Rhondda Cynon Taf County Borough Council

Rhondda Cynon Taf SFCA

Strategic Flood Consequence Assessment

Final Report
October 2008

Prepared for:

Revision Schedule

Strategic Flood Consequence Assessment

Rev	Date	Details	Prepared by	Reviewed by	Approved by
01	July 2008	Draft for comment	Ben Kathrens **Flood Risk Engineer**	Paul Curwen **Principal Engineer**	Jon Robinson **Associate Director**
02	October 2008	Final	Ben Kathrens **Flood Risk Engineer**	Paul Curwen **Principal Engineer**	Paul Curwen **Principal Engineer**

Scott Wilson
15a Axis Court,
Mallard Way,
Riverside Business Park,
Swansea Vale,
Swansea
SA7 0AJ

Tel +44 (0)1792 486050
Fax +44 (0)1792 486051

www.scottwilson.com

Executive Summary

This Strategic Flood Consequence Assessment (SFCA) was undertaken by Scott Wilson for Rhondda Cynon Taf County Borough Council (Rhondda Cynon Taf CBC). This Executive Summary has been produced as an overview of the technical content of the SFCA and accompanying appendices. A Glossary of Terms and Abbreviations are provided following this Executive Summary.

The overall purpose of the study is to prepare a SFCA for Rhondda Cynon Taf CBC, who are currently preparing their Deposit Draft Local Development Plan (LDP). The SFCA will inform the revision of policies and realistic approaches to managing the risk of flooding which can be taken forward into the LDP. The SFCA will provide Rhondda Cynon Taf CBC with a sufficient evidence base for the LDP.

The main focus of the SFCA will be the 8 strategic sites identified by Rhondda Cynon Taf CBC and Treforest Industrial Estate outlined below.

Site 1: Former Maerdy Colliery Site, Rhondda Fach;

Site 2: Former Fernhill Colliery Site, Blaenrhondda;

Site 3: Former Phurnacite Plant, Abercymboi;

Site 4: Robertstown / Abernant, Aberdare;

Site 5: Land South of Hirwaun / Penywaun;

Site 6: Cwm Colliery and Coking Works, Beddau;

Site 7: Mwyndy / Talbot Green Area;

Site 8: Former OCC Site, Llanilid, Llanharan;

Study Area Flood Sources

The planning of new developments must be considered with regard to the current and future risk of flooding from a number of sources. As the region is land-locked, the SFCA report has evaluated the flood risk from the flowing sources:

- Fluvial;
- Groundwater;
- Overland Flow;
- Sewers;
- Artificial Sources.

It is important that flood risk is considered at a strategic scale to inform land allocations and future developments within the emerging LDP. Therefore, The SFCA intends to assess flood risk at the key development sites at a strategic level.

The secondary focus of the SFCA is to assess the potential flood risk from drainage “hotspots” throughout the study area using information provided by Rhondda Cynon Taf CBC. Furthermore, a strategic assessment of flood risk from artificial sources, including canals and reservoirs, will be carried out throughout the study area.

Information Sources / Methodology

Data for the production of this report was collected from Environment Agency Wales (the Environment Agency) and Rhondda Cynon Taf CBC, and is the best available data at the time of writing. This SFCA is a 'live' document and should be updated on a regular basis as new information becomes available.

For the purpose of evaluating the fluvial flood risk at the nine study sites the Environment Agency flood maps and the Welsh Assembly Government (WAG) Development Advice Maps (DAMs) have been used with Geographical Information Systems (GIS) to highlight the areas at risk from flooding in a 1 in 100 year return period flood event and the extreme 1 in 1000 year return period flood event.

Where the information was available, floodwater levels derived from the Environment Agency’s hydraulic modelling have been combined with Light Detection and Ranging (LIDAR) topographical data. Utilising GIS software the predicted depth of flooding at the sites has been calculated and depicted graphically.

The quality of the data collected and produced varies and where less reliable information or assumptions are necessary, a precautionary approach is taken when identifying the flood risk probability.

Conclusions

The following points provide a summary of the SFCA Report and recommendations:

- Initial assessment of flood sources across the 9 study sites indicates that flood risk is predominately fluvial.
- Greater than 90% of the strategic development hectare-age evaluated in this report is potentially developable within the guidance of TAN15. Flood risks constraints impact significantly on the Phurnacite and the Robertstown / Abernant sites.
- The flood risks associated with minor watercourses and drainage systems should be explored further and management systems designed accordingly. This should be captured during the surface water management scheme detailed design phase pre-planning.
- Site specific FCAs will be needed to accompany any planning applications for the development sites.

- While the report has uncovered no evidence of groundwater flood risk the complexity of the bedrock geology across the catchment has resulted in a poor understanding of the groundwater conditions. Little data exists to permit site specific analysis of groundwater flood risk.

- Due to the steep sided valleys associated with the sites at the former Maerdy Colliery, the former Fernhill colliery, Hirwaun and Penywaun and the Cwm Colliery the soils are typically shallow with the underlying bedrock near the surface. This typically results in a flashy stream response to rainfall events.

- The current lack of maintenance of surface water management systems at the former colliery and open cast coal sites has the potential to increase flood risks.

- The Environment Agency have a risk based programme for hazard mapping areas at significant risk of flooding. The extent of this programme is subject to annual funding. New information is constantly available and must be considered as and when available. Most notable changes at this time involve new guidance on climate change and development life in addition to changes in flow calculations.

Table of Contents

Abbreviations

Abbreviation	Definition
AVM	Automated Voice Message
CBC	County Borough Council
CFMP	Catchment Flood Management Plan
DAMs	Development Advice Maps
DCWW	Dwr Cymru Welsh Water
DPD	Development Plan Documents
DTM	Digital Terrain Model
EC	European Commission
ES	Environment Strategy
FCA	Flood Consequence Assessment
FRMP	Flood Risk Management Plans
GIS	Geographical Information Systems
LDP	Local Development Plan
LiDAR	Light Detection and Ranging
LPA	Local Planning Authority
LPD	Local Planning Documents
mAOD	Metres Above Ordnance Datum
MPPW	Mineral Planning Policy Wales
NEDS	National Economic Development Strategy
NFCDD	National Flood and Coastal Defence Database
PCCA	Planning and Compulsory Purchase Act 2004
PPW	Planning Policy Wales
RBMP	River Basin Management Plans
RDP	Rural Development Plans
RPG	Regional Planning Guidance
SDAP	Sustainable Development Action Plan
SDP	Sustainable Development Plan
SDS	Sustainable Development Schemes
SEA	Strategic Environmental Assessment
SFCA	Strategic Flood Consequence Assessment
SMP	Shoreline Management Plans
SSSI	Site of Special Scientific Interest
SUDS	Sustainable Drainage Systems
TAN	Technical Advice Note
UDP	Unitary Development Plan
WAG	Welsh Assembly Government
WFD	Water Framework Directive
WSP	Wales Spatial Plan

Glossary

Term	Definition
Aquifer	A source of groundwater comprising water-bearing rock, sand or gravel capable of yielding significant quantities of water.
Catchment Flood Management Plan	Strategic plans, currently being produced by the Environment Agency, which produce policies to secure the long-term sustainable management of inland flood risk.
Culvert	A channel or pipe that carries water below the level of the ground.
CIRIA	CIRIA is a member-based research and information organisation dedicated to improvement in the construction industry.
Extreme Flood Outline	Areas where the flood risk is greater than or equal to 0.1% or 1 in 1000
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Floodplain	Area adjacent to river, coast or estuary that is naturally susceptible to flooding.
Flood storage	A temporary area that stores excess runoff or river flow often ponds or reservoirs.
Fluvial flooding	Flooding by a river or a watercourse.
Flood Risk	Flood risk is expressed by combining information on probability (sometimes referred to as likelihood) and consequence (sometimes referred to as impact).
Flood Zone A	Areas considered to be at little or no risk of fluvial or tidal/coastal flooding.
Flood Zone B	Areas known to have been flooded in the past evidenced by sedimentary deposits.
Flood Zone C1	Based on the Environment Agency's extreme flood outline (July 2004) the extent of a flood with a 0.1% (I in 1000) chance of happening each year but the area is served by significant infrastructure, including flood defences.
Flood Zone C2	Based on the Environment Agency's extreme flood outline (July 2004) the extent of a flood with a 0.1% (I in 1000) chance of happening each year but the area is not served by significant flood defence infrastructure.
Flood Zone 2	A highlighted area that will flood an average, at least once in every 1000 years. Also expressed as the 1 in 1000 year return period or extreme flood event.
Flood Zone 3	A highlighted area that will flood on average, at least once in every 100 years. Also expressed as the 1 in 100 year return period flood event
GIS	GIS acts as an effective management tool for the coordinated capture, storage and analysis of data of a geographical nature. GIS handles data in a hierarchical manner by storing spatial features within various layers, which are allied to an underlying database. It is a recognised tool for the efficient collation, storage and analysis of information and is also an increasingly valuable resource for local planning authorities.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
HEC-RAS	Hydrologic Engineering Centers River Analysis System (HEC- RAS) is a software packages that allows one-dimensional river flow and flood modelling to be undertaken.
ISIS	ISIS flow is a full hydrodynamic simulator that allows one-dimensional modelling of flows and levels in open channels and estuaries to be undertaken.
Local Development Plans (LDP)	The core of the updated planning system (introduced by the Planning and Compulsory Purchase Act 2004). The LDP comprises the Local Development Documents, including the Development Plan Documents that expand on policies and provide greater detail on the strategic planning aims of a Local Planning Authority. The development plan includes a core strategy, site allocations and a proposals map.
Main River	Main rivers are usually larger streams and rivers. However, they do include smaller watercourses of local significance. A main river is a watercourse marked as such on a main river map. The Environment Agency powers to carry out flood defence works apply to main rivers only.
Left Bank	When looking down stream the area of land to the left
MIKE11	Is a hydrodynamic simulator that allows one-dimensional modelling of flows and levels in open channels and estuaries.
Local Planning Authority	Body that is responsible for controlling planning and development through the planning system.
Mitigation Measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Ordinary Watercourse	An ordinary watercourse is every river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and passage through which water flows and which does not form part of a main river. The Local Authority or the Internal Drainage Board where relevant has powers for Ordinary Watercourses.

