EPA-600/9-75-001a

ABSTRACTS

REPORT NUMBERS

TITLES

PROGRAM AREAS

ORGANIZATIONS

AUTHORS

EXTRAMURAL NUMBERS

ORD PUBLICATIONS SUMMARY

MARCH 1975

U. S. ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, D.C. 20460

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ORD PUBLICATIONS SUMMARY

by

PUBLICATIONS STAFF
Office of Program Management

U.S. Environmental Protection Agency
Office of Research and Development
Washington, D.C. 20460

SEE INSIDE OF FRONT COVER FOR "HOW TO ORDER" REPORTS

FOREWORD

This is the first issue of the Office of Research and Development's (ORD's) quarterly **ORD PUBLICATIONS SUMMARY**. This **Summary** is intended to provide a current listing (since July 1973) of ORD's final reports on in-house, grant, contract, and interagency projects. A New Report Abstracts Section is included in the **Summary** to provide brief abstracts of recently printed reports, as well as indices by Title, Program Area (subject), Performing Organization, Personal Author, Report Number, and Grant, Contract, or Interagency Agreement Number to aid the reader in identifying reports of interest. Instructions on how to order copies of reports are on the inside of the front cover. Comments on how this **Summary** would serve the reader more effectively would be appreciated.

W K Talley

Wilson K. Talley
Assistant Administrator for
Research and Development

CONTENTS

Page

How to Order . . . . . inside front cover

Foreword iii

Series Description vi

Users' Guide vii

New Report Abstracts Section 1

Bibliographic Section

600 Reports 17

650 Reports 21

660 Reports 36

670 Reports 45

680 Reports 59

Title Index 61

Program Area Index 75

Performing Organization Index 91

Personal Author Index 105

Grant, Contract, Interagency Agreement Number Index 115

SERIES DESCRIPTION

The U.S. Environmental Protection Agency (EPA) was formed in late 1970 from programs in several executive agencies, i.e., the Department of Health, Education, and Welfare (air pollution, solid waste, radiation, water hygiene, and noise), the Department of the Interior (water pollution), and the Department of Agriculture (pesticide regulation).

In July 1972, EPA's Office of Research and Monitoring (now Office of Research and Development, ORD) established an office-wide series of designations within which each research report would be published. The series can be used to describe the general thrust of EPA research and development and also to aid in identifying the use for each report. The present numbering system and cover color for each report is keyed to this Series Description. In addition, ORD's research program has been categorized into 10 major Program Areas that serve to identify subject matter: these are described beginning on page vii.

SERIES 1 – ENVIRONMENTAL HEALTH EFFECTS RESEARCH (yellow covers)

Assigned to Series 1 are projects and studies relating to the tolerances of man for unhealthful substances or conditions, generally assessed from a medical viewpoint. In addition to toxicology and other medical specialties, study areas include physiological or psychological studies, and biomedical instrumentation and health research techniques utilizing animals—but always with intended application to human health protection.

SERIES 2 – ENVIRONMENTAL PROTECTION TECHNOLOGY (light blue covers)

Within Series 2 is research performed to develop and demonstrate instrumentation, equipment, and methodology to repair or prevent environmental degradation from point and nonpoint sources of pollution. This work provides the new or improved technology necessary to control and treat pollution sources so that environmental quality standards can be met.

SERIES 3 – ECOLOGICAL RESEARCH (light green covers)

In Series 3 are grouped the investigations on pollution effects on plant and animal species and on materials. Problems are assessed for their long- and short-term influences and studies include formation, transport, and pathway studies to determine the fate of pollutants and their effects. This work provides the basis for setting standards to minimize undesirable changes in living organisms in the aquatic, terrestrial, and atmospheric environments.

SERIES 4 – ENVIRONMENTAL MONITORING (gray covers)

Research conducted to develop new or improved methods and instrumentation for identifying and quantifying environmental pollutants is found in Series 4. Also included are studies to determine the ambient concentrations of pollutants in the environment, or the variance of pollutants as a function of time or meteorological factors, or both.

SERIES 5 – SOCIOECONOMIC ENVIRONMENTAL STUDIES (rust covers)

Included in Series 5 is research devoted to the socioeconomic impact of environmental problems, i.e., recycling and other recovery operations whose emphasis is on monetary incentives and nonscientific realms of legal systems, cultural values, and business systems. Because the interdisciplinary scope of system evaluations and environmental management, these reports are included in Series 5.

SERIES 6 – SCIENTIFIC AND TECHNICAL ASSESSMENT REPORTS (STAR) (dark blue covers)

In Series 6 are assessments of the available scientific and technical knowledge on major pollutants that would be helpful in regulatory decision making or assessments of a major area of completed study. The series is used to present objective evaluations of existing knowledge— evaluations that point out the extent to which it is definitive, the validity of the data on which it is based, and the uncertainties and gaps that may exist. (Most of the reports are multimedia in scope and focus on single media only to the extent warranted.)

SERIES 9 – MISCELLANEOUS (covers of various designs)

Series 9 is used for all reports issued by ORD not applicable to one of the series described above.

USERS' GUIDE

This volume contains an abstract section, a bibliographic section, and six indices. Within each index, reports are cross-referenced to the Bibliographic Section by report number.

NEW REPORT ABSTRACTS SECTION

This section contains a brief abstract of each recently printed report. If no source is shown in the Bibliographic Section, the report is not yet available. Future issues of the **Summary** will note those reports for which an abstract has been published and indicate the issue in which the abstract appeared; e.g., ---Abstracted 600/9-74-001a---.

BIBLIOGRAPHIC SECTION

In the Bibliographic Section is a numerical listing of reports published since July 1973. The source of each report follows the bibliographic entry, and how to order instructions are given on the inside front cover.

The major ORD organizations (Headquarters; Washington Environmental Research Center (WERC); and National Environmental Research Centers (NERC) responsible for preparing the report can be identified:

600 = ORD Headquarters, RD-674 (Washington, DC 20460; 202/426-2175)
and WERC (Washington, DC 20460; 703/557-7484)
650 = NERC-RTP (Research Triangle Park, NC 27711; 919/549-8411)
660 = NERC-Corvallis (Corvallis, OR 97330; 503/752-4211, X. 440)
670 = NERC-Cincinnati (Cincinnati, OH 45268; 513/684-8258)
680 = NERC-Las Vegas (PO Box 15027, Las Vegas, NV 89114; 702/736-2969)

TITLE INDEX

All reports are listed alphabetically by title; "A," "An," and "The" have been dropped from the beginnings of titles.

PROGRAM AREA INDEX

This Program Area Index provides a broad subject-matter index; each report is listed once, alphabetically by title, under the Program Area concerned with the report's research. These Program Areas contain sub-areas called Program Elements; these are the numbers appearing in the second column of the Bibliographic Section (e.g., 1BB037). Reports not falling within these Program Areas, such as bibliographies or annual reports, are listed under Miscellaneous Reports.

The objectives and responsibilities within each of the 10 Program Areas are:

HEALTH EFFECTS—assessing health hazards associated with environmental pollution from a number of media and categories including air, water, pesticides, radiation, and noise. Major program emphasis is devoted to evaluating, through community epidemiologic studies, the effects of exposure to common pollutants on sensitive health indicators and to assessing at the community level, the effects of pollutants on human physiology.

ECOLOGICAL PROCESSES AND EFFECTS-determining the effects of air and water pollutants on the structure and function of ecosystems and on biotic and abiotic subcomponents of these ecosystems. Programs on aquatic systems determine the acute and chronic effects of pollutants (e.g., temperature, pesticides, heavy metals) on life stages of fresh and marine water fish, invertebrates, and their food-chain organisms. Specific air pollutant studies include the effects of nitrogen oxides, sulfur oxides, hydrocarbons, and oxidants on representative terrestrial ecosystems. Also included are studies seeking alternative methods of pest control that have great specificity on target organisms and little or no effects on nontarget organisms.

USERS'GUIDE

MUNICIPAL POLLUTION CONTROL-developing and demonstrating technology applicable to controlling and treating wastewaters generated in and discharged from the urban environment. The entire urban drainage system is included, from sewer systems carrying stormwater and sewage (combined sewers) and from urban stormwater discharges.

INDUSTRIAL POLLUTION CONTROL-demonstrating the best practicable, best available, and zero pollution control technology (with emphasis on water reuse and product-by-product recovery) for manufacturing industries defined by the Standard Industrial Classification, Major Groups 19-39.

NONPOINT POLLUTION CONTROL-developing means to (1) predict and assess the impact of pollutants from nonpoint sources on waters from various land-use patterns; (2) determine the reduced pollutant load that results from implementing specific nonpoint source controls and the costs of achieving these reductions to meet established water quality standards; (3) establish limits of reasonable controllability for nonpoint sources; and (4) establish specific control guidelines for nonpoint sources.

Specific objectives include developing cost-effective, nonpoint management systems (with alternatives appropriate for various geographical and geological areas) for activities in: agriculture including forestry and logging operations; agricultural runoff; irrigation return flows; confined animal feeding; aquaculture and disposal of nonagricultural sludges; active mining operations and abandoned mining sites; hydrological modifications; and oil and hazardous material spills.

AIR POLLUTION CONTROL-ensuring the availability of control devices, processes, and approaches for control of air pollutants at their source. Currently, activity is in research and development of control technology in four principal areas: (1) sulfur oxides— historically, emissions from electric power generating plants; recently, from industrial combustion and process sources; (2) nitrogen oxides—in the area of combustion control and nitrogen oxide effluent treatment processes; (3) particulates—the need for fine particulate control technology and more economic conventional technologies; and (4) hazardous and other pollutants—those not included in the above three categories.

DATA AND INFORMATION RESEARCH-planning, coordinating, establishing, reviewing, and assessing research; and developing and demonstrating programs aimed at effective research information and data systems, including multimedia or multipollutant data analysis and special data handling and processing studies.

EQUIPMENT AND TECHNIQUES-developing methods and instrumentation for the detection, identification, and quantification of pollutants in all media at the lowest significant concentration. Included are state-of-the-art reviews, prototype instrumentation development, and pioneering research studies related to developing new or significantly improved analytical methods or instrumentation.

QUALITY ASSURANCE-planning, establishing, and coordinating an Agency-wide standardization and quality control program to ensure that environmental data produced by Federal, State, and local agencies are compatible, accurate, and legally defensible; and ensuring the selecting, standardizing, and publishing of procedures and methods for sampling and analyzing environmental pollutants.

SOCIOECONOMIC RESEARCH-developing and demonstrating analytical and management techniques required to implement Agency programs at the national, regional, and local levels. Interdisciplinary research is focused on the analysis of three general areas: (1) ecological impact—effects of various environmental policies and development of comprehensive environmental planning and management capability; (2) resources—economic aspects of environmental actions including cost-benefit, cost-risk benefit, and trade-off analysis; and (3) implementation and methods—developing forecasting capability to anticipate long-range impact of human and institutional activities on the environment.

PERFORMING ORGANIZATION INDEX

This is an alphabetical listing of the organizations that actually conduct ORD research projects. For grants or contracts, the organization is the grantee or contractor; for in-house reports, the organization is the EPA laboratory or office.

PERSONAL AUTHOR INDEX

The Personal Author Index lists alphabetically all authors of reports contained in the Bibliographic Section.

GRANT, CONTRACT, INTERAGENCY AGREEMENT NUMBER INDEX

This index contains a listing of ORD Contract, Grant, and Interagency Agreement numbers for which a final report has been produced. For each number listed the applicable report number is cross-referenced.

NEW REPORT ABSTRACTS SECTION

600/1-75-001 PE 1GB090 ROAP/TASK 21 AXV IN-HOUSE PROJECT

Federal Noise Effects Research: FY 73 – FY 75 Noise Technology Staff, EPA Washington, DC

Potential effects of noise on the public health and welfare are described, limitations and gaps in necessary knowledge of those effects are identified as research needs, and eight categories for analyzing noise effects research are presented. The current Federal research programs are summarized for each of the eight categories. The Noise Effects Research Research Panel through its collective knowledge of the needs and the current research has identified specific research areas which need additional emphasis in order to provide accurate and thorough information on effects of noise. The Panel concluded that the current programs need continued and in some instances expanded support in order to provide necessary information on the effects of noise. Some areas of concern which are not currently being addressed are also identified. EPA CONTACT: Berkau, G.

600/2-74-009a PE 1BB036 ROAP/TASK 21 AZR 006 GRANT NO. 800857

Effluents of the Inorganic Pesticide Industry BY J. Patterson, Illinois Institute of Technology Chicago, IL

A literature and field study of the manufacture of inorganic pesticides revealed that many inorganic formulations are still widely used for agricultural purposes. The inorganic pesticide industry is a small but distinct segment of the total agricultural chemical industry. Its manufacturing processes and wastewaters contrast sharply with those associated with organic pesticides. The inorganic pesticide market is dominated by eight products, each of which is discussed in this report with respect to its manufacturing effluent characteristics and applicable pollution control technology. Based upon field studies, it has been demonstrated that five of the eight products can be manufactured without generating any process wastewater. Aqueous effluents from the manufacture of the remaining three inorganic pesticides appear to be directly controllable by previously demonstrated in-plant control and/or wastewater treatment technologies. EPA CONTACT: Des Rosiers, P. 202-755-0448

600/2-74-009b PE 1BB036 ROAP/TASK 21 AZQ 029 GRANT NO. 800857

Pollution Control in the Commercial Explosives Industry BY J. Patterson, Illinois Institute of Technology Chicago, IL

A literature and field study of the commercial explosives industry reveals that on the basis of products manufactured, plant size, and the nature of the wastewater, the industry may be divided into three segments. One, complex facilities, are large plants manufacturing a variety of explosives and intermediate products. The second category is small specialized formulation plants, typically limited to blending explosives formulations for use in nearby mining activities. The final category is specialty product facilities, devoted to manufacture of select ingredients such as lead azide and other explosives initiators, blasting caps, electric matches and similar appurtenance items. The explosives industry discharges large volumes of wastewater, typically high in BOD, nitrogen, and solids, frequently at extreme pH, and containing trace to high quantities of dissolved and particulate explosives products. Although pollution abatement technology has not been widely implemented within the explosives industry, there is a potential for significant abatement of pollutant discharge by good housekeeping practice, application of proven treatment technology and under certain conditions total wastewater containment. EPA CONTACT: Des Rosiers, P. 202-755-0448

600/2-74-009c PE 1BB036 ROAP/TASK 21 AZQ 029 GRANT NO. 800857

Effluents of the Inorganic Gas Industry BY J. Patterson, Illinois Institute of Technology Chicago, IL

A literature and field study of the inorganic gas industry revealed that the industry is dominated by (1) air separation plants producing argon, nitrogen and/or oxygen, (2) hydrogen plants and (3) carbon dioxide plants. The major effluent of the industry is cooling water, which may be contaminated with raw product condensates, oil and grease, and water supply and cooling water treatment chemicals. Spent scrubber solutions from product purification may also constitute a significant waste, although newer production technology eliminates this aspect, as well as oil and grease. EPA CONTACT: Des Rosiers, P. 202-755-0448

600/2-75-001 PE 1BB036 ROAP/TASK PEMP 03 IN-HOUSE PROJECT

Projects in the Industrial Pollution Control Division – December 1974 Industrial Pollution Control Division, EPA Washington, DC

Projects of the Industrial Pollution Control Program – December 1974 is a compilation of information sheets from projects initiated since fiscal year 1967 through fiscal year 1974. Each sheet contains the objectives, statistical information, and a brief description of the project. General introductory information on the Federal Industrial Pollution Control Program is also presented to provide perspective on the magnitude of industrial pollution and the research directions that must be pursued in order to develop the technology to adequately control this largest point source of pollution in the United States.

600/2-75-002 PE 1GB090 ROAP/TASK 21 AXV IN-HOUSE PROJECT

Federal Surface Vehicle Noise Research, Development, and Demonstration Program: FY 73 – FY 75 Noise Technology Staff, EPA Washington, DC

The Interagency Surface Vehicle Noise Research Panel was established by the Environmental Protection Agency to aid EPA in fulfilling its responsibility for coordinating the Federal noise research activities. As its initial task, the Panel prepared this report summarizing the Federal governments' surface vehicle noise research, development, and demonstration activities. The Federal agencies which sponsor and/or conduct the major portion of the surface vehicle noise RD&D are represented on the Panel. They are the Department of Transportation, the Departmet of Commerce/ National Bureau of Standards, the Department of Defense, and the EPA. Other agencies which sponsor surface vehicle noise research are the Department of Agriculture and the National Science Foundaion. The report contains brief descriptions and fiscal data for the agencies' programs. Emphasis is on fiscal years 1973 through 1975. Also included are references and bibliographies of reports and publications which have resulted from the Federal surface vehicle RD&D activities. EPA CONTACT: Berkau, G. 202-755-0449

NEW REPORT ABSTRACTS SECTION

600/5-75-002 PE 1HA095 ROAP/TASK 21 ART 11 IAG NO. IAG-148(D)

Secondary Impact of Transportation and Wastewater Investments: Review and Bibliography BY S. B. Bascom, K. G. Cooper, M. P. Howell, A. C. Makrides, and F. T. Rabe, Environmental Impact Center Newton, MA

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 transportation and wastewater 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 collection systems); (b) where possible, according to type of secondary effects (economic, social and land use); (c) a brief summary of modeling techniques which may be utilized to analyze and project likely secondary environmental impacts. Section II condenses the findings 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 V classifies these literature studies by: (a) impact; (b) investment; (c) geographic area examined; (d) type of study; and (e) type of analytic techniques used in assessing secondary effects. EPA CONTACT: Scherer, R.

600/5-75-003 PE 1HA098 ROAP/TASK 21 AKL 02 GRANT NO. 801419

Land Use Forms and the Environment – An Executive Summary BY B. J. Berry, Chicago, University of Chicago, IL

This executive summary contains highlights of the full study which focused on the relationship between land use forms and environmental quality. It investigated the influence of the spatial distribution of land rises on the pollutants generated and the resulting environmental quality. The investigation was assisted by the preparation of a "sorted table" in which the "rows" are the various urban forms and land use patterns and the "columns" are the several classes, types and elements of environmental pollution. A comparative analysis of the materials assembled for the table determined trends across the urban forms and land use types, focusing particularly on the identification of those land use forms that naturally generate the least pollution. Also, parallel investigation of national trends in population distribution and land use was performed, so that some expectations could be developed as to the likely impacts on pollution of current patterns of regional growth and change. EPA CONTACT: Patterson, P.

600/5-75-004 PE 1BA030 ROAP/TASK 16 AFN 03 CONTRACT NO. 68-01-1863

Analysis of Nonpoint-Source Pollutants in the Missouri Basin Region BY A. D. McElroy, F. Y. Chin, and A. Aleti, Midwest Research Institute Kansas City, MO

A study was conducted of nonurban, nonpoint sources of pollution in the Missouri Basin utilizing a unique, computer-based data system. The Data Bank contains extensive information on land use, soil, climate, water quality, and other parameters in the Missouri Basin. The current study was concerned with the adequacy of the Data Bank relative to development of nonpoint pollution models. Evaluation of information in the Data Bank yielded detailed land use and water quality profiles in the basin. The results show that the Data Bank is a useful base to depict the basinwide relations between various land uses and water quality. Regression equations of these relationships were developed for individual subbasins as well as for the entire basin. The regression equations, and the accompanying statistical analysis of significance, indicated that the water quality parameters NO3, BOD, and turbidity correlate well with land use on a basinwide basis. Other parameters, namely phosphorus, dissolved oxygen, and dissolved solids, did not correlate well with land use. EPA CONTACT: Rose, M.

600/9-74-002 PE 1RW103 IN-HOUSE PROJECT

Indexed Bibliography of Office of Research and Development Reports – Updated to January 1975 OR&D, Publication Staff, EPA Washington, DC

This bibliography is a current listing of the Office of Research & Development's final reports on in-house, grant, contract, and interagency projects. Reports are indexed by Title, Program Area (subject), Performing Organization, Personal Author, Report Number, and Grant, Contract, or Interagency Agreement Number to aid the reader in identifying reports of interest. Instructions on how to order copies of reports are on the inside of the front cover.

660/2-74-070 PE 1BB044 ROAP/TASK 21 ASS 001 IN-HOUSE PROJECT

Extended Aeration Sewage Treatment in Cold Climate BY H. J. Coutts, and C. B. Christianson, Arctic Environmental Research Laboratory, EPA College, AK

To develop design criteria for biological treatment of low temperature domestic sewages, two parallel low temperature extended aeration units near Fairbanks, Alaska, were designed and operated. The two units had exposed aeration basins utilizing submerged aerators and were differentiated by type of clarifier. One unit had conventional horizontal flow clarifier while the other had a modified upflow clarifier with tube settlers. The liquid temperature varied from 0°C to 19°C. In addition, 0.5 MGD subarctic, oxidation ditch and low temperature bench scale units were studied. Organic loading was the parameter most seriously affected by low temperatures. EPA CONTACT: Latimer

660/2-74-094 PE 1BB036 ROAP/TASK 21 AZR 006 GRANT NO. 801577

Pollution Control Technology for Pesticide Formulators and Packagers BY T. L. Ferguson, Midwest Research Institute Kansas City, MO

The pesticide formulation and packaging industry transforms bulk pesticidal chemicals into packaged, ready-to-use form for sale to the consumer. Most pesticides are formulated in plants completely separate from the site of active ingredient manufacture. About 32,000 formulated products are federally registered to approximately 3,400 companies for interstate sale. Most are apparently formulated in 200 to 300 large formulation plants through the country. Techniques used to dispose of process wastewater include evaporation, landfill disposal, contract disposal services, including municipal systems. Current pretreatment and treatment techniques for process wastewater discharge are generally considered inadequate to meet increasingly stringent standards. The best practicable wastewater treatment technology appears to be complete evaporation. The best available treatment technology appears to be a pretreatment-filtration-adsorption process under development. Additional research is needed to: characterize the wastewater; assess the air pollution potential due to pesticides; and demonstrate the pretreatment-filtration-adsorption process. EPA CONTACT: Warner, A. 404-546-3160

NEW REPORT ABSTRACTS SECTION

660/2-75-001 PE 1BB037 ROAP/TASK 21 BAB 30 GRANT NO. 801432

Waste Citrus Activated Sludge As a Poultry Feed Ingredient BY R. H. Jones, J. T. White, and B. L. Damron, Winter Garden Citrus Products Cooperative Winter Garden, FL

This report presents an evaluation of the potential of utilizing waste activated sludge as a poultry feed supplement. The sludge used in this study was obtained from an activated sludge process treating concentrated citrus waste containing no sanitary wastewater. The sludge was thickened, dewatered and dried using full-scale and pilot-scale equipment. The dried sludge was then analyzed for protein, fiber, amino acids, nutrients and moisture. Poultry feeds containing varying concentrations of sludge were prepared. Two experiments with broiler chicks, each of three weeks duration, one 8-week broiler study, and a six-month laying hen study were conducted to determine the effect of the inclusion of sludge in poultry diets on performance. It is shown in this report that the inclusion of sludge in properly formulated diets up to 7.5 percent did not significantly affect poultry performance or meat or egg quality. The value of the sludge was calculated based on the reduction in feed ingredients resulting from the inclusion of sludge. It was found that the value of the recovered sludge significantly reduced the total cost of sludge handling. EPA CONTACT: Thompson, H.

660/2-75-002 PE 1BB037 ROAP/TASK 21 BAB 10 GRANT NO. 12060 HPC

Pilot Scale Treatment of Wine Stillage BY E. D. Schroeder, California, University of Davis, CA

Pilot and laboratory scale studies were run on aerobic and anaerobic biological treatment of winery stillage over a two year period. The pilot scale studies included work with aerobic lagoons and anaerobic packed towers. Laboratory systems studied were aerobic reactors without recycle and batch fed anaerobic processes. Because suspended solids removal proved to be a key factor in successful biological treatment, centrifugation, detartration, coagulation and flocculation, and combinations of these methods were included in the studies. Centrifugation proved to be the best method of removing solids prior to biological treatment. Solids removal in combination with an aerobic treatment process can be expected to produce final filtrate chemical oxygen demands of about 700 mg/1 and a final filtrate BOD of about 75 mg/1. Anaerobic processes studied did not operate well but produced effluents with chemical oxygen demands of the order of 4000 mg/1. EPA CONTACT: Cochrane, M.

660/2-75-003 PE 1BB039 ROAP/TASK 21 BES 14 GRANT NO. 801454

Livestock and the Environment—A Bibliography with Abstracts, Volume II BY R. H. Ramsey, M. L. Rowe, and L. Merryman, East Central Oklahoma State University Ada, OK

Management and research information on animal wastes has expanded rapidly in recent years. This material has appeared in such diverse sources as journal articles, conference proceedings papers, university publications, government publications, magazine articles, books, and theses. This bibliography was compiled in order to speed the flow of information on findings in one segment of the livestock industry to other segments that could benefit from this technology. Included in this publication are the following indexes: (1) title, (2) author, (3) keyword, (4) animal information categories. These indexes are followed by a section of abstracts of each reference entry found in the bibliography. Single copies of most articles can be obtained in hard copy or microfiche form at cost from the Animal Waste Technical Information Center, School of Environmental Science, East Central Oklahoma State University, Ada, Oklahoma 74820. (Ramsey-East Central) EPA CONTACT: Wood, M. L.

660/2-75-004 PE 1BB037 ROAP/TASK 21 AZX 27 GRANT NO. 12040 EJU

Activated Carbon Treatment of Unbleached Kraft Effluent for Reuse BY E. W. Lang, W. G. Timpe, and R. L. Miller, St. Regis Paper Company Pensacola, FL

A four-year pilot plant program was carried out to investigate the technical and economic feasibility of treating unbleached kraft pulp and paper mill effluent for reuse. Preliminary laboratory studies and cost estimates indicated that the following treatment sequences should be investigated in the pilot plant: 1) primary clarification, carbon adsorption; 2) lime treatment, carbon adsorption; 3) primary clarification, bio-oxidation, carbon adsorption. Water of reusable quality can be provided from unbleached kraft effluent by several combinations of treatment utilizing activated carbon. Unbleached pulping effluents typically contain about 1000 color units, 250 mg/1 BOD. Reusable water quality as defined in this study is 100 color units and 100 mg/1 TOC. The most economical treatment is the microlime-carbon process that utilizes low dosages of lime and clarification followed by carbon adsorption in down-flow granular carbon beds. Capital cost for treatment by this process of 9.6 mgd of unbleached kraft effluent from an 800-ton-perday mill was estimated to be approximately $6.7 million. Operating costs, inclusive of capital depreciation, were estimated to be $0.30 per 1000 gal and $3.58 per pulp-ton, including credit for the reused water. Carbon adsorption in continuous counter-current stirred contactors was found to have promise of lower operating cost and substantially lower capital costs as compared to adsorption in fixed beds. EPA CONTACT: Ruppersberger, J.

660/2-75-005 PE 1BB039 ROAP/TASK 21 AYS 05 GRANT NO. 801040

Management Practices Affecting Quality and Quantity of Irrigation Return Flow BY L. G. King, and R. J. Hanks, Utah State University Logan, UT

Field and laboratory research was conducted to determine the effects of irrigation management and fertilizer use upon the quality and quantity of irrigation return flow. The total seasonal discharge of salts from the tile drainage system was directly related to the quantity of water discharged, because the solute concentration of the ground water was essentially constant over time. Under such conditions, reduction of salt content of return flow is accomplished by reduced drain discharge. Irrigation management for salinity control must be practiced on a major part of a particular hydrologic unit so that benefits are not negated by practices in adjoining areas. Field studies and computer models showed that salts may be stored in the zone above the water table over periods of several years without adversely affecting crop yields on soils with high "buffering" capacity as encountered in this study. However, over the long term, salt balance must be obtained. Appreciable amounts of nitrate moved into drainage water at depths of at least 106 cm from the applications of commercial fertilizer and dairy manure to ground surface. Submergence of tile drains in the field reduced nitrate concentrations in the effluent, especially under heavy manure applications. This report was submitted in fulfillment of Grant No. S801040 by Utah State University under the partial sponsorship of the Environmental Protection Agency. Work was completed as of November 30, 1973. EPA CONTACT: Law, J. P.

NEW REPORT ABSTRACTS SECTION

660/2–75–007 PE 1BB045 ROAP/TASK 21 ASH 02 GRANT NO. 801400

Water Quality Effect of Diking a Shallow Arid-Region Lake BY D. K. Fuhriman, L. B. Merritt, J. S. Bradshaw, and J. R. Barton, Brigham Young University Provo, UT

The inflow, outflow, and in-lake water quality and quantity of Utah Lake in Central Utah was studied over a 36-month period. The work was undertaken to determine the effect of a proposed diking project on the quality and quantity of lake water and to develop methodology for determining the effect of diking or other management practices on the quality of water in any lake system. A computer simulation model was developed which is able to analyze the effect of a given management program on the water quality of the lake, particularly as related to the "conservative salts" present. The simulation model was also used to evaluate the evaporation from the lake by use of a salt balance technique. Results of the research indicate that the diking of Utah Lake will have a positive beneficial effect upon the water quality of the lake and will also result in considerable saving of water and reclamation of valuable land. EPA CONTACT: Leach, L.

660/2–75–008 PE 1BB045 ROAP/TASK 21 ASJ 02 GRANT NO. 800731

Role of Trace Elements in Management of Nuisance Growths BY T. Bott, R. Patrick, and R. Larson, Academy of Natural Sciences of Philadelphia Philadelphia, PA

The purpose of these studies was to examine the effects of various kinds and amounts of trace metals on the structure of algal communities and their possible subsequent effect upon the productivity of the aquatic ecosystem. To carry out this program of study, the following trace metals were examined: vanadium, chromium, selenium, boron, nickel, and rubidium. The results of these experiments indicate the concentration and form of a trace metal may have a definite effect upon which algal species can out-compete others. These shifts may greatly reduce the productivity of the system as a whole. If the shift is to species which has such lower predator pressure, large standing crops which may be nuisances may develop. EPA CONTACT: Duffer, W. R.

