Dougall Baillie Associates
DBA
civil. structural. transportation. water management

JBA consulting

Insch Natural Flood Management and River Basin Management Plan Report

Final Report

September 2018

Aberdeenshire Council

Aberdeenshire COUNCIL

JBA Project Manager

Caroline Anderton BSc MSc CEnv CSci MCIWEM C.WEM
JBA Consulting
Unit 2.1 Quantum Court
Research Avenue South
Heriot Watt Research Park
Edinburgh
EH14 4AP

Revision History

Revision Ref / Date Issued	Amendments	Issued to
P01 / 16 July 2018	-	Alistair Scotland and Lee Watson, Aberdeenshire Council
P03 / 21 Sept 2018	SEPA and Aberdeenshire Council comments addressed.	Alistair Scotland and Lee Watson, Aberdeenshire Council
C01 / 03 April 2019	Published.	Alistair Scotland and Lee Watson, Aberdeenshire Council

Contract

This report describes work commissioned by Gavin Penman, on behalf of Aberdeenshire Council, on 10 October 2017 by Purchase Order Number 1095192. Dougall Baillie's representative for the contract was Scott Macphail and Aberdeenshire Council's representative for the contract was Alistair Scotland. Hannah Otton, Briony McIntosh and Caroline Anderton of JBA Consulting carried out this work.

Prepared by ..... Briony McIntosh MEarthSci
Assistant Analyst

Hannah Otton BSc
Assistant Analyst

Reviewed by ..... Caroline Anderton BSc MSc CEnv CSci MCIWEM C.WEM
Technical Director

Purpose

This document has been prepared as a Final Report for Aberdeenshire Council. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to Aberdeenshire Council.

Acknowledgements

JBA wishes to thank SEPA for supplying the natural flood management, morphological pressures and river basin management plan datasets. JBA also thanks Aberdeenshire Council for the supply of data.

Copyright

Carbon Footprint

A printed copy of the main text in this document will result in a carbon footprint of 124g if 100% post-consumer recycled paper is used and 157g if primary-source paper is used. These figures assume the report is printed in black and white on A4 paper and in duplex.

JBA is aiming to reduce its per capita carbon emissions.

Executive Summary

Context

Under the Flood Risk Management (Scotland) Act 2009, this report forms part of the appraisal study for Insch commissioned by Aberdeenshire Council. The purpose of this report is to assess the current condition of the watercourses within The Shevock catchment, based on parameters set out in the River Basin Management Plan (RBMP) for watercourses with status less than good, and identify opportunities for Natural Flood Management (NFM).

This has been achieved through an initial desktop study of the catchment, determining the hydrological conditions and characteristics of the catchment, alongside SEPA's Section 20 screening data. The Shevock catchment is comprised of one primary watercourse, The Shevock, and several smaller tributaries which are primarily field drainage channels. The greatest proportional contribution in terms of peak flows is from the upper Shevock catchment north of Oldtown (39% to the overall catchment discharge), followed by the Mill of Glanderston tributary in the upper catchment (17%). In addition to The Shevock, the Valentine Burn which flows through Insch, and the Mill of Rothney and Newton of Rothney Burn's which flow to the west and east of Insch respectively present additional flood risk to the town. These watercourses contribute 12%, 11% and 9% to the overall catchment discharge respectively; these are therefore important in their own right in terms of NFM opportunities.

Natural Flood Management Summary

A long list of the relevance of a range of NFM options was created for each of the key areas in the catchment. A screening exercise was then undertaken using the collated GIS data to derive key locations for site inspection, with site walkover resulting in a short list of suitable opportunities for each of the prioritised catchments.

NFM opportunities across The Shevock and tributary sub-catchments are numerous. Land use is dominated by agricultural land and the catchment has a rolling topography with many of the watercourses flowing through open floodplain. Opportunities to implement floodplain storage and runoff reduction measures are high. Key locations identified for NFM were along The Shevock upstream of Insch within the vicinity of the level crossing at Shevock Farm and within the Mill of Rothney sub-catchment south of North Road. The Shevock is a tributary of the River Urie which presents a flood risk to Inverurie, also being assessed as part of the Aberdeenshire Council flood studies. NFM measures in The Shevock catchment would therefore have the multi-benefit of reducing flood risk to both Insch, Inverurie and Port Elphinstone, and could be monitored and used as a pilot NFM study.

A summary of NFM measures for the key sub-catchments are provided in Table 1, with specific locations and additional NFM measures recommended for the wider catchment mapped in Figure 1. It should be noted the opportunities mapped in Figure 1 are primarily based on the areas visited during the catchment walkovers and are not exhaustive, with similar measures applicable across The Shevock catchment.

River Basin Management Plan Summary

Despite the 'Good' physical condition classification (2016), there are several significant morphological pressures along The Shevock, the key one being high impact realignment for much of its reach. In addition, embankments and grey-bank reinforcement constrain the watercourse at several locations. These constraints are often the result of the railway which runs through the centre of the catchment and parallel to the watercourse for almost its entire length. Several opportunities to restore sinuosity along The Shevock removing realignment as a pressure were identified on site which would maintain the 'Good' RBMP status, as well as having NFM benefits by slowing flow towards Insch. Additionally, removal of embankments may be possible in certain locations to release channel capacity and improve floodplain connectivity.

The Valentine Burn was found to have a number of constraints on its morphology: it is highly straightened for the majority of its reach and been realigned and dredged by Insch Community Centre; a small informal concrete wall has been constructed within the channel by Insch Recycling Centre and it is culverted for sections through Insch. Meandering of the Valentine Burn or creation of a two stage channel at key locations, bank stabilisation and removal of the informal wall are recommended measures to improve the physical, as well as water quality condition of the burn. The

Mill of Rothney and Newton of Rothney Burn's in contrast have far fewer physical constraints other than being highly over-straightened, as are the tributaries in the western catchment near Oldtown. Meandering and bank stabilisation are the key RBMP recommendations to improve the physical and water quality condition of these tributaries.

Implementation Approach

The approach to implementing the above recommendations will depend on a number of factors, not least landowner involvement and the availability of funding for this type of measure. However, the recommended methodology for the delivery of river restoration and NFM within the catchments is suggested as follows:

- Incorporation of NFM within a proposed FPS either as a separate option or to supplement other more structural options to provide future adaptation against climate change.
- Inclusion within any wider Aberdeenshire Council NFM funding mechanism to deliver NFM and river restoration when specific funds become available on an ad-hoc basis.
- Delivery of measures via an FPS as a percentage uplift included within the total FPS costs set aside for local NFM and RBMP measures.

The following are considered key areas for NFM/ RBMP improvements and specifically we recommend:

- **The Shevock Burn at Insch Golf Course and upstream of Shevock Farm:** there is potential to increase sinuosity, improve floodplain connectivity, remove embankments and create storage ponds. **Downstream of Little Mains of Wardhouse** floodplain storage could be enhanced through the creation of wetlands, leaky bunds and installation of debris dams.
- **Mill of Rothney south of North Road** there is open uncultivated land which would be suitable for wetland development, storage ponds, debris dams and floodplain woodland planting to store water upstream of the railway culvert and confluence with The Shevock.
- **The Valentine Burn:** good land management practices in the upper catchment such as buffer strips, ideally 6m in width, hedgerows, leaky bunds and along contour ploughing will have the greatest benefits. Downstream within the scheme extent the greatest improvements to the physical condition of the watercourse and potential for NFM measures such as floodplain storage would be within the Golf Course. It may be possible to incorporate NFM without disrupting the Golf Course but considerable stakeholder engagement will be required.

Table 1: Summary of NFM options with the key sub-catchments assessed during the walkover

	Summary of proposed NFM interventions			
Catchment	**Increased vegetation cover**	**Working within/ on the banks**	**Land management**	**Runoff Management**
The Shevock incl. upper catchment tributaries	Floodplain woodland. Along contour woodland planting. Wet woodland.	Buffer strips. Meander, create two-stage or block straightened tributary channels. Debris dams. Online ponds.	Hedgerow planting. Block upland drainage channels. Along contour ploughing. Limit livestock poaching of the bank.	Leaky bunds. Wetlands. Offline ponds.
Valentine Burn	Catchment planting. Riparian planting. Wet woodland.	In-stream debris dams. Buffer strips. Restore dredged sections of channel. Bank stabilisation. Online ponds.	Along contour ploughing. Hedgerows.	Leaky bunds. Wetland. Offline storage ponds.
Newton of Rothney	Riparian planting.	Debris dams. Bank stabilisation.	Fence off watercourse to limit livestock poaching. Along contour ploughing.	Leaky bunds. Wetlands.
Mill of Rothney	Riparian and floodplain woodland. Catchment planting.	Online ponds. Meander. Debris dams.	Along contour ploughing. Hedgerow planting.	Wetland. Offline ponds.

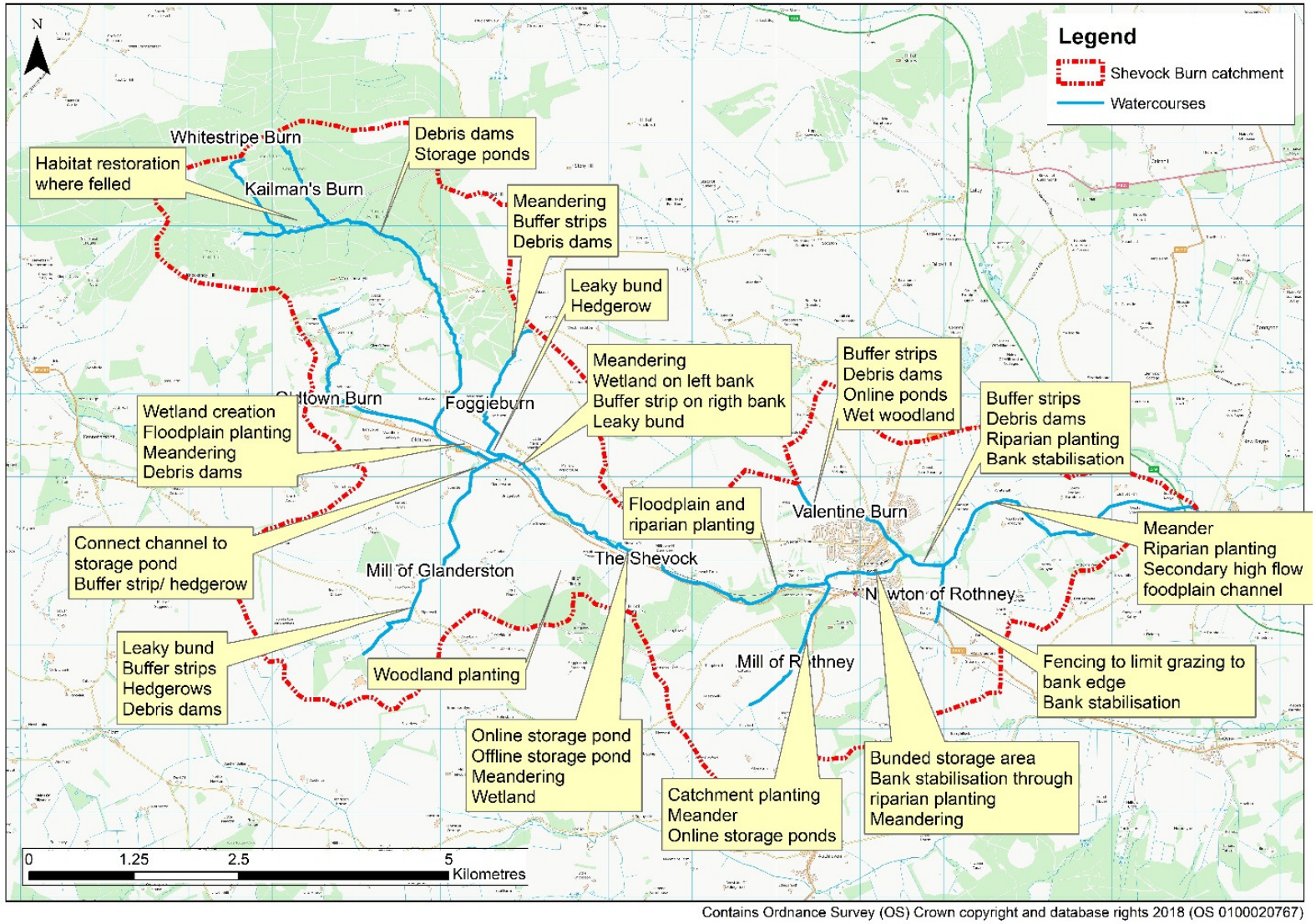


Figure 1: Summary of NFM recommendations across the Shevock catchment.

Contents

List of Figures

List of Tables

Abbreviations

BFIHOST	Base Flow Index estimated from soil type
BGS	British Geological Survey
DTM	Digital Terrain Model
FRM	Flood Risk Mapping
mAOD	metres Above Ordnance Datum
NFM	Natural Flood Management
NGR	National Grid Reference
OS	Ordnance Survey
OS NGR	Ordnance Survey National Grid Reference
PFRA	Preliminary Flood Risk Assessment
QMED	Median Annual Flood (with return period 2 years)
RBMP	River Basin Management Plan
SAAR	Standard Average Annual Rainfall
SAC	Special Area of Conservation, protected under the EU Habitats Directive
SEPA	Scottish Environment Protection Agency
SPA	Special Protection Area for birds, protected under the EU Habitats Directive
SPRHOST	Standard percentage runoff estimated from soil type
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
WFD	Water Framework Directive

1 Introduction

The purpose of this report is to assess the current condition of watercourses within The Shevock catchment at Insch based on parameters set out in the River Basin Management Plan (RBMP) and identify potential opportunities for Natural Flood Management (NFM). A desk-based review of the catchment was used to identify areas to be investigated further through site walkovers. The results of these are presented in the following chapters.

1.1 RBMP

1.1.1 Legislation

The River Basin Management Plan forms part of the European Water Framework Directive (WFD) 2000. The WFD is currently in its second cycle (2015 - 2027) and sets out the objectives for protecting and improving the water environment, balancing the environmental, societal and economic costs and benefits. The Scottish Environmental Protection Agency (SEPA) are responsible for managing this within Scotland.

The RBMP defines and classifies the environmental condition of water bodies, with the overall condition graded from poor to high based on a number of categories including: access for fish migration; water flows and levels; freedom from invasive species; water quality; ecology and physical condition.

1.1.2 Aim

The aim of this RBMP assessment was to consider the current overall status of each watercourse within the catchment and in particular identify those classified as less than good based on their physical condition. Focus is given to the physical condition of the watercourse as this has a direct impact on flood risk from the river. Additionally, improvements to the morphology are likely to also improve the status of other RBMP categories. Multiple RBMP criteria will be considered in the optioneering stage.

For those considered less than good or within the modelled reaches (i) a desk-based review of the current significant morphological pressures along each watercourse was undertaken; (ii) the percentage capacity of the river used by these pressures was calculated using a methodology in keeping with SEPA's Morphological Impact Assessment System (MImAS) and (iii) a catchment walkover to review the constraints and identify opportunities to improve physical condition undertaken. The results of these are discussed in further detail in the following chapters.

1.2 NFM

1.2.1 Legislation

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

'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.'

1.2.2 Aim of the assessments

In the past, flood management has typically focused on traditional methods of mitigating flood risk, such as the use of flood walls and embankments, although such methods are not considered to be sustainable, particularly in the face of the increased frequency and severity of flooding predicted to impact Scotland as a result of climate change.

In contrast, NFM measures work together with the natural characteristics and processes of the landscape to help manage the sources and pathways of flooding as part of a catchment-wide approach and are generally considered to be more sustainable. Traditional measures do however,

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

still have a role in terms of protection and cost benefit analysis with respect to large magnitude floods, as NFM measures may be more effective for smaller scale events.

NFM measures vary in scale and type depending on local conditions. The SEPA Natural Flood Management Handbook[2], Chapter 2, provides guidance on river- and catchment-based NFM measures. The ultimate goals of such measures are as follows:

- Reduce the rate or amount of runoff;
- Improve the ability of rivers and their floodplains to manage flood water.

These aims are largely achieved by storing more water within the catchment and slowing the flow of water overland or instream. The types of NFM measures considered for suitability within the catchment include those in Table 1-1.

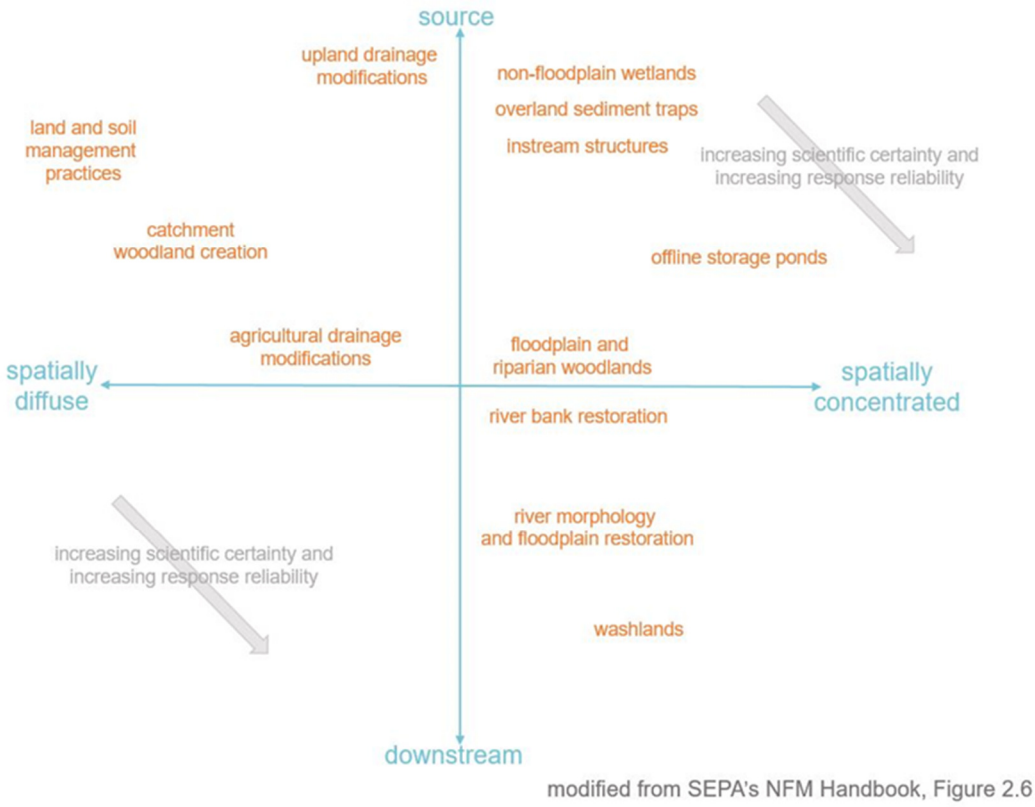
Table 1-1: Examples of types of NFM measures suitable for application across catchments

Type of NFM measure	Examples
Increased vegetation cover	Woodland planting (conifer, native and broadleaf) Gully woodland planting Creation of cross-slope tree shelter belts Riverbank woodland
Working within and on the banks of the channel	Placing of large woody debris and boulders In-channel barriers Bank restoration/erosion protection Managing channel instabilities (e.g. fencing) Reach restoration and floodplain reconnection Removal of obstacles to river flow
Land management	Soil and bare earth improvements Changing agricultural field drainage Blocking of upland drains
Runoff management	Overland flow interception Offline ponds Farm wetlands Sediment traps

NFM measures often offer a number of multiple benefits (such as improvements in water quality or increased access to nature) and can be used in conjunction with traditional engineering approaches to flood risk management where appropriate. The effectiveness of NFM measures is generally dependent on their location within the catchment (Figure 1-1).

2 https://www.sepa.org.uk/media/163560/sepa-natural-flood-management-handbook1.pdf [Chapter 2. Page 14].

Figure 1-1: Spatial distribution of NFM measures within a catchment



modified from SEPA's NFM Handbook, Figure 2.6

The aim of this NFM assessment was to consider the current state of the catchment and identify locations where NFM may be appropriate. Potential opportunities for NFM within the catchment are discussed in further detail in the following chapters.

2 Catchment characteristics

The catchment draining to Insch is relatively small covering an area of approximately 40 km^2 and is traversed by one primary watercourse The Shevock which discharges into the River Urie approximately 4 km downstream of Insch. The burn originates approximately 10 km northwest of Insch in the region of Gartly Moor and flows southeast in a relatively meandering channel toward Insch. A number of minor unnamed field drains and the Valentine Burn discharge into The Shevock. The Valentine Burn originates to the north of Insch, flowing through the village and into The Shevock on the left bank. The unnamed (Mill of Rothney and Newton of Rothney) burn's flow through farmland on the right bank discharging into The Shevock at the eastern and western extents of Insch respectively.

