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Review of Comments on the Environment Agency's Consultative Report: 'Endocrine Disrupting Substances in the Environment: *What should be done*?'

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ABBREVIATIONS

BATNEEC	Best Available Technology Not Entailing Excessive Cost
BPEO	Best Practicable Environmental Option
CRI	Chemical Release Inventory
DTA	direct toxicity assessment
ED	endocrine disruptor
EQS	environmental quality standard
EU	European Union
GIS	geographical information system
IPC	Integrated Pollution Control
STW	Sewage treatment works
TBT	tributyltin
USEPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

INTRODUCTION

As part of its remit, the Environment Agency has made a critical assessment of the evidence for endocrine disruption and its potential effects on the environment in England and Wales (Environment Agency, 1998a). On the basis of the findings from this review, the Agency has proposed an approach to protect the environment from the potential impact of endocrine-disrupting substances.

The Agency has undertaken an extensive consultation exercise, based on the publication of a consultative report (Environment Agency, 1998b). The intention has been to elicit comments from stakeholders before the Agency finalises its strategy. Although open to any comments relating to endocrine disruption, views on the following aspects of the report were specifically sought:

- how priorities can be determined for action and what are the priority categories of chemicals;
- the general balance of the proposed approach, which would involve taking certain preventative actions and, at the same time, continuing to improve understanding of the issue through targeted research;
- the areas identified in the document for further action and any other actions that are considered to be appropriate;
- the potential to develop alternative technologies and products, and what this might cost; and
- opportunities for collaboration in addressing further research priorities at both national and international levels.

The responses received by the Agency in reply to the consultative report are summarised below.

SUMMARY OF RESPONSES

Overall, 62 responses were received from a wide range of stakeholders including government departments and agencies, Environment Agency customer groups, academics and professional bodies, individual scientists and consultants, non-governmental organisations and various industries. A number of respondents appeared to have assumed that the proposals outlined in the consultative report constitute the Agencies definitive policy rather than proposals for comment. In consequence, there was a number of instances where stakeholders expressed either support or disagreement with 'the Agency's position'. In all such cases, comments are presented as made by the respondent, to avoid misinterpreting the respondents intention.

All respondents were positive about the consultation exercise and were grateful to the Environment Agency for the opportunity to provide comments.

Prioritisation of chemicals and actions

Some respondents recommended priority should be given to persistent and bioaccumulative substances. Concerns were expressed by others over the possible use of inventories of 'priority' chemicals, particularly given the limited classes of

chemicals considered by the Agency, and the lack of a validated testing strategy. There was an overall feeling that the development of such a testing strategy for endocrine disruptor (ED) activity should be given high priority. While some responses suggested that the precautionary principle should be invoked now, backed by regulatory action if necessary, a greater number considered that there was only sufficient evidence to cause concern rather than establish causality, and that there was currently insufficient information to warrant direct preventative action. Some additional chemicals were suggested for inclusion in the Agency's list.

Balance of the proposed approach

Some responses questioned the scientific basis for inclusion of certain chemicals and expressed concern that the range of sources considered by the Agency was too restricted. In addition, the need to balance the potential effects of EDs on human health and wildlife with other possible causal factors, such as lifestyle and diet, was highlighted.

The aqueous environment was recognised as being at risk from EDs. However, the need to investigate other habitats, including the terrestrial and sedimentary environments, was noted.

Further actions

Areas highlighted as requiring additional research included:

- basic science including inter-species differences in endocrine systems, assessment of the significance to populations of ED effects in individuals (especially fish and invertebrates), and the causes of reproductive abnormalities in the apparent absence of exposure to EDs;
- fate and behaviour of EDs in sewage treatment works (STWs) and the wider environment, identification of possible enhancements to STW treatment processes to remove or deactivate EDs, assessment of the contribution of landfill leachate to the observed effects in surface waters, determination of levels of EDs in underground water sources used for abstraction of drinking water, and assessment of the ED content of sewage sludge and the implications of its use on agricultural land; and
- the investigation of the effects of river flow rate on effluent dilution and review of abstraction licences, especially during times of drought.

Regarding monitoring, the general consensus was that this should initially focus on already identified high-risk areas, although a few responses called for widespread monitoring of all waters receiving effluent discharges. The majority opinion on the approach to the control of chemicals was that internationally-harmonised environmental quality standards (EQSs) for EDs should be developed, taking account ED-relevant endpoints. However, concern was expressed over the time that has been taken to develop such standards. Some responses recommended that EDs should be made prescribed substances, thus allowing control using best available techniques not entailing excessive cost (BATNEEC).

Development of alternative technologies or substances

While a number of responses recommended a move to more environmentally-friendly substances and processes through substitution, most highlighted the need to ensure

thorough comparative testing in advance of any replacement, and some felt that this was not currently possible because of the lack of agreed test methods or, indeed, confirmation of the existence of a problem.

Opportunities for future collaboration

There was a general consensus among those that commented on future approaches that these should take place on an international basis and involve all stakeholders, as long as this did not impede progress. Additional points raised included the need for national and international co-ordination, to take steps to ensure that adversarial attitudes do not develop between the various interest groups, and for all information to be published in an open and unbiased manner. One benefit suggested for an international approach was to avoid unilateral decisions adversely impacting on the national economy. Several responses stressed the need for future decisions to be based on sound science, validated risk assessments and cost-benefit analyses.

On the issue of funding for research and the development of alternative technologies, a significant number of responses accepted the principle of 'polluter pays', although it was noted that in instances where no specific substances or sources were identified, government funding for research would be necessary. Responses from industry highlighted the level of industrial funding already committed to research on the ED issue, both nationally and internationally.

OVERVIEW

While there was general concurrence with the Agency's paper in many areas, there was divergence of opinion on specific details, and many possible alternative approaches were suggested.

With the exception of academics and professional bodies, at least half the stakeholders from each interest group responded to the question on priorities for chemicals and actions. Concerns were expressed most frequently amongst industries other than the water companies. Many government departments and non-governmental organisations were generally supportive of the balance proposed by the Agency, although the non-water related industries stressed the need to concentrate on developing validated tests for EDs. The question of the balance of the proposals drew relatively few responses from the water industry, consultants, academics or professional bodies. Development of alternative technologies or chemicals also elicited much debate. Stakeholders from government departments, agency customer groups, and academic/ professional bodies stressed that any changes must be justifiable in terms of improved safety. This point was also made by some non-governmental organisations. Amongst the responses from industry, comments were quite varied and generally reflected the activities and interests of the particular stakeholder. Although all parties accepted the need to develop a collaborative approach to the ED issue, there were differences in emphasis. Several stakeholders responded favourably to the possibility of the Agency taking action at the national level while some industrial responses (especially from the non-water industry groups) emphasised the need for discussions involving multiple-stakeholders and decisions to be taken at the international level.

