

# Frodsham Solar

Hydraulic Modelling Report Addendum

## **November 2025**

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# **Frodsham Solar**

Frodsham Marsh, Frodsham, Cheshire West and Chester

# **Hydraulic Modelling Report Addendum**

**November 2025** 



Scheme Information		
Scheme:	Frodsham Solar	
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Client:	Frodsham Solar Limited	
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1	17/10/2025	First issue	
2	20/10/2025	Updated to include H++ Results	
3	19/11/2025	Update to the introduction section text	

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# **Glossary and Modelling Short Codes**

**Table 1: Glossary of Technical Terms** 

Term / Acronym	Definition		
1D (mandal)	One dimensional – A type of model typically built using watercourse cross-section		
1D (model)	survey data to represent the watercourse and adjacent floodplain		
2D (model)	Two dimensional – A type of hydraulic model typically built using LiDAR and site-		
	specific topographic data to represent the wider floodplain		
1D 2D /model\	A combination of 1D and 2D modelling (i.e. typically a representation of the		
1D-2D (model)	watercourse and floodplain respectively)		
AFD	Annual Exceedance Probability – the probability that a storm event will occur in		
AEP	any given year		
Defra	Department for Environment, Food and Rural Affairs		
Dti	Department for Infrastructure – one of nine departments in Northern Ireland		
Dfl	responsible for regional strategic planning and development policy		
ГΛ	Environment Agency – non-departmental public body responsible for the		
EA	protection and enhancement of the environment in England		
ESTRY	Industry standard flood modelling software (1D engine built into TUFLOW)		
FCA	Flood Consequence Assessment		
FRA	Flood Risk Assessment		
FFL	Finished Floor Level		
Fland side	The product of the frequency or likelihood of a flood event and the consequences		
Flood risk	(such as loss, damage, harm, distress and disruption)		
FMP	Flood Modeller Pro – industry standard flood modelling software		
HMR	Hydraulic Modelling Report		
IDB	Internal Drainage Board		
LA	Local authority		
LiDAR	Light Detection and Ranging (i.e. Ground elevation data)		
LLFA	Lead Local Flood Authority		
	A watercourse on which the relevant regulatory body (e.g. EA/NRW/SEPA/DfI) has		
Main river	permissive powers, but not a duty, to carry out maintenance, improvement, or		
	construction work.		
MIKE (11/21/FLOOD)	Industry standard flood modelling software		
NGR	National Grid Reference		
NRW	Natural Resources Wales – Welsh Government sponsored body responsible for		
	managing the environment and natural resources of Wales		
Oudline	A river, stream, ditch, cut, sluice, dyke or non-public sewer that is not a designated		
Ordinary	main river, and for which the LA has flood risk management responsibilities and		
watercourse	powers.		









Term / Acronym	Definition		
SEPA	Scottish Environment Protection Agency – non-departmental public body		
SEPA	responsible for the protection and enhancement of the environment in Scotland		
TN Technical Note			
TUFLOW Industry standard flood modelling software			

Short codes are used in the naming and referencing of model files, events and scenarios to ensure a consistent, high-quality naming convention is followed and to simplify communication of model results.

**Table 2: Modelling Short Codes** 

Model Short Code	Definition		
ABC	Model identifier		
BL[x]-[y]	A y% blockage at location x		
Br[x]-[y]	(e.g. BL1-67 – 67% blockage at location "1")		
BR[x]-[y]	A y metre wide breach scenario at location x		
םוי[א]-[א]	(e.g. BR2-50 – 50m wide breach at location "2")		
CC	Climate change		
DEV	Post-development site layout		
EXG	Existing (pre-development) site layout		
MIT	Flood mitigation option		
	"Normal conditions"		
NC	A model setup representative of present channel and floodplain conditions		
INC	throughout the study area – no additional structure blockages, defence breaches		
	or pump failures		
OPT	Development option		
Q[x]	1 / x % AEP fluvial event		
R[x]	1 / x % AEP pluvial event		
[v]T2	Sensitivity test x		
ST[x]	(e.g. ST1 – channel and floodplain roughness +20%)		
T[x]	1 / x % AEP tidal event		









#### Introduction

Waterco has been commissioned to undertake a hydraulic modelling study in relation to Frodsham Solar, located on land north of the M56, Frodsham, Cheshire, WA6 7BQ. This report has been prepared in response to the Relevant Representations provided by the Environment Agency (APP-024), specifically Issue ID EA018.

The study area is bordered by the River Weaver to the north-east of the site. The River Weaver flows in a north-westerly direction past the site before meeting the Manchester Ship Canal. The River Mersey Estuary is situated to the north of the study area, running parallel with the Manchester Ship Canal. The River Mersey flows in a westerly direction at the study area before turning north and discharging into the sea. The Mersey Estuary is tidally influenced.

A location plan and an aerial photograph of the study area are included in Appendix A. This hydraulic modelling report forms an addendum to the previous hydraulic modelling report prepared by Waterco in May 2025 (14740-HMR-05). This was provided as Environmental Statement: Volume 2 Appendix 9-3: Hydraulic Modelling Report (APP-090 to APP-094).

The main objective of this addendum is to update the proposed development scenario model to include the limited land raising associated with the proposed watercourse crossings. This study will quantify change in flood risk elsewhere (if any) as a result of the proposed development scenario when compared with the baseline scenario. To enable this, existing EA linked 1D/2D1 hydraulic models of the Mersey Estuary and River Weaver have been utilised.

### **Hydraulic Model Build**

The information provided in this section details the modelling works carried out as part of this scheme. The current EA Mersey Estuary and EA River Weaver FMP/TUFLOW hydraulic models were updated as part of the previous Hydraulic Modelling report. These models have been utilised for this addendum report.

The latest versions of the software available at the start of this study have been utilised (FMP version 7.3.1 and TUFLOW version 2025.1.2). Whilst no changes have been made to the baseline scenario, it has been rerun for consistency.

The model logs<sup>1</sup> provided with the FMP/TUFLOW model files (Model Reference: 14740-33256-020 Mersey Estuary Model and 14740-33256-052 River Weaver Model) should be consulted if further details are required. An explanation of the file, event and scenario naming convention used is provided in the model log.

#### **Proposed Development Model Updates**

The hydraulic models for both the River Weaver and Mersey Estuary had been setup to consider the proposed development scenario, taking into account of the footprint of structures within the flood extent, limited land raising associated with watercourse crossings (proposed bridges) and changes in land roughness values as a result of the proposed solar farm.

<sup>&</sup>lt;sup>1</sup> Doc ref: 14740-33256-Mersey\_Estuary\_Model\_Log.xlsx and 14740-33256-River\_Weaver\_Model\_Log.xlsx



This study has updated the proposed development scenario to include the watercourse crossings proposed across the onsite watercourses. In total there are 21 watercourse crossings which are either new or replacement crossings. The soffit level of each crossing will generally be situated 0.6m above the existing associated watercourse bank level. An indicative watercourse crossing schedule is included in Appendix B and provides the location and description of each crossing.

#### **Mersey Estuary Proposed Development Scenario**

The updates to the proposed development scenario for the Mersey Estuary model include raising one 2D model cell (10mx10m grid) by 0.6m at the location of each watercourse crossing. This is a conservative estimate of the land raising associated with each of the watercourse crossings.

A plan of the 1D/2D proposed model extent is shown in Appendix C.

The Mersey Estuary model has been simulated for the same return periods and scenarios as per the previous HMR. The scenarios include a defended and breach (M-BR1) scenario.

#### **River Weaver Proposed Development Scenario**

The updates to the proposed development scenario for the River Weaver model include raising two 2D model cells (6mx6m grid) by 0.6m at the location of each watercourse crossing. This is a conservative estimate of the land raising associated with each of the watercourse crossings.

A plan of the 1D/2D proposed model extent is shown in Appendix C.

The River Weaver model has been simulated for the same return periods and scenarios as per the previous HMR. The scenarios include a defended and two breach (W-BR1 and W-BR2) scenarios.

### **Model Results**

This section of the report discusses the results obtained from the hydraulic model simulations for the updated proposed development scenario and the impact compared to the baseline scenario. For information on flood mechanisms, please see the previous HMR (APP-090 – APP-093 / 14740-HMR-05).

Maximum flood depth, velocity and hazard mapping has been provided for each primary simulation and is included in Appendix D. Flood hazard ratings have been calculated in accordance with DEFRA document 'FD2320: Flood Risks to People' and EA guidance document 'Supplementary Note on Flood Hazard Ratings and Thresholds'.

Maximum water level mapping for selected return periods is provided in Appendix E.

### **Mersey Estuary Model**

#### **Defended**

During the proposed development scenario, the site is shown to flood during each simulated tidal flood event when the defended scenario is considered.

There is negligible change in flood risk offsite when the proposed development scenario is compared with the baseline scenario.



### Mersey Breach (M-BR1)

During the proposed development scenario, the site is shown to flood during each simulated flood event when a breach of the defences along the River Mersey is considered.

There is negligible change in flood risk offsite when the proposed development scenario is compared with the baseline scenario.

#### **River Weaver Model**

#### **Defended**

During the proposed development scenario, the site is shown to flood during each simulated fluvial flood event when the defended scenario is considered.

There is no increase in flood risk elsewhere as a result of the proposed development scenario.

#### Weaver Breach 1 (W-BR1)

During the proposed development scenario, the site is shown to flood during each simulated flood event when a breach of the flood defence along the northern boundary of the site is considered.

There is no increase in flood risk elsewhere as a result of the proposed development scenario.

#### Weaver Breach 2 (W-BR2)

During the proposed development scenario, the site is shown to flood during each simulated flood event when a breach of the flood defence along the eastern boundary of the site is considered.

There is no increase in flood risk elsewhere as a result of the proposed development scenario.



### **Conclusions**

Waterco have been instructed to undertake an update hydraulic modelling study for a proposed solar farm at land north of the M56, Frodsham, Cheshire, WA6 7BQ. The main objective of the update is to include the proposed watercourse crossings in the proposed development scenario in the Mersey Estuary and River Weaver models. The models used were EA models updated during a previous hydraulic modelling study undertaken by Waterco (App 091 – APP 093 / 14740-HMR-05.pdf).

The proposed watercourse crossings have been added to both models by increasing existing ground levels at the bridge approach by 0.6m.

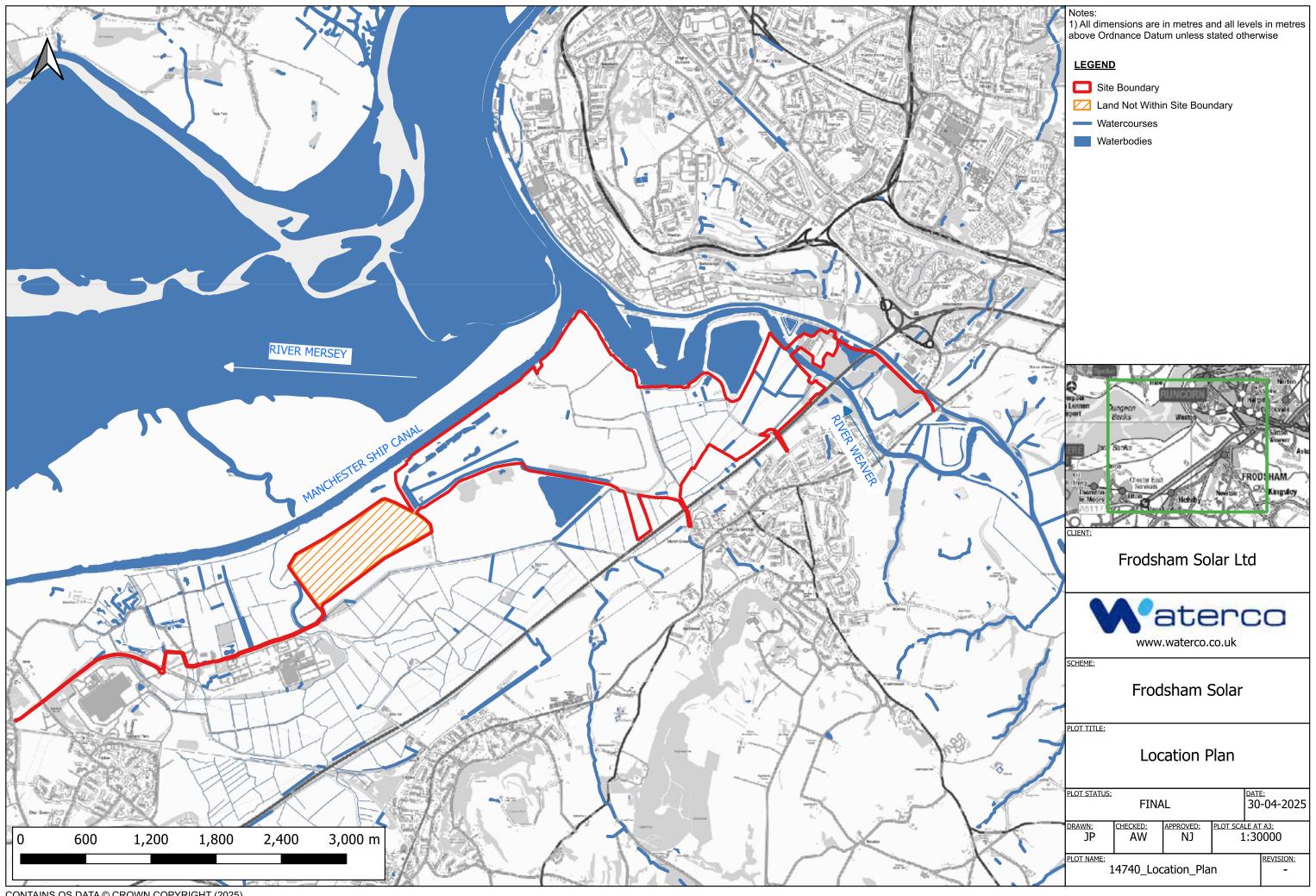
The modelled results for the Mersey Estuary model show that there is negligible change in flood risk elsewhere when the proposed scenario is compared with the baseline scenario.

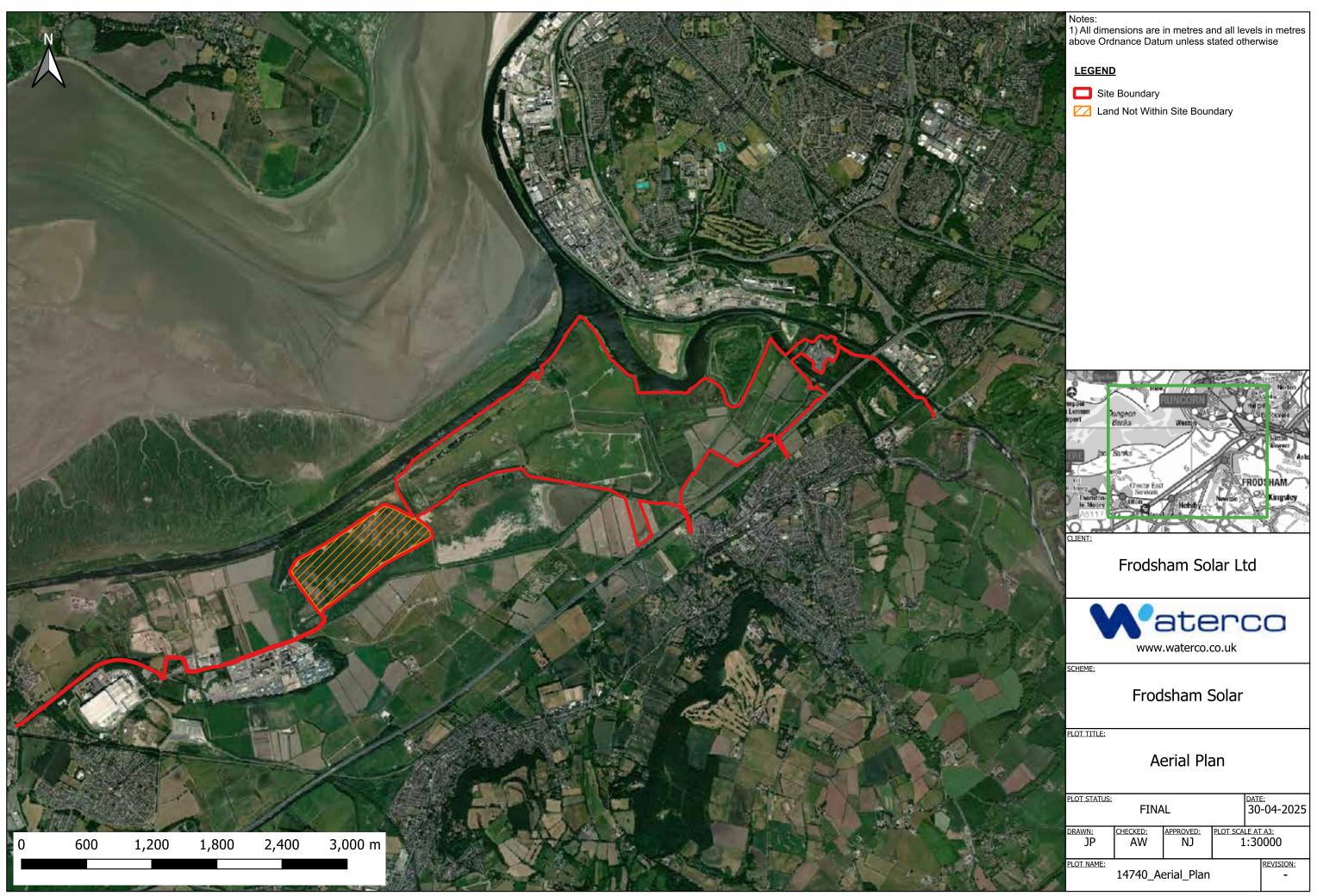
The modelled results for the River Weaver model show that there is no increase in flood risk elsewhere when the proposed development scenario is considered.



# Appendix A Location Plan and Aerial Image







# **Appendix B** Proposed Watercourse Crossing

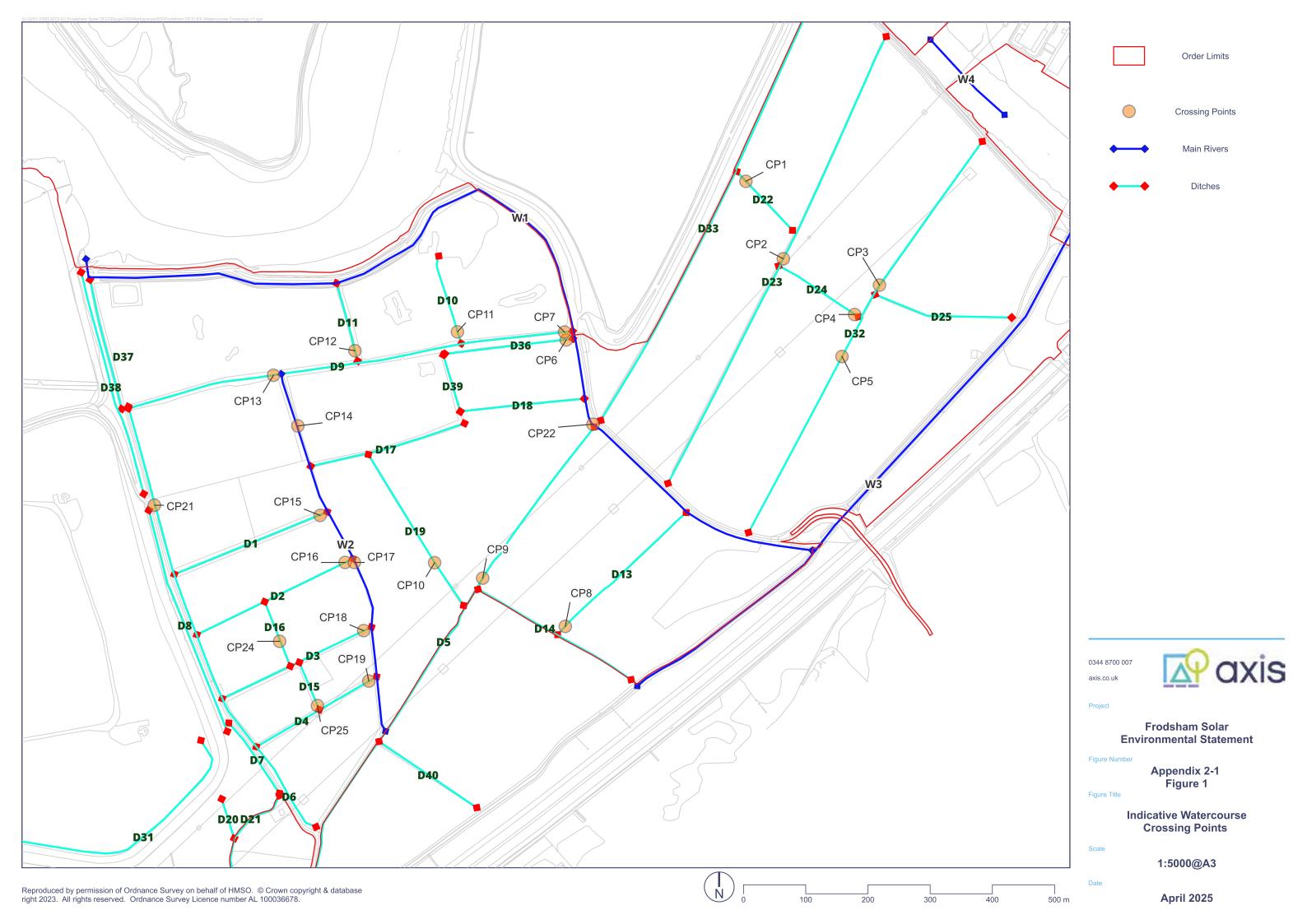


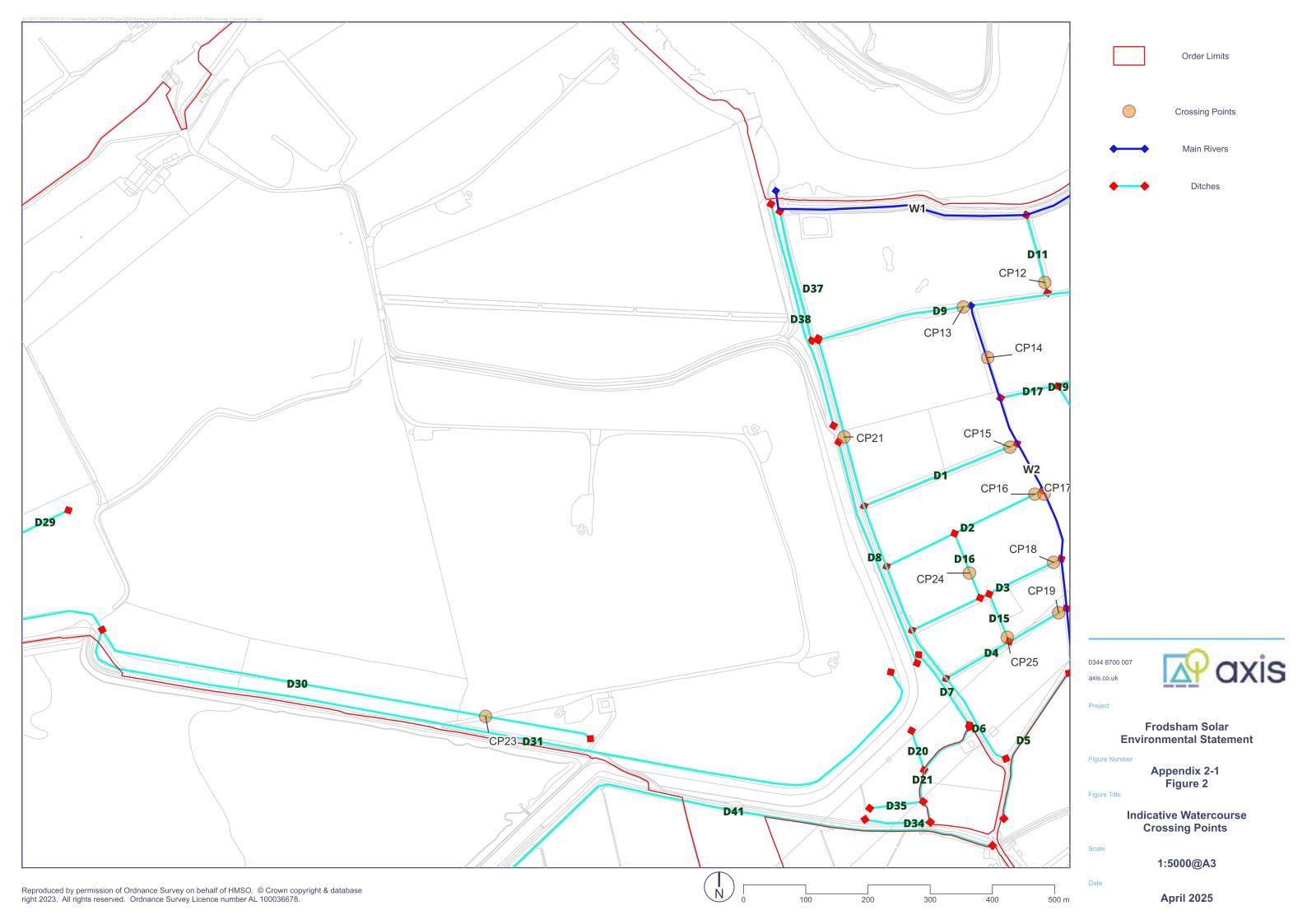
Crossing Point Ref.	Watercourse Ref.	Crossing		
Point Rei.	D# - Ordinary Watercourse W# - Main River	Existing or New	Туре	
CP1	D22	Existing	Replacement open span vehicular crossing, with MV and LV cable crossing.	
CP2	D23	New	New open span vehicular crossing and MV and LV cable crossing.	
СРЗ	D32	New	New open span vehicular crossing and MV cable crossing.	
CP4	D24	New	New open span vehicular crossing and MV cable crossing.	
CP5	D32	New	New open span vehicular crossing and MV cable crossing.	
CP6	D36	New	New open span vehicular crossing and MV and LV cable crossing.	
CP7	D9	Existing	Replacement open span vehicular crossing, with MV and LV cable crossing.	
CP8	D13	New	New open span vehicular crossing and MV cable crossing.	
CP9	D5	New	New open span vehicular crossing and MV cable crossing.	
CP10	D19	New	New open span vehicular crossing and MV cable crossing.	
CP11	D10	New	Replacement open span vehicular crossing, with MV and LV cable crossing.	
CP12	D11	New	New open span vehicular crossing and MV cable crossing.	
CP13	D9	New	New open span vehicular crossing and MV cable crossing.	
CP14	W2	Existing	Replacement open span vehicular crossing, with MV and LV cable crossing.	

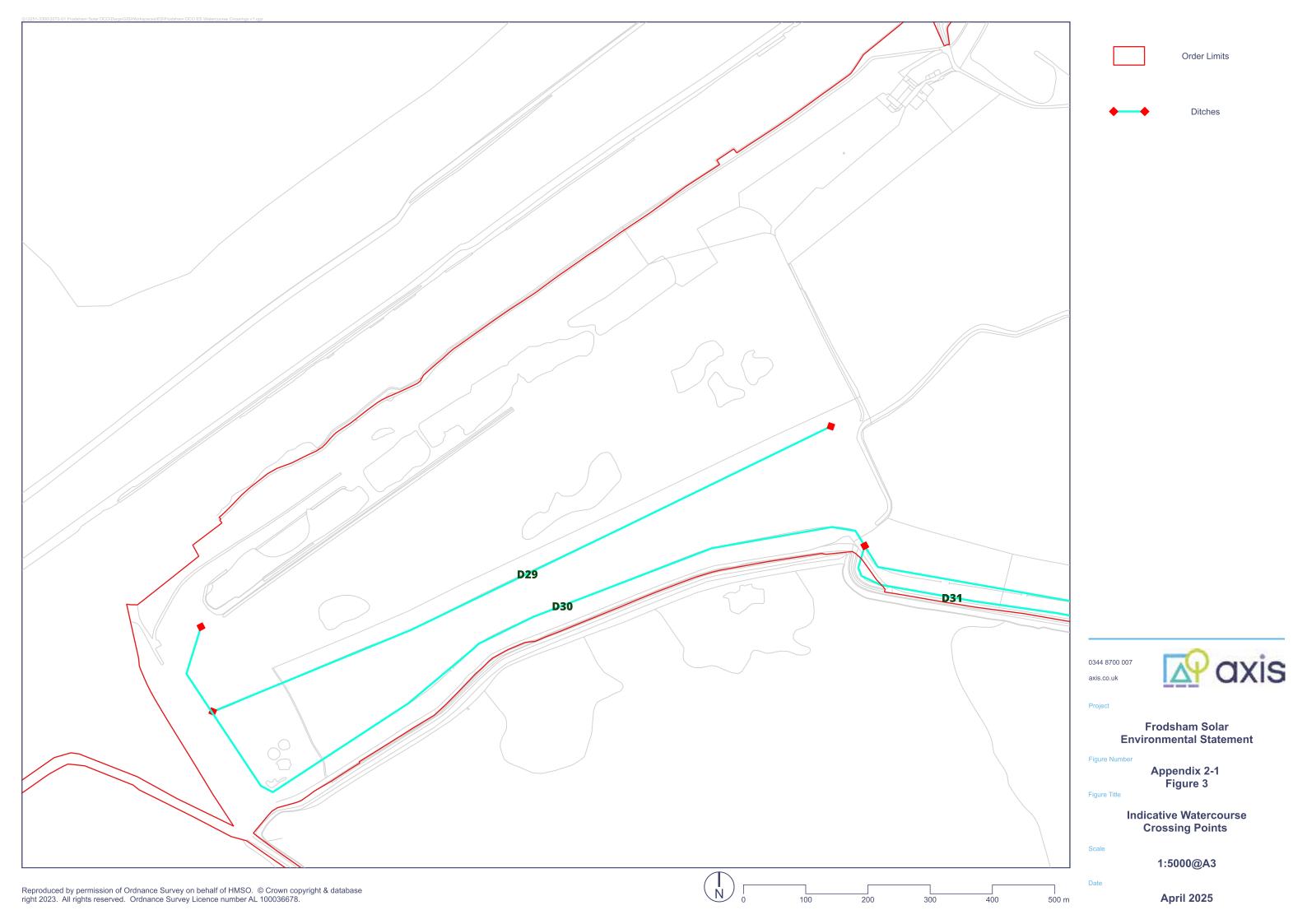
**Environmental Statement** 

Crossing Point Ref.	Watercourse Ref. D# - Ordinary Watercourse W# - Main River	Crossing		
		Existing or New	Туре	
CP15	D1	New	New open span vehicular crossing, with MV and LV cable crossing.	
CP16	D2	Existing	Replacement open span vehicular crossing, with MV cable crossing.	
CP17	W2	New	New open span vehicular crossing, with MV cable crossing.	
CP18	D3	Existing	Replacement open span vehicular crossing, with MV cable crossing.	
CP19	D4	New	New open span vehicular crossing, with MV and LV cable crossing.	
CP20	Not used			
CP21	D6	New	New open span vehicular crossing, with MV cable crossing.	
CP22	W1	New	Replacement open span vehicular crossing, with MV cable crossing.	
CP23	D3	Existing	Retain existing vehicular crossing.	
CP24	D16	Existing	Retain existing vehicular crossing, new LV cable crossing.	
CP25	D15	Existing	Retain existing vehicular crossing, new LV cable crossing.	

