


Powys County Council

Stage 2 Strategic Flood Consequences Assessment

Final Report

September 2013

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Powys County Council
Stage 2 Strategic Flood Consequences Assessment

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Glossary of Terms

AEP	Annual Exceedance Probability e.g. 1% AEP is equivalent to 1% probability of occurring in any one year (or, on average, once in every 100 years)
Brownfield (previously developed) land	Land which or has been occupied by a building including the curtilage of the building (excluding those used for forestry or agricultural use).
BFIHOST	FEH catchment descriptor quantifying the permeability of a catchment
CS	Candidate Site
DAMs	Development Advice Maps
DEFRA	Department for Environment, Food and Rural Affairs
EAW	Environment Agency Wales
FCAs	Flood Consequence Assessment
FEH	Flood Estimation Handbook
LDP	Local Development Plan
LPA	Local Planning Authority
NFCDD	National Flood and Coastal Defence Database
PCC	Powys County Council
PPW	Planning Policy Wales
SuDS	Sustainable Urban Drainage Systems
TAN	<i>Planning Policy Wales</i> Technical Advice Note
TAN 15	PPW Technical Advice Note relating to <i>Development and Flood Risk</i>
UDP	Unitary Development Plan (precursor to the LDP)
URBEXT	FEH catchment descriptor quantifying the extent of urbanisation with a catchment
Zone A	Considered to be at little or no risk of fluvial and/or tidal flooding
Zone B	Areas known to have been previously flooded in the past evidenced by sedimentary deposits
Zone C1	Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.
Zone C2	Areas of the floodplain without significant flood defence infrastructure.

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Executive Summary

Halcrow Group Limited was requested by Powys County Council to undertake a Stage 2 Strategic Flood Consequences Assessment (SFCA) in accordance with best practice, Planning Policy Wales (PPW), Technical Advice Note (TAN) 15 Development and other relevant national and local planning policy as well as EU legislation.

The aim of the SFCA was to provide an overview of the level of flood risk for the thirty Candidate Sites (CS) that are being considered for development and inclusion within the Powys County Council Local Development Plan (LDP). The SFCA will additionally form an evidence base through which Powys County Council, as the Local Planning Authority (LPA) can appropriately consider the consequences of flooding to new developments and implement a sequential and risk based approach to site allocation and development.

The flood risk to potential Candidate Sites has been assessed by reviewing existing flood model data sets and the creation of new fluvial and pluvial models as and when required. Where new modelling has been undertaken, the outputs, namely the spatial extent of any likely flooding and the anticipated hazard/risk quotient commensurate with this flooding, have been presented graphically.

Site specific recommendations and identification of constraints for each Candidate Site have been formulated for inclusion within the SFCA. Additional high level flood risk policy recommendations have been made for potential candidate sites and future windfall sites, in addition to outline guidelines which aim to assist Development Control and potential developers required to produce site specific Flood Risk Assessments.

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1 Introduction

1.1 Project Overview

1.1.1 Halcrow Group Limited has been requested by Powys County Council to undertake a Stage 2 Strategic Flood Consequences Assessment (SFCA) in accordance with best practice, Planning Policy Wales (PPW), Technical Advice Note (TAN) 15 Development and other relevant national and local planning policy as well as EU legislation.

1.2 Aims & Overview of the Strategic Flood Consequence Assessment Process

1.2.1 The aims of TAN15 planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages of the planning process, to avoid inappropriate development in areas at risk of flooding and to direct development away from areas at highest risk. Where new development is necessary in such areas, and can be justified against set criteria, the policy aims to make the development 'safe', ensures there is no increase of flood risk elsewhere and, where possible, reducing flood risk overall.

1.3 Stage 1 Strategic Flood Consequence Assessment Aims

1.3.1 The Planning and Compulsory Purchase Act 2004 requires the Planning Authority of Powys County Council to produce a Local Development Plan (LDP) that will serve to replace the existing Unitary Development Plan (UDP). As part of the LDP process authorities are encouraged to carry out a SFCA to ensure that sites are allocated into those areas that are at the lowest risk from flooding. The Powys County Council Stage 1 SFCA was completed in 2012.

1.3.2 The Stage 1 SFCA therefore:

- Helps to deliver a sequential approach to the allocation of land for development and will assist in the preparation of policies to minimise and manage flood risk; and
- Serves to quantify the risks of flooding in the county.

1.3.3 The overall aim of the Stage 1 SFCA as defined in the Final Report is:

- "To situate development in Powys according to the guidance set out in TAN 15, sequentially locating development taking the consequences of flooding into account"

Therefore the Stage 1 SFCA steers development towards Zone A and Zone B.

1.4 Stage 2 Strategic Flood Consequence Assessment Aims

1.4.1 This study refines and builds upon the work undertaken in the Stage 1 SFCA, which provided a strategic assessment of flood risk across Powys. It assesses the risk posed by flooding from all sources, and improves fluvial flooding information where necessary, allowing an assessment of the flood risk, hazard and residual flood risk. It will focus on directing new development to areas of lowest risk or where the risk can be acceptably managed. It also adopts a sequential approach at the individual site allocation level (i.e. vulnerable uses within a single site are directed to areas at the lowest probability of flooding in the first instance) and develops policies and practices for Powys Local Development Plan (LDP).

- 1.4.2 The principal purpose of a Stage 2 SFCA is therefore to facilitate the application of the Justification and Consequence tests, as outlined in Sections 6 & 7 of TAN15. It provides an assessment of those potential candidate sites identified as part of the Stage 1 Assessment, and seeks to understand if they are suitable for development, and if so, what type of development. The Stage 2 SFCA will also provide general and site specific policy recommendations to allow Powys County Council to ensure the development of these candidate sites is in harmony with relevant policy guidance. Detailed information of the approach, Flood Zones and the Justification and Consequences tests are contained in Section 3.
- 1.4.3 It is possible that Powys County Council will need to apply the Justification Test to future land allocations or brownfield re-developments. The purpose of this study is to provide the necessary information for this to be carried out in the study areas identified as part of this assessment, as the need arises. Should additional sites outside the study areas within this assessment come forward, there may be a need for further Stage 2 SFCA work.

1.5 Key Aspects of the Stage 2 SFCA Assessment Process

- 1.5.1 The scope of Stage 2 assessment involves a more detailed review of flood risk to a site. In order to achieve this, additional work may be required to ensure there is a suitable evidence base for assessment. Sites that are determined to be suitable for development, but have been identified as being at risk from flooding during the Stage 1 process, are fed through to the Stage 2 assessment.
- 1.5.2 Fluvial flood risk assessment needs to take into account flood probability, flood depth, extent, velocity, hazard and the rate of onset of flooding. The presence of flood risk management measures such as flood defences will be taken into account, as will the residual risk from blockage of structures, culverts defence overtopping and breaches. An assessment of flood hazard enables the variation in risk within a flood zone to be understood, as it distinguishes between areas of higher hazard (deep and/or fast flowing water) against areas of lower hazard (shallow and/or slow flowing water).
- 1.5.3 This increased level of detail, compared to the Stage 1 Assessment, will enable Powys County Council to:
- Allow informed development of flood risk areas in accordance with the Assessing Flooding Consequences guidance in Appendix 1 of TAN 15; and
 - Inform the section (iv) of the Justification Test in Section 6 of TAN 15. Part (iv) of the Justification Test states: the potential consequences of a flooding event for the particular type of development have been considered, and in terms of the criteria contained in sections 5 and 7 and Appendix 1 found to be acceptable.

1.6 Background to the Study Area

- 1.6.1 Powys is a unitary authority covering an area of some 5,179km², the largest county in Wales and borders with ten other Local Planning Authorities. A significant proportion of Powys is upland, mountainous and rural, with the Brecon Beacons National Park covering approximately 16% of the county (a Local Planning Authority in its own right and therefore excluded from this study).

- 1.6.2 The upland areas consist of areas with a high landscape value that include the Berwyns and Cambrian Mountains. The settlements and transport routes have historically developed in the valleys, often at important river crossings, which has significant importance for this study, as many urban areas are subject to and constrained by flood risk.

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2 Planning Policy/ Legislation

2.1 Introduction

2.1.1 This section provides a summary of the SFCA process and how this sits with International, National and Local Planning Policy (reproduced from the Stage 1 Report, and edited / expanded where necessary). This section will also provide a summary explanation of the Environment Agency Flood Zones.

2.2 International Legislation

The EU Water Framework Directive (WFD) 2000/60/EC

2.2.1 The Water Framework Directive has been described as the most substantial piece of EC water legislation to date; it was published in 2000 and transposed into Welsh law in December 2003. The Directive applies to all surface water bodies and groundwater, including lakes, streams, rivers and canals. Its overall objective is to establish a strategic framework (that is based on river basins) for managing surface water and groundwater through common objectives and principles; these include contributing towards mitigating the effects of floods and droughts.

The EU Floods Directive 2007/60/EC

2.2.2 The EU Floods Directive on the assessment and management of flood risks came into force November 2007. This Directive requires Member States to assess if all water courses and coast lines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk.

2.3 National Legislation

Flood Risk Regulations (2009)

2.3.1 The purpose of the Flood Risk Regulations is to implement the requirements of the European Floods Directive. As detailed above, the aim of the Directive is to provide a consistent approach to managing flood risk across Europe. It establishes three stages of activity that include assessing areas at risk from flooding, mapping them and producing a management plan. These three stages take place within a six year flood risk management cycle. In addition to this, the Flood Risk Regulations define new responsibilities for flood risk management which are consistent with the Flood and Water Management Act (2010):

- **Environment Agency Wales:** the competent authority for managing risk from main rivers, the sea and large raised reservoirs.
- **Lead Local Flood Authority (Powys County Council)** – responsible for managing local flood risk in particular from ordinary watercourses, surface runoff and groundwater.

The Flood and Water Management Act (2010)

2.3.2 The Flood and Water Management Act received Royal Assent on the 8th April 2010, with different sections of the Act coming into force in Wales at different times. It aims to improve both flood risk management and the way that water resources are managed. The Act defines clear roles and responsibilities and instils a more risk-based approach. Local authorities are given the lead role in managing local flood risk (from surface water, ground water and

ordinary watercourses) while the strategic overview role, for all flood risk is undertaken by the Environment Agency Wales. Schedule three of the act requires sustainable drainage systems (SuDS) to be incorporated into all construction works that have drainage implications. This new requirement works alongside the planning system, with combined planning applications needing approval for the SuDS from the approving body. This section of the Act is likely to come into force in 2012. The Flood and Water Management Act 2010, also establishes that flood risk will be managed in Wales through a National Strategy supported by a Local Strategy for each Lead Local Flood Authority area.

