DRAFT ENVIRONMENTAL IMPACT STATEMENT

CONCERNING NOTICE OF INTENT TO CANCEL REGISTERED USES OF PRODUCTS CONTAINING: CHLORDANE and HEPTACHLOR

AUGUST 1976

Criteria and Evaluation Division
Office of Pesticide Programs
U.S. ENVIRONMENTAL PROTECTION AGENCY
Washington, D.C. 20460

EPA—540/1-76-003

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PREFACE

On May 7, 1974, the Environmental Protection Agency published in the Federal Register a statement of policy announcing its intention to prepare Environmental Impact Statements in connection with its most significant regulatory actions, although not required to do so by law. On October 21, 1974, the Agency published procedures for the preparation of such voluntary statements and specified the regulatory actions that would be covered, including actions to cancel registered uses of pesticide products containing certain chemicals thought to cause unreasonable adverse effects on the environment, as provided for under section 6(b) of the Federal Insecticide, Fungicide and Rodenticide Act, as amended. This is the first draft Environmental Impact Statement submitted in connection with a section 6(b) action.

A notice of intent to cancel certain registered uses of pesticide products containing chlordane and heptachlor was published in the Federal Register on November 26, 1974. The notice stated that an Environmental Impact Statement would be available in approximately 60 days. However, unforeseen delays were encountered and the statement has only now become available.

On July 29, 1975, the EPA Administrator issued a notice of intent to suspend the registration of uses of pesticide products containing chlordane and heptachlor for all uses for which cancellation had been proposed, pending a final cancellation decision. On December 24, 1975, the Administrator issued a notice of suspension.

Single copies of the draft impact statement are available to all agencies, organizations and individuals who are interested in the proposed cancellation of heptachlor and chlordane uses. Their comments are invited. A public hearing, which is underway, was requested by persons who may be adversely affected by actual cancellation. Comments received from reviewers of the draft impact statement will be made available to assist any party in its participation in the hearing. During the hearing, parties may raise, in the form of testimony and exhibits for the record, any issues prompted by comments on the draft impact statement. Otherwise, comments submitted on the draft statement will be included in the record of the hearing only if the person submitting the comment indicates a willingness to appear at the hearing for the purpose of cross-examination on the comment submitted.

Comments on this draft statement, including an expression of willingness or unwillingness to appear as a witness at the cancellation hearing, should be sent to the following address:

Federal Register Section
Technical Services Division (WH-566)
Office of Pesticide Programs
Environmental Protection Agency
Room 401, East Tower
401 M Street, S. W.
Washington, D. C. 20460

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SUMMARY SHEET

DRAFT ENVIRONMENTAL IMPACT STATEMENT

OFFICE OF PESTICIDE PROGRAMS

1. Name of Action:

   Administrative, as authorized under section 6(b) of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended.

2. Description of Action:

   On November 26, 1974, the Environmental Protection Agency published in the Federal Register a notice of intent to cancel all registered uses of pesticide products containing chlordane and heptachlor, except subsurface applications. This action will be followed by a public hearing and final decision by the EPA Administrator.

   Because chlordane and heptachlor are used for such a variety of pesticidal purposes, the effects of cancellation will be felt throughout the United States. However, a particularly noticeable impact is expected in the states of Ohio, Indiana, Illinois, Iowa and Missouri where, in corn production, these chemicals receive their greatest agricultural use.

3. Summary of Environmental Impact:

   Current uses of these chemicals are producing widespread environmental contamination. Residues are found in soil, air, water and food and in wildlife and man. EPA has concluded on the basis of scientific evidence that these chemicals are carcinogenic and that their omnipresence in the environment represents a serious health risk.

The intended cancellation, if carried out, would lead to substantial reduction in environmental residues, with consequent reduction in the risk of illness and death and the accompanying economic and social costs. However, cancellation will also have some adverse effects. Allowing continuation of chlordane and heptachlor use for subsurface ground insertion for termite control will permit continuation of what is thought to be a slight long-term human health risk. (However, that risk is accepted in order to avoid the substantial economic and social impact expected if that use, for which there do not appear to be any effective, environmentally preferable substitutes, were cancelled.)

4. Alternatives Considered:

* No Cancellation Action
* Cancellation of All Uses
* Cancellation of All Uses Except Subsurface Ground Insertion for Termite Control and the Dipping of Roots or Tops of Nonfood Plants (The selected alternative)
* Cancellation of Food and Feed Crop Uses Only

5. Agencies and Organizations From Which Comments Have Been Requested:

Federal:

Department of Agriculture
Department of Commerce
Department of Interior
Department of Health, Education, and Welfare

State:

Each state pesticide control agency

Each state "clearinghouse" agency, as defined in OMB Circular A-95

Other:

Registrants of chlordane and heptachlor products

Velsicol Chemical Corporation

National chemical and agricultural trade associations

National environmental and conservation organizations

Any parties to the public hearing not included in the above

6. The Council on Environmental Quality (CEQ) will issue a notice (approximately in September 1976) in the Federal Register on the draft impact statement's public availability. Comments are due 45 days from publication of the CEQ notice listing the public availability of this statement.

7. Individual Copies May Be Obtained:

Free of charge from:

Federal Register Section
Technical Services Division (WH-569)
Office of Pesticide Programs
Environmental Protection Agency
Room 401, East Tower
401 M Street, S. W.
Washington, D. C. 20460

or

For sale by:

U. S. Department of Commerce
National Technical Information Service
Springfield, Virginia 22151

This draft impact statement is accompanied by supporting documentation which includes reviews of information on chlordane and heptachlor and the economic implications of cancellation or suspension.

I. BACKGROUND

Chlordane and heptachlor belong to a group of chlorinated hydrocarbon insecticides known as "cyclodienes," which also includes aldrin, dieldrin, endrin, thiodan and telodrin. Chlordane was first registered for use in the United States in 1948 and heptachlor in 1952. Over the years, they have been used in relatively large amounts in a growing number of products to control a wide variety of pests, for both agricultural and nonagricultural purposes. About 1,700 products containing these chemicals are currently registered for over 400 registrants. (This does not include products registered by states for intrastate uses.)

Principal uses are in farm crops, termite control, home lawns and gardens, control of house pests, and certain limited special uses. Most uses involve direct application to the soil. Currently, about 23 million pounds are used in the United States annually, of which about 21 million are chlordane and 2 million are heptachlor (see Appendix 2). The sole U. S. manufacturer of both chemicals is the Velsicol Chemical Corporation, a subsidiary of Northwest Industries, Inc.

Summary of Characteristics and Effects

(The following discussion summarizes scientific and technical data contained in the EPA review reports which are listed in Appendix 6 as references 1, 3 and 4. Anyone wishing more details or bibliographies of basic sources may obtain copies of these reports.)

Chlordane and heptachlor, as manufactured and marketed domestically in their "technical" forms, are complex mixtures of substances rather than single "pure" chemicals. Consequently, their interaction with the environment is complex and imperfectly understood.

Probably the most notable characteristic of these chemicals is persistence in the environment. They do not readily break down or degrade into harmless substances.

When they do break down, certain of the initial breakdown substances are potentially more hazardous than the parent chemicals. The best known of these substances is heptachlor epoxide, a metabolite (a substance produced by biological processes in or by living organisms) of heptachlor. Because chlordane averages about 10% heptachlor content, its use also leads to the presence of heptachlor epoxide in the environment. Oxychlordane, a toxic metabolite of chlordane, has been studied less extensively, and its effects are not as well understood.

Chlordane and heptachlor, and/or their toxic metabolites, have been found to persist in the soil for years following application. Residues are widely found in agricultural soils in the U. S. and Canada. In the case of chlordane, which is the more persistent, as much as 16% of the original amount applied for crop pests has been found in soil 15 years later. When applied underground for termite control, 15% has remained after 21 years. Heptachlor and its metabolite, heptachlor epoxide, have been found in detectable amounts 12 years after surface application.

Because most uses involve soil application, the movement and fate of these chemicals following such uses are of primary concern. Both are virtually insoluble in water and they become tightly bound to soil particles. Therefore, they offer considerable resistance to movement into underground and surface waters. In areas of extensive use, however, some residues have been found in the water and sediments of rivers, lakes and estuaries, and, in a few instances, in public drinking water

supplies. Residues have been found in the Sargasso Sea, which encompasses the Bermuda Islands. A few cases of contamination of private wells as a result of termite control use have also been reported. Both chemicals are volatile (heptachlor more so than chlordane), and their vapors have been detected both in the vincinity of sites of application and in ambient air samples. They have also been found in rainwater and dust. In one reported case, dust particles containing chlordane and heptachlor epoxide were borne by air currents from Dallas to Cincinnati.

Certain food and feed crops, especially root crops, have been shown to accumulate residues of both chemicals by absorption from the soil. Chlordane, heptachlor and heptachlor epoxide have been found as low-level residues (with occasional moderate or high levels) in earthworms, shellfish, fish, birds, and mammals. Heptachlor has been observed to concentrate at levels thousands of times greater than the surrounding water medium in several aquatic species. Some aquatic species such as catfish, bluegill, and rainbow trout have been shown to be sensitive to the toxic effects of low level concentrations. Considerable mortality among birds, mammals, fish and other aquatic species has been recorded in areas recently treated with heptachlor. Reductions in bird populations have been observed to continue for up to 3 years following heptachlor application. However, long-term effects on wildlife are largely unknown.

Through monitoring and surveillance activities, the Food and Drug Administration (FDA) and the U. S. Department of Agriculture (USDA) regularly find residues of these chemicals, and/or their metabolites in food and feed crops, in meat, fish and poultry, and in dairy products and eggs. Heptachlor epoxide occurs more frequently, expecially in meat, fish, poultry, and dairy products. Residue

tolerance levels (which represent the maximum level of a pesticide legally allowed in marketed foods) have been established by EPA for certain food and feed crops. FDA and USDA, who enforce the tolerance levels, have also established enforcement action levels for some foods not covered by tolerance levels. The Food and Agriculture Organization and the World Health Organization of the United Nations have established acceptable daily intake (ADI) levels for man. The most recent available results of FDA market basket residue surveys suggest that ADI levels were not normally being exceeded in 1972. However, in light of present knowledge concerning the health effects of these chemicals, tolerance levels and ADI levels may no longer be adequate to protect against serious health effects.

