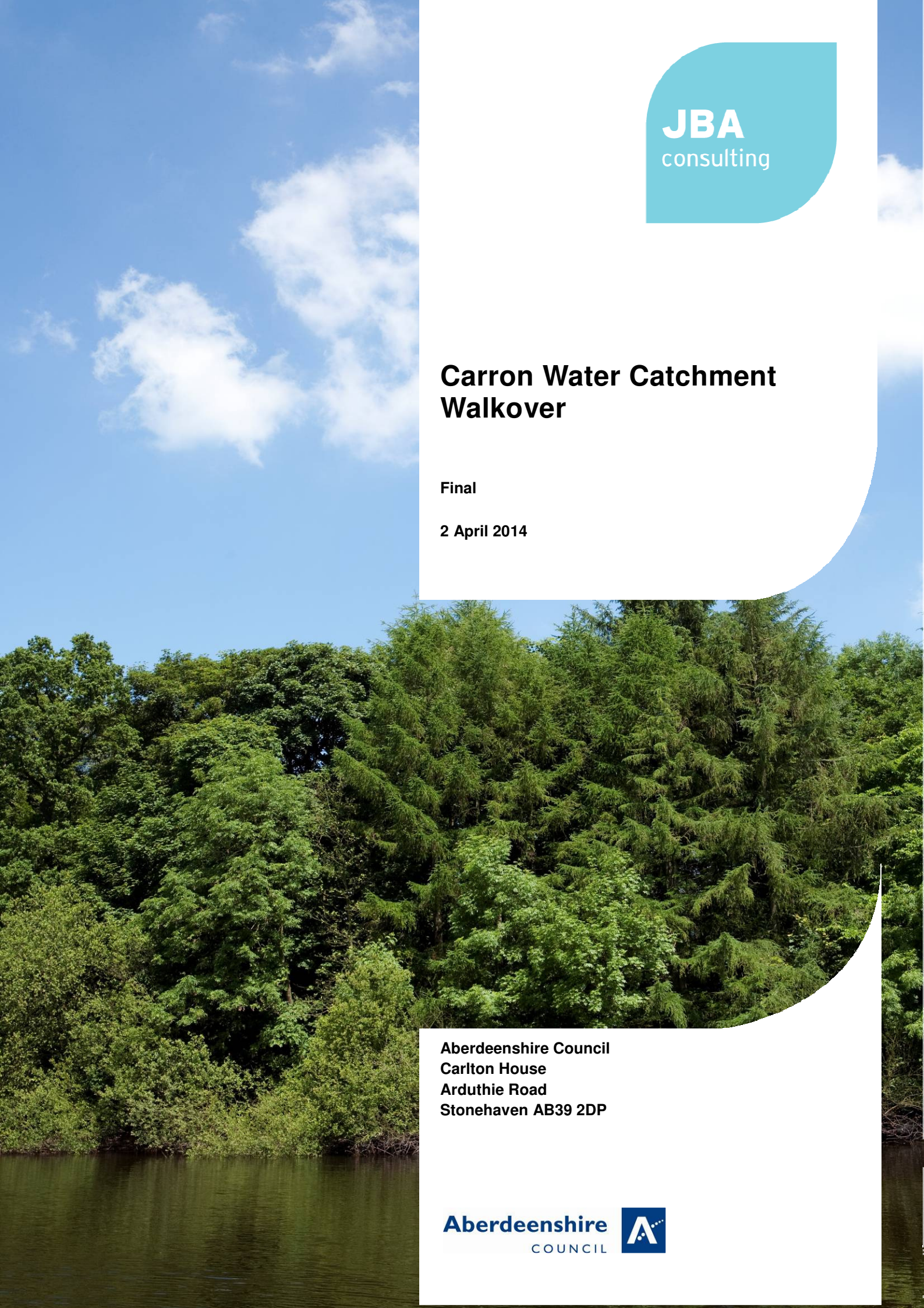

Carron Water Catchment Walkover

Final

2 April 2014

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Revision History

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Final 2/4/2014	New report format	Rachel Kennedy
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Contract

This report describes work commissioned by Rachel Kennedy, on behalf of Aberdeenshire Council by a letter dated 14 March 2013. Aberdeenshire Council's representative for the contract was Rachel Kennedy. Caroline Anderton of JBA Consulting carried out this work.

Prepared by ..... Caroline Anderton BSc MSc CEnv CSci MCIWEM C.WEM

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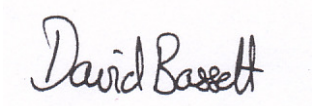

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Purpose

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1 Introduction

1.1 Legislation

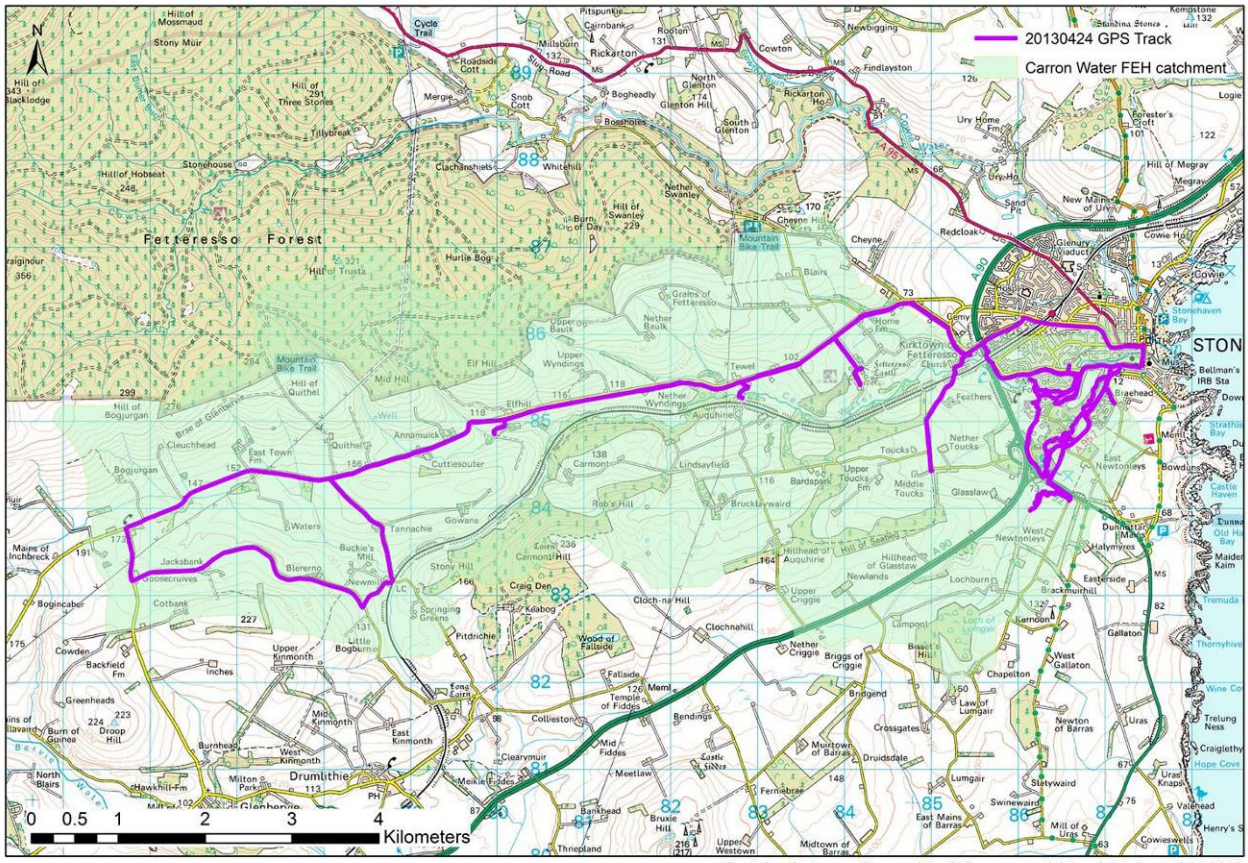
The Flood Risk Management (Scotland) Act 2009 requires SEPA and Responsible Authorities to consider sustainable approaches to managing flood risk. The FRM Act requires SEPA to assess and consider the role that Natural Flood Management (NFM) has in reducing flood risk, where Natural Flood Management was defined by SAIFF (2011)[1] as:

"Natural Flood Management can be defined as those techniques that aim to work with natural hydrological and morphological processes, features and characteristics to manage the sources and pathways of flood waters. These techniques include the restoration, enhancement and alteration of natural features and characteristics, but exclude traditional flood defence engineering that works against or disrupts these natural processes."

1.2 Aim of this assessment

A walkover of the Carron Water catchment was undertaken on 24 April 2013, the aim of this assessment was to consider the state of the current catchment and identify locations were NFM may be appropriate within the catchment. Figure 1-1 below shows the Carron Water catchment with the GPS track taken during the site visit showing the extent of the survey, this was primarily confined to public access and public rights of ways and included the Glaslaw Burn and Toucks Burn.

Figure 1-1: Carron Water Catchment and GPS track



[1] Scottish Advisory and Implementation Forum for Flooding (SAIFF, 2011)

Table 1-1: NFM Types

Increased vegetation cover	Working within and on the banks of the channel	Land management	Runoff (pathway) management
• Woodland planting (conifer, native and broadleaf) • Gully woodland planting • Creation of cross slope tree shelter belts • River bank woodland	• Placing of large woody debris and boulders • In-channel barriers • Bank restoration / erosion protection • Managing channel instabilities i.e. fencing • Reach restoration and floodplain reconnection • Reach restoration – removal of objects which restrict the flow of the river	• Soil & bare earth improvements • Changing agricultural field drainage • Upland drain blocking •	• Overland flow interception • Offline ponds • Farm wetlands • Sediment traps

2 Catchment Walkover – 24 April 2013

2.1 Catchment characteristics

The Carron Water rises in the hills around the Brae of Glenbervie flowing for approximately 15 km before discharging into the sea at Stonehaven. Much of the 43km2 catchment is composed of Devonian Old Red Sandstone sedimentary deposits overlain by a variety of glacial tills, sands and gravels. The main channel drains generally to the east with short, steep tributaries joining principally from the north (in particular Cheyne Burn). Two tributaries join the main river from the south in the vicinity of Stonehaven, namely Toucks Burn and the Burn of Glaslaw. Isostatic rebound following the last glaciation has resulted in channel incision reworking the glacial and fluvio-glacial deposits and creating limited areas of lowland floodplain.

The upper catchment is covered in coniferous plantation forest, arable and pastoral farmland and the lower reaches of the main river are extensively engineered throughout its course through Stonehaven. Large areas of the Glaslaw and the Carron are intensively used arable fields.

2.2 Watercourse characteristics

The main Carron Water may be classified as moderately active sinuous single thread displaying a cobble and gravel bed and the morphologic features associated with the temporary storage of this material (riffles, point bars, lateral bars, etc.). The tributary channels appear steep but are generally stable, flowing through confined wooded valleys. The river has been extensively altered over time through Stonehaven resulting in a single thread channel that in places is wider than the more natural sections upstream. The banks are well protected by a variety of revetment types and a number of ad-hoc structures presently encroach across the bed of the river. Grade control structures in the form of boulder weirs influence the character and hydraulics of the river and tributary in the vicinity of Green Bridge.

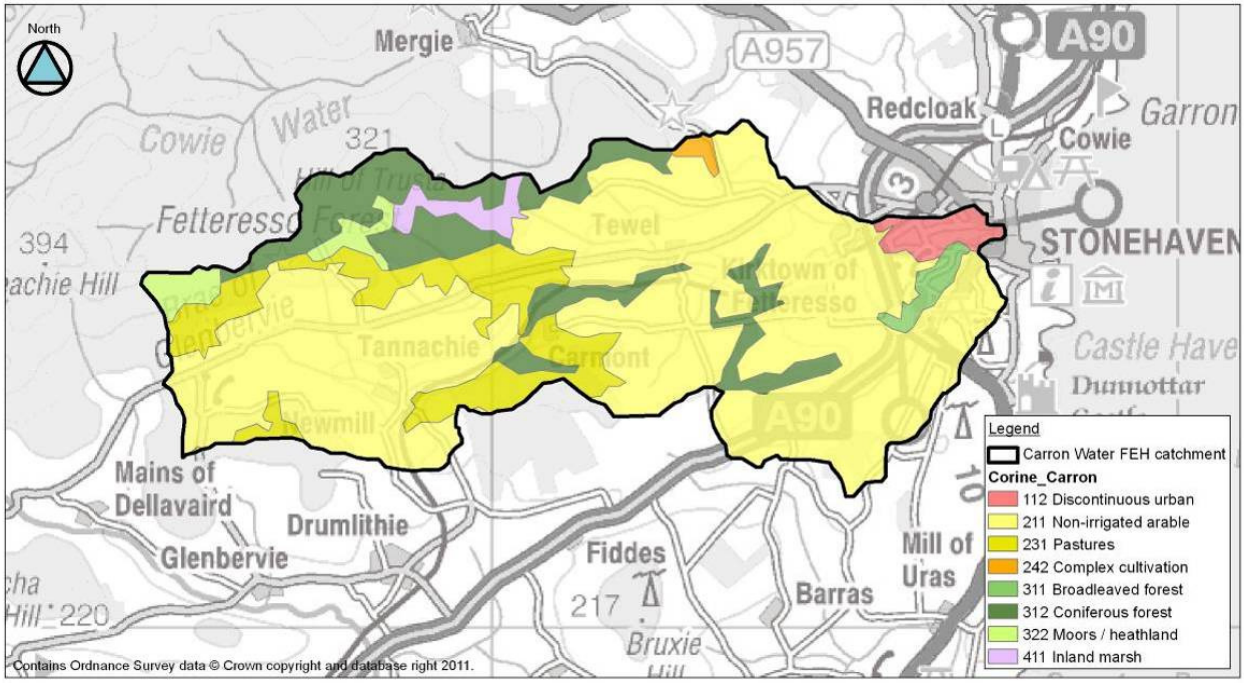
The combined effect of the various channel alterations has disrupted the sediment balance in the river through the town and concerns have been expressed that the sediment deposits seen at several locations along the river may be leading to localised flooding during extreme flow events.

