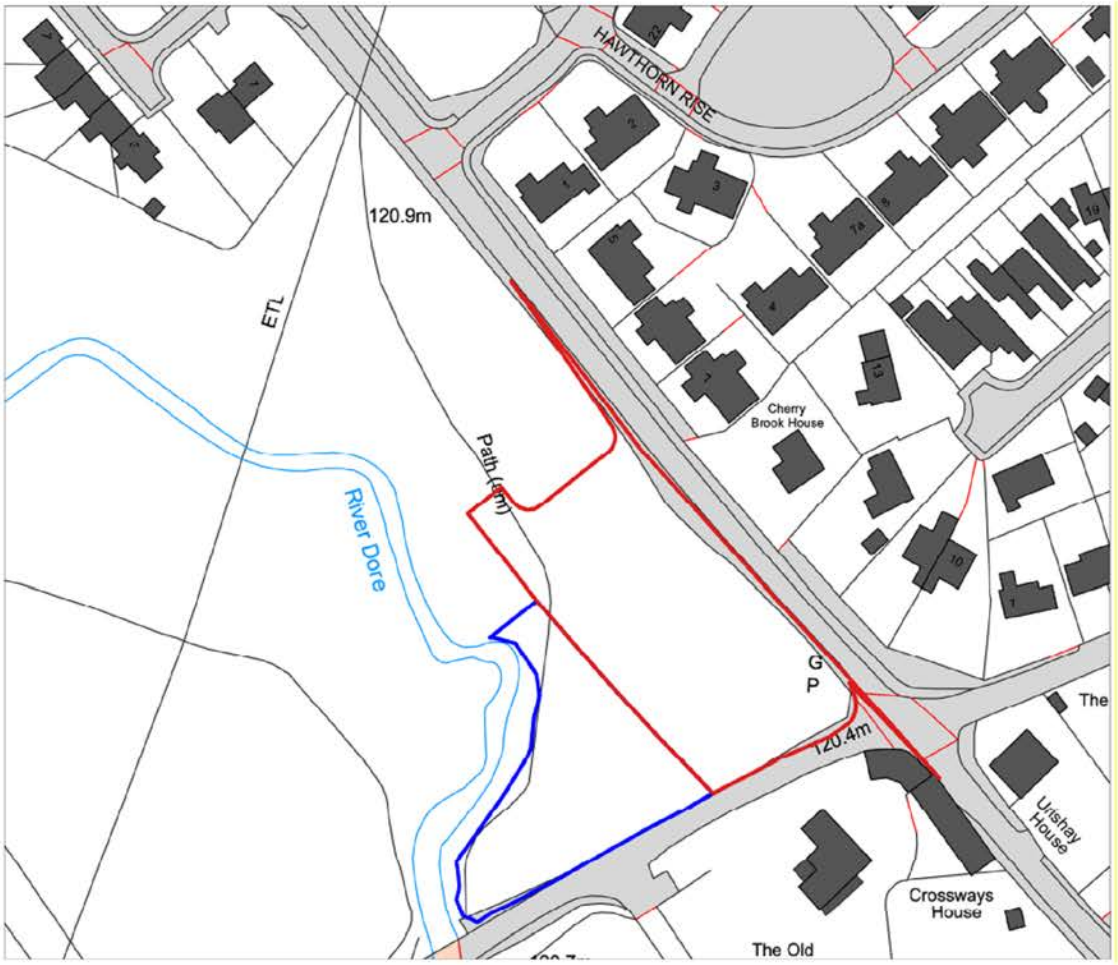

Land at Crossways, Peterchurch HR2 0RQ

Flood Risk Assessment

Project Ref: CWC126

Client: JR Planning and Development

CONTENTS

QUALITY ASSURANCE RECORD

Contributors for Corner Water Consulting:

Name	Role
Alan Corner	Project Director

Document Status and Revision History:

Version	Date	Project Contact	Status / Comment
1	17/02/2023	Alan Corner	First Issue

Limitation of liability and use

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1. INTRODUCTION

1.1 PURPOSE

Corner Water Consulting (CWC) was commissioned by Mr J Richards to undertake a site specific flood risk assessment plus drainage design at a proposed residential development consisting of 5 dwellings located at Land at Crosskeys, Peterchurch, HR2 0RQ.

The site is located towards the southern extreme of Peterchurch, adjacent to and south of the B4348. The River Dore is very close and southwest of the site, with the footway the shared driveway being just over 10m from the left riverbank. There is also a public right of way along to the west of the site – mostly this tracks parallel to the river.

The site redline boundary covers 3,215m^2 or 0.32ha and is currently open grassland, located immediately West of the Crossways junction. To the north of this site along the B4348 is a recently approved 10 dwelling scheme, planning application reference P204083/XA2. This adjacent site is on land abutting this new application site, and the two share a common entrance road to a T junction. This adjacent development details a new gravity foul sewer connection from the Welsh Water network in the B4348 into the turning hammerhead at the T-junction of the site area. To ensure this new shared access highway off the B4348 is available the redline boundary for this application includes the T-junction and entrance roadway.

CWC staff have detailed knowledge of this site having produced a FRA in 2017 with project reference K0773 for the land immediately north of this site when part of Hydro-Logic Services. This FRA included detailed hydraulic modelling that was reviewed and approved by the Environment Agency.

Soil testing was undertaken for the adjacent site and confirms that groundwater levels are more than 2.5m below the surface plus that infiltration techniques may be suitable for partial surface water disposal.

Apart from physical soil testing, all the conclusions drawn from this assessment were based on a desk study and publicly available information.

1.2 SOURCES OF INFORMATION

The following data was utilised:

- Scheme drawings by RRA Architects;
- The Flood Map for Planning and the Long-Term Flood Risk Map;
- Detailed River Dore hydraulic modelling at the site location by Hydro-Logic Services Ltd;
- The Non-Statutory Standards for the NPPF;
- The Technical Guidance to the National Planning Policy Framework;
- Design & Access Statement by RRA Architects.

2 BACKGROUND

2.1 SITE LOCATION

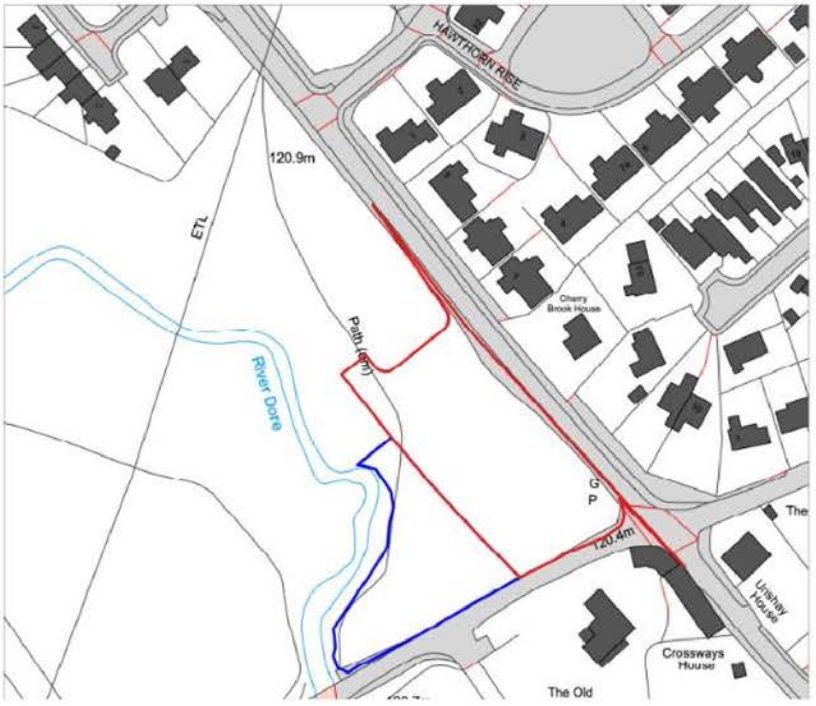
The site is located at Land at Crossways, Peterchurch, HR2 0RQ and is west of the Crossways junction.

The Local Planning Authority for the area is Herefordshire Council.

The Lead Local Flood Authority for the area is Herefordshire Council.

2.2 PROPOSED DEVELOPMENT

The existing site is open grassland and the scope of the works will include 5 dwellings plus associated parking and a shared access driveway.



1 SITE LOCATION PLAN
1:1250 @ A3

Figure 1 – Site Location Plan

Figure 2 – Site Aerial View

Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation.

