Environmental Protection
Final Draft Report

MANUAL FOR THE USE OF HERBICIDES IN OR NEAR WATER

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MANUAL FOR

THE USE OF HERBICIDES

IN OR NEAR WATER

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Appendices

THE USE OF HERBICIDES IN OR NEAR WATER

1. INTRODUCTION

With comprehensive legislation now in force, the National Rivers Authority - South West Region (NRA-SW), has statutory obligations which at all times must be observed. It is required under the Food & Environmental Production Act (FEPA), 1985 to protect the health of human beings, of creatures and of plants; to ensure the safe, efficient and humane ways of controlling pests and to take all positive steps to safeguard the environment. The Wildlife and Countryside Act, 1981 aims to protect wild plants, animals and their habitats from accidental or purposeful destruction or disturbance, so requiring NRA-SW to further the conservation of fauna and flora. Areas of conflict may thus arise when it becomes necessary for NRA-SW to determine internal and external applications for the control and growth of plants.

The purpose of this document is firstly to define those procedures which must be followed when chemical control is considered necessary and, secondly, to provide the relevant technical information on those herbicides which, under current legislation, are approved for safe use in or near water. (Appendices 1 - 3; 5 & 9).

2. METHODS OF CONTROLLING PLANTS

The old laborious but traditional methods of hand-cutting and raking-out have now been almost entirely superceded by the use of mechanical equipment. This ranges from mechanical cutters and flails to weed cutting boats and dredgers of which there are many different types and makes on the market.

Biological methods such as the planting of trees to provide shade are mostly long term in effect but are often useful as an adjunct to other methods. Sheep and cattle are sometimes used in arable areas to keep down reeds, grasses and hedges but bank damage may result from poaching and some form of fencing is invariably required. More recently, the experimental use of grass carp has been investigated by some authorities but with very variable results.

Chemical control has many advantages over other methods but inevitably, doubts do and will continue to exist over the long term environmental effects of using herbicides. Careful consideration must therefore be given to the most suitable method for each individual situation and any alternative to using chemicals should not be lightly dismissed.

There is no one single technique suitable for all circumstances. Thus, when control becomes necessary, the most appropriate method or combination of methods should be selected. Those most likely to be used are mechanical or manual cutting, chemical control or a combination of both.

3. CHEMICAL CONTROL

Vegetation requiring control will normally be growing either in or out of the water, on waterway banks and possibly elsewhere. The procedures outlined herein could also be used when dealing with algal problems in reservoirs.

Whenever the use of herbicides is decided, the procedures outlined in Section 6 of this document must be followed. The involvement at an early stage of the Environmental Protection Section is essential in order that the Section may perform its required function of assessing the environmental impact of any proposed operations.

4. THE CONTROL OF PESTICIDES REGULATIONS 1986

These regulations, which came into force in October 1986, replaced and now embrace the old Pesticides Safety Precautions Scheme (PSPS) which was responsible for safety and the Agricultural Chemicals Approval Scheme (ACAS) which covered efficacy. The current regulations define very closely the types of product included under FEPA and list prohibitions on those who advertise, sell, supply, STORE and USE pesticides. Under these regulations:-

* No product may be supplied, STORED or USED unless it has been given provisional or full approval covering both safety and efficacy.

Note:- Appendix 3 lists the products approved for use in or near water. Manufacturers addresses are listed in Appendix 4.

* EVERYONE MUST COMPLY WITH THE CONDITIONS OF APPROVAL in respect of which each product is restricted to a particular formulation and to specific uses and conditions of use. These embrace both the label and the container in which that product is sold.

* For ALL USERS there is a POSITIVE REQUIREMENT to take all reasonable precautions to protect the health of human beings, of creatures and plants; to safeguard the environment and, in particular, to avoid the pollution of water.

* All label recommendations must be observed together with any guidance relating to safe handling and use.

* Only 'listed' adjuvants and tank mixes may be used.

* Stipulated protective clothing MUST BE WORN.

* A register of all pesticide applications must be maintained and kept for a minimum of three years.

* All users of pesticides (excepting home gardeners) must have received adequate instruction and guidance in the efficient, safe and humane use of pesticides and MUST BE COMPETENT to perform the duties required of them.

Note:- The Code of Practice (Appendix 12) relating to the Agricultural and Commercial Horticultural use of pesticides states specifically that the 'use' of pesticides is not merely restricted to the application of a substance but that the person making decisions about application is also defined as a user. Employers thus have a particular responsibility to ensure that by means of thorough and adequate training, all decision makers, in addition to those who oversee and actually apply herbicides reach the required standard of competence.

* As of 1 January 1989 all persons applying pesticides to land or water which is not the property of themselves or their employers must hold a certificate of competence unless they work under the direct supervision (i.e. within eyesight)of a certificate holder. Furthermore, all persons born after 31 December 1964, irrespective as to where they are working, must hold a certificate of competence unless working under the direct supervision of a certificate holder.

Pesticides Approved under the Control of Pesticides Regulations are listed in 'Reference Book 500' (the Blue Book). This is published annually by MAFF/HSE, and may be obtained from HMSO bookshops or Accredited Agents (see Yellow pages). Approved pesticides are also listed in 'The U K Pesticide Guide" published annually by BCPC Publications. Refer Appendix 12.

A Code of Practice for the Agricultural and Commercial Horticultural Use of Pesticides has been published by MAFF and is applicable to the use of aquatic herbicides. It also covers the safe disposal of unwanted pesticides and containers. Refer Appendix 12.

A further Code of Practice, 'Guidelines for the Use of Herbicides on Weeds in or near Watercourses and Lakes' is published by MAFF and relates specifically to the use of aquatic herbicides. Refer Appendix 12.

The Water Resources Act 1991 provides for the control of polluting matter and effluents into water. Section 97 of the Act contains reference to good agricultural practice and a Code approved by the Minister of Agriculture, Fisheries and Food. Refer Appendix 12.

5. SELECTION OF HERBICIDES

Guidelines to assist the user in the selection of the most appropriate herbicide for any particular situation are contained in Appendices 1 and 2.

Herbicides for the control of aquatic and bankside plants are approved for safe use in or near water; the term 'near water' being taken to mean a watercourse, bank, or land of sufficient proximity to a waterbody as to drain either directly or indirectly into it.

For land situated well away from waterbodies, there is the further choice of a much wider range of herbicides approved for use in non-crop situations. These are listed in the 'Amenity' and 'Total Vegetation Control' sections of the annual BCPC UK Pesticides Guide.

For either situation, the Water Quality Planner will only recommend or endorse the use of those approved products as listed in 'Reference Book 500'.

