FLOOD DEFENCE GUIDANCE FOR CONSERVATION IN WATERCOURSE MAINTENANCE WORKS

NRA

National Rivers Authority
Thames Region

FLOOD DEFENCE GUIDANCE FOR CONSERVATION IN WATERCOURSE MAINTENANCE WORKS

August 1994

A document produced for NRA (Thames Region) by
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Acknowledgments

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Thanks are due to the RSPB, the WTs and the NRA for use of some photographs and artwork utilized in the New Rivers and Wildlife Handbook.

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1. DREDGING

Dredging is undertaken:

i) to maintain an adequate capacity or level (**desilting**),

ii) to increase existing capacity or lower water levels to a design standard executed previously (**re-forming**),

iii) to increase capacity and stabilize eroding banks (**re-grading/re-sectioning**).

All share a number of common features, but each has differing degrees of sensitivity requiring special attention.

Shared features always (•), and often (+) include:

- *production of spoil which has to be disposed of sensitively (see 5.1)*
- *access required for heavy machinery, which must be through land of low ecological value*
- *selection of working bank to avoid tracking through, and depositions on, sensitive land*
- *execution of works in an upstream direction enabling re-colonization downstream*
- *production of suspended sediment, requiring seasonality of work if fishery interests*

\+ *preparatory tree management (see 4)*

Critical aspects of i), ii) and iii) are:

i) **De-silting** removes only loose sediments, predominantly silt (plus vegetation) from the river channel and **never** firmer bed material such as gravel riffles. It is often a regular practice and **may** occasionally be executed without detailed instructions following river corridor survey (rcs).

ii) **Re-forming** involves removal of some firmer material from the river bed (and sometimes banks also). It is infrequently carried out (always >5years) and thus **cannot** be executed without detailed instructions after rcs.

iii) **Re-grading** results in major changes to bank, bed and marginal character. Since the potential for environmental degradation and enhancement can be equal or greater to that of regrading, agreed outputs from rcs and the EA procedure **must** be followed.

'Guidance for Conservation' for all dredging work **must** incorporate the following unless specific agreement to the contrary has been given.

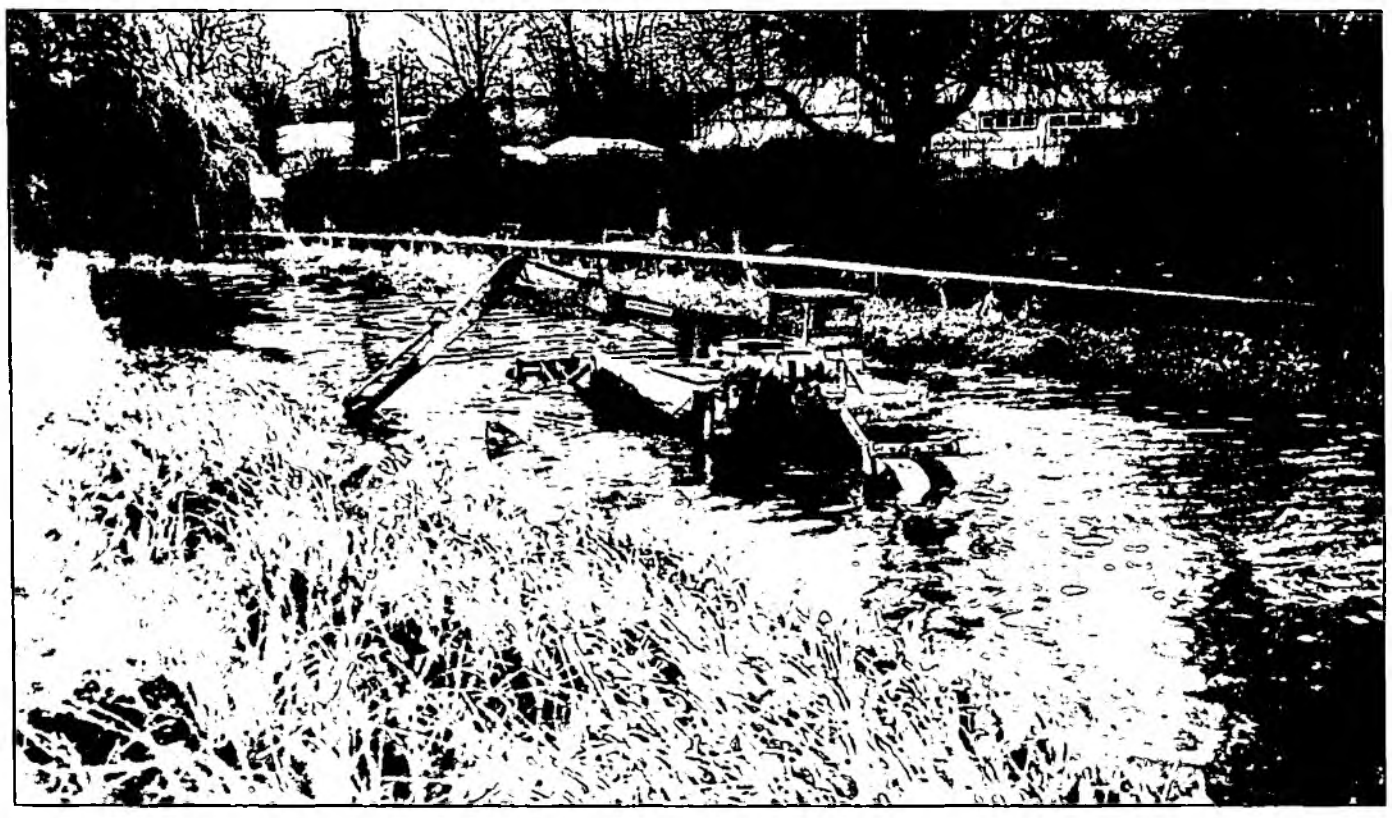
- *Use suitable machinery for the size of river to minimise impact and enable enhancement.*
- *Use bucket with 'holes' enabling some small animals and plant fragments to fall through.*
- *Dump material temporarily close to bank top (not margin) for a minimum of 12 hours (and always overnight) to enable mobile animals to migrate back to the channel.*
- *Involve picking through dredgings where fish, mussels and other large invertebrates are present and throwing them back into the river.*
- *Leaving a minimum percentage of river channel untouched, either in marginal strips, a single marginal strip or random/specific/even patches.*
- *Where banks are re-formed, new profiles will contain cross sectional variety and always provide a gradual transition at the bank toe to create marginal habitat.*
- *Regrading will create/restore variety of habitats in both cross and long sections.*
- *Wherever rare plants are indicated to be present, these will be either avoided or replanted/relocated (see 2).*
- *If dredging unavoidably results in loss of variety in bed character, coarse materials such as gravels/ pebbles /cobbles will be returned to the channel in suitable locations.*
- *All work will be executed with river processes and sustainable conditions in mind - by work with, not against, nature any retention, creation or removal of features should result in the imposed condition being maintained by fluvial processes .*

1.1 DE-SILTING

De-silting involves removal, or partial removal, from the bed of a watercourse loose deposits and accompanying vegetation. It **never** incorporates removal of any of the firm bed or re-profiling of banks. Silt is commonly the most troublesome sediment. When de-silting is undertaken on the same stretch of river on a regular basis, best working practice should suffice. Elsewhere working drawings will define precise areas (may be channel/margin/bank/adjacent habitats or plants) which **must** be avoided.

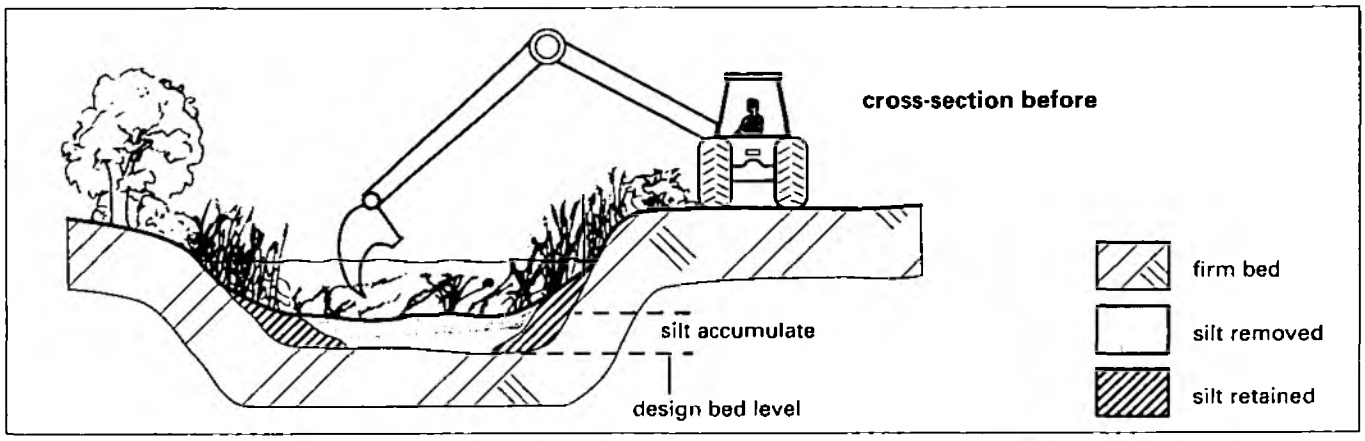
In other circumstances best working practice results in the following:

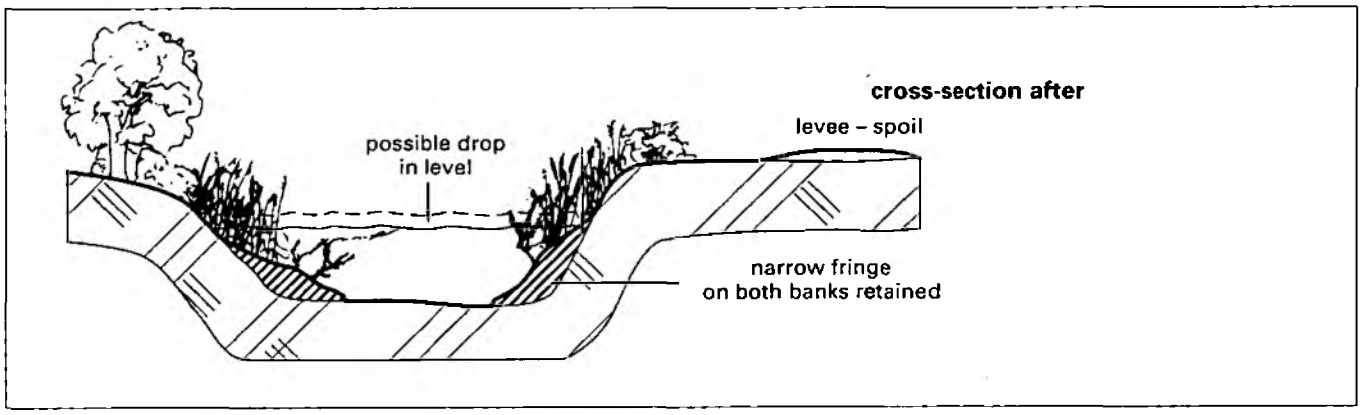
- *A minimum of 10% by plan area of the channel must remain untouched for water courses less than 10m wide and at least 20% for channels of greater width.*
- *No de-silting from mid-March to mid-July to protect breeding bird and coarse fish interests (if salmonid breeding interests, further restrictions of working period will be defined).*
- *Asymmetric working, creating (where possible) a sinuous de-silted channel within the broader 'design bed-width'; to mimic natural processes margins will be wider on the inside of bends.*
- *Where natural processes of sediment deposition or bank slippage have resulted in substrate and velocity changes which create habitat diversity, these should only be **modified**, not **destroyed**, through selective removal of material.*
- *Ensure sensitive spoil disposal (see 5.1).*
- *Access, selection of working bank, choice of suitable machinery are all important considerations for ensuring minimal environmental impact, as is seasonality of operation to minimise impact on fisheries and invertebrates.*
- *Work in an upstream direction.*
- *If any young bankside trees and shrubs impede machine access, follow tree management guidance in (see4).*

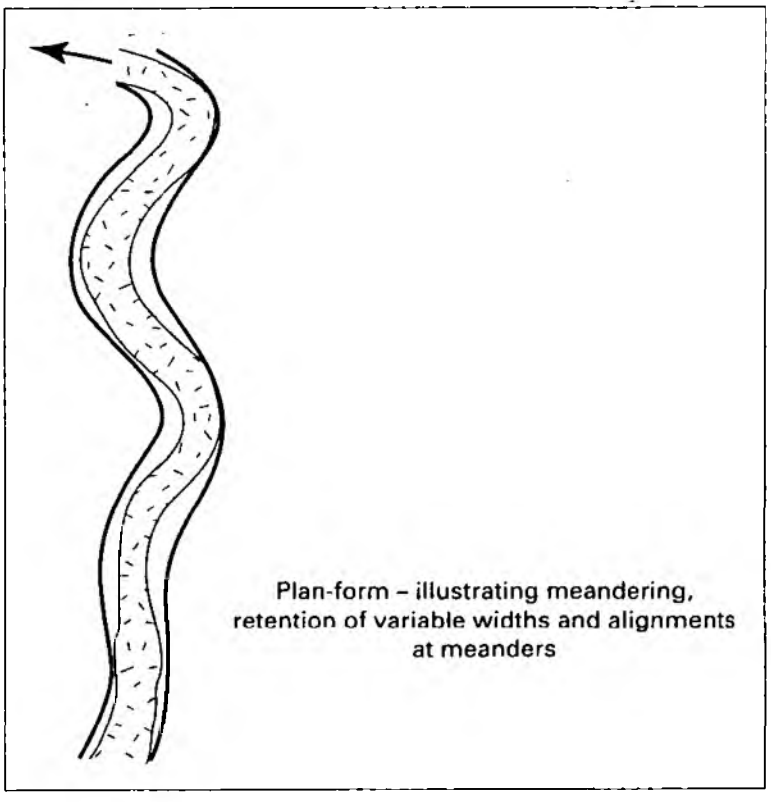


Desilting to create a narrow self-cleaning channel

1.1 DE-SILTING (Cont'd)







Plan-form – illustrating meandering, retention of variable widths and alignments at meanders

1.2 RE-FORMING

Re-forming involves the removal of consolidated material from the bed (and sometimes banks) of a river with associated rooted vegetation and mobile sediments. Minor works may affect only very small sections of a reach and be undertaken alongside desilting works (1.1). Work **must** be undertaken after rcs has resulted in precise and specific working drawings being produced.