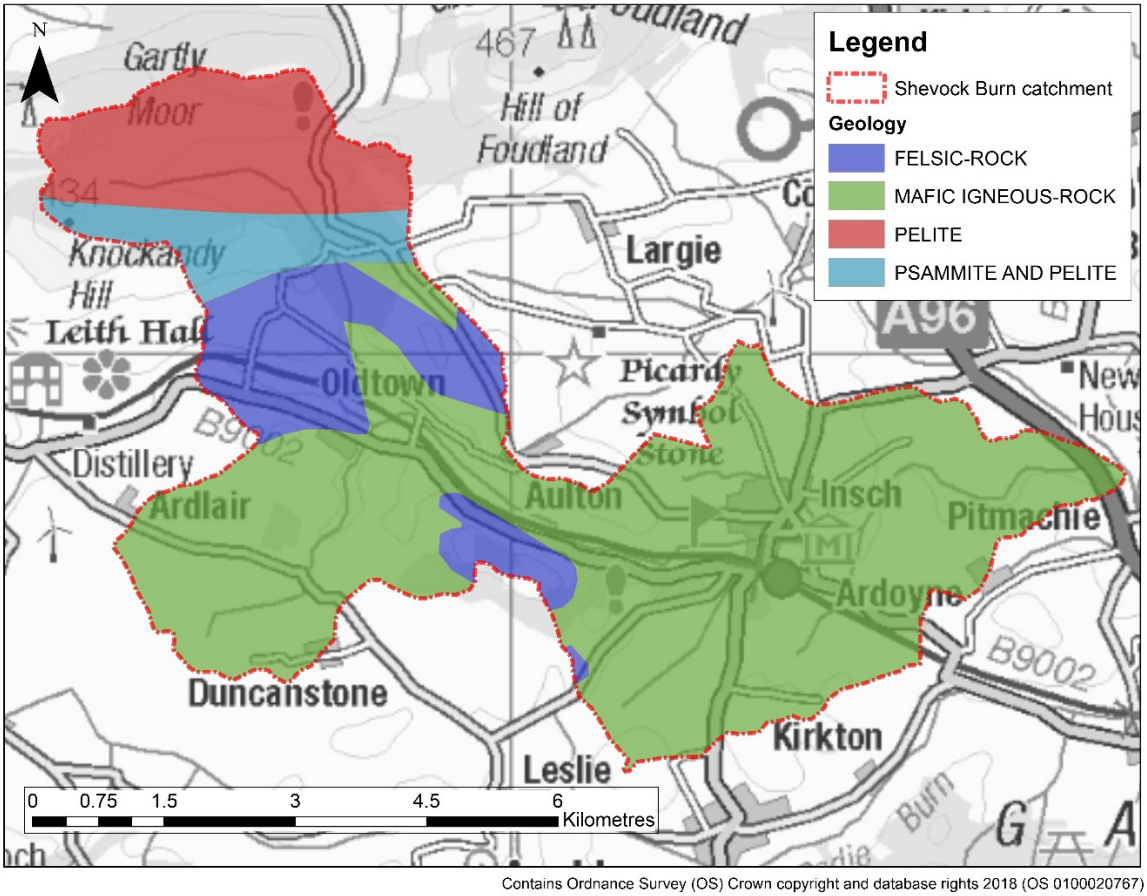
2.1 Catchment geology, soils and topography

According to the British Geological Survey (BGS) 1:625,000 scale geological map of Britain[3], the catchment is underlain by Ordovician to Silurian aged igneous bedrock with a region of metamorphic psammite and pelite in the northernmost extent of the catchment. The catchment is overlain by superficial glacial deposits (Figure 2-1).

The James Hutton Institute's 1:250,000 scale Soils of Scotland map[4], indicates the catchment is dominated by brown earths in the southern region of the catchment, humus-iron podzols in the north and peaty-gleyed podzols in the upland Gartly Moor region (Figure 2-2).

The catchment is therefore dominated by relatively impervious bedrock and mixed permeability superficial deposits. The catchment BFIHOST (baseflow index estimated from soil type) of 0.568 and SPRHOST (Standard percentage runoff estimated from soil type) of 32.4% indicate the catchment as a whole would respond relatively rapidly and show a flashy response to rainfall events.

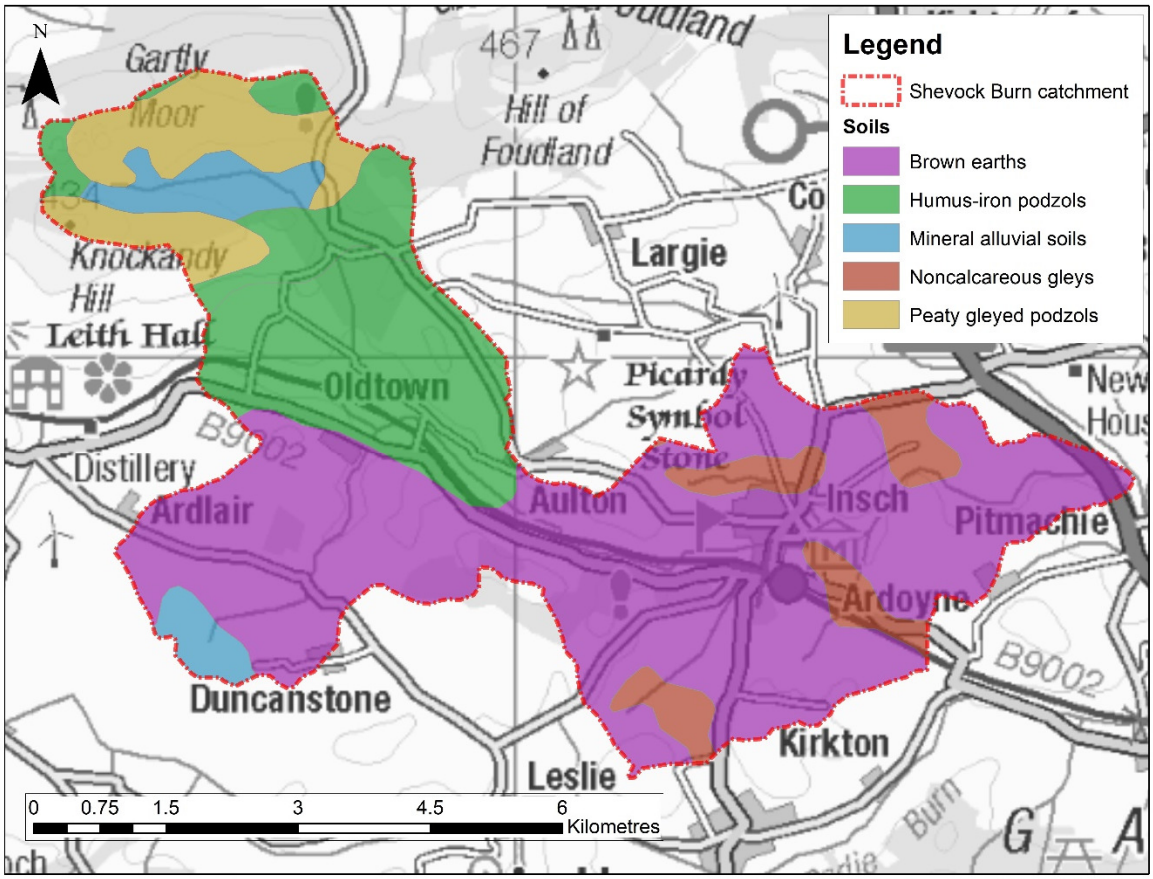
Figure 2-1: Geology



3 British Geological Survey http://mapapps.bgs.ac.uk/geologyofbritain/home.html [Accessed: November 2017]

4 http://www.hutton.ac.uk/learning/natural-resource-datasets/soilshutton/soils-maps-scotland/download#soilmapdata

Figure 2-2: Soils

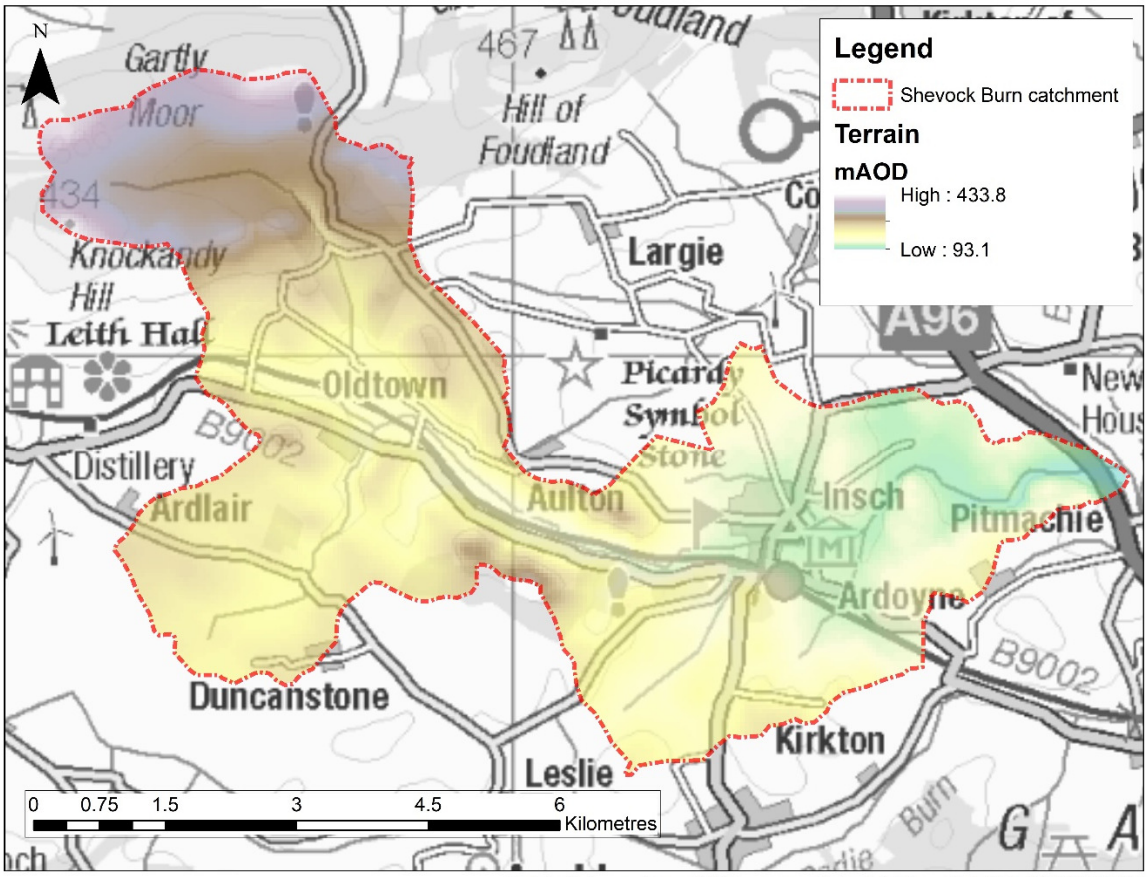


The geomorphology of the catchment reflects the glacial history of the region. During the last Ice Age, the Buchan region was covered by an ice sheet which flowed east toward the North Sea[5] and was then crossed by a number of meltwater channels during de-glaciation. The catchment therefore exhibits a relatively low-lying, gently undulating topography as a result of the glacio-fluvial history, with abundant glacial deposits.

Elevations within the catchment are greatest in the north reaching approximately 420 metres above Ordnance Datum (mAOD) at Gartly Moor and decrease to approximately 110 mAOD downstream of Insch. A Digital Terrain Model (DTM) of the catchment is illustrated in Figure 2-3.

5 Merritt, J. and Leslie, G. 2009. Scottish Natural Heritage. Northeast Scotland. A Landscape Fashioned by Geology. http://www.snh.org.uk/pdfs/publications/geology/northeastscotland.pdf [Accessed: Nov 2017] and Gunn, A., Mendum, J., and Thomas, C. 2015. Geology of the Huntly and Turriff Districts. http://nora.nerc.ac.uk/512185/1/Huntly_JRMedit_15-Mar-2015%20FINAL.pdf [Accessed: November 2017]

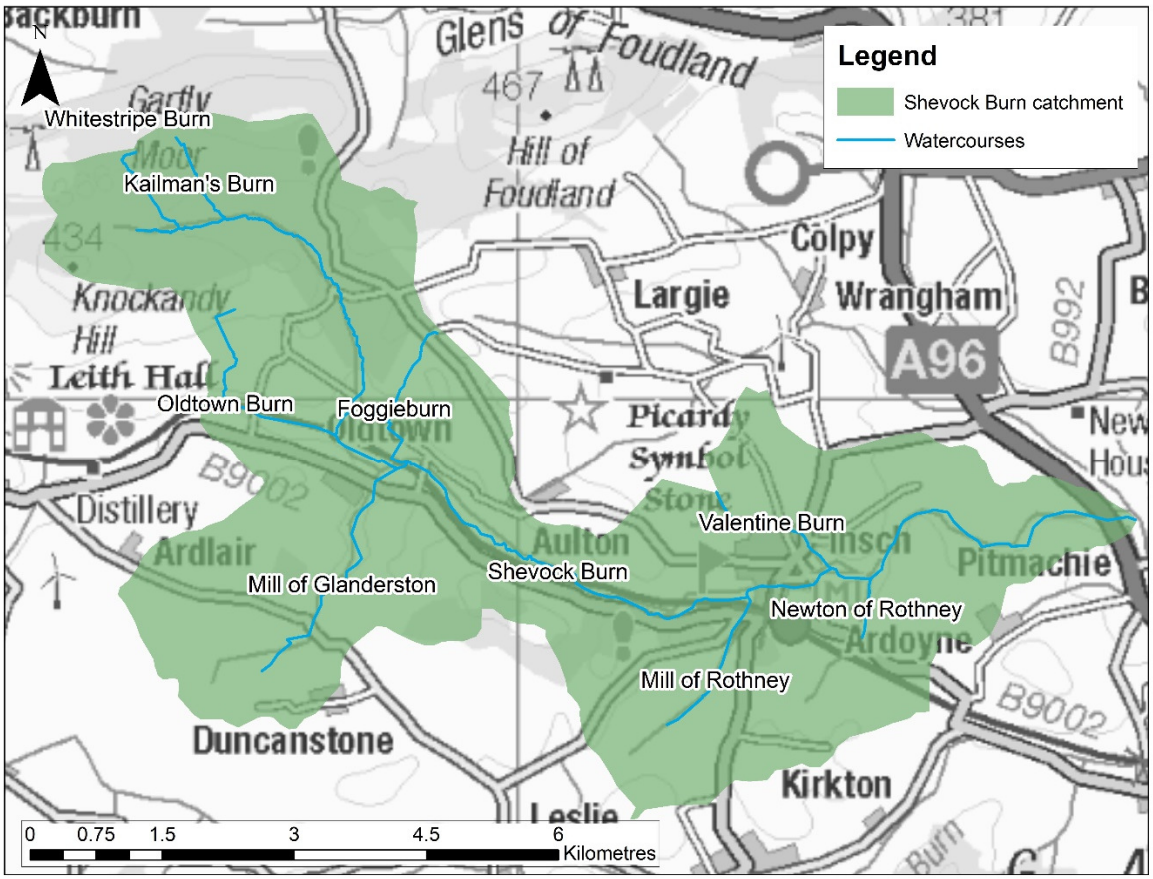
Figure 2-3: Catchment topography



2.2 Catchment hydrology and watercourse characteristics

The Shevock originates atop Gartly Moor from a spring in the northwesternmost extent of the catchment. It flows initially east where two small tributaries: the Whitestripe Burn and Kailman's Burn flow due south from the top of Gartly Moor into The Shevock along the left bank. The Shevock then flows in a southerly direction in a meandering channel towards Oldtown. A field drain discharges into The Shevock from the west (Oldtown Burn) and The Shevock become relatively straightened as it flows parallel to the railway line toward Insch. Approximately 600 m downstream of Oldtown two small field drains discharge into the burn on the left (Foggieburn) and right (Mill of Glanderston) bank. At the western extent of Insch another unnamed (Mill of Rothney) burn discharges into The Shevock along the right bank, and at the eastern extent of the village the Valentine Burn and Unnamed (Newton of Rothney) burn flow into The Shevock on the left and right bank respectively.

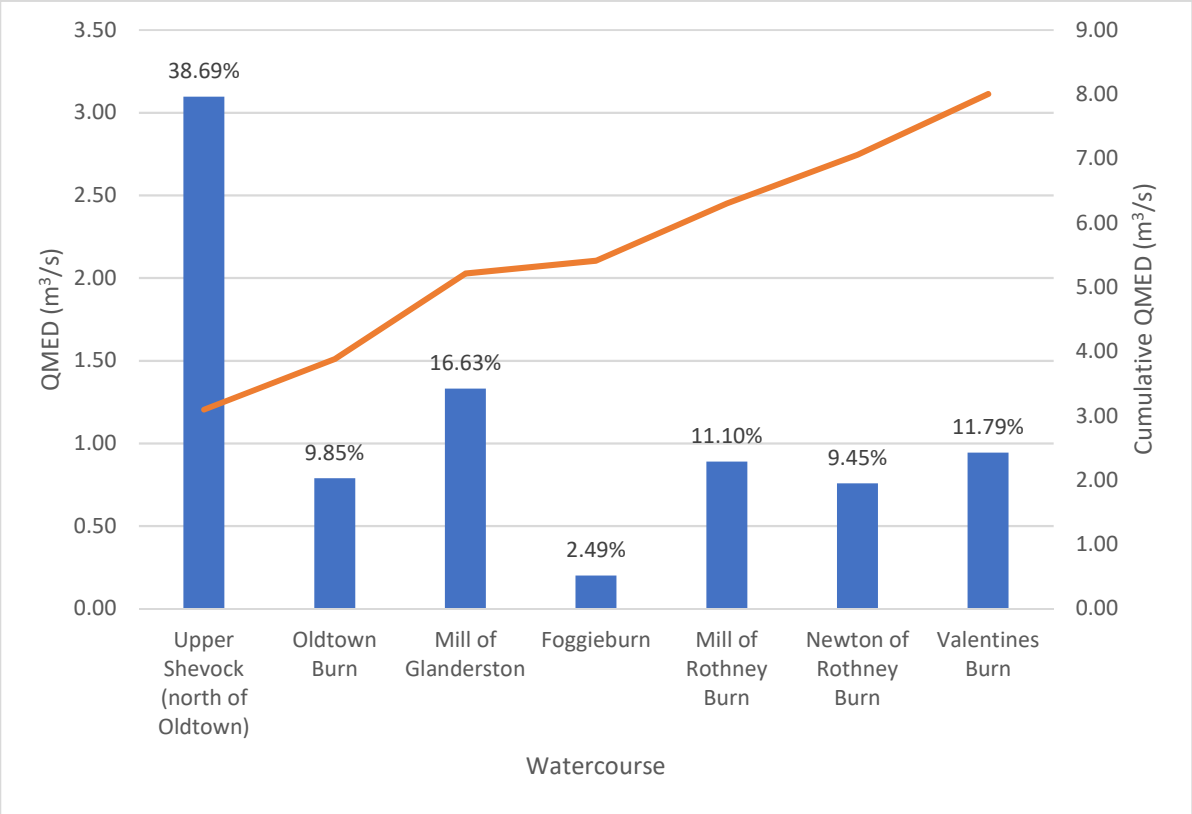
Figure 2-4: Key watercourses



Within the vicinity of Insch and along sections parallel to the railway, The Shevock has undergone realignment and is highly straightened in nature. A review of historical OS mapping[6] indicated The Shevock has had a relatively similar planform to present since the 1880's. Changes to morphology are seen where meanders have naturally migrated, but no major manmade alterations are indicated, and therefore pre-date modern OS mapping. At Insch a proportion of The Shevock was previously diverted into a Mill Lade at Mill of Rothney, as shown in the historical mapping from the 1880s, but is no longer in use. A review of historical military maps dating from the 18th century indicates The Shevock once flowed in an unconstrained, meandering channel. However, as this mapping dates from the 1700's, accurate identification of paleochannels is not possible.

6 National Library of Scotland http://maps.nls.uk/geo/find/# Ordnance Survey (OS) One-inch Scotland, 1892-1960 to present maps. Roy Military Survey of Scotland, 1747-1755, Maps of Scotland (18th century), Highlands.

