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Integrated washland management for flood defence and biodiversity

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Abstract*

In the context of growing interest in finding sustainable solutions to flood management in England and Wales, this study set out to determine the extent to which benefits to flood management and biodiversity can be achieved through an integrated approach to the creation and management of 'washlands'. For the purpose of the study, a washland is defined as "an area of the floodplain that is allowed to flood or is deliberately flooded by a river or stream for flood management purposes, with potential to form a wetland habitat".

Following a questionnaire survey of engineers and conservationists, a review of selected sites, and a workshop of key stakeholders, it was concluded that there is both scope and willingness to exploit potential synergy. It appears, however, that until now most washlands have either been used mainly for flood storage or for wetland habitat, and there has been only a limited attempt to integrate the two objectives.

In many respects, the opportunity for integrating biodiversity depends on the ability to maintain wet conditions on the washland beyond the period of the flood event, and this largely depends on the dominant land use. The scope is greatest where the washland is under grass or woodland, and actions can be taken to 'engineer' or manage soil wetness regimes which serve biodiversity interests. Such water management plans and related biodiversity targets are best designed into washland management from the outset, rather than as an afterthought, when conflicts of interest are likely to arise.

While there is much interest in pursuing an integrated approach, lack of funding for biodiversity on washlands and the relative complexity of preparing the washland case for appraisal appear to constrain washland development. Nevertheless, washlands are perceived by engineers and conservationists alike to offer potentially sustainable solutions to flooding, enabling biodiversity targets to be met within an integrated approach to catchment flood management.

Recommendations were made to:

- improve, through the use of guidance and training, understanding between engineers and conservationists of how flood management and biodiversity objectives can be simultaneously achieved;
- consider the establishment of a biodiversity fund to support the biodiversity components of washland schemes;
- develop practical guidance on the formulation of washland management plans that exploit biodiversity potential by managing wetness conditions in washlands beyond the flood-event period;
- review how washland creation and management can be integrated and help to deliver the objectives of Biodiversity Action Plans and Catchment Flood Management Plans.

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Executive summary

S1 Context

A combination of agricultural policy reform, changing priorities in the countryside, growing commitment to protect and enhance biodiversity and concerns about increased flood risk in lowland areas have drawn attention to the potential benefits of managed washlands. In this context, this study set out to determine how, and under what conditions, washlands might be developed to deliver both flood management and biodiversity benefits. The study also considered the extent to which improvements in habitats might be achieved within a predominantly flood defence framework.

S2 Definition of a washland

The study defines a washland as “an area of the floodplain that is allowed to flood or is deliberately flooded by a river or stream for flood management purposes, with potential to form a wetland habitat". This broad definition includes areas which provide natural storage as well as artificial storage and is justified because, in the context of England and Wales, virtually all river systems are managed in some way, and the retention or creation of natural storage is itself a management decision. Furthermore, the definition incorporates the setback of agricultural defences which restore natural floodplain.

S3 Approach

The approach to the study included the following activities:

- a review of research literature;
- an exploratory enquiry with key informants;
- a survey of flood defence engineers and conservationists within the Environment Agency and Non-governmental Conservation Organisations to ascertain perceived synergy between flood defence and biodiversity, and how this might be achieved in practice;
- site surveys and interviews with relevant personnel on five selected washland sites in England;
- a review of selected experience elsewhere in Europe;
- the development of a framework to classify washlands according to flooding and groundwater regimes, land use and habitat potential;
- compilation of a ‘menu’ of engineering and management interventions to enhance the habitat value of washlands;
- a one-day participatory workshop, attended by 35 representatives of key stakeholder groups, including personnel from Defra, English Nature, the Environment Agency and a range of Non-Government Organisations. Participants discussed the preliminary outcomes of the study, confirmed the main issues which define the feasibility of integrated washland development, and made recommendations for action.

S4 Washland classification

Washlands take a variety of forms and demonstrate a variety of characteristics. For management, washlands can be classified according to:

- flood regime;
- soil wetness (beyond the flood period); and
- land use and related habitats.

Given the purpose of defining the scope for integrating flood management and biodiversity, it is important that these defining characteristics are accommodated within a framework which can guide appropriate management strategies.

A two-stage approach was developed. The first, referred to as the Hydraulic Matrix, (Table S1) classifies washlands according to degree of hydraulic control of the inflow and outflow of flood waters, reflecting a mainly engineering and flood management perspective. Generally, the greater is the degree of engineering intervention, the greater is the degree of control.

