

ENVIRONMENTAL MANAGEMENT RESEARCH

ANNOTATED BIBLIOGRAPHY

PUBLICATIONS
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ACTIVE PROJECTS

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INTRODUCTION

This annotated bibliography is a collection of published reports and projects in progress from the Environmental Management Research Program, Office of Air, Land and Water Use, Office of Research and Development, U.S. Environmental Protection Agency. Environmental Management Research in EPA is divided into four general areas: planning, evaluation, implementation and enforcement. The characteristics of the EMR program that make it unique within the Agency's overall research program is its emphasis on intermedia effects (both physical and economic) of environmental management actions, its research on the integration of environmental management strategies (that is, development of information on implementation incentives and institutional arrangements, as well as physical methods or technological options for management purposes), and its consideration and evaluation of the complete range of implementation measures, including economic incentives, land use management measures, public education programs, as well as traditional regulatory mechanisms. Most of EPA's land use research is conducted in the Environmental Management Program. Information contained in these research reports should be of particular interest and use in the preparation of Areawide Waste Treatment Management (208) and Air Quality Maintenance plans.

Published reports are indicated by the EPA report number. These reports are available from either the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402, or the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22151.

Information on any of the active projects is available from the comprehensive planning and Land Use Staff at the address or phone number on the cover of this document.

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Planning

*Huffschtmidt, M. and Moreau, D., Planning for Regional Environmental Quality Management and Related Land Use and Transportation Systems, Final Report: December 1976.
Grant No. R803636-01-0.

The objective of this project is to design a process and supporting multi-sectoral, continuous planning techniques for environmental quality management systems and related elements of natural resource, land use and transportation systems in regions under significant pressures of urbanization. The project will specify properties required of analytical methods and related data sets to support the planning process, including a rationalization of the planning requirements of EPA, HUD, DOT and the DOC. The model process will be examined in several differing organization and administrative contexts.

*Howe, R. and White, N., Development of Residuals Management Strategies, Interim Report and Executive Summary, February 1976.
EPA-600/1-76-01/A & B.

The report is a primer on the development of residuals management strategies. It presents a general planning process applicable to Areawide Waste Treatment Management and Air Quality Maintenance plan development, and develops taxonomies of physical methods (technological options), implementation measures and institutional arrangements--the components of management strategies. A procedure for developing and evaluating residuals management strategies is outlined.

Stone, R. and Smallwood, H., Intermedia Aspects of Air and Water Pollution Controls, August 1973.
EPA-600/5-73-003.

Transfer of pollutants between the air and water media are identified for major air and water pollutant control strategies. Emphasis is on artificial transfer between air or water caused by pollution control processes. Natural transfers are not treated in depth and land is considered only as a means for residuals disposal. Discussions include costs of intermedia transfer from land to air or water.

Control methods for each intermedia pollutant are discussed; comparative costs and expected unit process efficiencies are given. Secondary Residuals disposal methods and problems are presented.

Institutional factors, regulations and strategies for pollution control are summarized and discussed, and are illustrated with a regional study of the Los Angeles Metropolitan Area.

Summary data are developed for primary and secondary residuals discharged nationally and in the California South Coast Region, along with product/residual ratios for industries represented by the Standard Industrial Classification Code and other public economic sectors.

The framework for a mathematical model is developed for the prediction of the effects of change in any of the elements of the production-consumption-pollution-regulation network.

*Teknekron, Inc., A Study of Water Quality
Impact of the Implementation of Air
Quality Standards, November 1975, Final
Report: March 1976.
Contract No. 68-01-2243.

The objective of this investigation is to examine the impact on water quality due to the implementation of air quality standards, with emphasis on the effects of disposal of air pollution control residuals on groundwater.

The pertinent regulations developed by EPA in compliance with the Air Quality Act and the Federal Water Pollution Control Act are reviewed. Air pollutant limitations are presented as well as water quality standards. An examination is made of the intent of the laws and regulations as they pertain to groundwater protection. State solid waste regulations are discussed; those for the State of California are reviewed in greater detail and are included as an appendix.

The five industries selected for the study were: the nitric acid industry, the sulfuric acid industry, the portland cement industry, municipal incineration, and fossil fuel fired steam electric generation. Brief descriptions are presented for each industry including basic feed stock materials, production statistics, air pollution control technology, and air pollution control residuals.

A pollutant transport model is presented for routing aqueous pollutant species down through the unsaturated zone of the soil and for showing the basic functional dependencies of pollutant transport. Data and information is presented on the absorption behavior of aqueous mercury, the sample pollutant, chosen because of its known toxicity and occurrence in certain residual leachates. Further data is presented on dispersion and also on the general characteristics of soil-pollutant interactions.

The potential environmental intermedia effects for the five selected industries are reviewed. Emphasis is on types of residuals produced, disposal techniques, and the potential for subsequent contamination of the groundwater resource.

*DeLucia, R. et al., Analysis of Residual Generation and Discharge from Urban, Non-Industrial Land Use Activities,
Final Report: March 1977.
Contract No. 68-01-2622.

The project will conduct "activity analyses" of a limited number of urban, non-industrial land use activities in order to examine the generation and discharge of residuals (gases, solids, liquids and energy) from these activities, and to evaluate the options available for modifying residuals discharge from these activities. A feasibility study will examine residential activities; a possible follow-on study will examine commercial, institutional, and other urban land use activities.

*Perez, A. et al., A Water Quality Model for a Conjunctive Surface-Groundwater System,
May 1974.
EPA-600/5-74-013.

Considered in this study were both flow and water quality processes occurring on the ground surface, in the unsaturated soil zone and in the saturated or groundwater zone. The objective was to improve already available formulations for the above processes and subsequently to develop a methodology for interfacing the individual models.

Emphasis was placed on the modeling of agricultural pollution. For this reason, nitrogen and phosphorous were the main substances considered. The selection of the Lake Apopka basin in Central Florida as the study area was made in accordance with these project goals. Current data limitations precluded a complete verification of the model. However, various general conclusions could be drawn. In the future, the formulation could be viewed as an instrument for structuring data gathering efforts.

*Grimsrud et al., Evaluation of Water Quality Models, Final Report: March 1976.
Contract No. 68-01-2641.

This report is designed as a handbook specifically oriented to water quality and water resources planners and managers. It presents a large amount of basic information concerning water quality modeling, including procedures for model evaluation, model selection, integration of modeling with planning

activities, and contracting modeling projects.

Planners without previous experience in water quality modeling may use the information and procedures included in the handbook to determine whether a water quality model could and should be used in a particular planning program, and which specific model would be cost-effective. This includes a step-by-step procedure leading to the rejection or selection of models according to specific project needs.

The handbook discusses the implications which accompany the decision to model, including the needs for additional labor and specialized technical expertise which are generated. Methods and procedures for integrating the use and results of water quality models with other activities of the planning process are described as well as the respective merits of in-house and contracted modeling. The handbook also deals with the procedures for obtaining and using contractual services for water quality modeling.

Delaware River Basin Commission, Interstate
Planning for Regional Water Supply and
Pollution Control, November 1971.
EPA-16110 FPP 11/71.

This report presents the results of a study of the problem of water supply and waste disposal in the three-State, six-county region for which the Tocks Island Reservoir and the Delaware Water Gap National Recreation Area are planned.

The report presents various alternatives for water supply and waste disposal in the 1,000 square mile drainage area of the Tocks Island Reservoir. This region is presently undergoing rapid growth as a result not only of the Federal dam, reservoir, and recreation area projects, but of major new highways, second-home development, land speculation, and the burgeoning recreation industry.