People, Places, Futures - The Wales Spatial Plan – 2008 update

2.3.3 The overall role, purpose and principles of the Wales Spatial Plan are:

- To make sure that decisions are taken with regard to their impact beyond immediate sectoral or administrative boundaries and that everything is governed by core sustainable values;
- To set the context for local community planning;
- To influence where the Welsh Assembly Government spends money by understanding the roles of and interactions between places
- To provide a clear evidence base for the public, private and third sectors to develop policy and action.

(Wales Spatial Plan 1.1)

2.3.4 The five national themes that govern the plan are the following:

- Building Sustainable Communities
- Promoting a Sustainable Economy
- Valuing our Environment
- Achieving Sustainable Accessibility
- Respecting Distinctiveness

(Wales Spatial Plan 9.1)

2.3.5 Wales has been split into six sub-regions (without the definition of hard boundaries). In each of these areas the local authorities, the private and third sectors along with the Welsh Government and its agencies, are working together in 'Spatial Plan Area Groups' to achieve the strategic vision for that area. The flooding priorities for the Central Wales Spatial Plan Area Group which encompass Powys include:

- Adapting and responding to climate change both in terms of challenges and opportunities for the Area (flood risk, carbon capture / offset, coastal erosion, renewable energy)

Environment Strategy for Wales (2006)

2.3.6 The purpose of the Environment Strategy for Wales (2006) is to provide a framework that will enable the achievement of an environment that is clean, healthy, biologically diverse and valued by the people of Wales. The strategy contains a series of outcomes that are supported by actions laid out in the 'Environment Strategy Action Plan (2008 – 2011). The main outcomes that relate to flooding are:

- Appropriate measures will be in place to manage the risk of flooding from rivers and the sea and help adapt to climate change impacts;

- Everyone who lives in a flood risk area will understand the flood risk they are subject to, the consequences of that risk and how to live with that risk.

Planning Policy Wales Edition 5 (November 2012)

- 2.3.7 Planning Policy Wales (PPW) sets out the land use planning policies of the Welsh Government. PPW alongside Technical Advice Notes (TANs), circulars and policy clarification letters make up the national planning policy which should be taken into account in the preparation of the local development plan.
- 2.3.8 In relation to flood risk PPW requires development plans to ensure that new developments are not at risk themselves from flooding and do not increase the risk of flooding elsewhere. It should be acknowledged that any resources for flood defence projects are aimed at protecting existing developments and are not available for anticipated future developments. A sustainable approach to flooding should be adopted that avoids developing flood hazard areas, and where practical managed retreat is promoted for flood plain restoration (para 13.3.1).

Technical Advice Note (TAN) 15 – Development and Flood Risk (2004)

- 2.3.9 TAN 15 supplements the policy set out in Planning Policy Wales in relation to development and flooding. It advises on development and flood risk and provides a framework within which risks arising from river and tidal flooding and from additional run-off from development in any location, can be assessed.
- 2.3.10 Similarly to Planning Policy Wales, this TAN advises caution in respect of new development in areas at high risk of flooding by setting out a precautionary framework to guide planning decisions. The overarching aim of this is to direct new development away from those areas at high risk from flooding.
- 2.3.11 Development advice maps have been drawn up for the whole of Wales; these maps identify different zones that represent different levels of risk from flooding, and therefore lend to different planning actions. Table 2.1 below is a reproduction of Figure 1 from TAN 15.

Table 2.1: Flood Zone Classification from TAN 15

Description of Zone	Zone	Use within the precautionary framework
Considered to be at little or no risk of fluvial or tidal/coastal flooding.	A	Used to indicate that justification test is not applicable and no need to consider flood risk further.
Areas known to have been flooded in the past evidenced by sedimentary deposits.	B	Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further.
Based on Environment Agency Wales extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal)	C	Used to indicate that flooding issues should be considered as an integral part of decision making by the application of the justification test including assessment of consequences.
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	C1	Used to indicate that development can take place subject to application of justification test, including acceptability of consequences.
Areas of the floodplain without significant flood defence Infrastructure.	C2	Used to indicate that only less vulnerable development should be considered subject to application of justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered.

2.3.12 TAN 15 states that particular flooding consequences may not be acceptable for particular types of development. The precautionary framework identifies the vulnerability of different land uses to flooding, which are contained in TAN 15 Figure 2, reproduced below in Table 2.2.

Table 2.2: TAN 15 Vulnerability Classification

Development Category	Types
Emergency Services	hospitals, ambulance stations, fire stations, police stations, coastguard stations, command centres, emergency depots and buildings used to provide emergency shelter in time of flood
Highly Vulnerable Development	all residential premises (including hotels and caravan parks), public buildings (e.g. schools, libraries, leisure centres), especially vulnerable industrial development (e.g. power stations, chemical plants, incinerators), and waste disposal sites
Less Vulnerable Development	General industrial, employment, commercial and retail development, transport and utilities infrastructure, car parks, mineral extraction sites and associated processing facilities, excluding waste disposal sites

- 2.3.13 There is a fourth, 'Other' category, which accommodates exceptions to the general rule e.g. boatyards, marinas and other uses that require them to be adjacent to fluvial / coastal areas due to their nature.
- 2.3.14 Emergency Services and Highly Vulnerable developments should not be permitted in Zone C2.
- 2.3.15 Any development proposal in Zone C must satisfy the Justification Test criteria set in paragraph 6.2 of TAN 15. Part of this justification is that a "Flood Consequence Assessment" is conducted to demonstrate that the risks from flooding can be managed to an acceptable level, which includes not increasing the risk of flooding elsewhere. Paragraph 10.11 of TAN 15 requires the LDP to include policies which promote the use in appropriate locations of sustainable drainage systems that control surface water as close to its source as possible.

National Strategy for Flood and Coastal Erosion Risk Management in Wales Adopted November 2011

- 2.3.16 The purpose of this strategy is to set out the Welsh Government's policies on flood and coastal erosion risk management and to establish a delivery framework that meets the needs of Wales both now and in the future. The Welsh Government is required to develop, maintain and apply this strategy under the Flood and Water Management Act 2010. The document provides detailed information on the roles and responsibilities of all those involved and how they should work together.
- 2.3.17 The Welsh Government's overall aim in the strategy is to develop a system that:
- Embeds sustainable development as the key principle informing decisions and which is reflected in an approach that promotes the wellbeing of people in Wales and addresses the needs of the economy and the environment;
 - Is focussed on the needs of individuals, communities and businesses and which recognises that different groups have different needs and varying capacity to deal with flood risk and that the service they receive must be tailored accordingly;
 - Promotes equality and does not exacerbate poverty;
 - Is based upon a holistic understanding of the risks and consequences;
 - Considers the full range of risk management responses;
 - Facilitates long term resource planning;
 - Allows prioritisation of investment, resources and actions.
- 2.3.18 In support of this aim, four objectives have been identified:
- Reducing the impacts on individuals, communities and businesses from flooding and coastal erosion;
 - Raising awareness of and engaging people in the response to flood and coastal erosion risk;
 - Providing an effective and sustained response to flood and coastal erosion events;
 - Prioritising investment in the most at-risk communities.
- 2.3.19 Once these objectives have been agreed following the consultation they will update and replace the outcomes for flood risk management set out in the Environment Strategy for Wales.

- 2.3.20 The strategy identifies that in order to implement its aims and objectives the lead local flood authorities will need to:
- Work with planning policy to ensure that new developments are discouraged from areas at risk from flooding
 - Work with planning policy to ensure that any redevelopment in an area at risk from flooding will take place only if it is properly justified

2.4 Local

Powys Adopted Unitary Development Plan 2001 – 2016 (Adopted March 2010)

- 2.4.1 The Unitary Development Plan (UDP) is the main local planning policy document against which planning applications will be assessed and proposals should conform. Preparation commenced on producing the Powys Local Development Plan (LDP) on 1 January 2011, to replace the UDP but the process is expected to take four years. The UDP document guides development within Powys until 2016. Policies pertinent to flood risk are as follows:

UDP SP14 - Development in Flood Risk Areas

- 2.4.2 Highly vulnerable development and emergency services will not be permitted in Zone C2. No other development will be permitted within an area of high risk of flooding unless it can be demonstrated that the development is of strategic importance and that the consequences of any flooding would be acceptable for the development proposed and that it would not give rise to any unacceptable flooding impacts elsewhere. For such developments to be permitted, they must ensure the provision of appropriate and environmentally sympathetic flood mitigation and / or compensatory measures.

DC13 - Surface Water Drainage

- 2.4.3 **A** - Development proposals will be permitted where:
1. They make adequate provision for land drainage and surface water disposal
 2. They would not adversely affect flood management or maintenance schemes
 3. They would not give rise to unacceptable on or off site flooding
- 2.4.4 **B** - If mitigation measures are required to permit a development to proceed, a condition will be attached to any planning permission, or a planning obligation by agreement sought, to ensure that the necessary works are completed prior to the commencement of the development.
- 2.4.5 **C** - Where proposals include satisfactory alleviation measures to overcome any problem of drainage these will only be acceptable where they will not result in:
1. The loss of wetland habitats
 2. Unacceptable adverse impacts on surface or groundwaters
 3. The loss or impediment of access to watercourses and public rights of way

DC14 - Flood Prevention Measures

- 2.4.6 Flood prevention and alleviation measures will be permitted where practicable and reasonable, subject to their being in accordance with the environment and conservation policies and proposals of the plan. If flood defence measures are required to permit a development to proceed, a condition will be attached to any planning permission, or a planning obligation by agreement sought, to ensure that the necessary works are completed

prior to the commencement of the development. Where proposals include satisfactory alleviation measures to overcome any problem of flooding risk including those to third parties, these will only be acceptable where they will comply with policy DC13 criteria C1, C2 and C3.

Powys Local Development Plan

- 2.4.7 In 2004, the Planning and Compulsory Purchase Act introduced a new Local Plan process for Wales. The new system requires each authority in Wales to prepare a Local Development Plan (LDP) for their area which, once adopted, replaces any existing development plan (Powys UDP). As part of the LDP process, a Delivery Agreement has been prepared that sets out the timescale for the preparation of the LDP and the opportunities for the public and agencies to contribute to the Plan preparation process.

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3 Stage 2 SFCA Methodology

3.1 Introduction

3.1.1 Sites that were determined to be potentially suitable for development from the Stage 1 SFCA process, but have been identified as being at risk from flooding, now require a greater level of assessment in this Stage 2 study.

3.1.2 Following the data gathering, screening and gap analysis stage, additional work is required to ensure that there is a suitable evidence base for assessment. Fluvial flood risk assessment needs to take into account flood probability, flood depth, extent, velocity, hazard and the rate of onset of flooding. The presence of flood risk management measures such as flood defences also needs to be taken into account, as will the residual risk from blockage of structures, culverts defence overtopping and breaches.

