HALL FARM, LODDON GARDEN VILLAGE SDL

RIVER LODDON MODEL REPORT

UNIVERSITY OF READING

18 AUGUST 2025

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Date:	18 August 2025
Document Reference:	A392-R064

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1.0 Introduction

Introduction

1.1. This Technical Note has been prepared by Abley Letchford on behalf of the University of Reading to set the baseline model and updated made to the River Loddon model to support an Outline planning application comprising of 2930 dwellings, employment space, two primary schools, a secondary school, a district centre, a local centre, a country park, SANG and green infrastructure and associated strategic infrastructure.

1.2. The site is located to the south of the M4, north of Arborfield and east of Shinfield.

1.3. Abley Letchford has updated the Wokingham Borough Council (WBC) 2021 Strategic Flood Risk Assessment (SFRA) hydraulic model of the River Loddon to make it suitable for assessing the risk of flooding to the proposed development and inform mitigation measures.

Model History

1.4. There are a number of hydraulic models of the River Loddon. This section sets out the available models, timeline and updates that were made to reach the WBC 2021 SFRA River Loddon model, hereafter referred to as the 2021 River Loddon model.

Lower Loddon Flood Study, 2007

1.5. The Lower Loddon Flood Study (hereafter known as the 2007 model) was built in 2007 by Jacobs on behalf of the EA. The Lower Loddon Flood Study's objective was to provide the EA with flood extent maps for the Lower Loddon from the confluence of the Upper Loddon and the Blackwater at Sheepbridge Court Farm to the confluence with the River Thames. The 2007 model is the origin model of the River Loddon. The model was run for the following return periods: 1 in 5 annual probability, 1 in 20 annual probability, 1 in 100 annual probability and 1 in 100 annual probability +20% climate change allowance.

1.6. The 2007 model was constructed using ISIS 1D, ESTRY 1D and TUFLOW 2D model software.

1.7. The hydrology of the 2007 model was calculated using the Flood Estimation Handbook Rainfall Runoff flood estimation method (FEH RR).

Lower Loddon Flood Map Update, 2009

1.8. The Lower Loddon Flood Map model update (hereafter known as the 2009 model) was completed in 2009 by WSP on behalf of the EA.

1.9. The objective of the 2009 study was to update the inflow hydrographs used in the 2007 model to the Statistical Method.

1.10. The model was run for the following return periods: 1 in 5 annual probability, 1 in 10 annual probability, 1 in 20 annual probability, 1 in 25 annual probability, 1 in 50 annual probability, 1 in 100 annual probability, 1 in 1000 annual probability and 1 in 100 annual probability +20% climate change allowance.

1.11. The 2009 model was updated to an ESTRY 1D, TUFLOW 2D model. Watercourses which were modelled in the 2007 model as 1D ISIS steady state models were removed from the 2009 model.

1.12. The hydrology of the 2009 model was calculated using the Statistical Method

Lower Loddon Flood Risk Management Options Study, 2018

1.13. The Lower Loddon Flood Risk Management Options Study (hereafter known as the 2018 model) was completed in 2018 by WSP on behalf of WBC to assess strategic options to reduce the impact of flooding at the Showcase Cinema roundabout.

1.14. The 2018 model included the following updates to the model schematic to improve the model schematisation:

- Hatch Farm Dairy proposals (land raising, floodplain culverts and floodplain compensation);
- The latest LiDAR data (obtained June 2017 from the EA);
- The latest Ordnance Survey Mastermap data;
- The latest additional channel survey for the River Blackwater, Barkham Brook, Arborfield ditches, and Hall Farm Mill pools and fish bypass (no represented in the EA 2009 model); and
- Data relating to the Shinfield/ Eastern Relief Road and culverts under the A327.

1.15. The model was run in the latest version of TUFLOW at the time of the modelling study.

WBC SFRA River Loddon Model, 2021

1.16. The WBC Strategic Flood Risk Assessment (SFRA) River Loddon model study (hereafter known as the 2021 model) was completed by Stantec on behalf of WBC to support the WBC SFRA 2021.

1.17. The 2021 modelling study updated the 2018 baseline model. The 2021 modelling study scaled the 1 in 100 annual probability hydrology to calculate the latest climate change allowances for the catchment.

1.18. The 2021 model was run for the following return periods: 1 in 20 annual probability, 1 in 100 annual probability, 1 in 1000 annual probability, 1 in 100 annual probability +14% climate change allowance and 1 in 100 annual probability +23% climate change allowance.

WBC SFRA River Loddon Model, 2022

1.19. The WBC SFRA River Loddon modelling study (hereafter known as the 2022 model) was completed in 2022 by JBA on behalf of WBC to support the WBC SFAR 2022.

1.20. The 2022 model is based on the 2009 model. The 2022 model scales up the 1 in 100 annual probability hydrology to calculate the latest climate change allowances.

1.21. The 2022 model does not include any updates to the model schematic.

1.22. The 2022 model was run for the following return periods: 1 in 5 annual probability, 1 in 20 annual probability, 1 in 30 annual probability, 1 in 50 annual probability, 1 in 100 annual probability, 1 in 10000 annual probability, 1 in 100 annual probability +14%, +23% and +46% climate change allowances.

Model Approach

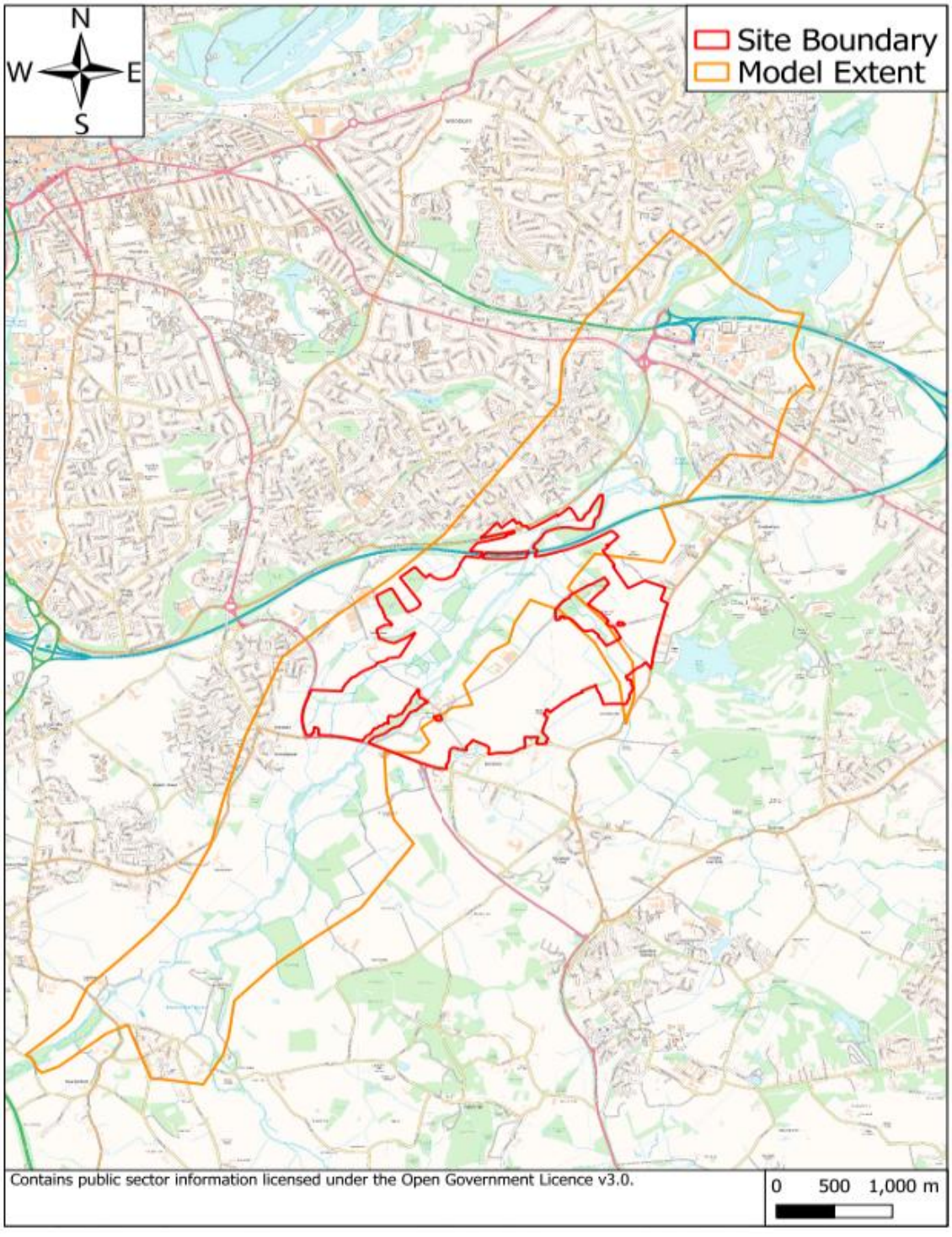
1.23. Abley Letchford believes that the 2021 model is the most representative model of the River Loddon as it include recent updates to topography within the catchment such as the Eastern Relief Road. The 2021 model has been used as a basis for this modelling study.

Site Location

1.24. **Figure 1** shows the extent of the 2021 model study and the site location.

1.25. The model extends from Kingsbridge Hill road in Swallowfield to north of the A329(M) in Winnesh.

Figure 1: 2021 Model Extent



Report Format

1.26. This report sets out the updates made to the baseline 2021 model, proposed development updates, and presents the model results.