6. THE USE OF HERBICIDES TO CONTROL PLANTS

6.1 Control in or near watercourses including the use of herbicides in locations where there might be a risk of contaminating water supplies

The main NRA-SW requirement for the control of vegetation in this category is for land drainage and operational purposes. For land drainage, the areas requiring treatment would probably be in watercourses, in adjacent flood relief channels or on watercourse banks.

The sites described are not the only ones where contamination of watercourses or of water supply could occur and each proposed use of a herbicide must be considered with contamination in mind. If there is any doubt, the Water Quality Planner must be consulted.

The procedures laid down in the following paragraphs must be adopted as soon as it is proposed to use herbicides in any such location. This would normally be during the growing season of the year before the intended treatment so as to ensure the accurate identification of the plants to be treated, the correct selection of herbicide and its correct time of application.

6.6.1 Notification by NRA-SW Region

Those in the River Engineering Department responsible for planning vegetation control in or near watercourses should send written notification of any proposed herbicide use. This should include brief details of site location; the approximate timing of intended treatment; the herbicide it is proposed to use; the amount to be used and the volume of water or area to be treated. Use the form entitled 'Notification of a proposed use of Herbicide' (Appendix 6) and send this to the Water Quality Planner well in advance (at least two weeks) of the proposed treatment. Appendices 10 and 11 list some common abbreviations and conversion tables which may be useful in the calculation of the quantities of chemical required.

6.1.2 Consideration

The Water Quality Planner will then consider the proposal by:-

i) Identifying the plants in the area to be treated - Conservation may be able to assist.

ii) Confirming that the proposed herbicide is appropriate and, if necessary, recommending an alternative product/non chemical method.

iii) Arranging consultation with all other interested parties including English Nature.

Note:- English Nature is the official body which promotes nature conservation in Great Britain by providing advice to the Government and all others whose activities may affect wildlife and wild places. They have powers to select, establish and manage National Nature Reserves (NNR's). It can also designate Sites of Special Scientific Interest (SSSI's) selected on account of their flora, fauna, geological or physiological features.

6.1.3 Decision

Once in possession of all the relevant information, the Water Quality Planner will either:-

a. Give his written consent by signing the application form to the proposal as submitted (see Appendix 6). He/she may impose certain conditions relating to the technique of application.

b. Give written consent to the use of a herbicide but suggesting an alternative product to that originally proposed.

c. State any objections to the use of chemicals in that location, giving reasons for such objections.

Where permission is granted, THE USER MUST THEN ARRANGE TO NOTIFY ALL RIPARIAN OWNERS WHO MAY BE IMMEDIATELY AFFECTED BY THE PROPOSAL i.e. stock owners, abstractors for overhead irrigation etc.

Any disagreement regarding the decision may be referred to the Regional General Manager.

6.1.4 Completion

If the Water Quality Planner or a member of his staff was not present when the herbicide was applied, the user should then inform the Water Quality Planner of the actual date of treatment, the quantity of chemical(s) used and the area/volume of water treated.

The Water Quality Planner or a member of his staff may wish to visit the site after treatment in order to evaluate the efficacy and environmental impact of the treatment.

6.1.5 Repeat Applications

If treatment is approved and it becomes necessary to repeat the application, the user should notify the Water Quality Planner in writing giving the proposed date of the repeat application. Based on the experience of the previous application and taking into account any subsequent changes at the site, the Water Quality Planner will then consider re-application but REPEAT APPLICATIONS MUST NOT TAKE PLACE UNTIL PERMISSION IS GRANTED.

6.2 Control Away from Watercourses

Where it is proposed to use a herbicide at a location away from a watercourse, prior notification will be necessary and reference should be made to Section 6.1 above.

Where there is no risk of contaminating supplies of drinking water, the use of herbicides away from watercourses will not require the detailed consultative measures which are needed for sites in or near watercourses. However, the essentials of the procedure should be adhered to in order that accurate records, now a legal requirement, are properly maintained and so that the efficacy of treatments can be monitored and assessed.

6.2.1 Notification

Whenever at any particular location the application of a herbicide away from a watercourse is desired, the user must complete the simplified yellow form (Appendix 7) and send this to the Water Quality Planner at least 14 days in advance of the proposed treatment. This will then enable the Water Quality Planner to monitor and assess the particular herbicides most commonly being used by NRA-SW and their amounts.

Should repeat applications of the same herbicide during the same growing season and at the same location become necessary, no further consultation is necessary PROVIDING the original application was effective and did not cause any problems. The user is simply required to submit details of the date(s) and quantities used on the appropriate form (see Appendix 7).

7. Notification by Outside Bodies

From time to time NRA-SW is asked by an outside body to agree the use of a particular herbicide in the aquatic environment. The Water Resources Act provides the NRA-SW with strengthened powers to prevent the pollution of rivers, groundwaters, lakes, ponds and tidal waters.

If it is the intention of an outside individual or body to use a herbicide in or near water and that water either enters into or forms part of a river system, should the water harbour fish or be used for amenity, recreation or crop irrigation, or if the intended use is to a waterbody where water is abstracted for public supply, the NRA-SW **WRITTEN** agreement **MUST** be obtained **BEFORE** any herbicide may be applied.

Warnings are always given to potential users of the possible legal consequences of causing pollution, or adversely affecting fish and other forms of aquatic life or of adversely affecting the ecology of other fauna and flora. The attention of outside individuals will also be drawn to the legal requirement that all applicants must have received adequate training in order that they be fully competent in the use and application of aquatic herbicides.

All external enquiries received by other sections within NRA-SW should be forwarded to the Water Quality Planner who will deal with them in a similar manner to that of internal enquiries by appropriate consultation with individuals both within and outside the Authority.

The appropriate officers are as follows:-

Conservation Officer

Fisheries Controller

Pollution Controller

Water Resources Planner

8. Records

Keeping track of pesticides can save both time and money by avoiding overstocking and by ensuring there is always available an adequate stock of products intended for use. They provide essential information for emergency services and, under the Control of Pesticides Regulations, are now a legal requirement. Records also serve as a useful check on the performance and results of chemical treatment. They should be kept for a minimum of three years. Refer Appendix 8 for the appropriate forms.

