Appendix 20.5 Fluvial Model Report

(Modified graphics)

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CAMBRIDGE WWTP RIVER MODELLING

Project no. 123239

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1. ~~Introduction~~Executive Summary

1.1 ~~Background~~Modelling approach

This report assesses the potential impact on flood risk from the New Outfall of the relocated Cambridge Wastewater Treatment Plant (WWTP). To make this assessment:

1. Outflows into the River Cam were calculated using Anglian Water's sewer model of the catchment.
2. The sewer model was simulated for three scenarios:
   a. Existing outfall without growth in the catchment ('Existing');
   b. Existing outfall with growth in the catchment ('Existing Future'); and
   c. New outfall with growth for the new works ('New Outfall').
3. Outfall flows for the three scenarios were applied as additional inflow hydrographs to the Environment Agency's latest model of the River Cam ('2023 Cam Urban').
4. The river model was simulated for a range of flood events:
   a. Nine flood magnitudes (from 1 in 2 year to 1 in 1000 year);
   b. Critical storm duration for the River Cam (55 hour) and the critical storm for the sewer catchment (4 hours); and
   c. Three climate change scenarios for the 1 in 100 year flood (9%, 19%, and 45% increases in flows).

1.2 Model assumptions

The following assumptions should be understood when interpreting the model results presented in this report:

1. The sewer model for future growth scenarios (Existing Future and New Outfall) includes a 5m^2 allowance for uncontrolled runoff entering the sewer network from each additional property in the catchment. This follows Anglian Water's design standards for sewer modelling to ensure the storm water management has sufficient capacity to deal with the runoff that will reach it. This allowance is not included in the Existing (no growth) case.
2. There is potentially some double counting of runoff in the model.
   a. The Cam Urban river model does not explicitly or separately represent WWTP discharges so these have been added to the model for this assessment. However, the river model should already implicitly account for discharges to the river as the hydrological assessment is based on defining the model inflows to give the correct flows at different points in the river.
   b. For the future growth scenarios, no reduction is made for the river catchment inflows to account for the additional 5m^2 runoff area for each new property entering the sewer system.

   In both cases, there is no straightforward way to accurately and fairly remove this double-counting within the river model.

As such, the model results in terms of the impact of the new WWTP are likely to be conservative.

1.3 Results

The river model results show that:

- **The new WWTP is located outside of the River Cam floodplain and is not at risk of fluvial flooding.**
- **The new outfall / WWTP does not change flood risk in the catchment for all tested flood magnitudes.** This is based on the comparison between Existing Future and New Outfall scenarios, with both scenarios including future growth within the catchment. The results from those two scenarios are almost identical. **This confirms that moving the WWTP facilities does not change the flood risk.**
- When comparing present flood risk to future scenarios, there is a small increase in flood risk predicted in some locations. This small increase in flood risk is caused by the assumed future development and population growth within the catchment. For the future growth cases, there are increased flows entering the sewer network. The same small increase in flood risk compared to the existing catchment (no growth) is shown for the existing WWTP and the new WWTP outfalls – this confirms that it is not the new outfall / WWTP causing the increase in flood risk.
- The increase in flood risk in the River Cam due to future growth in the catchment is extremely small, with flood level increases of only 0.01m or less. There are small areas with larger changes in flood levels predicted at the edges of the flooded extent, which relate to the slightly larger flood volume spreading further within the floodplain. However, given that the predicted river level changes are less than or equal to the convergence tolerance of the model simulations (0.01m) and considerably less than the model calibration tolerance (0.15m), it would not be unreasonable to conclude there is no genuine change in flood risk, even for the future growth scenarios.

2. Introduction

2.1 Background

The Cambridge Wastewater Treatment Plant (WWTP) Relocation project, also known as CWWTPRP, includes the relocation of the existing WWTP. The project scope also includes an extension of the existing Riverside Sewer Tunnel to convey flows to the proposed new WWTP location and a new outfall to discharge effluent from the WWTP into the River Cam.

This report describes the river modelling to assess the impact of outfall discharges on fluvial ~~flood levels in the River Cam~~flooding.

Since the production of the first version of this report (April 2022) the Environment Agency have updated their river model of the Cam[1] (the '2023 Cam Urban' model). This report was revised to use this updated model and therefore supersedes the first version. The 2023 Cam Urban hydraulic model has been reviewed which is discussed in section 5.2. There have been further subsequent revisions to this report in response to review by, and discussions with, the Environment Agency.

~~1.2~~2.2 Flood Risk Assessment

The project falls into the category of being 1 hectare or greater in Flood Zone 1 or a proposal located in Flood Zones 2 and 3 and therefore must be accompanied by a Flood Risk Assessment (FRA). ~~The CWWTPRP is now at the stage where the FRA is required. The FRA will:~~This report is not an FRA. However, the scenarios and results in this report have been tested and presented to assist in the assessment and understanding of the potential impacts on flood risk. As such, an FRA has been written in conjunction with this report (Application Document Ref 5.4.20.1: Flood Risk Assessment report) that:

- ~~Identify~~Identifies and ~~assess~~assesses the risks of all sources of flooding to and from the project.
- ~~Demonstrate~~Demonstrates how these flood risks will be managed.
- ~~Take~~Takes climate change into account.
- ~~Help develop the design of the new outfall.~~

~~For~~To assist the FRA ~~it is proposed that~~ three stages of modelling ~~are~~were carried out to understand the impact of the new WWTP and associated outfall on the local fluvial and land environment:

- Stage 1: river modelling of the River Cam using an existing one-dimensional (1D) – two-dimensional (2D) hydraulic model of the River Cam. This is to assess fluvial flood levels throughout the River Cam and the relative impact of the new outfall compared to existing conditions.
- Stage 2: river and outfall modelling using a new local hydrodynamic model of the River Cam in the vicinity of the new outfall (in 2D or 3D). This is to assess velocities and mixing of the effluent as it enters the River Cam.

1 Cam Urban Flood Modelling, Environment Agency 2023 ENV0002539C-JBA-XX-CA-RP-MO-L0116_3-A6-C01-L0116_3-EA0-LOD0-CAM_URBAN_MAIN_REPORT.pdf

- Stage 3: outfall modelling using Computational Fluid Dynamics (CFD). This is to inform the design of the outfall, for example to prevent scour of the river bed and opposite bank.

There is also potential for a further consideration of fluvial-geomorphology modelling. Detailed design of the relevant parts of the project will link into and be informed by the modelling results.

This report only covers the Stage 1 modelling.

2.3 Outfall flows

This report describes the river modelling undertaken to assess flood risk in the River Cam for three cases:

- With the existing WWTP and its existing outfall, for the catchment as it is now.
- With the new WWTP and its new outfall, including runoff from future growth[2] in the catchment.
- Following review by the Environment Agency, a further sensitivity case was recommended for the existing WWTP including runoff from future growth in the catchment (assuming that the new WWTP and outfall would not be constructed).

In effect, this is to:

- Confirm that the new WWTP is not at risk of river flooding; and
- Assess the relative impact on flood risk elsewhere of the flows from the new outfall compared to existing conditions.

It is really important to note that the new WWTP and outfall will not create water or increase catchment runoff. Whilst the modelling results show increased flow and volume through the new outfall when compared to the existing WWTP with the catchment as it is now, this is primarily due to inclusion of future growth within the catchment in the new outfall scenario. The existing outfall with future growth sensitivity test has been conducted to assess the impact of this change. The modelling approach for the two core scenarios is conservative in assessing the new WWTP and outfall's impact for several reasons:

- There is potentially some double counting of runoff in the model. The Cam Urban river model does not explicitly or separately represent WWTP discharges so these have been added to the model for this assessment. However, the river model should already implicitly account for discharges to the river as the hydrological assessment is based on defining the model inflows to give the correct flows at different points in the river, through comparison with estimates derived from observed flow records. The other model inflows could be adjusted to account for the added outfall discharge, to maintain the same peak river flows and volumes. However, it is not clear cut how that should be applied for the new outfall case. With additional treatment capacity and more flow passing to the WWTP, logically the runoff from the rest of the catchment would reduce to less than the existing outfall case. Implementing a closed water balance in the model

[2] Including runoff from 266 future growth (up to 2050) sites in the Cambridge and Waterbeach area.

would mean no change in river flows or volume at all. This may be the case but would make the modelling exercise redundant. To fully assess this would require an integrated river and surface water model of the whole catchment, which is a disproportionately large task for the needs in this study.

- The reason for the new WWTP is that the existing WWTP could not cope with the future demand. There would be more frequent spills to the outfall from the existing plant in the future growth case. As recommended by the Environment Agency, this case has also now been sensitivity tested for comparison to the new outfall.

In summary, our approach is conservative and overstates the relative impact of the new WWTP. Much of the small impact shown is due to the allowance for future growth within the catchment for the new outfall case, rather than the WWTP or outfall design itself. **When future growth is also considered in the model for the existing outfall, the new outfall shows no detrimental impact on flood risk**.

3. ~~2.~~ Scope

The scope provided for this work in the Project Brief is:

"Carry out hydraulic modelling of the River Cam to determine the baseline flows and water levels along the river. Modelling is also required across a range of return periods to determine the impact on water levels, flows, etc. and determine the likely impacts from flooding along the watercourse.

It is understood that, based on the location of the outfall and the surrounding area, the design flood standard should be 1 in 100 years (typical design standard for "Built-up Areas) " in Table 10.1/pg133 of CIRIA 786 (Culvert, Screen and Outfall Manual, 2019).

The model should include appropriate allowances for the potential effects of climate change.

The model of the River Cam is required (based on the EA ISIS data and Lidar sets) to assist with the design development of the proposed outfall for the new Cambridge Waste Water Treatment Plant at the location shown on Drawing No. 00000-100006-CAMEST-FED-GAR-C-3110. The modelling is to assess the impact of discharging Final Effluent and Storm Flows from the proposed outfall.~~The current flows are as follows although these are to be confirmed by CWRP Ltd/@One prior to commencement of the modelling:~~"

~~*Max FE outfall flow = 2.2m³/s, Max outfall storm flow = 5m³/s (tbc), Total max outfall flow (FE and storm) = 7.2m³/s (tbc)."*~~

~~3. Implementation~~

~~3.1 Model version~~

~~We have been provided with the "Cam Phase 2 – Cam Urban" existing Environment Agency (EA) ISIS – Tuflow model of the River Cam through Cambridge. We have a copy of the Product 7 model files (but no model results or documentation), downloaded from the Anglian Water~~

data storage system. From the version of Tuflow used, and the run file names, the model appears to date from 2011.

It is noted by Chris Swain of the Environment Agency in his email from the 21st June 2021 that:

> *"The EA are updating the Cam model (through Jacobs) in the 2021 financial year and likely including the existing outfall, may be able to use this model as it nears completion"*

We understand that the updated Cam model has not yet been finalised so that the 2011 model remains the most up-to-date model available. As such, we have used the 2011 model version for this study.

3.2 Modifications to the model

No changes have been made to the hydraulic model except:

4. Environment Agency January 2024 review

A previous version of this report and the associated model (P03) were reviewed by the Environment Agency in January 2024. The Environment Agency review proposed as a way forward:

> *"We consider that either another baseline scenario should be run with predicted future growth included or another post-development scenario should be run without planned future growth included. This would allow the baseline and post-development results to be directly compared and would allow the impact of the new WWTP and outfall on local flood risk to be determined. If possible, existing discharges from the Waterbeach outfall should be included in the baseline scenario."*

As described in Section 2.3, we have taken the first option – an additional baseline scenario representing the existing WWTP and outfall with future growth in the catchment included. As requested, discharges from the Waterbeach outfall are also now included for the two baseline scenarios (in earlier versions the Waterbeach discharge was not represented for the Existing case). This additional sensitivity test helps to understand what impact the future growth in the catchment has on the assessment of the proposed new outfall. As such, the report now (P04 onwards) includes this additional sensitivity testing by comparing the new outfall to the existing outfall **with** the inclusion of future growth in the catchment, along with the previous results comparisons. The additional scenario is referred to as the 'Existing Future' case below.

5. Implementation

5.1 Overview

The modelling assessment for the new outfall was conducted in two stages:

1. Calculate flows from the WWTP for the Existing, Existing Future, and New Outfall cases using the 'sewer model'.
2. Implement these outfall flows in the 'river model' to assess the impact on flood risk.

5.2 2023 Cam Urban model

We were provided the 2023 Cam Urban Flood Modeller–Tuflow model ('the river model') by the Environment Agency. This model supersedes the 2011 Cam Phase 2 – Cam Urban model that was used as part of the first version of this report. The 2023 Cam Urban model was finalised by the Environment Agency in September 2023 so represents the latest understanding of flood risk in the study area.

On receipt we (Binnies) reviewed the model's suitability for the purposes of the project scope. The full details of the river model review are provided in Appendix A; however, the following summarises the conclusion of the model review:

(a) **Type** – The model is a linked one-dimensional (1D) – two-dimensional (2D) Flood Modeller-Tuflow hydraulic model of the River Cam and its floodplain through Cambridge, from Sawston to its confluence with the Great Ouse. This choice of software and model extent is suitable for the project scope.

(b) **Survey** – The model employs more recent channel topographic survey collected in 2018 of the River Cam, from Haxton to Baits Bite Lock. This survey is only 5 years old and there is confidence that it is still representative of the River Cam.

(c) **Software** – The model used the latest available version of the software at the time of production, which were:

  (i) Flood Modeller (FM) version 5.0; and

  (ii) Tuflow version 2020-10-AD-iSP-w64.

  These versions of the software are now superseded by more recent releases, although for this study Flood Modeller 6.1 and TUFLOW 2020-10-AD-iSP-w64 were used to run the model due to compatibility issues linking Flood Modeller 6.1 to the latest version of TUFLOW (2023-03-AB). However, upgrading the software to the latest versions is very unlikely to have a significant impact on the model results.

(d) **Hydrology** – the model employs updated hydrological inflows for the River Cam and its tributaries which are the product of rating reviews of the gauging stations in the catchment (Dernford, Stapleford, and Burnt Mill) and fresh Flood Estimation Handbook

(FEH) calculations. The final choice of model inflows uses the FEH Statistical method combined with ReFH2 hydrographs. The FEH calculation record was reviewed as part of this study. The approach used follows industry standard methods and is appropriate for this study. We were able to closely reproduce the derived model inflows by repeating the calculations with the input data contained in the calculation record.

(e) **Storm duration** – the storm duration used for the design flood simulations is 55 hours. This was assessed to be the critical storm duration for the River Cam in Cambridge. However, this duration is significantly longer than the critical storm duration for the proposed outfall (4 hours) and therefore additional hydrological calculations will be necessary to obtain compatible River Cam flows for a 4-hour storm.

(f) **Climate Change** – the model has been simulated using the latest Environment Agency climate change allowances; these are 9%, 19%, and 45% increases to peak flow, which represent the Central, Higher Central, and Upper estimates for the 2080s.

(g) **Model Health** – the model is generally stable with only short occurrences of non-convergence that are unlikely to affect the results. The model reports unsatisfactory mass balance which the developers attribute to incorrect simulation monitoring rather than an inherent numerical or physical issue with the model. The model convergence and mass balance for the updated existing and new outfall scenarios have been reviewed and are also stable and satisfactory.

5.3 Cambridge sewer model

A model of the sewer catchment which drains to the existing WWTP was provided by Anglian Water ('the sewer model', "CAMBSC_Master_ICM_9.0"). As part of the work to design the new treatment plant the sewer model was verified to information recorded during 2019. The level of verification was discussed with Anglian Water and it was agreed that it represents the most up to date representation of the sewer system which drains to the existing WWTP. The sewer model was built within InfoWorks ICM (version 9) which is the industry standard for undertaking network modelling to understand the operation of a sewer system.

A modified version of the sewer model was first used to test and size the proposed new tunnel from the existing treatment plant to the new site to ensure that there was no impact on the flooding in the upstream system. The model was also used to calculate the operation of the new pumping station to empty the tunnel ensuring that the levels through the upstream catchment were not increased. Table 5-1 shows the proposed pump rates and start / stop levels used within the model. The model was then further modified to include the new WWTP itself and calculate the outfall flows.

Figure 5-1 compares the sewer model outfall hydrographs for the 55-hour storm case between the Existing, Existing Future, and New Outfall scenarios. The two stages of the new works, Phase 1 and Phase 2, for the New Outfall scenario have been separated here to show the similarity between phasing – where the noticeable difference is the increase in flow to full treatment (FFT) from 1.79 to 1.84m^3/s, respectively. Throughout this report 'New Outfall' is used to refer to Phase 2 of the new works, unless explicitly stated as 'New Outfall Phase 1'.

A separate Anglian Water InfoWorks ICM sewer model ("WATBSC_Master_ICM_9.0") was used to derive the Waterbeach outfall discharges to be used in the Existing and Existing Future sensitivity scenarios. There is no Waterbeach discharge for the New Outfall scenario as the flows from Waterbeach will be diverted to the new WWTP, the existing Waterbeach outfall will cease to operate and the Waterbeach runoff is accounted for within the New Outfall sewer model

Table 5-1 – Proposed pump operation at the new WWTP

	Pump rates, start and stop level to utilise the tunnel									
	CBARSM.1	**CBARSM.2**	**CBARSM.3**	**CBARSM.4**	**CBARSM.5**	**CBARSM.6**	**CBARSM.7**	**CBARSM.8**	**CBARSM.9**	**CBARSM.A**
			FFT					**STORM**		
On Level	-13.64	-13.44	-13.24	-13.22	-11.	-11.	-11.		-11	-10.7
Off Level	-13.94	-13.94	-13.64	-13.52	-12	-12	-11.	-11.	-11.	-11
Pump Rate	0.49	0.49	0.49	0.49	1.08	1.08	1.08	1.08	0.26	0.53

The sewer model results were converted to inflow timeseries in a spreadsheet to be applied to the river model for the WWTP outfall flows as follows:

- Existing and Existing Future outfalls:
  - Taking the sum of the flows from three sewer model conduit units – “Flow_to_Treatment”, “TL47616700.1” and “outfall1.1”. These units represent the treated flow from the existing plant and discharge from the existing lagoon respectively.
- New outfall:
  - Taking the sum of the flows from two sewer model conduit units – “Orifice Inlet_3.1” and “Conduit ST1-MH4.1”.

An example for the 1 in 100 year 55-hour storm is shown in Figure 5-1.

(Added)

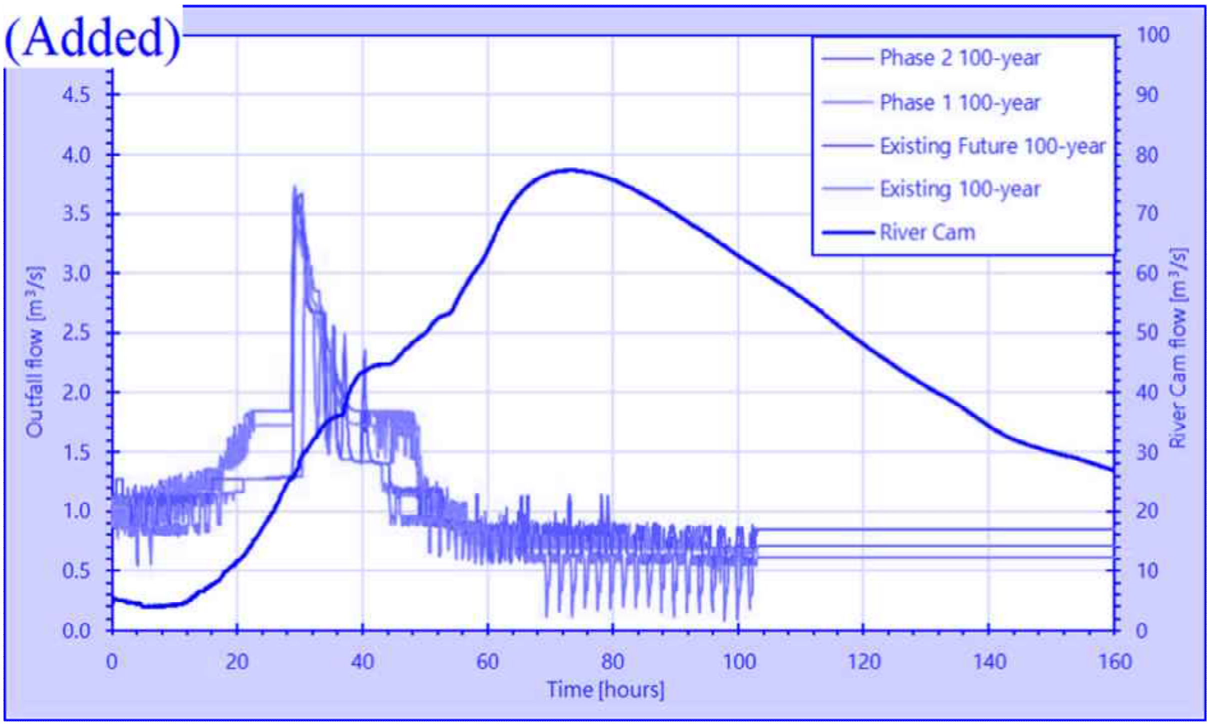

Figure 5-1. Example of new outfall discharge – 1 in 100 year, 55-hour storm

Table 5-2 compares the peak outfall flows as applied in the river model for the Existing outfall, the Existing Future, and New Outfall cases. It should be noted that in the New Outfall case the Cambridge WWTP would also receive flows from the Waterbeach catchment which are accounted for in the peak flows for this case in Table 5-2.

The peak flows in Table 5-2 shows that:

- Allowing for future growth in the catchment considerably increases the flows through the existing Cambridge WWTP outfall. This future growth accounts for much of the difference between the existing (no future growth in catchment) and new outfall (including growth in catchment) peak flows.
- It should be noted that the new outfall case includes a future growth design allowance of $5m^2$ per dwelling of misconnected surface area to the foul system, in accordance with Anglian Water' design standards for sewer modelling. This allowance is applied to ensure the design of the new works could accommodate incorrectly connected areas should this occur over time. However, Anglian Water are not responsible for preventing such connections from happening although flows derived from such areas are included for consistency between the sewer modelling (also used for storm water management design) and the river modelling.
- The peak Waterbeach outfall discharge is $0.2m^3/s$ across the whole range of flood magnitudes and durations.

There is not a direct relationship between changes in peak outfall flow to changes in peak flows in the River Cam as the peaks do not coincide. The river model considers the whole hydrograph shape so accounts for this in the results within section 6.

Table 5-2. Peak outfall flows used in the river model

Case	Peak flow [m³/s]									
	1 in 2	1 in 10	1 in 20	1 in 30	1 in 50	1 in 75	1 in 100	1 in 200	1 in 1000	1 in 100 (CC20	100 (CC40)
Existing outfall – existing Cambridge WWTP											
4-hour storm	2.4	2.8	2.9	3.2	3.7	3.9	4.0	4.1	4.1	4.1	4.1
55-hour storm	1.3	1.3	1.3	1.3	2.5	2.7	3.0	3.7	4.1	3.7	4.1
Existing outfall (Future Growth) – existing Cambridge WWTP											
4-hour storm	2.4	2.7	2.9	3.2	3.6	3.8	4.0	4.1	4.1	4.1	4.1
55-hour storm	1.3	1.3	2.4	2.7	3.0	3.6	3.7	3.7	4.1	4.1	4.1
Existing Waterbeach outfall (Existing / Future Growth) – existing Waterbeach outfall											
4-hour storm	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
55-hour storm	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
New Outfall – new Cambridge WWTP											
4-hour storm	2.8	4.8	5.0	5.5	5.7	5.8	5.8	5.9	5.9	5.9	5.9
55-hour storm	1.8	1.8	2.4	2.8	3.2	3.5	3.7	4.2	4.9	4.3	4.8

[illegible] Flood Modeller Pro (FMP, version 5.0, formerly ISIS) and TUFLOW (build 2020-10-AA) for these runs.

5.4 Modifications to the river model

No changes have been made to the 2023 Cam Urban river model except:

- Adding inflow locations for the existing and new WWTP outfall discharges, which were not represented explicitly in the 2023 Cam Urban model provided (see Figure 5-2).
    - Existing WWTP outfall – immediately upstream of the A14 bridge, left bank.
    - New WWTP outfall – immediately downstream of the A14 bridge right bank. ~~Note that the 'existing WWTP outfall' refers only to the existing outfall at Milton. There is also:~~
- ~~An~~For the Existing and Existing Future scenarios: adding the outfall at Waterbeach (around 4km downstream of the site), which currently discharges but will cease when the new WWTP is in place. ~~This has not been added to the model.~~

~~• The~~ Note that the 'existing WWTP outfall' refers only to the existing outfall at Milton. There is also the Riverside CSO (~~combined sewer overflow~~Combined Sewer Overflow), upstream within

Cambridge itself. We were informed by the project team that this CSO “never flows”. Again, thisThis has not been added to the river model.

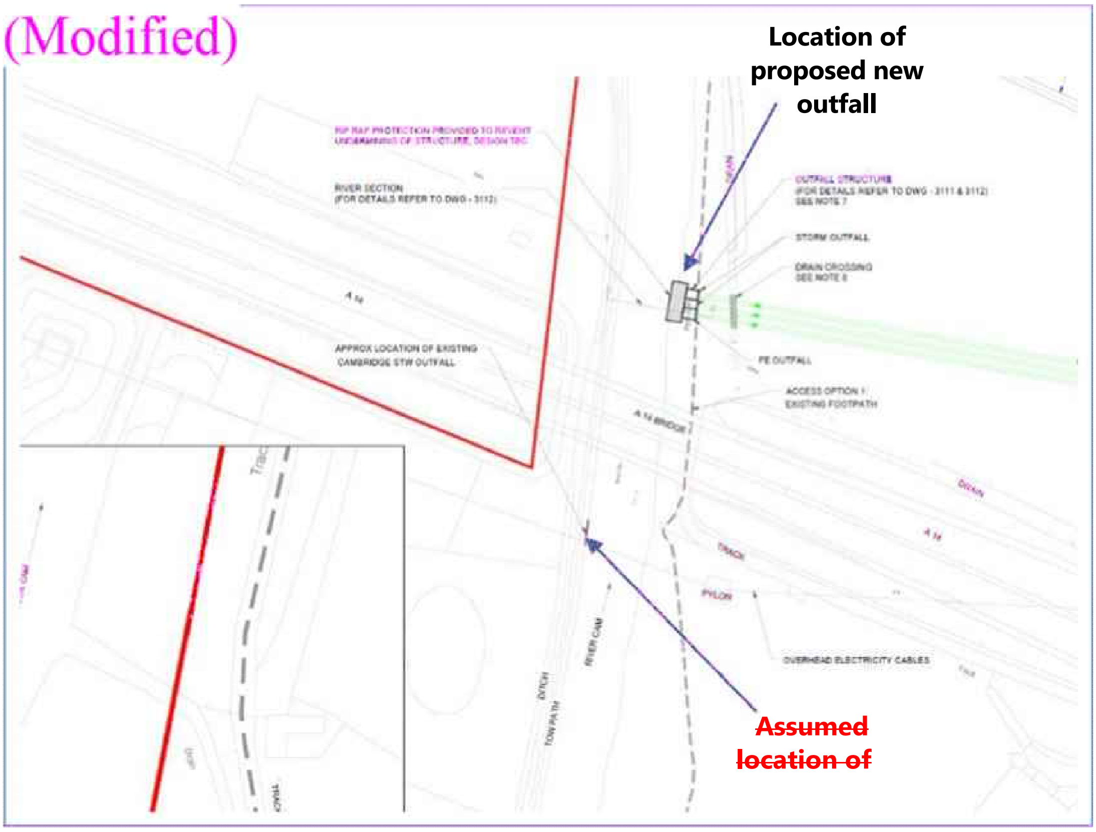

Figure ~~3.1~~5-2. Locations of existing and new outfall (drawing 00000-100006-CAMEST-FL

3.3 Fluvial flood5.5 River model inflows

(a) Storm duration

The critical storm duration used in the Cam Urban river model is 55 hours. This was selected by JBA in their hydrological analysis considering the catchment area and other descriptors, the duration recommended for the whole catchments within the ReFH2 software, the permeability of the catchment, and comparisons to observed data. This is similar to the 61-hour storm duration used in the previous 2011 Cam Urban model. This approach is reasonable and is a duration expected for a catchment of this size.

We have retained the 55-hour storm as the critical case for flooding from the River Cam. However, the critical case for the treatment plant is the 4-hour storm. To examine the sensitivity of the results to storm duration we have tested both cases.

(b) 55-hour storm duration

Design floods arewere implemented by JBA in the River Cam model as 1420 inflows representing a 61 55-hour storm over the whole 791km^{2}1076km^2 River Cam catchment.

Inflow files were provided for the 1 in 2, 10, 20, 30, 50, 75, 100, 200 and 1000 year floods, along with the 1 in 100 year flood plus climate change for 9%, 19%, and 45% uplifts. Details of these fluvial inflows are provided in Table 3.25-3 for the 1 in 100 year plus climate change (209% uplift) flood and their locations are shown in Figure 3.2.

Inflow files were provided for the 1 in 5, 10, 20, 25, 50, 75, 100, 200 and 1000 year floods, along with the 1 in 100 year flood plus climate change. However, it was straightforward to modify the inflows to create the other flood magnitudes required. These peak inflows are shown in Table 3.2.

Note that the hydrological approach used in the model is not up-to-date in terms of methodology (FEH rainfall-runoff model) so will likely be superseded in the new modelling being undertaken for the EA. However, it is not within the scope of our study to review or update the model inflows.

flood and their locations are shown in Figure 5-3. Peak inflows for the remaining flood magnitudes (present day) are shown in Table 5-4.

(c) 4-hour storm duration

Alternative peak inflows for the 1 in 100 year, and 1 in 100 year plus climate change flood(9%, 19% and 45% uplift) floods were calculated as part of this study (by adjusting the storm duration in the model input files) and. Peak flows for the 4-hour 1 in 100 year plus 9% climate change uplift are shown in Table 3.2 for a 4 5-3, alongside the 55-hour design storm. This is a sensitivity test to match the design storm duration used in the WWTP outfall flow modelling. values.

The 55-hour storm inflows are implemented in the 2023 Cam Urban model boundary files (*.IED) as flow-time (QT) units as, presumably, the calculations were done by JBA directly using the ReFH2 software rather than within Flood Modeller. This meant that it was not completely straightforward to test alternative storm durations. The approach used to generate 4-hour fluvial inflows was:

- Recreate the default ReFH2 model inflows for the 55-hour storm, using the catchment descriptors given in JBA's Cam Flood Estimation Report. These were checked against JBA's reported results and almost identical results were achieved.
- Calculate and apply scaling factors to the ReFH2 hydrograph to give the FEH statistical flood peak required for each model inflow. Again, these were checked against the actual model inflows and a very close match was achieved.
- Generate ReFH2 model inflow for a 4-hour storm.
- Apply the same scaling factors to the 4-hour storm inflows, as for the 55-hour storm and use these inflows in the model.

The flows in Table 5-3 show that:

- The 55-hour storm gives noticeably higher peak inflows for the larger sub-catchments, such as the upstream Cam, Granta, Rhee, Bourn Brook and Fidwell Fen. This is as expected. These sub-catchments comprise a large proportion of the total model inflow.
- The 4-hour storm gives higher inflows for the smaller sub-catchments, such as the lateral inflows, Coldham's Brook, Bin Brook and Hobson's Brook. Again, this is as expected as a shorter storm duration will be critical for smaller catchments.

- Overall, the 55-hour storm will give higher river flows and flood levels than the 4-hour storm.

Table ~~3.1. Information on fluvial~~5-3. Fluvial flood inflows within river model (1 in 100 year plus 9% climate change)

Model inflow name	Description	Catchment area (km²)	1 in 100 year plus 9% CC peak flow (m³/s)	
			~~61~~55 hour ~~catchment~~ storm	4 hour ~~WWTP~~ storm
~~C1~~CAM_01	River ~~Granta (~~Cam at ~~Stapleford)~~Sawston	~~115.1~~197.1	~~18.5~~31.9	~~12.1~~18.5
~~C2~~CAM_02*	~~River Cam (at Dernford)~~Lateral to Byron's Pool	~~201.8~~11.8	~~18.9~~0.0	~~9.3~~0.0
~~C3~~CAM_03*	~~River Rhee (at Burnt Mill)~~Lateral to M11 bridge	~~305.6~~4.9	~~26.3~~0.0	~~14.4~~0.0
~~C4~~CAM_04*	Lateral to Bourn Brook inflow	~~87.5~~5.8	~~33.1~~0.0	~~26.1~~0.0
~~C5~~CAM_06	~~Bin~~Lateral to Hobson's Brook	~~16.8~~6.0	~~8.9~~0.9	~~10.5~~1.2
~~C6~~CAM_08	~~Hobson's Brook~~Lateral to Elizabeth Way bridge	~~14.1~~5.4	~~2.1~~2.2	~~2.1~~4.2
~~C7~~	~~Cherry Hinton Brook~~	~~10.8~~	~~1.8~~	~~3.5~~
~~C8~~CAM_09	Lateral to ~~Byron's Pool~~Coldham's Brook	~~16.5~~3.1	~~5.6~~1.4	~~5.8~~2.6
~~C9~~CAM_10	Lateral to ~~Jesus Green~~Baits Bite Lock	~~9.9~~8.9	~~5.4~~2.5	~~14.5~~3.4
~~C10~~CAM_11	Lateral to ~~Baits Bite~~Swaffham Lodge	~~12.9~~7.4	~~6.5~~1.5	~~17.7~~1.9
~~C11~~CAM_13	Lateral to ~~River~~ Great Ouse	~~24.8~~8.3	~~4.7~~1.6	~~3.7~~2.0
COLDH_01	Coldham's Brook	10.9	1.6	2.1
GRNT_01	River Granta	111.3	14.6	8.4
RHEE_01	River Rhee	307.9	26.9	14.5
BIN_05	Bin Brook	17.2	8.3	11.2
BOUR_01	Bourn Brook	86.2	26.1	21.3
FID_FEN	Fidwell Fen	19.5	6.1	4.1
HOBS_03	Hobson's Brook	12.0	1.3	4.1
~~Bottisham PS~~Bottisham_PS	Pumped inflow ~~from~~ Bottisham Lode	-	~~3.4~~2.5	~~3.4~~2.5
~~Swaffham PS~~Swaffham_PS	Pumped inflow ~~from~~ Swaffham Lode	-	~~2.3~~1.7	~~2.3~~1.7

~~Upware PS~~Upware_PS	Pumped inflow ~~from~~ Reach Lode	-	2.5	2.5

*Note: CAM_02, CAM_03 and CAM_04 lateral inflows scaled to zero by JBA, as described in their reporting. This approach was retained.

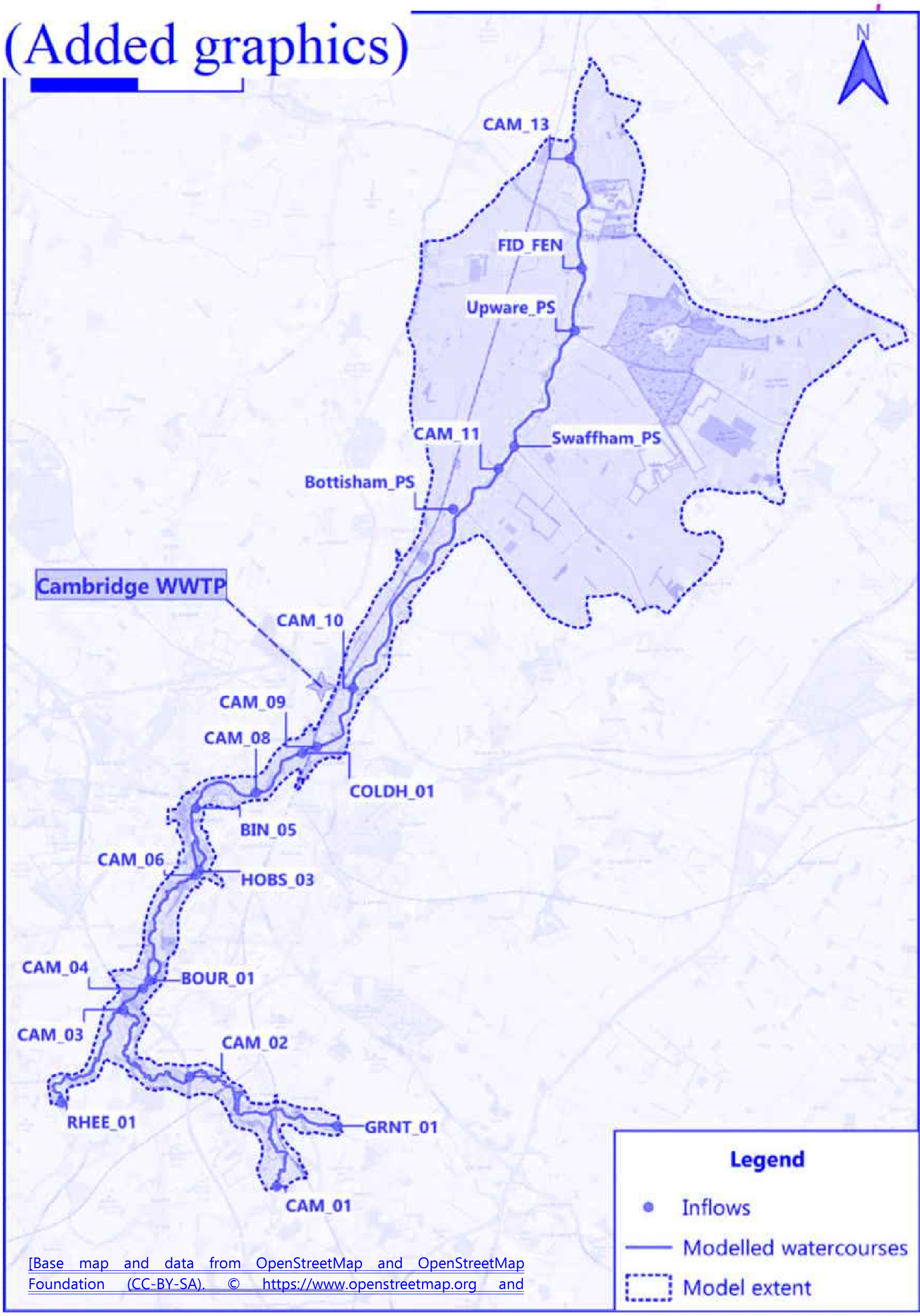

Figure 5-3. Location of inflow nodes from the model

Table ~~3.2. Information on fluvial~~5-4. Fluvial flood inflows within river model 55-hour storm (other flood magnitudes)

Model inflow name	Peak flow ~~(~~[m³/s~~)~~]								
	1 in 2	1 in 10	1 in 20	1 in 30	1 in 50	1 in 75	1 in 100	1 in 200	1 in 1000
~~C1~~CAM_01	~~3.3~~7.6	~~8.0~~14.1	~~10.1~~19.1	~~11.2~~20.9	~~13.0~~23.3	~~14.4~~27.2	~~15.5~~29.3	~~18.4~~34.0	~~28.6~~57.5
~~C2~~CAM_02	~~3.5~~0.0	~~8.0~~0.0	~~10.0~~0.6	~~11.3~~0.7	~~13.2~~0.0	~~14.5~~0.0	~~15.7~~0.0	~~18.9~~0.0	~~30.1~~0.0
~~C3~~CAM_03	~~4.8~~0.0	~~11.6~~0.0	~~14.5~~0.0	~~16.1~~0.0	~~18.6~~0.0	~~20.5~~0.0	~~22.0~~0.0	~~26.1~~0.0	~~39.8~~0.0
~~C4~~CAM_04	~~7.9~~0.0	~~16.2~~0.0	~~19.4~~0.0	~~21.3~~0.0	~~24.0~~0.0	~~26.0~~0.0	~~27.6~~0.0	~~31.8~~0.0	~~45.6~~0.0
~~C5~~CAM_06	~~2.2~~0.3	~~4.4~~0.5	~~5.3~~0.6	~~5.8~~0.6	~~6.5~~0.7	~~7.0~~0.8	~~7.4~~0.8	~~8.6~~1.0	~~12.2~~1.5
~~C6~~CAM_08	~~0.2~~0.8	~~0.8~~1.3	~~1.0~~1.4	~~1.2~~1.6	~~1.4~~1.7	~~1.6~~1.9	~~1.7~~2.0	~~2.1~~2.4	3.5
~~C7~~CAM_09	~~0.2~~0.5	~~0.6~~0.8	~~0.8~~0.9	~~0.9~~1.0	~~1.0~~1.1	1.2	1.3	~~1.7~~1.6	~~2.9~~2.3
CAM_10	0.8	1.3	1.6	1.7	1.9	2.1	2.3	2.8	4.2
~~C8~~CAM_11	~~1.2~~0.5	~~2.6~~0.8	~~3.2~~1.0	~~3.5~~1.1	~~4.0~~1.2	~~4.3~~1.3	~~4.6~~1.4	~~5.4~~1.7	~~7.9~~2.5
~~C9~~CAM_13	~~1.3~~0.5	~~2.3~~0.9	~~2.8~~1.0	~~3.1~~1.1	~~3.5~~1.3	~~3.9~~1.4	~~4.2~~1.5	~~4.9~~1.8	~~7.4~~2.7
COLDH_01	0.5	0.9	1.0	1.1	1.3	1.4	1.5	1.8	2.5
~~C10~~GRNT_01	~~1.6~~4.6	~~2.8~~7.8	~~3.3~~9.1	~~3.7~~10.0	~~4.2~~11.3	~~4.6~~12.5	~~4.9~~13.4	~~5.9~~16.3	~~8.8~~25.4
RHEE_01	8.5	14.2	16.6	18.3	20.6	22.8	24.6	30.3	47.3
~~C11~~BIN_05	~~0.8~~2.9	~~2.0~~4.6	~~2.6~~5.4	~~2.9~~5.9	~~3.3~~6.5	~~3.7~~7.1	~~3.9~~7.6	~~4.7~~8.9	~~7.2~~12.3
~~Bottisham PS~~BOUR_01	~~3.4~~9.5	~~3.4~~14.6	~~3.4~~16.9	~~3.4~~18.4	~~3.4~~20.5	~~3.4~~22.4	~~3.4~~23.9	~~3.4~~28.2	~~3.4~~39.4
~~Swaffham PS~~FID_FEN	~~2.3~~2.0	~~2.3~~3.2	~~2.3~~3.8	~~2.3~~4.2	~~2.3~~4.7	~~2.3~~5.2	~~2.3~~5.6	~~2.3~~6.5	~~2.3~~8.7
HOBS_03	0.4	0.7	0.8	0.9	1.0	1.1	1.2	1.4	2.1
~~Upware PS~~Bottisham_PS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Swaffham_PS	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Upware_PS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

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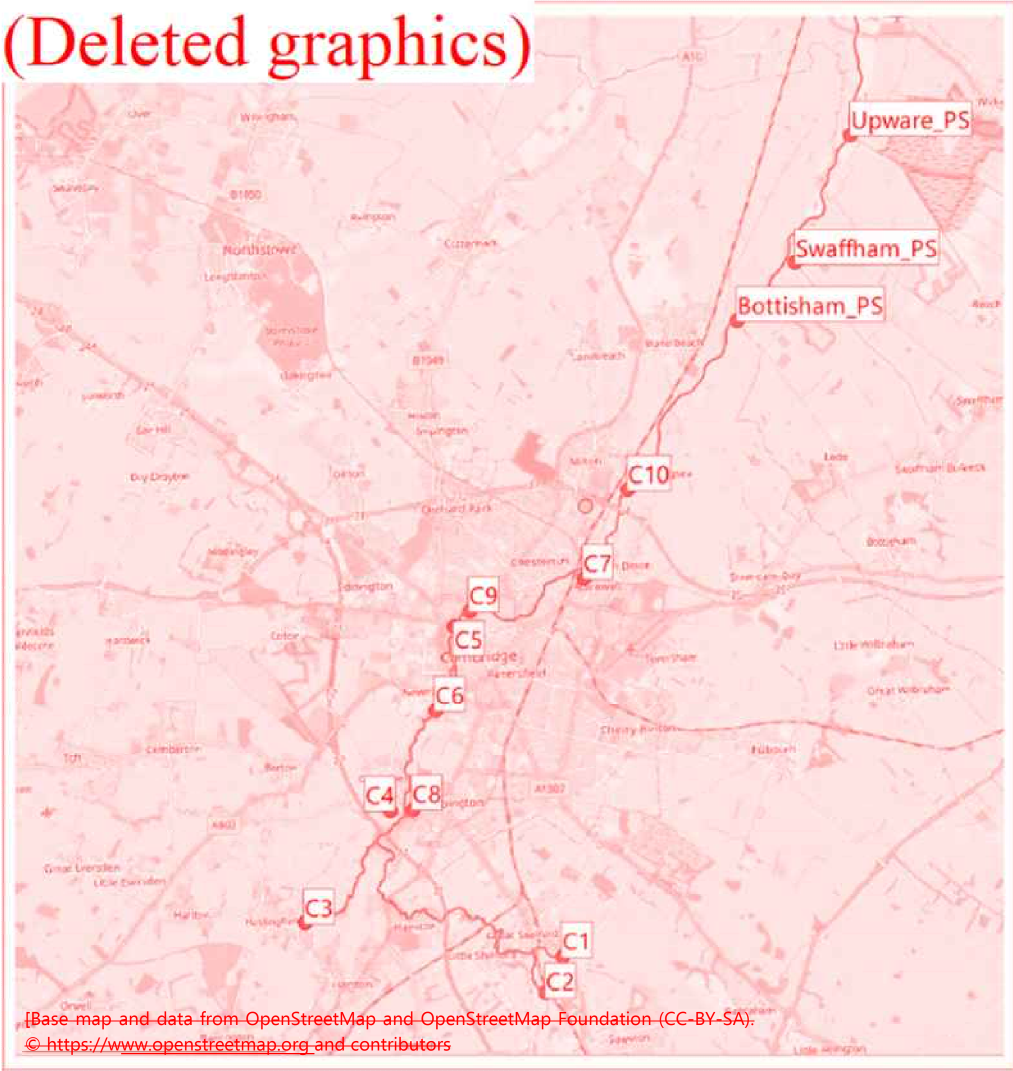

~~*Figure 3.2. Location of inflow nodes from the model*~~

(Mod)

~~3.4~~5.6 Climate change

The scope requires that the model should include appropriate allowan climate change. In the ~~existing~~2023 Cam Urban river model, the 100-y ~~is represented by a 20% uplift in flow rate. The EA released new~~has been simulated for a range of uplifts (9%, 19%, and 45%). These uplifts correspond to the 2080s epoch in the EA's latest climate change allowances (released in July ~~2021[1], with the values in~~2021[3]). Table ~~3.3 showing their~~5-5 shows the values for the River Cam catchment. ~~The model allowance of 20% for climate change uplift is similar to the values identified by the EA for 2050s Upper (22%) and 2080s Higher (19%). Therefore, we have retained the 20% uplift for climate change in the model simulations.~~

~~1~~3 https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

We have retained these river flow climate change allowances in our model runs. However, it should be stressed that the climate change allowance in focus is the 9% uplift, as reported for the flows in Table 5-3 and Table 5-4.

