

# Rivers & Wetlands Best Practice Guidelines



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## MIDLANDS REGION ADDRESSES

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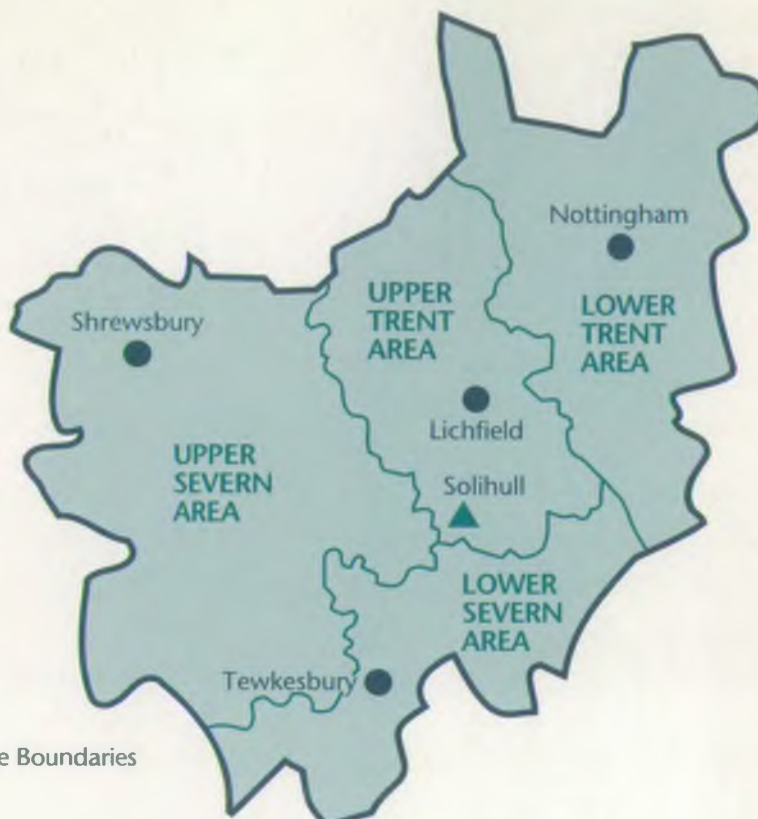
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— Area Administrative Boundaries

— Regional Boundary

● Area Office

▲ Regional Headquarters

Environment Agency  
Information Centre  
Head Office

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### HEAD OFFICE

Rio House, Waterside Drive,  
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Bristol BS32 4UD

*EA Midlands*

For general enquiries please call your local Environment Agency office. If you are unsure who to contact, or which is your local office, please call our general enquiry line.

ENVIRONMENT AGENCY  
GENERAL ENQUIRY LINE

**0645 333 111**

The 24-hour emergency hotline number for reporting all environmental incidents relating to air, land and water.

ENVIRONMENT AGENCY  
EMERGENCY HOTLINE

**0800 80 70 60**



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# Ponds

Ponds are important wildlife habitats which support a wide variety of wetland plants and animals including rare and endangered species.

The following guidelines contain general information on:

- Designing a pond
- Planning a pond
- Construction/bank profiles
- Planting
- Plant list
- Managing your pond

The Environment Agency encourages the creation of new ponds and management of existing ponds in order to:

- Create landscape features and wildlife habitats.
- Conserve varied habitats and species diversity.
- Link wildlife corridors such as hedges.
- Improve landscape appearance, particularly on derelict land.
- For smaller ponds see 'School Ponds' booklet.
- Further information available from Environment Agency Area office.



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**If carefully designed there is much that can be done to maximise the benefits of new ponds for wildlife.**

## Design

**A pond should look natural and blend into the landscape or immediate surroundings. This can be achieved and valuable habitat created by doing the following:**

Creating irregular edges with bays and spits to shelter wildlife and planting.

Grading spoil into the surrounding area when appropriate, or removed offsite.

Planting a few bankside trees for wildlife and shade.

On the northern side, keeping the south facing bank unshaded to allow sunlight to the water.

Restricting access to the water's edge by livestock to avoid damage and pollution of the water.

Providing a wide range of habitat to encourage greater diversity of wildlife.

Allowing some cattle trampling of shallower banks, providing invertebrate habitat and therefore feeding ground for waders.

Including some trees in all pond creation projects. Native low shrubs provide shelter for wildlife without overshadowing bays.

Assessing existing sources of water supply which feed the pond and considering water quality and quantity.

Creating gently sloping banks and bays to allow easy access for wildlife, therefore in places the vegetation, should be kept to a minimum. Gravelly 'beaches' are valuable.

Allowing margins to develop where land meets water, creating a very productive and valuable area in terms of wildlife. An indented shoreline and variety of bank shapes extends marginal habitat.

Providing islands separated from banks by deep water to create refuge for wildlife.



# Ponds

## Planning

These general guidelines advise on the creation of valuable wildlife habitats and attractive landscape features with new ponds or existing ponds and pools. Even the smallest pond can support a wide variety of habitat and good marshy wetland around the pond will encourage species diversity.

### Checklist

- 1 The best use is made of landform; a pond is likely to look and function better in a hollow or low point.
- 2 The pond will be appropriate to the existing landscape.
- 3 There is adequate access to the site to be able to construct the pond.
- 4 Services (gas pipelines, telephone wires etc.) are not interfered with.



- 5 No public footpaths cross the pond site.
- 6 That any existing rich wildlife habitat is protected.
- 7 That neighbours who may be affected, are aware of the proposals and in agreement.
- £ Grants or funding may be available:
  - English Nature/CCW
  - Local or County Authorities
  - MAFF/Welsh Office
 or from many other sources.

### Physical planning

#### 1 Water

A readily available source of water is required, either streams, ground runoff, springs or a high water-table. This will determine to some extent the siting of the pond.

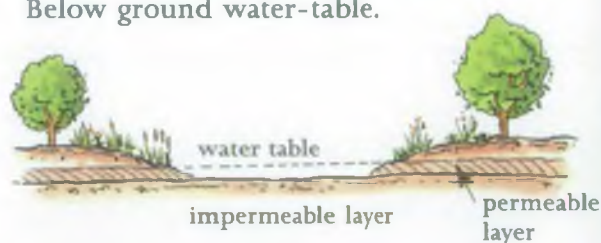
Good water quality is essential.

#### 2 Soils

Clay is the best material in which to create a pond as it makes a good permeable lining, therefore tests need to be done to determine the porosity of the soil.

#### 3 Pond creation without a liner

- a Below ground water-table.



- b Shallow cut and fill or scrapes adjacent to streams.
- c Damming of streams ('on-line').



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Locating the pond near an existing wetland environment encourages the rapid establishment of flora and fauna.

This is further aided by retaining as much of the existing vegetation as possible.

- 1 All ponds, and not only those close to rivers, form part of the aquatic environment and the Environment Agency has an interest in their creation, conservation or enhancement.
- 2 The Environment Agency advocates that where possible ponds are formed without an artificial liner. The movement and disposal of spoil must be carefully considered.
- 3 Before any work can commence, the Environment Agency needs to be consulted about Abstraction, Impounding, Land Drainage Consent, Discharge Consent and Water Quality.
- 4 Planning Permission from the Local Authority may be required. There may also be other nature conservation, landscape, planning or archaeological designations on the land.
- 5 If constructed adjacent to a watercourse, a margin of approximately 8 metres should be left clear for maintenance and access along the river.

**N.B.** Safety aspects must be borne in mind throughout the planning process.



# Ponds

## Construction

- 1 Clear unwanted vegetation and carry out any immediate management, for example pollarding or coppicing.



(Longer term management procedures should always be introduced gradually).

- 2 Good access to the site for machinery is essential. De-watering pumps may be needed temporarily if working in very boggy, damp areas.
- 3 Peg out the shape of the pond with stakes, marking the outlines of bays, spits and islands.
- 4 Machinery tends to produce harsh 'engineered' edges, so these need careful monitoring to create natural slopes and a variety in bank profile.
- 5 Leave as many rough surfaces as possible to speed recolonisation and extend variety of orientation at a detailed scale.

- 6 Unless the spoil can be used locally and marries into surrounding landform, it needs taking off site and must never be deposited on the flood plain of any watercourse.
- 7 The Environment Agency encourages ponds to be formed without artificial liners, but if a liner is required puddled clay is preferable, where there is a local source of clay.
- 8 Cover liner or base with at least 300mm of topsoil and deeper in parts where plants are to establish. Consider the need for a silt trap at the inlet point.



- 9 Allow to fill with water either from an existing stream or piped water or by natural filling such as a high water table.
- 10 Consult the Environment Agency Area Office for guidance on fish stocking.



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## Bank Profiles

Marsh areas can be created by making a scrape just above the water level or by taking advantage of an already damp area

Small cliffs can also be created preferably on the western or eastern side for kingfishers and sand martins to nest.

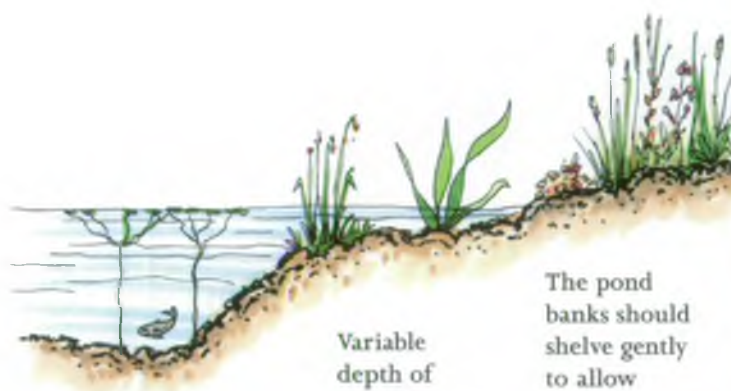
In planning the vegetation on the banks of the pond, a careful mix should be aimed at to support different forms of wildlife.

Choose vegetation that is growing locally or at other ponds in the area.

Well designed ponds with deep as well as shallow parts are less likely to dry out in summer, therefore a permanent aquatic environment can be established.

### Islands

Safe refuge from predators for wildfowl. In large ponds islands can be planned into the design – in small ponds they may be artificial floating islands. See 4.3.



Deep water refuge is needed for fish to shelter in winter storms and keep cool in summer. Bottom rooting plants establish here.

Variable depth of water allows different plant species to colonise.

The pond banks should shelve gently to allow creatures such as amphibians or wildfowl to leave the water.



### Reeds

Reed beds can be created as an additional habitat as well as a feeding ground for wildlife.



# Ponds

## Planting

When planting, the selection of correct species is very important. The selection of plants ensures that all the environmental demands can be satisfied.

### Principles

- Retain original vegetation wherever possible.
- Establish which plant types do well in the area.
- Replant some of the more unusual specimens.

### What do plants do?

- Provide food for fish, insects and mammals.
- Provide shelter and cover from predators.
- Encourage invertebrate life in the water.
- Integrate the pond into the landscape.

### Plant Sources

Neighbours, nurseries and specialist (aquatic) nurseries.



### What to plant

Native species are best as certain invertebrates and mammals are associated with them.

### When to plant

Aquatics and marginals in the spring, trees and shrubs in winter.

### How to plant aquatics and marginals

Plants must not be allowed to dry out before planting.

Cuttings can be pushed into mud or under stones, taking care not to damage shoots.

In deeper water, plants (roots wrapped in hessian), attached to stones and sunk.



Blackthorn

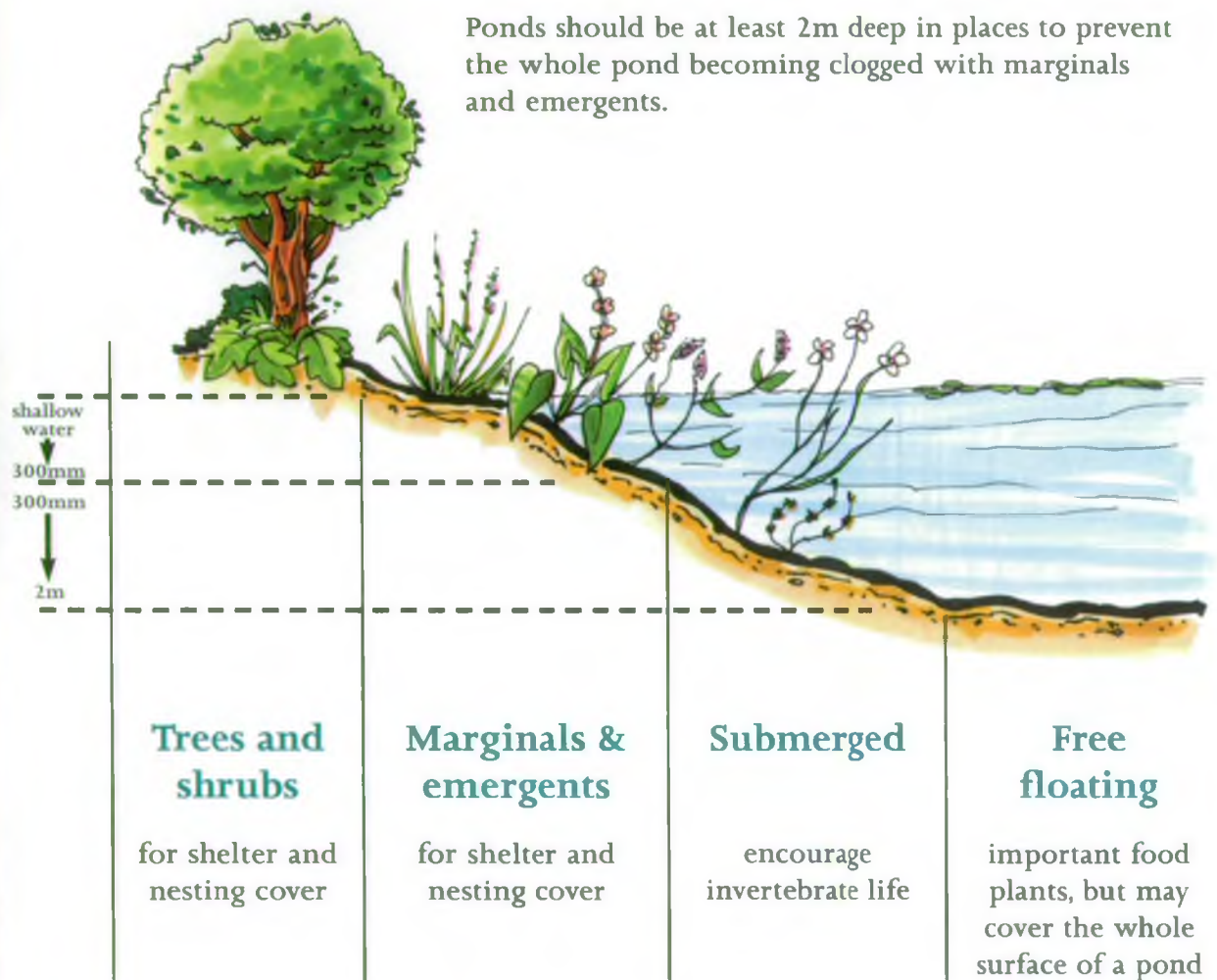


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## Planting

Ponds should be at least 2m deep in places to prevent the whole pond becoming clogged with marginals and emergents.





# Ponds

## Plant List

When planting, the selection of correct species is very important so that a balance can be created to maximise habitat value and avoid dominance by single species.

### Plants which are not desirable fall into three groups:

- 1 Those which present a health hazard, namely, Giant Hogweed (*Heracleum mantegazzianum*)

Hemlock (*Conium maculatum*)

- 2 Those which are invasive and may prove difficult to control Japanese Knotweed (*Reynoutria japonica*) Himalayan Balsam (*Impatiens glandulifera*)



Norfolk reed (*Phragmites australis*) and bullrush (*Typha latifolia*) are too dominant for a small pond, but suitable for large scale wetland creation.

Fringed water lily (*Nymphaoides peltata*)

Canadian pondweed (*Elodea canadensis*)

- 3 Those which have little habitat value.

Sycamore (*Acer pseudoplatanus*)

Snowberry (*Symphoricarpos racemosus*)

Cypressus (spp.)

### Pool or stream margins

#### Suitable species:

Arrowhead (*Sagittaria sagittifolia*)

Flowering rush (*Butomus umbellatus*)

Brooklime (*Veronica beccabunga*)

Water plantain (*Alisma plantago-aquatica*)

Branched bur-reed (*Sparganium erectum*)

Club Rush (*Scirpus lacustris*)

Sedges (spp.)

### Marshy sites

Flag iris (*Iris pseudacorus*)

Marsh marigold (*Caltha palustris*)

Rushes (*Juncus* spp.)

Meadowsweet (*Filipendula ulmaria*)

Water mint (*Mentha aquatica*)

### In water

Yellow water lily (*Nuphar lutea*)

Common water crowfoot

(*Ranunculus aquatilis*)

(flowering water)



Common water crowfoot



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# Plant List

## Ground cover

### Bramble

(*Rubus fruticosus*)

### Common ivy

(*Hedera helix*)



Wild flower mixes can now be obtained from commercial suppliers. Make sure that the mixture is appropriate to the soil and conditions for which it is required, for example a wetland mix for clay soils should be used on a clay flood plain site.

## Trees

Some plants have greater value for habitat than others, for example native species such as oak and willow support 284 and 266 species of insects respectively, whereas introduced species, such as fir, support only 16 species. Therefore before making a choice, it is important to check their appropriateness against the following criteria:

- should be native, for example English oak as opposed to red oak.
- be appropriate locally and in the broader landscape.
- tolerate damp conditions and/or occasional flooding.
- fulfil functional requirements of planting in that location.
- provide wildlife habitat, (food and cover).
- be appropriately planted within the flood plain, (check with your Area Office).

Willow (*Salix* spp.)

Alder (*Alnus glutinosa*) - Currently planting Alder should not be encouraged (unless planted from existing stock) due to the increasingly widespread Alder disease *Phytophthora*.

Ash (*Fraxinus excelsior*)

Native black poplar (*Populus nigra*)

Hawthorn (*Crataegus monogyna*)

Holly (*Ilex aquifolium*)

Oak (*Quercus robur* or other native species)

## Coppice

Willow (*Salix viminalis*)

Hazel (*Corylus avellana*)

Common alder (*Alnus glutinosa*)

Wild cherry (*Prunus avium*)

Mountain ash (*Sorbus aucuparia*)

## Shrubs

Dogrose (*Rosa canina*)

Guelder rose (*Viburnum opulus*)

Field maple (*Acer campestre*)

Hazel (*Corylus avellana*)

Spindle (*Euonymus europaeus*)

Elder (*Sambucus nigra*)

Goat willow (*Salix caprea*)

Blackthorn (*Prunus spinosa*)

Wild privet (*Ligustrum vulgare*)

Wild currant, gooseberry (*Ribes* spp.)

Wild pear (*Pyrus pyraeaster*)





# Ponds

## Management

Every pond is unique and the management required will depend on many factors related to the ecology of the plant and animal communities present.

Writing a management plan will help to ensure continuity of management which should be carried out on the 'little and often' principle until the effects are clearly established.

