

Land off Berse Road, Wrexham

Hydraulic Modelling Report

April 2016



DOCUMENT VERIFICATION RECORD

**CLIENT:**

Plas Power Estates

SCHEME:

Land off Berse Road, Wrexham – Hydraulic Modelling Study

INSTRUCTION:

The instruction to carry out this hydraulic modelling was received from Ms Jo Redmond of Strutt & Parker on behalf of Plas Power Estates.

ISSUE HISTORY:

Issue Date	Comment
12/08/2015	First issue
06/04/2016	Additional 95% blockage simulation of Higher Berse Rd Bridge included at request of NRW

DOCUMENT REVIEW & APPROVAL

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Contents

1	Introduction.....	1
2	Hydraulic Modelling	3
3	Results & Conclusions	6
4	Recommendations	10

Appendices

Appendix A – Location Plan & Aerial Photograph
Appendix B – Development site topographic survey data
Appendix C – TAN15 flood map
Appendix D – 1D/2D Model Extent
Appendix E – Tabulated 1D Model Results
Appendix F – 2D Flood Mapping

List of Figures

Figure 1: Extract of TAN15 Flood map.....	2
Figure 2: Maximum Flood depth map – 1% + CCA fluvial event.....	7
Figure 3: Maximum Flood depth map – 0.1% AEP fluvial event	7
Figure 4: Maximum Flood depth map – BL1-66	8
Figure 5: Maximum Flood depth map – BL1-95	9

List of Tables

Table 1 – 2D Model Manning’s n Roughness Coefficients.....	4
Table 2 – Primary (EXG) simulations completed in this study	5

Abbreviations

1D	One Dimensional
2D	Two Dimensional
1D/2D	Combined 1D and 2D hydraulic model
AEP	Annual Exceedance Probability
CC	Climate Change
EA	Environment Agency
LiDAR	Light Detection and Ranging
NRW	Natural Resources Wales
mAOD	metres Above Ordnance Datum

1 Introduction

- 1.1 Waterco Consultants have been commissioned to undertake detailed 1D/2D hydraulic modelling of the Afon Gwenfro watercourse through New Broughton, Wrexham to establish the fluvial flood risk at a proposed residential development site off Berse Road, Wrexham.
- 1.2 The outputs of this modelling exercise will be used to inform development design and support a Flood Consequences Assessment (FCA) being prepared for the development.

Site Description

- 1.3 The site covers an area of approximately 1.72ha and is bordered by Berse Road to the east, Strytybydden Road to the west, residential properties to the north and agricultural land to the south.
- 1.4 The existing site is entirely 'greenfield land' i.e. previously undeveloped. A location plan and an aerial photograph of the site are included in Appendix A.
- 1.5 A topographical survey of the site was undertaken by Geomatic Surveys Ltd in May 2015 and is included in Appendix B for information. The site generally slopes from northeast to southwest with the highest point located near to the eastern site boundary at an elevation of 114.5m AOD and lowest point located at the southern site boundary at an elevation of 109.13m AOD.

Existing Flood Risk Data

- 1.6 Flooding could occur at the site if Afon Gwenfro located approximately 250m west of the site overtops its banks during, or following, extreme rainfall events. The current Welsh Government Development Advice (TAN15) Map for the site has been reviewed and is presented in Appendix C for reference. An extract of the TAN15 flood map is provided in Figure 1.
- 1.7 The Welsh Government's TAN15 Map shows a portion of the site to be located in Flood Zone C2 – an area considered to be within the 0.1% annual exceedance probability (AEP) event flood extent without significant flood defence infrastructure. NRW has advised there are no existing local flood defences in the area maintained by NRW.
- 1.8 The purpose of this study is to more accurately assess the existing fluvial flood risk at site and investigate the impact on flood risk (if any) in the event of blockage of nearby critical hydraulic structures.



Figure 1: Extract of TAN15 Flood map

2 Hydraulic Modelling

- 2.1 To assess existing fluvial flood risk at the site, the latest NRW 1D/2D ISIS-TUFLOW model of Afon Gwenfro, constructed in 2013 as part of the NRW's "River Gwenfro at New Broughton Flood Risk Study", has been sourced and utilised.
- 2.2 This section provides details of the existing NRW model, site-specific updates made to the model and the simulations and scenarios completed as part of this study. The latest versions of Flood Modeller Pro (FMP – previously ISIS) and TUFLOW software available at the start of the project have been used for all simulations; i.e., 4.0 and 2013-12-AE respectively.

1D FMP Model

- 2.3 The Afon Gwenfro model starts at Tanyfron Road (NGR 329997 352038) approximately 250m upstream of Southsea and ends at the A483 road crossing (NGR 331708 350664) downstream of New Broughton. In total, approximately 3km of the Afon Gwenfro is modelled which generally flows northwest to southeast at this location.
- 2.4 Manning's n coefficients have been used to represent the roughness of the channel and structures in the 1D model. The coefficient values generally vary between 0.025 - 0.04 and remain unchanged from the existing model.
- 2.5 No changes have been made to the upstream and downstream boundary conditions given in the NRW model. Inflow hydrographs for the watercourses remain as specified. The downstream boundary condition of the 1D network has been set using a flow-head (Q-H) boundary unit.
- 2.6 To improve the numerical stability of the model an interpolate section has been added between 1D model river cross-section units GwenWr_8070 & GwenWr_8059 and between units Gwen_7179 & Gwen_7164. No other changes have been made to the existing model.

2D TUFLOW Model

- 2.7 The 1D network of the existing NRW model is hydrodynamically linked to a 2D TUFLOW domain, constructed primarily from 1m LiDAR data.
- 2.8 To provide a more accurate assessment of the fluvial flood risk at the site, the existing NRW model's 2D Digital Terrain Model (DTM) has been updated to include the site specific topographic data included in Appendix B.

- 2.9 The 2D model cell size is unchanged from the existing model at 2m. This is sufficient to represent flowpaths within the floodplain whilst maintaining reasonable simulation times.
- 2.10 OS MasterMap data has been used to classify land use and assign Manning's n roughness coefficients throughout the floodplain within the existing model. The coefficients used in the current NRW model are given in Table 1 below and remain unchanged for this study.

Table 1 – 2D Model Manning's n Roughness Coefficients

Land Use	Manning's n Roughness Coefficient ($\text{sm}^{-1/3}$)
General Surfaces	0.05
Buildings	1.0
Fields & natural land	0.065
Rail	0.065
Inland water	0.03
Roads and Footpaths	0.025
Structures	0.065

- 2.11 Similar to the existing NRW model, no open boundaries have been used within the 2D model domain.
- 2.12 No additional changes have been made to the existing NRW 2D TUFLOW model.

Primary (EXG) and Blockage Scenario (BL1) Simulations

- 2.13 In order to fully investigate the existing fluvial flood risk at the site, the updated model (including site-specific level data) has been run to simulate the 5% (1 in 20), 1% (1 in 100) and 0.1% (1 in 1000) AEP fluvial events. The effect of future climate change (CCA) has also been investigated for the 1% AEP event as 20% increase in flows. A total of four primary simulations have been completed as summarised in Table 2.

Table 2 – Primary (EXG) simulations completed in this study

Model ID	Annual Exceedance Probability (AEP)	Return Period
Q20	5%	1 in 20
Q100	1%	1 in 100
Q100CC	1% + CCA	1 in 100 + CCA
Q1000	0.1%	1 in 1000

2.14 To investigate the potential flood risk at the site in the event of a blockage to nearby critical structures, two blockage scenarios have been performed as summarised below:

- **Blockage Scenario BL1-66**
 - 66% blockage of Higher Berse Road culvert located upstream of the proposed development site location - FMP model unit 'GwenWr_6865C'.
 - Simulation completed with respect to the 1% AEP + CCA fluvial event.
- **Blockage Scenario BL1-95**
 - 95% blockage of Higher Berse Road culvert located upstream of the proposed development site location - FMP model unit 'GwenWr_6865C'.
 - Simulation completed with respect to the 0.1% AEP fluvial event.

3 Results & Conclusions

- 3.1 This section of the report documents the results obtained from the primary flow simulations, blockage scenarios and sensitivity tests.
- 3.2 Calculated maximum water levels were extracted at each node along the 1D network model and compared for each simulation. A table of this data has been provided in Appendix E. Maximum flood depth, velocity and flood hazard rating maps have been provided for all simulations in Appendix F.
- 3.3 The 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'.
- 3.4 The results of the hydraulic modelling show the entire development site to be dry during all fluvial events up to and including the 1% AEP + CCA event. An extract of the 1% AEP + CCA simulation flood depth map is given in Figure 2 for information.
- 3.5 During the 0.1% AEP event, approximately 20% of the site area is affected by shallow depth flooding. Maximum flood depth values are generally less than 200mm. An extract of the 0.1% AEP simulation flood depth map is given in Figure 3 for information.
- 3.6 This flooding is due to overland flow caused by insufficient capacity of the Higher Berse Road culvert (located 300m upstream of the site) to convey this extreme flow. During this event water level increases upstream of the culvert are sufficient to spill over the left bank, along Weston Road and down into the site. The maximum water level on the site during this event is 111.5mAOD in the north-west corner. Velocities through the site are generally low (<0.3m/s) but reach up to 0.75m/s at regions close to the northwest site boundary. The flood hazard rating is 'low' during this event.

Figure 2: Maximum Flood depth map – 1% + CCA fluvial event

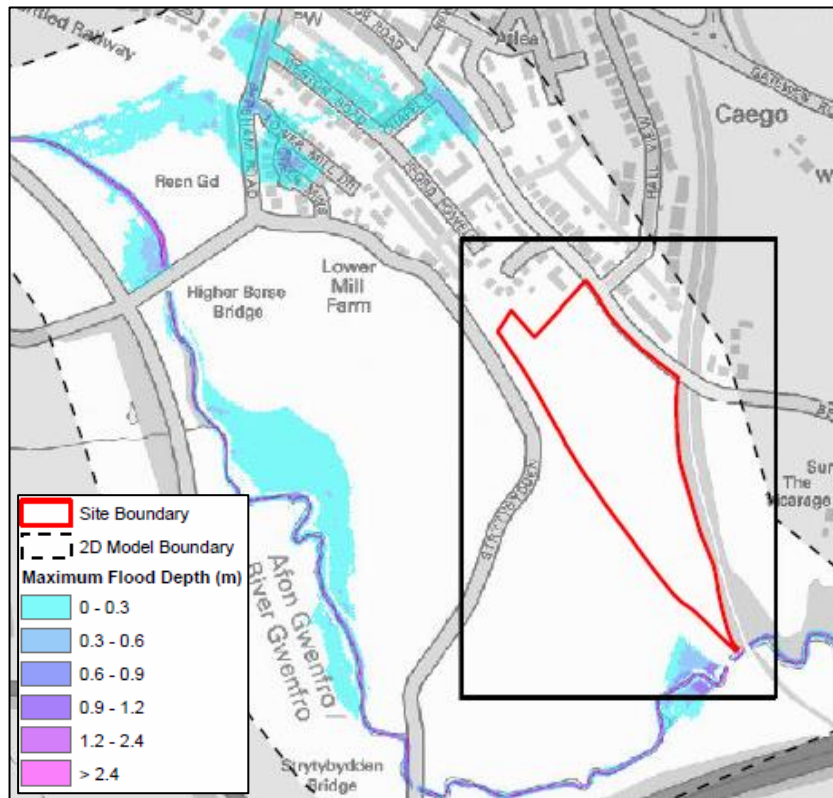
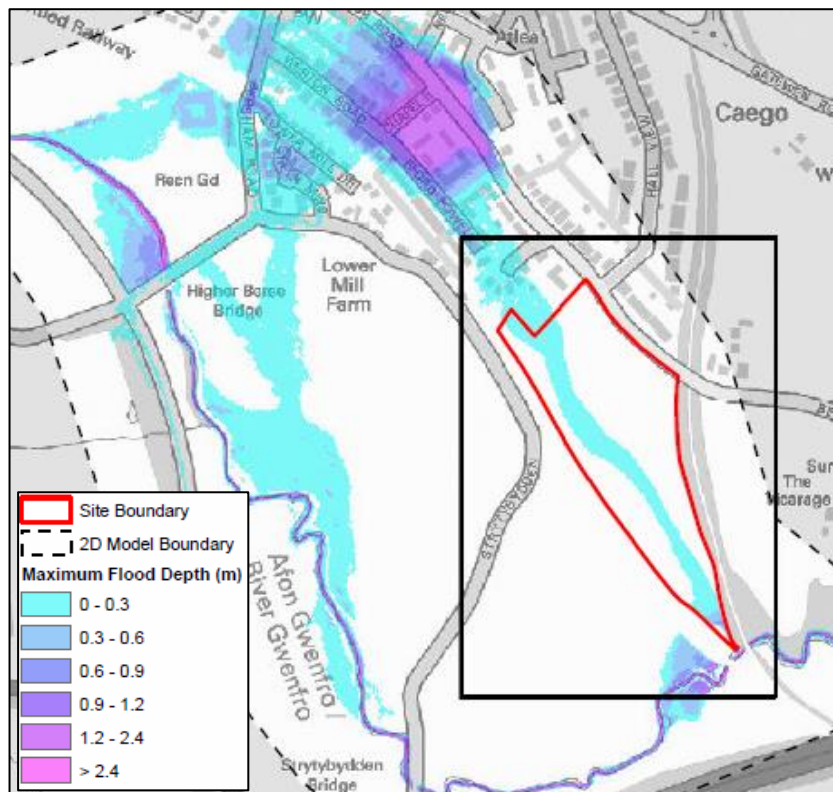


