Callander
Strategic Flood Risk Assessment

Report to:	Loch Lomond & the Trossachs National Park Authority
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1 Executive Summary

Loch Lomond and The Trossachs National Park, in their role as a statutory planning authority, commissioned a Strategic Flood Risk Assessment (SFRA) for the settlement of Callander under the guidance of both national and local planning policies. The aim of the report is to inform future planning decisions, in conjunction with other spatial plans, by providing a better and more robust evidence base on flood risk within the settlement. The approach of the SFRA was to characterise flood risk throughout the settlement of Callander, with particular focus on thirteen potential development sites identified by the Local Plan.

The SFRA has three primary components, the SFRA report, the zoning maps and the database which was compiled to characterise historic flood activity in the settlement. The SFRA report is designed to be a 'living document' and the database and associated mapping to be readily updated and accessible , with the potential to be expanded to cover any scale of area.

There are many different sources of information on flooding in Callander, and this study has highlighted the importance of considering a wide range of data sources. Formal floods reports, which often include outputs from hydraulic modelling, help to provide highly detailed quantifications of predicted flood extents from main watercourses. Hydrometric records and local witness accounts and photographs are necessary to inform and verify modelling outputs. Information from local sources is particularly critical to identify gaps, and can, for example, highlight where small watercourses or drains cause a localised flood problem not picked up by broader scale flood studies.

At the foundation of this SFRA is a database of various types of floods information for Callander, managed in spreadsheet format and visualised as maps created using a Geographical Information System (GIS). The database builds a comprehensive picture of previous recorded flood events together with predicted flood events generated by modelling. The database also highlights where works have been undertaken which reduce the risk of similar flooding occurring in the future. As well as informing longer term planning decisions, the database provides case officers with background information when considering site-specific development proposals and scoping out what a detailed FRA, if it is required, should consider. This approach also allows 'hot spots' for flood activity and gaps in the information record to be highlighted, which will help to streamline future development planning and flood studies. Like the SFRA report, the database has been designed in such a way that it can be readily updated as more information becomes available, or expanded to include a wider geographic area, such as a catchment or at a National Park scale.

Flood risks in Callander have been characterised through reviewing previous studies, compiling the database and mapping the results. The most significant source of flood risk in Callander is the River Teith, and this source is by far the best understood and most predictable. A critical outcome of this assessment is the need for a much greater understanding of flooding associated with small watercourses, storm drains and overland flow which can be highly localised, and often unpredictable. This is where local knowledge becomes critical. For this reason it is recommended that community surveys are carried out after floods and formally entered in the database. This exercise is currently coordinated within Callander by the Community Council and could readily be rolled out across the wider National Park when considering a park wide SFRA. In this case it could potentially be coordinated through the Association of Community Councils for the National Park.

The settlement has been zoned according to potential sources of flooding, relative flood risk and by potential flood management strategies. The risks in each zone within the town have not been categorised according to statistical probabilities, as there are too many uncertainties associated with this, which may make the outcomes misleading. Rather, zones were categorised by the need for a site-specific flood risk assessment prior to future development, which would help to eliminate some of the more localised uncertainties. The maps produced for the report are generalised and it is important that they are interpreted as indicative guidance for planning purposes only. When a development proposal emerges, the database then provides the individual case officer with a range of background information on the vulnerability of the development site to flooding and from what sources, to help inform the scope of a development-specific Flood Risk Assessment (FRA), linked to the planning application.

Guidance has been provided to assist the planning process in protecting more vulnerable residents and properties, such as schools and hospitals, whilst enabling sustainable development. Potential flood mitigation measures have been put forward at the settlement level, such as land-raising and management of channel structures. However, it is recommended that the most efficient and sustainable mitigation would be achieved through a strategic distribution of a range of sustainable flood management techniques throughout the whole catchment for instance, wetland restoration, riparian native species tree planting and reservoir management.

Supplementary Planning Guidance

Looking to the future sections 2 and 6 of this report, combined with the A3 maps and potential development site profiles in the appendices will form the basis of future Supplementary Planning Guidance on Strategic Flood Risk Assessment in the settlement of Callander.

2 Report Update (April 2011)

Since the Callander Strategic Flood Risk Assessment database was created in August 2010, seven new incidents of flooding have been reported to Stirling Council. The majority of the incidents recorded by Stirling Council have been recurrences of flooding at locations where flooding is already known to be an issue. Many of the incidents were also caused by the same specific problems, such as clogged culverts, which have been highlighted in the past. The following is designed to provide a short summary of the cases of flooding that have been reported to the Council since the original report was produced.

The first two incidents reported to Stirling Council took place on 29th September 2010. During this event, flooding was reported at 28A Main Street where the gully became blocked and resulted in the pavement and road being flooded to a depth of approximately 10cm. Although there are no records of this problem occurring before September 2010, this problem was again reported on the 22nd of October 2010 when the blocked gully led to flooding on Main Street.

Flooding is also known to have occurred on the 29th September 2010 at 25 Venachar Avenue when an inadequate field drain behind the house lead to water running into the garden, although the property itself was not affected. This is the first incident of flooding at Venachar Avenue that is known to have been reported to Stirling Council.

On the 8th of October 2010, a resident of Lagrannoch Drive reported a case of flooding on the A84 at the entrance to the Lagrannoch housing estate. It was noted that this is a persistent problem that occurs every time it rains. It is thought that this flooding issue must be related to inadequate or blocked road drains.

A further flooding incident was reported to Stirling Council on the 11th of November when a blocked gully resulted in flooding of approximately 15cm on one side of Castle Grove on the Main A81. It was noted that this problem was resolved by clearing the gully. Although flooding at Castle Grove has been previously reported to Stirling Council on the 1st November 2005, it is not thought that the two incidents are related, as the previous flooding was caused by a blocked culvert in a garden which resulted in flooding to a neighbouring garden.

A heavy rainfall event in Callander resulted in two incidents of flooding being reported to Stirling Council on the 15th January 2011. The first resulted in the A81 being closed both ways between the A84 and the A873 due to severe flooding on Mollands Road outside McLaren High School. It is thought that this flooding was caused by blocked/inadequate drains. Flooding has occurred on Bridge Street, adjacent to Mollands Road, on numerous occasions as a result of blocked drains and also flooding from the River Teith.

The second flooding incident on the 15th January 2011 took place at Culdaremore on the Ancaster Road when the culvert on the Burn on Ancaster Road became blocked and overflowed onto the Ancaster Road. Blocked ditches and culverts are known to have resulted in flooding along the Ancaster Road on many previous occasions.

As a result of the new flooding reports outlined above, the Callander SFRA database has been updated, and it was also deemed necessary to slightly alter the flood source type map (figure 5) to include the risk of flooding to The Mollands from overland flow and inadequate drainage from the fields behind the housing estate and the A81 to the front of the housing estate. It was also deemed necessary to alter the Flood Risk Assessment zoning map (figure 15) to reflect the level of flood risk posed to The Mollands housing estate.

3 Introduction

3.1 Purpose of the Callander Strategic Flood Risk Assessment and Management Guidance

The purpose of this document is to provide a Strategic Flood Risk Assessment (SFRA) of the settlement of Callander as part of establishing a robust evidence base for planning decision-making. The current Finalised Draft Local Plan contains development site allocations, and includes both new and legacy sites. By progressing a Strategic Flood Risk Assessment of the settlement a better understanding of the development constraints and limitations imposed by flood risk can be balanced alongside an appreciation of the specific issues that need to be addressed for sustainable development to proceed on the ground.

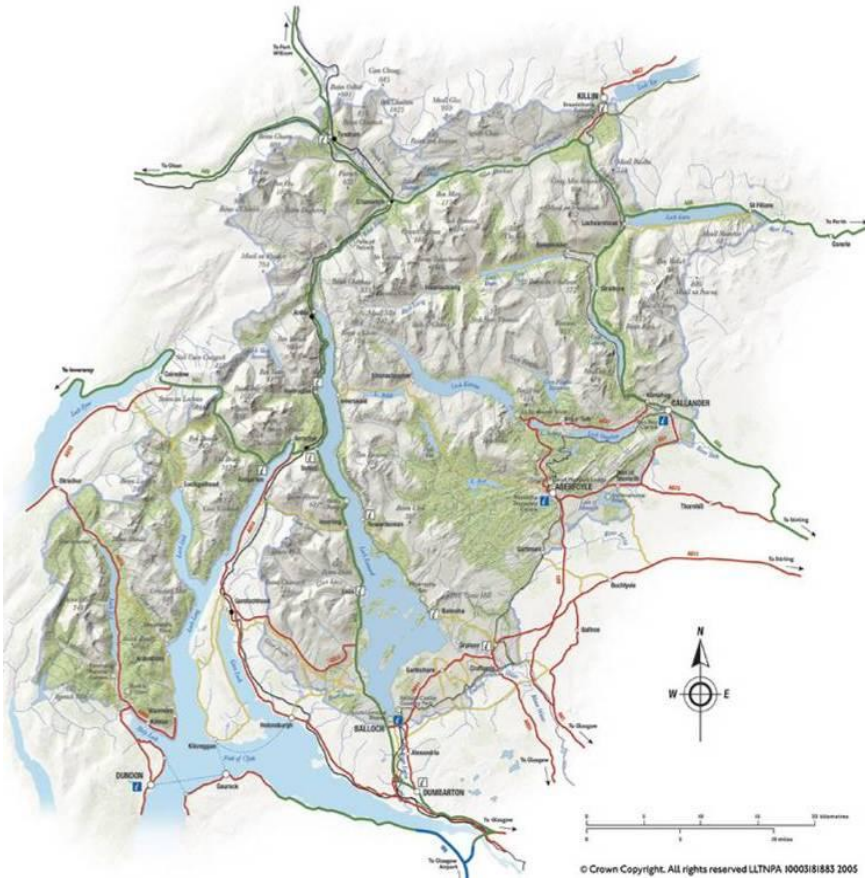
This SFRA of the settlement of Callander has therefore been commissioned as a core part of the development plan process and in direct response to comments received on the Draft Local Plan and the issues experienced by planning officers. It has been prepared at a settlement rather than regional level, and its purpose is to enhance the evidence base to support the implementation of the emerging Local Plan and to provide guidance for the determination of planning applications. As such it is a pilot piece of work for the Authority and its partners which will provide a basis for subsequently rolling the process out at a regional level across the entire National Park and establishing similar assessments for other settlements affected by flooding.

3.2 Document structure

This SFRA document is structured in 5 main sections:

Introduction	Purpose of this SFRA for the National Park, an overview of future development in the area and an explanation of how to use this 'living' guidance
Strategic Flood Risk Assessment Approach and Policy Framework	A summary of best practice guidance for the National Park and an overview of the national and local policy on FRA
Flood Information for Callander	A review of the range of information currently available for Loch Lomond & the Trossachs National Park and the settlement of Callander
Flood Risk in Callander	An appraisal of the different types of flooding and the impacts on the settlement of Callander
Strategic Flood Risk Planning and Management for Callander	An assessment of flood vulnerability and flood risk zoning of Callander and the proposed Development Sites in the current Local Plan. An overview of potential local community actions to help characterise flood risk, settlement based and catchment based flood risk management and mitigation and linkages with other Spatial Plans
Conclusions & Recommendations	Final conclusions and guidance on next steps

3.3 Overview



Loch Lomond & The Trossachs National Park was established in 2002 under the National Parks (Scotland) Act 2000. It extends for 1865 square kilometres, is home to over 15,600 residents and is situated immediately to the north west of the city of Glasgow and to the west of Stirling. The Park contains many inland water bodies of high environmental quality and also has a marine interface with 63 kilometres of Argyll coastline.

Flood management is a significant issue for many areas of Loch Lomond & The Trossachs National Park, and causes disruption to communication and transport routes and impacts on a number of communities and more remote individual properties. Given that predicted climate change is expected to result in increased rainfall in central Scotland and a rise in sea levels, these existing flooding pressures are expected to increase.

Loch Lomond & The Trossachs National Park Authority is not the Responsible Authority for flooding for the Park area but is the statutory planning authority with full responsibility for the preparation and delivery of the Local Plan plus development management decision making. The role of Responsible Authority lies with the local councils covering the National Park; namely Argyll & Bute Council, Stirling Council, West Dunbartonshire Council and Perth & Kinross Council. In the case of Callander, Stirling Council is the Responsible Authority.

When the National Park was established in 2002 it immediately became the statutory planning authority and inherited the land use planning policies and proposals set out in a series of 9 different Local and Structure Plans covering the area. Although an early priority was to establish

the Park's own land use planning policies, a greater priority for the authority was to produce the first National Park Plan, a strategic management document aimed at securing positive change over a five year period by leading, coordinating and integrating the actions of everyone involved in the management of the Park. In the meantime planning decisions were based on the inherited land use policies and proposals.

Partly because the Park Authority is not the Responsible Authority for flooding, and also because there is no recognised procedure in Scotland for collating flood information for planning purposes the Local Plan was prepared based on Scottish Environment Protection Agency's (SEPA) indicative flood map information. Meetings were also held with Responsible Authorities for flooding to source local information on specific sites, and site visits were undertaken.

3.4 Future Development in Loch Lomond & the Trossachs National Park

National Parks throughout the world are very different and are categorised as such. Loch Lomond & the Trossachs is an IUCN Category 5 National Park which is *'an area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinctive character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area'.* Development is anticipated within a Category 5 National Park and therefore a key aspect of the Park's management is to ensure this is undertaken in the most appropriate way possible.

The Loch Lomond & The Trossachs National Park Authority is responsible for ensuring that new development in the Park area helps to deliver the four aims of the Park, as set out in the National Parks (Scotland) Act 2000;

- *To conserve and enhance the natural and cultural heritage of the area*
- *To promote sustainable use of the natural resources of the area*
- *To promote understanding and enjoyment (including enjoyment in the form of recreation) of the special qualities of the area by the public, and*
- *To promote sustainable economic and social development of the area's communities*

In so doing if there is a conflict between the first aim – the conservation and enhancement of the natural and cultural heritage – and any other of the National Park aims, the Authority must give greater weight to the first aim (The Sandford Principle).

The Finalised Draft Local Plan therefore provides the spatial framework for the development and use of land in the Park. The plan focuses on development that is to be achieved over the next 5 years within a longer term strategic vision.

To achieve this the plan sets out a development strategy and identifies proposed development sites for housing, tourism and recreation, economic development and transport proposals. The development strategy sits alongside a range of important enabling and management policies to guide development to appropriate locations whilst ensuring that the Park's outstanding natural and cultural heritage is safeguarded.

Of specific relevance to this strategic flood risk assessment, Policies ENV 10, 11, 12 , 13, 14 and 15 set out the enabling and management policies relating to the Park's Water Environment and Policies ENV 16 and 17 specifically focus on Sustainable Flood Management (SFM) within the National Park.

Water Environment		
Finalised Draft Local Plan Policies	Policy ENV 10	Protecting the Water Environment
	Policy ENV 11	Connection to Sewerage and Water Supply
	Policy ENV 12	Surface Water Drainage
	Policy ENV 13	River Engineering Works and Culverts
	Policy ENV 14	Marine and Inland Aquaculture
	Policy ENV 15	Development in the Coastal Marine Area
Links to Park Plan Policies	Policy WM1	Safeguarding and Enhancing the Water Environment
	Policy FM1	A Strategic Approach to Fisheries Management
	Policy REC3	Managing Recreation on Water and on the Water's Edge
	Policy LS1	Conserving and Enhancing the Diversity and Quality of the Park's Landscapes
	Policy LS2	Landscape Character
Sustainable Flood Management		
Finalised Draft Local Plan Policies	Policy ENV 16	Development in medium to High Flood Risk Areas
	Policy ENV 17	Natural Flood Management
Links to Park Plan Policies	Policy WM1	Safeguarding and Enhancing the Water Environment
	Policy BD1	Biodiversity Enhancement
	Policy BD2	Integrated Approach to Biodiversity

3.5 Future development in and around the settlement of Callander

Callander is the largest settlement within the National Park having a population in excess of 3,000 residents and it provides a range of services and facilities including a secondary school, medical centre, fire and police stations and a leisure centre. Callander is the main eastern gateway into the National Park and is a popular visitor destination. A large area of the town is designated as a Conservation Area in recognition of its historic and architectural character and the Finalised Draft Local Plan proposes an extension to the Conservation Area Boundary. Callander has experienced significant flooding from both the River Teith and smaller water bodies. Stirling Council is the Responsible Authority and is responding to this. Flooding however could affect future developments in Callander and needs to be considered along with other spatial plans for the area (such as Biodiversity Action Plans or Core Paths Plans).

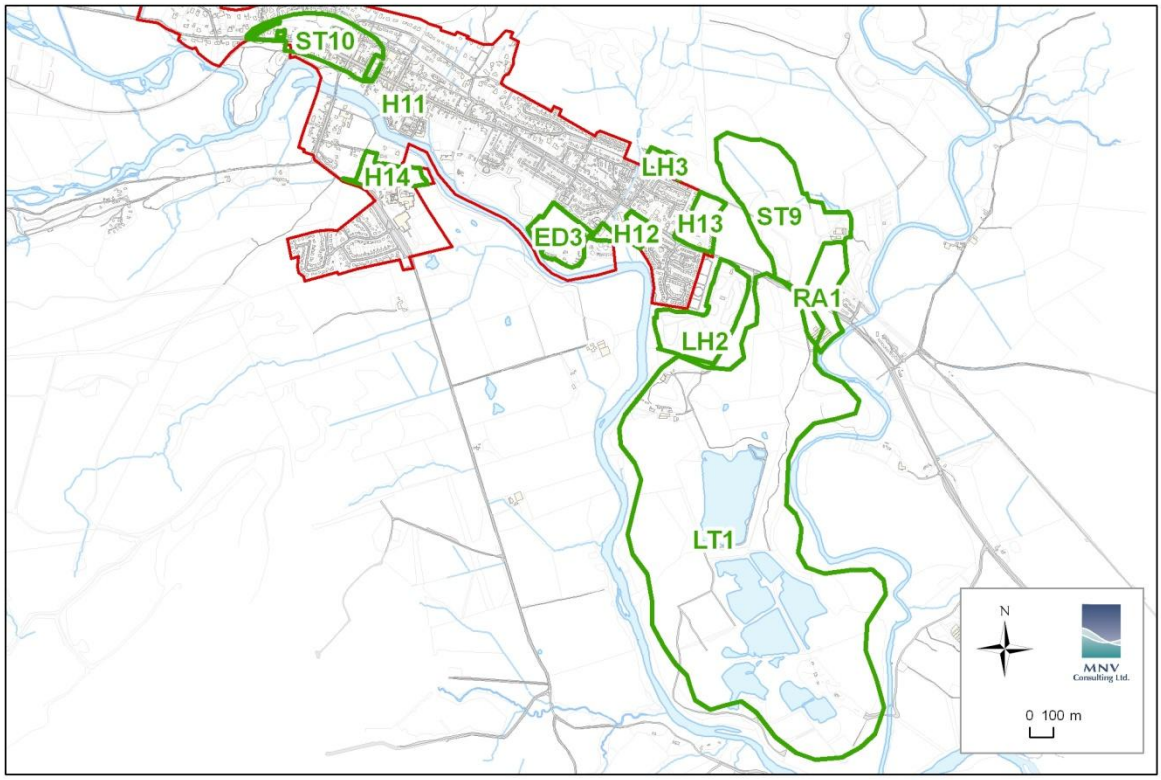
The development strategy for Callander articulated within the Finalised Draft Local Plan (below) clearly establishes that Callander offers a number of development opportunities relating to housing, economic development and sustainable tourism.

Callander Development Strategy
(Source: Finalised Draft Local Plan, Feb 2010)

"A number of allocated housing sites will deliver a range of open market and affordable housing opportunities during the lifetime of the plan. Two sites have been identified as potential long term housing sites and other areas of search will be considered as part of Local Plan process. Opportunities exist to consolidate and improve the role of Callander town centre to provide an enhanced visitor experience. Tourism development at Auchenlaich will provide a range of accommodation opportunities including hotel and self catering. Cambusmore is identified as a major long-term tourism opportunity of international significance. Some opportunities remain for further light industry and storage at Lagrannoch. The Callander East Rural Activity Area will be retained to enable expansion of businesses which have outgrown their premises or to develop businesses which suit this semi-rural location. Consultation on the Draft Local Plan highlighted the need to identify additional land for a cemetery* due to the current cemetery nearing capacity. Stirling council is reviewing preferred locations with a proposal near Balvalachlan Farm to the south of Callander being favoured."

*A Pre-Application Consultation notice has now been submitted for this site

The Finalised Draft Local Plan identifies 9 development sites and a further 3 longer term sites within and around the settlement:



FINALISED DRAFT LOCAL PLAN DEVELOPMENT PROPOSAL FOR CALLANDER

Housing
H11 Pearl Street
H12 Stirling Road
H13 Tannochbrae
H14 Churchfields*
H15 Old Telephone Exchange, Station Road

Economic Development
ED3 Lagrannoch*
RA1 Callander East – Rural Activity Area*

Sustainable Tourism
ST9 Auchenlaich*
ST10 Callander Town Centre

Long Term Proposals : Housing
LH2 The Gart Caravan Park
LH3 Lagrannoch Drive (north)

Long Term Proposals Sustainable Tourism
LT1 Cambusmore Callander

* indicates a flooding related development constraint/requirement has been highlighted in the Finalised Draft Local Plan

3.6 Using this document

This document is currently presented as a report setting out the context for and purpose of the SFRA for Callander together with the outputs and implications for the planning process and future development within Callander.

Looking to the future, sections 2 and 6 will combine with the development site profiles and A3 maps contained in the appendices to form the basis of future Supplementary Planning Guidance.

The document is linked to an extensive database of historic flood records and reports which informed the SFRA and which now forms an invaluable resource for case officers dealing with individual planning applications, and which can help inform the requirements that a site-specific FRA will need to consider. The data is historic and by its nature may indicate a risk that is no longer relevant or the risk is at a different level because works have been undertaken to reduce the risk. For this reason it is essential to keep the database up to date and any works which are undertaken to alleviate a flood risk are entered into the database. The database is not provided as an appendix to this report at this stage given various sensitivities associated with the data contained within it. The report does contain recommendations on where this database should be kept and how it should be used, plus the importance of keeping it up to date.