In recent years, EPA's human monitoring survey has found residues of heptachlor epoxide and oxychlordane in from 90 to 96% of a national sample of human adipose (fatty) tissue. Heptachlor epoxide has also been found in the tissues and organs of stillborn infants, indicating transfer from mother to offspring. Both heptachlor expoxide and oxychlordane have been found in human milk samples.

Controlled tests with laboratory animals, primarily rodents, have demonstrated that these chemicals produce both short- and long-term health effects. When administered in relatively heavy doses through feeding, skin application, or intravenous injection, they were found to affect primarily the central nervous system, causing death in a matter of hours or days. Long-term tests, in which lower doses were administered through feeding for periods of up to 2 years, demonstrated that both chlordane and heptachlor induce microscopic changes in the liver, and changes in liver weight, affect liver enzyme activity

and cause increased mortality in offspring. Tests to determine the effects of long-term exposure through inhalation are lacking.

Tests of chlordane, heptachlor, and heptachlor epoxide for mutagenic (hereditary change) or teratogenic (developmental) defects in offspring were negative.

In 1959, Kettering Laboratory reported on a long-term study conducted for Velsicol in which rats fed heptachlor epoxide developed tumors of the liver and other organs. In a study which was completed in 1965 by an EPA scientist, K. J. Davis (who was then with the Food and Drug Administration), mice fed heptachlor and heptachlor epoxide developed liver tumors. EPA consultants and outside experts, who recently re-evaluated those two studies, concluded that they demonstrated the chemicals to be carcinogenic.

In 1973, the International Research and Development Corporation completed two 18-month studies for Velsicol, one in which mice were fed chlordane and the other in which mice were fed a mixture of heptachlor and heptachlor epoxide. Significant liver hyperplasia (abnormal increase in the number of cells) was observed in both cases. Review of data from these experiments by EPA consultants and experts at the National Cancer Institute indicate that many of the test animals developed malignant liver tumors.

On October 21, 1974, the National Cancer Institute (NCI) issued a "Memo of Alert" stating that preliminary results of recently completed rat and mouse studies indicated that both chlordane and heptachlor showed carcinogenic activity in the livers of mice. A draft "Preliminary Report," dated January 23, 1975, provided more details concerning the studies. A

final report on these studies has not yet been issued.

Although a few reported human deaths and illnesses have been attributed to poisoning from accidental exposure to chlordane and heptachlor, these have often been under circumstances that did not rule out other possible causes. The few known studies of workers engaged in the manufacture, formulation or application of these chemicals suggest some possible short-term effects but permit no definitive conclusions as to long-term effects.

Because chlordane and heptachlor are widespread through the environment, occurring commonly in food and human tissue, it is impossible to conduct pesticide-free, controlled studies on human populations. For the most part, impact on human health must be derived from animal studies and other indirect evidence, as just outlined.

In summary, the salient facts concerning chlordane and heptachlor are:

1. They have been used for over 20 years in considerable quantities for a variety of crop and noncrop pest control purposes.

2. They are chemically similar; chlordane contains about 10% heptachlor.

3. They and their toxic breakdown products are very persistent in the environment, resisting chemical or biological breakdown into harmless substances.

4. They or their toxic breakdown products are found as residues throughout the environment, i.e., in soil, water, air, wildlife, and food.

5. Their toxic breakdown products are found to have accumulated in human adipose tissue and in human milk.

6. They and some of their breakdown products are acutely toxic to many forms of life, in addition to target species.

7. Heptachlor epoxide has been found to have accumulated in the organs of stillborn infants.

8. Heptachlor, heptachlor epoxide and chlordane induce tumors in laboratory animals, and thus pose a cancer threat to man.

Basis for Hearing

In 1969, the U. S. Department of Health, Education and Welfare Commission on Pesticides and Their Relationship to the Environmental Health recommended restricting the use of certain persistent pesticides (including chlordane and heptachlor) in the United States to specific essential uses which would create no known hazard to human health or to the quality of the environment. In a March 1971 statement, the Administrator of EPA announced that reviews were being initiated concerning the registration of certain pesticide products, including those containing chlordane and heptachlor. In 1972, a special EPA-sponsored review committee, which included a representative of USDA, completed a scientific review and filed a report on each chemical (references 3 and 4). The evidence then available was not thought to warrant immediate restrictive action on registered uses. As part of its continuing review, EPA recently updated the 1972 scientific reports (reference 1) and, in addition, performed an economic and social analysis to examine the consequences of cancelling

the registered uses of these two chemicals (reference 2). These recent studies revealed certain new information:

1. Without a cancellation action, uses of these chemicals would be expected to increase, particularly in light of the cancellation of aldrin and dieldrin, since chlordane and heptachlor are used as substitutes for many uses of aldrin and dieldrin. Environmental residues would therefore be expected to increase.

2. There are additional reports on accumulations of heptachlor epoxide in the organs and tissues of stillborn infants and in human milk.

3. Results of earlier laboratory tests on animals have been re-evaluated and are now considered to be evidence of carcinogenicity.

4. Preliminary information from the National Cancer Institute suggests additional evidence of a cancer threat.

In addition, in the course of the recent aldrin and dieldrin cancellation and suspension hearings, EPA has clarified certain concepts concerning regulation of these kinds of chemicals. (This was reflected in three documents published in the Federal Register on October 18, 1974 under the heading "Shell Chemical Co. et al....Consolidated Aldrin/Dieldrin Hearing.") The nature and amount of evidence necessary to justify a restrictive action was defined more clearly and the concept of carfinogenicity was amplified on the basis of recent scientific evidence and hypotheses. These concepts

regarding principles of chemical carcinogenesis were relied upon by the Administrator in issuing registration regulations under Section 3 of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended. These regulations provide that when there is evidence that a pesticide may have "unreasonable adverse effects on the environment," the burden is placed on the prospective registrant to prove why registration should not be denied.

The risks and benefits of chlordane and heptachlor were reevaluated in light of the new evidence and the most recent scientific hypotheses. As a result, the Administrator found that continued use of heptachlor and chlordane posed a substantial question of safety. Accordingly, he proceeded under Section 6(b) of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, with a notice of intent to cancel certain registered uses of products containing chlordane and heptachlor on the basis that currently registered uses may cause "unreasonable adverse effects on the environment." (See Appendix I, "Notice of Intent to Cancel.")

A public hearing, which is underway, has been requested by persons who may be adversely affected by actual cancellation.

In the evaluation that follows, Part II discusses alternative courses of action considered by EPA prior to its decision to proceed with the notice of intent to cancel and examines and compares the possible effects of four of these alternatives which were thought to warrant further exploration. Part III summarizes the possible effects (adverse and beneficial, short-term and long-term, and irreversible and reversible) of the course of action proposed in the notice of intent to cancel.

This evaluation is based primarily on the information available to EPA at the time the decision was made to issue the notice of intent to cancel. The evidence, sufficient to raise a serious question as to "unreasonable adverse effects on the environment" and thus to warrant a notice of intent to cancel, need not be so complete or thoroughly analyzed as the Administrator's final decision following the public hearing. A major purpose of the hearing is to provide the mechanism for generating and bringing together all the information needed to test the premises upon which the original decision was based. Then, in light of the more complete evidential base, the Administrator can make an informed final decision which confirms, modifies or reverses the original decision.

II. ALTERNATIVES

A. ALTERNATIVE COURSES OF ACTION CONSIDERED

Under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, the EPA Administrator may restrict the use of pesticides to reduce their potential hazard in several principal ways, including: (1) requiring changes in label instructions, (2) limiting use only to trained and certified applicators, and (3) cancelling or suspending and cancelling, some or all registered uses. He may also impose other regulatory restrictions which he deems appropriate in specific cases, such as seasonal and/or geographic pound limitations on use, annual permit requirements, control of distribution (including sale and purchase), and allowing use only in conjunction with certain other approved pest control techniques. Any of these restrictive actions may be taken singly or in combination. They may be initiated at one time or phased in over a longer time interval. Thus, there are many courses of action open to the Agency in any given situation, especially when all possible combinations are considered.

In evaluating the problem posed by chlordane and heptachlor, EPA considered its many options and concluded that effective control could most logically be attained through the cancellation mechanism. Any action short of cancellation was not felt to be consistent with the magnitude of the problem. However, the possibility of strengthening use restrictions, should any be appropriate, as well as cancellation, will also be considered during the hearing. The option of immediate suspension of registration, pending a final cancellation decision, was considered, but did not originally seem to be warranted. However, information subsequently available to the Administrator indicated that continued use of the chemicals during the cancellation proceedings would constitute an "imminent

hazard" as defined in the Act, and, on July 29, 1975, he issued a notice of intent to suspend. On December 24, 1975, the Administrator suspended the registration of uses of chlordane and heptachlor on lawns, gardens, turf and for household pest control. He allowed the continued use of chlordane and heptachlor on some minor crops and for control of cutworms on corn through August 1, 1976.

Four major cancellation alternatives were thought to warrant closer examination:

1. No Cancellation Action.
2. Cancellation of All Uses.
3. Cancellation of All Uses Except Subsurface Ground Insertion for Termite Control and the Dipping of Roots or Tops of Nonfood Plants.
4. Cancellation of Food and Feed Crop Uses Only.

The potential effects of each alternative were examined, to the extent that available information permitted, and are summarized below. (See Appendices 4 and 5 for summaries of estimated effects.)

Final cancellation of all registered pesticide uses of aldrin and dieldrin (except restricted termite use, dipping of roots and tops of nonfood plants, and use in a totally effluent-free moth-proofing system) was announced in an EPA order dated June 30, 1975. Furthermore, Shell Chemical Company, the sole manufacturer of aldrin and dieldrin, has stated that it does not intend to continue their production even for the exempted uses. Therefore, because chlordane and heptachlor are interchangeable with aldrin and dieldrin for many uses, it is assumed, in considering alternatives, that without EPA restrictive action on chlordane and heptachlor their volume of use will increase substantially as they are substituted for aldrin and dieldrin uses.

B. FOUR MAJOR ALTERNATIVES EXAMINED

Alternative 1: No Cancellation Action

EPA could permit continuation of all presently registered uses.