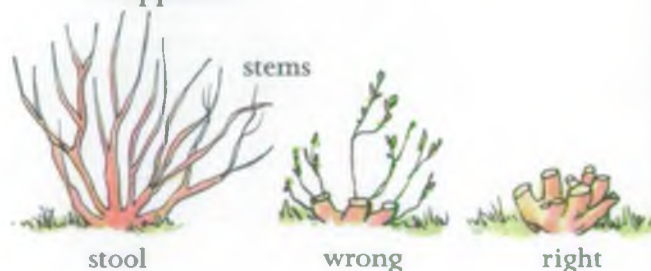
Once the pond has been created, it will constantly change through silting up and deposition of plant litter into the water. To retain the balanced environment of the pond, several steps need to be followed:

- 1 Excessive growth of marginal and emergent plants should be cleared with roots and dead or cut plant material removed from the water. This should then be left on the banks for a period of time to allow wildlife to return to the pond.

Never clear the whole pond, be selective, leave groups of plants so that wildlife habitats can re-establish.



- 2 Your pond needs careful monitoring for e.g. algal blooms and pollution which are indicated by deaths of plants and fish. Blue green algae is a particular safety hazard.
- 3 Where it is necessary to control vegetation, shrubby plants, such as willow, hazel or alder can often be coppiced.



Coppicing of shrubs and trees

Coppicing provides thick dense cover for wildlife and reduces shading of the water.

- 4 Herbaceous plants, such as thistles, docks or nettles can be cut back before seeding, but if at all possible, this should be done selectively by hand.
- 5 Floating vegetation can be controlled by raking off. Reeds need to be cut just below the water surface during July.



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## Existing pond

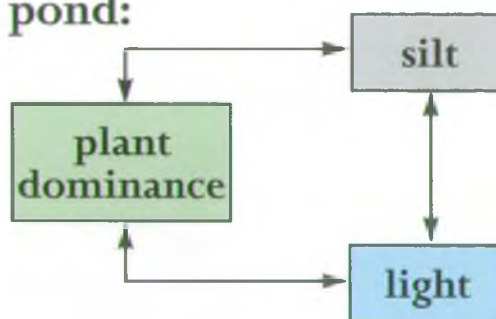
The water surface area of your pond may have been greatly reduced over the years due to silting and plant species choking the pond (plant dominance). To open the pond up and create increased wildlife habitats, several steps can be taken similar to those in the maintenance of new ponds:

1. Carry out a survey of plants existing in the pond and its surrounds in order to determine what to retain when cleaning the pond. Also check how the pond is lined.
2. When cleaning the pond refer back to the information on pond design. Ponds may be cleared by **hand**. Mechanical excavators should be used with extreme care.
3. Removal of small areas at a time is advisable. Never dredge the whole pond in one year as a large proportion of the wildlife will be lost.
4. Cut back trees and other overhanging vegetation, leaving a few areas of shade for fish.



## A well balanced pond:

Plant dominance can be controlled by hand or machinery clearance.



Silt is controlled by removal (removing deposited silt) and also by limiting its source and quality.

The pond needs to be opened up to the light to encourage the development of suitable wildlife habitats.



### ADVICE:

For further information contact the Environment Agency.



# Rivers and Wetlands Best Practice Guidelines

## ORDER FORM

For additional copies of Guidelines Leaflets please tick boxes next to those required, complete form at the foot of the page and send to: Rivers and Wetlands, Best Practice Guidelines, The Environment Agency, Lower Severn Area, Riversmeet House, Newtown Industrial Estate, Northway Lane, Tewkesbury, Gloucestershire GL20 8JG.

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- 13.1 Parish Pride ☐

- 14.1 Demonstration Area for The Royal Show ☐

Name .....

Organisation .....

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# Environmental Policy And Legislation

## Environmental Policy

The Environment Agency is committed to the principle of environmental stewardship and sustainability.

The Agency recognises that economic systems must be in harmony with ecological systems in order to conserve and enhance the natural environment, and will be guided by the principle of sustainable development throughout all of its operations and activities.

Its belief is in allowing present day development to meet our present needs, but at the same time, ensuring that future generations can still enjoy a meaningful environmental future.

## The Environment Act, 1995

places the following responsibilities on the Environment Agency:

- i) to conserve and enhance the whole environment in all its operations and activities.



- ii) to promote the conservation and enhancement of the environment.
- iii) to consider public access to the water environment and, specifically, to provide facilities for the disabled.

Other legislation augments these basic responsibilities including:

The EC Habitats Directive which seeks to protect Special Areas of Conservation (SAC) and Special Protection Areas (SPA), where special consent is required from English Nature/Countryside Council for Wales to carry out work.

Ancient Monuments and Archaeological Areas Act, 1979

Wildlife and Countryside Act, 1981

Badgers Act, 1973/1991

Salmon and Freshwater Fisheries Act, 1975

## Environmental Assessment

The Environment Agency undertakes environmental assessments of its own management works under the Land Drainage Improvement Works (Assessment of Environmental Effects; Regulations) S.I.1217; 1988.



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## Planning

Works on main rivers require the Environment Agency's consent and the Agency needs to approve certain works on ordinary water courses. In considering an application for Land Drainage Consent the following will be taken into account:

- Environmental impact and appearance
- Natural river processes, including flood risk implications
- Suitability for location
- Durability and flexibility

The Environment Agency regulatory functions relating to Abstraction and Discharge Licences and Fish Movement Licences also take account of conservation interests.

The Environment Agency is also a consultee to many statutory authorities, for example, Local Planning Authorities in respect of planning applications relating to the environment.

Much general planning legislation also clearly supports the conservation and enhancement of the water environment.

This series of guidelines has been compiled to raise awareness of some of the issues involved in river management. There are environmentally positive ways of carrying out most projects.

The reader is advised always to approach the Environment Agency's Area Office for guidance, unless absolutely certain that the proposed work does not fall within the scope of the Environment Agency's regulatory or advisory functions.



This revised edition of the Guidelines was compiled by staff in the Midlands Region in conjunction with Mark Ross Landscape Architects, Pershore, Worcs.

Revised version designed and produced by: Wilson Associates Advertising  
Sutton Coldfield, West Midlands

Acknowledgement is made to all those individuals who have played a part in the revision of these guidelines; also for photographs contributed by staff within the Midlands Region.

For further information call:  
The Environment Agency General  
Enquiry Line: 0645 333 111.



# Rivers and Wetlands

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This illustration and the accompanying information are intended for guidance only and do not constitute a detailed design. Individual designs must satisfy local requirements and will require the consent of the Environment Agency. Please contact the Area Office for advice and further information.





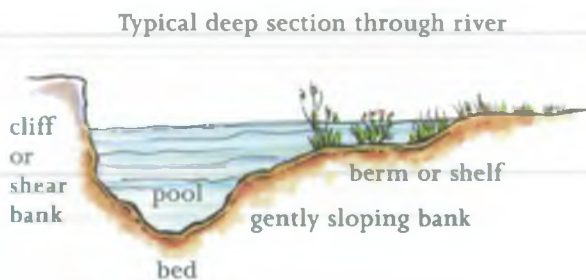
# River Management

The Environment Agency advocates that rivers should follow their natural course wherever possible, enabling natural processes of erosion and deposition to take place unhindered. Any corrective work which becomes necessary to protect buildings or infrastructure will require the approval and in most cases formal consent of the Agency.

## The Channel

### Bank profile

A watercourse naturally meanders creating a variety of bank and channel features.



### Bank Protection

If bank protection is ever required to avoid erosion/scour, it should be keyed in 600mm into the bank securely at 45°.

### Vegetation

Banktop, bank marginal, instream should all be protected and conserved.

Typical shallow section through river



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## Channel diversity

Should be conserved and enhanced where possible (e.g. pools, riffles, cliffs, berms, shoals).

### Berms (A low level shelf)

A berm may be dry, marginal or under water, supporting the associated types of vegetation, allowing for succession of plants from marginals to aquatics. Berms attract a wide range of species, both plant and insect providing invaluable habitat.

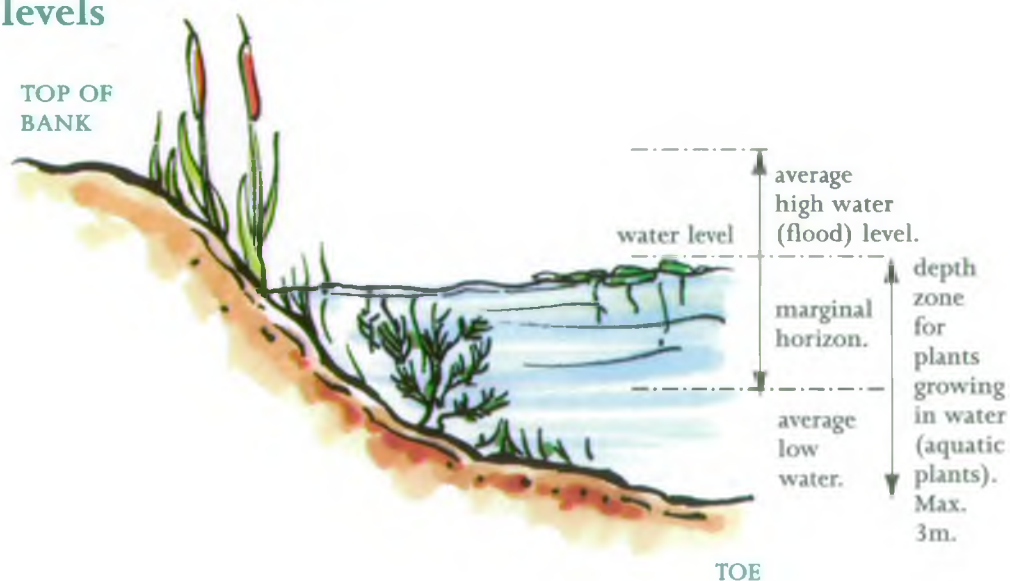
## The top of the bank

Access to the river for maintenance purposes is normally from the top of the river bank which must be able to withstand over-topping, vehicles, livestock, pedestrians and even vandals. The form of the bank dictates suitability for habitat of different plant species.

## The toe

Occasionally may need protection to prevent undermining and scour - in those instances where bank protection is used, it should extend at least 600mm below firm bed level.

## Section showing average water levels



# River Management

Thorough appraisal is essential well in advance of works to ensure that all environmental factors have been taken into account.

## De-silting

Current river maintenance practice includes relatively little de-silting. Ensure that existing wildlife habitats are conserved by leaving parts of the channel undisturbed; these will then form a nucleus for recolonisation.

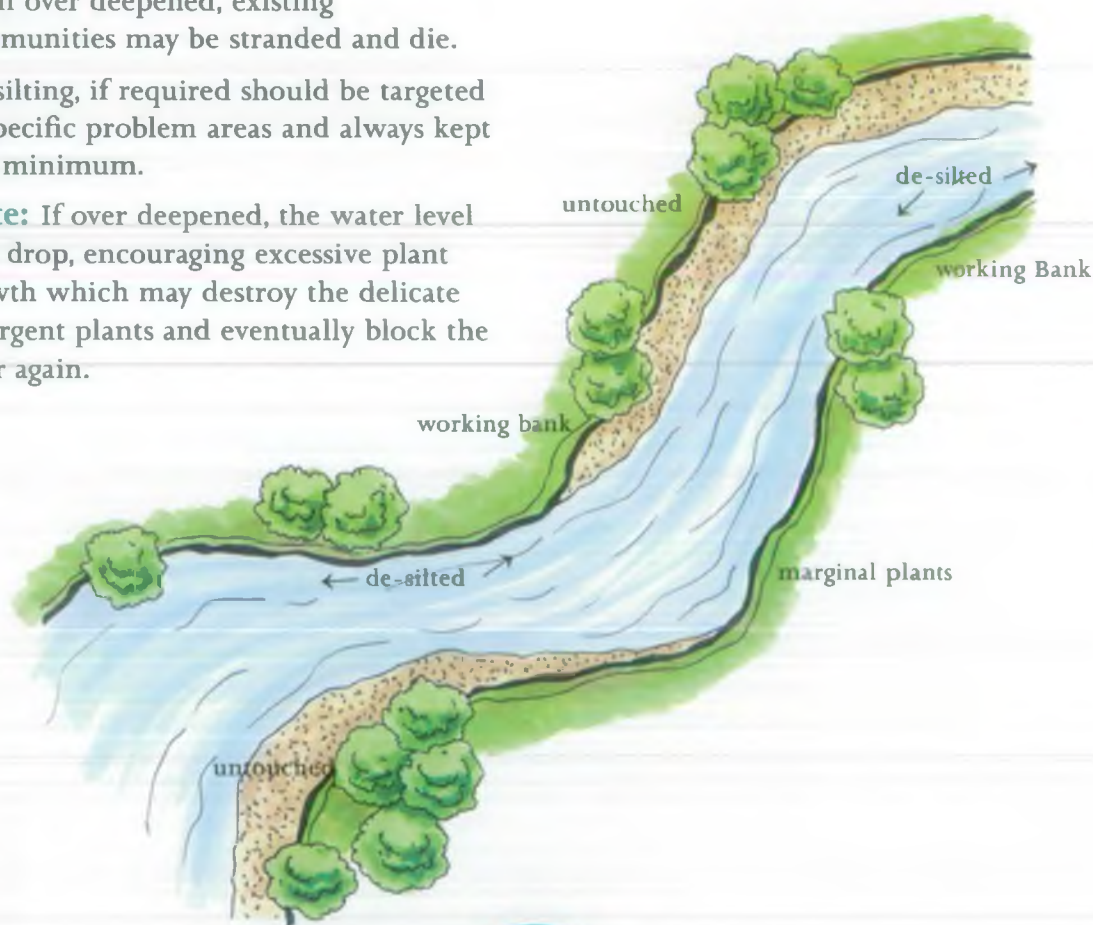
Channels occasionally need to be deepened to achieve the required flow, but if over deepened, existing communities may be stranded and die.

De-silting, if required should be targeted to specific problem areas and always kept to a minimum.

**Note:** If over deepened, the water level may drop, encouraging excessive plant growth which may destroy the delicate emergent plants and eventually block the river again.

## Purposes

To remove silt accumulation down to the hard bed and increase flood capacity. Accumulations of silt can be reduced in some circumstances by simply cutting back emerged weeds.



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- When de-silting is necessary, the river channel can usually be worked from either bank, so that working can alternate, leaving untouched stretches.
- A varied substrate should be retained by leaving pools and riffles untouched and replacing any gravels which are unavoidably disturbed.
- Every effort should be made to avoid disturbance to existing bankside vegetation by working between trees rather than uprooting shrubs and scrub.
- If bank protection is required, this operation should be combined with de-silting to minimise disturbance.
- If the bed has to be lowered, a minimum of silt should be removed and the channel profile retained in its natural form.
- Emergent plants which have been unavoidably disturbed should be transplanted.
- Fish and invertebrates should be protected and the fish spawning season avoided.
- The machine operator must be fully aware of ecological, landscape, archeological and other such environmental concerns.
- Minimise the effect of disturbed silt by placing straw bales downstream.

## River channel forms

The form the channel takes depends on:

The river substrate, water depth and water velocity which create diversity of conditions and habitats.

This diversity must be retained when operations are carried out on the channel. If the channel profile is too uniform, opportunities for wildlife habitat will be limited.

It is much easier and more effective to retain existing habitats rather than endeavouring to re-create them, once lost!

## Realignment

Channel realignment is not desirable, but if absolutely necessary and unavoidable (for example to allow development or infrastructure on a national or similarly significant scale), worthwhile new habitat must be created.

Another stretch of the same watercourse can be used as a blueprint for the realignment, recreating not only the plan form, but also the banks, riffles and peripheral habitat.

# River Management

Thorough appraisal is essential well in advance of works to ensure that all environmental factors have been taken into account.

## Meanders

Meanders are naturally formed curves and bends along a watercourse influenced by the flow pattern of the water and variation in bank shape and character. If meanders are removed, the rich diversity in river structure will be greatly reduced.

In some cases, old meanders abandoned alongside a new river channel have managed to provide excellent habitat for wildlife.

In other situations, the river can be re-meandered to flow along its original course.

Meanders should never be infilled with spoil or other surplus material.

There are several ways to retain meanders and the associated wetland habitats.

## Reasons to conserve meanders:

- To retain natural channel profile and banks.
- To retain bed levels and gradient – thus preventing downstream erosion.
- To ensure the diversity of shoals, beaches, riffles and pools created by variable flow across the channel.
- To retain valuable wetland margins.

The Environment Agency encourages the re-establishment of meanders wherever possible.



ENVIRONMENT AGENCY



## Riffles and Pools

A variety of bed profiles in terms of riffles and pools is essential for species diversity, therefore any work on channels should aim to conserve existing habitats.

Riffles oxygenate the water and enhance conditions for fish and invertebrate spawning. Deep pools provide fish with shelter and give shade during summer.

### Reinstatement:

Riffle - pool construction can benefit fishery habitat and is usually undertaken in order to improve the fishery.

### Recreated by:

1. Re-modelling of the channel bed.
2. Replacement of gravel shoals on new beds or scarifying (cleaning) of existing gravels.
3. Importing gravels to form riffles.
4. Encouragement of deposition and scour by the construction of low weirs, groynes or deflectors in appropriate locations.

The success in application of any of these methods is variable, and depends on knowledge of the natural process of the river, often related to the skill of machine operation and the care taken.

If possible, conservation of pool riffle profiles is preferable to reinstatement.

Riffles should be created with gravel from nearby stretches of the same river.

Topsoil from the old river channel can be spread onto the new banks to encourage colonisation by similar species.



See 3.1.



ENVIRONMENT AGENCY



# River Management

## Channel Improvements

Where natural bays exist on rivers, they should be conserved, but they can also be created to improve the quality of man-made channels. If shallow margins become clogged with vegetation, they can usually be cleared selectively by hand, or by cattle grazing.

### Note

Consider safety aspects - possible fencing of steep sided banks or re-grading. Protection of bay corners where the bay meets the river may be necessary to prevent erosion - possibly by tree planting.

### Shallow bays and beaches

Channel diversity can provide a variety of benefits.

- Fishing stations for anglers
- Access to the waterside for livestock or for public recreation, both active and passive
- Diverse wetland habitats can be created with pond-like characteristics in summer
- Shallow slow flowing margins provide shelter for small fish fry and other creatures



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## Habitat conservation

By creating by-pass channels, flood flows can be catered for, whilst retaining the existing wildlife habitat undisturbed.

### Wet by-pass channels

If water flows are very low, and the channel shallow, excessive plant growth can be a problem, threatening to choke the new channel. However, wet channels make excellent wetland wildlife habitats.

The wetter the by-pass channel the less maintenance is required.



## Maintenance:

### De-silting

Wherever possible, channel de-silting should only be partial in order to retain as much of the established

wildlife as possible. At least one third of the channel should remain untouched.



## Multi-stage channel

The over widening of channels, incorporating berms at varying levels to accommodate flood flows, allows diversity of habitats to develop. These berms range from damp river margins which are sometimes submerged, to drier bank situations.



## Dry Channels

Can be grazed or mown to control plant growth which might otherwise prevent the channel from serving its purpose.