Figure 3: Maximum Flood depth map – 0.1% AEP fluvial event

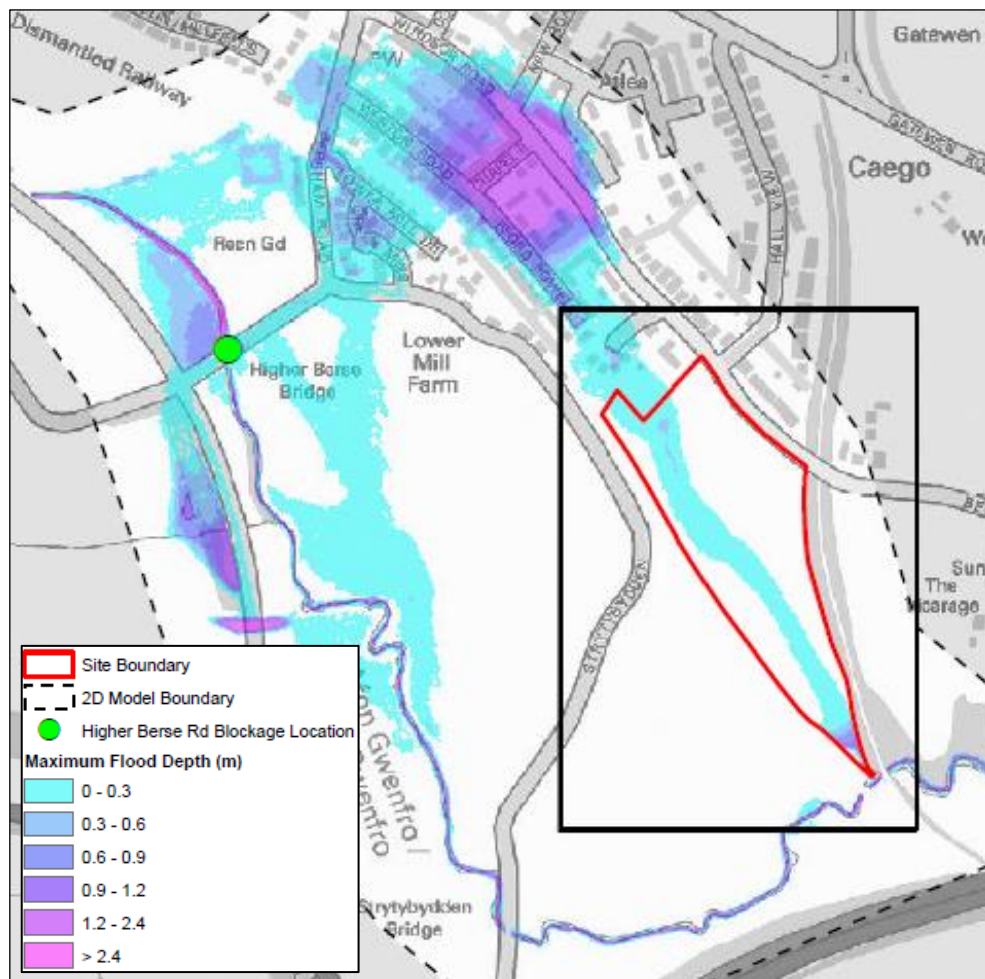


Blockage Scenarios

BL1-66 - 66% blockage to Higher Berse Road; 1% AEP + CCA

- 3.7 Model outputs for blockage scenario BL1-66 shows such an event would have a significant impact on flood risk at the site with approximately 40% of the site area is shown to experience flooding. Due to insufficient conveyance capacity caused by blockage of the culvert, the Afon Gwenfro overtops its banks upstream of the culvert inlet causing flood waters to enter the site from the north-west similar to the 0.1% AEP event simulation. An extract of the BL1-66 flood depth map is given in Figure 4 for information.
- 3.8 Maximum flood depth values are generally less than 300mm during the Q100CC BL1-66 blockage scenario. The maximum water level on the site during this scenario is 111.6mAOD. Velocities through the site increase up to 0.75m/s and the flood hazard rating varies between 'Danger for Some' to 'Danger for Most'.

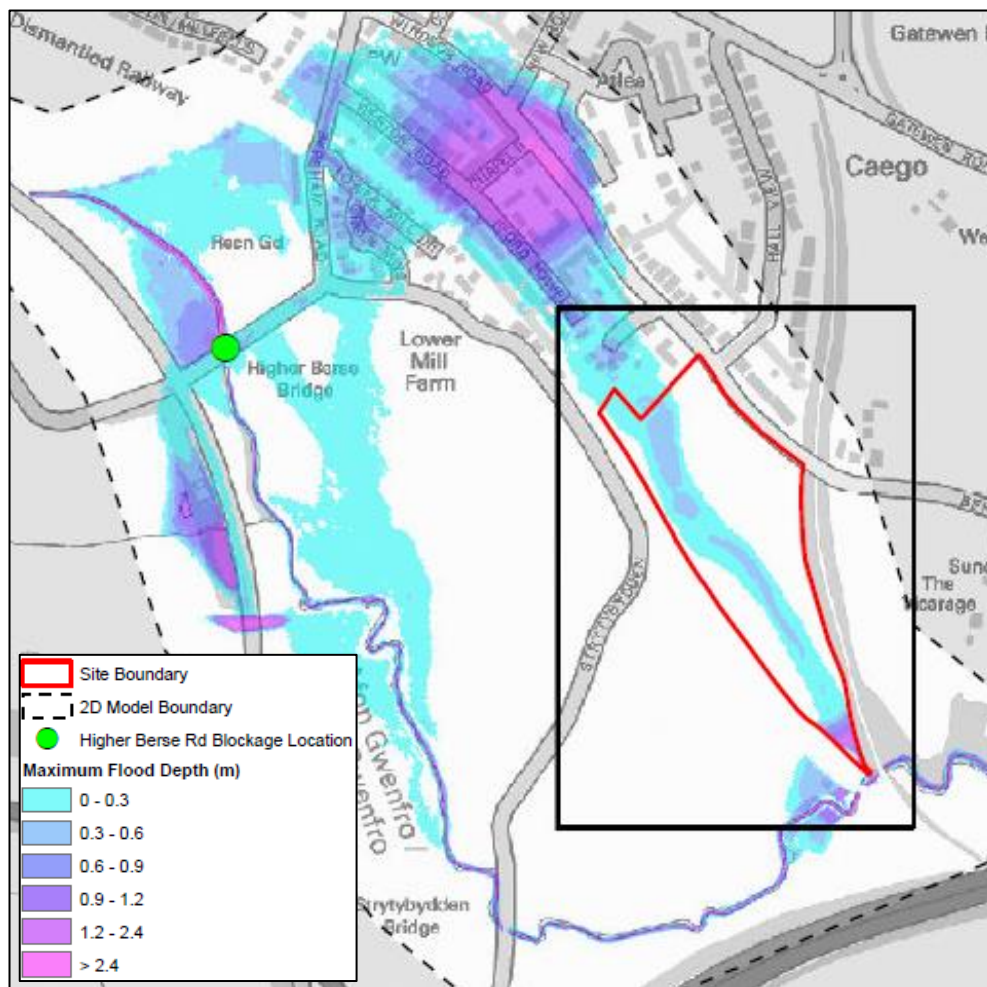
Figure 4: Maximum Flood depth map – BL1-66



BL1-95 - 95% blockage to Higher Berse Road; 0.1% AEP

- 3.9 Similar to the BL1-66 scenario, the BL1-95 simulation results show that the extreme scenario of a 95% blockage during the 0.1% AEP event has significant impacts on flood risk at the site. Approximately 45% of the site area is inundated during this scenario with maximum flood depths on site reaching up to 0.59m. An extract of the BL1-95 flood depth map is given in Figure 5 for information.

Figure 5: Maximum Flood depth map – BL1-95



- 3.10 The maximum water level on the site during this scenario is 111.9mAOD. Velocities through the site increase up to 1.3m/s and the flood hazard rating varies between 'Danger for Some' to 'Danger for Most'.

4 Recommendations

- 4.1 The hydraulic model and associated report should be submitted to NRW for review and approval as a reasonable representation of the existing fluvial flood risk at the proposed development site.
- 4.2 The outputs of this modelling study should be used to inform the site layout design/levels and support the Flood Consequences Assessment.

Appendix A – Location Plan & Aerial Photograph



Location Plan

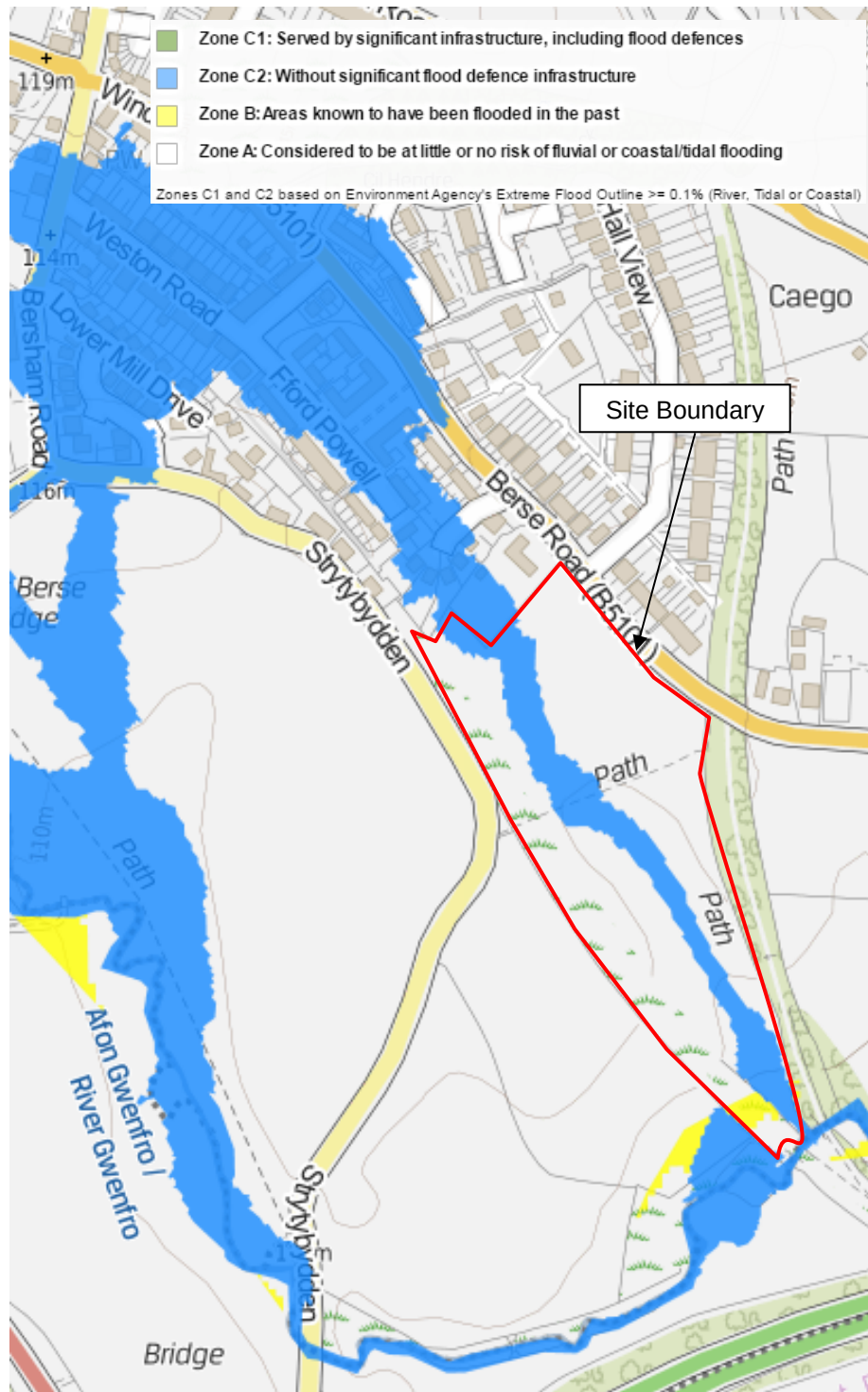
(Development site shown in red)



Aerial Photograph
(Development site shown in red)