Term	Definition
Overland Flow	Flooding caused when intense rainfall exceeds the capacity of the drainage system or when, during prolonged periods of wet weather, the soil is so saturated such that it cannot accept any more water.
Right Bank	When looking downstream the area of land on the right.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Sustainable Drainage System	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations meeting their own needs.
Q100	The peak discharge of the water in a 1 in 100 year flood event.
Q1000	The peak discharge of the water in a 1 in 1000 year flood event.
1 in 100 year event	Event that on average will occur once every 100 years. Also expressed as an event, which has a 1% annual probability of occurrence.
1 in 100 year design standard	Flood defence that is designed for an event, which has an annual probability of 1%. In events more severe than this the defence would be expected to fail or to allow flooding.
WRC 2006	A design and construction guide for developers with regards to sewerage infrastructure.

1 Introduction

1.1 Background

The Welsh Assembly Government (WAG) is responsible for developing flood and coastal risk policy and funding flood defence works. The responsibility for delivering flood risk management in Wales rests with a number of organisations with varying powers and responsibilities. The aim is to reduce flood risk by:

- Discouraging inappropriate development in areas at risk from flooding;
- Encouraging adequate technically, environmentally and economically sound; and sustainable flood risk management measures;
- Encouraging adequate and cost effective flood warning systems and flood emergency arrangements.

WAG launched its Environment Strategy in 2006. This multi-functional strategy for the environment of Wales sets the strategic direction for the next 20 years and confirms the need to adapt to climate change impacts. The strategy aims to develop a risk management approach when addressing flood and coastal erosion. A three year programme led by WAG is currently implementing the move to this new approach.

In order to adapt to an increased risk of flooding due to climate change, business, industry, Government and individuals need to be aware of the risks that they face, understand the consequences of flooding and decide how to manage it.

This new approach is founded on the principles of

- Supporting individuals by ensuring that they are placed at the centre of service design for flood risk and coastal erosion risk management;
- Collaborative and partnership working by a wide range of organisations including contributions across a spectrum of activities such as land management, development control, emergency planning and improved property resilience in new development and in the refurbishment of existing development.

On the 26 November 2007 the European Commission Directive 2007/60/EC on the assessment and management of flood risks entered into force. The Directive aims to reduce the risk to human health, the environment and economic activity associated with floods. The Directive will require the preparation of Flood Risk Management Plans (FRMPs) that will sit alongside the River Basin Management Plans (RBMPs) prepared under the Water Framework Directive (WFD). The FRMPs that are prepared will build on the Catchment Flood Management Plans (CFMPs) and Shoreline Management Plans (SMP)[1].

Planning Policy Wales (PPW) sets out the land use planning policies of WAG and are supplemented by a series of Technical Advice Notes (TANs). Local Planning Authorities (LPAs) should take into account the guidance provided in TAN15: Development and Flood Risk when preparing their Local Development Plans (LDPs) and when assessing individual planning applications.

[1] Taff and Ely CFMP (2007)

1.2 Purpose of the SFCA

The overall purpose of the study is to prepare a SFCA for Rhondda Cynon Taf County Borough Council (Rhondda Cynon Taf CBC) who are currently preparing their Deposit Draft LDP. They require a SFCA to inform policies and provide realistic approaches to managing the risk of flooding to be taken forward into the LDP. The SFCA will provide Rhondda Cynon Taf CBC with a sufficient evidence base for the LDP. The SFCA objectives as identified in the tender brief are;

- To identify past major flood events and the associated source of flooding;
- To identify potential sources of flooding in Flood Zone C2 (the extreme or 1 in 1000 year return period flood outline) as highlighted on WAG Development Advise Maps (DAMs);
- To refine or improve the accuracy of the Development Advice Maps (DAM) and extreme flood outline where required;
- To identify other sources of flooding that may present concern;
- To appraise existing flood defence infrastructure; and
- To undertake a broad level assessment of flood consequences where the LPA still have a requirement to allocate land for development within flood risk areas.

The SFCA is divided into two parts:

1.2.1 Strategic Site Analysis

All sources of flood risk to 8 strategic sites plus Treforest Industrial Estate (referred to as the “nine study sites”), identified by Rhondda Cynon Taf CBC are to be undertaken. Their locations are shown in Figure 1-1 and they are listed below.

Site 1: Former Maerdy Colliery Site, Rhondda Fach;

Site 2: Former Fernhill Colliery Site, Blaenrhondda;

Site 3: Former Phurnacite Plant Abercymboi;

Site 4: Robertstown / Abernant, Aberdare;

Site 5: Land South of Hirwaun / Penywaun;

Site 6: Cwm Colliery and Coking Works, Beddau;

Site 7: Mwyndy / Talbot Green Area;

Site 8: Former OCC Site, Llanilid, Llanharan.

Site 9: Treforest Industrial Estate.

1.2.2 Wider Site Analysis

It is understood that there are smaller potential “candidate” development sites identified across the study area. Rhondda Cynon Taf County Borough Council have requested that each site will be assessed against:

- The critical drainage areas in relation to the wider development sites, highlighting the drainage problem areas;
- The potential flood risk from artificial sources (canals and reservoirs) to the wider sites.

The candidate sites are shown in Figure 1-2.

Figure 1-1: Overview of Study Area and Strategic Sites plus Treforest Industrial Estate

