment Agency consent in the form of a Flood Risk Activity Permit. Under the Environmental Permitting (England and Wales) Regulations (2016), an environmental permit is required for certain types of works if they are to be carried out:

- on or near a Main River,
- on or near a flood defence structure,
- in a floodplain,
- on or near a sea defence.

Since requirements of the consenting process in relation to flood risk, biodiversity and pollution may result in changes to development proposals or construction methods, the Environment Agency aims to advise on such issues as part of its statutory consultee role in the planning process. Should proposed works not require planning permission the Environment Agency can be consulted regarding permission to do work on or near a river, a flood or sea defence or in the flood plain of a Main River by contacting enquiries@environment-agency.gov.uk.

Policy Recommendation: Where practical, retain at the very minimum an 8m undeveloped easement alongside Main Rivers or flood defence structure (at least 16m if it is a tidal Main River or defence structure) and explore opportunities for a larger buffer strip and/or riverside restoration. Undeveloped easements greater than 8m/16m will be encouraged where possible to provide biodiversity, flood risk and water quality benefits.

9.1.2 Ordinary Watercourses

Ordinary Watercourses are watercourses that are not part of a Main River and include streams, ditches, drains, cuts, culverts, dykes, sluices, sewers (other than public sewers) and passages, through which water flows.

In the case of Colchester, responsibility for the consenting of works by third parties on Ordinary Watercourses under Section 23 of the Land Drainage Act 1991 (as amended by the Flood and Water Management Act 2010) lies with ECC as the LLFA. ECC is responsible for the consenting of works to Ordinary Watercourses and it has powers to enforce the removal or correction of un-consented and non-compliant works. ECC's consenting powers includes any works (including temporary) that place or alter a structure within an Ordinary Watercourse or affect the flow or storage of water within an Ordinary Watercourse. ECC will also request an undeveloped easement to be retained alongside Ordinary Watercourses. Further information can be found on the ECC's website[52].

ECC intends to work with riparian owners[42] (those living adjacent to an Ordinary Watercourse) who are responsible for maintaining Ordinary Watercourses to ensure that the effectiveness of the existing ditches is improved and ensure that future maintenance is undertaken at appropriate intervals. The Environment Agency have prepared guidance which provides information on the rights and responsibilities of riparian owners relating to flood risk management[53].

[52] Essex County Council Ordinary Watercourse Consent: https://flood.essex.gov.uk/maintaining-or-changing-a-watercourse/apply-for-a-watercourse-consent/ [Accessed June 2024].
[53] Environment Agency (2018) Owning a Watercourse: https://www.gov.uk/guidance/owning-a-watercourse [Accessed June 2024].

Policy Recommendation: Where practical, an undeveloped easement should be retained alongside Ordinary Watercourses for maintenance purposes. This should be discussed and agreed with the LLFA. Developers should explore opportunities for riverside restoration as part of any development adjacent to Ordinary Watercourses.

9.2 River Restoration and Flood Storage

During the last century, many rivers were modified using hard engineering techniques to often straighten or canalise them. The disadvantages of these techniques have now become apparent which include the damage to the environment and ecosystems, and in some cases an increase in flooding.

River restoration contributes to flood risk management by supporting the natural capacity of rivers to retain water. By re-connecting brooks, streams and rivers to floodplains, former meanders, and other natural storage areas, and enhancing the quality and capacity of wetlands, river restoration increases natural storage capacity and can reduce flood risk. Excess water is stored in a timely and natural manner in areas where values such as attractive landscape and biodiversity are improved and opportunities for recreation can be enhanced.

Returning rivers to a more natural state can often include the removal of structures such as weirs or culverts which can have multiple benefits for biodiversity in addition to improving the flow regime[54]. Further guidance on river restoration is available from the Environment Agency[55].

Flood Storage Areas (FSAs) are natural or man-made areas that temporarily fill with water during periods of high river level, retaining a volume of water which is released back into the watercourse after the peak river flows have passed. There are two main reasons for providing temporary detention of floodwater:

- To compensate for the effects of catchment urbanisation, and
- To reduce flows passed downriver and mitigate downstream flooding.

Providing flood storage within a development area or further upstream of a development can manage and control the risk of flooding. In some cases, it can provide sufficient flood protection on its own; in other cases, it may be chosen in conjunction with other measures. The advantage of flood storage is that the flood alleviation benefit generally extends further downstream, whereas other methods tend to benefit only the local area and may increase the flood risk downstream.

Further guidance on Flood Storage is provided within Chapter 10 of the Environment Agency's Fluvial Design Guide[56].

Policy Recommendation: All new development close to rivers should consider the opportunity to improve and enhance the river environment. Developers should explore opportunities for river restoration, enhancement and provision of FSAs as part of the development. Options include backwater creation, de-silting, in-channel habitat enhancement and removal of structures. When designed properly, such measures can have benefits such as reducing the costs of maintaining hard engineering structures, reducing flood risk, improving water quality and increasing biodiversity. Social benefits are also gained by increasing green space and access to watercourses.

9.2.1 Floodplain Compensation

According to guidance provided in the PPG (notes to Table 2), all new development within Flood Zone 3 must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage. Where proposed development results in a change in building footprint, land raising or other structures such as bunds, the developer must ensure that it does not impact upon the ability of the floodplain to store water and should seek opportunities to provide betterment with respect to floodplain storage. Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain must be provided to ensure that the total volume of the floodplain storage is not reduced.

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[54] European Centre for River Restoration: https://www.ecrr.org/River-Restoration/Flood-risk-management/Healthy-Catchments-managing-for-flood-risk-WFD/Environmental-improvements-case-studies/Remove-culverts [Accessed June 2024].
[55] Environment Agency, Fluvial Design Guidance Chapter 8: https://assets.publishing.service.gov.uk/media/60549ae1e90e0724c0df4619/FDG_chapter_8_-_Works_in_the_river_channel.pdf [Accessed June 2024].
[56] Environment Agency's Fluvial Design Guide: https://assets.publishing.service.gov.uk/media/60549b7a8fa8f545cf209a29/FDG_chapter_10_-_Flood_storage_works.pdf [Accessed May 2024].