9. Health and Safety Aspects

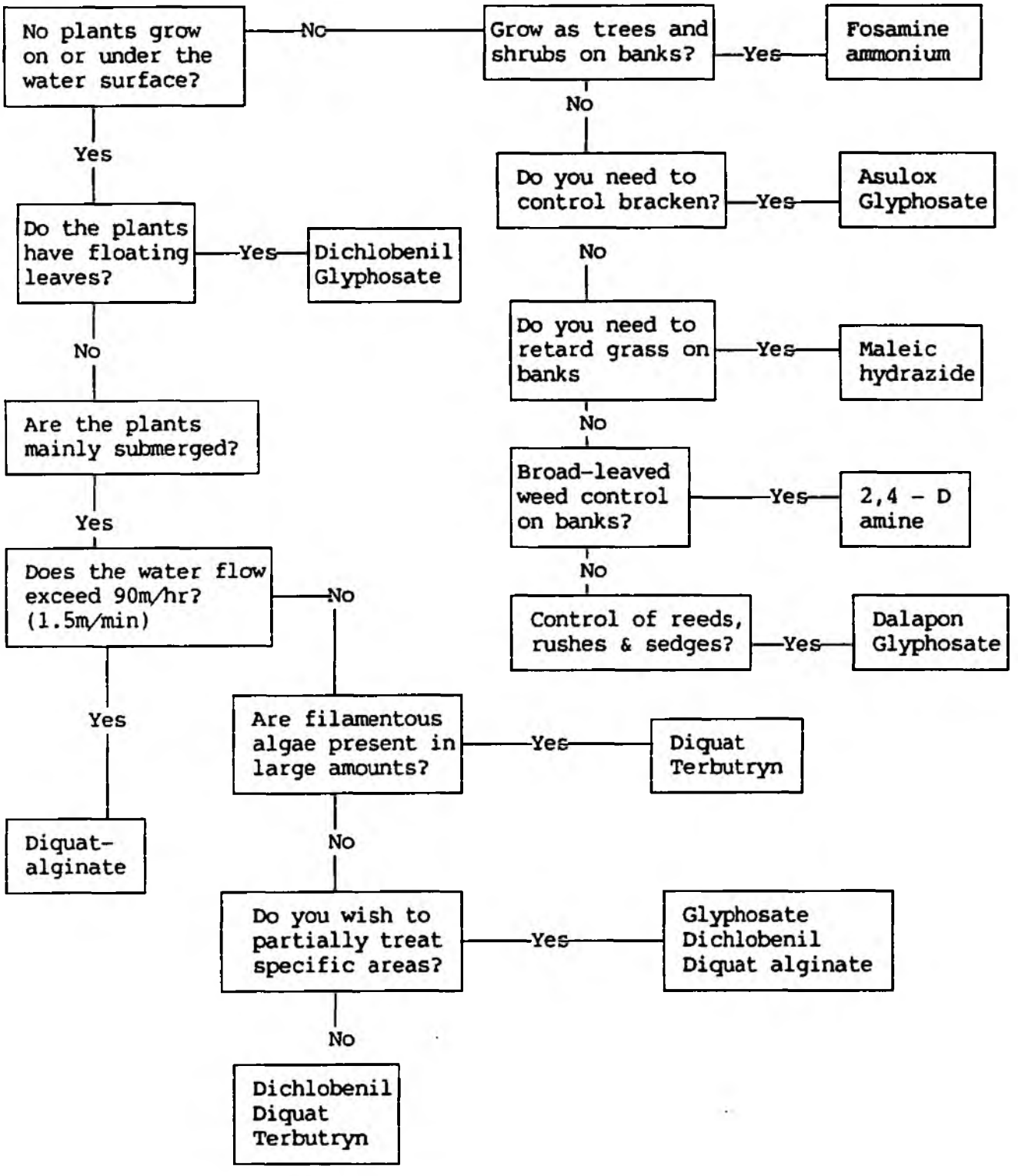
The Health and Safety at Work Act 1974 places legal responsibilities on both employers and employees. It covers such aspects as ensuring the safe use, handling, transport and storage of chemicals, the provision of the correct protective clothing and of providing adequate instruction and supervision.

Within the Authority, this is the responsibility of local management. Any advice given by the Water Quality Planner is on the strict understanding that there would be no infringement of the pertinent legislation and that safe systems of work will be followed on every occasion. (Advice will be given by the Health and Safety Adviser).

