



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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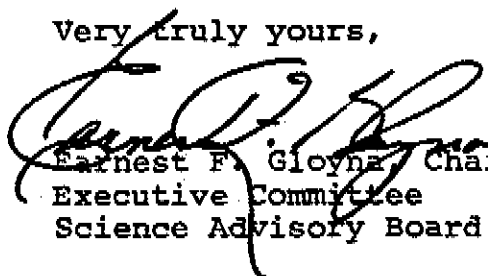
OFFICE OF
THE ADMINISTRATOR

Mrs. Anne M. Gorsuch
Administrator
U.S. Environmental Protection Agency
401 M Street, S.W.
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Dear Mrs. Gorsuch:

The Executive Committee of the Science Advisory Board has recently completed its report on the Agency's five-year plan for research and development entitled Research Outlook 1982. In carrying out its review the Committee made a number of recommendations for improving both the scientific adequacy of the document as well as enhancing its usefulness as a strategic planning tool. I hope that the Science Advisory Board's comments prove useful to you and the Office of Research and Development.

Very truly yours,


Ernest F. Gloyne, Chairman
Executive Committee
Science Advisory Board

Research Outlook 1982

A Report of the Executive Committee
of the
Science Advisory Board

U.S. Environmental Protection Agency

September 21, 1982

EPA NOTICE

This report has been written as a part of the activities of the Agency's Science Advisory Board, a public advisory group providing extramural scientific information to the Administrator and other officials of the Environmental Protection Agency. The Board is structured to provide a balanced expert assessment of scientific matters related to problems facing the Agency. This report has not been reviewed for approval by the Agency, and hence, its contents do not represent the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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Executive Summary

- For the most part, the research needs cited in the Research Outlook 1982 are important. The document reflects the Office of Research and Development's efforts to develop scientific data bases in support of the program requirements of EPA regulatory offices. However, it does not appear that the resources available to ORD will fund any but a small fraction of the needs mentioned.

- There is little or no identification of long-term exploratory research needs, and the reader is left to infer that such research has little if any priority within the Agency. Rather than acknowledge new needs in this area, the document is directed toward a defense of the status quo.

- Future Research Outlook documents should present a statement of research needs that is not subordinate to the research budget. Such budgetary scenarios, extrapolated into future fiscal years, have been frequently unrealistic, and the need to defend a particular set of resource forecasts has inhibited a truly candid discussion by the Agency of future research needs when those needs appear to exceed available resources. A more realistic alternative is for the Agency to strive to prepare a five-year plan which, when submitted to Congress at the same time as the Administration's budgetary proposals, does not contain specific resource projections. Congress could then continue to use the Outlook as a planning guide in authorizing and appropriating EPA's research and development (R&D) budget.

- From the standpoint of articulating a strategic research plan, it would be advisable to emphasize that risk abatement and the prevention of hazards are major goals.

- The productivity of EPA's research and development program in the next five years will depend critically on many factors which receive little or no discussion in Research Outlook 1982. Among these are the management, coordination, and allocation of resources among the various components of the intramural and extramural research program and the investigator-initiated Peer Review Grants Program.

- A review of the research needs identified in Research Outlook indicates that EPA's research mandate frequently overlaps that of other Federal agencies. It would be useful if the Outlook would compare EPA's definition of its research needs in the context of what research is being carried out by other agencies, the private sector, and other levels of government.

- The preparation of the Research Outlook should be closely tied to the development of research strategy documents within the Office of Research and Development (ORD), and the conceptualization of both sets of documents should be subject to early Science Advisory Board review.

I. Overview of Research Outlook 1982

As a whole, Research Outlook 1982 provides a brief overview of the major areas of research and development activity planned by the Agency for the next five years. It presents these plans in general terms, and the lack of specifics makes it difficult to evaluate its scientific and technical adequacy or its adequacy as a research planning tool. The report does not articulate an overall Agency strategy for conducting its research and development program. In the absence of such a clearly stated strategy, the reader is left with the impression that the program is a collection of tasks rather than an integrated program managed to achieve well-stated objectives.