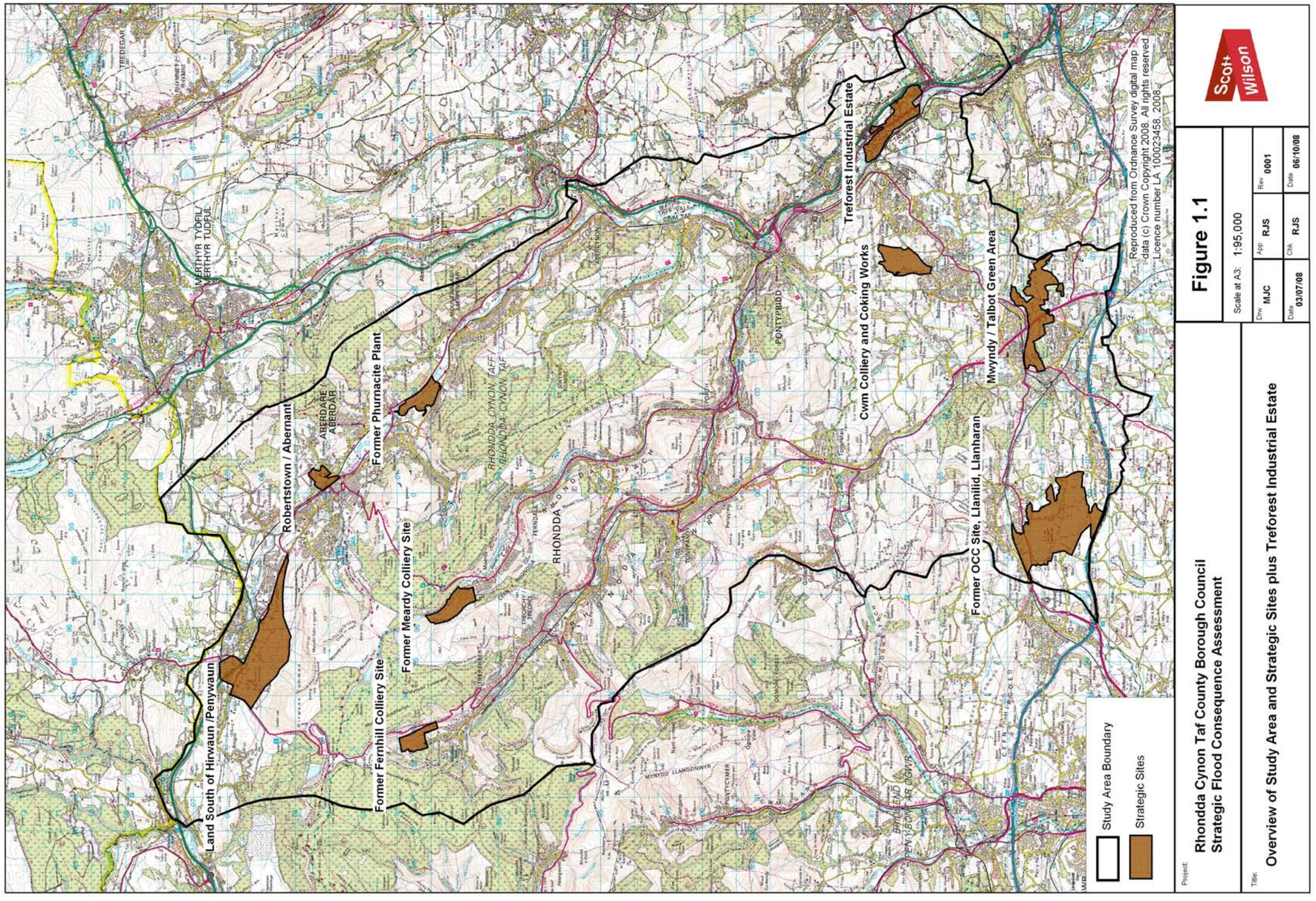
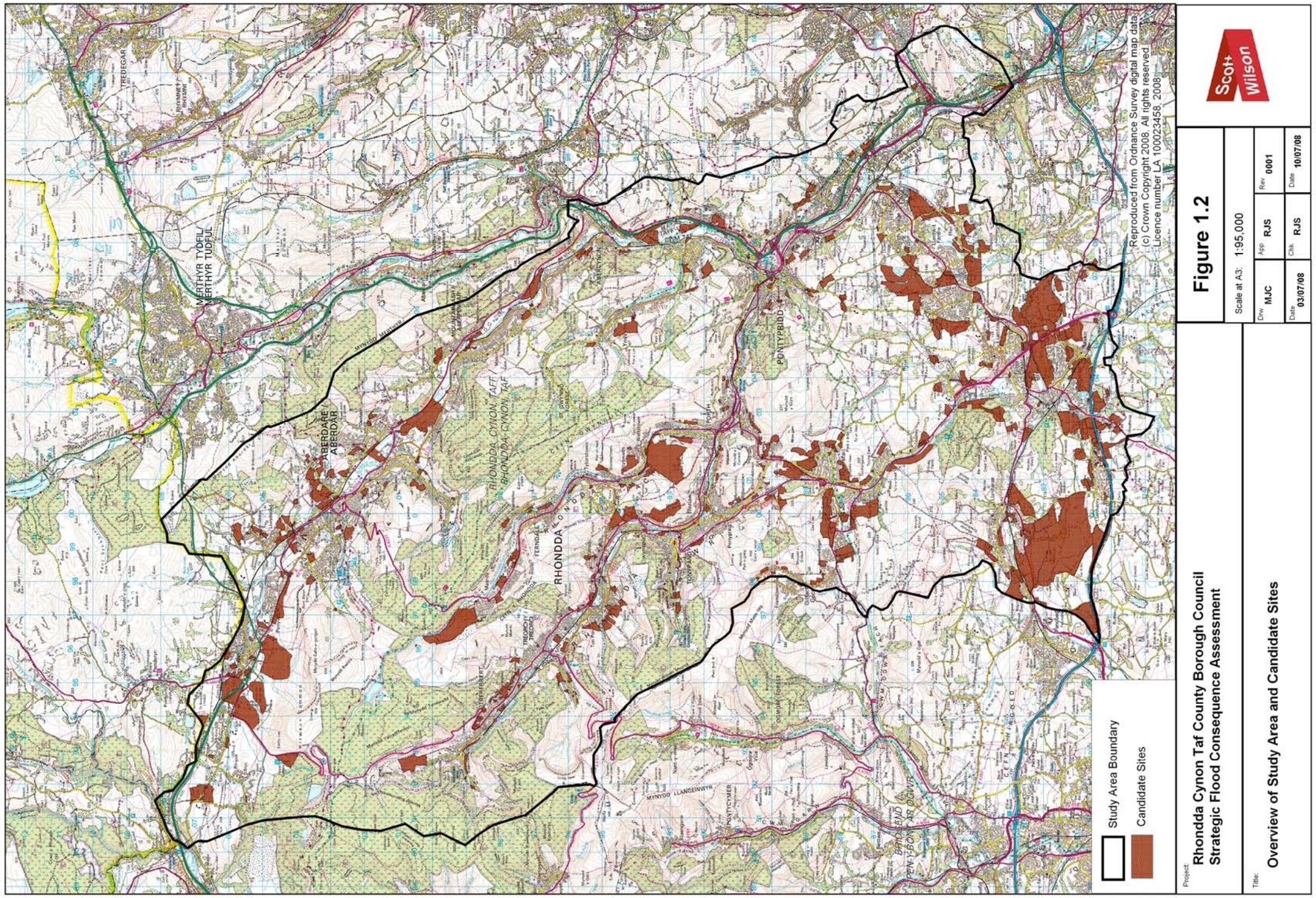


Figure 1-2: Overview of Study Area and Candidate Sites



2 Methodology

This Section describes the collection of data and analysis used in the compilation of the SFCA. The methodology is based on our analysis of the nine study sites in addition to the wider site analysis undertaken.

2.1 Strategic Site Analysis

The programme commenced with a high level review of all available information sources pertaining to flood risk in Rhondda Cynon Taf CBC. Stakeholders were identified and letters were issued requesting data/information on flood risk in the study area.

2.1.1 Site Specific Data Gathering

For the purpose of ensuring that all nine study sites were fully evaluated, site visits were undertaken. During these visits all features (water and topographical) were documented with photographs and notes.

After the site visits meetings were arranged, with the Rhondda Cynon Taf CBC Drainage Engineer (Mike Thomas) and the Environment Agency (Martin Cadogan Team Leader and Will Norman Technical Specialist - Asset Systems Management Team). In these meetings information about the flood history and current flooding regime across the study area was gathered and recorded in note form.

Historical Flooding Records

Information on the historical flooding has been provided by the Environment Agency in the form of the 1979 flood outline. The flooding of December 1979 has been regarded as the most notable and widespread, causing significant flooding to several thousand properties across South Wales. After this the Environment Agency gathered data on the areas affected and created a flood outline. The data simply highlights the areas that were affected but does not provide information on flood depth, speed or volume of flow.

For the purpose of this report this information will be depicted graphically using Geographical Information Systems (GIS).

Using GIS, the 1979 flood outline has been superimposed on to the base maps of the nine study sites to highlight the areas of these sites that were affected by flooding during this event. These are shown through the site specific assessments in Section 5.

Further information on historical flooding was collected from the Environment Agency, specifically from meetings with their Flood Risk Management Assets Team and the Taff and Ely CFMP. Further anecdotal information was collected from the Local Authority Drainage Engineers, although as with all anecdotal evidence there are likely to be inaccuracies with this. All flood risk information collected has been recorded in the “Flooding History” Sections pertaining to each of the nine study sites.

2.1.2 Review of Existing Modelling and Maps

Welsh Assembly Government Development Advise Maps (DAMs)

Rhondda Cynon Taf CBC has provided an extract of WAGs DAMs for the study area. The DAMs were the Environment Agency Flood Zone data (July 2004) which was provided to the WAG to inform their mapping of the Flood Zones as defined in TAN15. The Environment Agency data enabled WAG to map Flood Zone C in their DAMs. Flood Zone C is based on the Environment Agency’s extreme flood outline and if defined as an area with a flood risk equal to or greater than 0.1%. A description of the DAM Flood Zones is given in Table 3-2.

Using GIS the DAMs have been superimposed onto the base maps for the nine study sites. The purpose of the DAMs is to provide a reference as to the policy requirements for development within a specific Flood Zone as detailed in Section 3.1.8. Through GIS, calculations of the site area which can be developed for highly vulnerable usage and lower vulnerability development can be calculated. The vulnerability of different land uses is described in Table 3-1.

