River Ock Basin and Catchment Flood Management Plan

Study Draft Outline

Potential to Create Sustainable Flood Control Measures for Abingdon, Oxfordshire

DRAFT

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1.Introduction

This report makes the case to adopt a more comprehensive approach to mitigating the worst effects of flooding on Abingdon that can be achieved by studying the whole catchment area of the River Ock and its tributaries. There is an urgent need for better flood defences in Abingdon and to improve the capacity of the river through the town by regular management as carried out by the Ock Flood Group. These essential works can be made more effective if land management can help to reduce the peak flow of the river during extreme storms by delaying the arrival of storm water from the headwaters arriving at Abingdon. Measures to achieve this can include strategic tree planting and woodland management along the river corridor which could also provide other positive benefits such as enhanced landscapes, reduced soil erosion that causes siltation of the river, richer habitats and improved water quality.

The 2007 summer floods cost the UK £3.2 bn with an additional £660m in damage to critical infrastructure and key services according to The Institution of Civil Engineers, ICE. The ICE report, *Flood Risk Management: A Local Issue of National Importance,* stresses that while flooding is largely a localised issue it can have significant national consequences, particularly the impact on interdependent economic infrastructure that underpin local and national economies such as power, transport, waste and water supplies. ICE warned that a reduction of £150m in the budget over the next four years (announced in the Comprehensive Spending Review 2010) could in the worst case scenario cost the public circa £4.8bn in the future.

The Pitt Review clearly asked for more Government funding for flood defences but instead they have been substantially cut, although some funds were reinstated recently. The condition that Association of British Insurers (ABI) members will continue to insure properties in flood prone areas was based on increased Government investment in flood protection. Negotiations between Defra and the ABI are continuing.

In the Abingdon 2007 flood 433 homes and 21 businesses were flooded and the town centre was badly affected for many days. Following this The Environment Agency conducted a study into flood defences and came up with five options to protect the town including the construction of a retaining dam on the west side of the A34 on Abingdon Common, approx cost £3.5. The schemes achieved a cost/benefit analysis rank of 4.1-4.7 below the funding figure of 5 so did not reach the required Defra/EA figure and was not considered financially viable.

2.River Ock Basin and Catchment

The River Ock rises near the village of Little Coxwell, then runs around Longcot, flows past Stanford in the Vale,Charney Bassett, Lyford, Garford and Marcham Mill, before joining the Thames at Abingdon, a distance of about 25km. Its catchment extends to the Ridgeway in the west, north of Stanford in the vale north and Wantage in the south.

EA Catchment Plan

There is an urgent need to improve the capacity of the Ock in its lower reaches to handle higher flood flows and improve urban flood defences within Abingdon while also reducing the flood peaks that come down the River Ock through Abingdon by effective land management measures in the upper and middle sections of the river and its tributaries.

During extreme rainstorms holding back a proportion of the water run-off from fields to delay water entering the main river at the headwaters will allow time for flood water in the lower river sections to be evacuated without overflowing banks before this additional water reaches Abingdon. Added storage capacity in the mid sections of the Ock can also hold back water for a time to even out the flow lower down the river through Abingdon. The following extract explains the fundamental principles from the *Environment Agency and Forestry Commission - Woodland for Water summary report 2011*.

Modelling studies predict that floodplain and riparian woodland have potential for attenuating large floods within downstream towns and cities. Their ability to delay flood flows offers significant scope for desynchronising flood peaks and providing more time for issuing flood warnings. There is sufficient evidence to promote floodplain and riparian(riverside) woodland planting to reduce flood risk in appropriate locations, especially when other benefits are factored into the calculation. These include enhanced biodiversity, reduced diffuse pollution and improved hydromorphology.

This land management approach has been studied in a number of river catchments in the UK. The example described here is based on the **Slowing the Flow Project** in Pickering North Yorks undertaken by Forest Research and the EA demonstrates a viable way forward to reduce flood risk in Abingdon.

This report includes a brief description of this project and a study of **Pontbren in Wales** then outlines an approach that could be conducted for the River Ock Catchment to identify areas where tree planting and others measures could be most effective in reducing flooding in Abingdon. This is a preliminary review of this approach based on examining reports by the EA

and Forest Research which requires future a more thorough study to agree a practical way forward for all the key Stakeholders.