For the most part, the research needs cited in the Outlook are important. The document reflects the Office of Research and Development's efforts to develop scientific data bases in support of the program requirements of EPA regulatory offices. However, it does not appear that the resources available will fund any but a small fraction of the needs mentioned. For example, to validate stream models or other models for rapid evaluation of environmental toxicity would require an enormous effort. It is unclear from reading the Outlook how this would be done and with what resources.

There is little or no identification of long-term exploratory research needs in Research Outlook 1982, and the reader is left to infer that such research has little if any priority within the Agency. Rather than acknowledge new needs in this area, the document is directed toward a defense of the status quo.

The ORD investigator-initiated, Peer Review Grants Program is the only EPA effort that supports researcher-initiated studies that are not tied to short-term regulatory needs. This program meets the scientific community's accepted definition of long-term exploratory research and has enlisted the talents of an extremely broad and highly qualified segment of the nation's scientific community. The investigator-initiated grants program may not fit the organizational framework of the Research Outlook document very well, but it still needs to be accommodated within the Agency's plans. It provides an opportunity for new ideas and fresh approaches to be developed that, in the long run, can significantly assist the Agency in fulfilling its mission in a cost-effective manner. Unfortunately, this program is not even mentioned in Research Outlook 1982.

From the standpoint of articulating a strategic research plan, risk abatement and the prevention of hazards should be emphasized as major goals. Although these concepts are implied in many of the activities described in the Outlook, they are not mentioned explicitly enough to indicate that they are goals of particularly high priority. A related issue is whether there is a relationship between R&D expenditures and the degree of risk reduction. If such a relationship exists, it should be stated.

The productivity of EPA's program for research and development in the next five years will depend critically on factors which are not addressed at all in Research Outlook 1982. Among these are the management of the research budget and its allocation among the different types of research areas and research organizations. The program should have short-term (1 yr), intermediate (1-3 yrs), and long-term (3-5 yrs) components.

In the past, the Agency has used several approaches for the conduct of research including 1) in-house operations by EPA employees, 2) operations carried out under task-order contracts, 3) inter-agency agreements, and 4) grants to universities and other institutions. In the face of reduced financial resources, it would be of interest to know if changes in research management and the relative use of the various approaches noted above are contemplated to yield a more cost-effective and productive research program.

The Research Outlook document should more explicitly address the issue of management, coordination, and allocation among the various components of the intramural and extramural research program. Such background information would greatly assist reviewers and other interested parties in assessing the quality of the program and its prospects for successful implementation. Inclusion of a statement on the process used for preparation of the document would promote understanding of the relationship between the five-year plan and the research and development program in general. This information would, in turn, facilitate the development of a clearer statement of purpose as to what role this relationship serves for R&D managers within the Agency.

A review of the research needs and projects discussed in individual chapters indicates that EPA's research mandates frequently overlap those of other Federal agencies. For example, EPA sponsors research for pesticides, criteria and hazardous air pollutants, acidic deposition, and various toxic substances. It would be helpful if the Outlook would

compare the research needs that are identified by EPA in the context of what research is being carried out by other agencies. In addition, research initiatives undertaken by the private sector and other levels of government should be discussed.

It is clear that EPA cannot be the primary sponsor of research in all of the areas of research and development embraced by its regulatory mandate. Choices must be made to define in what fields of research EPA should have a primary role, a shared or contributory role, or no role. An example of a primary role for EPA should be the fields of environmental transformation, fate and ecology, and municipal wastewater. In the case of chemical processing technology in manufacturing plants, including synfuels plants, other organizations may be better qualified than EPA to be a primary sponsor of research and development. This year's Outlook provides little or no scientific rationale (as contrasted with a legislative rationale) for the inclusion or exclusion of specific research activities.

Research Outlook 1982 does not provide a clear statement of how the Agency's research budget will be allocated. A better explanation of the terms high, moderate, and low growth would also be helpful to the reader.

The need for health effects research is mentioned in several places in the document. For example, the Outlook states (p.33) that "Epidemiological studies germane to air quality are left to health agencies such as the National Institutes of Health (NIH) and academic institutions." This statement is inappropriate for an Agency whose mission is to protect the public health from environmental hazards.