1 INTRODUCTION

1.1 Background

The Environment Agency has a wide range of duties relating to the protection of the environment by pollution control, the proper management of waste, the proper management of fresh water and fisheries, and general conservation. It also has a wide range of responsibilities for monitoring of the state of the environment. The overall purpose of the Agency is to contribute towards the goal of sustainable development.

As part of this remit, the Environment Agency has made a critical assessment of the evidence for endocrine disruption and its potential effects on the environment in England and Wales (Environment Agency, 1998a). Subsequently, the Environment Agency has undertaken an extensive consultation exercise, including the production of a consultative report (Environment Agency, 1998b), to canvass opinion on the state of knowledge of the endocrine disrupter issue, the Agency's interpretation of the available information, and to discuss what actions are necessary. The intention was to elicit comments from other interested parties before the Agency finalised its own strategy.

1.2 The Environment Agency's consultation process

As part of the consultation process, in January 1998 the Agency produced a Consultative report 'Endocrine-disrupting substances in the environment: What should be done?' (Environment Agency, 1998b). This document focused primarily upon those issues of direct relevance to the Agency's own environmental management role, particularly the disruption of those physiological systems responsible for reproductive health in animals. Given its scope, the report inevitably touched upon human exposure via the environmental media but did not specifically address public health issues since responsibility for this area lies with government departments. As part of this document the Agency proposed an approach involving a number of steps:

- determine a list of priority endocrine-disrupting substances on the basis of actual or potential risk to the environment (a preliminary list of chemicals was given in the report as a starting point to aid discussions);
- developing pollution prevention and control plans for each of the priority substances aimed at reducing, or where possible, eliminating releases to the environment and keeping ambient levels below those that would adversely affect ecological or human health;
- developing a complete set of environmental quality standards (EQSs) for priority substances to serve as the basis for setting discharge consents and identifying catchment management solutions to address diffuse sources;
- targeting specific sectors such as the water industry, chemical manufacturing, industry, agriculture and waste management, and working with them to identify specific actions for preventing or minimising releases of priority substances;
- seeking opportunities in reviewing existing integrated pollution control (IPC) authorisations and introducing the new European Union directive on integrated pollution prevention and control (IPPC, 96/61/EC) for improved technological solutions;

- encouraging industry to take the lead in developing alternative products and in phasing out the use of existing products that are potentially harmful;
- providing technical support to Government Departments and expert committees in the review of existing and new chemicals and the risks to the environment associated with their marketing and use;
- carrying out targeted environmental monitoring programmes to improve the information base on the occurrence of priority chemicals in the environment and their ecological impact;
- developing alternative approaches for licensing of discharges, such as consents based on direct toxicity measurements;
- contributing to collaborative research and development programmes, both nationally and internationally, to improve scientific knowledge and thereby the basis for developing management solutions.

The objective of the consultative report was to elicit views as to the actions that should be taken by the Agency on the basis of current evidence on the environmental effects of endocrine-disrupting chemicals. To assist in the crystallisation of views and to stimulate interactive debate, the Agency held an open seminar in London on the 20 April 1998. Although open to any comments on the issue of endocrine disruption, the Agency specifically asked, in the consultative report, for comments on the following points:

1. how **priorities** could be determined **for action** and what were the **priority categories of chemicals;**
2. the general **balance of the proposed approach**, which would involve taking certain preventative actions and, at the same time, continuing to improve understanding of the issue through targeted research;
3. the **areas** identified in the document **for further action** and any other actions that are considered to be appropriate;
4. the potential to develop **alternative technologies and products**, and what this might cost; and
5. **opportunities for collaboration** in addressing further research priorities at both national and international levels.

1.3 Purpose of this report

This report summarises the views and opinions expressed in response to the Environment Agency's call for comments. It has been compiled for the Agency by the MRC Institute for Environment and Health from copies of the original responses received by the Agency. Wherever possible, responses have been grouped under the five question areas detailed above.

It is of note that a number of respondents appeared to have assumed that the proposals outlined in the consultative report constitute the Agencies definitive policy rather than proposals for comment. In consequence, there were a number of instances where stakeholders expressed either support or disagreement with 'the Agencies position'.

Although the consultation document asked for replies by 30 April 1998, a number of comments received after this time have been included in the assessment exercise.

2 COMMENTS ON QUESTIONS RAISED IN THE ENVIRONMENT AGENCY REPORT

In total, 62 organisations or individuals submitted formal comments to the Environment Agency (the Agency) on the consultative document. Comments were received from the following categories of organisation:

- Government departments or Regulatory agencies: **11 replies**. An additional response, not directly addressing the Agency document, was received from a European parliamentary source.
- Environment Agency customer groups: **4 replies**
- Academia or professional bodies: **11 replies**
- Scientific consultants: **4 replies**. A further set of comments was received from one individual but was omitted since it duplicated comments submitted separately by this individual on behalf of a professional body.
- Non-governmental organisations: **11 replies**
- Industrial organisations or federations: **19 replies**
- Other: **1** multi-stakeholder group

Details of the comments received from individuals or organisations have been summarised in Table 1. Where appropriate, the number of responses making the same point is indicated. For Table 1 and the commentary on the responses given below, it must appreciated that entries have only been made where a respondent specifically stated an opinion on a given area in their formal written reply to the Agency. In the absence of such a comment in the response, no reference to a view on a given subject has been made even if it is known that the respondent holds opinions on a particular area through comments they have made at other times or by other means. The responses received to the Agency's consultative report are discussed below, divided into the different interest groups (Section 2.1 to 2.8). An overview of the response to each of the five questions raised in the Agency's consultative document is presented in Section 3.

2.1 Government departments and agencies

Eleven responses were received, all welcoming the consultation exercise and agreed with the overall approach outlined in the consultation document.

With regard to the determination of **priority chemicals and actions**, five responses were in overall agreement with the proposals in the Agency report and three expressed the view that the issue of endocrine disruption was a cause for concern. However, only one response indicated that implementation of the precautionary principle was justified where it is clear that irreversible change would occur in the absence of taking action. Two responses suggested that the precautionary principle should not be implemented because of insufficient information and the need to first establish population effects. An inventory of chemicals was thought to be required in four responses, while one suggested that it was not appropriate due to possible mixture effects. It was suggested that the scope of sources and chemicals for consideration should be extended to include vinclozolin and food packaging materials and that field

studies (*e.g.* breeding success) should be used to supplement *in vitro* and *in vivo* studies of endocrine disrupting activity.