As depicted in Figure 9-1, floodplain compensation should be provided on a level for level, volume for volume basis on land which does not already flood and is within the site boundary. Where land is not within the site boundary, it should be in the immediate vicinity, in the applicant's ownership and linked to the site. Floodplain compensation must be considered in the context of the 1% AEP (1 in 100 year) flood level including an allowance for climate change. According to the Environment Agency's climate change allowances guidance[57], the appropriate allowance to assess off-site impacts and calculate floodplain storage compensation depends on land uses in affected areas. The allowances used should be:

- The Central allowance for most cases.
- The Higher Central allowance when the affected area contains essential infrastructure.

Likely future land uses should also be considered, shown by local plan allocations or unimplemented extant planning permissions.

When designing a scheme, floodwater must be able to flow in and out and must not pond. An FRA must demonstrate that there is no loss of flood storage capacity and include details of an appropriate maintenance regime to ensure mitigation continues to function for the life of the development. Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C624[58].

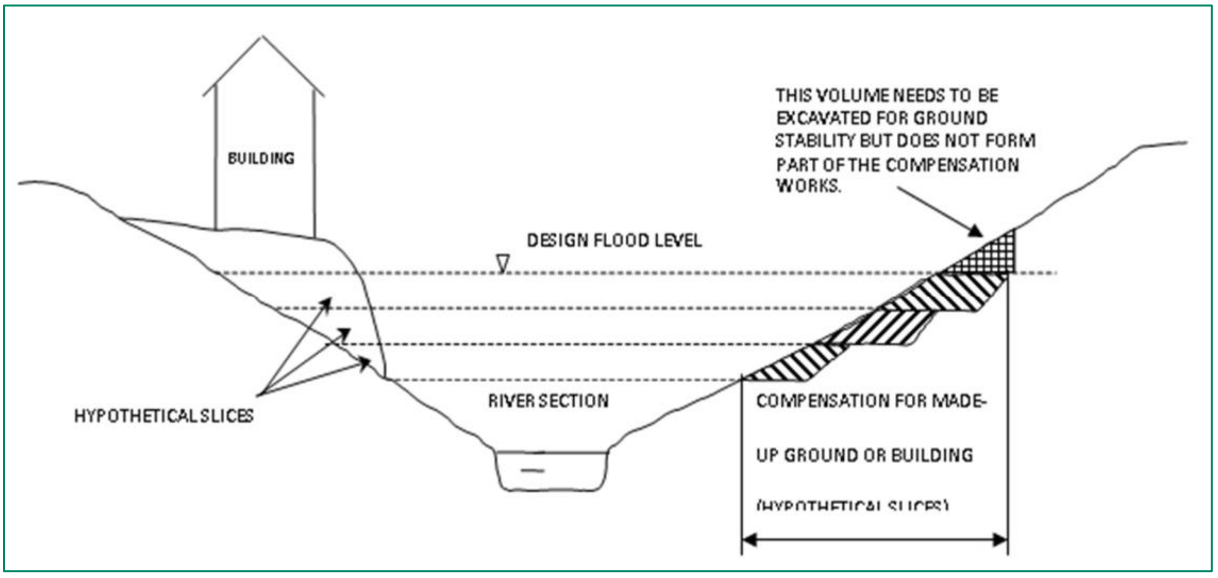

Figure 9-1: Example of Floodplain Compensation Storage (Environment Agency 2009)

The requirement for no loss of floodplain storage means that it is not possible to modify ground levels on sites which lie completely within the floodplain (when viewed in isolation), as there is no land available for lowering to bring it into the floodplain.

It is possible to provide off-site compensation within the local area e.g. on a neighbouring or adjacent site, or indirect compensation, by lowering land already within the floodplain, however, this would be subject to detailed investigations and agreement with the Environment Agency to demonstrate (using an appropriate flood model where necessary) that the proposals would improve and not worsen the existing flooding situation or could be used in combination with other measures to limit the impact on floodplain storage.

Should it not be possible to achieve all the level for level compensation required, the Environment Agency should be consulted to explore and discuss alternatives.

[57] Flood Risk Assessments: Climate Change Allowances: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances [Accessed May 2024].
[58] CIRIA (2004) CIRIA Report 624: Development and Flood Risk - Guidance for the Construction Industry.

While the use of stilts and voids below buildings may be an appropriate approach to mitigating flood risk to the buildings themselves, such techniques should not normally be relied upon for compensating for any loss of floodplain storage. This is because voids do not allow the free flow of water, trash screens get blocked, voids get silted up, they have limited capacity, and it is difficult to stop them being used for storing belongings or other materials. In line with the latest planning guidance, it is recommended that voids are not used as a form of mitigation i.e. compensatory storage.

Policy Recommendation: As referenced within this section, all new development within Flood Zone 3 must not result in a net loss of flood storage capacity. Where proposed development results in a change in building footprint, land raising or other structures such as bunds, the developer must ensure that it does not impact upon the ability of the floodplain to store water and should seek opportunities to provide betterment with respect to floodplain storage. Floodplain compensation should be provided on a level for level, volume for volume basis on land which does not already flood and is within the site boundary. Where land is not within the site boundary, it must be in the immediate vicinity, in the applicant's ownership and linked to the site. Floodplain compensation must be considered in the context of the 1% AEP (1 in 100 year) flood level including an allowance for climate change. This should be discussed and agreed with the Environment Agency.

9.3 Groundwater

There are areas across the CCC area identified as having the potential for groundwater flooding to occur at the surface including parts of the City of Colchester, Wivenhoe, Tiptree, Mersea Island, Dedham, and Langham.

Policy Recommendations: For all proposed developments in the CCC area identified as at risk of groundwater flooding at the surface or where there is a risk of groundwater flooding of property below ground level, construction phase groundwater monitoring during periods of high groundwater (October – March) should be mandated for inclusion in all FRAs to inform the design of developments and any mitigation measures, unless adequate justification can be provided by the applicant to exempt the proposed development from this requirement.

