Response to the report 'Monitoring Pesticides - A Review'

Report and recommendations of the Environmental Protection Authority

Environmental Protection Authority
Bulletin 499
February 1991

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ISBN 0 7309 3484 5
ISSN 1030-0120

Preface

In Western Australia there have been a number of suspected cases where adverse environmental impacts related to pesticide use have occurred. They range from localised patches of dead vegetation along railway reserves to organochlorine pesticide contamination of many soils and water courses in south-west WA. Pesticide contamination is a potentially important environmental problem, but often its effects are not immediately observable, and therefore the documented cases may not give a true indication of the scale of the problem. Consequently, in WA this issue tends to be neglected in the face of the more obvious and immediately demanding environmental problems of salinity, eutrophication, clearing of native vegetation, industrial waste discharges, and others.

Concerns over pesticide issues have been increasing both within Australia and overseas, as indicated by the following examples:

- the United States has recently publicised its decision to lower the permitted Maximum Residue Limits (MRLs) for contaminants (including pesticides) in imported foods;
- the recently released 'Report of the Senate Select Committee on Agricultural and Veterinary Chemicals in Australia' (The Parliament of the Commonwealth of Australia, 1990);
- the report 'Pesticides: Issues and Options for New Zealand' recently released by the New Zealand Ministry for the Environment (MacIntyre et al, 1989); and
- a draft OECD Act which would essentially be an international agreement for the investigation and control of existing chemicals in the environment and to which Australia is considering becoming a party.

There is clearly an increasing community expectation for Government to assume the responsibility of better managing pesticide use to minimise adverse impacts on both the environment and public health. The Environmental Protection Authority's concern over these issues prompted it to commission the report 'Monitoring Pesticides - A Review' by Mr P Rutherford, pesticide co-ordinator of the WA Department of Agriculture.

This bulletin is the Authority's response to the recommendations contained in the Rutherford report, and to the submissions received on it.

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The Environmental Protection Authority recommends that the Pesticides Advisory Committee (PAC) should coordinate pesticide-related environmental monitoring programmes and make recommendations to the appropriate agencies to assist with the coordination of environmental and health pesticide management and policy issues across government.

Recommendation 2

The Environmental Protection Authority recommends that the Pesticides Advisory Committee should be responsible for ensuring that the results of pesticide-related environmental monitoring programmes are made public.

Recommendation 3

The Environmental Protection Authority recommends that the WA Department of Occupational Health Safety and Welfare and the Environmental Protection Authority be given formal membership on the Pesticides Advisory Committee.

Recommendation 4

The Environmental Protection Authority recommends that the Pesticides Advisory Committee should advise on the resources required to enable programmes of pesticide monitoring, assessment, management and policy formulation to be adequately prioritised and addressed.

Recommendation 5

The Environmental Protection Authority recommends that the following programmes should be initiated by the Pesticides Advisory Committee as a matter of priority:

- **the environmental hazard posed by pesticide residues in the aquatic environment should be determined, with specific investigation of:**
  - **wetlands and the effect of pesticides on aquatic ecology;**
  - **river and estuarine systems, and the effect of pesticides on the associated flora and fauna;**
  - **the effect of transient pulses of pesticides from spraying programmes on stream and river communities; and**
  - **rainfall, groundwater under rubbish tips, harbour waters and sediments;**
- **the environmental hazard posed by agricultural spray drift and pest control operations to native terrestrial flora and fauna, and particularly to the ecosystems contained within Reserves and National Parks;**
- **the desirability of a systematic/opportunistic pesticide monitoring programme on the Australian Magpie (*Gymnorhina tibicen*) and the European Wild Rabbit (*Oryctolagus cuniculus*) should be determined;**
- **the fate of pesticides in Western Australian soils should be investigated;**

Recommendation 6

The Environmental Protection Authority recommends that the data collected by the Department of Agriculture on organochlorine pesticide contamination in Western Australian soils should be analysed and reported so that organochlorine pesticide monitoring programmes can be appropriately designed and executed.

Recommendation 7

The Environmental Protection Authority recommends that the Roadside Conservation Committee should continue to investigate reports of herbicide damage to native vegetation and should recommend to the Pesticides Advisory Committee ways of minimising the problem.

Recommendation 8

The Environmental Protection Authority recommends that Integrated Pest Management (IPM) methods should be investigated by the Department of Agriculture, Department of Conservation and Land Management and other relevant organisations, and promoted to the rural community.

Recommendation 9

The Environmental Protection Authority recommends that the Health Department and the Department of Agriculture should investigate ways of ensuring that pesticides and empty pesticide containers are stored and/or disposed in an environmentally responsible manner, particularly in rural areas. (This may require the use of legislation, guidelines and public education and should be supervised by the Pesticides Advisory Committee).

Recommendation 10

The Environmental Protection Authority recommends that the Government should encourage the chemical industry to introduce reusable containers and investigate the feasibility of deposit legislation for these containers.

Recommendation 11

The Environmental Protection Authority recommends that the Government should expedite implementation of the Draft Dangerous Goods Regulations.

1. Introduction

Since the 1940s chemical use for the control of pest species such as disease transmitting insects, crop damaging organisms, nuisance insects, weeds, fungi and bacteria has become of increasing importance. Pesticides were considered to be a solution to world food shortages and health problems. Now society as a whole relies upon the use of pesticides for primary production and disease control, and the world's food supply and economy would be threatened if pesticides were withdrawn from use.

Apart from the obvious benefits gained from pesticides, a number of undesirable effects have become apparent since the advent of their use. Long-term effects of exposure have been recognised and as a result health and environmental criteria for acceptable pesticide exposure levels are continually being revised as new information becomes available. Consequently newer pesticides which are more specific, and therefore environmentally safer, are being developed. As the older pesticides become obsolete, or are banned, an additional problem is raised, that of safe pesticide storage and disposal. It is essential that adequate provision is made for pesticides to be easily stored or disposed of so as to provide long-term protection for human health and the environment.

In Western Australia alone the agrochemical industry made approximately $70 million worth of sales in 1987, of which over 80% was herbicide (Figure 1), for treating approximately 29% or 4.6 million hectares of the agricultural land in the State. Moreover, the report of the Senate Select Committee on Agricultural and Veterinary Chemicals in Australia (The Parliament of the Commonwealth of Australia, 1990) estimates that 7.5 million hectares of agricultural land are sprayed from the air each year in Australia.