Appendix 1

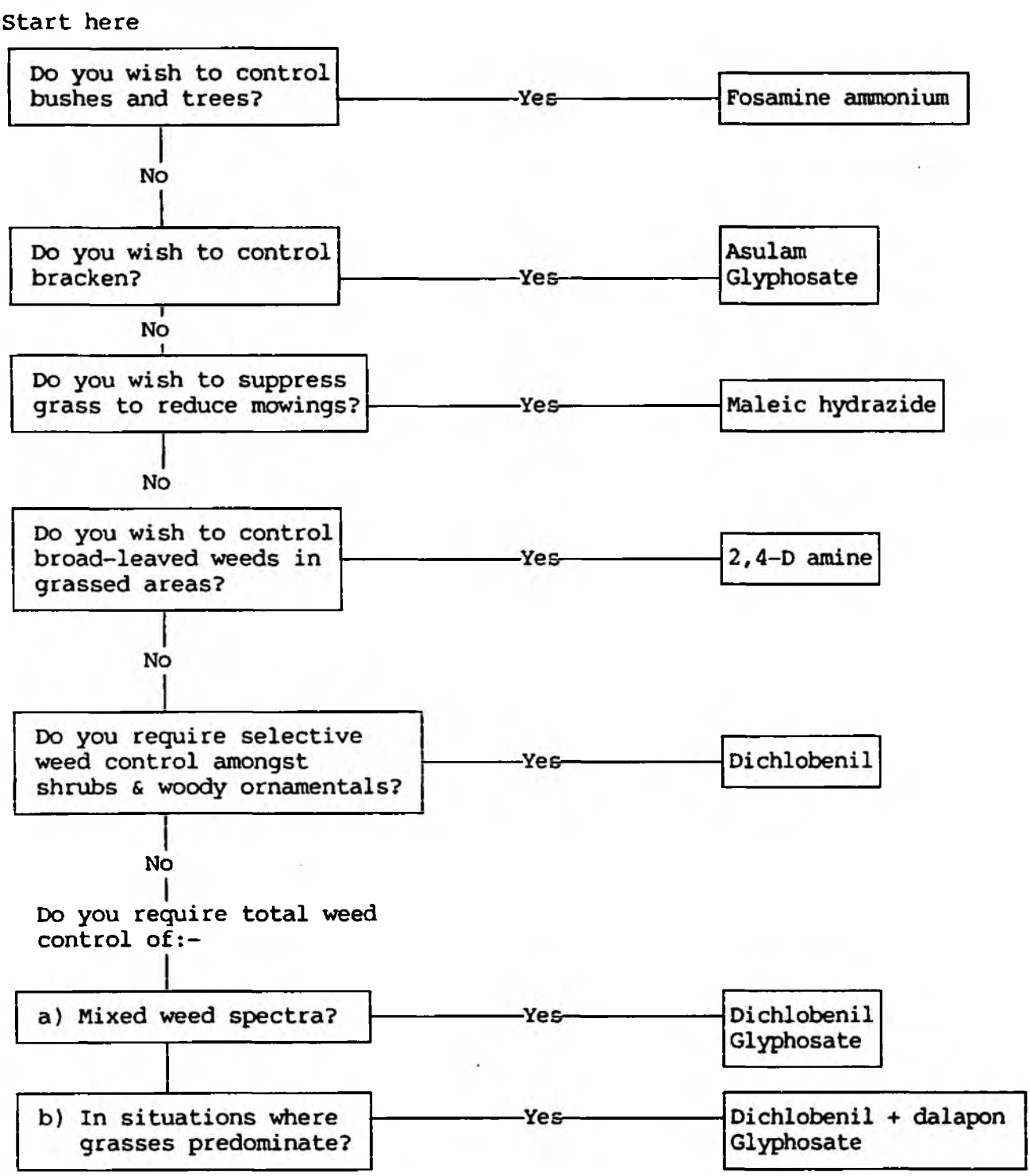
A GUIDE TO THE CHOICE OF HERBICIDES APPROVED FOR USE IN OR NEAR WATER

Start here



Appendix 2

HERBICIDES APPROVED FOR USE IN OR NEAR WATER WHICH ARE ALSO APPROVED AND CARRY LABEL RECOMMENDATIONS FOR TERRESTRIAL WEED CONTROL IN AMENITY AND INDUSTRIAL AREAS



Appendix 3

PRODUCTS APPROVED FOR USE IN OR NEAR WATER

Chemical	Controls	Irrigation interval	Product	Manufacturer
Asulam	Docks & bracken	Nil	Asulox	Embetec
2,4-D amine	Emergent broad-leaved weeds on banks	3 weeks	Atlas 2,4-D Dormone	Atlas RP Environ
Dalapon	Reeds, rushes, grasses & sedges	5 weeks	BH dalapon	RP Environ
Dalapon + dichlobenil	Grasses near water	N/A	Fydulan	Chipman
Dichlobenil	Submerged & some floating weeds	2 weeks	Casoron G Casoron GER	ICI
Diquat	Some floating & submerged weeds & algae	10 days	Regione 40	ICI
Diquat alginate	Submerged weeds in flowing water	10 days	Midstream	ICI
Fosamine ammonium	Deciduous trees & shrubs on banks	Nil	Krenite	Selectokil
Glyphosate	Reeds, rushes, grasses, sedges, water lilies	Nil	Roundup Roundup Spasor Mascot Sonic	Monsanto Schering RP Environ Rigby Taylor
Maleic hydrazide	Suppression of grass on banks	3 weeks	Bos MH 180 Regulox K	Bos RP Environ
Terbutryn	Algae & some floating & submerged weeds	7 days	Clarosan 1FG	Ciba-Geigy

Appendix 4

MANUFACTURERS/SUPPLIERS OF HERBICIDES APPROVED FOR USE IN OR NEAR WATER

Atlas: Atlas Interlates Ltd
Fraser Road, ERITH
Kent DA8 1PW
(03224) 32255

Bos: Bos Chemicals Ltd
Paget Hall, Tydd St Giles
WISBECH, Cambs PE13 5FL
(0945) 870014

Chipman: Chipman Ltd
HORSHAM Sussex RH12 2NR
(0403) 60341/5

Ciba-Geigy: Ciba-Geigy Agrochemicals
WHITTLESFORD Cambridge
CB2 4QT
(0223) 833621

Embetec: Embetec Crop Production Ltd
Regent House, Hubert Road,
BRENTWOOD Essex
(0277) 225886

ICI: ICI Professional Products
Woolmead House East
Woolmead Walk, FARNHAM
(0252) 733919

Monsanto: Monsanto Agricultural Co
Thames Tower, Burleys Way,
LEICESTER LE1 3TP
(0533) 20864

RF Environ: Rhone Poulenc
Environmental Products
Regent House, Hubert Road,
BRENTWOOD, Essex
CM14 4TZ
(0277) 261415

Rigby Taylor: Rigby Taylor Ltd
Rigby Taylor House
Garside Street, BOLTON
Lancs BL1 4AE
(0204) 349888

Schering: Schering Agricultural
Nottingham Road
Stapleford, NOTTINGHAM
NG9 8AJ
(0602) 390202

Selectokil:
Selectokil Ltd
Abbey Gate Place
TOVIL Maidstone
Kent
(0622) 55471

Appendix 5

HERBICIDES APPROPRIATE FOR THE CONTROL OF AQUATIC PLANTS WHICH COMMONLY OCCUR IN THE SOUTH WEST REGION

		2,4-D AMINE	DALAPON	GLYPHOSATE	DICHLOBENIL	DIQUAT	TERBUTRYN
EMERGENT NARROW-LEAVED PLANTS							
Carex spp	Sedges		/	/			
Eleocharis spp	Spike-rushes			/			
Equisitum spp	Horsetails				/		
Iris pseudacorus	Yellow Iris			/			
Juncus spp	Rushes			/			
Phalaris arundinacea	Reed Canary-grass		/	/			
Phragmites communis	Common Reed		/	/			
Schoenopletus lacustris	Common Club-rush			/			
Sparganium erectum	Bur-reed		/	/			
Typha latifolia	Bulrush		/	/			
EMERGENT BROAD-LEAVED PLANTS							
Alisma plantago-aquatica	Water-plantain	/			/		
Apium nodiflorum	Fool's Water-cress	/		/	/		
Lycopus europaeus	Gipsywort			/	/		
Lythrum salicaria	Purple-loosestrife	/		/	/		
Mentha aquatica	Water Mint			/	/		
Myosotis caespitosa	Water Forget-me-not			/	/		
Rorippa spp	Water-cresses	/		/	/		
Veronica spp	Speedwells			/	/		

Appendix 5 (Contd)

