Disposal of Cut Vegetation
Best Practice Guidelines

Research and Development

Technical Report
W138

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Disposal of Cut Vegetation Best Practice Guidelines

R&D Technical Report W138

P R F Barrett, M P Greaves and J R Newman

Research Contractor:
IACR - Centre for Aquatic Plant Management

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Aztec West
Almondsbury
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Research contractor
This document was produced under R&D Project W5A039 by:

IACR-Centre for Aquatic Plant Management
Broadmoor Lane
Sonning-on-Thames
Reading
Berkshire
RG4 6TH

Tel: 0118 969 0072 Fax: 0118 944 1730

Environment Agency Project Leader
The Environment Agency's Project Leader for R&D Project W5A039 was:
Mr Stewart Powers, Environment Agency, Midlands Region

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EXECUTIVE SUMMARY

Thousands of tonnes of aquatic and riparian bankside vegetation are cut each year by the Environment Agency and other organisations responsible for the management of water bodies. If this material were left in the water it would cause many problems and so, in most situations, it must be removed from the water and disposed of safely in a cost effective way.

Disposal can be achieved in three ways:

- the material can be left on the bank
- spread on land, or
- taken to a licensed landfill site.

Before decisions on the most appropriate method of disposal can be made, the economic and environmental implications of the disposal options must be considered. Disposal options are determined by the methods of collection and removal. These are dictated by the quantity and type of plant material and the specific sites.

The most common method of disposal is to deposit cut weed on the banks. Under the Waste Management Licensing Regulations (WMLR), up to 50 tonnes of material per metre of bank can be disposed of in this manner with certain limitations. Where disposal on the bank is the preferred option, environmental impact can be minimised by careful selection of the location and reducing the thickness of vegetation layers to a minimum.

In some situations, it is necessary, or even advantageous, to transport the material away from the water body for disposal on land. Under the WMLR, 5000 tonnes per hectare per year can be disposed of in this way. There are risks attached to this method, the most obvious of which is the spread of invasive and, potentially troublesome, species of riparian and aquatic plants. The amount of land suitable for this method is limited and, agricultural practices may make it necessary to store the material temporarily before spreading, adding to costs and increasing the risk of adverse environmental impacts.

Disposal in a licensed landfill site is the third major method of disposal. In some situations, this may be the only acceptable method although it is likely to be the most expensive, involving tipping charges, taxes and transport costs. Transport has both economic and environmental costs. Unnecessary use of landfill sites also reduces the space available for less benign materials. It is possible to reduce or to eliminate the amount of material which has to be cut, removed and disposed of.

This document provides water managers with guidelines to:

- Select the most appropriate disposal options in relation to the type of plant material. It describes the type of debris produced, how this can be collected and removed from the water and the options for disposal.

- Determine the environmental implications of control methods and associated disposal methods. It describes the environmental risks and hazards associated with disposal of cut vegetation and sets out techniques to minimise both.

- Ensure compliance with legislation covering disposal activities and sets out obligations to be adhered to during disposal operations.

This document complements the detailed information in the document Aquatic Weed Control Operation, Best Practice Guidelines, Environment Agency Technical Report No. W111.

KEYWORDS:

aquatic vegetation, riparian vegetation, weed removal, weed disposal, legislation, environmental impact, macrophytes, algae, invasive species, duty of care, waste regulations

CHECKLIST

- Establish objectives of the weed control operation and set the level of control required for flood defence, amenity or conservation purposes

- Notify the Environment Agency Waste Regulation Unit (0645 333 111) of your intention to dispose of cut vegetation, even if it is an exempt activity and obtain agreement for the proposed activity.

- Ensure that guidelines are followed where poisonous or invasive species are present

- Ensure that any rare plants and animals will be adequately protected

- Ensure that the volume of weed to be disposed of is minimised by using the most appropriate method of weed control

- Ensure that machinery is cleaned thoroughly to remove any traces of invasive species before moving between sites

- Ensure that the risk to human health, wildlife or the environment from the operation is assessed and minimised by adhering to best practice

This document answers questions related to disposal of aquatic and riparian weeds after mechanical cutting. Some of the broad subject areas are set out in Table 1 below:

Table 1. Guidance on how to use this document

QUESTION	DOCUMENT REFERENCE
1. Is weed cutting necessary?	*R&D Technical Report W111*
2. How much of the channel should be cut? Has an estimate of the quantities of vegetation generated been made?	*R&D Technical Report W111*
3. How is the weed to be cut, removed from the water and deposited on the bank?	*Chapter 1*
4. Will the type of weed affect disposal options?	*Chapter 2*
5. What are the options for disposal?	*Chapter 3*
6. Does the operation comply with current legislation?	*Chapter 4 and Appendix 1*
7. How can environmental impact be minimised?	*Chapter 5*
8. Can the amount of weed to be disposed of be minimised	*Chapter 6*

1 CUTTING, COLLECTION AND REMOVAL OF VEGETATION

1.1 Introduction

There are several techniques for cutting and removing aquatic and riparian vegetation. Normally, the method is selected principally to suit the type of weed and the character of the watercourse, with less consideration being given to the method of disposal. This usually ensures that the plant material is cut and removed efficiently but may add to disposal costs, especially if it increases the amount of handling required after the weed has been removed from the water. Consideration of the problems of disposal when selecting the method of cutting and removal helps to reduce costs.

Riparian and aquatic plant material can be disposed of in three main ways.

- Leave the material on the bank
- Spread the material on suitable land
- Dispose of material at a landfill site

There are a few other methods of disposal which have very limited current application.

Disposal on agricultural land and at landfill sites involves additional handling and transport and is more expensive than disposal on the bank. If vegetation must be removed from the bank, it is more efficient to collect it at a few sites rather than to have it dispersed over the whole length of the bank, which will add to subsequent collection and handling costs and may increase environmental damage. The method of cutting, removing and/or collecting the vegetation will greatly influence the most cost effective and environmentally acceptable method of disposal.

1.2 Problems of Disposal

Every year, thousands of tonnes of aquatic and riparian bankside vegetation are cut by the Environment Agency (EA), Internal Drainage Boards (IDBs), British Waterways (BW) and others. Over 80% of aquatic and riparian weed control activities in the UK are carried out using mechanical means which generates some form of waste for disposal. Unfortunately, the high water content, low nutrient value and high costs of collection and transport have prevented the exploitation of this resource except for a few minor uses. These problems are compounded by the variable nature of the waste material, which may contain a wide range of plant types and foreign material, the composition varying from site to site and year to year.

Removing plant material from water is a very energy-expensive operation because large quantities of entrained water are also removed. For every 100 kg of weed, up to 90 kg of entrained water is lost, leaving about 10 kg of fresh weight of weed. After this weed has dried and lost a further 90% of water content in the cells, only about 1 kg remains. If this plant cell liquor enters water is degraded by bacterial action. This degradation consumes large amounts of oxygen very rapidly, often resulting in fish kills and damage to other aquatic life.

In most situations, weed can be deposited on the bank, but there may be site-specific reasons

why this would be unacceptable, and it may be necessary to transport the weed for disposal elsewhere. For example, there might be insufficient space on the bank, or there may be a recreational function which precludes the placement of weed. The presence of foreign material, for example metal, plastic or glass, may affect the suitability for disposal on banks and disposal to landfill may be required.

1.3 Factors Affecting Method of Disposal

There are several factors which influence the method of disposal. The following list provides an introduction to some of the factors to be taken into consideration. More detail is given in Chapter 3, but the list of the most common factors is given below. This section is aimed at providing an overview of common problems encountered during disposal operations. The three main factors which influence how material will be disposed of are:

- How the weed is cut
- How the weed is removed from the water
- How the weed is deposited on the bank or collected for subsequent disposal

In practice, the conditions which determine these three factors are the type and quantity of weed and the characteristics of the watercourse. The types of weeds are detailed in Chapter 2.

Both geographical and physical characteristics of the watercourse can strongly influence the choice of disposal method. There are a number of other factors, both practical and regulatory, which also have to be taken into account. The most common subsidiary factors are related to:

- The site
- The environmental impact
- Available machinery and resources
- The composition of cut weed
- The water flow
- The bank
- Soil characteristics
- Public access
- Legislation

Some of the questions posed by these are outlined below.

1) **The location of the disposal operation.** Depending on whether the site is urban or rural some or all of the following should be considered:

    - Is a suitable area available for disposal?
    - Does the site have a conservation designation?
    - Is bank top space available?
    - Is agricultural land available?
    - Is there a bunded storage area for large heaps?
    - Are local composting or recycling facilities available?
    - Is there suitable access for transport, if removal is required?

2) **Bank characteristics.** The shape, slope and other bank features determine the suitability for depositing weed *in situ*:

- Is the slope of the bank shallow enough for vegetation to be placed on it, or should the bank top be used?
- Are there any suitable disposal sites previously used? Can they be used again?
- Is the vegetation likely to be damaged by deposition of cut weed?
- Will nutrient additions from cut material damage the native flora?
- Can bunds be easily created?
- Can flail mowed vegetation be left *in situ*
- Is the bank suitable for burning operations?