2.0 Baseline Model Updates

Model Review

2.1. Abley Letchford completed a review of the 2021 model and updates required to make the model suitable for this modelling study. The following updates were identified.

- Hydrological update – Whilst the hydrology was last updated in 2021, the 1 in 100 annual probability climate change allowances were scaled up to the current climate change allowances. The baseline hydrology within the model dates from the 2009 model. More recent software is now available.
- LiDAR update – The LiDAR in the 2021 model was obtained from the EA in 2017. More recent LiDAR data has been flown since the model was produced. The latest LiDAR should be used within the modelling study.

Hydrology Review

2.2. Abley Letchford reviewed the hydrology of the 2021 model, which originates from the 2009 model. There have been a number of updates to the software and methods since 2009. Abley Letchford had intended on updating the hydrology to the latest methods and software version.

2.3. On review of the 2009 model and hydrology reports and plans, no catchment outlines or sufficient catchment descriptors were provided to be able to replicate the 2009 hydrology in the latest software versions.

2.4. The 2009 hydrology has therefore been accepted for use within this study.

2.5. The 2021 model scaled up the 1 in 100 annual probability peak flows to reflect the latest climate change allowances. The allowances within the 2021 model remain the current climate change allowances therefore these have been used within this study.

Model Software

2.6. The 2021 model was run in TUFLOW 2017-09-AB. There have been a number of updates to TUFLOW since the 2021 modelling study was completed. Abley Letchford therefore reran the model in the latest version of TUFLOW.

2.7. The latest version of TUFLOW, at the time of completing this study, was 2025.1.0.

LiDAR Data

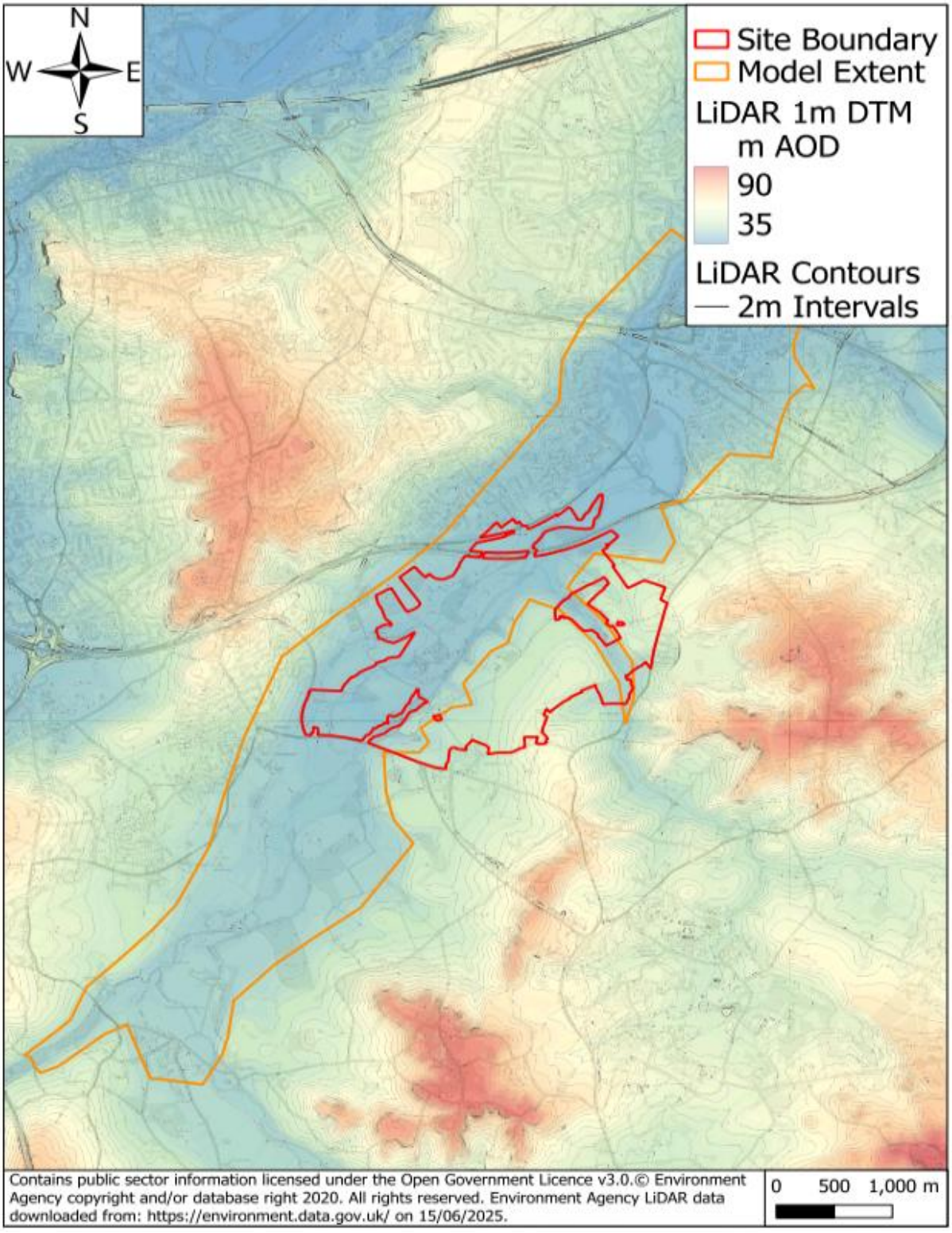
2.8. The LiDAR data within the 2021 model was obtained in 2017 from the EA, as part of the updates completed within the 2018 modelling study.

2.9. Abley Letchford downloaded the latest Environment Agency LiDAR data on 15th and 19th May 2025 and compared the ground levels. There were difference between the LiDAR levels between the two datasets. Abley Letchford therefore updated the LiDAR within the model to the latest available.

2.10. The LiDAR used within this modelling is 1m DTM LiDAR flown in 2020 and 2023. This is the best available dataset and at the finest resolution available.

2.11. **Figure 2** shows the extent of LiDAR available for the model.

Figure 2: EA LiDAR Coverage



3.0 Baseline Model Results

Overview

3.1. The baseline model was run for the following return periods:

- 1 in 20 annual probability;
- 1 in 100 annual probability;
- 1 in 1000 annual probability;
- 1 in 100 annual probability +14% climate change allowance; and
- 1 in 100 annual probability +23% climate change allowance.