Figure 2-5: QMED contributions



2.3 Land Management

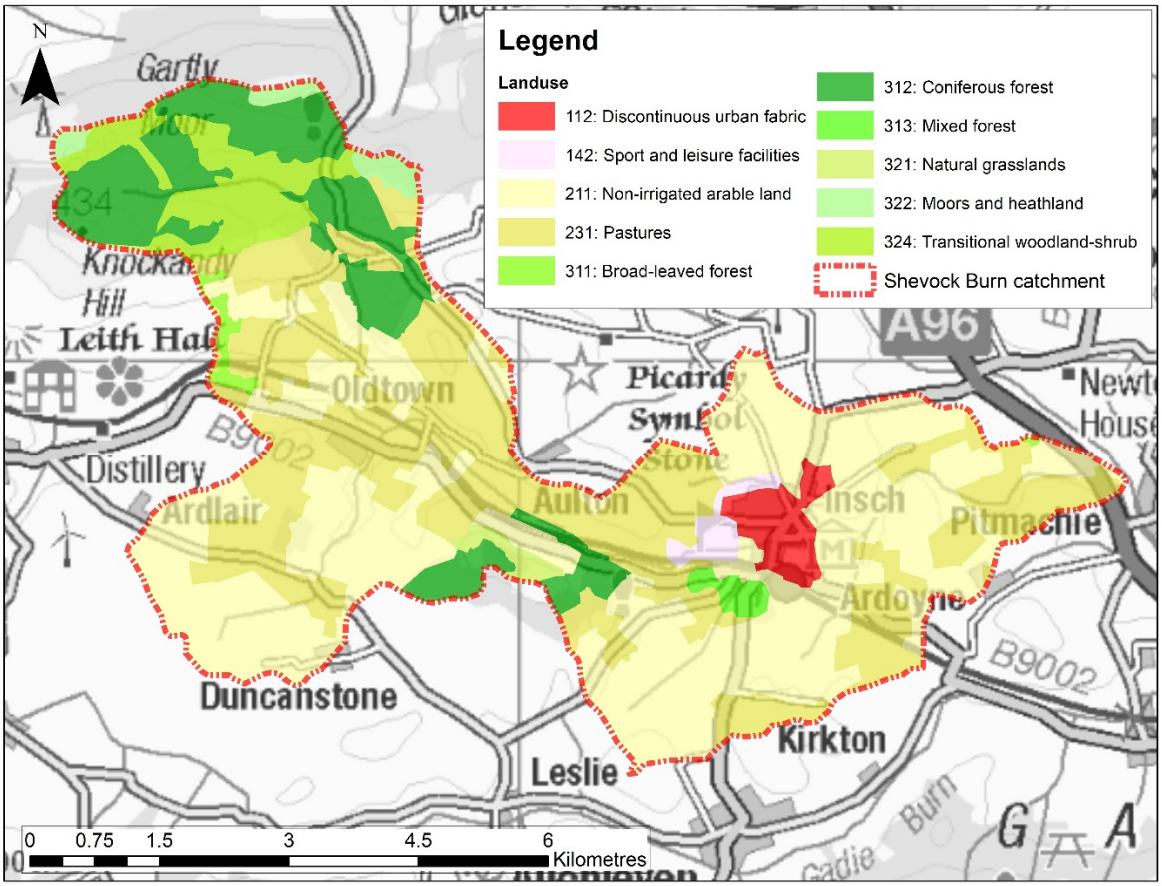
2.3.1 Land Use

Figure 2-6 illustrates the land cover types in the catchment based on the Land Cover Map 2012[7]. Gartly Moor in the northern headwaters is dominated by forestry which has been felled in a number of areas. The southern catchment in contrast is dominated by pasture and arable land with the town of Insch representing the only area of urban land use.

2.3.2 Protected areas

A review of Scottish Natural Heritage[8] and Historic Scotland datasets indicate there are no Sites of Special Scientific Interest (SSSI), Special Protected Areas (SPA) or Special Areas of Conservation (SAC). There are however, two Historic Scotland monuments: Wardhouse Settlement and Hill of Dunnideer, as well as several listed buildings.

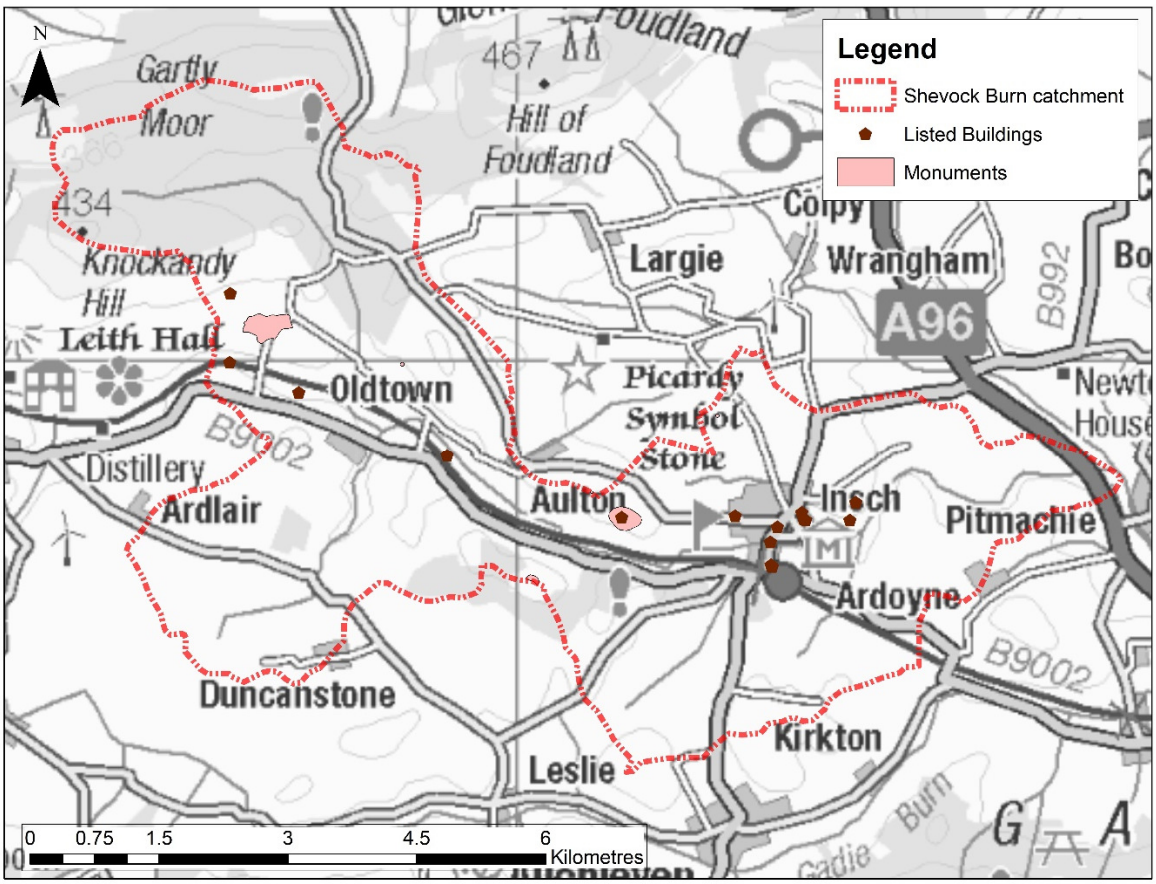
Figure 2-6: Land Use



7 Corine Land Cover European seamless vector database. Release v18_5 (02/2016) http://land.copernicus.eu/pan-european/corine-land-cover

8 Scottish Natural Heritage http://gateway.snh.gov.uk/sitelink/searchmap.jsp [Accessed: November 2017]

Figure 2-7: Historic Scotland sites

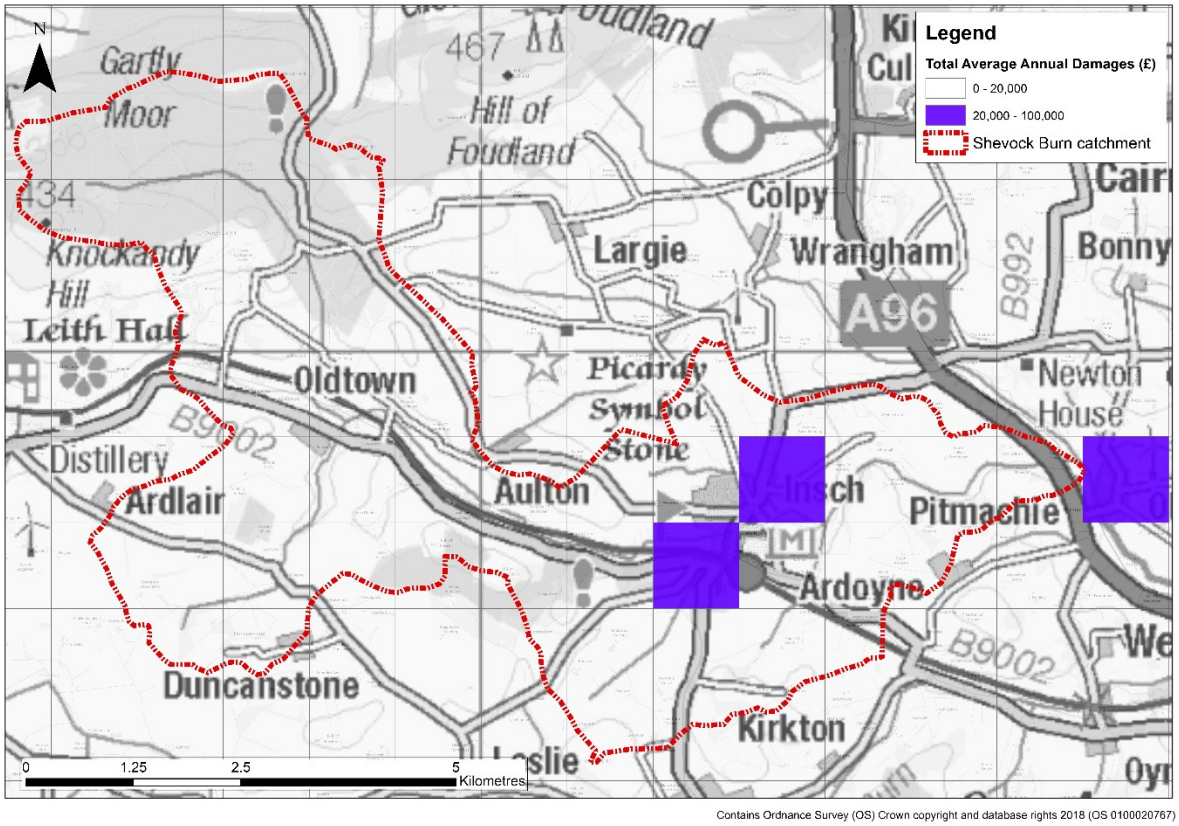


2.4 Flood damages and areas at risk

SEPA supplied their Preliminary Flood Risk Assessment (PFRA) analysis of flood damages. Figure 2-8 shows total average annual damages (AAD) within the Insch catchment indicating key areas affected by fluvial flooding.

The dataset indicates the primary area of damages is at Insch itself where the catchment is urbanised which is to be expected.

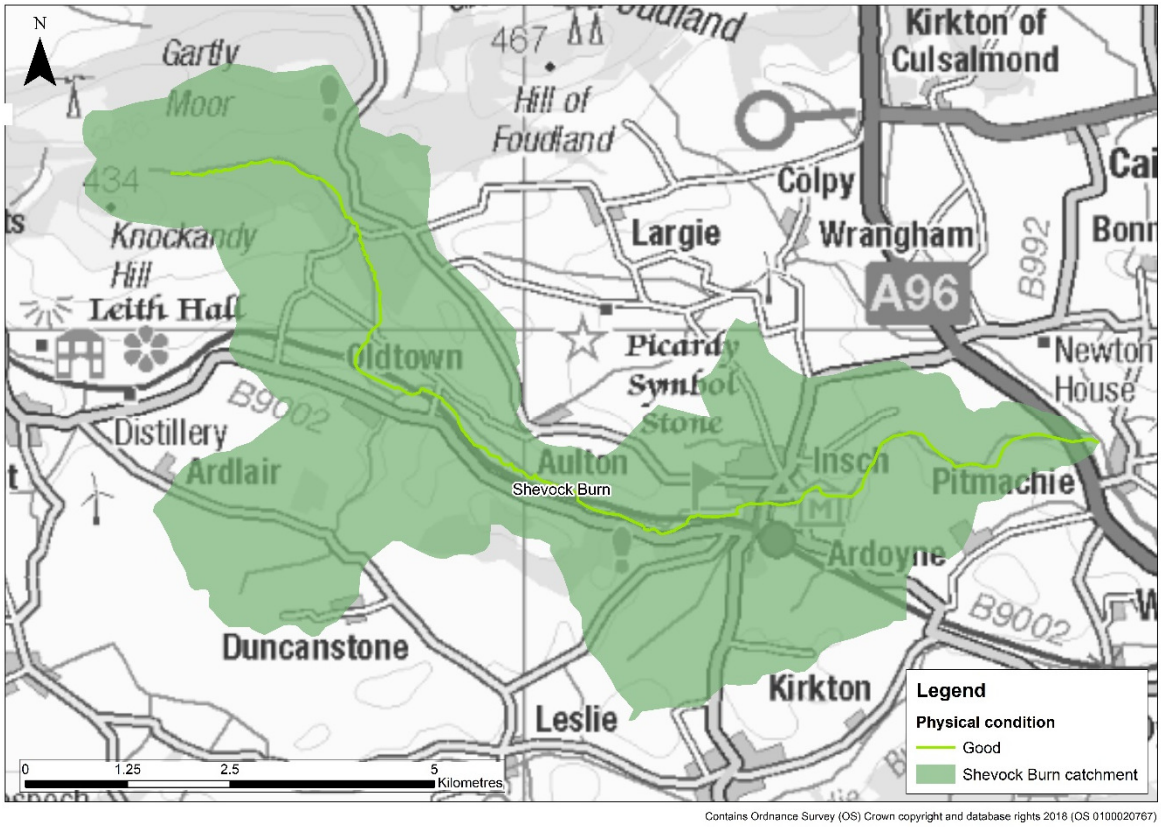
Figure 2-8: Fluvial Average Annual Damages



3 RBMP - review of physical pressures

RBMP data were examined using the Water Environment hub[9] and RBMP datasets supplied by SEPA. Only catchments greater than 10 km^2 are defined in the RBMP therefore The Shevock is the only watercourse to have been classified. It has a 'Poor' overall condition based on the 2016 waterbody classifications (Figure 3-1) but is classified as 'Good' on the basis of its physical condition.

Figure 3-1: Current physical condition of The Shevock



Despite being in good physical condition, the significant morphological pressures along The Shevock were assessed using the SEPA morphological pressures dataset[10]. Significant pressures are defined as:

- Impoundments.
- Set back embankments.
- Embankments with and without reinforcement.
- Green and grey bank reinforcement.
- High and low impact realignment.
- Culverts.

These are shown in the following figures. It should be noted that the SEPA mapping does not necessarily follow the watercourse with straight lines drawn between the start and end of the pressure.

9 SEPA Water Environment Hub https://www.sepa.org.uk/data-visualisation/water-environment-hub/ [Accessed: November 2017]

10 SEPA is currently reviewing and revising the morphological pressures dataset, as such pressures indicated may have since been removed. It was outwith the scope of this contract for JBA to survey physical pressures along the watercourses .

Figure 3-2: Significant morphological pressures along The Shevock at Insch

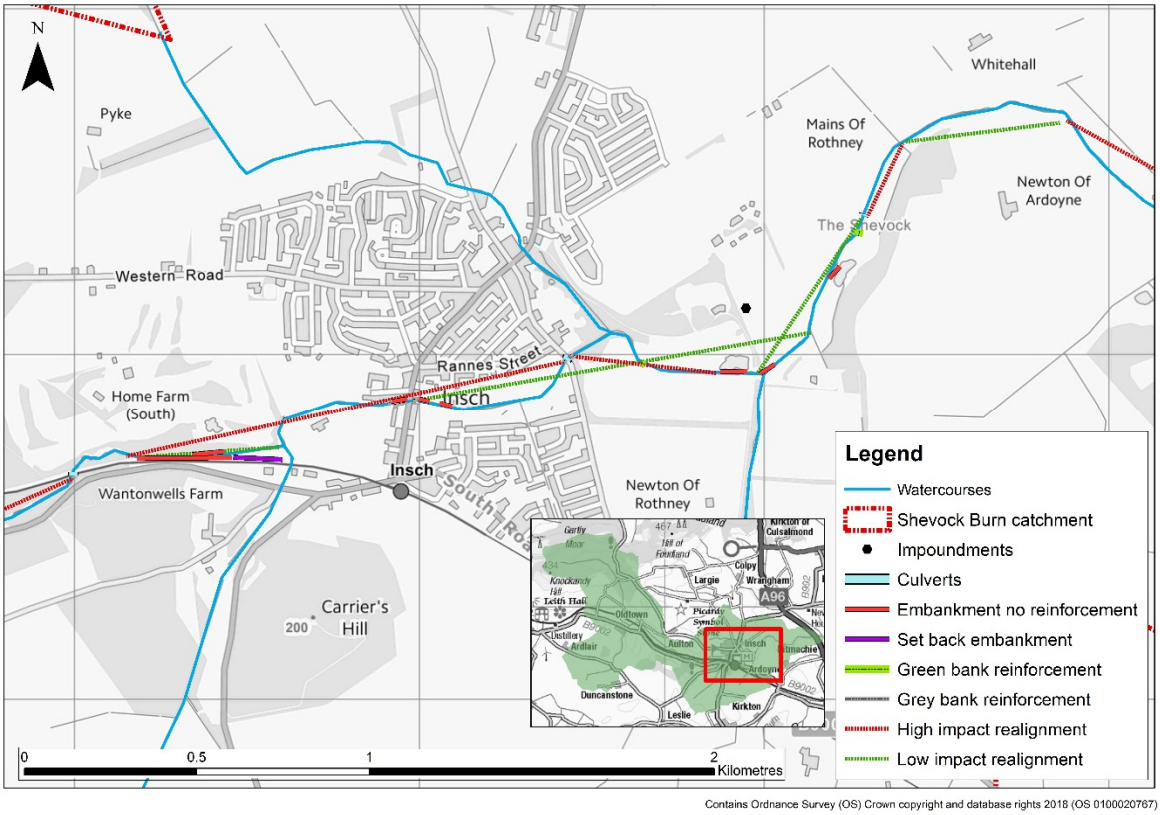
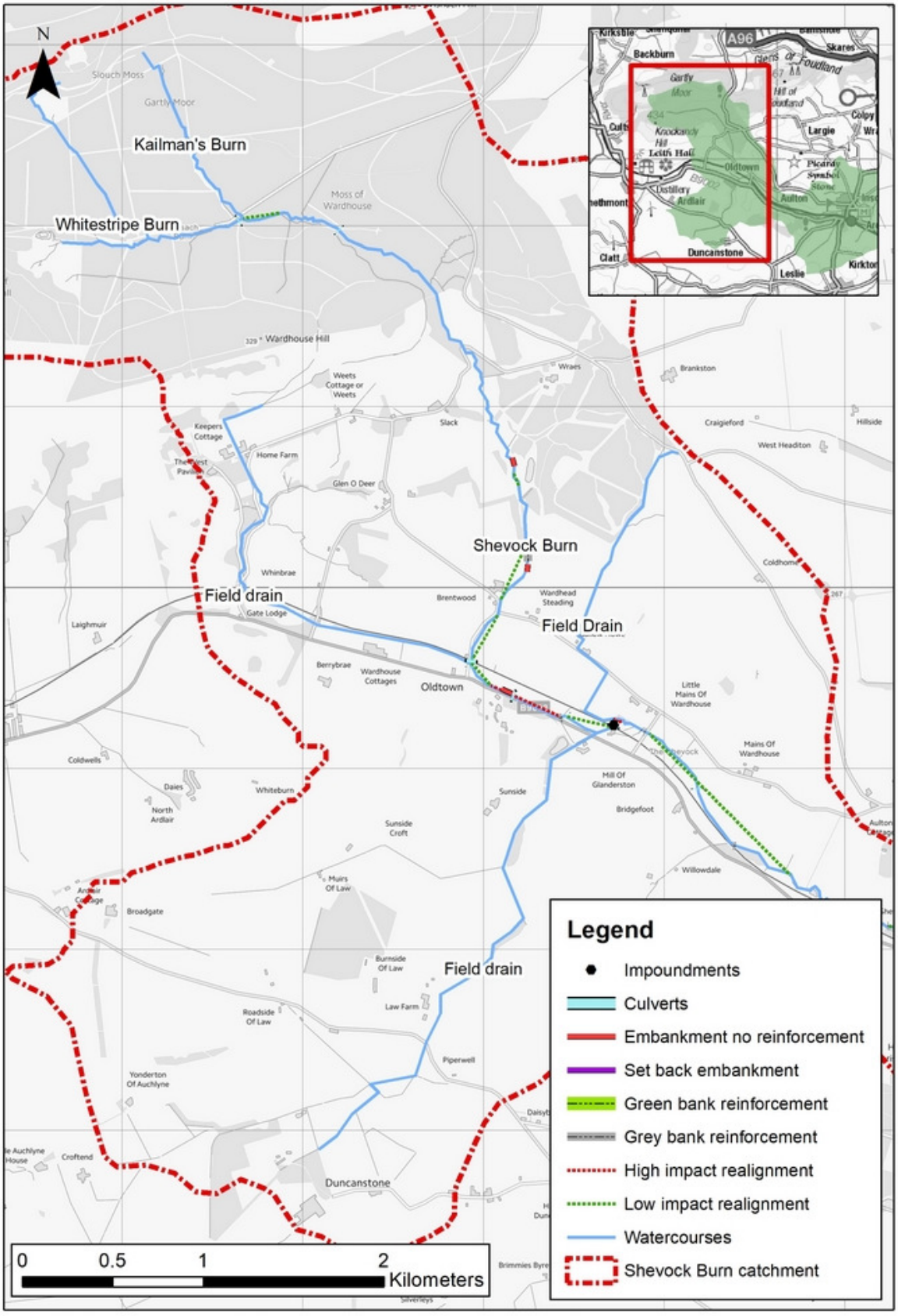


Figure 3-3: Significant morphological pressures along the Shevock Burn in the upper catchment



Contains Ordnance Survey (OS) Crown copyright and database rights (2017)

4 Opportunities for Natural Flood Management

SEPA as part of the FRM Act Section 20 screening process has undertaken a high-level strategic analysis of Scotland to determine the areas in which NFM measures could be most effective[11]. In particular, for The Shevock at Insch this broad-scale analysis has demonstrated where opportunities exist for the following:

- Runoff reduction.
- Floodplain storage.
- Sediment management.

