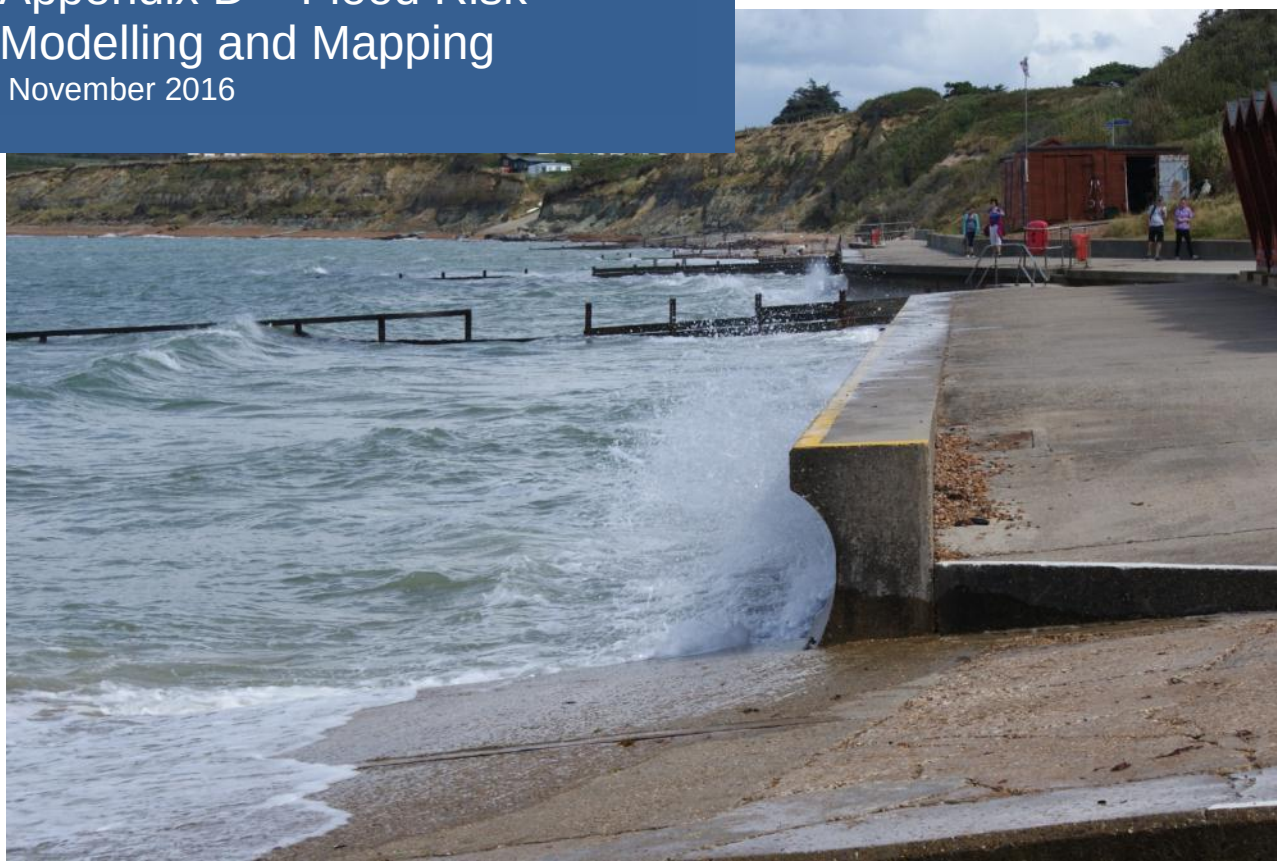
CAPITA | AECOM

Water and Environment Management Framework
Lot 3 – Engineering and Related Services

West Wight Coastal Flood and Erosion Risk Management Strategy

Appendix D – Flood Risk Modelling and Mapping

November 2016



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Document overview

Capita | AECOM was commissioned by the Isle of Wight Council in October 2014 to undertake a Coastal Flood and Erosion Risk Management Strategy. As part of this commission, a brief review of the hydraulic model assumptions and process has been undertaken to inform the option development phase of the Strategy.

Document history

Version	Status	Issue date	Prepared by	Reviewed by	Approved by
1	Draft	20 March 2015	Mark Davin – Senior Engineer	Jonathan Short – Senior Coastal Specialist	Tara-Leigh McVey - Associate
2	Updated following client comments	04 August 2015	Mark Davin – Senior Engineer Jason Drummond – Principal Flood and Coastal Specialist	Jonathan Short – Senior Coastal Specialist	Tara-Leigh McVey - Associate
3	Update following client comments	18 December 2015	Ben Taylor – Graduate Coastal Engineer	Jonathan Short – Senior Coastal Specialist	Tara-Leigh McVey - Associate
4	Issue for consultation	March 2016	Ben Taylor – Assistant Consultant	Jonathan Short – Principal Consultant	Tara-Leigh McVey - Associate
5	Final	November 2016	IWC	IWC	IWC

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The methodology adopted and the sources of information used by Capita | AECOM in providing its services are outlined in this Report. The work described in this Report was undertaken between December 2014 and June 2015 [with a clarification added in November 2016] and is based on the conditions encountered and the information available during the said period of time. The scope of this Report and the services are accordingly factually limited by these circumstances.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

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Contents

1. Hydraulic Modelling Overview

Capita | AECOM has been commissioned by the Isle of Wight Council (Client) to undertake a Coastal Flood and Erosion Risk Management Strategy for the West Wight, Isle of Wight in October 2014 (Figure 1-1).

As part of this commission, several existing hydraulic models were provided to the Project Team by the Environment Agency for the purposes of simulating coastal flooding, assessing future damages and benefits and informing management option decision making. Due to significant updates required to the hydraulic models, this was undertaken by a WEM Framework consultant. The details of the updates can be viewed in 'Isle of Wight Coastal Remediation Works' (2015).

The hydraulic models provided included coastal regions beyond the extent of the study but only those which encompassed by the boundary of the study were taken forward. Namely, the hydraulic models taken forward (Figure 1-1) represent the following flood cell regions:

Model 1 – Cowes (TUFLOW)
Model 2 – Freshwater/Yarmouth (TUFLOW)
Model 3 – Gurnard (TUFLOW)

Figure 1-1 – Location of Hydraulic Models

2. Hydraulic Model - Updates

At the time of commission The Environment Agency informed both the Isle of Wight Council and Capita | AECOM that the hydraulic models representing coastal regions of the Isle of Wight (2014) were being reviewed and updated by an external consultant with an anticipated delivery of mid-2015. The models were provided to Capita | AECOM during May 2015.

The received models were checked at a high level by Capita | AECOM in June 2015.

The high level check confirmed that only changes to the peak of the tide curve were required and that building representation is suitable. The main changes that were undertaken are summarised in the sections below:

Tide Representation

The tidal levels boundaries used in the existing hydraulic models were reviewed and updated to reflect the latest FCERM Climate change guidance (Environment Agency, 2010) which utilises information from the UK Climate Projections database (UKCP09). The generation of the extreme water level estimations used in this study are discussed in more detail within the Main Strategy Document Coastal Processes Appendix C.

To simulate flood risk under a range of extreme events over time (incorporating the effects of climate change / sea level rise), and thus provide the range of outputs required to generate annual average flood damage curves in the economic assessment, four time periods were represented within the hydraulic models, namely, 2015 (present day), 2025, 2055 and 2115.

Baseline Runs

Each model was used to run 12 simulations producing outputs which encompass the required range of return period events at periods in time. This approach, rationalised the number of runs required, as one model simulation result is used to represent several different return periods in time (which have equivalent water levels) (Table 2-1 to 2-3).

For example, at Cowes, a 1 in 200-year tide event in 2015 (2.99m AOD) closely resembles tide 1 in 100-year tide event in 2025 (2.98m AOD). As such, at this strategic level, and given the envelope of future uncertainty this simulation can be considered representative of both events in time.

Each model simulates the conditions of wave overtopping and still water levels. A limited range of overtopping boundary data was supplied with the hydraulic models. The wave overtopping discharge was $0.2m^3/s/m$, which capped the overtopping discharges observed by the external consultant; this was done because $0.2m^3/s/m$ is a significant volume of water in the EurOtop manual (Pullen et al., 2007) in terms of potentially causing structural damage and breaching. The capped figure also resolved instabilities in the TUFLOW model. Further explanation of the approach to overtopping is described in the Isle of Wight Coastal Remedial Works report accompanying the modelling (JBA Consulting, 2015). The approach used in the models was agreed by the Environment Agency, as was the subsequent adoption of the models for use in the Strategy.

The supplied overtopping data was only incorporated at Freshwater Bay because of its exposure to storm conditions, and wave overtopping is interpreted to be a key contributory factor to flooding; the winter flooding of 2013/14 was a good demonstration of wave overtopping at Freshwater Bay. The other locations, Cowes and Gurnard are in more sheltered locations and flooding is largely dependent on still water flooding. This would avoid over estimation of flood risk from unrealistic combined events.

Sensitivity testing confirmed that in terms of flood extents and depths, the influence of overtopping in the Cowes and Gurnard models is very marginal relative to still water level impacts, and therefore exclusion of overtopping is considered satisfactory for informing this strategic level study. For Freshwater Bay, however, the influence of overtopping was actually less evident than anticipated and still water flooding was the dominant mechanism. Despite this finding, overtopping was retained in the Freshwater Bay model because this is an appropriate representation of known flood mechanisms at this location.

The model runs covering the range of return period events over time is present for each model in Tables 2-1 to 2-3.

The flood mapping is presented for each of the main flood risk areas for selected return period events in Appendix A. Flood risk mapping is also provided in Appendix B at the ODU scale, for both the present day and 2115 1:200 year tidal flood events.

Table 2-1 - Cowes Run Specification

Run ID	Tidal Return Period	Climate Change Epoch	Peak Tide Level (m AOD)	Overtopping Included
1	2-year 1-year	2015	2.53 2.51	No
2	20-year 10-year 2-year	2015 2025 2055	2.77 2.76 2.79	No
3	5-year 75-year 50-year	2055 2015 2025	2.90 2.89 2.92	No
4	10-year 200-year 100-year 75-year	2055 2015 2025 2025	2.97 2.99 2.98 2.95	No
5	200-year 500-year 20-year	2025 2015 2055	3.05 3.08 3.05	No
6	1000-year 75-year 1-year	2025 2055 2115	3.21 3.18 3.23	No
7	2-year 200-year	2115 2055	3.32 3.28	No
8	1000-year 5-year	2055 2115	3.44 3.44	No
9	20-year	2115	3.60	No
10	75-year	2115	3.74	No
11	200-year	2115	3.86	No
12	1000-year	2115	4.03	No

Table 2-2 – Yarmouth/Freshwater Run Specification					
Run ID	**Tidal Return Period**	**Climate Change Epoch**	**Yarmouth Peak Tide Level (m AOD)**	**Freshwater Peak Tide Level (m AOD)**	**Overtopping Included**
1	2-year 1-year	2015 2025	1.91 1.89	1.55	Yes – Freshwater Bay only
2	20-year	2015	2.15	1.78	Yes – Freshwater Bay only
3	5-year 75-year 50-year	2055 2015 2025	2.28 2.27 2.30	1.91	Yes – Freshwater Bay only
4	200-year 100-year 75-year 10-year	2015 2025 2025 2055	2.35 2.35 2.33 2.35	1.98	Yes – Freshwater Bay only
5	500-year 200-year 20-year	2015 2025 2055	2.44 2.41 2.43	2.06	Yes – Freshwater Bay only
6	1000-year 75-year	2025 2055	2.56 2.56	2.18	Yes – Freshwater Bay only
7	200-year 1-year	2055 2115	2.65 2.61	2.28	Yes – Freshwater Bay only
8	5-year 1000-year	2115 2055	2.82 2.80	2.45	Yes – Freshwater Bay only
9	20-year	2115	2.98	2.61	Yes – Freshwater Bay only
10	75-year	2115	3.13	2.76	Yes – Freshwater Bay only
11	200-year	2115	3.22	2.85	Yes – Freshwater Bay only
12	1000-year	2115	3.39	3.01	Yes – Freshwater Bay only

Table 2-3 - Gurnard Run Specification				
Run ID	Tidal Return Period	Climate Change Epoch	Peak Tide Level (m AOD)	Overtopping Included
1	2-year 1-year	2015 2025	2.43 2.41	No
2	20-year 10-year 2-year	2015 2025 2055	2.67 2.66 2.69	No
3	5-year 75-year 50-year	2055 2015 2025	2.80 2.79 2.82	No
4	10-year 200-year 75-year	2055 2115 2025	2.87 2.88 2.85	No
5	20-year 500-year 200-year	2055 2015 2025	2.95 2.97 2.94	No
6	1000-year 75-year 1-year	2025 2055 2115	3.10 3.08 3.13	No
7	2-year 200-year	2115 2055	3.22 3.17	No
8	5-year 1000-year	2115 2055	3.34 3.34	No
9	20-year	2115	3.50	No
10	75-year	2115	3.65	No
11	200-year	2115	3.75	No
12	1000-year	2115	3.93	No

3. Hydraulic Model - Summary

March 2016

The three hydraulic models which represent the tidal and overtopping interaction at Cowes, Yarmouth/Freshwater and Gurnard have been internally reviewed by Capita | AECOM and are considered suitable for their application in the strategic level of assessment; this conclusion has subsequently been confirmed by the Environment Agency.

As and when further improved model data is made available, this should be reviewed and incorporated in future detailed studies, or in an update of the Strategy modelling should fundamental differences in the results be identified within the study programme.

The Technical Review Certificates for all hydraulic models updated within this report are provided in Appendix C.

November 2016

Following the public consultation on the Strategy in Spring 2016, additional studies were undertaken for the Gurnard Luck area, including a flood modelling review and update for this area to take account of improved information. Details of these further works are provided in the 'Gurnard Luck – Additional Studies' technical note added to Appendix J - Options Appraisal.