1. Environmental Effects

(a) Adverse

Due to their persistence, each additional application of these chemicals tends to add to previous residues and raise the total residue levels in the environment. Thus, the environmental burden may worsen even if the annual volume used were to remain at present levels. However, the volume used is expected to increase at first quite rapidly as chlordane and heptachlor are substituted for aldrin and dieldrin, with smaller increases thereafter. (For most uses, heptachlor is applied at about the same rate as aldrin and dieldrin, but chlordane must usually be applied at two or three times the rate of the other pesticides to provide a comparable degree of control.) Increased use will further increase the likelihood of residue buildup, with consequent increased risk to man and other living things. Contamination of drinking water supplies may occur more often and reach higher levels. Plants, including food and forage crops, may accumulate higher residue levels, and as a result, there are likely to be higher and more widespread residues in the human diet. Residue accumulations in wildlife are expected to increase; episodes of direct kills from the acute toxicity of heptachlor would probably occur more frequently, and there would be greater likelihood of long-term effects.

Finally, since EPA has concluded that human exposure to present levels of these chemicals poses a risk to human health, notably the threat of cancer, continuing all registered uses would serve to continue this risk. As residues in

food and other sectors of the environment increase and become more widespread, the risk will increase. The net effect will be a growing risk of otherwise avoidable illness and death from cancer.

(b) Beneficial

There are no known benefits to the natural environment or to human health from continued use of these chemicals.

2. Economic and Social Effects

(a) Adverse

The presently observed distribution of these chemicals in the environment and their known effects, as outlined in Part I, have been interpreted by EPA as constituting a real, although largely unquantified, adverse effect on the environment. If this effect were more precisely measurable, it would be possible to assign it, at least in part, a dollar cost. For example, if we could project with a moderate degree of certainty the number of deaths and illnesses that would result, it would be relatively easy to calculate a resulting dollar loss from lost earning power due to premature death and the medical care costs for avoidable health effects. In some instances, risk ratios for different levels of exposure to toxic chemicals have been derived from the results of tests with laboratory animals. However, uncertainties concerning average total exposure of the human population and the direct applicability of animal exposure experience to man would render mortality and morbidity predictions and consequent dollar loss calculations extremely unreliable. Effects such as the pain and suffering associated with illness and death and the loss of wildlife species can probably never be assigned meaningful dollar values or other quantified measures of impact.

Although it is quite unsatisfying to be unable to define the precise size and nature of the impact, available evidence clearly indicates the possibility of a considerable health and environmental impact, with accompanying economic and social costs.

The ready availability, relatively low cost, and well-demonstrated effectiveness of chlordane and heptachlor encourage unnecessary use; a part of the amount used often produces no direct pest control benefit. According to an estimate cited in EPA's economic study (Reference 2), as much as 50% of use on corn may be unnecessary. Unnecessary use increases the probability of development of pest resistance, needlessly kills beneficial parasites and adds to the total environmental burden without compensating benefits.

(b) Beneficial

Economic benefits of continued use of chlordane and heptachlor in agriculture take the form of higher yields and/or lower costs than with use of best available alternatives. To these primary benefits (yield and cost) must be added secondary benefits which take the form of impacts on farm prices for not only the crops on which chlordane and heptachlor are used but also for other crops. In turn, these impacts on farm prices of chlordane/heptachlor-treated crops and related crops lead to impacts on the cost of food to the consumer.

There are two ways of looking at yield benefits in the agricultural area. First, there is benefit in terms of increased yields to the individual farmer and to the total agricultural sector due to pest control with the best available chemical or other methods. Then there is increased yield attributable uniquely

to chlordane and heptachlor, above and beyond any increase attainable with the next best available pesticide or other control measures. The latter increase, which is more meaningful in this context, should be approximately equivalent to the loss in yield that would be expected if chlordane and heptachlor were cancelled and therefore not available.

The EPA economic study (reference 2) included a special analysis to determine the economic effects of cancellation on corn production -- the area of greatest agricultural use of chlordane and heptachlor. The study concluded that, while cancellation could have significant adverse effects on certain corn-growing areas or groups of farmers, the overall impact on the national economy would be slight. (The findings are discussed at greater length, commencing on page 19.) This result can be taken to mean that current use of chlordane and heptachlor on corn may have slightly beneficial economic effects on a national scale, while providing more substantial benefits to limited areas and groups of farmers.

Since the study estimated that cancellation of uses in other areas of agriculture would produce few significant adverse economic effects, benefits attributable uniquely to chlordane and heptachlor use in those areas can also be assumed to be slight.

Use in termite control presumably prevents a substantial annual loss in damage to structures. No reliable estimate of such benefits has been obtained, however. The benefits of home, lawn and garden uses and other special uses are even less measurable, but they apparently contribute to improving the quality of life of the user. Because alternative controls may be unavailable for

certain pests in turf and nursery plants, chlordane and heptachlor may be assumed to have unique but unmeasured value in controlling such pests.

Alternative 2: Cancellation of All Uses

EPA could take this most thorough approach of cancelling all currently registered uses.

1. Environmental Effects

(a) Adverse

As on-hand supplies of chlordane and heptachlor products are depleted, they will be replaced to a considerable extent with other pesticide products already registered for the same uses. This does not mean, however, that the other pesticides are equally effective for each use or that they would necessarily be used as replacements. (See Appendix 3 for examples of a few currently registered uses of chlordane and heptachlor and other registered chemicals which are possible substitutes in those uses. Reference 1 contains a more complete listing of registered chlordane and heptachlor uses and substitute chemicals). It is not possible to predict at this time which of the other chemicals would most likely be employed as substitutes for chlordane and heptachlor, although state agricultural extension services have been contacted for their recommendations. Substitutes will generally be much less persistent than chlordane and heptachlor. However, some of them, particularly the organophosphates, will be more acutely toxic and will thus pose a greater short-term risk to those exposed to them in manufacturing and application. Some of the substitutes may also be more mobile in the environment, but this detrimental quality may be largely offset by their lack of persistence.

While the aldrin and dieldrin cancellation action would continue to permit use of aldrin and dieldrin, under specified conditions, for termite control, Shell Chemical Company has indicated that it does not intend to market aldrin or dieldrin even for that use. If aldrin and dieldrin were unavailable and if chlordane and heptachlor were cancelled for termite control, compounds such as BHC, lindane, pentachlorophenol, creosote and coal tar neutral oils which are registered for termite control would remain the only registered substitutes. Only the first two of these pesticides are registered for subterranean soil use, and none are as persistent as aldrin, dieldrin, chlordane or heptachlor. Since aldrin and dieldrin are very similar to chlordane and heptachlor in their probable effects on the environment and human health, cancellation of one pair of chemicals for termite control without also cancelling the other would bring little improvement in environmental effects. If all four chemicals were cancelled, the total environmental burden of these persistent and hazardous pesticides would be reduced. However, adverse economic effects would be likely (see last paragraph, p. 24).

(b) Beneficial

Total cancellation is the only alternative that would promise eventual elimination of all environmental contamination and risk to living things attributable to these chemicals. Although as a result of their persistence they or their toxic metabolites would be found in the environment in detectable amounts for years to come, there should be a general decline from present residue levels, the rate of decline varying greatly in different sectors of the environment. (This expectation has been borne out in the case of DDT, wherein recent DDT

residue data have reflected gradual declines in food and wildlife, paralleling declining use of that chemical.)

Residues in soil and aquatic sediments would probably persist the longest, dropping off quite rapidly in the first four or five years, but more gradually thereafter. In most cases, they should decline to undetectable or trace levels within 25 to 30 years. However, soil residues from subterranean applications, such as termite control, may last longer. Food residues should drop off quite rapidly in the first few years thus reducing what is currently thought to be the most dangerous source of human exposure. Most air and water contamination should decline to trace levels within 5 to 10 years. Accumulations in wildlife should also subside in a relatively short time, the rate of subsidence differing with the species, its location in the food chain, and other factors. Being less persistent, pesticides used as substitutes for chlordane and heptachlor products would be less prone to accumulate in the environment. Consequently, the environmental burden of chlordane and heptachlor residues would not be replaced by equal residues of the substitutes.

Furthermore, the EPA economic study (reference 2) estimated that one of the effects of cancelling chlordane and heptachlor use in corn would be a substantial increase in the total corn acreage on which no pesticide at all is used. This would be due to a combination of factors including termination of chemical controls on corn land where chlordane and heptachlor were previously used and replacement of discontinued corn acreage in infested areas with new corn acreage in uninfested areas. Therefore, at least in corn, there would not be a one-for-one replacement of chlordane and heptachlor with other pesticides and the

environmental burden of all pesticides would be reduced.

In general, the exchange of persistent chemicals with long-term effects on the environment for shorter-lived but sometimes acutely toxic chemicals should result in a substantial net gain to the environment and human health. There would be some increased risk of acute toxic effects to the relatively small population of manufacturing, formulating and application workers because they would be handling more of the acutely toxic pesticides than at present. However, that increased risk should be small and should be outweighed by the reduction in long-term health risks to the population at large, which includes the workers. A direct risk which is known by those to be exposed (such as plant workers and field applicators of acutely toxic substances) can be protected against through proper precautions. Also, as the presently developing EPA-State program to train and certify applicators progresses, the risk of acute effects from accidents and misuse by applicators should be further reduced. On the other hand, long-term exposure of the general population to ubiquitous chemical contaminants such as chlordane and heptachlor from food, air and water cannot be avoided by individual precautions. No known change in the preparation of the principal contaminated foods in the home, for example, would significantly reduce exposure through food. Moreover, although drastic changes in eating habits such as elinimating meat and dairy products could reduce exposure, such a change is not feasible since these products are major sources of nourishment in this country.

2. Economic and Social Effects

(a) Adverse

The increased use of more acutely toxic substitute pesticides may produce some increase in deaths and injury through accidents and misuse, with resulting

costs. If such costs occur, they would be of major consequence to affected individuals and their families. However, on a national scale, they should be relatively small compared to the costs of the suspected long-term health impact on the general public from chlordane and heptachlor use.