2.3 Land management

On general inspection of the catchment it can be seen that there is very little natural or unmanaged land within the catchment, with arable and managed pasture making up the majority of land use within the catchment. The northern fringes of the catchment are coniferous plantation with areas of moorland. Figure 2-1 below shows the Carron catchment and land use taken from the Corine dataset[2].

[2] http://www.eea.europa.eu/

Figure 2-1: Carron Water catchment and land use



3 Findings

The findings and recommendations from the site visit are made in the following sections. The weather conditions on the day of the walkover were fair, clear and dry.

3.1 Carron Water

3.1.1 Carron Water upper catchment

Due to the time of year that the visit was undertaken there were a number of large fields which had recently been ploughed and hence were exhibiting bare soil conditions (Figure 3-1B & D). In some locations the impact of this on runoff generation is exacerbated through ploughing with the slope rather than cross contour ploughing (Figure 3-1D). Figure 3-1C shows some areas of confined floodplain on glacial terraces.

Figure 3-1: Carron Water upper catchment

In these areas improve management techniques including contour ploughing and improved buffer strip provision, together with including increased vegetation variety and roughness along the channels edge are recommended. Buffer strips should be at least 5m in width. Gully woodland planting and cross contour shelter belt planting would also be beneficial in the upper

catchment. Opportunities also exist for the construction of leaky barriers at the edges of field to intercept overland flow where runoff is concentrated.

3.1.2 Carron Water upper catchment tributaries

Figure 3-2: Carron Water upper catchment tributaries

Figure 3-2 shows typical tributary channels in the upper catchment of the Carron. These exhibit extensive straightening and in some locations over deepening (Figure 3-2C). In many cases buffer strips are non-existent and almost direct connection between the edge of the field and the channel exists, for example Figure 3-2B bottom left corner where soil and gravel is being mobilised into the river. Natural floodplain characteristics are minimal.

In these areas improved land and soil management techniques, including contour ploughing and improved buffer strip provision with an increase in vegetation variety and roughness along the channels edge, are recommended. Buffer strips should be at least 5m in width. Opportunities also exist for the construction of leaky barriers at the edge of field to intercept overland flow where runoff is concentrated. Reconnection of the watercourse with its floodplain through encouraging channel meandering would be beneficial where channels have been straightened and over deepened. This would create opportunities for large woody debris placement, river bank woodland planting, off-line storage ponds and channel restoration. In addition some off line storage – effectively a SuDs type pond could be constructed at the end of arable fields.

3.1.3 Carron Water mid catchment

Figure 3-3: Carron Water mid catchment

In the mid catchment there are areas of floodplain confined between glacial terracing. These areas have been typically grazed (Figure 3-3A). Figure 3-3B shows typical agricultural land sloping towards the watercourse and limited buffer strip on the left bank.

The area shown in Figure 3-3A presents opportunities for the placement of large wood debris within the channel along with woody barriers or earthen bunds across the floodplain to retain water for longer on the floodplain. Opportunities also exist in this area for floodplain woodland planting.

Where the floodplain is narrower, such as shown in Figure 3-3B opportunities exist for the construction of leaky barriers at the edge of field to incept overland flow where runoff is concentrated. Opportunities also exist for riparian woodland planting and channel restoration.

Figure 3-4: Carron Water Bridge of Fetteresso

As the Carron Water reaches Fetteresso and Bridge of Fetteresso the valley is much wider and is currently used as a horse paddock and grazing. As can be seen in Figure 3-4A & B the channel is tree lined with mature trees along the left bank, however vegetation cover consists of short grazed grasses up to the edge of the right bank. Man made features such as walls and garden terraces are prevalent.

The ground on the left floodplain rises steeply to the railway line. Beyond the railway line, the land continues to rise away from the railway line and hence watercourse. Figure 3-5A shows evidence of significant runoff over time eroding the edge of the road and creating a rill along the roads edge which is a fast flow pathway to the watercourse. Figure 3-5B is taken adjacent to the railway and looking upslope across a ploughed field, here significant volumes of fine sediments

have been deposited at the field's edge, resulting in water now running straight onto the road. Surface water was witnesses pouring from this location during the December 2012 event (see Figure 3-6).

In the area of Fetteresso Bridge floodplain opportunities exist for river bank woodland planting and improving the buffer between the grazed land and the watercourse. Fast flow pathways should also be intercepted. Where land is overgrazed reduction in grazing pressure should be considered and any accesses to the watercourse controlled to reduce poaching of teh river bank.

Figure 3-5: Carron Water near to Bridge of Fetteresso

Figure 3-6: Photograph taken by SEPA during December 2012 event – note sediment and surface water flowing onto the road