3.2 Summary of Approach Required

3.2.1 To fulfil the objectives of this study, the following approach is needed:

- Undertake a data gathering, screening exercise and gap analysis;
- Following identification of areas where additional modelled data is required, develop hydraulic models for the identified model extents. In most cases, the modelling includes:
 - For fluvial modelling, creating new 2D TUFLOW models (using LIDAR or SAR data for the channel and representing structures in 1D using either ISIS or ESTRY) to enable flood hazard mapping of the floodplain
 - For pluvial modelling, creating new 2D ISIS models (Using LiDAR or SAR data to represent the surface topography) to enable flood hazard mapping of the floodplain
 - Structure details (such as bridges and culverts) were obtained from existing dataset and specially commissioned survey to enable their impact on sites to be assessed, in addition to investigation residual risk from blockages
- For very small drains / watercourses deriving from small catchments (around 1km²), to recommend a development buffer zone adjacent to the drain / watercourse;
- Undertake hydrological analysis, if none already exists, for the 1 in 20, 1 in 100, 1 in 100 plus climate change and 1 in 1000 year events. These return periods have been selected so that the results can be interpreted and related to the Development Advice Flood Zone designations, Environment Agency Wales Flood Zone Maps and Flood Consequence Assessment outputs;
- Produce flood maps showing flood extent and flood hazard;
- Identify locations where culvert blockage scenarios would cause residual risk to sites and model this;
- Assess the influence of flood defences and model the residual risk posed by those defences from breach and overtopping;

- Use Flood Map for Surface Water Flooding datasets to maintain consistency with the Preliminary Flood Risk Assessment (PRFA) for Powys, as this is more appropriate than the Areas Susceptible to Surface Water Flooding Map, as most of the candidate sites are within settlements and near existing buildings (which this alternative dataset does not take into account);
- Use Historic Flood Map information where appropriate;
- Assess flood risk posed to the identified risk areas and recommend appropriate policies for potential development proposals that may come forward in the future;
- Provide appropriate Development Plan policies and FCA guidance for developers.

3.3 Data Sources

The following data was used to develop the hydraulic models and assess the flood risk to the Candidate sites:

- LiDAR and SAR data made available by the EA (further details on the type and date of this data is discussed in the individual model technical notes in Appendix B);
- Survey data of structures gathered by Halcrow as part of this study.

GIS datasets used for the Site Assessment analysis included:

- Flood Map for Surface Water 1:30 Rainfall;
- Flood Map for Surface Water 1:200 Rainfall;
- Areas Susceptible to Ground Water Flooding;
- Groundwater Vulnerability;
- Areas Susceptible to Surface Water Flooding;
- Flood map;
- National Receptors Dataset.

These datasets were sourced from the Environmental Agency Geostore.com website.

3.4 Candidate Sites – Background & Screening

3.4.1 A total of 1,168 candidate site submissions were received in 2011 as part of the Powys Local Development Plan (LDP). The Stage 1 SFCA process assessed these sites to see if they were at risk from fluvial & tidal, surface water and sewer flooding.

Those sites shown to be located within Zone C of the DAM were actioned in the following manner:

- Candidate sites shown to be located in Zone C1 were identified for inclusion in this Stage 2 assessment
- Candidate Sites that intersected with Zone C2 were given one of the following recommendations:
 - Unsuitable for development - a large proportion of the site is within Zone C2
 - Amend boundary to exclude the area in Zone C2
 - Proceed to Stage 2 of the SFCA - most of the site is not in C2 but some of the access (within the site boundary is)

- Proceed to Stage 2 - the site is within Zone C2 but the proposed use is for less vulnerable development
- Refer to detailed Flood Consequence Assessment (FCA), the site is within Zone C2 but a FCA has been conducted and submitted as part of the proposal

Sites were also assessed against the Environment Agency Wales Flood Zone Maps. In instances where discrepancies existed between the EA Floodzone 2 and Zone C2, the following approach was taken:

- When it was found that Floodzone 2 was larger than the extent of Zone C2, then Floodzone 2 was used to determine the full extent of the area at high risk from flooding (as this was judged to be the most up to date dataset);
- Where the extent of Zone C2 was found to be larger than Floodzone 2, and it may affect a candidate site's suitability for development, it was recommended that the site proceeds to Stage 2 of the SFCA to ascertain an improved knowledge of flood risk to the site.

If a site was shown to have a significant proportion affected by surface water flooding, then it was identified for further assessment in this Stage 2 commission. Due to the coarse nature of the DG5 register, where data records indicated that sites might be vulnerable to sewer flooding, the relevant Water Authority was contacted to determine if the risk was still valid before determining if a site should be taken forward for Stage 2 assessment.

The conclusion of the Stage 1 screening assessment was that 30 sites were identified as requiring additional information and therefore should be taken forward into this Stage 2 assessment, see Figure 3.1. More detailed site plans are provided in Appendix A.

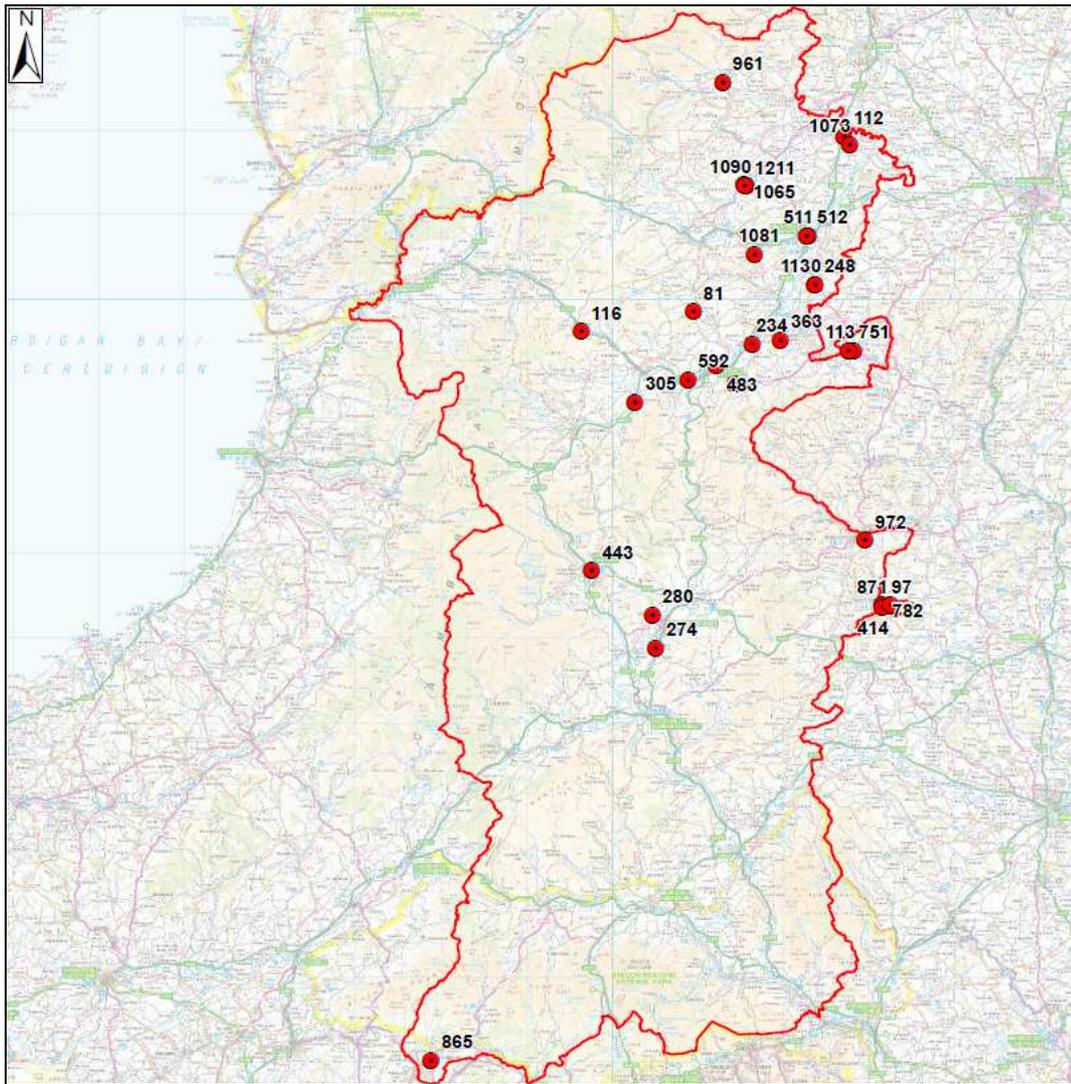


Figure 3.1: Powys Stage 2 SFCA sites

3.5 Stage 2 SFCA Candidate Site Assessment Method

- 3.5.1 A desk top GIS-based appraisal was carried out for the 30 potential development sites identified within the study area, using the flood risk information set out below. The results of this assessment can be found in Appendix A, along with individual site plans.
- 3.5.2 An assessment of the historic flood risk from all sources was undertaken for each of the sites where available using GIS data supplied at the start of this commission. It should be noted that for areas where historic flood outlines are not available, this does not mean that a flood event has never occurred; further, the historic flood outlines provided by the Environment Agency Wales are not definitive and may not capture the definitive extents of all historic flooding.
- 3.5.3 Fluvial flood risk was assessed using the results of the modelling work undertaken as part of this Stage 2 SFCA, and incorporated both extent and hazard risk posed to each site, including an assessment of the likely impacts of climate change.
- 3.5.4 Where the risk of potential defence and/or canal breach and overtopping, or culvert blockage, was identified, this has been modelled and an assessment of the residual risk made. In addition, reservoir location information was used to identify if reservoirs are located upstream of potential development sites.
- 3.5.5 Surface water flood risk was assessed using the Environment Agency Wales' Flood Map for Surface Water data, to remain consistent with the PFRA. The data was used to assess the risk of surface water flooding posed to each site, including an identification of areas where surface water flood risk covers an area greater than the fluvial flood risk areas.

Flood Risk Suitability Assessment Criteria

- 3.5.6 TAN15 should not be applied in isolation, but as part of the planning process. The formulation of Council policy and the allocation of land for future development must also meet the requirements of other planning policy (as outlined in Section 2) and it is recognised that flood risk forms just one material planning consideration among many. To assist the Council in assessing flood risk issues in conjunction with other planning considerations, each site has been assigned with a suitability 'traffic light' style ranking, as outlined in Table 3.1. This allows an easy review and comparison of different candidate sites.