Additionally, slope stabilisation and reprofiling measures shall be avoided wherever possible, to minimise/prevent disruption to groundwater flows, and the aggravation of groundwater flood risk elsewhere.

Where the installation of foundations and associated excavation works is required for proposed developments, these should either take place above the maximum height of the groundwater table (as confirmed by on-site groundwater monitoring) or shall implement appropriate pumping and SuDS to dewater the excavated area and to mitigate against the loss of groundwater storage.

9.4 Working with Natural Processes

Natural flood management involves techniques that aim to work with natural hydrological and morphological processes, features, and characteristics to manage the sources and pathways of flood waters. Techniques include the restoration, enhancement and alteration of natural features and characteristics, but exclude traditional flood defence engineering that works against or disrupts these natural processes.

There are a number of opportunities available to reduce the causes and impacts of flooding through Working with Natural Processes (WWNP). This involves implementing measures that help to protect, restore, and emulate the natural functions of catchments, floodplains, rivers, and the coast. WWNP takes many forms and can be applied in urban and rural areas, and on rivers, estuaries, and coasts. Potential natural processes are detailed in Table 9-1.

As part of a research project undertaken by the Flood and Coastal risk Management Research and Development Programme and the Environment Agency[59], a series of spatial datasets have been generated for these natural processes, identifying their best estimate of locations in the country where the methods can be applied (Table 9-1). As well as reducing the causes and impacts of flooding, WWNP has a number of environmental, social, and cultural benefits, including water quality, habitat, climate regulation, health access, air quality, and aesthetic quality. Although WWNP methods have very promising benefits, they are relatively new concepts, and more research is required to gain a greater understanding of their impacts in different conditions and representation in models. The WWNP data does not provide information on design, which may need to consider issues such as drain-down

[59] Working with natural processes to reduce flood risk: https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/working-with-natural-processes-to-reduce-flood-risk [Accessed June 2024].

between flood events. It is important to note that land ownership and change to flood risk have not been considered. Locations identified may have more recent building or land use than available data indicates.

Appendix A, Figure 18 provides information from the Environment Agency's 'Working with Natural Processes' spatial datasets and displays where these measures could be applied within the CCC area.

Policy recommendation: Where possible, all new developments should explore the opportunity to implement natural processes to alleviate flooding. This should be discussed and agreed with CCC.

Table 9-1: Description of WWNP datasets

Natural Process	Benefits	Most Effective Conditions	Notes
Floodplain Woodland Planting Potential	Slows floodwaters and increases water depth on the floodplain. Reduces flood peaks, delays flood peak timing and desynchronises flood peaks. Enhances sediment deposition on the floodplain.	Middle and lower reaches of medium-sized and large catchments.	Based upon Flood Zone 2. Information is largely based on modelled data and open access constraints data. It is indicative rather than specific. Locations may have more recent building or land use than the available data indicates.
Riparian Woodland Planting Potential (woodlands on land immediately adjoining a watercourse)	Slows flood flows. Reduces sediment delivery to the watercourse. Reduces bankside erosion. Creates below ground storage.	At the reach scale in middle and upper catchments.	Based upon a 50m buffer of available OS Open Data river networks. Information is largely based on open data and is indicative rather than specific. Locations may have more recent building or land use than the available data indicates.
Wider Catchment Woodland	Intercepts, slows, stores and filters water. Reduced flood peaks, flood flows and frequency.	Small events on small catchments – extent of reduction decreases as flood magnitude increases.	Based upon the 1:50k BGS geology survey and relies upon identifying drift and bedrock geologies that are characteristic of slowly permeable soils. Information is largely based on the 100m gridded version of BGS data and open constraints data and is indicative rather than specific.
Floodplain Reconnection Potential (reconnecting watercourses and floodplains)	Encourages more regular floodplain inundation and floodwater storage. Decreases the magnitude and delays the onset of flood peaks. Reduces downstream floodplain depths.	High frequency, low return period floods.	Designed to support signposting of areas where there is currently poor connectivity such that flood waters are constrained to the channel and flood waves may therefore propagate downstream rapidly. Based upon the Risk of Flooding from Rivers and Sea probability maps and identifies areas of low and very low probability that are close to a watercourse, but do not contain residential properties or key services (may contain non-residential properties).
Runoff Attenuation Features (3.33% and 1% AEP) (includes swales, ponds, and sediments traps)	Delays and flattens the hydrograph and reduces peak flow locally for small flood events.	A cluster of features working as a network throughout the landscape.	Based upon the Risk of Flooding from Surface Water datasets and identifies areas of high flow accumulations for the 1% and 3.33% AEP surface water maps. The areas of ponding or accumulation are between 100 and 5000 metres squared and have been tagged where they fall on an area of slope steeper than 6% as gully blocking opportunities.

9.5 Surface Water Management

Development should be designed so that there is no increase in flood risk elsewhere and the development will be safe from surface water flooding.

As noted in the NPPF, applications which could affect drainage on or around the site should incorporate sustainable drainage systems to control flow rates and reduce volumes of runoff, and which are proportionate to the nature and scale of the proposal. These should provide multifunctional benefits wherever possible, through facilitating improvements in water quality and biodiversity, as well as benefits for amenity

Drainage systems must be designed such that flooding does not occur in any part of a site for the 3.33% (1 in 30 year) rainfall event (including the relevant allowance for climate change), and so that flooding does not occur in any part of a building, or in any utility plant susceptible to water within the development for the 1% AEP (1 in 100 year) rainfall event (including the relevant allowance for climate change). Exceedance flows resulting from rainfall in excess of the 1% AEP (1 in 100 year) rainfall event must be managed in such a way that minimises the risks to people and property[60].

