CLACKMANNANSHIRE COUNCIL

Measures Required to Prevent or Mitigate the Flooding of Land

River Devon Floodplain from the Ochil Hills at Alva - 14/01/08

BIENNIAL REPORT – November 2009

As required by

THE FLOOD PREVENTION AND LAND DRAINAGE (SCOTLAND) ACT1997

Contents

1.0 INTRODUCTION

The *Flood Risk Management (Scotland) Act 2009*[4] was passed by the Scottish Parliament on 13 May 2009 and received royal assent on 16 June 2009. This Act repeals, *The Flood Prevention (Scotland) Act 1961*[1] and *The Flood Prevention & Land Drainage (Scotland) Act 1997*[2]. The 1997 Act required the publication of a Biennial Report, specifying the measures required to prevent or mitigate the flooding of land in the Clackmannanshire area. However, to ensure a continuity between the repealed and new legislation the Council has published this Biennial Report for 2009. This report will continue to refer to the repealed legislation but will form the basis of the schedules of work required to be produced under the new legislation. The report covers the elapsed time since the production of the previous report in November 2007.

The report will specify:

- all known occurrences of flooding of land, not being agricultural land, within the Council area since the last biennial report in November 2007;
- the measures that the Council has taken since November 2007 to prevent or mitigate flooding of such land; and
- the measures that the Council considers it requires to take to prevent or mitigate the flooding of land in the Council area.

The report will also:

- summarise the legislative framework and current Council policy on flooding and flood risk;
- provide an inventory of watercourses, watercourse crossings and structures;
- consider associated environmental issues; and
- describe development of the River Devon Flood warning system.

River Devon Floodplain at Elistoun Drive, Tillicoultry - 14/01/08

2007 Report

Since the previous report most of the proposed prevention and mitigation measures have been successfully carried out. Of the 56 sites that have been identified as suffering from flooding incidents only 9 have had recurring issues since the last report was published in 2007. There are 5 sites where flooding has occurred where no flooding has been previously recorded. The most significant flood event to have occurred in the area since the implementation of the 1997 Act inundated a number of properties in Tillicoultry in January 2008 when the River Devon overtopped the old railway embankment at Elistoun Drive. The Council took immediate action by reconstructing the railway embankment as a short term measure and instigating a Flood Prevention Scheme aimed at dealing with the longer term flood threat in the area. In addition a Flood Warning System for the River Devon Valley has been developed in partnership with SEPA.

Points to note:

- In broad terms, flooding of non-agricultural property in Clackmannanshire can normally be attributed to blockage of, or obstruction within, watercourses, inadequate capacity of watercourses or surface water drainage systems and

increasingly through the effects of climate change.

- Although possible causes of flooding of property are referred to and offered as examples in this report, it is important to note that although the Council has a duty to inspect and maintain watercourses, it has limited funds to improve the physical capacity of watercourses. *The Flood Prevention & Land Drainage (Scotland) Act 1997* [2] bestowed a duty on Local Authorities to ensure the maintenance of those watercourses likely to affect non-agricultural property. There is no duty to instigate new works to increase the capacity of a watercourse; however the local authority is given the necessary powers to implement such measures as may be appropriate.
- The Council has adopted a "prioritised watercourse assessment" methodology in carrying out functions to improve inspection and maintenance regimes.
- The Council has established a database detailing the condition of constructed, or otherwise retaining, embankments and also a database of crossings, pipes, bridges etc. on the principal burns. A prioritised programme of intervention works based on the information derived from this inspection process is being prepared.
- It should be noted that "riparian" duties of all landowners still apply in Scotland. This means that landowners retain a responsibility to ensure their land is protected from flooding, but in doing so, they cannot act in a manner that increases flood risk to other landowners. Where appropriate, works to reduce flood risk may be carried out by the Council in partnership with landowners.

2.0 LEGISLATION AND POLICY

2.1 Interpretation of Covering Legislation

Prior to 1997 it had become apparent that much of the flooding in Scotland was caused as a result of poor maintenance of watercourses. The, often innumerable, riparian landowners along a watercourse could not always be relied upon to carry out appropriate and regular maintenance works. The result was that many areas suffered from localised flooding during extreme weather events, most instances of which might have been averted had appropriate maintenance been carried out. This situation highlighted a need to place the statutory responsibility to ensure the maintenance of watercourses onto a single body.

The 1961 and 1997 Acts

The Flood Prevention (Scotland) Act 1961 [1] gave Local Authorities the necessary powers to carry out measures for the prevention or mitigation of flooding of non-agricultural land. The Act bestowed powers to enter land and to carry out maintenance works to watercourses with further powers to improve and alter a watercourse under a Flood Prevention Order.

The introduction of *The Flood Prevention & Land Drainage (Act) 1997* [2] amended the powers of the 1961 Act and places the following duties on Local Authorities:

- assessment of watercourses in their area from time to time to ascertain whether the condition of any watercourse might contribute to the flooding of non-agricultural land;
- cleansing, repairing and otherwise maintaining watercourses, barriers, embankments, other flood defence infrastructure and other ancillary apparatus such as screens, overflow runs etc.
- preparation and publishing of biennial reports specifying measures considered necessary to prevent or mitigate the flooding of non-agricultural land in their area; measures which have been taken since the publication of the previous report to prevent or mitigate flooding of such land and all occurrences of

flooding of such land since that date.

The 1997 Act does not apply where failure to maintain a watercourse would cause flooding to land in the same ownership as the said watercourse.

The Council has adopted a programme of cyclical watercourse inspection and maintenance. This includes inspection and clearance of watercourses and at times planned sediment and vegetation removal. An inventory of watercourse infrastructure and ancillary apparatus has been completed for most of the principal watercourses in the Council area and implementation plans for maintenance works have been prepared. The Council has also developed databases detailing the condition of constructed watercourse embankments and watercourse crossings on the principal burns and has prepared a programme of prioritised intervention works.

The Flood Risk Management (Scotland) Act 2009

The Flood Risk Management (Scotland) Act 2009 [4] received royal assent on 16th June 2009. The main local authority functions coming from the bill will be:-

- Reduction in flood risk at a local level through implementation of flood plans and planning,
- Delivering flood management measures or "Flood Protection Schemes",
- Preparation of Local Flood Risk Management Plans consistent with District Flood Risk Management Plans to be prepared by SEPA,
- Preparation of maps of bodies of water (watercourses, ditches, ponds etc.) and Sustainable Urban Drainage systems (SUDs).
- Assessment and inspection of bodies of water that may give rise to flooding. Preparation of a schedule of works arising from inspections to reduce flood risk. There will also be a duty to prepare this schedule of works for public inspection.

Despite the above duties for local authorities, a significant responsibility for flood

risk is to be passed to the Scottish Environment Protection Agency (SEPA), who have been tasked with carrying out a Preliminary Flood Risk Assessment for Scotland by 22 December 2011, with further duties to map flood hazards and flood risks in Scotland by 22 December 2013. Following on from these duties and using the hazard and risk information previously gathered, SEPA must then prepare District Flood Risk Management Plans by December 2015.

2.2 Statement of Policy & Actions

Introduction

The purpose of this statement is to explain the methods used by Clackmannanshire Council to comply with its current duties under *The Flood Prevention and Land Drainage (Scotland) Act 1997* [2]. The responsibility lies within Environmental Services and in particular with the Roads & Transportation Unit. Development Services, Policy and Implementation Unit has responsibility for promoting sustainable flood prevention through the planning process.

The *1997 Act* [2] places the responsibility for the assessment and maintenance of watercourses on local authorities. There is, however, no duty placed on local authorities to improve the capacity of watercourses.

The maintenance work currently carried out by Clackmannanshire Council, as a result of the assessment of watercourses, falls into the following categories:

- Clearing of debris blocking the free flow of a watercourse,
- Maintenance of walls, banks and other structures forming watercourses, and
- Improvement of infrastructure which can aid reduction in flood risk and reduce the need for maintenance.

Policy FP1 - Development of Flood Prevention Strategy

‘The Council shall develop watercourse assessment and inspection procedures annually building on the previous year’s progress’

Subsequent to the *1997 Act* [2], Clackmannanshire Council proceeded towards developing a watercourse maintenance and flood prevention strategy. The Council was advised that the development of such a strategy would take a number of years. The recommended course of action was to start by identifying and listing the watercourses, assessing the flood risk and the propensity of each section of watercourse to be affected by debris and hence to set up a cyclical programme of watercourse inspection and clearing. Each year the scope of assessment should be widened incrementally to gather more information.

Policy FP2 - Clearing of Debris

‘The Council shall take appropriate action to ensure watercourses are routinely cleared of loose debris to reduce the risk of flooding to non-agricultural land'.

Between 1997 and 2002 the entire lengths of all watercourses that could potentially affect non-agricultural land were inspected at least once each year. This inspection regime resulted in appropriate clearance works being carried out. During this time ad hoc inspections of known problem sites were carried out at regular, short intervals. During 2003 this information was analysed and together with an increasing understanding of the local hydrological characteristics it was possible to identify the appropriate priority to be placed on particular sections of each watercourse. From this a *Prioritised Inspection and Clearance Regime* [5] was developed. This is continually monitored and amended to ensure that all watercourses receive optimum attention.

Initially the clearance operations involved the removal of loose vegetation, tree material and the detritus from fly tipping. During 2002 this was extended to assessment of silt and coarse sediments within watercourses where these were considered to be adversely affecting the capacity of the watercourse channel.

Watercourse Audits and Work Implementation Plans [6] were developed during 2006 for the principal watercourses in the Council area with the clear principle in mind to ensure that resulting site works having a minimal adverse affect on local biodiversity. Similar watercourse audits are being completed for other priority named watercourses with all information to be available during 2010.

Policy FP3 - Maintenance of Banks, Walls, Culverts and other Infrastructure
'The Council shall continue to develop a database of watercourse walls, banks and other infrastructure and set up a programme of routine maintenance where lack of maintenance might increase the risk of flooding to non-agricultural land'

The Council carries out two yearly inspections of all bridges that carry adopted roads and three yearly inspections of all other bridges with spans greater than 2 metres, over watercourses. These inspections assess the structural integrity of the bridges, the condition of adjacent banks and training walls and any issues relating to debris in the adjacent section of watercourse. This information is utilised in the *Prioritised Inspection and Clearance Regime* [5].

Prior to the *1997 Act* [2] some watercourses had suffered from an extended period of poor maintenance by riparian landowners. This left a legacy of problems for the local authority. Initially maintenance work was carried out mainly at sites where structural failure had already occurred. The Council has now completed *Watercourse Audits and Work Implementation Plans* [6] for most of the principal burns in the Council area assessing the structural integrity of banks, walls, culverts, vegetation and coarse sediments within or affecting watercourse channels. Management Plans for watercourses have been developed as a result of these audits. Although some works, for example de-vegetation, do not require direct authorisation from the Scottish Environment Protection Agency (SEPA) through *The Water Environment (Controlled Activities) (Scotland) Regulations 2005* [17] prior consultation will take place with other interested parties to ensure best practice. These *Watercourse Audits and Work Implementation Plans* [6] have

helped populate a infrastructure database and also generate watercourse maintenance improvement programmes. The production of these documents were aims set out the Council's previous *Biennial Reports of 2005 and 2007* [3.]

Policy FP4 - Flood Warning Scheme

'The Council shall develop a flood warning scheme and related preparation plans'

The Clackmannanshire Council area is significantly influenced by the catchment of the River Devon and to a lesser degree by the catchment of the River Black Devon. The geomorphology of the River Devon catchment means that rain falling on the Ochil Hills together with rainfall from lower catchments can reach urban areas relatively quickly. Although effective flood warning is possible for developed areas in the vicinity of the River Devon, the Hillfoots burns fall from the steep escarpment above the Hillfoots villages and as such this renders the provision of a three-hour advance flood warning period (this is the criteria required for SEPA to adopt any warning system) impossible. However, a flood forecasting model has been developed over the last two years covering the River Devon catchment. The model uses measured data and relevant methodology to predict the flooding affects from storm events within the River Devon catchment at previously identified sensitive locations along the river.

SEPA will be able to issue advance "Flood Warnings" and "Severe Flood Warnings" for each sensitive location through their current public information service "Floodline". In addition to this service, Clackmannanshire staff will have access to the real-time Flood Early Warning System (FEWS) interface which will allow staff access to more accurate, local information (river levels, flows etc) than is otherwise available.

Watercourse and flood related survey and assessment work is continuing and the Council has commissioned a number of reports relating to specific watercourses or sections of watercourses since November 2007 as listed below :-

- Tillicoultry Elistoun Drive Flood Alleviation Study - August 2007 *(included for reference)*
- Woodburn Drive and Gavins Road, Alloa - Flood Alleviation Feasibility Study - January 2008 [8]
- Elistoun Drive, Tillicoultry - Post Flood Study - May 2008 [9]
- Tillicoultry Flood Prevention Scheme - Ground Assessment Desk Study - September 2008 [10]
- Tillicoultry Flood Prevention Scheme - Report for Stakeholders - September 2008[11]
- Geordies Wood, Pool of Muckhart - December 2008 [12]
- River Devon Flood Warning - April 2009 [13]

Policy FP5 - Flood Alleviation Works

'The Council shall develop a prioritised list of flood prevention works aimed at minimising flood risk to non-agricultural land and reducing maintenance costs'

Flood alleviation works aimed at maintaining the functional integrity of watercourses are carried out where required. The works were initially generated as a result of flood events. Now watercourses have been identified, inspection and clearance regimes are in place, an audit of all principal watercourses has been carried out and a burn crossing register for the principal Hillfoots Burns prepared. The Council continues to assess potentially problematic watercourse channels to identify works to reduce flood risk during high rainfall events and also work which will help to reduce future maintenance costs.

3.0 INVENTORY OF WATERCOURSES

3.1 Descriptions of Principal Watercourses

There a numerous watercourses within the Council area. Many of these are relatively insignificant but most have a flooding impact on non-agricultural land. The more important, or those with potentially the largest flooding impact, are termed, for the purposes of this report, as principal watercourses. Table 3.1, overleaf, identifies the principal watercourses that flow through the Clackmannanshire Council Area: -

Table 3.1- Principal Watercourses

Ref	Watercourse	Affected Community	OS Ref U/S End	OS Ref D/S End	Length (Km)
R - 01	River Devon	South side of Dollar, Tillicoultry, Alva, Menstrie and Cambus	963 976	853 940	6.8km
R - 02	River Black Devon	Clackmannan and east of Alloa	916 923	906 923	1.3km
B - 01	Brothie Burn	Alloa	912 939	887 915	4.0km
B - 02	Sauchie Burn	Sauchie	885 944	896 933	1.5km
B - 03	Fairy Burn	Alloa	871 944	889 929	2.2km
B - 04	Goudnie Burn	Clackmannan	924 914	915 923	1.4km
B - 05	Menstrie Burn	Menstrie	849 971	850 959	1.2km
B - 06	Dams Burn	Victoria Terrace, east Menstrie	856 971	857 968	0.2km
B - 07	Alva Burn	Alva	886 976	883 962	1.0km
B - 08	Carnaughton Burn	West side of Alva	878 975	877 965	0.3km
B - 09	Spring Burn	East side of Alva	888 969	889 965	0.5km
B - 10	Silver Burn	East side of Alva	892 974	889 965	0.6km
B - 11	Tillicoultry Burn	Tillicoultry	912 977	910 964	1.0km
B - 12	Kirk Burn	East side of Tillicoultry	923 978	926 967	1.1km
B - 13	Quarrel Burn	West side of Dollar	954 984	954 987	0.7km
B - 14	Dollar Burn	Dollar	961 989	964 969	1.6km
B - 15	Kelly Burn	East side of Dollar	970 990	965 973	1.6km
B - 16	Back Burn	South side of Pool O'Muckhart	030 007	993 992	4.2km

Back Burn Culvert at Muckhart Golf Club - 09/03/09

River Devon

The River Devon rises in the Ochil Hills to the north of the area and flows east to west. The catchment comprises a mountainous upper catchment and a lower floodplain. The main river and some smaller tributaries on the upper catchment have been developed as part of the public water supply by forming three large reservoirs (Upper Glen Devon (NN 908 045), Lower Glen Devon (NN 931 048) and Castlehill (NN 996 033)). These reservoirs are operated and controlled by Scottish Water. The River Devon flows off the upper catchment of the Ochil Hills as an energetic and turbulent river but slows rapidly when it reaches the floodplain generally south of the Hillfoots villages. The floodplain is confined by the Ochil Hills to the north and by low hills to the south. The Hillfoots Burns fall steeply from the Ochils over a short length of floodplain into the river. The river flows into the River Forth at Cambus (NS 849 936).

River Devon Floodplain at Marchglen - 25/01/08

River Black Devon

The River Black Devon flows from east to west through the northern edge of Clackmannan. It rises as a series of small tributaries in low lying hills to the east and outwith the Council area. The river flows through a steeply incised valley as it passes through Clackmannan (the River Black Devon is culverted beneath the A907, Clackmannan By-pass (NS 915 923)) with the majority of development being set away from its banks. It then flows into the River Forth through agricultural land to the south of Clackmannan (NS 896 904).

The Hillfoots Burns

The principal Hillfoots Burns are, **Dollar Burn, Tillicoultry Burn, Alva Burn and Menstrie Burn**. They rise in the Ochil Hills and typically flow southwards down steep channels, often through sections of inaccessible gorge, over the major escarpment that forms the south face of the Ochil Hills. The burns meet the floodplain at their eponymous towns before flowing into the River Devon. The channels of some of these burns have been greatly modified on their passage through the Hillfoots settlements. Most of this work was carried out during the development of the former mills so that water could be drawn off the burns to provide for the industry. The mills are now closed but the burns remain largely in their modified condition with straightened channels, banks protected with masonry walls, sills constructed across the burn beds and bridges and culverts constructed across the channels. Menstrie, Alva and Tillicoultry were originally constructed on the alluvial fans at the base of the escarpment but in later years development has moved south onto the upper reaches of the Devon floodplain. It is this later development that is at risk from overtopping of the watercourses.