4. References

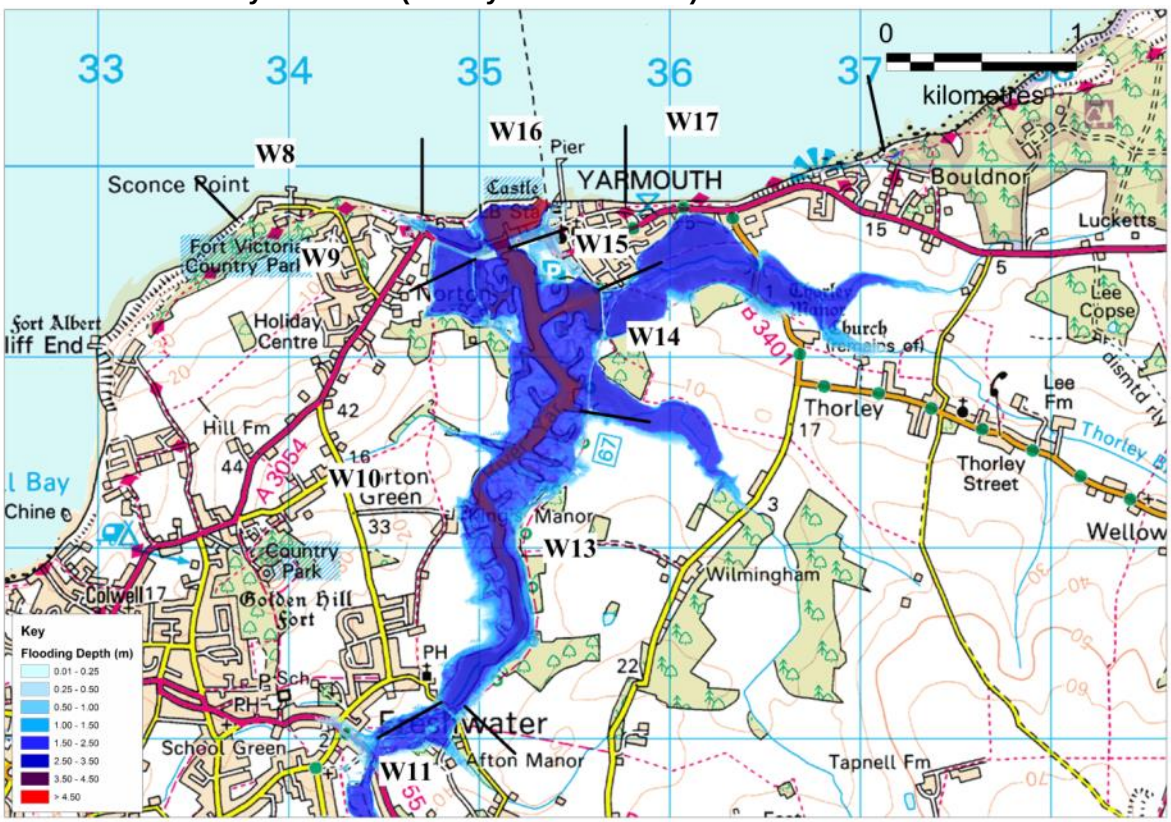
Environment Agency (2010) Flood and Coastal Erosion Risk Management appraisal guidance (FCERM-AG).

JBA Consulting (2015). *Isle of Wight Coastal Remedial Works*. Draft Report, May 2015. For Environment Agency – South East Region.

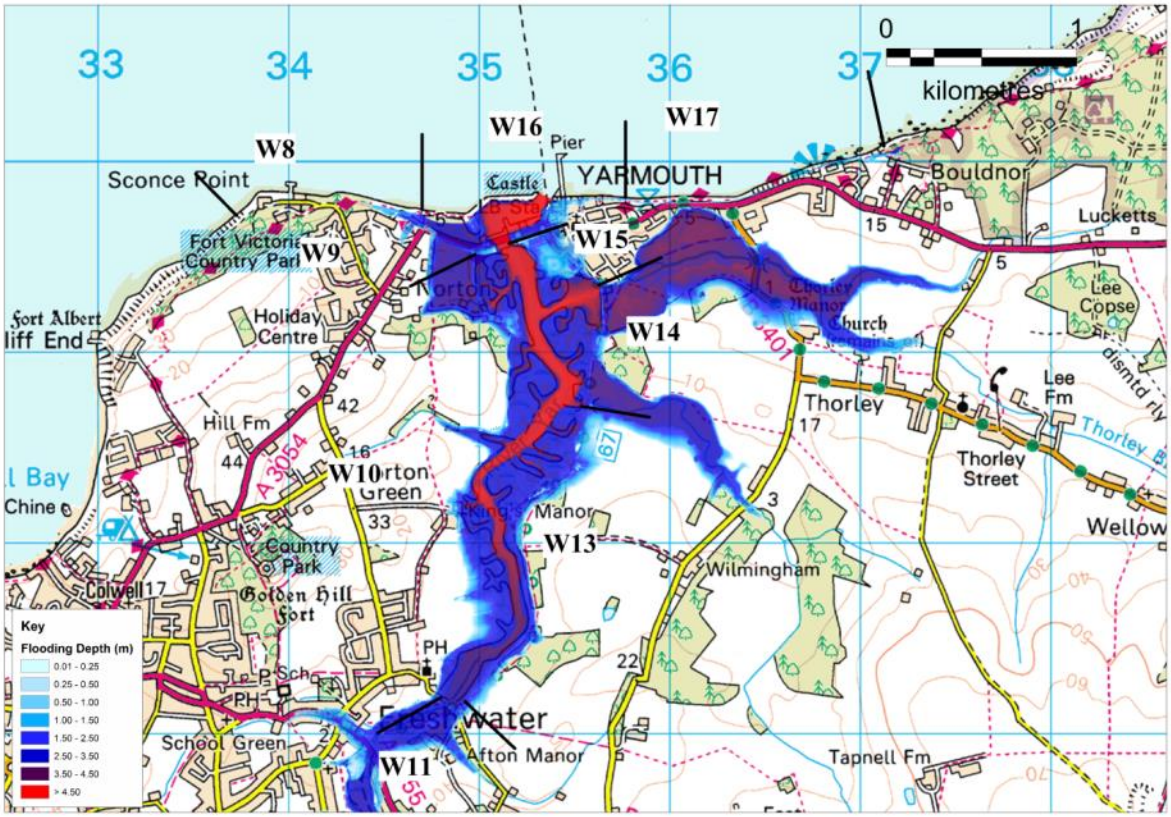
Pullen, T., Allsop, N.W.H., Bruce, T., Kortenhaus, A., Schüttrumpf, H., van der Meer,J.W. (2007). *EurOtop: Wave Overtopping of Sea Defences and Related Structures: Assessment Manual*.

Appendix A – Flood Mapping Outputs (SMZ scale)

Yarmouth - Present day 0.5% AEP (1:200 year flood event)



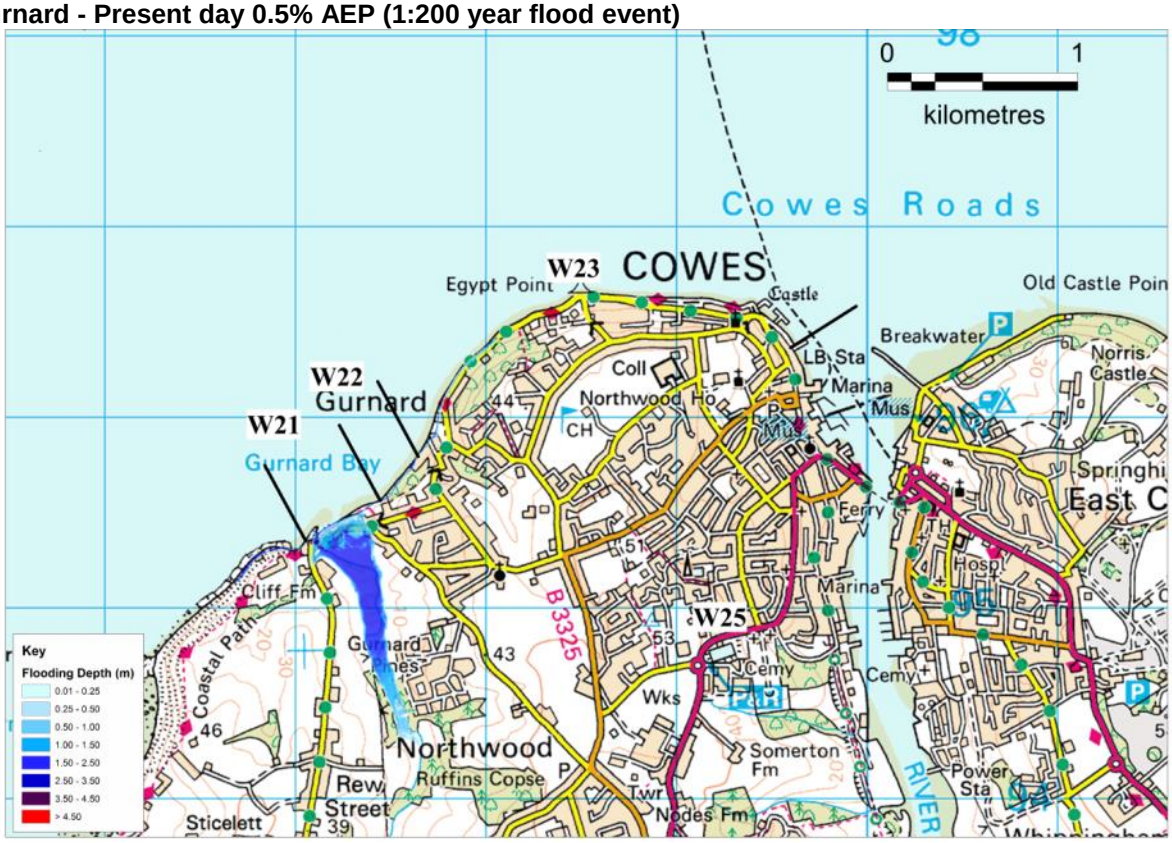
Yarmouth - 2115 0.5% AEP (1:200 year flood event)



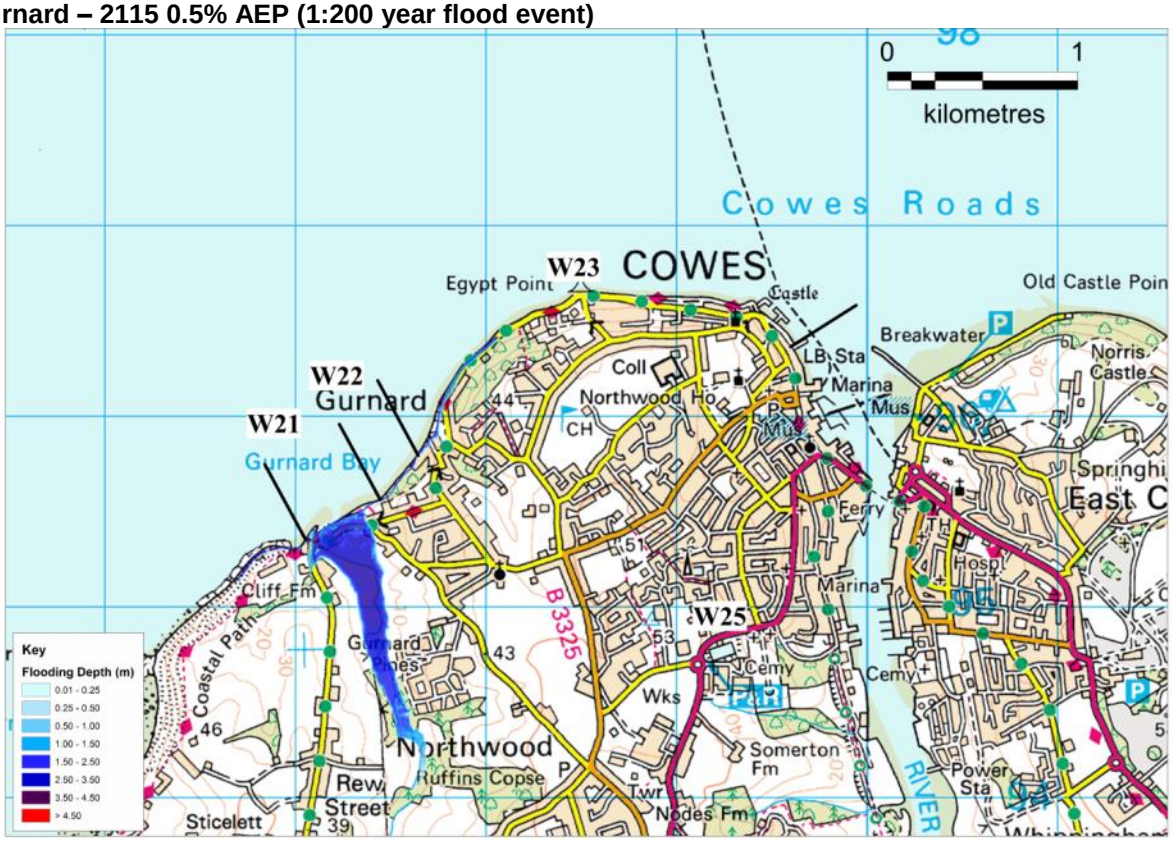
Freshwater - Present day 0.5% AEP (1:200 year flood event)

Freshwater – 2115 0.5% AEP (1:200 year flood event)

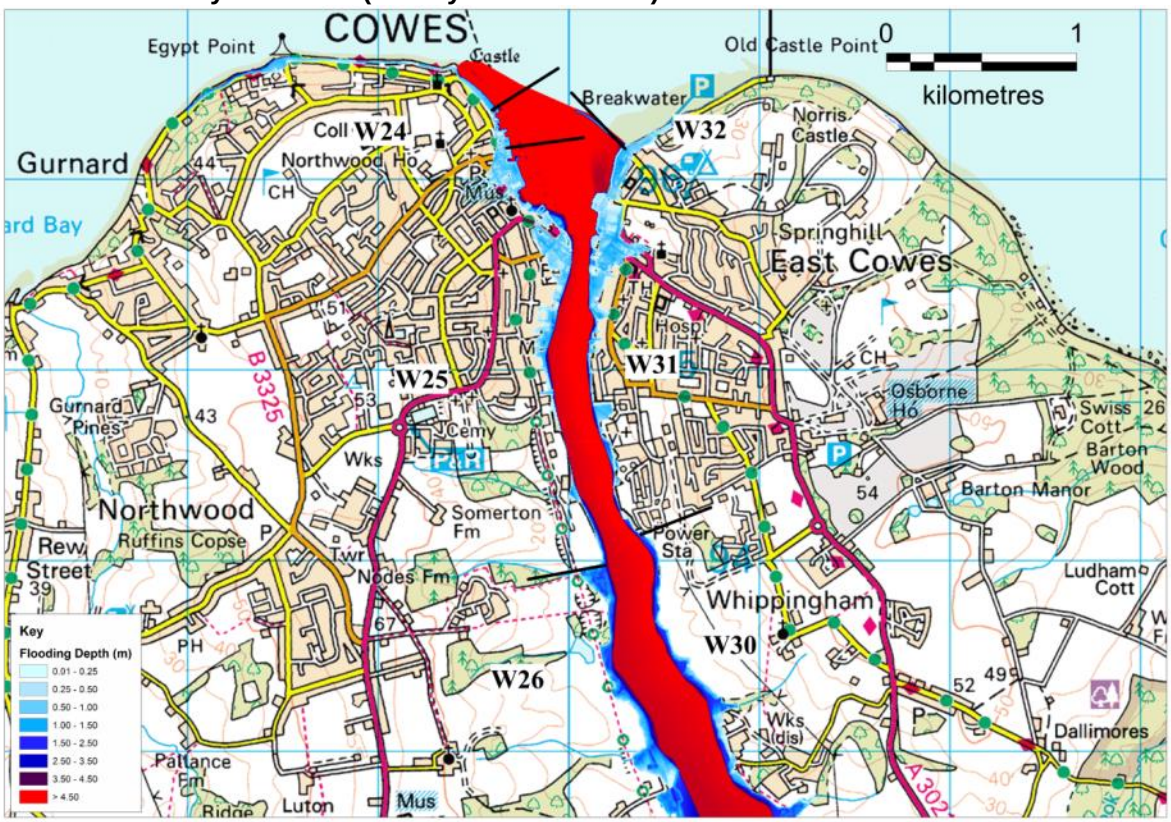
Gurnard - Present day 0.5% AEP (1:200 year flood event)



