# CC010-A

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| | **Chelmsford City Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables** |
| **Site details** | |
| **Site Code** | **CW1d** |
| **Address** | Baddow Road Car Park and Land to the East |
| **Area** | 1.15ha |
| **Current land use** | Baddow Road Mixed Stay Car Park |
| **Proposed land use** | Residential |
| **Flood Risk Vulnerability** | More Vulnerable |
| **Sources of flood risk** | |
| **Location of the site within the catchment** | This site is located in Chelmsford, between the River Chelmer and the A1060 (Parkway), northeast of the Odeon Roundabout junction with the A1099 (High Bridge Road).<br>The site is located within the Chelmer Operational Catchment of the Combined Essex Management Catchment. This management catchment is 3,413km$^2$ and spans the counties of Essex, Suffolk, and a small part of Cambridgeshire. The site is located at the downstream end of the catchment, near the confluence of the River Can and River Chelmer. Although the catchment is predominately rural, the site is located in a highly urbanised part of the catchment: Chelmsford City. |
| **Topography** | Environment Agency 1m resolution LiDAR across the site shows that the topography is relatively consistent, but gently slopes downwards towards the southeast of the site. The highest elevations are to the northwest of the site, at 23.4mAOD, and the lowest elevations are to the southeast of the site, at 22.2mAOD.<br>It is important to note that the site is situated within a densely populated and developed urban area, therefore LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in this assessment. |
| **Existing drainage features** | There are no existing drainage features within the borders of the site. The site lies immediately adjacent (<15m) to the confluence between the River Can and the River Chelmer, which flow west to east along the northern border of the site. In addition, much of the site has impermeable surfaces, meaning it is likely drained by the surface water drainage network. |
| **Critical Drainage Area** | The site is not located within a Critical Drainage Area. |
| **Fluvial and tidal** | **The proportion of site at risk FMFP:**<br>**FZ3 – 97.6%**<br>**FZ2 – 100%**<br>**FZ1 – 0%**<br><br>*The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the* |

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| | *area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).*<br><br>**Defended outputs:**<br>**3.3% AEP fluvial event – 8.5%**<br>**1% AEP fluvial event – 86.3%**<br>**0.1% AEP fluvial event – 98.8%**<br><br>*Modelled results show the percentage of site at risk from a given AEP flood event.*<br><br>**Available data:**<br><br>The proportion of the site at flood risk is determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario.<br><br>Therefore, the defended scenario outputs from the Environment Agency's 1D-2D ISIS-TUFLOW River Chelmer (2010) hydraulic model have been reported as a more accurate representation of the flood risk to this site due to the presence of flood defence structures.<br><br>**Flood characteristics:**<br><br>In the 3.3% AEP event, flood water encroaches approximately 48m into the site, from the south-eastern corner. LiDAR shows that this part of the site lies at a lower elevation. The maximum depth and velocity* of the flooding is 0.39m and <0.1m/s respectively.<br><br>In the 1% AEP event, most of the site is inundated by flood waters. As the south-east of the site lies at a lower elevation, the flooding here is more extreme. The maximum depth and velocity in this event are 0.56m and 0.45m/s respectively. In the north of the site, due to the higher topography, the maximum depth and velocity only reach 0.12m and 0.17m/s respectively. There are small, isolated areas of high ground that are not inundated in this event.<br><br>In the 0.1% AEP event, the entire site, aside from a small corner of the path leading to Bailey Bridge over the River Chelmer, is inundated by flood water. Again, the most extreme levels are found in the south-east of the site, with a maximum depth and velocity of 1.18m and 0.7m/s respectively. In the north of the site, maximum depth and velocity reaches 0.52m and 0.46m/s.<br><br>Whilst hazard results are not available for this model, maximum depths and velocities suggest flooding is likely to pose significant danger to most site users in the 0.1% AEP.<br><br>**Please note: Hazard ratings for the defended model outputs for the River Chelmer are unavailable.* |
| **Surface Water** | **Proportion of site at risk (RoFfSW):**<br>**3.3% AEP** – 4.8%<br>Max depth – 0.15m – 0.3m<br>Max velocity – 0.25m/s – 0.5m/s<br>**1% AEP** – 13.4%<br>Max depth – 0.3m – 0.6m<br>Max velocity – 0.25m/s – 0.5m/s<br>**0.1% AEP** – 81.6%<br>Max depth – 0.6m – 0.9m<br>Max velocity – >2m/s<br><br>*The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* |