4.1 Runoff Reduction

To identify the areas with the greatest potential for runoff reduction, SEPA has produced a map showing which areas make the greatest contribution to overland flows, based on factors including land cover, soil type, slope and rainfall.

Areas with medium to high potential for runoff reduction within the catchment are illustrated in Figure 4-1. The dataset suggests there are no areas of high potential for runoff reduction, but a number of areas are indicated as having medium potential. Key areas of interest include:

- The headwaters of The Shevock at Gartly Moor.
- The Shevock near Aulton to the west of Insch.
- The Mill of Rothney sub-catchment.

4.2 Floodplain Storage

SEPA has also produced a map to identify areas with potential for floodplain storage, considering factors such as floodplain slope and land cover (in particular, the potential to increase surface roughness). Areas with medium and high potential for floodplain storage within the catchment are illustrated in Figure 4-2. It should be noted that SEPA's floodplain storage mapping was carried out only for areas of the floodplain with an annual probability of flooding at least every 200 years.

The dataset suggests there are limited opportunities for floodplain storage and indicative regions are primarily within the vicinity of Insch. Floodplain storage potential is however indicated along the Mill of Glanderston.

4.3 Sediment Management

SEPA has produced a map identifying areas of erosion, deposition and transport within Scottish rivers, thus identifying where sediment management measures may be appropriate for implementation to decrease flood risk. This was achieved using a model to estimate the amount of sediment entering and leaving a given reach and calculating the overall sediment balance. Sediment in a river is naturally eroded and transported downstream, however activities such as straightening of the channel and land management activities can disturb natural processes and cause excessive erosion or deposition.

A sediment management potential map for the catchment is illustrated in Figure 4-3. The mapping indicates moderate erosion is occurring in the upper headwaters of The Shevock before the reach becomes balanced as it flows south toward Oldtown. The Shevock between Oldtown and Insch is in contrast generally moderately eroding.

11 Nutt, N. 2012. Flood Risk Management (Scotland) Act 2009. Methods to screen and quantify natural flood management effects. Report commissioned by SEPA and Forestry Commission Scotland, May 2012.

Figure 4-1: Areas with medium potential for runoff reduction

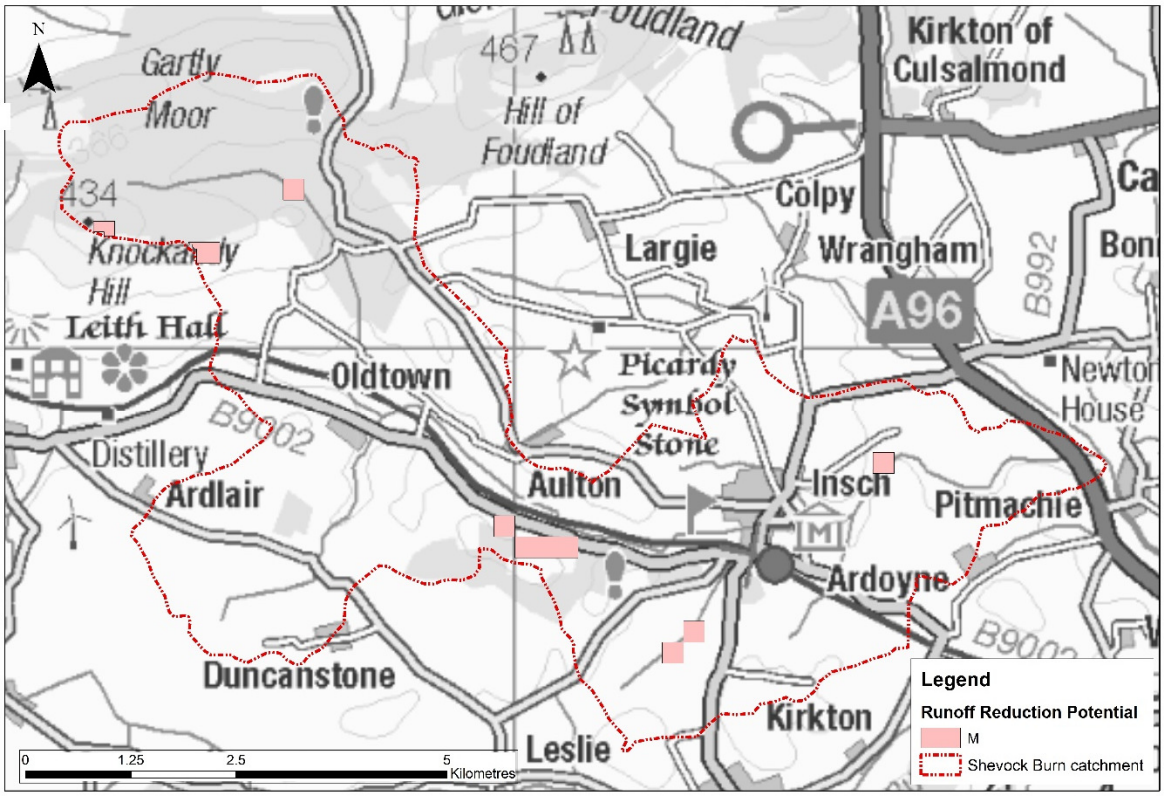


Figure 4-2: Areas with medium to high potential for floodplain storage

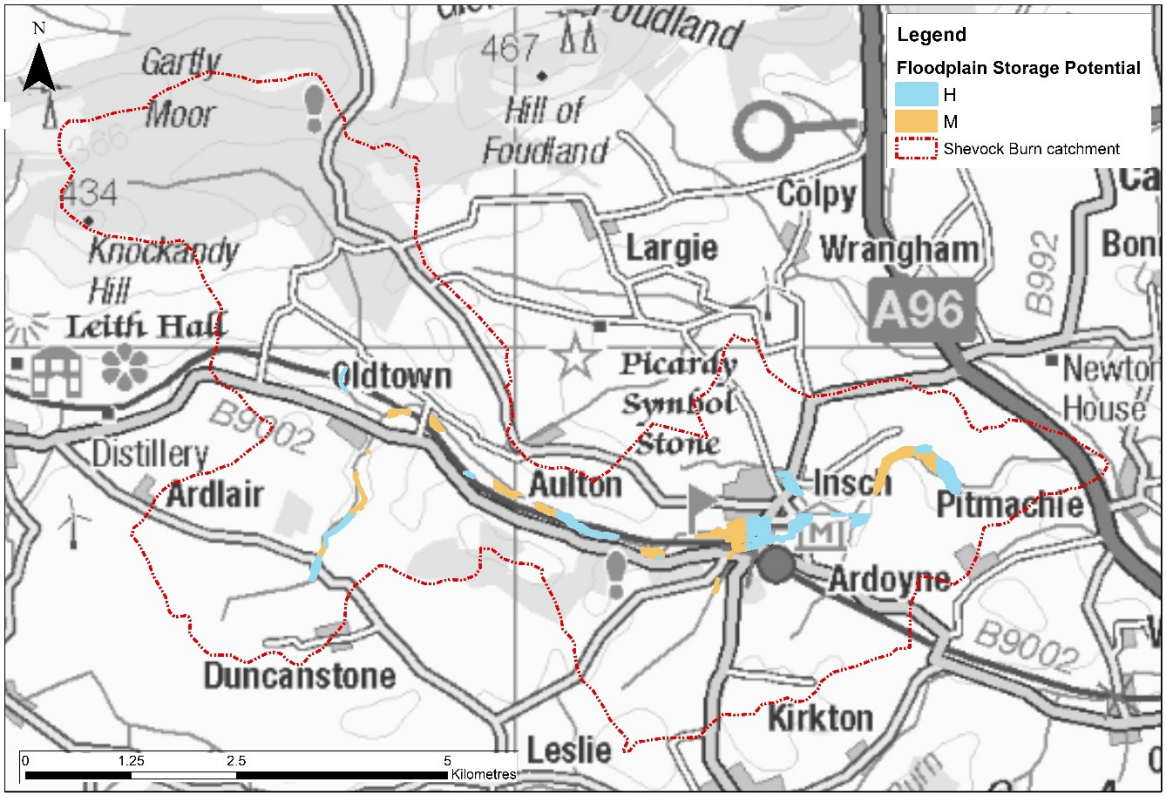
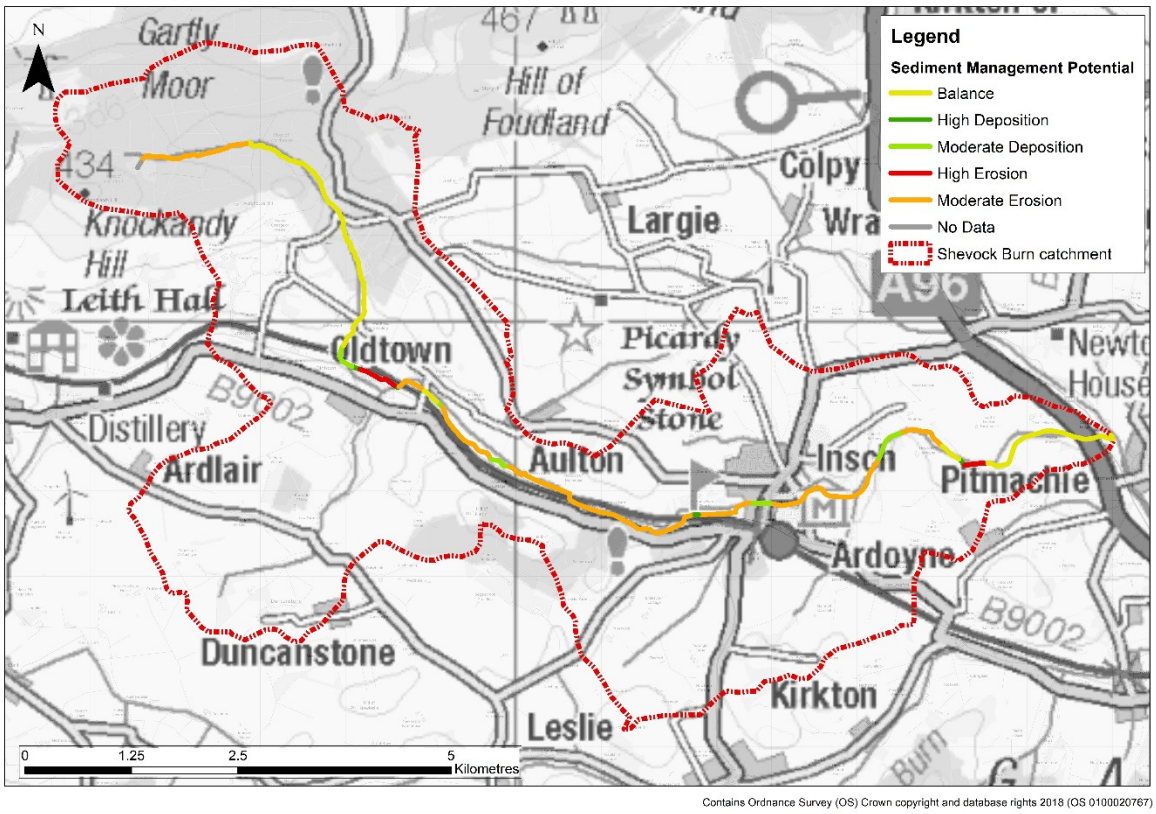


Figure 4-3: Potential for sediment management



4.4 Long list of options

Based on the SEPA mapping datasets and additional information in the preceding chapters, a long list of NFM options within key sub-catchments of The Shevock are provided below. One to three ticks are used to indicate from a desk-based review the likelihood of being able to implement that NFM measure.

Table 4-1: Long list of NFM options

Category	Type of NFM measure	Headwaters of The Shevock	The Shevock between Oldtown and Insch	Valentine Burn	Mill of Rothney and Newton of Rothney Burns
Increased vegetation cover	Woodland planting (conifer, native and broadleaf)	✓✓✓	✓✓✓	✓✓	✓✓
	Gully woodland planting	✓✓			
	Creation of cross-slope tree shelter belts	✓✓	✓	✓	✓✓
	Riverbank woodland	✓✓✓	✓✓✓	✓✓	✓✓
Working within and on the banks of the channel	Placing of large woody debris and boulders	✓	✓		
	In-channel barriers	✓✓	✓✓	✓	✓
	Bank restoration/erosion protection	✓✓	✓	✓	
	Managing channel instabilities (e.g. fencing)	✓	✓	✓	✓
	Reach restoration and floodplain reconnection	✓✓	✓✓✓	✓✓	✓✓
	Removal of obstacles to river flow			✓	
Land management	Soil and bare earth improvements	✓✓✓		✓	✓
	Changing agricultural field drainage	✓✓	✓✓✓	✓✓✓	✓✓
	Blocking of upland drains	✓✓✓			
Runoff management	Overland flow interception	✓✓	✓✓	✓✓	✓✓
	Offline ponds	✓✓	✓✓	✓	✓✓
	Farm wetlands		✓		
	Sediment traps				

5 Screening process

The information highlighted in the preceding chapters is summarised in Table 5-1. This has been used to inform where to focus site visits within The Shevock catchment (highlighted in bold in Table 5-1).

Table 5-1: Summary of desk based NFM and RBMP findings

Sub-catchment	Key flood risk sub-catchment	Watercourses have a high number of significant morphological pressures	Potential for runoff reduction	Potential for floodplain storage	Immediate area incurs major damages	High proportional contribution to The Shevock flow
Upper Shevock (north of Oldtown)	No	No	**Yes**	No	No	**Yes**
Shevock Burn between Oldtown and Insch	No	**Yes**	**Yes**	**Yes**	No	-
Shevock Burn at Insch	**Yes**	**Yes**	No	**Yes**	**Yes**	-
Valentine Burn	**Yes**	No	No	**Yes**	**Yes**	**Yes**
Mill of Rothney	**Yes**	No	**Yes**	**Yes**	**Yes**	No
Newton of Rothney	**Yes**	No	No	No	No	No

The priority based on the above table is for areas of greatest influence on the flood risk community, where there are multiple NFM opportunities and existing RBMP constraints. Sites have been selected on the basis that there were multiple opportunities to both assess improving the physical condition of the watercourses and implement NFM measures. The Shevock is a tributary of the River Urie which presents a flood risk to the Inverurie community and is being appraised in an independent report as part of the Ellon, Inverurie and Port Elphinstone Flood Studies[12]. NFM options within The Shevock catchment therefore have dual benefits to both the Insch community and downstream communities of Inverurie and Port Elphinstone through limiting sub-catchment discharge to the River Urie.

The following areas were selected for further investigation:

- The Shevock between Oldtown and Insch to assess NFM and RBMP opportunities upstream of Insch, in particular floodplain storage and runoff reduction opportunities.
- The Valentine Burn sub-catchment to assess floodplain storage, runoff reduction and channel morphological improvement opportunities.
- The Mill of Rothney sub-catchment to assess NFM opportunities.

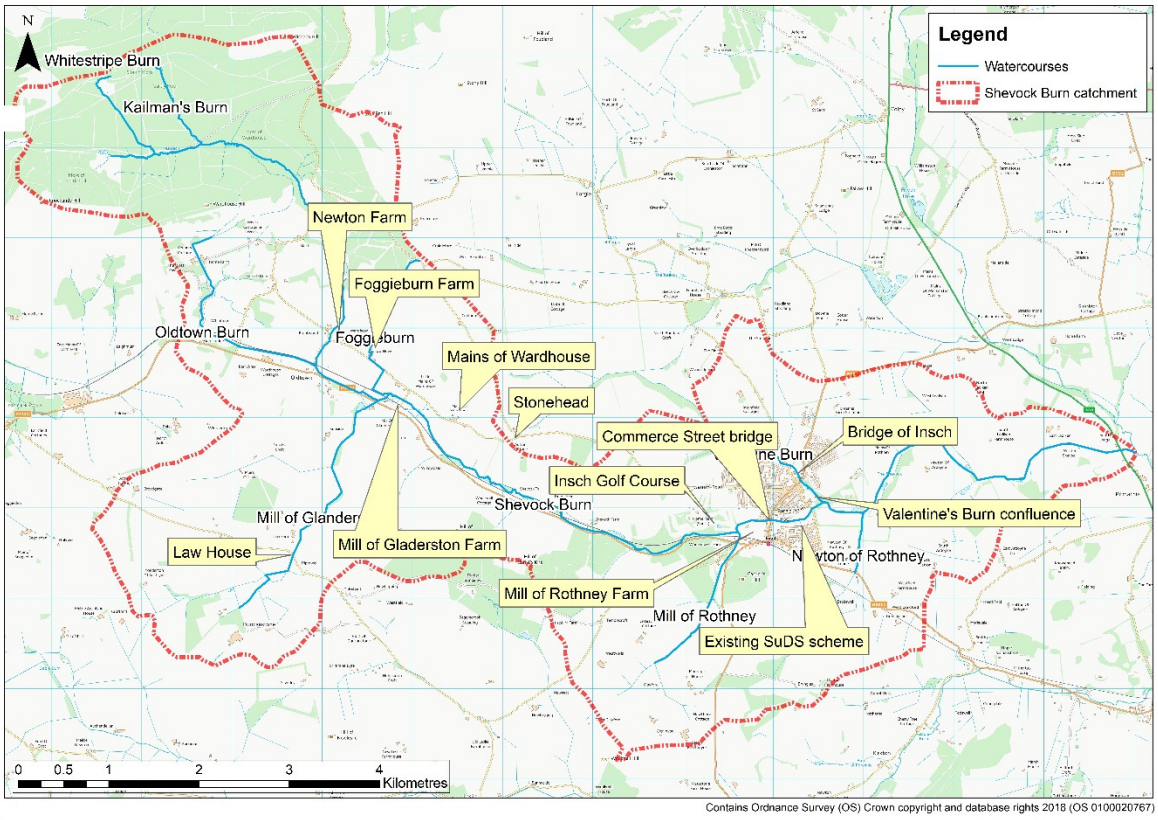
12 JBA Consulting. Inverurie and Port Elphinstone Natural Flood Management and River Basin Management Plan Report. Draft Report. July 2018.

6 The Shevock

6.1 Catchment summary

The Shevock has a catchment area of approximately 40 km^2 and originates west of Insch on Gartly Moor at an elevation of 330 mAOD, meandering east to its confluence with the River Urie where elevation drops to 96 mAOD. The watercourse has a number of minor tributaries from source to confluence namely the Valentine Burn, Mill of Rothney Burn and Newton of Rothney Burn which flow through or at the margins of Insch. The SEPA physical pressures dataset indicates there are limited pressures on The Shevock, the key ones being low and high impact realignment. Land use is predominantly agricultural, with areas of forestry at higher elevations and in the northern catchment at The Shevock source.

Figure 6-1: The Shevock catchment key locations



6.2 NFM and RBMP Site Visit Findings

The site visit took place 19 and 20 April 2018 and weather conditions of the days of the walkover were bright and dry with sunny intervals. Access to many areas of The Shevock catchment were restricted due to the railway line which runs directly through the centre of the catchment. Key locations where access was possible were covered on foot, while additional locations were photographed from an appropriate viewpoint. A map showing the location of photos taken in The Shevock catchment is included in Appendix B.1 and B.2.

6.2.1 The Shevock within the Scheme Extent

The predominant land uses within the scheme extent are urban and agricultural. At the western margin of Insch, The Shevock flows through Insch Golf Course within an area of woodland where it is indicated to have undergone high impact realignment and be constrained by embankments. The burn was found to flow in a relatively straightened channel but was eroding into the banks thus acting to restore sinuosity. The right bank embankment is the railway line and therefore cannot be removed. The left embankment could be removed and sinuosity restored through the area of woodland without impacting the Golf Course; runoff from the course and fluvial out-of-bank flow would be slowed and stored in the wide rough riparian buffer strip. Restoring sinuosity would have

RBMP benefits by releasing channel capacity, as well as NFM benefits as increased channel length slows flow toward Insch.

The channel itself contained many river weeds, wooden debris was evident along the right bank and woody barriers have formed within the channel due to branches having fallen into and across the burn (Figure 6-2, A). Channel maintenance to remove the man-made debris is recommended and the natural process of woody debris dam formation is encouraged as it leads to out-of-bank flow into the floodplain where storage and infiltration within the forest (and upstream of the Insch community) can occur. Medium floodplain storage potential is indicated in the SEPA mapping through the Golf Course. The woodland and area of vegetation between the Golf Course and river (Figure 6-2, B) is presently acting as floodplain storage, buffering runoff from the low roughness areas of the course where the grassland is cut and maintained. Continued and further planting along the bank to increase the infiltration and storage capacity of the floodplain, as well as potential meandering of the watercourse through the left bank woodland are additional recommended NFM measures.