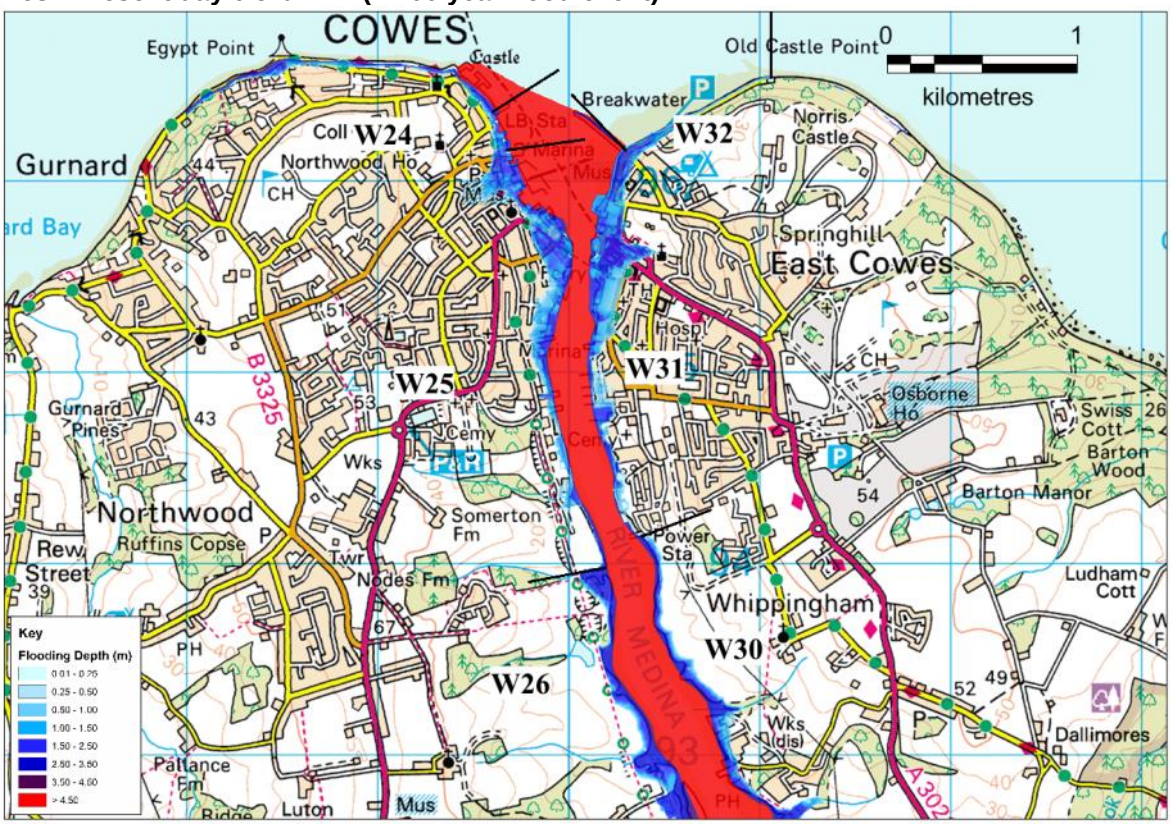
Gurnard – 2115 0.5% AEP (1:200 year flood event)



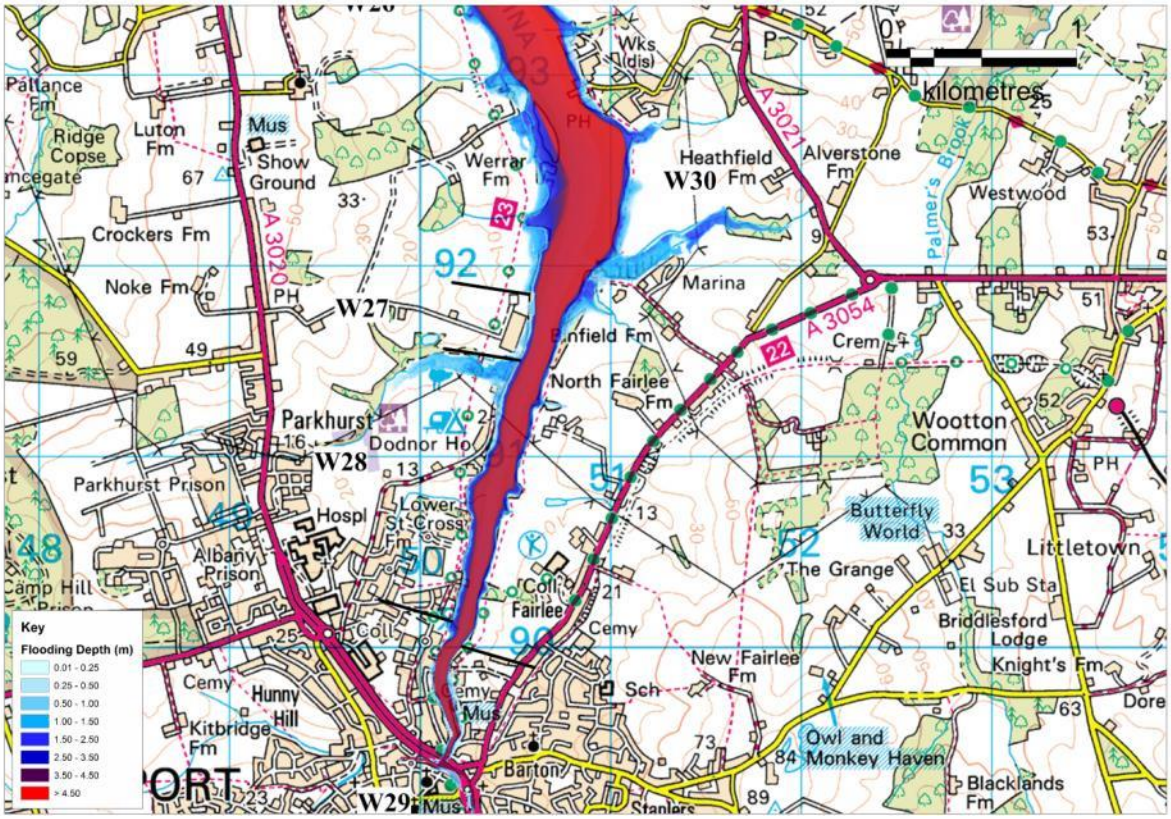
Cowes - Present day 0.5% AEP (1:200 year flood event)



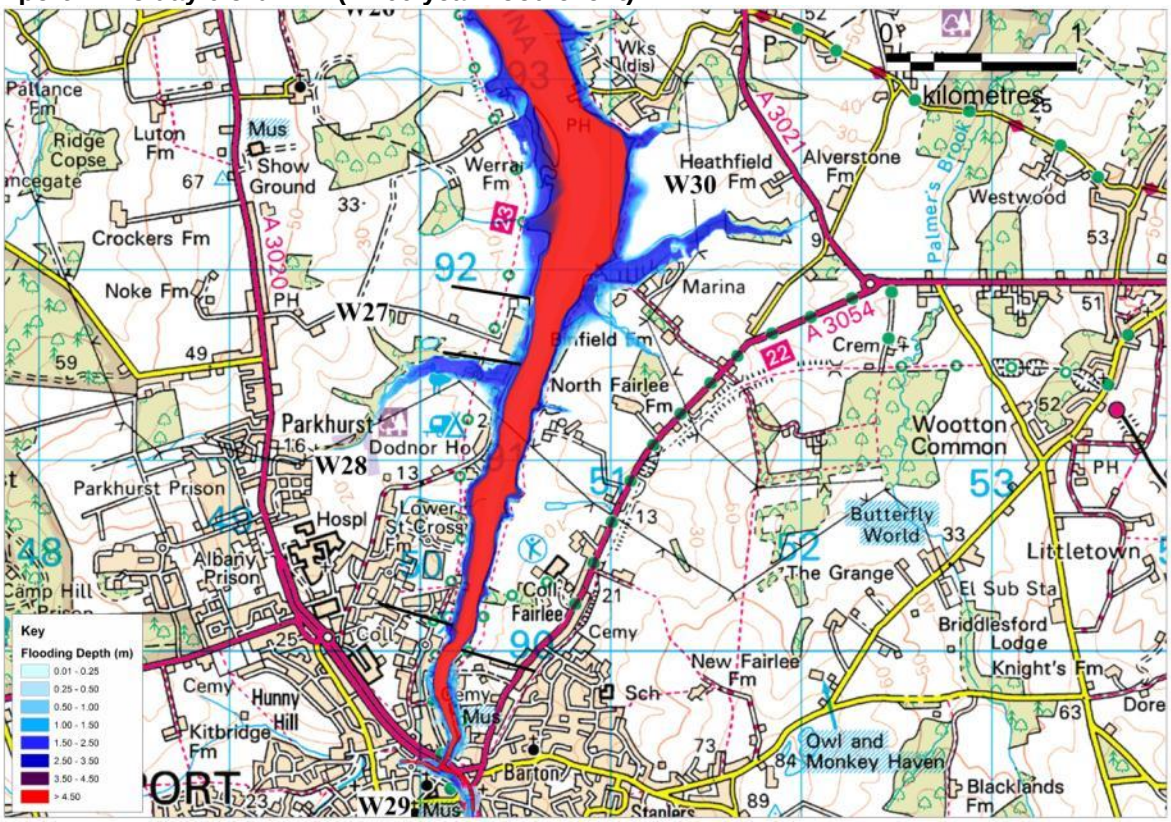
Cowes - Present day 0.5% AEP (1:200 year flood event)



Newport- Present day 0.5% AEP (1:200 year flood event)



Newport- 2115 day 0.5% AEP (1:200 year flood event)

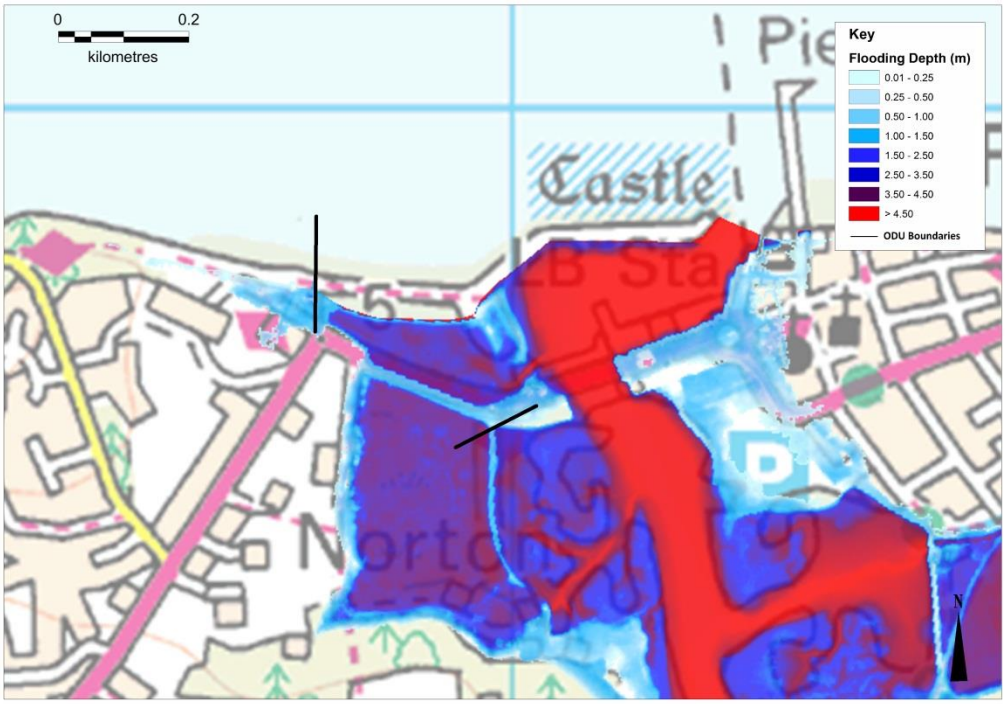


Appendix B – Flood Mapping Outputs (ODU scale)

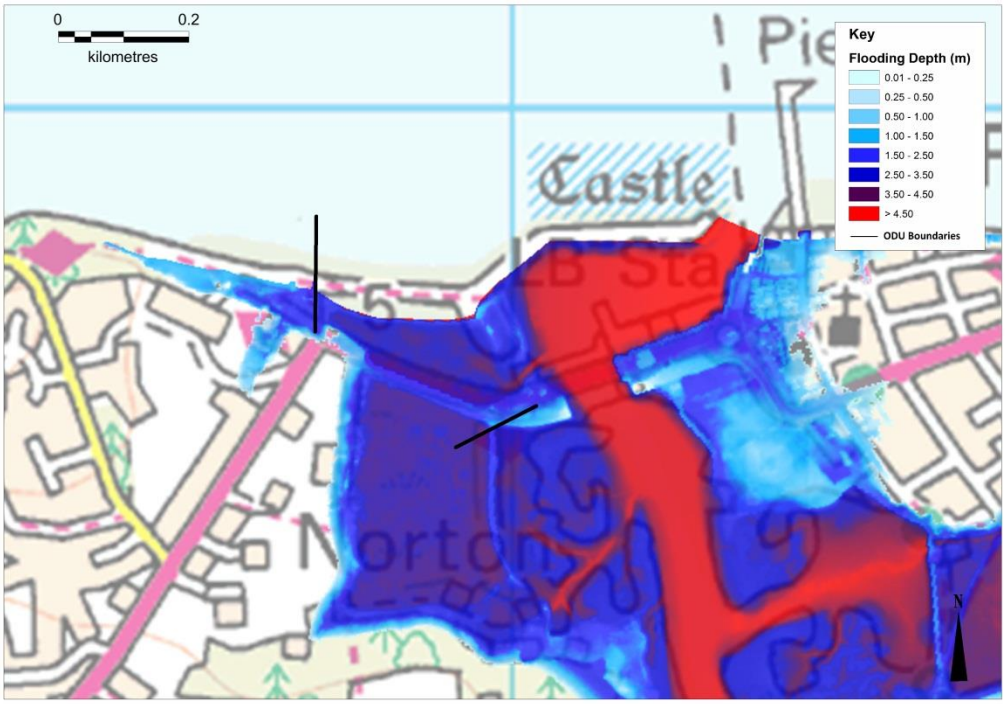
ODU 8 – Present day 0.5% AEP (1:200 year flood event)

ODU 8 – 2115 0.5% AEP (1:200 year flood event)