Figure 3 – Proposed Site Plan Overview with Modelled Flood Zones

(Extract of drawing Proposed Site Plan, drawing number 4405 P(0) 002 Rev-)

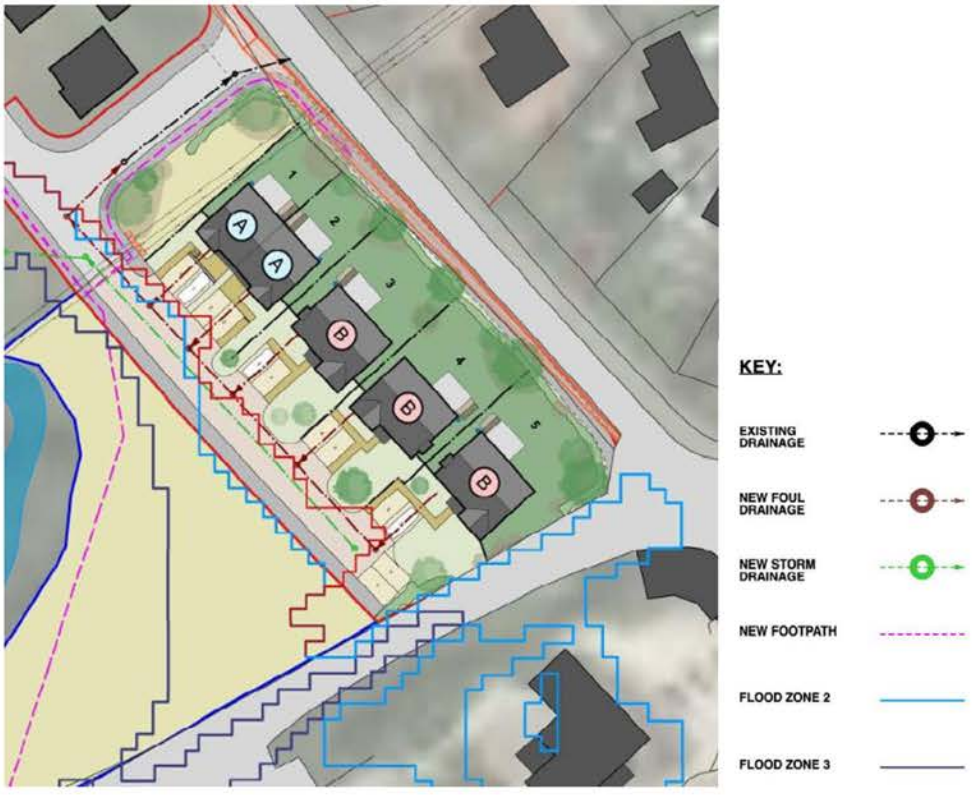


Figure 4 – Proposed Site Plan Enlarged with Key

2.3 EXISTING DRAINAGE AND GEOLOGY

There are no drainage systems within the current site.

Soil testing was undertaken as part of the planning application for the adjacent development – application reference 172543 and the latter P204083/XA2.

This testing confirms that groundwater levels are more than 2.5m below the surface. Infiltration techniques may be suitable for partial surface water disposal but likely not as the overall solution due to half drain times. Infiltration rates of 6.33 x 10^{-6} m/s were recorded by soakaway tests. (Ref: Geotechnical and Geo-environmental Site Investigation Report – Terra Firma (Wales) Limited – November 2016).

2.4 TOPOGRAPHY

A site-specific topographical survey has been undertaken and the contours show that the land across the 5 proposed dwellings is effectively level parallel to the main road.

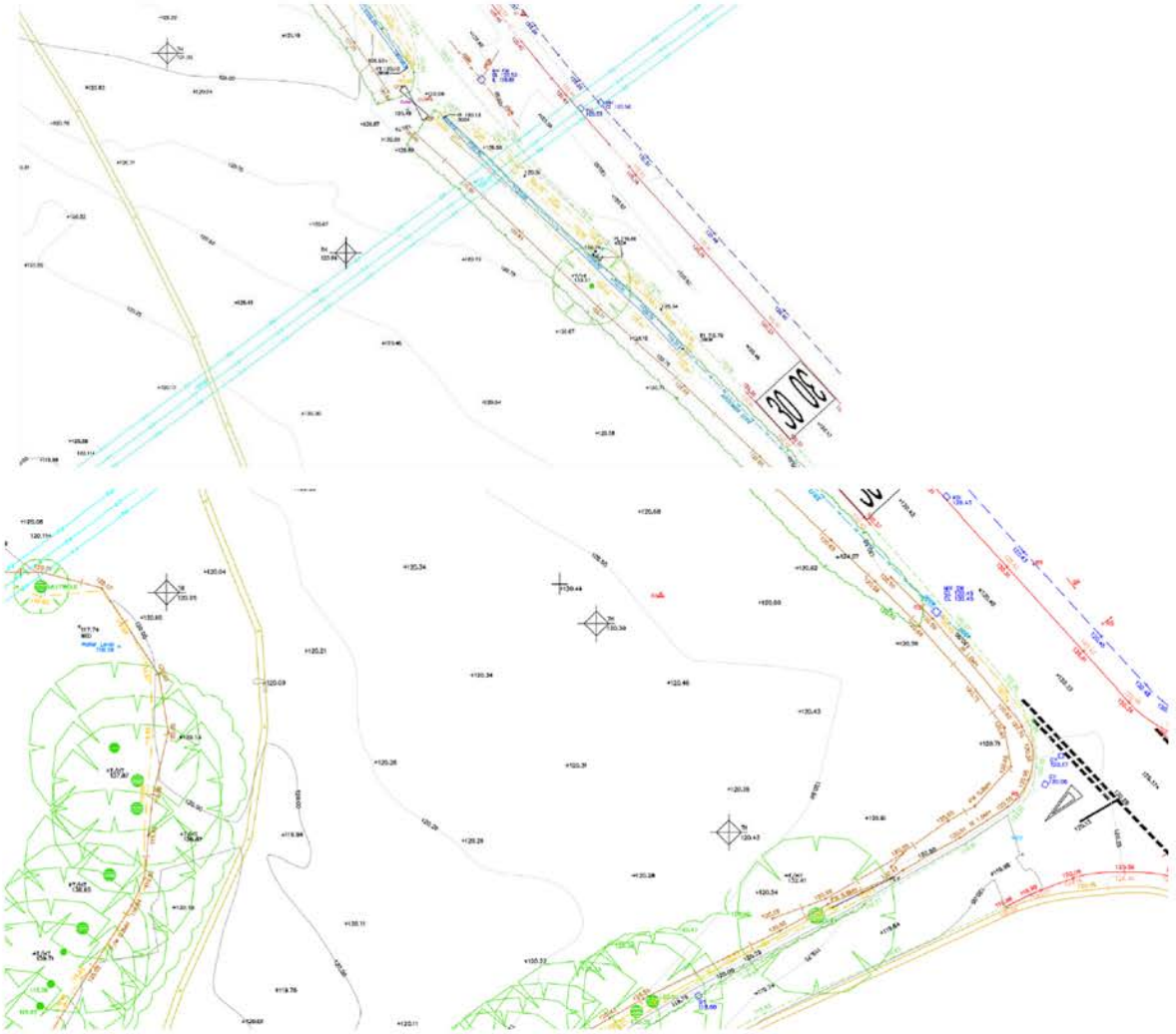


Figure 5 – Extract of Survey Showing The Entire Site

2.5 LOCAL SEWERS

There are no sewers on the site, however Welsh Water have foul sewers in the B4348 road and there is a surface water sewer outfalling to the river across the development site to the north. Neither of these sewers will affect this development.

3 FLOOD RISK ASSESSMENT

3.1 VULNERABILITY OF THE DEVELOPMENT

The proposed residential development is classed as 'More Vulnerable" according to Annex 3: Flood risk vulnerability classification of the NPPF.

3.2 FLUVIAL AND TIDAL FLOOD RISK

Fluvial or river flood risk dominates at this site due to the close proximity of the River Dore, but following detailed hydraulic modelling of the river in 2017 it has been shown that whilst fluvial flooding does occur from the River Dore the dwellings are located in Flood Zone 1 with the associated shared driveway southwest of the dwellings partially within Flood Zone 2 – which is in accordance with planning policy. See Reference report Flood Risk Assessment for residential and commercial development in Peterchurch, Herefordshire Report K0773 Rep. 2 (Rev. 1) dated September 2017, as part of planning application 172543.

This has been confirmed by the Environment Agency in 2017 as part of planning application 172543, see EA letter in full within Appendix A.

The EA have reconfirmed in 2023, see Appendix A for full details of the email with an extract below, that this modelling is still current plus acceptable to accurately determine the site specific flood risk to the land of the site and around the River Dore.

Specifically on 18 January 2023 at 15:41 the EA confirmed by email, extract as below in italics, with the key points highlighted in bold:

"When we reviewed the previous application (in 2017 and again in 2020 with the Reserved Matters) we were satisfied that the proposed development, including the dwellings, was primarily in Flood Zone 1.

Reading your email I suppose there are two elements here; opportunities for Phase 2 development and changes to the Flood Map for Planning. ***For the former as the modelling work you undertook was relatively recent we would be happy for that to support any FRA accompanying the forthcoming planning application. The same requirements would apply to this site i.e. built development on land outside the 1 in 100 year plus climate change and FFLs set appropriately.***

I have attached the latest copy of our general guidance for development in Flood Zones 2/3. When considering the latest climate change allowances (see also attached) it should be noted that there is now a 37% uplift in the Wye Catchment (Central 2080's for more vulnerable development). The previous figure, which will have applied to the earlier application, was 35% but we would not expect revised modelling in considering of this minimum uplift.

Looking at your second attachment I note that the 5 units all lie on land outside the 1 in 100 year plus 70% and Flood Zone 2 extent. *We would expect to see no land raising in the 1 in 100 year plus climate change extent and no works within 8m of the watercourse. Looking at the plans this should be achievable. Should you wish to discuss this further there would be likely be a charge under our Cost Recovery Service."*

Therefore for this development it has been confirmed by detailed hydraulic modelling that:

- **the location of the proposed houses are within Flood Zone 1 and;**
- **outside of the 1 in 100 year or 1%AEP event plus a 70% allowance for climate change and;**
- **outside of the 1 in 100 year or 1%AEP event plus 35% allowance for climate change which at this location along the River Dore equates to a peak water level of 120.27mAOD;**
- **the published Flood Map for Planning is not correct as it shows the north eastern edge of the site and the B4348 within Flood Zone 2;**

- there are mechanisms in place to challenge and make alterations to the Flood Map for Planning. But this can be a lengthy process and would involve a detailed review of the flood modelling by the EA Evidence and Risk Team, as detailed in EA correspondence within Appendix A. This long term re-evaluation of the flood zones is outside of the scope of this report.