With respect to peak runoff rates discharged from developments, these should never exceed the greenfield runoff rates for the annual (1 in 1 year) and 1% AEP (1 in 100 year) rainfall events (including relevant allowances for climate change) for greenfield developments. For developments on brownfield sites, the peak runoff rates must be as close to the greenfield runoff rates for the annual (1 in 1 year) and 1% AEP (1 in 100 year) rainfall events (including relevant allowances for climate change) as reasonably practicable and should not exceed the runoff rates from the site prior to redevelopment for these two events.

Proposed drainage systems should be able to accommodate multiple consecutive rainfall events by ensuring that they can empty within 48 hours. As it is not possible to design for every rainfall event, it is important that excess flows can be managed safely during rainfall events exceeding that for which the proposed drainage system has been designed for.

The Sustainable Drainage Systems Design Guide[23] outlines the design requirements for SuDS, and the delivery stages for SuDS that should be followed by developers within the ECC area.

The relevant allowances for climate change (described in Table 3-6) should be identified through reference to the lifetime of the development:

- For development with a lifetime beyond 2100, use the upper end allowances for the 2070s epoch.
- For development with a lifetime of between 2061 and 2100 use the central allowance for the 2070s epoch.
- For a development with a lifetime up to 2060 use the central allowances for the 2050s epoch.

Policy recommendation: All new developments should incorporate a range of SuDS to target the required water quantity, quality, amenity and biodiversity benefits, unless it can be demonstrated that SuDS are not technically appropriate. Proposed SuDS should be designed such that surface water runoff rates from greenfield developments should not exceed greenfield runoff rates for the annual and 1% AEP rainfall events, and so that surface water runoff rates for brownfield developments should not exceed existing runoff rates and should be as close to greenfield runoff rates as reasonably practicable.

For each new development, SuDS guidance should be developed to inform future management. A maintenance schedule must be prepared for all proposed SuDS, which will identify the body responsible for the maintenance and continuing funding of these. Developers should adhere to the guidance within the ECC Sustainable Drainage Systems Design Guide.

[60] DEFRA Sustainable Drainage Systems Non-statutory technical standards for sustainable drainage systems (March 2015): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf [Accessed June 2024].

9.6 Sustainable Drainage Systems

Suitable surface water management measures should be incorporated into new development designs in order to reduce and manage surface water flood risk to, and posed by, a development. This should ideally be achieved by incorporating SuDS.

SuDS are typically softer engineering solutions inspired by natural drainage processes such as ponds and swales which manage water as close to its source as possible. However, harder engineering solutions such as oversized pipes and tanks are often relied upon to provide adequate surface water storage to meet design requirements. It is recommended that preference be given to above ground SuDS in line with best practice.

Wherever possible, a SuDS technique should seek to contribute to each of the three following goals:

- To control the quantity and rate of surface water runoff from a development,
- To improve the quality of the surface water runoff,
- To provide wider landscape, amenity, and wildlife benefits to the development site and its surroundings.

According to the PPG, the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:

- Into the ground (infiltration),
- To a surface water body,
- To a surface water sewer, highway drain, or another drainage system, and,
- To a combined sewer.

SuDS techniques can be used to reduce the rate and volume, and to improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourse or public sewer etc). The CIRIA SuDS manual[61] identifies several processes that can be used to manage and control runoff from developed areas. Each option can provide opportunities for storm water control, flood risk management, water conservation and groundwater recharge. Reference should be made to the non-statutory technical standards[62] for guidance on the design, maintenance, and operation of SuDS.

- Infiltration: The soaking of water into the ground. This is the most desirable solution as it mimics the natural hydrological process. The rate of infiltration will vary with soil type and condition, the antecedent conditions and with time. The process can be used to recharge groundwater sources and feed baseflows of local watercourses, but where groundwater sources are vulnerable or there is risk of contamination, infiltration techniques are not suitable. Where infiltration is proposed, the findings of a detailed ground investigation undertaken at the same location and depth as the proposed infiltration system, should underpin the SuDS design.
- Detention/Attenuation: The slowing down of surface flows before their transfer downstream, usually achieved by creating a storage volume and a constrained outlet. In general, though the storage will enable a reduction in the peak rate of runoff, the total volume will remain the same, just occurring over a longer duration.
- Conveyance: The transfer of surface runoff from one place to another e.g. through open channels, pipes and trenches.
- Water Harvesting: The direct capture and use of runoff on site e.g. for domestic use (flushing toilets) or irrigation of urban landscapes. The ability of these systems to perform a flood risk management function will be dependent on their scale, and whether there will be a suitable amount of storage always available in the event of a flood.

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[61] CIRIA C697 SuDS Manual
[62] Sustainable drainage systems non-statutory technical standards: https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards [Accessed June 2024].

As part of any SuDS scheme, consideration should be given to the whole life management and maintenance of the SuDS to ensure that it remains functional for the lifetime of the development. All parts of the drainage system should be designed to be accessible at all times and location in private property should be avoided, wherever possible. It is advisable that a maintenance plan be submitted with the drainage application, including details of access arrangements, the safety of operatives, and the frequency of maintenance. The adopting organisation may require the developer to maintain the drainage system for a minimum period of one year, so that problems can be identified and addressed.

As per Policy DM23 in the Colchester Borough Local Plan, all new developments that have potential to increase flood risk are required to incorporate SuDS, where technically feasible, to ensure there is no increase in surface water runoff from new developments. It is recommended that Policy DM23 of the Colchester Borough Local Plan be reviewed once the legislation regarding SABs is released.

The application of SuDS is not limited to a single technique per site. Often a successful SuDS solution will utilise a combination of techniques, providing flood risk, pollution, and landscape/wildlife benefits. In addition, SuDS can be employed on a strategic scale, for example with a number of sites contributing to a large scale jointly funded and managed SuDS. However, it should be noted that each development must offset its own increase in runoff and attenuation cannot be “traded” between developments.

SuDS should be considered and integrated into the site layout at the early stages of planning to reduce the risk of abortive work associated with needing to modify the site layout to include SuDS at a later stage, and so that the principles of a surface water drainage strategy can be agreed through consultation with the LLFA and CCC. The existing and proposed drainage outfall points for the site must be agreed with relevant stakeholders before fixing the site layout.