The other named burns rising in the Ochil hills and passing through the settlements below include **Kelly Burn and Quarrel Burn (Dollar), Kirk Burn (Tillicoultry), Silver Burn and Carnaughton Burn (Alva), Balquharn Burn and Dams Burn (Victoria Terrace, Menstrie).**

Flood flows in the Hillfoots burns are generated by a range of climatic conditions including intense, but short lived, storms, prolonged rainfall and snow melt events. The upper catchments are steep with little natural attenuation generating flood flows that can occur over a very short period of time but can equally quickly recede. When these flows tumble over the escarpment they are highly energetic and concentrated into deep gullies forming a series of chutes and falls with very few pools to slow the flow. At the base of the escarpment the flows naturally dispersed over the floodplain, forming delta shaped fans over which, prior to the development of the early mill towns, the burns could lose much of their energy. The Hillfoots towns are clearly constructed on a highly dynamic part of the river systems and through their construction and the subsequent modification of the watercourse channels any natural attenuating effects have been lost. This makes parts of each settlement vulnerable to flood events.

Brothie Burn

Brothie Burn drains a catchment located between the River Devon and the River Black Devon. The burn rises as a series of small tributaries in low lying hills before flowing into Gartmorn Reservoir (NS 912 939), it then flows through an open channel to the A907 where it becomes culverted for the remainder of its length through the urbanised area of Alloa before flowing to the River Forth (NS 887 915). In the urban section, the burn is joined by Sauchie Burn (NS 896 933) and further downstream by Fairy Burn (NS 889 929). Each of the three burns having been heavily modified by industrial development in the past.

Gartmorn Dam was constructed in 1785 on top of a former structure dating from 1713 and originally supplied water to power the area's mining industry. The reservoir became a public water supply in 1820 and was enlarged and raised in level in 1894. The reservoir is no longer used as a public water supply, although ownership remains with Scottish Water.

Brothie Burn at ALDI Store - 14/01/08

Fairy Burn

Fairy Burn flows generally west to east and is one of several smaller, but important watercourses that drain the residential areas of Alloa. Fairy Burn is an open watercourse emanating to the west of Donaldson Avenue (NS 871 944) but becomes culverted a short distance to the south (NS 873 943). The large culvert containing Fairy Burn provides the main surface water drainage for much of this part of Alloa. This culvert extends, with a few open sections, until it reaches an open confluence with Brothie Burn (NS 889 929) immediately east of its crossing under the A908, Whins Road, Alloa. The un-named burns to the north of Ormiston Drive (NS 874 945), Inglewood (NS 879 942) and Inglewood Pond (NS 878 940) flow into Fairy Burn as well as many other unmapped piped drainage systems in the area.

Goudnie Burn

Goudnie Burn is a tributary of the River Black Devon and flows along the north eastern edge of Clackmannan. It is culverted beneath the A907 Clackmannan By-pass (NS 915 923).

Sauchie Burn

Sauchie Burn passes through and beneath Sauchie from the west. It enters a culvert immediately west of Ten Acres (NS 885 944) and remains underground for the majority of its length through Sauchie and Alloa before appearing as an open channel approximately 300 metres before joining Brothie Burn (NS 896 963). It appears briefly but significantly beside Parkhead Road (NS 892 939) where it is joined by an unnamed, and unidentified, pipe from the north.

Back Burn

Back Burn passes through the Clackmannanshire Council area on the south side of Muckhart. It passes through the Muckhart Golf course and just north of a row of houses fronting the Dollar-Crook of Devon Road. It is a small tributary of the River Devon flowing roughly east to west and has a downstream confluence with the Hole Burn (NS 030 007 993 992).

Out of Channel Flows at Back Burn, by Pool O'Muckhart - 25/01/08

3.2 Descriptions of Un-Named Watercourses

The following are un-named watercourses which have the propensity to affect land, other than agricultural land, in the Clackmannanshire Council Area: -

(U-01) - Burn to the north of Inglewood, Alloa.

This burn issues into woodland to the north of Inglewood House (NS 879 942). The burn flows from a small pond above the woodland and flows south through the wood. As a result of recent intervention by the Council to reduce flood risk in the area, the burn now flows into a short section of piped drainage system then into an open watercourse, thereby diverting its recent course away from houses in Forrester Grove back to its original outlet into Inglewood Pond (NS 878 940).

(U-02) - Burn at Ormiston Drive, Alloa.

This burn issues from woodland (lower slopes of Gubber Hill) to the north of Ormiston Drive. It enters a culvert just north of Ormiston Drive (NS 874 945) and thereafter flows in to the culvert carrying Fairy Burn (NS 877 940).

(U-03) - Gean House, Alloa.

This burn issues from the woodland in the grounds of Gean House, to the east of Dunmar Drive, flows in to a small pond (NS 873 939), then to an open watercourse and pipe installed by the Council in 2001/02 to reduce flood risk.

(U-04) - Ditch System to north of Woodburn Drive and Gavins Road, Alloa.

The ditch system north of Woodburn Drive and Gavins Road collects over-land water flows from the Gubber Hill area to the north of the houses. The ditches do not flow during dry periods but when wet, they flow to the rear of, and parallel to, terraced housing backing on to Gubber Hill then to a 225mm pipe drainage system (NS 876 942) which itself leads to the culverted section of Fairy Burn.

(U-05) - Burn / ditch at Whiteyetts

This watercourse begins in the golf course at (NS 899 948) crosses under the disused railway (cycle track) (NS 895 947) then re-enters agricultural land at (NS 893 947).

(U-06) - Burn to west of Glenochil Terrace, Glenochil

This burn gathers several drains and over-land flow into a small piped system, which is culverted beneath the B9140. It then passes, in an open channel, to the west of Glenochil Terrace (NS 870 957), then northwards across agricultural land towards the River Devon.

(U-07) - Burn to east of Bards Way, Tillicoultry

This is a small burn that flows virtually along the boundary between the house gardens on Bards Way and the wooded area to the east. It outfalls into a culvert beneath the A91 (NS 928 971) then flows south towards the River Devon.

(U-08) - Burn to north of Stalker Avenue, Tillicoultry.

This small open watercourse issues from the Ochil Hills to the north and passes adjacent to Fir Park Primary School. It enters a culvert (NS 920 972) under the housing area at Stalker Avenue then continues through the piped system, which in turn outfalls to the River Devon (NS 922 966). It appears briefly in the garden of house No. 6 Dollar Road (A91) (NS 921 970) and again in a ditch behind a garden wall immediately north of the A91. It is piped under the A91 and continues in a series of pipes down Glebe Crescent before crossing under the old railway embankment at Elistoun Drive whereupon it discharges into the River Devon. From Glebe Crescent the pipe becomes a sealed system all the way to the River Devon. This provides the hydrostatic head required to discharge into the river even when the river level exceeds the pipe outlet height.

(U-09) - Burn to south of Marchglen.

This is a small burn which emanates from field and roadside drainage to the south of the A908 (NS 910 960). The watercourse then passes through a wooded area to the south of Marchglen and through piped systems serving the former railway line. These piped systems outlet to the River Devon just east of the River Devon Bridge (NS 910 964).

(U-10) - Burn to the south of Drummie Road, Devonside, by Tillicoultry.

This is a sizeable burn that issues from elevated land to the south of Drummie Road. The watercourse is open and steep before falling over a small cliff and into a culvert just south of Drummie Road (NS 922 962). This culvert was upgraded in 2002/03 to reduce flood risk in the adjacent properties. The culvert enters the River Devon (NS 922 964) immediately north of Drummie Road.

(U-11) - Burn at The Glen, Devonside.

This burn flows in wet weather conditions through an incised but short valley known as The Glen. The burn then enters a culvert (NS 920 963) (the inlet structure was upgraded in 2003 by the Council to reduce flood risk to property to the north), which in turn outfalls to the River Devon.

(U-12) - Burn on north side of A91, west of Bryanston Drive, Dollar.

This is a small open burn emanating in the Ochil Hills to the north, which then passes in to a roadside drainage system (NS 953 980). It then discharges into Quarrel Burn to the north of the disused railway.

(U-13) - Burn to north of Kirkhill, Muckhart.

This burn emanates from a wooded area on the south slopes of the Ochil Hills. The burn flows along the southern edge of the wood and then westwards towards a culvert at Kirkhill and Cairns Place (NO 000 008). The culvert was upgraded in 2001/02 to increase its capacity.

(U-14) - Thornbank Road, Dollar (NS 958 980)

Emanates from the Ochil Hills runs under Back Road, through the grounds of Dollar Academy then under Thornbank Road. It then enters a pipe under A91 then outfalls into Quarrel Burn.

(U-15) - Donaldson Avenue, Alloa (NS 873 944)

This is a shallow swale to the south of the houses in Donaldson Avenue. Generally dry but gathers significant over-land flow from time to time. It then enters the open (rural) section of Fairy Burn.

(U-16) - Back Road, Dollar (NS 957 983)

A small burn that issues just north of No. 32 Back Road during wet periods. The burn passes into a small diameter pipe through the garden of No. 32 then discharges into the roadside ditch on Back Road.

(U-17) - Back Road (Private), Dollar (NS 955 982)

A number of small, ephemeral watercourses issue to the north of the houses served by the private section of Back Road. They are gathered into roadside ditches on the north side of Back Road. The ditches discharge into Quarrel Burn. The ditches are piped under driveway accesses and are prone to blockage.

(U-18) - Long Row, Menstrie (NS 851 970)

A small burn issues low in the Ochil Hills and passes through the garden of No. 32 Long Row before entering a piped system just north of the house. It then connects into the surface water drainage system.

(U-19) - Driving Range, Tillicoultry (NS 928 971)

This is a small watercourse flowing east of the urban boundary under the A91.

(U-20) - Glen Affric, Alva (NS 875 973)

A number of small, ephemeral burns flowing off the lower slopes of the Ochil Hills and collected by ditches associated with Alva Golf Course. The resulting watercourse meets another small watercourse at the north boundary of the house ‘Glen Affric’ where it enters a pipe. It continues under Back Road then into the main surface water drainage system for the residential area.

(U-21) - House Lade, Rackmill (NS 960 969)

The disused lade served the former mill building at Rackmill House, taking water from the adjacent River Devon. It starts east of the B913 bridge passes below the road then re-enters the River Devon to the west.

(U-22) – Rhodders Grove, Alva (NS 889 973)

Rises in the Ochils passes through a culvert under Back Road. Open watercourse between MacLean Crescent and Alva Cemetery then it sinks at a pipe to the NE of Rhodders Grove.

(U-23) – Rear of 58/60 Main Street West, Menstrie (NS 847 970)

A small watercourse emerges from the Ochil Hills, falls to a private road side ditch, before sinking just north of nos. 58/60 Main Street West.

(U-24) – East of Kennet Lodge, Clackmannan (NS 919 914)

A small watercourse flows east of Kennet Lodge sinking thru a culvert beneath the public road between Kennet and Clackmannan.

4.0 OCCURRENCES OF FLOODING

4.1 Flooding Occurrences

Alloa

AL-01 Donaldson Avenue (NS 873 944)

Watercourse ref. U-15.

Previous flood incidents (18/06/03, 23/09/03, 17/11/06).

No flooding occurrence since 17/11/06.

AL-02 Forrester Grove (NS 878 941)

Watercourse ref. U-01.

Previous flood incidents (23/01/02, 15/06/02, 30/07/02, 16/01/03).

No flooding occurrence since 16/01/03.

AL-03 Gubber Hill – Woodside Road (NS 878 942)

Watercourse ref. U-04.

Previous flood incident (13/12/06).

Reports from time to time of non-significant flooding to the rear gardens on Woodside Road. No flooding occurrence since 13/12/06.

AL-04 Gubber Hill – Gavins Road (NS 875 942)

Watercourse ref. U-04.

Previous flood incident (30/07/02). Reports from time to time of non-significant flooding to the foundations of houses, gardens and the public road in Gavins Road.

No flooding occurrence since 30/07/02.

AL-05 Gubber Hill - Woodburn Drive (NS 877 942)

Watercourse ref. U-04.

Previous flood incidents (21/10/04, 10/01/05, 11/10/05, 17/11/06, 13-14/12/06).

24/10/08 - Further instance of flooding recorded here due to fly tipping at ditch / culvert headwall affecting the rear of 17/19 Woodburn Drive. Resultant flows still through garden grounds only, by-passing houses into street to south.

19/11/09 - New flood event - 21 Woodburn Drive (NS 877 942) Flooding occurred to garden from surcharging foul manhole, also slight overland flow. No water entered house but foul water escaped through concrete floored garage.

AL-06 Ormiston Drive (NS 874 945)

Watercourse ref. U-02.

Previous flood incidents (June 03, September 03, 17/11/06).

No flooding occurrence since 17/11/06.

AL-07 Dunmar Drive (NS 873 940)

Watercourse ref. U-03.

Previous flood incident (October 2005).

No flooding occurrence since 2005.

AL-08 Lambert Terrace (NS 893 932)

Watercourse ref. B-01.

Previous flood incidents (09/08/04, 18/08/04).

No flooding occurrence since 18/08/04.

AL-09 New ALDI Superstore Site (NS 890 930)

Watercourse ref. B-01.

No flooding occurrence since completion of Brothie Burn improvement works (Oct 2007).

AL-10 Archray Court (NS 893 924)

Overland flow.

Previous flood incidents (13-14/12/06).

19/12/08 - New flood event. Flooding to a public footpath and garden properties occurred during a storm event from overland flows from ground being excavated in association with a development site at Ash Grove. Council resources were deployed on the night to reduce risk of flooding to properties. The contractor response for the works was contacted and instructed to remove a temporary excavated area from which the flood flows emanated.

03/09/09 - A further instance of flooding to the footpath occurred but also minor flooding to adjacent front garden areas, caused by contaminated flows again emanating from the adjacent development site. Existing drainage systems in the area, which have been confirmed to be the responsibility of Scottish Water, appear to have been blocked by the contaminated flows from the site.

Each of the above were caused from different sources than the flooding recorded in 2006.

AL-11 Longcarse Farm (NS 868 924)

Overland flow

Previous flood incidents (26/10/06, 13-14/12/06, 19-20/01/07).

No flooding occurrence since 20/01/07.

AL-12 Inglewood Pond (NS 878 940)

Watercourse Ref. U-01.

19/11/09 - New flood event. Flooding to parkland areas surrounding the pond and to parkland on the east side of Inglewood Gardens. Water comes from a failed pipe system slightly to the

north. The water is retained safely in the parkland, contrary to previous belief this water does not emanate from the pond. The pond drains into the Fairy Burn.

19/11/09 - Note

Blocked road gulleys in the private section of the road add to the flows gathering in the parkland.

AL-13 Alloa Park Drive (nr Sandpiper Meadows) (NS 897 923)

Overland flow.

19/11/09 - New flood event. Extensive flooding to carriageway due to insufficient capacity of adjacent SUDs system to deal with this intensity of rainfall.

Alva

AV-01 Brook Street (NS 883 972)

Watercourse ref. B-07.

Previous flood incidents have never led to waters leaving the Alva Burn channel.

No flooding occurrence.

AV-02 Henry Street (NS 884 969)

Watercourse ref. B-07.

Previous flood incident (09/08/04).

No flooding occurrence since 09/08/04.

AV-03 Alva Primary School (NS 884 968)

Watercourse ref. B-07.

Previous flood prone site (09/08/04).

No flooding occurrence since 09/08/04.

AV-04 **Greenhead Farm (NS 884 966)**

Watercourse ref. B-07.

Previous flood incident (09/08/04).

No flooding occurrence since 09/08/04.

AV-05 **Back Road – Glen Affric (House) (NS 875 973)**

Watercourse ref. U-20.

Previous flood incident (09/08/04).

No flooding occurrence since 09/08/04.

AV-06 **Back Road (NS 875 973)**

Watercourse ref. U-20.

Previous flood incident (09/08/04).

No flooding occurrence since 09/08/04.

AV-07 **Cochrane Crescent / Back Road (NS 874 973)**

Watercourse ref. U-20.

Previous flood incident (09/08/04).

19/11/09 - New Flood Event. Overflow pipe from manhole into Cochrane Park activated. Overflow water was not fully redirected by existing north - south bund and caused floodng to gardens 12 - 24 Cochrane Crescent, also 9 - 13 Wharry Road. Most of water retained safely in the bunded area to east of Wharry Road. This was then let out into the piped drainage system to the east of the bunded area.

AV-08 **Wharry Road (NS 875 971)**

Watercourse ref. U-20.

Previous flood incident (09/08/04).

19/11/09 - New flood event. Water from surcharging manholes on old drainage system caught between large bund and house at No. 26 Wharry Road. Caused extensive flooding to garden and to just

below ground floor level in house. Fire service were able to pump the floodwater into the SW system (manhole in A91 footway at SW corner of park / Glenwhinnel Rd). This water did not emanate from the manhole overflow (AV-07).

AV-09 **Cochrane Park (NS 876 972)**

Watercourse ref. U-20.

Previous flood incident (09/08/04).

19/11/09 Extensive pond gathered in bunded area to east of Wharry Road. (see AV-07 & AV-08)

AV-10 **Rhodders Grove / Alva Cemetery (NS 889 971)**

Watercourse ref. U-22

Previous flood incident (13-15/12/06).

09/01/08 & 15/09/08 - Further instances of flooding through and below the cemetery gathering in the area behind the bund north of Rhodders Grove, due to flows emanating from a blocked ditch on the north side of Back Road to the north.

AV-11 **Blindwells / Southcroft (NS 879 969)**

Overland flow.

Previous flood incidents prior to 1997.

No flooding occurrence since 1997.

AV-12 **C110 – Shavelhaugh Loan (NS 893 963)**

Watercourse ref. R-01.

Previous flood incident (10/01/05, 13-15/12/06).

Ongoing - Flooding to public road due to inundation from River Devon floodplain. Road closed during period. Closure inevitable

during inundation by river floodplain. (25,26/01/08 and 19-21/11/09)

AV-13 Cleuch Drive (NS 871 971)

Overland flow.

Previous flood incident (17-20/11/06).

19-20/11/09 - Recurrence of flooding emanating from large pond gathering in field to the west of the second cul-de-sac on Cleuch Drive. Flooding to street, gardens and garages but no reports of water entering houses.

AV-14 B908 (River Devon Road Bridge) (NS 883 691)

Watercourse ref.R-01.

Previous flood incident (13-17/12/06).

25-26/01/08 & 19-21/11/09 - Flooding to public road (B908) due to operation of River Devon floodplain. Road closed during period. Flooding inevitable due to action of floodplain.

AV-15 9 & 11 Grodwell Drive (NS 874 972)

Drainage systems in street.

New flood site added since Nov. 2007.

19-20/11/09 - Nuisance flooding to gardens. Appears to be a low point in the local drainage system, emanating from manholes in the garden of no. 11.

AV-16 41 Cleuch Drive (NS 872 971)

Drainage systems in street.