Downstream of the Insch Golf Course The Shevock is straightened to a greater extent and the banks become more urbanised. At Mill of Rothney Farm both banks are grazed, agricultural pasture with no buffer strip on the right bank and minimal buffer strip on the left bank which is also eroding and grazed to the bank edge (Figure 6-2, C). Increasing the area of buffer strip along both banks to reduce runoff, increase infiltration and stabilise the bank, as well as limiting livestock grazing to the bank edge by setting-back the fence is recommended. Potential for meandering is unlikely due to the river being very incised at this point.

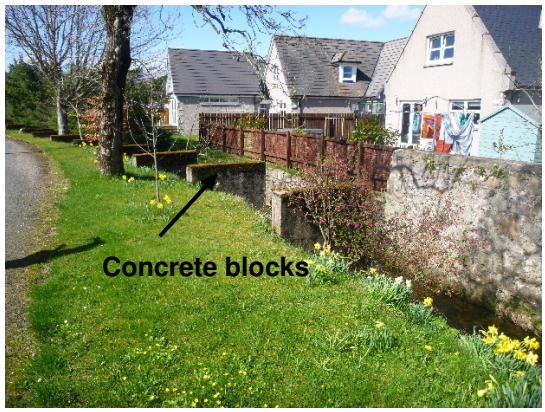
Adjacent to Mill Road the left bank is constrained by a high brick wall alongside the Mill House and several concrete structures (Figure 6-2, D) are embedded in the right bank. These may have been part of the original Mill Lade aqueduct or formed part of a delivery or transport system to or from the Mill but appear to have no purpose presently. It is suggested these could be removed to improve watercourse condition, however further discussion with the historic environment office would be necessary before this can take place. The Shevock is highly constrained through this reach with a high proportion of the channel being concrete/ brick lined remnant from the working mill (Figure 6-2, E). Downstream of Commerce Street bridge the grey bank reinforcement indicated in the SEPA morphological pressures dataset was evident along the left bank in the form of a small, low wall adjacent to a depot. The wall is in poor condition crumbling into the reedy channel with supporting sandbags placed in the crumbled section (Figure 6-2, F). Improvement to the condition of the banks is recommended to ensure continued 'Good' RBMP status of The Shevock in terms of water quality and physical condition.

Figure 6-2: The Shevock within the scheme extent

A: Insch Golf Course. Woodland between the Golf Course and watercourse to buffer runoff. Woody debris is naturally accumulating in the channel to encourage out-of-bank flow and greater floodplain connectivity and storage. (OS NGR NJ 62133 27714)

B: Large vegetated area between the Golf Course and The Shevock which buffers high runoff from the maintained cut grass regions of the course. Right embankment is the railway which cannot be removed but meandering and further planting on the left floodplain is recommended. (OS NGR NJ 62212 27710)

C: Downstream of Insch Golf Course. Grazed banks with minimal buffer strip and high erosion on left bank. (OS NGR NJ 62742 27815)



D: Wall lining the left bank and concrete blocks embedded into the right bank. It is suggested these could be removed. (OS NGR NJ 62884 27853)

E: Straightened channel with grey bank pressures along the left bank remnants from the working Mill. (OS NGR NJ 62884 27853)

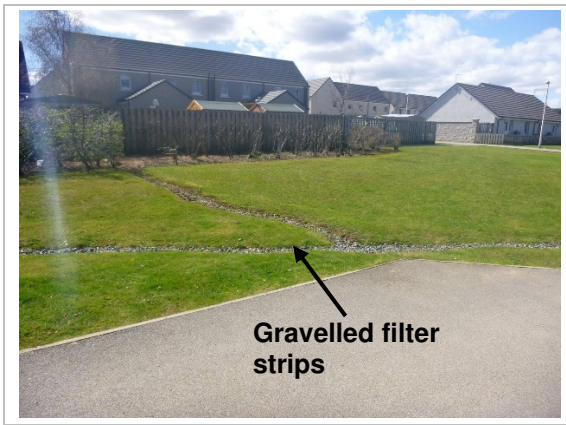
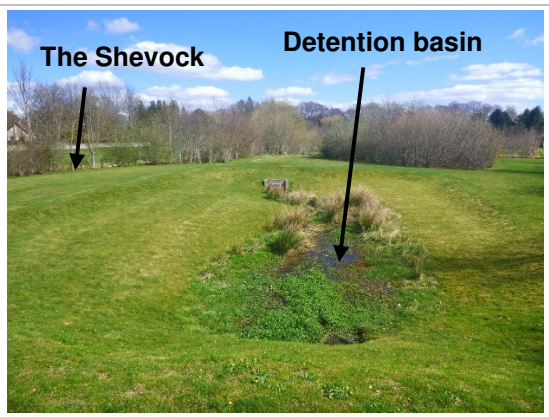
F: Downstream of Commercial Bridge. River weed in the channel, crumbling wall with sand bags along the left bank and overgrown right bank. Repairs and channel improvements in line with the RBMP objectives recommended. (OS NGR NJ 62980 27861)

Further downstream north of Old Mart Avenue (OS NGR NJ 63244 27848) a SuDS scheme has been developed on the right bank (Figure 6-3, A; B) which includes a detention basin and gravel trenches limiting runoff from the urbanised area. Downstream The Shevock continues in a highly straightened, eroding channel containing river weeds. The channel has undergone high impact realignment and the NFM dataset indicates the channel is undergoing moderate erosion. This was observed during the walkover as the watercourse tries to restore a sinuous morphology. The left bank contains a large playing field and there were a number of freshly felled tree stumps along the left bank (Figure 6-3, C). Restoring a sinuous morphology through this reach by meandering into the playing field is suggested and it is recommended this be undertaken before further incision of the channel occurs. Additionally, it is recommended re-planting vegetation or riparian trees along the left bank to buffer direct runoff from the playing field. The left bank is also indicated as having high floodplain storage potential and could be used as a storage area during periods of high flow. For example, by installing a leaky bund system whereby at times of high flow the bund is overtopped and out-of-bank discharge from The Shevock is stored temporarily within the playing field and slowly released via ground infiltration and back into The Shevock via the leaky bund, with the playing field available for recreational purposes at lower flows.

By the Bridge of Insch on High Street (OS NGR NJ 63425 27991) morphological pressures on The Shevock include a small wall on the right bank, concrete wall on the left bank (Figure 6-3, D) and gabion filled baskets, there is however substantial riparian planting on both banks. Near the Valentine Burn confluence The Shevock flows through woodland in a wide channel with eroding banks (Figure 6-3, E) and woody debris is naturally collecting within the river channel (Figure 6-3,

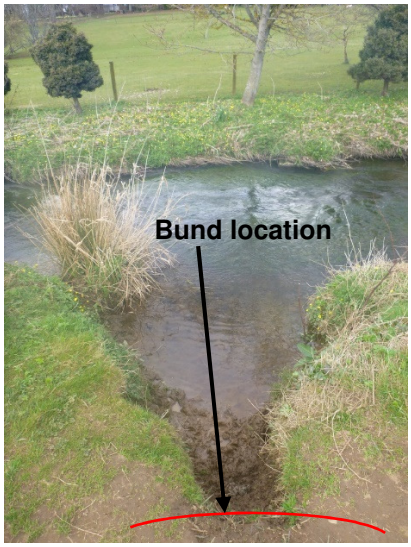
F). Large woody debris dams could be constructed through the woodland to encourage online ponding and out-of-bank flow into the wooded floodplain. However, this would require careful consideration of location and design of dams so as not to cause water to back-up upstream towards Insch or the Valentines Burn and the effect this may have on the public footpaths. At the time of visiting the wooded floodplain contained a high degree of bare earth. Vegetation planting adjacent to the footpaths and through the woodland is recommended to increase floodplain roughness and limit sediment input along both The Shevock and downstream extent of the Valentine Burn floodplain. As the Shevock flows out of the woodland, it flows parallel to a number of fields where there is clear evidence of runoff and sediment input from the right bank (Figure 6-3, G) and the left bank is also considerably eroding with grazing to the bank edge. Leaky bunds at the field corner, riparian vegetation planting to buffer runoff from the grazed land and fencing to limit poaching of and stabilise the eroding banks is recommended. A large man-made pond is located along the left bank (Figure 6-3, H) which is unconnected to the watercourse itself but likely buffers and holds runoff.

Figure 6-3: The Shevock urban scheme extent

<table>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>A: SuDS scheme north of Old Mart Avenue on the right bank of The Shevock. Gravelled drainage trenches to encourage infiltration and slow conveyance towards the burn. (OS NGR NJ 63173 27823)</td><td>B: Detention basin on the right bank of The Shevock which can store runoff from the Old Mart Avenue housing scheme or overflow from The Shevock. (OS NGR NJ 63251 27829)</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>C: Left bank playing field which could be made into a high flow storage area and/ or meandered into. Riparian woodland or vegetation planting recommended to limit runoff from the field and stabilise the eroding bank. (OS NGR NJ 63262 27862)</td><td>D: Small left bank training wall present on left bank (not seen in photo) and large concrete wall along the right bank downstream of the Bridge of Insch. (OS NGR NJ 63426 27991)</td></tr>
</table>

E: Confluence with Valentine Burn. The Shevock flows in a wide, eroding channel through woodland but with limited additional floodplain vegetation cover. (OS NGR NJ 63539 28060)

F: Trees within the watercourse downstream of Insch woodland as well as additional debris from the adjacent overland runoff. (OS NGR NJ 63638 27978)



G: Runoff channel from right bank field which could be reduced by the creation of a leaky bund at the edge of the field as well as vegetation planting to stabilise the eroding bank. Fencing on the left bank upstream of this photo is also recommended to limit poaching of the banks which is causing similar erosion. (OS NGR NJ 63728 27945)

H: Man-made pond on left bank. Unconnected to The Shevock but likely buffering and storing runoff. (OS NGR NJ 63896 27938)

6.2.2 Middle Catchment

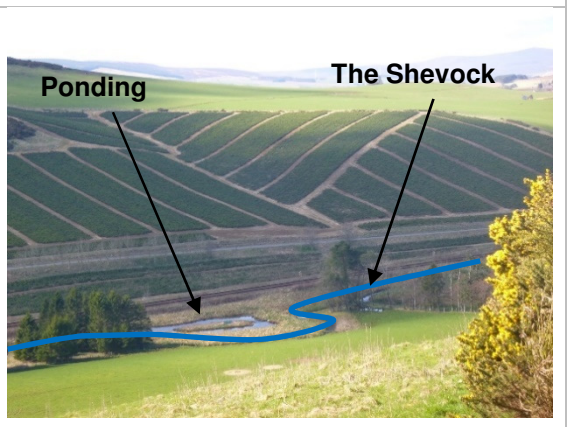
The middle catchment is defined as the area from Insch Golf Course west of Insch to OS NGR NJ 59349 28507 below the Mains of Wardhouse (Figure 6-1). Access to this reach of The Shevock and catchment is very limited due to the active railway line but could be viewed at the Mill of Dunnideer, Mains of Wardhouse and the minor road to the north of the railway.

Upstream of Insch The Shevock catchment consists of rolling hills covered in agricultural land and occasional areas of forestry. The Shevock has undergone a combination of high and low impact realignment through the middle part of the catchment meandering in areas but straightened in others. At the level crossing at OS NGR NJ 60969 27725 The Shevock has undergone high impact realignment and floodplain storage potential is indicated in the SEPA NFM dataset. There is a wide active floodplain on either side of the watercourse which is suitable for re-meandering as well as further floodplain planting (Figure 6-4, A). Additionally, there is potential to create online storage ponds. Increasing sinuosity will slow flows towards Insch and floodplain planting and storage ponds

increase up-catchment storage thereby reducing and delaying flows towards Insch as well as having RBMP benefits through restoring the straightened channel.

The sloped land on either side of The Shevock and railway are already well forested (Figure 6-4, B) in areas but there are opportunities for further upslope along contour woodland planting particularly south of the B9002; at and to the west of where the SEPA NFM runoff reduction potential is indicated. Good forestry land management practices should be considered alongside planting. For example, ideally plant along contour and avoid downslope firebreaks and straightened drainage channels where runoff will be directed rapidly downslope (Figure 6-4, D), block straightened forestry drainage ditches to slow rapid conveyance and consider buffer strips at the base of existing hillslope forestry (Figure 6-4, D). Upstream of the level crossing a small pond is located in the right bank floodplain, a similar right bank storage pond is located south of Stonehead Farm (OS NGR NJ 60211 28798) and The Shevock itself is meandered with no physical pressures (Figure 6-4, D). The site visit was unable to determine if the storage ponds were connected to The Shevock but similar offline floodplain storage ponds could be implemented and are recommended along this middle reach. Good land management practices in this region would also benefit flood risk, for example avoiding straightened field drains that direct runoff straight into The Shevock and hedgerow/ leaky bund features at field boundaries to limit downslope runoff. By the Mains of Wardhouse, NJ 59379 28967, a large area of ponded water was present downslope of the ploughed land in a depression (Figure 6-4, C) which is acting as a runoff store. Similar floodplain storage ponds could be replicated elsewhere along the upstream Shevock to increase upper catchment floodplain storage.

Figure 6-4: The Shevock middle catchment

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>A: Rough, open floodplain whose potential could be maximised through re-meandering, increased floodplain woodland planting, wetland creation, online and/ or offline storage ponds. (OS NGR NJ 60977 27750)</td><td>B: Cross-slope forestry on the right bank of The Shevock, similar could be replicated further to the west. (OS NGR NJ 60968 27674)</td></tr>
<tr><td>  </td><td> 
</td></tr>
<tr><td>C: Ponding by Mains of Wardhouse up-slope of The Shevock which is storing surface runoff from the left bank catchment. (OS NGR NJ 59365 28927)</td><td>D: Meandering Shevock with pond on right floodplain. Forested southern catchment slopes. Future planting should consider the effect of downslope firebreaks and drainage channels on runoff towards The Shevock. (OS NGR NJ 60021 28522)</td></tr>
</table>

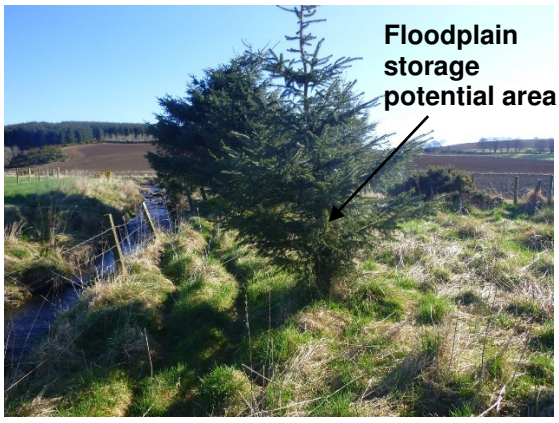
6.2.3 Upper catchment and minor tributaries

The upper catchment is defined as the area upstream of Glanderston and includes three minor tributaries: Oldtown Burn, Mill of Glanderston Burn and Foggieburn (Figure 6-1).

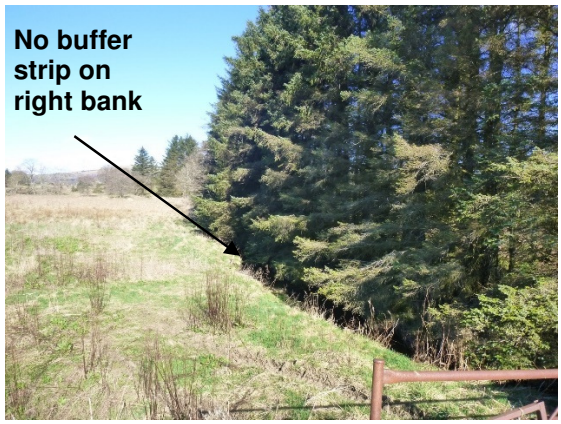
The Shevock originates in the woodland northwest of Glanderston where it flows in a narrow sinuous channel east and then south towards Newton Farm. The SEPA NFM mapping indicates medium runoff reduction potential in this region, however the catchment is already well forested. Habitat restoration in the felled areas would limit runoff and as land use is not agricultural there is high potential for upper catchment storage opportunities such as online storage ponds and debris dams in the open less steep valley floor. Moderate erosion is indicated in the uppermost reach which is to be expected and is in balance as the burn flows south, therefore no significant sediment management measures are recommended. As the burn approaches Newton Farm it continues in a narrow channel but becomes much straighter in morphology having undergone low and high impact realignment. Opposite Newton Farm a small area of rough wooded ground on the left bank has potential to be used as floodplain storage (Figure 6-5, A). Downstream of the minor road bridge at OS NGR NJ 58900 29196, The Shevock appears to be restoring sinuosity through the open floodplain, setting back the fence and allowing sinuosity to be restored is recommended. A large boggy area is present within the left floodplain (Figure 6-5, C) where wetland development could be encouraged for greater storage potential. The Shevock could be re-meandered into the floodplain to restore sinuosity but lower velocities may mean wetland development and in-stream debris dams are more sustainable and appropriate measures. Upstream of the bridge, the river is more incised and eroding. The left bank is wooded but riparian vegetation on the right bank is limited (Figure 6-5, B).

The Oldtown burn is a small, narrow watercourse that originates near Home Farm and flows south then east through forest, beneath a minor road bridge south of Whinbrae Farm and discharges into the right bank of The Shevock downstream of Newton Farm at OS NGR NJ 57917 29590. Potential to meander the tributary through, and create an area of wet-woodland storage was identified by the Whinbrae Farm road bridge (Figure 6-5, D) but consideration of the risk of bridge scour if channel instability results must be given, as well as velocities to maintain the sinuous morphology. Land management measures to reduce runoff to the straightened tributary such as hedgerow planting, cross contour planting on upper slopes and avoiding straightened field drains are recommended NFM measures in this area.

Figure 6-5: The Shevock upper catchment and the Oldtown tributary



A: Looking upstream along The Shevock. Wooded upper catchment visible in background. Burn moderately incised but potential for floodplain connection and storage on left bank. (OS NGR NJ 58152 30000)



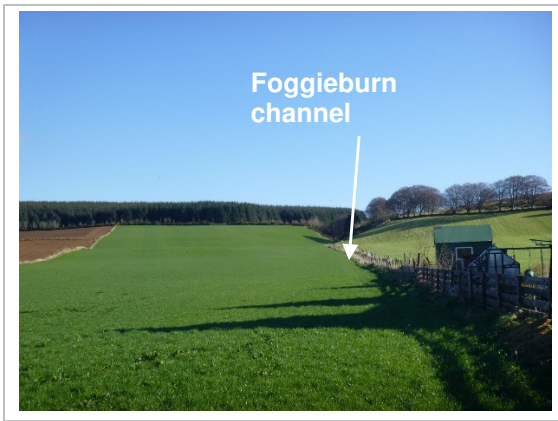
B: Looking upstream along The Shevock. Channel is moderately incised, left bank woodland but lack of riparian planting along the right bank. Bank erosion and sediment input also occurring at the edge of the bridge (out of picture). (OS NGR NJ 58899 29201)

C: Looking downstream along The Shevock. Boggy area on left bank through which burn could be meandered or wetland encouraged along with woody debris dams. Channel contained river weeds. (OS NGR NJ 58899 29201)

D: Looking upstream from the Whinbrae road bridge along the Oldtown Burn. Highly straightened channel with potential for greater floodplain woodland connection and meandering. (OS NGR NJ 57918 29585)

The Foggieburn tributary runs in a straightened channel along field boundaries through the agricultural left bank of The Shevock. It is recommended the burn be meandered in its upper reaches adjacent to the area of forestry and at OS NGR NJ 58567 29836, north of Foggieburn Farm, to slow agricultural runoff in the upper catchment (Figure 6-6, A). Downstream of the farm and minor road the buffer strip on both banks of the Foggieburn could be widened, the fencing set back to reduce field runoff and a new river corridor created (Figure 6-6, C). This will result in minor loss of agricultural land but brings additional benefits including visual improvements in the vicinity to the farmhouse, as well as sediment and nutrient deposition in the productive land as a result of increased floodplain connectivity. Field runoff is high in this area with runoff and sediment pathways from the Foggieburn Farm toward the channel south of the minor road evident. Land management improvements such as hedgerows at field boundaries, leaky bunds, buffer strips and along contour ploughing are suggested NFM measures to reduce runoff in this region of the catchment and to reduce the risk runoff poses to road traffic (Figure 6-6, B). South of the farm there is the potential to increase the area of buffer strip along both banks, as well as installing in-stream debris dams to slow flow toward The Shevock (Figure 6-5, C).

Figure 6-6: The Shevock upper catchment - Foggieburn tributary



A: Narrow Foggieburn channel lined by ploughed fields with small buffer strips on both banks. Meandering and debris dams suggested. (OS NGR NJ 58487 29674)

B: Runoff from field straight across the road and towards the Foggieburn. Hedgerow planting and leaky bunds suggested along field boundaries. (OS NGR NJ 58487 29674)

	
C: South of the farm looking downstream towards The Shevock confluence. Set back fencing, increase buffer strip on either side of the Foggieburn, in-stream debris dams to slow flow and potential to create new river corridor. (OS NGR NJ 58487 29674)	

The Mill of Glanderston burn is a right bank tributary of The Shevock which was assessed near its source at OS NGR NJ 57680 27481 and confluence with The Shevock. At OS NGR NJ 57680 27481 near Law House in the upper catchment, the burn is highly straightened, relatively incised and with no buffer strip on either bank (Figure 6-7, A). Runoff and sediment input from the adjacent fields and road is high with several runoff pathways evident at the time of the visit (Figure 6-7, B). Re-meandering may be possible before further incision takes place but additional NFM recommendations include: debris-dams to slow flow; hedgerow planting at field boundaries; set back fencing and undertake riparian planting/ buffer strips to reduce runoff. Creation of a new river corridor in the upper catchment to slow flow and increasing storage reduces discharge towards The Shevock itself lower in the catchment.