Environmental Statement 2

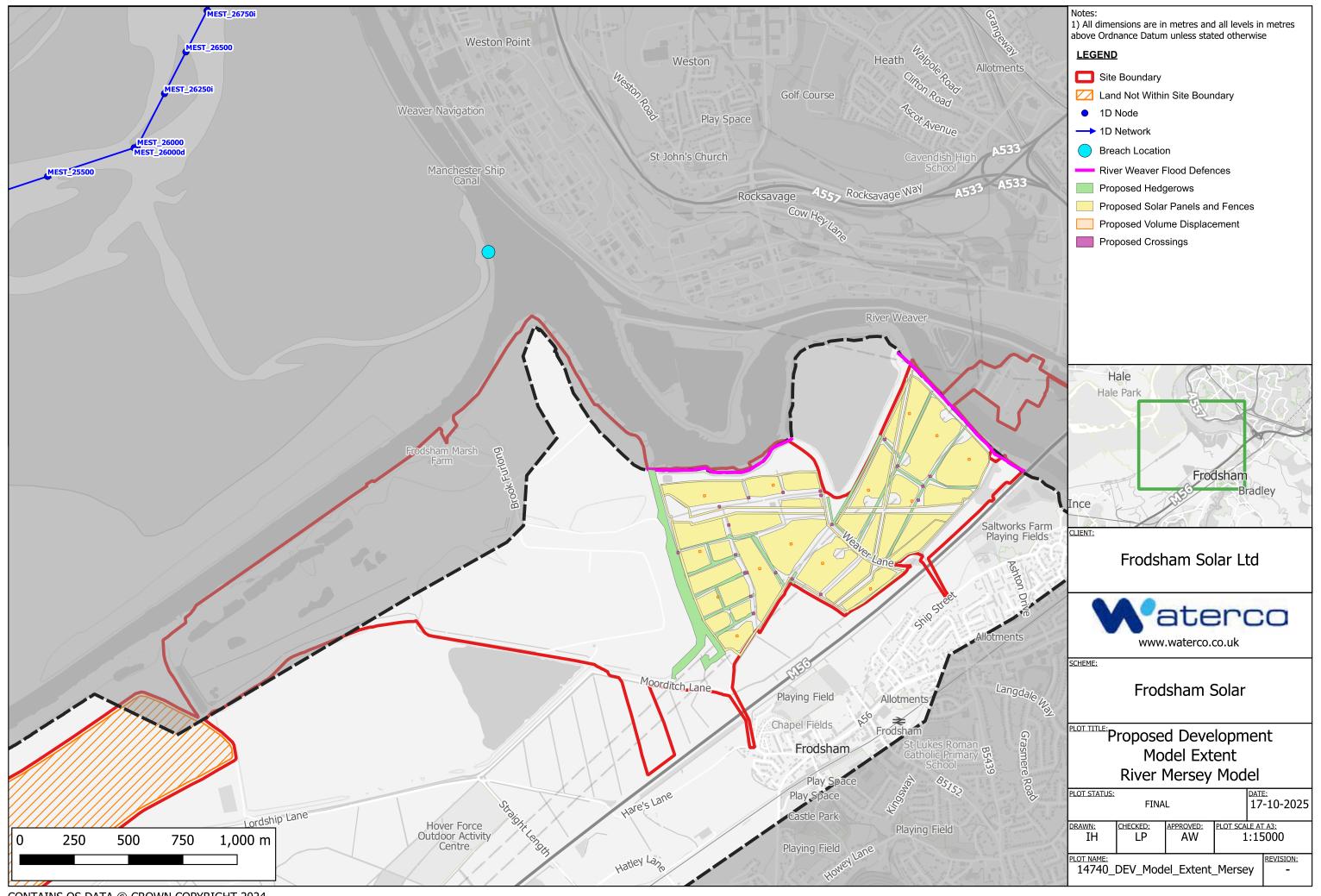


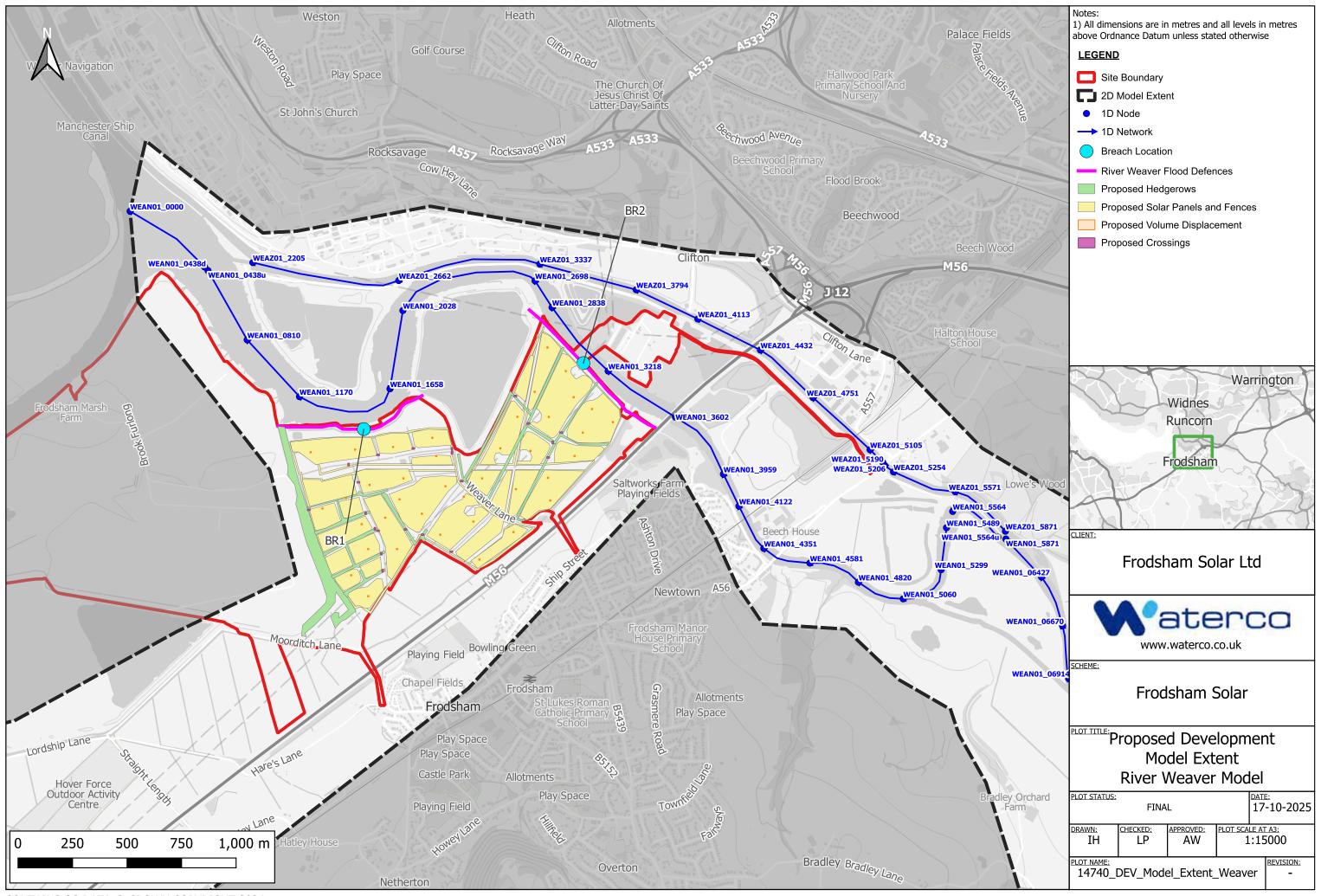




# Appendix C 1D/2D Model Extents





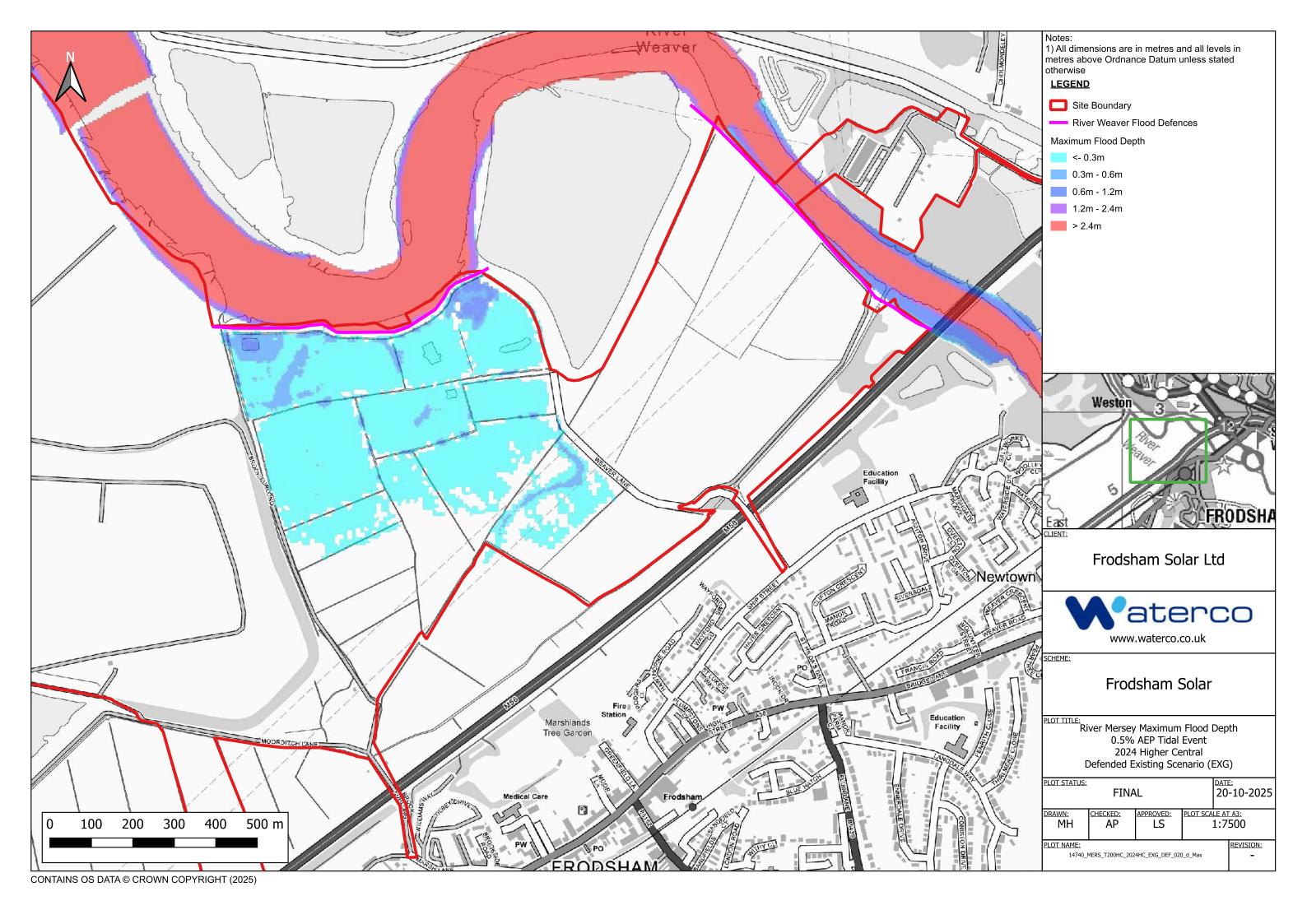


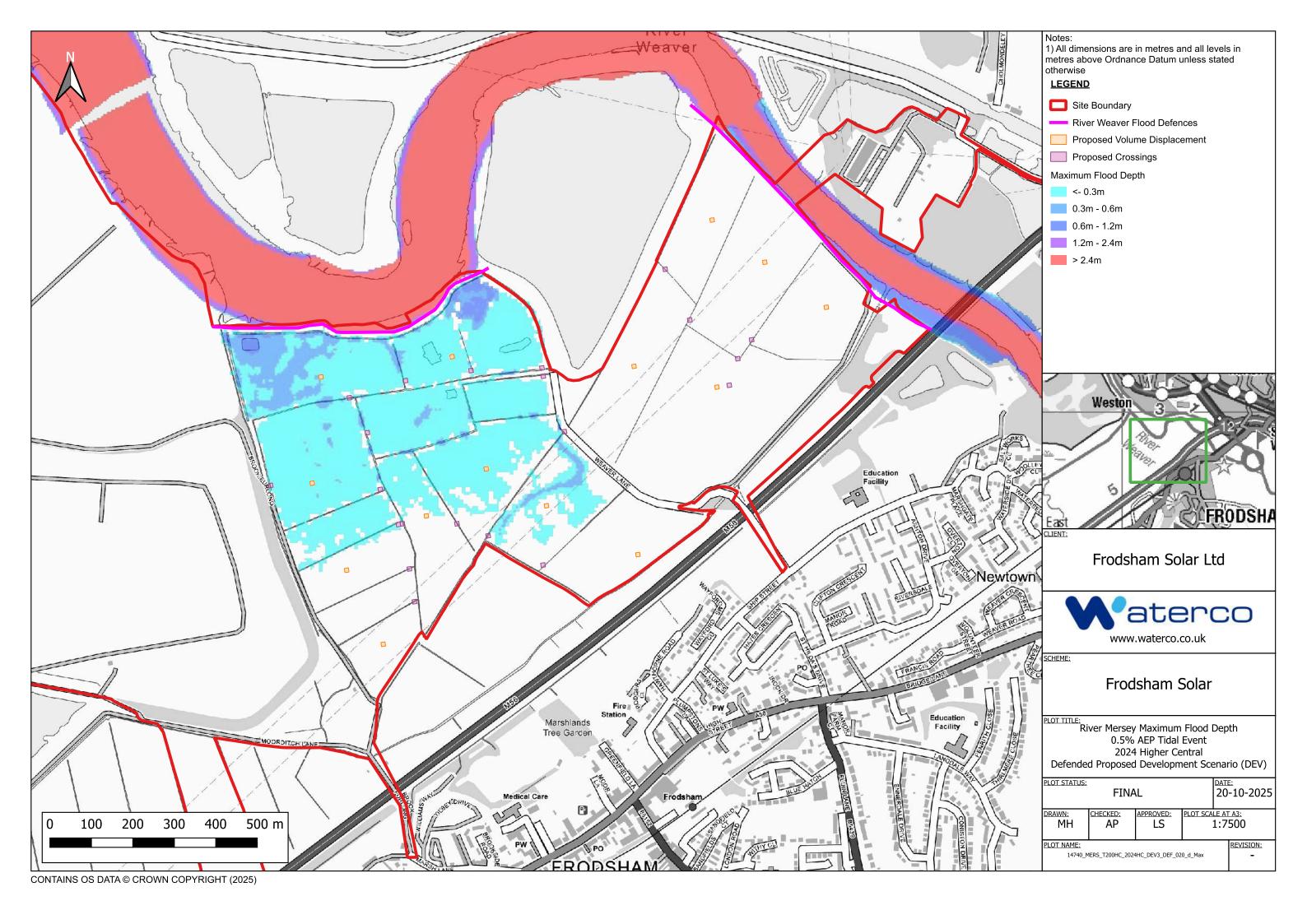
# Appendix D Simulated Flood Maps

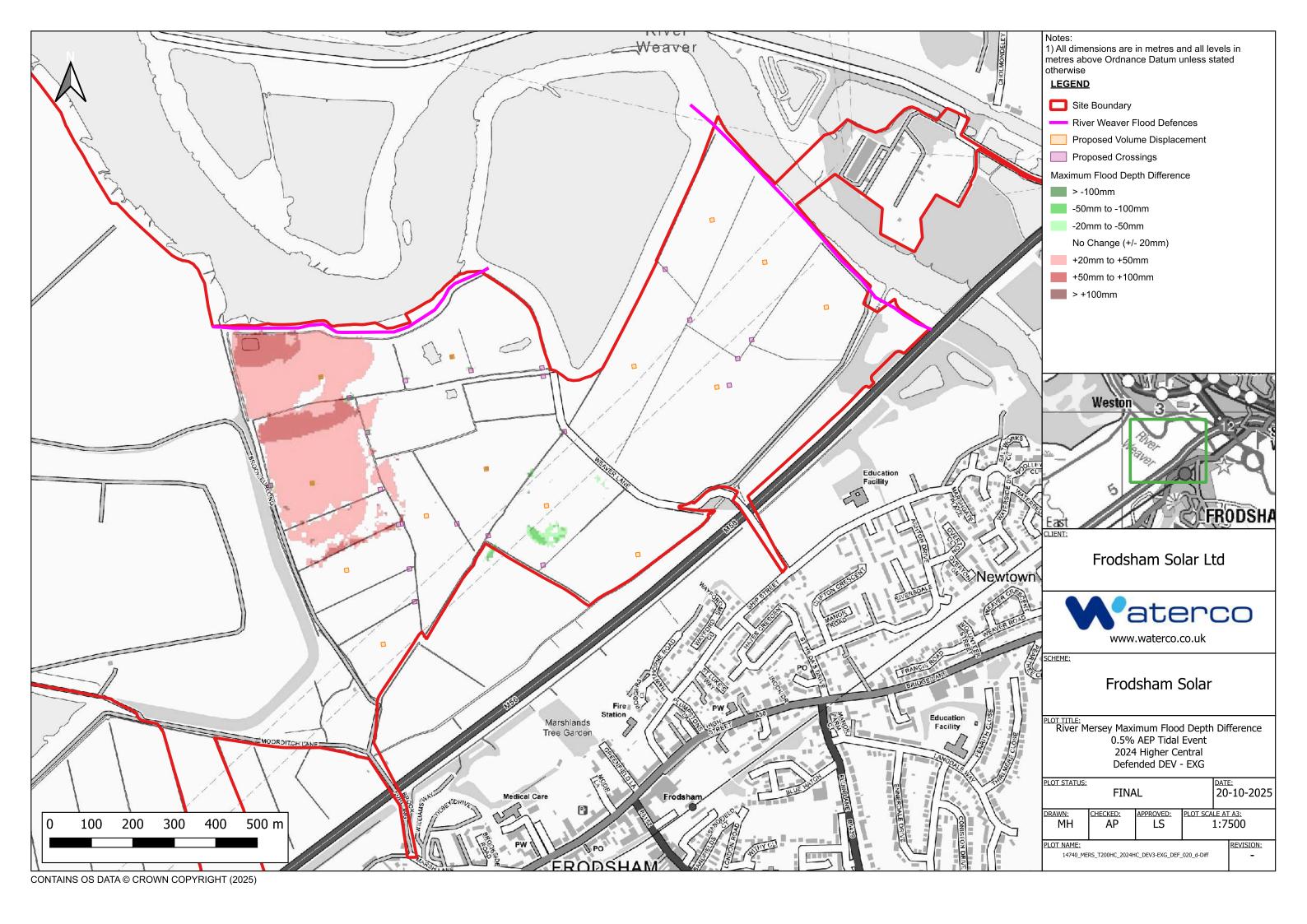


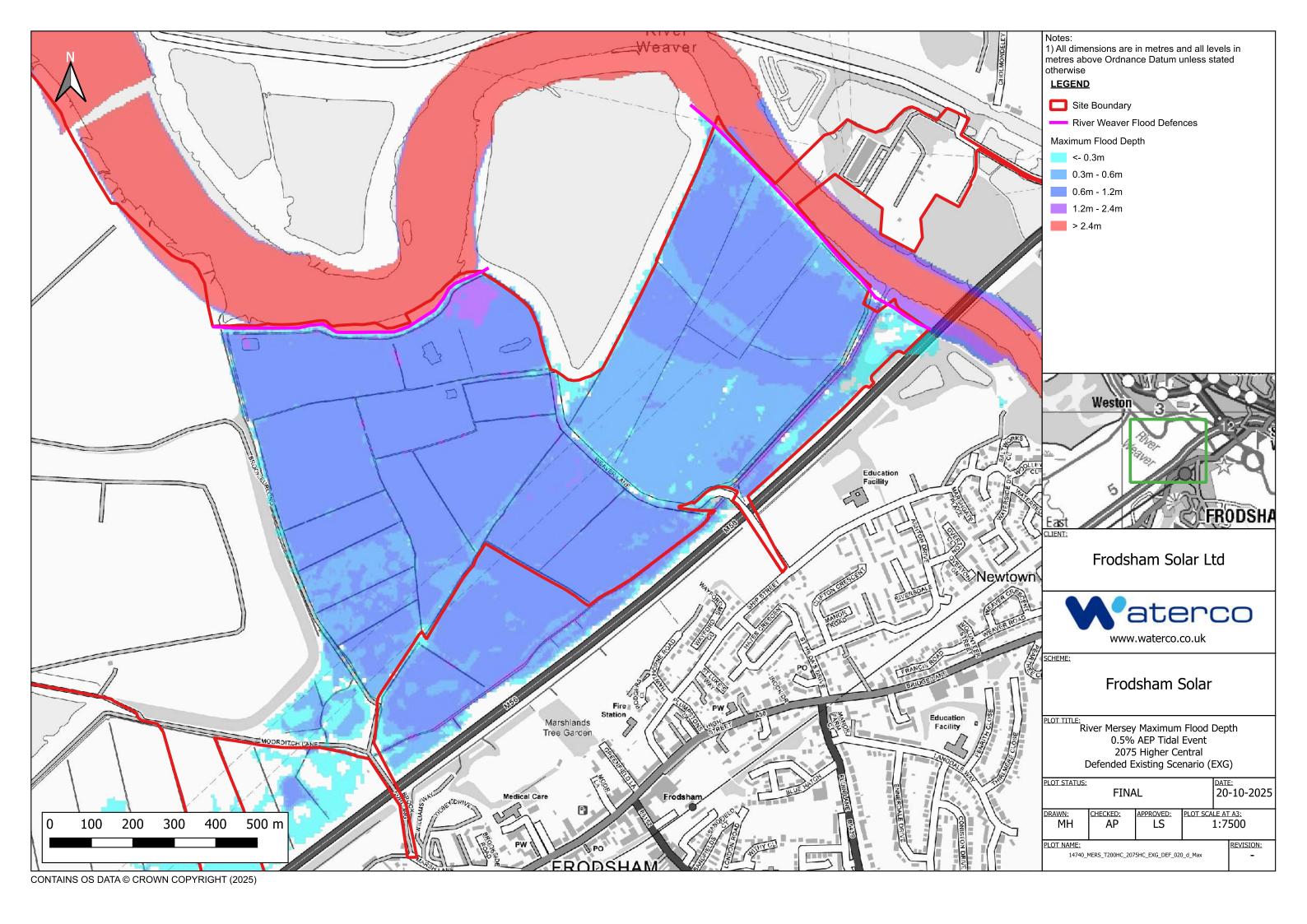
# **Mersey Estuary Flood Mapping**

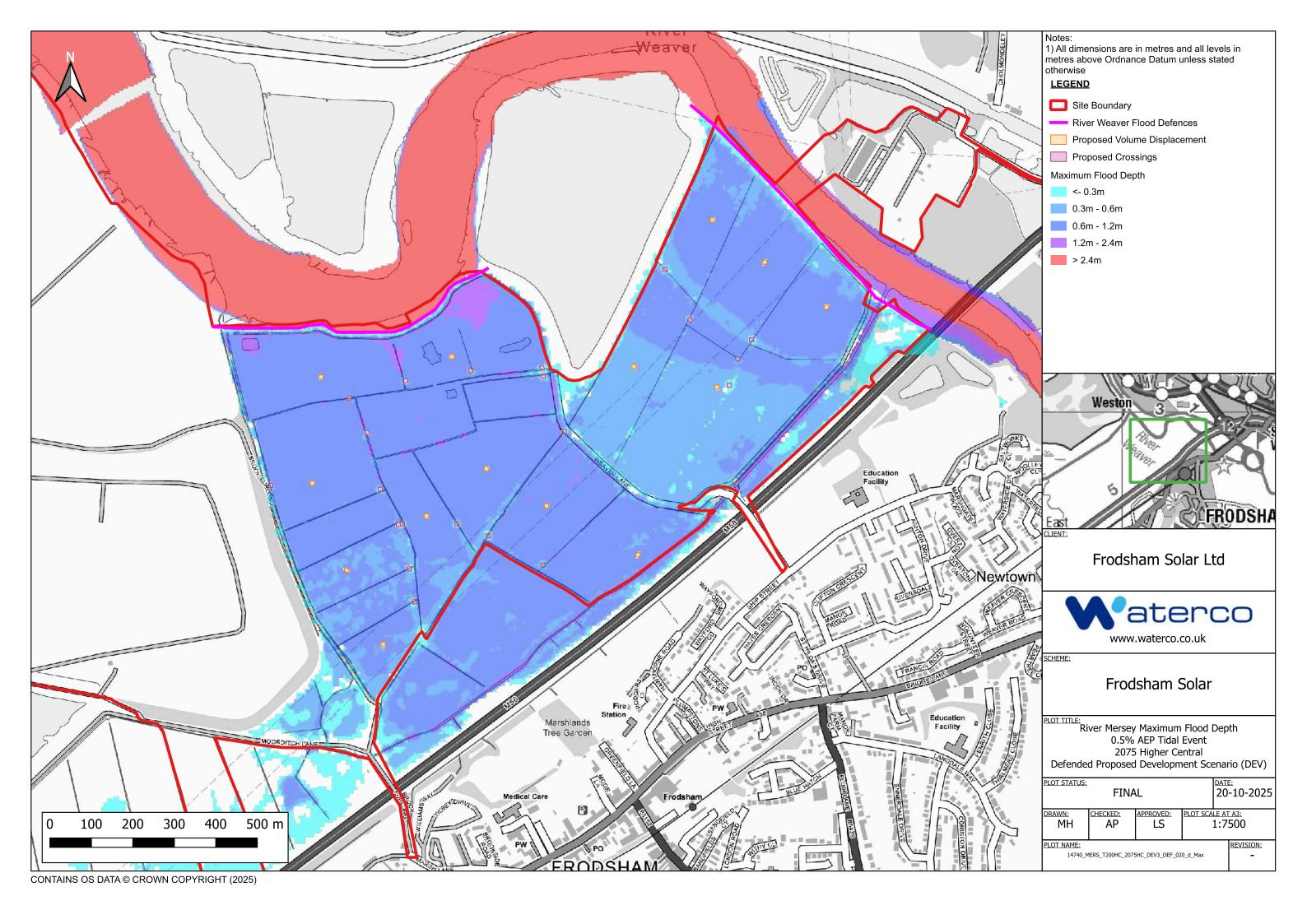


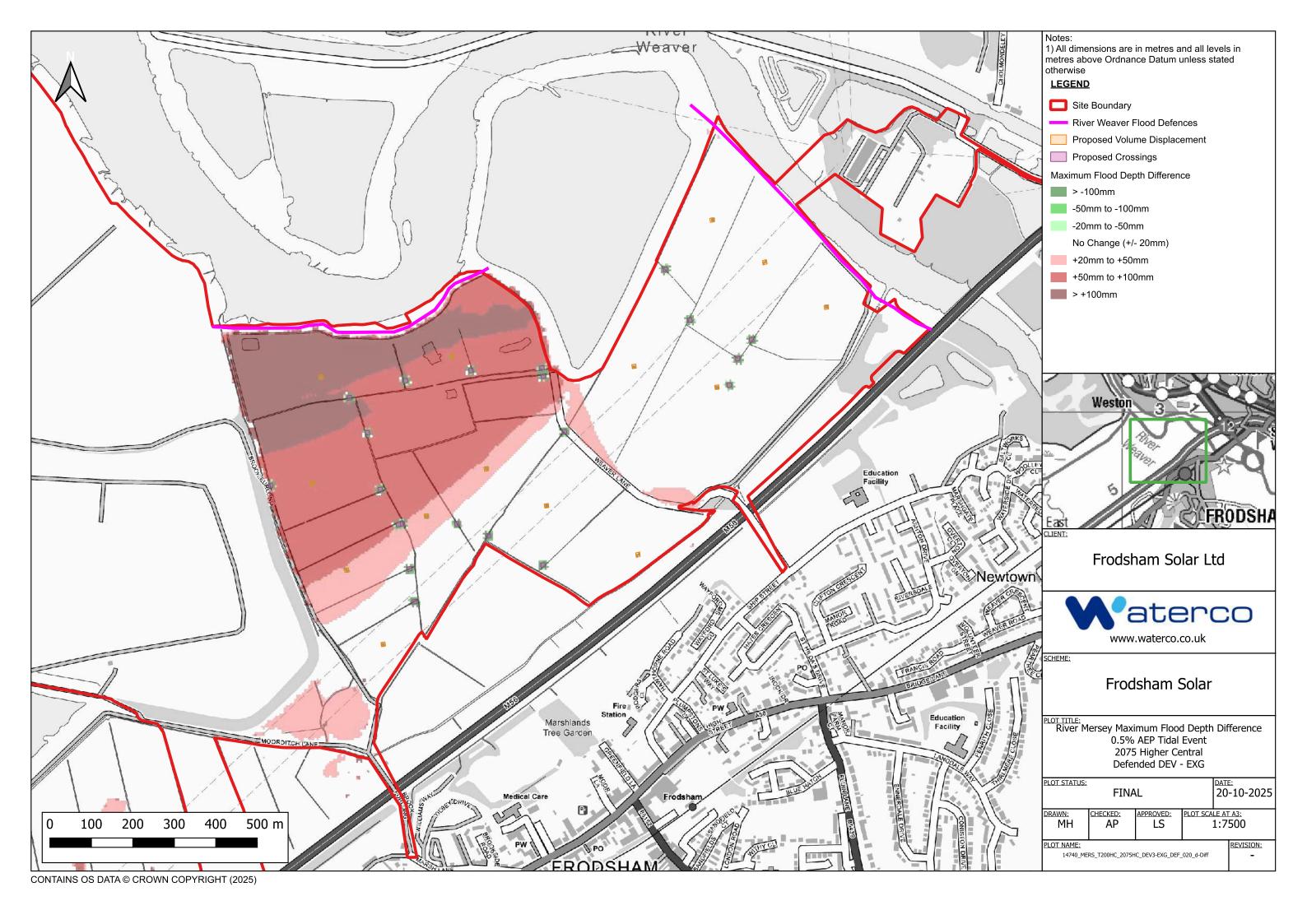


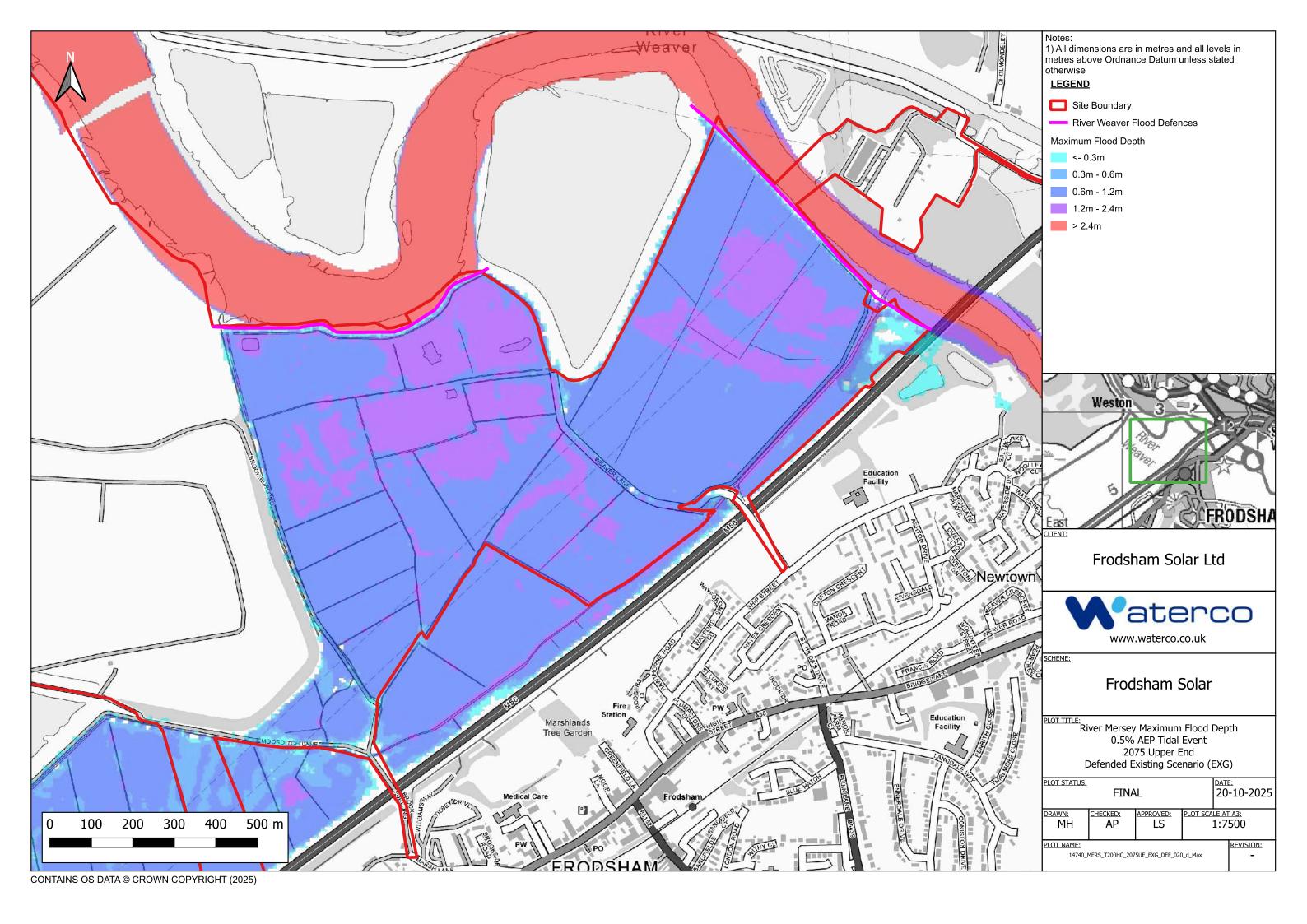


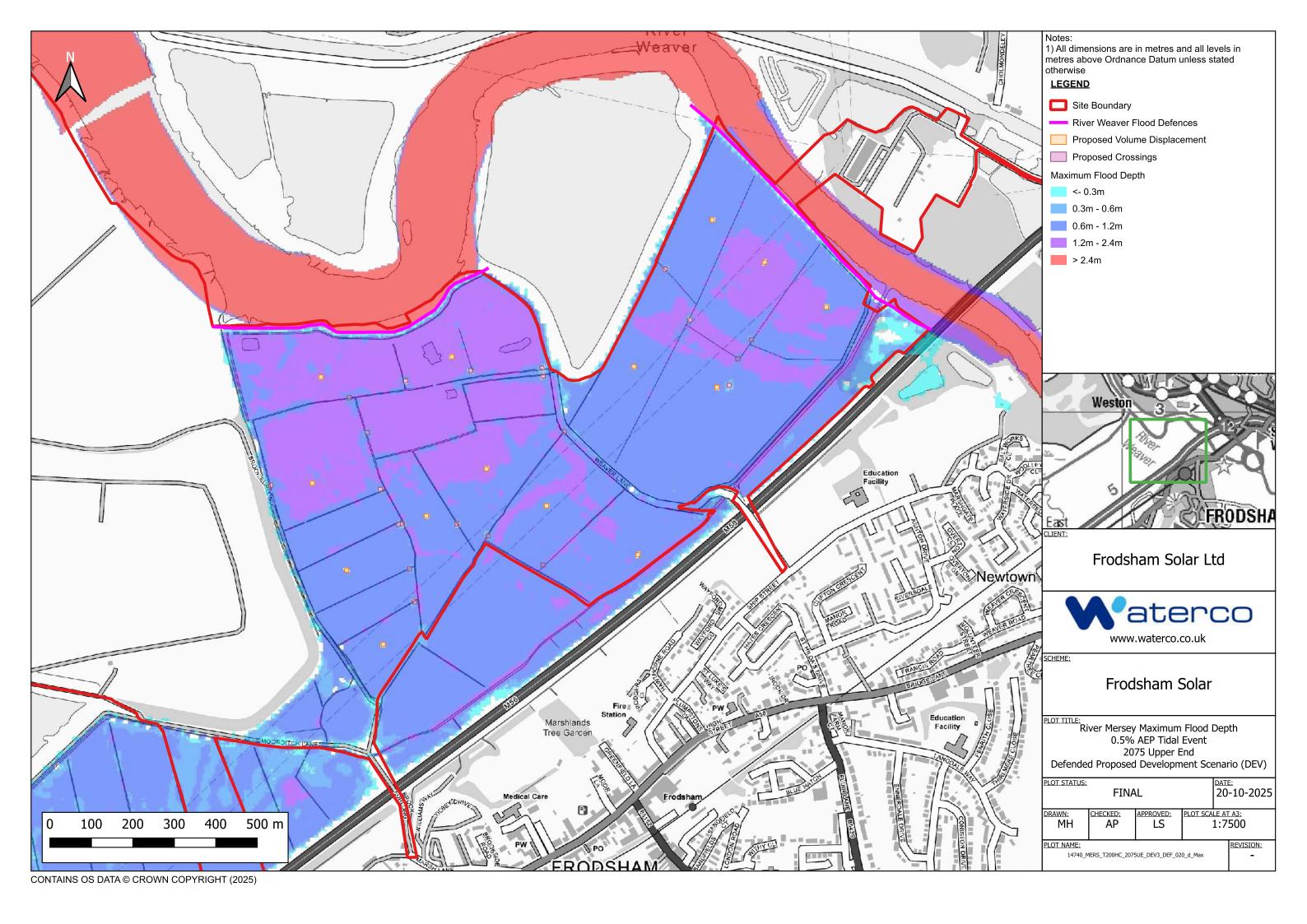


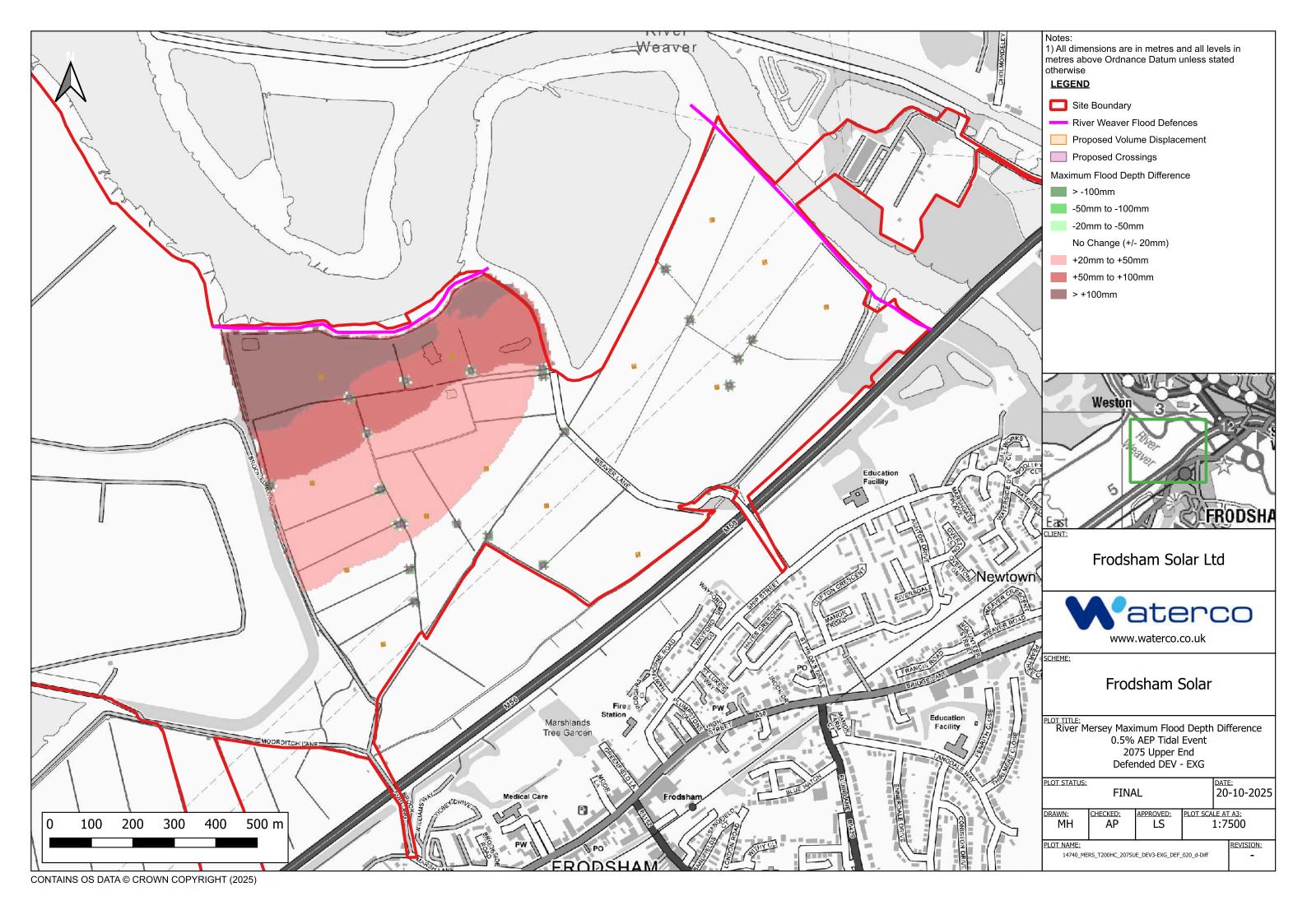


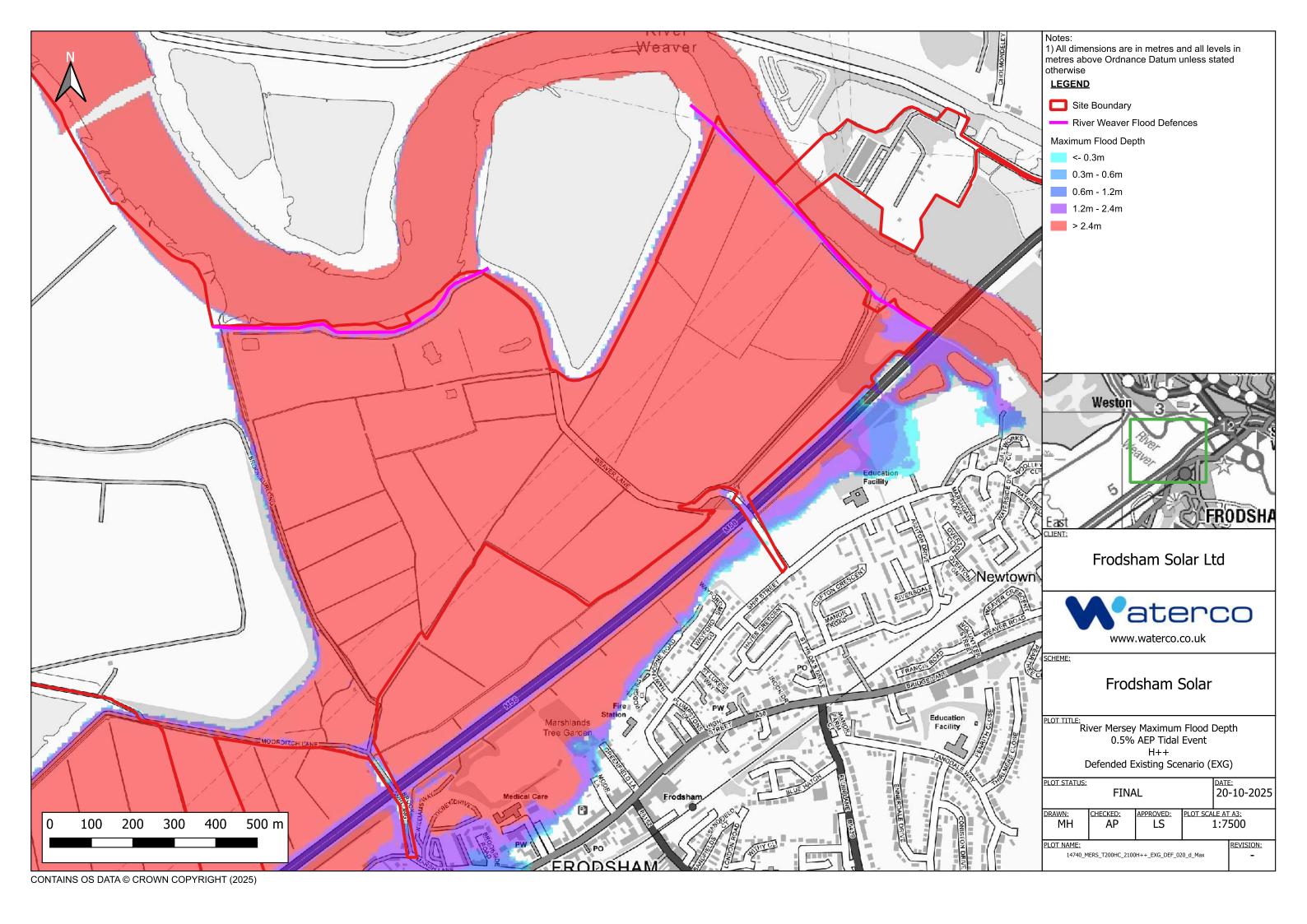


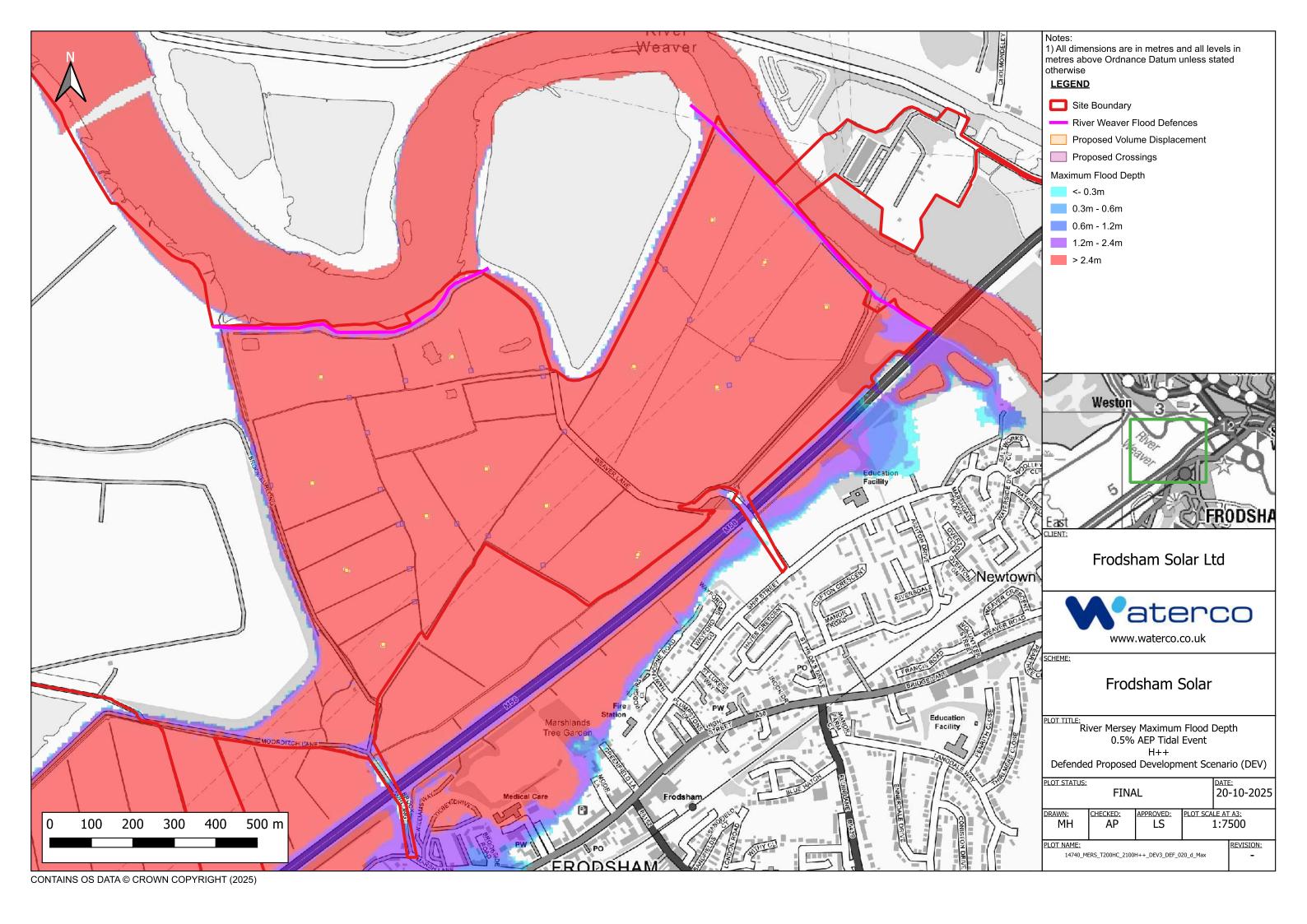


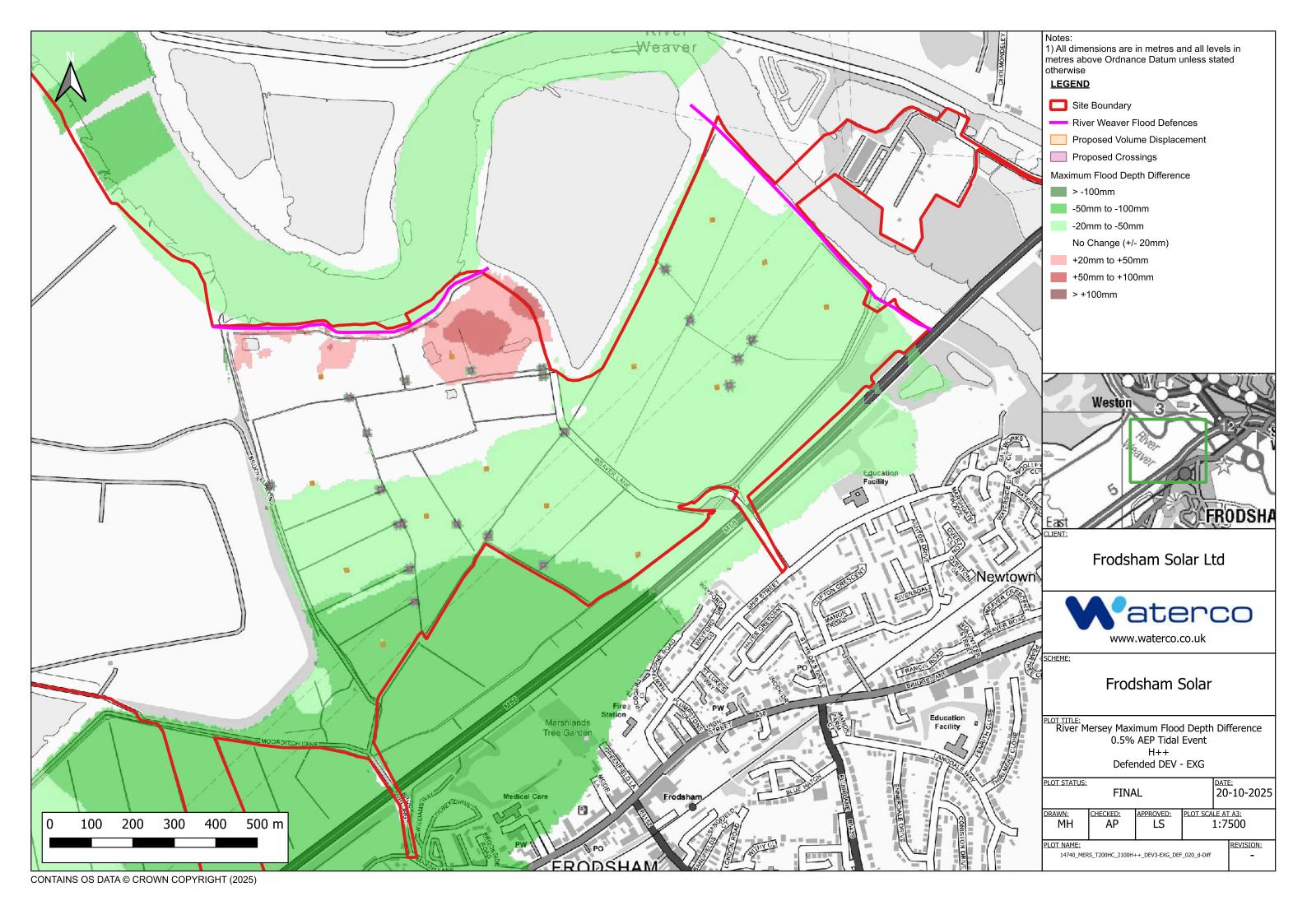


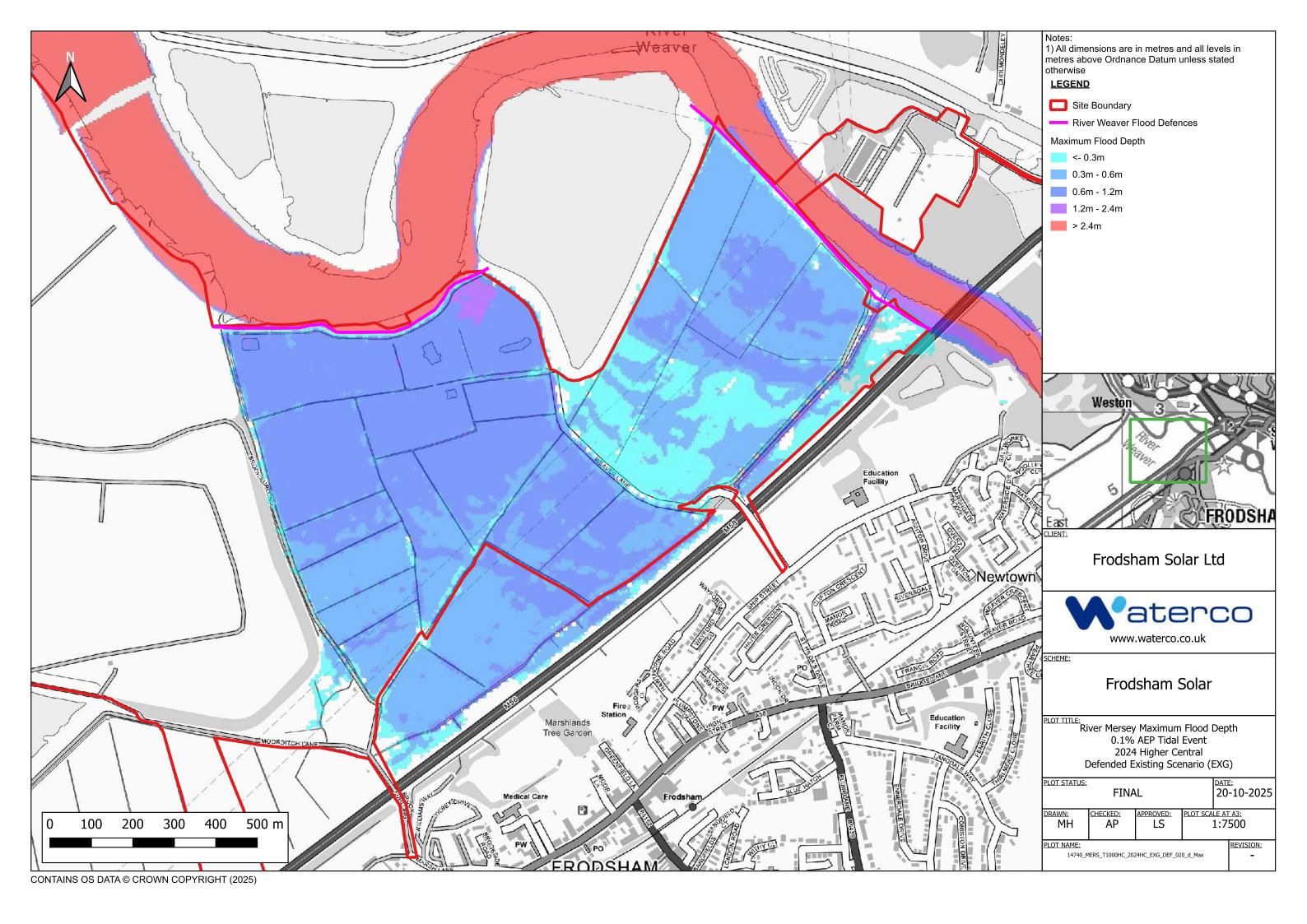


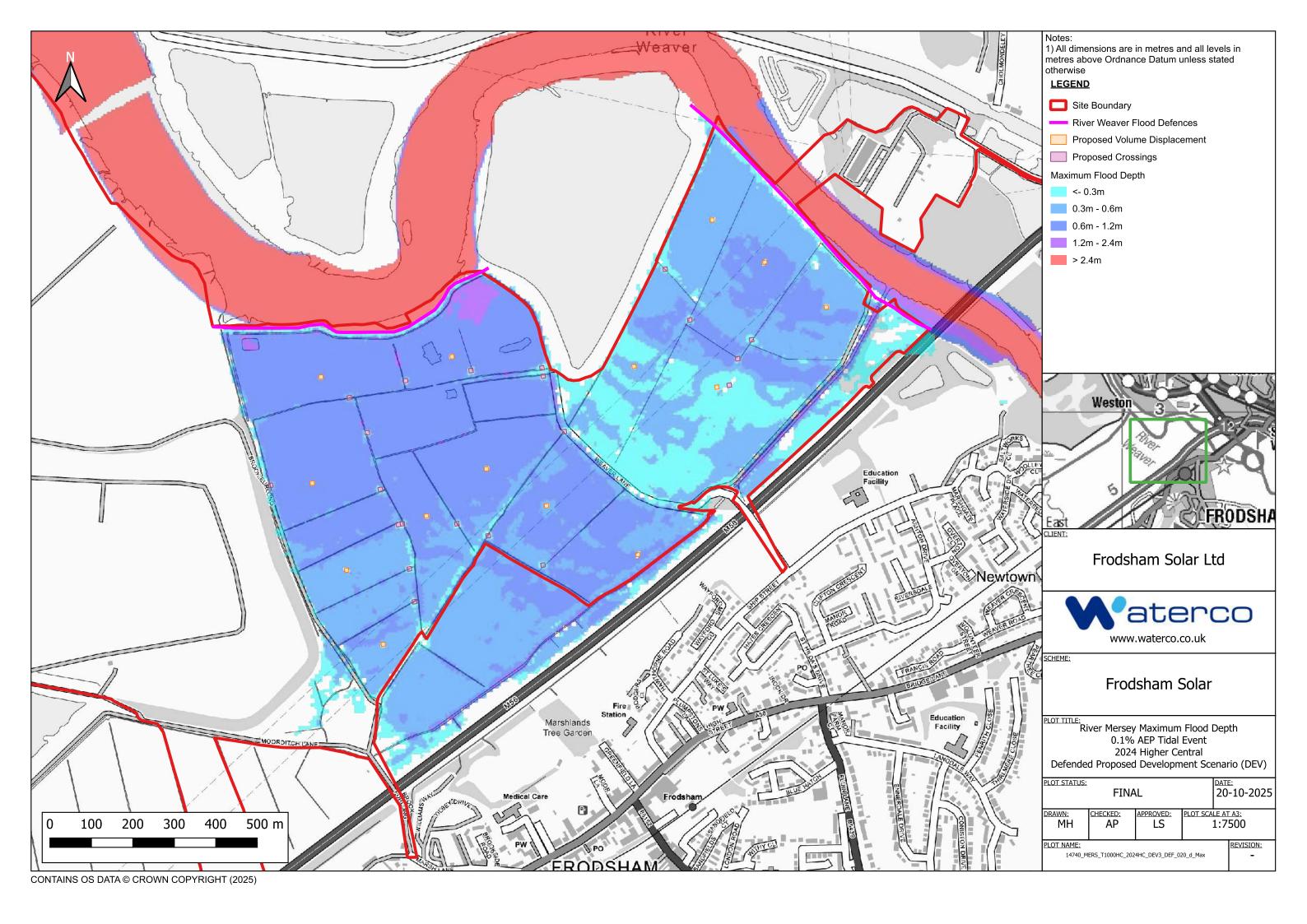


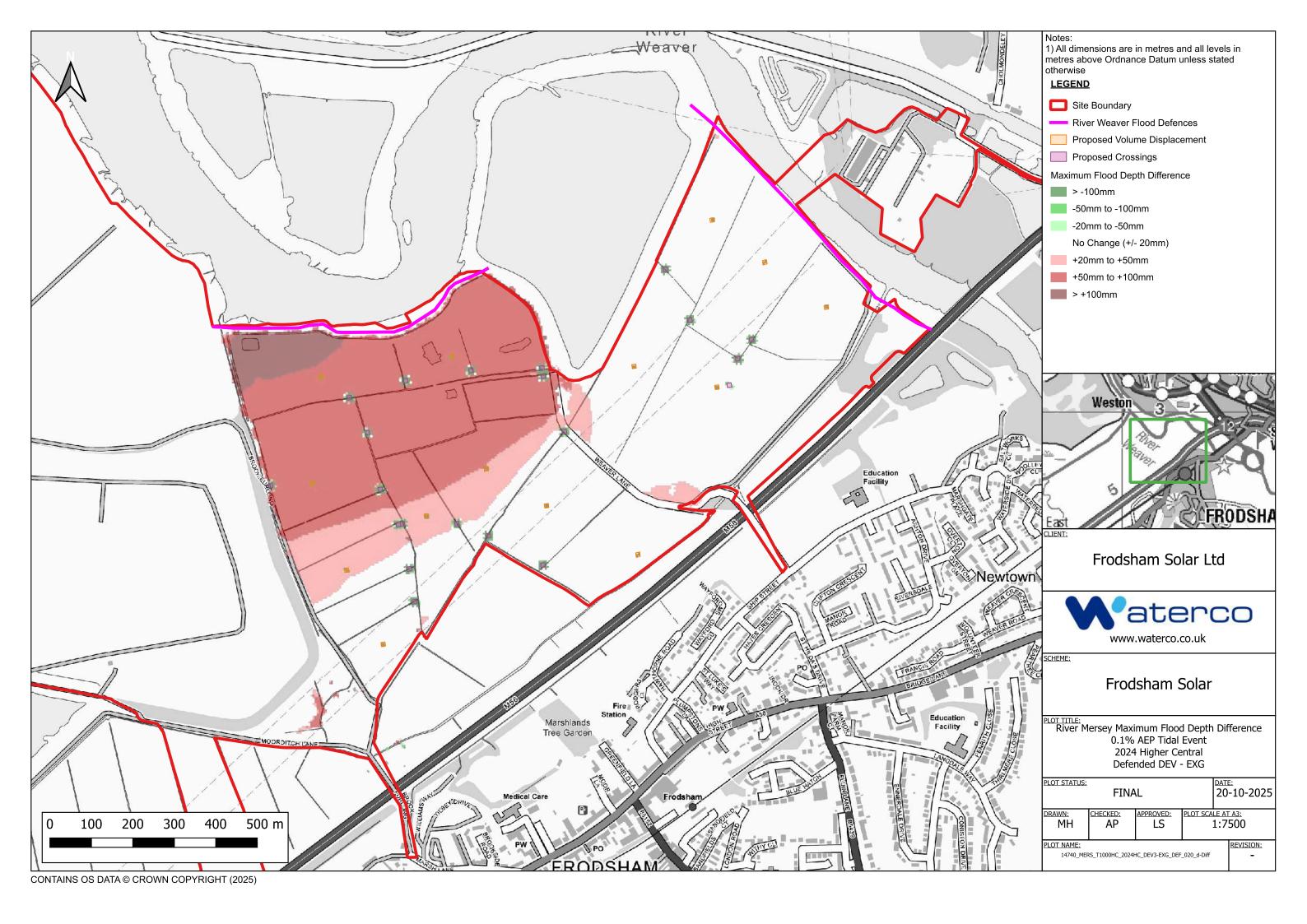


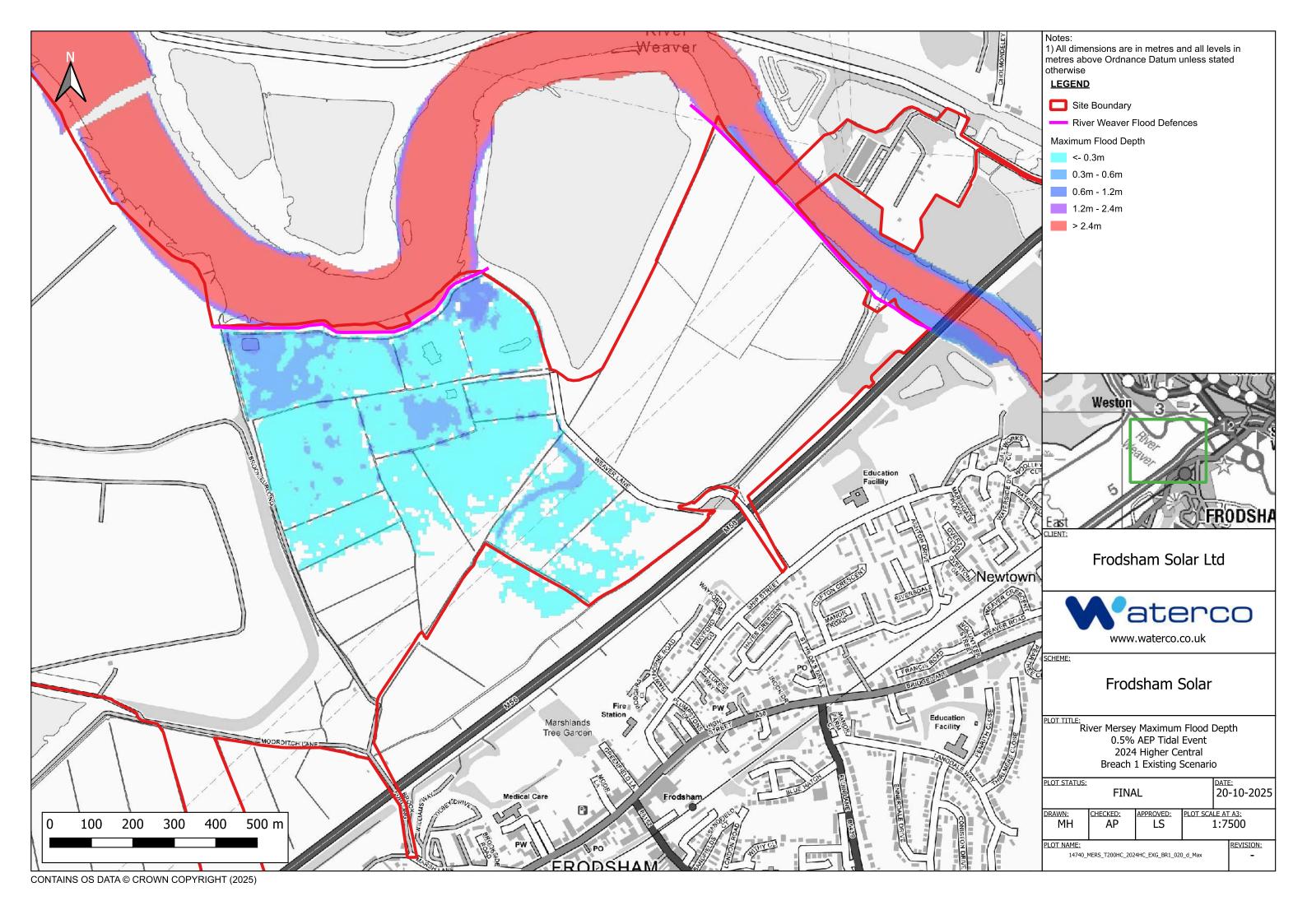


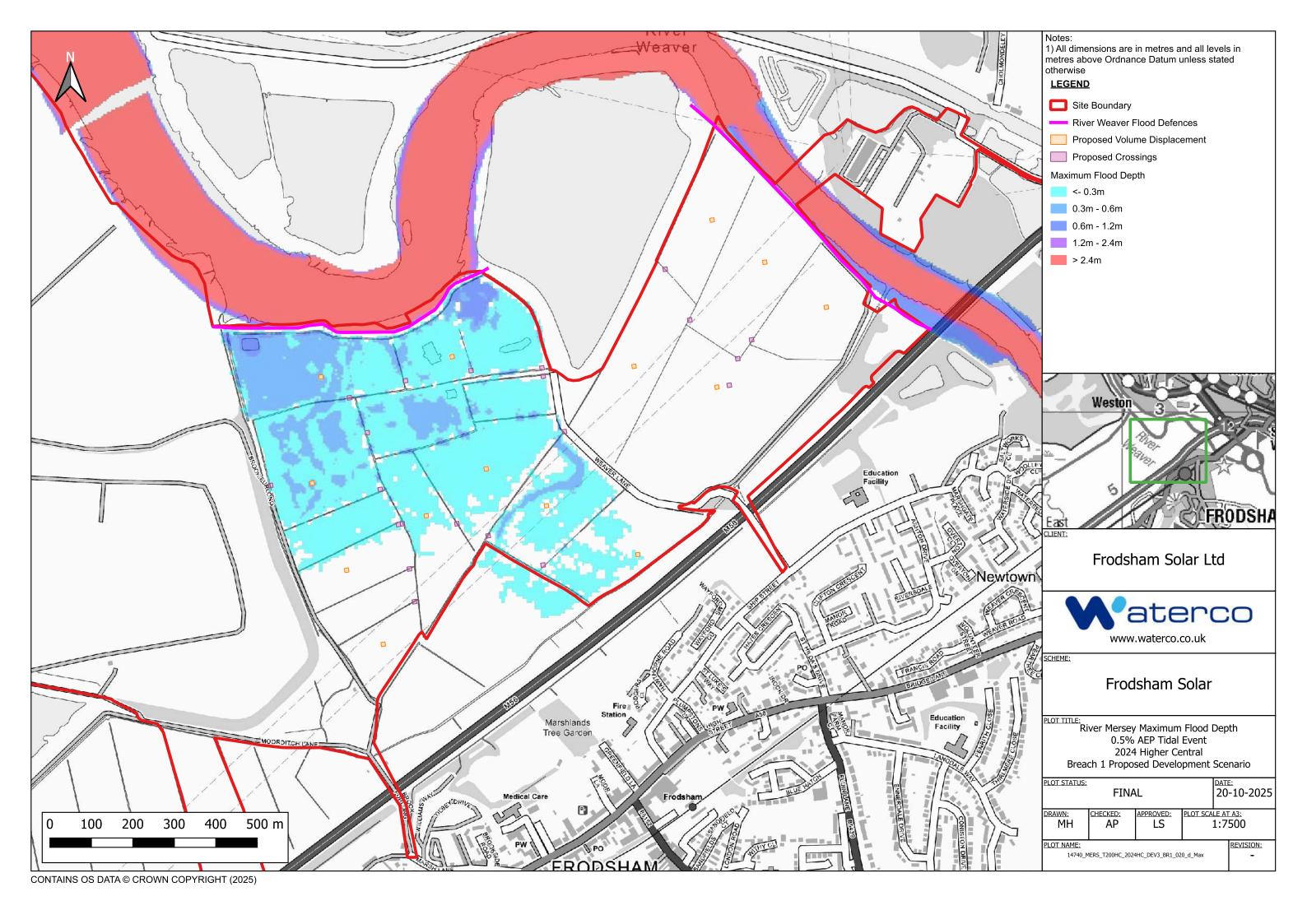


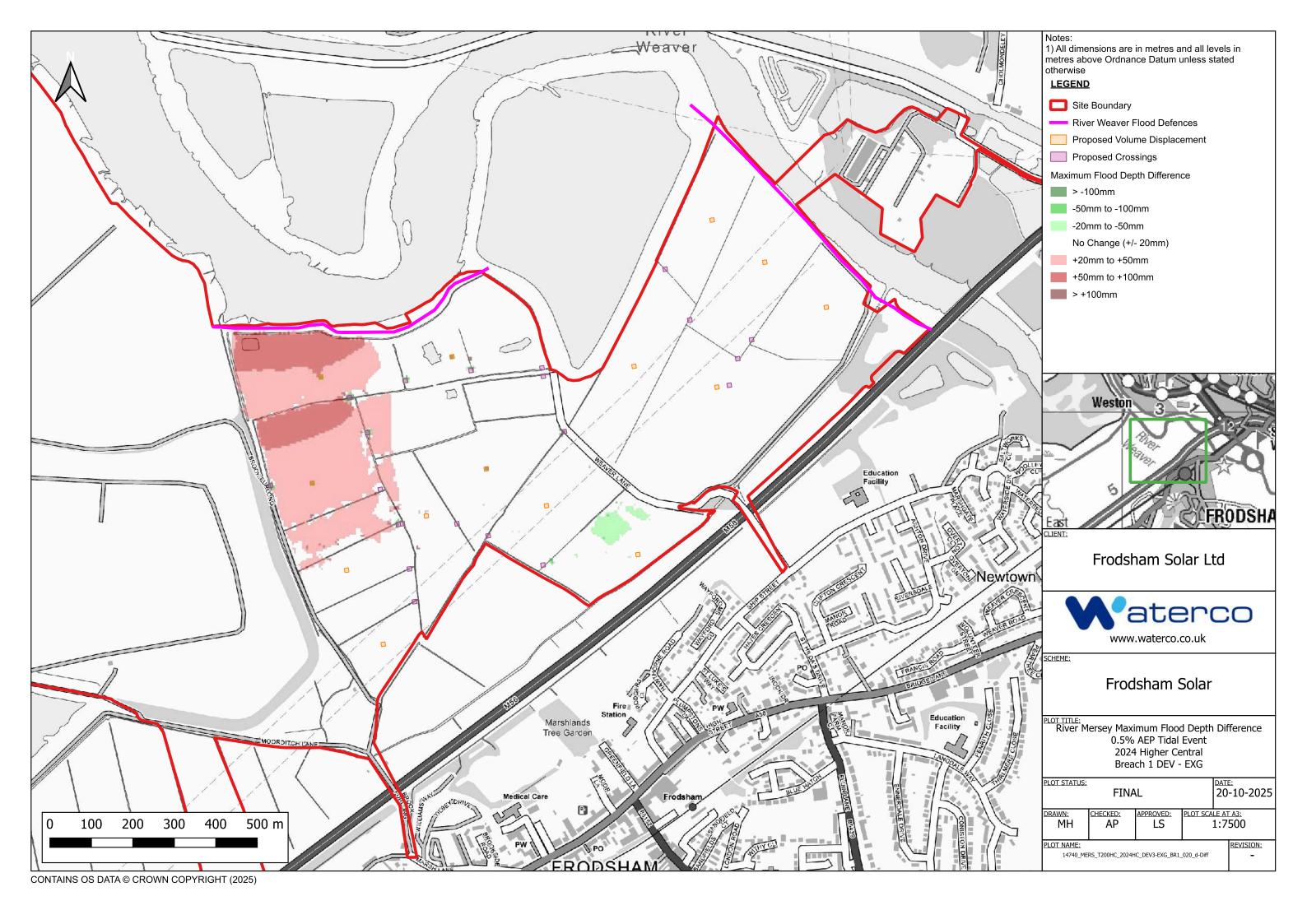


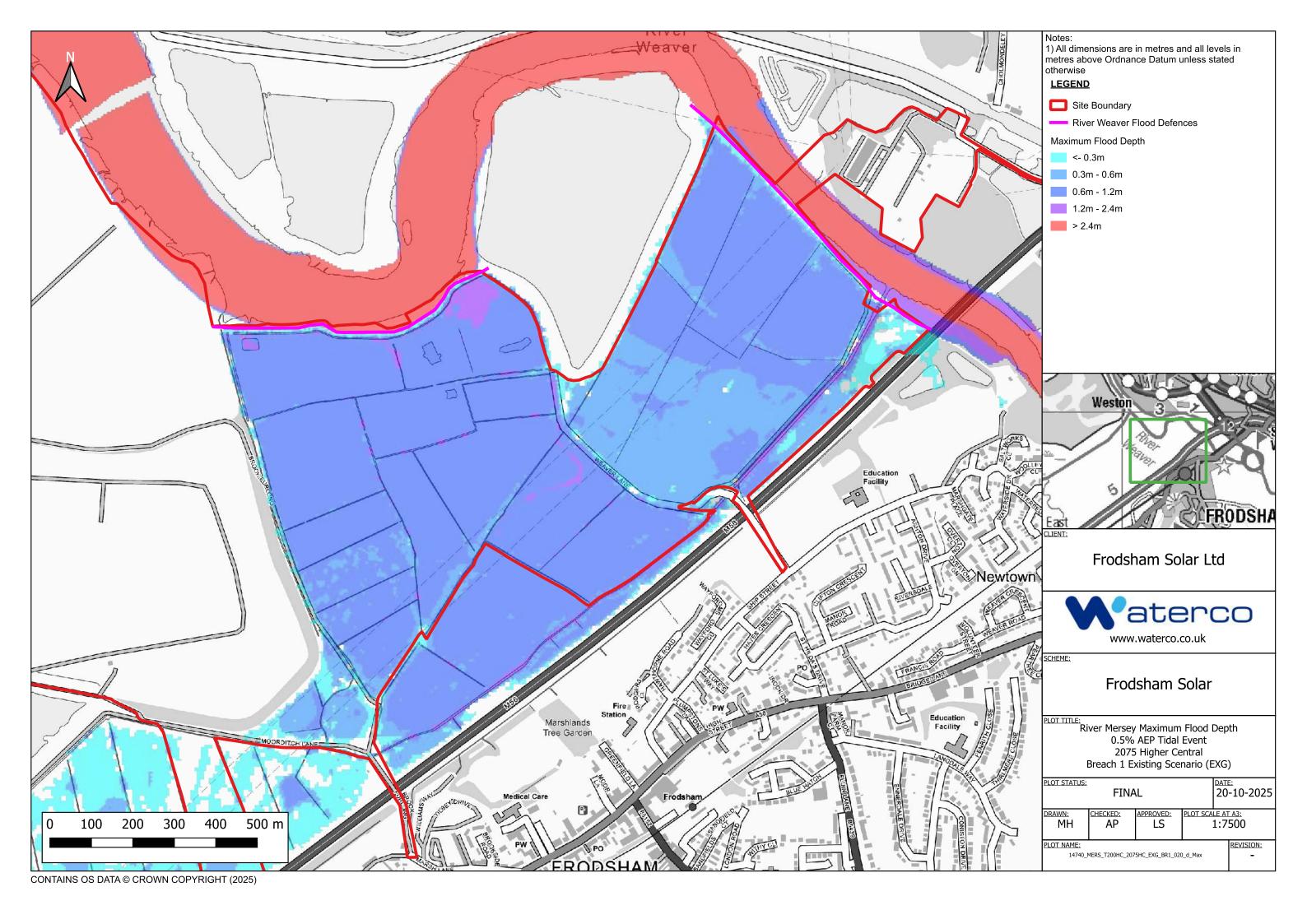


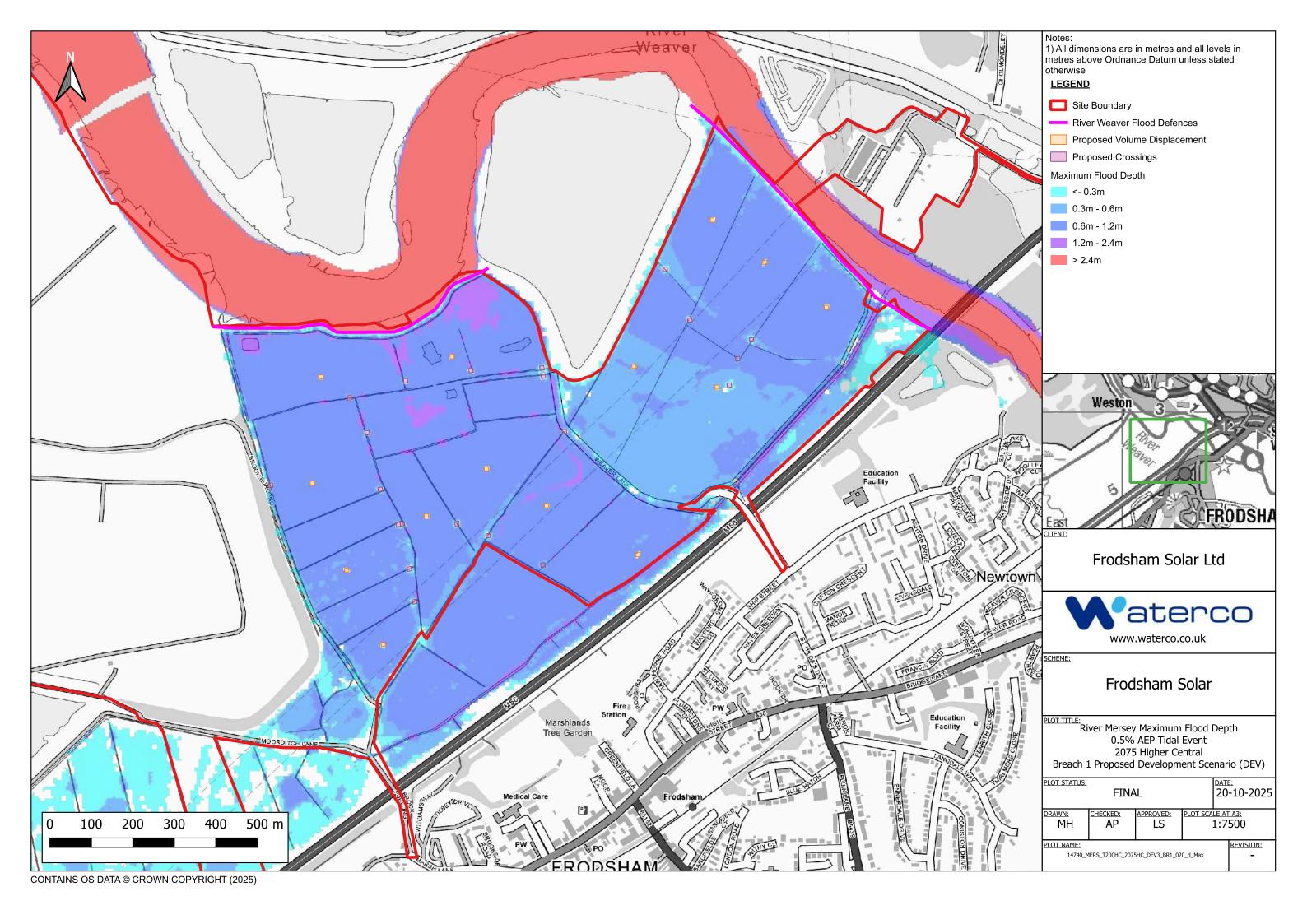