New flood site added since Nov. 2007.

19-20/11/09 - Flooding to garden from surcharging foul manhole in garden. Pumps deployed to keep level under control. No flood waters entered house.

Cambus

CA-01 **Forth Street (NS 854 938)**

Watercourse ref.R-01.

Previous flood incident (17/06/01).

No flooding occurrence since 17/06/01.

Clackmannan

CL-01 **Duke Street (NS 917 915)**

Overland flow.

Previous flood incidents (date not recorded).

No flooding occurrence since 2007.

CL-02 **Brucefield Crescent (NS 917 918)**

Overland flow.

Previous flood incidents (date not recorded).

No flooding occurrence since 2007.

CL-03 **Ladywood Drive (NS 921 915)**

Overland flow.

No previous recorded incidents.

28/12/07 & 07/08/08 New flood event. Possible flood risk to houses from overland flows gathering in adjacent agricultural land.

Coalsnaughton

No flood events recorded since 1997.

Devonside

DS-01 Alexandra Street at The Glen (NS 920 963)

Watercourse ref. U-11.

Previous flood incident (09/08/04).

No flood occurrence since 09/08/04.

DS-02 Drummie Road (NS 922 962)

Watercourse ref. U-10.

Previous flood incidents prior to 2004.

No relevant flood events recorded since October 2002.

Note: 01/08/08 & 18/12/08 - Flood risk to number 10 Drummie Road property from surcharging manholes and (private) road gullies. Council resources employed in emergency circumstances to alleviate risk to property. Scottish Water contacted and jetting of systems undertaken to clear blockages.

DS-03 Alexandra Street at West End (NS 916 961)

Overland flow.

Previous flood incidents (Summer 2002, Winter 2005/06).

No flood events recorded since Winter 2005/06.

DS-04 Bain Street, (NS 918 962)

Overland flow.

Previous flood incidents prior to 2002.

No flood events recorded since 2002.

DS-05 4 The Craigs, (NS 918 962)

Overland flow.

New flood site added since Nov. 2007.

19/11/09 - Nuisance flooding to garden from flows from garage court, caused by blocked gulley.

Devon Village

No flood events recorded since 1997.

Dollar

DL-01 A91 Muckhart Road (at Kelly Bridge) (NS 966 980)

Road Drainage

Previous flood incident (09/08/04 & 21/10/04).

No flood events recorded since 2004.

DL-02 Thornbank Road (NS 958 980)

Watercourse ref. U-14.

Previous flood incident (21/10/05).

21/11/07 - Flood threat to basement of St James' Church following blockage of culvert trash screen at Thornbank Road. Council services deployed to protect property and clear blockage at trash screen. Subsequent confirmation of significant collapse of culvert system (north-south) beneath Thornbank Road.

DL-03 Back Road (Private) (NS 955 982)

Watercourse ref. U-17.

Previous flood incident (25/05/05).

No flood events recorded since 2005.

DL-04 Caravan Site, Rackmill (NS 962 969)

Watercourse ref. R-01.

Previous flood incidents (21/10/04, 10/01/05, 13-14/12/06).

25-26/01/08 - Evidence of floodwaters entering caravan park site, but no reports of buildings or other accommodation being flooded.

19-20/11/09 - River burst banks and inundated west end of caravan site. 3 caravans flooded.

DL-05 House Lade, Rackmill (NS 962 969)

Watercourse ref. R-01.

Previous flood incident (10/01/05).

25-25/01/08 - Evidence of floodwaters entering gardens, but no reports of buildings being flooded.

DL-06 Bryanston Drive (at Cycle Way) (NS 954 977)

Watercourse ref. DL-08.

Previous flood incident (June 2003).

No flood events recorded since 2003.

DL-07 A91 Opposite Bryanston Drive (NS 953 980)

Watercourse ref. DL-08.

Previous flood incident prior to 2003).

No flood events recorded since 2003.

DL-08 Back Road (No. 32) (NS 957 983)

Watercourse ref. U-16.

Previous flood incident (June 2003).

No flood events recorded since 2003.

DL-09 Lovers Loan (The Warren) (NS 965 975)

Watercourse ref. B-15.

New flood site added since 2007 report.

24/10/08 - Flooding to a single property from "out of bank" flows from a section of the Kelly Burn within that house's ownership, due to blockage of a downstream culvert.

DL-10 Drum Court (NS 966 982)

Overland flow.

New flood site added since November 2007.

06-09/08/08 & 24/10/08 - Flooding occurred to properties with the Drum Court area on several occasions largely from sheet flow from a kick-about pitch to the north during heavy rain storm events. Although flooding did not occur due to a lack of watercourse maintenance, it was decided to intervene as the kick-about pitch was the maintenance responsibility of the Council.

DL-11 **Westmill House, East of B913, Rackmill (NS 958 971)**

Watercourse ref. R-01.

New flood site added since November 2007.

25-26/01/08 - Notification from owner of flood threat to this property from river floodplain operation during this event.

DL-12 **7, 9 & 11 Princes Crescent (NS 966 987)**

Overland flow.

New flood site added since November 2007.

06/07/09 & 24/07/09 - Flood flows affected the properties 7, 9 and 11 Princes Crescent. Overland flows emanated from the Princes Crescent and Upper Hillfoots Road to the west apparently as a result of the failure of local surface water drainage systems to cope with very heavy rainfall conditions. Overland flows then affected garden property and an integral garage at a natural low point in the carriageway opposite number 9 Princes Crescent. However, no reports were received of flood flows entering houses.

Fishcross

No flood events recorded since 1997.

Forestmill

No flood events recorded since 1997.

Glenochil Village

GL-01 Glenochil Terrace (NS 870 957)

Watercourse ref. U-06.

Previous flood incident (2002).

No flood events recorded since 2002.

Kennet

No flood events recorded since 1997.

Marchglen

MA-01 C99 River Devon Bridge (NS 910 963)

Watercourse ref. R-01.

Previous flood incidents (10/01/05, 12-16/12/06, 10/01/07).

25-26/01/08, 10-11/10/08, 03/09/09 & 19-20/11/09 - The section of road immediately south of the River Devon road (C99) bridge regularly floods as part of the operational floodplain.

MA-02 No.1 Marchglen (NS 909 962)

Watercourse ref. U-09.

Previous flood prone site (2001).

No flood events recorded since 2001.

Menstrie

ME-01 Burnside Road (NS 848 967)

Watercourse ref. B-05.

Previous serious flood incident (09/08/04).

No flood events recorded since 2005.

ME-02 **Ochil Road (Back Road) (NS 848 970)**

Overland flow

Previous flood incidents (25/12/05, 27/10/06).

Uncontrolled drainage problems to private section of road and properties to south from occasional over-land flows from hillside to north. **03/09/09 & 19/20/11/09 -** Further instances of nuisance flooding to driveways and garage reported due to poor maintenance of drainage ditch and pipes adjacent to private section of road and footpath.

ME-03 **Ochil Road (NS 849 970)**

Flood mechanism - Overland flow from water main burst .

28/09/09 - New Flood Event (non-qualifying under legislation, but noted due to significance of event)

High velocity and volume flood flows affected 7 houses on Ochil Road and the private road, Back Road to the west, from the steep slopes to the north in the early hours of Monday 28th September 2009. Police, fire brigade, Scottish Water and emergency planning / Roads and Transportation Section staff response initiated to control flows away from houses to nearby Menstrie Burn. Residents were evacuated from several properties, one household was kept away overnight. Emergency rest centre established. Investigations that day by Category 1 responders confirmed flows had emanated from a water main failure on the lower slopes of Ochil Hills to the north. Water main is owned and maintained by Scottish Water.

ME-04 **Victoria Terrace, (NS 859 970)**

Watercourse Ref. B-06

New flood site added since Nov. 2007.

20/11/09 - Blockage in piped section of watercourse led to surcharging manhole on access road. Waters entered field and added to pond adjacent to low back wall to rear of Terrace..

Muckhart

MK-01 **Kirkhill (NO 000 007)**

Watercourse ref. U-13.

Previous flood incidents (12/01/07, 13-14/12/06).

No floods recorded since 2006.

MK-02 **Dollar-Crook of Devon Road - Housing to south-east of Muckhart Primary School (NO 004 999).**

Watercourse ref. B-16.

New flood site since November 2007.

25/01/08 - A significant flood threat to house and safety, due to the depth of flooding noted, became apparent during a storm event. Debris became blocked at an wooden bridge used by local school pupils to access Muckhart Primary School to the north-west.

Flood Threat to house from debris blockage at Wooden Bridge adjacent Dollar Crook of Devon Road - 25/01/08

MK-03 **Balliliesk House / A91 Between Pool and Yetts O'Muckhart (N0 003 010)**

Watercourse ref. B-16.

New flood site since November 2007.

25-26/01/08 - Significant overland flows were generated on the southern slopes of Seamab Hill and on the A91 carriageway between Yetts of Muckhart and Pool O' Muckhart. These flows bypassed some properties and gathered to the rear of a stone boundary wall. The wall failed and debris and floodwaters then inundated a section of the A91 carriageway.

Flood flows and soils reach a boundary wall south of Geordie's Wood - 29/01/08

Sauchie

SA-01 **Parkhead Road (NS 892 940)**

Watercourse ref. B-02.

Previous flood incident (June 2000 & Sept. 2003).

No flood events recorded since 2003.

SA-02 **Branshill Road (2 sites) (NS 885 944 / NS 885 942)**

Overland flow.

Previous flood incident (June 2000).

No flood events since 2000.

SA-03 A908 Whiteyetts (NS 899 948)

Watercourse ref. U-05.

Previous flood incident prior to 2002.

No flood events since 2002.

SA-04 Cat's Close (NS 895 936)

Watercourse ref. B-02.

Previous flood incidents (July 2002, June 2003).

No flood events recorded since 2003.

SA-05 Devon Valley Drive / Craigview (NS 897 947)

Watercourse ref. U-05

Previous flood incident (2005).

No flood events recorded since 2005.

Tillicoultry

TI-01 Hareburn Road (NS 912 967)

Watercourse ref. B-11.

Previous flood incident (09/08/04).

No flood events recorded since 2004.

TI-02 Elistoun Drive, Kirktoun Gardens, Glebe Crescent, Derby Place, Moss Road (NS 922 967)

Water course ref. R-01; U-08.

Previous flood incidents (27/03/06, 13-15/12/06, 11/01/07).

No flood events from above source since 2007.

25-26/01/08 - New flood event same location. Previous flooding came from surcharging of the piped watercourse U-08. This time

serious flooding occurred to Elistoun Drive, Kirktoun Gardens, Glebe Crescent, Derby Place, Moss Road and the Sterling Furniture Store site, when the River Devon over topped the former railway embankment to the south of Elistoun Drive. The flooding also extended to Sterling Retail Village and Tillicoultry Bowling Club. This resulted in evacuation of residents and significant property damage. A threat to life was perceived for a time as the flooding at Elistoun Drive was said to be exceeding 1m in depth. 15 houses were flooded with some residents unable to fully return for 10 months. Flooding to Sterling Furniture Centre, Butterfly Inn, Devonvale Hall, Tillicoultry Bowling Club and Sterling Mills retail Village.

19-20/11/09 - Surcharging manhole, part of 'sealed system', affecting Elistoun Drive. Waters flooded street but did not reach properties (pump in operation through the night of 19/11/09).

A908 Moss Road, Tillicoultry - 26/01/08

TI-03 A908 Moss Road (NS 920 968)

Drainage system

Previous flood incident (14/12/06).

No flood events from above source since 2006.

25-26/01/08 - New flood event same location. Previous flooding came from surcharging of the piped drainage / sewerage system. This time serious flooding occurred to Moss Road when the River Devon over topped its banks in the grounds of the Sterling Furniture Store site and flowed out onto the road. Road closed.

19/11/09 - Flooding at entrance to Retail Village due to over capacity road drainage. Did not lead to road closure but carriageway only just passable with care.

TI-04 **Stalker Avenue (NS 920 972)**

Watercourse ref. U-08.

Previous incidents prior to 2005.

No flood events since 2005.

TI-05 **6 Dollar Road (NS 921 970)**

Watercourse ref. U-08.

Previous flood incident (May 2007).

No flood events since 2007.

Tullibody

No Flood Events recorded since November 2007.

5.0 MEASURES TAKEN TO PREVENT OR MITIGATE FLOODING

5.1 Flooding Problems and Mitigation Measures

All flood events at the following locations have been described. To identify those occurring since the last Flood Report (Nov. 2007) refer to the information in Section 4.0.

Alloa

AL-01 Donaldson Avenue (NS 873 944)

Problem: Blockage at trash screen.

Prevention / Mitigation Action: Cleared.

Monitoring: Priority 3 Inspection.

AL-02 Forrester Grove (NS 878 941)

Problem: Watercourse to west of Forrester lodge (Ceteris) had been removed during construction of office block. During high rainfall events waters flowing overland into Forrester Drive and flooding gardens and house foundations.

Prevention / Mitigation Action: New cascade / channel / trash screen / piped system constructed to carry watercourse around office block. Continue into open channel through Inglewood grounds into Inglewood Pond. New inlet created into pond.

Monitoring: Priority 1 Inspection

AL-03 Gubber Hill – Woodside Road (NS 878 942)

Problem: During high rainfall events waters flowing overland through woods channelled along informal paths into waste ground behind houses then seepage into gardens.

Prevention / Mitigation Action: See report *Woodburn Drive and Gavins Road Flood Alleviation Feasibility Study* [8] which was produced for the Council and published in January 2008.

Monitoring: Pass-by inspections.

AL-04 Gubber Hill – Gavins Road (NS 875 942)

Problem: Although no flooding problems have affected this area since the last report, this catchment is linked to that which affects Woodburn Drive (AL-05). Significant resources are needed to solve this occasional, but serious, problem.

Prevention / Mitigation Action: See report *Woodburn Drive and Gavins Road Flood Alleviation Feasibility Study* [8] which was produced for the Council and published in January 2008.

Monitoring: Priority 1 Inspection.

AL-05 Gubber Hill – Woodburn Drive (NS 877 942)

Problem: Flood waters affect garden ground and threaten buildings of 17 and 19 Woodburn Drive. The woodland area to rear regularly discharges flows during severe storm events which can affect property. The pipe inlet at the woods / garden boundary is small and easily blocked with debris.

Prevention / Mitigation Action: See report *Woodburn Drive and Gavins Road Flood Alleviation Feasibility Study* [8] which was produced for the Council and published in January 2008. In the interim some minor headwall improvements have been carried out.

Monitoring: Priority 1 Inspection.

Note: 19/11/09 event. Reported to Scottish Water.

AL-06 Ormiston Drive (NS 874 945)

Problem: Trash screen prone to blockage.

Prevention / Mitigation Action: Trash screen replaced, safety railing and access path added (12/12/06).

Monitoring: Priority 2 Inspection.

AL-07 Dunmar Drive (NS 873 940)

Problem: Old pond in Gean House grounds overtops into unmaintained ditch systems. Waters finding way into gardens to rear of Dunmar Drive.

Prevention / Mitigation Action: New ditch constructed in grounds of Gean House to inlet of culvert under B9096 / Fairy Burn (August 2002).

Monitoring: Priority 2 Inspection

AL-08 Lambert Terrace (NS 893 932)

Problem: Significant backing up of the Brothie Burn at bridge and other pinch points.

Prevention / Mitigation Action: Constructed gates in fence to facilitate access for clearance work.

Monitoring: Priority 2 Inspection

AL-09 New Aldi Store Site (NS 890 930)

Problem: Significant backing up of the Brothie Burn at culverts and other pinch points.

Prevention / Mitigation Action: Site re-developed as an ALDI superstore in 2007. Brothie Burn diverted to new 4m x 2m culvert structure. Detailed design of inlet and outlet screens, new flood storage pond and culvert (adopted by developer) October 2007.

Monitoring: Priority 2 Inspection and maintenance programme agreed with landlord.

AL-10 Archray Court (NS 893 924)

Problem: 19/12/08 - Flooding occured due to working practices adopted by contractor and through a lack of capacity of local drainage system during a storm event. 03/09/09 – Flooding due to Scottish Water piped systems being blocked by contaminated site run-off.

Prevention / Mitigation Action: Although responsibility for maintenance of systems was initially unclear, systems jetted and cleared of blockages shortly after first event by Council staff. 03/0909 - The site contractor agreed to deploy pumps to reduce the flood levels.

Monitoring: Liaison with Scottish Water is ongoing to determine whether a more serious problem exists with the local drainage systems than a mere blockage due to transported contaminents from the development site.

AL-11 Longcarse Farm (NS 868 924)

Problem: Overland flows during storm events coming from adjacent pond and non-operation of pumps at pond.

Prevention / Mitigation Action: Pump management system re-evaluated and management agreement system in place. Pump Station pumps checked and now operational

Monitoring: Remote failure alarm system operational by end of 2007.

AL-12 Inglewood Pond (NS 878 940)

Problem: Overland flows during storm events coming from failed drainage system in parkland and blocked gulleys at top of private section of Inglewood Gardens.

Prevention / Mitigation Action: Gulleys cleared. Failed system to be investigated.

Monitoring: Pass-by inspections.

AL-13 Alloa Park Drive (nr Sandpiper Meadows) (NS 897 923)

Problem: Overland flows during storm events caused by inadequate SUDs system.

Prevention / Mitigation Action: SUDs to be cleared and checked for capacity by developer. Council will seek full assurance that systems has capacity prior to adoption.

Monitoring: Regular site inspections / meetings with developers.

Alva

AV-01 Brook Street (NS 883 972)

Problem: No flooding issues but severe erosion of steep banks and retaining walls occurring.

Prevention / Mitigation Action: Works carried out to arrest erosion of earth banks. Retaining wall to rear of flats rebuilt and underpinned. Further works proposed 2009/10 to repair various embankment wall failures along urban section of the Alva Burn as identified in the *Watercourse Audits and Work Implementation Plans* [6].

Monitoring: Priority 1 Inspection.

AV-02 Henry Street (NS 884 969)

Problem: In times of severe rainfall event / high flows the bridge capacity is exceeded.

Prevention / Mitigation Action: removal of coarse sediment from culvert / bridge floor.

Monitoring: Priority 1 Inspection.

AV-03 Alva Primary School (NS 884 968)

Problem: School boundary wall and pedestrian bridge acting as pinch points, gathering debris and forcing water out of the channel in severe rainfall events.