3.Slowing The Flow, Pickering, North Yorks

Slowing the Flow at Pickering is a partnership project led by Forest Research, closely supported by Forestry Commission England, The Environment Agency, The North York Moors National Park Authority, Durham University, Natural England and the wider community. The lead funder is Defra.

Slowing the Flow is a new project that seeks to demonstrate how better land management can help to tackle the flooding problem faced by Pickering in North Yorkshire, in common with many other towns and cities across the country. There is a great deal of public interest in the project and local people and organisations are actively encouraged to participate and help achieve a successful outcome. The new approach to flood management relies on making changes to the way the landscape is managed, so that the passage of rainfall to rivers and its movement downstream is reduced and delayed. This will involve a range of 'measures', including:

* Constructing low-level bunds
* Planting more trees, especially along streamsides and in the floodplain
* Restoring woody debris dams in small streams
* Restoring wetlands.

The aim of the project is to implement a range of land management measures that will slow down water in the upper catchment, store more in the middle section and improve its conveyance through the town. Success will be gauged by the number of measures that are implemented and by their combined effect on the frequency of future flooding in Pickering.

Initially, mathematical models will be used to estimate the impact on flood risk but continued monitoring of river flows will allow these predictions to be tested and to prove whether the measures have been effective. The wider environmental benefits of the measures will also be assessed.

National pilot studies are also underway for the: Ouse, Aider, River Uck in Sussex, Pontbren in Mid Wales

4.A study of Pontbren - Does Tree Planting Reduce the Risk of Flooding?

There is growing concern that modern farming practices are increasing the risk of flooding. Changes to these practices, such as planting trees and lowering stocking rates increase the thickness of surface vegetation and improve soil structure, thus reducing the flood risk by allowing more rainwater to soak through the soil.

In Pontbren, farming practices are changing. Ten farming families in mid-Wales are changing their farming practices to ensure a sustainable future for their children. The Pontbren group, as they are known, live in a small community near Llanfair Caereinion and farm 1000 hectares in the upper reaches of the River Severn.

They aim to reduce their costs and workload by reducing the management of the most marginal land. But what's good for them may also be good for the environment. The Pontbren group noticed that planting trees reduced the amount of rainwater flowing off the land to the local streams, apparently reducing the risk of floods. To find out if this was true, they asked the Centre for Ecology & Hydrology (CEH) and the University of Wales Bangor (UWB) to study how their new farming methods are affecting the environment.

What they discovered at Pontbren. They soil measurements in grazed grassland (pasture) and in areas where trees had been planted. In the planted areas the soil structure had changed, and water moved through the soil more rapidly than in the grassland. We looked at a range of tree ages and were surprised to find that these changes occurred with trees as young as two years old Infiltration rates were up to 60 times higher within young native woodland shelterbelts compared to grazed pasture. Recent modelling predicts that planting shelterbelts across the lower parts of grazed grassland sites could reduce peak flows by between 13 and 48%26. These benefits could apply to woodland planting as a part of future sustainable drainage systems.

Current research at Pontbren. The Flood Risk Management Research Consortium (FRMRC) is a unique collaboration between research councils, government departments and agencies, and industry. The sponsors include the Engineering and Physical Science and Natural Environment Research Councils, DEFRA, the Environment Agency of England and Wales, the Scottish Executive, the Northern Ireland Rivers Authority and UKWIR (the UK water utilities' research organisation).

Support has been obtained from the FRMRC to continue and expand the experimental work at Pontbren.

This now includes:

- Experiments to investigate the effects of different land use.
- Studies on hill slopes to examine surface and subsurface runoff processes, the effects of agricultural drainage, and the effects of tree shelter belts.
- Monitoring of flows in a network of drains, ditches, small and large streams to understand the generation of river flows.

Acknowledgements - Pontbren Group, Coed Cymru, Welsh Assembly Government, Countryside Council for Wales, Forestry Commission, University of Wales Bangor, Centre for Ecology & Hydrology at Bangor.

5. Tree Planting, Landscape Impact and Ecology

There may be areas of particularly sensitive ecology that need to be identified and it is hoped that local nature groups would contribute to these tasks as well as Natural England. Landscape consultants will be able to help with the design and layout of new wooded areas to enhance the landscape value of the catchment areas and riparian planting.

