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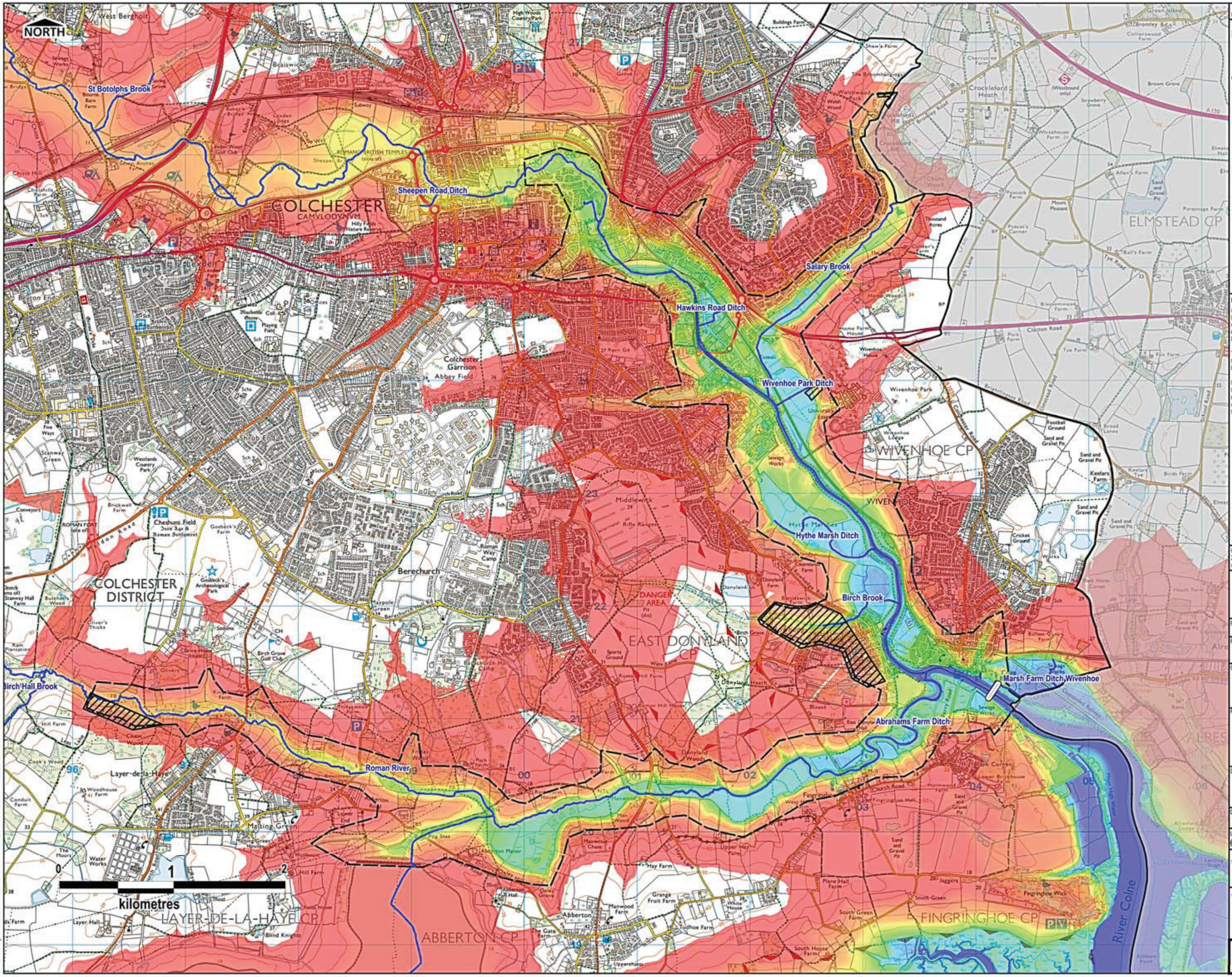