In health-oriented sections of the document, reference is made repeatedly to the development, use, and validation of short-term tests for predicting the toxicity of various materials. In most cases, the implication is that short-term tests can be used to predict latent health effects. If this is the objective and if it is to be attained, validation will require a well-developed strategy. Such a strategy should include the conduct of long-term animal studies; yet such studies receive limited attention in the document.

The major milestones cited throughout the document for individual research projects do not, for the most part, extend past 1984. This is inconsistent for a document that is supposed to be a five-year plan.

The report could be improved if it included an Executive Summary highlighting the most important conclusions and contents. In the absence of such a Summary, it is difficult to identify those research issues that are considered most significant by the Agency's scientists and policy makers.

II. Chapter by Chapter Review of Research Outlook 1982
Comments on Chapter 1: ENERGY

Introduction

- Given the extent to which other agencies, such as the Department of Energy, have major research efforts underway in this area, the report should clearly identify how the EPA effort will complement the research sponsored by these agencies. In addition, there should be additional discussion of how EPA set its own energy research priorities.
- Long term energy research is confined to a narrow part of EPA's discussion of its energy research mandate. Not represented are (1) long-term effects of acid deposition and (2) long-term effects of waste disposal from energy technologies.

Acid Deposition

- Transport and transformation of acidic deposition precursors should be emphasized. More discussion is needed on the scale of acid deposition impacts, research on the trend of the impact, or the relationship between the tractability of the problem and the scientific capability for abatement. The Outlook does not address in sufficient detail acidic deposition mitigation methods such as liming.
- Since many significant gaps exist in our understanding of dry deposition, there should be more discussion of this part of the research program.
- EPA should provide its estimate of how long it will take to establish reliable trend data in the pH of precipitation samples (page 4).
- The impact of acidic deposition on construction materials may be less than the impact on the overall structure's integrity, life span, etc. The document should, therefore, include a discussion of impacts on riveted and welded joints, concrete-to-steel interfaces, etc. (page 6, paragraph 2).
- The research strategy for acid deposition discusses fishery resource losses, aquatic assessment models, fate, and additional priority for development of criteria to judge sensitivity of soils to acid deposition. If there is a single major factor interrelating the acid

deposition strategies to the solid state intermedia, it is the ion exchange capacity of soils. The proposed strategies seem either to lead up to or to skirt this problem, when indications are that it may be the central point of an integrated assessment.

Combustion Technology

The rationale for the NO_x program needs to be further developed, since in very few regions of the country are the standards exceeded.

- Particulate control technology is discussed under the heading of Combustion Technology (page 7). This is not the appropriate category in which to review this subject, because air pollution control technology is not a branch of combustion technology. The title of the section should be changed to Air Pollution Control Technology. There is also no discussion of the control of fugitive or non-ducted sources. EPA is the natural sponsor for support of this type of research, and a significant level of research activity should be maintained. Are all of the technologies relating to NO_x, SO_x, and particulate emissions to be given equal emphasis, or is NO_x given priority because "it is the only class of major air pollutants to have increased over the past decades"? Is there any plan to test an ammonia scrubber to reduce NO_x?

Synthetic Fuels

- There should be a discussion of the pace of development of the synthetic fuels industry and its impact on the research program described in the Outlook. The Agency should maintain a continuing capability to assess the environmental effects of this industry, paying particular attention to existing or developing synthetic fuels projects.
- The synfuels research strategy indicates that a significant amount of environmental research has already been done. This document should clarify which are the principal pollutants and the principal environmental problems associated with this industry. In addition, the statement "risk-benefit assessments will be limited to utilizing existing data and addressing major research endpoints" (page 10, paragraph 1, line 2) needs to be explained.

Environmental Effects

- Neither cold climate studies nor pollutant transport modeling can actually be classified as an environmental effect. The former is discussed in the context of monitoring CO concentrations in Alaska and the latter with tracking pollutants in terrains complicated by mountains, ridges, etc. There may be a more appropriate title for this section of the document (pages 10-11).

Long-term Research

- There seem to be no plans for supporting long-term acid deposition research. Instead, short-term effects/mitigation studies are planned. In addition, based upon experience in arctic research, it is not clear how the statement, "In support of the cold-climate research...for permafrost and tundra ecosystems" (page 11, paragraph 2, line 7), relates to energy-driven environmental effects, or why it warrants a high priority for scarce long-range funds.