There is also a significant and growing market for chemicals that are used for non-agricultural purposes. Of the approximately 274 active chemicals registered in 1986 for use as pesticides in WA, almost half were registered for non-agricultural use, although a much smaller proportion of the sales were for non-agricultural uses.

In Western Australia, as has occurred elsewhere in the world, there has been an increase in understanding of the adverse effects of pesticides on non-target organisms. However, to date most of the government effort has focused on human health issues. The current State Government has a statutory advisory committee established under the Health Act to deal with health-related issues, including the registration of pesticides for use in WA.

The Environmental Protection Authority (EPA) of WA has become concerned that the issue of pesticides in the environment, both management and monitoring, is not being adequately addressed. For this reason in 1987 Mr P Rutherford was seconded to the EPA from the Department of Agriculture to review pesticide use and monitoring in the State. The objectives of his study were three-fold:

- To review existing patterns of pesticide use in Western Australia and identify actual and potential environmental impacts;
- To review past and current procedures conducted by the State Government and other agencies for monitoring the environmental impact of pesticides and discuss the adequacy of the existing programmes on an ecosystem basis; and
- To make recommendations to the EPA regarding future monitoring requirements, and other actions necessary to eliminate or minimise the adverse environmental effects of pesticides.

The Rutherford report was completed as EPA Bulletin 407 (Rutherford, 1989) and released for public comment in December 1989. Submissions were also elicited from a number of State government agencies. Fifteen submissions were received, and these are summarised in the Appendix.

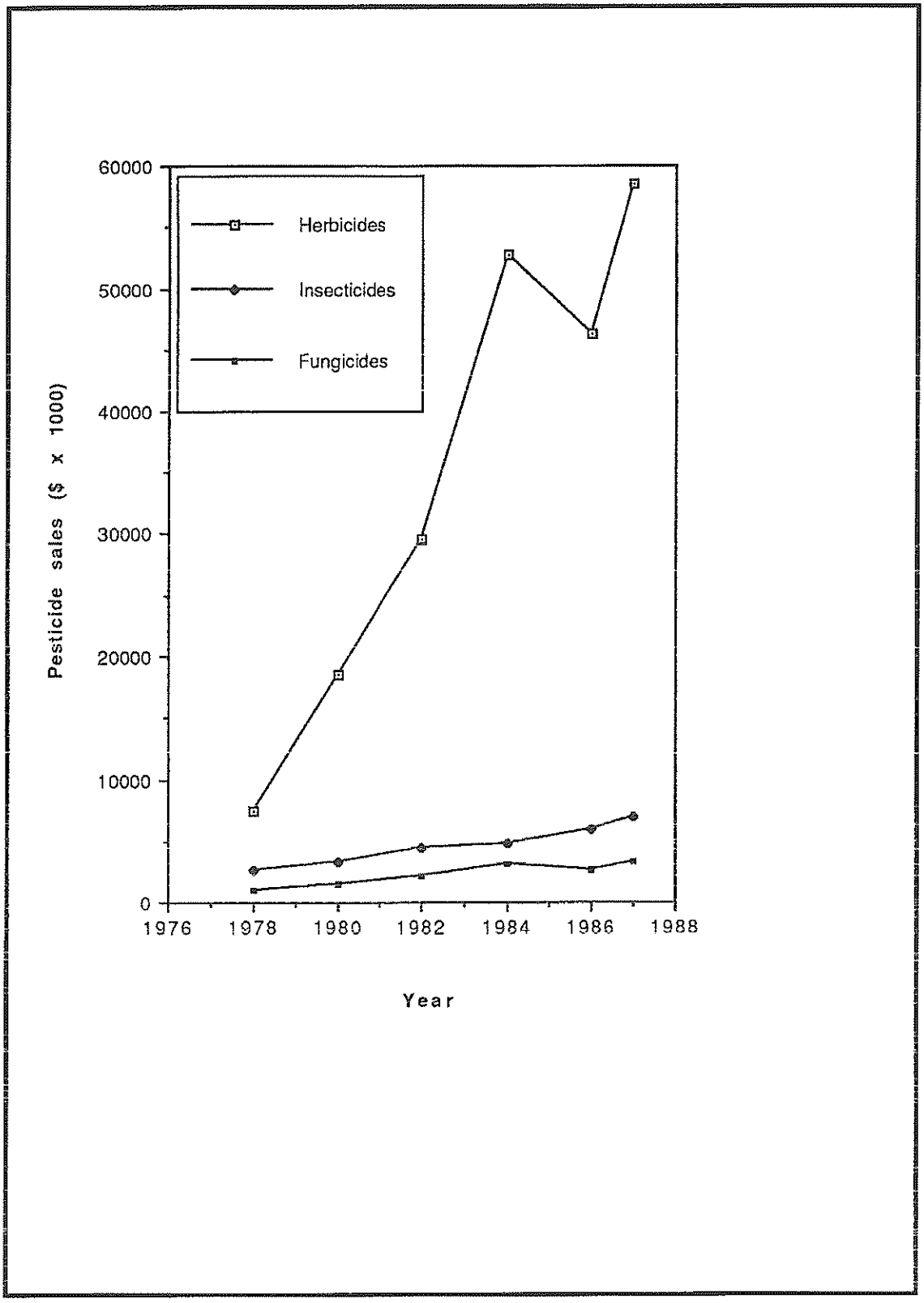

Figure 1: Pesticide sales for Western Australia (data from Bulletin 407 (Rutherford, 1989))

2. Summary of the Rutherford Report

The report considered the effects of pesticides, as defined in the Health Regulations of the Health Act, on the natural and physical environment, including soil, water, air and all native animals and plants.

The report briefly discusses the pesticides used in WA, the methods of application and associated potential and actual environmental impacts for a range of associated agricultural and non-agricultural activities such as: manufacture and formulation, transport and storage, disposal of surplus pesticide and used containers, cultivation of broadacre crops and pastures, horticulture, grain protection, animal husbandry, declared plant and animal control, forestry, industrial weed control, aquatic weed control, commercial pest control, Argentine Ant control and mosquito/midge control. Horticultural crops were identified as the most intensive users of agrochemicals, often receiving several applications of chemicals over a growing season. Methods of application were similar for a wide range of activities. Some of the more commonly used methods of application include boomspray, mister, knapsack, single nozzle sprayer and aerial techniques. The predominant actual and potential environmental impacts common to most pesticide activities, and those which should be of most concern, were identified in the report as follows:

contamination of surface water (eg. water courses and waterbodies);

contamination of groundwater;

contamination of soil;

contamination of air; and

adverse impacts on non-target species of fauna and flora.