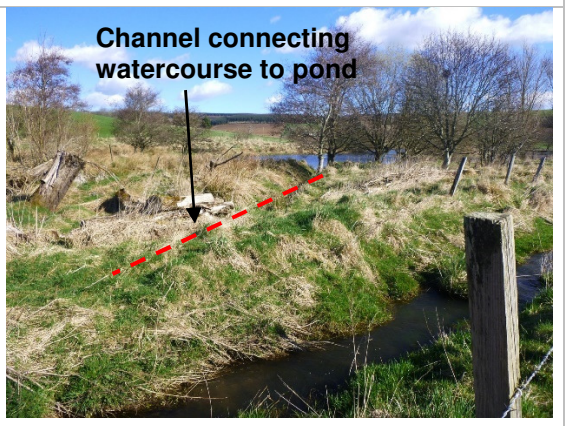
In the lower catchment at Mill of Glanderston a large pond is present on the left bank to the west of the farm which stores a large volume of water (Figure 6-7, C). There appeared to be a channel leading from the burn to the pond that is likely only connected during periods of high flow (Figure 6-7, D), thus acting as an offline storage pond. The right bank slopes steeply towards the burn and there is no buffer strip meaning runoff from the field flows directly into the watercourse (Figure 6-7, E). Runoff reduction measures are suggested such as upper slope along contour planting and/ or a hedgerow along the bottom margin of the field. The narrow valley and flat, open floodplain at this location limits options for meandering and further ponding. The SEPA NFM mapping indicates high floodplain storage between the source and Glanderston which may be possible with landowner consent and re-meandering is highly recommended.

Figure 6-7: The Shevock upper catchment - Mill of Glanderston tributary

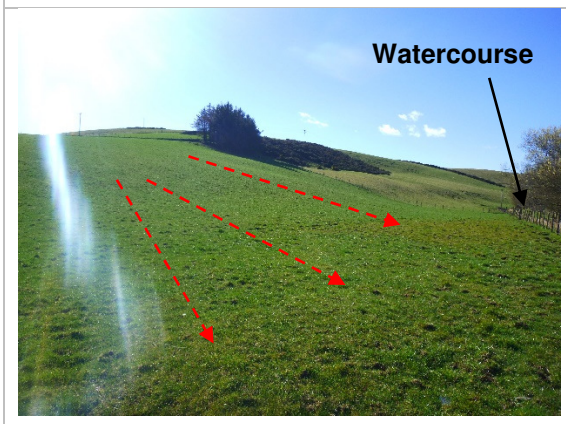
A: Straightened channel with no buffer strip and sediment input at the field corner where a leaky bund could be installed. Set-back fencing, riparian planting and creation of a new river corridor suggested. (OS NGR NJ 57678 27480)

B: Roadside runoff channel with high sediment input from the road into the burn. (OS NGR NJ 57678 27480)

C: Offline storage pond already present. (OS NGR NJ 58396 29063)



D: High flow channel to pond. (OS NGR NJ 58396 29063)

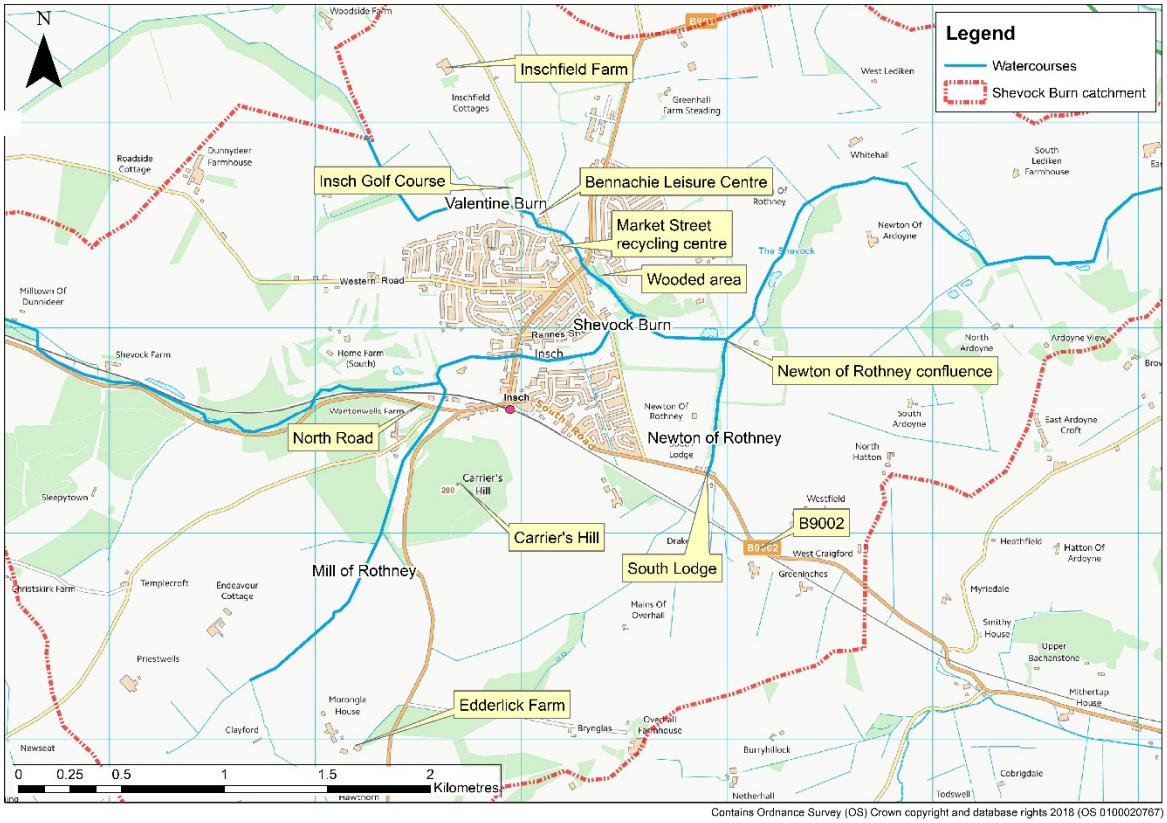


E: Runoff from field straight into watercourse as there is no buffer strip. (OS NGR NJ 58396 29063)

7 The Shevock tributaries

Three watercourses present additional flood risk to the community of Insch. These are the Valentine, Mill of Rothney and Newton of Rothney burns. Each has a catchment area of less than 10 km^2 and have not therefore been classified within the RBMP or SEPA morphological pressures dataset. A walkover of each was used to identified pressures and NFM potential within the catchments. Key locations at which the watercourses were viewed are shown in Figure 7-1. A map showing the location of photos taken in the following catchments is included in Appendix B.3.

Figure 7-1: The Shevock tributaries key locations



7.1 Valentine Burn

The Valentine Burn was walked from its confluence with The Shevock at OS NGR NJ 63500 28100 to the Leisure Centre at OS NGR NJ 63100 28500 and upstream in the region of its source at OS NGR NJ 62319 28786 below Inschfield Farm. Land use is varied in the Valentine catchment for such a small area: agricultural land dominates the upper catchment before the burn flows through Insch Golf Course and is urbanised in the lower catchment.

South of Inschfield Farm a number of field drains converge to become the Valentine Burn. Whilst some of the field drains have small buffer strips along both banks there is potential to increase their width for example along the Valentine Burn southwest of Inschfield Farm at OS NGR NJ 62569 28926 (Figure 7-2, A). It may also be possible to encourage wetland development or make channel morphology improvements including small online storage pools and debris dams in the buffer zone to slow runoff from the upper-catchment towards Insch (Figure 7-2, A). Similar measures along tributary field drains are recommended. Runoff channels carrying sediment from the ploughed fields directly into the burn were evident onsite (Figure 7-2, B) therefore land management NFM techniques including along contour ploughing; buffer strips; hedgerows and strategically placed leaky-bunds to reduce and slow runoff and sediment input and deposition downstream are recommended.

As the Valentine Burn approaches the outskirts of Insch it flows through the Golf Course. Access to the burn was limited, however it was noted that the burn is highly straightened (Figure 7-2, C) with a number of small bridges along this reach. A large proportion of the floodplain is maintained, cut grass of the golf course which is of low roughness, runoff will therefore be high and rapid toward

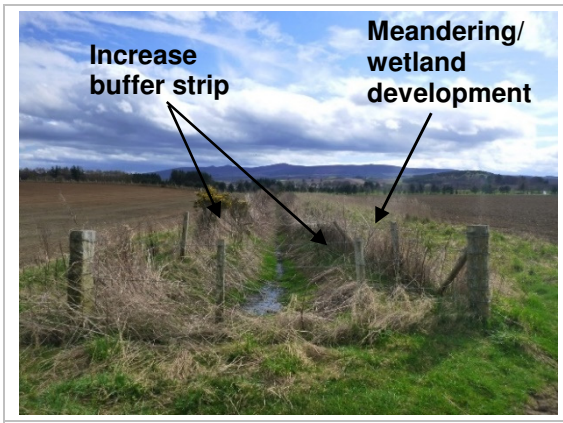
and in the canalised channel. Creation of a new river corridor with incorporation of NFM options such as meandering, storage ponds or small wet-woodland areas within the Golf Course may be possible while still maintaining its recreational value but would require stakeholder engagement and agreement with the Golf Course. It was noted that a large area of uncultivated rough ground is present along the northern margin of the Golf Course. It is wooded in areas and will be acting to buffer runoff from the agriculturally ploughed fields downslope towards the Valentine Burn. It is recommended further woodland planting along this northern margin or vegetation planting be undertaken as a runoff reduction measures towards the lower reaches of the burn and community of Insch.

As the burn exits the Golf Course and flows through the playpark adjacent to Bennachie Leisure Centre, it continues in a highly straightened recently excavated channel (Figure 7-2, D). It is suggested the watercourse be re-excavated and meandered in the left bank to increase channel length and thus slow the velocity at which water is conveyed towards the properties downstream of the Leisure Centre. Further vegetation planting along both banks to increase roughness as well as stabilise the recently excavated, eroding banks are recommended. On the east side of Market Street a field drain has been freshly excavated (Figure 7-2, E). At the time of the visit this was inputting a high volume of sediment to the Valentine Burn in addition to rapid conveyance of polluted waters originating near a small greenhouse on the left bank and would convey roadside runoff rapidly towards the burn. Sedimentation of the outlet pipe at the downstream face of the Market Street road bridge was evident (Figure 7-2, F) and a local resident stated the Valentine Burn channel downstream of the bridge had silted considerably over the last 10 years. The left bank downstream of the bridge was eroding considerably inputting sediment while the right bank is stabilised by large boulders (Figure 7-2, G). It is believed the left bank field is council owned and presently unfarmed, therefore there could be potential for floodplain storage feature in this region but a buffer strip and riparian planting are suggested if not.

Further downstream of the Market Street bridge behind the Recycling Centre, the Valentine Burn is constrained by a low concrete wall that occupies half of the width of the watercourse (Figure 7-2, H) which a local resident informed us had been constructed by another resident of Insch. The wall does not appear to be providing any form of flood protection and morphological alterations such as this should be removed. The burn is eroding into the right bank and further downstream both banks are highly eroding with the right bank also constrained by a large wall along its length. Riparian planting to stabilise the banks limiting excessive erosion and sediment deposition, as well as increasing channel roughness are suggested.

South of the recycling centre by the B992 road bridge a trash screen is present at the upstream face and the right bank eroding. Downstream of the bridge the Valentine Burn enters an area of woodland that is naturally boggy and wet-woodland is developing. Encouragement of in-stream woody debris barriers to encourage out-of-bank flow is recommended (Figure 7-2, I). The final reach of the Valentine Burn is relatively unconstrained with limited physical pressures. The channel is eroding in many places, there is woody debris within the channel and the primary pressure is a twin pipe culvert beneath the track through the wood at the confluence with The Shevock (Figure 7-2, J).

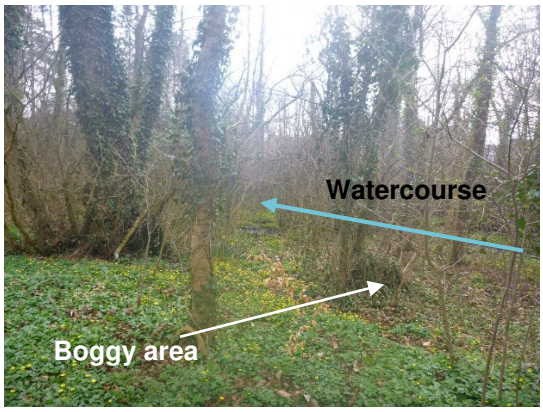
Figure 7-2: Valentine Burn



A: Field drain where buffer strip width could be increased on both banks, debris dams and wetland development recommended. (OS

B: Sediment and runoff from the agricultural upper Valentine catchment. Hedgerows, leaky bunds and bank stabilisation to reduce runoff

NGR NJ 62544 28944)	and reduce sediment input recommended. (OS NGR NJ 62313 28784)
	
C: Valentine Burn through Insch Golf Course. Nothing to buffer runoff from the maintained grass into the canalised channel. Wet-woodland area could be encouraged by meandering the channel through the right bank woodland. (OS NGR NJ 63048 28553)	D: Looking downstream toward Insch Leisure Centre. Recently excavated Valentine Burn. Riparian planting to stabilise the bank limiting sediment input and re-excavation to meander through the left bank recommended. (OS NGR NJ 63048 28553)
	
E: Freshly excavated field drain near Bennachie Leisure Centre carrying sediment and pollutants rapidly and directly toward The Shevock. (OS NGR NJ 63138 28511)	F: High sedimentation at the outlet pipe of the Market Street bridge. (OS NGR NJ 63148 28477)
	
G: Large boulders stabilising the right bank where the Valentine Burn flows adjacent to a number of properties. Eroding left bank inputting sediment to already silted channel. (OS NGR NJ 63148 28477)	H: Concrete wall within the watercourse behind the Recycling Centre and eroding left and right banks. Removal of wall to increase channel capacity and riparian planting to increase channel roughness suggested. (OS NGR NJ 63239 28430)



I: Valentine Burn downstream of the B992. Boggy floodplain where wet woodland is developing and should be encouraged. (OS NGR NJ 63462 28154)

J: Twin pipe culvert near The Shevock confluence. Eroding banks and woody debris within the channel in this reach. (OS NGR NJ 63540 28090)

7.2 Newton of Rothney

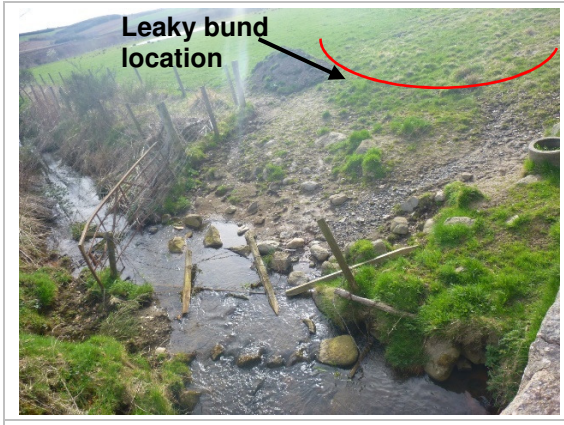
The Newton of Rothney Burn is primarily field drainage and originates in agricultural land to the south of Insch from where it flows north beneath the railway line and then B9002. It was walked from this point to its confluence with The Shevock. The upper catchment, north of the railway, is low lying farmed land (Figure 7-3, E). NFM measures recommended in this region include: along contour woodland planting and ploughing, hedgerows at field boundaries, meandering of tributary field drains and in-stream debris dams.

At South Lodge, OS NGR NJ 63898 27285, the left bank was highly eroded with runoff, sediment and debris input high from left bank upstream of the road bridge (Figure 7-3, A). This may be a livestock watering hole but improvements to the channel should be made to prevent debris being washed downstream. A leaky bund could be put in the corner of the field and riparian planting to stabilise the eroded bank. It appears the watercourse was previously fenced off but the fence has now collapsed into the burn. This should be reinstated to reduce livestock poaching of the bank edge other than at a specific fenced watering hole area as this otherwise can result in bank instability, erosion and reduce water quality. The burn is highly straightened along its length and an embankment was indicated to be present on the left bank upstream of the B9002. The watercourse has become incised and thus even with removal of the embankment it may be hard to meander the watercourse in this reach.

Downstream of the B9002 the channel is wider but the right bank is steep with bare earth which is depositing sediment into the watercourse (Figure 7-3, B). Riparian planting to stabilise the bank as well as field-boundary hedgerow planting will limit fluvial and sediment runoff and increase bank stability. There are little opportunities for meandering as the right bank is steep and there is a road adjacent to the left bank which appears to be protected by a small embankment (Figure 7-3, C). Natural woody debris is accumulating within the channel which should be encouraged.

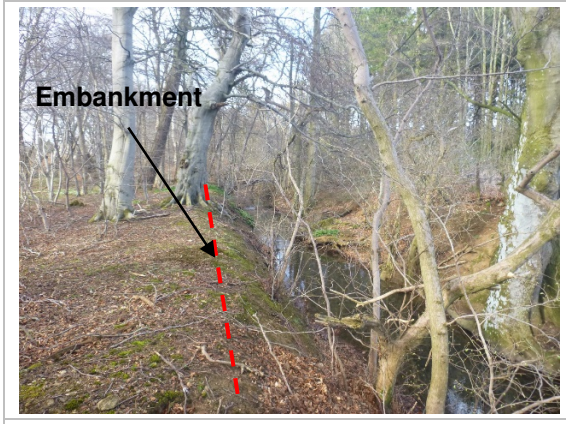
At the confluence with The Shevock the Newton of Rothney burn flows in a straightened but eroding channel lined on the left bank by woodland and pasture on the right. The right bank is marked as having high floodplain storage potential. The channel has become incised and works on the floodplain are constrained by the presence of a sewage works resulting in low storage potential.

Figure 7-3: Newton of Rothney Burn



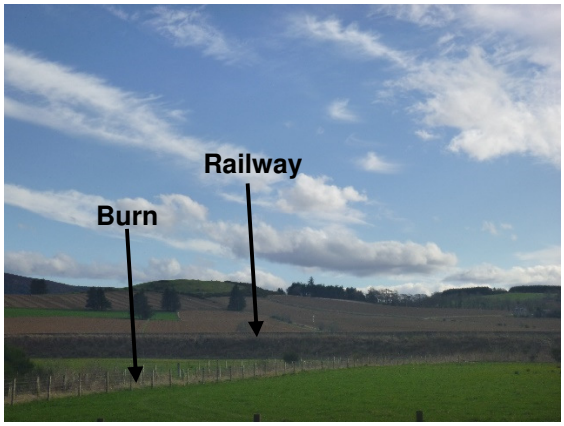
A: Eroding bank and field runoff upstream of the B9002. Potential for leaky bund. Repair fence along field boundary and define the watering hole to avoid continued erosion of the surrounding bank. (OS NGR NJ 63898 27277)

B: Steep right bank with bare earth downstream of the B9002. Planting to stabilise the bank and increase channel roughness suggested. (OS NGR NJ 63914 27451)



C: Small informal embankment-like feature visible on left bank. (OS NGR NJ 63914 27451)

D: By confluence with The Shevock. Wooded left bank, planted right bank and eroding channel. (OS NGR NJ 63976 27929)



E: Upper catchment. Additional along contour tree planting, hedgerows to reduce runoff and debris-dams and wetlands in and along watercourses suggested. (OS NGR NJ 63898 27277)

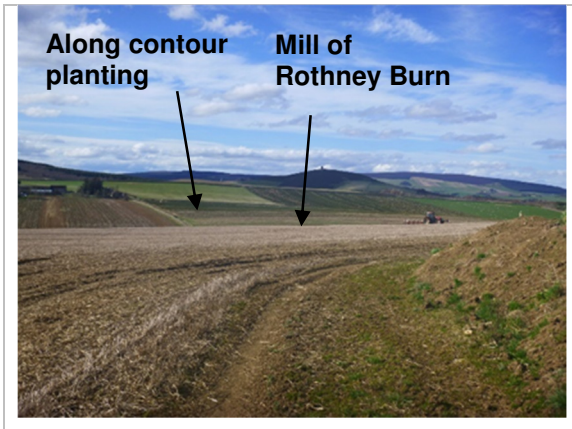
7.3 Mill of Rothney

The Mill of Rothney Burn has a very small catchment of just 3 km^2 and access to the wider catchment was limited. It was observed near its source at Edderlick Farm at OS NGR NJ 62011 26099 and just upstream of its confluence with The Shevock south of the railway and North Road at OS NGR NJ 62557 27535.