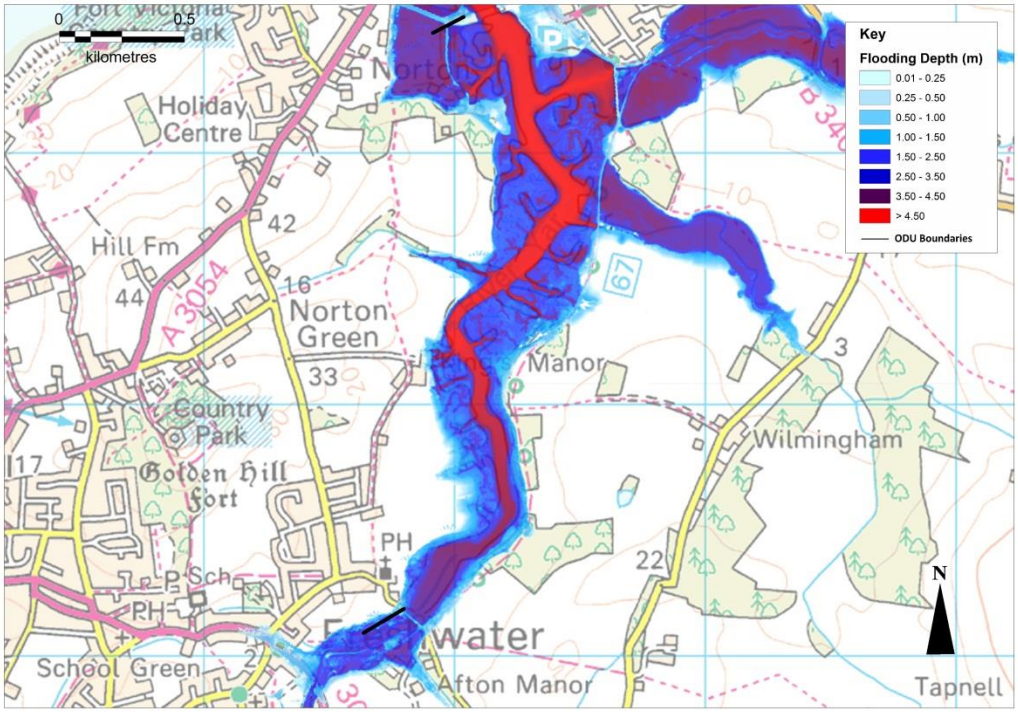
ODU 9 – Present day 0.5% AEP (1:200 year flood event)



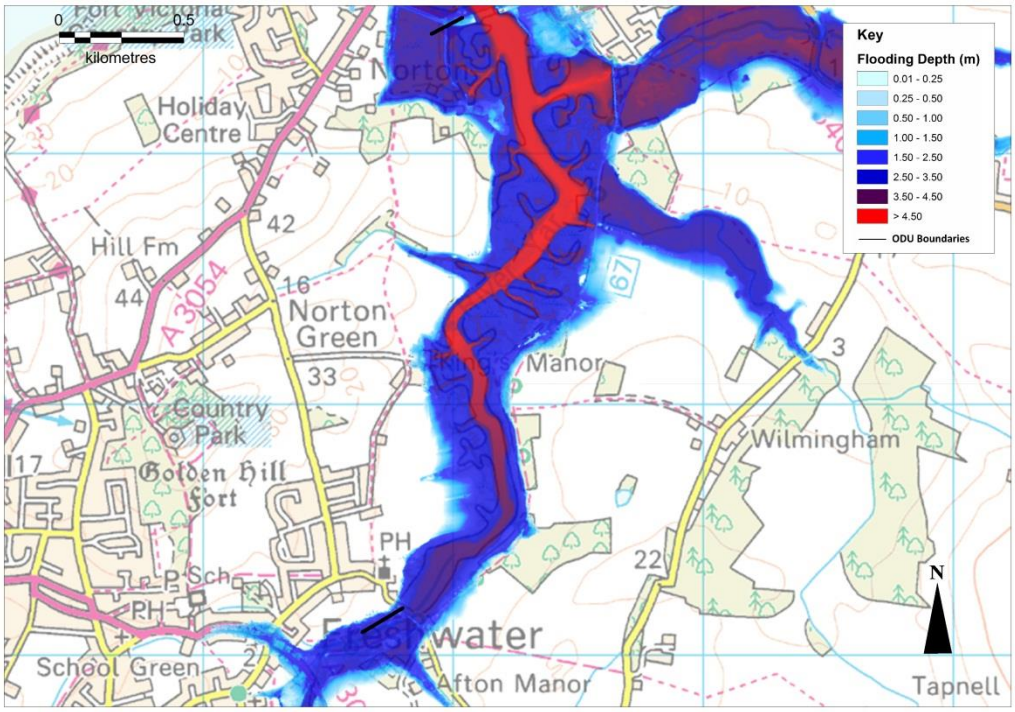
ODU 9 – 2115 0.5% AEP (1:200 year flood event)



ODU 10 – Present day 0.5% AEP (1:200 year flood event)



ODU 10 – 2115 0.5% AEP (1:200 year flood event)



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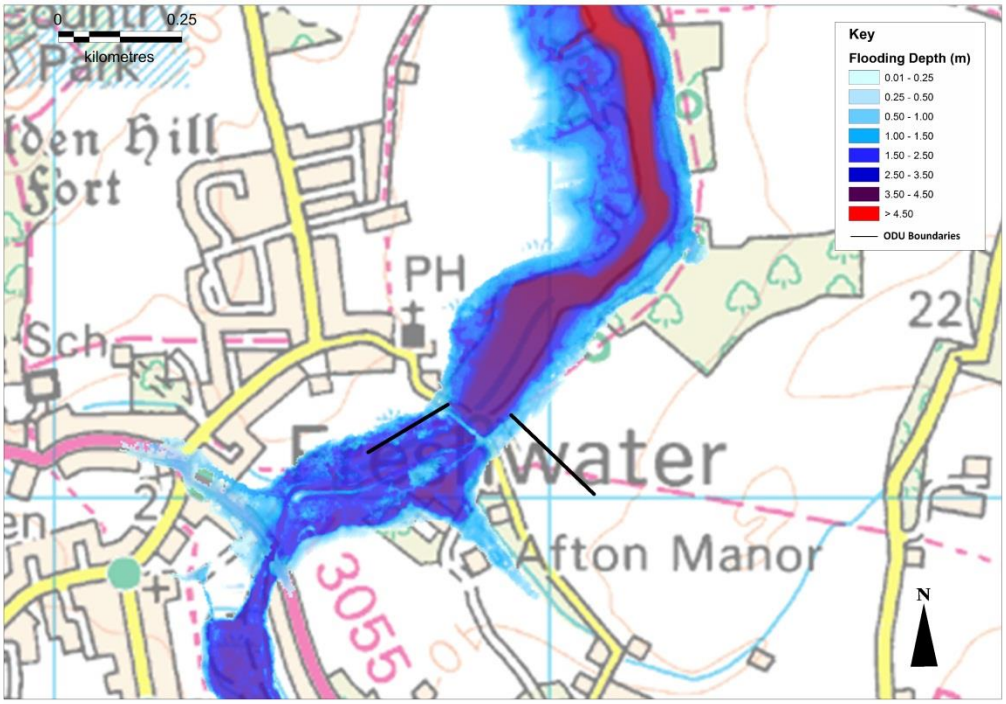
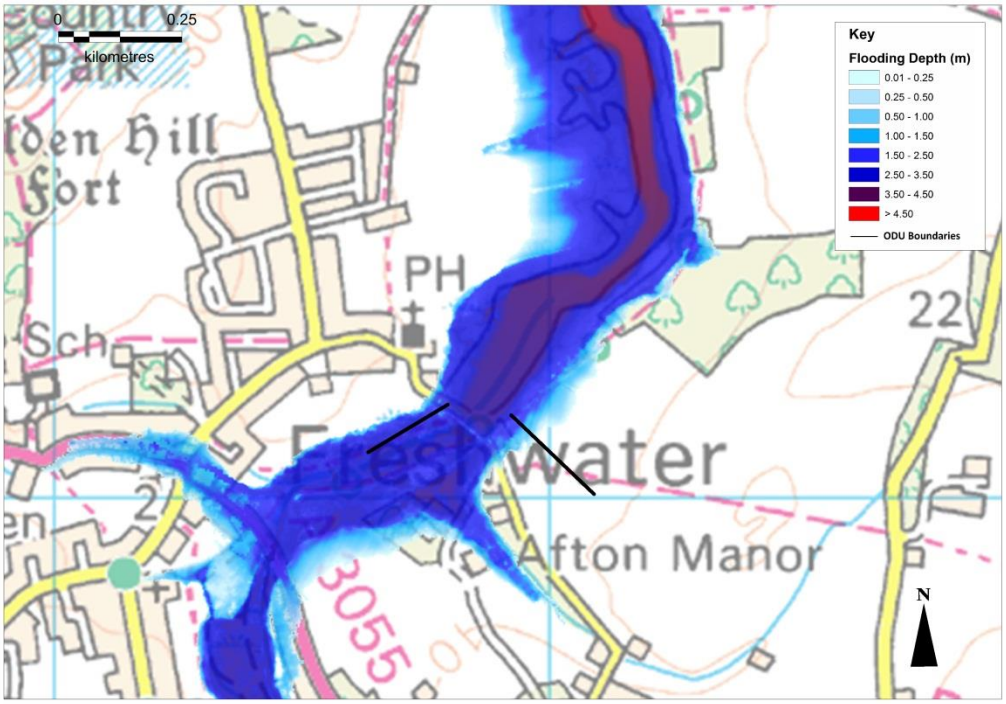


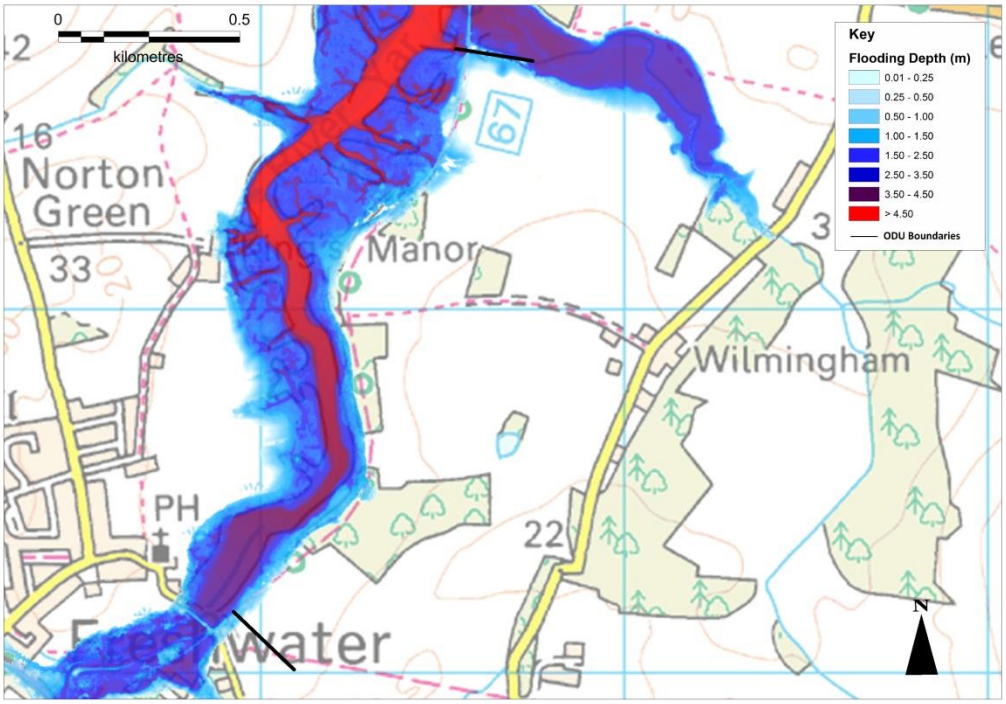
ODU 11 – 2115 0.5% AEP (1:200 year flood event)



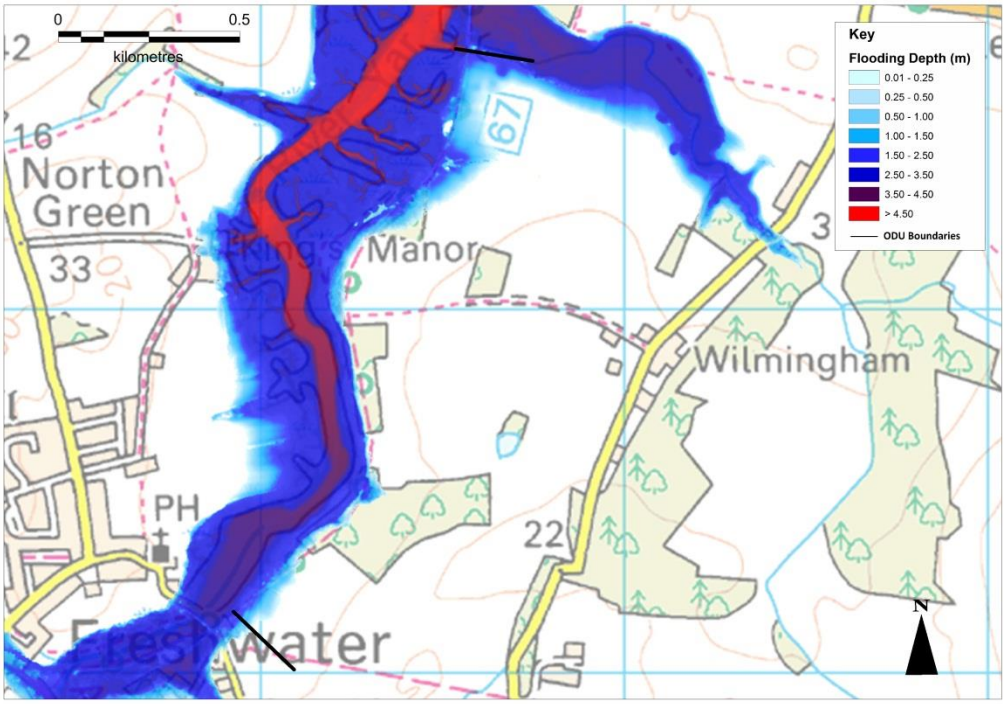
ODU 12 – Present Day 0.5% AEP (1:200 year flood event)

ODU 12 – 2115 0.5% AEP (1:200 year flood event)

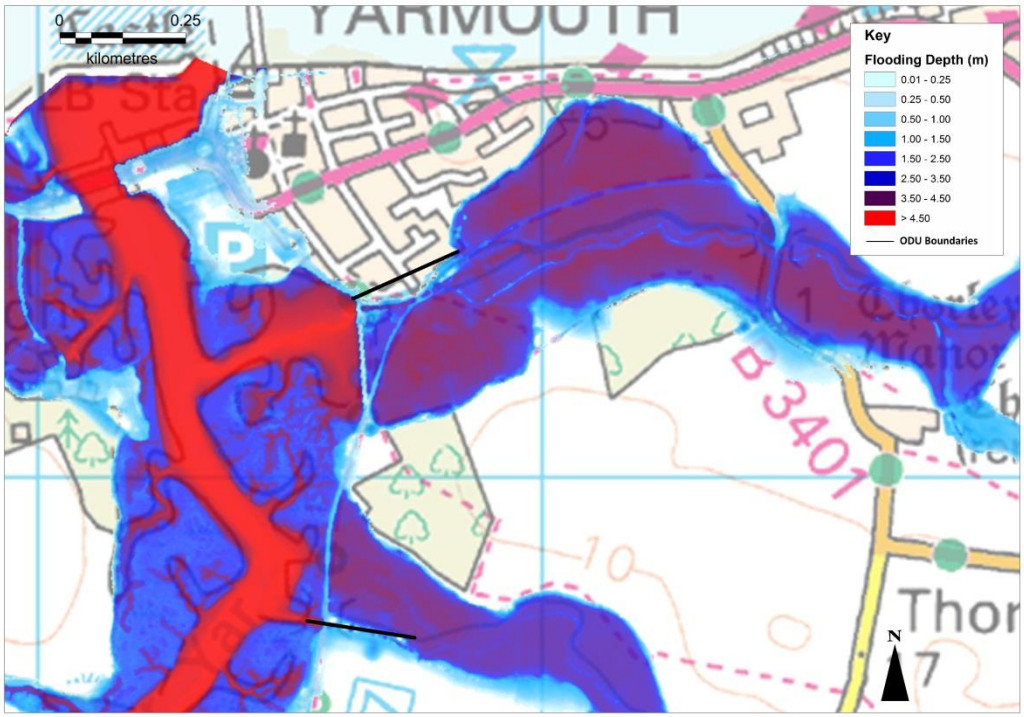
ODU 13 – Present Day 0.5% AEP (1:200 year flood event)