The balance between preventative action and continued research suggested by the Agency was thought to be appropriate in eight responses. Other issues noted included the importance of considering over-fishing in the marine environment, and the need to be aware of potential effects on human health and not to simply focus on wildlife effects. The aquatic environment was considered to be at risk in four responses, while the terrestrial environment was highlighted in two and humans in one response. The need to develop of a testing strategy for EDs was considered to be a high priority in two responses.

The Agency's position with regard to **further action** was accepted in six responses. However, others suggested that further research was needed before the introduction of any regulatory controls. Several areas were suggested for further research, mostly involving the fate and behaviour of natural and synthetic chemicals in STWs and the wider environment, consideration of non-reproductive endpoints, assessment of reproductive effects at non-exposed sites to assist in monitoring for evidence of recovery, development of additional biomarkers for non-fish species and identification of sentinel species. It was suggested that attention should be given to the non-aqueous environment and that all activities should be focused on those species considered at greatest risk. For monitoring, it was suggested the focus should be on identifying population impacts in high risk areas followed by extension of investigations to low risk habitats. It was suggested that the polluter(s) should fund the research and monitoring. It was also noted that an extensive research programme targeting the marine environment would be starting shortly. Other ongoing research considered of importance to the ED issue included work on food and potency of ED contaminants and phytoestrogens, and the funding of research into drinking water quality by the water industry.

Concerning control of chemicals and the **development of alternatives**, consent controls were felt to require further development for the priority substances and, although it will possibly take some time, EQSs should be developed that incorporate ED-relevant endpoints. It was suggested that residue monitoring should be reviewed to investigate controls possibly using IPC or BATNEEC. It was suggested that reductions in the levels of chemicals should be encouraged on a voluntary basis but that action should be taken where there was clear evidence of effect. Substitution issues raised in responses included the need to consider costs to industry and the possibility that a substitute could prove more harmful. There was considered to be insufficient data to warrant action at present, and pressure on industry was not felt to be justified in the absence of valid test methods.

It was suggested that there were **opportunities for collaboration**, and that future efforts should involve all stakeholders, with the government funding work where no particular chemical or source has been identified. It was felt that access to information should be improved and that Agency activities should be listed on the German database of European ED research.

In addition, comments not specifically focused on the Agency's document were received from a European parliamentary source which were supportive of the overall approach adopted by the Agency. This response recommended adoption of the

precautionary principle for a wide range of chemical types, focusing on those showing bioaccumulation or having high production volumes and/or known ED activity. The need to adopt a 'class' approach to chemical regulation was emphasised.

A number of areas for basic research were identified, including human reproductive, behavioural, and neurological or immunological effects. The need to give a high priority to developing a comprehensive range of test models (*i.e.* including non-reproductive end points) was also stressed. Further research was also suggested into human health, cosmetics, polyvinyl chloride (PVC) in toys, washing powders and residues in clothing, foodstuffs and pesticides, and the migration of EDs. A number of actions were suggested including moves to replace EDs used in products or processes with less harmful alternatives, and the blocking of new marketing licenses. It was suggested that the burden of proof and the cost implications should lie with the producer, and that amendments to labelling regulations would be helpful in informing the public.

Finally, the submission from the European government source recommended action at an international level, with industry being heavily involved in financing the actions and research.

2.2 Environment Agency Customer Groups

Four submissions were received from Agency customer groups and, while all were in general agreement with the document and welcomed the consultation, one thought the report to be too scientific for the lay reader. Two respondents specifically agreed with the Agency's proposals for the determination of **priority chemicals and actions** and one commented that the issue of EDs was of concern. Two groups felt the precautionary principle should be implemented. Of these, one suggested its use until further information became available to enable a re-evaluation while the other response suggested that implementation of the precautionary principle was only justified when the amount of data available was sufficient to enable a balanced judgement to be reached. None of the responses commented specifically on issues of prioritisation, chemical inventories or priority substances, but one response suggested that the influence of effluent dilution at STWs should be investigated.

Two responses agreed with the **balance of the proposed approach** between prevention and further research, and two also felt the development of a testing strategy for EDs should be a high priority and also accepted the Agency's position on **further actions**. Additional topics suggested for research included investigation of population level effects of EDs on fish and extension of work to invertebrate populations. Also it was suggested that there should be further investigations into the effects of mixtures. Commenting on the approach to control of chemicals, the testing and approvals scheme was felt to be in need of a complete overhaul, the development of EQSs was considered to be important, and it was suggested that minimum flow rates for rivers should be established and enforced. It was suggested that the testing of chemicals for ED activity should be funded by industry.

Two responses accepted the Agency's position on **developing alternative technologies and products,** and one felt that there should be a move to substitution where possible, with the producers and users of chemicals with environmental impact assessments providing support for substitution and amelioration programmes. It was

considered important to make efforts to reduce the impacts of EDs and increase river flow rates and effluent dilution. With regard to the **opportunities for** future **collaboration**, it was considered that the latter point would be best dealt with on a national basis, and that the time scale for this and other activities should be firmly established.

2.3 Academia and Professional Bodies

Eleven academics and professional bodies provided submissions, of which four expressed general agreement with the document and specifically welcomed the consultation exercise. Three responses agreed with the proposals for the determination of **priority chemicals and actions,** and four felt the issue of EDs to be of concern. Only one response commented on the precautionary principle, suggesting that it should not be implemented at present. Also on the prioritisation issue, four respondents felt further information was required before a prioritisation process could be undertaken but three agreed with the development of an inventory of chemicals. A number of additional sources and chemicals to those priority substances highlighted in the document were suggested, including: domestic sources; phytoestrogens; mycoestrogens; groundwater; and the chemicals atrazine and simazine. Two responses suggested non-reproductive endpoints should be considered. One response recommended controls on new products with potential ED activity, pharmaceutical hormones, and on the fortification of food with supplementary hormonally-active substances such as phytoestrogens.

With regard to the **balance of the proposed actions**, animals and habitats at risk were felt to include sediment invertebrates and also ground water and aquifers because of their use in supplying drinking water. Three responses considered there to be a need for an ED testing strategy, while one response noted that work on mixtures was unlikely to be fruitful. However, it was noted in one response that it is currently too early to apply screening tests to new chemicals.