3) **The width, depth and velocity of the water.** Water flow effects the efficiency of weed cutting and collecting operations, and the potential for spread of weed species downstream:

- Can machinery reach the whole width of the watercourse to remove weed?
- Can weed be placed on the opposite bank?
- Is the flow fast enough to carry weed to a collection point downstream?
- Is the flow fast enough to prevent deoxygenation of the water?
- Is the flow slow enough to prevent collection booms becoming overloaded?

4) **Access along the bank**

- Is there access to collect large heaps for removal to land or landfill?
- Can public access be controlled during operations?
- Have warning notices been placed prominently?
- Has the potential for noxious odours been minimised?
- Have disposal locations been correctly sited away from the bank?

5) **Machinery and resources**

- Are trained staff available at the right time?
- Are extra staff required?
- Do contractors require briefing?
- Are removal, collection and loading machinery available?
- Has transport been arranged?

6) **Composition of the cut weed.** The make up and quantity of weed influences where it can be stored, how it can be processed and what method of disposal is best suited to the particular location. The following should be taken into consideration during removal and disposal operations:

- Excess entrained water in weed should be drained off over water before placing on bank
- Small quantities of wet weed can be spread thinly or, as small heaps, on the bank top

- Larger quantities of wet weed can be disposed of to land, landfill or composting after a temporary drying out period of no more than 48 hours on the bankside
- The presence of foreign material:
  Plastic, glass and metal in cut weed make disposal on bank top or on land inappropriate;
  Remove to landfill if excessively contaminated or, sort by hand to remove small quantities of foreign matter.
- Woody debris does not rot down fast enough and should be burned *in situ* or removed from the bank
- Soil is only a problem when contaminated sediments are removed with plant material
- Bank and agricultural soil fertility may be adversely affected by deposition of silt from watercourses. Floral composition may change if repeated applications are made.
- Alien invasive species and poisonous plants require extra precautions to be taken during disposal.

These factors determine which types of weed cutting machines can be used, how and where the material can be removed or collected and where it can be deposited temporarily or permanently. It would be impractical to have a complete range of weed cutting and collecting equipment to suit every watercourse detailed in this document. Generally, only those machines suitable for the more common situations and weed types are available. Thus the method of cutting and harvesting may depend largely on what equipment is available. Further details are provided in the Environment Agency document "Aquatic Weed Control Operations" R&D Technical Report W111.

Table 2. Weed control activity and appropriate methods of disposal

WEED CONTROL ACTIVITY	SUITABLE METHODS OF DISPOSAL
Hand Cutting	• Leave to float downstream uncollected • Collect at boom downstream and remove to heap • Deposit on bank in small heaps, or chop and spread • Leave cut bankside vegetation *in situ*
Weed Cutting Boats (including amphibious boats)	• Leave to float downstream, collect at boom and put in a heap • Remove with weed rake or bucket at cutting site • Deposit in large or small heaps along bank, or chop and spread
Weed Harvesting Boats and Weed Collecting Boats	• Deposit on either bank in small heaps • Deposit at central collection point in large heap • Deposit in tender boat for offloading later
Weed Buckets and Weed Rakes	• Deposit in small heaps on bank top, or chop and spread
Flail Mower, Strimmer, Forage Harvester, Allen Scythe, Spider and Bicycle Mowers	• Leave *in situ* to decompose • Do not spread invasive plants to uninfested areas
Chain saw	• Burn or chip material *in situ*, leave to decompose or remove from site.

2 PLANT TYPES AND IMPLICATIONS FOR SELECTION OF DISPOSAL OPTIONS

2.1 Introduction

The types of plant which grow on banks or in water vary widely in size, shape and structure. This affects how they can be cut, removed from the water and disposed of. Before appropriate methods of cutting, removal and disposal can be chosen, it is necessary to identify the types of weed which need to be controlled and the situations in which they may be growing. A general description of the different types of plant and the appropriate methods of disposal is given below. Those plants which cause specific cutting, collection or disposal problems, and need to be considered separately from the general weed types, are described in more detail at the end of this chapter.

2.2 Bankside Plants

2.2.1 Growth habit

Bankside plants range from low growing grasses, which need little maintenance, to tall reeds, thistles, nettles, shrubs and trees which require more intensive or complicated management. They also include alien and invasive plants, such as Japanese Knotweed (*Fallopia japonica*), Giant Hogweed (*Heracleum mantegazzianum*), Himalayan Balsam (*Impatiens glandulifera*) and a range of poisonous plants. Bankside plants may include emergent aquatic species growing at the water's edge, as well as terrestrial species further up the bank. Care should be taken when cutting Giant Hogweed that sap does not come into contact with skin and cause serious burns.

2.2.2 Disposal options

Material cut with a flail mower is finely chopped and can usually be left on the banks to decompose. Frequent cutting generates less plant debris at each cut and reduces the need to collect and remove it, but it may adversely affect floristic diversity. Flail mowing can spread viable propagules of willows and Japanese Knotweed, and care should be taken when these species are present on the bank to prevent fragments entering the watercourse.

Bankside weeds which are cut by hand or weed bucket can be collected for disposal elsewhere, left on the bank to decompose, or to dry prior to burning. Some bankside vegetation may be suitable as feed for livestock provided that there are no poisonous plants (see list in Section 2.9).

2.3 Emergent Aquatic Plants

2.3.1 Growth habit

The most common emergent aquatic weeds requiring cutting are rushes, reeds and sedges which are rooted in the sediment and grow in water less than 1 m deep. Some species can also colonise the banks close to the water. Rushes and reeds can reach heights of up to 3 m above

water surface and can form dense beds which impede the flow of water. Some emergent, broad-leaved species such as Watercress and Water Plantain are less common but may need to be controlled.

2.3.2 Disposal options

If deposited on the bank, rushes, reeds and sedges rot slowly and may suppress underlying vegetation or impede access to the banks. Decomposition can be accelerated by chopping the cut vegetation with a flail mower. Reeds and sedges dry out quickly and can be collected and burnt after drying where this is appropriate. However, heaps of dry vegetation form a good habitat for some wildlife. It is important not to disturb hedgehogs, nesting birds, snakes and snake's nests. These dry heaps can therefore be left on the banks if they do not interfere with other functions of the channel. Some emergent weeds, such as Reed Sweet-Grass may be suitable as feed for livestock provided that there are no poisonous plants (see 2.9).

2.4 Floating-Leaved Plants

2.4.1 Growth habit

Most floating-leaved plants, including the Water-lilies, Broad-leaved Pondweed and Amphibious Bistort, are rooted in the sediment and produce long leaf stalks which grow up to the surface. Others are free-floating plants such as the Duckweeds, Water Fern and a few, relatively rare, species such as Frogbit. These plants have short roots which hang in the water without attachment to the sediment. The free-floating plants can drift or be carried by currents and can form dense masses sometimes up to 20 cm thick.

2.4.2 Disposal options

The rooted floating-leaved plants seldom grow in sufficient quantity to create a problem if deposited on the banks where they rot quickly. Free-floating plants also rot quickly when removed from the water but can produce such a large biomass of weed (up to 200 kg per square metre of watercourse) that disposal on the bank can damage underlying vegetation or impede access.

2.5 Submerged Plants

2.5.1 Growth habit

Most submerged plants, such as Water Crowfoots (*Ranunculus* spp.), Water Milfoil (*Myriophyllum spicatum*) and Canadian Waterweed (*Elodea canadensis*), are rooted in the sediment and grow up to the surface where they produce flowers. A few species do not have roots and are found only in static or very slow flowing waters. Many submerged species can regenerate from fragments produced when they are cut and care should be taken to limit the spread of species during cutting and collecting operations.

2.5.2 Disposal options

Submerged macrophytes rot quickly and cause few problems if spread or deposited along the banks in small heaps. In some situations, where the soil is acid or low in organic matter, submerged weeds, particularly *Ranunculus* spp., are used as soil fertilisers and conditioners.

2.6 Algae

2.6.1 Growth habit

Although there are many growth forms, algae can be considered as either filamentous (also called blanket weed or cott) or unicellular. The latter make the water turbid and green but are too small to see individually with the naked eye. They drift freely in the water and are usually only troublesome in static or very slow flowing water where they grow rapidly. Filamentous algae start growth in the spring attached to bottom sediment or plant material and produce a mass of filaments which eventually becomes thick enough to trap bubbles of oxygen causing it to rise to the surface where forming a floating blanket. Filamentous algae can regrow rapidly from fragments left in the water after the floating blanket has been removed.

2.6.2 Disposal options

Some species of filamentous algae, particularly *Vaucheria dichotoma,* form a persistent, thick blanket which kills underlying bankside vegetation. Chopping the dry mats with a flail mower and spreading the material thinly may help to prevent damage to underlying vegetation, but, where this is not possible, it may be necessary to remove weed to an alternative disposal site if unacceptable damage to bankside flora is likely. The death of underlying flora may lead to bank destabilisation and slippage due to loss of surface root-binding strength.