The maximum extent of Flood Zone 2, which is the 1 in 1000 year or 0.1% AEP extent, as detailed within the 2017 FRA shows that the road frontage and a considerable area of the site is not affected and is thus within Flood Zone 1, see Figure 6. Nor are the houses affected by climate change – see Figure 7 and Figure 8.

Figure 3-22 Maximum flood depths and extent – 1:1,000 year fluvial flood

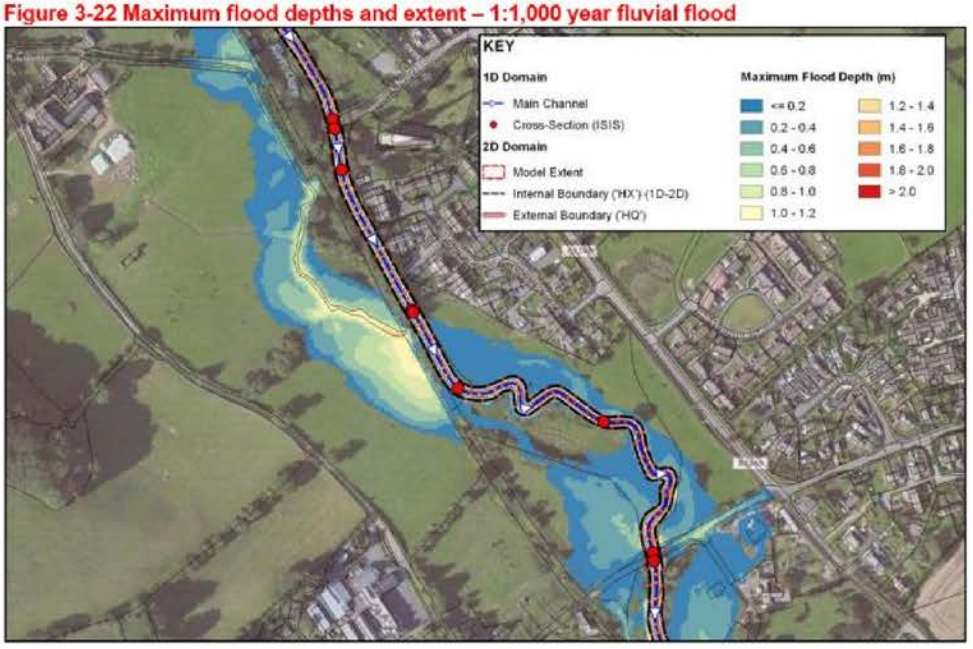


Figure 6 – Extent of Flood Zone 2 and Showing Area within Flood Zone 1

Figure 3-20 Maximum flood depths and extent – 1:100 year+35%CC fluvial flood

Figure 7 – Flood Extent for 1 in 100 year plus 35% Climate Change Allowance

Figure 3-21 Maximum flood depths and extent – 1:100 year+70%CC fluvial flood

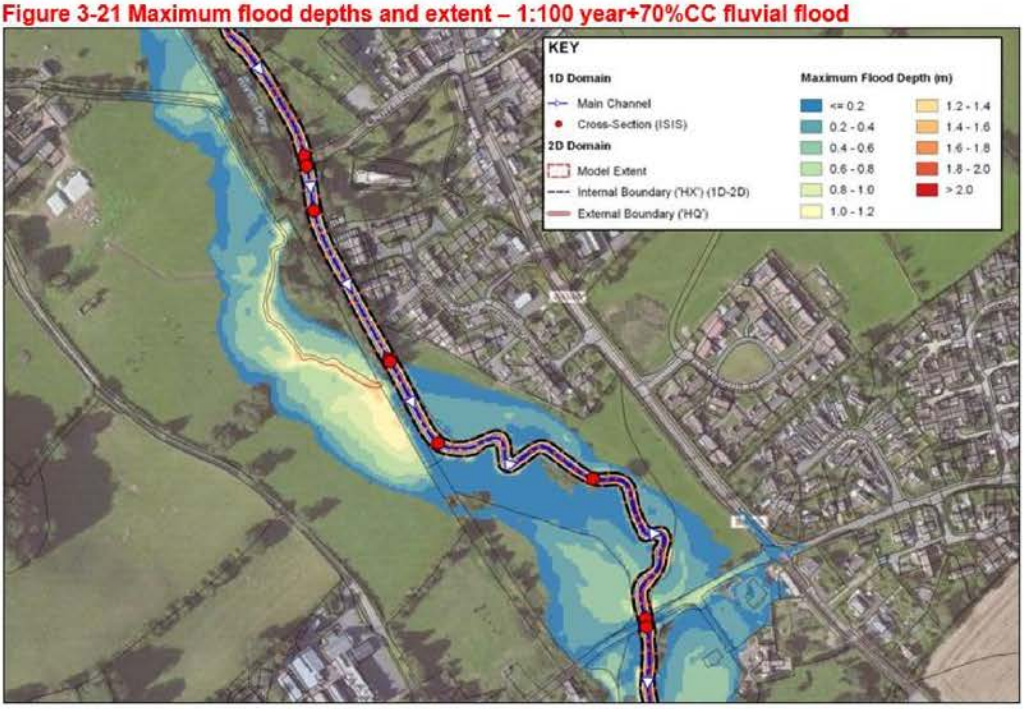


Figure 8 – Flood Extent for 1 in 100 year plus 70% Climate Change Allowance

As part of further work undertaken by Hydro-Logic Services an overlay plan was produced to allow an easy comparison of the various hydraulically modelled flood risk return periods and zones. This plan is shown in Figure 9 and details the maximum extents of:

- the 1 in 100-year or Flood Zone 3;
- the Flood Zone 2 or 1 in 1000-year event;
- plus the 1 in 100-year or 1%AEP plus 70% Climate Change.

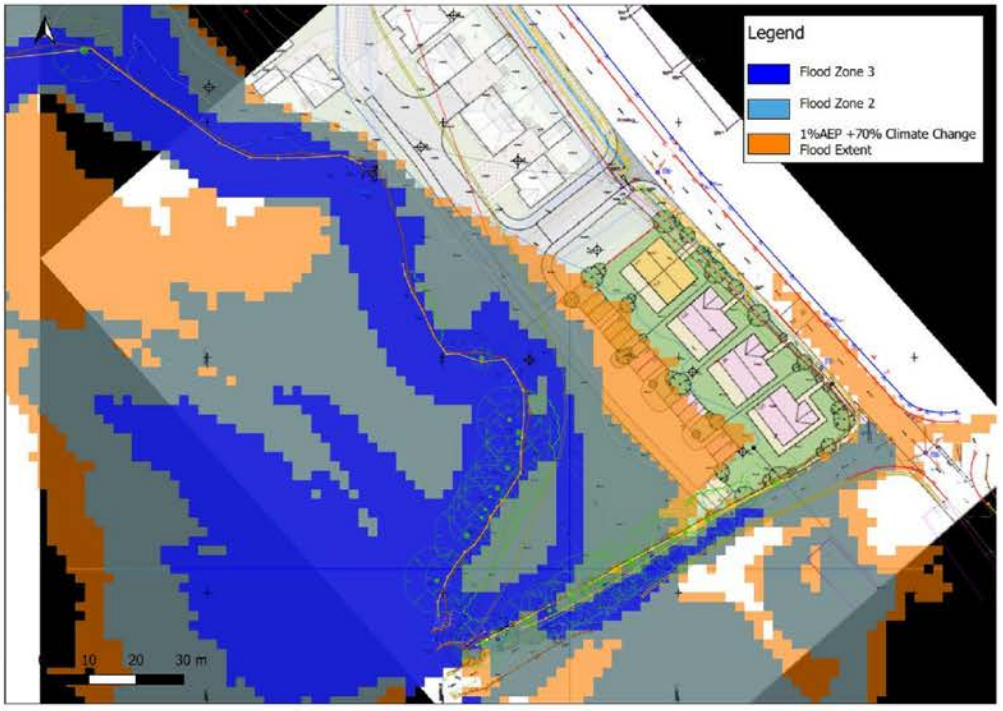


Figure 9 – EA Approved Flood Modelling Output Overlay – Houses Outside of FZ2 plus 1%AEP + 70%CC Extent