Table 3.1: Flood Risk Suitability Assessment Summary

Summary Code	Criteria Definition
Red	Flood risk not considered manageable. Site not recommended to proceed further
Amber	<p>Inclusion of the site requires further consideration by LPA:</p> <ul style="list-style-type: none"> • Flood risk has not been demonstrated as manageable. Options to consider: <ul style="list-style-type: none"> - Re-draw site boundary to exclude all areas of flood risk; - Designate the flood risk area(s) as open space within the allocation. These areas should be used to provide environmental benefit (e.g. additional flood storage / new habitat / green infrastructure). The area(s) shall be clearly defined as such in the LDP; - Undertake further assessment to understand whether the risks and consequences of flooding can be managed in line with TAN15. <p>Note: If following further consideration by the LPA, the site proceeds as an allocation, a site specific FCA will still be required to support a planning application, unless all areas of flood risk have been excluded from the allocation.</p> <p>And /Or –</p> <ul style="list-style-type: none"> • The allocation is for HVD or ES in zone C2, which is contrary to Section 10 of TAN15.
Green	Flood risk is considered manageable and site can be proceed to allocation

3.5.7 It should be noted that historical flooding, flood risk from other sources and residual risk has also been incorporated into the suitability assessment. Where any of these risks are present, the scoring code has been reduced, commensurate with the level of risk (noted, where relevant, in Appendix A).

3.5.8 For each proposed site allocation, a quantification of the availability of land outside of the areas at risk has been undertaken.

4 Hydraulic & Hydrological Modelling Approach

4.1 Introduction

4.1.1 This chapter provides a brief overview of the technical methods applied to produce the Stage 2 SFCA flood hazard model and mapping data. Of the 30 candidate sites brought forward for the Stage 2 assessment, 18 were deemed to require new hydraulic models specifically to allow a Stage 2 assessment to be undertaken. For the remaining 12 candidate sites, sufficient historic modelling data was available which enabled a robust assessment of flood risk to be undertaken without recourse to further hydrological or hydraulic modelling. A review of historic modelling and justifications for the reliance on this historic data is presented within the Site Assessment Table (Appendix A). Technical Notes, setting out the hydrological and hydraulic approach for each of the separate hydraulic models developed, can be found in Appendix B, while modelled flood hazard maps can be found in Appendix C.

4.1.2 The key return period flood extents to enable a comprehensive Stage 2 SFCA to be undertaken are the 1 in 20 (often termed the 'functional floodplain', 1 in 100, 1 in 100 plus climate change and the 1000 year event. Using these events will provide information that can be directly related to the Welsh Assembly Government's Development Advice Maps and TAN15, and give meaningful results allowing a comprehensive assessment of varying degrees of risk and consequence. The 2D software modelling packages TUFLOW and ISIS 2D have been used to produce peak flood extents, depths and flow velocities of these return periods, in addition to allowing the production of hazard maps for each return period.

4.1.3 The results from these models have been used to assess risk and recommend flood risk management policies for the areas affected.

4.2 Hydrological Approach

The hydrological approach differed depending on the type of model being used to assess the flood risk within the CS. Two approaches were used:

- a fluvial assessment to determine point and lateral hydrograph inputs to the river system; and
- a pluvial assessment to determine the net rainfall contributing to the study area.

In both cases the adopted approach is based on the latest Environment Agency Wales Flood Estimation Guidance and the guidelines and methodologies included in the Flood Estimation Handbook (FEH).

This suggests in the first place a review of the level of details required for the study, in order to identify the best approach, which implies as well a conceptual understanding of the catchment - whether the catchment is permeable, urbanised or if there is any history of flooding or any records such as gauging stations.

For most of the sites, catchments are highly to moderately rural (3 sub-catchments have an URBEXT greater than 0.03 and only one has an URBEXT greater to 0.1). As well, sub-catchments are generally poorly to moderately permeable (3 sub-catchments have an BFIHOST index greater than 0.6 and all are below 0.65),

Finally, there is no gauging station in close proximity to any of the sites and due to the high level nature of this study, it was decided to apply exclusively a Rainfall-runoff approach

without any recourse to the FEH statistical methodology (which would imply the use of a donor catchment and pooling group analysis for each candidate site). FEH CD-ROM v3 has been used in order to derive the inputs necessary for the hydrological assessment.

4.2.1 Pluvial inputs

The methodology consists of applying the calculated net rainfall directly in the 2D hydraulic model domain. In order to calculate the rainfall hyetographs, rainfall-runoff boundary units are utilised with the help of the Isis software. The catchments in the study area are predominantly rural and ReFH analysis has been undertaken to generate the hyetographs rather than FEH. Time to peak and storm duration are also determined using ReFH formula.

In terms of catchment delineation, the contributing catchment needs to be kept as lumped, with a storm area defined by the catchment size. Therefore, the hydraulic model boundaries have been set up to be reasonably close to the storm/catchment area.

4.2.2 Fluvial inputs

The methodology consists of distributed rainfall-runoff inflows that are applied in the hydraulic models to generate flood hydrographs. Depending on the complexity of the catchment and the study area, the model catchment can be divided into several sub-catchments, based upon model boundaries and key tributary inflows.

The catchments in the study area are predominantly rural and ReFH analysis has been undertaken to generate the inflow hydrographs for each sub-catchment with the help of the Isis software. Time to peak and storm duration are also determined using ReFH formula. For distributed catchments with multiple inputs, the storm duration is based on the dominant upstream inflow.

4.3 **Hydraulic Approach**

Hydraulic models have been developed, generally by:

- For fluvial modelling, creating new 2D TUFLOW models (using LIDAR or SAR data for the channel and representing structures in 1D using either ISIS or ESTRY) to enable flood hazard mapping of the floodplain; SX connections were used in order to represent the structures with a 1D approach (ESTRY) connected to the 2D domain. Every time that a link is made between a 1D and 2D domain, the momentum transferred between them is lost. However, inlet and outlet losses have been considered in the ESTRY unit.
- For pluvial modelling, creating new 2D ISIS models (Using LiDAR or SAR data to represent the surface topography) to enable flood hazard mapping of the floodplain.
- Z lines have been used to set channel bed levels based on the DTM as topographical survey data was not available. Points have been added where necessary in order to represent the particularities of the reach and a check of the bed levels at every structure in comparison with the DTM level was carried out. It is noteworthy that the invert levels at the structures were the only available topographical information and normally this level not necessarily represents accurately the bed level of the natural reach. Also, the DTM at the structures is highly affected by the filtering process. Therefore, it was assumed that the adopted approach is conservative based on the sources of uncertainties (e.g. Lidar vertical error, Lidar resolution, computational cell size and the water level at the time of the Lidar survey, etc).

Appendix B presents a summary of the modelled extents, outlining in detail the hydrological and hydraulic modelling approaches adopted for each study area.

4.3.1 The Stage 2 SFCA studies must take account of the presence of flood risk management measures, therefore defences, culverts, reservoirs and pools and major flow control structures have been incorporated into the models where they exist (for full details see Appendix B). Culvert dimensions were measured during site surveys undertaken in July and August 2012. The elevations and dimensions of structures were gathered using GPS and levelling techniques. Where measurement of structures was not possible, i.e. due to access issues or for health and safety reasons, the culvert sizes and levels were estimated based on the ground levels from the DTM and Google Earth photographs. This approach has been used to model structures located away from the Candidate Sites and will have no influence on water levels at the sites. (Refer to Appendix B).

4.4 UK Flood Hazard

4.4.1 In addition to the TUFLOW outputs of depth and velocity, the UK Flood Hazard is also calculated by the model. The output includes a grid of Flood Hazard derived from the flood depth and velocity outputs and a debris factor. The hazard and its associated classification are calculated within TUFLOW. The UK Flood Hazard is calculated by using the UK industry standard equation (provided in Defra’s Flood Risks to People – Phase Two Document (FD2321/ TR2) (2006).

4.4.2 Hazard is calculated as follows:

$$\text{Hazard} = d \times (v + 0.5) + DF$$

Where **d = depth (m)**

V = velocity (m/s)

DF = debris factor

4.4.3 Based on the value of the hazard for a given area, a Hazard Classification is then assigned. The Flood Hazard classifications are divided into four classes of risk:

Table 4.1: Flood Hazard Rating and Associated Category

Flood Hazard Rating	Category
0.0 – 0.75	Low
0.75 – 1.25	Moderate
1.25 – 2.5	Significant
2.5 +	Extreme

4.4.4 These classes of risk then translate into the following Flood Hazard classification (Figure 4.1):

- Class 1: Danger for some (Hazard rating 0.75 -1.25) – Flood zone with deep or fast flowing water that presents a hazard for some people (i.e. children);
- Class 2: Danger for most (Hazard rating 1.25 - 2.5)– Flood zone with deep or fast flowing water that presents a hazard for most people;

- Class 3: Danger for all (Hazard rating >2.5) – Flood zone with deep or fast flowing water that presents a hazard for all people.

4.4.5 For example, if peak water depths are 1.0 m, for velocities less than 1.0 m/s, the flooding is considered to present 'Danger for some'. For velocities between 1.0 m/s and 2.0 m/s the flooding is considered to present 'Danger for most'. For velocities greater than 2.0 m/s the flooding is considered to present 'Danger for all'.



Figure 4.1: Flood Hazard Classification

4.5 Breach and Overtopping Scenarios

Culvert Blockage

4.5.1 There are numerous culverts in the study area, each of which pose the risk of complete or partial blockage, or indeed collapse. This poses residual risk to the surrounding area (which might be bigger than the risk area identified by the modelled outputs and EA mapping data).

4.5.2 A review was undertaken of culverts along the modelled watercourses. Where the modelling exercise indicated issues of surcharging (due to insufficient capacity for a given flood event) or where a culvert was located in the vicinity a study area, an analysis of residual risk was deemed necessary. For the purposes of this study, a 75% blockage was modelled using the 1 in 100 year events for the relevant watercourses. Appendix B summarises the locations at which culvert blockages were undertaken in relation to the modelled watercourses and identified sites. Further details on the impact of culvert blockage is described in the model Technical Notes in Appendix B.

Defence Breach and Overtopping

4.5.3 Flooding behind flood defences can occur as a result of constructional or operational failure of the defence, either in whole or in part (breach), or water levels rising to exceed the level of the defence (overtopping). The NFCDD dataset was used to identify the presence of flood defences in each of the areas where hydraulic models were developed. No defences were identified and no defence breach or overtopping analysis was undertaken.

Canal Breach and Overtopping

4.5.4 Flooding from raised sections of canal embankments can occur as a result of constructional or operational failure of the embankment, either in whole or in part (breach), or water levels rising to exceed the level of the canal embankment (overtopping). Whilst canals are located adjacent to certain Candidate Sites, an initial assessment of relative topographical levels concluded that the adjacent sites were unlikely to be influenced by canal derived flooding. Hence no canal breach or overtopping analysis has been undertaken.