Suggestions for further action included basic endocrinology, fate and behaviour of natural and man-made chemicals (especially at low levels in water, during STW processes and in landfills), investigation of photocatalysis as a means of removing natural hormones in STWs, study of STW and landfill production of EDs, and the identification of rivers containing a high proportion of STW effluent. Other topics suggested included: the use of laboratory mesocosm experiments to study effects on fish breeding and fertility; the assessment of population level effects in UK wild fish; studies of potential effects of EDs on invertebrates and population level effects in top predators and amphibians; studies of mixtures; development of biological indicators of endocrine disruptive effects in wild populations; use of GIS systems to model EDs in surface, ground and coastal waters; and the establishment of a database of potencies. It was also suggested that the recovery of coastal gastropod populations should be monitored following the ban on TBT, and this work should be extended to benthic communities. In addition, three responses suggested that techniques for low level monitoring should be improved. Also, river and pump-well water should be investigated with the water companies, focusing on sites at greatest risk from EDs.

With regard to control of chemicals and the **development of alternative technologies**, two responses recommended that the Agency and water industry should reduce the release levels of EDs. It was felt that it was not yet possible to develop

EQSs incorporating ED effects, and the effectiveness of EQSs was considered questionable in any case. Direct toxicity assessment (DTA) was suggested for evaluating the effects of environmental mixtures, with the focus on improving treatment processes. One response agreed with the Agency's position on alternative technology development, and two recommended moving to substitute chemicals wherever possible. Suggested requirements before substitution could occur included the need to ensure the substitute was less harmful than the existing chemical, and the development of information on speciation and ED activity. An approval scheme for new products was recommended in one response while another felt substitution should only take place once satisfactory test methods were available.

One response commented that industry should focus on waste minimisation and developing the means to destroy any EDs that must be used during waste processing before they can reach the general environment. Another recommended that EDs should be subject to the same approach as applied to other pollutants. It was suggested in one response that it would be appropriate to identify and act on the point sources of ED pollution rather than water treatment processes, and another response suggested that STW pollution prevention and control investigations should be carried out in conjunction with the water companies, with the development of mitigation strategies that take account of a chemical's fate and behaviour.

Two responses specifically concurred with the Agency's position on **opportunities for** future **collaboration,** and felt that it was important that future work was targeted and co-ordinated to avoid waste or duplication of effort. One respondent specifically mentioned the need for an international approach incorporating all stakeholders.

2.4 Scientific Consultants

Four responses were received from individual consultants, with one specifically welcoming the consultation and agreeing in general with the Agency's position. Two responses recognised EDs as a cause for concern and one felt the precautionary principle should be implemented while another individual thought this was not appropriate. For the **prioritisation of chemicals**, the development of an inventory was considered important by two consultants with one suggesting this should be done on the basis of potency and exposure. It was suggested that risk assessment processes were in need of improvement to address different types of substances, and one response considered that controls should be tightened for synthetic chemicals.

On the **balance of the** future **approach**, the need for development of a testing strategy for EDs was recognised in two responses with both considering this to be the highest priority. Areas suggested for further research included fate and behaviour of steroids in STWs and of EDs in the wider environment. Under monitoring, one respondent recommended the development of biological methods to assess exposure and effect.

With regard to **future actions**, it was suggested that industry should participate in assessment and prevention work but should only bear the costs of action where effects could be demonstrated to arise from their particular products or processes. With regard to **opportunities for collaboration**, it was suggested that good communications were required between government departments and agencies in order to avoid duplication of effort and resources.

2.5 Non-governmental Organisations

Eleven responses were received from NGOs of which seven expressed general agreement with the Agency's document and eight welcomed the consultation. Four responses concurred with the Agency's position on **priority chemicals and actions**, and eight recognised EDs as of concern. Three responses suggested that the precautionary principle should be implemented, with two suggesting that action should be taken on the basis of effects being shown at the level of the individual organism rather than the population. One response recommended backing such action with regulation as necessary, and another suggested improved product labelling was needed to allow individuals to take personal action.

Two responses expressed concern over the proposed use of the Weybridge definition of an ED since they suggested this to be inadequate. Instead they recommended adoption of the US EPA definition. Four responses recognised the need for an inventory of chemicals, while two added that EDs should be included on the Chemical Release Inventory (CRI) and that priority should be given to those chemicals testing positive *in vivo*. One response suggested that prioritisation should be based on exposure and toxicity, and that the initial focus should be on persistent lipophilic EDs, widespread chemicals in the environment and on chemicals which tend to accumulate in lipid rather than aqueous materials (*i.e.* those with a high octanol:water partition coefficient, usually expressed as log K_{ow}).

In addition to the substances mentioned in the consultative report, a number of chemicals were suggested for consideration, including: phytoestrogens; chemicals affecting hormone synthesis and/or degradation (*e.g.* conazole fungicides and chlorophenoxy herbicides); hormonally-active polycyclic aromatic hydrocarbons; fenimarol and pyrethroids other than permethrin. Other aspects highlighted included concern over the lack of ability to screen for EDs using structure-activity relationships, and the need to develop voluntary agreements in order to minimise the risk of chemical spills into watercourses. One response noted the need to improve user information on organophosphorus compounds. Two responses recognised the aquatic environment as being at risk, with particular mention of juvenile fish and otters.

On the **balance of the proposed approach**, three organisations recognised the need for a testing strategy for EDs, with one calling for the development of invertebrate models and another recommending that such tests are incorporated into EU legislation for new and existing chemicals. In addition, it was suggested that improved testing of pesticides and chemicals should be encouraged, with the methods being enhanced to cover ED-relevant endpoints.

Recommendations for **further action**, included research into STWs included investigation of fate and behaviour of EDs in sewage sludge, assessment of the contribution of landfill leachate into STWs and rivers and the extension of the STW work to identify specific sources of EDs. Two responses recommended the assessment of population level effects in fish and investigations into their possible links with pesticide/herbicide exposure. One response suggested the need to develop a risk assessment paradigm for fish population effects. It was also suggested that the minimum flow rates of rivers necessary to avoid problems should be assessed and that abstraction licences should be reviewed, particularly for period of drought. In addition, it was suggested that the effects of EDs should be assessed in sediments, in