All re-forming **will** be undertaken according to the generic 'dredging' protocol outlined in (1). The following are specific 'Guidance for Conservation' for re-forming:

- *Retaining or enhancing long- and cross-sectional (l-s/c-s) variety where this exists.*
- *Undertaking improvements to rivers with uniform characteristics through creation of variety in l-s and c-s and possibly importation of new substrate.*
- *Partially dredging channels only, keeping all excavations to a minimum unless system is degraded or uniform - this applies to both long and cross-section.*
- *Unless re-grading occurs in impounded reaches, there must be an appropriate variety of pool, slack, riffle and run features for such a river type evident on completion of the work.*
- *Where banks are re-formed, new profiles will contain cross sectional variety and always provide a gradual transition at the bank toe creating marginal habitat.*
- *Regrading will create/restore variety of habitats in both cross and long sections.*
- *Wherever rare plants are indicated to be present, these will be either avoided or replanted/relocated.*
- *If dredging unavoidably results in loss of variety in bed character, coarse materials such as gravels/ pebbles/cobbles will be returned to the channel in suitable locations.*

Before Re-forming

Immediately after

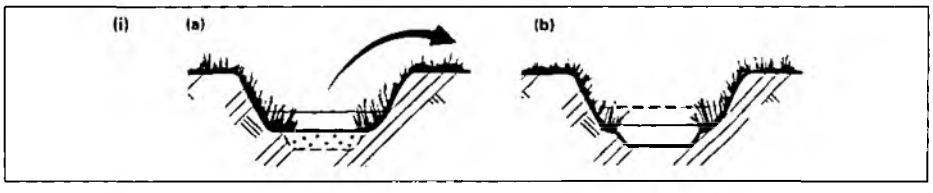
4 Months later

1.2 RE-FORMING (Cont'd)

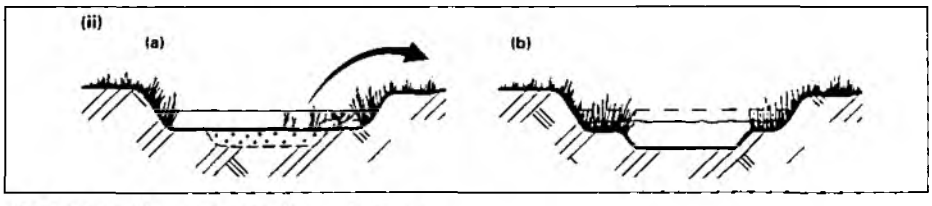
Re-forming is a term that **can only** be applied to rivers where previous works have resulted in a design standard. Follow-up works must ensure the same 'standard' for flood defence (if this is still required) but achieving this should be through best practice procedures, which may not result in copying of the original design.

Re-forming can affect whole reaches, influencing all margins and banks. Removal of any firm material from the bed can affect water levels in the river, saturation characteristics of banks and inundation/freeboard/ water-table characteristics of adjacent habitats; work therefore **must** be undertaken after rcs has resulted in precise and specific working drawings which will recommend methods to avoid damaging areas of interest. For degraded rivers with no river corridor wetlands, the opportunities for in-stream, and sometimes floodplain, enhancements are great.

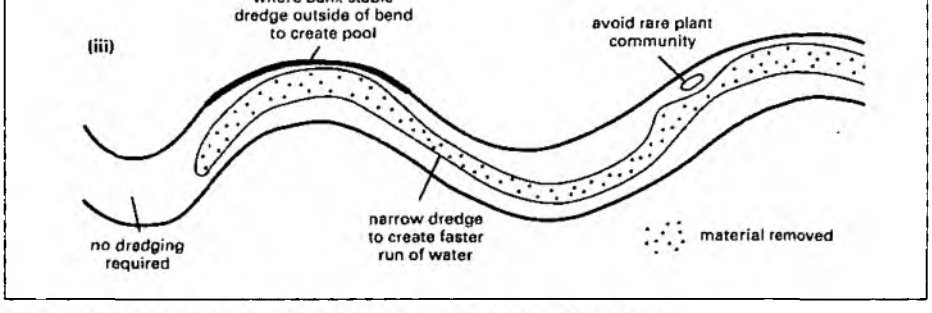
Drawings are always produced for re-forming works, irrespective of ecological sensitivity, because of the great potential for degradation of good reaches and enhancements of poor ones. Partial dredging of channels minimises disturbance, is cheaper, produces less spoil and can induce a greater self-cleansing regime to minimise the need for future management.



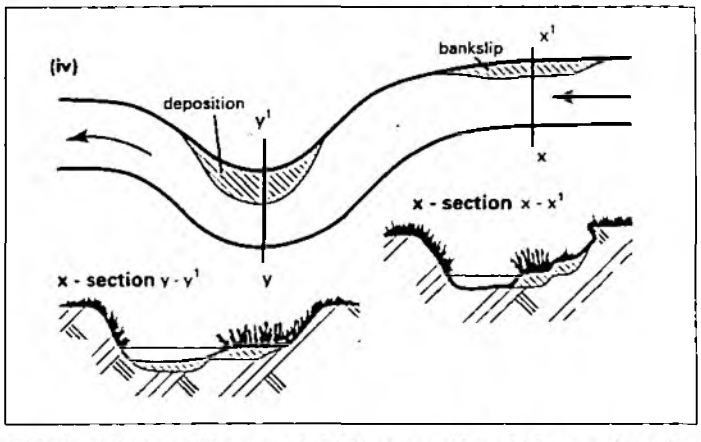
(i) Retaining small margins on narrow watercourse



(ii) Retaining wide margins on wider watercourse



(iii) Meandering & varied nature of reforming to match 'need' and 'character'



(iv) bed and bank reprifiling to retain habitats created by point bars and bankslips

1.3 RE-GRADING / RE-SECTIONING

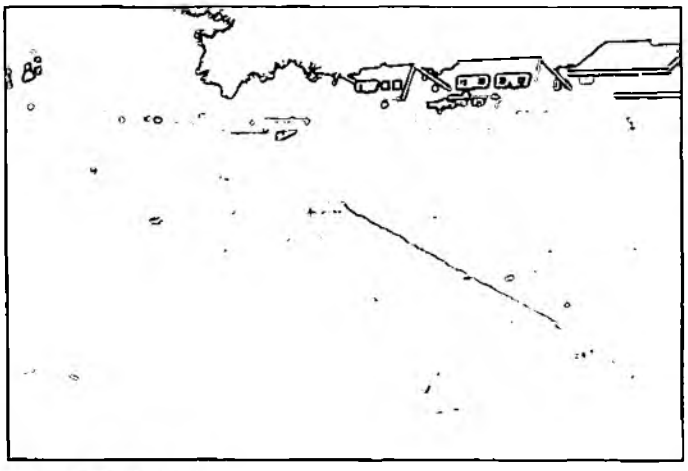
Changes to the original/previous design cross-section and/or gradient will result from re-grading and re-sectioning; as a consequence, enhancements or degradation impacts have maximum potential.

All such works must comply with the generic protocol outlined for dredging. For works affecting the channel only the specific requirements outlined for re-forming (1.2) apply.

- *Retain/enhance long- and cross-sectional (l-s/c-s) variety where this exists.*
- *Improve habitats in uniform rivers through creation of variety.*
- *Partially dredge channels only.*
- *A variety of pools, slacks, riffles and runs should be evident on completion of the work.*
- *Work will create/restore variety of habitats in both cross and long sections.*
- *Wherever rare plants are indicated to be present, these will be either avoided or replanted/relocated (see 2).*
- *If dredging unavoidably results in loss of variety in bed character, coarse materials such as gravels/ pebbles/cobbles will be returned to the channel in suitable locations.*

Specific requirements for bank re-sectioning include the following:

- *Increasing capacity through widening will require the least sensitive bank to be re-sectioned in a manner which restores good bank and marginal habitat, or enhances degraded ones.*
- *Where banks are of equal interest, alternate bank re-profiling will accentuate sinuosity.*
- *Bank re-profiling should incorporate slopes ranging from vertical cliffs to shallow margins.*
- *Cross-sections should encompass features which reflect the need for a low-flow channel with self-cleansing ability as well as features enabling performance during the design flood.*
- *Unless vertical cliffs are being created, a shallow slope at the base of the bank to create a wet 'toe' is required.*



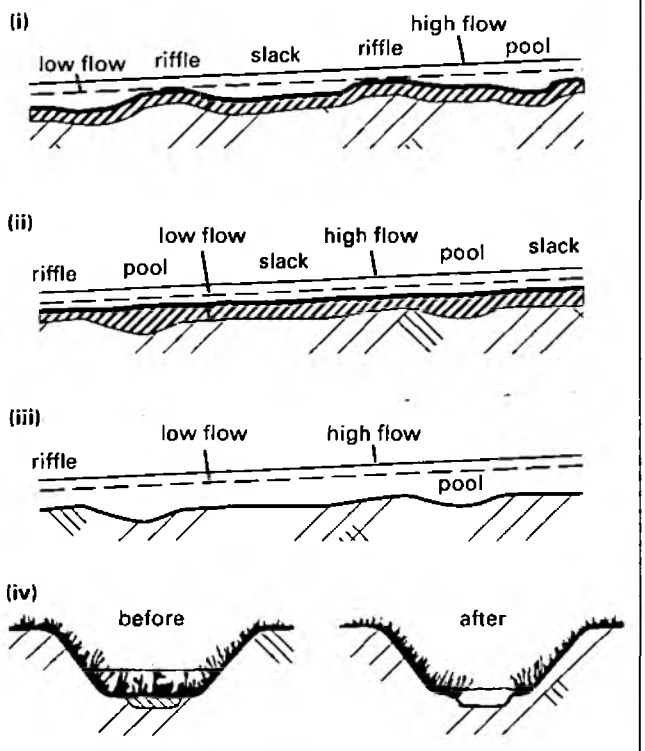
Before Re-sectioning

After

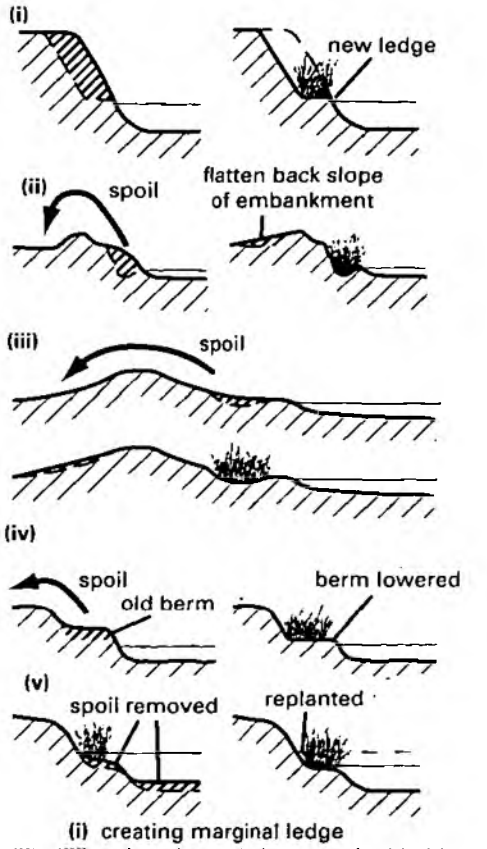
1.3 RE-GRADING / RE-SECTIONING (Cont'd)

Changes to cross-section and/or gradient will result from re-grading and re-sectioning and as a consequence degradation impacts (as well as enhancement opportunities) have maximum potential. Often works will affect both the bed and the banks of a river, but either can be affected in isolation from the other. No such work can be executed without working instructions generated through rcs and the EA procedure. Unless work is carried out which enhances the riverine environment, it is the contractor's responsibility to ensure that the statutory ES procedure has been followed.

Illustrated are examples where improvements to degraded reaches have resulted from opportunities presented through promotion of new schemes.



(i) regrade of riffle / pool sequence
(ii) regrade of uniform reach to create riffle, pool, slack, run habitats
(iii) L-S after work
(iv) X-S before and after partial dredging to create increased velocity



(i) creating marginal ledge
(ii) / (iii) enhancing existing marginal habitat
(iv) / (v) recreating existing good habitat at lower level

2. AQUATIC PLANT CONTROL

The control of aquatic plant growth in rivers is primarily undertaken on lowland rivers where slight gradients and rich substrate and water chemistry combine. Aquatic 'weeds', both submerged and emergent, can cause serious flood defence problems through impeding flow, causing silt deposition, or by snagging on pumps and sluices. These same plants, however, are a vital component of river habitat, creating shelter, food, spawning/egg laying areas for many aquatic animals and hugely increasing surface area for those microbes which help purify water. Because of the positive roles performed by river plants it is important to undertake the required management of them for flood defence purposes in a sensitive manner.

There are three main ways to manage/control aquatic vegetation in rivers. By far the most prevalent is cutting but other measures include the use of herbicides and de-weeding or removal using cutters attached to silt buckets mounted on hydraulic machines (Bradshaw buckets). Mechanical cutting and herbicides are described in 2.1/2.2; when using Bradshaw or similar equipment to control aquatic vegetation work must be undertaken using the principles outlined under De-silting. Raking of non-rooted vegetation and dredging are also used to control vegetation, as is planting of bankside trees to create shade.

'Guidance for Conservation' principles for all 'weed' control include the following:

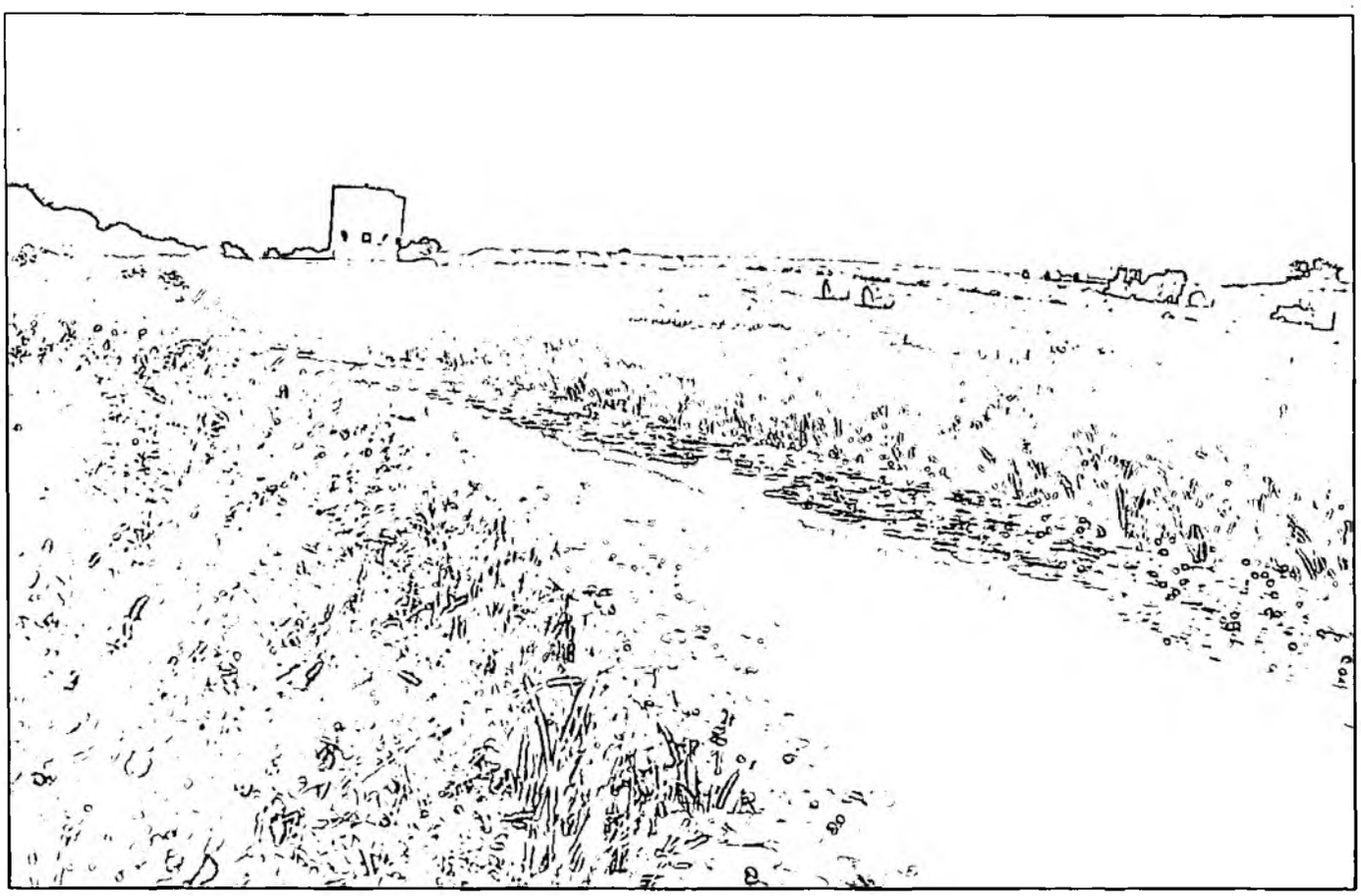
- *No more than two-thirds of the vegetation in any one stretch of river should be removed if more than 3km is being managed and the management is an annual practice.*
- *At least 10% of the vegetation in any 1km stretch MUST be retained when management is undertaken on an infrequent basis and this minimum amount must only apply when working on stretches shorter than 3km.*
- *'Weed' must be cut so as to leave at least 100mm of shoot (see 2.1).*
- *When especially rare plants are known for a specific river reach, these will be identified to the contractor on maps and MUST be retained.*
- *If an hydraulic bucket/cutter is used which removes silt with the vegetation, vegetation must be temporarily deposited close to the river bank for a minimum of 18 hours to enable some invertebrates to crawl back to the river; within this time period silt and weed should be searched for freshwater mussels and other large invertabrates such as crayfish and any found thrown back into the river.*
- *Cut weed cannot be left in the river to drift downstream and cause de-oxygenation or block structures - it must be removed (often at pre-determined locations) and NOT stored close to the river where liquors can pollute,* **or** *on important wildlife habitats - (see 5.4).*
- *Management should be undertaken working in an upstream direction so that recolonization by disturbed animals is into cleared areas (working in the opposite direction results in accumulative removal).*

2.1 AQUATIC WEED CUTTING

Most emergent, submerged and floating-leaved rooted plants can be effectively controlled by cutting. Water depth, and sometimes velocity, normally determines whether this is achieved by hand or by mechanisms attached to boats on the water or hydraulic excavators on the banksides. This section deals only with hand or machine cutting which removes shoots but leaves the roots within the sediments undisturbed. Whatever the method used, 'Guidance for Conservation' adheres to all the generic requirements outlined in detail in (2.) and summarized here.