Table S 1 Hydraulic Matrix: washland classification by degree of hydraulic control

		Inflow		
		Uncontrolled inflow	Fixed controlled inflow	Variable controlled inflow
Outflow	Uncontrolled gravity return	**1**	**2**	**3**
	Fixed controlled gravity return	**4**	**5**	**6**
	Controlled return (sluices/pumps)	**7**	**8**	**9**

The second stage, referred to as the Habitat Matrix (Table S2), captures those attributes of washland hydrology that critically define the type and quality of the habitat that exists or can be created. From a flora viewpoint, habitat type and quality depend on the duration and seasonality of flooding and, in many ways more critically, on the relative wetness of washland soils during the post-flooding periods. Any one cell in the Habitat Matrix can have up to ten variants in habitats depending on the detail of water regimes and site conditions. The habitat potential for fauna also depends on non-hydraulic features such as size, connectivity and freedom from human disturbance.

Although there is no direct link between the Hydraulic and the Habitat matrices, it is possible to adopt interventions to engineer and manage particular flooding and soil wetness regimes and thereby exploit habitat potential. These are listed in a ‘Menu of Interventions’ (Table S3).

The typology provides a logical framework for classifying washlands in terms of flood management and biodiversity. The classification is output rather than input driven, perceiving engineering and management options as the means by which flood management and biodiversity objectives can be met. The classification method can be used in two ways: to show the habitat potential of a given water regime, or to show the changes in water

regimes needed to achieve a desired change in habitat. The choice of most appropriate intervention method to achieve this change will depend on site conditions.

Table S 2 Habitat Matrix: washland classification by flood and soil water regimes and related habitat types

	Winter flooding only			Flooding at any time of year		
	Rapid soil drainage	Moderate soil drainage	Slow soil drainage	Rapid soil drainage	Moderate soil drainage	Slow soil drainage
Short duration flooding	**1** Arable Hay meadow Pasture Alder Woodland	**2** Flood meadow Pasture Alder Woodland	**3** Flood meadow Inundation pasture Alder Woodland	**4** Water Meadow Pasture Alder Woodland	**5** Inundation pasture Alder Woodland	**6** Inundation pasture Rush pasture Swamp Willow carr
Medium duration flooding	**7** Hay meadow Pasture Alder Woodland	**8** Flood meadow Pasture Alder Woodland	**9** Flood meadow Inundation pasture Willow carr Swamp	**10** Pasture Rush pasture Willow carr	**11** Inundation pasture Rush pasture Swamp Willow carr	**12** Inundation pasture Rush pasture Swamp Willow carr
Long duration flooding	**13** Flood meadow Pasture Willow carr	**14** Inundation pasture Rush pasture Swamp Willow carr	**15** Inundation pasture Rush pasture Swamp Willow carr	**16** Swamp Willow carr	**17** Swamp Reedbed	**18** Swamp Reedbed

Table S 3 Menu of Interventions to modify flooding and soil drainage

Actions to modify frequency/duration of washland flooding and the downstream hydrograph	**Actions to modify washland soil drainage conditions**
Set-back/removal of embankments	Vegetation management to facilitate natural retention
Introducing/lowering spillways in banks	Control outflow sluices
Decreased channel maintenance leading to increased in-river and bank vegetation	Changes in pumping regime
Creation of on-line dams/sluices	Introduce hydrological compartments
Increased pumping/siphoning into washland	Create scrapes
Reduced pumping/restricted gravity outflow from washland	Modify ditches
Increased vegetation height on floodplain	Introduce subsurface pipes
Lowering of floodplain	Increase ditch ‘roughness’
Ecological flooding: retention and evacuation just in time for next flood	

S5 Conclusions

The following conclusions are drawn:

Defining washlands

For the purpose of integrating flood defence and biodiversity objectives, it is considered appropriate to adopt a broad, inclusive definition of washlands which includes areas which provide natural as well as artificial storage.

Classification framework for washland water regimes and habitats

The classification framework confirmed that flood duration, flood seasonality and wetness conditions in the washland are the key factors that determine the potential type and quality of washland habitat. The retention of surface and soil wetness beyond the flood event period is a particularly critical determinant of habitat quality. The study showed that habitat potential on washlands mainly depends on land and water management practices beyond the flooding period, especially the management of groundwater levels.