The report also gave a review of past and present-pesticide related environmental monitoring programmes conducted by WA government agencies, CSIRO and tertiary institutions. These are listed below by agency.

Department of Agriculture:

Pesticide investigations carried out by the Department of Agriculture have mainly been issue-based, dealing predominantly with effects on agricultural production and, to some extent, the fate of the pesticides after their application.

Airborne 2,4-D and tomato damage at Geraldton;

Long-term effects of herbicides in cropping systems;

Organochlorine levels in soil, pasture and water at Lake Neerabup;

DDT levels in soil, crop and pasture, water and sediment as a result of its use in cereal cropping;

Insecticide residues in agricultural soils (organochlorines); and

Miscellaneous monitoring work.

Agriculture Protection Board:

Herbicide residues in flowing streams as a result of Blackberry control;

Non-target fauna — effect of dingo baiting; and

Fenitrothion levels in the environment after locust spraying campaign, 1982.

Department of Conservation and Land Management:

Organochlorine residues in the Western or Australian Magpie;

Pesticide levels after Plague Locust spraying operations; and

Miscellaneous residue levels in birds.

Environmental Protection Authority:

Pesticide residue levels in Cockburn Sound;

Study to establish baseline levels of contaminants and nutrients in marine waters of WA; and

- A preliminary study of pesticides in rivers and estuaries of WA.

Fisheries Department:

- Pesticides in Marron; and
- Miscellaneous pesticide monitoring.

Chemistry Centre of WA:

- Report on pesticide residue sampling for the Ord River irrigation area 1964 - 1978 (Gorman, 1979); and
- Dieldrin residues— a Western Australian study (Shewchuk, 1981).

Water Authority of WA:

- Monitoring of river systems and reservoirs for contaminants, including pesticides, at several levels under several different programmes;
- Groundwater monitoring at CIK Pty Ltd in Kwinana;
- Routine monitoring of groundwater production bores;
- Routine monitoring of waste disposal sites; and
- Soil sampling in the south-west.

Waterways Commission:

- Heavy metals in sediments and mussels of the Swan River system;
- Heavy metals and pesticides in surface sediments near slipping facilities on the Swan River;
- Swan Canning Estuarine System: Environment Use and the Future (Thurlow et al, 1986);
- Organochlorine pesticide residues in the Preston River (Atkins, 1982; Klemm, 1989) and ongoing in the Preston and Collie Rivers; and
- Avon River System Fact Finding Study (Hansen, 1986).

CSIRO:

- An EPA commissioned report 'Organochlorine residues in sediments and soils in and around Lake Goolellal' (Gerritse, 1988).

Curtin University of Technology:

- Pesticide Residues around Swan Coastal Plain Lakes (Ford and Stacey, 1983).

Murdoch University:

- Herdsman Lake Pesticide Study - Interim Report (Davis and Garland, 1986) plus subsequent studies;
- Forrestdale Lake Chironomid Study (Davis et al, 1987); and
- Investigations into more Effective Control of Nuisance Chironomids (non-biting midges) in Metropolitan Wetlands, Perth, WA (Davis et al, 1988).

The report identifies the organochlorine insecticides as being potentially the most environmentally threatening of the pesticides. It concludes that pesticide contamination in the air is insignificant and that further substantial environmental monitoring in this regard is unnecessary, but that the effects of contamination in the soil, on native vegetation, in groundwater and in aquatic and marine environments require further investigation. The report considers that previous environmental monitoring programmes, particularly for streams and rivers, had been rather ad hoc and uncoordinated and that a structure is therefore required to coordinate future work on an across government basis.

The recommendations of the Rutherford report are contained in the Appendix together with a summary of the received submissions.

3. Discussion of EPA recommendations

The EPA accepts the broad thrust of the Rutherford report and its recommendations. However, from suggestions made in submissions, and from further consideration by the Authority, some additional recommendations are made in this report. Some of the recommendations contained in the Rutherford report have been amalgamated in the EPA's recommendations, or have already been implemented. The Rutherford recommendations concentrated on the organochlorine insecticides, however, the Environmental Protection Authority considers that the intent of its recommendations should be broadened to include all pesticides. Many of the chemicals that have replaced the organochlorines are certainly much less persistent, but are more toxic.

3.1 Programme coordination

There are many cases of pesticide contamination of agricultural soils and some evidence of contamination in aquatic environments in WA. There are also a number of suspected cases where wildlife have been poisoned by pesticides, but these are very difficult to prove.

Organochlorine pesticide residues have been detected in many of Western Australia's aquatic ecosystems. A recent EPA survey of several river systems in the south-west of the State revealed that many of these rivers contain concentrations above the EPA criteria for the preservation of aquatic ecosystems as published in DCE (now EPA) Bulletin 103 (DCE, 1981). These pesticides have recently been banned from almost all agricultural uses and therefore environmental contamination should slowly reduce as the chemicals break down. As already mentioned, many of the chemicals used in the place of organochlorines (eg. organophosphates) are more toxic to animals, but break down much more quickly. Hence long-term contamination of the environment and accumulation in ecosystems is less likely to occur, however, impacts on non-target organisms may be more pronounced unless new broad spectrum pesticides are used with care.

Pesticides have become an integral part of everyday life, serving a number of important functions such as pest control and enhancement of primary production. For this reason some pesticides may always have a place in our society, however, their use should always be managed in such a way as to reduce any adverse environmental impacts. Unfortunately there is no government mechanism to determine the environmental acceptability of agricultural chemicals, or appropriate methods for their use, in Western Australia. Some environmental pesticide monitoring programmes have been carried out by a number of government agencies and tertiary institutions, but almost always in response to a particular issue that was prominent at the time and never with a pro-active objective. Some exceptions are the efficacy investigations carried out by the Department of Agriculture, but they have little relevance to environmental issues. The problem is that too few resources are committed to determining the adverse environmental impacts of agrochemicals. This problem is not confined to WA and has also been highlighted in two other recent reports:

- Pesticides: Issues and Options for New Zealand published by the New Zealand Ministry for the Environment (MacIntyre et al, 1989);
- Report of the Senate Select Committee on Agricultural and Veterinary Chemicals in Australia (The Parliament of the Commonwealth of Australia, 1990).