Peak summer populations are projected over a 50-year period and utilities systems alternatives which could accommodate such projected growth are presented in the report. Water supplies in the region are seen as adequate to meet future demands, with heavy emphasis in development of groundwater resources. Five alternative sewerage plans, ranging in degree of regionalization from 116 local treatment systems to a single system for the entire region, are outlined including detailed cost estimates. Preservation of water quality in the region is a primary objective of the study.

Alamo Area Council of Governments, Basin
Management for Water Reuse, February 1972.
EPA-16110 EAX 02/72.

Computer programs were developed for the preliminary design and costing of wastewater renovation by the lime-clinoptilolite-carbon processes of advanced waste treatment; for activated sludge treatment; and for pipeline conveyance of water. These together with methods or or algorithms of lesser depth for other processes were used to cost water supply and waste treatment under conditions expected in San Antonio in the year 2000, for two extreme alternatives: importation of surface water according to the Texas Water Plan and conventional water treatment, waste treatment and disposal by discharge; and completely closed recycle, discharging no waste water and reusing all the wastewater after treating it to make it reusable. The unit costs for these two extremes were about 20¢/kilogallon of water used and the reuse scheme was only 10% more costly than the conventional scheme, i.e., well within the expected error of the estimates. It was shown that the seasonality of the water consumption in the face of non-seasonality of the sewage produced has an important bearing on the design and cost of reuse systems.

Porcella, D. et al., Comprehensive Management
of Phosphorus Water Pollution, February 1974.
EPA-600/5-74-010.

The environmental problems of phosphorus pollution are examined using an activity analysis approach to account for phosphorus inputs to surface waters. For purposes of analysis, this study assumes phosphorus to be the limiting factor in algal growth and eutrophication. A mass flow model, general enough to be applied to specific lakes or river basins, was developed in order to relate the flow of phosphorus from all activities in a basin to the consequences of eutrophication. Various control tactics to limit mass flow and thus eutrophication were defined from the standpoint of both supply and demand for phosphorus producing products and the management of phosphorus uses.

Combinations of feasible controls, designated as strategies, were applied to the model to determine the cost-effectiveness of the strategies in minimizing eutrophication. An hypereutrophic hypothetical lake basin, Lake Michigan, and Lake Erie were analyzed as case examples to test the model and control methods. Overall strategies were derived for the hypothetical lake and then applied to Erie and Michigan using available information on these lakes. In simple terms, phosphorus management strategies seemed feasible for control of eutrophication in present-day Lake Michigan, while waste treatment together with management strategies were necessary for Lake Erie.

Barresi, J. et al., The Northern Maine Regional Treatment System, April 1973.
EPA-R5-73-013.

Detailed sampling, gaging and laboratory analyses determined current waste loads from the Aroostook-Prestile Basin's potato processing industry. Studies indicated that significant reductions in load could be accomplished by in-plant conservation. Biological treatment of the residual wastes, however, was found necessary.

Preliminary designs were prepared for numerous treatment and loading operations, including joint industry-municipal plants and regionally inter-connected systems. A transport-treatment channel system covering some eleven miles was shown to be technically feasible.

Cost analyses of all viable options and alternatives were prepared, including capital and operating costs. Annual revenue requirements for each system were projected, including evaluation of current State and Federal grant-in-aid programs. Joint municipal-industrial treatment facilities proved the most economic course of action.

The technical studies of the research and development program were evaluated for water quality impact on the receiving waters, as determined by companion river basin studies.

*Spooner, C. et al., A Demonstration of Areawide Water Resources Planning, June 1975, Final Report: March 1976.
Grant No. EPA 16110 FEY and S802149.

The Metropolitan Washington Council of Governments Framework Water Resources Planning Model developed and tested under this study is a comprehensive analytical tool for use in areawide water resources management planning. The physical simulation portion was formed by linking component computer models which test alternative future community development patterns by small area, estimate water demands by usage categories, calculate sewage flows based on water demands and add infiltration/inflow, simulate stormwater runoff, test application of alternative waste treatment management systems, and simulate the quality response of the regions major water body. The impact assessment portion of the Framework Model includes methodologies for assessing the fiscal, social, and environmental impacts of alternatives. The Framework Model has been tested for the Metropolitan Washington region by identifying the cost-effectiveness of six alternative areawide water resources management strategies, and is currently in use in many planning programs.

Engineering Science. Inc., Development of a Trial
Air Quality Maintenance Plan Using the Baltimore
Air Quality Control Region, September 1974.
EPA-450/3-74-050.

This report is a prototype Air Quality Maintenance Plan for the Baltimore Air Quality Control Region. The report contains an analysis of whether the National Ambient Air Quality Standards will be maintained for the ten year period 1975-1985; a trial plan to maintain the standards which are not expected to be maintained over that period; and a description of the method used to develop the trial plan.

The Residual Environmental Quality Management (REQM) framework is used to identify and rank control measures and to select a control strategy. This framework provides a systematic analysis of the range of options available for responding to air quality maintenance requirements. Matrices developed using the REQM framework describe the generated residuals and methods for their prevention as well as secondary impact resulting from socioeconomic implications of the control measures and policy instruments.

The plan was prepared using draft EPA guidelines concerning air quality maintenance area analysis and plan development.

*Bishop, A. B. and Bigler, A Planning Process
for Residuals Management: A Regional
Application, Final Report, August 1976.
Grant No. R803203-01-3.

The project is analyzing the effects associated with resource development in the Uintah Basin of Northeast Utah. The residuals management approach is being used to estimate residuals generated and discharged by new activities and to develop and evaluate environmental quality management strategies for the basin. A linear programming model is being used to identify least-cost alternatives. The results will be applicable to both 208 and AQM planning requirements. Forecasts of population, employment and land use for the study area have been made through the development of the State of Utah's UPED and UPLAND models.

*Energy & Environmental Analysis, Preparation of a Prototype Parking Management Plan for the Metropolitan Washington, D.C., area,
Final Report: March 1976.
Contract No. 68-01-3243.

The contract developed a prototype parking management planning process using Washington, D.C., as an example. The contractor developed a plan which minimizes vehicle-miles-travelled (VMT) through a mix of management strategies, examine the legal and institutional implications of various strategies, determine those strategies which can be most effectively implemented, and evaluate the socio-economic effects of integration of parking management into the total transportation management program.

Stevens, B., Criteria for Regional Solid Waste Waste Management Planning, December 1974.
EPA-670/5-74-006.

This report consists of a collection of studies on selected aspects of the problem of regional solid waste management planning. The research efforts fall into three main subject areas: the economics of solid waste generation recycling, and disposal, the economic and social effects of landfills, and the issues involved in local intergovernmental cooperation for regional solid waste management. The individual studies are the following: "A Framework for Evaluating the Economic Effects of Regional Solid Waste Systems", "Production Functions for Solid Wastes Disposal", "Solid Waste Generation Coefficients: Manufacturing Sectors", "Solid Waste Generation Coefficients: Non-Manufacturing Sectors", "Perceptions of Landfill Operations Held by Nearby Residents", and "Efforts at Intermunicipal Cooperation for Solid Waste Disposal: Why They Fail". The report also includes a summary of the studies.

Battelle Columbus Labs., Socio-Economic Factors Affecting Demand for Municipal Collection of Household Refuse, August 1973.
EPA-670/9-73-035.

This study has investigated the relationship between several socio-economic characteristics and household refuse. In particular, the two socio-economic variables, income and race, appear to have significant effects on the demand for municipally-provided waste collection services. There is a marked seasonal variation in the comparative effects of income and race, alone or in combination. One interpretation of these

effects, based on data from quantities of municipal waste collected in Chicago, is that solid waste consists of two components. The basic waste component is constant throughout the year and is independent of income and race. The additional component fluctuates greatly with the season, and is lower in the winter. It is very sensitive toward income and race, except in midsummer. Then it stems from different but unidentified consumption activities, which are independent of income, and are more popular with nonwhite than with white families.