Scope for synergy between flood management and biodiversity

With respect to a key objective of this study, whether biodiversity objectives can be met within a predominantly flood defence framework, the answer appears to rest on whether the dominant land use requires flood and land drainage regimes which are not conducive to habitat creation. Most parts of the flood plain have the potential to be maintained in a wet condition, but whether they are or not depends on the drainage requirements of the dominant land use and the expectations of land managers. Where the washland is given to arable cropping (implying infrequent flooding and rapidly drained soils), the scope for habitat enhancement is often limited. Where washlands are given to grassland or woodland (often implying more frequent flooding and wetter ground conditions), there is more scope for habitat improvement. Some species-rich grassland, however, requires short duration flooding followed by rapid soil drainage which is fully compatible with flood defence preferences. This confirms that even within a predominantly flood defence framework there can be scope for synergy, but much depends on dominant land use.

The main source of conflict between flood management and biodiversity objectives on washlands arises with respect to the duration and seasonality of flooding. Flood management generally requires the storage of flood water during the period of peak flows followed by evacuation of flood water as soon as possible in order to secure the storage facility for re-use. Biodiversity objectives, however, usually require some retention of water beyond the flood period. Opportunities for synergy rest on the ability to reconcile these interests, for example, by over-designing flood storage capacity so that the wetness of the washland beyond the flood event period is retained without compromising flood storage capacity when it is needed. In many respects, the potential to exploit biodiversity rests on the ability to separate out the management of flood events and non-flood water regimes.

The study showed that it is possible to create a range of land uses and related habitat types in a given washland through intervention measures which modify flooding and soil drainage. The scope for habitat creation, and the suitability of engineering and management interventions, will however vary amongst sites. Large washlands in particular could support

a diverse mosaic of habitat types involving a range of management interventions creating variations in flooding and soil water conditions.

Evidence of integration

Although flood defence managers and conservation officers perceive potential synergy between flood management and biodiversity in washlands, the English and European case studies show that there has been limited achievement of this in practice. Older, established washlands appear to have been developed primarily for flood defence where agriculture has developed within the prevailing flood regimes. Little attention was paid to biodiversity. However, more recently, in the light of reduced viability of conventional farming, biodiversity options have sometimes been taken up through agri-environment schemes independent of any changes in flood management.

Initial design

For new washland schemes, potential synergy is best exploited if it is included at the design stage. For example, species rich grassland and breeding waders require or can tolerate short duration flooding followed by relative quick drainage of the land, which is the regime best suited to flood storage. This can be engineered by creating a microtopography to give good drainage in general whilst maintaining wet features in scrapes and foot drains. In this respect, there is scope for compatibility of flood defence and biodiversity objectives. Biodiversity has been a more explicit aspect of scheme design for more recently completed schemes, and synergy has been achieved. The key to successful washland biodiversity is a site specific water level management plan targeted at specific outcomes, with appropriate interventions in place to deliver this.

Washland types

The study concludes that is valid and useful to distinguish three types of washlands according to priority, namely:

Flood management washlands where flood management is the main concern and biodiversity is a secondary consideration;

Integrated washlands where flood management and biodiversity are given equal importance; and

Conservation washlands where biodiversity is the main concern and flood management is secondary.

Such a framework can help to promote understanding and agreement about what a particular washland can reasonably be expected to deliver, as well as the identification of appropriate management and funding arrangements. It was generally felt, by flood managers and conservation managers alike, that flood management objectives should take precedence where there is serious risk to human welfare, such as during a major flood event.

Funding and administration

During discussions with flood managers and conservation managers, there appeared to be agreement that, although flood defence budgets cannot be expected to be a major source of

funds for biodiversity enhancement, some limited allocation of funding for biodiversity within flood defence budgets was possible. Strong arguments were made, however, for designated funds for biodiversity to be channelled through Defra and the Environment Agency. This, it was argued, is required if the development of integrated washlands is going to happen on the scale possible or desirable. Such designated biodiversity funds would be a key source for integrated washlands. Proposals for integrated washlands should focus on BAP targets, for it is these that will determine access to funds for biodiversity in future.

Administrative arrangements

Of the options for the administration of washlands, land purchase was commonly perceived by flood and conservation managers to be the best arrangement for securing integrated washland development, because this gave the greatest degree of control over water regime and habitat management. This has implications for funding.