660/3–74–013 PE 1EA077 ROAP/TASK 10 AKC 018 IN-HOUSE PROJECT

Theoretical Model and Solubility Characteristics of Aroclor R 1254 in Water: Problems Associated with Low-Solubility Compounds in Aquatic Toxicity Test BY W. P. Schoor, Gulf Breeze Environmental Research Laboratory, EPA Gulf Breeze, FL

A theoretical model of the behavior of substances having low water-solubility is presented and discussed with respect to aqueous bioassay. Ultracentrifugal techniques were used in an attempt to study size distributions of Aroclor 1254 aggregates in aqueous emulsions. Results indicate strong adsorption from emulsion by surfaces and a water-solubility at 20°C of less than 0.1 micrograms/liter in distilled water and approximately 40% of that value in water containing 30 grams/liter NaC1. Implications with regard to aqueous bioassay are discussed. EPA CONTACT: Valmus, A. (Librarian)

660/3–74–017 PE 1BA031 GRANT NO. 16010 ELF

Silt Removal From a Lake Bottom Lake Herman Development Associates, Inc. Madison, SD

Dredging was used as a method to remove 62,600 cubic yards of silt from Lake Herman during the summers of 1970, 1971, and 1972. The silt was transported via a pipeline to a silt deposit area adjacent to the northeast corner of the lake. The water removed by the dredging process drained by gravity along a gradual slope, dropping its silt and losing nutrients to the lush vegetation, and eventually returned to the lake. In the bay area where dredging occurred water depth was increased from 5.5 feet to approximately 11 feet. There was no significant change in the levels of biological organisms or nutrients, except for phosphorus, which increased just after the dredging began. Whether dredging actually caused the increase is still debatable. Vegetation in the deposit area became extremely lush. Water returning to the lake from the deposit area was lower in nutrients than the water in the lake. This report was submitted in fulfillment of Contract Number 16010 ELF under partial sponsorship of the Water Quality Office, Environmental Protection Agency.

660/3–74–028 PE 1BA026 ROAP/TASK 21 AKP 011 GRANT NO. 800778

Cladophora Distribution in Lake Ontario (IFYGL) BY C. T. Wezernak, D. R. Lezenga, and F. C. Polcyn, Environmental Research Institute of Michigan Ypsilanti, MI

Multispectral remote sensing data were collected along the U.S. shoreline of Lake Ontario, under the sponsorship of the Environmental Protection Agency, as part of the International Field Year on the Great Lakes (IFYGL) program in Lake Ontario. Data were processed to show the distribution of *Cladophora* in the nearshore zone and to estimate the standing crop. Additionally, thermal data in the study area were displayed. The results show an extensive growth and development of *Cladophora* in the study area. Approximately 66% of the nearshore zone in the western portion of the lake and 79% in the eastern portion, is covered by *Cladophora*. Several major and minor thermal features and thermal discharges were evident at several locations along the U.S. shoreline. EPA CONTACT: Mullen, M. 313–226–7911

660/3–74–029 PE 1BA026 ROAP/TASK 25 ADX 003 GRANT NO. 801062

Future Dredging Quantities in the Great Lakes BY C. N. Raphael, E. Jaworski, C. Ojala, and D. S. Turner, Eastern Michigan University Ypsilanti, MI

Based on historical records, an overview and projection of U.S. and Canadian dredging quantities in the Great Lakes are presented. Using current pollution criteria, future quantities of polluted maintenance dredging are estimated for each lake. Recent environmental policies have influenced dredging and particularly disposal practices. These policies, as well as sedimentation, lake levels, and economic factors are discussed in relation to dredging. During the next decade, maintenance and private dredging volumes will not change significantly, whereas new work will decrease. As in the past, most maintenance dredging will occur in U.S. projects, particularly in Lake Erie. EPA CONTACT: Mullen, M. 313–226–7911

NEW REPORT ABSTRACTS SECTION

660/3-74-033 PE 1BA024 GRANT NO. 800994

Salt Water Detection in the Cimarron Terrace, Oklahoma Oklahoma Water Resources Board Oklahoma City, OK

The objectives of this project were to demonstrate the applicability of surface resistivity techniques to delineate salt water contamination in a shallow alluvial aquifer, to outline areas of salt water contamination in a valuable terrace aquifer, to permit safe future development, and to identify the sources of such contamination. Surface resistivity using the Wenner spread and both Barnes layer and apparent resistivity interpretive methods was found useful in outlining areas of major water quality changes where the geologic environment was simple and the terrace composed of sand. However, where clay was present in the terrace or where the bedrock relief was large, surface resistivity was not found to be an accurate definitive tool. Two large areas of salt water contamination were intensively studied by test drilling. In one of these areas resistivity was extensively used. Brine contamination of one of these areas was attributed to oil field brine evaporation pits while the other area was contaminated by natural brines from the underlying bedrock. The sodium/chloride ration was used to identify the source of brines. EPA CONTACT: Scalf, M. R.

660/3-75-001 PE 1EA077 ROAP/TASK 25 AJN 10 IN-HOUSE PROJECT

Impact of the Use of Microorganisms on the Aquatic Environment BY D. G. Ahearn, Georgia State University Atlanta, GA BY A. W. Bourquin, Gulf Breeze Environmental Research Laboratory, EPA Gulf Breeze, FL BY S. P. Meyers, Louisiana State University Baton Rouge, LA

Proceedings of a symposium-workshop to determine the possible impact of artificially introducing microbial insect control agents or oil-degrading agents into the aquatic environment. The efficacy and safety testing, especially against non-target aquatic organisms, for use of bacteria, viruses, fungi, and protozoa to control aquatic insect pests is discussed with remarks of panel members representing government, academia, and industry. Special attention is given to persistence of pathogens in aquatic environments as well as control of aquatic weeds and other non-insect pests. Summary papers are presented for each panel concerned with microbial pesticides and one summary for the session on microbial degradation of oil. Excellent bibliographies are presented with each paper and discussion. EPA CONTACT: Bourquin, A. W. 904-377-5268

660/3-75-002 PE 1BA032 ROAP/TASK 21 AJH 12 GRANT NO. 800613

Effect of Meteorological Variables on Temperature Changes in Flowing Streams BY R. W. Troxler, and E. L. Thackston, Vanderbilt University Nashville, TN

A mathematical model for predicting the change in water temperature in a flowing stream as a function of stream geometry and standard weather information was developed and tested. Five field tests were conducted on cold water released from hydro-power stations as it warmed up moving downstream over periods up to 38 hours. Predictions of temperature changes were made based on (a) weather data from a boat floating with the water, (b) data from a station on the bank, and (c) data from a remote weather station 100 miles away. Agreement between predicted and observed temperature changes was good, even with remote data, when adjustments to compensate for the local micro-climate were made. Computer programs and all data are included. EPA CONTACT: Tichenor, B. 503-752-4348

660/3-75-003 PE 1BA031 ROAP/TASK 21 AIZ 15 GRANT NO. 801003

Eutrophication of Surface Waters—Lake Tahoe's Indian Creek Reservoir Lake Tahoe Area Council South Lake Tahoe, CA

From April 1969 to October 1974 field and laboratory analyses and observations were made at approximately weekly intervals to evaluate the relationship between the quality of water impounded at Indian Creek Reservoir (ICR) and the reclaimed water exported by the South Tahoe Public Utility District. The reclaimed water comprised from 70 to 80 percent of the annual impoundment. It is concluded that the reservoir responds to more complex factors than are measurable by analysis of reclaimed water. The results show why a system of wastewater reclamation must be designed on the basis of the natural as well as the man-controlled components of the system, and points the way to the necessary parameters and institutional concepts if water is to be reclaimed for a specific purpose. EPA CONTACT: Maloney, T.

660/3-75-004 PE 1BA026 ROAP/TASK 21 AKP 07 GRANT NO. 800605

Phytoplankton Composition and Abundance in Lake Ontario During IFYGL BY E. F. Stoermer, M. M. Bowman, J. C. Kingston, and A. L. Schaedel, Michigan, University of Ann Arbor, MI

Based on samples collected during the International Field Year for the Great Lakes, the phytoplankton assemblage of Lake Ontario is dominated by taxa indicative of degraded water quality, including many potentially nuisance producing species. Many taxa characteristic of the offshore waters of the upper Great Lakes are either absent from flora or very rare. Compared to the upper lakes, the flora of Lake Ontario undergoes extreme seasonal succession, with diatoms predominating during the winter and early spring, green algae becoming abundant during the summer, and blue-green algae showing a distinct fall peak. Various species of microflagellates are a relatively important element of the flora during all seasons. EPA CONTACT: Davies, T. T.

660/3-75-005 PE 1BA026 ROAP/TASK 21 AKP 15 GRANT NO. 800610

Mathematical Modeling of Phytoplankton in Lake Ontario BY R. V. Thomann, R. P. Winfield, and D. M. DiToro, Manhattan College Bronx, NY

The basic mathematical structure for describing the dynamics of phytoplankton in Lake Ontario is presented in this report. Data on chlorophyll and principle nutrients are reviewed and summarized and the mathemmatical modeling strategy is detailed. The modeling strategy begins with the construction of a horizontally completely mixed lake with vertical layers, LAKE 1. This spatially simplified model is used to develop the interactions and kinetic behavior of the various components of each subsystem. A more detailed 3-dimensional model is then used to describe open lake and near shore variations in phytoplankton biomass. Ten biological and chemical variables are used in both models and include four trophic levels above the phytoplankton, chlorophyll as a measure of phytoplankton biomass two phosphorus components and three nitrogen components. Under reasonable sets of model parameters as reported in the literature, the Lake 1 model output compared favorably with observed data on the dependent variables. Spring growth and peak chlorophyll concentrations are related primarily to increasing light and temperature. The model indicates that growth ceases due to phosphorus limitation. The results to date indicate that the mathematical model of phytoplankton in Lake Ontario as developed herein is a reasonable first approximation to observed data. As such, the model can form a basis for preliminary estimates of the effects of nutrient reduction programs on Lake Ontario. EPA CONTACT: Richardson, B.

NEW REPORT ABSTRACTS SECTION

660/3-75-006 **PE 1BA026** **GRANT NO. 800609**

Phosphorus Uptake and Release by Lake Ontario Sediments BY R. T. Bannerman, D. E. Armstrong, R. F. Harris, and G. C. Holdren, Wisconsin, University of Madison, WI

Sediment cores were obtained from 15 lake stations representing the three major basins and the Inshore Zone of Lake Ontario. Cores were sectioned for characterization of the surface sediments according to inorganic P chemical mobility. Physical mobility was characterized by measurement of P release from intact cores incubated under controlled laboratory conditions. The proportions of potentially chemically mobile inorganic P were usually high (30 to 60%) in the central basin sediments and low (2 to 8%) for the inshore zone sediments. Although the amounts of inorganic P desorbed after three successive equilibrations (in .1M NaC1) of Lake Ontario sediments represented only 3 to 17% of the potentially mobile inorganic P, sufficient inorganic P was desorbed to restore a large part of the original interstitial inorganic P concentrations. EPA CONTACT: Thomas, N.

660/3-75-008 **PE 1BA031** **ROAP/TASK 21 AJF** **IN-HOUSE PROJECT**

Marine Algal Assay Procedure Bottle Test National Environmental Research Center, EPA Corvallis, OR

Describes protocol for a standardized primary producer nutrient bioassay for assessment of the effect of cultural eutrophication in estuarine and coastal marine areas. It is a companion procedure to the freshwater ALGAL ASSAY PROCEDURE: BOTTLE TEST, EPA, August, 1971. The green biflagellate unicellular alga *Dunaliella tertiolecta* Butcher (DUN clone) was selected as the bioassay organism because of its wide salinity tolerance, sensitivity to incremental additons and natural levels of critical or limiting nutrients, excellent replication and simple evaluation characteristics. Contains numerous references. EPA CONTACT: Maloney, T. E.

660/3-75-009 **PE 1BA021** **IN-HOUSE PROJECT**

Methods for Acute Toxicity Tests with Fish, Macroinvertebrates, and Amphibians National Water Quality Laboratory, EPA Duluth, MN

Four detailed methods for conducting acute toxicity tests with freshwater, estuarine, and marine fish, macroinvertebrates, and amphibians are presented in an integrated format. Nomenclature is consistent with that used in other branches of toxicology. Concepts incorporated into the methods are applicable to toxicity tests with most aquatic organisms. This report was prepared by the Committee on Methods for Toxicity Tests with Aquatic Organisms under the partial sponsorship of the U.S. Environmental Protection Agency. Work was completed as of December, 1974. EPA CONTACT: Stephan, C. E.

660/3-75-010 **PE 1BA021** **ROAP/TASK 16 AA1 10 IAG NO. IAG-152(D)**

Studies to Determine Methods for Culturing Three Freshwater Zooplankton Species BY D. B. Martin, and J. F. Novotny, U.S. Fish and Wildlife Service Yankton, SD

Studies to determine laboratory methods for culturing unispecific populations of *Bosmina longirostris, Chydorus sphaericus* and *Cyclops bicuspidatus thomasi* were carried out. These cultures are to provide a source of animals to be used as live food for fish and as bioassay test organisms. *B. longirostris* was not successfully cultured. High mortalities, apparently associated with the phenomenon of "air-locking", always occurred during handling in the laboratory. *C. sphaericus* was successfully maintained in relatively dense cultures (approximately 1,000 per liter) using a mixture of dried foods, less that 37 microns in size. One-fourth of the standing crop was harvested each week without apparently reducing the production in the culture. *C. bicuspidatus thomasi* could be grown using both dried food and live *Paramecium multimicronucleatum* as an energy source. However, the latter resulted in higher standing crops. Total standing crop as well as the proportion of each life stage in the population fluctuated greatly in the *C. bicuspidatus thomasi* cultures. Both *C. bicuspidatus thomasi* and *C. sphaericus* were grown at 15°C, at a light:dark cycle of 12:12 hours, and in a synthetic medium of known chemical composition. *C. sphaericus* was recommended as being best suited for live fish food and as a bioassy test animal. EPA CONTACT: Siefert, R. E.

660/3-75-011 **PE 1BA021** **ROAP/TASK 16 AAK 17 IAG NO. IAG-141 (D)**

Acquisition and Culture of Research Fish BY J. L. Brauhn, and R. A. Schoettger, U.S. Department of Interior Columbia, MO

Rainbow trout *(Salmo gairdneri)*, channel catfish *(Ictalurus punctatus)*, fathead minnows *(Pimephales promelas)*, and bluegills *(Lepomis macrochirus)* are cultured widely for toxicological research. However, vacillant or extreme cultural conditions are sometimes suspected of compromising the test animals and, thus, results of comparative or confirmatory research. Because exact optimum conditions for indoor maintenance and culture of the four species are not well defined, we have adopted standardized practices that are intended to reduce cultural conditions to a common variable status. Water quality, nutrition, genetic variation, diseases, fish handling, gross behavior, and required facilities are discussed. Well known propogation techniques provide the basis for the intensive care methods used. Special emphasis is given to diets, diet preparation, and residues of pesticides or other contaminants in diets and fish. EPA CONTACT: Mueller, L.

660/3-75-012 **PE 1BA023** **ROAP/TASK 03 ACQ 09** **IN-HOUSE PROJECT**

Modeling Dynamics of Biological and Chemical Components of Aquatic Ecosystems BY R. R. Lassiter, Southeast Environmental Research Laboratory, EPA Athens, GA

To provide capability to model aquatic ecosystems or their subsystems as needed for particular research goals, a modeling strategy was developed. Submodels of several processes common to aquatic ecosystems were developed or adapted from previously existing ones. Included are submodels for photosynthesis as a function of light and depth, biological growth rates as a function of temperature, dynamic chemical equilibrium, feeding and growth, and various types of losses to biological populations. These submodels may be used as modules in the construction of models of subsystems or ecosystems. A preliminary model for the nitrogen cycle subsystem was developed using the modeling strategy and applicable submodels.

NEW REPORT ABSTRACTS SECTION

660/3–75–013 PE 1BA025 ROAP/TASK 21 AIS 08 GRANT NO. 800365

Analysis of the Dynamics of DDT in Marine Sediments BY J. H. Phillips, E. E. Haderlie, and W. L. Lee, Stanford University Pacific Grove, CA

The concentrations of DDT, DDD and DDE were measured in sediments at 57 stations in Monterey Bay on the Central California coast during 1970–1971. Mean concentrations in parts per billion were DDT 3.1, DDD 2.3, and DDE 5.4. During 1973 nineteen of the original stations were sampled. Mean concentrations were DDT 15.5, DDD 2.3, and DDE 5.4 PPB. Laboratory assays were developed to determine the relative rate of decomposition in sediment under conditions selective for various physiologically different kinds of microorganisms. Decay under aerobic conditions was greater than under anaerobic conditions. Nitrate increased the rate of decomposition under anaerobic conditions. The Q10 for decay was 2.5. EPA CONTACT: Baumgartner, D. J.

660/3–75–014 PE 1BA032 ROAP/TASK 21 AJH 15 GRANT NO. 800435

Flow Establishment and Initial Entrainment of Heated Water Surface Jets BY H. Stefan, L. Bergstedt, and E. Mrosla, Minnesota, University of Minneapolis, MN

Mathematical modeling of the zone of flow (re-)establishment (ZFE) of heated water surface jets has been found to be difficult because of the complex dependence on outlet geometry, discharge velocity, buoyancy, and ambient currents. Laboratory experiments have therefore been conducted to provide more observations and data on flow patterns, temperatures, and flow velocities in the ZFE and some distance beyond. EPA CONTACT: Shirazi, M.

660/3–75–015 PE 1EA077 ROAP/TASK 10 AKC 40 GRANT NO. 802348

Effects of Mirex and Methoxychlor on Striped Mullet, Mugil cephalus L. BY C. E. Nash, and J. R. Sylvester, Oceanic Foundation Waimanalo, HI

The effects of two chlorinated insecticides, mirex and methoxychlor, on striped mullet, *Mugil cephalus* L., were studied. Test concentrations of both insecticides used were 0.01, 0.1, 1.0 and 10.0 ppm in dynamic bioassay. Young juveniles were more susceptible to mirex exposure than older juveniles or adults. No mortalities occurred in older juveniles and adults exposed to mirex for 96 hours. For young juveniles, mortalities were highest in concentrations of 0.1 and 1.0 ppm and were less in concentrations of 0.01 and 10.0 ppm. Significant amounts of mirex residues were accumulated in the body tissues of the test fish; concentrations increased with increased environmental concentrations. Methoxychlor was more toxic to mullet than mirex. Mortalities were greater than 90 percent over a 96-hour period for all life stages studied at concentrations of 0.1, 1.0 and 10.0 ppm. Mortality at a concentration of 0.01 was 5.1 percent or less for 96 hours. Relative to mirex, small amounts of methoxychlor residues accumulated in the tissues of the test fish. Results of the experiments on eggs and larvae were inconclusive. Egg survival was slightly better in mirex than in methoxychlor over a 96-hour period. Larval survival was generally better in mirex than methoxychlor. EPA CONTACT: Hansen, D. J.

660/4–75–001 PE 1BA027 ROAP/TASK 16 ADN 38 IN-HOUSE PROJECT

Determination of Molecular Hydrogen Sulfide BY T. B. Hoover, Southeast Environmental Research Laboratory, EPA Athens, GA

The gas sparging technique and a new gas-sensing electrode were evaluated for the determination of dissolved molecular hydrogen sulfide at environmentally significant concentrations in water. From the sparging experiments approximate coefficients were obtained for the distribution of hydrogen sulfide between nitrogen and distilled water, seawater, or municipal sewage effluent. In the latter medium the volatility of hydrogen sulfide was very much less than predicted from the pH-total sulfide relationship. The electrode, consisting of various semipermeable membranes, buffered electrolyte filling solution, silver-silver sulfide crystal sensor, and lanthanum fluoride internal reference electrode, gave a generally Nernstian response to more than 0.1 mg/1 of molecular hydrogen sulfide. At lower concentrations the response was typically several tenths of a volt per decade of concentration, but was not reproducible among different samples or electrodes. Various sources of the anamalous behavior were considered. The electrode is recommended for *in situ* measurements of molecular hydrogen sulfide at concentrations greater than 0.1 mg/1. More work is needed to make it useful at lower concentrations.

660/4–75–002 PE 1BA027 ROAP/TASK 16 ADN 64 GRANT NO. 802980–01

Aqueous Odor Thresholds of Organic Pollutants in Industrial Effluents BY D. A. Lillard, and J. J. Powers, Georgia, University of Athens, GA

This investigation was designed to determine the odor thresholds in water of organic pollutants that have been identified in industrial effluents. Seven to fourteen judges were used to determine the odor threshold values of 13 compounds at room temperature and 60°C. Extreme value calculations were made to predict a concentration below which a certain percentage of the population might still be able to detect the compound(s). The threshold values obtained at 60°C in most cases do not differ or are higher than those determined at room temperature. EPA CONTACT: Webb, R. G.

660/9–74–002 PE 1BB045 IN-HOUSE PROJECT

Great Lakes Water Quality — Status of Pertinent EPA Research BY A. F. Bartsch, C. Frank, and S. Peterson, National Environmental Research Center, EPA Corvallis, OR

Report summarized major segments of research activities that the U.S. Environmental Protection Agency has completed or now has under way that relate to nitrilotriacetate, viruses, disinfection of municipal wastewater and the effects of poly-chlorinated biphenyls on fish and fish products. Summary highlights research areas which may have impact on objectives of the International Joint Commission and recommended in its 1973 annual report and should not be considered inclusive of all activities presently funded by EPA in the above subject areas.

NEW REPORT ABSTRACTS SECTION

670/2-73-077 PE 1BB034 IN-HOUSE PROJECT

Combined Sewer Overflow Seminar Papers Edison Water Quality Laboratory, EPA Edison, NJ

The U.S. Environmental Protection Agency in conjunction with the New York State Department of Environmental Conservation conducted three one-day siminars on the problem of wet-weather flow pollution abatement. Many facets of the problem were considered including a brief overview of its magnitude and what the federal government is doing to manage and control this source of pollution. Various management, control, and treatment techniques were described and the most up-to-date information on design and economics was presented. The audience consisted of consulting and municipal engineers from all areas of New York State. This publication is a compilation of the papers presented at the siminar.

670/2-74-003 PE 1BB040 ROAP/TASK 21 AGC 004 CONTRACT NO. 68-03-0268

Mine Drainage Pollution Control Demonstration Grant Procedures and Requirement BY F. J. Zaval, and R. Burns, Cyrus Wm. Rice Division, NUS Corporation Pittsburgh, PA

This report is a presentation of procedures and requirements for use by all individuals considering or participating in Section 107 grant demonstration projects authorized by Federal Water Pollution Control Act Amendments of 1972. It provides an interpretation of Section 107, defines the procedures and requirements for grant applicants, and discusses all phases of demonstration projects, including monitoring requirements and reports. EPA CONTACT: Harris, E. F. 513-684-4417

670/2-74-035A PE 1DB314 ROAP/TASK 02 AAE 004 GRANT NO. 801289

First Annual Report: Routing of Solid Waste Collection Vehicles and Appendix A - A Linear Programming Approach for the Traveling Salesman Problem BY M. Wathne, Illinois, University of Urbana, IL

The first report provides the background for routing solid waste collection vehicles. Problems encountered with existing methods and possible solutions are given. Appendixes A and B are solutions to two classic routing problems. Appendix A takes the integer programming formulation of Dantzig, Fulkerson, and Johnson which is relaxed to a linear program and a column generation scheme found for its dual. A matching constraint is then added to eliminate some of the fractional solutions which contain an odd cycle of noninteger edges. Finally, a branch-and-bound scheme is employed to search for an optimal all-integer solution. Appendix B (separately bound) is a study applying network theory to the problem of routing a solid waste collection vehicle through a street network. The total length of the tour is sought rather than the detailed and chronologic schedule of the vehicle. This tour is found by minimizing the total length of street segments which have to be retraced. The problem can be described mathematically as a linear program whose optimal solution is guaranteed to be integer. Due to the size of the problem, linear program algorithms cannot be used.

670/2-74-035B PE 1DB314 ROAP/TASK 02 AAE 004 GRANT NO. 801289

First Annual Report: Routing of Solid Waste Collection Vehicles and Appendix B - Optimal Routing of Solid Waste Collection Vehicles BY S. Hong, Illinois, University of Urbana, IL

The first report provides the background for routing solid waste collection vehicles. Problems encountered with existing methods and possible solutions are given. Appendixes A and B are solutions to two classic routing problems. Appendix A takes the integer programming formulation of Dantzig, Fulkerson, and Johnson which is relaxed to a linear program and a column generation scheme found for its dual. A matching constraint is then added to eliminate some of the fractional solutions which contain an odd cycle of noninteger edges. Finally, a branch-and-bound scheme is employed to search for an optimal allinteger solution. Appendix B is a study applying network theory to the problem of routing a solid waste collection vehicle through a street network. The total length of the tour is sought rather than the detailed and chronologic schedule of the vehicle. This tour is found by minimizing the total length of street segments which have to be retraced. The problem can be described mathematically as a linear program whose optimal solution is guaranteed to be integer. Due to the size of the problem, linear program algorithms cannot be used.

670/2-74-036A PE 1DB314 ROAP/TASK 02 AAE 004 GRANT NO. 801289

Routing of Solid Waste Collection Vehicles, Final Report: Appendix A - Manual for Use of the Computer Codes BY J. C. Liebman, Illinois, University of Urbana, IL

This report describes research on computer-based and manual techniques for the routing of solid waste collection vehicles. Algorithms are given for the routing of single vehicles under three conditions: (1) all streets are two way, (2) all streets are one way, and (3) some streets are two way and others are one way. In addition, a heuristic algorithm is provided for routing several vehicles in a larger area. Appendix A is a manual for use of the computer codes. Appendix B (separately bound) is a heuristic solution to the m-postmen's solution.

670/2-74-036B PE 1DB314 ROAP/TASK 02 AAE 004 GRANT NO. 801289

Routing of Solid Waste Collection Vehicles: Appendix B - A Heuristic Solution to the M-Postmen's Problem BY J. W. Mole, Illinois, University of Urbana, IL

This report describes research on computer-based and manual techniques for the routing of solid waste collection vehicles. Algorithms are given for the routing of single vehicles under three conditions: (1) all streets are two way, (2) all streets are one way, and (3) some streets are two way and others are one way. In addition, a heuristic algorithm is provided for routing several vehicles in a larger area. Appendix A is a manual for use of the computer codes. Appendix B is a heuristic solution to the m-postmen's solution.