invertebrates and in the terrestrial environment. Sedimentary invertebrates were suggested as possibly being of use in biomonitoring. Indeed, biomonitoring was suggested as a useful tool for monitoring of industrial effluents. Additional areas of research suggested included: study of low dose effects; mixtures; species differences; and dose-responses. Specifically, one response suggested the need to identify sources of PCBs and DDT, and to prevent discharge/loss from these sources. Geographical information systems were suggested as a means to target environmental research. It was also suggested in one response that chemical release and use data might be used as a surrogate for exposure. It was also suggested that, in the River Lea, breeding success of otters should be investigated for any correlation with ED exposure. Two responses recommended that all waters receiving effluent discharges should be monitored, and one was critical of the Toxicity Identification & Evaluation (TIE) approach [a method by which sequential fractions of chemicals from a complex mixture are systematically tested using appropriate models to identify the biologically-active constituent(s)] since they claimed that this method does not address low level persistent or bioaccumulative chemicals, non-oestrogenic endpoints or mixture effects. The need for the development of EQSs for alkyl phenols (APs) and alkylphenol polyethoxylates (APEs) was highlighted, as was the need to refine the EQS to include ED-relevant endpoints, based upon agreed criteria. Two responses commented that EQSs were preventative and not precautionary. Both also raised the point that most EDs are not covered by IPC and recommended proscribing them, thus enabling their control under BATNEEC. One response highlighted the need for discharge limits for oestrone and ethinyloestradiol from STWs. Another recommended that effluent discharge fees should include the costs of fish restocking.

Four responses accepted the Agency's position on the **development of alternative technologies**, with one suggesting a voluntary approach and four being in favour of substitutions wherever possible. Two responses commented that industry should take the lead in this area, and one added that benefits to industry may come through the development of improved processes. One response suggested that industry should only bear the cost where it was established that harm had resulted from existing products or processes. Another response highlighted the need to ensure thorough and comparative testing of substitutes before replacement.

A number of other points were raised in the comments from non-governmental organisations including: develop methods to remove female hormones during STW treatment (cost to be met by water industry); focus on high risk areas, (*e.g.* rivers with high levels of effluent); remove TBT from the market, and make industry develop alternatives; use BPEO to promote use of alternatives; develop dredging methods to reduce turbulence and mobilisation of sediment pollutants. The onus was said to be on industry to develop safer products.

Four responses accepted the Agency's position on **opportunities for collaboration**, with two adding that this needs to be international, and one commenting that all stakeholders should be involved as long as this does not impede progress. It was suggested that polluters should bear the cost for research, substitution and preventative actions, and that care should be taken to ensure that industry-funded research does not introduce bias and is published openly. One organisation recommended that the Agency should encourage the establishment of an EU polluting

emissions register to include EDs. It was also stressed that Government departments should avoid duplication of effort.

2.6 Water Industries

Four submissions were received from various water companies or groups, with one expressing general agreement with the Agency's approach and two specifically welcoming the consultation exercise. One response was received which questioned the relevance of endocrine disruption to human health on the basis that drinking water treatment processes were sufficient to remove such chemicals. A further response recommended that the possible implications to health be put into context against such factors as diet and lifestyle. There was considerable concern regarding the topic of **prioritisation of chemicals and actions**. Two respondents suggested that introduction of the precautionary principle was not yet appropriate because of lack of evidence while the subject of chemical inventories also raised considerable interest. The criteria suggested by the Agency were questioned and three responses provided detailed arguments relating to the selection of appropriate criteria. One response suggested prioritisation should be based on volume and purpose; another suggested water quality data, dose-response and threshold levels should be used, while a further response stressed the need for collaboration with DETR on the use of risk assessment processes to prioritise chemicals for further study. At present the basis for identification of chemicals by Agency was considered to require clarification. The need to incorporate field data into any assessment rather than relying solely on laboratory-generated data was noted in one response.

On the **balance of the proposed actions**, one response suggested that the extent of regulation for some chemicals was already such that they would be unlikely to present a danger since they were already below EQS levels, and the relative importance of endocrine disruptive activity in comparison to other agents was again questioned. The role of synthetic and natural hormones as likely causative agents was, however, recognised. Other areas which were considered to warrant **further attention** included the dumping of sludge at sea and its use on agricultural land, investigation of effects in terrestrial groups and the need to address a wide range of possible routes by which animals and man might be exposed to chemicals with endocrine disruptive potential. The need to focus on environmentally-relevant mixtures rather than individual chemicals was noted in one response while it was also suggested that the absence of temporal data might mask any improvements following recent modifications to STWs. A further recommendation was to assess the overall quantities of chemicals used within the UK. One response stressed the need to apply a testing strategy to all new chemicals as quickly as possible, while prioritising existing chemicals on the basis of existing data.

A number of additional areas for action were identified, many of which related to the fate and behaviour of steroids during the STW processing of sewage sludge and the possible enhancement of treatment processes. The need to study the implications of reproductive abnormalities in fish not exposed to endocrine disrupters, and the significance of the effects of endocrine disruption for fish populations, was also highlighted. Studies of fish and mammalian populations around sites of STW discharge (of both domestic and industrial origin) and investigation of the effects of improved STW treatment processes were also recommended. Such studies were felt to

require an historic perspective. It was also requested that the raw data from existing studies of the effects of fish around STW discharges should be subject to re-evaluation.

The need to investigate all routes of exposure to hormonal substances was suggested together with the assessment of the contribution made by different sources of EDs in the marine environment. One respondent questioned the influence and importance of STW treatment on APE degradation processes.

It was considered that monitoring should be focused on problem sites or site-specific effects, while investigation of ground and bore hole sources of drinking water was also supported. Similarly, adoption of an EQS approach was recommended although it was noted that contributions from natural sources should also be recognised in any such process. As far as **development of alternative processes or chemicals** was concerned, one response suggested that alternative processes or substitute chemicals should be used where cheap and simple alternatives exist. A key aspect raised was the need to weigh any potential benefit from taking action against the cost and extent of such action. One response suggested that improvements should be made by action at the level of the source rather than by concentrating on STW processes. For example, by removing EDs at source rather than during waste treatment. One response expressed concern that future control measures should be equitably applied rather than impacting unfavourably on any one water company.

Regarding **future opportunities for collaboration**, a multi-stakeholder approach was supported in two responses with one stressing the need for an international element to any further action. It was also considered essential that information should be shared between interested parties in a manner that prevented the development of any adversarial attitudes.