Appendix B – Development site topographic survey data

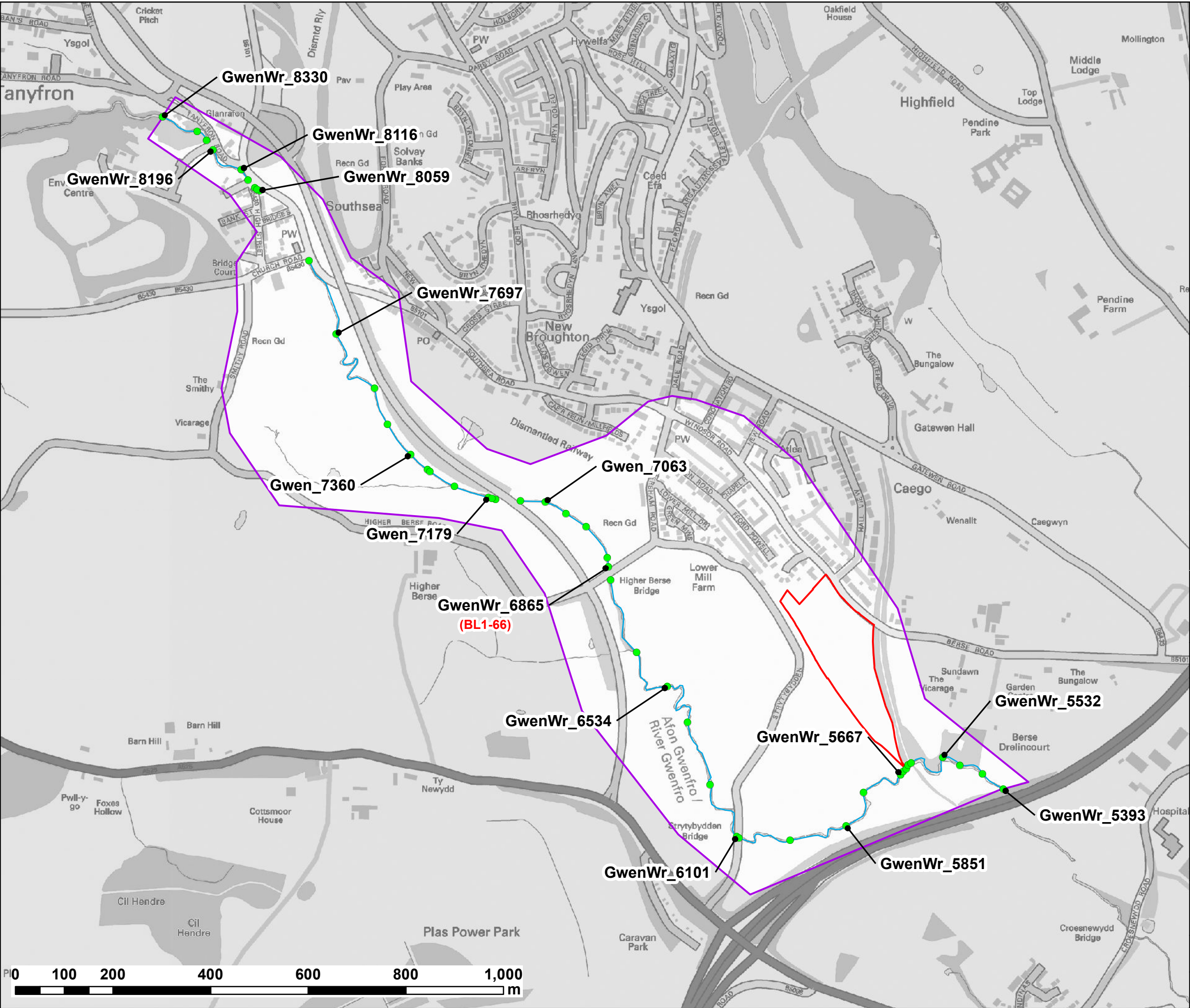
Appendix C – TAN15 flood map



TAN15 Flood Map

(Development site shown in red)

Appendix D – 1D/2D Model Extent



LEGEND

- Site Boundary
- 1D Model Nodes
- 2D Model Boundary

CLIENT:

PLAS POWER ESTATES

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:

**LAND OFF BERSE ROAD
WREXHAM**

PLOT TITLE:

1D/2D MODEL EXTENT

PLOT STATUS:

ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:7,500 (UNLESS STATED OTHERWISE)
DATE: 05/08/2015		PLOT NAME: w3183-Model_Extent	REV: A

Appendix E – Tabulated 1D Model Results

Land off Berse Road, Wrexham



Hydraulic Model Results - Afon Gwenfro
1D FMP Model Results - Maximum Water Levels (mAOD) and Depths (m)

Job Name: Berse Road, Wrexham
Job Number: w3183
Date: 31/03/16
Model Type: FMP-TUFLOW
FMP Build: 4.0 64-bit DP
TUFLOW Build: 2013-12-AE 64-bit iDP

Notes:

Waterco model build 003

			EXISTING SITE LAYOUT (EXG)								BLOCKAGE SCENARIOS					
			Q20		Q100		Q100CC		Q1000		Q100CC BL1-66			Q1000 BL1-95		
Node Label	Feature	Bed Elevation (mAOD)	Max WL (mAOD)	Max Flood Depth (m)	Max WL (mAOD)	Max Flood Depth (m)	Max WL (mAOD)	Max Flood Depth (m)	Max WL (mAOD)	Max Flood Depth (m)	Max WL (mAOD)	Max Flood Depth (m)	WL Diff vs EXG (m)	Max WL (mAOD)	Max Flood Depth (m)	WL Diff vs EXG (m)
GwenWr_8249	Higher Berse Road Bridge	135.33	136.36	1.02	136.65	1.32	136.82	1.48	137.30	1.97	136.82	1.48	0.00	137.30	1.97	0.00
GwenWr_8219		135.07	136.19	1.12	136.52	1.45	136.71	1.64	137.23	2.16	136.71	1.64	0.00	137.23	2.16	0.00
GwenWr_8219C		135.07	135.88	0.81	136.11	1.04	136.24	1.17	136.64	1.57	136.24	1.17	0.00	136.64	1.57	0.00
GwenWr_8196C		134.82	135.61	0.78	135.83	1.01	135.97	1.15	136.40	1.58	135.97	1.15	0.00	136.40	1.58	0.00
GwenWr_8196		134.81	135.52	0.71	135.71	0.90	135.82	1.01	136.19	1.38	135.82	1.01	0.00	136.20	1.38	0.00
GwenWr_8116		132.78	134.04	1.26	134.85	2.07	134.89	2.11	134.92	2.14	134.89	2.11	0.00	134.92	2.14	0.00
GwenWr_8091		132.49	133.87	1.38	134.94	2.44	135.05	2.56	135.30	2.81	135.05	2.56	0.00	135.31	2.82	0.00
GwenWr_8091C		132.49	133.64	1.15	134.56	2.07	134.68	2.19	134.97	2.48	134.68	2.19	0.00	134.97	2.48	0.00
GwenWr_8086C		132.40	133.62	1.22	134.52	2.11	134.64	2.24	134.93	2.53	134.64	2.24	0.00	134.93	2.53	0.00
GwenWr_8081a		132.32	133.60	1.28	134.47	2.16	134.60	2.28	134.89	2.57	134.60	2.28	0.00	134.89	2.58	0.00
GwenWr_8081b		132.32	133.60	1.28	134.47	2.16	134.60	2.28	134.89	2.57	134.60	2.28	0.00	134.89	2.58	0.00
GwenWr_8075C		132.23	133.49	1.27	134.32	2.09	134.45	2.22	134.75	2.52	134.45	2.22	0.00	134.75	2.52	0.00
GwenWr_8070C		132.14	133.39	1.25	134.16	2.02	134.29	2.15	134.61	2.47	134.29	2.15	0.00	134.62	2.48	0.01
GwenWr_8070		132.06	132.96	0.90	133.76	1.70	133.86	1.80	134.16	2.10	133.86	1.80	0.00	134.17	2.11	0.00
GwenWr_8064i		131.70	132.85	1.15	133.84	2.14	133.93	2.23	134.16	2.46	133.93	2.23	0.00	134.16	2.46	0.00
GwenWr_8059		131.40	132.90	1.50	133.87	2.47	133.94	2.54	134.21	2.81	133.94	2.54	0.00	134.20	2.80	-0.01
GwenWr_8059C		131.40	132.49	1.09	133.19	1.79	133.23	1.83	133.54	2.14	133.23	1.83	0.00	133.54	2.14	0.00
GwenWr_7894a		129.65	130.58	0.93	130.79	1.14	130.88	1.23	130.98	1.33	130.88	1.23	0.00	130.99	1.34	0.00
GwenWr_7894b		129.65	130.58	0.93	130.79	1.14	130.88	1.23	130.98	1.33	130.88	1.23	0.00	130.99	1.34	0.00
GwenWr_7884C		129.54	130.58	1.04	130.79	1.25	130.85	1.31	130.93	1.39	130.85	1.31	0.00	130.93	1.39	0.00
GwenWr_7884		129.48	130.42	0.94	130.60	1.12	130.67	1.19	130.76	1.28	130.67	1.19	0.00	130.76	1.28	0.00
GwenWr_7697		126.20	126.84	0.64	126.97	0.77	127.03	0.83	127.14	0.94	127.03	0.83	0.00	127.14	0.94	0.00
GwenWr_7519		123.18	124.24	1.06	124.42	1.24	124.51	1.33	124.63	1.45	124.51	1.33	0.00	124.63	1.44	0.00
Gwen_7440		122.45	123.44	0.99	123.55	1.09	123.60	1.14	123.83	1.38	123.60	1.14	0.00	123.83	1.38	0.00
Gwen_7360		121.73	122.90	1.18	123.04	1.31	123.06	1.34	123.07	1.35	123.06	1.34	0.00	123.07	1.35	0.00
GwenWr_7281a		121.00	121.99	0.99	122.23	1.23	122.33	1.33	122.80	1.80	122.33	1.33	0.00	122.81	1.81	0.01
GwenWr_7281b		121.00	121.99	0.99	122.23	1.23	122.33	1.33	122.80	1.80	122.33	1.33	0.00	122.81	1.81	0.01
Gwen_7223		119.92	120.94	1.02	121.16	1.24	121.35	1.43	122.38	2.46	121.35	1.43	0.00	122.41	2.49	0.02
Gwen_7179		119.10	120.26	1.16	120.59	1.49	121.00	1.90	122.42	3.32	121.00	1.90	0.00	122.44	3.34	0.02
Gwen_7171i		118.95	120.20	1.25	120.61	1.66	121.01	2.06	122.42	3.47	121.01	2.06	0.00	122.44	3.49	0.02
GwenWr_7164		118.82	120.20	1.38	120.62	1.80	121.02	2.20	122.42	3.60	121.02	2.20	0.00	122.45	3.63	0.02
GwenWr_7164C		118.82	119.50	0.68	119.71	0.89	119.82	1.00	120.40	1.58	119.82	1.00	0.00	120.42	1.60	0.01
GwenWr_7139a		118.35	119.07	0.72	119.30	0.95	119.40	1.05	119.75	1.40	119.40	1.05	0.00	119.76	1.41	0.01
GwenWr_7139b		118.35	119.07	0.72	119.30	0.95	119.40	1.05	119.75	1.40	119.40	1.05	0.00	119.76	1.41	0.01
GwenWr_7113C		117.87	118.69	0.82	118.89	1.02	118.95	1.08	119.06	1.19	118.95	1.08	0.00	119.09	1.22	0.02
GwenWr_7113		117.57	118.59	1.02	118.76	1.19	118.80	1.23	118.89	1.32	118.80	1.23	0.00	118.91	1.34	0.02
Gwen_7063		116.60	117.45	0.85	117.64	1.04	117.72	1.12	117.83	1.23	117.73	1.13	0.00	117.81	1.21	-0.02
GwenWr_7014		115.65	116.56	0.91	116.76	1.11	116.92	1.27	117.10	1.45	117.15	1.50	0.23	117.23	1.58	0.13
Gwen_6976		115.00	115.94	0.94	116.29	1.29	116.70	1.71	117.01	2.02	117.18	2.19	0.48	117.29	2.30	0.28
Gwen_6901		113.99	115.16	1.17	116.09	2.10	116.68	2.69	117.01	3.01	117.01	3.02	0.33	117.06	3.07	0.05
GwenWr_6865		113.66	115.12	1.46	116.09	2.43	116.67	3.01	117.00	3.34	117.11	3.45	0.44	117.18	3.52	0.18
GwenWr_6865C		113.66	114.76	1.10	115.17	1.51	115.49	1.83	115.64	1.98	116.87	3.21	1.38	113.91	0.25	-1.73
GwenWr_6856C		113.51	114.72	1.21	115.01	1.49	115.27	1.76	115.39	1.88	116.28	2.77	1.01	113.88	0.37	-1.51
GwenWr_6847C		113.35	114.64	1.29	114.84	1.49	115.06	1.71	115.14	1.79	115.69	2.34	0.63	113.88	0.53	-1.27
GwenWr_6838C		113.20	114.56	1.36	114.69	1.49	114.85	1.65	114.90	1.70	115.10	1.90	0.26	113.88	0.67	-1.02
GwenWr_6838		113.17	114.35	1.18	114.56	1.39	114.64	1.47	114.66	1.49	114.25	1.08	-0.39	113.87	0.69	-0.80
GwenWr_6678		111.20	112.02	0.82	112.05	0.86	112.07	0.87	112.08	0.88	112.00	0.80	-0.07	111.94	0.74	-0.14
GwenWr_6534		109.42	110.10	0.68	110.23	0.80	110.27	0.85	110.32	0.89	110.12	0.69	-0.16	110.19	0.77	-0.12
Gwen_6389		107.58	108.49	0.91	108.64	1.06	108.69	1.11	108.72	1.14	108.52	0.94	-0.17	108.58	1.00	-0.14
Gwen_6246		105.76	106.62	0.86	106.82	1.06	106.89	1.13	106.95	1.19	106.65	0.89	-0.24	106.73	0.96	-0.22
GwenWr_6101	103.92	105.19	1.27	105.49	1.57	105.61	1.69	105.72	1.80	105.23	1.31	-0.39	105.33	1.41	-0.38	
GwenWr_6101C	103.92	104.90	0.98	105.12	1.20	105.20	1.28	105.27	1.35	104.93	1.01	-0.27	105.00	1.08	-0.27	
GwenWr_6095C	103.90	104.85	0.95	105.06	1.16	105.13	1.23	105.20	1.30	104.88	0.98	-0.25	104.94	1.04	-0.25	
GwenWr_6095	103.86	104.69	0.83	104.83	0.97	104.88	1.02	104.92	1.06	104.71	0.85	-0.17	104.75	0.89	-0.17	
Gwen_5973	102.15	102.99	0.84	103.19	1.04	103.29	1.14	103.41	1.26	103.02	0.86	-0.28	103.12	0.96	-0.30	
GwenWr_5851	100.44	101.45	1.01	101.59	1.15	101.60	1.16	101.61	1.17	101.48	1.04	-0.12	101.51	1.07	-0.10	
Gwen_5759	99.34	100.50	1.16	100.76	1.42	100.89	1.55	101.05	1.71	100.53	1.19	-0.36	100.92	1.58	-0.13	
GwenWr_5667	98.24	99.97	1.73	100.33	2.09	100.48	2.24	100.63	2.39	100.07	1.83	-0.41	100.75	2.51	0.13	
GwenWr_5667C	98.24	99.80	1.56	100.10	1.86	100.23	1.99	100.35	2.11	99.95	1.71	-0.28	100.64	2.40	0.29	
GwenWr_5658C	98.64	99.70	1.06	99.99	1.35	100.12	1.48	100.24	1.60	99.90	1.26	-0.22	100.62	1.97	0.38	
GwenWr_5658	98.64	99.56	0.92	99.83	1.19	99.94	1.30	100.05	1.41	99.82	1.18	-0.12	100.58	1.94	0.53	
GwenWr_5648	98.65	99.53	0.88	99.82	1.17	99.94	1.29	100.06	1.41	99.82	1.17	-0.12	100.59	1.94	0.53	
GwenWr_5642	98.40	99.53	1.13	99.82	1.42	99.94	1.54	100.05	1.65	99.68	1.28	-0.26	100.32	1.92	0.27	
GwenWr_5642C	98.45	99.20	0.75	99.41	0.96	99.50	1.05	99.58	1.13	99.31	0.86	-0.19	99.77	1.32	0.19	
GwenWr_5633C	98.11	99.17	1.06	99.39	1.28	99.49	1.38	99.57	1.46	99.28	1.17	-0.20	99.77	1.66	0.20	
GwenWr_5633	98.11	99.03	0.92	99.21	1.10	99.28	1.17	99.35	1.24	99.12	1.01	-0				