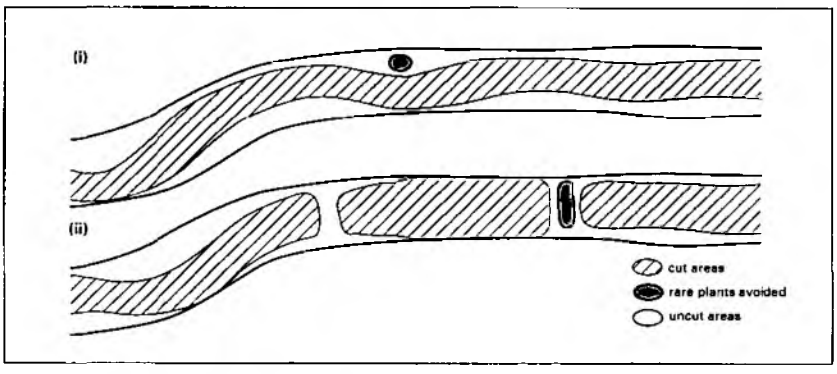
- *No more than two-thirds of the vegetation in any one stretch should be removed if more than 3km is managed.*
- *At least 10% of the vegetation in any 1km stretch MUST be retained when management is undertaken on an infrequent basis.*
- *'Weed' must be cut so as to leave at least 100mm of shoot.*
- *Especially rare plants identified to the contractor MUST be retained.*
- *Cut weed must be removed from the river - (see 5.4).*
- *Management should be undertaken working in an upstream direction.*

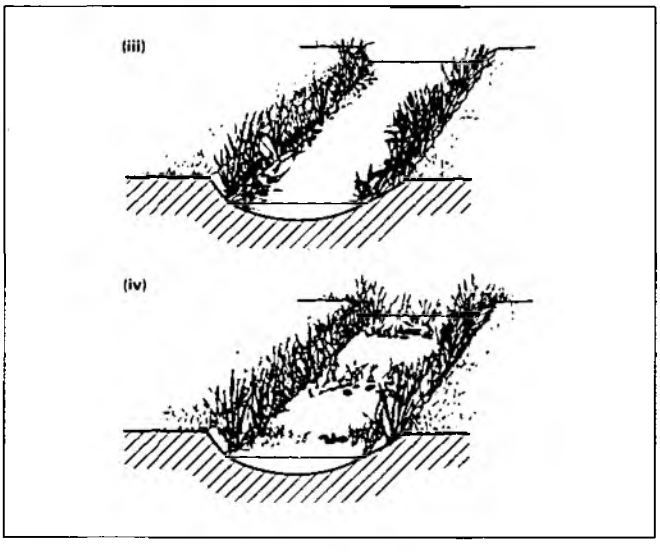
Special attention is drawn to the need to remove cut vegetation from the river and dispose of this in the manner outlined in (5.4).



2.1 AQUATIC WEED CUTTING (Cont'd)

It will be rare that watercourses requiring just aquatic weed control will be of critical ecological importance. However there will be notable exceptions, some of the most valued rivers with a large groundwater flow, and others with important river corridor habitats, being examples. Where management of aquatic vegetation is required on ecologically important rivers, site-specific prescriptions will be given. For others, adherence to the 'Guidance for Conservation', as illustrated by examples below, will ensure flood defence standards are met and wildlife and fishery interests are at least maintained, and sometimes even enhanced.





All illustrate <66% of vegetation cut.
Planforms illustrate:

i) sinuous cut leaving most margins untouched and avoidance of rare plant on one side of the watercourse

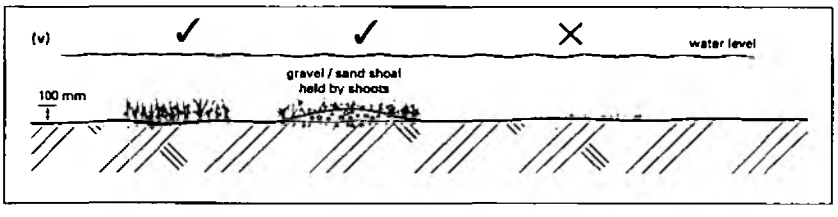
ii) combination cuts which leave margins where appropiate / easy, avoid patches of rare plants in the centre of the channel, cut the complete width where locally this is critical and leaves strips across the channel to maintain minimum of 33% untouched

cross-sections illustrates

iii) vegetation in marginal areas left untouched
iv) patch cutting leaving one third uncut through retention of minimal fringes and some strips across the river

longitudinal-section

v) shows minimum of 100 mm of shoot left



2.2 HERBICIDE CONTROL OF AQUATIC VEGETATION

In many situations herbicides are an effective method of weed control. On the positive side they can be:

- *applied quicker than mechanical methods;*
- *used in locations where machine access is difficult;*
- *cheaper;*
- *results of management usually last longer than cutting methods.*

On the negative side are the following effects of weed control using herbicides:

- *hydraulic benefits are often slow to materialise;*
- *decay of the dying plants can result in de-oxygenation (so only small areas can be treated at one time);*
- *protection of potable water and other environmental interests often lead to their use being banned.*

Because of these effects herbicides are most sensitively used for 'patch' and 'strip' control of vegetation. However used, **NO MORE THAN 5% OF A WATERCOURSE CAN BE TREATED WITH HERBICIDE AT ANY ONE TIME without prior instruction from the client (repeat applications within the same river reach should not occur within six weeks).**

Selection of the herbicide to use is critical, as is the timing and method of application. No contractor should use herbicides for aquatic weed control unless authorised by the NRA. The relevant pollution control section should be approached AFTER the following have been done **[note in NRA (Thames Region), assumption is AGAINST use].**

- *Target weeds identified and the proposed treatment identified.*
- *Checked with conservation department if rare species present which need protection.*
- *Determined if poisonous plants such as Ragwort or Hemlock Water-dropwort are present which could be affected and become more palatable to animals as they die.*
- *Ensured operators are fully trained and provided evidence that the work will be executed within the rules laid down in relevant statutes.*
- *DOUBLE-CHECKED THAT THE USE OF HERBICIDE IS THE MOST APPROPRIATE METHOD OF WEED CONTROL.*

3. NON-WOODY VEGETATION CONTROL

This generic group includes all mowing/flailing of river banks, floodbanks and amenity/riparian grasslands as well as methods used to control invasive alien plants. Tractor-mounted cutters on hydraulic arms are normally used for mowing steep banks and a variety of equipment is used for more level surfaces. Hand cutting is also employed for general vegetation control using strimmers and slashers. Such labour-intensive work is also used to control of invasive aliens in combination with, or instead of, herbicides (see 3.2).

Vegetation control is executed for a variety of reasons. Items 1-3 are the principal ones for mowing the sides of river banks and 4-5 are primarily associated with flatter land close to rivers.

(1) *Provide clear passage for flood water, reducing bank roughness and providing increased capacity.*

(2) *Stimulate a strong matted root growth and a thick protective leaf cover to maximise protection of bank from erosion.*

(3) *Control succession of vegetation to scrub and trees.*

(4) *Enable inspection of floodbanks for damage by burrowing animals.*

(5) *Maintain amenity/recreational use of land adjacent to rivers.*

Because river banks often contain considerable wildlife interest, the manner, timing and frequency of vegetation management is critical. Best management practices therefore MUST work within the framework outlined below when undertaking non-woody vegetation control on river banks.

- *Only a single bank of a watercourse to be cut in any one year unless specified.*
- *A strip of vegetation must be retained at the toe of the bank.*
- *Cut material to be gathered and stored in heaps in non-sensitive areas (see 5.3).*
- *A minimum area of 10% riverbank should be retained uncut for rivers less than 10m wide (20% for wider rivers) in any one year. The location of uncut areas being determined by balancing flood defence and conservation interests.*
- *All young trees or shrubs with a stem diameter of more than 25mm MUST be retained.*
- *Areas identified as supporting particularly rich plant communities will have to be avoided or given special treatment at specific times of the year.*
- *No herbicides to be used unless specifically instructed.*

3.1 MOWING

'Guidance for Conservation' for mowing 'natural' river banks, floodbanks and adjacent grasslands incorporates all the generic aspects described in (3).

- *Only a single bank of a watercourse to be cut in any one year unless specified.*
- *Cut material to be gathered and stored in heaps in non-sensitive areas (see 5.3).*
- *A strip of vegetation must be retained at the toe of the bank.*
- *A minimum of 10% of riverbank retained uncut for rivers less than 10m wide (20% for wider rivers) in any one year, the location of this being determined by flood defence, conservation and other factors.*
- *All young trees or shrubs with a stem diameter of more than 25mm MUST be retained.*
- *Areas identified as supporting particularly rich plant communities will have to be avoided or given special treatment at specific times of the year.*
- *No herbicides to be used unless specifically instructed.*

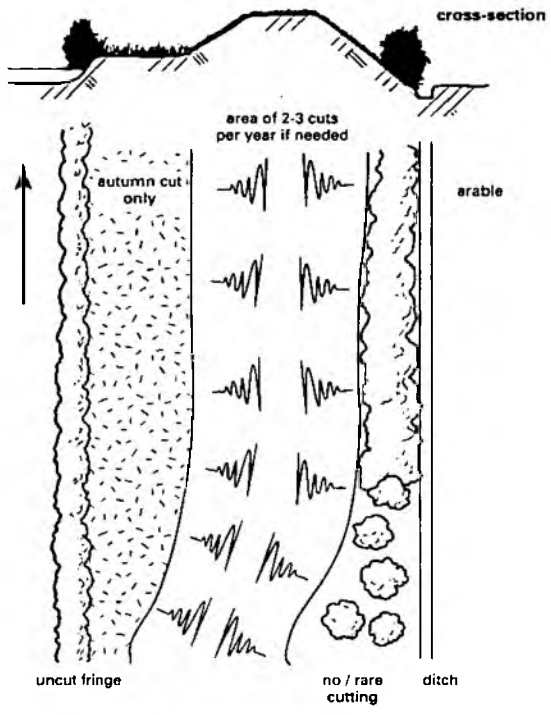
For amenity grasslands and floodbank management a similar 'Guidance for Conservation' applies, with the last four attributes always being adhered to. The first three, however, are often inappropriate since more than a single mowing per year is usually deemed to be required. If a single cut is all that is required, they must **always** apply. In environmentally sensitive reaches, the timing and extent of a cut, together with information on areas which MUST remain untouched (and where cut material CANNOT be placed) will be identified.

3.1 MOWING (Cont'd)

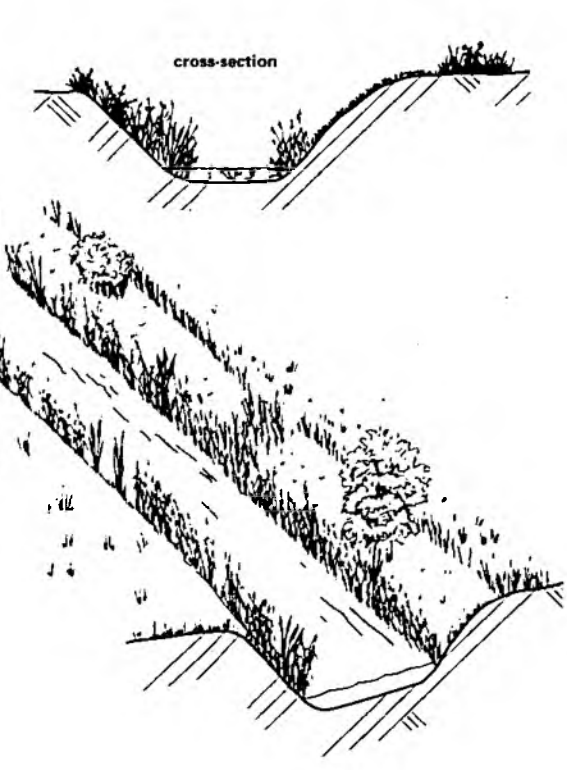
Adherence to guidelines will ensure that a variety of vegetation types and structure is maintained through routine management.

The following additional points of detail and opportunities are important:

- *The uncut fringe at the base of the mown bank of all rivers is very important for aquatic and bankside animals (and plants). The wider it is the better, but it must be at least 0.25m wide for narrow rivers (bed-widths <5m). The 'edge' cover is important for animals of the river which need cover and some shade whilst the structure provides nesting, shelter and food for a wide range of small mammals, birds and invertebrates.*
- *The maintenance of a percentage of the bank remaining uncut is vital for many animals associated with rivers because they require the habitat throughout the year for food, shelter and sometimes breeding. Many plants also require this to enable them to set viable seeds. In wide rivers it is often possible for the percentage area maintained to rise to a minimum of 25%.*
- *Where woody vegetation is not prone to develop, altering the working bank after 2-3 years will enable vegetation structure to develop greater habitat variety for the benefit of many plants and animals.*
- *Mowing of floodbanks and amenity areas should achieve the required standard of service but also look to take advantage of undertaking fewer cuts and leaving uncut areas where these are unnecessary to maintain the desired service.*



Modified mowing on floodbanks which maintains strength, enables inspection and habitat structure to develop and identifies areas for changed management



Maintaining an uncut fringe along the bank margin, working around large trees / bushes / sensitive areas and leaving strips uncut

3.2 INVASIVE WEED CONTROL

There are three main invasive weed species on river banks which often require control measures. These are Indian/Himalayan Balsam *(Impatiens glandulifera)*, Giant Hogweed *(Heracleum mantagazzianum)* and Japanese Knotweed *(Fallopia/Reynoutria japonica)*. The Balsam is an annual, so spreads and survives through seeding only, whilst the other two can live for many years and simply stopping development of seeds is ineffective. For this reason herbicides are often used to control them.