The general conclusion of this study is that the demand for household refuse collection service in Chicago is a positive function of the income level and the fraction of nonwhites using the municipal service.

Clark, R. and Gillean, J., Systems Simulation and Solid Waste Planning : A Case Study, July 1973.
EPA-670/5-73-12.

The work cited in this report shows the successful application of systems analysis to solid waste management problems in Cleveland, Ohio, and is intended to illustrate the power of the "systems approach" when properly applied. Reliable, uniform and continuous data collection is combined with a dynamic simulation model to form a system for making short- and long-term management decisions. As a result of the system's implementation, the city has brought Cleveland's solid waste management problems under control.

Pathak, A., Optimal Configuration of a Solid Waste Management System, May 1974.
EPA-670/5-74-007.

A system for the treatment and disposal of the solid waste generated in a region is developed under the assumptions of a steady state. The region selected for study comprises two counties of the San Francisco Bay Area. The wastes under consideration exclude certain toxic and dangerous fractions as well as the industrial wastes salvaged at source. Recycling is assumed to be nonexistent and the flows of wastes and their treated byproducts are contained within the region. Certain conventional as well as recently proposed processes constitute the candidate technologies. An optimal configuration of these

technologies is sought, the objective being the disposal of waste in reference to the mode of its financing. In the framework of steady state planning, the objective of social desirability is translated to returns through the use of the social discount rate. Generation of certain byproducts representing externalities in the economic sense is controlled by constraints. A linearly constrained mathematical program is obtained which is optimized through the use of a branch and bound technique.

Evaluation

Real Estate Research Corp., The Cost of Sprawl,
U. S. Government Printing Office, April 1974.

This document attempts to integrate the various economic, environmental, natural resource and social costs of different types of residential development. This study is an analysis of prototype development, not of actual developments. The approach was to assume typical site conditions and an absence of any existing infrastructure (roads, sewers, etc.) at the site and then, using standard unit cost figures, to estimate the costs of building alternative types of development.

The various costs were first estimated for different neighborhood types, each neighborhood being composed of 1,000 dwelling units of one of the following housing types: single family homes, conventionally located; single family homes clustered; townhouses; walkup apartments (two stories); and high rise apartments (six stories). Since many environmental and some economic costs cannot be clearly identified on such a small scale, neighborhoods were aggregated into different communities, each containing 10,000 dwelling units or a population of 33,000. Six community types were analyzed, each containing a mixture of the various neighborhood housing types but differing in the amount of community "planning" and in the average development density.

The results of the study show a surprising consistency: "planning" to some extent, but higher densities to a much greater extent, result in lower economic costs, environmental costs, natural resource consumption, and some personal costs for a given number of dwelling units.

*Bateman et al., The Effects of Alternative Metropolitan Development Patterns: A Study of the Effects of Alternative Metropolitan Development Patterns on Economic, Environmental Quality, Energy Use and Social Considerations, Final Report: December 1976.
Inter-Agency Agreement (CEQ, EPA, DOT, HUD, FEA, NSF) EQ 5AC028.

The study will enumerate, analyze and quantify, where possible, (1) the economic, fiscal, environmental quality, energy and other resources, social and personal effects of alternative metropolitan area-wide development patterns, and (2) the effects on those development patterns of alternative transportation systems and other governmental programs. The of transportation systems in determining these patterns, and on the relationship between transportation systems, land use, environmental quality and energy use.

Berry, B. et al., Land Use, Urban Form and Environmental Quality, University of Chicago
Dept. of Geography Research Paper No. 155, 1974.

This study deals with the ways in which urban form and land use affect the nature and intensity of environmental pollution. The inquiry proceeds at two scales: (a) from one urban region to another, and (b) on a more detailed basis within urban regions. At the first level of analysis, attention is directed to the effects of different urban forms and land use mixes on the levels of environmental pollution reported by U.S. government monitoring stations to be characteristic of the urban regions. At the second scale, spatial patterns of pollution are related to spatial patterns of land use within a sample of metropolitan areas that have different urban forms and that exemplify the range of pollution types characterizing American urban regions today. The report is structured cumulatively, to provide an understanding to those urban forms that naturally generate the lowest pollution levels, the environmental consequences of contemporary urban dynamics, and the role that urban planning may potentially play in the achievement and maintenance of the nation's environmental quality standards.

Bascom, S. et al., Secondary Impacts of Transportation and Wastewater Investments: Review and Bibliography, January 1975.
EPA-600/5-75-002.

The Bibliography contains a review of over fifty major studies and three hundred relevant reports related to secondary environmental impacts on various forms of public investments, e.g. land based transportations and wastewater treatment and collection systems. The Bibliography is organized into four sections:

Section I is subdivided into: (a) a review of secondary impacts classified according to type of investment (highways, mass transit, and wastewater treatment systems); (b) where possible, according to type of secondary effect (economic, social and land use); and (c) a brief summary of modeling techniques which may be utilized to analyze and project likely secondary environmental impacts. Section II condenses the finding of about fifty major studies related to land transportation and wastewater treatment systems. Section III is an annotated bibliography of about three hundred relevant studies. Section IV classifies these literature studies by: (a) impact; (b) investment type; (c) geographic area examined; (d) type of study; and (e) type of analytic techniques used in assessing secondary effects.

Bascom, S. et al., Secondary Impacts of
Transportation and Wastewater Investments:
Research Results, July 1975.
EPA-600/5-75-013.

The report presents the results of original research on the extent to which secondary development can be attributed to highways and wastewater treatment and collection systems, and conditions under which causal relations appear to exist. Case studies of recent development trends were made in four metropolitan regions: Boston, Massachusetts; Denver, Colorado; Washington, D.C.; and Minneapolis-St. Paul, Minnesota. Data for the four metropolitan regions were analyzed using econometric techniques and simulation modeling.

Warner, M. et al., An Assessment Methodology for
The Environmental Impact of Water Resources
Projects, July 1974.
EPA-600/5-74-016.

This report presents materials intended for use by reviewers of environmental impact statements on major water reservoir projects. This report is prepared as series of six related but individually referenced discussions of the following major topics:

- o Reservoir project planning, construction, and operation activities
- o Water quality impacts of reservoir construction
- o Ecological impacts of reservoir construction
- o Economic, social, and aesthetic impacts of reservoir construction
- o Review criteria for assessing general statement completeness and accuracy
- o A review of impact assessment methodologies.

The materials presented attempt to call attention to important issues or potential impacts that an adequate impact state should address. In addition, the water quality and ecological impacts sections discuss the site-specific conditions under which a given potential impact may or may not occur.

The section on water quality impacts also presents a detailed comparison of mathematical models for predicting impacts on water temperature, dissolved oxygen levels, and some chemical constituents of surface waters. The sections dealing with water quality, ecological, and economic-social-aesthetic impacts include extensive citations to relevant literature the impact statement reviewer may wish to consult for further information.

Waddell, T., The Economic Damages of Air Pollution, 1974
EPA-600/5-74-012.

A benefit-cost analytical framework for environmental decision-making is outlined. The methods that have been or can be used to estimate the damages of air pollution are identified. These methods are: (1) technical coefficients of production and consumption; (2) market studies; (3) opinion surveys of air pollution sufferers; (4) litigation surveys; (5) political expressions of social choice; and (6) the delphi method. The strengths and weaknesses of each method are discussed.