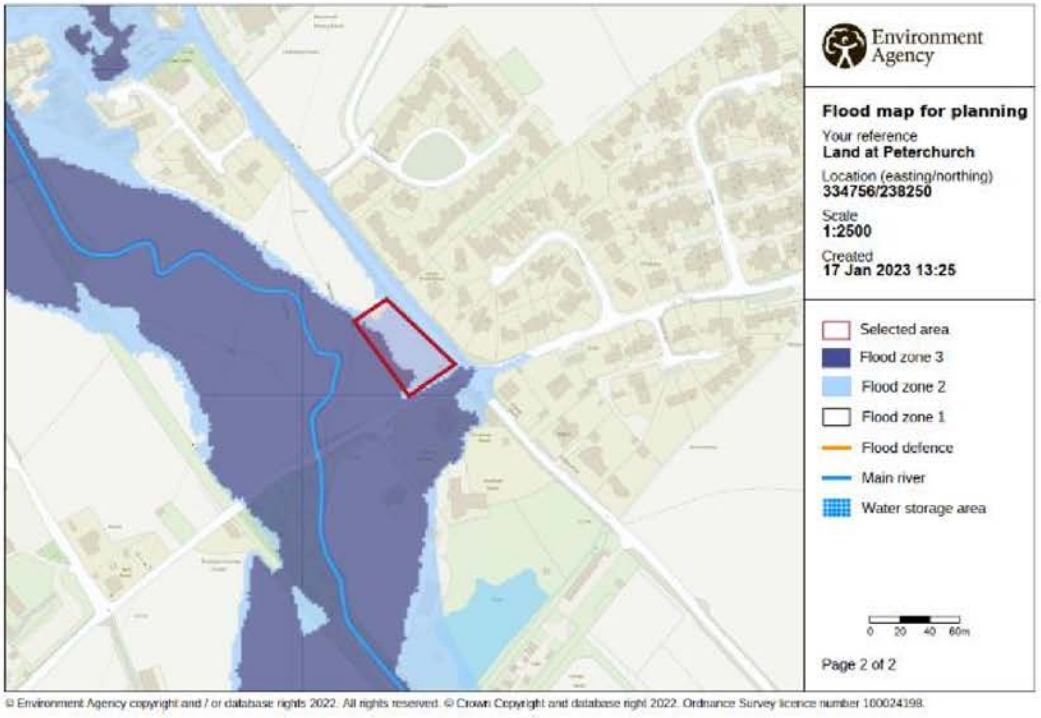


Figure 10 – Flood Map for Planning. Source EA-Government

The recently approved neighbouring development, which is located immediately north of this site, consisting of 10 dwellings and associated works shows the modelled outlines from the 2017 work. See planning application reference P204083/XA2.

Figure 11 – Development Immediately North of the Site – Agreed Modelled Flood Outlines

3.3 SURFACE WATER FLOOD RISK

The EA Long-Term Flood Risk Map for the Medium Risk scenario that is equivalent to the 1% AEP or 1 in 100-year shows that this rainfall is contained within the River Dore watercourse channel and there is no out of bank flooding, see Figure 12.

For more extreme or lower risk events e.g. those with a yearly chance of around 0.1% or 1 in 1000-year there is additional flow in the river and this results in some out of bank flooding within the site, see Figure 13.

This extreme surface water flood extent closely matches the accurate hydraulically modelled fluvial flood extents for both Flood Zone 3 and Flood Zone 2.

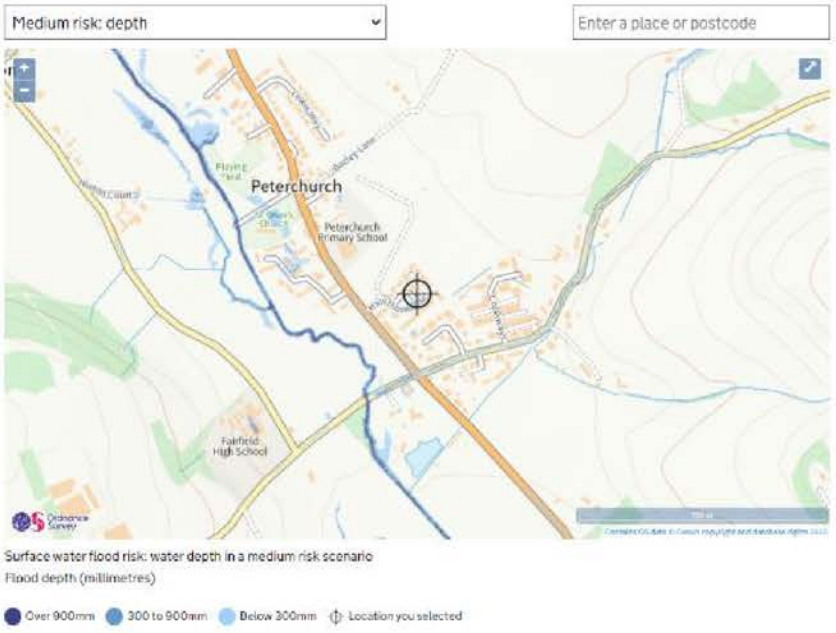


Figure 12 – Long Term Surface Water Medium Risk Flood Map or 1% AEP or 1 in 100-year Risk

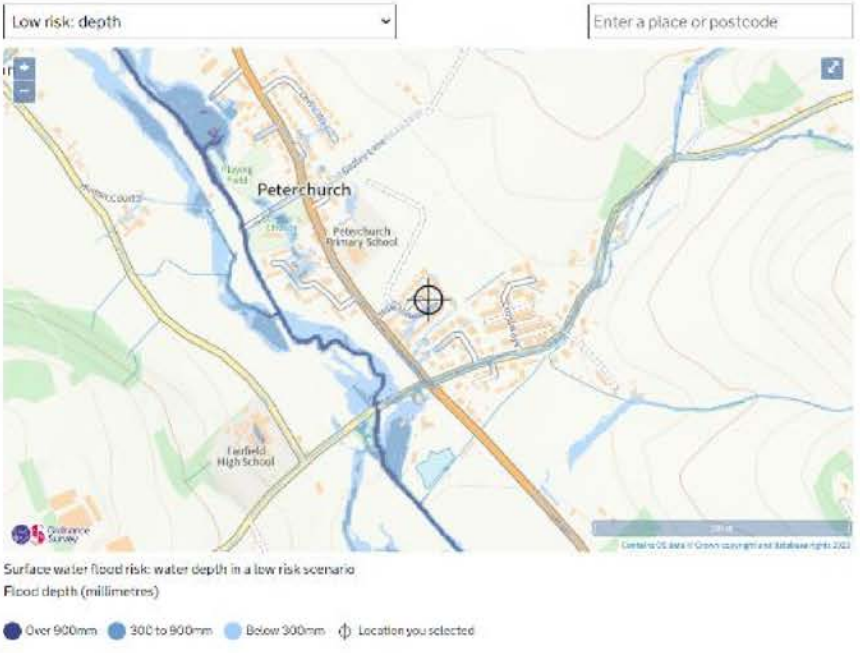


Figure 13 – Long Term Surface Water Low Risk Flood Map or 0.1% AEP or 1 in 1000-year Risk

According to the Design & Access Statement by RRA Architects the site redline boundary covers an area of 3,215m^2. The area to the southeast of the shared entrance road and T-junction is 2,461m^2.

3.4 FLOOD RISK FROM OTHER SOURCES

Groundwater has been physically checked and is 2.5m below the surface. The EA Long Term Flood Map shows no reservoir flood risk in Peterchurch and there are no sewers within the site.

4 MITIGATION MEASURES

4.1 FLUVIAL FLOOD RISK MITIGATION MEASURES

The dwellings are located outside of the 1 in 100 year or 1% AEP flood extent with an additional 70% increase in climate change flows, see Figure 8 and Figure 9.

The dwellings are located in Flood Zone 1 – as determined by the detailed hydraulic modelling of this section of the River Dore in 2017 by Hydro-Logic Services Ltd as part of project K0773 and approved by the Environment Agency as part of planning application 172543.

The dwellings have Finished Floor Levels set at 600mm above the 1 in 100 year or 1% AEP flood extent with 35%CC peak flood level, as required by the NPPF and the Environment Agency, see Figure 14 and Figure 15. At this location the hydraulic modelling has determined that for the River Dore fluvial flooding for 1%AEP plus 35%CC equates to a peak water level of 120.27mAOD. Therefore the dwellings need to be elevated to at least 120.87mAOD, but the proposed levels exceed this value with the lowest FFL set a further 130mm higher at 121.00mAOD.

Flood Zone 3 or the 1%AEP level is 120.10mAOD.

Figure 14 – Finished Floor Levels
(Extract of drawing Proposed Site Landscaping Plan, drawing number 4405 P(0) 007) Rev-

Figure 15 – Site Sections Showing Flood Levels versus FFL
(Extract of drawing Proposed Site Sections, drawing number 4405 P(0) 009 Rev-)

4.2 SURFACE WATER MITIGATION MEASURES AND SUDS

The proposed development has a redline boundary encompassing 0.3215 ha and includes the creation of dwellings with impermeable roof areas, domestic gardens and some shared space, plus associated permeable paved parking, a permeable paved shared driveway and a tarmac entrance roadway. The current land usage is scrubland that is effectively Greenfield. This land mass falls towards the River Dore and any Greenfield overland that currently occurs will enter the river.

The site has been initially assessed from a runoff and drainage perspective, see Figure 16 as having:

- 0.09ha of gardens and green space that will be permeable and are effectively unchanged from the current arrangement;
- 0.067ha impermeable roof areas plus localised area around houses;
- 0.038ha of parking spaces/zone in front of the dwellings;
- 0.048ha of shared driveway and footways.

These areas are then broken down within the detailed drainage modelling. As mentioned in 3.3, there is no surface water flood risk affecting the site.

Figure 16 – Site Areas Contributing to Rainfall Runoff

Using data from the FEH Webservice FEH-13 data was obtained including point rainfall. The previous modelling work had considered the entire river catchment upstream of the site. Using the hydrological data the following design parameters were established.

Pre-development the site Greenfield Flows are 1.2 l/s in the 2 year event, 2.5 l/s in the 39 year event and 3.2 l/s for the 100 year event, see Figure 17. The Greenfield Volume is 149m³. See Figure 18.