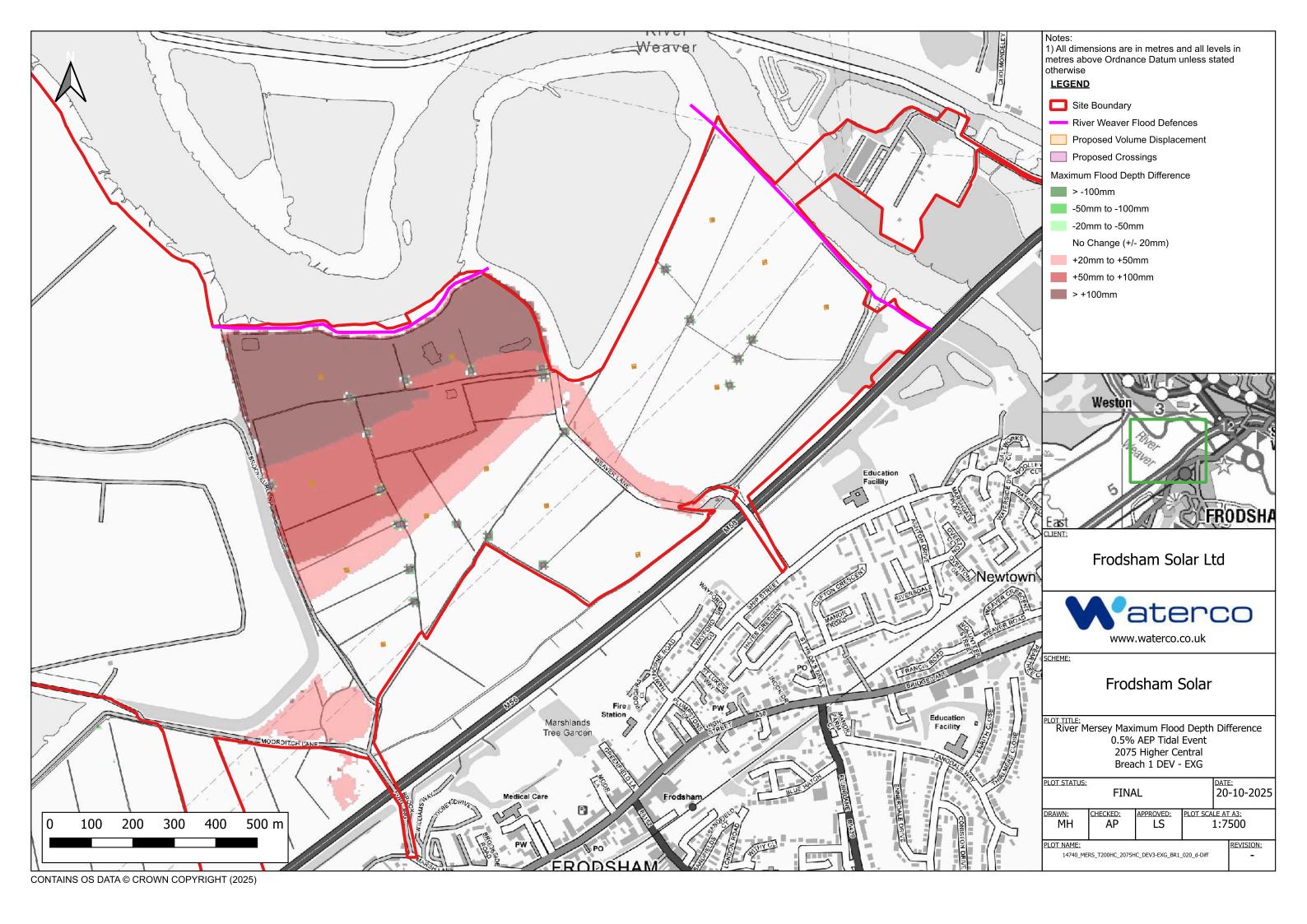


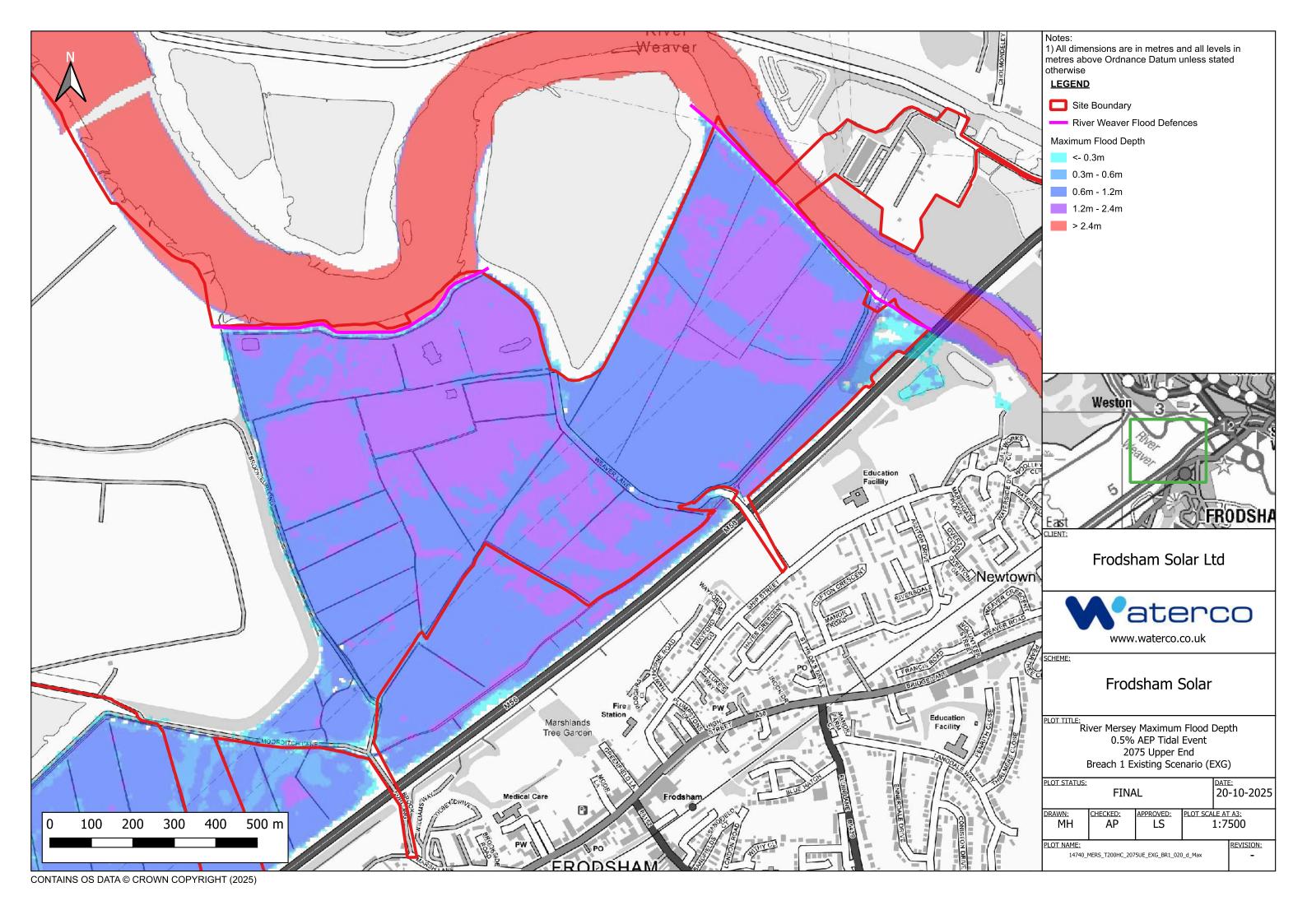


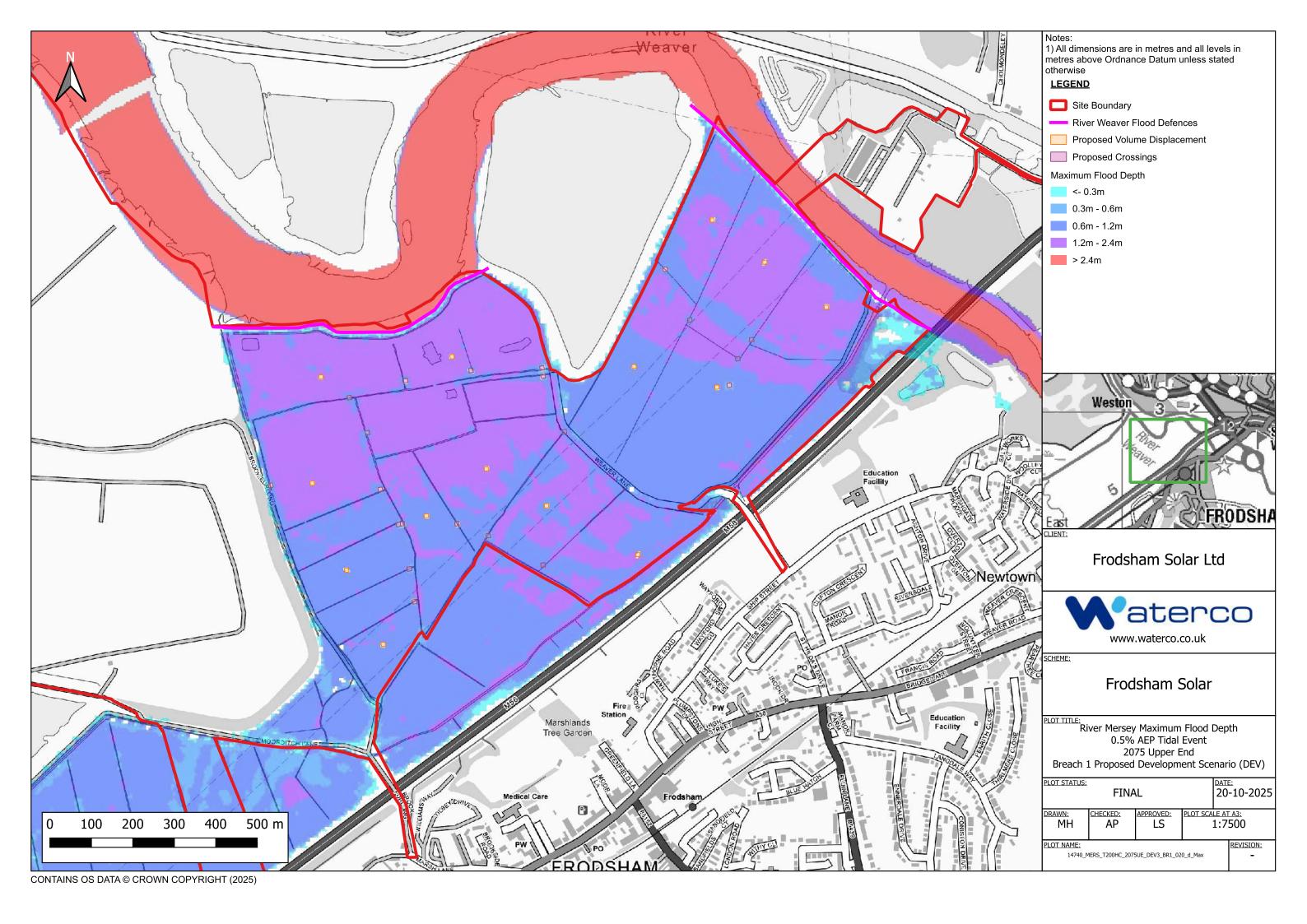


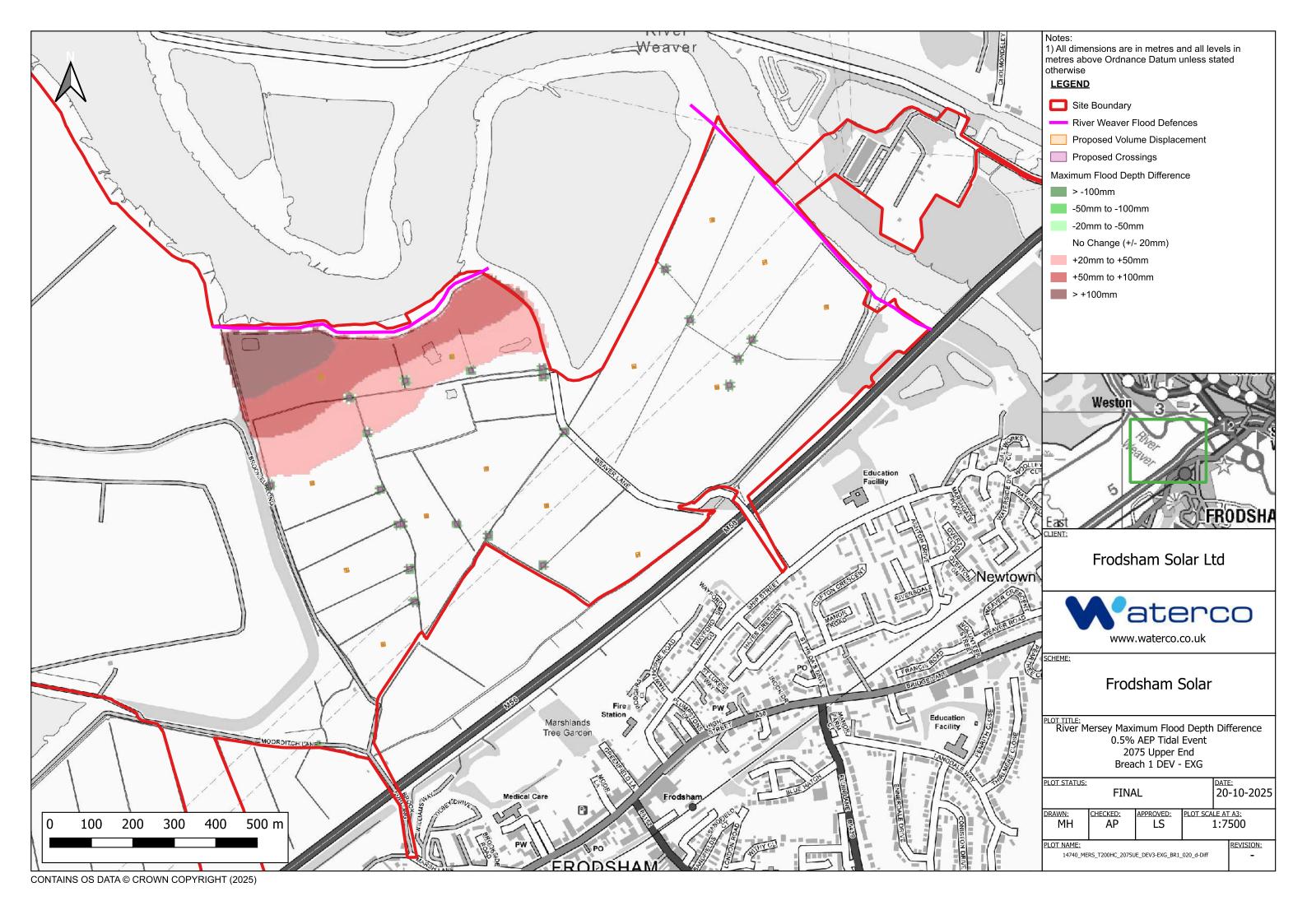


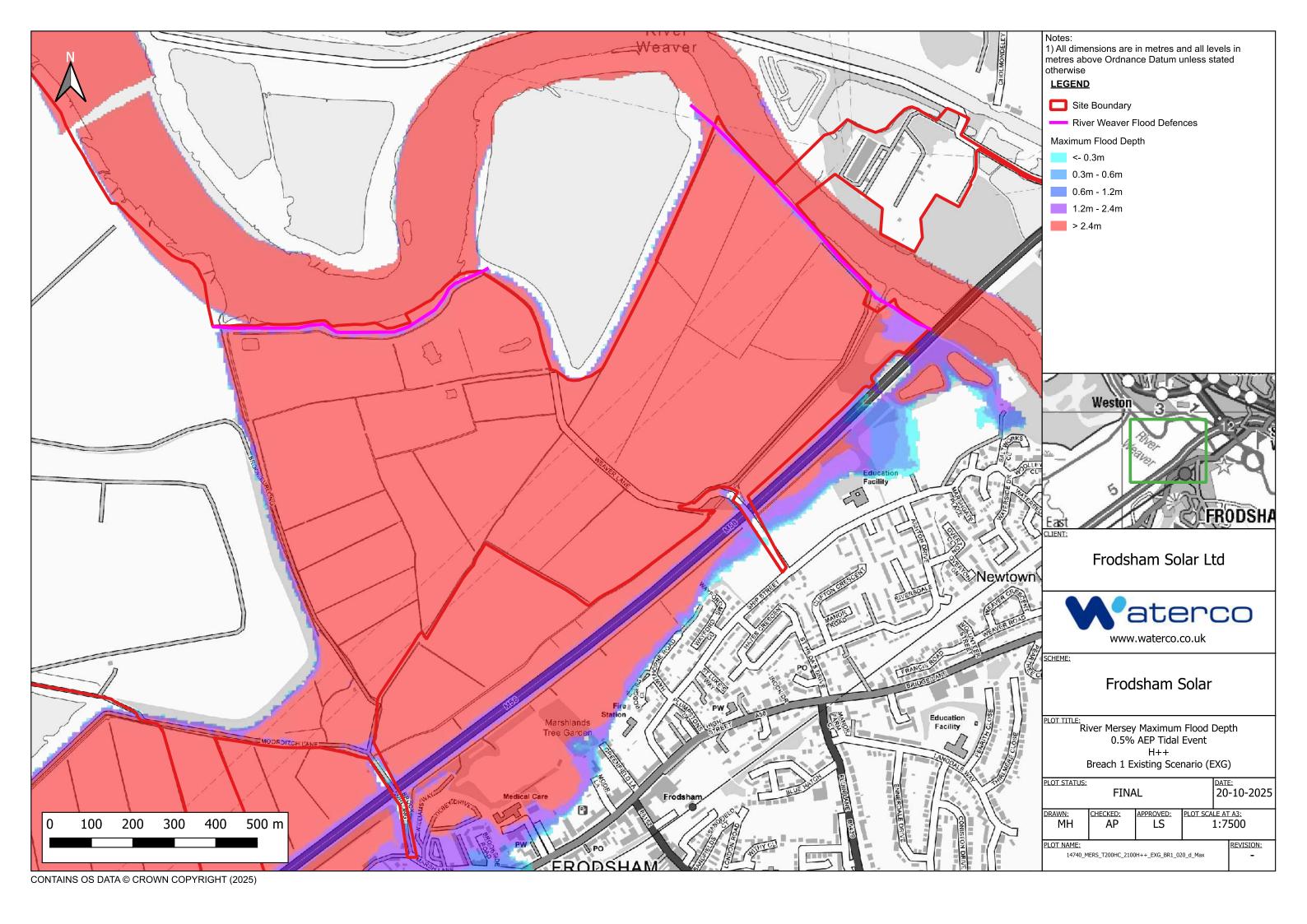


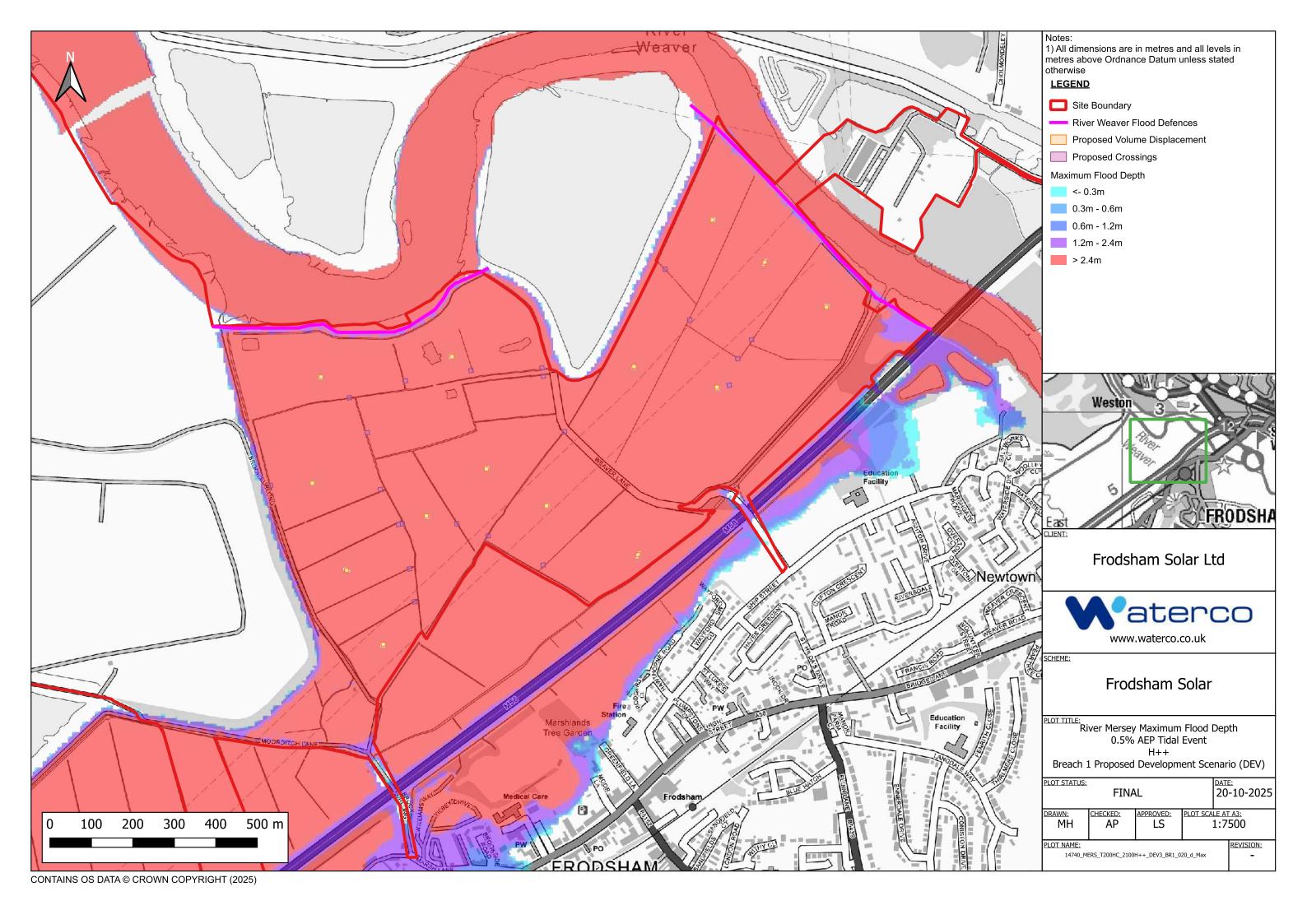


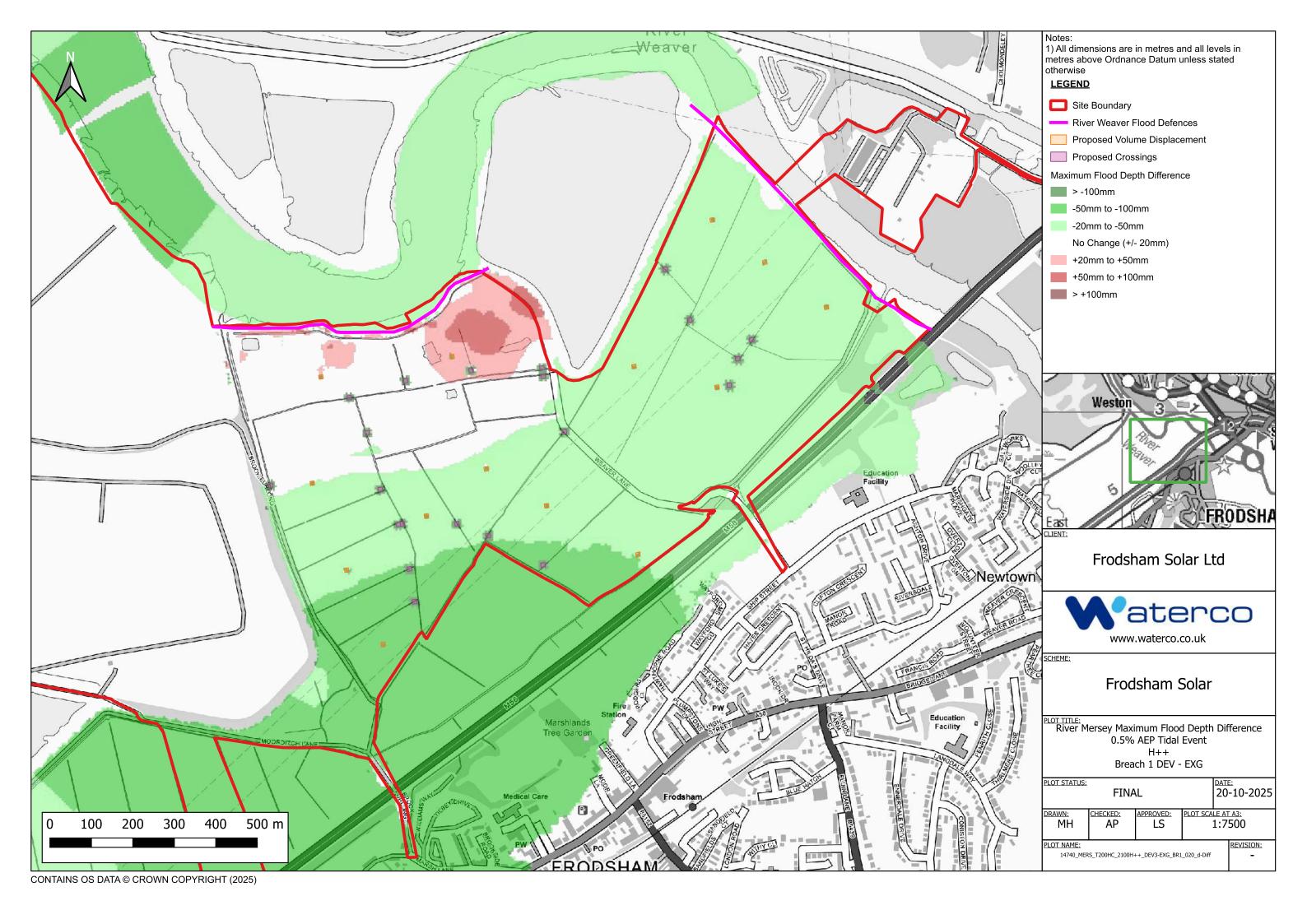


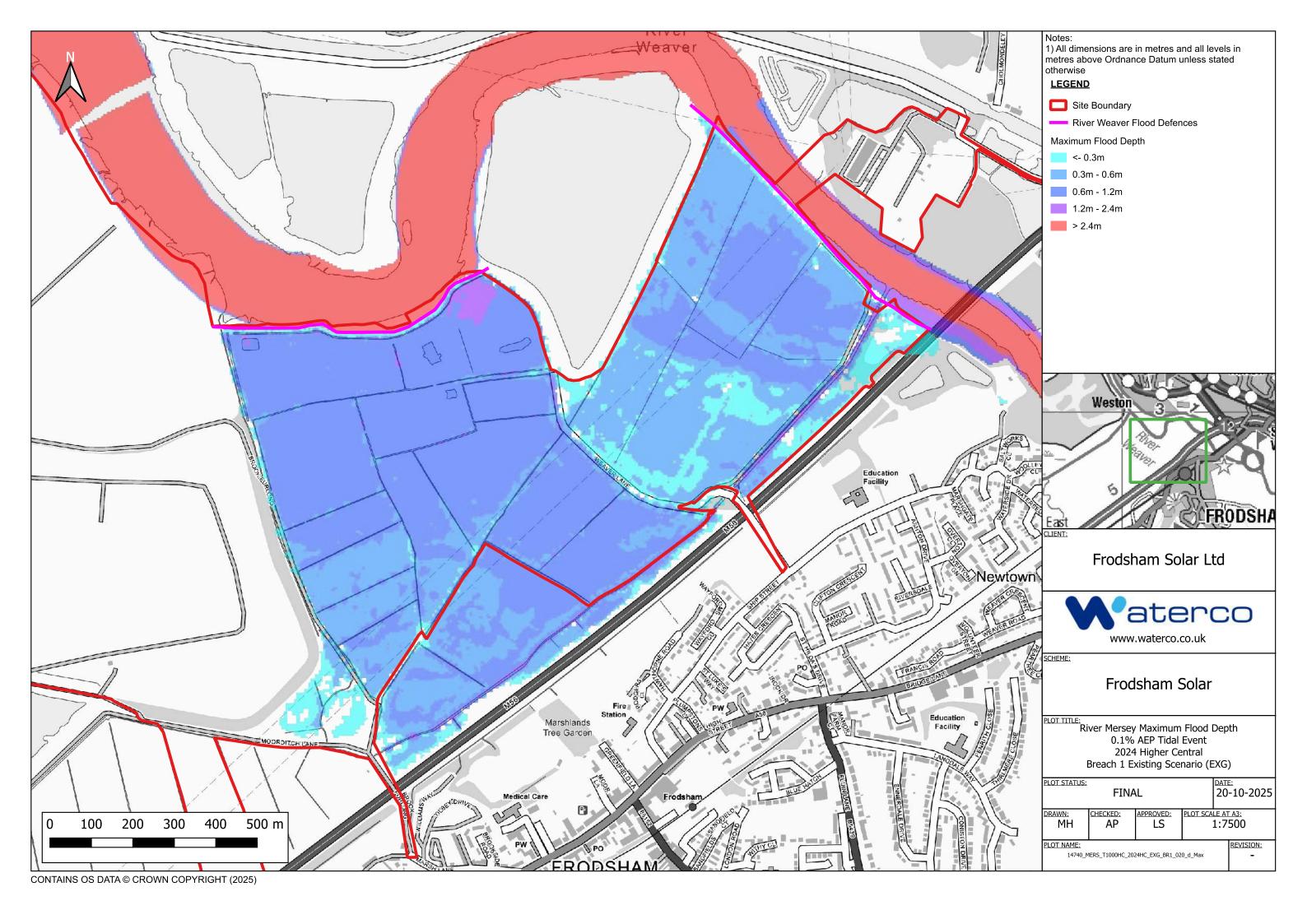


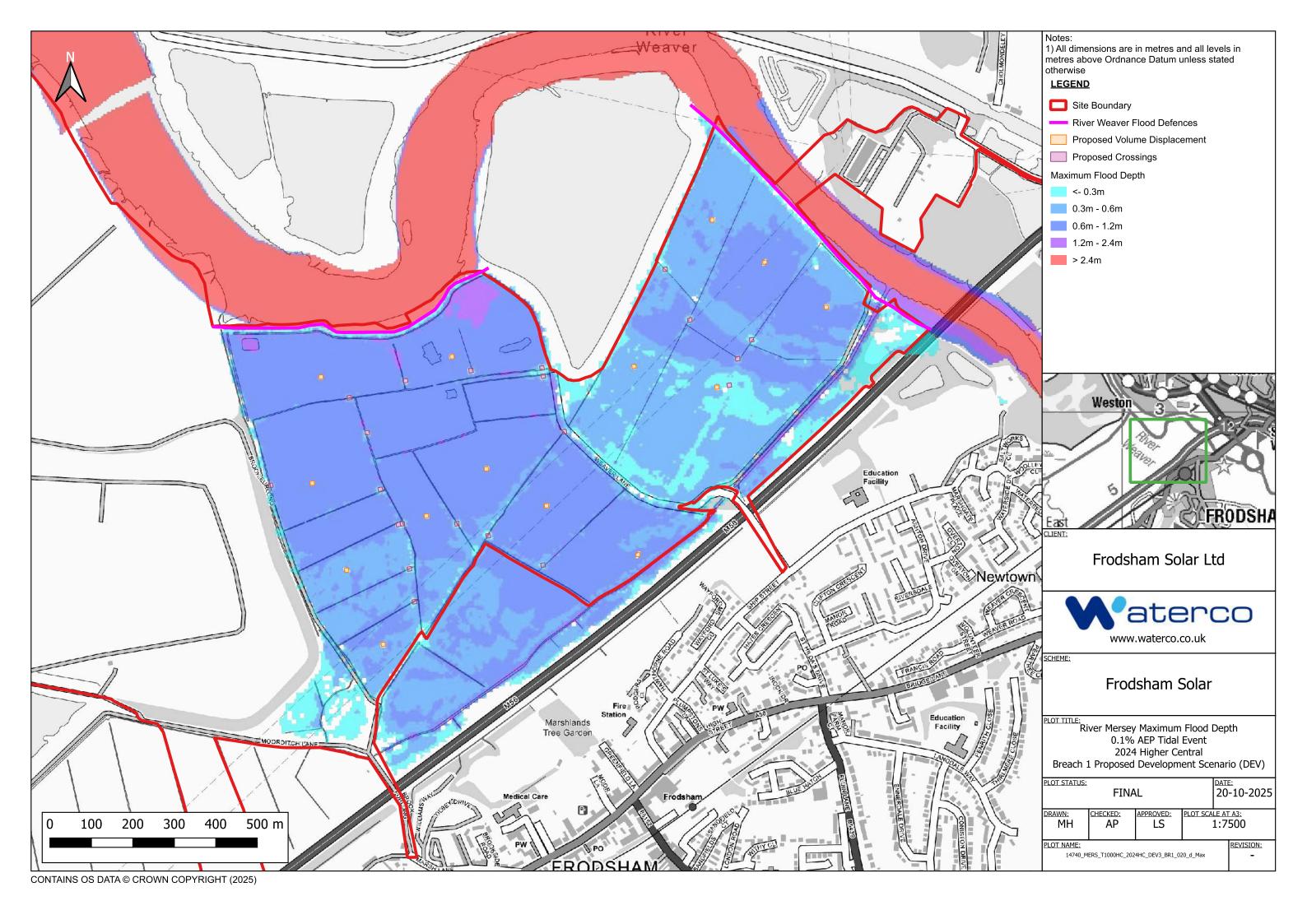


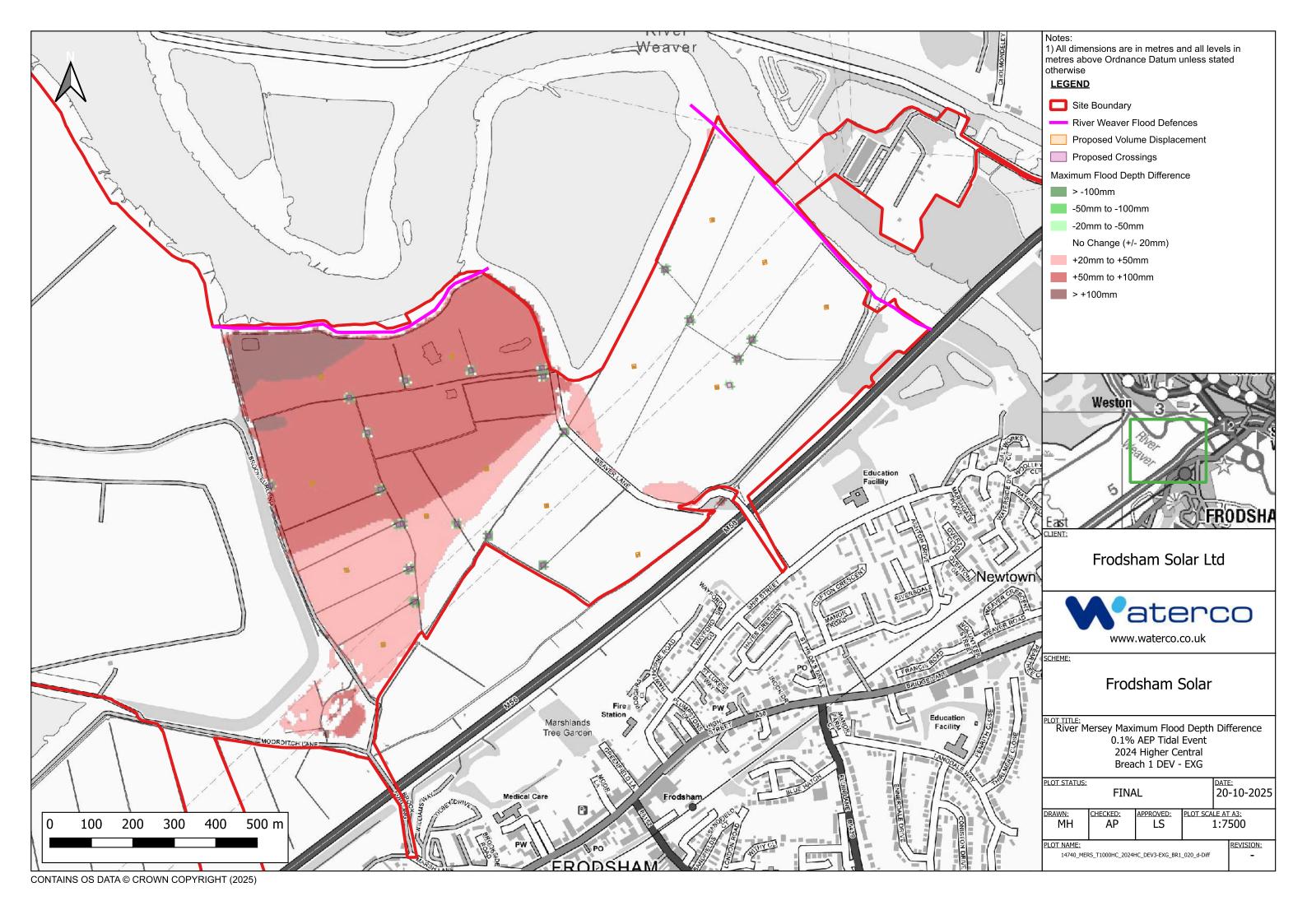


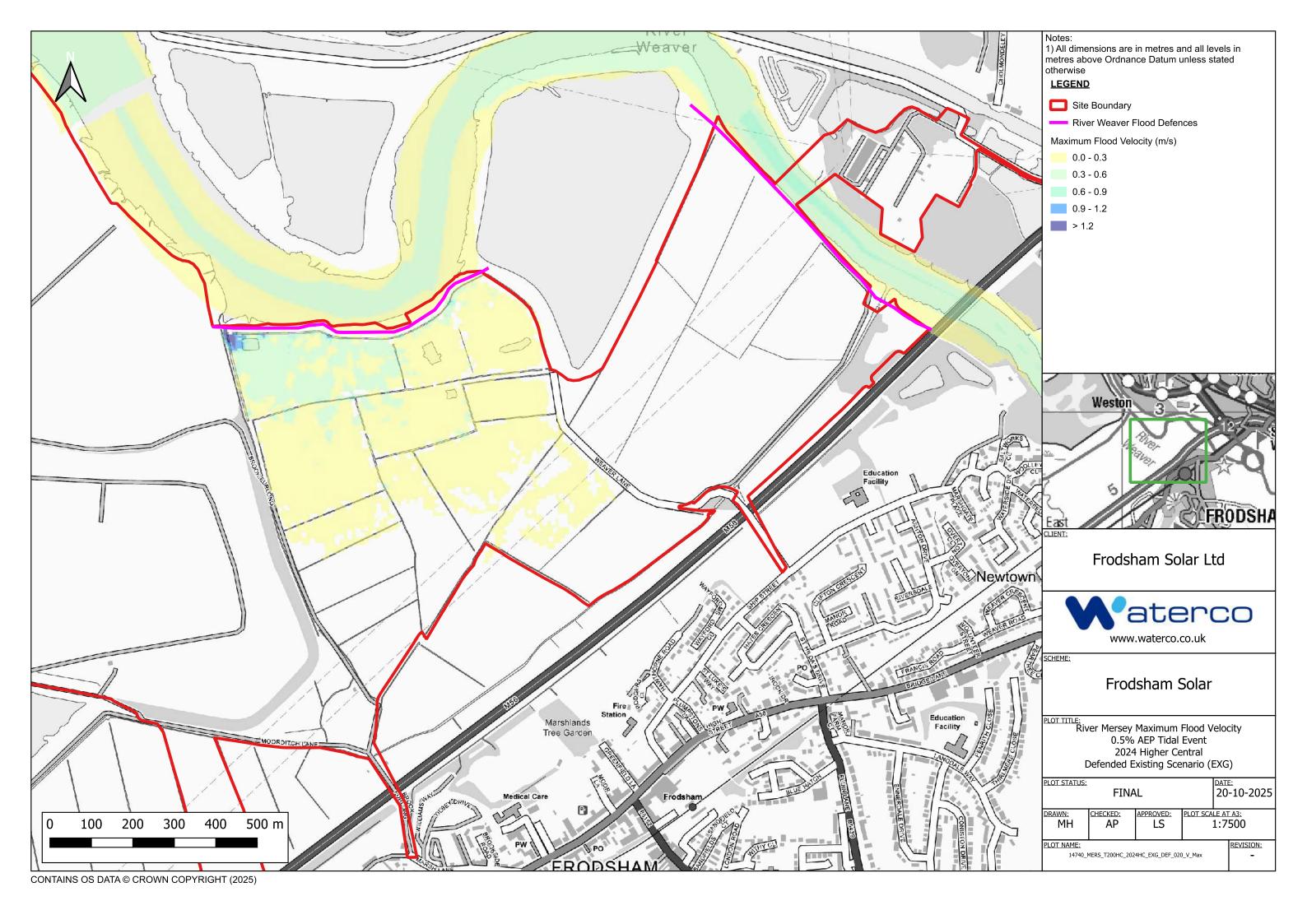


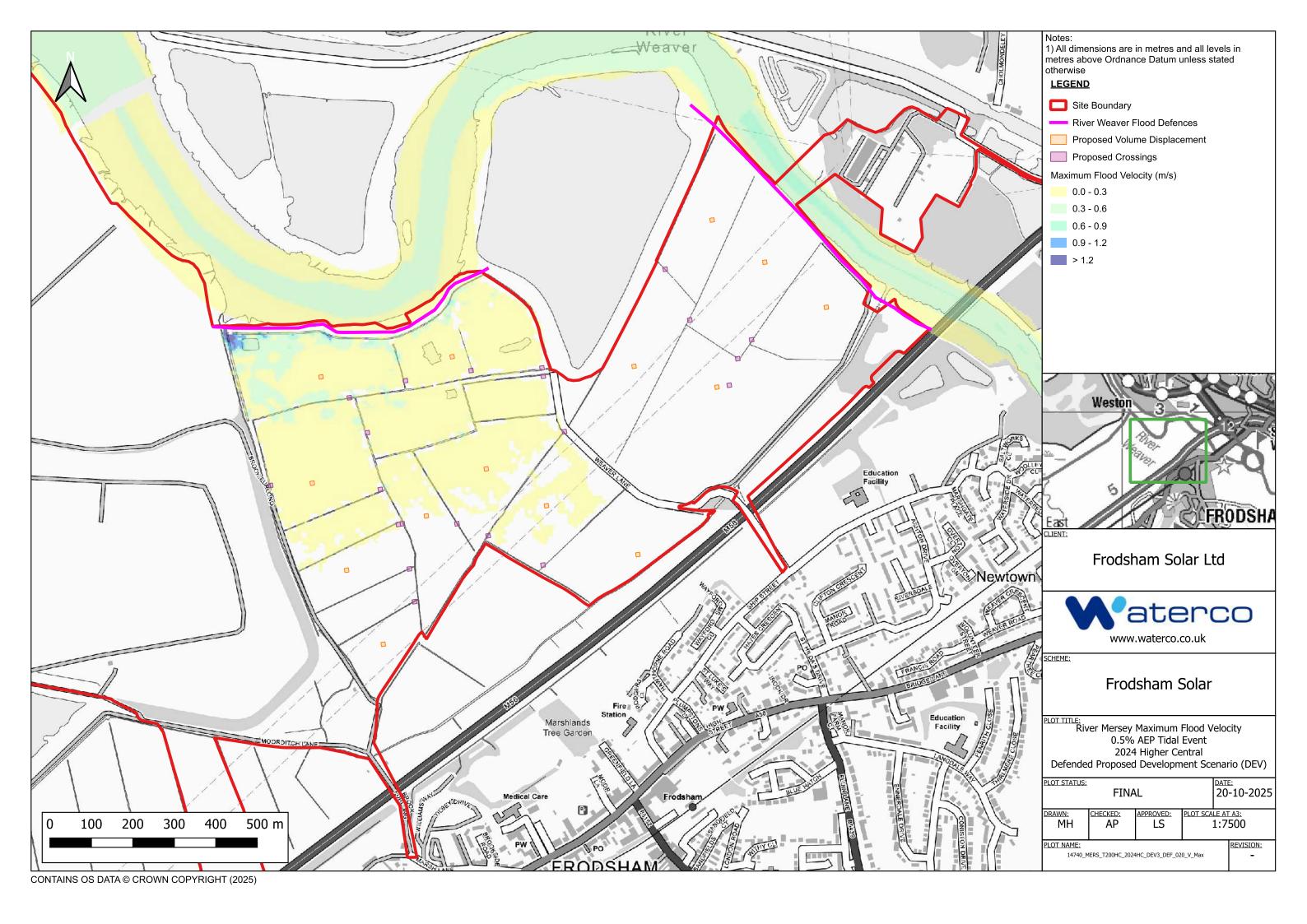


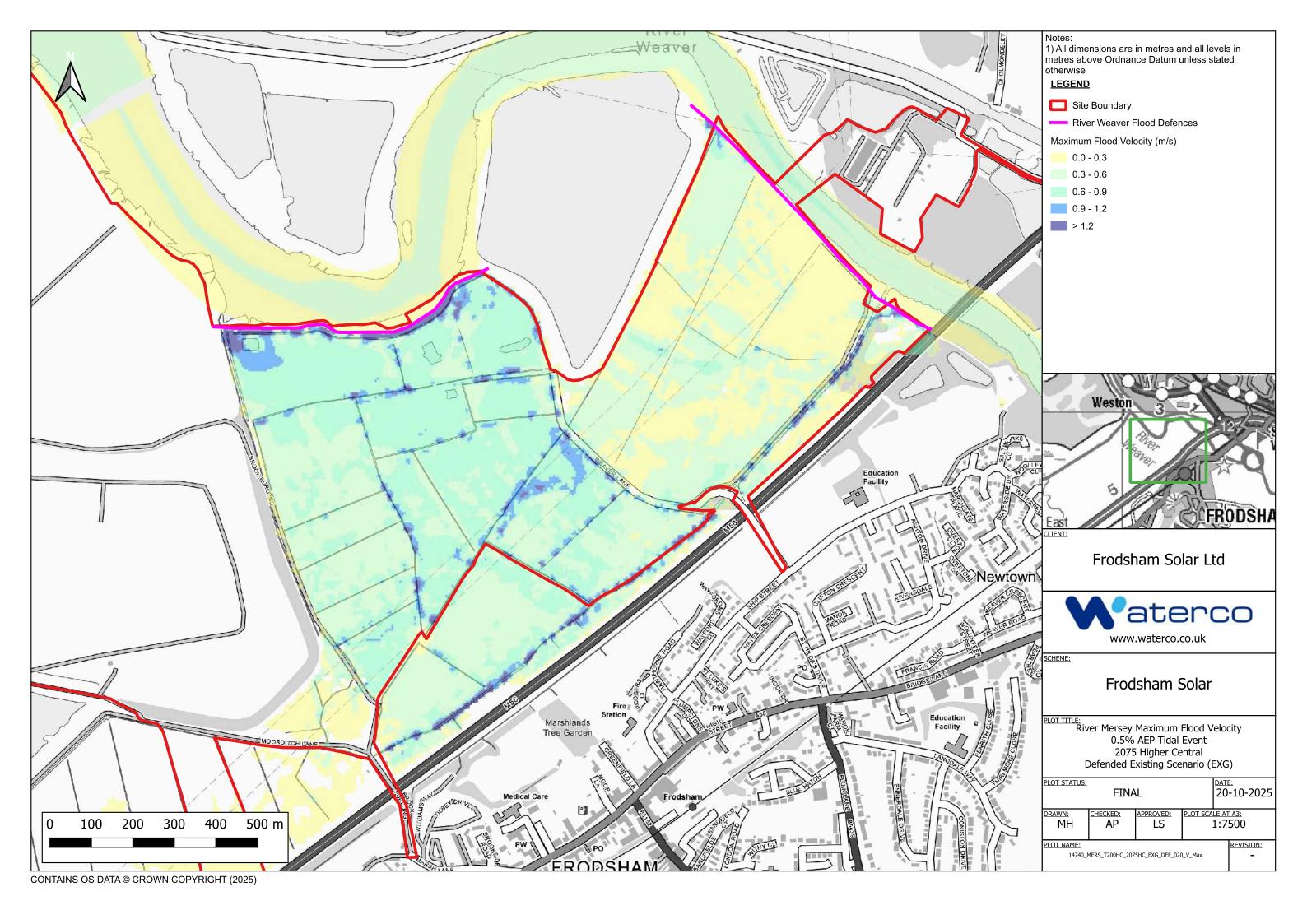


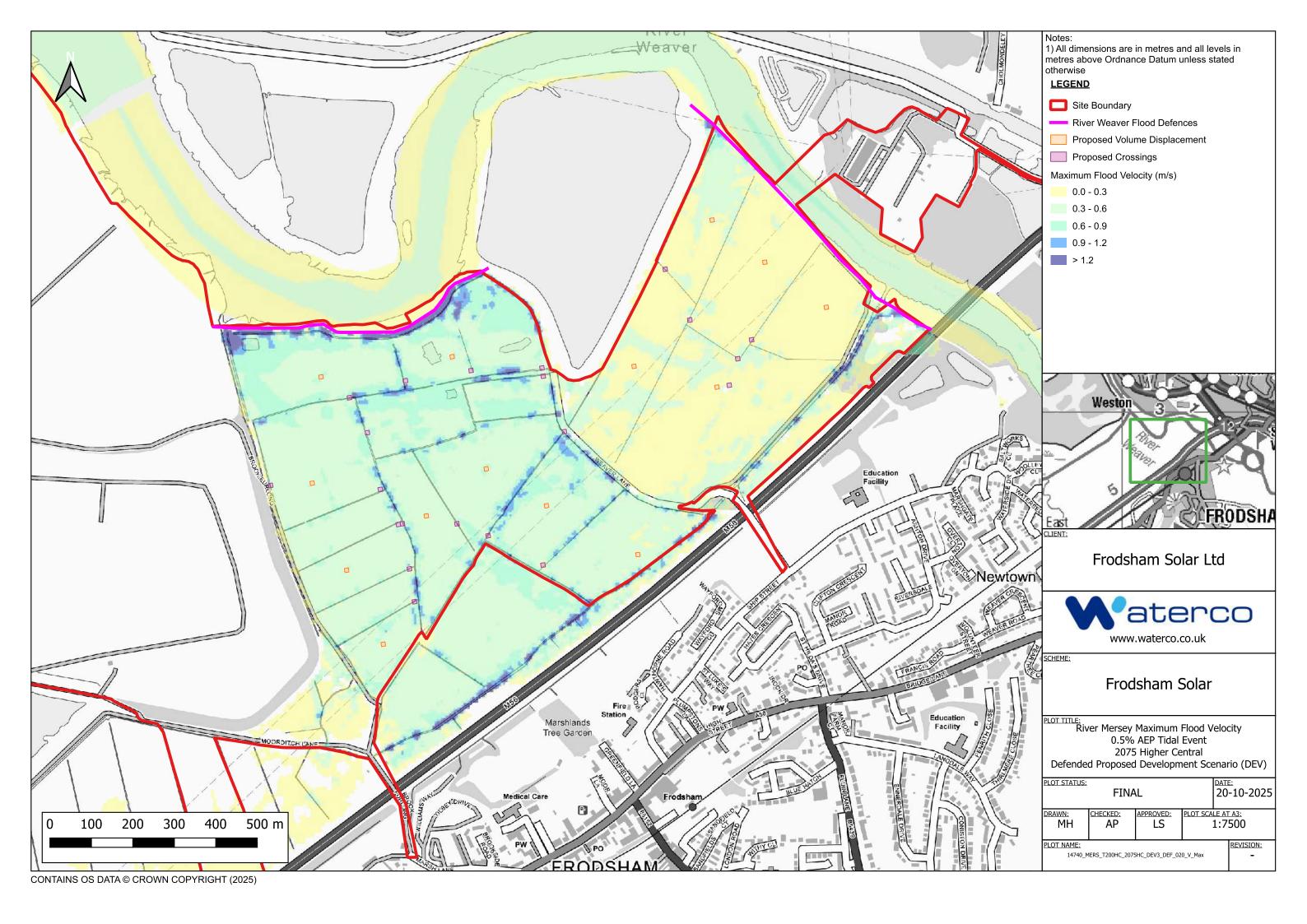


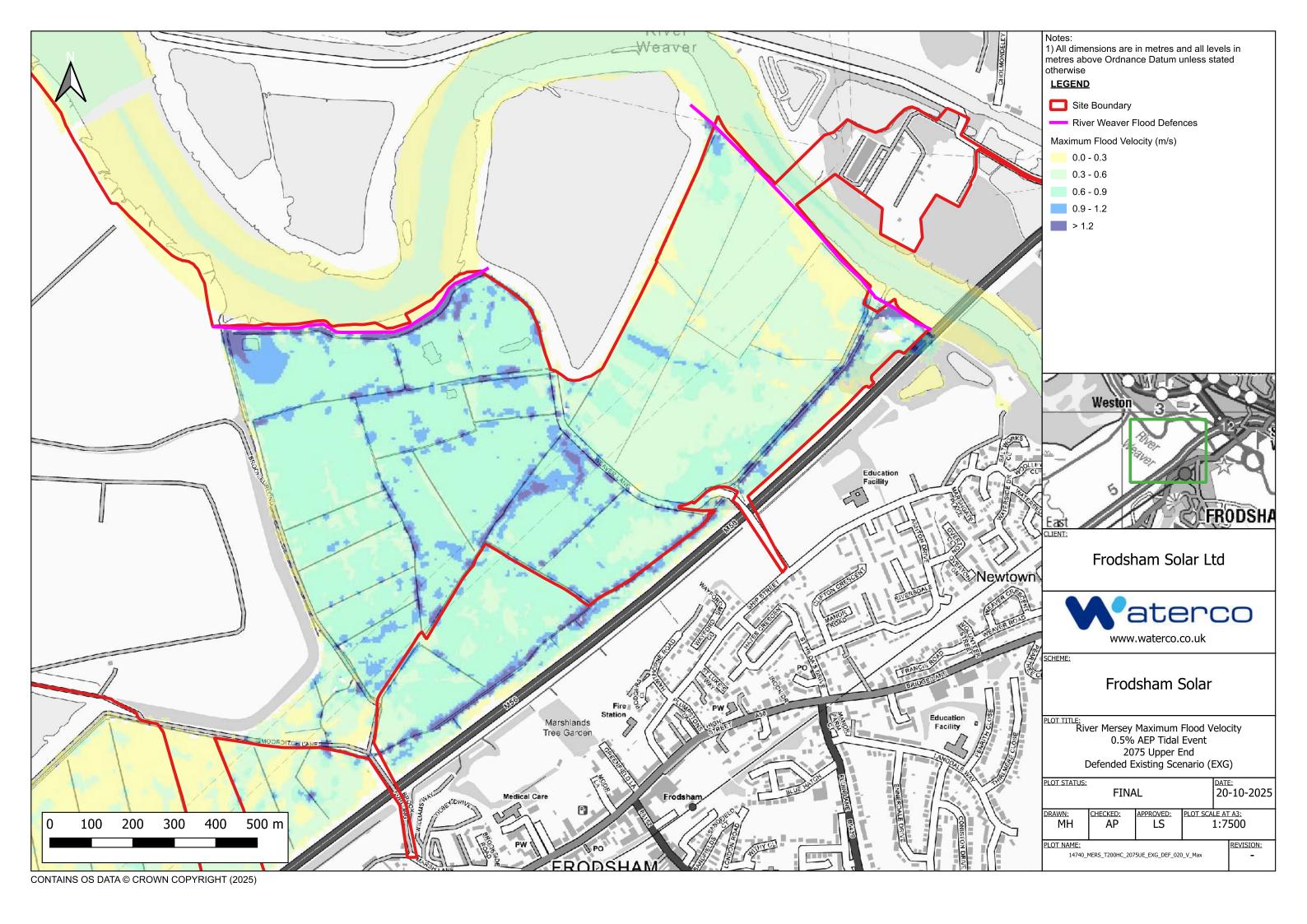


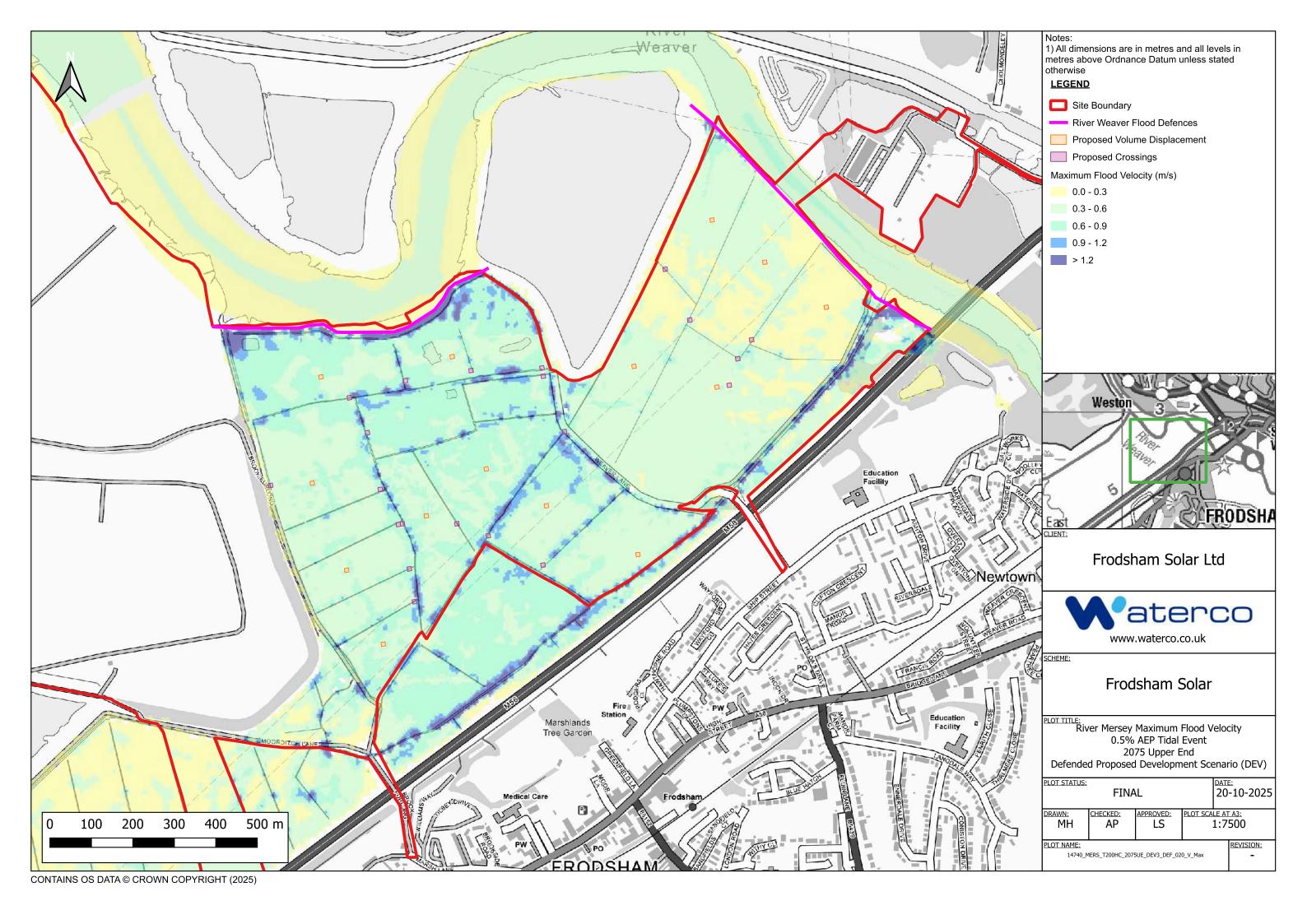


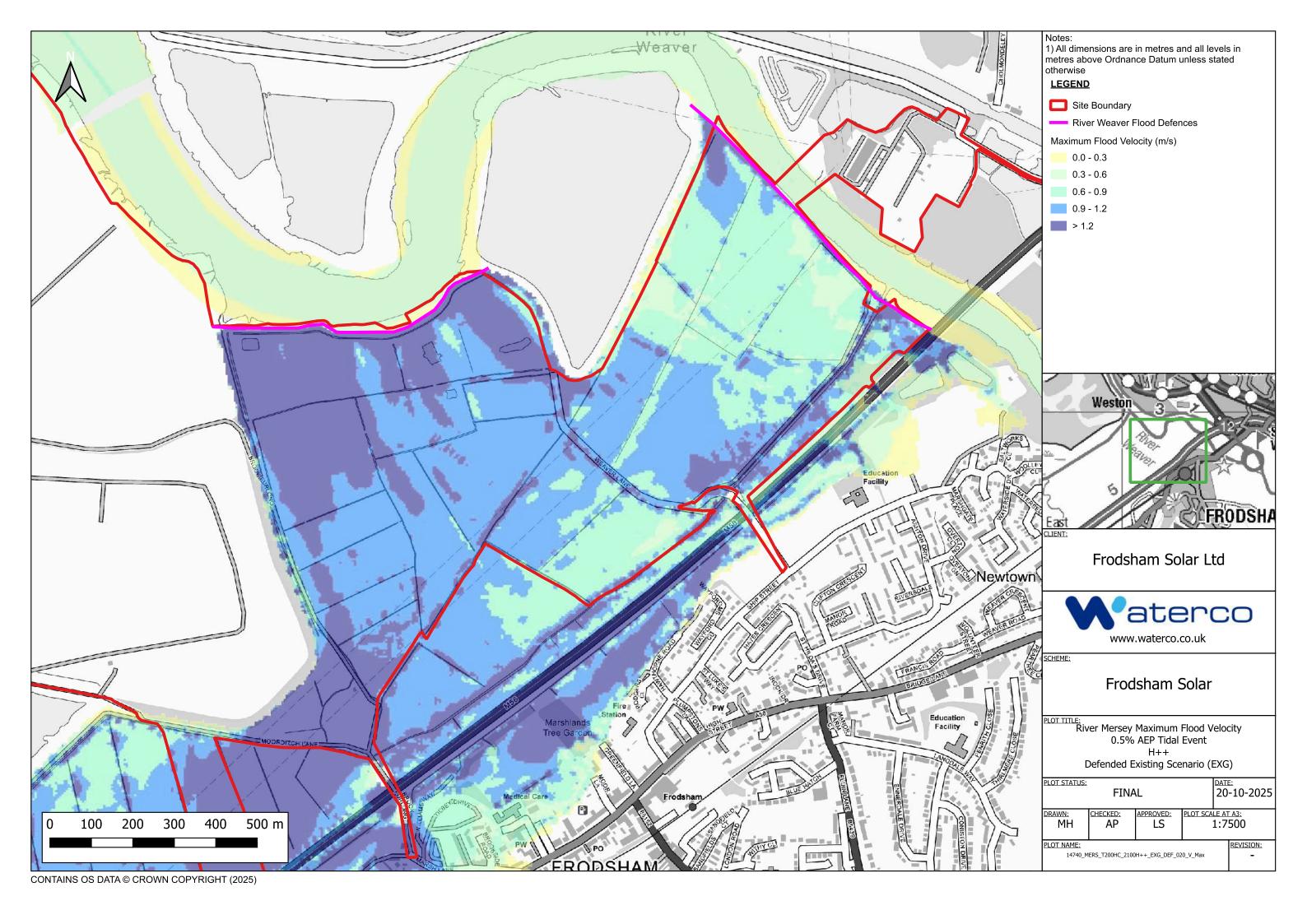


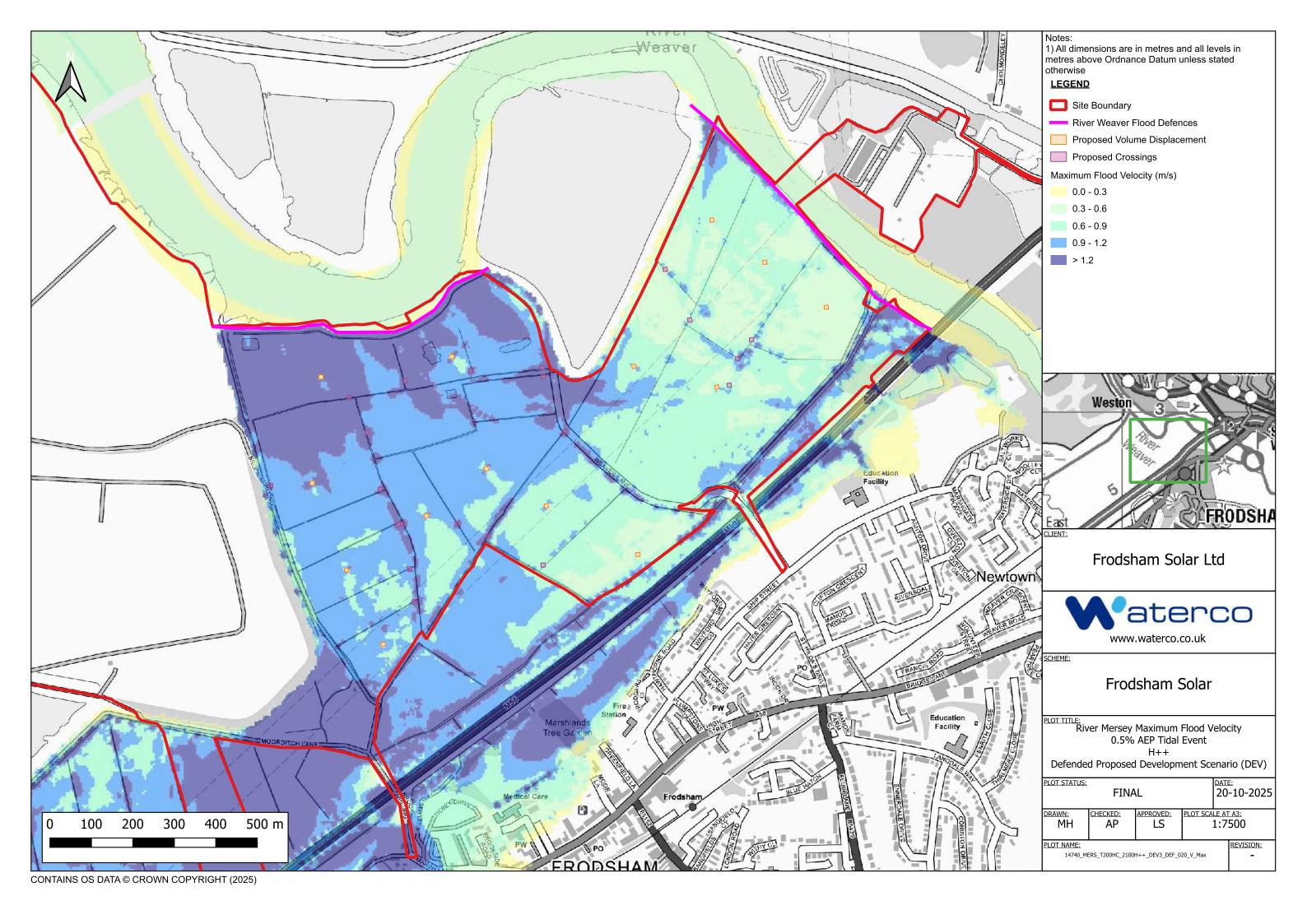


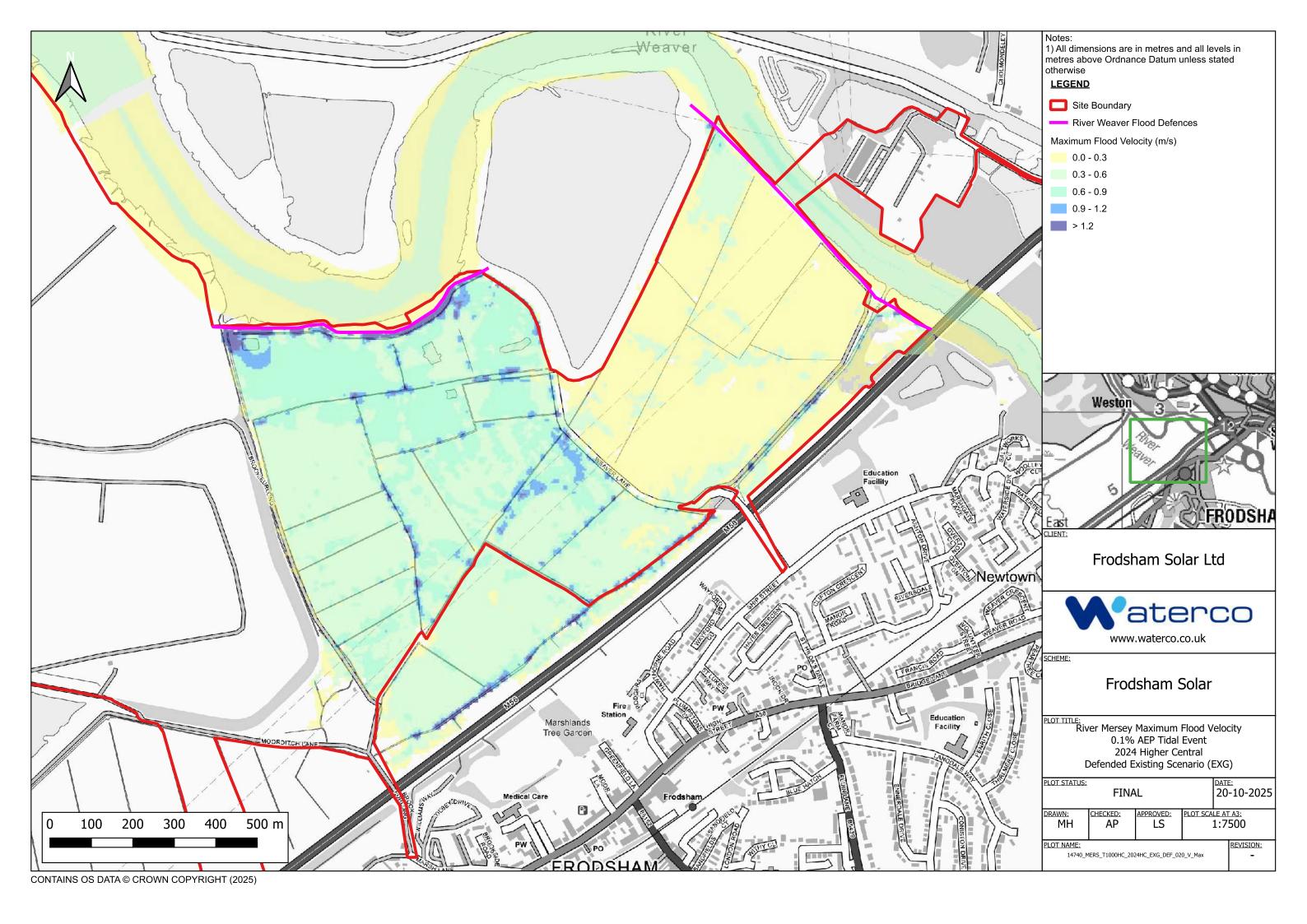


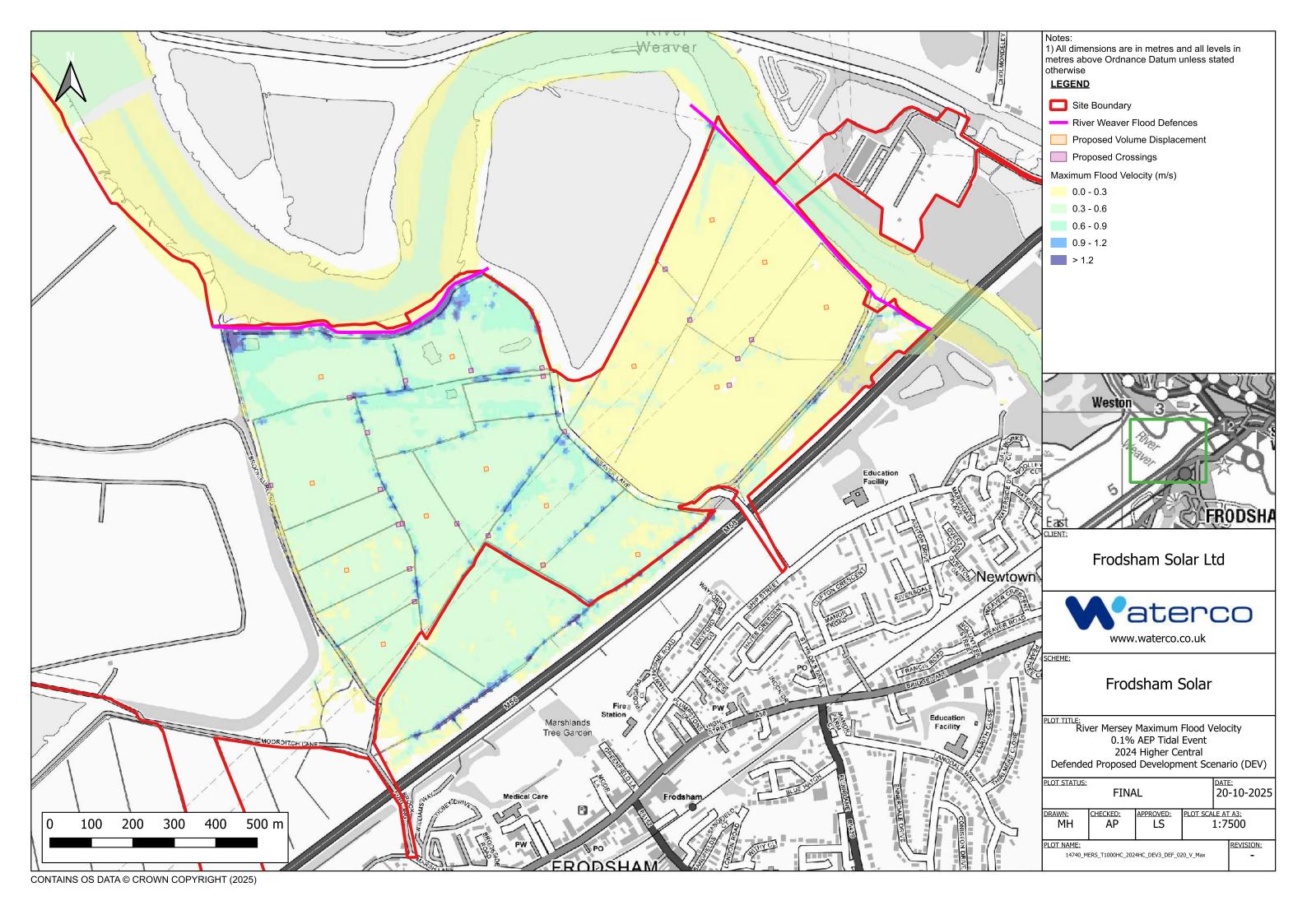


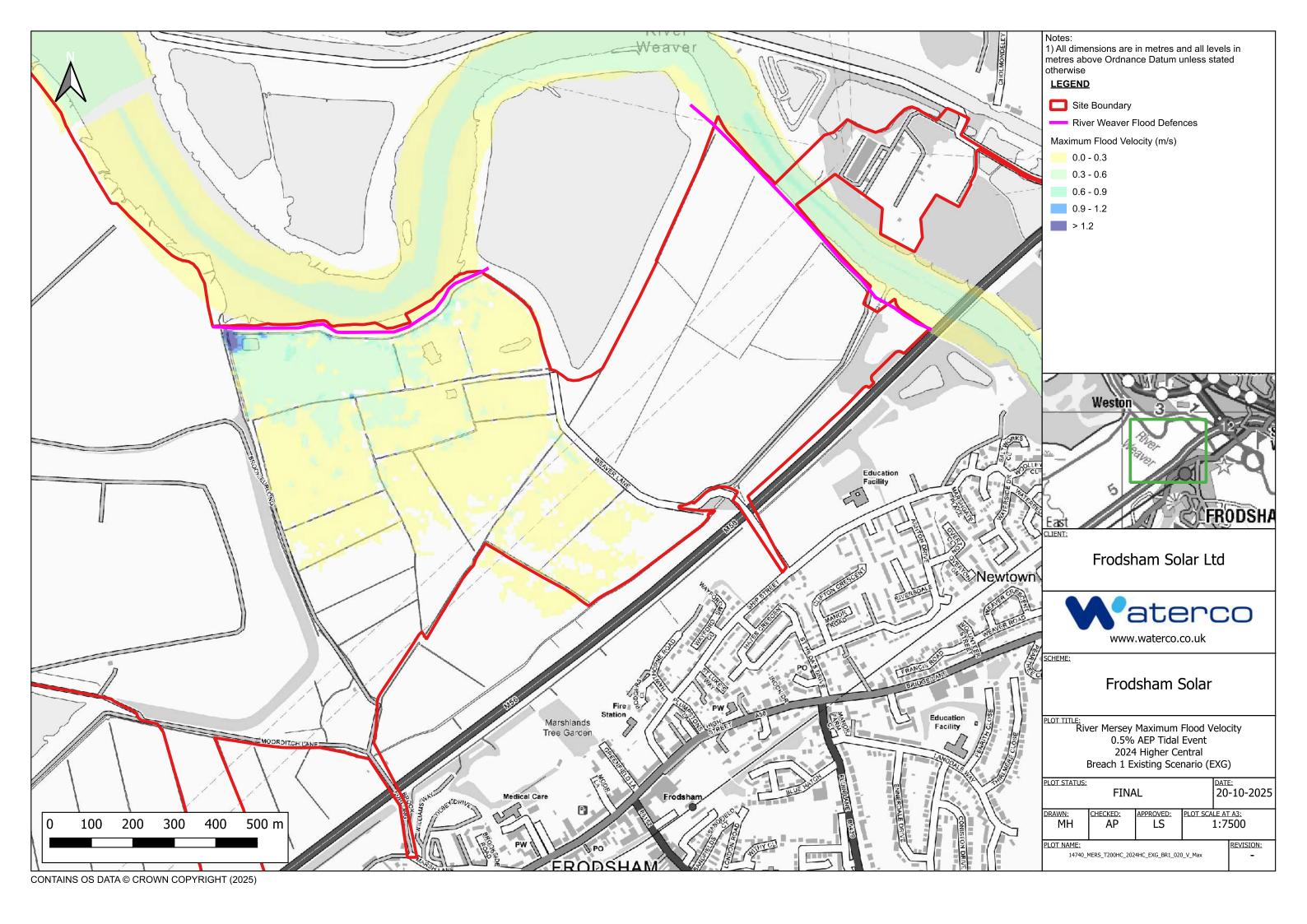


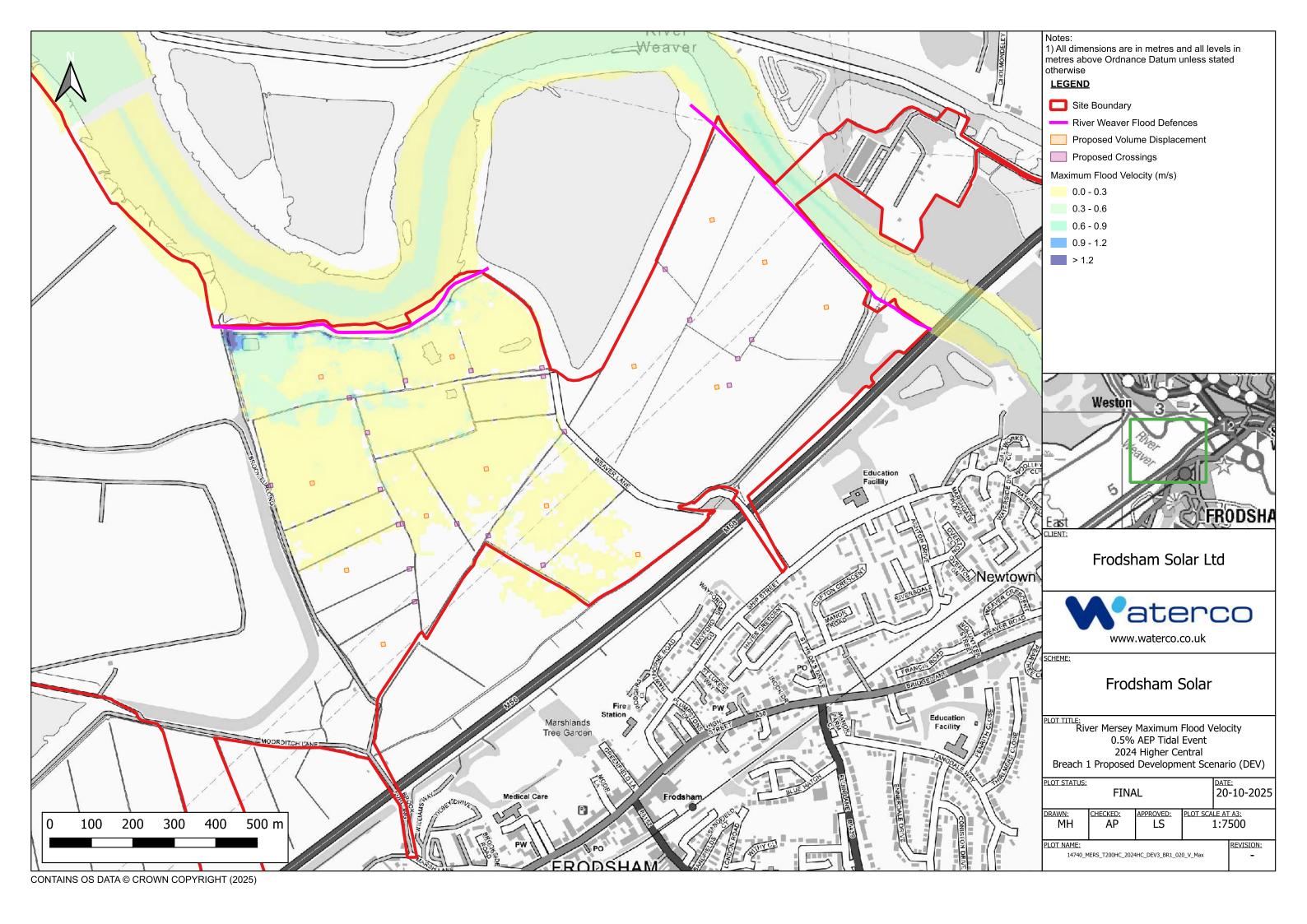


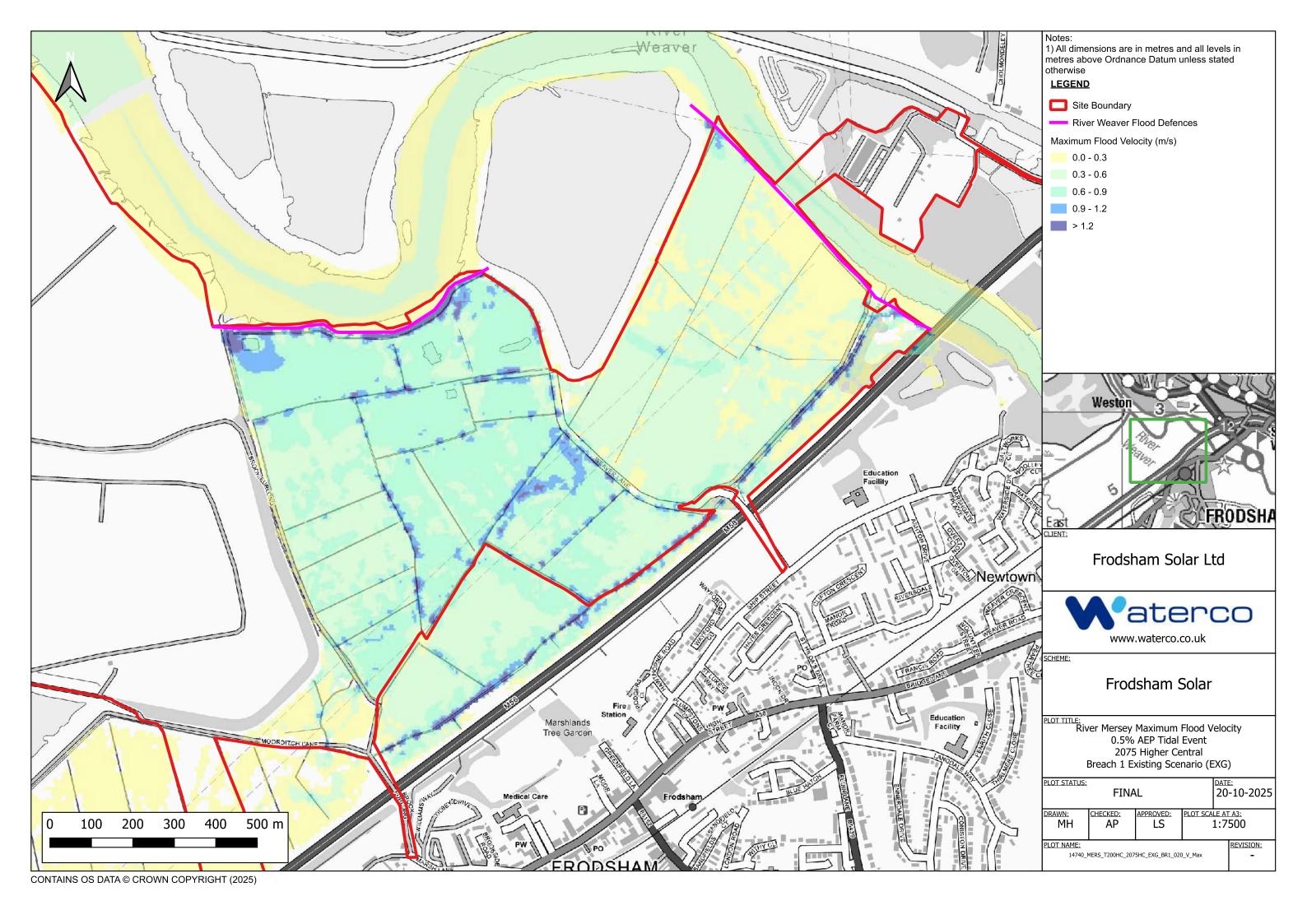


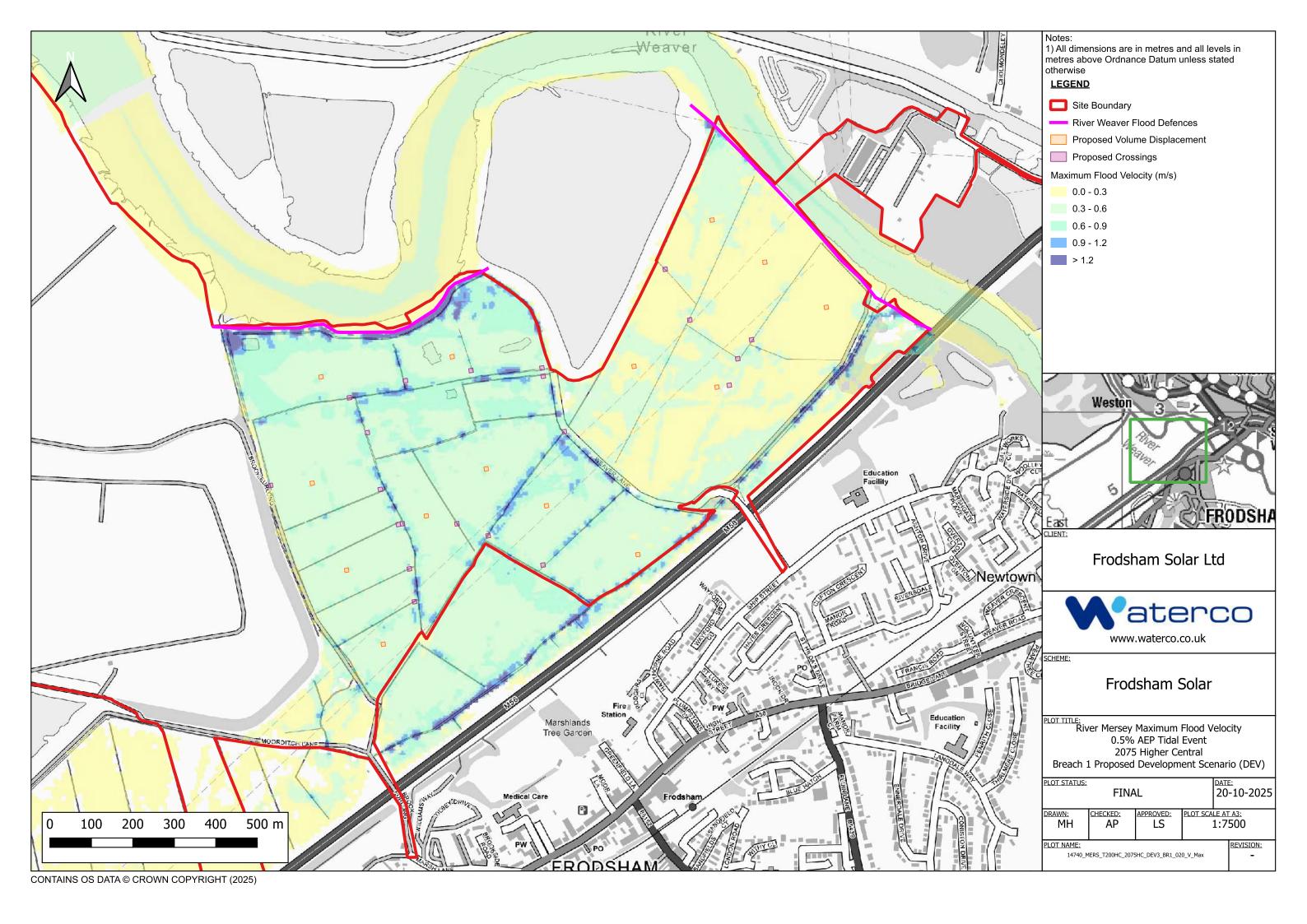


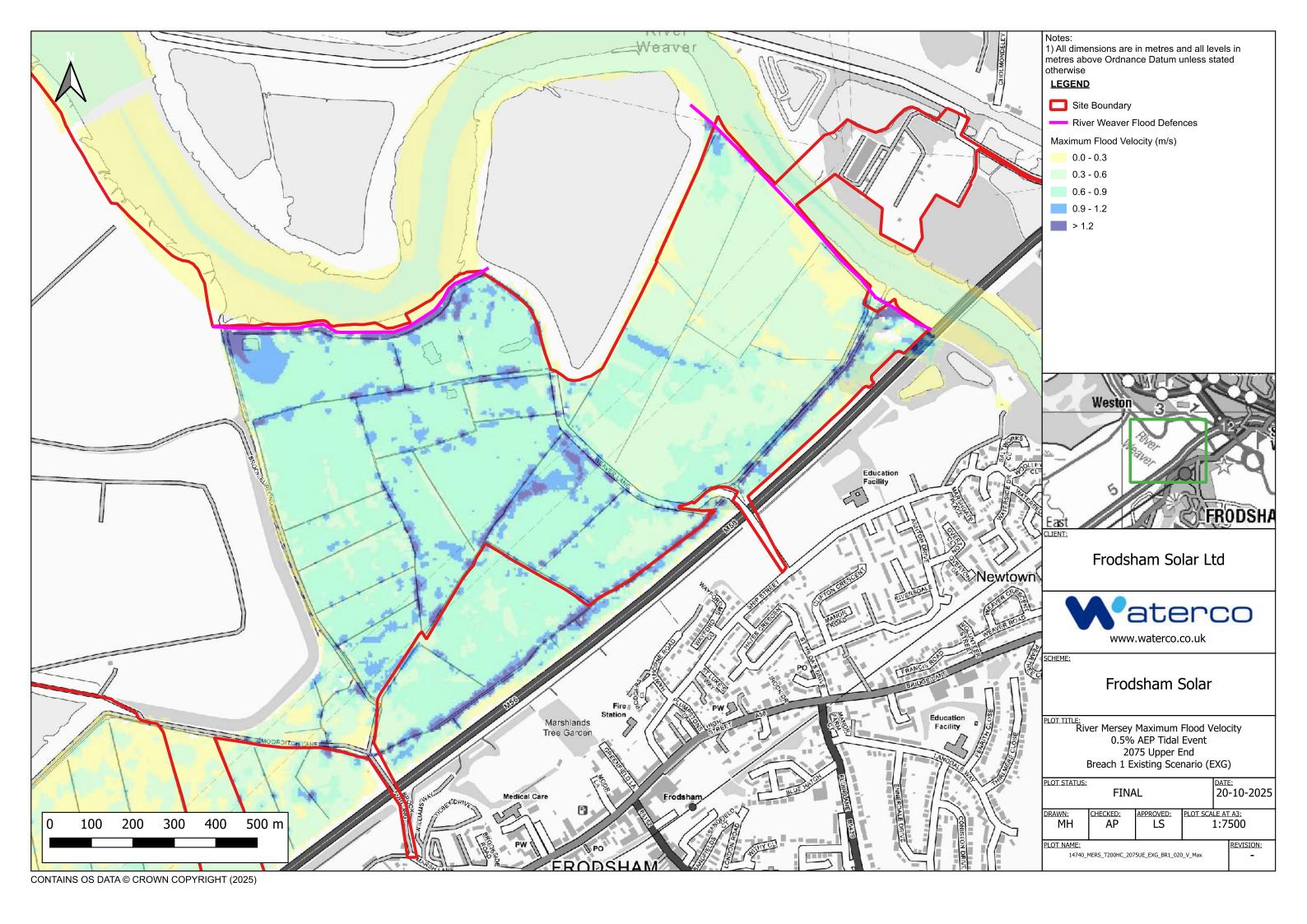