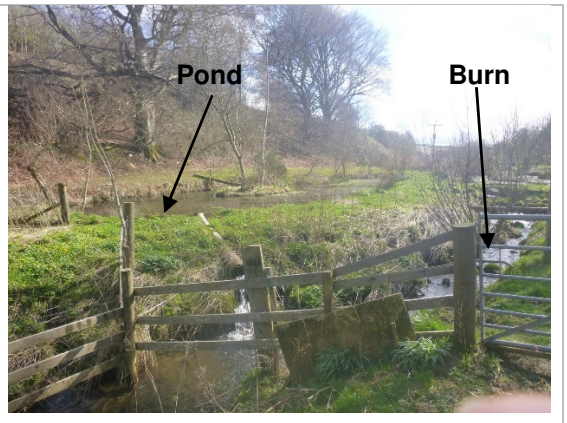
The burn originates to the west of Edderlick Farm in a small valley at the base of pastural land. The watercourse flows in a highly straightened channel through the valley but there is potential for meandering and online storage ponds similar to those seen in aerial photography[13]. There is also potential in the upper catchment to increase planting within the areas suggested for runoff reduction in the SEPA NFM mapping. The land is used for crops and grazing and so there is potential to plant hedgerows along field boundaries, as well as implementing along contour planting, which can act as shelter belts for livestock (Figure 7-4, A). Farmers should be encouraged to plough along contour to slow sediment and water runoff from the field into the watercourse.

Further downstream in the catchment, south of North Road, there is high potential for a range of NFM measures. East of Wentonwells Farm the burn flows in an unconstrained but relatively straightened channel. The burn is eroding and restoring a degree of sinuosity upstream of a large storage pond. The pond is located on the right bank, the burn flows parallel to it with an outflow pipe discharging water back into the burn at the downstream extent of the pond (Figure 7-4, B). Downstream the watercourse is highly straightened with open floodplain and the sloped right bank already forested to buffer runoff (Figure 7-4, C). It is recommended the burn morphology be improved through this reach, debris dams, and online storage ponds created to encourage greater floodplain connection and storage. Just south of the B992 the burn continues through rough ground (Figure 7-4, D) and wetland creation to increase floodplain storage and infiltration of hillside runoff is recommended. At the base of the Carrier's Hill forest there is potential for further woodland planting which would reduce runoff rates from the hillside. North of North Road the burn flows through a small industrial estate where high sediment and runoff input is able to enter the burn just upstream of the railway and Shevock confluence (Figure 7-4, E). Consideration should be given to measures to improve the condition of the watercourse to limit the high degree of sediment, debris and diffuse pollution able to enter in this reach to maintain good water quality as per the RBMP.

Figure 7-4: Mill of Rothney Burn

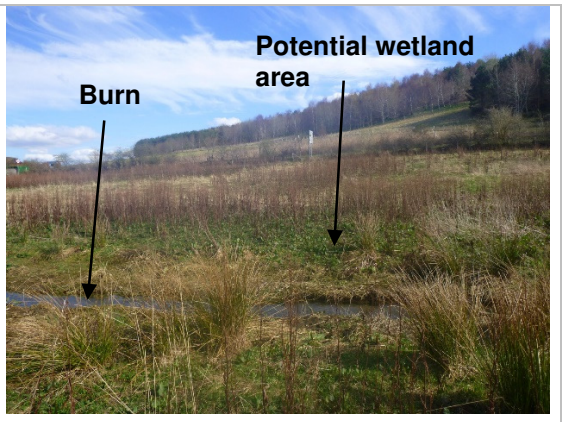


A: Upper catchment. Runoff reduction potential through hedgerow and along contour tree planting. (OS NGR NJ 62016 26080)



B: Online large storage pond with outlet pipe. Eroding, semi-sinuous channel flowing parallel to the pond. (OS NGR NJ 62457 27398)

13 Google Earth. Imagery date 22/03/2012. [Accessed: July 2018]

	
C: Straightened channel south of the storage pond. Channel morphology improvements, debris dams and online storage ponds suggested along this reach. (OS NGR NJ 62457 27398)	D: South of North Road. Unconstrained burn flowing through rough ground with potential for wetland creation and/ or online storage ponds. (OS NGR NJ 62564 27551)
	
E: North of North Road, high sediment, runoff and diffuse pollutant input from the industrial estate. (OS NGR NJ 62601 27634)	

8 Conclusions

8.1 The Shevock summary and recommendations

The Shevock is characterised as being in 'Poor' overall condition but 'Good' physical condition due to the limited number of physical pressures along it. The key pressure affecting the watercourse is realignment with the channel being highly straightened for much of its length, although sections are relatively sinuous in the middle and upper catchment. The Shevock runs parallel to the railway for the majority of its length limiting in areas the capacity to increase sinuosity, particularly in the lower urban regions of the catchment. Opportunities for re-meandering were identified at several locations in the upper and middle catchment. Increasing sinuosity, and thus channel length, both work towards maintaining the 'Good' RBMP morphological status, as well as having NFM benefits through a reduction in velocity in longer sinuous channels limiting flood risk downstream. Consideration of stream power in any reach being re-meandered should be given, as wetland development and in-stream debris dams may be more sustainable and appropriate measures e.g. The Shevock near the Mill of Glanderston Farm. The Shevock was actively eroding along most of its reach indicating it is relatively unconstrained and thus able to work towards restoring sinuosity. As the Shevock approaches and flows through Insch the channel becomes far more constrained due to urbanisation of the banks. The condition of the watercourse near Mill Road could be improved by repairs to the failing concrete wall downstream of Commercial Road bridge. In addition, removal of the physical pressures identified such as the concrete blocks by the former mill and bank stabilisation e.g. by Old Mart Avenue through riparian planting would maintain the 'Good' RBMP physical condition status and improve water quality through sediment management.

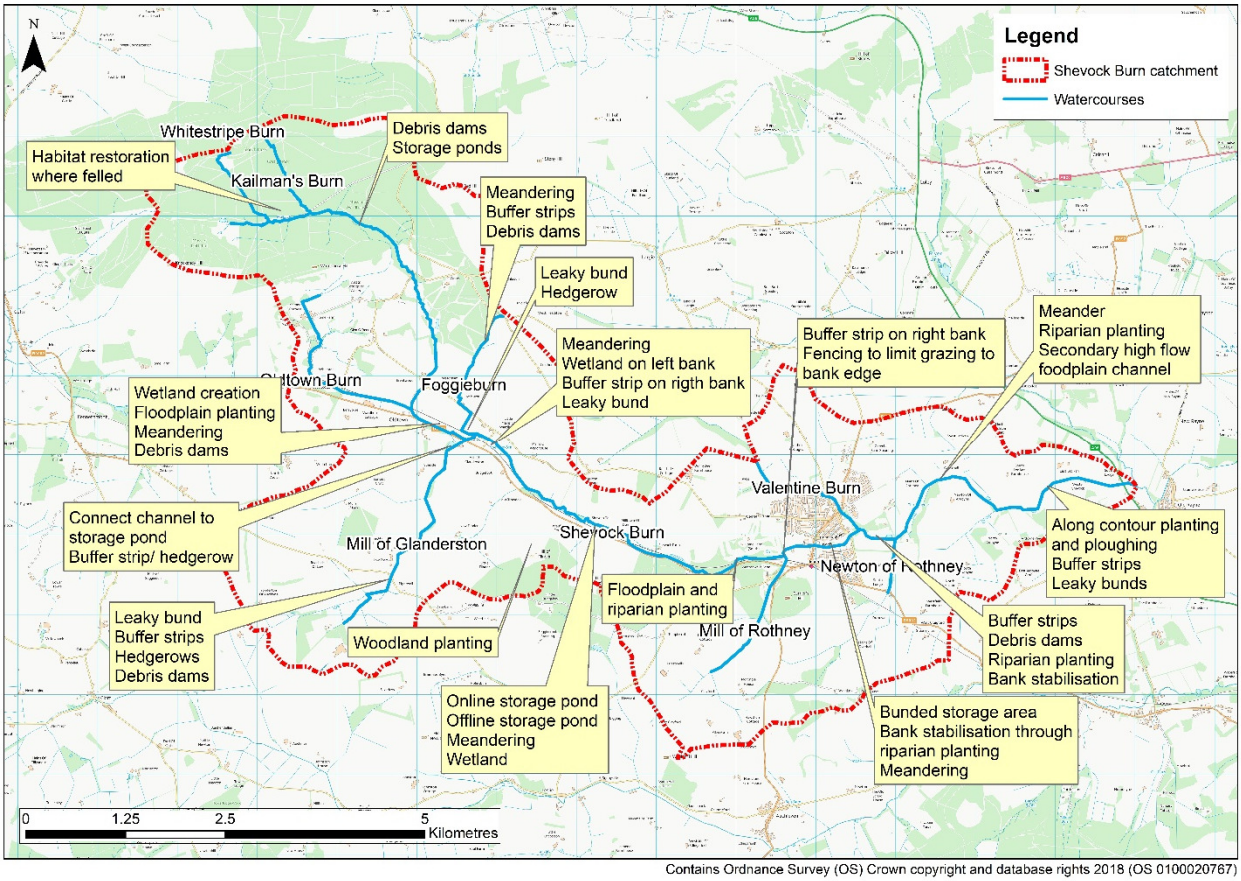
NFM potential is high across The Shevock catchment. In general there is already evidence of runoff being managed with several areas already forested and along contour planted which is limiting hillslope runoff in the upper and central catchment. Land management improvements such as blocking forestry drainage channels, avoiding downslope firebreaks, hedgerow planting, along contour ploughing and increasing areas of buffer strips will provide further benefit. A number of floodplain storage opportunities along The Shevock were identified during the walkover and include storage ponds, wetlands and wet-woodlands on the floodplain through the central catchment where the watercourse flows through a flat, open valley. Sediment management potential to combat excessive erosion and hence deposition further downstream can be made through bank stabilisation in areas and restoring sinuosity. NFM opportunities are shown in Figure 8-1.

The Shevock is a tributary of the River Urie which presents a flood risk to the Inverurie community and is being appraised in an independent report as part of the Ellon, Inverurie and Port Elphinstone Flood Studies[12]. NFM options within The Shevock catchment therefore have dual benefits to both the Insch community and downstream communities of Inverurie and Port Elphinstone through limiting sub-catchment discharge to the River Urie.

Key recommendations based on the site visits and applicable to the wider catchment are as follows:

- Upper catchment planting and land restoration where trees have been felled near the source of The Shevock. Land management in forested regions such as blocking of straightened drainage channels is also recommended.
- Increase the area of riparian planting and buffer strips in the upper catchment along The Shevock and tributary watercourses, particularly along the Foggieburn, to reduce runoff and increase infiltration.
- Create leaky bunds and plant hedgerows at key locations to help control runoff e.g. by the source of the Glanderston Burn and Foggieburn field boundary.
- Install in-stream debris dams within watercourses to slow flow within the scheme extent and along straightened field drains in the upper catchment.
- Offline and online storage ponds along The Shevock in the middle and upper catchment.
- Floodplain woodland planting e.g. near Mill of Dunnideer, at the Oldtown burn confluence and opposite the SuDS scheme in Insch
- Creation of a wet woodland in the upper Shevock catchment e.g along the Oldtown Burn.
- Encourage wetland formation particularly along the upper Shevock and minor tributaries outwith the scheme extent where stream power is less and therefore debris dams and wetlands more appropriate than re-meandering.

Figure 8-1: The Shevock NFM opportunities



NB: These are key NFM/ RBMP recommendations within The Shevock catchment based on the site visits but are not exhaustive and are applicable elsewhere in the catchment. Figure 8-2 gives further opportunities identified within the tributary catchments at Insch.

8.2 Mill of Rothney, Newton of Rothney and Valentine Burn summary and recommendations

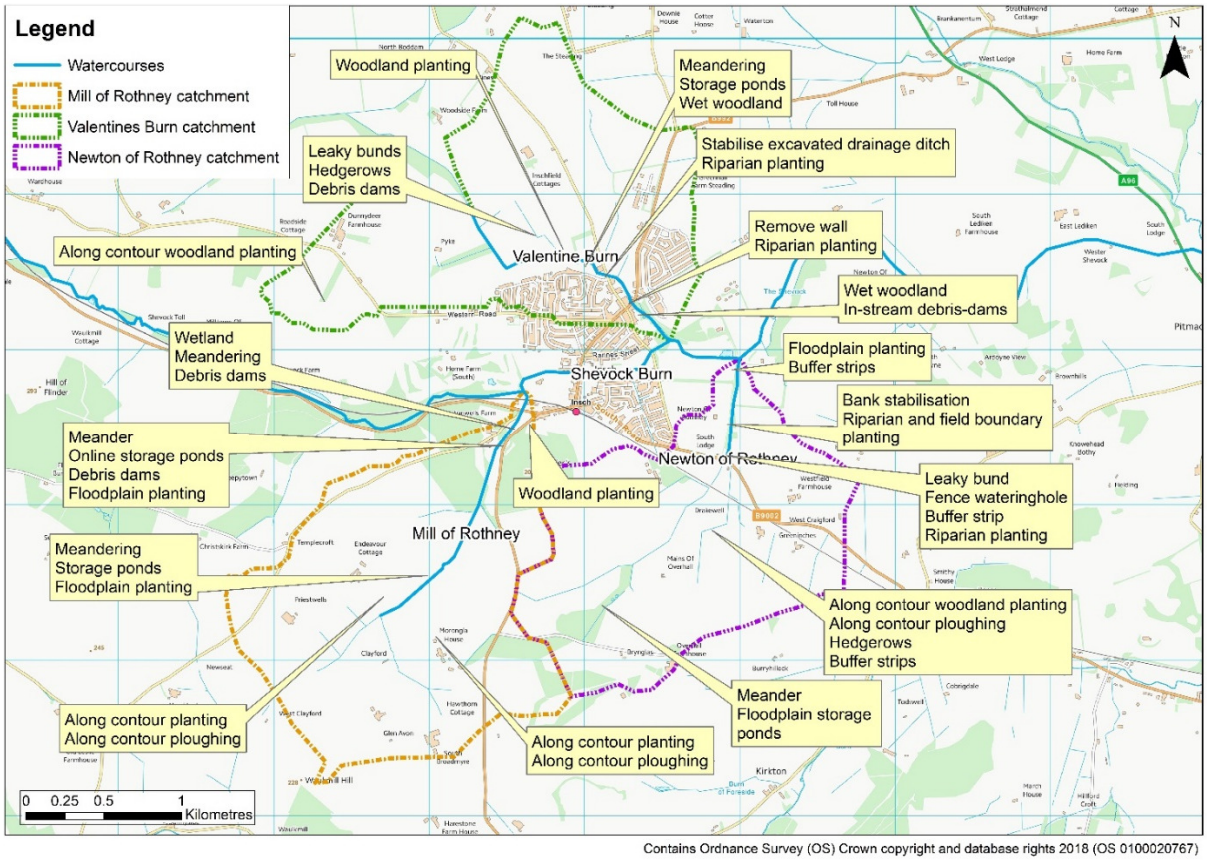
The three tributaries' catchments are not large enough to be classified within the SEPA RBMP or morphological pressures datasets. The condition of and constraints on all watercourses were therefore assessed onsite. There are limited pressures along all three watercourses with respect to embankments, culverts and grey-green bank protection. Each however originates as field drainage and are therefore highly straightened, with sediment and diffuse pollutant input which affects water quality found to be a problem along the Valentine and Newton of Rothney burns. Opportunities to improve the morphology, as well as water quality of all watercourses in line with the RBMP were identified on site. These include, strategically placed bunds, good agricultural practices such as ploughing along contour, buffer strip planting and bank stabilisation through riparian planting. In the Valentine catchment options for improving morphology are greatest in the upper catchment and potentially through Insch Golf Course to slow flow toward the community at Insch. Further morphological improvements can also be made in to the urban reaches by removing grey-bank pressures such as the concrete wall by the Recycling Centre and stabilising areas with excessively eroding banks. Morphological improvements to the Mill of Rothney and Newton of Rothney catchments are similarly greater in the upper rural catchment where straightening is the greatest pressure affecting the watercourses.

NFM opportunities within these catchments are also numerous, particularly within the Mill of Rothney catchment. Key recommendations based on the site visits include (Figure 8-2):

- Increase the area of, or plant additional buffer strips at agricultural field boundaries to limit runoff e.g. further woodland/ vegetation planting north of Insch Golf Course within the Valentine Burn catchment.
- Wetland creation particularly in the Mill of Rothney catchment south of North Road.

- In-stream debris dams to flow slow towards The Shevock.
- Good land management practices e.g. along contour ploughing, keeping/ planting hedgerows, meandering or improving the morphology of field drains.
- Bank stabilisation is suggested for the Newton of Rothney Burn and riparian planting to stabilise and prevent excessive bank erosion and sedimentation within channels. For example as is already occurring within the Valentine Burn near the excavated sections of channel by Bennschie Leisure Centre.
- Offline and online storage ponds e.g. in the upper Valentine Burn catchment and along the Mill of Rothney Burn.
- Wet woodlands for example along the Valentine Burn south of the B9002.
- Fencing off watercourses to reduce livestock poaching and erosion of the banks also improving water quality.

Figure 8-2: Valentine Burn, Newton of Rothney Burn and Mill of Rothney Burn NFM opportunities



NB: These are key NFM/ RBMP recommendations within the tributary catchments based on the site visit but are not exhaustive and are applicable elsewhere within the catchment.

8.3 Overall NFM conclusions

It can be seen from the above summaries there are abundant NFM opportunities across The Shevock and tributary catchments. Outwith the scheme extent, NFM opportunities are greatest in the upper Shevock catchment and upstream tributaries. Opportunities to improve morphology and increase floodplain connectivity and storage in the upper catchment will slow and reduce flow downstream towards the community of Insch. NFM measures in these reaches include: re-meandering watercourses; creation of and connection with offline ponds to store water in times of peak flow e.g. at Mill of Glanderston; online storage ponds; buffer strips, hedgerows, leaky bunds to reduce sediment and fluvial runoff and wetland creation, particularly where stream power is low. Within the scheme extent and three key tributary catchments (Valentine, Newton of Rothney and Mill of Rothney Burns) NFM measures identified included: online storage ponds; debris dams; meandering; wetlands; riparian planting; improved land management practices such as along contour ploughing, maintaining hedgerows and buffer strips.

8.4 Overall RBMP conclusions

The Shevock is classified as being in 'Poor' overall condition but 'Good' physical condition. The main physical pressure is realignment which could be rectified by meandering sections of the burn through the middle of the catchment. Improvements to condition within the scheme extent and urban reaches of the watercourse include repairs to damaged constraining walls, removal of redundant grey-bank pressures by the former mill and bank stabilisation where excessive erosion is occurring which has the multi-benefit of improving water quality. This will maintain and improve the 'Good' RBMP status. The Shevock tributaries are less than 10 km^2 and therefore not classified within the RBMP datasets. Their condition was assessed during the site walkovers and were found to be in generally good physical condition with few constraints with the exception of being highly over-straightened through pastural land along with minor tributary field drains. Morphological improvement opportunities such as restoring sinuosity and in-channel morphological diversity, as well as wetland creation to store water upstream are numerous. There are also opportunities within the scheme extent to improve the physical condition of the burns, for example removal of the small concrete wall within the Valentine Burn channel behind the Recycling Centre. The NFM riparian planting, hedgerows and leaky bund measures within the catchments to reduce sediment laden inflow to the watercourses, as well as bank stabilisation in excessively eroding reaches will also lead to improved water quality, improving the overall RBMP status of the Insch catchment.

8.5 Economic, social and environmental benefits and disbenefits

A high-level consideration of the economic, social and environmental benefits and disbenefits have been considered in the table below.