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| | The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment.<br>**Description of surface water flow paths**:<br>The 3.3% AEP extent only ponds in an area of lower elevation at the southeast of the existing Baddow Road car park. The ponding extends approximately 40m long by 16m wide. The maximum depth and velocity of this ponding is quoted above, the maximum hazard rating is 'Danger for Some'.<br>In the 1% AEP event, ponding occurs in the same location but to a more extreme depth and velocity. Maximum depth and velocity are quoted above, and the hazard rating remains at 'Danger for Some'. Additional ponding occurs to the south of the site, in another low spot, and enters the site along the existing access route into the site off Baddow Road. Here, the maximum depth, velocity, and hazard is 0.15m – 0.3m, 0.25m/s – 0.5m/s, and 'Danger for Some' respectively.<br>In the 0.1% AEP event, the majority of the site is inundated. The only areas not at risk of surface water flooding are isolated high spots to the northwest of the site. Maximum depth, velocity, and hazard to the north of the site is 0.15m – 0.3m, 0.25m/s – 0.5m/s, and 'Very Low Hazard/Caution' respectively. The flow paths described for the 1% AEP event are exacerbated in this event and are the worst affected areas of the site. The maximum depth and velocity of the southeast of the site is quoted above, the maximum hazard rating is 'Danger for Most. |
| **Reservoir** | According to the Environment Agency's (EA) risk of flooding due to reservoirs dataset, In the Dry Day Scenario, Chignal Hall Farm, Handley Barns Farm (Private Individual) and Marshbury Hall Farm (CJH Farming) flood extends cover a small proportion of the southeast corner of the site.<br>In the Wet Day scenario, Chignal Hall, Handley Barn Farm and Marshbury Hall Farm flood extents cover the entirety of the site.<br>The risk designation of Chignal Reservoir has not yet been determined while the others have been determined to be high risk, therefore, in the very unlikely event that the reservoirs fail, there is be a risk to life. |
| **Groundwater** | The JBAs Groundwater Emergence Map, is provided as 5m resolution grid squares.<br>The whole site is shown to have negligible risk of groundwater emergence in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence. There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location. |
| **Sewers** | Sewer flooding records were not available for this assessment. The entirety of Chelmsford is identified as a Flood priority catchment in Anglian Water's Drainage and Wastewater Management Plan (DWMP). Developers should consult Anglian Water as part of any development proposal to ensure development does not exacerbate existing issues and maximise opportunities for development to deliver benefits in line with the long term strategic aims set out in the DWMP. |
| **Flood history** | The Environment Agency's Historic Flood Map shows records of flooding on the site, associated with the River Chelmer.<br>Essex County Council as LLFA has no records of flooding within the site boundary. The closest incidences are 350m to the northwest, north of the River Can. These 2 incidences depict internal flooding that occurred in 2007-2008, the cause of the flooding is unknown. |
| **Flood risk management infrastructure** | |

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| **Defences** | The Environment Agency AIMS dataset shows that the northwest of the site is protected by engineered high ground defences along the River Can and River Chelmer. These defences run from the Bond Street bridge to the north of the site, along its northern border, and stopping at High Bridge Road bridge. Downstream of this on the River Chelmer, natural high ground defences border the watercourse.<br><br>The Margaretting Flood Alleviation Scheme to safeguard the city centre was cancelled in March 2022. The risk from flooding remains. The City Council continues to work with the Environment Agency to supplement existing flood defences and deliver a new series of catchment-based measures under the Chelmsford Flood Resilience Partnership. Developers should consult the Environment Agency to find out whether this site will be affected by this flood alleviation scheme. Sites affected by flood risk should devise an FRA on the basis that existing city centre flood defences are in place and, if sufficiently advanced, the catchment-based measures identified by the Chelmsford Flood Resilience Partnership project. In either scenario a financial contribution to the Chelmsford Flood Resilience Partnership project would be required. |
| **Residual risk** | The site is at residual risk from an overtopping or breach of defences along the River Can and River Chelmer.<br><br>The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed. |
| **Emergency planning** | |
| **Flood warning** | The entire site is located in both an Environment Agency Alert Area, and an Environment Agency Flood Warning Area.<br><br>Flood Alert Area: 051WAFEF6BC (The River Wid from Brentwood, to and including Writtle, and the River Can at Chelmsford)<br><br>Flood Warning Area: 051FWFEF6C2 (The Rivers Can and Chelmer through Chelmsford, including the High Street and Meadows Shopping Centre) and 051FWFEF6C1 (Riverside properties in Chelmsford, from Rivermead Industrial Estate through Central and Admirals Park including the cricket ground, to Lordship Lane). |
| **Access and egress** | Existing access and egress to the site is currently via a small access road off Baddow Road. The site is bordered by the River Can and River Chelmer along the north, Bailey Bridge currently allows pedestrian access to the site; however, there is not vehicular access from this direction.<br><br>In the fluvial 3.3% event, defended model outputs for the River Chelmer show that access and egress is unaffected.<br><br>In the fluvial 1% AEP and more extreme events, defended model outputs for the River Chelmer show the entire site, and its access roads, to be at flood risk. Baddow Road and the existing access road are shown as having a maximum depth and velocity* of 0.36m and 0.29m/s respectively. As such, access and egress to this site during a 1% AEP event may be impacted.<br><br>In the fluvial 0.1% AEP event, defended model outputs for the River Chelmer show the entire site, and its access roads, to be at flood risk. Baddow Road and the existing access road are shown as having a maximum depth and velocity of 0.75m and 1.06m/s respectively.<br><br>In the surface water 3.3%AEP event, the small access road into the site from Baddow Road, as well as Baddow Road itself, are not shown to be at flood risk. And access/egress is unlikely to be impacted. |