Total cancellation would certainly have an impact on the chemical manufacturer (Velsicol) and the other firms presently marketing products containing chlordane or heptachlor. Any loss in jobs and income (the magnitude presently unknown) could be offset by new jobs and income created by increased demand for other pesticide products used as replacements for chlordane and heptachlor.

In the agricultural area, adverse economic effects can result from unavailability of effective substitute chemicals or other pest control methods. They can also result when substitutes are available, but (1) are more expensive (2) are less effective, or (3) require more manpower and time to use. Although substitutes will most often be more expensive than chlordane and heptachlor, that in itself will not be necessarily be a deterrent to their use since pesticides are a relatively small part of crop production costs. Where a serious insect problem in a given crop has previously been controlled with chlordane or heptachlor and where available substitute controls would not be economically acceptable, the land may be converted to production of another crop or agricultural purpose less vulnerable to the problem insects. This alternative agricultural purpose, however, may represent a less productive use of land than the original crop.

Corn production presently accounts for the largest agricultural use of chlordane and heptachlor. Consequently, the most serious economic impact from cancelling agricultural uses could be expected in corn. However, during the aldrin/dieldrin proceeding the Administrative Law Judge and the Administrator found that insect problems in corn production have been reduced in recent years and that effective pesticide alternatives are available for the important corn insects.

EPA's economic study (reference 2) indicates that, in Midwestern Corn Belt States, chlordane, heptachlor, aldrin or dieldrin were in 1973-1974 used on an estimated 8.8 million acres of corn (or about 12% of total corn acreage) annually. The study estimated the combined economic impact of cancelling use of all four pesticides in corn. One estimate, based on "worst case" assumptions, that is, most pessimistic estimates of infestation by soil insects and decline in yield, found that by 1977 corn production could decline by 36.9 million bu, or about 0.7% of total production for that year. This decline would be accompanied by an increase in total corn acreage, an increase in acreage of other grains to compensate for decreased corn production, and changes in the price of the other grains, ranging from a slight decline in the price of soybeans to an increase of 2.5% for sorghum. Price impacts of this magnitude, though significant, are minor in comparison with ordinary year-to-year changes due to weather and other factors.

Consumer prices for meat, poultry, eggs, and other products requiring substantial feedgrain input could increase by about 0.4 to 0.5%. This could result in an increase of about 0.19% in total food costs to the consumer, or an annual per capita increase of about $1.70 for food. Due to the nature of the market

structure for agricultural commodities, these adjustments would result in a net increase in overall agricultural income; however, the increase would not be distributed evenly among farmers or producing areas. Many of the farmers who had previously used chlordane and heptachlor would experience a drop in income, while farmers who benefited most from the price increase would be in areas where chlordane and heptachlor either were not used or were less essential in corn pest control. This change in distribution of agricultural income, the reduced efficiency in land use (more land in corn but less total production), along with the increase in the price of corn and other agricultural commodities, are found to add up to a slight but discernible adverse impact on the national economy.

These results, it should be remembered, are based on "worst case" estimates. It is unlikely that such high level pest infestations would occur in all impacted states in any one year; at least there is no record of outbreaks of these pests on such a scale.

A subsequent analysis of the impact of cancelling corn use was based on more probable or "typical case" assumptions concerning insect infestations and crop loss. This resulted in a projected increase in the price of meat and related products of only about 0.015 - 0.019% and an increase in total food costs of 0.0072% - or an annual per capita increase of about 6.5¢ for food. This quite negligible impact is much more likely than the impact estimated for the "worst case" situation.

Florida citrus producers face potentially large impacts due to cancellation of aldrin and dieldrin. If, as some Florida citrus specialists indicate, chlordane and heptachlor are the only feasible substitutes for control

of Fuller's Rose Beetle -- a pest problem in Florida's east coast groves -- then cancellation of chlordane and heptachlor, along with aldrin and dieldrin, could produce substantial adverse impact. However, chlordane and heptachlor have not hitherto been used extensively for Fuller's Rose Beetle, and their efficacy is uncertain. Also, state and Federal registrations are inconsistent, with no present Federal registration for either chlordane or heptachlor for control of Fuller's Rose Beetle in citrus. It is, therefore, not possible at present to ascribe a specific impact on Florida citrus to chlordane and heptachlor cancellation.

Several states estimated that cancellation of chlordane and heptachlor would produce a significant impact on strawberry production, but EPA has not yet obtained sufficient information to assess the extent of such impact. For other crops in which chlordane and heptachlor are used, effective substitutes are generally available, and the adverse economic effects of cancellation are expected to be slight.

Since aldrin and dieldrin are not likely to be available for any pesticide uses, including termite control, chlordane and heptachlor remain the principal chemical means for termite control. If they, too, become unavailable due to cancellation, the economic effects should be substantial. The other pesticides presently registered for termite control (BHC, lindane, pentachlorophenol, creosote, and coal tar neutral oils) are shorter-lived and generally thought to be less effective. Only the chlorinated hydrocarbons, BHC and lindane, are registered for subterranean soil use. Due to the need for more frequent application of the substitutes, costs to consumers for termite control services

would probably increase markedly. The lesser effectiveness of the substitutes and higher application costs could cause some consumers to do without termite control services entirely. Thus, there could be considerable losses from an increased rate of termite damage. Probable effects on the termite control companies are hard to estimate. As the companies and consumers adjust to the less persistent substitutes, the longer-term effect could be an increase in termite control business due to the need for more frequent application of the less persistent chemicals.

In areas of use other than agriculture and termite control, the economic effects of cancellation are even more difficult to estimate since the benefits of use are also so difficult to measure. Among these other uses are the control of insect pests inside houses and other buildings, on home gardens, on lawns and turf, on shade trees, and ornamentals, on forestry plantations, on agricultural premises, in nurseries and in sewage treatment plants. Also included are control of crabgrass on lawns and turf, mosquito control and seed treatment. In most cases, effective, environmentally-preferable substitute pesticides are registered for the chlordane and heptachlor uses, and little or no interruption of the benefits currently obtained is anticipated.

In summary, a significant economic and social effect may be felt in a small sector of the pesticides industry, and by certain farmers, nurserymen, and pest control operators. On a national scale these effects should be slight. However, the probable increase in termite damage, due to lack of suitable substitute pesticides, could produce a substantial economic loss, even on a national scale.

(b) Beneficial

The most important economic and social benefits would result from reduction and eventual elimination of the human illness and death that may result from current and projected uses of chlordane and heptachlor. The associated medical care costs and costs of lost productivity and suffering, disruptions of family life, and other psychological and social effects would also be eliminated. (Although all sectors of the economy have experienced serious price increases over the past several years, recent increases in the costs of health services have exceeded those of any other sector.)

To the extent that alternative chemical pesticides are more expensive, less effective, or simply more trouble to use, some farmers may be led to modify their present agricultural practices to minimize the use of chemicals. The same considerations could lead to reduction in use of chemicals for primarily cosmetic or convenience purposes, as in household and home garden and lawn uses. The end result could be a reduction in the total burden placed on the environment in the form of pesticide chemicals, with accompanying costs, and some saving in the energy now expended in the manufacture and application of those chemicals.

Alternative 3: Cancellation of All Uses Except Subsurface Ground Insertion for Termite Control and the Dipping of Roots or Tops of Non-food Plants

The EPA Administrator's notice of intent to cancel, published November 26, 1974, proposed this limited cancellation of registered uses of chlordane and heptachlor.

1. Environmental Effects

(a) Adverse

Although most of the benefits described under Alternative 2 (Cancellation of All Uses) would still be realized, continuation of termite control uses would permit continuation of some possible threat to human health and the environment. While subsurface application of these chemicals around the foundations of structures should minimize movement within or from the soil and should therefore present a much lower risk to man and other living things than surface and above-surface uses, several uncertainties remain. The fact that private well contamination has been reported in conjunction with termite control suggests that even with subsurface application, some direct threat to human health would remain. Also, during their many years of persistence following subsurface application, these chemicals continue to represent possible surface problems should the soil be disturbed through such activities as demolition or construction.

Since both chemicals are volatile, their vapors may filter up through the soil and contaminate the air in the immediate vicinity of the structures around which they are buried. The present lack of test data concerning the long-term effects of low vapor concentrations is particularly serious because any potential vapor problem from termite control use would be centered in the immediate vicinity of human habitation. Furthermore, this potential risk should be viewed in light of the fact that at present an estimated 35% of the total chlordane and 26% of the total heptachlor used annually in the United States (or about 7.3 million pounds and .5 million pounds, respectively)

go to termite control.

Dipping of the roots or tops of nonfood plants, the other registered use that would be exempt from cancellation under this alternative, should have minimal impact. This use relates to preventive treatments to ensure insect-free nursery plants which are to be shipped from quarantined zones, as required by the U. S. Department of Agriculture under its plant quarantine authority. Chlordane is currently recommended for quarantine use to control such pests as the Japanese Beetle and the White-fringed Beetle. Dipping of roots and tops would presumably involve relatively small quantities in containers where there would be little release to the environment. The specific procedures allowed under this expected use will not be spelled out until the hearing. Depending on the procedures finally authorized, there may be problems in such areas as disposal of used dip solutions, contamination of balls of soil attached to the roots of shipped shrubs and trees, and exposure of nursery personnel.

(b) Beneficial

This alternative would terminate what are considered to be the most significant sources of environmental contamination by these chemicals -- those resulting from soil-incorporated uses, and application to the ground surface and to plant foliage and other above-ground uses. It is these uses that permit most of the extensive environmental diffusion observed for these chemicals. Cancelling such uses should result in essentially the same decline in soil,

water, and air contamination and residue levels in food, wildlife and man, as expected under Alternative 2. The risk to wildlife and to human health should be similarly reduced, with the exception of the possible remaining risk from termite control uses, as discussed on page 27.

2. Economic and Social Effects

(a) Adverse

Adverse economic and social effects would be much the same as under Alternative 2 (cancellation of all uses) except that those attributable to cancellation of termite control uses would be avoided.

(b) Beneficial

Benefits would be essentially the same as under Alternative 2, less those attributable to termite use cancellation. The chlordane-heptachlor part of the pesticides industry would retain a considerable demand for these products for termite control uses (presently estimated at 35% of total chlordane used and 26% of total heptachlor used in the U.S.). Any increased termite damage to structures due to cancellation would be avoided. The benefits in terms of reduced social and economic impact from mortality and illness would be similar to Alternative 2 but diminished to the extent that termite control uses pose a risk to human health.