Comments on Chapter 2: HAZARDOUS AIR POLLUTANTS

General Comments

- This chapter should present and discuss the criteria for the selection of pollutants identified for research funding.
- More information is needed on the interaction of complex mixtures of pollutants, including whether such mixtures act synergistically or through other mechanisms.

Health Effects Research

- The scope of the effort outlined in this section defines two major objectives: "(1) the screening and identification of biologically active compounds so that appropriate candidate substances are prioritized for further analyses, and (2) the conduct of detailed assessments of selected substances in support of regulatory decisions" (page 17, paragraph 3). The research dollars budgeted are insufficient to carry out these ambitious tasks.

Comments on Chapter 3: GASES AND PARTICLES

General Comments

- In this chapter and in Chapter 4, Oxidants, there is discussion of research strategies for oxides of nitrogen and sulfur. More discussion of the relationships between the NO_x and the gases and particles program is needed.
- The Agency has expressed considerable interest in the use of the "Bubble" concept for controlling emissions from an entire industry rather than on an individual process or equipment item basis. This may simplify pollution control efforts and reduce costs. The usefulness of the "Bubble" approach could be enhanced if the Agency sponsored further research of this concept. Such research could be initiated through the Peer Review Grants Program at an early date.

Environmental Processes and Effects

- Inasmuch as gaseous SO₂ and acid deposition will be evaluated together for their impact on materials, one might expect a similar integrated approach in regard to vegetation.

Health Effects

- A discussion of any plans to test combinations of lead and gaseous pollutants would be useful.
- Since the National Ambient Air Quality Standards (NAAQS) are to be reexamined at five-year intervals, there is a continuing need to develop better indices of particulate air quality than the non-specific mass concentrations used for TSP, PM₁₀, or fine particulates, because particulate mass concentrations, even when specified by size range, remain crude indices of air quality.
- There is relatively sparse discussion about specific research projects in this chapter, making it difficult to evaluate the prospects for effective implementation of this section of Research Outlook 1982. Where specific projects are stated, they sometimes raise concerns about the criteria and judgment used in their selection. For example, on page 33, lines 6-7, the three chemicals identified for specific study are ammonium sulfate, iron oxide, and kaolin clay. Ammonium sulfate is the most innocuous chemical in the series

SO₂, SO₃, H₂SO₄, NH₄HSO₄, and (NH₄)₂SO₄. Iron oxide is one of the least likely metal oxides to have adverse effects by itself. It is less active as a catalyst than many other metal oxides and other particles, such as carbon. It is also difficult to understand the selection of kaolin, a relatively innocuous silicate, as a research priority.

- The focus of the planned human studies (page 33, paragraph 2) will involve exposures to sulfate and nitrate aerosols alone and in combination with O₃, NO₂, and SO₂. It is difficult to see how much useful information can come from additional studies of this type. These kinds of studies, using the most sensitive available methods and having excellent quality control, have been carried out recently.

Resource Options

- It is difficult to understand the emphasis on human exposures in view of the limited range of important questions that can be addressed by clinical exposure studies compared to the versatility and economy of animal models for screening chemicals, characterizing particle size influences, and adding to our understanding of chronic exposures and persistent effects.
- Given the levels of funding as projected for 1983-1986, the allocation of a major portion of the budget to high cost clinical studies would leave other critical areas of investigation unfunded.

Comments on Chapter 4: OXIDANTS

General Comments

- The objectives and strategies in this chapter clearly complement each other. Specific problems and their solutions are explicitly stated, especially in relation to health effects and air quality models. As a minimal program, the chapter represents a well-designed and well-balanced effort.

Exposure and Effects

- With respect to the discussion of important O₃ health effects, there is inadequate attention to the cumulative effects of chronic, low level exposures. These exposures may contribute to cellular changes in the

small airways and alveoli which, with continued periodic exposures, may cause cumulative and irreversible adverse changes to human respiratory systems. Examination of lung sections of humans whose residential and occupational histories can be determined will be expensive and will take at least several years to perform. It is unlikely that they will be performed without EPA's support and encouragement. More chronic low level inhalation exposure studies in laboratory animals are needed to guide and complement studies on human lung tissue.