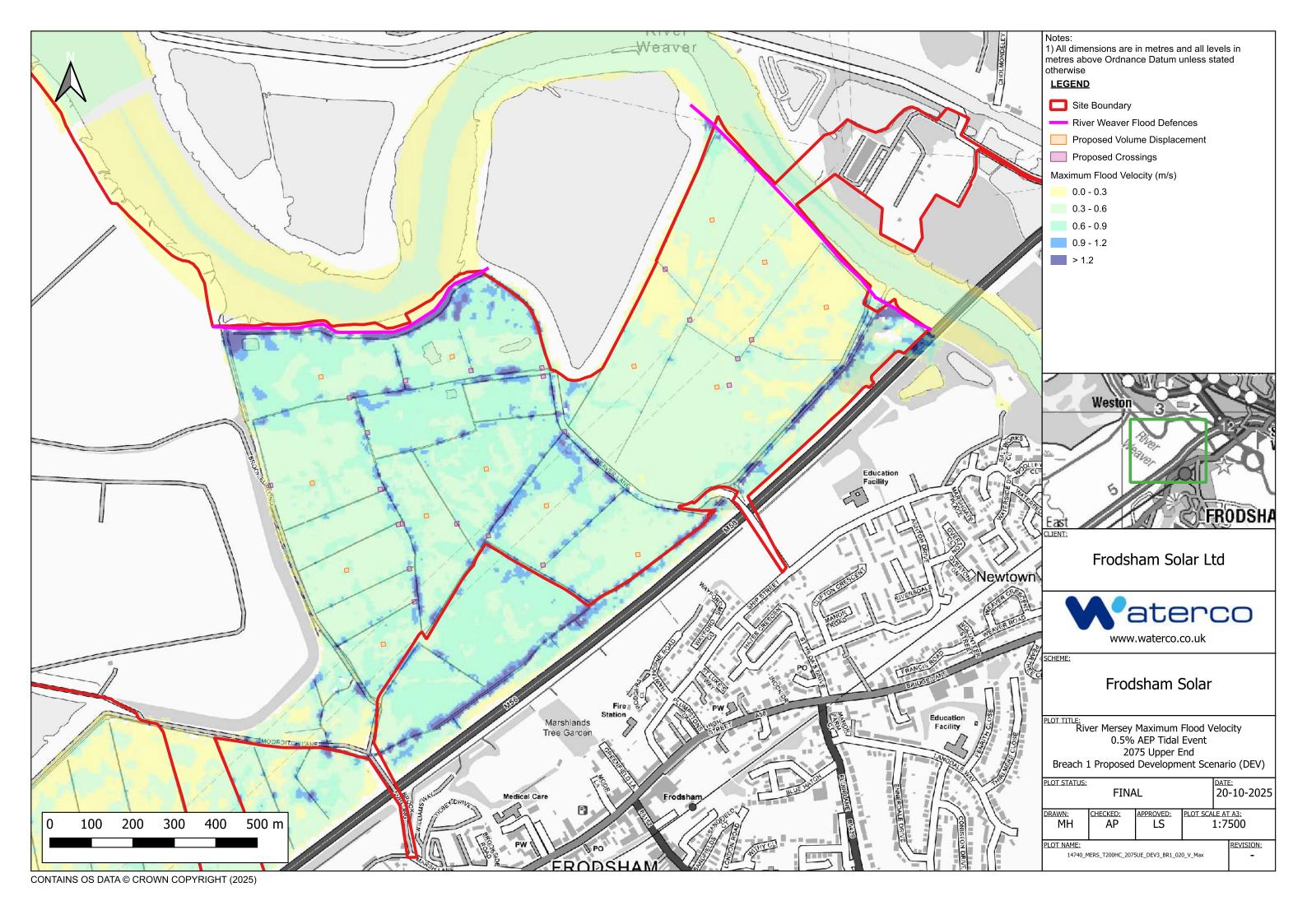


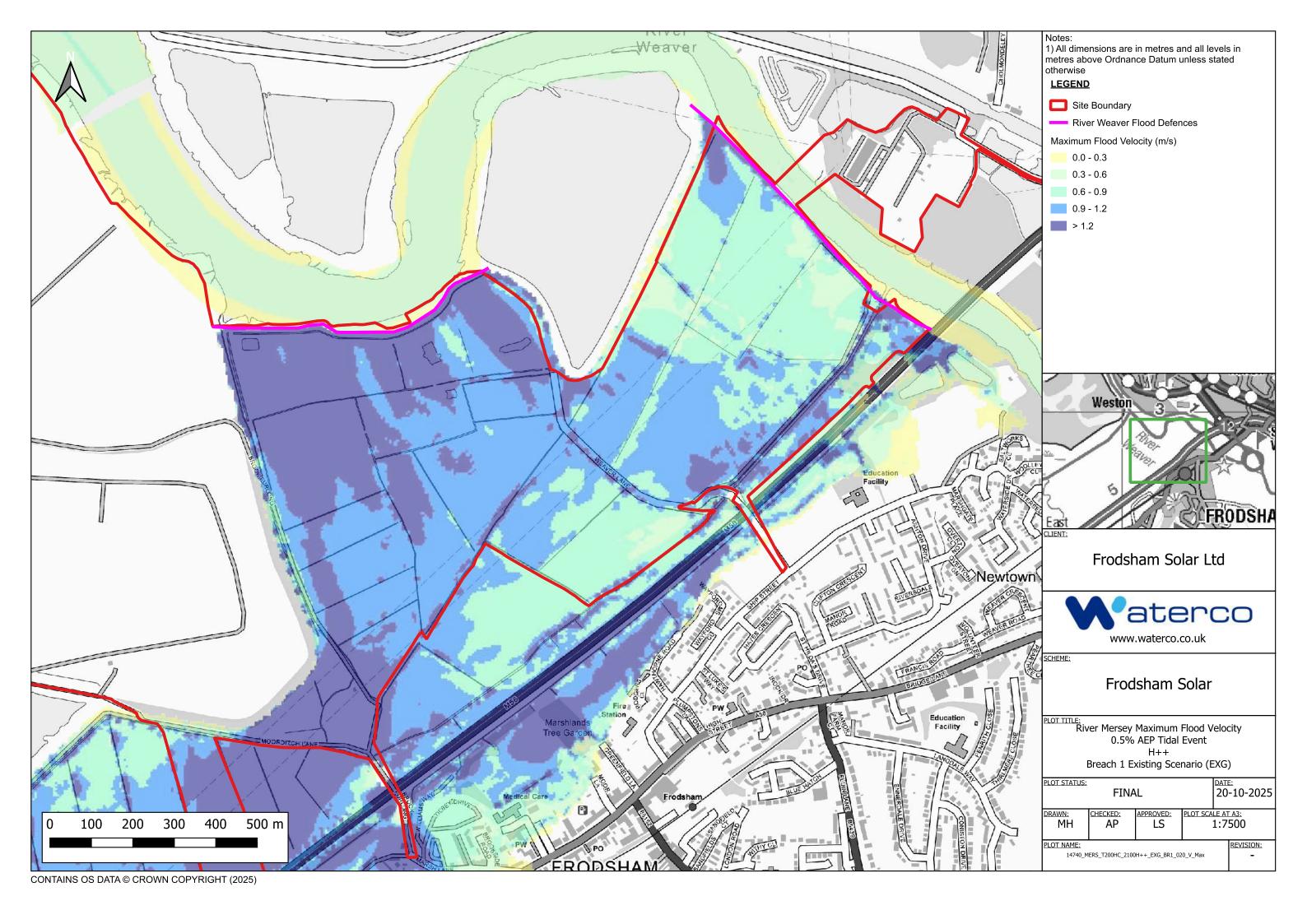


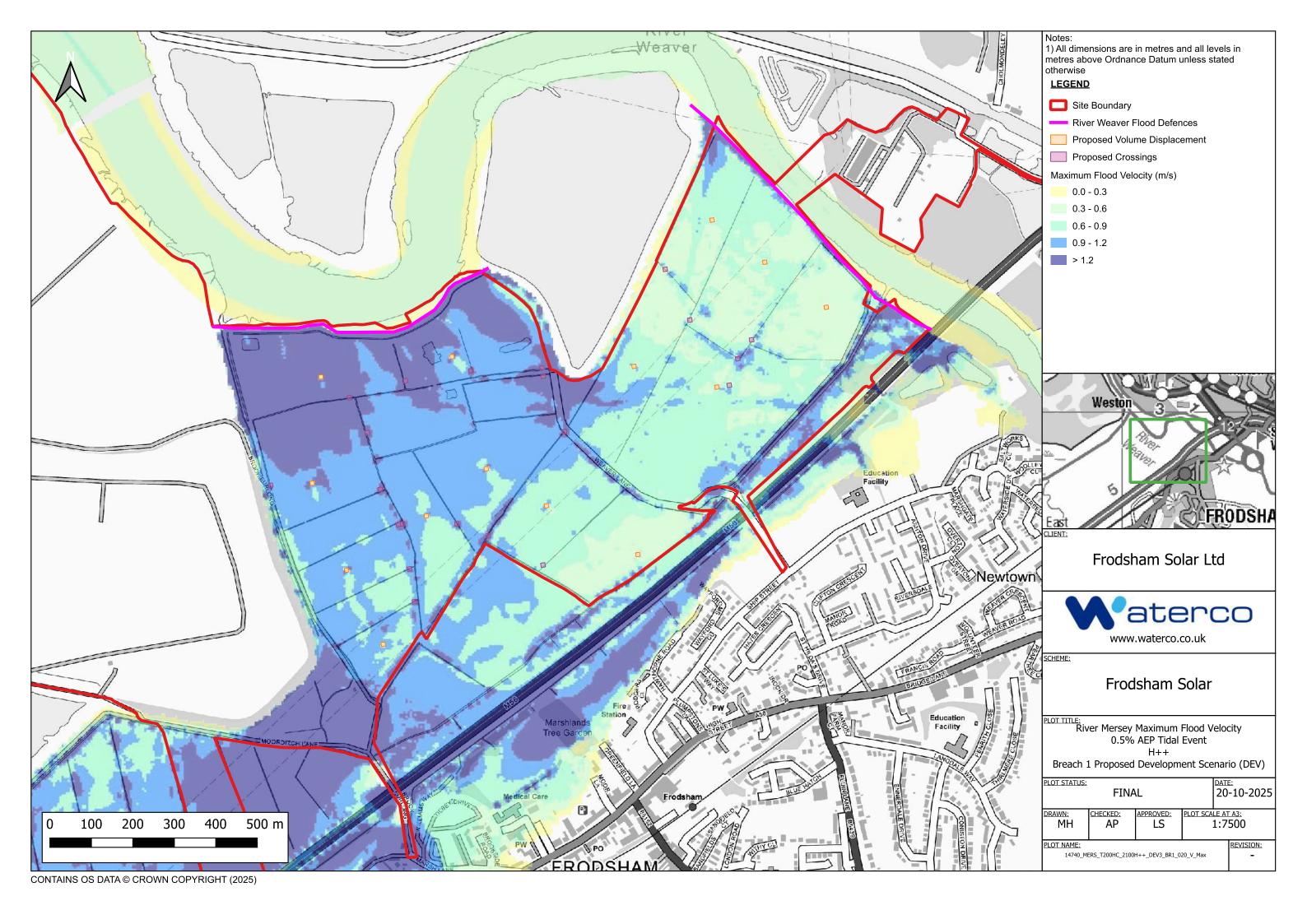


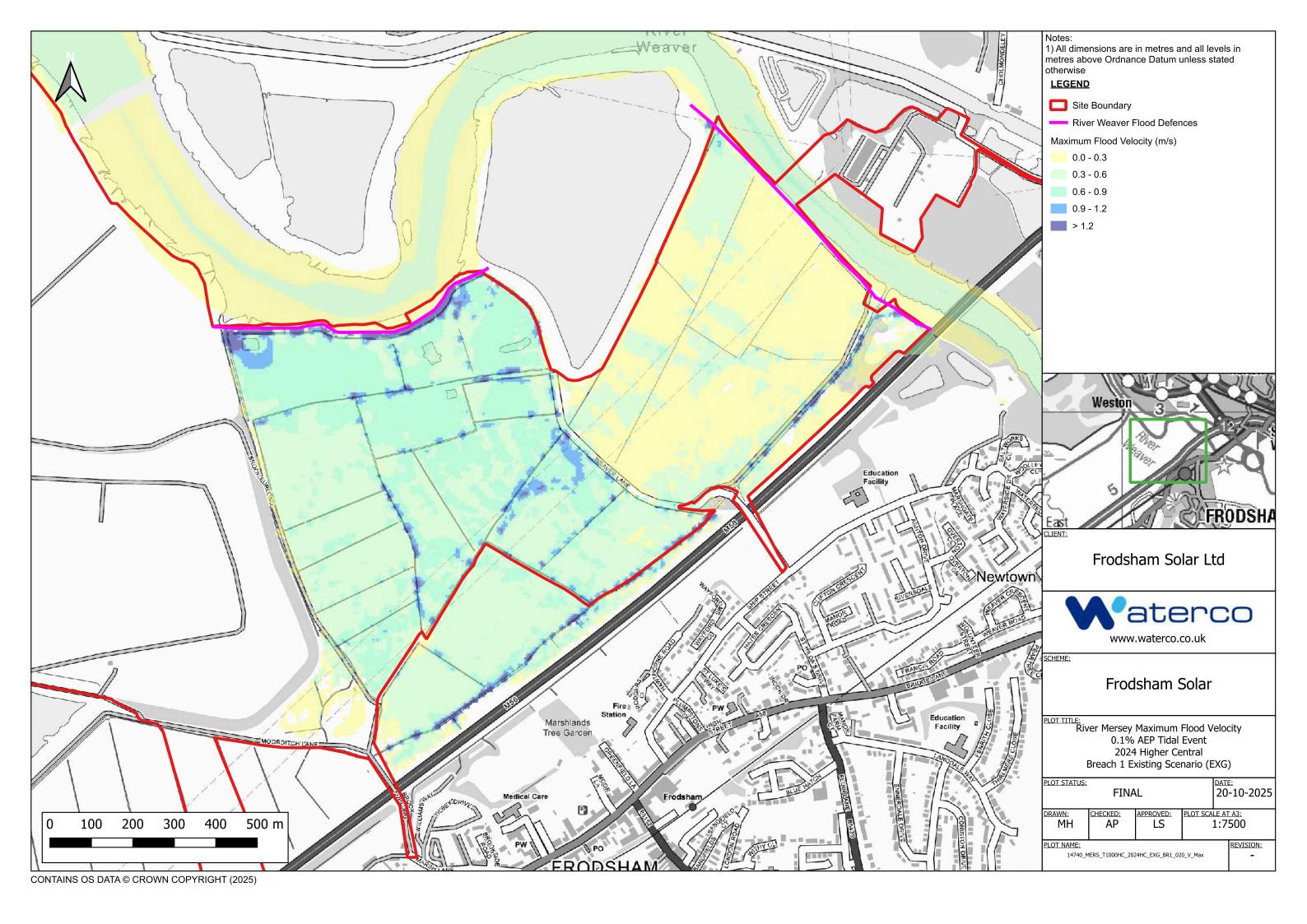


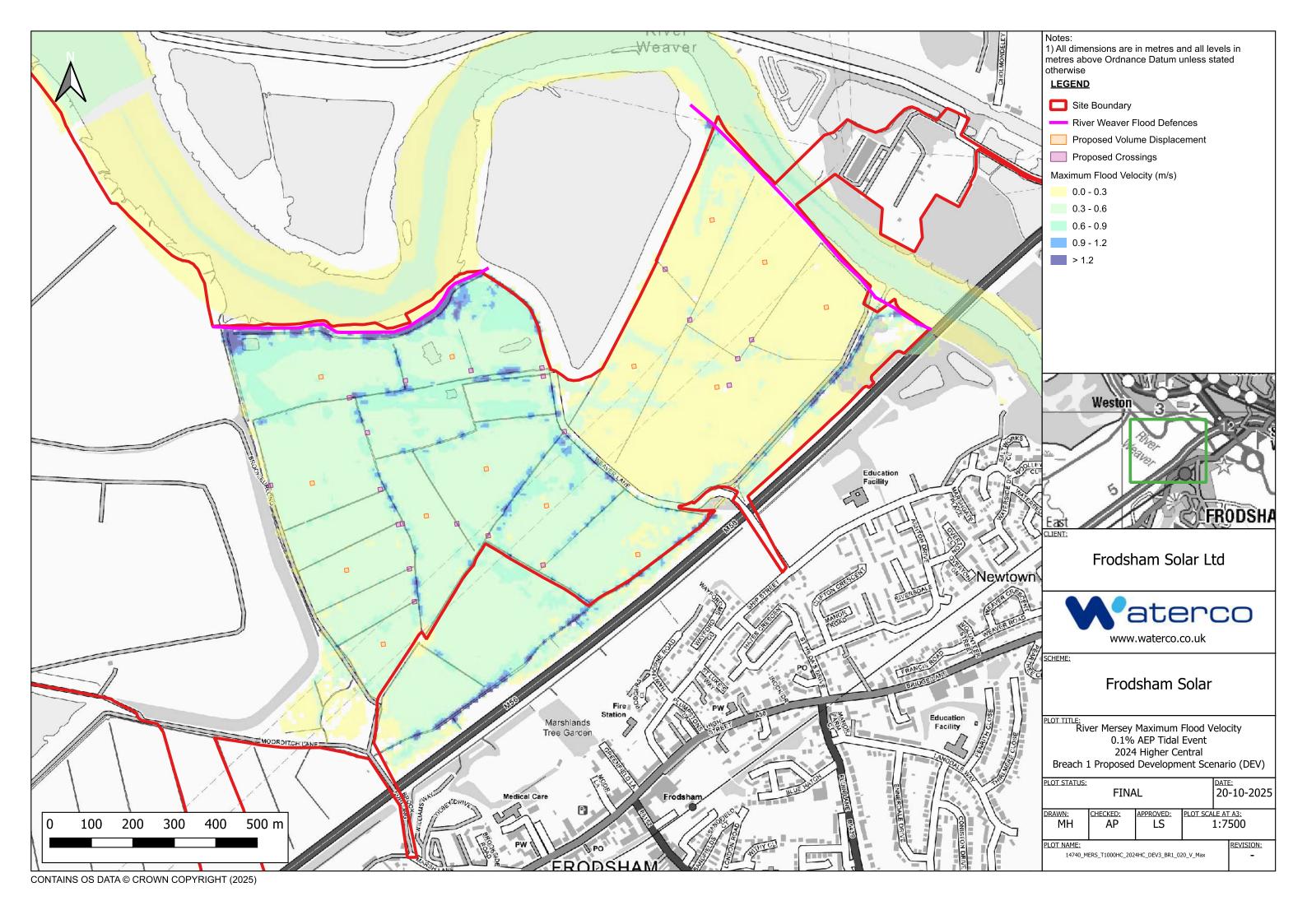


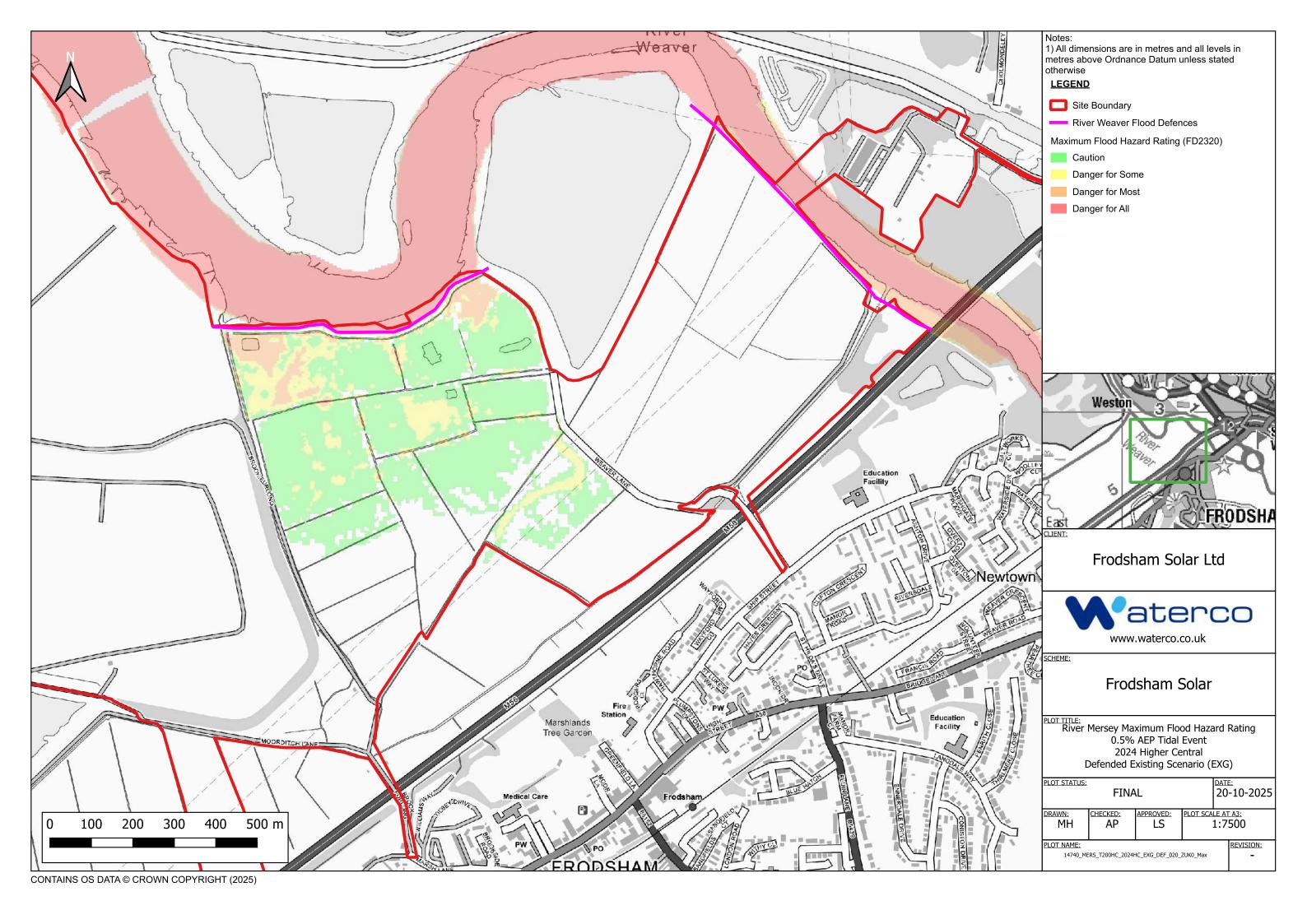


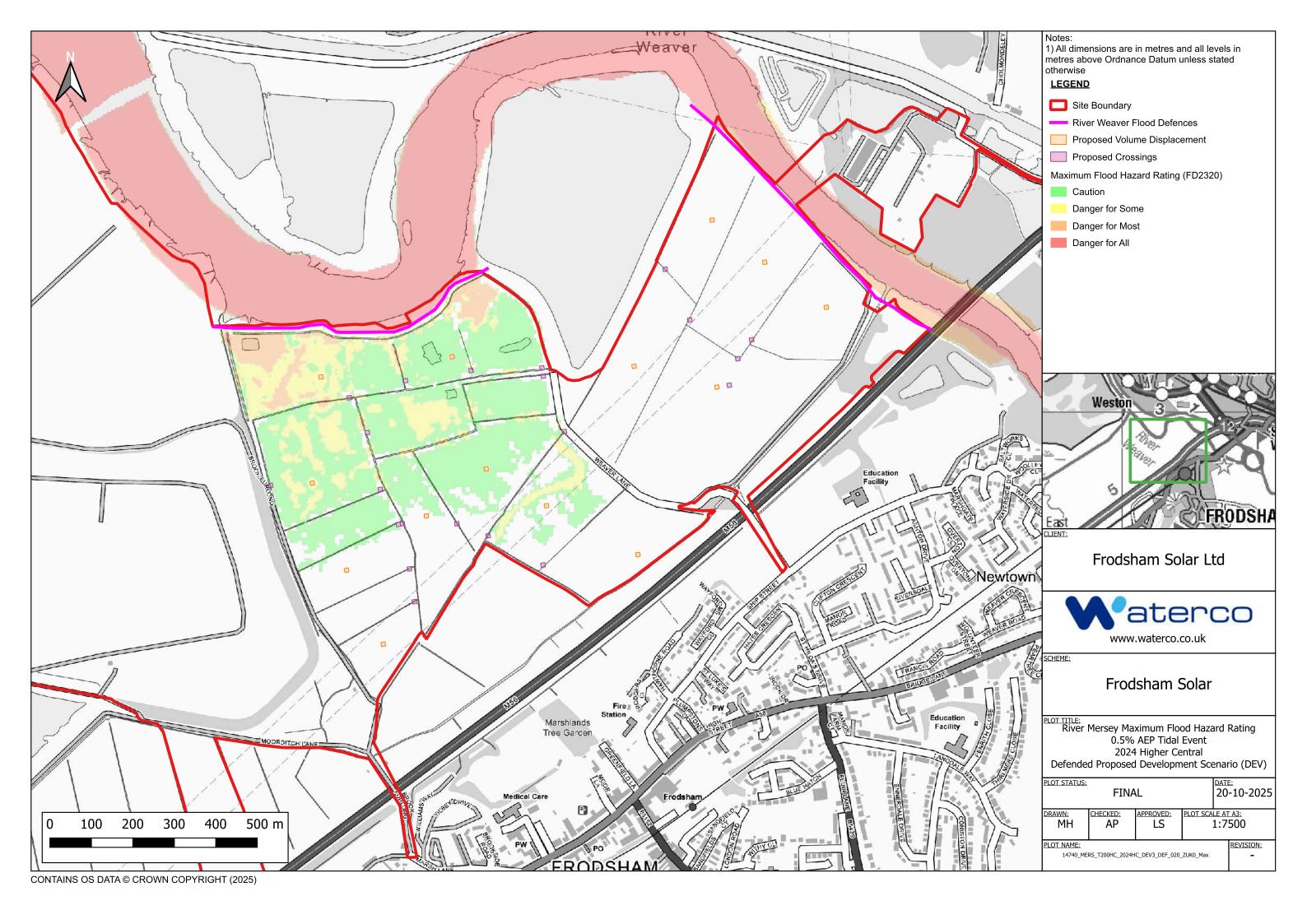


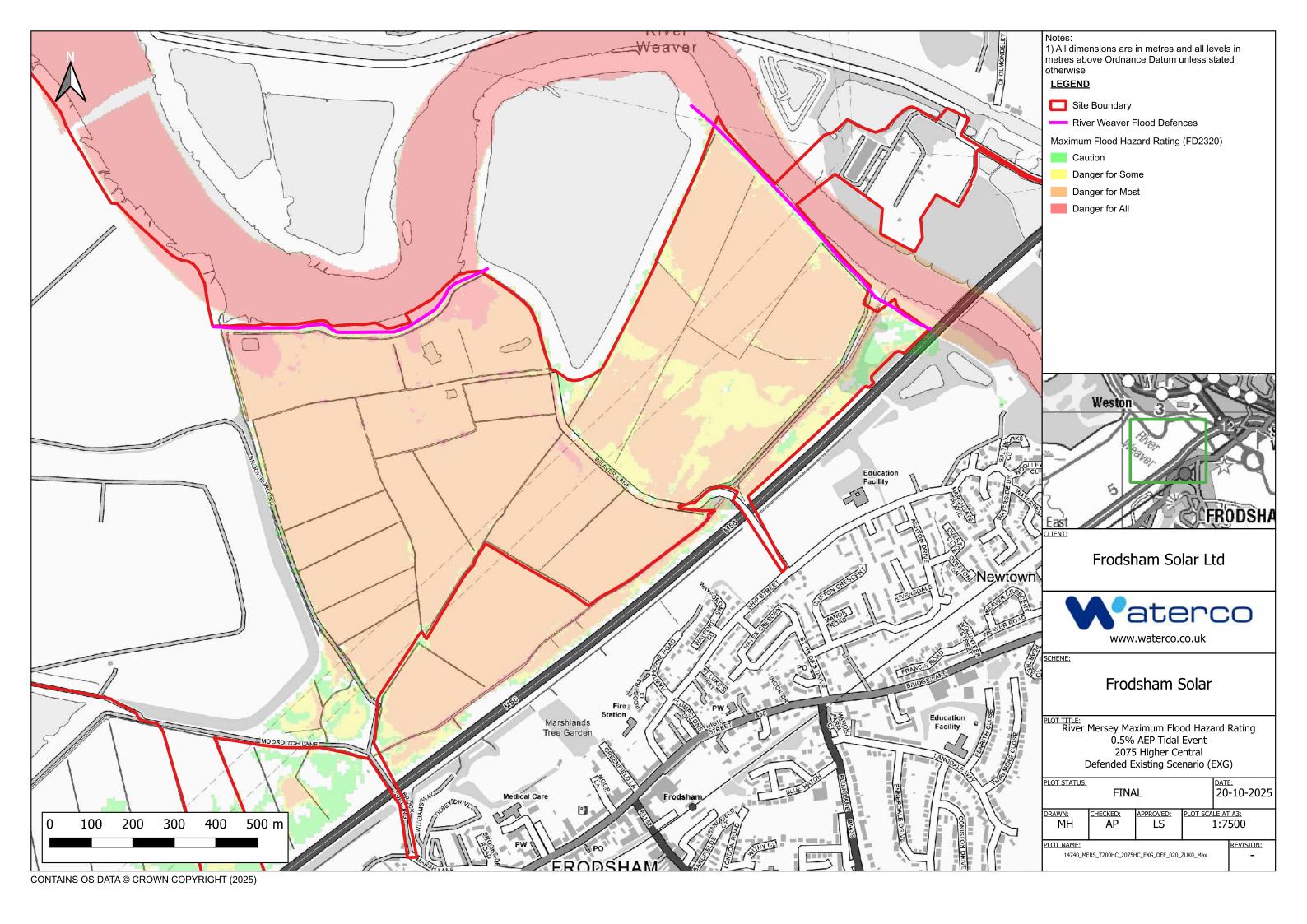


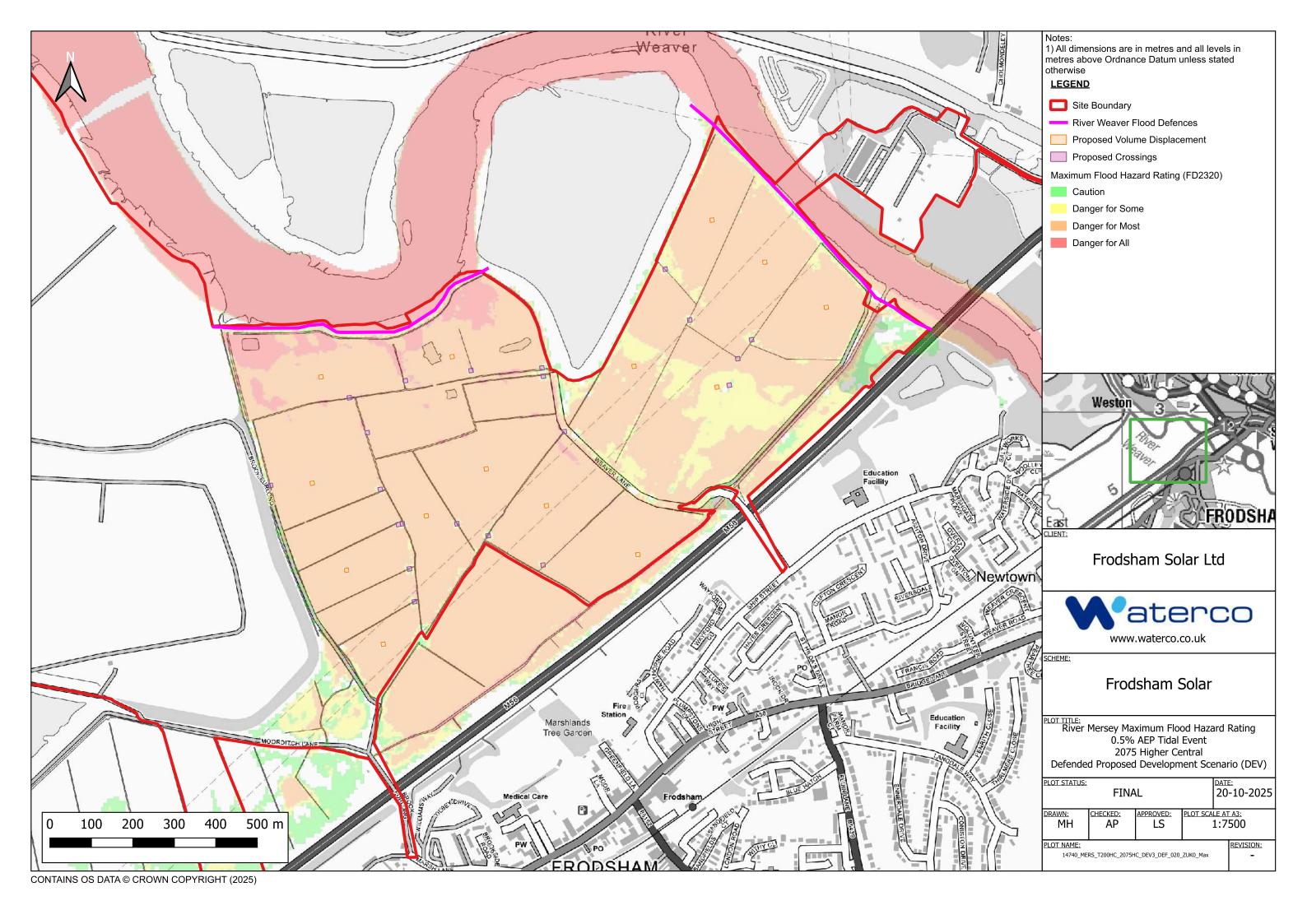


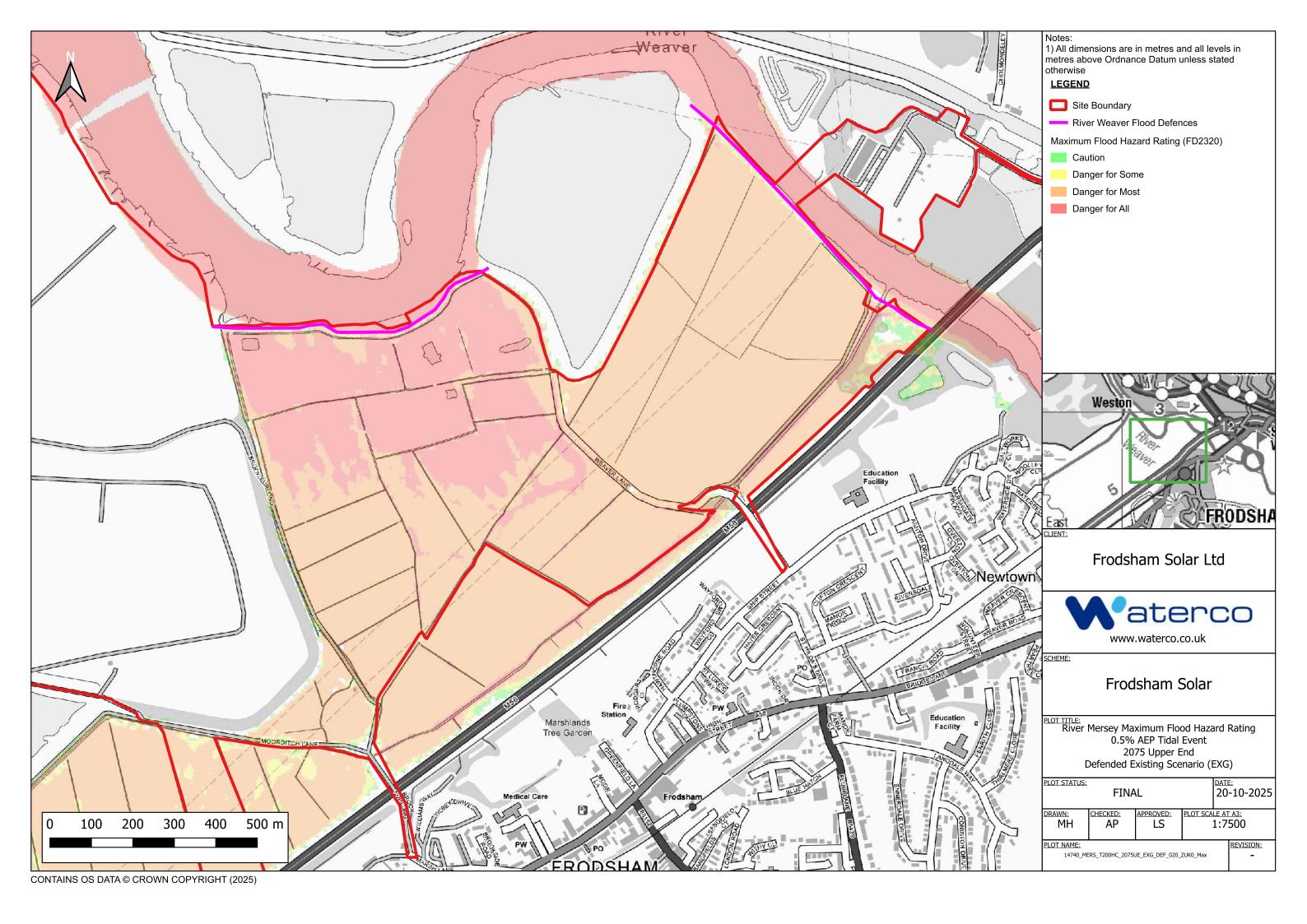


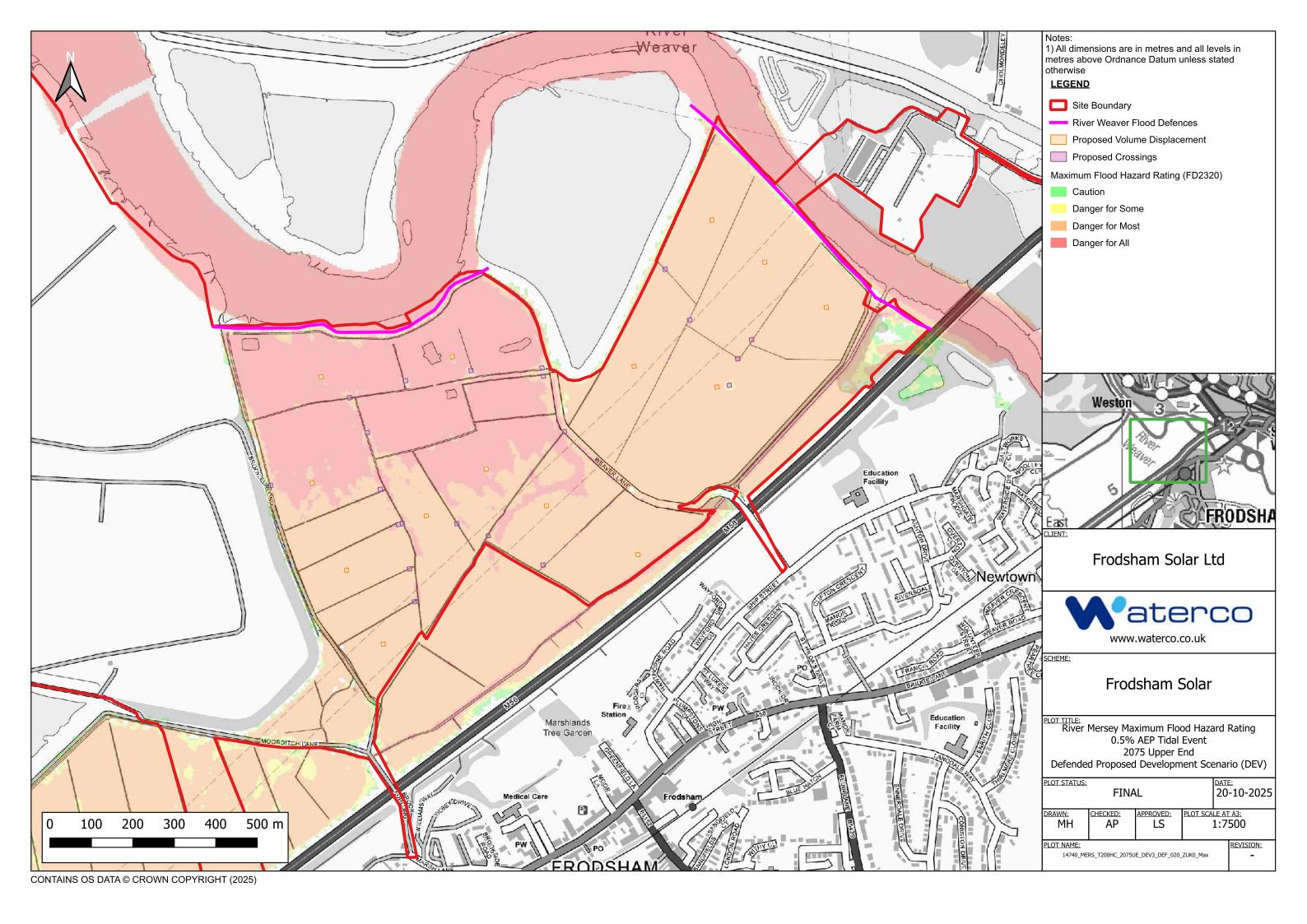


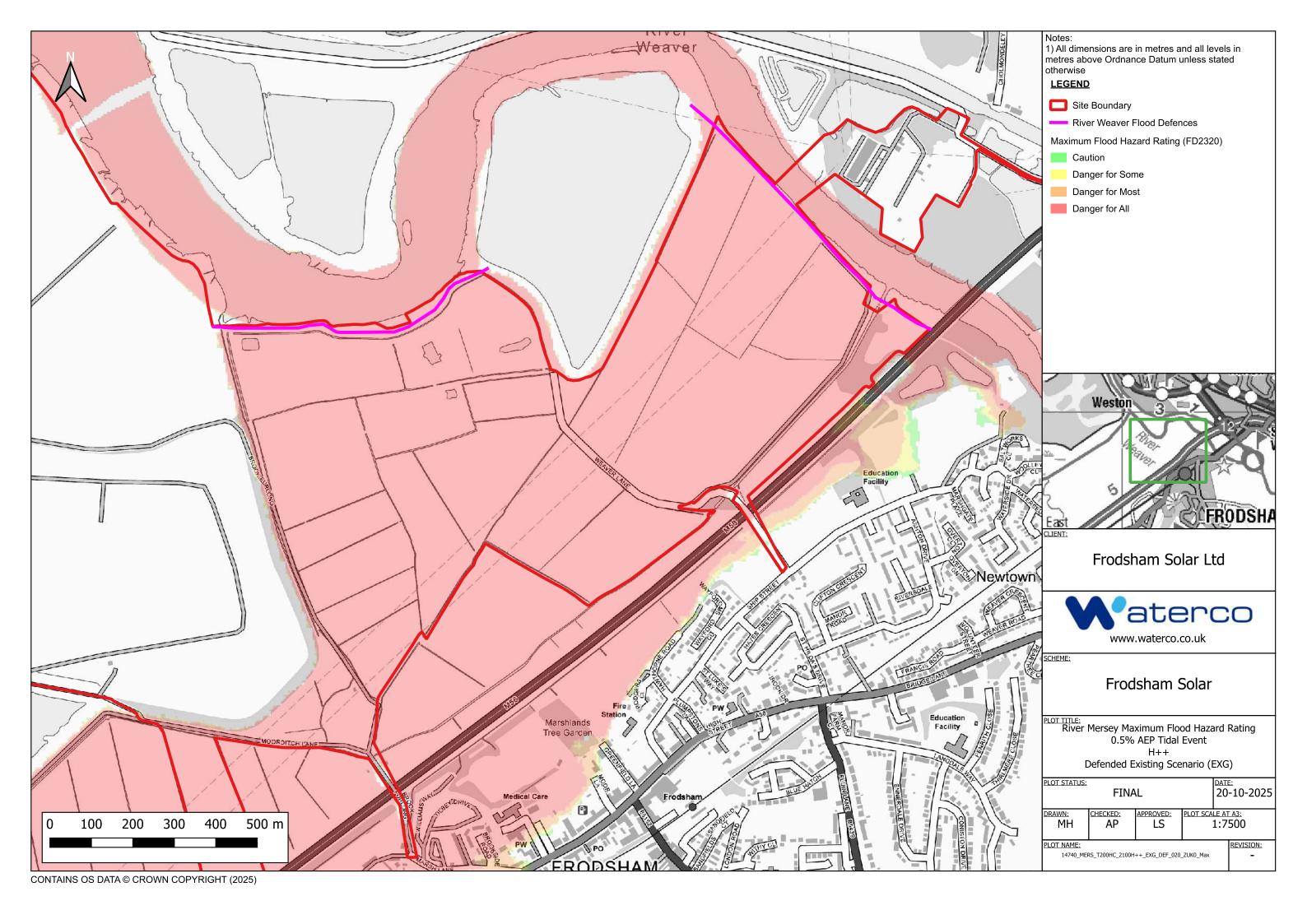


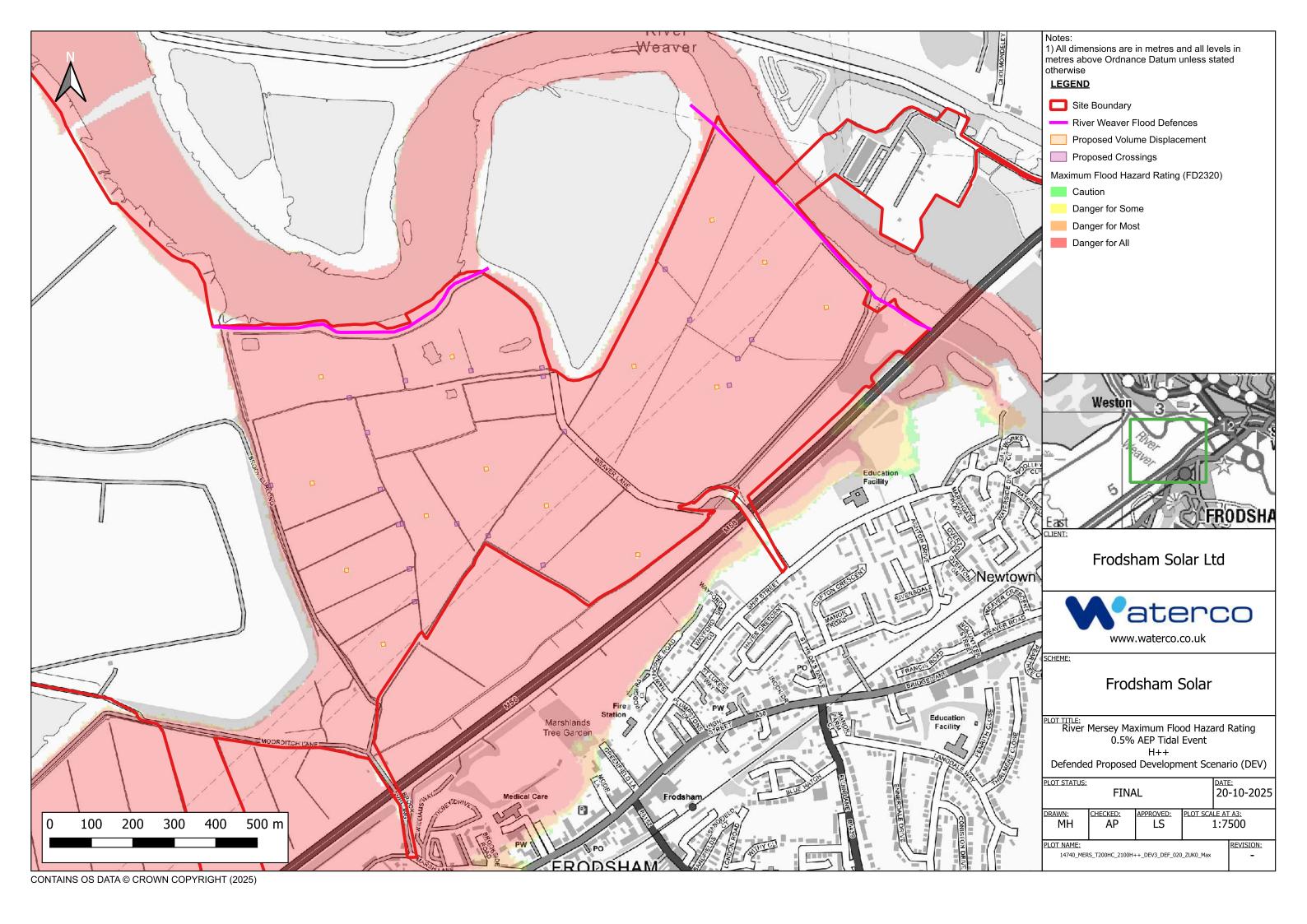


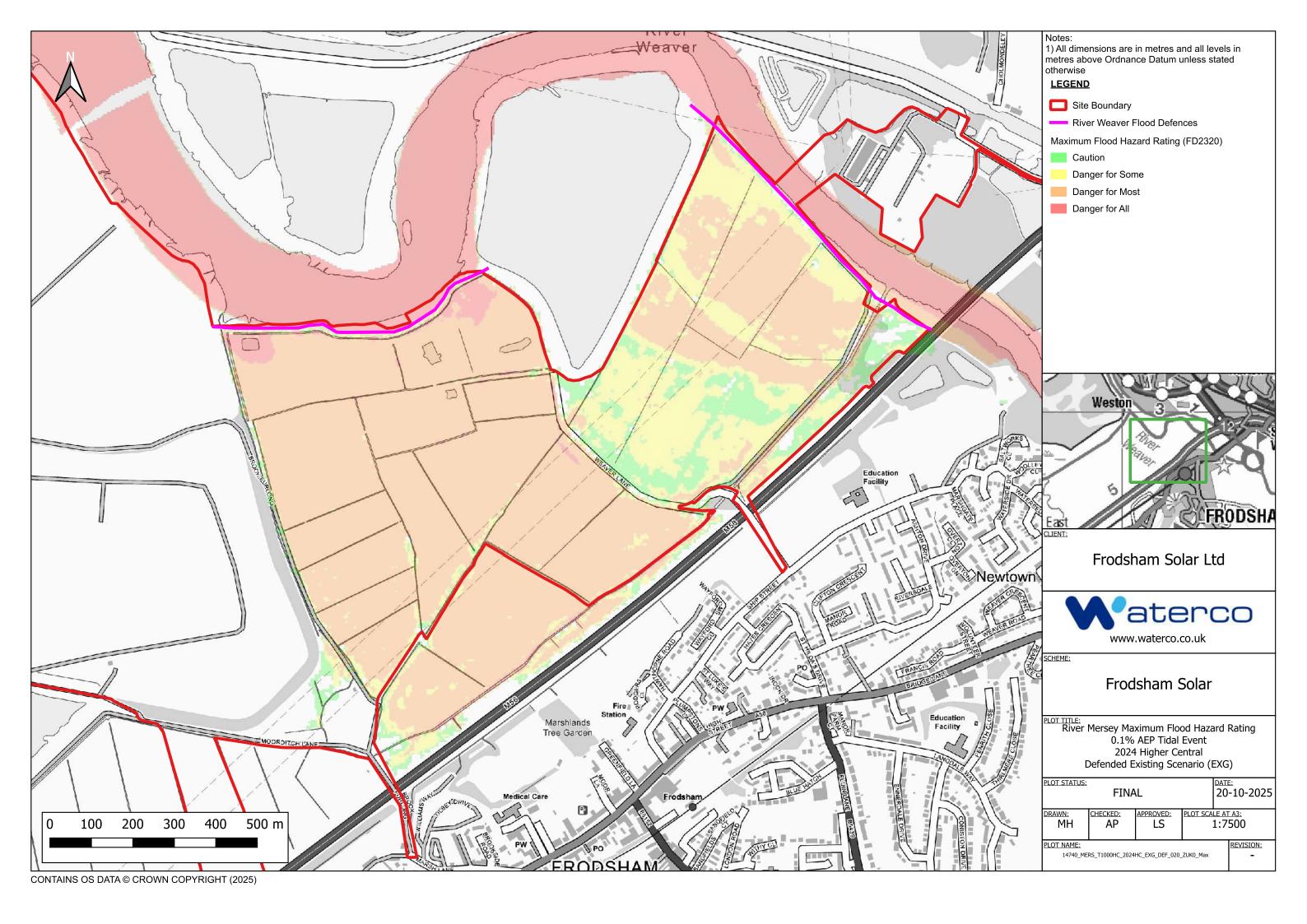


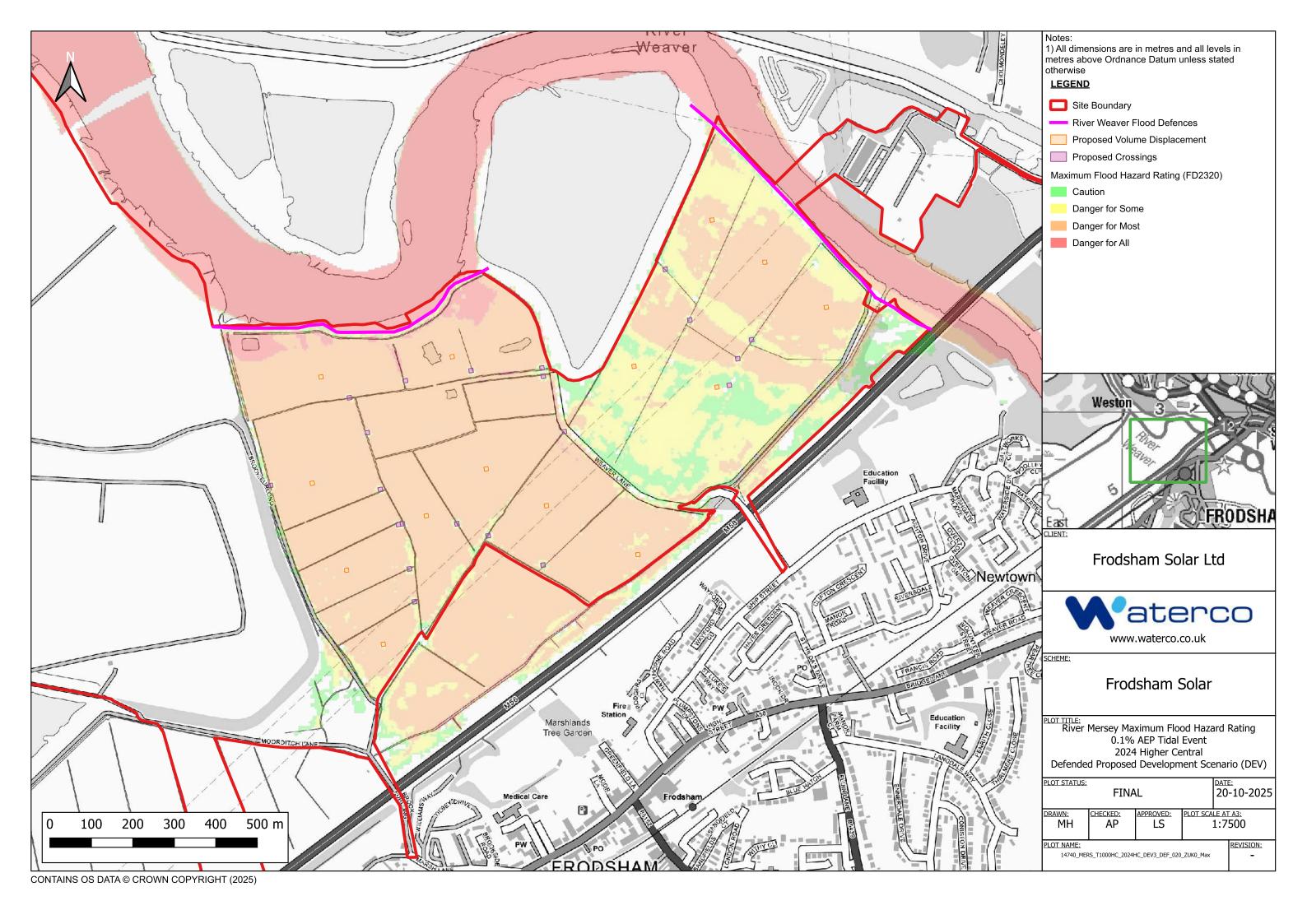


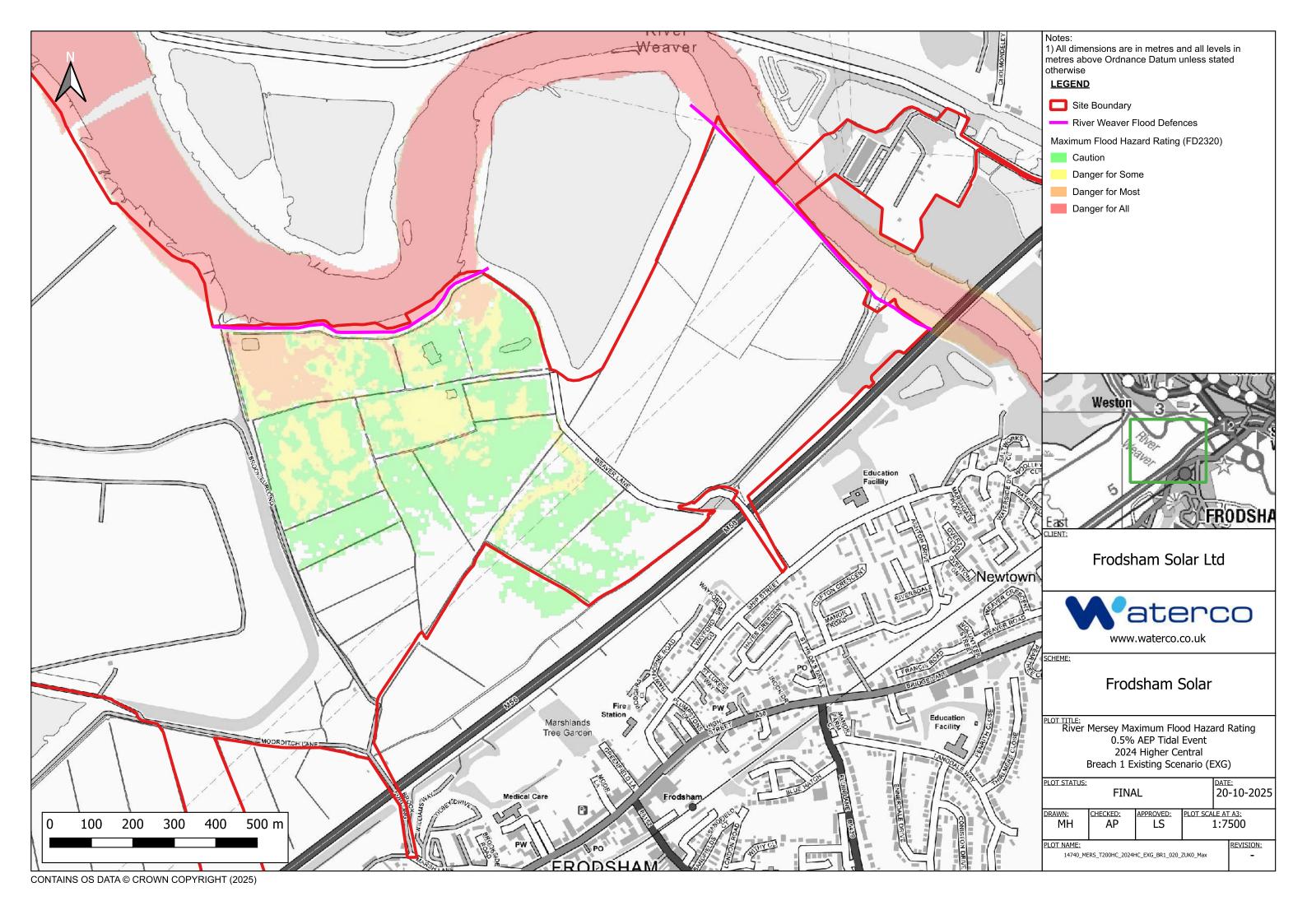


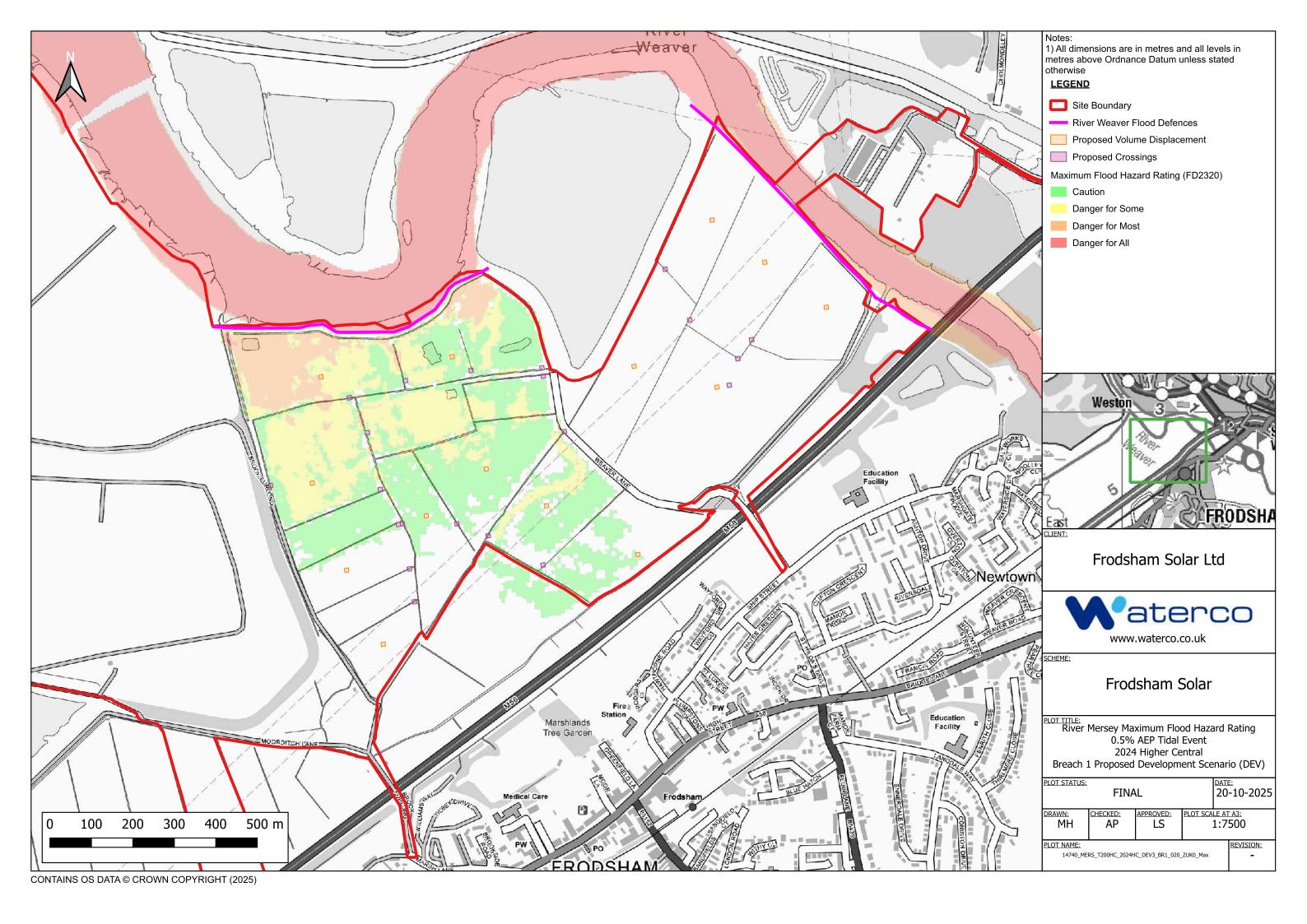


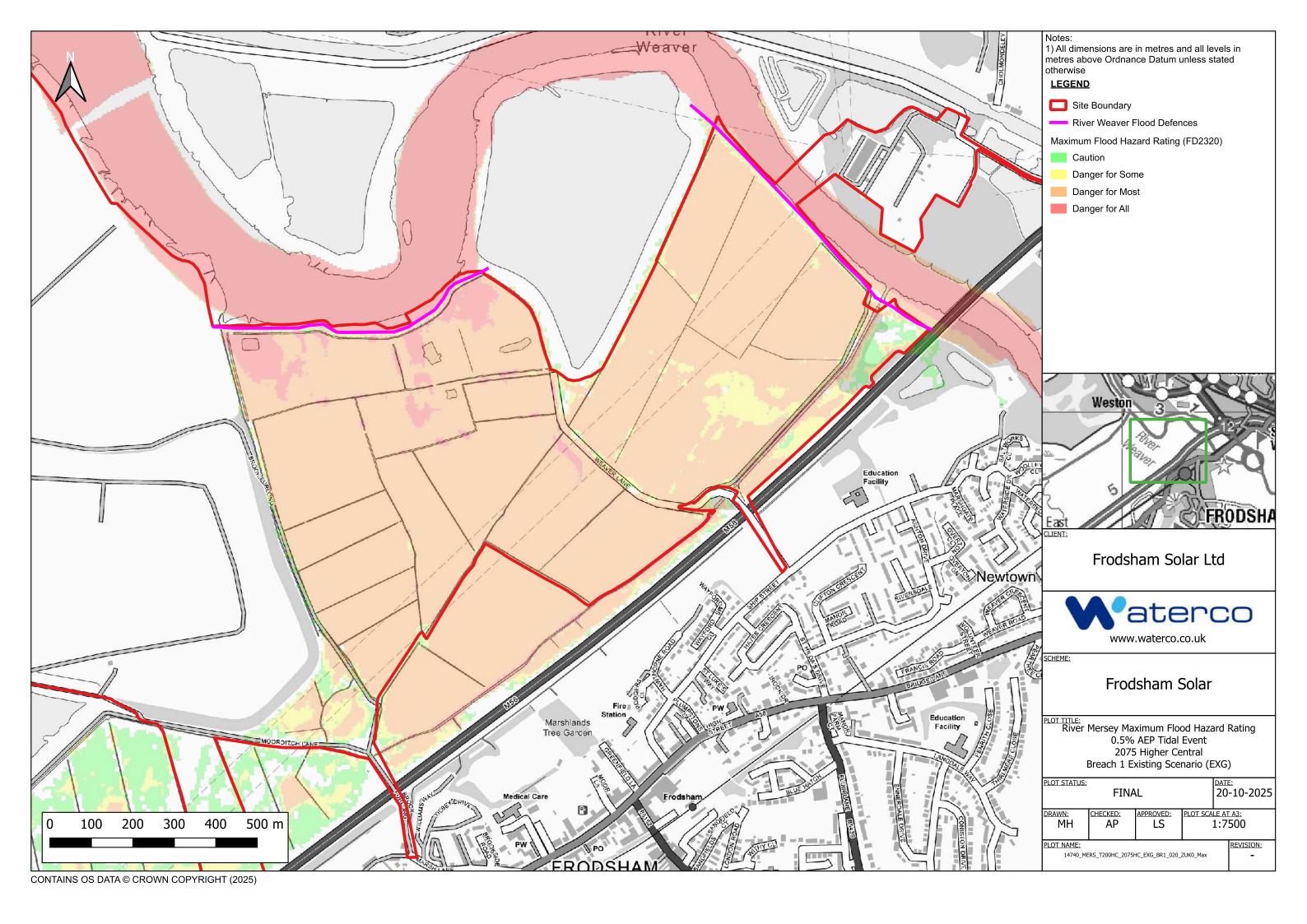


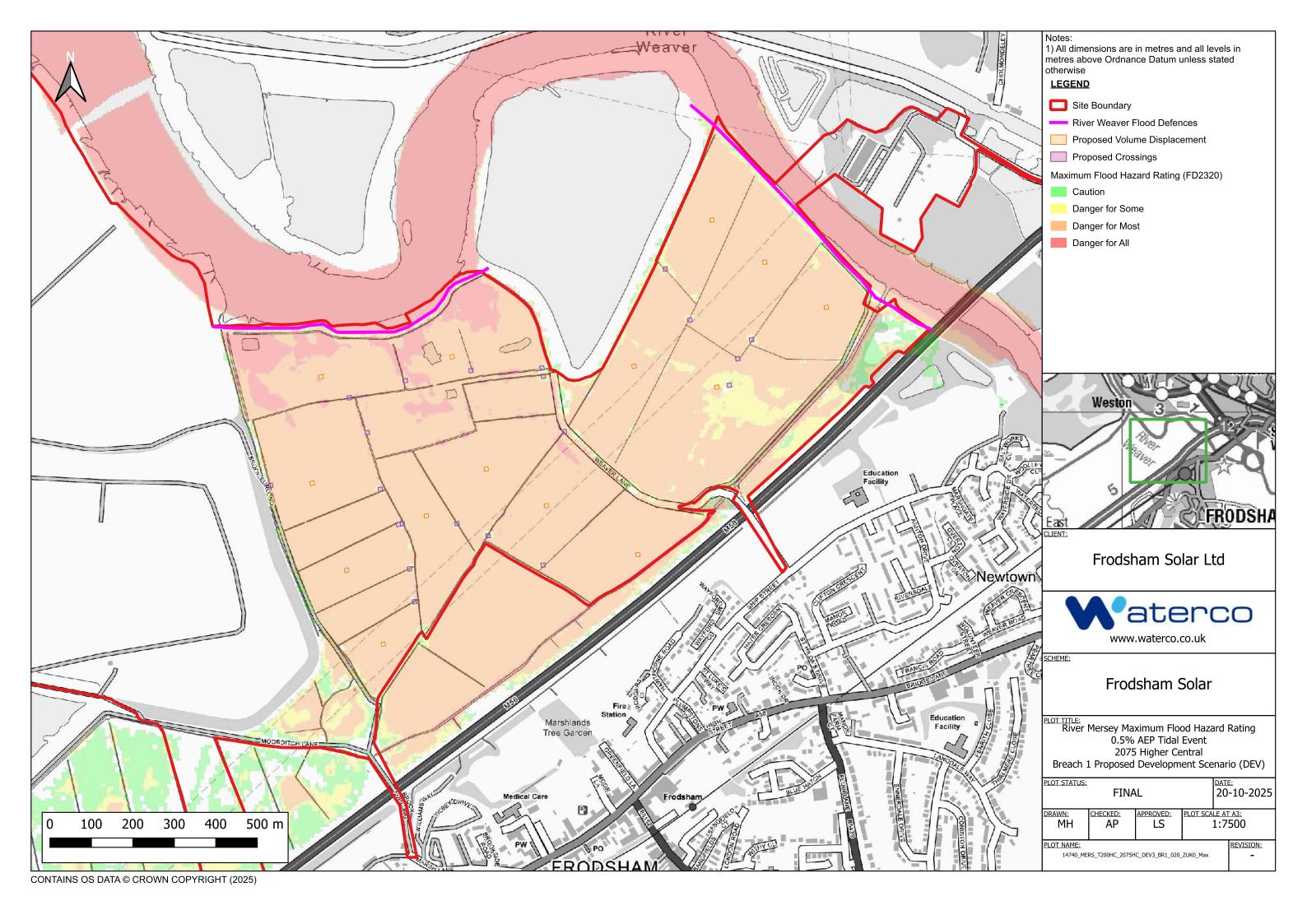


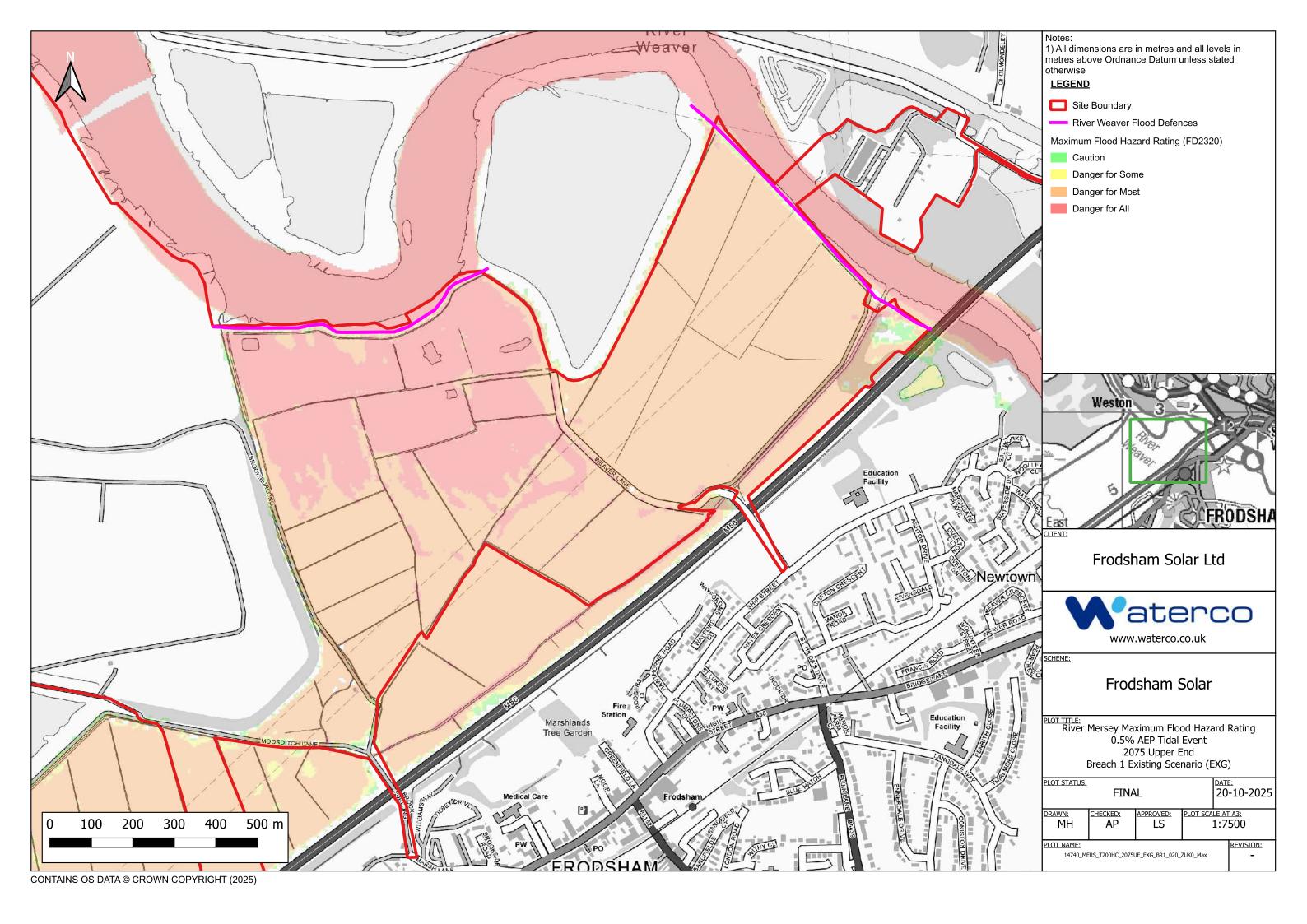


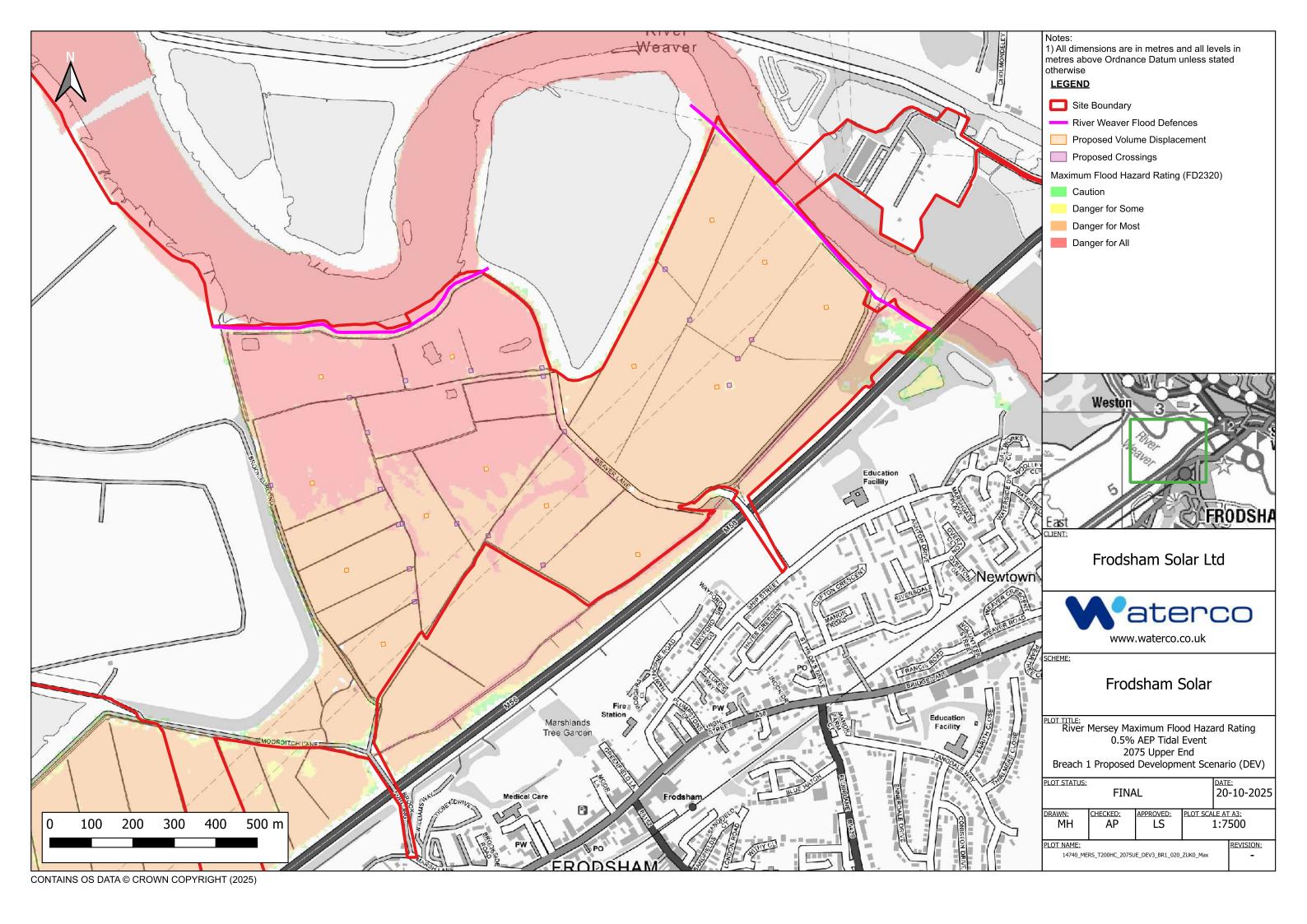


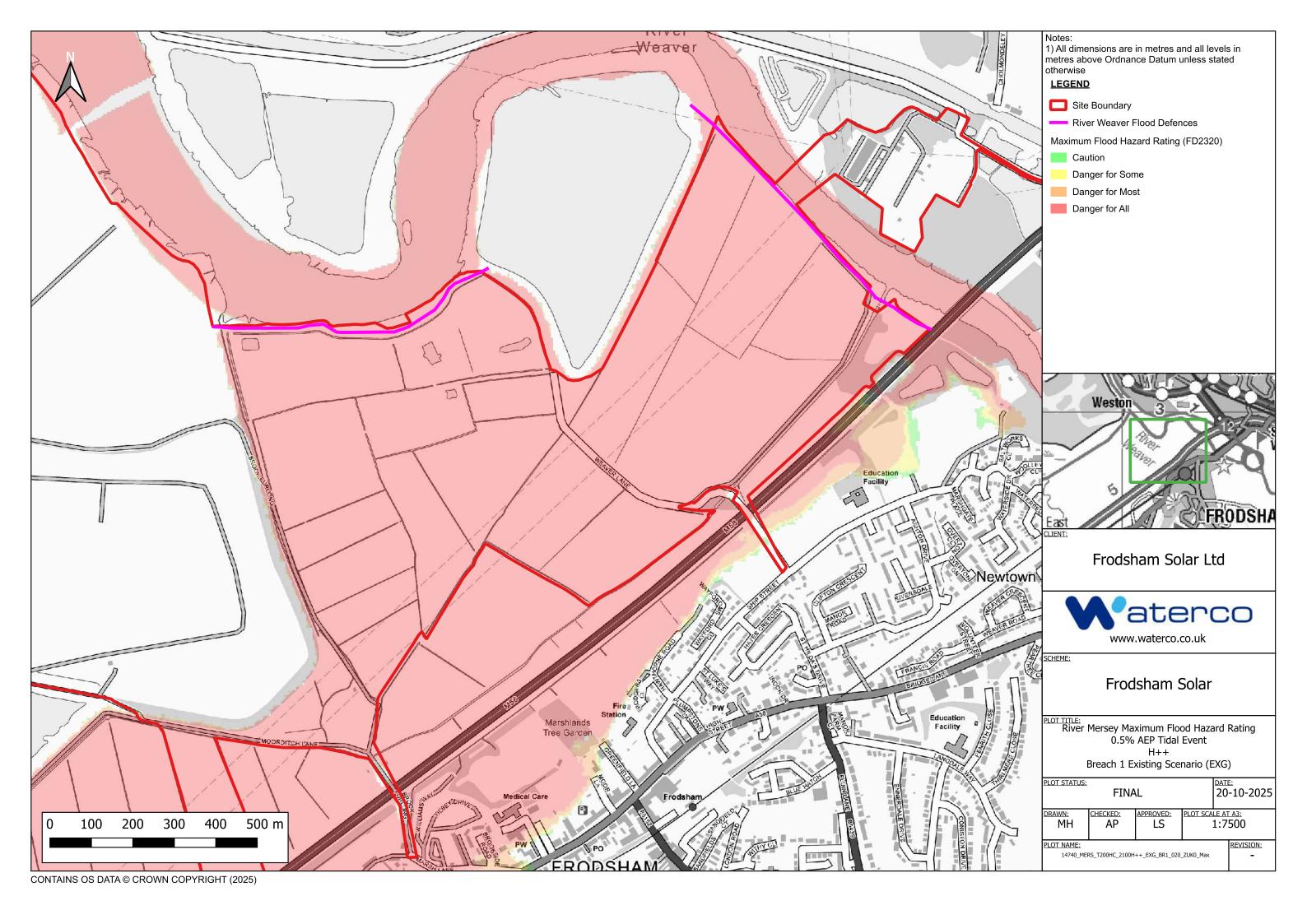


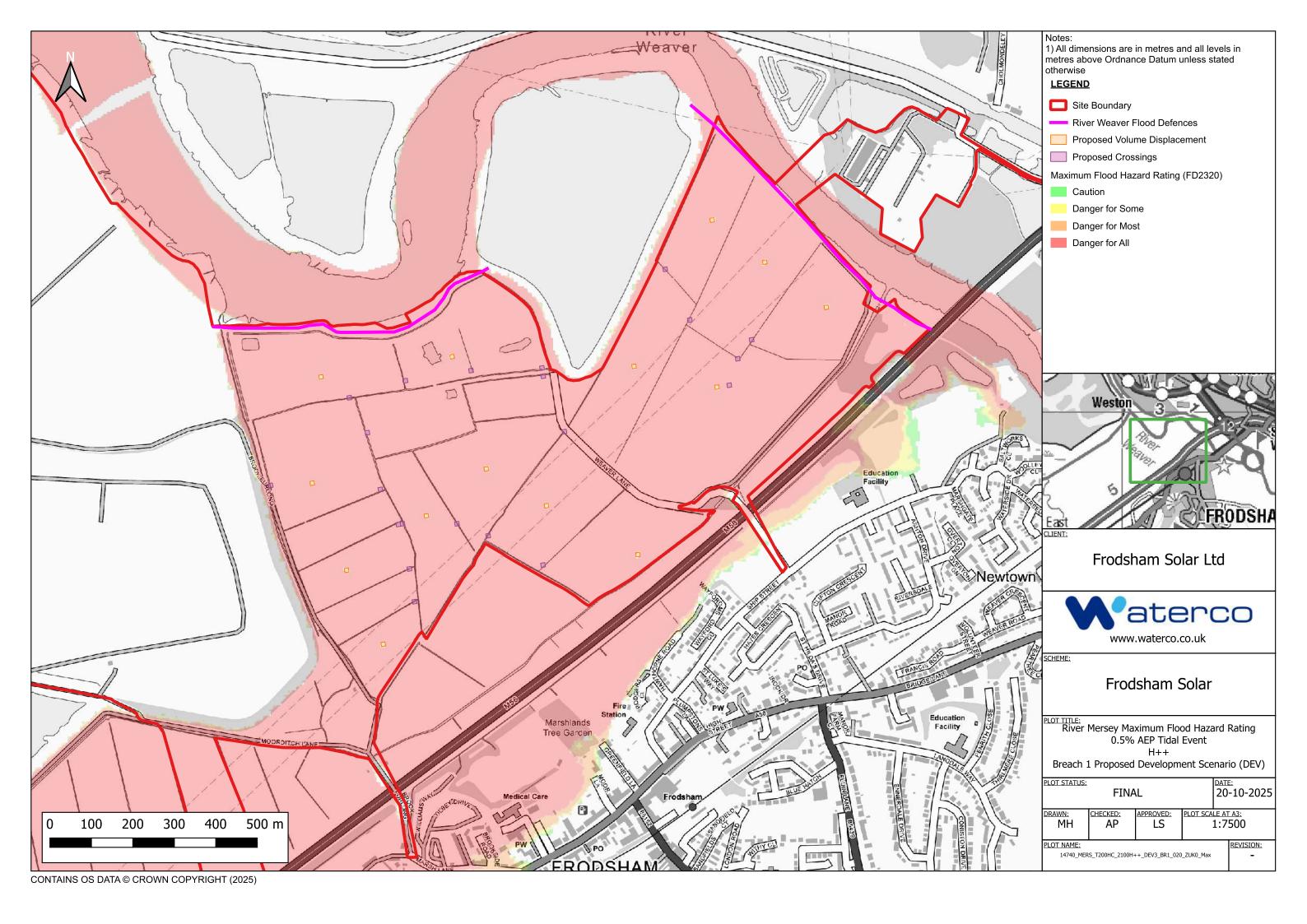


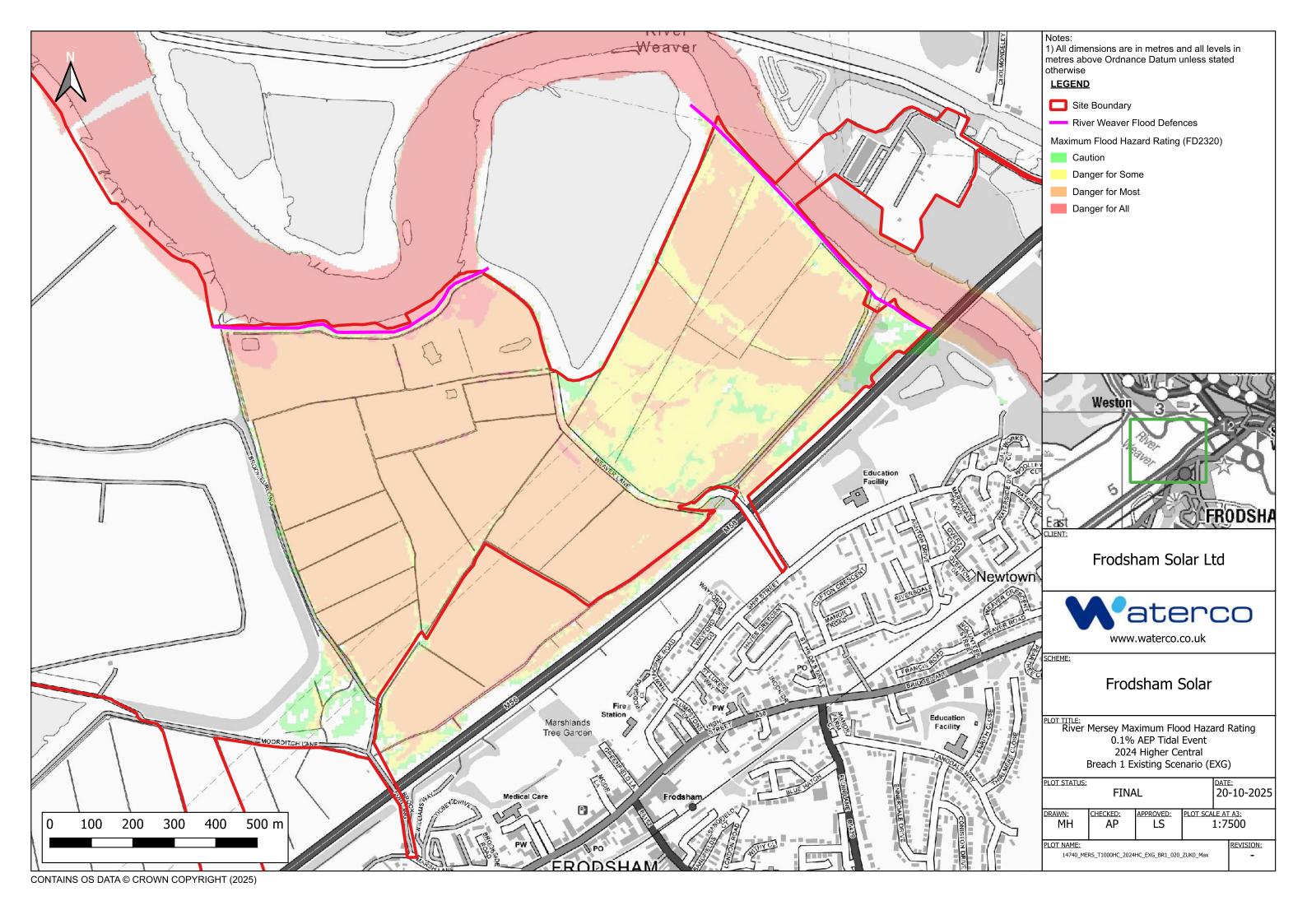


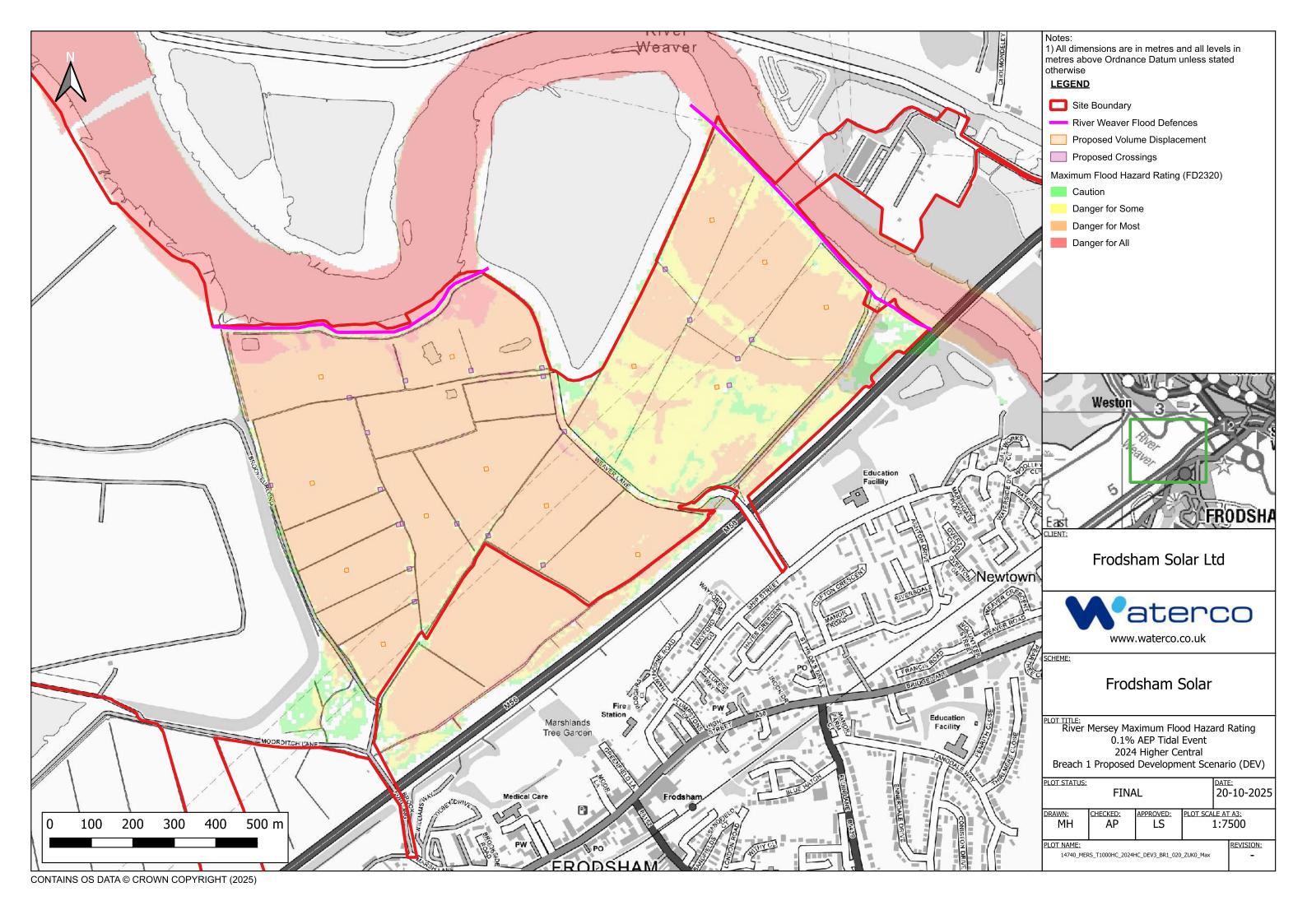