2.7 Woody Plants

2.7.1 Growth habit

Trees and shrubs can grow on banks from seeds or fragments washed up on the margins. Often they are deliberately planted to stabilise the bank, or shade the water to reduce growth of aquatic vegetation. Species commonly found on banks include Willow, Alder and Poplar although many other woody species, for example Hawthorn, can grow adjacent to water.

2.7.2 Disposal options

Woody species do not rot quickly after cutting and may require specialised disposal procedures. Although wood can be burnt, it is preferable to find alternative uses. Larger trunks and branches can be used for bank stabilisation in the form of posts, rails and spiles. Smaller branches can be woven into hurdles or tied into faggots for use in bank protection schemes or other purposes. If the material is not needed for bank protection, it can often be sold locally for firewood, craft or other industrial uses. Bundles of branches, left well back from the bank where they cannot be washed back into the water during floods, also provide a valuable habitat for wildlife. Smaller branches can be turned into wood chip and used as a mulch to prevent weed growth and retain soil moisture where ornamental or other desirable plants are

being established. Care should be taken when cutting woody plants, particularly willow species, not to leave fragments which can be dispersed by water and colonise banks where they are not wanted.

2.8 Invasive Alien Plants

2.8.1 Growth habit

A number of invasive alien weeds introduced to this country have escaped from gardens and ponds. Some of these are bankside plants, such as Japanese Knotweed (*Fallopia japonica*), Giant Hogweed (*Heracleum mantegazzianum*), Himalayan Balsam (*Impatiens glandulifera*), which can spread rapidly along river banks, suppressing and displacing underlying native vegetation. Others, such as Australian Swamp Stonecrop (*Crassula helmsii*) and Floating Pennywort (*Hydrocotyle ranunculoides*), are aquatic species which form dense growths on or below the water surface creating serious flooding risks and suppressing native plants, but also grow on banks close to the water. Some of these alien species produce large numbers of viable seeds, others are spread as fragments, but they are all capable of prolific growth and rapidly colonise new areas.

2.8.2 Disposal options

All invasive alien weeds are spread easily either as seeds or fragments. They can be disposed of on the bank close to the source. Care should be taken to discourage the spread of these plants by not leaving fragments in the water and by preventing seeds or viable fragments of plants from moving to other locations where they can regenerate. They must not be moved to another site for disposal if either close to the water or on agricultural land, unless it is possible to ensure that they will not regenerate at the new site. If neither of these options is available, they should be disposed of in a landfill site.

Where waste going to landfill contains either Japanese Knotweed or Giant Hogweed, these species must be listed in the waste registration document so that appropriate measures can be taken at the landfill site.

It is unlikely that mechanical control will give any long-term control of these invasive alien weeds. At present, the only effective, long-term, method of control is to treat them with an appropriate herbicide. This approach will reduce or eradicate the weeds, thus facilitating future cutting and disposal operations at the site.

2.9 Poisonous Plants

2.9.1 Growth habit

There are many species of plants growing in or near water which are poisonous to livestock. Normally, livestock avoid these plants because they are unpalatable. However, after they are cut, the odour or unpalatability diminishes but, in some species, the plant material remains toxic. Thus, the cut material is a risk to livestock until it has completely decomposed. Some of the more common poisonous plants which remain toxic after cutting are listed below.

POISONOUS PLANTS GROWING IN OR NEAR WATER	
Cicuta virosa	Cowbane or Water Hemlock
Digitalis purpurea	Foxglove
Equisetum spp.	Horsetails
Iris pseudacorus	Yellow Iris
Oenanthe crocata	Hemlock Water Dropwort, Deadman's Fingers
Pteridium aquilinum	Bracken
Senecio jacobea	Common Ragwort

2.9.2 Disposal options

When these plants are present at a site where weeds are cut, they should only be deposited on the banks if livestock are excluded. The cut plant material should be allowed to decompose completely before livestock access is permitted, or removed from site (away from livestock). Toxic plant debris can be buried or burned on site, removed to a safe disposal site, on land to which livestock cannot gain access, or to a landfill site.

Where poisonous plants are established and cause persistent risks to livestock, disposal problems add significantly to costs, and the use of an appropriate herbicide, to control the weed, should be considered.

2.10 Other Practical Considerations

It is relatively uncommon for a weed problem to involve a single species. Often there will be a range of plant species containing representatives of some or all of the types described above. If it is essential to remove all the vegetation, it might be necessary to use more than one cutting technique although this can add greatly to the cost of the operation. In many situations it is, however, possible to achieve adequate control by targeting the more troublesome of the weed types and selecting a cutting and removal technique which will deal adequately with these while leaving much of the less troublesome weed in place.

AS A GENERAL HYGIENE PRECAUTION, WEED CUTTING, COLLECTING OR TRANSPORTING EQUIPMENT SHOULD BE CLEANED BEFORE MOVING TO A NEW SITE TO PREVENT THE SPREAD OF WEEDS, PARTICULARLY INVASIVE ALIEN WEEDS, EITHER AS FRAGMENTS OR SEEDS.

3 SELECTION OF DISPOSAL OPTIONS

3.1 Introduction

Waste plant material arising from weed cutting operations must be disposed of in a way which does not cause harm to humans or to the environment. The first stage in the disposal process is to ensure that sufficient material is removed from the water to prevent deoxygenation, or other problems, which could arise as weed rots in water. The second stage is to decide whether it can safely be left on the bank or whether it is necessary to move it to another disposal site.

Moving the vegetation for a second time clearly incurs additional costs. There are also environmental considerations in deciding whether to move the material to another site or to leave it *in situ*. There may be environmental risks associated with moving the material which could be as great, or greater than, those arising from leaving it on the bank. Of the three principal methods of disposing of riparian and aquatic vegetation, disposal along the bank has been used for longest and is still the most commonly used. Disposal on agricultural land, or land belonging to the operating authority, or at a licensed landfill site is generally the second option. This is used mainly when there are overriding reasons why the material cannot be left on the bank, due for example to amenity and recreational land use or to prevent any adverse impact on sensitive riparian vegetation. If the material is to be disposed of on land, it may be necessary to demonstrate that agricultural benefit or ecological improvement results from this activity (WMLR, 1994).

Other methods of disposal are of limited use, or are still at the experimental or pilot stage of development. However, they may be of use locally and opportunities to use them should not be ignored if circumstances are appropriate. Advantage should be taken of offers of free removal for local composting schemes.

3.2 Disposal on Banks

There are two main methods of disposal on banks. Material can be deposited linearly along the bank, either in small heaps or spread over the surface, or it can be collected in a few large heaps. Some collection techniques (*e.g.* weed buckets) favour the former method of disposal while others, (*e.g.* weed booms) favour the latter.

3.2.1 Disposal along the bank top

Clearly, placing the weed along the bank as it is harvested is a simple option because it involves minimal handling and therefore, minimal additional cost.

The Waste Management Licensing Regulations 1994 specify that up to 50 tonnes of material per linear metre can be deposited along banks, provided that there is sufficient space to do so and that it does not harm human health or the environment or create a risk to soil, water, air or wildlife. In practice, when material is being removed continuously as it is cut, amounts of less than 1 tonne per metre of bank are usual. When bankside disposal is the best option, the factors to consider are set out below:

- Weeds cut with a flail mower can generally be left to decompose on the bank without further handling.
- Material removed from the water by hand, a weed bucket or weed harvesting boat, can be deposited and, if necessary, spread linearly close to, or along the top of the bank. Material removed with a weed bucket can be placed in front of the excavator, provided that there is sufficient space, or the excavator can slew to deposit the weed on the bank top, or behind the bank.

- Material deposited on the bank should be organised so as to cause minimal inconvenience to anglers and other riparian users.

- Material should be spread in thin layers less than 30 cm thick.

- Rushes and reeds decompose slowly, but can be placed in heaps well away from the bank where they provide a good habitat for wildlife.

Decomposition of plant material can be accelerated by chopping the material with a flail mower or forage harvester. If it is combined with a bank mowing operation overall costs can be further reduced.

Material which does not rot quickly can be dried and burnt, provided that this does not endanger adjacent crops, buildings, human health or wildlife. The legal amount of material which can be burnt under the WMLR is limited to 10 tonnes at any one time at any one site. Do not light fires on sloping banks where killing underlying vegetation will destabilise the bank. This is particularly important in peat areas where underground fires can take hold and are extremely difficult to extinguish.

Summary - Disposal on Banks

Advantages

1. Very quick, with no additional transport or handling costs.
2. Rapid aerobic decomposition for many species in layers less than 30 cm thick.
3. Well placed small piles and heaps are not likely to fall back into water or create liquor seepage.
4. Allows escape of some vertebrates and invertebrates back into water.