Pre-development discharge

Site Makeup	Greenfield
Greenfield Method	IH124
Positively Drained Area (ha)	0.320
SAAR (mm)	840
Soil Index	2
SPR	0.39
Region	9
Betterment (%)	0
	Calc
QBar (l/s)	1.3

Return Period (years)	Growth Factor	Q (l/s)
2	0.93	1.2
30	1.95	2.5
100	2.48	3.2

Figure 17 – Greenfield Runoff Rates

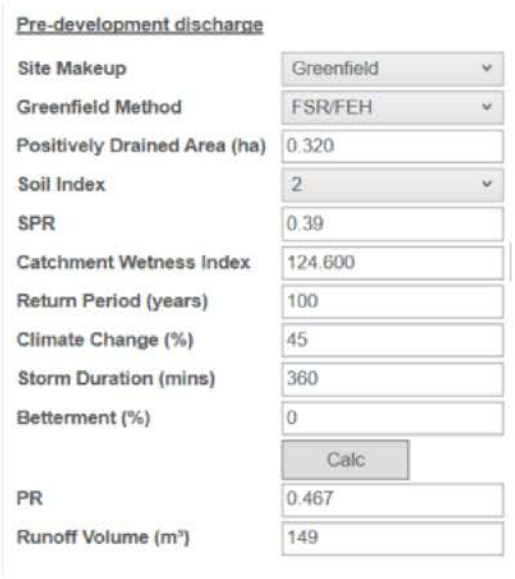


Figure 18 – Greenfield Runoff Volume

The drainage layout includes sub-base storage under the parking zone to accommodate the dwelling runoff initially and provide source control. This then discharges into a buried geocellular tank in the area southwest of the T-junction. The tank is located in land that is outside of Flood Zone 3 and has a flap valve to prevent water ingress from the river.

The results of the network performance are given in Figure 19 and show that the design proposed performs better than Greenfield.

Event	Greenfield (l/s)	Actual Outflow (l/s)	Peak WL (mAOD)
2 year	1.2	1.1	119.303 or 89mm – 571mm freeboard
30 year	2.5	1.2	119.456 or 241mm – 420mm freeboard
100 year +45%CC + 10% creep	3.2	3.0	119.747 or 533mm – 127mm freeboard

Figure 19 – Drainage SuDS Performance

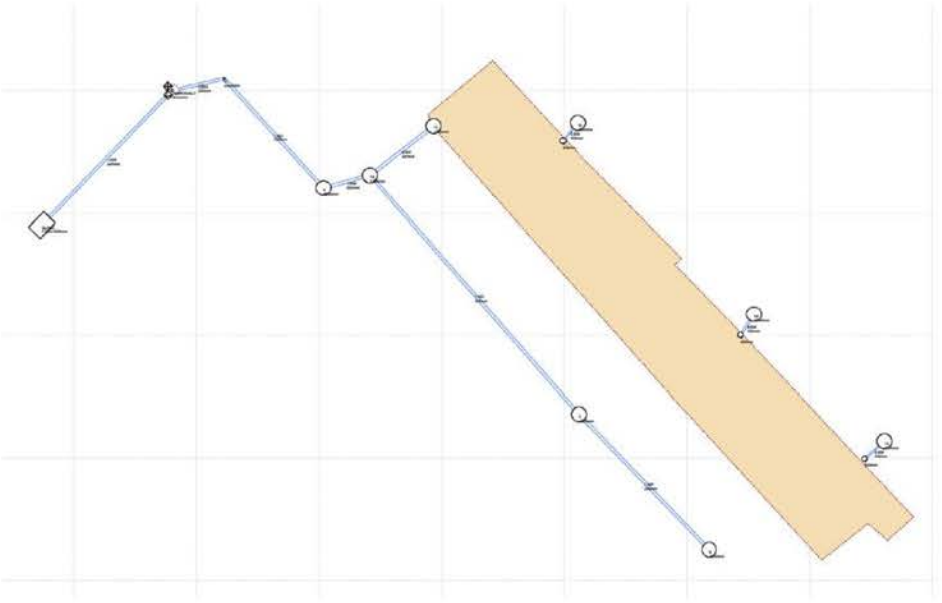


Figure 20 – Surface Water Drainage Layout

Corner Water Consulting	Corner Water Consulting Ltd 1 Cricklade Court Cricklade Street Swindon SN1 3EY	File: CWC126 SWMP.pfd Network: Storm Network Alan Corner 17/02/2023	Page 8 Crossways Peterchurch SWMP

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	8	160	119.748	0.168	1.9	0.2248	0.0000	OK
180 minute winter	Outfall	160	118.844	0.023	1.8	0.0000	0.0000	OK
180 minute winter	Depth/Area 2	160	119.747	0.533	15.4	50.6362	0.0000	SURCHARGED
180 minute winter	4	160	119.748	0.433	15.9	0.4894	0.0000	SURCHARGED
15 minute winter	5	11	120.073	0.133	9.6	0.0212	0.0000	OK
15 minute winter	6	11	120.068	0.128	14.5	0.0203	0.0000	OK
15 minute winter	7	11	120.054	0.114	7.3	0.0181	0.0000	OK
180 minute winter	9	160	119.748	0.270	4.2	0.3703	0.0000	SURCHARGED
180 minute winter	10	160	119.748	0.414	16.8	0.6691	0.0000	SURCHARGED
180 minute winter	11	160	119.748	0.248	8.7	0.2807	0.0000	SURCHARGED
180 minute winter	J1	160	119.747	0.513	15.6	0.0000	0.0000	SURCHARGED
15 minute winter	12	11	120.716	0.165	9.7	0.3201	0.0000	FLOOD RISK
15 minute winter	13	11	120.571	0.121	7.4	0.2108	0.0000	FLOOD RISK
15 minute winter	14	11	120.558	0.118	14.5	0.2598	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
180 minute winter	8	1.000	9	1.9	0.385	0.045	0.5491
180 minute winter	Depth/Area 2	1.005	Outfall	1.8	0.855	0.022	0.0324
180 minute winter	Depth/Area 2	Hydro-Brake®	Outfall	1.2			
180 minute winter	Depth/Area 2	Infiltration		0.3			
180 minute winter	4	1.003	J1	15.6	0.684	0.367	0.4804
15 minute winter	5	Flow through pond	11	26.9	0.180	0.026	2.9858
15 minute winter	6	Flow through pond	11	26.9	0.180	0.026	2.9858
15 minute winter	7	Flow through pond	11	26.9	0.180	0.026	2.9858
180 minute winter	9	1.001	10	4.2	0.311	0.108	1.0298
180 minute winter	10	1.002	4	15.9	0.841	0.444	0.1567
180 minute winter	11	2.000	10	8.7	0.972	0.149	0.2616
180 minute winter	11	Infiltration		0.0			
180 minute winter	J1	1.004	Depth/Area 2	15.4	1.006	0.438	0.1728
15 minute winter	12	5.000	5	9.6	1.225	1.557	0.0149
15 minute winter	13	3.000	7	7.3	0.941	1.124	0.0161
15 minute winter	14	4.000	6	14.5	1.066	0.769	0.0277

Figure 21 – Results for 100 Year plus 45%CC plus 10% Creep

To account for possible flood locking due to elevated river levels the drainage has been modelled with a surcharged outfall for a period of 6 hours – with the river water level set at 120.10mAOD which is the Flood Zone 3 peak at this location. The outfall pipe has an invert level of 118.82mAOD so the surcharge depth is 1.28m, see Figure 22.

In this scenario there is no flooding as the attenuation on site still accommodates the rainfall.

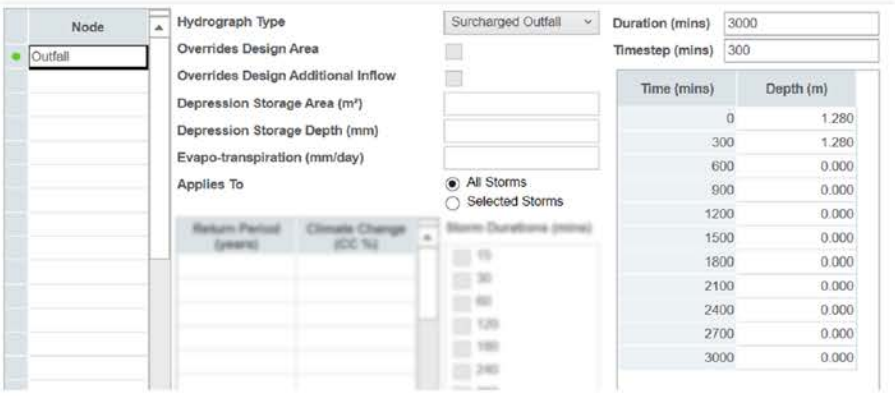


Figure 22 – Surcharged Outfall

Corner Water Consulting	Corner Water Consulting Ltd 1 Cricklade Court Cricklade Street Swindon SN1 3EY	File: CWC126 SWMP.pfd Network: Storm Network Alan Corner 17/02/2023	Page 8 Crossways Peterchurch SWMP