Climate change was applied in the Cambridge and Waterbeach sewer models using uplifts to the storm rainfall, rather than to runoff. The sewer models were run for the 100-year flood with two climate change cases – 20% and 40% increases to rainfall. This corresponds to the 2050s epoch in the EA climate change guidance (Table 5-6).

There is not a direct link between the river flow and rainfall climate change guidance, due to different epochs and named allowances being used. Acknowledging the mismatch in epochs, we elected to retain the same climate change factors for consistency with other work and used the following combinations:

- 9% uplift for river flows with 20% uplift in rainfall for outfall flows;
- 19% uplift for river flows with 20% uplift in rainfall for outfall flows; and
- 45% uplift for river flows with 40% uplift in rainfall for outfall flows.

Table ~~3.3~~5-5. Climate change allowances for river flows in the Cam and Ely Ouse Management Catchment

~~Epoch~~	~~Central~~	~~Higher~~	~~Upper~~
~~2020s~~	~~2%~~	~~7%~~	~~21%~~
~~2050s~~	~~-2%~~	~~5%~~	~~22%~~
~~2080s~~	~~9%~~	~~19%~~	~~45%~~

Epoch	Central	Higher Central	Upper
2020s	2%	7%	21%
2050s	-2%	5%	22%
2080s	**9%**	**19%**	**45%**

Table 5-6. Climate change allowances for rainfall in the 100-year event in the Cam and Ely Ouse Management Catchment

Epoch	Central	Upper End
2050s	**20%**	**40%**

2070s	25%	**40%**

3.55.7 Model inflows – outfall discharge

For the existing outfall:**scenarios**

- Outfall discharges were provided by the Binnies Network Modelling team from their sewer model of Cambridge, used in the WWTP design.
- Initially only flows for the 1 in 100 year (1% annual exceedance probability) flood including climate change allowance were available. This was for a 4 hour (239 minute) design storm.
- This is the combined discharge from the existing lagoon and flow to full treatment (FFT) from the existing WWTP.
- Discharge was applied as a hydrograph input to the model, as shown in Figure 3.3.
- Was only included for the existing WWTP scenarios (zero inflow is applied for the future WWTP scenarios).
- Has a peak flow of 3.8m^3/s, occurring 5 hours after the start of the rainfall event.

For the new outfall:

- Outfall discharges were provided by the Binnies Network Modelling team from their sewer model of Cambridge, used in the WWTP design.
- This is the combined discharge from the ten pumps (pumps 1-9 and pump A). The 14,000m^3 storm storage tank within the new WWTP has been accounted for in the calculation.
- Was applied as a hydrograph input to the model, as shown in Figure 3.4.
- Was only included for the future WWTP scenarios (zero inflow is applied for the existing WWTP scenarios).
- Has a peak flow of 7.0m^3/s, occurring 3.5 hours after the start of the rainfall event.

~~After the draft version of this report was issued, the project team requested the analysis was extended to cover other flood magnitudes. The same process was repeated to cover the 1 in 2, 10, 20, 30, 50, 75, 100, 200 and 1000 year floods.~~

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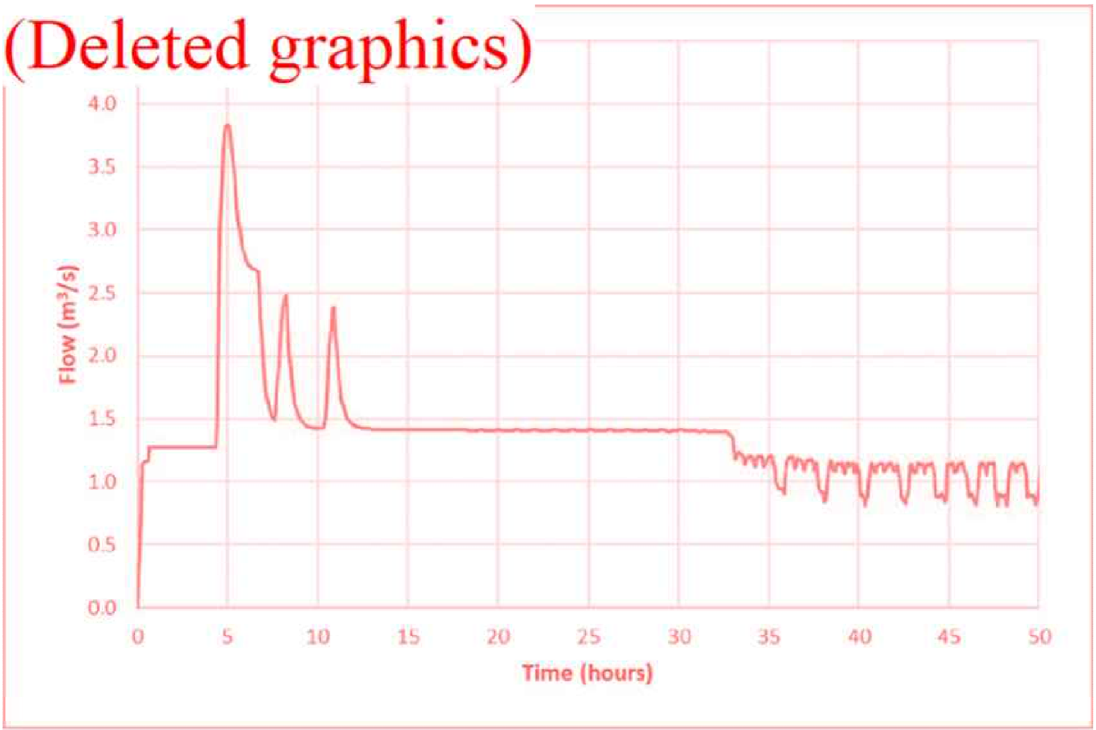


Figure 3.3. Existing outfall discharge (1 in 100 year flood plus climate change)

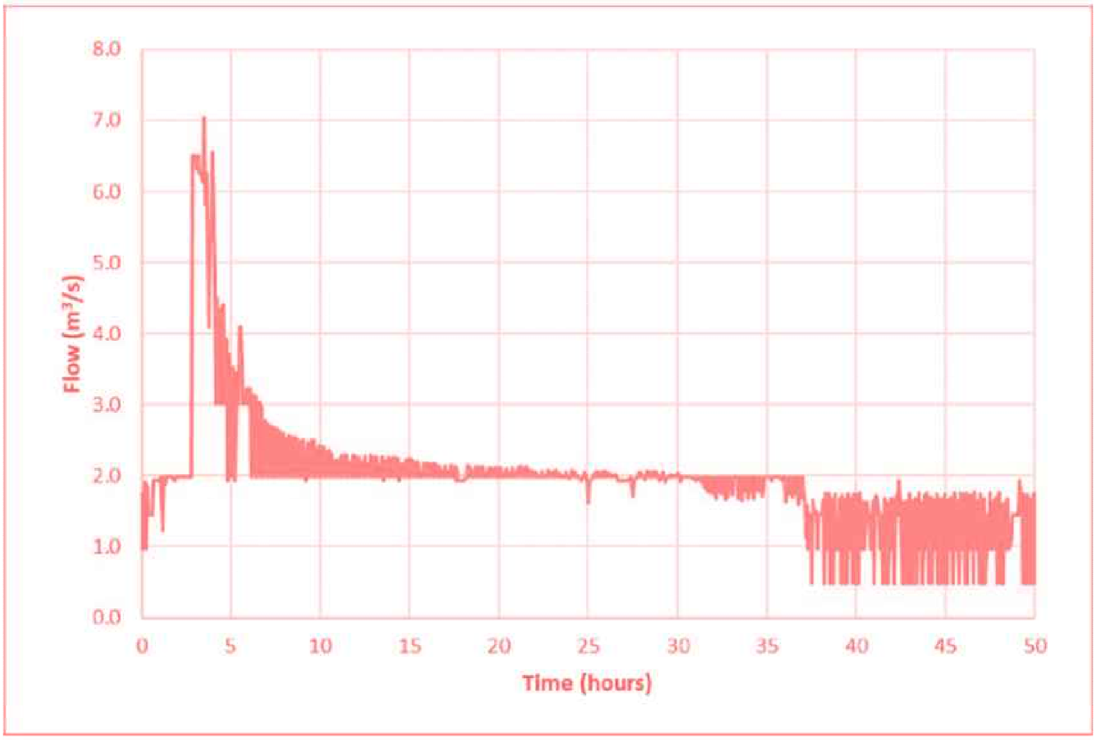


Figure 3.4. New outfall discharge (1 in 100 year flood plus climate change)

(Mod)
love every drop
anglianwater

As noted in Section 3.3, the River Cam model uses a storm duration of 61 hours, compared to the 4 hour duration used in the WWTP model to derive the outfall discharges. This reflects the different runoff mechanisms between an urban drainage/sewer system and a large river catchment. To address this disparity, we took the following approach:

1. Base case assumption that the outfall discharge begins at the centroid of the rainfall in the fluvial river model. That is, the outfall discharges shown in Figure 3.3 and Figure 3.4 are offset by 30 hours. This is a conservative simplification given the different storm durations used for river and WWTP flows.

2. Sensitivity test with the outfall discharge occurring 15 hours earlier than in the base case (outfall discharge offset by 15 hours from the fluvial flows).

3. Sensitivity test with the outfall discharge occurring 15 hours later than in the base case (outfall discharge offset by 45 hours from the fluvial flows).

4. Sensitivity test using a 4 hour design storm for the whole River Cam catchment. Therefore, no offset was required for the outfall discharge.

3.6 Scenarios to run

The scenarios that were simulated are listed in Table 3.45-7. As noted above, initially for the draftfirst version of this report only the 1 in 100 year plus climate change case was tested (runs 1 to 8run 11). However, at the project team's request, this was then expanded to include a range of other flood magnitudes (runs 9 to 26).

flood magnitudes as shown in the table. Runs 35-51 have also been included in version P04 onwards of this report to consider future growth in the catchment for the existing works ('Existing Future'), while runs and 52-53 have been included to demonstrate the potential impact for Phase 1 of the New Outfall.

Table ~~3.4~~5-7. Modelling scenarios ~~to be carried out~~

Run no.	~~Type~~Scenario	Flood magnitude (fluvial and outfall flow)	Storm duration (hours)	~~Existing outfall flow~~	~~New outfall flows~~	~~Outfall flow offset~~
	Existing	1 in 2			55	
	Existing	1 in 5			55	
	Existing	1 in 10			55	
	Existing	1 in 20			55	
	Existing	1 in 30			55	
	Existing	1 in 50			55	
	Existing	1 in 75			55	
	~~Base~~Existing Outfall	1 in 100 ~~plus climate change~~	~~6~~1~~5~~ 5	~~✓~~	~~☐~~	~~30 hours~~
	Existing	1 in 200			55	
	Existing	1 in 1000			55	
	~~Base~~Existing Outfall	1 in 100 ~~plus~~ +9% climate change	~~6~~1~~5~~ 5	~~☐~~	~~✓~~	~~30 hours~~
	~~Sensitivity test 1~~Existing Outfall	1 in 100 ~~plus~~ +19% climate change	~~6~~1~~5~~ 5	~~✓~~	~~☐~~	~~15 hours~~
	Existing	1 in 100 +45% climate			55	
	~~Sensitivity~~Existing Outfall ~~test 1~~(Sensitivity)	1 in 100 ~~plus climate change~~	~~6~~1~~4~~ 4	~~☐~~	~~✓~~	~~15 hours~~
	Existing Outfall	1 in 100 +9% climate			4	
	~~Sensitivity~~Existing Outfall ~~test 2~~(Sensitivity)	1 in 100 ~~plus~~ +19% climate change	~~6~~1~~4~~ 4	~~✓~~	~~☐~~	~~45 hours~~
	~~Sensitivity~~Existing Outfall ~~test 2~~(Sensitivity)	1 in 100 ~~plus~~ +45% climate change	~~6~~1~~4~~ 4	~~☐~~	~~✓~~	~~45 hours~~
	New Outfall	1 in 2			55	

New Outfall	1 in 5			55	
New Outfall	1 in 10			55	
New Outfall	1 in 20			55	
New Outfall	1 in 30			55	
New Outfall	1 in 50			55	
New Outfall	1 in 75			55	
Sensitivity test 3New Outfall	1 in 100 plus climate change	455	✓	☐	0 hours
New Outfall	1 in 200			55	
New Outfall	1 in 1000			55	
New Outfall	1 in 100 +9% climate			55	
New Outfall	1 in 100 +19% climate			55	

Run no.	~~Type~~Scenario	Flood magnitude (fluvial and outfall flow)	Storm duration (hours)	~~Existing outfall flow~~	~~New outfall flows~~	~~Outfall flow offset~~
3	New Outfall	1 in 100 +45%	55			
3	New Outfall (Sensitivity)	1 in 100	4			
~~8~~32	~~Sensitivity~~New Outfall ~~test 3~~(Sensitivity)	1 in 100 ~~plus~~ +9% climate change	4	~~x~~	~~i~~	~~0 hours~~
~~9~~33	~~Base~~New Outfall (Sensitivity)	1 in ~~2~~100 +19% climate change	~~61~~4	~~i~~	~~x~~	~~30 hours~~
3	New Outfall (Sensitivity)	1 in 100 +45%	4			
~~10~~35	~~Base~~Existing Future	1 in 2	~~61~~55	~~x~~	~~i~~	~~30 hours~~
~~11~~36	~~Base~~Existing Future	1 in ~~10~~5	~~61~~55	~~i~~	~~x~~	~~30 hours~~
~~12~~37	~~Base~~Existing Future	1 in 10	~~61~~55	~~x~~	~~i~~	~~30 hours~~
~~13~~38	~~Base~~Existing Future	1 in 20	~~61~~55	~~i~~	~~x~~	~~30 hours~~
~~14~~39	~~Base~~Existing Future	1 in ~~20~~30	~~61~~55	~~x~~	~~i~~	~~30 hours~~
~~15~~40	~~Base~~Existing Future	1 in ~~30~~50	~~61~~55	~~i~~	~~x~~	~~30 hours~~
~~16~~4	~~Base~~Existing Future	1 in ~~30~~75	~~61~~55	~~x~~	~~i~~	~~30 hours~~

1						
1742	BaseExisting Future	1 in 50100	6155	¡	×	30 hours
1843	BaseExisting Future	1 in 50200	6155	×	¡	30 hours
1944	BaseExisting Future	1 in 751000	6155	¡	×	30 hours
2045	BaseExisting Future	1 in 75100 +9% climate change	6155	×	¡	30 hours
2146	BaseExisting Future	1 in 100 +19% climate change	6155	¡	×	30 hours
4	Existing	1 in 100 +45%		55		
2248	BaseExisting Future	1 in 100	614	×	¡	30 hours
2349	BaseExisting Future	1 in 200100 +9% climate change	614	¡	×	30 hours
2450	BaseExisting Future	1 in 200100 +19% climate change	614	×	¡	30 hours
2551	BaseExisting Future	1 in 1000100 +45% climate change	614	¡	×	30 hours
2652	BaseNew Outfall Phase 1	1 in 100075	6155	×	¡	30 hours
5	New Outfall Phase 1	1 in 100		55		

~~4~~6. Model results

~~4.1~~ 6.1 General

The river modelling results are presented as:

- Tables of peak water levels and flows (Table ~~4.1~~6-1 to Table ~~4.4 for the 1 in 100 year plus climate change flood~~6-6; Appendix ~~A for other flood magnitudes~~B and Appendix E) in the River Cam. Note that the flows are based on the ~~FMP~~1D FM results only so do not include bypassing alongside the river in the floodplain. The node locations for these comparison points ~~are~~ (shown in Figure ~~4.2~~6-1) have been selected at identifiable points of interest (as described in the first column in Table 6-1) to assist in comprehension.

- ~~Simple flood~~Flood extent and depth difference maps (Figure ~~4.1, and Figure 4.3~~6-2 to Figure ~~4.5 for the 1 in 100 year plus climate change flood; Appendix B for other flood magnitudes~~6-7; Appendices C, D, F, and G).

~~4.2 Base case – 1 in 100 year plus climate change~~

~~The base case comparison of results for the 1 in 100 year plus climate change flood is shown in Table 4.1 and Figure 4.1. These results indicate that:~~

  - These maps simultaneously show the change in flood extents and maximum water depth for the same flood magnitude between the Existing / Existing Future and New Outfall model scenarios.

  - The Existing (and Existing Future) flood extent (black-outlined polygon) is compared to additional areas that flood in the New Outfall case ('Now Flooded' pink-outlined polygon).

  - Areas within the Existing (and Existing Future) flood extent where depths change by less than 0.01m are defined as 'No Change' areas and are denoted by the blue shaded polygon.

  - Changes in maximum flood depth were calculated by subtracting the New Outfall water depth results from the Existing (and the Existing Future) results, such that positive values represent an increase in depth for the New Outfall scenario.

  - The additional flooded areas where depths are less than 0.01m **are** included inside the 'Now Flooded' pink polygon.

6.2 Existing outfall (no growth) compared to New Outfall (with growth) – 55-hour storm

This base case compares results between the Existing (no growth) and the New Outfall (with growth) scenarios for the 55 hour storm (the design storm). A comparison of results for the 1 in 100 year present day and 1 in 100 year plus 9% climate change floods are shown in Table 6-1, Table 6-2, Figure 6-2 and Figure 6-3 (Appendix B and Appendix C provide the results tables and flood maps for other flood magnitudes). These results indicate that:

- The new WWTP lies well outside the River Cam flood extents.

- There is almost no change in peak water levels, or flows or flood extents with the new WWTP outfallin the River Cam for the New Outfall case compared to the existing WWTPExisting.

- The maximum predicted increase in peak in-channel water level is 0.007m0.002m (7mm2mm) at Baits Bite Lock.

- Elsewhere the predicted increase in peak water levels is even smaller:
  - Either 1mm or zero increase upstream of the A14 through Cambridge.
  - A 3mm increase between the A14 and Baits Bite Lock and downstream of Shrubbs Marina.
  - A 3-6mm increase between Horningsea and Bottisham Lock.

- There is no change in flood depths throughout Cambridge (upstream of the A14 / the WWTP outfalls).

- There are some changes in flood depths and extents in the downstream floodplain. Flood depths increase further downstream of the outfall for locations near Waterbeach and beyond:

    - For the majority of the inundated area, there is no change in flood depth (blue shading in Figure 6-2 and Figure 6-3).

    - There are areas where depths increase by a small amount (up to 0.10m – red shading in the figures). There are also small areas where flooding is predicted to occur in the New Outfall scenario that is not predicted in the Existing (no growth) scenario. This leads to larger depth changes as the differences are between initial flooding and zero depth. These areas are predicted to flood due to the floodwater spreading further in the floodplain. **These flooding changes are a consequence of the larger flood volume in the New Outfall scenario compared to the no future growth Existing scenario. This is directly caused by allowing for future growth in the New Outfall scenario since the new outfall and WWTP will not increase flood volume themselves.** In any case, the affected areas are generally low impact farmland, except for a few properties near to Bottisham Lock.

- The changes in in-channel peak flow are ~~0.3m^3~~0.1m^3/s or smaller (which is a very small proportion of the total flow in the River Cam, which is ~~around 90m^3~~generally 70-90m^3/s). This is because the peak WWTP discharge occurs well before the river peak flow.

    - ~~There is no perceptible change in flood extent (Figure 4.1), which is unsurprising given how small the water level changes are.~~

Note that, with changes this small, to some extent they may be due to minor differences in the iterative numerical solution produced by ~~FMP-Tuflow~~FM-Tuflow rather than genuine physically based differences. For example~~: (1) there is not a logical explanation for the 0.1m^3/s change in flow at the M11 crossing with no other difference predicted upstream of the A14; and (2)~~, the water level convergence tolerance for each model iteration is 0.01m. Normally we would only present water level results to two decimal places (to the nearest centimetre), reflecting the accuracy possible with a hydraulic model of this type. But in this case, as the differences are so small, we have shown three decimal places to avoid ~~misleading~~ rounding effects. This could create a misleading impression of the accuracy of the model predictions. For comparison, the 2023 Cam Urban peak river level calibration tolerance target was ±0.15m.

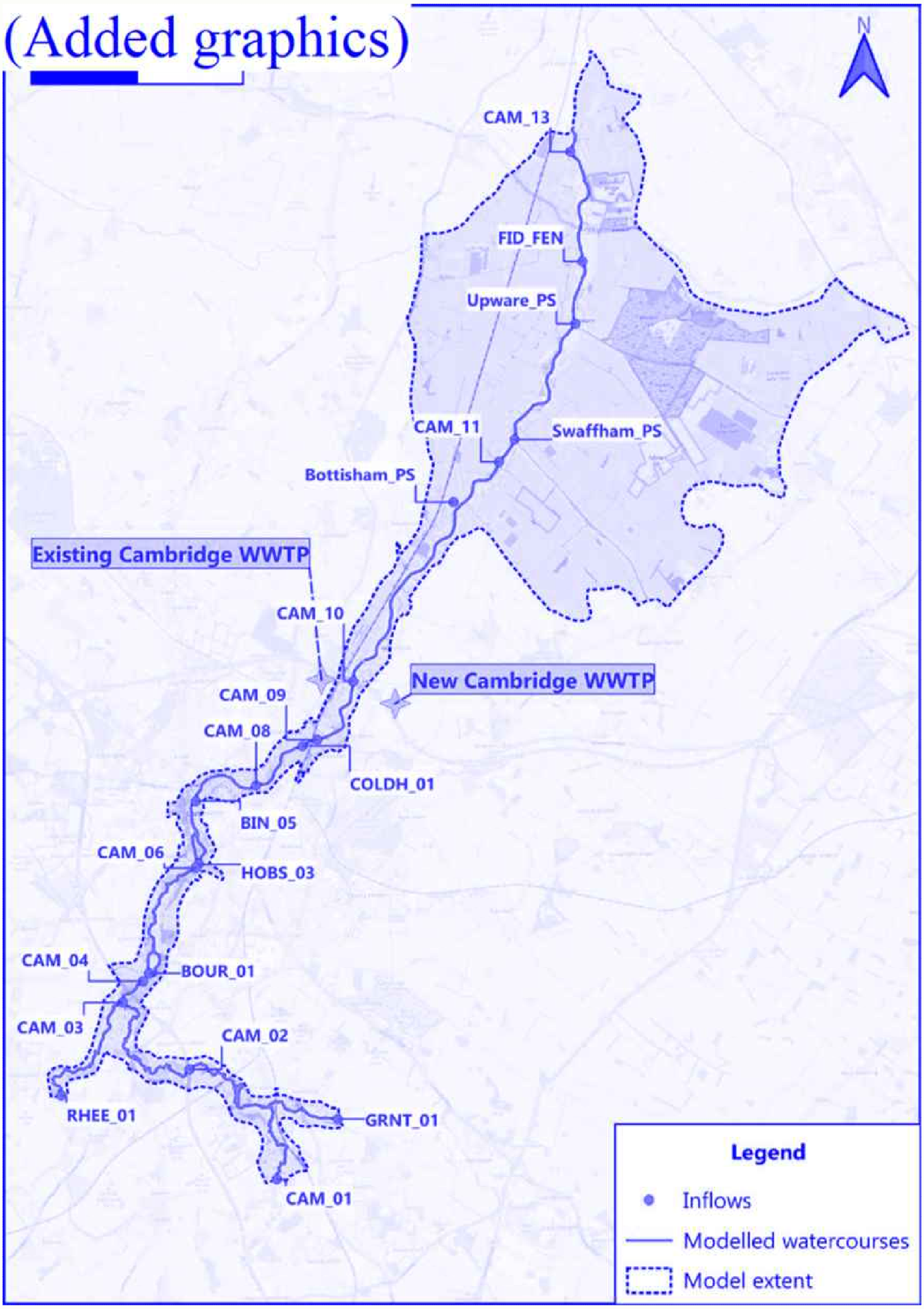
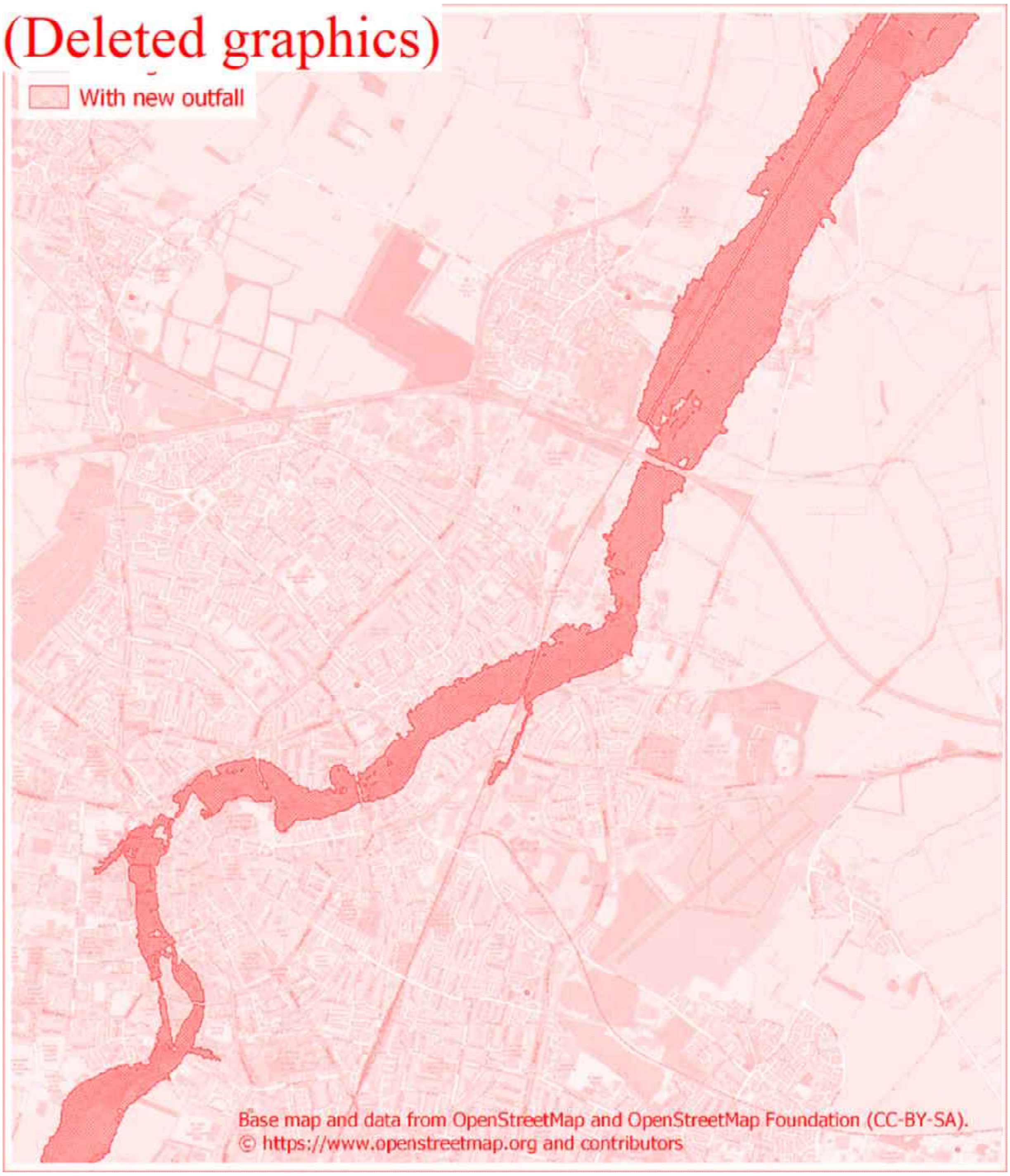

(Added graphics)
N
CAM_13
FID_FEN
Upware_PS
CAM_11
Swaffham_PS
Bottisham_PS
Existing Cambridge WWTP
CAM_10
New Cambridge WWTP
CAM_09
CAM_08
COLDH_01
BIN_05
CAM_06
HOBS_03
CAM_04
BOUR_01
CAM_03
CAM_02
RHEE_01
GRNT_01
CAM_01
Legend
Inflows
Modelled watercourses
Model extent

Figure 6-1 1D model nodes where results are compared (note that this is a reduced selection of the overall 1D model nodes)

Table ~~4.1~~6-1 Base case – 1 in 100 year ~~plus climate change, 61~~, 55-hour storm~~, 30 hour outfall flow offset~~ 1D model results

Location	Node	Existing outfall (no	New outfall (with
		Peak water level (mAOD)	
M11	~~CA27350~~CAM01_4253	~~9.507~~9.460	~~9.507~~9.460
A1134 Fen Causeway	~~CA22770~~CAM02_7723d	~~7.644~~7.509	~~7.644~~7.509
Silver Street	~~CA22230us~~CAM02_7160	~~7.426~~7.397	~~7.426~~7.397
Trinity Bridge	~~CA21670~~CAM02_6603	~~7.132~~7.017	~~7.132~~7.017
Bridge Street	~~CA21250~~CAM02_6177	~~6.557~~6.506	~~6.557~~6.506
Victoria Avenue	~~CA20440~~CAM02_5371	~~5.941~~5.837	~~5.942~~5.837
A1134 Elizabeth Way	~~CA19600us~~CAM02_4494	~~5.699~~5.590	~~5.700~~5.590
Railway	~~CA17720~~CAM02_2638	~~5.314~~5.204	~~5.314~~5.204
A14	~~CA15730~~CAM02_0636	~~4.671~~4.641	~~4.674~~4.641
Baits Bite Lock US	~~CA15170J~~CAM02_0200	~~4.587~~4.507	~~4.590~~4.508
Baits Bite Lock DS	~~CA15140~~CAM02_0000	~~4.372~~4.299	~~4.379~~4.301
Horningsea	~~CA14200~~CA14400	~~4.214~~4.203	~~4.220~~4.204
Waterbeach	CA12080J	~~4.006~~4.104	~~4.011~~4.106
Bottisham Lock US	CA10600J	~~3.835~~3.959	~~3.838~~3.960
Bottisham Lock DS	CA10560	~~3.738~~3.875	~~3.742~~3.876
Shrubbs Marina	~~Cam8647~~Cam8794	~~3.603~~3.774	~~3.606~~3.774
Upware	~~Cam4930~~Cam5007	~~3.504~~3.683	~~3.507~~3.684
A1123	Cam2651u	~~3.452~~3.623	~~3.455~~3.624
Great Ouse confluence	Cam0000	~~3.396~~3.574	~~3.399~~3.575
		Peak flow (m³/s)	
M11	~~CA27350~~CAM01_4253	~~63.1~~60.9	~~63.2~~60.9
A1134 Fen Causeway	~~CA22770~~CAM02_7723d	~~42.0~~36.5	~~42.0~~36.5
Silver Street	~~CA22230us~~CAM02_7160	~~4.7~~65.7	~~4.7~~65.8
Trinity Bridge	~~CA21670~~CAM02_6603	~~91.6~~76.5	~~91.6~~76.5
Bridge Street	~~CA21250~~CAM	~~94.3~~78.2	~~94.3~~78.2

	02_6177		
Victoria Avenue	~~CA20440~~CAM02_5371	~~93.2~~74.2	~~93.2~~74.2
A1134 Elizabeth Way	~~CA19600us~~CAM02_4494	~~92.0~~76.7	~~92.0~~76.7
Railway	~~CA17720~~CAM02_2638	~~85.7~~78.7	~~85.7~~78.7
A14	~~CA15730~~CAM02_0636	~~93.4~~77.4	~~93.5~~77.3
Baits Bite Lock US	~~CA15170J~~CAM02_0200	~~56.1~~53.6	~~56.2~~53.6
Baits Bite Lock DS	~~CA15140~~CAM02_0000	~~56.1~~53.6	~~56.2~~53.6
Horningsea	~~CA14200~~CA14400	~~46.0~~40.0	~~45.8~~40.0
Waterbeach	CA12080J	~~58.0~~55.1	~~57.9~~55.0
Bottisham Lock US	CA10600J	~~74.5~~70.4	~~74.6~~70.5
Bottisham Lock DS	CA10560	~~74.5~~70.4	~~74.6~~70.5
Shrubbs Marina	~~Cam8647~~Cam8794	~~76.8~~71.8	~~76.9~~71.8
Upware	~~Cam4930~~Cam5007	~~74.2~~70.6	~~74.5~~70.6
A1123	Cam2651u	~~73.9~~75.6	~~74.1~~75.7
Great Ouse confluence	Cam0000	~~60.3~~65.0	~~60.3~~65.0



~~Figure 4.1~~Table 6-2. Base case – 1 in 100 year plus 9% climate change, ~~61~~ 55-hour storm~~, 30 hour outfall flow offset~~ 1D model results

Location	**Node**	**Existing outfall (no**	**New outfall (with**
		Peak water level (mAOD)	
M11	CAM01_4253	9.557	9.557
A1134 Fen Causeway	CAM02_7723d	7.779	7.779
Silver Street	CAM02_7160	7.564	7.564
Trinity Bridge	CAM02_6603	7.154	7.154

Bridge Street	CAM02_6177	6.608	6.608
Victoria Avenue	CAM02_5371	5.913	5.913
A1134 Elizabeth Way	CAM02_4494	5.657	5.657
Railway	CAM02_2638	5.265	5.265
A14	CAM02_0636	4.669	4.669
Baits Bite Lock US	CAM02_0200	4.539	4.541
Baits Bite Lock DS	CAM02_0000	4.342	4.343
Horningsea	CA14400	4.247	4.249
Waterbeach	CA12080J	4.139	4.141
Bottisham Lock US	CA10600J	3.987	3.988
Bottisham Lock DS	CA10560	3.901	3.901
Shrubbs Marina	Cam8794	3.793	3.794
Upware	Cam5007	3.698	3.698
A1123	Cam2651u	3.635	3.635
Great Ouse confluence	Cam0000	3.585	3.585
		Peak flow (m^3/s)	
M11	CAM01_4253	65.9	65.9
A1134 Fen Causeway	CAM02_7723d	41.9	41.9
Silver Street	CAM02_7160	76.0	76.0
Trinity Bridge	CAM02_6603	83.2	83.2
Bridge Street	CAM02_6177	85.1	85.1
Victoria Avenue	CAM02_5371	76.5	76.5
A1134 Elizabeth Way	CAM02_4494	82.8	82.8
Railway	CAM02_2638	85.5	85.5
A14	CAM02_0636	83.9	83.8
Baits Bite Lock US	CAM02_0200	54.6	54.6
Baits Bite Lock DS	CAM02_0000	54.6	54.6
Horningsea	CA14400	40.2	40.2
Waterbeach	CA12080J	55.1	55.0
Bottisham Lock US	CA10600J	73.4	73.4
Bottisham Lock DS	CA10560	73.4	73.4
Shrubbs Marina	Cam8794	74.7	74.6
Upware	Cam5007	72.6	72.6
A1123	Cam2651u	78.0	78.0
Great Ouse confluence	Cam0000	65.3	65.3

F

(Added graphics)

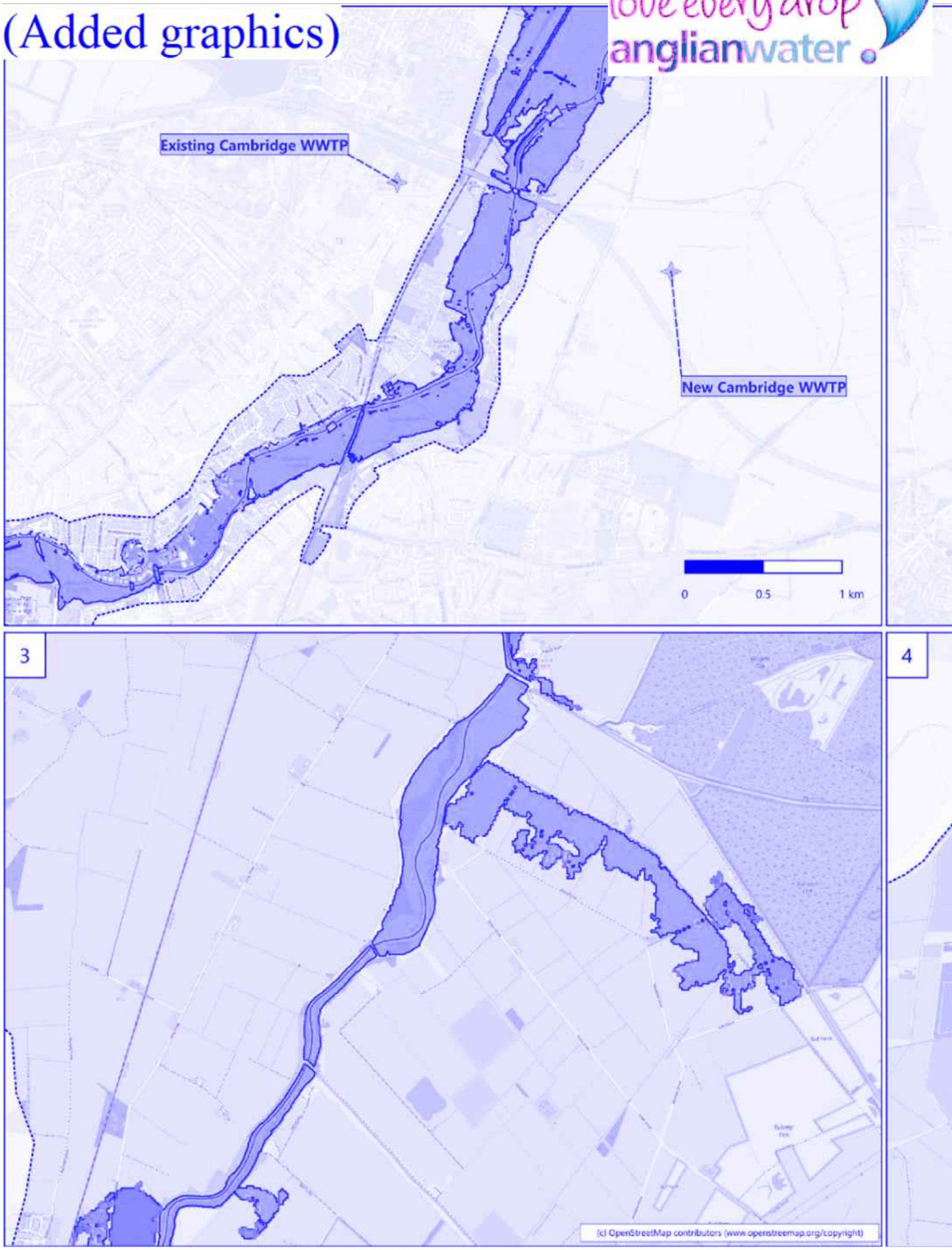


Figure 6-2. Existing (no growth) to New Outfall (with growth) change in flood extent and depth – 1 in 100 year, 55-hour storm