LEGEND

- Borough Boundary
- Main River Centreline
- Colne Barrier at Wivenhoe
- Breach Model Domain

LiDAR Topography (mAOD)

- <= 1m
- 2m
- 3m
- 6m
- 8m
- 20m - 32m
- Areas of 2m2 resolution LiDAR

Notes

As part of the update to the Level 2 Strategic Flood Risk Assessment (SFRA) for Colchester Borough Council (BC), revised modelling has been undertaken to provide an up to date assessment of the residual tidal flood risk to Colchester town centre in the event of a breach of the Colne Barrier at Wivenhoe.

This figure shows the model domain for the breach model, which includes the tidal part of the River Colne floodplain, as well as the floodplain of the Roman River (to the west) and Salary Brook (to the north east).

Up to date Light Detection and Ranging (LiDAR) data was obtained for the model area and used to generate the DTM. LiDAR data with 1m2 resolution is available for the majority of the model domain. Where there were gaps, 2m2 LiDAR has been used to provide complete coverage; these areas are shown in the adjacent figure.

Revision Details	By / Check	Check Date	Suffix

Purpose of Issue

VERSION 1

Client

Colchester, the place to live, learn, work and visit.

Project Title

COLCHESTER BOROUGH COUNCIL
LEVEL 2 STRATEGIC
FLOOD RISK ASSESSMENT

Drawing Title

MODEL DOMAIN AND LIDAR COVERAGE

Drawn	Checked	Approved	Date
SL	MI	SK	AUG 2016

URS Internal Project No.	Scale at A3
60473444	1:20,000

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Drawing Number	Rev
FIGURE 2-2	1

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2.5 Model Domain Grid Size

The Environment Agency Estuary Model utilised multiple 2D domains with variable grid sizes to enable better resolution of flood extents in urban areas, whilst maintaining reasonable run times. The main grid size is 30m^2 with high resolution areas around Colchester, Brightlingsea, Maldon and Mersea of 10m^2. The wider estuary has a 90m^2 grid resolution.

During the development of the Colchester Town model, there was opportunity to refine the grid size and enable a slightly improved representation of the model domain.

A 5m^2 grid size was selected and used across the entire model domain for the Colchester Town model, as it represented a good balance between the degree of accuracy (i.e. ability to model overland flow paths across the study area) whilst maintaining reasonable model run times.

2.6 Digital Terrain Model (DTM) Generation

LiDAR data was obtained for the model area and used to generate the DTM. LiDAR data with 1m^2 resolution is available from the Environment Agency for the majority of the model domain. Where there were gaps, 2m^2 resolution LiDAR has been used to provide complete coverage, as shown in Figure 2-2.

2.7 Water Level Derivation

For the Colne and Blackwater Estuary Model, the base tide shape was derived from astronomical tide predictions at Clacton. A surge residual was then added and scaled to obtain the extreme tide level for each design run. The shape of the surge residual was determined by reviewing gauge data of surges recorded at Clacton-on-Sea.

The extreme tide levels estimated for Colne Point and Sales Point, (taken from the Anglian Region Eastern and Central Areas Extreme Tide Levels report (Haskoning, 2007)), were used as the maximum level in the head-time tidal boundary. The extreme tide levels for Colne Point were imposed at the eastern boundary of the domain and tide levels for Sales Point imposed at the western boundary of the domain. Levels along the southern boundary were interpolated along the length of the tidal boundary.

In order to generate a suitable tidal boundary for the Breach Model, the Estuary Model was first re-run with revised water levels using the latest extreme water level data for the region and the latest climate change datasets (UKCP09). For this simulation, the Colne Barrier was modelled to be open, to provide a suitable tidal boundary for the Breach Model (which assumes that the Barrier fails to close). The base tide shape derived for the original Colne and Blackwater Estuary Model was retained. Extreme sea level data supplied by the Environment Agency (Environment Agency Coastal Boundary Extreme Sea Levels (Base Year 2008)) was used to determine the extreme water levels at Colne Point and Sales Point either end of the Estuary Model tidal boundary. Onto this, a surge residual and allowance for sea level rise allowances have been applied in line with the data obtained from the UK Climate Projections (UKCP09) for the years 2015 and 2115.