If herbicides are a proposed method of control, the following **MUST** apply:

- *permission given from NRA;*
- *not used in areas where important adjacent habitats identified, unless by prior agreement;*
- *only applied on still, dry, days;*
- *never applied on banks where drift or run-off from leaves could enter a watercourse.*

Giant Hogweed - It can grow in dense stands on both river banks and riparian zones where it can cause major ecological, aesthetic and health problems. Special precautions are necessary when dealing with this plant since contact with the skin usually causes severe blistering. Control requires killing existing plants and preventing them from producing seeds.

When only a few plants (<10) are present plants should be cut down **below** ground level by means of a spade so that all that remains is the bottom of the tuberous root. This MUST be done before the end of August if flower shoot are present but can be done later for young plants. Material must be disposed of to ensure re-growth does not occur from the cut material (see 5.3).

An alternative method is to use the herbicide Glyphosate at recommended concentrations in late spring (according to conditions above) when leaves are large but no flowering shoots have been produced. A repeat treatment may be required in late summer and MUST be accompanied by physical destruction of any plants which survived the original treatment and have produced flowering shoots. Repeat control is likely to be required for several years so notification to the NRA of work undertaken, and the locations where done, is necessary.

Japanese Knotweed - This is a long-lived perennial which has invaded many river banks and corridors to displace native species. Unlike the Hogweed, it does not spread by seed but by shoot and root fragments which take root readily. There is no quick control method and eradication comes only with the death of the root system. Constant cutting and pulling out, in combination (where acceptable) with herbicide use (as described for Hogweed), is the only effective control measure.

Both physical removal and spraying needs to be done in spring and again in autumn. As with Hogweed, all live material MUST be destroyed to prevent further spread in the location or elsewhere.

Indian Balsam - This is an annual, spreading only by seed. Plants should be cut or pulled out before August when seeds mature. Providing seeds have not set, no special off-site removal is required since the green matter composts safely. Herbicide use is rarely justified, regular annual cutting being more effective. Without catchment control of Balsam, specific site clearance will be rarely justified.

3.2 INVASIVE WEED CONTROL (Cont'd)

Giant Hogweed

Japanese Knotweed

Indian Balsam

4. BRUSH AND TREE MANAGEMENT

Whilst trees and shrubs can create potential flood hazards and obstructions to machinery, the emphasis of 'Guidance for Conservation' is 'MANAGE', not 'REMOVE'. Removal is thus a last resort which requires prior approval unless it is small saplings growing within the channel.

Because of the importance of trees and shrubs to the landscape and ecology of river corridors, management work must aim to work around them whenever possible. When this is not possible, a limited number may have to be removed and others managed to provide access for machinery. In other instances, trees and shrubs require managing to provide necessary hydraulic conveyance. For whatever reason, tree management MUST always work within the framework outlined below.

- *No tree surgery can be undertaken in the bird breeding season from Mid-March to Mid-July WITHOUT CHECKING FOR THE PRESENCE OF NESTS.*
- *No mature tree (girth 500mm) to be felled without approval from the NRA.*
- *Check before managing mature trees that proper surveys have been carried out for the potential use by otters or bats.*
- *Work in any one year must be limited to a single bank (unless 'tunnel' management of shrubs on narrow watercourses 4.1).*
- *At least 50% of trees and shrubs must remain unmanaged in a single year.*
- *All work is undertaken by HAND-HELD machines (including chainsaws) but heavy limbs/trunks can be lifted by machines.*
- *Brush should be burnt on ground at least 10m from the nearest tree or shrub and NEVER on vegetated shingle, rock slabs and any land of ecological interest (eg woodland, herb-rich grassland etc.). In rivers with high adjacent sensitivity burning areas will be pre-determined or agreed following consultation. When riparian zones are wooded or dominated by nettles, brush should be stacked in heaps above the flood-level to provide habitat.*
- *Large unwanted timber should be stacked, and secured if necessary, adjacent to managed trees to provide deadwood habitat. Other material can be used for revetment etc (see 6).*

Tree and shrub management must be accompanied by dialogue with the landowner to ensure opportunities for replacement planting, and new planting to replace trees lost through previous management activities, are maximised and do not constrain landowner interests. Likewise there is a need to check with flood defence planning sections of the proposed plantings do not infringe bye-laws; however permission can be sought for relaxation of the bye-laws to enable suitable planting to be undertaken.

Trees and shrubs along river banks are often significant landscape features and as such extra sensitivity is often required when managing them. Conservation sensitivity demands knowledge of the importance of various aspects of trees and shrubs for the river environment if inadvertent damage is not to be done. The following are a few of many important considerations.

- *Underwater fine roots provide varied habitat for aquatic invertebrates whilst those on banks help stabilise friable soils.*
- *Trunks and large limbs overhanging water provide fish shelter and branches arching over the water offer perch sites for kingfisher and the canopy produces important shade.*
- *Large cavities under root systems are potential resting (holt) sites for otters; if used they are PROTECTED BY LAW.*
- *Hollows and cavities in mature trees are potential roosts and breeding habitats for bats; if used, these too are PROTECTED BY LAW.*
- *Old trees frequently support many breeding birds and are often covered by rich fern, lichen and moss communities.*
- *Bushes provide cover, food, shelter and breeding sites for many birds and other animals.*

4.1 TREE AND SHRUB TRIMMING

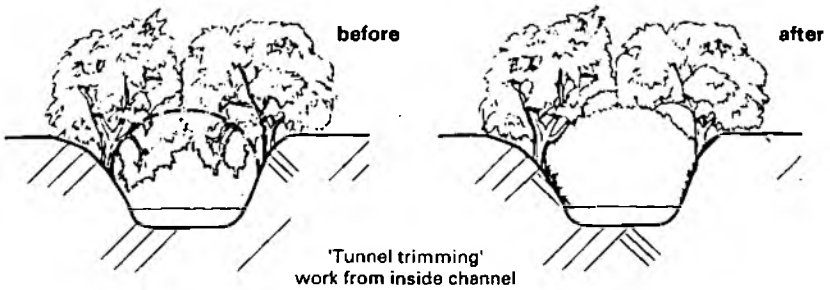
'Guidance for Conservation' will always be to 'MANAGE', not 'REMOVE' trees and shrubs unless they are very unstable. Removal is thus a last resort which requires prior approval unless it is small saplings growing within the channel.

- *No tree surgery can be undertaken in the bird breeding season from Mid-March to Mid-July WITHOUT CHECKING FOR THE PRESENCE OF NESTS.*
- *No mature tree (girth 500mm) to be felled without approval from the NRA.*
- *Check before managing mature trees that proper surveys have been carried out for the potential use by otters or bats.*
- *Work in any one year must be limited to a single bank (unless 'tunnel' management of shrubs on narrow watercourses).*
- *At least 50% of trees and shrubs must remain unmanaged in a single year.*
- *All work is undertaken by HAND-HELD machines (including chainsaws) but heavy limbs/trunks can be lifted by machines.*
- *Brush should be burnt on ground at least 10m from the nearest tree or shrub and NEVER on vegetated shingle, rock slabs and any land of ecological interest (eg woodland, herb-rich grassland etc.). In such sensitive situations, burning areas will be pre-determined or agreed following consultation. When riparian zones are wooded or dominated by nettles, brush should be stacked in heaps above the flood-level to provide habitat.*
- *Large unwanted timber should be stacked, and secured if necessary, adjacent to managed trees to provide deadwood habitat. Other material can be used for revetment etc (see 6).*

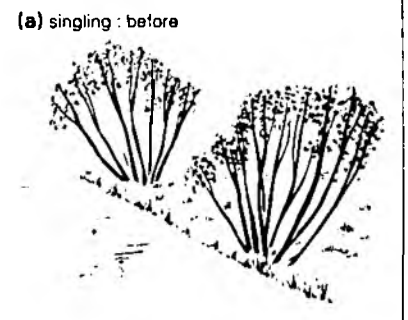
4.1 TREE AND SHRUB TRIMMING (Cont.d)

Depending on the location of the trees, different management strategies will be appropriate. Some will require coppicing, others singling and others merely having limbs lopped. Management of trees must, therefore, utilize a system of tree marking using 'S' for singling, 'C' for coppicing, 'P' for pollarding and 'LB' for 'lop branch' to show precisely which limbs are to be removed on mature trees.

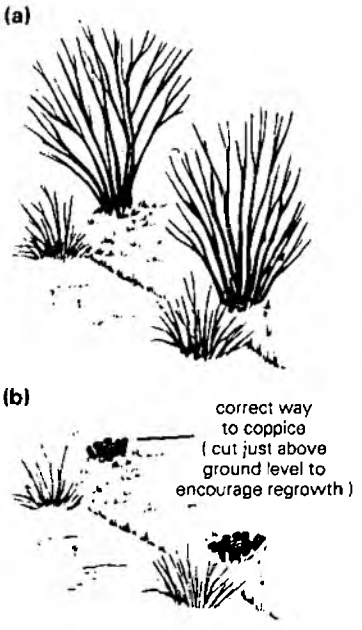
Shrub management will take the form of selective removal or trimming by hand. Where large stretches are to be managed by machine brushing, prior approval must be sought from the NRA; it will provide precise details of extent and methods when granting any such approval. Areas where livestock are present should be fenced for a minimum of three years to enable re-growth.



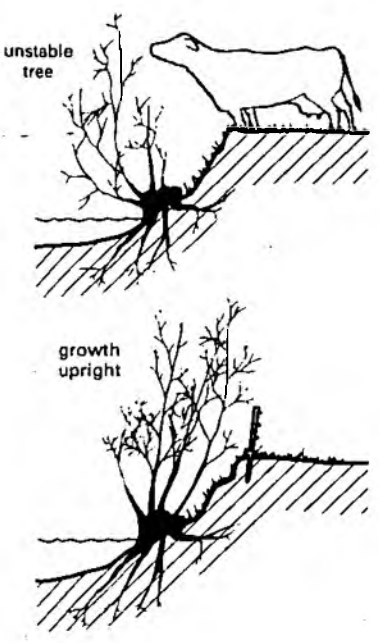
'Tunnel trimming'
work from inside channel
hauling cut brush through gaps



'SINGLING' - provides machine access and clear conveyance with conversion of broad coppice to simple tree



the correct way to 'COPPICE'



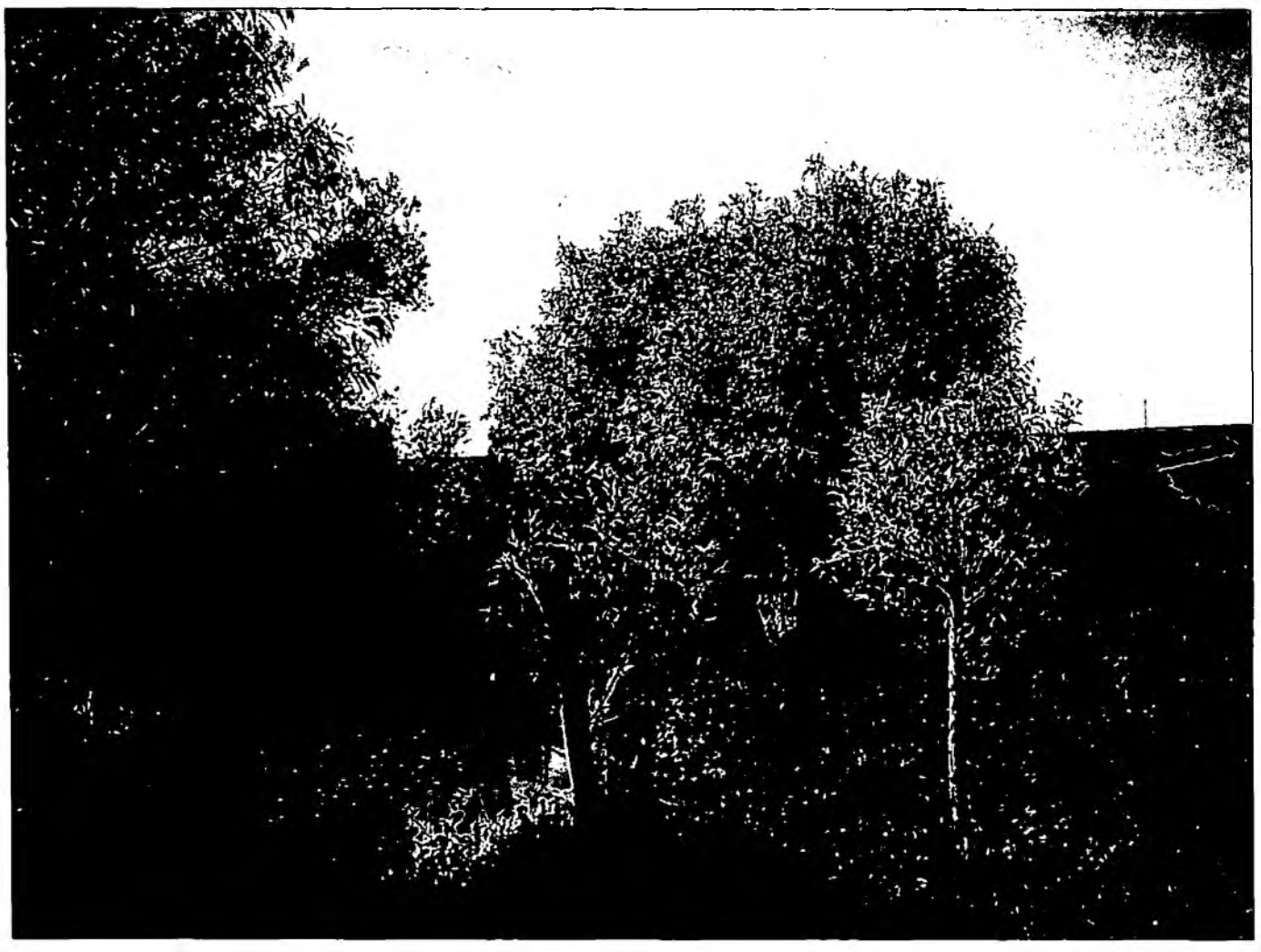
fencing must be provided where livestock have access to the bank

4.2 POLLARDING

Any flood defence work with adjacent, mature, and not recently managed, pollards should incorporate an element of tree management following generic requirements given under Brush and Tree Management (4) and the additional guidelines outlined below:

- *No more than half of the trees within a reach should be pollarded in a single season.*
- *No trees other than Crack Willows (Salix fragilis) can be pollarded without prior approval from the NRA's Conservation section.*
- *Re-pollarding must be undertaken so that new cuts are immediately above previous cuts.*
- *Limbs are cut obliquely, with the slope facing out to ensure rain water is shed away from the crown.*
- *Pollards created from previously unpollarded trees must be cut at a height of 2m above ground level or immediately above a fork of the trunk if there is one between 2-4m above ground.*

A single pollarded willow is likely to produce a minimum of 10 stakes suitable for planting as new pollards. To establish new pollards, straight stems, c2.5m long and 100-200mm in diameter, are selected and cut cleanly at both ends. Within a week of cutting they are hammered into the ground to a depth of c0.5m, with buds facing upwards. No watering or after-care is required from the contractor. Typical locations where additional planting, in addition to along the river bank itself, as shown opposite.