Georeferenced as built drawings of proposed SuDS must be supplied to ECC as the LLFA, together with CCTV or any other surveys used to support the drainage design, for inclusion in their Asset Register. Table 9-2 details typical SuDS components, as well as their common uses.

Table 9-2*: Typical SuDS Components (Y = primary process, * = some opportunities subject to design)*

Technique	Description	Conveyance	Detention	Infiltration	Harvesting
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.		Y	Y	*
Filter Drains	Linear drains/trenches filled with a permeable material, often with a perforated pipe in the base of the trench. Surface water from the edge of paved areas flows into the trenches, is filtered, and conveyed to other parts of the site.	Y	Y		
Filter Strips	Vegetated strips of gently sloping ground designed to drain water evenly from impermeable areas and filter out silt and particulates.	*	*	*	
Swales	Shallow vegetated channels that conduct and/or retain water and can permit infiltration when unlined.	Y	Y	*	
Ponds	Depressions used for storing and treating water.		Y	*	Y
Wetlands	As ponds, but the runoff flows slowly but continuously through aquatic vegetation that attenuates and filters the flow. Shallower than ponds. Based on geology these measures can also incorporate some degree of infiltration.	*	Y	*	Y
Detention Basin	Dry depressions designed to store water for a specific retention time.		Y		
Soakaways	Sub-surface structures that store and dispose of water via infiltration.			Y	
Infiltration Trenches	As filter drains but allowing infiltration through trench base and sides.	*	Y	Y	
Infiltration Basins	Depressions that store and dispose of water via infiltration.		Y	Y	
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation. It is noted that the use of brown/green roofs should be for betterment purposes and not to be counted towards the provision of on-site storage for surface water. This is because the hydraulic performance during extreme events is similar to a standard roof.		Y		
Rainwater Harvesting	Storage and use of rainwater for non-potable uses within a building e.g. toilet flushing. It is noted that storage in these types of systems is not usually considered to count towards the provision of on-site storage for surface water balancing, given the sporadic nature of the use of harvested water, it cannot be guaranteed that the tanks are available to provide sufficient attenuation for the storm event.	*	*	*	Y

9.7 Flow routing

Redevelopment in areas at risk of flooding from surface water, river flooding or groundwater flooding has the potential to affect flood routing and increase flood risk elsewhere. For example, redevelopment may give rise to backwater effects or divert floodwaters on to other properties.

Consideration should be given to configuring road and building layouts to preserve existing flow paths and improve flood routing, whilst ensuring that flows are not diverted towards other properties. Consideration should be given to the use of fences and landscaping walls so as to prevent causing obstruction to flow routes and increasing the risk of flooding to the site or neighbouring areas.

Opportunities should be sought within site design to make space for water, such as:

- Identification of existing surface water or fluvial flow routes across the site, so that road and building layouts can be safely designed around them.
- Removing boundary walls or replacing with other boundary treatments such as hedges and fences (with gaps).
- Considering alternatives to solid wooden gates or ensuring that there is a gap beneath the gates to allow the passage of floodwater.
- On uneven or sloping sites, consider lowering ground levels to extend the floodplain without creating ponds. The area of lowered ground must remain connected to the floodplain to allow water to flow back to river when levels recede.
- Create under-croft car parks or consider reducing ground floor footprint and creating an open area under the building to allow flood water storage.
- Where proposals entail floodable garages or outbuildings, consider designing a proportion of the external walls to be committed to free flow of floodwater.

Policy Recommendation: All new development should not adversely affect flood routing and thereby increase flood risk elsewhere. Opportunities shall be sought within the site design to make space for water.

10 Recommendations of how to address flood risk in development

It may not always be possible to avoid locating development in areas at risk of flooding. This section builds on the findings of the SFRA to provide guidance on the range of measures that could be considered on site in order to manage and mitigate flood risk. These measures should be considered when preparing a site-specific FRA. The section outlines the approach that CCC should consider in relation to flood risk planning policy and development management decisions.

10.1 Sequential Approach

Flood risk should be considered at an early stage in deciding the layout and design of a site so that development in current and future medium and high flood risk areas can be avoided so far as possible. Most large development proposals include a variety of land uses of varying vulnerability to flooding. The sequential approach should be applied within development sites to locate the most vulnerable elements of a development in the lowest risk areas (considering all sources of flooding) e.g. residential elements should be restricted to areas at lower probability of flooding whereas parking, open space or proposed landscaped areas may be placed on lower ground with a higher probability of flooding. Adopting a sequential approach is the most effective measure for addressing flood risk as it is not reliant on measures such as flood defences, property level resilience, and flood warnings.

As per the NPPF, development should only be allowed in areas at risk of flooding where it can be demonstrated that: within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location; the development is appropriately flood resistant and resilient; it incorporates SuDS; any residual risk can be safely managed; and safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

Policy Recommendation: A sequential approach to site planning should be applied within new development sites.

10.2 Appropriate types of development

Table 2 in the PPG provides a compatibility matrix and determines which types of development are appropriate in areas of flood risk.

Policy Recommendation: Location of development shall take into account the vulnerability of users to avoid the siting of inappropriate development in areas of flood risk.

10.3 Previously developed sites

It is possible that some areas of previously developed land could come forward as part of the site allocation process which are now considered to be at risk from fluvial/tidal flooding.

Policy Recommendation: Where buildings have been demolished within the functional floodplain (Flood Zone 3b) for a significant length of time (i.e. over a year), the land should be reverted back to functional floodplain and consequently, development should be avoided within these areas. Where a building(s) is already located in the functional floodplain, any proposals to regenerate/replace such building(s) will not increase the footprint any greater than the existing footprint or will seek opportunities to reduce the historic footprint. A change of use within the functional floodplain will not be permitted where it may involve an increase in flood risk if the vulnerability of the development is changed.