Prevention / Mitigation Action: Replaced old footbridge (I-beams) with raised soffit level above burn cross section; completed March 2006. Concrete sill across burn just south of north boundary wall crossing burn repaired and re-set to reduce scour and improve capacity (July 2006).

Monitoring: Priority 1 Inspection.

AV-04 Greenhead Farm (NS 884 966)

Problem: Pipes under Farm road crossing Alva Burn could not cope with burn capacity on storm event. Severe flooding to farm buildings.

Prevention / Mitigation Action: Landowner replaced pipes with large Armco culvert.

Monitoring: Priority 1 Inspection / liaison with landowner.

AV-05 Back Road – Glen Affric (House) (NS 875 973)

Problem: Coarse sediment and other debris blocking pipe inlet at fence line between hillside and house garden. Further problem at lower garden wall where coarse sediment regularly blocks manhole in garden and pipe under Back Road.

Prevention / Mitigation Action: Upgraded pipe in culvert and repaired manhole, 2004.

Monitoring: Householder inspects and clears watercourse to north of property. Priority 3 Inspection.

AV-06 Back Road (NS 875 973)

Problem: Manhole to rear of house, 40 Cochrane Crescent, regularly backed up with coarse sediment. Outfall pipes from manhole into main drainage system in Cochrane Crescent found to be collapsed at a number of locations.

Prevention / Mitigation Action: New manhole constructed with adequate silt-trap. New outlet pipe constructed along Back Road, old pipe system to rear of gardens abandoned. Emergency overflow from manhole into Cochrane Park constructed, 2004. North - south bund in Park extended northwards (Dec 09) to retain all waters emanating from manhole overflow.

Monitoring: Priority 3 Inspection.

AV-07 Cochrane Crescent / Back Road (NS 874 973)

Problem: Waters from broken pipe system and surcharging manhole (see AV-06) reaching Cochrane Crescent. Drainage system in Cochrane Crescent partially blocked with sediment. Nov 09 - waters from manhole (rear of No. 40) overflow not fully retained by north - south bund in Park.

Prevention / Mitigation Action: See AV-06. Also jetted out pipe system in Cochrane Crescent. Extended bund in Park (see AV-06).

Monitoring: Priority 3 Inspection. Scottish Water notified.

AV-08 Wharry Road (NS 875 971)

Problem: Water from blocked pipe system in Cochrane Park entering Wharry Road. Drainage system in Wharry Road partially blocked with sediment. 19/11/09 - drainage system surcharging at low point (two manholes between garden of no.26 and large bund.

Prevention / Mitigation Action: Council replaced and upgraded the piped drainage system in Cochrane Park and Glenwhinnel Road and into main drainage system. Dec 2009 - Manholes raised (and

sealed) to higher level than rest of drainage system to remove low point from no. 26.

Monitoring: Scottish Water notified. Manholes added to Priority 3 Inspection.

AV-09 Cochrane Park (NS 876 972)

Problem: Much of Cochrane Park semi-permanently flooded and permanently un-useable. Problem caused by above (AV-07 & AV-08).

Prevention / Mitigation Action: As AV-08.

Monitoring: Council Land Services monitor the park.

AV-10 Rhodders Grove (NS 889 971)

Problem: A blockage to the culvert in 'bog' area resulted in excess flood water to the north of the houses. (15/12/06).

On two occasions access to a road culvert on the Back Road has been blocked, run-off waters threatened the same area to the north of the houses (09/01/08, 15/09/08).

Prevention / Mitigation Action: Vegetation removal and clearing of open ditch in the bog area and placement of a new hake and access platform at the culvert mouth (Oct 2009).

Works completed (07/10/08) to deepen and formalise ditch on Back Road to aid the capture of flood flows. Works also consisted of the provision of an open grated manhole cover at ditch end and kerbing at culvert system entry point.

The bog area is currently zoned as part of the Cemetery extension; there is currently a drainage impact assessment underway for the site.

Monitoring: Priority 2 Inspection

AV-11 Blindwells / Southcroft (NS 879 969)

Problem: Flooding to public road from overland flow.

Prevention / Mitigation Action: Drainage system cleared prior to 1997.

Monitoring: Casual inspection by Roads Officers.

AV-12 C110 – Shavelhaugh Loan (NS 893 963)

Problem: During periods of high rainfall / high River Devon levels the public road is inundated north of River Devon bridge.

Prevention / Mitigation Action: Road is closed. As this is operational floodplain flooding of this section of the road is inevitable. Flood Warning / Road Closed (covered) signs permanently installed at each end of road.

Monitoring: Major (annual) Inspection and Local (bi-monthly) Inspection of River Devon by Roads Officers, part of 'Flood Watch' and 'Flood Warning' plans. This area is now included in the River Devon flood warning scheme (2009) operated by SEPA. The site is located within the 0.5% probability operational floodplain of the river as identified by SEPA's *Indicative River and Coastal Flood Maps* [15].

AV-13 Cleuch Drive (NS 871 971)

Problem: Overland flows from adjacent agricultural land came through damaged bund and flooded gardens and public road.

Prevention / Mitigation Action: Landowner repaired the bund, August 2007. Dec 2009 - Landowner has agreed to reconstruct bund and to provide pipe / drain / swale into manhole at SE corner of field.

Monitoring: Pass-by inspection of swale and bund.

AV-14 B908 (River Devon Road Bridge) (NS 883 691)

Problem: During periods of high rainfall / high River Devon levels the public road is inundated north of River Devon bridge.

Prevention / Mitigation Action: Road is closed. As this is operational floodplain flooding of this section of the road is inevitable. Flood Warning / Road Closed (covered) signs permanently installed at each end of road.

Monitoring: Major (annual) Inspection and Local (bi-monthly) Inspection of River Devon by Roads Officers, part of 'Flood Watch' and 'Flood Warning' plans. This area is now included in the River Devon flood warning scheme (2009) operated by SEPA. The site is located within the 0.5% probability operational floodplain of the river as identified by SEPA's *Indicative River and Coastal Flood Maps* [15].

AV-15 **9 & 11 Grodwell Drive (NS 874 972)**

Problem: Low point in drainage system.

Prevention / Mitigation Action: Scottish Water notified.

Monitoring: Householders

AV-16 **41 Cleuch Drive (NS 872 971)**

Problem: Low point in drainage system (foul).

Prevention / Mitigation Action: Scottish Water notified.

Monitoring: Householders

Cambus

CA-01 **Forth Street (NS 854 938)**

Problem: During a surge tide and high river level event waters left the River Devon channel and entered Forth Street. No buildings were affected (17/06/01).

Prevention / Mitigation Action: No recurrence. SEPA operate a coastal flood warning system. This needs to be developed / refined overtime.

Monitoring: The (non-tidal) section is now included in the River Devon flood warning scheme (2009) operated by SEPA.

Clackmannan

CL-01 Duke Street (NS 917 915)

Problem: Minor nuisance, water from piped drainage system reaching garden and garage.

Prevention / Mitigation Action: Old piped drainage system was connected into a positive outlet. No recurrence.

Monitoring: Pass-by Inspection.

CL-02 Brucefield Crescent (NS 917 918)

Problem: Occasional nuisance flood to one property. Caused by break in pipe within same property.

Prevention / Mitigation Action: Although normally this would be the responsibility of the property owner the pipe carries road drainage. Further the pipe does not have an adequate outlet. Efforts to survey the pipe and its upstream feeders were proving inconclusive. Eventually the source was discovered and redirected to a positive outfall further upstream (03/06/09). Pipe causing problem is now redundant.

Monitoring: Not required.

CL-03 Ladywood Drive (NS 921 915)

Problem: Possible flood risk to houses from occasional overland flows gathering in adjacent fields (28/12/07, 07/08/08).

Prevention / Mitigation Action: Landowner dug a small ditch to guide the collected flows to the nearby Goudnie Burn.

Monitoring: Pass-by inspection

Coalsnaughton

No flood events recorded since November 2007.

Devonside

DS-01 Alexandra Street at The Glen (NS 920 963)

Problem: In periods of high rainfall watercourse was bypassing inlet to A908 culvert.

Prevention / Mitigation Action: New watercourse channel created in the glen, headwalls and new trash screen constructed, 2005.

Monitoring: Priority 1 Inspection

DS-02 Drummie Road (NS 922 962)

Problem: Piped system to rear of houses blocked and inlet insufficient to deal with watercourse during high rainfall events.

Prevention / Mitigation Action: Pipe system excavated and cleared. Upper inlet cleared and repaired. Overflow channel constructed and secondary inlet, headwalls and trash screen constructed at new manhole, 2005. Access path cleared at nos. 20/22 Drummie Rd. in 2007.

Monitoring: Priority 1 Inspection

Note: Recent problem (01/08/08, 18/12/08) flood risk to number 10 Drummie Road property from surcharging manholes and (private) road gullies. Responsibility of Scottish Water who were contacted and jetting of systems undertaken to clear blockages.

DS-03 Alexandra Street at West End (NS 916 961)

Problem: Water running from new build house into grounds of other house.

Prevention / Mitigation Action: Dealt with between householders.

Monitoring: Not required.

DS-04 **Bain Street, (NS 918 962)**

Problem: Overland flow (foul) from adjacent agricultural / fallow land.

Prevention / Mitigation Action: Scottish Water identified and corrected the fault.

Monitoring: Not required.

DS-05 **4 The Craigs, (NS 918 962)**

Problem: Overland flow from adjacent garage area due to blocked gulley.

Prevention / Mitigation Action: Gulley cleared.

Monitoring: Priority 3 Inspection.

Devon Village

No flood events recorded since 1997.

Dollar

DL-01 **A91 Muckhart Road (Kelly Bridge) (NS 966 980)**

Problem: Flooding of A91 and potential to enter residential properties.

Prevention / Mitigation Action: Road drainage cleared and repaired, 2005.

Monitoring: Pass-by inspection by Roads Officers.

DL-02 **Thornbank Road (NS 958 980)**

Problem: Culvert inlet overtopping, flooding Thornbank Road and basement and grounds of St. James Church. Initially problem was thought to be limited to regular blocking of trash screen, 2005. Problem persisted and further investigation found that the piped

culvert had partially collapsed at a couple of locations under Thornbank Road.

Prevention / Mitigation Action: Trash screen cleared and replaced, 2005. Culvert replaced over whole length under Thornbank Road, access manholes constructed, 08/02/08.

Monitoring: Priority 1 Inspection.

DL-03 Back Road (Private) (NS 955 982)

Problem: Waters overtopping roadside ditch, blocked piped sections under driveways and choked road gulley. Waters flowing down steps into Strachan Crescent.

Prevention / Mitigation Action: Ditch, pipes and gulley cleared, 2003.

Monitoring: Priority 3 Inspection.

DL-04 Caravan Site, Rackmill (NS 962 969)

Problem: During periods of high rainfall / high River Devon levels, the caravan site and the public road are threatened. Evidence of floodwaters entering the caravan park site (21/10/04, 10/01/05, 13-14/12/06, 25 - 26/01/08).

Prevention / Mitigation Action: B913 road is closed. As this is operational floodplain flooding of this section of the road is inevitable. Flood Warning / Road Closed (covered) signs permanently installed at each end of road. Any flooding of the caravan park emanates from within its own land.

Monitoring: Major (annual) Inspection and Local (bi-monthly) Inspection of River Devon. Inspection of River Devon. Roads Officers monitor 'Flood Watch' and 'Flood Warning' plans. This area is now included in the River Devon flood warning scheme (2009) operated by SEPA. The site is located within the 0.5% probability

operational floodplain of the river as identified by SEPA's *Indicative River and Coastal Flood Maps* [15].

DL-05 House Lade, Rackmill (NS 962 969)

Problem: Evidence of floodwaters from River Devon entering property, but no reports of buildings being flooded (10/01/05, 25 - 26/01/08).

Prevention / Mitigation Action: Local measures (sandbags etc.) taken by landowner.

Monitoring: Major (annual) Inspection and Local (bi-monthly) Inspection of River Devon. Inspection of River Devon. Roads Officers, part of 'Flood Watch' and 'Flood Warning' plans. This area is now included in the River Devon flood warning scheme (2009) operated by SEPA. The site is located within the 0.5% probability operational floodplain of the river as identified by SEPA's *Indicative River and Coastal Flood Maps* [15].

DL-06 Bryanston Drive (Cycle Way) (NS 954 977)

Problem: Culvert under Cycle Way (old railway embankment) blocking. No threat to property but depth of water a potential threat to life.

Prevention / Mitigation Action: Gate, steps and walkway constructed out to improve access to inlet points at culvert for maintenance completed March 2007.

Monitoring: Priority 3 Inspection

DL-07 A91 Opposite Bryanston Drive (NS 953 980)

Problem: Small culvert under A91, easily blocked by leaf fall.

Prevention / Mitigation Action: Cleared.

Monitoring: Priority 3 Inspection

DL-08 Back Road (No. 32) (NS 957 983)

Problem: Small culvert under Back Road, easily blocked by leaf fall.

Prevention / Mitigation Action: Cleared.

Monitoring: Priority 3 Inspection

DL-09 Lovers Loan (The Warren) (NS 965 975)

Problem: Blocked culvert caused flooding to gardens in same property (24/10/08).

Prevention / Mitigation Action: Culvert cleared.

Monitoring: The nature of this flooding is not reportable under the legislation governing the Council's watercourse maintenance functions. However, the incident was noted. Also, as foul materials were evident in flood flows, incident was formally reported to Scottish Water.

DL-10 Drum Court (NS 966 982)

Problem: Overland flow from new kick-about pitch.

Prevention / Mitigation Action: Works were completed March 2009 to form a collecting swale at the pitch’s south end, directing collected flows to an open grated manhole in the swale. This manhole is connected to a pipe system which then directs flows to Kelly Burn.

Monitoring: Pass-by inspection.

Completed swale to capture flows at Drum Court, Dollar - 06/03/09

DL-11 Westmill House, East of B913, Rackmill (NS 958 971)

Problem: Evidence of floodwaters from River Devon entering property, but no reports of buildings being flooded. Notification was received from owner of flood threat to this property from river floodplain operation during this event. (25 - 26/01/08).

Prevention / Mitigation Action: Local measures (sandbags etc.) taken by landowner.

Monitoring: Major (annual) Inspection and Local (bi-monthly) Inspection of River Devon. Inspection of River Devon by Roads Officers as part of 'Flood Watch' and 'Flood Warning' plans. This area is now included in the River Devon flood warning scheme (2009) operated by SEPA. The site is located within the 0.5% probability operational floodplain of the river as identified by SEPA's *Indicative River and Coastal Flood Maps* [15].

DL-12 7, 9 & 11 Princes Crescent (NS 966 987)

Problem: Over land flows emanated from the Princes Crescent and Upper Hillfoots Road to the west apparently as a result of the failure

of local surface water drainage systems to cope with very heavy rainfall conditions.

Prevention / Mitigation Action: On each occasion Council staff were deployed to ensure road gullies were operating properly and that householder had sufficient sand bags in case water levels increased. These events have subsequently been investigated, both by the Council and Scottish Water. Scottish Water has subsequently confirmed in writing they are satisfied that the local drainage systems maintained by them had operated within expected design parameters on both occasions. The Council is carrying out a survey of all road gullies in the vicinity to determine whether gully performance could be improved. Also, a survey of carriageway and kerb levels is to be undertaken to consider whether any alterations to levels could either, store extreme flood flows temporarily, or re-direct flood flows to a less sensitive location / drainage system. A review of the larger sub-catchment in the vicinity will also be undertaken to determine whether there are any other factors that may have contributed to the generation of such unusually high surface flows.

Monitoring: Ongoing investigation.

Fishcross

No flood events recorded since 1997.

Forestmill

No flood events recorded since 1997.

Glenochil Village

GL-01 Glenochil Terrace (NS 870 957)

Problem: Blockage to ditch inlet to west of Glenochil Terrace.

Prevention / Mitigation Action: Removal of vegetation and debris.

Monitoring: Priority 3 Inspection

Kennet

No flood events recorded since 1997.

Marchglen

MA-01 C99 River Devon Bridge (NS 910 963)

Problem: The section of road immediately south of the River Devon road (C99) bridge regularly floods as part of the operational floodplain.

Prevention / Mitigation Action: Permanent, variable road signage to warn that the road ahead is closed due to flooding was erected at each end in February 2009.

Monitoring: The area is now included in the review and development of a new flood warning scheme to be operated by SEPA. The scheme is to be operational by summer 2009. The site is located within the 0.5% probability operational floodplain of the river as identified by SEPA's *Indicative River and Coastal Flood Maps* [15].

MA-02 No.1 Marchglen (NS 909 962)

Problem: Waters from blocked drainage system associated with old rail line (cycleway) affecting garden at No.1 and access path to cycleway.

Prevention / Mitigation Action: Works completed to install a new trash screen and safe maintenance access to a former railway line culvert in the woods to the south of Marchglen in 2007.

Monitoring: Priority 2 Inspection.

Menstrie

ME-01 Burnside Road (NS 848 967)

Problem: Burn blocked and overtopped at bridges due to excessive tree and trunk material brought down from Menstrie Glen in severe event.

Prevention / Mitigation Action: Maintenance of retaining walls, and replacement footbridge in 2005 (detailed in *2005 Biennial Report* [3]).

Monitoring: Priority 1 Inspection. Also from time to time inspecting the upper reaches of the burn for large debris.

ME-02 Ochil Road (Back Road) (NS 848 970)

Problem: Overland flow from steep hillside to north is not being caught due to poor maintenance of drainage ditches adjacent to private section of road.

Prevention / Mitigation Action: Sand bags deployed to direct flows away. Community Council has instructed contractor to clear and upgrade blocked pipe and to clear ditch.

Monitoring: Advice given by Council staff to affected resident to ensure regular maintenance of small ditch system on north side of private road.

Previous flood prone site (25/12/05, 27/10/06). Landslip issue affected house owner and remains unresolved. Problems appear to be triggered by high overland and sub-surface water flows from the hillside to north. Affected parties include Northern Hydroseeding Ltd, Scottish Water and owners of the property “Deafhills” Ochil Road, Stirling and Clackmannanshire Councils.

ME-03 Ochil Road (NS 849 970)

Problem : Significant flood to 7 properties resulting from overland flows from a water main burst on the hillside above.

Prevention / Mitigation Action : Note - SW shut off the water main, works completed several days after incident by Scottish Water to repair water main.

Monitoring : N/A

ME-04 Victoria Terrace (NS 859 970)

Problem : Blockage in piped section of watercourse.