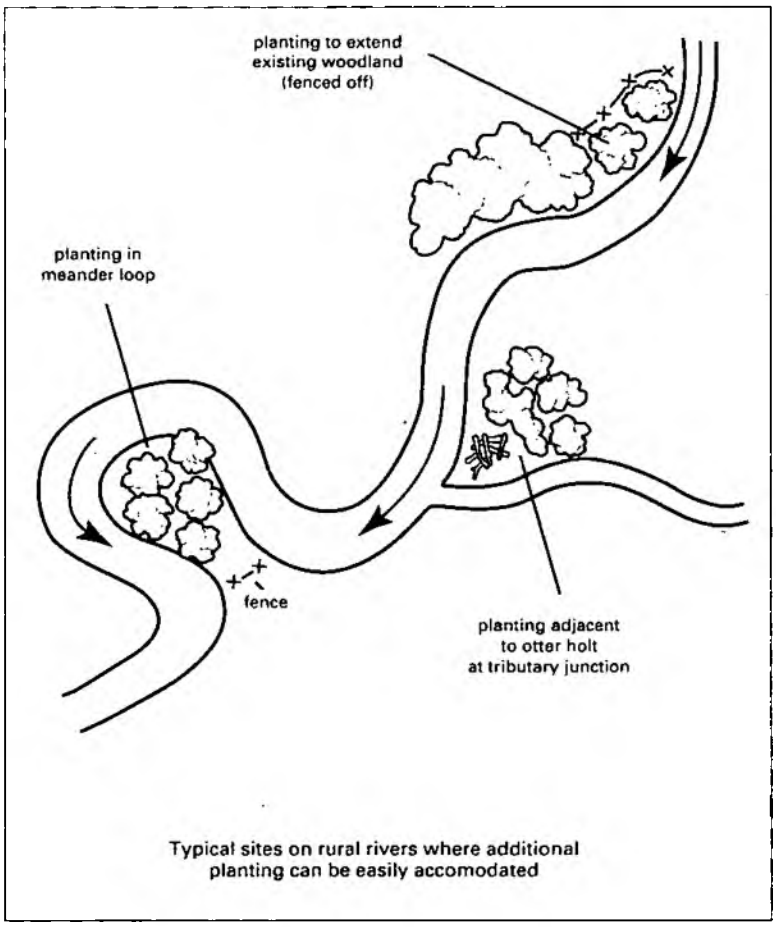


Pollarding and stake planting

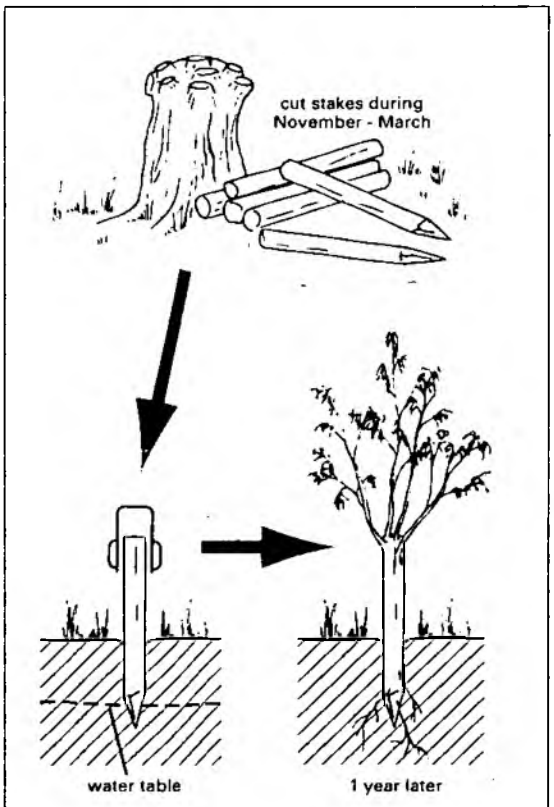
4.2 POLLARDING (Cont.d)

Pollarding of willows is an activity that is especially closely linked to historical river corridor management. For this reason the 'Guidance for Conservation' encourages management of aging pollards and promotes the replacement of those lost by present and past activities which have affected floodplains. Without management old pollards may split and die with consequent risk of obstruction and loss of landscape and ecological value.

Management of pollards, like all trees, must be accompanied by dialogue with the landowner. Pollarded willows provide ideal material for cheap and effective new trees for the future. It is EXPECTED practice for 5-10 new willows to be planted within 100m of a managed tree (only one batch of planting is expected where several trees are close together, but efforts should be made to maximise planting if site opportunities and land-owner cooperation dictate).



Typical sites on rural rivers where additional planting can be easily accomodated



'Pollarding' and use of stakes for planting

5. SPOIL DISPOSAL

Many river management activities generate materials that have to be removed from site or 'lost' within the working area. All dredging, re-sectioning and construction works as well as weed control, tree/shrub management and mowing produce materials that are potentially damaging to wildlife unless they are disposed of sensitively. However by-products of management can be utilized for environmental gain (eg river dredgings with vegetation used to establish flora at an impoverished site; willow logs and stakes used for planting schemes or for spiling to protect banks).

In most cases spoil material is disposed of/utilized 'on site' but in some cases it may have to be removed to an authorised disposal site. When the client has instructed the contractor to remove spoil from the site, agreement on the specific site, and methods of transport to it, MUST BE AGREED IN ADVANCE between both parties.

When a contractor is working on a river with specific ecological interests associated with adjacent land, sensitive areas where no spoil should be disposed of will be identified on prepared maps. Unless these are provided by the client, spoil disposal will follow the procedure outlined in the following sections which describe approaches for the disposal of:

5.1 Dredgings

5.2 Woody Material

5.3 Terrestrial Non-woody Vegetation

5.4 Aquatic Vegetation

5.1 SPOIL DISPOSAL - DREDGINGS

In most examples of dredging, spoil is simply incorporated into the soil of adjacent land and this land is then restored to its pre-management condition. However in other cases the spoil may be utilized to improve habitats as described and illustrated opposite.

For de-silting operations on rivers flowing through arable land it is standard practice to simply spread the material thinly on adjacent land for subsequent incorporation within the existing soil. If the arising are not rich in invertebrates this is acceptable for conservation.

Unless a contractor is working to specific client instructions, spoil disposal will follow the procedure outlined for re-sectioning and re-grading (and de-silting when the spoil is rich in invertebrates). It will NEVER be spread in hollows in adjacent fields.

a) Dredge channel and temporarily store material overnight on top of bank to de-water and enable mobile animals to crawl back to the river (unnecessary for dry bank material).

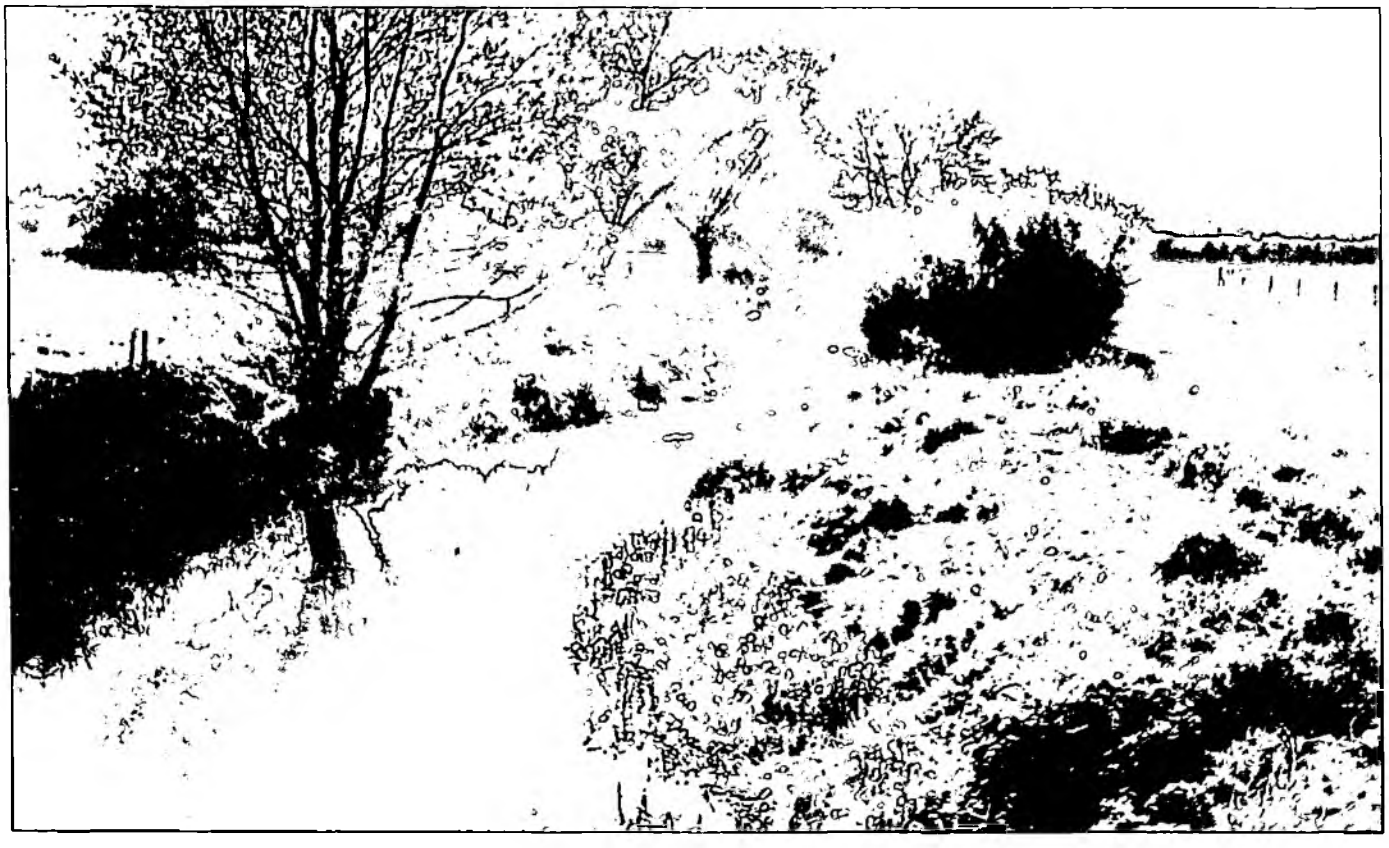
b) When spoil is of suitable consistency, strip topsoil from land adjacent and store alongside.

c) Place spoil in stripped area and replace the original soil over it.

d) Re-seed to re-instate to original condition or leave ready for arable sowing.

Common exceptions to these general rules apply when:

- *volume of silt/soil removed is so small that it can be spread thinly over existing soil;*
- *arisings are as suitable for cultivation as the existing soil;*
- *gravel and low-nutrient sub-soil is deliberately incorporated into the surface layer of soil to create a suitable site for establishing wildflowers etc.*
- *material is stored in different piles according to their type when coarse materials are temporarily stockpiled before being returned to the river bed (always with client instructions).*



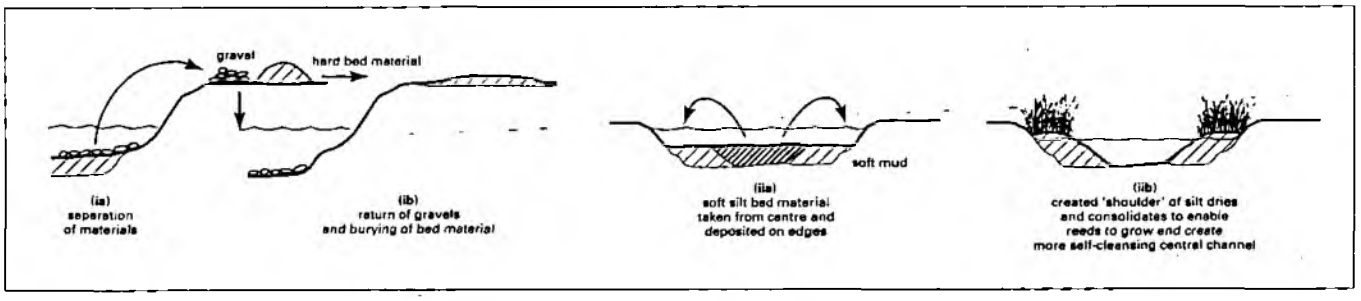
Sensitive spoil Disposal

5.1 SPOIL DISPOSAL - DREDGINGS (Cont.d)

All dredging activities result in the production of spoil which has to be either disposed of/utilized 'on site' or removed to an authorised disposal site. Re-grading, re-forming and de-silting produce a variety of materials which vary according to location. De-silting of the bed in lowland rivers, and re-grading or re-forming of banks in most other watercourses, usually produces spoil with a soily texture suitable for easy incorporation with existing soils enabling a rapid return of the land to agricultural use. Removal of hard materials and mobile gravels/pebbles/cobbles from the bed produces a spoil which is rarely conducive to rapid establishment of agricultural crops. Awareness of the potential dangers to stock is important. If able to eat plant material such as Iris, Hemlock and Water-dropwort normally inaccessable to them, they may become ill.

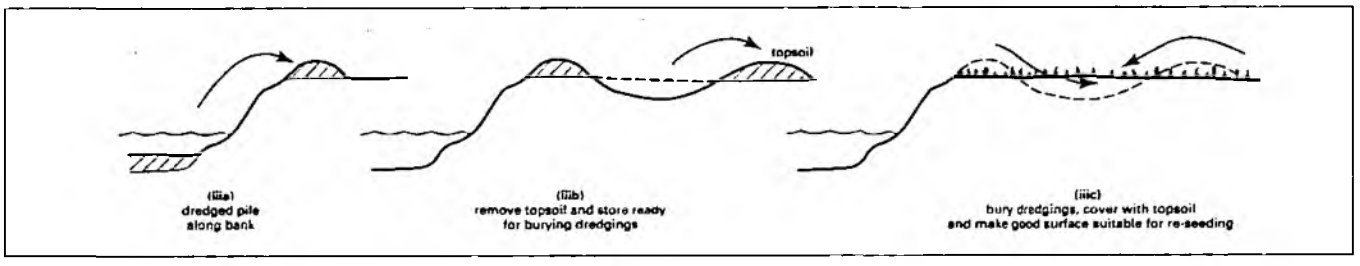
In most examples of dredging, spoil is simply incorporated into the soil of adjacent land and this land is then restored to its pre-management condition. However in other cases the spoil may be utilized to improve riverine habitats or even terrestrial ones. Examples of the former include:

- *returning gravels to suitable locations where they will help form coarse-bedded riffle habitats suitable for fish spawning;*



- *removing a central swathe of silt to lower water levels but returning these silts to the margins to create edge habitat to enable emergent reeds to develop and sustain faster, cleansing, flows through the central channel.*

Wherever these potentials exist the contractor will be given details by the client.



5.2 SPOIL DISPOSAL - WOODY MATERIAL

Management of trees and shrubs produces a variety of materials ranging from fine brush material to huge tree trunks. Suitably sited, these decaying by-products of tree management can form important wildlife habitats. However, suitable locations are not always available and alternative disposal methods, which do not improve wildlife habitats, have to be employed. In other situations live material from freshly cut willows can be used for tree planting schemes (see 4.2) and these and other trees can be used for bank protection works (see 6.1, 6.2).

In environmentally sensitive river corridors the NRA will give guidance on the approach to be taken for disposal of woody material. In other reaches the contractor WILL operate within the guidelines 1 - 3 set out below for disposing of brush material (anything finer than 15cm diameter) when these are not being used for bank protection or tree planting schemes.

1. If material is not carted from the site, and it cannot remain on site in its present form, the contractor has two options: burning or chipping. Burning MUST NOT take place on shingle, solid rock faces, peaty soils, herb-rich vegetation and in close proximity to trees (precise distance will depend on size of fire and weather conditions but FIRE DAMAGE to trees MUST NOT result). The alternative is chipping, a practice which does not damage the environment and produces a product that can be utilized as a mulch for newly planted trees or disposed of widely without detriment.