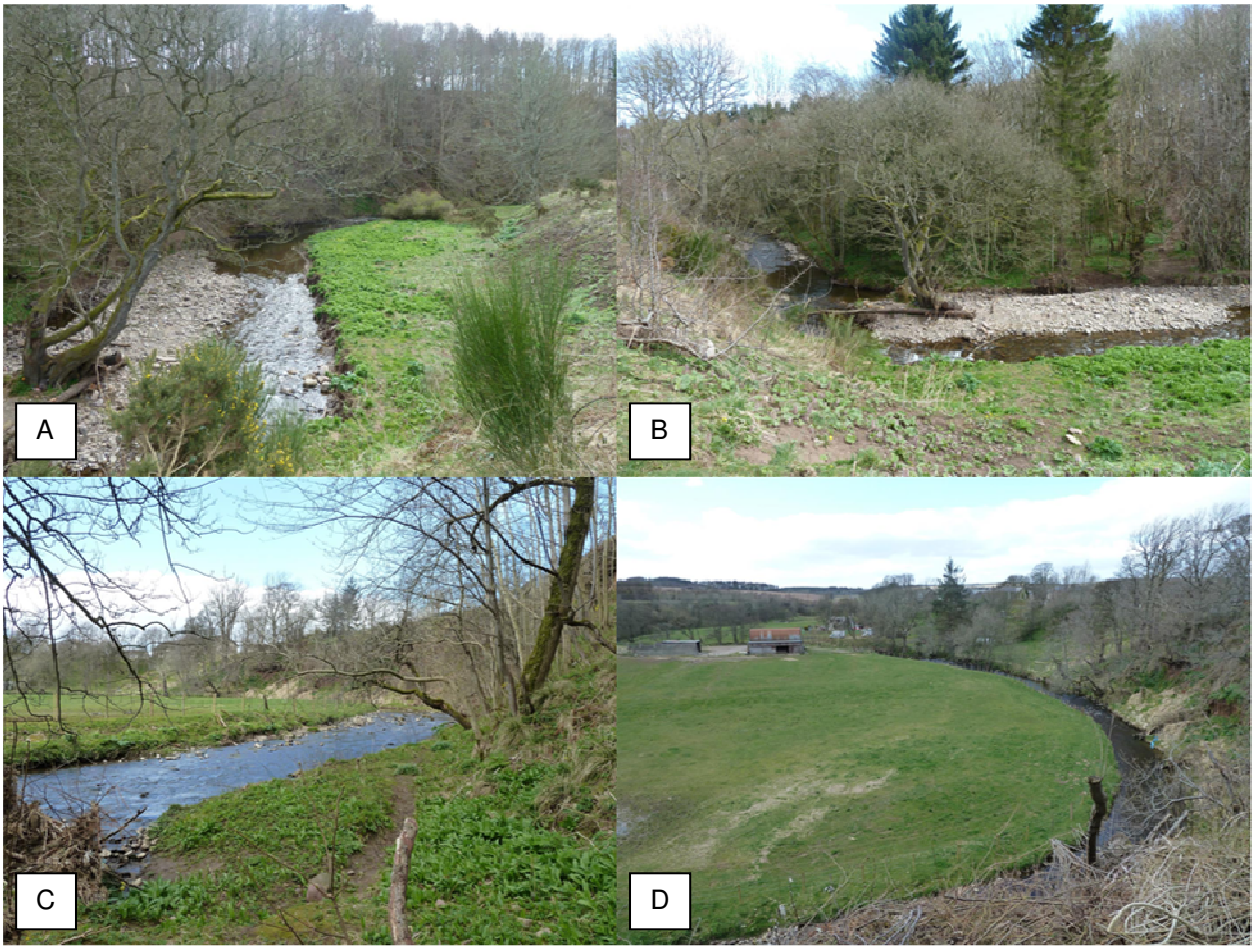
Interception and disconnection of such fast flow pathways is needed in areas such as this (inc. runoff attenuation features). It is recommended that a leaky barrier / sediment trap is located at the corner of the field. Further investigation should also be given to runoff which is generated further upslope and running down the roads edge.

Immediately upstream of the main settlement of Stonehaven the channel flows beside Mill O' Forest Cottage and a high wooded glacial terracing confines the watercourse the along the left bank (Figure 3-7C & D). Residential areas of Stonehaven are located up high upon this terracing. The right bank and inside of this large meander is significantly lower and will act as floodplain during times of flood. This area has been significantly managed and grazed.

This wide area of floodplain would lend itself to the creation of a wooded floodplain and river bank area, including the encouragement of the watercourse onto the floodplain and the creation of backwater channels on the floodplain. Consideration should also be given to the construction of shallow earthen bunds (with simple piped outlets) – designed to allow both livestock and machinery to traffic over them without any problems but to hold water on the floodplain for longer.

3.1.4 Carron Water lower catchment

Figure 3-7: River Carron Deil's Kettle and Mill O'Forest Cottage



As the watercourse flows through the Deils Kettle (Figure 3-7A & B), the right bank floodplain exhibits good examples of wet woodland floodplain. The extension of which should be encouraged onto the lower areas floodplain including areas such as that on the left bank shown in Figure 3-7A. There are also large gravel bars present

Increase river bank woodland coverage through the Deil's Kettle. Monitor progress of gravel bars.

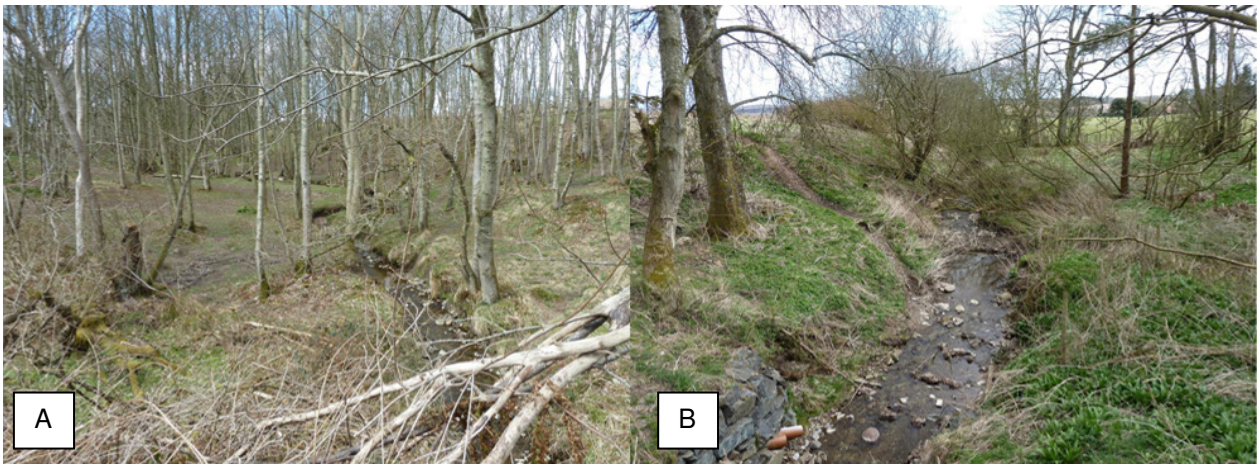
3.2 Cheyne Burn

The Cheyne Burn in the vicinity of the Bridge of Fetteresso has been historically straightened and presents limited floodplain connectivity as the watercourse has been canalised between garden walls (Figure 3-8D).

Figure 3-8: Cheyne Burn at Bridge of Fetteresso

Upstream on the Cheyne Burn there are examples of wooded floodplain which should be maintained (Figure 3-9A &B). Natural woody debris dams could be encouraged including the placement of artificial debris dams.

Figure 3-9: Cheyne Burn



3.3 Glaslaw Burn

Figure 3-10: Glaslaw Burn Upstream of Stonehaven

The Glaslaw Burn is also impacted by land management, including over grazing and large field systems.