Prevention / Mitigation Action : Blockage cleared and trash screen installed, manhole raised.

Monitoring : Priority 3 Inspection.

Muckhart

MK-01 Kirkhill (NO 000 007)

Problem: Flooding of gardens due to blockage of watercourse through garden by man made obstructions, including a boundary fence, and partial blockage of culvert entry.

Prevention / Mitigation Action: New trash screen installed at headwall and fence removed (February 2007).

Monitoring: Priority 2 Inspection.

MK-02 Dollar-Crook of Devon Road - Housing South-east of Muckhart Primary School (NO 004 999)

Problem: A low bridge carrying a footpath was contributing to blockage in burn. The resultant garden flooding upstream at properties was significant (deep water rather than flooding to property). No floodwaters entered any houses, but this was considered likely during larger rainfall events

Prevention / Mitigation Action: To resolve the problem it was decided to remove bridge and reroute the footpath along the edge of the adjacent Dollar-Crook of Devon Road for a short distance. The works were completed 09/03/09

Monitoring: Priority 3 inspection.

MK-03 **Balliliesk House and A91 Pool / Yetts O'Muckhart (N0 003 010)**

Problem: Significant overland flows were generated on the southern slopes of Seamab Hill and on the A91 carriageway between Yetts O'Muckhart and Pool O' Muckhart.

Prevention / Mitigation Action: Subsequent investigations revealed that the Woodland Trust had commenced a programme of woodland regeneration on the southern steep slopes and in preparing the ground for tree planting had removed the natural ground cover and exposed soils over large tracts of land. When heavy rain fell soils and flood flows were transported quickly downhill towards the wall, properties and the A91. A further, joint investigation of this issue was carried out by the Woodland Trust and the Council and an independent report was produced, *Geordie's Wood, Pool O'Muckhart* [12,] in December 2008. This resulted in works being completed to the north and south of Geordie's Wood. The area for the intended woodland has been replanted and has also regained its natural ground cover. However, an artificial transverse drain to the north of the wood has been reinstated to encourage more natural rainfall absorption in the area and woody debris has been deliberately placed within the burn channel to help slow the flows.

Monitoring: The area will be regularly monitored by both parties.

Sauchie

SA-01 **Parkhead Road (NS 892 940)**

Problem: Blockage of trash screen.

Prevention / Mitigation Action: cleared out.

Monitoring: Casual inspection.

SA-02 Branshill Road (2 sites) (NS 885 944 / NS 885 942)

Problem: Overland flow from fields.

Prevention / Mitigation Action: Drain installed to rear of properties.

Monitoring: None required. Residents will report any issues.

SA-03 A908 Whiteyetts (NS 899 948)

Problem: Overland flow from Golf Course access road affecting A908.

Prevention / Mitigation Action: Remedial work carried out in access road.

Monitoring :Not required.

SA-04 Cat's Close (NS 895 936)

Problem: Burn blocking and flooding footpath and allotments site.

Prevention / Mitigation Action: Trash screen replaced.

Monitoring: Priority 3 Inspection.

SA-05 Devon Valley Drive / Craigview (NS 897 947)

Problem: Ditch blocking at cyclepath.

Prevention / Mitigation Action: Piped systems upgraded as part of new residential development. Ditch cleared of fly tipping debris.

Monitoring: Priority 3 Inspection.

Tillicoultry

TI-01 Hareburn Road (NS 912 967)

Problem: Burn overtopping, flowing into Hareburn Road and gathering at low point.

Prevention / Mitigation Action: Burn wall maintained to previous height. Scottish Water system upgraded at low-point on Hareburn Road.

Monitoring: Tillicoultry Burn is Priority 1 Inspection.

TI-02 Elistoun Drive, Kirktoun Gardens, Glebe Crescent, Derby Place, Moss Road (NS 922 967)

Problem: Previous flood incidents (27/03/06, 13-15/12/06, 11/01/07) were due to exceeded drainage capacity of the watercourse U-08 prevalent when the River Devon is high and blocks the outflow of the piped watercourse.

Prevention / Mitigation Action: A joint project between the Council and Scottish Water improved local drainage and sealed a culverted watercourse in the area to improve hydrostatic head to improve outlet into River Devon even at high (above outlet pipe) river levels (completed in December 2007). There has been no further flooding directly from this source.

Problem: New flood incident, 25 - 26/01/08 - Watercourse ref. R-01. Serious flooding occurred to Elistoun Drive, Kirktoun Gardens, Glebe Crescent, Derby Place, Moss Road and the Sterling Furniture Store site, when the River Devon over topped the former railway embankment to the south of Elistoun Drive. This resulted in evacuation of residents and significant property damage. A threat to life was perceived for a time as the flooding at Elistoun Drive was said to be exceeding 1m in depth.

Prevention / Mitigation Action: The Council carried out an extensive investigation of the incident (list of reports in section 2.2) public consultation, detailed hydrological modelling and design. This resulted in the reconstruction of the railway embankment to a consistent level and specification. The principal works to form the reinstated embankment were complete by December 2008 with final completion of all project elements by March 2009.

Further Prevention / Mitigation Action: Tillicoultry Flood Prevention Scheme is currently being developed. The main issues have been

analysed and initial stakeholders consultation carried out. Presently undergoing option testing. The main components in the scheme are, the provision of further defences in Tillicoultry and retention works upstream.

Nov 2009 event - SW contractor returned to site to install sealed cover to manhole. **Note:** River Devon was at least as high as previous overtopping event - waters were contained by embankment; Sterling bund was not breached although river started to breach kerb at rear of Butterfly restaurant.

Monitoring: This area is included in the flood warning scheme operated by SEPA. The scheme was put into operation in summer 2009. The site is located within the 0.5% probability operational floodplain of the river as identified by SEPA's *Indicative River and Coastal Flood Maps* [15].

TI-03 **A908 Moss Road (NS 920 968)**

Problem: Previous flood incident (14/12/06), flooding to carriageway south of Sterling Mills, due to surcharging drainage systems in Moss Road. This occured when the River Devon (Watercourse ref. R-01) is high and the outlet to the river was submerged and system capacity exceeded.

Mitigation / Prevention action: Drainage systems considered under the study report produced in association with issue TI-02. Scottish Water, as part of a major improvement of their foul water systems, connections to the local water treatment works and combined sewer overflow, has diverted some minor foul water pipes away from the main drainage in Moss Road, increasing the capacity of this system. Further, improvements to the flap valve at the outflow into the River Devon have stopped waters backing up into the system when the river is high.

Problem: New flood incident (25 - 26/01/08). Serious flooding occurred on Moss Road when the River Devon over topped its banks in the grounds of the Sterling Furniture store site and flowed onto the road. Road drainage system already at capacity and could not deal with the flood waters. Road closed.

Further Prevention / Mitigation Action: Improvements to the drainage system in Moss Road are mentioned above. Scottish Water also separated the drainage systems in Elistoun Drive, providing more capacity for drainage and flood waters and removing the incidence of contamination from foul systems.

Whilst the works to reinstate the disused railway embankment / cycle track will further protect the Elistoun Drive area from high river levels there is still the potential for the river to over top its banks within the Sterling site. This is being investigated through the Tillicoultry Flood Prevention Scheme (see T1-02).

Monitoring: This area is now included in the review and development of a new flood warning scheme to be operated by SEPA. The scheme is to be operational by summer 2009. The site is located within the 0.5% probability operational floodplain of the river as identified by SEPA's *Indicative River and Coastal Flood Maps* [15].

TI-04 Stalker Avenue (NS 920 972)

Problem: The trash screen, immediately north of Stalker Avenue is easily blocked by playground litter and household rubbish and can form a small but deep pond. This is a safety issue rather than flood risk.

Prevention / Mitigation Action: Cleared of debris.

Monitoring: Priority 1 Inspection.

TI-05 6 Dollar Road (NS 921 970)

Problem: Flooding to gardens due to blockage in pipe within same property.

Prevention / Mitigation Action: Cleared blockage. Improved the capacity of the culvert downstream where it crosses the A91.

Monitoring: Householder has plans to demolish extension that sits above the damaged pipe; will take opportunity to have pipe reinstated to full capacity. Priority 3 Inspection.

Tullibody

No flood events recorded since 1997.

6.0 MEASURES REQUIRED TO PREVENT OR MITIGATE FLOODING

6.1 Watercourse Maintenance Programmes

This section of the report explains the methods used by the Council to comply with its duties under the *Flood Prevention and Land Drainage (Scotland) Act 1997* [2] (the 1997 Act) and to report on the works undertaken on watercourse maintenance throughout the Council area. The Council's legislative responsibility lies with Development and Environment Services and in particular with the Roads and Transportation Section.

The *1997 Act* [2] places the responsibility for the assessment and maintenance of watercourses on the local authority. This applies to watercourses that would affect non-agricultural land, but does not apply where failure to maintain would result in flooding of land in the same ownership as the watercourse requiring maintenance. Importantly, the *1997 Act* [2] does not place a duty on the local authority to improve the capacity of watercourses.

The maintenance work currently carried out by Clackmannanshire Council, as a result of the assessment of watercourses, falls into three categories :-

- Clearing of urban debris from watercourses
- Maintenance of walls, banks and other structures that form, or cross watercourses
- Provision of flood alleviation works i.e. new infrastructure to prevent and limit further flooding and reducing the need for maintenance.

Clearing of Natural and Urban Debris

Between 1997 and 2002 the entire lengths of all watercourses that could potentially affect non-agricultural land were inspected once each year. This inspection regime resulted in appropriate clearance works being carried out.

During this time ad hoc inspections of known problem sites were carried out at regular, short intervals. During 2003 this information was analysed and together with an increasing understanding of the local hydrological characteristics it was possible to identify the appropriate priority to be placed on particular sections of each watercourse. From this a *Prioritised Watercourse Inspection and Clearance Regime* [5] (see section 5.2) was developed and initiated during 2004/05. This regime is continually monitored and, where necessary, amended to ensure that all watercourses receive optimum attention.

Initially the clearance operations involved the removal of loose vegetation, tree material and the detritus from fly tipping. Between 2002 and 2005 this was extended to consider removing silts and coarse sediments from watercourses where these were considered to be affecting the capacity of the watercourse channel. During 2007/08 *Watercourse Audit and Works Implementation Plans* [6] were produced for the Principal burns in the Council area. These reports itemise all structural, vegetation and coarse sediment removal works considered necessary on the principal urban burns. The production of these watercourse audits and improvement plans were a policy commitment of the Council's *2005 Biennial Report* [3] (Policy FP3).

Maintenance of Banks, Walls, Culverts and other Infrastructure

Roads and Transportation carries out two yearly inspections of all bridges that carry adopted roads and three yearly inspections of all other bridges, with spans greater than 2m, over watercourses. These inspections assess the structural integrity of the bridges, the condition of adjacent training banks and walls and any issues relating to debris in the adjacent section of watercourse. This information is utilised in the *Prioritised Watercourse Inspection and Clearance Regime* [5] and the recently completed *Principal Hillfoots Burns Crossing Register Structure Information and Crossing Inspection - 2009 (Urban Reaches)*[18] document.

Prior to the *1997 Act* [2] watercourses had suffered from an extended period of poor maintenance by riparian landowners. This left a legacy of problems for the local authority. Initially, maintenance work was carried out mainly at sites where structural failure had already occurred.

The aforementioned *Watercourse Audit and Works Implementation Plans* [6] have now been produced (see section 5.3) and these itemise all necessary structural maintenance (and vegetation and coarse sediment removal) works required on along the principal urban burns.

As with any works within watercourses, examination of *The Water Environment (Controlled Activities) (Scotland) Regulations 2005* [17] will be undertaken to determine where any necessary approvals from the SEPA will be required to ensure that resulting works comply with the regulations and therefore have minimal adverse affect on local biodiversity.

Flood Alleviation Works

Small-scale flood alleviation works aimed at maintaining the functional integrity of watercourse channels are also carried out where required. The works were initially mainly generated as a result of flood events. Now that the watercourses have been identified, prioritised inspection and clearance regimes are in place and burn Audits have been completed, the Council can now assess watercourse channels to identify areas where over-topping of banks either occurs or may be likely to occur during an event with significantly heavy rainfall.

6.2 Prioritised Watercourse Inspection & Clearance Regime

River Devon (R-01)

Two inspection regimes have been put in place to monitor the build up of wood debris and other significant flow obstructions upstream of all major river crossings on the River Devon. Initially, these inspections will occur on a bi-monthly and an annual basis. The bi-monthly inspections are focussed on the bridges and other

likely points of constraint on the river. The annual inspection is carried out on foot along the whole length of the river between Cambus and Dollarbeg. This identifies build up of debris, overgrowing vegetation and other potential issues. The following table sets out the annual debris inspection process commencing April 2009 (the initial full inspection occurred April 2008). A shallow draft rowing boat has been acquired to assist access to remote spots on the river. The River Devon has been split into sections to be inspected as follows:-

Section 1. Vehicle Bridge to Bonded Warehouses at Cambus (NS 2854 7941) to Historic Iron Bridge (NS 2854 7941)

Section 2. Historic Iron Bridge to Stirling – Alloa Railway Bridge (NS 2849 7946)

Section 3. Stirling - Alloa Railway Bridge (NS2849) to Old Devon Bridge (by A907) (NS 2847 7952)

Section 4. Old Devon Bridge (by A907) (NS 2847 7952) to A907 Road Bridge (NS3847 7952)

Section 5. A907 Road Bridge (NS 2847 7952) to Menstrie Branch Rail Bridge (disused) (NS2852 7952)

Section 6. Menstrie Branch Rail Bridge (disused) (NS 2852 7959) to C101 Tullibody Road Bridge (NS 8717 9641)

Section 7 C101 Tullibody Road Bridge (NS 8717 9641) to Bailey Bridge - Access to Tipping Site (NS 2868 7967)

Section 8. Bailey Bridge - Access to Tipping Site (NS 2868 7967) to B908 Devon Bridge (NS 2884 7963)

Section 9. B908 Devon Bridge (NS 2884 7963) to Shavelhaugh Loan Bridge (NS 2894 7960)

Section 10. Shavelhaugh Loan Bridge (NS 2894 7960) to Glenfoot Bridge (NS 2911 7965)

Section 11. Glenfoot Bridge (NS 2911 7965) to Dismantled Railway (NS 2913 7964) to Cycle Bridge (NS 2917 7964)

Section 12. Dismantled Railway Bridge to Cycle Bridge (NS 2917 7964)

Section 13. Cycle Bridge (NS 2917 7964) to A908 Bridge Tillicoultry (NS 2921 7965)

Section 14. A908 Bridge Tillicoultry (NS 2921 7965) to Railway Bridge (disused) (NS 2926 7966)

Section 15. Railway Bridge (disused) (NS 2926 7966) to Bridge to Wester Sheardale (NS 2943 7975)

Section 16. Bridge to Wester Sheardale (NS 2943 7975) to Bridge to Haugh Farm (NS 2949 7976)

Section 17. Bridge to Haugh Farm (NS 2949 7976) to B 913 Rackmill Bridge (NS 2961 7969)

Section 18. B 913 Rackmill Bridge (NS 2961 7969) to Weir at Dollarfield (NS 2964 7969)

Section 19. Weir at Dollarfield (NS 2964 7969) to Dismantled Railway (NS 2967 7969)

Section 20. Dismantled Railway (NS 2967 7969) to Vicar's Bridge (NS 2986 7980)

Tree debris within the River Devon, west of Dollar - 21/04/09

Method of Prioritisation for other Watercourses

Due to the variable nature of the environmental factors that can contribute to flood risk, every watercourse will have different hydrological and hydraulic characteristics. These characteristics also change over time. To facilitate these variances and to maximise efficiency of watercourses throughout the Council area, all known watercourses have been assessed and critical locations identified. Three levels of inspection and maintenance priority cover these critical locations (see following Tables 6.1, 6.2, & 6.3). The priority ratings given to each location reflect the propensity of the watercourse to become blocked with debris (man-made or natural materials) and also take account of the severity of flood risk to adjacent non-agricultural land. Pass-by inspections also cover the lower priority stretches of watercourses. Feedback from the inspections carried out by Council staff, and indeed from other sources, is analysed regularly and priorities altered or new sites added as necessary.

Priority 1 Sites for Inspection and Maintenance as of April 2009

Watercourses and other sensitive locations to be inspected and subsequently cleared of debris, to be carried out on a **monthly** basis.

Priority 2 Sites for Inspection and Maintenance as of April 2009

Watercourses and other sensitive locations to be inspected and subsequently cleared of debris, to be carried out on a **three monthly** basis.

Priority 3 Sites for Inspection and Maintenance as of April 2009

Watercourses and other sensitive locations to be inspected and subsequently cleared of debris, to be carried out **twice annually**, at the beginning of April and October.