# Management

## Riparian Land

Land owners owning property adjacent to a watercourse or river are known as riparian owners.

The Environment Agency seeks to encourage riparian owners to maintain or enhance their sections of river for wildlife and amenity through the provision of advice.

In special circumstances riparian owners may feel that certain environmentally sensitive techniques are required. The Environment Agency will advise on such techniques.

Riparian owners are encouraged to improve existing poor river environments, using natural forms of bank protection wherever possible.

For possible bio-engineering methods see 5.1.



Any method of bank stabilisation or protection must seek to further conservation and respect the immediate environment as well as the broader landscape. This will be achieved by ensuring that techniques and materials are both sympathetic and appropriate.

**Remember wherever possible, rivers should be encouraged to maintain a natural course allowing for natural processes of erosion and deposition.**



ENVIRONMENT AGENCY



**Livestock can erode riverbanks if allowed unrestricted access. Fencing allows for the establishment of a vegetated buffer zone adjacent to the river.**

Research has shown that a well vegetated strip of land alongside a watercourse can reduce chemical and silt levels in surface and groundwater before they reach the river. A vegetated buffer zone also improves the habitat value of the river corridor.

Fences should be:

- sited up to 10 metres back from the crest of the bank to prevent erosion of the slope. This will also allow line regeneration of vegetation.
- of temporary construction if in the floodplain so that they will be swept away rather than obstruct a flood.
- should not be constructed at right angles to the river on the floodplain.

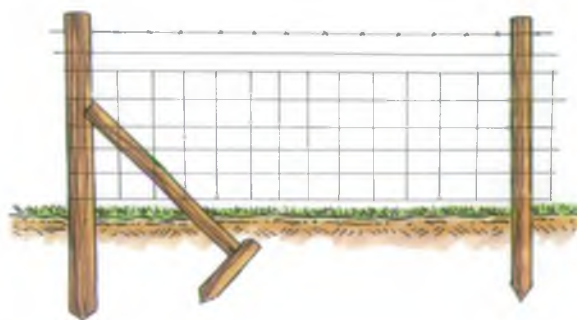
In areas with shallower bank profiles the fencing can be constructed to allow sheep access whilst keeping cattle out. This can be beneficial as non-intensive grazing by sheep will keep tall reeds from dominating and allow lower growing wetland plants to thrive, avoiding the erosive effect of cattle.

#### Note:

Fences within the floodplain will require Land Drainage Consent from the Environment Agency.



The line of temporary fencing should be sited well back from the top of the bank, allowing a buffer strip of vegetation to regenerate.





# River Rehabilitation

**Creating a sustainable balance between necessary flood defence, enjoyment of property and allowing river ecosystems to flourish naturally.**

## The need for rehabilitation

The quality of our rivers and their environment has in many cases, become degraded over the years. Many have been straightened, deepened, diverted or contained and their flood plains and valleys intensively farmed or developed. In some places, much of their natural beauty and value to both people and wildlife has been lost.

## Why rehabilitate rivers?

- To create a sustainable balance between necessary flood defence, farming and allowing river ecosystems to flourish naturally.
- To restore and protect wildlife habitats, encouraging biodiversity and a healthy fishery.
- To re-establish the river landscape as a captivating and picturesque focus for amenity and recreation.
- To restore the natural role of the floodplain in accommodating seasonal flooding and helping to improve water quality, whilst also providing flood protection.
- Use pollutants (chemicals such as fertiliser) sparingly: never discard containers on the land.
- Create 'buffer' planting (see 4.7) wherever appropriate.
- Create wetland and reedbed 'filters' alongside rivers.
- Protect the visual amenity against vandalism, litter.
- Try to encourage collaborative projects to enhance or rehabilitate local stretches of river.
- Seek guidance from your local Environment Agency Office, Local Authority, Parish Council, Ministry of Agriculture, Fisheries and Food, who may be able to help you with advice and/or funding.

## How can you help with rehabilitation?

- Use water sparingly, in the home, at work and on the land.



For further information call:  
The Environment Agency General  
Enquiry Line: 0645 333 111.



**ENVIRONMENT AGENCY**



In 1992, the River Restoration Project began to examine the feasibility of undertaking three pilot restoration projects. These projects, on the Brede in Denmark, the Cole near Swindon (UK) and the Skerne in Darlington (UK) were supported by EC LIFE funding. The study areas were chosen to demonstrate a varied range of rehabilitation/restoration methods as well as River Management techniques.

A. The River Skerne is an engineered and straightened urban watercourse in Darlington, County Durham. Its restoration will enable it to provide a rich countryside experience on peoples' doorsteps.

Methods of bank treatment stabilise the river and allow new habitats to develop. A nature reserve is being enhanced and local drainage modified to protect the water quality.

B. The River Cole near Swindon is a small rural river whose course has been straightened and deepened in the past for agriculture and for milling.

The river channel has been redesigned to vary flow patterns with contrasting deep pools and backwaters, sheltering fish and aquatic life.

Riverside fields will be farmed as traditional flower rich meadow, whilst the river comes back to life, tumbling over shoals of gravel.

C. This aerial photograph shows both the old straight course of the river Brede in South Jutland and also the new sinuous course. Many small weirs have been removed to help the migratory fish, seasonal inundation restored to the flood plain, settling out nutrient rich silt. With tree planting and footpath access, the river has become a valuable visual amenity and focus for recreations such as canoeing, walking and riding.



A. River Skerne, Darlington. U.K.



B. River Cole, Swindon. U.K.



C. River Brede, Denmark

The River Restoration Project Tel: 01525 863341 or 01480 456001  
The Environment Agency General Enquiry Line Tel: 0645 333111

The project has been supported by many organisations, such as The Environment Agency, English Nature, Heritage Lottery Fund, Northumbrian Water, Darlington Borough Council, Department of Agriculture for Northern Ireland, The National Trust, Life, Countryside Commission.



# River Rehabilitation

Creating a sustainable balance between necessary flood defence, enjoyment of property and allowing river ecosystems to flourish naturally.

## The rehabilitation philosophy

The rehabilitation process encourages chemical and biological systems to gradually recover their balance. A healthy river system is capable of maintaining a wide diversity of plants and animals. This complex ecosystem acts as a biochemical shock absorber against upsets in the balance of nature.

### Rehabilitation can involve:

- Recreating a natural channel by introducing diversity of bank shape and bed, including berms, pools and riffles to the river channel. Steep and shallow banks create varied habitat; kingfishers and sandmartins love steep banks above deep pools. Pebbly riffles are home to invertebrates and reedy margins house birds and mammals.

- Planting scrub, trees and rough vegetation to create a natural 'buffer strip' which is capable of filtering substances which pass through the ground and helping to protect water quality in the river.

### Long Section across Watercourse



### Sections

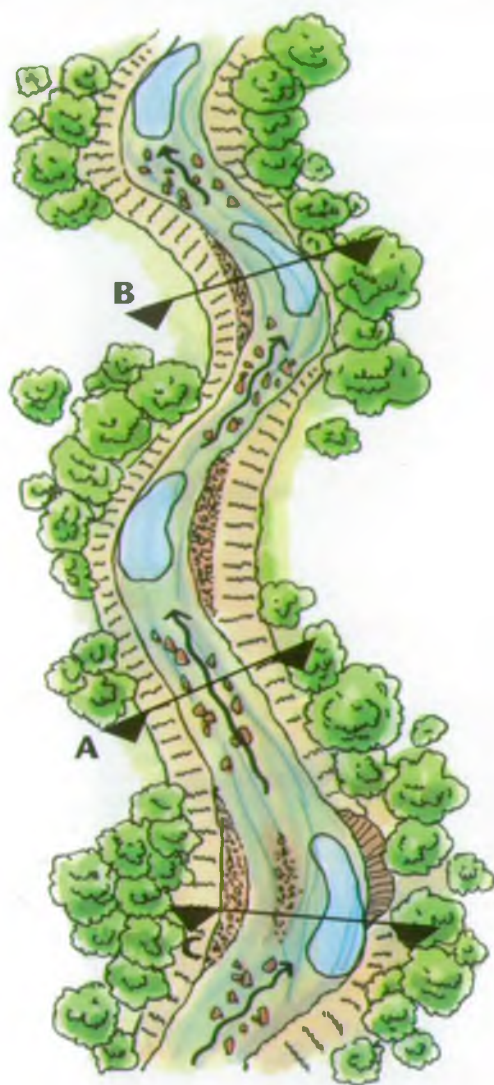


(See plan overleaf).



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## Rehabilitation can involve (cont'd):

- Allowing the river to flood seasonally across its natural floodplain, creating sustained wetlands.
- Creating differing flow regimes and velocities to encourage a rich variety of plants and animals to thrive in a sinuous channel.
- Developing pools within the river provide cool shelter for fish in the summer months and riffles aerate the water. Here the larvae of caddis flies and mayflies are found and the characteristic water crowfoot.
- Creating wetlands, meadows and pools close to the river extend this special type of habitat which is so important to species such as wading birds like the snipe.
- Planting up of field margins along the river with native trees and scrub, making sure to allow for maintenance access, provides shelter for animals like otter and many bird species.
- Enhancing the river landscape, ensuring that changes of land use and visual emphasis are appropriate to the local character.

For further advice contact your local Environment Agency Area Office.



# Vegetation

## Trees

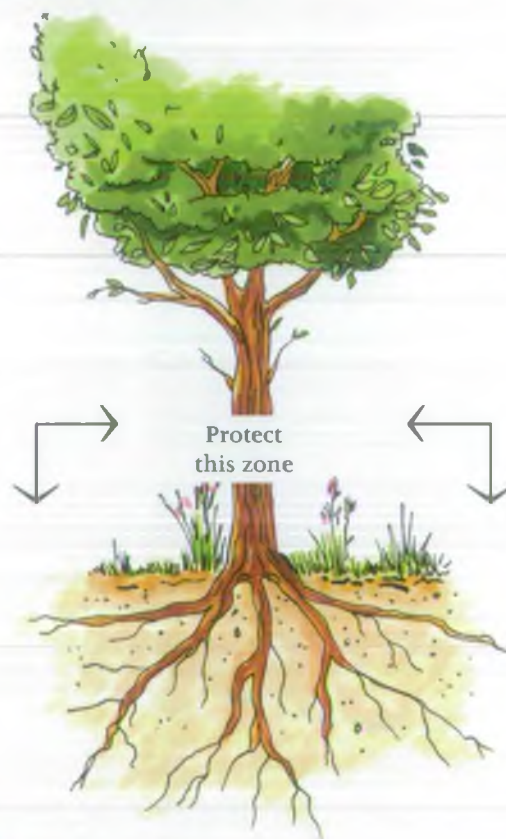
Trees, particularly mature trees, are vital existing habitats for wildlife. Their survival depends on the careful treatment of their root surface area which absorbs minerals and water for the trees.

### Factors which may damage the roots:

1. A build up of spoil around the tree stem may suffocate the roots and kill the bark.
2. A decrease in soil level will expose and damage the roots rendering the tree susceptible to drying out and making the tree unstable.
3. If works are going on, trees must be protected from soil compaction by machinery. Temporary fencing should be used to protect the tree, extending at least as far out as the edge of the canopy. The bark can be protected with hessian and chestnut paling.
4. Changes in the level of the water table can affect growth and stability.
5. Don't store toxic materials (or vehicles) around trees as any seepage or spills will poison the tree. Don't have fires in close proximity to trees.

### Dead and dying trees

Should be retained in a stable state where possible as they provide valuable habitats for insects and birds - overhanging branches provide perches for kingfishers and live trees provide shade for fish. These trees should be firmly anchored so that they cannot obstruct the flow in rivers. Insects falling from them into the water provide food for fish.



ENVIRONMENT AGENCY



The protection of existing vegetation is of prime importance in order to prevent the destruction of existing valuable wildlife habitat.

### Using and managing existing vegetation

It is far easier to save and manage an already existing habitat, than to create new ones.



Therefore a detailed survey needs to be made of those plant species which exist on the waterside in order to decide which ones to keep.

### The reasons for planting:

1. To provide wildlife habitats on watersides particularly where no habitats exist, for example, scrub planting to provide shelter for otters.
2. To create diverse and balanced plant communities, avoiding the more aggressive plants which tend to invade.
3. To ensure the survival of particular plants or animals, for example the reed warbler and the common reed.
4. Erosion control - bank protection.
5. To integrate the river corridor into the landscape.





# Vegetation

## Water Plants



Marsh Plants	Marginal (upto 20mm water depth) and emergents (upto 600 mm water depth)	Submerged plants (upto 2000mm water depth)	Floating leafed plants (upto 2000mm water depth)	Free floating plants
<p>Plants that will live in waterlogged ground or standing water during the winter months.</p> <p>Marshes and wetlands are a pressured habitat providing valuable shelter and food sources for aquatic wildlife.</p> <p><b>Typical marsh plants:</b> Ragged robin Marsh marigold Hard &amp; soft rushes Meadowsweet</p> <p><b>Avoid:</b> Himalayan balsam (<i>Impatiens glandulifera</i>)</p> <p>Japanese knotweed (<i>Polygonum cuspidatum</i>)</p>	<p>Most of these live in the first 500mm depth of water.</p> <p>Species need to be compatible with each other as some species tend to become invasive and will dominate the rest.</p> <p>Common reed is excellent for waterside plantings.</p> <p><b>Avoid:</b> Reed mace (<i>Typha latifolia</i>) as it is invasive.</p>	<p>Important plants for oxygenating the water and providing a food source for aquatic wildlife.</p> <p><b>Avoid:</b> Canadian pond weed (<i>Elodea canadensis</i>) as it will become invasive and is not native.</p>	<p>Do not need introducing as they will arrive naturally in time.</p> <p>Important food plants, however, they <b>must</b> be prevented from covering the surface and blocking out the light.</p> <p>Most common is duckweed.</p> <p><b>Avoid:</b> Water fern (<i>Azolla filiculoides</i>)</p>	<p>Important for their visual contribution but may become invasive.</p> <p>Floating leaves provide landing sites for damselflies etc.</p> <p>Water needs to be deep enough to allow the plants to over winter deeper down.</p>



ENVIRONMENT AGENCY



## Sources of Water Plants

### From the wild

Those taken straight from a local wild source are generally favoured.

It is an offence to uproot any plant without the landowner's permission. Also some species are protected and it is forbidden to dig them up at all (see Schedule 8 of the Wildlife and Countryside Act 1981)



If in any doubt contact the Environment Agency or your local Wildlife Trust.

### De-silting operations

Recent local de-silting operations of rivers or ponds are extremely beneficial sources. Most water plants spread vegetatively by rhizomes, tubers etc. rather than by seed, therefore from just a few bucket loads of silt, will come a great deal of plant material that is typically successful in the area, combined with a variety of aquatic organisms.



### Invasive plants

Beware, however, of the unwanted introduction of invasive species:

Giant hogweed  
(*Heraclium mantegazzianum*)

Japanese knotweed  
(*Polygonum cuspidatum*)

Himalayan balsam  
(*Impatiens glandulifera*)

Water fern (*Azolla filiculoides*)

### Specialist nurseries

Specialist aquatic nurseries or water garden specialists supply a wide range of ornamental aquatic waterside plants, many of which will not be appropriate to a natural conservation pond.

Note: Do not use exotic plants.



# Vegetation

## Plant Establishment

It is important to ensure that species (and varieties) are appropriate to the type of waterside environment.

(See 'Sources of Waterplants')

### Marginals and emergents

Notch plant rooted plants, rhizomes and small marginal plants in up to 20cm of water. Rhizomatous species often do not grow well from seed.

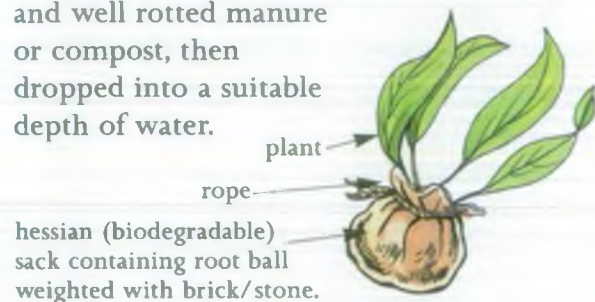
The best time to plant is in May at 500-1000mm centres, when plants are growing most rapidly. Grazing by wildfowl can be a problem but this can be overcome by planting protecting species.



Notch planting

### Floating leafed and submerged plants

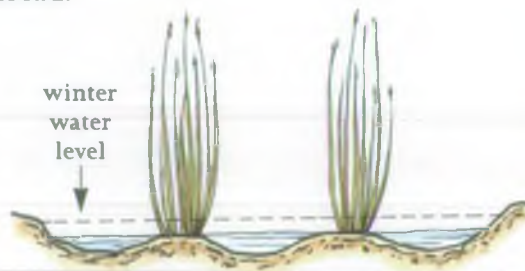
For planting in water that has little organic matter, a sack can be filled with 50:50 soil and well rotted manure or compost, then dropped into a suitable depth of water.



### Common reed beds

Traditionally grown for thatching, they form valuable wildlife habitats, especially for warblers. Contact the Environment Agency for more information.

Establish in drier margins where they will spread to deeper areas. Planting reeds on banks is also good practice as they will spread.



### Salt marshes

Most of the salt marshes in the Midlands region have been designated as Sites of Special Scientific Interest. English Nature advocate that salt marsh should be left to colonise naturally; they must, by law, be consulted about any works.



ENVIRONMENT AGENCY



## Island Vegetation

An island in a pond provides safe refuge from predators as long as the depth of water is sufficient and vegetation exists to give cover.



Part covering of an island with trees and shrubs provides shelter for nesting birds and bankside trees provide shade for fish.

Islands should never be created in watercourses where they are not naturally present and self-sustaining as they are likely to increase the risk of flooding.

Open grass areas allow wildfowl to graze. Beaches are important for certain species of birds. If an island becomes devoid of vegetation, Canada geese may dominate and they may impede the growth of vegetation by grazing.

### Design

Above all, islands must be sufficiently distant from the shore across deep enough water to prevent predators reaching them.

Ensure species that you wish to attract are catered for by creating the correct habitat for them.

Islands should have bays and spits, steep and shallow banks for access for wildfowl. Marginal plants should be included (see sheet 4.2).

### Planting must be self maintaining

#### Note:

Take into consideration the prevailing wind and wave action when orientating the bays and also the planting.

#### Features which attract birds

	Small birds thrushes finches etc.	Water fowl ducks, swans, geese, herons etc.	Waders lapwing, snipe, curlew etc.
Beaches	✓	✓	✓
Grassland	✓	✓	✓
Wetland/Marsh	✓	✓	✓
Open Water	✓	✓	✓
Tree & Shrub	✓	✓	✓



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# Vegetation

## Tree Planting

Trees provide shade and visual interest: hedgerow trees create invaluable habitat within the agricultural landscape.

### Tree sizes for planting



When considering what tree species to plant, take a look at the species that already exist in the area. They give a good indication of what will thrive.

### Choose species that will

- Grow in the soil type.
- Require the minimum looking after, during establishment and subsequently.
- Look appropriate in the landscape and fulfil the screening requirement.
- Assist erosion control with their roots and provide shelter belts.
- Provide food for wildlife.
- Provide shade for fish in specific areas.
- Suppress weed growth.
- Not cause excessive leaf fall where this could be a problem.