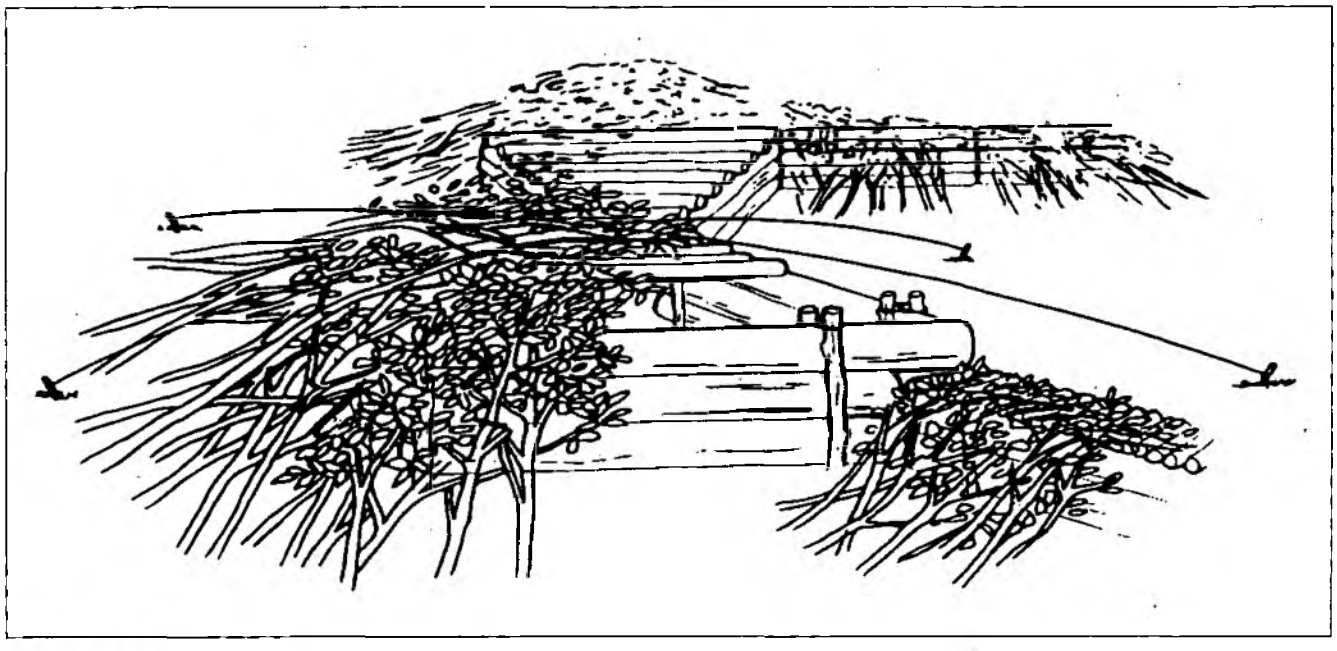
2. Cut material can be used for habitat creation to reduce costs and benefit wildlife. Loose brush material should be piled into heaps above the flood level or in heaps closer to the river where they must be wired down and anchored by stakes or to trees. Such brush forms good cover for a wide variety of small mammals, birds and insects and the dying wood is important for many larvae, and lower forms of life (eg fungi).

3. Where otters occur in, or may spread to, the rivers being managed, brush in combination with logs should be used to create otter holts (resting/breeding cover) where agreed with the landowner. The client will advise when this is appropriate and provide designs for their establishment

Chippings and Brush Piles

5.2 SPOIL DISPOSAL - WOODY MATERIAL (Cont.d)

Large tree trunks and limbs may be carted off site and utilized as firewood or stacked temporarily for subsequent collection by the landowner. It is the client's responsibility to liaise with landowners as in the majority of cases the wood is the latter's property. Burning large trunks should be a last resort since piles of slowly decaying wood are exceptionally important for wildlife. For otters a structured pile is best (see below) whilst for invertebrates it is preferable for there to be ground contact for many of the logs in dappled shade. Storing logs in ad hoc piles, or stacking them neatly under managed trees, are simple and sympathetic treatments of the by-product of management. Wherever these are within the floodplain they should be secured to trees or staked.



Log pile otter holt

5.3 SPOIL DISPOSAL - TERRESTRIAL NON-WOODY MATERIAL

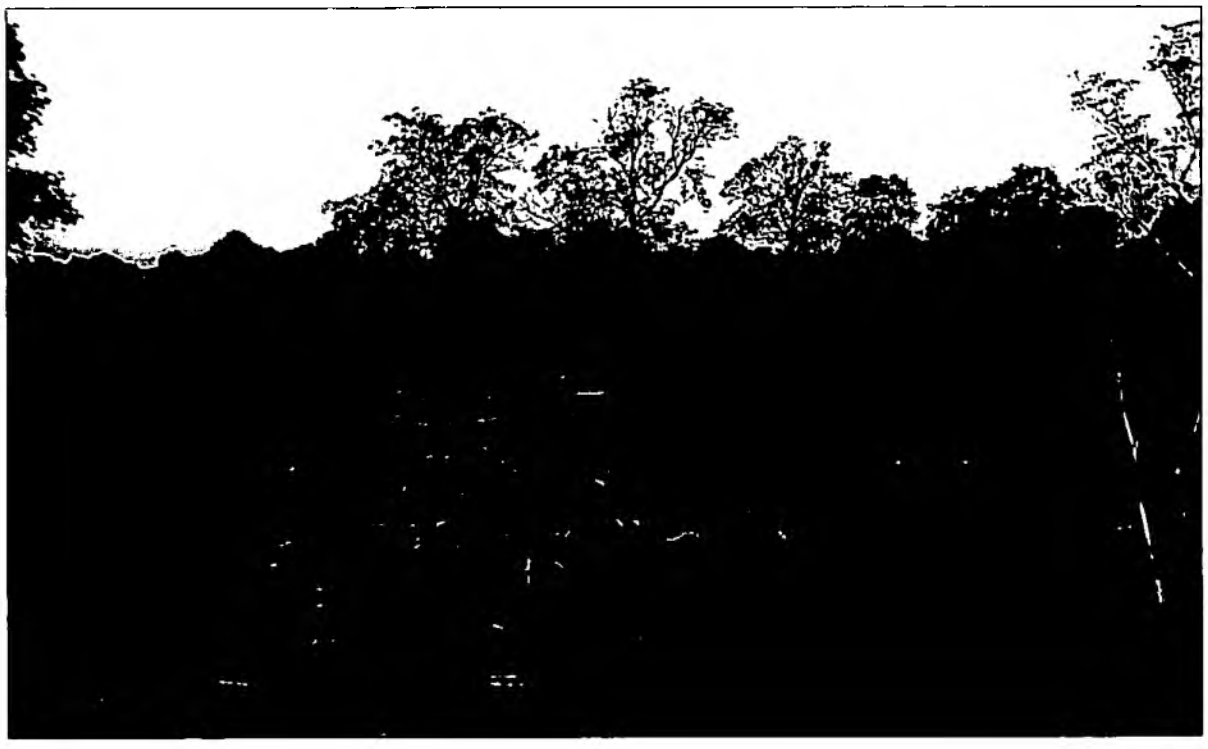
Bank and floodbank mowing/cutting produces waste material which, depending on the frequency of the management, can produce spoil which has the potential to cause ecological damage and water quality, amenity or flood defence problems. Disposal must therefore be sympathetically managed. Below are listed important general considerations which should be adopted when disposing of non-woody vegetation resulting from banks, floodbanks and riparian grasslands managed by cutting techniques.

- *In reaches with ecologically sensitive river corridors, disposal of cuttings must avoid areas identified on maps by the client.*
- *Where vegetation management occurs on banks in sensitive areas, special disposal requirements will be stipulated by the client.*
- *The general principles outlined below will always apply unless special agreements have been drawn up between client and contractor.*
- *Cut bankside vegetation should not be allowed to drift into the river where it may cause de-oxygenation, spoil aesthetics, disrupt some recreational activities and potentially snag on structures to increase flood risks.*
- *When bankside vegetation is cut or mown three or more times per year leaving the cut material in situ is acceptable (twice-yearly cuts using a flail which leaves material finely chopped is acceptable for rivers of low ecological sensitivity).*
- *Annual flail cuts normally produce copious material (as does hand-cut vegetation) which will ultimately lead to suppression of many wildflowers and potentially produce a rank vegetation structure which does not adequately bind the soil of the bank - for this reason it should be raked from these areas and heaped in suitable locations.*
- *One-off flailing of banks which takes place less frequently than once every three years may be left above high water level on steep banks but should not be left in situ on floodbanks and other flatter surfaces.*
- *Cut material which is not carted away should be heaped into piles away from the bank of the river. Such piles should be above the normal flood level of the river, behind flood defences or be protected from being washed away by hedges or other similar features. Heaps of dry vegetation are very important breeding and hibernating sites for a wide range of animals including hedgehogs, voles, snakes and bumble-bees.*
- *Non-woody vegetation MUST NOT BE BURNT without prior approval.*
- *Vegetation containing seeds and root-stocks of troublesome aliens such as Japanese Knotweed or Giant Hogweed should be carted to approved tips for safe disposal.*

5.4 SPOIL DISPOSAL - AQUATIC VEGETATION

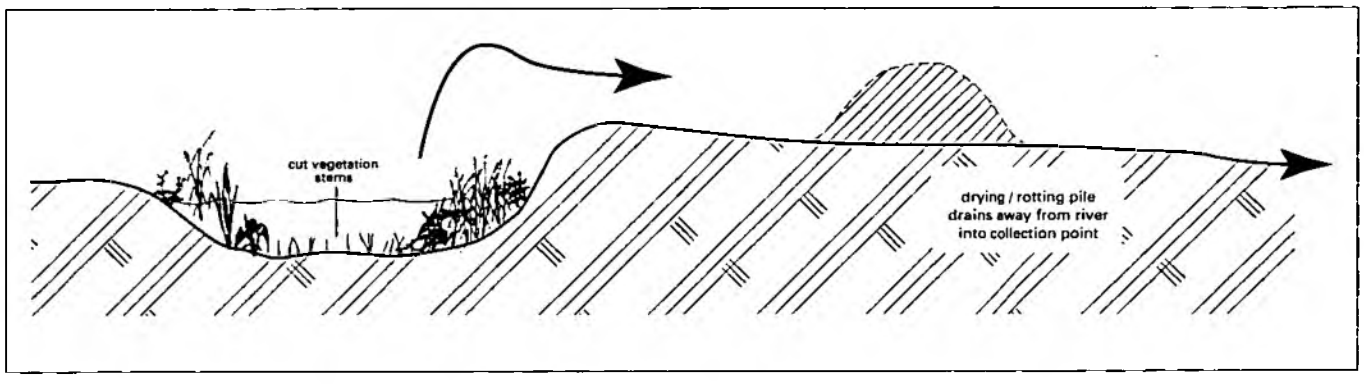
Aquatic vegetation, whether cut by hand or machine, must be removed from the river. Without removal de-oxygenation of the water may occur (with resultant fish and other animal mortalities) as might obstruction of flow which can result in flooding hazards. Depending on the physical nature of the river, and the type of vegetation cut, removal from the river may be at the point where the control is executed or downstream where the flow of the river carries the material to pre-determined locations where it can be removed easily.

Because aquatic vegetation is more than 90% water, it is normal practice to remove material from a river, temporarily store it to de-water (and sometimes to partially decompose), and then to dispose of it. Unless a river has sensitive ecological habitats adjacent to the river or on its banks, it will be the contractors responsibility to determine appropriate locations for hauling material out of the river and its temporary storage UNLESS there are pre-determined sites which the NRA has established, and used for many years.



Location and treatment of storage areas for drying and rotting aquatic vegetation are critical. If material is temporarily stored simply to de-water over a period of a maximum of 48 hours, storage areas can be close to the river where the water will run back to the watercourse. UNDER NO CIRCUMSTANCES CAN STORAGE AREAS BE LOCATED CLOSE TO RIVERS IF THE CUT VEGETATION IS LEFT LONG ENOUGH FOR IT TO BEGIN DECOMPOSITION.

When material is to be left to rot, storage must be away from the river bank in locations where the resultant liquor runs away from, not towards, the river. The contractor will be responsible for containment, and safe disposal of, any noxious substances.

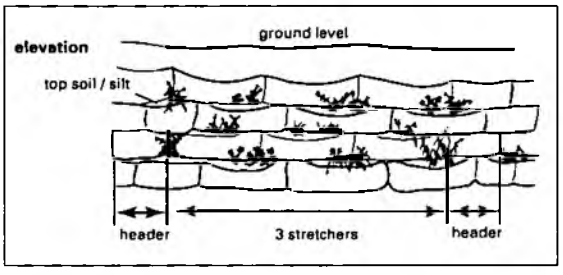


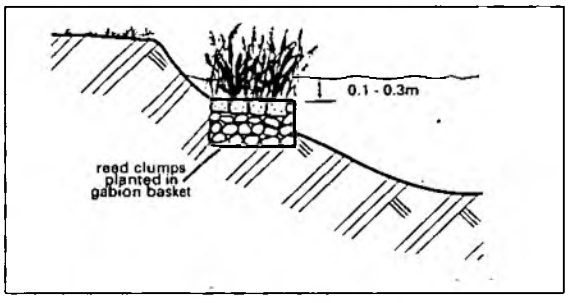
6. REVETMENT

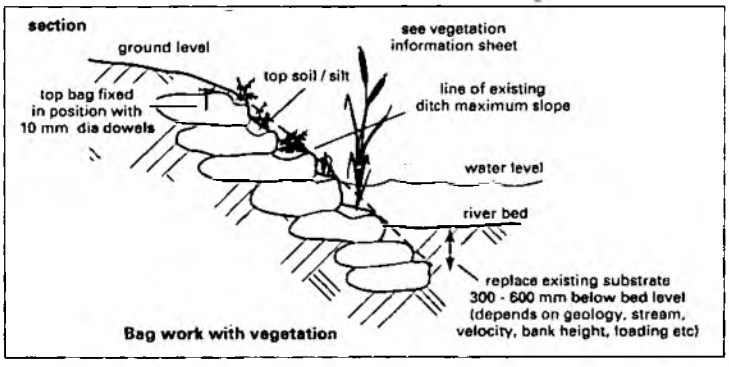
Revetment of banks is normally undertaken to prevent or cure erosion so that it is stabilised and/or protected against erosion from currents and wave action. Whilst the NRA undertakes erosion control in some circumstances, bank protection is the responsibility of the landowner, not the NRA. Despite erosion being a natural process, in some locations it is essential to control and maintain bank stability; it is in these circumstances that the NRA may require the use of revetment techniques.

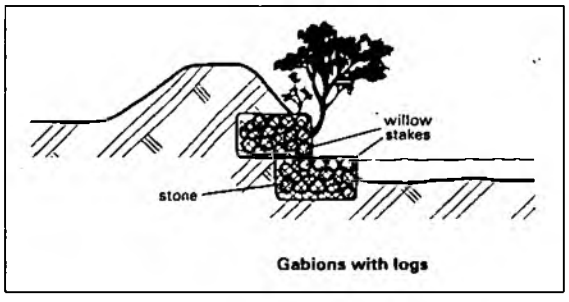
Contractors will not undertake bank revetment as part and parcel of routine maintenance but will be required to undertake such work on an ad hoc basis and when problems arise following major floods. All such work will require SITE SPECIFIC attention so that details of methods will be stipulated by the client. The NRA will not accept hard defences to be used when more environmentally friendly solutions can be used. Contractors will be therefore expected to undertake work which utilizes the latest technologies which often combine traditional armouring techniques WITH woody or other vegetative material.