Table 6.1 Priority 1 Inspections

Priority Ref.	W/course Ref.	W/course Name	Location	OS Ref (NS)
P1 – 01	B – 05	Menstrie Burn, **Menstrie**.	North of Ochil Rd Bridge to A91	849 970 to 848 969
P1 – 02	B – 05	Menstrie Burn, **Menstrie.**	A91 to south of Brook St. bridge	848 969 to 851 969
P1 – 03	B – 05	Alva Burn, **Alva**.	From nature walk car park to Beauclerc St.	884 975 to 883 973
P1 – 04	B – 07	Alva Burn, **Alva**.	Beauclerc St to A91 bridge	883 973 to 884 970
P1 – 05	B – 07	Alva Burn, **Alva**.	From A91 bridge south of School site.	884 970 to 884 966
P1 – 06	B – 11	Tillicoultry Burn, **Tillicoultry**	Upper Mill St. Bridges	914 974 to 914 970
P1 – 07	B – 11	Tillicoultry Burn, **Tillicoultry**	Lower Mill St. Bridges	914 970 to 910 965
P1 – 08	U – 08	Stalker Avenue, **Tillicoultry**	Hake at south east corner of school grounds	920 972
P1 – 09	U – 01	Forrester Grove / Inglewood, **Alloa**	New system north of Forrester Grove	878 942 to 878 940
P1 – 10	U – 14	Thornbank Road, **Dollar**	System east of St. James Church	958 980
P1 – 11	U – 11	The Glen, **Devonside**	Watercourse, new hake / manhole system in The Glen, Devonside	920 962 to 920 963
P1 – 12	U – 10	Drummie Road, **Devonside**	New system and hakes south of Drummie Road	922 962
P1 – 13	B – 01	Brothie Burn, **Alloa**	Hake at Shillinghill Rbt.	889 929
P1 – 14	B – 03	Fairy Burn, **Alloa**	Outlet of Fairy Burn into Brothie (in ALDI pond area)	889 929
P1 – 15	U – 04	Woodburn Drive, **Alloa**	New hake and ditch system rear of 17/19 Woodburn Dr.	876 942

Table 6.2 Priority 2 Inspections

Priority Ref.	W/course Ref.	W/course Name	Location	OS Ref (NS)
P2 – 01	U – 09	**Marchglen**	Hakes on former railway line to south east	910 962
P2 – 02	B – 12	Simpson Court, **Tillicoultry**	Culvert of Kirk Burn beneath Simpson Court	927 973
P2 – 03	B – 03	Fairy Burn, Parkway, **Alloa**	Hake to south of Parkway in Greenfield Grounds	884 932
P2 – 04	B – 01	Brothie Burn, **Alloa**	From Hilton Road bridge to Lambert Terrace Bridge	893 931
P2 – 05	B – 01	Brothie Burn, **Alloa**	From Lambert Terrace to access to Hamilton & Brydie	893 932 to 892 931
P2 – 06	B – 01	Brothie Burn, **Alloa**	From access to Hamilton & Brydie to Railway Br.	892 931 to 891 931
P2 – 07	U – 04	Gavins Road, **Alloa**	Ditch in woodland to rear of houses	875 942
P2 – 08	U – 03	Dunmar Drive, **Alloa**	Pond and to watercourse south of Dunmar Drive	873 939
P2 – 09	U – 20	Rhodders Grove, **Alva**	Short section of watercourse west of 16 McLean Crescent	889 972
P2 – 10	U – 13	Kirkhill, **Muckhart**	Open ditch, culverted system between nos 3 and 5 Kirkhill	000, 008
P2 – 11	B – 03	Fairy Burn, **Alloa**	Section through Greenfield grounds	884 932
P2 – 12	B – 11	Dollar Burn, **Dollar**	Adjacent to golf club.	961 989 to 964 969
P2 - 13	B - 11	Dollar Burn, **Dollar**	Between Back Road and A91 Rd Bridge	963 983 to 963 973
P2 - 14	B-11	Dollar Burn, **Dollar**	Between A91 Road Bridge and former railway bridge	963 973 to 963 to 976
P2 - 15	B-01	Brothie Burn, **Alloa**	Hakes beneath railway Bridge and just downstream of ALDI store	891 931 to 890 930
P2 – 16	U – 02	Ormiston Drive, **Alloa**	Hake to north west	874 945
P2 - 17	B-16	Dollar-Crook of Devon Rd, **Muckhart**	Road culvert at west end of houses	998 999

Table 6.3 Priority 3 Inspections

Priority Ref.	W/course Ref.	W/course Name	Location	OS Ref (NS)
P3 – 01	B – 12	Kirk Burn, **Tillicoultry**	Section through Heathwood Crescent	924 974 to 925 975
P3 – 02	B – 12	Kirk Burn, **Tillicoultry**	Section through Tillicoultry Mains	925 975 to 927 974
P3 – 03	U – 08	6 Dollar Rd, **Tillicoultry**	Pipe system forming part of U-08 in garden, 6 Dollar Rd.	921 970
P3 – 04	U – 12	Un-named small burn, **Dollar**	North side of A91, west of Bryanston Drive	953 980
P3 – 05	B – 13	Quarrel Burn, **Dollar**	Section through Bridge.	955 980
P3 – 06	B – 15	Kelly Burn, **Dollar**	Section through A91 Bridge	966 980
P3 – 07	U – 16	Un-named burn**, Dollar**	32 Back Rd,	957 983
P3 – 08	U – 17	Back Rd**, Dollar**. .	Public/private sections. Watercourse, all driveway culverts and gully above Strachan Cres	954 981
P3 – 09	B – 13	Bryanston Drive, **Dollar**	Culvert to rear of Bryanston Drive beneath former railway line.	954 977
P3 – 10	U – 03	Dunmar Drive, **Alloa**.	Culvert to east +system from pond in wooded area	873 939
P3 – 11	B – 04	Goudnie Burn, **Clackmann.**	B910 Bridge over burn	915 922
P3 – 12	R – 02	Black Devon, **Clackmannan**	A907 culvert Tree Grid	916 923
P3 – 13	U – 18	Long Row, **Menstrie.**	Drainage system from hill to north thru' 35/37	851 970
P3 – 14	B – 08	Carnaughton Burn, **Alva**.	Section from Back Rd to A91 culvert	877 971
P3 – 15	B – 09	Spring Burn, **Alva**	A91 Culvert	888 970
P3 – 16	U – 19	Un-named burn, **Tillicoultry**	A91 culvert, east of golf driving range access	928 971
P3 – 17	U – 05	Un-named w/c, **Sauchie**	Between Diverswell and Whiteyetts	897 947
P3 – 18	U – 07	Watercourse, **Tillicoultry**	Piped system east of Bards Way	928 976

Table 6.3 continued

Priority Ref.	W/course Ref.	W/course Name	Location	OS Ref (NS)
P3 – 19	U – 20	Cochrane Crescent / Back Road, **Alva**	Clear manhole Chamber in north east corner of 40 Cochrane Crescent and catch pit in garden at Glen Affric.	875 973
P3 – 20	U - 24	Kennet Lodge, **Clackmanan**	New hake to east of Kennet Lodge.	920 914
P3 – 21	B – 02	Roundelwood, **Sauchie**	Hake on burn at culvert entry point from rural area.	885 944
P3 – 22	B – 03	Inglewood, **Alloa** Pond Outlet	Outlet from Pond to Fairy Burn culvert	877 940
P3 – 23	U – 15	Donaldson Av, **Alloa**	Hake to south of No. 2 Don. Avenue	873 943
P3 – 24	B – 06	Victoria Terrace **Menstrie**	Hake north of Victoria Terr.	859 970
P3 – 25	B – 10	Silver Burn **Alva**	Open section from A91 to Alva Ind. Estate Rd	892 969 to 892 968
P3 – 26	B – 10	Silver Burn, **Alva**	Open section from Alva Ind. Estate Rd south for 100m	892 968 to 892 967
P3 – 27	U – 06	Glenochil Terrace, **Glenochil**	Ditch west of Glenochil Terrace	870 957
P3 – 28	B – 02	Cats Close, **Alloa**	Hake at end of Cats Close	895 936
P3 - 29		58/60 Main Street West, **Menstrie**	Small watercourse north of garden ground sinks to piped system	846 969
P3 - 30		Burnside Road, **Alva**	Section of Silver Burn adjacent to road + A91 Culvert screen	892 970
P3 - 31	U-20	Wharry Road, **Alva**	Check seals on manholes	875 971
P3 - 32		The Craigs, **Devonside**	Clear gulley in garage court	918 962

Note - Maps indicating all identified Priority locations can be found in Roads and Transportation file reference number, W4/1, Room 11, Kilncraigs, Alloa.

Information on Coarse Sediment Build up in Watercourses

In addition to carrying out its prioritised watercourse inspection & clearance regime, the Council has also adopted a further assessment process to audit the condition of all watercourses and to plan improvement strategies. This is known as the Watercourse Audit and Improvement Plan[6]. It is clear from the knowledge gained from these inspection processes that the movement of coarse sediments during high flow events can affect flood risk. A Council commissioned report, *Flood Management in the Hillfoots Burns* [23] *(2004)* confirmed that due to the steep topography of the adjacent Ochil escarpment, which forms the catchment of each of the Hillfoots Burns, these burns have a highly dynamic nature. Large amounts of sediments move through these watercourses and the retention of excessive coarse sediments in the watercourse channels in certain sensitive locations can lead to three particular issues, each of which, either singularly or cumulatively, have the potential to exacerbate the likelihood of flooding to non-agricultural land.

- Coarse sediments such as boulders in the watercourse bed allow finer sediments to gather creating banks and islands. More often than not the build up of sediments enhance the watercourse, slowing down the speed of the water thereby creating some attenuation for downstream areas and providing habitat for flora and fauna. There will however be locations where sediment accumulates and alters the flow line within the burn channel. This can lead to scouring of banks, damage to walls and potentially to collapses and damming in the watercourse.
- Coarse sediments gathering in any watercourse for extended periods leading to a general increase in the watercourse bed level. This is can be problematic at bridges and culverts where the channel capacity can be reduced.
- Areas where excessive coarse sediment gathers may also create snagging points for vegetation and other debris creating dams and changing the flow line.

Sediments in watercourse beds are essential for insects and fish and it is not appropriate to clear sediments from watercourses without prior consideration of the biodiversity impacts. Through consultation with the Scottish Environmental Protection Agency (SEPA) and other interested groups, such as the Forth District Salmon Fisheries Board (FDSFB) and local angling clubs, removal of sediments can be essential to reduce flood risk in certain circumstances but any works deemed necessary must be carried out in a sensitive manner and always under cover of an appropriate CAR authorisation, as required by *The Water Environment (Controlled Activities) (Scotland) Regulations 2005* [17].

Build up of sediment beneath Mixed Leisure Route (Former Railway Bridge), Dollar Burn, Dollar - 22/06/09

As finer sediments are also of importance to biodiversity, where possible only coarse sediments will be removed from open watercourses and only where a clear flooding hazard would be alleviated. The dynamic nature of watercourses will ensure that finer sediments will move downstream naturally once the larger boulders have been removed. There will be locations where finer sediments gather in large quantities, e.g. weirs, bridge piers and on bends, and this will be removed if it appears to be retarding fine sediment movement, or if it might potentially lead to over topping, or significant capacity reduction. Coarse

sediment removal will only be carried out over limited lengths of watercourses to minimise impact on biodiversity.

The urban sections of the following watercourses, which have not as yet been assessed as part of the *Watercourse Audit and Improvement Plans*[6], will be routinely inspected until burn audits are complete, to identify areas which may require removal of coarse sediment and locations of excessive fine sediment build up.

- Carnaughton Burn, Alva
- Silver Burn, Alva
- Quarrel Burn, Dollar
- Kelly Burn, Dollar
- Drummie Road, Devonside
- The Glen, Devonside
- Sauchie Burn, Sauchie

Vegetation Removal in Burns

It is clear from the knowledge gained from the inspection processes that excessive vegetation growing in watercourse channels effects flood risk.

When considering vegetation maintenance that is deemed to have a beneficial flood risk affect, there is an important balance to be struck between reducing flood risk and maintaining habitat. Advice received from the Scottish Environmental Protection Agency (SEPA) suggests that management of watercourse vegetation should minimise potential environmental effects. Therefore the following criteria must be met preceding any works: -

- Vegetation will only be removed where there is a clearly identified flood risk to sensitive non-agricultural land, or where vegetation is likely to cause damage to walls, bridges, embankments etc.
- No more than one third of vegetation identified for clearance on any stretch of watercourse should be removed annually. The vegetation should

be thinned evenly along the watercourse to ensure that no section is unduly denuded.

- The stability of watercourse embankments should not be compromised during, or as a result of, removal of vegetation.
- Although application to SEPA, under *The Water Environment (Controlled Activities) (Scotland) Regulations 2005* [17], is not required for vegetation removal, prior notification will still be given to other affected parties.

6.3 Watercourse Audit and Implementation Plans

Watercourse Audit and Implementation Plans [6] have been prepared by the Council for the principal Hillfoots burns, the Fairy Burn and the Brothie Burn. The function of these plans is to identify and prioritise current maintenance issues and defects relating to flood risk within the principal burns examined and then to prioritise identified works for subsequent implementation. The Plan for the Fairy Burn was completed in August 2007 with the Brothie Burn plan completed in April 2009. The plan for the Sauchie Burn will be published later in 2009.

Damage to Retaining wall, Alva Burn, Alva - 28/05/09

Maintenance Audit and Implementation Plan for Menstrie Burn

General Information :-

Burn Ref. = B-05
Grid Ref. = NS 849 971 to NS 850 959
Urban Length = 1.2km
Catchment = 12.07 km2
0.5% return period flow = 24.2cumecs (JBA report April 2005)

Chainage 0m = North side of Ochil Road Bridge NS 849 971

Table 6.4a - Audit Results - Menstrie Burn		
Ref.	**Chainage**	**Notes**
1.		**Embankment and Wall Repairs**
a.	(-36m to -29m)	Repair partially collapsed east wall
b.	(-31m to -28m)	Severe scour of west embankment
c.	(-18m to -12m)	Unstable section of west wall
d.	(5m to 10m)	Unstable section of east wall (S of Ochil bridge)
e.	(13m to 15m)	Partial collapse of east wall
f.	(30m to 59m)	Partial collapse of east wall at toe of earth bank
g.	(46m)	Pointing failure on east wall
h.	(123m to 131m)	East wall washed out.
i.	(188m to 195m)	Scouring and pointing failure on west wall
j.	(296m to 301m)	Pointing failure on new footbridge wall (west side)
k.	(421m to 426m)	Scouring to embankment
2.		**Structural Maintenance**
a.	(237m to 295m	Base of boulder wall failing due to tree roots
3.		**Course Sediment Removal**
		No Action Required
4.		**Vegetation Removal**
a.	(-23m to -20m)	2 saplings and general scrub
b.	(150m)	Large bush, west side
c.	(219m)	Large dead tree trunk to be removed

5.		**Other Maintenance Works**
a.	(114m to 139m)	Old fence posts and founds causing obstruction

Table 6.4b - Implementation Plan - Menstrie Burn					
Ref.	**Description of Works**	**Cost (£)**	**Priority 1 - 10 1(low)**	**Works Schedule (Date)**	**Complete (Date)**
1a.	Repair wall	800	6.5	2010/11	
1b.	Rebuild and reinforce embankment	500	7.5	2010/11	
1c.	Rebuild wall	1000	5.5	2012/13	
1d.	Pointing masonry wall	1500	8	Nov. 06	Nov. 06
1e.	Rebuild boulder wall	600	5	2011/12	
1f.	Rebuild stone wall	3000	3.5	2012/13	
1g.	Re-point masonry wall	50	2	2012/13	
1h.	Rebuild wall	1500	4	2012/13	
1i.	Reconstruct foundation to concrete wall and pointing	2000	6	2011/12	
1j.	Re-point wall	250	4	2012/13	
1k.	Replace boulders	500	3	2012/13	
2a.	Reconstruct boulder wall	8000	7	2011/12	
4a.	Remove scrub and saplings	100	4	2010/11	
4b.	Cut back large bush	75	3	2010/11	
4c.	Remove tree trunk	100	6	2010/11	
5a.	Remove concrete posts and bases	700	6	2010/11	

Maintenance Audit and Implementation Plan for Alva Burn

General Burn Information :-

Burn Ref. = B-07
Grid Ref. = from NS8849 9750 to NS8833 9627
Urban Length = 1.0km
Catchment Area = 8.03km2
0.5% return period = 19.1cumecs (JBA report June 2006)

Chainage 0m = S of Footbridge, Golf Club Car Park. NS 884 974
Chainage 0m = S of A91 Bridge. NS 884 970
Chainage 0m = S of Henry Street Bridge. NS 884 969

Table 6.5a - Audit Results - Alva Burn		
Ref.	**Chainage**	**Notes**
1.		**Embankment and Wall Repairs**
	GC Bridge	
a.	(45m to 49m)	Loss of mortar to west wall
b.	(102m)	Minor deterioration and mortar loss to west wall
c.	(118m to 123m)	Minor deterioration and mortar loss to west wall
d.	(121m to 159m)	Mortar loss west wall
e.	(173m to 181m)	Partial loss of stone west wall
f.	(181m to 192m)	Significant failure west wall
g.	(192m to 202m)	Loss of stone in west wall
h.	(202m to 216m)	Scouring of base, west wall
i.	(220m to 225m)	Pointing failure on east wall
j.	(232m to 239m)	Mortar loss east wall
k.	(252m to 262m)	Scouring to base of east wall
l.	(284m to 290m)	Severe scouring and defect to west wall
m.	(287m to 327m)	Scouring to east embankment and wall base
n.	(357m to 361m)	Failing section of east wall
	A91 Bridge	
o.	(25m to 31m)	Minor failure of east wall
p.	(45m to 61m)	Scouring beneath concrete sill east embankment
	Henry St.	
q.	(49m to 54m)	Damage to gabion baskets east embankment
r.	(60m)	Minor failure of east wall
2.		**Structural Maintenance**
a.	(263m to 272m)	Major failure of west wall

b.	(278m to 282m)	Major failure of west wall
3.		**Course Sediment Removal**
a.	A91 bridge	Sediment build up on approach to and under bridge
b.	Henry St bridge	Sediment build up under bridge
4.		**Vegetation Removal**
a.	(28m)	Overgrown tree branches east side
b.	(39m)	Small dead tree, east side
c.	(49m to 71m)	Heavy shrubbery growth east side
d.	(86m to 96m)	Heavy shrubbery growth east side
	Henry Street	
e.	(24m)	Overgrown bush west side
5.		**Other Maintenance Works**
		None

Table 6.5b - Implementation Plan - Alva Burn					
Ref.	**Description of Works**	**Cost (£)**	**Priority 1 - 10 1(low)**	**Works Schedule (Date)**	**Complete (Date)**
	GC Bridge				
1a.	Pointing to masonry wall	100	4.5	2011/12	
1b.	Pointing and minor repairs to masonry wall	400	4	2011/12	
1c.	Pointing and minor repairs to masonry wall	750	4	2011/12	
1d.	Pointing to masonry wall	500	4	2011/12	
1e.	Patching to wall stonework	800	4.5		Nov 09
1f.	Rebuild wall	3000	8		July 09
1g.	Patching to wall stonework	1000	5		Nov 09
1h.	Rebuild base of wall	2500	6		Nov 09
1i.	Pointing beneath cope	250	3	2011/12	
1j.	Pointing to masonry wall	300	4	2011/12	
1k.	Rebuild base of wall	1500	6		Nov 09
1l.	Rebuild base of wall	1500	6		Nov 09
1m.	Place boulders at base of embankment	2000	6		Nov 09
1n.	Rebuild wall	1200	3	2012/13	
	A91 Bridge				
1o.	Rebuild wall	500	4	2012/13	
1p.	Place boulders at foot of sill	1000	5	2011/12	
	Henry St.				
1q.					
1r.	Rebuild wall	250	3	2012/13	
2a.	Rebuild wall	3000	7.5		Nov 09
2b.	Rebuild wall	2000	7.5		Nov 09
3a.	Remove sediment	4000	8		Nov 09
3b.	Remove sediment	1500	8		Nov 09
4a.	Cut back branches	50	4		Nov 09
4b.	Remove dead tree	50	3		Nov 09
4c.	Cut shrubbery back	300	6		Nov 09