Flood Extents

3.2. The baseline maximum modelled flood extent is shown in **Figure 3** and **Figure 4**.

Figure 3: Baseline Modelled Flood Extents – Model Overview

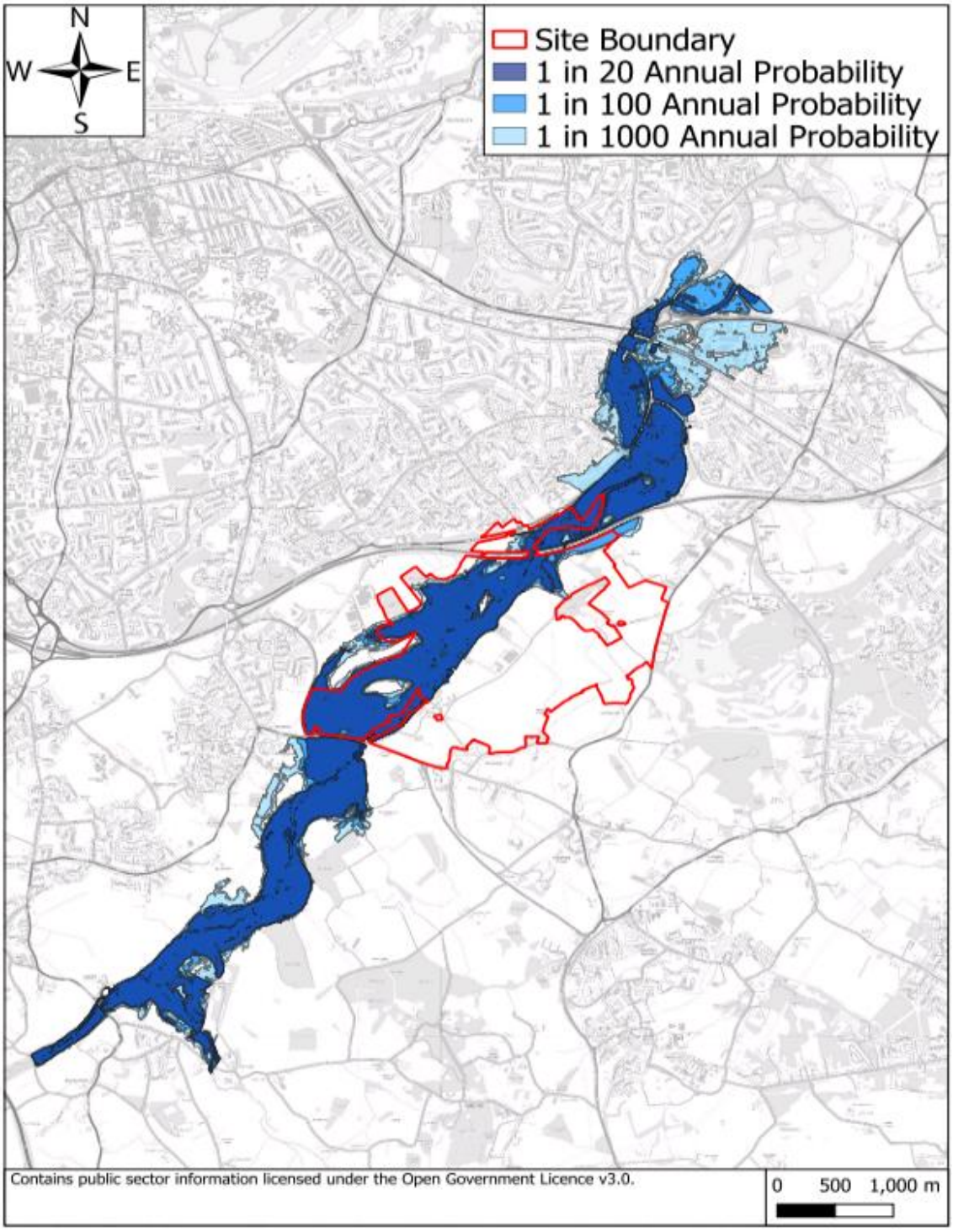
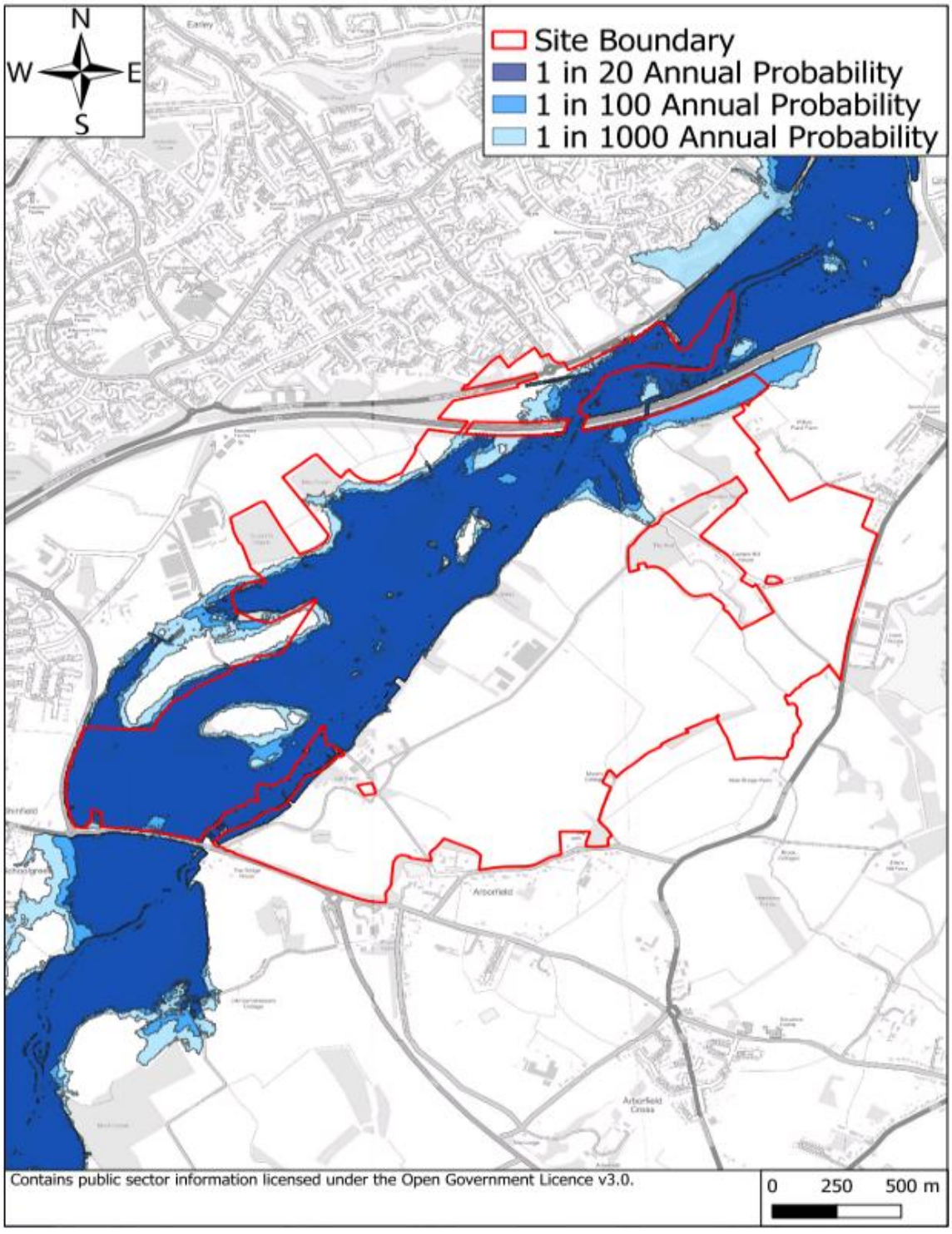


Figure 4: Baseline Flood Extents – Site View



Impact of Climate Change

3.3. The site is located within the Loddon and Tributaries Management Catchment. The latest (July 2021) climate change allowance for the catchment were used in this study. The potential impacts of climate change were modelled as +14% and +23% increase in the 1 in 100 annual probability peak flows.

3.4. The 1 in 100 annual probability +14% climate change allowance is shown in **Figure 5** and **Figure 6**.

Figure 5: Baseline 1 in 100 Annual Probability +14% Climate Change Allowance – Model Overview

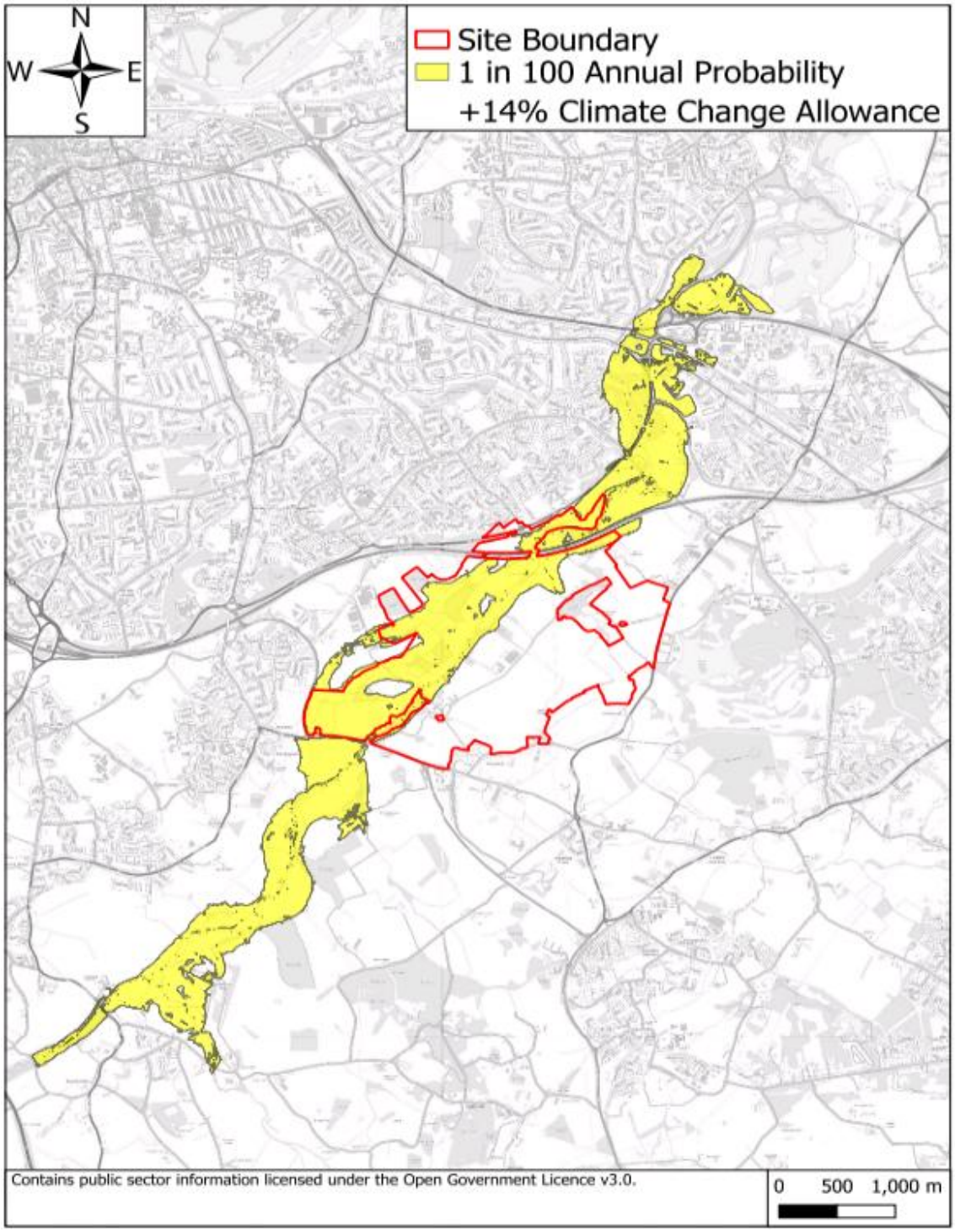
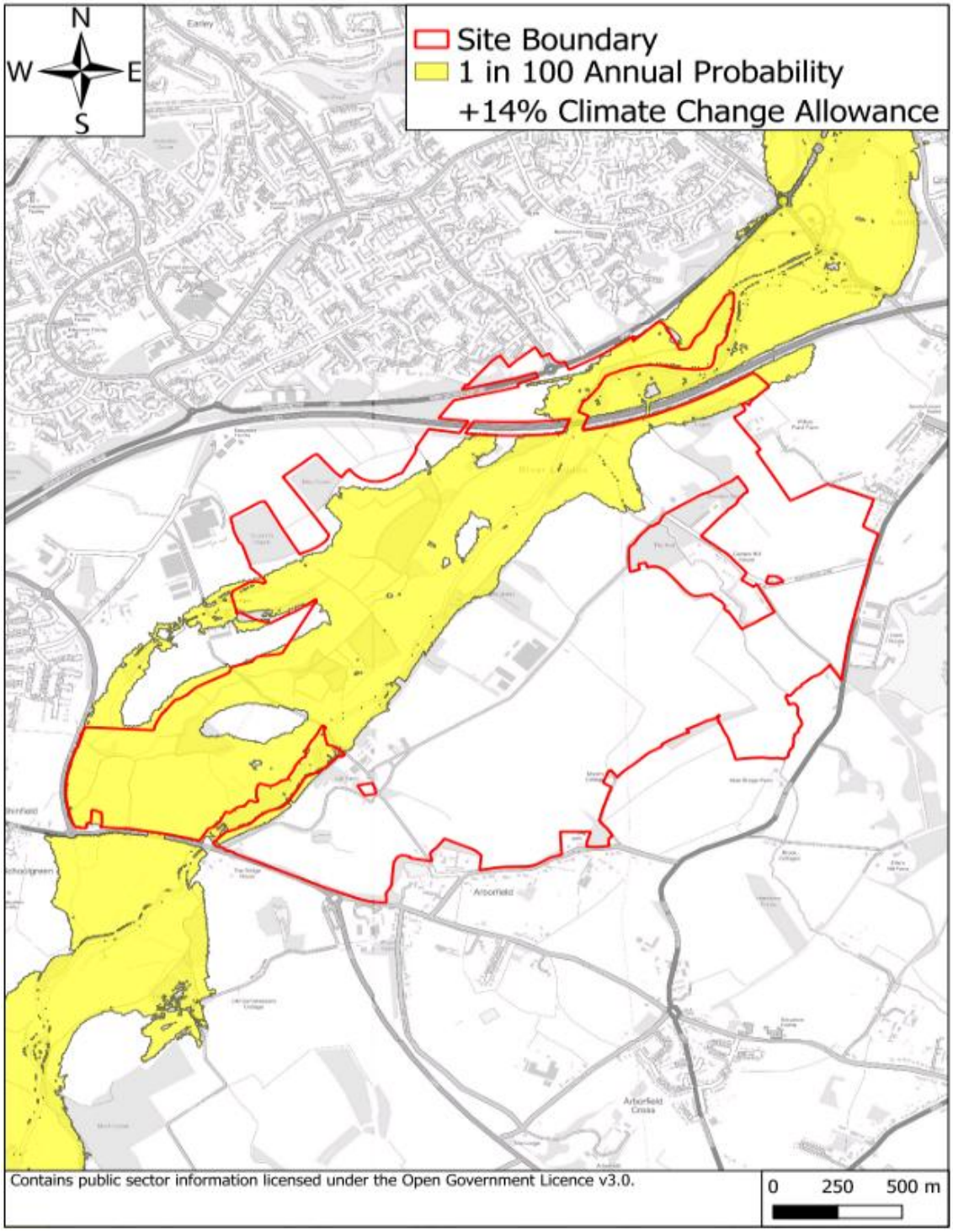