The original tidal boundaries for the Estuary Model were scaled to match the new peak water levels shown in Table 2-1 overleaf, by applying the predicted increase across the entire tidal boundary. The green shaded cells highlight the water levels for the return periods that have been considered in this modelling exercise.

Table 2-1 Extreme Water Level Derivation for Estuary Model

	EWL (mAOD)						EWL + Storm Surge (mAOD)			
	2008		2015		2115		2015		2115	
	Colne_Pt	Sales_Pt	Colne_Pt	Sales_Pt	Colne_Pt	Sales_Pt	Colne_Pt	Sales_Pt	Colne_Pt	Sales_Pt
Return Period (Years)	4262	4276	4262	4276	4262	4276	4262	4276	4262	4276
1	3.09	3.31	3.13	3.35	3.87	4.09	3.13	3.35	3.87	4.09
2	3.22	3.42	3.26	3.46	4.00	4.20	3.26	3.46	4.01	4.21
5	3.39	3.58	3.43	3.62	4.17	4.36	3.43	3.62	4.18	4.37
10	3.53	3.72	3.57	3.76	4.31	4.50	3.57	3.76	4.32	4.51
20	3.67	3.84	3.71	3.88	4.45	4.62	3.71	3.88	4.46	4.63
25	3.72	3.89	3.76	3.93	4.50	4.67	3.76	3.93	4.51	4.68
50	3.87	4.02	3.91	4.06	4.65	4.80	3.91	4.06	4.67	4.82
75	3.95	4.10	3.99	4.14	4.73	4.88	3.99	4.14	4.75	4.90
100	4.01	4.15	4.05	4.19	4.79	4.93	4.05	4.19	4.81	4.95
150	4.11	4.23	4.15	4.27	4.89	5.01	4.15	4.27	4.91	5.03
200	4.17	4.28	4.21	4.32	4.95	5.06	4.21	4.32	4.97	5.08
250	4.22	4.33	4.26	4.37	5.00	5.11	4.26	4.37	5.02	5.13
300	4.26	4.36	4.30	4.40	5.04	5.14	4.30	4.40	5.06	5.16
500	4.38	4.46	4.42	4.50	5.16	5.24	4.42	4.50	5.18	5.26
1000	4.54	4.58	4.58	4.62	5.32	5.36	4.58	4.62	5.34	5.38

2.8 Breach Model Boundary Conditions

The Estuary Model was run for the return periods and revised water levels shown in Table 2-1. A Plot Output (PO) line was added to the model to record the water level immediately downstream of the Colne Barrier. This data was then used to generate the boundary conditions for the Breach Model. The resulting peak water levels applied to the Breach Model are presented in Table 2-2. The time series data is shown in Figure 2-3.

Table 2-2 Peak water levels for Colne Barrier Breach Model

Return Period	Peak Water Level (mAOD)
0.5% AEP (1 in 200 year) for the year 2015	4.49
0.5% AEP (1 in 200 year) for the year 2115	5.34
0.1% AEP (1 in 1000 year) for the year 2015	4.79
0.1% AEP (1 in 1000 year) for the year 2115	6.23