The Environment Agency Flood Maps

The Environment Agency has provided an extract of their Flood Map for the study area. The Flood Map shows the estimated extent of Flood Zones 2 and 3 (ignoring the presence of flood defences) for all “Main Rivers” and / or watercourses with identified critical drainage problems. Flood Zone 2 comprises of land that will flood an average, at least once in every 1000 years. Also expressed as the 1 in 1000 year return period or extreme flood event. Flood Zone 3 comprises of land that will flood on average, at least once in every 100 years. Also expressed as the 1 in 100 year return period flood event. The flood map gives an indication of the areas at risk of flooding in the study area; however it does not provide details on individual properties. The Environment Agency have a risk based programme for hazard mapping areas at significant risk. The extent of this programme is subject to annual funding. New information is constantly available and must be considered as and when available.

The Environment Agency Flood Maps do not provide information on flood depth, speed or volume of flow, or do they include the presence of flood defences. They also do not cover flooding from other sources, such as groundwater, direct runoff from fields, or overflowing sewers. In addition, there are limitations of the modelling undertaken to generate the generalised flood map. The Environment Agency flood maps only consider catchments that are greater than 3km^2. This does not mean that there is no flood risk, just that the techniques used to develop nationally resolute data are not sufficiently refined to produce suitable results.

The Environment Agency Flood Zones should not be used to justify the location of development under Section 6 of TAN15 or determine the planning policy requirements as set out in Section 9 of TAN15. The Environment Agency latest and best available flood data and Flood Zones can be used to support others assessing flooding consequences (subject to data licensing).

For the purpose of this report the Environment Agency Flood Maps have been superimposed on to base maps from the nine study sites using GIS software. The areas within the study sites that are currently predicted to be affected by fluvial flooding in the 1 in 100 year return period and the 1 in 1000 year return period flood events can be highlighted and depicted graphically. In addition the GIS software is used to calculate the area and percentage of the development site affected in the 1 in 100 and the 1 in 1000 year return periods. Applying this data to the policy requirements of TAN15, the report details the area of the site that is potentially developable, what development

type policy will permit and what further information or studies the policy requires to facilitate development.

Light Detection and Ranging (LiDAR)

The Environment Agency has provided Light Detection and Ranging (LiDAR) data for the study area. LiDAR is an airborne mapping technique that uses a laser to measure the distance between the aircraft and the ground. These data vary in accuracy depending on the nature of the terrain such as in woodlands, complex urban areas and near lakes, due to the limitations in the technique. However, LiDAR data is generally recognised to be accurate to within +/- 300mm when compared to actual vertical levels.

For the purpose of this report LiDAR data has been used in conjunction with GIS to allow the creation of site topographical maps (or DTM – digital terrain models) for the purpose of flood depth analysis as detailed below.

Flood Depth Analysis

The Environment Agency has provided details of existing hydraulic models that have been used to inform the Flood Maps. Where the data is available, the models topographical cross sections and water levels have been extracted and combined with each DTM. Both data sets were input into GIS and superimposed. By overlaying the predicted water levels onto the DTMs, the predicted water depths across the study sites can be calculated and displayed graphically. Where modelled cross sections and floodwater level information is not insufficient LiDAR and GIS is used to calculate an average gradient across the site and the flood level interpolated accordingly. Interpolation has been undertaken to account for the hydraulic gradient and provide a more realistic flood depth map.

Some of the study sites are located in rural areas where the neighbouring watercourse is not classified as a “main river”. As such the Environment Agency’s remit does not extend to these areas and therefore no hydraulic modelling or detailed flood risk analysis has been undertaken in these areas. Where this is the case the data required to undertake flood depth analysis is not readily available. This is noted in the individual strategic site assessments within Section 5.

2.1.3 Review of Existing Flood Warning Data

From a review of the CFMP, information of the flood warning system operated by the Environment Agency has been collated. The Environment Agency provides an essential service in all areas at risk of flooding. Informing people of the potential flood risk within their area is key in ensuring that the necessary preparations can be made to protect property or/and evacuate affected areas.

Flood warnings are disseminated through a variety of mediums that include TV, radio, Automated Voice Messaging (AVM) service direct to a phone/fax/pager, internet and/or loudhailer. There is also an emergency Floodline number (0845 988 1188) and a quick dial number for individual rivers. The flood warning service is also available on the Environment Agency website (www.environment-agency.gov.uk).

The Environment Agency aim to provide a minimum of two hours warning prior to the onset of a flood event. However the rapid onset of some flood events, within small catchments or when a high intensity rainfall event occurs within an urban catchment, means that sometimes there is insufficient time to raise a warning. It should be noted that within large areas of the study area, the topography and natural characteristics of the catchments make it very difficult to provide a reliable, accurate and timely flood warning service. The urbanisation of catchments only serves to make the situation worse.

There are four flood warning codes that indicate the level of flood risk to the area. These are presented in Table 2-1 below.

Table 2-1: Environment Agency Flood Warning Codes

Flood Warning Code	Description
Flood watch	Flooding of low lying land and roads is expected. Make the necessary actions to prepare for a flood event.
Flood warning	Flooding of homes and businesses is expected. Take immediate action.
Severe flood warning	Severe flooding is expected. Extreme danger to life and property is expected. Take immediate action.
All clear	Flood watches or warnings are no longer in force for this area

The Environment Agency Flood Warning Areas for Rhondda Cynon Taf CBC are listed below and shown on Figure 4-2.

- River Cynon at Aberdare;
- River Cynon at Hirwaun, Aberaman, Mountain Ash and Abercynon;
- River Ely at Ynysmaerdy Industrial Estate, Lanelay, Talbot Green, Pontyclun and Maes y Felin;
- River Rhondda at Ferndale, Treherbert and Pentre;
- River Rhondda at Gelli, Trehafod and Hopkinstown;
- River Rhondda at Porth;
- River Taff at Hawthorn and Rhydyfelin.

2.1.4 Detailed Assessment of Flood Risk

Fluvial

For the purpose of evaluating the fluvial flood risk at the nine study sites the information detailed in the above sections has been used in conjunction with information collected during the site visits, meeting with the stakeholders and various other sources.

To enable the calculation of the potential developable area at the nine study sites the Environment Agency flood maps have been superimposed onto base maps for the study area. The areas predicted to be at risk of flooding in the 1 in 100 year return period flood event and the 1 in 1000 year return period flood event are highlighted accordingly. The Environment Agency flood maps are preferred to the DAM maps as they are updated quarterly, when new information is available, where as the DAM maps have not been updated since 2004.

The area highlighted as being at risk of flooding are then calculated using GIS. The flood risk area is subtracted from the total area of the site to give a potential developable area, quoted in ha. The developable area is then divided further into areas where

- All development is permitted (areas outside the 1 in 1000 year return period flood outline);
- Areas where policy recommends that only less vulnerable development types should be permitted, subject to a Flood Consequence Assessment (FCA) demonstrating that the risk is manageable (areas within the 1 in 1000 year return period flood outline but outside the 1 in 100 year return period flood outline);
- Areas where policy recommends that no development should be permitted (areas within the 1 in 100 year return period flood outline).

For the purpose of this report the "developable area" quoted is an approximation of the land that is identified outside the flood zones where policy does not restrict development. The actual area of developable land may be less than the figure quoted due to site specific constraints (such as minor water features or isolated areas of raised ground). However, precise developable land available for each site should be confirmed in a detailed FCA as mitigation measures may also be necessary.

Where the Environment Agency have provided a copy of their latest HEC-RAS or ISIS hydraulic model this information has been used to undertake more site specific analysis through the creation of new flood outlines, analysis of the potential flood depths and calculations of culvert capacity.

For the purpose of undertaking flood depth analysis peak water flood levels (1 in 100 year and 1 in 1000 year return period) were extracted from the hydraulic models. This information is then combined with LiDAR topographical data. The ground level is then subtracted from the estimated water levels to give a predicted depth of flooding. These depths are then superimposed back onto the base maps to display graphically a new flood outline and the depths of floodwater within that outline. The depth of water is highlighted in 0.5 metre intervals e.g. 0 - 0.5m, 0.5 – 1m etc.

Topographical data from the hydraulic modelling has also been used to confirm observations made on site or information received from third parties. The data highlights the presence of features that may affect the flood regime and highlights areas where floodwaters can potentially flow and areas where floodwaters would be expected to pool. This helps build a more detailed understanding of the flood regime at each strategic development site.

The ISIS hydraulic model for the Clun catchment has been used to create a new flood outline and to demonstrate the affects that structures have on flow. The flood model highlights areas upstream of bridges and culverts where the flood outline is enlarged. Discussions with the Environment Agency have confirmed that this highlights areas where floodwaters are pooling behind the structures as the flow of water is greater than the capacity of the bridge or culvert. This helps to increase understanding of the flood risks afforded to the infrastructure servicing the study sites.

Finally, the Environment Agency river flow calculations have been used in conjunction with culvert capacity calculation software to determine if the culverts beneath the former Fernhill colliery site have sufficient capacity to convey extreme flood flows. For the purpose of ascertaining the size of the culverts beneath the site the existing report on the culvert was used ("Report on the Inspection of Fernhill Colliery Culverts (Halcrow 1989)").