HERBICIDES APPROPRIATE FOR THE CONTROL OF AQUATIC PLANTS WHICH COMMONLY OCCUR IN THE SOUTH WEST REGION

		2,4-D AMINE	DALAPON	GLYPHOSATE	DICHLOBENIL	DIQUAT	TERBUTRYN
FLOATING PLANTS							
Glyceria fluitans	Sweet-grass				/		
Lemna spp	Duckweeds			/		/	/
Nuphar lutea	Yellow Water-lily			/	/		
Nymphaea alba	White Water-lily			/	/		
Polygonum amphibium	Amphibious Bistort				/		
Potamogeton natans	Broad-leaved Pondweed				/		
Ranunculus spp	Water-crowfoots					/	/
SUBMERGED PLANTS							
Callitriche spp	Water-starworts				/	/	/
Ceratophyllum spp	Hornworts					/	/
Chara spp	Stoneworts				/		
Elodea spp	Canadian Waterweeds				/	/	/
Myrtopyllum spp	Water-milfoils				/	/	/
Potamogeton spp	Pondweeds				/	/	/
FILAMENTOUS ALGAE							
Cladophora spp	Cott					/	/
Enteromorpha intestinalis	Bladderweed					/	/
Hydrodictyon	Cott					/	/
Rhyzoclonium spp	Cott					/	/
Spirogyra	Cott					/	/
Vaucheria spp	Cott					/	/
Zygnema	Cott					/	/

Appendix 6

NOTIFICATION OF A PROPOSED USE OF HERBICIDE IN OR NEAR A WATERCOURSE (INCLUDING DRINKING WATER SUPPLIES)

RIVER CATCHMENT (EXE, DART, FOWEY, ETC) .....

Applicant Name (Company or Individual) .....

Address ..... Telephone No. .....

.....

.....

Location of Application (Site Name) .....

NATIONAL GRID REFERENCE .....

IS THE SITE (please tick appropriate box)

i)	In a Watercourse.	☐
ii)	Adjacent to a Watercourse.	☐
iii)	On-stream Pond.	☐
iv)	Off-stream Pond with no Discharge.	☐
v)	Off-stream Pond with Discharge to Watercourse.	☐

Will the Discharge be Stopped Following Application Yes/No Time Period .....

Plant(s) to be Controlled .....

Chemical Proposed (inc. Trade Name) .....

Area/Volume to be Treated ..... Quantity Proposed .....

Proposed Date of Treatment .....

Precautions which will be Taken .....

.....

.....

Send to M R N Newton, Freshwater Officer, NRA SW, Manley House, Kestrel Way, Exeter EX2 7LQ Tel: (0392) 444000.

Applicant Signature .....

Date .....

NRA Comments ..... NRA Approval .....

....

Appendix 7

NOTIFICATION OF A PROPOSED USE OF HERBICIDE AWAY FROM WATERCOURSES

User: Post:

Department/Section: Telephone:

Location/Name of Site: National Grid Ref:

Description of Site:

General nature of plants:

Chemical proposed (inc. Trade name):

Quantity proposed: Area to be treated:

Proposed date of treatment:

First application or repeat ?

Send to: B MILFORD, WATER QUALITY PLANNER, NRA SW, MANLEY HOUSE, KESTREL WAY, SOWTON EXETER EX2 7LQ

Signed.....

Date.....

Appendix 8

IMPORTANT

In granting you permission to
use .....
.....
at .....
we draw your attention to the Control of Pesticides Regulations, 1986. This stipulates that all users of aquatic herbicides must have received adequate instruction and guidance in the efficient, safe and humane use of pesticides and that those applying aquatic herbicides MUST, AFTER HAVING BEEN TRAINED, BE COMPETENT in undertaking such operations. Furthermore, for all users, there is a POSITIVE REQUIREMENT to take all reasonable precautions to protect the health of human beings, of creatures and of plants; to safeguard the environment and, in particular, to avoid the pollution of water.

THESE ARE LEGAL REQUIREMENTS WHICH CARRY VERY SEVERE PENALTIES IF THEY ARE IN ANY WAY TRANSGRESSED OR IF THEY ARE NOT FULLY OBSERVED.

Appendix 9

RECORD SHEET

Location/Name of site: National Grid Ref:

Date of treatment/re-treatment:

Reason for use - Tick as relevant:

Control of:- Emergent monocots/Floating/Submerged/Algae/Bankside plants

Other areas

Details of material(s) used:

Product name (as given on container label):

Application rate:	kg/ha	l/ha
Total amount used:	kg/l	
Area of water/bank/land treated:		ha
Water depth (when applicable):		mm

Water flow - still/sluggish/slow/medium/fast:

Weather conditions at application:

Name of operator: Division:

Remarks/Effect of treatment:

Note: If two products were mixed together (i.e. 2,4-D amine + maleic hydrazide), record the details of each product separately and indicate in 'remarks' that they were mixed and used together.

Appendix 10

TECHNICAL SPECIFICATION OF HERBICIDES APPROVED FOR USE IN OR NEAR WATER

The herbicides listed on the following pages have been approved by the Government for use in or near water.

The data accompanying each chemical have been selected to give a preliminary guide to the physical, biological and toxicological properties of the chemicals. These data are by no means exhaustive and manufactuers' labels and technical literature along with published works should be consulted if more information is required.

Notes:

1. 1 g/m^3 = 1 ppm = 2.7 lb/acre/ft.depth. Applies to active ingredient only.

2. LD_{50} is the dose required to kill 50% of the test animals.

3. LC_{50} is the concentration in water required to kill 50% of the test animals. In the case of fish toxicity, the LD_{50} value should be qualified by the time of exposure i.e. 24, 48 or 96 hours and the experimental conditions of the test e.g. hardness of water and whether static or continuous replacement of test solution.

4. The quantity of active ingredient in a formulation is expressed as weight per volume (w/v) in the case of liquid formulations and weight per weight (w/w) in the case of solid formulations.

5. The concentration of herbicides in water refers to the active ingredient unless otherwise stated.

6. Where the entry against 'Application' is 'To foliage' the herbicide is applied as a spray directly onto emergent or floating leaves, which should be dry at the time.

ASULAM

Type:		Bracken, docks and certain broad - leaved weeds.
Suitable for:		Aquatic weeds.
1.	Formulation:	Aqueous solution containing 40% w/v active ingredient.
2.	Application:	To foliage.
3.	Flow rate limitations:	Flow rates are irrelevant since the spray is applied to the foliage.
4.	Flow control:	Not applicable (see 3).
5.	Dose:	4.4 kg/ha - active ingredient. 11 l/ha - product.
6.	Maximum permitted water concentration under PSPS:	1 mg/l active ingredient.
7.	Timing of application	June to September, preferably at full frond development.
8.	No of applications anticipated per season:	One.
9.	Minimum interval between treatment and use of water for irrigation:	None specified.
10.	Taint data:	Not available.