- Greater discussion is needed on why the assumption is made that there is a threshold for O_3 in normal subjects (page 40).
- The issue of the effect of repeated exposures to peak concentrations of NO_2 has not been adequately addressed. A focused program of animal studies of the effects of periodic peak NO_2 exposures on lung defense functions should have a high priority.
- Recent reviews by the scientific community indicate that there are critical gaps in (1) health effects research on NO_x to justify more stringent control, and (2) epidemiology studies relative to NO_x and O_3 .

Air Quality Models

- This chapter has not sufficiently emphasized the issue of model validation as a research priority, even though there are large uncertainties in the current state-of-the-art of the precision of models. There should also be greater emphasis on developing a method for measuring hydrocarbons.
- It is appropriate that peroxyacetylnitrate (PAN) be evaluated for its role in photochemistry of the atmosphere and for its possible health effects. PAN should also be evaluated as a contributor to acidic deposition.
- It may be overly optimistic to promise a dispersion model for PAN, HNO_3 , etc. for 1984.
- More justification is needed as to why biogenic emissions are considered to be an important research priority (page 42, paragraph 1).

Control Technology

- EPA should determine the extent to which private industry is sponsoring control technology research for volatile organics, and, in light of this information, the Agency should assess its own research needs and degree of support.

Comments on Chapter 5: MOBILE SOURCES

General Comments

- There is no reference in this chapter to the role of the Health Effects Institute, jointly funded by EPA and the automobile industry. It would be appropriate to discuss the Institute's program and how it relates to or differs from the rest of the EPA mobile source program.
- Some research issues outlined in this chapter are too broad to be critically evaluated. For example, on page 50, paragraph 1, it is indicated that various animal tests would be performed comparing diesel soot and several known carcinogens and that the results would provide a basis for performing human risk assessments on diesel exhaust samples. The Outlook needs to address the merits of this testing approach and identify methodological weaknesses or problems. Further, it is unclear what is meant by the statement that in vitro tests might be used for "cancer-based regulation of engine systems and fuels and fuel additives."
- The important issue of research on aerosol sampling techniques for exhaust particles has been overlooked (page 51, paragraph 6).

Comments on Chapter 6: RADIATION

General Comments

- This chapter seems deficient in at least two respects. First, given the plethora of governmental agencies which address some aspect of the health effects of ionizing radiation (DOD, DOE, EPA, NIH-NCI, ...), it is not clear how EPA's effort compares with that of the

others. Is it truly unique, and if so, how? How do these activities, in turn, relate to recommendations by such organizations as the National Council on Radiation Protection? Second, there seems to be no aspect of the program on non-ionizing radiation devoted to the possible health effects of extremely low frequency radiation (50-75 Hz) as geomagnetic waves. Are studies of this kind underway in some other agency?

- Most of the research strategies proposed and the milestones developed in this chapter focus on experimental animals. What support exists for epidemiological investigations? Some further studies on human health may help to inform the public better as to either the presence or absence of radiation hazards.

Research Strategy

- Too much emphasis is placed on the mammalian nervous system with no mention of immunology or growth and development. The importance of the study of mechanisms within the health effects program is appropriate. The focus on the effects on growth and function of bacterial and other unicellular organisms at specific frequencies is unclear. What is the relevance of these studies, and how can one extrapolate their results to man in the face of other more extenuating problems such as immunology, reproduction, growth, and development?
- What credence does EPA place on the Soviet literature on limited clinical data from studies of occupationally exposed people (page 57, paragraph 4, line 3)? What criteria were used to select 500 MHz as a level to which man might be exposed without consideration of scaling factors?
- There is no mention of combined exposures, that is exposure to non-ionizing radiant energies and other factors such as ionizing radiation, as well as to oxidants or other chemicals. Environmental exposures are a manifestation of multiple factors rather than a single factor.

Major Milestones

- EPA should provide more information as to why there is to be research in the area of calcium efflux studies when studies conducted by Blackman are very authoritative.