Figure 6: Baseline 1 in 100 Annual Probability +14% Climate Change Allowance – Site View



3.5. The 1 in 100 annual probability +23% climate change allowance is shown in **Figure 7** and **Figure 8**.

Figure 7: 1 in 100 Annual Probability +23% Climate Change Allowance – Model Overview

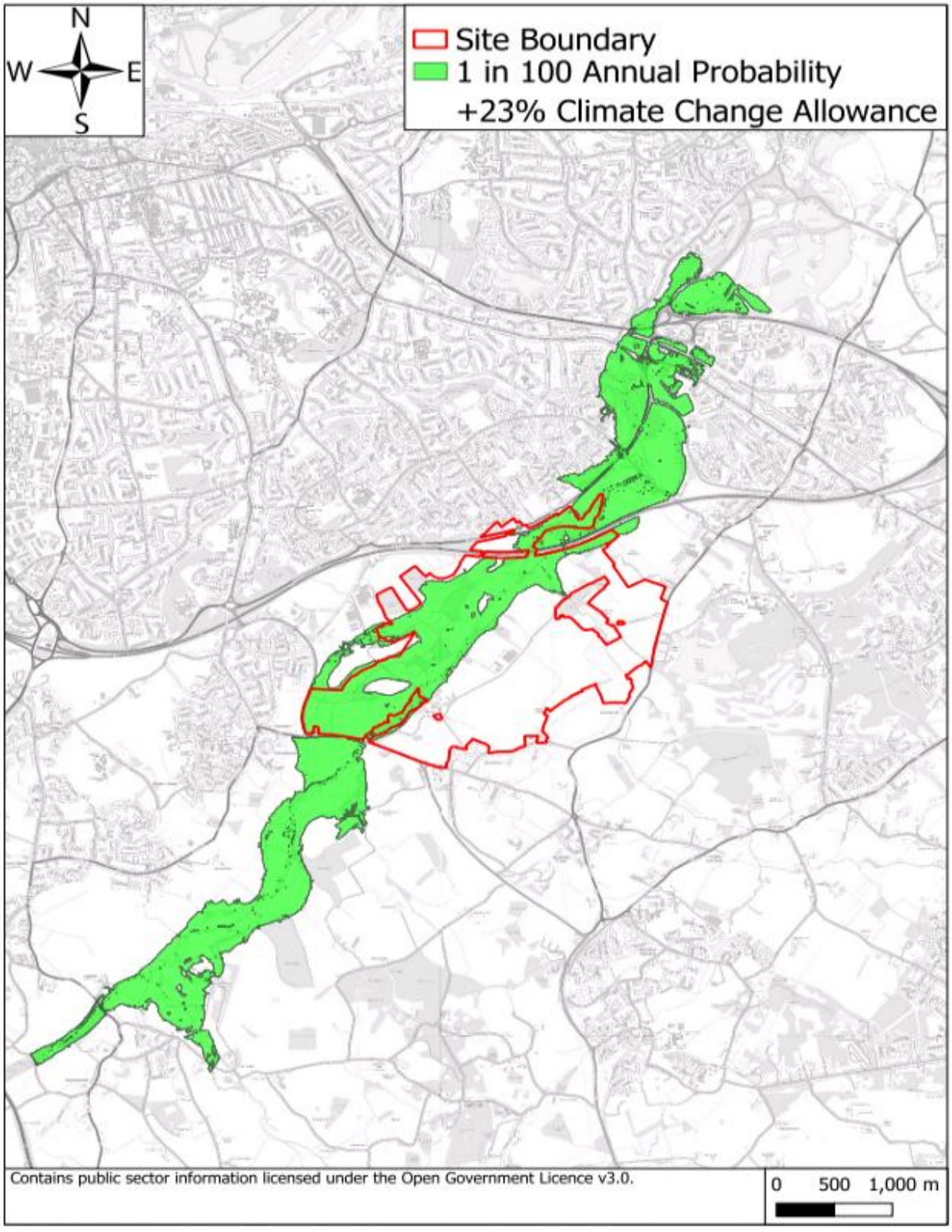
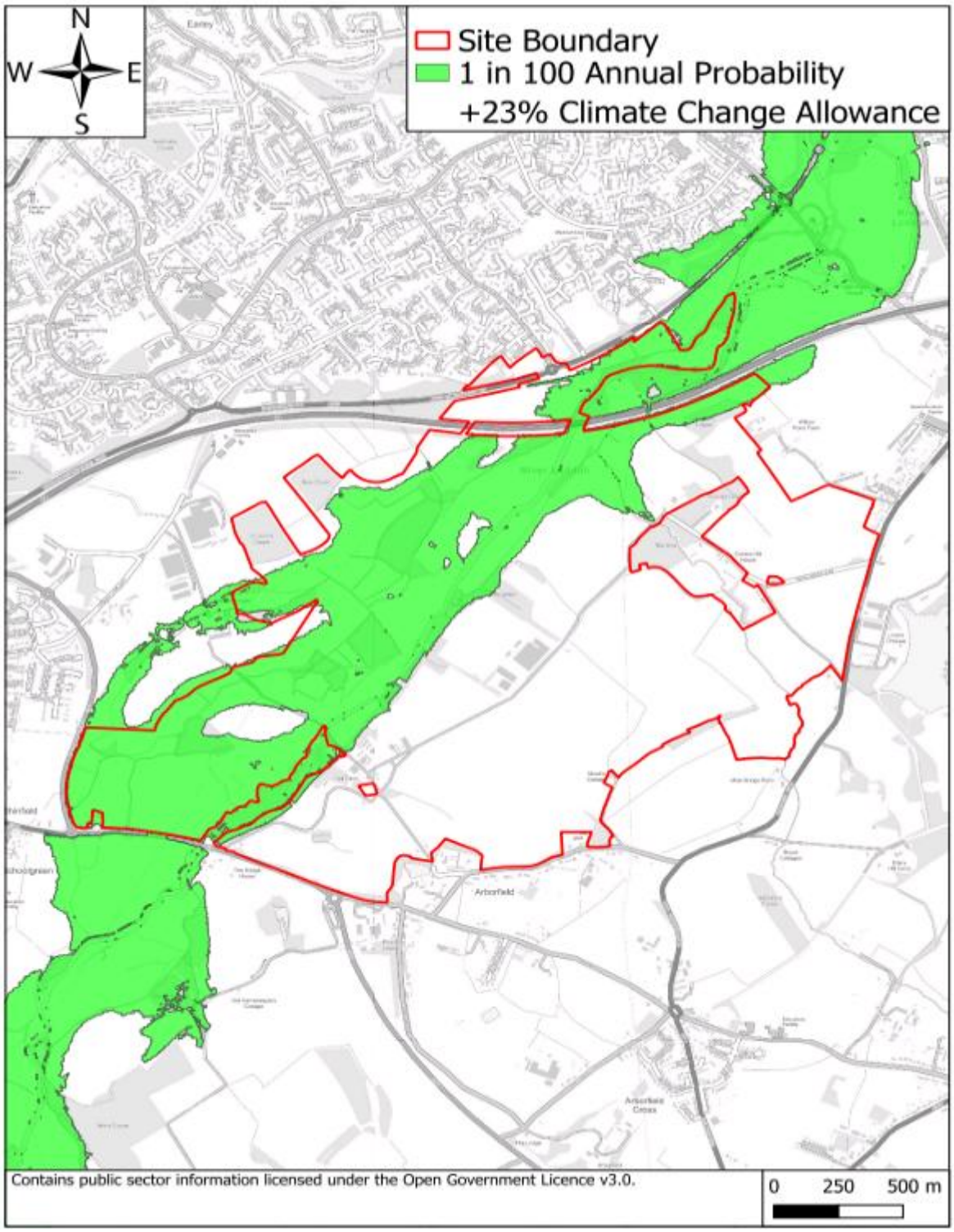