4.6 Model Quality Assurance

4.6.1 TUFLOW and ISIS automatically generate a list of errors, warnings and notes for each model run. A review of these messages was undertaken to assess any potential problems with the

model. The messages were checked in the model and were either consistent with the model inputs or had no impact on the model results and thus no changes were required. All hydraulic and hydrological models have undergone a thorough checking process and subsequent QA and approval by a senior hydraulic modeller and senior hydrologist respectively.

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5 Assessment of Flood Risk

5.1 Overview

The assessment of flood risk from all sources is summarised in the *site assessment table* contained in Appendix A. Additional technical details regarding the fluvial and pluvial modelling are contained within the Technical Notes for each site, contained in Appendix B.

The purpose of this chapter is to provide a summary of the risks and findings and highlight key sites and areas of concern.

5.2 Assessment of Flood Risk

Fluvial Flood Risk – Model Results

A detailed summary of the modelling undertaken and results obtained is provided for each site in Appendix B.

For all of the sites, we have used an automated process for filtering and post-processing the flood extents in MapInfo GIS which consists of two steps. The first step involves removing holes in the flood extents (in this case where the area of the hole is 300m² or less). The second step involves removing flood polygons, with an area of 100m² or less, which are separated from the main flood extent polygon, both are in line with agreed EA flood mapping specification.

The return periods chosen for assessment will enable a sequential approach to assessing areas of each site. A summary is provided below in Table 5.1.

Table 5.1: Headline summary of sites significantly affected by fluvial flooding

Flood Zone	Description & Enhanced Assessment Level from Modelling	Summary of Sites Affected
C	Sites significantly affected by the 'functional floodplain' (1 in 20 year return period)	234, 280, 592, 1220
C	Sites significantly affected by the 1 in 100 year return period	234, 280, 592, 1220
C	Sites significantly affected by the 1 in 100 + climate change return period	234, 280, 592, 1220
C	Sites significantly affected by modelled 1 in 1000 year return period	113, 234, 280, 592, 961, 1220

Fluvial Flood Risk – Based on Historic Modelling

Of the candidate sites assessed based on historic data, only CS 865 was found to be at significant risk from the 1in1000 year flood event as indicated by the Environment Agency Flood Zone map.

Surface Water Flood Risk

Following consultation with stakeholders and the Environment Agency Wales, it is critical that the surface water flood risk maps are considered in conjunction with the fluvial flood risk results – in particular to ensure safe access and egress of sites. Regeneration offers an ideal opportunity to provide better management of surface water at source, and make space for this water through open spaces. The need to make space for water is pertinent in areas shown to be affected by deep surface water flooding.

The adoption of surface water management measures within these areas provides an opportunity to manage the risk. Where surface water flow paths are identified it is recommended that these areas are kept clear of built development and are adopted as open space, particularly where access routes are required.

5.3 Residual Risk

Structure and Culvert Blockage

During the assessment process, a number of structures were identified as potentially being critical in terms of residual risk from blocking. The following is a summary of those sites where culvert and structure blockages were undertaken. Further details can be found in the Technical Notes contained in Appendix B.

Table 5.2: Residual Risk from Blockages

Location	Grid Reference	Site(s) Affected	Change to Fluvial Flood Risk
Abermule – railway crossing bridge	SO 3162 2946	234	Marginal impact
Churchstoke – Castle Road culverts	SO 3275 2941 SO 3280 2938	113, 751	Fir House watercourse – no impact Hill Side watercourse – Significant impact upstream
Four Crosses Kens culvert & Overflow culvert Housing culvert	SJ 3274 3181 SJ 3276 3183	1073	Kens culvert – no impact Housing culvert – Significant impact
Howey – Holly Lane	SO 3049 2589	274	Marginal impact – no impact to site
Kerry / Ceri – Main Road bridge	SO 3140 2899	1220	Increased flood extent and hazard via overtopping of road
Llanyre - Cagebrook Lane culvert	SO 3045 2627	280	Marginal increase to risk

The identified residual risk areas outlined in Table 5.2 above must therefore be taken into consideration when considering the potential development of the site, and particular attention should be given to the Blockage Assessment PDF (Appendix C) maps that indicate the extent of change to flood extent and hazard as a result of these structures.

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6 Recommendations

6.1 Overview

- 6.1.1 This chapter utilises the individual site assessments in each of the modelled areas to provide development recommendations, in line with TAN15 and other relevant planning policy guidance and objectives.
- 6.1.2 Recommendations are provided to enhance the existing flood risk management policies outlined in the Stage 1 SFCA report. Site specific recommendations for potential Candidate Sites and suggested scope of future FCAs are provided in the Site Assessment Table provided in Appendix A and summarised in Table 6.1.
- 6.1.3 This chapter also provides recommended Development Plan policies (Section 6.3) and provides guidance for development in different Flood Zones (Section 6.4), which can be used by potential developers required to produce site-specific FCAs, and to help the Council deal with non-allocated 'windfall' sites, should they arise.

6.2 Site Specific Policy Recommendations

Each of the potential candidate sites has been assessed in detail and individual recommendations on what may need to be considered for each site given in the Site Assessment Tables (Appendix A) and summarised in Table 6.1.

Table 6.1 – Summary of Candidate Site Assessments

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
81	Tregynon	Residential	A	A small area to the south-west of the site is affected by surface water flooding during the 1 in 1000 year event. An un-named brook is culverted underneath the site, with the inlet structure located adjacent to the residential properties to the north. Pluvial modelling has indicated the tendency for surface water to accumulate at this location which has the potential to generate overland flows should the culvert inlet blockage.	The site is suitable for residential development as it is within flood zone A, and is only susceptible to minor levels of surface water flooding, for which mitigation could be provided at detailed design stage through a site specific FCA. An appraisal of the residual flood risk to the site from blockage at the culvert inlet to the north should also be undertaken as part of a site specific FCA. As part of any development, consideration should be given to the opening up the culverted brook that crosses the site. Note: the developable area of the site may be constrained as a result of the mitigation required. A suitable easement will be required adjacent to the culvert / opened up watercourse.	Green
97	Presteigne	General employment	A & C2	The northern and eastern portions of the site area located in the C2 DAM zone. The Clatter Brook runs along the northern site boundary. There is an additional small, un-named brook running south along the western site boundary. Whilst the site is significantly affected spatially from fluvial flooding from the un-named brook to the west and the Clatter Brook the depth of flooding is shallow and the subsequent hazard rating low. There are however, overland flow routes from the un-named brook which have the potential to affect site access and third parties.	Flood risk at the site is considered manageable. However, demonstration that access / egress to the site can be achieved in line with guidance set out in TAN15 should be provided in a site specific FCA. Recommend consultation with Emergency Services / Emergency Planners re access / egress. The site specific FCA would need to consider the overland flow routes from the Clatter Brook and the un-named brook forming the western boundary of the site, in addition to considering the impact of the development on third-parties. Infrastructure design will be key for this site. Note: the developable area of the site may be	Amber

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
					constrained as a result of the mitigation required.	
414	Presteigne	Retail	A & C2	The C2 DAM zone covers the majority of the site. The site is affected by overland flows from the Clatter Brook located approximately 500m to the west. There is also a residual risk to the site from blockage of the Hereford St. culvert. There are minor, low-lying areas of the site that are susceptible to surface water flooding.	<p>LPA need to consider whether this site should proceed, as management of consequences are unknown.</p> <p>Highly vulnerable development not recommended due to the majority of the site being in the C2 DAM zone.</p> <p>However, demonstration that access / egress to the site can be achieved in line with guidance set out in TAN15 should be provided in a site specific FCA. Recommend consultation with Emergency Services / Emergency Planners re access / egress.</p> <p>Any site specific FCA should consider access to the site to the north via the B4362. It should also consider blockage of the Hereford Rd. culvert and the impact of the development on third-parties.</p>	Amber
782	Presteigne	Residential /Employment	A & C2	The candidate site is split into a larger western site and an additional site located to the east of the Broadaxe Rd. The north-eastern corner of the western site is located within the C2 DAM zone. A large portion of the eastern site is also located within the C2 zone. The western site is subject to overland flow originating from the Clatter Brook. These overland flows are effectively contained within the western site and do not reach the boundary of the eastern site. Pluvial modelling has indicated that, due to the low-lying topography prevalent at both sites, surface water flooding is	<p>Acceptable management of flood consequences to be demonstrated in a site specific FCA.</p> <p>However, demonstration that access / egress to the site can be achieved in line with guidance set out in TAN15 should be provided in a site specific FCA. Recommend consultation with Emergency Services / Emergency Planners re access / egress.</p> <p>Any site specific FCA should consider in more detail overland flows affecting the sites and also the issue of dry access/egress in addition to any impacts on third-</p>	Amber

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
				also an issue. The aforementioned overland flow routes also raise potential issues regarding dry access/egress.	parties.	
871	Presteigne	Residential/Retail	A & C2	DAM zone C2 occupies a relatively small area to the north of the site. Modelled fluvial flood risk derives from overland flows from the north and west. But only the 0.1% event marginally affects the north-western corner of the site.	Flood risk at the site is considered manageable. The site is to be developed sequentially, with only less vulnerable development types to be located within DAM zone C2 Site specific FCA would need to consider the effect of overland flows on the northern portion of the site and potential effects on third-parties.	Amber
112	Four Crosses	Residential	A, B & C2	DAM zones B and C2 cover approximately half of the northern part of the site.	Flood risk at the site is considered manageable. The site is to be developed sequentially, with only less vulnerable development types to be located within DAM zone C2 Site specific FCA would need to confirm site levels and that the development has no impacts to third-parties. This site includes land which was used for compensatory storage as part of the Four Crosses bypass scheme; this area should be retained in perpetuity.	Amber
113	Churchstoke	Residential	A	The Castle Brook runs through the centre of the site in a north to south direction.	Development would be suitable to the eastern half of the site (between the brook and Castle Rd.) outside of the modelled flood extent. The site to the west of Castle	Amber