Alternative 4: Cancellation of Food and Feed Crop Uses Only

This Alternative represents an even more limited cancellation action than the preceding alternative. It focuses on a major source

of human exposure -- the diet. It would continue registrations not only for termite control but also for uses on lawns and flower gardens, inside homes, and other uses where the likelihood of contamination of food or feed would be slight. Uses on nonfood field crops, such as flax and tobacco, which could be grown on land that might later be used for food or feed crops, would also be cancelled.

1. Environmental Effects

(a) Adverse

This Alternative would produce the same adverse effects as Alternative 3 (cancellation of all uses but termite control and dipping of plant roots and tops), plus some additional ones. It would permit about 8 million additional pounds of chlordane and 312,000 additional pounds of heptachlor to enter the environment annually, above amounts permitted under Alternative 3. Since these additional amounts would be applied to the ground surface or used above the surface, they could move about more extensively in the environment than amounts applied below ground for termite control. They could more readily find their way into the air and water and would therefore constitute a more direct threat to wildlife and man. In addition, by continuing to permit extensive uses in and around the home, direct, day-to-day exposure of people would remain high.

Although the degree of added risk from these uses is not known, any such risk is less defensible than the risk that may be involoved in termite control. Not only can such uses lead to wider dispersion

in the environment, but, unlike termite control, there are effective and environmentally-preferable substitute products currently registered for most of these uses.

(b) Beneficial

Elimination of food and feed crop uses should, in about 3 to 5 years following last use, reduce residues of chlordane and heptachlor in the human diet to relatively negligible amounts. A substantial decline in soil, water, and air contamination and in residue levels in wildlife and man would be expected, although it would be less rapid or complete than under Alternatives 2 or 3. Thus, the risk to human health and wildlife would be substantially lessened, but not to the extent resulting from Alternatives 2 or 3.

2. Economic and Social Effects

(a) Adverse

Adverse effects in the agricultural sector and on consumer food prices would be about the same as under Alternative 2 (cancellation of all uses). The chlordane-heptachlor part of the pesticides' industry may suffer the loss of some jobs and revenues, but to a lesser extent than under Alternatives 2 or 3. These losses may be offset by increased demand in other sectors of the industry for substitutes for the cancelled chlordane and heptachlor products.

There would be some additional social and economic costs resulting from any adverse long-term health effects caused by the additional uses permitted under this alternative. They should be relatively small,

however, since human exposure through the diet would be virtually eliminated.

(b) Beneficial

Agricultural benefits would be approximately the same as those described under Alternative 2. The impact on the chlordane-heptachlor industry would be less than under Alternative 3, since more uses would be permitted. Those additional uses presently account for an estimated 37% of the chlordane and 15% of the heptachlor used annually. Therefore, about 72% of present total annual chlordane use and about 41% of heptachlor use could continue. Any adverse economic effects from uses cancelled under Alternative 3, but not cancelled under this alternative, would be avoided. (Such effects are thought to be minimal, however.) As under Alternative 3, there would be little impact on termite control companies, or increased termite damage to structures. The economic and social benefits resulting from reduced risk of mortality and illness should be substantial -- somewhat less than Alternative 3 and considerably less than Alternative 2.

C. ALTERNATIVES COMPARED

In making its decision, EPA had first to choose between "no cancellation action" and "some cancellation action." Alternative 1 could be selected only if it was determined that chlordane and heptachlor, as presently used, do not cause "unreasonable adverse effects on the environment." EPA concluded from the available evidence, as summarized in Part I, that present uses of these chemicals

do adversely affect the environment, including a substantial degree of risk to the human population. In light of such risks, EPA determined that there was a substantial question of safety and proposed to cancel certain uses as detailed in Alternative 3. The adverse effects of these uses were judged to outweigh any known benefits from continued use. This action gave registrants an opportunity to demand a public hearing in which they have the burden of demonstrating that the risks posed by the uses to be cancelled are outweighed by the benefits derived from these uses.

Cancellation of all uses, Alternative 2, represents the most thorough solution to the problem. It would ensure that all hazards resulting from current chlordane and heptachlor uses would eventually diminish to zero. Such an action would also, of course, produce the greatest adverse economic impact on individuals and organizations which benefit from currently registered uses of these chemicals. Even at worst, the adverse economic effects which could include lower crop yields, additional termite damage to structures, higher operating costs, higher prices, lost income, and inconvenience, would be on a relatively small scale and represent a rather minor impact on the national economy. In most areas of use these effects would be minimized by the availability of other pesticides which are registered for the same uses as chlordane and heptachlor products. However, in the major use area of termite control there are no currently registered, environmentally-preferable substitutes which are thought to approach the effectiveness of chlordane and heptachlor. But fortunately, when

used for termite control, chlordane and heptachlor are usually applied below the ground around the foundations of termite-threatened structures where, in the light of current knowledge, they would seem to pose a minimal threat to the environment and to human health.

Alternative 3, therefore, would remove most environmental risks while permitting continuation of what seems to be a minimal risk in one major use area, termite control, thereby avoiding sharp economic dislocations in that area.

Alternative 4 reflects an even more limited cancellation approach. It would only cancel those uses involving application on or around food or feed crops, on the assumption that (1) control of residues in the human diet will remove an important human exposure, and (2) risks from other uses are outweighed by the benefits of those uses. It would permit continuation of the same registered uses as Alternative 3, plus other nonfood and nonfeed crop uses, such as control of pests inside houses, in flower gardens, lawns and turf, agricultural premises, and nurseries. However, Alternative 4 is not well-founded on several counts. The benefits of these kinds of uses are quite intangible and immeasurable. Although they provide convenience to the users, they apparently are not of great economic consequence. Furthermore, for almost all these uses, there are effective, environmentally-preferable substitutes already registered. In addition, these uses all involve application to ground surface or above ground surface, which is thought to constitute a much more serious risk to the environment than subsurface

application as in termite control. In addition, many of these uses involve direct exposure of homeowners and home gardeners and their families.

In light of the foregoing considerations, EPA chose Alternative 3 (cancelling all uses except subsurface termite control and the dipping of roots or tops of nonfood plants) and published the notice of intent to cancel (see Appendix 1). The belief that use for termite control poses minimal environmental risks and provides substantial benefits in protecting dwellings led to the exemption of that use from cancellation

The matrix display, Appendix 5, attempts to compare in a simplified way the probable effects estimated for the four alternatives.

III. SUMMARY OF IMPACT OF PROPOSED ACTION

While this type of evaluation can help guide decision-making, it is limited by the need to consider many factors that are neither measurable nor capable of being weighed precisely against one another or against other factors that are quantifiable. Differing perceptions as to how real are the risks and benefits and how much weight to give one versus the other will lead to different conclusions. The final decision, then, at best, will represent an informed judgement that will not be beyond dispute.

In selecting Alternative 3, EPA has attempted to balance costs and risks against benefits. Where risks and benefits seemed relatively equal, preference was given to minimizing the human health risk.

In summary, the principal effects of Alternative 3 are estimated as follows:

1. Beneficial

    a. Probable substantial reduction in long-term risk to human health and wildlife.

    b. Probable substantial reduction in economic and social loss due to long-term human health effects of chlordane and heptachlor.

    c. Substantial reduction in environmental contamination.

    d. Avoidance of the economic impact in the area of termite control that would result from cancellation of that use.

2. Adverse

a. Some possible long-term risk to human health and the environment due to a presumably slight, but not fully defined, hazard from continued use of chlordane and heptachlor for termite control.

b. Some possible risk to human health and the environment from increased use of substitute pesticides which, while generally less persistent, may be more acutely toxic.

c. Minor economic and social impact on a national scale, with moderate impact in a few sectors of agriculture and a few nonagricultural activities.

d. Minor economic impact on the pesticides industry.

Short-term and Long-term Considerations

Persistent pesticides, such as chlordane and heptachlor, can produce residues in various sectors of the environment in the short term and, with continued use, these can be built to higher-level residues in the long term. They can produce acute toxic effects in man and wildlife as well as delayed effects such as tumors or mortality in offspring.

In general, Alternative 3 would produce both short- and long-term effects of about the same magnitude in each major impact area (see Appendix 5). Effects on the environment would be felt quite early following cancellation and they would continue to be felt as long as the cancellation remained in force. Some effects on human health would begin shortly after cancellation, e.g., the possible

increase in acute effects from use of some substitute products, and the relatively early drop-off in crop residues which would reduce the exposure and resulting risk of eventual chronic effects. Such effects would also continue indefinitely. Economic and social effects, too, would occur early following cancellation and continue at about the same level thereafter. However, some of the initial effects should be ameliorated over time. These would include reduced crop production which would be counterbalanced in subsequent years by the planting of increased acreage and by the development and adoption of other pest control methods, as well as lost jobs and income in the pesticides industry which may be offset by the increased demand for other chemicals to replace heptachlor and chlordane.

Reversible and Irreversible Aspects

The proposed action and most of its effects are reversible. Even if cancellation is carried out, registration could be reinstated later in the light of new evidence or other changed circumstances. By the same token, chlordane and heptachlor uses not covered by the present cancellation action could be cancelled at a later date. If cancellation were carried out and later rescinded, all beneficial effects and most adverse effects of cancellation would rapidly dissipate, to be replaced with the effects originally estimated for "no cancellation."

Irreversible effects, in the form of human death, chronic illness, or other permanent damage to health (and the resulting economic and social consequences), are expected to occur in greater or lesser degree under any of the three alternatives which permit continuation of all or some uses of these chemicals. Only Alternative 2 (cancellation of all uses) would lead to virtual elimination of such irreversible effects (excepting effects from the use of substitute pesticides). Under the selected alternative (Alternative 3), adverse human health effects are expected to be minimal; therefore, irreversible effects are also expected to be minimal.

Among wildlife, mortality and long-term effects from continued uses would be considered reversible as long as populations of individual species remain at levels above the point of no return leading to extinction and as long as reproductive ability is not seriously impaired. Because available evidence does not suggest any threat of species extinction due solely to chlordane and heptachlor use, irreversible wildlife effects are not anticipated under any of the alternatives.