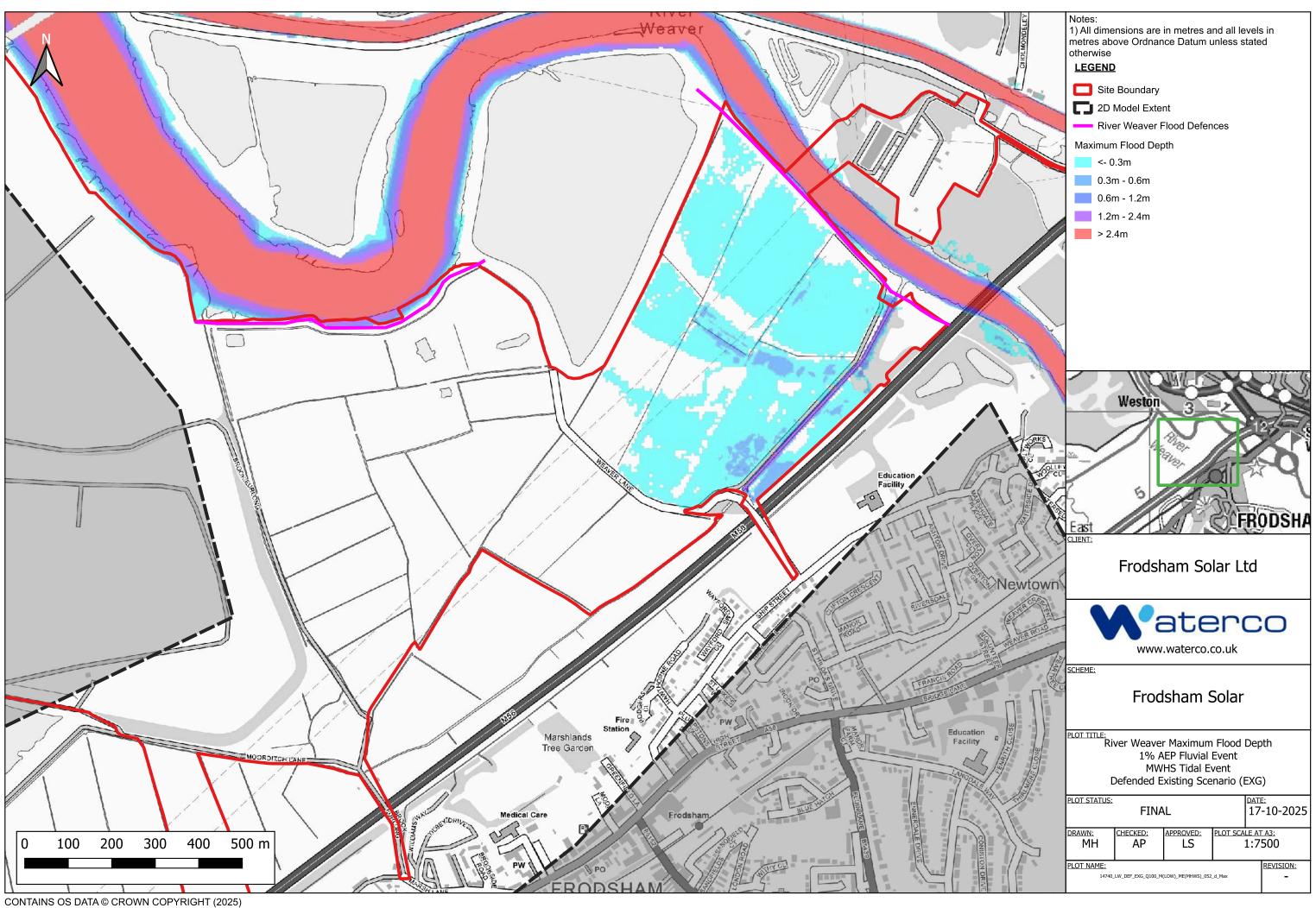


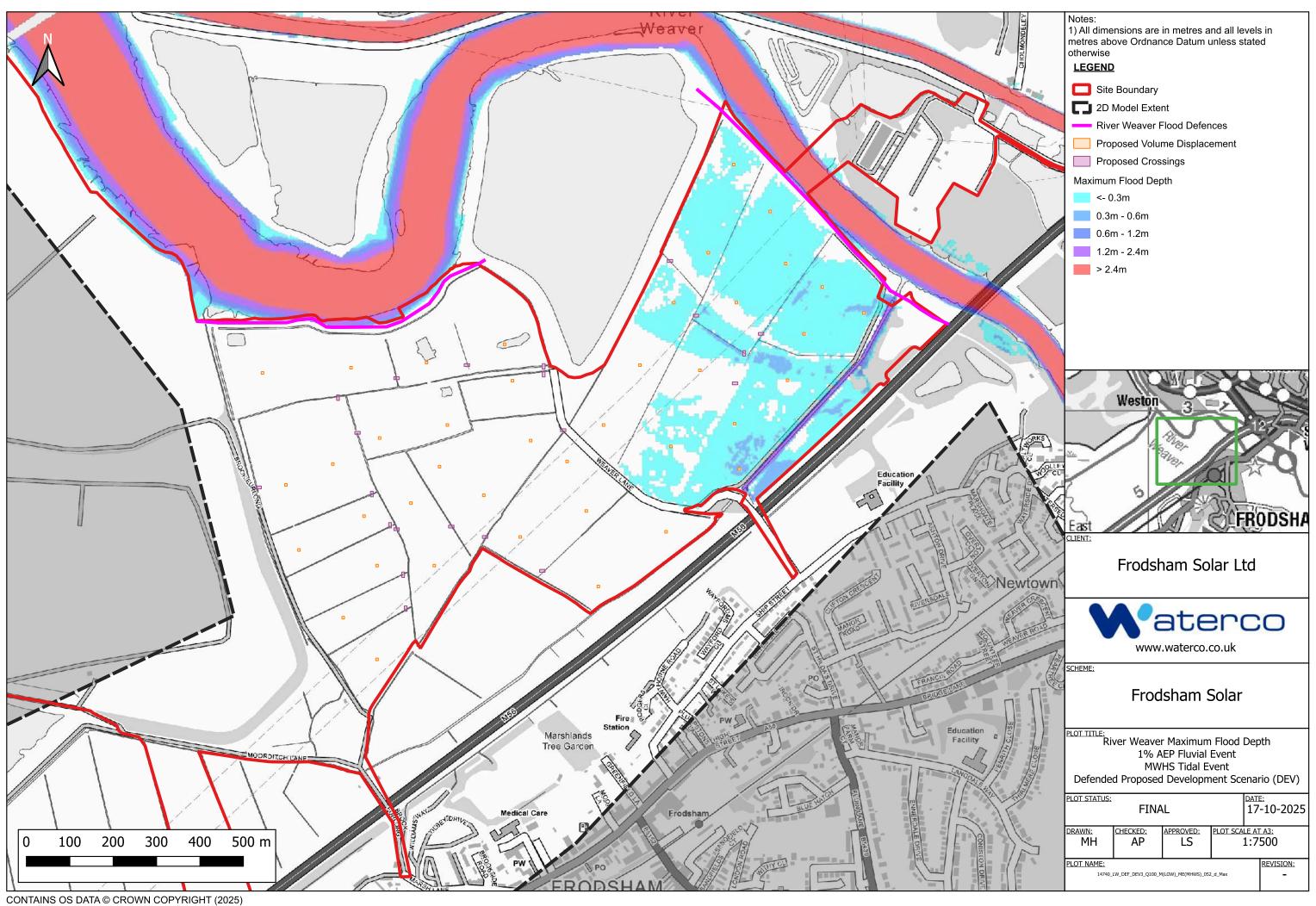


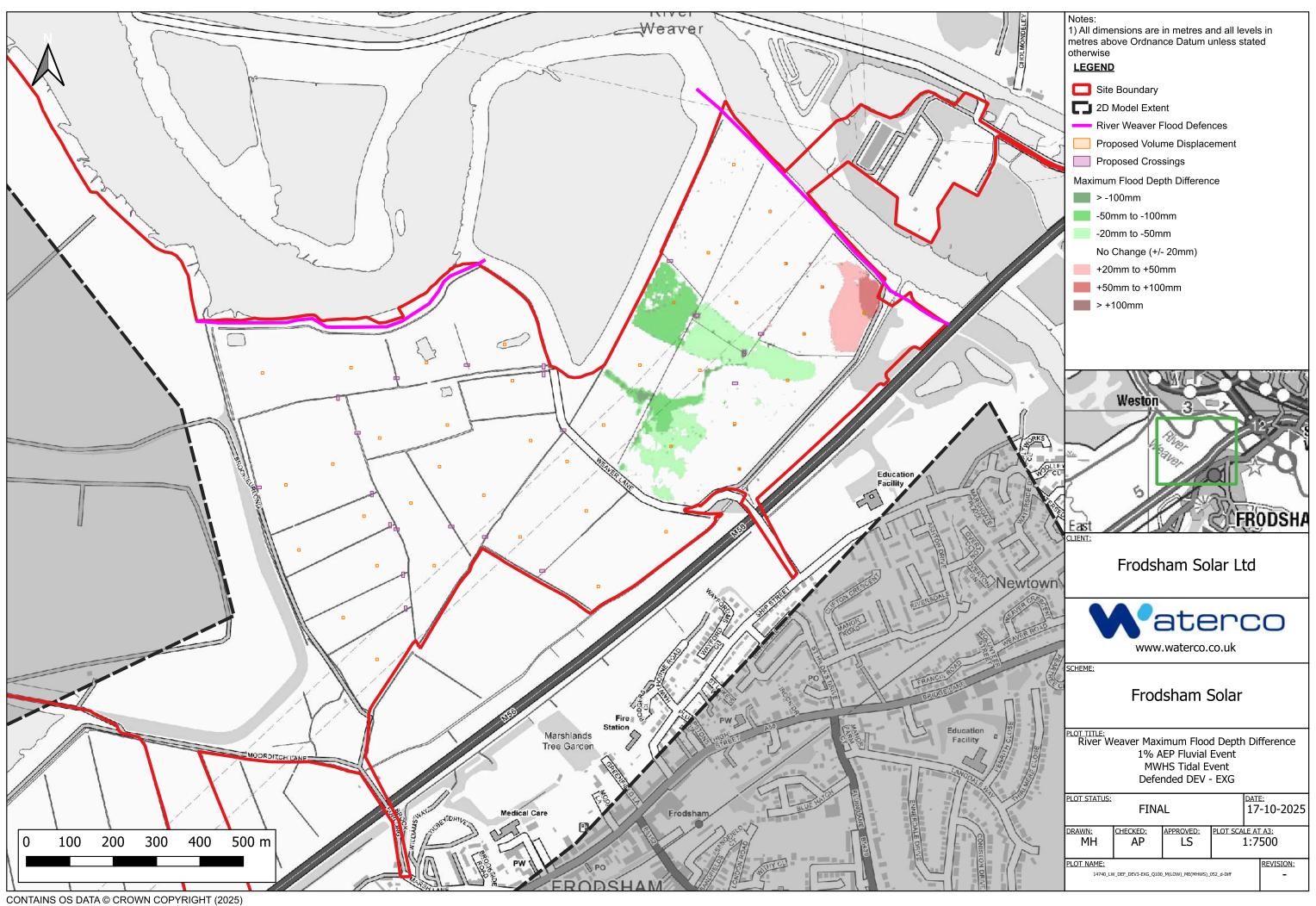


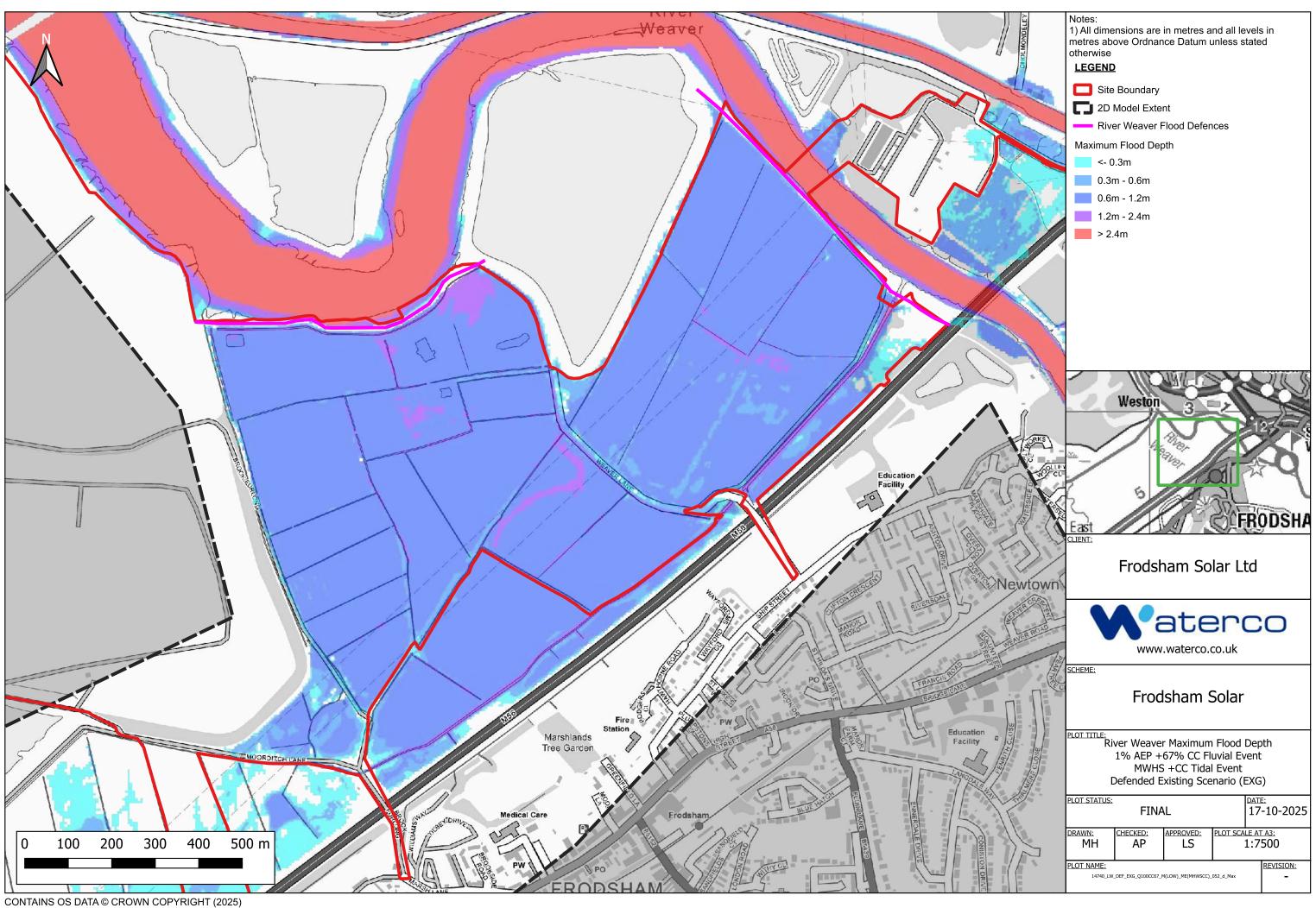
## **River Weaver Flood Mapping**

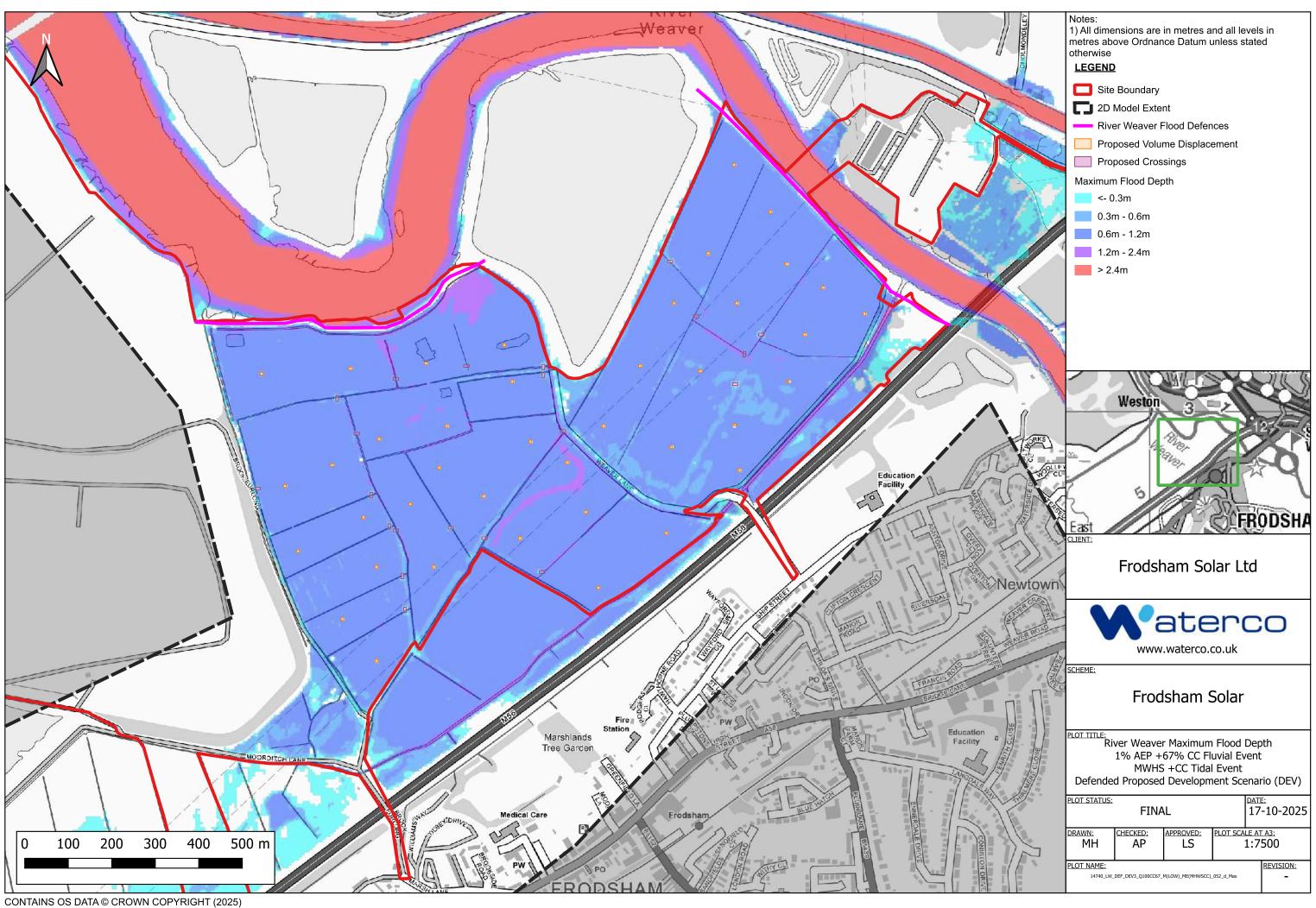


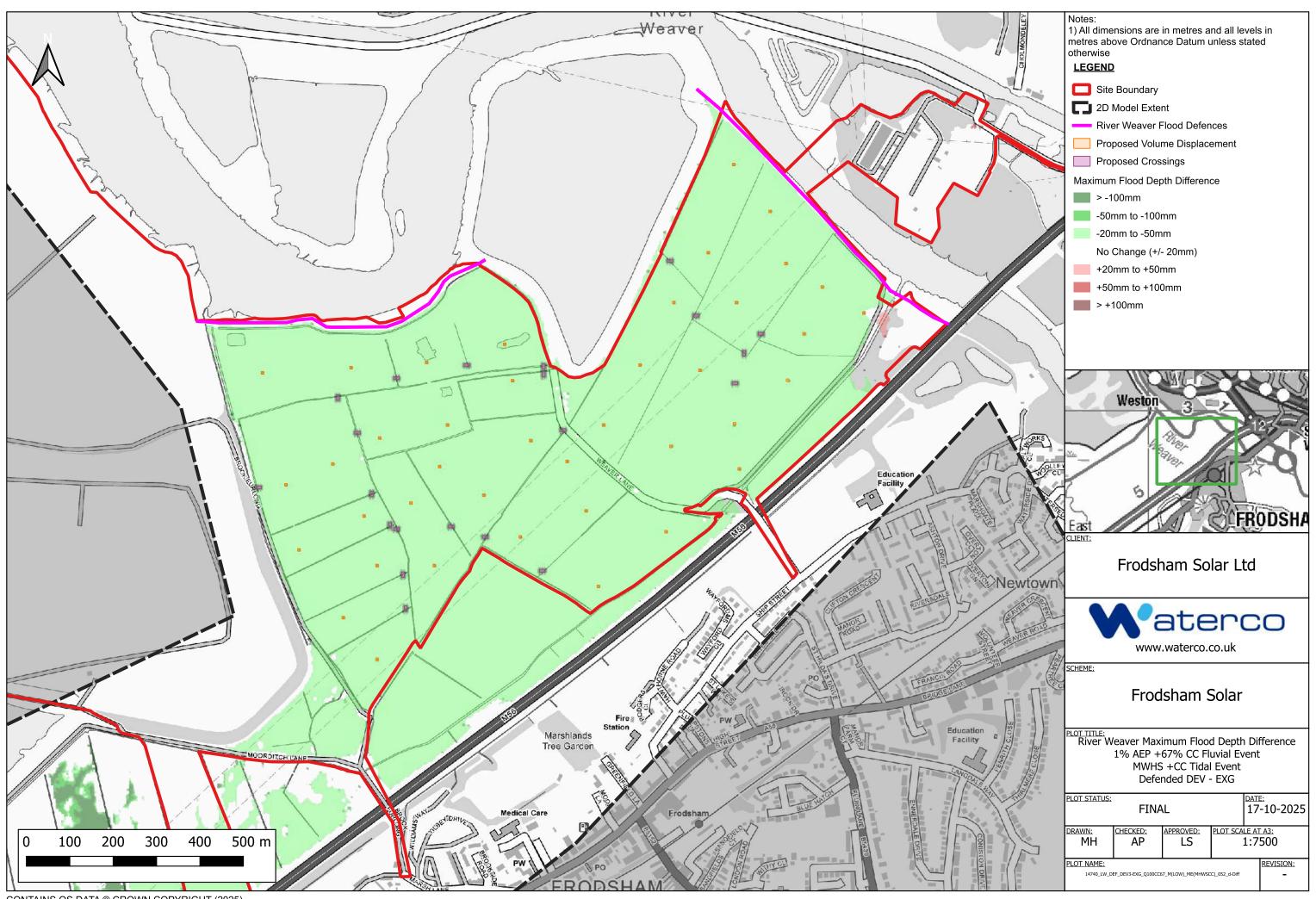


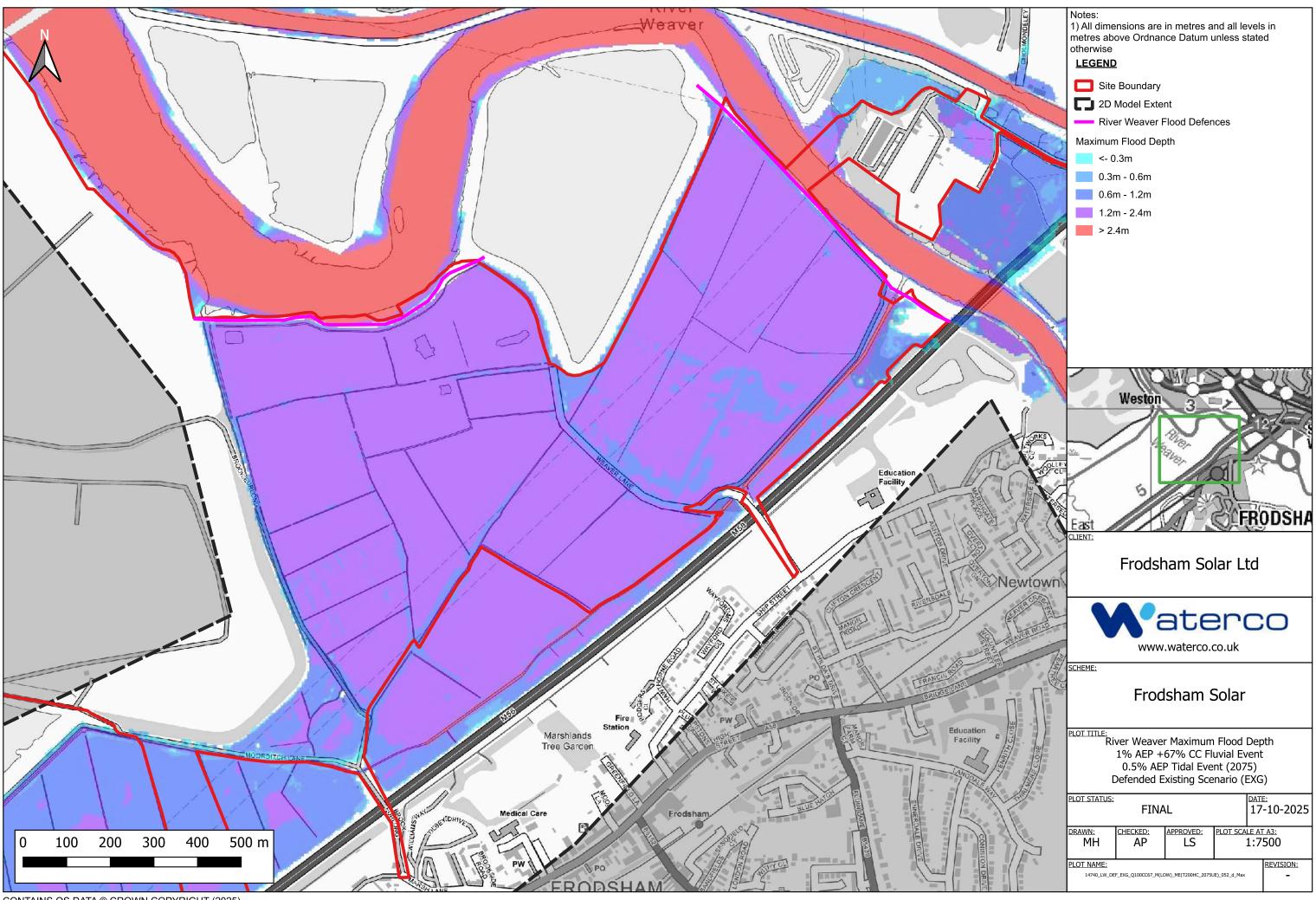


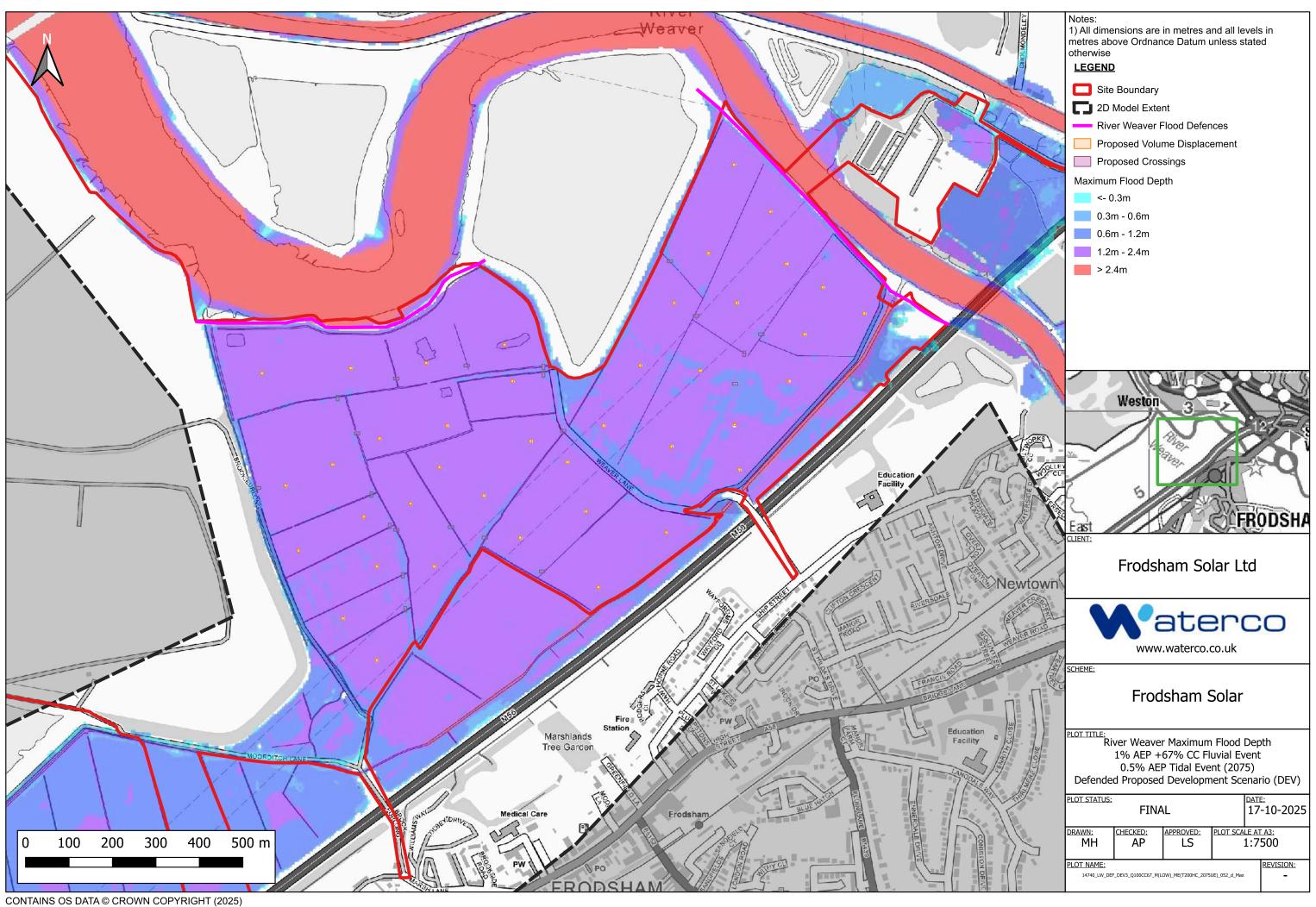


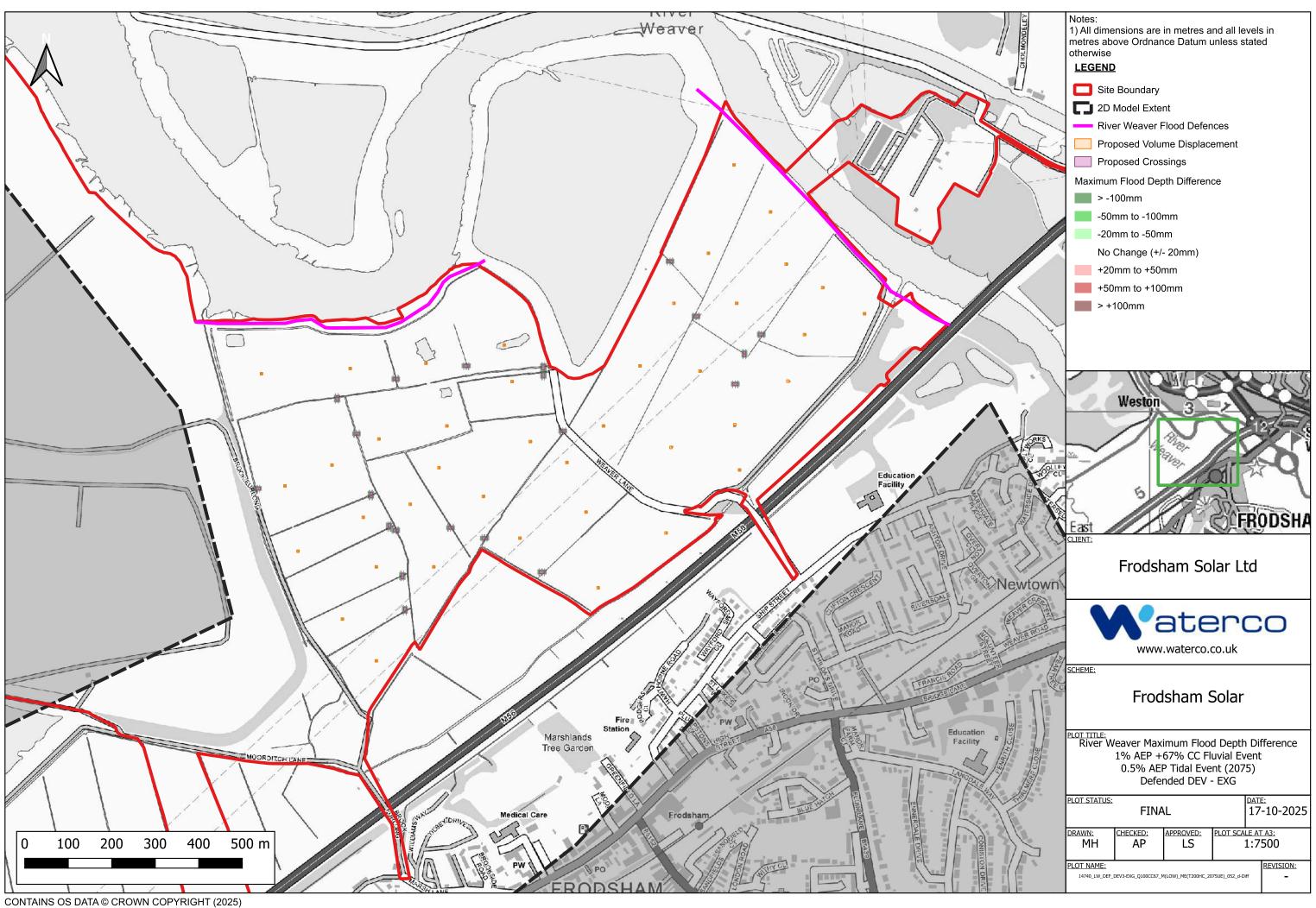


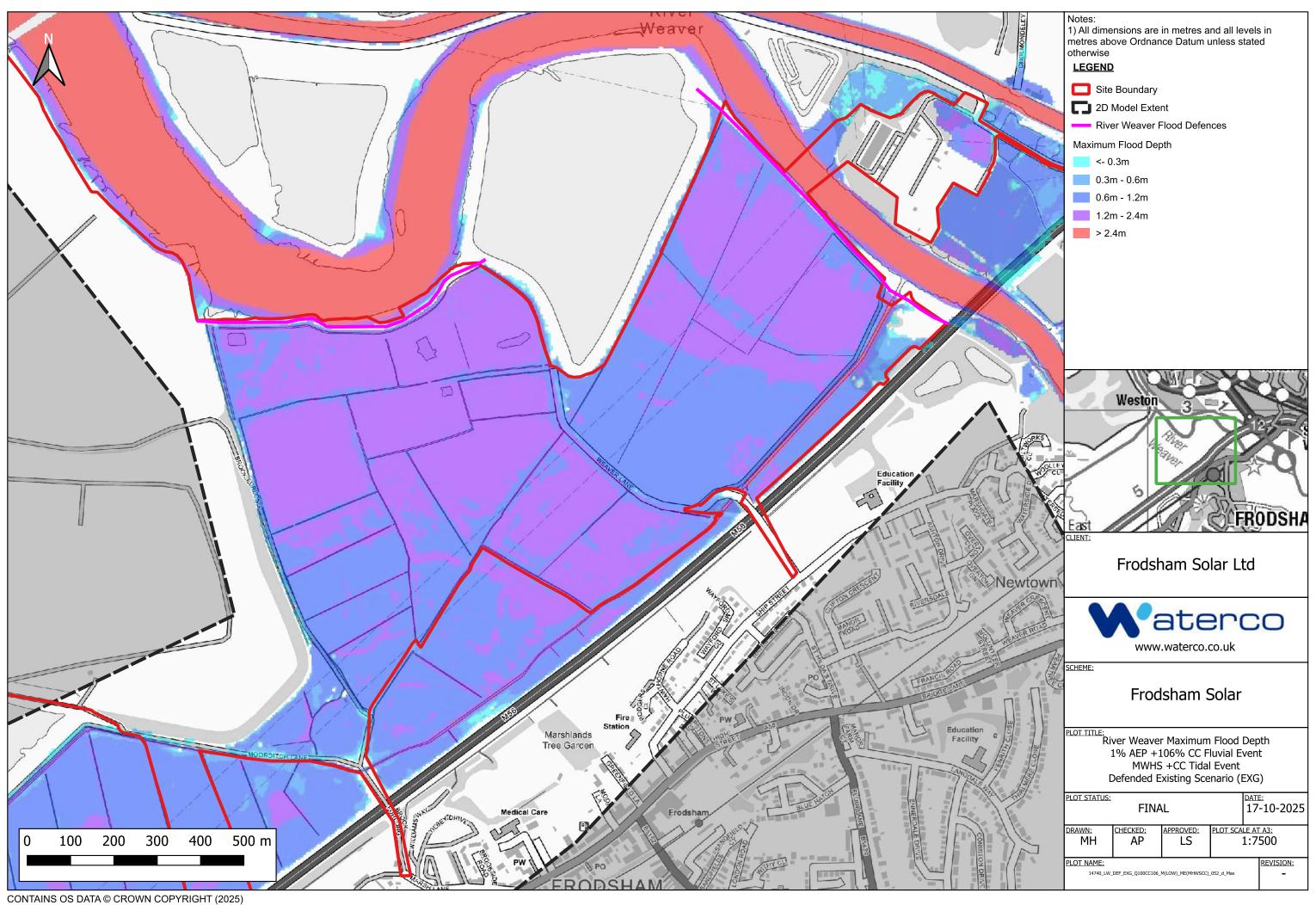


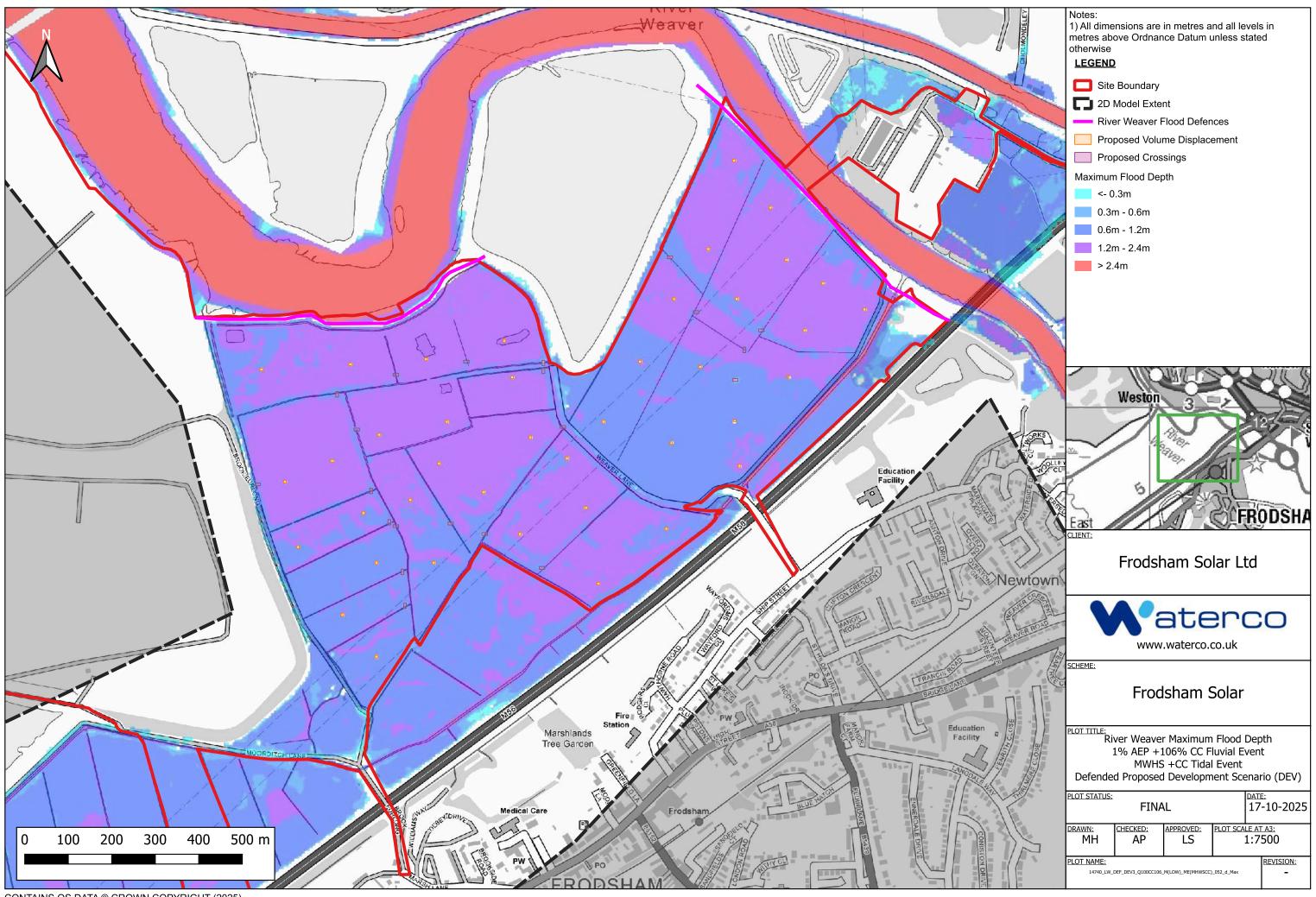


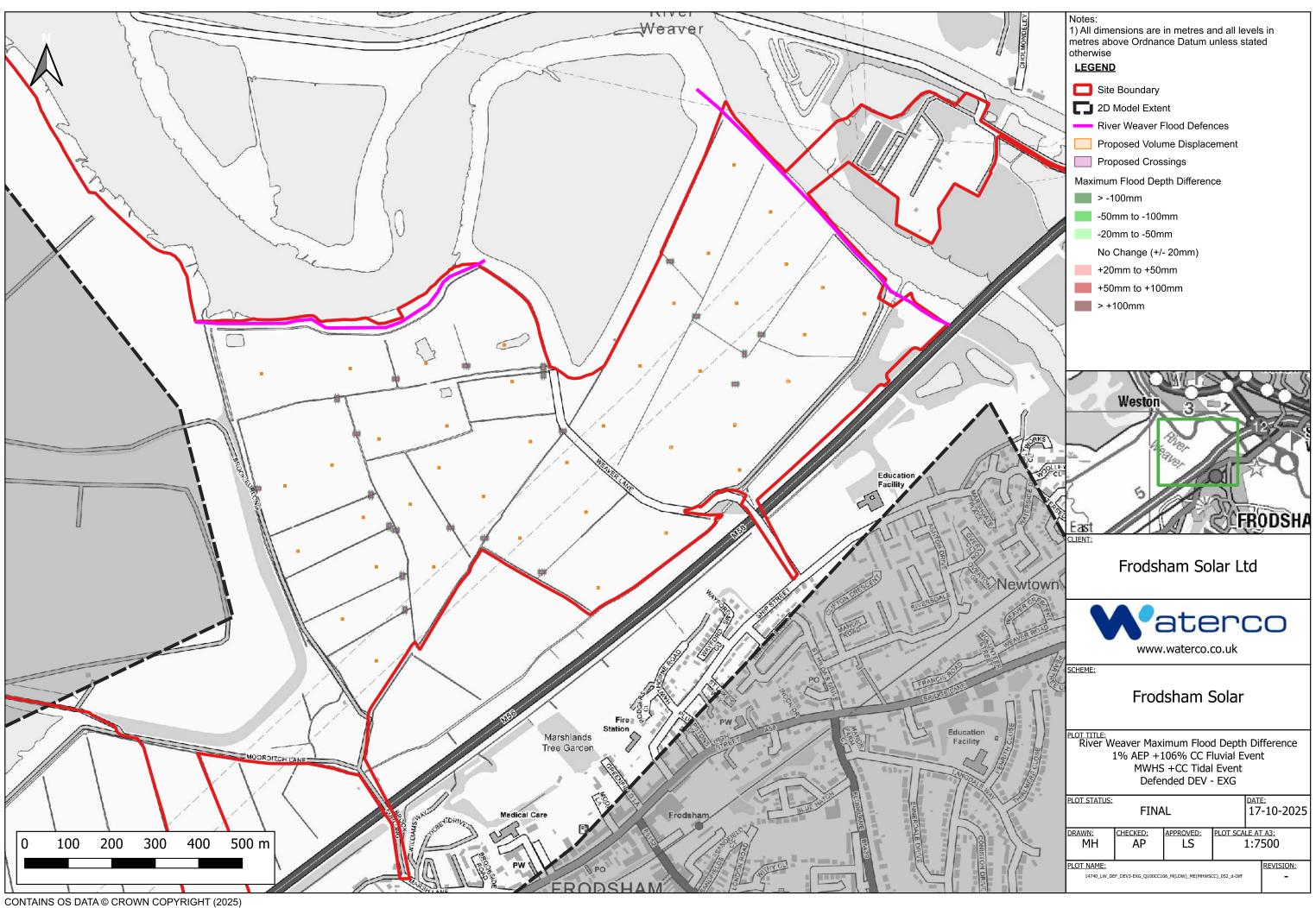


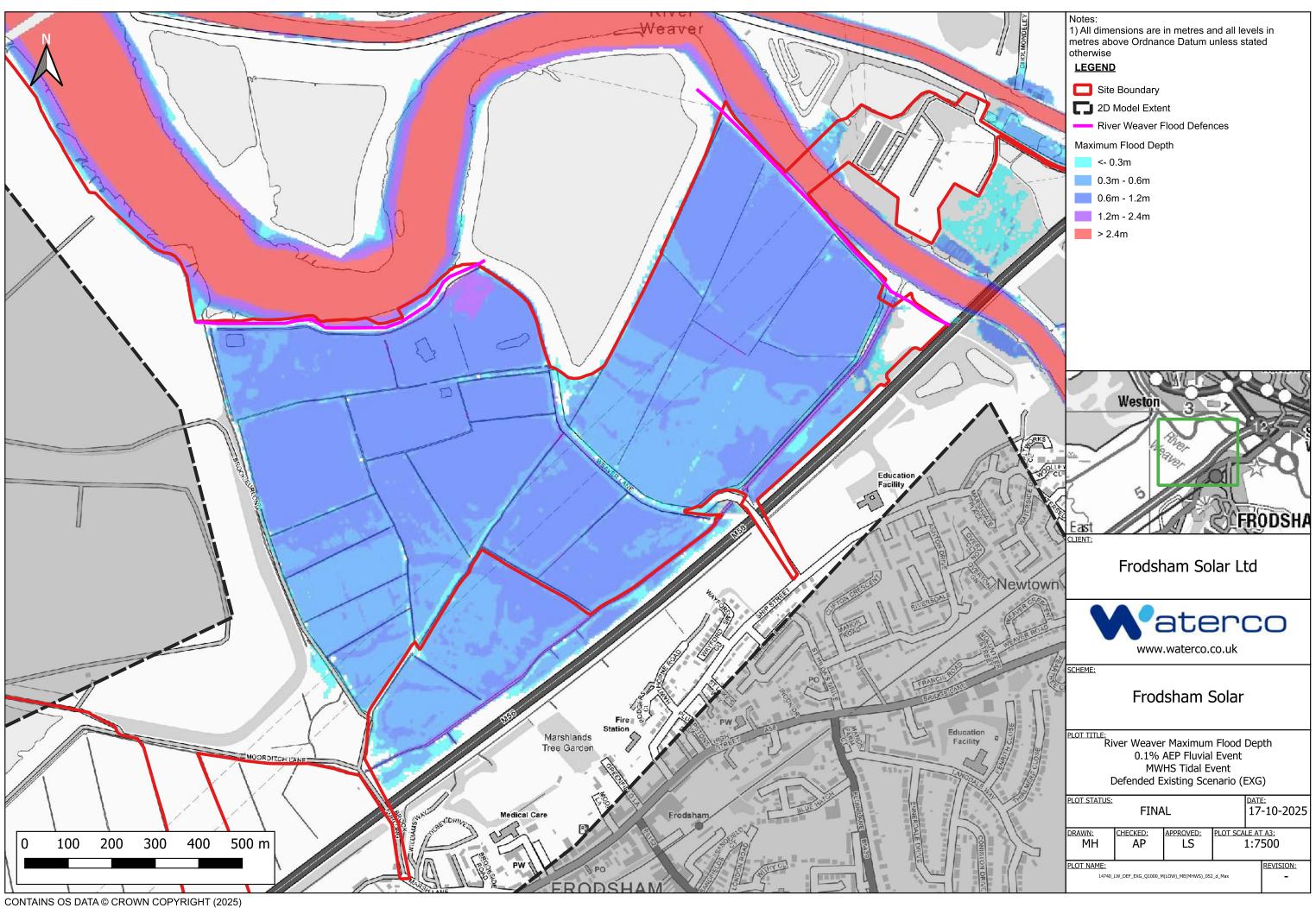


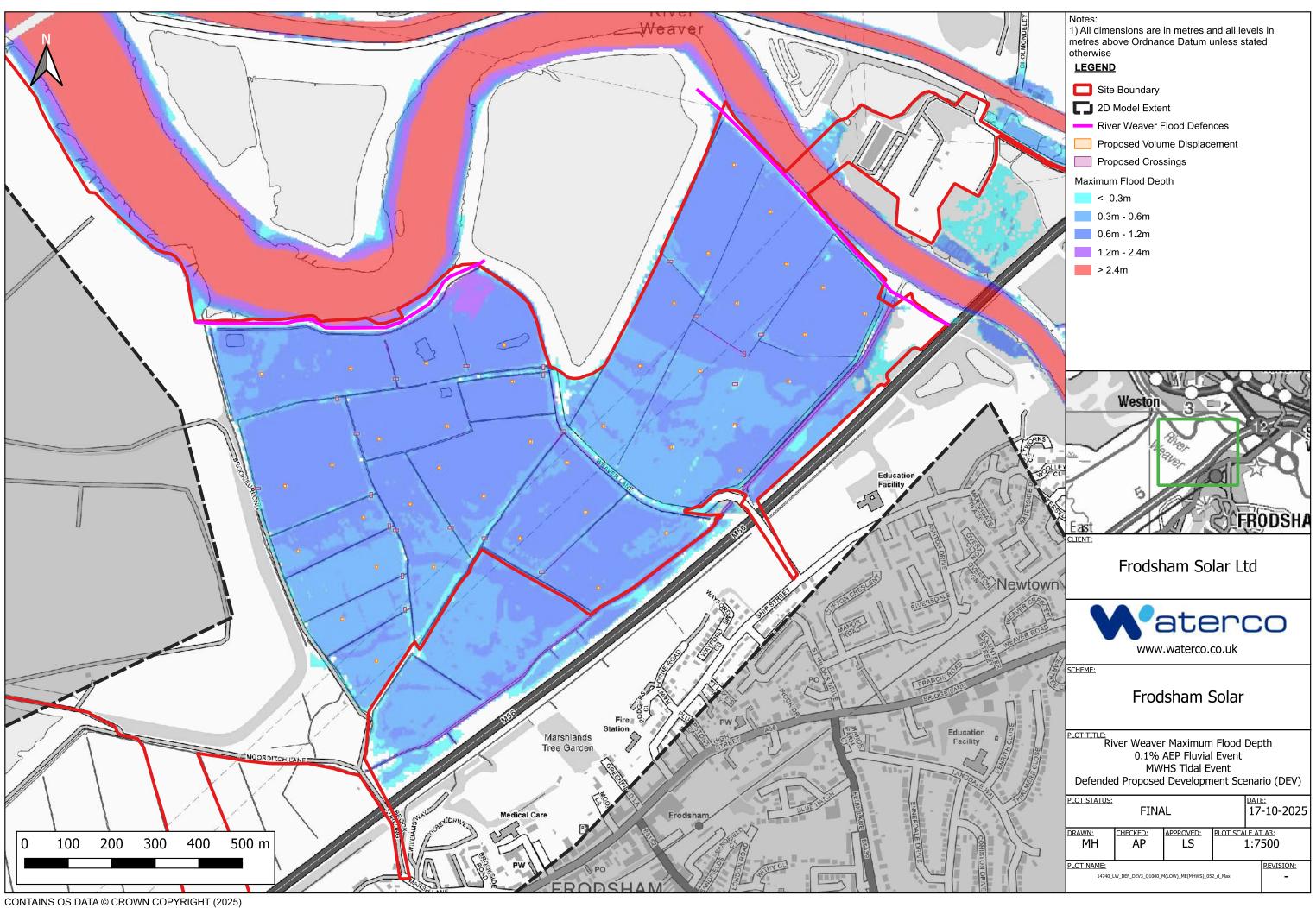


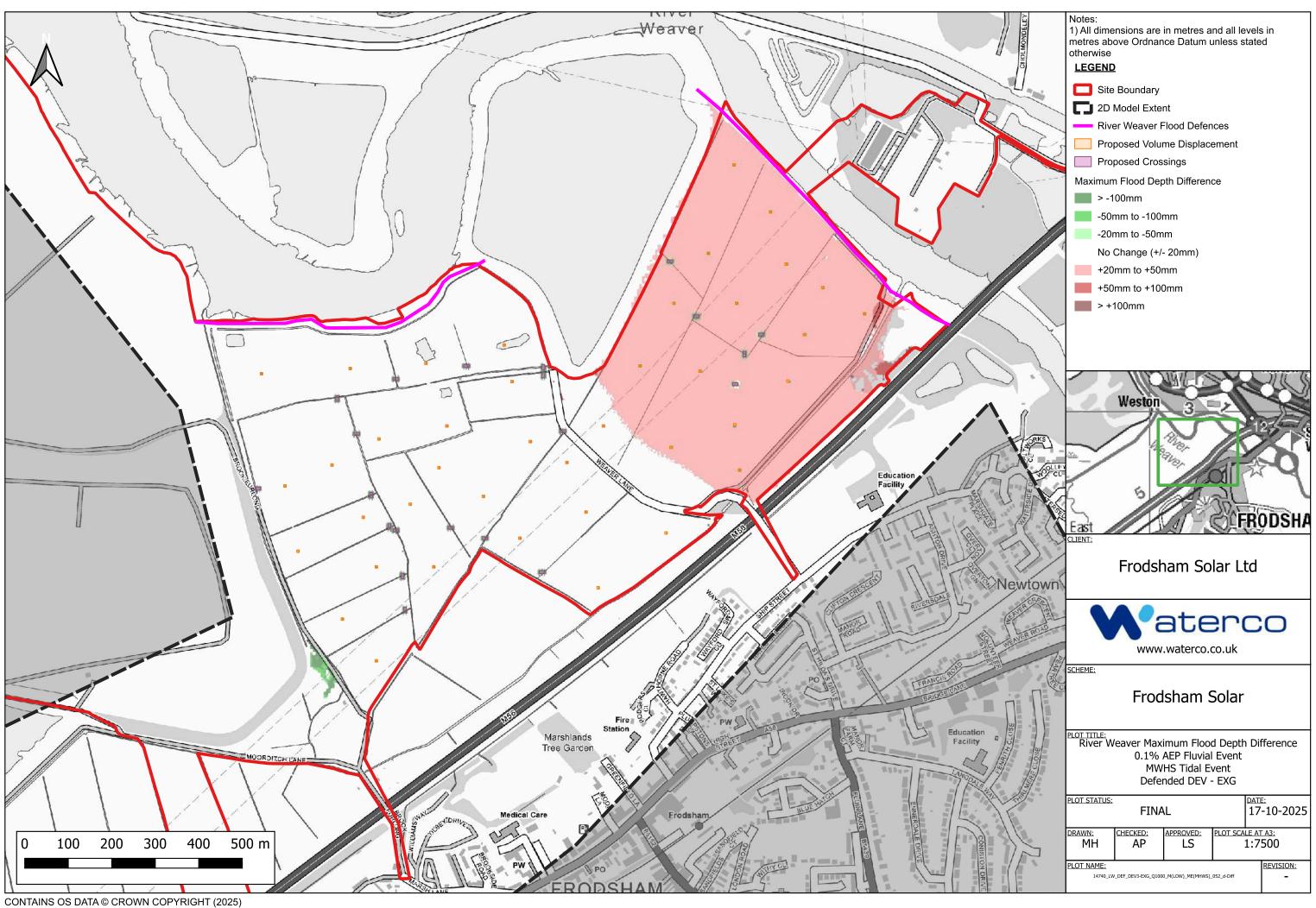


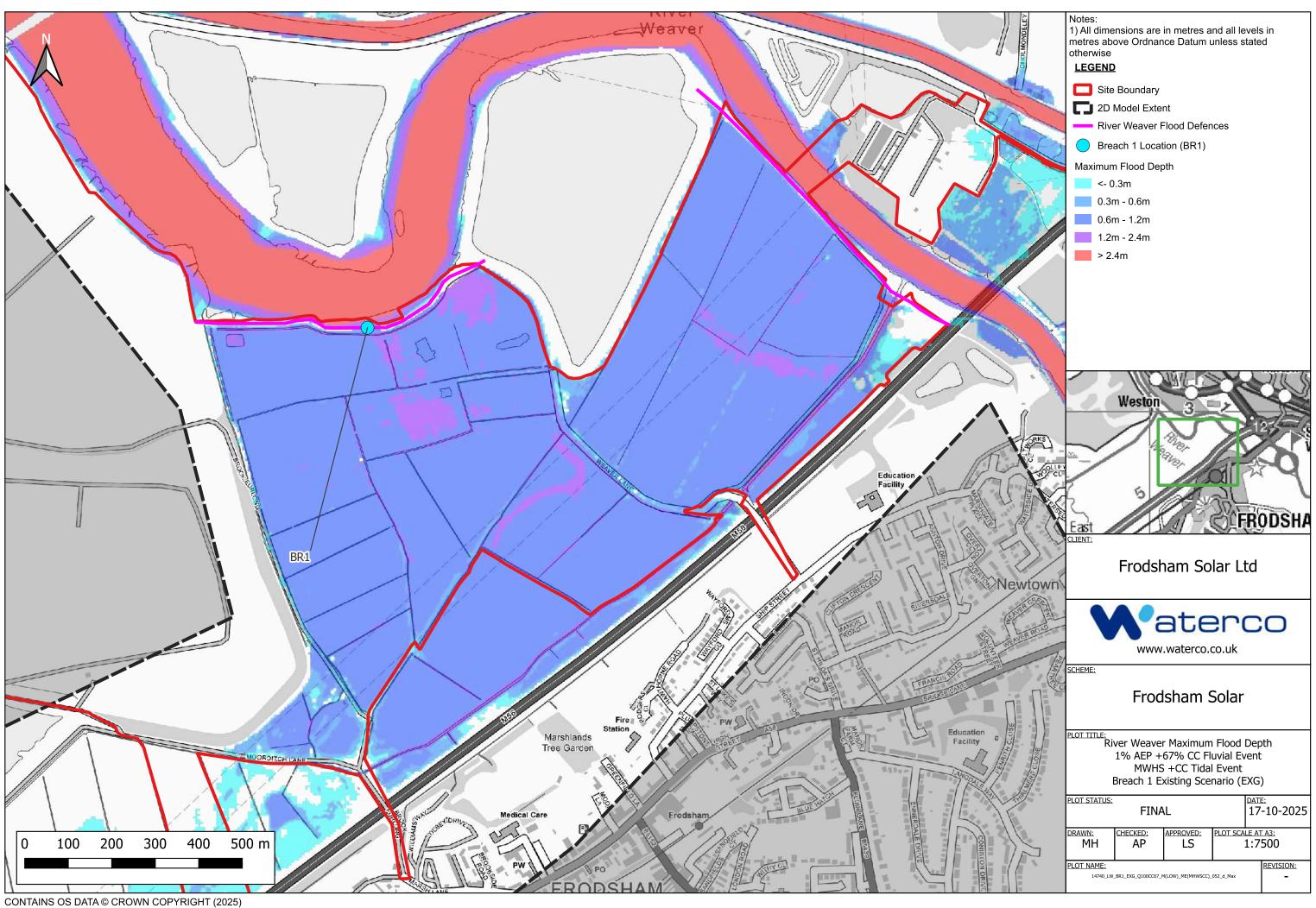


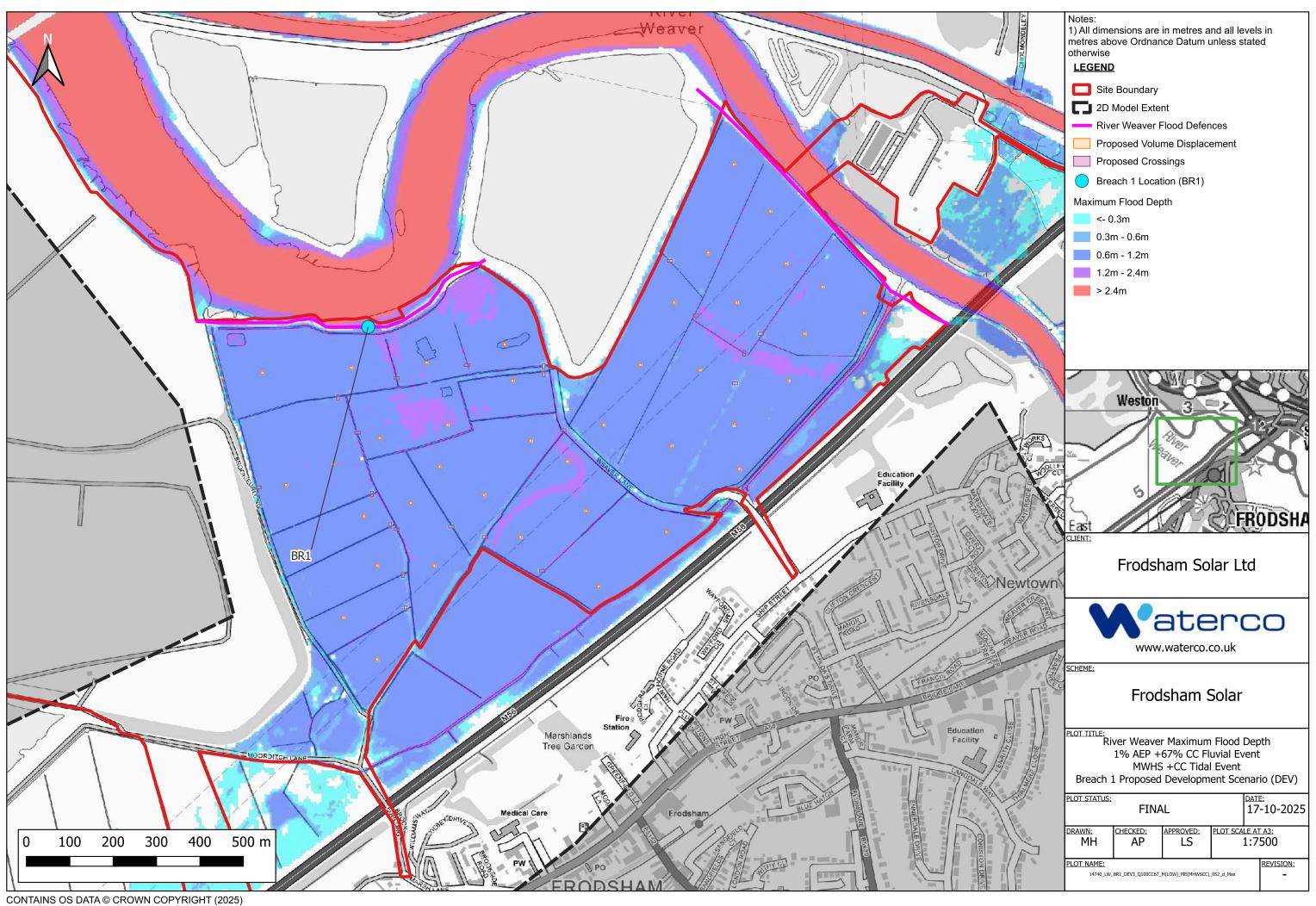


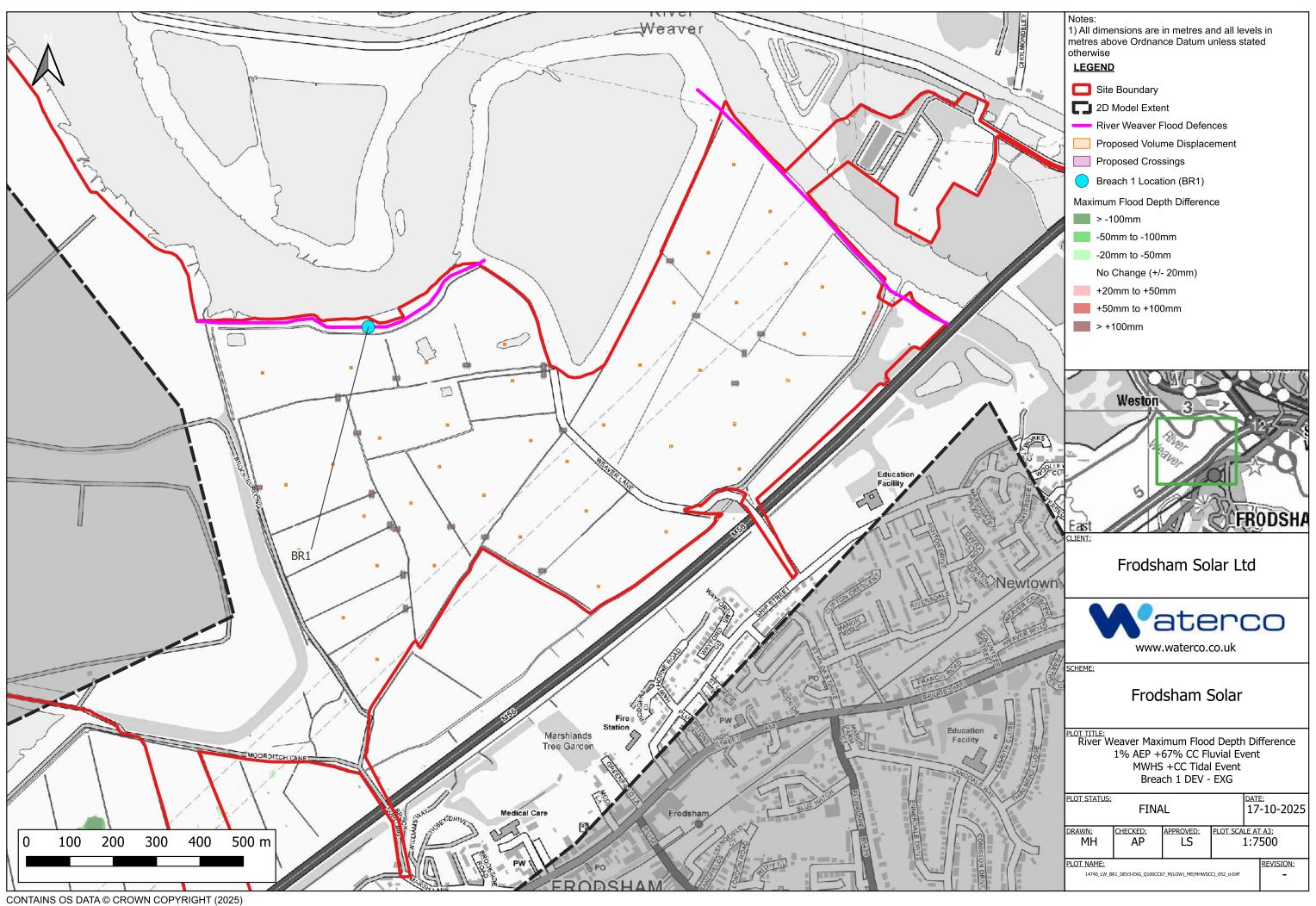


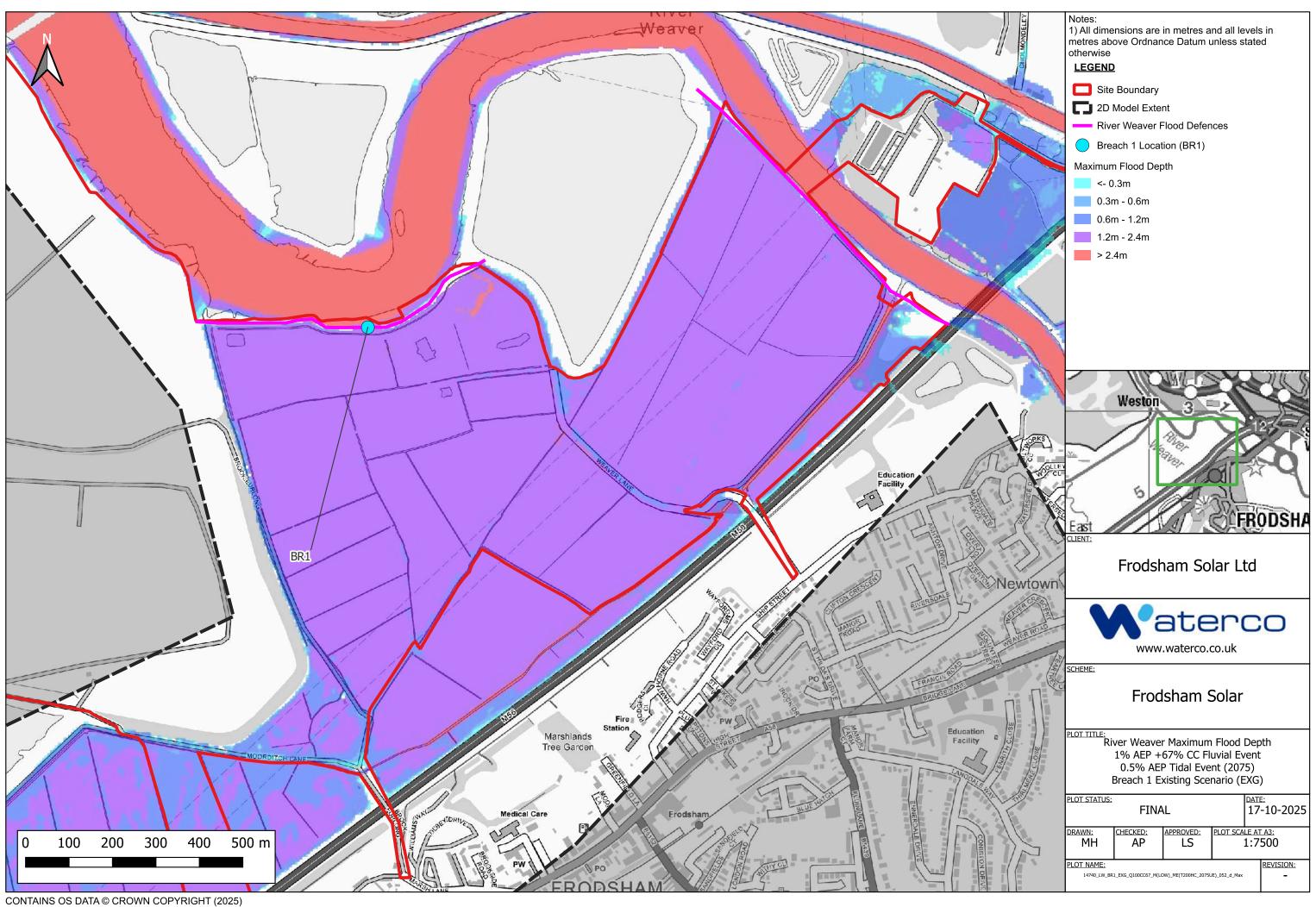


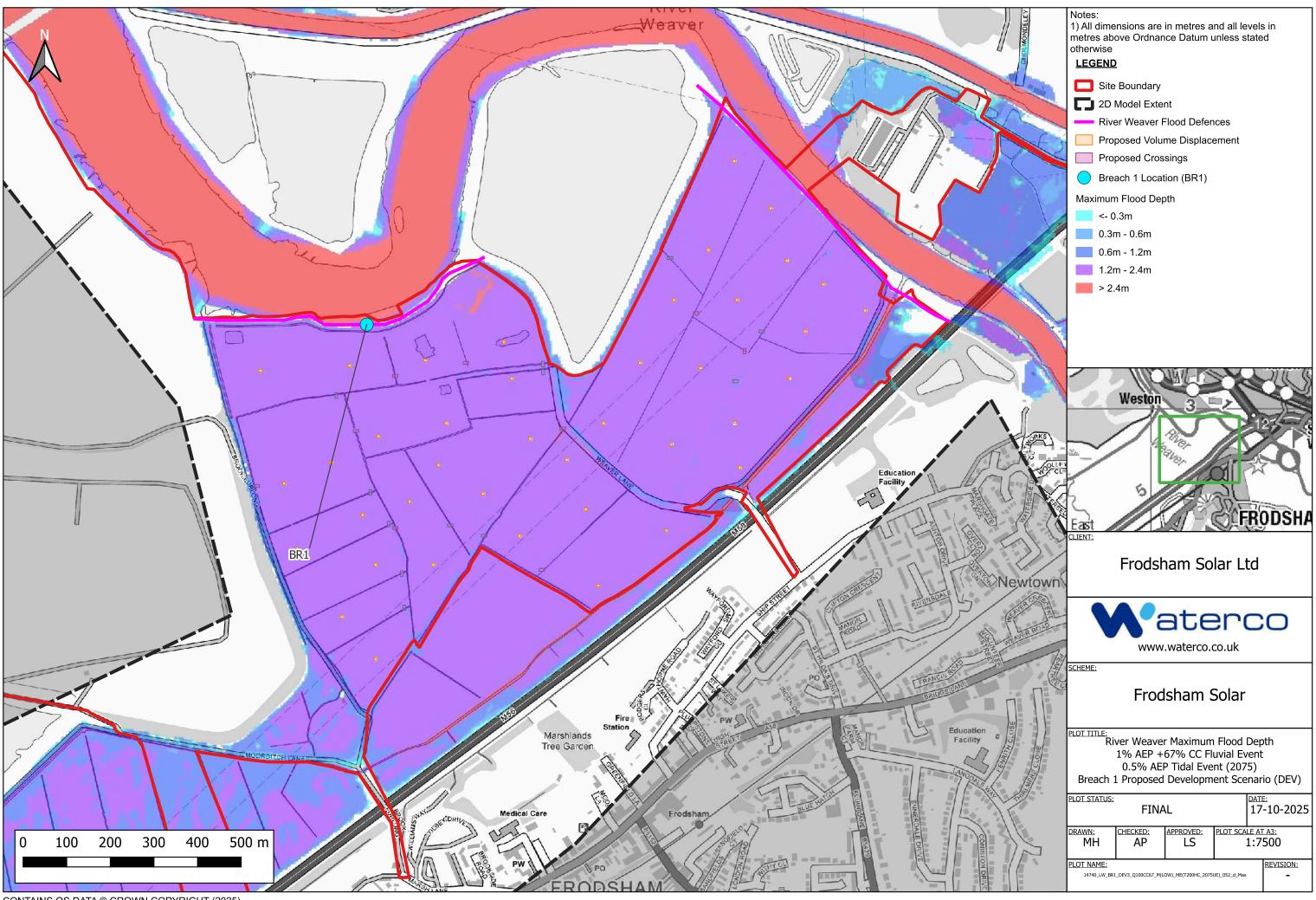


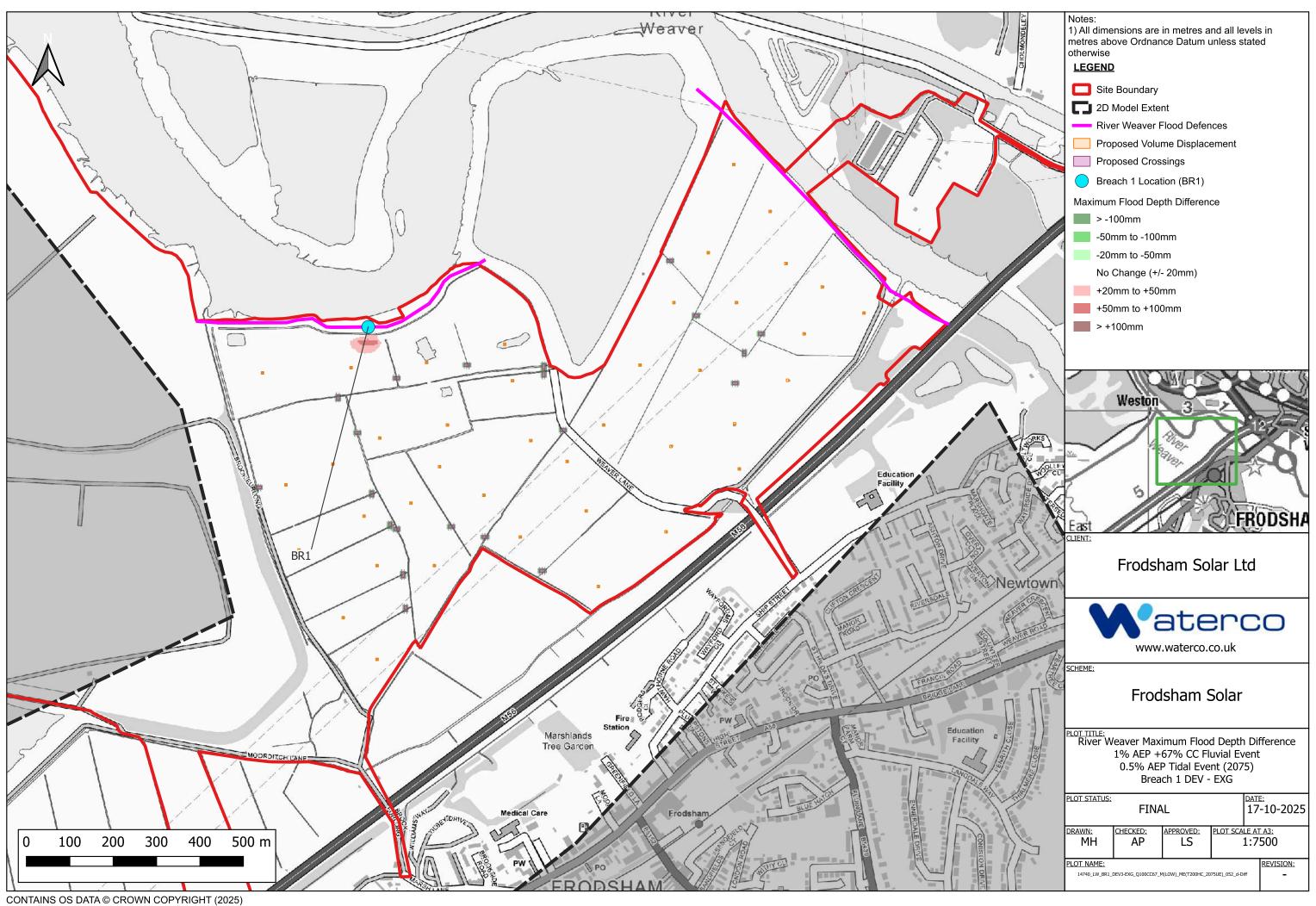


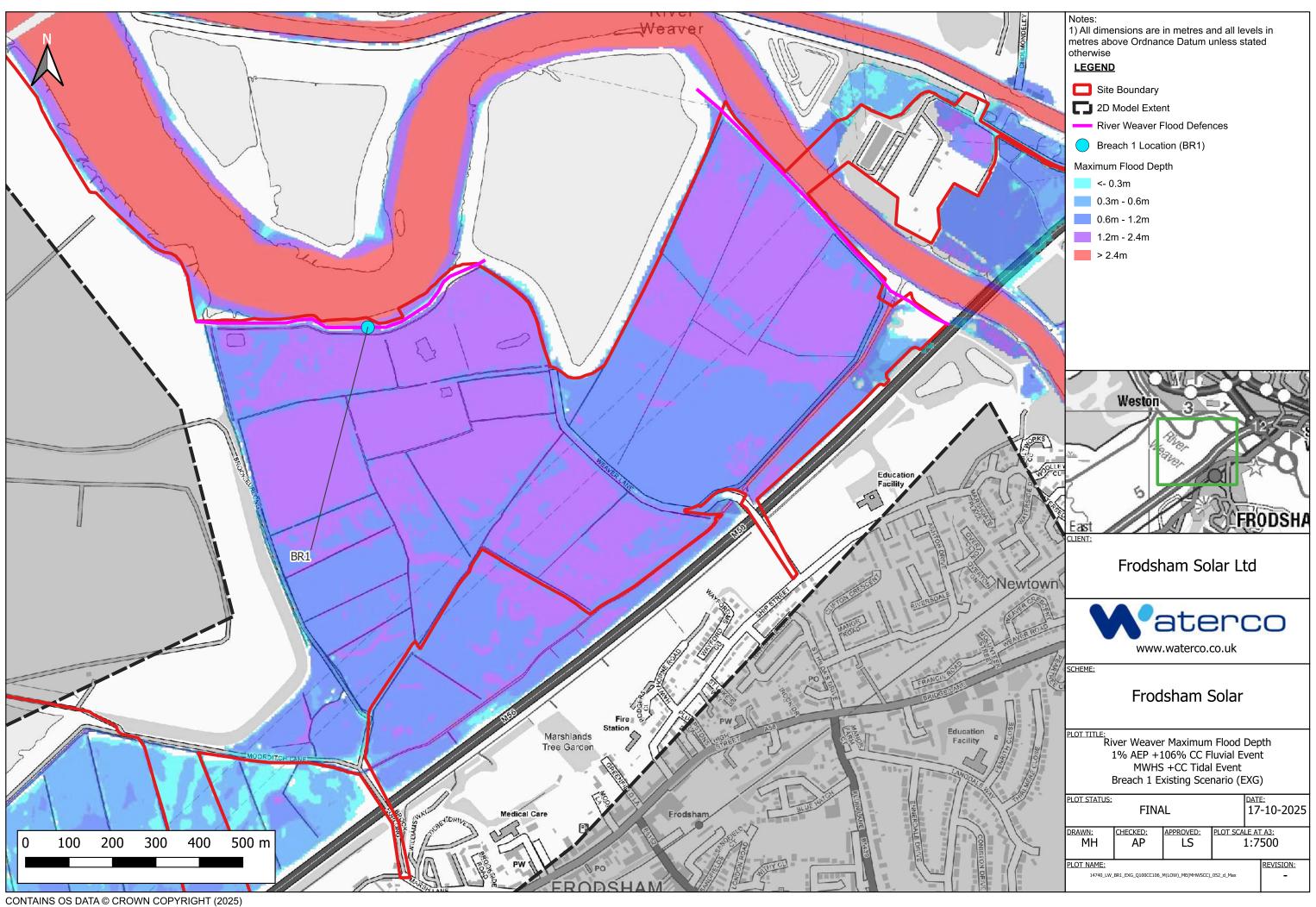


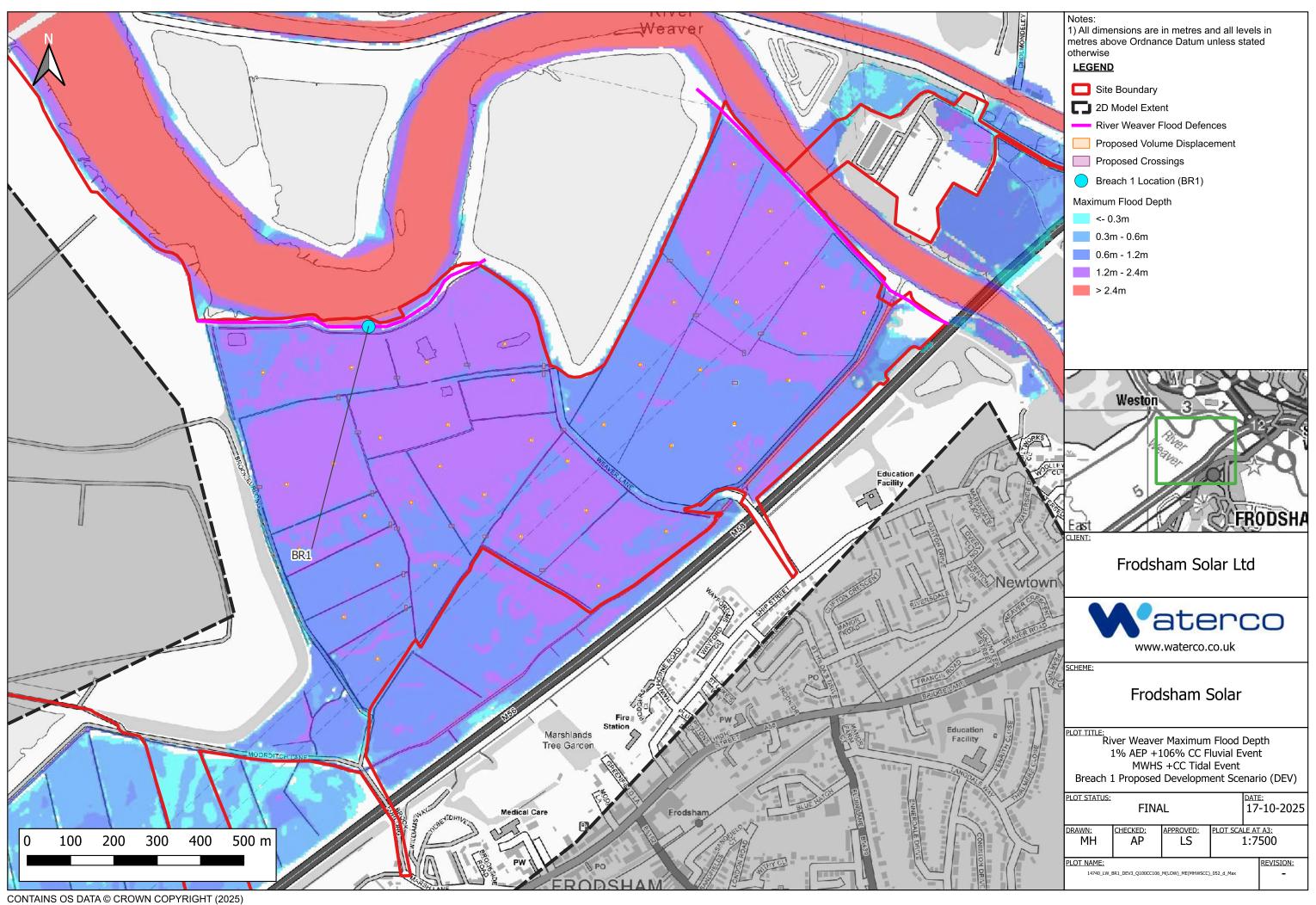


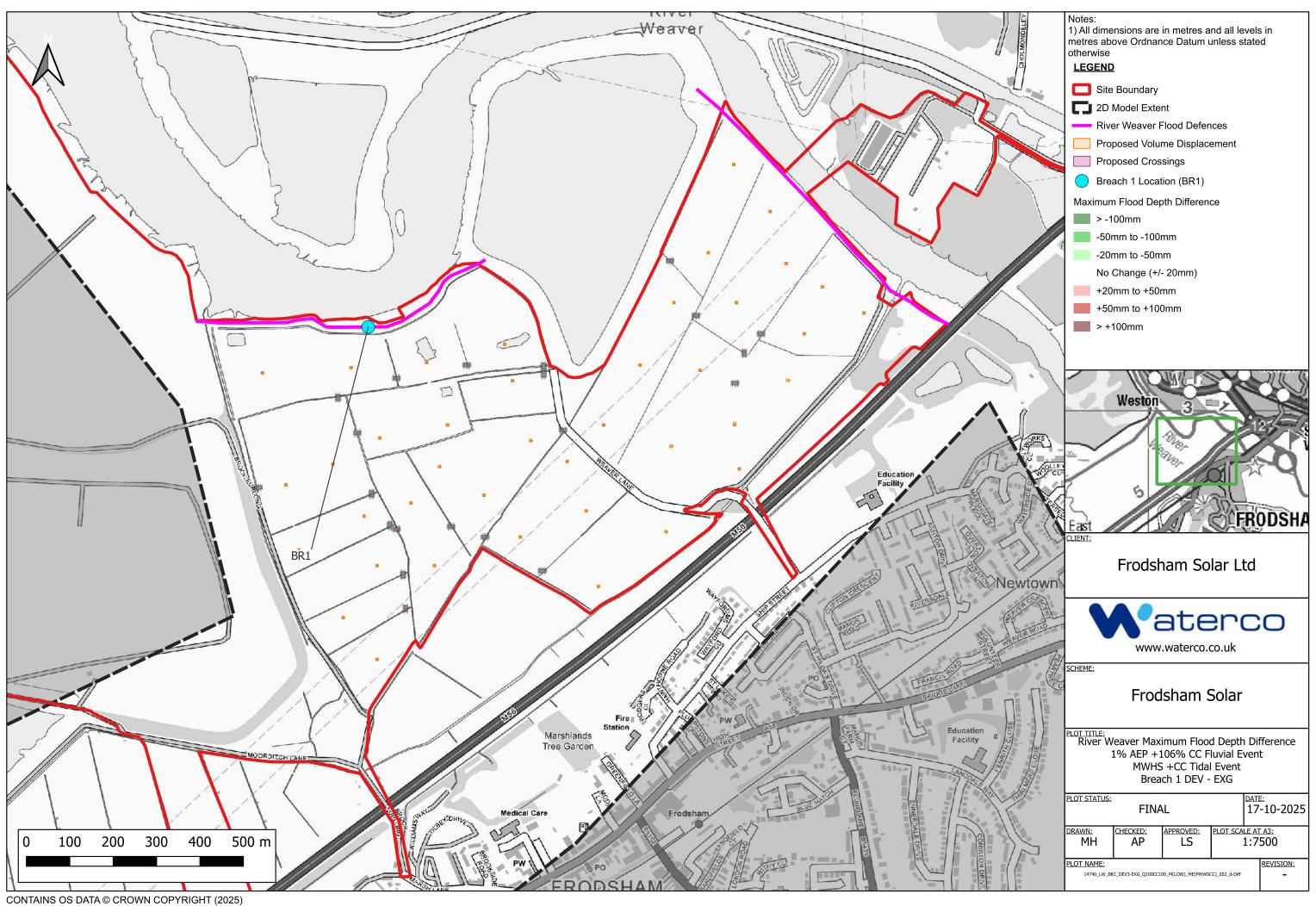