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### Remember

Trees grow and their ultimate size should be taken into account.

Small trees establish more readily than larger trees. All will need management to establish, grow and mature properly.

### Problems

Seedlings and small transplants may have trouble in establishing on exposed sites and will need protection from wildlife and stock.

### Planting methods

#### Notch planting

Small transplants that are put into notches and heeled in, is the quickest, cheapest and preferred way of planting.

#### Pit planting

A more elaborate form of planting for larger transplants. Trees may establish better, but it is much more expensive. Also rabbit guards are essential for most tree planting.





# Hedge Planting

Hedges are wildlife corridors of the countryside linking woodlands, meadows and watersides.

## Shrubs for hedges must be:

- Quick growing
- Long-lived
- Hardy to wind and frost
- Able to provide shelter if necessary
- Adaptable to local soil conditions
- Able to provide fruiting species for wildlife in winter

## And must not:

- Require too much care
- Smother other plants through dense foliage
- Obstruct flood flows
- Prevent maintenance of watercourses

## Good species to use:

- Blackthorn
- Crab apple
- Hawthorn
- Buckthorn

## Flailing

Trimming hedges with a mechanical hedge cutter. Most hedges are trimmed between 1 to 2 metres into various styles. However, years of flailing can make hedges hollow at the base and reduce the habitat value.

## Hedge laying

Hedges are valuable wildlife habitats. Laying will preserve and enhance the wildlife value and ensure the longevity of the hedge.

Hedge laying makes a hedge:

- Stockproof
- Improves shelter for stock
- Enhances the conservation value of the hedge

Hedge laying is a highly skilled aspect of countryside management, creating the type of landscape to which we have become accustomed.

It is a traditional skill which needs to be encouraged for the benefit of the landscape/habitat and visual enjoyment.





# Vegetation

## Willow Management

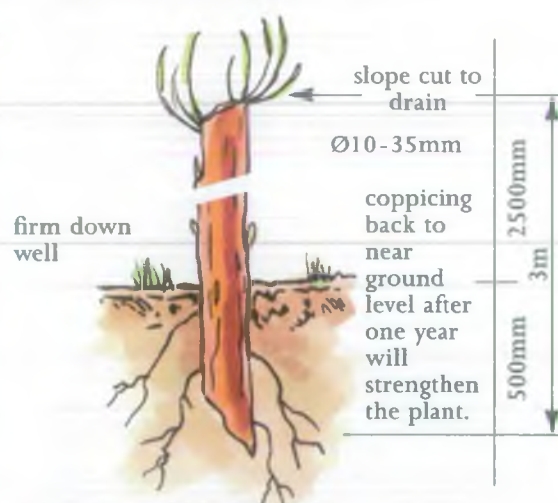
Willow species are excellent for waterside planting; they rapidly establish, thrive on moist soils, have many forms and habits providing windbreaks, shelter for wildlife, ground cover, erosion protection and an attractive natural waterside environment.

### Planting and management

Most willows can be easily and cheaply established from unrooted cuttings.

Unrooted cuttings are recommended for the following reasons:

- Rooted material is easily damaged.
- They take well and grow quickly on poor soil.
- Planting is simple.



### Willow cutting for poles

November - April, and ideally March - April. Shrubby willows should be cut to ground level; a 2-3 year old stem being ideal for poles. For larger trees, take cuttings from the top, avoiding soft young growth.

The recommended diameter will vary from approximately 100mm according to use.

### Osiers for harvesting

Salix species grown for coppicing - varies from region to region, the common osier (*Salix viminalis*) is used widely.

**Uses:** Basket making, fencing, energy crops and fascine (e.g. faggot) making.

**Planting:** Plant in blocks of different species to prevent dominance by one variety and the spread of disease.

**Benefits:** As well as being commercial crops, planting can function as windbreaks, shelter belts and create planting colour variations on the waterside. An osier bed must be maintained annually.



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Pollarding and coppicing are ancient practices dating back over 6000 years. Management by pollarding and coppicing maintains access to watersides and such traditional forms add to the waterside character.

## Pollarding

The tree is cut 2.5m+ above the ground and therefore develops a crown, which is subsequently recut to provide poles or wands which are generally larger than those obtained from coppicing. Pollarding prevents livestock reaching the new growth.

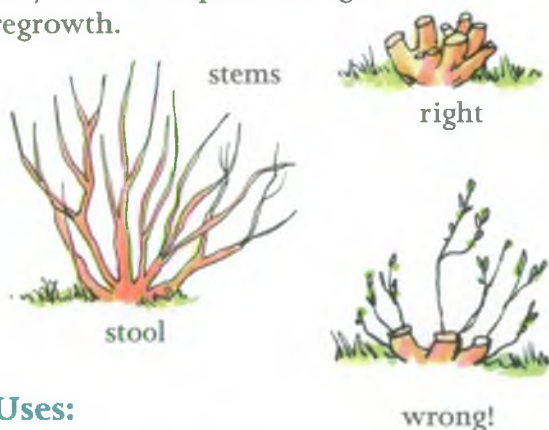
## Timing

Re-cutting of pollards depends on the product required and type of tree, every 3-5 years for willow poles. Re-pollarding will not exceed a 10 year cycle. Pollards are found in nearly all English counties and are often of historical importance due to their age. Older pollard crowns provide unique wildlife habitats - leaf litter and soil collect in the crown allowing other plants to grow. Many trees are grown for pollarding, the most common being willow, ash and elm.



## Coppicing

The stool (the base of the plant above ground) remains alive whilst all the stems are periodically removed. Coppicing should take place in the winter when there are no leaves on the trees. Coppicing of such species as hazels, osiers, oak, chestnut and hornbeam will open up the ground flora to light, helping it to flourish. Care must be taken that the tree to be coppiced has not become too large, with the danger that it may die. Most broad-leaved trees can be coppiced, but they must be capable of vigorous regrowth.



### Uses:

Alder	firewood
Willow	basket-making, hurdles, hedging and spiling
Ash	firewood, poles and small tools
Chestnut	temporary fencing
Hazel	hurdles and fencing





# Vegetation

## Planting on river banks; in garden or ornamental situations

If at all possible riverbanks and water related landscape should be designed to use native species, as these will be more appropriate to indigenous wildlife.

However, there are situations where ornamental plants are appropriate.

### Reasons for planting

- To integrate the waterside bank into the design landscape, thus enhancing the visual quality of the landscape.
- To stabilise banks using plant material, therefore controlling erosion problems.
- To prevent or facilitate access to the water's edge, whichever is appropriate.
- To reduce maintenance and management implications and to ensure quick establishment where necessary.

### Opportunities

- To extend existing wildlife habitats or create new waterside habitats in the garden.
- To create diverse plant communities.

### Considerations before planting

1. The slope of the bank and its size
  - Steep slopes require close planting and a dense root structure.
2. The aspect of the slope
  - South facing slopes require sun loving plants, north facing require those that like cool and shade.
3. The soil quality of the slope
  - Shallow, rocky soils possibly subject to erosion can be improved by the creation of rock gardens. Larger rocks can be bought in and rock plants planted between.

### Planting design

- Generally the design of the planting should be compatible with that of the rest of the garden.
- It may be necessary to deter pedestrian access through the planting therefore plant deterrent species such as roses, berberis or mahonias, but always remember to leave space for maintenance access to the river.
- Low maintenance may be a required design feature, and if so, plant low growing species that cover the ground rapidly to prevent weeds coming through.

### Plant choice

- Plant choice is a combination of all the points already mentioned, however plants must be able to withstand periodic flooding.
- In the case of tidal area the types of plants chosen may be limited by their saline resistance.
- Plants can easily be sourced in garden books under the heading "Moisture loving plants" and similarly under this section at your local garden centre.



ENVIRONMENT AGENCY





## When to plant

- Marginal and emergent plants in spring.
- Bare - rooted trees and shrubs in the winter (not in frozen ground).
- Containerised plants all year, but remember to water in dry conditions.

## What to plant

- Ground cover plants with spreading rhizomes or suckers will quickly grow stabilising banks.
- The flowering season may be increased by planting spring or autumn bulbs.
- Purchasing larger plants will speed up establishment. Plants can usually be bought in different sized pots.
- Ever green plants for all year round cover.

## Pot size

- |         |   |                                            |
|---------|---|--------------------------------------------|
| 1 litre | = | Small, low growing plants e.g. rock plants |
| 2 litre | = | Small shrubs come in this size             |
| 3 litre | = | Larger shrubs e.g. Buckthorn               |

## How to plant

### 1. Pegged netting

On loose soil, peg netting to the slope e.g. wire mesh, wind break netting, greenhouse shading and plant through.



### 2. Plant in small pockets

Plant in small pockets - dig hole larger than rootball making it deeper at the back - make soil up to not quite level with original slope.



### 3. Temporary wooden terraces

Terraces can be created by pulling soil forward and possibly securing with pegged wooden boards. Plant into the terrace.



## Care of your plants

- Although planting near water, it is important that newly planted plants do not dry out - this may happen at any time of the year
- Prune and cut back as necessary to ensure vigorous healthy growth.



# Vegetation

## Buffer Strips

A **buffer strip** is a term used to describe a range of vegetation features alongside watercourses that have a role in reducing the negative impact of agriculture and pollution on the water environment.

Buffer strips can consist of wetland, reed bed, scrub or other vegetation which serve to improve the quality of ground water passing through them.

Buffer strips potentially have a wide range of benefits. For example, they may create new wildlife habitats and improve water quality, benefiting fisheries. They also help to stabilize river banks. Buffer strips used in conjunction with sensitive land management could potentially reduce land run-off and the risk of flooding downstream.

### Riparian buffer strips

These are vegetated strips of land from 5 to 50m in width, alongside a watercourse, managed separately from the rest of the field. Although buffer strips are normally a permanent feature, they can be temporary (eg as part of an arable rotation).

### Buffer strips and pollution reduction

Riparian buffer strips can reduce pollution in two ways. They distance agriculture from the riparian area, thus reducing direct pollution (eg. spray drift), and they intercept run-off from agricultural land. By intercepting run-off, buffer strips act as a sediment sink, they transform and assimilate nutrients and they breakdown pesticides.

Buffer strips, whilst a valid option to reduce diffuse pollution, are not a solution to the root cause of the problem. Best results in reducing diffuse pollution will be achieved by good agricultural practice. However, for buffer strips to be effective, it is fundamental to know the type of pollution that needs to be controlled and to know the pollutant pathway.



### Wetland buffer strips

Floodplain buffer strips are composed of plants such as reeds, tolerant of, or dependent on periods of inundation. Some floodplain wetlands may develop eventually into scrub and/or woodland, dependent on water level and management.

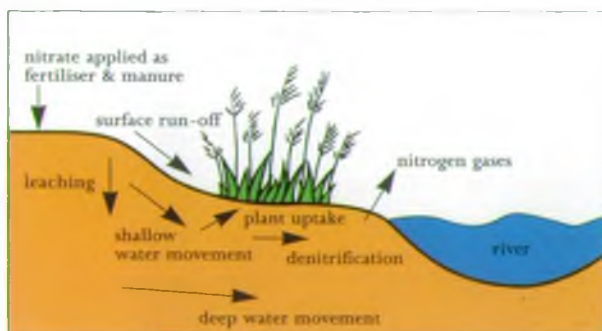


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## The main benefits of riparian buffer strips;

- provide diverse habitats for terrestrial and aquatic wildlife
- provide corridors for wildlife movement
- provide organic matter to watercourses
- control temperature in the water body through shading
- enhance the visual quality and amenity of the landscape



## River bank protection

Buffer strips can help to safeguard against bank erosion, since vegetation will help to stabilize river banks.

Buffer strips can provide a number of land management benefits to the farmer.

- beetle banks and habitat for other predators of crop pests
- prevention of migration of harmful weeds
- access for traffic
- cost savings by not forming field margins with poor yields
- reduction in need for trimming hedges which would normally be carried out to reduce shading of crops
- creation of regular field areas which are more easily worked with machinery
- bank stabilization to prevent loss of valuable agricultural land
- enhanced numbers of game birds and improved fisheries





# Vegetation

## Grass Seeding

Grass species are an essential part of waterside vegetation. The range of grasses able to grow in an area is influenced by many varied factors, therefore the grass seed mix for a site must be tailored accordingly.

### Choosing a grass seed mix:

Contact grass seed merchants. The following factors affect choice of grasses:

- Degree of shade from trees and shrubs.
- Soil type and quality.  
eg. wetland, clay or sandy loam.
- Bank profile.
- Drainage and flooding pattern of the river.
- Salinity.
- Land-use practices e.g. grazing.
- The type of wildlife that you want to be encouraged.

Point these factors out when discussing seed mixes with the seed supplier.

Avoid rye grasses, except in locations where erosion control is the priority or where some annual ryegrass would provide quick-growing protection against erosion in the first year.

### Timing:

Grass seed should be sown during spring and mid-summer avoiding very dry periods.

### Wildflower mixes:

To establish a more varied plant community, wildflower seeds can be mixed with low productivity native grass seed mixes. Perhaps a more successful way of establishing wild flowers is by planting small plugs or plants individually in the sward.

### Turf:

Meadow turf can be transplanted to provide immediate scour resistant grass cover, once established but is relatively expensive.

### Grass planting uses:

- Erosion control binding roots together.
- Improves access to watersides.
- Visual variation.
- Additional habitat creation.
- For sea walls/embankments but a special saline tolerant mix may be needed.



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## Species List

The following mixes are suitable for the suggested situations, although different seed houses will have their own variations. The suggested mixes should not be considered to be definitive.

## General Points

Avoid perennial ryegrasses, particularly in wildflower mixes. If quick cover is required in order to stabilise banks some annual ryegrass may need to be included. This will provide cover until the slower growing grasses and wild flowers establish.

If wildflower seed is included it should be of local provenance if possible, otherwise of British origin. Imported seed should be avoided.

A wildflower mix should be 80% grass seed mix and 20% wildflower seed.

Wildflower mix should be sown at a rate of 5gms per m<sup>2</sup> - higher rates tend to smother the wildflowers.

## Pond Edge Mix

% Mix	Common Name	Botanical Name
35	Crested dogtail	<i>Cynosurus cristatus</i>
30	Creeping red fescue	<i>Festuca rubra</i>
5	Meadow foxtail	<i>Alopecurus pratensis</i>
5	Tufter hairgrass	<i>Deschampsia caespitosa</i>
5	Meadow barley	<i>Hordemon secalinum</i>

## Mix for Wet Soils

% Mix	Common Name	Botanical Name
36	Crested dogtail	<i>Cynosurus cristatus</i>
20	Hard fescue	<i>Festuca longifolia</i>
20	Creeping red fescue	<i>Festuca rubra</i>
10	Meadow foxtail	<i>Alopecurus pratensis</i>
5	Tufted hairgrass	<i>Deschampsia caespitosa</i>
5	Smooth stalked meadow grass	<i>Poa pratensis</i>
2	Yorkshire fog	<i>Holcus lanatus</i>
2	Meadow barley	<i>Hordeum secalinum</i>

## Mix for Shaded Areas

% Mix	Common Name	Botanical Name
35	Hard fescue	<i>Festuca longifolia</i>
25	Crested dogtail	<i>Cynosurus cristatus</i>
15	Creeping red fescue	<i>Festuca rubra</i>
10	Tufted hairgrass	<i>Deschampsia caespitosa</i>
5	Browntop bent	<i>Agrostis castellana</i>
5	Sweet vernal grass	<i>Anthoxanthum odoratum</i>
5	Wood meadow grass	<i>Poa nemoralis</i>

All these mixes are suitable for inclusion of wildflower seed. Seek further advice from wildflower seed merchants.



# Vegetation

## Black Poplar

### Guidelines for planting native black poplar *Populus nigra betulifolia*

**Choice of stock:** There are only a few specialists in the country who are qualified to identify the black poplar and it is therefore essential that cuttings are from an approved source - guidance on this can be gained from your local Environment Agency Office, Forestry Commission or County Council.

The black poplar is a rare tree. In order to maintain the present distribution, the tree must be planted sensitively and usually in small numbers.

New trees must be planted well away from any structures and underground services. It is estimated that the poplar will affect the ground for a distance with a radius that is at least equal to the height of the mature tree.

The ability of any poplar to dry out the ground needs to be considered carefully when introducing new black poplars to an area of existing wetland habitat or adjacent to an area of archaeological importance. Your local Environment Agency staff will advise you. As with any tree planting, the effects of shade and leaf fall on the existing habitat need to be weighed up.

Planting sites will ideally be in full light with good moisture supply and a lowland climate. Black poplar is not thought to tolerate a great deal of shade.

Whatever the location, soils must be water retentive or rainfall needs to be high.



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# Bank Protection

## Bio-engineering

Remember wherever possible, rivers should be encouraged to maintain a natural course allowing for natural processes of erosion and deposition.

### Why use it?

Occasionally some form of bank stabilisation is necessary and in such circumstances the use of vegetation can help to bind together soil that has already begun to erode. Plant material is also adaptable to changes in conditions.



- **Buttressing:**  
propping of soil mass by plants.
- **Surface reinforcement:**  
by roots at different depths.
- **Underground anchoring:**  
roots anchor surface to subsoil.

### Using vegetation to support and protect the bank

- improved wildlife habitat and river environment
- good proven results, easily achieved
- works well with other protection
- integrates into landscape
- low capital cost



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### Remember

- needs time to establish and become fully effective
- careful experienced management needed at all stages of establishment and aftercare

### What to use?

#### ♦ Trees

For river banks where appropriate, plant small groups of willow (*Salix alba*, *Salix fragilis*). Willow roots very quickly. Ensure trees are planted young and are well guarded against vermin and grazing.

Currently planting Alder should not be encouraged (unless planted from existing stock) due to the increasingly widespread Alder disease *Phytophthora*.



### KEY

♦ For use on steep cliffs, possibly with severe erosion problems or heavily eroded areas.

◇ Sloping banks

○ Toe protection



The sward establishment on the bank should include dense growing grasses and wild flowers. A more vigorous annual grass should also be included where fast colonisation is required to protect the bank. This diversity of species will help produce stable banks in time. Different species thrive in varying conditions and have different attributes, therefore the mixture should be carefully planned.



Grass will need regular maintenance and mowing, unless a scrub bank is wanted. Stock may cause the bank to deteriorate rapidly but also produce a worthwhile form of habitat.

If grass is mown frequently to keep it low, most wild flowers will not grow and seed.

## Ground cover

Creeping plants such as bramble, assist with the binding banks, need minimal maintenance but should not be allowed to impede flow.

## Reeds

Plant reed rhizomes  
March to May.  
Firm in well,  
taking care  
not to damage  
shoots and cut back  
once in each of the first two seasons.



## Using newly cut timber

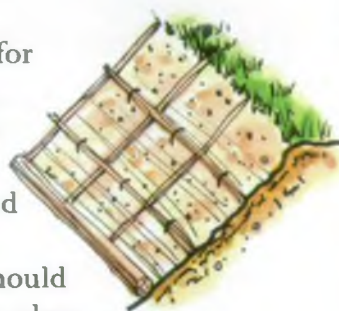
### Faggot

Bundle size 35-400mm.