2.7 Other Industries

Fifteen responses were received from a wide range of British industry, with 10 specifically welcoming the opportunity to comment on the Agency's document. Two responses expressed reservations about the Agency's approach. This related to concerns that when considering the issues, it was important to remain dispassionate and objective and to concentrate on facts rather than bowing to public opinion pressures. This aspect was further addressed in seven responses who questioned the scientific basis for the Agency's proposals on **priority chemicals**. Three responses considered the issue of endocrine disruption to be a major cause for concern. However, seven responses questioned the scientific justification of the overall position taken by the Agency and only one response expressed general agreement with the Agency's position. Adoption of the precautionary principle for matters relating to endocrine disruption was not supported in nine responses, although one offered their support in situations where conclusive evidence of harm was available, such as for synthetic and natural hormones and alkylphenols in the aquatic environment. Overall, it was suggested that precautionary action could only be justified on the basis of a scientifically-based risk assessment using a weight of evidence approach. Although seven responses accepted that there was cause for concern, the banning of chemicals based only upon suspicion was not considered acceptable. These seven responses also suggested that any action based upon the current prioritisation proposals was invalid as it was considered essential to address all factors and sources not simply those

falling within the current Agency remit. One response noted that it might be appropriate to develop inventories on a local area basis and clearly recognised the need to address/manage local pollution episodes. However, there was concern that such actions should not be used to justify generalised controls. The need to establish causality was noted in seven responses while the need to assess the relative importance of anthropogenic versus naturally-occurring sources was also stressed. One response noted that the implementation of the precautionary principle was only justifiable if evidence was convincing, and then only after conducting a rigorous cost benefit analysis. Similarly, concerns were expressed over the proposals to develop an inventory of chemicals or any attempt to develop a prioritisation list. The need for an inventory was questioned since it was suggested that few new chemicals had been identified as potential endocrine disrupters over recent years and, until valid testing methods were developed, there was no sound basis on which to establish the relative endocrine-disruptive potencies of chemicals. Three responses recommended the development of a inventory of chemicals with one also recommending targeting of those chemicals with a structural similarity to oestrogens. Another recommended targeting of substances with existing environmentally-friendly alternatives, and an additional suggestion was that BPEO and BATNEEC should be applied to identifying priority chemicals. Seven responses noted that such lists were inadequate and tended to be unnecessarily biased against anthropogenic sources. It was generally considered that the only valid uses for such an inventory were to assist in identifying data gaps and to aid in the selection of chemicals for further study. Eight responses stressed there must a mechanism by which chemicals could be removed from the list if subsequently proven to be inactive, and that only chemicals that had been independently confirmed as EDs should be candidates for inclusion. Concerns were also expressed in several responses over the specific chemicals identified by Agency. Inclusion of certain crop protection products, phthalates and bisphenol-A was considered scientifically unjustified by some, while many responses felt there was a lack of attention to natural or synthetic steroids and the phytoestrogens (four and seven responses, respectively). The need to address other agricultural sources of hormonally-active chemicals was also raised. It was recommended that only up to date, validated and repeatable experimental data should be considered during any prioritisation exercise, and that equal weight should be given to potency and exposure data. The need for inclusion of *in vivo* test models before considering further actions was also highlighted in seven responses. It was also suggested that it was necessary to balance the positive and negative aspects of any given chemical. Indeed, one response disputed the impact of industrial chemicals on the observed effects, arguing that such chemicals had a long history of use but that environmental problems had only recently occurred. Further, they suggested that other factors may be causal for the effects seen in fish, such as increasing water demand at the expense of environmental protection.

With regard to the **balance between preventive action and continued research**, only one response supported the Agency approach while another noted that there was no evidence that the proposed actions would result in any beneficial effect. However, the need to give priority to the development of a validated testing strategy was strongly supported in eight responses. It was considered necessary to fully validate and harmonise the tests, and to include multiple species and mechanisms. It was also stressed that any tests developed must be rapid and cost effective. In the interim, the use of traditional toxicity tests with particular focus on ED relevant endpoints was

recommended. Additional areas suggested for **further research** focused on the possible role of the STW treatment process in the activation and deactivation of endocrine disrupters in waste, particularly with respect to domestic sources. The continuation of the existing research into the effects of STW effluent on fish was recommended, to assist in any prioritisation process. It was also suggested that there should be moves to improve treatment processes, and to increase water flows and the dilution of effluent. A number of additional areas of possible research were suggested, including the comment in eight responses that there was a need to investigate areas with high exposure and substances having high potency. The pharmacokinetics of bisphenol-A and the effects of natural and synthetic steroids on fish were also suggested as additional areas for research. Interestingly, one response suggested that the effects and exposures of phytoestrogens and man-made chemicals should be compared to identify any differences and, if so, the reasons for such differences.

Eight responses recommended that monitoring should be carefully targeted at locations with high exposure and to the investigation of specific chemicals with established high potency. In addition, any suggestion that potential endocrine disrupting chemicals should be subjected to tighter control or assessed using techniques other than those already established for other forms of toxicity was strongly opposed. The use of an EQS-based approach was supported in eight responses, as was the need to address chemicals individually not generically. The need to develop and use validated techniques for chemical analyses of EDs in food was recognised in one response. It was also suggested that validated tests should be applied to effluent discharges and other environmental mixtures to generate information of use in prioritisation. Application of a DTA approach was only considered useful if based upon robust and cost effective tests. Comments also reflected a general concern that any resultant benefits from regulatory action should be balanced against the potential cost and impact on competitiveness of UK industry. In particular, it was noted that control levels were already the strictest within the EU. With regard to **adopting alternative technologies** or moving towards **substitution of chemicals**, only one response agreed with the overall proposals of the Agency. There was a strong sentiment that change should await the scientific confirmation of the problems suggested as possibly arising from endocrine disruption (seven responses) while one response noted that any substitute chemical would need to be tested thoroughly against the current chemical to confirm the benefits of any change. Seven responses stressed the need for any decision on alternatives to be based on sound science. However, one response noted that there was a potential conflict for industry between the development of alternatives and the rapid increase in numbers of potential EDs. It was further suggested in many responses that consumer-led pressure and free-market forces were already sufficient to ensure that industry moved towards more environmentally-friendly products or processes. However, concern was expressed over the costs involved, with one response noting that there was currently no financial reward for change. It was also suggested that regulatory enforcement might have a place if it ensured a 'level playing field' across industry. One response felt that voluntary controls were unlikely to be effective and that enforcement by regulation may be required to ensure general compliance. The implication here was that because of globalisation, care should be taken to ensure that UK industry was not unfairly disadvantaged. Seven responses, however, noted that where there was clear evidence, based on sound science and risk assessment, of harm to humans or wildlife,

industry would take appropriate action. It was also noted that substitution of particular substances was already occurring in some industrial sectors, for example, APEs although two responses requested that more detailed information on composition was provided by chemical suppliers to the intended industrial users. Regarding **future progress and collaboration**, there was strong recognition of the need to adopt an international (10 responses), multi-stakeholder (eight responses) approach to this issue, and the comment was made that the Agency initiative in isolation was unhelpful and too restrictive in scope. Intergovernmental co-ordination was considered essential. Many responses highlighted the extent of research being funded by industry, in particular research on testing strategies, human health and environmental effects.