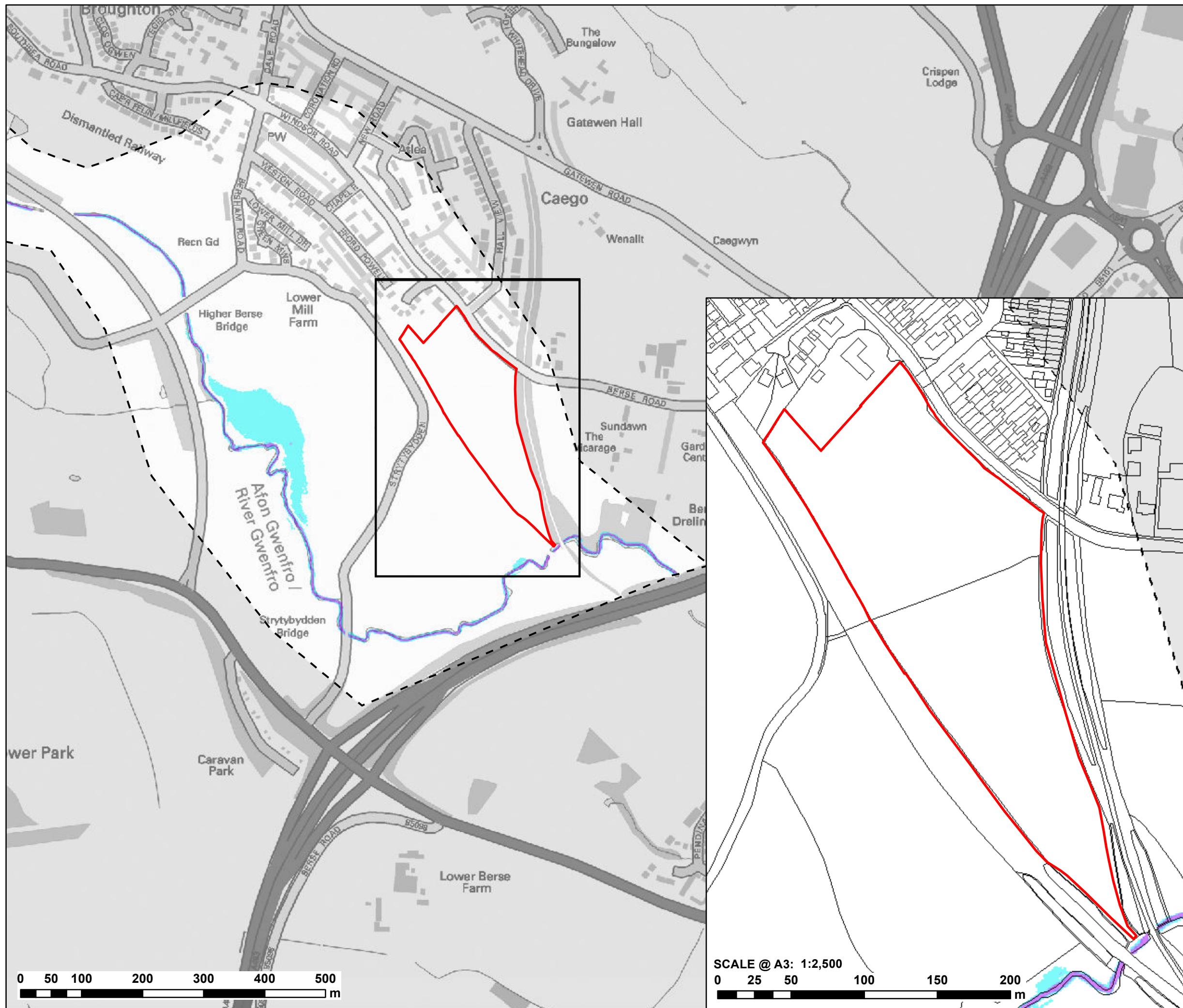
Appendix F – 2D Flood Mapping

Maximum Flood Depth

Maximum Velocity

Flood Hazard Rating

Primary Simulations



LEGEND

Site Boundary

2D Model Boundary

Maximum Flood Depth (m)

0 - 0.3

0.3 - 0.6

0.6 - 0.9

0.9 - 1.2

1.2 - 2.4

> 2.4

CLIENT:

PLAS POWER ESTATES

waterco
consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

**LAND OFF BERSE ROAD
WREXHAM**

PLOT TITLE:

**MAXIMUM FLOOD DEPTH
5% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT**

PLOT STATUS:

ISSUE

DRAWN: SB

CHECKED: DH

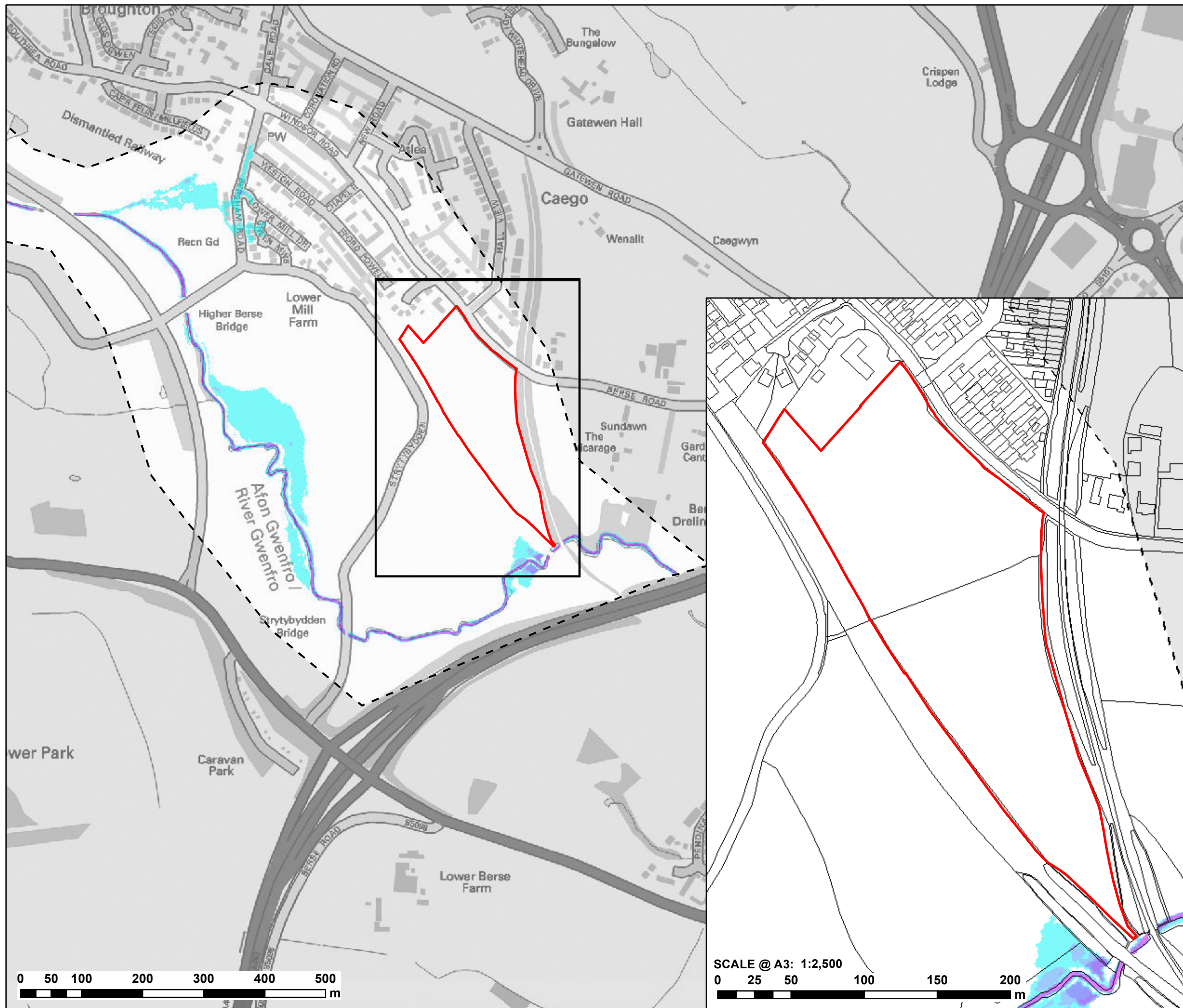
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PLOT SCALE @ A3: 1:6,000
(UNLESS STATED OTHERWISE)

DATE: 04/04/2016

PLOT NAME: w3183-Q20_EXG_D

REV: A



LEGEND

Site Boundary

2D Model Boundary

Maximum Flood Depth (m)

0 - 0.3

0.3 - 0.6

0.6 - 0.9

0.9 - 1.2

1.2 - 2.4

> 2.4

CLIENT:
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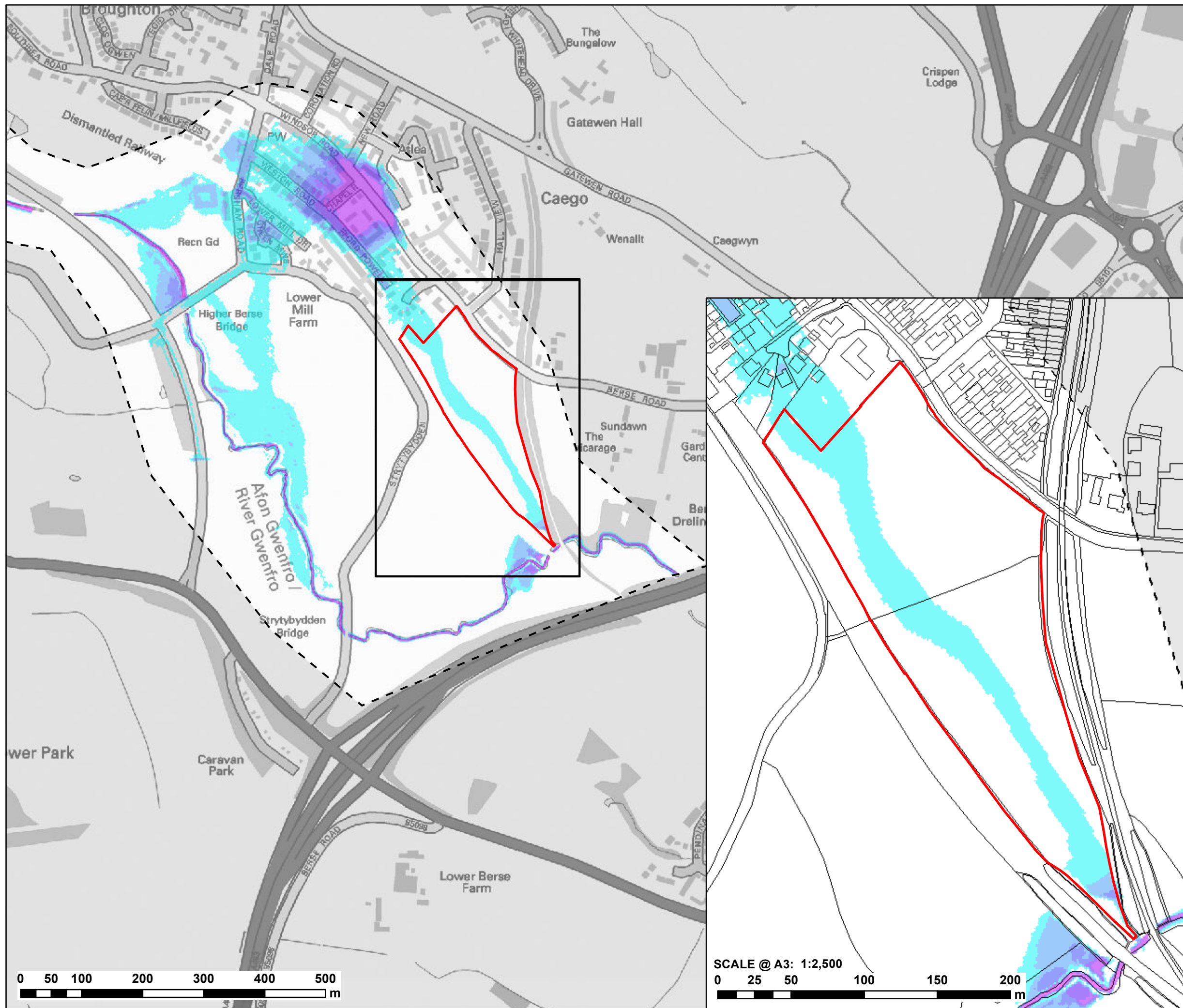
Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:
**LAND OFF BERSE ROAD
WREXHAM**