NEW REPORT ABSTRACTS SECTION

670/2-74-076a PE 1DB064 ROAP/TASK 24 ALA 002 GRANT NO. 801282

Experimental High Ash Papermill Sludge Landfill – First Annual Report BY O. B. Andersland, R. P. Vallee, and T. A. Armstrong, Michigan State University East Lansing, MI

An experimental papermill sludge landfill was constructed and monitored to obtain engineering information essential to the development of guidelines and recommendations for the design and operation of solid papermill waste landfills. The experimental landfill consisted of two sludge layers, with sand drainage blankets, an earth dike for lateral confinement and a natural soil cover. The landfill was instrumented for settlement, water pressure, vertical and lateral earth pressure, temperature, sludge unit weights, specific gravity, and water contents. Laboratory work was also conducted. A detailed description of the field behavior is given in the report along with predictions based on laboratory results and soil mechanics theory. Sampling of leachate from the sludge landfill at weekly intervals and laboratory analysis according to standard methods for the examination of water and wastewater provided documentation as to leachate composition. A lysimeter study provides information of changes in quality of the leachate when passed through selected natural soils. EPA CONTACT: Schomaker, N. B. 513-684-4487

670/2-74-076b PE 1DB064 ROAP/TASK 24 ALA 002 GRANT NO. 801282

Experimental High Ash Papermill Sludge Landfill – Second Annual Report BY O. B. Andersland, R. P. Vallee, W. A. Charlie, and D. W. Marshall, Michigan State University East Lansing, MI

The second annual report investigated slope stability by removal of one dike from the sludge landfill. The landfill was excavated to form a 3:4 slope and trimmed to 1:8 slope. Prior to construction, vane shear strength and Dutch cone resistance data were obtained. Slope indicator and piezometers were installed. Laboratory studies and analysis were also conducted. Leachate sampling and analysis documented changes occurring during the project period. EPA CONTACT: Schomaker, N. B. 513-684-4487

670/2-74-079 PE 1BB034 ROAP/TASK 21 ASY 032 GRANT NO. 11020 FAM

Evaluation of Three Combined Sewage Overflow Treatment Alternatives BY J. W. Parks, Shelbyville, City of Shelbyville, IL

An evaluation of the performance of three different combined sewer overflow treatment units is presented, with influent and effluent flow, BOD, and suspended solids data for a single-cell flow-through lagoon; a retention lagoon followed by a two-cell facultative lagoon system and effluent chlorination; and a sedimentation tank with influent chlorination. The extent of preconstruction pollution from combined sewer overflow is discussed as well as the success of partial sewer separation in reducing the strength of combined sewer overflow. The performance of the two-cell facultative lagoon as a tertiary treatment system for the existing sewage treatment plant effluent is also analyzed in detail, demonstrating a dual use for this type of combined sewer overflow treatment unit. Each of the three treatment alternatives were found to provide substantial reduction in combined sewer overflow pollution, with the lagoon units giving the greater removal efficiencies. Specific recommendations for additional study and evaluation are offered. EPA CONTACT: Cesares, D. 201-548-3546

670/2-74-083 PE 1DB063 ROAP/TASK 02 AAE 006 GRANT NO. 800055

Analysis of the Current Impact of Plastic Refuse Disposal Upon the Environment BY D. A. Braughan, M. Y. Anastas, and H. H. Krause, Battelle Columbus Laboratories Columbus, OH

In view of the 7-fold growth in the amount of plastic waste over the past 20 years the impact of plastic refuse disposal upon the environment has been evaluated on the basis of the major current methods of disposal, municipal incineration, landfill and litter. While weight percentage of the plastic component may tend to be used to evaluate its contribution to the environmental impact via incineration the volume percentage of plastics is more important with respect to its contribution to landfill, both sanitary and open dump with and without burning. A useful life analysis of plastic products is described which quantifies the amounts of plastic waste by type. EPA CONTACT: Oberacker, D. A. 513-684-4493

670/2-74-084 PE 1DB063 ROAP/TASK 24 ALL 019 GRANT NO. 800055

Study of Corrosion in Municipal Incinerators Versus Refuse Composition BY D. A. Braughan, H. H. Krause, and W. W. Boyd, Battelle Columbus Laboratories Columbus, OH

Fireside corrosion resulting from the combustion products of municipal and industrial refuse is a severe problem to solid waste disposal by incineration in water-wall furnaces, and/or where heatrecovery systems are employed. Furthermore with advances in recycling and resource recovery the composition of the burnable portion of the refuse will be altered. Hence, a study was made of the effects of refuse composition on fireside corrosion of nine alloys and two protective coating materials to develop a better understanding of corrosion in solid waste incinerators. The refuse compositional variables investigated were chlorine, which was introduced through the addition of polyvinyl chloride (PVC), and sulfur, which was added in the elemental state. Air-cooled probes exposed to the resulting combustion environments were analyzed for corrosion rates and for deposit composition. Also, the combustion gases were monitored. EPA CONTACT: Oberacker, D. A. 513-684-4493

670/2-74-087 PE 1BB034 ROAP/TASK 21 ASY 038 CONTRACT NO. 68-03-0262

Assessment and Development Plan for Monitoring of Organics in Storm Flows BY A. E. Molvar, and A. Tulumello, Raytheon Company Protsmouth, RI

Sewer line scouring, urban runoff, and combined sewage associated with storm events represent a substantial organic pollution load. Since storms usually exhibit high flow rates over a short period of time, the treatment facilities become overloaded and deliver an organic pollution load to receiving water bodies. Many times a significant amount of the combined sewage bypasses the treatment plant and is discharged untreated. A method for assessing the organic content of storm related wastewaters would permit programming discharges, and monitoring and controlling treatment processes. Experience with currently available commercial TOC units has not resulted in a sense of confidence in the hardware. Tests are presently underway to establish sample processing, modifications of the engineering model, and accumulation of the continuous monitoring data on total organic carbon content of storm and combined sewage. EPA CONTACT: Masters, H. E. 201-548-3541

NEW REPORT ABSTRACTS SECTION

670/2-74-090 PE 1BB034 ROAP/TASK 21 ASY 001 IN-HOUSE PROJECT

Countermeasures for Pollution From Overflow – The State of the Art BY R. Field, and J. A. Lager, National Environmental Research Center, EPA Cincinnati, OH

Control and/or treatment of stormwater discharges and combined sewage over-flows from urban areas are problems of increasing importance in the field of water quality management. Over the past decade much research effort has been expended and a large amount of data has been generated. Presented in this text are selected results of a comprehensive investigation and assessment of promising, completed and ongoing projects, representative of the state-of-the-art in abatement theory and technology; a look at recent legislation; and the identification of program needs and emphasis. Full text published by EPA September 1974 under title "State of the Art – Urban Stormwater Management and Technology: An Assessment" EPA-670/2-74-040. EPA CONTACT: Lederman, P. 201-548-3503

670/2-74-091 PE 1BB038 ROAP/TASK 21 APK 018 CONTRACT NO. 68-01-0115

Devices for On – Board Treatment of Waste from Vessels BY T. J. O'Grady, and T. D. Lakomski, Thiokol Corporation Brigham City, UT

A program involving the demonstration of a pleasure craft zero discharge, physical/chemical waste treatment system employing a unique filter-incinerator device was conducted. Extensive test data from laboratory and shipboard demonstration tests of the system are presented. Data on manufacture and installation costs for the pleasure craft are also presented. The program demonstrated the ability to zero discharge waste and comply with the 23 June 1972 EPA no-discharge standard. This report was submitted in fulfillment of Contract 68-01-0115, under the sponsorship of the Environmental Protection Agency. EPA CONTACT: Mc Carthy Jr., L. T. 201-548-3549

670/2-74-092 PE 1BB038 ROAP/TASK 21 APO 008 CONTRACT NO. EHS 70-108

Crankcase Drainage from In-Service Out-board Motors BY C. P. Hare, and C. J. Pringer, Southwest Research Institute San Antonio, TX

Crankcase drainage from 35 outboard motors was measured during normal operation on two lakes in the San Antonio area. The motors included a variety of sizes and brand names, and they were tested under prolonged constant-speed conditions as well as cyclic speed conditions designed to simulate user operation in the field. Four engines of the same group were also tested with a drainage intercepting and recirculating device. Drainage was measured by both mass and volume, and results were also computed in mass per unit time (g/hr) and percentage of fuel consumed by weight and by volume. Analysis of some fuel samples was conducted by gas chromatograph, including a few in which drainage was mixed with fuel by the recirculating device mentioned above. Photographic documentation of the test engines, the drainage systems, and test/measurement techniques was also obtained. Based on measurements obtained during this study and estimations on the current outboard motor population, a range for the national total crankcase drainage emissions was estimated. It was also found that the major causes of variation in drainage rates were engine type, engine operating speed, and differences from one engine to another of the same type (or a similar type). EPA CONTACT: Padden, T. J. 202-426-4188

670/2-74-095a PE 1DB314 ROAP/TASK 09 ABF 003 CONTRACT NO. 68-03-0244

Effects of Water Pollution Controls on Solid Waste Generation, 1971 to 1985: Executive Summary BY R. Stone, Ralph Stone and Company, Inc. Los Angeles, CA

The effects of air and water pollution controls on solid waste generation were evaluated. The solid wastes from pollution control were identified for individual industrial sectors by their original air or water pollutant constituents, and the treatment process applied. The wastes were categorized by type and by location (rural or urban). Total solid wastes from pollution control activities were estimated for 1971 and projected for 1985. Particulates and sulfur oxides were identified as the major air pollutants capable of generating solid wastes when treated; suspended solids and biological oxygen demand were identified as the principle means of estimating the impact of water pollution control on solid wastes. EPA CONTACT: Talley, R. J. 513-684-4484

670/2-74-095b PE 1DB314 ROAP/TASK 09 ABF 003 CONTRACT NO. 68-03-0244

Forecast of the Effects of Air and Water Controls of Solid Waste Generation BY R. Stone, and D. Brows, Ralph Stone and Company, Inc. Los Angeles, CA

The effects of air and water pollution controls on solid waste generation were evaluated. The solid wastes from pollution control were identified for individual industrial sectors by their original air or water pollutant constituents, and the treatment process applied. The wastes were categorized by type and by location (rural or urban). Total solid wastes from pollution control activities were estimated for 1971 and projected for 1975, 1980, and 1985. Particulates and sulfur oxides were identified as the major air pollutants capable of generating solid wastes when treated; suspended solids and biological oxygen demand were identified as the principle sources for the impact of water pollution control on solid wastes. EPA CONTACT: Talley, R. J. 513-684-4484

670/2-74-096 PE 1BB034 ROAP/TASK 21 ATB 014 GRANT NO. 11030 HJP

Characterization and Treatment of Urban Land Runoff BY N. V. Colston, North Carolina, University of Raleigh, NC

Urban land runoff from a 1.67 square-mile urban watershed in Durham, North Carolina, was characterized with respect to annual pollutant yield. Regression equations were developed to relate pollutant strength to hydrograph characteristics. Urban land runoff was found to be a significant source of pollution when compared to the raw municipal waste generated within the study area. On an annual basis, the urban runoff yield of COD was equal to 91 percent of the raw sewage yield, the BOD yield was equal to 67 percent, and the urban runoff suspended solids yield was 20 times that contained in raw municipal wastes for the same area. Downstream water quality was judged to be controlled by urban land runoff 20 percent of the time. In urban drainage basins, investments in upgrading secondary municipal waste treatment plants without concomitant steps to moderate the adverse effects of urban land runoff are questionable in view of the apparent relative impact of urban land runoff on receiving water quality. EPA CONTACT: Tafuri, A. N. 201-548-3512

NEW REPORT ABSTRACTS SECTION

670/2-75-001 PE 1BB043 ROAP/TASK 21 ASR 45 IN-HOUSE PROJECT

Alternative Systems for Supplying Dissolved Oxygen in Wastewater Treatment BY R. Smith, and W. F. McMichael, Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH

Various alternative systems for supplying oxygen to wastewater treatment processes were studied and evaluated in terms of cost and effectiveness. Systems which deliver atmospheric air to the process such as diffused aeration, mechanical aeration, and turbine aeration are compared to systems which deliver pure oxygen gas. The relationship between oxygen consumption and excess sludge production in the activated sludge process is quantified. Factors such as the diurnal variation in oxygen demand and the oxygen demand as a function of distance along the aerator in the activated sludge process are studied. Finally, the total cost for oxygen supply expressed as cents per pound of oxygen dissolved in the wastewater is estimated as a function of total oxygen consumption expressed as tons of oxygen used per day. The least costly system was found to be mechanical aeration. The pure oxygen system was found to cost roughly the same as a diffused air system with an aeration efficiency of 5.4%. EPA CONTACT: Smith, R. 513-684-8352

670/2-75-002 PE 1BB034 ROAP/TASK 21 ASY 37 CONTRACT NO. 14-12-0494

Suspended Solids Monitor BY J. W. Liskowitz, G. J. Francey, and J. Tarzynski, American Standards, Inc. New Brunswick, NJ

A method for measuring concentration of suspended solids in liquid media, based on depolarization of backscattered polarized light, has been developed and instrumented. Feasibility studies and field evaluation of the instrument, using sewage influent, effluent and sludge, showed that there is a specific relationship between concentration of solid particles and polarization ratio. It was also shown that the relationship is independent of size distribution and density of particles, color of particles or solution, sludge consistency, velocity, and build-up of solids on the optical window. The field evaluation results indicate that this insturument provides a continuous instantaneous *in situ* measurement of suspended solids concentrations in combined sewers and other wastewater flows. This report was submitted in fulfillment of Project No. 11024DZB, Contract No. 14-12-494 by American Standard Inc. under the sponsorship of the U.S. Environmental Protection Agency. Work was completed in August, 1970. EPA CONTACT: Field, R. 201-548-3503

670/2-75-003 PE 1BB041 ROAP/TASK 21 BEA 08 GRANT NO. 803063-01

Oil Spill and Oil Pollution Reports BY Jr., F. A DeWitt, and P. Melvin, California, University of Santa Barbara, CA

The July 1974 – October 1974 Oil Spill and Oil Pollution Reports is the first quarterly compilation of oil spill events and oil pollution report summaries. Presented in the report are: (a) summaries of oil spill events; (b) summaries and bibliographic literature citations; (c) summaries of current research projects; and (d) patent summaries. This report is submitted in partial fulfillment of EPA Grant No. R-803063 by the Marine Science Institute, University of California, Santa Barbara, under the sponsorship of the Environmental Protection Agency. EPA CONTACT: Dorrler, J. S. 201-548-3508

670/2-75-004 PE 1BB041 ROAP/TASK 21 AVN 22 CONTRACT NO. 68-03-0228

Feasibility of 5 gpm Dynactor/Flash Magnetic Separator System to Treat Spilled Hazardous Materials BY R. G. Sanders, S. R. Rich, and T. G. Pantazelos, Industrial Bio-Test Laboratories, Inc. Northbrook, IL

Design and operating details are given for a new type of continuous flow thin-film, gas-liquid-particulate contact device called the Dynactor. The device is used as a continuous flow short-time contact reactor to effectively decontaminate water contaminated with spilled hazardous materials. The decontamination is effectively achieved by one or more processes involving oxidation, neutralization, precipitation or adsorption on powdered carbon. Contaminated water is processed by the pilot plant model Dynactor at 100 psi and at a rate of 5 gpm; stoichiometric quantities of decontaminating agents in the form of gases, liquids, slurries or powders are metered into the continuously flowing liquid configuration. The device is portable, lightweight polypropylene construction, has no moving parts, requires a pump for liquid motive power and can be scaled up to 250 gpm of contaminated water. Design and operating details are given for continuous flow magnetic separation to remove flocculated carbon and precipitates from the Dynactor effluent after decontamination of hazardous materials. Experimental data on successful decontamination of heavy metals by precipitation, acids and bases by neutralization, phenol, chlorine and pesticides by powdered carbon adsorption and other selected hazardous compounds are presented. EPA CONTACT: Wilder, I. 201-548-3507

670/2-75-005 PE 1DB311 ROAP/TASK 07 ADZ 10 IN-HOUSE PROJECT

Degradation Mechanism: Controlling the Bioaccumulation of Hazardous Materials BY C. Rogers, and R. Landreth, Solid and Hazardous Waste Research Laboratory, EPA Cincinnati, OH

Numerous toxic and hazardous compounds are being generated for commercial, industrial and agricultural uses. Most of these materials are eventually released into the environment. This study documented the existance of biological, chemical and physical transformation processes of hazardous wastes in the environment. It was determined that the rates of transformation of these hazardous materials, when applied and/or discharged to the environment, are slow. Case studies confirmed that persistency of certain hazardous materials results in the bioaccumulation of residues in living systems. A lack of knowledge of the fate and clinical manifestation of persistant residues in living systems dictates the need for implementation of the described scheme of control technology. EPA CONTACT: Rogers, C. 513-684-4484

670/2-75-007 PE 1BB038 ROAP/TASK 21 BBU 03 CONTRACT NO. 68-03-0221

On-Shore Treatment Systems for Sewerage from Watercraft Retention Systems BY A. J. Glueckert, and P. A. Saigh, General American Transportation Corporation Niles, IL

During this program an evaporative waste treatment system for onshore treatment of sewage from watercraft retention systems was developed and demonstrated. Wastes and chemical additives associated with recreational watercraft holding tanks were characterized by analyses of sewage samples obtained from marina and watercraft retention tanks utilizing both freshwater and seawater flushed sanitary systems and by a survey of typical chemical additives employed as bacteriostatic and odor reducing agents. An evaporative waste treatment system was evaluated by testing a propane-fired evaporator for 224 hours with inhouse sewer wastes and wastes collected from

marina holding tanks. The evaporative system treated 4,590 liters (1,212 gal.) of sewage and concentrated the total solids of the sludge from the initial 0.5% to 13.4% before servicing and removal of the concentrated sludge was required. Because the chemical additives of holding tanks caused foaming, the evaporator had to be operated at approximately 50% of its capacity; however, additives had no other deleterious effects on the evaporative system. The concentrated sludge produced in the evaporator was incinerated in a batch-type incinerator. Although the incineration of the sludge was feasible, the available incinerator was too small to handle all the sludge which could be produced by the continuously operating evaporator. EPA CONTACT: Cesarea, D. J. 201–548–3546

670/2–75–008 PE 1BB043 ROAP/TASK 21 ASR 15 IN-HOUSE PROJECT

System Alternatives in Oxygen Activated Sludge BY D. F. Bishop, S. M. Bennet, and A. B. Hais, Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH

An oxygen activated sludge system with co-current contacting of oxygen and mixed liquor in a plug flow reactor was operated on District of Columbia primary effluent during a two-year period over a wide range of loading (F/M 0.26 to 2.0) with Solids Retention Times (SRT) from 2.0 to 13.0 days at the EPA-DC Pilot Plant. EPA CONTACT: Bishop, D. F. 513–684–8353

670/2–75–009 PE 1BB033 ROAP/TASK 21 ASW 00 CONTRACT NO. 14–12–0831

Water Renovation of Municipal Effluents by Reverse Osmosis BY J. E. Cruver, J. E. Beckman, and E. Bevege, Gulf Environmental Systems Company San Diego, CA

The purpose of the work performed under this contract has been to obtain reverse osmosis operating data on primary and secondary effluents with varying degrees of pretreatment. Field tests were conducted at the Pomona Water Renovation Plant of the County Sanitation Districts of Los Angeles. Two parallel reverse osmosis systems were operated with spiral wound membrane modules. It was concluded that spiral wound reverse osmosis units can be economically operated on primary and activated-sludge effluents with only moderate pretreatment and periodic chemical cleaning. Activated-carbon pretreatment was shown to be unnecessary for successful operation on sand-filtered activated sludge or chemically clarified and sand-filtered primary effluent. A simplified economic analysis indicated that reverse osmosis treatment costs are favorable and that the process merits serious consideration in a planned water supply and waste management program. EPA CONTACT: Bostian, H. 513–684–8358

670/2–75–012 PE 1BB043 ROAP/TASK 21 ASD 16 CONTRACT NO. 68–03–0203

Lime Stabilized Sludge: Its Stability and Effect on Agricultural Land BY C. A. Counts, and A. J. Shuckrow, Battelle Memorial Institute Richland, WA

An optimum system for the lime stabilization of municipal sewage sludge was first developed and then evaluated. The primary objectives of this work were: (1) to determine the degree of stability induced in a sludge by lime addition and (2) to determine the effects of spreading lime-stabilized sludge on agricultural land. Lime doses and contact times required to eliminate the pathogenic bacteria and odors from a raw sludge were determined by laboratory studies, and the information obtained was translated into design and operational parameters for a pilot scale, continuous flow process. Physical, chemical and biological characteristics of both the raw and stabilized sludges were measured. Soil and crop studies, both in a greenhouse and on controlled outdoor plots, were performed to determine the effects of spreading lime-stabilized sludge. Effective lime stabilization of sludge was accomplished by elevating the pH to 12.0 with lime addition and maintaining this pH level for at least 30 minutes. EPA CONTACT: Smith, Jr., J. E. 513–684–8267

670/2–75–013 PE 1BB043 ROAP/TASK 21 ASD 27 IN-HOUSE PROJECT

Interim Report of Task Force on Phosphate Removal Sludges BY J. B. Farrell, Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH

Information on dewatering properties of municipal wastewater sludges is scant and poorly organized. A Task Force has collected information on wastewater sludges with particular emphasis on sludge produced when lime, Fe^{+++}, or AL^{+++} are added for the purpose of P removal to some portion of the wastewater treatment sequence. Data are presented on the thickening and dewatering characteristics of the sludges. Most of the information relates to the mass of sludge produced and its filtering properties. Sludges produced when lime is added to wastewater have greater solids content after settling and dewater at greater mass rates than conventional sludges. However, mass of sludge per volume of wastewater is greatly increased. Considerable information is available on such sludges. Sludges produced when AL^{+++} or Fe^{+++} is added to wastewater dewater more poorly than conventional sludges and sludge solids content is less. Sludge mass is greater than in conventional treatment but not as great as would be produced by lime addition. Information is clearly not yet adequate for accurately predicting dewatering properties of such sludges. Research studies and field investigations of the dewatering properties of the sludges produced by adding AL^{+++} and Fe^{+++} to wastewater are being continued. EPA CONTACT: Farrell, J. B. 513–684–8265

670/2–75–017 PE 1BB034 ROAP/TASK 21 ATA 22 GRANT NO. 802411

Storm Water Management Model: User's Manual – Version II BY W. C. Huber, J. P. Heaney, M. A. Medina, W. A. Peltz, H. Sheikh, and G. F. Smith, Florida, University of Gainesville, FL

A comprehensive mathematical model (the EPA Storm Water Management Model, SWMM) capable of representing urban stormwater runoff and combined sewer overflow phenomena was developed. SWMM portrays correctional devices in the form of user-selected options for storage and/or treatment with associated estimates of cost. Effectiveness is portrayed by computed treatment efficiencies and modeled changes in receiving water quality. The original project report published in 1971 is divided into four volumes: Volume I, "Final Report"; Volume II, "Verification and Testing"; Volume III, "User's Manual"; and Volume IV, "Program Listing" (EPA Report Nos. 11024DOC07/71, 1102DOC08/71, 11024DOC09/71, and 11024DOC10/71, respectively.) Effort on modification and improvement of the SWMM has been, and is being continued since its release. As a result, this official "Release 2" of the SWMM includes additional program components, i.e., new runoff routine, urban erosion prediction, new treatment process performance and cost functions, and new receiving water quality. This report provides a revised and improved User's Manual to accompany "Release 2" as in the original User's Manual, Volume III. EPA CONTACT: Fan, C. Y. 201–548–3419

NEW REPORT ABSTRACTS SECTION

670/2-75-024 PE 1DB064 ROAP/TASK 24 ALH 06 CONTRACT NO. 68-03-0123

Industrial Solid Waste Classification Systems BY J. B. Berkowitz, F. March, and R. Horne, Arthur D. Little, Inc. Cambridge, MA

A Classification system for industrial processing wastes was developed based on waste stream characteristics, materials components, and chemical composition. An associated inventory form was devised for systematic reporting of a variety of waste descriptors including physical form, composition, methods of handling, treatment and disposal, and potential for reuse. The system was developed by literature review, consultations, and site visits. It is intended for application to industrial waste surveys and to the preparation of statiscal summaries of parameters pertinent to solid waste management. The system is adaptable to computer storage and retrieval of information related to reuse potential and disposability of industrial wastes. It is designed to cover all industries of the SIC codes, and has been tested on a broad representation of processing waste streams in a large number of industries. EPA CONTACT: Carnes, R. A. 513-684-4487

670/2-75-025 PE 1DB063 ROAP/TASK 24 ALL 03 IN-HOUSE PROJECT

High-Temperature Vortex Incinerator BY R. C. Thurnau, and D. A. Oberacker, Solid and Hazardous Waste Research Laboratory, EPA Cincinnati, OH

This study was designed to help fill the gap between antiquated incinerators and the solid waste problem. Work was initiated on a new type of incinerator—a high-temperature vortex incinerator. The project was sponsored by the U.S. Environmental Protection Agency, National Environmental Research Center-Cincinnati, Solid and Hazardous Waste Research Laboratory. Specifically, the incinerator was designed and built at the Center Hill Pilot Plant of SHWRL and used only untreated municipal waste as its fuel. EPA CONTACT: Thurnau, R. C. 513-684-8414

670/2-75-026a PE 1DB314 ROAP/TASK 02 AAE 03 GRANT NO. 801633

Analysis Models for Solid Waste Collection *BY J. F. Hudson, D. S. Grossman, and D. H. Marks, Massachusetts Institute of Technology Cambridge, MA*

Analytic models are developed as aids in decision-making at many points in the solid waste collection and haul system. Models for daily operating policy include breakdown or excess load, maintenance and stochastic influences such as weather. Longer range issues include choosing a level of service and the implications upon equipment, crew size, and work rules of such a decision. The primary thrust of the report develops an econometric model for prediction of waste output from census data and then districts into daily collection areas. A computer based districting methodology is outlined; an easily applicable heuristic for routing trucks within the districts was also developed. Actual data from Brookline, Massachusetts, serves in a sample application of the proposed models. Finally, on the regional level, a Linear Programming Model for equitable and efficient system design has been realized. All models are designed as management tools for public collection from residences and include discussion of appropriate extensions to commercial and industrial collection and haul. EPA CONTACT: Oberacker, D. A. 513-684-4484

670/2-75-026b PE 1DB314 ROAP/TASK 02 AAE 03 GRANT NO. 801633

Analysis Models for Solid Waste Collection BY J. F. Hudson, D. S. Grossman, and D. H. Marks, Massachusetts Institute of Technology Cambridge, MA

Analytic models are developed as aids in decision-making at many points in the solid waste collection and haul system. Models for daily operating policy include breakdown or excess load, maintenance and stochastic influences such as weather. Longer range issues include choosing a level of service and implicatons upon equipment, crew size, and work rules of such a decision. The primary thrust of the report develops an econometric model for prediction of waste output from census data and then districts into daily collection areas. A computer based districting methodology is outlined; an easily applicable heuristic for routing trucks within the districts was also developed. Actual data from Brookline, Massachusetts, serves in a sample application of the proposed models. Finally, on the regional level, a linear programming model for equitable and efficient system design has been realized. This second volume contains documentaion of the computer programs used and developed in the course of the work as well as the appendices to the main volume. EPA CONTACT: Oberacker, D.A. 513-684-4484

670/2-75-027 PE 1BB043 ROAP/TASK 21 AST 05 GRANT NO. WPRD 4-01-67

Reverse Osmosis of Treated and Untreated Secondary Sewage Effluent; Appendix A-2 and Appendix A-6 BY D. F. Boen, and G. L. Johannsen, Eastern Municipal Water District Hemet, CA

The two appendices in this volume complete report "Reverse Osmosis of Treated and Untreated Secondary Sewage Effluent", EPA 670/2-74-077; the following abstract is that for the main volume. A pilot study was conducted to determine reverse osmosis feasibility on untreated and treated secondary effluents. Six commercially designed reverse osmosis pilot units, with 3,000 to 10,000 GPD nominal capacities and different module concepts, were tested. Post treatment of secondary effluent feeds, using alum clarification, sand filtration, granular activated carbon treatment, chlorine additions and pH adjustment, in different combinations improves reverse osmosis performance and significantly extends useful membrane life. Membrane fouling occurs despite post secondary effluent treatments. Enzymatic detergent solutions were moderately effective as membrane rejuvenation treatments. Inorganic fouling (particularly with phosphates) could be removed with solutions of the sodium salt of ethylenediaminetetraacetic acid. Of the module concepts tested, one of the tabular makes and the spiral wound had the best overall costs, excluding brine disposal, is estimated to be $0.73/1,000 gallons for 9 MGD product water facility. EPA CONTACT: Stern, G. 513-684-8276

670/2-75-029 PE 1BB036 ROAP/TASK 21 AZD 23 GRANT NO. 803226-01

Copper Recovery from Brass Mill Discharge by Cementation with Scrap Iron BY P. O. Case, Anaconda Company Waterbury, CT

This report presents the results of studies of copper recovery (and incidental reduction of hexavalent chromium) in brass mill discharge by passage of the discharge over scrap iron in a rotating drum. The drum feed consisted of normal production discharge of combined pickle rinse water and spent sulfuric acid and sulfuric acid-bichromate pickle. About half of the total mill waste discharge over a period of 16 weeks was processed. Four modes of drum operation were studied: (1) continuous rotation, (2) no rotation, (3) intermittent rotation (1 hr off – 5 min on), and (4) intermittent rotation (2-1/2 hr off – 10 min on). Each mode was studied at two flow levels and two scrap iron surface area levels. Data were evaluated in terms of percent cementation of available copper, excess iron consumption over theoretical, and completeness of chromium reduction. Results indicate that the over-riding factor in the efficiency of copper cementation is the level of copper in the feed solution. Hexavalent chromium is effectively reduced providing the pH is below 2.5. EPA CONTACT: Tabakin, R. B. 201-548-3414

NEW REPORT ABSTRACTS SECTION

670/2-75-030 PE 1DB064 ROAP/TASK 02 AAE 05 GRANT NO. 800938

Urban Street Cleaning BY A. H. Levis, Polytechnic Institute of Brooklyn Brooklyn, NY

This report presents the results of the analysis of mechanized street cleaning in urban areas. It includes the description of a data bank that contains detailed information on a blockside basis for a 300 block area. On the basis of these data the strong interrelationship between sweeper routes and no-parking regulations is estabilshed. It is then shown that the effectiveness of street cleaning by mechanical brooms is limited by the presence of illegally parked cars along curbs. Analytical models that assess the degradation of performance are developed for both metered and non-metered zones, and for any distribution of illegally parked cars. A model that relates enforcement to expected level of compliance is developed and validated with actual data. The effects of deterministic and random enforcement policies are analyzed, and a class of implementable policies that yields satisfactory results is presented. Optimal feedback policies that tend to minimize the cost of manpower while maximizing the level of compliance are derived. These results are used to determine routes and schedules that increase the effectiveness of enforcement officers. A litter generation model based on the System Dynamics methodology is developed and used to evaluate different operation conditions for commercial and residential areas. EPA CONTACT: Oberacker, D. A. 513-684-4484

670/2-75-031 PE 1DB314 ROAP/TASK 24 AIN 26 GRANT NO. 800688

Solid Waste Conversion: Cellulose Liquefaction BY J. A. Kaufman, and A. H. Weiss, Worcester Polytechnic Institute Worcester, MA

An extensive survey of the state-of-the-art in cellulose liquefaction and its chemistry, and the process concept is detailed and related to pyrolysis. Material with a heating value close to that of wood was used to make oxygen, nitrogen, and sulfur free oil having a heating value in the vicinity of 10,000 cal/gm. Cellulose liquefaction process is a continuous hydro cracking process, based on technology which is readily available from the petroleum industry, although not previously applied to solid waste. The process envisioned uses a carrier oil in which the solid waste feed is slurred. The advantage of using an oil carrier is that a liquid reaction medium is present which does not present a critical tempperature problem and the attenuant requirement of high operating pressures. Water plays an intrinsic part in the reaction for the in-site production of hydrogen. Equilibrium calculations indicate that hydrogen is the preferable reactant gas. The effects of catalyst, temperature, pressure and reaction time were correlated and catalyst optimized by simple batch and continuous experimentation. Data from a continous reactor were used to make economic projections for a 36 ton/day unit. EPA CONTACT: Schomaker, N. B. 513-684-4484

670/2-75-032 PE 1DB314 ROAP/TASK 21 BFS 15 GRANT NO. 801944

Fabrication of Single Cell Protein From Cellulosic Wastes BY W. H. Daly, and Jr., L. P Ruiz, Louisiana State University Baton Rouge, LA

Techniques to produce a protein isolate from a cellulolytic bacteria were researched with the intent of producing a potential human food supplement. The use of chemical additives which cause the cells to flocculate enabling them to be removed from the fermentation media by desludging centrifuge offers an inexpensive means of cell harvesting. Several flocculating agents which are effective at a concentration of 0.1% for flocculating *Cellulomonas* are reported. The addition of food grade proteins followed by a pH adjustment offers an alternative to chemical flocculation. In addition, acid and alkaline hydrolysis to remove nucleic acids from the bacterial protein was investigated. EPA CONTACT: Rogers, C. J. 513-684-4484

670/2-75-035 PE 1BB034 GRANT NO. 11022 FLV

Stream Pollution Abatement by Supplement Pumping BY C. W. Reh, and W. W. Sadler, Richmond, City of Richmond, VA