ODU 13 – 2115 0.5% AEP (1:200 year flood event)



ODU 14 – Present Day 0.5% AEP (1:200 year flood event)



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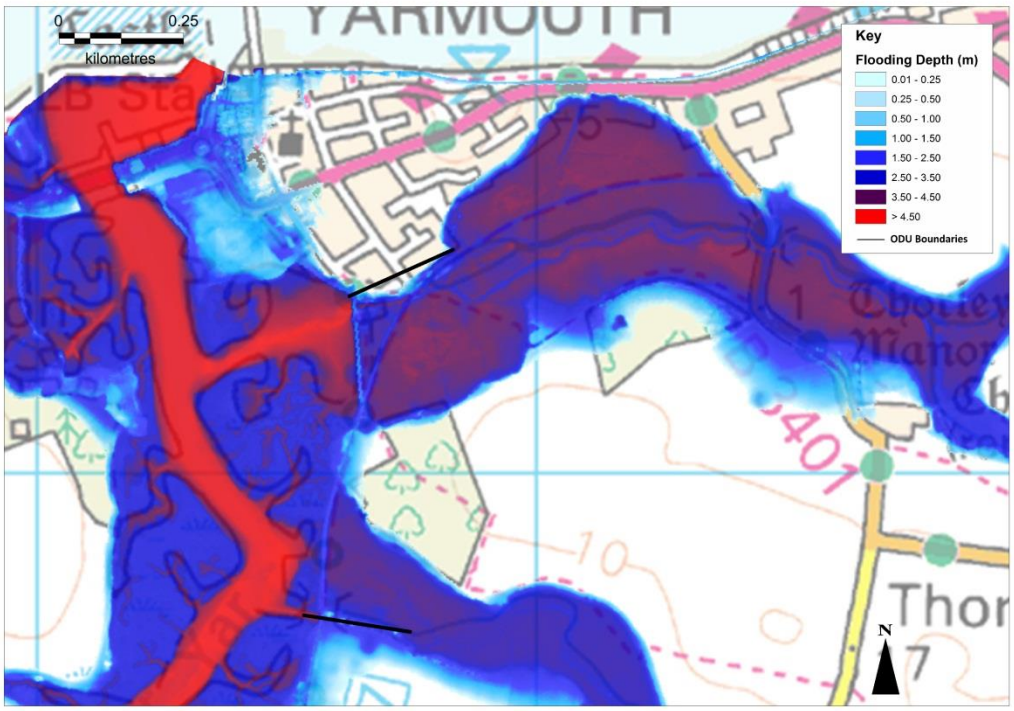

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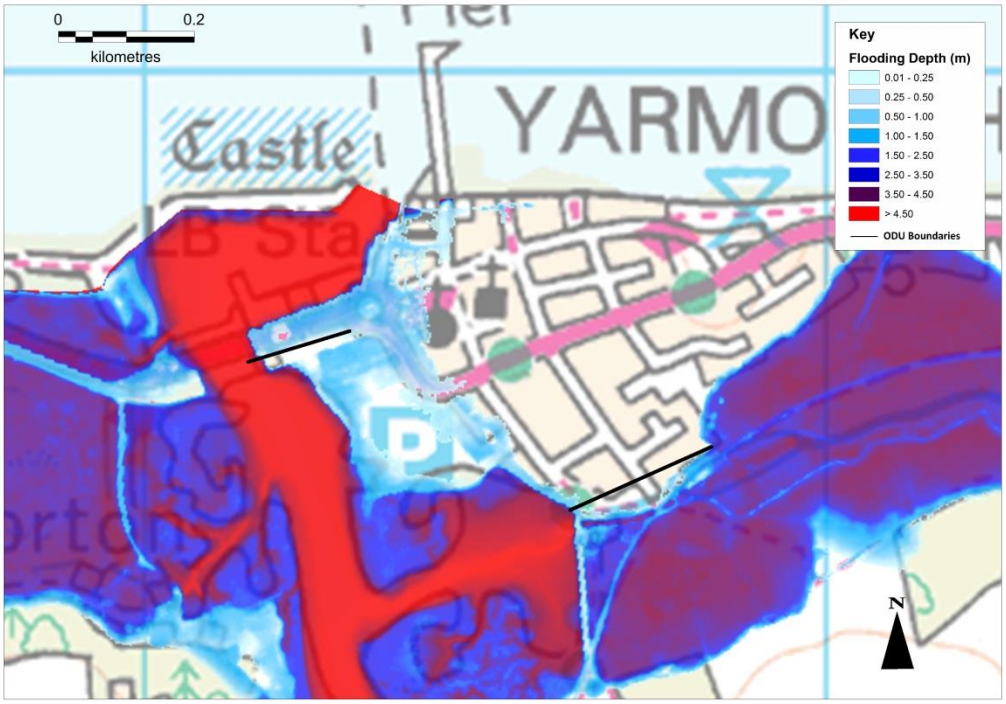
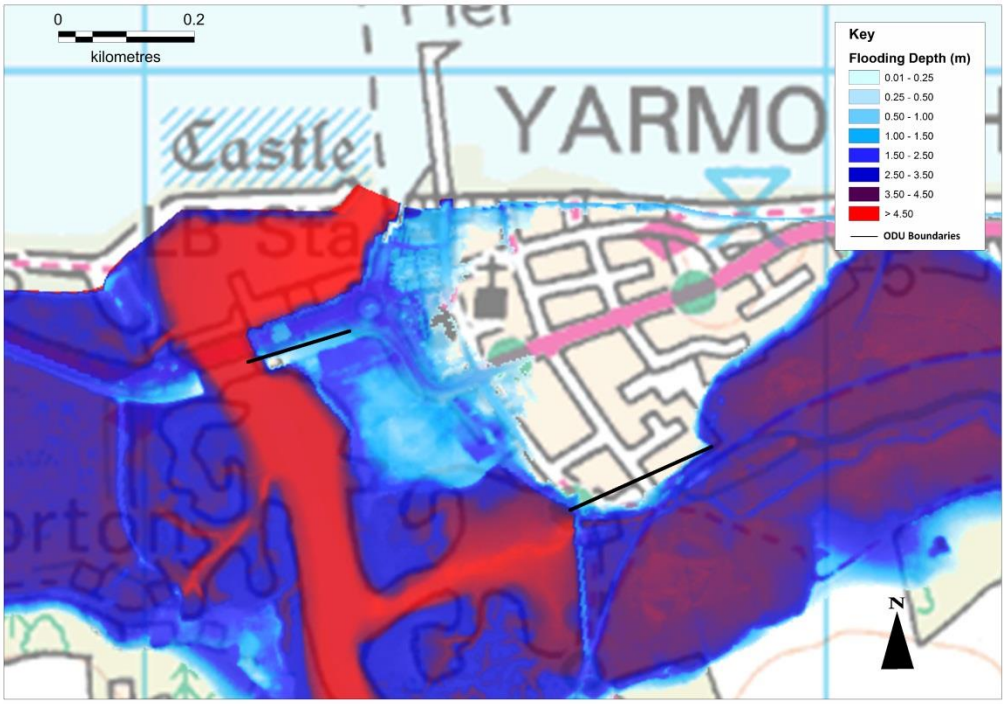


ODU 15 – 2115 0.5% AEP (1:200 year flood event)



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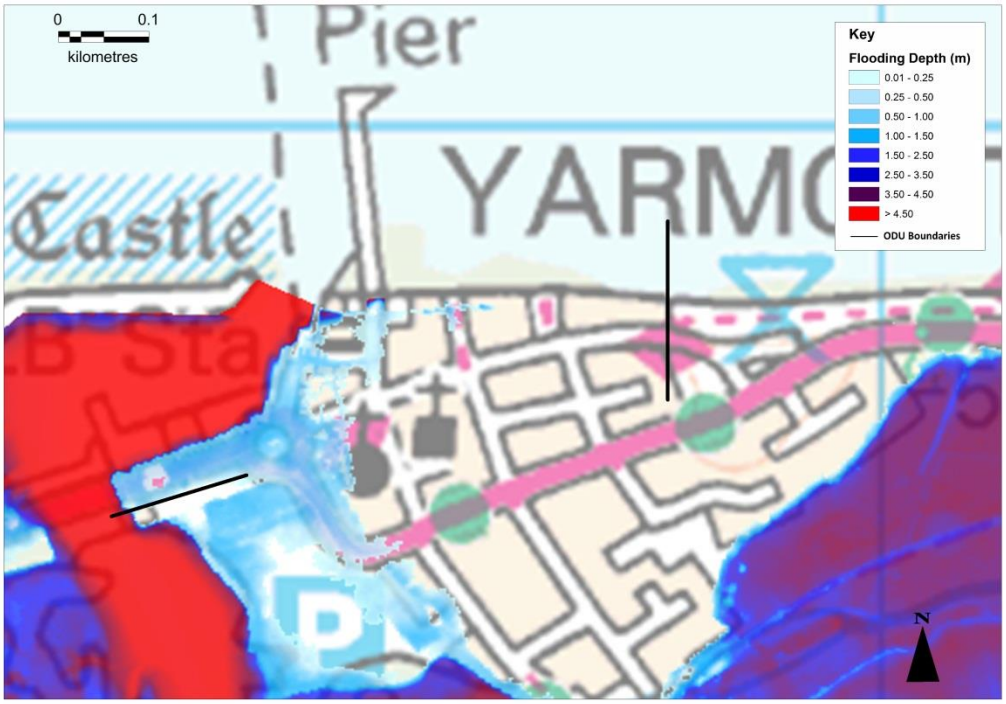

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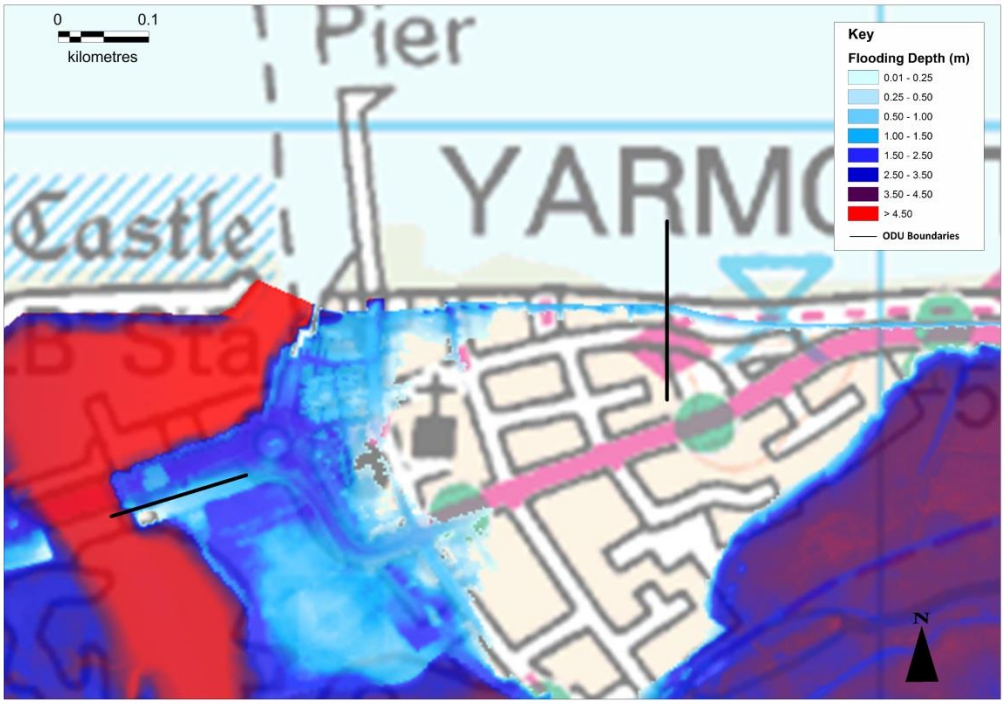

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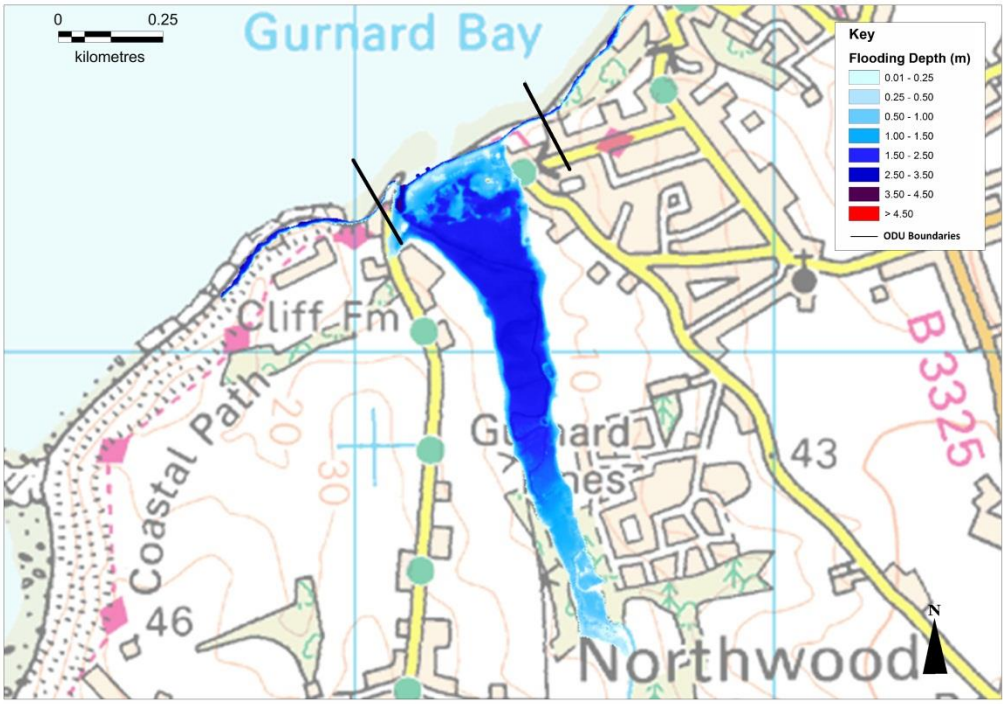