Disadvantages

1. Poor placement causes leaching of liquor and risk of weed falling back into watercourse.
2. Poisonous plants may be eaten by livestock.
3. Thick layers can cause suppression of bank vegetation, leading to bank instability.
4. May cause nutrient enrichment of soil.

3.2.1 Disposal of material on banks in large heaps

This option is usually only practised when vegetation is removed at booms or weed screens. If the material is to be left at, or close to, the removal site, the heaps must be carefully sited. The heaps should be:

- Sufficiently far from the bank to ensure that material cannot fall back into the water.
- Surrounded by a bank or bund of earth or located where liquor cannot drain into the water.
- Located where odours and pests attracted to the decomposing material will not adversely affect the public.
- Sited where they do not cause a safety hazard to the public.
- Sited where they do not cause a risk to wildlife.

In some situations, the quantity of material may be too large to be deposited in a single heap. In order to reduce heap size, it is sometimes possible to move the boom progressively downstream, as sections of river are cut, so reducing the quantity of material accumulated at each site.

Summary - Disposal in Large Heaps

Advantages

1. Easy and efficient method of disposal when collection is at a boom.
2. Easy to arrange transport to land or landfill.
3. Access by public and livestock is controllable.
4. Maximum permitted volumes unlikely to be exceeded.

Disadvantages

1. Risk of noxious odours.
2. Risk of leaching.
3. Risk of Health and Safety problems.
4. Highly visible.

3.3 Disposal of weed on land

Up to 5,000 tonnes per hectare of aquatic and bankside vegetation can be spread on agricultural land with landowners permission. Weed for disposal in this manner may be transferred directly from the water into vehicles for immediate transport to the disposal site. Alternatively, and more frequently, it is first removed and allowed to drain temporarily at the collection site on the river bank. If it is to be stored temporarily on the bank, or elsewhere, for more than 48 hours before spreading onto land, the requirements for safe storage listed under paragraph 3.2.1 (above) apply.

Types of agricultural land (and land use categories) on which material can be deposited are:

- Fallow and set-aside land where there is no existing crop. The material can be left to rot and ploughed in when convenient.

- Arable land, after crop harvest and before any subsequent crop is planted.

- Pasture land where, ideally, livestock would be temporarily removed or where, by agreement with the farmer, livestock could be allowed to eat the material. In this case, the material should be of a type suitable for animal feed, freshly cut and should not contain poisonous plants or other material which could be dangerous to livestock. This method of disposal is likely to be most appropriate for material which is generated in small amounts so that the livestock consume it as it is generated, without leaving large quantities lying on the pasture to damage underlying grasses.

- Operational land of a railway, light railway, Internal Drainage Board or the Environment Agency.

- Land which is forest, woodland, park, garden, verge, landscaped area, sports ground, recreation ground, churchyard or cemetery.

> **Note: with the exception of land directly owned by the undertaking generating the waste material, it is necessary to obtain the approval of the owner before disposing of the waste.**

In some circumstances, exemptions under the Waste Management Licensing Regulations 1994 may be granted only if agricultural benefit or ecological improvement will result from the cut vegetation being deposited on land. Improvement or benefit is usually taken to mean improvement in soil structure or fertility resulting from incorporation of weed into soil by additional harrowing or ploughing in. Incorporation of cut weed into soil will achieve agricultural benefit or ecological improvement to the soil if practised at recommended rates given in the MAFF Booklet: The Soil Code. Code of Good Practice for the Protection of Soil, 1998. In practice, rates should not exceed 5000 tonnes per hectare per year. This is equivalent to a layer 50cm deep, spread evenly over a hectare and is very unlikely to be achieved during most disposal operations.

This method of disposal is effective if:

- the soils are poor and benefit from incorporation of plant material
- the material is uniform
- the material has physical and chemical properties which benefit the land
- there are sufficient farms within an appropriate distance of the rivers to accept the material
- the farms have suitable storage sites where the weed can be left to rot before it is spread
- the crop regime allows time for the material to be spread and incorporated into the soil between harvest and subsequent planting.

In many other situations, it may be difficult to find suitable disposal sites. In modern agriculture, there is often only a very short time between harvest and autumn cultivation and planting. Thus, it may not be possible to collect, transport, decompose and spread the material at a time which suits the farming regime. Also, suitable land for spreading the material may not be available close to the harvest site or the weed may not be of a type which would be beneficial to the land. Aquatic weeds have a low nutrient value and contribute little to most soils. Extra costs would be incurred in handling, chopping, transporting and spreading the

weed and in paying the farmer, but environmental benefits of removing material from the bankside may outweigh these costs.

3.3.1 Contaminated spoil

If plant material removed from a watercourse for disposal on land contains large amounts of soil or silt, it is necessary to ensure that this spoil is does not contain toxic components (*e.g.* organic compounds or metals). Contamination is likely to derive from natural geological processes, industrial processes or unlicensed dumping in water. Suspected contaminated waste containing the spoil should not be spread onto agricultural land until a full identification has been made of the toxic components, professional advice obtained and management programmes for application and subsequent treatment drawn up. In some cases contaminated spoil may be subject to Hazardous Waste legislation.

Detailed guidance on disposal of dredgings to land is covered in "*CIRIA Report 157, Guidance on the Disposal of Dredged Material to Land*". Available from the Construction Industry Research and Information Association, 6 Storey's Gate, Westminster, London SW1P 3AU. Telephone 0171 222 8891, or email switchboard@ciria.org.uk.

Summary - Disposal to Land

Advantages

1. Large volumes are exempt under WMLR
2. Agricultural benefit and/or ecological improvement to soil is likely to occur
3. Limits damage to banks and nutrient enrichment of bank soils
4. Reduces the risk of liquor leaching into watercourse
5. Removes problems of livestock and public access

Disadvantages

1. Incurs additional handling and transport costs
2. Collection sites may not be close to collection sites
3. Access to land may not be available at right time of year
4. Temporary bunded storage areas may be required
5. Potential growth of weed species in crop land
6. May require sorting to remove foreign matter

3.4 Disposal at a landfill site

Landfill sites are relatively few and are often distant from rivers, making transport costs high. Therefore, this method of disposal is generally only used where it is impossible to leave the weed on the bank and where no other suitable disposal site is available.

Under proposed EU Directives, the total amount of decomposable or recyclable waste going to landfill sites will have to be reduced from the current level of 75% (of total waste) to around 25%. In this case, there will be a strong incentive to reduce further the amount of weed disposed of in this way and alternative methods will have to be found.

It is economically advantageous to reduce the weight and volume to minimise transport and landfill costs. The weeds should be allowed to drain as much as possible (without allowing liquor to drain back into the water). Chopping the weed should also be considered.

Summary - Disposal to Landfill

Advantages

1. Disposal of weed containing foreign material is acceptable
2. Removes problems caused by decomposing weed in urban areas
3. Limits damage to banks and nutrient enrichment of bank soils
4. Eliminates leaching of liquor into watercourse
5. Removes problems of livestock and public access

Disadvantages

1. Additional costs from transport and landfill
2. Environmental impacts from transport and landfill

3.5 Other methods of weed disposal

Apart from the three basic methods described above, there are a number of other methods of disposing of aquatic weed which are in limited use at present but which may become more useful in the future. Managers and operators should be aware of these so they can be exploited if the opportunity arises.

There are three problems which make it unlikely that major uses will be exploited in the near future:

- Weed is usually only available for a relatively short period in the summer, creating storage and supply problems.

- It is unusual for the mass of harvested weed to be composed of a single species. Generally, the material contains a wide range of emergent, floating and submerged plants and algae. Therefore, quality control and consistency of product would be difficult to achieve.

- Aquatic weeds are difficult to collect and heavy to transport so that, unless very local uses can be found, there is likely to be a high cost of delivery which would make their use uneconomic.

There are however, several uses for cut vegetation which are important on a small scale or at a local level and these should be explored as disposal options if available.

3.5.1 Composting

Water plants do not compost well by themselves but may do so if mixed with other organic material. Experience of composting marine algae has shown that the decomposition process works best with only 30% of weed in the mixture. A number of pilot or small scale composting plants dealing mainly with garden or municipal park waste have been set up. At present, these can deal with only a few tonnes of material at a time. Some centres may take weed material for free but others may charge. There will also be a cost of transporting the weed to the site.

Composting of aquatic and riparian weeds is currently practised in the Netherlands and Germany. Reductions in disposal costs of up to 90% have been achieved by composting compared with landfill, as there is a saleable end-product to offset some of the transport and operating costs.

Material for composting may require sorting to remove as much foreign matter as possible at the start of the process. Material derived from rural watercourses is much less likely to have foreign matter than that from urban or industrial sites. However, urban sites are most likely to have large scale domestic refuse composting facilities nearby. It is likely that as the demand for non-peat-derived composts increases, local composting facilities will become more available.

Application of 10 tonnes per hectare of composted aquatic vegetation will add approximately 3 tonnes of organic matter to soils.