PLOT TITLE:
**MAXIMUM FLOOD DEPTH
1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT**

PLOT STATUS:
ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016		PLOT NAME: w3183-Q100_EXG_D	REV: A



LEGEND

- Site Boundary
- 2D Model Boundary

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- 1.2 - 2.4
- > 2.4

CLIENT:

PLAS POWER ESTATES

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SCHEME:

LAND OFF BERSE ROAD WREXHAM

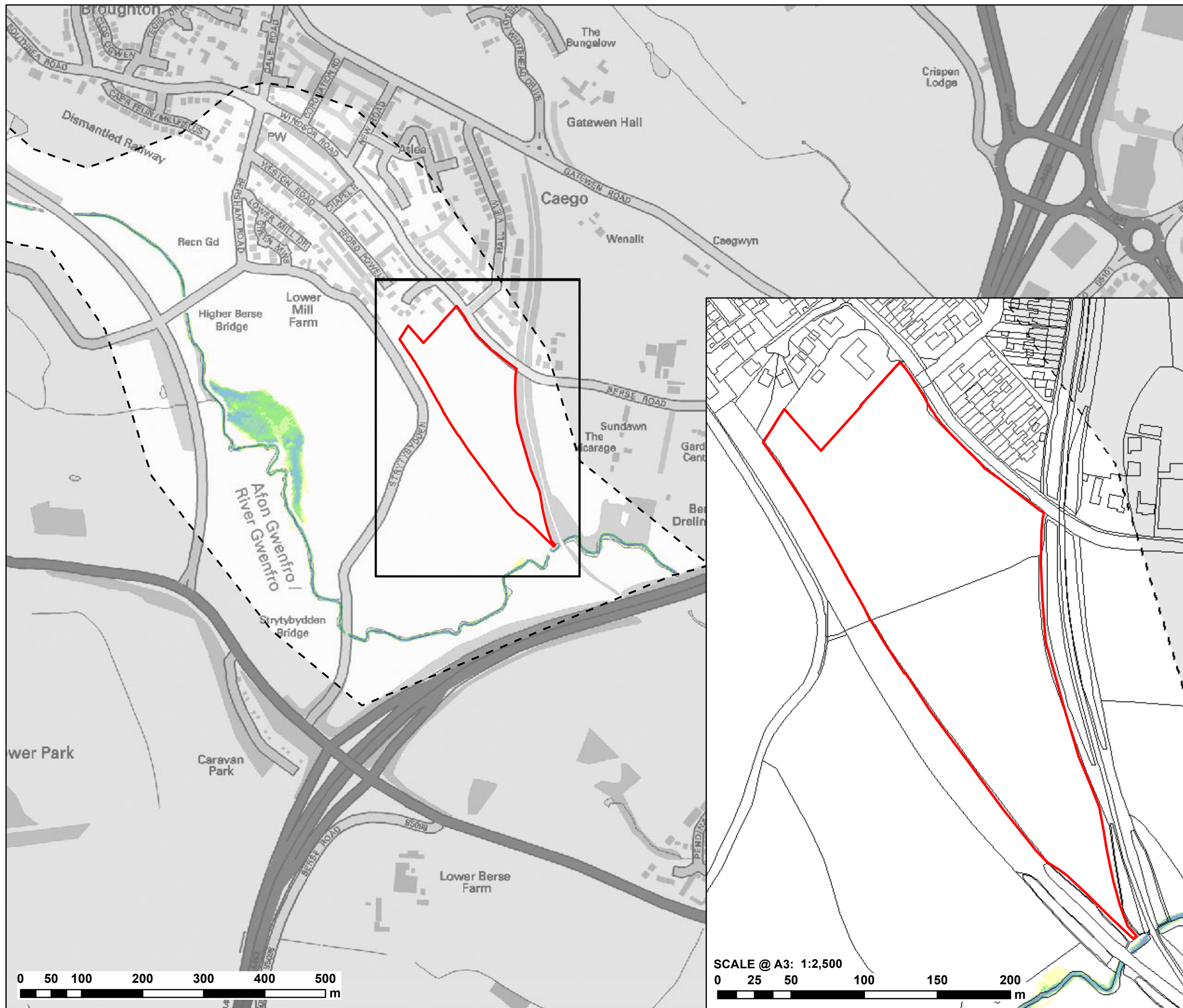
PLOT TITLE:

MAXIMUM FLOOD DEPTH
0.1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT

PLOT STATUS:

ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016		PLOT NAME: w3183-Q1000_EXG_D	REV: A



LEGEND

Site Boundary

2D Model Boundary

Maximum Velocity (m/s)

0 - 0.15

0.15 - 0.3

0.3 - 0.45

0.45 - 0.6

0.6 - 1.2

1.2 - 2.4

> 2.4

CLIENT:
PLAS POWER ESTATES

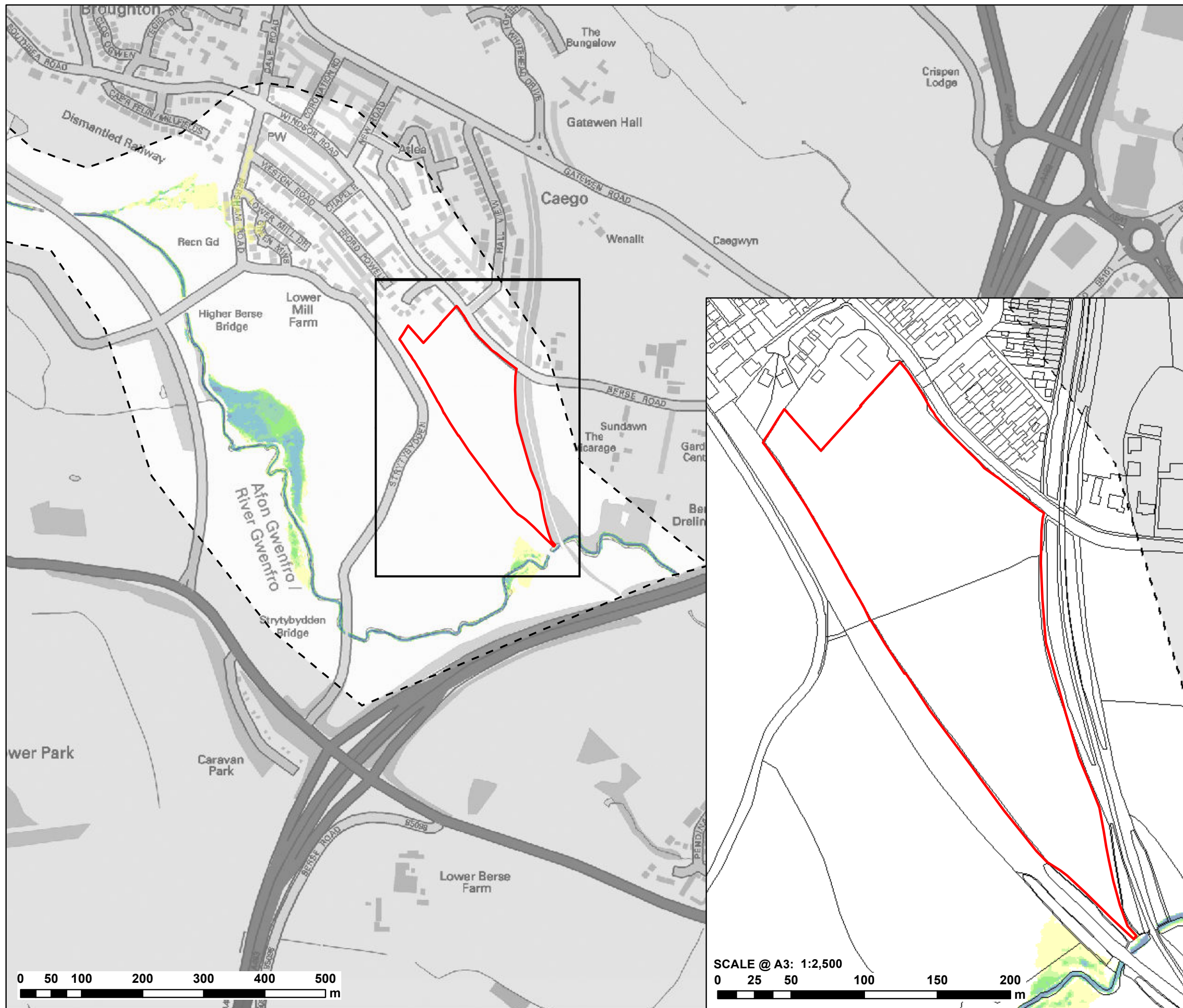
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Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:
**LAND OFF BERSE ROAD
WREXHAM**

PLOT TITLE:
**MAXIMUM VELOCITY
5% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT**

PLOT STATUS:
ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016		PLOT NAME: w3183-Q20_EXG_V	
		REV: A	



LEGEND

Site Boundary

2D Model Boundary

Maximum Velocity (m/s)

0 - 0.15

0.15 - 0.3

0.3 - 0.45

0.45 - 0.6

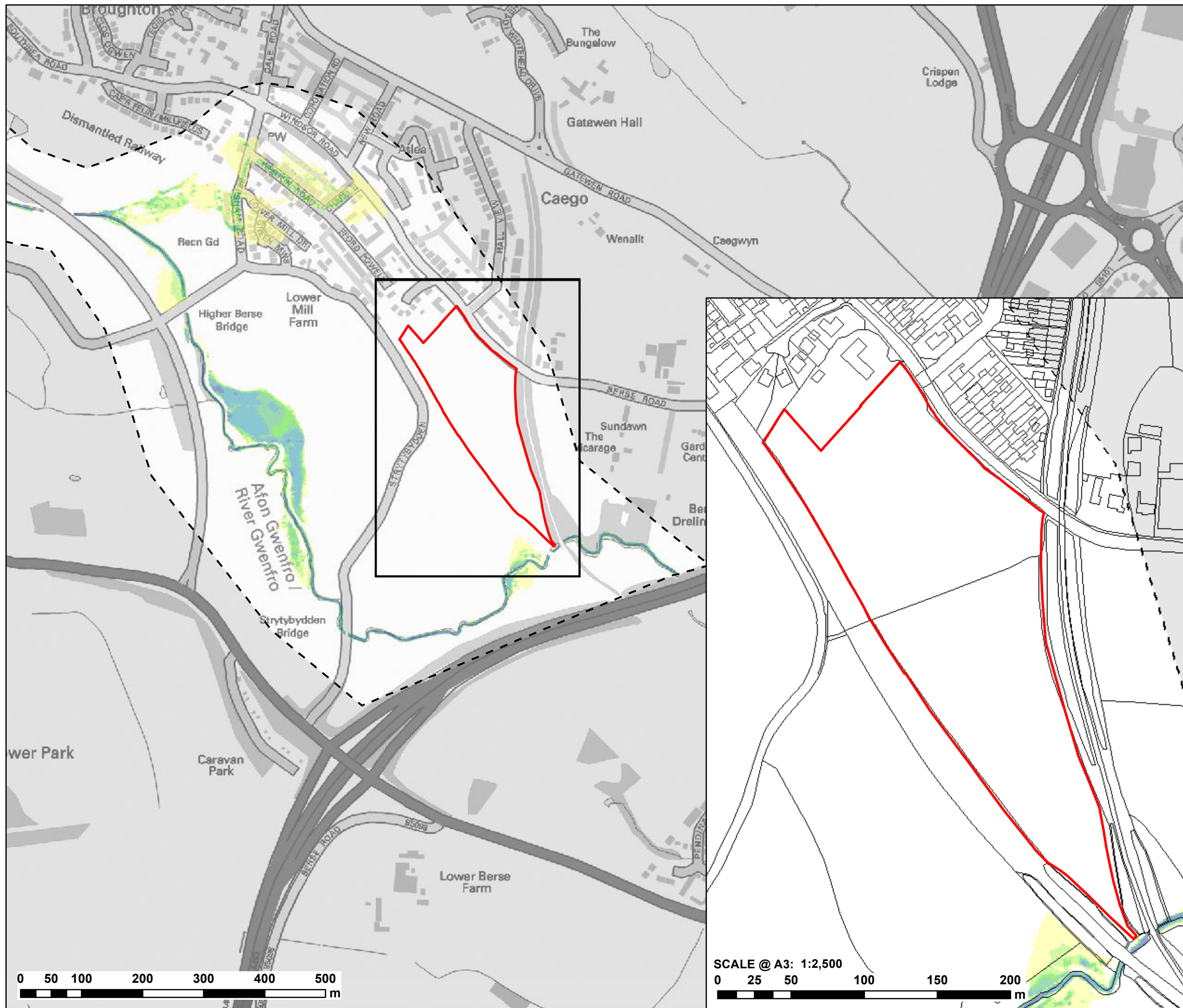
0.6 - 1.2

1.2 - 2.4

> 2.4

CLIENT:
PLAS POWER ESTATES
Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk**SCHEME:**
**LAND OFF BERSE ROAD
WREXHAM****PLOT TITLE:**
**MAXIMUM VELOCITY
1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT****PLOT STATUS:**
ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016		PLOT NAME: w3183-Q100_EXG_V	REV: A