10.4 Access / egress

Where development may be proposed in areas at risk of flooding, safe access and egress are required to enable the evacuation of people from the development, provide the emergency services with access to the development during times of flood, and enable flood defence authorities to carry out any necessary duties during periods of flood.

A safe access/egress route should allow occupants to safely enter and exit the buildings and be able to reach land outside the flooded area (e.g. within Flood Zone 1) using public rights of way without the intervention of emergency services or others during design flood conditions, including climate change allowances. Where a dry route is not possible the FRA should provide an assessment of the flood hazard rating along the route and demonstrate that the route is a low hazard (as defined in the FD2320 Flood risk to people calculator[63]).

The guidance document 'Flood Risk Emergency Plans for New Development' published by the Environment Agency and ADEPT[64] provides more detail on safe access and escape.

Policy recommendation: Safe access / egress must be provided for new development in areas which are at risk of flooding and must reflect the type of flooding (source of flooding, scale of flooding, floodwater depth, and floodwater velocity) that the location is vulnerable to.

10.5 Flood warning and evacuation

The Environment Agency operates an effective flood warning service with respect to Main River and tidal flooding across England. Three different codes are issued depending on the type of flooding forecasted including Flood Alerts, Flood Warnings and Severe Flood Warnings (Section 8.4).

Information on these warnings can be issued via a number of methods[65]. The Environment Agency's website offers up-to-date flood information, monitoring information of river and sea levels and latest flood risk forecast, as well as a page to sign up to warnings by phone, text, email, or fax[66].

Evacuation is where flood alerts and warnings provided by the Environment Agency enable timely actions by residents or occupants to allow them to get to safety unaided, i.e. without the deployment of trained personnel to help people from their homes, businesses, and other premises. Rescue by the emergency services is likely to be required where flooding has occurred, and prior evacuation has not been possible.

For all developments proposed in Flood Zone 2 or 3, a Flood Warning and Evacuation Plan should be prepared to demonstrate what actions site users will take before, during and after a flood event to ensure their safety, and to demonstrate that their development will not impact on the ability of the local authority and the emergency services to safeguard the current population.

For sites in Flood Zone 1 that are located on 'dry islands', it may also be necessary to prepare a Flood Warning and Evacuation Plan to determine potential egress routes away from the site through areas that may be at risk of flooding during the 1% AEP (1 in 100 year) fluvial flood event including an allowance for climate change, or a 0.5% AEP (1 in 200 year) tidal flood event including an allowance for climate change if tidal is the dominant source.

The Environment Agency has a tool to create a Personal Flood Plan[67]. The Plan comprises a checklist of things to do before, during and after a flood and a place to record important contact details. Where proposed development comprises non-residential extension <250m^2 and householder development (minor development), it is recommended that the use of this tool to create a Personal Flood Plan will be appropriate.

Flood Warning and Evacuation Plans should include:

- How flood warning is to be provided, such as:
    - Availability of existing flood warning systems,
    - Where available, rate of onset of flooding and available flood warning time, and,
    - How flood warning is given.
- What will be done to protect the development and contents, such as:

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[63] Defra Environment Agency Flood and Coastal Defence R&D Programme, 2004: https://assets.publishing.service.gov.uk/media/602a9348e90e070559970f9d/Operations_and_Maintenance_Concerted_Action_Report_pdf.pdf [Accessed June 2024].
[64] ADEPT, Environment Agency, September 2019, Flood Risk Emergency Plans for New Development: https://www.adeptnet.org.uk/floodriskemergencyplan [Accessed June 2024].
[65] Environment Agency Flood Warnings: Flood Guidance Statement: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/services/government/hazard-manager-flood-guidance.pdf [Accessed June 2024].
[66] Environment Agency, 2022, Check for Flooding in England: https://check-for-flooding.service.gov.uk/ [Accessed June 2024].
[67] Environment Agency Tool 'Make a Flood Plan'. Available from: https://www.gov.uk/government/publications/personal-flood-plan [Accessed June 2024].

  - How easily damaged items (including parked cars) or valuable items (important documents) will be relocated,
  - How services can be switched off (gas, electricity, water supplies),
  - The use of flood protection products (e.g. flood boards, airbrick covers),
  - The availability of staff/occupants/users to respond to a flood warning, including preparing for evacuation, deploying flood barriers across doors etc., and,
  - The time taken to respond to a flood warning.
- Ensuring safe occupancy and access to and from the development, such as:
  - Occupant awareness of the likely frequency and duration of flood events, and the potential need to evacuate,
  - Safe access route to and from the development,
  - If necessary, the ability to maintain key services during an event,
  - Vulnerability of occupants, and whether rescue by emergency services will be necessary and feasible, and,
  - Expected time taken to re-establish normal use following a flood event (clean-up times, time to re-establish services etc.).

There is no statutory requirement for the Environment Agency or the emergency services to approve evacuation plans. ECC is accountable via planning condition or agreement to ensure that plans are suitable. This should be done in consultation with emergency planning staff.

Policy Recommendation: A Flood Warning and Evacuation Plan, including safe access/egress routes and emergency planning measures, should be prepared as part of an FRA for all developments sited within areas at risk of flooding and that have potentially vulnerable users.

10.6 Finished Floor Levels

Where developing in Flood Zone 2 and 3 is unavoidable, the recommended method of mitigating flood risk to people, particularly with More Vulnerable (residential) and Highly Vulnerable development types (as outlined in Annex 3 of the NPPF), is to ensure internal floor levels are raised to a freeboard level above the design flood level including an appropriate allowance for climate change.

For fluvial flooding, the design flood is the 1% AEP (1 in 100 year) event plus an appropriate allowance for climate change, whilst for tidal flooding, the design flood is the 0.5% AEP (1 in 200 year) event plus an appropriate allowance for climate change. Less vulnerable development should also aim to raise the floor levels. Where this is not achievable, flood resilience measures should be incorporated. These measures should be detailed within the FRA.