3.5.2 Mulches and soil amendments

The establishment of trees along river banks and in other situations can be adversely affected by the growth of grasses and tall herbs, which compete with the young trees for water and light. Aquatic vegetation used as a mulch can suppress the growth of competing grasses and herbs and enhance the survival of the young trees. The best types of aquatic weed for this purpose are filamentous algae which dry to form a mat which can last for more than a year. This will suppress the growth of grasses and small herbs but allow water to drain through the mat. However, it is important to ensure that the material used as a mulch does not contain seeds or rhizomes of plants which could establish themselves at the site and compete with the young trees.

The smaller branches of trees which have been pollarded, coppiced or felled along river banks can be chipped and used as mulch. This material is increasingly sold on the garden market.

Soil amendments, or soil improvers, are added to soils to improve physical characteristics such as soil structure or water retention capacity. The organic matter content of cut vegetation may improve both soil structure (especially in clay rich soils) and water retention capacities (especially in sandy soils). Incorporation into soils will result in an increase in soil stability which guards against erosion and may decrease water loss from soils.

3.5.3 Thatching, basket making and weaving

Rushes and Reeds and some Willow species are used for thatching, basket making and other forms of weaving. The increasing interest in rural crafts may help the uptake of material to this market.

3.5.4 Replanting schemes

There may be opportunities available for disposal of weed to other sites where planting is required. This is usually a cheap option for the disposer as the recipient should pay all transport costs. The most effective method of replanting is to introduce dredged spoil with living roots, rhizomes and seeds to newly dug areas or areas subject to rehabilitation works.

Care should be taken when transporting material for this purpose that alien invasive species are not present to avoid introduction into uninfested areas.

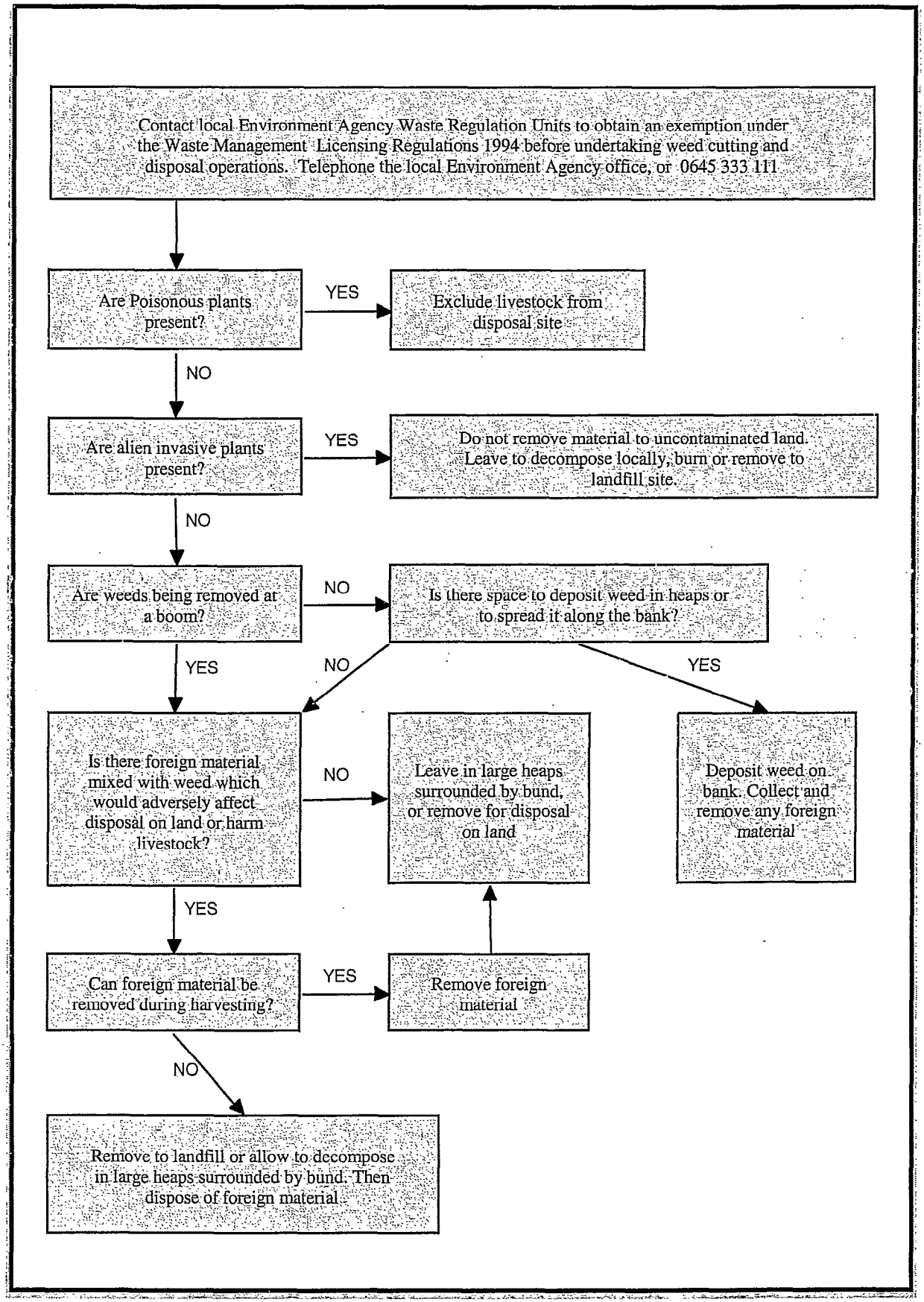
3.6 Problems Encountered During Disposal of Cut Weed

Several problems are commonly encountered when cut weed is placed on bank tops which can be alleviated by alternative practice or additional processing. Many of the procedures may already be part of the collection and disposal procedure and Table 3 is provided as a summary of options.

Table 3. Methods to Alleviate Problems During Disposal of Cut Weed

FACTOR	PROBLEM	SOLUTIONS
Liquor production and Leaching	Extraneous water drains out of cut material first resulting in an approximate 70-90% reduction in weight. No problems are caused by this extraneous water. Subsequently, plant tissue starts decomposing and cell contents leak out. These are rich in carbohydrates and other foods for bacteria. If this liquor enters water, bacteria grow rapidly and consume oxygen. This can deoxygenate the water and kill fish and invertebrates.	• Ensure the weed heap is well away from the bank side. • Ensure that large weed heaps are surrounded by an earth bund to retain liquor and allow it to seep slowly into the ground.
Suppression of Bank Flora	Thick layers of weed dumped on top of bank vegetation kills it. Root loss leads to bank destabilisation and slippage. Nutrients in cut vegetation and in associated spoil can alter the nutrient content of bank soils. The existing flora may be suppressed by added nutrients and more aggressive species may become dominant.	• Ensure layers are less than 30 cm deep to encourage rapid decomposition. • Shred or chop the cut vegetation • Remove the cut vegetation from the bank. • Deposit weed on alternate banks each year to reduce nutrient input.
Odour	Odours are greatest when decomposition of large weed heaps proceeds without oxygen (anaerobically).	• Add straw or woody vegetation • Use smaller heaps • Remove to land or landfill
Livestock	Some plants are fatal to livestock if eaten, especially after cutting, as palatability increases due to loss of unpalatable compounds **without** loss of toxicity. Improved access to banks after cutting can result in poaching damage to banks and increased risk of erosion and drowning of livestock	• Fence off cut areas if poisonous plants are present • Remove cut plant material to secure storage area. • Place in large heaps where access can be controlled. • Selectively remove, burn or bury poisonous vegetation. • Leave marginal fringe

3.7 Disposal Option Flowchart



4 LEGISLATION

4.1 Introduction

Several Acts of Parliament and other local or national regulations affect how and where weeds are cut or removed from the water and how the resultant waste material is deposited, stored and disposed of. The Environmental Protection Act 1990 is concerned with the disposal of cut weed because, supplementary to this Act, the Waste Management Regulations 1994 stipulate how waste materials can be disposed of safely. Other Acts of Parliament affecting weed control operations include the Wildlife and Countryside Act 1981, The Health and Safety at Work etc. Act 1974, The Water Resources Act 1991 and The Weeds Act 1959. In certain circumstances, there may be other local bye-laws which can affect weed control operations.

4.2 Health and Safety at Work etc. Act 1974

This Act imposes duties on employers, employees and the self employed to secure the health, safety and welfare of people at work and protect people other than those at work against risks to their health and safety arising out of work activities. This Act covers all aspects of weed cutting, harvesting and disposal and affects operators and the general public. Apart from the normal risk assessment and precautions which should precede these activities, the following risks (which may be covered by the Health and Safety at Work etc. Act 1974 or the Environmental Protection Act 1990) should also be assessed and due precautions exercised:

- Operators are at risk if they come into contact with poisonous plant material or sap when cutting or handling weed. In particular, sap of Giant Hogweed can sensitise the skin to sunlight, leading to burns and blistering.

- Contact with water containing blooms of toxic blue-green algae can be dangerous as the algae contain nerve, skin and liver toxins. Ingestion or handling of blue-green algal scum, or handling plants removed from water containing these scums, can create a danger. The material should not be deposited so as to cause danger to public health.