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	8	160	119.748	0.168	1.9	0.2248	0.0000	OK
180 minute winter	Outfall	160	118.844	0.023	1.8	0.0000	0.0000	OK
180 minute winter	Depth/Area 2	160	119.747	0.533	15.4	50.6362	0.0000	SURCHARGED
180 minute winter	4	160	119.748	0.433	15.9	0.4894	0.0000	SURCHARGED
15 minute winter	5	11	120.073	0.133	9.6	0.0212	0.0000	OK
15 minute winter	6	11	120.068	0.128	14.5	0.0203	0.0000	OK
15 minute winter	7	11	120.054	0.114	7.3	0.0181	0.0000	OK
180 minute winter	9	160	119.748	0.270	4.2	0.3703	0.0000	SURCHARGED
180 minute winter	10	160	119.748	0.414	16.8	0.6691	0.0000	SURCHARGED
180 minute winter	11	160	119.748	0.248	8.7	0.2807	0.0000	SURCHARGED
180 minute winter	J1	160	119.747	0.513	15.6	0.0000	0.0000	SURCHARGED
15 minute winter	12	11	120.716	0.165	9.7	0.3201	0.0000	FLOOD RISK
15 minute winter	13	11	120.571	0.121	7.4	0.2108	0.0000	FLOOD RISK
15 minute winter	14	11	120.558	0.118	14.5	0.2598	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
180 minute winter	8	1.000	9	1.9	0.385	0.045	0.5491
180 minute winter	Depth/Area 2	1.005	Outfall	1.8	0.855	0.022	0.0324
180 minute winter	Depth/Area 2	Hydro-Brake®	Outfall	1.2			
180 minute winter	Depth/Area 2	Infiltration		0.3			
180 minute winter	4	1.003	J1	15.6	0.684	0.367	0.4804
15 minute winter	5	Flow through pond	11	26.9	0.180	0.026	2.9858
15 minute winter	6	Flow through pond	11	26.9	0.180	0.026	2.9858
15 minute winter	7	Flow through pond	11	26.9	0.180	0.026	2.9858
180 minute winter	9	1.001	10	4.2	0.311	0.108	1.0298
180 minute winter	10	1.002	4	15.9	0.841	0.444	0.1567
180 minute winter	11	2.000	10	8.7	0.972	0.149	0.2616
180 minute winter	11	Infiltration		0.0			
180 minute winter	J1	1.004	Depth/Area 2	15.4	1.006	0.438	0.1728
15 minute winter	12	5.000	5	9.6	1.225	1.557	0.0149
15 minute winter	13	3.000	7	7.3	0.941	1.124	0.0161
15 minute winter	14	4.000	6	14.5	1.066	0.769	0.0277

Figure 23 – Drainage Performance with Surcharged Outfall

5 FOUL DRAINAGE

The foul drainage from the dwellings will be collected in a separate and fully enclosed gravity sewer serving each dwelling and flowing south westwards into the shared access driveway. The flows all then enter a gravity sewer aligned along the shared driveway to a chamber in the T-junction, before the final outfall to the Welsh Water network in the public highway. See Figure 24 for details of the proposed alignment.

All details are subject to approval by Building Control and Welsh Water.

As the site is within the River Wye catchment this arrangement accords with the council River Lugg Positions Statement.

Figure 24 – Proposed Foul Gravity Sewer Alignment

6 RECOMMENDATIONS

The detailed hydraulic modelling undertaken in 2017 was reviewed by the Environment Agency and approved by them, then further reconfirmed in January 2023. This modelling shows that the Flood Map for Planning is incorrect.

Specifically the Government website mapping shows the site to be totally within Flood Zone 2, however the detailed modelling shows that it is within Flood Zone 1, plus that the dwellings are outside of the extreme 1 in 100 year plus 70%CC flood extent.

Surface water runoff from the dwellings and associated parking hard surfaced areas will be collected by a completely separate surface water drainage network with the flows attenuated and controlled, before discharge to the River Dore. All outflows to the river are controlled to greenfield rates as required by UK /national policy and the council's SuDS Guidance.

A gravity foul sewer connection to a Welsh Water public sewer is proposed.

7 REFERENCES

Author	Date	Title/Description
Ministry of Housing, Communities and Local Government.	2021	National Planning Policy Framework
Communities and Local Government (CLG)	Mar 2012b	Technical Guidance to the National Planning Policy Framework
Environment Agency (EA)	-	Long Term Flood Risk mapping for Rivers or the Sea
Environment Agency (EA)	-	Long Term Flood Risk mapping Flood Risk from Reservoirs
Environment Agency (EA)	-	Long Term Flood Risk mapping for Surface Water
Herefordshire Council		SuDS Guidance Handbook

APPENDIX A: ENVIRONMENT AGENCY CORRESPONDENCE

From: Irwin, Graeme <graeme.irwin@environment-agency.gov.uk>
Sent: 18 January 2023 15:41
To: Alan Corner [redacted]
Cc: Williams, Paul <paul.williams1@environment-agency.gov.uk>
Subject: FW: Crossways, Peterchurch - Modelled Flood Extents versus EA Flood Maps

Good afternoon Alan. I hope all is well with you.

Yes, I recall this site. Looking at the email chain I understand you are now looking at Phase 2 of the development. When we reviewed the previous application (in 2017 and again in 2020 with the Reserved Matters) we were satisfied that the proposed development, including the dwellings, was primarily in Flood Zone 1. Reading your email I suppose there are two elements here; opportunities for Phase 2 development and changes to the Flood Map for Planning.

For the former as the modelling work you undertook was relatively recent we would be happy for that to support any FRA accompanying the forthcoming planning application. The same requirements would apply to this site i.e. built development on land outside the 1 in 100 year plus climate change and FFLs set appropriately. I have attached the latest copy of our general guidance for development in Flood Zones 2/3. When considering the latest climate change allowances (see also attached) it should be noted that there is now a 37% uplift in the Wye Catchment (Central 2080's for more vulnerable development). The previous figure, which will have applied to the earlier application, was 35% but we would not expect revised modelling in considering of this minimum uplift. Looking at your second attachment I note that the 5 units all lie on land outside the 1 in 100 year plus 70% and Flood Zone 2 extent. We would expect to see no land raising in the 1 in 100 year plus climate change extent and no works within 8m of the watercourse. Looking at the plans this should be achievable. Should you wish to discuss this further there would be likely be a charge under our Cost Recovery Service.

For the latter there maybe scope to make alterations to the Flood Map for Planning but this can be a lengthy process and would involve a detailed review of the flood modelling by our Evidence and Risk Team. I would suggest this would be a long term action and maybe not something that would fall in the timescales of any forthcoming application. Based on the scale of the potential changes I can offer no guarantee at this time that alterations would be made to the Flood Map. However, should you wish you pursue this you are advised to contact us via our area Enquiries Team (Enquiries_Westmids@environment-agency.gov.uk). There would be a cost associated with the model review.

I trust the above is of assistance at this time.

Kind regards.

Graeme Irwin

Planning Specialist - Sustainable Places

Environment Agency - West Midlands Area

Contact | Mob: 07500 760028 | **Ext:** 020302 51624 | **Int**: 31624 | Team email: westmidsplanning@environment-agency.gov.uk

Incident management role: Assistant Flood Warning Duty Officer

Herefordshire Council
PO Box 230
Hereford
Herefordshire
HR1 2ZB

Our ref: SV/2017/109509/03-L01
Your ref: 172543

Date: 24 October 2017

F.A.O: Mr. Roland Close

Dear Sir

PROPOSED RESIDENTIAL DEVELOPMENT AND ASSOCIATED WORKS ON LAND TO THE SOUTH OF CLOSURE PLACE, PETERCHURCH, HEREFORDSHIRE

I refer to additional information received in support of the above application and, specifically, in relation to our current objection on flood risk grounds. Having reviewed the revised Flood Risk Assessment (Report K0773 Rep.2 (Rev. 1) – September 2017) we are in a position to remove our objection and would recommend the following comments and conditions be applied to any permission granted.

Flood Risk: As previously stated parts of this site, adjacent to the River Dore, are shown to lie in Flood Zones 2 (Medium Probability) and 3 (High Probability) on our Flood Map for Planning as defined in Table 1 of the National Planning Policy Framework. However, the majority of the site is shown to lie in Flood Zone 1 (Low Probability) i.e. land having a less than 1 in 1000 annual probability of river flooding. Flood Zone 2 is shown to surround the site, including the B4348 to the north of the site which potentially has implications for safe access/egress during flood events.

Sequential Test: The NPPF details the requirement for a risk-based ST in determining planning applications. See paragraphs 100–104 of the NPPF and the advice within the Flood Risk and Coastal Change Section of the government's NPPG.

Paragraph 101 of the NPPF requires decision-makers to steer new development to areas at the lowest probability of flooding by applying a ST. It states that *'Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding'.*

Further detail is provided in the NPPG; 'Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test (ET) if required (see Paragraph 102 of the NPPF).

Environment Agency
Hafren House, Welshpool Road, Shelton, Shropshire, Shrewsbury, SY3 8BB.
Customer services line: 03708 506 506
www.gov.uk/environment-agency
Cont/d..

Flood Risk Assessment (FRA): The revised Flood Risk Assessment (Report K0773 Rep.2 (Rev. 1) – September 2017) has utilised best available information and has been updated in consideration of our previously raised flood risk concerns along with the most recent climate change guidance.

The Flood Map for planning is a generalised modelling which is produced based on topography and channel depth not taking into account any structures, buildings or culverts. Hydro-logic services have taken the existing 1D modelling and updated this to produce a 1D-2D model, using better catchment data. Updated modelling confirms that the majority of the site lies within Flood Zone 1 (figure 3-20, 3-21 & 3-22).