(Added graphics)

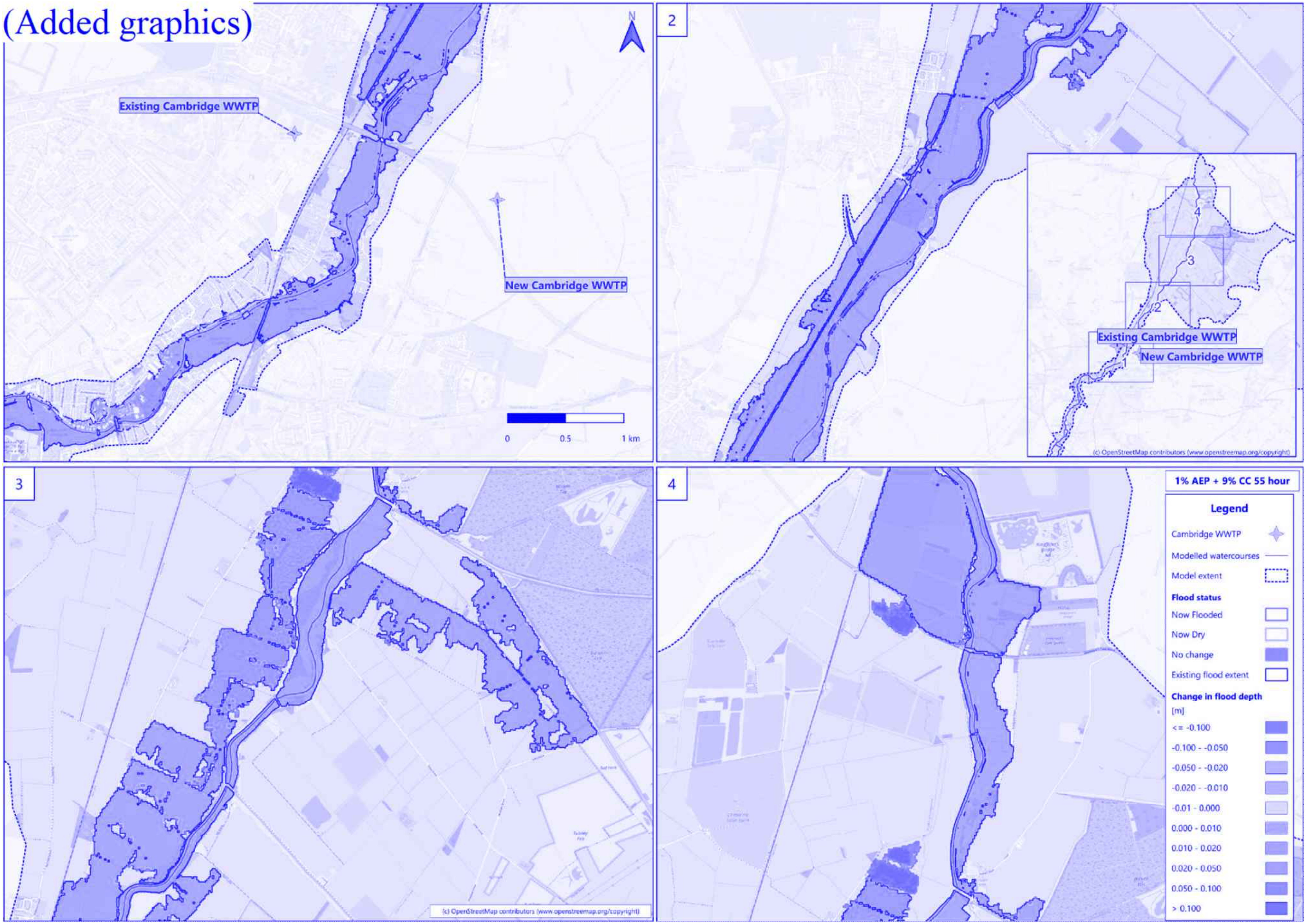


Figure 6-3. Existing (no growth) to New Outfall (with growth) change in flood extent and depth – 1 in 100 year plus 9% climate change, 55-hour storm

~~*Figure 4.2. Comparison node locations*~~

~~CamkSlu~~

~~Binnies UK Limited~~
~~Project no. 123239 / April 2022~~

~~@trines~~

~~Cam4930~~

~~Cam8647~~

~~CA10560~~

~~CA106003~~

~~CA120801~~

~~CA14200~~

~~CA151701CA15140~~

~~CA15730~~

~~CA17720~~

~~.CA20440~~

~~CA212541~~ ~~CA19600us~~

~~&A21670 ICA22Z3Ous~~

~~&A22770~~

~~•CA27350~~

~~Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA).~~
~~https://www.openstreetmap.org and contributors~~

4.3 Sensitivity testing – 1 in 100 year plus climate change

6.3 Existing outfall (no growth) compared to New Outfall (with growth) – 4-hour storm

Sensitivity test results for the New Outfall (with future growth) 4-hour storm scenario are compared the Existing (no growth) outfall 4-hour storm for the 1 in 100 year present day and 1 in 100 year plus 9% climate change floods in Table 6-3, and Table 6-4, respectively (Appendix D provides the equivalent flood extent and depth differences maps for the four tested flood magnitudes). Figure 6-4 and Figure 6-5 also compare flood extents for the Existing outfall (no growth) for both storm durations for the 1 in 100 year present day and 1 in 100 year plus 9% climate change floods, respectively.

The 4-hour storm sensitivity testing results in Table 4.2 to Table 4.4 and Figure 4.3 to Figure 4.5 indicate that:

- Predicted in-channel flood levels are noticeably lower (by 0.2 to 0.7m) for the 4-hour storm sensitivity test compared to the 55-hour storm base case for both flood magnitudes. Unsurprisingly, predicted flood extents are also noticeably smaller for the 4-hour storm than the 55-hour storm. This confirms that the 55-hour storm remains the appropriate duration to assess flood risk from the River Cam. Using the 4-hour storm would underestimate the existing and post-development flood extent.
- The predicted increases in peak water levels are even smaller with the alternative offsets for the 61 hour storm duration:
  - Table 4.2 shows a maximum increase of only 2mm in any location, with a shorter offset for the outfall discharge (sensitivity test 1).
  - Table 4.3 shows a maximum increase of only 4mm, with a longer offset for the outfall discharge (sensitivity test 2).
  - This suggests the 30 hour offset for the outfall discharge is a conservative assumption for the 61 hour catchment storm.
  - Again, there is no perceptible difference in the flood extents for either sensitivity test, or compared to the base case.
- For the 4 hour catchment storm duration (sensitivity test 3):
  - The relative impact of the new WWTP outfall discharge is larger (up to 15mm) but still very small.
- o There is almost no impactremains minimal impact in the New Outfall scenario upstream of the outfall / A14 (2mm0.002m or less) whereas the impact increases moving downstream along the River Cam (6 to 15mm in the river channel).
- The relative impact from the new outfall (including future growth) downstream of the outfall is larger for the 4-hour storm than the 55-hour storm. This is because, with lower peak flows in the River Cam, the outfall flows make up a bigger proportion of

the total river flow. However, the predicted changes in flood depth and extent between the Existing and New Outfall scenarios remain small.

- Peak water levels in the River Cam are much lower (0.3 to 1.1m) than for the 61 hour storm duration. This illustrates that the critical storm duration for the WWTP is very different to the river catchment.
- There is still no perceptible difference in flood extent between the existing and new WWTP outfall discharges.
- The flood extent is much smaller than for the 61 hour storm.

Table ~~4.2~~6-3. Sensitivity test ~~1~~ – 1 in 100 year ~~plus climate change, 61~~, 4-hour storm~~, 15 hour outfall flow offset~~

Location	Node	Existing outfall (no	New outfall (with
		Peak water level (mAOD)	
M11	~~CA27350~~CAM01_4253	~~9.506~~9.156	~~9.507~~9.156
A1134 Fen Causeway	~~CA22770~~CAM02_7723d	~~7.644~~7.280	~~7.644~~7.280
Silver Street	~~CA22230us~~CAM02_7160	~~7.426~~6.756	~~7.426~~6.756
Trinity Bridge	~~CA21670~~CAM02_6603	~~7.132~~6.389	~~7.131~~6.389
Bridge Street	~~CA21250~~CAM02_6177	~~6.557~~6.024	~~6.557~~6.025
Victoria Avenue	~~CA20440~~CAM02_5371	~~5.941~~5.444	~~5.941~~5.445
A1134 Elizabeth Way	~~CA19600us~~CAM02_4494	~~5.699~~5.250	~~5.699~~5.250
Railway	~~CA17720~~CAM02_2638	~~5.313~~4.916	~~5.313~~4.917
A14	~~CA15730~~CAM02_0636	~~4.671~~4.474	~~4.673~~4.477
Baits Bite Lock US	~~CA15170J~~CAM02_0200	~~4.586~~4.322	~~4.588~~4.326
Baits Bite Lock DS	~~CA15140~~CAM02_0000	~~4.371~~4.056	~~4.372~~4.060
Horningsea	~~CA14200~~CA14400	~~4.210~~3.892	~~4.211~~3.897
Waterbeach	CA12080J	~~4.002~~3.458	~~4.004~~3.475
Bottisham Lock US	CA10600J	~~3.831~~3.335	~~3.833~~3.352
Bottisham Lock DS	CA10560	~~3.735~~3.224	~~3.737~~3.240
Shrubbs Marina	~~Cam8647~~Cam8794	~~3.600~~3.139	~~3.601~~3.155
Upware	~~Cam4930~~Cam5007	~~3.502~~3.060	~~3.503~~3.076
A1123	Cam2651u	~~3.450~~3.004	~~3.452~~3.020
Great Ouse confluence	Cam0000	~~3.394~~2.946	~~3.395~~2.963
		Peak flow (m³/s)	
M11	~~CA27350~~CAM01_4253	~~63.1~~33.6	~~63.1~~33.6
A1134 Fen Causeway	~~CA22770~~CAM02_7723d	~~42.0~~29.1	~~42.0~~29.1
Silver Street	~~CA22230us~~CAM02_7160	~~4.7~~53.2	~~4.7~~53.2
Trinity Bridge	~~CA21670~~CAM02_6603	~~91.6~~51.2	~~91.5~~51.2
Bridge Street	~~CA21250~~CAM02_6177	~~94.3~~51.9	~~94.3~~51.9
Victoria Avenue	~~CA20440~~CAM	~~93.2~~50.7	~~93.2~~50.7

	02_5371		
A1134 Elizabeth Way	~~CA19600us~~CAM02_4494	~~92.0~~51.3	~~92.0~~51.3
Railway	~~CA17720~~CAM02_2638	~~85.6~~50.8	~~85.6~~50.9
A14	~~CA15730~~CAM02_0636	~~93.3~~49.6	~~93.5~~49.6
Baits Bite Lock US	~~CA15170J~~CAM02_0200	~~56.0~~45.3	~~56.1~~45.5
Baits Bite Lock DS	~~CA15140~~CAM02_0000	~~56.0~~45.3	~~56.1~~45.5
Horningsea	~~CA14200~~CA14400	~~46.1~~38.3	~~45.9~~38.4
Waterbeach	CA12080J	~~57.9~~46.9	~~57.8~~47.8
Bottisham Lock US	CA10600J	~~74.3~~46.6	~~74.2~~47.5
Bottisham Lock DS	CA10560	~~74.3~~46.6	~~74.2~~47.5
Shrubbs Marina	~~Cam8647~~Cam8794	~~76.7~~48.8	~~76.6~~49.5
Upware	~~Cam4930~~Cam5007	~~74.0~~47.3	~~74.1~~47.9
A1123	Cam2651u	~~73.7~~49.9	~~73.8~~50.4
Great Ouse confluence	Cam0000	~~60.2~~49.1	~~60.2~~49.5

Table ~~4.3~~6-4. Sensitivity test ~~2~~ – 1 in 100 year plus 9% climate change, ~~61~~ 4-hour storm~~, 45 hour outfall flow offset~~

Location	Node	Existing outfall (no	New outfall (with	
		Peak water level (mAOD)		
M11	~~CA27350~~CAM01_4253	~~9.506~~9.234	~~9.506~~9.234	
A1134 Fen Causeway	~~CA22770~~CAM02_7723d	~~7.644~~7.469	~~7.644~~7.469	
Silver Street	~~CA22230us~~CAM02_7160	~~7.426~~6.854	~~7.426~~6.854	
Trinity Bridge	~~CA21670~~CAM02_6603	~~7.132~~6.494	~~7.132~~6.494	
Bridge Street	~~CA21250~~CAM02_6177	~~6.557~~6.105	~~6.557~~6.105	
Victoria Avenue	~~CA20440~~CAM02_5371	~~5.941~~5.516	~~5.942~~5.516	(
A1134 Elizabeth Way	~~CA19600us~~CAM02_4494	~~5.699~~5.310	~~5.699~~5.311	(
Railway	~~CA17720~~CAM02_2638	~~5.314~~4.967	~~5.314~~4.969	(
A14	~~CA15730~~CAM02_0636	~~4.672~~4.508	~~4.675~~4.511	
Baits Bite Lock US	~~CA15170J~~CAM02_0200	~~4.588~~4.357	~~4.590~~4.361	(
Baits Bite Lock DS	~~CA15140~~CAM02_0000	~~4.375~~4.088	~~4.379~~4.092	
Horningsea	~~CA14200~~CA14400	~~4.216~~3.926	~~4.220~~3.929	(
Waterbeach	CA12080J	~~4.007~~3.593	~~4.011~~3.605	(
Bottisham Lock US	CA10600J	~~3.835~~3.474	~~3.838~~3.486	(
Bottisham Lock DS	CA10560	~~3.738~~3.371	~~3.742~~3.384	(
Shrubbs Marina	~~Cam8647~~Cam8794	~~3.602~~3.287	~~3.605~~3.300	(
Upware	~~Cam4930~~Cam5007	~~3.504~~3.211	~~3.507~~3.225	(
A1123	Cam2651u	~~3.452~~3.159	~~3.455~~3.173	(
Great Ouse confluence	Cam0000	~~3.396~~3.107	~~3.399~~3.121	(
		Peak flow (m³/s)		F
M11	~~CA27350~~CAM01_4253	~~63.1~~36.4	~~63.1~~36.4	
A1134 Fen Causeway	~~CA22770~~CAM02_7723d	~~42.0~~34.9	~~42.0~~34.9	
Silver Street	~~CA22230us~~CAM02_7160	~~4.7~~56.0	~~4.7~~56.0	
Trinity Bridge	~~CA21670~~CAM02_6603	~~91.6~~54.6	~~91.5~~54.6	
Bridge Street	~~CA21250~~CAM02_6177	~~94.3~~55.7	~~94.3~~55.7	

Victoria Avenue	~~CA20440~~CAM02_5371	~~93.2~~54.4	~~93.2~~54.3
A1134 Elizabeth Way	~~CA19600us~~CAM02_4494	~~92.0~~55.1	~~92.0~~55.1
Railway	~~CA17720~~CAM02_2638	~~85.6~~55.1	~~85.6~~55.1
A14	~~CA15730~~CAM02_0636	~~93.4~~53.6	~~93.5~~53.6
Baits Bite Lock US	~~CA15170J~~CAM02_0200	~~56.1~~46.9	~~56.2~~47.1
Baits Bite Lock DS	~~CA15140~~CAM02_0000	~~56.1~~46.9	~~56.2~~47.1
Horningsea	~~CA14200~~CA14400	~~46.4~~38.7	~~46.5~~38.9
Waterbeach	CA12080J	~~58.1~~51.6	~~58.1~~51.9
Bottisham Lock US	CA10600J	~~74.6~~52.2	~~74.8~~52.7
Bottisham Lock DS	CA10560	~~74.6~~52.2	~~74.8~~52.7
Shrubbs Marina	~~Cam8647~~Cam8794	~~77.0~~54.1	~~77.2~~54.6
Upware	~~Cam4930~~Cam5007	~~74.3~~51.7	~~74.5~~52.0
A1123	Cam2651u	~~73.9~~53.9	~~74.1~~54.3
Great Ouse confluence	Cam0000	~~60.3~~52.9	~~60.3~~53.3

(Added graphics)

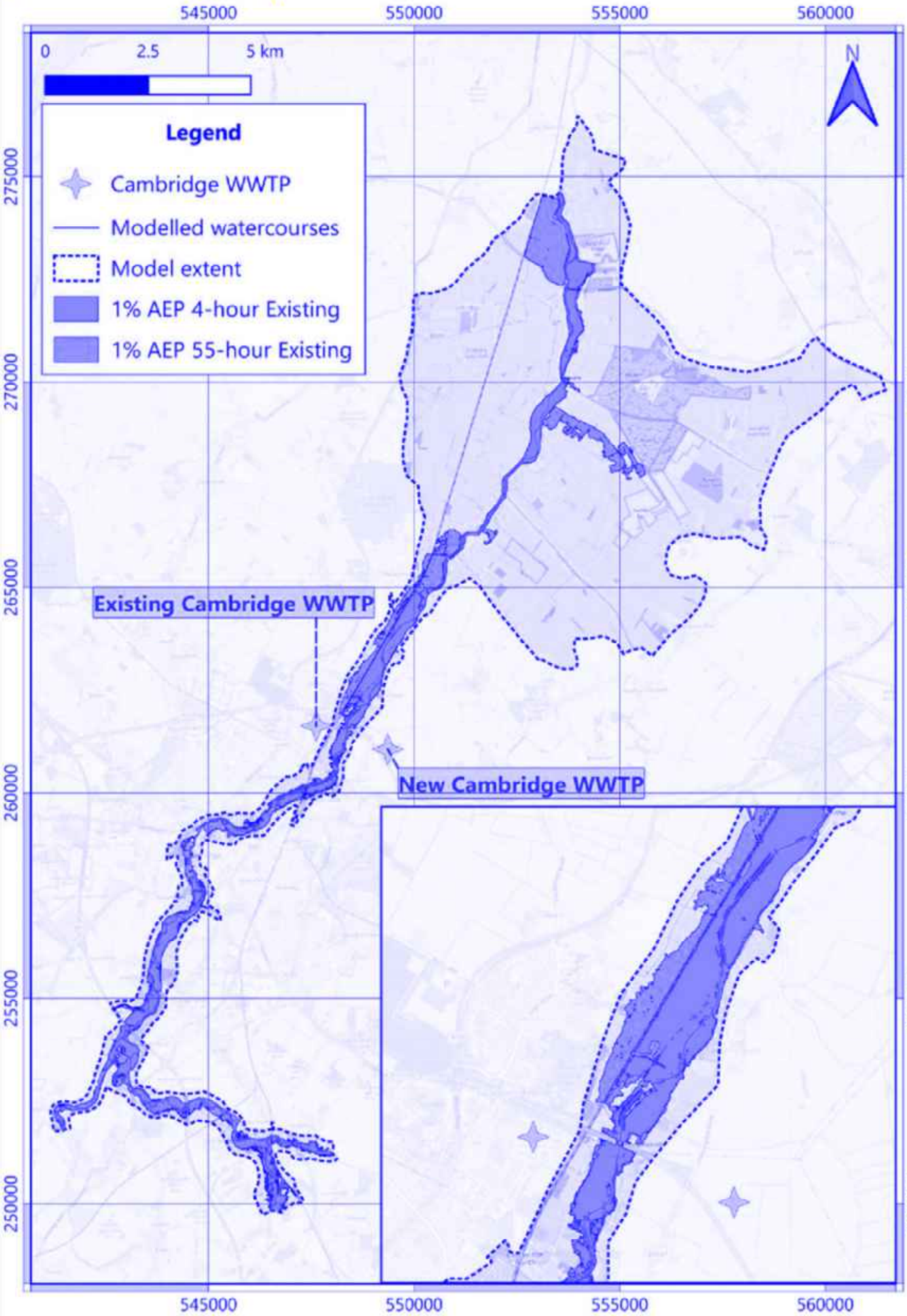


Figure 6-4. 1 in 100 year, 55-and 4-hour storms compared for the Existing Outfall case (no growth)

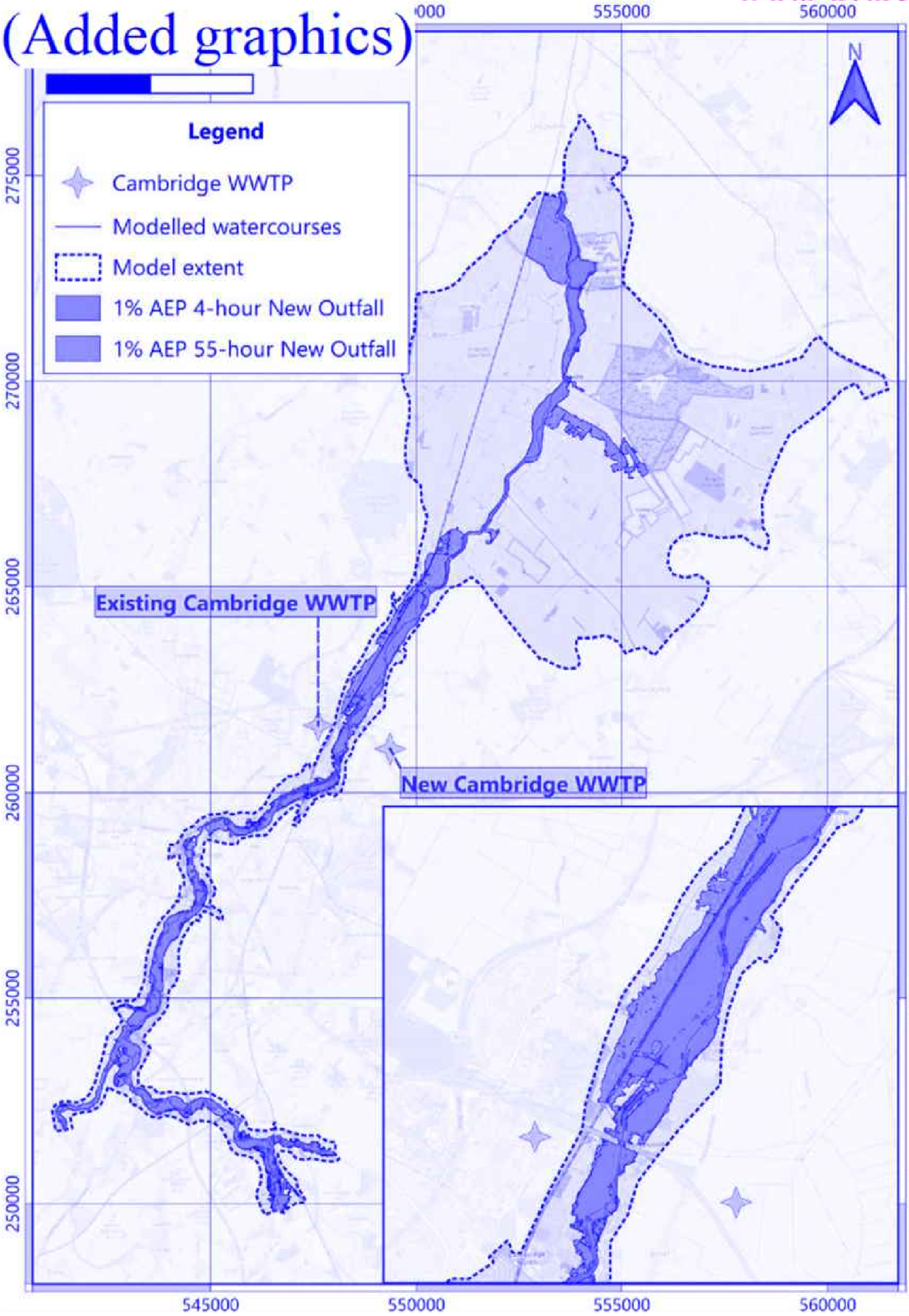


Figure 6-5. Sensitivity test – 1 in 100 year, 55- and 4-hour storms compared for the New Outfall case (with growth)

6.4 Existing outfall (no growth) compared to New Outfall (with growth) – other flood magnitudes

The results for other flood magnitudes are shown in Appendix B and C for the 55-hour storm. These results indicate that:

- The new WWTP lies well outside the River Cam flood extents, even in the largest flood magnitudes.
- There is no genuine impact on peak water levels, peak flows or flood extent upstream of the A14. The maximum predicted in-channel increase in water level is 0.007m, with no discernible change in flood extent.
- Small increases in in-channel water level (up to 0.010m) and flow (up to 0.3m^3/s) are predicted downstream of the A14. The impact is larger for the lower return periods because the WWTP discharge makes up a larger proportion of the total River Cam flow.
- As with the 1 in 100 year flood, there are some small increases in flood depth and extent shown at locations downstream of the outfall. There is not a consistent pattern to where these increases occur as it relates to different parts of the floodplain activating in different flood magnitudes. **Again, these predicted changes, compared to the Existing outfall (with no future growth in the catchment) relate to changes in flood volume between the two scenarios. The increase in flood volume for the New Outfall scenario is due to inclusion of future growth in the catchment, rather than the new WWTP or outfall itself.**

6.5 Existing outfall (with Future Growth) compared to New Outfall (with growth)

Sensitivity results comparing the New Outfall (with growth) to the Existing Future (with growth) scenarios for the 55-hour storm are presented in Table 6-5 and Figure 6-6, and in Table 6-6 and Figure 6-7 for the 1 in 100 year present day, and 1 in 100 year plus 9% climate change floods, respectively. The results for the remaining flood magnitudes are provided in Appendix E for the tabulated results, and in Appendices F and G for the comparative flood maps.

The comparative flood maps presented in Figure 6-6 and Figure 6-7 show the change in flood depth and extent between the Existing Future scenario and the New Outfall, such that positive depth changes indicate areas where depths would increase with the New Outfall. Negative depth changes indicate areas where flood depths would reduce with the New Outfall.

These sensitivity results indicate that when future growth in the catchment is considered:

- There is almost no change in peak water levels or flows in the River Cam for the New Outfall case compared to Existing Future.
- The maximum predicted increase in peak in-channel water level is 0.001m (1mm) at Horningsea. More often there is no change or a very small reduction to peak in-channel water levels.
- There is no change in flood depths throughout Cambridge (upstream of the A14 / the WWTP outfalls).

- The New Outfall does not increase floodplain water levels for the design storm (55-hour) anywhere in the study area beyond +0.001m, for the range of flood magnitudes considered, expect for the few isolated exceptions discussed below.

- Although the New Outfall would discharge a slightly higher peak flow than the Existing with future growth (see Table 5-2 above), these increases (0.1-0.7m^3/s) do not coincide with the peak river flow. The maximum change in peak river flow is 0.1m^3/s and more often there is no change or a small reduction.

- The new outfall does show a few small, isolated areas of minor detriment downstream of Upware. For the 1 in 100 year plus 9% climate change, there is a small region of a field in the left-bank floodplain adjacent to the River Cam at Upware where levels have increased by generally 0.04m (as seen in Figure 6-7) with several model cells increasing to 0.1m; and another region of a field on the south side of Stretham Road in the vicinity of Dimmock's Cote Drain where levels have increase by up to 0.01m. No sensitive receptors appear to be impacted by this increase.

- There are no increases in flood depth during the 4-hour storm case. In general, there are reductions in flood depth in the floodplain around Waterbeach and downstream of Upware, although the reductions are small and isolated, as seen in Appendices G.2 to G.4.

Table ~~4.4. Sensitivity test 3~~6-5 Existing Future sensitivity – 1 in 100 year ~~plus climate change, 4 hour storm, 0 hour outfall flow offset~~, 55-hour storm1D model results

Location	Node	Existing ~~outfall~~future (with growth)	New outfall (with growth)
		Peak water level (mAOD)	
M11	~~CA27350~~CAM01_4253	~~9.073~~9.460	~~9.073~~9.460
A1134 Fen Causeway	~~CA22770~~CAM02_7723d	~~7.241~~7.509	~~7.241~~7.509
Silver Street	~~CA22230us~~CAM02_7160	~~6.299~~7.397	~~6.299~~7.397
Trinity Bridge	~~CA21670~~CAM02_6603	~~6.072~~7.017	~~6.072~~7.017
Bridge Street	~~CA21250~~CAM02_6177	~~5.806~~6.506	~~5.806~~6.506
Victoria Avenue	~~CA20440~~CAM02_5371	~~5.244~~5.837	~~5.244~~5.837
A1134 Elizabeth Way	~~CA19600us~~CAM02_4494	~~5.082~~5.590	~~5.083~~5.590
Railway	~~CA17720~~CAM02_2638	~~4.767~~5.205	~~4.769~~5.204
A14	~~CA15730~~CAM02_0636	~~4.384~~4.642	~~4.390~~4.641
Baits Bite Lock US	~~CA15170J~~CAM02_0200	~~4.244~~4.508	~~4.250~~4.508
Baits Bite Lock DS	~~CA15140~~CAM02_0000	~~3.995~~4.302	~~4.000~~4.301
Horningsea	~~CA14200~~CA14400	~~3.742~~4.204	~~3.747~~4.204
Waterbeach	CA12080J	~~3.228~~4.106	~~3.237~~4.106
Bottisham Lock US	CA10600J	~~3.094~~3.960	~~3.104~~3.960
Bottisham Lock DS	CA10560	~~2.980~~3.876	~~2.992~~3.876
Shrubbs Marina	~~Cam8647~~Cam8794	~~2.873~~3.774	~~2.886~~3.774
Upware	~~Cam4930~~Cam5007	~~2.783~~3.684	~~2.797~~3.684
A1123	Cam2651u	~~2.731~~3.624	~~2.745~~3.624
Great Ouse confluence	Cam0000	~~2.654~~3.575	~~2.669~~3.575
		Peak flow (m^3/s)	
M11	~~CA27350~~CAM01_4253	~~27.3~~60.9	~~27.3~~60.9
A1134 Fen Causeway	~~CA22770~~CAM02_7723d	~~33.2~~36.5	~~33.2~~36.5
Silver Street	~~CA22230us~~CAM02_7160	~~1.8~~65.7	~~1.8~~65.8
Trinity Bridge	~~CA21670~~CAM02_6603	~~45.2~~76.5	~~45.2~~76.5

Bridge Street	~~CA21250~~CAM02_6177	~~45.4~~78.2	~~45.4~~78.2
Victoria Avenue	~~CA20440~~CAM02_5371	~~45.4~~74.2	~~45.4~~74.2
A1134 Elizabeth Way	~~CA19600us~~CAM02_4494	~~45.2~~76.6	~~45.2~~76.7
Railway	~~CA17720~~CAM02_2638	~~44.3~~78.7	~~44.3~~78.7
A14	~~CA15730~~CAM02_0636	~~44.1~~77.3	~~44.1~~77.3
Baits Bite Lock US	~~CA15170J~~CAM02_0200	~~43.2~~53.6	~~43.4~~53.6
Baits Bite Lock DS	~~CA15140~~CAM02_0000	~~43.2~~53.6	~~43.4~~53.6
Horningsea	~~CA14200~~CA14400	~~42.5~~40.0	~~42.7~~40.0
Waterbeach	CA12080J	~~40.8~~55.1	~~41.3~~55.0
Bottisham Lock US	CA10600J	~~40.4~~70.5	~~40.7~~70.5
Bottisham Lock DS	CA10560	~~40.4~~70.5	~~40.7~~70.5
Shrubbs Marina	~~Cam8647~~Cam8794	~~43.7~~71.9	~~44.0~~71.8
Upware	~~Cam4930~~Cam5007	~~45.6~~70.6	~~45.9~~70.6
A1123	Cam2651u	~~47.8~~75.7	~~48.1~~75.7
Great Ouse confluence	Cam0000	~~42.6~~65.0	~~42.9~~65.0

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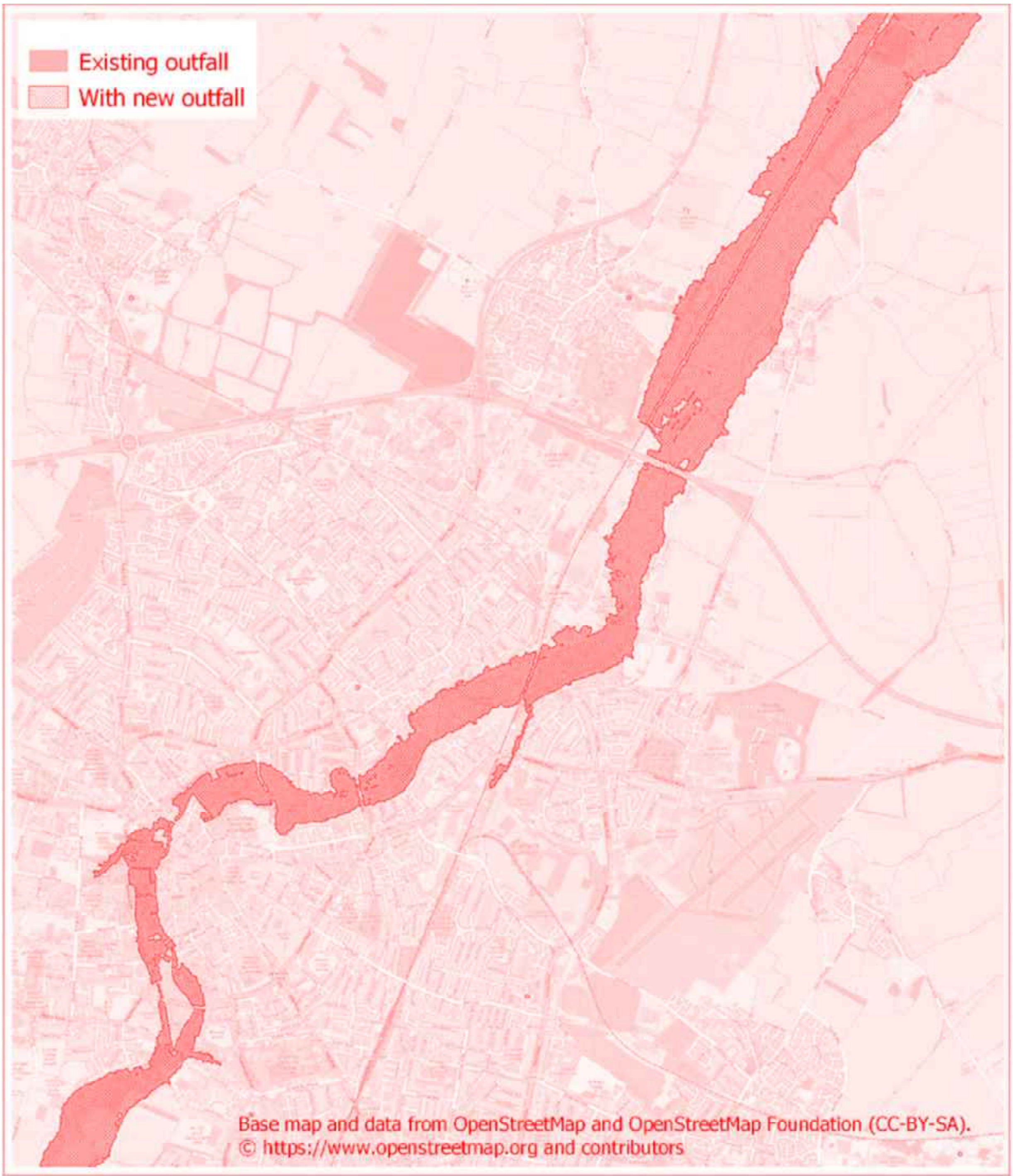


Figure 4.3. Sensitivity test – 1 in 100 year plus climate change, 61 hour storm, 15 hour outfall flow offset

Table 6-6 Existing Future sensitivity – 1 in 100 year plus 9% climate change, 55-hour storm1D model results

Location	Node	Existing future (with	New outfall (with
		Peak water level (mAOD)	
M11	CAM01_4253	9.557	9.557
A1134 Fen Causeway	CAM02_7723d	7.779	7.779
Silver Street	CAM02_7160	7.564	7.564
Trinity Bridge	CAM02_6603	7.154	7.154
Bridge Street	CAM02_6177	6.608	6.608
Victoria Avenue	CAM02_5371	5.913	5.913
A1134 Elizabeth Way	CAM02_4494	5.657	5.657
Railway	CAM02_2638	5.265	5.265
A14	CAM02_0636	4.670	4.669
Baits Bite Lock US	CAM02_0200	4.540	4.541
Baits Bite Lock DS	CAM02_0000	4.343	4.343
Horningsea	CA14400	4.249	4.249
Waterbeach	CA12080J	4.141	4.141
Bottisham Lock US	CA10600J	3.988	3.988
Bottisham Lock DS	CA10560	3.902	3.901
Shrubbs Marina	Cam8794	3.794	3.794
Upware	Cam5007	3.698	3.698
A1123	Cam2651u	3.635	3.635
Great Ouse confluence	Cam0000	3.585	3.585
		Peak flow (m³/s)	
M11	CAM01_4253	65.9	65.9
A1134 Fen Causeway	CAM02_7723d	41.9	41.9
Silver Street	CAM02_7160	76.0	76.0
Trinity Bridge	CAM02_6603	83.2	83.2
Bridge Street	CAM02_6177	85.1	85.1
Victoria Avenue	CAM02_5371	76.5	76.5
A1134 Elizabeth Way	CAM02_4494	82.8	82.8
Railway	CAM02_2638	85.5	85.5
A14	CAM02_0636	83.8	83.8
Baits Bite Lock US	CAM02_0200	54.6	54.6
Baits Bite Lock DS	CAM02_0000	54.6	54.6
Horningsea	CA14400	40.3	40.2
Waterbeach	CA12080J	55.0	55.0
Bottisham Lock US	CA10600J	73.4	73.4
Bottisham Lock DS	CA10560	73.4	73.4
Shrubbs Marina	Cam8794	74.7	74.6
Upware	Cam5007	72.7	72.6
A1123	Cam2651u	78.1	78.0
Great Ouse confluence	Cam0000	65.3	65.3

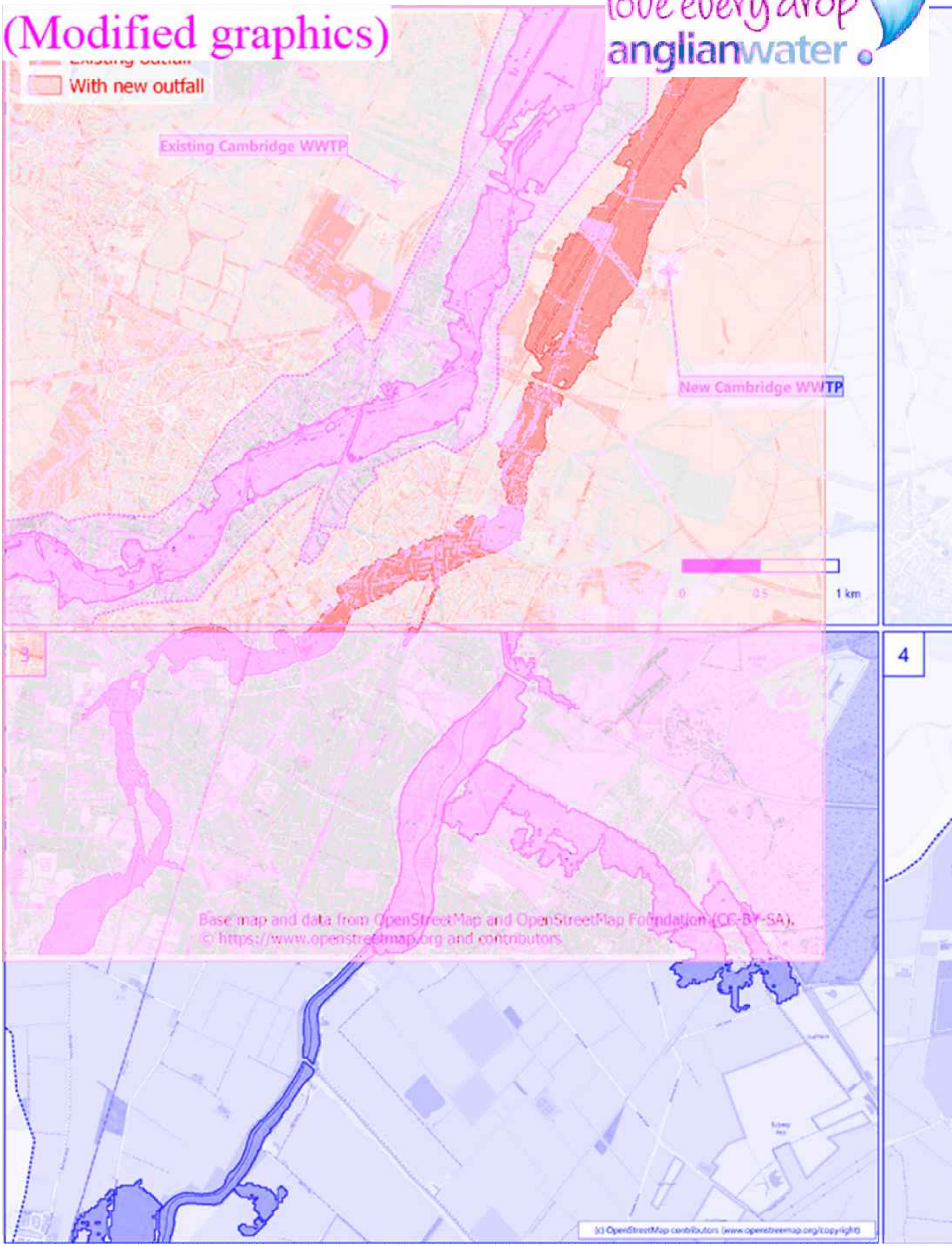

(Modified graphics)
With new outfall
Existing Cambridge WWTP
New Cambridge WWTP
0
0.5
1 km
3
4
Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA).
© https://www.openstreetmap.org and contributors
(c) OpenStreetMap contributors (www.openstreetmap.org/copyright)