- Vegetation deposited on the banks can be slippery and may cover holes or other obstructions, creating a hazard to workers or the public using river banks.

- Large heaps of rotting weed attract flies and other pests, creating a health hazard.

4.3 Waste Management Licensing Regulations 1994 (Environmental Protection Act 1990, Part II Waste on Land)

4.3.1 Exemption criteria

Under these Regulations waste materials must be disposed of in an approved manner. However, in most situations, weed cutting and dredging, and the disposal of the resulting waste material, is an exempt activity provided that the quantity of material does not exceed certain limits and that the organisation undertaking the weed cutting and harvesting has

obtained a certificate of exemption. When weed or dredgings from an inland water are to be deposited on the bank, transported onto agricultural land or sent for composting, the establishment or undertaking (this will include the Environment Agency, Internal Drainage Board, British Waterways, fishing or recreational clubs, local authorities and private owners) must furnish particulars of the operation in advance to the local Waste Regulation Unit of the Environment Agency. They can be contacted during office hours through the regional offices of the Environment Agency listed at the end of this document or by telephoning the Environment Agency general enquiry number 0645 333111.

BEFORE ANY OF THESE ACTIVITIES CAN BE EXEMPTED FROM A LICENCE, THEY MUST BE REGISTERED WITH THE ENVIRONMENT AGENCY.

Any establishment or undertaking carrying out the recovery or disposal of controlled waste will be subject to appropriate periodic inspections by the Environment Agency.

The Waste Regulation Units of the Environment Agency have produced three summaries of the Waste Management Licensing Regulations which describe the legislation relating to the various methods of disposal. These are reproduced in Appendix 1 and are briefly summarised below. There are three principal sections:

- **Waste for the benefit of land** - Up to 5,000 tonnes per hectare per year may be disposed of on operational land belonging to the undertaking or on agricultural land or on land which is forest, woodland, park, garden, verge, landscaped area, sports ground, recreation ground, churchyard or cemetery.
- **Waterway dredging** - Up to 50 tonnes per metre of bank may be deposited on the bank or towpath in any one day.
- **Composting waste** - Up to 1,000 cubic metres of plant material may be composted or stored for composting at one place at any one time.

EVEN IF AN EXEMPTION HAS BEEN OBTAINED, IT IS STILL AN OFFENCE TO "TREAT, KEEP OR DISPOSE OF CONTROLLED WASTE IN A MANNER LIKELY TO CAUSE POLLUTION OF THE ENVIRONMENT OR HARM TO HUMAN HEALTH."

The exempt activity must be consistent with the need to attain the following objectives (taken from the Waste Framework Directive):

"Ensure that waste is recovered and disposed of without endangering human health and without using processes or methods which could harm the environment and in particular without:

i) risk to water, soil, plants or animals, or
ii) causing nuisance through noise or odours, or
iii) adversely affecting the countryside or places of special interest."

4.3.2 Transporting waste

If material is to be transported for subsequent disposal by anyone other than the establishment or undertaking which has generated the waste, the carrier must be registered with the Environment Agency as a carrier or broker of controlled waste. This applies even though the

activity of disposing of aquatic and riparian vegetation has been registered with the Environment Agency as an exempt activity. However, the establishment or undertaking may transport waste without registration if it is solely waste generated by its own activities. Further information can be obtained from The Environment Agency, Waste Regulation Policy Group, Room A2O1A, Romney House, 43 Marsham Street, London, SW1 3PY.

4.4 Water Resources Act 1991

This Act is concerned, amongst other things, with the prevention of pollution of water. If weed is cut and left in the water or is placed in heaps on the bank, it may cause, or release, polluting substances within the meaning of the Act. The microbial decomposition of the weed in water, or liquors released from heaps of weed on the bank seeping into water, can deoxygenate water very rapidly, killing fish and other wildlife and causing taint and odour problems. Therefore, it is usually necessary to remove cut weed from the water and dispose of it in a way which will prevent potentially polluting substances from draining into water.

4.5 Wildlife and Countryside Act 1981

Under this Act, it is an offence for anyone to kill, or otherwise damage, wild plants unless it is necessary as a part of good agricultural practice. There are a number of rare plants and animals which are specifically protected under this Act. Aquatic weed control is regarded as good agricultural practice but it should be carried out in such a way as to minimise adverse impacts on wildlife generally, and should not harm any rare species, or their habitats, named in the Act. (For a list of specially protected plants and animals, see Chapter 6, Environment Agency R&D Technical Report No W 111).

It is also an offence under this Act to allow to grow knowingly, or encourage the spread in the wild, of invasive riparian weeds, Japanese Knotweed *(Fallopia japonica)* and Giant Hogweed *(Heracleum mantegazzianum)* are cited specifically. Both species are often spread by disposal of cut weed, if seeds or fragments of these plants are present.

If these weeds are known to be present where weed cutting operations are planned, several options are available:

- The cut material can be left on the bank (provided that it does not endanger the public) so that any invasive weed material is not spread to other locations.

- The cut material can be disposed of in a licensed landfill site where it will be buried to a depth where the invasive weeds cannot regrow.

- The invasive weeds can be cut and disposed of prior to the main weed cut. The invasive weeds can be cut and allowed to dry before being burned or they can be disposed of in a licensed landfill site.

- The invasive weeds can be controlled using an approved herbicide at least three weeks prior to the weed cut. Glyphosate applied in late spring or early summer will control these species but treatment of Giant Hogweed should be made before seed is set. Spot or localised treatment can be used to minimise environmental impact where the infestation is small (See Environment Agency R&D Note 233).

4.6 The Weeds Act 1959

Some weed species which can grow near water are scheduled as injurious weeds under The Weeds Act 1959. These are Spear Thistle *(Cirsium vulgare),* Creeping Thistle *(Cirsium arvense),* Curled Dock *(Rumex crispus),* Broad-leaved Dock *(Rumex obtusifolius)* and Common Ragwort *(Senecio jacobea).* Under the Weeds Act 1959, the Ministry of Agriculture, Fisheries and Food can serve notice on land owners or occupiers requiring them to take action to destroy or prevent the spread of injurious weeds. If these weeds are allowed to set seed, they can be spread during weed cutting and disposal operations. Common Ragwort is also a poisonous plant which should not be left on the bank, or elsewhere, where livestock have access to the cut vegetation.

Seed production is prevented by cutting early in the season and by spraying with a herbicide approved for use in or near water (Guidelines for the use of herbicides on weeds in or near watercourses and lakes. MAFF 1995). Asulam and 2,4-D amine are selective herbicides which will assist in the control of these weeds. Glyphosate is not selective but can be used for spot or localised treatment of these weeds by spray or weed wiper.

4.7 Other Precautions

Weed cutting and disposal operations can interfere with navigation and recreational activities such as fishing. While there may not be any legislation preventing the operation from taking place when these activities are occurring, it is good practice to warn those concerned that weed cutting and disposal operations are about to occur and to ensure that they do not take place immediately before, or during, important events, such as regattas or angling matches.

5 ENVIRONMENTAL RISKS

5.1 Introduction

An important objective of good management is to minimise the risk of environmental disturbance. Because of the widely variable nature of the problems and methods of disposal outlined here, this objective can only be achieved by carrying out an environmental impact assessment of all the relevant aspects applicable to each location where weed control is to be practised. Even within a single reach of channel, it may be necessary to vary the method of cutting, collecting or disposing of the material locally to minimise environmental problems. Because of this unpredictability, it is impossible to define a set of rigid rules covering the correct method of disposal of cut material for all situations. These guidelines can only advise on the aspects of the environmental assessment which should be considered before a decision is made on the optimum method of weed disposal taking into account all the local factors involved.

Particular are should be taken is the weed control operation is undertaken in, or close to, a Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC) or other designated conservation or wildlife site. Before any operation is started, or before any existing operation is changed, the appropriate conservation body should be consulted. They will be able to advise on the presence and specific location of rare plants or animals.

On all situations, the timing and method of weed cutting and disposal operations should be carefully considered and adjusted if necessary to minimise any adverse effects on spawning fish, nesting birds, hedgehogs, snakes or any other wildlife. Riparian areas are important wildlife corridors and management of these should be carried out with regard to their importance to flora and fauna.

5.2 Environmental Risks of Weed Removal

5.2.1 Removal of fish and invertebrates from water

During the removal of cut weed from water, fish and invertebrates can be trapped in the weed and removed with it. Where possible, material should be removed in such a way that it is held over the water surface for a few seconds to allow the water to drain out and these organisms to get back into the water before the weed is deposited on the bank. Fish which are seen in the deposited weed should also be returned to the water as quickly as possible. Leaving the weed in small heaps near the water helps fish and invertebrates to return to the water. In the most sensitive areas it may be advisable to avoid weed control operations during spawning times.