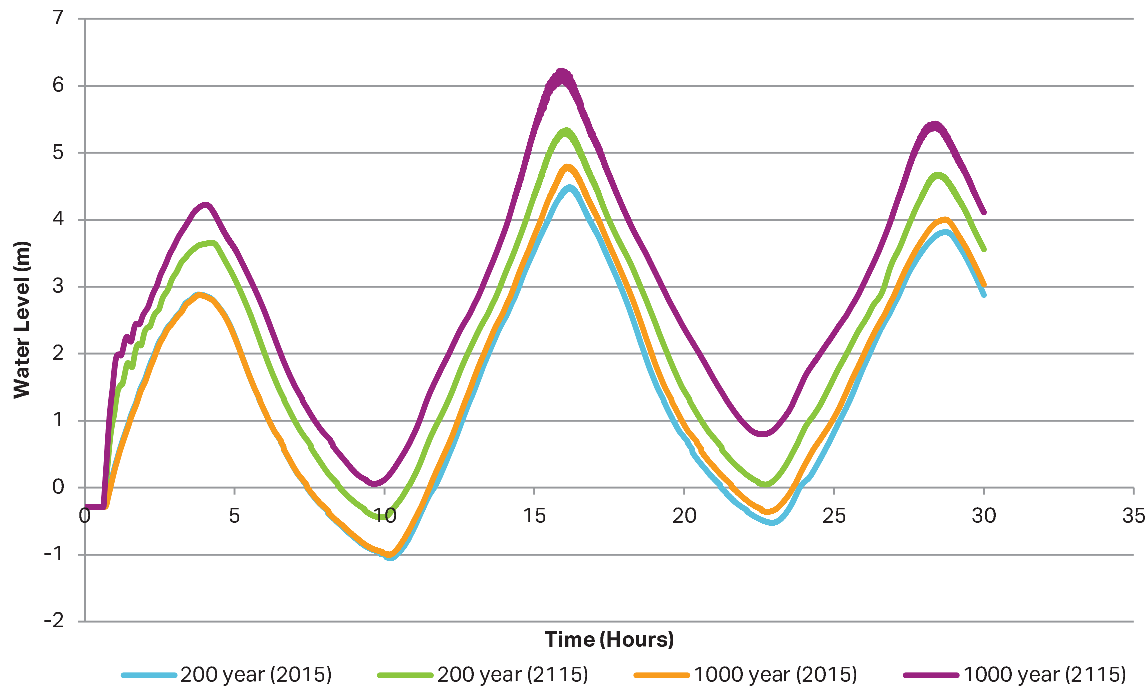

Figure 2-3 Boundary Conditions generated for the Colne Barrier Breach Model

2.9 Watercourses

In order to represent the inflows from the River Colne and Roman River, the fluvial boundaries have been retained from the Estuary Model. These are flow-time (QT) boundaries at the estimated base flow rates of 5m^3/s for the River Colne and 1m^3/s for the Roman River.

2.10 Modelling Outputs

2.10.1 Maximum Flood Depth

Maximum flood depth mapping has been generated to show the maximum depth of flooding across the floodplain during the entire model simulation.

2.10.2 Hazard Rating

Flood hazard mapping has also been prepared. Flood hazard is a function of flood depth, velocity and a debris factor. Each grid cell within the model domain has been assigned one of four hazard categories: 'Extreme Hazard', 'Significant Hazard', 'Moderate Hazard', and 'Low Hazard'. The derivation of these categories is set out in Table 2-3 and is based on Flood Risks to People FD2321 (Defra & Environment Agency, 2005), using the following equation:

*Flood Hazard Rating = ((v+0.5)*D) + DF*

(Where v = velocity (m/s), D = depth (m) and DF = debris factor)

For this study, a precautionary approach for the debris factor has been adopted in line with FD2321. A debris factor of 0.5 has been used for depths less than and equal to 0.25m, and a debris factor of 1.0 has been used for depths greater than 0.25m.

Table 2-3: Hazard categories based on FD2320, Defra & Environment Agency 2005

Hazard Rating		Description
HR < 0.75	**Low**	**Caution** – Flood zone with shallow flowing water or deep standing water
0.75 ≥ HR ≤ 1.25	**Moderate**	**Dangerous for some** (i.e. children) – Danger: flood zone with deep or fast flowing water
1.25 > HR ≤ 2.0	**Significant**	**Dangerous for most people** – Danger: flood zone with deep fast flowing water
HR > 2.0	**Extreme**	**Dangerous for all** – Extreme danger: flood zone with deep fast flowing water

2.11 Model Simulations

The design model simulations listed below were run on a fixed 2 second time step using TUFLOW Build 2013-12-AC-iDP-w64.