Flooding is an emotive subject and much of the mapping and material contained in the database which supports this SFRA does directly relate to private properties. In addition, the database refers to reports prepared for specific purposes which have licensing restrictions on the data contained within these reports / studies. For this reason the database should not be made publicly available but held as a resource on the National Park Authority's system, whereby information could be made available on request. The database should be maintained with close collaboration with Stirling Council (the Responsible Authority for flooding), who also maintain a GIS database containing flood information. It should be used as a resource by case officers to help inform development planning decision making, and be made available to partner agencies such as SEPA.

One of the key conclusions from this SFRA report is the identification of zones in and around Callander where a detailed FRA should be undertaken if a development proposal is put forward. These maps are not suggesting everywhere within each zone is or is not at risk of flooding and must not be interpreted in this way. The zones are purely established to help guide the development management process by indicating whether a site-specific Flood Risk Assessment is recommended based on historic flooding activity, previous studies and/or inclusion in the SEPA 0.5% indicative maps.

The report contains a number of maps and for ease a single legend has been provided at the back of the report (section 9.3) as a fold out key for all maps (similar to the key provided within the Finalised Draft Local Plan).

3.7 A Living Document

The Callander Strategic Flood Risk Assessment has been developed building on existing knowledge of flood risk within the settlement and the wider catchment. Stirling Council has a duty to maintain flood records under the 1997 Flood Prevention and Land Drainage (Scotland) Act. As part of the Flood Risk Management (Scotland) Act of 2009, SEPA also have a duty to develop a national floods database. Therefore, both Stirling Council and SEPA will be regularly reviewing

and updating their flood maps together with collating data on specific flood events at different levels of detail. Equally, the Callander Community Council flood record system will continue to be supplemented as events take place and local residents and property owners submit formal records of the flood sources, impacts and pathways. The database which has been generated within this SFRA process is a living document and a mechanism should be established for collating new data and information as it emerges, and then periodically updating the database. This highly detailed and localised database could then be used to inform SEPA's national floods database, which will be more generalised by nature.

This will collectively provide a basis for continuous improvement of current knowledge of flood risk within Callander and will invariably alter predicted flood extents through time. The flood extents could also change over time due to factors such as updated flood magnitudes of given return periods, climate change and catchment management.

Since the Local Plan process began a number of the sites identified in Callander have already been the subject of planning applications / approvals. This is partly because they are legacy sites from previous plans. Equally, some new sites identified within the plan have also been the subject of planning applications, including 'windfall' sites where an opportunity has newly arisen for development.

It is imperative that this SFRA is adopted as a living document and is reviewed regularly in the light of emerging policy directives, new planning applications and an improving knowledge base and understanding of flood risk within the settlement of Callander. Equally if and when a strategic flood risk assessment is progressed for the wider catchment and/or the entire National Park as part of the development planning process this settlement based SFRA needs to be reviewed.

The SFRA has been built using a database of historic flood information and this must be maintained and periodically updated if its full potential as a planning tool is to be realised.

4 Strategic Flood Risk Assessment Approach & Policy Framework

4.1 Introduction

The overall aim of a SFRA is to aid the planning process by allocating different types of developments on a regional basis to the areas with an appropriate level of flood risk. SFRAs are intended to be part of the planning process so they must be prepared alongside other spatial plans for the area. This avoids inappropriate development in areas at risk of flooding, reduces future flood risk to people and properties and ensures that land allocated for flood management remains un-developed.

For Callander a SFRA needs to take a slightly different approach because it is for a single settlement rather than a region, and development areas have already been identified in the Local Plan. Therefore the usual process of going through a sequential test and an exception test are not appropriate. However if the National Park were to adopt SFRA on a Park wide scale then these tests should be carried out.

A SFRA has three main aims:

1. appraising the risk - identify land at risk from different types of flooding;
2. managing the risk – allocating appropriate types of development to areas with different levels of flood risk and taking climate change into account, as well as identifying mitigation measures;
3. reducing the risk – safeguarding land from development which is needed for current and future flood management.

This is therefore a risk based approach which follows the sequence source-pathways-receptors. In this context the sources are created by inappropriate developments either on sites which are at risk of flooding or which increase the flood risk elsewhere. The pathways take into account flood water management through SUDS, existing flood defences and the routes flood water will take from all potential sources. The receptors are the people, property and infrastructure which could be flooded by inappropriate development. The risk based approach therefore relies on allocating certain types of developments, which have a known vulnerability to flooding, to specific sites in the area which have a known risk of flooding.

SFRA is not intended as a detailed determination of the risk of flooding to a site. When a planning application is made the SFRA will enable the planning authority to give the developer guidance on whether a site-specific FRA is needed, and where this is the case, the types of issues that need to be appraised.

It is important to define some key flood risk terms before interpreting the SFRA:

- **Flooding** – the temporary covering by water from any source of land not normally covered by water
- **Hazard** – potential for harm e.g. presence of a watercourse next to the development
- **Probability** – statistical likelihood of harm e.g. return periods
- **Risk** – a combination of the probability of a flood and of the potential adverse consequences associated with a flood
- **Resilience / vulnerability** – capacity / incapacity to anticipate withstand and recover from harm

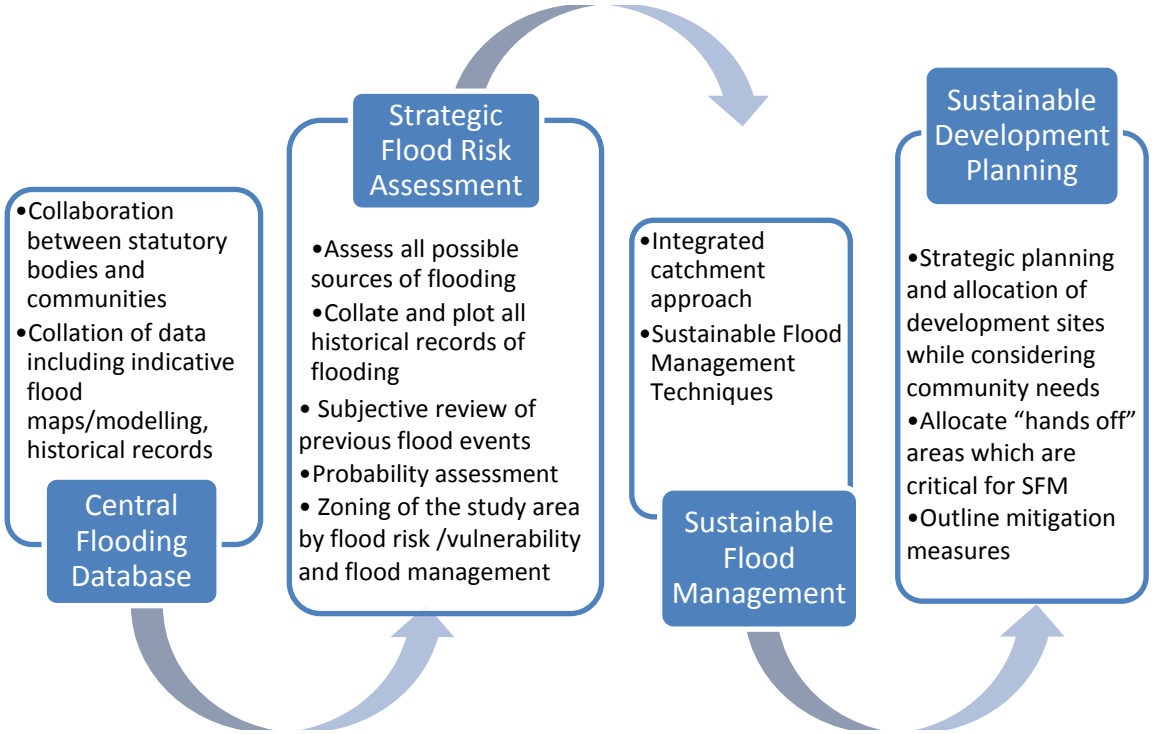


Figure 1 Diagrammatic structure of a SFRA

Typically a central flooding database is collated, if it does not already exist, and is then used as the basis for understanding previous flood events in the area and to better understand sources and probability. This then allows the study area to be separated into different zones both according to their flood risk and vulnerability and in terms of flood management, for instance:

Zonation according to flood risk and vulnerability:
- essential infrastructure (roads, power station)
- highly vulnerable (emergency services stations)
- more vulnerable (housing)
- less vulnerable (industrial units)
- water compatible sites (flood defences, water recreation, nature conservation sites)

Zonation in terms of flood management areas:
- Awareness – public information, flood warning
- Avoidance – flood management areas – storage or conveyance (hands off areas unsuitable for development)
- Alleviation – remaining areas zoned according to mitigation measures e.g. runoff reduction, drainage management, flood storage, re-routing, land raising, flood defences
- Resilience measures – flood gates, evacuation plans etc

When these different zones are superimposed long-term strategic planning decisions can be made on the most appropriate use of different parcels of land for different purposes from a flood risk perspective and also such decisions can be more effectively linked in to other spatial planning processes. This ensures a much more integrated approach to managing the catchment can be progressed with 'hands off' flood management areas clearly defined alongside land capable of alleviating flood risk.

4.2 National Policy for assessing flood risk

The national policy for assessing flood risk is set out in the Scottish Planning Policy (SPP)[1]. Since 2008 the Scottish Government is seeking to reduce the number of planning advice notes available, with a number being revoked in recent months. Planning Advice Note 69[2] (PAN 69) on Planning and Building Standards advice on Flooding, 2004 is still valid. SPP requires the planning process for new developments to take the risk of flooding fully into account. In general the policy suggests that planning permission should not be granted for new or further building in areas liable to flood, but at a local level and in exceptional circumstances this may be permitted. Planning authorities also have a responsibility for allocating sufficient land for development. For this to happen an appropriate flood risk assessment would be necessary and for this to be reviewed (in the case of Callander) by SEPA and Stirling Council as well as the NPA.

When assessing flood risk the potential effects of development upon the localised flood risk arising from alterations to site drainage and rainfall runoff characteristics need to be taken into account.

There is no specific guidance at this point in time on the process to be adopted in preparing a Strategic Flood Risk Assessment in Scotland. In England Planning Policy Statement 25[3] (PPS25) sets out some guidance for preparing SFRAs, and establishes that the overall aim of a SFRA is to aid the planning process by allocating different types of developments on a regional basis to the areas with an appropriate level of flood risk. They are intended as part of the planning process and ideally they should be prepared alongside and fully integrate with other spatial plans for the area and form the basis to defining future development sites for different types of development. In the absence of Scottish guidance for preparing a SFRA, the process adopted for the Callander SFRA has taken cognisance of material contained in PPS25. However it should be noted that this SFRA has been undertaken at a settlement level rather than a catchment or regional level, albeit this will hopefully be progressed in due course.

The SFRA for Callander has also been prepared after development sites have been identified through the Local Plan process and assesses those contained within the Finalised Draft Local Plan 2010.

4.3 Local Planning Policy for assessing flood risk

In Scotland there is no single authority charged with responsibility for flooding. At a national level SEPA has a duty to provide flood advice, as well as duties under the Flood Risk Management (Scotland) Act 2009 as the flood warning authority and the competent authority to deliver a National Flood Risk Assessment, Flood Hazard and Risk Maps and National Flood Management Plans in conjunction with the other responsible authorities. Local Authorities are responsible for maintaining flooding records, providing supporting information on flood risk to SEPA, and for preparing 'local flood risk management plans'. . In the National Park this is further complicated as unlike other areas of Scotland where the Council is both the Responsible Authority for flooding and the planning authority, this latter role is performed by the NPA.

Under the new Flood Risk Management (Scotland) Act 2009 responsibilities at a national level and specifically in the Callander area are shown in Table 1.

[1] http://www.scotland.gov.uk/Topics/Built-Environment/planning/National-Planning-Policy/newSPP
[2] http://www.scotland.gov.uk/Topics/Built-Environment/planning/publications/pans
[3] http://www.communities.gov.uk/planningandbuilding/planning/planningpolicyguidance/planningpolicystatements/planningpolicystatements/

Table 1 Responsibilities for flooding in Callander

Who	Responsibility
Land and property owners	Responsibility for flood prevention and land drainage on their own property. This includes allowing unrestricted flow of water through their property and keeping watercourse free of obstructions that are liable to pose a risk of flooding. Dam and reservoir owners have a strict liability for flooding caused by failure of dams or embankments.
SEPA[4]	SEPA is the competent authority for flood risk management at a national level with responsibility for producing catchment flood risk management plans for Scotland by December 2015 in conjunction with other competent authorities. Other responsibilities include preparing a national flood risk assessment by December 2011; preparing national flood risk and hazard maps by December 2013; when requested by a NPA as planning authority give advice on flood risk in the NP; disseminate warnings in relation to flooding and be enforcement authority under the Reservoirs Act. SEPA operate a national network of flood monitoring stations[5].
Stirling Council – as Responsible Authority for flooding	Responsible for periodically assessing relevant bodies of water to ascertain whether its condition gives rise to a risk of flooding. Where a flood risk is perceived and works would substantially reduce the risk, a schedule of work must be prepared, publicised and implemented. Producing flood reports. Responsible for providing SEPA with information necessary for them to carry out their responsibilities and to work with other local authorities to produce local flood risk management plans.
Stirling Council – as building control authority	Responsible for enforcing technical construction standards relating to flood risk management.
Stirling Council – as Roads Authority	Responsible for maintaining road drainage systems and clearing roads of flooding.
Scottish Water	Must identify areas where a flood is likely to originate from a sewerage system or combined sewerage system which includes storm water.
LL&TTNPA – as planning authority	Under Scottish Planning Policy (SPP) the NPA's planning process for new development must account for the risk of flooding and generally should not agree to further building in areas liable to flood, and can only do so in exceptional circumstances after an appropriate FRA has been prepared and reviewed by SEPA and SC, and flood alleviation measures are considered. As a planning authority the NPA also has a responsibility to allocate sufficient land for development.

[4] http://www.sepa.org.uk/flooding.aspx
[5] http://www.sepa.org.uk/water/river_levels.aspx

From a Local Plan perspective, the current Finalised Draft Local Plan for Loch Lomond & the Trossachs National Park[6] sets out the policy for sustainable flood management in Policy ENV 16 Development in Medium to High Flood Risk Areas and Policy ENV 17 Natural Flood Management.

The Policy ENV 16 seeks to direct new development away from 'medium to high' flood risk areas but recognises that many existing settlements are located in such areas, and Callander being a case in point. The policy provides for individual flood risk assessments being undertaken for each development proposal and also recognises that a future Strategic Flood Risk Assessment undertaken for the entire Park will identify further areas additional to those on SEPA's 0.5% flood map. This SFRA for Callander establishes that at a settlement level the SEPA 0.5% map does provide indicative guidance for flood risk linked to the River Teith but there are substantial areas at risk of flooding from other sources such as small watercourses and overland flow.

[6] http://www.lochlomond-trossachs.org/images/stories/Looking%20After/PDF/NPA%20Board/Final%20Local%20Plan%20Doc.pdf

Policy ENV 16 Development in Medium to High Risk Areas

"New development on undeveloped or sparsely developed functional floodplain will not be supported, unless it is demonstrated that the proposed development complies with the Risk Framework as defined in Scottish Planning Policy 7: Planning and Flooding or subsequent national planning guidance[7]. Development in the National Park will not normally be permitted in areas that are:

(a) outwith existing settlements and that have been identified as medium to high flood risk on SEPA's flood map or in areas known to flood frequently that have not been identified by SEPA unless:
   i. the location is essential for operational purposes such as navigation and water-based recreation uses, agriculture, transport or utilities infrastructure;
   ii. an alternative lower risk location is not physically available; and
   iii. a flood risk assessment in compliance with (b) i, ii, iii, and approved by the relevant flooding authority can demonstrate that the risk can be mitigated; and

(b) within existing settlements and that have been identified as medium to high risk on SEPA's flood map or in areas otherwise known to flood frequently unless a flood risk assessment is approved by the relevant flooding authority and can demonstrate that:
   i. the assessment has been developed in consultation with SEPA and complies with SEPA's Technical Flood Risk Guidance;
   ii. the site will not be at risk of flooding; and
   iii. the development will not increase the risk of flooding elsewhere and where land raising is proposed on functional floodplains new development will seek to provide compensatory flood storage to ensure that the lost storage volume is replaced in full. Provision of like-for-like replacement storage will be the preferred method."

Policy ENV17 Natural Flood Management

"Flood prevention schemes will be expected to adopt a natural flood management approach which involves the restoration of riparian areas of water bodies, wetlands and floodplains to slow water flow. Traditional hard engineering approaches for flood prevention will only be supported where it can be demonstrated that a natural flood management approach is not feasible and where there will be minimal adverse effects on the natural, cultural and historic environment."

[7] In 2010 Scottish Planning Policy 7 was superseded by Scottish Planning Policy

5 Flood Information for Callander

5.1 Overview

Central to any Strategic Flood Risk Assessment is a comprehensive data collection process, followed by a critical review and gap analysis of the data. For the Callander SFRA, information was sourced from Loch Lomond & the Trossachs National Park (LLTNP), Stirling Council, SEPA, Callander Community Council, and the internet. An overview of the types of information collected is summarised in Table 2.

Table 2 Sources of information on flood risk

Data source	Description	Applications
Hydrometric data	Records from rain gauges & river gauging stations in the catchment	Analysed to assess trends over time, e.g. climate change & to determine the statistical probability of flood events of varying magnitudes
Detailed hydraulic models	Digital representations of the channel & floodplain landscape through which flood flows can be simulated. A model can be calibrated e.g. against observed data or trash-lines	To help interpret the dynamics of the river, e.g. how far flood water might spread, overland flow routes, speed of flow & influence of structures like bridges or weirs
SEPA Indicative Flood Maps[8]	Hydraulic model of all major watercourses throughout Scotland. Updated annually. Excludes detail on channel dimensions and structures.	A tool for broad-scale assessment of predicted flood extents
Flood Risk Assessments	Detailed reports on flood risk at localised scales	To assess in detail flood risk to individual proposed developments
Witness accounts	Community surveys carried out after flood events	Used to characterise flooding, e.g. source of floodwater and extent / depths of inundation
Information on localised flooding issues	Reports from community, Community Councils or Council	Used to help understand and prioritise flooding issues & to inform flood studies. Important to highlight vulnerable areas or potential mitigating factors such as propensity for debris blockage at structures
Photographs	Photographs collected from a variety of sources, including aerial imagery (preferably date-stamped)	Help to record the source and extents of previous flood events
Council records of flood incidents and repairs and maintenance	Records of flood incidents (including community & council reports), with details on the repair & maintenance of channels or structures	Collected to help target flood management & to keep updated records of potential sources of flood risk

[8] http://www.sepa.org.uk/flooding/flood_map.aspx

Topographic surveys	Data, for instance, in the form of detailed channel cross-sections, spot heights, structure dimensions & remotely-sensed Digital Elevation Models (DEM)	Used to inform models and highlight important areas for flood storage etc
Flood Management Plans	Studies commissioned by the local Responsible Authority	Catchment and settlement based flood management plans highlight important sources of flooding & potential mitigation measures
BHS Chronology of British Hydrological Events website	A collection of historic flood event data, including citations from old newspaper articles & journal accounts	Although largely subjective, can provide a useful overview of flood history in the area

A sustainable approach to flood risk management requires an understanding of the history of flooding, set against a context of changing land use, channel management and development. The data collected for this purpose must be analysed carefully, as it is important to understand the different strengths and limitations or uncertainties associated with each type of data source. It is particularly important to distinguish between historic observations of actual flood events, and predicted, or modelled, flood events.

5.2 Recorded flooding

Historic flood data can take many forms, and may be relatively anecdotal (e.g. old church records, farm records, community council records, newspaper articles), more definite (e.g. flood levels marked on buildings, old photographs (particularly if dated)), or more recently, highly quantitative (e.g. data from river gauging stations and trashline surveys)). Anecdotal or subjective information is often viewed as being of limited use for future planning, while quantitative information is invaluable, particularly where hydrological modelling is required. It is recommended however that a combination of all levels of information must be used, as they can be used to verify each source. For instance, anecdotal information is often essential to ground-truth the predictions of statistical analyses or models; the outputs of a 1 in 20 year flood model can be verified against the more subjective statement that “during the 20th century there have been floods that have reached Main Street roughly every 20 years”

Continuous measurements of precipitation and flow data are available from several gauging stations throughout the Teith catchment, mostly maintained by SEPA (

Table 3). Analysing the time series allows the response of the catchment to rainfall to be characterised and critical conditions or critical areas for flood generation and storage to be highlighted. Figure 2 illustrates the catchment response to heavy rainfall during the December 2006 flood event.