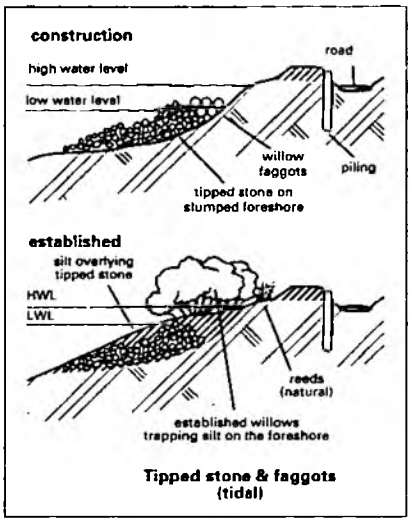
Below are illustrated a few of the bio-technical techniques which contractors will be expected to be proficient at undertaking. The illustrations should be used in conjunction with techniques described under Geotextiles (which are often used between the soil of the bank and the more substantial revetment), and the separate sections on Spiling (6.1) and Faggoting (6.2) which describe the utilization of woody material.

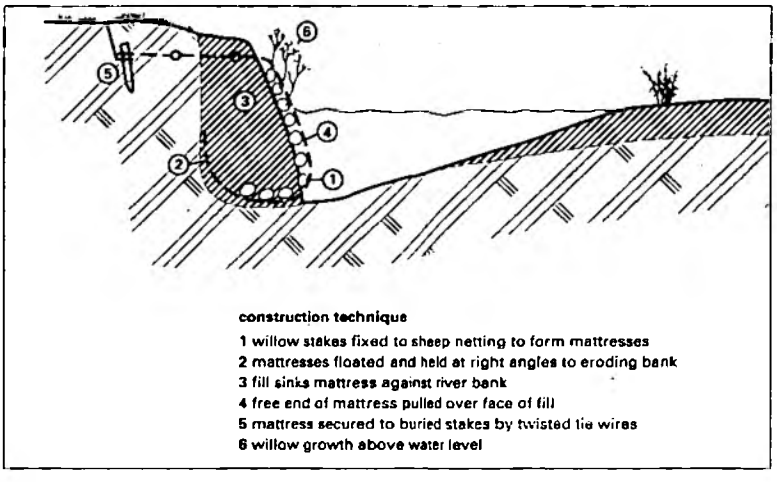












6.1 SPILING

Spiling is a method of bank protection which utilizes live willow stakes and withes (strong flexible twigs) which are inter-twined between the stakes. For success the following guidelines need to be followed.

1. Stakes should be ALIVE and freshly cut from willows. Each stake should be straight, pointed at the BOTTOM end, c100mm dia and at least 1 metre long (depending on height of spiling and strength of bed into which they are driven). They are driven into the base of the bank at c0.5m intervals.

2. Withes should be fresh-cut osiers *(Salix viminalis)*, sallow *(S. cinerea)*, grey willow *(S. caprea)* or other hybrids of similar character. They need to be 2-3m long and no more than 50mm in dia. and are woven between the stakes to form a dense continuous mat capable of supporting the back-fill material (which must be of an 'earth' character to encourage rapid growth of the cut willows).

3. Work is best executed between November and February but can be effective anytime from October to April.

4. Where livestock have access to the top of the bank, fencing to stop grazing will be required to allow healthy establishment and growth.

Instaling Spilling

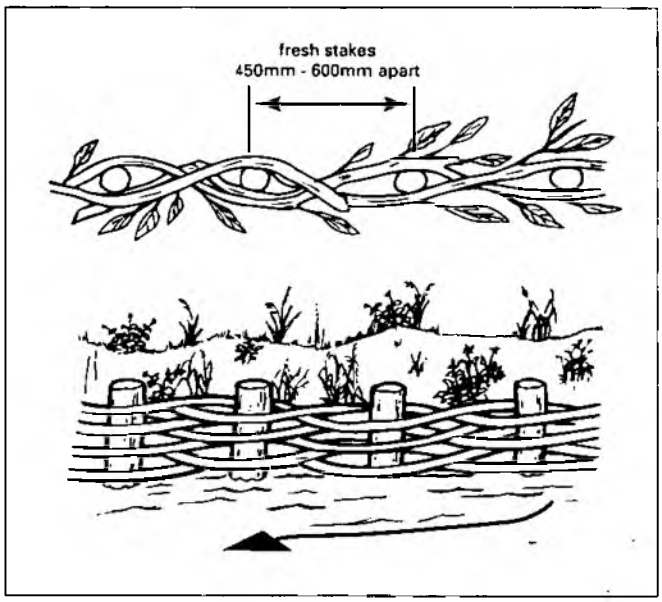
Spiling 3 months after installation

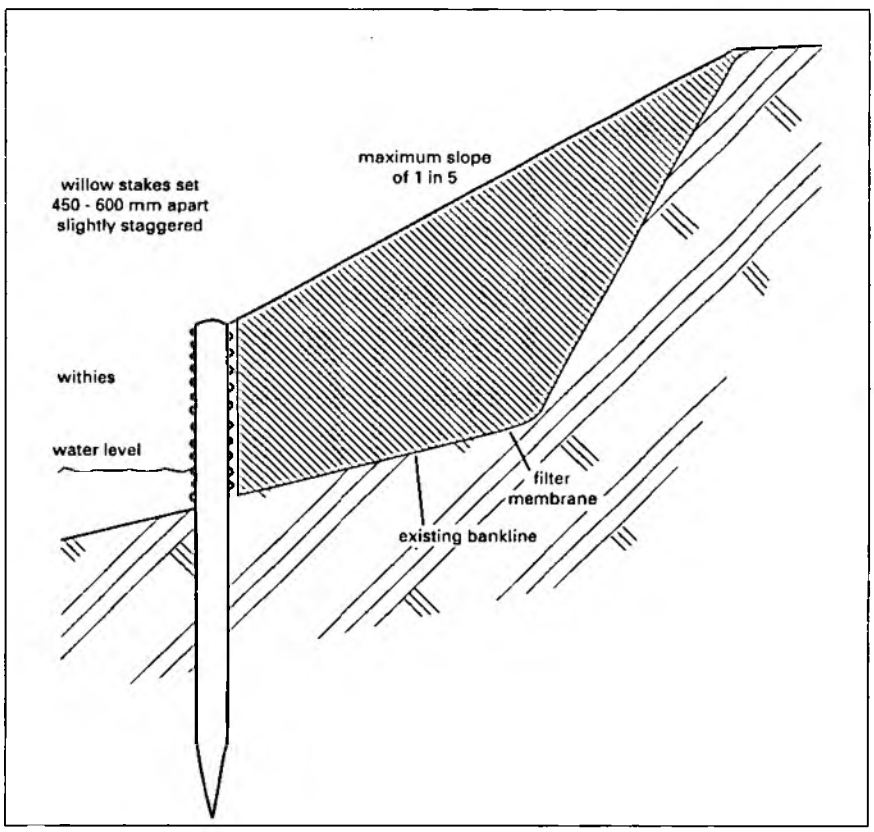
18 months after installation

6.1 SPILING (Cont.d)

Spiling is a traditional method of bank protection where banks are steep and the soils are soft and sandy. Spiling has the benefit of being a cheap method of bank protection whereby the roots bind the soils of the bank whilst the shoots partially deflect and dissipate erosive currents; at the same time the sprouting stakes and twigs create bankside trees and shrubs for improved river corridor habitats and landscapes.

The client will always state to the contractor when spiling should be used as a method of bank revetment to counteract bank slippage or erosion. When instructed to undertake spiling, the contractor will always preferentially utilize local willows which require managing (see 4.2) and undertake this management using the best practice guidance given in that section. Spiling is normally undertaken in combination with back-filling with soil between the spiles and the bank; where banks are composed of fine materials, a geotextile membrane filter may be needed.

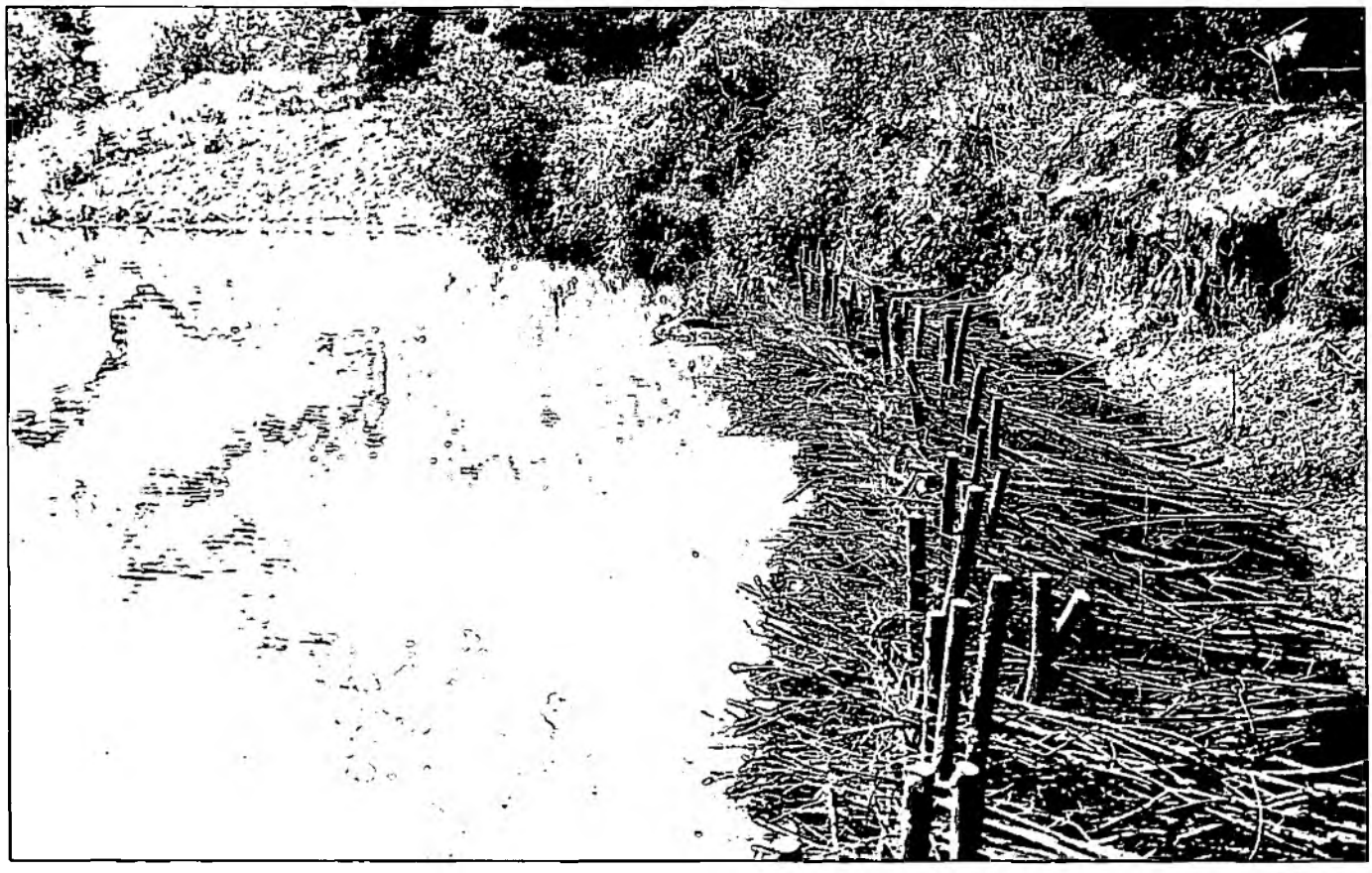




6.2 FAGGOTING

Faggoting is a method of bank stabilisation which normally utilizes non-growing by-products of tree management and therefore contrasts with spiling, a method of bank protection utilizes LIVE willow. It is a traditional method to reinforce soft weak banks where good drainage is vital and when banks cannot accept any appreciable surcharge loading. Faggoting is a cheap method of bank protection whereby brushwood entraps silts so that marginal and other bank vegetation can become establish and together they deflect and dissipate erosive currents and wave action. They may be usefully employed on major slips and minor bank repairs. If tree/shrub cover is desired on a bank, live willows are used.

The client will always state to the contractor when faggoting should be used as a method of bank revetment to counteract bank slippage or erosion. Faggoting is always undertaken in combination with back-filling with soil, and may be combined with vegetation planting too.



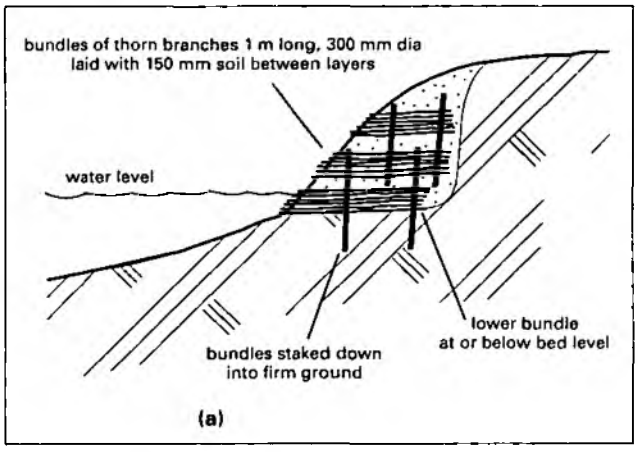
Chesnut Faggoting

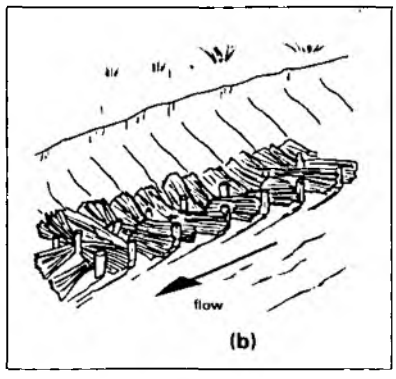
6.2 FAGGOTING (Cont.d)

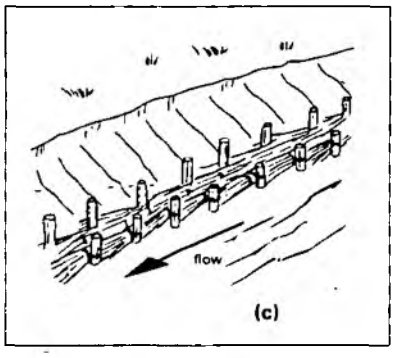
Faggoting is a method of bank stabilisation which normally utilizes non-growing by-products of tree management.

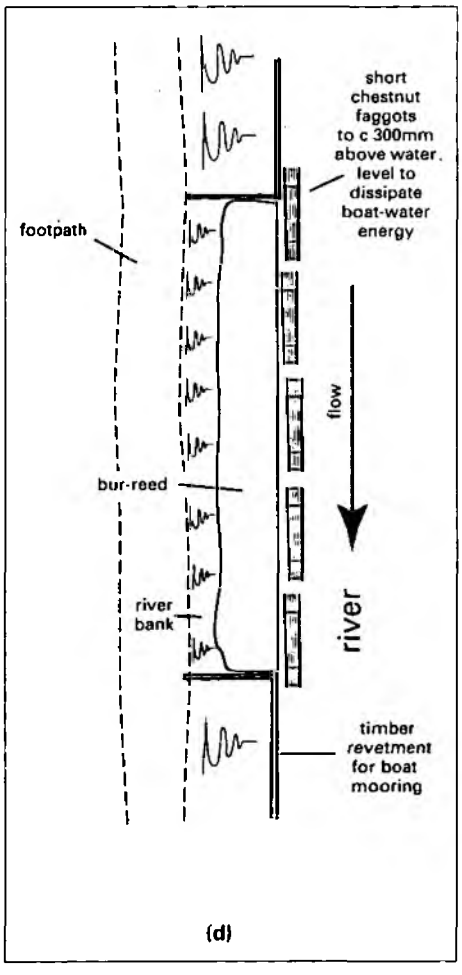
Faggots are made of bundles of brush (can be thorn, sweet-chestnut or others) about 1m long and 300mm in diameter, tied with bio-degradable string. When not made into fascine mattresses they are held in place by means of stakes and between them are placed layers of soil, typically 150mm deep.