11.	Toxicological data:	Acute oral LD_{50} rat 5000 mg/kg LD_{50} fish - rainbow trout 5000 mg/l (96h) channel catfish 5000 mg/l (96h) LC_{50} invertebrate fauna - Lymaea app 17,000 mg/l Gammarus spp 17,000 mg/l Chronomid larvae 31,600 mg/l Tubificid worms 31,600 mg/l.
12.	Special instructions to operators:	None.
13.	Protective clothing requirements:	
	(a) handling concentrate	Normal hygiene precautions.
	(b) during application	Normal hygiene precautions.
14.	Trade name of product	Manufacturer/Distributor.
	Asulox	Embetec.
15.	MAFF No	00122.
	Restrictions:	For recommended use, none.
	Comments:	Can give control for up to 3 years.

2,4-D AMINE

Type:		Translocated foliar/root herbicide Distorte new growth.
Suitable for:		Broad leaved weeds on banks and some emergent reeds.
Unsuitable for:		Grasses.
1.	Formulation:	Solution of amine salt containing 50% w/v active ingredient.
2.	Application:	To foliage.
3.	Flow rate limitations:	Flow rates are irrelevant since the spray is appied to the foliage.
4.	Flow control:	Not applicable (see 3).
5.	Dose range:	1.4 - 4.5 kg/ha - active ingredient. 4.5 - 9.0 1/ha - product.
6.	Maximum permitted water concentration under PSPS:	5 mg/1.
7.	Timing of application:	May to September, but most effective when used early on fast growing weeds.
8.	No of applications anticipated per season:	One.
9.	Minimum interval between treatment and use of water for irrigation:	Three weeks or until the concentration in water is below 0.05 m/1 active ingredient.

Continued.....

10.	Taint data:	May be detected at 0.001mg/l active ingredient after the normal chlorination process
11.	Toxicological data:	Acuteoral LD_{50} rat 400 mg/kg LC_{50} fish - rainbow trout 250 mg/l (24 b) LC_{50} invertebrate fauna - Daphnia magna 100 mg/l (25 h).
12.	Special instructions to operators:	Wash concentrate from skin or eyes immediately.
13.	Protective clothing requirements:	
	(a) handling concentrate	Normal hygiene precautions.
	(b) during application	Normal hygiene precautions.
14.	Trade names of products	Manufacturers/Distributors.
	Atlas 2,4-D	Atlas
	Dormone	RP Environ.
15.	MAFF No	03052 Atlas 00751 RP Envron.
	Restrictions:	At 0.001 mg/l active ingredient can taint and colour water after chlorination. Not to be used where any risk to potable water supply.

DALAPON

Type:		Translocated herbicide which is absorbed through leaves.
Suitable for:		Control of emergent vegetation of grass family.
Unsuitable for:		Algae, floating and submerged plants.
1.	Formulation:	Soluble or wettable powders containing 85% w/w active ingredient.
2.	Application:	To foliage.
3.	Flow rate limitations:	Flow rates are irrelevant since the spray is applied to the foliage.
4.	Flow control:	Not applicable (see 3).
5.	Dose range:	19–47 kg/ha (active ingredient) 20–66 kg/ha product.
6.	Maximum permitted water concentration under PSPS:	30 mg/l active ingredient.
7.	Timing of application:	Spring to late summer.
8.	No of applications per season:	One.
9.	Minimum interval between treatment and use of water for irrigation.	Five weeks or until concentration in water is below 0.3 mg/l active ingredient.
10.	Taint data:	Not available.

Continued.....

11.	Toxicological data:	Acuteoral LD_{50} rat 7575-9330 mg/kg LC_{50} fish - harlequin 222-300 mg/l (24 h) rainbow trout 252-340 m/l (24 h) LC_{50} invertebrate fauna - brown shrimp 100 mg/l Daphnia 16 mg/l (48 h).
12.	Special instructions to operators:	Dalapon is irritating to the eyes and skin. Remove heavily contaminated clothing immediately. Wash splashes from skin or eyes immediately.
13.	Protective clothing requirements:	
	(a) handling concentrate	Normal hygiene precautions (but see 12 above).
	(b) during application	Normal hygiene precautions.
14.	Trade names of products	Manufacturers/Distributors.
	B H Dalapon	R P Environ.
15.	MAFF No	03047.
	Restrictions:	Could damage bulb crops.
	Comments:	Some formulations are appropriate for full aquatic use. Others are recommended for treating plants which have invaded agricultural land.

DICHLOBENIL

Type:		Resistant soil-acting herbicide affecting growing points of roots and shoots. Powerful inhibitor of germination and of actively dividing meristems.
Suitable for:		Rooted submerged or rooted emergent broad-leaved weeds.
Unsuitable for:		Narrow-leaved weeds and free floating rootless weeds or algae.
1.	Formulation:	Granule containing 20% (Casoron GSR) or 6.75% w/w (Casoron G) active ingredient.
2.	Application:	Direct to water.
3.	Flow rate limitations:	Still water Slow flowing water up to 90 m/hour.
4.	Flow control:	If possible, flow should be stopped for seven days after treatment.
5.	Dose:	1 g/m^3 - 2 g/m^3 - active ingredient 50 - 100 KG/ha/m depth) 45 Kg/ha/30 cm depth) product.
6.	Maximum permitted water concentration under PSPS	3 mg/1 active ingredient. Normally apply at 1 mg/1 active ingredient.
7.	Timing of application:	Early spring. In still water: use as soon as weed growth commences (late March/early April) to minimise effects of decaying weeds later. Slow moving waters: apply in May.
8.	No of applications anticipated per season:	One.
9.	Minimum interval between treatment and use of water for irrigation:	Four weeks or until concentration in water is below 0.3 mg/1 active ingredient.
10.	Taint data:	Threshold odour concentration 0.02 mg/1 active ingredient - unaffected by Chlorination.

Continued.....

11. Toxicological data: Acute oral LD_{50} rat 3,160 mg/kg
LC_{50} fish - harlequin 16-8 mg/l (24-96 h)

Anguilla Japonica 32-10 mg/l (24-48 h)

LC_{50} invertebrate fauna - Daphnia magna 9.8 mg/l (26 h).

12. Special instructions to operators: None.

13. Protective clothing requirements:

(a) handling concentrate Normal hygiene precautions.
(b) during application Normal hygiene precautions.

14. Trade names of products Manufacturers/Distributors.

Casoron G (contains 6.75% dichlobenil) ICI Professional Products.

Casoron GSR (contans 20% dichlobenil) ICI Professional Products.