The technical coefficients methods is utilized in estimating the value of air pollution damage to human health, to man-made materials, and to vegetation. A market study method, the site differential or property value approach, was used to estimate aesthetic and soiling-related costs. Economic losses associated with air pollution effects on domestic animals and wildlife and the natural environment are not estimated because of data limitations.

Estimates of damages are allocated by major pollutant and source categories. The utility and limitations of gross damage estimates are discussed, and comparison with other such estimates is made. One of the major informational gaps identified is the economic effects of automobile and related air pollutants on human health and welfare.

Dornbusch, D. and Barrager, S., Benefits of Water Pollution Control on Property Values, 1973.
EPA-600/5-73-005.

This study was undertaken to determine the current state-of-knowledge concerning the measurement of the potential benefit of water pollution control on property values, and to analyze the relationship between water quality parameters and property values at several sites where water pollution has been substantially reduced in recent years. Multiple-regression analysis and an interview technique were employed to study the relationship between residential and recreational property values and water quality components. Study sites were located on San Diego Bay and the Kanawha, Ohio, and Willamette Rivers. It was found that effective pollution abatement on badly polluted water bodies can increase the value of single-family homes situated on water front lots by 8 to 25 percent, and that these water quality improvements can affect property values up to 4000 feet away from the water's edge. It was also found that the measurable water quality parameters which have the greatest influence on property values are dissolved oxygen concentration, fecal coliform concentrations, clarity, visual pollutants (trash and debris), toxic chemicals, and pH.

Case study results were combined with water pollution survey to estimate the national benefit expressed in increased residential, recreational and rural waterfront property values, to be gained from water pollution abatement.

Implementation

Strong, A. and Keene, J., Environmental Protection Through Public and Private Development Controls, May 1973.
EPA-R5-73-018.

The studies described in this report are an integral part of a much larger study of land management for purposes of water resource protection. The larger study is popularly known as the "Brandywine Project."

The EPA-supported research is classified into three principal categories: (1) research directly related to the Brandywine Project; (2) investigation of public regulatory and less than fee controls on development; and (3) shaping of the concept of a private development corporation. The research approach is predominantly legal and governmental. In all instances in which information is available, citizen response to the various development controls has been examined and is included in the research reports.

The research conclusion is that greater use of larger scale public and private control of land development will not only contribute significantly to water resource protection but will increase private benefits. Increasing use of these forms of controls are predicted despite a substantial amount of opposition from private landowners.

Coughlin, R. and Hammer, T., Stream Quality Preservation Through Planned Urban Development, May 1973.
EPA-R5-73-019.

The effects of a land use plan to restrict urban development in areas critical to the water resource system are identified through empirical studies. Specifically, relationships are established between amount, density, type, and location of urban development, on the one hand, and stream water quality and stream channel enlargement on the other. The amount of open space with such a plan as compared to that with normal development is determined. Water quality, as perceived by untrained field observers, and the relationship between the water quality and overall site preferences are studied. Pilot studies concerning the preferences of a sample of observers for various landscape characteristics are reported.

The evaluation of these effects is approached through household surveys designed to determine how use of and preference for stream sites is related to water quality of stream and distance of residence from stream. In addition, the effect of preserved open space on adjacent land values is explored empirically.

Kaiser, E. et al., Promoting Environmental
Quality Through Urban Planning and
Controls, February 1974.
EPA-600/5-73-015.

This study focuses on the changing awareness and current practices in promoting environmental quality through urban planning and control in local and metropolitan planning agencies. To provide perspective for understanding the current scene, it reviews the mainstream and cutting edge practices and orientations of the 1960's in the following sectors of planning activity related to environmental quality: comprehensive planning; planning for urban spatial structure (land use, open space, and transportation); urban design (urban renewal and planning for esthetic objectives); and urban environmental management (air, water and noise). It indicates that planners during that period reflected society as a whole and were little concerned with environmental quality as related to natural systems.

A national survey of urban and regional planning agencies was conducted. The findings indicate that environmental awareness in such agencies followed rather than led national environmental awareness through the 1960's. There is indication of considerable current environmental concern but of only modest planning and implementation activity with indirect introduction of environmental goals into a broad range of traditional urban planning concerns. Local government is currently the weak link in the intergovernmental environmental policy framework mainly because it lacks technical capacity and is underutilized by higher levels of government. However, the findings suggest that local governments do have a strong sense of responsibility and would respond positively to further encouragement of greater participation in environmental planning.

The study then reviews the more promising and innovative approaches that form the cutting edge of awareness and practice in four sectors of planning activity that are related to environmental quality

Thurow, C. et al., Performance Controls for
Sensitive Lands: A Practical Guide for
Local Administrators, March 1975.
EPA-600/5-75-005.

This report is to be used as a handbook by local planning officials in planning for and regulating the use of the five distinct natural areas: streams creeks, wetls, woodls, hillsides, groundwater aquifer recharge areas. Each section is devoted to the discussion of local regulation of land use in

areas identified as "sensitive"; and each area is discussed in terms of its ecology and value to the public, current regulatory practices, and recommended programs for regulating the area. Also included are appendices showing where and how to go about getting technical assistance from existing governmental agencies and examples of local ordinances for protecting the environmentally sensitive areas.

The final section is a monograph on environmental performance standards, the result of a preliminary study on the feasibility of extending the performance standard concept used in industry to regulation of the environment. Its purpose is to explore this possibility and to suggest new areas for research.

*Alford et al., Evaluation of the Use of Existing and Modified Land Use Implementation Measures to Achieve and Maintain Environmental Quality, Final Report: June 1976.
Contract No. 68-01-3231.

To analyze land use instruments (e.g., zoning, subdivision regulations, mapped street ordinances, building/construction codes), commonly used by local governments, to determine the ways in which they indirectly influence environmental quality through the regulation of land use; to develop model ordinances or other appropriate regulatory instruments which can be used by local governments and which build upon commonly used local instruments.

*Kneese, A. and Church, A., Effectiveness of Local/Regional Policy Instrument In Achieving and Maintaining Environmental Quality Objectives, Final Report: August 1976.
Grant No1 R803539-01-0.

To investigate and evaluate the cost-effectiveness of existing local/ regional policy instruments in achieving and maintaining environmental quality objectives over an intermediate planning horizon (10-20 years) through the process of affecting the characteristics, location and performance of urban and suburban development and the conversion of rural areas. The instruments to be evaluated include tax policy, capital improvements programming, and police power mechanisms. The Albuquerque/Bernalillo County region will be used as a case study.

Vermont Dept. of Water Resources - Agency of
Environmental Conservation, Development of a
State Effluent Charge System, February 1972.
EPA-1611 GNT0 2/72.

Following passage of legislation authorizing the levying of pollution charges against certain waste dischargers, the State of Vermont's Dept. of Water Resources began consideration of procedures and regulations to implement the law. This report documents experiences during the the first two years of the program.

The objectives sought were first, to select, develop and implement a pollution charge structure and system under provisions of No. 252 of the Vermont Acts of 1969 and, second, to demonstrate the problems, limitations, and potentialities of the Vermont system or variations thereof.

The Vermont permit and fee system has been developed and is presently being implemented. Various methods of fee calculation are discussed and the reasons for selection of one (annualized cost of treatment) are set forth. The issues of incentive effect on dischargers, relation of dischargers to instream economic damages, equity, constitutionality, economic efficiency, technical and administrative feasibility and income potential are discussed in the context of Vermont law and administrative procedures.

DeLucia, R., An Evaluation of Marketable
Effluent Permit Systems, September 1974.
EPA-600/5-74-030.