Table 3 Hydrometric network in the vicinity of Callander

Type	Station Name	National Archive Number	Grid reference	Start of Record	Catchment Area (km2)	Notes
River gauges	Leny at Anie	18008	258523 709613	1974	190	1.5km downstream of Loch Lubnaig outlet
	Eas Gobhain at Loch Venachar	18015	260205 706926	1979	202	0.5 km downstream of Loch Venachar outlet. Influenced by regulated releases from reservoirs
	Teith at Callander footbridge	N/A	262833 707735	1992	406	At footbridge, stage only.
	Teith at Bridge of Teith	18003	272519 701136	1956	517	12 km downstream of Callander, at Doune
Rain gauges	Loch Katrine	N/A	249060 706499	1993	N/A	14.5 km west of Callander
	Loch Venachar	N/A	260205 706926	2006	N/A	3.5 km west of Callander
	Strathyre	N/A	256061 716676	1992	N/A	12.5 km northwest of Callander
	Deanston	N/A	271200 701900	2005	N/A	9.5 km southeast of Callander

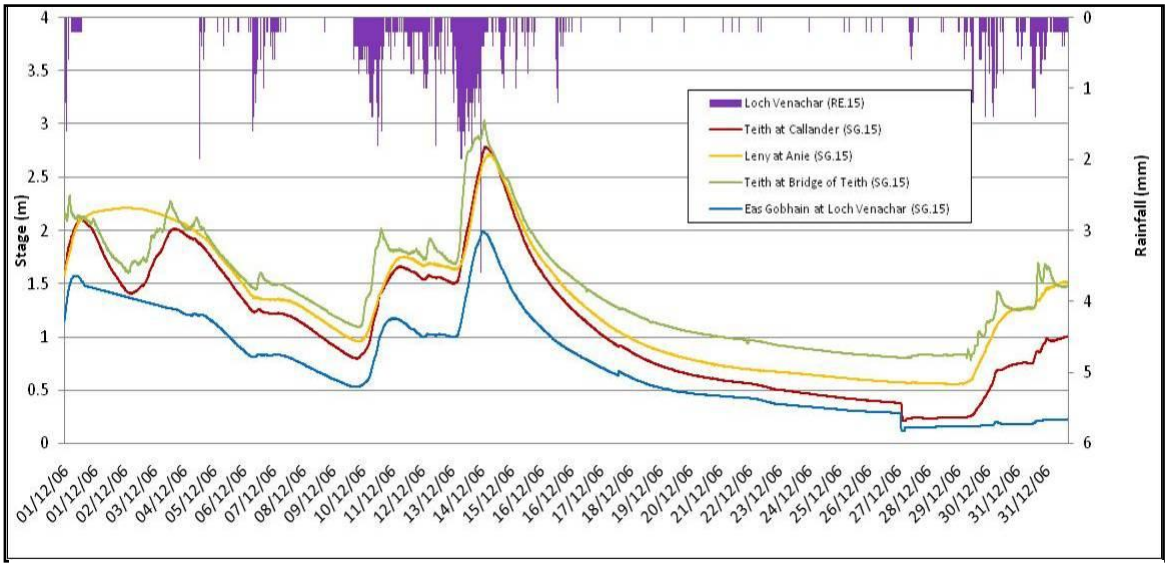


Figure 2 Sample of rainfall at Loch Venachar & river discharge data gathered from various stations during December 2006 flood event

Figure 2 shows that in December 2006 there was prolonged heavy rainfall which resulted in the largest flood recorded in the Teith since 1956. The peak discharge measured on the Teith at Bridge of Teith (Doune) was nearly 500 cubic metres per second. River levels recorded at the footbridge at Callander were around 2.5 metres higher than 'typical' river levels, and this caused extensive flooding of properties in Callander.

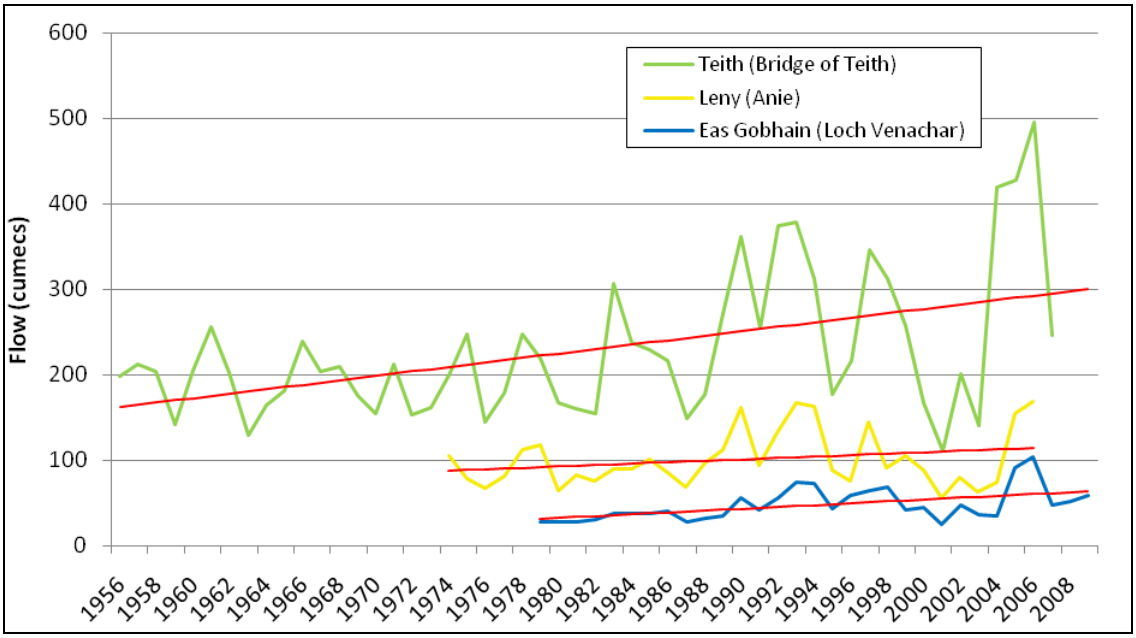


Figure 3 Annual maximum flood flows in the Teith Catchment

Figure 3 shows that annual maximum flows from various stations in the Teith catchment indicate a possible trend towards increasing magnitude of flooding, but more in-depth analysis is required to determine whether this is a long-term trend or part of a "flood-rich / flood-poor" cycle.

The hydrometric records are extremely useful for carrying out any level of FRA. Some of the records have not been collated over a sufficiently long period to pick up underlying long-term trends in climate, as these are masked by variations between years. However a tentative interpretation of the trends has highlighted the following:

- There is likely to be an overall trend towards increasing volumes of daily rainfall, although in very recent years there has been a slight *decreasing* short-term trend in the volume of daily rainfall at all four of the rain gauge sites.
- More recently the rainfall may however have been falling over shorter timescales, at higher intensity. Short bursts of intense rain, which are often observed at a highly localised scale, can cause devastating flash flooding where the catchment cannot absorb the rainfall as fast as it is falling.
- For the period of 1989 to 2006, there has been a decrease in the frequency of flood events; although the four largest events recorded over this timescale took place in 2005 and 2006 (Figure 3).
- All river gauging stations show a long-term increasing trend in the magnitude of flood events, and at the Bridge of Teith, the largest 3 flood events recorded between 1956 and 2007 have occurred in 2004, 2005 and 2006.

A comprehensive review of data would be valuable to determine trends and variability, but a preliminary appraisal indicates that flood risk to Callander, or any given location, is not static, and analysis should ideally be updated as more information becomes available. Statistical analysis and modelling is a very important tool to help predict the impacts of potential changes in climate or catchment conditions.

5.3 Modelled flooding

Please note that this study has made reference to modelling results from both SEPA indicative flood maps and other sources, although maps have not been reproduced in this report for licensing reasons.

5.3.1 SEPA Indicative flood maps

Indicative flood maps are generated through nationwide modelling carried out by SEPA, and available publicly on the SEPA website[9]. The maps were designed as a generic tool to predict the 1 in 200 year flood envelopes around major water bodies, for the purpose of assisting strategic planning decisions. They are regularly updated but are not detailed enough to assess flood risk for settlements or individual properties. In these instances, the responsibility for assessment and modelling shifts to local planning authorities or individual developers.

5.3.2 Detailed Hydraulic Models

Flood Risk Assessment and Flood Risk Management most often involves detailed hydrological and hydraulic modelling. This process should take account of the influence of features such as small watercourses, local drainage, bridges and localised changes in channel dimensions. Potential exacerbating factors such as debris blockages or climate change should also be taken into account.

Modelling is a useful tool to help interpret river dynamics, but there are many limitations and uncertainties associated with models which must be fully understood for interpretation to be appropriate. For instance:

- ***Extent of consideration*** – interactions between all possible sources of flood risk are very rarely taken into account in one single assessment
- ***Flow predictions*** – a variety of statistical techniques can be applied to flood frequency analysis, which can lead to a very wide range of discharge predictions for the 1 in 200 year flood (particularly for small ungauged watercourses).
- ***Joint probability*** - it is very difficult to estimate the likelihood of floods of a given frequency occurring simultaneously in two different watercourses (e.g. Leny & Eas Gobhain) or between a water flood and a high tide in the sea (not applicable to Callander)
- ***Topographic data*** – most models are based on a sample of topographic data and cannot account of every potential flow route or breaching point, for instance
- ***Friction*** – hydraulic models can be very sensitive to changes in friction (typically represented by subjectively selected 'Manning's values') due to vegetation or landscape features, particularly where gradient is relatively flat
- ***Changing conditions*** - models represent a snapshot in time, and significant changes in the river or catchment can make a model redundant.
- ***Random events*** - The likelihood of relatively random events such as debris blockage or structural collapse cannot be predicted

Planners must be aware of the limitations and uncertainties associated with hydraulic models, and attempt to interpret the reasons for any differences between models. Zones of uncertainty will be highlighted by discrepancies in model results, and reasoned judgement of suitability may hinge upon actual flood observations.

[9] http://www.sepa.org.uk/flooding/flood_map.aspx

Callander has been the subject of numerous hydraulic modelling studies, with different levels of detail. The purpose of all of the studies was to help assess flood risk and most have focussed on the River Teith. Some have attempted to predict the effects of climate change and some have simulated various flood management scenarios such as changing reservoir operations or building flood walls through the town centre.

The most recent and detailed modelling was carried out by Atkins (February 2010). It has been constructed using a combination of channel cross-sections and a high resolution digital terrain model (DTM), through which flood waters can be simulated to flow allowing prediction of flow routes, velocities and depths. The model predicts flood extents in the main river over a range of flood magnitudes. There are occasional anomalies in the results of the model, for instance around the Tom na Chisaig mound (upstream of the A81 road bridge) the model predicts the width of a 50 year flood to be more than double the width of a 100 year flood at the same location. Although highly complex, this model does not consider flood sources outwith the River Teith, and so does not provide a fully comprehensive picture of flood risk throughout the settlement. Therefore, it is advised that model results are interpreted cautiously.

In 2009 Atkins produced a separate model of small watercourses. Again the modelling was complex, using sophisticated two-dimensional hydraulics software and high resolution DTM, and careful interpretation of the results is necessary to realise the limitations of the results. The study considered a sample of burns on the northern side of the town only, and the boundaries of the model do not fully interact with the river model or surface water drainage system. Overlaying the outputs of this model with witness accounts of observed flood extents from small watercourses has revealed that while the model largely agrees with flood extents observed in certain critical small watercourses, it may have overlooked some significant flood risk issues. For instance the model did not predict the flooding of Gullipen View and Glen Gardens from the Mellis Burn which has happened on a number of occasions.

5.4 National Park SFRA Database for Callander

To obtain an overview of all the available information, the data for Callander were collated and reviewed, and around 360 relevant flood records were reviewed and entered into a database. The database was managed in spreadsheet format, and data with a spatial context were plotted on maps using ArcMap GIS (Geographical Information System) software.

The Callander SFRA database is designed to be readily updated and searched, and includes:

- Flood event records:
    - Date
    - Location
    - Description of impacts
    - Source of flooding
    - Hyper-linked photographs
    - Source of information
- Records of channel, channel structure and flood defence infrastructure, such as
    - Routine maintenance
    - Emergency mitigation
    - Renewals / upgrades
    - Recommended maintenance / upgrades

GIS allows the information contained in the database to be visualised in a very powerful way, while being simple and flexible to use. A set of maps were produced to show the distribution of observed flooding incidents, categorised by date, extent, or source of flooding, for instance. This data was overlain with the flood envelopes predicted by various models of Callander, with the following outcomes:

- Overlaying the predicted 1 in 200 year flood outlines of various models has revealed that many parts of the town are at risk from flooding from the River Teith. Clusters of data from the database were grouped and outlined to created simplified zones on the map
- The maps reveal 'hotspots' for flood risk as well as potential gaps in the information record; these gaps can help to target future modelling effort
- Overlaying flood observations and predictions can help to calibrate and verify model outputs, but can also reveal significant discrepancies between models and observed flood events (particularly where comparing observed and predicted events with different flood frequencies) . These inconsistencies can help to highlight areas of uncertainty and help to target future modelling effort
- Using GIS allows spatial analysis of types, sources and frequency of past flood events, allowing case officers to appraise flood risk on a site-by-site basis, through collaboration with Local Authority Flood Officers if necessary

The database generated through this assessment will be provided to the National Park Authority in GIS format, and it is recommended that it is made available subject to the recommendations set out in section 5.6

5.5 Gap Analysis

By reviewing literature, building a flood database and mapping the observed and predicted flood extents, certain gaps or uncertainties can be revealed. Table 4 summarises the focus of previous flood studies for Callander. This table reveals that while many aspects of flooding have been considered in the past (with particular focus on the main river), they have mostly been studied in isolation. The dynamic interactions between various flood sources have not be fully explored, for instance, the potential for flooding in the river to exacerbate flooding in both the surface water drainage system and in small watercourses.

An extremely useful source of information for bringing together a complete picture of flood risk in Callander is community sources of information. For the last decade or so, Callander Community Council has made a coordinated effort to collate accurate flood information from the community, including:

- Formal flood questionnaires
- Letters
- Photographs (dated & annotated where possible)
- Discussions from public meetings

However, many flooding incidents still go un-reported, perhaps due to lack of awareness of the reporting system, or because of anxiety over how the information might be used.

Another potential gap is that the observed events may not be compared against events of an equivalent magnitude in the models; unless a 1 in 200 year flood has actually occurred within recent times, it is unlikely that any comparison is 'like-for-like'.

Table 4 Gap analysis of previous flood studies for Callander *(based on information made available for the study)*

Previous Studies				Main Flood Risk Elements Considered (✓)								
Source		Report	Date	River	Small Water-courses	Rainwater / overland flow	Rural drainage	Urban Drainage / Sewer Systems	Lochs & Reservoirs	Structural failure / blockage	Ground-water	Sea
Professional studies	SEPA	Indicative Flood Map	2010	✓					✓			N/A
	Atkins	Stirling Council River Teith Hydraulic Model Update: Draft for Client Review	2010	✓								N/A
	Atkins	Callander Small Watercourses Capacity Assessment Report	2009		✓			✓				N/A
	Mountain Environments	Callander Meadows Flood Risk Assessment	2008	✓						✓		N/A
	Stirling Council	Flood Report	2005	✓								N/A
	Atkins	Callander Meadows Car Park Flood Risk Assessment	2005	✓					✓			N/A
	Mott MacDonald	East of Scotland Water. Sewerage Infrastructure Investment & Operational Planning.. Model Build & Verification – Callander Catchment	2003	✓				✓		✓		N/A
	Stirling Council (Bullen Consultants)	Flood Prevention Study Stage 2	2000	✓	✓			✓	✓			N/A
	Mountain Environments	Flooding in Callander: Update Report to Callander Community Council	1999	✓	✓			✓		✓		N/A
	Central Regional Council	Callander Flood Plan	1995	✓								N/A
	Mott MacDonald	Flood Management of the Upper Teith Basin, Above Callander (Callander Flood Study Phase II)	1993	✓					✓			N/A
	Mott MacDonald	Floods in Callander Stage 1 Final Report Preliminary Investigations	1992	✓								N/A
	Sir M MacDonald & Partners	Callander Flood Study Final Report	1989	✓					✓			N/A
	Halcrow	River Teith Rural Flood Mapping	Ongoing	✓								N/A
Witness records	Callander Community Council	Formal record of letters & photographs	Misc	✓	✓	✓	✓	✓	✓	✓		N/A
	Callander Community Council	Flood Surveys	1998	✓	✓	✓	✓	✓	✓	✓		N/A

5.6 Recommendations for future data collection & management

Finding and accessing all of the available data is often one of the biggest challenges when carrying out a flood study. For the planning process to be informed and streamlined, it is recommended that a central floods database is regularly maintained. The database must also keep up-to-date records of upgrades and maintenance of channel and flood defence infrastructure, to avoid misuse of outdated information. The Callander database has been designed in a format which could be expanded to cover any geographic area, at any scale.

Certain information, particularly maps, topographic data and models often cannot be publicly shared due to licensing issues. Flood incident reporting from individual properties is also sensitive data, as the information could disadvantage certain properties. It is recommended that the planning authority manage and maintain the data so that access to raw or sensitive data can be limited, whilst other statutory authorities and stakeholders can freely access non-sensitive information. This work should be carried out in close collaboration with Stirling Council, who also operate a GIS database system for flooding, and the Community Council, who can provide information for the database.

It is also recommended that guidance on interpretation should accompany the database. Interpretation of the data must be carried out cautiously, in light of the fact that the data was collected for a wide range of purposes, with very different levels of detail or accuracy. By reviewing all of the available data together, inconsistencies and information gaps become apparent, which may help to streamline any future flood studies carried out in the area. Any omissions or uncertainties must be highlighted together with the model outputs to avoid misinterpretation.

Rain gauges and river gauges are vital for statistical analysis and modelling, and it is recommended that all settlements at flood risk should have some means to gather hydrometric data. SEPA already maintain a relatively extensive monitoring network in Scotland, but in the absence of a local gauging station, simple maximum water level indicators or trashline surveys can be used to help calibrate future models. These are very cheap and easy to establish and could be maintained by local community volunteers. By gathering this kind of data during floods, future models can be calibrated against flood observations of the same event. This is a useful strategy to address gaps in the modelling process.

The importance of community sources of information cannot be underestimated, although its interpretation must be weighted appropriately against information from professional studies. The process of recording and archiving floods must be streamlined to make this source more reliable, because currently many floods go unreported and descriptions can be vague, or even exaggerated / understated, (depending on a person's motivation for reporting). Appropriate levels of detail and consistency can be achieved by providing the community with post-flood surveys, coordinated through local community councils. A recommendation should be made that any photographs should be associated with a date / time and preferably a location reference (GPS cameras are useful tools for this purpose). Some sample questions for a community flood survey for individual property owners are illustrated below and a similar format could be developed for more general reports where public areas have been affected as well as individual properties.

Table 5 Post-flood survey: sample questions

The following survey is being issued in order to collect detailed information on the causes and impacts of the recent flooding event in Callander, and to highlight potential solution. Any information provided will be used sensitively and will not be published in its raw format.

Personal Details:

- **Name:**
- **Address:**
- **Telephone Number:**
- **Address of flooded property (If different from home address):**

Flood Information:

- **What part of the property was flooded?**
- **Approximately how deep was the flood water inside the property?**
- **Approximately how deep was the flood water outside the property?**
- **At what time did the property begin to flood?**
- **How long was the property under water?**
- **What do you think was the cause of the flooding to the property?**
    - **Did you receive assistance during the flood? If yes, what kind of assistance did you receive?**
- **What damage was caused to the property?**
- **What was the total financial cost of the damage to the property?**
- **Are you aware of flooding in this property before?**
    - **If yes, how many times has the property been flooded? When?**
    - **What was the damage to the property?**
    - **Was the source of the flooding the same on this occasion?**
    - **If no, what was the source of the previous flooding?**
- **What do you think needs to be done to reduce the risk of possible future flooding?**
- **Are you aware of any previous post-flood maintenance or works carried out in this area?**
- **Do you have any photographs of the flood damage to the property or of flooding in other areas of Callander? Can you date any of these photographs?**
- **Any other comments?**

6 Flood Risk in Callander

6.1 Overview

Callander has a history of flooding dating back over 400 years with the older records describing spates on the River Teith while the more recent records have also included smaller watercourses flowing off the surrounding hills. As with many settlements in the National Park the original village was built at the boundary between the lowlands and highlands and at a crossing point over a major river. This piedmont location is where rivers emerge from the upper catchments with high energy flows and high sediment loads which are dissipated and dispersed within the channels and over the floodplain. Callander is also built at the foot of a major escarpment (Callander Crags) and other surrounding hills all of which have small watercourses draining off them and into the main river. This makes the location naturally high risk in terms of flooding and this is compounded when the settlement's infrastructure also restricts the rivers' flows.

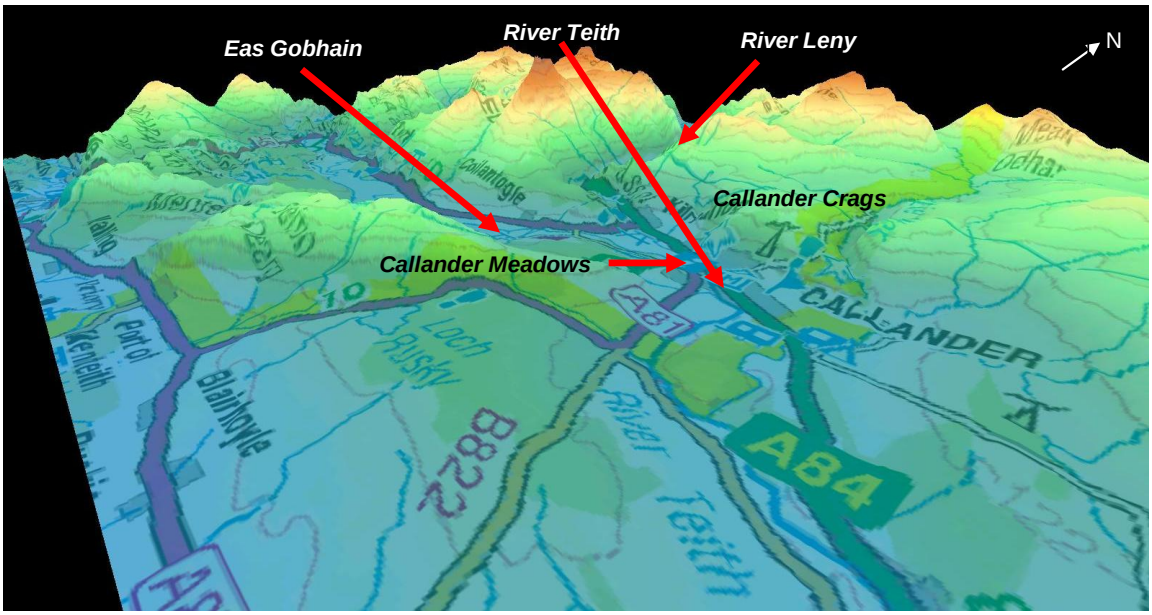


Figure 4 3D view of landscape around Callander, generated in Global Mapper software. Reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and database rights 2010. All rights reserved. Ordnance Survey Licence number 100031883.

The lowland-highland border often has areas of natural protection from the flood flows where the rivers have for centuries deposited their sediment load forming extensive floodplains and wetlands. In the Callander area the village developed mostly on the north side of the river but also extended southwards from the natural bridging point. This meant expansion over parts of the floodplain and some small areas of wetland although the main upstream floodplain and wetland of the Meadows and Little Leny were too wet to develop.