At the Richmond, Virginia, Wastewater Treatment Plant, a major structure, i.e., a Supplemental Pumping Station, and several ancillary structures were provided to achieve the project objective of no bypassing while a new grit chamber was being connected ahead of the existing Main Pumping Station, which station received and pumped all of the raw sewage. The Supplemental Pumping Station was constructed by sinking a two-compartment, sheet steel cofferdam around an existing 72-inch concrete sewer and rearranging the effluent sewer flow pattern so that the sewage was redirected to the site of the Supplemental Pumping Station. The redirection of sewage flow was achieved by the reconstruction of a junction chamber and by the insertion of a specially designed removable bulkhead, all without bypassing sewage. The time required for the design, construction and operation of the Supplemental Pumping Station was about 36 months and the cost of this project was approximately $900,000. EPA CONTACT: Brunner, C. A. 513-684-8305

670/4-74-006 PE 1BA027 ROAP/TASK 05 AEF 005 IN-HOUSE PROJECT

Taxonomy and Ecology of Asponenona Mayflies of the Ohio River Basin BY P. A. Lewis, National Environmental Research Center, EPA Cincinnati, OH

This manual provides keys and descriptions of all North American species of *Stenonema* mayflies and consolidates information from the literature on their ecology, environmental requirements, and pollution tolerance. Accounts of each species include synonymy, nymphal description, collection records, and a distribution map. The 31 species described and keyed include three recently described species, four new synonyms, two resurrected species, and new combinations involving three additional species and subspecies. Twelve species and one subspecies are classified as intolerant to organic pollution, eight species as tolerant of mild pollution, and seven species and two subspecies as tolerant to moderate pollution. EPA CONTACT: Lewis, P. A. 513-684-2980

670/4-75-001 PE 1HA327 ROAP/TASK 24 ALE 03 IN-HOUSE PROJECT

Performance of the OSCO Model 1391 Water Wastewater Sampler BY R. P. Lauch, Methods Development and Quality Assurance Research Laboratory, EPA Cincinnati, OH

Performance of the ISCO model 1391 water sampler was tested. Tests were run at 2, 19, and 35C to check accuracy and precision of the timer, flowmeter, and sample volumes. The multiplexer function of delivering multiple aliquots per bottle was tested. Performance checks were made on both converter and battery power, and battery endurance was determined. Discrete sample temperatures were recorded versus time under iced conditions. Manufacturer's claims were mostly confirmed, but improvement is warranted for some sampler components. EPA CONTACT: Lauch, R. P. 513-684-2935

NEW REPORT ABSTRACTS SECTION

670/4–75–002 PE 1HA327 ROAP/TASK 01 AAD 10 IN-HOUSE PROJECT

Interfacing a 24-Point Analog Recorder to a Computer Controlled Telemetry Line BY J. M. Teuschler, Methods Development and Quality Assurance Research Laboratory, EPA Cincinnati, OH

Interface circuitry was designed so that telemetered data originating from various remote stations could be recorded by both a digital computer and an analog recorder. The entire interface circuitry is mounted on a 3–1/2 x 2–1/2 inch printed circuit card and installed in the receiver. Data from the two methods of collection can, therefore, be collected and a comparison can be made. A switching network also permits computer control with computer and recorder logging; or computer logging only; or recorder logging only. EPA CONTACT: Teuschler, J. M. 513–684–2918

670/4–75–003 PE 1HA327 ROAP/TASK 24 ALE 04 IN-HOUSE PROJECT

Application and Procurement of Automatic Wastewater Samplers BY R. P. Lauch, Methods Development and Quality Assurance Research Laboratory, EPA Cincinnati, OH

Application and procurement of automatic sampling devices are discussed. Different sampler characteristics including compositing, proportionality, preservation, lift, and power are described. Manufacturers are listed. Application is discussed with reference to compliance with the National Pollutant Discharge Elimination System permit program, treatment plant control, and other uses. Method of selection and procurement (involving application, familiarization, and purchase) are discussed. EPA CONTACT: Lauch, R. P. 513–684–2935

670/4–75–004a PE 1HA327 ROAP/TASK 24 AEL 06 IN-HOUSE PROJECT

Fortran Programs for Analyzing Collaborative Test Data: Part I General Statistics BY E. C. Julian, Methods Development and Quality Assurance Research Laboratory, EPA Cincinnati, OH

A FORTRAN program for IBM 1130 is described by which general statistics on interlaboratory studies of chemical analytical methods may be obtained. Data screening followed by a statistical t-test for identifying outliers is included. A histogram of data in ascending order is provided. EPA CONTACT: Julian, E. C. 513–684–2985

670/4–75–004b PE 1HA327 ROAP/TASK 24 AEL 06 IN-HOUSE PROJECT

Fortran Programs for Analyzing Collaborative Test Data: Part II Scatter Plots BY E. C. Julian, Methods Development and Quality Assurance Research Laboratory, EPA Cincinnati, OH

A FORTRAN program for IBM 1130 designed to plot three pairs of data sets in three scatter diagrams on one page is described. These data stem from interlaboratory studies of chemical analytical methods. EPA CONTACT: Julian, E. C. 513–684–2985

670/5–74–006 PE 1DA312 ROAP/TASK 24 ABV 018 GRANT NO. EP-01090

Criteria for Regional Solid Waste Management Planning BY B. H. Stevens, Regional Science Research Institute Philadelphia, PA

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 Waste 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. EPA CONTACT: Talley, R. J. 513–684–4484

670/5–75–001 PE 1DA312 ROAP/TASK 24 ABU 04 CONTRACT NO. 68–03–0193

Evaluation of Feasibility and Economic Implication of Pricing Mechanisms in Solid Waste Management BY E. Ernst, ABT Associates, Inc. Cambridge, MA

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 solid 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 subsystem suggests that these cost functions are subject to variable returns to scale. For smaller communities, there are economies off 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 concludes with a brief suggestion for a feasible method for implementing an effective pricing mechanism in SWM systems. EPA CONTACT: Goddard, H. C. 513–684–4484

NEW REPORT ABSTRACTS SECTION

670/9-74-006 **PE 1RA103** **IN-HOUSE PROJECT**

Pollution Control Technology Assessment – Proceedings of an Environmental Resources Conference, May 1–3, 1974 Battelle Columbus Laboratories Columbus, OH

A Compilation of papers presented at the third of a series of conferences on environmental matters cosponsored by the National Environmental Research Center — Cincinnati (USEPA) and the Columbus Laboratories of Battelle Memorial Institute, Columbus, Ohio. The conference subject area concerned a multifaceted assessment of water pollution control technology. Session topics included legislative mandates and standards, control technology, activities indirectly affecting water pollution control, an assessment full use of water pollution control technology. EPA CONTACT: Gigliotti, G. M. 513–684–4484

670/9-75-001 **PE 1RA103** **IN-HOUSE PROJECT**

Environmental Research Publications 1971–1975 Technical Information Staff, NERC Cincinnati, OH

This list of Publications has been created to announce reports and publications of the U.S. Environmental Protection Agency's National Environmental Research Center (NERC) in Cincinnati. This literature reports on results of scientific and engineering studies on pollution control technology performed by intramural activities of the NERC Cincinnati laboratories by cooperative activities with research and industrial organizations through contracts and grants. This publication is not intended to be a complete reference of all the technical publications of the U.S. Environmental Protection Agency. Rather, it is a selected list of those publications from the National Environmental Research Center in Cincinnati. EPA CONTACT: Gigliotti, G. M. 513–684–8259

670/9-75-003 **PE 1RA103** **IN-HOUSE PROJECT**

News of Environmental Research in Cincinnati, January – December 1974 Technical Information Staff, NERC Cincinnati, OH

A series of reports on the following subjects: impact of environmental control technologies on the energy crisis; publications – 1973; advanced wastewater treatment plant at Piscataway, Maryland; identifying organic pollutants in water; survival of fecal coliforms and fecal streptococci in a sanitary landfill; sludge incineration and fuel conservation; producing protein while reducing waste; toxicity of wastewater disinfectants; BGM: a new cell line for recovering viruses from water; radiorespirometry: rapid toxicological screening of environmental pollutants; a swirl device for regulating and concentrating combined sewer overflows; recreational water quality criteria; granular media filtration of secondary effluent; and coal refuse disposal in the Eastern United States. EPA CONTACT: Gigliotti, G. M. 513–684–8258

670/9-75-004 **PE 1BB043** **ROAP/TASK 21 ASR 119** **GRANT NO. 803294**

Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards BY E. J. Middlebrooks, D. H. Falkenborg, R. F. Lewis, and D. J. Ehreth, Utah State University Logan, UT

The question as to whether lagoons, as they now exist, meet the new secondary treatment standards and what methods would work to upgrade lagoon treatment in cases where they presently do not meet the standards is of high priority for many Regional Offices of EPA. The symposium was held for EPA staff and State Officials to review the Office of Research and Development's program for upgrading lagoons. The intermittent sand filter, land application of algae laden effluents and the submerged rock filter offer good potential for cost effective upgrading. The basic biology of the treatment mechanism, disinfection technology, the controlled discharge operation (and results), cost effective analysis, and new fields of research were covered by speakers. Intermittent sand filtration, submerged rock filtration, and land application of sewage effluents are effective alternatives to removing algae from sewage lagoons.

680/4-75-001 **PE 1HA325** **IN-HOUSE PROJECT**

Handbook of Radiochemical Analytical Methods BY F. B. Johns, National Environmental Research Center, EPA Las Vegas, NV

A compilation of the chemical procedures used at the National Environmental Research Center-Las Vegas for determining stable elements and radionuclides in environmental surveillance samples. It supersedes "Southwestern Radiological Health Laboratory Handbook of Radiochemical Analytical Methods" published as Report No. SWRHL-11 in March 1970. It should be noted that the procedures in the current compilation are intended for use in processing relatively large numbers of samples in the shortest possible time for environmental radiological surveillance and, therefore, in some cases represent a compromise between precise analytical determination and adequate determination for surveillance purposes. For historical purposes, two methods for radiostrontium in milk are included since large numbers of samples were analyzed by these methods. Appendix A provides instructions for preparing reagents listed for each method. It does not provide instructions for preparing solutions normally found in chemistry laboratories. EPA CONTACT: Johns, F. B.

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SAB-73-001	1HA410	**Nitrogenous Compounds in the Environment** Office of Research and Development, Science Advisory Board, EPA Washington, DC **ORDER FROM: GPO-** EP1.2:N63 – $2.20
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BIBLIOGRAPHIC SECTION

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BIBLIOGRAPHIC SECTION

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BIBLIOGRAPHIC SECTION

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BIBLIOGRAPHIC SECTION

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BIBLIOGRAPHIC SECTION

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BIBLIOGRAPHIC SECTION

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TITLE INDEX

Abatement of Mine Drainage Pollution By Underground Precipitation – REF. NO. EPA-670/2-73-092
Absorption of SO_2 by Alkaline Solutions in Venturi Scrubber Systems – REF. NO. EPA-650/2-73-003
Absorption of SO_2 into Lime Slurries: Absorption Rates and Kinetics – REF. NO. EPA-650/2-73-047
Accumulation of Tritium in Various Species of Fish Reared in Tritiated Water – REF. NO. EPA-680/4-74-001
Acid Hydrolysis of Cellulose in Refuse to Sugar and Its Fermentation to Alcohol – REF. NO. EPA-670/2-73-011
Acquisition and Culture of Research Fish – REF. NO. EPA-660/3-75-011
Actions of Pesticides and Other Drugs on the Male Reproductive System – REF. NO. EPA-650/1-74-011
Activated Carbon Treatment of Unbleached Kraft Effluent for Reuse – REF. NO. EPA-660/2-75-004
Activated Silica in Wastewater Coagulation – REF. NO. EPA-670/2-74-047
Activated Sludge – Bio-Disc Treatment of Distillery Wastewater – REF. NO. EPA-660/2-74-014
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Air Pollution Effects on Catastrophic Failure of Metals – REF. NO. EPA-650/3-74-009
Alternative Systems for Supplying Dissolved Oxygen in Wastewater Treatment – REF. NO. EPA-670/2-75-001
Alum Addition to Activated Sludge With Tertiary Solids Removal – REF. NO. EPA-670/2-73-037
Aluminum as a Component of Solid Waste and a Recoverable Resource – REF. NO. EPA-670/5-74-005
Ammonia Nitrogen Removal By Breakpoint Chlorination – REF. NO. EPA-670/2-73-058
An Investigation of Ion Removed From Water and Wastewater – REF. NO. EPA-660/3-74-022
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Analysis of the Dynamics of DDT in Marine Sediments – REF. NO. EPA-660/3-75-013
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Analysis of Cost Sharing Programs for Pollution Abatement of Municipal Wastewater – REF. NO. EPA-600/5-74-031
Analysis of Nonpoint-Source Pollutants in the Missouri Basin Region – REF. NO. EPA-600/5-75-004
Analysis of Pollution Control Costs – REF. NO. EPA-670/2-74-009
Analysis of Test Data for NOX Control in Gas and Oil-Fired Utility Boilers – REF. NO. EPA-650/2-75-012
Analysis Models for Solid Waste Collection – REF. NO. EPA-670/2-75-026a
Analysis Models for Solid Waste Collection – REF. NO. EPA-670/2-75-026b
Analytical Methodology Information Center: Activities for 1973 – 1974 – REF. NO. EPA-670/4-74-003a
Andersen Filter Substrate Weight Loss – REF. NO. EPA-650/2-75-022
Annual Report for Calendar Year 1972, Environmental Toxicology Research – REF. NO. EPA-670/1-73-036
Annual Report, 1972, NERC – Cincinnati – REF. NO. EPA-670/9-73-055
Applicability of the Meyers Process of Chemical Desulfurization of Coal: Initial Survey of Fifteen Coals – REF. NO. EPA-650/2-74-025
Application and Procurement of Automatic Wastewater Samplers – REF. NO. EPA-670/4-75-003
Application of Holographic Methods to the Measurement of Flames and Particulate – Volume II – REF. NO. EPA-650/2-74-031b
Application of Holographic Methods to the Measurement of Flames and Particulate – Volume 1 – REF. NO. EPA-650/2-74-031a
Application of Odor Technology to Mobil Sources Emission Instrumentation – REF. NO. EPA-650/2-73-025
Application of Repro-Modeling to the Analysis of a Photochemical Air Pollution Model – REF. NO. EPA-650/4-74-001
Applications of Growth and Sorption Algal Assays – REF. NO. EPA-660/3-73-023
Applications of Reverse Osmosis to Acid Mine Drainage Treatment – REF. NO. EPA-670/2-73-100
Applying Fabric Filtration to Coal Fired Industrial BoilersA Preliminary Pilot Scale Investigation – REF. NO. EPA-650/2-74-058
Appraisal of Neutralization Processes to Treat Coal Mine Drainage – REF. NO. EPA-670/2-73-093
Aqueous Odor Thresholds of Organic Pollutants in Industrial Effluents – REF. NO. EPA-660/4-75-002
Assessing Effects on Water Quality by Boating Activity – REF. NO. EPA-670/2-74-072
Assessment and Development Plan for Monitoring of Organics in Storm Flows – REF. NO. EPA-670/2-74-087
Assessment of the Applicability of Automotive Emission Control Technology to Stationary Engines – REF. NO. EPA-650/2-74-051
Assessment of the Potential of Clean Fuels and Energy Technology – REF. NO. EPA-600/2-74-001
Assessment of Catalysts for Control of NOX from Stationary Power Plants, Phase I, Volume I – Final Report – REF. NO. EPA-650/2-75-001a
Assessment of Catalysts for Control of NOX from Stationary Power Plants, Phase I, Volume II – Data Bank Citation Indices – REF. NO. EPA-650/2-75-001b
Assessment of Economic Impact of Air Pollutants on Vegetation in the United States, 1969 and 1971 – REF. NO. EPA-650/5-73-002
Assessment of Particle Control Technology for Enclosed Asbestos Sources – REF. NO. EPA-650/2-74-088
Assessment of Wet Systems for Residential Refuse Collection: A Summary Report – REF. NO. EPA-670/2-74-068
Assessment Methodology for the Environmental Impact of Water Resource Projects – REF. NO. EPA-600/5-74-016
Atmospheric Emissions from the Asphalt Industry – REF. NO. EPA-650/2-73-046
Atmospheric Emissions from Asphalt Roofing Processes – REF. NO. EPA-650/2-74-101
Atmospheric Emissions From the Petroleum Refining Industry – REF. NO. EPA-650/2-73-017
Atmospheric Measurement of Photochemical Smog Reactions – A Preliminary Analysis – REF. NO. EPA-650/4-74-037

TITLE INDEX

Atomic Absorption Analysis of Phosphates in Water – REF. NO. EPA-670/2-73-079
Automated Analysis of Individual Refractory Organics in Polluted Water – REF. NO. EPA-660/2-74-076
Bacterial Zoogloea Formation – REF. NO. EPA-670/2-74-018
Batch Disinfection of Treated Wastewater With Chlorine at Less Than 1 Degree C – REF. NO. EPA-660/2-73-005
Bench-Scale High-Rate Disinfection of Combined Sewer Overflows With Chlorine and Chlorine Dioxide – REF. NO. EPA-670/2-75-021
Benefit of Water Pollution Control on Property Values – REF. NO. EPA-600/5-73-005
Bibliography of the Cat – REF. NO. EPA-650/3-74-001
Bibliography of Publications and Reports of the Pacific Northwest Environmental Research Laboratory – REF. NO. EPA-660/9-74-001
Bibliography of R&D Research Reports – July 1973 – REF. NO. EPA-600/5-73-002
Bibliography of Water Pollution Control Benefits and Costs – REF. NO. EPA-600/5-74-028
Big Eddies and Mixing Processes in the Great Lakes – REF. NO. EPA-660/3-73-011
Bio-Environmental Impact of Air Pollution from Fossil Fuel Power Plants – REF. NO. EPA-660/3-74-011
Biological Control of Aquatic Vegetation – REF. NO. EPA-660/3-74-007
Biological Conversion of Animal Wastes to Nutrients – REF. NO. EPA-670/2-73-009
Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents – REF. NO. EPA-670/4-73-001
Biological Models of Freshwater Communities – REF. NO. EPA-660/3-73-008
Biological Treatment of Combined Sewer Overflow at Kenosha, Wisconsin – REF. NO. EPA-670/2-75-019
Biological Treatment of Concentrated Sugar Beet Wastes – REF. NO. EPA-660/2-74-028
Biologically Allowable Thermal Pollution Limits, Parts I and II – REF. NO. EPA-660/3-74-003
Boiler Modification Cost Survey for Sulfur Oxides Control by Fuel Substitution – REF. NO. EPA-650/2-74-123
Braxton Sonic Agglomerator Evaluation – REF. NO. EPA-650/2-74-036
Brine Disposal Treatment Practices Relating to the Oil Production Industry – REF. NO. EPA-660/2-74-037
BOD, Solids and Nutrient Removal By Foam Flotation – REF. NO. EPA-670/2-73-096
California Environmental Quality Act: Innovation in State and Local Decision making – REF. NO. EPA-600/5-74-023
Can Federal Procurement Practices be Used to Reduce Solid Waste – REF. NO. EPA-670/5-74-003
Capacity of the Soil as a Natural Sink for Carbon Monoxide – REF. NO. EPA-650/2-73-043
Carbonate Bonding of Taconite Tailings – REF. NO. EPA-670/2-74-001
Carrying Capacity in Regional Environmental Management – REF. NO. EPA-600/5-74-021
Case Study and Business Analysis of the Scrap Industry – REF. NO. EPA-670/5-74-002
Catalytic Combustion, a Pollution-Free Means of Energy Conversion – REF. NO. EPA-650/2-73-018
Catalytic Oxidation of Sulfur Dioxide Using Isotopic Tracers – REF. NO. EPA-650/2-73-020
Catalyzed Bio-Oxidation and Tertiary Treatment of Integrated Textile Wastewaters – REF. NO. EPA-660/2-74-039
Changes in the Global Energy Balance – REF. NO. EPA-650/2-74-116
Characterization and Control of Asbestos Emissions from Open Sources – REF. NO. EPA-650/2-74-090
Characterization and Treatment of Urban Land Runoff – REF. NO. EPA-670/2-74-096
Characterization and Utilization of Municipal and Utility Sludges and Ashes: Vol. I – Summary – REF. NO. EPA-670/2-75-033a
Characterization and Utilization of Municipal and Utility Sludges and Ashes: Vol. II – Municipal Sludges – REF. NO. EPA-670/2-75-033b
Characterization and Utilization of Municipal and Utility Sludges and Ashes: Vol. III – Utility Coal Ash – REF. NO. EPA-670/2-75-033c
Characterization and Utilization of Municipal and Utility Sludges and Ashes: Vol. IV – Municipal Incinerator Residues – REF. NO. EPA-670/2-75-033d
Characterization of Atmospheric Emissions from Polyurethane Resin Manufacture – REF. NO. EPA-650/2-74-107
Characterization of Vessel Waste in Duluth-Superior Harbor – REF. NO. EPA-670/2-74-097
Characterization of Waste Waters from the Ethical Pharmaceutical Industry – REF. NO. EPA-670/2-74-057
Charged Droplet Scrubbing of Submicron Particulate – REF. NO. EPA-650/2-74-075
Chemical and Physical Characterization of Automotive Exhaust Particulate Matter in the Atmosphere (Year Ending June 30, 1972) – REF. NO. EPA-650/2-73-001
Chemical and Physical Characterization of Automotive Exhaust Particulate Matter in the Atmosphere (Year Ending June 30, 1973) – REF. NO. EPA-650/2-73-002
Chemical Characterization of Model Aerosols – REF. NO. EPA-650/3-74-011
Chemical Conversion of Solid Waste to Useful Products – REF. NO. EPA-670/2-74-027
Chemical Conversion of Wood and Cellulosic Wastes – REF. NO. EPA-670/2-74-015
Chemical Impact of Snow Dumping Practices – REF. NO. EPA-670/2-74-086
Chemical/Physical and Biological Treatment of Wool Processing Wastes – REF. NO. EPA-660/2-73-036
Chemically Active Fluid-Bed Process for Sulphur Removal During Gasification of Heavy Fuel Oil—Second Phase – REF. NO. EPA-650/2-73-039
Chemically Active Fluid-Bed Process for Sulphur Removal During Gasification of Heavy Fuel Oil – Second Phase – REF. NO. EPA-650/2-74-109
Chemistry of Organmercurials in Aquatic Systems – REF. NO. EPA-660/3-73-012
Cladophora Distribution in Lake Ontario (IFYGL) – REF. NO. EPA-660/3-74-028
Coke Charging Pollution Control Demonstration – REF. NO. EPA-650/2-74-022
Coke Oven Charging Emission Control Test Program – Supplemental Observations – REF. NO. EPA-650/2-74-062a
Coke Oven Charging Emission Control Test Program—Volume I – REF. NO. EPA-650/2-74-062
Coke Oven Smokeless Pushing System Design Manual – REF. NO. EPA-650/2-74-076
Coliform Bacteria Growth and Control in Aerated Stabilization Basins – REF. NO. EPA-660/2-73-028
Collaborative Study of EPA Methods 5,6, and 7 in Fossil Fuel-Fired Steam Generators – REF. NO. EPA-650/4-74-013
Collaborative Study of Method for the Determination of Nitrogen Oxide Emissions from Stationary Sources (Fossil Fuel-Fired Steam Generators) – REF. NO. EPA-650/4-74-025
Collaborative Study of Method for the Determination of Nitrogen Oxide Emissions from Stationary Sources (Nitric Acid Plants) – REF. NO. EPA-650/4-74-028
Collaborative Study of Method for the Determination of Particulate Matter Emissions From Stationary Sources (Fossil Fuel-Fired Steam Generators) – REF. NO. EPA-650/4-74-021
Collaborative Study of Method for the Determination of Particulate Matter Emissions from Stationary Sources (Municipal Incinerators) – REF. NO. EPA-650/4-74-022
Collaborative Study of Method for the Determination of Particulate Emissions from Stationary Sources (Portland Cement Plants) – REF. NO. EPA-650/4-74-029

TITLE INDEX

Collaborative Study of Method for the Determination of Sulfur Dioxide Emissions From Stationary Sources (Fossil Fuel-Fired Steam Generators) – REF. NO. EPA-650/4-74-024
Collaborative Study of Method for the Determination of Sulfuric Acid Mist and Sulfur Dioxide Emissions from Stationary Sources – REF. NO. EPA-650/4-75-003
Collaborative Study of Method for Determination of Stack Gas Velocity and Volumetric Flow Rate in Conjunction with EPA Method 5 – REF. NO. EPA-650/4-74-033
Collaborative Study of Method for Stack Gas Analysis and Determination of Moisture Fraction with Use of Method 5 – REF. NO. EPA-650/4-74-026
Collaborative Study of Method 10 – Reference Method for Determination of Carbon Monoxide Emissions from Stationary Sources – Report of Testing – REF. NO. EPA-650/4-75-001
Collaborative Study of Method 104 – Reference Method for Determination of Beryllium Emission from Stationary Sources – REF. NO. EPA-650/4-74-023
Collaborative Study of Reference Method for Determination of Sulfur Dioxide in the Atmosphere (Pararosaniline Method) (24-hour Sampling) – REF. NO. EPA-650/4-74-027
Collaborative Test of the TGS-ANSA Method for Measurement of Nitrogen Dioxide in Ambient Air – REF. NO. EPA-650/4-74-046
Collaborative Testing Methods for Measurements of NO2 in Ambient Air Volume I – Report of Testing – REF. NO. EPA-650/4-74-019a
Color Characterization Before and After Lime Treatment – REF. NO. EPA-660/2-74-029
Color Removal and Sludge Disposal Process for Kraft Mill Effluents – REF. NO. EPA-660/2-74-008
Color Removal From Kraft Mill Effluents By Ultrafiltration – REF. NO. EPA-660/2-73-019
Combined Sewer Overflow Seminar Papers – REF. NO. EPA-670/2-73-077
Combined Sewer Overflow Treatment by the Rotating Biological Contactor Process – REF. NO. EPA-670/2-74-050
Combustion Control of Pollutants from Multiburner Coal-fired System – REF. NO. EPA-650/2-74-038
Combustion Products from the Incineration of Plastics – REF. NO. EPA-670/2-73-049
Combustion Toilet for Use on Small Boats – REF. NO. EPA-670/2-74-053
Compact Sampling System for Collection of Particulates from Stationary Sources – REF. NO. EPA-650/2-74-029
Comparability of Nine Methods for Monitoring NO2 in Ambient Air – REF. NO. EPA-650/4-74-012
Comparison of Germanium Detectors for Neutron Activation Analysis for Mercury – REF. NO. EPA-660/2-74-045
Composted Municipal Refuse as a Soil Amendment – REF. NO. EPA-670/2-73-063
Comprehensive Management of Phosphorus Water Pollution – REF. NO. EPA-600/5-74-010
Comprehensive Technical Report on all Atmospheric Contaminants Associated with Photochemical Air Pollution – REF. NO. EPA-650/4-75-002
Computer Management of a Combined Sewer System – REF. NO. EPA-670/2-74-022
Concepts for Development of Field Usable Test Atmosphere Generating Devices – REF. NO. EPA-650/4-74-016
Conceptual Model for the Movement of Pesticides Through the Environment – REF. NO. EPA-660/3-74-024
Conditioning of Fly Ash with Sulfamic Acid, Ammonium Sulfate, and Ammonium Bisulfact – REF. NO. EPA-650/2-74-114
Conference on Recycling Treated Municipal Wastewater Through Forest and Cropland – REF. NO. EPA-660/2-74-003
Continuous Inplant Hot Gas Blanching of Vegetables – REF. NO. EPA-660/2-74-091
Continuous Measurement of Total Gas Flowrate from Stationary Sources – REF. NO. EPA-650/2-75-020
Contributions of Urban Roadway Usage to Water Pollution – REF. NO. EPA-600/2-75-004
Control of Environmental Impacts From Advanced Energy Sources – REF. NO. EPA-600/2-74-002
Control of Sulfur Dioxide Emissions from Copper Smelters: Volume I Steam Oxidation of Pyritic Copper Concentrates – REF. NO. EPA-650/2-74-085a
Control of Sulfur Dioxide Emissions from Copper Smelters: Volume II Hydrogen Sulfide Production from Copper Concentrates – REF. NO. EPA-650/2-74-085b
Control Schemes for the Activated-Sludge Process – REF. NO. EPA-670/2-74-069
Control Technology for Fine Particulate Emissions – REF. NO. EPA-650/2-74-027
Conversion of Cattle Feedlot Wastes to Ammonia Synthesis Gas – REF. NO. EPA-660/2-74-090
Copper Recovery from Brass Mill Discharge by Cementation with Scrap Iron – REF. NO. EPA-670/2-75-029
Cost of Dissolved Air Flotation Thickening of Waste Activated Sludge at Municipal Sewage Treatment Plants – REF. NO. EPA-670/2-74-011
Cost Evaluation of Alternative Air Quality Strategies – REF. NO. EPA-600/5-74-003
Cost-Effective Design Based Upon Field Derived Parameters – REF. NO. EPA-670/2-74-062
Cost-Effectiveness of a Uniform National Sulfur Emissions Tax – REF. NO. EPA-600/5-74-009
Costs of Filter Pressing Domestic Sewage Sludges – REF. NO. EPA-670/2-74-006
Costs of Hauling and Land Spreading of Domestic Sewage Treatment Plant Sludge – REF. NO. EPA-670/2-74-010
Countermeasures for Pollution From Overflow – The State of the Art – REF. NO. EPA-670/2-74-090
Crankcase Drainage from In-Service Out-board Motors – REF. NO. EPA-670/2-74-092
Criteria for Regional Solid Waste Management Planning – REF. NO. EPA-670/5-74-006
Critique of Pollution Time Allocation in River Basin Model – REF. NO. EPA-600/5-73-007
Crop Insurance and Information Services to Control Use of Pesticides – REF. NO. EPA-600/5-74-018
Culturing and Ecology of Diaptomus Clavipes and Cyclops Vernalis – REF. NO. EPA-660/3-74-006
Degradation Mechanism: Controlling the Bioaccumulation of Hazardous Materials – REF. NO. EPA-670/2-75-005
Demetallization of Heavy Residual Oils – REF. NO. EPA-650/2-73-041
Demetallization of Heavy Residual Oils – Phase II – REF. NO. EPA-650/2-73-041a
Demonstration of a Non-Aqueous Sewage Disposal System – REF. NO. EPA-670/2-73-088
Demonstration of a State Water Quality Management Information System – REF. NO. EPA-600/5-74-022
Demonstration of the Separation and Disposal of Concentrated Sediments – REF. NO. EPA-660/2-74-072
Demonstration of Thermal Water Utilization in Agriculture – REF. NO. EPA-660/2-74-011
Demonstration of Three Recirculating Swine Waste Management Systems – REF. NO. EPA-660/2-74-009
Demonstration of Waste Flow Reduction from Households – REF. NO. EPA-670/2-74-071
Design and Control of Incinerators, Volume I – REF. NO. EPA-670/2-73-089A
Design and Control of Incinerators, Volume II – Appendices – REF. NO. EPA-670/2-73-089B
Design and Simulation of Equalization Basins – REF. NO. EPA-670/2-73-046
Design of an Optimum Distillate Oil Burner for Control of Pollutant Emissions – REF. NO. EPA-650/2-74-047
Design of the EPA Semi-Trailer Mobile Air Pollution Laboratory – REF. NO. EPA-650/4-74-017
Design of Cost-Effective Water Quality Surveillance Systems – REF. NO. EPA-600/5-74-004
Design Development and Fabrication of a Prototype High-Vol. Particulate Mass Sampling Train – REF. NO. EPA-650/2-74-067
Design Parameters for Animal Waste Treatment Systems – REF. NO. EPA-660/2-74-063
Design Trends and Operating Problems in Combustion Modification of Industrial Boilers – REF. NO. EPA-650/2-74-032