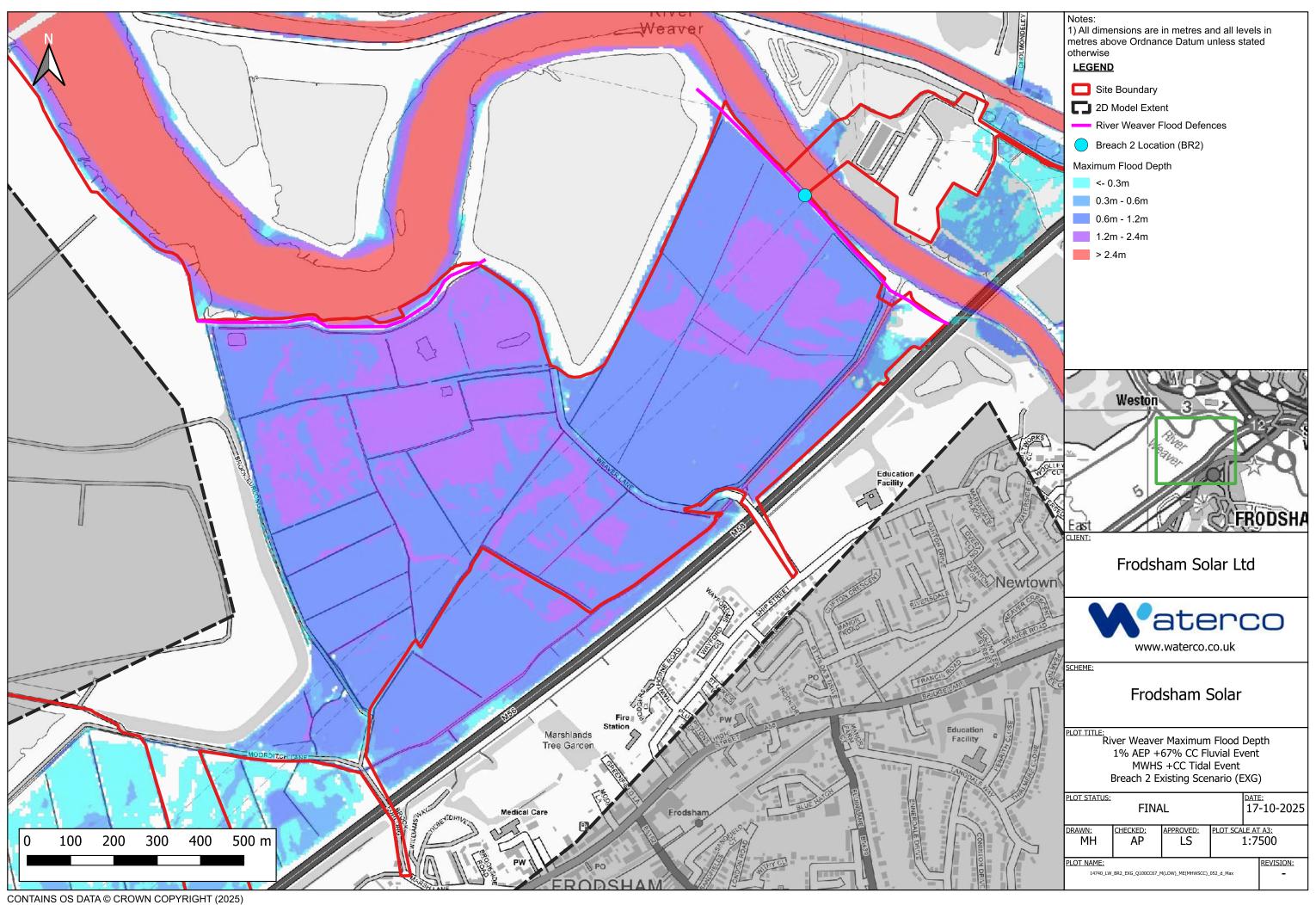


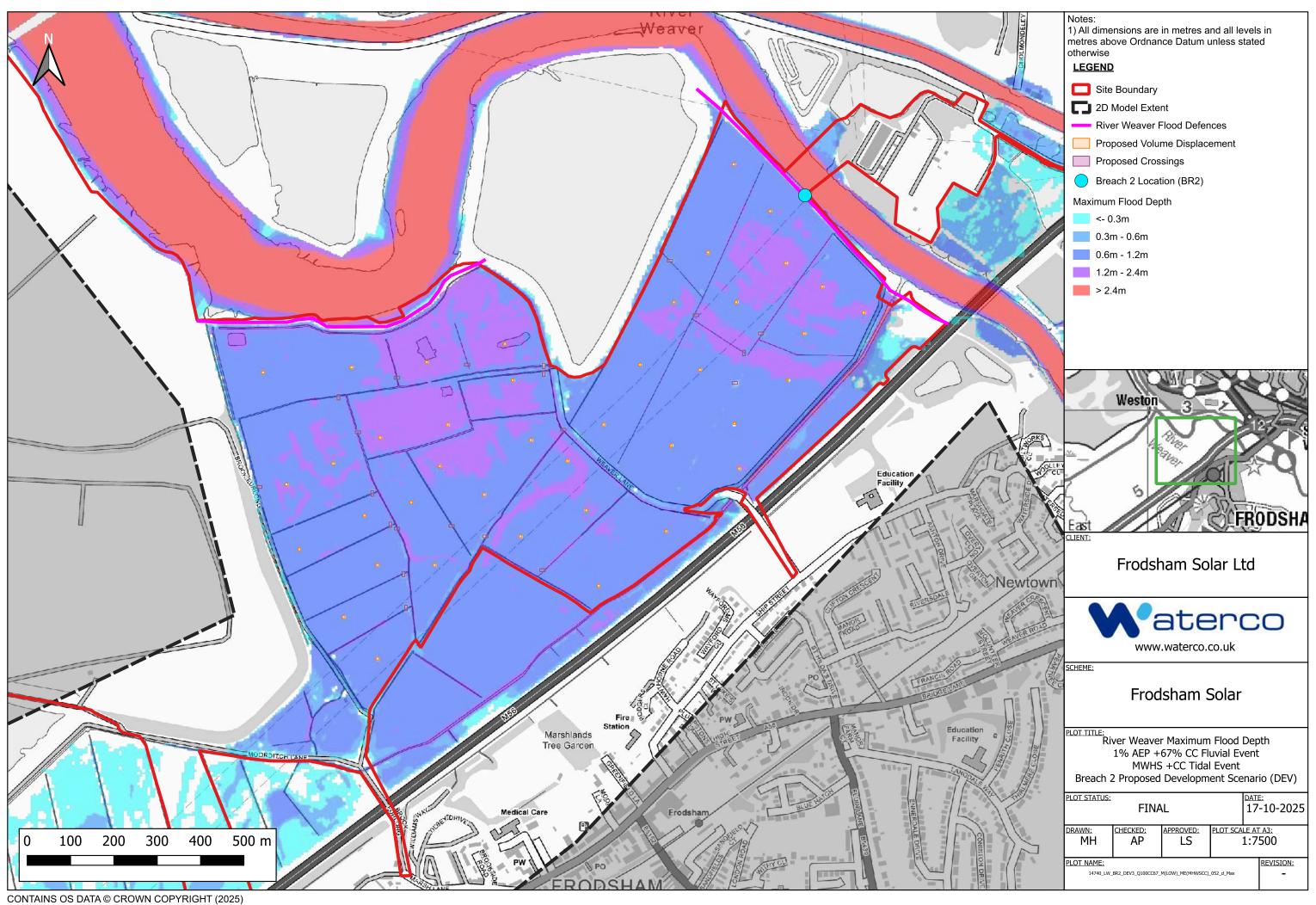


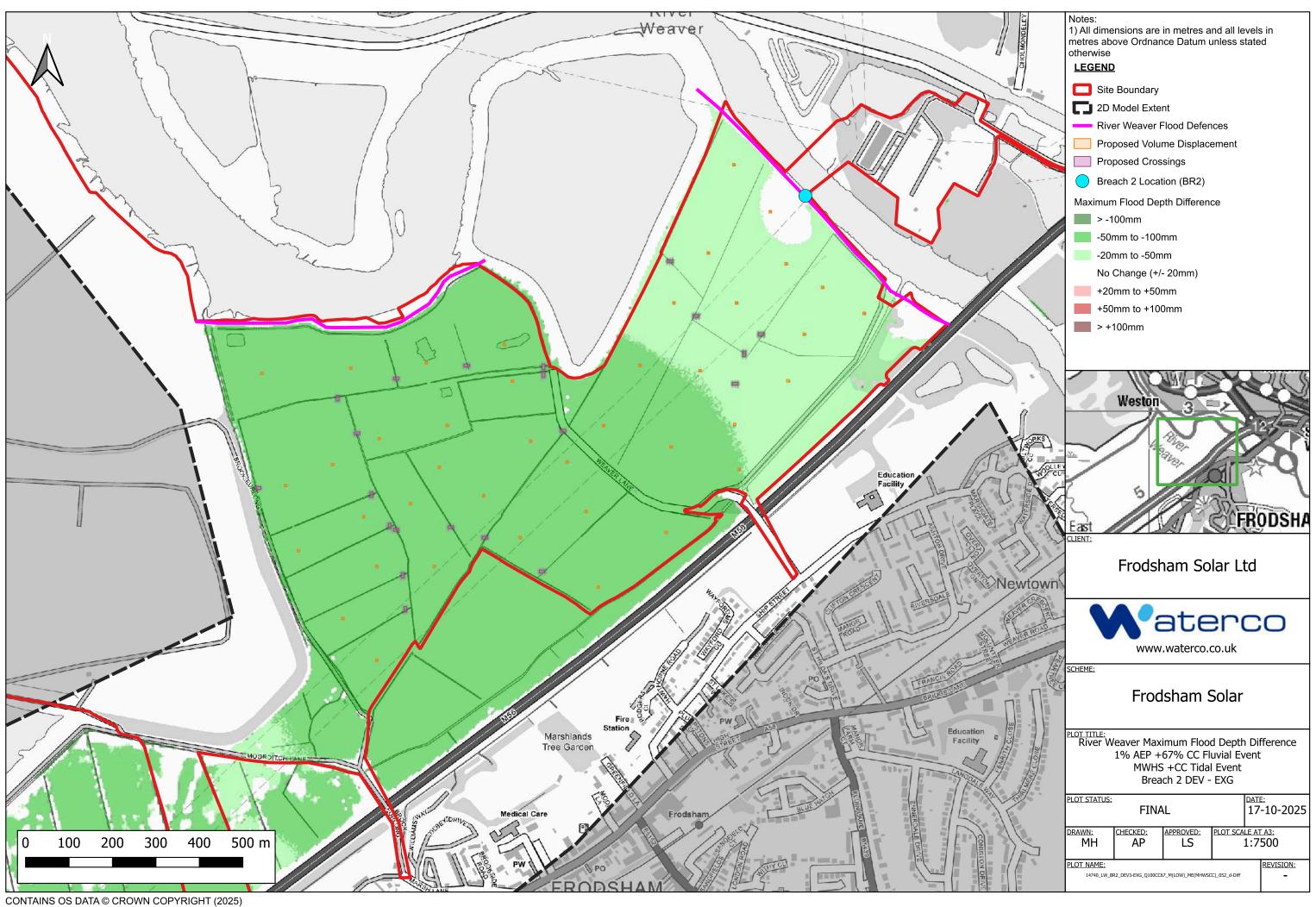


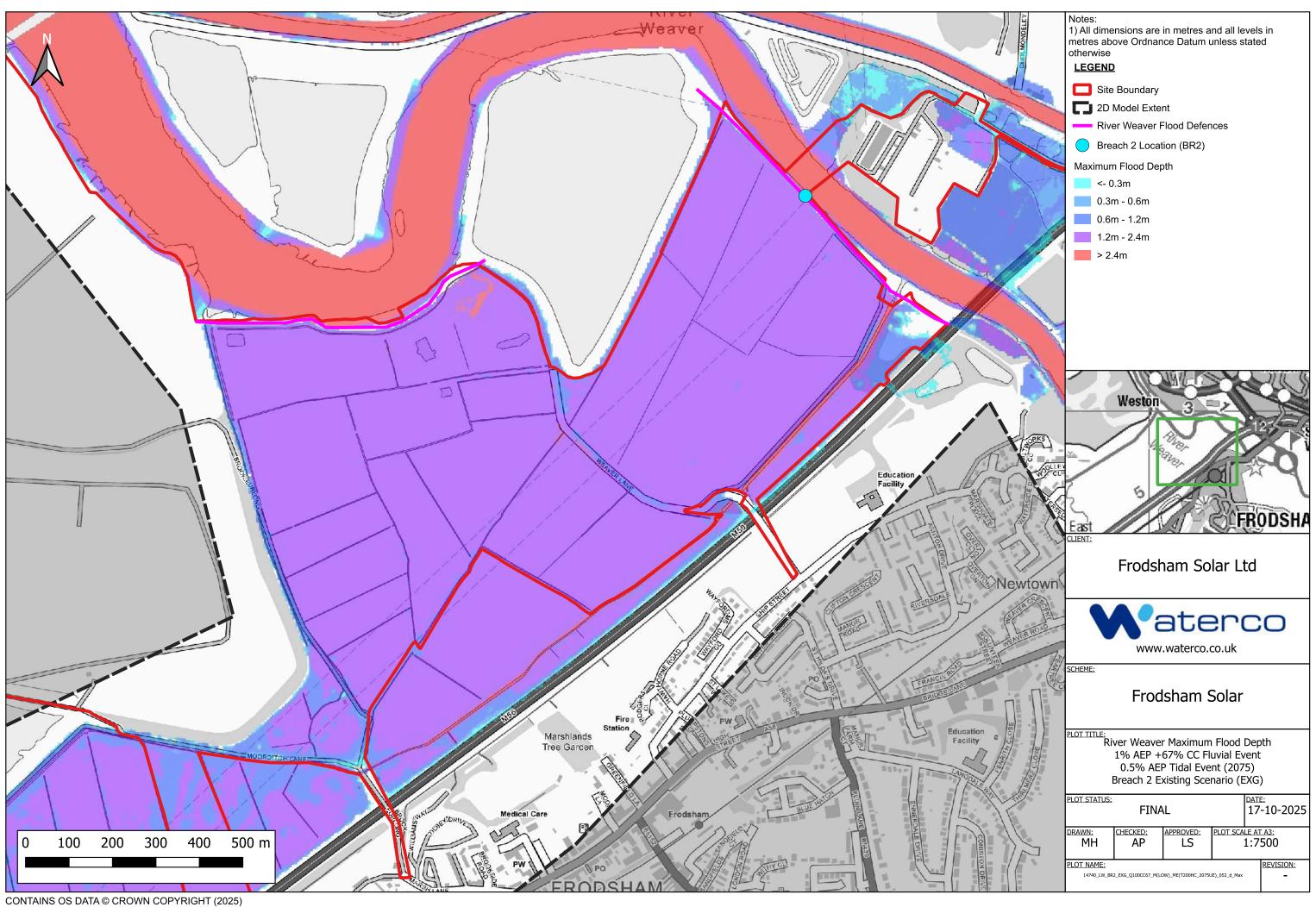


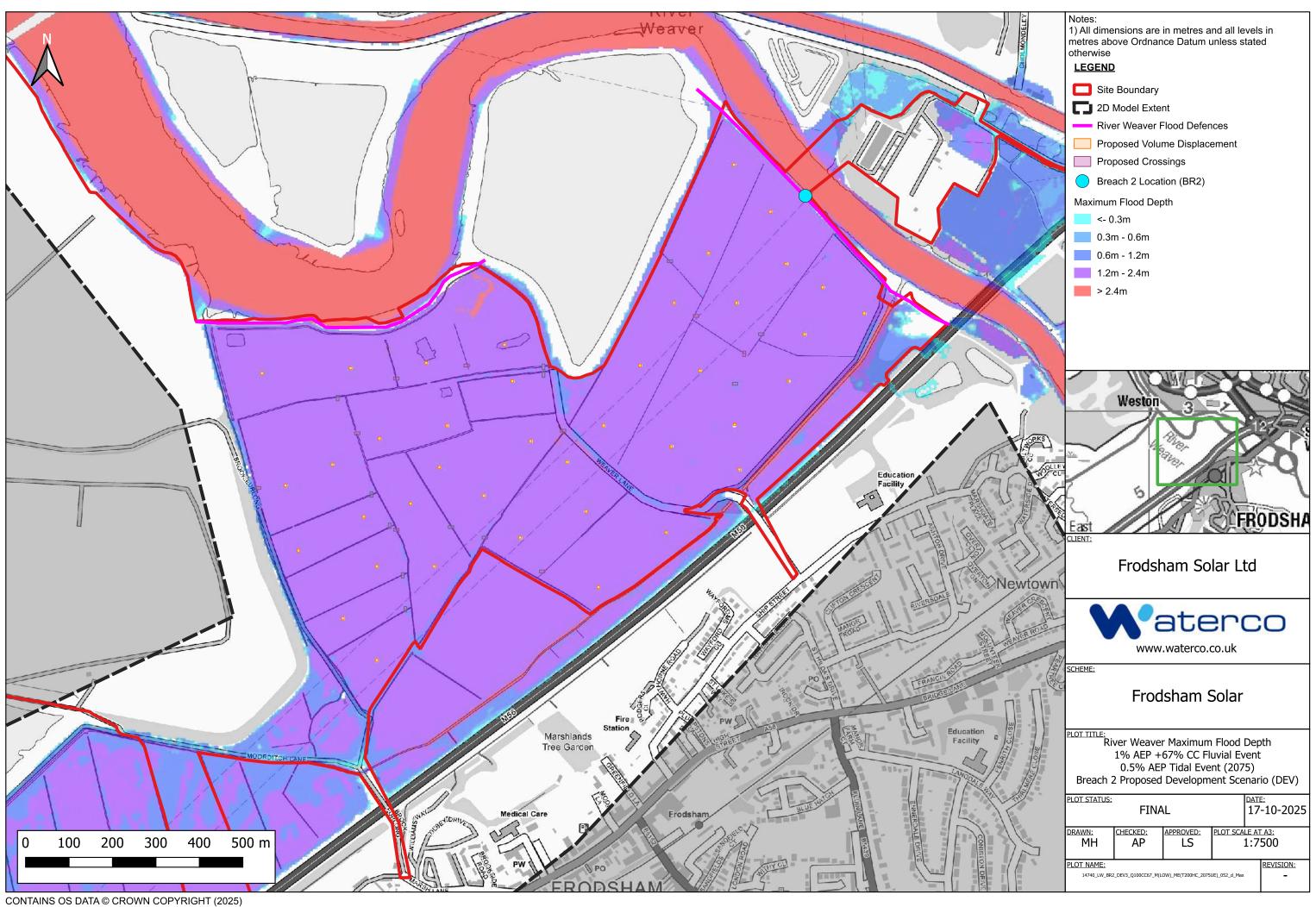


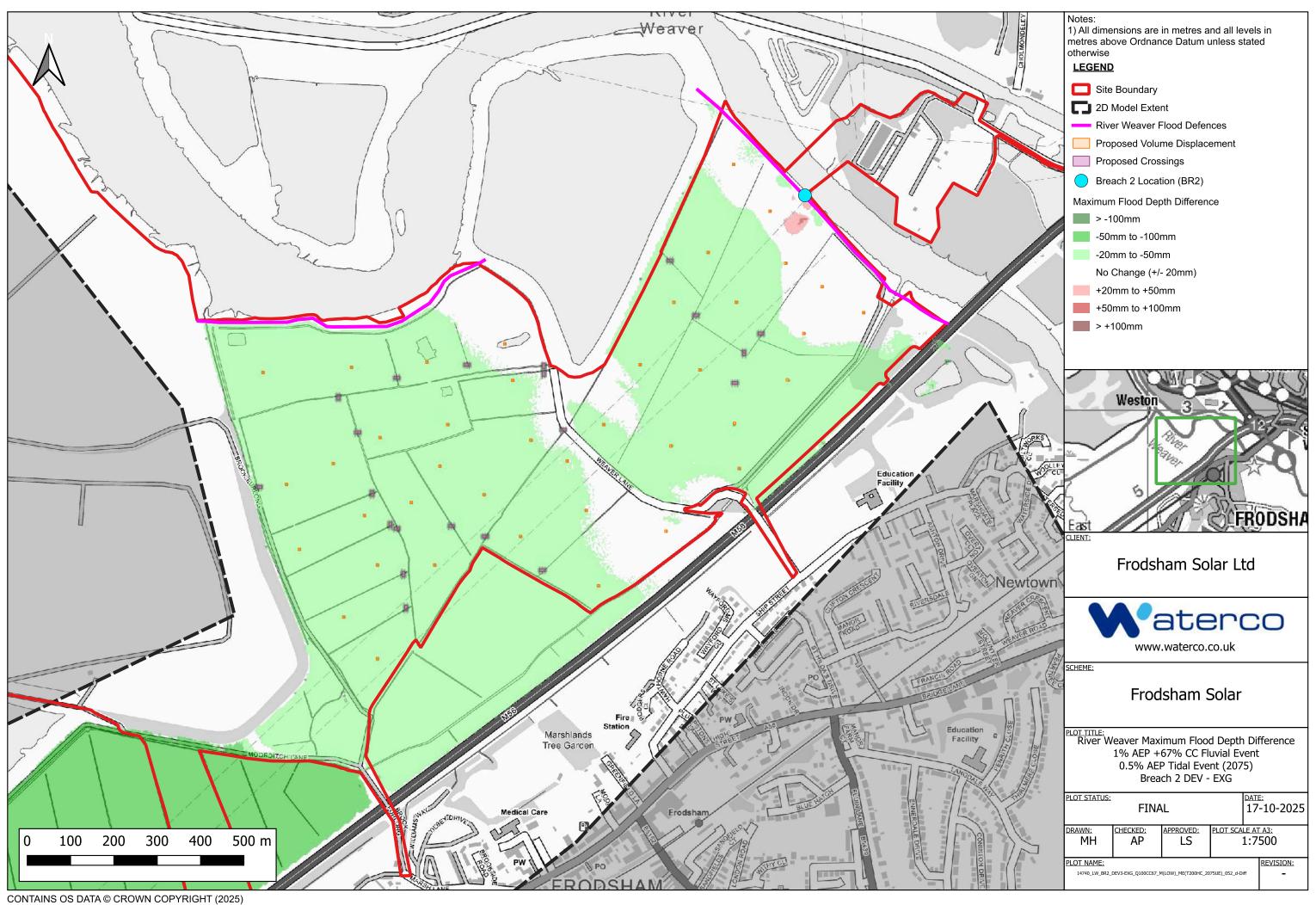


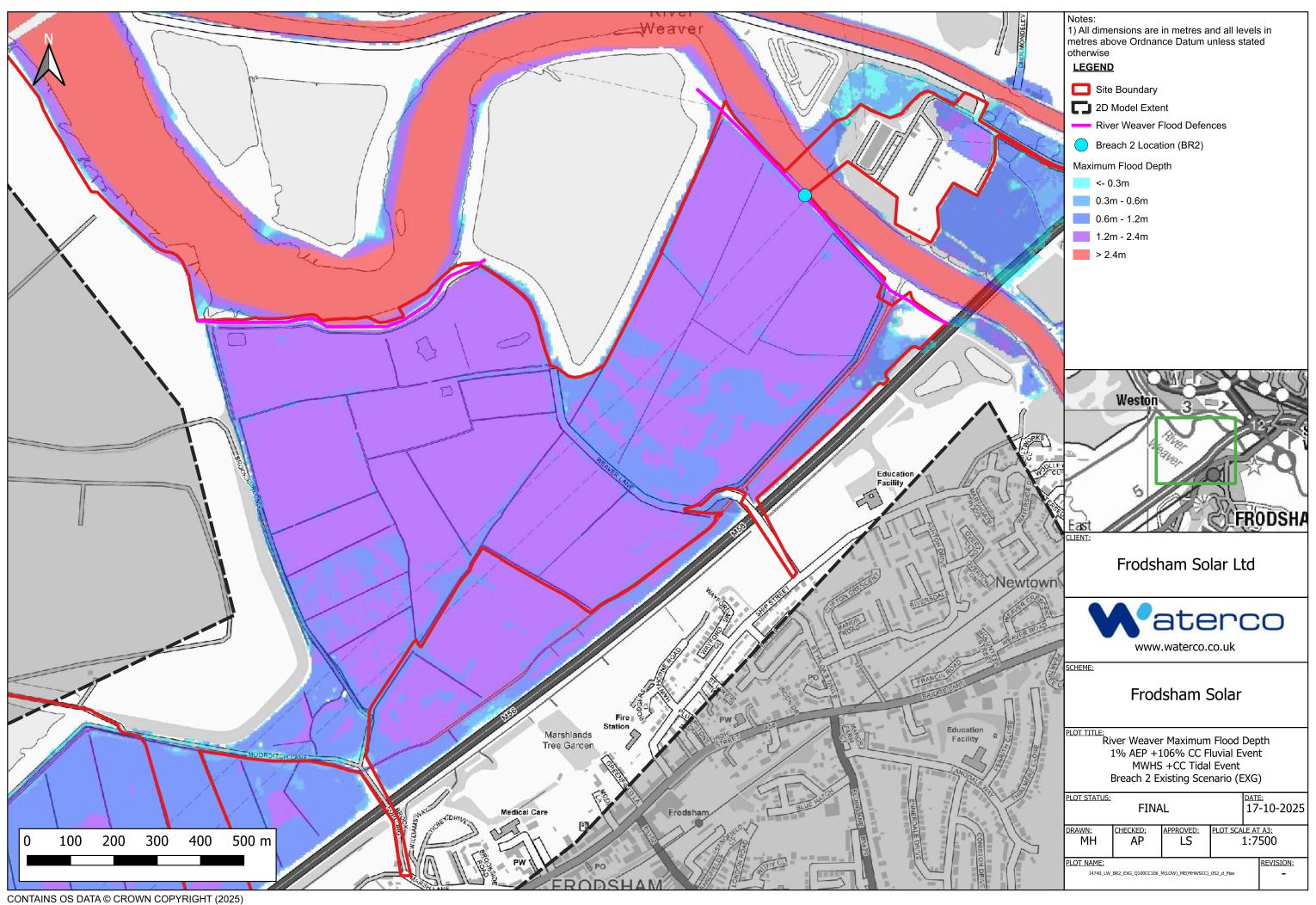


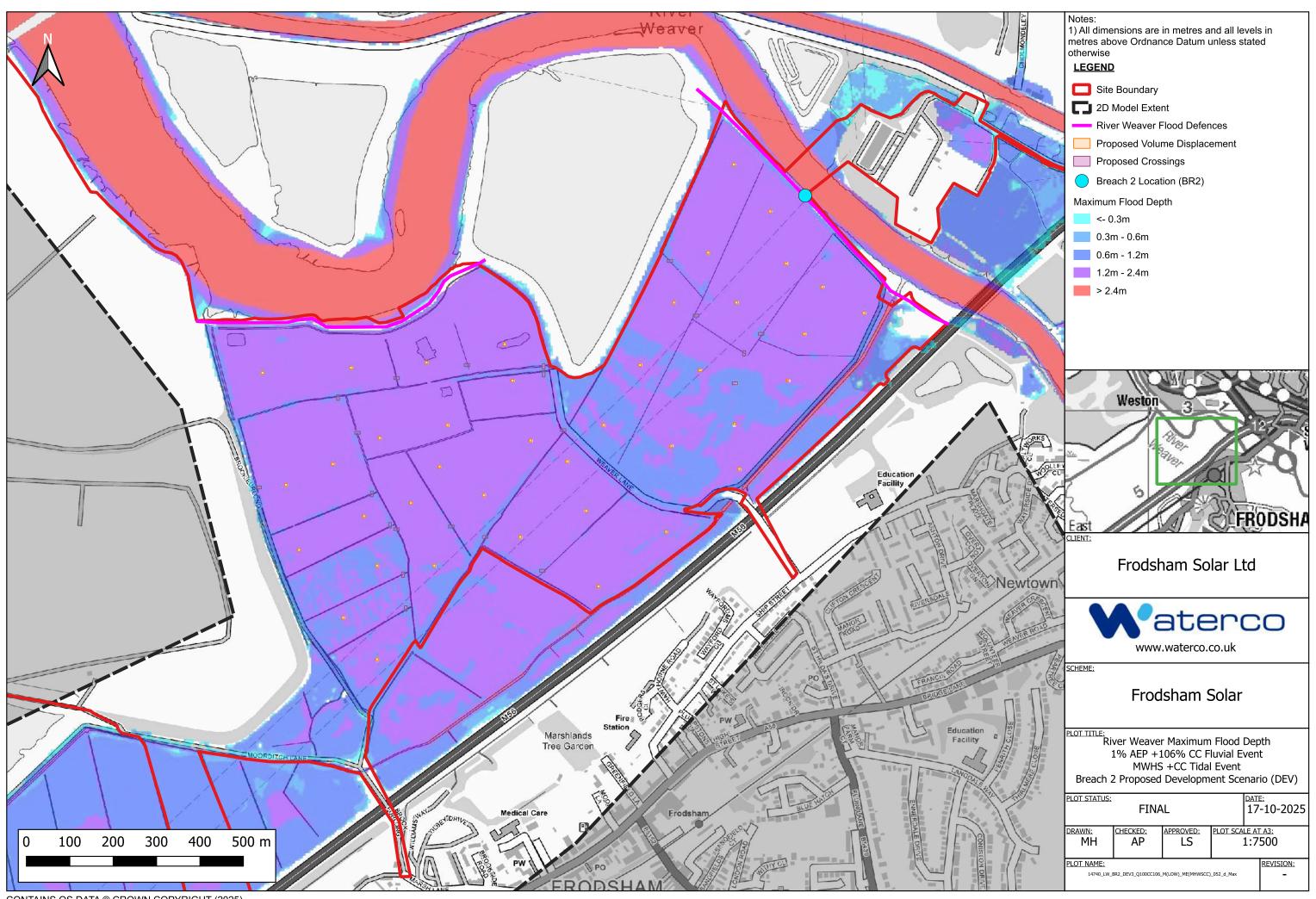


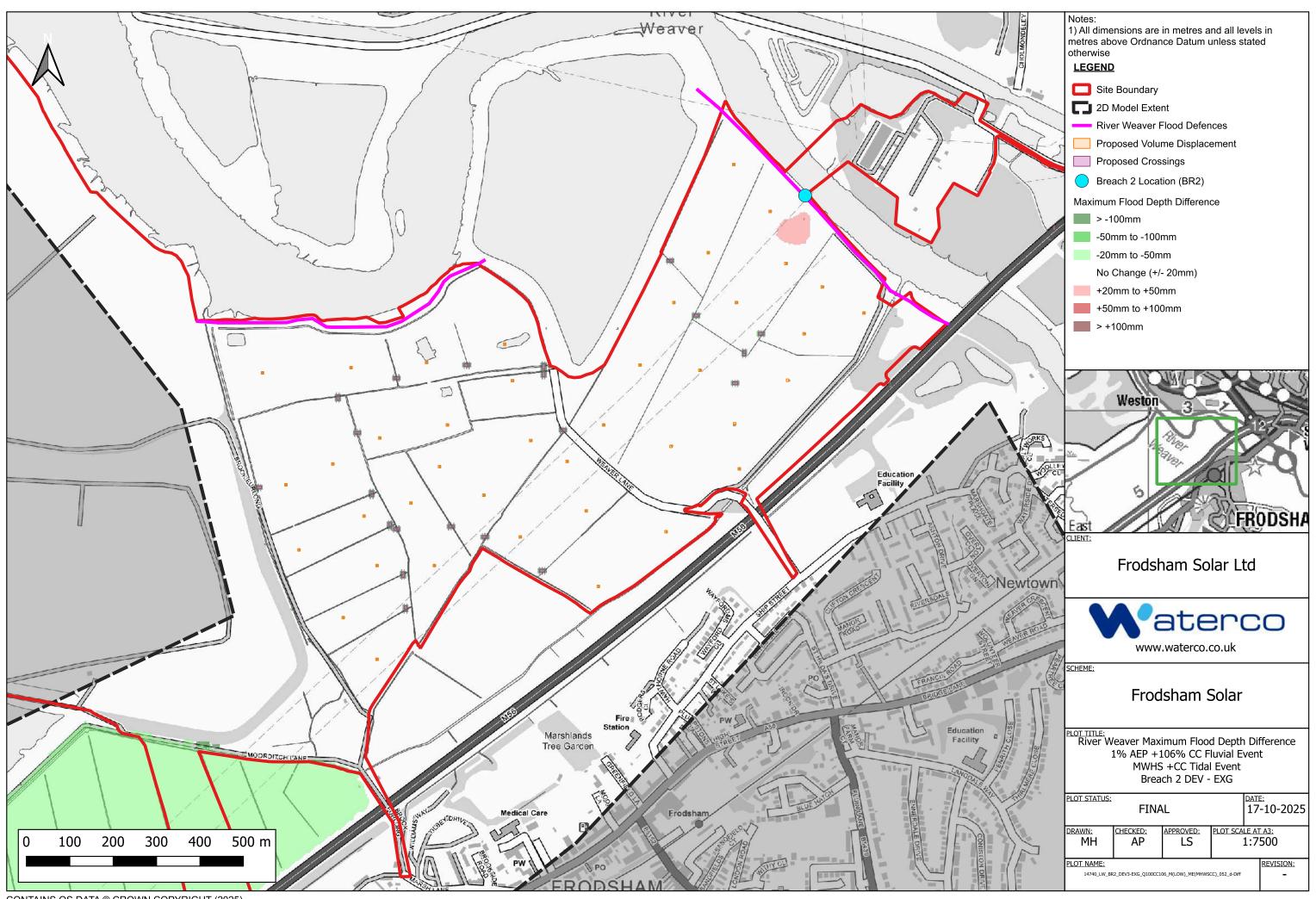


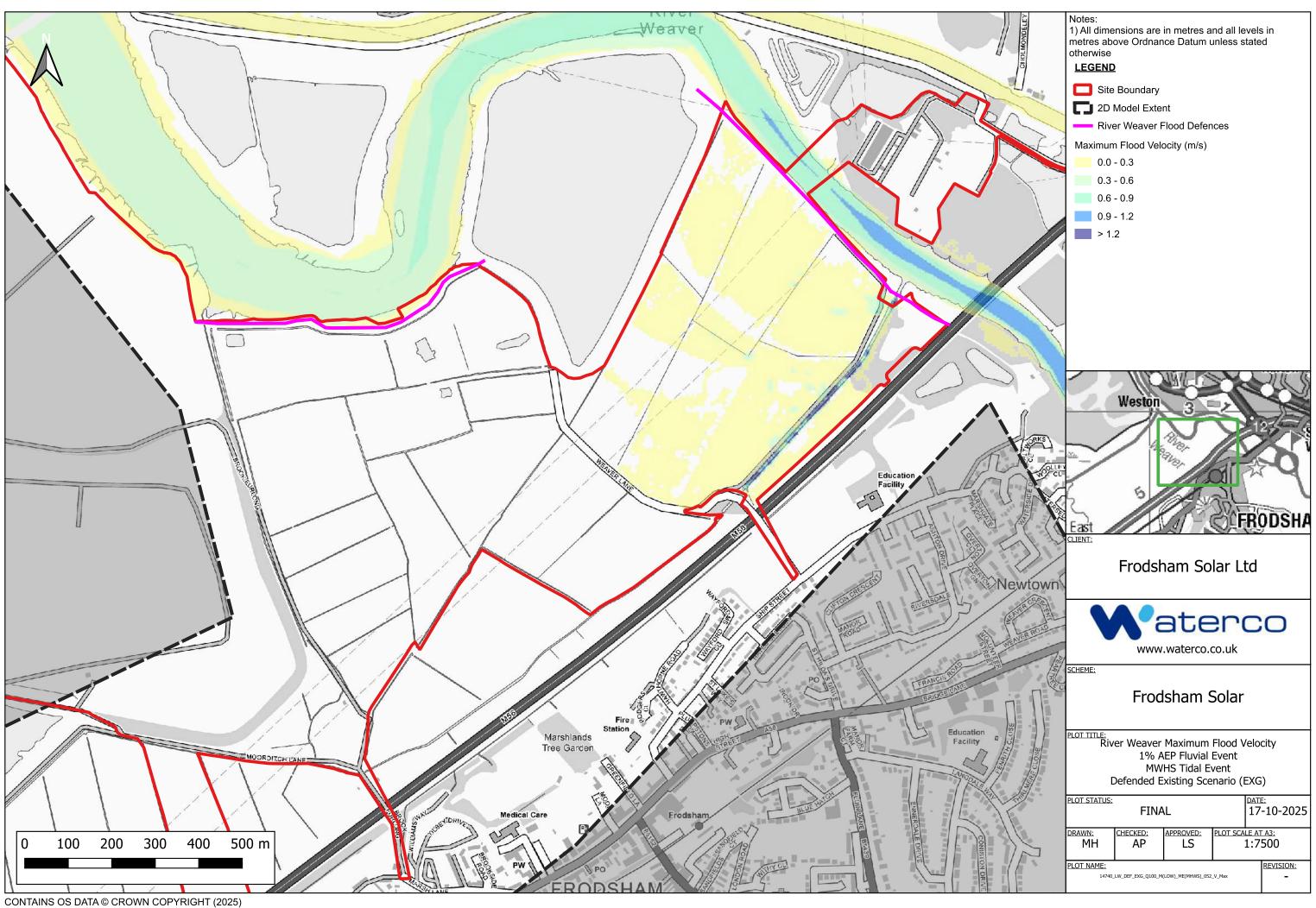


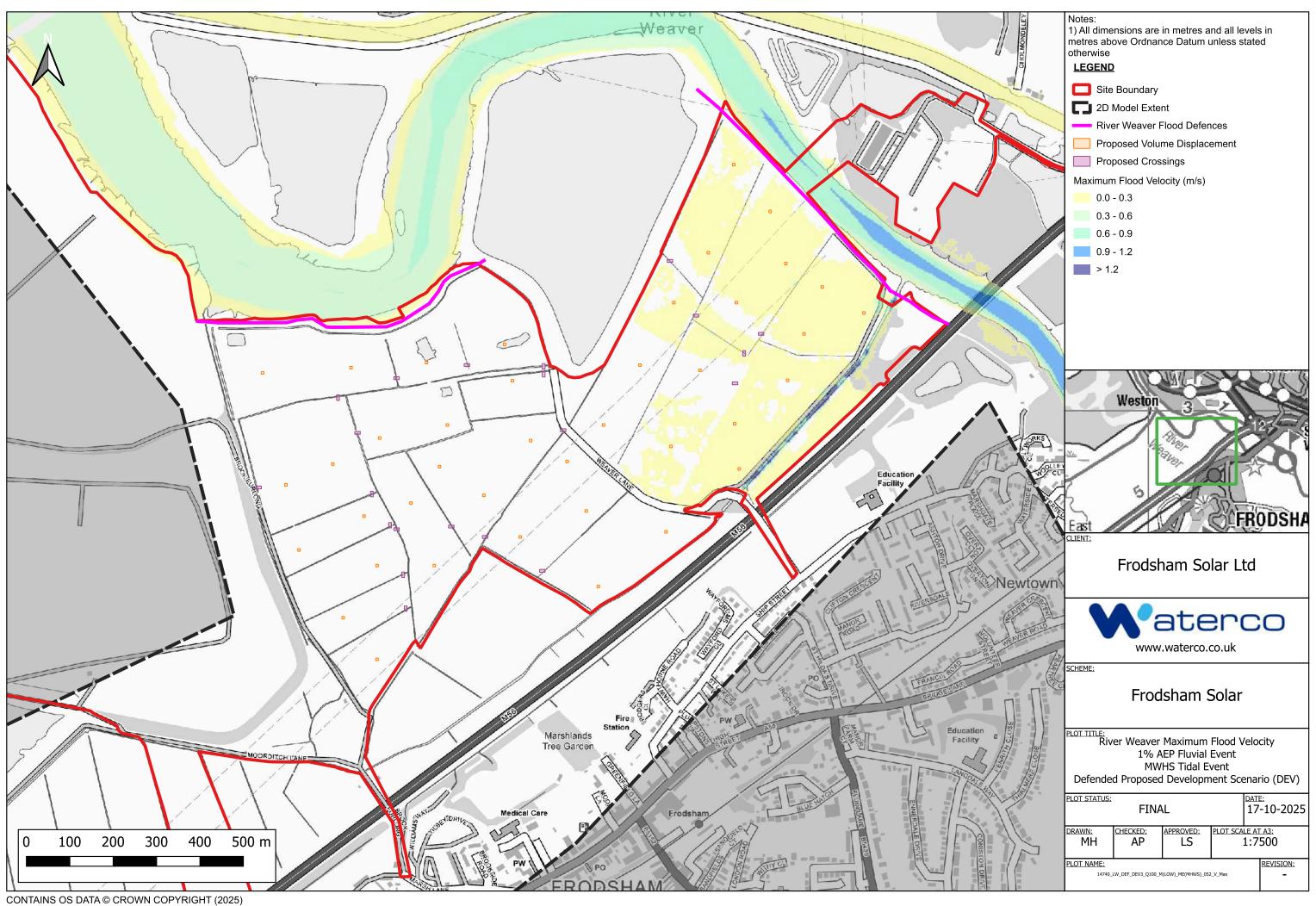


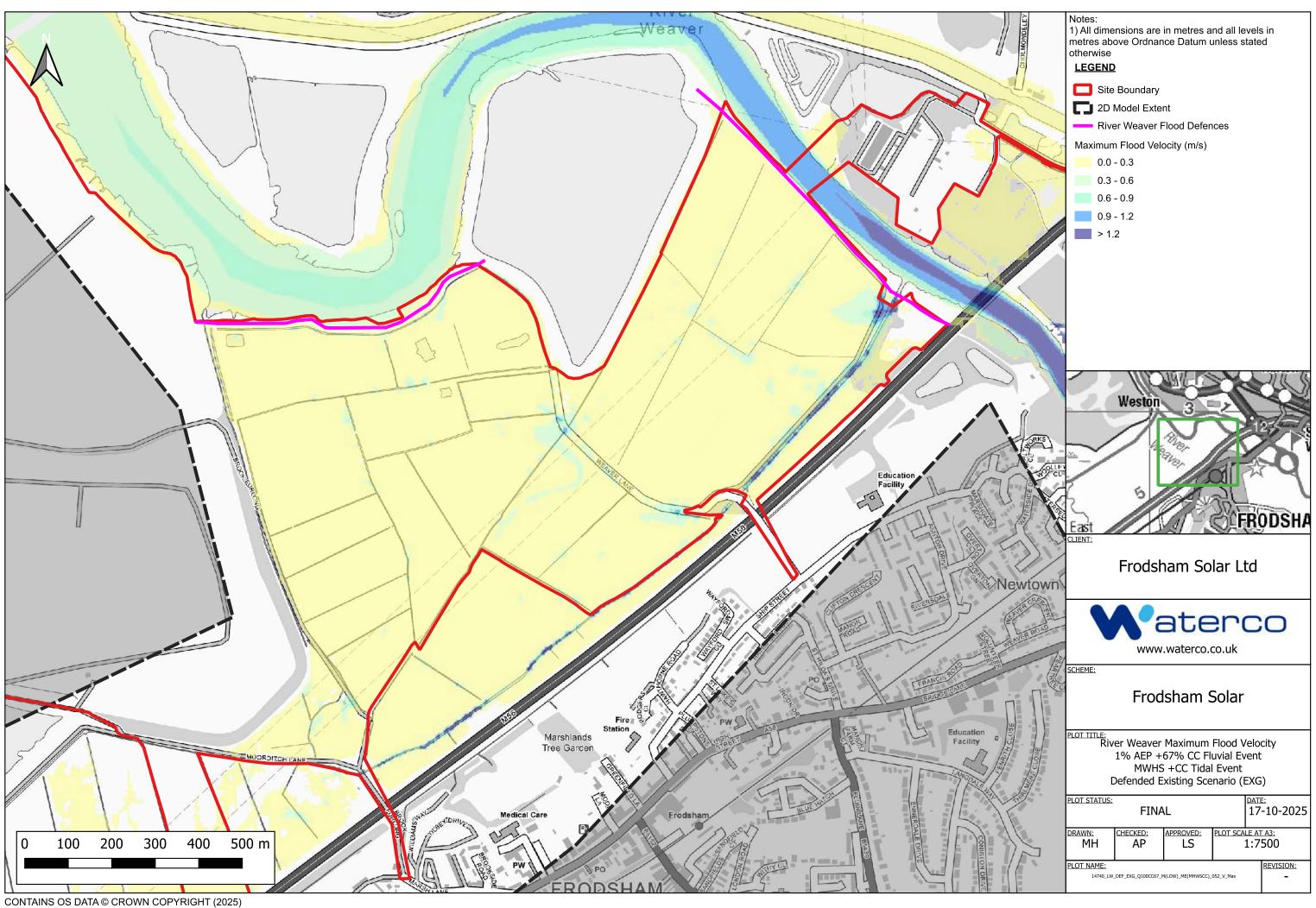


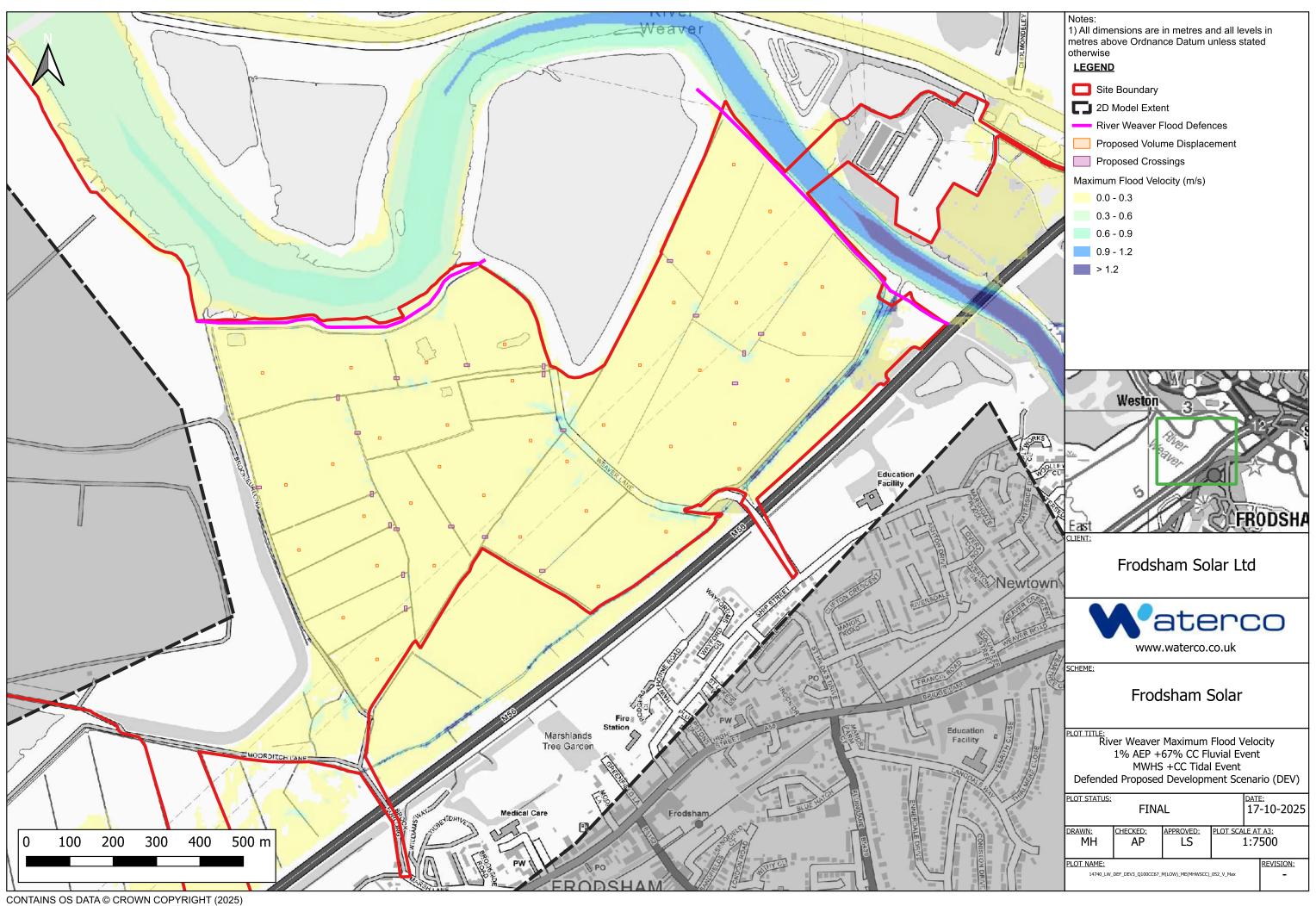


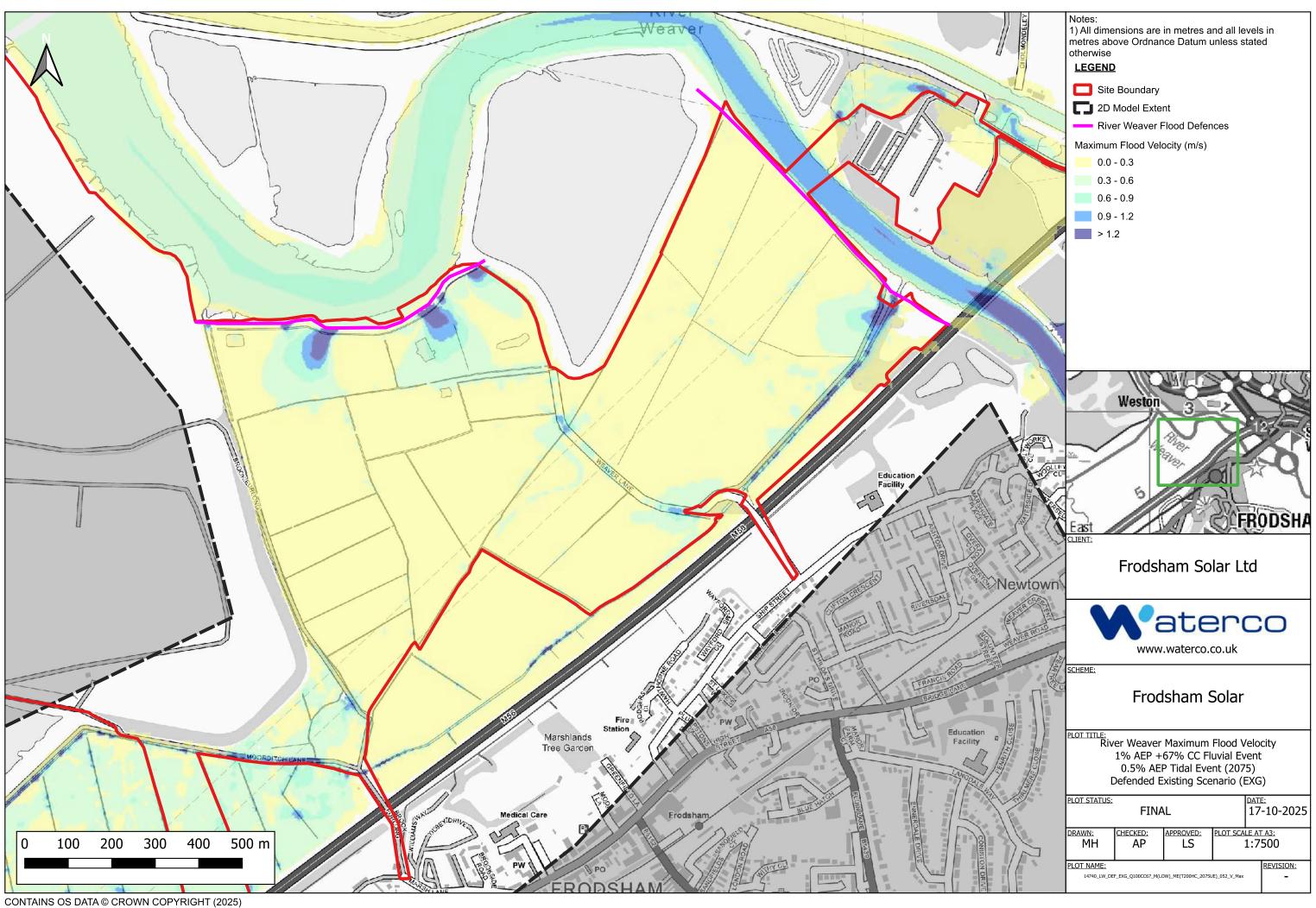


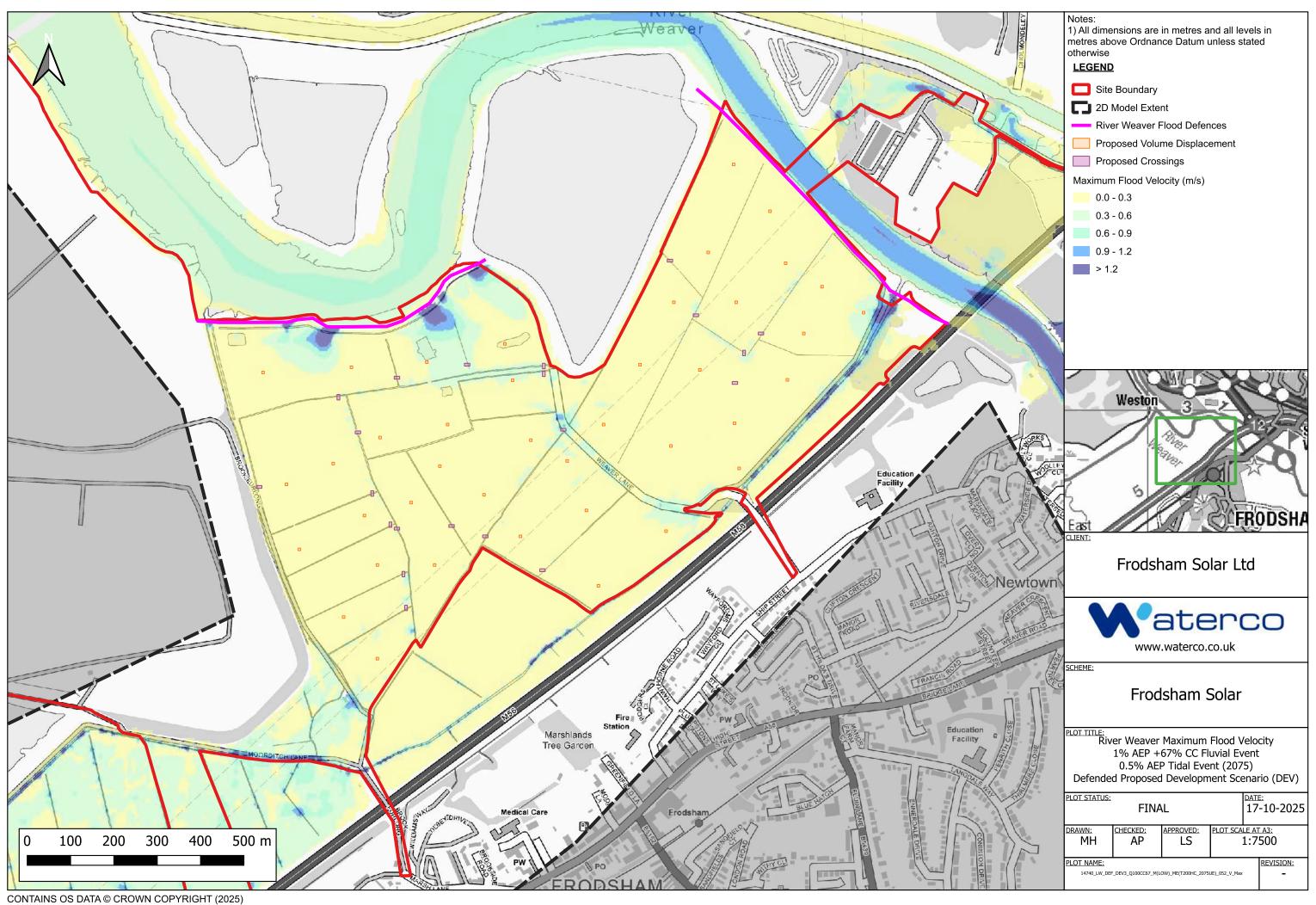


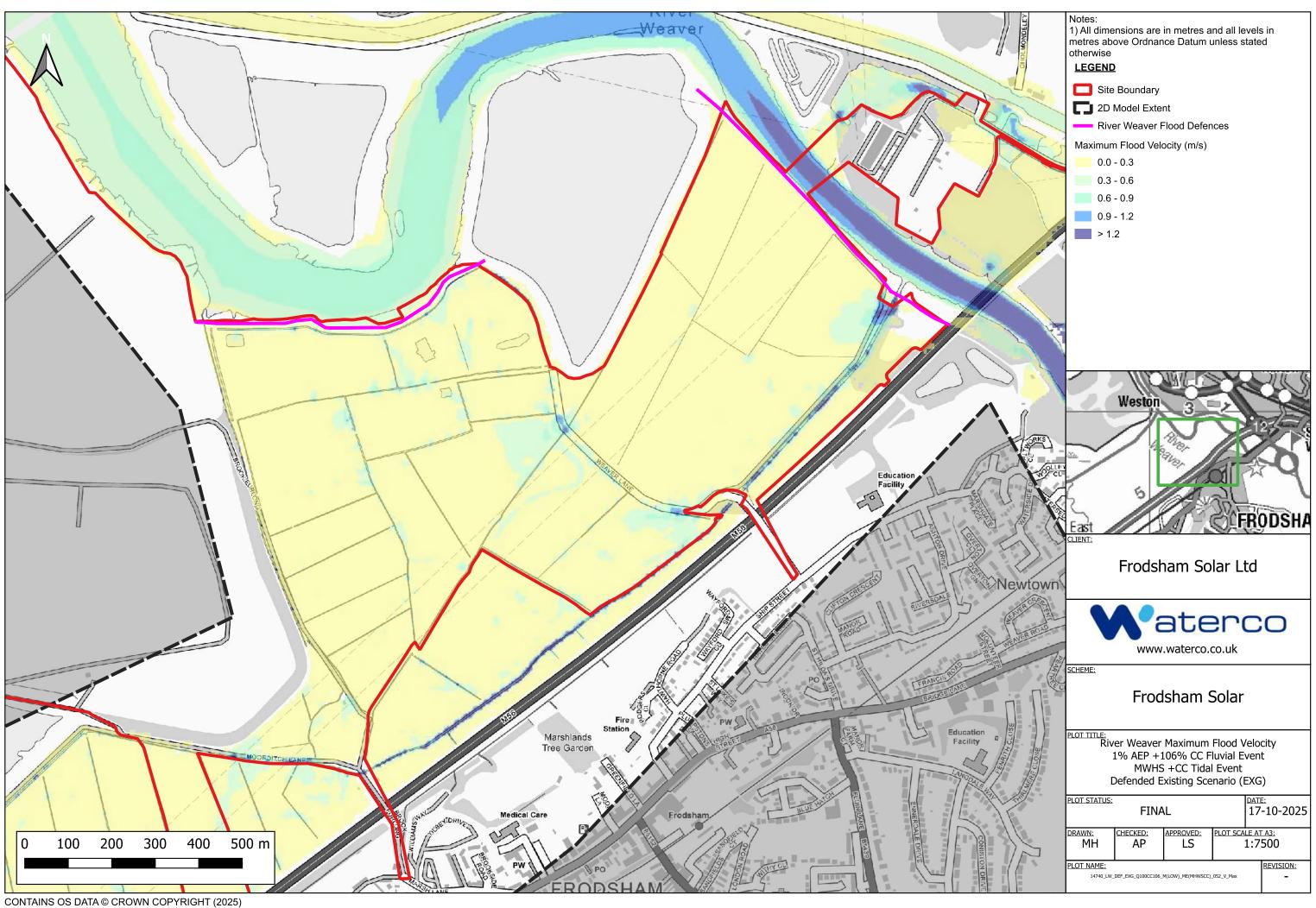


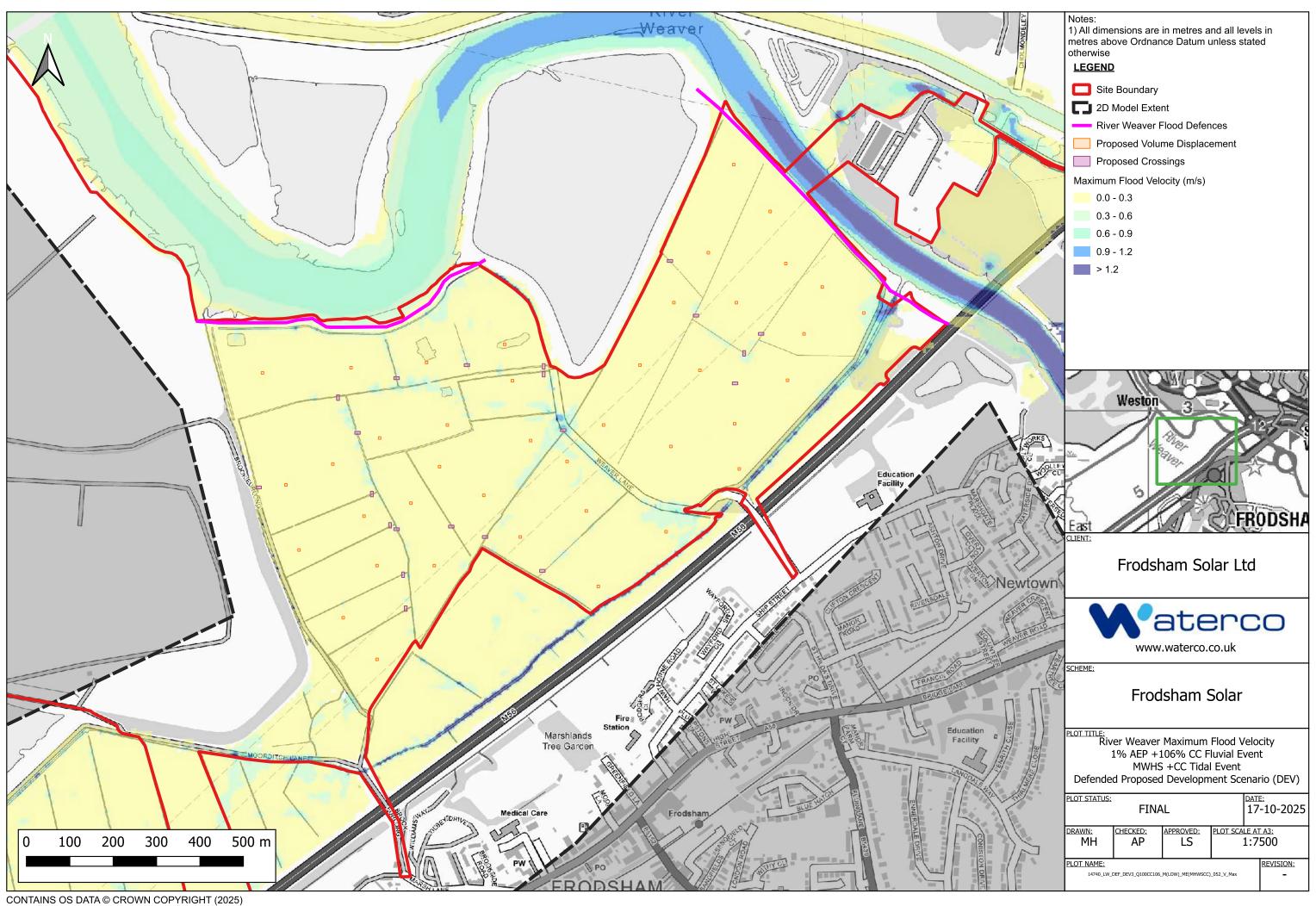


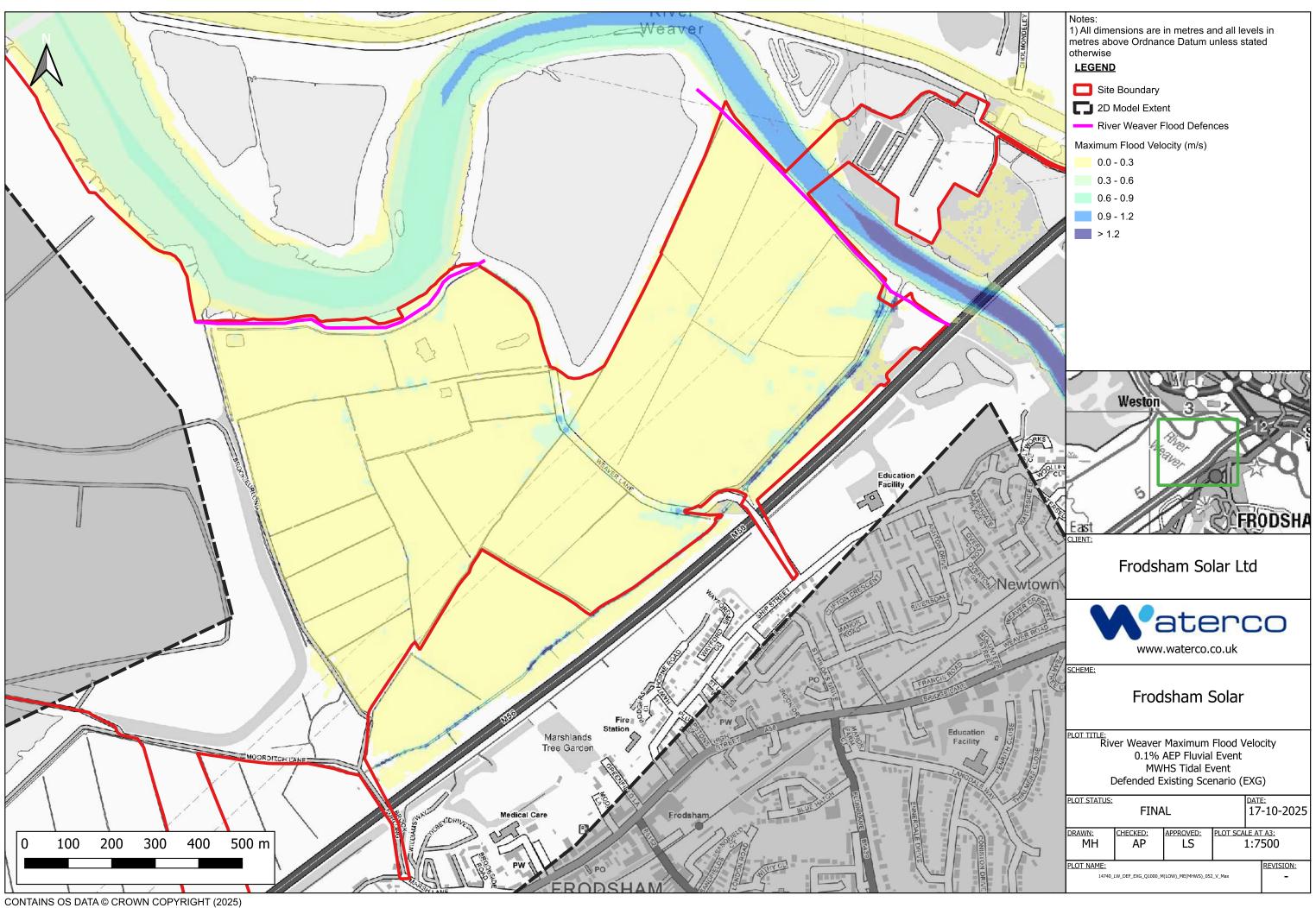


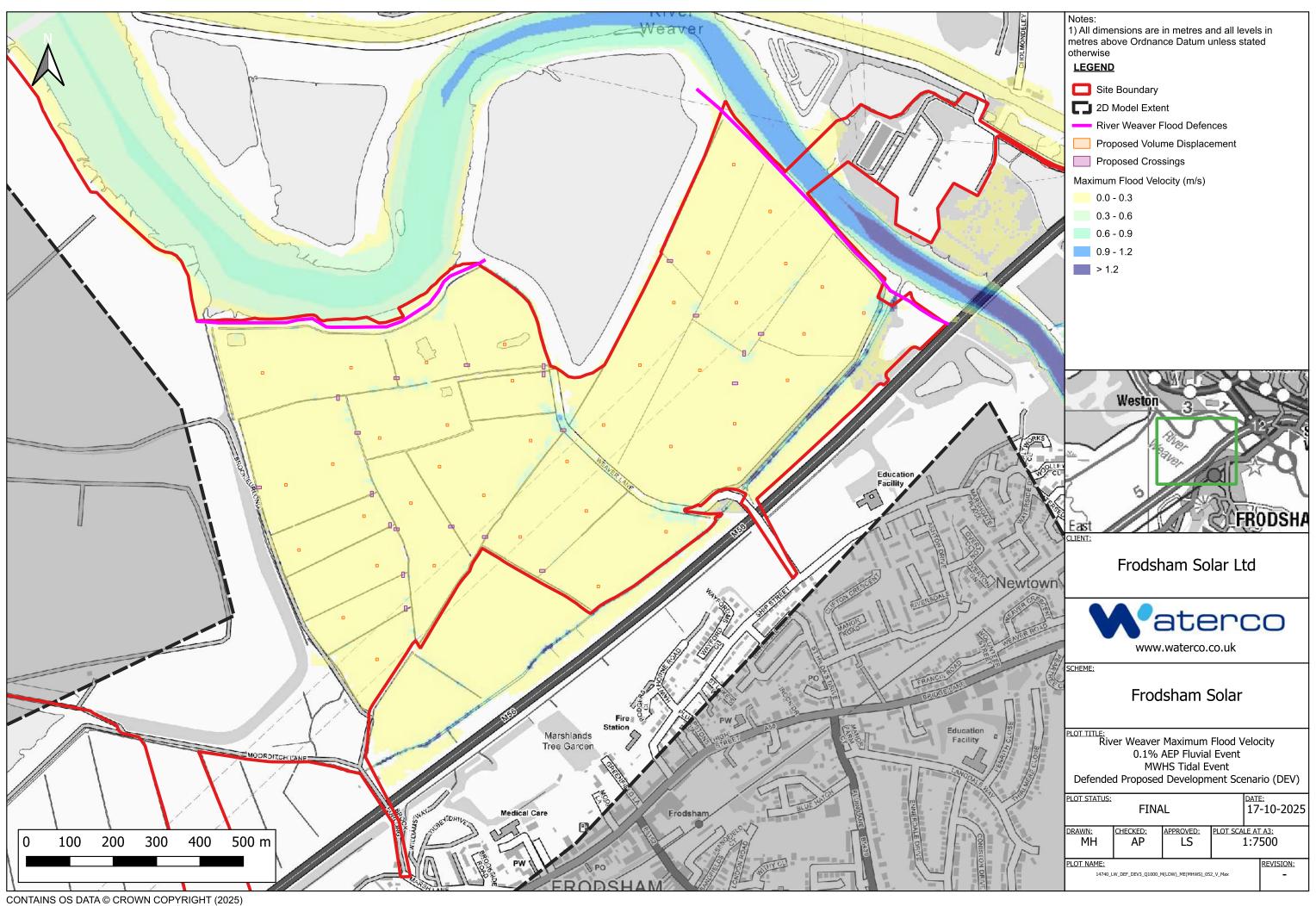


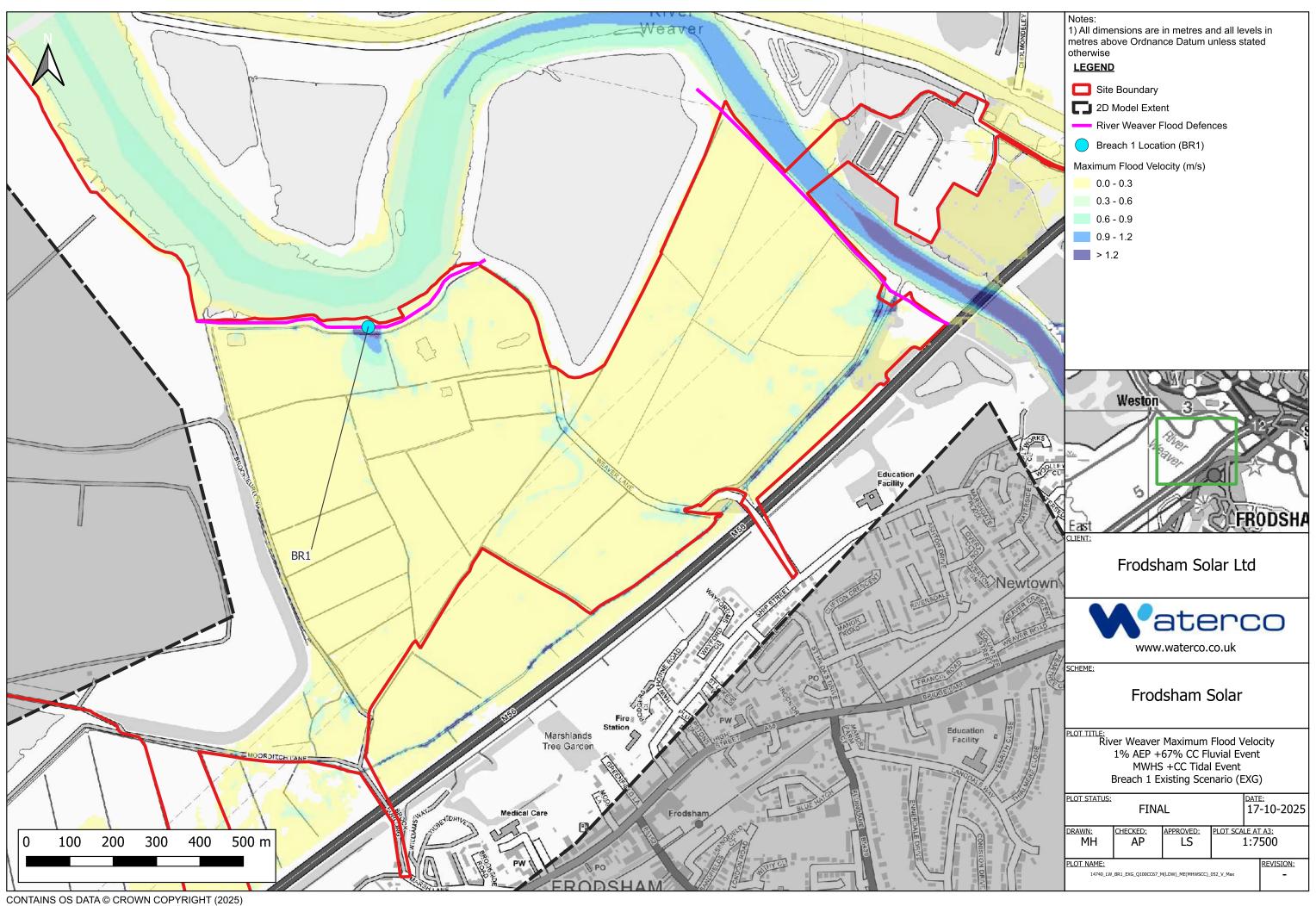


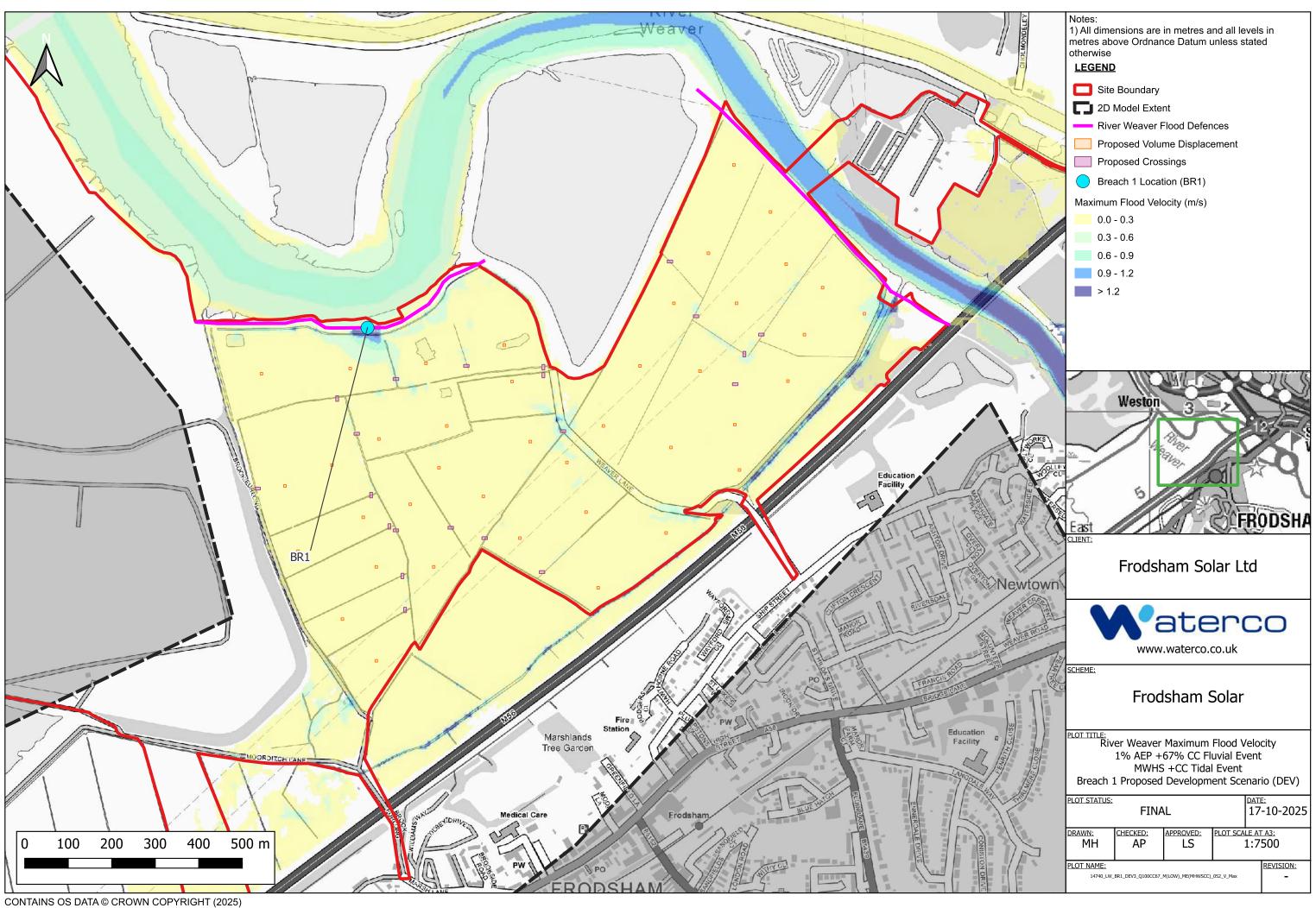


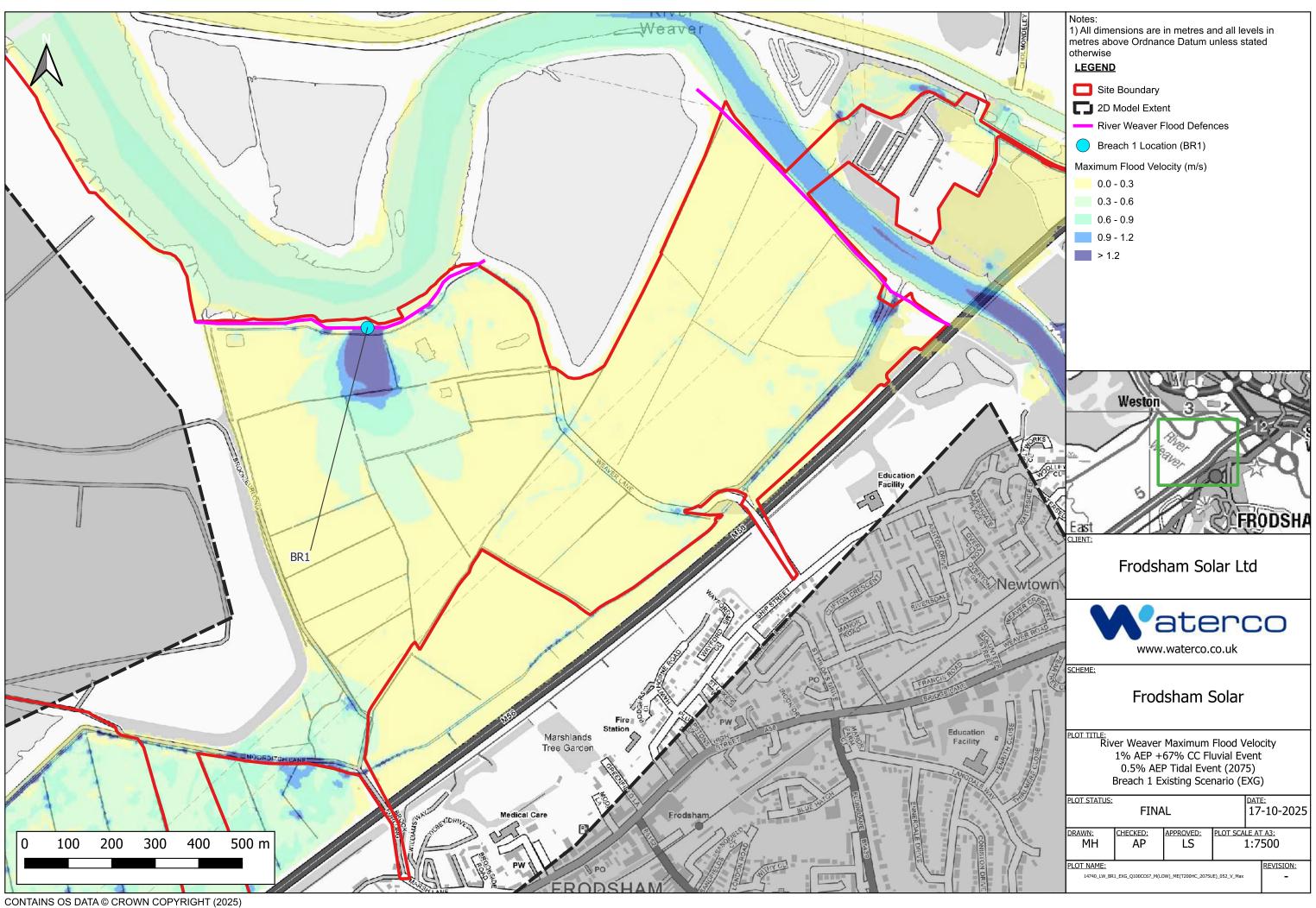


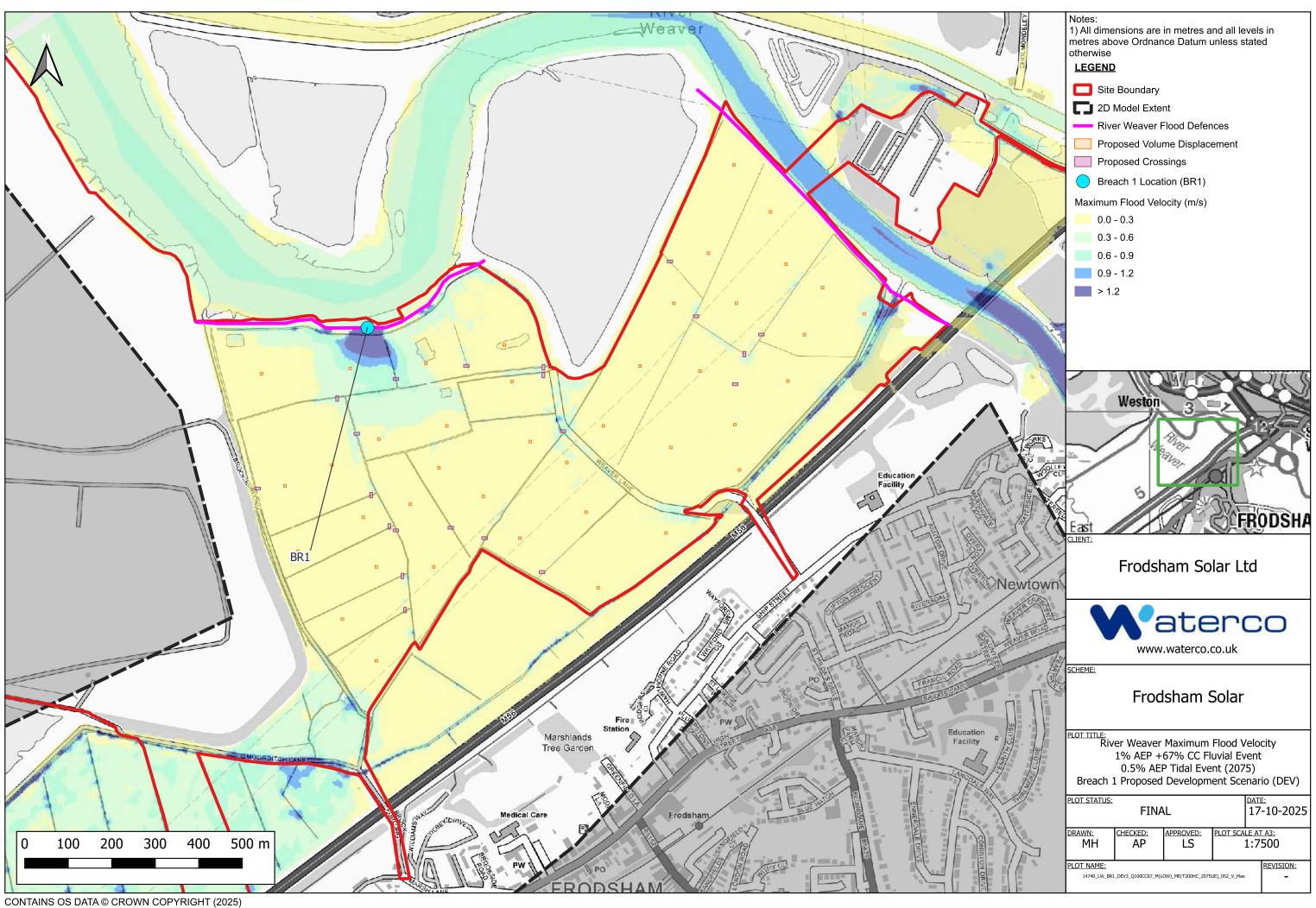


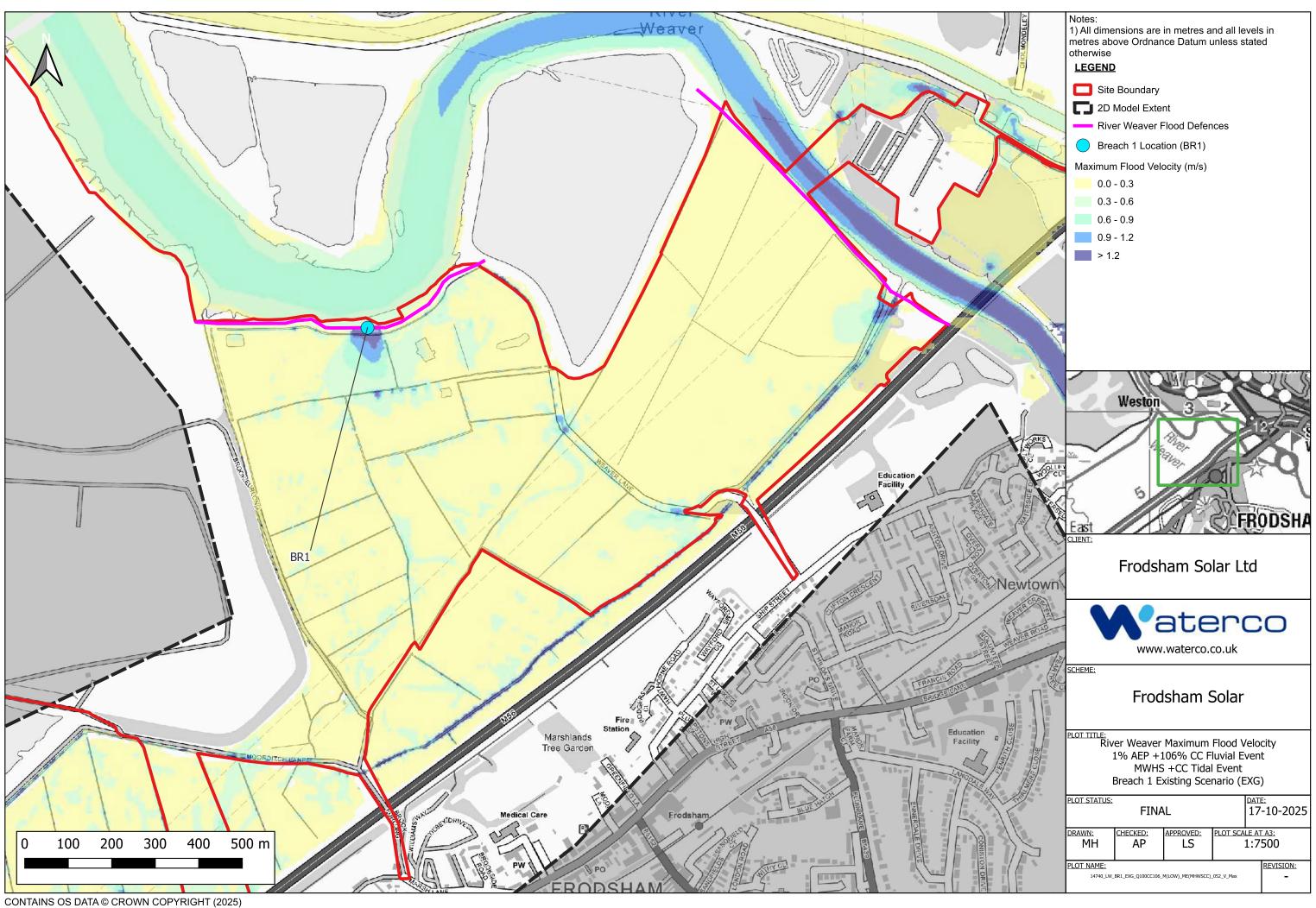


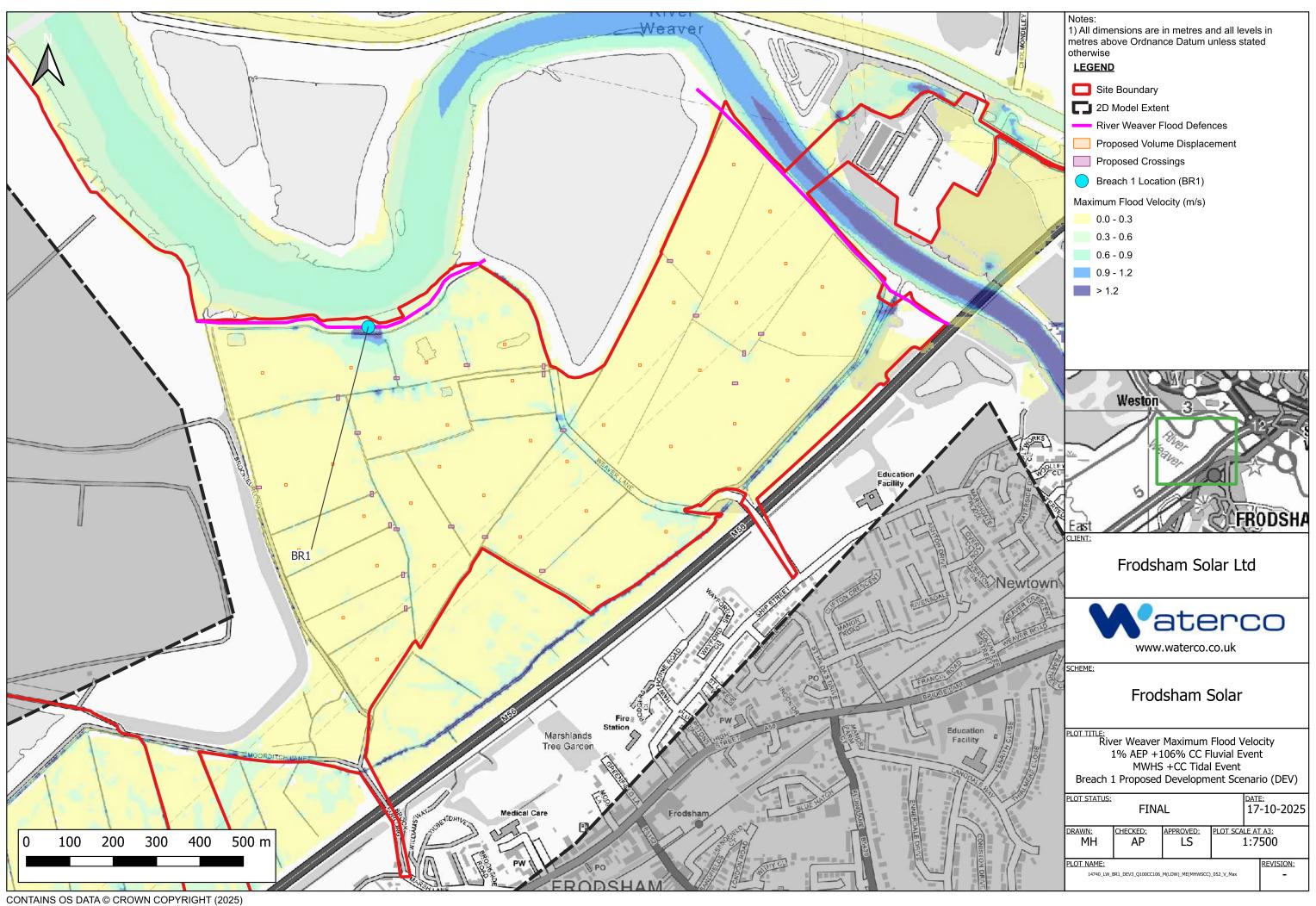