As the area of housing gradually expanded the buildings were constructed along the edge of the River Teith, a major road bridge was constructed over the river and most of the small watercourses were culverted. Drainage of the land surrounding Callander was also encouraged

as the areas of non-native woodland expanded, hill roads were constructed, fields cultivated and a golf course developed. This resulted in storm water flowing more rapidly off the surrounding hills, small watercourses being culverted under the buildings and roads, the main river constricted by a bridge and significant areas of natural floodplain and wetland were lost. The loss of flood storage and potential for culverts to be blocked with debris or sediments increase the flood risk to Callander.

Flood management planning and flood prevention infrastructure exist in the town but there is still a high flood risk in many areas. A number of previous studies have been undertaken investigating the options for flood protection from the main river and also the small watercourses. Regular inspections and maintenance are carried out on culverts and drains while planned developments close to the main river will include a formal flood risk assessment. There however remains a significant amount which could be done to reduce flood risk including the identification of the risk at development sites from all types of flooding, incorporation of SUDS into new development sites, the designation of flood management zones, management of flood flows in the upstream catchments and operating the upstream reservoirs to store more flood water.

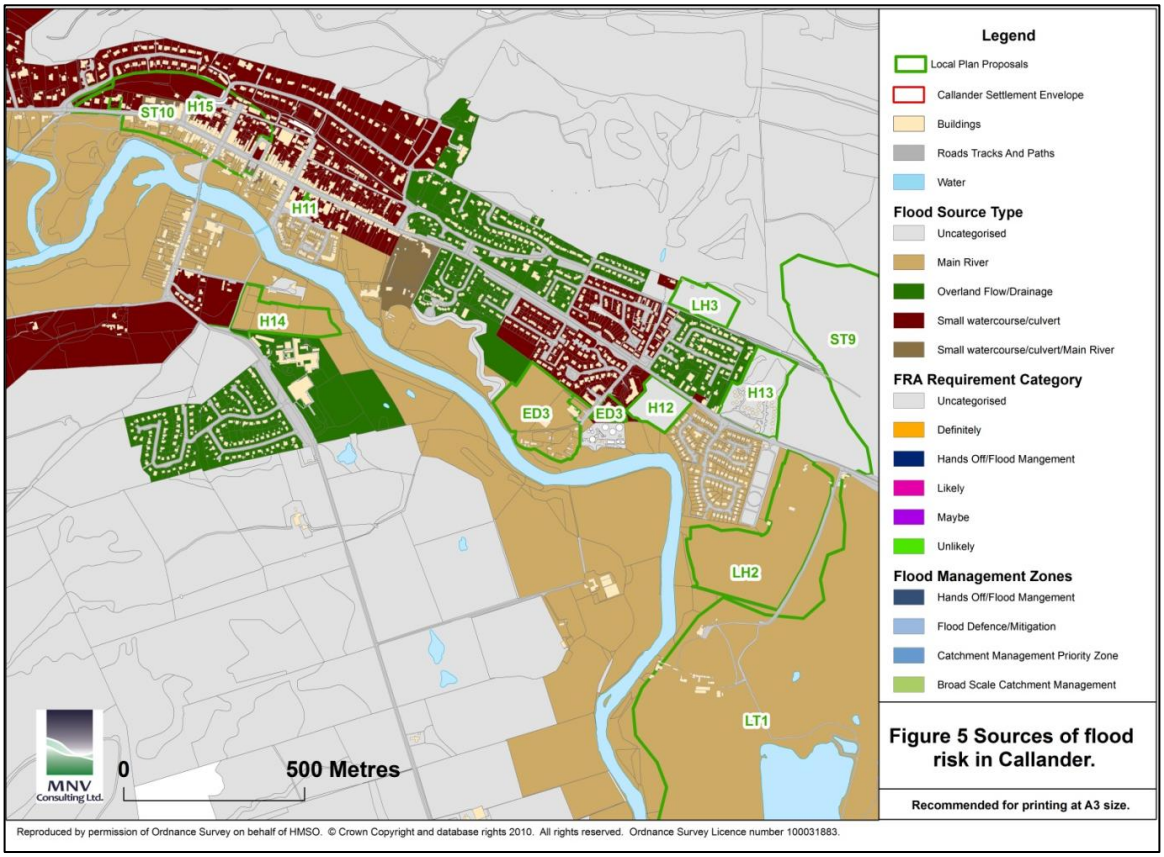


Figure 5 Sources of flood risk in Callander (A3 printable version provided in the Appendix)

6.2 Flooding from the River Teith

The River Teith naturally spills out of its banks in the Callander area during times of high flows. It drains a large catchment area which is very responsive to rainfall due to the steep slopes, thin soils, lack of native woodland protection and drainage of wetlands. The runoff from rainfall is often enhanced by snow melt following periods when snow has accumulated on the hills but melts rapidly when a warm front crosses the area. High flows in the River Teith can be either winter or summer events although most of the significant flooding problems from the Teith have been winter events. Flooding occurs where the capacity of a catchment to absorb or buffer rainwater is exceeded. This may occur where the catchment slowly becomes saturated during prolonged rainfall events, or where rainfall occurs at such high intensity that the catchment cannot absorb it as fast as it falls. The latter type of 'flash' flooding tends to occur during summer months, and also tends to occur on a very localised scale.

The location of Callander in relation to the river is critical in terms of the flood risk. Immediately upstream of Callander the River Teith is formed from the confluence of two rivers: Leny and Eas Gobhain. Both of these rivers drain large mountain areas although the Leny flows through three natural lochs (Doine, Voil and Lubnaig) while the Eas Gobhain includes a number of reservoirs (Katrine, Achray, Drunkie, Finglas and Venachar). In flood flows the lochs and reservoirs have the ability to store water and delay the flood peaks but once they are full they will spill with the water flowing into the River Teith and through Callander. The major flooding problems occur when there is prolonged heavy rain, supplemented with snow melt and the flood peaks from both rivers, Leny and Eas Gobhain, coincide to form a single large flood peak through Callander. The passage of the flood peak through the town is controlled by the shape and slope of the channel, and is influenced by the trees along the banks and the A81 road bridge, which was built on a natural constriction, traditionally used as a fording point. The footbridge downstream does not exert a significant effect on flood passage, and any potential replacement bridge should be planned carefully to maintain conveyance.

The main river is by far the most significant source of flood risk in Callander, and the most predictable. Private properties along the length of the river through the town are well known to be at risk of flooding, as shown by observed and modelled flood extents. Due to the way the settlement has developed, several important public amenities have also been located in the flood risk area, including major roads, the police station, library and primary school.

Figure 6 Flooding near the Meadows car park, 1990

6.3 Flooding from small watercourses

There are numerous small watercourses which drain off the surrounding hills and flow through the town and into the River Teith. Figure 7 illustrates some of the issues associated with small watercourses in Callander. Many have been altered in their upper reaches, for instance through canalisation or diversion related to forestry or agricultural developments. Most of the burns flow through woodland areas and so significant amounts of tree debris can fall into the channel with the larger material becoming trapped over the channel while the smaller material is washed downstream. In the right conditions tree debris can be beneficial for flood management, breaking up high energy flows and trapping smaller material and other debris, but near vulnerable structures, such as low bridges and culverts, it can become a flood hazard.

Several small watercourses flow through the Callander golf course where there have been significant modifications to land drainage and to the watercourses. Most have been canalised with many drains discharging into these channels. The watercourses are now concentrated into a single watercourse, the Mellis Burn, which then flows through a housing development.

Where the burns flow through Callander most of them have been culverted under roads, gardens and car parks usually discharging directly into the main river. Since the first town plan was produced and watercourses were culverted there was little upgrading of the drainage system until relatively recently. As the settlement expanded, more of the watercourses were culverted increasing the runoff rates through the town but also increasing the chance of a culvert becoming blocked. In the old part of the town drainage from new developments was often added to the original culverted watercourses without considering the capacity of the culvert.

In 2009 Atkins carried out an assessment of several more significant watercourses, which included modelling scenarios of debris blockages or changes in channel capacity. The study highlighted some important issues for flood risk and management, but due to the complex nature of the flood dynamics within an urban landscape, cannot account for all watercourses or scenarios in Callander.

Stirling Council have used various sources of information to design a routine maintenance programme to keep culvert entrances clear, and respond to emergency situations e.g. if there was a structural collapse or blockage in a watercourse.

Undersized culverts

Modified channels

Potential large woody debris blockages

Potential for sediment blockages from steep modified watercourses

Figure 7 Issues associated with small watercourses in Callander

6.4 Stormwater Drainage Issues

Stormwater drains are designed to collect rainwater originating from urban areas including roofs, car parks and roads and discharge the water into surface watercourses. In some parts of Callander the drainage system takes the form of a combined stormwater and sewage system with the water discharging into the Callander wastewater treatment works. This part of the network was not designed to cope with major flood events and in these situations the combined flow can exceed the system's capacity and water surcharges potentially flowing through residential areas. Floodwater from other sources, particularly when a burn spills out of bank, can enter the storm water system, again potentially causing surcharging problems further along the system.

In 2003 Scottish Water commissioned a survey of the combined sewer system in Callander and found that many of the pipes were badly silted. Maintenance of the system was subsequently carried out to clear any blockages and upgrade the pipe system.

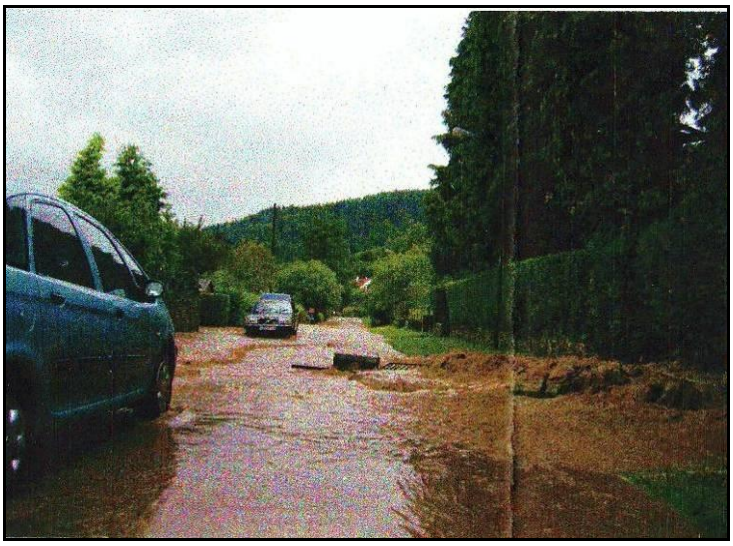


Figure 8 Broken culvert on Ancaster Road 2004

6.5 Loch or Reservoir Failure

A number of natural lochs and artificial reservoirs exist upstream of Callander and the collapse or breach of the retaining structure could cause flood damage in Callander. The risk of this occurrence is however extremely small and so is not considered in this report.

6.6 Groundwater Issues

There are no known issues in Callander related to groundwater flooding.

6.7 Surface Runoff

Surface runoff or overland flow has been a major issue in many parts of Callander. The problem is usually related to small watercourses where either the flow exceeds the capacity of the channel or a culvert becomes blocked. The direction of the flood flow is difficult to predict but it usually runs down roads and paths but it can also go into gardens, driveways and houses. This type of flood risk is often ignored, especially once the watercourse is culverted.

Figure 9 Overland flow through golf course 1993

Figure 10 Overland flow from the golf course 2004

Figure 11 Corner of Glenartney Road and North Church Street

6.8 Coastal Flooding

Callander is some 30km from the nearest coastline and 75m above sea level and is not a coastal location. Coastal flooding is therefore not an issue in Callander.

6.9 Potential future changes to flood risk in Callander

Flood risk in Callander may change in the future due to a number of factors, such as changes in land use (e.g. deforestation), management regimes of water resources, and particularly climate change.

UKCP09 (UK Climate Programme 2009) predicts that under a 'medium emissions' scenario, by 2050 temperatures are expected to increase by 2 to 3°C in summer and 1 to 3°C in winter. Seasonality of precipitation is likely to change, with a 10 to 20% increase in average precipitation in winter and 10 to 20% decrease in summer. Associated with the changes in average precipitation is a predicted increase in the intensity of events (by 10% in both summer and winter), which could significantly increase the occurrence of high magnitude events and flash flooding.

Climate change is therefore likely to have a significant impact on flood risk in Callander due to increased winter rainfall and summer flash floods. It is difficult to know if the apparent increase in flooding incidents over recent years is related to climate change or is simply due to the expansion of the settlement. Potential climate change should be taken into account with all new developments and flood risk assessments now have standard factors for increasing flood flows when using modelling techniques.

7 Strategic Flood Risk Planning & Management for Callander

7.1 Overview

This SFRA has been generated to assist flood risk planning and management for Callander. Through assessment of the needs and addressing the challenges associated with this process, future planning can be carried out in a coordinated and sustainable manner throughout the National Park. The textbox below outlines some of the issues together with some potential solutions.

Needs	• Provide a pilot study which can be rolled out over rest of the park
	• Promote sustainable catchment flood management
	• Encourage and support sustainable development
Challenges	• Scope for better integration between statutory bodies
	• Timely access to information and gaps
	• Reliance on statistics and different models
	• Dealing with conflicting results and information
	• Previous studies had narrow focus on specific sites
	• Usually undertaken on a regional level – this is a settlement level
Strategy	• Information gathering from the statutory bodies and community
	• Collation of information and data from monitoring records, indicative flood map, models etc
	• Identify all types of potential flooding sources
	• Collate and plot all historical records
	• Review of records
	• Identify potential mitigation measures
	• View the settlement in the wider catchment scale
	• Identify flood vulnerable zones
	• Identify risk to the development sites
	• Identify flood management areas
	• Educate riparian owners of their responsibilities

A conceptual catchment (which can represent whole catchments or sub-catchments) can be used to demonstrate the flood frequencies associated with each risk category in Scottish Planning Policy (Figure 12). It is designed to help to inform planning policy, allowing future development to be located in suitable locations, depending on vulnerability. The 'active floodplain' zone has been added to demonstrate one simple way in which sustainable flood management can be built into spatial planning. Figure 13 is a schematic outlining how the area around Callander can be zoned to correspond to this model.

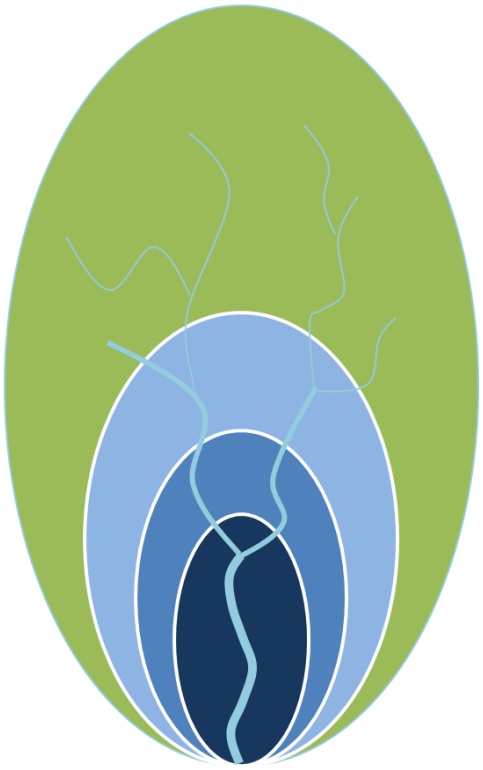
A Simple Catchment	Risk Category	Flood frequency	Development restrictions
	Little or no risk	less than 1:1000	•Develop as appropriate
	Low-to-medium risk	1:1000 to 1:200	•No vulnerable properties e.g. hospitals
	Medium-to-high risk	1:200 or greater	•No residential development
	Active Floodplain or conveyance zone	1:20 or less	•Hands-off areas to be reserved for flood storage and management

Figure 12 Simplified Conceptual Catchment Zoning Model, based around Scottish Planning Policy regarding flooding and development. Please note that this model can be representative of both whole catchments and also sub-catchments containing active floodplain.

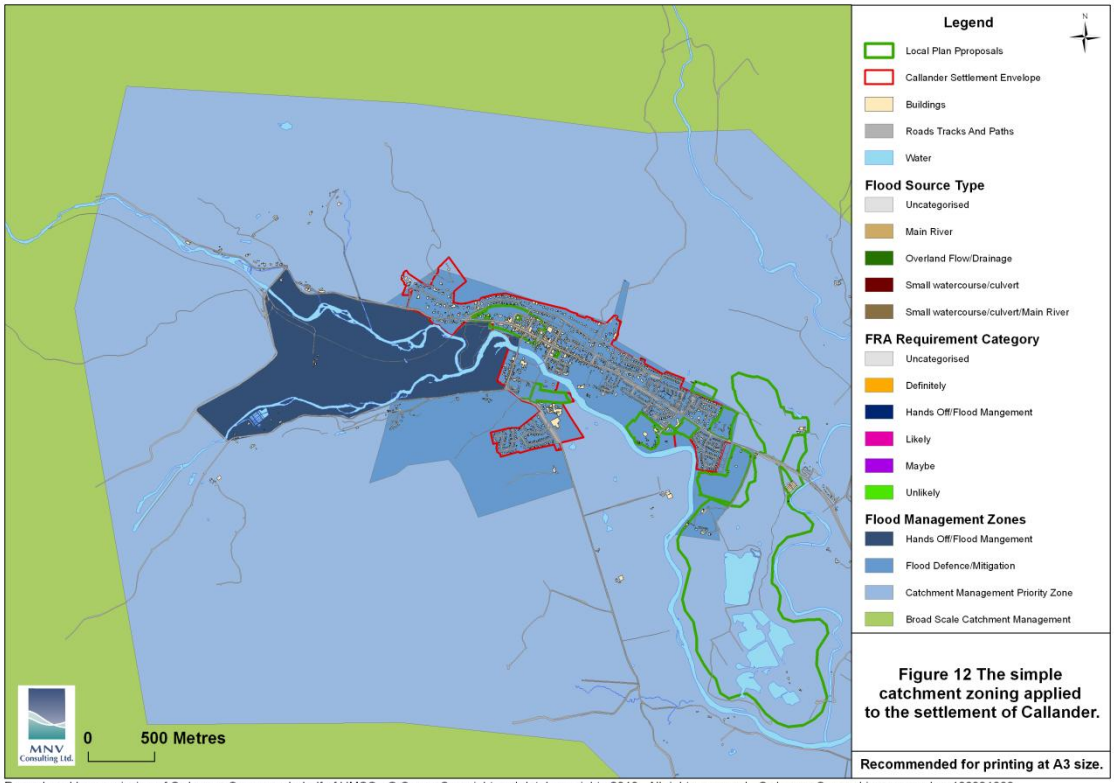


Figure 13 The Simple Catchment Zoning applied to the settlement of Callander (A3 printable version provided in the Appendix)

Figure 14 Callander meadows area – proposed as a "hands-off" area reserved for flood management

7.2 Flood Vulnerability

It is important that flood risk does not totally preclude sustainable development; however it is vital that potentially vulnerable people and developments are protected. Guidelines are available to assess the vulnerability of different types of development, in order to ensure the appropriate level of protection against flood risk. Table 6 is based upon Stirling Council's policy on development vulnerability, and has been adapted by the more recent Risk Framework in SPP. Table 7 provides more general guidance on requirement for a FRA depending on development type.

Table 6 Extract from Stirling Council Development Advice Note: Development & Flooding[10] (adapted to correspond with the more recent Risk Framework in SPP)

As a guideline, the following predicted flood events are considered appropriate for excluding the particular forms of development proposal from areas at risk:	
Essential civil infrastructure	1 in 1,000 year flood
Developments whose occupants may be particularly vulnerable in the event of a flood (e.g. Sheltered housing, homes for the disabled)	1 in 1,000 year flood
Developments whose occupants are children, or adults who may be unfamiliar with escape routes (e.g. children's homes, schools, hotels, hostels)	1 in 1,000 year flood
Developments including buildings with occupied basements	1 in 750 year flood
Developments including ground floor flats or bungalows without roof openings	1 in 500 year flood
Residential caravans	1 in 500 year flood
Developments near 'young' rivers, with steep gradients and small catchments (<10km^2)	1 in 500 year flood
Developments including bungalows with roof openings	1 in 300 year flood
All other residential development	1 in 200 year flood
Caravans for seasonal occupancy (warning notices to be provided)	1 in 200 year flood

[10] http://www.stirling.gov.uk/dan_flooding-3.pdf

Table 7 Guidance on requirement for a FRA depending on development type

Risk framework	Risk	Little or no risk	Low to medium	Medium to high ("Functional Floodplain")
	Annual probability of flooding (AEP, %)	Less than 0.1%	0.1% to 0.5%	Greater than 0.5%
	Return period (years)	1:1000	1:1000 to 1: 200	1:200
Development Type	**Definition**	**NPA FRA requirement**		
Minor & Change of Use	• Minor non-residential extensions • Alterations that do not increase the size of buildings	NO	CASE-SPECIFIC[11]	YES
Essential Civil Infrastructure	• Hospitals, Police stations, Ambulance stations, Fire stations • Emergency depots & command centres • Essential transport infrastructure • Strategic utility infrastructure, including electricity generating power stations & grid & vital telecommunications installations	YES	YES	YES
More Vulnerable	• Dwellings, particularly basement dwellings • Residential institutions e.g. residential care homes, children's homes, prisons and hostels, student accommodation • Hotels & licensed premises including night clubs • Non residential health service buildings, nurseries, education establishments • Caravans, mobile homes and park home, campsites (permanent residential / temporary leisure) (subject to a specific warning and evacuation plan) • Landfill and sites used for waste management facilities for hazardous waste or installations requiring hazardous substances consent	NO	YES	YES
Less Vulnerable	• Retail units • Offices for financial / professional services • Eating establishments • General industry e.g. assembly, storage and distribution • Leisure facilities. • Land and buildings used for agriculture and forestry • Water treatment plants • Waste treatment (except landfill and hazardous waste facilities) • Sewage treatment plants (if adequate pollution control measures are in place) • Minerals working and processing (except for sand and gravel working)	NO	CASE-SPECIFIC	YES
Water Compatible Development	• Flood control infrastructure • Water transmission infrastructure and pumping stations • Sewage transmission infrastructure and pumping stations • Water-based / outdoor sports recreation facilities • Lifeguard and coastguard stations • Amenity open space, nature conservation and biodiversity • Sand and gravel workings • Fish farms	NO	CASE-SPECIFIC	YES
Major development	• As defined in the Town & Country Planning (Hierarchy of Developments) (Scotland) Regulations 2009, Reg 2 (1) and as included in the Schedule[12]	YES	YES	YES

[11] Flood Risk Assessment may be required if likely to have a significant effect on the storage capacity of the functional floodplain or affect local flooding problems

[12] http://www.opsi.gov.uk/legislation/scotland/ssi2009/ssi_20090051_en_1

7.3 Flood Risk Zoning of Callander

As a core element of the SFRA for Callander, a map has been generated setting out five different zones relating to the need for a FRA should a development proposal be put forward for a site within that zone (Figure 15).