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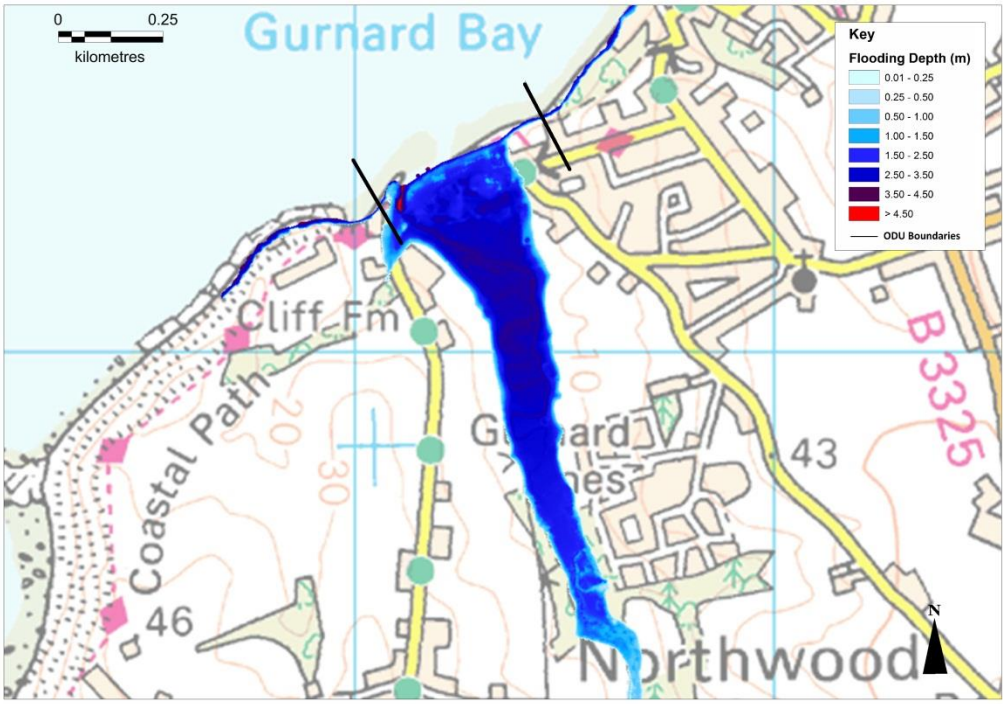

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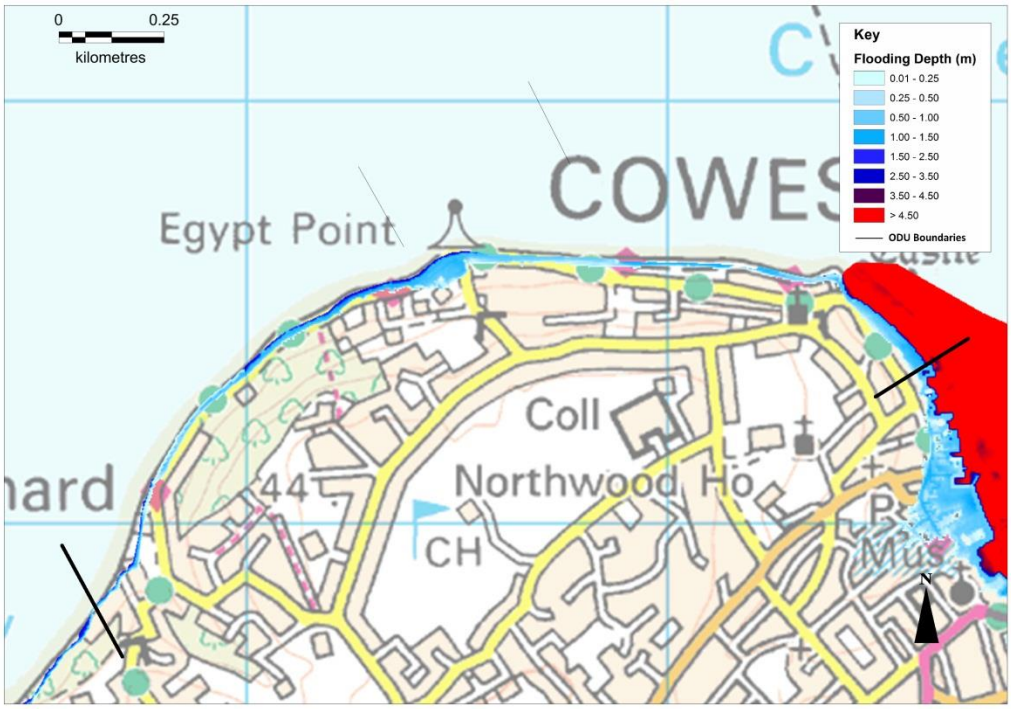

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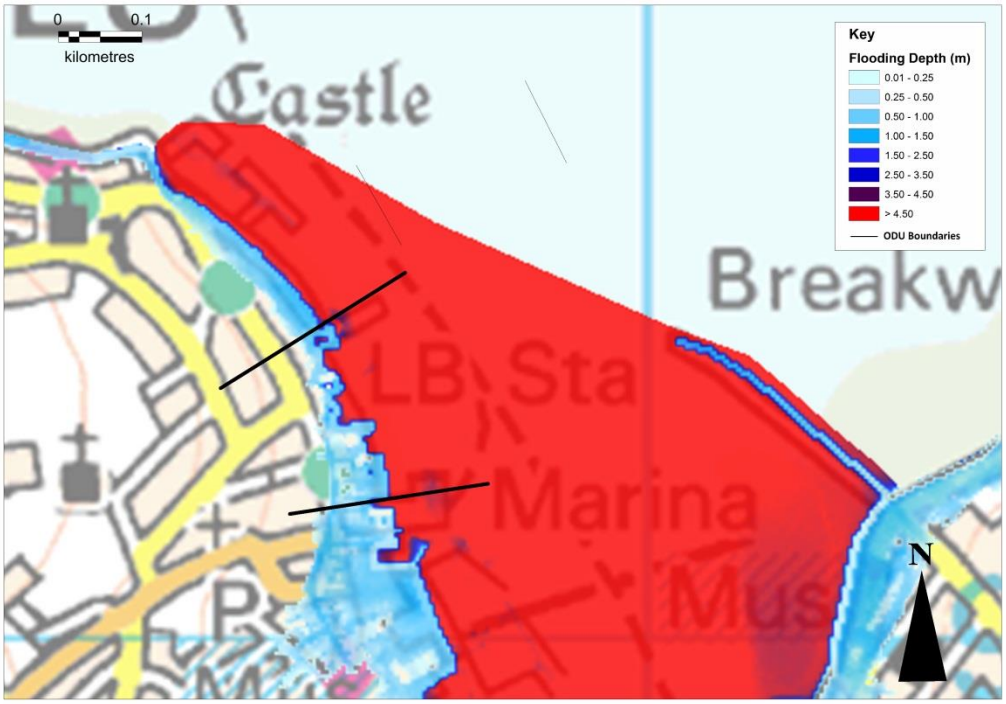

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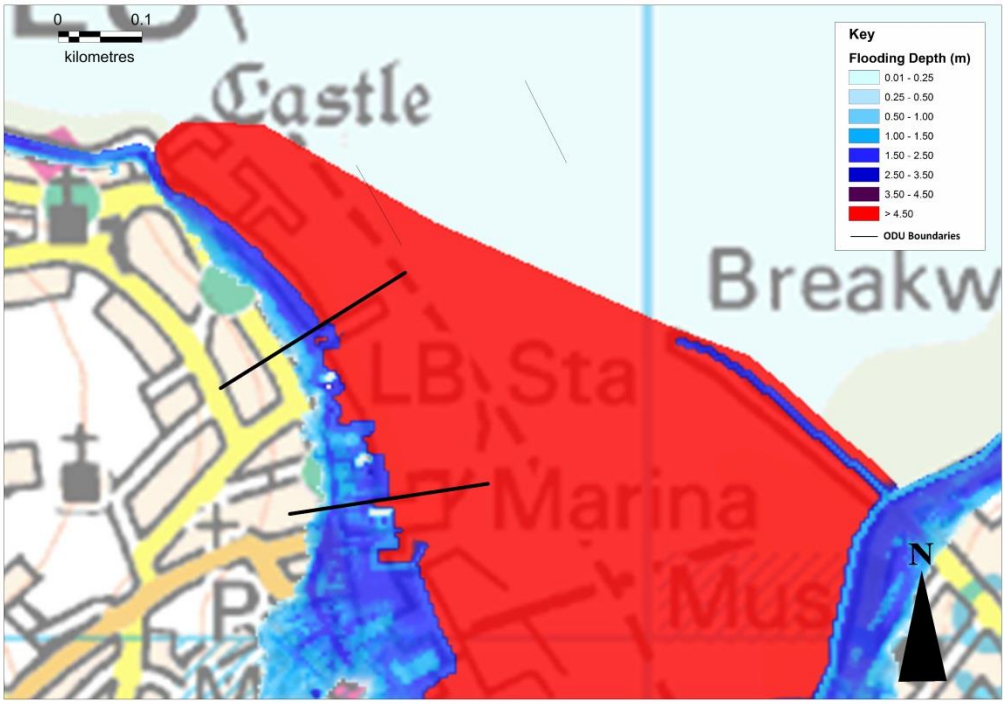

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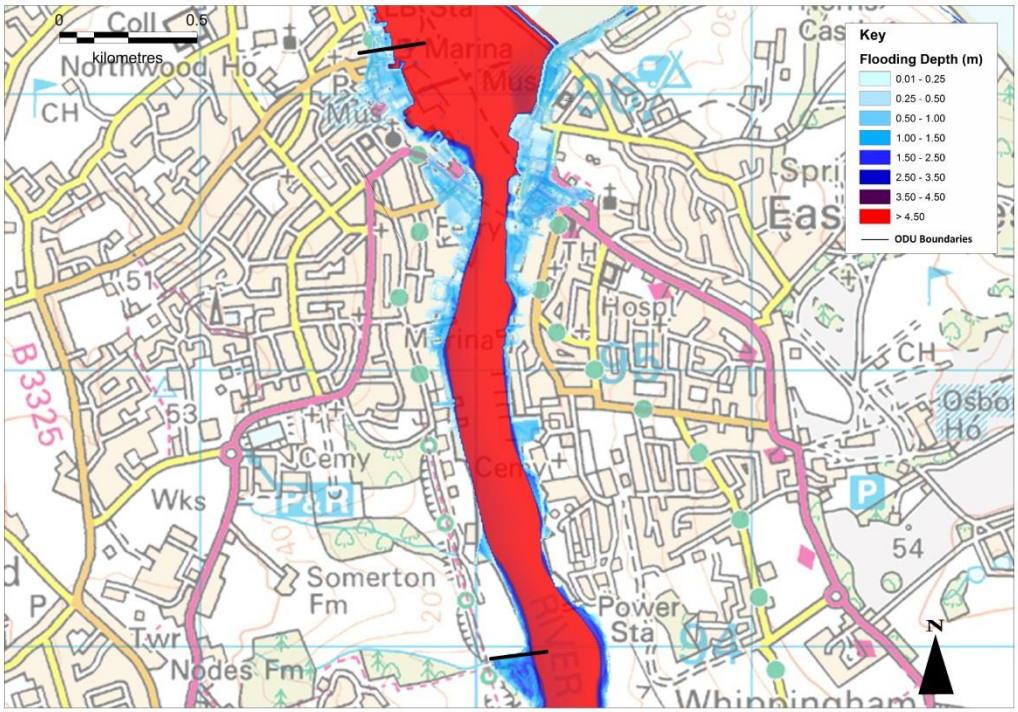
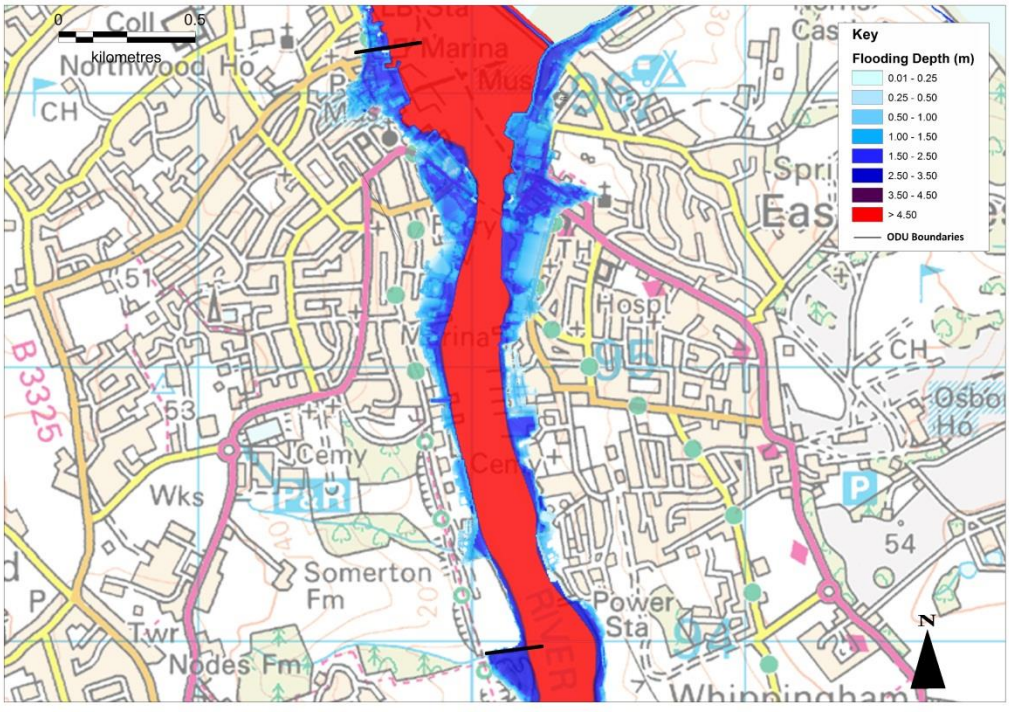
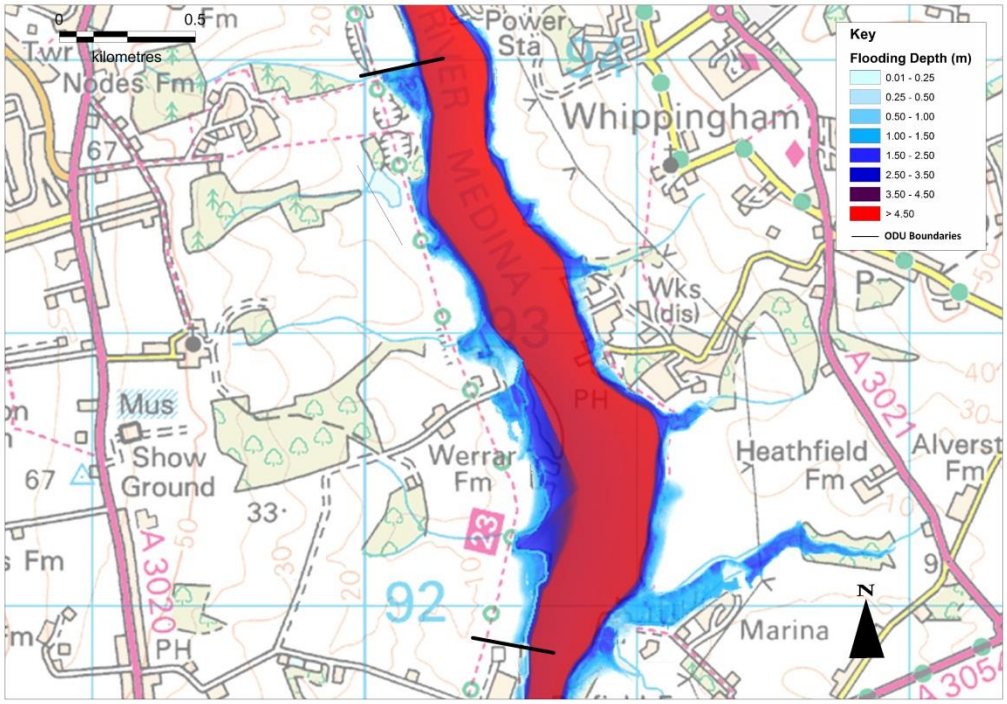