IV. APPENDICES

1. NOTICE OF INTENT TO CANCEL

2. ESTIMATED DOMESTIC USE OF CHLORDANE AND HEPTACHLOR - 1974

3. EXAMPLES OF POSSIBLE SUBSTITUTES FOR CHLORDANE AND HEPTACHLOR

4. QUANTITY USED, BY ALTERNATIVE

5. MATRIX DISPLAY OF IMPACTS, BY ALTERNATIVE

6. REFERENCES

APPENDIX I

NOTICE OF INTENT TO CANCEL

ENVIRONMENTAL PROTECTION AGENCY

[FIL 792-2]

PESTICIDE PRODUCTS CONTAINING HEPTACHLOR OR CHLORDANE

Intent To Cancel Registrations

On March 18, 1971, the Administrator of this Agency announced that active internal review was being initiated on a number of pesticide products, including those containing chlordane and heptachlor. As the result of such review and for the reasons set forth in the attached statement of reasons, I find that the continued registration and use of these pesticides appear to pose substantial questions of safety amounting to an unreasonable risk to man and the environment. I therefore serve and file this notice of intent, together with the attached statement of reasons, to cancel all registered uses of heptachlor and chlordane within thirty (30) days, pursuant to section 6 of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, (86 Stat. 973, 7 U.S.C. 136d), with the exception of the use of heptachlor or chlordane through subsurface ground insertion for termite control and the dipping of roots or tops of nonfood plants. Any affected party may contest this action by requesting a hearing on specific registered uses on or before December 26, 1974. Requests for hearings should be submitted to the Agency's hearing clerk at the following address:

Mrs. Betty J. Billings
Hearing Clerk
U.S. Environmental Protection Agency
Room 1019, Waterside Mall—East Tower
401 M Street, SW.
Washington, D.C. 20460

The proposed cancellation shall become final and effective thirty (30) days from the date of this notice as to those registered uses for which a hearing is not requested by any affected party. The proposed cancellation shall not take effect regarding any registered use for which a hearing is requested until the hearing has been completed, unless there is a concurrence from all parties to the proceeding. The Agency reserves the opportunity to present evidence on any registered use affected by this order regardless of whether or not a hearing has been requested on that use, or whether or not such use is to be actively defended in the hearings.

Dated: November 18, 1974.

RUSSELL E. TRAIN,
Administrator.

STATEMENT OF REASONS: HEPTACHLOR AND CHLORDANE

I. LEGAL AUTHORITY

Section 6(b) of the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 135 et seq) as amended (7 U.S.C. 136a(c)(5)(D)) authorizes the Administrator of the Environmental Protection Agency (or his designee) to issue a notice of intent to cancel the registration of a pesticide or to hold a hearing "[I]f it appears to the Administrator that a pesticide or its labeling * * * does not comply with the provisions of this act or, when used in accordance with widespread and commonly recognized practice, generally causes unreasonable adverse effects on the environment * * *." The phrase "unreasonable adverse effects on the environment" is defined in section 3 of the Act (7 U.S.C. 136(bb)) as "any unreasonable risk to man or the environment taking into account the economic, social, and environmental costs and benefits of any pesticide."

The Act also prohibits the sale of pesticides which are misbranded. A product is considered misbranded if the label does not contain directions for use and a warning or caution statement which are necessary and if complied with are adequate to protect health and the environment. (7 U.S.C. 136(a)(1)(F) and (G).)

II. CHEMISTRY OF HEPTACHLOR AND CHLORDANE

Heptachlor and chlordane are chlorinated hydrocarbon insecticides, and have a chemical structure which is similar to that of Aldrin and Dieldrin. Both pesticides consist of a complex mixture of compounds whose ratios in the final technical product have been standardized. Technical heptachlor consists primarily of pure heptachlor (70–73 percent), gamma-chlordane (20–23 percent), nonachlor (4.5–5 percent), and small amounts of both the initial reactant (hexachlorocyclopentadiene) and chlorene. Technical chlordane consists primarily of approximately equal amounts of alpha-chlordane and gamma-chlordane (total: 43±5 percent), pure heptachlor (10±3 percent), nonachlor (8±3 percent), chlordene isomers (21±4 percent), and a number of other compounds in varying lesser amounts.

Both heptachlor and chlordane form toxic metabolites (including heptachlor epoxide, chlordene epoxide and oxychlordane) which are found in the tissue and feces of mammals. Chlordene epoxide may also be formed by soil organisms. In addition, caged mixer more toxic to insects and fresh water animals than heptachlor has been shown to be formed on exposure of heptachlor to sunlight. Oxychlordane, a major metabolite of chlordane, found primarily in animals (including man), is formed very slowly in normal liver tissue. Its formation, moreover, is accelerated by the presence of compounds such as DDT, dieldrin, or heptabarium.

III. USES

Heptachlor and chlordane have been used extensively in the United States since the 1950's. In 1971, 70 percent of the approximately one million pounds of heptachlor used in U.S. agriculture was as a soil treatment for a wide variety of crops. Its primary use was on corn, but also included vegetables, cereals, forage crops, seed crops, and seed treatments. The remaining 30 percent was used for the protection of commercial and residential structures against termites and for a variety of nursery, lawn, and garden applications, and for foliar application to ditch banks, roadsides and vacant fields. Total use of heptachlor more than tripled in 1972, of which over 1.7 million pounds was used for termites and structural pest control alone, and 1.6 million pounds was used on agricultural crops. It is estimated that the use of heptachlor on corn alone could increase to 3 million pounds in 1975.

Chlordane is used in much greater quantities than heptachlor, and is one of the most widely used household and garden pesticides. The quantity used has increased from approximately 11 million pounds in 1971 to between 15–16 million pounds in 1972. About 60 percent of the 1972 volume was used for termite control and other household and commercial applications, including crabgrass control, use on shade trees and ornamentals, and treatment of indoor pests. An additional 6.5 million pounds were applied to corn, grain, fiber and forage crops, and a variety of fruits and vegetables. Chlordane is also used as a seed treatment and in summer months is applied directly to water in sewage treatment plants for control of *Psychoda* larvae.

IV. ALTERNATIVE PESTICIDES

There are alternative pesticides registered for virtually all of the registered uses of both heptachlor and chlordane. As registered alternatives, these pesticides should be effective although there may be geographical areas or special situations where this is not true. Many of these substitutes may be more expensive than heptachlor and chlordane. In addition, most are less persistent, al-

though persistence is frequently not critical factor in terms of efficacy. In the case of subsurface termite control, however, persistence is critical. Aldrin and dieldrin are the principal other persistent pesticides presently registered for subsurface application for termite control. These uses of aldrin and dieldrin were not included in the recent suspension order of the Administrator nor in the cancellation action now pending.

Although some alternatives may be more acutely toxic than heptachlor and chlordane, hazards to applicators may be minimized by adherence to labeling instructions and other precautions, with the benefit of eliminating the chronic effects of heptachlor and chlordane.

We do not now have information on the usefulness of nonchemical control methods for each of the registered uses of chlordane and heptachlor but these methods should be thoroughly explored in the hearing.

V. Toxicity

Heptachlor and chlordane are chlorinated hydrocarbon pesticides which are broad spectrum pesticides and are toxic to nontarget organisms as well as to insect pests. Reductions in bird populations following application of heptachlor to an area have been reported frequently. It is difficult, however, to determine what impact these toxicities have on species populations, as opposed to individual fish or wildlife or specific local populations.

Heptachlor and chlordane have demonstrated toxic effects which may have significant adverse effects on human health. Heptachlor and its metabolite, heptachlor epoxide, have been found to increase significantly the incidence of liver tumors including carcinomas in one strain of mouse (C3H/eb/Fe/J) at a single feeding level of 10 ppm. The majority of these tumors were originally reported as benign. On the basis of the original reported experiment the Carcinogenicity Panel of the HEW Secretary's Commission on Pesticides and their Relationship to Environmental Health judged heptachlor epoxide "positive for tumor induction on the basis of tests conducted adequately in one or more species, the results being significant at the 0.01 level." Subsequent analysis by pathologists revealed a high incidence of carcinomas in animals from the experiment (greater than 90 percent incidence in animals given heptachlor epoxide).

In addition a two-year feeding study of heptachlor epoxide to 225 CFN rats showed a significant increase in the number of animals with tumors at the 0.5 ppm feeding level, and for all test animals at all feeding levels (0.5 ppm to 10 ppm) when the groups were combined. The tumors were found primarily in the endocrine organs, but a substantial number of liver tumors were found in the treated animals while no liver tumors developed in the control group.

There is evidence of embryotoxicity on the part of both heptachlor and chlordane to some strains of rats or mice. Embryotoxicity is of particular importance since heptachlor epoxide residues have been detected in human fetuses and neonates. There is additional evidence in the literature indicting other toxic effects of a chronic nature attributable to heptachlor and chlordane. All such evidence should be further explored in the hearings.

Since technical chlordane generally contains 8 to 12 percent heptachlor, all of the findings reported above for heptachlor and its metabolites are relevant to technical chlordane when adjusted for the difference in concentration. Pure alpha and gamma chlordane without heptachlor are not registered as a pesticide nor is the Agency aware of the existence of adequate efficacy data to satisfy registration requirements. Sufficient testing has not yet been completed or reported on highly purified chlordane to warrant a determination of the carcinogenicity of pure chlordane (without heptachlor).

VI. Environmental Contamination and Persistence

Heptachlor and chlordane, or their metabolites, are persistent in the environment long after use. Residues of heptachlor epoxide have been detected in soil samples for as long as ten years after application. Chlordane is even more persistent, with 18–20 percent of the originally applied dosage recoverable in soil ten years after application. In addition, heptachlor is quite volatile. Chlordane is also volatile, though somewhat less so than heptachlor. Chlordane vapors can penetrate packaging material and contaminate food in homes in which it is used.

Although we do not have data which can be considered representative of the ambient air nationally, limited sampling of sites selected for other purposes showed the presence of heptachlor, and to a very limited extent, chlordane. This indicates that air can be a source for human intake of these compounds.