2.8 Multi-stakeholder group

Other comments, not presented in Table 1, included those of a multi-stakeholder group which noted that it was appropriate to address effluents rather than attempt to develop controls on a chemical by chemical basis, and suggested the need for screening tests capable of testing mixtures.

3 SUMMARY OF FINDINGS

Overall, 62 responses were received from a wide range of interest groups including government departments and agencies, Environment Agency customer groups, academics and professional bodies, individual scientists or consultancies, non-governmental organisations and various industries. It is important to acknowledge that this document only reports views as presented in the written responses received by the Agency. As such, no account was taken of any views or opinions of an interested party that may have been expressed through other means but which were not included in their written response.

All those responding were positive about the consultation exercise and were grateful to the Environment Agency for the opportunity to provide comments. Although the majority of responses recognised the importance of the EDs issue, a small number expressed concern that actions were being driven by public opinion rather than sound science. The responses of the various stakeholders to the five points (or questions) raised by the Agency are summarised below:

Point 1: how can priorities be determined for action and what are the priority categories of chemicals?

Some respondents recommended priority should be given to persistent and bioaccumulative substances. Concerns were expressed by others over the intended use of inventories of priority chemicals, particularly given the limited scope of the chemicals currently considered in the Agencies lists and the lack of any validated testing strategy. There was an overall feeling from all those responding that the development of a testing strategy for ED activity should be given high priority. While some responses suggested that the precautionary principle should be invoked now, backed by regulatory action if necessary, a greater number were of the opinion that there is currently insufficient information to warrant action, and current evidence was suggested to only provide cause for concern rather than to establish any causality. Some responses suggested additional chemicals for inclusion in the Agency's list.

Point 2: Is the general balance of the proposed approach correct?

Some respondents questioned the scientific basis for identification of some chemicals as endocrine disrupters and were concerned that the range of sources considered by the Agency was too restrictive. In addition, a number of respondents highlighted the need to balance the potential effects of EDs on human health and wildlife with other possible causal factors such as lifestyle and diet. The aqueous environment was recognised as being at risk from EDs. However, the need to investigate other habitats, including the terrestrial and sedimentary environments, was noted.

Point 3: Are the areas identified in the document for further action adequate and what other actions should be considered?

A large number of topics were highlighted as requiring additional research effort. These can be classified into three main areas:

- basic science, involving the study of inter-species differences in endocrine systems, assessment of the significance to populations of ED effects in individuals (especially fish and invertebrates), and investigation of the causes of reproductive abnormalities in the apparent absence of ED exposure;

- fate and behaviour of EDs in STWs and the wider environment, identification of possible enhancements to STW treatment processes to remove or deactivate EDs, assessment of the contribution of landfill leachate to the observed effects in surface waters, determination of levels of EDs in those underground water sources used for abstraction of drinking water, and assessment of the ED content of sewage sludge and the implications of its use on agricultural land; and the
- investigation of the effects of river flow rate on effluent dilution and review of abstraction licences, especially regarding times of drought.

The general consensus was that monitoring should be focused initially on already identified high risk areas, although a few respondents called for widespread monitoring of all waters receiving effluent discharges.

The majority opinion on the approach to the control of chemicals was that internationally-harmonised EQSs for EDs should be developed, taking account of ED-relevant endpoints. However, concern was expressed over the time that is required to develop such standards. Some responses recommended that EDs should be made prescribed substances, thus allowing control using BATNEEC.

Point 4: What is the potential to develop alternative technologies and products, and what this might cost?

While a number of respondents recommended moving to more environmentally-friendly substances and processes through substitution, most highlighted the need to ensure thorough comparative testing in advance of any replacement, and some felt that this was not currently possible because of the lack of agreed test methods or, indeed, confirmation of the existence of a problem. There was little attempt to estimate the likely costs involved in the development of such alternatives.

Point 5: What are the opportunities for collaboration in addressing further research priorities at both national and international level?

There was a general consensus by those that commented that future activities should take place on an international basis and should involve all stakeholders, although there were some concerns that this approach introduced the risk of delay and might impede progress. Additional points raised included the need for national and international co-ordination to avoid duplication of effort or resource, for steps to be taken to avoid the development of any adversarial attitudes between the various interested parties, and for all information to be published openly in an unbiased manner. Some responses suggested that one benefit of an international approach would be to avoid unilateral decisions that could potential lead to adverse impacts on the national economy. Several responses stressed the need for any future decisions to be based on sound science, validated risk assessment, and to incorporate cost-benefit analysis.

On the issue of funding, a significant number of responses accepted the principle of 'polluter pays', although it was noted that in the absence of identified substances or sources, government funding would be required. Responses from industry groups highlighted the high level of existing funding already committed to research on the ED issue, both nationally and internationally, by various industrial organisations.

Overview

Overall, the consultation exercise was welcomed by all stakeholders. While there was general concurrence with many areas of the Agency's proposals, there was some divergence of opinion relating to specific details of the document, and a number of possible alternative approaches were suggested.

With the exception of academics and professional bodies, at least half of the stakeholders from each interest group addressed the question of the prioritisation of chemicals and actions. Support for this aspect of the Environment Agency proposals was variable, with concerns being expressed most frequently amongst industries other than the water companies. Many Government departments and non-governmental organisations were generally supportive of the balance of the proposed approach. However, non-water related industries in particular stressed the need to concentrate mainly upon developing a validated testing strategy for EDs. This question drew relatively few responses from the water industry, consultants, academics or professional bodies. Further actions were suggested by all interest groups; these are discussed in detail in Section 2. The issue of alternative technologies and chemical substitution elicited much debate. Stakeholders from government departments, agency customer groups and academic/ professional bodies cautioned that care would be necessary to ensure any changes were justified in terms of improved safety. This point was also made by some non-governmental organisations. Amongst industrial respondents comments were quite divergent reflecting the range of activities and interests of these stakeholders. Consultants did not make particular comment on this issue. Although all parties accepted the need to develop a collaborative approach to the ED issue, there was evidence of some difference in emphasis, with several stakeholders responding favourably to the possibility of taking action at the level of the Agency while many industrial respondents (especially among the non-water industry groups) believed that successful solutions could only result from discussions involving multiple-stakeholders at an international level.