ODU 25 – 2115 0.5% AEP (1:200 year flood event)



ODU 26 – Present Day 0.5% AEP (1:200 year flood event)



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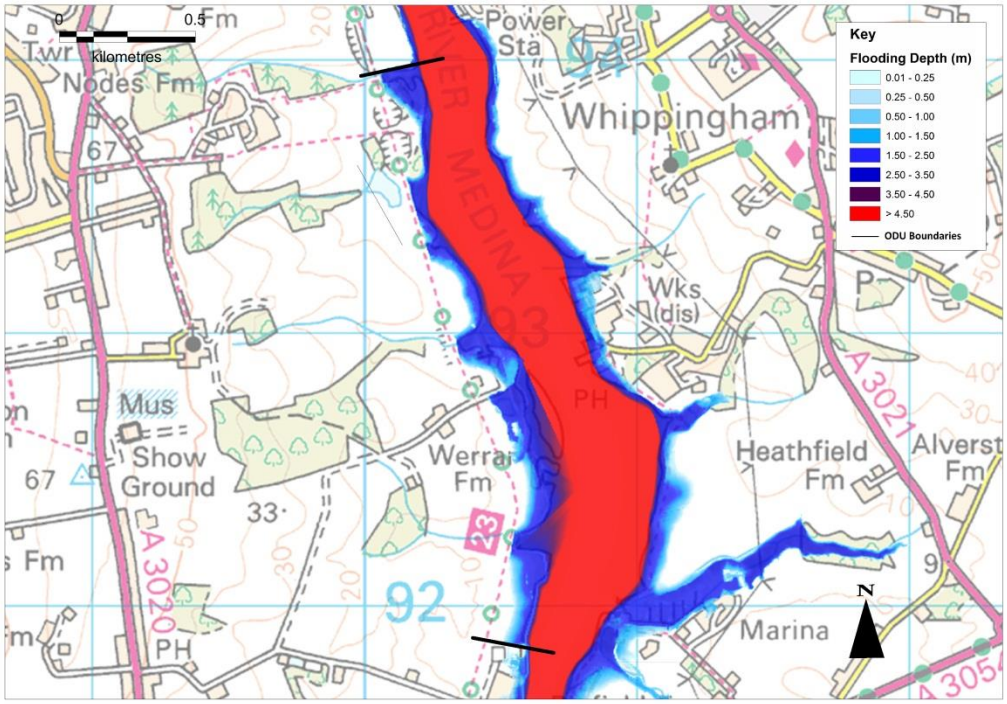
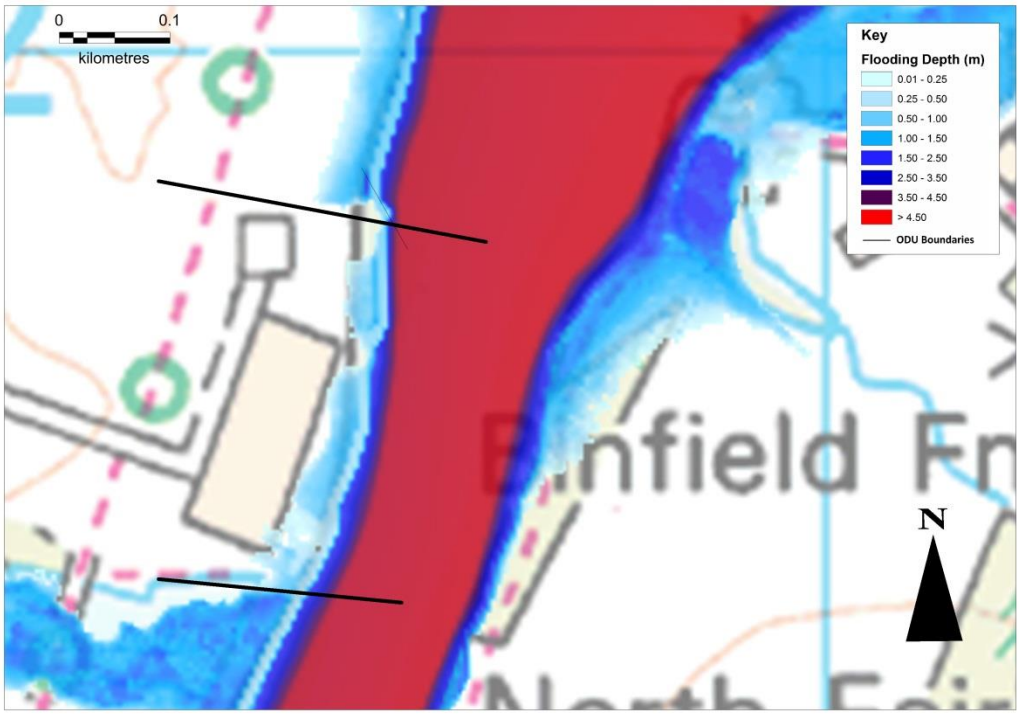


ODU 27 – Present Day 0.5% AEP (1:200 year flood event)



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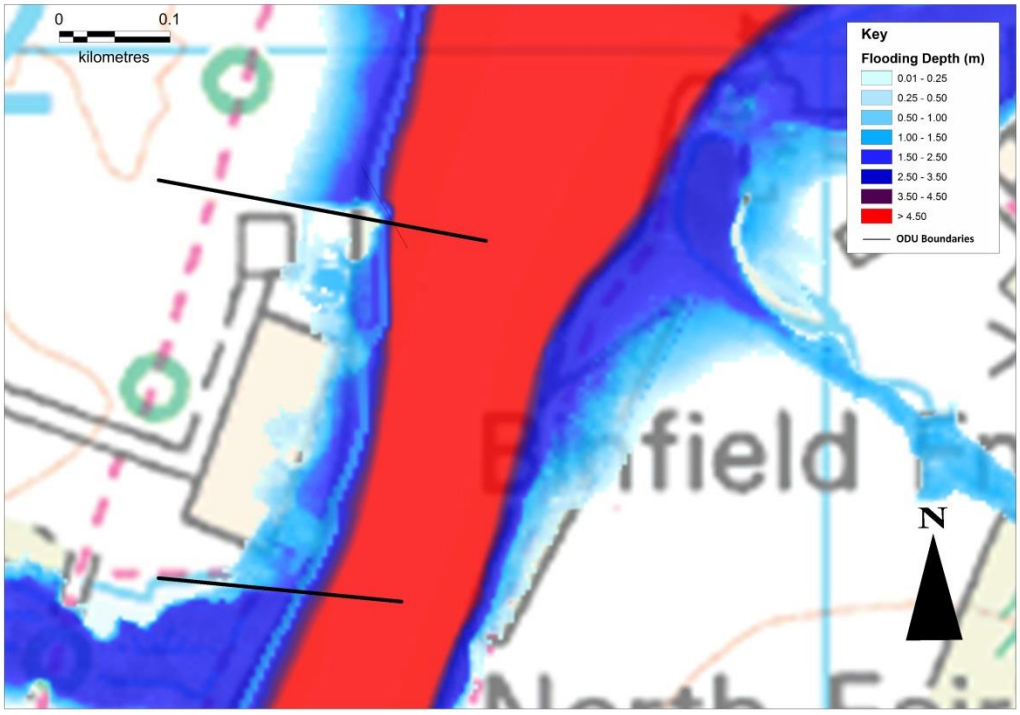
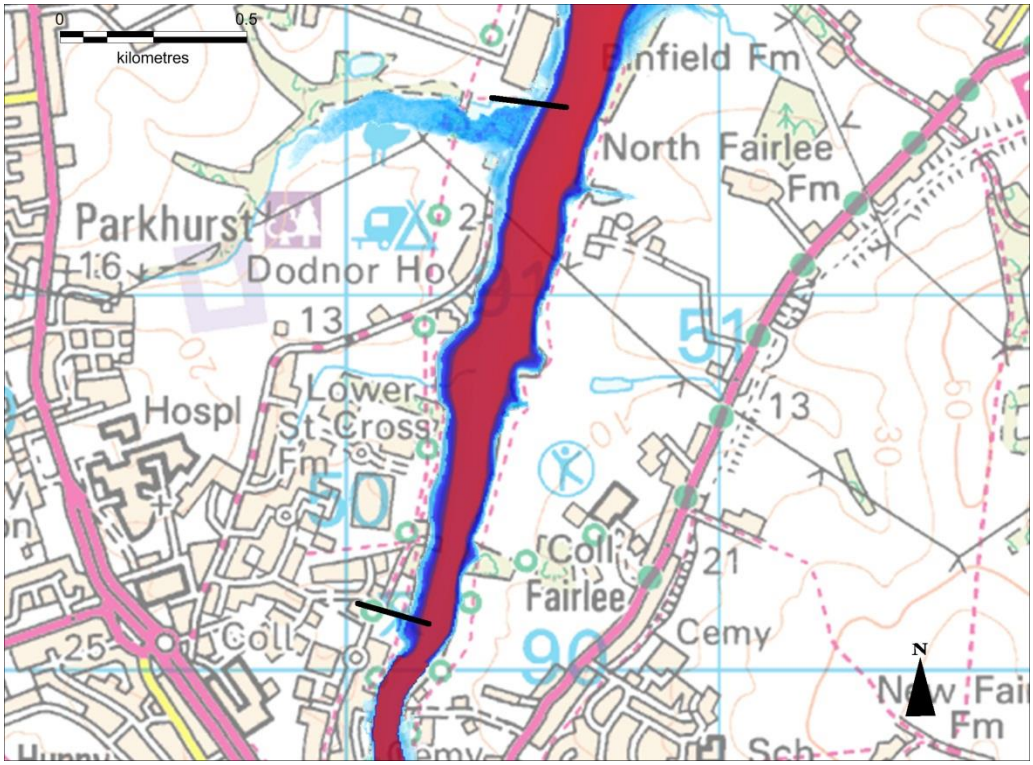


ODU 28 – Present Day 0.5% AEP (1:200 year flood event)



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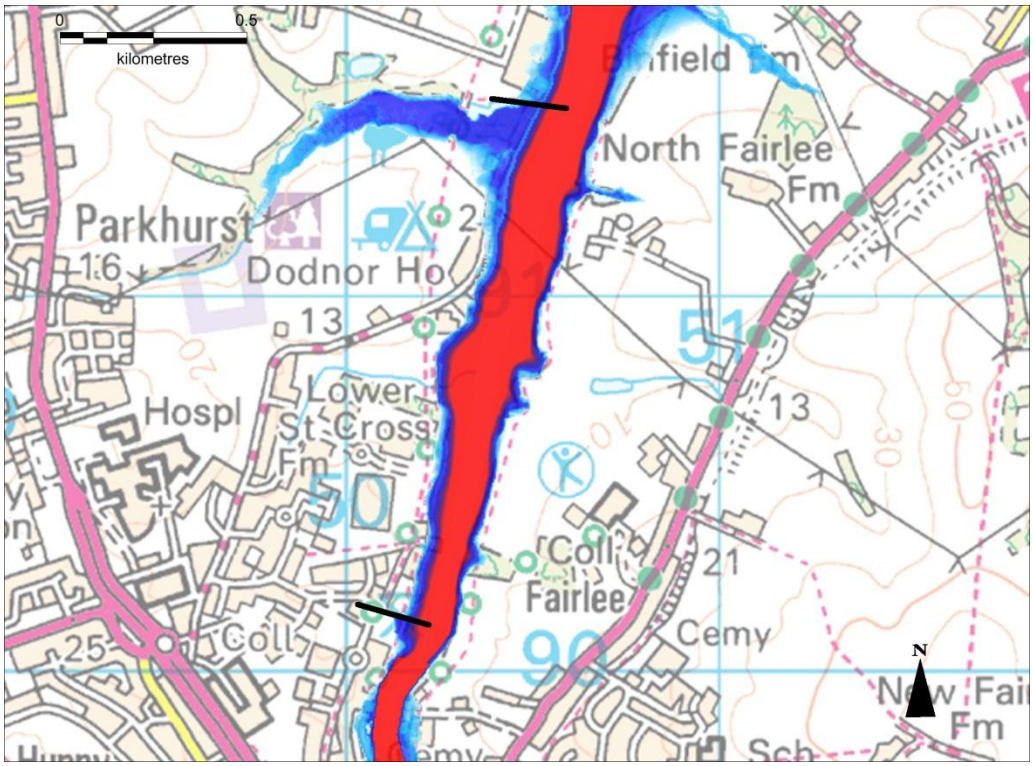