Figure 8: Baseline 1 in 100 Annual Probability +23% Climate Change Allowance – Site View



4.0 Post Development Model Updates

Loddon Crossing

4.1. Abley Letchford has added the proposed M4 and Loddon crossing into the 2021 Loddon model to model the impacts of the embankment of flood levels and extents.

4.2. **Figure 9** shows the location of the M4 and Loddon crossing.

Figure 9: M4 and River Loddon Crossing Embankment

4.3. The M4 and Loddon crossing embankment was modelled using a ground surface.

4.4. The River Loddon channel was conveyed through the embankment using a rectangular culvert. The culvert dimensions were assumed at this stage, based on the surrounding topography.

4.5. **Table 1** summarises the culvert dimensions.

Table 1: Loddon Crossing Dimensions

Attribute	Dimension	Source
Length	43m	Measured width of the embankment
Width	46m	Measured width of the Loddon and tributary
Height	4.8m	Maximum allowable height of the culvert based on the embankment dimensions
Upstream invert level	36.4m AOD	Interpolated from the channel section bed level
Downstream invert level	36.2m AOD	Interpolated from the channel section bed level

5.0 Post Development Model Results

Overview

5.1. The post development model was run for the following return periods:

- 1 in 20 annual probability;
- 1 in 100 annual probability;
- 1 in 1000 annual probability;
- 1 in 100 annual probability +14% climate change allowance; and
- 1 in 100 annual probability +23% climate change allowance.

Flood Extents

5.2. The baseline maximum modelled flood extent is shown in **Figure 10** and **Figure 11**.

Figure 10: Post Development Modelled Flood Extents – Model Overview

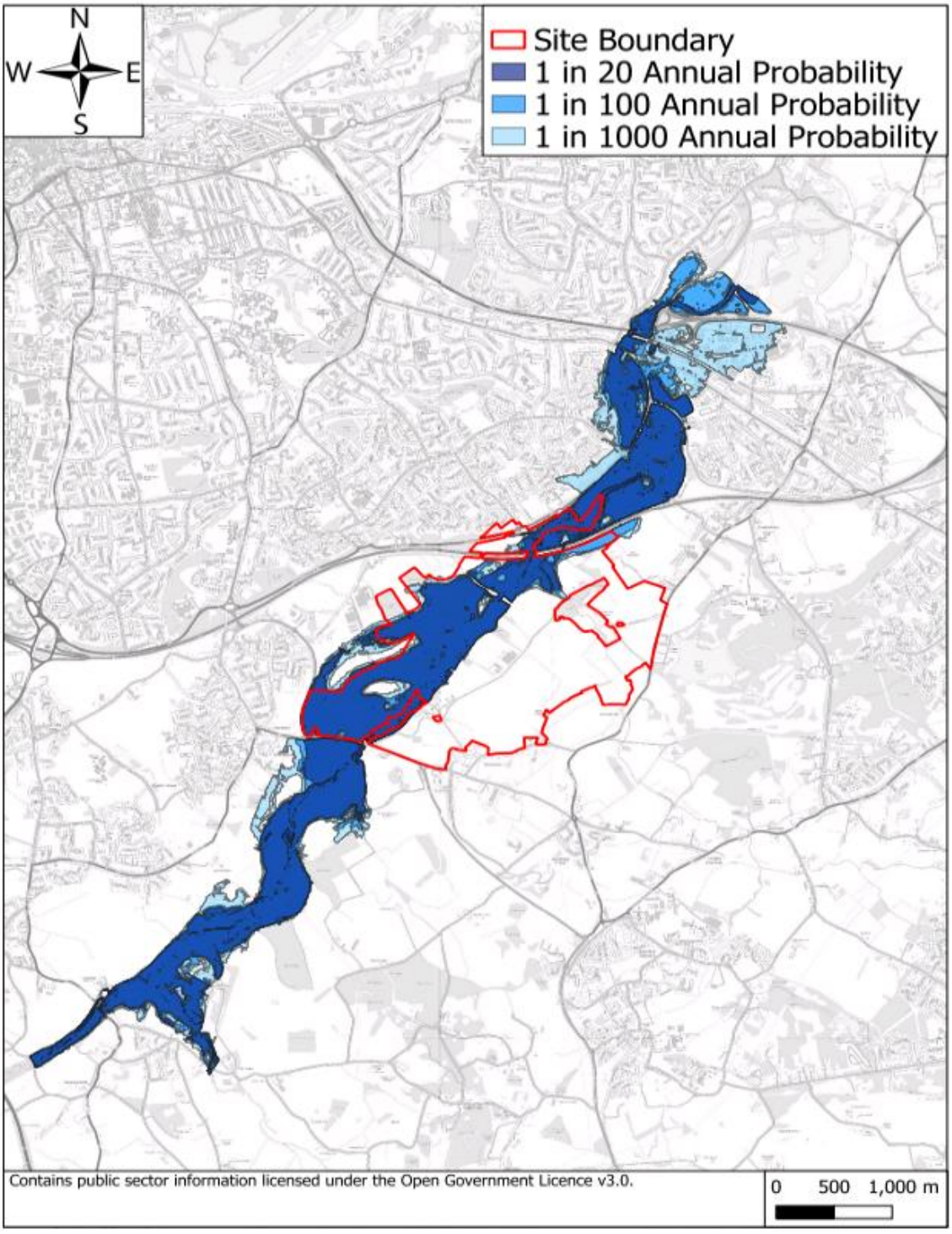
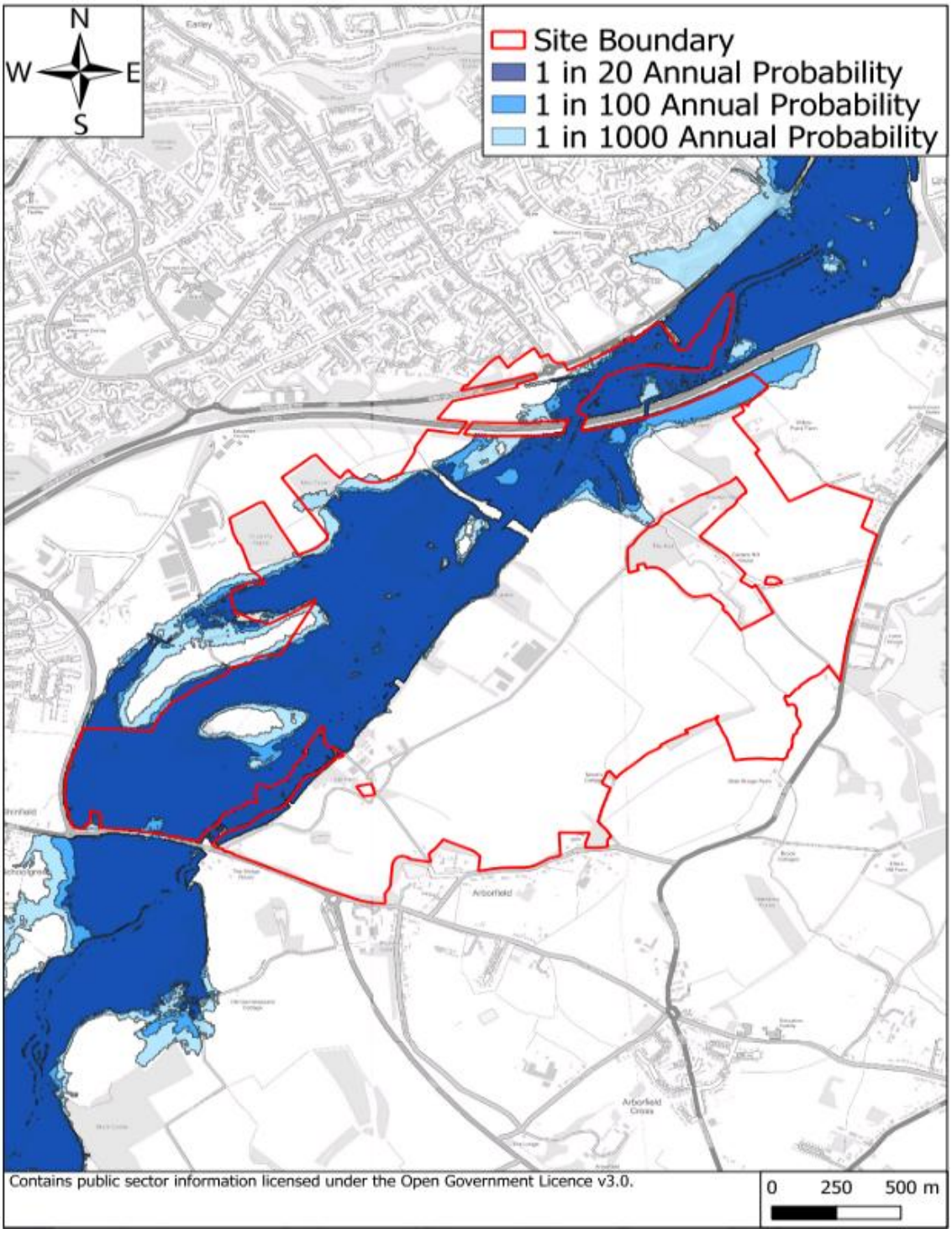