Usually osier willow, poplar or hazel stems no greater than 25mm diameter. Use wire, hemp or cut stem ties (not polypropylene) to bind.



◇ Faggot mattress for surface protection. Large key faggot at base. Loose spread of willow, anchored down by smaller faggots. Mattress should be staked firmly in place.



◆ ◇ Bundles of faggots held by poles and buried beneath surface soil. Back-fill surface with earth.



## ◇ Hurdles

Hazel wattle hurdles 1.8m x 1.8m fixed with U shaped lightweight retaining bar or stake, provides good temporary erosion protection until vegetation grows through and panels rot away. Firm anchorage is required.



## KEY

◆ For use on steep cliffs, possibly with severe erosion problems or heavily eroded areas.

◇ Sloping banks

○ Toe protection



# Bank Protection

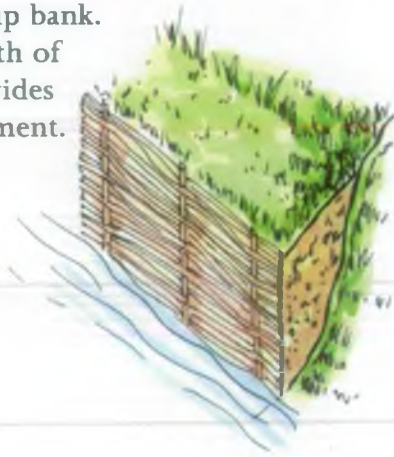
## Bio-engineering

Remember wherever possible, rivers should be encouraged to maintain a natural course allowing for natural processes of erosion and deposition.

### Using newly cut timber

#### ◆ Spiling

75mm diameter poles are driven in and green (live) osier woven through on bank edge. Back-fill with soil to make up bank. The growth of osier provides reinforcement.



○ Green (live) willow poles can be driven in for toe protection; poles shoot and root, stabilising bank.

Growing shoots reinforce the surface. Surface is back-filled with earth.

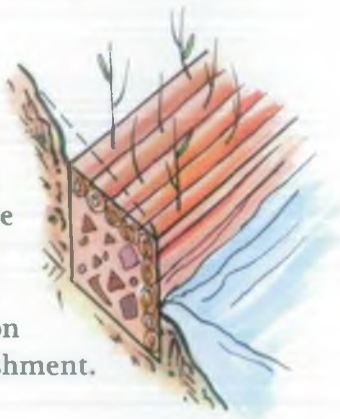
Stakes and galvanised wire secure poles until rooted.



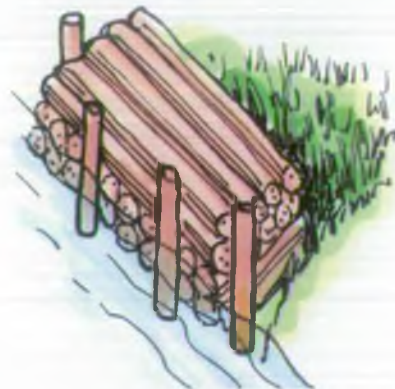
#### ◆ ○ Poles (with gabion basket core)

Gabion with willow pole facing.

Core material, including stone within the gabion basket, gives protection during establishment.



◆ ○ Cut willow poles to repair erosion of sand or gravel banks must be firmly secured to each other and to the bank.



### KEY



For use on steep cliffs, possibly with severe erosion problems or heavily eroded areas.



Sloping banks



Toe protection



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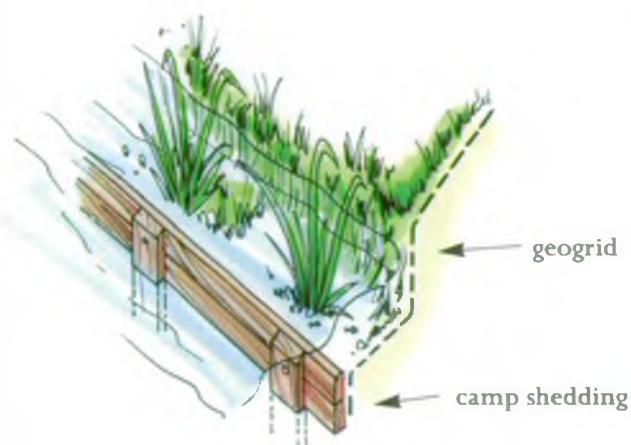


### ◆ Dead wood

Felled or fallen tree stumps provide excellent habitat: pegged and wired into the bank and back-filled, also act as reinforcement. Care should be taken that work does not become unsightly or become an obstruction in the channel.



### Toe boarding (or camp shedding)



The toe may sometimes need protection to prevent undermining and scour.

- Sawn timber toe boards bolted to toe posts 100 x 100mm spaced at 2m. intervals. Larch poles can be used for rustic effect.

Toe boarding or camp shedding is commonly used in conjunction with geotextile as toe protection for underwater berm. (Low shelves).

### General reminders

- No loose material, or fill of any sort should be imported into the flood plain without Environment Agency consent.
- All construction must be well secured.
- The erosive power of water must always be taken into account in designing.

### KEY



For use on steep cliffs, possibly with severe erosion problems or heavily eroded areas.



Sloping banks



Toe protection



# Bank Protection

## Hard Engineering

Ideally, rivers should be encouraged to maintain a natural course allowing for natural processes of erosion and deposition. In circumstances where the structural strength of hard engineering techniques is specifically required, the sympathetic choice of method and materials is essential.

Where watercourses are no longer in their natural state due to the past influences of man, the habitat can often still be enhanced for fishery or wildlife value.

Owners have the right to protect their property from flooding and their land from erosion providing such work does not affect the rights of other riparian owners to receive flow in its natural state. They also have the responsibility to pass this flow on without obstruction, pollution or diversion affecting the rights of others. It is expected that any bank protection work will only be appropriate in a very few circumstances and may require consent from the Environment Agency.

Where the structural strength of hard engineering techniques is needed, an appropriate combination of techniques and the sympathetic use of local materials is vital. The following pages give guidance on hard engineering techniques which may be considered in specific circumstances. In most cases such works must only be carried out with specific prior approval from the Environment Agency, who should be contacted well in advance to ensure all interests are safeguarded.

## Bank protection

### General principles

The height of bank protection depends on the range of water levels.

Design of bank protection and choice of materials depends on load conditions (type of water flow) and function of the protection.

It must be sympathetic with the natural river environment - its habitat value must also be considered.

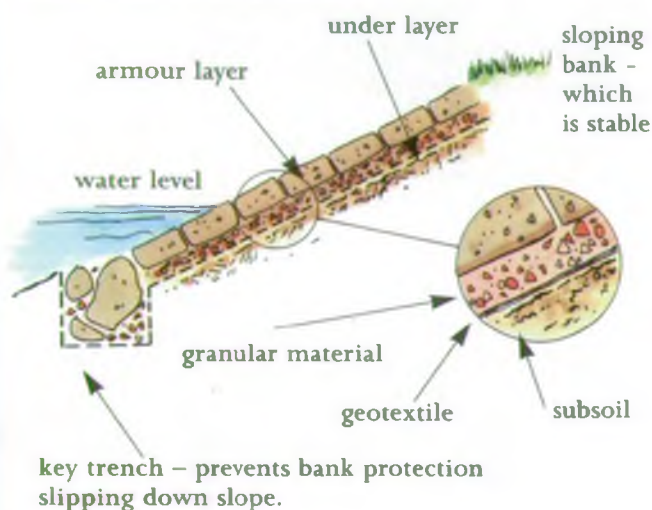


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## ○ ◇ Typical Bank Protection (also known as revetment)

Cladding on a sloping soil bank to protect and stabilise the surface. In many situations, hard materials can be combined with appropriate facing materials or vegetation.



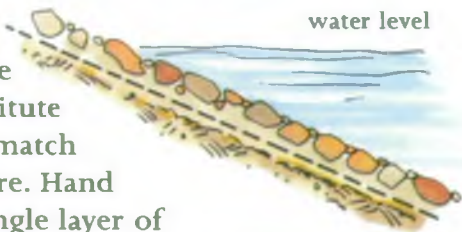
The height of bank protection depends on the range of water levels, but typically, is limited to 450 mm above normal water level.

## Bank protection

### Materials

#### ○ ◇ Hand pitched stone

Use only local stone or a substitute of visual match and texture. Hand place a single layer of dressed stone - can be grouted with mortar or mastic. Although stone is natural in appearance, avoid coursing and soften edges with random stones. Loose tipped rubble should not be used!



## ○ ◇ Rip-rap

Very flexible - quick to repair.

Rock armour is dug and replaced by machine - even underwater. Do not armour too high up bank i.e. not above the mean flood line. Depth of armour depends on function. Ensure sufficient stone below bed to prevent scour. Stability is increased by using a range of stone sizes and a well designed toe.



### N.B.

Encourage integrated or supporting vegetation by seeding, hydroseeding, or planting wherever appropriate.

## ◇ Concrete blocks as armour

### General principle

Cellular units good for combining with vegetation.



Laid blockwork is subsequently filled with soil and seeded. Precast or in situ units laid as individual units or as a mattress tied with cable.



Flexible armour gives best resistance to soil heave from bank. Semi-flexible - grouted units accommodate some heave. In situ monolithic structures must be designed to allow for soil movement.

## KEY

◆  
For use on steep cliffs, possibly with severe erosion problems or heavily eroded areas.

◇  
Sloping banks

○  
Toe protection



# Bank Protection

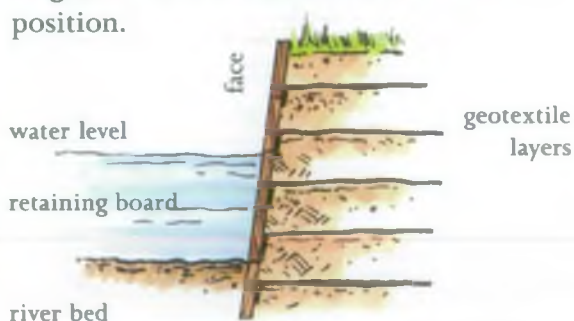
## Hard Engineering

Ideally, rivers should be encouraged to maintain a natural course allowing for natural processes of erosion and deposition. In circumstances where the structural strength of hard engineering techniques is specifically required, the sympathetic choice of method and materials is essential.

### Retaining methods

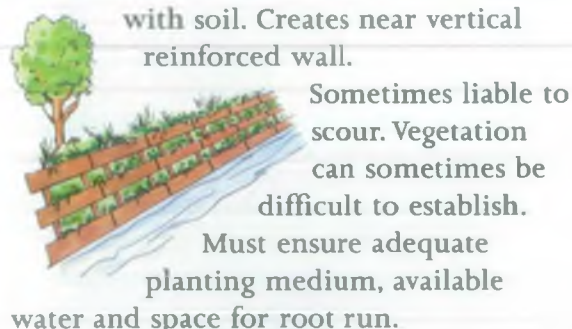
#### ◆ Reinforced earth

Geotextile web fixed to retaining board or gabion face. Reinforced soil holds position.



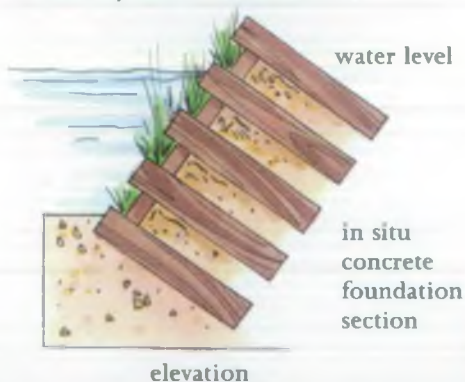
#### ◆ ◇ Crib walls

Interlocking beams of wood or concrete create a lattice which is then back-filled with soil. Creates near vertical reinforced wall.



Sometimes liable to scour. Vegetation can sometimes be difficult to establish.

Must ensure adequate planting medium, available water and space for root run.



### Geotextiles

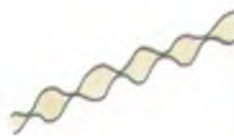
Full bio-degradable liners and barriers (either synthetic or natural fibre).

**USES:** Filtration, reinforcement and transference of loads over greater areas. Erosion control, bank stabilisation.

### Geomeshes

Woven open meshes of natural bio-degradable yarns, synthetic yarns or combinations.

**USES:** ◇ Surface erosion control and soil reinforcement.



### Geogrids

Punched out of polymer material or welded from polymer strands. (netting structure)

**USES:** ◆ ◇ Reinforcing soil walls or slopes or rock faces.



### Geocells

Three-dimensional flexible honeycombs. Laid over geotextiles or subsoil and filled with topsoil or gravel.

**USES:** ◇ To prevent slippage.



### KEY

◆ For use on steep cliffs, possibly with severe erosion problems or heavily eroded areas.

◇ Sloping banks

○ Toe protection

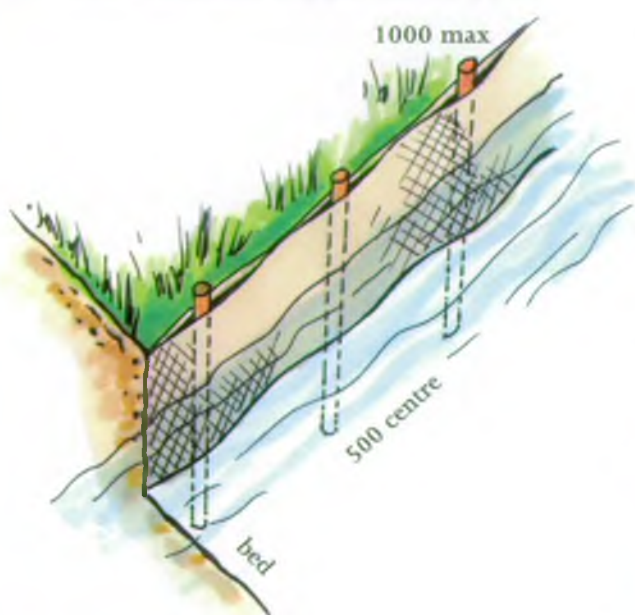




## Retaining methods

### ◆ ○ Retaining geotextile

A double layer of fabric is sewn to form pockets which are supported by posts



## Walls

The design of retaining walls is determined by a number of complex factors such as ground and surface water - therefore it is essential for an engineer to determine the structural design.

### Solid walls

The use of solid walls e.g. steel sheet pile, concrete retaining walls, and channels or block, are discouraged and soft engineering techniques should be considered in preference.

◆ ◇ ○ Where solid walls are essential, their visual appearance must be improved by cladding with timber, brick, stone or appropriate local materials.

Where sheet steel piling is essential because space is limited and structural strength is required it may be buried so that earth shaping recreates the natural landscape.

In the case of concrete, the surface can be textured and opportunities made for planting.

Design opportunities should always be explored.



### KEY

◆  
For use on steep cliffs, possibly with severe erosion problems or heavily eroded areas.

◇  
Sloping banks

○  
Toe protection



# Bank Protection

## Hard Engineering

Ideally, rivers should be encouraged to maintain a natural course allowing for natural processes of erosion and deposition. In circumstances where the structural strength of hard engineering techniques is specifically required, the sympathetic choice of method and materials is essential.

### ◆◆ Sheet toe piling:

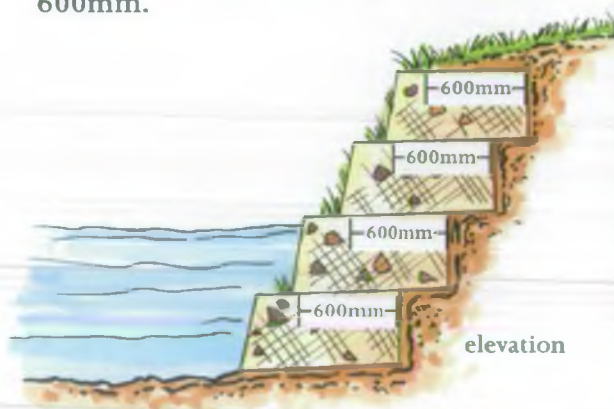


A significantly longer life span than timber. Consideration must be given to visually improving the very engineered effect.

Allow space between the sheet pile and the reinforcing concrete at the top for silt, then vegetation to develop. Painting in colours matt grey/green grey /brown range may help.

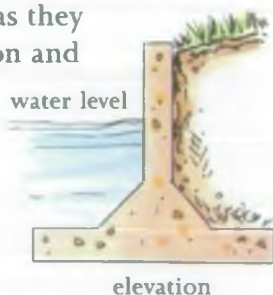
### Gabions

Wire mesh cages tightly packaged until stone to form either basket or mattress shaped solid structure. Consider for short term work (15yrs) below water level. Cages should be keyed in to bank at least 600mm.



### Precast concrete units:

Use discouraged as they require foundation and dry work and provide no possibility of naturalising. Use only as a last resort.



The interface between gabion walls and the rest of the bank is liable to erosion and should be designed to avoid this by keying into the bank.

◆◆○ Vegetation may be planted in top half of gabion basket. Roots will either grow in soil retained or penetrate through to subsoil behind, so reinforcing the bond between gabion and bank.

### Combination toe protection

Where toe protection is essential, hard materials such as stone can be used very effectively in conjunction with hurdles, mattresses or rolls of bio-engineering materials.

### KEY

◆ For use on steep cliffs, possibly with severe erosion problems or heavily eroded areas.

◆ Sloping banks

○ Toe protection



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## Gabions with fibre mats

◆ ◇ ○ Gabions can be lined with fibre mats (either pre-seeded or not) prior to filling with rocks. Soil can be brushed into the fitted gabions to allow vegetation to root.

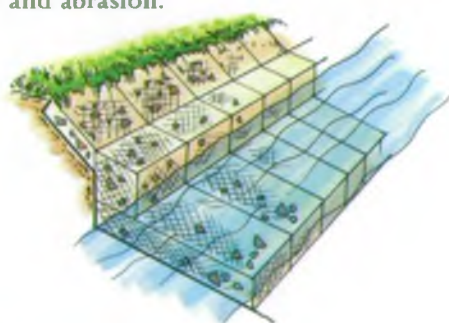
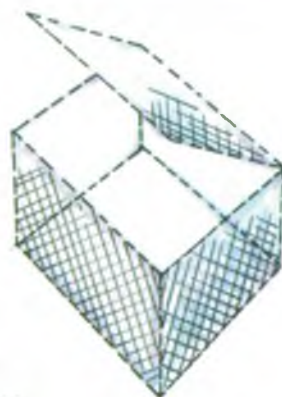
Soil filled planting pockets can be incorporated into the gabions when they are filled.



1½ mesh dimension

Stone must be hand placed in gabion baskets.

Mesh type- galvanised or coated dependent on water type and abrasion.



## Gabions or 'Reno' mattress

Gabions must be no higher than 300mm above water level in order that vegetation can thrive.