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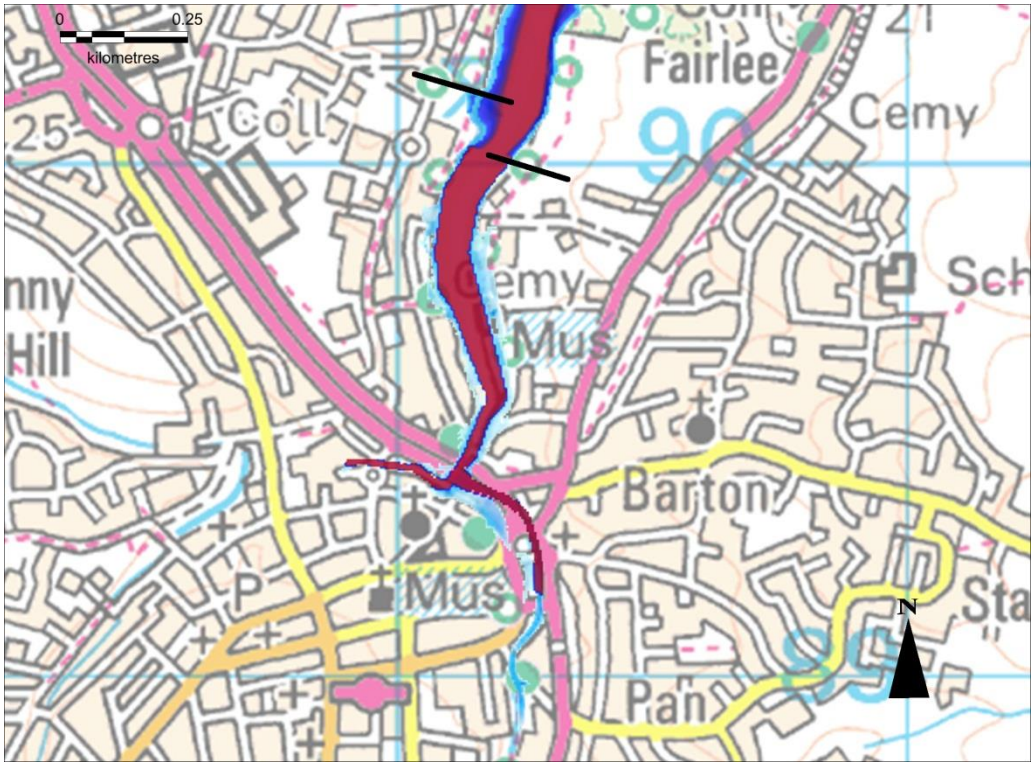
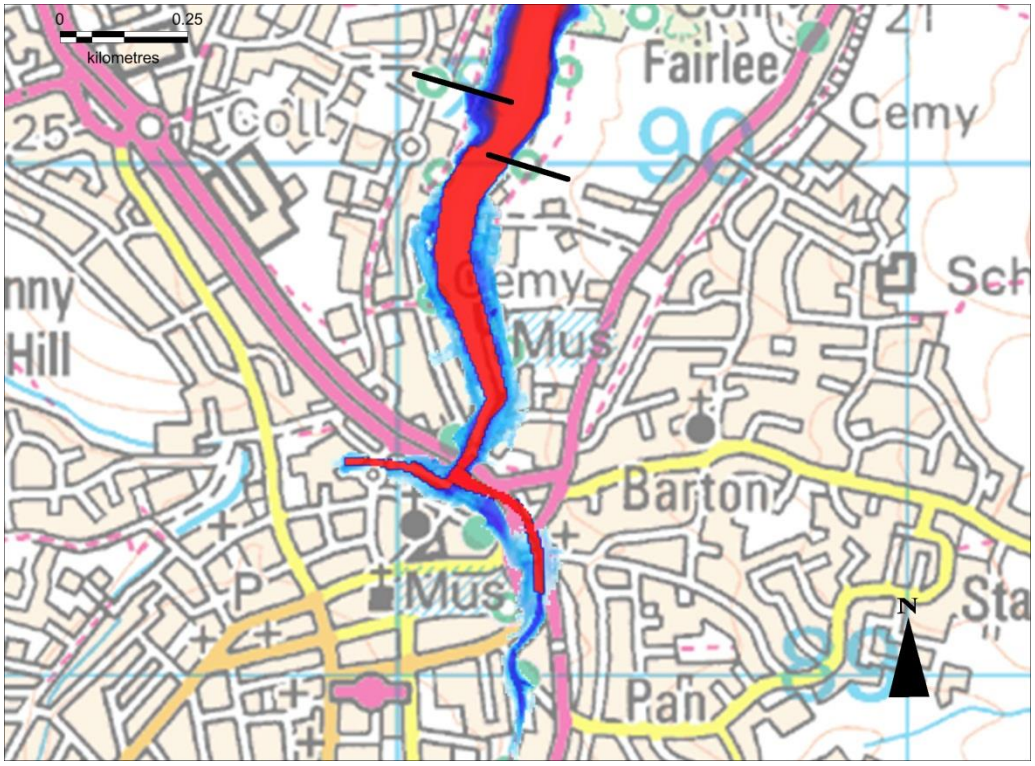
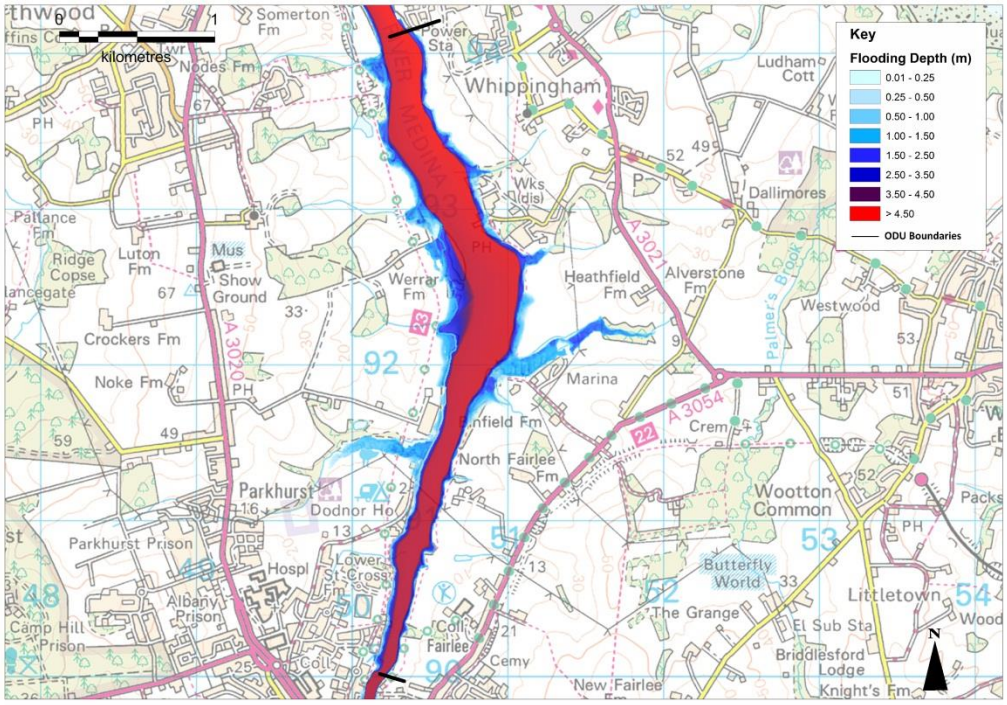


ODU 29 – 2115 0.5% AEP (1:200 year flood event)



ODU 30 – Present Day 0.5% AEP (1:200 year flood event)



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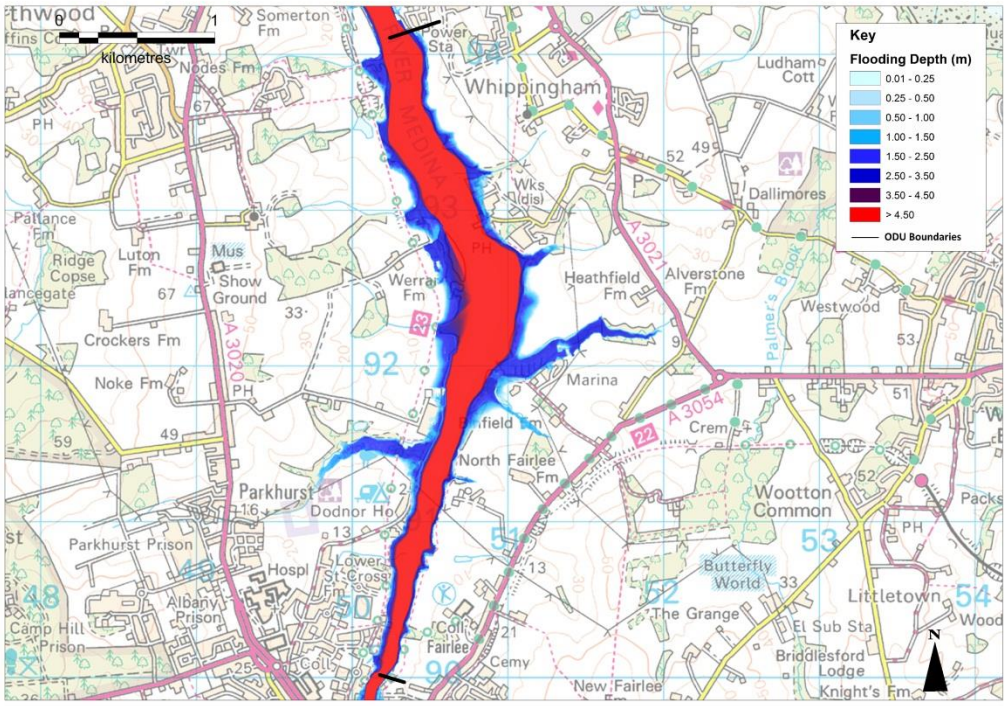
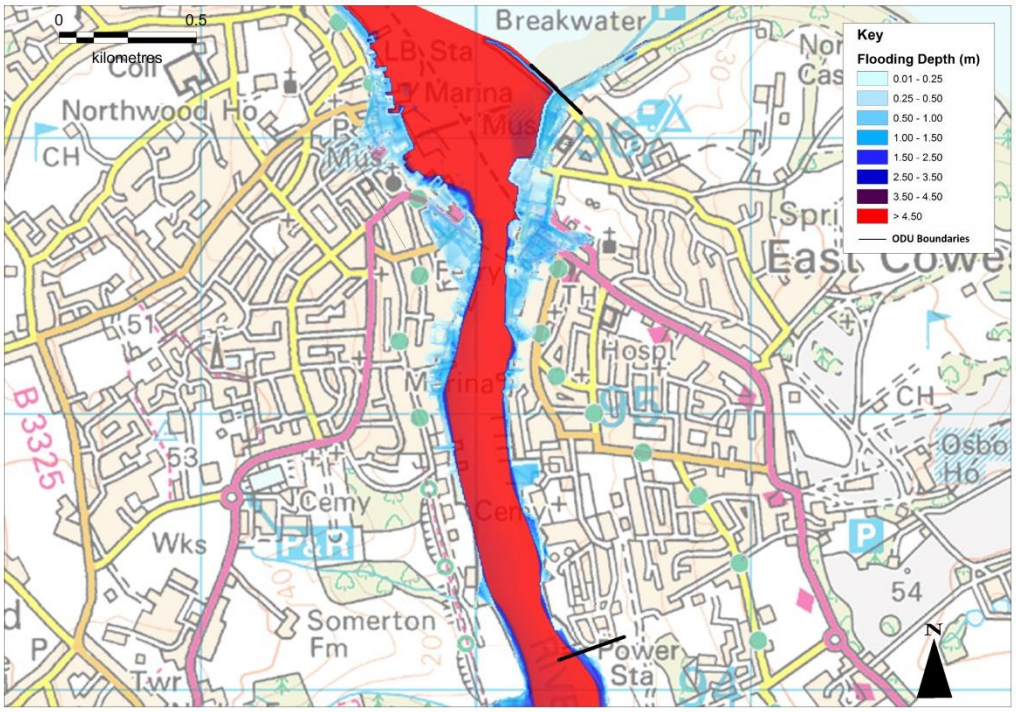


ODU 31 – Present Day 0.5% AEP (1:200 year flood event)



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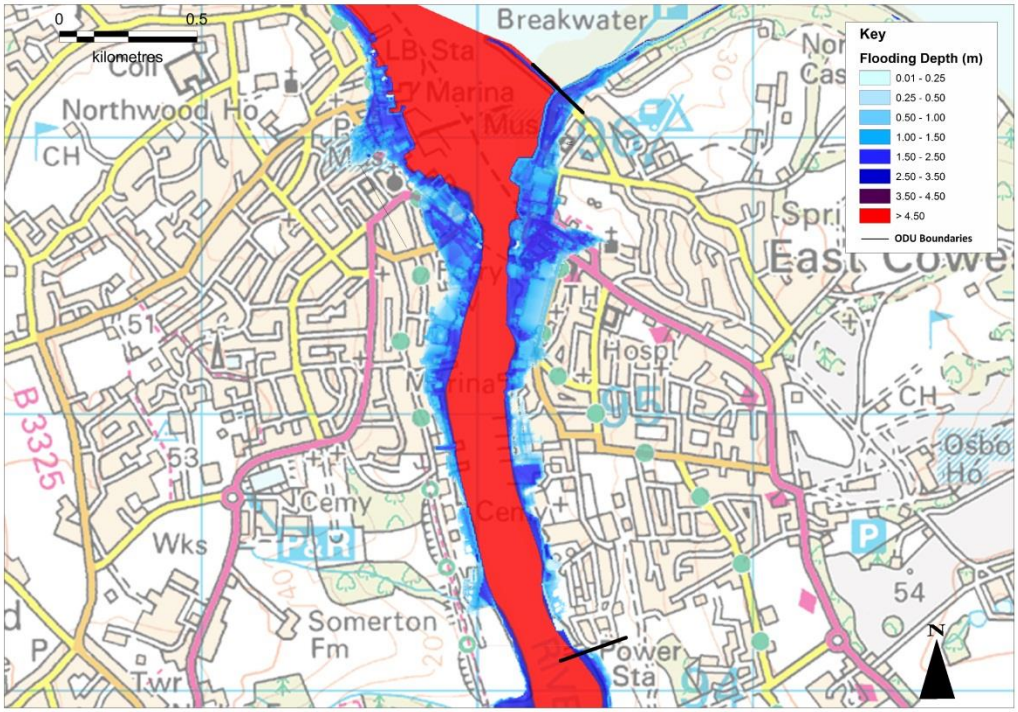

Appendix C - Technical Review Certificates

CAPITA | AECOM

Project Data

Project Title	Isle of Wight Strategy	**Project Group**	
Project Manager	Tara-Leigh McVey	**Project Number**	47072378
Client	Isle of Wight Council		

Instruction to Reviewer

Undertake technical review and approval of hydraulic model checking that the agreed updates have been adequately undertaken.

Technical Reviewer	Mark Davin	**Date of Instruction**	01/06/2015
Scope	Technical Approval of Model Update - Cowes		

Reviewer Details
(to be completed by the Technical Reviewer)

Scope of Review	To confirm extent of changes made to model by JBA.
Documents & Data used in Review	Check of incoming model data and specification files within the JBA model review against their suitability.
Comments	Comments provided within additional column in JBA Model Log document. Summary: All updates appear suitable for use.
Items recommended for further review	

Approvals

Review Type	Signature	Date	Statement
Interim	M. Davin		I consider the technical and / or design concepts are sound, subject to the comments listed above. Please inform me when you have considered the comments above so that I may complete the Technical Review
Final	M. Davin		

CAPITA | AECOM

Project Data

Project Title	Isle of Wight Strategy	**Project Group**	
Project Manager	Tara-Leigh McVey	**Project Number**	47072378
Client	Isle of Wight Council		

Instruction to Reviewer

Undertake technical review and approval of hydraulic model checking that the agreed updates have been adequately undertaken.

Technical Reviewer	Mark Davin	**Date of Instruction**	29/05/2015
Scope	Technical Approval of Model Update - Gurnard		

Reviewer Details
(to be completed by the Technical Reviewer)

Scope of Review	To confirm extent of changes made to model by JBA.
Documents & Data used in Review	Check of incoming model data and specification files within the JBA model review against their suitability.
Comments	Comments provided within additional column in JBA Model Log document. Summary: All updates appear suitable for use.
Items recommended for further review	

Approvals

Review Type	**Signature**	**Date**	**Statement**
Interim	M. Davin		I consider the technical and / or design concepts are sound, subject to the comments listed above. Please inform me when you have considered the comments above so that I may complete the Technical Review
Final	M. Davin		

CAPITA | AECOM

Project Data

Project Title	Isle of Wight Strategy	**Project Group**	
Project Manager	Tara-Leigh McVey	**Project Number**	47072378
Client	Isle of Wight Council		

Instruction to Reviewer

Undertake technical review and approval of hydraulic model checking that the agreed updates have been adequately undertaken.

Technical Reviewer	Mark Davin	**Date of Instruction**	27/05/2015
Scope	Technical Approval of Model Update - Yarmouth		

Reviewer Details
(to be completed by the Technical Reviewer)

Scope of Review	To confirm extent of changes made to model by JBA.
Documents & Data used in Review	Check of incoming model data and specification files within the JBA model review against their suitability.
Comments	Comments provided within additional column in JBA Model Log document. Summary: All updates appear suitable for use.
Items recommended for further review	

Approvals

Review Type	**Signature**	**Date**	**Statement**
Interim	M. Davin		I consider the technical and / or design concepts are sound, subject to the comments listed above. Please inform me when you have considered the comments above so that I may complete the Technical Review
Final	M. Davin		