Figure 11: Post Development Modelled Flood Extents – Site View



Impact of Climate Change

5.3. The site is located within the Loddon and Tributaries Management Catchment. The latest (July 2021) climate change allowance for the catchment were used in this study. The potential impacts of climate change were modelled as +14% and +23% increase in the 1 in 100 annual probability peak flows.

5.4. The 1 in 100 annual probability +14% climate change allowance is shown in **Figure 12** and **Figure 13.**

Figure 12: Post Development 1 in 100 Annual Probability +14% Climate Change Allowance – Model Overview

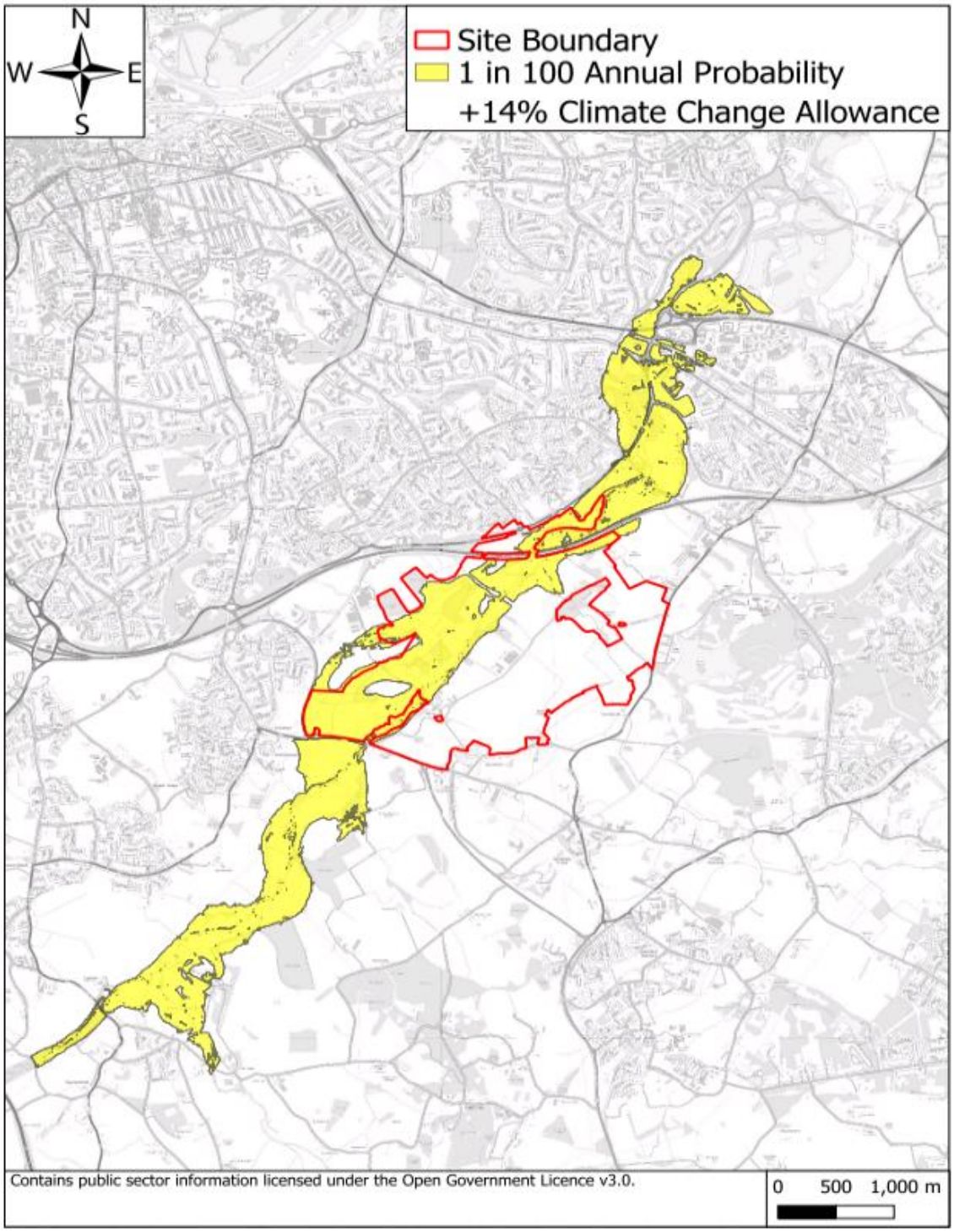
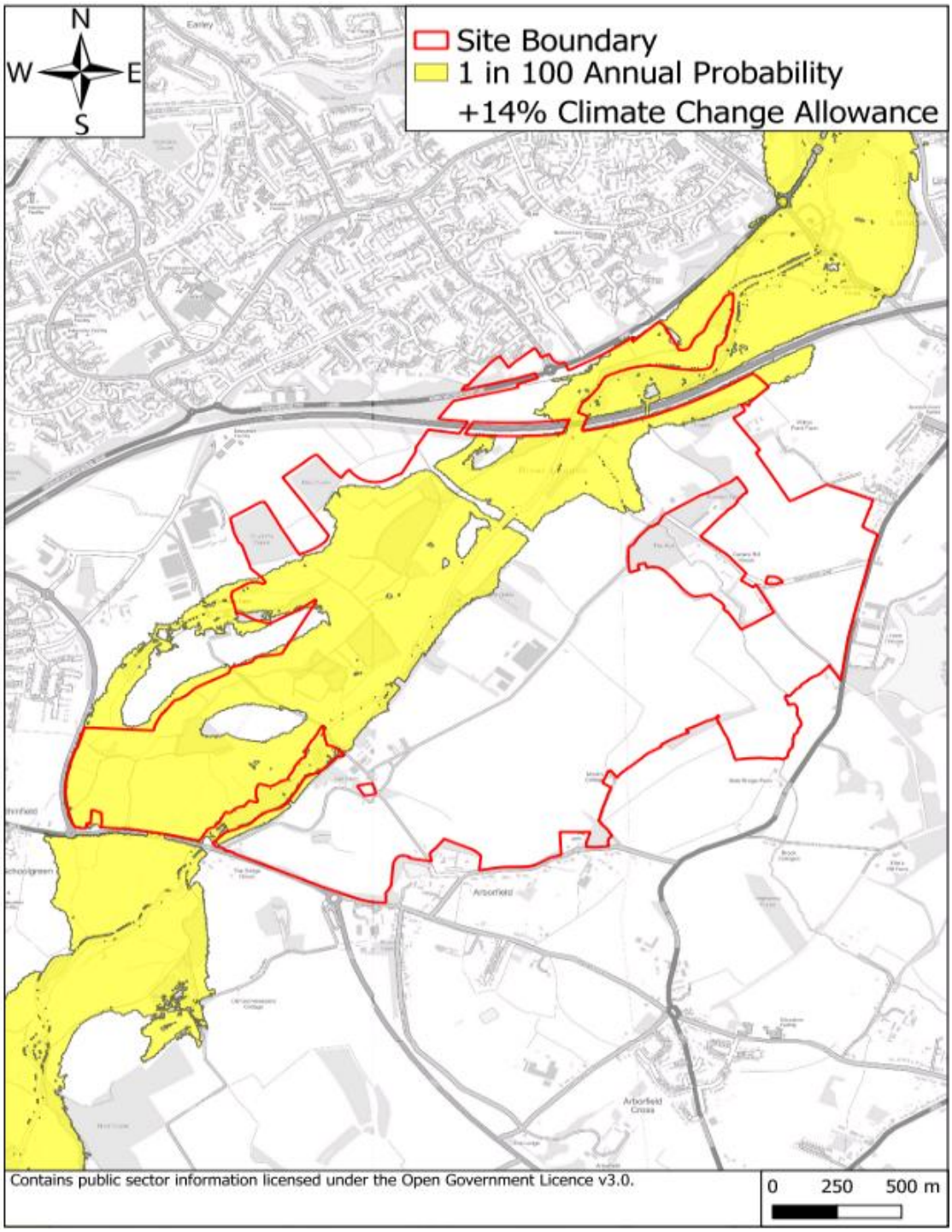


Figure 13: Post Development 1 in 100 Annual Probability +14% Climate Change Allowance – Site View