**N.B.** These are not earth retaining structures, but protect a bed or stable sloping bank against surface erosion.

## Design check:

Before submitting plans for approval consider the following points:

1. Identify the reason for the bank needing protection
2. Would it be cheaper or more acceptable not to protect the bank in the long-term?
3. Evaluate appropriate protection in choice of design solution.
  - Only use other methods if natural vegetation or composites with natural vegetation cannot be installed.
  - Soft or bio-engineering can cope with most river situations.
4. Identify the area above and below the water level that needs protection.
5. Does the bank horizon need protection?
6. Is the foundation suitable and protected from scour?
7. Will the protection be integrated with the surroundings?
8. Is the protection in keeping with the rest of the bank?
9. Will the bank include natural vegetation wherever possible?
10. Does it require Land Drainage Consent, any other licences or consultation with the Environment Agency or any other body?

## KEY

◆ For use on steep cliffs, possibly with severe erosion problems or heavily eroded areas.

◇ Sloping banks

○ Toe protection



# Outfalls

## General Principles

### Head walls and wing walls

lying within line of bank and be married into surroundings.

### Pipe invert position

access for sampling – even with flap valve, safely.

(A sampling chamber will be required in a safe location).

### Apron position and design

just above normal water level and adequate for exit velocity?

### Outfall discharge

outfall positioned correctly: to function without affecting recipient watercourse or bank stability?

### Materials

appropriate to function and appearance.

### Bank protection

does it harmonise and assist in naturalising bank?

### Design purpose

does the outfall perform to the criteria for its situation? e.g. flap valves when in floodbank.

### Foundation

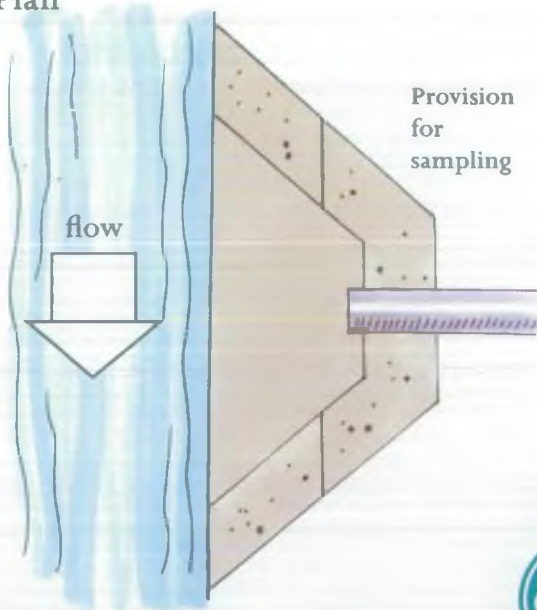
sufficient design depth and anti-scour protection?

### Small pipes

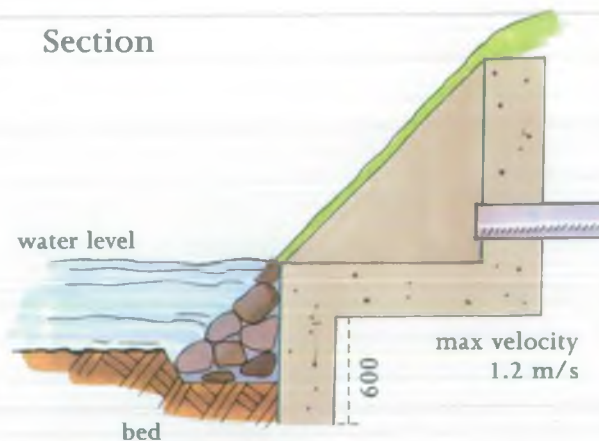
(smaller than 300mm in diameter)

Small outfalls can be max 90° to flow.

### Plan



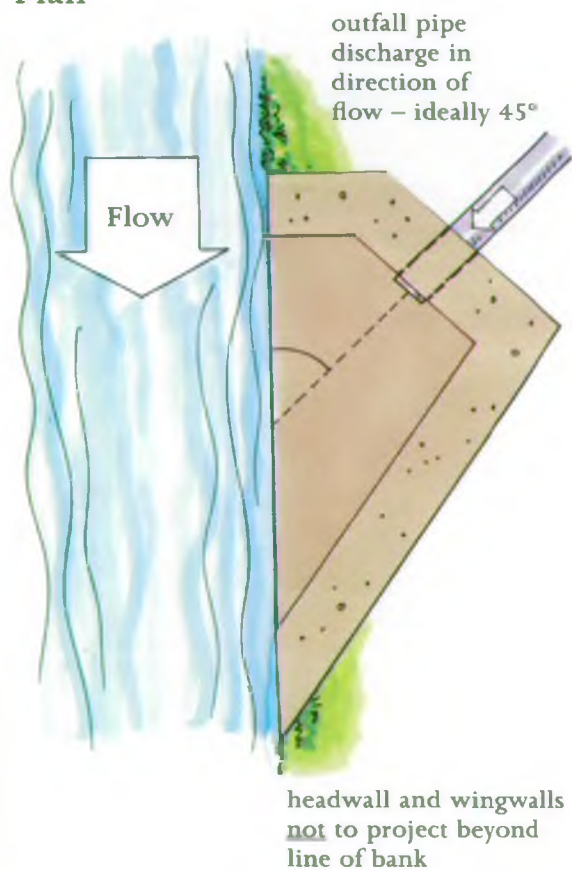
### Section



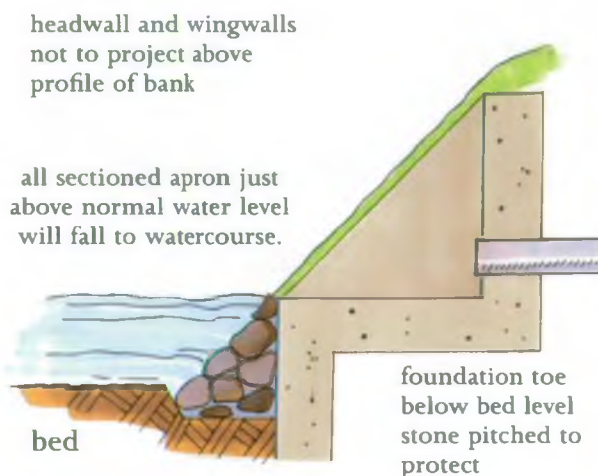
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## Plan



## Section



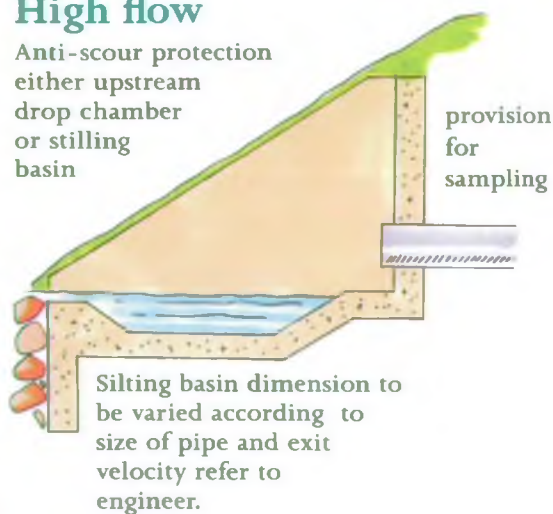
## Notes:

- Normally no outfall structure to cut into flood embankments. (There are rare exceptions)
- Design to be approved by Land Drainage Consents Officer.
- Protection may be required on bed and opposite bank downstream.
- Location of outfall to be indicated and should be visually appraised prior to design.

These notes apply to sheet 6.2.

## High flow

Anti-scour protection either upstream drop chamber or stilling basin





# Outfalls

Materials and style should always be appropriate to the character of the landscape/townscape.

## Natural stone

- Stone selected should not only be to the engineering specification but in keeping with the local geology in colour and texture.
- Loose stone around small precast units helps naturalise and blend into river bank.
- Mortar bedded stone pitching is more satisfactory with raked or open joints encouraging plant colonisation and naturalisation of the river bank.

## Brick

- All brick to be class A or B engineering brick according to situation.
- All retaining head and wing walls to be min. 215mm thick.
- Design opportunity  
Consider use of vaulted outfall –  
Allowing sampling access,  
reducing visual impact of brick.
- Consider different bonds, brick, colour and mortars e.g. “dull” mortars.

## Concrete

### In situ

- All mixes as specified/approved by engineer.
- All in situ work to be form work – to especially avoid “Back of shovel” work on small outfalls.
- Consider surface treatments – hammered or exposed aggregate to encourage algae/moss establishment

Minimise ‘X’ on sketch or form overhang to reduce visual impact.



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## Special Situations

### Very low flow

- Conventional headwalls look misplaced, heavy and are not necessary in most natural pool situations.
- The impact of the outfall is greatly reduced using alternative materials.



Geotextile planting pockets.



Geotextiles webs or membranes under soil provide reinforcement around the outfall.

**Any person intending to construct an outfall into a watercourse requires the approval of the Environment Agency.**



# Bankside Structures

## Fishing Platforms

### Purpose of guidelines

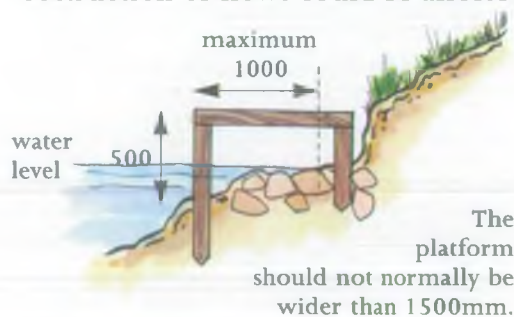
- To encourage high quality design and construction of fishing platforms.
- To encourage consideration of the safety and enjoyment of anglers of all abilities.
- To ensure that the engineering and legal aspects have been considered in the planning process.
- To promote the use of platforms which will enhance the environment for which they are intended.
- To ensure that such structures do not impede water flow or navigation.

### Initial considerations

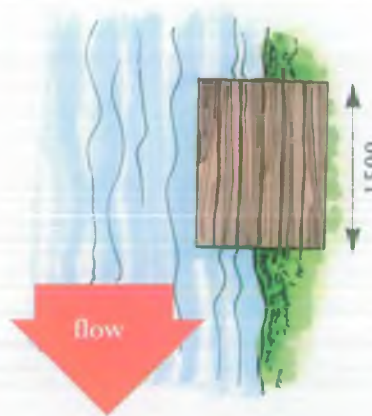
- Fishing platforms must not:
  - make the bank unstable
  - cause subsequent erosion of the bank
  - create an obstacle to the flow of water.
- All fishing platforms are considered temporary structures with a maximum life-span of five years before replacement.
- All platforms are liable for annual inspection and subject to maintenance orders by the Environment Agency.
- If the bank is cut, the owner or club is considered responsible for its stability. The amount of bank cut must be kept to a minimum.
- All platforms require consent from the landowner.

### Position

The platform must be sited parallel to the flow and project a maximum of 1000mm into the river, exceptions being on small narrow rivers with shallow banks or where navigation or flooding risk due to obstruction of flows could be affected.



The platform must be no higher than 500mm above water level at normal flow.



Platforms **MUST NOT** disturb any bank revetment, protection work, trees or bushes.



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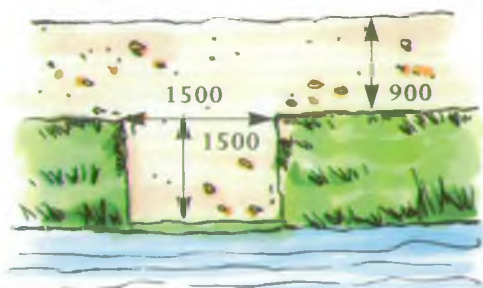
## Platforms for disabled anglers

### General considerations

- Do not segregate disabled anglers away from the other fishermen. Ensure that there is plenty of choice of fishing places.
- Paths will need to be constructed between the angling station and parking facilities.
- If information is displayed it should be clear, concise and at a readable height – especially important for warning signs.
- The platform should take into account fluctuating water levels, if these changes are frequent e.g. tidal areas or reservoirs.
- Ideally the platform should be sheltered from cold winds.

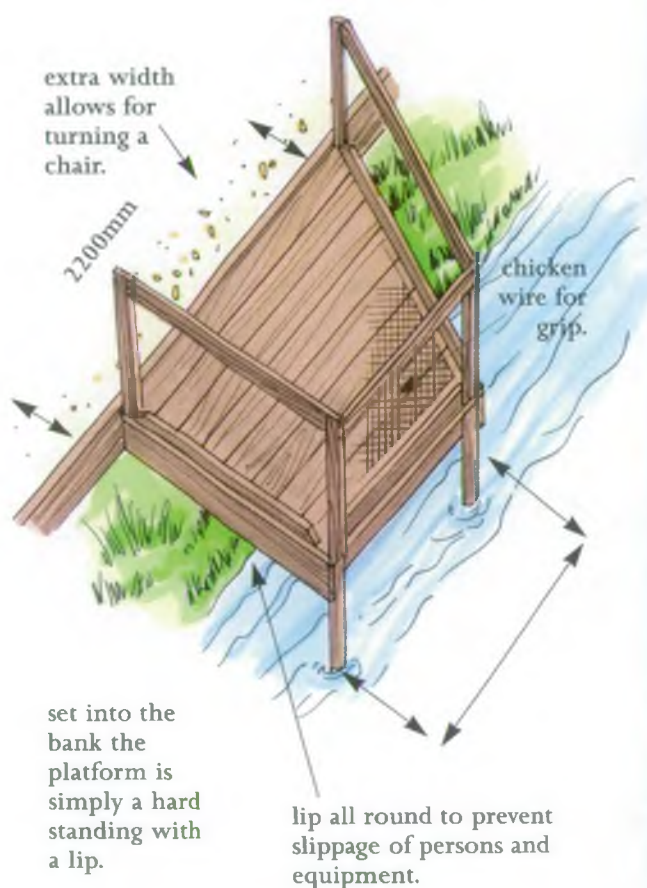
### Construction

- Basic construction as detailed in preceding pages.
- Platforms may be set into the bank or jut into the water.
- Consider making some platforms wide enough to take angler and companion.



### Access

- The platform and access point from the path must be at the same level.
- Platform approach path should be hard surfaced e.g. hoggin, unit paving etc.
- Access should have a maximum fall of 1:12 along its entire length.



Planning Permission and Land Drainage Consent (from the Environment Agency) will almost certainly be required.



# Bankside Structures

## Fishing Platforms

### Bank cutting

(Where very steep banks need retaining)

Such cuts must be retained with permissible material such as tanalised 100mm round timber, or webbed geotextiles, anchored securely by soil. The latter requires immediate seeding to encourage revegetation.



Use tanalised board pegged and nailed in position to retain consolidated stone surface.

The base should be seeded or stoned immediately after cutting to prevent scour. The maximum dimensions for cuts are 1m into the bank and 3m along the bank.

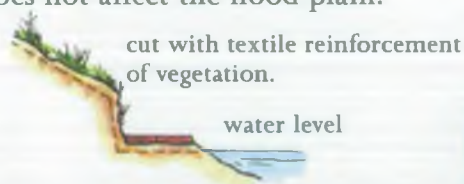
The maximum depth of cut should be 500mm deep from the existing line of the bank.



### Decking

A hard surface can be created using materials in keeping with the surroundings but is normally only suitable in urban areas.

Spoil from cutting work must not be deposited in the river. It is to be removed to above the bank top to a position where it does not affect the flood plain.



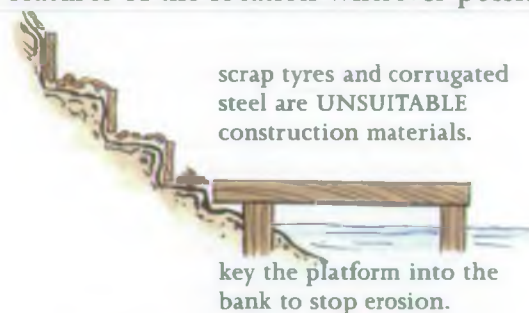
cut with textile reinforcement of vegetation.

water level

### Access

All access paths to fishing pegs and platforms must follow the most direct route.

They should blend with the natural features of the location wherever possible.



scrap tyres and corrugated steel are UNSUITABLE construction materials.

key the platform into the bank to stop erosion.

On very steep banks preventing direct access, steps may be cut across the bank. The side of the step will also require retaining using tanalised timber rounds driven to a minimum of half their length into the bank.

### Step construction

Typical construction using retaining board 150mm x 25mm x 450mm held by two No 450mm long 1/2 round posts.

Use simple cut and fill to minimise spoil removal.



the step surface should be reinforced with consolidated hoggins, and sides reseeded.



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## Platforms

The platform should consist of a timber frame on uprights with a deck. The frame may be fabricated as detailed. A range of deck materials are permissible but consideration should be given to the appropriateness of appearance, durability and safety in water. The platform frame must be driven securely into bank and river bed by at least half the overall length of the vertical posts.



### top edge

50mm x 75mm tanalised soft wood securely bolted to uprights. There must be no projections.

### uprights

100mm diameter tanalised softwood driven to at least half their length into firm bank or river bed.

## Note:

Maximum dimensions as per front 7.1.



## Decking

Covering of 20mm galvanised chicken wire securely fixed to prevent slippery surface. All decking must be securely fixed to the top edge of the frame.





# Bankside Structures

Structures on the bankside should be secure and comply with the Environment Agency guidelines. Structures should not make the bank unstable, cause subsequent erosion or create an obstacle to the flow of water.

## Cattle Drinks

Bays formed in the river bank to provide stock watering points

### Requirements

- Should not be less than 3m wide.
- Approach ramp should have a 1:4 slope or shallower.
- Should ensure that the cattle drink construction does not protrude into the main flow of the river, causing an obstruction to water flow.
- Fencing should be of appropriate strength and should be continuous to prevent livestock entering the river channel.
- The cattle drink should have a hard core, gravel or rubble base that extends beyond the fencing and above the flood level on the approach slope.
- Ensure that the base of the watering point is constantly under water by making the base level with river base.

### Alternative 1



### Alternative 2



bollards/posts  
1500mm and  
1000mm high driven  
well into solid bed 150mm  
apart. Diameter 150mm.



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# Bankside Structures

## Otter Hols

The Environment Agency together with local and national conservation bodies, is actively promoting recolonisation of otters in river corridors.

Riparian owners are encouraged to construct artificial hols.

### Siting

OTTER HOLTS SHOULD IDEALLY BE SITED IN ISOLATED POSITIONS:

- In scrub or woodland.
- Next to a side stream or ditch.
- Preferably fenced.
- No easy public access.



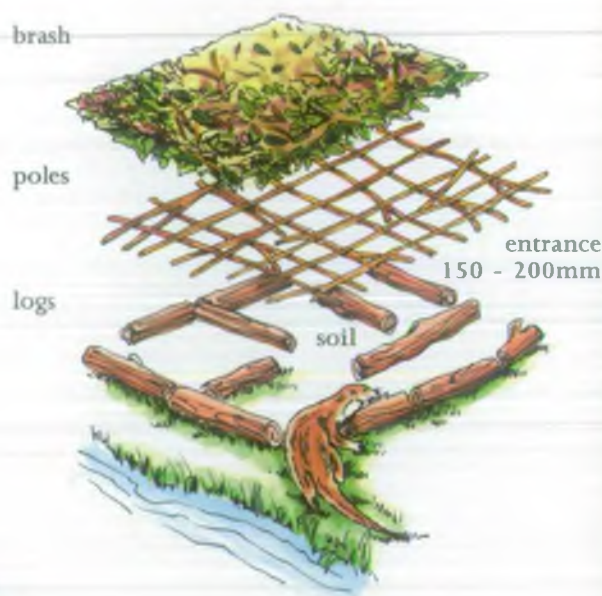
### Log pile holt

Create interconnecting chambers up to approximately 1m<sup>2</sup> using logs 150-225mm diameter as cut. The holt can be any shape, but plan according to the site making it as large as possible.