5.2.2 Interference with recreational and amenity values

Both cutting and removing weed interfere with angling, boating and other recreational activities and temporarily reduce amenity values. Where possible, weed cutting and removal should be undertaken at times and in ways which reduce disruption and adverse impact to other water users.

5.2.3 Transporting material

Although there are unavoidable environmental risks associated with all steps in the process of mechanical weed control, transporting the waste material can greatly increase risks and costs (both environmental and economic). Transport involves the use of fossil fuels, adding to pollution of the atmosphere, and causes damage to banks, agricultural land, farm tracks and roads. If the weed is disposed of at landfill sites, long journeys may be necessary, adding to congestion in towns and villages. Large quantities of weed in landfill sites also takes up space which is better used for more dangerous, and less easily degraded materials. It also increases liquor and methane production at the site. Material deposited on agricultural land also involves an environmental risk in terms of transport and pollution, although distances are usually less than those associated with transport to landfill sites.

Transporting material also increases the risk of spreading alien or undesirable weed species along the route to the disposal site.

5.3 Environmental Risks of Disposal of Cut Vegetation

Environmental risks associated with methods of disposal may arise as a result of a combination of factors, some of which may be difficult to predict. For example, heavy rain or flooding may cause problems if material has been deposited on banks but could also interfere with transport and incorporation of material deposited on agricultural land. Thus, an environmental assessment of the risks of the alternative methods of disposal should consider possible future events as well as current, practical needs.

Some of the more common environmental risks are listed below.

5.3.1 Environmental impacts of disposal on banks

- Material deposited on banks can impede footpaths and public access. It may cover holes and irregularities in the ground making access dangerous.
- Thick layers of material can smother underlying vegetation, particularly grasses, which stabilise the soil. The loss of soil stability can result in slippage of sloping banks. Bare ground left after the material has decomposed is susceptible both to erosion during periods of high water and re-invasion by undesirable and troublesome weed species, such as docks, thistles or nettles.
- Plant material deposited on sloping banks below flood level can be washed or fall back into the water causing deoxygenation and blocking culverts, weirs and pumps.
- Large heaps of decomposing plant material release liquor, which can drain back into the watercourse causing deoxygenation.
- Poisonous plants left on the bank may be consumed by livestock if they have access.
- Invasive and poisonous weeds can be spread as fragments or seeds onto banks or adjacent land

- Heaps of decomposing weed can produce odours and encourage flies and other pests.

- Material deposited on banks may be damaging to native plant communities or wildlife habitats adjacent to the water body.

- Waste material may contain hedgehogs or grass snakes and their eggs. Animals may also be killed if dry material is burnt. Check heaps carefully before moving or burning.

5.3.2 Situations where disposal on banks is usually inappropriate

- Where the slope of the bank is steep or where the bank top is used for other purposes. This can include public parks, playing fields, amenity areas or gardens extending close to the water margin; public footpaths, cycle tracks and roads running along the bank top and where arable crops grow close to the bank top.

- Where rare plants or animals, which could be harmed by such disposal, grow or live on banks.

- In SSSIs, SACs, or other conservation and amenity areas where disposal would be damaging to wildlife or amenity values.

- Where the material contains poisonous, dangerous or damaging plant residues and where its presence will adversely affect local residents, livestock or wildlife.

5.3.3 Environmental impacts of depositing on agricultural land

- Transfer of material containing invasive, or noxious weed species, as seeds or fragments spreads weeds to agricultural, recreational and amenity land. The seeds of some of these weeds remain viable for many years (often greater than10) necessitating long-term control programmes to eliminate the problem.

- Large quantities of fresh plant material can impair soil fertility by altering the carbon/nitrogen ratio. Additional nitrogen might have to be applied to alleviate the problem, increasing potential run-off to water. Composting alleviates this impact.

- Heavy vehicles transporting waste material across fields can damage soil structure, field drainage and farm tracks.

- Material removed from the water before crops are harvested must be stored before it can be spread, increasing the risk of liquor, odour and pest problems.

- Disposal of aquatic and riparian plant material on agricultural land can interfere with good agricultural practice by impairing or delaying farming operations.

- Material removed from watercourses may contain non-degradable materials (plastic, wire, wood, etc) which can harm livestock and damage agricultural equipment.

- Depositing waste material on agricultural land may cause noise, odour and pollution affecting residents along the route of disposal, or adjacent to the disposal site.

- Material deposited in forest, woodland and other non-agricultural land may alter or harm existing established plant and animal communities.

5.3.4 Situations where disposal on land is usually inappropriate

- Where weed cannot be spread immediately and there is no suitable area to store material.
- On any land, especially areas of conservation value or land which is farmed organically, where there is a risk that weed species will be introduced which cannot be controlled effectively by the methods currently in practice on that land.
- Where the type of material will not rot down adequately to allow normal agricultural operations at appropriate times.
- Where the route from the harvesting site to the disposal site would cause an unacceptable transport risk or disturbance.

5.3.5 Environmental impacts of depositing weed in landfill sites

- Very large quantities of plant material could fill the limited space available in licensed landfill sites unnecessarily, thus reducing the space available for more dangerous and non-degradable materials.
- Organic material decomposing anaerobically in landfill sites adds to methane and liquor production from the sites.
- Transport (see 5.2.3).

5.3.6 Situations where disposal at landfill sites is inappropriate

- Where the distance from the harvesting site is excessive.
- Where transport using the route from the collection site to the landfill site would involve unacceptable dangers to the public, wildlife or buildings, structures and roads.
- Where savings achieved using a less expensive disposal option can be used to enhance other environmental objectives.

5.3.7 Risk assessment for landfill

The range and severity of the risks identified above can only be assessed by inspection of the local conditions which will vary from site to site and from year to year, depending on the amount and type of weed which is present. Where the potential risks of alternative methods of disposal are judged to be roughly equal, the financial cost will usually be the deciding factor. Usually, this will lead to disposal along the banks, which has been the normal long term practice and has caused relatively few problems.

6 WAYS OF REDUCING OR ELIMINATING THE AMOUNT OF MATERIAL FOR DISPOSAL

6.1 Introduction

It is sometimes possible to reduce, or even eliminate, the amount of material which has to be cut, removed and disposed of. This may become particularly important where the costs of cutting and disposing of aquatic vegetation are excessive, or where it is physically impossible to cut, remove or dispose of the material satisfactorily.

6.2 Use of Alternative Control Methods

Mechanical weed control, one of four possible control techniques, is the only one which generates material for disposal. The use of herbicides, biological control and environmental control can, in some situations, offer an effective alternative form of management which eliminates the need for weed disposal. These are described in detail in Aquatic Weed Control Best Practice Guidelines (Environment Agency, R&D Technical Report No W111).

6.3 Use of Integrated Control Techniques

Generally, communities of aquatic weeds are made up of mixed species assemblages. Sometimes, within these communities, one species or one group of weeds adds significantly to the problems of cutting, harvesting or disposing of the weed mass as a whole. Examples of particularly troublesome weed types include tall invasive weeds on banks, poisonous weeds, filamentous algae and free floating weeds such as Duckweeds. In these circumstances, it is sometimes possible to use two separate methods of control, one designed specifically to control or eradicate the weed which is causing a specific harvesting or disposal problem so that the remaining weeds can be dealt with more easily by mechanical methods. Integrated control is described more fully in Environment Agency R&D Technical Report No W111, but three examples are shown below.

- **Algal Control using barley straw.** Dense mats of filamentous algae reduce the effectiveness of weed cutting equipment and make weed collection and removal more difficult. Filamentous algae also cause disposal problems on banks and agricultural land. Barley straw effectively controls filamentous algae but has no effect on submerged or other weeds. The inclusion of barley straw into a control programme where algae form a dominant or difficult component of the plant community can facilitate cutting, removal and disposal operations.

- **Use of herbicides and cutting.** All the herbicides approved for use in or near water are selective to some degree. Where a single weed or group of weeds adds significantly to the problems of cutting, removing or disposing of the weed mass, it may be possible to use a herbicide which will control the problem species but leave the remainder of the plant community intact. For example, invasive alien bankside weeds such as Giant Hogweed or Japanese Knotweed can be controlled by spraying with glyphosate. Careful spot or localised application can be quite selective and the control of these invasive weeds allows grasses to recolonise the banks and greatly facilitates bank maintenance.

- **Biological control**. Grass carp can be used in enclosed waters, where floating weeds such as Duckweed which is extremely difficult to collect and remove mechanically, can cause serious problems. These fish will also control many submerged weeds, but have little effect on emergent weeds or larger rooted plants, such as Water-lily. The long term management of such waters can be improved by an integrated management programme combining Grass Carp with either mechanical or chemical control of the remaining weeds.

6.4 Use of Frequent Cutting Regimes

In some rivers, weed cutting boats are an effective form of control but, because of access problems along the bank or for other reasons, it may be extremely difficult to collect and remove the weed. One solution may be to increase the frequency of cutting so that the amount of cut weed generated on each occasion is sufficiently small for it to be left safely in the water to rot or to be carried out to sea. This approach is most effective and has the least risk of creating problems, where there is a fast flow and where the cut is at the lower end of the river close to the point of discharge into the sea.