As persistent compounds, heptachlor, chlordane, and their metabolites are subject to considerable movement from the site of actual application. Residues of both heptachlor and chlordane can be picked up from the soil and translocated to various parts of plants. Remnant residues are particularly significant in root crops such as carrots, potatoes, and beets. In addition, residues of chlordane were detected in alfalfa growth sampled at 2 months, 4 months, and 1 year after application to soil, at a dosage of 5 to 10 pounds actual chlordane per acre. One of the major residues found in alfalfa was oxychlordane (17 percent).

Although low in water solubility, their affinity for lipids and their ability to adhere to particulate matter make heptachlor and chlordane subject to bioaccumulation and transfer in the food chain, particularly in aquatic species. While heptachlor and chlordane would appear to be relatively immobile once they are bound to the soil, C_{14} labeled pesticides from treated fields east of Dallas, Texas, were monitored and later found to have been deposited by rain over Cincinnati, Ohio. The dust deposits contained 0.5 ppm chlordane. Treated soil is also subject to water erosion, ultimately leading to aquatic contamination, including contamination of phytoplankton and fish.

Chlorinated hydrocarbon pesticides have been detected in surface waters in concentrations of 10–150 ppt. Heptachlor concentrations in the Upper Mississippi and Missouri River Basins were all in the parts-per-trillion range and in many river basins of the country, ranged between 5–30 ppt. Heptachlor epoxide concentrations have ranged between 5–40 ppt.

Heptachlor, heptachlor epoxide and chlordane residues have been found frequently in fish, birds, and other wildlife. Heptachlor epoxide has been detected in birds at levels of 0.01–1.0 ppm. Chlordane residues in fish have generally been less than 0.5 ppm. Bluegill growth was reduced in heptachlor-treated ponds at a concentration in the water of 0.03 ppm. Heptachlor and heptachlor epoxide residues of 0.01–8.46 ppm were found in fish from the Great Lakes area.

Heptachlor epoxide has also been discovered in the tissues of several mammals, including pronghorn antelope (0.03 ppm), and mountain goats in South Dakota (0.12 ppm), which is indicative of its widespread distribution.

Heptachlor, heptachlor epoxide, and chlordane residues have also been found in food samples. Market basket samples for total diet studies were purchased from retail stores on a bi-monthly basis in five regions of the United States over a 6½ year period. Heptachlor epoxide was commonly found in the dairy, meat, fish and poultry components of the diet, with the residue levels ranging from trace (0.001 ppm) up to .03 ppm. The same surveys have indicated the presence of chlordane with first quarter 1974 levels being found at 0.01 to 0.3 ppm in significant percentages of cattle and poultry. The primary source of such residues in these products is probably the use of chlordane and heptachlor on feed crops like corn and alfalfa.

The most important aspect of the movement of heptachlor and chlordane in the environment is the presence of the metabolites of these pesticides in man. Human monitoring studies conducted in this country found concentrations of heptachlor epoxide in the adipose tissue in 96 percent of the 3451 hospital patients studied in 1970 (mean concentration: 0.08 ppm); 97 percent of the 3762 patients studied in 1971 (mean concentration: 0.08 ppm); and 93 percent of the 2854 patients studied in 1972 (mean concentration: 0.09 ppm). (Level of detection= 0.01 ppm). Oxychlordane residues were detected in the adipose tissue of 97 percent of 3339 patients sampled in 1971 (mean concentration: 0.10 ppm), and 97 percent of 2707 patients sampled in 1972 (mean concentration: 0.11 ppm). (Level of detection=0.02 ppm). Residues of heptachlor epoxide in adipose tissues ranged as high as 2.68 ppm, while oxychlordane residues were as high as 1.61 ppm. Recent studies indicate that an additional chlordane metabolite, trans-

nonachlor, may also be present in a very high percentage of humans.

Concentrations of heptachlor epoxide residues are found not only in adults, but in stillborn infants as well. The organs of 10 stillborn infants obtained in two Atlanta hospitals were found to contain an average of 0.51 ppm heptachlor epoxide. The highest levels were found in the heart, adrenal gland, and liver. The findings of residues in stillborn infants demonstrates that heptachlor epoxide is transferred from the mother to the infant across the placenta. In addition, 53 human milk samples collected in Philadelphia, and Center County, Pennsylvania, had an average concentration of heptachlor epoxide of 0.06 ppm on milk fat. In a study reported in 1973, Three of the samples were in the 0.40 ppm to 0.49 ppm range.

These findings are disturbing since organisms that are exposed from the time of conception and then for the balance of their life are apt to be more responsive than those whose exposure begins after weaning. For this reason evidence that human fetuses are exposed across the placenta is considered especially significant even without quantitative evaluation. Similarly levels in milk that may be the sole source of food for infants is of especial concern even though that level may not be continued after weaning. Quantification of the risk to men on the basis of a comparison between the levels of a carcinogen to which man is exposed and the levels which produce cancer in experimental animals is extremely difficult because of the number of factors which must be considered. In the case of heptachlor epoxide, experimental animals were dosed only by the oral route whereas man may be exposed by inhalation of air as well. The dosage to which animals are exposed are often in terms of concentrations in the feed (10 ppm and 0.5 ppm in experiments reported above). For a direct comparison of oral dosages, the concentration in feed (or man's food) must be multiplied by the volume of feed (or food) consumed per day to give the daily intake of the carcinogen. This must be further adjusted either for weight or size of the animal or man. Even such an adjustment is incomplete without some compensation for differences in metabolic rates. Both length of exposure (probably in terms of percentage of normal life span) and the age at which exposure is initiated must be considered. Additionally, an assumption must be made about the relative sensitivities of the experimental animals and man to the carcinogen in question. In the absence of data concerning the carcinogenicity of heptachlor epoxide to man, we must assume that the relative sensitivity of man to this effect is comparable or possibly greater than that of the experimental animals unless there is convincing evidence otherwise.

Thus even though it is impossible, because of all of the unquantified factors discussed above, to assign a numerical probability to the risk that heptachlor epoxide may produce cancer in humans, some generalized conclusions are possible. The presented evidence of measurable quantities entering man's body and further being transferred to fetuses in the uterus, indicates that humans are exposed to heptachlor epoxide from the moment of conception on throughout life. This is sufficient basis for grave concern for the possibility that humans, like the experimental mice and rats, may react to such exposure by producing malignant tumors.

VII. Economic Impacts of Cancellation

On the basis of present information, national macroeconomic effects from the cancellation of chlordane and heptachlor are estimated to be negligible. Overall national production, cost and price effects will be minor for all uses. However, some microeconomic effects in specific regional and local areas may occur for corn, particularly on land subject to black cutworm infestation. Some microeconomic effects are possible for citrus and strawberry uses. Certain specialty crops may also be impacted but this will need to be assessed in the hearing. For all remaining uses including hay and forage, tobacco, peanuts, vegetables, livestock, soybeans, cotton, potatoes, grapes and other fruits and vegetables, there is no indication of significant macro- or micro-economic impacts or disruptions.

VIII. Balance of Risks and Benefits

For the purposes of the following discussion findings with regard to the risk of heptachlor must apply to registered chlordane products since chlordane as registered and used always includes heptachlor in substantial amounts.

A discussion of the risks associated with a pesticide under question as posing environmental or human health concerns must be based upon assessment of two interrelated factors: the toxicological characteristics of the compound, and the availability of the compound in environmental compartments which leads to exposure of man or of other organisms. Neither factor taken alone is sufficient to determine or estimate total risk. Evidence concerning risk will, then, be summarized in two parts: First, the effects of chlordane and heptachlor on man or other organisms; and second the levels of exposure which have been found to occur as a consequence of the use of these two products.

Concerning toxicity, heptachlor epoxide has been demonstrated to be carcinogenic in two species of laboratory animals; mice and rats at levels as low as 10 ppm and 0.5 ppm respectively. In the rat studies, several organs in addition to the liver, including the endocrine glands, showed increases in tumors. Both heptachlor and chlordane have significant toxicity for various species of wildlife, although it is difficult to determine what impact these toxicities have on species populations, as opposed to individual fish or wildlife or specific local populations.

With respect to exposure, available evidence indicates that both chlordane and heptachlor or their metabolites are present in water, dairy products, and other foods. Man's exposure to these compounds at significant levels is demonstrated by residues present in human milk, and the distribution of the compounds throughout the organs of stillborn fetuses. Analysis of autopsy and biopsy samples shows chlordane, heptachlor, and/or their metabolites at significant levels in human adipose tissue, further indicating intake and bioconcentration by man.

Available evidence of the costs of discontinuing the use of heptachlor and chlordane can be summarized as follows: Economic costs of pest control may rise but it is expected that the use of alternative means of pest control will allow continued control at costs which indicate no significant adverse macroeconomic effects. In certain geographical areas or for certain crops, microeconomic dislocations at the farm or county level might occur. The extent of this impact, if any, will need to be assessed further in the hearings.

IX. Conclusion

Weighing the risks presented by the continued use of heptachlor and chlordane against their benefits, it appears that they pose an unreasonable risk to men. Although these risks require further definition, a notice of intent to cancel these products should be issued in order that both the risks and the benefits may be more fully developed through the public hearing process. Public hearings should allow all pertinent evidence to be brought forth and examined so that a fully informed, indepth analysis of risks and benefits may be made and appropriate remedies fashioned. Remedies to be considered at the hearings should include strengthening use restrictions, should any be appropriate, as well as removal of these products from the market for some or all uses.

Because heptachlor and chlordane have a very large number of uses, the Agency reserves the opportunity to present evidence on any registered use affected by this order regardless of whether or not a hearing has been requested on that use, or whether or not such use is to be actively defended in the hearings.

The only exceptions to the notice of intent to cancel are the use of chlordane and heptachlor for subsurface ground insertions for termite control and for the dipping of nonfood plants. These uses achieve the desired control of insects without apparent unreasonable environmental contamination.

A draft environmental impact statement concerning this intent to cancel certain products containing heptachlor and chlordane is being prepared and will be available in approximately 60 days.

An Order concerning intermediate products containing heptachlor and chlordane is also being issued today.

Dated: November 18, 1974.

RUSSELL E. TRAIN,
Administrator.