Figure ~~4.4. Sensitivity test~~6-6. Existing Future (with growth) to New Outfall (with growth) change in flood extent and depth – 1 in 100 year~~ plus climate change, 61 ~~, 55-hour storm~~, 45 hour outfall flow offset~~

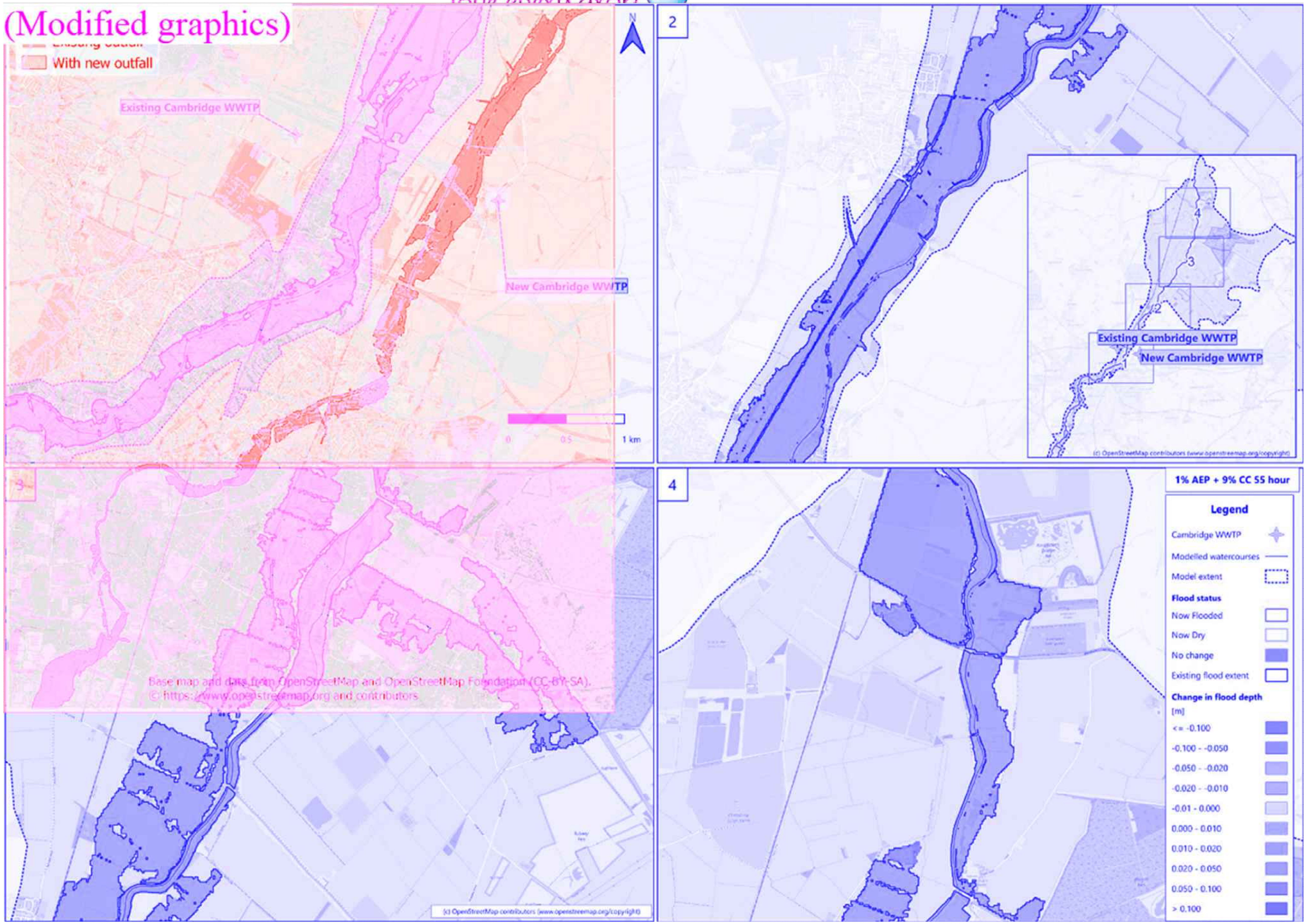


Figure 6-7. Existing Future (with growth) to New Outfall (with growth) change in flood extent and depth – 1 in 100 year plus 9% climate change, 55-hour storm

Figure 4.5. Sensitivity test – 1 in 100 year plus climate change, 4 hour storm, 0 hour outfall flow offset

4.4 Base case – other flood magnitudes

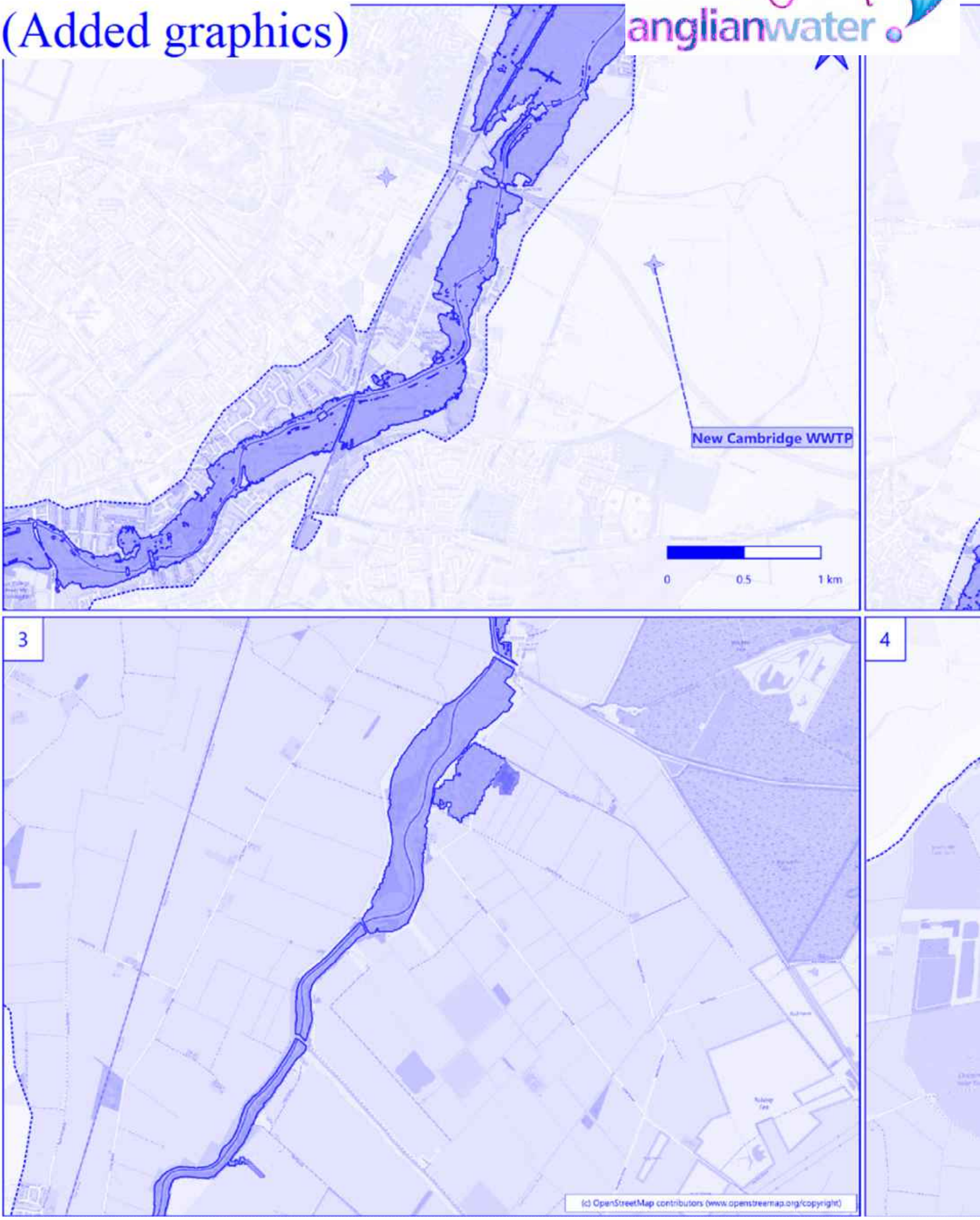
The results for other flood magnitudes are shown in Appendix A and B. These results indicate that:

6.6 Existing outfall (no growth) compared to New Outfall Phase 1

The flood difference maps in Figure 6-8 and Figure 6-9 compare depths and extents between for the Existing outfall and New Outfall Phase 1 scenarios for the 1 in 75 and 1 in 100 year floods (55-hour storm), respectively. These flood magnitudes were used as these are the cases with greatest, albeit still small, impacts predicted from future growth in the catchment.

The maps demonstrate that there is minimal difference between the Phase 1 impact (shown here in Figure 6-8 and Figure 6-9) and the Phase 2 impact (shown in section 6.2 and Appendix C) of the New Outfall (with growth) compared to the Existing outfall (no growth). The predicted changes are marginally smaller for Phase 1 (approximately 0.02m lower than Phase 2 in the areas of greatest change) but the extent of areas affected remain very similar.

(Added graphics)



~~There is~~

- no genuine impact on peak water levels, peak flows or flood extent upstream of the A14. The maximum predicted increase in water level is 0.002m, with no discernable *Figure 6-8 Existing (no growth) to Phase 1 New Outfall (with growth)* *change in flood extent.* *and depth – 1 in 75 year, 55-hour storm*

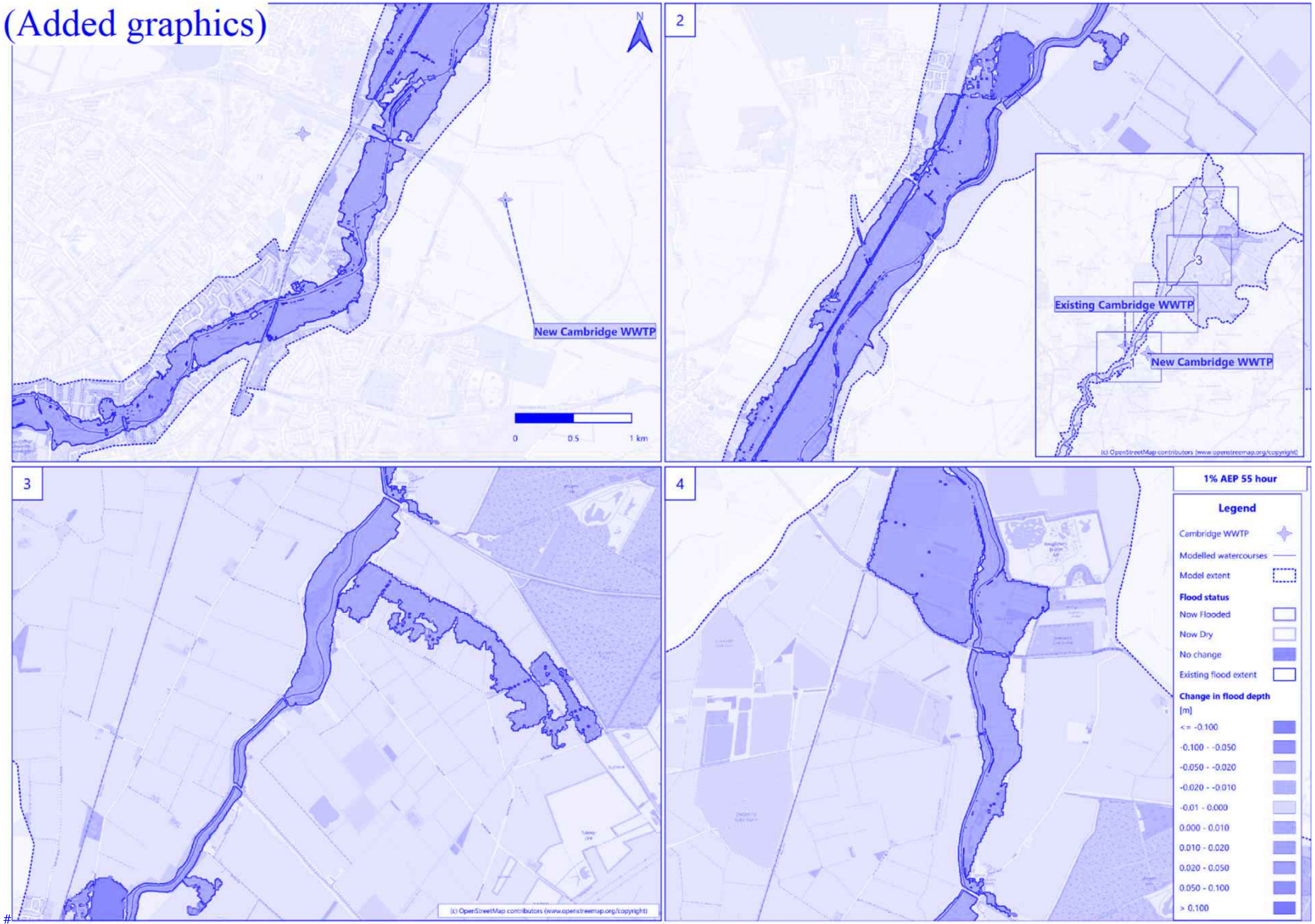
- Small increases in water level (up to 0.02m) and flow (up to 1m³/s) are predicted downstream of the A14. The impact is larger for the lower return periods because the WWTP discharge makes up a larger proportion of the total River Cam flow.

- There are some minor differences in the flood extent for the 1 in 10 to 1 in 50 year flood extents downstream of the A14. There are no properties within the affected area.

Note that the downstream impact is likely to be overstated by the modelling since the existing Waterbeach outfall is not represented in the model. There will be flow through the Waterbeach outfall in existing conditions but not with the new WWTP.

(Add)nies

(Added graphics)



#
Figure 6-9 Existing (no growth) to Phase 1 New Outfall (with growth) change in flood extent and depth – 1 in 100 year, 55-hour storm

4.56.7 Non-flood conditions

In non-flood conditions (normal and low flows), river levels at the outfall location are controlled by the operation of Baits Bite Lock. Water levels upstream of Baits Bite Lock are maintained at around 3.85mAOD (normally within 3.80 to 3.90mAOD), as shown by both:

- The operating logic within the hydraulic model for the Bates Bite sluice gates (node CA15170SusCAM_0200Sus).
- Recorded water levels for Bates Bite gauge. For example, as shown on the River Levels website[2]website[4].

Figure 4.66-10 contains:

- The hydraulic model results for the model node immediately downstream ofat the A14 bridge (the new WWTP outfall site), comparing flow and water levels. Results are presented for both the whole rising limb of the 1 in 2 year flood and the flood peaks for all the design floods considered.
- The nominal 3.85mAOD retention level.
- Flow exceedance statistics for the closest river flow gauging station – the River Cam at Bottisham, a short distance downstream.

These results confirm that even at the peak of the 1 in 2 year flood, water levels at the A14 are only 0.1m0.15m above the normal 3.85mAOD retention level at Baits Bite Lock. In normal flows and low flows, we would expect water levels at the outfall to be at, or very close to, 3.85mAOD.

2 https://riverlevels.uk/river-cam-fen-ditton-cambridge-baits-bite#.YlgtFcjMKUk
https://riverlevels.uk/river-cam-fen-ditton-cambridge-baits-bite#.YlgtFcjMKUk

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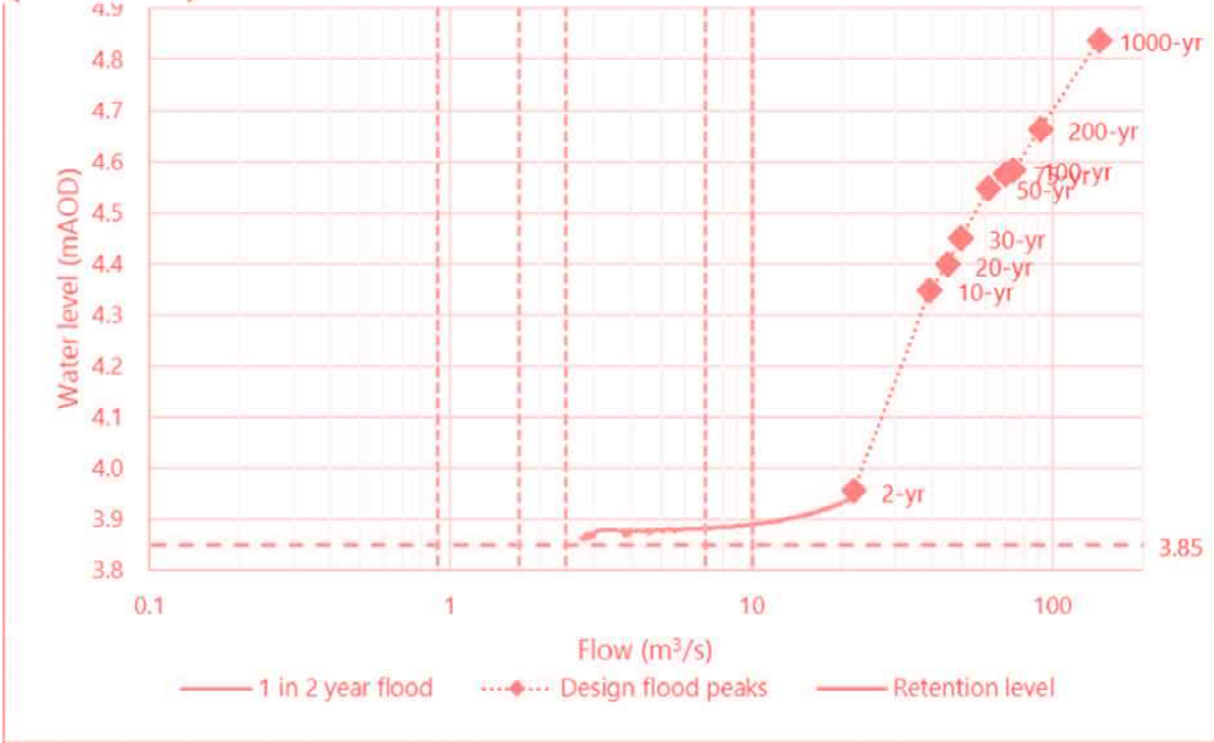

Q95
Q70
Q50
Q10
Q5
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
Water level (mAOD)
1000-yr
200-yr
100-yr
50-yr
30-yr
20-yr
10-yr
2-yr
3.85
0.1
1
10
100
Flow (m³/s)
1 in 2 year flood
Design flood peaks
Retention level

(Added)

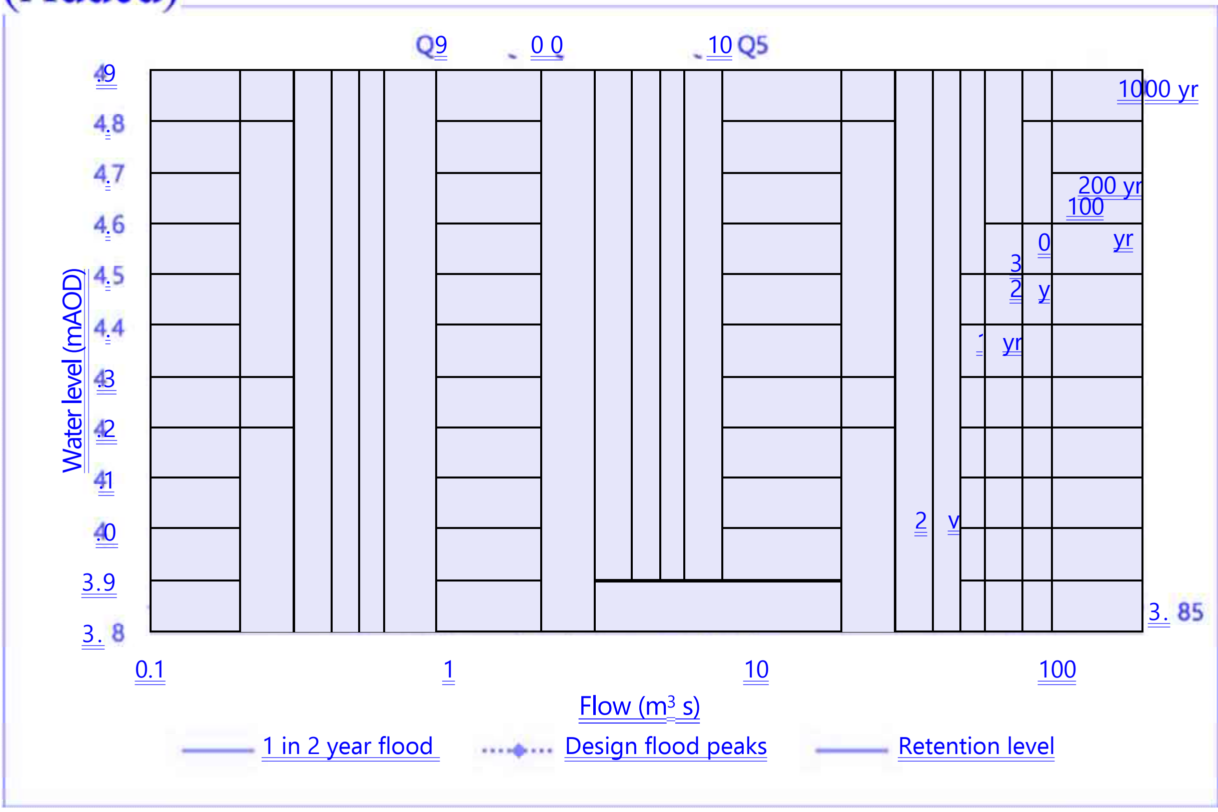


Figure ~~4.6~~6-10. Water level – flow relationship at the new outfall (from hydraulic model r(Mod)

love every drop
anglianwater

~~5~~7. Conclusions

This report describes river modelling undertaken to assess the impact of the Cambridge WWTP Relocation project new outfall on fluvial flood risk in the River Cam.

~~The modelling was undertaken using information readily available to the project team.~~ The Environment Agency's ~~2011 River~~2023 Cam ~~hydraulic~~Urban river model was used with only minor modifications (to ~~enable the model to run using up-to-date software versions and to~~ explicitly include the existing and new WWTP outfall discharge). Outfall discharges (existing and new outfall) were calculated using results from Anglian Water's Cambridge sewer model.

An additional scenario was tested, as recommended by the Environment Agency, to consider the existing outfall **with** future growth in the catchment to provide a more comparable case with which to compare to the new outfall.

It is important to note that:

- **For the Existing Outfall scenario, runoff in the sewer model is for the catchment as it is now**.
- **For the New Outfall scenario, runoff in the sewer model is for the catchment including future growth**. This means that the New Outfall flow volume is larger than for the Existing outfall. The new WWTP and outfall will not increase flow volume, it is only because future growth within the catchment is included for this scenario.
- **The additional Existing Future scenario accounts for future growth in the catchment but for the existing WWTP and outfall**.

The 1 in 100 year flood ~~including~~with and without climate change allowance was used as the primary design case and for sensitivity testing. A range of other fluvial flood magnitudes were also simulated.

There is a ~~mismatch~~large difference in the critical storm durations ~~used in the modelling – the river model uses a 61~~ for the WWTP outfall flows and the River Cam catchment – a 55-hour storm ~~as~~is the critical case for the whole River Cam fluvial catchment; whereas the critical case for the WWTP outfall discharge is a 4 hour storm. We have explored this issue using sensitivity testing ~~to offset the timing of the WWTP discharge and also test~~for a 4-hour river catchment storm, in addition to the base case of a 55-hour storm.

~~The river model results indicate that:~~

- ~~Only a very minor impact on peak flood levels in the River Cam is predicted for the 1 in 100 year plus climate change flood. There is a maximum increase of only 7mm, and generally less, for the base assumptions (61 hour duration storm).~~
- ~~There is no perceptible increase in flood extent due to the new WWTP outfall discharge for any of the 1 in 100 year plus climate change cases considered (base or sensitivity tests).~~
- ~~Sensitivity testing indicates we have taken a conservative assumption for the timing of the WWTP discharge relative to the river flood. With alternative offset timings, the predicted relative impact of the new WWTP is smaller.~~

- With a much shorter river catchment storm, the relative impact of the new WWTP on peak water levels is larger but still small (up to 15mm increase). However, river levels are much lower and flood extents are much smaller, as this is not the critical duration for river flooding.

- For smaller magnitude floods (1 in 10 to 1 in 50 year), the predicted impact is greater because the WWTP discharge makes up a larger proportion of the total River Cam flow. The impact, however, remains very small with no change at all through Cambridge and a maximum increase in downstream peak water levels of only 0.02m and only very minor changes to the predicted downstream flood extent. The downstream impact is likely to be overstated because the model does not include the Waterbeach outfall flow, which is currently present but will cease with the new WWTP.

When comparing the New Outfall (with growth) to the Existing outfall (without growth), the river model results show that:

- The new WWTP lies well outside the River Cam flood extents, even in the largest flood magnitudes.

- The 55-hour storm gives noticeably higher flood levels and larger flood extents than the 4-hour storm. This confirmed that the 55-hour storm is the right case for assessing flood risk from the River Cam.

- There is almost no change in peak water levels or flows in the River Cam for the New Outfall case compared to Existing. The maximum predicted increase in peak in-channel water level is 0.002m (2mm) at Baits Bite Lock in the 1 in 100 year flood (present day or climate change case). Across the range of flood magnitudes tested, the largest increase in in-channel flood levels is 0.010m for the 55-hour storm.

- There are no changes in flood depth and extent throughout Cambridge (upstream of the A14 / the WWTP outfalls) across all the flood magnitudes tested.

- The are some areas downstream of the outfall with small increases in flood depth and extent for the New Outfall (with growth) scenario compared to Existing (without growth). These predicted differences are a result of the increased flow volume through the New Outfall, due to including future growth within the catchment in this scenario. This is not a change due to the new WWTP or new outfall itself.

- The phasing of the new works (Phase 1 and Phase 2) would see a small increase in FFT (from 1.729m^3/s in Phase 1 to 1.840m^3/s in Phase 2). The impact of Phase 1 of the New Outfall has been tested for sensitivity and is marginally smaller than Phase 2; although depth increases would only be approximately 0.02m lower in the areas of greatest increase (from 0.07m in Phase 1 to 0.09m in Phase 2).

- In non-flood conditions, water levels at the outfall will be controlled by the operation of Baits Bite Lock, which has a normal retention level of around 3.85mAOD.

In summary, based on these modelling results, we expect no impact on flood risk from the new WWTP outfall.

However, when the New Outfall (with growth) is compared to the Existing Future scenario (including future growth in the catchment), the river model results show that:

- The new outfall does not increase in-channel or floodplain water levels for the 1 in 100 year design storm (55-hour) anywhere in the study area beyond 0.001m, for the range of flood magnitudes considered.

- The new outfall would slightly increase water levels in a few isolated small areas within fields during the 1 in 100 year plus 9% climate change flood, where levels would increase by up to 0.1m. There are no properties within these areas.

- In other flood magnitudes, there are some very small reductions in flood depths and extent predicted with the new outfall compared to the existing outfall. Again, these are rural locations with no properties so there is no practical difference in flood risk.

In summary, we have found minimal impact from the new WWTP and outfall on fluvial flood risk. Even where small changes are shown, we believe these are due to the modelling assumptions and setup rather than genuine impacts from the new WWTP or outfall itself. The additional sensitivity testing requested by the Environment Agency has confirmed that the differences shown in flood extent and level are almost entirely due to future growth within the catchment, rather than the new WWTP or outfall. **The presence of the new WWTP and outfall does not increase flood risk.**

Appendix A: River model review record

Appendix B: Results tables for other flood magnitudes 55-hour - comparing Existing (no growth) to New Outfall (with growth)

~~A~~B.1 1 in 2 year flood

Location	Node	Existing outfall (no	New outfall (with	Increase
		Peak water level (mAOD)		Level (m)
M11	~~CA27350~~CAM01_4253	~~8.455~~8.719	~~8.455~~8.719	0.000
A1134 Fen Causeway	~~CA22770~~CAM02_7723d	~~7.046~~7.145	~~7.046~~7.145	0.000
Silver Street	~~CA22230us~~CAM02_7160	~~5.559~~5.814	~~5.560~~5.814	~~0.001~~0.000
Trinity Bridge	~~CA21670~~CAM02_6603	~~5.447~~5.595	~~5.447~~5.595	0.000
Bridge Street	~~CA21250~~CAM02_6177	~~5.342~~5.406	~~5.342~~5.406	0.000
Victoria Avenue	~~CA20440~~CAM02_5371	~~4.490~~4.739	~~4.492~~4.742	~~0.002~~0.003
A1134 Elizabeth Way	~~CA19600us~~CAM02_4494	~~4.395~~4.614	~~4.396~~4.618	~~0.001~~0.004
Railway	~~CA17720~~CAM02_2638	~~4.181~~4.349	~~4.183~~4.353	~~0.002~~0.004
A14	~~CA15730~~CAM02_0636	~~3.949~~4.016	~~3.955~~4.023	~~0.006~~0.007
Baits Bite Lock US	~~CA15170J~~CAM02_0200	~~3.877~~3.911	~~3.894~~3.918	~~0.017~~0.007
Baits Bite Lock DS	~~CA15140~~CAM02_0000	~~3.288~~3.495	~~3.310~~3.503	~~0.022~~0.008
Horningsea	~~CA14200~~CA14400	~~3.097~~3.292	~~3.114~~3.297	~~0.017~~0.005
Waterbeach	CA12080J	~~2.723~~2.836	~~2.727~~2.838	~~0.004~~0.002
Bottisham Lock US	CA10600J	~~2.637~~2.725	~~2.641~~2.725	~~0.004~~0.000
Bottisham Lock DS	CA10560	~~2.314~~2.552	~~2.333~~2.560	~~0.019~~0.008
Shrubbs Marina	~~Cam8647~~Cam8794	~~2.219~~2.468	~~2.238~~2.475	~~0.019~~0.007
Upware	~~Cam4930~~Cam5007	~~2.096~~2.365	~~2.117~~2.373	~~0.021~~0.008
A1123	Cam2651u	~~2.014~~2.277	~~2.035~~2.287	~~0.021~~0.010
Great Ouse confluence	Cam0000	~~1.910~~2.183	~~1.932~~2.193	~~0.022~~0.010
		Peak flow (m^3/s)		Flow (m^3/s
M11	~~CA27350~~CAM01_4253	~~11.9~~20.3	~~11.9~~20.3	0.0
A1134 Fen Causeway	~~CA22770~~CAM02_7723d	~~18.4~~22.3	~~18.4~~22.3	0.0
Silver Street	~~CA22230us~~CAM02_7160	~~1.8~~25.2	~~1.8~~25.2	0.0
Trinity Bridge	~~CA21670~~CAM02_6603	~~19.8~~25.2	~~19.8~~25.2	0.0
Bridge Street	~~CA21250~~CAM02_6177	~~21.2~~26.5	~~21.2~~26.5	0.0

Victoria Avenue	~~CA20440~~CAM02_5371	~~21.2~~26.6	~~21.2~~26.6	0.0
A1134 Elizabeth Way	~~CA19600us~~CAM02_4494	~~21.3~~26.5	~~21.3~~26.5	0.0
Railway	~~CA17720~~CAM02_2638	~~21.4~~26.6	~~21.4~~26.6	~~0.0~~-0.1
A14	~~CA15730~~CAM02_0636	~~21.6~~26.9	~~21.8~~26.7	~~0.1~~-0.2
Baits Bite Lock US	~~CA15170J~~CAM02_0200	~~23.0~~27.3	~~23.7~~27.5	~~0.7~~0.2
Baits Bite Lock DS	~~CA15140~~CAM02_0000	~~23.0~~27.3	~~23.7~~27.5	~~0.7~~0.2
Horningsea	~~CA14200~~CA14400	~~22.9~~27.5	~~23.5~~27.7	~~0.6~~0.2
Waterbeach	CA12080J	~~23.1~~27.6	~~23.7~~27.8	~~0.6~~0.2
Bottisham Lock US	CA10600J	~~23.3~~27.8	~~23.8~~28.0	~~0.5~~0.3
Bottisham Lock DS	CA10560	~~23.3~~27.8	~~23.8~~28.0	~~0.5~~0.3
Shrubbs Marina	~~Cam8647~~Cam8794	~~26.5~~30.1	~~27.0~~30.2	~~0.6~~0.2
Upware	~~Cam4930~~Cam5007	~~26.9~~30.7	~~27.3~~30.9	~~0.4~~0.2
A1123	Cam2651u	~~28.7~~33.2	~~29.0~~33.3	~~0.4~~0.2
Great Ouse confluence	Cam0000	~~28.4~~33.1	~~28.8~~33.3	~~0.4~~0.2

B.2 1 in 10 year flood

Location	Node	Existing outfall (no	New outfall (with
		~~A.2 1 in 10 year~~	
M11	CAM01_4253	9.131	9.131
A1134 Fen Causeway	CAM02_7723d	7.241	7.241
Silver Street	CAM02_7160	6.394	6.394
Trinity Bridge	CAM02_6603	6.104	6.104
Bridge Street	CAM02_6177	5.810	5.810
Victoria Avenue	CAM02_5371	5.245	5.246
A1134 Elizabeth Way	CAM02_4494	5.079	5.080
Railway	CAM02_2638	4.780	4.781
A14	CAM02_0636	4.381	4.383
Baits Bite Lock US	CAM02_0200	4.233	4.236
Baits Bite Lock DS	CAM02_0000	3.974	3.977
Horningsea	CA14400	3.773	3.777
Waterbeach	CA12080J	3.260	3.268
Bottisham Lock US	CA10600J	3.145	3.153
Bottisham Lock DS	CA10560	3.036	3.042
Shrubbs Marina	Cam8794	2.950	2.956
Upware	Cam5007	2.865	2.871
A1123	Cam2651u	2.802	2.809
Great Ouse confluence	Cam0000	2.732	2.739
		~~Location~~	~~Node~~ ~~Existing~~
M11	CAM01_4253	32.8	32.8
A1134 Fen Causeway	CAM02_7723d	27.6	27.6
Silver Street	CAM02_7160	40.6	40.6
Trinity Bridge	CAM02_6603	40.6	40.6
Bridge Street	CAM02_6177	41.6	41.6
Victoria Avenue	CAM02_5371	41.3	41.3
A1134 Elizabeth Way	CAM02_4494	41.6	41.6
Railway	CAM02_2638	41.8	41.8
A14	CAM02_0636	42.0	41.7
Baits Bite Lock US	CAM02_0200	40.8	40.9
Baits Bite Lock DS	CAM02_0000	40.8	40.9
Horningsea	CA14400	37.9	37.9
Waterbeach	CA12080J	38.6	38.7
Bottisham Lock US	CA10600J	37.9	38.1
Bottisham Lock DS	CA10560	37.9	38.1
Shrubbs Marina	Cam8794	40.3	40.5
Upware	Cam5007	41.2	41.4
A1123	Cam2651u	45.1	45.1
Great Ouse confluence	Cam0000	44.2	44.4

B.3 1 in 20 year flood

Location	Node	Existing outfall (no	New outfall (with
		(Add)	
M11	CAM01_4253	9.240	9.240
A1134 Fen Causeway	CAM02_7723d	7.290	7.290
Silver Street	CAM02_7160	6.766	6.766
Trinity Bridge	CAM02_6603	6.432	6.432
Bridge Street	CAM02_6177	6.062	6.062
Victoria Avenue	CAM02_5371	5.484	5.484
A1134 Elizabeth Way	CAM02_4494	5.284	5.284
Railway	CAM02_2638	4.940	4.940
A14	CAM02_0636	4.488	4.489
Baits Bite Lock US	CAM02_0200	4.337	4.339
Baits Bite Lock DS	CAM02_0000	4.073	4.075
Horningsea	CA14400	3.915	3.917
Waterbeach	CA12080J	3.582	3.588
Bottisham Lock US	CA10600J	3.471	3.477
Bottisham Lock DS	CA10560	3.371	3.378
Shrubbs Marina	Cam8794	3.288	3.295
Upware	Cam5007	3.212	3.218
A1123	Cam2651u	3.159	3.166
Great Ouse confluence	Cam0000	3.106	3.113
		(Add)	
M11	CAM01_4253	41.3	41.3
A1134 Fen Causeway	CAM02_7723d	29.1	29.1
Silver Street	CAM02_7160	52.4	52.3
Trinity Bridge	CAM02_6603	51.9	52.0
Bridge Street	CAM02_6177	53.3	53.3
Victoria Avenue	CAM02_5371	52.4	52.4
A1134 Elizabeth Way	CAM02_4494	53.2	53.2
Railway	CAM02_2638	53.3	53.3
A14	CAM02_0636	51.5	51.4
Baits Bite Lock US	CAM02_0200	45.7	45.8
Baits Bite Lock DS	CAM02_0000	45.7	45.8
Horningsea	CA14400	38.4	38.4
Waterbeach	CA12080J	50.2	50.3
Bottisham Lock US	CA10600J	50.5	50.7
Bottisham Lock DS	CA10560	50.5	50.7
Shrubbs Marina	Cam8794	52.6	52.7
Upware	Cam5007	51.0	51.2
A1123	Cam2651u	53.6	53.7
Great Ouse confluence	Cam0000	52.9	53.1

B.4 1 in 30 year flood

Location	Node	Existing outfall (no	New outfall (with
		~~A.3~~	~~1 in 20 year~~
M11	CAM01_4253	9.286	9.286
A1134 Fen Causeway	CAM02_7723d	7.316	7.316
Silver Street	CAM02_7160	6.891	6.891
Trinity Bridge	CAM02_6603	6.539	6.539
Bridge Street	CAM02_6177	6.141	6.141
Victoria Avenue	CAM02_5371	5.550	5.550
A1134 Elizabeth Way	CAM02_4494	5.345	5.345
Railway	CAM02_2638	4.996	4.996
A14	CAM02_0636	4.524	4.525
Baits Bite Lock US	CAM02_0200	4.373	4.375
Baits Bite Lock DS	CAM02_0000	4.105	4.106
Horningsea	CA14400	3.953	3.955
Waterbeach	CA12080J	3.722	3.728
Bottisham Lock US	CA10600J	3.615	3.620
Bottisham Lock DS	CA10560	3.523	3.529
Shrubbs Marina	Cam8794	3.443	3.448
Upware	Cam5007	3.370	3.376
A1123	Cam2651u	3.320	3.326
Great Ouse confluence	Cam0000	3.272	3.278
		~~Location~~	~~Node~~ ~~Existing~~
M11	CAM01_4253	44.8	44.8
A1134 Fen Causeway	CAM02_7723d	29.1	29.1
Silver Street	CAM02_7160	56.2	56.2
Trinity Bridge	CAM02_6603	56.2	56.2
Bridge Street	CAM02_6177	57.4	57.4
Victoria Avenue	CAM02_5371	55.6	55.6
A1134 Elizabeth Way	CAM02_4494	56.6	56.5
Railway	CAM02_2638	56.8	56.8
A14	CAM02_0636	56.3	56.2
Baits Bite Lock US	CAM02_0200	47.7	47.8
Baits Bite Lock DS	CAM02_0000	47.7	47.8
Horningsea	CA14400	38.8	39.0
Waterbeach	CA12080J	52.5	52.5
Bottisham Lock US	CA10600J	55.0	55.2
Bottisham Lock DS	CA10560	55.0	55.2
Shrubbs Marina	Cam8794	57.0	57.1
Upware	Cam5007	54.9	55.0
A1123	Cam2651u	57.6	57.8
Great Ouse confluence	Cam0000	57.0	57.2

B.5 1 in 50 year flood

Location	Node	Existing outfall (no	New outfall (with
		(Add)	
M11	CAM01_4253	9.352	9.352
A1134 Fen Causeway	CAM02_7723d	7.365	7.365
Silver Street	CAM02_7160	7.087	7.087
Trinity Bridge	CAM02_6603	6.715	6.715
Bridge Street	CAM02_6177	6.274	6.274
Victoria Avenue	CAM02_5371	5.662	5.662
A1134 Elizabeth Way	CAM02_4494	5.440	5.440
Railway	CAM02_2638	5.072	5.072
A14	CAM02_0636	4.572	4.572
Baits Bite Lock US	CAM02_0200	4.424	4.426
Baits Bite Lock DS	CAM02_0000	4.164	4.166
Horningsea	CA14400	4.034	4.037
Waterbeach	CA12080J	3.898	3.903
Bottisham Lock US	CA10600J	3.785	3.790
Bottisham Lock DS	CA10560	3.706	3.711
Shrubbs Marina	Cam8794	3.627	3.632
Upware	Cam5007	3.557	3.562
A1123	Cam2651u	3.510	3.514
Great Ouse confluence	Cam0000	3.464	3.469
		(Add)	
M11	CAM01_4253	50.2	50.2
A1134 Fen Causeway	CAM02_7723d	29.1	29.1
Silver Street	CAM02_7160	60.7	60.7
Trinity Bridge	CAM02_6603	62.9	62.9
Bridge Street	CAM02_6177	64.3	64.3
Victoria Avenue	CAM02_5371	62.7	62.7
A1134 Elizabeth Way	CAM02_4494	63.7	63.7
Railway	CAM02_2638	64.5	64.5
A14	CAM02_0636	63.7	63.6
Baits Bite Lock US	CAM02_0200	50.4	50.4
Baits Bite Lock DS	CAM02_0000	50.4	50.4
Horningsea	CA14400	39.3	39.5
Waterbeach	CA12080J	53.7	53.7
Bottisham Lock US	CA10600J	61.3	61.5
Bottisham Lock DS	CA10560	61.3	61.5
Shrubbs Marina	Cam8794	63.0	63.1
Upware	Cam5007	60.0	60.1
A1123	Cam2651u	62.8	63.0
Great Ouse confluence	Cam0000	62.0	62.2