The zones have been generated using GIS and they have been compiled through a composite of all the information available at the time of the database collation, including predicted flood outlines. GIS is the ideal tool to visualise information from the database and to streamline the outputs of the maps. Clusters of data have therefore been grouped to create clearer boundaries, and in this context generalisation leads to loss of detail.

The zones are therefore subjective as there are some areas and properties within envelopes where there are no historic records of flooding and no reports of flood incidents in the database. The terminology is therefore critical as these zones are not flood risk areas but areas where FRA would be recommended for a development as and when a proposal is put forward. FRA's may be stage 1 (simple) or stage 2 (including modelling), depending on the specifics of the site. In most cases a stage 2 report will be required to quantify the risk to a site and to determine safe development levels. Depending upon circumstances (such as size of development, perceived risk and complexity of the area), a stage 1 FRA may be sufficient (perhaps requiring level information, an assessment of design flows and some simpler hydraulic calculations). The SEPA website provides technical advice on requirements for FRA's[13].

The zoning adopted in this SFRA has five different levels, which case officers must interpret on a 'sliding scale', varying according to the vulnerability of the proposed development:

- FRA **definitely** required
- FRA **likely** to be required
- FRA **may be** required
- FRA **unlikely** to be required
- **Flood management zone**

Guidance for case officers on how to interpret the zoning and the database are provided in the Appendix 9.2.

It is further recommended that a Drainage Impact Assessment is requested as a mandatory component of any FRA in Callander where a development would involve any changes to existing drainage networks.

[13] http://www.sepa.org.uk/flooding/flood_risk.aspx

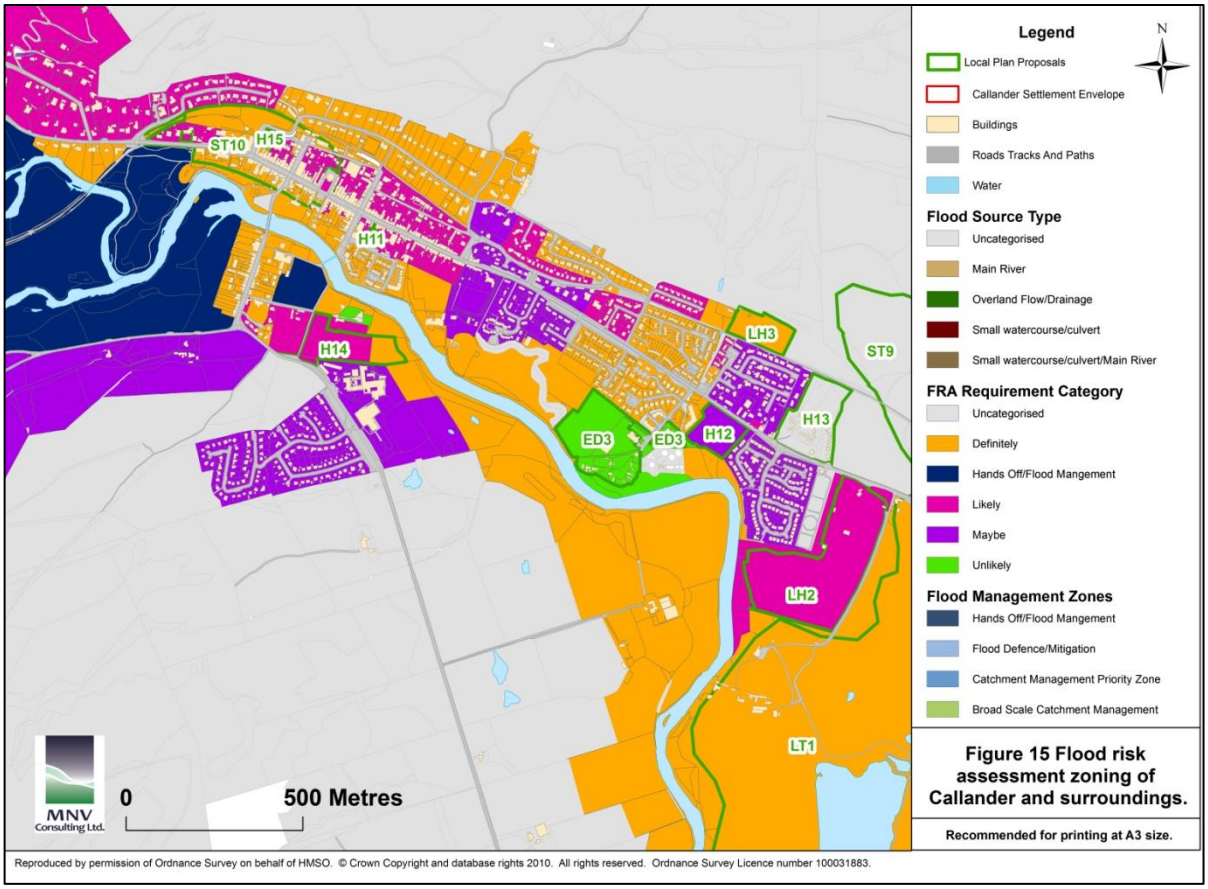


Figure 15 Flood Risk Assessment Zoning of Callander and surroundings (A3 printable version provided in the Appendix)

7.4 Flood Risk Assessment for Proposed Development Sites

When the 13 proposed development sites are superimposed on the FRA zoning it is clear that a number of the sites are at risk to some degree and therefore a development and site-specific FRA would be required / recommended. This allows the case officer to determine whether a FRA is definitely required, is likely to be required, may be required or is unlikely to be required. The database can then be interrogated to provide a more detailed understanding of historic flood activity, potential sources of flooding in the future and specific issues that need to be considered in the development-specific FRA. Guidance on the interpretation and use of the database is provided in appendix 9.2. The characteristics of the proposed development sites for Callander are summarised in Table 8.

Table 8 Summary table of proposed development sites in Callander

No.	Proposed Development	Development Description	Potential sources of flood risk	FRA requirement
H15	Old telephone exchange housing	Conversion to 10 residential properties	Overland flow from Crags behind Tulipan crescent and Ancaster Road. Overflow from culvert at station road car park.	Unlikely
ST10	Callander town centre tourism	Re-development and Improvement of facilities	Overland flow from Crags behind Tulipan crescent and Ancaster Road. Flooding from River Teith	Site-specific
H11	Pearl Street housing	5 individual Residential Properties	Minimal risk of flooding from burn to east. Minimal risk of flooding from main river. Likely a low risk site (not known to flood).	Likely
H14	Churchfields housing	28 individual Residential Properties	Minimal risk of flooding from River Teith. Overland Flow and saturated ground. Discharge from main road during flood onto fields.	Site-specific
ED3	Lagrannoch economic development	Encourage Class 4 and 5 commercial uses	River Teith in lower area. Flooding from Mellis Burn.	Unlikely
ED3	Lagrannoch waste management	Development of a waste management plant		Unlikely
H12	Stirling Road Housing	30 individual residential properties	Flooding from Mellis Burn. Likely a low risk site (not known to flood).	Maybe
LH2	The Gart Caravan park housing	174 individual residential properties	River Teith along the western edge of the site.	Likely
LH3	North of Lagrannoch Drive Housing	28 individual residential properties	Flooding from Mellis Burn. Overland flow from ponds & culverts on golf course.	Definitely
H13	Tannochbrae Housing	52 Individual Residential Properties	Potential for overland flow but likely a low risk site.	Uncategorised
LT1	Callander Cambusmore Tourism	Large tourism and recreation development	River Teith, Keltie Water and quarry ponds.	Definitely
ST9	Callander East Caravan Tourism	New location of Gart Caravan park	Keltie Water	Uncategorised
RA1	Callander East Rural Development	Hotel/campsite and manufacturing industry	Keltie Water	Site-specific

Figure 16 Flooding from the River Teith on the Meadows car park area in December 2006

In all cases it is recommended that the FRA requirements are explored and considered as early as possible and are an integral part of any pre application discussions. It is recommended case officers and colleagues utilise the database to fully understand site-specific dynamics relating to historic flooding and use this to help inform developers and applicants of the likely issues. For a major development, such as the Cambusmore tourism site (LT1) there would be significant merit in the FRA (or a similar appraisal) being undertaken by the developer at an early stage in the design process ahead of any planning application being prepared to help inform the master planning and overall site layout.

Flood risk management prescriptions fit under four broad headings; awareness, avoidance, alleviation and resilience. Table 9 sets out prescriptions for flood risk management at a community, settlement and catchment level and differentiates between short- to medium- term and longer-term actions.

7.5 Local Community Actions

Based on historic activity, recent hydraulic modelling of the River Teith and the small watercourses by SEPA, Stirling Council and others and from the outputs of this strategic flood risk assessment undertaken for the Callander settlement, several properties are at risk of flooding.

It is essential to ensure that within the community there is a broad awareness with respect to flood risk, and the community has access to knowledge and advice on how to help themselves and their neighbours should a flood event occur.

Stirling Council and SEPA have carried out a number of awareness raising initiatives in recent years within the community of Callander and also provided properties at risk with information packs and free advice. A simple action has been to advise householders how to set up the SEPA flood alert warning on their home PCs. The Council also progressed an initiative where they negotiated discounts with a flood board supplier for the purchase of flood gates.

The local Community Council has been particularly active in the local area having three appointed volunteers from their Environment and Planning Sub Groups to provide advice and be a liaison

point providing help in the event of a flood. There is a regular column within the local community newspaper providing contact points, and in the event of a flood, specific articles are provided asking residents to submit reports and photographic evidence. The Community Council are currently considering the purchase of some innovative absorbent crystal based sand bags to trial within the community.

There are a number of cost effective solutions that the local community can introduce to minimise damage to their properties in the event of a flood.

Flood Proofing

For existing homes and properties

- Sand bags can be placed at strategic points within gardens and across thresholds when a flood event is predicted to slow the flow of water and provide temporary protection. Sand bags are available at the Stirling Council depot in Lagrannoch Industrial Estate and individuals can purchase more effective absorbent crystal based sandbags to have in the event of an emergency.
- Flood boards, in the form of temporary watertight seals which are placed across doors, windows and air bricks to reduce inundation of the building interior, do provide temporary protection.
- Raising electrical wiring and sockets above the maximum flood level to reduce health and safety risks and the time required for repairs/reinstatement after a flood event
- Home flood plans prepared by the household/property owner setting out which furniture and appliances can readily be relocated to a higher floor level when a flood warning is issued

New Homes and/or during redevelopment

The construction of new homes and redevelopments will, in the main be subject to planning permission and/or building warrants and as set out elsewhere in this guidance, to zoning will determine whether a development-specific FRA should be required from the developer. Flood proofing considerations will include raising floor levels above the maximum anticipated flood level.

7.6 Settlement based Flood Risk Management

At a settlement level Callander is affected by flooding and therefore future development will inevitably have to work within this restriction. This SFRA provides a strategic context for the current development sites set out in the Finalised Draft Local Plan and in general flood risk management should be achieved through a site and development-specific FRA as development proposals emerge.

However, on gap or redevelopment sites it may not always be possible to guarantee that flood risk can be dealt with on a site-by-site basis and a more strategic, settlement-based approach is recommended.

In explanation, by taking a site-by-site approach on gap and redevelopment sites, it may prove not possible to provide for example 100% displacement compensation for proposed developments which could lead to key gap sites being ‘blighted’. For example, in Callander Town Centre (S10, Sustainable Tourism) site conditions on individual sites may not readily allow on site

compensation to be provided, or the costs associated with this are prohibitive and involve excessive civil engineering through the provision of flood tanks. A careful balance is required as Callander Town Centre is within the designated Callander Conservation Area and is a core part of the town's tourism experience. Gap sites by their nature can be eye sores and significantly detract from the overall townscape experience. Should gap and other sites become 'blighted' due to insurmountable issues associated with addressing displacement compensation this could lead to a long term townscape issue.

Consideration could be given to alternative uses of such sites for public open space and townscape enhancements and funding packages drawn up to deliver these for public benefit. Equally however, a more innovative settlement based approach could be developed where displacement compensation sites are identified in the wider area and natural flood management techniques introduced to slow flood flows and help reduce impacts in general. This innovative approach could be controversial and require agreement from agencies such as Stirling Council and SEPA, alongside a formal mechanism for ensuring any development related impacts are directly linked and more than compensated for through the sustainable flood management works to secure an overall public benefit as well as mitigate the development. It will be important to understand the lag time between implementing a sustainable flood management scheme and securing the benefits as planting and other techniques mature.

A programme approach will be required to identify and secure suitable sites, develop Sustainable Flood Management proposals for each site, secure funding, implement and maintain the works and also monitor their effectiveness through time. From a planning perspective a formal mechanism linking the development to the sustainable flood management scheme would also be required.

Table 9 Prescriptions for flood management

Elements	Measures	Settlement / localised scale		Catchment-wide scale	
		Short-medium term	**Long-term**	**Short-medium term**	**Long-term**
Awareness	• Community involvement • Flood Warning systems				Community flood groups
Avoidance	• Local Plan • Strategic FRA • Site-specific flood risk assessment	Avoid building in flood risk areas	Introduce "Hands off" areas		Avoid building in areas important for flood management
Alleviation	Runoff reduction measures	Green roofs Permeable paving SUDS Modify structures maintenance	Leaky barriers Manage structures	Large-woody debris introduction & management Drainage blocking	Hillslope woodland Gully woodlands Soil management
	Channel management	Diverting watercourses, spillways	Meander restoration	Meander restoration	Channel restoration
	Flood storage	Interception e.g. water butts SUDS		Reservoir management	Wetland restoration Floodplain restoration
	Flood defence	Flood walls Embankments	Land-raising & compensatory storage	Reservoir management	
Resilience	Building resilience Community resilience	Flood gates Evacuation plans	Flood resilience built in to design of new properties		

7.7 Catchment based Flood Risk Management

Flood risk management requires the coordination of a variety of actions, including development control and land use planning, flood warning and the creation of structures to reduce flood risk. As actions that affect one part of river can have consequences elsewhere, flood management measures are most effective when they are coordinated across catchments.

Catchment flood risk management: A summary

(source: CIS WG F on Floods, Thematic workshop on Catchment Flood Risk Management, Oct 2009 – Draft Report)

What it is…

Catchment flood risk management is a strategic approach which is built up from an appreciation of the hydrological processes and physical features within a catchment and an understanding of how best to manage the sources and pathways of flood waters.

An important element is exploring how flood hydrographs can be altered by reinstating natural hydrological processes and natural features within the catchment, and understanding how this fits with engineering, planning and other optional solutions.

Importantly a catchment approach allows the coordination of flood risk management with other aspects of water and land management.

What it can deliver….

- Wider benefits for the local environment, community and biodiversity
- Involving stakeholder engagement, including communities
- Sustainable solutions which are self maintaining with long term benefits
- Uses natural features and processes
- Adaptable to changes including climate change
- Integrates packages of management measures

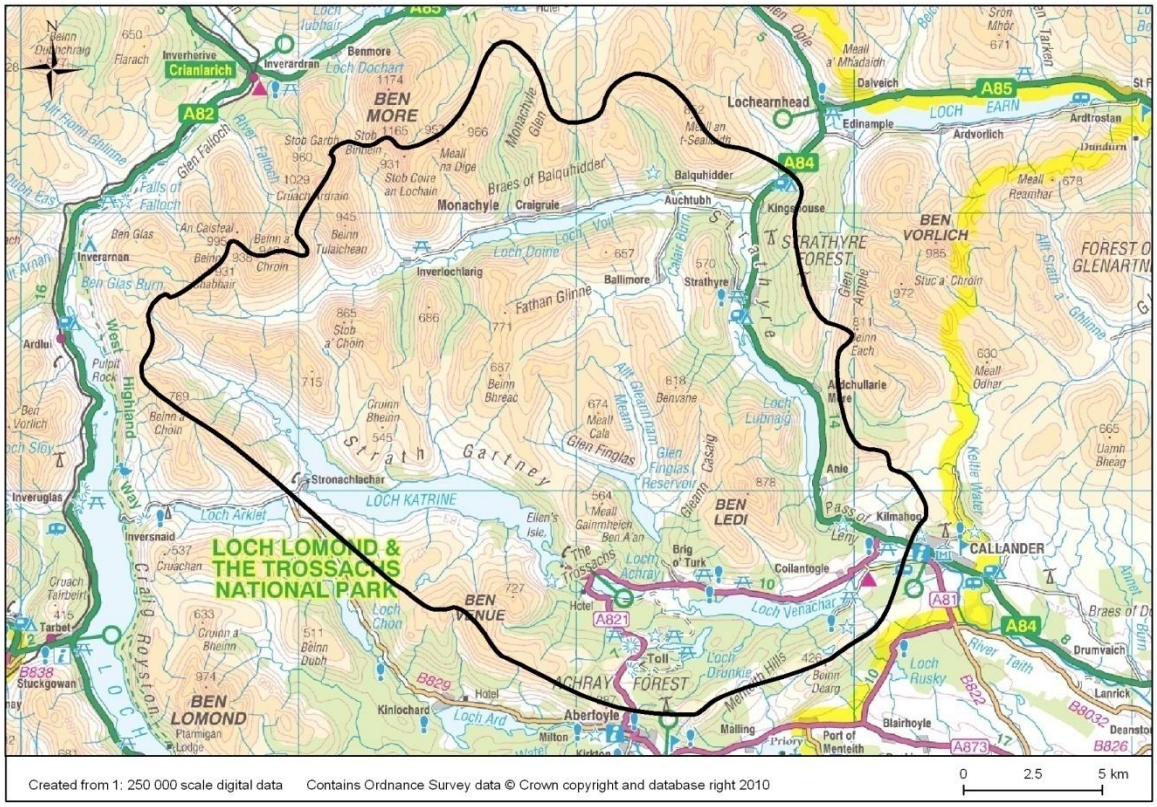


Figure 17 Outline of the catchment of the River Teith upstream of Callander: 406 km^2

In the context of Callander, there is a large rural catchment area above the settlement with mixed land uses providing plenty opportunities for a variety of sustainable flood management measures. Examples of different techniques are set out in appendix 9.2.

Specific measures of relevance to Callander are leaky barriers and wetland restoration. Figure 18 & Figure 19 below are of existing features which could readily be expanded in the immediate vicinity of the settlement at Little Leny to the west of the town, and Callandrade.

With the introduction of the Flood Risk Management (Scotland) Act 2009 consideration is being given by the Scottish Government and partner agencies to providing guidance on integrating different components of the flood management process, although the mechanism for implementing catchment-scale management is as yet uncertain. It may be that Stirling Council, as the Responsible Authority for flooding should promote the work as a flood scheme.

A simple step by step process for catchment flood risk management is provided in Figure 21 (source CIS WG F on Floods, Thematic workshop on Catchment Flood Risk Management, Oct 2009 – Draft Report)

Figure 18 Existing leaky barriers at the Meadows which could readily be expanded

Figure 19 Existing wetland at Callandrade which could readily be expanded

7.8 Generating a National Park SFRA

The process adopted to generate this settlement based SFRA for Callander is readily transferable to both a catchment scale and a Park wide scale. The settlement based approach has highlighted the limitations for flood mitigation being provided within the settlement envelope, whereas a catchment level approach provides significant opportunities for flood management. By now adopting a Park-wide approach, which embraces more than 20 settlements and considers a number of catchments each with different characteristics and options for sustainable flood management and mitigation, there is strong potential for the Loch Lomond & The Trossachs National Park to pilot this SFRA approach at the settlement, catchment and Park-wide level. In so doing the Park will hopefully develop best practice which can be adopted by other planning authorities in Scotland. This is entirely in line with the spirit of the National Parks (Scotland) Act 2000.

The importance of greater collaboration between partner agencies does however become even more significant as there is only one planning authority covering the Park area but there are four different flood prevention authorities; Argyll & Bute Council, Stirling Council, West Dunbartonshire Council and, to a much lesser extent, Perth & Kinross Council. Each of these authorities tackle very different issues relating to flooding and have a geographic interest which extends beyond the Park itself. For instance West Dunbartonshire Council tackles the issues associated with the Firth of Clyde and the River Leven, and Argyll & Bute has an extensive length of coastline and associated flooding issues. Interestingly however, the Park does contain the headwaters of the Teith, the Forth, the Dochart and the Earn which each form part of larger catchments with specific flooding issues for Perth & Kinross and Stirling Councils. Equally Loch Lomond which is the largest freshwater body in the UK flows into the Clyde along the River Leven and much of the flooding experienced in Dumbarton and Alexandria is linked to the interaction between the Loch, the River Leven and the tide on the Clyde.

The Callander SFRA process has highlighted the value of integrating different sources of information on flooding, and ensuring records of actual flood events are taken at the time a flood incident occurs, and where the data has a spatial context this is plotted on maps using GIS. The database compiled for this SFRA has provided a strong foundation for the development of the SFRA zoning of the settlement of Callander. Similar zoning could be applied at a Park-wide scale although, given the geographic extent, the four FRA related zones could readily be reduced to 3 with the 'likely and 'maybe' zones amalgamated. Equally the flood management zones will be significant when considered at the catchment scale and across the full Park area. This level of SFRA zoning and the comprehensive flood database for the entire Park would be powerful tools for planning decision making.