Groundwater

From a review of the CFMPs, open sources, reports and from meetings with the Environment Agency and Local Authority Drainage Engineers information on the groundwater flood risks have been collated. Strategic, area wide analysis is included in Section 4.3 of the report and information specific to the nine study sites included within the site specific flood risk analysis in Section 5.

Overland Flow

Information on the overland flow flood risk was largely collected form the evaluation of the geology, soils (British Geological Survey maps) and from topographical analysis using LiDAR and Ordnance Survey maps of the area. Hypothesis made at the desk study stage were checked during site visits and the Environment Agency and Local Authority Drainage Engineers consulted accordingly. Strategic, area wide analysis is included in Section 4.4 of the report and information specific to the nine study sites included within the site specific flood risk analysis in Section 5.

Sewers

Information on the sewerage infrastructure, flooding incidents and potential flood risk areas was request from Dwr Cymru Welsh Water (DCWW). This request was followed up on three occasions but at the time of writing this report no information had been received. As such this report relies on information from the Environment Agency and Local Authority Drainage Engineers and information known to Flood Risk Engineers at Scott Wilson.

Artificial Sources

From a review of the geographical data for the study area and though liaison with British Waterways, the Environment Agency, the Local Authority and DCWW bodies of waters such as lakes, canals and reservoirs have been identified.

Using the LiDAR topographical data and the location of the impounding structures provided by the Environment Agency the local topography has been evaluated to analysis what direction water would flow in the event of a breach or overtopping. Utilising GIS the location of these bodies of water in relation to the LDP candidate sites has been highlighted geographically. Arrows indicating the potential direction of flow have been inserted to identify those areas that are potentially at risk of flooding.

In addition an indication of the flood risk following a failure of Castell Nos Reservoir has been undertaken. Utilising GIS and LiDAR topographical data the peak water level, derived from the top of the dam wall, has been extrapolated down through the site. The area lower than the height of the dam wall is then highlighted as being potentially at risk of flooding in the event of a dam wall breech. This area is then depicted graphically on a map of the site. This method of calculating flood risk is in keeping with the precautionary approach of TAN15. However it does not evaluate the rate of flow or depth of water as it passes through the site. It can be assumed that velocities and flood depths would be in excess of the policy requirements.

2.1.5 Summary of Data

Below outlines the information received for each of the nine study sites.

Table 2-2: Summary of information received

	Data received													
	Flood Maps					Hydrology	Hydraulic Modelling		Other					
Site Reference	1979 Flood Map	DAM	EA FZ (100)	EA FZ (100 +CC)	EA FZ 3 (1000)	Flow Data	ISIS Model	Hec-Ras Model	Flood Warning Data	Canal Flood Risk	LiDAR	DCWW	Flood Defences	Overland Flood Risk
Site 1: Former Maerdy Colliery, Rhondda Fach	×	✓	✓	×	✓	×	×	×	✓	×	✓	×	×	×
Site 2: Former Fernhill Colliery Blaenrhondda	×	✓	✓	×	✓	✓	×	×	×	×	✓	×	×	×
Site 3 – Former Phurnacite Plan, Abercwmboi, Cynon Valley	✓	✓	✓	✓	✓	✓	×	✓	✓	×	✓	×	×	×
Site 4 – Robertstown and Abernant, Aberdare	✓	✓	✓	✓	✓	✓	×	✓	✓	×	✓	×	×	✓
Site 5 – Land South of Hirwaun and Penywaun, Aberdare	✓	✓	✓	×	✓	×	×	×	×	×	✓	×	×	×
Site 6 – Former Cwm Colliery and Cwm Coking Works, Beddau	×	✓	✓	✓	✓	✓	✓	×	×	×	✓	×	×	×
Site 7 – Mwyndy and Talbot Green, Llantrisant	×	✓	✓	✓	✓	✓	✓	×	✓	×	✓	×	×	×
Site 8 – Former Llanilid Open Cast Coal Site, Llanharan	×	✓	×	×	✓	✓	×	×	×	×	✓	×	×	×
Site 9 – Treforest Industrial Estate	✓	✓	✓	✓	✓	✓	✓	×	✓	×	✓	×	✓	×

× - signifies “No data available”

2.2 Wider Site Analysis

In September 2005 Rhondda Cynon Taf CBC wrote to landowners, identified agents and developers giving them the opportunity to identify and promote any areas of land they considered suitable for residential or commercial development. Sites identified through this process were registered in the Candidate Site Register and are shown in Figure 1-2. The LDP Manual recommends the compilation of the site register to allow any interested party to view the sites that have been put forward for consideration in the LDP.

Two aspects of flood risk have been assessed for these candidate sites, as requested in the Tender Brief. These include:

- Identification of the areas which have known surface water drainage problems;
- Identification of the risk of flooding to the candidate sites from artificial sources, such as canals and reservoirs.

The methodology is discussed below and the assessment of these included in Section 6.

3 Policy Context

In compiling their LDP, Rhondda Cynon Taf CBC should consider a range of planning policies (of which those relating to flooding cover a relatively limited number) to ensure developments are sustainable. This section sets out the national, regional and local policies in place relating to development and flooding and/or flood risk management within the Rhondda Cynon Taf CBC study area.

3.1 National Policies

3.1.1 Welsh Assembly Government High Level Targets (2001)

WAG has responsibility for flood defence policy in Wales and is committed to playing its part in wider Government policies for the protection of the environment and biodiversity. In April 2001, WAG set out its High Level Targets for flood and coastal defence to facilitate a more certain delivery of the Government's national policy aim and strategy for flood and coastal defence in Wales.

3.1.2 Minerals Planning Policy Wales and Minerals Technical Advice Notes (Welsh Assembly Government 2001 onwards)

Minerals Planning Policy Wales (MPPW) (WAG, 2001) sets out the land use planning policy guidance in relation to mineral extraction and related development in Wales. It is intended for use by Mineral Planning Authorities in the preparation of their policies and in the determination of individual planning applications. Its content will be taken into account by WAG and by Planning Inspectors in the determination of “called in” applications and appeals in Wales. The document is supported by MPPW Mineral TANs which set out detailed advice on the mechanisms for delivering the policy for mineral extraction. The overarching objective of these documents is to ensure mineral supply is managed in a sustainable way so that the best balance between environmental, economic and social considerations is struck, while making sure that the environmental and amenity impacts of any necessary extraction are kept to a level that avoids causing demonstrable harm to interests of acknowledged importance.

3.1.3 Planning Policy Wales (WAG, March 2002)

PPW provides the strategic land use planning policy framework for the effective preparation of Local Plannning Authorities (LPAs) LDPs. PPW identifies the requirement for the planning system to move away from flood defence and the mitigation of the consequences of new development in areas of flood hazard, towards a more positive avoidance of development in areas defined as being of flood hazard. It also advocates that planning authorities adopt a precautionary approach when formulating policies on development and flood risk and when considering planning applications. The guidance also suggests that LPAs take a strategic approach to flood risk and consider the catchment as a whole.

3.1.4 Wales a Better Country (WAG, September 2003)

“Wales: A Better Country” is the strategic agenda of WAG. The document sets out:

- WAG’s guiding vision of a fairer, more prosperous, healthier and better educated country, rooted in our commitment to social justice and to putting health and wealth creation that is sustainable at the heart of policymaking;
- The agenda WAG has for public services in Wales, with a programme for delivering the manifesto commitments;
- The priority issues which are broader than any one section of government and where smarter working and working together can make a bigger and longer lasting impact;
- The way WAG wants to deliver jointly with partners in local government, business, the trade unions and the voluntary sector.

3.1.5 People Places Futures: The Wales Spatial Plan (WAG, 2004)

The Planning and Compulsory Purchase Act 2004 (PCPA) is a key element for reducing delays within the planning system. The provisions introduce powers that allow for the reform and speeding up of the planning system. The Act makes provision for WAG to prepare and publish a national spatial plan for Wales (the "Wales Spatial Plan") to which LPAs will be required to have regard when preparing their LDPs.

The Wales Spatial Plan (WSP)[2] provides a strategic context for the development necessary to allow Wales to fulfil its ambitions for economic success, social inclusion and a quality environment. The purpose of the plan is to support and influence spatial polices and programmes of WAG and others. Plans to date include the Sustainable Development Schemes (SDS), PPW, the National Economic Development Strategy (NEDS) and Rural Development Plans (RDP). WSP reflects the planning policies set out in PPW. The key issues identified within WSP are carried through to the relevant local plans and the opportunities and conflicts between these plans with the other stratergies have been reviewed within the Strategic Environmental Assessment (SEA).