B.6 1 in 75 year flood

Location	Node	Existing outfall (no	New outfall (with
		~~A.4~~	~~1 in 30 year~~
M11	CAM01_4253	9.420	9.420
A1134 Fen Causeway	CAM02_7723d	7.436	7.436
Silver Street	CAM02_7160	7.281	7.281
Trinity Bridge	CAM02_6603	6.904	6.904
Bridge Street	CAM02_6177	6.419	6.419
Victoria Avenue	CAM02_5371	5.772	5.772
A1134 Elizabeth Way	CAM02_4494	5.534	5.534
Railway	CAM02_2638	5.154	5.154
A14	CAM02_0636	4.617	4.617
Baits Bite Lock US	CAM02_0200	4.477	4.479
Baits Bite Lock DS	CAM02_0000	4.247	4.250
Horningsea	CA14400	4.149	4.152
Waterbeach	CA12080J	4.053	4.055
Bottisham Lock US	CA10600J	3.921	3.923
Bottisham Lock DS	CA10560	3.840	3.842
Shrubbs Marina	Cam8794	3.746	3.747
Upware	Cam5007	3.662	3.663
A1123	Cam2651u	3.606	3.607
Great Ouse confluence	Cam0000	3.558	3.559
		~~Location~~	~~Node~~ ~~Existing~~
M11	CAM01_4253	56.6	56.6
A1134 Fen Causeway	CAM02_7723d	34.0	34.0
Silver Street	CAM02_7160	63.9	63.9
Trinity Bridge	CAM02_6603	71.1	71.1
Bridge Street	CAM02_6177	72.8	72.8
Victoria Avenue	CAM02_5371	70.5	70.5
A1134 Elizabeth Way	CAM02_4494	71.6	71.6
Railway	CAM02_2638	73.1	73.1
A14	CAM02_0636	72.0	71.9
Baits Bite Lock US	CAM02_0200	52.6	52.7
Baits Bite Lock DS	CAM02_0000	52.6	52.7
Horningsea	CA14400	39.8	39.8
Waterbeach	CA12080J	54.7	54.6
Bottisham Lock US	CA10600J	67.3	67.4
Bottisham Lock DS	CA10560	67.3	67.4
Shrubbs Marina	Cam8794	68.8	68.9
Upware	Cam5007	67.8	67.9
A1123	Cam2651u	72.4	72.5
Great Ouse confluence	Cam0000	64.5	64.5

(Mod)

B.7 1 in 200 year flood

Location	Node	Existing outfall (no	New outfall (with
		(Add)	
M11	CAM01_4253	9.562	9.562
A1134 Fen Causeway	CAM02_7723d	7.755	7.755
Silver Street	CAM02_7160	7.728	7.728
Trinity Bridge	CAM02_6603	7.315	7.315
Bridge Street	CAM02_6177	6.705	6.705
Victoria Avenue	CAM02_5371	5.996	5.996
A1134 Elizabeth Way	CAM02_4494	5.736	5.736
Railway	CAM02_2638	5.332	5.332
A14	CAM02_0636	4.698	4.698
Baits Bite Lock US	CAM02_0200	4.570	4.571
Baits Bite Lock DS	CAM02_0000	4.382	4.384
Horningsea	CA14400	4.293	4.295
Waterbeach	CA12080J	4.176	4.177
Bottisham Lock US	CA10600J	4.012	4.012
Bottisham Lock DS	CA10560	3.922	3.922
Shrubbs Marina	Cam8794	3.809	3.809
Upware	Cam5007	3.708	3.708
A1123	Cam2651u	3.644	3.644
Great Ouse confluence	Cam0000	3.593	3.593
		(Add)	
M11	CAM01_4253	72.2	72.2
A1134 Fen Causeway	CAM02_7723d	40.4	40.4
Silver Street	CAM02_7160	71.4	71.4
Trinity Bridge	CAM02_6603	89.9	89.9
Bridge Street	CAM02_6177	92.6	92.6
Victoria Avenue	CAM02_5371	77.7	77.7
A1134 Elizabeth Way	CAM02_4494	90.1	90.1
Railway	CAM02_2638	93.3	93.3
A14	CAM02_0636	91.2	91.2
Baits Bite Lock US	CAM02_0200	55.7	55.7
Baits Bite Lock DS	CAM02_0000	55.7	55.7
Horningsea	CA14400	40.5	40.6
Waterbeach	CA12080J	56.3	56.3
Bottisham Lock US	CA10600J	76.2	76.1
Bottisham Lock DS	CA10560	76.2	76.1
Shrubbs Marina	Cam8794	77.3	77.1
Upware	Cam5007	74.1	74.1
A1123	Cam2651u	80.0	80.1
Great Ouse confluence	Cam0000	65.5	65.5

B.8 1 in 1000 year flood

Location	Node	Existing outfall (no	New outfall (with
A.5 1 in 50 year			
M11	CAM01_4253	9.942	9.942
A1134 Fen Causeway	CAM02_7723d	8.632	8.632
Silver Street	CAM02_7160	8.596	8.596
Trinity Bridge	CAM02_6603	8.199	8.199
Bridge Street	CAM02_6177	7.157	7.157
Victoria Avenue	CAM02_5371	6.500	6.500
A1134 Elizabeth Way	CAM02_4494	6.170	6.170
Railway	CAM02_2638	5.740	5.740
A14	CAM02_0636	4.877	4.876
Baits Bite Lock US	CAM02_0200	4.724	4.725
Baits Bite Lock DS	CAM02_0000	4.572	4.573
Horningsea	CA14400	4.487	4.488
Waterbeach	CA12080J	4.298	4.298
Bottisham Lock US	CA10600J	4.086	4.086
Bottisham Lock DS	CA10560	3.986	3.985
Shrubbs Marina	Cam8794	3.851	3.851
Upware	Cam5007	3.737	3.737
A1123	Cam2651u	3.667	3.667
Great Ouse confluence	Cam0000	3.613	3.613
		Location	Node Existing
M11	CAM01_4253	113.0	113.0
A1134 Fen Causeway	CAM02_7723d	48.4	48.3
Silver Street	CAM02_7160	96.7	96.7
Trinity Bridge	CAM02_6603	92.6	92.6
Bridge Street	CAM02_6177	143.4	143.4
Victoria Avenue	CAM02_5371	81.0	81.0
A1134 Elizabeth Way	CAM02_4494	127.5	127.5
Railway	CAM02_2638	145.1	145.1
A14	CAM02_0636	138.9	139.0
Baits Bite Lock US	CAM02_0200	63.6	63.6
Baits Bite Lock DS	CAM02_0000	63.6	63.6
Horningsea	CA14400	41.1	41.1
Waterbeach	CA12080J	58.6	58.6
Bottisham Lock US	CA10600J	84.6	84.7
Bottisham Lock DS	CA10560	84.6	84.7
Shrubbs Marina	Cam8794	85.2	85.2
Upware	Cam5007	78.9	78.9
A1123	Cam2651u	86.4	86.4
Great Ouse confluence	Cam0000	66.0	66.0

(Mod)

B.9 1 in 100 year flood + 19% climate change

Location	Node	Existing outfall (no	New outfall (with
		(Add)	
M11	CAM01_4253	9.609	9.609
A1134 Fen Causeway	CAM02_7723d	7.892	7.892
Silver Street	CAM02_7160	7.742	7.742
Trinity Bridge	CAM02_6603	7.314	7.314
Bridge Street	CAM02_6177	6.705	6.705
Victoria Avenue	CAM02_5371	5.996	5.996
A1134 Elizabeth Way	CAM02_4494	5.736	5.736
Railway	CAM02_2638	5.331	5.331
A14	CAM02_0636	4.697	4.697
Baits Bite Lock US	CAM02_0200	4.569	4.570
Baits Bite Lock DS	CAM02_0000	4.380	4.381
Horningsea	CA14400	4.290	4.292
Waterbeach	CA12080J	4.173	4.173
Bottisham Lock US	CA10600J	4.011	4.011
Bottisham Lock DS	CA10560	3.922	3.922
Shrubbs Marina	Cam8794	3.808	3.809
Upware	Cam5007	3.708	3.708
A1123	Cam2651u	3.644	3.644
Great Ouse confluence	Cam0000	3.593	3.593
		(Add)	
M11	CAM01_4253	71.5	71.5
A1134 Fen Causeway	CAM02_7723d	43.1	43.1
Silver Street	CAM02_7160	78.6	78.6
Trinity Bridge	CAM02_6603	89.8	89.8
Bridge Street	CAM02_6177	92.6	92.6
Victoria Avenue	CAM02_5371	77.8	77.8
A1134 Elizabeth Way	CAM02_4494	90.1	90.1
Railway	CAM02_2638	93.3	93.3
A14	CAM02_0636	91.1	91.1
Baits Bite Lock US	CAM02_0200	55.7	55.7
Baits Bite Lock DS	CAM02_0000	55.7	55.7
Horningsea	CA14400	40.5	40.5
Waterbeach	CA12080J	55.7	55.7
Bottisham Lock US	CA10600J	75.9	75.8
Bottisham Lock DS	CA10560	75.9	75.8
Shrubbs Marina	Cam8794	77.1	76.9
Upware	Cam5007	74.1	74.1
A1123	Cam2651u	80.1	80.1
Great Ouse confluence	Cam0000	65.5	65.5

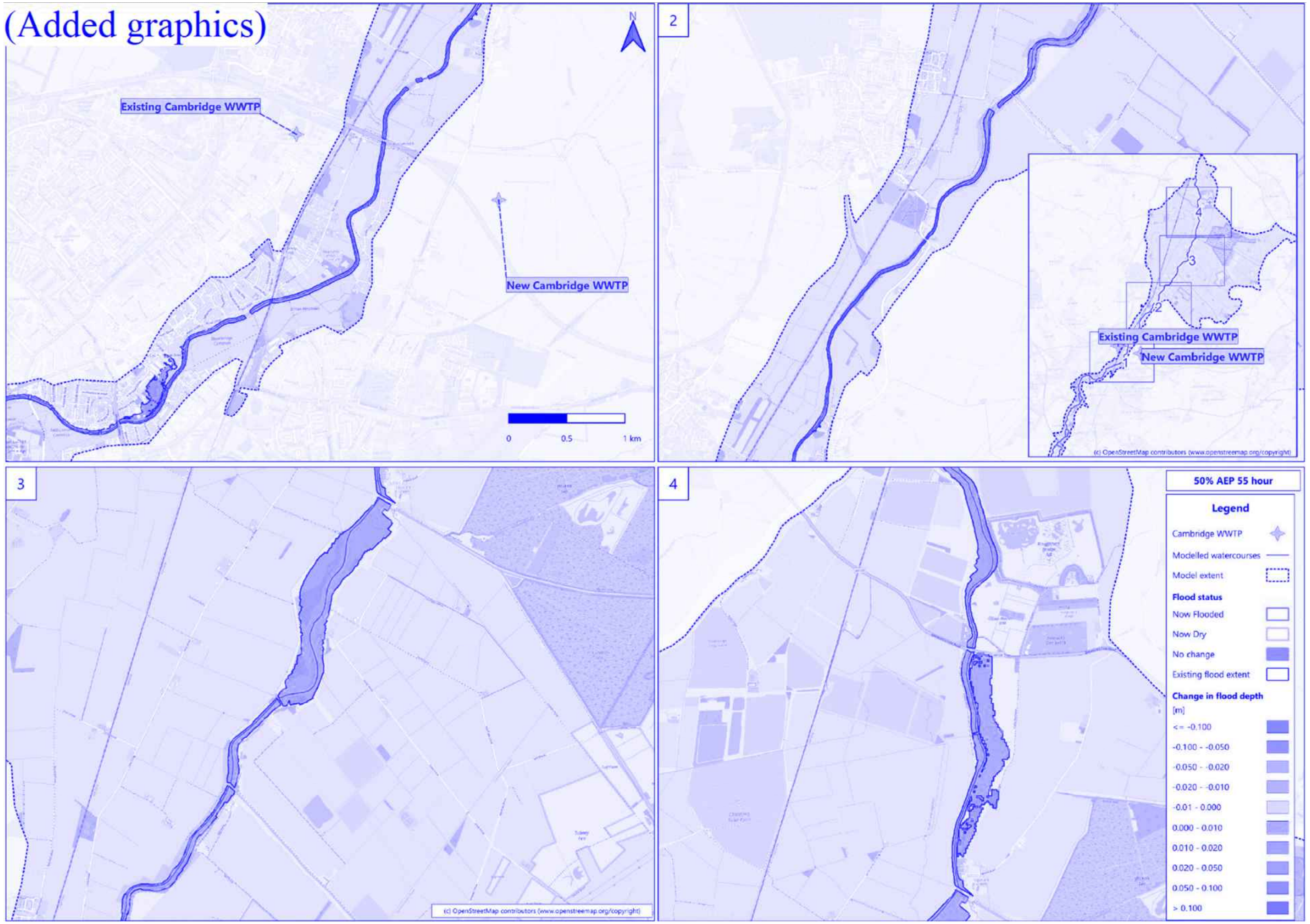
B.10 1 in 100 year flood + 45% climate change

Location	Node	Existing outfall (no	New outfall (with
		A.6	1 in 75 year
M11	CAM01_4253	9.738	9.738
A1134 Fen Causeway	CAM02_7723d	8.206	8.206
Silver Street	CAM02_7160	8.128	8.128
Trinity Bridge	CAM02_6603	7.703	7.703
Bridge Street	CAM02_6177	6.900	6.900
Victoria Avenue	CAM02_5371	6.204	6.204
A1134 Elizabeth Way	CAM02_4494	5.911	5.911
Railway	CAM02_2638	5.504	5.504
A14	CAM02_0636	4.768	4.767
Baits Bite Lock US	CAM02_0200	4.637	4.637
Baits Bite Lock DS	CAM02_0000	4.466	4.467
Horningsea	CA14400	4.379	4.379
Waterbeach	CA12080J	4.232	4.232
Bottisham Lock US	CA10600J	4.050	4.050
Bottisham Lock DS	CA10560	3.956	3.956
Shrubbs Marina	Cam8794	3.833	3.833
Upware	Cam5007	3.725	3.725
A1123	Cam2651u	3.658	3.658
Great Ouse confluence	Cam0000	3.606	3.606
		Location	Node Existing
M11	CAM01_4253	86.2	86.2
A1134 Fen Causeway	CAM02_7723d	44.8	44.8
Silver Street	CAM02_7160	85.8	85.8
Trinity Bridge	CAM02_6603	92.0	92.0
Bridge Street	CAM02_6177	113.2	113.2
Victoria Avenue	CAM02_5371	79.5	79.5
A1134 Elizabeth Way	CAM02_4494	105.0	105.0
Railway	CAM02_2638	113.8	113.8
A14	CAM02_0636	110.5	110.5
Baits Bite Lock US	CAM02_0200	58.4	58.5
Baits Bite Lock DS	CAM02_0000	58.4	58.5
Horningsea	CA14400	40.9	40.8
Waterbeach	CA12080J	57.5	57.5
Bottisham Lock US	CA10600J	79.9	79.7
Bottisham Lock DS	CA10560	79.9	79.7
Shrubbs Marina	Cam8794	80.7	80.5
Upware	Cam5007	76.3	76.3
A1123	Cam2651u	83.9	83.9
Great Ouse confluence	Cam0000	65.8	65.8

Appendix C: Flood difference for other flood magnitudes 55-hour – comparing Existing (no growth) to New Outfall (with growth)

C.1 1 in 2 year flood

(Added graphics)



(Del)

Location	Node	Existing	New outfall	Increase
		Peak water level (mAOD)		Level (m)
M11	CA27350	9.394	9.393	
A1134 Fen Causeway	CA22770	7.405	7.405	0.000
Silver Street	CA22230us	7.046	7.045	
Trinity Bridge	CA21670	6.761	6.760	
Bridge Street	CA21250	6.328	6.327	
Victoria Avenue	CA20440	5.719	5.719	0.000
A1134 Elizabeth Way	CA19600us	5.507	5.507	0.000
Railway	CA17720	5.137	5.137	0.000
A14	CA15730	4.582	4.584	0.002
Baits Bite Lock US	CA15170J	4.478	4.482	0.004
Baits Bite Lock DS	CA15140	4.245	4.249	0.004
Horningsea	CA14200	4.059	4.065	0.006
Waterbeach	CA12080J	3.852	3.860	0.008
Bottisham Lock US	CA10600J	3.692	3.700	0.008
Bottisham Lock DS	CA10560	3.595	3.603	0.008
Shrubbs Marina	Cam8647	3.474	3.482	0.008
Upware	Cam4930	3.387	3.394	0.007
A1123	Cam2651u	3.340	3.347	0.007
Great Ouse confluence	Cam0000	3.282	3.289	0.007
		Peak flow (m^3/s)		Flow (m^3/s)
M11	CA27350	52.5	52.4	-0.1
A1134 Fen Causeway	CA22770	41.2	41.2	0.0
Silver Street	CA22230us	4.6	4.6	0.0
Trinity Bridge	CA21670	74.9	74.9	0.0
Bridge Street	CA21250	76.0	75.9	-0.1
Victoria Avenue	CA20440	74.6	74.6	0.0
A1134 Elizabeth Way	CA19600us	73.9	73.8	0.0
Railway	CA17720	70.0	70.0	0.0
A14	CA15730	74.5	74.5	-0.1
Baits Bite Lock US	CA15170J	52.4	52.4	0.0
Baits Bite Lock DS	CA15140	52.4	52.4	0.0
Horningsea	CA14200	45.2	44.8	-0.4
Waterbeach	CA12080J	57.0	57.0	0.0
Bottisham Lock US	CA10600J	66.0	66.3	0.3
Bottisham Lock DS	CA10560	66.0	66.3	0.3
Shrubbs Marina	Cam8647	68.5	68.8	0.3
Upware	Cam4930	65.5	65.9	0.4
A1123	Cam2651u	65.8	66.2	0.3
Great Ouse confluence	Cam0000	57.3	57.4	0.2

C.2 1 in 10 year flood

C.3 1 in 20 year flood

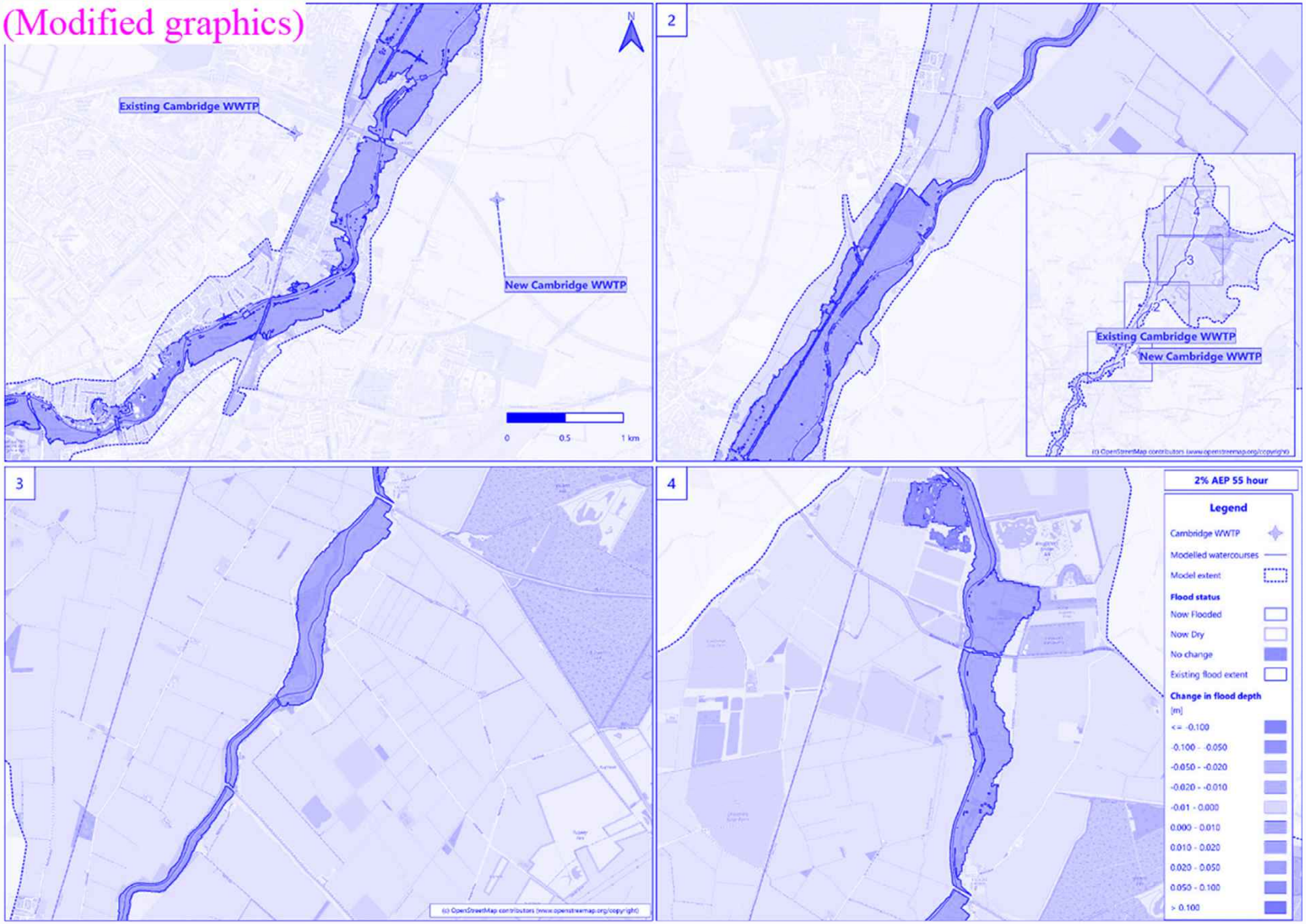
Location	Node	Existing	New outfall

(Mod)

C.4 1 in 30 year flood

Anglian Water Cambridge WWTP River Modelling

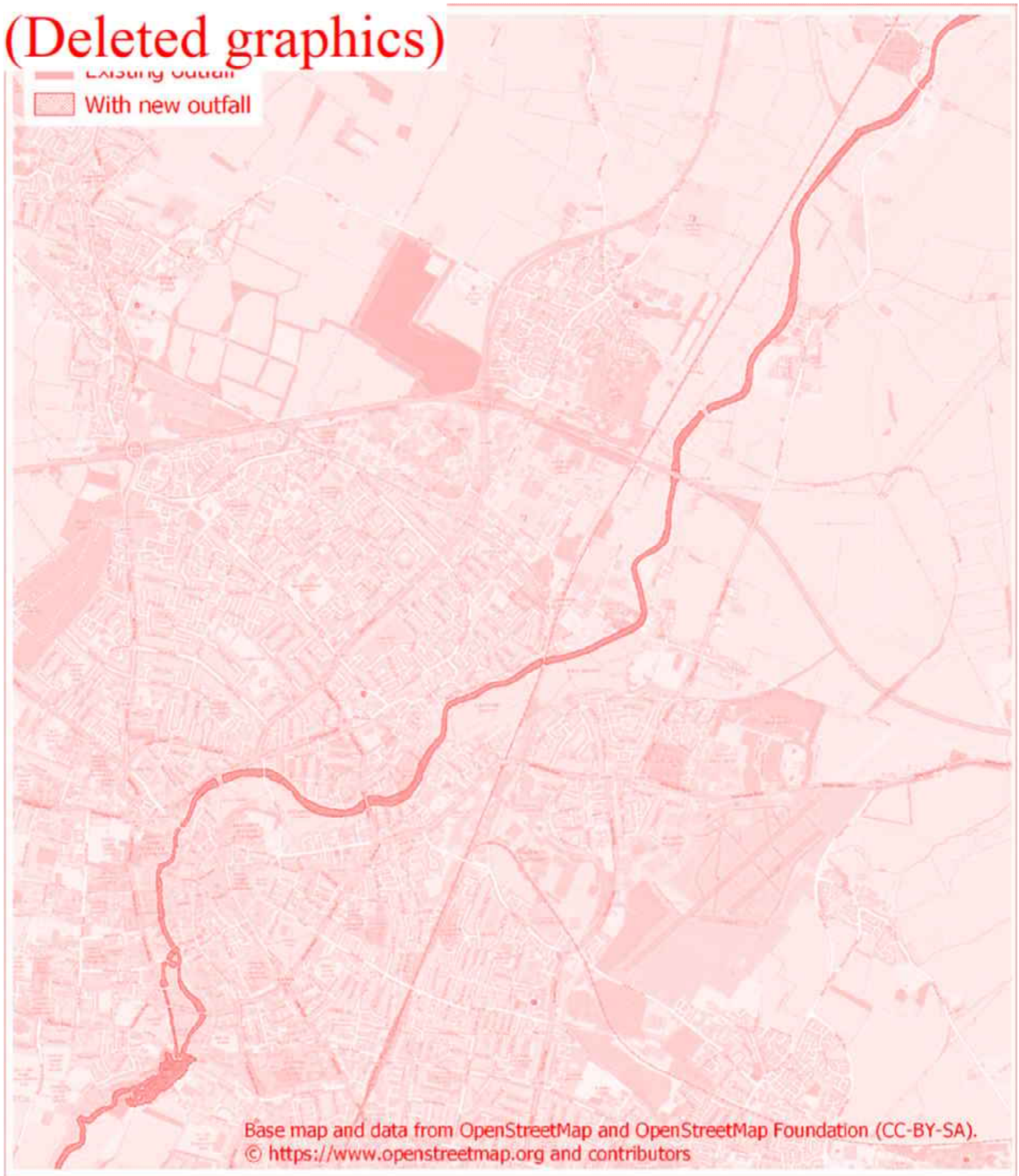
Location	Node	Existing	New outfall


(Modified graphics)
N
Existing Cambridge WWTP
New Cambridge WWTP
0
0.5
1 km
2
Existing Cambridge WWTP
New Cambridge WWTP
3
4
2% AEP 55 hour
Legend
Cambridge WWTP
Modelled watercourses
Model extent
Flood status
Now Flooded
Now Dry
No change
Existing flood extent
Change in flood depth
[m]
<= -0.100
-0.100 - -0.050
-0.050 - -0.020
-0.020 - -0.010
-0.01 - 0.000
0.000 - 0.010
0.010 - 0.020
0.020 - 0.050
0.050 - 0.100
> 0.100

~~Appendix B: Flood outlines for other flood magnitudes~~

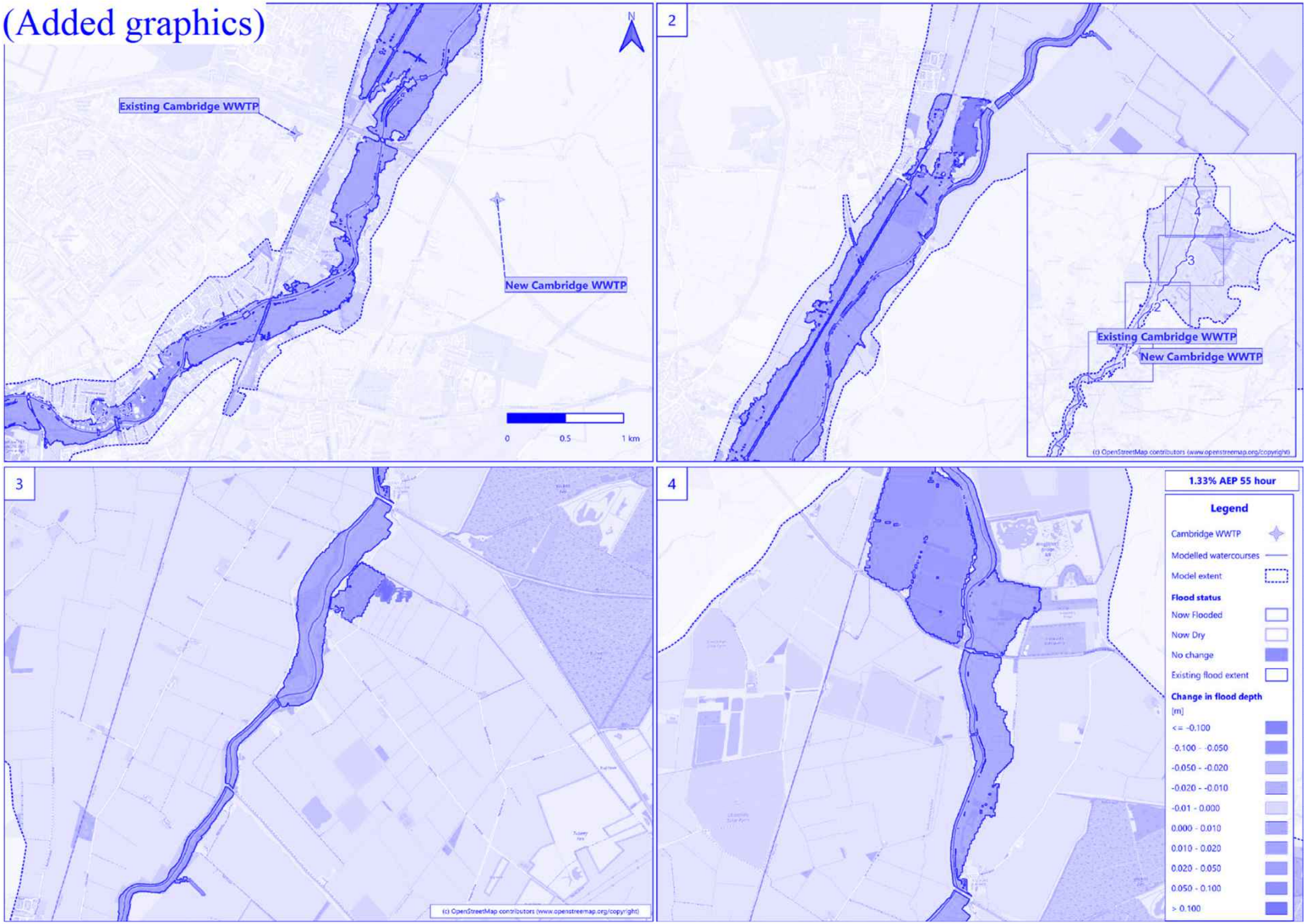
~~B.1~~C.5 1 in ~~2~~50 year flood

(Deleted graphics)



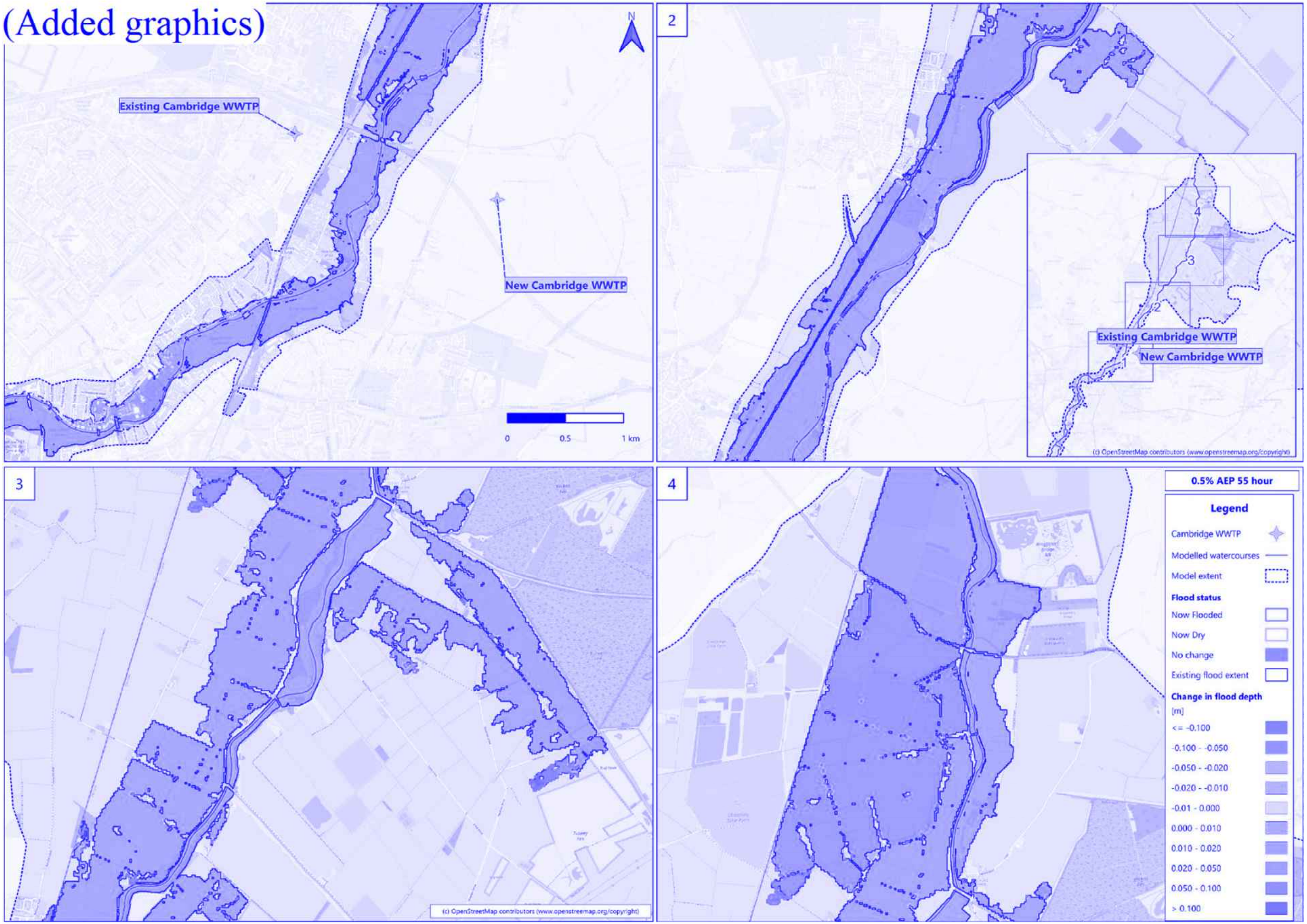
C.6 1 in 75 year flood

(Added graphics)



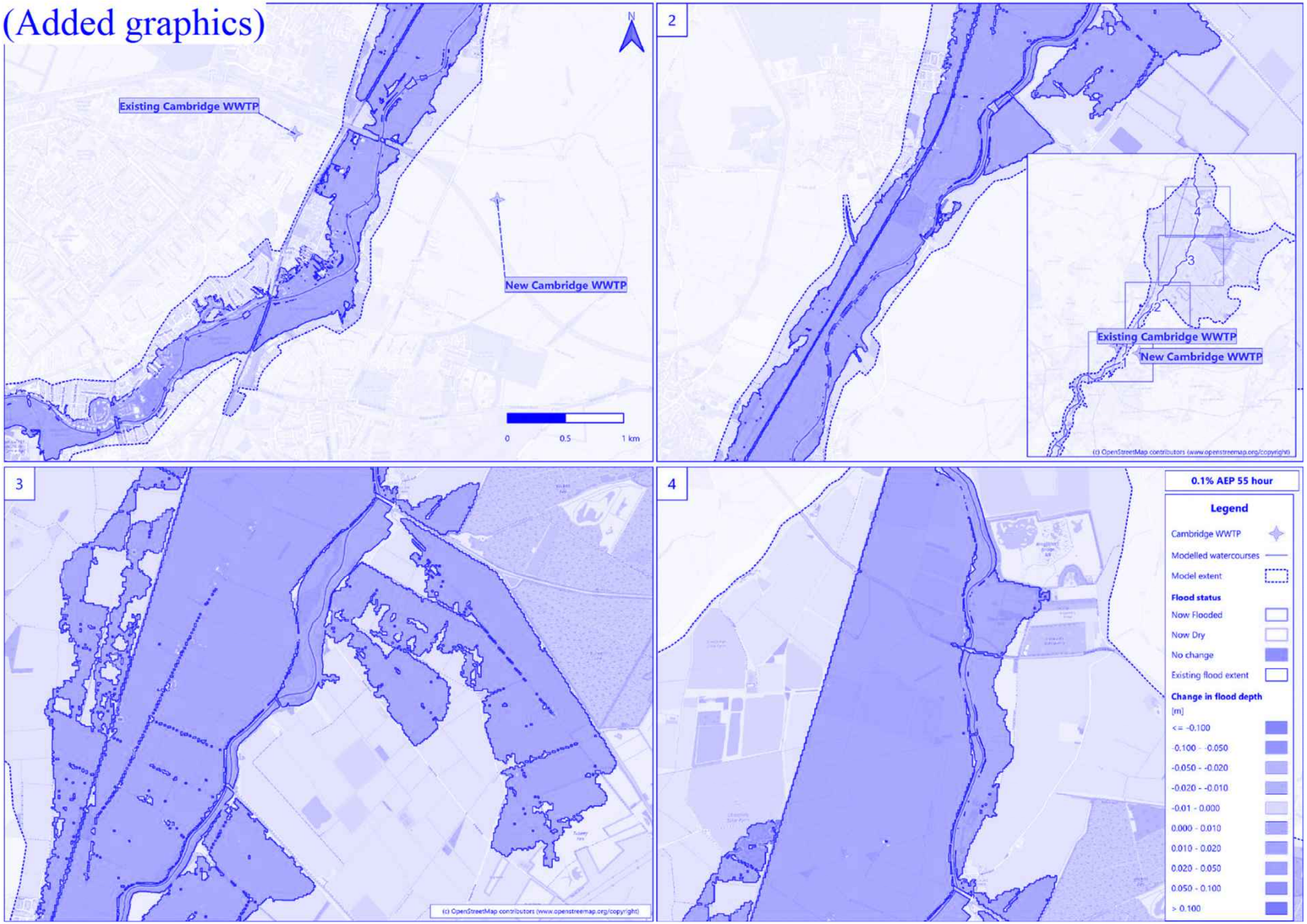
(Mod)

C.7 1 in 200 year flood



C.8 1 in 1000 year flood

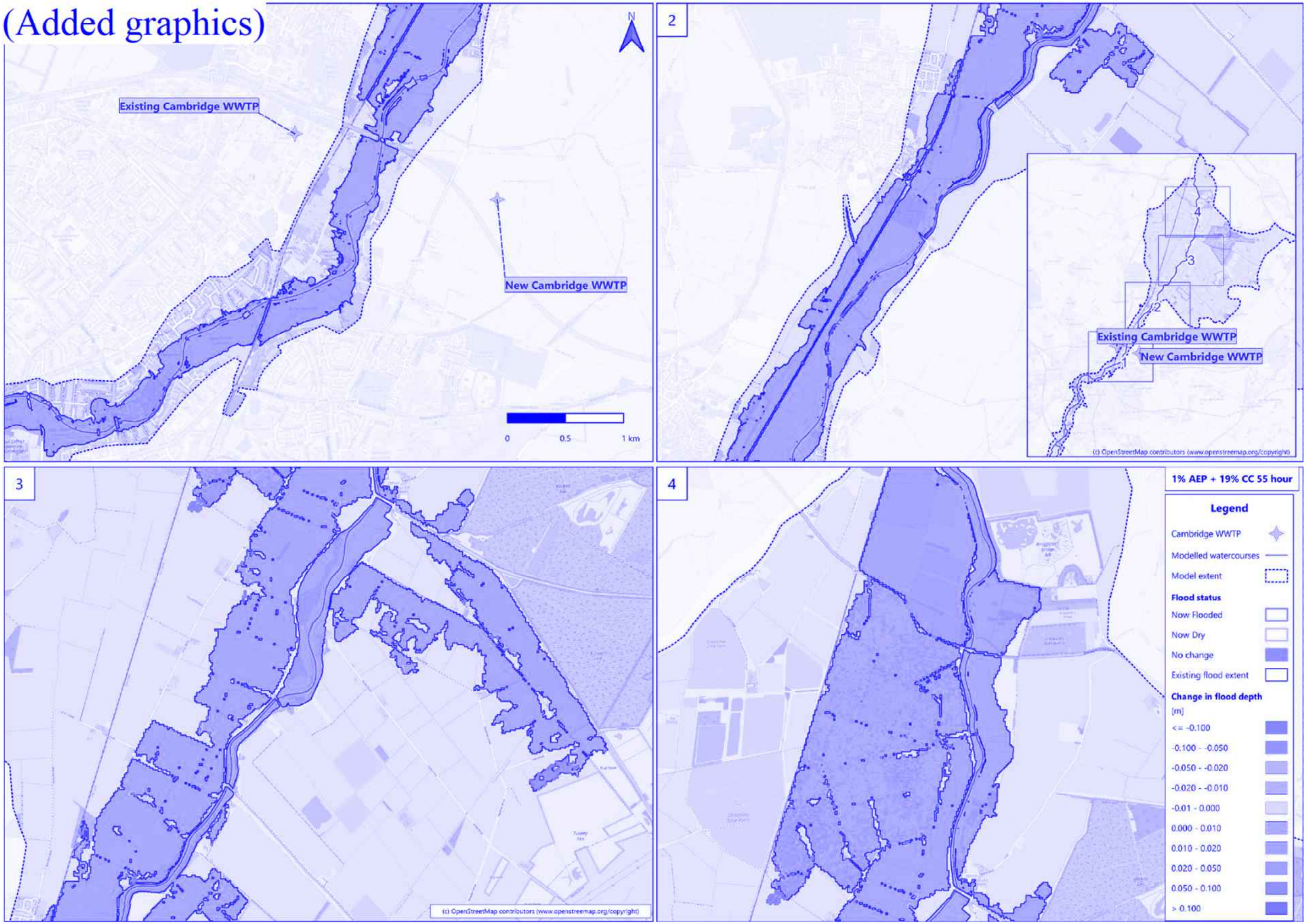
(Added graphics)