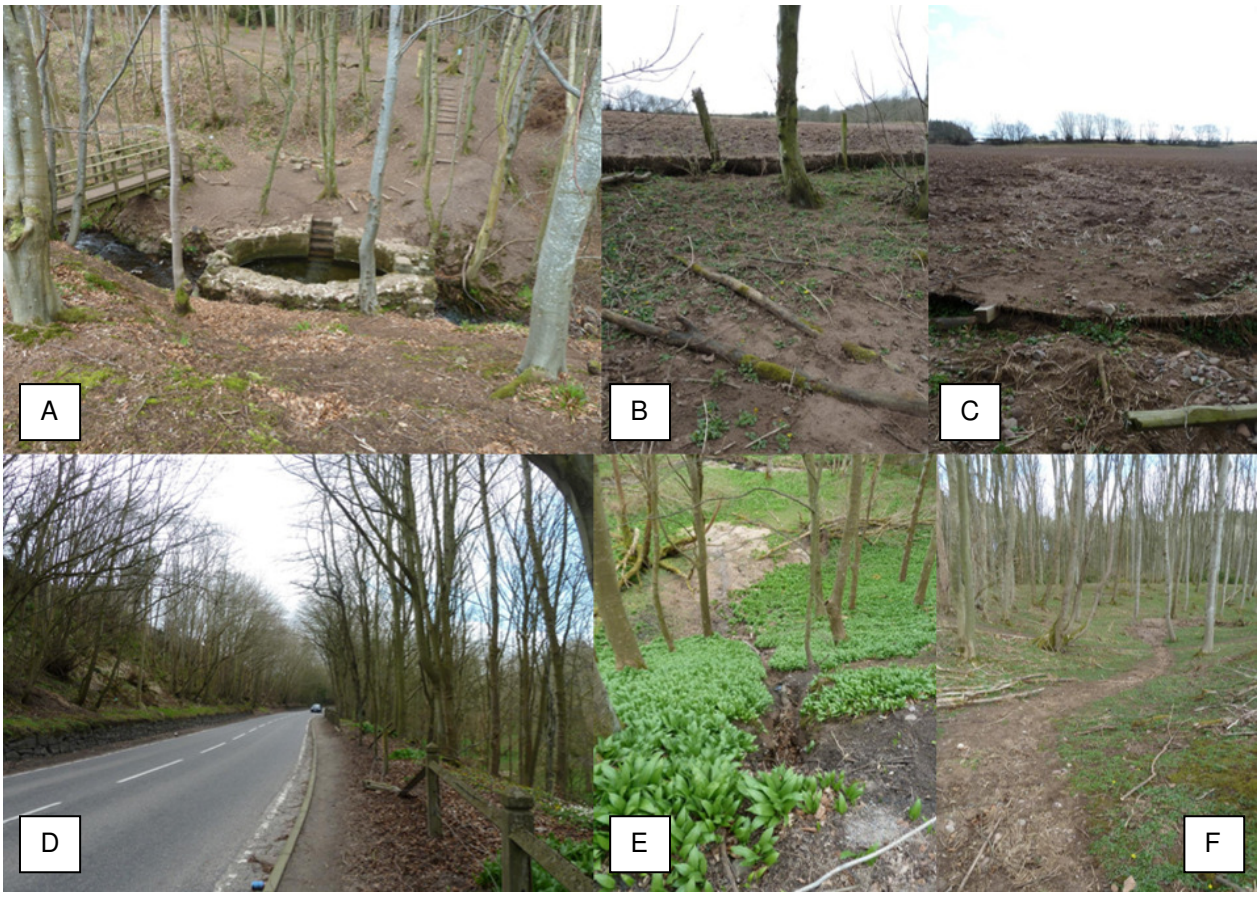
In these areas improved land and soil management techniques, including contour ploughing and improved buffer strip provision with an increase in vegetation variety and roughness along the field-channels edge, are recommended. This is particularly important as significant overland flow was reported in the last flood.

Extensive floodplains are not present on this catchment upstream of the A92 road, with confined gully / confined valleys being predominant. In addition Figure 3-10B shows existing farm wetlands on areas of floodplain which already exist.

Gully / valley woodland planting is evident and consideration of extending this tree planting on the floodplain should be considered.

The restriction of grazing on the floodplain and encouragement of vegetation diversity (e.g. more woody and stiffer tussocky material) on the floodplain are recommended. The introduction of large woody debris within this reach upstream of the A92 would encourage flow out onto the floodplain.