15. MAFF No 00448 Casoron G
00451 Casoron GSR.

Restrictions: Dichlobenil has a low safety factor for fish acute toxicity and is accumulated in fish tissues. If a second treatment is required allow at least six month interval to avoid overdose through persistence of residues. If fish are known to be present, only partial i.e. localised, treatment is recommended.

Comments: Water treated with dichlobenil may be invadedby algae to give an equally dense vegetation as before treatment. Needs extra care to avoid problems of deoxygenation and fish mortalities. Can be used for localised control, particularly for plants having extensive root systems in mud.

DIQUAT

Type:		Contact herbicide, also translocated through leaves. Rapid defoliant.
Suitable for:		Wide range of aquatic plants but especially submerged and floating weeds. Suitable for the blanket weed. (Filamentous algae).
Unsuitable for:		Most algae except Cladophera, emergent vegetation.
1.	Formulation:	Solution containin 20% w/v (Reglone) or viscous gel (Midstream) containing 10% w/v active ingredient.
2.	Application:	To foliage, direct to water and as sub-surface injection as appropriate for weed circumstances.
3.	Flow rate limitations:	Still water. Slow flowing water up to 90 m/hour. (Reglone) No flow limitation on Midstream. Diquat is rapidly inactivated in muddy water.
4.	Flow control:	If possible flow should be stopped for <u>one day</u> after treatment (Reglone only).
5.	Dose:	0.5 - 1.0 g/m^3 - active ingredient 25-50 l/ha/m depth - product.
6.	Maximum permitted water concentration under PSPS	2 mg/l active ingredient. Normally use at 1 mg/l active ingredient.
7.	Timing of application:	May to September, but early treatment advisable to avoid severe deoxygenation. Short persistence of herbicide may result in later regrowth, especially of normally later-maturing weeds. Repeated applications may be necessary.

Continued....

8.	No of applications anticipated per season:	Normally one. It is suggested that later applications should be restricted to alternate short sections - the remainder treated two weeks later.
9.	Minimum interval between treatment and use of water for irrigation:	Ten days or until concentration in water is below 0.02 mg/1 active ingredient. Livestock can drink water at normal doses but it should not be used for human consumption or swimming for up to ten days after treatment.
10.	Taint data:	Not available.
11.	Toxicological data:	Acute oral LD_{50} rate 300 mg/kg LD_{50} fish - rainbow trout 8 mg/1 blue gill 36 mg/1.
12.	Special instructions to operators:	Wash concentrate from skin or eyes immediately. Avoid working in spray mist.
13.	Protective clothing requirements:	
	(a) handling concentrate	Wear protective gloves and face shield
	(b) during application	Normal hygiene precautions (but see 12 above)(Reglone). Protective gloves and faceshield (Midstream).
14.	Trade names of products:	Manufacturers/Distributors.
	Regions	ICI Professional Products ICI Professional Products.

Continued.....

15. MAFF No: 01713 Reglone.
01348 Midstream.

Restrictions: Care must be taken to avoid spray drift. Diquat is safer than paraquat but isan eye irritant.

Comments: When duckweed (Lemna) is present, penetration is poor and respraying may be necessary. Booms may be used to prevent reinvasion until the total area has been treated. Regrowth of certain filamentous algae is a great possibility.

GLYPHOSATE

Type:		Foliar acting herbicide which is translocated from treated vegetative growth to underground roots, rhizomes and stolons.
Suitable for:		Control of emergent and floating species.
Unsuitable for:		Algae and submerged weeds.
1.	Formulation:	Water soluble formulation containng 35% w/w active ingredient.
2.	Application:	To foliage.
3.	Flow rate limitations:	Flow rates are irrelevant since the spray is applied to the foliage.
4.	Flow control:	Not applicable (see 3).
5.	Dose:	1.8 - 2.16 kg/ha - active ingredient 5 - 6 l/ha - product.
6.	Maximum permitted water concentration under PSPS:	0.2 mg/l active ingredient.
7.	Timing of application:	July to early September according to weed species to be controlled. When the plant is fully developed, use preferably just before it starts to die back naturally.
8.	No of applications anticipated per season:	Only one application per season.
9.	Minimum interval between treatment and use of water for irrigation	Nil.
10.	Taint data:	Taint detectable up to 10 mg/l.

Continued.....

11.	Toxicological data:	Acute oral LD_{50} rat 4900 mg/kg LC_{50} fish - harlequin 11.7mg/l (96 hours constant flow) 168 mg/l (96 hours static flow) blue gill 28 mg/l (96 hours static flow) rainbow trout 48 mg/l (96 hours static flow) LC_{50} invertebrate fauna- Daphnia pulex 192 mg/l (48 hours static flow).
12.	Special instructions to operators:	Wash concentrate from skin or eyes immediately. Avoid working in spray mist. Do not mix, store or apply in galvanised or unlined mild steel containers or spray tanks since an inflammable gas may be produced.
13.	Protective clothing requirements:	
	(a) handling concentrate	Wear protective gloves and faceshield
	(b) during application	Normal hygiene precautions.
14.	Trade name of product:	Manufacturers/Distributors
	Roundup	Monsanto
	Roundup	Schering
	Spasor	RP Environ
	Mascot Sonic	Rigby Taylor.
15.	MAFF No:	01828 Monsanto 03947 Schering 03436 RP Environ 03376 Rigby Taylor.
	Restrictions:	Do not spray in windy conditions or use high pressure. Drift onto crops can severely damage them.
	Comments:	Can be used successfully for partial clearance i.e. spraying only those patches needing to be cleared. This lessens the chance of other plants becoming a problem. Glyphosate is rapidly inactivated and degraded by aquatic micro-organisms.

MALEIC HYDRAZIDE

Type:		Translocated growth regulator which inhibits cell division and retards growth of grasses. Does not affect broad-leaved plants.
Suitable for:		Control of grass on watercourse banks after cutting to maintain a short grass award, sometimes combined with 2,4-D amine to control broad leaved weeds. Can also be used to kill grass.
1.	Formulation:	Solution containing 36% or 50% w/v active ingredient.
2.	Application:	Foliage.
3.	Flow rate limitations:	Flow rates are irrelevant as the herbicide is used to control grass growth on banks and dykes.
4.	Flow control:	Not applicable (see 3).
5.	Dose:	4.0 kg/ha - 5.6 kg/ha - active ingredient 8-16 1 ha - product.
6.	Maximum permitted water concentration under PSPS:	2 mg/1 active ingredient.
7.	Timing of application:	March - September.
8.	No. of applications anticipated per season:	Normally one - a second application where necessary should only be made 8-10 weeks after the first.
9.	Minimum interval between treatment and use of water for irrigation:	Three weeks - or until concentration in water is below 0.02 mg/1 active ingredient.