TITLE INDEX

Design, Construction and Initial Evaluation of the El Lago, AWT Facility – REF. NO. EPA-670/2-73-101
Design, Construction, and Testing of a Commercial Prototype Disc Diluter – REF. NO. EPA-650/2-74-055
Design, Development, and Field Test of a Droplet Measuring Device – REF. NO. EPA-650/2-75-018
Design, Fabricate, and Demonstrate an Instrument for Assaying Benzo (a) Pyrene – REF. NO. EPA-650/2-74-068
Design, Fabrication, and Installation of a Particulate Aerodynamic Test Facility – REF. NO. EPA-650/2-74-103
Detailed Cost Estimates For Advanced Effluent Desulfurization Processes – REF. NO. EPA-600/2-75-006
Determination of the Formation Mechanisms and Composition of Photochemical Aerosols – REF. NO. EPA-650/3-73-002
Determination of Coronal Ozone Production by High Voltage Power Transmission Lines – REF. NO. EPA-650/4-73-003
Determination of Effect of Particulate Exhaust Emissions of Additives and Impurities in Gasoline – REF. NO. EPA-650/2-74-061
Determination of Energetic Characteristics of Urban-Rural Surfaces in the Greater St. Louis Area – REF. NO. EPA-650/4-74-007
Determination of Hazardous Elements in Smelter-Produced Sulfuric Acid – REF. NO. EPA-650/2-74-131
Determination of Molecular Hydrogen Sulfide – REF. NO. EPA-660/4-75-001
Determination of Volatile Organic Compounds at the UG/1 Level in Water by Gas Chromatography – REF. NO. EPA-670/4-74-009
Development and Evaluation Report: Physical Chemical Marine Sanitation System – REF. NO. EPA-670/2-74-043
Development and Fabrication of Mass Emission Data and Control System for the Stationary Source Simulator – REF. NO. EPA-650/2-73-009
Development and Testing of An Air Monitoring System – REF. NO. EPA-650/2-74-019
Development of a Decision Room For Environmental Studies – REF. NO. EPA-600/5-73-011
Development of a High-Purity for High Temperature Particulate Sampling and Analysis – REF. NO. EPA-650/2-73-032
Development of a Methodology for the Assessment of the Effects of Fuels and Additives on Control Devices – REF. NO. EPA-650/2-74-060
Development of a Monthly Industrial Technology Bulletin – REF. NO. EPA-600/2-74-007
Development of a Monthly Technology Bulletin – REF. NO. EPA-600/2-74-005
Development of a Prototype Nitrate Detector – REF. NO. EPA-650/2-74-133
Development of a Prototype Sulfuric Acid Monitor – REF. NO. EPA-650/2-75-013a
Development of a Selective Algaecide to Control Nuisance Algal Growth – REF. NO. EPA-660/3-73-006
Development of a Supplementary Emission Measurements Monitoring System – REF. NO. EPA-650/2-73-008
Development of an Acetylene Monitor at the PPB Level – REF. NO. EPA-650/2-74-056
Development of an Approach to Identification of Emerging Technology and Demonstration Opportunities – REF. NO. EPA-650/2-74-048
Development of an Instrumental Monitoring Method for Measurement of Asbestos Concentrations in or Near Sources – REF. NO. EPA-650/2-73-016
Development of A Gas Laser System to Measure Trace Gases by Long Path Absorption Techniques: Volume II – Field Evaluation of Gas Laser System for Ozone Monitoring Final Report – REF. NO. EPA-650/2-74-046b
Development of Air Particulate Monitoring Systems – REF. NO. EPA-650/4-74-030
Development of Analytic Techniques to Measure Human Exposure to Fuel Additives – REF. NO. EPA-650/1-74-003
Development of Field Applied DDT – REF. NO. EPA-660/2-74-036
Development of Gas Laser System to Measure Trace Gases by Longpath Absorption Techniques:Volume I – Gas Laser System Modification for Ozone Monitoring Final Report – REF. NO. EPA-650/2-74-046a
Development of Instrumentation for Measurement of Stationary Source Aldehyde Organic Acid and Amine Emissions – REF. NO. EPA-650/2-73-010
Development of Instrumentation for Quantitative Collection of Total Atmospheric Mercury From Ambient Air-Final Report – REF. NO. EPA-650/2-73-052
Development of Low Pressure Impactor – REF. NO. EPA-650/2-74-014
Development of Method for Carcinogenic Vapor Analysis in Ambient Atmospheres – REF. NO. EPA-650/2-74-121
Development of Modeling Technique for Photochemical Air Pollution – REF. NO. EPA-650/4-74-003
Development of On-Shore Treatent System for Sewage from Watercraft Retention System – REF. NO. EPA-670/2-74-056
Development of Phosphate – Free Heavy Duty Detergents – REF. NO. EPA-600/2-74-003
Development of Predictions of Future Pollution Problems – REF. NO. EPA-600/5-74-005
Development of Range Squared and Off-Gating Modifications for a Lidar System – REF. NO. EPA-650/2-73-040
Development of Sample Preparation Methods for Development of Marine Organisms – REF. NO. EPA-660/3-74-026
Development of Sampling and Analytical Methods of Lime/Limestone Wet Scrubbing Tests – REF. NO. EPA-650/2-74-024
Development of Sampling Devices for Gaseous Atmospheric Tracers – REF. NO. EPA-650/4-74-050
Development of Sampling Method for Total Atmospheric Selenium – REF. NO. EPA-650/2-74-124
Development of Sampling Procedures for Polycyclic Organic Matter and Polychlorinated Biphenyls – REF. NO. EPA-650/2-75-007
Development of Technical Specifications for Standard Gas-Diluent Mixtures for Use in Measurement of Mobile Source Emissions – REF. NO. EPA-650/4-74-020
Development of X-Ray Fluorescence Spectroscopy in Element Analysis of Particulate Matter Phase II: Evaluation of Commerical Multiple Crystal Spectrometer Instruments – REF. NO. EPA-650/2-73-006
Device Collection and Assay of Ambient Gases – REF. NO. EPA-650/2-74-006
Devices for On – Board Treatment of Waste from Vessels – REF. NO. EPA-670/2-74-091
Diffusion in Turbulent Surface Layer and the Development of an Atmospheric Wind Tunnel – REF. NO. EPA-650/4-74-041
Direct Determination of Metals in Air – REF. NO. EPA-650/2-73-011
Directory of EPA, State and Local Environmental Quality Monitoring and Assessment Activities – REF. NO. EPA-600/4-75-001
Disinfection of Sewage Effluents – REF. NO. EPA-670/2-73-029
Dispersal Processes in Lake Huron – REF. NO. EPA-660/2-74-082
Dispersion in Hydrologic and Coastal Environments – REF. NO. EPA-660/3-73-010
Disposal of By-products from Non-regenerable Flue Gas Desulfurization Systems: Initial Report – REF. NO. EPA-650/2-74-037a
Distributions of Industrial and Commercial-Institution External Combustion Boilers – REF. NO. EPA-650/2-75-021
Dry Caustic Heating of Clingstone Peaches on a Commercial Scale – REF. NO. EPA-660/2-74-092
Dual Functioning Swirl Combined Sewer Overflow Regulator/ Concentrator – REF. NO. EPA-670/2-73-059
Dynamic Water Quality Forecasting and Management – REF. NO. EPA-660/3-73-009
Dynamics and Diffusion in the Great Lakes – REF. NO. EPA-660/2-74-083
Early Life History and Feeding of Young Mountain Whitefish – REF. NO. EPA-660/3-73-019
Economic and Environmental Benefits from Improving Electrical Rate Structures – REF. NO. EPA-600/5-74-033
Economic and Technological Impediments to Recycling Obsolete Ferrous Solid Waste – REF. NO. EPA-670/5-73-021
Economic Analysis of the Processing and Disposal of Refuse Sludges – REF. NO. EPA-670/2-74-037
Economic Damages of Air Pollution – REF. NO. EPA-600/5-74-012
Economic Damages to Household Systems From Water Supply Use – REF. NO. EPA-600/5-73-001

TITLE INDEX

Economic Disincentives for Pollution Control: Legal Political and Administrative Dimensions – REF. NO. EPA-600/5–74–026
Effect of Carbon to Nitrogen Ratio on Activated Sludge Subsidence and Dewatering Characteristics – REF. NO. EPA-670/2–74–025
Effect of Carbon Monoxide on Time Perception – REF. NO. EPA-650/1–74–005
Effect of Fuel Additives Study – REF. NO. EPA-650/2–74–096
Effect of Gas Turbine Efficiency and Fuel Cost on Cost Producing Electric Power – REF. NO. EPA-650/2–74–041
Effect of Gasoline Additives on Gaseous Emissions – REF. NO. EPA-650/2–75–014
Effect of Geographical Variation on Performance of Recirculating Cooling Ponds – REF. NO. EPA-660/2–74–085
Effect of Meteorological Variables on Temperature Changes in Flowing Streams – REF. NO. EPA-660/3–75–002
Effect of Phosphorus Removal Processes on Algal Growth – REF. NO. EPA-660/3–73–015
Effect of Processing Poultry Manure on Disease Agents – REF. NO. EPA-670/2–73–041
Effectiveness of Selected Fuel Additives in Controlling Pollution Emissions From Residual Oil-Fired Boilers – REF. NO. EPA-650/2–73–031
Effects of Air Pollutants on Textile Fibers and Dyes – REF. NO. EPA-650/3–74–008
Effects of Crude Oil and Some of Its Components on Young Coho and Sockeye Salmon – REF. NO. EPA-660/3–73–018
Effects of Design and Operating Variables on NOx from Coal-Fired Furnaces— Phase I – REF. NO. EPA-650/2–74–002a
Effects of Design and Operating Variables on NOX from Coal-Fired Furnaces – Phase II – REF. NO. EPA-650/2–74–002b
Effects of Exhaust from Two-Cycled Outboard Engines – REF. NO. EPA-670/2–74–063
Effects of Mirex and Methoxychlor on Striped Mullet, Mugil cephalus L. – REF. NO. EPA-660/3–75–015
Effects of Nozzle Design and Sampling Techniques on Aerosol Measurements – REF. NO. EPA-650/2–74–070
Effects of Protozoa on the Fate of Particulate Carbon – REF. NO. EPA-660/3–73–007
Effects of Temperature on Diseases of Salmonid Fishes – REF. NO. EPA-660/3–73–020
Effects of Water Pollution Controls on Solid Waste Generation, 1971 to 1985: Executive Summary – REF. NO. EPA-670/2–74–095a
Efficiencies in Power Generation – REF. NO. EPA-650/2–74–021
Effluents of the Inorganic Gas Industry – REF. NO. EPA-600/2–74–009c
Effluents of the Inorganic Pesticide Industry – REF. NO. EPA-600/2–74–009a
Electrochemical Carbon Regeneration – REF. NO. EPA-670/2–75–028
Electrochemical Removal of Heavy Metals from Acid Mine Drainage – REF. NO. EPA-670/2–74–023
Electrostatic Precipitator Performance Model – REF. NO. EPA-650/2–74–132
Enclosed Coke Pushing and Quenching System Design Manual – REF. NO. EPA-650/2–73–028
Enforcement Economics in Air Pollution Control – REF. NO. EPA-600/5–73–014
Enhancing Trickling Filter Plant Performance By Chemical Precipitation – REF. NO. EPA-670/2–73–060
Entrainment Separators for Scrubbers – Initial Report – REF. NO. EPA-650/2–74–119a
Environment: A Bibliography of Social Science and Related Literature – REF. NO. EPA-600/5–74–011
Environmental Applications of Advanced Instrumental Analyses: Assistance Projects, FY '73 – REF. NO. EPA-660/2–74–078
Environmental Applications of Advanced Instrumental Analysis: Assistance Projects, FY 72 – REF. NO. EPA-660/2–73–013
Environmental Chamber Studies of Atmospheric Aerosols – REF. NO. EPA-650/4–74–009
Environmental Consideration in Future Energy Growth – REF. NO. EPA-600/5–73–004
Environmental Considerations for Oil Shale Development – REF. NO. EPA-650/2–74–099
Environmental Exposure System for Studying Air Pollution Damage to Materials – REF. NO. EPA-650/3–75–001
Environmental Guidelines for Development Roads in the Subarctic – REF. NO. EPA-660/3–74–009
Environmental Impact Requirements in the States: NEPA's Offspring – REF. NO. EPA-600/5–74–006
Environmental Management and Local Government – REF. NO. EPA-600/5–73–016
Environmental Protection in Surface Mining of Coal – REF. NO. EPA-670/2–74–093
Environmental Radioactivity Laboratory Intercomparison Studies Program, 1973 – 1974 – REF. NO. EPA-680/4–73–001b
Environmental Requirements and Pollution Tolerance of Freshwater Diatoms – REF. NO. EPA-670/4–74–005
Environmental Requirements of Selected Estuarine Ciliated Protozoa – REF. NO. EPA-660/3–74–031
Environmental Research in 1973, Annual Report – REF. NO. EPA-670/9-74–001
Environmental Research Publications – REF. NO. EPA-670/9-73–004
Environmental Research Publications 1971–1975 – REF. NO. EPA-670/9-75–001
Epidemiology of Chronic Respiratory Disease: A Literature Review – REF. NO. EPA-650/1–74–007
Equimolar NO2 Absorption into Magnesia Slurry – A Pilot Feasibility Study – REF. NO. EPA-650/2–73–015
Estimating Nutrient Loadings of Lakes from Non-Point Sources – REF. NO. EPA-660/3–74–020
Estimating Water Quality Benefits – REF. NO. EPA-600/5–74–014
Estimation of Polychlorinated Biphenyls in the Presence of Dot-Type Compounds – REF. NO. EPA-670/4–74–004
Eutrophication of Lake Tahoe Emphasizing Water Quality – REF. NO. EPA-660/3–74–034
Eutrophication of Surface Waters—Lake Tahoe's Indian Creek Reservoir – REF. NO. EPA-660/3–75–003
Evaluation and Collaborative Study of Method for Visual Determination of Opacity of Emissions from Stationary Sources – REF. NO. EPA-650/4–75–009
Evaluation and Demonstration of the Capillary Suction Sludge Dewatering Device – REF. NO. EPA-670/2–74–017
Evaluation and Modification of Fluoride Sampling and Analytical Methods – REF. NO. EPA-650/2–73–007
Evaluation of a Computer Program for GC-MS Specific Ion Monitoring – REF. NO. EPA-660/2–74–002
Evaluation of a Microwave-Induced Plasma Spectrometer for Trace Analysis – REF. NO. EPA-660/2–73–009
Evaluation of the Arsenite Procedure for the Determination of Nitrogen Dioxide in Ambient Air – REF. NO. EPA-650/4–74–048
Evaluation of the Bio-Disc Treatment Process for Summer Camp Application – REF. NO. EPA-670/2–73–022
Evaluation of the Fluidized-Bed Combustion Process Volume I Pressurized Fluidized-Bed Combustion Process Development and Evaluation – REF. NO. EPA-650/2–73–048a
Evaluation of the Fluidized-Bed Combustion Process Volume II – Fluidized Bed Boiler Combined-Cycle Power Plant Development—Volume I Appendices – REF. NO. EPA-650/2–73–048b
Evaluation of the Fluidized-Bed Combustion Process Volume III Pressurized Fluidized-Bed Boiler Development Plant Design – REF. NO. EPA-650/2–73–048c
Evaluation of the Fluidized-Bed Combustion Process Volume IV – Fluidized-Bed Gasification Desulfurization – REF. NO. EPA-650/2–73–048d
Evaluation of the Regenerative Pressurized Fluidized-Bed Combustion Process – REF. NO. EPA-650/2–74–012
Evaluation of the Ryan's Waterproof Thermograph (Model F-30) – REF. NO. EPA-670/4–74–007
Evaluation of the Triethanolamine Procedure for the Determination of Nitrogen Dioxide in Ambient Air – REF. NO. EPA-650/4–74–031
Evaluation of Adjustment Assistance Program with Application for Pollution Control – REF. NO. EPA-600/5–74–029
Evaluation of Aeronetic Two-Phase Jet Scrubber – REF. NO. EPA-650/2–74–129

TITLE INDEX

Evaluation of Alternative Methods For Financing Municipal Waste Treatment Works – REF. NO. EPA-600/5-75-001
Evaluation of Drainage for Salinity Control in Grand Valley – REF. NO. EPA-660/2-74-084
Evaluation of Equations for Designing Ammoniacal Scrubbers to Remove Sulfur Oxides from Waste Gas – REF. NO. EPA-650/2-74-035
Evaluation of Feasibility and Economic Implication of Pricing Mechanisms in Solid Waste Management – REF. NO. EPA-670/5-75-001
Evaluation of Flame Emission Determination of Phosphorus in Water – REF. NO. EPA-660/2-73-007
Evaluation of Health Hazards Associated With Solid Waste Sewage Sludge Mixtures – REF. NO. EPA-670/2-75-023
Evaluation of Instrumentation for Monitoring Total Mercury Emissions from Stationary Sources – REF. NO. EPA-650/2-74-039
Evaluation of Irrigation Scheduling for Salinity Control in Grand Valley – REF. NO. EPA-660/2-74-052
Evaluation of Marketable Effluent Permit Systems – REF. NO. EPA-600/5-74-030
Evaluation of MTF for Testing Hazardous Material Spill Control Equipment – REF. NO. EPA-670/2-74-073
Evaluation of Odor Measurement Techniques Volume I – Animal Rendering Industry – REF. NO. EPA-650/2-74-008a
Evaluation of Pollution Control in Fossil Fuel Conversion Processes Gasification; Section I: Synthane Process – REF. NO. EPA-650/2-74-009b
Evaluation of Pollution Control in Fossil Fuel Conversion Processes Gasification Section I: Kappers-Totzek Process – REF. NO. EPA-650/2-74-009a
Evaluation of Pollution Control in Fossil Fuel Conversion Processes Gasification; Section I: CO2 Acceptor Process – REF. NO. EPA-650/2-74-009d
Evaluation of Pollution Control in Fossil Fuel Conversion Processes Liquefaction: Section I. COED Process – REF. NO. EPA-650/2-74-009e
Evaluation of Pollution Control in Fossil Fuel Conversion Processess Gasification; Section I; Lurgi Process – REF. NO. EPA-650/2-74-009c
Evaluation of Polymeric Clarification of Meat-Packing and Domestic Wastewaters – REF. NO. EPA-660/2-74-020
Evaluation of Prechamber Spark Ignition Engine Concepts – REF. NO. EPA-650/2-75-023
Evaluation of R&D Investment Alternatives for SOx Air Pollution Control Processes – REF. NO. EPA-650/2-74-098
Evaluation of Sulfur Dioxide Emission Control Options for Iowa Power Boilers – REF. NO. EPA-650/2-74-127
Evaluation of Tailings Ponds Sealants – REF. NO. EPA-660/2-74-065
Evaluation of Three Combined Sewage Overflow Treatment Alternatives – REF. NO. EPA-670/2-74-079
Evaluation of TGS-ANSA Procedure for Determination of Nitrogen Dioxide in Ambient Air – REF. NO. EPA-650/4-74-047
Excerpts from Control of Infiltration and Inflow into Sewer Systems and Prevention and Correction of Excessive Infiltration and Inflow Into Sewer Systems – REF. NO. EPA-670/9-74-004
Executive Summary of Three EPA Demonstration Programs in Erosion and Sediment Control – REF. NO. EPA-660/2-74-073
Experimental High Ash Papermill Sludge Landfill – First Annual Report – REF. NO. EPA-670/2-74-076a
Experimental High Ash Papermill Sludge Landfill – Second Annual Report – REF. NO. EPA-670/2-74-076b
Explicit Calibration of the Pills II System – REF. NO. EPA-660/2-73-011
Exploratory Study of Factors Affecting Aerosol Formation – REF. NO. EPA-650/3-75-002
Extended Aeration Sewage Treatment in Cold Climate – REF. NO. EPA-660/2-74-070
EPA Alkali Scrubbing Test Facility: Limestone Wet Scrubbing Test Result – REF. NO. EPA-650/2-74-010
EPA Alkali Scrubbing Test Facility: Sodium Carbonate and Limestone Test Results – REF. NO. EPA-650/2-73-013
EPA Fine Particle Scrubber Symposium (San Diego, 5/28-30/74) – REF. NO. EPA-650/2-74-112
Fabric Boom Concept for Containment and Collection of Floating Oil – REF. NO. EPA-670/2-73-069
Fabric Filter Cleaning Studies – REF. NO. EPA-650/2-75-009
Fabrication and Installation of the Stationary Source Simulator – REF. NO. EPA-650/2-75-015
Fabrication of Single Cell Protein From Cellulosic Wastes – REF. NO. EPA-670/2-75-032
Fate and Effects of Trace Elements in Sewage Sludge When Applied to Agricultural Lands: A Literature Review Study – REF. NO. EPA-670/2-74-005
Fate of Select Pesticides in the Aquatic Environment – REF. NO. EPA-660/3-74-025
Fate of Trace Constituents of Coal During Gasification – REF. NO. EPA-650/2-73-004
Feasibility of a CW Lidar Technique for Measurement of Plume Opacity – REF. NO. EPA-650/2-73-037
Feasibility of Emission Standards Based on Particle Size – REF. NO. EPA-600/5-74-007
Feasibility of Flux Force/Condensation Scrubbing for Fine Particulate Collection – REF. NO. EPA-650/2-73-036
Feasibility of Hydraulic Transport and Treatment of Ground Household Refuse Through Sewers – REF. NO. EPA-670/2-74-019
Feasibility of Hydraulic Transport of Ground Household Refuse Through Sewer Appurtenances – REF. NO. EPA-670/2-74-021
Feasibility of Metrac System for Regional Air Pollution Study – REF. NO. EPA-650/4-74-051
Feasibility of Overflow Overland Flow Treatment of Feedlot Runoff – REF. NO. EPA-660/2-74-062
Feasibility of Overland Flow for Treatment of Raw Domestic Wastewater – REF. NO. EPA-660/2-74-087
Feasibility of 5 gpm Dynactor/Flash Magnetic Separator System to Treat Spilled Hazardous Materials – REF. NO. EPA-670/2-75-004
Feasibility Study of a New Surface Mining Method "Longwall Stripping" – REF. NO. EPA-670/2-74-002
Feasibility Study of the Use of Resonance Scattering for the Remote Detection of S02 – REF. NO. EPA-650/2-74-020
Feasibility Study of Use of Molten Salt Technology for Pyrolysis of Solid Waste – REF. NO. EPA-670/2-75-014
Federal Aircraft Noise Research, Development, and Demonstration Programs: FY 73 – FY 75 – REF. NO. EPA-600/2-75-003
Federal Noise Effects Research: FY 73 – FY 75 – REF. NO. EPA-600/1-75-001
Federal Surface Vehicle Noise Research, Development, and Demonstration Program: FY 73 – FY 75 – REF. NO. EPA-600/2-75-002
Ferric Chloride and Organic Polyelectrolytes for the Removal of Phosphorus – REF. NO. EPA-670/2-73-103
Field Measurements of Particle Size Distribution Sizing Devices – REF. NO. EPA-650/2-73-035
Field Testing: Application of Combustion Modifications to Control NOx Emissions for Utility Boilers – REF. NO. EPA-650/2-74-066
Field Testing: Application of Combustion Modifications to Control Pollutant Emissions from Industrial Boilers – Phase I – REF. NO. EPA-650/2-74-078a
Final Report Deep Water Pilot Plant Treatability Study – REF. NO. EPA-660/2-73-038
Fine Particle Scrubber Performance Tests – REF. NO. EPA-650/2-74-093
First Annual Progress Report on a Study of Corrosion in Municipal Incinerators – REF. NO. EPA-670/2-73-032
First Annual Report: Routing of Solid Waste Collection Vehicles and Appendix B – Optimal Routing of Solid Waste Collection Vehicles – REF. NO. EPA-670/2-74-035B
First Annual Report: Routing of Solid Waste Collection Vehicles and Appendix A – A Linear Programming Approach for the Traveling Salesman Problem – REF. NO. EPA-670/2-74-035A
First Annual Reports of EPA Grants Funded for 1FYGL – REF. NO. EPA-660/3-73-021
Flame Characterization Probes – REF. NO. EPA-650/2-74-023
Flow Establishment and Initial Entrainment of Heated Water Surface Jets – REF. NO. EPA-660/3-75-014
Fluidized Bed Combustion Process Evaluation (Phase I – Residual Oil Gasification/Desulfurization Demonstration at Atmospheric Pressure) Volume I – Summary – REF. NO. EPA-650/2-75-027a