Form a roof over the logs with a matrix of poles - to make interior dark and dry.

Place brashings and leaves well packed and flat, to overlap over whole structure - if liable to flood, cover with sheep wire and stake down, then hide wire with brash.

Entrance 150-200mm, with at least two access points on the water's edge and another onto the land.

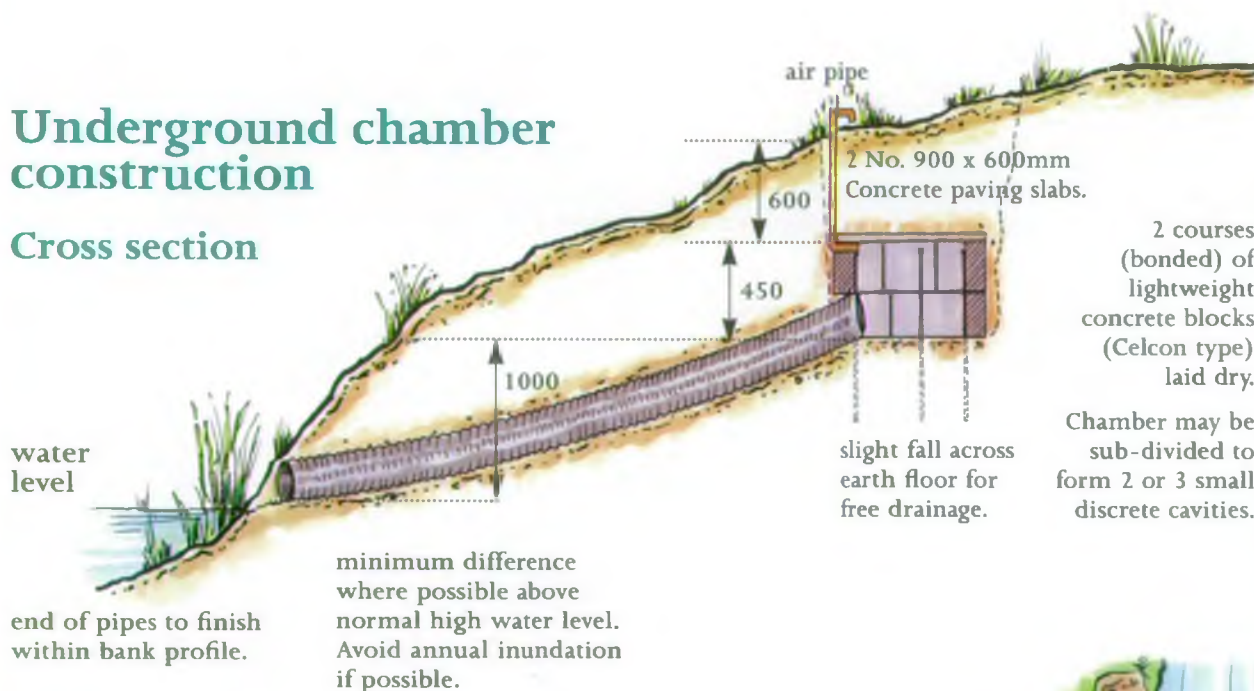


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## Underground chamber construction

### Cross section



### Plan

small sheet of polythene (ex refuse sack) laid over joint between slabs.

metal bar (or tube) driven in close to face of blockwork to prevent collapse.

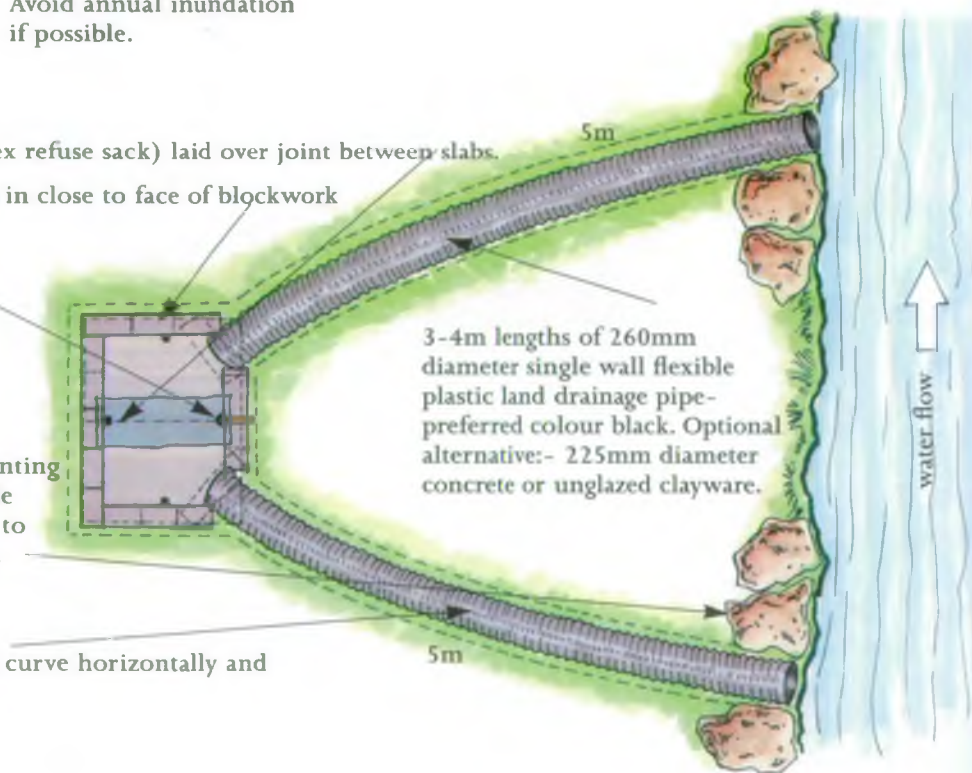
brown 35mm diameter UPVC plastic vent pipe concealed by planting.

### Optional:-

Large stones to protect entrance and provide sprainting sites. (Not used in navigable waterways or where likely to cause obstruction to flow).

### Note:

Pipes to be laid on a slight curve horizontally and vertically to exclude light.





# Bankside Structures

## Boardwalks

These are raised walkways above water or marshy ground or even above dry ground.

### Uses

- As a platform.
- As part of riverside walks/pond dipping platform.
- As extensions to the bankside.
- Projects where access to marsh, wetland or open water are desirable for pedestrians.
- Alternative surfacing material.

### Considerations

- Use or function.
- Safety, especially where accessible to the public.
- Aesthetic quality and design.
- Type of timber available.
- Future maintenance.
- Weathering and tolerance to flooding.

### Joists

- Makes decking cheaper by allowing greater spans but may need bracing, however.



### Beams

- Support the joists or decking if there are no joists.
- Spacing 1.8 – 2.4m apart without joists; 2.4 – 4.9m with.

### Posts

- Need to be supported with galvanised steel post anchors set into concrete foundations.
- Can be projected up for handrail supports.
- Square section posts to be used to prevent twisting.

### Construction

- Must be non-slip.
- Gaps between decking boards must be no greater than 15mm.
- Decking boards must be strong enough to carry expected weight without splitting (between 25 and 50mm thick). Can be hardwood or pressure treated softwood.



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# Seats and Benches

## Considerations

- Siting ● Materials ● Design

## Siting

### Depends on use

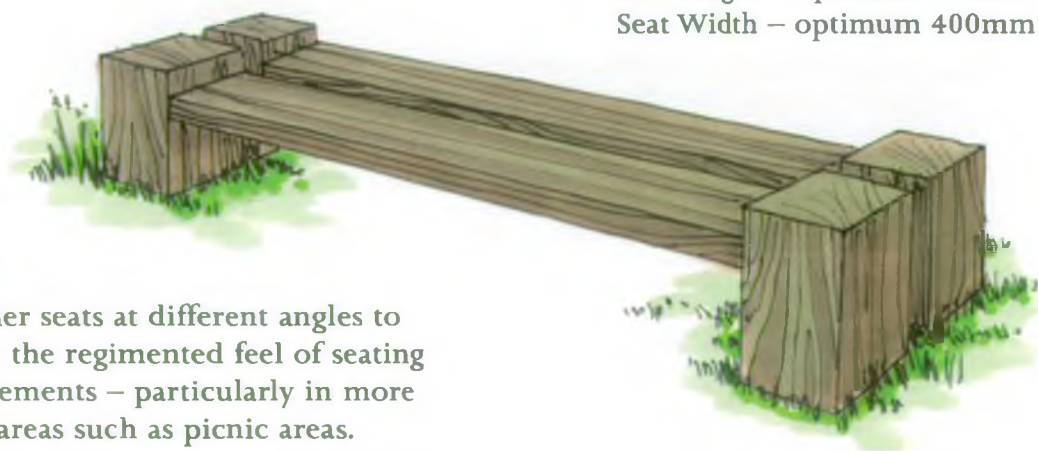
- For fishing purposes, seats and benches should be near enough to the water's edge.
- For general use they should be sited to maximise views and yet not obstruct footpaths or maintenance access.
- Seats should be easily seen from pathways and sited at frequent intervals.

## Materials

- Material should be appropriate to the design.
- Durable – reasonably resistant to periodic flooding and vandalism.
- Should have hardstanding/foundations to secure seating fixings to and to avoid pedestrian erosion.
- Also approach path should be surfaced to prevent erosion.
- Fixing should be secure.

## Design

- Appropriate for the site – urban or rural.
- Unobtrusive.
- Seat height – optimum 430mm  
Seat Width – optimum 400mm.



## Note

Consider seats at different angles to reduce the regimented feel of seating arrangements – particularly in more social areas such as picnic areas.

Seating encourages people to stop and linger, benefiting from the type of environment that the river has to offer.



# Bankside Structures

## Pedestrian Ramps and Steps

### Ramps

Necessary for wheelchair, pram and cycle access.

Tamped concrete ramp with raised bricks strips and open joints.



### Design

Surfacing materials and the shape of the ramp will depend on location and must be appropriate to its setting.

For example, bound gravel and raised sleeper strips would be appropriate for a rural area and tarmac or tamped concrete with raised brick strip in a more urban setting.

### Requirements

- Non-slip surfacing.
- Maximum gradient: 1:10, 1:12 preferred, 1:7 if the ramp is less than 2m.
- Width at least 1.5m.
- Consider deposition of silt if flooding occurs.

### Surfacing

Bound gravel

Tarmac

Tamped concrete

Raised brick or sleeper strips can be incorporated for added safety. These should have some open joints for drainage.

Ramps can be direct or curved

Consider what happens at the base of the ramp and the side – a kerb or handrail may be needed to prevent wheelchairs leaving the sides.

**SAFETY IS VERY IMPORTANT NEAR WATER!**

A cross-fall of approximately 1:60 will also be needed for drainage.

### Stepped ramps

Stepped ramps provide a very gradual rise on a long slope.

Allow three paces at least to each tread as they can be very tiring for pram pushers.



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## Steps

### Safety

Depending on surrounding land form, steps may need handrails.

### Note:

Steps that are narrower than 112mm can be very uncomfortable, if not dangerous!



Sleeper Steps

### Requirements:

- Tread surface to be non-slip.
- Try not to use less than 3 steps in a flight and not more than 16 without a landing. The dimension of the landing should be at least the square of the stairway width, and a little longer if practicable.
- Leisurely ascent - 112mm rise x 425mm tread.
- Consider position of steps in the landform and what occurs at the sides of the steps.

### Construction

Rustic steps such as timber or logs may simply be placed on prepared ground in a rural situation.

Bricks, stone, granite setts or pavements will probably need a raft type concrete foundation which may need reinforcement for long flights of steps.

### Materials

Depend on design and site (urban/rural). Steps must have some form of wearing course on the tread and this may mean a hard edge at the nose of the step.

<b>Treads:</b>	Sleepers*	– may become slippery when wet
	Stone	– may be slippery, but cheap if from local source
	Granite Setts	– expensive, but attractive in the right setting
	Brick	– slippery when wet
	Concrete	– cheap, quick and easy, but can look ugly
	Timber*	– very slippery
	Pavements	
<b>Wearing Courses:</b>	Tarmac, hoggin (bound gravel)	
<b>Edging:</b>	Sleepers*	
	Retaining boards	
	Bricks	

\*If covered with chicken wire, surface is slip-free and wire can be extended into bank for stability.



# In Channel Structures

## Weirs

Low structures within the channel can help to oxygenate water by creating riffles but fish passage upstream must normally be ensured when designing new structures.

### Weirs

Weirs create a barrier to water flow and a change in water levels. In conservation terms, they have the following uses:

- To control flow velocity.
- To improve water habitat diversity encourage pools created by water turbulence.
- Can assist oxygenation.
- Act as silt traps for pond feeder watercourses.
- To retain water, for example, in a pool but allow an overflow.
- Additionally, larger weirs can be used to create fish holding pools.

### Materials

When timber is selected as a construction material then it is best practice to secure supplies from sources which have been verified as complying with the highest possible standards of sustainable management by independent third party audit.

Consequently the Environment Agency endorses the aims of the Forest Stewardship Council and wishes to procure timber produced in accordance with FSC Principles. For more information contact the Environment Agency.

### Timber

**Softwood:** Relatively cheap and must be pressure treated. Less durable than most materials.

Strong and visually attractive when available - get advice on treated timber (toxicity in water).

**Hardwood:** Use short lengths. Expensive and difficult to obtain appropriate types. (Elm excellent under water).

Timber is well preserved under water and small natural weirs can be made from large logs or tree trunks where these can be found.



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## Sheet Piling (Steel)

Can be used successfully when needed for structural strength. If carefully designed, it can be used in appropriate locations. Can also be painted, capped or clad.

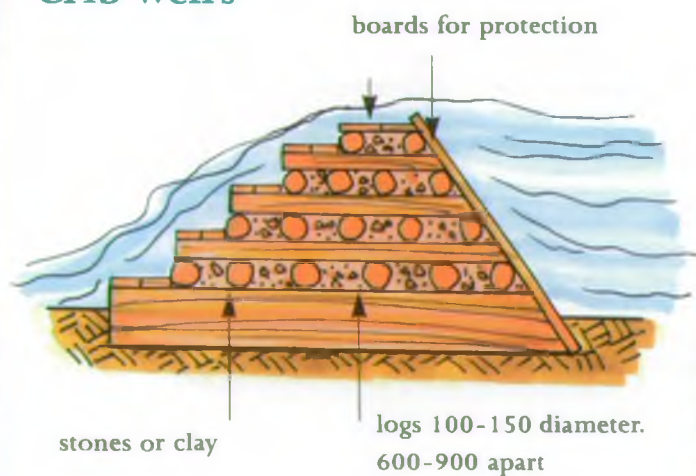
## Stone, Brick

Sometimes used in combination with sheet piling and/or concrete as a natural facing. Both provide structural strength where visual appearance is important.

## Concrete

Easy to use and durable but can look unsightly if not carefully designed or faced. Can also be finished with various textures.

## Crib weirs



## Note

Must be built on solid base, may need foundations

- Fish movement must be safeguarded. The installation of a fish pass may be required.
- Canoe or boat activity must be considered.

## Porous Weirs

Less effective at slowing flow rate (but capable of allowing fish passage upstream according to design).

## Materials

- Rubble & Boulders
- Gabions
- Brushwood or logs
- Stone

The seating of the structure in the banks on either side is vital to its stability. Protection immediately upstream and downstream must be considered.

The speedy establishment of vegetation cover will provide protection against bank erosion.



Straight weirs on curved rivers

Curved weirs on straight rivers





# In Channel Structures

Low structures within the channel can help to oxygenate water by creating riffles but fish passage upstream must normally be ensured when designing new structures.

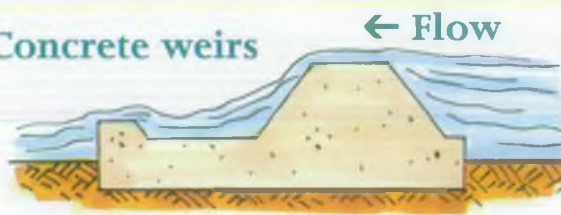
## Design Considerations

Reinforcing the base of the weir should be with a stone layer upstream and downstream otherwise pools by scouring will develop. Stones immediately downstream of the toe of the weir will create riffles and usually allow passage of fish downstream.

The material with which the weir is constructed must be strong enough to withstand the water flow.

If stone blocks are used they should not weigh less than 50kg and neither should individual gabion baskets. Stones forming rubble should be carefully laid to lock together.

### Concrete weirs



At Least 50% greater than height



← Flow



Interlocking stones weighing no less than 50Kg, keyed into river bed.



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Easy to use and durable but can look unsightly if not carefully designed.

Can be finished with various textures.



### Low stone weirs

Most often used in the reinstatement of pools for improving the habitat diversity of a watercourse, generally submerged during high flows. Low stone weirs can be used in conjunction with current deflectors to slow water speed to reduce erosion risks.

Often used to enhance habitat diversity on recently de-silted watercourses. Cheap to construct, they make a tremendously beneficial difference, both visually and physically, by breaking the water flow.

### Benefits

Oxygenation of the water. Trapping of organic particles as a source of food for fish and other water life. Providing suitable materials for colonisation by algae and mosses.

### Materials

Preferably local, natural blockstone, not tipped concrete, bricks or rubble. It may be necessary to use gabion baskets or 'reno' mattresses where local stone is unavailable - they are not suitable for swift flowing rivers.

### Methods

Lay stone blocks to allow water to flow between them. Blocks may be fixed if necessary by metal or wood stakes.

**Control structures** (NB: normally only for use in slow flowing lowland watercourses and can cause, if used at in appropriate locations, an increase in flood risk. It is essential that advice be sought from the Environment Agency Area Office).



# Nest and Roosting Sites On River Bridges

**This information sheet is designed to encourage bridge designers to incorporate, (at the design stage and during repairs to old bridges), ledges and holes suitable as nest/roost sites for birds.**

Nowadays, as old bridges are being repaired and replaced, such sites are being lost. Pointing old brickwork destroys essential nooks and crannies, whilst modern and concrete sectional bridges lack the holes, ledges and cracks associated with old stone and brick structures. The smooth uniform design renders them virtually useless for wildlife.



Dipper, wagtails and spotted flycatchers traditionally nest under old bridges and would benefit if suitable holes and ledges were incorporated into new bridges or during bridge repairs. This sheet gives guidance on how such features can be incorporated into structures and on suitable sizes, shapes and preferred locations for their inclusion.

Clearly they must be incorporated in a way that does not damage or affect the strength of the bridge, or causes future maintenance problems. The viability of including holes and ledges must be assessed for each individual structure.