The Government has a clear responsibility to the community to ensure that the environment is maintained in a healthy and resilient state. There are only two legislative controls that the State Government may use to prevent contamination of the natural environment by pesticide use. Under Part V of the Environmental Protection Act, the act of contamination could be termed pollution and the polluter, if an individual, fined $10 000 (or 6 months imprisonment) and $2 000 per day of continued pollution, or $20 000 and $4 000 daily, if the polluter is a body corporate, and ordered to pay for the cost of clean-up. Action taken under Part V of the Environmental Protection Act is reactive, and does not fulfil the requirements outlined above. The Health Department has extensive control of the registration and use of pesticides within the State in regard to health matters. A Pesticides Advisory Committee (PAC) has been established under the Health Act and has a statutory responsibility to advise the Minister for Health on pesticide-related health matters, and also on the registration of pesticides for use in WA. It also provides advice on the use and disposal of pesticides to minimise the

risk to human health. Membership of the PAC consists of two representatives from the Health Department (Chairman and Secretary), and representatives from the Chemistry Centre of WA and the Department of Agriculture. The EPA and the Department of Occupational Health, Safety and Welfare have observer status only at PAC meetings. Unfortunately ecosystems are more sensitive to pesticides than are humans and therefore require further protection.

To provide effective advice, guidance and control on pesticide use and associated adverse environmental impacts, the Western Australian Government must commit adequate resources to the area and develop a strategy which ensures a coordinated Government approach. The government agencies who promote the use of pesticides should be part of the strategy, along with the agencies with responsibility for managing the environment.

An appropriate agency for implementing or coordinating this strategy would appear at first sight to be the Environmental Protection Authority since it administers the legislation of the Environmental Protection Act. However, efficient across government coordination is unlikely without the formation of a new committee which includes representatives from all the other relevant government agencies. The Pesticides Advisory Committee, under the Minister for Health, may therefore be the most appropriate agency for this role if it were expanded to include environmental issues. The committee should be independent and should provide a focal point for the dissemination of information and advice on policy matters relating to the effects of pesticides on the environment and health, and for the responsibility of coordinating monitoring and management programmes within the State. It should be concerned with monitoring the fate and impacts of pesticides in the environment and toxicity to local species, and should ensure that the information is made available to the public. It should be involved in making recommendations to the Minister for Health, the Minister for Environment and the Western Australian Advisory Committee on Hazardous Substances (WAACHS) on policy. The committee should also ensure the coordination of funding for priority projects. Given the heavy work load expected of the committee it may need full time staff resources allocated in addition to relying on the resources of its member agencies to carry out the work. The Authority therefore supports Recommendation 15 of the Rutherford report and proposes the following recommendations:

Recommendation 1

The Environmental Protection Authority recommends that the Pesticides Advisory Committee (PAC) should coordinate pesticide-related environmental monitoring programmes and make recommendations to the appropriate agencies to assist with the coordination of environmental and health pesticide management and policy issues across government.

Recommendation 2

The Environmental Protection Authority recommends that the Pesticides Advisory Committee should be responsible for ensuring that the results of pesticide-related environmental monitoring programmes are made public.

Recommendation 1 is the most important of this report. The thrust of the other recommendations would be the brief of this committee and therefore considerable discussion and effort is required to develop an effective structure. Since the brief of the PAC would be much broader if it also dealt with environmental issues, it is the EPA's view that the PAC membership should also include representation from the Environment Portfolio. The EPA understands that amendment of the Health Act to formally include the EPA and Department of Occupational Health Safety and Welfare on the PAC is in process. The EPA fully supports the proposed change.

Recommendation 3

The Environmental Protection Authority recommends that the WA Department of Occupational Health Safety and Welfare and the Environmental Protection Authority be given formal membership on the Pesticides Advisory Committee.

For the PAC to effectively deal with issues relating to pesticides and the environment it may be necessary to form a subcommittee which reports to it. This has been endorsed by WAACHS and the Health Department for implementation.

The Authority envisages that membership of the subcommittee would include representatives from the following government departments:

- Environmental Protection Authority;
- Chemistry Centre;
- Department of Agriculture;
- Agriculture Protection Board;
- Department of Conservation and Land Management;
- Department of Local Government; and
- Water Authority of WA.

Representation from the Waterways Commission, Main Roads Department and Westrail may also be considered appropriate to increase the resources available to the Committee.

The Committee would continue to report to the Minister for Health in an advisory capacity and for input into policy formulation. Reporting to the Minister for Environment would be on a formal basis through the Minister for Health, and/or through EPA representation. The Committee would maintain its role in the pesticide registration process.

In addition to the committed resources of its member agencies, the Committee may need additional resourcing for administration and investigations, or to contract professional assistance. In this case potential sources which Government may consider for fund generation should be on a polluter pays basis and could include grants from those agencies which promote pesticide use, a tax on the agrochemical companies or an environmental levy on all pesticide purchases. The funding mechanism would need to be built into the structure under which the Committee works. The New Zealand Ministry for the Environment report 'Pesticides: Issues and Options for New Zealand' (MacIntyre et al, 1989) gives an excellent detailed discussion of funding alternatives for New Zealand Government involvement in the areas of risk assessment, environmental research and residue monitoring, education/training and labelling, and the research, development and dissemination of low pesticide use alternatives. These funding options are listed below:

- general tax revenue;
- registration charges;
- charges for the renewal of registrations;
- taxing pesticide use (a tax on company turnover, or on active ingredient);
- direct charges for services;
- producer board (growers) levies; and
- joint funding (of all or some of the above).

Recommendation 4

The Environmental Protection Authority recommends that the Pesticides Advisory Committee should advise on the resources required to enable programmes of pesticide monitoring, assessment, management and policy formulation to be adequately prioritised and addressed.

3.2 Aquatic systems

Examples of pesticide application directly to aquatic systems are few. Probably the most common examples would be midge and mosquito control programmes and the use of antifouling paints on the bottom of boats.

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3.2 Aquatic systems

Examples of pesticide application directly to aquatic systems are few. Probably the most common examples would be midge and mosquito control programmes and the use of antifouling paints on the bottom of boats.

Many of the lakes in the Perth metropolitan region have become eutrophic and now support nuisance populations of insect pests such as midges and mosquitos. Pesticides are generally applied directly to the lakes for control of these pests at the larval stage. Midge species have been monitored extensively around some of the major lakes to determine the effectiveness of the control programmes. However, many other non-target aquatic species are also susceptible to the control chemicals, and are killed. Until recently, these impacts had not been considered. Investigations are now in place to determine more effective and environmentally acceptable methods of control.