TITLE INDEX

Fluidized Bed Combustion Process Evaluation (Phase I – Residual Oil Gasification/Desulfurization Demonstration at Atmospheric Pressure) Volume II – Appendices – REF. NO. EPA-650/2-75-027b
Fluoride Emissions from Phosphoric Acid Plant Gypsum Ponds – REF. NO. EPA-650/2-74-095
Forecast of the Effects of Air and Water Controls of Solid Waste Generation – REF. NO. EPA-670/2-74-095b
Formation of Aerosols in a Photochemical Fast Row Reactor – REF. NO. EPA-650/3-75-004
Fortran Programs for Analyzing Collaborative Test Date: Part I General Statistics – REF. NO. EPA-670/4-75-004a
Fortran Programs for Analyzing Collaborative Test Date: Part II Scatter Plots – REF. NO. EPA-670/4-75-004b
Full-Scale Desulfurization of Stack Gas by Dry Limestone Injection: Volume 1 – REF. NO. EPA-650/2-73-019a
Full-Scale Desulfurization of Stack Gas by Dry Limestone Injection: Volume II – Appendices A through H – REF. NO. EPA-650/2-73-019b
Full-Scale Desulfurization of Stack Gas by Dry Limestone Injection: Volume III – Appendices I through L – REF. NO. EPA-650/2-73-019c
Future Dredging Quantities in the Great Lakes – REF. NO. EPA-660/3-74-029
Gas Requirements to Pressurize Abandoned Deep Mines – REF. NO. EPA-670/2-73-054
Gasification of Fossil Fuels Under Oxidative, Reductive, and Pyrolytic Conditions – REF. NO. EPA-650/2-73-042
Granite Industry Wastewater Treatment – REF. NO. EPA-660/2-74-040
Great Lakes Water Quality — Status of Pertinent EPA Research – REF. NO. EPA-660/9-74-002
Ground Water Contamination in the Northeast States – REF. NO. EPA-660/2-74-056
Ground Water Pollution Features of Federal and State Laws and Regulations – REF. NO. EPA-600/4-73-001a
Guide for the Evaluation of Atmospheric Analyzers – REF. NO. EPA-650/4-74-014
Guide to Models in Governmental Planning and Operations – REF. NO. EPA-600/5-74-008
Guidelines for Determining Performance Characteristics of Altimated Methods for Measuring Nitrogen Dioxide and Hydrocarbons, Corrected for Methane in Ambient Air – REF. NO. EPA-650/4-74-018
Guidelines for Development of a Quality Assurance Program: Volume XII – Determination of Phosphorus in Gasoline – REF. NO. EPA-650/4-74-005L
Guidelines for Development of a Quality Assurance Program: Volume XIII – Test for Lead in Gasoline by Atomic Absorption Spectrometry – REF. NO. EPA-650/4-74-005m
Guidelines for Development of a Quality Assurance Program: Volume I-Determination of Stack Gas Velocity and Volumetric Flow Rate (Type-S Pitot Tube) – REF. NO. EPA-650/4-74-005a
Guidelines for Development of a Quality Assurance Program: Volume II Gas Analysis for Carbon Dioxide, Excess Air, and Dry Molecular Weight – REF. NO. EPA-650/4-74-005b
Guidelines for Development of a Quality Assurance Program: Volume III Determination of Moisture in Stack Gases – REF. NO. EPA-650/4-74-005c
Guidelines for Development of a Quality Assurance Program: Volume IV Determination of Particulate Emissions from Stationary Sources – REF. NO. EPA-650/4-74-005d
Guidelines for Development of a Quality Assurance Program: Volume VIII Determination of CO Emissions from Stationary Sources by NDIR Spectrometry – REF. NO. EPA-650/4-74-005h
Handbook of Radiochemical Analytical Methods – REF. NO. EPA-680/4-75-001
Haze Formation: It's Nature and Origin – 1973 – REF. NO. EPA-650/3-74-002
Health and Annoyance Impact of Odor Pollution – REF. NO. EPA-650/1-75-001
Health Consequences of Sulfur Oxides: A Report from CHESS,1970–1971 – REF. NO. EPA-650/1-74-004
Heavy Metal Accumulation in Soil and Vegetation From Smelter Emissions – REF. NO. EPA-660/3-74-012
Herbicide Runoff from Four Coastal Plain Soil Types – REF. NO. EPA-660/2-74-017
High-Temperature Vortex Incinerator – REF. NO. EPA-670/2-75-025
Highway Air Pollution Measurement Program Using Sulfur Hexafluoride Tracer Gas – REF. NO. EPA-650/4-74-043
Hospital Solid Waste Disposal in Community Facilities – REF. NO. EPA-670/2-73-048
Hospital Solid Waste: An Annotated Bibliography – REF. NO. EPA-670/5-74-001
Hydrogen Peroxide Cures Filamentous Growth in Activated Sludge – REF. NO. EPA-670/2-73-033
Hypochlorination of Pollution Stormwater Pumpage at New Orleans – REF. NO. EPA-670/2-73-067
Hypolimnetic Flow Regimes in Lakes and Impoundments – REF. NO. EPA-660/2-74-053
Hypolimnion Aeration With Commercial Oxygen – Volume I – Dynamics of Bubble Plume – REF. NO. EPA-660/2-73-025a
Hypolimnion Aeration With Commercial Oxygen – Volume II – Bubble Plume Gas Transfer – REF. NO. EPA-660/2-73-025b
Identification and Assessment of Asbestos Emissions from Incidental Sources of Asbestos – REF. NO. EPA-650/2-74-087
Identification and Characterization of the Use of Mixed Conventional and Waste Fuels – REF. NO. EPA-650/2-75-017
Impact of the Use of Microorganisms on the Aquatic Environment – REF. NO. EPA-660/3-75-001
Implementation of a Computer Based Information System for Mass Spectral Identification – REF. NO. EPA-660/2-74-048
Improved Air Pollution Control for a Kraft Recovery Boiler: Recovery Boiler No. 4 – REF. NO. EPA-650/2-74-071b
Improved Air Pollution Control for Kraft Recovery Boiler: Modified Recovery Boiler No. 3 – REF. NO. EPA-650/2-74-071a
Improvement of Instrumentation and Methodology for Collection and Analysis of Mercury – REF. NO. EPA-650/2-75-028
Improvement of Treatment of Food Industry Waste – REF. NO. EPA-660/2-74-035
In-Stack Transmissometer Evaluation and Application to Particulate Opacity Measurement – REF. NO. EPA-650/2-75-008
In-Stack Transmissometer Measurement of Particulate Opacity and Mass Concentration – REF. NO. EPA-650/2-74-120
Incineration of Bulky Refuse Without Prior Shredding – REF. NO. EPA-670/2-73-023
Incineration of Plastics Found in Municipal Wastes – REF. NO. EPA-670/2-73-087
Indexed Bibliography of Office of Research and Development Reports – Updated to January 1975 – REF. NO. EPA-600/9-74-002
Indexed Bibliography of Office of Research and Development Reports – REF. NO. EPA-600/9-74-001
Indigester Black Liquor Oxidation for Odor Control in Kraft Pulping – REF. NO. EPA-650/2-74-005
Industrial Chemicals Solid Waste Generation — The Significance of Process Resource Recovery, and Improved Disposal – REF. NO. EPA-670/2-74-078
Industrial Solid Waste Classification Systems – REF. NO. EPA-670/2-75-024
Industrial Water Softener Waste Brine Reclamation – REF. NO. EPA-660/2-74-007
Influence of Fiber Characteristics on Particulate Filtration – REF. NO. EPA-650/2-75-002
Influence of Fly Ash Compositional Factors on Electrical Volume Resistivity – REF. NO. EPA-650/2-74-074
Influences of Wastewater Management on Land Use: Tahoe Basin 1950–1972 – REF. NO. EPA-600/5-74-019
Information Resource: Final Report Water Pollution Control in Water Utilities – REF. NO. EPA-660/2-73-020
Infrared Dry Caustic vs. Wet Caustic Peeling of White Potatoes – REF. NO. EPA-660/2-74-088
Infrared Fourier Transform Spectrometry of Gas Chromatography Effluents – REF. NO. EPA-660/2-73-034
Infrared Gas Filter Correlation Instrument for In-Situ Measurement of Gaseous Pollutants – REF. NO. EPA-650/2-74-094

TITLE INDEX

Infrared Spectral Sensor for Refuse Sorting – REF. NO. EPA-670/2-74-031
Instream Aeration to Control Dissolved Sulfide in Sanitary Sewers – REF. NO. EPA-670/2-73-024
Instrument for Simultaneous Monitoring NO_x and SO_2 in Stationary Sources – REF. NO. EPA-650/2-73-027
Instrument to Monitor CH_4, CO and CO_2 in Auto Exhaust – REF. NO. EPA-650/2-73-030
Instrumental Analyses for Wet Scrubbing Processes – REF. NO. EPA-650/2-74-064
Instrumentation and Methodology for the Assay of Polynuclear Aromatic Hydrocarbons – REF. NO. EPA-650/2-74-069
Integrated Multi-media Pollution Model – REF. NO. EPA-600/5-74-020
Interactions of Stack Gas Sulfur and Nitrogen Oxides on Dry Berkau – REF. NO. EPA-650/2-73-029
Interactions of Various Air Pollutants on Causation of Pulmonary Disease – REF. NO. EPA-650/1-73-002
Interfacing a 24-Point Analog Recorder to a Computer Controlled Telemetry Line – REF. NO. EPA-670/4-75-002
Interferometric Instrumentation For Particle Size Analysis – REF. NO. EPA-650/2-73-034
Interim Report of Task Force on Phosphate Removal Sludges – REF. NO. EPA-670/2-75-013
Intermedia Aspects of Air and Water Pollution Control – REF. NO. EPA-600/5-73-003
Interpretative Compilation of EPA Studies Related to Coal Quality and Cleanability – REF. NO. EPA-650/2-74-030
Invariant Modeling of Turbulence and Diffusion in the Planetary Boundary Layer – REF. NO. EPA-650/4-74-035
Investigation of the Effects of Carbon Monoxide on Humans in the Driving Task – REF. NO. EPA-650/1-73-003
Investigation of Corrosion Deposition Phenomena on Gas Turbine Blades – REF. NO. EPA-670/2-73-006
Investigation of Extractive Sampling Interface Parameters – REF. NO. EPA-650/2-74-089
Investigation of Particulate Emission from Oil-Fired Residential Heating Units – REF. NO. EPA-650/2-74-026
Investigation of Remote Sensing Techniques for Agricultural Feedlot Pollution Detection – REF. NO. EPA-670/4-73-002
Investigation of Surface Combustion Concepts for NO_x Control in Utility Boilers and Stationary Gas Turbines – REF. NO. EPA-650/2-73-014
Investigation of Surface Films – Chesapeake Bay Entrance – REF. NO. EPA-670/2-73-099
Ion Exchange Process for Recovery of Chromate from Pigment Manufacturing – REF. NO. EPA-670/2-74-044
Ion-Selective Membranes Electrodes for Water Pollution Water Monitoring – REF. NO. EPA-660/2-74-079
Iron Foundry Cupola Recuperative Emission Control Demonstration — Design Manual – REF. NO. EPA-650/2-74-004
Isolation of Hayfever Antigens from Short Ragweed Pollen – REF. NO. EPA-650/2-74-044
Joint Construction Sediment Control Project – REF. NO. EPA-660/2-73-035
Kinetic Mechanisms of Methane/Air Combustion with Pollutant Formation – REF. NO. EPA-650/2-74-045
Kinetic Mechanisms Governing the Fate of Chemically Bound Sulfur and Nitrogen in Combustion – REF. NO. EPA-650/2-74-017
Laboratory and Field Evaluations of EPA Methods 2, 6 and 7 – REF. NO. EPA-650/4-74-039
Laboratory and Numerical Simulation of Plume Dispersion in Stably Stratified Flow Over Complex Terrain – REF. NO. EPA-650/4-74-044
Laboratory Analyses of Atmospheric Hydrocarbon – California South Coast Air Basin (Los Angeles Air Quality Control Region) August – November 1973 – REF. NO. EPA-650/4-74-052
Laboratory Ozonation of Municipal Wastewater – REF. NO. EPA-670/2-73-075
Laboratory Study of Continous Electro-oxidation of Dilute Cuanide Waste – REF. NO. EPA-670/2-74-059
Laboratory Study of Self-Sealing Limestone Plugs for Mine Openings – REF. NO. EPA-670/2-73-081
Land Application of Sludge Effluent and Sludges: Selected Abstracts – REF. NO. EPA-660/2-74-042
Land Use Forms and the Environment – An Executive Summary – REF. NO. EPA-600/5-75-003
Lidar Studies of Stack Plumes in Rural and Urban Environments – REF. NO. EPA-650/4-73-002
Lime Disinfection of Sewage Bacteria at Low Temperature – REF. NO. EPA-660/2-73-017
Lime Stabilized Sludge: Its Stability and Effect on Agricultural Land – REF. NO. EPA-670/2-75-012
Lime/Limestone Scrubbing in a Pilot Dustraxtor – Key West – REF. NO. EPA-650/2-74-077
Limestone and Limestone-Lime Neutralization of Acid Mine Drainage – REF. NO. EPA-670/2-74-051
Limited SO_2 and NOX Measurements in St. Louis, 1974: Volume I – Plume Tracking by Correlation Spectroscopy – REF. NO. EPA-650/2-75-005a
Limnological Studies of Flat-head, Montana: A Status Report – REF. NO. EPA-660/3-74-023
Liquid Aerobic Composting of Cattle Wastes and Evaluation of Byproducts – REF. NO. EPA-660/2-74-034
Literature Search and Analysis of Information Regarding Sources, Uses, Production, Consumption, Reported Medical Cases and Toxicology of Platinum and Palladium – REF. NO. EPA-650/1-74-008
Literature Survey of Instrumental Measurements of Biochemical Oxygen Demand for Control Application, 1960–1963 – REF. NO. EPA-670/4-74-001
Livestock and the Environment – A Bibliography without Abstracts – REF. NO. EPA-660/2-74-024
Livestock and the Environment—A Bibliography with Abstracts, Volume II – REF. NO. EPA-660/2-75-003
Lone Star Steel Steam-Hydro Air Cleaning System Evaluation – REF. NO. EPA-650/2-74-028
Losses of Fertilizers and Pesticides from Claypan Soils – REF. NO. EPA-660/2-74-068
Low Winter Dissolved Oxygen in Some Alaskan Rivers – REF. NO. EPA-660/3-74-008
Management Practices Affecting Quality and Quantity of Irrigation Return Flow – REF. NO. EPA-660/2-75-005
Managing the Environment – REF. NO. EPA-600/5-73-010
Manual for Deicer Chemical Application Practices – REF. NO. EPA-670/2-74-045
Manual for Deicing Chemical Storage and Handling – REF. NO. EPA-670/2-74-033
Manual Methods for Sampling and Analysis of Particulate Emissions From Municipal Incinerators – REF. NO. EPA-650/2-73-023
Marine Algal Assay Procedure Bottle Test – REF. NO. EPA-660/3-75-008
Marketing H_2SO_4 from SO_2 Abatement Sources— The TVA Hypothesis – REF. NO. EPA-650/2-73-051
Mathematical Analysis of the Kinetics of Viral Inactivation – REF. NO. EPA-670/2-74-067
Mathematical Model for Aerobic Digestion – REF. NO. EPA-670/2-73-045
Mathematical Model for Barged Ocean Disposal of Wastes – REF. NO. EPA-660/2-73-029
Mathematical Model for Post Aeration – REF. NO. EPA-670/2-73-044
Mathematical Modeling of Phytoplankton in Lake Ontario – REF. NO. EPA-660/3-75-005
Mathematical Simulation of an Adsorber for Pollutant Removal – REF. NO. EPA-650/2-74-110
Mathematical Simulation of Atmospheric Photochemical Reactions: Model Development, Validation, and Application – REF. NO. EPA-650/4-74-011
Mathematical Simulation of Smog Chamber Photo-Chemical Experiments – REF. NO. EPA-650/4-74-040
Measurement and Characterization of Particles in Wet Scrubbing Process for SO_x Control – REF. NO. EPA-650/2-73-024
Measurement of the Opacity and Mass Concentration of Particulate Emissions by Transmissometry – REF. NO. EPA-650/2-74-128
Measurement of Entrained Liquid Levels in Effluent Gases from Scrubber Demisters – REF. NO. EPA-650/2-74-050

TITLE INDEX

Measurement of Residual Chlorine Levels in Cooling Water — Amperometric Method – REF. NO. EPA-660/2–73–039
Measurement of Sulfur Dioxide, Particulate, and Trace Elements in Copper Smelter Converter and Roaster/Reverberatory Gas Streams – REF. NO. EPA-650/2–74–111
Measures of Effectiveness for Refuse Storage, Collection, and Transportation Practices – REF. NO. EPA-670/2–74–082
Mercury in the Aquatic Systems: Metholation, OxidationReduction; in Bio Accumulation – REF. NO. EPA-660/3–74–021
Mercury in the Environment – REF. NO. EPA-660/2–73–008
Mercury Recovery from Contaminated Waste Waters and Sludges – REF. NO. EPA-660/2–74–086
Mesoscale Windfield Analysis of Los Angeles Basin – REF. NO. EPA-650/4–73–001
Metabolism of Carbamate Insecticides – REF. NO. EPA-650/1–74–002
Metallic Recovery From Waste Waters Utilizing Cementation – REF. NO. EPA-670/2–74–008
Metallurgical Upgrading of Automotive Scrap Steel – REF. NO. EPA-670/2–73–091
Meteorological Episodes of Slowest Dilution in Contiguous United States – REF. NO. EPA-650/4–74–002
Methodology for Assignment of a Hydrocarbon Photochemical Reactivity Index for Emissions From Mobile Sources – REF. NO. EPA-650/2–75–025
Methodology for Treating Large Localized Emissions of Reactive Pollutants – REF. NO. EPA-650/4–74–006
Methods for Acute Toxicity Tests with Fish, Macroinvertebrates, and Amphibians – REF. NO. EPA-660/3–75–009
Methods for Improvement of Trickling Filter Plant Performance, Part I Mechanical and Biological Optima – REF. NO. EPA-670/2–73–047a
Methods for Improvement of Trickling Filter Plant Performance, Part II – REF. NO. EPA-670/2–73–047b
Methods for Rapid and Accurate Measurement of Nitrate and Sulfate in Atmospheric Particulates – REF. NO. EPA-650/2–73–050
Microbial Degradation and Accumulation of Pesticides in Aquatic Systems – REF. NO. EPA-660/3–75–007
Microbiological Production of Geosmin – REF. NO. EPA-670/2–74–094
Microbiology of Sewage Sludge Disposal in Soil – REF. NO. EPA-670/2–74–074
Microstraining and Disinfection of Combined Sewer Overflows – Phase III – REF. NO. EPA-670/2–74–049
Mine Drainage Pollution Control Demonstration Grant Procedures and Requirement – REF. NO. EPA-670/2–74–003
Mine Spoil Potentials for Soil and Water Quality – REF. NO. EPA-670/2–74–070
Modal Cities – REF. NO. EPA-600/5–74–027
Model for Optimal Design and Operation of Solid Waste Transfer Stations – REF. NO. EPA-670/5–74–009
Model Verification – Aircraft Emissions Impact on Air Quality – REF. NO. EPA-650/4–74–049
Modeling Dynamics of Biological and Chemical Components of Aquatic Ecosystems – REF. NO. EPA-660/3–75–012
Modifications to the Executive Computer Program for Steady-State Simulation of Wastewater Treatment Facilities – REF. NO. EPA-670/2–74–066
Modular Wastewater Treatment System Demonstration For the Textile Maintenance Industry – REF. NO. EPA-660/2–73–037
Molecular Modulation Spectrometry for Observation of Free Radicals – REF. NO. EPA-650/4–74–004
Multi-Purpose Combined Sewer Overflow Treatment Facility, Mount Clemens, Michigan – REF. NO. EPA-670/2–75–010
Multielement Analyses of Environmental Samples by Spark Source Mass Spectrometry – REF. NO. EPA-660/2–74–001
Municipal Waste Disposal by Shipborne Incineration and Sea-Disposal of Residues – REF. NO. EPA-670/2–73–017
Municipal Water Pollution Control Abstracts for 1974 – REF. NO. EPA-600/2–75–005
Negatively Buoyant Jets in a Cross Flow – REF. NO. EPA-660/2–73–012
New Membranes for Reverse Osmosis Treatment of Metal Finishing Effluents – REF. NO. EPA-660/2–73–033
New Microbial Indicators of Wastewater Chlorination Efficiency – REF. NO. EPA-670/2–73–082
News of Environmental Research in Cincinnati – May-December, 1973 – REF. NO. EPA-670/9-74–002
News of Environmental Research in Cincinnati, January – December 1974 – REF. NO. EPA-670/9-75–003
Nitrate and Nitrite Volatilization By Microorganisms in Laboratory Experiments – REF. NO. EPA-660/2–73–002
Nitrite-Accelerated Photochemical Degradation of Cellulose as a Pretreatment for Microbiological Conversion to Protein – REF. NO. EPA-670/2–73–052
Nitrogen and Phosphorus Losses from Agronomy Plots in North Alabama – REF. NO. EPA-660/2–74–033
Nitrogen Removal By Ammonia Stripping – REF. NO. EPA-670/2–73–040
Nitrogen Sources and Cycling in Natural Waters – REF. NO. EPA-660/3–73–002
Nitrogenous Compounds in the Environment – REF. NO. EPA-SAB-73–001
No. Cancelled – REF. NO. EPA-660/3–74–030
Nomographs for Thermal Pollution Control Systems – REF. NO. EPA-660/2–73–004
Normal Carboxyhemoglobin Levels of Blood Donors in the United States – REF. NO. EPA-650/1–73–004
North Fork Alluvial Decontamination Project, Hubbard Creek Reservoir Watershed – REF. NO. EPA-660/2–74–019
Nutrient Inactivation As A Lake Restoration Procedure — I. Laboratory Investigations – REF. NO. EPA-660/3–74–032
NERC-Cincinnati Annual Report, 1974 – REF. NO. EPA-670/9-75–002
NO2 Actinometer for Field Use – REF. NO. EPA-650/4–74–036
NO2 Measuring System – REF. NO. EPA-650/2–74–059
NTA and Mercury in Artificial Stream Systems – REF. NO. EPA-660/3–73–025
Occurrence and Distribution of Potentially Volatile Trace Elements in Coal – REF. NO. EPA-650/2–74–054
Occurrence of Organohalides in Chlorinated Drinking Waters – REF. NO: EPA-670/4–74–008
Odor Removal from Air by Adsorption on Charcoal – REF. NO. EPA-650/2–74–084
Odors from Confined Livestock Production – A State of the Art – REF. NO. EPA-660/2–74–023
Odors Emitted From Raw and Digested Sewage Sludge – REF. NO. EPA-670/2–73–098
Off-the-Shelf Analyzers for Measuring Adenosine Triphosphate (ATP) in Activated Sludge – REF. NO. EPA-670/2–74–034
Oil Recovery System Using Sorbent Material – REF. NO. EPA-670/2–73–068
Oil Recovery System Utilizing Polyurethane Foam—A Feasibility Study – REF. NO. EPA-670/2–73–084
Oil Spill and Oil Pollution Reports – REF. NO. EPA-670/2–75–003
On-Line Colorimetric Analyzers for Monitoring Nitrate-Nitrite, Ammonia, Orthophosphorus and Total Hydrolyzable Phosphorus in Wastewater-Treatment Process Streams – REF. NO. EPA-670/2–74–046
On-Shore Treatment Systems for Sewerage from Watercraft Retention Systems – REF. NO. EPA-670/2–75–007
Optical Measurements of Smoke Particle Size Generated by Electric Arcs – REF. NO. EPA-650/2–74–034
Optimal Configuration of a Regional Solid Waste Management System – REF. NO. EPA-670/5–74–007
Optimization and Design of an Oil/Activated Sludge Concentration Process – REF. NO. EPA-670/2–74–004
Optimization of Air Pollution Measurement Locations – REF. NO. EPA-650/4–75–005
Optimization Models for Regional Public Systems – REF. NO. EPA-670/5–74–008
Organic Compounds Entering Groundwater from a Landfill – REF. NO. EPA-660/2–74–077

TITLE INDEX

Organic Nutrient Factors Effecting Algal Growths – REF. NO. EPA-660/3–73–003
Outpatient Medical Costs Related to Air Pollution in the Portland, Oregon Area – REF. NO. EPA-600/5–74–017
Oxidation of Organic Matter in Sediments – REF. NO. EPA-660/3–73–005
Oxygenation of Aqueous Bodies Using Liquid Oxygen-Loxination – REF. NO. EPA-670/2–74–048
Particulate Collection Study, EPA/TVA Full-Scale Dry Limestone Injection Tests – REF. NO. EPA-650/2–74–053
Particulate Emissions from Alfalfa Dehydrating Plants — Control Costs and Effectiveness – REF. NO. EPA-650/2–74–007
Particulate Sizing Techniques for Control Device Evaluation – REF. NO. EPA-650/2–74–102
Paunch Manure as a Feed Supplement in Channel Catfish Farming – REF. NO. EPA-660/2–74–046
Pentapure Impinger Evaluation – REF. NO. EPA-650/2–75–024a
Performance of the OSCO Model 1391 Water Wastewater Sampler – REF. NO. EPA-670/4–75–001
Performance of the Union Carbide Dissolved Oxygen Sensor – REF. NO. EPA-670/4–73–018
Performance Controls for Sensitive Lands – REF. NO. EPA-600/5–75–005
Performance Specifications for Stationary-Source Monitoring Systems for Gases and Visible Emissions – REF. NO. EPA-650/2–74–013
Pesticide Movement from Crop Lands into Lake Erie – REF. NO. EPA-660/2–74–032
Pesticide, Transport and Runoff Model for Agricultural Land – REF. NO. EPA-660/2–74–013
Pesticides in the Illinois Waters of Lake Michigan – REF. NO. EPA-660/3–74–002
Pesticides Epidemiological Field Studies – REF. NO. EPA-650/1–74–009
Petrograhpic Characteristics and Physical Properties of Marls, Chalks, Shells and Their Calcines Related to Desulfurization of Flue Gases – REF. NO. EPA-650/2–73–044
Petroleum Weathering: Some Pathways, Fate and Disposition on Marine Waters – REF. NO. EPA-660/3–73–013
Pharmacokinetics of Toxic Elements in Rainbow Trout – REF. NO. EPA-660/3–74–027
Phosphate Removal in an Activated Sludge Facility – REF. NO. EPA-670/2–74–061
Phosphorus Uptake and Release by Lake Ontario Sediments – REF. NO. EPA-660/3–75–006
Physical – Chemical Treatment of Raw Material Wastewater – REF. NO. EPA-670/2–73–070
Physical and Setling Characteristics of Particulates in Storm and Sanitary Wastewaters – REF. NO. EPA-670/2–75–011
Physical-Chemical Treatment of Municipal Wastes by Recycled Magnesium Carbonate – REF. NO. EPA-660/2–74–055
Physical, Chemical and Microbiological Methods of Solid Waste Testing – REF. NO. EPA-670/2–73–001
Physical, Chemical and Microbiological Methods of Solid Waste Testing: Four Additional Procedures – REF. NO. EPA-670/2–74–007
Phytoplankton Composition and Abundance in Lake Ontario During IFYGL – REF. NO. EPA-660/3–75–004
Pilot – Demonstration Project for Industrial Reuse of Renovated Municipal Wastewater – REF. NO. EPA-670/2–73–064
Pilot Plant Optimization of Phosphoric Acid Recovery Process – REF. NO. EPA-670/2–75–015
Pilot Scale Treatment of Wine Stillage – REF. NO. EPA-660/2–75–002
Pilot-Plant Study of an Ammonia Absorption Ammonium Bisulfate Regeneration Process, Topical Report Phases I and II – REF. NO. EPA-650/2–74–049a
Planned Maintenance Management System for Municipal Wastewater Treatment Plants – REF. NO. EPA-600/2–73–004
Plant Scale Studies of the Magnesium Carbonate Water Treatment Process – REF. NO. EPA-660/2–75–006
Plume Temperature Measurements of Shallow Submerged Model Discharges With Current – REF. NO. EPA-660/2–73–001
Pneumo-Slurry Pipeline Collection and Removal of Municipal Solid Waste – REF. NO. EPA-670/2–73–072
Pollutant Analysis Cost Survey – REF. NO. EPA-650/2–74–125
Polluted Groundwater: A Review of the Significant Literature – REF. NO. EPA-600/4–74–001
Polluted Groundwater: Estimating the Effects of Man's Activities (Formerly 600/4–74–002) – REF. NO. EPA-680/4–74–002
Polluted Groundwater: Some Causes, Effects, Controls and Monitoring – REF. NO. EPA-600/4–73–001b
Pollution Aspects of Catfish Production—Review and Projections – REF. NO. EPA-660/2–74–064
Pollution Control in the Commercial Explosives Industry – REF. NO. EPA-600/2–74–009b
Pollution Control Technology for Pesticide Formulators and Packagers – REF. NO. EPA-660/2–74–094
Pollution Control Technology Assessment – Proceedings of an Environmental Resources Conference, May 1–3, 1974 – REF. NO. EPA-670/9-74–006
Pollution Effects on Adult Steelhead Migration in the Snake River – REF. NO. EPA-660/3–73–017
Pollution Problems and Research Needs for an Oil Shale Industry – REF. NO. EPA-660/2–74–067
Portable Device for Measuring Wastewater Flow in Sewers – REF. NO. EPA-600/2–73–002
Poultry Manure Disposal by Plow-Furrow-Cover – REF. NO. EPA-670/2–73–085
Poultry Processing Wastewater Treatment and Reuses – REF. NO. EPA-660/2–74–060
Precipitation Scavenging of Inorganic Pollutants from Metropolitan Sources – REF. NO. EPA-650/3–74–005
Prediction of Sub-soil Erodibility Using Chemical, Mineralogical and Physical Parameters – REF. NO. EPA-660/2–74–043
Preliminary Assessment of Wet Systems for Residential Refuse Collection – REF. NO. EPA-670/2–74–065
Preliminary Design of a Household Refuse Grinder – REF. NO. EPA-670/2–74–020
Preparation and Evaluation of Activated Carbon Produced from Municipal Refuse – REF. NO. EPA-670/2–73–010
Preventing Landfill Leachate Contamination of Water – REF. NO. EPA-670/2–73–021
Pricing for Water Supply: Its Impact on Systems Management – REF. NO. EPA-670/1–74–001
Problems and Opportunities in Management of Combustible Solid Wastes – REF. NO. EPA-670/2–73–056
Procedures for Measurement in Stratified Gases – Volume I – REF. NO. EPA-650/2–74–086a
Procedures for Measurement in Stratified Gases – Volume II, Appendices – REF. NO. EPA-650/2–74–086b
Proceeding, Coal Combustion Seminar, June 19-20, 1973 – REF. NO. EPA-650/2–73–021
Proceedings of the Solvent Reactivity Conference – REF. NO. EPA-650/3–74–010
Proceedings of Seminar on Methodology for Monitoring the Marine Environment – REF. NO. EPA-600/4–74–004
Proceedings of Symposium on Statistical Aspects of Air Quality – REF. NO. EPA-650/4–74–038
Proceedings of Third International Conference on Fluidized-Bed Combustion – REF. NO. EPA-650/2–73–053
Proceedings Fourth National Symposium on Food Processing Wastes – REF. NO. EPA-660/2–73–031
Proceedings, Symposium Control of Fine-Particulate Emissions from Industrial Sources, January 15–18, 1974 San Francisco, CA – REF. NO. EPA-600/2–74–008
Proceedings: Fifth National Symposium on Food Processing Wastes – REF. NO. EPA-660/2–74–058
Proceedings: Flue Gas Desulfurization Symposium 1973 – REF. NO. EPA-650/2–73–038
Proceedings: Symposium on the Use of Fabric Filters for the Control of Submicron Particulates (April 8–10, 1974, Boston, Ma.) – REF. NO. EPA-650/2–74–043
Proceedings: Symposium on Flue Gas Desulfurization – Atlanta, November 1974, Volume II – REF. NO. EPA-650/2–74–126b
Process Modifications for Control of Particulate Emissions from Stationary Combustion, Incineration, and Metals – REF. NO. EPA-650/2–74–100
Production of Clean Fuel Gas From Bituminous Coal – REF. NO. EPA-650/2–73–049