Table 8-1: Economic, social and environmental assessment

Criteria	The Shevock	Upstream Tributaries (Oldtown, Foggieburn and Mill of Glanderston)	Scheme extent tributaries (Valentine, Newton of Rothney and Mill of Rothney)
Interventions	Floodplain planting, meandering, wetland creation, catchment planting, riparian planting	Riparian planting, meandering, leaky bunds, debris dams, hedgerows	Riparian planting, catchment planting, floodplain storage, meandering, in-stream barriers, leaky bunds
Morphology (including WFD objectives)	Benefit: Stabilisation of banks, increased sinuosity and improved connection with floodplain Disbenefit: Potential loss of productive agricultural land	Benefit: Meandering of straightened reaches to slow flow; stabilisation of banks Disbenefit: Potential loss of productive agricultural land	Benefit: Meandering of straightened reaches to slow flow; stabilisation of banks through riparian planting Disbenefit: Impact on productive agricultural land
Water quality (including WFD objectives)	Benefit: Improve runoff water quality from farmland. Disbenefit: Temporary effect of re-meandering works on water quality.	Benefit: Improve runoff water quality from farmland by catching sediment and pollutants. Disbenefit: Temporary effect of re-meandering works on water quality.	Benefit: Improve runoff water quality from farmland; buffer strips catch sediments and pollutants. Disbenefit: Impact on productive agricultural land.
Natural processes (soils, geomorphology, geology)	Benefit: Reduce soil loss from upper catchment and farmland Disbenefit: Potential loss of productive agricultural land	Benefit: Natural geomorphic process restored; reduce soil loss Disbenefit: Potential loss of productive agricultural land	Benefit: Natural geomorphic process restored; reduce soil loss Disbenefit: Potential loss of productive agricultural land
Climate change impact	Benefit: Improving floodplain connectivity allows the watercourse to better adapt to climate change; carbon sequestration benefits of wetlands and woodland planting Disbenefit: Limited ability to future proof; trees take time to reach maturity	Benefit: Improving floodplain connectivity allows the watercourse to better adapt to climate change; carbon sequestration benefits of increased planting Disbenefit: Limited ability to future proof	Benefit: Improving floodplain connectivity allows the watercourse to better adapt to climate change; carbon sequestration benefits of woodland planting Disbenefit: Limited ability to future proof; woodland takes time to establish
Habitats and species	Benefit: Opportunities to create new habitats Disbenefit: Planting may impact grazing habitats	Benefit: Limiting sedimentation of waters will aid better ecological status Disbenefit: Offline storage may impact grazing habitats	Benefit: Limit sedimentation of waters increasing ecological status Disbenefit: Woodland planting may impact grazing habitats
Recreation, tourism and education	Benefit: Visual improvements within the catchment where	Benefit: Visual improvements within the catchment	Benefit: Primary school in Insch provides educational

	the Insch Cycle Routes go; Primary school in Insch provides educational opportunities Disbenefit: Current access is limited and constrained by active agriculture.	where the Insch Cycle Routes go Disbenefit: Current access is limited and constrained by active agriculture	opportunities Disbenefit: Potential impacts to the golf course
Landscape	Benefit: Improve visual impacts in the rural and urban areas in the catchment Disbenefit: Elements limited by urban infrastructure, Scottish Natural Heritage and Historic Scotland sites.	Benefit: Improve visual impacts in rural catchment Disbenefit: Potential loss of productive land	Benefit: Upper catchment visual improvements Disbenefit: Potential loss of productive land; public walking in areas of habitat restoration
Perceived multiple benefits	Improved morphology, runoff reduction, water quality and positive impact on biodiversity.	Improved morphology, water quality, water storage and runoff reduction	Runoff reduction, improved water quality and morphology, new habitats, climate change benefits

8.6 Recommendations and proposed mechanisms to develop NFM and RBMP

Without detailed modelling the interventions discussed within this report have not been quantified in terms of economic, social or environmental benefits. The way in which the council may wish to take the recommendations for environmental improvement forward will depend on a number of factors including the scale of opportunities, the funding available and whether a FPS is likely to go ahead. We propose that the recommendations could be undertaken as follows:

- **Incorporation of NFM within a proposed FPS either as a separate option** (particularly along The Shevock upstream of Insch near the level crossing at Shevock Farm) or to supplement other more structural options to provide future adaptation against climate change. Additional modelling may help to quantify the benefits of such measures and facilitate inclusion within the wider appraisal studies.
- **Inclusion within any wider Aberdeenshire NFM funding mechanism to deliver NFM** and river restoration when specific funds become available on an ad-hoc basis (e.g. a pick list of measures to implement with land owner consent, but without further appraisal). This would lend itself to a separate catchment or sub-catchment study and would suit the recommendations made for the Valentine Burn and the Foggieburn catchment further upstream which would benefit Insch. Such studies may present many multiple benefits including environmental improvements by reviewing opportunities and success would rely on favourable landowners.
- **Delivery of measures via an FPS as a percentage uplift included within the total FPS costs set aside for local NFM and RBMP measures**. For example, 10% of the total FPS costs could be set aside for wider environmental improvements and NFM delivery. Once again, this could help to achieve the adaptation and wider environmental benefits without the need for wider appraisal and modelling. This would be suited to the Mill of Rothney catchment, where a number of NFM measures have been recommend and would reduce flood risk within Insch. Early discussions with landowner and legal department may also be beneficial.

8.7 Future works

To enable future implementation of RBMP improvements and NFM interventions, the following may be required:

- Raise awareness
- Early landowner awareness and consultation
- Public awareness raising event
- Further investigation
- Ground investigations (including infiltration testing and contamination testing)
- Utilities search and review
- Detailed topographic survey
- Ecological survey
- Detailed hydraulic modelling
- Set up pre-works monitoring
- Outline design
- Early contractor involvement
- Public engagement
- Detailed design
- Produce bill of quantities and contract documents
- Tender for contractor
- Planning application including CAR licence
- Construction
- Post-works monitoring.

Appendices

A RBMP

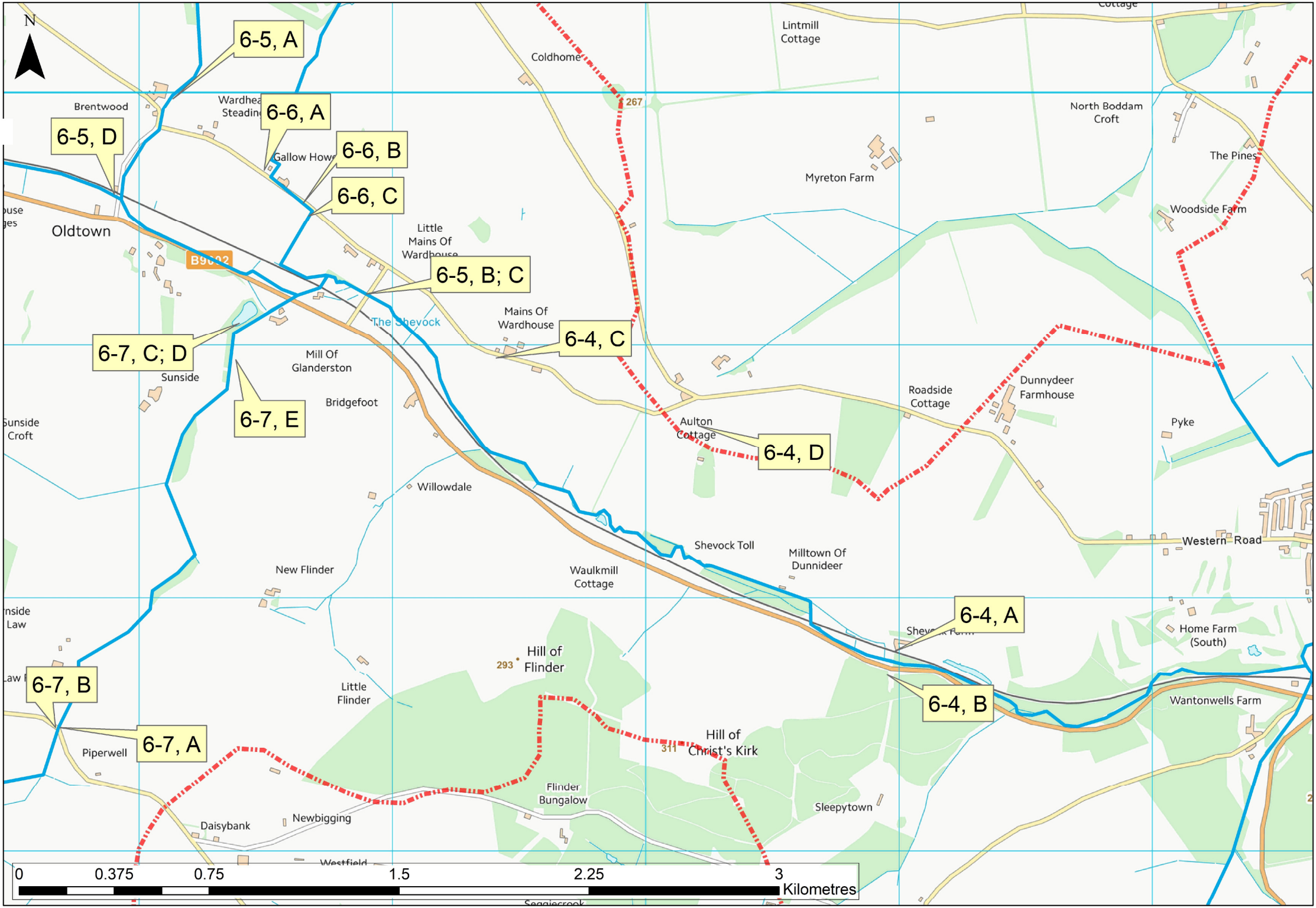
A.1 Current Overall waterbody status

			Reason for Downgrade (2016)				
Watercourse	RBMP ID	Present Overall Condition (2016)	Overall ecology	Physico-chem	Biological elements	Specific pollutants	Hydromorphology
INSCH							
Shevock Burn	23291	Poor	Poor	Good	Poor		Good

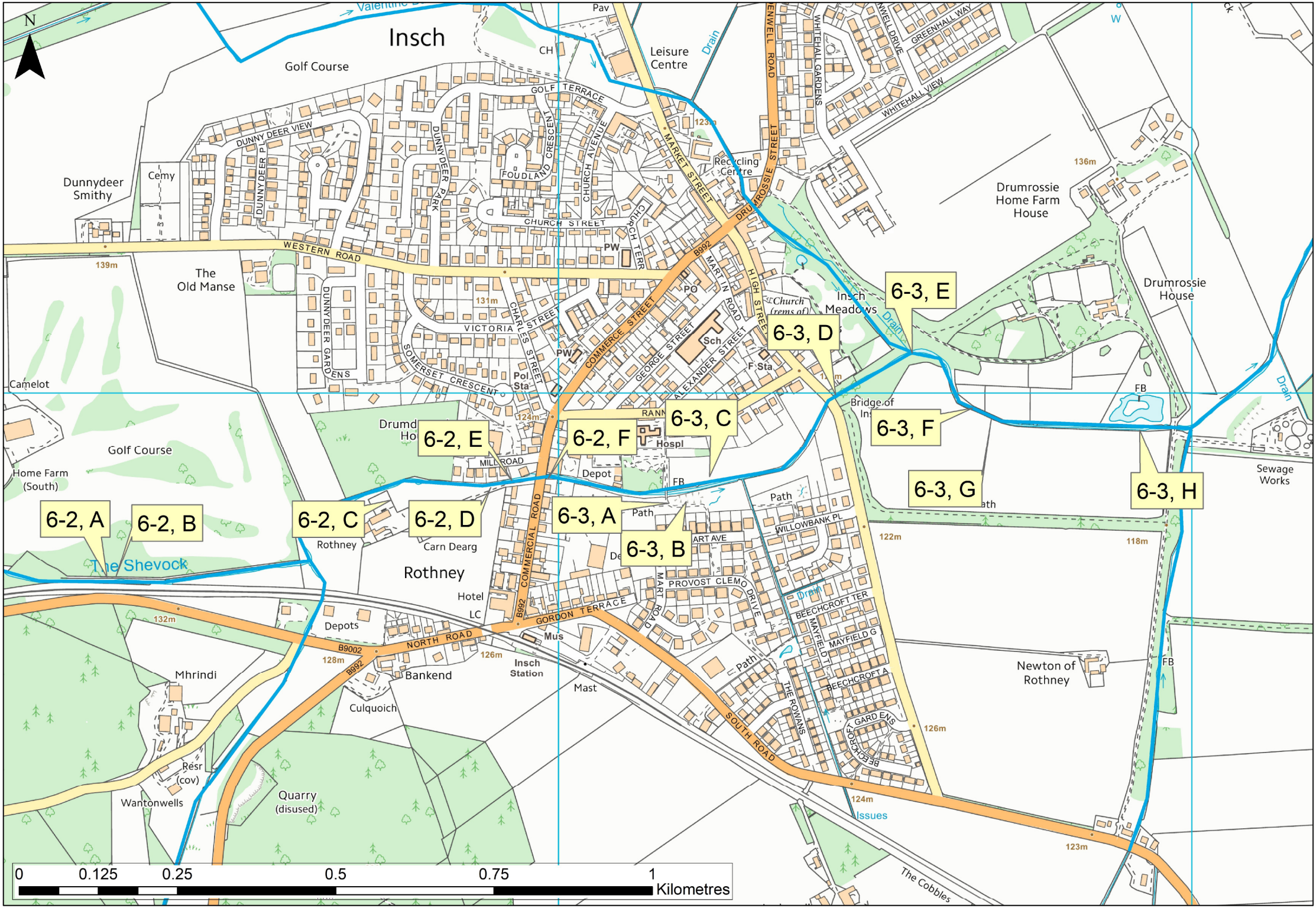
A.2 The Shevock overall status

B Site Visit Photo Maps

B.1 The Shevock Upper Catchment



B.2 The Shevock Scheme Extent



N

North Boddam Croft

Myreton Farm

West Lodge

Home Farm

Toll House

Woodside F

Lediken

Wester Shevock

Maiden Of Rothney

The Shevock

Western Road

Shevock Farm

Home Farm (South)

Ranges Street

Insch

Insch

South Road

Wantonwells Farm

Newton Of Rothney

North Ardoyne

Ardoyne View

Westfield Farmhouse

Smithy House

Upper Bachanstone

Mithertap House

Brynglas

Overhall Farmhouse

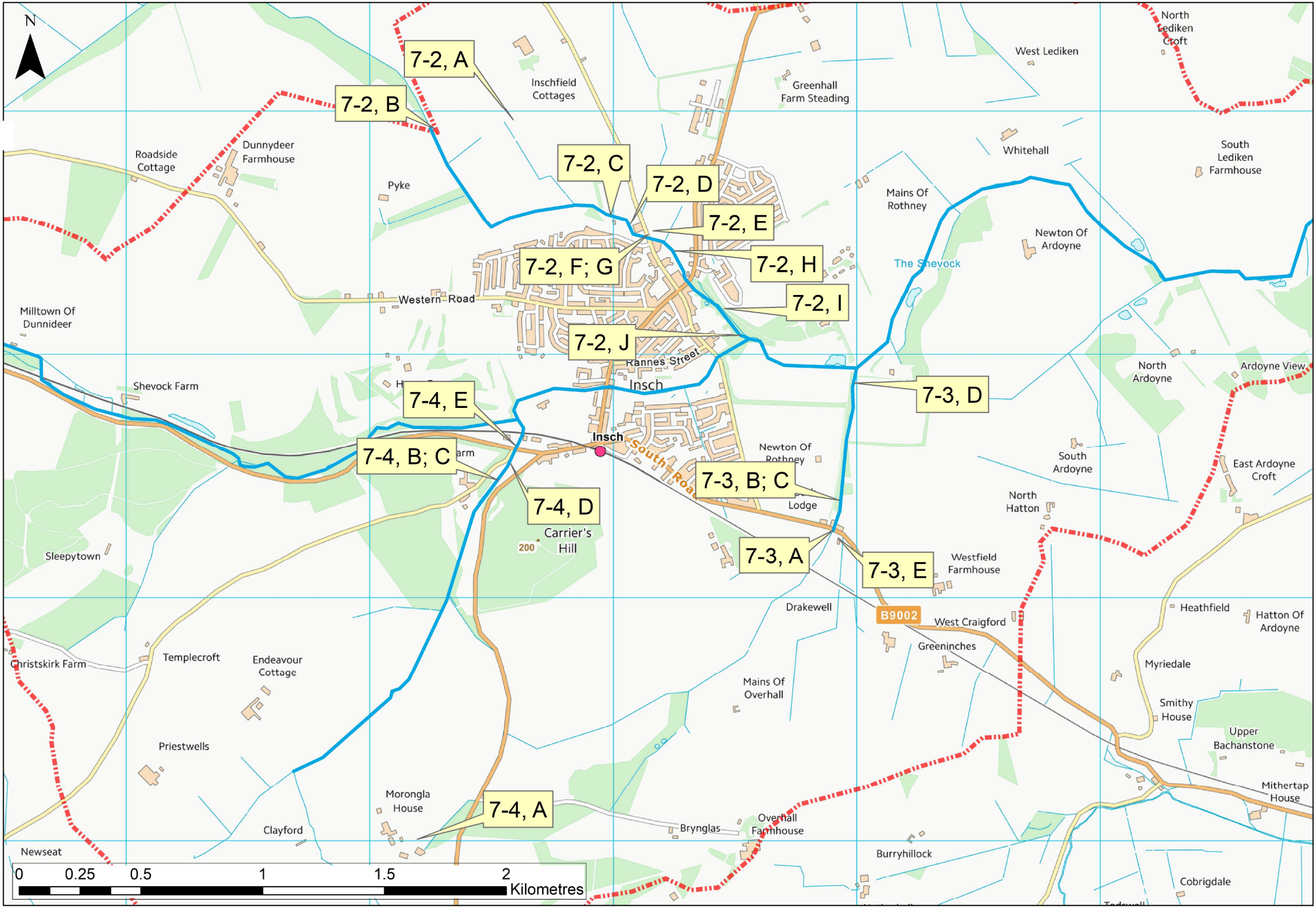
Burryhillock

Cobrigdale

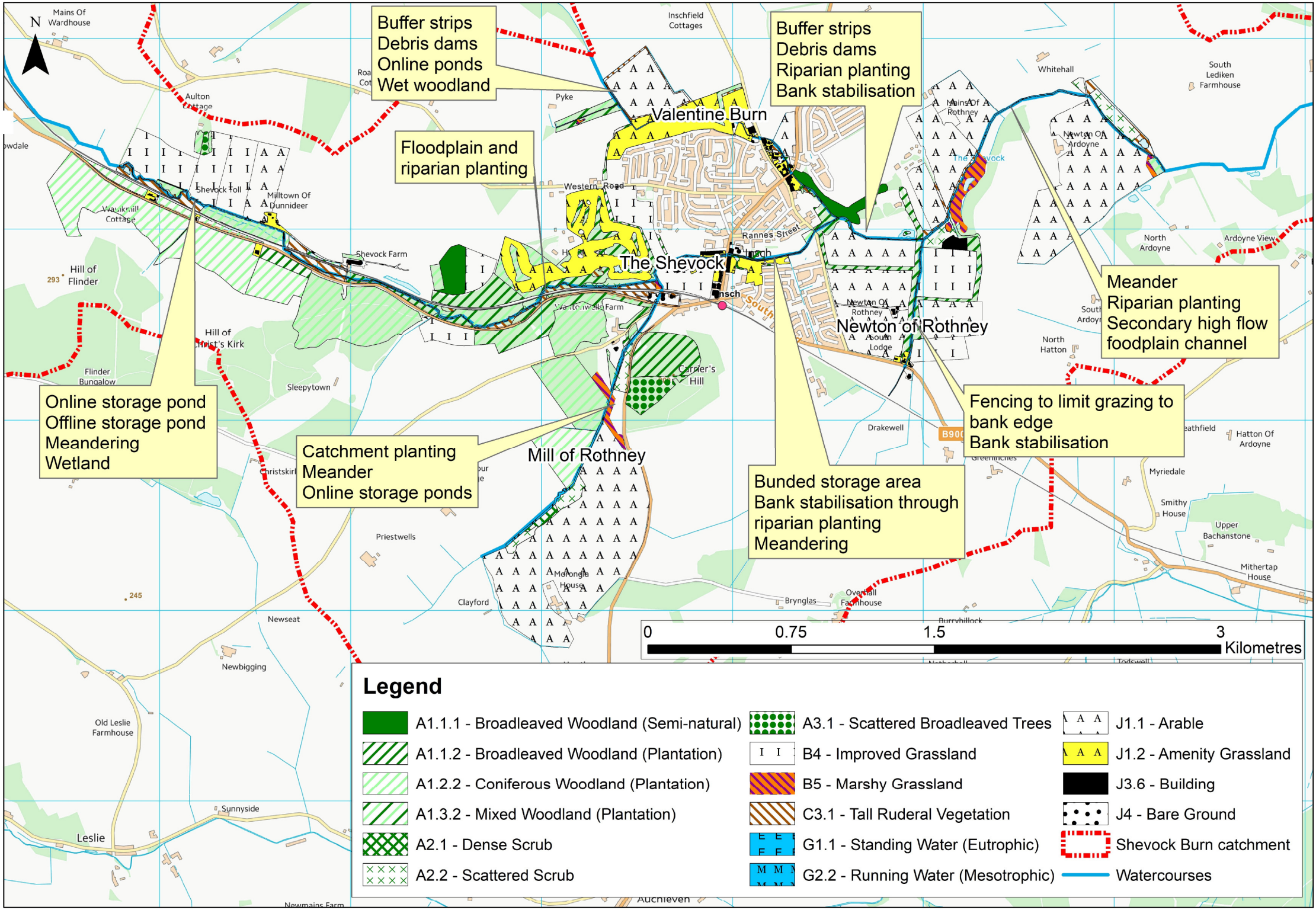
Newseat

0 0.375 0.75 1.5 2.25 3 Kilometres

B.3 The Shevock Tributaries in the Scheme Extent



C Ecology within the Scheme Extent



Offices at
Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Isle of Man
Limerick
Newcastle upon Tyne
Newport
Peterborough
Saltaire
Skipton
Tadcaster
Thirsk
Wallingford
Warrington

Registered Office
South Barn
Broughton Hall
SKIPTON
North Yorkshire
BD23 3AE
United Kingdom

t:+44(0)1756 799919
e:info@jbaconsulting.com

Jeremy Benn Associates Ltd
Registered in England
3246693

JBA Group Ltd is certified to:
ISO 9001:2015
ISO 14001:2015
OHSAS 18001:2007

Visit our website
www.jbaconsulting.com