Antifouling paints contain chemicals to either discourage organisms from attaching to the bottom of boats or kill them after they have settled. These chemicals leach from the painted surfaces and have been found to accumulate in the sediments of enclosed areas such as harbours, bays and estuaries. Some are persistent and can accumulate down the food chain. They are toxic to non-target marine organisms, some at extremely low levels, and in extreme situations have been known to cause fish kills. For example tributyl tin has been shown to interfere with the reproductive processes of the female Dog Whelk at levels below 0.002 µg/L (Bryan et al, 1988).

Some pesticides applied to the land find their way into aquatic systems. The transport mechanisms involved are predominantly two-fold. The first is by spray drift extending beyond the boundaries of the target areas and settling directly onto the surface of nearby waters. This form of contamination can be minimised with appropriate management practices at the time of application (eg. buffer zones and appropriate wind conditions). Probably the majority of pesticide detected in aquatic environments has been leached from the treated areas by rainfall. The main mechanism appears to be surface runoff during and immediately after rainfall. A recent programme in the south-west which monitored herbicide concentrations in streams after it was applied to adjacent catchments found that peak concentrations occurred during heavy rainfall (McAlpine, 1990). This is substantiated by other studies conducted overseas (Bouchard, 1985; Neary et al, 1983; Lavy et al, 1989). Appropriate management techniques can be used to reduce the quantity of pesticide residue exported from the treated area by reducing the quantity of runoff. In the leached sandy soils that are particularly common on the coastal plains of WA, transport by groundwater movement may also be an important mechanism. Laboratory studies using a range of pesticides in leaching columns have shown that greatest mobility occurs in sandy soils (Helling, 1970; Council for Agricultural Science and Technology, 1985) and the pesticides could therefore accumulate in groundwater below the zone of biological activity where chemical breakdown is slow. There are reported cases of low persistence pesticides (other than the persistent organochlorines) accumulating in groundwater in both Europe and the United States (Williams et al, 1988; International Environment Reporter, 1989).

The effects of agrochemicals on the Western Australian flora and fauna has been largely ignored but this information is vital for their protection and for the environmental assessment of operations involving pesticides and for the development of monitoring programmes. The water quality criteria that are generally used as acceptable limits of contamination are based on toxicity studies carried out in the northern hemisphere on species that are not found in Australia and under conditions that may have no relationship to local conditions. Monitoring programmes and other investigations coordinated by the Pesticides Advisory Committee should include relevant toxicity studies.

3.3 Terrestrial systems

Most pesticides are used in the terrestrial environment for a wide range of reasons, ranging from weed and disease control to insect and mammal pest control. Most of the chemicals are applied to agricultural land by aerial, mister or boomspray equipment, depending on topography, size of the area to be treated, the target, etc. They are used throughout the year and therefore over a range of climatic conditions, and in WA the conditions are extreme, from cold and very wet to hot and very dry. As a result the fate (persistence, mobility and distribution) of the applied chemical will vary since it is depends on temperature, rainfall, moisture etc. There has been very little work carried out in WA on the fate of pesticide residues under local conditions, however, there are models that simulate chemical degradation and mobility in soils and these may be applicable to our situation.

Studies on the environmental fate of agrochemicals are particularly important in areas of heavy use, for example areas of intensive horticulture or areas that are heavily infested with pests such as Argentine Ants. As discussed earlier many of the chemicals used today are not as persistent as the

organochlorines but are often more toxic and therefore have a high potential for adverse environmental impact.

A number of pesticides are used in natural ecosystems for control of declared animal and plant pest species. This is usually carried out on the assumption that both the economic and the environmental impact of the control pesticide is less than that of an alternative method of control or of not controlling the pest. This is often just an assumption and needs to be considered more carefully by implementing a programme to adequately investigate the impacts of the chemicals on native species. These investigations are also required for areas where pesticides applied for agricultural purposes may drift and/or leach into natural environments and to which native species may consequently be exposed.

The majority of pesticide application is in the form of a liquid (atomised) spray which is easily transported several kilometres by either very light or strong winds (Gilbey et al, 1984), shown in Figure 2. As a result the effectiveness of spraying in adverse wind conditions has been questioned because a large proportion of the spray can be lost from the target area. There have been a number of cases where crops have been damaged by pesticides applied to different crops upwind (Gilbey et al, 1984). In this instance the persons responsible for spraying are legally liable for any damage to crops downwind. Guidelines have therefore been provided for the correct conditions of application. However, the fact that crops can be damaged downwind of spraying operations also has obvious implications for natural ecosystems. Taller vegetation in particular has a tendency to accumulate airborne particles including droplets of pesticide. As a result the margins of reserves and road reserves may need special attention in areas of heavy use since the natural vegetation is generally taller than surrounding crops. It may be necessary to develop appropriate strategies to protect natural environments, particularly reserves, and to reduce spray drift during application.