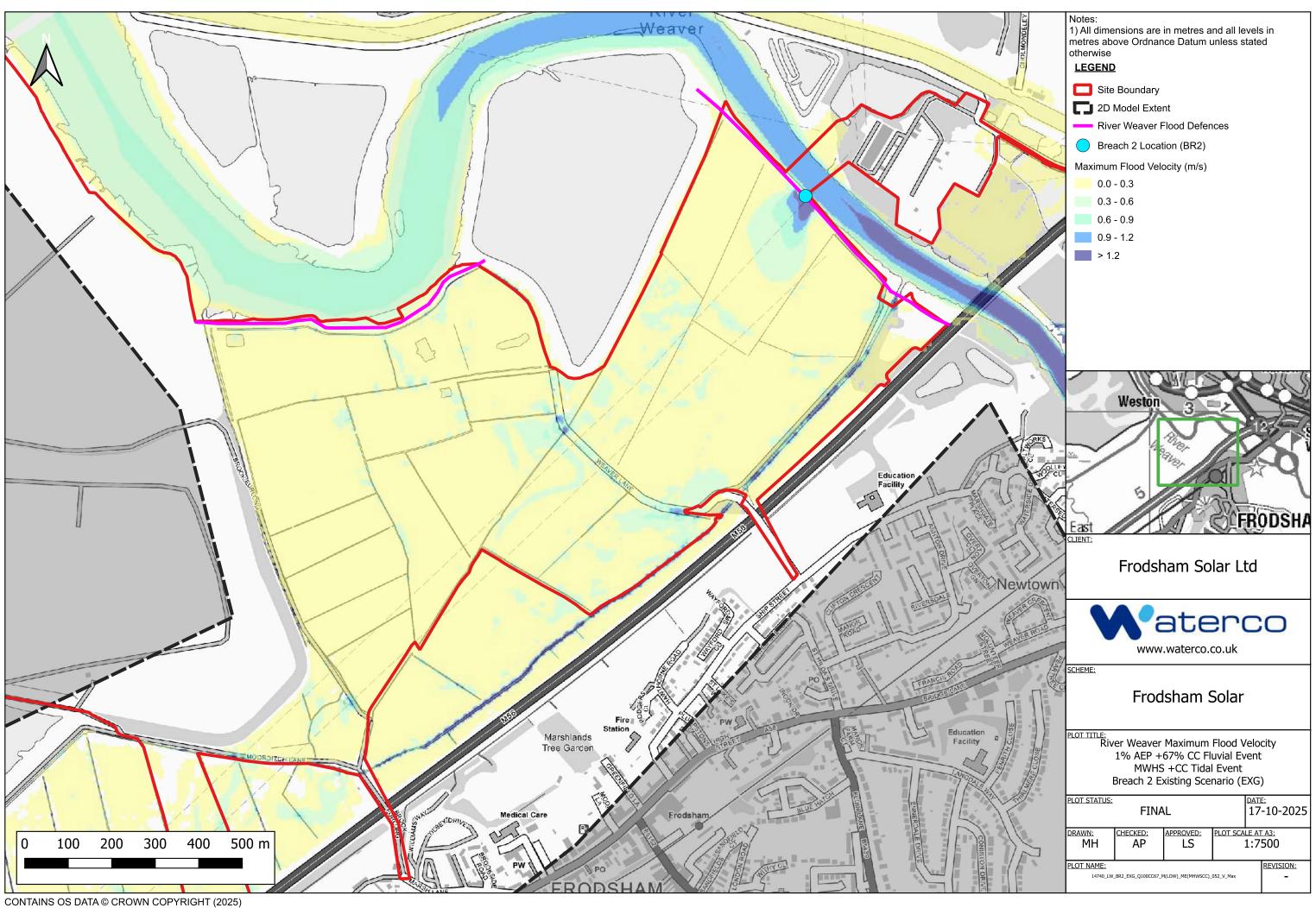


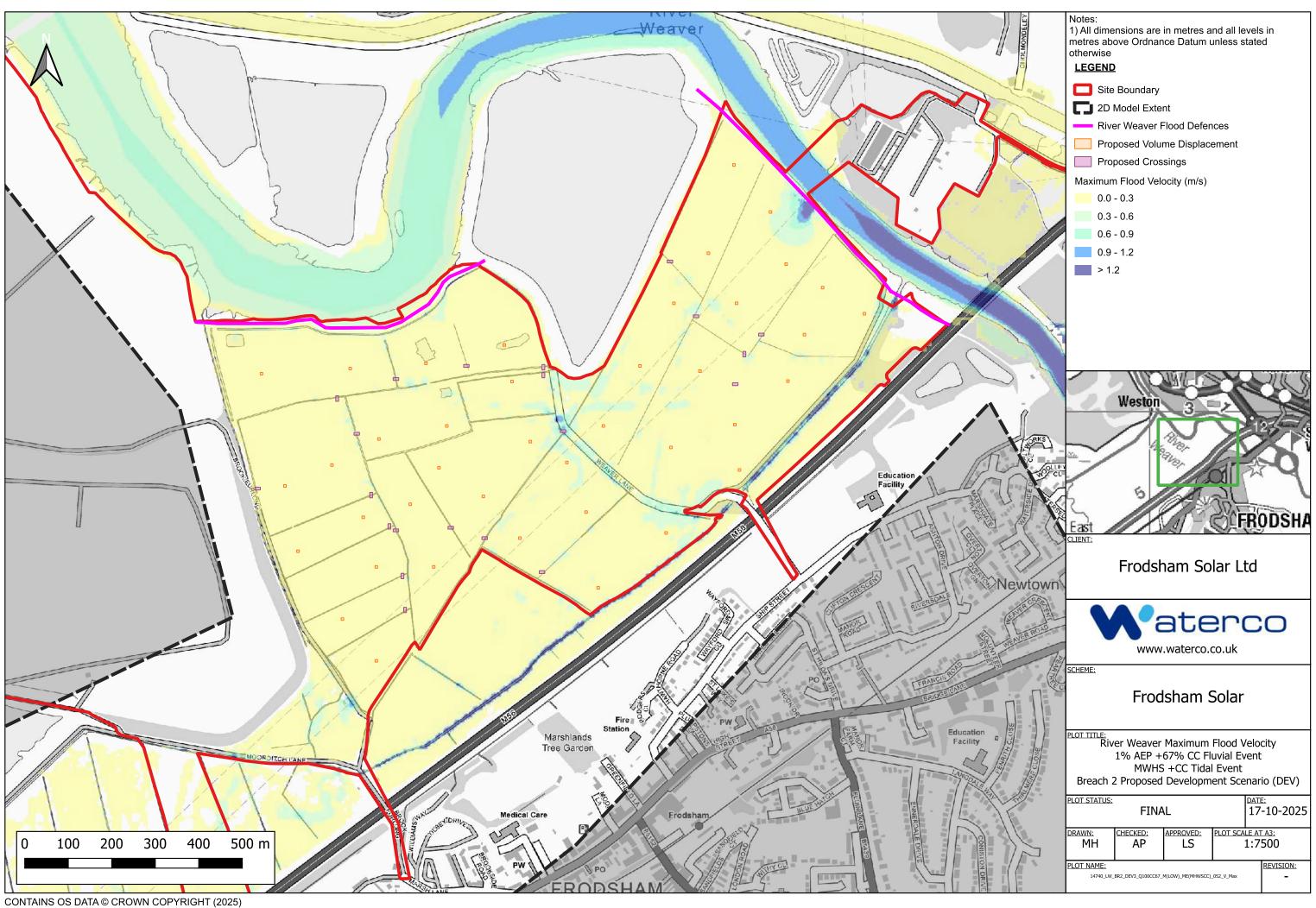


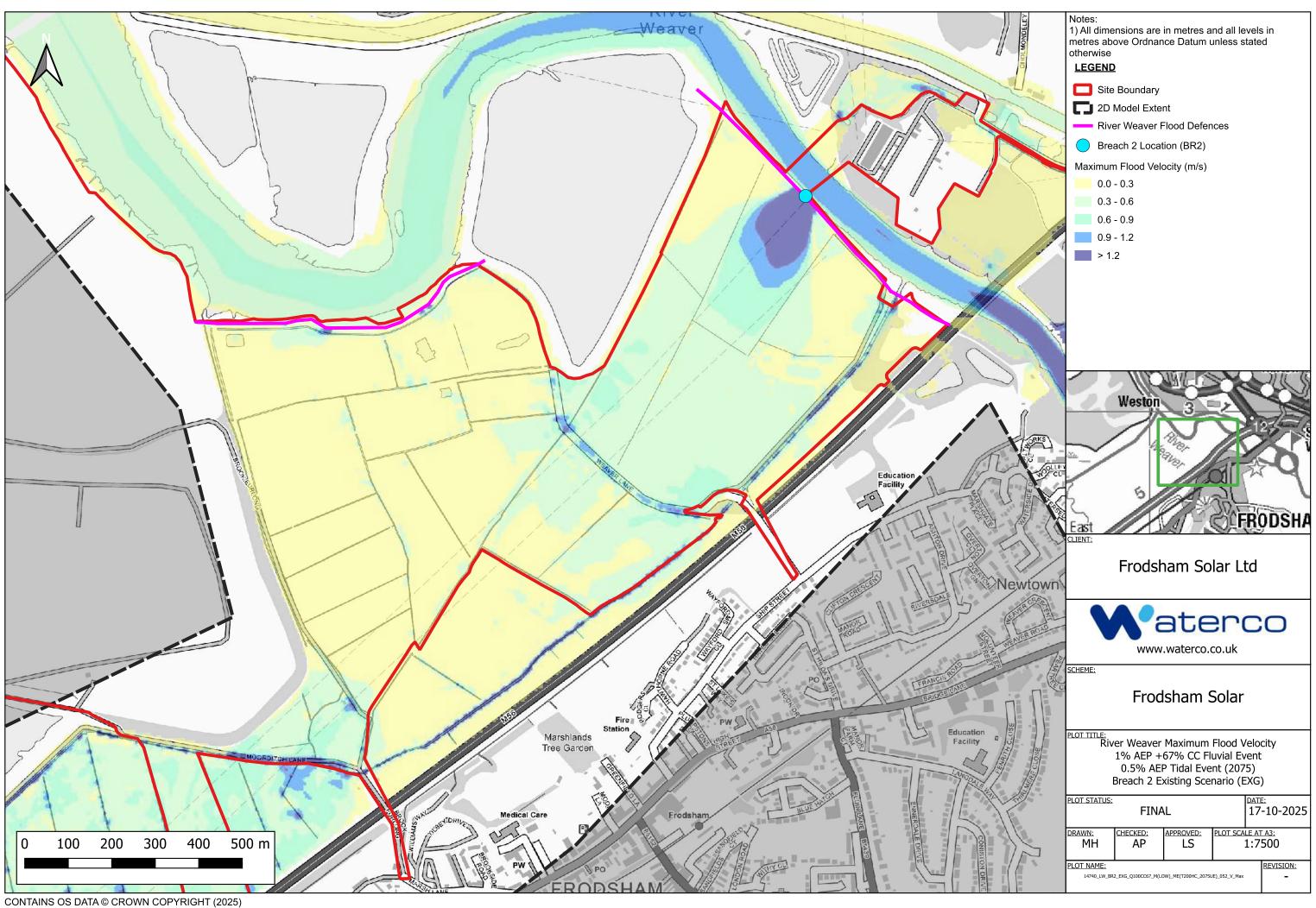


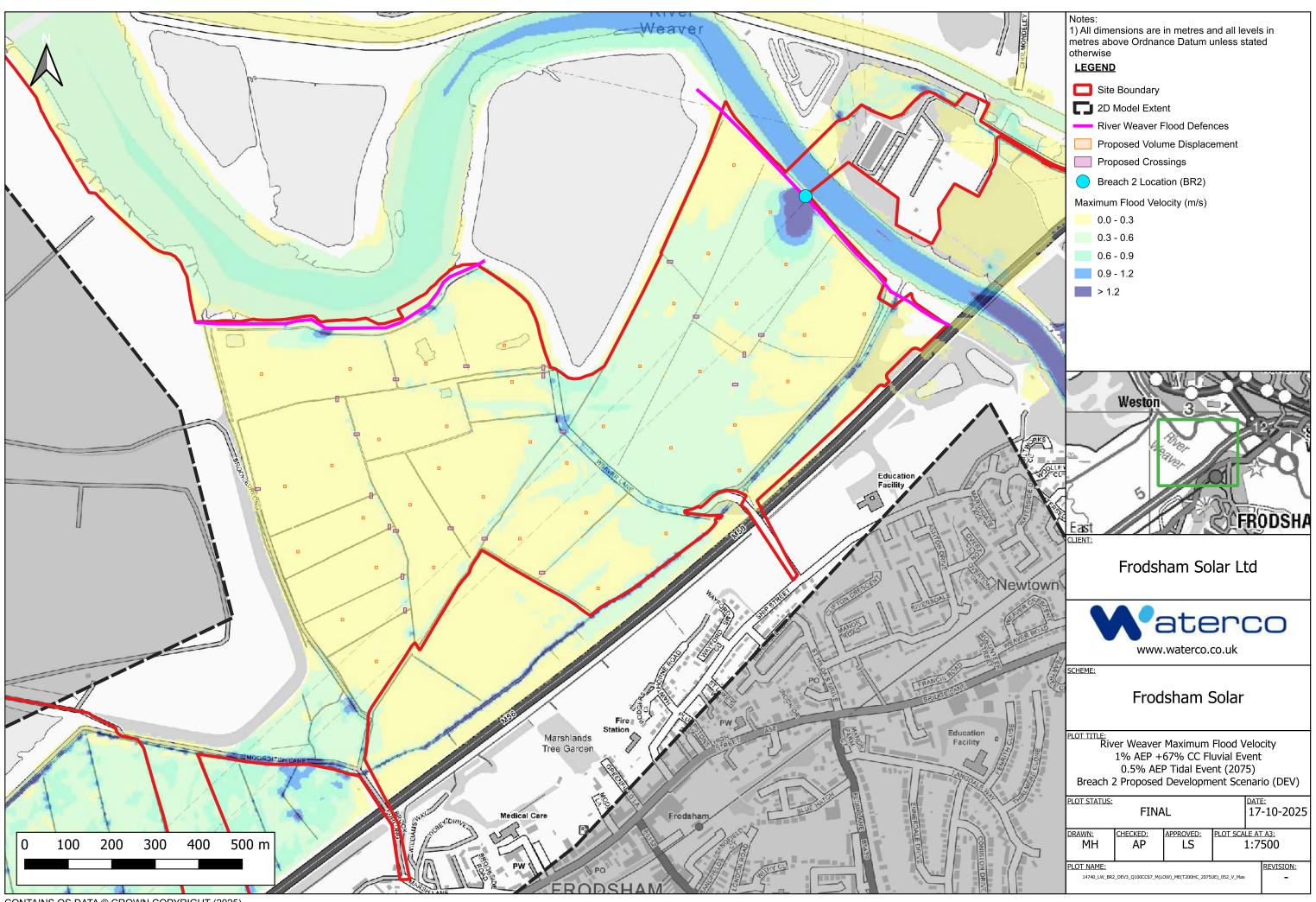


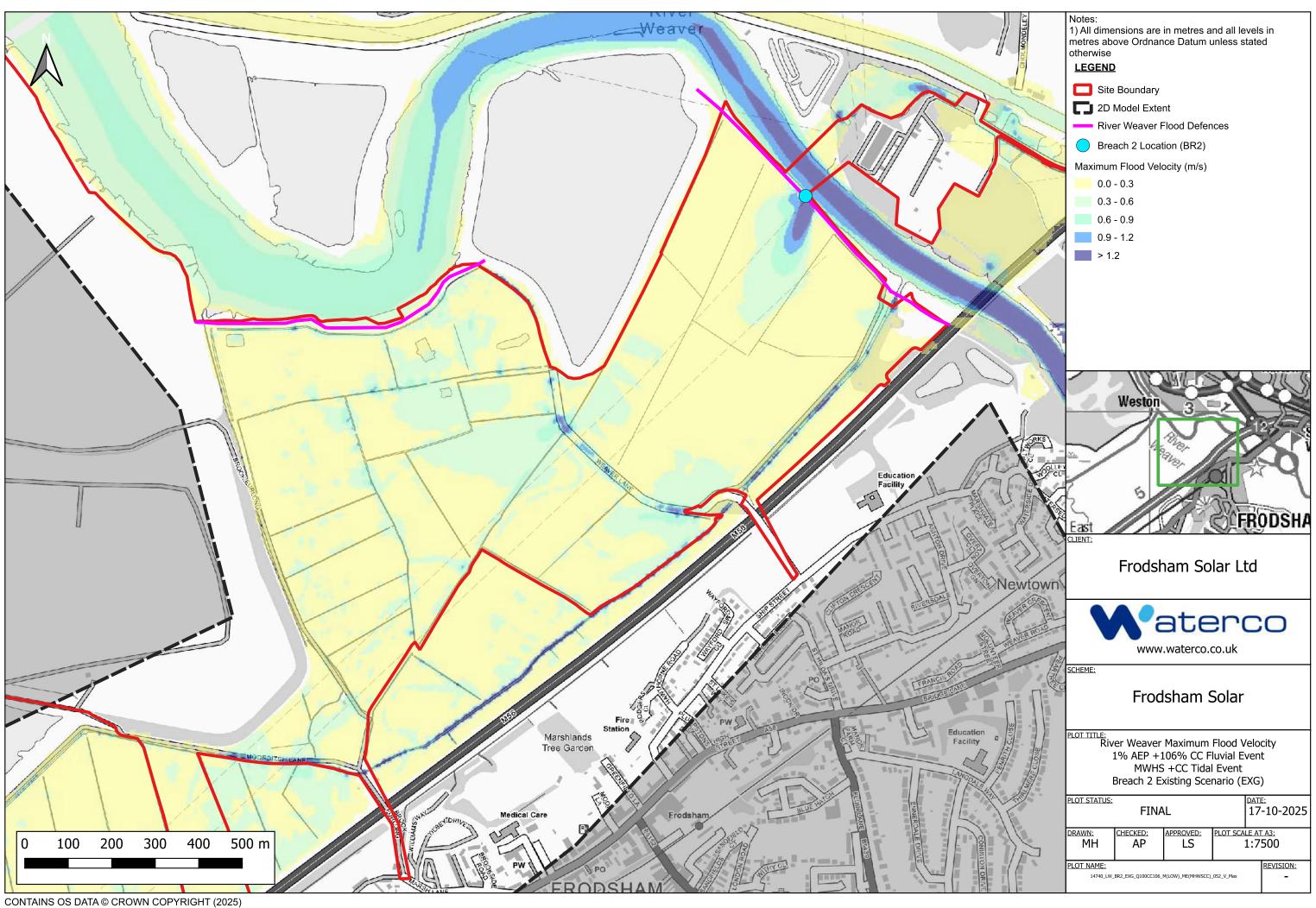


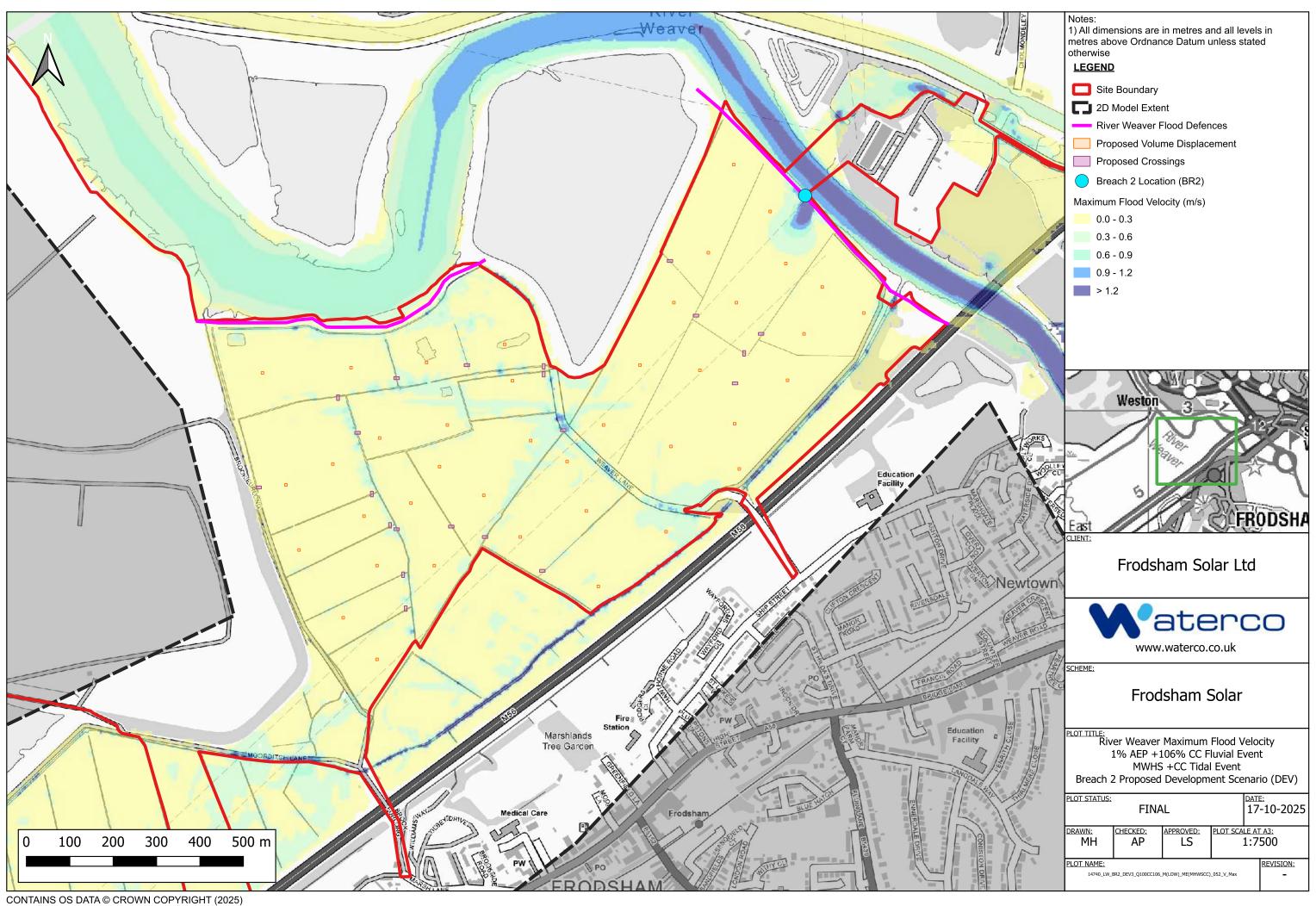


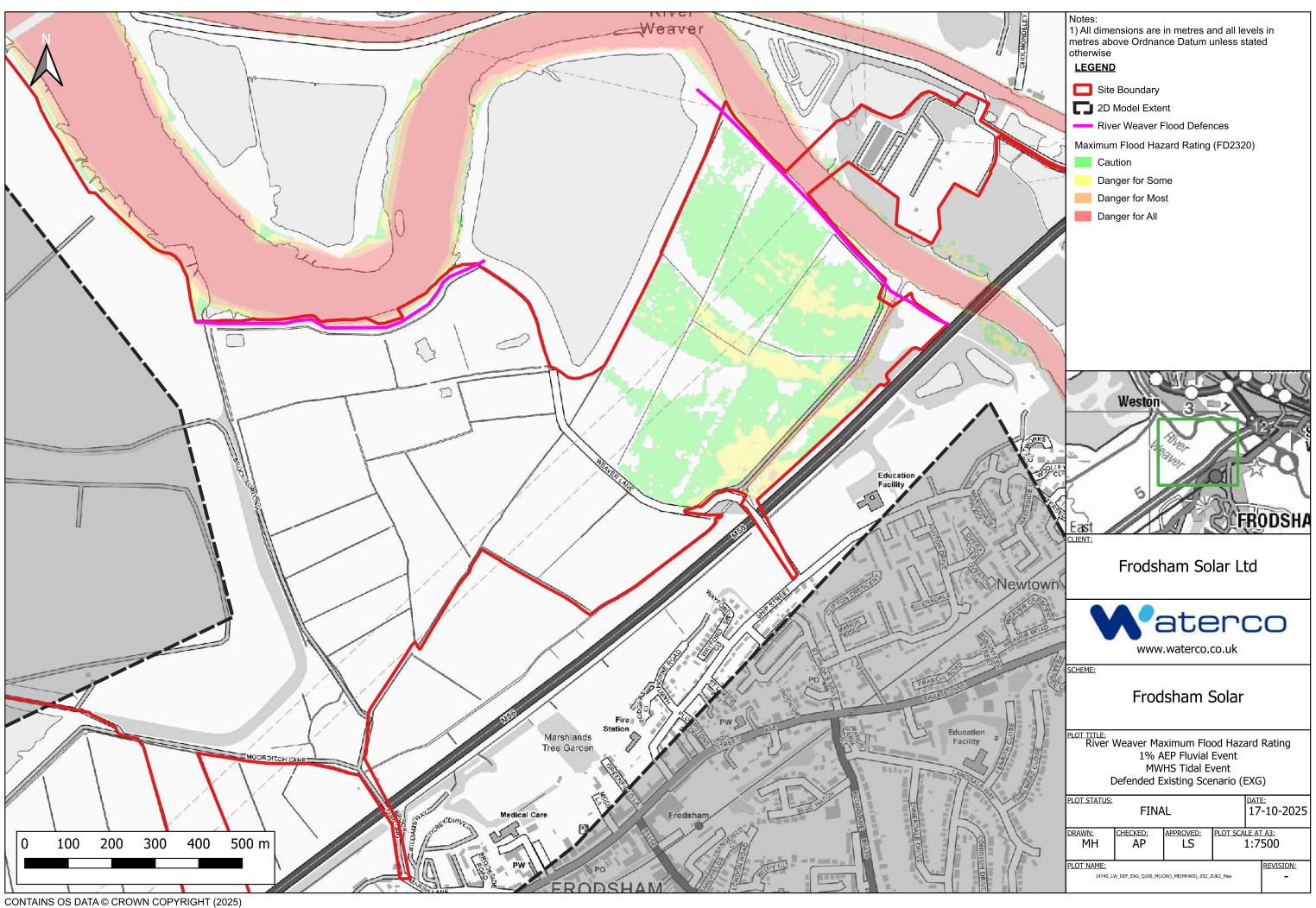


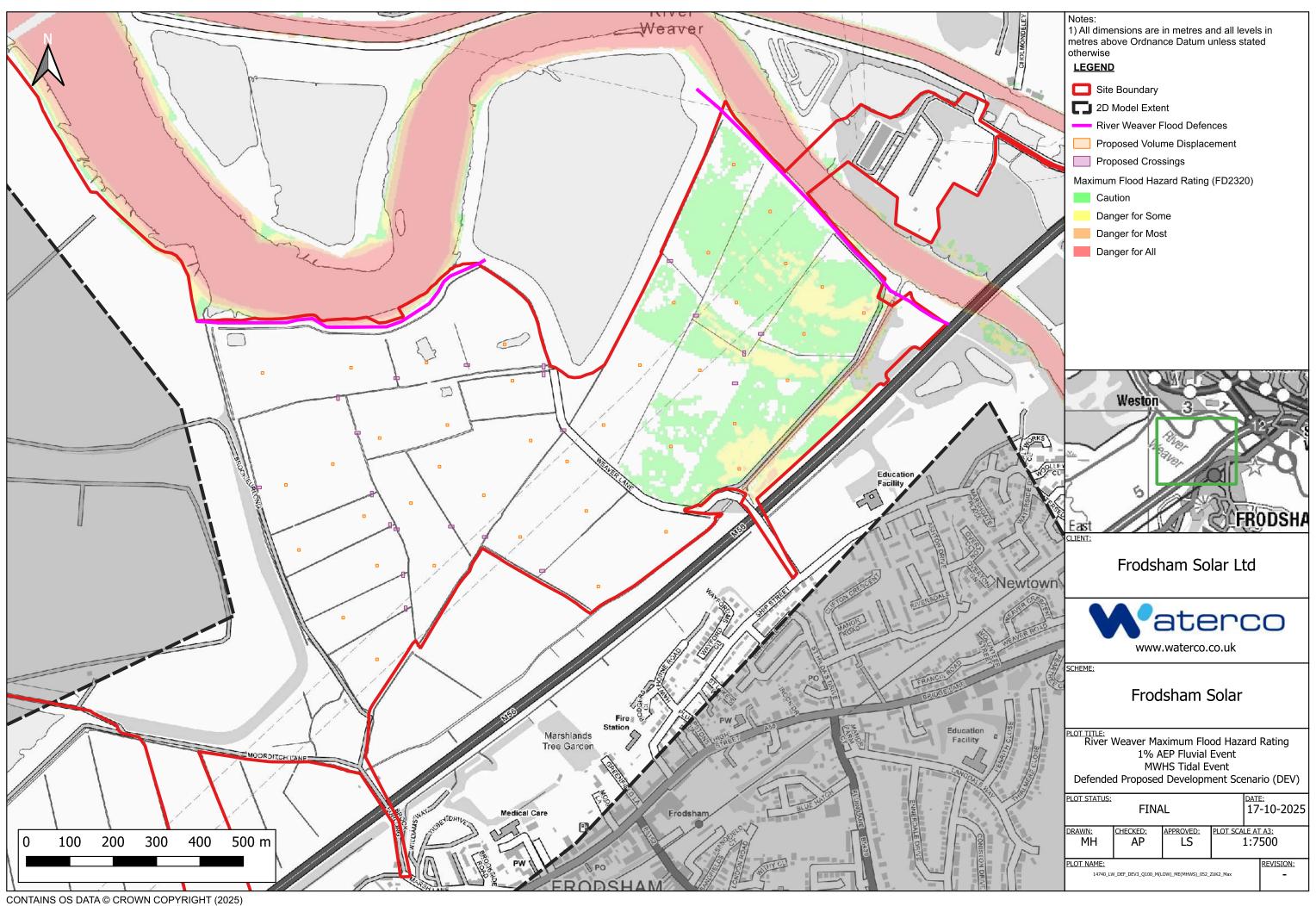


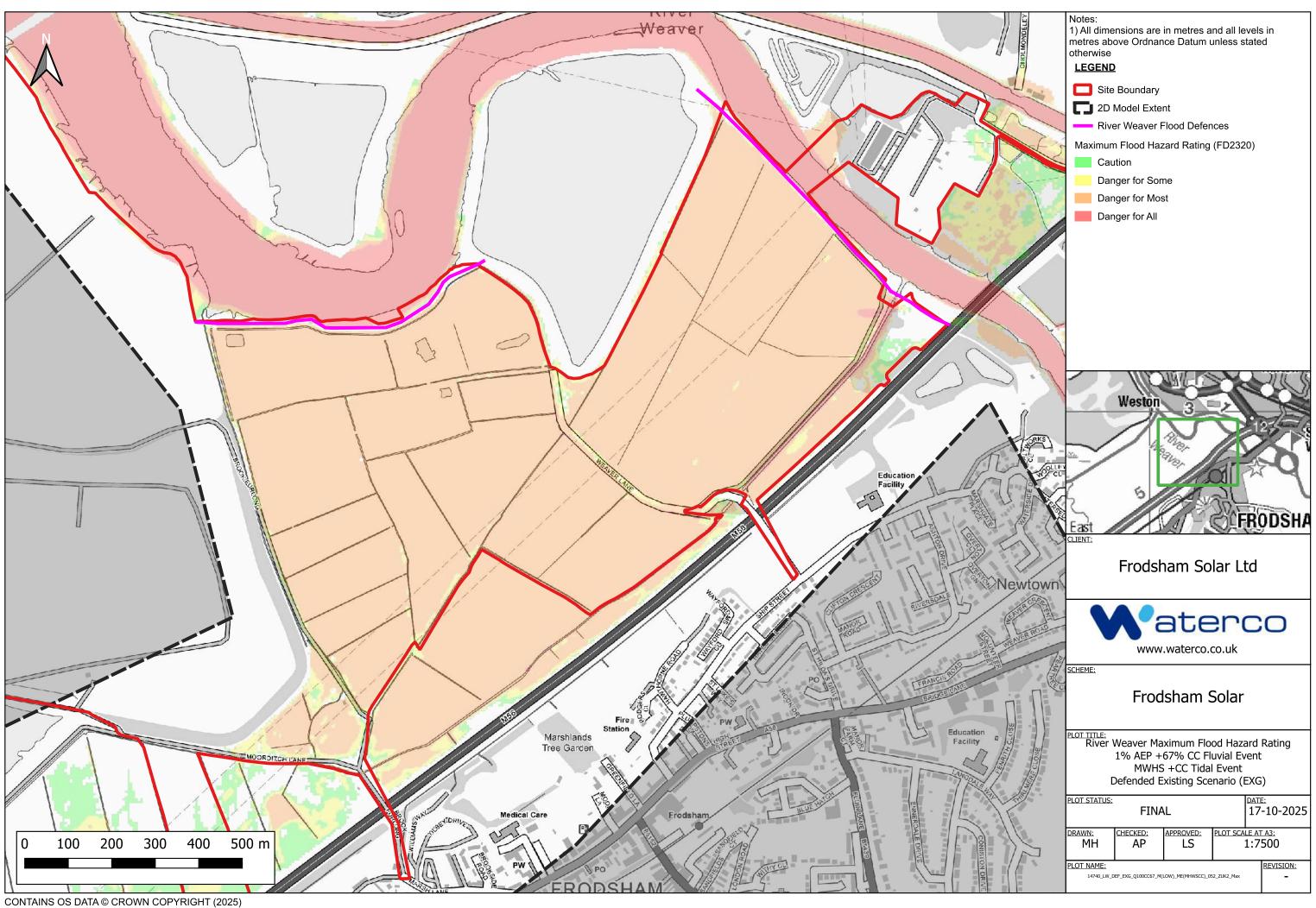


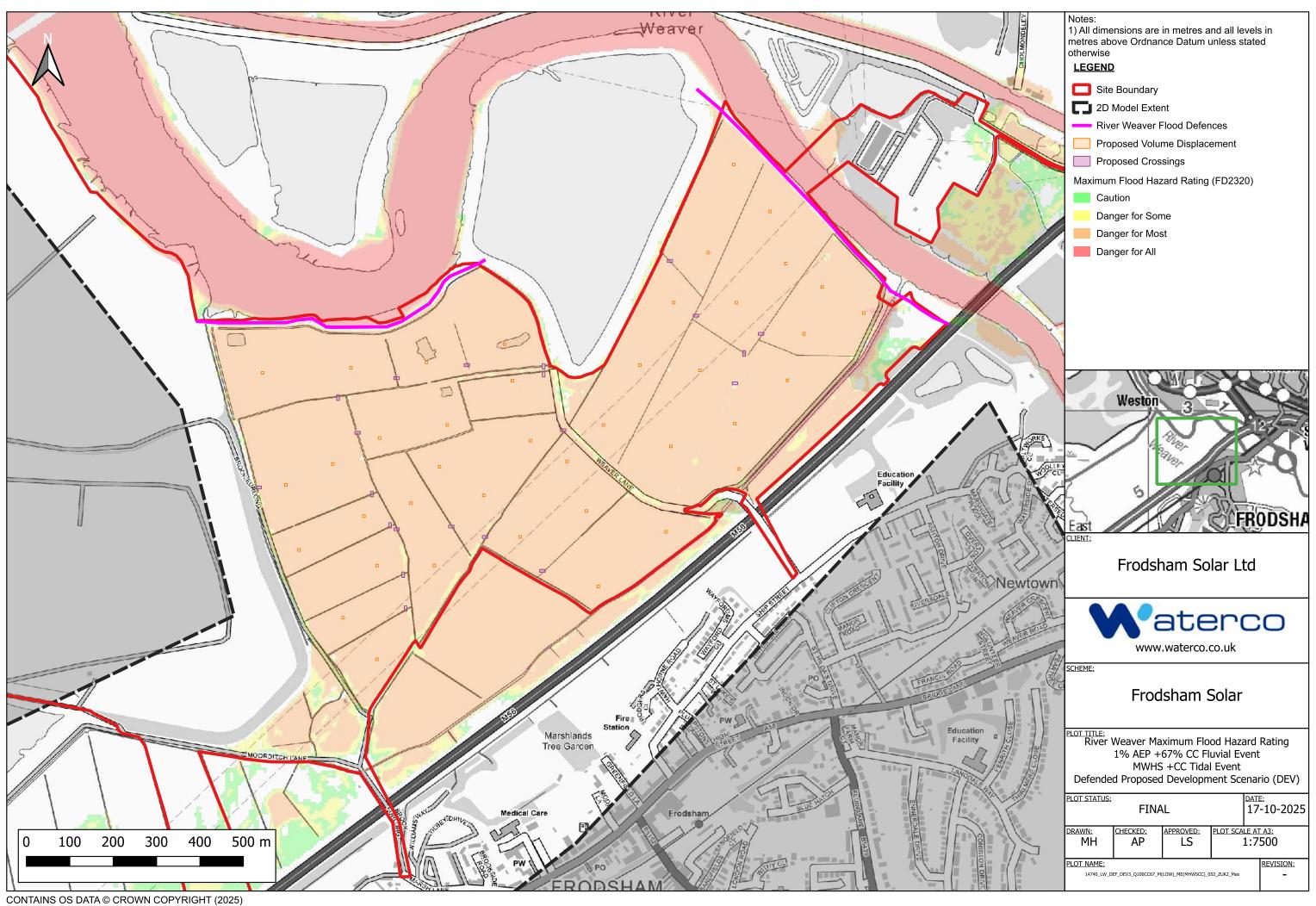


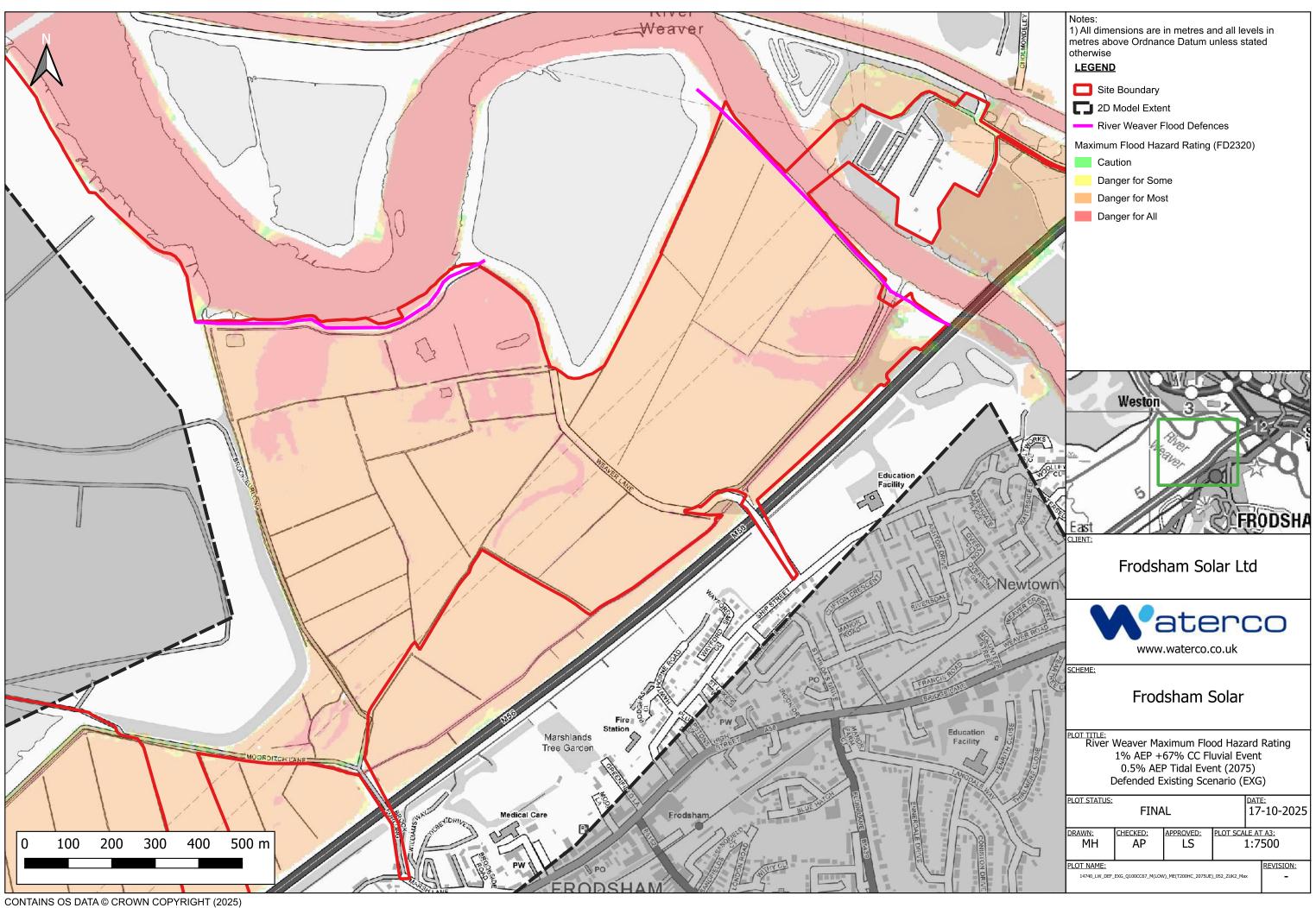


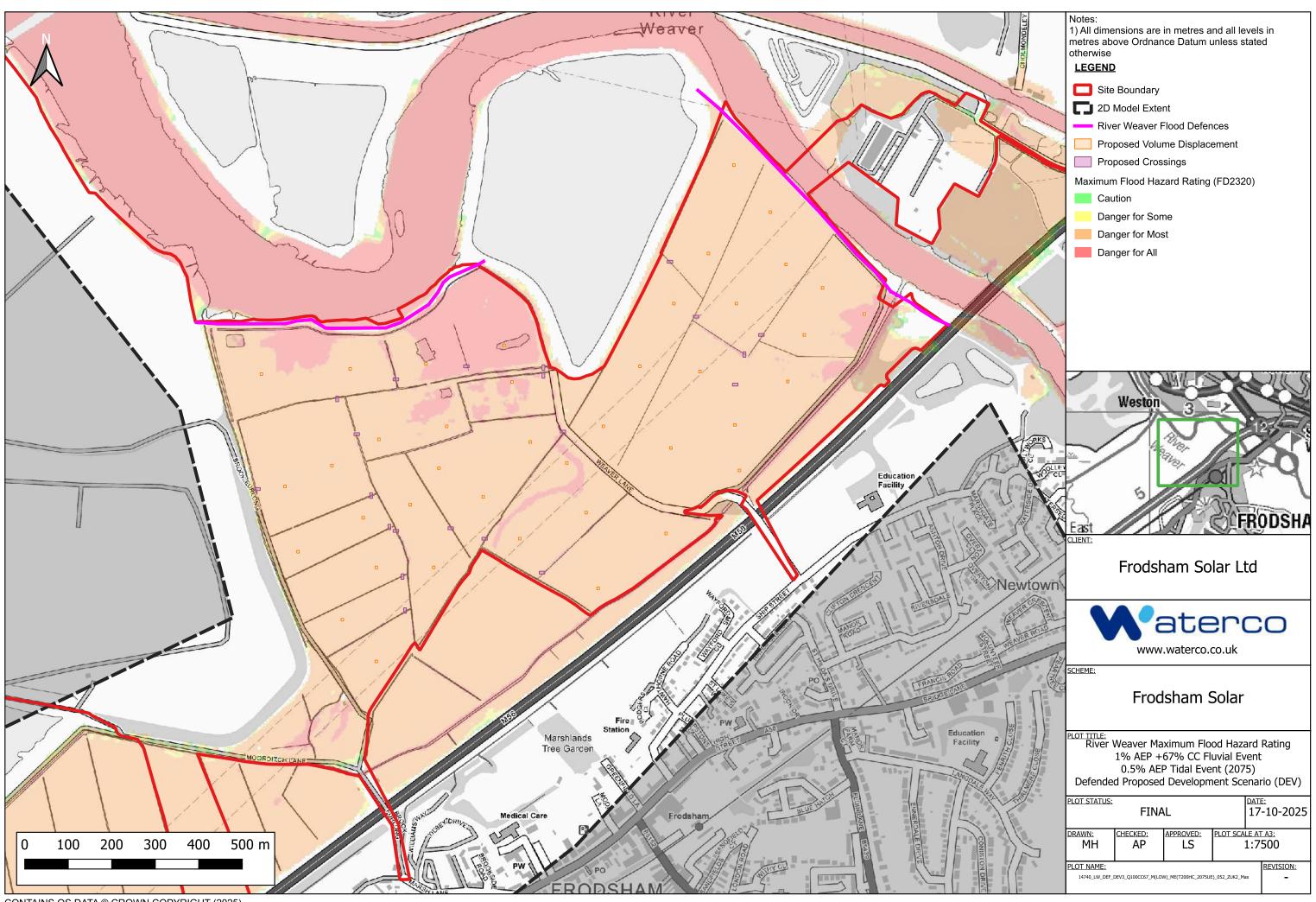


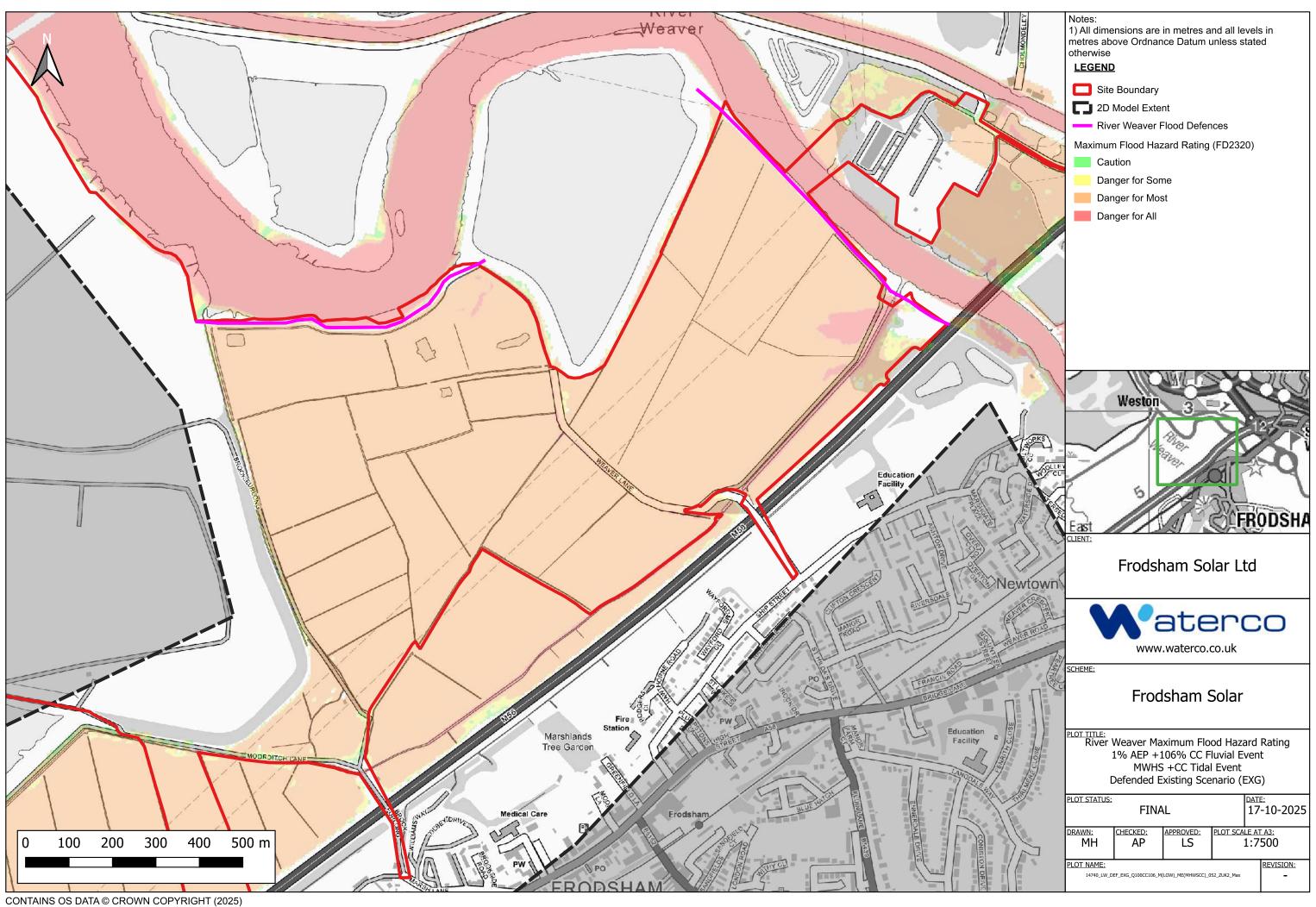


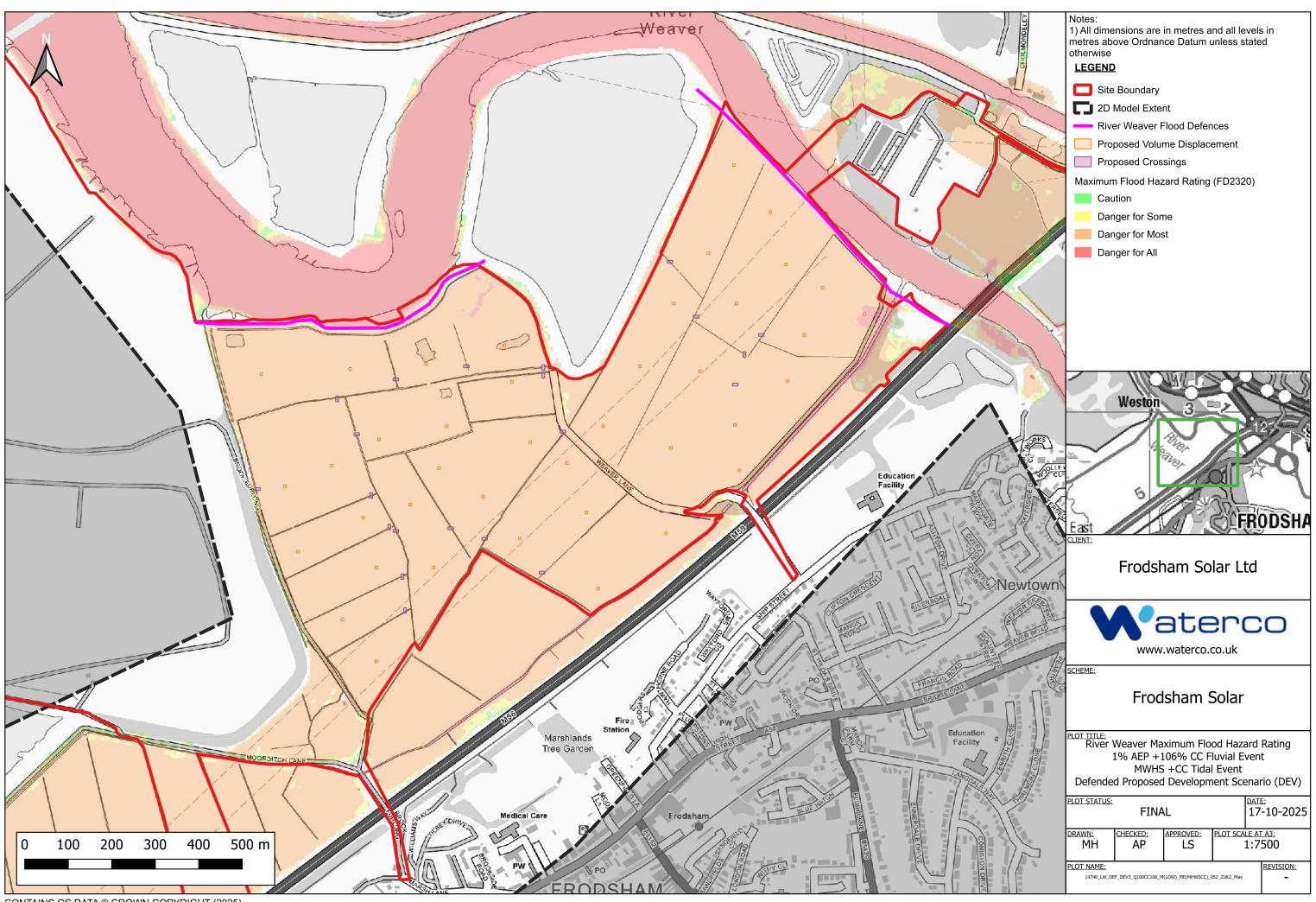


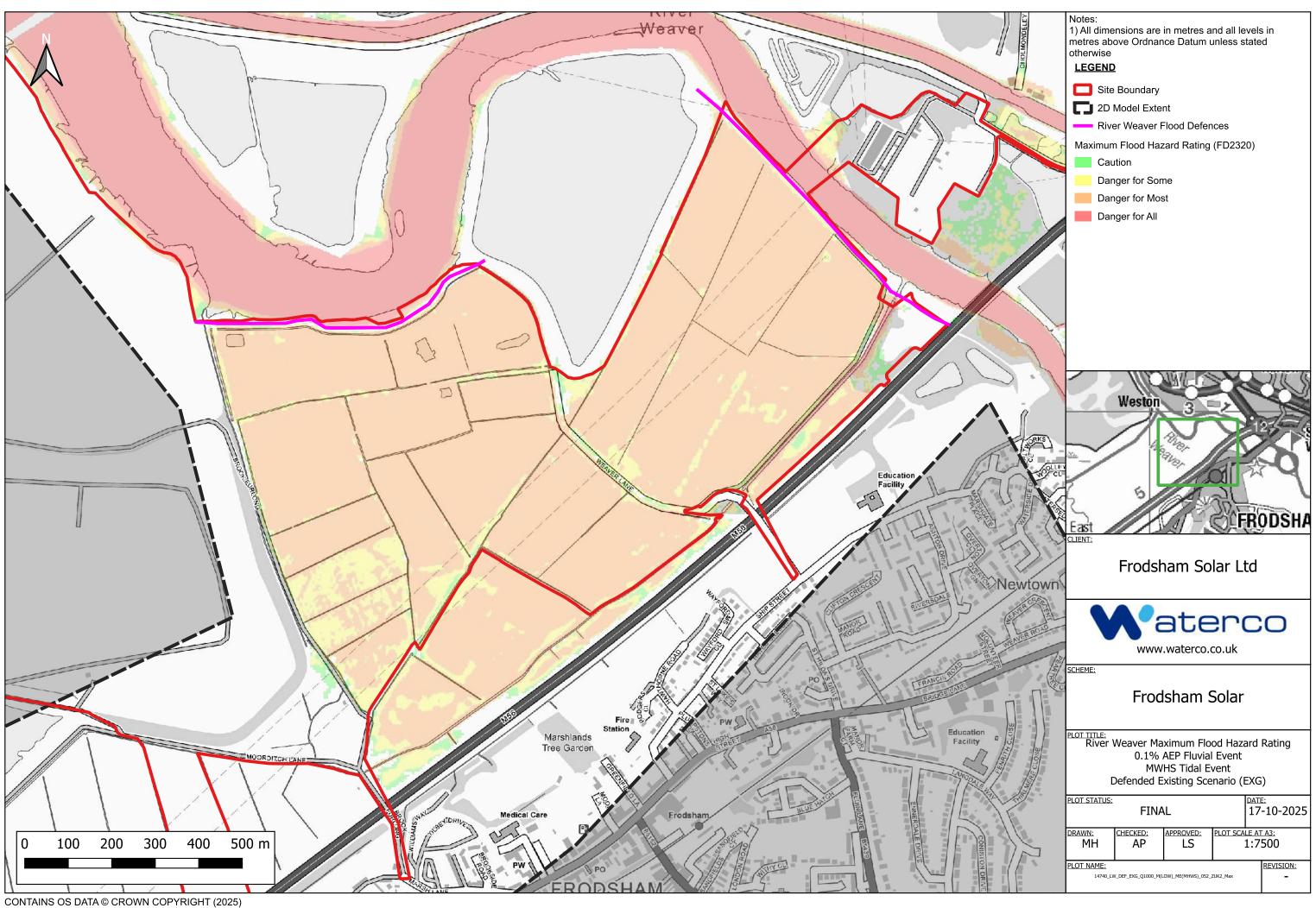


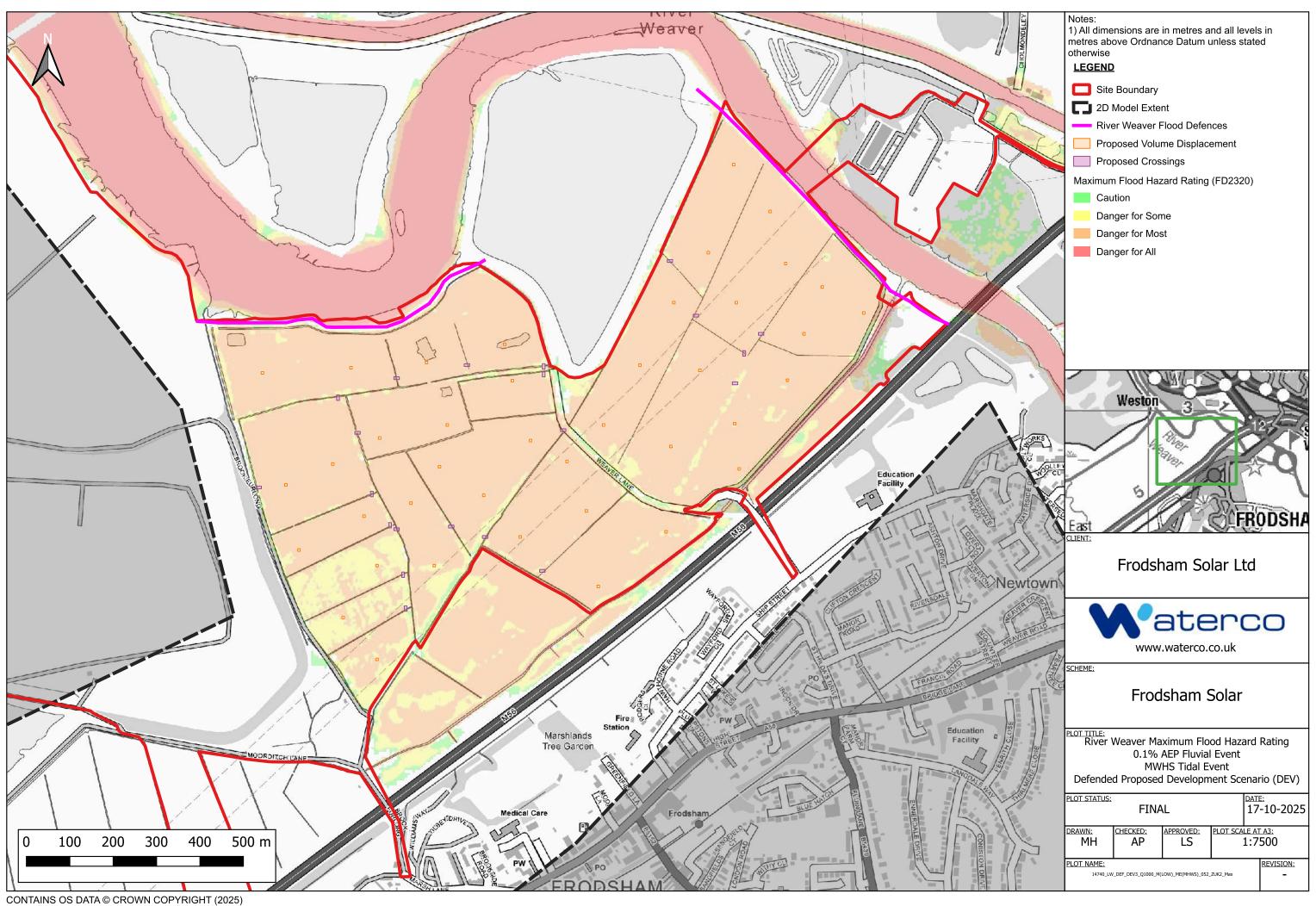


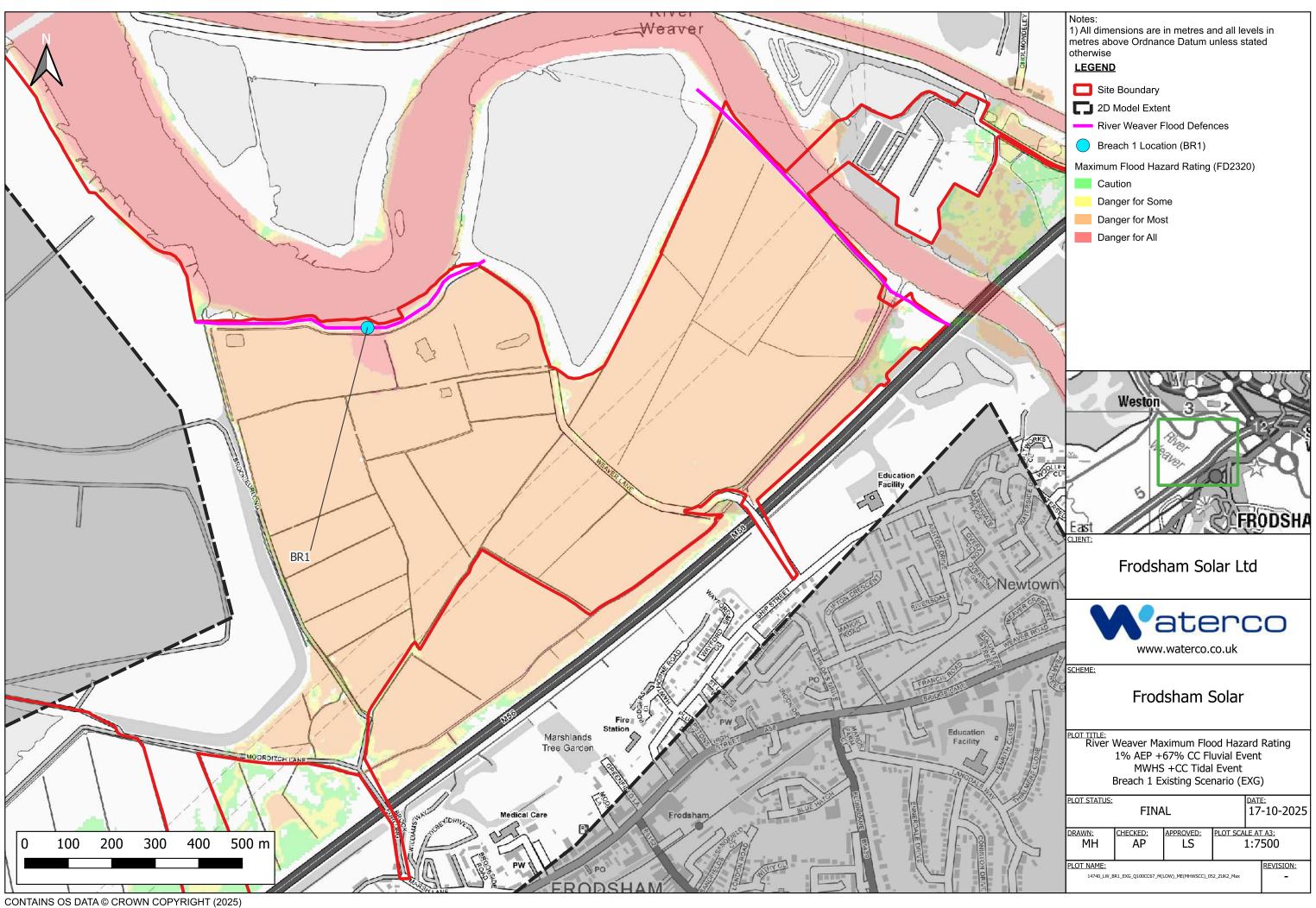


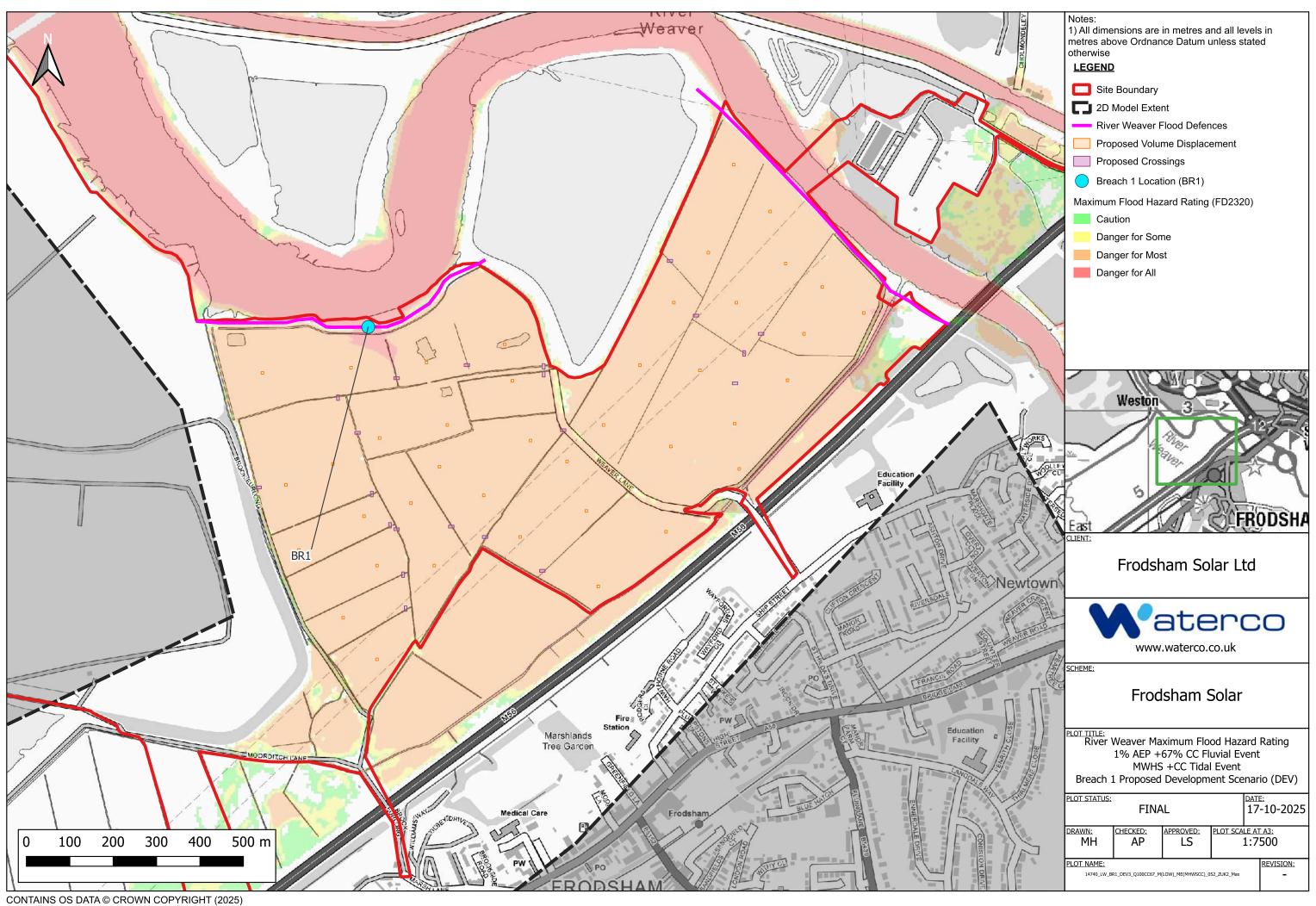


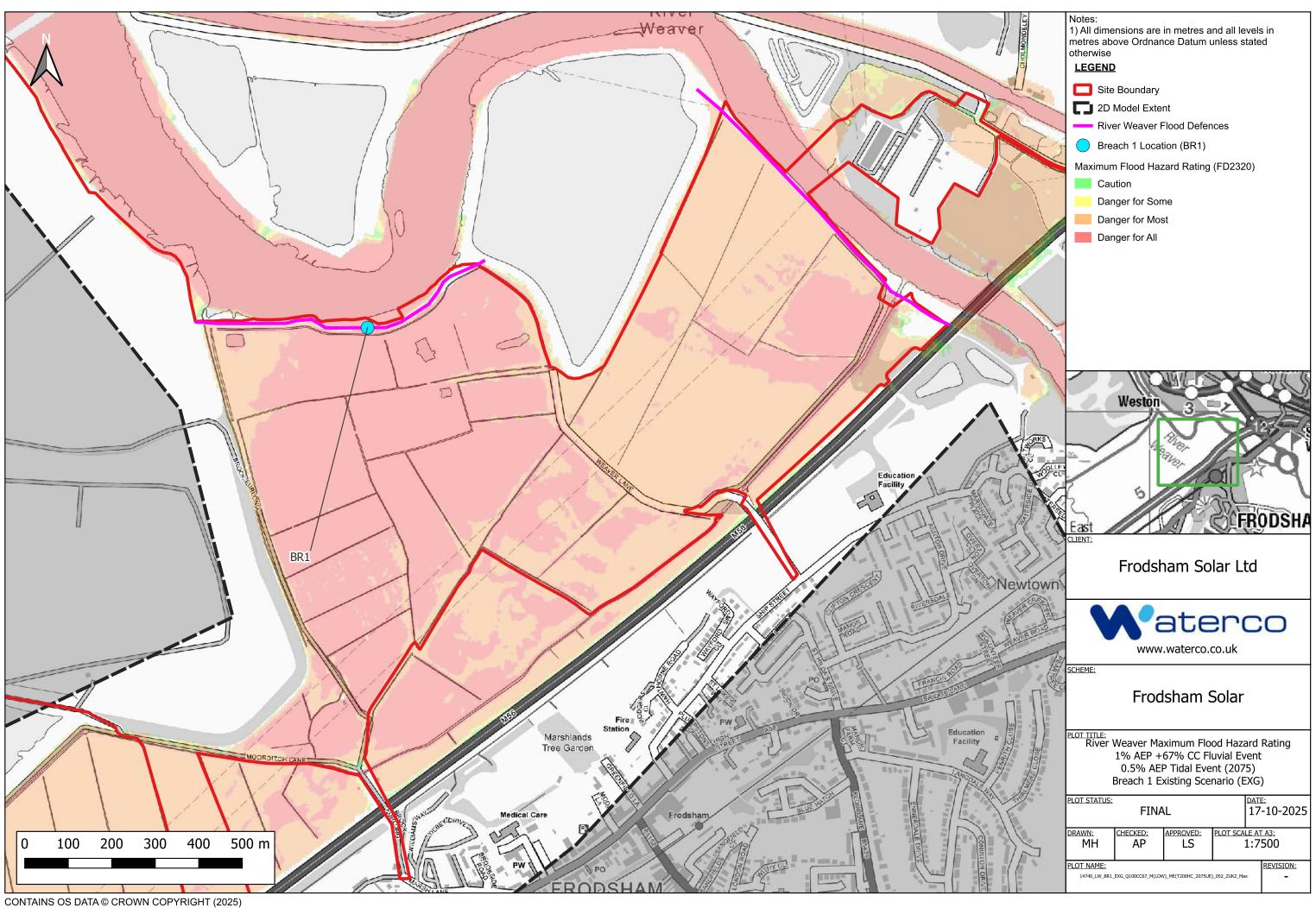


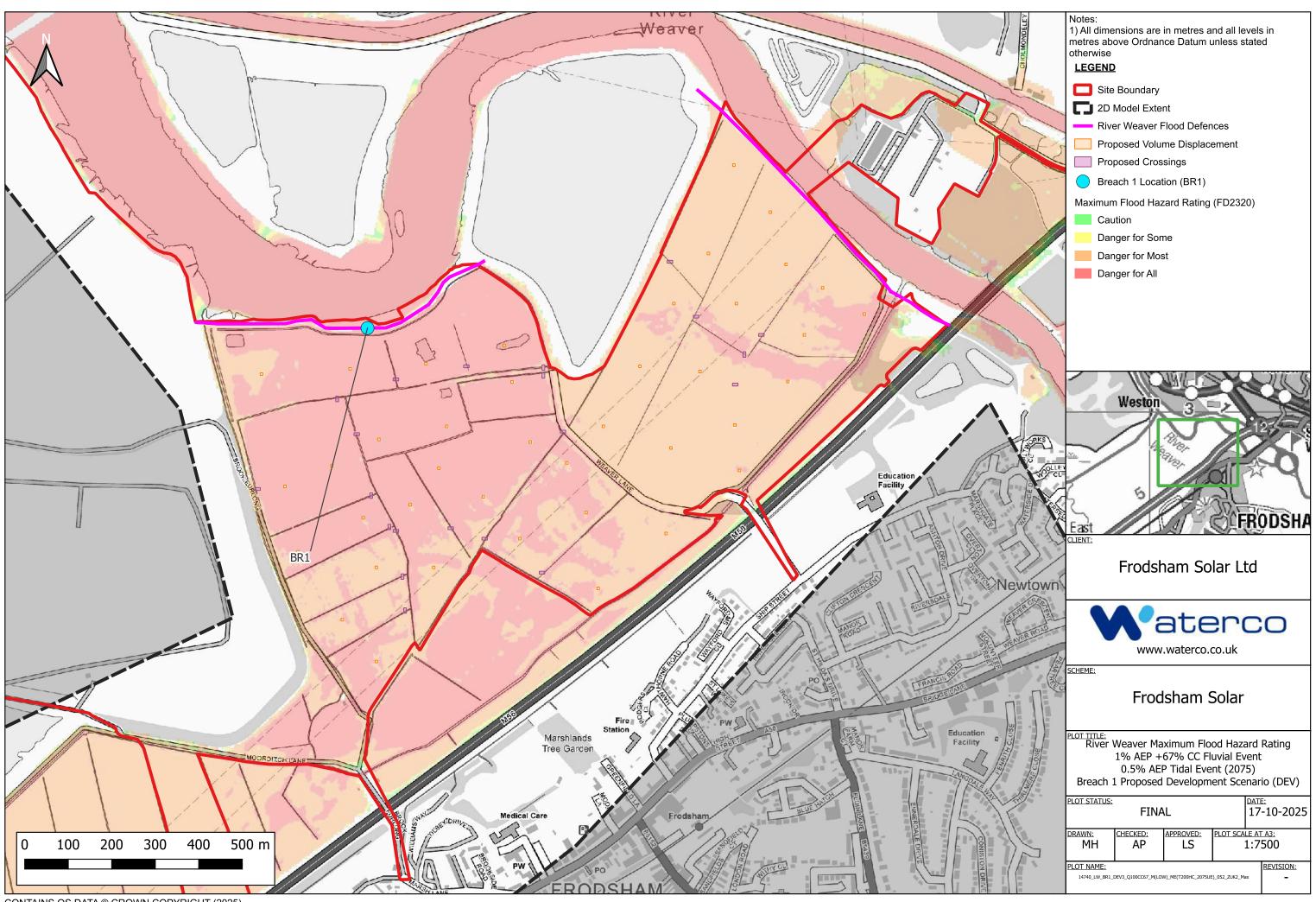


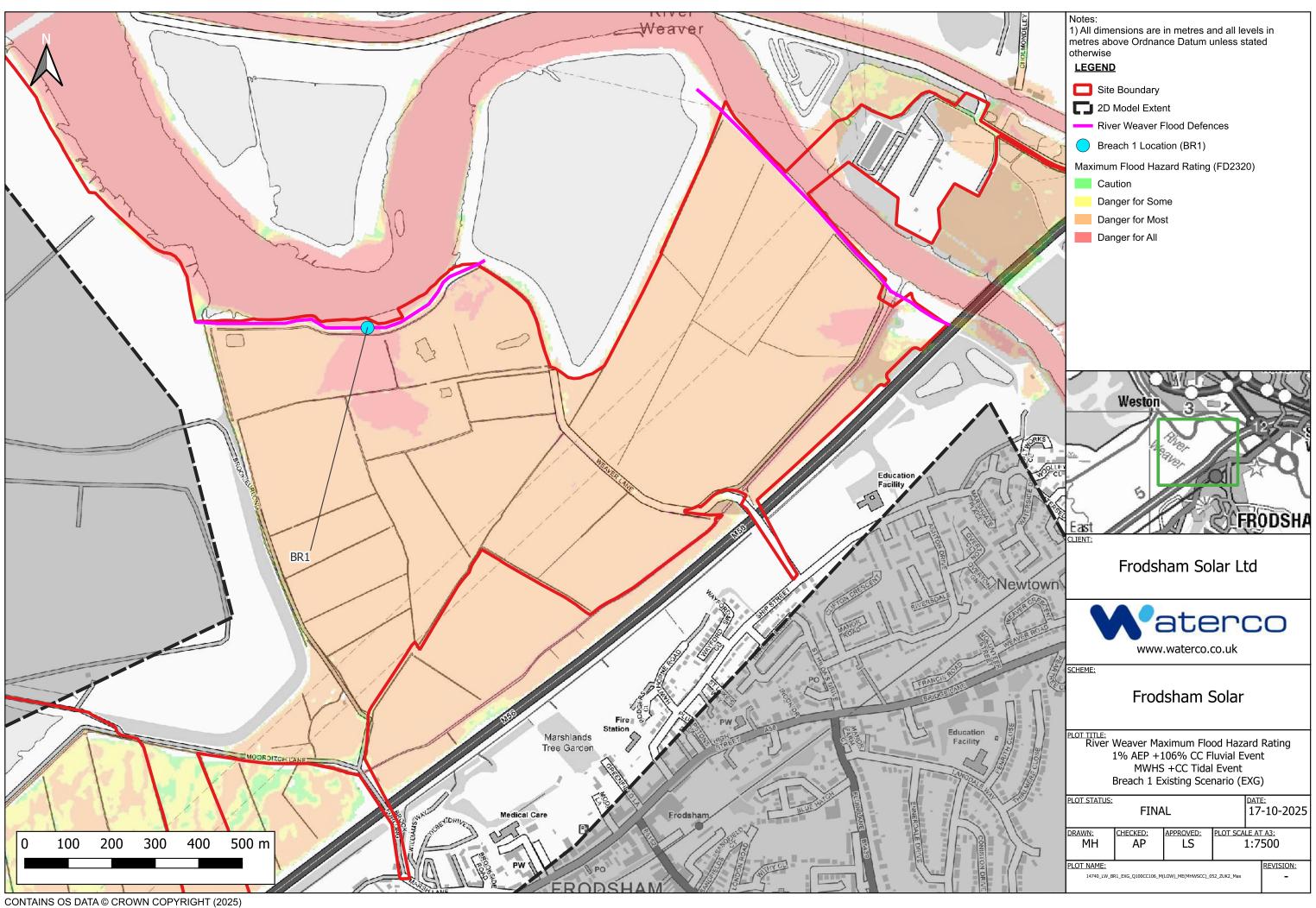


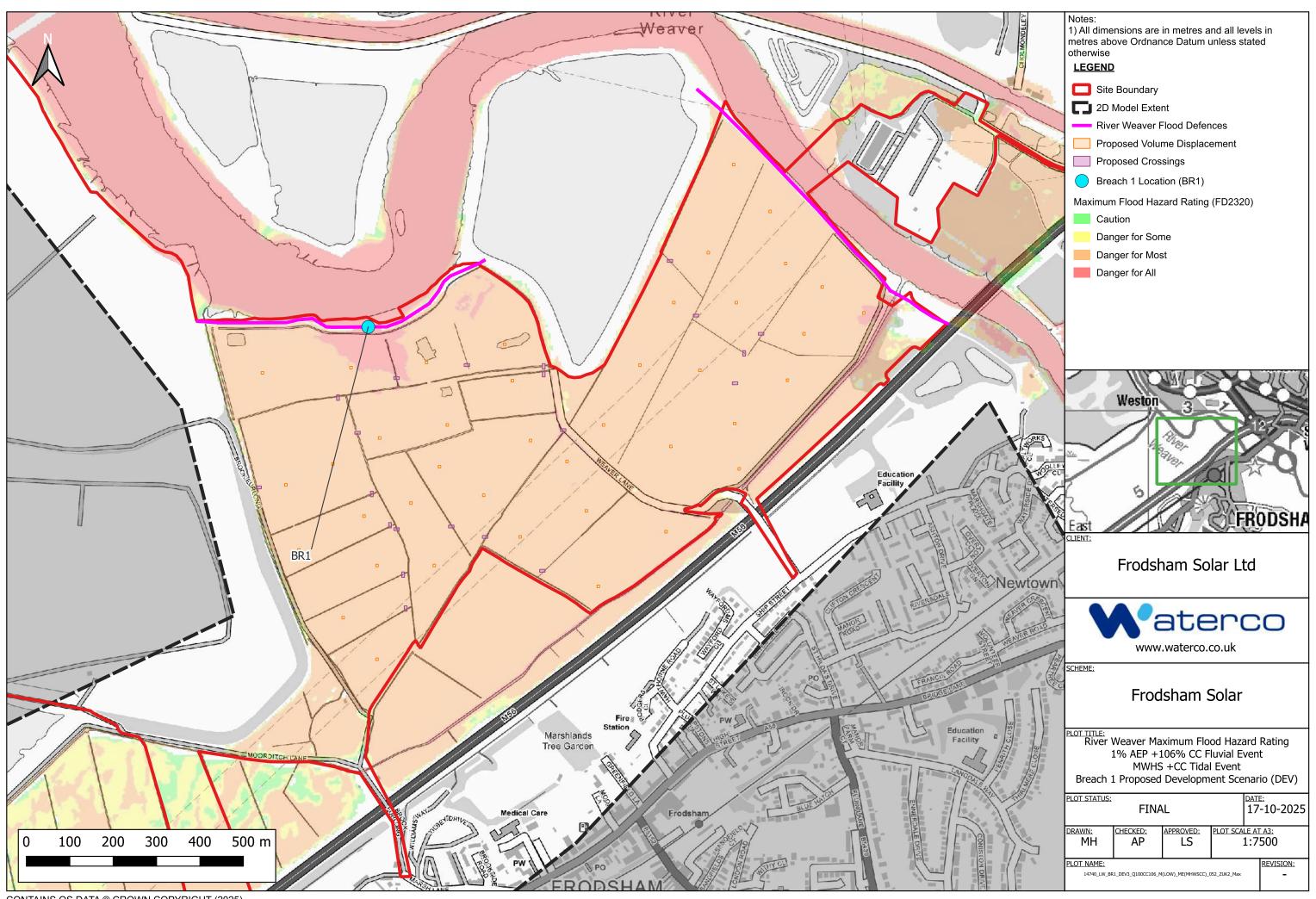


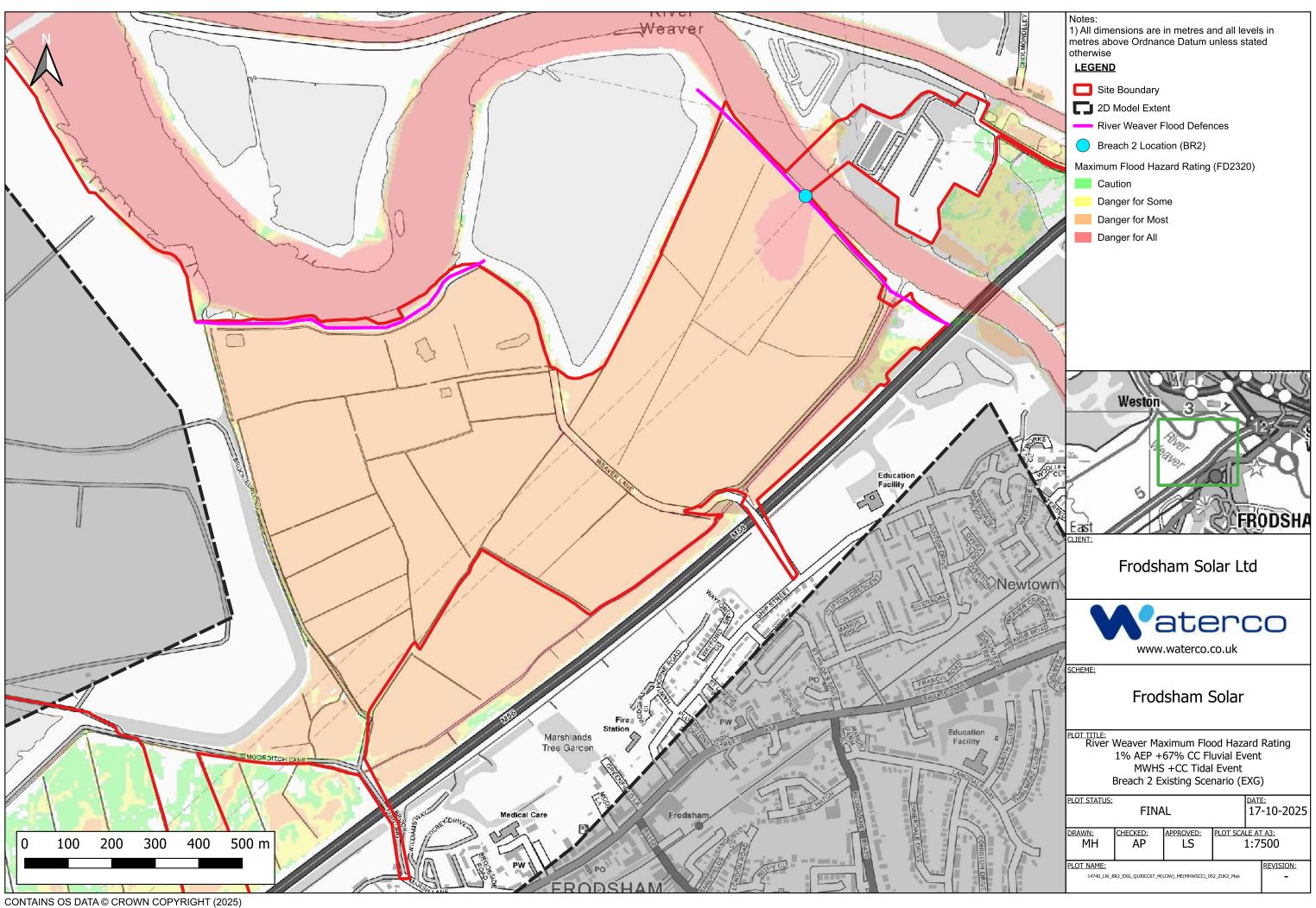


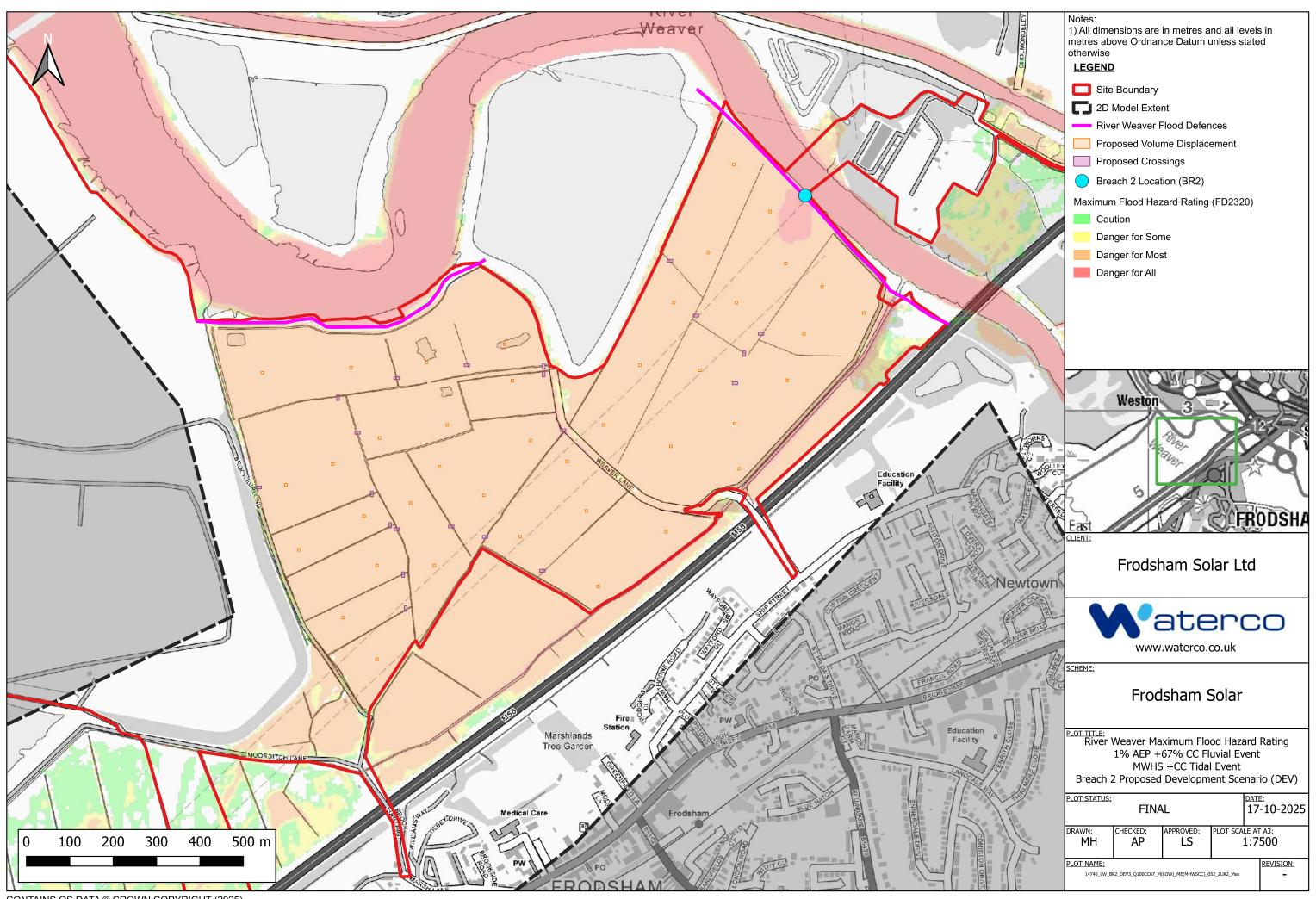


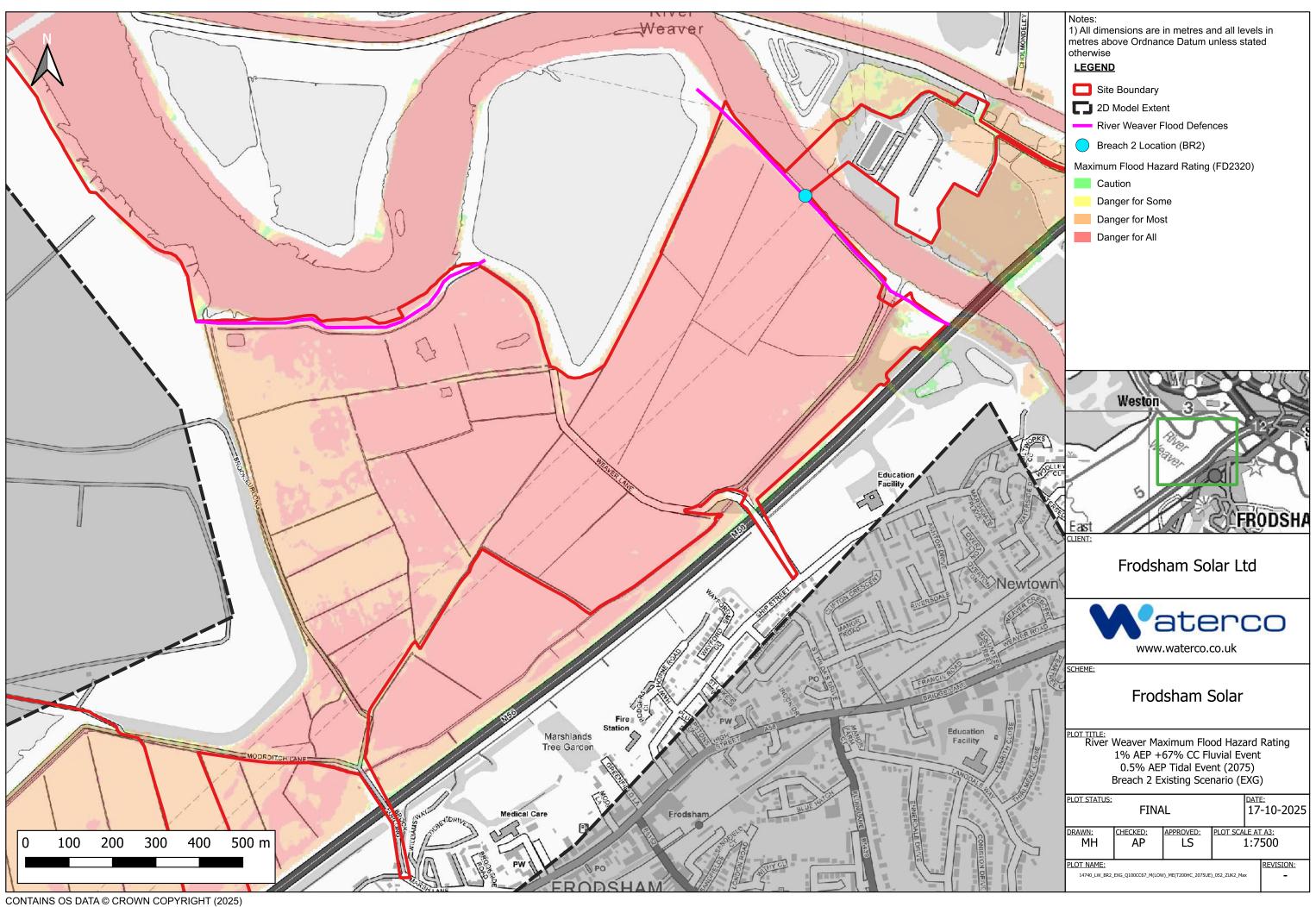