Coppicing

Coppicing can increase the effectiveness of riparian woodland buffers by maintaining the optimum vegetation structure for river morphology and sediment trapping, and by enhancing

tree growth and thereby nutrient uptake. Coppicing is also an effective measure for increasing hydraulic roughness and delaying flood flows.

Additional gains can result from SRC for energy crops by further promoting vegetation roughness and productivity. The planting of high yielding willow has been shown to be very effective at removing nutrients and reducing the oxygen demand. Similarly, the rapid growth and multi-stemmed nature of these crops makes them ideally suited to flood risk management. Available payments for the planting of energy crops and income generated by selling the harvested biomass also makes this an attractive option for landowners.
(Woodlands for Water. Forest Research 2011)

Hydraulic Roughness

The increased hydraulic roughness associated with planting native floodplain woodland along a 2.2 km grassland reach of the River Cary in Somerset was predicted to reduce water velocity by 50% and raise the flood level within the woodland by up to 270 mm for a 1 in 100 year flood Temporary flood water retention increased by 71% and the downstream progression of the flood peak was delayed by 140 minutes.

Riparian woodland acts in a similar way to floodplain woodland but on a different scale. In addition to the hydraulic roughness associated with bankside and adjacent trees in the riparian zone, the presence of large woody debris (LWD) dams within stream channels acts to delay flood flows, promote out-of-bank flows and increase flood storage. Studies show that these porous dams can significantly delay flood peak travel time, although the effect reduces with size of event and condition of the dams.
(Environment Agency and Forestry Commission - Woodland for Water summary report)