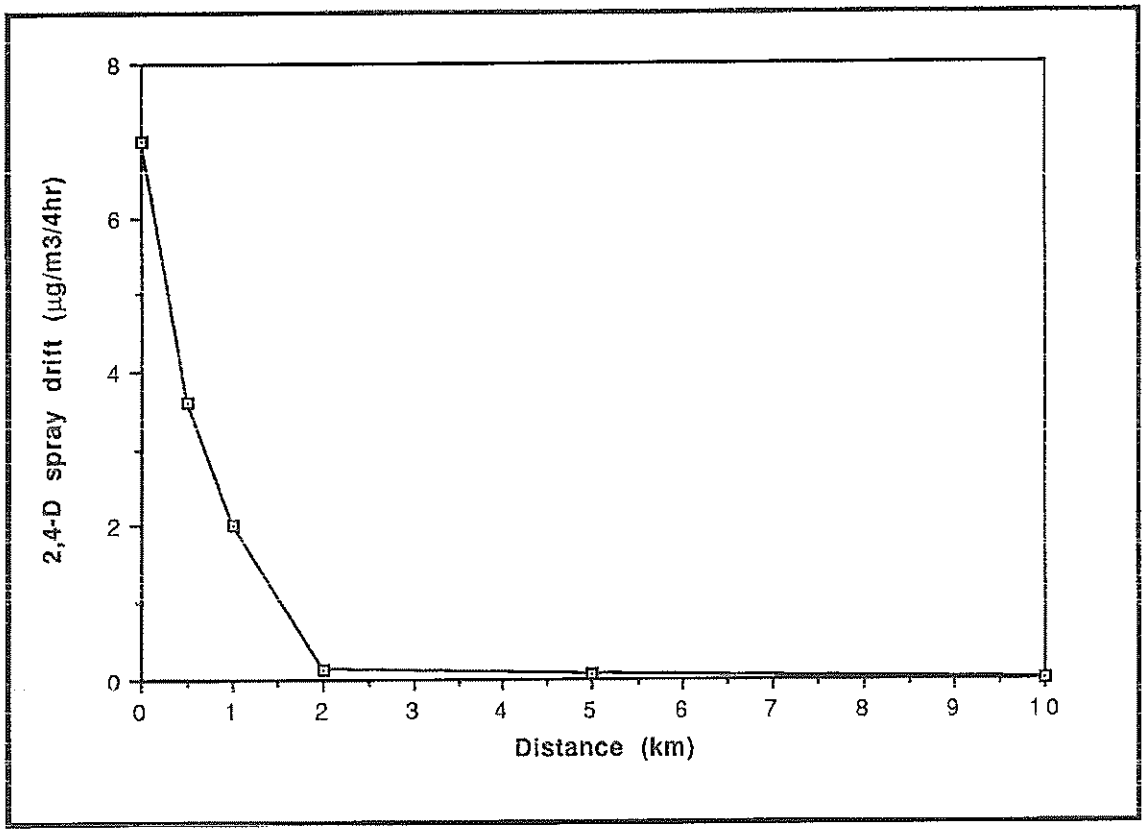

Figure 2: Downwind spray drift measured after 2,4-D application near Geraldton, WA (data from Gilbey et al, 1984)

Overseas studies have also identified an increase in nutrient export from catchments sprayed with herbicides (Neary et al, 1986). This appears to be a result of an increase in the quantity of decomposing organic matter, increased runoff because of lost transpiration and from the stimulation/inhibition of soil micro-organisms (eg. denitrifying bacteria)(Wardrop, undated), many of which can be quite sensitive to the applied chemicals . Apart from the obvious consequence of increased nutrient input to WA's already nutrient threatened waterbodies of the south-west, exposure of the soil microfauna to pesticides may secondarily affect the associated floral communities.

Recommendations 7 to 14 of the Rutherford report have been supported by the Authority and included in Recommendation 5 below.

Recommendation 5

The Environmental Protection Authority recommends that the following programmes should be initiated by the Pesticides Advisory Committee as a matter of priority:

- **the environmental hazard posed by pesticide residues in the aquatic environment should be determined, with specific investigation of:**
  - **wetlands and the effect of pesticides on aquatic ecology;**
  - **river and estuarine systems, and the effect of pesticides on the associated flora and fauna;**
  - **the effect of transient pulses of pesticides from spraying programmes on stream and river communities; and**
  - **rainfall, groundwater under rubbish tips, harbour waters and sediments;**
- **the environmental hazard posed by agricultural spray drift and pest control operations to native terrestrial flora and fauna, and particularly to the ecosystems contained within Reserves and National Parks;**
- **the desirability of a systematic/opportunistic pesticide monitoring programme on the Australian Magpie (*Gymnorhina tibicen*) and the European Wild Rabbit (*Oryctolagus cuniculus*) should be determined;**
- **the fate of pesticides in Western Australian soils should be investigated.**

Recommendation 6

The Environmental Protection Authority recommends that the data collected by the Department of Agriculture on organochlorine pesticide contamination in Western Australian soils should be analysed and reported so that organochlorine pesticide monitoring programmes can be appropriately designed and executed.

Recommendation 6 of the Rutherford report has been supported by the Authority and included as Recommendation 7 below.

Recommendation 7

The Environmental Protection Authority recommends that the Roadside Conservation Committee should continue to investigate reports of herbicide damage to native vegetation and should recommend to the Pesticides Advisory Committee ways of minimising the problem.

3.4 Management of pesticides

The controls currently on pesticide use in WA are predominantly related to the potential human health hazards associated with their use. Current mechanisms for the protection of the environment from pesticides are inadequate, mainly because the impacts often have not been determined. Pesticides

are readily available in our society and reasonably easy to use, which often leads to their over-use because of insufficient education or poor management practices. Currently there are no accurate statistics kept on pesticide use in the State apart from data that the Agricultural and Veterinary Chemical Association (AVCA) can supply based on sales from their member companies. This may be satisfactory in the short term, but in the long term Government may need to give some consideration to collecting accurate statistics on pesticide use.

The most effective method of preventing adverse environmental impacts from agrochemicals is to prevent their use, but this is not practical. However, adverse environmental effects can be minimised by introducing appropriate management techniques, known as Integrated Pesticide Management (IPM) strategies. These are strategies that involve using small quantities of selective, low persistence chemicals at critical times in an environmentally-responsible manner, and using other preventative techniques to reduce pest build up. The expected result of introducing IPM would be a reduction in the quantity of pesticide used, but with an increase in the variety of pesticides available since many current pesticides are broad spectrum chemicals which act against a wide variety of organisms. In addition to reducing potential environmental impacts, IPM strategies are expected to reduce pest resistance to pesticides. IPM should be an attitude as much as a strategy and would require ongoing commitment and liaison between relevant government departments (mainly the Department of Agriculture, the Agriculture Protection Board and the Department of Conservation and Land Management), the chemical industry and the user groups. It should involve assessing the appropriateness of new chemicals quickly, and the investigation of alternative pest control procedures, and should include an education component to ensure that up-to-date information is available to the pesticide users. This would probably best be coordinated by the WA Department of Agriculture. The recently released Report of the Senate Select Committee on Agricultural and Veterinary Chemicals in Australia (The Parliament of the Commonwealth of Australia, 1990) also suggested that pesticide education for users was essential to ensure their responsible and judicious use, but that it may have to be formalised by licensing all those who apply pesticides.

Many farmers tend to buy large quantities of pesticide and store it until it is required. This practice has two main associated problems: the problem of safe storage and the problem of accumulating old stock. Often chemicals are stored in locations of high risk or become outdated. Subsequent decomposition of the container or disaster, such as fire, may release these chemicals to the environment often with substantial local effect on either human health or the natural ecosystem. In other instances old stock has been disposed down a nearby watercourse, again with substantial adverse environmental impacts. An environmentally safe system for the storage and disposal of pesticides needs to be considered by Government and should come under the brief of the Pesticides Advisory Committee and its member agencies, particularly the Health Department and the Department of Agriculture. It will require a substantial effort to increase public awareness of the problem and to encourage participation. It may require legislation, for example to limit the quantity of pesticide that can be bought to the amount required for the job in hand.