Elsewhere in this report it is recommended that a standardisation of flood records is introduced for all settlements across the Park, potentially under the leadership of the Association of Community Councils, and it is further recommended that these records are collated centrally and periodically entered on the Park wide database along with any new reports and studies to ensure it is as comprehensive and up to date as possible.

7.9 Links with other Spatial Plans

It is important to ensure there are not just links between flood risk management and other spatial plans but through time these become closely integrated. The EU Water Framework Directive (2000), Floods Directive (2007) and climate change adaptation policies are all trying to achieve a more integrated approach to land, water and resource planning processes, and this SFRA is an important step forward.

A catchment focused approach will assist in the coordination of flood risk management with other aspects of water, land and resource management, ultimately providing a basis for integrated management of water and land resources. This can help identify opportunities where public funding can be used to deliver multiple benefits, which could include simultaneously reducing the risk of flooding, while also improving water quality and enhancing water resources and biodiversity.

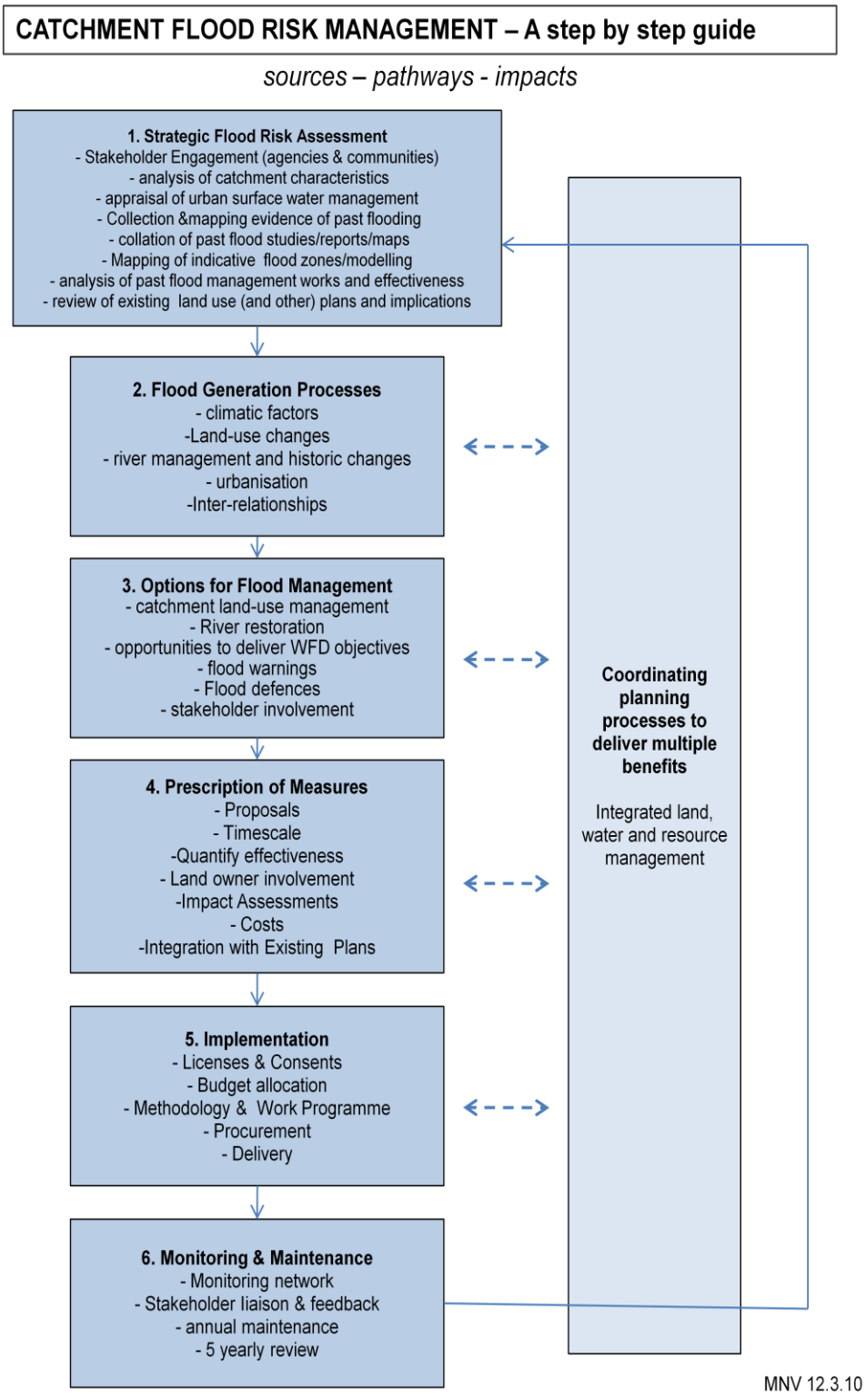


Figure 20 Catchment Flood Risk Management – a step by step guide

8 Conclusions & Recommendations

A significant number of properties in Callander are at risk of flooding from a number of sources. The River Teith is by far the most significant potential flood source, and the most well understood. However, a number of other sources including small watercourses, combined sewer systems and overland flow routes pose a substantial level of flood risk. The flooding data available for these sources is often limited, and the level of flood risk associated with these sources is very unpredictable.

A large amount of information was made available for this SFRA, including various flood studies, photographs and letters from the community. Bringing the information together into a single database will allow the planning process to be fully informed and streamlined.

The database is simple to use and maintain, and the link to GIS allows flood risk issues in Callander to be visualised in a unified and straightforward way, and ensuring that development planning and future flood studies can be suitably targeted. It is recommended that the National Park (the Planning Authority) should be responsible for managing this database, in close collaboration with Stirling Council (the Responsible Authority for flooding), with access allowed to other statutory bodies and stakeholders. A key benefit of maintaining the flood risk database would be that it will be relatively easy for the National Park to establish this SFRA as a 'living document', maintaining its relevance in the face of changes in climate, land use, development and legislation. If possible, the system should be piloted by case officers before being formalised.

The study has revealed that there are many potential ways to mitigate against flooding in Callander. At a settlement level, options include land-raising with compensatory storage, channel management, and appropriate maintenance of water-related infrastructure, although in an urban setting these measures tend to be carried out in a reactionary and piecemeal manner. Options for flood management are much less restricted when the catchment is considered as the unit of focus. This integrated approach to flood risk management is in line with contemporary legislation, including the Flood Risk Management (Scotland) Act of 2009. Sustainable Flood Management techniques that can be carried out at a catchment level include reservoir management, establishing native woodlands and restoring wetlands.

This SFRA was commissioned for the settlement of Callander, but the structure has been designed to allow it to be used as a template for expanding the SFRA to the catchment level, and beyond to National Park level. It can also be used to inform future planning policy guidance. In particular, sections 2 and 6, and the appendices could form the basis of a generic Park-wide Supplementary Planning Guidance document with settlement based SFRA's.

Local development policy regarding flood risk should be designed to protect the most vulnerable people and property, yet be flexible to ensure sustainable development. It is important that flood risk information is reviewed together with other spatial plans and park plan policies, and that all statutory agencies work cooperatively to achieve a sustainable catchment-wide approach to flood management.

9 Glossary & Abbreviations

Annual Exceedance Probability	The probability, determined statistically, that a flood of given size will be equalled or exceeded in any given year. See also 'Return Periods'
Annual Flood Maxima Series	The highest peak discharge of a stream in a hydrological year.
CCC	Callander Community Council
Catchment	An area that collects and drains rainwater. All of the runoff produced in a single catchment will drain into a single river.
Conservation Area	Conservation areas are places which are designated as desirable to preserve as a result of special environmental, architectural, historic or scientific interest.
Digital Elevation Model (DEM)	A digital representation of ground surface topography or terrain. DEMs are used within a GIS.
Floodplains	The area of low-lying land next to a river that is inundated with water, occasionally or periodically, when the river overtops its banks.
Flood Envelopes	The area potentially affected by a flooding source.
Flood Frequency Analysis (FFA)	The use of historical flow records to investigate of the average time periods between flood events with a similar magnitude. FFA can be used to help predict the magnitude of future flood flows.
Flood Management Zones	Encompasses potential areas in which flooding can be reduced or prevented through the implementation of a range of flood mitigation measure.
Flood Model	A computer simulation of a flood event using topographic information and discharge data.
FPA	Flood Prevention Authority
FRA	Flood Risk Assessment. FRAs assess the risk of flooding to a localised area from a number of potential flood sources.
Fluvial	Refers to rivers and river processes.
GIS	Geographic Information Systems. Specialised software used to store, integrate, analyse and display spatially referenced data.
Hydrometric Data	Data relating to rainfall and water flow.
Leaky Barriers	Natural Flood defences that 'hold' water during times of flooding, releasing it gradually back into the river when the flooding subsides (e.g. riparian woodland).
LL&TTNPA	Loch Lomond & The Trossachs National Park Authority
NPA	National Park Authority
PPS25	Planning Policy Statement No.25: Development and Flood Risk. Available on-line at: http://www.communities.gov.uk/publications/planningandbuilding/pps25floodrisk
RE.15	Rainfall Equivalent recorded at 15 minute intervals
Return Periods (e.g. 1 in 50 year Flood Events)	The average length of time between two flood events of a similar magnitude. For example, a '1 in 50 year flood event' refers to a magnitude of flood that is on average only experienced every 50 years. See also 'Annual Exceedance Probability'
Runoff	Precipitation that drains through the catchment to become stream flow
SC	Stirling Council

SEPA	Scottish Environment Protection Agency
SFRA	Strategic Flood Risk Assessment
SFM	Sustainable Flood Management
SG.15	Height of River Stage (level) recorded at 15 minute intervals
SPP	Scottish Planning Policy
SUDS	Sustainable Drainage Systems. SUDS are systems used to manage surface water runoff in an urban environment (e.g. wetlands, permeable surfaces, underground storage etc.)
Topographic Data	Data relating to the shape and elevation of the ground surface.
Trash lines	Visual indications of the height of a flood from the debris left behind. For example, branches caught in a fence.
0.5% Flood Map	Map showing areas in which there is a 1 in 200 chance that they will flood in a given year.

10 Appendices

10.1 Potential Development Site Profiles

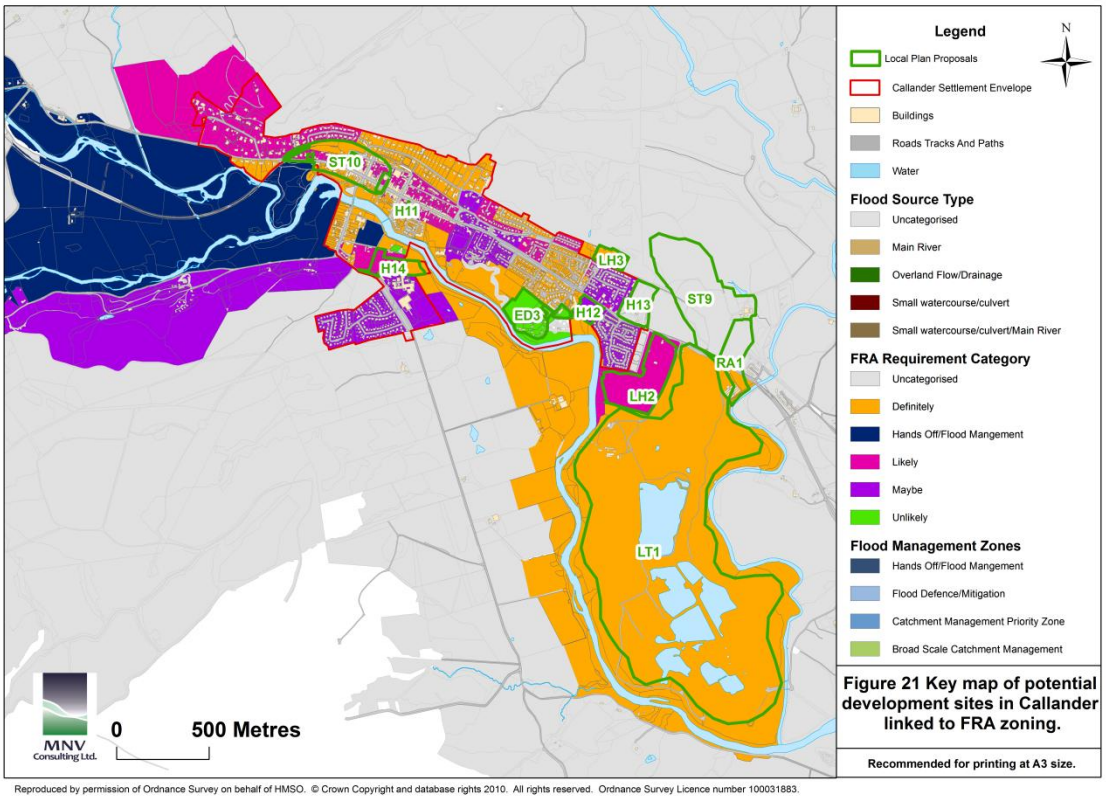


Figure 21 Key map of potential development sites in Callander linked to FRA zoning (A3 printable version provided in Appendix 9.5)

10.1.1 Pearl Street Housing (H11)

Location:

The Pearl Street site is a disused plot of land located at the rear of the Callander Kirk building and extending from the Main Street to Pearl Street.

The area of the site is approximately 0.09ha.

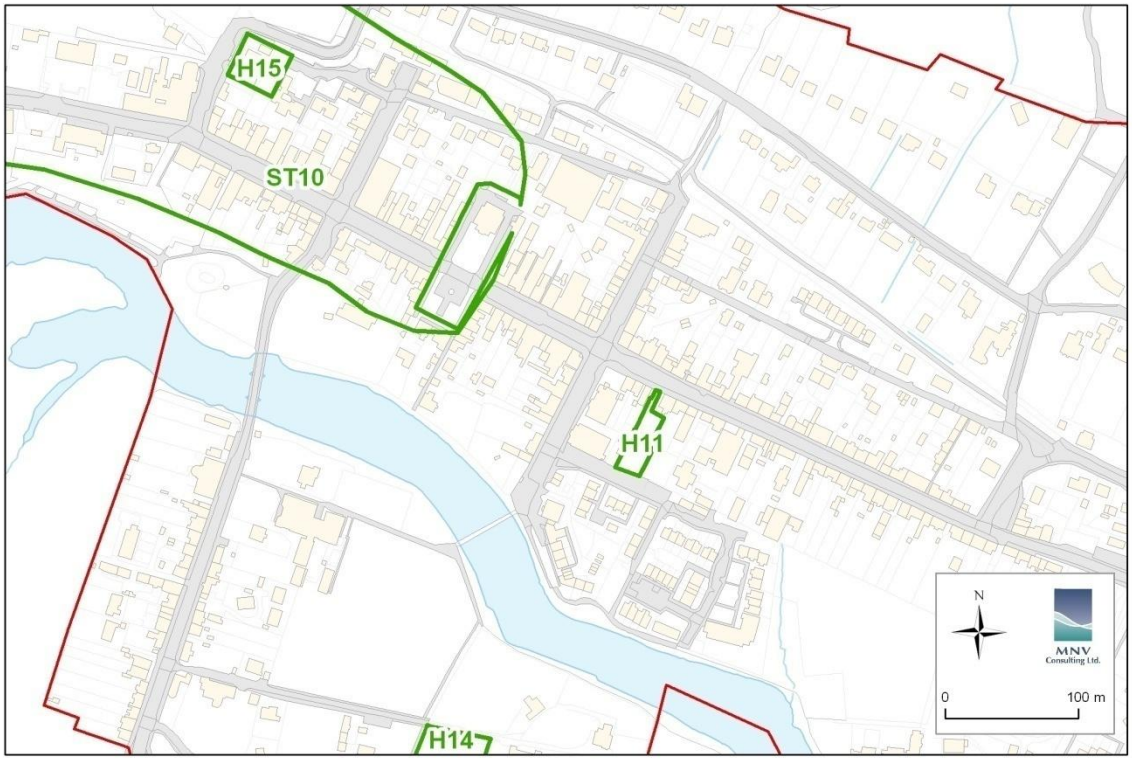


Figure 22 Location of the Pearl St development site.

Proposed development:

The site has been allocated in the Local Plan as a potential development site for 5 houses.

Potential flood risks:

There is no recorded history of flooding at this site however, it lies in a vulnerable area of the town and therefore an FRA should be carried out for this site.

Flooding from the River Teith has occurred at properties on South Church St. There is also a small burn to the east of the site which could have the potential to cause flooding. There is a documented history of flooding at properties on Main Street as a result of insufficient drainage systems to cope with peak flood events. This problem has been corrected and currently appears to be working effectively.

Figure 23 Flooding in Callander in 2006 showing the location of the Pearl St development site.

Potential flood mitigation measures:

To reduce the likelihood of flooding at the site, sufficient drainage should be installed to reduce the impact of any overland flow from flooding of the River Teith or the burn or from insufficient drainage network capacity.

The historical issue of flooding from poor drainage capacity on the Main St is likely to have been resolved, however, maintenance is ongoing and this should be continued with future reassessments of the drainage capacity.

A flood risk assessment may highlight the potential for parts of the site to be inundated and in such a case, some land-raising or flood proofing may be necessary.

10.1.2 Old Telephone Exchange (H15)

Location:

The Old Telephone Exchange building is located adjacent to the current Post Office on the corner of station Road, below the car park.

The site covers an area of 0.13ha.

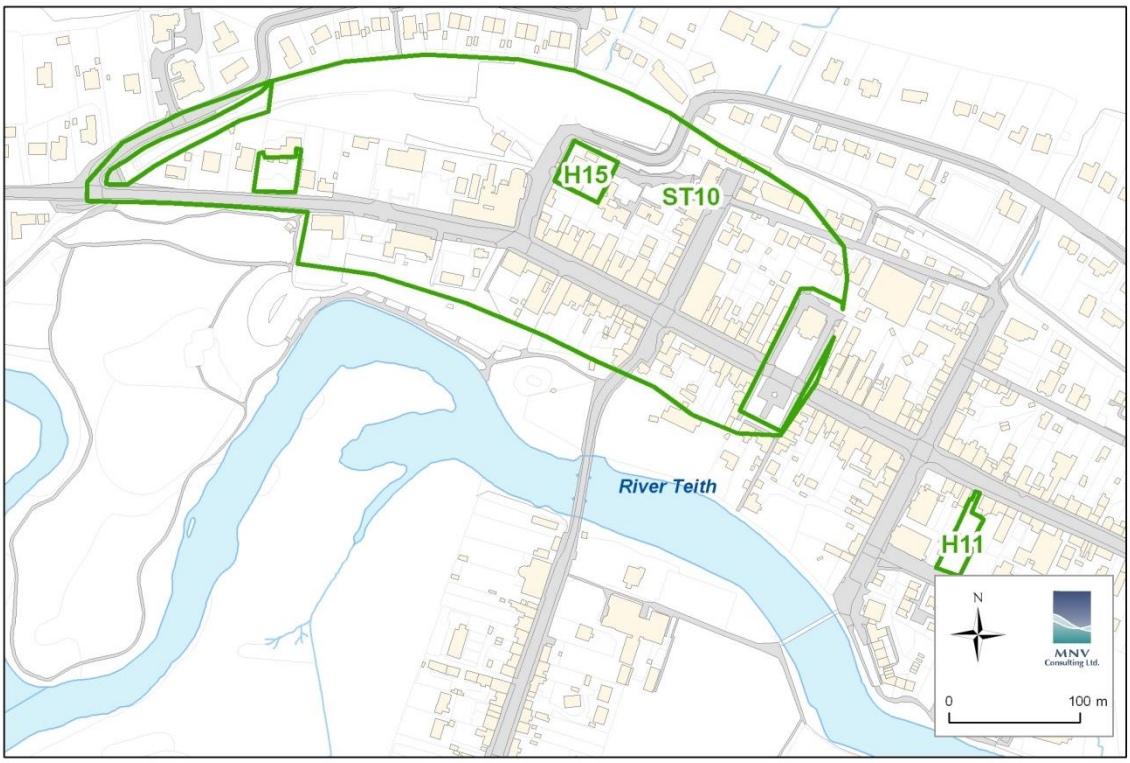


Figure 24 Location of the Old Telephone Exchange development site.

Proposed development:

The existing building is disused and consent has been provided for redevelopment into 10 residential units and 1 commercial unit. The site has now been enlarged and an application for 17 flats and one commercial unit is currently under consideration.

Potential flooding concerns:

Potential flood risk at the site is principally from drainage issues and overland flow.

There is a known flooding problem associated with the burn flowing into a culvert at the north eastern side of the Station Road car park. The capacity of the culvert is not sufficient to convey all flow during flood and debris blocks the screen, leading to overtopping and flow across the car park and down Station Road. See photograph of culvert below.

This could potentially affect the development site as it lies below the current road and car park elevation.

Figure 25 Culvert at Station Road car park

Potential flood mitigation measures:

Regular monitoring and maintenance of the culvert is currently in place and this should continue.

Future reassessment of the drainage capacity for the road and the car park should ensure that any surcharge or overland flow is redirected away from buildings including the development site, and that the flooding problem is resolved through upgrading of the drainage network including the culvert.

10.1.3 Callander Town Centre (ST10)

Location:

The Callander Town Centre development zone incorporates much of the Main Street business area of Callander from the western side of Ancaster Square to Leny Road at the end of Tulipan Crescent. The zone includes the Station Road car park and part of the Meadows area. Buildings excluded from this zone are the Episcopal Church and the end of the station road car park below the main road. Please refer to Figure 24 for location map.

Land use within the zone is principally commercial and tourism with some residential properties.

The proposed development site covers an area of approximately 8ha.

Proposed development:

The proposed development would include a mixture of tourism, recreation and community uses; including shops, restaurants, accommodation and office space. Services such as extended car parking, community space and visitor facilities would also be improved.

The development includes plans to integrate Main Street and the Meadows car park area through the use of double facade buildings.

Potential flooding concerns:

The previously stated issue of the culvert at the Station Road car park has historically affected infrastructure and a number of buildings in the vicinity.

The River Teith regularly floods the Meadows car park, adjacent buildings and the Main Street.