3.1.6 Sustainable Development Action Plan 2004-2007 (Welsh Assembly Government, 2004)

WAG is required by law to develop a scheme stating how it will promote sustainable development in the exercise of its functions. WAGs first scheme “Learning to Live Differently: The SDS was adopted in November 2000. In March 2004 WAG adopted a revised SDS: Starting to Live Differently[3]. The Sustainable Development Action Plan (SDAP) 2004-2007 (WAG 2004) presents how WAG will implement the commitments of this new scheme. This embeds a legal duty for sustainable development within activities, including sustainable procurement and minimising waste generation, energy, water and transport demands. A key objective, (No. 10) of the SEA, is that any flood risk management measures should seek to be sustainable, both in terms of maintenance requirements and in ensuring the reintroduction or continuation of natural processes.

[2] People, Places, Futures - The Wales Spatial Plan, November 2004
[3] Starting to Live Differently – The Sustainable Development Scheme for the National Assembly for Wales (March 2004).

3.1.7 Environment Strategy for Wales (Welsh Assembly Government, 2006).

This sets WAG's long-term (20 years) strategic direction for the environment of Wales. The Environment Strategy (ES) is supported by action plans and links directly with the SDP and WSP. This strategy directly references the environmental themes of biodiversity, landscape, climate change and flood risk management and supports the approach of managing the risks and consequences of flooding. This strategy will be reviewed by WAG and the action plan updated annually.

3.1.8 Planning Policy Wales Technical Advice Note 15 (TAN15): Development and Flood Risk (June 2004)

PPW is supplemented by 20 topic based TANs. TAN15: Development and Flood Risk (July 2004) is the most relevant for this SFCA.

3.1.8.1 Overview of TAN15

The general approach of PPW, supported by TAN15, is to advise 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 the precautionary framework is, in order of preference, to:-

- Direct new development away from those areas which are at high risk of flooding;
- Where development has to be considered in high risk areas (Zone C), only those developments which can be justified on the basis of the tests outlined in Section 6 and Section 7 of TAN15 are located within such areas.

The operation of the precautionary framework is governed by:-

- Definitions of vulnerable development and advice on permissible uses in relation to the location of development and the consequences of flooding (Table 3-1).
- A development advice map containing three zones (A, B and C with subdivision into C1 and C2; described in Table 3-2) which should be used to trigger the appropriate planning tests in relation to Sections 6 and 7 and Appendix 1 of TAN15.

The above mentioned Section 6 test in TAN15 relates to the development supporting LPA objectives and Section 7 test relates to the consequences of flooding. Both tests should be passed before any permission is granted.

Urban development in Wales has taken place alongside rivers and in the coastal plain and it is therefore inevitable, despite the overall aim to avoid flood risk areas, that some existing development will be vulnerable to flooding and fall within Zone C. Some flexibility is necessary to enable the risks of flooding to be addressed whilst recognising the negative economic and social consequences if policy were to preclude investment in existing urban areas, and the benefits of reusing previously developed land. Further development in such areas, whilst possibly benefiting from some protection, will not be free from risk and could in some cases exacerbate the consequences of a flood event for existing development and therefore a balanced judgement by the LPA is required.

Table 3-1: The vulnerability of different land uses (abstracted from TAN15)

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.

New development should be directed away from Flood Zone C and towards suitable land in Flood Zone A, otherwise to Flood Zone B, where river or coastal flooding will be less of an issue. In Flood Zone C the tests outlined in sections 6 and 7 in TAN15 will be applied, recognising, however, that highly vulnerable development and Emergency Services in Flood Zone C2 should not be permitted. All other new development should only be permitted within Flood Zones C1 and C2 if determined by the planning authority to be justified in that location. Development, including transport infrastructure, will only be justified if it can be demonstrated that:-

- Its location in Zone C is necessary to assist, or be part of, a local authority regeneration initiative or a local authority strategy required to sustain an existing settlement[4]; or;
- Its location in Zone C is necessary to contribute to key employment objectives supported by the local authority, and other key partners, to sustain an existing settlement or region; and;
- It concurs with the aims of PPW and meets the definition of previously developed land[4] and;
- 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 of TAN15 and found to be acceptable[4].

[4] Technical Advice Note (TAN15) - June 2004

Table 3-2: Descriptions of the composition and use of the Development Advice Map Flood Zones and the use of these zones to manage development (TAN15, 2004)

Description of Zone	Zone	Use within the precautionary framework
Considered to be at little or no fluvial or tidal / coastal flooding.	A	Used to indicate that justification test in not applicable and no need to consider flood risk further.
Areas known to have flooded in the past evidenced by sedimentary deposits	B	Used as part of the precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If the site levels area greater than the flood levels used to define the adjacent extreme flood outline there is no need to consider flood risk further.
Based on the Environment Agency's extreme flood outline, the flood risk is equal to or greater than 0.1% (flood events with a 0.1% annual probability or a 1 in 1000 year return period). Includes river tidal and 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 flood 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.

3.1.9 Assessing Flood Consequences

Where development is justified the FCA can be used to establish whether suitable mitigation measures can be incorporated within the design to ensure that development is as safe as possible and there is:

- Minimal risk to life;
- Minimal disruption to people living and working in the area;
- Minimal potential damage to property;
- Minimal impact of the proposed development on flood risk generally; and,
- Minimal disruption to natural heritage.

Therefore, before deciding whether a development can take place an FCA which examines the likely mechanisms that cause the flooding, and the consequences on the development of those floods, must be undertaken[4].

To assist in this process, TAN15 states that there are particular flooding consequences that may not be considered acceptable for particular types of development. For instance, in view of the traumatic impact of flooding on people's personal lives it is not sensible to allow residential development in areas that flood frequently. A frequency threshold of flooding below which flooding of development should not be allowed has been developed within TAN15 and provides indicative guidance for frequency threshold related to development (Table 3-3).

Table 3-3: Flood frequency guidance (Table A1.14 TAN15)

Type of Development	Threshold Frequency (Years)	
	Fluvial	Tidal
Residential	1%	0.5%
Commercial / Retail	1%	0.5%
Industrial	1%	0.5%
Emergency Services	0.1%	0.1%
General Infrastructure	1%	0.5%

Beyond the threshold frequency, proposed development would be expected to flood under extreme conditions. However, even with adequate mitigation measures TAN15 deems it "insensible" to allow particular development to take place where, for example, the velocity and depth of floodwaters was such that structural damage may be possible or that people could be swept away by the flood. Section A1.15 of TAN15 provides prescriptive, indicative guidance on what it considers tolerable conditions for different types of developments. This is outlined in Table 3-4.

Table 3-4: Tolerable conditions for different types of development (A1.15 TAN15)

Type of Development	Maximum depth of flooding (mm)	Maximum rate of rise of floodwaters (m/hr)	Maximum speed of inundation of flood risk area (hrs)	Maximum velocity (m/s)
	Property Access			Property Access
Residential (habitable rooms)	600 600	0.1	4	0.15 0.3
Commercial and Retail	600 600	0.3	2	0.15 0.3
Industrial	1000 1000	0.3	2	0.3 0.45
Emergency Services	450 600	0.1	4	0.15 0.3
General Infrastructure	600 600	0.3	2	0.3 0.3

3.2 Reservoir Flood Plans

The Water Act 2003 amended the Reservoirs Act 1975 and introduced a requirement for reservoir undertakers to prepare reservoir flood plans.

A reservoir flood plan will include:

- An inundation analysis to identify the extent and severity of flooding which could result from an uncontrolled release of water;
- An on-site plan setting out what the undertaker would do in an emergency to try to contain and limit the effects of the incident;
- A communications plan with external organisations, mainly the emergency services.

They are expected to become a legal requirement in spring 2009 when WAG will direct undertakers to produce flood plans for reservoirs where failure could have a major impact on risk to property and lives.

3.3 Local Development Plan

Under the PCPA (2004), the LPA is required to prepare an LDP for Rhondda Cynon Taf CBC. When adopted the LDP will replace the existing local plans.

The LDP will provide the development strategy and policy framework for Rhondda Cynon Taf CBC over a fifteen-year period, from 2006 to 2021. It will be used by Rhondda Cynon Taf CBC to guide and control development, providing a basis by which planning applications can be determined consistently and appropriately.

3.4 Catchment Flood Management Plans (CFMPs)

CFMPs are strategic plans, currently being produced by the Environment Agency, that produce policies to secure the long-term sustainable management of inland flood risk. The Environment Agency engages stakeholders within the catchment in order to produce policies for sustainable flood management whilst also considering the land use changes and the effects of climate change. It should be noted that the CFMPs are currently in draft form. The plans published in October and November 2007 was the Stage 1 “Scoping Reports”. The Stage 2 “Main Stage” reports are due out for consultation in September 2008 and final publication is due in January 2009.