The disposal of empty containers is another management problem associated with pesticide use, particularly in rural areas where substantial quantities are used, and is probably best dealt with on a regional basis. Used containers often still contain significant quantities of unused chemical and therefore need to be dealt with appropriately to reduce the risk of environmental contamination after they are discarded. The recycling of consumable goods containers is now becoming a common activity in the community and this should be actively encouraged for pesticide containers. Already one major chemical company is reusing pesticide containers, but there is still a need for Government to encourage the remainder of the chemical industry to introduce reusable or recyclable pesticide containers. Government should consider the introduction of deposit legislation to provide an incentive for the containers to be returned.

Recommendation 8

The Environmental Protection Authority recommends that Integrated Pest Management (IPM) methods should be investigated by the Department of Agriculture, Department of Conservation and Land Management and other relevant organisations, and promoted to the rural community.

The Authority has supported the general thrust of recommendations 3, 4 and 5 of the Rutherford report and has amalgamated them into Recommendation 9.

Recommendation 9

The Environmental Protection Authority recommends that the Health Department and the Department of Agriculture should investigate ways of ensuring that pesticides and empty pesticide containers are stored and/or disposed in an environmentally responsible manner, particularly in rural areas. (This may require the use of legislation, guidelines and public education and should be supervised by the Pesticides Advisory Committee).

Recommendation 10

The Environmental Protection Authority recommends that the Government should encourage the chemical industry to introduce reusable containers and investigate the feasibility of deposit legislation for these containers.

Recommendation 1 of the Rutherford report has been implemented. The third schedule of the Explosives and Dangerous Goods Act has been amended to include Chronic Hazardous Substances. This has been proclaimed and will come into effect in three months. Schedule 5, 6 and 7 chemicals of the Poisons Act, which includes the more toxic pesticides, will be included as Chronic Hazardous Substances.

Recommendation 2 of Bulletin 407 is in process. Draft Dangerous Goods Regulations have been issued, public comments received and recommendations given to the Parliamentary Council early in 1990. The implementation of these regulations should be expedited.

Recommendation 11

The Environmental Protection Authority recommends that the Government should expedite implementation of the Draft Dangerous Goods Regulations.

4. Conclusions

The Environmental Protection Authority considers that the recommendations contained in this report should be implemented forthwith. The implementation of the recommendations will improve the quality of the State's environment and enhance its protection. It may also benefit pesticide users such as the agricultural industry by improving farm economics and management techniques through IPM.

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Appendix 1

Summary of the responses arising from the submissions addressing the report to the Environmental Protection Authority, 'Monitoring Pesticides - A Review'.

(This report was released in December 1989 for public review.
Comments were also solicited from relevant government departments
before it was considered by the Environmental Protection Authority.)

Submission responses addressing the recommendations

One submission commented that some of the recommendations are already in place, or in the process of being implemented.

Recommendation 1

The Government should give consideration to expanding the scope of the Dangerous Goods (Road Transport) Regulations 1983 to include those additional pesticides which are deemed by the Environmental Protection Authority to be of environmental concern.

Submissions:

1 The Explosives and Dangerous Goods Act has been amended to include a new class of dangerous goods, 'Chronic Hazardous Substances'. This has opened the way for Government to control the transport of Chronic Hazardous Substances such as pesticides if necessary.

Recommendation 2:

The Recommendations of the Stored Chemicals Sub-Committee, presented in its final report of February 1986, should be implemented as soon as possible.

Submissions:

1 The recommendations of the Stored Chemicals Sub-Committee regarding controlling the storage of dangerous goods in Western Australia have resulted in the formation of a Public Safety Sub-Committee which has drafted regulations for the storage of dangerous goods. The Draft Dangerous Goods Regulations 1989 have been circulated and a three-month period for public comment has closed. The responses are being reviewed and recommendations for amendment will be made to the Hon Minister for Mines for approval to implement the regulations as soon as possible.

Recommendation 5:

The Government should investigate ways of encouraging the use of pesticide drum-crushing contractors as a means of disposing of unwanted used containers.

Submissions:

1 The alternative of developing recycling of pesticide containers should be pursued.

Recommendation 6:

The Roadside Conservation Committee should continue to investigate reports of herbicide damage to native vegetation, and if necessary, recommend ways of minimising the problem.

Submissions:

1 The Roadside Conservation Committee is currently doing this for road and rail reserves. The Committee is also sponsoring small research projects relevant to this issue.

Recommendation 7:

The Department of Conservation and Land Management should re-introduce a monitoring programme for pesticide residues in the Australian Magpie (*Gymnorhina tibicen*).

Submissions:

1 One submission indicated concern that although the recommendation probably had some merit it was 'open-ended' and poorly defined.

2 It may be more appropriate for a research organisation to monitor pesticide levels in magpies rather than CALM fund and conduct the programme.

Recommendation 8:

The Agriculture Protection Board, in conjunction with the Department of Agriculture, should investigate the possibility of using the European Wild Rabbit (*Oryctolagus cuniculus*) as a means of monitoring organochlorine (and other) pesticide residues in WA land and vegetation.

Submissions:

1 Monitoring changes in field populations of birds and animals is resource consuming, and the results are generally inconclusive.

Recommendation 9:

The Water Authority of Western Australia should extend its pesticide residue monitoring programme to include all major river systems which drain agricultural land.

Submissions:

1 The benefit to the State and the logic that this programme be developed as an extension of the Water Authority's regular stream flow gauging and water quality programme is acknowledged. Funding for this programme, and various other initiatives proposed, needs to be considered in a "whole of Government" context, perhaps through the proposed committee in Recommendation 15.

2 All major river systems should be monitored for pollutants, including pesticides, salt and nutrients.

Recommendation 11:

A research project into the levels of pesticides found in rainfall over the coastal plain should be carried out by an appropriate body, such as the Chemistry Centre of WA, Murdoch University or CSIRO.

Submissions:

1 Further work into the understanding of the behaviour and attenuation of pesticides in soils of the coastal plain would be preferable to monitoring of pesticide concentrations in rainfall.

2 It is appropriate that Murdoch University become involved in measuring pesticide levels since their expertise in this area is increasing.

Recommendation 13:

The Department of Conservation and Land Management, as the manager of Western Australia's fauna, in conjunction with other managers of wetlands, should monitor wetlands for pesticide residues, and their effects on wetland ecology.

Submissions:

1 One submission indicated concern that although the recommendation probably had some merit it was 'open-ended' and poorly defined.

2 This recommendation was supported by one submission while underlining the 'in conjunction with other managers of wetlands'.

3 Species abundance and diversity surveys should be conducted on representative and important areas to serve as indicators of environmental problems.