5.5. The 1 in 100 annual probability +23% climate change allowance is shown in **Figure 14** and **Figure 15**.

Figure 14: Post Development 1 in 100 Annual Probability +23% Climate Change Allowance – Model Overview

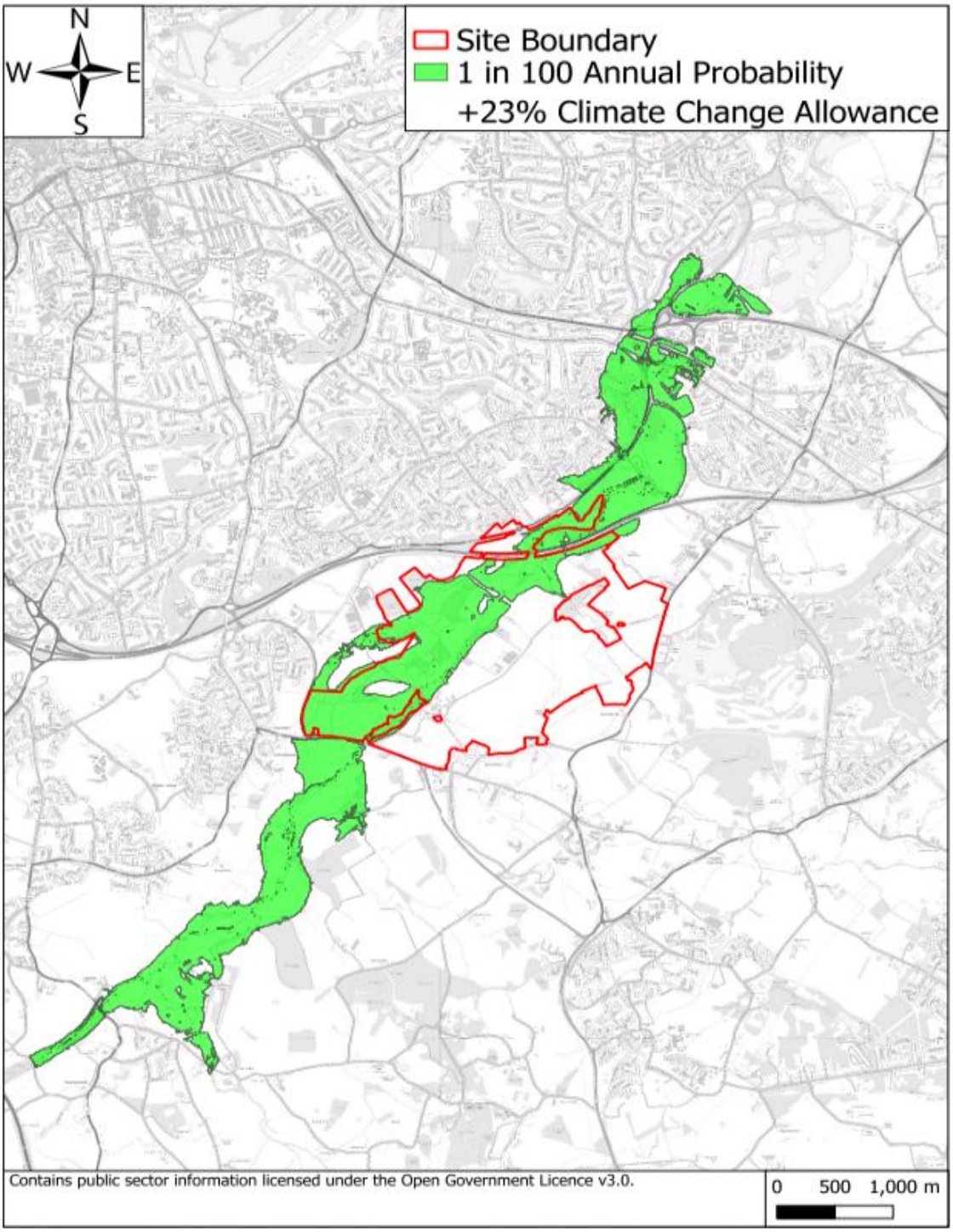
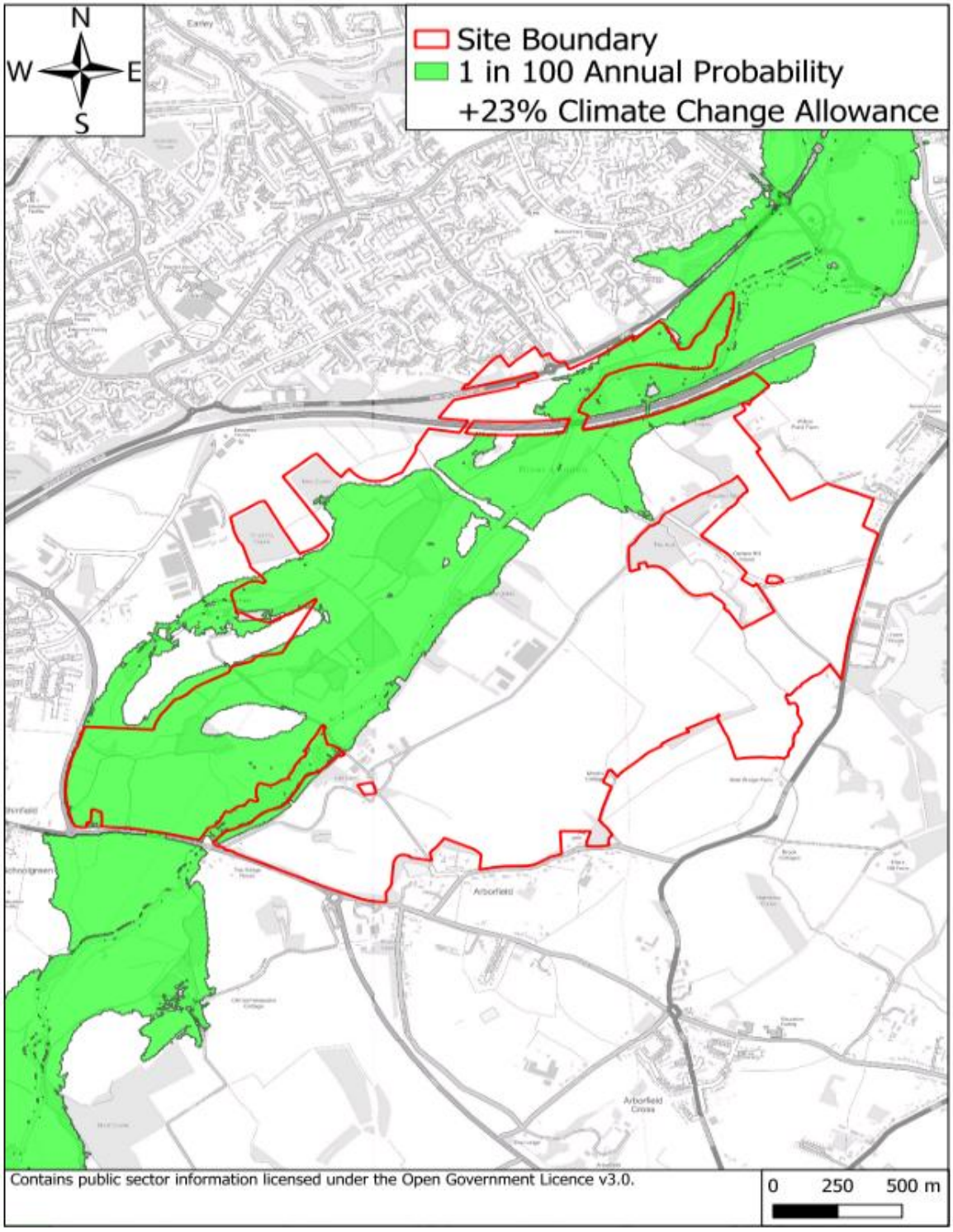


Figure 15: Post Development 1 in 100 Annual Probability +23% Climate Change Allowance – Site View



5.6. **Figure 16** shows the difference in modelled flood levels for the baseline model and model including the M4 and Loddon embankment.

5.7. **Figure 17** shows the difference in wet and dry areas.

Figure 16: 1 in 100 Annual Probability - Difference in Modelled Flood Levels between the Baseline Model and Model Including the M4 and Loddon Embankment