With reference to the 'Flood risk emergency plans for new developments[68]', internal places of safety should be provided to account for the extreme flood event (0.1% AEP event) or for developments in a defended area but with a residual risk of hazardous inundation should defences fail/breach or be overtopped by a flood in exceedance of the design flood. Places of refuge play an important role where evacuation in advance of flooding is not achieved.

With reference to the 'Flood risk assessment: standing advice for flood risk[40]', finished floor levels for vulnerable developments in Flood Zone 2 and 3 should be a minimum of 600mm above the estimated design flood level, unless there is a level of certainty about the estimated flood level, in which case it can be reduced to 300mm[69]. If there is a particularly high level of uncertainty this level may need to be increased. The guidance document

[68] ADEPT and Environment Agency (2019) Flood risk emergency plans for new developments: https://www.adeptnet.org.uk/system/files/documents/ADEPT%20%26%20EA%20Flood%20risk%20emergency%20plans%20for%20new%20development%20September%202019....pdf [Accessed January 2025].
[69] This finished floor level guidance should also be applied for vulnerable developments in Flood Zone 1 which will be at increased risk of flooding from rivers or the sea during the development lifetime when considering climate change.

"Accounting for residual uncertainty: an update to the fluvial freeboard guide – technical report"[70] explains how to determine the appropriate residual uncertainty allowances. The process involves identifying sources of uncertainty in the datasets upon which the assessment is based, estimating the magnitude of residual uncertainties, and determining the appropriate response. The resulting residual uncertainty allowances range from 300mm to 900mm.

In certain situations (e.g. for proposed extensions to buildings with a lower floor level or conversion of existing historical structures with limited existing ceiling levels), it could prove impractical to raise the internal ground floor levels to the required height. The FRA standing advice for flood risk stipulates that in these cases the design should be made sufficiently flood resilient and resistant by:

- using flood resistant materials that have low permeability to at least 600mm above the estimated flood level.
- making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level.
- using flood resilient materials (for example lime plaster) to at least 600mm above the estimated flood level.
- by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
- making it easy for water to drain away after flooding such as installing a sump and a pump.
- making sure there is access to all spaces to enable drying and cleaning.
- ensuring that soil pipes are protected from back-flow such as by using non-return valves.

The FRA standing advice for flood risk also states that the details of emergency escape plans for any parts of a building below the estimated flood level should also be provided as part of an FRA.

In addition to the measures outlined in the FRA standing advice for flood risk, it is also recommended that the following steps be taken to ensure that the design of a building is flood resilient and resistant:

- ensuring that all waste pipes are protected from back-flow by using non-return valves.
- ensuring that all doors are flood-resistant doors and have not been tampered with, for example through the installation of a cat flap.
- all utilities servicing the building must be watertight.
- voids should have smart air bricks which utilise in-built sensors to regulate air flow in response to changes in humidity and temperature.

Policy Recommendation: For More Vulnerable and Highly Vulnerable developments within Flood Zones 2 and 3a the finished floor levels for the lowest room of a building should be set above the minimum ground level of the site, above the adjacent road to the building, or above the estimated flood level for the design flood, depending on which of these three values is highest. For minor extensions, the finished floor levels of the lowest room of a building should be no lower than existing floor levels or above the estimated flood level for the design flood. The design flood here pertains to either the 1% AEP (1 in 100 year) fluvial event with an appropriate allowance for climate change, or the 0.5% AEP (1 in 200 year) tidal event with an appropriate allowance for climate change. The required freeboard value for the finished floor levels of developments is defined within the Environment Agency's online standing advice for flood risk assessments.

10.7 Flood resistance and resilience strategies

There are a range of flood resistance and resilience construction techniques that can be implemented in new developments to mitigate potential flood damage. The Ministry of Housing, Communities and Local Government (MHCLG) have published a document 'Improving the Flood Performance of New Buildings, Flood Resilient

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[70] Accounting for residual uncertainty an update to the fluvial freeboard guide: https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/accounting-for-residual-uncertainty-an-update-to-the-fluvial-freeboard-guide?web=1&wdLOR=c7DCE6B52-35F0-469F-843D-3238FA827B79 [Accessed June 2024].

Construction'[71], the aim of which is to provide guidance to developers and designers on how to improve the resistance and resilience of new properties to flooding through the use of suitable materials and construction details. Paragraph 181b of the NPPF states that developments in areas at risk of flooding be appropriately flood resistant and resilient in order that in the event of a flood, they can be quickly brought back into use without significant refurbishment. Figure 10-1 provides a summary of the Water Exclusion Strategy (flood resistance measures) and Water Entry Strategy (flood resilience measures) which can be adopted depending on the depth of floodwater that could be experienced.

Policy recommendation: Where proposing development or redevelopment in areas at risk of flooding, flood resilience and resistance strategies must be implemented to reduce damage in a flood and increase the speed of recovery. These measures should be designed to accommodate the 1% AEP event plus climate change flood level and should not be normally relied on for new development as an appropriate mitigation method. Where resilience and resistance measures are required, proposals must include details of their construction, removal, the party responsible for their maintenance, and the cost of replacement when they deteriorate.