TITLE INDEX

Production of Low-Sulfur Gasoline – REF. NO. EPA-650/2–74–130
Program for Reduction of NOx from Tangential Coal-Fired Boilers Phase 1 – REF. NO. EPA-650/2–73–005
Programmed Demonstration for Erosion and Sediment Control Specialist – REF. NO. EPA-660/2–74–071
Progress in Instrumentation and Techniques for Measurement of Air Pollutants – REF. NO. EPA-650/2–74–015
Projects in the Industrial Pollution Control Division – December 1974 – REF. NO. EPA-600/2–75–001
Promising Technologies for Treating Hazardous Waste – REF. NO. EPA-670/2–74–088
Promoting Environmental Quality Through Urban Planning and Control – REF. NO. EPA-600/5–73–015
Properties of Ammonium Sulfate, Ammonium, and Sulfur Dioxide Solutions in Ammonia Scrubbing Processes – REF. NO. EPA-650/2–73–012
Protein Production from Acid Whey VIA Fermentation – REF. NO. EPA-660/2–74–025
Protocol for Evaluating the Nitrogen Status of Lake Sediments – REF. NO. EPA-660/3–73–024
Public Attitudes Toward Hazardous Waste Disposal Facilities – REF. NO. EPA-670/2–73–086
Puget Sound Oceanographic Field Studies Data Report, Everett, BELLINGHAM, Port Angeles, 1962–63 – REF. NO. EPA-660/3–73–014
Pyrolysis of Solid Municipal Wastes – REF. NO. EPA-670/2–73–039
Quantification of Pollution in Agricultural Runoff – REF. NO. EPA-660/2–74–005
Quantitative Analysis of Airborne Asbestos by X-Ray Diffraction: Final Report on Feasibility Study – REF. NO. EPA-650/2–75–004
Radioactivity Standards Distribution Program, 1973 – 1974 – REF. NO. EPA-680/4–73–001A
Radiolytic Hydrolysis of Cellulose – REF. NO. EPA-670/2–73–030
Rationale and Methodology for Monitoring Groundwater Polluted by Mining Activities (Formerly 600/4–74–003) – REF. NO. EPA-680/4–74–003
Raw Materials Transportation Costs and Their Influence on the Use of Wastepaper and Scrap Iron and Steel, Volume I – Technical Discussion – REF. NO. EPA-670/2–74–024A
Raw Materials Transportation Costs and Their Influence on the Use of Wastepaper and Scrap Iron and Steel, Volume II – Appendices – REF. NO. EPA-670/2–74–024B
Reactivity of Polynuclear Aromatic Hydrocarbons with O2 and NO in the Presence of Light – REF. NO. EPA-650/1–74–010
Recirculating Waste System for Swine Units – REF. NO. EPA-670/2–73–025
Reclamation of Energy from Organic Waste – REF. NO. EPA-670/2–74–016
Reclamation of Metal Values from Metal-Finishing Waste Treatment Sludges – REF. NO. EPA-670/2–75–018
Reclamation of Sulfuric Acid From Waste Streams – REF. NO. EPA-670/2–75–016
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume I – Summary Report – REF. NO. EPA-670/2–73–053A
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume II – Toxicologic Summary – REF. NO. EPA-670/2–73–053B
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume III – Disposal Process Discriptions: Ultimate Disposal Incineration, and Pyrolysis Processes – REF. NO. EPA-670/2–73–053C
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volum IV – Disposal Process Descriptions: Biological and Miscellaneous Waste Treatment Processes – REF. NO. EPA-670/2–73–053D
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume V – National Disposal Site Candidate Waste Stream Constituent Profile Reports – Pesticides and Cyanide Compounds – REF. NO. EPA-670/2–73–053E
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume VI – National Disposal Site Candidate Waste Stream Constituent Profile Report – Mercury, Arsenic, Chromium and Cadmium Compounds – REF. NO. EPA-670/2–73–053F
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume VII – National Disposal Site Candidate Waste Stream Constituent Profile Report – Propellants, Explosives, and Chemical Warfare Materiel – REF. NO. EPA-670/2–73–053G
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume VIII – National Disposal Site Candidate Waste Stream Constituent Profile Report – Miscellaneous Inorganic and Organic Compounds – REF. NO. EPA-670/2–73–053H
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume IX – National Disposal Site Candidate Waste Stream Constituent Profile Report – Radioactive Materials – REF. NO. EPA-670/2–73–053I
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume X – Industrial and Municipal Disposal Candidate Waste Stream Constituent Profile Reports – Organic Compounds – REF. NO. EPA-670/2–73–053J
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume XI – Industrial and Municipal Disposal Candidate Waste Stream Constituent Profile Reports – Organic Compounds – REF. NO. EPA-670/2–73–053K
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume XII – Industrial and Municipal Disposal Candidate Waste Stream Constituent Profile Reports – Inorganic Compounds – REF. NO. EPA-670/2–73–053L
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume XIII – Industrial and Municipal Disposal Candidate Waste Stream Constituent Profile Reports – Inorganic Compounds – REF. NO. EPA-670/2–73–053M
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume XIV – Summary of Waste Origins, Forms and Quantities – REF. NO. EPA-670/2–73–053N
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume XV – Research and Development Plans – REF. NO. EPA-670/2–73–053O
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume XVI – References – REF. NO. EPA-670/2–73–053P
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume I thru Volume XVI – REF. NO. EPA-670/2–73–053A-P
Recovery of Fatty Materials From Edible Oil Refinery Effluents – REF. NO. EPA-660/2–73–015
Reduction of Atmospheric Pollution by the Application of Fluidized-Bed Combustion – REF. NO. EPA-650/2–74–057
Reduction of Atmospheric Pollution by the Application of Fluidized-Bed Combustion and Regeneration of Sulfur-Containing Additives – REF. NO. EPA-650/2–74–104
Refinery Catalytic Cracker Reginerator SOx Control Process Survey – REF. NO. EPA-650/2–74–082
Regeneration of Chromated Aluminum Deoxidizers – REF. NO. EPA-660/2–73–023
Regenerative Limestone Process for Fluidized – Bed Coal Combustion and Desulfurization – REF. NO. EPA-650/2–74–001
Regional Governmental Arrangements in Metropolitan Areas: Nine Case Studies – REF. NO. EPA-600/5–74–024
Relationship Between Diameter and Height for the Design of a Swirl Concentrator as a Combined Sewer Overflow Regulator – REF. NO. EPA-670/2–74–039
Remote Sensing of Air Pollution in Urban Areas – REF. NO. EPA-650/2–73–026
Remote Sensing of Pollutants – Computerized Reduction of Long-Path Absorption Data – REF. NO. EPA-650/2–74–113
Removal of Heavy Metals from Mine Drainage by Precipitation – REF. NO. EPA-670/2–73–080
Removal of Manganese From Mine Drainage by Ozone and Chlorine – REF. NO. EPA-670/2–75–006

TITLE INDEX

Renovation of Seconda ? Effluent for Re-use as a Water Resource – REF. NO. EPA-660/2-74-016
Research and Development of a Selective Algaecide to Control Nuisance Algal Growth-Phase III – REF. NO. EPA-660/3-74-019
Research Needs and Priorities: Water Pollution Control Benefits and Cost – Volume II – REF. NO. EPA-600/5-73-008b
Research Study of Coal Preparation Plant and By-Product Coke Plant Effluents – REF. NO. EPA-660/2-74-050
Reverse Osmosis of Treated and Untreated Secondary Sewage Effluent – REF. NO. EPA-670/2-74-077
Reverse Osmosis of Treated and Untreated Secondary Sewage Effluent; Appendix A-2 and Appendix A-6 – REF. NO. EPA-670/2-75-027
Review of the Physiological Impact of Mercurials – REF. NO. EPA-660/3-73-022
Review of Environmental Impact Assessment Methodologies – REF. NO. EPA-600/5-74-002
Reviewing Environmental Impact Statements – Power Plant Cooling Systems, Engineering Aspects – REF. NO. EPA-660/2-73-016
Reviews of Current Literature on Analytical Methodology and Quality Control – Activities for 1973 through 1974 – REF. NO. EPA-670/4-74-003b
Role of Polyelectrolytes in Filtration Processes – REF. NO. EPA-670/2-74-032
Role of Solid-Gas Interactions in Air Pollution – REF. NO. EPA-650/3-74-007
Role of Trace Elements in Management of Nuisance Growths – REF. NO. EPA-660/2-75-008
Rotating Biological Disk Wastewater Treatment Process – Pilot Plant Evaluation – REF. NO. EPA-670/2-73-027
Routing of Solid Waste Collection Vehicles, Final Report: Appendix A – Manual for Use of the Computer Codes – REF. NO. EPA-670/2-74-036A
Routing of Solid Waste Collection Vehicles: Appendix B – A Heuristic Solution to the M-Postmen's Problem – REF. NO. EPA-670/2-74-036B
Rum Distillery Slops Treatment by Anaerobic Contact Process – REF. NO. EPA-660/2-74-074
Saline Groundwater Produced with Oil and Gas – REF. NO. EPA-660/2-74-010
Salt Water Detection in the Cimarron Terrace, Oklahoma – REF. NO. EPA-660/3-74-033
Sampling Interface for Quantitative Transport of Aerosols – REF. NO. EPA-650/2-74-016
Sasol Type Process for Gasoline, Methanol, SNG, and Low-BTU Gas from Coal – REF. NO. EPA-650/2-74-072
Scientific and Technical Assessment Report on Manganese – REF. NO. EPA-600/6-75-002
Scientific and Technical Assessment Report on Particulate Polycyclic Organic Matter (PPOM) – REF. NO. EPA-600/6-75-001
Scrap Rubber Tire Utilization in Road Dressings – REF. NO. EPA-670/2-74-014
Second U.S. – Japan Conference on Sewage Treatment Technology December 1-6, 1972 – REF. NO. EPA-670/9-74-003
Secondary Fiber Recovery Incentive Analysis – REF. NO. EPA-670/5-74-004
Secondary Impact of Transportation and Wastewater Investments: Review and Bibliography – REF. NO. EPA-600/5-75-002
Sediments and Sediment-Water Nutrient Interchanges in Upper Klamath Lake, Oregon – REF. NO. EPA-660/3-74-015
Select Research Group in Air Pollution Meteorology, Second Annual Progress Report Volume I – REF. NO. EPA-650/4-74-045a
Select Research Group in Air Pollution Meteorology, Second Annual Progress Report Volume II – REF. NO. EPA-650/4-74-045b
Selected Abstracts for Instrumentation and Automation of Wastewater Facilities – REF. NO. EPA-670/2-73-104
Selected Characteristics of Hazardous Pollutant Emissions – REF. NO. EPA-600/2-74-004
Selected Irrigation Return Flow Quality Abstracts: 1972-1973 – REF. NO. EPA-660/2-74-049
Selective Nutrient Removal Secondary Effluent – REF. NO. EPA-670/2-73-076
Seminar on Electrostatics and Fine Particles — September 1973 – REF. NO. EPA-650/2-74-081
Seminar Summary: Sampling and Analysis of the Various Forms of Atmospheric Lead – REF. NO. EPA-650/2-75-003
Separation, Dewatering, and Disposal of Sugar Beet Transport Water Solids Phase I – REF. NO. EPA-660/2-74-093
Sewerage System Monitoring and Remote Control – REF. NO. EPA-670/2-75-020
Shrimp Canning Waste Treatment Study – REF. NO. EPA-660/2-74-061
Significance and Control of Waste Water Floatables in Coastal Waters – REF. NO. EPA-660/3-74-016
Silt Removal From a Lake Bottom – REF. NO. EPA-660/3-74-017
Simplified Atomic Absorption Determination of Stable Strontium in Milk and Hay – REF. NO. EPA-680/4-73-002
Simulation City Approach for Preparation of Urban Area Data Bases – REF. NO. EPA-600/5-74-001
Simultaneous and Automated Determination of Total Phosphorous and Total Kjeldahl – REF. NO. EPA-670/4-74-002
Single-Cell Protein From Waste Cellulose – REF. NO. EPA-670/2-73-095
Sludge Conditioning Using SO_2 and Low Pressure for Production of Organic Feed Concentrate – REF. NO. EPA-670/2-73-062
Socio-Economic Factors Affecting Demand for Municipal Collection of Household Refuse – REF. NO. EPA-670/9-73-035
Sodium Conditioning to Reduce Fly Ash Resistivity – REF. NO. EPA-650/2-74-092
Soil Modification for Denitrification and Phosphate Reduction of Feed Lot Wastes – REF. NO. EPA-660/2-74-057
Solid Waste Conversion: Cellulose Liquefaction – REF. NO. EPA-670/2-75-031
Solid Waste Disposal Final Report – REF. NO. EPA-650/2-74-033
Source Assessment Prioritization of Air Pollution from Industrial Surface Coating Operations – REF. NO. EPA-650/2-75-019a
Sources and Characterization of Fine Particulate Test Dusts – REF. NO. EPA-650/2-74-117
Sources and Natural Removal Processes for Some Atmospheric Pollutants – REF. NO. EPA-650/4-74-032
Sources of Oil and Water in Bilges of Great Lakes Ships – REF. NO. EPA-670/2-74-054
Specific Ion Mass Spectrometric Detection for Gas Chromatographic Pesticide Analysis – REF. NO. EPA-660/2-74-004
Specifications for Materials Recovered from Municipal Refuse – REF. NO. EPA-670/2-75-034
Spectroscopic Study of California Smog – REF. NO. EPA-650/4-75-006
St. Louis/Union Electric Refuse Firing Demonstration Air Pollution Test Support – REF. NO. EPA-650/2-74-073
State of the System (SOS) Model – REF. NO. EPA-600/5-73-013
State of Maryland Waste Oil Recovery and Reuse Program – REF. NO. EPA-670/2-74-013
State-of-the-Art Report on Sampling of Particulates in Combustion Gases from Fossil Fuels – REF. NO. EPA-650/2-74-018
State-of-the-Art Review: Water Pollution Control Benefits and Costs Volume I – REF. NO. EPA-600/5-73-008a
State-of-the-Art: Sand and Gravel Industry – REF. NO. EPA-660/2-74-066
State-of-the-Art: Uranium Mining, Milling, and Refining Industry – REF. NO. EPA-660/2-74-038
State-of-the-Art: 1971 Instrumentation for Measurement of Particulate Emissions from Combustion Sources – REF. NO. EPA-650/2-73-022
Statistical Concepts for Design Engineers – REF. NO. EPA-650/2-74-080
Statistical Prediction of Equilibrium Temperature From Standard Meteorological Data Bases – REF. NO. EPA-660/2-73-003
Storage and Disposal of Iron Ore Processing Wastewater – REF. NO. EPA-660/2-74-018
Storm Water Management Model: User's Manual – Version II – REF. NO. EPA-670/2-75-017
Stream Pollution Abatement by Supplement Pumping – REF. NO. EPA-670/2-75-035
Structure and Reactivity of Adsorbed Oxides of Sulfur – REF. NO. EPA-650/3-74-006
Studies in Environment – Volume I – Summary Report – REF. NO. EPA-600/5-73-012a

TITLE INDEX

Studies in Environment – Volume II – Quality of Life – REF. NO. EPA-600/5-73-012b
Studies in Environment – Volume III – Pollution and the Municipality – REF. NO. EPA-600/5-73-012c
Studies in Environment – Volume IV – Consumption Differentials and the Environment – REF. NO. EPA-600/5-73-012d
Studies in Environment – Volume V – Outdoor Recreation and the Environment – REF. NO. EPA-600/5-73-012e
Studies of Low Molecular Weight Lignin Sulfonates – REF. NO. EPA-660/2-74-069
Studies of Pollutant Concentration Frequency Distributions – REF. NO. EPA-650/4-75-004
Studies on Effects of Thermal Pollution in Biscayne Bay in Florida – REF. NO. EPA-660/3-74-014
Studies on Modifications of Solid Industrial Wastes – REF. NO. EPA-670/2-73-065
Studies on Southeastern Aquatic Insects – REF. NO. EPA-660/3-73-016
Studies to Determine Methods for Culturing Three Freshwater Zooplankton Species – REF. NO. EPA-660/3-75-010
Study of an Integrated Power, Water and Wastewater Utility Complex – REF. NO. EPA-670/2-74-080
Study of the Ecology of Pesticides – REF. NO. EPA-650/1-74-012
Study of the Economics of Hospital Solid Waste Systems – REF. NO. EPA-670/5-73-020
Study of the Effects of Low Levels of Carbon Monoxide Upon Humans Performing Driving Tasks – REF. NO. EPA-650/1-74-006
Study of the Social and Economic Impact of Odors – Phase III – REF. NO. EPA-650/5-73-001
Study of Air Pollutant Emissions from Residential Heating Systems – REF. NO. EPA-650/2-74-003
Study of Combustor Flow Computations and Comparison with Experiment – REF. NO. EPA-650/2-73-045
Study of Corrosion in Municipal Incinerators Versus Refuse Composition – REF. NO. EPA-670/2-74-084
Study of Factors Affecting Reactions in Environmental Chambers Final Report on Phase II – REF. NO. EPA-650/3-74-004a
Study of Feasibility of Herbicide Orange Chlorinalysis – REF. NO. EPA-600/2-74-006
Study of Hazardous Waste Materials, Hazardous Effects and Disposal Methods, Volume I – REF. NO. EPA-670/2-73-014
Study of Hazardous Waste Materials, Hazardous Effects and Disposal Methods, Volume II – REF. NO. EPA-670/2-73-015
Study of Hazardous Waste Materials, Hazardous Effects and Disposal Methods, Volume III – REF. NO. EPA-670/2-73-016
Study of Incinerator Residue Analysis of Water Soluble Components – REF. NO. EPA-670/2-73-057
Study of Indoor Air Quality – REF. NO. EPA-650/4-74-042
Study of Institutional Solid Wastes – REF. NO. EPA-670/2-73-083
Study of Potential Problems and Optimum Opportunities in Retrofitting Industrial Processes to Low and Intermediate Energy Gas from Coal – REF. NO. EPA-650/2-74-052
Study of Upflow Filter for Tertiary Treatment – REF. NO. EPA-670/2-73-074
Study on Technical and Economic Feasibility of a Hydrogenation Process for Utilization of Waste Rubber – REF. NO. EPA-670/2-73-066
Submerged Combustion Evaporator for Concentration of Brewery Spent Grain Liquor – REF. NO. EPA-660/2-74-059
Subsurface Biological Activity in Relation to Ground Water Pollution – REF. NO. EPA-660/2-73-014
Sulfur and Nitrogen Balances in the Solvent Refined Coal Process – REF. NO. EPA-650/2-75-011
Sulfur Content of Douglas Fir Foliage Near a Paper Mill – REF. NO. EPA-660/3-74-018
Sulfur Oxide Throwaway Sludge Evaluation Panel (SOTSEP), Volume I: Final Report – Executive Summary – REF. NO. EPA-650/2-75-010a
Sulfur Oxide Throwaway Sludge Evaluation Panel (SOTSEP), Volume II: Final Report – Technical Discussion – REF. NO. EPA-650/2-75-010b
Sulfuric Acid and Ferrous Sulfate Recovery From Waste Pickle Liquor – REF. NO. EPA-660/2-73-032
Summary Report – Pilot Plant Studies on Dewatering Primary Digested Sludge – REF. NO. EPA-670/2-73-043
Summary Report, Trail-Marking and Alarm Pheromones of Some Ants of the Genus Atta – REF. NO. EPA-660/2-74-081
Summary Report: Workshop on Ozone Measurement by the Potassium Iodide Method – REF. NO. EPA-650/4-75-007
Surge Facility for Wet and Dry Weather Flow Control – REF. NO. EPA-670/2-74-075
Survey of Corrosion Products in the Seattle Water Department Toilt Distribution – REF. NO. EPA-670/2-75-036
Survey of Manual Methods of Measurements of Asbestos, Beryllium, Lead, Cadmium, Selenium, and Mercury in Stationary Source Emissions – REF. NO. EPA-650/4-74-015
Survey of Users of the EPA – Reference Method for Measurement of Non-Methane Hydrocarbons in Ambient Air – REF. NO. EPA-650/4-75-008
Survival of Pathogens in Animal Manure Disposal – REF. NO. EPA-670/2-73-051
Suspended Solids Monitor – REF. NO. EPA-670/2-75-002
Symposium on Electrostatic Precipitators for the Control of Fine Particles – REF. NO. EPA-650/2-75-016
Symposium on Flue Gas Desulfurization – Atlanta, November 1974 Volume I – REF. NO. EPA-650/2-74-126a
Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology (May 1974, St. Louis, Missouri) – REF. NO. EPA-650/2-74-118
Synthesis and Purification of Carcinogenic Polynuclear Aromatic Hydrocarbon Standards – REF. NO. EPA-650/2-74-040
Synthesis of Trifluoromethylsulfur Pentafluoride (CF_3SF_5) – REF. NO. EPA-650/4-74-010
System Alternatives in Oxygen Activated Sludge – REF. NO. EPA-670/2-75-008
System Analysis of Air Pollutant Emissions from the Chemical/ Plastics Industry – REF. NO. EPA-650/2-74-106
Systems Analysis Requirements for Nitrogen Oxide Control of Stationary Sources – REF. NO. EPA-650/2-74-091
Systems Simulation and Solid Waste Planning: A Case Study – REF. NO. EPA-670/5-73-012
SWIRL Concentrator as a Grit Separator Device – REF. NO. EPA-670/2-74-026
Taxonomy and Ecology of Aspenonena Mayflies of the Ohio River Basin – REF. NO. EPA-670/4-74-006
Technical and Economic Evaluation of Cooling Systems Blowdown Control Techniques – REF. NO. EPA-660/2-73-026
Techniques for Measuring Fly Ash Resistivity – REF. NO. EPA-650/2-74-079
Tertiary Treatment With a Controlled Ecological System – REF. NO. EPA-660/2-73-022
Test Method for Volatile Component Stripping of Wastewater – REF. NO. EPA-660/2-74-044
Testing of a Molecular Sieve Used to Control Mercury Emission From A Chlor-Alkali Plant, Volume I – REF. NO. EPA-650/2-75-026a
Testing of a Molecular Sieve Used to Control Mercury Emission From A Chlor-Alkali Plant, Volume II – Appendices – REF. NO. EPA-650/2-75-026b
Theoretical and Experimental Study of the Lime/Limestone Wet Scrubbing Process – REF. NO. EPA-650/2-75-006
Theoretical Model and Solubility Characteristics of Aroclor R 1254 in Water: Problems Associated with Low-Solubility Compounds in Aquatic Toxicity Test – REF. NO. EPA-660/3-74-013
Thermal Radiation Modeling for Pollution Predictions – REF. NO. EPA-650/2-74-011
Thermophilic Aerobic Digestion of Organic Solid Wastes – REF. NO. EPA-670/2-73-061
Tissue Enzyme Assay for Chlorinated Hydrocarbon Insecticides – REF. NO. EPA-660/2-73-027
Trace Pollutant Emissions from the Processing of Metallic Ores – REF. NO. EPA-650/2-74-115
Trace Pollutant Emissions from the Processing of Non-Metallic Ores – REF. NO. EPA-650/2-74-122
Training Manual for Teratology – REF. NO. EPA-650/1-73-001

TITLE INDEX

Travels of Airborne Pollen – REF. NO. EPA-650/3–75–003
Treatment and Recovery of Fluoride Industrial Waste – REF. NO. EPA-660/2–73–024
Treatment of Cheese Processing Wastewaters in Aerated Lagoons – REF. NO. EPA-660/2–74–012
Treatment of Domestic Wastewater and NSSC Pulp and Paper Mill Wastes – REF. NO. EPA-660/2–73–010
Treatment of Hazardous Material Spills With Floating Mass Transfer Media – REF. NO. EPA-670/2–73–078
Treatment of Packing House Waste by Anaerobic Lagoons in Plastic-Media Filters – REF. NO. EPA-660/2–74–027
Treatment of Sulfite Evaporator Condensates for Recovery of Volatile Components – REF. NO. EPA-660/2–73–030
Turbulent Diffusion in Liquid Jets: Final Report – REF. NO. EPA-660/3–74–004b
Turbulent Diffusion in Liquid Jets: Part I – REF. NO. EPA-660/3–74–004a
U-Tube Aeration – REF. NO. EPA-670/2–73–031
Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards – REF. NO. EPA-670/9-75–004
Urban Stormwater Management and Technology: An Assessment – REF. NO. EPA-670/2–74–040
Urban Stormwater Management Modeling and Decision-Making – REF. NO. EPA-670/2–75–022
Urban Street Cleaning – REF. NO. EPA-670/2–75–030
Use of Domestic Waste Glass for Urban Paving – REF. NO. EPA-670/2–73–038
Use of Environmental Analyses on Wastewater Facilities by Local Government – REF. NO. EPA-600/5–74–015
Use of Leucocyte Metabolism as a Health Effects Indicator – REF. NO. EPA-650/1–74–013
Use of Panelist as Substitutes for Taxicab Drivers in Carbon Monoxide Exposure – REF. NO. EPA-650/1–74–001
Used Oil Law in the U.S. and Europe – REF. NO. EPA-600/5–74–025
User's Guide for Hiway, A Highway Air Pollution – REF. NO. EPA-650/4–74–008
User's Manual for the APRAC-1A Urban Diffusion Model Computer Program – REF. NO. EPA-650/3–73–001
Utilization of Bark Waste – REF. NO. EPA-670/2–73–005
Utilization of Fibrous Wastes as Sources of Nutrients – REF. NO. EPA-670/2–73–090
Utilization of Trickling Filters for Dual Treatment of Dry and Wet Weather Flows – REF. NO. EPA-670/2–73–071
Vinyl Chloride – An Assessment of Emissions Control Techniques and Costs – REF. NO. EPA-650/2–74–097
Virus in Waste, Renovated, and Other Waters – 1973 Literature Abstracts – REF. NO. EPA-670/9-74–005
Viruses in Waste Renovated and Other Viruses – 1972 Literature Abstracts – REF. NO. EPA-670/2–73–003
Volatization of Losses of Pesticides from Soil – REF. NO. EPA-660/2–74–054
Waste Automotive Lubricating Oil Reuse as a Fuel – REF. NO. EPA-600/5–74–032
Waste Citrus Activated Sludge As a Poultry Feed Ingredient – REF. NO. EPA-660/2–75–001
Waste Control and Abatement in the Processing of Sweet Potatoes – REF. NO. EPA-660/2–73–021
Waste Oil Recycling and Disposal – REF. NO. EPA-670/2–74–052
Waste Treatment System for Confined Hog Raising Operations – REF. NO. EPA-660/2–74–047
Waste Water Treatment and Reuse in a Metal Finishing Job Shop – REF. NO. EPA-670/2–74–042
Wastewater Abatement in Canning Vegetables by IQB Blanching – REF. NO. EPA-660/2–74–006
Wastewater Characterization for the Specialty Food Industry – REF. NO. EPA-660/2–74–075
Wastewater Treatment and Reuse By Land Application, Volume I – Summary – REF. NO. EPA-660/2–73–006a
Wastewater Treatment and Reuse By Land Application, Volume II – Summary – REF. NO. EPA-660/2–73–006b
Wastewater Use in the Production of Food and Fiber—Proceedings of Conference held at Oklahoma City, OK March 5–7, 1974 – REF. NO. EPA-660/2–74–041
Water and Waste Management in Poultry Processing – REF. NO. EPA-660/2–74–031
Water Quality Effect of Diking a Shallow Arid-Region Lake – REF. NO. EPA-660/2–75–007
Water Quality Model for a Conjunctive Surface – Groundwater System – REF. NO. EPA-600/5–74–013
Water Quality Requirements of Aquatic Insects – REF. NO. EPA-660/3–73–004
Water Recycle/Reuse Possibilities: Power Plant Boiler and Cooling System – REF. NO. EPA-660/2–74–089
Water Renovation of Municipal Effluents by Reverse Osmosis – REF. NO. EPA-670/2–75–009
Waterborne Wastes of the Paint and Inorganic Pigments Industries – REF. NO. EPA-670/2–74–030
Weed Harvest and Lake Nutrient Dynamics – REF. NO. EPA-660/3–73–001
Wet Scrubber Liquid Utilization – REF. NO. EPA-650/2–74–108
Wet Systems for Residential Refuse Collection: A Case Study for Springfield, Massachusetts – REF. NO. EPA-670/2–74–038
Wind Tunnel Tests of Negatively Buoyant Plumes – REF. NO. EPA-650/3–74–003
Wood Waste Reuse in Controlled Release Pesticides – REF. NO. EPA-670/2–73–034
200 MGD Activated Sludge Plant Removes Phosphorus by Pickle Liquor – REF. NO. EPA-670/2–73–050

CURRENT PROGRAM AREA INDEX

HEALTH EFFECTS

Actions of Pesticides and Other Drugs on the Male Reproductive System – REF. NO. EPA-650/1–74–011
Comparability of Nine Methods for Monitoring NO2 in Ambient Air – REF. NO. EPA-650/4–74–012
Effect of Carbon Monoxide on Time Perception – REF. NO. EPA-650/1–74–005
Epidemiology of Chronic Respiratory Disease: A Literature Review – REF. NO. EPA-650/1–74–007
Health and Annoyance Impact of Odor Pollution – REF. NO. EPA-650/1–75–001
Health Consequences of Sulfur Oxides: A Report from CHESS,1970–1971 – REF. NO. EPA-650/1–74–004
Interactions of Various Air Pollutants on Causation of Pulmonary Disease – REF. NO. EPA-650/1–73–002
Investigation of the Effects of Carbon Monoxide on Humans in the Driving Task – REF. NO. EPA-650/1–73–003
Mathematical Analysis of the Kinetics of Viral Inactivation – REF. NO. EPA-670/2–74–067
Metabolism of Carbamate Insecticides – REF. NO. EPA-650/1–74–002
Microbiological Production of Geosmin – REF. NO. EPA-670/2–74–094
Normal Carboxyhemoglobin Levels of Blood Donors in the United States – REF. NO. EPA-650/1–73–004
Pesticides Epidemiological Field Studies – REF. NO. EPA-650/1–74–009
Pricing for Water Supply: Its Impact on Systems Management – REF. NO. EPA-670/1–74–001
Reactivity of Polynuclear Aromatic Hydrocarbons with O2 and NO in the Presence of Light – REF. NO. EPA-650/1–74–010
Scientific and Technical Assessment Report on Manganese – REF. NO. EPA-600/6–75–002
Scientific and Technical Assessment Report on Particulate Polycyclic Organic Matter (PPOM) – REF. NO. EPA-600/6–75–001
Study of the Ecology of Pesticides – REF. NO. EPA-650/1–74–012
Study of the Effects of Low Levels of Carbon Monoxide Upon Humans Performing Driving Tasks – REF. NO. EPA-650/1–74–006
Study of the Social and Economic Impact of Odors – Phase III – REF. NO. EPA-650/5–73–001
Survey of Corrosion Products in the Seattle Water Department Tolt Distribution – REF. NO. EPA-670/2–75–036
Training Manual for Teratology – REF. NO. EPA-650/1–73–001
Use of Leucocyte Metabolism as a Health Effects Indicator – REF. NO. EPA-650/1–74–013
Use of Panelist as Substitutes for Taxicab Drivers in Carbon Monoxide Exposure – REF. NO. EPA-650/1–74–001