Blockage scenario's at 95% for 1% & 0.1% events carried out within the modelling confirm that some of the site will be at flood risk, however all dwellings are located outside of the risk area and will not be inundated by flood water (Appendix E Map E-18 & Map E-19). We would concur with assessments made in section 3.6 & 3.6.2 based on updated modelling.

Finished floor levels are to be set 600mm above current ground level of the site which represent a precautionary approach given that all built development is located within Flood Zone 1 and ground levels are 2mAOD in difference to the top of bank.
Updated modelling shows that there is no access & egress restrictions of the site (figure 3-23) as the main road (B4348) is no longer showing risk of flooding in the 1% and 1 in 100 plus climate change (35%) flood event.

Condition: Floor levels should be set at least 600mm above the current ground level in line within section 3.6.1 of the revised Flood Risk Assessment (Report K0773 Rep.2 (Rev. 1) – September 2017).

Reason: To protect the development from flooding.

As the River Dore is classed as Main River the Environment Agency has permissive powers to gain access to the watercourse to undertake maintenance and improvement works. There should be no walls or fences on the proposed development that would prevent access to the watercourse for vehicles. We note from the submitted plans that hedging is proposed to divide the rear garden areas. Please be aware that we may remove these hedges should we need to access the watercourse in a flood event. Overall responsibility for maintenance of the River Dore at this location would continue to lie with the riparian landowner.

Condition: There must be no new buildings, structures (including gates, walls and fences) or raised ground levels within 8m of the top of bank of the River Dore (Main River).

Reason: To maintain access to the watercourse for maintenance or improvements and provide for overland flood flows.

Foul Drainage: In line with the Table in Schedule 5 (as amended by us) and in accordance with Article 16 - (1) (c) of the Town and Country Planning (Development Management Procedure) Order 2010, the Environment Agency has no comments to make with regard to foul drainage, in respect of this application. You might seek the completion of the 'Foul Drainage Assessment Form' for your consideration.

Yours faithfully

Cont/d..

Mr. Graeme Irwin
Senior Planning Advisor
Direct dial: 02030 251624
Direct e-mail: graeme.irwin@environment-agency.gov.uk

End

APPENDIX B: DRAINAGE MODELLING

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	1.000
CV	0.750	Preferred Cover Depth (m)	0.300
Time of Entry (mins)	6.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	200.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Width (mm)	Easting (m)	Northing (m)	Depth (m)
8	0.011	6.00	120.700	1200		71.811	72.509	1.120
Outfall			120.030	1760	1320	17.422	99.038	1.209
Depth/Area 2			120.350			28.040	110.037	1.136
4			120.400	1200		40.375	102.046	1.085
5			120.950	450		59.890	105.903	1.010
6			120.890	450		74.366	90.051	0.950
7			120.850	450		84.500	79.955	0.910
9	0.013	6.00	120.650	1200		61.200	83.586	1.172
10	0.024	6.00	120.400	1200		44.173	103.095	1.066
11		6.00	120.400	1200		49.355	107.145	0.900
J1			120.400			32.276	111.007	1.166
12	0.015	6.00	120.950	1200		61.097	107.405	0.400
13	0.011	6.00	120.850	1200		86.090	81.395	0.400
14	0.022	6.00	120.890	1200		75.481	91.762	0.450

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
4.000	14	6	2.042	0.600	120.440	120.417	0.023	88.8	150	6.03	149.9
3.000	13	7	2.145	0.600	120.450	120.425	0.025	85.8	100	6.04	149.8
5.000	12	5	1.927	0.600	120.550	120.530	0.020	96.3	100	6.04	149.9
2.000	11	10	6.577	0.600	119.500	119.418	0.082	80.0	225	6.07	149.6
1.003	4	J1	12.079	0.600	119.315	119.234	0.081	150.0	225	6.95	142.3
1.002	10	4	3.940	0.600	119.334	119.315	0.019	207.4	225	6.76	143.9
1.000	8	9	15.339	0.600	119.580	119.478	0.102	150.0	225	6.24	148.2
1.001	9	10	25.894	0.600	119.478	119.334	0.144	180.0	225	6.68	144.5

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
4.000	1.067	18.9	8.9	0.300	0.323	0.022	0.0	72	1.051
3.000	0.831	6.5	4.5	0.300	0.325	0.011	0.0	61	0.897
5.000	0.783	6.2	5.9	0.300	0.320	0.015	0.0	79	0.892
2.000	1.463	58.2	0.0	0.675	0.757	0.000	0.0	0	0.000
1.003	1.065	42.3	18.1	0.860	0.941	0.047	0.0	102	1.023
1.002	0.904	35.9	18.3	0.841	0.860	0.047	0.0	114	0.908
1.000	1.065	42.3	4.2	0.895	0.947	0.011	0.0	48	0.685
1.001	0.971	38.6	9.1	0.947	0.841	0.023	0.0	74	0.798

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.004	J1	Depth/Area 2	4.346	0.600	119.234	119.214	0.020	217.3	225	7.03	141.6
1.005	Depth/Area 2	Outfall	15.288	0.600	119.214	118.821	0.393	38.9	225	7.15	140.7

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.004	0.883	35.1	18.0	0.941	0.911	0.047	0.0	114	0.887
1.005	2.103	83.6	17.9	0.911	0.984	0.047	0.0	71	1.687

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
4.000	2.042	88.8	150	Circular	120.890	120.440	0.300	120.890	120.417	0.323
3.000	2.145	85.8	100	Circular	120.850	120.450	0.300	120.850	120.425	0.325
5.000	1.927	96.3	100	Circular	120.950	120.550	0.300	120.950	120.530	0.320
2.000	6.577	80.0	225	Circular	120.400	119.500	0.675	120.400	119.418	0.757
1.003	12.079	150.0	225	Circular	120.400	119.315	0.860	120.400	119.234	0.941
1.002	3.940	207.4	225	Circular	120.400	119.334	0.841	120.400	119.315	0.860
1.000	15.339	150.0	225	Circular	120.700	119.580	0.895	120.650	119.478	0.947
1.001	25.894	180.0	225	Circular	120.650	119.478	0.947	120.400	119.334	0.841
1.004	4.346	217.3	225	Circular	120.400	119.234	0.941	120.350	119.214	0.911
1.005	15.288	38.9	225	Circular	120.350	119.214	0.911	120.030	118.821	0.984

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Width (mm)	Node Type	MH Type
4.000	14	1200	Manhole	Adoptable	6	450		Manhole	Adoptable
3.000	13	1200	Manhole	Adoptable	7	450		Manhole	Adoptable
5.000	12	1200	Manhole	Adoptable	5	450		Manhole	Adoptable
2.000	11	1200	Manhole	Adoptable	10	1200		Manhole	Adoptable
1.003	4	1200	Manhole	Adoptable	J1			Junction	
1.002	10	1200	Manhole	Adoptable	4	1200		Manhole	Adoptable
1.000	8	1200	Manhole	Adoptable	9	1200		Manhole	Adoptable
1.001	9	1200	Manhole	Adoptable	10	1200		Manhole	Adoptable
1.004	J1		Junction		Depth/Area 2			Junction	
1.005	Depth/Area 2		Junction		Outfall	1760	1320	Manhole	Headwall

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Connections	Link	IL (m)	Dia (mm)
8	71.811	72.509	120.700	1.120	1200					
							0	1.000	119.580	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Connections	Link	IL (m)	Dia (mm)
Outfall	17.422	99.038	120.030	1.209	1760	1320	1	1.005	118.821	225
Depth/Area 2	28.040	110.037	120.350	1.136			1	1.004	119.214	225
							0	1.005	119.214	225
4	40.375	102.046	120.400	1.085	1200		1	1.002	119.315	225
							0	1.003	119.315	225
5	59.890	105.903	120.950	1.010	450		1	5.000	120.530	100
6	74.366	90.051	120.890	0.950	450		1	4.000	120.417	150
7	84.500	79.955	120.850	0.910	450		1	3.000	120.425	100
9	61.200	83.586	120.650	1.172	1200		1	1.000	119.478	225
							0	1.001	119.478	225
10	44.173	103.095	120.400	1.066	1200		1	2.000	119.418	225
							2	1.001	119.334	225
							0	1.002	119.334	225
11	49.355	107.145	120.400	0.900	1200		0	2.000	119.500	225
J1	32.276	111.007	120.400	1.166			1	1.003	119.234	225
							0	1.004	119.234	225
12	61.097	107.405	120.950	0.400	1200		0	5.000	120.550	100
13	86.090	81.395	120.850	0.400	1200		0	3.000	120.450	100
14	75.481	91.762	120.890	0.450	1200		0	4.000	120.440	150

Simulation Settings

Rainfall Methodology	FEH-13	Check Discharge Rate(s)	✓
Summer CV	0.750	2 year (l/s)	1.2
Winter CV	0.840	30 year (l/s)	2.5
Analysis Speed	Detailed	100 year (l/s)	3.2
Skip Steady State	x	Check Discharge Volume	✓
Drain Down Time (mins)	3600	100 year +45% 360 minute (m^3)	149
Additional Storage (m^3/ha)	20.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	45	10	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)	0.320	Betterment (%)	0
SAAR (mm)	840	QBar	1.3
Soil Index	2	Q 2 year (l/s)	1.2
SPR	0.39	Q 30 year (l/s)	2.5
Region	9	Q 100 year (l/s)	3.2
Growth Factor 2 year	0.93		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	45
Positively Drained Area (ha)	0.320	Storm Duration (mins)	360
Soil Index	2	Betterment (%)	0
SPR	0.39	PR	0.467
CWI	124.600	Runoff Volume (m^3)	149