Recommendation 14:

The Department of Marine and Harbours should extend their harbour water sampling programme to include sediments, and analysis for pesticide residues.

Submissions:

1 Contrary to the statement in 6.4.2 in the Bulletin the Department of Marine and Harbours does not carry out regular sampling of water and sediments in boat harbours. The Department will continue to support sampling of swimming areas on public health grounds and could take samples on behalf of an appropriately funded research body provided the necessary materials and directions were supplied.

Recommendations 7, 8, 9, 10, 11, 12, 13, and 14:

Submissions:

1 A review of these recommendations should be undertaken by key players prior to implementation. The Chemistry Centre of WA should be included because of work load implications.

Recommendation 15:

A Co-ordinating Committee for Environmental Monitoring of Pesticides should be established and serviced by the Department of Agriculture. It may be appropriate for the Committee to report to the WA Advisory Committee on Hazardous Substances (WAACHS).

Submissions:

1 Five submissions specifically support the establishment of such a committee and three suggest that it should report to the PAC which then advises WAACHS as appropriate.

2 This committee may have implications for WAACHS in that its advice and recommendations may effect Government policy.

3 This committee should not be serviced and administered by the Department of Agriculture since this would not be compatible with the public view that the Department supports pesticide use for agriculture. Administration by Health, CALM or EPA would be more appropriate.

4 Chemistry Centre of WA should be represented on this committee to ensure that appropriate resources are available for proposed monitoring.

5 The Water Authority would be pleased to participate in this committee if established.

6 A review of monitoring undertaken for health purposes should be included in the committee's terms of reference.

7 This committee, or one similar, should investigate means of reducing pesticide use in ways compatible with farmer requirements, but without adversely affecting the environment, involving such concepts as Integrated Pest Management.

8 This committee may be the forum to coordinate funding for the proposed initiatives in this report.

Recommendation 16:

The Department of Agriculture should increase its commitment of financial and human resources for the adequate monitoring of pesticides and the effects in the rural environment.

Submissions:

1 This recommendation should be broadened to include a health monitoring programme, involving the Health Department of WA and including reports by physicians of suspected pesticide related illness or injury.

Recommendations 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16:

Submissions:

1 These recommendations should be ongoing.

2. Submission responses requiring consideration for additional recommendations:

   (i) Consideration should be given to involving input from outside Government into the process of assessing pesticides in the environment, perhaps through membership of relevant committees.

   (ii) As already mentioned in the submission comments under Recommendation 11, further investigation is needed into the behaviour and attenuation of pesticides in soils of the coastal plain.

   (iii) A 'market basket' pesticide monitoring programme should be included in the State's pesticide monitoring strategy. This would assist in controlling pesticide misuse, and give information on human pesticide intake.

   (iv) A monitoring programme looking at residue loads in the Western Australian human population should be carried out over the period of a year.

   (v) Statistics should be kept on the importation and sale of all pesticides in WA, probably by the Health Department of WA.

3. General submission responses on monitoring which would apply to the recommendations:

   (i) The agricultural use of organochlorines has been phased out as of July 1990, except for the limited and stringently controlled use of Mirex. It is unnecessary, therefore, to increase monitoring which will concentrate on organochlorines as it will only give us a history of what we already know.

   (ii) Most pesticide monitoring programmes tend to pick up the stable, bio-accumulating compounds. A major problem which needs to be addressed is how to monitor the environment for ephemeral pesticides which are generally much more toxic.

   (iii) Any aspects involving hydrogeology with respect to groundwater monitoring should be referred to Geological Survey of WA, Hydrogeology Branch, at the planning stage to ensure resource allocation and expert advice.

4. Submission responses addressing the report text:

   (i) Metsulfuron-methyl should be moved to the list of APB widely used herbicides (page 19).

   (ii) Phosphine fumigation of rabbit burrows is also used to control rabbits (page 20).

   (iii) APB dingo baiting is carried out using 1080 with the exception of all wild dog/dingo baiting carried out in the south-west agricultural areas where strychnine is used (page 20).

   (iv) On page 21 it is implied that the APB uses strychnine to bait feral pigs. While some primary producers may use this to poison feral pigs it is APB policy to use 1080.

   (v) The pesticides malathion, methyl bromide, dichlorvos and carbaryl are also used to control grain insects (page 21).

   (vi) Non-target poisoning of some native animal species may occur with the use of pindone. There are stringent precautions to prevent this (page 21).

   (vii) There may be minor levels of strychnine residues left in the environment as a result of its use (page 21).

   (viii) Improvement to the environment as a result of controlling declared animals should be discussed (page 21).

   (ix) Generally granular pesticides are of little harm to higher animals as they have a clay base. If poisoning occurs, it is most likely to be via consumption of contaminated invertebrates (page 27).

   (x) Aldrin and heptachlor are currently used widely, but dieldrin and chlordane were used extensively in the past (page 28).

   (xi) Mirex is registered by the APB for control of the Darwin Termite. It is applied by trained operators under very stringent conditions and therefore there is little actual or potential environmental impact (page 28).

   (xii) The document should discuss the Health Department air monitoring programme in houses which is measuring occupant exposure to termiticides (page 29).

   (xiii) The statement on page 29 "There is no doubt that most of the organochlorine and organophosphate insecticide residues found in groundwater and in urban wetlands, originate from pest control activities in the Perth metropolitan area (Davis and Garland, 1986)" is misleading. In fact Davis' and Garland's work did not include analysis of insecticide residues in groundwater. The insecticide residues were identified in urban drainage entering the lakes. CSIRO information indicates that levels in groundwater are insignificant.

   (xiv) The table on page 46 could be misleading because of poor levels of detection in the 1970s, and better detection but possible false positives in the 1980s.

   (xv) On page 47 of the report reference is made to a lack of information on pesticide concentration in water at waste disposal sites. The Public Health Department have conducted several surveys of pesticide levels in leachate polluted groundwater and it is suggested that Sven Hansen be contacted for more detailed information.

   (xvi) Organochlorine contamination in Lakes Carabooda and Goolelal is more likely a result of adjacent horticultural activities rather than Argentine Ant control (page 54.c).

   (xvii) Further to CSIRO's work on pesticides on page 55. In a study into the effect of urbanisation on the quality of groundwater in Bassendean Sands, no significant pollution was detected. It was concluded that pollution of groundwater and surface water was only likely through movement of organochlorine pesticides with particulates or from illegal dumping of wastes by pest control operators.

   (xviii) No organochlorines have been used around wetlands since 1984-85. The term 'recent years' should therefore be more clearly defined (page 61).