This report is a study of the practical problems and prospects of using marketable effluent permits (MEP) as a water pollution control tool. Under such a system, pollution rights are contingent upon possession of permits; the permits are acquired and/or traded through an auction or market. This study details the requirements of MEP systems, discusses their theoretical advantages, and examines them through the use of industrial organization theory, comparisons with analogous markets, and a simulation model. The simulation model employs Mohawk River data to determine the effect of different system parameters on the operation of a MEP system. The legal and administrative aspects of the marketable permit system are also dealt with. The conclusion is that marketable permits are a promising control tool for many river basins.

Irwin, W. and Liroff, R., Economic Disincentives for Pollution Control: Legal, Political and Administrative Dimensions, July 1974.
EPA-600/5-74-026.

This report defines an economic disincentive as a monetary charge levied by government on conduct which is not illegal but which does impose social costs, for the principal purpose of discouraging the conduct. Disincentives are distinguished from other legal mechanisms which may have incidental economic disincentive effects, e.g., fines, user charges, and license fees. The constitutionality of federal or state imposition of disincentives is examined and the authority of the U.S. Environmental Protection Agency and the states to utilize disincentives under selected federal environmental states is discussed. The charges imposed by several European countries are described and distinguished from disincentives. The history of some previous proposals for federal disincentives is reviewed and suggestions for additional disincentives which might be feasible are offered.

Ferrar, T. et al., Finanicial Incentives and Pollution Control: A Case Study, April 1975.
EPA-600-5/75-007.

Confronted with shortages of low-sulfur content residual fuel oil, several air-pollution-control authorities in the northeastern states were forced to relax air-quality standards during the winters of 1972-73 and 1973-74. The authorities did so by granting variances to their sulfur standards for residual fuel oil. The characteristics of these variances provide the basis for this analysis.

Extensive investigation of variance strategies have shown that a general (uniform) variance structure coupled with a fuel-oil surcharge represents a desirable variance policy. The report recommends, however, that a fuel-oil surcharge should be designed to more than compensate for the price (and/or profit) differentials between conforming and nonconforming fuel oil. The report also examines alternative policies such as emission taxes and quantity controls.

Atkinson, S. and Lewis, D., A Cost Evaluation of Alternative Air Quality Control Strategies, January 1974.
EPA-600/5-74-003.

Total regional costs for meeting particulate air quality standards by controlling stationary sources were estimated for two different least-cost strategies and compared with traditional

(State Implementation Plan or SIP) strategies. Included in the evaluation were the variations in marginal control costs from source to source and in the impact a source may have as a function of location, stack height, etc.; the impact on total regional costs of increasingly stringent ambient air quality standards; costs of alternative emissions tax strategies; and marginal costs and benefits of control.

Results indicated that an emissions-least-cost (ELC) strategy captures only one-half of the total potential savings achieved by an ambient-least-cost (ALC) strategy in attaining a given air quality standard and that the ALC strategy required as little as one-tenth the expenditure of the SIP strategy. Similarly, it was shown that a policy which employs a single emissions tax based on mass emissions, rather than implementing the ALC solution to attain a desired air quality, sacrifices substantial savings since the emissions tax strategy can be no cheaper than the ELC solution.

A comparison of marginal costs and benefit figures for health and welfare at the primary standard indicated that stricter control was economically justified. Marginal control costs of the secondary ambient air quality standard were found to be four times the level of the primary standard.

Bingham, T. et al., Cost Effectiveness of A
Uniform National Sulfur Emissions Tax,
February 1974.
EPA-600/5-74-009.

This study provides an initial examination of the effectiveness and costs of a uniform national tax on the major emitters of sulfur compounds.

Since current legislative and political considerations, coupled with the still advancing state-of-the-art in sulfur oxide flue gas control techniques, make the implementation of such a tax unlikely before 1978, this study is directed toward the goal of evaluating the potential costs and implicit reductions in emissions that would occur in the presence of various tax rates on sulfur emissions during that year. Although most of the results address the national impact of such a policy tool on each of the five major sulfur emissions categories, some attention is also given to regional effects and to the intrafuel price effects of such a tax.

Based on the results of the research presented in this study, it appears that a national tax on the sulfur emissions of the five major sources of this pollutant would be an effective means of inducing emissions reductions.

Sharefkin, M., The Economic and Environmental
Benefits from Improving Electrical Rate
Structures, November 1974.
EPA-600/5-74-033.

Quantitative estimates of the internal cost savings to be derived from changes in the pricing of electric power are devised and evaluated. The econometric literature on electricity demand is surveyed, and elasticity values are selected which are parameters for the overall benefit measures. A method for using reported utility data to estimate the cost of delivered power--at the system peak and off the system peak, and for each customer class--is devised. Data on five electric utilities is used to make estimates of the potential benefits from improvements in the pricing of electric power, for each customer class in each system. The estimated potential benefits are sufficiently large to merit load curve studies by block for residential customers. Such studies are necessary preliminaries to a definitive assessment of the proposals for so called rate inversion.

*Bingham, T. et al., Allocative and Distributive
Effects of Alternative Air Quality Attainment
Policies, October 1974, Final Report: March 1976.
Contract No. 68-01-0484.

This study provides projections of the allocative and distributive effects of emission standards, several types emission charges, and a combination of standards and charges (called "hybrid programs") as applied to the major point sources of sulfur emissions in the St. Louis and Cleveland Air Quality Control Regions. The allocative effects relate to the aggregate level of the resource costs whereas the distributive effects concern the incidence of the private costs of a policy instrument. The central focus of this study was to identify the trade-off between allocative efficiency and negative redistributive effects.

The capital and operating costs and abatement efficiencies of abatement alternatives have been included in a programmed, deterministic, simulation model that uses a comparative statics approach in estimating costs and emissions under each policy approach. The specific policy instruments considered in the analysis fall into three broad categories: direct controls, price incentives, and hybrid programs. The results of the different policy approaches are compared.

*Charles River Associates, Inc., Economic Analyses
of Policies for Controlling Automotive Air
Pollution In the Los Angeles Region, March 1974,
Final Report: March 1976.

This report evaluates the effectiveness of four incentives measures which are designed to cause less use of automobiles and, in some instances, to cause a higher proportion of low-emission automobiles to be owned. These measures are: increased gasoline taxes; parking surcharges; emission taxes; and extension of route miles by conventional bus.

To determine the effect of the policies on travel in the Los Angeles area, a disaggregate behavioral model of travel demand was applied to estimate the impacts of the policies on 1974 travel behavior. To determine the effects of an emissions tax on the size and age distribution of the auto stock in the Los Angeles area, a model of auto stock adjustments was developed and applied.

The cost effectiveness of the policies was calculated by determining the cost per VMT reduced by each strategy. Two types of costs were calculated: costs to individuals, including tax payments and the opportunity cost of travel foregone; resource costs, including the opportunity cost of travel foregone, the cost of bus system improvements, and the costs of administering an emissions inspection tax program.

The study's conclusions suggest that a gasoline tax is significantly more cost-effective in reducing VMT's than a parking tax and taxes based on emission rates will have a large impact on the age distribution of cars.

Trzyna, T., Environmental Impact Requirement in the
States: NEPA's Offspring, April 1974.
EPA-600/5-74-006.

There is a growing trend in the States to adopt requirements for environmental impact statements like those in the National Environmental Policy Act of 1969. Fifteen States and Puerto Rico now require impact statements for a wide range of activities significantly affecting the quality of the environment, and several others apply the process to limited classes of projects. At least twenty other States have such requirements under consideration

The State requirements are summarized and compared to each other and to the national act. Some key issues are discussed: contents of the impact statement, applicability to private projects and local governments, relation to land use regulation, enforcement, and citizen participation

There are many problems involved in adapting the impact requirement to State needs and institutions. More evaluation of State programs is needed, and a new organization should be created to facilitate communication among the States on administration of impact statement programs.