Continued.....

10.	Taint data:	Not available.
11.	Toxicological data:	Acuteoral LD50 rat 4000 mg/kg LC_{50} fish - rainbow trout 85-56 mg/l (24-48 hours).
12.	Special instructions to operators:	Wash concentrate from skin or eyes immediately.
13.	Protective clothing requirements:	
	(a) handling concentrate	Normal hygiene precautions.
	(b) during application	Normal hygiene precautions.
14.	Trade names of products:	Manufacturers/Distributors.
	Regulor K -	RP Environ
	Bos MH 180	Bos.
15.	MAFF No:	01716 Regulox K 03589 Bos MH 180.
	Restrictions:	Can affect a range of crops. Care is needed to avoid spray drift and contamination of irrigation waters. If used too frequently or in too high a concentration, maleic hydrazide can turn grass yellow and may encourage a tough wiry growth that is difficult to cut.

TERBUTRYNE

Type:		Translocated herbicide absorbed by filiage or roots. Photosynthesis inhibitor. Not persistent but slow release formulation controls regrowth.
Suitable for:		Wide range of submerged and floating weeds and algae.
Unsuitable for:		Reeds, emergent weeds, water lilies or certain plants with floating leaves.
1.	Formulation:	Granules containing 1% w/w active ingredient.
2.	Application:	Direct to water
3.	Flow rate limitations:	Still water. Sluggish water - up to 20 m/hour.
4.	Flow control:	If possible, flow should be stopped for seven days to improve weed control.
5.	Dose:	0.05-0.1 g/m^3 - active ingredient. 50-100 Kg/ha/m depth - product.
6.	Maximum permitted water concentration under PSPS:	0.1 mg/1.
7.	Timing of application:	April - May before heavy build-up of weeds.
8.	No of applications anticipated per season:	One.
9.	Minimum interval between treatment and use of water for irrigation:	One week.

Continued.....

10.	Taint data:	Threshold odour concentration 5.7 mg/l soft water, 4.8 mg/l hard water, 16.8 mg/l and 16.8 mg/l respectively after dechlorination.
11.	Toxicity data:	Acute oral LD_{50} rat 2400 mg/kg LC_{50} fish - rainbow trout 3.5 mg/l (96 h) carp 4 mg/l (96 h) LC_{50} invertebrate fauna - Daphnia magna 1.4 mg/l (48 h).
12.	Special instructions to operators:	None.
13.	Protective clothing requirements:	
	(a) handling concentrate	Normal hygiene precautions.
	(b) during application	Normal hygiene precautions.
14.	Trade name of product:	Manufacturer/Distributor.
	Clarosan 1FG	Ciba-Geigy Agrochemicals.
15.	MAFF No	00520.
	Restrictions:	The potentially severe problems arising from oxygen depletion with this herbicide means that it cannot be recommended where fish would be at risk, or where suitable alternative herbicides may be used. Experience has shown that partial treatment is not possible. Terbutryne appears to become inaffective at or below temperatures around 5-8 ^{o}C.
	Comments:	High safety factor of acute toxicity to mammals and birds. Weed growth ceases after application but obvious signs of death may not occur for 2-4 weeks.

APPENDIX 12

CONVERSION TABLES

WEIGHT

A	B	A-B	B-A
oz	g	x28.35	x0.0355
lb	kg	x0.454	x2.205
cwt	kg	x50.80	x0.0197
ton (long)	kg	x1016.0	x0.000984
ton (short)	ton (long)	x0.893	x1.12

SURFACE

A	B	A-B	B-A
sq in	sq cm	x6.45	x0.155
sq ft	sq m	x0.093	x10.764
sq yd	sq m	x0.836	x1.196
acres	hectares	x0.405	x2.471

1 acre - 4,840 sq yd - 43.560 sq ft

LENGTH

A	B	A-B	B-A
in	cm	x2.54	x0.394
ft	m	x0.305	x3.281
yd	m	x0.914	x1.094
miles	km	x1.609	x0.621

VELOCITY

A	B	A-B	B-A
ft/sec	m/sec	x0.305	x3.281
ft/min	m/sec	x0.00508	x197.0
miles/h	km/h	x1.609	x0.621
miles/h	ft/min	x88.0	x0.0113

VOLUME

A	B	A-B	B-A
Imp gal	US gal	x1.20	x0.833
fl oz (Imp)	ml	x28.35	x0.0352
gal (Imp)	litres	x4.55	x0.22

PRESSURE

A	B	A-B	B-A
lb/sq in	kg/sq cm	x0.0705	x14.22

1 atm - 14.7 lb/sq in - 10.3 kg/sq cm

QUANTITIES/AREA

A	B	A-B	B-A
lb/acre	kg/hectare	x1.12	x0.894
lb/acre	mg/sq ft	x10.4	x0.09615
kg/hectare	mg/sq in	x100	x0.01
mg/sq ft	mg/sq m	x0.093	x10.764
oz/sq yd	cwt/acre	x2.70	x0.370

DILUTIONS

A	B	A-B	B-A
l oz/100 gal	ml/100 litres	x6.25	x0.16
ints/100 gal	ml/100 litres	x125.0	x0.008
z/Imp gal	g/litre	x6.24	x0.160
z/US gal	g/litre	x7.49	x0.134
b/100 Imp gal	kg/100 litres	x0.00998	x100.2

Appendix 11

GENERAL

1 cu ft water - 62.374 lb at 15°C - 6.24 Imp. gal.
1 inch rain - 4.67 Imp gal/sq yd - 22,671 Imp gal/acre - 100 long ton/acre.
To convert Fahrenheit to Centigrade, subtract 32°, then multiply by 5 and divide by 9.
To convert Centigrate to Fahrenheit, multiply by 9 and divide by 5, then add 32°.
Freezing point - 32°F or 0°C.
Boiling point - 212°F or 100°C.
1 gm/m^3 = 1 ppm = 2.7 lbs/ac/ft.

ABBREVIATIONS. . . . . .

atm.	atmosphere
C.	Centigrade
cm	centimetre
cwt.	hundredweight
F.	Fahrenheit
fl	fluid
ft	foot
g.	gram
gal.	gallon
h.	hour
Imp gal.	Imperial gallon
in	inch
kg	kilogram
km	kilometre
lb	pound
m.	metre
mg	milligram
min.	minute
ml	millilitre
mm	millimetre
m/s.	metres per second
oz	ounce
p.p.m.	parts per million
sec.	second
sq	square-
yd	yard
U.S. gal	United States gallon

APPENDIX 13

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