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
					<p>Brook may experience access difficulties during times of flood. Recommend consultation with Emergency Services / Emergency Planners re access / egress.</p> <p>Note: the developable area of the site may be constrained as a result of the mitigation required. A suitable easement will be required adjacent to the watercourse.</p>	
751	Churchstoke	Residential	A	<p>The 1 in 20 year return period - the 'functional floodplain' remains close to the channel boundary, extending slightly wider in the north and south of the site. The 100 year return period is larger in the south, than the north. However, the flood extent increases significantly during the Climate Change and 1 in 1000 year scenarios.</p> <p>Flood hazard is shown to be Significant for virtually all of the out of bank flooding for the full range of return periods modelled in this study, with a section of Extreme hazard in the channel at the southern edge of the site for the 1000 year return period.</p>	<p>Acceptable management of flood consequences to be demonstrated in a site specific FCA.</p> <p>Note: the developable area of the site may be constrained as a result of the mitigation required. A suitable easement will be required adjacent to the watercourse.</p>	Amber
116	Caersws	Residential	A	<p>There are a number of unnamed field drains / brooks that flow around the site. One of these forms the southern boundary. The site also lies to the south of Afon Cerniog (approximately 50m to the south) - a tributary of the Afon Carno.</p> <p>The site is shown to be just outside of Flood Zone C2 and the 1 in 1000 year flood event.</p>	<p>Site is outside of the 1 in 1000 year flood outline and flood zone C2. However, the LPA will need to be satisfied that access / egress to the site can be achieved in line with guidance set out in TAN15 (Appendix A) .</p> <p>Recommend consultation with Emergency Services / Emergency Planners re access / egress.</p>	Amber

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
					Site access could be provided at the north-western corner of the site, however, the road is cut-off immediately north and also to west at Hendre Cerniog during the 1 in 100 year event. Whilst the site remains dry during these flood events, careful consideration should be given to the development use given the potential periods of isolation.	
234	Abermule	Car park	C2	The site is shown to be significantly affected by the modelled flood extents. The functional floodplain (1 in 20 years) covers approximately 50% of the site, with the larger return periods extending slightly further eastwards. Hazard is significant for the majority of the flooding during all of the return periods modelled, with areas of moderate and low only being present at the extremities.	Flood risk to this site is not considered manageable given the considerable hazard to areas of the site subject to flooding. Consideration should be given to re-drawing the site boundary to remove areas that are not manageable. If this is not possible the site should not proceed further.	Amber
248	Kingswood	Residential	A	Due to the small catchment size of the brook adjacent to the site, only pluvial modelling was undertaken for this site - however there is significant risk associated with the pluvial modelling results (see Surface Water Flood Risk Assessment comments)	A small sized development could be accommodated in the south-eastern corner of the site, keeping out of the modelled pluvial flood outlines. Given the high risk to the site, a site specific detailed FCA should be undertaken with a fluvial flood risk assessment of the adjacent brook. Only less vulnerable development should be permitted in those areas shown to be at risk of flooding, with recommendations being made to keep them as open spaces and amenity areas - however significant hazard should be considered, and	Amber

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
					appropriate signage should be provided communicating risks to the public and instructions during times of flooding.	
1130	Kingswood	Residential	A	Due to the small catchment size of the brook adjacent to the site, only pluvial modelling was undertaken for this site - however there is significant risk associated with the pluvial modelling results	A small sized development could be accommodated in the south and south-western corner of the site, keeping out of the modelled pluvial flood outlines. Given the high risk to the site, a site specific detailed FCA should be undertaken with a fluvial flood risk assessment of the brook running through the site. Only Less Vulnerable development should be permitted in those areas shown to be at risk of flooding, with recommendations being made to keep them as open spaces and amenity areas - however significant hazard should be considered, and appropriate signage should be provided communicating risks to the public and instructions during times of flooding.	Amber
274	Howey	Residential	A & C2	The fluvial flood risk comes from the north and southern areas of the site. In the north, flood water from the tributary of the Howey Brook flows over the road and meets the far north-western corner of the site. Along the southern edge of the site, the flooding extends slightly into the site, with the most extensive areas being the in the south-western area. The risk from Hazard increases the closer to the channel, but is largely low to moderate in the site	The site is to be developed sequentially, with only less vulnerable development types to be located within DAM zone C2 Acceptable management of flood consequences to be demonstrated in a site specific FCA.	Amber

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
				for most return periods (this rises to significant during the 1000 year event, but still only affects the southern edge).		
280	Llanyre	Residential	A	<p>The fluvial flood risk comes from the brook that flows from the east of the site. The flood extent is wide, even in the lower return period events such as the 1 in 20 year. Out of bank flows occur on the land to the east of the site, which flows towards and onto the site. For the 1 in 20 year event, the flooding reduces westwards towards the Cagebrook Lane structure. During the larger flood return periods, with extent of flooding remains largely the same upstream, to downstream across the site (approximately the lower half).</p> <p>The majority of the flood extent affecting the site is low Flood Hazard, with a small area of moderate and significant in the centre of the site. However, to the west of the site boundary there is a large Zone of significant hazard which needs to be considered.</p>	<p>Flood Risk is not considered manageable at this site even with mitigation measures in place. Recommend that this site does not proceed further. The site is in close proximity to fluvial channels and is shown to be at considerable risk during the 1 in 20 year event. There is no dry access, and areas to the west of the site are shown to have significant Flood Hazard.</p>	Red
305	Llandinam	Residential	A & C2	<p>Fluvial flood risk to the site is predominately from the River Severn to the West. Flood outlines have been created from a 1D-2D ISIS-TUFLOW model, built by JBA 2007 as part of River Severn study. No significant secondary watercourses nearby, therefore no further modelling was required. The Tan15 Flood Zone C2 shows that the western edge</p>	<p>The site is to be developed sequentially, with only less vulnerable development types to be located within DAM zone C2</p> <p>Acceptable management of flood consequences to be demonstrated in a site specific FCA.</p> <p>Development could be possible in the eastern area of</p>	Amber

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
				of the site is flooded, but the larger Eastern section remains outside of the 1 in 1000 year event.	the site. Access is a potential issue from the A470, as the road is predicted to be flooded during the 1 in 100 year event and this needs to be considered further. The LPA will need to be satisfied that access / egress to the site can be achieved in line with guidance set out in TAN15 (Appendix A) . Recommend consultation with Emergency Services / Emergency Planners re access / egress.	
363	Llandyssil	Residential	A & C2	The flood outlines have been produced from the JBA River Severn JFLOW model. The local area has steep valley sides, and suggests little change in flood outlines should new modelling be undertaken - therefore no additional modelling was undertaken. Only the north-eastern and south-eastern edges of the site are shown to be at risk from the modelled outputs.	The site is to be developed sequentially, with only less vulnerable development types to be located within DAM zone C2 Acceptable management of flood consequences to be demonstrated in a site specific FCA. Adequate easements would be needed along the eastern boundary of the site by the watercourse.	Amber
443	Rhayader	Employment/industrial	A & C2	The fluvial flood risk occurs from two watercourses - the Rhyd-hir-Brook (a tributary of the River Wye) and from the River Wye itself (located approximately 260m downstream of the site). Due to the local topography, it is only the western edge of the site that is shown to be at risk of fluvial flooding (both modelled return periods and Flood Zone C2).	Flood risk is considered manageable. However, the LPA will need to be satisfied that access / egress to the site can be achieved in line with guidance set out in TAN15. Access could be an issue if the desired route was via the existing Brynberth Industrial Estate. Recommend consultation with Emergency Services / Emergency Planners re access / egress.	Amber

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
				Flood Hazard ranges from low to significant within the site, with areas of high alongside the north-western boundary of the site, for the 1 in 20 and 1 in 100 year return periods. For the higher modelled return periods - the 100 year + CC and the 1 in 1000 year, there is a zone of high flood hazard within the site.		
483	Newtown	Residential/employment/retail/mixed use	A & C2	The modelled flood outlines and Flood Zones show that the northern section of the site is at risk of flooding, from the 1 in 5 year event upwards (based on available data).	The site is to be developed sequentially, with only less vulnerable development types to be located within DAM zone C2 Acceptable management of flood consequences to be demonstrated in a site specific FCA.	Amber
592	Newtown	Employment/mixed use	A & C"	Fluvial flooding of the site occurs from the Mochdre Brook and the River Severn. Flooding from the Mochdre Brook during the 1 in 20 year event comes directly from the brook. For the larger return period events that were modelled, an overland flow from upstream of Dulais Bridge. For the 100 year and 100 year + Climate Change events just under half of the site is affected by flooding. For the 1000 year fluvial event, over half of the site is flooded. Flood hazard is shown to range from low to high, with a large proportion of the flood extent being	Acceptable management of flood consequences to be demonstrated in a site specific FCA. Access to the site - even for areas outside of the modelled flood extents needs to be carefully considered. The LPA will need to be satisfied that access / egress to the site can be achieved in line with guidance set out in TAN15. Recommend consultation with Emergency Services / Emergency Planners re access / egress.	Amber

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
				classified as significant. Dry access to the site - even areas outside of the modelled flood extents need to be carefully considered. During the 1 in 20 year event, Dulais bridge is overtopped, and access from the west may not be possible. Dry access from the west is achievable; however, there is an overland flow north of Heol Mochdre that reaches the edge of the main road adjacent to the site.		
511	Welshpool	Retail/restaurant/motel/car park	A & C2	Flood Zone C2 covers virtually the entire site. Whilst the modelled outputs show that the extent of flooding is less (affecting the eastern half of the site) it must be highlighted that flooding occurs during the 1 in 20 year event. However, the site falls within the influence of the recent Flood Alleviation Scheme. The site appears to be at a higher level than the adjacent Shropshire Union Canal.	Flood risk at the site is considered manageable. The western half of the site is outside of the modelled flood outlines, and the site has dry access. Development could therefore be accommodated across this area, with less vulnerable development types being potentially suitable for the eastern section. However, it is recommended that the areas shown to be at risk of fluvial flooding are kept as open spaces and amenity areas. The site has been classified as 'amber' subject to confirmation of the status of the local flood alleviation scheme. Additional confirmation of topographic levels relative to the nearby canal would be expected as part of a site specific FCA	Amber
512	Welshpool	Retail/car park/bus station	A & C2	Flood Zone C2 is shown to flood the western edge of the site adjacent to the Lledan Brook. The modelled flood extents show that flooding during the 1 in 20 year event marginally affects this	Flood risk at the site is considered manageable. Majority of site is outside of the modelled flood zones and has dry access from the north-east (Mill Lane).	Green