(Mod)

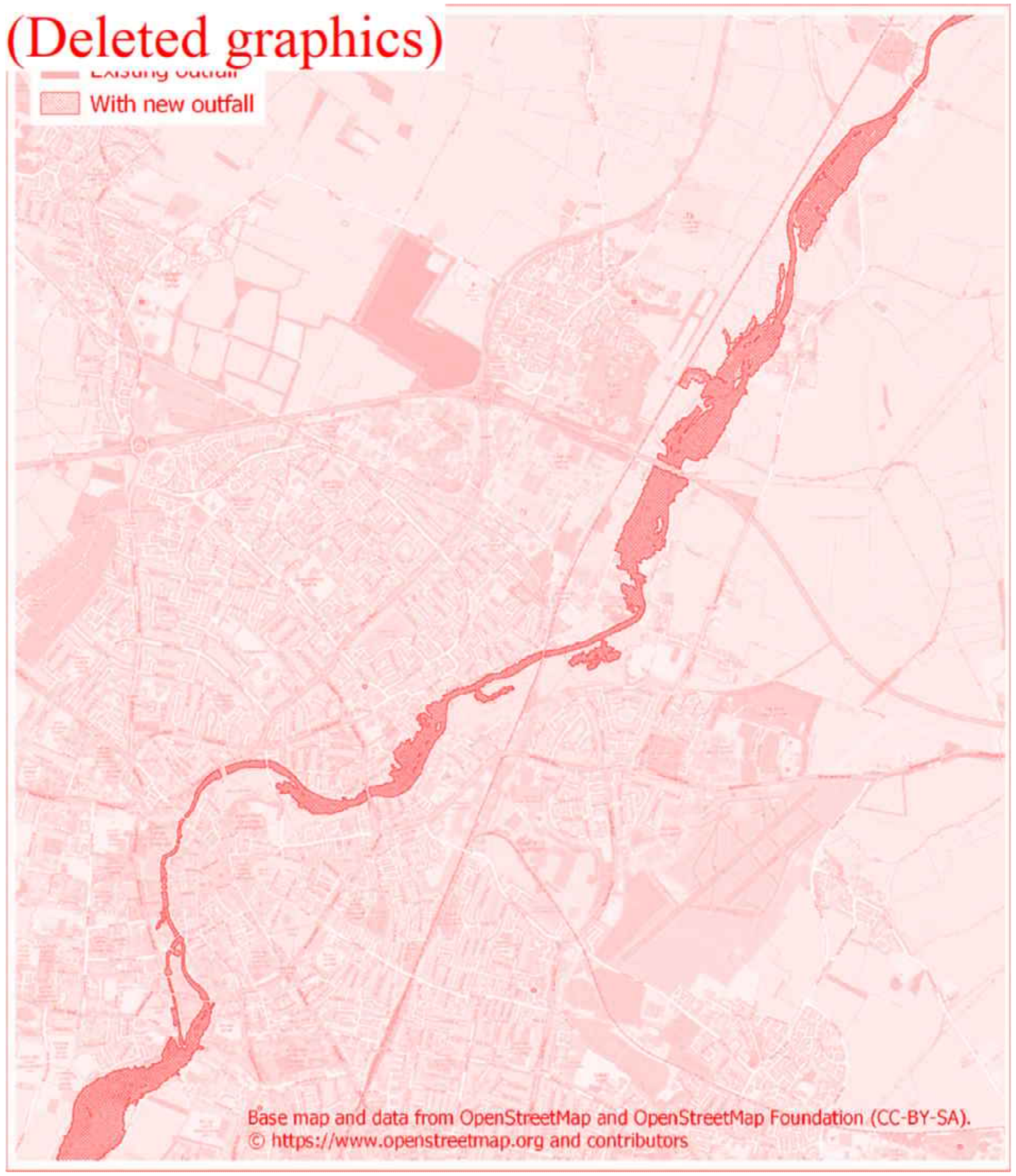
~~B~~C.~~2~~9 1 in ~~10~~100 year flood + 19% climate change

(Added graphics)



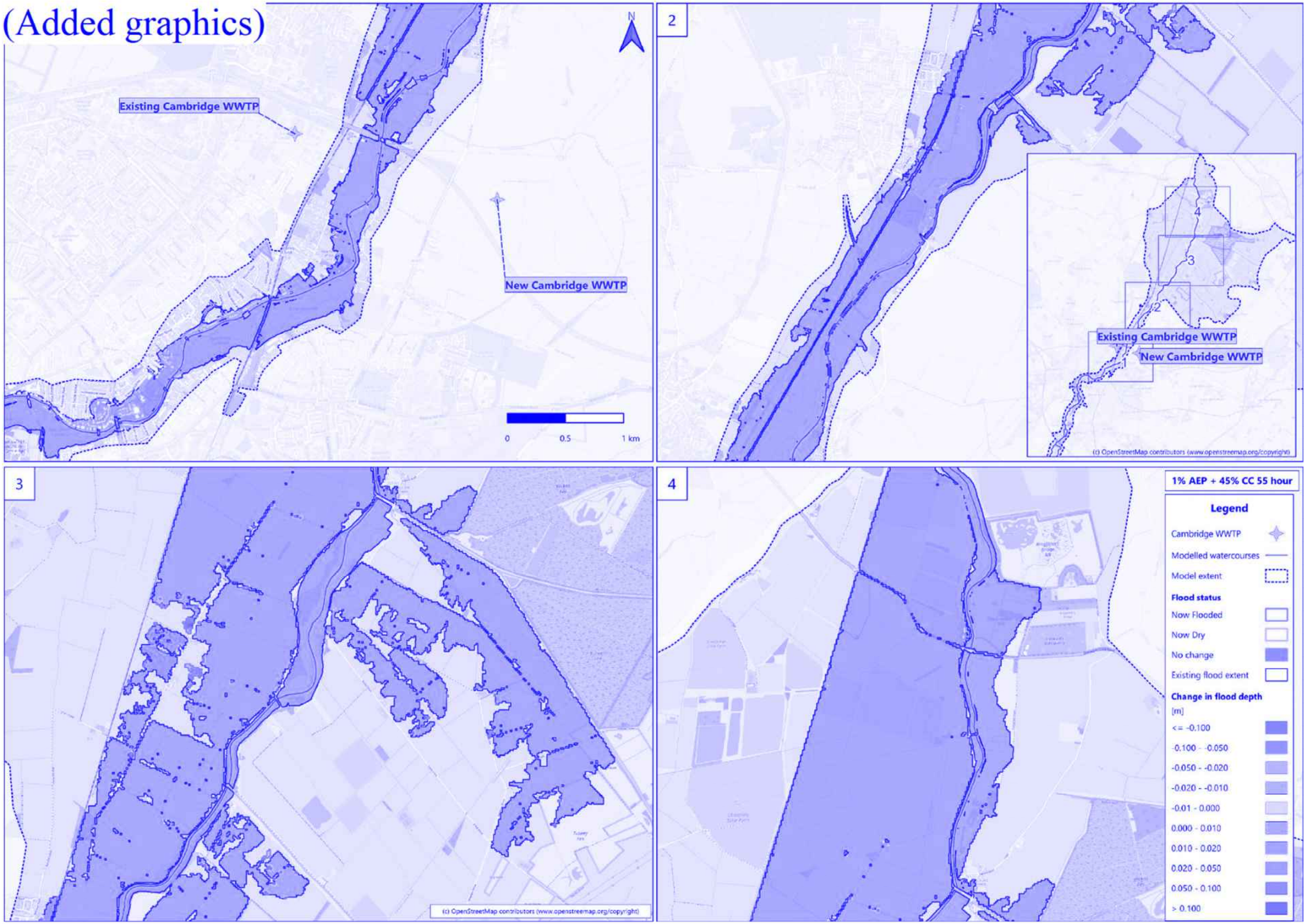
(Mod)

(Deleted graphics)



C.10 1 in 100 year flood + 45% climate change

(Added graphics)

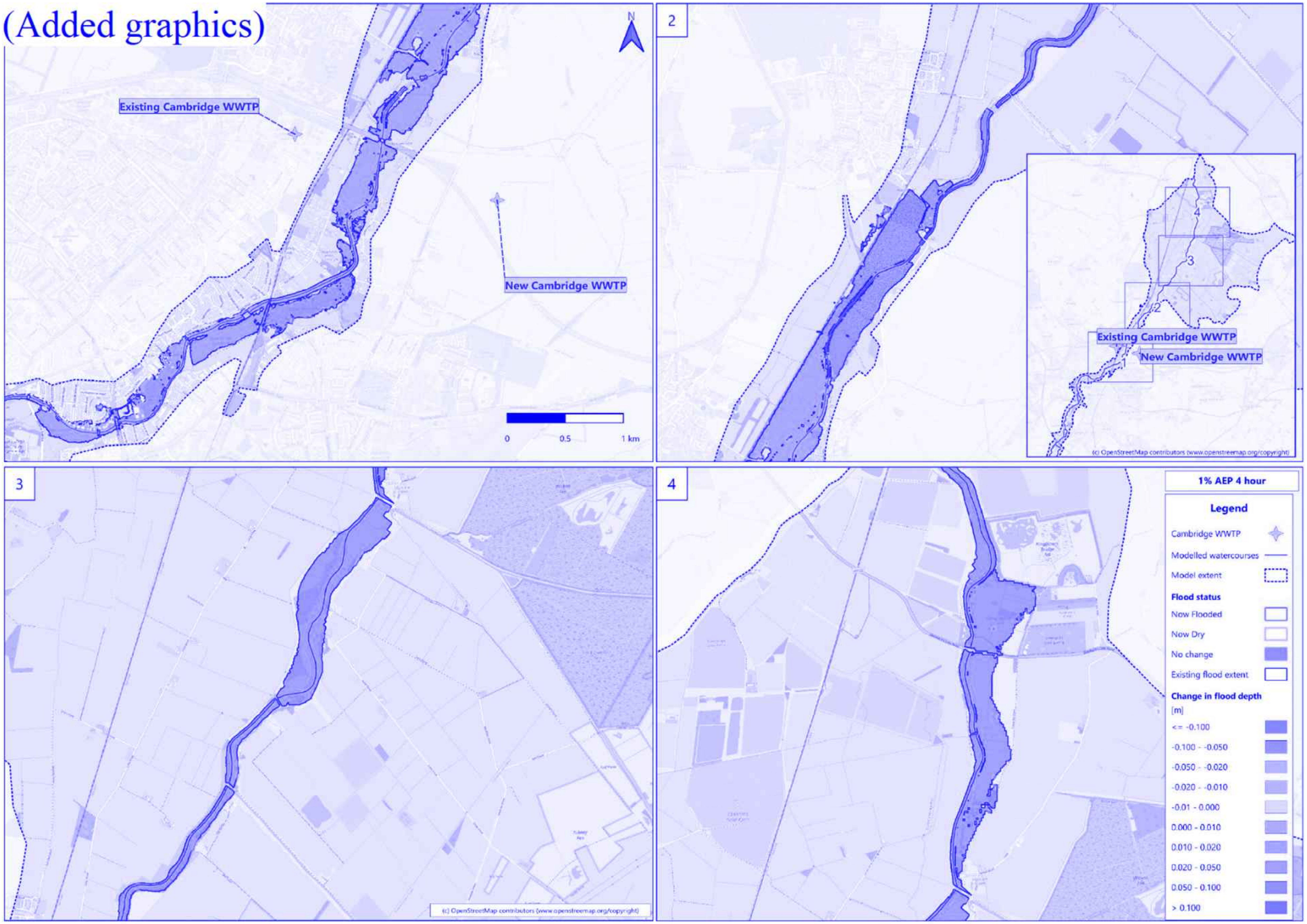


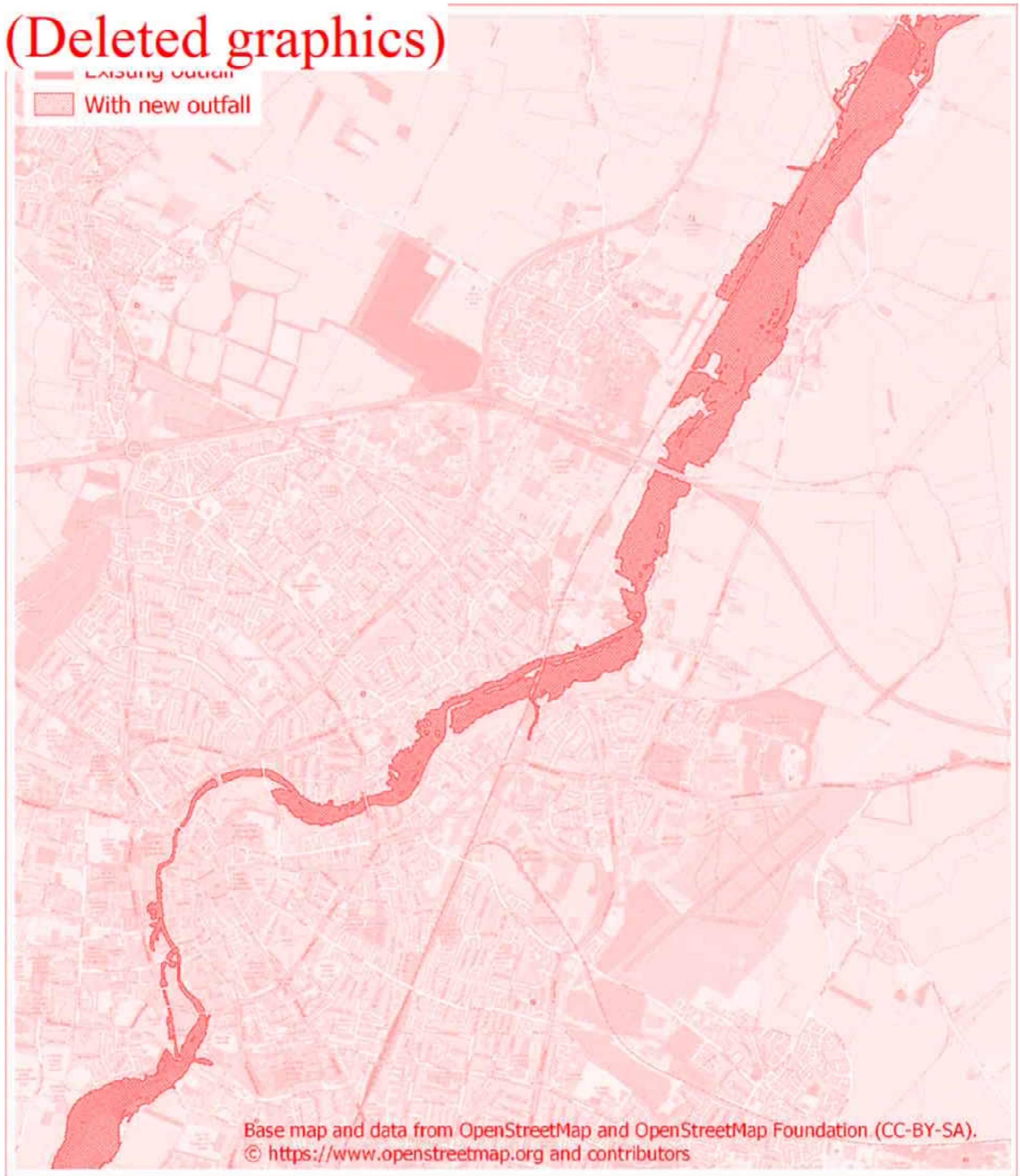
(Mod)

Appendix D: Flood difference for 4-hour storm – comparing Existing (no growth) to New Outfall (with growth)

~~B.3~~D.1 1 in ~~20~~100 year flood

(Added graphics)




(Deleted graphics)
With new outfall
Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA).
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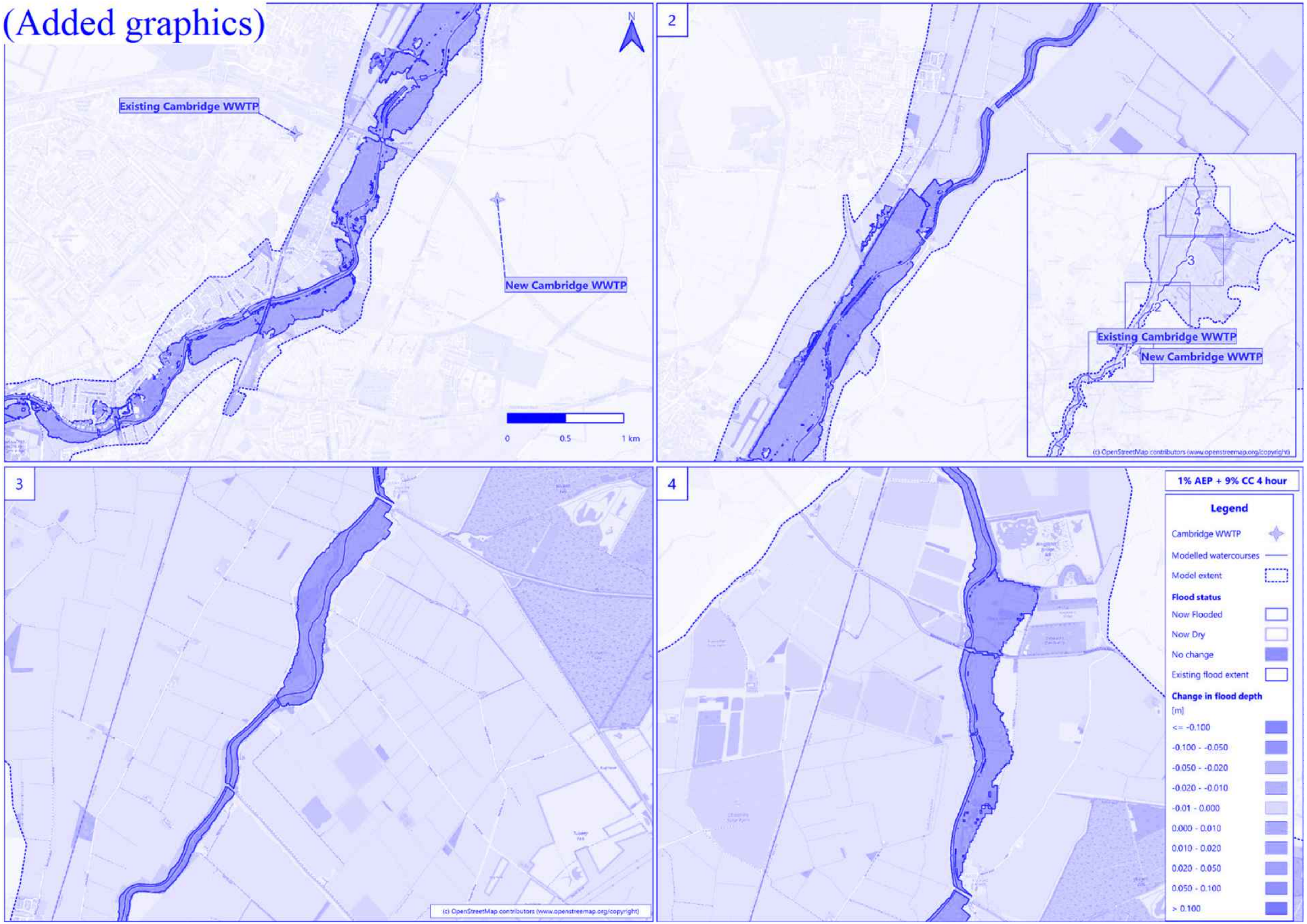
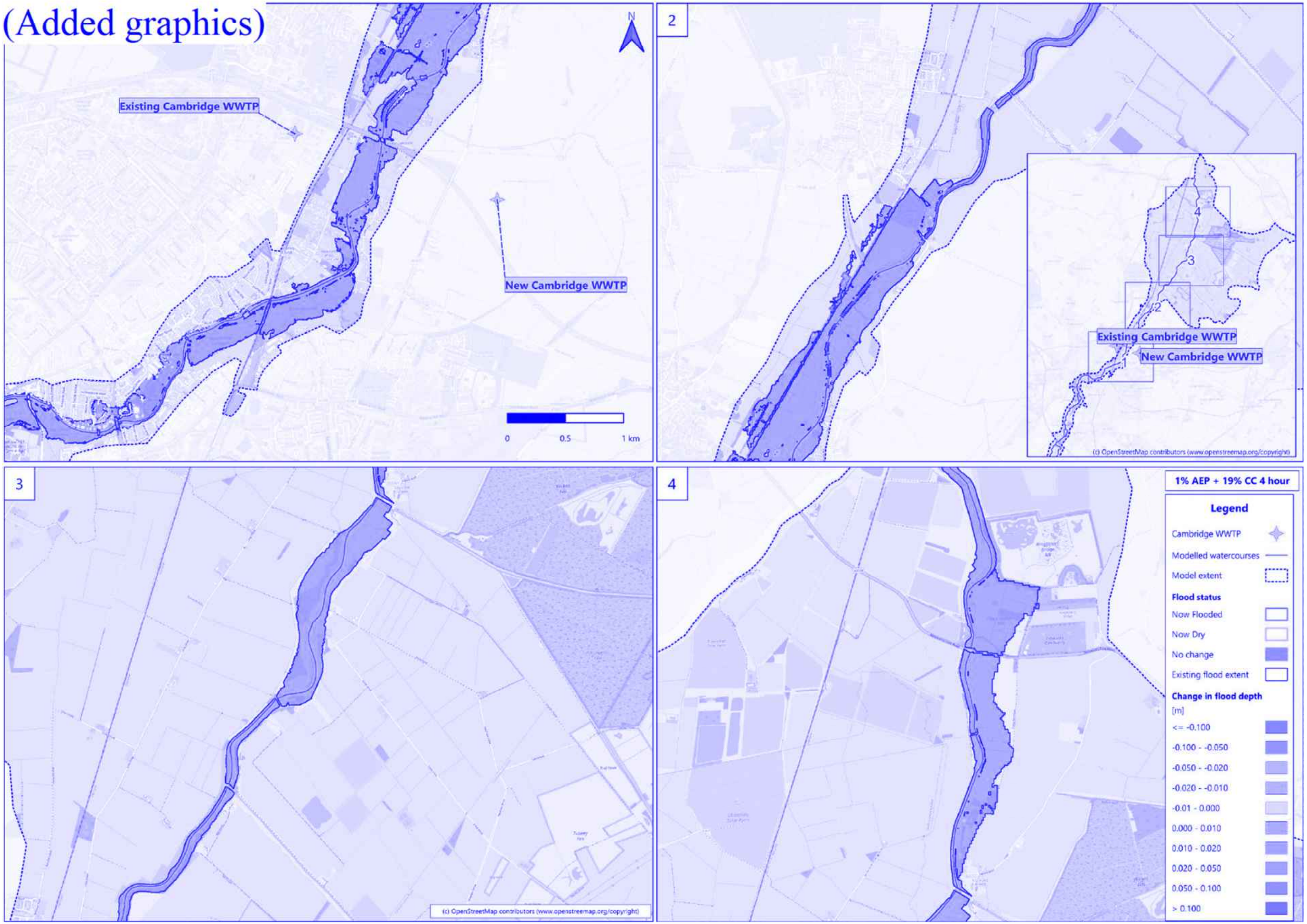
D.2 1 in 100 year flood + 9% climate change

(Added graphics)



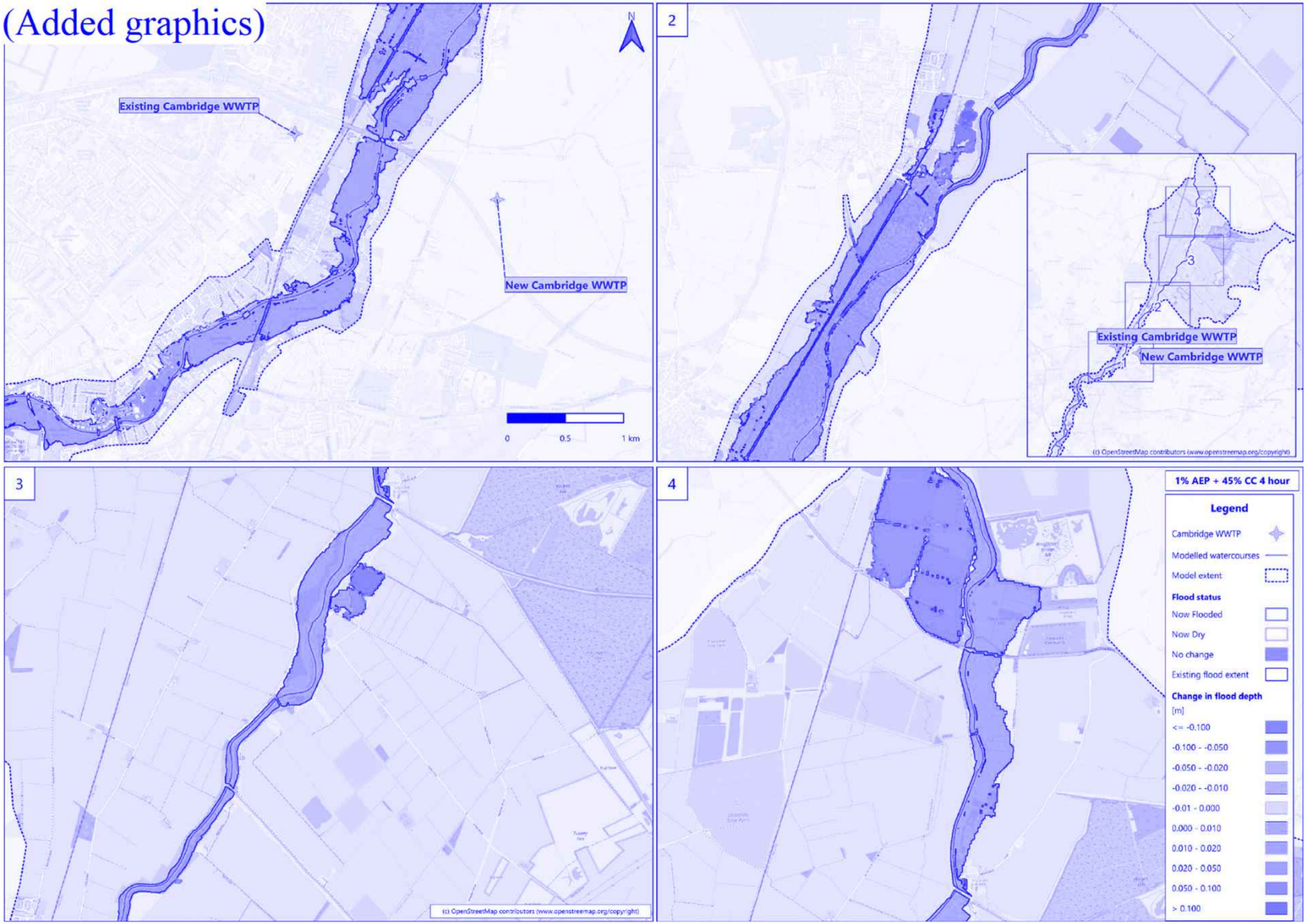
(Mod)

D.3 1 in 100 year flood + 19% climate change



(Mod)

D.4 1 in 100 year flood + 45% climate change



(Mod)

Appendix E: Results tables for Existing Future vs New Outfall – comparing Existing Future (with growth) to New Outfall (with growth)

E.1 1 in 2 year flood

Location	Node	Existing outfall (with growth)	New outfall (with	Increase
		Peak water level (mAOD)		Level (m)
M11	CAM01_4253	8.719	8.719	0.000
A1134 Fen Causeway	CAM02_7723d	7.145	7.145	0.000
Silver Street	CAM02_7160	5.814	5.814	0.000
Trinity Bridge	CAM02_6603	5.595	5.595	0.000
Bridge Street	CAM02_6177	5.406	5.406	0.000
Victoria Avenue	CAM02_5371	4.743	4.742	-0.001
A1134 Elizabeth Way	CAM02_4494	4.619	4.618	-0.001
Railway	CAM02_2638	4.356	4.353	-0.003
A14	CAM02_0636	4.028	4.023	-0.005
Baits Bite Lock US	CAM02_0200	3.923	3.918	-0.005
Baits Bite Lock DS	CAM02_0000	3.508	3.503	-0.005
Horningsea	CA14400	3.301	3.297	-0.004
Waterbeach	CA12080J	2.839	2.838	-0.001
Bottisham Lock US	CA10600J	2.726	2.725	-0.001
Bottisham Lock DS	CA10560	2.561	2.560	-0.001
Shrubbs Marina	Cam8794	2.477	2.475	-0.002
Upware	Cam5007	2.375	2.373	-0.002
A1123	Cam2651u	2.289	2.287	-0.002
Great Ouse confluence	Cam0000	2.195	2.193	-0.002
		Peak flow (m^3/s)		Flow ($m^3/$
M11	CAM01_4253	20.3	20.3	0.0
A1134 Fen Causeway	CAM02_7723d	22.3	22.3	0.0
Silver Street	CAM02_7160	25.2	25.2	0.0
Trinity Bridge	CAM02_6603	25.2	25.2	0.0
Bridge Street	CAM02_6177	26.5	26.5	0.0
Victoria Avenue	CAM02_5371	26.5	26.6	0.0
A1134 Elizabeth Way	CAM02_4494	26.5	26.5	0.0
Railway	CAM02_2638	26.6	26.6	0.0
A14	CAM02_0636	26.9	26.7	-0.1
Baits Bite Lock US	CAM02_0200	27.7	27.5	-0.2
Baits Bite Lock DS	CAM02_0000	27.7	27.5	-0.2
Horningsea	CA14400	27.8	27.7	-0.2
Waterbeach	CA12080J	27.9	27.8	-0.1
Bottisham Lock US	CA10600J	28.1	28.0	-0.1
Bottisham Lock DS	CA10560	28.1	28.0	-0.1
Shrubbs Marina	Cam8794	30.4	30.2	-0.1
Upware	Cam5007	31.0	30.9	-0.1
A1123	Cam2651u	33.3	33.3	0.0
Great Ouse confluence	Cam0000	33.3	33.3	0.0

E.2 1 in 10 year flood

Location	Node	Existing outfall (with growth)	New outfall (with	Increase
		Peak water level (mAOD)		Level (m)
M11	CAM01_4253	9.131	9.131	0.000
A1134 Fen Causeway	CAM02_7723d	7.241	7.241	0.000
Silver Street	CAM02_7160	6.394	6.394	0.000
Trinity Bridge	CAM02_6603	6.105	6.104	-0.001
Bridge Street	CAM02_6177	5.810	5.810	0.000
Victoria Avenue	CAM02_5371	5.246	5.246	0.000
A1134 Elizabeth Way	CAM02_4494	5.080	5.080	0.000
Railway	CAM02_2638	4.781	4.781	0.000
A14	CAM02_0636	4.384	4.383	-0.001
Baits Bite Lock US	CAM02_0200	4.236	4.236	0.000
Baits Bite Lock DS	CAM02_0000	3.977	3.977	0.000
Horningsea	CA14400	3.776	3.777	0.001
Waterbeach	CA12080J	3.268	3.268	0.000
Bottisham Lock US	CA10600J	3.153	3.153	0.000
Bottisham Lock DS	CA10560	3.043	3.042	-0.001
Shrubbs Marina	Cam8794	2.957	2.956	-0.001
Upware	Cam5007	2.872	2.871	-0.001
A1123	Cam2651u	2.810	2.809	-0.001
Great Ouse confluence	Cam0000	2.740	2.739	-0.001
		Peak flow (m^3/s)		Flow ($m^3/$
M11	CAM01_4253	32.8	32.8	0.0
A1134 Fen Causeway	CAM02_7723d	27.6	27.6	0.0
Silver Street	CAM02_7160	40.6	40.6	0.0
Trinity Bridge	CAM02_6603	40.6	40.6	0.0
Bridge Street	CAM02_6177	41.6	41.6	0.0
Victoria Avenue	CAM02_5371	41.3	41.3	0.0
A1134 Elizabeth Way	CAM02_4494	41.6	41.6	0.0
Railway	CAM02_2638	41.8	41.8	0.0
A14	CAM02_0636	41.8	41.7	0.0
Baits Bite Lock US	CAM02_0200	40.9	40.9	0.0
Baits Bite Lock DS	CAM02_0000	40.9	40.9	0.0
Horningsea	CA14400	37.9	37.9	0.0
Waterbeach	CA12080J	38.6	38.7	0.0
Bottisham Lock US	CA10600J	38.0	38.1	0.0
Bottisham Lock DS	CA10560	38.0	38.1	0.0
Shrubbs Marina	Cam8794	40.5	40.5	-0.1
Upware	Cam5007	41.4	41.4	0.0
A1123	Cam2651u	45.2	45.1	-0.1
Great Ouse confluence	Cam0000	44.4	44.4	0.0

E.3 1 in 20 year flood

Location	Node	Existing outfall (with growth)	New outfall (with	Increase
		Peak water level (mAOD)		Level (m)
M11	CAM01_4253	9.240	9.240	0.000
A1134 Fen Causeway	CAM02_7723d	7.290	7.290	0.000
Silver Street	CAM02_7160	6.768	6.766	-0.002
Trinity Bridge	CAM02_6603	6.432	6.432	0.000
Bridge Street	CAM02_6177	6.062	6.062	0.000
Victoria Avenue	CAM02_5371	5.484	5.484	0.000
A1134 Elizabeth Way	CAM02_4494	5.284	5.284	0.000
Railway	CAM02_2638	4.940	4.940	0.000
A14	CAM02_0636	4.489	4.489	0.000
Baits Bite Lock US	CAM02_0200	4.339	4.339	0.000
Baits Bite Lock DS	CAM02_0000	4.075	4.075	0.000
Horningsea	CA14400	3.917	3.917	0.000
Waterbeach	CA12080J	3.588	3.588	0.000
Bottisham Lock US	CA10600J	3.478	3.477	-0.001
Bottisham Lock DS	CA10560	3.378	3.378	0.000
Shrubbs Marina	Cam8794	3.295	3.295	0.000
Upware	Cam5007	3.219	3.218	-0.001
A1123	Cam2651u	3.166	3.166	0.000
Great Ouse confluence	Cam0000	3.114	3.113	-0.001
		Peak flow (m^3/s)		Flow ($m^3/$
M11	CAM01_4253	41.3	41.3	0.0
A1134 Fen Causeway	CAM02_7723d	29.1	29.1	0.0
Silver Street	CAM02_7160	53.1	52.3	-0.8
Trinity Bridge	CAM02_6603	52.0	52.0	0.0
Bridge Street	CAM02_6177	53.3	53.3	0.0
Victoria Avenue	CAM02_5371	52.4	52.4	0.0
A1134 Elizabeth Way	CAM02_4494	53.2	53.2	0.0
Railway	CAM02_2638	53.3	53.3	0.0
A14	CAM02_0636	51.5	51.4	-0.1
Baits Bite Lock US	CAM02_0200	45.8	45.8	0.0
Baits Bite Lock DS	CAM02_0000	45.8	45.8	0.0
Horningsea	CA14400	38.4	38.4	0.0
Waterbeach	CA12080J	50.3	50.3	0.0
Bottisham Lock US	CA10600J	50.7	50.7	0.0
Bottisham Lock DS	CA10560	50.7	50.7	0.0
Shrubbs Marina	Cam8794	52.8	52.7	0.0
Upware	Cam5007	51.2	51.2	0.0
A1123	Cam2651u	53.7	53.7	0.0
Great Ouse confluence	Cam0000	53.1	53.1	0.0

BE.4 1 in 30 year flood

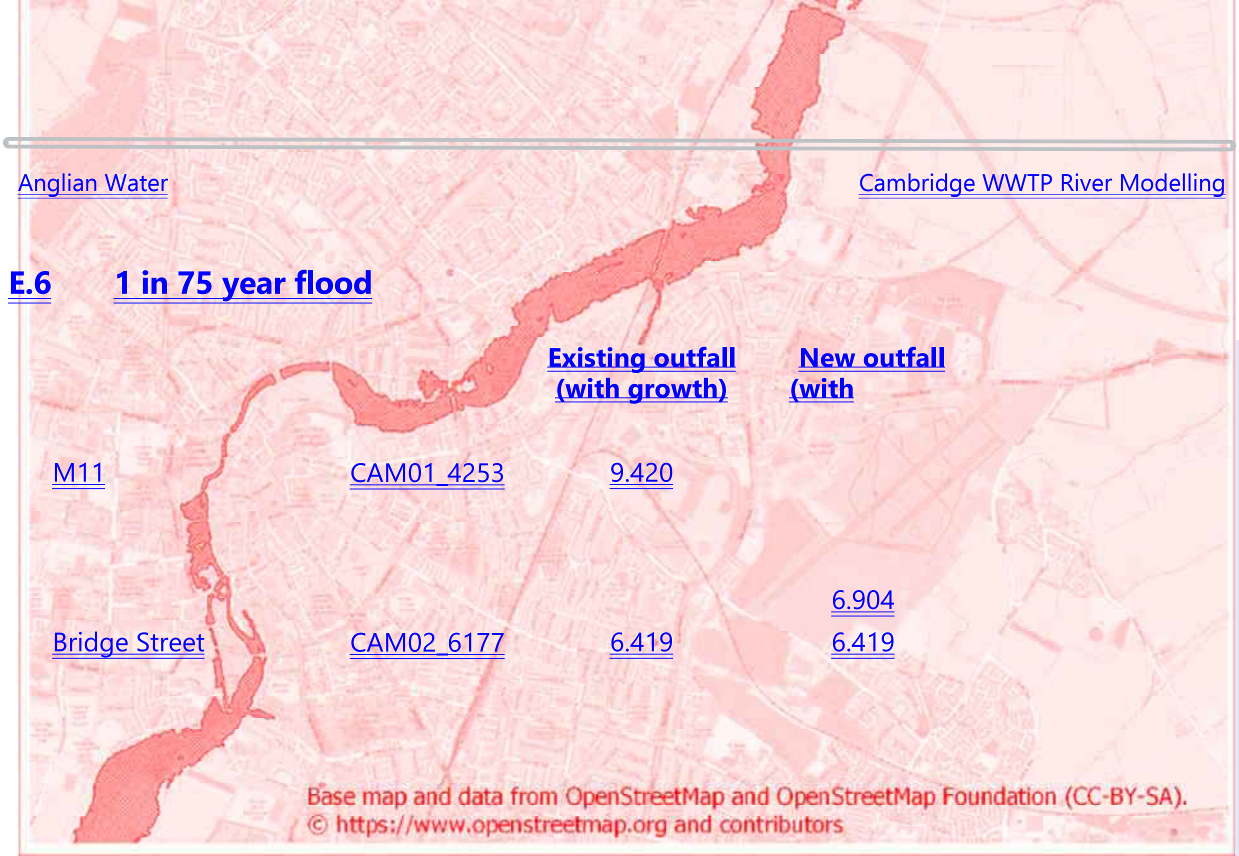
Location	Node	Existing outfall (with growth)	New outfall (with	Increase
		Peak water level (mAOD)		Level (m)
M11	CAM01_4253	9.286	9.286	0.000
A1134 Fen Causeway	CAM02_7723d	7.316	7.316	0.000
Silver Street	CAM02_7160	6.891	6.891	0.000
Trinity Bridge	CAM02_6603	6.539	6.539	0.000
Bridge Street	CAM02_6177	6.141	6.141	0.000
Victoria Avenue	CAM02_5371	5.550	5.550	0.000
A1134 Elizabeth Way	CAM02_4494	5.345	5.345	0.000
Railway	CAM02_2638	4.996	4.996	0.000
A14	CAM02_0636	4.526	4.525	-0.001
Baits Bite Lock US	CAM02_0200	4.375	4.375	0.000
Baits Bite Lock DS	CAM02_0000	4.107	4.106	-0.001
Horningsea	CA14400	3.955	3.955	0.000
Waterbeach	CA12080J	3.728	3.728	0.000
Bottisham Lock US	CA10600J	3.621	3.620	-0.001
Bottisham Lock DS	CA10560	3.530	3.529	-0.001
Shrubbs Marina	Cam8794	3.449	3.448	-0.001
Upware	Cam5007	3.376	3.376	0.000
A1123	Cam2651u	3.327	3.326	-0.001
Great Ouse confluence	Cam0000	3.278	3.278	0.000
		Peak flow (m^3/s)		Flow (m^3/s)
M11	CAM01_4253	44.8	44.8	0.0
A1134 Fen Causeway	CAM02_7723d	29.1	29.1	0.0
Silver Street	CAM02_7160	56.2	56.2	0.0
Trinity Bridge	CAM02_6603	56.2	56.2	0.0
Bridge Street	CAM02_6177	57.4	57.4	0.0
Victoria Avenue	CAM02_5371	55.5	55.6	0.0
A1134 Elizabeth Way	CAM02_4494	56.5	56.5	0.0
Railway	CAM02_2638	56.8	56.8	0.0
A14	CAM02_0636	56.3	56.2	-0.1
Baits Bite Lock US	CAM02_0200	47.9	47.8	-0.1
Baits Bite Lock DS	CAM02_0000	47.9	47.8	-0.1
Horningsea	CA14400	38.8	39.0	0.1
Waterbeach	CA12080J	52.6	52.5	0.0
Bottisham Lock US	CA10600J	55.2	55.2	0.0
Bottisham Lock DS	CA10560	55.2	55.2	0.0
Shrubbs Marina	Cam8794	57.2	57.1	-0.1
Upware	Cam5007	55.0	55.0	0.0