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| | In the surface water 1% AEP and more extreme events, the entirety of Baddow Road is inundated by surface water to a maximum depth, velocity, and hazard of 0.15m – 0.3m, 0.25m/s – 0.5m/s, and 'Danger for Some'. This rises to 0.6m – 0.9m, 0.9m/s – 1.2m/s, and 'Danger for All' in the 0.1% AEP event. This suggests access and egress may be impacted in this event; however, access by emergency vehicles may be possible.<br><br>It important to note for the surface water datasets, that the site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the site topography and structures such as underpasses. As such, surface water flow paths shown at highways or railways where there is an underpass, such as those on the roundabout junction on the A1060 (Parkway), have been excluded from the calculation of maximum depth, velocity, and hazard.<br><br>Arrangements for safe access and egress will need to be demonstrated for 1% AEP plus an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the breach and surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.<br><br>**Please note: Hazard ratings for the defended model outputs for the River Chelmer are unavailable.* |
| **Dry Islands** | The site is not located on a dry island. |
| **Climate change** | |
| **Implications for the site** | **Management Catchment: Combined Essex Management Catchment**<br><br>Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding.<br><br>**Fluvial**<br><br>The River Chelmer has available climate change outputs for the Central (25%) allowance for the 2080s.<br><br>As the 1% AEP event inundates such a large percentage of the site, the change in extent between the baseline and climate changes events is minor. As such, this assessment will focus on the 3.3% AEP event, as this is likely to provide a more accurate assessment of sensitivity to climate change.<br><br>Like the associated baseline event, the 3.3% AEP plus central climate change allowance only inundates the south-east of the site due to its low-lying elevation. The change in extent between these events is minimal, and the maximum depth and velocity is 0.43m and 0.54m/s.<br><br>On the other hand, 3.3% AEP plus the upper end climate change allowance, the majority of the site is inundated by flood water. The south of the site has a maximum depth and velocity is 0.72m and 0.7m/s, compared with the north where the maximum depth and velocity of 0.18m and 0.57m/s- this is similar to the present day 1% AEP event. This indicates that the site is highly sensitive to climate change, particularly in relatively frequent events.<br><br>**Surface Water:**<br><br>The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario.<br><br>The 1% AEP plus climate change event impacts a much larger proportion of the site. All of the site south-east of the access road, as well as isolated areas of the north of the site that lie at a lower elevation, are all shown to |

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| | be inundated. In the south of the site, the maximum depth, velocity, and hazard is 0.6m, 2.04m/s, and 'Danger for Most'. This change in extent and depth, shows that this site is sensitive to climate change in the surface water events.<br><br>Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding. |
| **Requirements for drainage control and impact mitigation** | |
| **Broad-scale assessment of possible SuDS** | **Geology & Soils**<br>• Geology at the site consists of:<br>  ○ Bedrock Geology - London Clay Formation - Clay, silt, and sand.<br>  ○ Superficial Geology - Alluvium - Clay, silt, sand, and gravel.<br>• Soils at the site consist of:<br>  ○ Loamy and clayey floodplain soils with naturally high groundwater<br><br>**SuDS**<br>• The site is considered to have very low susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.<br>• BGS data indicates that the underlying geology is a mixture of clay, silt, sand, and clay which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.<br>• The site is not located within a Groundwater Source Protection Zone<br>• The entire site is not located within two Nitrate Vulnerable Zones (2021-2014. These are as follows:<br>  ○ Sandings and Chelmsford<br>  ○ River Chelmer<br>• The entire site is within Drinking Water Safeguard Zone SWSGZ1029<br>• The site is not located within a historic landfill site.<br>• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.<br>• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.<br>• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner. |
| **Opportunities for wider sustainability benefits and integrated flood risk management** | • Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity, and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints.<br>• Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. |