LEGEND

Site Boundary

2D Model Boundary

Maximum Velocity (m/s)

0 - 0.15

0.15 - 0.3

0.3 - 0.45

0.45 - 0.6

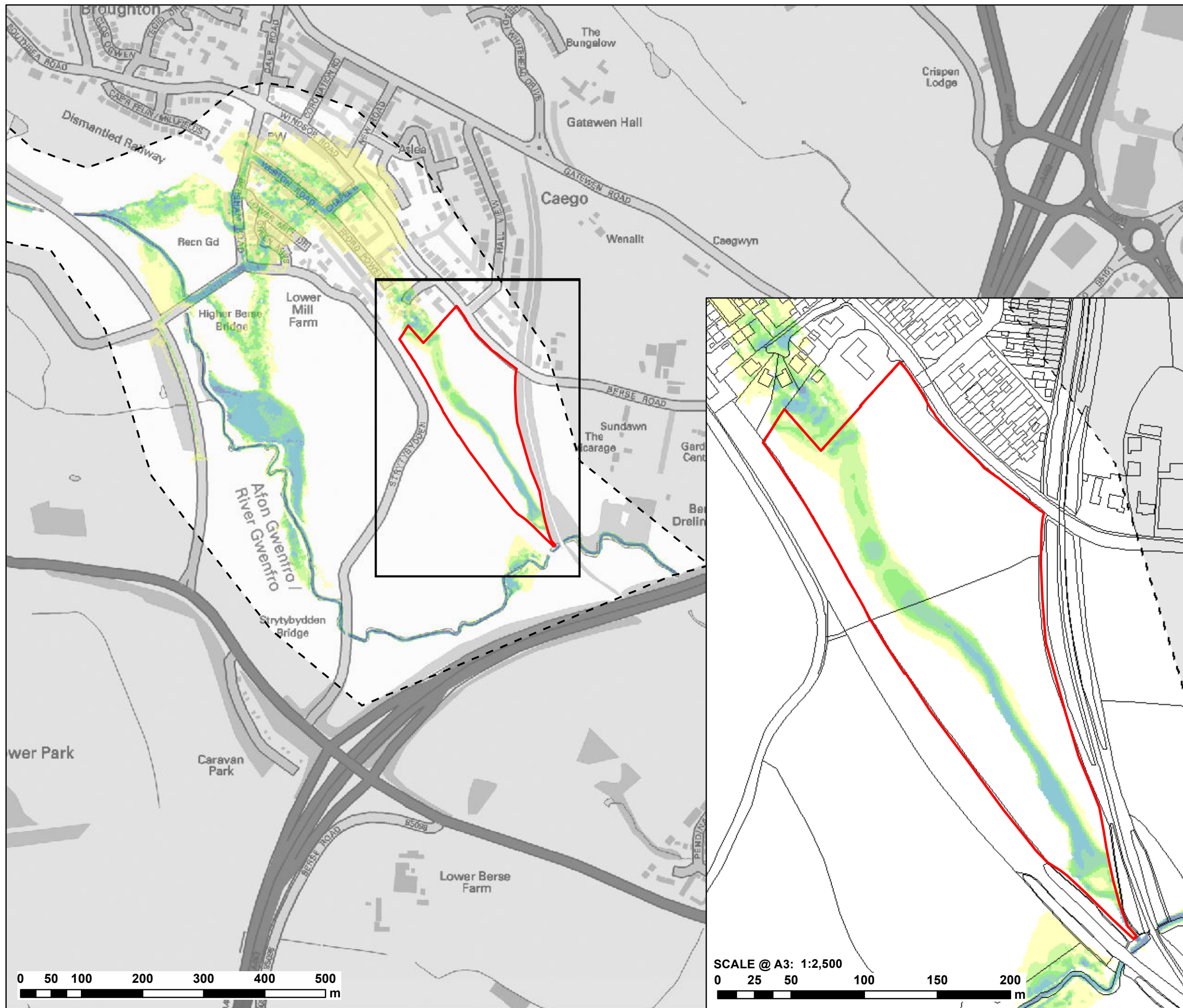
0.6 - 1.2

1.2 - 2.4

> 2.4

CLIENT:
PLAS POWER ESTATES
Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk**SCHEME:**
**LAND OFF BERSE ROAD
WREXHAM****PLOT TITLE:**
**MAXIMUM VELOCITY
1% AEP + CCA FLUVIAL EVENT
EXISTING SITE LAYOUT****PLOT STATUS:**
ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016		PLOT NAME: w3183-Q100CC_EXG_V	REV: A



LEGEND
 Site Boundary
 2D Model Boundary
Maximum Velocity (m/s)
 0 - 0.15
 0.15 - 0.3
 0.3 - 0.45
 0.45 - 0.6
 0.6 - 1.2
 1.2 - 2.4
 > 2.4

CLIENT:
PLAS POWER ESTATES

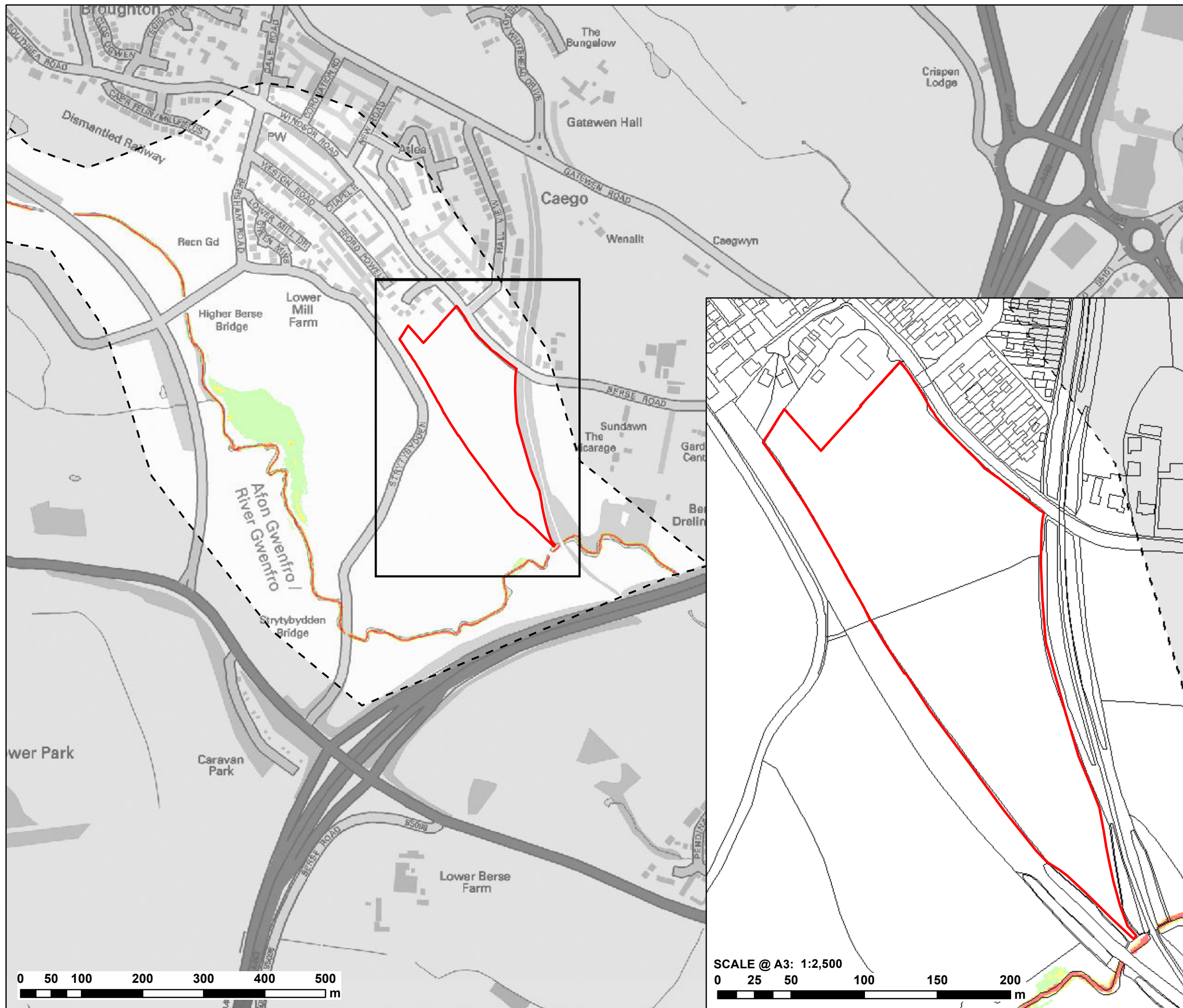
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Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:
**LAND OFF BERSE ROAD
WREXHAM**

PLOT TITLE:
**MAXIMUM VELOCITY
0.1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT**

PLOT STATUS:
ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016		PLOT NAME: w3183-Q1000_EXG_V	REV: A



LEGEND

- Site Boundary
- 2D Model Boundary
- Maximum Flood Hazard Rating (FD2320)**
 - < 0.75 (Caution)
 - 0.75 - 1.25 (Danger for Some)
 - 1.25 - 2 (Danger for Most)
 - > 2.0 (Danger for All)

CLIENT:

PLAS POWER ESTATES

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consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:

**LAND OFF BERSE ROAD
WREXHAM**

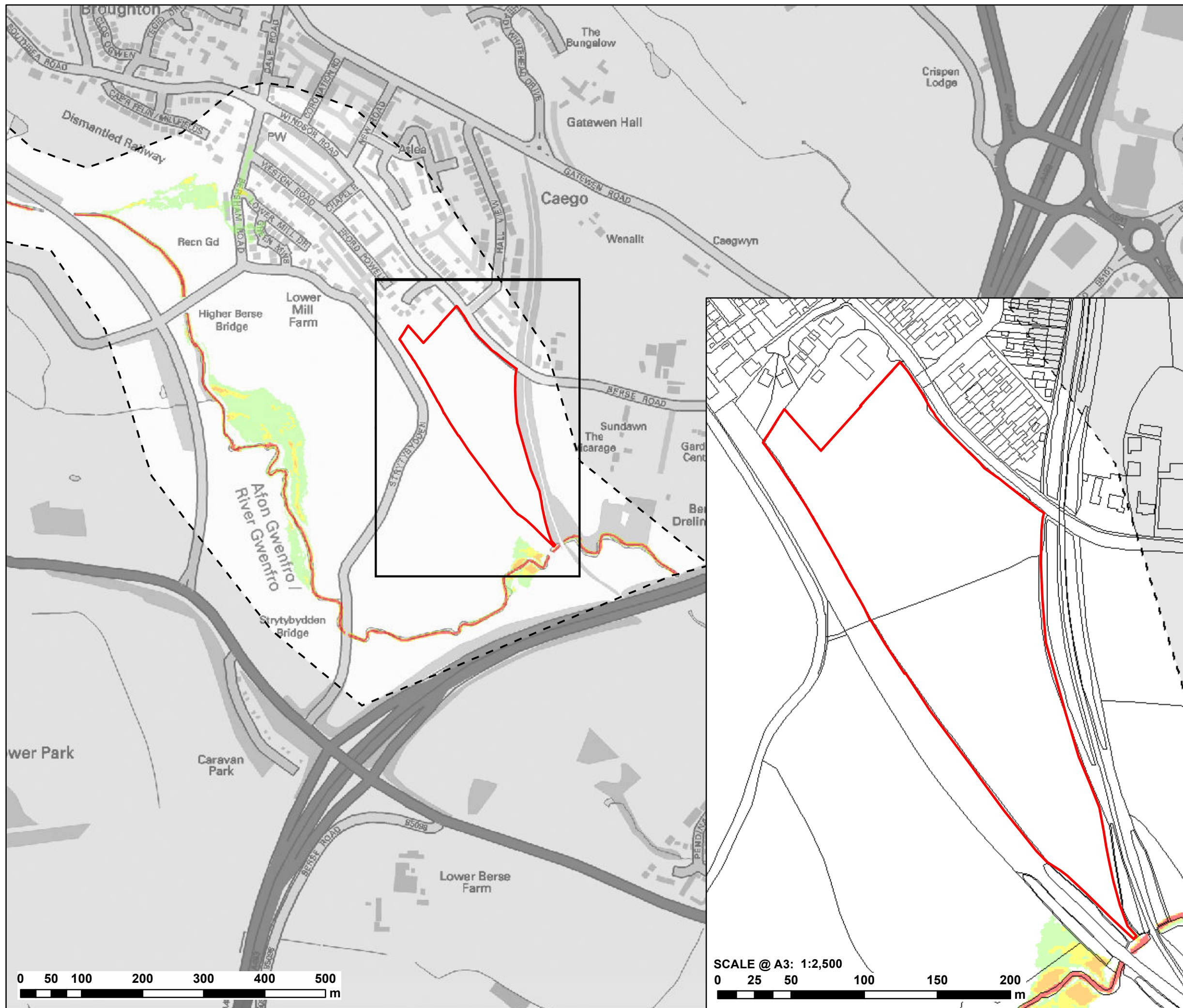
PLOT TITLE:

**MAXIMUM FLOOD HAZARD
5% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT**

PLOT STATUS:

ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016	PLOT NAME: w3183-Q20_EXG_H	REV: A	



LEGEND

Site Boundary

2D Model Boundary

Maximum Flood Hazard Rating (FD2320)

< 0.75 (Caution)

0.75 - 1.25 (Danger for Some)

1.25 - 2 (Danger for Most)

> 2.0 (Danger for All)

CLIENT:
PLAS POWER ESTATES

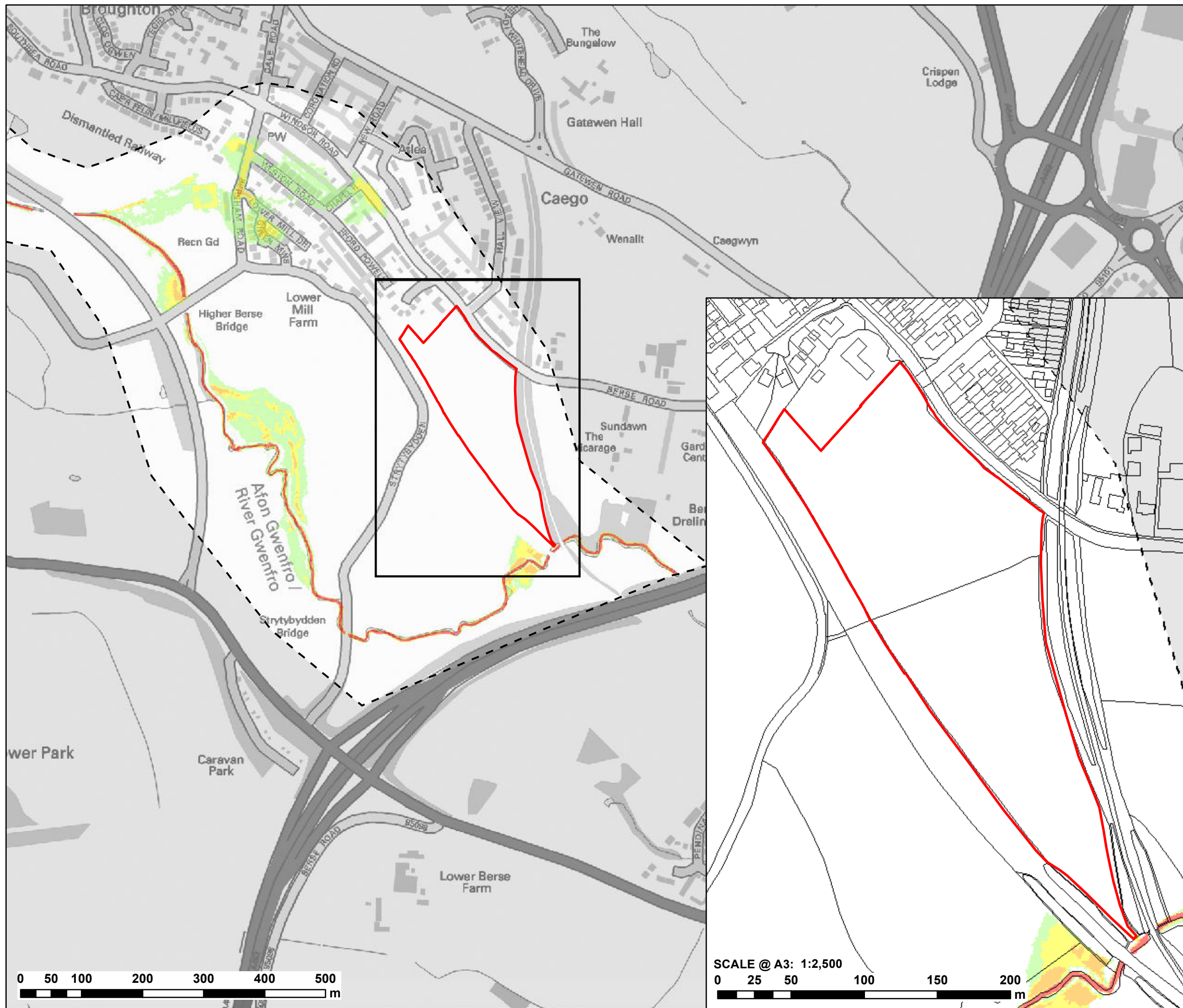
Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:
**LAND OFF BERSE ROAD
WREXHAM**

PLOT TITLE:
**MAXIMUM FLOOD HAZARD
1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT**

PLOT STATUS:
ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016		PLOT NAME: w3183-Q100_EXG_H	REV: A



LEGEND

Site Boundary

2D Model Boundary

Maximum Flood Hazard Rating (FD2320)

< 0.75 (Caution)

0.75 - 1.25 (Danger for Some)

1.25 - 2 (Danger for Most)

> 2.0 (Danger for All)

CLIENT:
PLAS POWER ESTATES

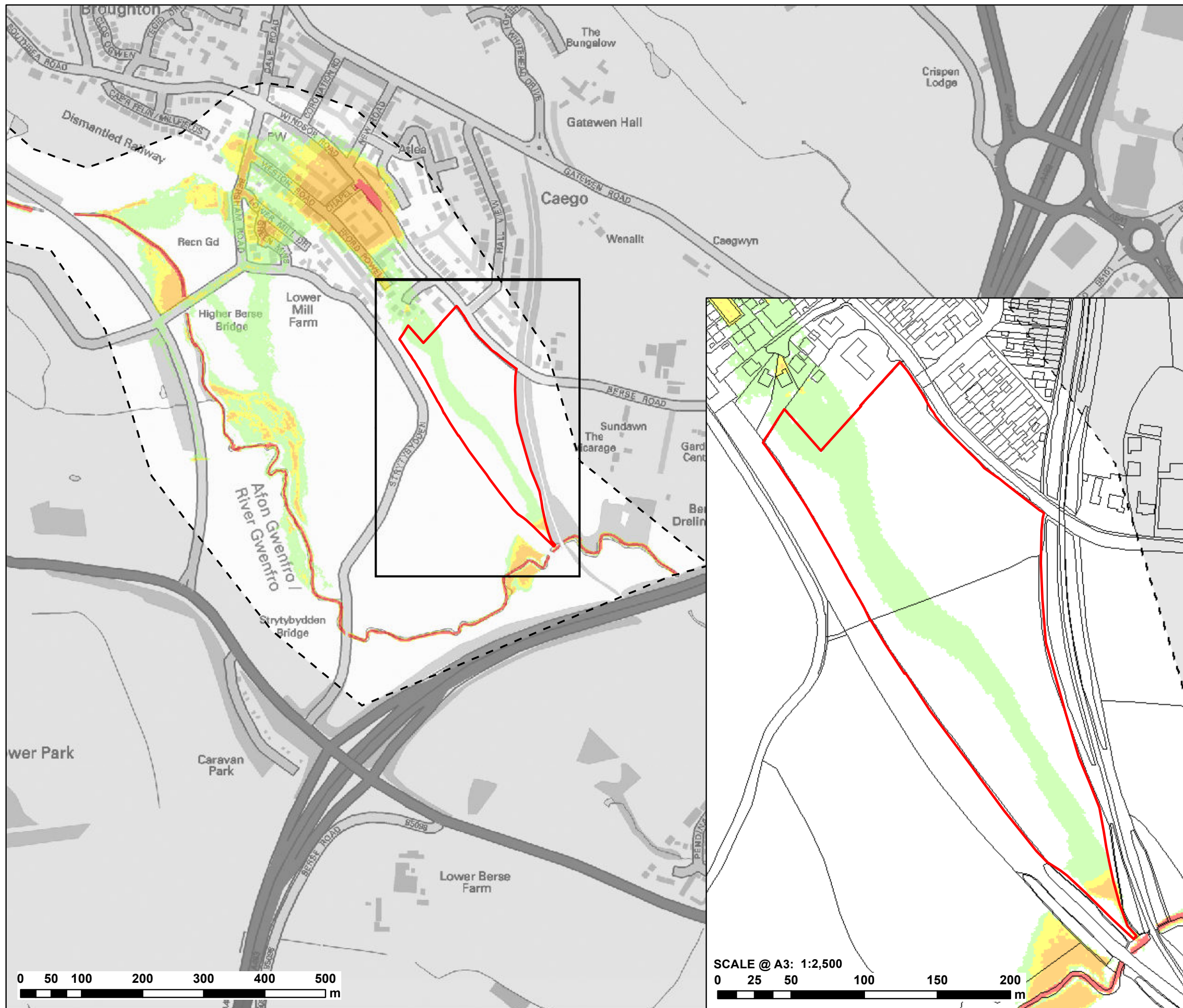
Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:
**LAND OFF BERSE ROAD
WREXHAM**

PLOT TITLE:
**MAXIMUM FLOOD HAZARD
1% AEP + CCA FLUVIAL EVENT
EXISTING SITE LAYOUT**

PLOT STATUS:
ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016	PLOT NAME: w3183-Q100CC_EXG_H	REV: A	



LEGEND

- Site Boundary
- 2D Model Boundary
- Maximum Flood Hazard Rating (FD2320)**
 - < 0.75 (Caution)
 - 0.75 - 1.25 (Danger for Some)
 - 1.25 - 2 (Danger for Most)
 - > 2.0 (Danger for All)

CLIENT:

PLAS POWER ESTATES

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consultants

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01824 702220
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SCHEME:

**LAND OFF BERSE ROAD
WREXHAM**

PLOT TITLE:

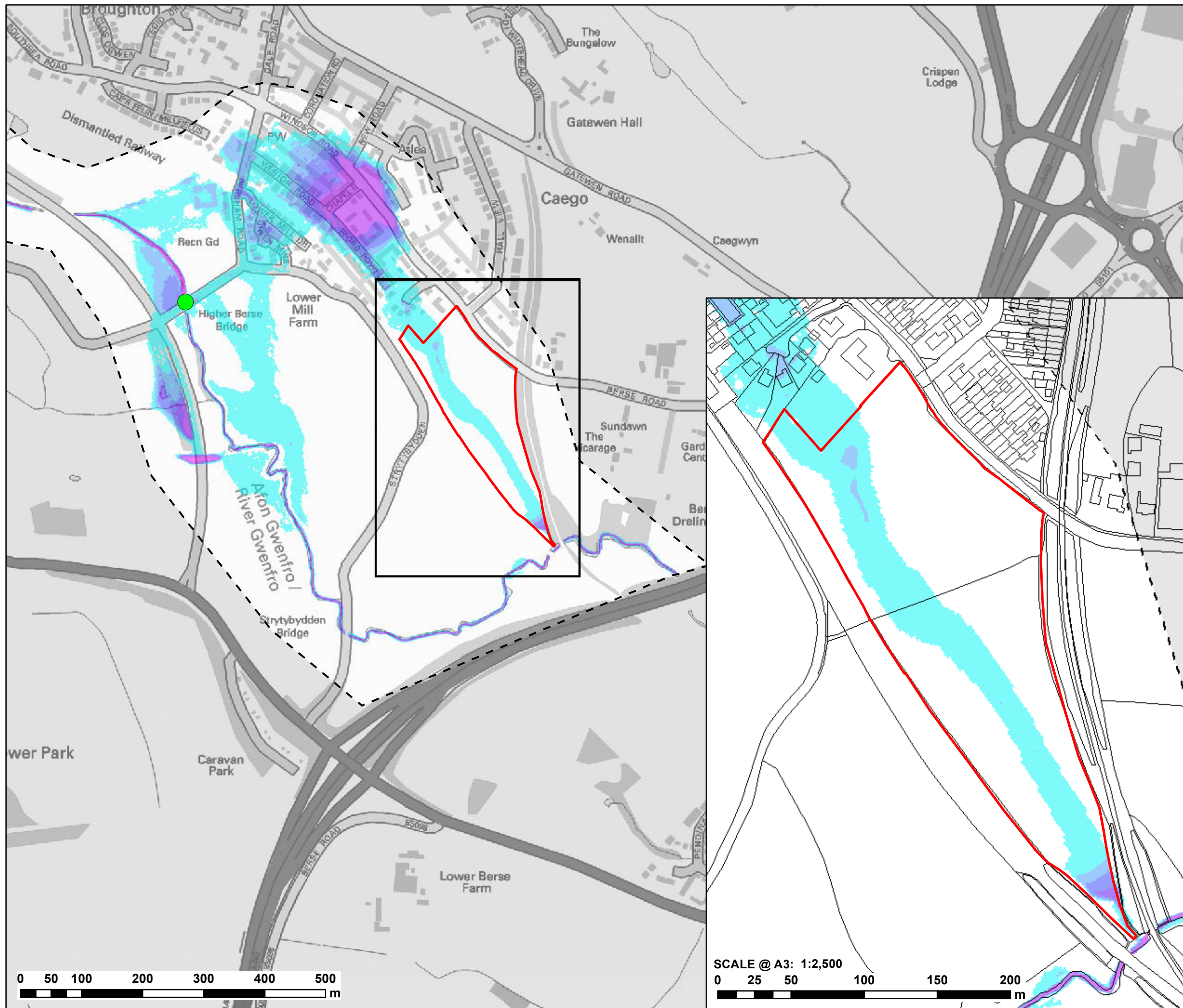
MAXIMUM FLOOD HAZARD
0.1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT

PLOT STATUS:

ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016	PLOT NAME: w3183-Q1000_EXG_H	REV: A	

Blockage Simulations



LEGEND

- Site Boundary
- 2D Model Boundary
- Higher Berse Rd Blockage Location

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- 1.2 - 2.4
- > 2.4



CLIENT:

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SCHEME:

**LAND OFF BERSE ROAD
WREXHAM**

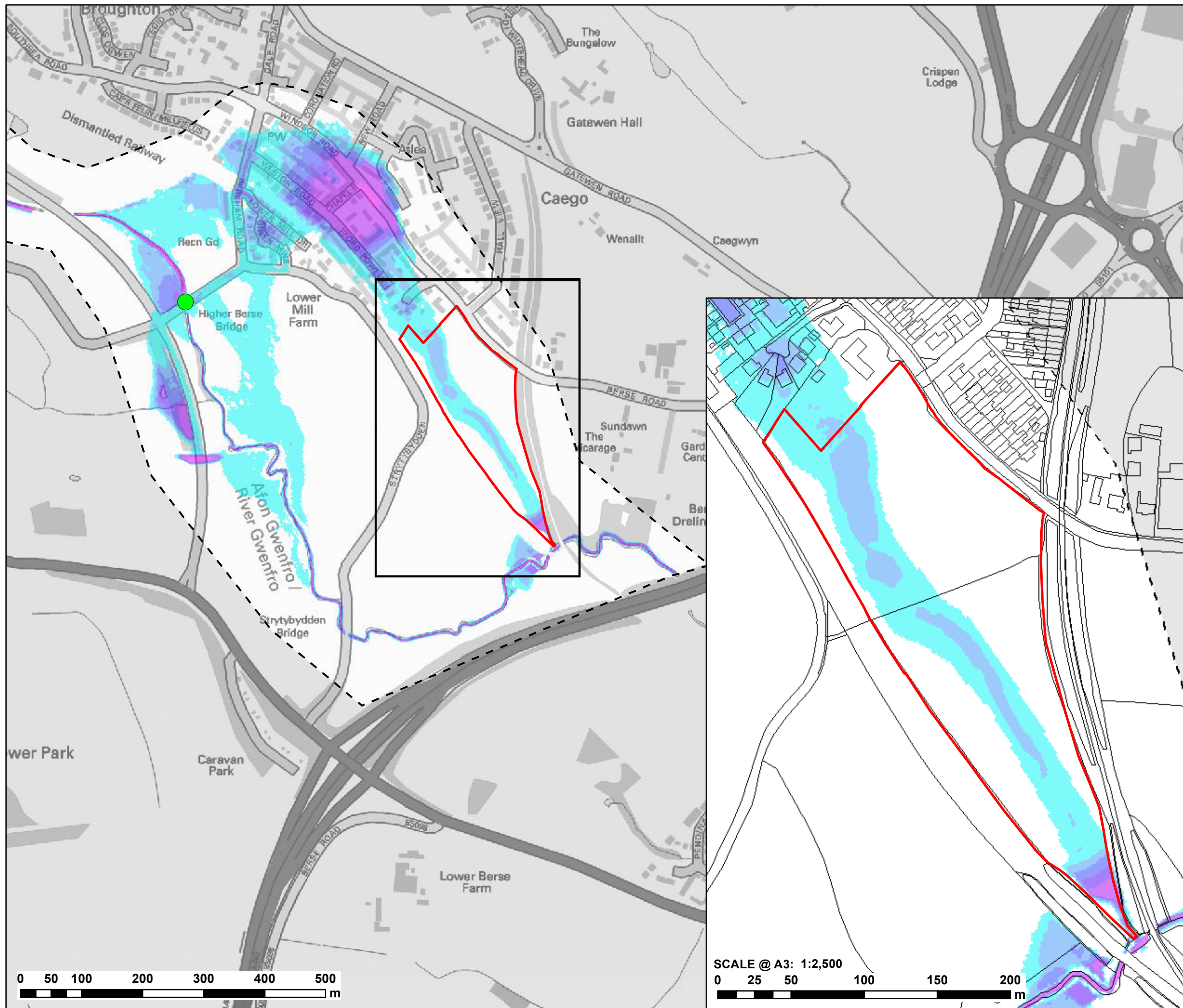
PLOT TITLE:

**MAXIMUM FLOOD DEPTH
1% AEP + CCA FLUVIAL EVENT
HIGHER BERSE RD 66% BLOCKAGE**

PLOT STATUS:

ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016	PLOT NAME: w3183-Q100CC_BL1-66_D		REV: A



LEGEND

Site Boundary

2D Model Boundary

Higher Berse Rd Blockage Location

Maximum Flood Depth (m)

0 - 0.3

0.3 - 0.6

0.6 - 0.9

0.9 - 1.2

1.2 - 2.4

> 2.4

CLIENT:
PLAS POWER ESTATES
Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk**SCHEME:**
**LAND OFF BERSE ROAD
WREXHAM****PLOT TITLE:**
**MAXIMUM FLOOD DEPTH
0.1% AEP FLUVIAL EVENT
HIGHER BERSE RD 95% BLOCKAGE****PLOT STATUS:**
ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016		PLOT NAME: w3183-Q1000_BL1-95_D	REV: A



LEGEND

Site Boundary

2D Model Boundary

Higher Berse Rd Blockage Location

Maximum Velocity (m/s)

0 - 0.15

0.15 - 0.3

0.3 - 0.45

0.45 - 0.6

0.6 - 1.2

1.2 - 2.4

> 2.4

CLIENT:
PLAS POWER ESTATES

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:
**LAND OFF BERSE ROAD
WREXHAM**

PLOT TITLE:
**MAXIMUM VELOCITY
1% AEP + CCA FLUVIAL EVENT
HIGHER BERSE RD 66% BLOCKAGE**

PLOT STATUS:
ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016	PLOT NAME: w3183-Q100CC_BL1-66_V		REV: A



LEGEND

- Site Boundary
- 2D Model Boundary
- Higher Berse Rd Blockage Location

Maximum Velocity (m/s)

- 0 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- 0.45 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4

CLIENT:

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01824 702220
www.waterco.co.uk

SCHEME:

**LAND OFF BERSE ROAD
WREXHAM**

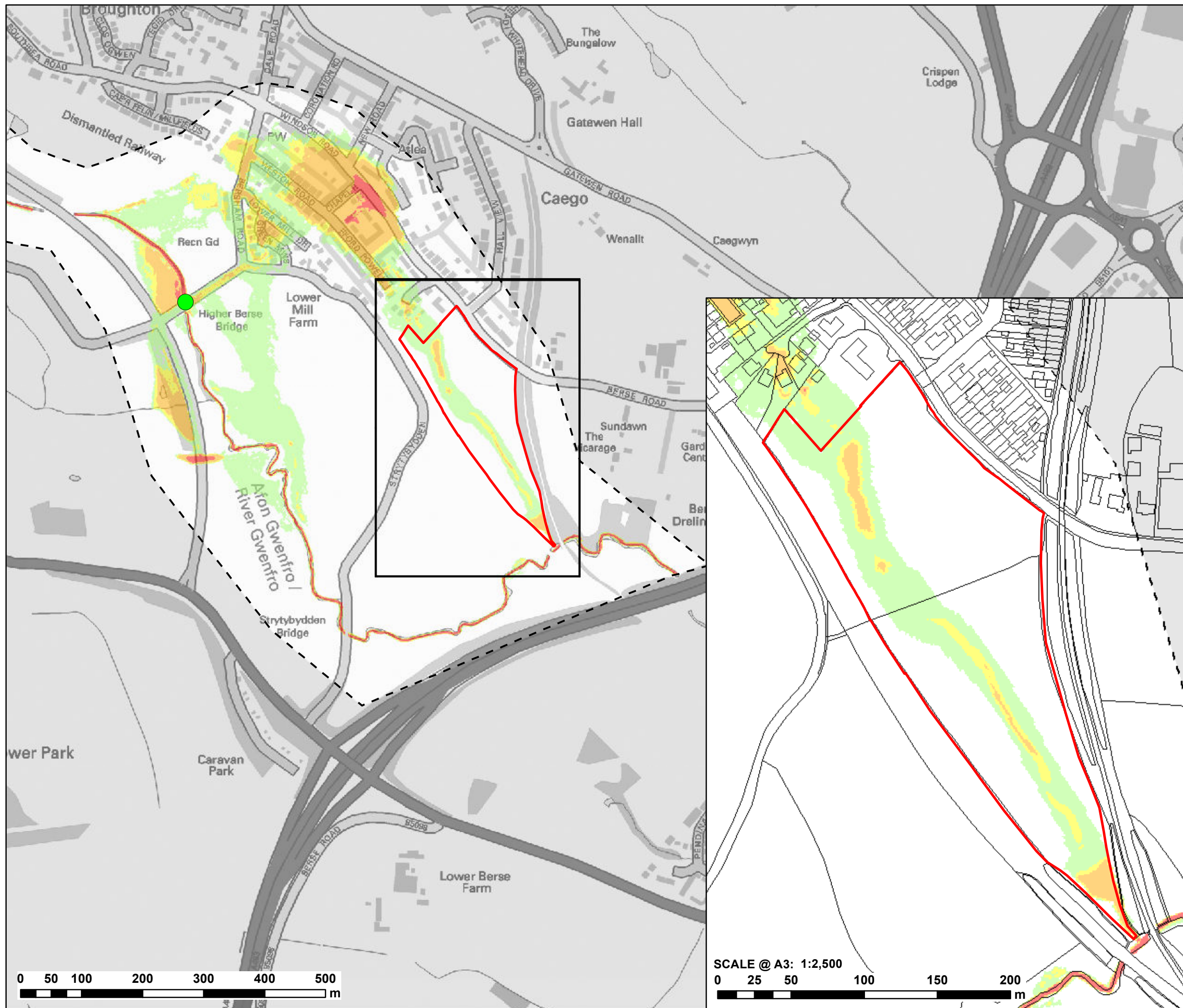
PLOT TITLE:

**MAXIMUM VELOCITY
0.1% AEP FLUVIAL EVENT
HIGHER BERSE RD 95% BLOCKAGE**

PLOT STATUS:

ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016	PLOT NAME: w3183-Q1000_BL1-95_V	REV: A	



LEGEND

- Site Boundary
- 2D Model Boundary
- Higher Berse Rd Blockage Location

Maximum Flood Hazard Rating (FD2320)

- < 0.75 (Caution)
- 0.75 - 1.25 (Danger for Some)
- 1.25 - 2 (Danger for Most)
- > 2.0 (Danger for All)

CLIENT:

PLAS POWER ESTATES

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
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SCHEME:

**LAND OFF BERSE ROAD
WREXHAM**

PLOT TITLE:

**MAXIMUM FLOOD HAZARD
1% AEP + CCA FLUVIAL EVENT
HIGHER BERSE RD 66% BLOCKAGE**

PLOT STATUS:

ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016	PLOT NAME: w3183-Q100CC_BL1-66_H	REV: A	



LEGEND

- Site Boundary
- 2D Model Boundary
- Higher Berse Rd Blockage Location

Maximum Flood Hazard Rating (FD2320)

- < 0.75 (Caution)
- 0.75 - 1.25 (Danger for Some)
- 1.25 - 2 (Danger for Most)
- > 2.0 (Danger for All)

CLIENT:

PLAS POWER ESTATES

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consultants

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01824 702220
www.waterco.co.uk

SCHEME:

**LAND OFF BERSE ROAD
WREXHAM**

PLOT TITLE:

**MAXIMUM FLOOD HAZARD
0.1% AEP FLUVIAL EVENT
HIGHER BERSE RD 95% BLOCKAGE**

PLOT STATUS:

ISSUE

DRAWN: SB	CHECKED: DH	APPROVED: RCL	PLOT SCALE @ A3: 1:6,000 (UNLESS STATED OTHERWISE)
DATE: 04/04/2016	PLOT NAME: w3183-Q1000_BL1-95_H	REV: A	