Figure 3-11: Glaslaw Burn Woods of Dunnottar

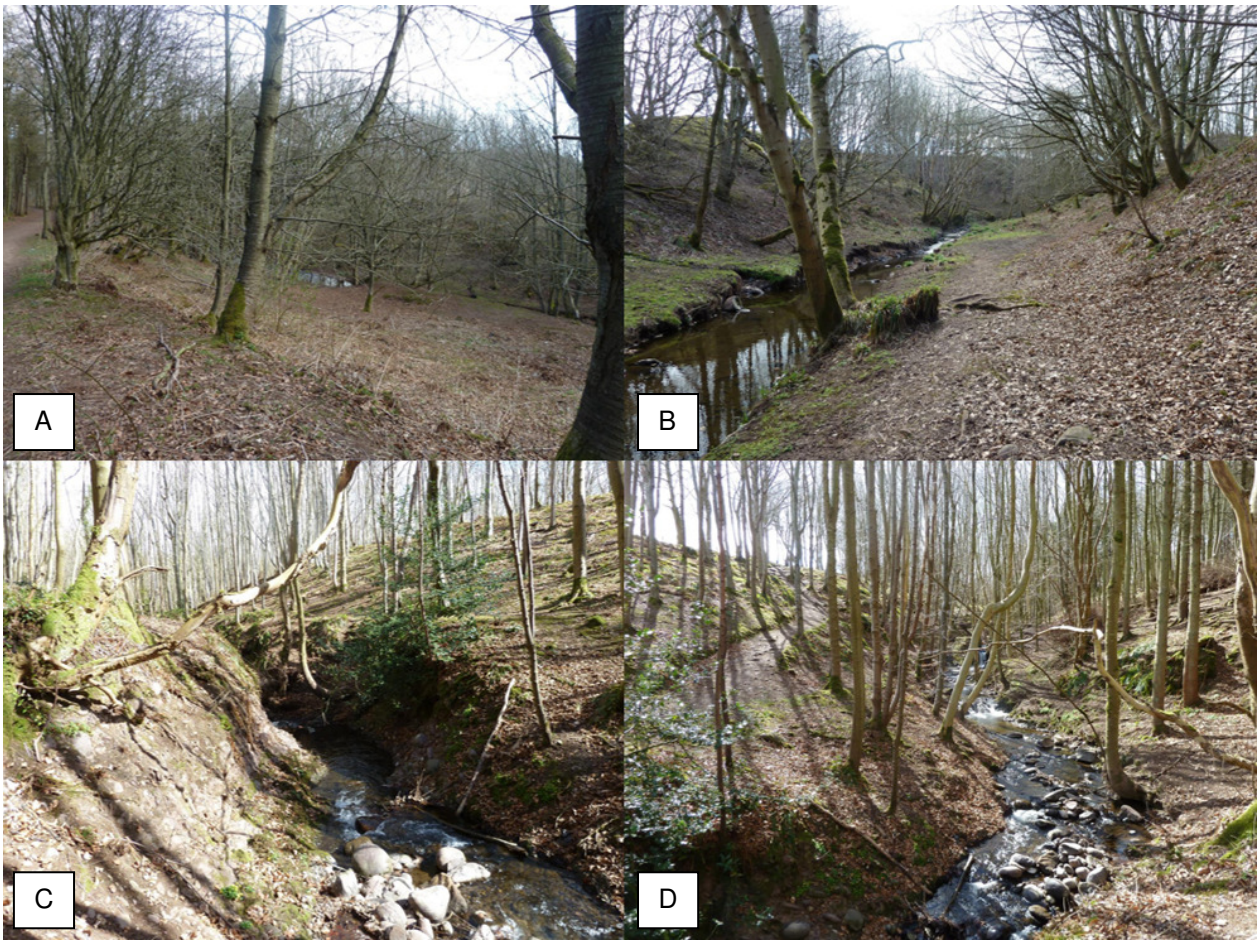


Downstream of the A92 road, the Glaslaw Burn enters the Woods of Dunnottar. This area of woodland acts as an ideal buffer to runoff from surrounding areas; however, there are locations where land management practices could be improved.

The land to the south of the Glaslaw Burn is located upon glacial terracing which then slopes steeply down to the watercourse. Figure 3-11B, C and F show significant sediment loss and rill formation on farm land on the terrace adjacent to the Woods of Dunnottar. Sediment can be seen building up against the boundary of the field and then flowing down into the Glaslaw Burn connecting directly with the watercourse and its floodplain. The A957 road also runs parallel to the Glaslaw Burn; with Figure 3-11D and E showing that road drainage is directly connected to the floodplain. The A957 road is steep and likely to pass high volumes runoff during times of intense rainfall.

Opportunities for improved management on the land adjacent to the woodland would assist with both reductions in runoff and reduction in the loss of sediment/ nutrients from the farmland (which in turn would reduce sediment inputs into the Glaslaw Burn and Carron Water. The locations shown in Figure 3-11B, C and F are ideal locations for the construction of runoff attenuation features such as a leaky barrier and sediment trap on adjacent land. The general lie of the land such as gradients, depressions and flow pathways will determine what runoff attenuation feature(s) might be appropriate. Where flow pathways through the woodland are evident woody debris dams should be encouraged to slow and dissipate runoff. Consideration should also be given to the disconnection of the road drainage to areas where increased infiltration into the soil could be encouraged.

Figure 3-12: Glaslaw Burn Woods of Dunnottar



Immediately downstream of the A92 road culvert the Glaslaw Burn is well confined within limited floodplain extents.

Trees extend down to the water's edge and this should be maintained. The introduction of woody debris dams within the woodland should be considered.

Figure 3-13: Glaslaw Burn Woods of Dunnottar

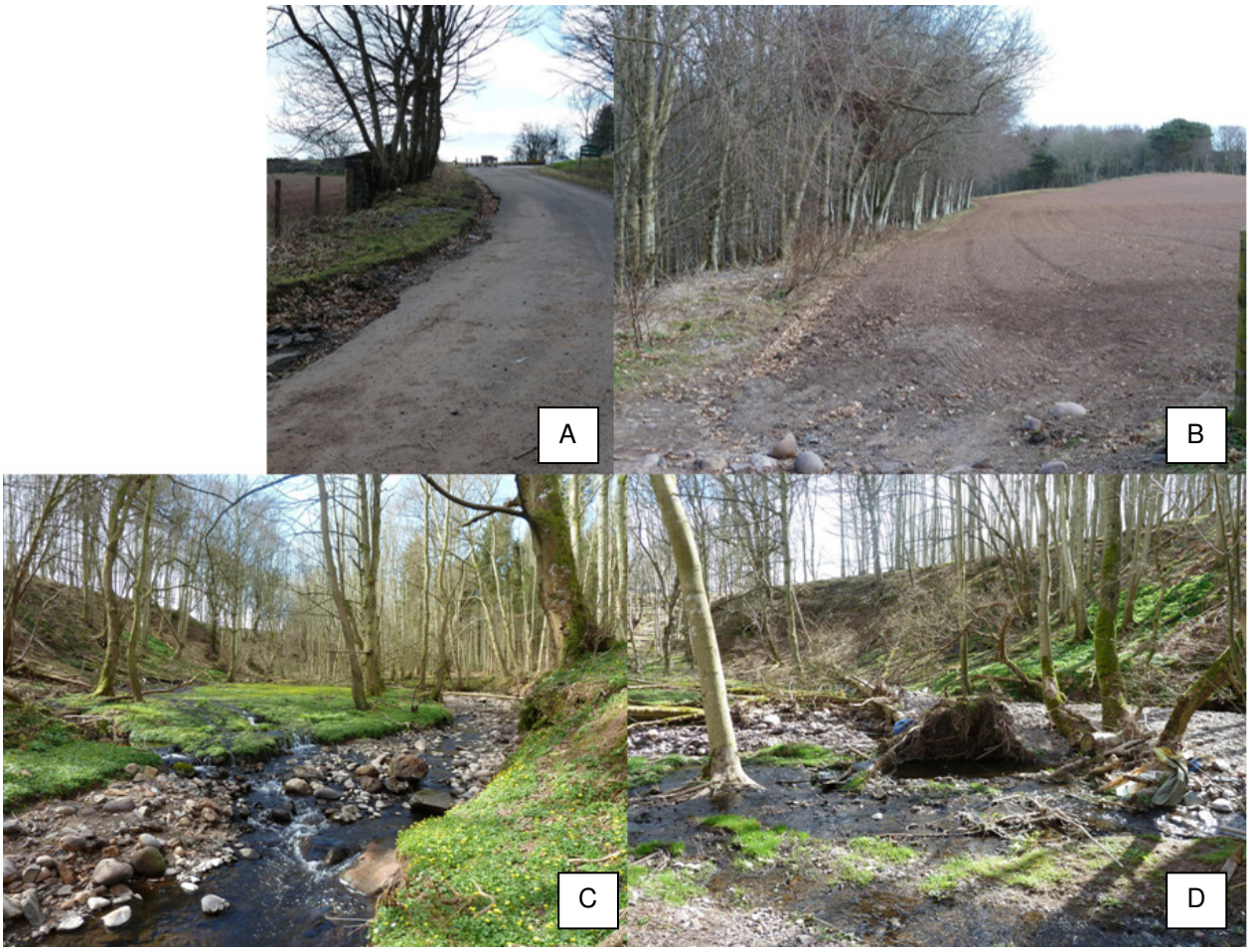
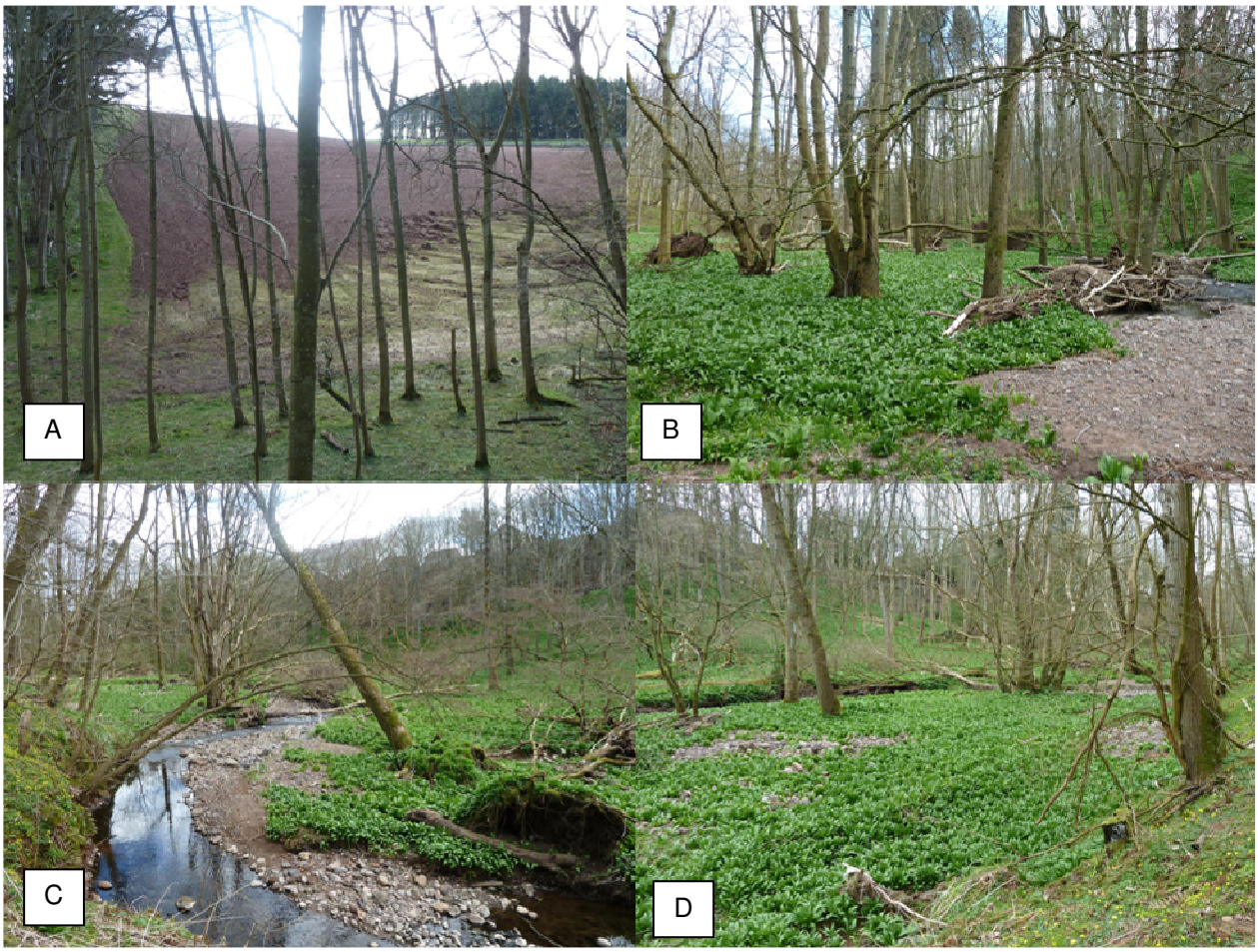