- It would be helpful to have a discussion of the relationship between the National Research Council study by Robinette and the sixth research milestone identified on page 58 which states, "Final report on mortality, cause of death, and morbidity in a population exposed to radar 40 years ago - 1984."

Comments on Chapter 7: PESTICIDES

General Comments

- Research needs for Pesticides should be discussed in the context of what research is being sponsored by other agencies and by the industrial sector.
- The phrase "biological pest controls" should be substituted for "biological pesticides." Not all biological pest controls operate through lethal effects; some are reproductive inhibitors or repellants, etc.

Environmental Risk Assessment

- There should be a statement in the paragraph on modeling (pages 63-64) to emphasize the need for verification of models and the need for repeated comparison of model predictions with actual performance.

Quality Assurance

- The Outlook should reference work carried out by the National Bureau of Standards and other professional organizations concerned with analytical quality assurance.

Comments on Chapter 8: TOXIC CHEMICAL TESTING AND ASSESSMENT

Health Effects

- A statement of the criteria used to establish research priorities for this issue should be included.
- It would be helpful to identify more specifically the participants involved in the validation of predictive tests (page 72, paragraph 1, line 2).

Environmental Processes and Effects

Environmental fate

- There is not sufficient emphasis on validation of fate predictions. Is the research to be done on mixtures, pure chemicals, or both?

Environmental toxicology

- Community level toxicity tests are mentioned but not described. Will the tests be on community function, structure, or both? Why standardize species and diets when variability is characteristic of all natural systems? Recovery time following ecological displacement is not mentioned, and recovery and restoration should be discussed. Most present tests are steady-state; is pulsed exposure research being considered?

Extrapolation from the laboratory to the real environment

- There is no major body of evidence to support the assumption in the Outlook that microcosms and model ecosystems can be used to validate extrapolations from the laboratory to the real environment. The document should discuss the suitability of funding microcosms and model ecosystems research for this purpose before spending more money for development of such methods. The nature of the field validation effort should be described in more detail to clarify whether validating predictions will be made with single species tests with higher levels of biological organization or at the same level.

Indirect human exposure

- A statement should be included indicating the frequency of exposures resulting from the consumption of contaminated plants and animals and providing examples of such exposures.

Monitoring and Quality Assurance

- This section discusses mainly chemical and physical monitoring. EPA should also provide its analysis of the role of biological monitoring. Second, since natural systems are highly variable, conventional statistical methods may not be suitable, and discussion of the types of statistical methods to be used for such situations would be helpful.

Major Milestones

- The relationship between the milestones and the narrative is not clear; for example, where are the structure-activity models mentioned? It would also be helpful to indicate what projects have been dropped, diminished, or augmented.

Comments on Chapter 9: HAZARDOUS WASTES

Research Strategies

- On page 81, paragraph 1, line 5, the words "dispose of" are not appropriate. More appropriate language would be to "dispose of, contain, or detoxify."

Spills response

- Not enough priority is assigned to ecosystem recovery processes. The development of guidelines to establish ecologically acceptable residual levels of contaminants where scientific criteria for the extent of clean-up do not exist is a meritorious research endeavor. However, the Outlook should describe the research efforts needed to obtain such criteria. In addition, spill avoidance should be explicitly identified as a technology development target.

Long-term research

- In managing hazardous waste disposal sites and spill areas, there should be better methods for identifying the point at which waste removal is warranted vs. other less costly containment steps. EPA probably cannot make a "determination of threshold factor for irreversibility of ecosystem damage" (page 88) unless a major effort is undertaken, which is currently not the case.

Comments on Chapter 10: SUPERFUND

General Comments

- The chapter largely addresses technical service needs rather than research needs.

- More thought should be given to development of a "hazardous spill index," which would be a function of the degree of hazard based upon the quantity, toxicity, and media in which the spill occurred. Such an index could be used in triggering the Superfund reporting requirement.
- Development of adequate mobile equipment for rapid detoxification of liquid wastes, as well as collection and storage of hazardous solid wastes, should be underwritten. Mobile treatment equipment should include carbon treatment techniques, chemical neutralization, and/or chemical oxidation or detoxification. Also, the addition of solidification constituents available on a mobile basis should be researched.
- Scientific guidelines for the restoration of affected areas should be formulated with emphasis on assessing waste impacts on topsoil, vegetation, and, particularly, groundwater. For example, a protocol could be established for immediately installing observation wells in and around an affected area.