[FR Doc.74-27545 Filed 11-25-74;8:45 am]

APPENDIX 2

ESTIMATED DOMESTIC USE OF CHLORDANE AND HEPTACHLOR

1974

	CHLORDANE		HEPTACHLOR	
	%	lb*	%	lb*
Agriculture Use	28	6,005,000	59	1,187,000
Termite Control	35	7,342,000	26	551,000
Other**	37	7,826,000	15	312,000
Total	100	21,173,000	100	2,000,000

* Active Ingredient

** Including use inside houses and other buildings, on home gardens, on lawns and turf, on ornamentals and shade trees, on forestry plantations, on agricultural premises, in nurseries, in sewage treatment plants, in mosquito control and in seed treatment.

Source: EPA extrapolation of industry data

APPENDIX 3

EXAMPLES OF POSSIBLE SUBSTITUTES

FOR

CHLORDANE AND HEPTACHLOR

CORN

Ants	-	Carbaryl
Armyworm	-	Methoxychlor, Methyl Parathion, Carbaryl, Malathion, Diazinon, Toxaphene
Climbing Cutworms	-	Methyl Parathion, Toxaphene
Crickets	-	Carbaryl, Trichlorfon, Toxaphene
Cutworms	-	Methyl Parathion, Carbaryl, Diazinon, Trichlorfon, Toxaphene, Dylox
Earwigs	-	Carbaryl
Fleabeetle	-	Methoxychlor, Methyl Parathion, Carbaryl, Malathion, Diazinon, OMPA, Toxaphene
Grasshoppers	-	Mevinphos, Methoxychlor, Methyl, Parathion, Carbaryl, Malathion, Diazinon, Endosulfan, Toxaphene
Japanese Beetle	-	Methoxychlor, Carbaryl, Malathion, OMPA, Toxaphene
June Beetles	-	Carbaryl
Mole Crickets	-	Diazinon
Root Maggots	-	Diazinon
Rootworm	-	Methyl Parathion, Phorate, Malathion, Diazinon, Disulfaton, Bux, Dasanit, Furadan, Dyfonate Mocap
Rose Chafer	-	Methoxychlor
Slugs	-	Metaldehyde

CORN

Snails	-	Metaldehyde
Sowbugs	-	Carbaryl
Wireworms	-	Lindane, DD Mixture, Diazinon, EDB, Dasanit, Dyfonate, Furadan, Mocap, Phorate

SMALL FRUITS

Ants	-	Carbaryl, Methyl Bromide, Chlorpicrin
Cabbage Looper	-	Mevinphos, Carbaryl, Malathion
Climbing Cutworms	-	Toxaphene
Crickets	-	Lindane, Methoxychlor, Carbaryl, Malathion, Toxaphene
Cutworms	-	Carbaryl, Malathion, Lindane, Toxaphene
Darklin Beetle	-	Carbaryl
Earwigs	-	Carbaryl, Lindane
False Chinch Bug	-	Methyl Parathion
Field Crickets	-	Methoxychlor, Carbaryl, Malathion, Endosulfan
Flea Beetles	-	Methoxychlor, Carbaryl, Malathion, Diazinon
Fuller's Rose Beetle	-	Guthion
Grasshoppers	-	Lindane, Mevinphos, Naled, Endrin, Carbaryl, Toxahpene
Japanese Beetle	-	Methoxychlor, Carbaryl, Malathion
Leaf Miners	-	Diazinon

SMALL FRUITS

Lygus Bugs	- Endosulfan, Mevinphos, Methoxychlor, Carbaryl, Malathion
Mole Crickets	- Diazinon
Pill Bugs	- Lindane, Methoxychlor, Naled, Carbaryl, Malathion, Diazinon, Endosulfan
Rose Chafer	- Methoxychlor, Carbaryl
Slugs	- Methaldehyde, Carbaryl
Snails	- Metaldehyde
Stink Bugs	- Mevinphos, Carbaryl, Guthion
Strawberry Crown Borer	- Toxaphene
Strawberry Root Weevil	- Malathion, Methoxychlor, Endosulfan
Strawberry Weevil	- Lindane, Perthane, Methoxychlor, Naled, Carbaryl, Malathion, Toxaphene
Thrips	- Endosulfan, Naled, Methyl Parathion, Carbaryl, Malathion, Guthion, Mevinphos, Methoxychlor, Diazinon
White Grubs	- Chlorpicrin, Lindane, Methyl Bromide
Wireworms	- DD Mixture, Chlorpicrin, EDB Methyl Bromide

PREMISES (indoor)

Ants	- Lindane, Methoxychlor, Lethane Malathion, Ronnel, DDVP, Pyrethrins, Baygon, Diazinon
Bees	- Pyrethrins
Brown Dog Tick	- Naled, DDVP, Baygon, Carbaryl, Malathion, Diazinon, Chlorpyrifos, DDVP

APPENDIX 3 (continued)

PREMISES (indoor)

Cadelle	-	Methoxychlor, Ethylendichloride, Pyrethrins, EDB, Methyl Bromide
Cockroaches	-	Diazinon, Ronnel, DDVP, Baygon, Lindane, Fenthion, Malathion, Trichlorfon, Pyrethrins, Chlorpyrifos
Crickets	-	Baygon, Ronnel Pyrethrins
Fleas	-	Thanite, Diazinon, Chlorpyrifos, Ronnel, Rotenone, DDVP, Compound 4072, Pyrethrins, Naled, Dioxithon, Carbaryl, Resemthrin, Lindane, Lethane, Methoxychlor, Baygon, Malathion
Files	-	Lindane, Malathion, Trichlorfon, Ronnel, DDVP, Pyrethrins, Lethane 384, Methoxychlor, Carbaryl, Diazinon, Fenthion, Resemthrin
Gnats	-	Pyrethrins, DDVP, Methoxychlor, Malathion, Resemthrin
Granary Weevil	-	Lindane, Methoxychlor, Malathion, Pyrethrins, Ethylene Dichlordie, Methyl Bromide
Hornets	-	Pyrethrins, DDVP, Resemthrin
Mosquitoes	-	Lindane, Malathion, Ronnel, DDVP, Pyrethrins, Lethane 384, Methoxychlor, Carbaryl, Fenthion, Diazinon, Rseemthrin
Rice Weevil	-	Lindane, Methoxychlor, Malathion, Pyrethrin, EDB, Ethylene Dichloride, Methyl Bromide, Trichlorethylene
Silverfish	-	Ronnel, DDVP, Pyrethrins, Baygon, Lindane, Methoxychlor, Malathion, Diazinon
Spiders	-	Lethane 384, Methoxychlor, Malathion, Ronnel, DDVP, Baygon, Pyrethrins
Ticks	-	Naled, Dioxithon, Carbaryl, Baygon, Malathion, Compound 4072, Lindane, Methoxychlor, Pyrethrins, DDVP
Wasps	-	Ronnel, Pyrethrins, DDVP, Fenthion, Resemthrin

APPENDIX 4

QUANTITY OF CHLORDANE AND HEPTACHLOR USED, BY ALTERNATIVE

ESTIMATED AMOUNTS USED (1974 BASIS)

ALTERNATIVE	USE AREAS CANCELLED	USE AREAS CONTINUED	Chlordane %	Chlordane lb (mil)	Heptachlor %	Heptachlor lb (mil)
No Cancellation	None	Agri., Termites & Other*	100	21.0	100	2.0
Cancel All Uses	Agri., Termites, & Other*	None	0	0	0	0
Cancel All But Termites & Dips	Agri., and Other*	Termites	35	7.3	26	.5
Cancel Food & Feed Uses	Agri.	Termites & Other*	72	15.2	41	.9

* "Other" includes use inside homes and other buildings, on home gardens, on lawns and turf, on ornamentals and shade trees, on forestry plantation, on agricultural premises, in nurseries, in sewage treatment plants, in mosquito control and in seed treatment.

APPENDIX 5

ESTIMATED IMPACT OF ALTERNATIVE COURSES OF ACTION

ALTERNATIVES AND EFFECTS	NATURE OF EFFECT			
	Adverse		Beneficial	
	Short-term*	Long-term**	Short-term*	Long-term**
ALTERNATIVE #1: No Cancellation				
Environmental	Moderate	Major	None	None
Human Health	Minor	Major	None	None
Economic & Social	Moderate	Major	Moderate	Moderate
ALTERNATIVE #2: Cancel All Uses* **				
Environmental	Minor	None	Major	Major
Human Health	Minor	None	Moderate	Major
Economic & Social	Minor[1] Major[2]	Moderate	Moderate	Major
ALTERNATIVE #3: Cancel All But Termite Control & Dips				
Environmental	Minor	Minor	Major	Major
Human Health	Minor	Minor	Moderate	Moderate
Economic & Social	Minor[1] Moderate[2]	Minor	Moderate	Moderate
ALTERNATIVE #4: Cancel Food & Feed Uses				
Environmental	Minor	Moderate	Major	Moderate
Human Health	Minor	Moderate	Moderate	Moderate
Economic & Social	Minor	Minor	Moderate	Moderate

* One year or less after action taken (and cancelled uses terminate).
** One to ten years after action taken (and cancelled uses terminate).
*** Assumes unavailability of aldrin and dieldrin for termite control uses.
1. Nationally
2. Limited geographic area, user group, or industry sector.

APPENDIX 6

REFERENCES

1. U. S. Environmental Protection Agency. Pesticidal Aspects of Chlordane and Heptachlor in Relation to Man and the Environment A Further Review, 1972 - 1975.

2. U. S. Environmental Protection Agency. EPA Actions to Cancel and Suspend Used of Chlordane and Heptachlor as Pesticides: Economic and Social Implications. 1975.

3. U. S. Environmental Protection Agency. Heptachlor - A Review of Its Uses, Chemistry, Environmental Hazards and Toxicology. 1972.

4. U. S. Environmental Protection Agency. Pesticidal Aspects of Chlordane in Relation to Man and The Environment. 1972.

NOTE: For single copies of reference documents 1 and 2 and for information on the availability of documents 3 and 4 write:

Federal Register Section
Technical Services Division (WH-569)
Office of Pesticide Programs
Environmental Protection Agency
Room 401, East Tower
401 M Street, S. W.
Washington, D. C. 20460