The Rhondda Cynon Taf CBC administrative area is covered by two CFMPs namely:

- Taff and Ely CFMP (November 2007);
- Ogmore to Tawe CFMP (October 2007)

3.5 Sewers for Adoption (6th Edition)

Sewers for Adoption (6th Edition) provides guidance to developers undertaking new development when planning, designing and constructing conventional foul and surface water gravity sewers, lateral drains and pumping stations intended for adoption under an agreement made in accordance with Section 104 of the Water Industry Act (1991). The developer is recommended to consult the Dwr Cymru Welsh Water (DCWW) and the Local Drainage Authority (LDA) Engineers at the earliest opportunity before a planning application has been made, so that drainage arrangements can be agreed.

4 The Study Area

Rhondda Cynon Taf CBC is located within South Wales and predominantly set within valleys that drain the Brecon Beacons in the north of the study area. The administrative area is approximately 424 km^2 (inclusive of the area within the Brecon Beacons) and is a mixture of urban, but predominantly rural, land use, with main settlements located within the valley location.

The main urban settlements within the administrative area of Rhondda Cynon Taf are Aberdare, Llantrisant, Mountain Ash, Pontypridd, Porth, Tonypandy and Treorchy. There are also a number of smaller settlements within the study area. Figure 1-1 provides an indication of watercourses, settlements and infrastructure within the study area.

4.1 Climate

Average annual rainfall exceeds 2,400mm in the upper catchment areas of the Taff and Rhondda and is less than 1,000mm along the lower catchments in the south of the area. The average, annual rainfall is 1,850mm compared to an average for Wales of 1,310mm.[1]

4.2 Watercourse and catchments

Fluvial flooding is the main source of flooding within the study area. The rivers within Rhondda Cynon Taf CBC are not tidally influenced therefore tidal flooding is not considered further within this SFCA as a potential source of flooding.

The study area contains a number of catchments namely the Rhondda, Cynon, Taff, Ely and Ogmore. At least one of the Rhondda Cynon Taf CBC study sites is located in each catchment. The main rivers and catchments are indicated in Figure 1-1 and described below.

4.2.1 The Rhondda Catchment

The Rhondda catchment has an area approximately 103km^2 draining the north-west of the study area. The catchment comprises of three principal tributaries namely the Rhondda Fach, Rhondda Fawr and the Nant Selsig. The River Rhondda is 22km in length from its source (above Blaen Rhondda) to its confluence with the Taff (at Pontypridd) and flows in a north-west to south-east direction. Two of the study sites are located within this catchment, at the top of the Rhondda Fach catchment and at the top of the Rhondda Fawr catchment.

4.2.2 The Cynon Catchment

The Cynon catchment is slightly larger covering an area of 106km^2. The catchment comprises of two principal tributaries including the Afon Dar and the River Aman. This catchment drains the far north and east of the study area from the Beacon Beacons to Abercynon over a length of 19km. There are three of the study sites within this catchment.

4.2.3 The Taff Catchment

The Taff catchment is 527km^2 however the upper and lower reaches extend into other Local Authority districts. Abercynon is located at the confluence between the River Cynon and the River Taff, while a little further downstream at Pontypridd the River Rhondda meets the River Taff. The River Taff then continues south for approximately 5km before it leaves the Rhondda Cynon Taf CBC district. Other tributaries in the catchment include the Taff Fechan, the Taf Fawr, the Bargod Taf, the Nant Clydach and the Cynon.

4.2.4 The Ely Catchment

The Ely catchment is 169km^2 although its lower reaches extend into the City and County of Cardiff and The Vale of Glamorgan Local Authority. The upstream extent of the Ely catchment drains the south-west of the study area. The River Clun, Nant Myddlyn and River Clun are the Ely's principal tributaries.

4.2.5 The Ogmore Catchment

The Ogmore catchment is 167km^2 however only a 5km stretch of the upper most reaches of its tributary, the River Ewenny Fach, is within Rhondda Cynon Taf CBC. The uppermost reaches of the Afon Ogwr Fach form the study area boundary at Gilfach Goch.

4.3 Hydrogeology/Groundwater

The catchments covered are situated within the South Wales Coalfield Basin, a large east-trending synclinal-structural fold. The lower unit (Millstone Grit) is overlain by coal-bearing mudstones and sandstones (Coal Measures) of late Carboniferous age that occupy the centre of the County, and comprise the South Wales Coalfield. In the later Carboniferous a period of folding and faulting culminated in the uplift of the area. This was followed by extensive erosion during the Permian and early Triassic. Sedimentation recommenced in the late Triassic with the deposition Triassic Mudstone, which locally pass laterally into the calcareous sandstones, conglomerates and dolomitic limestones (Triassic Sandstone and Conglomerate). The fluvial rocks of the Triassic are succeeded by Jurassic Limestones and Mudstone which pass into oolitic limestones (Jurassic Oolitic Limestone).[1]

The main aquifers in Rhondda Cynon Taf CBC comprise of bedrock strata of Upper Coal Measures, Carboniferous Limestone, the Upper Old Red Sandstone, the Triassic Marginal Facies and assorted fluvio-glacial drift. Groundwater is abstracted for a variety of uses across Rhondda Cynon Taf CBC including industrial, agricultural, quarrying, golf club irrigation, domestic use and also public water supply. Groundwater also provides important baseflow to the various surface water features in the catchment either via spring discharge along the sides of the respective valleys or direct discharge into the rivers themselves.[1]

Due to the complexity of the bedrock geology across the catchment, there is little information available on the groundwater conditions and flow directions across the catchment. Best available information suggests that groundwater flow is predominantly controlled by the structural dip of the solid geology and or the local surface gradients. In addition, the historic mining activities are believed to affect the "natural" groundwater regime within the Coal Measures strata[1]. As a result of these activities it is possible that groundwater flow moves across catchments but the scale and exact nature of this process is uncertain.

4.4 Overland Flow

Overland flow results from rainfall that fails to infiltrate the surface and flows along the ground. Surface water flooding is likely to occur at the base of hills, escarpments and/or low points in terrain. As the topography of the Rhondda Cynon Taf CBC is predominately steep sided valleys with solid geology and impermeable soils overland flow is exacerbated.

Surface water flooding also occurs when natural and surface water drainage systems are unable to accommodate surface water runoff. There is limited recorded information available about flooding from this source. Anecdotal evidence from the Environment Agency suggests that this is a problem across the study area. Details from the flood event in 1979 identified that surface water runoff was responsible for flooding in Robertstown (Aberdare), Fernhill and Hirwaun[1]. In addition, in 1998 “minor” flooding occurred at Hirwaun, Robertstown, Abercynon and Mountain Ash and surface water was highlighted as a key contributor[1]. There is also an appreciated risk due to “sheeting” runoff from agricultural fields within the upper valley areas which results from the removal of vegetation which would normally act as a natural control feature holding back the surface water. It is understood that the lead in time for flood warning and response to these areas is estimated to be less than 2 hours.

4.5 Sewers

Catchment wide data on areas at risk from surface water flooding have been sought from DCWW, the sewerage undertaker. However, it should be noted that the nature of such incidents largely depends on a combination of local conditions at the time of individual storm events (e.g. individual blocked drains; frequency of maintenance, time lapsed since last maintenance) and it is therefore difficult to estimate the number of properties at risk from sewer flooding at any one time.

The majority of modern sewers are built to the guidelines within “Sewers for Adoption” (WRC, 2006). As a minimum, storm water sewers have historically been designed to manage runoff predominantly from the 1 in 30 year storm event. Therefore, it is likely that the majority of existing storm water sewer systems will surcharge to some degree during storm events with a return period greater than 30 years which could in turn cause flooding of property and land both from surface water but also foul water from combined sewer systems.

In addition, as flood risk has increased in importance within planning policy, a disparity has emerged between the design standard of conventional sewer systems (1 in 30 year) and the typical Land Drainage Act design standard flood (1 in 100 year) or the latest TAN15 guidance (1 in 1000 year). This results in drainage inadequacies for the flood return period developments need to consider, often resulting in potential flood risk from surface water/combined sewer systems.

Furthermore, older sewer systems were often constructed without consideration of a design standard and may in some areas (served by Victorian sewers) have an effective design standard of less than 30 years. In addition, development beyond the original design capacity of the sewer resulting from town and village expansion can result in the system being overloaded, reducing the effective design standard of systems in central urban areas.

It is therefore important to understand where the sewer system is restricted in capacity by considering where historical sewer flooding has occurred and where sewer flooding is considered to be higher risk.

However, at the time of writing there has been no available data from DCWW and therefore anecdotal evidence has been used to evaluate the sewer flood risk to each strategic development site.

4.6 Artificial Sources

Artificial flood sources within the scope of this report will include reservoirs and any raised channels, canals or storage features such as ponds and lagoons. These will be evaluated on a site specific basis.