4d.	Cut shrubbery back	100			Nov 09
	Henry Street				
4e.	Remove bush	100	6		Nov 09

Maintenance Audit and Implementation Plan for Silver Burn

General Burn Information :-

Burn Ref. = B-10
Grid Ref. = NS 9132 9630 to NS 8922 9699
Length = 0.65km
Catchment Area = 2.8km2
0.5% return period flow = 6.6cumecs (JBA report June 2006)

Chainage 0m = north of Silverburn Gardens NS 892 971

Table 6.6a - Audit Results - Silver Burn		
Ref.	**Chainage**	**Notes**
1.		**Embankment and Wall Repairs**
a.	(not recorded)	Gabion shows signs of damage (N of A91)
2.		**Structural Maintenance**
		None recorded
3.		**Course Sediment Removal**
a.	(not recorded)	Minor build up under A91 bridge.
4.		**Vegetation Removal**
		None recorded
5.		**Other Maintenance Works**
		None recorded

Table 6.6b - Implementation Plan - Silver Burn					
Ref.	**Description of Works**	**Cost (£)**	**Priority 1 - 10 1(low)**	**Works Schedule (Date)**	**Complete (Date)**
1a.	Inspect Gabions	nil	8	2010/11	
3a.	Monitor level of sediment	nil	8	2010/11	

Maintenance Audit and Implementation Plan for Tillicoultry Burn

General Burn Information :-

Burn Ref. = B-11
Grid Ref. = NS 914 975 to NS 910 967
Urban Length = 1.0km
Catchment Area = 6.6km2
0.5% return period flow = 16.2 cumecs (JBA report June 2006)

Chainage 0m = North side of Shillinghill Bridge. NS 914 974

Table 6.7a - Audit Results - Tillicoultry Burn		
Ref.	**Chainage**	**Notes**
1.		**Embankment and Wall Repairs**
a.	(-47m to -44m)	Mortar loss to walls each side
b.	(-34m to 0m)	Mortar loss in walls each side of burn
c.	(16m to 18m)	Scouring to east wall base
d.	(23m)	Mortar loss under footbridge, west side
e.	(31m to 39m)	Loss of mortar on east wall.
f.	(53m to 58m)	Loss of copes and damage to east wall
g.	(63m to 65m)	Mortar loss east wall
h.	(109m)	Missing cope east wall
i.	(115m to 119m)	Damage to east wall
j.	(258m)	Damage to wall bases each side
k.	(312m)	Damage to east wall (deep void)
	(323m)	Minor damage to east wall
l.	(330m)	Damage to east wall
	(365m)	Damage to east wall
m.	(392m to 394m)	Damage to east wall
n.	(449m to 452m)	Damage to concrete cope, east wall
o.	(456m to 458m)	Damage to east wall
p.	(467m)	Scouring of east wall base
q.	(479m to 483m)	Scouring of east wall base
r.	(519m)	Missing copes east wall
s.	(533m)	Scouring of east wall base
t.	(518m to 520m)	Significant crack east wall
u.	(648m)	Damage to east wall
v.	(764m)	Missing cope east wall
w.	(853m)	Damage to east wall base

2.		**Structural Maintenance**
a.	(-5m)	Collapse of part of stone wall
b.	(145m)	Failure to wood/stone sill across burn
c.	(230m)	Failure to wood/stone sill across burn
d.	(381m to 388m)	Failure to wood/stone sill across burn, damage to wall and scour to wall base
e.	(698m)	Pedestrian steps create low point in burn wall
f.	(852m to 857m)	East embankment failing
g.	(858m)	Severe failure of west wall at s. access bridge
h.	NS9141 9708	Small weir is stopping movement of fish upstream
i.	NS9143 9748	Potential for blockage at Shillinghill Bridge
j.	NS9144 9726	Potential for blockage at Upper Mill St Bridge
k.	(483m)	Potential for blockage at A91 Bridge
3.		**Course Sediment Removal**
a.	(438m)	Sediment build up on under A91 bridge
b.	(438m to 600m)	Sediment build up in channel
c.	NS9101 9647	Sediment build up at confluence with R. Devon
4.		**Vegetation Removal**
a.	(-53m to -34m)	Overgrown shrubbery on east side
b.	(-33m to 0m)	Shrubbery growing out of east wall
c.	(35m to 46m)	Three large saplings in east wall
d.	(63m to 88m)	Four large saplings in east wall
e.	(95m)	Two large saplings in east wall
f.	(130m)	Two large saplings in west wall
g.	(185m to 193m)	Large bush in east wall
h.	(230m)	Sapling in west wall
i.	(274m)	Two large saplings in east and west walls
j.	(285m to 299m)	Tree root and saplings in east wall
k.	(319m)	Sapling in west wall
l.	(322m)	Sapling in west wall
m.	(332m to 349m)	4 Saplings in east wall
n.	(365m)	Large sapling in east wall
o.	(373m to 403m)	Bushes and sapling in west wall
p.	(456m to 464m)	Two large saplings in east wall
q.	(480m)	Two large saplings in east wall
r.	(500m to 700m)	Numerous saplings in east wall
s.	(837m)	Rotting tree root
5.		**Other Maintenance Works**
a.		Footbridge to rugby pitches is too low

Table 6.7b - Implementation Plan - Tillicoultry Burn					
Ref.	**Description of Works**	**Cost (£)**	**Priority 1 - 10 1(low)**	**Works Schedule (Date)**	**Complete (Date)**
1a.	Pointing to masonry walls	500	3	2010/11	
1b.	Pointing masonry walls	750	3	2010/11	
1c.	Place boulders to wall base	100	5	2009/10	
1d.	Pointing to bridge wall	100	2	2011/12	
1e.	Pointing to masonry wall	200	8	2009/10	
1f.	Replace copes & rebuild wall	700	6	2009/10	
1g.	Pointing to masonry wall	150	5	2009/10	
1h.	Replace cope stone	100	4	2011/12	
1i.	Rebuild wall	500	5	2009/10	
1j.	Rebuild bases of walls	300	5	2009/10	
1k.	Rebuild wall	700	7	2009/10	
	Rebuild wall				
1l.	Rebuild wall	500	7	2009/10	
	Rebuild wall				
1m.	Rebuild wall	500	7	2009/10	
1n.	Concrete repair to cope	250	3	2010/11	
1o.	Rebuild wall	500	7	2010/11	
1p.	Place boulders to wall base	200	4	2010/11	
1q.	Rebuild wall	500	4	2010/11	
1r.	Replace copes	300	5	2011/12	
1s.	Rebuild base of wall	500	4	2011/12	
1t.	Repair crack in wall	100	4	2011/12	
1u.	Rebuild wall	200	6	2011/12	
1v.	Replace cope	100	5	2011/12	
1w.	Repair base of wall	250	4	2011/12	
2a.	Reconstruct wall	1500	9	2009/10	
2b.	Rebuild sill	1200	4	2010/11	
2c.	Rebuild sill	1200	4	2010/11	
2d.	Rebuild sill, repair walls	2000	7	2009/10	
2e.	Rebuild steps and wall	2000	6	2010/11	
2f.	Reconstruct embankment	2500	6		Mar 07
2g.	Rebuild wall base	1500	9		Mar 07
2h.	Provide fish ladder	3000	4	2010/11	
2i.	Investigate options			2010/11	
2j.	Investigate options			2010/11	

2k.	Investigate options			2010/11	
3a.	Remove sediment	2000	8	2010/11	
3b.	Remove sediment				
3c.	Investigate				Sep 08
4a.	Cut shrubbery back	200	4		Nov 09
4b.	Cut back shrubbery and weedkiller on wall	300	4		Nov 09
4c.	Remove saplings and weedkill wall	100	4		Nov 09
4d.	Remove saplings and weedkill wall	100	4		Nov 09
4e.	Remove saplings and weedkill wall	100	4		Nov 09
4f.	Remove saplings and weedkill wall	100	4		Nov 09
4g.	Remove bush, root and weedkill wall	100	4		Nov 09
4h.	Remove saplings and weedkill wall	50	4		Nov 09
4i.	Remove saplings and weedkill walls	100	4		Nov 09
4j.	Remove saplings and weedkill wall	100	4		Nov 09
4k.	Remove saplings and weedkill wall	50	4		Nov 09
4l.	Remove saplings and weedkill wall	300	5		Nov 09
4m.	Remove saplings and weedkill wall	100	4		Nov 09
4n.	Remove saplings and weedkill wall	400	6		Nov 09
4o.	Remove saplings, bushes and weedkill wall	100	4		Nov 09
4p.	Remove saplings and weedkill wall	100	4	2010/11	
4q.	Remove saplings and weedkill wall	100	4	2010/11	
4r.	Remove saplings and weedkill wall	300	4	2010/11	
4s.	Remove tree stump	500	6	2010/11	
5a.	Design new bridge			2011/12	

Maintenance Audit and Implementation Plan for Kirk Burn

General Burn Information :-

Burn Ref. = B-12
Grid Ref. = NS 924 976 to NS 927 972
Length = 1.1km
Catchment Area = unknown
0.5% return period flow = unknown

Chainage 0m = Nth of Heathwood Crescent Culvert NS 924 976

Table 6.8a - Audit Results - Kirk Burn		
Ref.	**Chainage**	**Notes**
1.		**Embankment and Wall Repairs**
a.	(-5m)	Scour to concrete embankment
b.	(57m)	Scour to concrete apron (2 locations)
c.	(393m)	Collapsed east wall
2.		**Structural Maintenance**
a.	(-12m to -20m)	Collapsed concrete embankment both sides
b.	(230m)	Major damage to stone bridge (private road)
3.		**Course Sediment Removal**
a.	(0m to 11m)	Sediment build up at start of Heathwood Crescent
b.	(96m to 103m)	Sediment build up at end of Heathwood Crescent
c.	(271m to 313m)	Sediment build up in Armour St culvert
d.	(448m)	Sediment build up in culvert
4.		**Vegetation Removal**
a.	(170m)	Overgrown vegetation both sides
5.		**Other Maintenance Works**
		None

Table 6.8b - Implementation Plan - Kirk Burn					
Ref.	**Description of Works**	**Cost (£)**	**Priority 1 - 10 1(low)**	**Works Schedule (Date)**	**Complete (Date)**
1a.	Place boulders to protect embankment	1000	6	2011/12	
1b.	Place boulders to protect embankment	700	3	2012/13	
1c.	Rebuild wall	1000	2	2012/13	
2a.	Rebuild concrete embankment apron	4000	5	201/11	
2b.	Rebuild parapet wall	2000	3	2009/10	
3a.	Remove sediment	1000	7	2011/12	
3b.	Remove sediment	500	5	2011/12	
3c.	Remove sediment	1000	7	2011/12	
3d.	Remove sediment	500		2011/12	
4a.	Remove vegetation	100	3	2011/12	

Maintenance Audit and Implementation Plan for Dollar Burn

General Burn Information :-

Burn Ref. = B-14
Grid Ref. = NS 963 984 to NS 964 976
Urban Length = 1.6km
Catchment Area = 7.87 km2
0.5% return period flood flow = 9.6cumecs (JBA report June 2006)

Chainage 0m = N of Back Road Bridge NS 963 984

Table 6.9a - Audit Results - Dollar Burn		
Ref.	**Chainage**	**Notes**
1.		**Embankment and Wall Repairs**
a.	(36m to 40m)	Damage to east wall
b.	(50m)	Damage to east wall
c.	(75m to 81m)	Minor scour to wall
d.	(508m)	Scour to west embankment
e.	(0m - 400m)	Minor damage to burn walls both sides
2.		**Structural Maintenance**
a.	(-37m to -21m)	Severe scour at earth embankment
b.	(394m)	Scour at A91 abutment
c.	(615m)	Scouring under brick structure, iron sill loose
d.	(745m)	Failing stepped sills across burn
3.		**Course Sediment Removal**
a.	(760m)	Sediment build in old railway culvert
4.		**Vegetation Removal**
a.	(0m to 90m)	Numerous saplings in east wall
b.	(8m)	Overhanging vegetation on east side
c.	(50m)	Sapling in east wall
d.	(98m)	Sapling in west wall
e.	(100m to 110m)	Numerous saplings in east wall
f.	(117m)	Large sapling in east wall
g.	(460m to 506m)	Numerous saplings in east wall

5.		**Other Maintenance Works**
a.	(6m)	Large piece of concrete in burn
b.	(722m)	Collapsed wooden sill (sleepers)

Table 6.9b - Implementation Plan - Dollar Burn

Ref.	Description of Works	Cost (£)	Priority 1 - 10 1(low)	Works Schedule (Date)	Complete (Date)
1a.	Rebuild wall	300	7	2010/11	
1b.	Rebuild wall	300	4	2010/11	
1c.	Protect scour area with boulders	200	5	2011/12	
1d.	Protect scour area with boulders	200	5	2011/12	
1e.	Inspect burn walls			2010/11	
2a.	Construct supporting wall	5000	7	2010/11	
2b.	Protect scour area with suitable material	200	6	2010/11	
2c.	Rebuild brickwork and reset iron sill	1000	5	2012/13	
2d.	Rebuild damaged sills	1500	7	2010/11	
3a.	Remove sediment	1000	8	2010/11	
4a.	Remove saplings and weedkill wall	250	5	2011/12	
4b.	Cut back vegetation	100	4	2011/12	
4c.	Remove sapling and weedkill wall	50	4	2011/12	
4d.	Remove sapling and weedkill wall	50	4	2011/12	
4e.	Remove saplings and weedkill wall	200	4	2011/12	
4f.	Remove sapling and weedkill wall	100	4	2011/12	
4g.	Remove saplings and weedkill wall	250	4	2011/12	

5a.	Remove concrete block	100	5	2010/11	
5b.	Rebuild sill (sleepers)	600	5	2012/13	

Maintenance Audit and Implementation Plan for Fairy Burn

General Burn Information :-

Burn Ref. = B-03
Grid Ref. = NS 872 944 to NS 890 930
Urban Length = 2.2km
Catchment Area = 0.69 km^2
0.5% return period flood flow = 1.41cumecs (JBA report Jan 2008)

Chainage 0m = Culvert exit at Forester Gr NS 877 941
Chainage 0m = Culvert exit at Greenfield NS 883 939

Table 6.10a - Audit Results - Fairy Burn		
Ref.	**Chainage**	**Notes**
1.		**Embankment and Wall Repairs**
	Greenfield	
a.	(27m to 37m)	Damage to low walls both sides
b.	(51m to 62m)	Damage to low south wall
c.	(81m to 91m)	Damage to low walls both sides
d.	(115m to 140m)	Dislodged support stones on both sides
2.		**Structural Maintenance**
	Forester Grove	
a.	(95m)	Unsuitable trash screen and poor access / platform
3.		**Course Sediment Removal**
		None
4.		**Vegetation Removal**
	Forester Grove	
a.	(4m to 40m)	Overhanging rhododendron bushes
	Greenfield	
b.	(21m to 25m)	Overhanging rhododendron bushes
c.	(140m to 164m)	Dead wood debris in burn
d.	(164m to 180m)	Overhanging rhododendron bushes
5.		**Other Maintenance Works**
		None

Table 6.10b - Implementation Plan - Fairy Burn					
Ref.	**Description of Works**	**Cost (£)**	**Priority 1 - 10 1(low)**	**Works Schedule (Date)**	**Complete (Date)**
1a.	Rebuild walls	700	5	2012/13	
1b.	Rebuild wall	400	5	2012/13	
1c.	Rebuild walls & stone supports	1000	6	2012/13	
1d.	Replace support stones at pedestrian bridge	400	5		Dec 07
2a.	Install new trash screen & access path & platform	2500	7		Jan 09
4a.	Cut back bushes	200	4	2012/13	
4b.	Cut back bushes	200	4	2012/13	
4c.	Remove debris	100	4	2012/13	
4d.	Cut back bushes	200	4	2012/13	

Failing Retaining structure adjacent to the Brothie Burn, Alloa - 15/04/09

General Burn Information:-

Burn Ref. = No. B-01
Grid Ref. = NS 896 933 to NS 890 930
Urban Length = 2.4km
Catchment = 8.32km^2
0.5% return period flood flow = Unknown
Chainage 0m =Culvert exit w of Diageo bonds NS 896 933

Table 6.11a - Audit Results - Brothie Burn		
Ref.	**Chainage**	**Notes**
1.		**Embankment and Wall Repairs**
a.	(223m to 228m)	Collapse of north wall
b.	(390m to 400m)	Large crack and damage to north wall
c.	(402m to 413m)	Collapse of north wall
2.		**Structural Maintenance**
		None
3.		**Course Sediment Removal**
		None
4.		**Vegetation Removal**
a.	(453m)	Broken tree on north bank
b.	(503m)	Vegetation growth on south bank
c.	(505m to 570m)	Vegetation on north bank
5.		**Other Maintenance Works**
a.	(375m)	Significant debris (planks and fence material)
b.	(503m to 515m)	Builders' debris in burn channel

Table 6.11b - Implementation Plan - Brothie Burn					
Ref.	**Description of Works**	**Cost (£)**	**Priority 1 - 10 1(low)**	**Works Schedule (Date)**	**Complete (Date)**
1a.	Rebuild wall	3000	4	2012/13	
1b.	Rebuild wall & repair crack	5000	4	2012/13	
1c.	Rebuild wall	8000	5	2012/13	
4a.	Remove tree and debris	400	8		Apr 09
4b.	Cut back vegetation	150	8		Apr 09
4c.	Cut back vegetation	250	4		Apr 09
5a.	Remove debris	200	9		Apr 09
5b.	Remove debris	200	6		Apr 09

7.0 ENVIRONMENT AND SUSTAINABILITY ISSUES

7.1 The Water Environment (Controlled Activities) (Scotland) Regulations 2005 [17]

The Council remains concerned that any required maintenance works adjacent to, or within, watercourses are carried out in a manner that limits adverse impacts on biodiversity and the environment. Any intervention in the water environment will have some affect on the prevailing ecological status and, with the exception of vegetation clearance, such works will require prior approval from the Scottish Environment Protection Agency (SEPA). *The Water Environment (Controlled Activities) (Scotland) Regulations 2005* [17] (CAR) came into force as of 1 October 2005, but directly affected watercourse maintenance works from 1 April 2006. This legislation is essentially the regulatory means by which SEPA controls the use of, or intervention in, the water environment. In all cases where maintenance works are considered necessary to a watercourse and these works require a specific approval under this (CAR) legislation, appropriate prior applications will be made.