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| | • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces, and rainwater harvesting must be considered in the design of the site.<br>• SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.<br>• Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean and improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies.<br>• The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows. |
| **NPPF and planning implications** | |
| **Exception Test requirements** | The site is classified as more vulnerable and is entirely within Flood Zones 2 and 3, therefore the Exception Test is required for this site.<br><br>Furthermore, the site is at significant risk from surface water flooding. Whilst the Exception Test is only required for sites at risk from fluvial flooding, it is recommended the Chelmsford City Council carefully weigh up the benefits of developing the site against the flood risk. Developers will need to demonstrate through a site-specific flood risk assessment that users of the site will be safe throughout its lifetime. |
| **Requirements and guidance for site-specific Flood Risk Assessment** | **Flood Risk Assessment:**<br><br>• At the planning application stage, a site-specific FRA will be required as the proposed development site if:<br>  ○ Almost entirely within fluvial Flood Zones 2 and 3<br>  ○ Greater than one hectare<br>  ○ At risk of other sources of flooding (surface water, groundwater, and reservoir)<br>• All sources of flooding should be considered as part of a site-specific FRA, including consideration of the residual risk from a failure, or overtopping of defences.<br>• Consultation with Chelmsford City Council, Essex County Council, Anglian Water, and the Environment Agency should be undertaken at an early stage.<br>• Climate Change outputs for the 0.1% AEP event for the Chelmer 2010 model could not be produced for this study. At time of writing, the Environment Agency are currently undertaking updates to modelling in this area and developers should consult the Environment Agency to understand the latest available information. If climate change scenarios for the latest allowances for the 0.1% AEP event are not available, developers will need to undertake additional work as part of a site-specific FRA to determine the risk to the site in this scenario.<br>• Any FRA should be carried out in line with the National Planning Policy Framework (NPPF); Flood Risk and Coastal Change Planning Practice Guidance (PPG); and the Council's Local Plan Policy's and SuDS Strategy.<br>• The development should be designed with mitigation measures in place where required.<br><br>**Guidance for site design and making development safe:**<br><br>• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards |

throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).

- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to pre-development greenfield rates.
- Arrangements for safe access and egress will need to be provided for the 1% AEP fluvial and rainfall events with an appropriate allowance for climate change, considering depth, velocity, and hazard. Design and access arrangements will need to incorporate measures, so development and occupants are safe. Given the significant risk to the site and proximity to the watercourse, a flood warning and evacuation plan should be prepared for the site. See Section 8.6 of the Level 1 SFRA for details of the requirements for plans.
- Developers should consult with Chelmsford City Council and the Environment Agency to determine whether any land within the site needs to be safeguarded for improvements to flood defences either as part of the development, or in the future.
- Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk.
- Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels and use of boundary walls. These measures should be assessed to make sure that flooding is not increased elsewhere.

**Key messages**

The site is at significant risk of fluvial and surface water flooding and is shown to be highly sensitive to increased risk as a result of climate change, therefore the Exception Test will need to be passed before the site can be bought forwards. With regards to the flood risk portion of the Exception Test, development may be able to proceed if:

- Development is steered away from the area of fluvial flood risk in the eastern side of the site and the small flow paths/areas of surface water ponding are incorporated and considered within the development design.
- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development steered away from the areas identified to be at risk of surface water flooding across the site.
- Safe access and egress can be demonstrated in the fluvial and surface water 1% AEP plus climate change events. This includes measures to reduce flood risk along these routes such as raising access, but not displacing floodwater elsewhere. Given the significant risk to the site a suitable flood warning and evacuation plan will be required, including consideration of breach scenarios.
- A site-specific FRA demonstrates that site users will be safe throughout the lifetime of the development and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring areas.
- If flood mitigation measures are implemented then they are tested to check that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

**Mapping Information**

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| The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's River Chelmer model. More details regarding data used for this assessment can be found below. | |
| **Flood Zones** | Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.<br>The River Chelmer (2010) Environment Agency model has been used in this assessment. |
| **Climate change** | The central and upper end allowances were available for the River Chelmer (2010) hydraulic model to indicate the impacts on fluvial flood risk.<br>The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. |
| **Fluvial and tidal extents, depth, velocity and hazard mapping** | Depth, velocity, and hazard data was derived from the River Chelmer (2010) hydraulic model. |
| **Surface Water** | The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding. |
| **Surface water depth, velocity and hazard mapping** | The surface water depth, velocity, and hazard mapping for the 3.3%, 1%, and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW. |