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
				boundary also - however, due to the flow magnitudes and site topography, the 1 in 1000 year event only floods a slightly larger area (being confined to the western border, and a small area along the south-eastern border).	Development could therefore be accommodated across the majority of this site, keeping an easement from the areas adjacent to the Lledan Brook that are shown to be at risk of fluvial flooding. It is recommended that these areas are kept as open spaces and amenity areas. Site specific FCA to consider relative levels of the adjacent Shropshire Union Canal.	
865	Ystradgynlais	Bus station/car park/servicing/public realm	A & B	Site is on the boundary of flood risk from the River Tawe (assessment made on based on DAM and EA Flood Zone data). Shown to be at risk from the River Tawe from the 1 in 1000 year flood event in the Environment Agency Flood Zones, but outside of Flood Zone C2.	A site specific FCA has already been undertaken for this site and therefore flood risk is considered manageable. Site is shown to be a risk of flooding from the River Tawe, being wholly within the 1 in 1000 year flood extent. A site specific FCA should be submitted to support any future planning application.	Green
961	Llanrhaeadr	Employment	A & C2	The fluvial flooding extent across the site increases steadily between the lower return periods modelled, but significantly with the extreme flood extent. For the 1 in 20 year event, only the far western edge of the site that borders the river is flooded. During the 1 in 100 year event, this flood extent increases slightly towards the east. The increase in flood extent is also proportional with the 1 in 100 year climate change event; however, with the 1 in 1000 year flood extent, nearly the entire site is inundated. Flood Hazard for the site is	Acceptable management of flood consequences to be demonstrated in a site specific FCA.	Amber

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
				classified as low.		
972	Knighton	Residential	A & C2	Only 1% of the proposed site is within the modelled flood extents from the Pont-Faen Brook, which is a tributary of the River Teme.	<p>Flood risk at the site is considered manageable. Majority of site is outside of the modelled flood zones and has dry access from the east. Development could therefore be accommodated across the majority of this site, keeping out of the modelled flood outline areas to the north. It is recommended that the areas shown to be at risk of fluvial flooding are kept as open spaces and amenity areas.</p> <p>Site specific FCA to consider specifically the means of controlling surface water within the site given the steep topography.</p>	Green
1065	Meifod	Residential	A & C1	The flood outlines available for use in this area are JFLOW and those created from 1D-2D ISIS-TUFLOW model, built by Jacobs 2010 as part of Meifod Flood Study. The site is offered protection from the River Vyrnwy Meifod flood defences, and is therefore shown to be in flood Zone C1. From the modelled outputs (JFLOW), it is shown that the site is flooded from the 1 in 20 year return period from the tributary to the south of the site.	Acceptable management of flood consequences to be demonstrated in a site specific FCA.	Amber
1090	Meifod	Residential	A & C1	The flood outlines available for use in this area are JFLOW and those created from 1D-2D ISIS-TUFLOW model, built by Jacobs 2010 as part of	Acceptable management of flood consequences to be demonstrated in a site specific FCA.	Amber

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
				Meifod Flood Study. The site is offered protection from the River Vyrnwy Meifod flood defences, and is therefore shown to be in flood Zone C1.		
1211	Meifod	Residential	A & C1	The flood outlines available for use in this area are JFLOW and those created from 1D-2D ISIS-TUFLOW model, built by Jacobs 2010 as part of Mieford Flood Study. The site is offered protection from the River Vyrnwy Meifod flood defences, and is therefore shown to be in flood Zone C1.	Acceptable management of flood consequences to be demonstrated in a site specific FCA.	Amber
1073	Four Crosses	Residential	A	Fluvial flood risk to the site comes from the Sarnwen Brook. This remains largely in bank for all of the modelled return periods apart from the 1 in 1000 year event. During this event, the centre section of the site is shown to be at risk. Hazard is low to moderate for the flood extent.	<p>Acceptable management of flood consequences to be demonstrated in a site specific FCA.</p> <p>Liaison with the IDB should help ascertain the level of flood risk based on historic events.</p> <p>The majority of the site is developable with dry access available from the B4393 to the south. It is recommended that the area in the mid-west of the site shown to be affected by the 1 in 1000 year modelled flood event should be kept as open space / amenity areas and provide betterment to existing flood risk</p> <p>The blockage at the Housing culvert (SJ 3276 3183) has shown that it can have an increase to the flood extent and also raises the hazard from low to moderate. Therefore it is recommended that this is maintained / or improved as part of any proposed development.</p>	Amber

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
					A blockage applied at Kens culvert (SJ 3274 3181) showed no impact to the site. The water levels upstream the B4393 are increased, however the increase is not enough to overtop the B4393 and flood site 1073 located downstream. However, the blockage at the Housing culvert (SJ 3276 3183) has a significant effect on the flood risk to the site - the flood extent is increased and it is therefore recommended that detailed studies are carried out by any potential developer as part of a site specific FCA before any future developments in this area.	
1081	Castle Caereinion	Residential	A	The pluvial modelling that was undertaken at this location demonstrates that the site is affected by surface water flooding and from the Sylfaen Brook. During the 1 in 20 year event, the site is shown to be affected from flooding along the western and northern edge. The flood extent increases marginally up to the 1 in 100 year + CC event due to the topographic nature of the site; however the 1 in 1000 year event increases significantly in the south of the site.	Flood Risk at this site is not considered manageable. There is significant flood risk to the site with no dry access. It is recommended that this site does not proceed further.	Red
1220	Kerry	Recreational facilities (tennis courts)	A & C2	The modelled data for this area demonstrates that this site is at a high risk of flooding, with significant consequences. The site is affected by two sources - the Afon Miwi / The Mule, which flows eastwards and forms the	As modelled, there is significant flood risk to the site with no dry access which may become manageable after the completion of an ongoing flood alleviation scheme in Kerry. Given the less vulnerable nature of the proposed development, the site has been classified as 'green' given that flooding issues can likely be mitigated via	Green

Site Reference Number	Site	Proposed Use	TAN 15 Zone	Nature of flood risk	Recommendation	Flood Risk Suitability Assessment Summary (ref. Table 3.1)
				<p>northern boundary of the site, and an unnamed tributary of this river, which joins the Afon Miwi upstream of the site. The model results show that for the 1 in 20 year event flooding occurs along the northern edge of the site from the river. More significantly though, flows come out of bank upstream of the site (and the A489), and follow a natural depression in the local topography, flowing along the A489 eastwards - resulting in the site being cut off from dry access.</p> <p>With each of the higher return periods modelled, the flood extent encroaches into the site to a greater degree, leaving a small number of dry isolated islands, however the flood hazard largely remains as low.</p>	<p>appropriate design measures.</p>	

6.3 Development Plan Policies

6.3.1 For the purposes of development management, detailed policies will need to be set out in the LDP to ensure that flood risk is taken account for both allocated and non-allocated 'windfall' sites. The following policy objectives are recommended for all sites that may come forward for development within Powys:

- **Ensure no increase in flood risk elsewhere** – Development may increase run-off and/or reduce the existing storage capacity afforded by pre-development topography. The aim should therefore be to ensure that a development does not increase flood risk elsewhere. This would ordinarily be assessed via a site specific flood consequence assessment.
- **Identify opportunities to reduce existing flood risk** – In areas identified at risk of flooding (fluvial, surface water) or where a watercourse has insufficient channel capacity opportunities to improve existing flood risk by using SuDS, wetlands or other agreed and appropriate measures as well as reducing runoff rates should be investigated and implemented wherever possible..
- **A Sequential Approach and Use of the Justification Test** - Use the principles of TAN15, taking a sequential approach to steer development to Flood Zone A. Where this is not always possible, the Justification Test will need to be applied.
- **Protect the functional floodplain (in Greenfield and previously developed areas)** – Avoid development in the Greenfield functional floodplain in the first instance. Identify opportunities for making space for water on previously developed areas by reinstating the functional floodplain.
- **Site Layout** - apply a sequential approach within the development site by locating the most vulnerable elements of a development in the lowest flood risk / hazard areas in the first instance. The use of Flood Zones C2 areas should be primarily retained for recreation, amenity and environmental purposes, which can also provide an effective means of flood risk management as well as providing connected green spaces with consequent social and environmental benefits.
- **Enhance and restore the river corridor** - identify opportunities to undertake river restoration and enhancement as part of a development to make space for water. Actions such as the removal of in-stream obstructions and anthropogenic features, removal of non-native species and the erection of fencing to control access to the river bank could potentially be implemented and would contribute to Water Framework Directive objectives as set out in the relevant River Basin Management Plan.
- **De-culvert wherever possible** - Where this is not possible, an assessment of the structural integrity of the culvert, with any required remedial work, should be carried out prior to the development. A maintenance schedule should be developed for all culverts to ensure regular clearance.

- **Set development back from watercourses** - any developments located adjacent to a watercourse should leave an appropriate undeveloped buffer strip, maintaining the watercourse and the immediate riparian zone as an enhancement feature and allowing for routine maintenance. The width of any buffer strip should be agreed with the relevant authorities on a site by site basis.
- **Reduce surface water runoff from new developments** – any development must ensure that post development runoff volumes and peak flow rates are maintained at either the Greenfield rate (for greenfield sites) or deliver a 50% reduction to surface water runoff rates for brownfield sites (up to and including the 1 in 100 year event inclusive of an appropriate allowance for climate change for both development scenarios). SuDS should also be a requirement for all new development and space should be specifically set aside for SuDS and used to inform the overall site layout. Hardstanding areas should be kept to a minimum and infiltration techniques and the re-use of water should be considered before attenuation devices in accordance with the SuDS hierarchy. SuDS will need to have a maintenance strategy to ensure they are maintained and working efficiently. Subject to commencement of the relevant Schedule of the Flood and Water Management Act 2010, the Lead Local Flood Authority as SuDS approval body, should be consulted to confirm the appropriate requirements and specification of SuDS components that are to be adopted.
- **Sequential approach to the release of development land** - Brownfield land should be developed in advance of Greenfield sites.
- **Maintenance of existing flood storage areas, both formal and informal** – existing storage areas should be maintained and safeguarded from development.
- **Maintenance of water channels** – New developments adjacent to watercourses should have a maintenance strategy for clearing and maintaining the channel, in particular structures such as trash screens and bridges.
- **Ensure safe access and egress to and from developments** – Access/egress routes should allow occupants of the site safe means of access and exit to buildings at the appropriate threshold flooding frequency in addition to providing vehicular access for emergency services. Where possible, safe access/egress routes should be located above the level of the threshold frequency event. However, if this is not feasible, a limited depth of flooding may be permissible subject to the provision of appropriate signage and the consideration of potential underwater hazards. Developers should additionally ensure, to the satisfaction of the relevant authorities that appropriate flood response and evacuation procedures are in place to manage the risk associated with above threshold frequency events. If proposed evacuation routes are not immediately obvious, appropriate signage should be provided, and maintained along with the proposed evacuation route itself.
- **Residual risks** – new developments proposed behind flood defences must carefully consider the residual risks associated with development in such locations, i.e. the risks and consequences in the event of a breach or overtopping of the defences.

6.3.2 In addition, the following guidance should be followed:

6.4 Requirements for Flood Consequence Assessments

6.4.1 Appendix 1 of TAN15 provides comprehensive guidance for a FCA study. Reference should also be made to Table 6.1 and Appendix A of this report where specific recommendations for the scope of future FCAs has been provided, where required, for the candidate sites considered in the Stage 2 SFCA.