Comments on Chapter 11: DRINKING WATER

General Comments

- The Outlook should emphasize low cost testing procedures as a research priority. In addition, development of tests for specific pathogens is going to be far more valuable than previous gross testing for coliform organisms, especially since pathogens may come from varied sources.
- The emphasis being placed on subsurface contaminant detection is commendable.
- An index, showing where various aquifers and storage areas are located regionally and the current status of their chemistry, would be extremely valuable to the drinking water control laboratories.

Comments on Chapter 12: WATER QUALITY

Introduction

- There is no mention of regional and seasonal differences in the assimilative capacity of watercourses, even though this is an important issue in water pollution control

decisions. Biological monitoring, which is mentioned in much of the legislation, is also not specifically addressed in the Outlook.

Legislated Responsibilities

- Neither short-term nor long-term risks at levels of biological organization higher than single species can now be assessed. This was the main theme of the book Testing for Effects of Chemicals on Ecosystems, prepared for EPA in 1981 by the National Research Council. This book clearly demonstrates that laboratory-based single species toxicity tests may not accurately predict responses in more complex systems. In view of this information, the statement, "The most significant constraint on effectively addressing Phase II water quality impacts is an inability to accurately quantify the risks associated with long-term exposure to toxins," (page 108) is questionable.

Research Strategy

- Why should a high priority be given to increasing sensitivity down to laboratory derived criterion values unless these have been validated? If they have been validated, that should be explicitly stated.
- Field evaluation of selected laboratory derived ecological water quality criteria and identification of field situations in which criteria adaptation protocols are urgently needed is one of the most important problems yet to be resolved and deserves more than "a small effort" (page 111, paragraph 5).
- One of the most important aspects of contamination of public waters, from point or non-point sources, is the speed of detection and the determination of gradient concentration. Unless specific emphasis is given to these issues the pathology of a sensitive organism or series of organisms will not be sufficiently understood or reported.

Comments on Chapter 13: INDUSTRIAL WASTEWATER

General Comments

- Research efforts should be oriented toward cost-effective and energy-efficient pollution control systems. There should be greater emphasis on removing organic materials with low energy-requiring systems.

- The use of bioassays to trigger specific analyses of toxic wastewater materials is conceptually sound, and standard research relating the presence of toxic materials to existing or new bioassay techniques has merit and long-range implications for control strategies.
- EPA should continue to reassess the capability of biological systems (so-called BPT technology) to remove toxic wastewater constituents to low-level concentrations.

Comments on Chapter 14: MUNICIPAL WASTEWATER

General Comments

- Additional research is needed in the area of low cost treatment of municipal effluents including overland flow treatment, waste stabilization pond treatment, and low energy biological systems in selected areas.
- Research into improvement of individual treatment systems could be advantageous, especially in light of the proliferation of individual treatment systems on the market as many municipalities are forced to make judgments on septic tank or individual unit treatment facilities as compared to central system hook-up. This research could emphasize treatment systems for individual households, condominium complexes, motels, etc. This would be particularly useful for developments located on rocky or impervious surfaces.
- Pretreatment requirements for industries discharging into Publicly Owned Treatment Works (POTW's) should not be based on industrial categories, but should be based on case-by-case analysis. For example, research could lead to development of a protocol under which industries would be required to meet pretreatment quality levels based on a methodology using treatability studies. Such studies, in which the industrial component of treatment would be proportioned by flow, could constitute a rational basis for determining the impact of industrial discharges on the POTW system. This information could then be used to establish pretreatment requirements for particular industrial plants.

III. Findings and Recommendations on the Process for the Preparation of Research Outlook

Following its review of Research Outlook 1982 the Science Advisory Board is convinced that its role in reviewing future five-year plans needs altering. Discussions with the staff of the Office of Research and Development at the July 8-9 meeting of the Board indicate similar thinking on their part. The process for preparing this year's Outlook has thus proven to be mutually unsatisfactory. From the Board's perspective, there are at least several factors responsible for the poor quality of this year's document. These include:

- lack of input by the scientific community in the preparation of research strategy documents which form the basis for the Research Outlook;
- a paucity of conceptual thinking for translating general goals into specific research and management strategies at various levels of funding;
- the tendency of the document to present a defense of the near term status quo rather than articulating a forward looking plan.