Figure 26 Flooding at Callander Meadows car park and Main St in 2005 and 2006.

Potential flood mitigation measures:

Flood proofing for individual buildings must be maintained and enhanced for existing structures and new development must be designed in such a way that it will be resistant to flood damage.

Any existing problematic culverts and pipelines should continue to be monitored and maintained, with reassessment of their suitability in the future.

The catchment approach should be implemented on the River Teith to reduce peak flood flows, although this would require a coordinated approach beyond the responsibility of individual developers.

10.1.4 Churchfields Housing (H14)

Location:

The proposed site is located immediately to the north of McLaren High School on the south side of the River Teith.

The site is currently utilised as grazing land and has an area of 2.54ha.

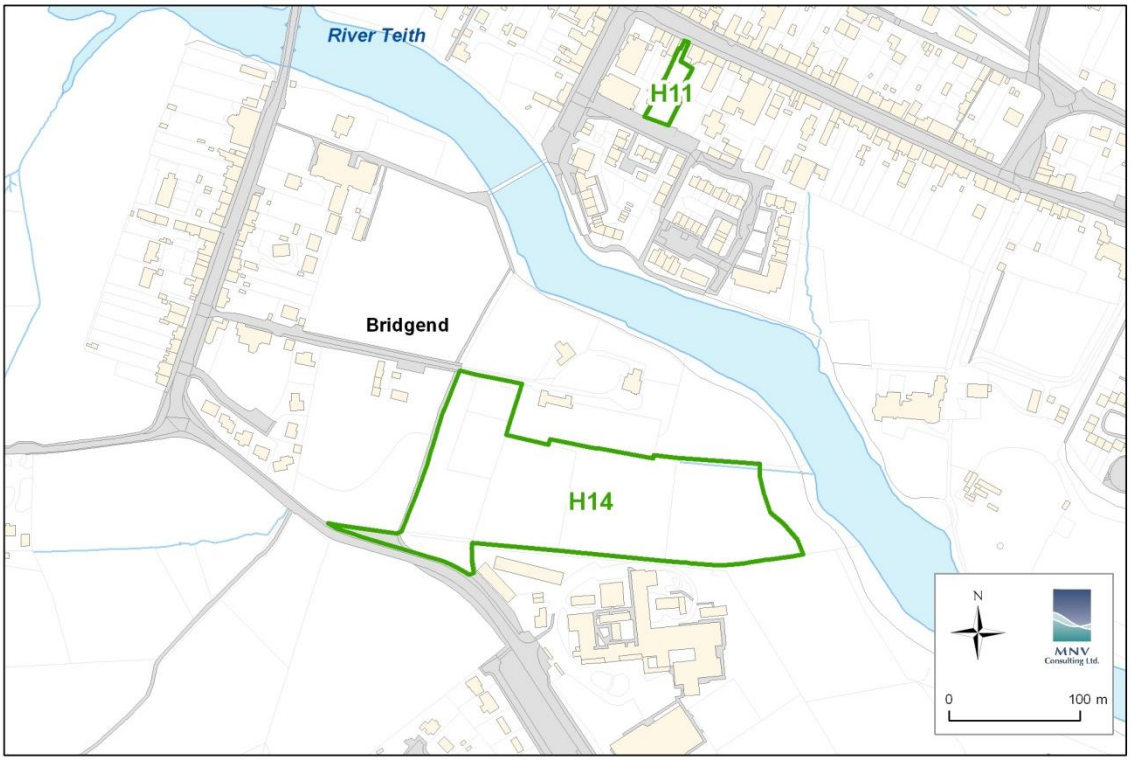


Figure 27 Location of the Churchfields development site.

Proposed development:

This site has been identified as the potential location for up to 28 residential properties.

Existing development constraints:

No development will be permitted adjacent to the river due to landscape and flooding constraints.

Any development would be required to leave open land along the western boundary and footpath adjacent to this site.

Potential flooding concerns:

The majority of this site is not thought to be at risk of flooding from the River Teith.

Drainage issues cause saturation and occasional standing water over this site. Existing road drainage problems have resulted in excess water from the adjacent being discharged onto the fields. Flooding related to a problem culvert at Castle Grove to the west is unlikely to affect the development site.

Figure 28 Churchfields site showing some standing water.

Potential flood mitigation measures:

Ensuring that sufficient drainage is included in future construction plans.

Existing drainage problems should be assessed and solutions agreed on by all relevant parties.

If required, designs for construction should include placing houses away from flood prone areas, using flood proof materials and placing floor levels at an elevation that would prevent inundation of properties if flooding was to occur.

10.1.5 Tannochbrae Housing (H13)

Location:

Currently in the construction phase, this site is located at the entrance to Callander from the east, on the northern side of the A84; the site previously used as a chalet park.

The site occupies an area of around 3.05ha.

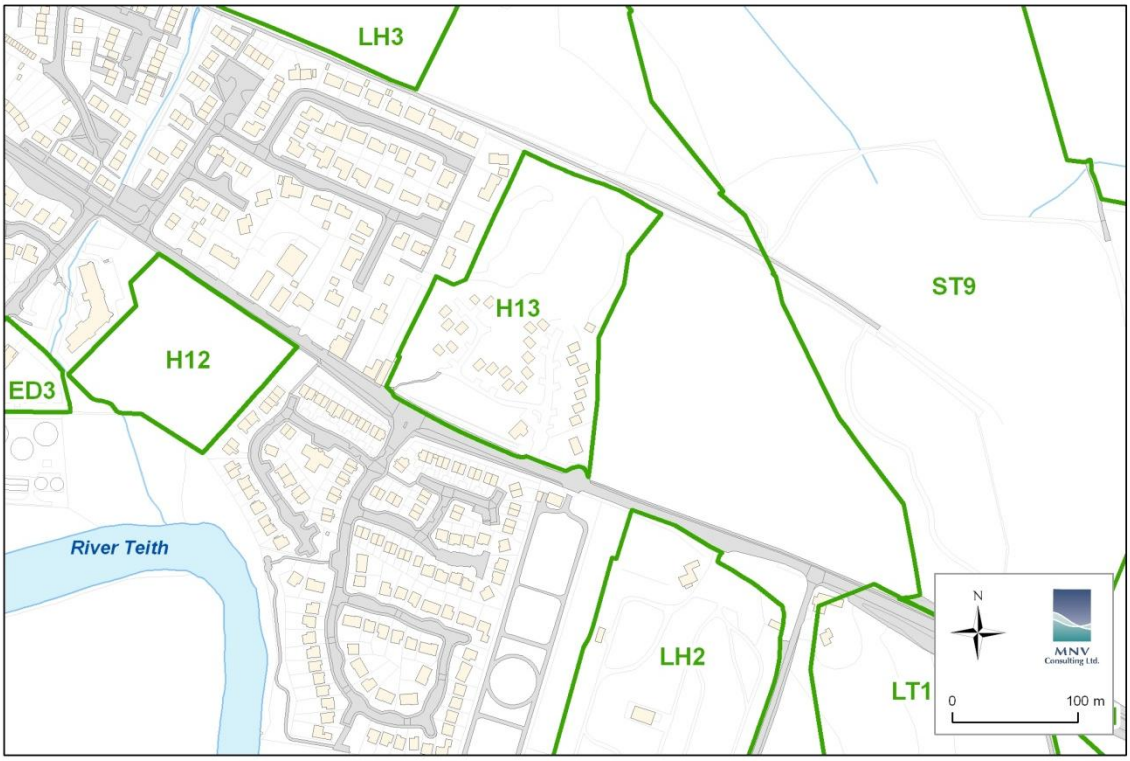


Figure 29 Location of Tannochbrae development site.

Proposed development:

The proposed development is for 52 individual residential properties (Figure 30).
Planning permission has been granted for this site and development is underway

Figure 30 Published design of the Tannochbrae site by Bellway

Potential flooding concerns:

Overland flow and sub surface drains from the woodlands to the north of the site are the principal concerns here. There are no open watercourses in the vicinity.

Potential flood mitigation measures:

Ensuring that adequate drainage is included in the development plans to allow any water to drain away quickly.

Cooperation with neighbouring land owners could potentially lead to a reassessment of the existing drainage network. Redirection of existing drains, management of wet areas and ponds and upgrading of structures may, in the future, present opportunities for more effectively managing the drainage.

10.1.6 Lagrannoch Economic Development (ED3)

Location:

Further development is proposed for the existing Lagrannoch industrial estate to the south of the Gullipen View.

The proposed site has an area of approximately 4.08ha.

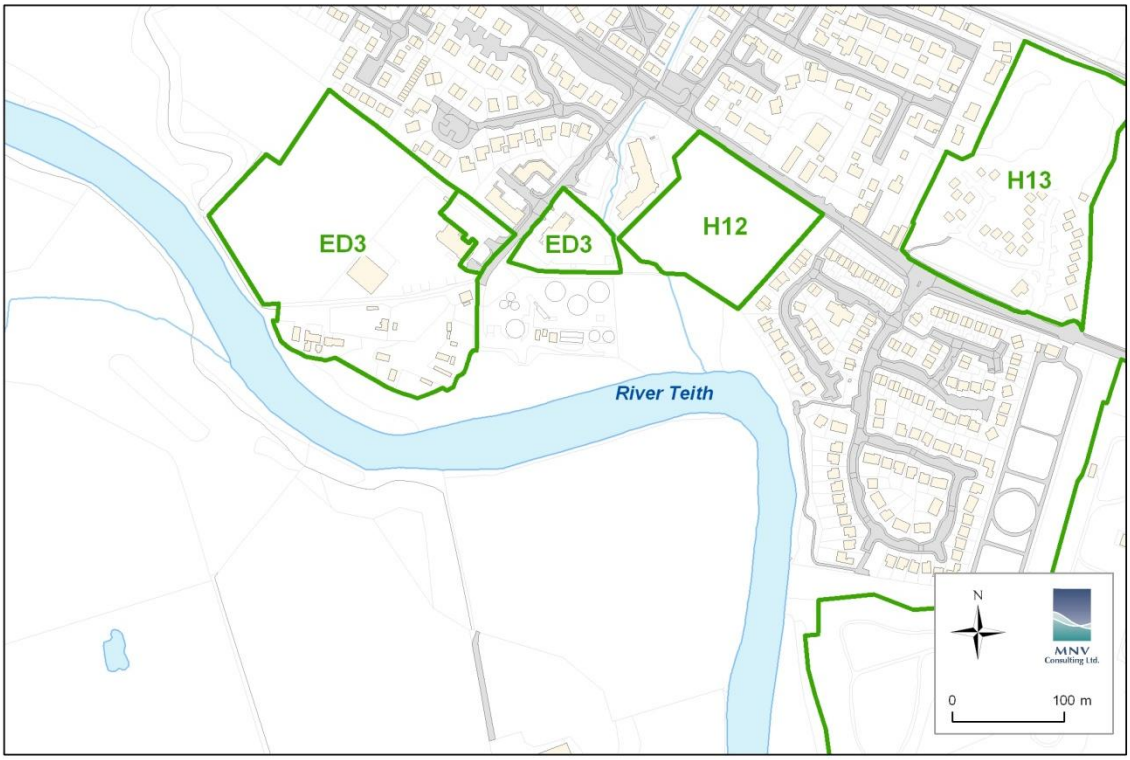


Figure 31 Location of Lagrannoch development sites.

Proposed development:

The proposed development consists of plans for Class 4 and 5 (office and industrial) uses.

Potential flooding concerns:

The development site is adjacent to the River Teith, and could therefore be at risk of flooding (Figure 32). The SEPA indicative flood map shows that part of the site is likely to be inundated in a 0.5% AEP, or 1 in 200 year flood event.

Previous flooding problems have been recorded at Gullipen View to the north east of the site and are related to flooding of the Mellis Burn (Figure 33). This recurring problem could potentially impact new development in this area.
A piped watercourse beneath part of this site will need to be investigated in terms of flood risk

Figure 32 2006 flood at the Lagrannoch industrial site.

Figure 33 Mellis Burn at the A84 during flood in 2004 (photograph taken at the junction of the A84 and the road to leading to the Medical Centre, Gullipen View and the industrial estate).

<u>Potential flood mitigation measures:</u>

Catchment wide and local scale mitigation of floods in the Mellis Burn using Sustainable Flood Management techniques as well as upgrading and maintaining existing structures and pipeline capacity. This may require a coordinated approach beyond the capability of individual developers.
Development on the site should be located outside of the 0.5% AEP flood outline and any structures or buildings should be built using flood-proof and resilient materials.

10.1.7 Lagrannoch Waste Management Development (ED3)

Location:

Please refer to Figure 31 for location map.

The site is located in the Lagrannoch industrial estate, immediately to the south west of the Medical Centre, on the plot currently occupied by the Callander Fire Station.

Proposed development:

The safeguarded site consists of a waste management facility.

Potential flooding concerns:

Previous flooding problems have been recorded at the A84 and at Gullipen View to the west of the site, related to flooding of the Mellis Burn (Figure 33). This recurring problem could potentially impact new development in this area.

Potential flood mitigation measures:

Catchment-wide and local scale mitigation of floods in the Mellis Burn using Sustainable Flood Management techniques as well as upgrading and maintaining existing structures and pipeline capacity. This may require a coordinated approach beyond the capability of individual developers.

Structures and buildings should be designed in such a way that they are resilient to flooding.

10.1.8 Stirling Road Housing (H12)

Location:

Please refer to Figure 31 for location map.

This site is a 1.48ha open area of grassland which is not currently in use. It lies to the south west of the A84, immediately to the east of the Health Centre.

Proposed development:

Planning permission has been granted for the construction of 30 housing units.

Potential flooding concerns:

Flooding of the Mellis Burn onto the A84 is common (Figure 33) and has the potential to impact on the Stirling Road site although this has not previously been documented.

Potential flood mitigation measures:

Catchment wide and local scale mitigation of floods in the Mellis Burn using Sustainable Flood Management techniques as well as upgrading and maintaining existing structures and pipeline capacity. This may require a coordinated approach beyond the capability of individual developers.

Adequate drainage capacity should be integrated in the final design for the site and should be capable of removing overland flow to prevent any build up of floodwater on the site.

10.1.9 Callander East Auchenlaich Development (ST9)

Location:

The site lies on the outskirts of Callander, to the west of the Keltie Water and to the north of the A84. The existing Keltie Caravan Park development and potential Callander East Rural Development (RA1) are situated to the east of the site.

The development area is 18.29 ha and is currently used predominantly for grazing, part of which has been reclaimed form quarry workings.

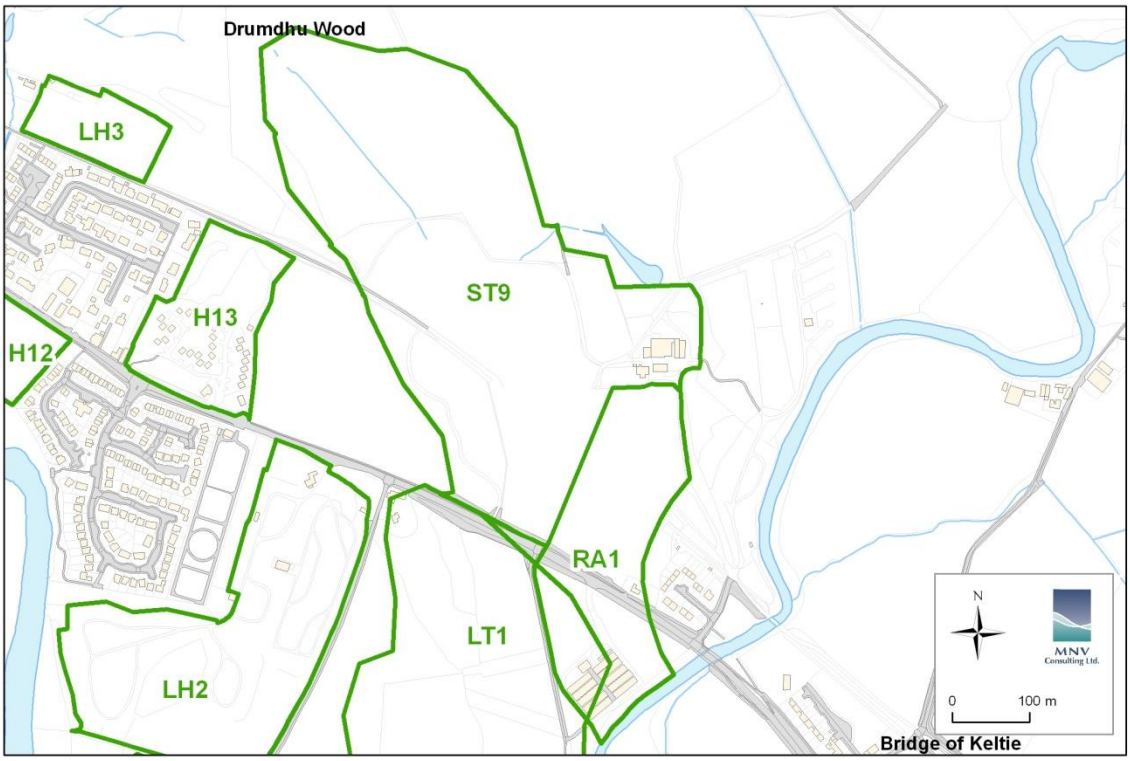


Figure 34 Location of Callander East development sites.

Proposed Development:

Hotel on western part of the site to the west of a farmhouse and buildings, some scope for self catering accommodation and camping and caravanning.

Existing development constraints/requirements:

Any development of this site would have to be feasible with respect to the history of mineral extraction at this site.

This site falls within a Special Area of Conservation linked to the River Teith and therefore any development would be subject to restrictions related to this.

Site access including pedestrian and cycle routes should be preserved and improved.

Potential flooding concerns:

The Keltie Water can be a source of flooding in the area and other burns and ponds should also be considered when assessing flood risk.

Overland flow from farmland and the golf course is a potential issue for this site.

Potential flood mitigation measures:

Catchment wide and local scale mitigation of flooding on the Keltie Water could have a wide variety of benefits. This may require a coordinated approach beyond the capability of individual developers.

Structures should be placed outwith any areas that are known to flood and at an elevation at which they will be protected from floodwaters.

Sufficient drainage must be in place on the site to prevent accumulation of overland flow.

10.1.10 Callander East Rural Development (RA1)

Location:

The site lies on the outskirts of Callander, on the western side of the Keltie Water and on either side of the A84 immediately to the west of the existing caravan park and including the existing mushroom factory. See Figure 34 for location map.

The area of the site covers 5.59ha.

Proposed development:

The proposed development consists of horticultural, small scale wood processing, food processing and other business/industry.

The east of the site would be primarily commercial land potentially including horticultural land, a small-scale wood processing plant and food processing factories.

Existing development constraints/requirements:

Any development of this site would have to be feasible with respect to the history of mineral extraction at this site.

Any future development would be required to retain any areas with special designations such as ancient monument/archaeology sites and sites with features associated with relict farming and historical land use. This site also falls within a Special Area of Conservation linked to the River Teith and therefore any development would be subject to restrictions related to this.

Site access including pedestrian and cycle routes should be preserved and improved.

Potential flooding concerns:

The Keltie Water can be a source of flooding in the area.

Overland flow from farmland and the golf course is a potential issue for this site.

Potential flood mitigation measures:

Catchment wide and local scale mitigation of flooding on the Keltie Water could have a wide variety of benefits. This may require a coordinated approach beyond the capability of individual developers.

Structures should be placed outwith any areas that are known to flood and at an elevation at which they will be protected from floodwaters.

Sufficient drainage must be in place on the site to prevent accumulation of overland flow.

10.1.11 North of Lagrannoch Drive (LH3)

Location:

The development site is a 1.44ha area of grazing land immediately to the east of the Mellis Burn north of Lagrannoch Drive.

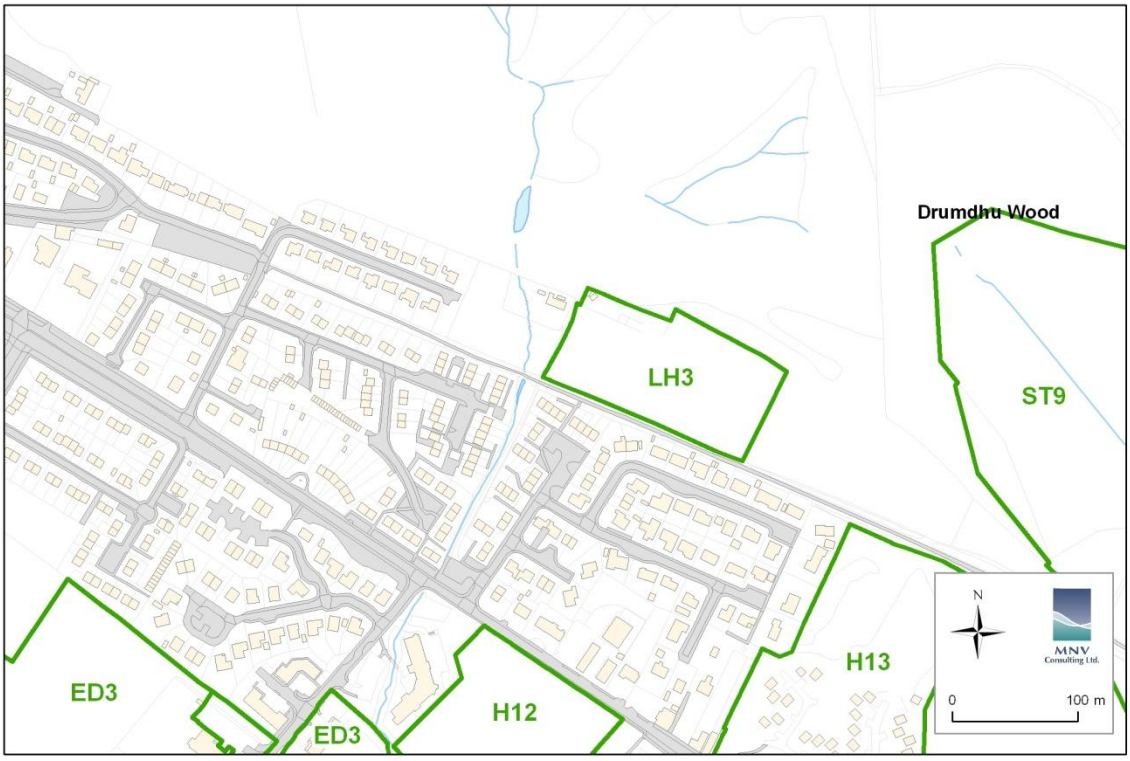


Figure 35 Location of North Lagrannoch development site.