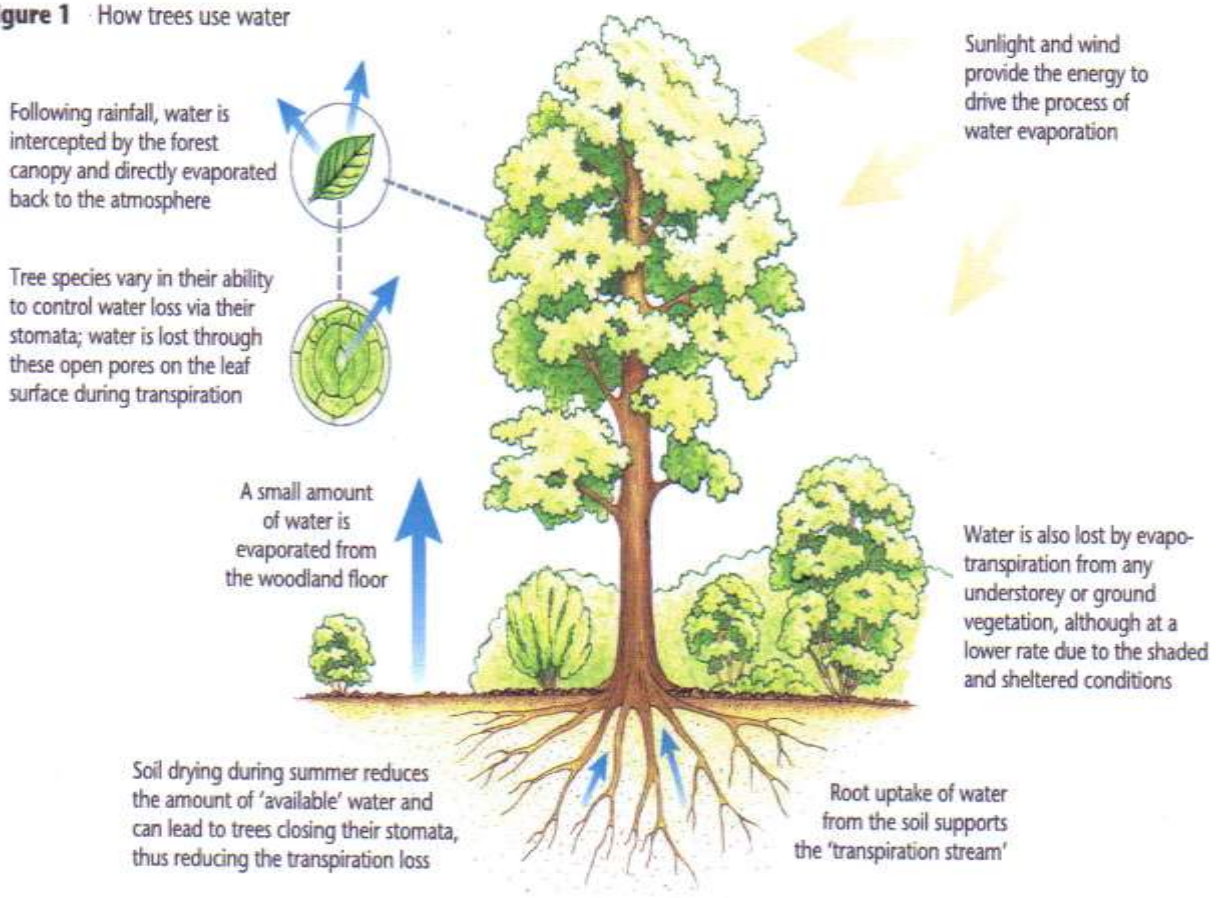
Evapotranspiration

Trees extract large quantities of water from the ground and lower the water table

Evapotranspiration is the term to describe the total loss of water from land by trees:

- by evaporation from leaves
- through transpiration through roots
- interception of rain water by leaves and branches.
  (Water Use By Trees. Forestry Commission 2005. Image)

Figure 1 How trees use water



Key terms describing the processes that govern water use by trees:

Evaporation: The process by which water changes from a liquid to a vapour. The rate of evaporation is dependent on the amount of solar radiation, the temperature of the air and water, humidity and wind speed.

Transpiration: The process by which water taken in by tree roots from the soil is evaporated through the pores or *stomata* on the surface of leaves.

Interception: The process by which water held on the surface of leaves, branches and trunk during and after rainfall is directly evaporated back to the atmosphere. Often expressed as a proportion of annual precipitation (interception ratio).

Evapotranspiration: A term describing the total loss of water by evaporation from the land, including that lost by interception, transpiration and directly from the soil surface.

Penman (Potential) Evapotranspiration (PEt): The total loss of water by evaporation from an actively growing, short, green (grass) crop that is never short of soil water (see Alternative land cover).

6. River Ock Catchment Flood Management Study. Draft

The Outline Programme for the study includes a number of tasks, these include:

1. List all potential stakeholders, businesses and groups who have an interest and could participate.
2. Form Steering Group
3. Liaise with EA concerning mapping of Ock catchment area and collate all existing data, topographical data, modelled flood maps, modelled flow rates, records of flooding from all sources such as; groundwater, surface water, minor and ordinary watercourses, main rivers and sewers.
4. Identify additional data required, such as topographical surveys of watercourse and river channels.
5. Identify suitable computer modelling programmes required to carry out flood modelling of watercourses and main rivers not currently modelled.
6. Prepare Terms of Reference of initial study and list available resources and skill to carry it out, such as:

- Hydraulic engineers
- EA and FC advice and information.
- Strategic Flood Risk Assessment
- Parish Council Flood Reports
- GIS based Opportunity mapping for identifying where woodland creation in the landscape
- Ecologists- to map all sensitive areas, ecologically sensitive areas, historic sites-White Horse Hill, etc
- Landscape consultant - to assess potential impact on landscape
- Funding advisors to investigate all sources of funding.
- Estimate outline cost of study.

7. Funding

Forestry Commission Woodland Creation Grant supports the establishment of new woodlands that meet government priorities. To qualify for this grant the application and subsequent activities must meet the standards of environmental protection and practice set out in the UK Forestry Standard and its supporting guidelines. The aim of this grant is to create woodlands that generate public benefits. Particular priorities are new woodlands:
To help reduce flood risk, improve water quality and prevent soil erosion; To be eligible for this AC the new woodland must be:

- within a priority target catchment
- in the right location within the target catchment
- comply with the design principles outlined in EWGS 7 National Guidance: Woodland Creation Grant

The study will investigate if local farmers in England will be eligible to apply for grants of up to £10,000 when the Catchment Sensitive Farming capital grant fund opens for applications on Friday 1st March 2013. Grants will be available for carrying out practical works on farms that

will help boost the health of England's streams, rivers, meres and mosses by improving water quality and reducing pollution from agricultural activity. The fund, which is administered by Natural England, operates across England and is available to holdings situated within the CSF project's 79 catchment areas.