The benefits of frequent cutting regimes must be balanced the increased risk of disturbance to wildlife. Site specific assessments will be required.

6.5 Use of Partial Cutting

Research by the HR Wallingford and the Centre for Aquatic Plant Management has shown that there is little benefit, in terms of reducing the hydraulic resistance of a channel, from cutting more than 80% of the channel width. The benefits of cutting more than 50% of the channel width decrease proportionally compared with the effort involved and problems of removing and disposing of the additional material generated. There are, therefore, both economic and environmental benefits from reducing the proportion of the channel which is cut. The amount of weed for disposal is reduced and at least some of the habitat for wildlife is maintained.

Where it is possible to practice partial control of weeds in channels, good practice involves:

- Leaving emergent weeds along the margins where they contribute to bank stabilisation and form an important habitat for wildlife.

- Leaving rooted floating weeds (e.g. Water-lilies) where possible as they suppress the growth of more troublesome submerged weeds and algae.

- Alternating the cut section so that different parts of the channel are cut on each occasion.

- Leaving some areas of submerged weed as a habitat.

Further details on partial or localised control are given in the New Rivers and Wildlife Handbook, Nature Conservation and the Management of Drainage Channels and in Environment Agency R&D Technical Report No W111.

APPENDIX 1 THE ENVIRONMENTAL PROTECTION ACT 1990

A1 PART II, WASTE ON LAND

THE WASTE MANAGEMENT REGULATIONS 1994

The Waste Management Licensing Regulations 1994 provide for a number of activities to be carried on without the need for a waste management licence.

1 Waste For The Benefit Of Land

The following is an extract from **Schedule 3** of the Regulations and details an exemption from licensing:.

7. (1) The spreading of any of the wastes listed in Table 2 on land used for agriculture

(2) The spreading of any of the wastes listed In Part 1 of Table 2 on-
(a) operational land of a railway, light railway, internal drainage board or the National Rivers Authority (now the Environment Agency); or
(b) land which is forest, woodland, park, garden, verge, landscaped area, sports ground, recreation ground, churchyard or cemetery.

Table 2

PART 1	*Waste soil or compost* *Waste wood, bark or other plant matter*
PART 2	*(The materials listed in Part 2 do not include aquatic plants or dredgings and are not reproduced in this document).*

(3) *Sub-paragraphs (1) and (2) above only apply if -*
(a) no more than 250 tonnes or, in the case of dredgings from inland waters, 5,000 tonnes of waste per hectare are on the land in any period of twelve months;
(b) the activity in question results in benefit to agriculture or ecological improvement;
(c) where the waste is to be spread by an establishment or undertaking on land used for agriculture, it furnishes to the Environment Agency in whose area the spreading is to take place the particulars listed in sub-paragraph (4) below apply;
(i) *in a case where there is to be a single spreading, in advance of carrying out the spreading; or*
(ii) *in a case where there is to be regular or frequent spreading of waste of a similar composition, every six months or, where the waste to be spread is of a description different from that last notified, in advance of carrying out the spreading.*

(4) The particulars referred to in sub-paragraph (3)(c) above are-

(a) The establishment or undertaking's name and telephone or fax number (if any);

(b) a description of the waste, including the process from which it arises;

(c) where the waste is being or will be spread;

(d) an estimate of the quantity of waste or, in such a case as is mentioned in sub-paragraphs (3)(c)(ii) above, of the total quantity of waste which is to be spread during the next six months; and

(e) *the location, and intended date or, in such a case as mentioned in sub-paragraph (3)(c)(ii) above, the frequency of the spreading of the waste.*

(5) Subject to sub-paragraph (6) below, the storage, at the place where it is to be spread, of any waste (other than septic tank sludge) intended to be spread in reliance upon the exemption conferred by sub-paragraph (1) and (2) above.

(6) Sub-paragraph (5) above does not apply to the storage of waste in liquid form unless it is stored in a secure container or lagoon and no more than 500 tonnes is stored in any one container or lagoon.

(7) The storage, in a secure container or lagoon (or in the case of dewatered sludge, in a secure place), of septic tank sludge intended to be spread in reliance upon the exemption conferred by sub-paragraph (1) above.

(8) In this paragraph and paragraph (8), "agriculture" has the meaning as in the Agriculture Act 1947(a) or, in Scotland, the Agriculture (Scotland) Act 1948(b).

(9) In this paragraph and paragraph 30, the "Internal Drainage Board" has the meaning given by section 1(1) of the Land Drainage Act 1991(c) and, for the purposes of definition of operational land, an Internal Drainage Board shall be deemed to be a statutory undertaker.

(10) In this paragraph and in paragraphs 8 and 10, "septic tank sludge" has the meaning given in regulation 2(1) of the sludge (use in Agriculture) Regulations 1989(d).

This exempt activity may only be carried on if:

- it is by or with the consent of the occupier of the land where the activity is carried on; or
- the person carrying on the exempt activity is otherwise entitled to do so on that land.

2 Waterway Dredging

The following is an extract from Schedule 3 of the Regulations and details an exemption from licensing:

(1) Subject to sub-paragraphs (2) and (4) below, the deposit of waste arising from dredging inland waters, or from clearing plant matter from inland waters, if either -

(a) The waste is deposited along the bank or towpath of the waters where the dredging or clearing takes place;

or

(b) The waste is deposited along the bank or towpath of any inland waters so as to result in benefit to agriculture or ecological improvement.

(2) The total amount of waste deposited along the bank or towpath under sub-paragraph (1) above on any day must not exceed 50 tonnes for each metre of the bank or towpath along which it is deposited.

(3) Sub-paragraph (1) does not apply to waste deposited in a container or lagoon.

(4) Sub-paragraph (1)(a) above only applies to an establishment or undertaking where the waste deposited is the establishment or undertaking's own waste.

(5) The treatment by screening or dewatering of such waste as is mentioned in sub-paragraph (1) above -

(a) *on the bank or towpath of the waters where either the dredging or clearing takes place the waste is to be deposited, prior to it being deposited in reliance upon the exemption conferred by the foregoing provisions of this paragraph;*

(b) *on the bank or towpath of the waters where the dredging or clearing takes place, or at a place where the waste is to be spread, prior to its being spread in reliance upon the exemption conferred by paragraph 7(1) or (2); or*

(c)prior to its being spread in reliance upon the in the case of waste from dredgings, on the bank or towpath of the waters where the dredging takes place, or at a place where the waste is to be spread, exemption conferred by paragraph 9(1).

This exemption does not apply if the activity involves Special Waste (as defined by the Special Waste Regulations 1996).

3 Composting Waste

The following is an extract from Schedule 3 of the Regulations and details an exemption from licensing:

12 (1) *Composting biodegradable waste at the place where the waste is produced or where the compost is to be used, or at any place occupied by the person producing the waste being composted at that place at any time does not exceed -*

(a) *in the case of waste composted or to be composted for the purposes of cultivating mushrooms, 10,000 cubic metres; and*

(b) *in any other case 1,000 cubic metres*

(2) *The storage of biodegradable waste which is to be composted if that storage is at the place where the waste is produced or is to be composted.*

(3) *In this paragraph, "composting" includes any other biological transformation process that results in materials which may be spread on land for the benefit of agriculture or ecological improvement.*

This exemption does not apply if the activity involves special waste (as defined by the Special Waste Regulations 1996).

4 Guidance Notes which apply to all three activities listed above

You are advised that it will, however, still be an offence under Section 33(1)(c) of the Environmental Protection Act 1990 to:

> *treat, keep or dispose of controlled waste in a manner likely to cause pollution of the environment or harm to human health.*

The exempt activity must be consistent with the need to attain the following objectives (from the Waste Framework Directive);

> *"Ensure that waste is recovered or disposed of without endangering human health and without using processes or methods which could harm the environment and in particular without:*
>
> (i) *risk to water, air, soil, plants or animals; or*
> (ii) *causing nuisance through noise or odours; or*
> (iii) *adversely affecting the countryside or places of special interest."*

It is an offence for an establishment or undertaking to carry on an exempt activity without being registered.

The following information will be held by the registration authority and will be open to inspection by members of the public:

(a) *The name and address of the establishment or undertaking.*
(b) *The activity which constitutes the exempt activity; and*
(c) *The place where the activity is carried on.*
(d) *(in the case of disposal of waste for the benefit of land) the information required in accordance with paragraph 7(3) and 7(4).*

YOU ARE ADVISED THAT ANY ESTABLISHMENT OR UNDERTAKING CARRYING OUT THE RECOVERY OR DISPOSAL OF CONTROLLED WASTE SHALL BE SUBJECT TO APPROPRIATE PERIODIC INSPECTIONS BY THE ENVIRONMENT AGENCY.

For further information contact your local Environment Agency Waste Regulation Unit. The address can be obtained by calling 0645 333111.

APPENDIX 2 BIBLIOGRAPHY

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