4.7 Climate Change

As highlighted in TAN15, the UK Climate Impacts Programme (UKCIP02) climate change scenarios for the UK suggest that winters will become wetter by as much as 20% by 2050. Rainfall patterns are also predicted to change, with summers and autumn becoming much drier, but the number of rain-days and average intensity of rainfall is expected to increase.

Consequently, the future climate change scenario will mean that the risk of flooding from fluvial, groundwater and overland flow sources will increase during the winter months, whilst increased rainfall intensity means an increased potential for flooding from overland flow and fluvial flooding during the summer months. Impermeable catchments dominated by clay soils and urban areas will experience the greatest increase in flood risk.

The effects of climate change will also place additional demand on existing infrastructure systems. The implications of climate change forecasts will increase the pressure on existing sewer systems reducing their design standard. It is possible that without infrastructure investment or a reduction in the volume and rate of storm water entering the sewer system, an increase in the average intensity of rainfall may result in a higher number of properties suffering from both internal and external flooding from surcharged sewers.

WAG, in consultation with the Environment Agency, is potentially amending the guidance with regards to development life and climate change and the extreme fluvial flood level. It is proposed that climate change for commercial and industrial development should be calculated over a 60 year development life and that climate change on housing developments should be calculated over an 80 year development life. In addition, it is proposed that climate change should be routinely added to the extreme fluvial flood levels.

It can be expected that large areas that are currently within the 1000 year flood outline will be within the 100 year flood outline in the future and this should be evaluated when reviewing development. Where detailed flood modelling is not available an estimate as to the affects of climate change can be obtained by basic flow inference (i.e. adding 20% to 100 year flow calculations and compare to existing 1000 year figures. If these values are similar then the 100 year flood outline with climate change will be close to the current 1 in 1000 year flood outline).

In the evaluation of flood risk at the study sites the principal data utilised is the Environment Agency flood zones. Table 4-1 below identifies the return periods that each site has been evaluated against.

4.8 Bridge and Culvert Design

It is Environment Agency best practice that structures should be located adjacent to and not above a culvert. The foundations of any structure should be, where appropriate, taken down to below the invert of the culvert or outside the zone of influence. The extent of any easement above

the culvert should be maximised as it may need to be repaired, replaced or up-rated in the future. There is also the need to maintain an overland flow route if the culvert is blocked or its capacity exceeded.

It should be noted that the responsibility for the maintenance of the culvert, within the boundaries of the site, lies solely with the landowner as the riparian owner. Any damages caused by the failure to maintain, may leave the riparian owner liable to summary action to recover those damages, should a third party be affected. It is therefore recommended by the Environment Agency that a development free buffer zone i.e. open space, is provided and that the culvert is situated within land under public ownership. It should be noted that the maintenance of the culvert by an individual would not normally be acceptable to the Environment Agency. It is recommended that:

- A full risk management strategy be undertaken, and agreed with Rhondda Cynon Taf CBC with the party responsible for the maintenance and management of the culvert and any associated structures;
- The exact location of the culvert must be established prior to a formal layout being proposed.

The management strategy must cover all information and agreements to cover all risks associated with such a culvert, with special attention being paid to the following:

- Agreements for the maintenance in perpetuity of the culvert;
- Structural failure of the culvert;
- Blockages within the culvert.

Table 4-1: The Environment Agency Hydraulic Modelling and Climate Change Evaluation

Study Sites		Q_{100} (m^3/s) (1 in 100 year flood flow)	Q_{100} plus climate change	Q_{1000} (m^3/s)(1 in 1000 year flood flow)	Q_{1000} plus Climate Change (m^3/s)
1	Maerdy Colliery	EA Flood Zone 3	No	EA Flood Zone 2 & DAM C2	No
2	Fernhill Colliery	EA Flood Zone 3 & EA HEC-RAS Model	EA HEC-RAS	EA Flood Zone 2 & DAM C2	No
3	Phurnacite	EA Flood Zone 3 & EA HEC-RAS Model	EA HEC-RAS	EA Flood Zone 2 & DAM C2	No
4	Robertstown / Abernant	EA Flood Zone 3 & EA HEC-RAS Model	EA HEC-RAS	EA Flood Zone 2 & DAM C2	No
5	Hirwaun / Penywaun.	EA Flood Zone 3 & EA HEC-RAS Model	No	EA Flood Zone 2 & DAM C2	No
6	Cwm Colliery	EA Flood Zone 3 & EA HEC-RAS Model	EA HEC RAS	EA Flood Zone 2 & DAM C2	No
7	Mwyndy / Talbot Green	EA Flood Zone 3 & EA MIKE 11 Model	EA MIKE 11	EA Flood Zone 2 & DAM C2	No
8	Llanilid OCCS	EA Flood Zone 3	No	EA Flood Zone 2 & DAM C2	No
9	Treforest Industrial Estate	EA ISIS Model	EA ISIS Model	EA ISIS Model	No

(refer to the glossary for explanation of terminology)

Figure 4-1: Overview of Major Strategic Water Features Within the Study Area

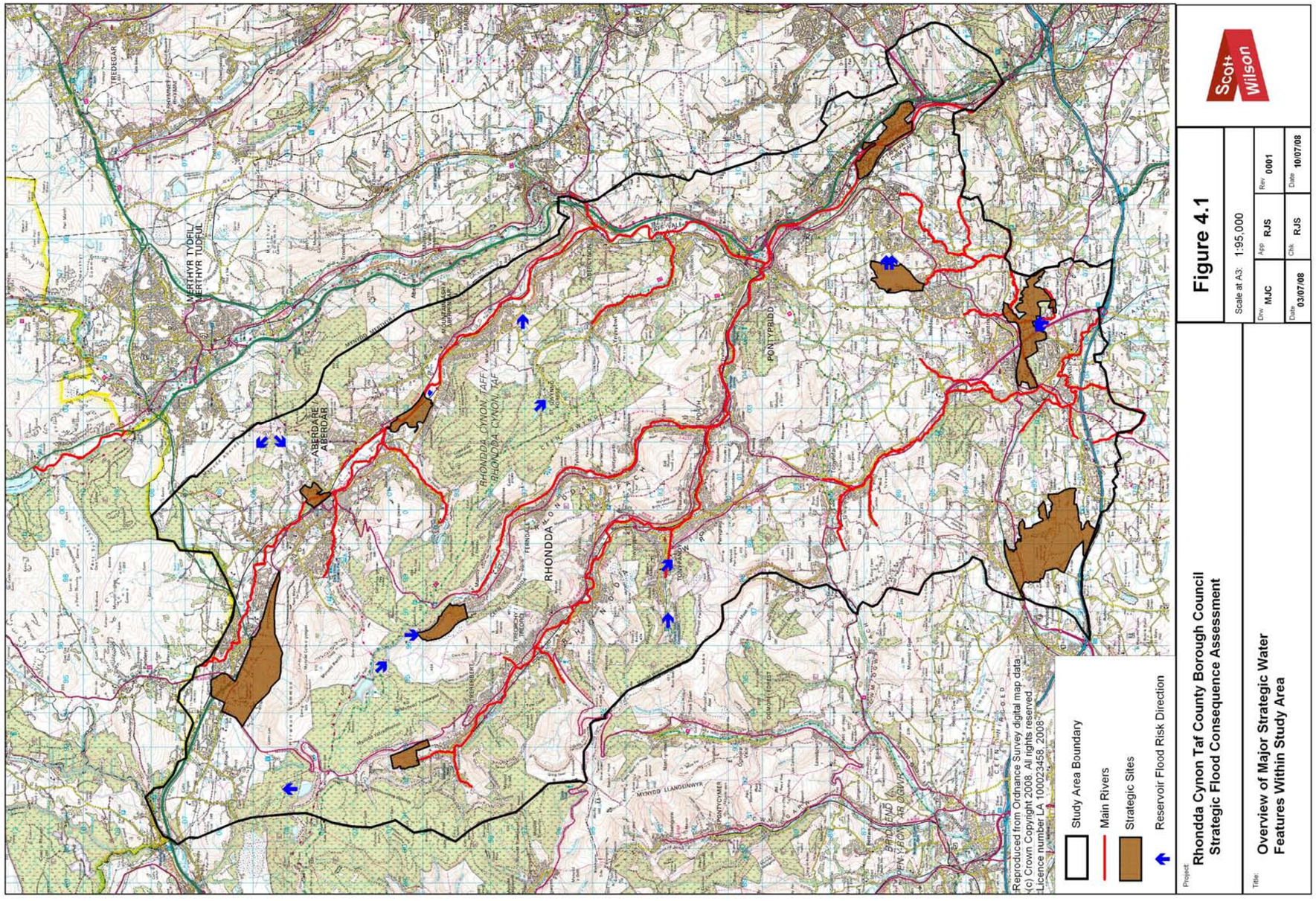


Figure 4-2: Environment Agency Flood Warning Areas within the Study Area