Trzyna, T. and Jokela, A., California Environmental Quality Act: Innovation in State and Local Decision-Making, October 1974.
EPA-600/5-74-023.

The California Environmental Quality Act of 1970 (CEQA) requires State and local agencies to prepare an environmental impact report on public and private projects that may have a significant effect on the environment. It is patterned after the National Environmental Policy Act of 1969.

The development and current status of California's environmental impact assessment program is described. CEQA was virtually ignored during its first two years, largely because there was no clear authority or deadline for issuance of detailed guidelines. The turning point was CEQA's judicial discovery and enforcement by the California Supreme Court, and its subsequent amendment by the State Legislature.

CEQA's greatest impact has been on private projects permitted by cities and counties. In many localities, environmental impact reports clearly influence decisions on such permits. Still, some State and local agencies are not fully complying with CEQA, and the act's implementation is hampered by the lack of a State agency with authority and resources to enforce it. Based on California's experience, some general recommendations are made for other States considering adopting similar requirements.

Fensterstock, J. and Speaker, D., Use of Environmental Analyses of Wastewater Facilities by Local Government, July 1974.
EPA-600/5-74-015.

Environmental analyses (assessments, environmental impact statements, negative declarations, appraisals, etc.) on wastewater treatment facilities reflecting Council of Environmental Quality and Environmental Protection Agency guidelines in force during the period of 1970 through 1972, were reviewed and evaluated. Case studies selected ensured representation of different types of both jurisdictional patterns and locational settings. The study process reviewed decision-making flows, organizational structures, public and

state government roles, and EPA regional office review processes. The general conclusions reached showed that environmental considerations played a relatively minor role in the decision-making processes.

The analysis detected both substantive and procedural problems. The problems include: inadequate environmental orientation of staffs; exclusion of public input; intra-organizational conflicts; and inadequate Federal guidelines.

Recommendations which would be appropriate for local, state and Federal implementation include: Federal funding to state and local agencies for training staffs; more precise Federal guidelines; legislative changes; and suggestions to improve public participation in the entire decision-making process.

Milgrom, J., Can Federal Procurement Practices Be Used To Reduce Solid Waste, October 1973.
EPA-670/5-74-003.

Although the Federal Government purchases only a small percentage of the domestic output of most commercial products, the purchase of these products can have a greater impact on the economy than these small percentages suggest, because of the multiplier or "ripple" effect.

In this study it was recognized that this "ripple" effect exists and certain conditions that tend to promote it were also identified. However, the "ripple" effect could not be quantified. Nevertheless, even on a qualitative basis the "ripple" effect was an essential criterion in the selection of those product specifications among the more than 50,000 that should be modified to effectively promote recycling and/or reduce the generation of solid waste.

On the basis of the analysis of all product categories, modifying Government specifications for packaging materials and systems will have the greatest impact on reducing solid waste. The Government uses 6 to 10 percent of all packaging in the United States (based on value), according to estimates made by some Government agencies. The Government buys packaging indirectly when it buys most products, and the Government also purchases packaging materials directly, such as corrugated shipping cases and metal drums, for various shipping applications. Because packaging is a very "visible" purchase, and because it is widely used in the economy, potentially, then, the "ripple" effect of this purchase can be very great.

Ernst, E., Evaluation of Feasibility and Economic Implications of Pricing Mechanisms in Solid Waste Management, January 1975.
EPA-670/5-75-001.

This study analyzes the potential of pricing mechanisms in solid waste management systems. Such pricing mechanisms have been suggested as appropriate means for encouraging greater efficiency of resource, both within the solid waste management system proper and among sources of solid wastes.

The study reviews the limited empirical evidence concerning supply and demand characteristics in markets for solids waste management (primarily collection) services. The analysis of processing and disposal and ancillary SWM services is hampered by the diversity of existing systems, and remaining problems in the conceptual clarification of the services provided.

The analysis of cost functions in the collection and transportation sub-system suggest that these cost functions are subject to variable returns to scale. For smaller communities, there are economies of scale with respect to the amount of waste handled. For larger communities, scale effects vanish.

The available literature provides sufficiently strong evidence for the importance of both prices (and pricing policies) and incomes as determinants of the amount of waste collected per household. This evidence is used in an exploratory numerical analysis employing decision-theoretic elements to assess the likely impact of pricing mechanisms. The analysis suggests that total system costs could be reduced through pricing mechanisms, even though there would be a tendency to rely more on self-disposal as prices for collection services increase.

The study suggests a feasible method for implementing an effective pricing mechanism in SWM systems.

Carter, S. et al., Environmental Management and Local Government, February 1974.
EPA-600/5-73-016.

This report presents the results of a study of environmental management and local government. The study has two main components: (1) a survey of chief executives in cities over 10,000 population and counties over 50,000; and, (2) a series of field studies of local environmental management in Dallas, Texas; Inglewood, California; Miamisburg, Ohio; and the Piedmont Triad Region (Forsyth and Guilford Counties), North Carolina.

The major topics covered in the study include perception of the definition of environment, priority of environment as a local policy issue, and types of environmental problems facing each local government; adoption of local policy statement on the environment; existence of citizen environmental boards, environmental agencies, environmental sections in master plans, land use controls, other environmental controls, moratoria, environmental quality standards, environmental impact assessment procedures, environmental law suits, tax incentives and penalty charges; factors contributing to and factors creating obstacles to development of environmental programs; and, relations with state and federal agencies.

Hein, C. et al., Regional Governmental Arrangements in Metropolitan Areas: Nine Case Studies,
January 1974.
EPA-600/5-74-024.

The findings indicate that the core of what is called metropolitan government in the United States is the county, usually reorganized and given urban powers. There are no multi-county general purpose metropolitan governments in the United States.

Patterns of regional governmental arrangements based on the urban county were judged more effective in dealing with emerging environmental management problems than patterns based on special districts and regional councils of government; the two-tier federation was judged about equal to the best of the urban county arrangements.

In virtually every case, further state action was needed to make the regional arrangements more effective. Metropolitan regional reorganization has occurred in over 20% of the states, and therefore should be possible in most urban states.

*Parker, F., et al., Ingegrating Environmental Planning and Management in State Government,
Final Report: January 1976.
Grant No. R803171-01-0.

This study was conducted by the Center for Urban and Regional Studies at the University of North Carolina, working with the Council of State Governments, and consisted of three main elements: (1) a literature search; (2) a 50-state survey, and (3) a study workshop. The literature search examined previous

studies and documents prepared by various States in connection with their own studies of environmental management, as well as writings in the fields of management and public administration.

The survey was made of all state air, water, and solid waste environmental program officials; the heads of environmental departments; state planners; state budget officers; Governor's aides; and Legislative Service Agency staff. The survey was designed to elicit information about the use of specific techniques of coordination and integration within the States, as well as the attitudes of the state officials toward the need for and current level of coordination and integration in their States.

Four research questions served as the basis for the study: 1) What organizational and nonorganizational coordinative techniques are now being used in the States? 2) How effective has each of these techniques been in the achievement of integrated environmental management? 3) What factors contribute to a State's adoption of particular techniques? 4) What are the perceptions of State officials as to the need and usefulness of integration, and what are the various techniques employed?