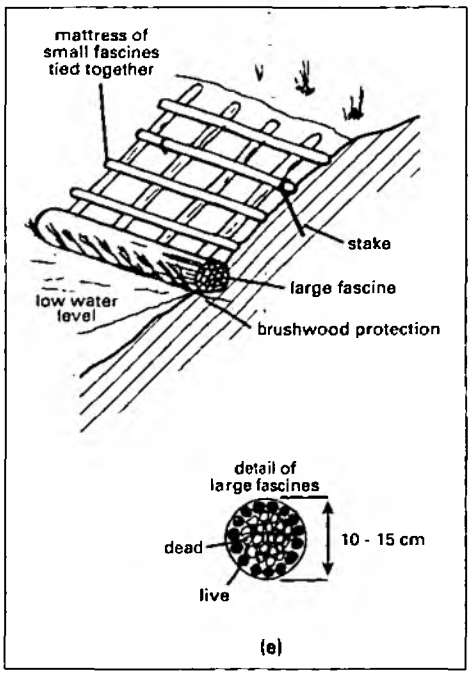
Typical arrangements are illustrated below: a) is the most usual method of faggot use, b) shows bank protection with faggots laid at right angles, c) & d) are examples of faggots used parallel to the bank for protection and e) faggots bound together to form fascine mattresses.









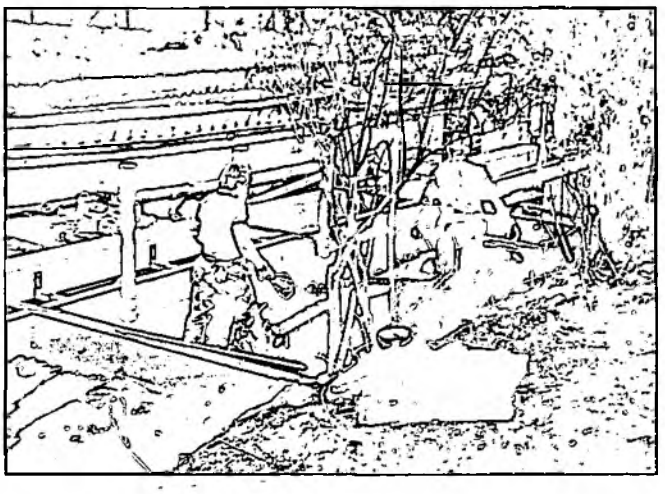


7. GEOTEXTILES

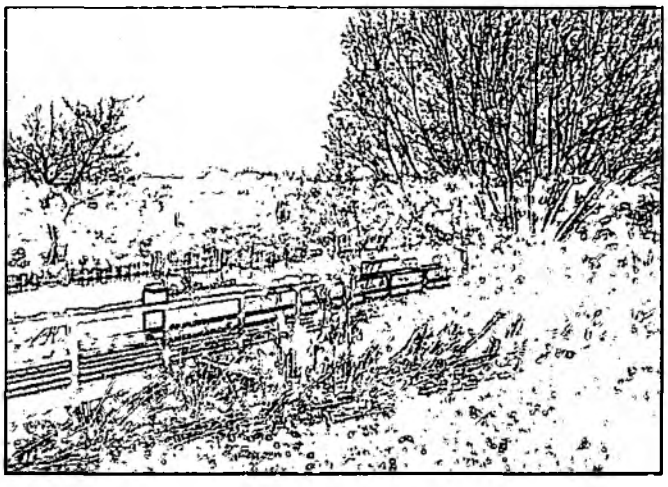
Geotextiles are often used in flood defence works for bank protection and habitat creation at river margins. They are generally flexible fabrics or mesh mats which were traditionally pinned over existing banks or slopes to provide stability. More recently a range of geotextiles have been used to improve river edge habitats by staking them well in front of an eroding (or ecologically degraded) bank before material is placed between the two to create wetland marginal habitat and erosion protection for the toe of the bank.

Use of geotextiles in routine flood defence maintenance works is rare but increasingly problems of bank erosion or degradation of river edge habitat can be overcome by the combined use of geotextiles and vegetation.

Contractors will be expected to undertake bank protection works and marginal habitat enhancements using a range of techniques which use geotextiles. The client, which may be flood defence or other functions within the NRA, will always stipulate where and when this is appropriate and what methods should be employed. Illustrated below are examples of geotextiles used to good effect in either bank protection or river-edge enhancements (or both). Contractors must be aware that successful use of geotextiles demands they are properly installed, with all edges carefully buried and protected.



Enkamat Installation



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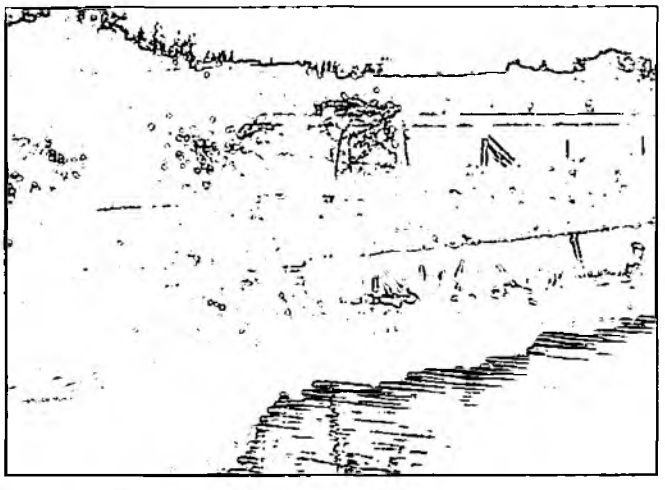
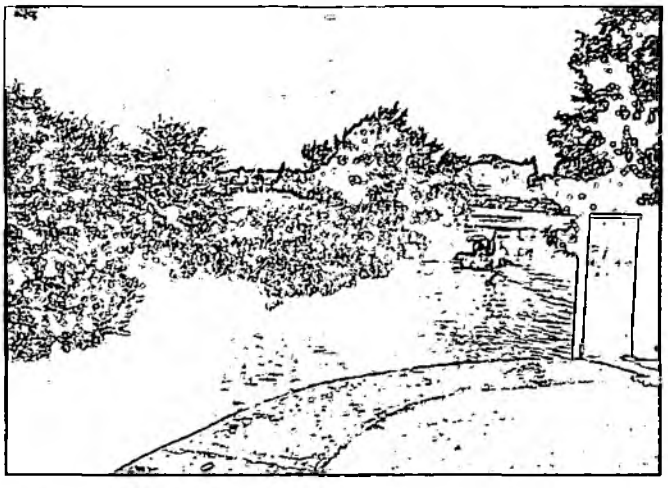


Nicospan and Nicobags with reed planting



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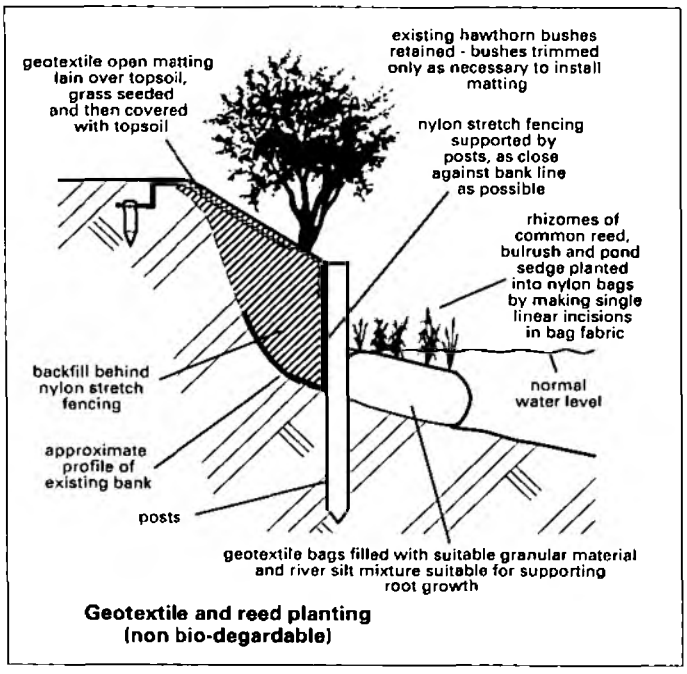
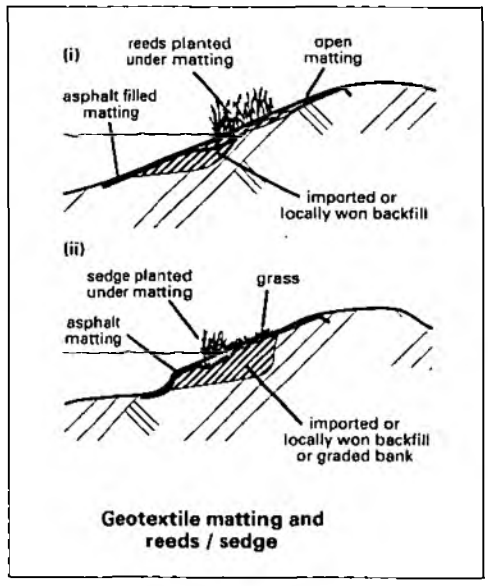
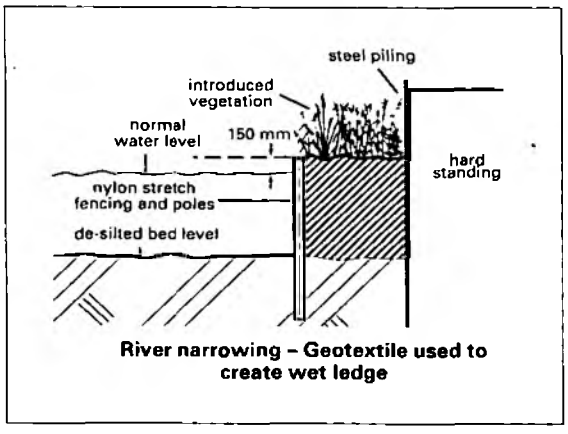


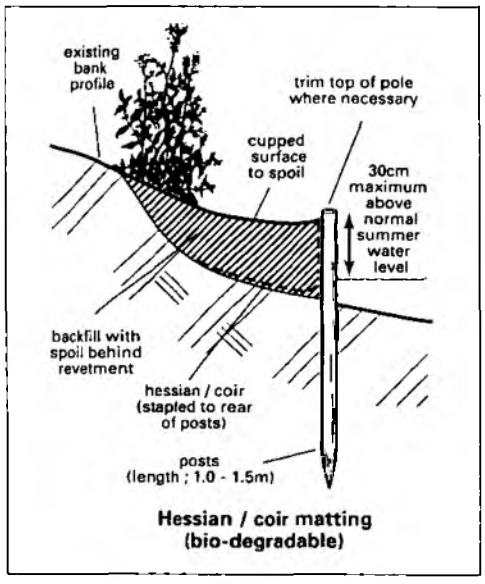
Geotextile and reed planting (non bio-degardable)



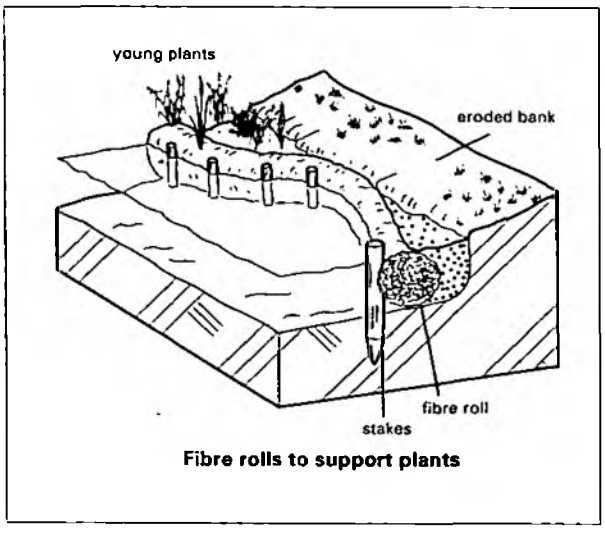
Geotextile matting and reeds / sedge



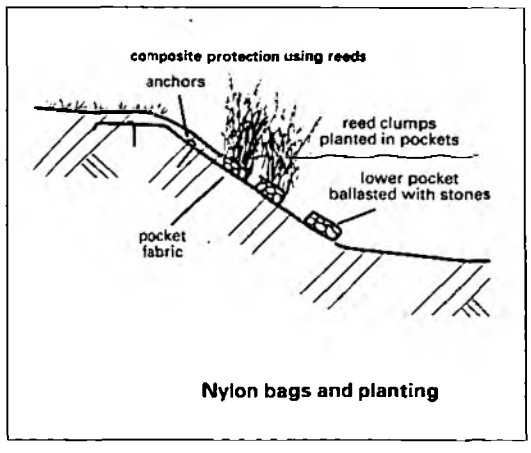
River narrowing – Geotextile used to create wet ledge



Hessian / coir matting (bio-degradable)



Fibre rolls to support plants



Nylon bags and planting

8. SEEDING AND TURFING

Seeding of re-sectioned river banks is not normal practice within the NRA (Thames Region). Thus contractors, under normal circumstances, will only have to re-seed or re-turf repaired floodbanks and land adjacent to rivers where dredging spoil has been buried.

Best Working Practice normally requires re-instatement of the soil structure to a condition which enables the previous land-use to continue. For arable land re-sowing is generally undertaken by the land owner. For improved, and amenity, grasslands, contractors will re-seed using an appropriate mix of grass seed which meets the client's and the land owner's needs. Traditionally this has been a sowing of a grass mix dominated by rye-grass which quickly establishes and produces a productive sward but today low productivity may be more desirable in certain locations to reduce management costs.

In ecologically important river reaches some banks which are to be re-sectioned, or the land in the river corridor onto which spoil has to be spread, may be of ecological interest and require specially sensitive restoration. Soil preparation for translocation of turf, or for re-seeding using a wild flower or low-maintenance mix, is critical. This normally requires reducing soil fertility by utilizing minimal amounts of top soil mixed with sub-soil prepared to a fine tilth.

The benefits of a low maintenance mix are numerous, and not confined to enhancing wildlife. Whilst they support a wider variety of wildlife, including plants, invertebrates and ground nesting birds, they also require less maintenance, are more tolerant of environmental stress and look better in amenity terms.

Where special re-seeding is required the client will give precise details on locations, timings and methods of soil preparation and seed planting to the contractor. Details will be provided on suitable seed mixes to use (which may be different in different locations of the same reach if environmental conditions vary markedly). It is also possible that seed from plants growing in the sites to be managed will be required to be collected and used (or mixed with a proprietary mix) to re-seed the site once the work is completed. For floodbanks of a critical nature to flood defence there may be a need to establish a vegetation sward immediately after completion of the work to ensure bank integrity. Establishment of an environmentally desirable sward in the long term may therefore be combined with the sowing of a 'nurse' crop. Details of how this should be established and managed will be given by the client as they will frequently be very site-specific.

An alternative to sowing seed on an exposed bank is the establishment of turf; this may be the *in-situ* re-establishment of herb-rich swards that cannot be avoided or the translocation of such swards from other disturbed areas to newly exposed soils on floodbanks. Again the client will give details on when this is appropriate and the timing when, and manner in which, this should be done. Experience has shown that many rare species can be lost if an inadequate depth of soil is not removed with the turf or when these are not quickly re-planted.

NRA

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