A1123	Cam2651u	57.8	57.8	0.0
Great Ouse confluence	Cam0000	57.2	57.2	0.0

BE.5 1 in 50 year flood

Location	Node	Existing outfall (with growth)	New outfall (with	Increase
		Peak water level (mAOD)		Level (m)
M11	CAM01_4253	9.352	9.352	0.000
A1134 Fen Causeway	CAM02_7723d	7.365	7.365	0.000
Silver Street	CAM02_7160	7.087	7.087	0.000
Trinity Bridge	CAM02_6603	6.715	6.715	0.000
Bridge Street	CAM02_6177	6.274	6.274	0.000
Victoria Avenue	CAM02_5371	5.662	5.662	0.000
A1134 Elizabeth Way	CAM02_4494	5.440	5.440	0.000
Railway	CAM02_2638	5.072	5.072	0.000
A14	CAM02_0636	4.573	4.572	-0.001
Baits Bite Lock US	CAM02_0200	4.426	4.426	0.000
Baits Bite Lock DS	CAM02_0000	4.166	4.166	0.000
Horningsea	CA14400	4.037	4.037	0.000
Waterbeach	CA12080J	3.903	3.903	0.000
Bottisham Lock US	CA10600J	3.790	3.790	0.000
Bottisham Lock DS	CA10560	3.711	3.711	0.000
Shrubbs Marina	Cam8794	3.632	3.632	0.000
Upware	Cam5007	3.562	3.562	0.000
A1123	Cam2651u	3.515	3.514	-0.001
Great Ouse confluence	Cam0000	3.469	3.469	0.000
		Peak flow (m³/s)		Flow (m³/
M11	CAM01_4253	50.2	50.2	0.0
A1134 Fen Causeway	CAM02_7723d	29.1	29.1	0.0
Silver Street	CAM02_7160	60.7	60.7	0.0
Trinity Bridge	CAM02_6603	62.9	62.9	0.0
Bridge Street	CAM02_6177	64.3	64.3	0.0
Victoria Avenue	CAM02_5371	62.7	62.7	0.0
A1134 Elizabeth Way	CAM02_4494	63.7	63.7	0.0
Railway	CAM02_2638	64.5	64.5	0.0
A14	CAM02_0636	63.6	63.6	0.0
Baits Bite Lock US	CAM02_0200	50.4	50.4	0.0
Baits Bite Lock DS	CAM02_0000	50.4	50.4	0.0
Horningsea	CA14400	39.4	39.5	0.1
Waterbeach	CA12080J	53.7	53.7	0.0
Bottisham Lock US	CA10600J	61.5	61.5	-0.1
Bottisham Lock DS	CA10560	61.5	61.5	-0.1
Shrubbs Marina	Cam8794	63.2	63.1	-0.1
Upware	Cam5007	60.2	60.1	0.0
A1123	Cam2651u	63.1	63.0	0.0
Great Ouse confluence	Cam0000	62.2	62.2	0.0

E.6 1 in 75 year flood



		Existing outfall (with growth)	New outfall (with	Increase
				Level (m)
M11	CAM01_4253	9.420		0.000
				0.000
				0.000
			6.904	0.000
Bridge Street	CAM02_6177	6.419	6.419	0.000
				0.000
				0.000
				0.000
				-0.001
Baits Bite Lock US	CAM02_0200	4.479	4.479	0.000
Baits Bite Lock DS	CAM02_0000	4.250	4.250	0.000
Horningsea	CA14400	4.151	4.152	0.001
Waterbeach	CA12080J	4.055	4.055	0.000
Bottisham Lock US	CA10600J	3.923	3.923	0.000
Bottisham Lock DS	CA10560	3.842	3.842	0.000
Shrubbs Marina	Cam8794	3.748	3.747	-0.001
Upware	Cam5007	3.663	3.663	0.000
A1123	Cam2651u	3.607	3.607	0.000
Great Ouse confluence	Cam0000	3.559	3.559	0.000
		Peak flow (m³/s)		Flow (m³/s)
M11	CAM01_4253	56.6	56.6	0.0
A1134 Fen Causeway	CAM02_7723d	33.9	34.0	0.0
Silver Street	CAM02_7160	63.9	63.9	0.0
Trinity Bridge	CAM02_6603	71.1	71.1	0.0
Bridge Street	CAM02_6177	72.8	72.8	0.0
Victoria Avenue	CAM02_5371	70.5	70.5	0.0
A1134 Elizabeth Way	CAM02_4494	71.6	71.6	0.0
Railway	CAM02_2638	73.1	73.1	0.0
A14	CAM02_0636	71.9	71.9	0.0
Baits Bite Lock US	CAM02_0200	52.7	52.7	0.0
Baits Bite Lock DS	CAM02_0000	52.7	52.7	0.0
Horningsea	CA14400	39.8	39.8	0.0
Waterbeach	CA12080J	54.6	54.6	0.0
Bottisham Lock US	CA10600J	67.5	67.4	0.0
Bottisham Lock DS	CA10560	67.5	67.4	0.0
Shrubbs Marina	Cam8794	69.0	68.9	-0.1
Upware	Cam5007	68.0	67.9	0.0
A1123	Cam2651u	72.6	72.5	0.0
Great Ouse confluence	Cam0000	64.5	64.5	0.0

E.7 1 in 200 year flood

Location	Node	Existing outfall (with growth)	New outfall (with	Increase
		Peak water level (mAOD)		Level (m)
M11	CAM01_4253	9.562	9.562	0.000
A1134 Fen Causeway	CAM02_7723d	7.755	7.755	0.000
Silver Street	CAM02_7160	7.728	7.728	0.000
Trinity Bridge	CAM02_6603	7.315	7.315	0.000
Bridge Street	CAM02_6177	6.705	6.705	0.000
Victoria Avenue	CAM02_5371	5.996	5.996	0.000
A1134 Elizabeth Way	CAM02_4494	5.736	5.736	0.000
Railway	CAM02_2638	5.332	5.332	0.000
A14	CAM02_0636	4.699	4.698	-0.001
Baits Bite Lock US	CAM02_0200	4.571	4.571	0.000
Baits Bite Lock DS	CAM02_0000	4.384	4.384	0.000
Horningsea	CA14400	4.295	4.295	0.000
Waterbeach	CA12080J	4.177	4.177	0.000
Bottisham Lock US	CA10600J	4.012	4.012	0.000
Bottisham Lock DS	CA10560	3.923	3.922	-0.001
Shrubbs Marina	Cam8794	3.809	3.809	0.000
Upware	Cam5007	3.708	3.708	0.000
A1123	Cam2651u	3.644	3.644	0.000
Great Ouse confluence	Cam0000	3.593	3.593	0.000
		Peak flow (m^3/s)		Flow ($m^3/$
M11	CAM01_4253	72.2	72.2	0.0
A1134 Fen Causeway	CAM02_7723d	40.4	40.4	0.0
Silver Street	CAM02_7160	71.4	71.4	0.0
Trinity Bridge	CAM02_6603	89.9	89.9	0.0
Bridge Street	CAM02_6177	92.6	92.6	0.0
Victoria Avenue	CAM02_5371	77.7	77.7	0.0
A1134 Elizabeth Way	CAM02_4494	90.1	90.1	0.0
Railway	CAM02_2638	93.3	93.3	0.0
A14	CAM02_0636	91.2	91.2	0.0
Baits Bite Lock US	CAM02_0200	55.7	55.7	0.0
Baits Bite Lock DS	CAM02_0000	55.7	55.7	0.0
Horningsea	CA14400	40.5	40.6	0.1
Waterbeach	CA12080J	56.3	56.3	0.0
Bottisham Lock US	CA10600J	76.1	76.1	0.0
Bottisham Lock DS	CA10560	76.1	76.1	0.0
Shrubbs Marina	Cam8794	77.2	77.1	-0.1
Upware	Cam5007	74.2	74.1	0.0
A1123	Cam2651u	80.1	80.1	0.0

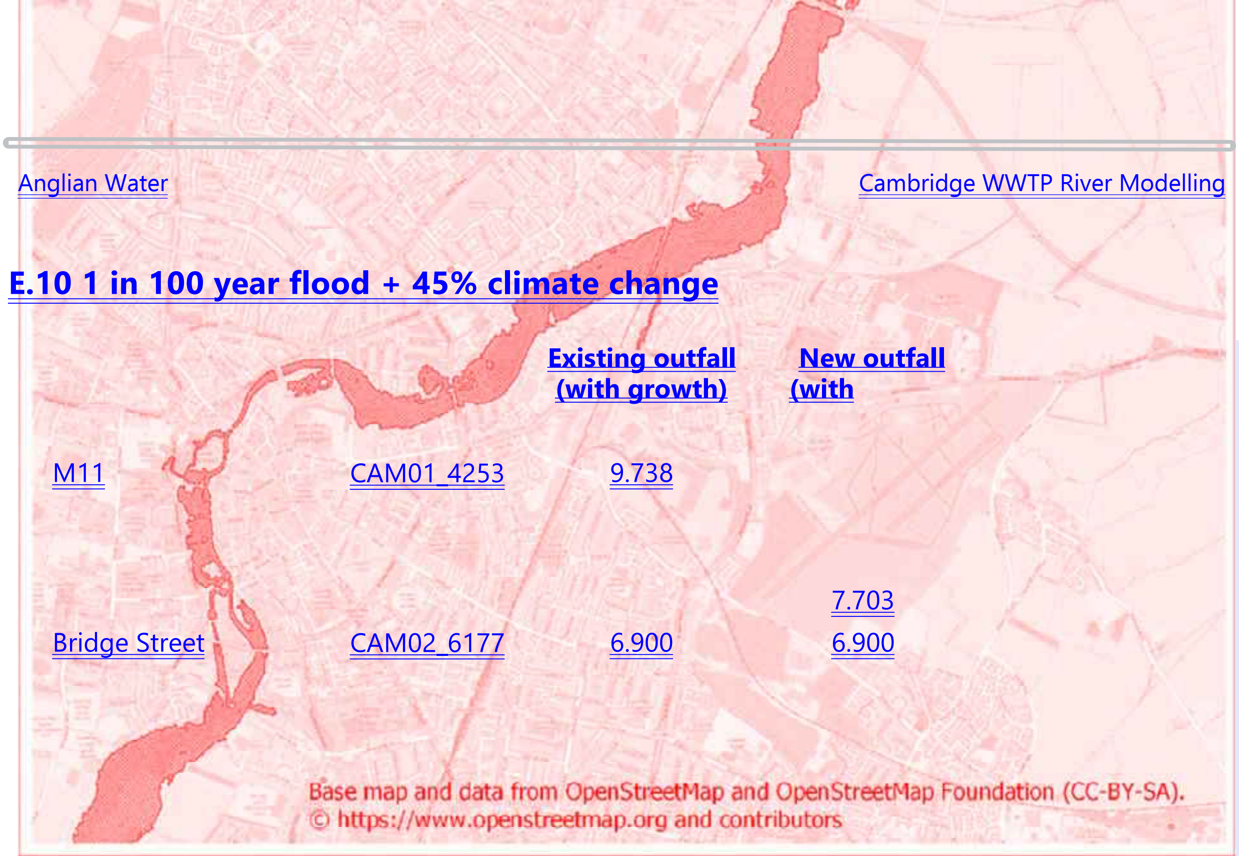
Great Ouse confluence	Cam0000	65.5	65.5	0.0

E.8 1 in 1000 year flood

Location	Node	Existing outfall (with growth)	New outfall (with	Increase
		Peak water level (mAOD)		Level (m)
M11	CAM01_4253	9.942	9.942	0.000
A1134 Fen Causeway	CAM02_7723d	8.632	8.632	0.000
Silver Street	CAM02_7160	8.596	8.596	0.000
Trinity Bridge	CAM02_6603	8.199	8.199	0.000
Bridge Street	CAM02_6177	7.157	7.157	0.000
Victoria Avenue	CAM02_5371	6.500	6.500	0.000
A1134 Elizabeth Way	CAM02_4494	6.170	6.170	0.000
Railway	CAM02_2638	5.740	5.740	0.000
A14	CAM02_0636	4.878	4.876	-0.002
Baits Bite Lock US	CAM02_0200	4.725	4.725	0.000
Baits Bite Lock DS	CAM02_0000	4.573	4.573	0.000
Horningsea	CA14400	4.488	4.488	0.000
Waterbeach	CA12080J	4.298	4.298	0.000
Bottisham Lock US	CA10600J	4.086	4.086	0.000
Bottisham Lock DS	CA10560	3.986	3.985	-0.001
Shrubbs Marina	Cam8794	3.851	3.851	0.000
Upware	Cam5007	3.737	3.737	0.000
A1123	Cam2651u	3.667	3.667	0.000
Great Ouse confluence	Cam0000	3.613	3.613	0.000
		Peak flow (m³/s)		Flow (m³/
M11	CAM01_4253	113.0	113.0	0.0
A1134 Fen Causeway	CAM02_7723d	48.4	48.3	0.0
Silver Street	CAM02_7160	96.7	96.7	0.0
Trinity Bridge	CAM02_6603	92.6	92.6	0.0
Bridge Street	CAM02_6177	143.4	143.4	0.0
Victoria Avenue	CAM02_5371	81.0	81.0	0.0
A1134 Elizabeth Way	CAM02_4494	127.5	127.5	0.0
Railway	CAM02_2638	145.1	145.1	0.0
A14	CAM02_0636	138.9	139.0	0.0
Baits Bite Lock US	CAM02_0200	63.6	63.6	0.0
Baits Bite Lock DS	CAM02_0000	63.6	63.6	0.0
Horningsea	CA14400	41.1	41.1	0.0
Waterbeach	CA12080J	58.6	58.6	0.0
Bottisham Lock US	CA10600J	84.6	84.7	0.1
Bottisham Lock DS	CA10560	84.6	84.7	0.1
Shrubbs Marina	Cam8794	85.2	85.2	0.0
Upware	Cam5007	78.9	78.9	0.0
A1123	Cam2651u	86.4	86.4	0.0
Great Ouse confluence	Cam0000	66.0	66.0	0.0

~~B~~E.~~6~~9 1 in ~~75~~100 year flood + 19% climate change

Location	Node	Existing outfall (with growth)	New outfall (with	Increase
		Peak water level (mAOD)		Level (m
M11	CAM01_4253	9.609	9.609	0.000
A1134 Fen Causeway	CAM02_7723d	7.892	7.892	0.000
Silver Street	CAM02_7160	7.742	7.742	0.000
Trinity Bridge	CAM02_6603	7.314	7.314	0.000
Bridge Street	CAM02_6177	6.705	6.705	0.000
Victoria Avenue	CAM02_5371	5.996	5.996	0.000
A1134 Elizabeth Way	CAM02_4494	5.736	5.736	0.000
Railway	CAM02_2638	5.332	5.331	-0.001
A14	CAM02_0636	4.698	4.697	-0.001
Baits Bite Lock US	CAM02_0200	4.570	4.570	0.000
Baits Bite Lock DS	CAM02_0000	4.381	4.381	0.000
Horningsea	CA14400	4.292	4.292	0.000
Waterbeach	CA12080J	4.174	4.173	-0.001
Bottisham Lock US	CA10600J	4.011	4.011	0.000
Bottisham Lock DS	CA10560	3.922	3.922	0.000
Shrubbs Marina	Cam8794	3.809	3.809	0.000
Upware	Cam5007	3.709	3.708	-0.001
A1123	Cam2651u	3.644	3.644	0.000
Great Ouse confluence	Cam0000	3.593	3.593	0.000
		Peak flow (m³/s)		Flow (m³/
M11	CAM01_4253	71.5	71.5	0.0
A1134 Fen Causeway	CAM02_7723d	43.1	43.1	0.0
Silver Street	CAM02_7160	78.6	78.6	0.0
Trinity Bridge	CAM02_6603	89.8	89.8	0.0
Bridge Street	CAM02_6177	92.6	92.6	0.0
Victoria Avenue	CAM02_5371	77.8	77.8	0.0
A1134 Elizabeth Way	CAM02_4494	90.1	90.1	0.0
Railway	CAM02_2638	93.3	93.3	0.0
A14	CAM02_0636	91.1	91.1	0.0
Baits Bite Lock US	CAM02_0200	55.7	55.7	0.0
Baits Bite Lock DS	CAM02_0000	55.7	55.7	0.0
Horningsea	CA14400	40.5	40.5	0.0
Waterbeach	CA12080J	55.7	55.7	0.0
Bottisham Lock US	CA10600J	75.9	75.8	-0.1
Bottisham Lock DS	CA10560	75.9	75.8	-0.1
Shrubbs Marina	Cam8794	77.0	76.9	-0.1
Upware	Cam5007	74.1	74.1	0.0
A1123	Cam2651u	80.1	80.1	0.0
Great Ouse confluence	Cam0000	65.5	65.5	0.0



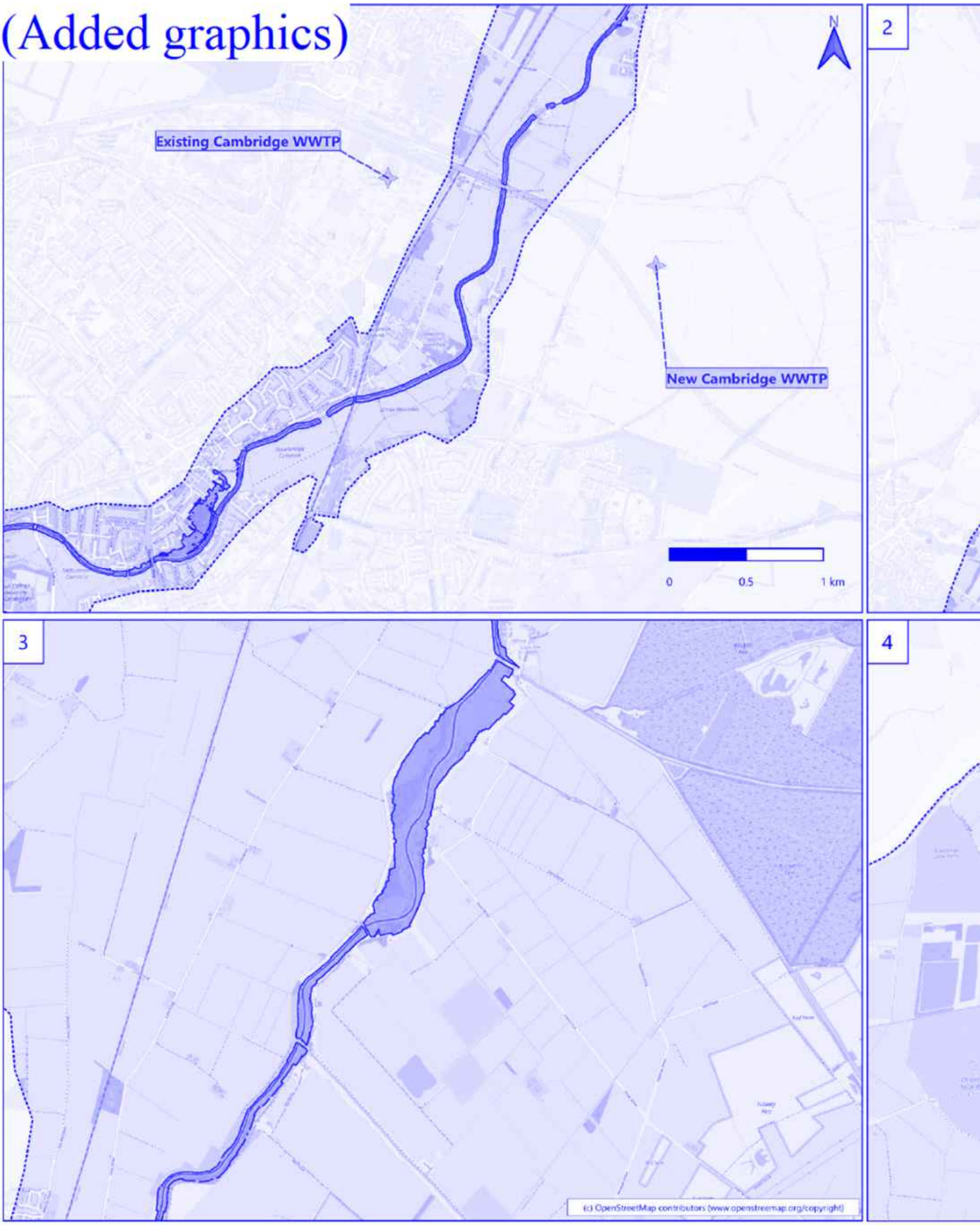
E.10 1 in 100 year flood + 45% climate change

		Existing outfall (with growth)	New outfall (with	Increase
				Level (m)
M11	CAM01_4253	9.738		0.000
				0.000
				0.000
			7.703	0.000
Bridge Street	CAM02_6177	6.900	6.900	0.000
				0.000
				0.000
				0.000
				-0.001
Baits Bite Lock US	CAM02_0200	4.637	4.637	0.000
Baits Bite Lock DS	CAM02_0000	4.467	4.467	0.000
Horningsea	CA14400	4.379	4.379	0.000
Waterbeach	CA12080J	4.233	4.232	-0.001
Bottisham Lock US	CA10600J	4.050	4.050	0.000
Bottisham Lock DS	CA10560	3.956	3.956	0.000
Shrubbs Marina	Cam8794	3.833	3.833	0.000
Upware	Cam5007	3.726	3.725	-0.001
A1123	Cam2651u	3.658	3.658	0.000
Great Ouse confluence	Cam0000	3.606	3.606	0.000
		Peak flow (m³/s)		Flow (m³/
M11	CAM01_4253	86.2	86.2	0.0
A1134 Fen Causeway	CAM02_7723d	44.8	44.8	0.0
Silver Street	CAM02_7160	85.8	85.8	0.0
Trinity Bridge	CAM02_6603	92.0	92.0	0.0
Bridge Street	CAM02_6177	113.2	113.2	0.0
Victoria Avenue	CAM02_5371	79.5	79.5	0.0
A1134 Elizabeth Way	CAM02_4494	105.0	105.0	0.0
Railway	CAM02_2638	113.8	113.8	0.0
A14	CAM02_0636	110.4	110.5	0.0
Baits Bite Lock US	CAM02_0200	58.4	58.5	0.0
Baits Bite Lock DS	CAM02_0000	58.4	58.5	0.0
Horningsea	CA14400	40.7	40.8	0.1
Waterbeach	CA12080J	57.4	57.5	0.1
Bottisham Lock US	CA10600J	79.8	79.7	0.0
Bottisham Lock DS	CA10560	79.8	79.7	0.0
Shrubbs Marina	Cam8794	80.6	80.5	-0.1
Upware	Cam5007	76.3	76.3	0.0
A1123	Cam2651u	83.9	83.9	0.0
Great Ouse confluence	Cam0000	65.8	65.8	0.0

Appendix F: Flood difference Existing Future vs New Outfall 55 hour – comparing Existing Future (with growth) to New Outfall (with growth)

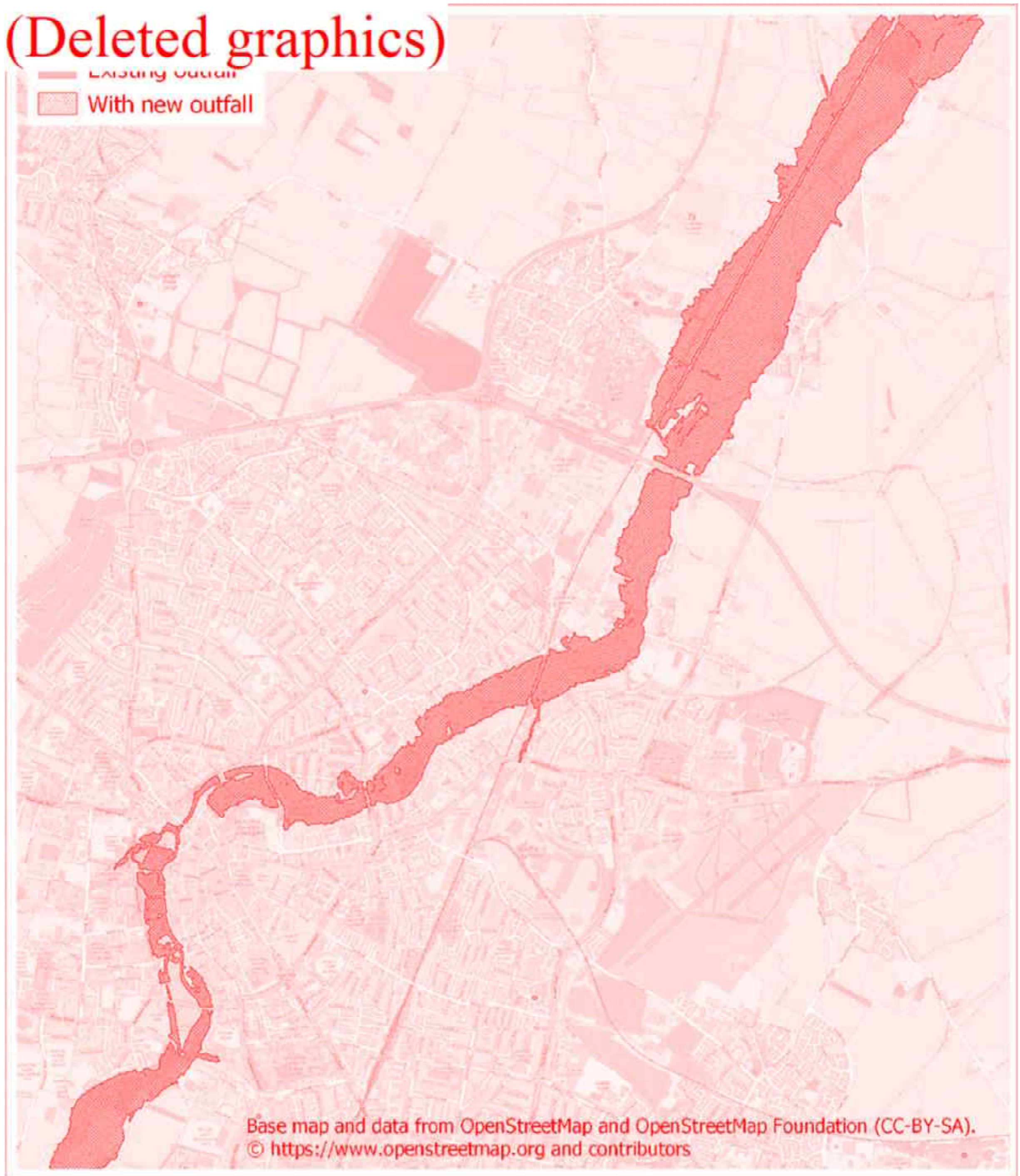
~~B~~F.~~7~~1 1 in ~~100~~2 year flood

(Added graphics)

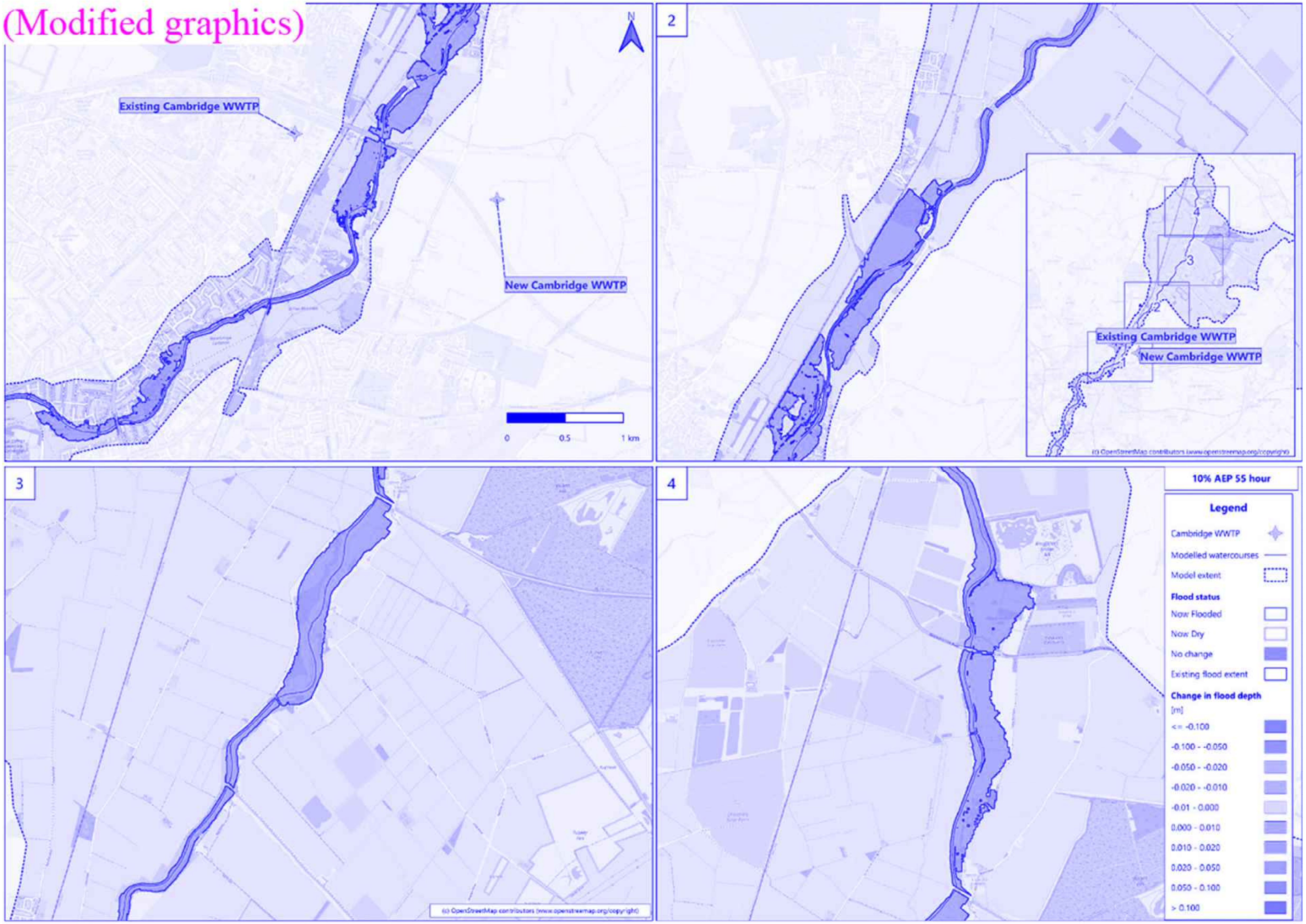


(Mod)

(Deleted graphics)

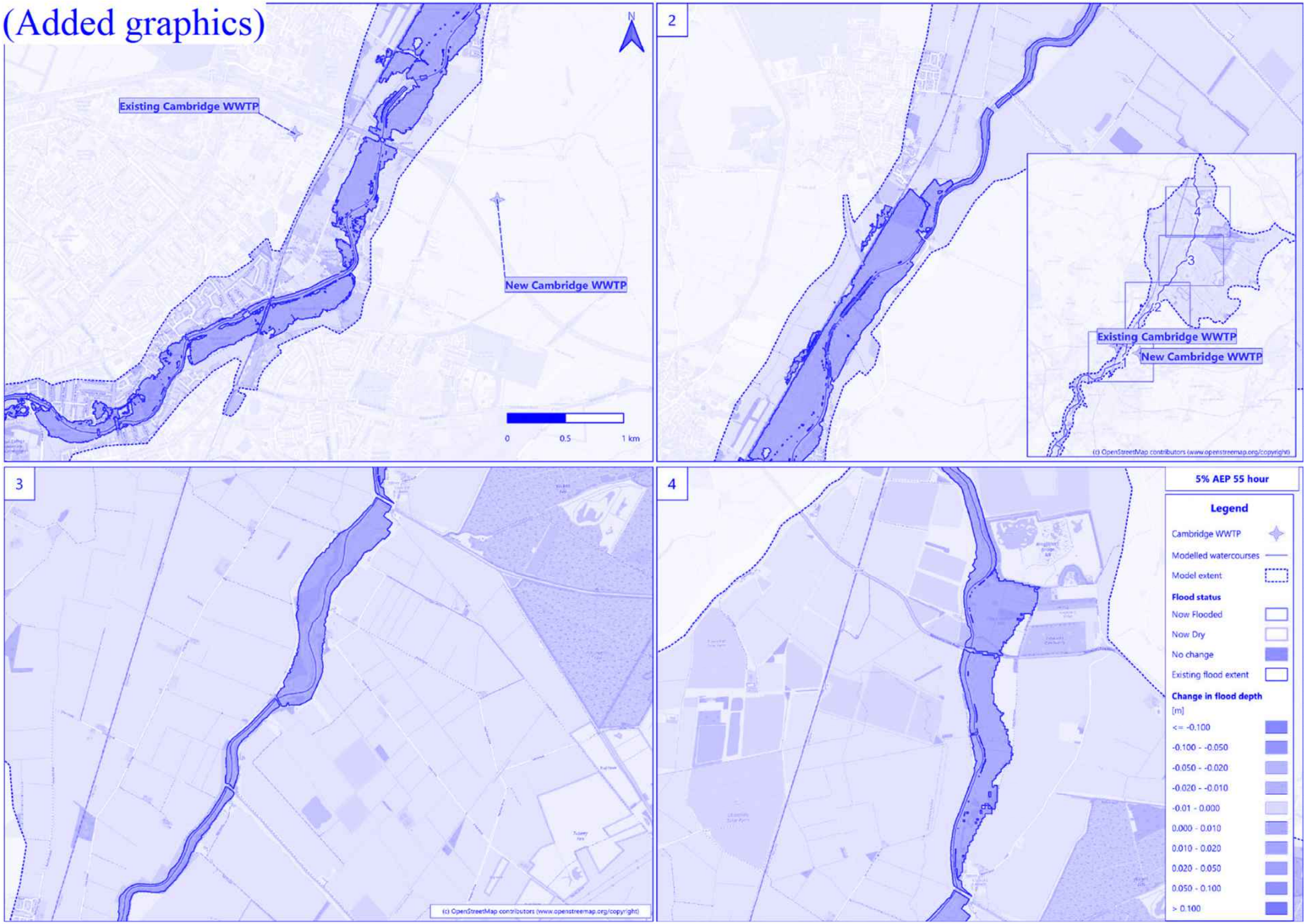


(Modified graphics)



F.2 1 in 10 year flood

BF.83 1 in 20020 year flood



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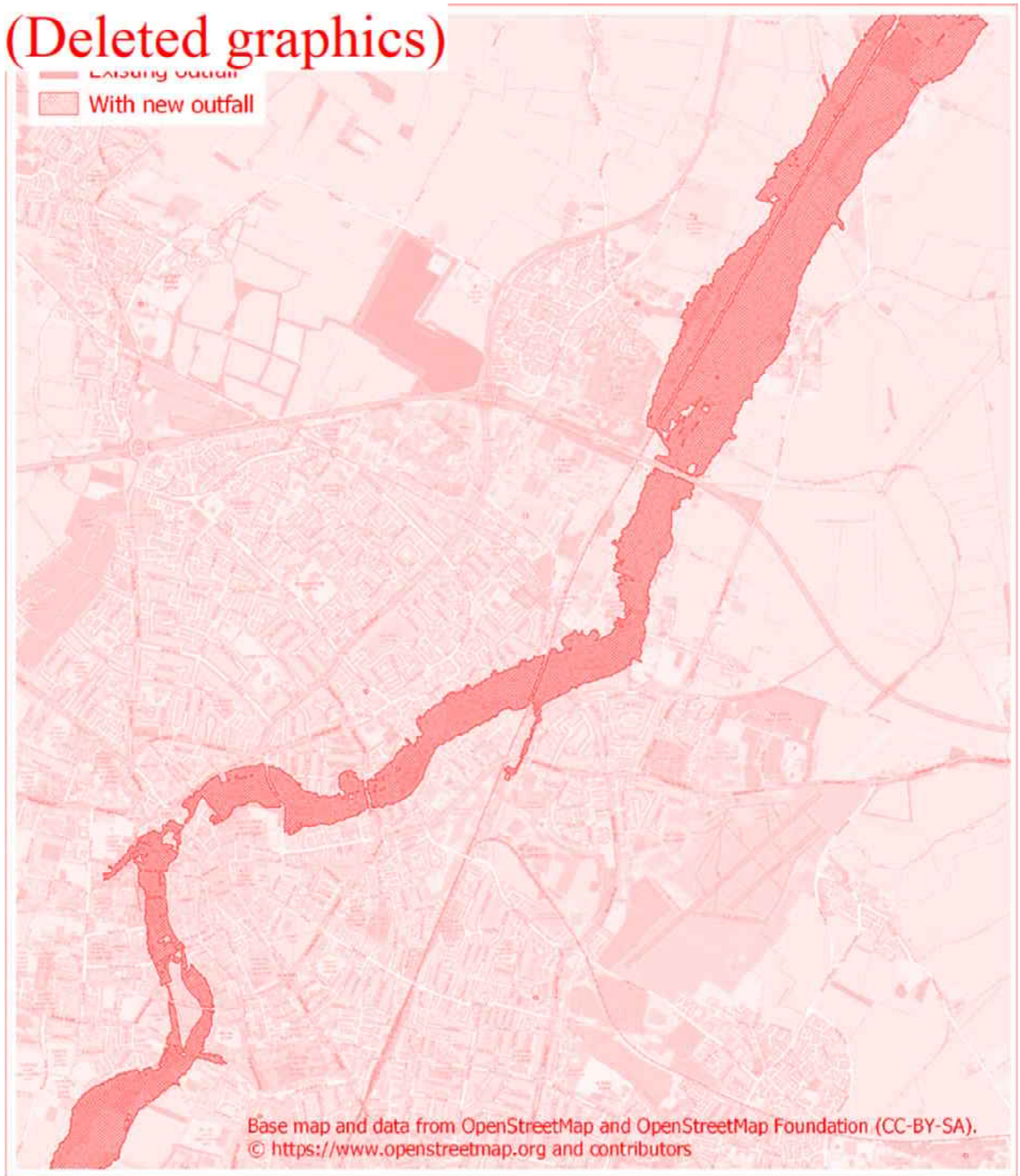
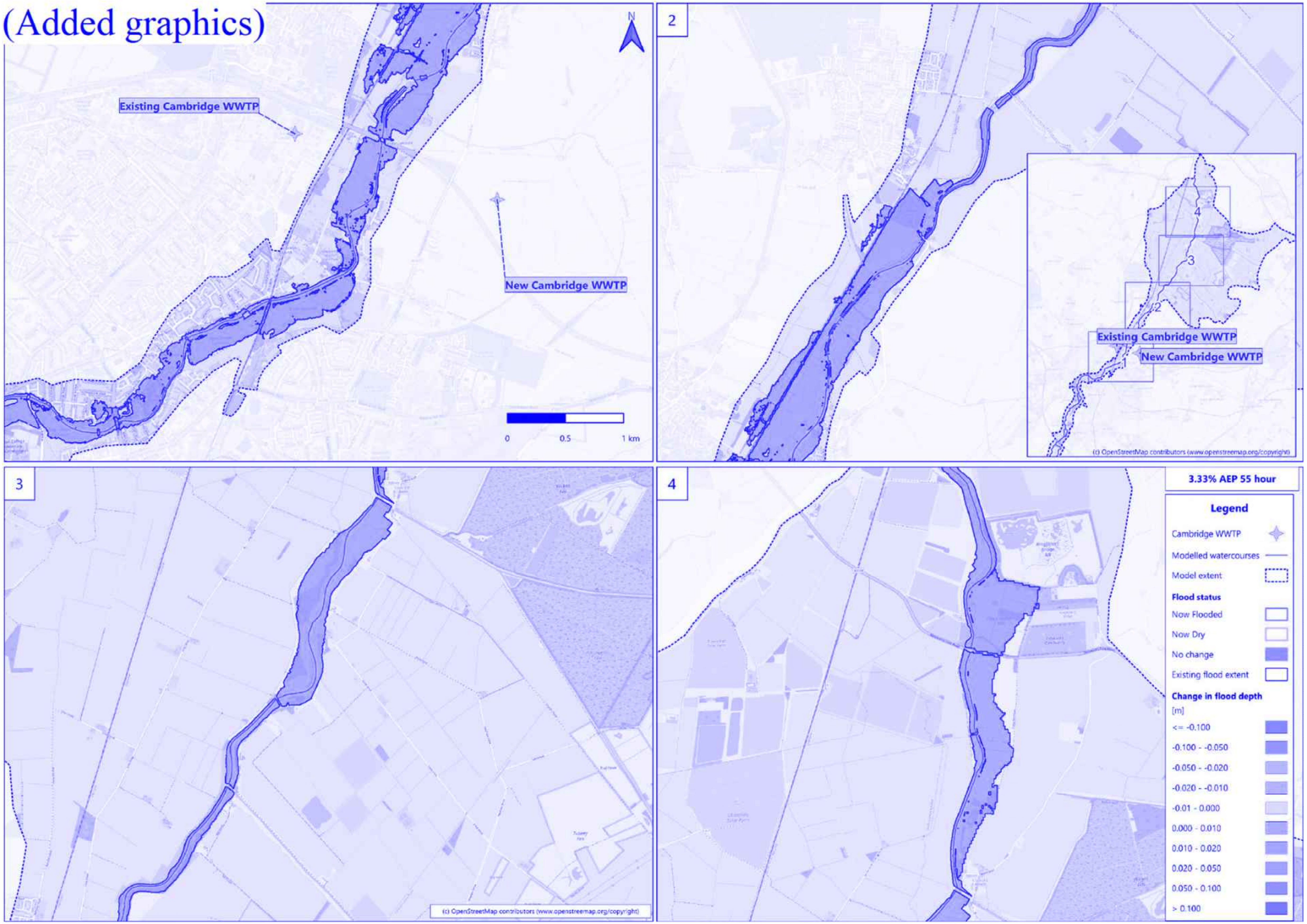