- 0.5% AEP (1 in 200 year) for Present Day (2015);
- 0.5% AEP (1 in 200 year) including allowance for Climate Change to 2115;
- 0.1% AEP (1 in 1000 year) for Present Day (2015); and,
- 0.1% AEP (1 in 1000 year) including allowance for Climate Change to 2115.

3 Mapping Outputs

3.1 Breach Modelling Results

The following maps have been prepared to present the findings of the breach modelling and are included within Appendix A of the Level 2 SFRA.

Modelled Scenario 0.5% AEP (Present Day 2015)

Figure A9 0.5% AEP (Present Day 2015) Maximum Flood Depth View 1

Figure A10 0.5% AEP (Present Day 2015) Maximum Flood Depth View 2

Figure A11 0.5% AEP (Present Day 2015) Maximum Flood Depth View 3

Figure A12 0.5% AEP (Present Day 2015) Hazard Rating View 1

Figure A13 0.5% AEP (Present Day 2015) Hazard Rating View 2

Figure A14 0.5% AEP (Present Day 2015) Hazard Rating View 3

Modelled Scenario 0.5% AEP (Climate Change 2115)

Figure A15 0.5% AEP (Climate Change to 2115) Maximum Flood Depth View 1

Figure A16 0.5% AEP (Climate Change to 2115) Maximum Flood Depth View 2

Figure A17 0.5% AEP (Climate Change to 2115) Maximum Flood Depth View 3

Figure A18 0.5% AEP (Climate Change to 2115) Hazard Rating View 1

Figure A19 0.5% AEP (Climate Change to 2115) Hazard Rating View 2

Figure A20 0.5% AEP (Climate Change to 2115) Hazard Rating View 3

Modelled Scenario 0.1% AEP (Present Day 2015)

Figure A21 0.1% AEP (Present Day 2015) Maximum Flood Depth View 1

Figure A22 0.1% AEP (Present Day 2015) Maximum Flood Depth View 2

Figure A23 0.1% AEP (Present Day 2015) Maximum Flood Depth View 3

Figure A24 0.1% AEP (Present Day 2015) Hazard Rating View 1

Figure A25 0.1% AEP (Present Day 2015) Hazard Rating View 2

Figure A26 0.1% AEP (Present Day 2015) Hazard Rating View 3

Modelled Scenario 0.1% AEP (Climate Change 2115)

Figure A27 0.1% AEP (Climate Change to 2115) Maximum Flood Depth View 1

Figure A28 0.1% AEP (Climate Change to 2115) Maximum Flood Depth View 2

Figure A29 0.1% AEP (Climate Change to 2115) Maximum Flood Depth View 3

Figure A30 0.1% AEP (Climate Change to 2115) Hazard Rating View 1

Figure A31 0.1% AEP (Climate Change to 2115) Hazard Rating View 2

Figure A32 0.1% AEP (Climate Change to 2115) Hazard Rating View 3

3.2 Areas Susceptible to Tidal Flooding

In addition, Figure A33 has been prepared to identify those areas of Colchester upstream of the Colne Barrier at a level below 3.2mAOD and could be subject to flooding on a more regular basis, as described in Section 1.3.

Figure A33 Areas below the manning threshold of the Barrier (3.1mAOD)

The figure shows areas along Haven Road and Hawkins Road, which are particularly low-lying and may be susceptible to tidal flooding.

Haven Road has been identified by Colchester BC and the Environment Agency as an area which experiences flooding during high tides, which is exacerbated during periods of heavy rainfall. Further details are included in Section 4.3 of the Level 1 SFRA Report.

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