Summary conclusions and recommendations from this study include: 1) There is no ideal state organization to promote integration and coordination. However, the health department approach ranks behind the little EPA and superagency approaches in its rating of effectiveness by most state officials. 2) Environmental department heads stress the need to pursue the coordination of planning, granting of permits, regulation, and environmental standard-setting activities among the pollution control programs. 3) The use of environmental policy, environmental plans, environmental coordinating councils, and environmental impact statement review should be seen as complementary activities. None of the techniques was seen by state officials as individually being very effective in promoting coordination. 4) There is some indication that interagency councils are seen as most effective when given substantive program responsibilities. 5) Careful attention should be paid to the coordinative potential of state land use planning, coastal zone management, and critical areas management programs. The potential of these programs lies in the direct and indirect environmental impacts of alternative land use patterns and the scope of decision-making inherent in these growth management programs. 6) When considering the formation of an environmental superagency, should be given to including state development programs. Very few state environmental superagencies presently include any development programs. Superagencies typically have joined environmental protection programs with conservation programs such as forestry, parks and recreations, and fish and wildlife.

*Rink, D., Evaluation of Alternative Institutional Arrangements for Regional Environmental Management,
Final Report: February 1976.
Grant No. 803847.

In meeting its research objectives, this study will: (1) identify the regional components of the major environmental problems, (2) describe the present intergovernmental system of regulations, programs, organizations, etc., for regional environmental management, (3) assess the potential impact of recent or proposed policy changes that could significantly alter the institutional arrangements for regional environmental management, (4) develop criteria and supporting arguments for evaluating alternative institutional arrangements and (5) outline several alternative procedures by which public officials or their representatives can use the criteria.

*Gleeson, M. et al., Case Study of the Twin Cities Metropolitan Council as an Environmental Management Organization,
Final Report: January 1976.
Grant No. R803406-01-0.

The primary tasks of this investigation included: (1) An organizational history of the environmental management system in the Twin Cities area focusing on the Metropolitan Council, (2) a description of the current operating system, and (3) a number of specific studies which sought to analyze the operation of the system.

An understanding of the larger concept of governance in the Twin Cities is necessary to an understanding of the system of environmental management in the region. While a review of environmentally oriented special districts would be appropriate in some other metropolitan regions of the nation, it is inappropriate in the Twin Cities. The current legislative policy is opposed to further independent agencies. The principal actor among the many metropolitan agencies is the Metropolitan Council.

A description and analysis of the Council, its surrounding organizations, and its broad ranges of implementation and management tools is useful for suggesting how other areawide environmental management organizations might be formed or adapted to meet the requirements of federal legislation. Accordingly, the study sets out to describe and analyze the strategy for regional environmental management as it has evolved since 1967 in the Twin Cities area. The study examines the array of implementation tools used by the Council, the ties between implementation tools and Council policy statements, linkages between the implementation tools themselves and the relationship of this array of management mechanisms to the broader institutional structure of which the Council is a part.

The results of selected case analyses of the Metropolitan Council as an environmental management organization deal with the institutional arrangements defined by the Council--institutional arrangements defined here as decision-making structures. The first case deals with one special characteristic of the Council as an environmental management organization--its being a multi-functional regional jurisdiction. The second case deals with another special characteristic of the Council--its being a policy-making body without direct operating authority (for the most part).

Brief recommendations are made for case studies of environmental quality management in other urban areas.

Gorden, et al., Development of Environmental Management Performance Criteria, Draft Report:
June 1976.
Contract No. 68-01-3556.

This study is intended to address the general research area of Evaluation Methods and to develop a set of criteria and techniques for measuring the performance effectiveness of environmental quality management strategies being carried out by state, regional and local environmental management agencies. The following objectives are to be met by this study: A) To develop criteria for the evaluation of environmental management strategies and the management performance of regional environmental programs. B) To develop techniques to analyze the effectiveness of institutional configurations used in achieving regional environmental quality objectives. C) To determine applicability of the criteria by conducting pilot tests evaluating past performance of particular environmental quality plans, strategies, or policies.

For the purposes of this study, regional environmental quality management organizations are defined as those (public) organizations having decision and enforcement authority over environmental quality matters at the (sub-state) regional or local government level. Included in this definition would be Councils of Governments, 208 Water Quality Agencies, other special-purpose environmental quality agencies, city and county functional departments responsible for environmental quality management, or institutional configurations which combine authority from several of these organizations. Management performance, for purposes of this study, may be defined as the "operation" of a set of control measures and implementation instruments implemented through an organization, ordinance, or set of institutional arrangements, which together comprise an environmental quality management strategy. As such, each component (control measure, implementation instrument, etc.) "performs" or "operates" with a varying degree of effectiveness in contributing to the overall strategy.

*Gorden et al., Regional Opportunities for
Industrial Residuals Management, March 1975,
Final Report: March 1976.
Contract No. 68-01-2295

This investigation attempted to uncover the principles of success in several cases of regional industrial residual management. The study explores the environmental and economic benefits of residuals management by taking a regional and intermedia (land, water, and air) approach. This involves both tracing the residuals as they flow through a region and seeking opportunities for economics of scale in the treatment of recovery.

The report presents the data base of specific cases in New Jersey, New York, Vermont, Texas, and California, and also describes some additional partial cases in other areas of the country. Profiles of success, that is, the preconditions for success in the various cases, are described. Then the environmental, economic, and energy related factors are set in context and their role in encouraging successful action is shown. The background information needed for success and the methods of its collection are defined. Organizational factors, both internal and external, including the role of government, are examined.

An illustration of the methodology of defining and developing opportunities is given as it applies to industrial residuals in the San Francisco Bay area. This leads to recognition of the need to take new institutional steps toward action.

Enforcement

Beckers, C. et al., Quantitative Methods for Preliminary Design of Water Quality Surveillance Systems, November 1972.
EPA-R5-72-001

This report presents the development and successful demonstration of quantitative design methods for preliminary design of water quality surveillance systems. It includes a comprehensive set of quantitative design procedures in handbook form for use within the existing capabilities of governmental water quality agencies. The quantitative methods are intended for use in design of monitoring systems that satisfy an abatement objective. The preliminary design includes specification of station locations, sampling frequencies, and priorities. Incorporation of such practical engineering concerns as cost, reliability and maintainability, and computerization of the procedure are recommended areas for additional development.

The methods are based on a systems approach, in which the performance of the total surveillance system is evaluated as a whole. A new method for establishing sampling frequency is developed, based on a unique formulation of sampling design problem.

The quantitative preliminary design methods are demonstrated to function satisfactorily on the Wabash River Basin. It is concluded that the methods incorporated in the "User Handbook" represent an acceptable method for use by governmental water quality agencies under the existing constraints.

Ward, R., Data Acquisition Systems in Water Quality Management, May 1973.
EPA-R5-73-014

The role of routine water quality water quality surveillance in a water quality management program was investigated. This included a delineation of the objectives of a state water quality program based upon the state and federal laws. Seven specific objectives are listed under the two general objectives of prevention and abatement. These seven specific objectives are planning; research; aid programs; technical assistance; regulation; enforcement; and data collection, processing, and dissemination.

The information requirements of the objectives were delineated in general terms. Each objective was broken down into the general activities required for its accomplishment and the data needed for each activity was identified.

A survey of the current state-of-the-art of grab sampling, automatic monitoring, and remote sensing was performed. Each data acquisition technique was analyzed as to its capabilities, reliability, and cost.

With the above information, a design procedure was developed for designing a state water quality surveillance program which is responsive to the objectives of the agency. The design procedure has two major aspects: (1) determination of the state agency's strategy with respect to its attack on water pollution, and (2) characterization of the streams in the state so that rational decisions with respect to sampling location and frequency can be made. The optimum grab sampling network was designed and then the possibilities of substituting automatic monitoring and remote sensing and various points in the surveillance system were explored.