## Location and numbers of nest sites

On medium to large sized bridges up to three per abutment and up to two per training wall should be provided. The holes should be of varying sizes and located at different heights above flood level, as different birds prefer different locations.

On small structures, holes should be sited as high as possible to be out of reach of flash floods.

Fig1. View of face of abutment and wing walls, showing typical nest sites locations.



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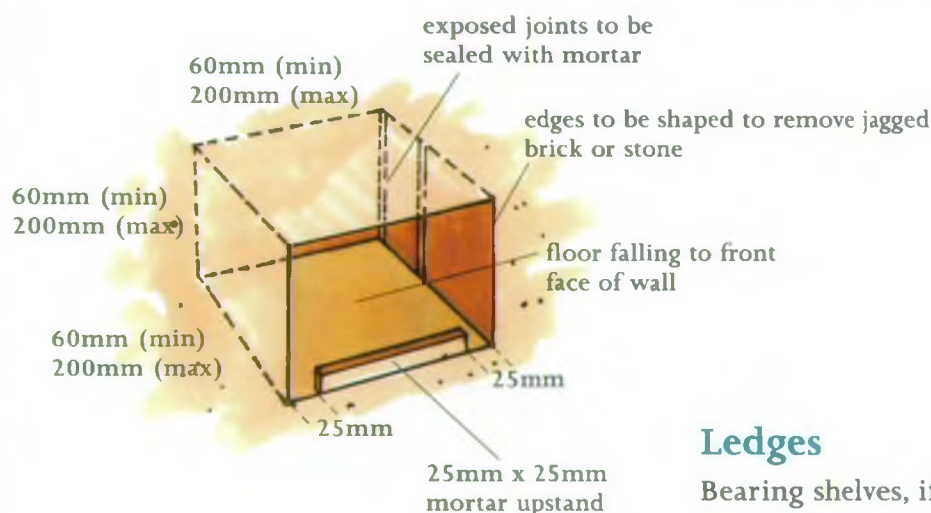
## Design of nest holes

The base of a hole should be flat or have a slight fall towards the front face of the wall to avoid waterlogging. The edges of the hollow may need to be shaped to avoid leaving jagged pieces of stone or brick that may subsequently erode. Also, to prevent further erosion, the interior of the hollow may need to be sealed with mortar in places where joints in masonry or brickwork are exposed.

## Nest sites on new structures

To create suitable nest sites, bricks or pieces of masonry or blockwork can be left out of brickwork, masonry or concrete facing abutments, wing walls or training walls.

In mass concrete walls, holes should be cast into the face of the wall. (this is not normally practical in the case of unfaced reinforced concrete walls, but it may be if there is a patterned finish into which holes can be incorporated).

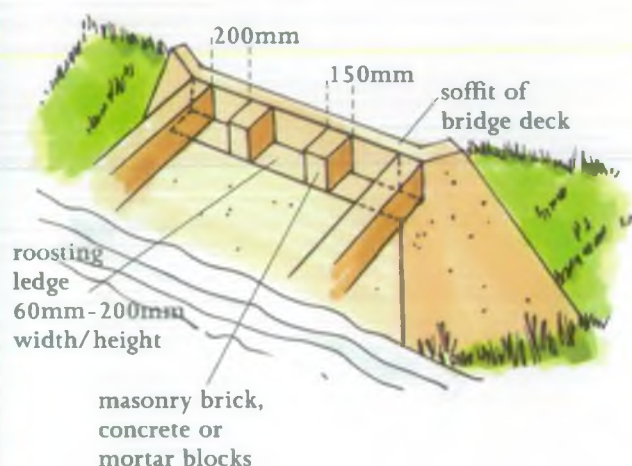


## Ledges

Bearing shelves, if accessible to nesting birds, are likely to be used as roosting ledges. On bridges without bearing shelves, ledges will be difficult to incorporate in the majority of cases. However, they should be provided at the top of abutments and run for all or part of the length of the abutment.



# Nest and Roosting Sites On River Bridges



View of face of abutment showing requirement for ledges.

Ledges should be between 60mm and 200mm in width and height. The length should be the maximum possible, i.e. the full width of the abutment. They should also be blocked off at both ends to keep out predators such as rats and mink. Similarly, if a ledge is larger than 300mm, the ledge should be divided up into 300mm lengths.

## Roosting provisions

Metal struts or bars are useful for roosting birds and drainpipes (diameter greater than 80mm-100mm) are also useful for nesting dippers and grey wagtails and for roosting dippers. Such drainpipes can go back 60cm or more and be very slightly at an angle, pointing downwards, then they will be more readily used.

## Nest sites on existing structures

Birds will usually make use of an existing hollow in the masonry or brickwork of the abutment, wing wall, or training wall. Alternatively, if bricks are badly spalled they could be removed and not replaced, in order to leave a hollow. Height, width and length of each hollow should be between 60mm and 200mm. A hollow can have different dimensions in each direction provided that each comes within these limits.

## Recording of positions of nest sites or roosting ledges

When any nest sites or roosting ledges are provided on bridges, their positions, measurements and any other relevant information should be noted and a record kept on the relevant bridge file.



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# Archaeology

**During activities such as the de-silting of rivers or excavation in the flood plain remains or artifacts of archaeological interest, may be disturbed.**

## Archaeology

Items of archaeological and historical value have been dredged from the river systems for as long as anyone can remember. There are many good reasons for this, but the main factor is that rivers have been a focus for human activity since the earliest times. Because of this, rivers have attracted accumulations of lost, abandoned or concealed artefacts of all ages.

Where navigable rivers are concerned, it is likely that set patterns of dredging have been established, and the frequency of discovery has diminished. However, as new patterns and volumes of dredging are required - for flood alleviation works, or improved locks, weirs and sluices - it is probable that the potential for artefact discovery will increase. Steps should always be taken to monitor the discoveries which are likely to result.

## Ownership

With the exception of Treasure Trove, ownership of artefacts from watercourses goes hand in hand with ownership of the bed and soil. Thus, unless the Environment Agency lays claim to the bed and soil, ownership of artefacts lies with the relevant riparian owner.

Where practicable, the owner should be informed of discoveries, and advised of their rights of ownership. If such rights are waived, or ownership is impossible to deduce (due, perhaps, to the scale of the works in hand), then items should be offered, ultimately, to a relevant local or national museum.

## Treasure trove

The law relating to Treasure Trove is complicated but the significant fact is that items of gold or silver, if discovered, must be reported to the police. Such items will become the subject of a special inquest which will determine their ownership and disposal.

It must be emphasised that, however unjust it may seem, "finders, keepers" is not a valid legal principle.

It is important to consult the County Archaeological Services in England and the Curatorial sections of the Welsh Archaeological Trusts in Wales prior to the commencement of dredging operations.

The above bodies hold the County Sites Monuments Records which are the repositories for all the archaeological information in each county area and can recommend further archaeological investigation prior to work and recording before and during works.



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## Reporting procedures

Any persons involved in operational work or de-silting should always be aware of the potential for discovering artefacts or physical remains and are encouraged to follow a set of procedures which will ensure suitable treatment and deposition of the items concerned.

## Do's and don'ts

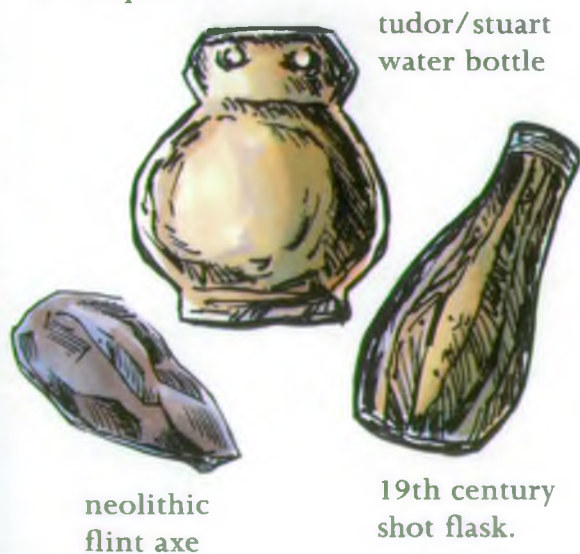
A few basic words of advice for the guidance of those who discover historic items.

### Do report your discovery

If there is any chance that your find is of interest, retain it and seek advice.

### Do take care of things

They belong to somebody and may be important.



neolithic  
flint axe

tudor/stuart  
water bottle

19th century  
shot flask.

## Do record where things come from

This may not be possible, but if the location is recorded, it adds greatly to the information value of discoveries.

## Do not offer items for gift or sale

It is unlikely they will be yours to dispose of (see front 11.1 Ownership).

N.B. It is very rare to find complete pieces of pottery or items of gold for example. A find may be timbers from earlier bridges, these, to the archaeological community, are of equal importance.

## Do not attempt to treat items

Any attempt to clean items, using chemical or physical means, is inadvisable, as it may actually damage them.

## Do not publicise discoveries

Ill-considered publicity for findspots may attract the attention of treasure hunters who seek to make gain by removing articles to which they have no right. Seek advice before giving interviews.



# Protected Species

**As the Environment Act 1995 makes clear, the conservation of flora and fauna must be taken into account when carrying out activities which may disturb or affect wildlife and the natural environment.**

The primary legislation is the Wildlife and Countryside Act 1981, which lists those species (birds, other animals and plants) which are given protection. These lists are reviewed at five-yearly intervals; the Secretary of State may add species to the schedules at any time.

Certain species receive protection under their own legislation rather than under the Wildlife and Countryside Act. This includes the Seals Act 1970 and the Badgers Act 1973.

The information contained in this leaflet gives only the essential details of the legislation as may be applicable to operational staff or others carrying out maintenance works. The Area staff must be informed of any works or authorisations likely to affect protected species.

The Acts mentioned encompass many other aspects of less direct relevance. If you wish for further information, contact the Area staff.



## Birds

The basic principle of the Wildlife and Countryside Act 1981 is that all wild birds, their nests and eggs are protected by law (with a few exceptions - those regarded as pest species) and some rare species are afforded special protection.

It is an offence intentionally to take, damage or destroy the nest of any wild bird whilst that nest is in use or being built.

Schedule 1 of the Act lists those species that are given special protection. Under these provisions, approximately 85 species are given absolute protection against damage or disturbance at all times. These species include the following which may be encountered, either breeding or wintering.

Avocet	Divers (all species)
Garganey	Greenshank
Kingfisher	Barn owl
Bewick's swan	Green sandpiper
Bittern	Marsh warbler
Red kite	Harriers (all species)
Redwing	Peregrine falcon
Whooper swan	Spotted crane
Fieldfare	Merlin
Hobby	Ruff
Little ringed plover	Bearded tit



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A licence may be granted for the purpose by the Ministry of Agriculture Fisheries and Food which means that a person would not be guilty of an offence if their activities were "for the purposes of preventing serious damage to .....crops.....or fisheries". However, MAFF will generally be extremely reluctant to grant a licence and serious damage would need to be proved before any such activity was allowed.

Carrying out maintenance work during the nesting season - roughly April to July - is probably the commonest avoidable cause of conflict between maintenance work and conservation interests. Whenever possible, work which could destroy the nests of any species should be re-scheduled. Particular care is needed with kingfisher nests, where late broods of young may be present until September.

### Other animals

Schedule 5 of the Wildlife and Countryside Act 1981 lists those animal species (other than birds) which are given specific protection. It is an offence intentionally to kill, injure or take a wild animal included on this schedule.

The exact number of species on this schedule is difficult to define, as it includes all whales, etc., in British waters, but it is around 100.

The list includes the following species which are fully protected:

All bats	Otter
All dolphins, porpoises & whales	Red squirrel
All marine turtles	Sturgeon
Burbot	Swallowtail butterfly
Dormouse	Vendace
Great crested newt	Walrus
Medicinal leech	Whitefish
Mire pill beetle	



Other species offer partial protection:

Adder	Grass snake
Allis shad	Palmate newt
Common frog	Pearl mussel
Common lizard	Slow-worm
Common toad	Smooth newt
Freshwater crayfish	

There are currently proposals to give further or full protection to a number of species including:

Pearl mussel	Twaite shad
Allis shad	Water vole



# Protected Species

## Species which need particular consideration are:

### Otter

Can be affected by tree felling and scrub clearance, leading to loss of holt sites.

### Bats

Some roost in cracks in bridges, culverts, etc., and others in dead/hollow trees. English Nature/Countryside Council for Wales must be informed before any work is done on any structure occupied by bats.

### Badgers

The Badgers Act (1973), as amended by the later legislation provides protection for Badgers covering several main points:

i. It is illegal to cruelly ill-treat a badger. This also means that to attempt to exclude them using rags soaked in creosote or diesel oil is illegal; only



animal repellents approved by MAFF may be used (mainly those with aluminium ammonium sulphate as the active ingredient).

ii. It is illegal to dig for a badger, and also illegal to wilfully kill, injure or take any badger, or attempt to do so. However, for the protection of crops, etc., MAFF may issue licences allowing removal of badgers.

iii. It is illegal to possess or to have under control any live badger, or any part of a dead badger. The only exception is for temporarily tending to an injured badger.

iv. It is an offence to damage, destroy or obstruct access to a Badgers sett, to cause a dog to enter a sett, or to disturb a badger when it is occupying a sett.

MAFF may issue licences to interfere with Badger setts if it is essential for flood defence works.

### Seals

Under the Seals Act 1970, the two British species of seals are fully protected during close seasons. The close seasons are:



Common seal: 1 June - 31 August

Grey seal: 1 September - 31 December

During the close season it is an offence to kill, injure or take seals. Licences can be granted to control seals if this is unavoidable or if they are causing damage to fisheries. Outside the close season there are restrictions on the methods of killing seals (the use of poison or shooting is illegal).



## Newts, Frogs, Toads

Can be affected by drainage of ponds.  
Note that the great crested newt is a fully protected species.

## Grass Snake, Adder, Slow-worm

Snakes present in wetland areas are generally grass snakes or slow-worms, not adders, which prefer dry habitats. Snakes and slow-worms should definitely not be routinely killed.

It is also an offence to intentionally damage, destroy or obstruct access to any structure or place which an animal on Schedule 5 uses for shelter or protection, or to disturb any scheduled animal whilst occupying such a structure or place (except within a dwelling house).

## Plants

It is an offence under the Wildlife and Countryside Act 1981 to uproot any wild flower without the landowner's authorisation. (Note that it is not an offence to pick wild flowers - although it is to be discouraged - nor to pick wild fruits, etc.)

Schedule 8 of the Act lists plant species which are specially protected. It is an offence intentionally to pick, uproot or destroy any wild plant on this schedule. The following wetland species, listed on Schedule 8, indicated, are definitely present in the Midlands area:

Adder's-tongue spearwort  
(Gloucestershire)

Ribbon-leaved water plantain  
(Worcestershire)

Floating water plantain  
(Staffs and Shropshire)

As for animals, it is possible to act against the provisions of the legislation under licence, and it is not an offence if an act was an incidental result of a lawful operation and could not reasonably have been avoided. Again, however, these exceptions should be noted with caution.





# Parish Pride

A joint environmental initiative between Hereford and Worcester County Council and the Environment Agency

## What is Parish Pride?

Parish Pride is a partnership between Hereford and Worcester County Council and the Environment Agency, to help encourage and support local environmental projects.

Parish Pride is an annual competition to encourage parishes to care for and be involved in the improvement of their environment. Parish and Town Councils, Community Groups, and groups of residents are well placed to identify projects that will conserve and enhance the local environment. Such groups are able to stimulate community involvement in projects and are therefore seen as the contact point for the competition.

## The prizes

The real prize is undertaking a project that will be of benefit to all the local community, but there are some financial rewards as well!

The winners receive a cheque for £500 with runners-up prizes of £250 and £100. The winners are announced, and the prizes awarded, at the annual Parish Evening held at County Hall.



The prizes are sponsored by the Environment Agency, formerly the National Rivers Authority. The competition organisers very much appreciate this continued generous support of the competition.

## The judging

Judging for each year's competition takes place in Spring. It is not just the nature of the project that is important, but how it is carried out and by whom.

The following points are worth bearing in mind when planning a project as they form the main judging criteria:

- Involvement of the local community.
- A positive improvement in the local environment – visually, for wildlife or for local residents.



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- Photographs and other records to show how the project has progressed.
- Use of advice (from a variety of sources), practical support, funding, organisation, etc.
- Plans for the future management of the project or area of land.

### Why Parish Pride?

Many local environmental initiatives are already taking place through the hard work of Parish Councils and community groups. Parish Pride helps build on this, to encourage further local action, and to promote environmental achievement throughout the county.

Many valued landscape features and wildlife habitats are being lost every year. Parishes can easily lose their local character and identity - Parish Pride can help redress these losses and restore the feeling of local individuality.



### What is eligible for Parish Pride?

Virtually any environmentally based project, covering both the natural and built heritage is eligible.

- Tree, hedge and shrub planting - what will the parish look like for future generations when all of the existing trees have died of old age?
- Pond creation and restoration - is there an old pond tucked away in the village that could do with a little help, or is there an area where a new pond could be created? Ponds are both an attractive landscape feature and an important habitat for wildlife.
- Maintaining or restoring local features - are there distinctive landmarks around the village that need some tender loving care to maintain your village's character?
- Celebrate the Parish - is there any history, special anniversary on maps, ciné film, videos, documents or people's memories that could be saved to produce a Parish History for generations to come?

**For more information on Parish Pride, please contact The Parish Project Officer at Hereford and Worcestershire County Council on: 01905 766726.**



# Demonstration Area for the Royal Show

Between February and April 1995, the Environment Agency constructed a demonstration reach of river at The Royal Agricultural Society's Showground, Stoneleigh.

Ideally, rivers should be encouraged to maintain a natural course allowing for natural processes of erosion, deposition and seasonal flooding. The site which forms part of the Farming and the Countryside Area, allows first hand experience of a variety of management techniques for rivers and wetlands.

The demonstration river flows from the top to the bottom of the site over a series of riffly rubble weirs and the water re-circulates underground to rejoin the system at the top.



The features illustrated include:

- traditional pollarding of willow trees and willow spiling, as a bank stabilisation method.
- the introduction of meadow grassland as a species rich buffer zone.
- botanically rich marginal and aquatic planting
- a conservation reedbed
- structures such as a small timber footbridge, an otter holt, a cattle drinking area
- interpretation panels about otters, black poplars, river rehabilitation and many other topical themes.

During future Royal Shows, visitors will have the opportunity to become involved in interactive demonstrations of many aspects of the Agency's work.



The site was visited by HRH Prince Charles during the Royal Show in July 1995. He took a keen interest in the site, watching a demonstration of fish stocking and also seeking advice about willow management.



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# Demonstration Area for the Royal Show



Design and supervision by Arthur Amos Associates, Worcester and Land Care Associates, Birmingham in association with the Environment Agency.

The collaboration and support of companies such as Flyghts (pumps), Yarningdale Nurseries, Landline, Forest Products and Hereford and Worcester County Council, is gratefully acknowledged.

For further information call:  
The Environment Agency General  
Enquiry Line: 0645 333 111.