Table 1 Overview of responses to the Environment Agency received from various interest groups

EA Question/ response	Respondent						
	Government	Agency-customer groups	Academia/ Professional bodies	Consultants	NGOs	Water Industry	Other Industry
No. of submissions:	11	4	11	4	11	4	15
Overall attitude to EA document -							
In agreement:	11	4	4	1	7	1	
Reservations:		1 (too scientific for lay reader)					2
Welcomed consultation exercise:	11	4	4	1	8	2	10

Table 1 (continued) Overview of responses to the Environment Agency received from various interest groups

EA Question/ response	Respondent						
	Government	Agency-customer groups	Academia / professional bodies	Consultants	NGOs	Water Industry	Other Industry
Determination of priority chemicals and actions							
Overall agreement with Agency proposal: Yes No	5	2	3	1	4		1 7
Acceptance of endocrine disruption as a cause for concern:	3	1	4	2	8		3 (1 considered not to be a problem for own industry)
Immediate implementation of precautionary principle justifiable - Yes: No:	1 2	2	1	1 1	3	2	1 9
Accept Agency position on inventory of chemicals and/or Prioritisation	4		3	2	4	3	3

Table 1 (continued) Overview of responses to the Environment Agency received from various interest groups

EA Question/ response	Respondent						
	Government	**Agency-customer groups**	**Academia / professional bodies**	**Consultants**	**NGOs**	**Water Industry**	**Other Industry**
Setting a balance between prevention and continued research							
Overall agreement with attitude to EA proposals	8	2	2		6		1
At risk habitats and animals							
Humans	1						
Human water supplies:			1 (ground water & aquifers)				
Top predators:			1		1		
Aquatic environment:	4				2		
Terrestrial:	2						
Sediment:			1 (invertebrates)				
Prioritisation of development of ED testing strategy:	2	2	3	2	3	1	8

Table 1 (continued) Overview of responses to the Environment Agency received from various interest groups

EA Question/ response	Respondent						
	Government	Agency-customer groups	Academia / professional bodies	Consultants	NGOs	Water Industry	Other Industry
Areas for further action							
Accept EA position on areas for further action -	6	2	1		5		
Monitoring strategies	Currently use a targeted approach					Water industry will monitor APs & APEs.	
Development of alternative technologies							
Acceptance of EA position:	4	2	1		4		1
Other suggestions							
Adopt market led/voluntary approach:	1				1		1 (focus on chemicals with existing environmentally friendly alternatives)
Attitude to introduction of substitutes							
Introduce wherever possible:		1	2		4	1	1 (work with suppliers to identify new processes & chemicals)

Table 1 (continued) Overview of responses to the Environment Agency received from various interest groups

EA Question/ response	Respondent						
	Government	Agency-customer groups	Academia / professional bodies	Consultants	NGOs	Water Industry	Other Industry
Future approach to problem:							
Accept EA position:	4	2	2		4		
Require national approach		1 (to address river flow / effluent dilution)					
Require international approach	3		1		2	1	10
Require multiple stakeholders:	4		1		1	2	8

REFERENCES

Environment Agency (1998a) *Endocrine-disrupting substances in wildlife: A review of the scientific evidence and strategic response*, Publication number: HO-11/97-100-B-BANP available from Environment Agency, Rio House, Bristol, UK

Environment Agency (1998b) *Endocrine-disrupting substances in the environment: What should be done?* (Environmental Issues Series), available from Environment Agency, Rio House, Bristol, UK

ANNEX

Organisations submitting comments

NAME OF INDIVIDUAL	COMPANY NAME AND ADDRESS
Dr E Ebert	AgroEvo
Dr P J Donnelly	Akros Chemicals
A J Newbould	British Coatings Federation Ltd
Mr Grahame Newman	British Waterways
D J Allen	British Geological Survey
Dr S M Grimes	Brunel University
Mr Merfyn Williams	Campaign for the Protection of Rural Wales
Elizabeth Surkovic	Chemical Industries Association
Tanya Hodge	Country Landowners Association
Dr Ted Richards	Courtaulds
Ms F Pollitt	Department of Health
Sheena Fraser	East of Scotland Water
Dr K L Duff	English Nature
Nigel Morris	Environment Agency

	(for REPAC South West)
Mr J R Lamont	Environment and Heritage Service Northern Ireland
Mr G R Hayward	European Resin manufacturers' Association
Mr Ken Collins	European Parliament
Mr Rothwell	Fisheries Advisory Committee Chairman
Mr D G Bellamy	Food and Drink Federation
Professor Colin S Reynolds	Freshwater Biological Association
Dr Michael Warhurst	Friends of the Earth
Mr Paul Goettlich	Hoosier Environmental Council, Indiana, USA
F G Rose	ICI
Mr Dave Muir	Industry Nature Conservation Association
Professor A D Pickering Dr Mike Ladle	Institute of Freshwater Ecology
Dr A C Johnson	Institute of Hydrology
Keith Fitzpatrick	Kimberly-Clark Europe
Councillor Sir John Harman	Kirklees Metropolitan Council

D E Jones	MAFF
Professor Lewis Smith	MRC Institute for Environment and Health
Mr M H Litchfield	Melrose Consultancy
Robin Davis	Metal Packaging Manufacturers Association
Mr Mark Hatcher	National Association of Fisheries and Angling Consultatives
Dr Keith Hendry	National Federation of Anglers
Dr T H Massey	National Power PLC
Bill Emery	OFWAT
Dr G Rees	Robens Centre for Public and Environmental Health
Dr R B Pearson	Rupert Pearson Consultants
Mr G K Bruce	Pesticides Safety Directorate
Mr G A Young	Portals Ltd
Ms Kathleen Atkinson	REPAC (North West Region)
Ms Lynda M Warren	REPAC Sub-Group (Welsh)
Ms M P Henton	SEPA
Mr Roger Martin	Somerset Wildlife Trust

Mr John Spence	Southern Water
P Hackett	Specialist Anglers Conservation Group
Jane Cecil	Sussex Area Environment Group (Environment Agency)
Dr John Solbe	The Atlantic Salmon Trust
Professor Peter Calow	Department of Animal and Plant Sciences
Dr H J Harvey	The National Trust
Mr Richard Shuter	The Otter Trust
Mr Neil Edwards	The Inland Waterways Association
Dr R A Fuller	The Institute of Environmental Sciences
Ms Patricia Donoghue	The Confederation of British Wool Textiles Limited
Professor D Taylor	The Royal Society of Chemistry
Dr D C Cowell	University of the West of England
Ted Thairs	Water UK
Dr G Lyons	World Wildlife Fund UK
Mr Geoff Roberts	Yorkshire Water Services Ltd