The design procedure was applied to the State of Colorado and a water quality monitoring system was developed for the Water Pollution Control Division of the Colorado Department of Health. Financial and manpower constraints were considered in the design.

Beckers, C. and Chamberlain, S., Design of
Cost-Effective Water Quality Surveillance
Systems, January 1974.
EPA-600/5-74-004.

This report presents the development and successful demonstration of quantitative methods for the design of river basin water quality surveillance systems for pollution abatement. The methods provide a systematic approach to the consideration of expected stream conditions, system characteristics, equipment performance, and cost in the selection of a preferred system design from among a number of candidates.

The methods are based on a systems approach in which the total system is evaluated for cost and effectiveness. They make extensive use of mathematics previously developed to describe the effectiveness of sampling in the context of abatement. The analysis of candidate system performance draws heavily on reliability and maintainability engineering technology. Data availability remains a constraint to the general application of the methods, but acquisition of the necessary data is wholly within the prerogatives of governmental agencies operating monitoring systems.

The methods are computerized and the computer programs are detailed in this report. They make use of the information available from the computerized river basin models now under general development.

The computerized design methods are demonstrated to function satisfactorily on the Beaver River Basin when artificial data is used to supplement the data base. It is concluded that the methods are acceptable for use by governmental water quality agencies under the existing constraints.

Cohen, A. et al., A Quantitative Method for
Effluent Compliance Monitoring Resource
Allocation, September, 1975.
EPA-600/5-75-015.

This report develops and demonstrates a quantitative method for the preliminary design of effluent standard surveillance systems. The principal output of the report is a procedure to be used in water quality programs to determine the frequency of effluent compliance monitoring visits. The procedure allocates compliance monitoring budgetary resources so as to minimize environmental damage. It utilizes a statistical model of the effluents that is obtained from self-monitoring and compliance monitoring data. The procedure is demonstrated on an example river basin using data supplied by the State of Michigan.

Guenther, G. et al., Michigan Water Resources
Enforcement and Information System, July 1973.
EPA-R5-73-020.

This report depicts a workable interactive Federal/State water-pollution control enforcement and information system. The project demonstrated interactive computer graphics as a method of output presentation.

Two systems were interfaced--Michigan's Water Information System for Enforcement (WISE) and EPA's STORET system. The WISE system is used to alert enforcement personnel to problems through exception reporting, and to provide follow-up information on these problems. STORET is utilized as a storage and retrieval system for water quality and inventory information. As information enters WISE, certain inputs are coded for storage in STORET. The interface mechanism is a common numbering system. Because WISE is modular in design, it can be used in part or in total by other agencies.

Careful consideration should be given to the information that will comprise the computer file. Administrative, procedural, and auditing techniques should be completely set down before proceeding with management's commitment to the system. Microfilm should be used when feasible, both as Computer Output Microfilm (COM) and in manual files.

*McIntire, M., Improved Procedures for Municipal Regulation of Industrial Discharges To Public Sewers, Final Report: March 1976.
Grant No. 801372.

This report reviews the current status of local government control of industrial wastes discharged into publicly owned treatment works and finds them ineffective as a means of controlling large scale industrial activities. Sewer use regulations are usually established by local ordinance which specify the nature and character of pollutants which can and cannot be discharged, and provide for criminal-type penalties for violation. Violations of such regulations are difficult to detect, difficult to prove in a court of law under the high burden of proof and due process safeguards required by the criminal process.

This report suggests an effective and economical regulatory scheme for complying with the federal pretreatment and effluent standards and the federal cost-recovery requirements imposed on federally-financed treatment works. The approach requires the industry to contract with the public entity for industrial wastewater treatment by a document (1) establishing relationships between units of production (an easily verified statistic) and character and quantity of waste, (2) requiring installation of control manhole, continuous recording flow measuring device and sewer shut-off mechanism, (3) establishing a simple self-reporting system from the industrial user to the public entity, and (4) setting remedies for minor and major breaches. Data gathering, verification, charges for service and inspection are simplified, yet sufficient to support a court action. All legal activity related to enforcement would be of a civil nature, rather than criminal.

Each industrial wastewater treatment contract is individually negotiated under an enabling ordinance detailing criteria and establishing the substantive and formal provision of each such contract. A form of such ordinance is included.

Downing, P. and Watson, W., Enforcement
Economics in Air Pollution Control,
Dec. 1973.
EPA-600/5-73-014.

This report investigates the effects of alternative enforcement strategies on the pollution control activities of the firm. There are a number of tradeoffs available to a firm including delay and noncompliance which allow it to minimize expected pollution control costs. These are identified within the context of a generalized behavioral model for the firm and an empirical study is undertaken to determine their importance.

In a simulation of current enforcement of the federal new source particulate matter discharge standard for coal-fired power plants (start-up compliance or certification tests for pollution control devices plus fines for violating in-operation emission standards) it is found that cost-minimizing power plants will install relatively costly pollution control technology and frequently violate federal fly ash standards. Two alternative enforcement strategies for overcoming these shortcomings, namely compliance tests in combination with emission taxes and emission taxes alone, are analyzed.

It is recommended that enforcement agencies give careful consideration to management costs imposed upon the firm and the control agency by an implementation and enforcement scheme. In the case of the federal fly ash discharge standard for coal-fired power plants it is tentatively concluded that emission tax enforcement would probably result in an approximate minimization of the sum of firm and enforcement agency resource costs. The general applicability of this result to other enforcement problems is discussed.

*TRW, Inc., Critical Uncertainties Associated
With Alternative Vehicle Exhaust Emission
Control Programs, September 1975, Final
Report: March 1976.
Contract No. 68-01-2927.

This report focuses upon identifying and characterizing a number of factors that contribute to the uncertainty associated with performance of various vehicle exhaust emission control programs (EECPs). These programs include inspection/maintenance (I/M) procedures, retrofit, fuel modification schemes, and I/M-retrofit combinations.

The methodology for evaluating I/M programs consists of a computer simulation of the basic process over time. Experimental data on individual retrofit devices were statistically analyzed and fuel modification procedures were reviewed using engineering cost estimates. Finally, optimal (least-cost) I/M-retrofit combinations are determined using two alternative integer programming formulations.

The potential impact of the following factors on I/M were found to be highly uncertain: individual engine and emission deterioration rates; extent of owner or mechanic tampering; the extent of voluntary maintenance; effectiveness of the service industry in repairing engine parameters; cost factors for programs including vehicle owner time lost during the inspection and repair process. Furthermore, the effectiveness and cost measures of these programs are often quite sensitive to variations in these parameters and thus themselves highly uncertain.

The study also revealed that there are significant uncertainties regarding the estimates for retrofit program effectiveness and cost. These uncertainties may tend to limit the potential application of retrofit control programs.

Commonwealth of Pennsylvania, Demonstration
of a State Water Quality Management
Information System, August 1974.
EPA-600/5-74-022.

This report is documentation of the Pennsylvania Water Quality Management Information System (WAMIS). The report is divided into two volumes. The first is a program manager's overview of the system, while the second is a compilation of elements required for system application. The program manager's overview discusses the objectives of the system and its development, describes the operations of the various system modules, including required inputs and outputs as well as uses to which the system may be put, estimates manpower and operating cost requirements, and summarizes methods for system application. Detailed documentation of elements required to apply the existing three system modules - the Facility Status, Water Quality, and Contact Modules - is included in Volume II. Volume II includes system inputs with detailed coding instructions, sample output reports, and documentation of each of the three system modules. Module documentation is comprised of system inputs and outputs, operator's instructions, and all program books. Sufficient information is provided to enable application of WAMIS modules by other states or jurisdictions. Volume II is available only through EPA Headquarters, Office of Research and Development.

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