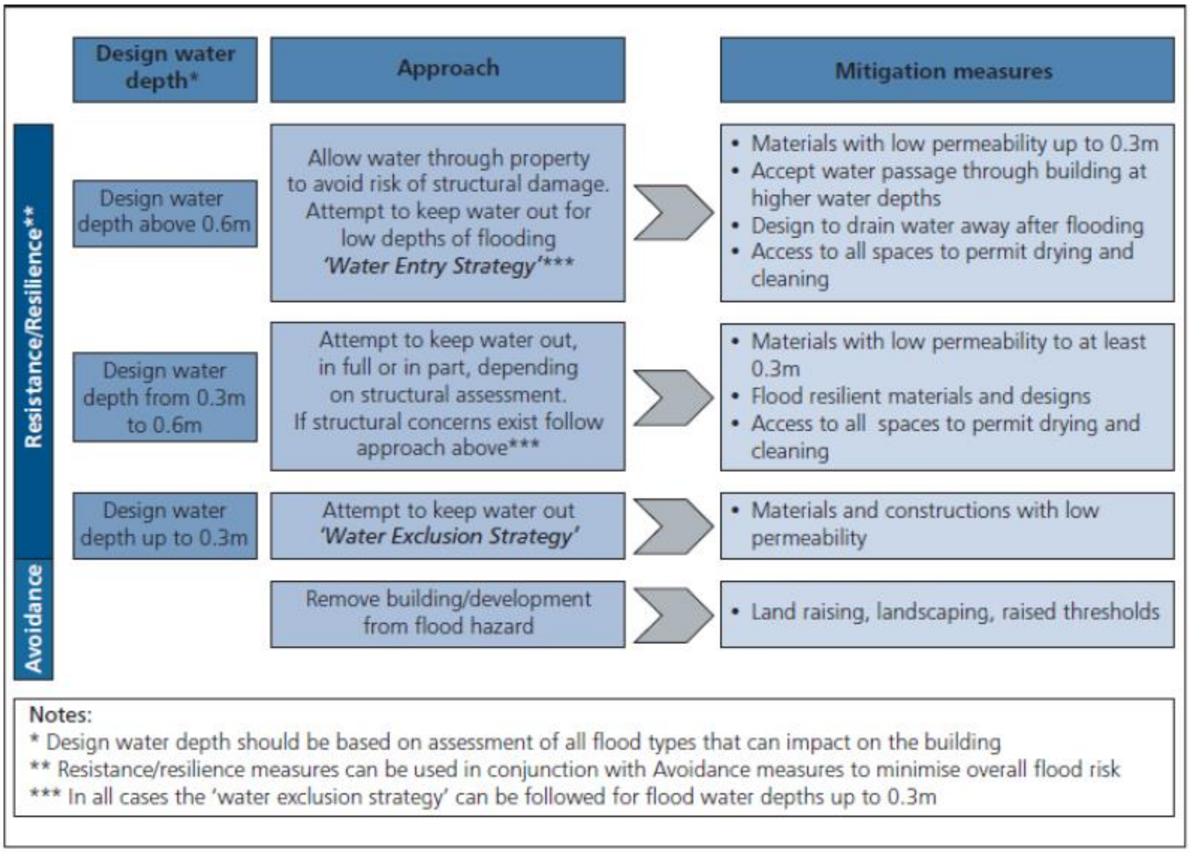

Figure 10-1: Flood Resistant/Resilient Design Strategies, Improving Flood Performance (DHLUC 2007)

10.7.1 Flood resistance design strategies

Resistance measures are aimed at preventing water ingress into a building (Water Exclusion Strategy): they are designed to minimise the impact of floodwaters directly affecting buildings and to give occupants more time to relocate ground floor contents. These measures will only be effective for short duration, low depth flooding i.e. less than 300mm, although these measures should be adopted where depths are between 300mm and 600mm and there are no structural concerns.

In areas at risk of flooding of low depths (<300mm), implement flood resistance measures such as:

- Using materials and construction with low permeability,

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[71] CLG (2007) Improving the Flood Performance of New Buildings, Flood Resilient Construction: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf [Accessed June 2024].

- Land raising,
- Landscaping e.g. creation of low earth bunds (subject to this not increasing flood risk to neighbouring properties),
- Raising thresholds and finished floor levels e.g. porches with higher thresholds than main entrance,
- Flood gates with waterproof seats, and,
- Sump and pump for floodwater to remove water faster than it enters.
- Properties (residential and commercial) to have smart water butts installed

There are a range of property flood protection devices available on the market, designed specifically to resist the passage of floodwater. These include removable flood barriers and gates designed to fit openings, vent covers and stoppers designed to fit WCs, and non-return valve fitments to sanitary outlets. These measures can be appropriate for preventing water entry associated with fluvial flooding as well as surface water and sewer flooding. The efficacy of such devices relies on them being deployed before a flood event occurs. It should also be considered that devices such as air vent covers, if left in place by occupants as a precautionary measure, may compromise safe ventilation of the building in accordance with Building Regulations.

10.7.2 Flood resilience design strategies

For flood depths greater than 600mm, it is likely that structural damage could occur in traditional masonry construction due to excessive water pressures. In these circumstances, the strategy should be to allow water into the building, but to implement careful design in order to minimise damage and allow rapid re-occupancy. This is referred to as the Water Entry Strategy. These measures are appropriate for uses where temporary disruption is acceptable and suitable flood warning is received.

Materials should be used which allow the passage of water whilst retaining their structural integrity and they should also have good drying and cleaning properties. Alternatively sacrificial materials can be included for internal and external finishes; for example, the use of gypsum plasterboard which can be removed and replaced following a flood event. Flood resilient fittings should be used to at least 100mm above the design flood level. Resilience measures are either an integral part of the building fabric or are features inside a building that will limit the damage caused by floodwaters.

In areas at risk of frequent or prolonged flooding, implement flood resilience measures such as:

- Use of materials with either, good drying and cleaning properties, or sacrificial materials that can easily be replaced post-flood.
- Design for water to drain away after flooding.
- Design access to all spaces to permit drying and cleaning.
- Raise the level of electrical wiring, appliances, and utility meters.
- Coat walls with internal cement-based renders; apply tanking on the inside of all internal walls.
- Ground supported floors with concrete slabs coated with impermeable membrane.
- Tank basements, cellars, or ground floors with water resistant membranes.
- Use plastic water resistant internal doors.

Further specific advice regarding suitable materials and construction techniques for floors, walls, doors and windows and fittings can be found in 'Improving the Flood Performance of New Buildings, Flood Resilient Construction[71].

Structures such as bus, bike shelters, park benches and refuse bins (and associated storage areas) located in areas with a high flood risk should be flood resilient and be firmly attached to the ground and designed in such a way as to prevent entrainment of debris which in turn could increase flood risk and/or breakaway posing a danger to life during high flows.

Appendix A - Figures

Appendix B – Hydraulic Model Review

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