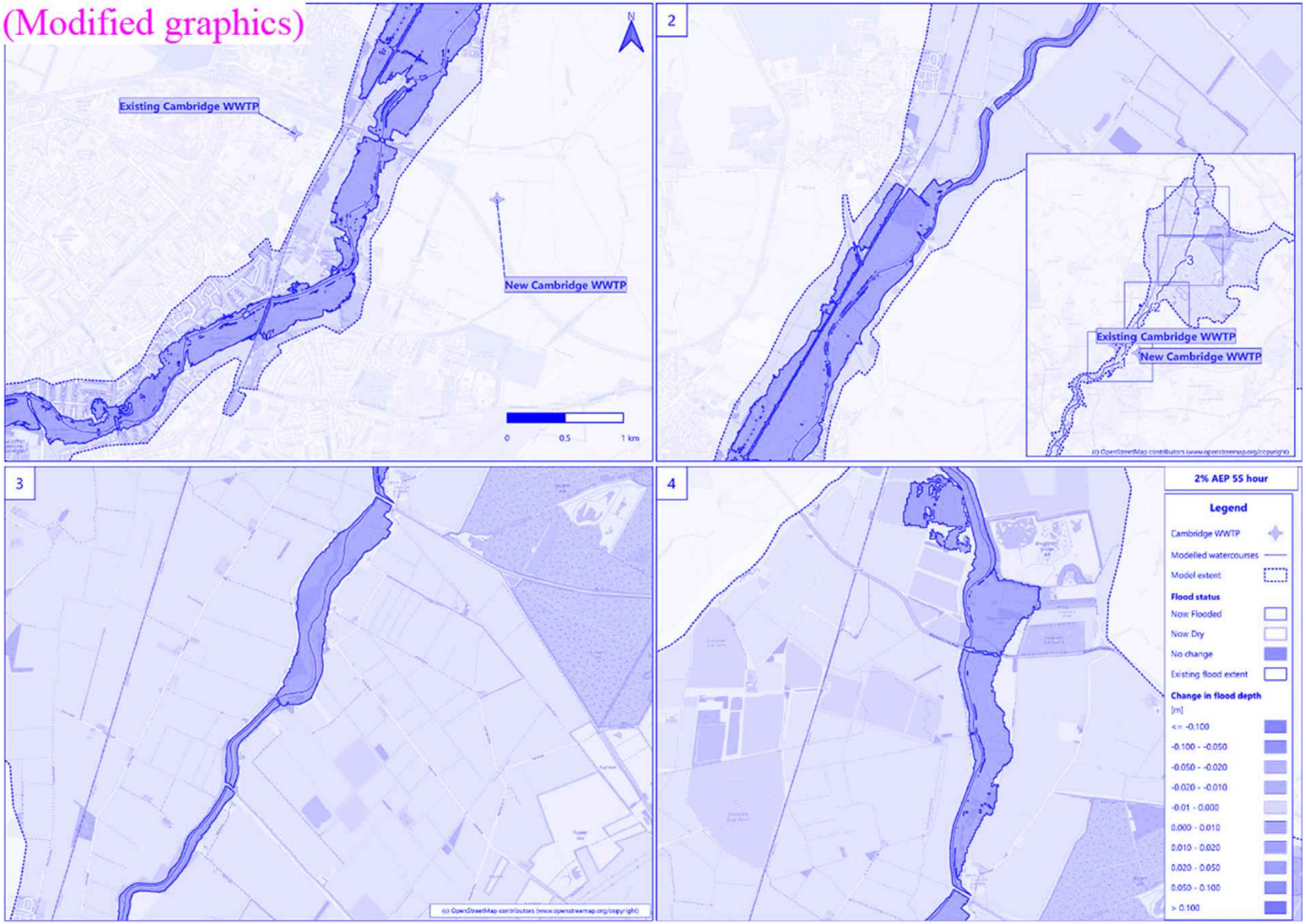
F.4 1 in 30 year flood

(Added graphics)



(Mod)

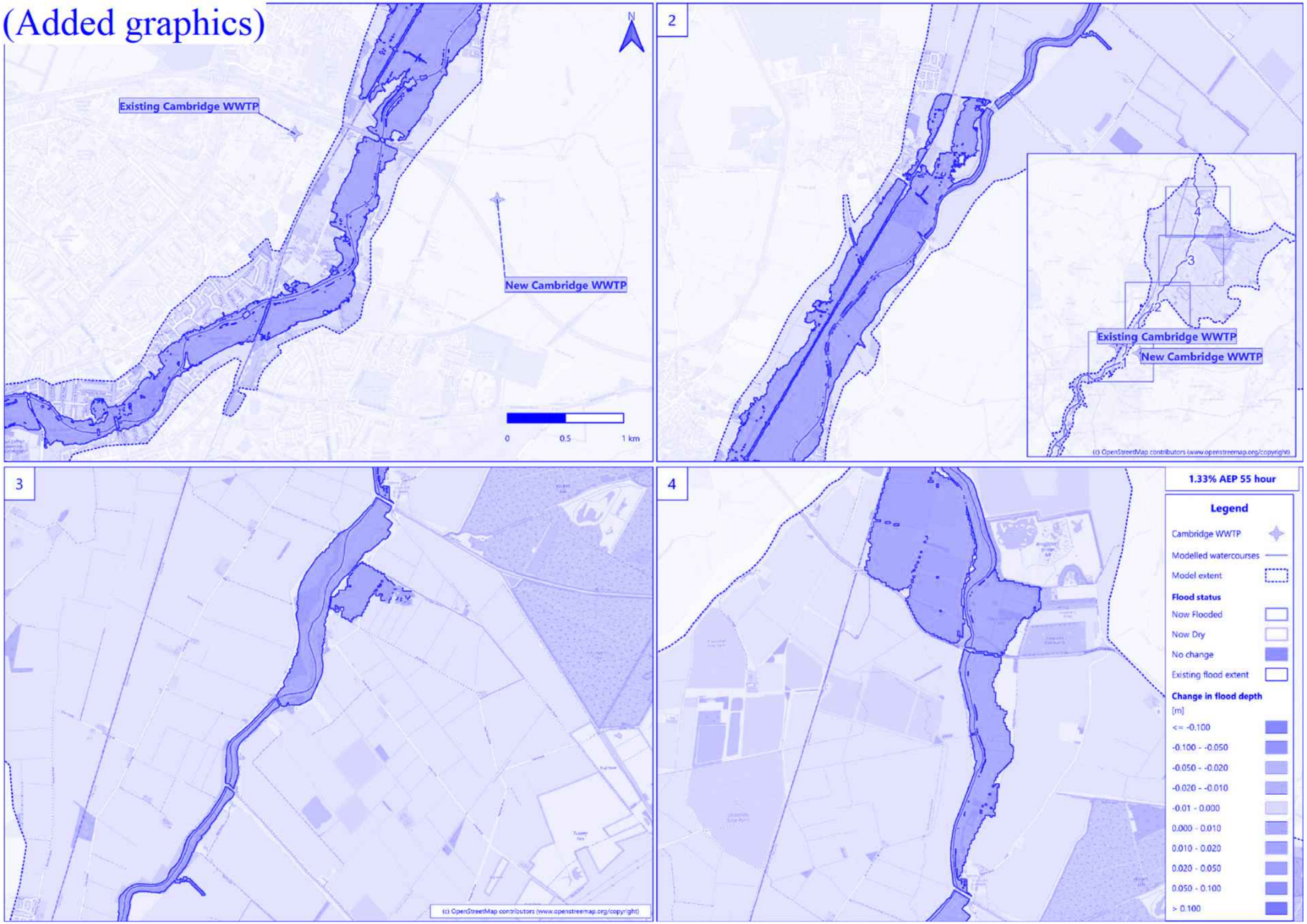
(Modified graphics)



F.5 1 in 50 year flood

F.6 1 in 75 year flood

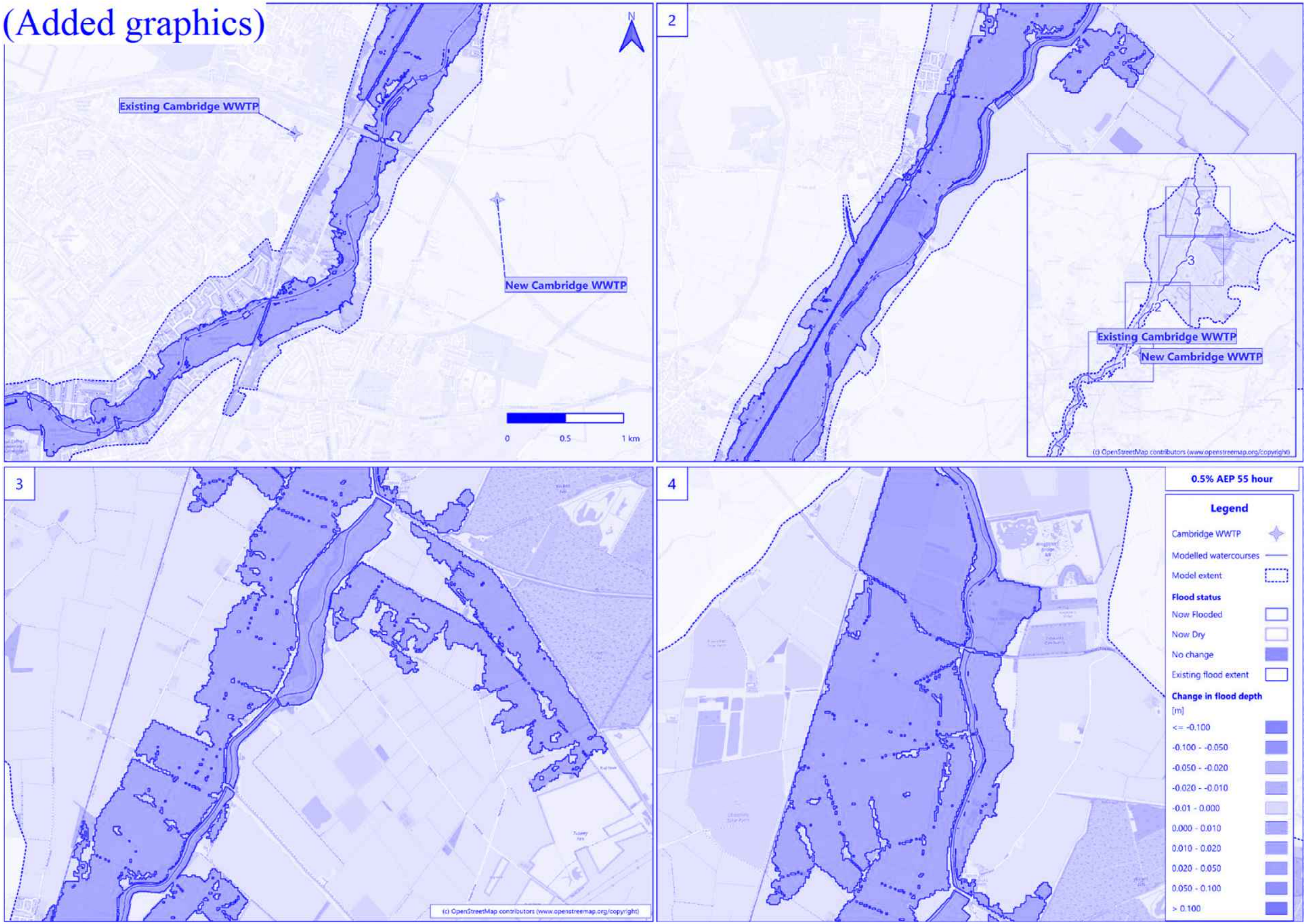
(Added graphics)



(Mod)

F.7 1 in 200 year flood

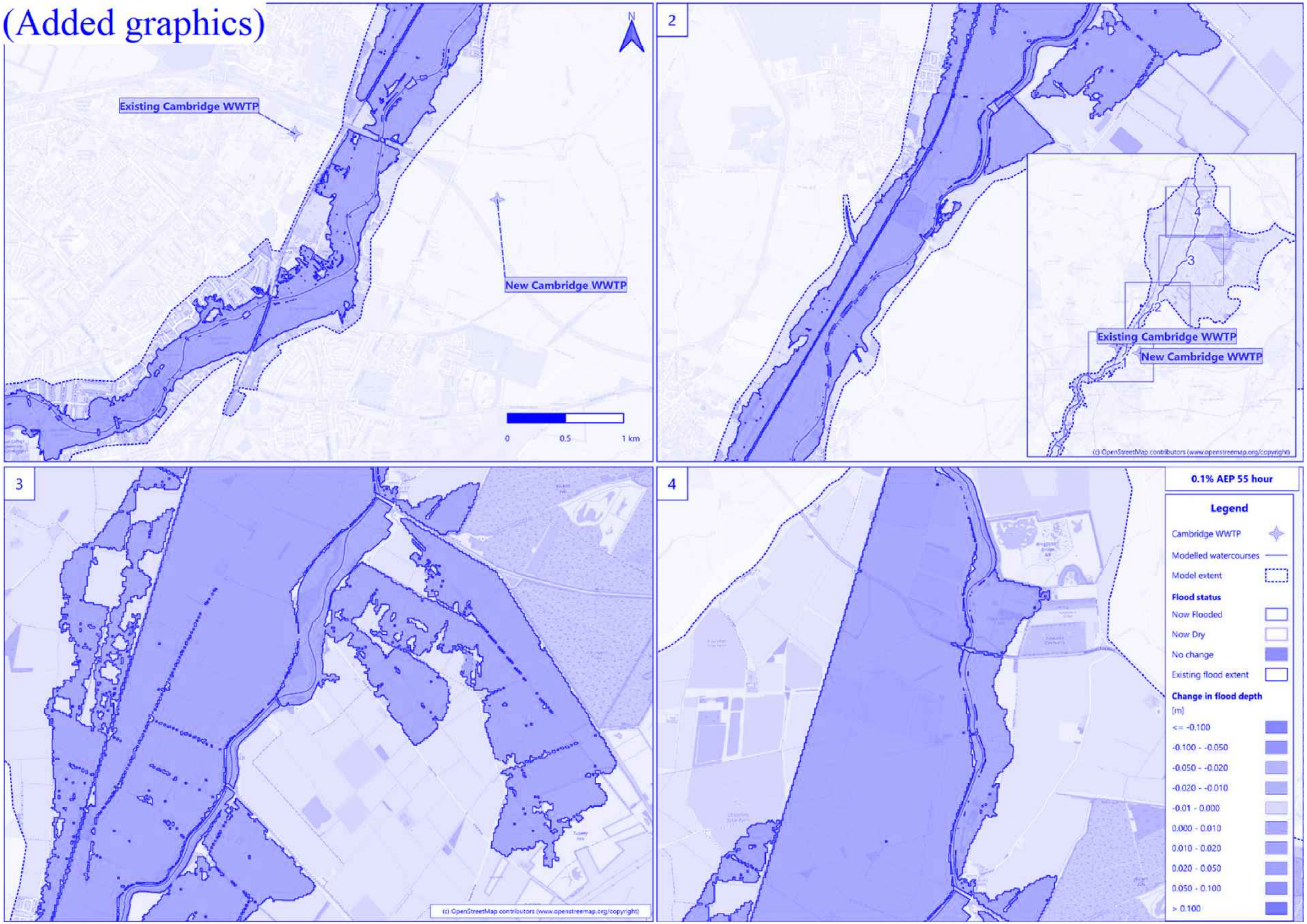
(Added graphics)



(Mod)

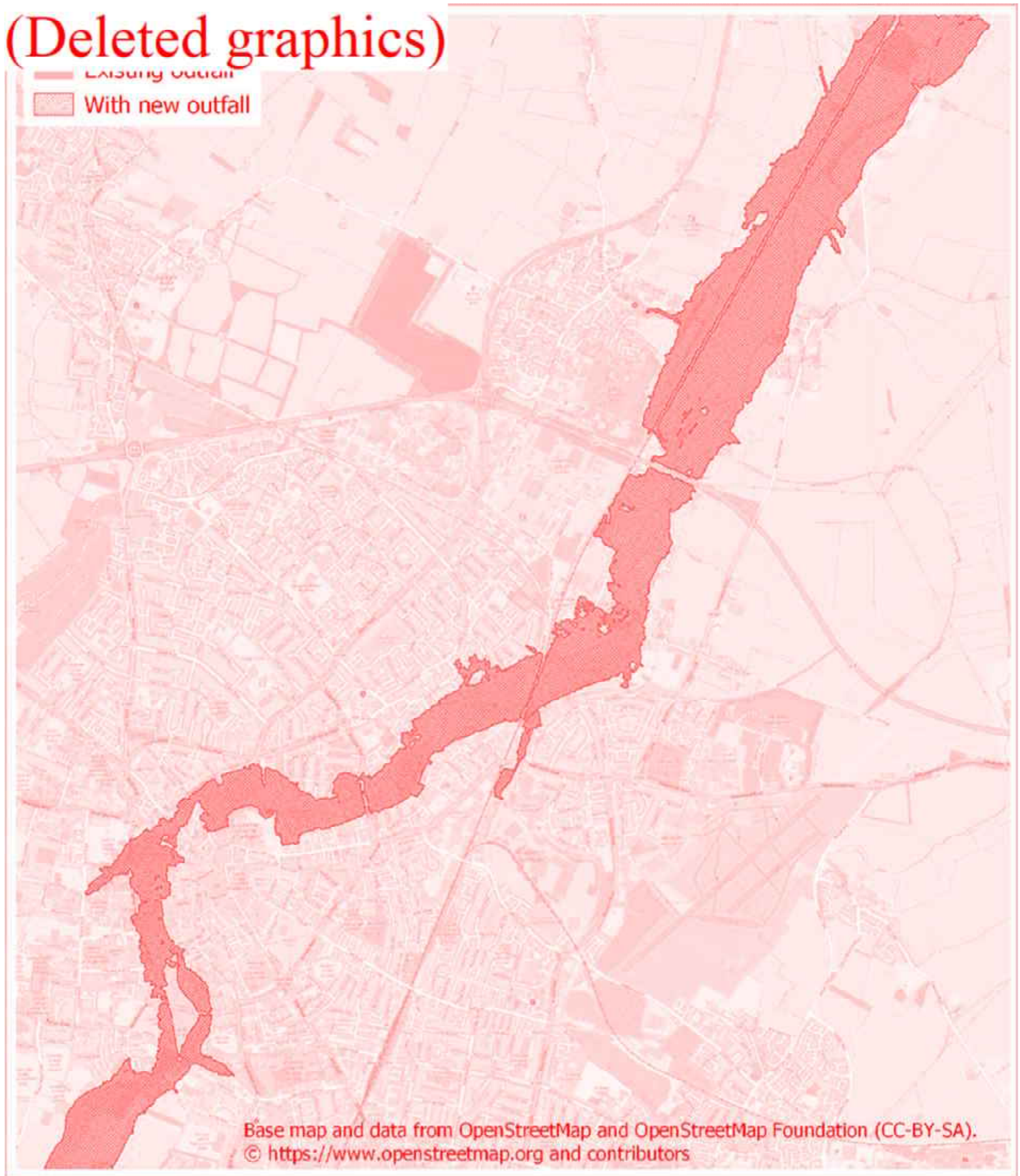
~~BF.9~~8 1 in 1000 year flood

(Added graphics)

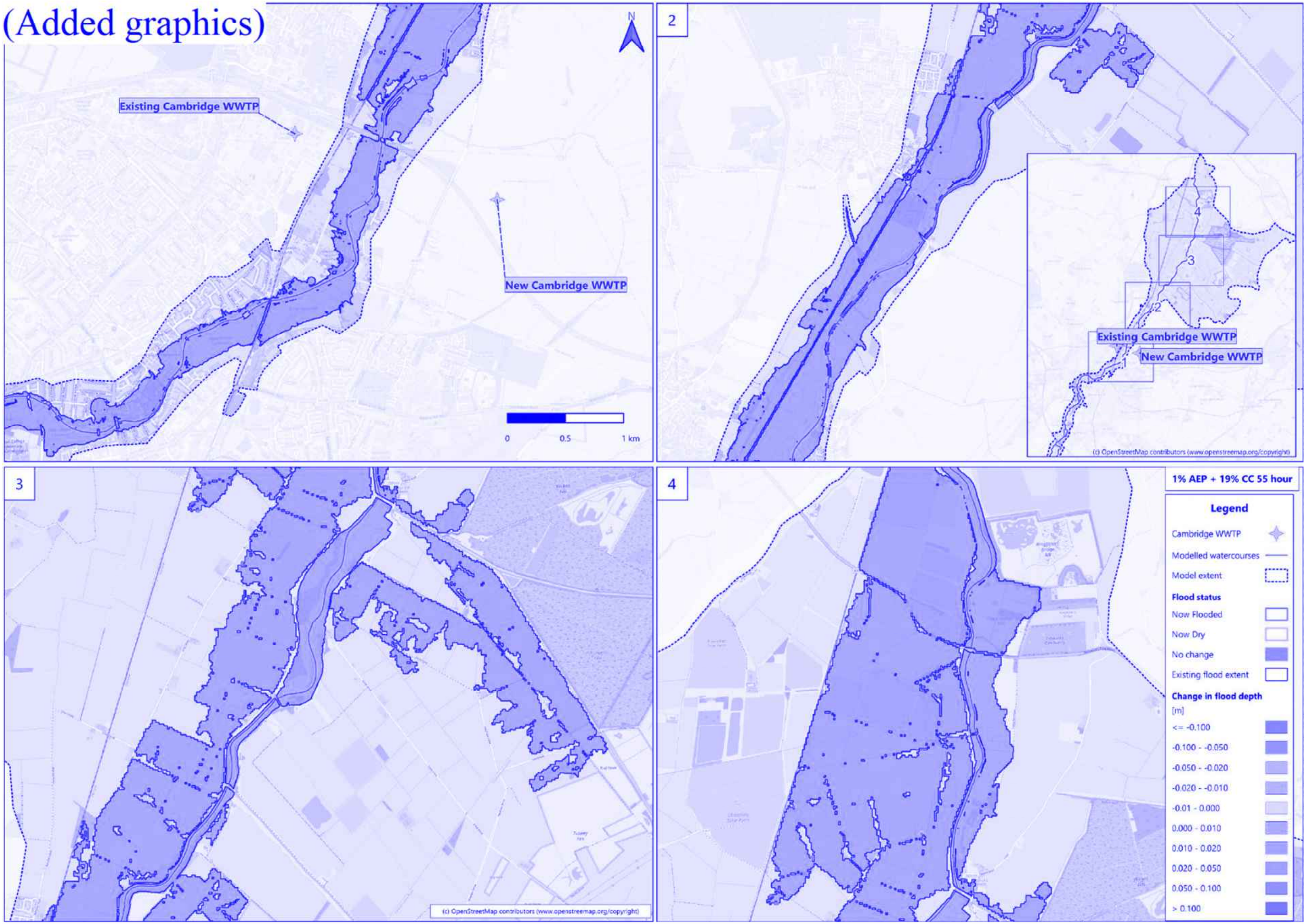


(Mod)

(Deleted graphics)



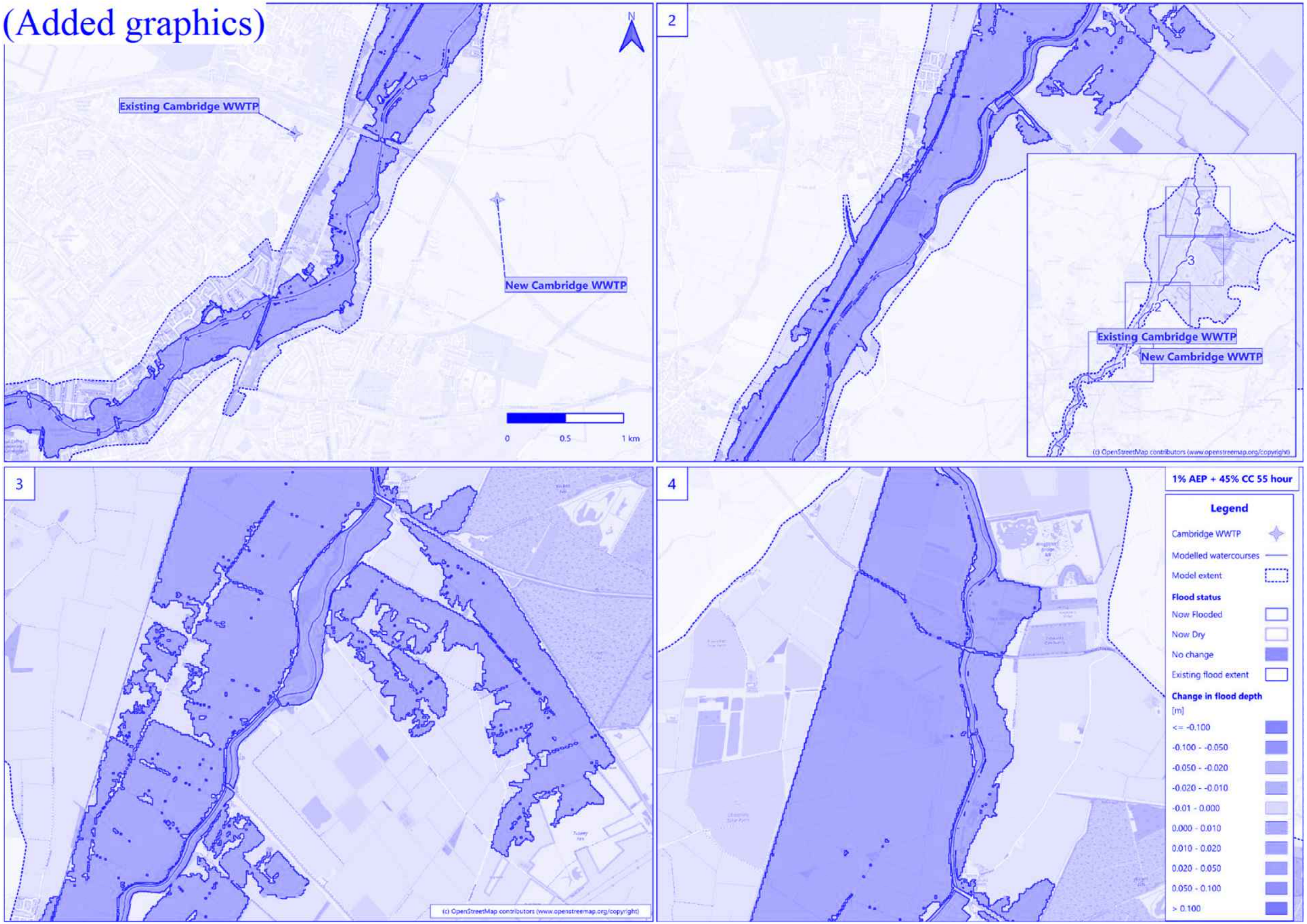
F.9 1 in 100 year flood + 19% climate change



(Mod)

F.10 1 in 100 year flood + 45% climate change

(Added graphics)

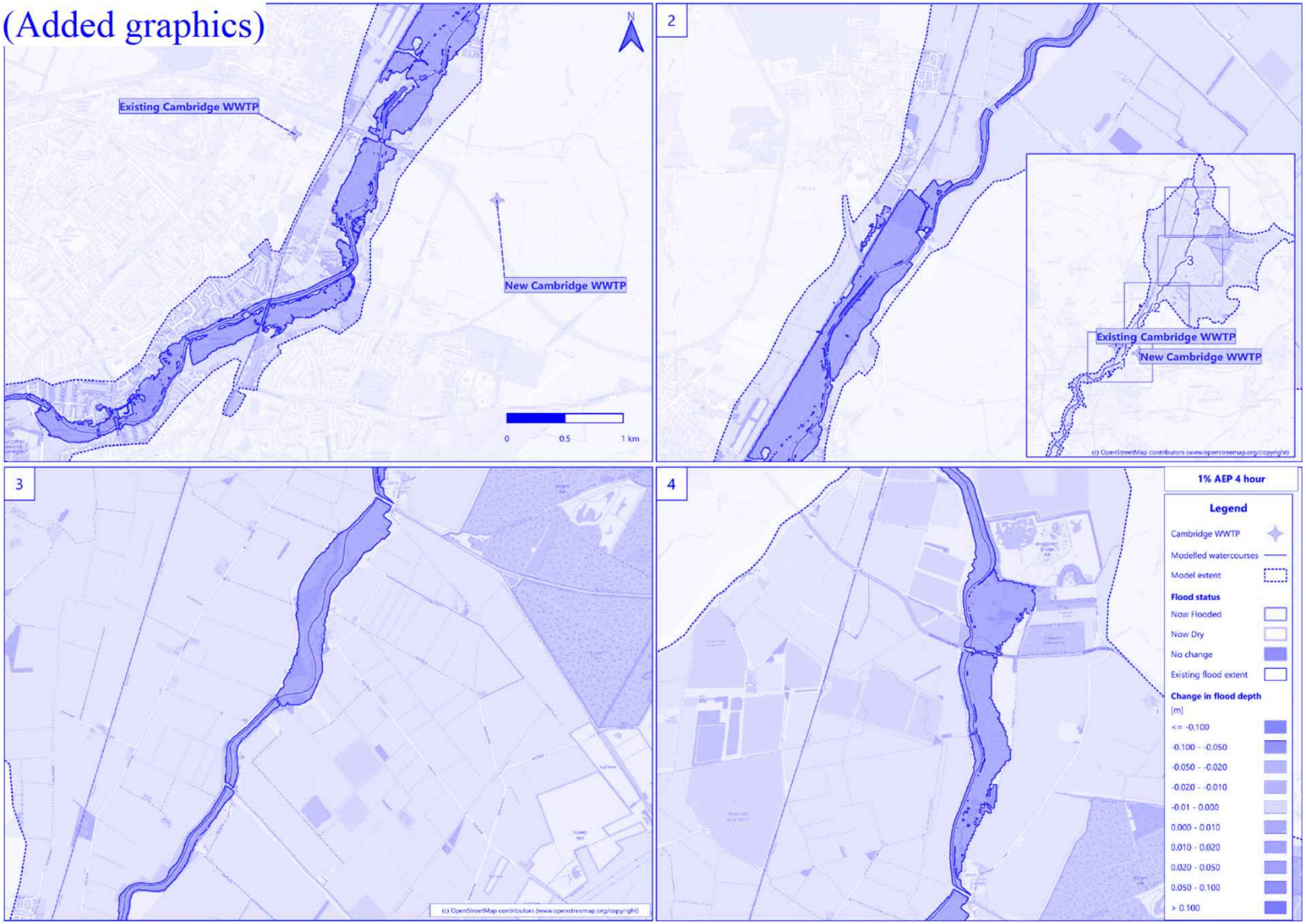


(Mod)

Appendix G: Flood difference Existing Future vs New Outfall 4 hour – comparing Existing Future (with growth) to New Outfall (with growth)

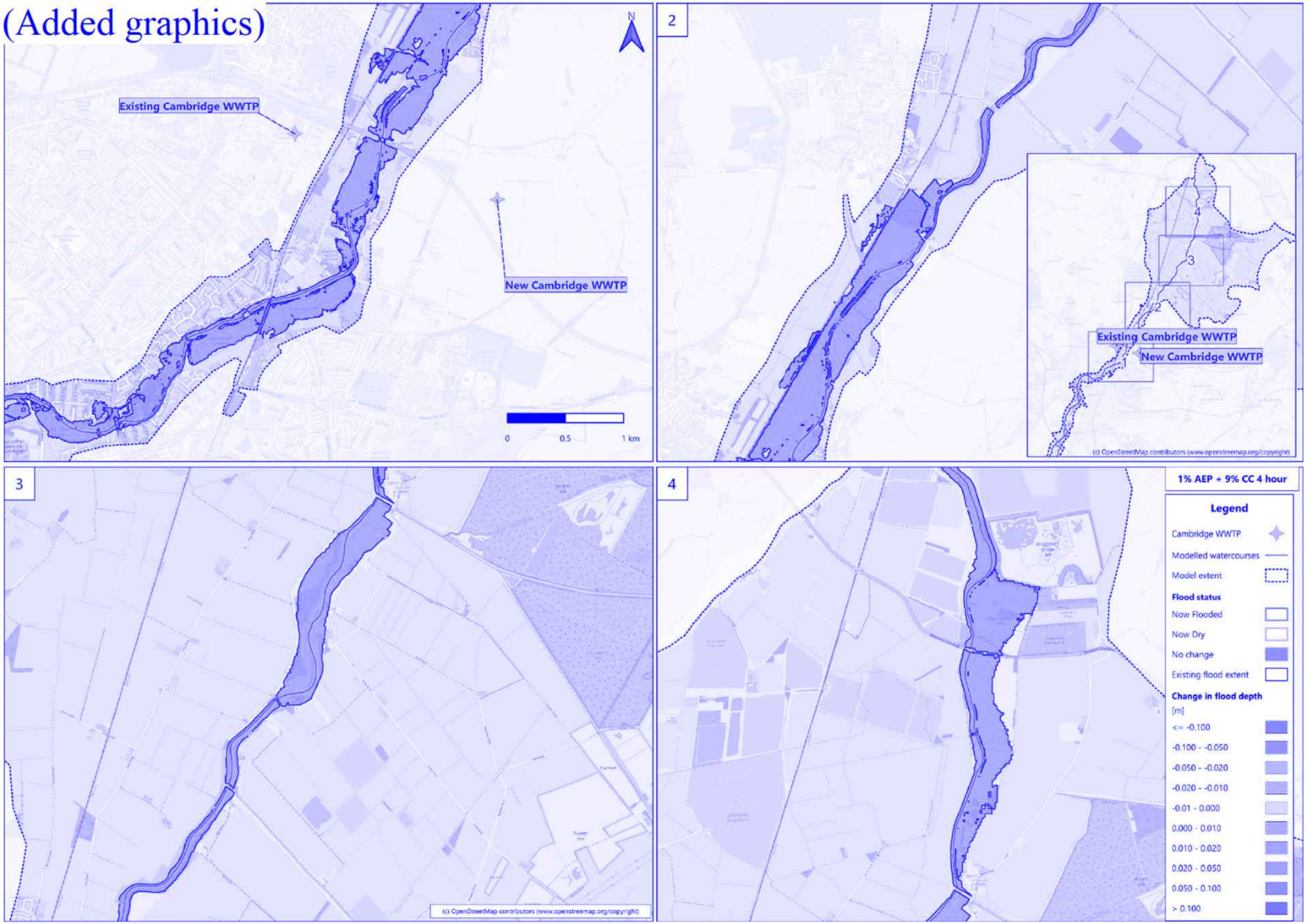
G.1 1 in 100 year flood

(Added graphics)



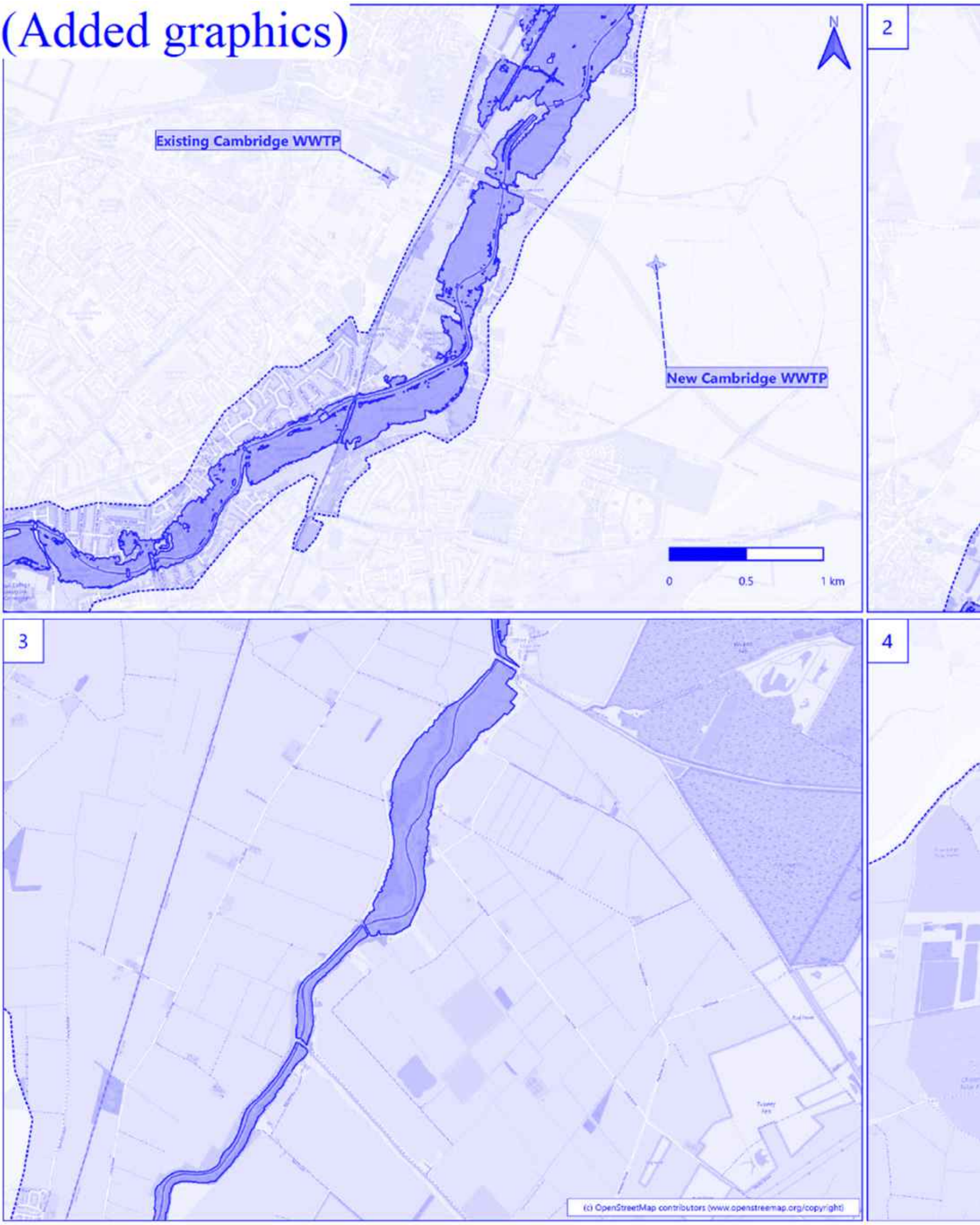
(Mod)

G.2 1 in 100 year flood + 9% climate change



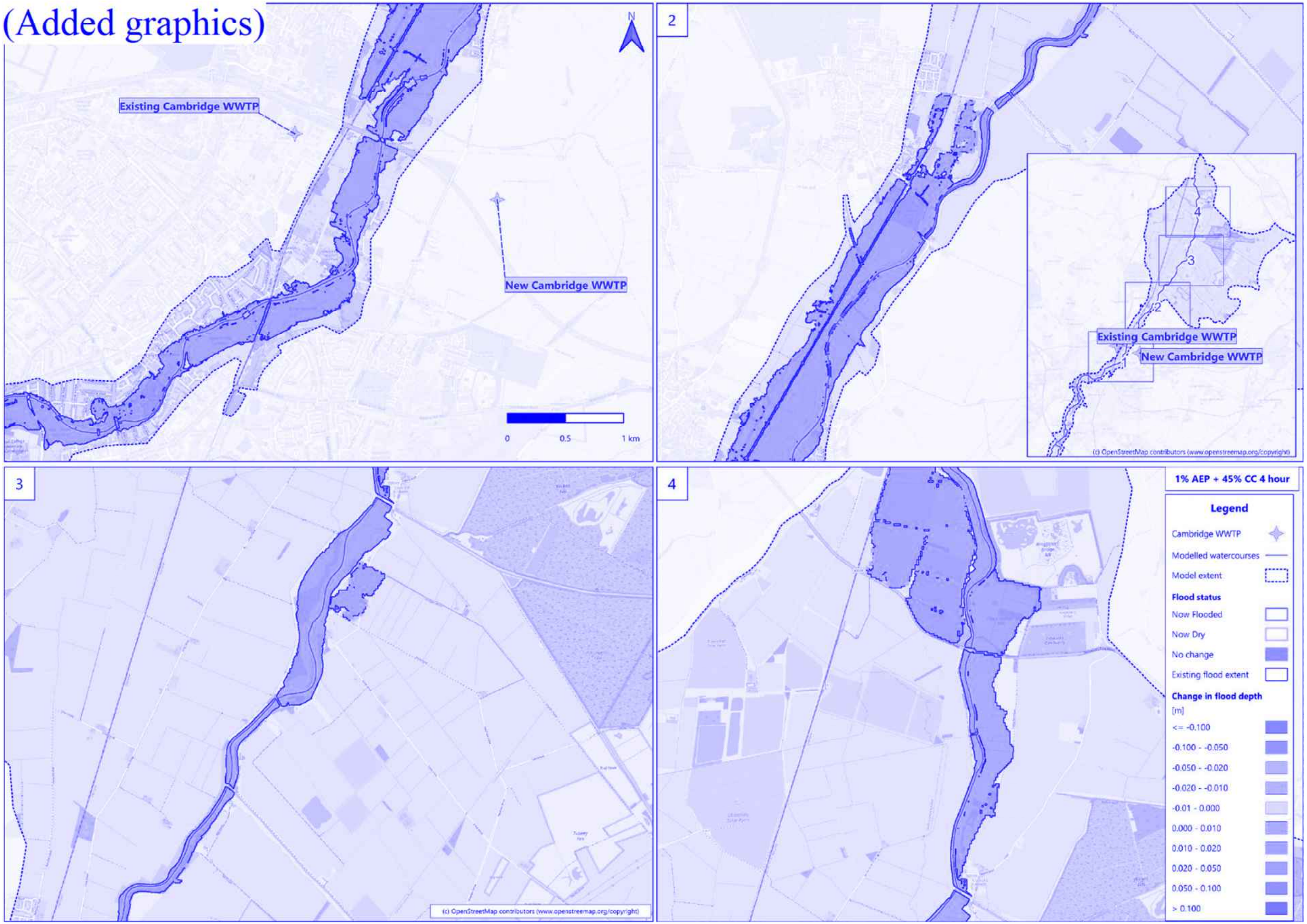
(Mod)

G.3 1 in 100 year flood + 19% climate change



(Mod)

G.4 1 in 100 year flood + 45% climate change



(Modified graphics)

love every drop anglianwater

Get in touch

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Calling our Freephone information line on **0808 196 1661**

Writing to us at **Freepost: CWWTPR**

You can view all our DCO application documents and updates on the application on The Planning Inspectorate website:

~~https://infrastructure.planninginspectorate.gov.uk/projects/eastern/cambridge-waste-water-treatment-plant-relocation/~~https://infrastructure.planning

Summary report: Litera Compare for Word 11.5.0.74 Document comparison done on 04/04/2024 16:36:38	
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Modified filename: 5.4.20.5 Fluvial Modelling Report (Cambridge WWTP RP River Modelling Report) NEW.docx	
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