Figure 3-13 A and B were taken adjacent to the Dunnottar Church road culvert which experienced significant scouring during the December 2013 event. Runoff was clearly concentrated along the unclassified road and its verge.

Leaky barriers and sediment traps would be recommended in the fields to the south of the unclassified road, but also within the field edges where runoff is concentrated adjacent to the wood (for example Figure 3-13B). Where there is obvious overland flow from the edge of the fields consider low bunding and storage.

Figure 3-14: Glaslaw Burn Woods of Dunnottar, Downstream of Dunnottar Church Road.



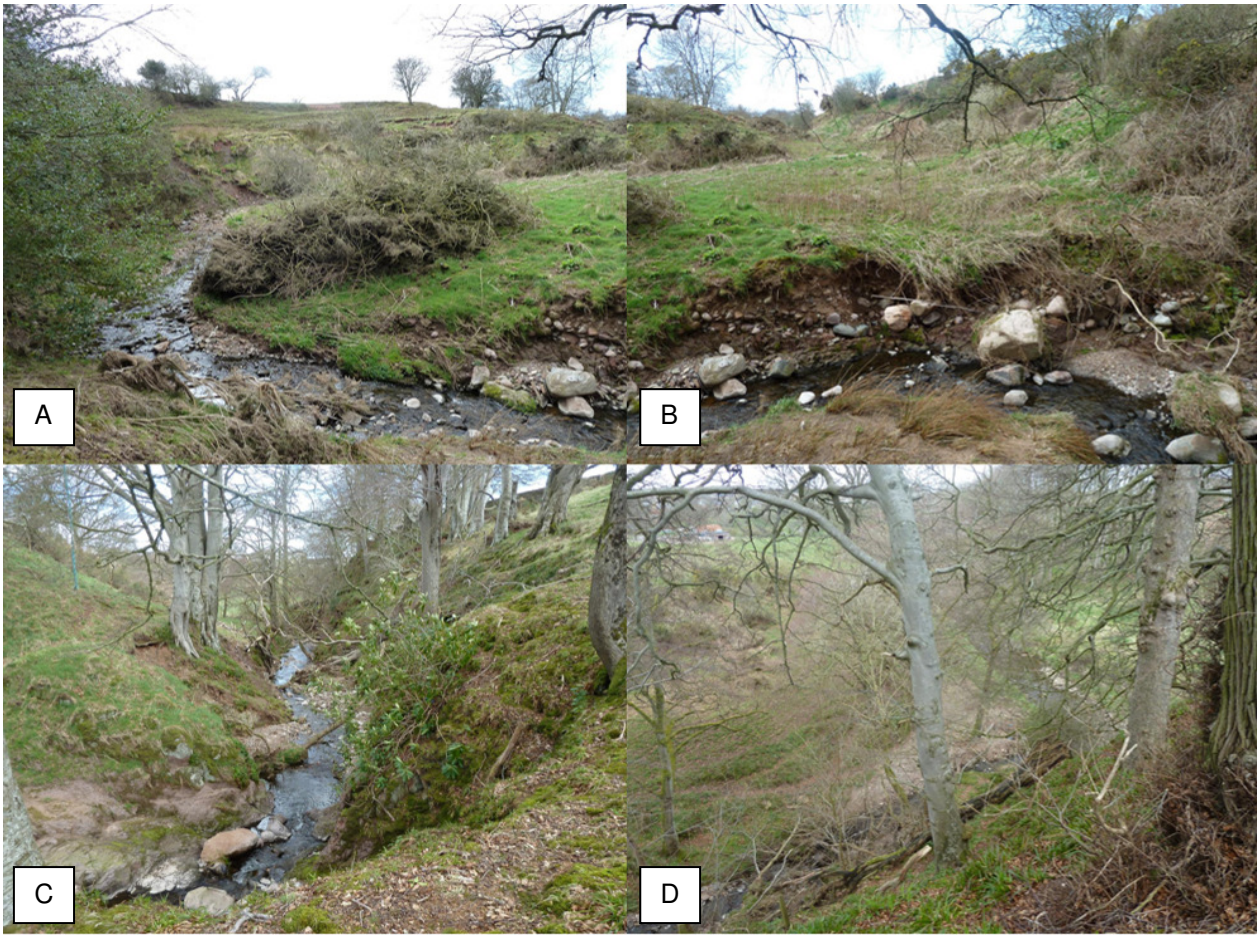
As the Glaslaw Burn nears Carron Gardens the valley floor and hence floodplain widen significantly, with the entire floodplain showing evidence as having been active during the flooding in December 2012, including deposition on the floodplain, excellent examples of natural woody debris and channel activity (Figure 3-14,B C & D).