Appraisal

Strong views were expressed by both flood managers and conservation officers that the current priority scoring and benefit:cost appraisal methods used to judge the viability of schemes do not adequately recognise and value the environmental and other benefits associated with the washland option. This may be due to a shortcoming in the policy and appraisal process, or it could be that existing guidance is misunderstood or not properly applied. This identifies a need to consider how guidance is currently used, whether it is suitable in its present form, and whether there are needs for training to equip users with the appropriate knowledge and skills to prepare and present integrated schemes.

Awareness creation and stakeholder interaction

There is a general feeling that a lack of awareness and understanding between engineers and conservationists means that opportunity for synergy is not identified or taken up. The study revealed a bias towards conventional rather than sustainable solutions to flooding problems. The perceived relative complexity of the washland option, involving multiple objectives and stakeholders and more complicated appraisal methodology and funding mechanisms, presents particular challenges. There appears to be a need for guidance, experience-based learning and case study material to support washland development, targeting the needs of various stakeholder groups.

Catchment scale

It is perceived that the search for synergy must be considered at the catchment level, recognising that different sites will have potential to serve different needs. There is a strong call to integrate CFMPs and BAPs as a means of actively searching out opportunities for compatibility of flood management and biodiversity.

Policy review

There is a general feeling that lack of integration of policy and related funding mechanisms currently acts as a barrier to integrated washland management. Overall, it is apparent that, in spite of the commonly held view that integrated washlands are feasible, desirable, and

potentially offer good value for money, they are unlikely to make a significant contribution to BAP targets without a major shift in policy, administration and funding regimes.

S6 Recommendations

The following recommendations are made.

Guidance to support the creation and management of washlands

Consideration should be given to undertaking a review of existing guidance to determine whether it is fit for purpose and accessible for those who need it. There is a clear need to develop a better understanding between engineers and conservationists of the extent to which flood defence and biodiversity objectives can be achieved through integrated washlands. There is also a call for guidance on how engineers and conservationist can work together to find sustainable solutions that serve multiple purposes, rather than, as has been the case to date, having one or other added on as an afterthought. Such guidance, will help clarify, justify and gain acceptance of the balance of priority given to flood management and biodiversity on a given site or within a given catchment.

Assessment of training needs, and design and delivery of training

There is a clear need for training to facilitate an improved understanding between the flood management and conservation functions, and practical methods of integration. There is specific need to improve knowledge of the principles and competency in the practice of the design, preparation and appraisal of projects which can integrate flood management and biodiversity. Practical, case-study based training materials demonstrating the application of guidance should be prepared accordingly. These should be delivered through a series of participatory short courses to relevant personnel within Defra, Environment Agency and other organisations as appropriate.

Policy guidance

Defra, English Nature and the Environment Agency should consider the production of a policy note on washland creation and management which states the purpose and rationale of an integrated approach to washland management and, in broad terms, how, under what circumstances and through what mechanisms this might be achieved in practice.

Funding for washlands

Consideration needs to be given to funding mechanisms for washlands, especially given the clear preference by engineers and conservationists for land purchase. Three types of washland schemes were identified in terms of the balance of priority. It is recommended that funding sources are identified for each of these scenarios.

Consideration should be given to establishing a biodiversity fund operated by the Environment Agency on behalf of Defra which could finance the biodiversity component of washland schemes. This would be a major source of funds for integrated washlands and possibly for some predominantly conservation washlands, although the latter would most likely continue to draw funds from other sources as they do now.

Where the additional cost of achieving environmental enhancement within flood storage schemes is small, it may be possible to fund this from existing flood defence budgets. It is recommended that those responsible for preparing schemes are made aware of the scope for such funding and that guidance is provided on how to make the case for using funds in this way.

Development of Washland Management Plans

There is a need to develop Water Level Management Plans specifically for washlands which address the flood event and the management of water levels beyond the flood period. These water management plans will focus on intervention methods to supply and retain water on the surface, in the drainage network and/or in the soil profile as required, while at the same time securing the flood storage facility. Although it is recognised that practical recommendations must be site specific, this review, drawing on examples and existing knowledge, would help provide guidance on sources of information and the selection of appropriate management interventions.

Washland strategy

It is recommended that the Environment Agency seeks better ways of integrating Biodiversity Action Plan targets into flood defence schemes, possibly by drawing up specific biodiversity targets for the river basin or catchment. It is strongly recommended that a review of washland potential in the context of BAP and CFMP is undertaken for selected pilot catchments, in order to inform a washland strategy.

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