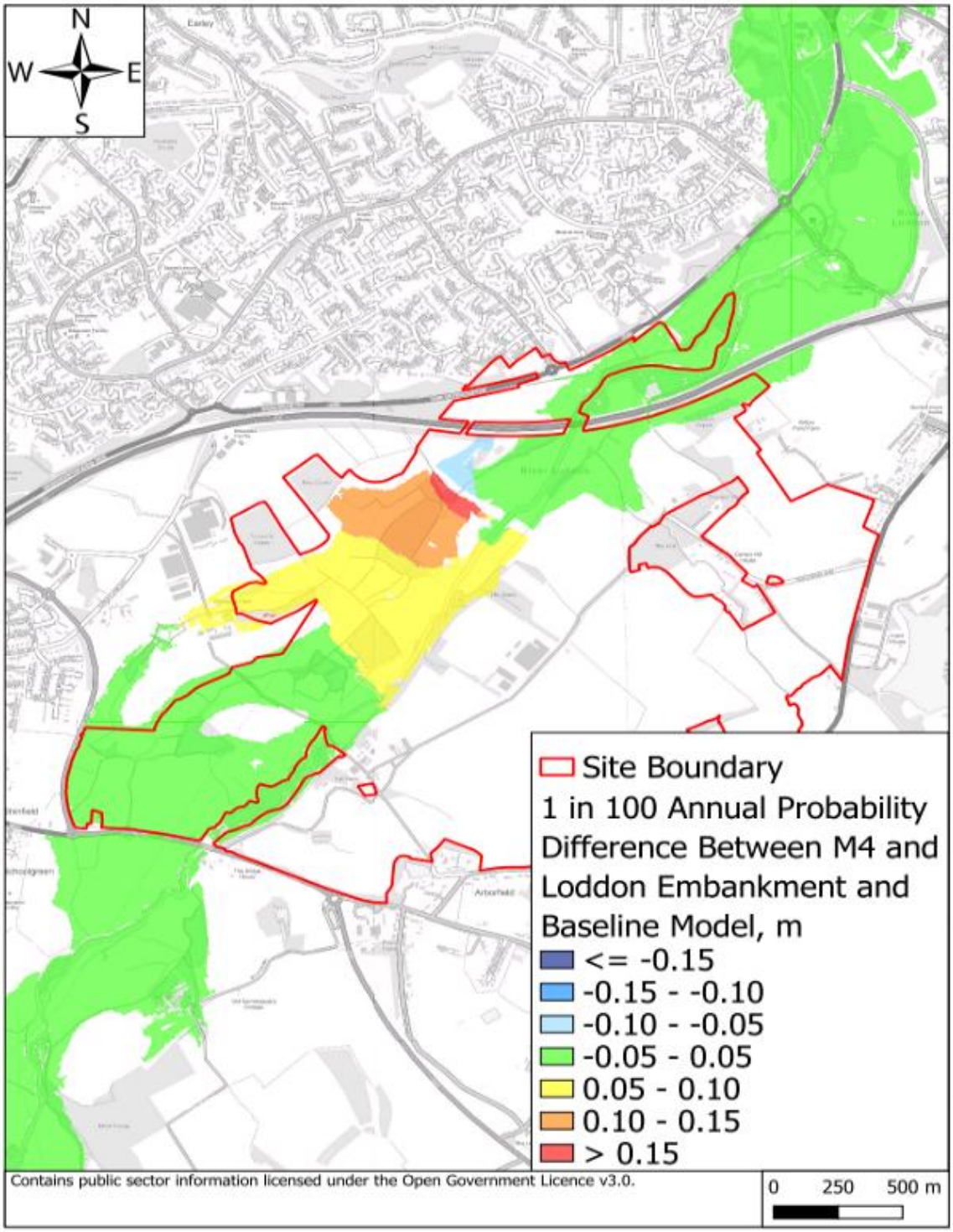
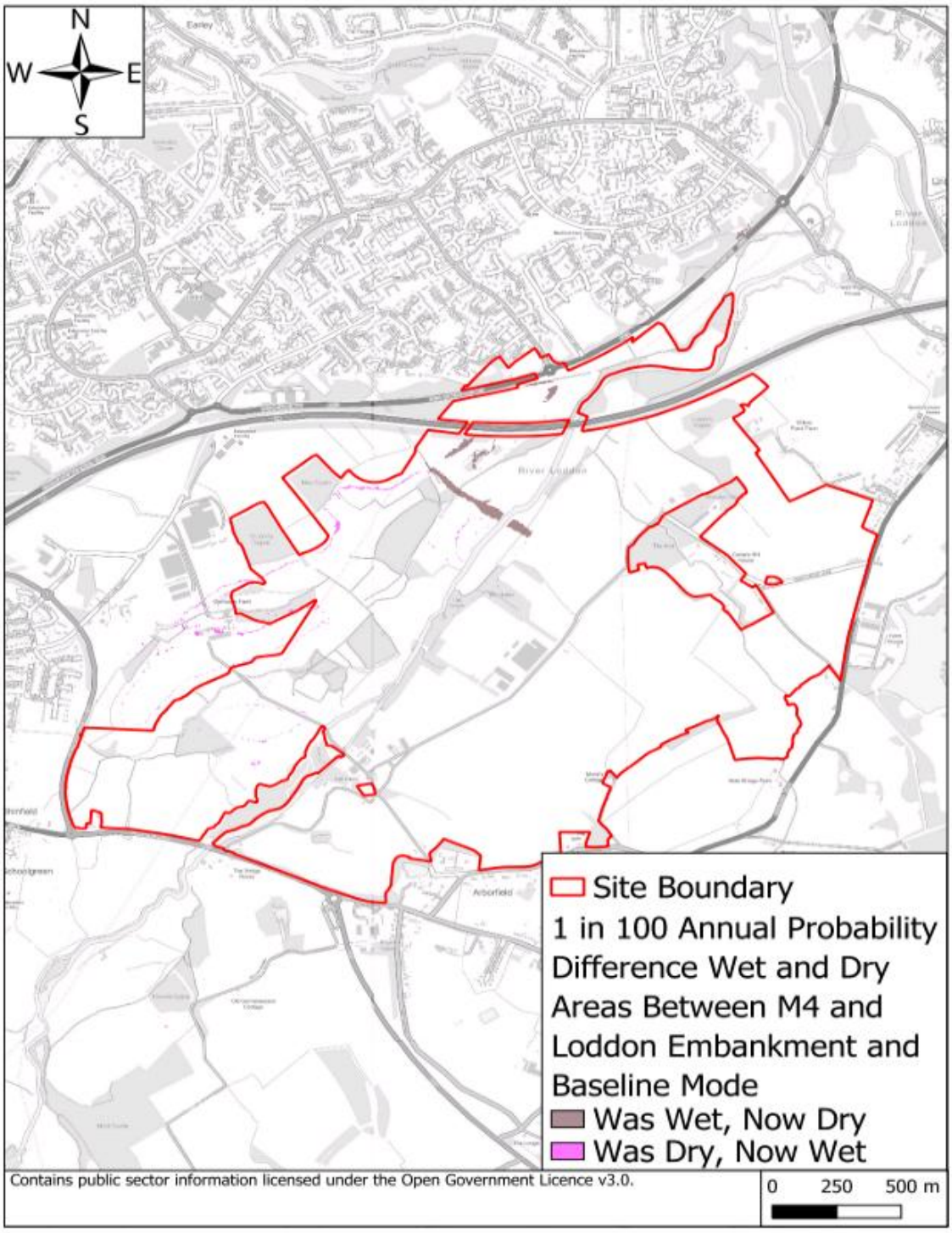


Figure 17: 1 in 100 Annual Probability +14% Climate Change Allowance - Difference in Wet and Dry Areas Between the Baseline Model and Model Including the M4 and Loddon Embankment



5.8. **Figure 16** shows that there is an increase of greater than 0.15m immediately upstream of the embankment. There is insignificant (±0.05m) difference in the modelled flood levels upstream of Arborfield Road. The majority of the increase in modelled flood levels are within the site boundary. The exception to this is an increase in modelled flood levels of up o 0.1m at Oldhouse Farm.

5.9. There is a decrease of up to 0.1m immediately downstream of the embankment.

5.10. **Figure 17** shows that there is a slight increase in the extent upstream of the M4 and Loddon embankment. **Figure 17** shows that the location of the M4 and Loddon embankment is now dry as the ground levels are raised up above the flood level. There are several areas downstream of the M4 and Loddon embankment which are now dry. This is expected as more water is held back by the M4 and Loddon embankment.

6.0 Conclusion

6.1. This hydraulic modelling report has been prepared by Abley Letchford on behalf of the University of Reading to set out the updates made to the Wokingham Borough Council (WBC) Strategic Flood Risk Assessment (SFRA) model of the River Loddon, dated 2021 (hereafter known as the 2021 model) and the model results.

Baseline Model

6.2. Abley Letchford reviewed the available models of the River Loddon. Abley Letchford believes that the 2021 model is the most representative of flooding within the Loddon area as it includes the recent topographic updates within the catchment such as the Eastern Relief Road. Abley Letchford has therefore used the 2021 model as a basis for this study.

6.3. The hydrology of the model was reviewed, with the aim of replicating the hydrology in the latest software methods and software versions. The previous hydrology reports did not include sufficient information on the catchment areas and descriptors to allow for Abley Letchford to replicate the hydrology. The hydrology in the 2021 model has therefore been utilised.

6.4. Abley Letchford ran the model in the latest version of TUFLOW. At the time of completing the study, the latest version of TUFLOW was 2025.1.0.

6.5. Abley Letchford updated the ground model within the model. The 2021 model used LiDAR obtained from the Environment Agency in 2017. More recent LiDAR data was flown in 2020 and 2023 which was deemed to be the best available data.

Loddon and M4 Crossing

6.6. Abley Letchford added the proposed M4 and Loddon crossing ground model, and culvert into the model. The model results show that there is an increase in the modelled flood levels of over 0.15m immediately upstream of the embankment, and an increase in the modelled flood extent. The M4 and Loddon embankment is holding flood flows back, causing the increase in flood levels and extent.

6.7. The majority of the increase in flood levels and extent is within the site boundary. The exception to this is at Oldhouse Farm, where modelled flood levels are up to 0.1m greater.

6.8. There is a decrease of up to 0.1m downstream of the embankment, and areas that are now dry, as a result of water being held back by the embankment.

6.9. The location of the M4 and Loddon embankment is now dry and the ground levels are greater than the modelled flood level, which is as expected.

Model Results

6.10. The model was run for the following return periods: 1 in 20 annual probability, 1 in 100 annual probability, 1 in 1000 annual probability, 1 in 100 annual probability +14% climate change allowance and 1 in 100 annual probability +35% climate change.