The chapter-by-chapter analysis of the Outlook by the Science Advisory Board has highlighted flaws in the process for preparing the document. Simultaneously, the Board's evaluation has served as the basis for generating new proposals which will hopefully lead to significant improvements in the quality of next year's update of the five-year research and development plan.

As a guide to formulating specific recommendations for altering the Research Outlook development process, the Board offers two general observations. These include:

- The preparation of the Research Outlook should be closely tied to the development of research strategy documents within the Office of Research and Development, and the conceptualization of both sets of documents should be subject to early Science Advisory Board review.
- Future Research Outlook plans should present a statement of research needs that is not subordinate to the research budget. Such budgetary scenarios, extrapolated into future fiscal years, frequently have been unrealistic, and the need to defend a particular set

of resource forecasts has inhibited a truly candid discussion by the Agency of future research needs when those needs appear to exceed available resources. As a result, the Research Outlook has suffered from a dual identity crisis--on one hand it is supposed to represent a scientific statement of EPA's strategic research planning needs for a five-year period, and on the other hand it represents a political statement, as does any document during any Administration which addresses resource allocations and the Agency's spending priorities for environmental research. These two characteristics of the Outlook have proven to be mutually incompatible. Perhaps a more realistic alternative is for the Agency to strive to prepare a five-year plan which, when submitted to Congress at the same time as the Administration's budgetary proposals, does not contain specific resource projections. Congress could then continue to use the Outlook as a planning guide in authorizing and appropriating EPA's research and development budget.

In accordance with these observations, the Science Advisory Board recommends that the following steps be implemented by the Office of Research and Development for the preparation of future Research Outlooks:

1. There should be a two-tiered set of guidelines for drafting research strategies and the research plan. This would include

- a) identification of major research needs that are important for national environmental protection. At this stage the information gathering process would not specify which research is to be carried out by other Federal agencies or the private sector, and would be independent of budgetary constraints.

- b) after formulating this comprehensive research needs inventory, ORD staff should identify those needs that are clearly within EPA's legislative mandate and should command high priority for funding. This ORD-generated set of priorities would be sent to various program offices within EPA for review and comment and possible modification.

2. Following the ORD-program office review phase, ORD should submit draft strategy documents to a Science Advisory Board subcommittee for review. The subcommittee's comments

and recommendations would be forwarded to ORD, the program offices, and the Deputy Administrator. Figure 1 illustrates this and subsequent steps of the process for the preparation of the five-year plan.

3. The results of the preceding process would provide the basis for a draft Research Outlook. Some of the features of this document would include

- a) citations and footnotes to document key assertions;

- b) a matrix comparing each of EPA's major program areas with a range of research activities ranging from the toxicology of individual chemicals to technology development to ecological effects research. Within the matrix cells would be noted areas in which EPA is carrying out research and development, research supported by other Federal agencies, and areas in which EPA expects either private industry or the states to assume research funding responsibility. An example of such a matrix is provided in Figure 2;

- c) a scientific as well as a legislative rationale for the research priorities recommended in the research strategies and the Research Outlook;

- d) approximation of the contribution of each research priority to abatement of risks to public health or the environment, perhaps only "high," "medium," and "low."

4. The Research Outlook would be submitted to the Executive Committee of the Science Advisory Board for its review. The SAB would carry out its review and prepare a report to the Administrator which would be transmitted to Congress along with the Research Outlook.

5. The Research Outlook would be revised annually by repeating the same process. However, to assure continued improvement, copies of each current Outlook would be mailed to a broad spectrum of outstanding environmental researchers not serving on any EPA advisory committees. Their recommendations for innovative research ideas that might be candidates for inclusion in EPA's future research strategies would be solicited. Copies of the Outlook would also be mailed to other Federal agencies carrying out environmental research with a request for suggestions that might be considered for future research strategies. The EPA/ORD staff would analyze these suggestions and share them with the SAB.

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