Node Depth/Area 2 Online Hydro-Brake® Control

Flap Valve	✓	Objective	(HE) Minimise upstream storage
Downstream Link	1.005	Sump Available	✓
Replaces Downstream Link	✓	Product Number	CTL-SHE-0057-1200-0600-1200
Invert Level (m)	119.214	Min Outlet Diameter (m)	0.075
Design Depth (m)	0.600	Min Node Diameter (mm)	1200
Design Flow (l/s)	1.2		

Node Depth/Area 2 Online Orifice Control

Flap Valve	✓	Replaces Downstream Link	x	Diameter (m)	0.050
Downstream Link	1.005	Invert Level (m)	119.600	Discharge Coefficient	0.600

Node 11 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.02280	Porosity	0.30	Main Channel Length (m)	20.000
Side Inf Coefficient (m/hr)	0.02280	Invert Level (m)	119.900	Main Channel Slope (1:X)	500.0
Safety Factor	3.0	Time to half empty (mins)	0	Main Channel n	0.030

Inlets

7 | 6 | 5

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	377.0	0.0	0.400	377.0	0.0	0.401	0.0	0.0	0.500	0.0	0.0

Node Depth/Area 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.02280	Safety Factor	3.0	Invert Level (m)	119.214
Side Inf Coefficient (m/hr)	0.02280	Porosity	0.95	Time to half empty (mins)	228

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	100.0	100.0	0.660	100.0	125.0	0.661	0.0	125.0	1.250	0.0	125.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	8	11	119.605	0.025	1.1	0.0329	0.0000	OK
15 minute summer	Outfall	1	118.821	0.000	0.0	0.0000	0.0000	OK
240 minute winter	Depth/Area 2	176	119.303	0.089	2.9	8.4832	0.0000	OK
15 minute winter	4	13	119.374	0.059	6.2	0.0668	0.0000	OK
15 minute winter	5	11	119.981	0.041	1.6	0.0066	0.0000	OK
15 minute winter	6	11	119.978	0.038	2.4	0.0060	0.0000	OK
15 minute winter	7	12	119.973	0.033	1.2	0.0052	0.0000	OK
15 minute winter	9	11	119.516	0.038	2.5	0.0515	0.0000	OK
15 minute winter	10	13	119.401	0.067	6.2	0.1050	0.0000	OK
30 minute winter	11	23	119.534	0.034	2.7	0.0389	0.0000	OK
240 minute winter	J1	176	119.303	0.069	2.9	0.0000	0.0000	OK
15 minute winter	12	11	120.588	0.038	1.6	0.0715	0.0000	OK
15 minute winter	13	11	120.482	0.032	1.2	0.0534	0.0000	OK
15 minute winter	14	11	120.480	0.040	2.4	0.0846	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute winter	8	1.000	9	1.1	0.325	0.026	0.0523
240 minute winter	Depth/Area 2	1.005	Outfall	0.0	0.000	0.000	0.0000
240 minute winter	Depth/Area 2	Hydro-Brake®	Outfall	1.1			
240 minute winter	Depth/Area 2	Infiltration		0.2			
15 minute winter	4	1.003	J1	6.2	0.709	0.146	0.1054
15 minute winter	5	Flow through pond	11	2.5	0.063	0.002	0.8034
15 minute winter	6	Flow through pond	11	2.5	0.063	0.002	0.8034
15 minute winter	7	Flow through pond	11	2.5	0.063	0.002	0.8034
15 minute winter	9	1.001	10	2.4	0.366	0.063	0.1844
15 minute winter	10	1.002	4	6.2	0.681	0.172	0.0358
30 minute winter	11	2.000	10	2.7	0.729	0.046	0.0243
30 minute winter	11	Infiltration		0.0			
240 minute winter	J1	1.004	Depth/Area 2	2.9	0.624	0.083	0.0544
15 minute winter	12	5.000	5	1.6	0.616	0.259	0.0050
15 minute winter	13	3.000	7	1.2	0.598	0.183	0.0043
15 minute winter	14	4.000	6	2.4	0.681	0.127	0.0072

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	8	11	119.622	0.042	3.2	0.0549	0.0000	OK
15 minute summer	Outfall	1	118.821	0.000	0.0	0.0000	0.0000	OK
180 minute winter	Depth/Area 2	172	119.456	0.241	7.8	22.9387	0.0000	SURCHARGED
180 minute winter	4	172	119.456	0.141	8.0	0.1589	0.0000	OK
15 minute winter	5	11	120.024	0.084	4.5	0.0133	0.0000	OK
15 minute winter	6	11	120.016	0.076	6.7	0.0121	0.0000	OK
15 minute winter	7	11	120.008	0.068	3.4	0.0108	0.0000	OK
15 minute winter	9	11	119.543	0.065	7.1	0.0871	0.0000	OK
15 minute winter	10	13	119.473	0.139	22.0	0.2191	0.0000	OK
15 minute winter	11	14	119.570	0.070	10.3	0.0791	0.0000	OK
180 minute winter	J1	172	119.456	0.221	8.0	0.0000	0.0000	OK
15 minute winter	12	11	120.623	0.073	4.5	0.1356	0.0000	OK
15 minute winter	13	11	120.508	0.058	3.4	0.0984	0.0000	OK
15 minute winter	14	11	120.512	0.072	6.7	0.1509	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute winter	8	1.000	9	3.2	0.449	0.076	0.1107
180 minute winter	Depth/Area 2	1.005	Outfall	0.0	0.000	0.000	0.0000
180 minute winter	Depth/Area 2	Hydro-Brake®	Outfall	1.2			
180 minute winter	Depth/Area 2	Infiltration		0.2			
180 minute winter	4	1.003	J1	8.0	0.670	0.189	0.3967
15 minute winter	5	Flow through pond	11	10.3	0.117	0.010	1.7671
15 minute winter	6	Flow through pond	11	10.3	0.117	0.010	1.7671
15 minute winter	7	Flow through pond	11	10.3	0.117	0.010	1.7671
15 minute winter	9	1.001	10	7.0	0.456	0.183	0.4520
15 minute winter	10	1.002	4	21.6	0.913	0.602	0.0936
15 minute winter	11	2.000	10	10.4	1.048	0.178	0.0650
15 minute winter	11	Infiltration		0.0			
180 minute winter	J1	1.004	Depth/Area 2	7.8	0.836	0.222	0.1725
15 minute winter	12	5.000	5	4.5	0.791	0.730	0.0109
15 minute winter	13	3.000	7	3.4	0.776	0.520	0.0094
15 minute winter	14	4.000	6	6.7	0.886	0.355	0.0154

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	8	160	119.748	0.168	1.9	0.2248	0.0000	OK
180 minute winter	Outfall	160	118.844	0.023	1.8	0.0000	0.0000	OK
180 minute winter	Depth/Area 2	160	119.747	0.533	15.4	50.6362	0.0000	SURCHARGED
180 minute winter	4	160	119.748	0.433	15.9	0.4894	0.0000	SURCHARGED
15 minute winter	5	11	120.073	0.133	9.6	0.0212	0.0000	OK
15 minute winter	6	11	120.068	0.128	14.5	0.0203	0.0000	OK
15 minute winter	7	11	120.054	0.114	7.3	0.0181	0.0000	OK
180 minute winter	9	160	119.748	0.270	4.2	0.3703	0.0000	SURCHARGED
180 minute winter	10	160	119.748	0.414	16.8	0.6691	0.0000	SURCHARGED
180 minute winter	11	160	119.748	0.248	8.7	0.2807	0.0000	SURCHARGED
180 minute winter	J1	160	119.747	0.513	15.6	0.0000	0.0000	SURCHARGED
15 minute winter	12	11	120.716	0.165	9.7	0.3201	0.0000	FLOOD RISK
15 minute winter	13	11	120.571	0.121	7.4	0.2108	0.0000	FLOOD RISK
15 minute winter	14	11	120.558	0.118	14.5	0.2598	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
180 minute winter	8	1.000	9	1.9	0.385	0.045	0.5491
180 minute winter	Depth/Area 2	1.005	Outfall	1.8	0.855	0.022	0.0324
180 minute winter	Depth/Area 2	Hydro-Brake®	Outfall	1.2			
180 minute winter	Depth/Area 2	Infiltration		0.3			
180 minute winter	4	1.003	J1	15.6	0.684	0.367	0.4804
15 minute winter	5	Flow through pond	11	26.9	0.180	0.026	2.9858
15 minute winter	6	Flow through pond	11	26.9	0.180	0.026	2.9858
15 minute winter	7	Flow through pond	11	26.9	0.180	0.026	2.9858
180 minute winter	9	1.001	10	4.2	0.311	0.108	1.0298
180 minute winter	10	1.002	4	15.9	0.841	0.444	0.1567
180 minute winter	11	2.000	10	8.7	0.972	0.149	0.2616
180 minute winter	11	Infiltration		0.0			
180 minute winter	J1	1.004	Depth/Area 2	15.4	1.006	0.438	0.1728
15 minute winter	12	5.000	5	9.6	1.225	1.557	0.0149
15 minute winter	13	3.000	7	7.3	0.941	1.124	0.0161
15 minute winter	14	4.000	6	14.5	1.066	0.769	0.0277

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