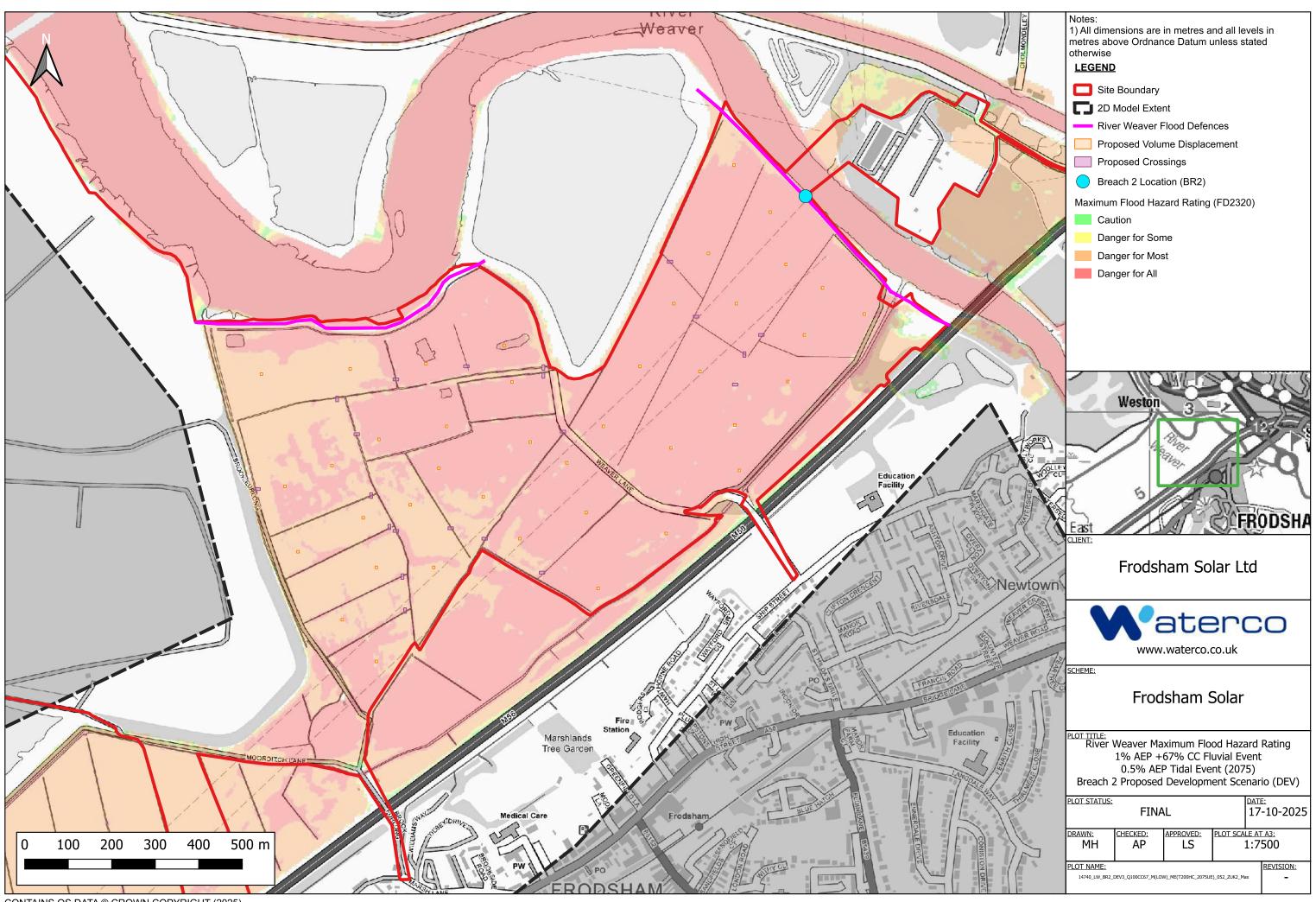


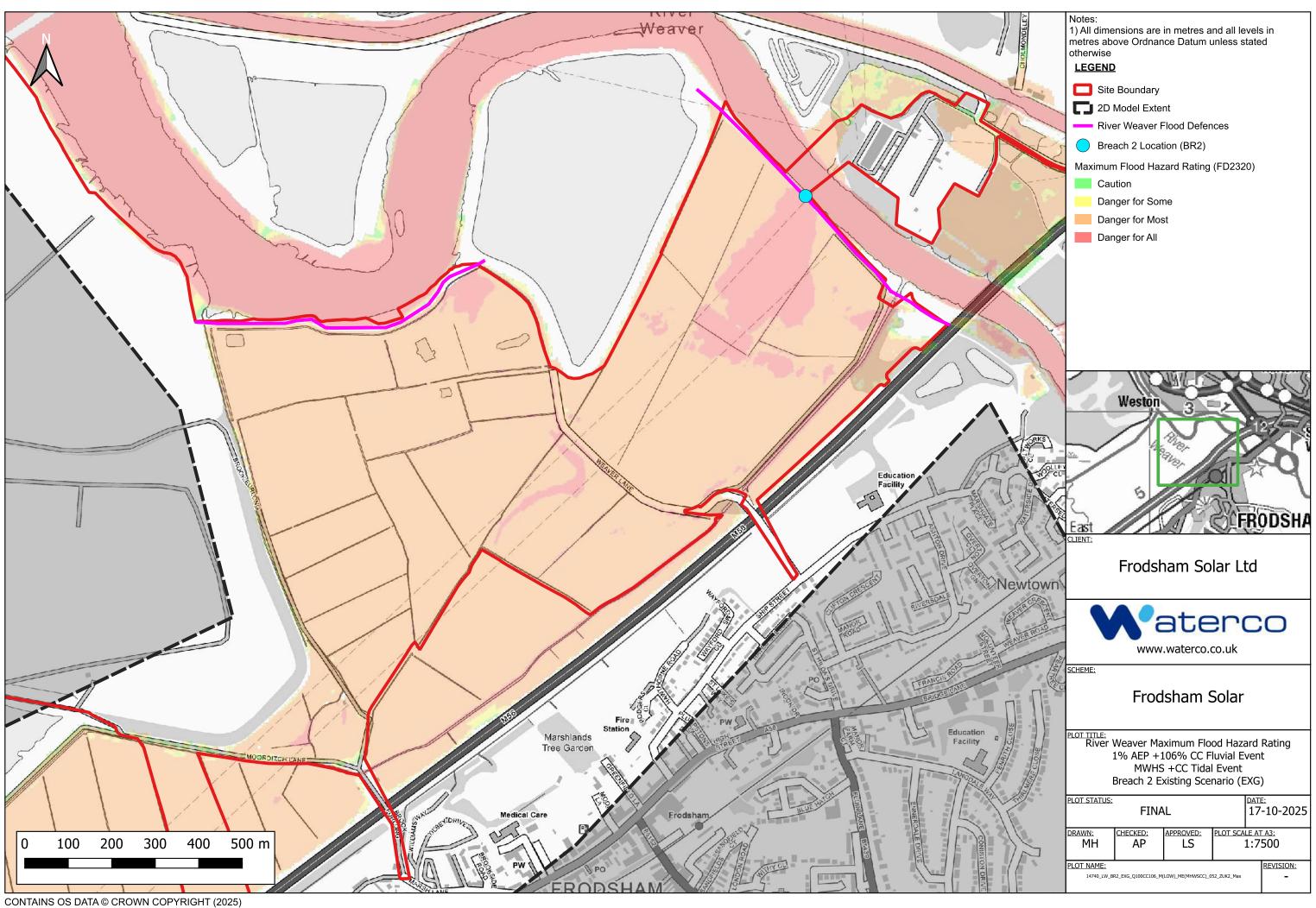


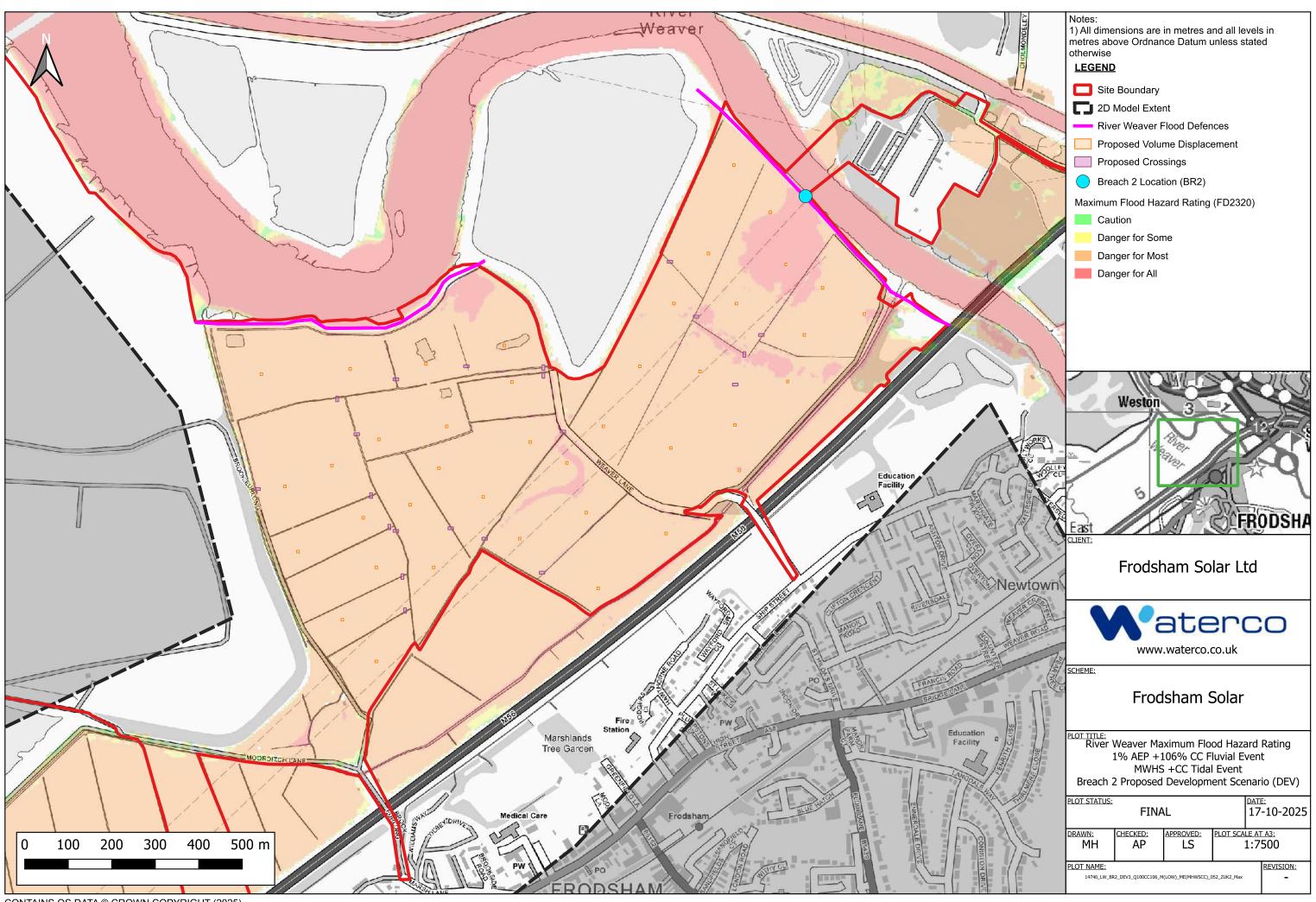










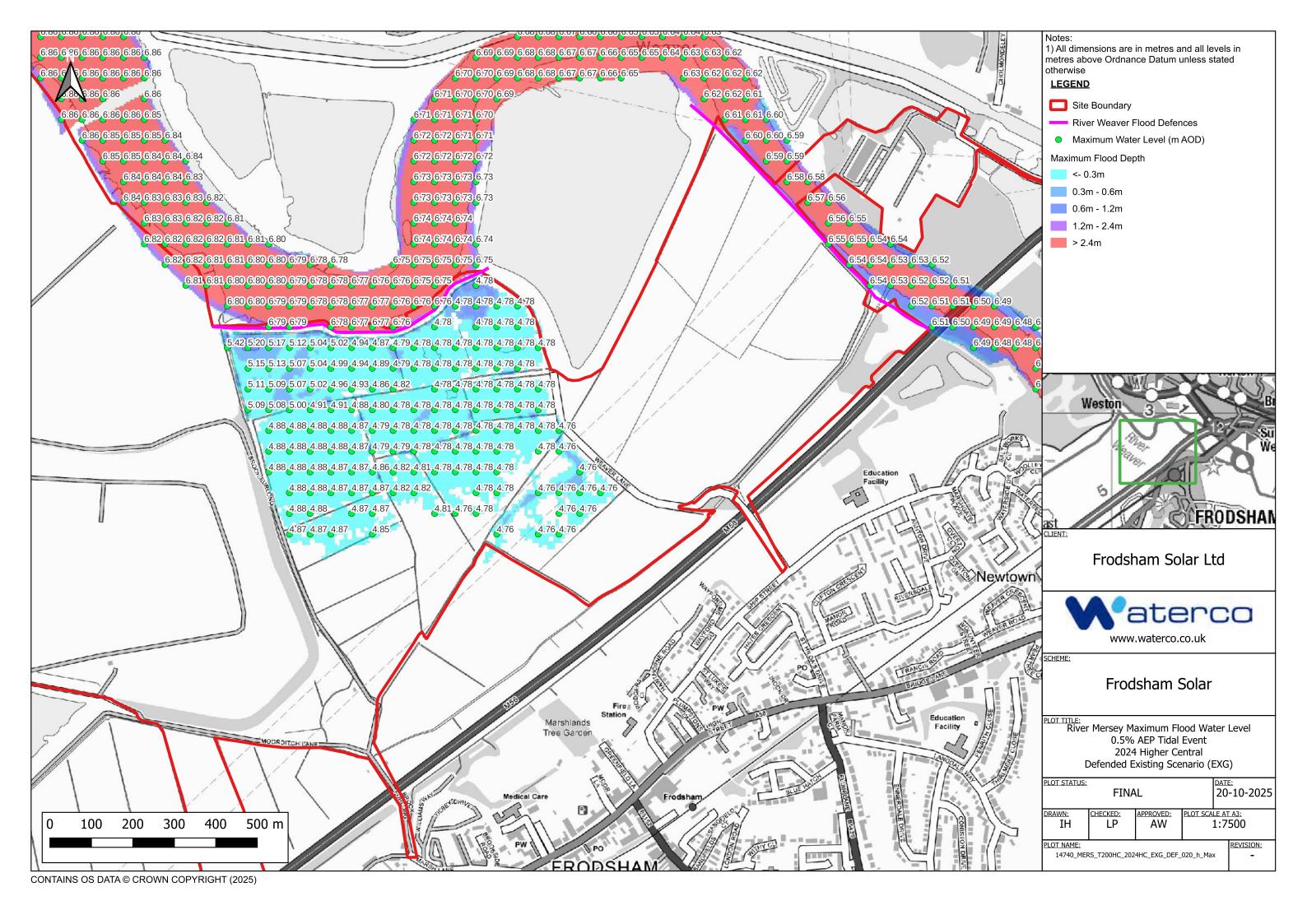


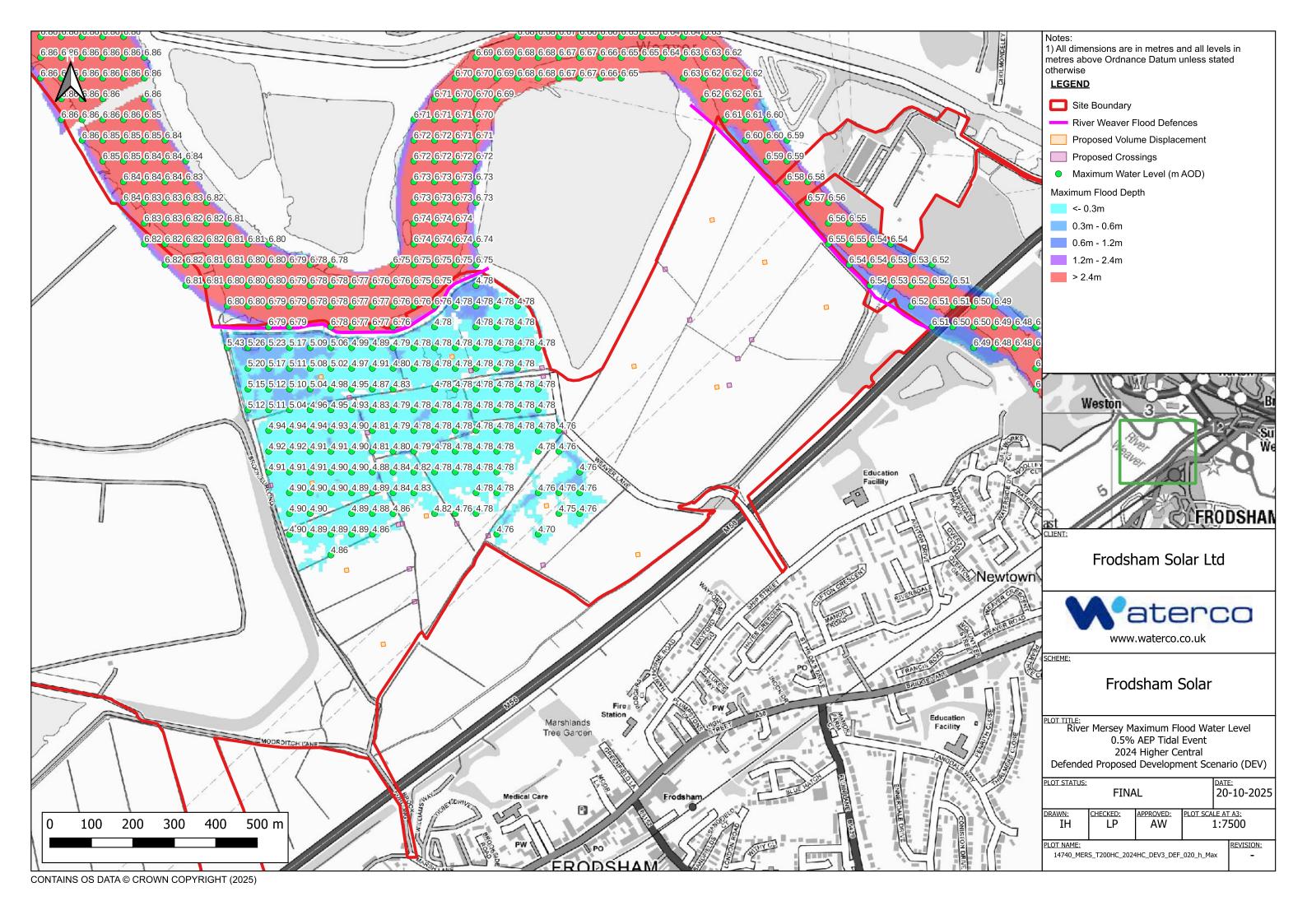
## **Appendix E** Simulated Water Level Maps

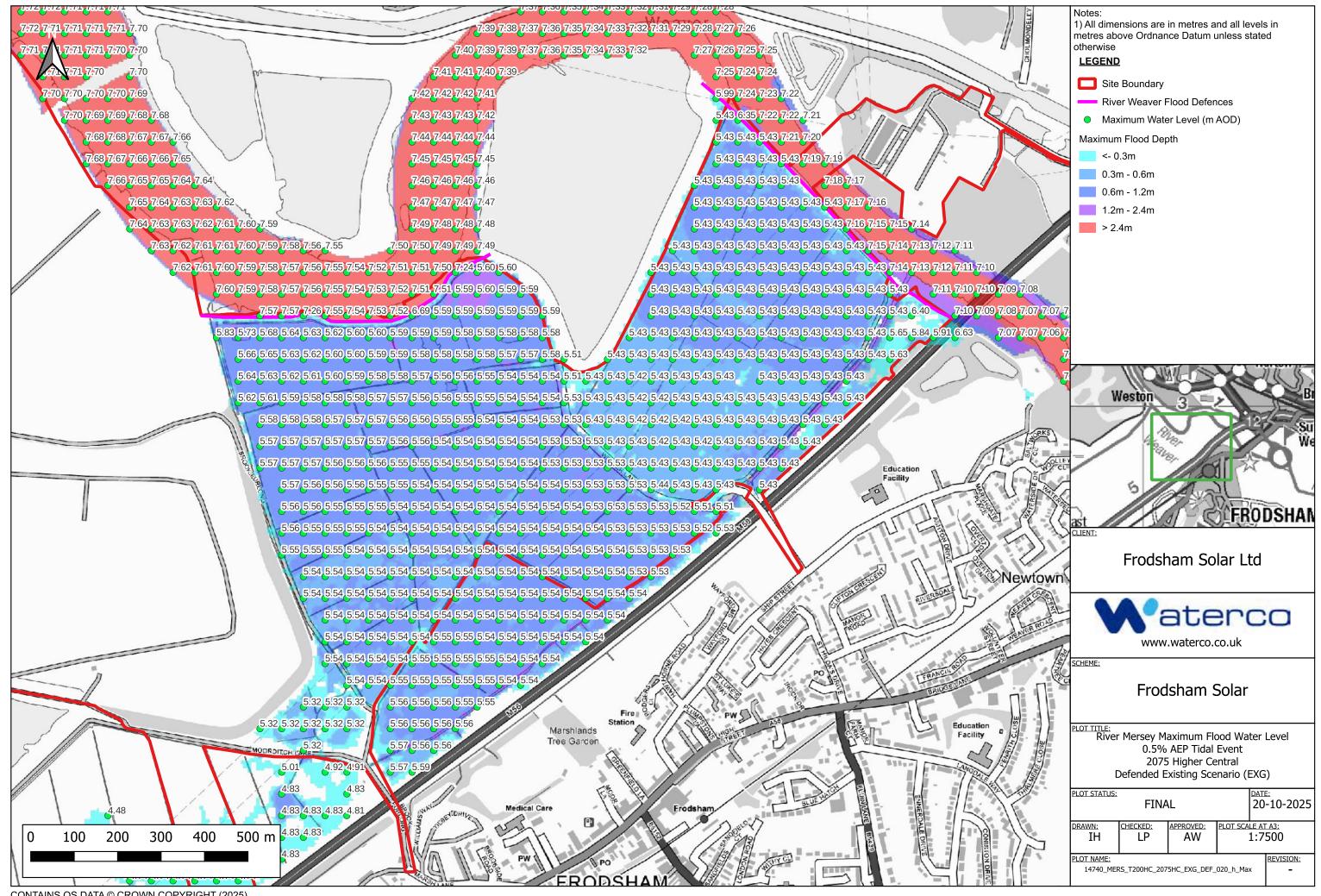


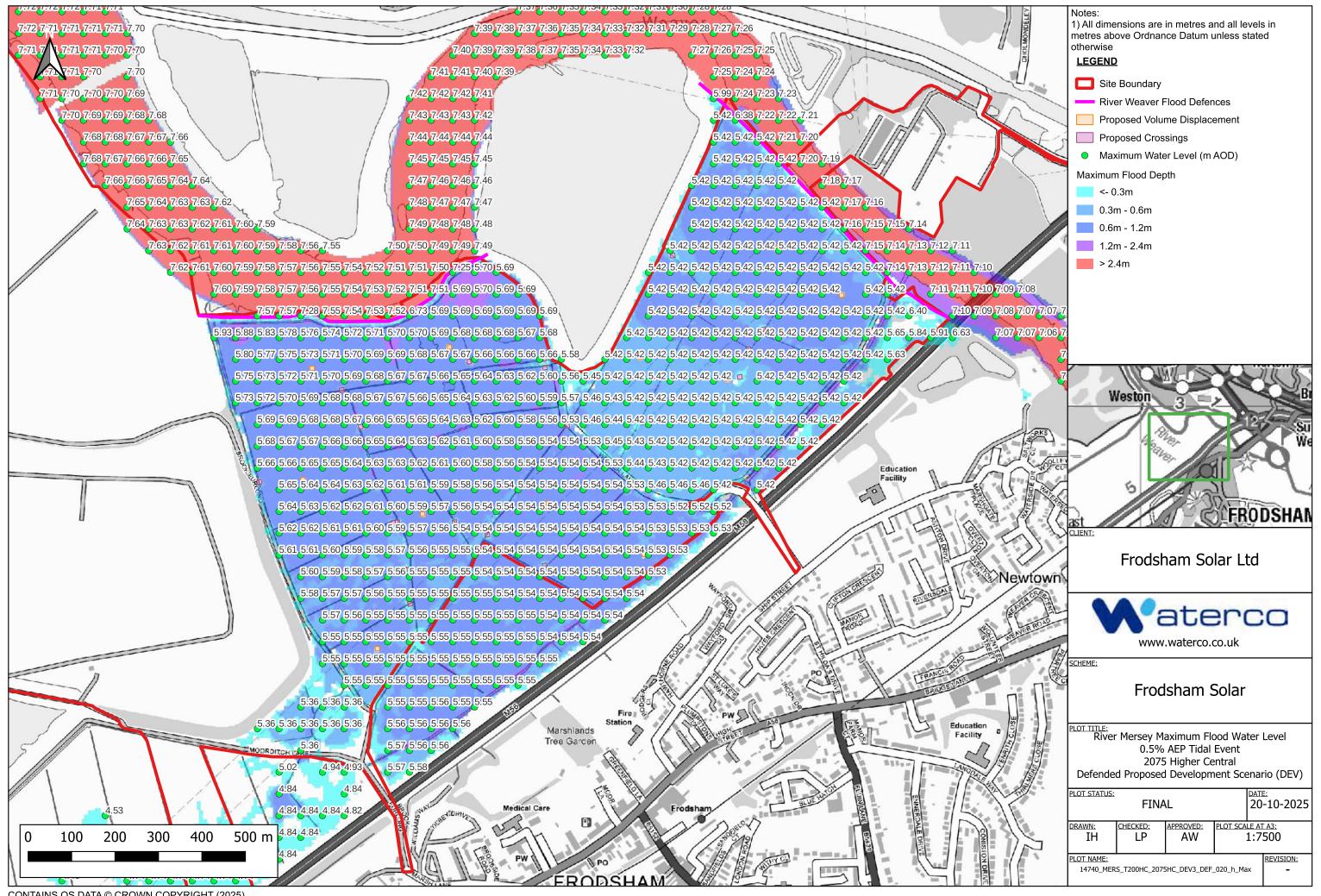
## **Mersey Estuary Water Level Mapping**

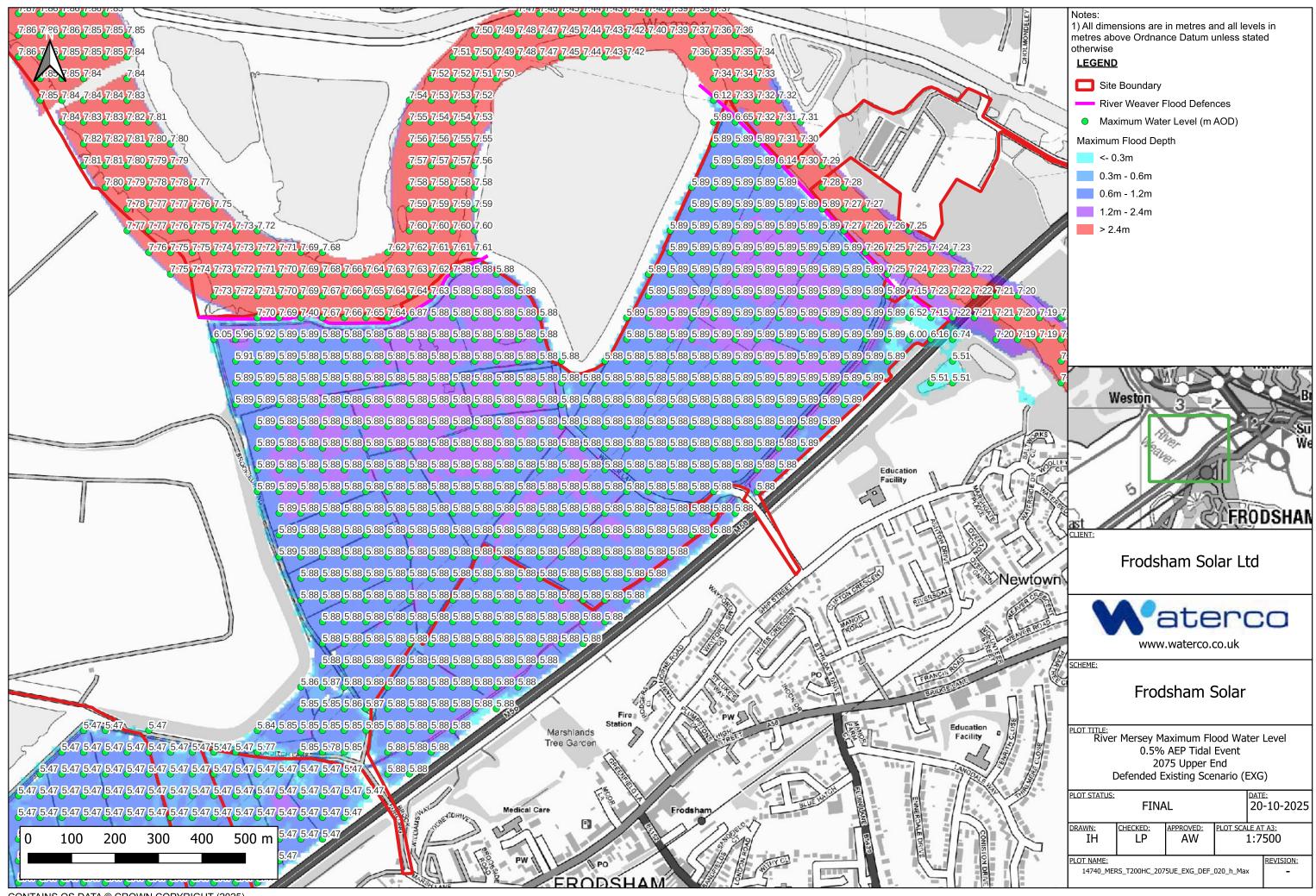


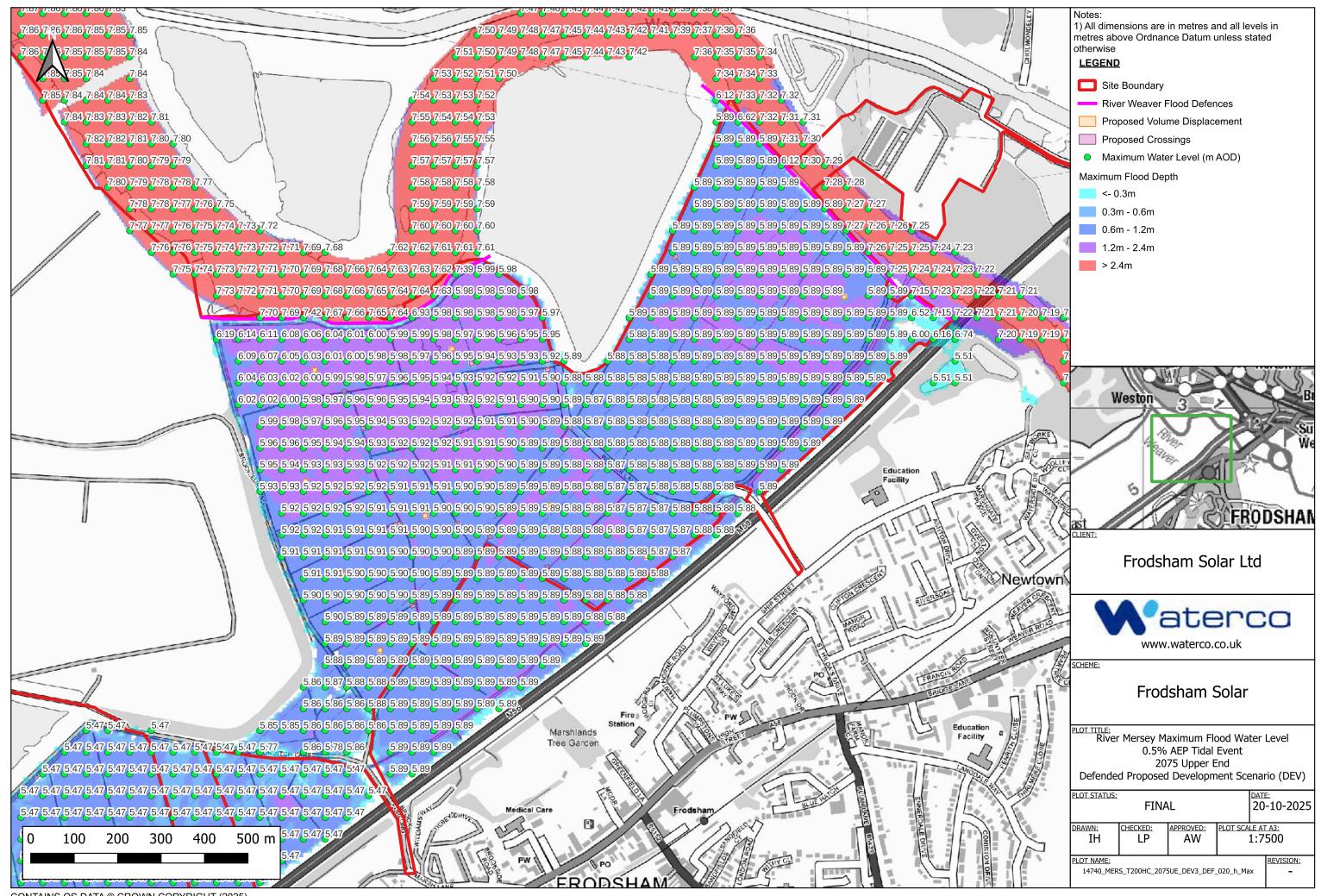


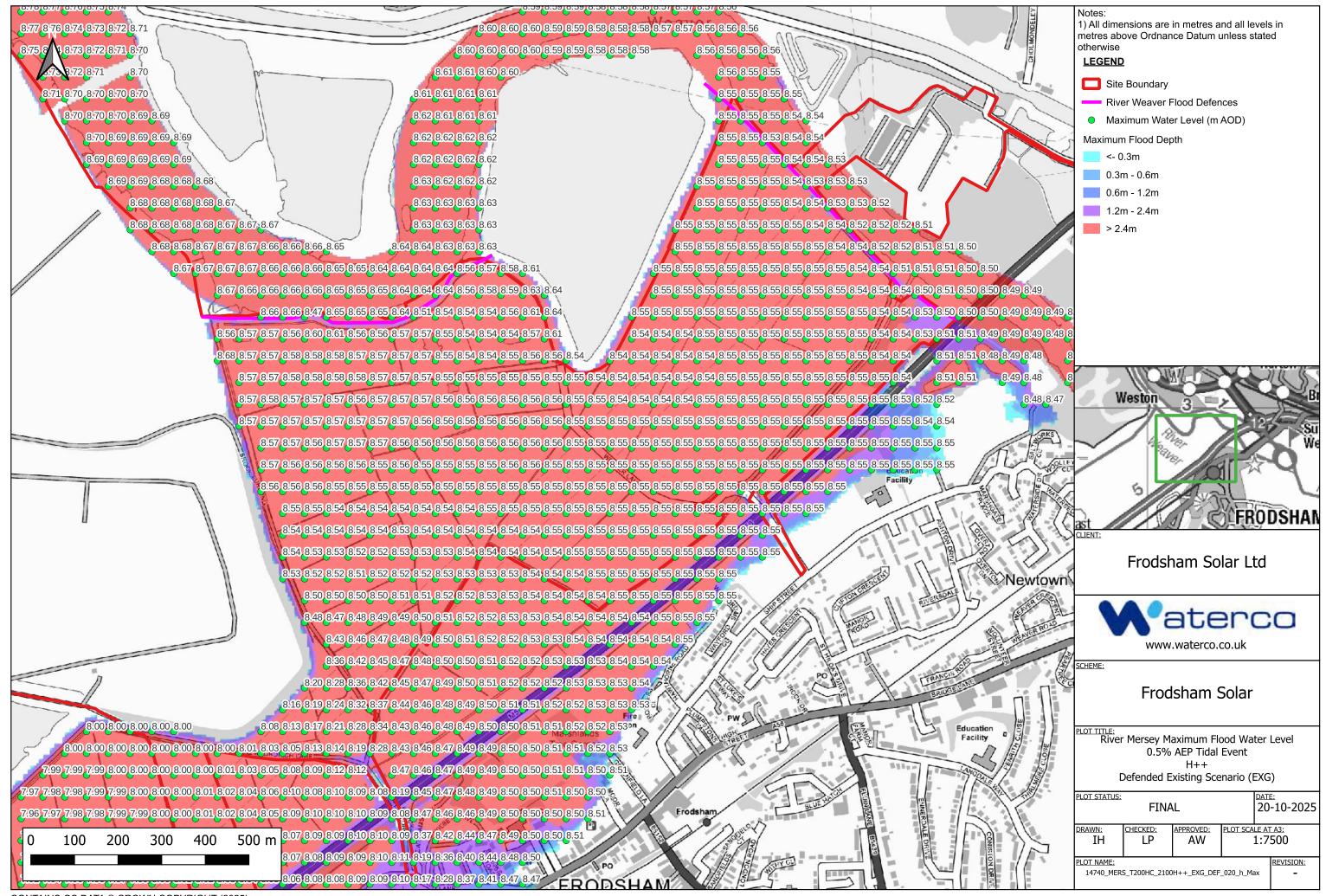


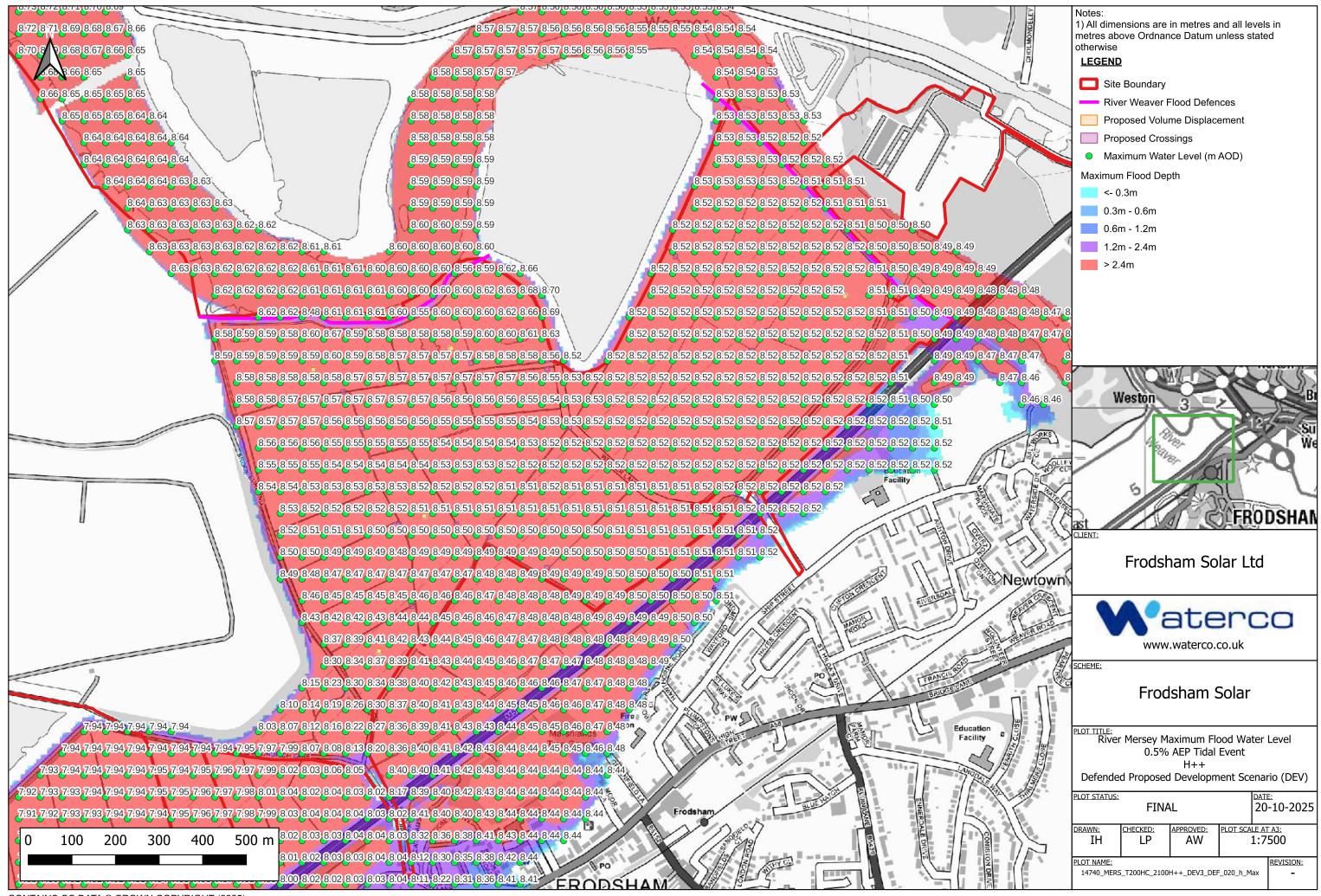


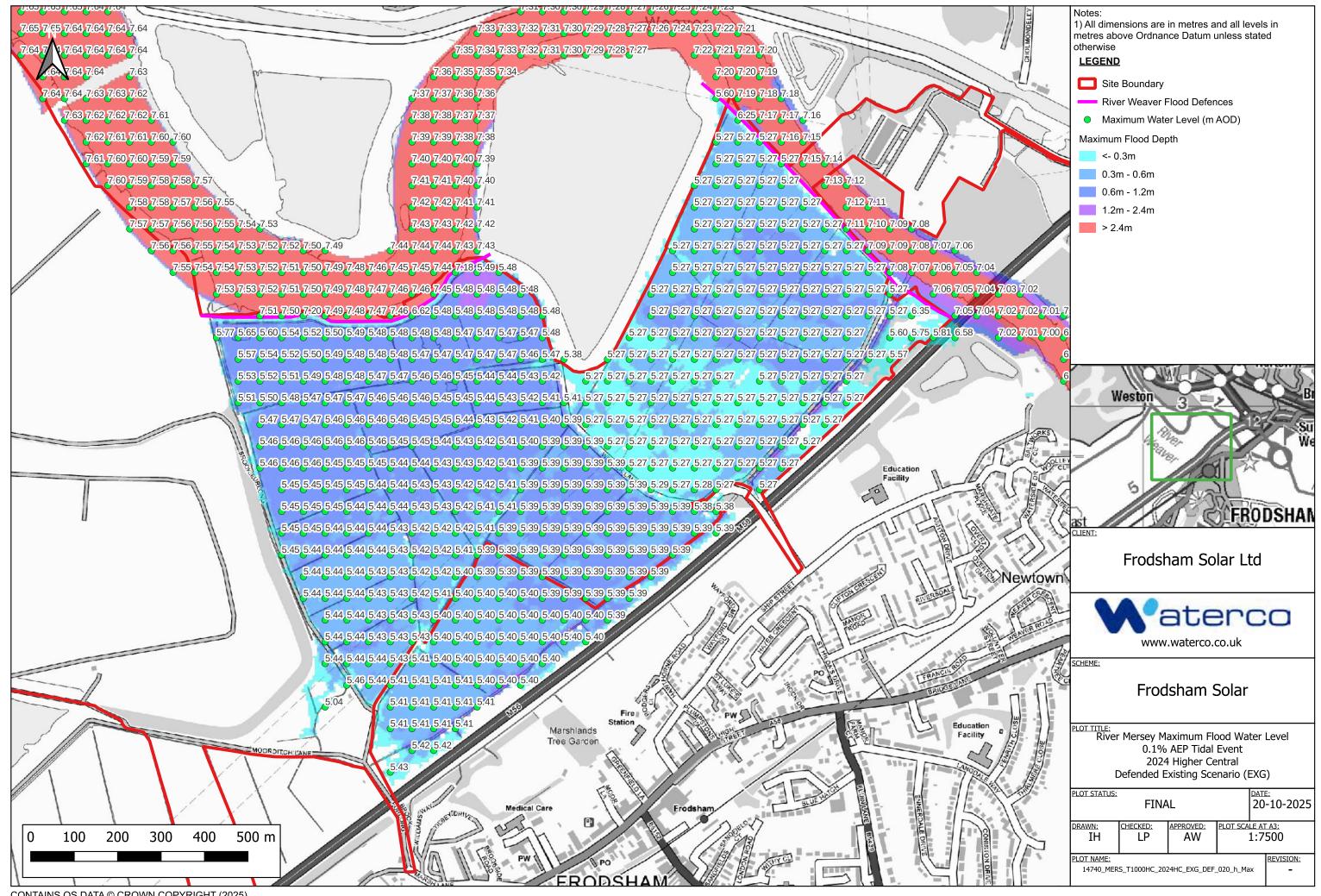


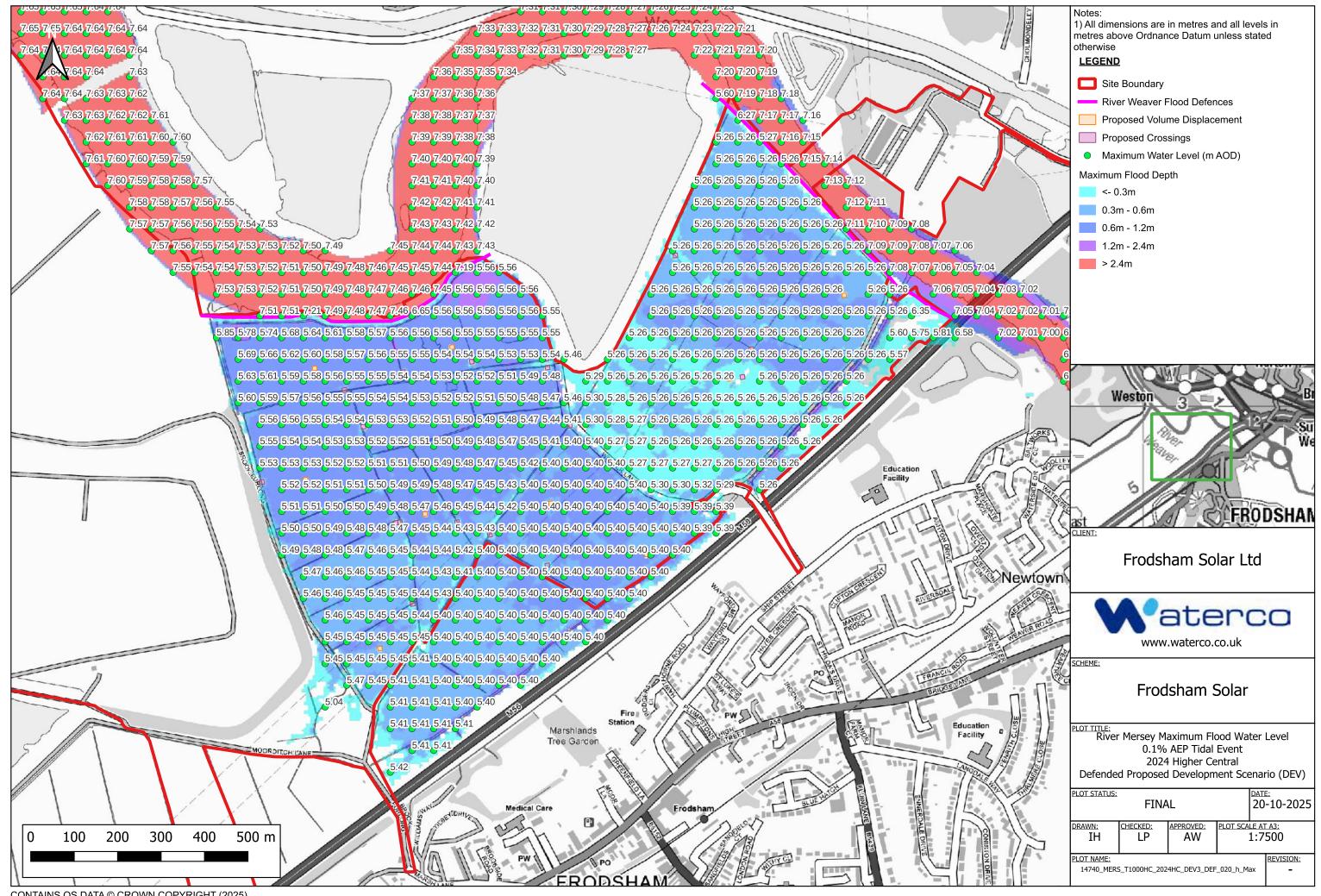


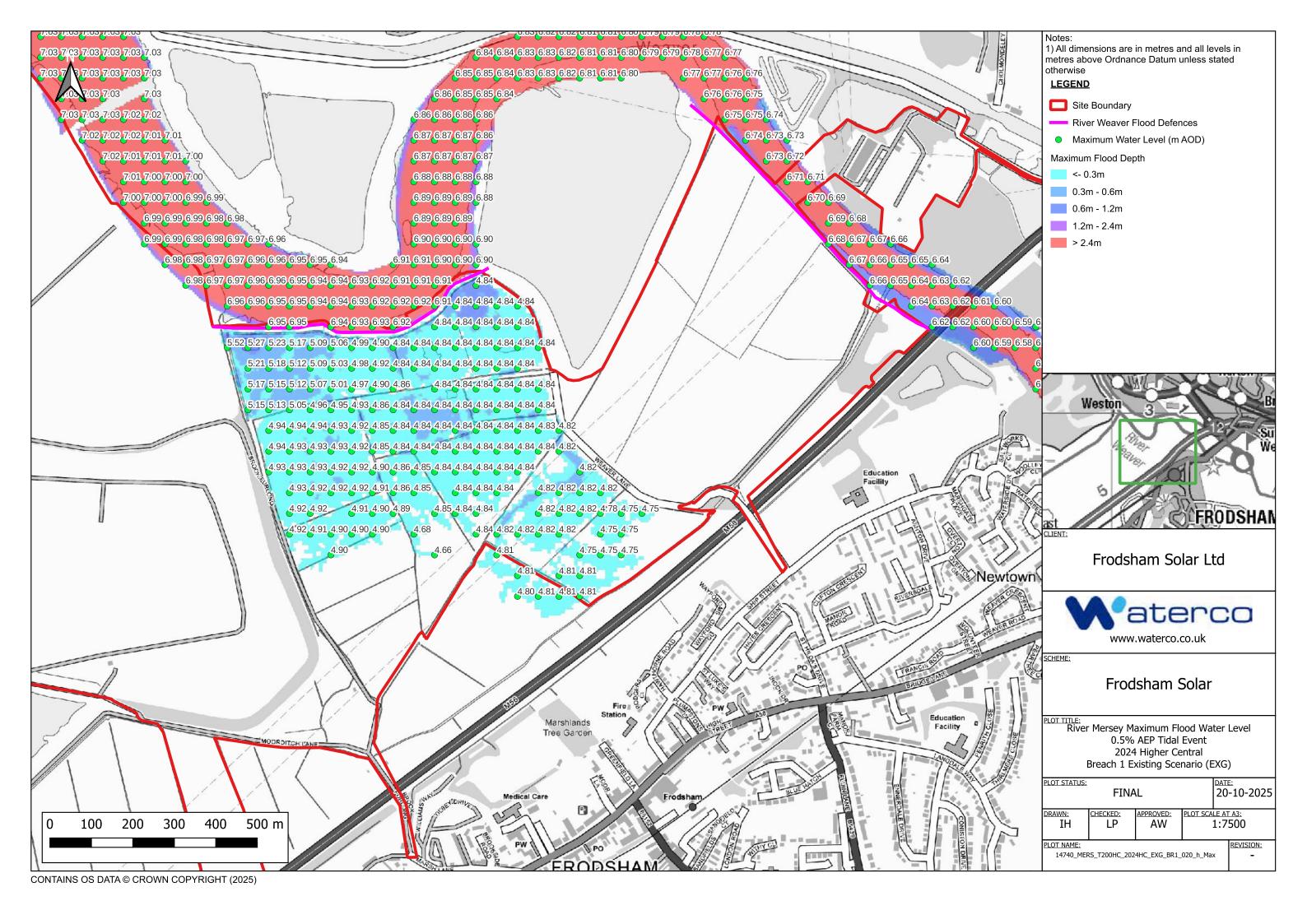


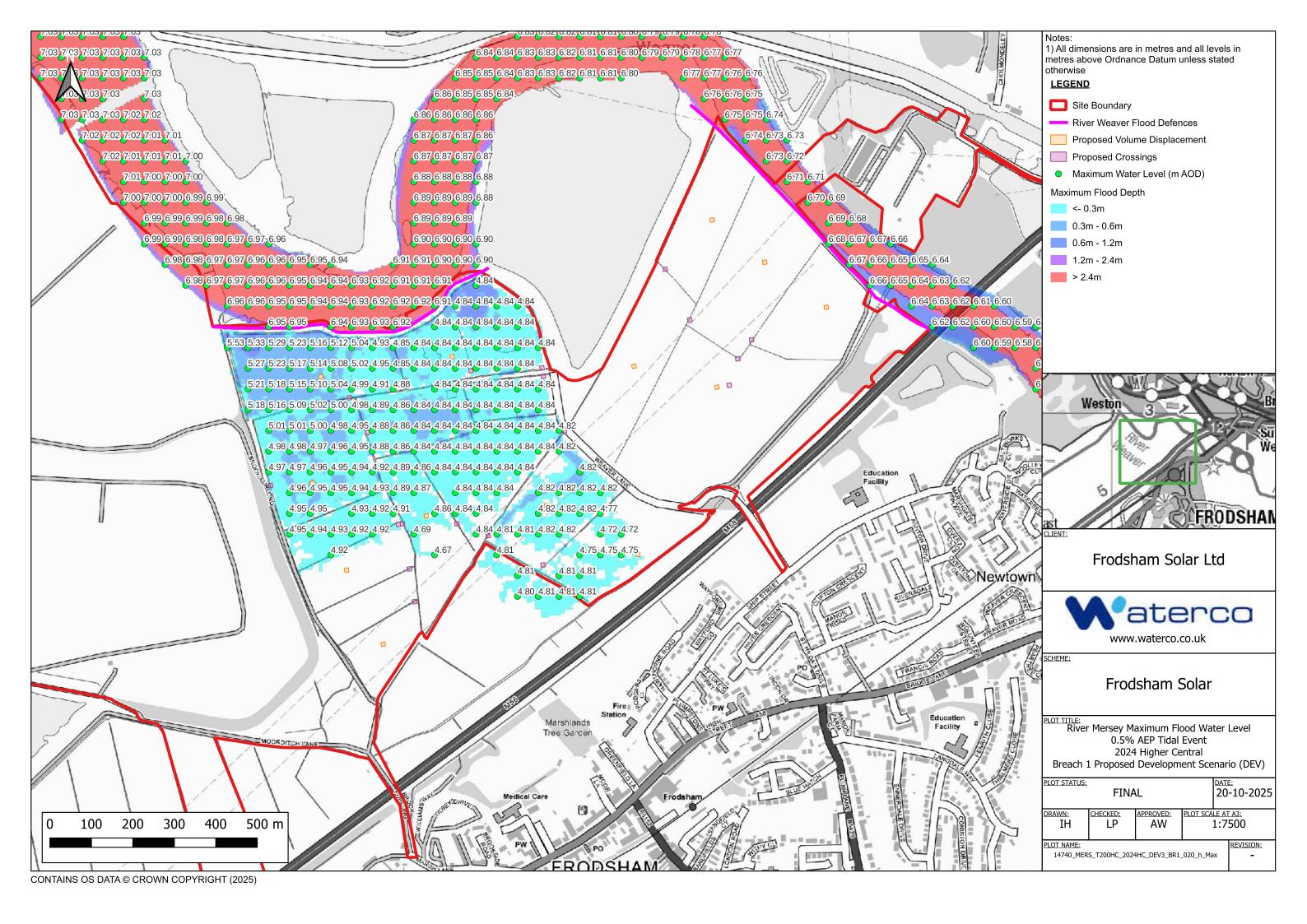


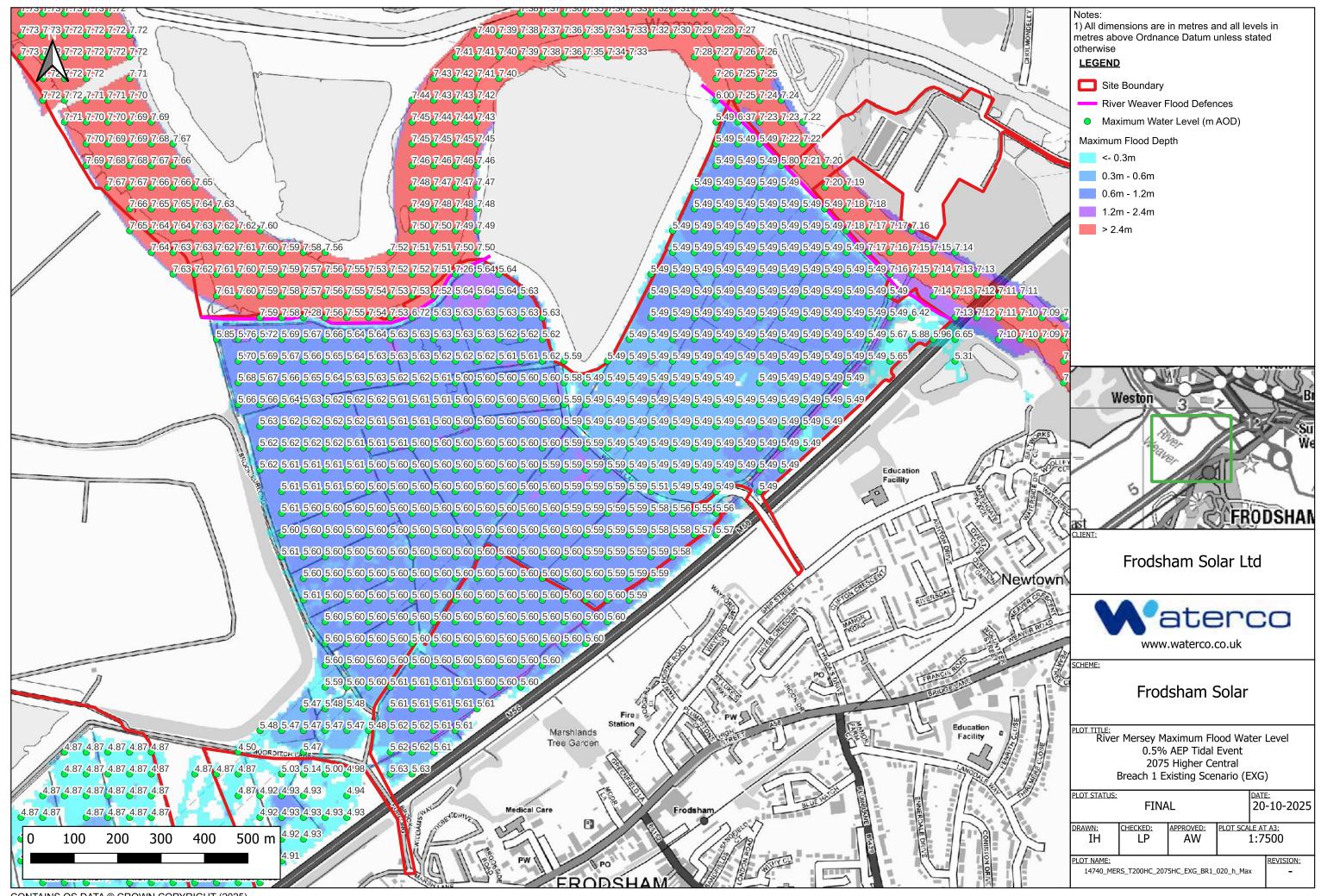


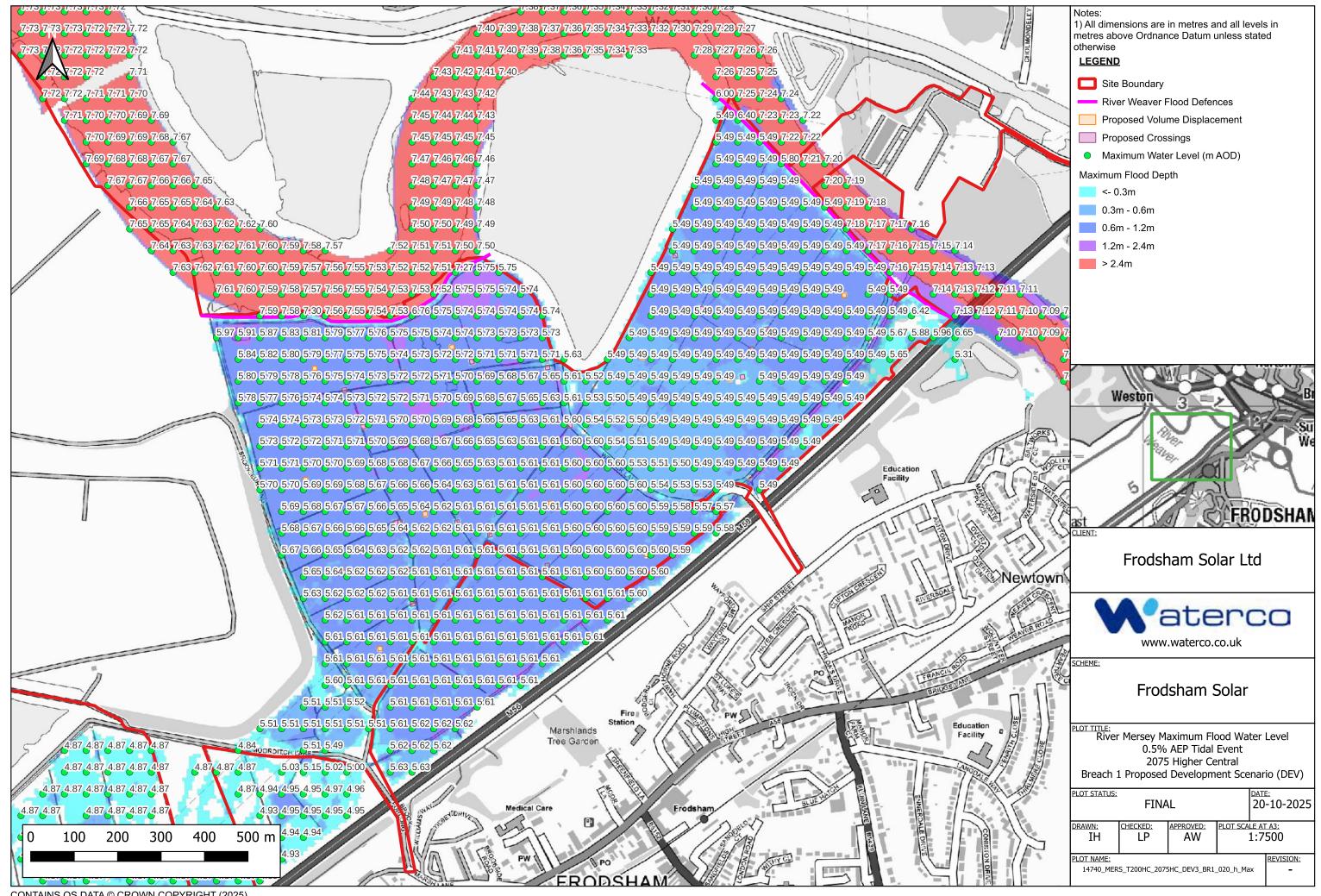


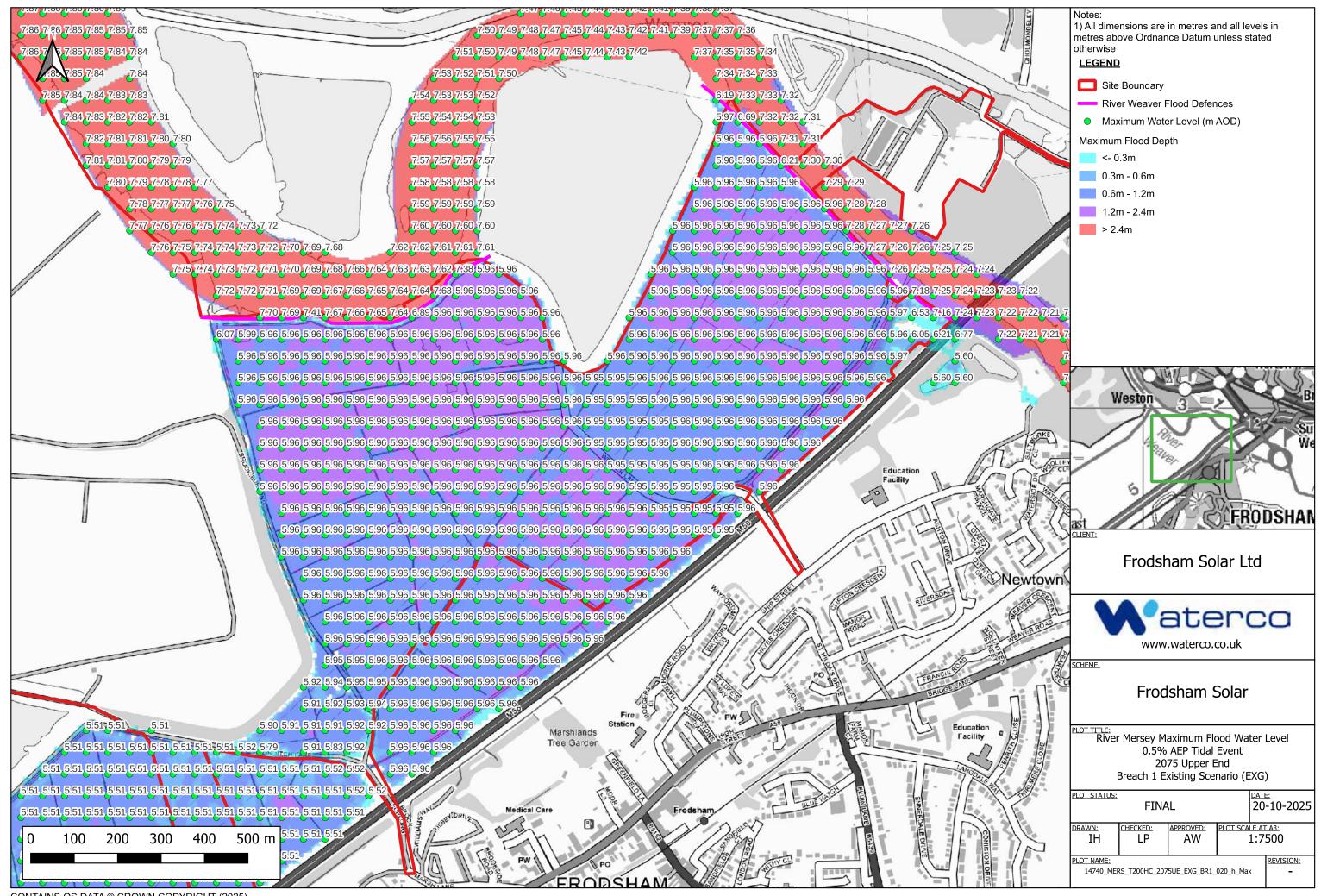


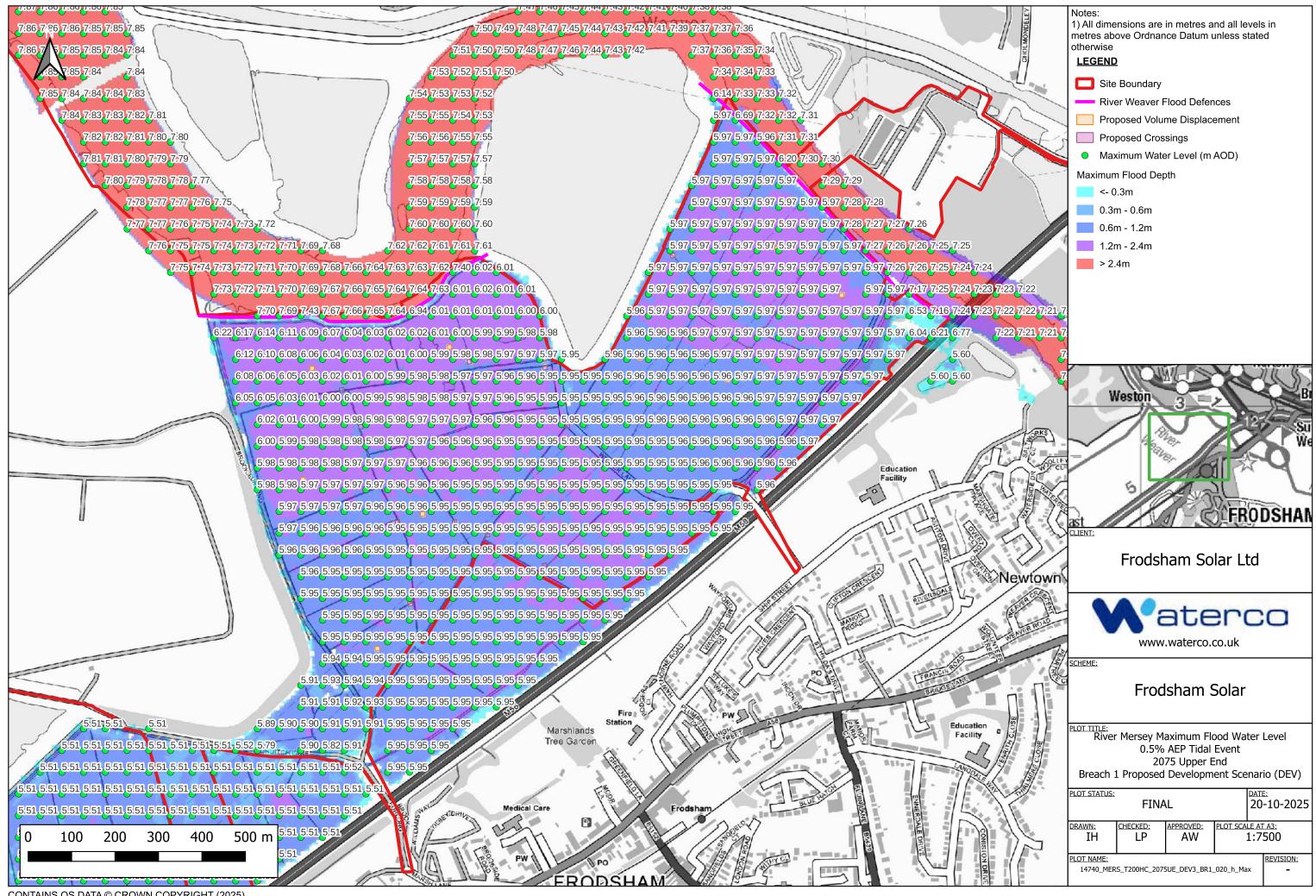


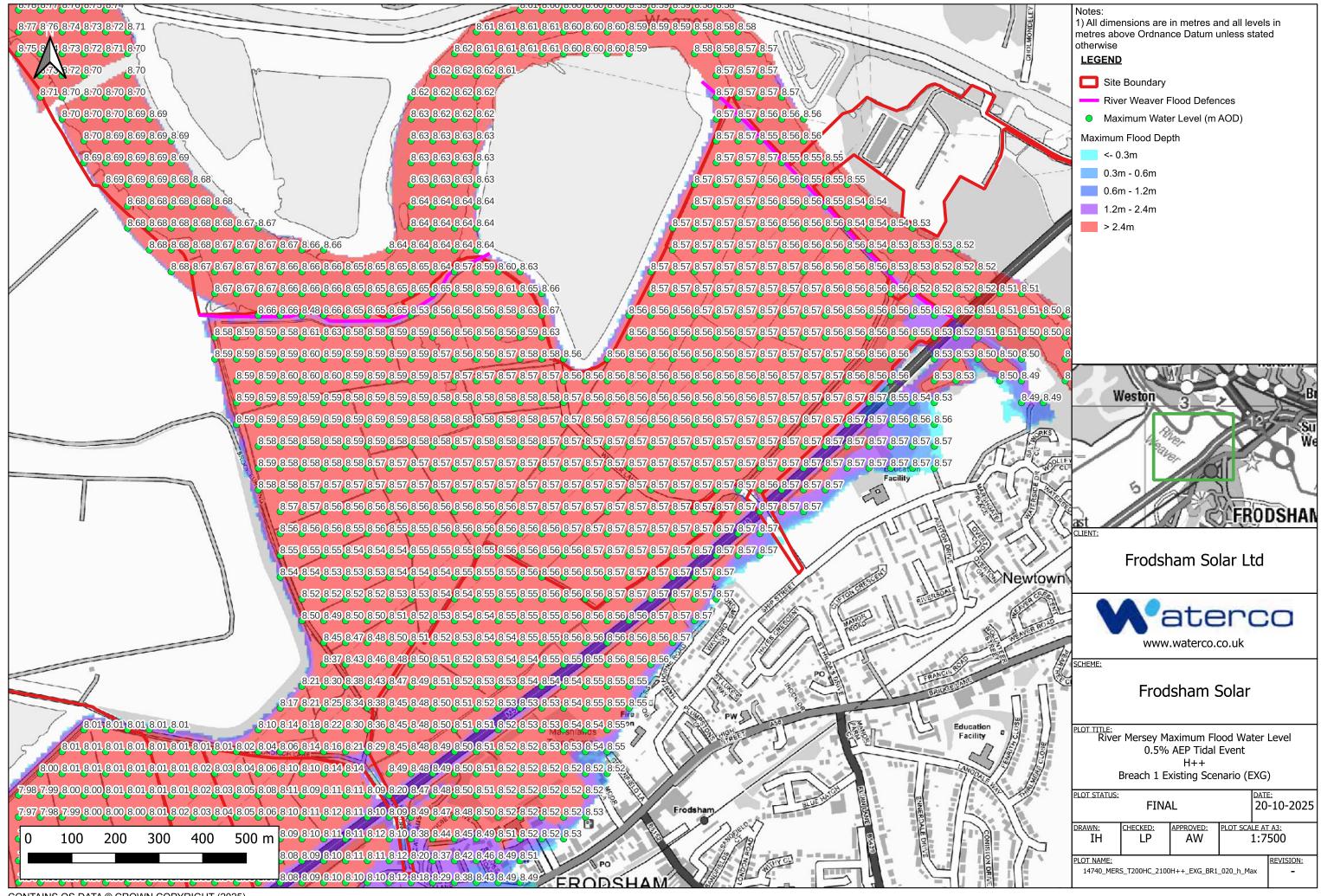


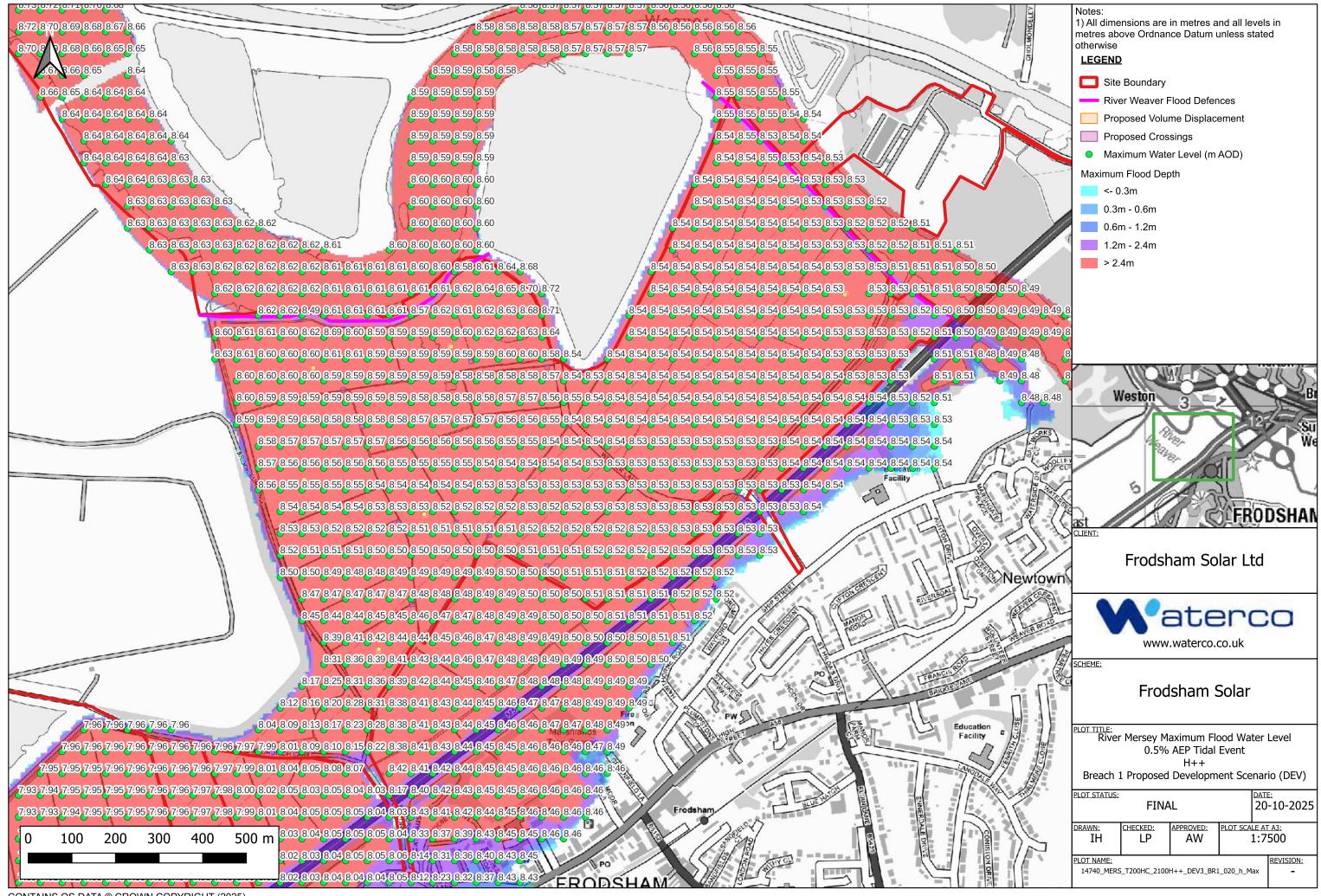
















## **River Weaver Water Level Mapping**