3.4 Toucks Burn

The Toucks Burn originates to the west of the A90 and flows into the Carron Water downstream of the Mill O' Forrest floodplain. The Toucks Burn has a steep gradient and active bank erosion is event as the burn passes the Dunnottar Church. Deposits of sediment have been caused to drop out onto the floodplain at the confluence with the Carron Water (Figure 3-15D taken in the vicinity of the Dunnottar Church).

Channel instabilities should be monitored on the Toucks Burn. Consider riparian fenincg and planting to stabilise eroding banks.

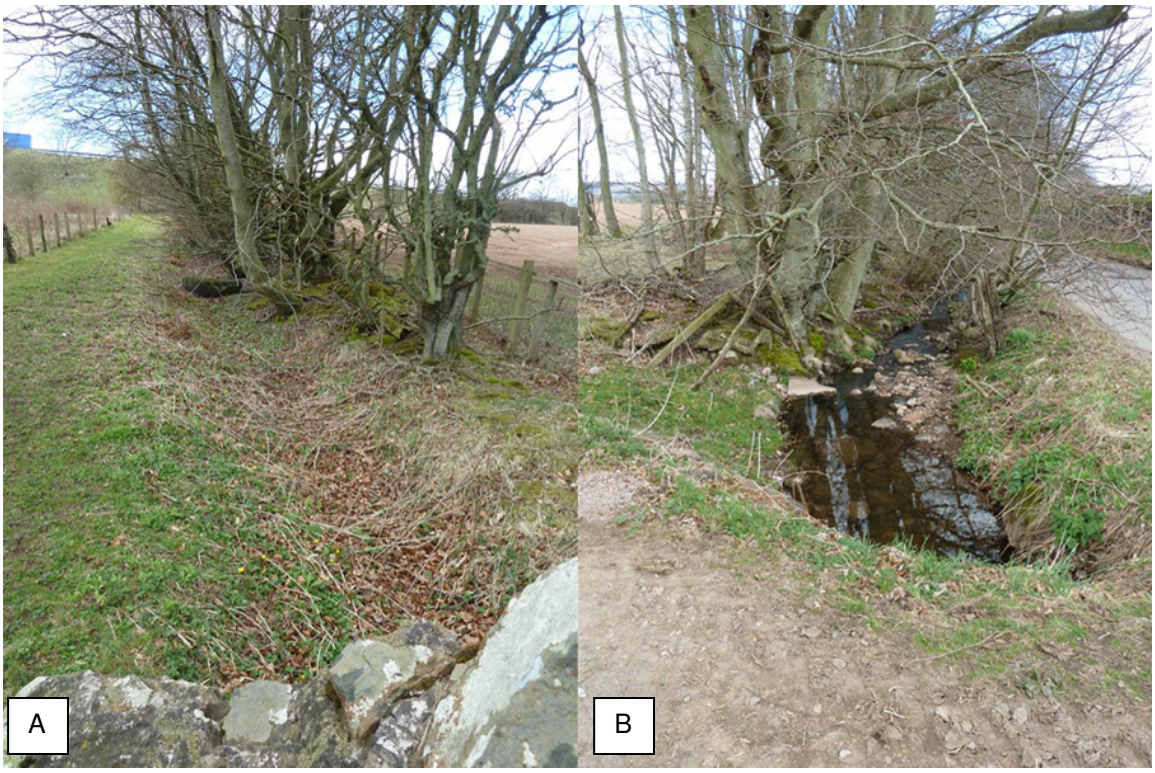
Figure 3-15: Toucks Burn Upstream of Confluence with the Carron



3.5 Unnamed tributary – Dunnottar Square

OS mapping suggests that a small watercourse originates to the west of the A90 / A92 interchange and flows north east, joining the Carron Water downstream of the Toucks Burn confluence. Figure 3-16A is taken from Dunottar Church road and looking towards the A90, this flow pathway was dry at the time of the site visit. Further investigations into the pathway of this unnamed watercourse would be required. Figure 3-16B is then from the same location looking north east along the edge of Dunnottar Church road.

Figure 3-16: Unnamed tributary



3.6 Overall recommendations

This catchment walkover has shown that there are a number of locations where improved land management and natural flood management practices could reduce both runoff generation and sediment loss within the catchment.

Further analysis of runoff concentration areas and surface water flow pathways would allow targeting of gully and cross contour shelter belt planting, along with leaky barriers, off-line ponds or shallow earthen bund construction (in particular at field and farm access boundaries).

Historically, flooding in Stonehaven has been exacerbated by bridge blockage both at the Red Bridge and the Green Bridge. Should increased tree planting take place, then an assessment of risk would also need to be undertaken in conjunction with the potential construction of coarse debris barriers / screens upstream of Stonehaven.

Runoff / drainage connectivity from the A90 which cuts across the Carron, Glaslaw and Toucks Burn catchments is unknown. The Carron lies at a low spot in the A90, as the road rises both to the north and south. Further assessment of this is recommended.

An assessment of the drainage within the Fetteresso Forest Plantation may also be beneficial and highlight locations where drainage blockage would assist in slowing down runoff in the northern upland part of the catchment.

References

Scottish Advisory and Implementation Forum for Flooding (SAIFF, 2011)

http://www.eea.europa.eu

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