8. **Land Ownership and Additional Funding**

Once potential areas for planting and flood detention ponds have been identified the landowners need to be identified to open discussions on funding and commercial use of timber and biomass, etc. Additional sources of funding could include:

- Commercial investments; including woodland products, firewood, biomass
- Woodland charities
- Local Govt, County Council, District Councils
- Local businesses that would benefit most from flood defences.

9. Summary

It is clear that engineered flood defences in urban areas will struggle to cope with increasingly frequent severe flooding and insufficient public funds will be available to cover all flood prone areas in the country so a more comprehensive solution that works with nature is required.

The landscape of Britain has been slowly evolving in line with changes in agricultural practices since the process of enclosure of common lands began to be a widespread feature of the English agricultural landscape during the 16th century. In more recent times farmers have received financial incentives to remove hedgerows to combine fields into larger units to be more efficient for agriculture which has led to losses of hedgerows with their benefits to wildlife, retention of soil to prevent silting of rivers and holding back water from flowing too quickly into stream courses. *(Together with woods, hedges reduce the rate of flow of water within catchments, so help to reduce flooding downstream. A comparison between two very similar catchments in Brittany, one with hedges and the other without, showed that peak flows in streams are less extreme and minimum flows greater in the hedged areas.(Ref Hedgelink.)*

This part of Oxfordshire is fairly sparsely wooded so an increase of woodland cover could help rebalance our lack of tree cover. Our location within Science Vale and next to a famous seat of learning makes a scientifically sound and sustainable solution particularly appropriate to alleviate the flood risk that casts a shadow over the lives of many Abingdon residents.

If this study and appropriate tree planting had taken place after the 2007 Summer Floods then many trees would already have been in place for five years and Abingdon and the Ock catchment would already have the framework for a long term sustainable flood defence strategy in place.

Scientists involved say that more research is needed to fill evidence gaps which is good science, however given the urgency of the local situation, it seems that the balance of benefits make suitably located tree planting a viable and practical means to delay flood waters at the headwaters after heavy rainfall. Creating a time lag has the potential to desynchronise the flood flows from tributary catchments and so lower the downstream flood peak as the main river flows through Abingdon. Such an approach to sustainable flood defence is able to naturally expand and grow over time in step with the increasingly wet weather predicted through global warming.

References:

1.Woodland for Water: Woodland measures for meeting Water Framework Directive Objectives
Forest Research Monograph: 4 2011

2.Project SLD2316: Restoring Floodplain Woodland for Flood Alleviation.
Forest Research 2008

3. EWGS 7: Woodland Creation Grant
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4.Water Use by Trees.
Forest Research. 2005

http://www.environment-agency.gov.uk/research/planning/136425.aspx

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SAFAG

South Abingdon Floodplain Action Group was formed in 2001 to oppose development by Discovery Properties of a hotel and industrial property on the large publicly owned site west of Tesco. As this site lies within the functional floodplain of the River Ock residents felt that the loss of the floodplain could increase flood risk in South Abingdon.

The Tesco store was built before the EA tightened regulations through Planning Policy Statement 25 – Development and Flood Risk, which restricts development within the floodplain. Despite occupying a very large site within the floodplain and the store being flooded in 2000 and 2007 Tesco have applied to expand the store and would relay the car park with permeable paving and provide a compensatory flood storage area.

SAFAG have always maintained that Tesco should carry out these improvement works to help mitigate the effects of their existing store that has removed a large area of permeable land from the floodplain and may have made the flood risk higher. A financial contribution towards future flood risk measures would be an appropriate contribution by a company sensitive to local needs.

SAFAG prepared a Management Plan for the creation of the Ock Meadow Nature Reserve in Nov 2002, this was subsequently designated as a Local Nature Reserve.

Malcolm Moor. SAFAG.

JTConsulting:

- Carried out river flood modelling and flood mapping for flood risk assessments, using Infoworks RS.
- Carried out Sustainable Drainage System (SuDS) design and flood mitigation design, for new and existing developments, using WinDes MicroDrainage.
- Conducted Flood Risk Assessments for Greenfield and Brownfield site developments, in accordance with the National Planning Policy Framework 2012, Flood and Water Management Act 2010 and Environment Agency's Flood Risk Standing Advice, to mitigate and reduce flood risk from all sources of flooding.

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