Proposed development:

The proposed long term development is for 28 residential housing units on the site. This would be a long term development (expected between 2016 and 2020) as site access has not yet been resolved.

Potential flooding concerns:

The Mellis Burn regularly causes flooding problems downstream, partly as a result of insufficient capacity in the culvert on the upstream side of the cycle track close to the southern edge of the development site. Backing up of this culvert and blocking of the channel by debris could lead to water spilling out from the Burn onto the site. The culvert has been twinned since 2004, doubling its capacity, but it is recommended that this potential bottleneck should be re-assessed prior to any development.

Overland flow from the golf course is another source of potential flood risk for the site.

Potential flooding mitigation measures:

Continuation of existing monitoring and maintenance program on Mellis Burn and golf course culverts and ditches.

Future reassessment on the suitability and capacity of the drainage network in this area.

Increased capacity as required if the development plan proceeds in order to prevent overwhelming the existing drainage network.

Sufficient drainage systems to prevent the build up of overland flow at the site.

10.1.12 The Gart Caravan Park (LH2)

Location:

The existing caravan park is located at the entrance to Callander from the east, adjacent to the town cemetery.

The site has an area of 8.74ha.

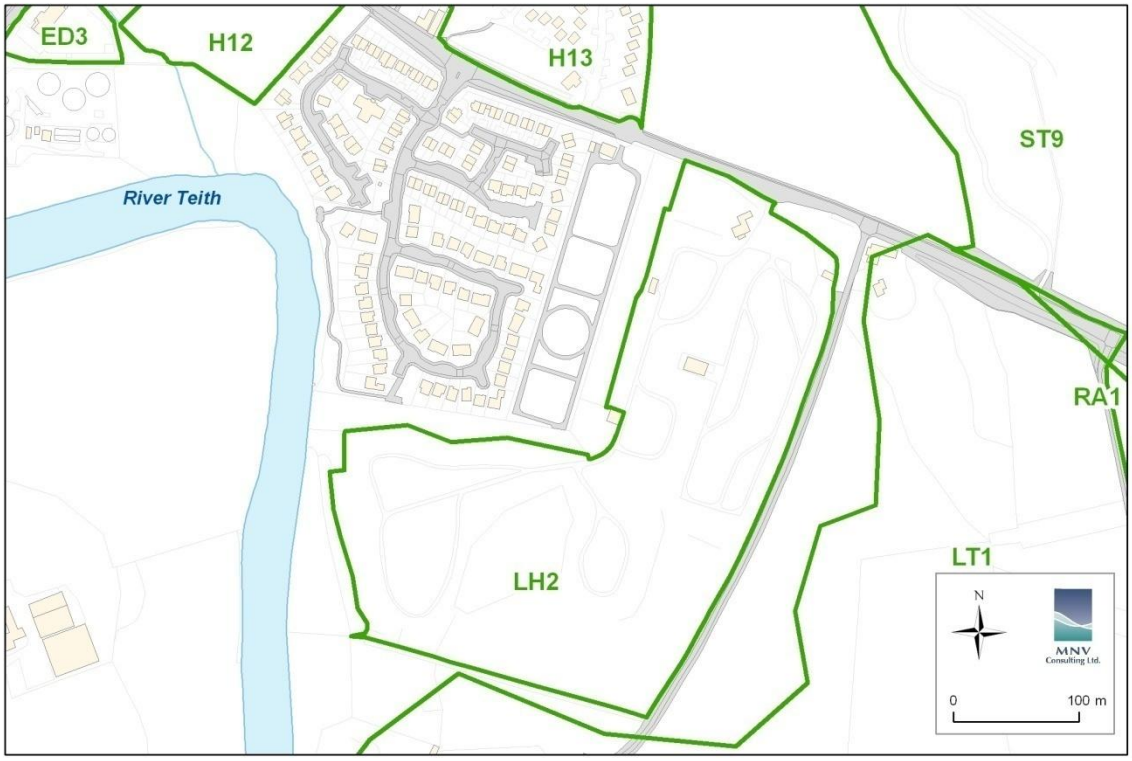


Figure 36 Location of the Gart Caravan Park development site.

Proposed development:

The proposal is for 174 individual houses as part of a long-term housing opportunity.

As the site is currently occupied by the Gart Caravan Park, and contributes to the tourism industry in Callander, any re-development of this site could only take place if the static caravan park could be re-located to another suitable site (e.g. the Callander East Caravan Tourism site).

Potential flooding concerns:

Although there is no documented history of flooding at this site, there is a potential risk for the western edge, adjacent to the River Teith (Figure 37). The SEPA indicative flood map shows that a small part of the site is likely to be inundated during a 0.5% AEP event.

Figure 37 flooding in the River Teith at the Gart Caravan Park

Potential flood mitigation measures:

Catchment scale flood management on the River Teith could help to reduce the peak flows during floods, which would reduce flood risk at this site and others. This may require a coordinated approach beyond the capability of individual developers.

It is critical that a detailed flood risk assessment be carried out and that development is outwith flood prone areas of the site.

The left bank of the River Teith on the western edge of the site could be maintained to prevent degradation and to allow it to continue to protect the site in high flows. However as this embankment is not part of a formal flood defence scheme, it is unlikely to provide adequate protection to permit residential properties within the 1 in 200 year floodplain. The natural (undefended) extent of the active floodplain would have to be determined through site-specific FRA. This may restrict the space available for the proposed development.

10.1.13 Callander Cambusmore Tourism (LT1)

Location:

The development site is located to the South west of Keltie Bridge, on the outskirts of Callander, at the confluence of the Keltie Water and the River Teith.

The entire development covers an area of 133.64 ha.

An Aggregates (sand and gravel) quarry operated by Russell Quarry Products Ltd currently occupies much of this site. Mineral extraction consents for this site have been granted up to the year 2023.

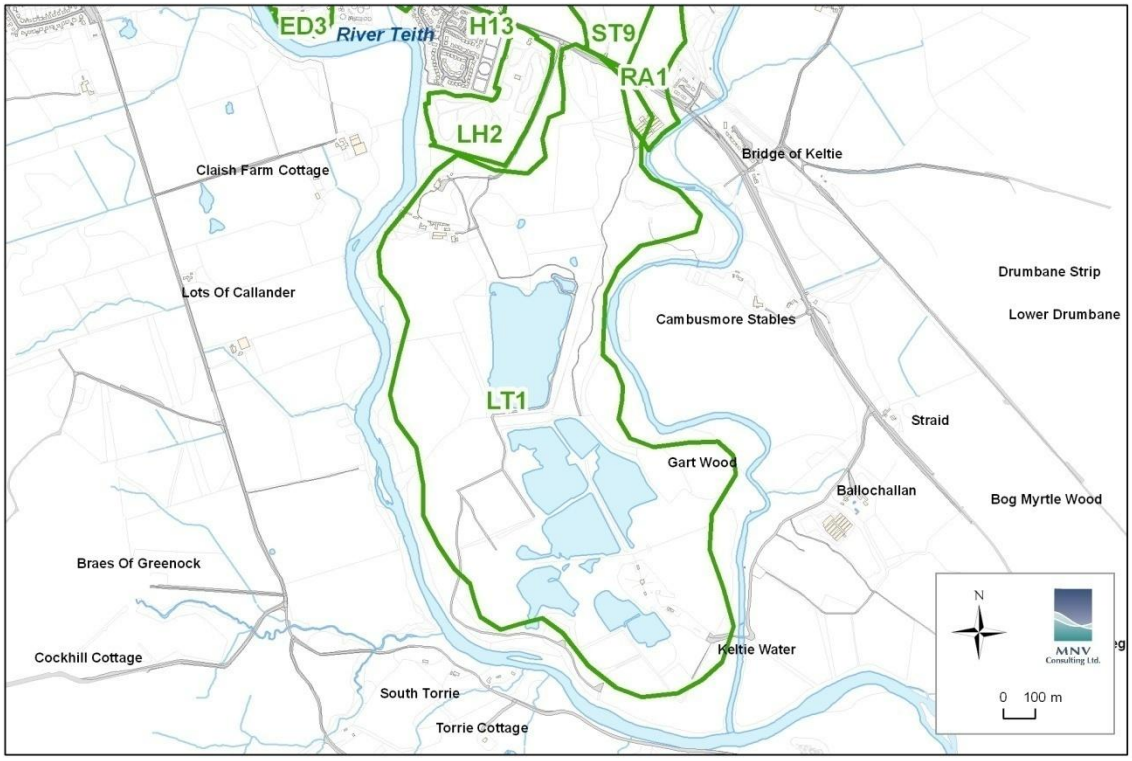


Figure 38 Location of Cambusmore development site.

Proposed development:

The proposed development is a large-scale tourism resort comprised of a Hotel/Spa development and a self-catering/timeshare development.

Other possible uses include recreational activities such as walking and cycling, construction of a golf course and possible equestrian uses.

Existing development constraints:

The site would be required to comply with regulations concerning the protection of the Scheduled Ancient Monument and preserve the existing features associated with past land uses and relict farming.

Appropriate site access would also be a requirement of development at this location and would be co-ordinated with surrounding developments, potentially incorporating a pedestrian footpath along the side of the Teith to link the site with the town.

The way in which the development will exist within the character and setting of Callander would also be a major consideration with a landscape and visual assessment being conducted. Continued and improved use of the existing quarry's structural planning would be required.

Potential flooding concerns:

As the proposed development would be situated at confluence between the River Teith and the Keltie Water it may be vulnerable to flooding during periods of high flow.

The capacity of the ponds may be such that during excessive rainfall, overtopping may occur.

Potential flood mitigation measures:

Catchment scale flood management on the River Teith and Keltie Water could help to reduce the peak flows during floods, which would reduce flood risk at this site and others. This may require a coordinated approach beyond the capability of individual developers.

It is critical that a detailed flood risk assessment be carried out and that development is outwith flood prone areas of the site. Given the extent of the site, the recommended approach would be to master plan the site, balancing proactive flood mitigation and management alongside development inspirations.

An assessment should be made of the capacity and drainage network associated with the quarry ponds on the site.

10.2 Guidance on the Interpretation and Use of the Callander SFRA Zoning and SFRA Database for Case Officers

Callander SFRA Zoning
As a core element of the SFRA for Callander, a map has been generated setting out five different zones for the settlement, and providing guidance on the need or otherwise for a site-/ development-specific FRA for any development proposals put forward for a site within that zone (Figure 15).

Case officers should note that the zones have been generated using GIS and they have been compiled from the information contained within the database. GIS is the ideal tool to visualise information from the database and to streamline the outputs of the maps. Clusters of data have therefore been grouped to create clearer boundaries, and in this context generalisation leads to loss of detail.

The zones are therefore subjective as there are some areas and properties within envelopes where there are no historic records of flooding and no reports of flood incidents in the database. The terminology is therefore critical as these zones are **not** flood risk areas but areas where FRA would be recommended for a development as and when a proposal is put forward. FRAs may be stage 1 (simple) or stage 2 (including modelling), depending on the specifics of the site.

The zoning adopted in this SFRA has five different levels with four ranging from 'FRA definitely required' through to 'FRA unlikely to be required' and the final zone being defined as 'flood management zone'. When considering individual applications or proposals, case officers must interpret the zoning on a 'sliding scale', varying according to the vulnerability of the proposed development based on current national guidance:

FLOOD RISK AND VULNERABILITY

- Essential infrastructure (roads, electricity sub stations)
- Highly vulnerable (emergency services stations – medical centres, fire stations)
- More vulnerable (housing)
- Less vulnerable (industrial units, retail)
- Water compatible (flood defences, water recreation, nature conservations)

No development should be considered within the flood management zone unless this is water compatible and does not in any way exacerbate existing known flood risk.

Callander SFRA Database
The SFRA database was compiled in 2010 utilising some 360 relevant flood records covering a period of 20 years from 1990. For each entry in the database the following information has been recorded (where available)

- Grid reference
- Location of flooding
- Flood Date
- Source of flooding
- Issues / Information on the flood event
- Information Source

This is compiled in a spreadsheet, and where the data has a spatial context this has been plotted on maps using ArcMap GIS (Geographical Information System) software. The spreadsheet was loaded into GIS software with the OS Mastermap data as a background layer (see Figure 39). Mastermap data is presented as layers of lines and areas indicating features such as roads, buildings, field boundaries, natural features and others. This data can be selected and categorised and it was this process which formed the basis of the maps shown in the finished report. By manually assessing the database, it was possible to make a general assessment of the likelihood of future flooding for sections of Callander based on past flooding history, model outputs and reports of the causes and sources of flooding. Boundary lines and buildings from the Mastermap layers have been used as the primary basis of these classifications.

One of the primary benefits from compiling the database for this SFRA is that it contains a significant amount of data and information which will assist planning case officers when considering site-specific development proposals. The information contained within the database is sensitive and therefore should not be made publicly available. It is also historic and care should be taken to ascertain whether an historic occurrence has, on the face of it, been rectified through maintenance work and investment in infrastructure. For example where a property has previously flooded from a small watercourse or drain, has maintenance or other work subsequently been undertaken to tackle the cause of the flood such as increasing the size of a culvert. Any interpretation of the data needs to be carried out cautiously, in light of the fact that the data was collected for a wide range of purposes, with very different levels of detail and accuracy.

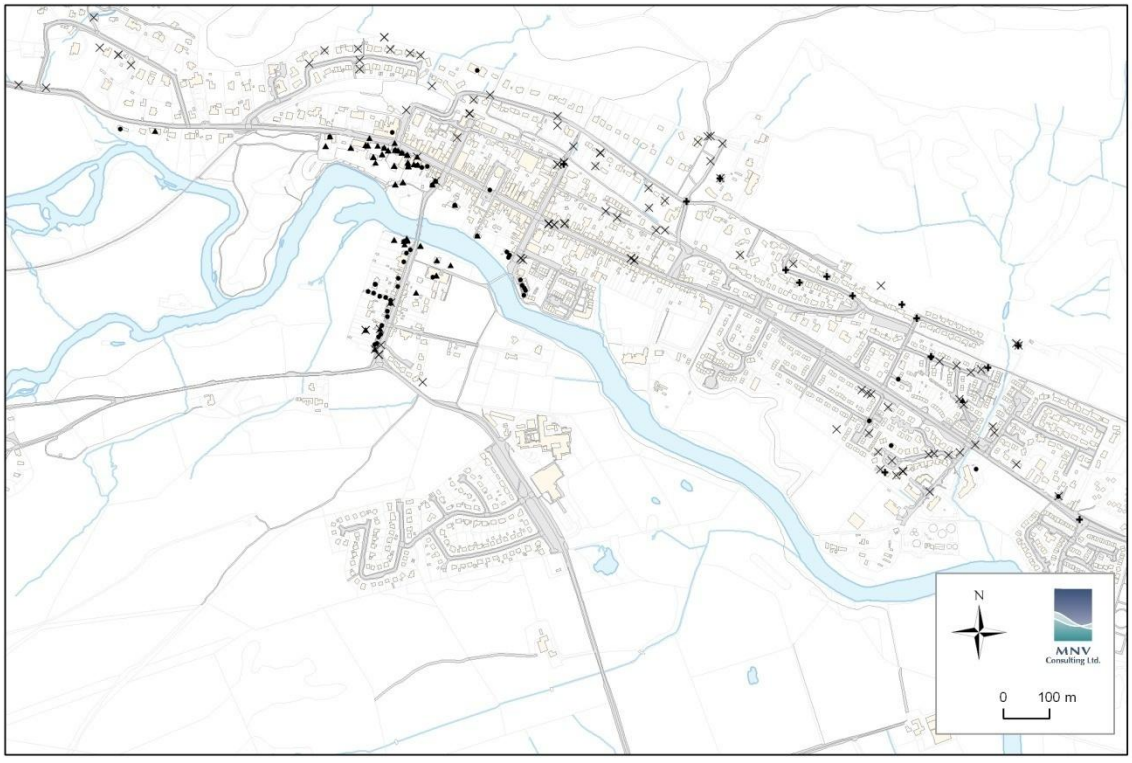


Figure 39 Indicative Map of spatial database records

A simple process is recommended for case officers when dealing with a planning application (or pre application ('pre app') discussions) for a development proposal within the settlement.

1. Determine how vulnerable the particular development type is to flood risk (see above and any recent updates in national guidance). Apply the following considerations with a greater degree of rigour, the more vulnerable the development type is.

2. Establish which Callander SFRA zone the development proposal site sits within

3. Determine whether it is an identified development site within the Local Plan and if so refer to the site profiles in appendix 9.1 for guidance

4. For non Local Plan development sites

   a) FRA definitely required: use the database and associated GIS maps to determine whether the site falls within SEPA's indicative flood zone and /or other modelling produced by SEPA / SC, or if there is a history of the site flooding. Use the information on the database to determine the main source(s) of flooding in the past to further determine whether a stage 1 (simple) or 2 (including modelling) is recommended, and also to determine what source(s) of flooding need to be considered in the FRA

   b) FRA likely to be required: use the database to determine why the site has been categorised as such. Is it a specific property with a history of flooding or is it in the vicinity of properties which have previously flooded. Determine the source of the flooding and assess whether there is a serious possibility of the site in question being affected in the future. Use this information to determine whether a stage 1 or 2 FRA is required

   c) FRA may be required: as for b) use the database to determine why the site is included in this zonation and if there is a specific concern linked to the site in question which would justify the need for a site-specific simple FRA.

   d) FRA unlikely to be required: use the database, especially any recent updates, to ensure the site is well away from other sites and potential flood sources or which have had flood issues in the past and confirm that a FRA would not be necessary

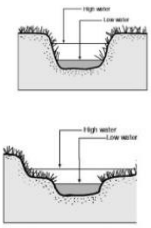
   e) Flood Management Zone: resist any form of development in this zone unless it is specifically suited (e.g. nature conservation, flood management, water recreation based) and through its implementation it can be designed to enhance its flood management role if it is specifically suited a FRA should be required and should also be used to demonstrate and possibly help define further flood management benefits offered by the scheme. It may be there are very exceptional circumstances where a development in the flood management zone can be justified, such as appropriate changes to existing structures or buildings within the zone. These type of proposals would need to be considered on a site and development-specific basis.

Table 10 Decision tree for site-specific Flood Risk Assessments

Assess vulnerability & apply a 'sliding scale' to the following considerations	**View map to assess SFRA zone**	**For Local Plan sites:**	Review site profile
		For Non Local Plan sites: review maps & database to determine potential sources of flooding:	FRA definitely required: *determine whether a stage 1 (simple) or 2 (including modelling) is required*
			FRA likely to be required: *assess whether there is a specific concern linked to the site in question which would justify the need for a site-specific FRA (stage 1 or stage 2).*
			FRA may be required: *assess whether the possibility of flood risk cannot be fully excluded from the available information. Use this information to determine whether a stage 1 or 2 FRA is required.*
			FRA unlikely to be required: *use the database to ensure the site is well away from other potential flood sources or previously flooded sites & confirm that a FRA would not be necessary.*
			Flood Management Zone: *resist any form of development unless it is specifically suited or in exceptional circumstances. Assess whether flood management benefits could be achieved e.g. by restoring wetlands as part of the development.*

10.3 Sustainable Flood Management (SFM): Sample of techniques for natural approaches in reducing flooding

SFM Technique	Example	Riparian	Floodplain	Catchment-wide	Potential locations	Key goals	Notes
Wetland restoration		✓	✓	✓	Flat upland areas, hillfoots and floodplains prone to waterlogging	To enhance flood storage capacity throughout the catchment	Can be online (i.e. physically linked to watercourse) or offline (e.g. on flat hilltops)
Gully woodland planting		✓		✓	Upland gullies	To impede rapid runoff entering steep channels and to contribute LWD to channel	May require livestock fencing
Native mixed woodland on hillslopes				✓	Deforested and drained hillslopes	To intercept rainfall and enhance soil storage capacity, and to reduce erosion	Planting on north-facing slopes, gullies and corries can enhance snow-pack retention, desynchronising winter flood peaks
Floodplain 'leaky barriers'			✓		Key floodplain zones (not close to buildings or important infrastructure)	To intercept overland flows and enhance floodplain storage potential for both water and sediments	Living walls of woven willow spiles can be constructed to disrupt flow paths over floodplains

SFM Technique	Example	Riparian	Floodplain	Catchment-wide	Potential locations	Key goals	Notes
Planting riparian buffer zones, or water margins		✓			All watercourses, particularly heavily modified watercourses and those within artificially drained areas	To impede overland flow, enhance soil storage capacity and intercept mobilised debris and sediments	May require fencing and provision of alternative water sources for livestock
Hedgerow planting and management			✓	✓	Planted across-slope along existing field boundaries	To enhance infiltration and storage within soils, and to impede overland flow of water and sediments	Perhaps suited to more intensive agricultural landscapes
Channel re-profiling		✓			Creating a two-stage channel	To maintain adequate depths during low flows, enhance winter storage and encourage more natural morphology	Requires consultation with statutory bodies
Blocking of inappropriate artificial drains using dams (permanent)		✓			Any artificial drain throughout catchment, provided it would not increase flood risk to structures or property	To slow flows, enhance water storage and intercept excess sediments. Will eventually fill in over time	Blockages may be constructed by LWD, earth, rocks, bales of hay or heather. Plastic piling may be required if incision reaches mineral substrates

10.4 Bibliography

See section 5.5

10.5 Maps at A3 size

Figures 5, 12, 15 and 21 are set out in the body of the main report but are best displayed at A3 size.

These are available as separate electronic zip files for printing at A3.

Figure 5	Sources of Flood Risk in Callander
Figure 12	The simple catchment zoning applied to the settlement of Callander
Figure 15	FRA zoning of Callander and surroundings
Figure 21	Key Map of potential development sites in Callander linked to FRA Zoning