6.5 Guidance for 'Windfall' Sites

6.5.1 Table 6.1 and Appendix A provide site-specific recommendations for the candidate sites considered under the Stage 2 SFCA. However, in order to help the council to deal with non-allocated 'windfall' sites, the following sections provide additional guidance. This is not exhaustive but should be used as a general indicator for what information should be submitted with a planning application, Advice should always be sought from the relevant bodies for specific sites before submitting a planning application.

Sites in Flood Zone A

6.5.2 Although TAN15 designates zone A as areas where there are likely to be little or no flood risk issues, some sites in zone A may have flood risk issues associated with them. Many sites in zone A may have a small drain flowing through them as well as potentially localised flood risk issues with no associated Flood Zone information. This section details the requirements for development in Flood Zone A. Some sites may have specific recommendations, in addition to those put forward here, which are detailed in Appendices A and B.

- In accordance with the guidance in Section 5 of TAN15, any type of development can be located in Flood Zone A, where there is 'little or no risk of fluvial or tidal/coastal flooding'.
- The vulnerability of the development from other sources of flooding should be considered as well as the effect of the new development on surface water runoff. The Level 1 SFCA provides information on other sources of flooding throughout Powys.
- The potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water runoff, with appropriate mitigating action, should be incorporated in the planning application. It may prove useful to include these in a Flood Consequences Assessment (FCA) for the site depending on the issues. This is required to demonstrate that runoff from the site is the same as in the predevelopment case thereby ensuring flood risk is not increased (though wherever possible, betterment should be achieved). This will involve the use of SuDS techniques which should take into account the local geological and groundwater conditions. Where possible these should be strategic SuDS. Space should also be set-aside for SuDS at the master planning stage. **Developments greater than 1.0 hectares where there are reasonable grounds to believe that the development could exacerbate flooding elsewhere may require a flood consequence assessment. This should be agreed with the relevant authorities but the onus should be on the developer.**

- Where a small watercourse or drain, with no Flood Zone information, either runs through the site or follows the boundary of the site, a development easement from the top of bank should be applied. The exact distance of the easement should be discussed with the Environment Agency Wales, but should typically be 8m, to allow appropriate access for routine maintenance and emergency clearance. Early engagement with the Lead Local Flood risk authority is advised.

Sites in Flood Zone B

- 6.5.3 Areas that are known to have been flooded in the past as evidenced by sedimentary deposits are identified as Flood Zone B on the Development Advice Maps. These are used as part of the precautionary approach to indicate if further detailed investigations are required.

If the site levels are greater than the flood levels used to define the adjacent extreme flood outline there is no need to consider fluvial flood risk further, however, surface water flooding should be assessed:

- The vulnerability of the development from other sources of flooding should be considered as well as the effect of the new development on surface water runoff. The Level 1 SFCA provides information on other sources of flooding throughout Powys.
- The potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water runoff, with appropriate mitigating action, should be incorporated in a Flood Consequences Assessment (FCA) for the site. This is required to demonstrate that runoff from the site is the same as in the predevelopment case thereby ensuring flood risk is not increased (though wherever possible, betterment should be achieved). This will involve the use of SuDS techniques which should take into account the local geological and groundwater conditions. Where possible these should be strategic SuDS. Space should also be set-aside for SuDS at the master planning stage. **Developments greater than 1.0 hectares where there are reasonable grounds to believe that the development could exacerbate flooding elsewhere may require a flood consequence assessment. This should be agreed with the relevant authorities but the onus should be on the developer.**

Sites in Flood Zone C1

- 6.5.4 For future development sites shown to be in Flood Zone C, but that are served by significant infrastructure such as flood defences, the FCA should demonstrate the Justification Test and provide an assessment of consequences.

- 6.5.5 Wherever possible, development in Flood Zone C1 should be avoided, and steer towards Flood Zone A and B, due to the potential reduction in flood storage that can result, and the increased flood risk which can occur as a result of climate change. However, for the sake of completion and for future reference, the following recommendations are put forward for development of Flood Zone C1:

- All new development will require a successful Justification Test and acceptability of consequences.

- An FCA should be prepared for the site, which should confirm flood extents, levels and hazard (fluvial and surface water), in accordance with Section 7 and Appendix 1 of TAN15.
- Properties situated within close proximity to formal defences or water retaining structures (reservoirs/canals) will require a detailed breach and overtopping assessment to ensure that the potential risk to life can be safely managed throughout the lifetime of the development. The nature of any breach failure analysis should be agreed with the Environment Agency Wales. For breaches of canals, the relevant canal organisation should be consulted.
- The development should not increase flood risk elsewhere, and opportunities should be taken to decrease overall flood risk.
- Tables A1.14 and A1.15 of TAN15 should be used as indicative guidance when defining floor levels, with an appropriate freeboard allowance added. This should take into account the nature of the development, uncertainty in flood level predictions, flood behaviour, residual risk and climate change predictions over the lifetime of the development. Safe access should also be provided.
- Dry pedestrian access/vehicular access for emergency services to and from the development should be possible above the 1 in 100 year plus climate change flood level.
- The development should be safe, meaning that: people (including those with restricted mobility) should be able to remain safe inside the new development up to a 1 in 1000 year event; and rescue and evacuation of people from a development (including those with restricted mobility) to a place of safety is practicable up to a 1 in 1000 year event.
- The development should incorporate flood resistance and resilience measures.
- Basements should not be used for habitable purposes. Where basements are permitted for commercial use, it is necessary to ensure that the basement access points are situated 600mm above the maximum depth of flooding as per the advice in A1.15 of TAN15.
- An evacuation plan should be prepared in consultation with the Council's Emergency Planning team. The development should incorporate flood resistance and resilience measures.
- Residents should be made aware that they live in a flood risk area, and should be encouraged to sign up to Floodline Warnings Direct, should a Flood Warning system exist (as indicated by the Stage1 SFCA).
- The proposed development should be set-back from the watercourse with an appropriate buffer zone agreed with relevant authorities, to allow appropriate access for routine maintenance and emergency clearance.

- SuDS should be implemented to ensure that runoff from the site (post development) is reduced or restricted to Greenfield values. Space should be set-aside for SuDS at the master planning stage.

Sites in Flood Zone C2

6.5.6 For any development falling in Flood Zone C2, this section should be used to understand the requirements of development.

- Emergency Services or Highly Vulnerable Development should not be permitted.
- Land use should be steered towards 'less vulnerable' and 'water compatible' uses as described in 5.3. Development must be designed and constructed to remain operational in times of flood and not impede water flow. The development will still require an assessment of the consequences of flooding which should be accepted by the LPA.
- An FCA should be prepared for the site, which should confirm flood extents, levels and hazard (fluvial and surface water), in accordance with Section 7 and Appendix 1 of TAN15.
- Any proposed flood defence scheme must have agreement for construction and maintenance costs secured in addition to demonstrating an acceptable assessment of flooding consequences. This includes providing a detailed breach and overtopping assessment to ensure that the potential risk to life can be safely managed throughout the lifetime of the development. The nature of any breach failure analysis should be agreed with the Environment Agency Wales.
- The development should not increase flood risk elsewhere, and opportunities should be taken to decrease overall flood risk and provide wider community benefits.
- Tables A1.14 and A1.15 of TAN15 should be used as indicative guidance when defining floor levels, with an appropriate freeboard allowance added. This should take into account the nature of the development, uncertainty in flood level predictions, flood behaviour, residual risk and climate change predictions over the lifetime of the development. Safe access should also be provided.
- Dry pedestrian access/vehicular access for emergency services to and from the development should be possible above the 1 in 100 year plus climate change flood level.
- The development should be safe, meaning that: people (including those with restricted mobility) should be able to remain safe inside the new development up to a 1 in 1000 year event; and rescue and evacuation of people from a development (including those with restricted mobility) to a place of safety is practicable up to a 1 in 1000 year event.
- An evacuation plan should be prepared in consultation with the Council's Emergency Planning team.
- The development should incorporate flood resistance and resilience measures.
- Basements should not be used for habitable purposes. Where basements are permitted for commercial use, it is necessary to ensure that the basement access points are

situated 600mm above the maximum depth of flooding as per the advice in A1.15 of TAN15.

- An evacuation plan should be prepared in consultation with the Council's Emergency Planning team.
- Residents should be made aware that they live in a flood risk area, and should be encouraged to sign up to Floodline Warnings Direct, should a Flood Warning system exist (as indicated by the Stage 1 SFCA).
- The proposed development should be set-back from the watercourse with an appropriate buffer zone agreed with relevant authorities, to allow appropriate access for routine maintenance and emergency clearance.
- SuDS should be implemented to ensure that runoff from the site (post development) is reduced or restricted to Greenfield values. Space should be set-aside for SuDS at the master planning stage.

6.6 Guidance on the use of the Stage 2 SFCA Flood Zone Data

- 6.6.1** The modelling approach adopted by this Stage 2 SFCA builds upon the Planning Policy Wales Development Advice Maps and the Environment Agency Wales Flood Zone Maps, however, it should be noted that the method undertaken in this study varies somewhat to the Environment Agency Wales' own flood mapping approach.
- 6.6.2** The Environment Agency Wales' original Flood Zone philosophy uses a quasi 2D hydraulic modelling package in conjunction with a digital terrain model (DTM). The DTM is filtered to remove flood defences as well as de facto defences (man-made barriers to flow) to create 'undefended' flood maps. This is a key difference to Stage 2 SFCA modelling, which, in accordance with TAN15 guidance, includes flood risk management measures, thereby producing 'defended' flood maps. The Environment Agency Wales' approach is precautionary and in many instances derives a hypothetical flood regime. Since publication of the flood maps in 2004 there have been many challenges to the original philosophy, in particular with regard to the presence of de facto defences. The Environment Agency Wales' position now on the status of de facto defences within their flood mapping is to generate a combination map showing a worst case scenario of the undefended and defended situation. This approach aims to highlight the risks of both the current situation merged with some possible future scenario where a defence has failed or been removed.
- 6.6.3** New flood modelling data should be used in conjunction with the existing zone mapping; in particular, the Environment Agency Wales' flood mapping and development control teams will look to use it as a complimentary dataset. The new Stage 2 SFCA modelling information should be used by the Council to undertake site assessments and carry out and review Justification Tests. This would be supported where appropriate with a detailed FCA from the developer.

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Appendix A: Site Assessment Tables & Site Plans

NOTE - *Site Assessment Tables are located on the accompanying CD-ROM due to their size – they are unsuitable for printing.*

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Appendix B: Hydrological Analysis & Hydraulic Modelling Technical Notes

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Appendix C: Modelled Flood Extent and Flood Hazard Maps

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Appendix D: Environment Agency Wales Letter of Support

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