The following examples are given to demonstrate the Council's commitment to adhere to the requirements of the CAR regulations when undertaking it's current flooding risk reduction duties :-

- A91 Road Bridge at Alva Burn - Coarse sediment removal was identified as necessary at the A91 Road Bridge in Alva. The sediment build up here, upstream of and beneath this bridge, was deemed to create an undue flood risk to the surrounding urban area. An application was made to SEPA for the necessary sediment removal works on 19/07/07. SEPA deemed that a formal permission was not necessary on this occasion and the works took place on 09/11/07.
- Tillicoultry Burn Alluvial Fan - A significant build up of the alluvial fan at Tillicoultry burn's confluence with River Devon (NS9101 9647) was noted during the *Watercourse Audit and Works Implementation Plan* [6] survey

(Table 6.7b 3c) for the Tillicoultry Burn and works were considered to be necessary by Council staff to reduce the potential flood risk. However, advice was sought from the Council's hydrological advisors, JBA Consulting Ltd, which suggested that in fact there was not a strong enough case for intervention here as works to remove the sediment would have a relatively high environmental impact and that the flood risk benefit derived from such an intervention was thought to only be short lived.

- Elistoun Drive, Tillicoultry - A CAR licence was applied for and received (Application ID CAR/S/1033506) for the embankment reconstruction works carried out at Elistoun Drive, Tillicoultry. The level of the embankment was reinstated following the flood event on 25/26th January 2008. The licence was granted by SEPA on 6th March 2009.

7.2 Flood Liaison and Advice Group

The Council continues to operate its "Flood Liaison and Advice Group" (FLAG) as encouraged by Scottish Government's *Scottish Planning Policy 7 (SPP7)* [19]. The principal purpose of the FLAG is to provide a forum for all interested parties to share knowledge and offer advice on flooding issues as they relate to the each party's actions and responsibilities. The FLAG is aware of the need to promote sustainable flood management techniques, as required by *The Water Environment Water Services (Scotland) Act 2003* [16] and the *The Flood Risk Management (Scotland) Act 2009* [4] and regularly comments on emerging flooding legislation and other important related topics.

7.3 Natural Flood Management

The Council supports the principals and aims of catchment-scale Natural Flood Management (NFM). NFM has come to the fore in recent years as a subject in itself and has the general aim to reduce rainfall run-off rates and flow speeds in upland areas and to increase natural flood storage throughout the catchment. NFM advocates a range of flood risk reduction techniques developed around natural systems and processes throughout catchments. NFM is considered to be

less expensive than engineered solutions and benefits landowners, habitats and wildlife. The “River Devon Project”, which resulted from an effective partnership between the World Wildlife Fund Scotland, Clackmannanshire Council and the Forestry Commission, studied the effectiveness of a range of NFM techniques in the River Devon catchment. The project also undertook to actively promote awareness of flood issues among the general public and other interested stakeholders within the Council area. The study resulted in the production of two key documents in 2006, *Flood Planner* [20] and *Slowing the Flow* [21] which are now widely recognised to have added to the knowledge available to flood managers in Scotland.

Willow walling of the north bank of the River Devon between Tillicoultry and Dollar

8.0 FLOOD WARNING IN CLACKMANNANSHIRE

8.1 Development of Flood Warning System

The Clackmannanshire Council area is significantly influenced by the catchment of the River Devon and to a lesser degree by the catchment of the River Black Devon. The geomorphology of the River Devon catchment means that rain falling on the Ochil Hills together with rainfall from lower contributing catchments can reach urban areas relatively quickly. Although effective flood warning is possible for developed areas in the vicinity of the River Devon, the Hillfoots burns fall from the steep escarpment above the Hillfoots villages and as such this renders the provision of a three-hour advance flood warning period impractical. Three hours advance warning is the minimum period required by SEPA in order for any designed system to be adopted by SEPA.

A flood forecasting model has been developed for the Council during 2008/09 covering the River Devon catchment in the report *River Devon Flood Warning - April 2009* [13] . The model is essentially an accepted methodology to predict the river flooding affects from storm events within the River Devon catchment at identified sensitive locations along the River Devon. These sensitive locations have been identified as :-

- Rackmill Caravan Park, Dollar
- Elistoun Drive / Sterling Furniture / Sterling Retail Village, Tillicoultry
- Marchglen River Bridge, Marchglen
- Shavelhaugh Loan, Alva
- C101, Menstrie (Road crossing and at Diageo / Kerry Bioscience Complex)
- Cambus (Diageo) Warehouses

The flood warning model and associated site infrastructure is to be adopted and operated by SEPA for inclusion in it's Flood Early Warning System (FEWS). A principal infrastructure requirement that has been identified is the upgrading of

the flow / level gauging station at the outflow from Castlehill Reservoir such that the station can be remotely interrogated. This is to enable collection and analysis of continuous real-time flow, volume, and river level data at the station as part of SEPA's centrally operated FEWS system. This is also important to further inform and update the flood forecasting model's performance. Through ongoing discussion with SEPA during the development of the model, SEPA agreed to install the necessary telemetry equipment at the Castlehill.

Despite the above advances in flood warning for the area, the River Devon catchment is not well covered by telemetered rain gauge stations. The Ochil hills is a crucial area where additional rain gauges would help to better inform and refine the model's performance. Information from such stations will help to more accurately predict flood effects at downstream sensitive locations. It has also been recommended that a new telemetered river level and / or flow gauging station be installed at Tillicoultry with the aim of further improving the resilience and accuracy of the model. The Council, in partnership with SEPA, hope to develop the system appropriately in the coming years.

Nevertheless, SEPA will now be able to issue advance "Floodwatch Warnings", "Flood Warnings" and "Severe Flood Warnings" for each of the identified sensitive locations, through their public information service "Floodline". In addition to this service however, Clackmannanshire staff are likely to also have access to the real-time FEWS interface which will allow staff access to more accurate information (river levels, flows etc) than is available to the public.

8.2 Flood Warning - Weather Monitoring Procedures and Preparation Plans *(currently under amendment)*

Flow / level gauging station at the river outflow from Castlehill Reservoir - 16/03/09

Stage 1

1.1 From 9am until 5pm each working day, Road Officers, Stuart Cullen (07773366245) and Kenny Jackson (07792952838), or Alan Murray (07968785274) if both the above are unavailable, will monitor general weather information from TV, Radio and general internet sources.

1.2 If adverse weather is predicted for East, South East or Central Scotland over next 24 hours (Mon – Fri) or next 48 hours over a weekend, initiate **Stage 2** monitoring procedure.

1.3 If adverse "Weather / Severe Weather Warning" issued by the Met Office for East / South East or Central Scotland, initiate **Stage 2** monitoring procedure.

1.4 If a "Floodwatch", "Flood Warning" or "Severe Flood Warning" is issued for any/all River Devon section locations, initiate **Stage 2** monitoring procedure.

Stage 2

2.1 (Between April and end of September) - Monitor web page - http://secure.wsiopenroute.co.uk/Falkirk/, consult “precipitation rate forecast information”.

2.2 (Between October and March) - Monitor "Metox.com" Web site rainfall radar - http://www.meteox.com/h.aspx?r=&jaar=-3&soort=loop1uur and Met Office rainfall radar information - http://www.metoffice.gov.uk/weather/uk/radar/

2.3 If information gathered from Stage 1 assessment, or from assessment of the web pages detailed in 2.1 and 2.2 above, or any other viable source, suggests an imminent, or increased flood risk within River Devon catchment, the Hillfoots Burns sub-catchments, or any other urban areas within the Council area, **initiate Appropriate Preparation Plan (1, 2 or 3) based on SEPA "FEWS" location specific Flood Warning Information.**

2.4 Initiate **Stage 3** monitoring procedure.

2.5 Note action in Duty Officer Log Report - Duty Officer to log times of checking stages 2 and 3 and note situation (see Alex Hood for year round log).

2.6 If the predicted rainfall rate from the sources given in paras 2.1 and 2.2 is less than 8mm to 16mm per hour over the following 24/48 hour period for the Clackmannanshire area, continue to monitor until weather forecast improves.

2.7 If Met Office “National Severe Weather Warning Service” information is received giving “Regional Risk Assessment” information, relating to rainfall, for Eastern Scotland with a likelihood of occurrence greater than 80%, or if SEPA Flood Warning level is increased from current, **initiate, or upgrade, appropriate Preparation Plans, if not already commenced.**

Stage 3

3.1 Continue to monitor SEPA “Live Flood Warning Information” web site.

3.2 If neither “Flood Warning nor Severe Flood Warning has been issued, continue to monitor SEPA “Live flood warning Information” web site.

3.3 Note actions in Duty Officer Log (see Alex Hood)

3.4 If Met Office “National Severe Weather Warning Service” information is received giving “Regional Risk Assessment” information, relating to rainfall, for Eastern Scotland with a likelihood of occurrence greater than 80%, or if SEPA Flood Warning level is increased from current level, **initiate, or upgrade as appropriate, Preparation Plans, if not already commenced.**

"Floodwatch" Roads and Transportation - Preparation Plan 1

- Notify and liaise as necessary with Emergency Planning (EP) Central Control office (01259 452199). Also liaise, if necessary, directly with EP Officers, Richard O'Grady (mob no 07977 446349) and / or Campbell Carsten (mob no 07970622169).
- For **River Devon** only, ensure SMS texts of "Floodwatch" status on River Devon have been issued by EPO to designated receivers for identified river sections (by SEPA's FEWS - Flood Early Warning system).
- Development and Flooding Officer (DFO), Kenny Jackson, (Mob no 07792 952838) (or Stuart Cullen - 0777 33 66 245 if Kenny Jackson not available) to review date of last Priority 1 site inspections / clearance works proforma sheets, including Hillfoots Burns, Brothie Burn, Fairy Burn proforma sheets.
- If re-inspection needed, DFO to carry out inspections of above locations, as considered necessary.
- If required, DFO to instruct immediate response contractor to clear any blockages (Roads Contracts – Tom Davidson 07966 193652, Alan Hunter 07974 837 814). If neither available, or incident is "out of hours", contact EP central control (01259 452199) and request works to be co-ordinated by Duty Supervisor.
- If any inspections indicate that a significant flood event is occurring at specific locations along the identified River Devon sections, or the Brothie Burn, or the Fairy Burn, or any other information source suggests flood risk is to increase in the area, initiate "**Severe Flood Warning" Preparation Plan 3.**
- Activate permanent "flood - road closed" signs, as required, at affected river crossings.

"Flood Warning" - Roads and Transportation Preparation Plan 2

- Notify and liaise as necessary with Emergency Planning (EP) Central Control office (01259 452199). Also liaise, if necessary, directly with EP Officers, Richard O'Grady (mob no 07977 446349) and / or Campbell Carsten (mob no 07970622169). Check with EPOs that emergency services have been informed of Council Status.
- For **River Devon**, ensure SMS text of "Floodwatch" status on River Devon has been issued by EPO to designated receivers for identified river sections (by SEPA's FEWS - Flood Early Warning system).
- If not already completed, DFO to contact immediate response contractor (DLO), or the Duty Supervisor via EP central control (01259 452199) if "out of hours", to initiate immediate inspection and clearance of Priority 1 sites and including Hillfoots Burns, Brothie and Fairy Burns.
- DFO to co-ordinate emergency closure of River Devon road crossings using permanent "Flood" signs as indicated by SEPA flood warning location (FEWS) information (??).
- Contact Forthbank Depot (Alan Hunter - 07974 837 814)
- Prepare 1000 sandbags and prepare 4 No. water pumps
- Place appropriate lorries / drivers on "standby" footing
- Place "gulley emptier" on "standby" footing
- Prepare temporary "flood" and "Road Closed" signs and barriers
- Contact Kelliebank Depot (Tom Davidson 07966 193652) to ensure contractor's Supervisor and stand-by squad's availability for period.
- If considered necessary in consultation with EPO, establish co-ordinator in Roads and Transportation Office. Provide phone number (EP Central Control 01259 452199) to Roads Officers, Contractor's Supervisor.
- Ensure Roads Officers availability for Emergency Planning Core Group, if called by CMT (Corporate Management Team) On-Call Person.
- Activate permanent "flood - road closed" signs, as required, at affected river crossings.

"Severe Flood Warning" Roads and Transportation Preparation Plan 3

- Notify and liaise as necessary with Emergency Planning (EP) Central Control office (01259 452199). Also liaise, if necessary, directly with EP Officers, Richard O'Grady (mob no 07977 446349) and / or Campbell Carsten (mob no 07970622169). Check with EPOs that emergency services have been informed of Council Status.
- For **River Devon** only, ensure SMS text of "Floodwatch" status on River Devon have been issued by EPO to designated receivers for identified river sections (by SEPA's FEWS - Flood Early Warning system).
- If not already completed, DFO (or substitute) to contact immediate response contractor (DLO), or the Duty Supervisor via EPO (central control 01259 452199) if "out of hours", to initiate inspection and clearance of Priority 1 sites including Hillfoots Burns, Brothie and Fairy Burns.
- DFO to co-ordinate emergency closure of River Devon road crossings using permanent "Flood" signs as indicated by SEPA flood warning location (FEWS) information (??).
- Contact / liaise with Forthbank Depot (Alan Hunter - 07974 837 814)
- Prepare 2000 sandbags and initiate preparation of 4 No. water pumps.
- Place appropriate lorries / drivers on "standby" footing
- Place "gulley emptier" in "standby" footing
- Prepare temporary "flood" and "Road Closed" signs and barriers
- Contact Kelliebank Depot (Tom Davidson 07966 193652) to ensure contractor's Supervisor and stand by squads availability for period.
- Establish co-ordinator in Roads and Transportation Office – provide phone number (EP Central Control) 01259 452199) to Roads Officers, Contractor's Supervisor and Foremen.
- Ensure Roads Officers availability for Emergency Planning Core Group, if called by CMT (Corporate Management Team) On-Call Person.
- Activate permanent "flood - road closed" signs, as required, at affected river crossings.

Table 8.1 - Possible SMS Text Receivers (*currently under review*)

Location	SMS Text Notifications for "Floodwatch", "Flood Warning" and "Severe Flood Warning"
River Devon at Rackmill Caravan Park	• Dollar Caravan park (01259 742896) • Rackmill Cottage • Converted Barn to west of rackmill (north side), at former Mill Lade.
River Devon at Sterling Furnitutre/ Retail Village, Tillicoultry	• Sterling Furniture (Tom Hoy - 01259 750655) • Retail Village • Tillicoultry Bowling Club (01259 750395) • Devonvale Hall (Mrs Mitchell - 01259 750432)
River Devon at Marchglen	• Robert Marshall (01259 750631)
River Devon at Shavelhaugh Loan	• Alva PPP (Headteacher John Meney - 01259 760342) • Ceteris (Alan Stewart 01259 720101) • Kersiepow Farm
River Devon at C101 Menstrie at Diagio	• Diagio Distilling Ltd (01259 761351) • Kerry Bioscience (01259 761381)
River Devon at Cambus (Diagio)	• Diagio Global Supply (01259 722093)
Brothie Burn through Alloa	• ALDI
Fairy Burn through Alloa	• ASDA (01259 226600) • CC Greenfield office (01259 452000)

9.0 INVESTMENT

Table 9.1 - Annual Council Spending on Flood Prevention- 2003 to 2010

	2003/04 (£)	2004/05 (£)	2005/06 (£)	2006/07 (£)	2007/08 (£)	2008/09 (£)	2009/10 (£)
Planned Maintenance Works	12,000	17,000	20,000	29,000	18,000	18,000	21,000
Reactive (Emergency) Works	25,000	7,000	1,000	2,000	1,000	700	2,000
Planned Structural Works	33,500	105,000	100,000	37,000	200,000	426,000	128,000
Flood Prevention System Development	8,500	2,000	2,000	-	1,000	47,000	2,500
Vegetation Removal	-	2,000	-	1,000	2,000	2,000	1,500
Sediment Removal	-	5,000	-	-	6,000	-	-
Trash Screen Replacement	2,500	2,500	3,000	-	2,000	2,000	5,000
Flood Studies	6,500	17,500	15,000	51,000	1,000	6,000	-
Totals	**88,000**	**158,000**	**142,000**	**120,000**	**231,000**	**501,700**	**160,000**

The cost of “Reactive (Emergency) Work”, which is essentially the cost of works undertaken in emergency circumstances, which was £25,000 in 2003/04 is now only £1,000 - £2,000 per annum. In the same period “Planned Maintenance Works” costs which had risen from £12,000 to about £29,000 is now on average about £20,000. This is seen as an improving situation as the need to spend resources on relatively expensive reactive works has no real long term benefit. The reduction in “Reactive (Emergency) Work” costs demonstrates that the Prioritised Watercourse Inspection and Clearance Regime (section 6.2), i.e. planned regular inspection of key watercourses and sensitive locations, is having a positive effect. More importantly perhaps there has been a significant reduction in “Flooding incidents” largely due to the “Planned Maintenance Works”. Although a “year to year” direct comparison can be misleading as weather is changeable,

this general improvement suggests that the adverse flooding effects of severe weather events have been minimised since the implementation of regular inspection and clearance works. However, in 2008 a number of properties were inundated when the River Devon rose to unprecedented levels and overtopped the old railway embankment adjacent to Elistoun Drive. The Council and Scottish Water carried out some large scale works in the vicinity, to upgrade the capacity of foul sewers and drainage systems and to reinstate the old railway embankment to a consistent level. This explains the high levels of capital investment during 2008/9 and 2009/10.

References

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4. *Flood Risk Management (Scotland) Act 2009*
5. *Prioritised Watercourse Inspection and Clearance Regime (Section 6.2 of this report).*
6. *Watercourse Audits and Implementation Plans (Section 6.3 of this report).*
7. *Elistoun Drive Flood Alleviation Study, Tillicoultry (August 2007) (Clackmannanshire Council Roads & Transportation Library).*
8. *Woodburn Drive and Gavins Road Flood Alleviation Study, Alloa (January 2008) (Clackmannanshire Council Roads & Transportation Library).*
9. *Elistoun Drive, Tillicoultry - Post Flood Study - (May 2008) (Clackmannanshire Council Roads & Transportation Library).*
10. *Tillicoultry Flood Prevention Scheme - Ground Assessment Desk Study - September 2008 (Clackmannanshire Council Roads & Transportation Library).*
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