ECOLOGICAL PROCESSES AND EFFECTS

Acid Hydrolysis of Cellulose in Refuse to Sugar and Its Fermentation to Alcohol – REF. NO. EPA-670/2–73–011
Acquisition and Culture of Research Fish – REF. NO. EPA-660/3–75–011
Aerosol Formation from Gas-Phase Reactions of Ozone and Olefin in the Presence of Sulfur Dioxide – REF. NO. EPA-650/4–74–034
Air Pollution Effects on Catastrophic Failure of Metals – REF. NO. EPA-650/3–74–009
An Investigation of Ion Removed From Water and Wastewater – REF. NO. EPA-660/3–74–022
Analysis of the Abandoned Automobile Problem – REF. NO. EPA-670/2–73–013
Analysis of the Composition of the Atmosphere in the Los Angeles Basin – REF. NO. EPA-650/2–74–105
Analysis of the Current Impact of Plastic Refuse Disposal Upon the Environment – REF. NO. EPA-670/2–74–083
Analysis of the Dynamics of DDT in Marine Sediments – REF. NO. EPA-660/3–75–013
Analysis Models for Solid Waste Collection – REF. NO. EPA-670/2–75–026a
Analysis Models for Solid Waste Collection – REF. NO. EPA-670/2–75–026b
Application of Repro-Modeling to the Analysis of a Photochemical Air Pollution Model – REF. NO. EPA-650/4–74–001
Applications of Growth and Sorption Algal Assays – REF. NO. EPA-660/3–73–023
Assessment of Wet Systems for Residential Refuse Collection: A Summary Report – REF. NO. EPA-670/2–74–068
Atmospheric Measurement of Photochemical Smog Reactions – A Preliminary Analysis – REF. NO. EPA-650/4–74–037
Big Eddies and Mixing Processes in the Great Lakes – REF. NO. EPA-660/3–73–011
Bio-Environmental Impact of Air Pollution from Fossil Fuel Power Plants – REF. NO. EPA-660/3–74–011
Biological Control of Aquatic Vegetation – REF. NO. EPA-660/3–74–007
Biological Conversion of Animal Wastes to Nutrients – REF. NO. EPA-670/2–73–009
Biological Models of Freshwater Communities – REF. NO. EPA-660/3–73–008
Biologically Allowable Thermal Pollution Limits, Parts I and II – REF. NO. EPA-660/3–74–003
Capacity of the Soil as a Natural Sink for Carbon Monoxide – REF. NO. EPA-650/2–73–043
Characterization and Utilization of Municipal and Utility Sludges and Ashes: Vol. I – Summary – REF. NO. EPA-670/2–75–033a
Characterization and Utilization of Municipal and Utility Sludges and Ashes: Vol. II – Municipal Sludges – REF. NO. EPA-670/2–75–033b
Characterization and Utilization of Municipal and Utility Sludges and Ashes: Vol. III – Utility Coal Ash – REF. NO. EPA-670/2–75–033c
Characterization and Utilization of Municipal and Utility Sludges and Ashes: Vol. IV – Municipal Incinerator Residues – REF. NO. EPA-670/2–75–033d
Chemical Characterization of Model Aerosols – REF. NO. EPA-650/3–74–011
Chemical Conversion of Solid Waste to Useful Products – REF. NO. EPA-670/2–74–027
Chemical Conversion of Wood and Cellulosic Wastes – REF. NO. EPA-670/2–74–015
Chemistry of Organmercurials in Aquatic Systems – REF. NO. EPA-660/3–73–012
Cladophora Distribution in Lake Ontario (IFYGL) – REF. NO. EPA-660/3–74–028
Combustion Products from the Incineration of Plastics – REF. NO. EPA-670/2–73–049
Composted Municipal Refuse as a Soil Amendment – REF. NO. EPA-670/2–73–063
Comprehensive Technical Report on all Atmospheric Contaminants Associated with Photochemical Air Pollution – REF. NO. EPA-650/4–75–002
Conceptual Model for the Movement of Pesticides Through the Environment – REF. NO. EPA-660/3–74–024
Culturing and Ecology of Diaptomus Clavipes and Cyclops Vernalis – REF. NO. EPA-660/3–74–006
Degradation Mechanism: Controlling the Bioaccumulation of Hazardous Materials – REF. NO. EPA-670/2–75–005
Design and Control of Incinerators, Volume I – REF. NO. EPA-670/2–73–089A

CURRENT PROGRAM AREA INDEX

ECOLOGICAL PROCESSES AND EFFECTS

Design and Control of Incinerators, Volume II – Appendices – REF. NO. EPA-670/2-73-0898
Design of the EPA Semi-Trailer Mobile Air Pollution Laboratory – REF. NO. EPA-650/4-74-017
Determination of the Formation Mechanisms and Composition of Photochemical Aerosols – REF. NO. EPA-650/3-73-002
Determination of Effect of Particulate Exhaust Emissions of Additives and Impurities in Gasoline – REF. NO. EPA-650/2-74-061
Determination of Energetic Characteristics of Urban-Rural Surfaces in the Greater St. Louis Area – REF. NO. EPA-650/4-74-007
Development and Testing of An Air Monitoring System – REF. NO. EPA-650/2-74-019
Development of a Methodology for the Assessment of the Effects of Fuels and Additives on Control Devices – REF. NO. EPA-650/2-74-060
Development of a Selective Algaecide to Control Nuisance Algal Growth – REF. NO. EPA-660/3-73-006
Development of an Acetylene Monitor at the PPB Level – REF. NO. EPA-650/2-74-056
Development of Air Particulate Monitoring Systems – REF. NO. EPA-650/4-74-030
Development of Analytic Techniques to Measure Human Exposure to Fuel Additives – REF. NO. EPA-650/1-74-003
Development of Modeling Technique for Photochemical Air Pollution – REF. NO. EPA-650/4-74-003
Development of Sample Preparation Methods for Development of Marine Organisms – REF. NO. EPA-660/3-74-026
Development of Sampling Devices for Gaseous Atmospheric Tracers – REF. NO. EPA-650/4-74-050
Diffusion in Turbulent Surface Layer and the Development of an Atmospheric Wind Tunnel – REF. NO. EPA-650/4-74-041
Dispersal Processes in Lake Huron – REF. NO. EPA-660/2-74-082
Dispersion in Hydrologic and Coastal Environments – REF. NO. EPA-660/3-73-010
Dynamic Water Quality Forecasting and Management – REF. NO. EPA-660/3-73-009
Dynamics and Diffusion in the Great Lakes – REF. NO. EPA-660/2-74-083
Early Life History and Feeding of Young Mountain Whitefish – REF. NO. EPA-660/3-73-019
Economic Analysis of the Processing and Disposal of Refuse Sludges – REF. NO. EPA-670/2-74-037
Effect of Fuel Additives Study – REF. NO. EPA-650/2-74-096
Effect of Gasoline Additives on Gaseous Emissions – REF. NO. EPA-650/2-75-014
Effect of Geographical Variation on Performance of Recirculating Cooling Ponds – REF. NO. EPA-660/2-74-085
Effect of Meteorological Variables on Temperature Changes in Flowing Streams – REF. NO. EPA-660/3-75-002
Effect of Phosphorus Removal Processes on Algal Growth – REF. NO. EPA-660/3-73-015
Effect of Processing Poultry Manure on Disease Agents – REF. NO. EPA-670/2-73-041
Effects of Air Pollutants on Textile Fibers and Dyes – REF. NO. EPA-650/3-74-008
Effects of Crude Oil and Some of Its Components on Young Coho and Sockeye Salmon – REF. NO. EPA-660/3-73-018
Effects of Mirex and Methoxychlor on Striped Mullet, Mugil cephalus L. – REF. NO. EPA-660/3-75-015
Effects of Protozoa on the Fate of Particulate Carbon – REF. NO. EPA-660/3-73-007
Effects of Temperature on Diseases of Salmonid Fishes – REF. NO. EPA-660/3-73-020
Effects of Water Pollution Controls on Solid Waste Generation, 1971 to 1985: Executive Summary – REF. NO. EPA-670/2-74-095a
Environmental Chamber Studies of Atmospheric Aerosols – REF. NO. EPA-650/4-74-009
Environmental Guidelines for Development Roads in the Subarctic – REF. NO. EPA-660/3-74-009
Environmental Requirements of Selected Estuarine Ciliated Protozoa – REF. NO. EPA-660/3-74-031
Estimating Nutrient Loadings of Lakes from Non-Point Sources – REF. NO. EPA-660/3-74-020
Eutrophication of Lake Tahoe Emphasizing Water Quality – REF. NO. EPA-660/3-74-034
Eutrophication of Surface Waters—Lake Tahoe's Indian Creek Reservoir – REF. NO. EPA-660/3-75-003
Evaluation of Health Hazards Associated With Solid Waste Sewage Sludge Mixtures – REF. NO. EPA-670/2-75-023
Experimental High Ash Papermill Sludge Landfill – First Annual Report – REF. NO. EPA-670/2-74-076a
Experimental High Ash Papermill Sludge Landfill – Second Annual Report – REF. NO. EPA-670/2-74-076b
Exploratory Study of Factors Affecting Aerosol Formation – REF. NO. EPA-650/3-75-002
Fabrication of Single Cell Protein From Cellulosic Wastes – REF. NO. EPA-670/2-75-032
Fate of Select Pesticides in the Aquatic Environment – REF. NO. EPA-660/3-74-025
Feasibility of Hydraulic Transport and Treatment of Ground Household Refuse Through Sewers – REF. NO. EPA-670/2-74-019
Feasibility of Hydraulic Transport of Ground Household Refuse Through Sewer Appurtenances – REF. NO. EPA-670/2-74-021
Feasibility of Metrac System for Regional Air Pollution Study – REF. NO. EPA-650/4-74-051
Feasibility Study of Use of Molten Salt Technology for Pyrolysis of Solid Waste – REF. NO. EPA-670/2-75-014
First Annual Progress Report on a Study of Corrosion in Municipal Incinerators – REF. NO. EPA-670/2-73-032
First Annual Report: Routing of Solid Waste Collection Vehicles and Appendix B – Optimal Routing of Solid Waste Collection Vehicles – REF. NO. EPA-670/2-74-035B
First Annual Report: Routing of Solid Waste Collection Vehicles and Appendix A – A Linear Programming Approach for the Traveling Salesman Problem – REF. NO. EPA-670/2-74-035A
First Annual Reports of EPA Grants Funded for 1FYGL – REF. NO. EPA-660/3-73-021
Flow Establishment and Initial Entrainment of Heated Water Surface Jets – REF. NO. EPA-660/3-75-014
Forecast of the Effects of Air and Water Controls of Solid Waste Generation – REF. NO. EPA-670/2-74-095b
Formation of Aerosols in a Photochemical Fast Row Reactor – REF. NO. EPA-650/3-75-004
Future Dredging Quantities in the Great Lakes – REF. NO. EPA-660/3-74-029
Ground Water Contamination in the Northeast States – REF. NO. EPA-660/2-74-056
Haze Formation: It's Nature and Origin – 1973 – REF. NO. EPA-650/3-74-002
Heavy Metal Accumulation in Soil and Vegetation From Smelter Emissions – REF. NO. EPA-660/3-74-012
High-Temperature Vortex Incinerator – REF. NO. EPA-670/2-75-025
Highway Air Pollution Measurement Program Using Sulfur Hexafluoride Tracer Gas – REF. NO. EPA-650/4-74-043
Hospital Solid Waste Disposal in Community Facilities – REF. NO. EPA-670/2-73-048
Impact of the Use of Microorganisms on the Aquatic Environment – REF. NO. EPA-660/3-75-001
Incineration of Bulky Refuse Without Prior Shredding – REF. NO. EPA-670/2-73-023
Incineration of Plastics Found in Municipal Wastes – REF. NO. EPA-670/2-73-087
Industrial Chemicals Solid Waste Generation — The Significance of Process Resource Recovery, and Improved Disposal – REF. NO. EPA-670/2-74-078
Industrial Solid Waste Classification Systems – REF. NO. EPA-670/2-75-024

CURRENT PROGRAM AREA INDEX

ECOLOGICAL PROCESSES AND EFFECTS

Infrared Spectral Sensor for Refuse Sorting – REF. NO. EPA-670/2–74–031
Invariant Modeling of Turbulence and Diffusion in the Planetary Boundary Layer – REF. NO. EPA-650/4–74–035
Investigation of Corrosion Deposition Phenomena on Gas Turbine Blades – REF. NO. EPA-670/2–73–006
Laboratory and Numerical Simulation of Plume Dispersion in Stably Stratified Flow Over Complex Terrain – REF. NO. EPA-650/4–74–044
Laboratory Analyses of Atmospheric Hydrocarbon – California South Coast Air Basin (Los Angeles Air Quality Control Region) August – November 1973 – REF. NO. EPA-650/4–74–052
Lidar Studies of Stack Plumes in Rural and Urban Environments – REF. NO. EPA-650/4–73–002
Limited SO2 and NOX Measurements in St. Louis, 1974: Volume I – Plume Tracking by Correlation Spectroscopy – REF. NO. EPA-650/2–75–005a
Limnological Studies of Flat-head, Montana: A Status Report – REF. NO. EPA-660/3–74–023
Literature Search and Analysis of Information Regarding Sources, Uses, Production, Consumption, Reported Medical Cases and Toxicology of Platinum and Palladium – REF. NO. EPA-650/1–74–008
Low Winter Dissolved Oxygen in Some Alaskan Rivers – REF. NO. EPA-660/3–74–008
Marine Algal Assay Procedure Bottle Test – REF. NO. EPA-660/3–75–008
Mathematical Model for Barged Ocean Disposal of Wastes – REF. NO. EPA-660/2–73–029
Mathematical Modeling of Phytoplankton in Lake Ontario – REF. NO. EPA-660/3–75–005
Mathematical Simulation of Atmospheric Photochemical Reactions: Model Development, Validation, and Application – REF. NO. EPA-650/4–74–011
Mathematical Simulation of Smog Chamber Photo-Chemical Experiments – REF. NO. EPA-650/4–74–040
Measures of Effectiveness for Refuse Storage, Collection, and Transportation Practices – REF. NO. EPA-670/2–74–082
Mercury in the Aquatic Systems: Metholation, OxidationReduction; in Bio Accumulation – REF. NO. EPA-660/3–74–021
Mesoscale Windfield Analysis of Los Angeles Basin – REF. NO. EPA-650/4–73–001
Metallurgical Upgrading of Automotive Scrap Steel – REF. NO. EPA-670/2–73–091
Meteorological Episodes of Slowest Dilution in Contiguous United States – REF. NO. EPA-650/4–74–002
Methodology for Treating Large Localized Emissions of Reactive Pollutants – REF. NO. EPA-650/4–74–006
Methods for Acute Toxicity Tests with Fish, Macroinvertebrates, and Amphibians – REF. NO. EPA-660/3–75–009
Microbial Degradation and Accumulation of Pesticides in Aquatic Systems – REF. NO. EPA-660/3–75–007
Model Verification – Aircraft Emissions Impact on Air Quality – REF. NO. EPA-650/4–74–049
Modeling Dynamics of Biological and Chemical Components of Aquatic Ecosystems – REF. NO. EPA-660/3–75–012
Modifications to the Executive Computer Program for Steady-State Simulation of Wastewater Treatment Facilities – REF. NO. EPA-670/2–74–066
Molecular Modulation Spectrometry for Observation of Free Radicals – REF. NO. EPA-650/4–74–004
Municipal Waste Disposal by Shipborne Incineration and Sea-Disposal of Residues – REF. NO. EPA-670/2–73–017
Negatively Buoyant Jets in a Cross Flow – REF. NO. EPA-660/2–73–012
Nitrite-Accelerated Photochemical Degradation of Cellulose as a Pretreatment for Microbiological Conversion to Protein – REF. NO. EPA-670/2–73–052
Nitrogen Sources and Cycling in Natural Waters – REF. NO. EPA-660/3–73–002
Nutrient Inactivation As A Lake Restoration Procedure — I. Laboratory Investigations – REF. NO. EPA-660/3–74–032
NO2 Actinometer for Field Use – REF. NO. EPA-650/4–74–036
NTA and Mercury in Artificial Stream Systems – REF. NO. EPA-660/3–73–025
Optimization of Air Pollution Measurement Locations – REF. NO. EPA-650/4–75–005
Organic Compounds Entering Groundwater from a Landfill – REF. NO. EPA-660/2–74–077
Organic Nutrient Factors Effecting Algal Growths – REF. NO. EPA-660/3–73–003
Oxidation of Organic Matter in Sediments – REF. NO. EPA-660/3–73–005
Pesticides in the Illinois Waters of Lake Michigan – REF. NO. EPA-660/3–74–002
Petroleum Weathering: Some Pathways, Fate and Disposition on Marine Waters – REF. NO. EPA-660/3–73–013
Pharmacokinetics of Toxic Elements in Rainbow Trout – REF. NO. EPA-660/3–74–027
Phosphorus Uptake and Release by Lake Ontario Sediments – REF. NO. EPA-660/3–75–006
Physical, Chemical and Microbiological Methods of Solid Waste Testing – REF. NO. EPA-670/2–73–001
Physical, Chemical and Microbiological Methods of Solid Waste Testing: Four Additional Procedures – REF. NO. EPA-670/2–74–007
Phytoplankton Composition and Abundance in Lake Ontario During IFYGL – REF. NO. EPA-660/3–75–004
Plume Temperature Measurements of Shallow Submerged Model Discharges With Current – REF. NO. EPA-660/2–73–001
Pneumo-Slurry Pipeline Collection and Removal of Municipal Solid Waste – REF. NO. EPA-670/2–73–072
Pollution Effects on Adult Steelhead Migration in the Snake River – REF. NO. EPA-660/3–73–017
Poultry Manure Disposal by Plow-Furrow-Cover – REF. NO. EPA-670/2–73–085
Precipitation Scavenging of Inorganic Pollutants from Metropolitan Sources – REF. NO. EPA-650/3–74–005
Preliminary Assessment of Wet Systems for Residential Refuse Collection – REF. NO. EPA-670/2–74–065
Preliminary Design of a Household Refuse Grinder – REF. NO. EPA-670/2–74–020
Preparation and Evaluation of Activated Carbon Produced from Municipal Refuse – REF. NO. EPA-670/2–73–010
Preventing Landfill Leachate Contamination of Water – REF. NO. EPA-670/2–73–021
Problems and Opportunities in Management of Combustible Solid Wastes – REF. NO. EPA-670/2–73–056
Proceedings of the Solvent Reactivity Conference – REF. NO. EPA-650/3–74–010
Proceedings of Symposium on Statistical Aspects of Air Quality – REF. NO. EPA-650/4–74–038
Promising Technologies for Treating Hazardous Waste – REF. NO. EPA-670/2–74–088
Protocol for Evaluating the Nitrogen Status of Lake Sediments – REF. NO. EPA-660/3–73–024
Public Attitudes Toward Hazardous Waste Disposal Facilities – REF. NO. EPA-670/2–73–086
Puget Sound Oceanographic Field Studies Data Report, Everett, BELLINGHAM, Port Angeles, 1962–63 – REF. NO. EPA-660/3–73–014
Pyrolysis of Solid Municipal Wastes – REF. NO. EPA-670/2–73–039
Radiolytic Hydrolysis of Cellulose – REF. NO. EPA-670/2–73–030
Raw Materials Transportation Costs and Their Influence on the Use of Wastepaper and Scrap Iron and Steel, Volume I – Technical Discussion – REF. NO. EPA-670/2–74–024A
Raw Materials Transportation Costs and Their Influence on the Use of Wastepaper and Scrap Iron and Steel, Volume II – Appendices – REF. NO. EPA-670/2–74–024B
Recirculating Waste System for Swine Units – REF. NO. EPA-670/2–73–025

CURRENT PROGRAM AREA INDEX

ECOLOGICAL PROCESSES AND EFFECTS

Reclamation of Energy from Organic Waste – REF. NO. EPA-670/2–74–016
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume I – Summary Report – REF. NO. EPA-670/2–73–053A
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume II – Toxicologic Summary – REF. NO. EPA-670/2–73–053B
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume III – Disposal Process Discriptions: Ultimate Disposal Incineration, and Pyrolysis Processes – REF. NO. EPA-670/2–73–053C
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volum IV – Disposal Process Descriptions: Biological and Miscellaneous Waste Treatment Processes – REF. NO. EPA-670/2–73–053D
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume V – National Disposal Site Candidate Waste Stream Constituent Profile Reports – Pesticides and Cyanide Compounds – REF. NO. EPA-670/2–73–053E
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume VI – National Disposal Site Candidate Waste Stream Constituent Profile Report – Mercury, Arsenic, Chromium and Cadmium Compounds – REF. NO. EPA-670/2–73–053F
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume VII – National Disposal Site Candidate Waste Stream Constituent Profile Report – Propellants, Explosives, and Chemical Warfare Materiel – REF. NO. EPA-670/2–73–053G
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume VIII – National Disposal Site Candidate Waste Stream Constituent Profile Report – Miscellaneous Inorganic and Organic Compounds – REF. NO. EPA-670/2–73–053H
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume IX – National Disposal Site Candidate Waste Stream Constituent Profile Report – Radioactive Materials – REF. NO. EPA-670/2–73–053I
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume X – Industrial and Municipal Disposal Candidate Waste Stream Constituent Profile Reports – Organic Compounds – REF. NO. EPA-670/2–73–053J
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume XI – Industrial and Municipal Disposal Candidate Waste Stream Constituent Profile Reports – Organic Compounds – REF. NO. EPA-670/2–73–053K
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume XII – Industrial and Municipal Disposal Candidate Waste Stream Constituent Profile Reports – Inorganic Compounds – REF. NO. EPA-670/2–73–053L
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume XIII – Industrial and Municipal Disposal Candidate Waste Stream Constituent Profile Reports – Inorganic Compounds – REF. NO. EPA-670/2–73–053M
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume XIV – Summary of Waste Origins, Forms and Quantities – REF. NO. EPA-670/2–73–053N
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume XV – Research and Development Plans – REF. NO. EPA-670/2–73–053O
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume XVI – References – REF. NO. EPA-670/2–73–053P
Recommended Methods of Reduction, Neutralization, Recovery or Disposal of Hazardous Waste, Volume I thru Volume XVI – REF. NO. EPA-670/2–73–053A-P
Research and Development of a Selective Algaecide to Control Nuisance Algal Growth-Phase III – REF. NO. EPA-660/3–74–019
Review of the Physiological Impact of Mercurials – REF. NO. EPA-660/3–73–022
Reviewing Environmental Impact Statements – Power Plant Cooling Systems, Engineering Aspects – REF. NO. EPA-660/2–73–016
Role of Solid-Gas Interactions in Air Pollution – REF. NO. EPA-650/3–74–007
Routing of Solid Waste Collection Vehicles, Final Report: Appendix A – Manual for Use of the Computer Codes – REF. NO. EPA-670/2–74–036A
Routing of Solid Waste Collection Vehicles: Appendix B – A Heuristic Solution to the M-Postmen's Problem – REF. NO. EPA-670/2–74–036B
Saline Groundwater Produced with Oil and Gas – REF. NO. EPA-660/2–74–010
Salt Water Detection in the Cimarron Terrace, Oklahoma – REF. NO. EPA-660/3–74–033
Scrap Rubber Tire Utilization in Road Dressings – REF. NO. EPA-670/2–74–014
Sediments and Sediment-Water Nutrient Interchanges in Upper Klamath Lake, Oregon – REF. NO. EPA-660/3–74–015
Select Research Group in Air Pollution Meteorology, Second Annual Progress Report Volume I – REF. NO. EPA-650/4–74–045a
Select Research Group in Air Pollution Meteorology, Second Annual Progress Report Volume II – REF. NO. EPA-650/4–74–045b
Significance and Control of Waste Water Floatables in Coastal Waters – REF. NO. EPA-660/3–74–016
Silt Removal From a Lake Bottom – REF. NO. EPA-660/3–74–017
Single-Cell Protein From Waste Cellulose – REF. NO. EPA-670/2–73–095
Solid Waste Conversion: Cellulose Liquefaction – REF. NO. EPA-670/2–75–031
Sources and Natural Removal Processes for Some Atmospheric Pollutants – REF. NO. EPA-650/4–74–032
Specifications for Materials Recovered from Municipal Refuse – REF. NO. EPA-670/2–75–034
Spectroscopic Study of California Smog – REF. NO. EPA-650/4–75–006
Statistical Prediction of Equilibrium Temperature From Standard Meteorological Data Bases – REF. NO. EPA-660/2–73–003
Structure and Reactivity of Adsorbed Oxides of Sulfur – REF. NO. EPA-650/3–74–006
Studies of Pollutant Concentration Frequency Distributions – REF. NO. EPA-650/4–75–004
Studies on Effects of Thermal Pollution in Biscayne Bay in Florida – REF. NO. EPA-660/3–74–014
Studies on Modifications of Solid Industrial Wastes – REF. NO. EPA-670/2–73–065
Studies on Southeastern Aquatic Insects – REF. NO. EPA-660/3–73–016
Studies to Determine Methods for Culturing Three Freshwater Zooplankton Species – REF. NO. EPA-660/3–75–010
Study of Corrosion in Municipal Incinerators Versus Refuse Composition – REF. NO. EPA-670/2–74–084
Study of Factors Affecting Reactions in Environmental Chambers Final Report on Phase II – REF. NO. EPA-650/3–74–004a
Study of Hazardous Waste Materials, Hazardous Effects and Disposal Methods, Volume I – REF. NO. EPA-670/2–73–014
Study of Hazardous Waste Materials, Hazardous Effects and Disposal Methods, Volume II – REF. NO. EPA-670/2–73–015
Study of Hazardous Waste Materials, Hazardous Effects and Disposal Methods, Volume III – REF. NO. EPA-670/2–73–016
Study of Incinerator Residue Analysis of Water Soluble Components – REF. NO. EPA-670/2–73–057
Study of Institutional Solid Wastes – REF. NO. EPA-670/2–73–083
Study on Technical and Economic Feasibility of a Hydrogenation Process for Utilization of Waste Rubber – REF. NO. EPA-670/2–73–066
Subsurface Biological Activity in Relation to Ground Water Pollution – REF. NO. EPA-660/2–73–014
Sulfur Content of Douglas Fir Foliage Near a Paper Mill – REF. NO. EPA-660/3–74–018

CURRENT PROGRAM AREA INDEX

ECOLOGICAL PROCESSES AND EFFECTS

Survival of Pathogens in Animal Manure Disposal – REF. NO. EPA-670/2-73-051
Theoretical Model and Solubility Characteristics of Aroclor R 1254 in Water: Problems Associated with Low-Solubility Compounds in Aquatic Toxicity Test – REF. NO. EPA-660/3-74-013
Thermophilic Aerobic Digestion of Organic Solid Wastes – REF. NO. EPA-670/2-73-061
Travels of Airborne Pollen – REF. NO. EPA-650/3-75-003
Turbulent Diffusion in Liquid Jets: Final Report – REF. NO. EPA-660/3-74-004b
Turbulent Diffusion in Liquid Jets: Part I – REF. NO. EPA-660/3-74-004a
Urban Street Cleaning – REF. NO. EPA-670/2-75-030
Use of Domestic Waste Glass for Urban Paving – REF. NO. EPA-670/2-73-038
User's Guide for Hiway, A Highway Air Pollution – REF. NO. EPA-650/4-74-008
User's Manual for the APRAC-1A Urban Diffusion Model Computer Program – REF. NO. EPA-650/3-73-001
Utilization of Bark Waste – REF. NO. EPA-670/2-73-005
Utilization of Fibrous Wastes as Sources of Nutrients – REF. NO. EPA-670/2-73-090
Water Quality Requirements of Aquatic Insects – REF. NO. EPA-660/3-73-004
Weed Harvest and Lake Nutrient Dynamics – REF. NO. EPA-660/3-73-001
Wet Systems for Residential Refuse Collection: A Case Study for Springfield, Massachusetts – REF. NO. EPA-670/2-74-038
Wind Tunnel Tests of Negatively Buoyant Plumes – REF. NO. EPA-650/3-74-003
Wood Waste Reuse in Controlled Release Pesticides – REF. NO. EPA-670/2-73-034

MUNICIPAL POLLUTION CONTROL

Activated Silica in Wastewater Coagulation – REF. NO. EPA-670/2-74-047
Activated Sludge Process Using Pure Oxygen – REF. NO. EPA-670/2-73-042
Activated Sludge Treatment Systems With Oxygen – REF. NO. EPA-670/2-73-073
Adsorption from Aqueous Solution – REF. NO. EPA-670/2-74-012
Alternative Systems for Supplying Dissolved Oxygen in Wastewater Treatment – REF. NO. EPA-670/2-75-001
Alum Addition to Activated Sludge With Tertiary Solids Removal – REF. NO. EPA-670/2-73-037
Ammonia Nitrogen Removal By Breakpoint Chlorination – REF. NO. EPA-670/2-73-058
Assessment and Development Plan for Monitoring of Organics in Storm Flows – REF. NO. EPA-670/2-74-087
Bacterial Zoogloea Formation – REF. NO. EPA-670/2-74-018
Batch Disinfection of Treated Wastewater With Chlorine at Less Than 1 Degree C – REF. NO. EPA-660/2-73-005
Bench-Scale High-Rate Disinfection of Combined Sewer Overflows With Chlorine and Chlorine Dioxide – REF. NO. EPA-670/2-75-021
Biological Treatment of Combined Sewer Overflow at Kenosha, Wisconsin – REF. NO. EPA-670/2-75-019
BOD, Solids and Nutrient Removal By Foam Flotation – REF. NO. EPA-670/2-73-096
Characterization and Treatment of Urban Land Runoff – REF. NO. EPA-670/2-74-096
Chemical Impact of Snow Dumping Practices – REF. NO. EPA-670/2-74-086
Combined Sewer Overflow Seminar Papers – REF. NO. EPA-670/2-73-077
Combined Sewer Overflow Treatment by the Rotating Biological Contactor Process – REF. NO. EPA-670/2-74-050
Computer Management of a Combined Sewer System – REF. NO. EPA-670/2-74-022
Conference on Recycling Treated Municipal Wastewater Through Forest and Cropland – REF. NO. EPA-660/2-74-003
Contributions of Urban Roadway Usage to Water Pollution – REF. NO. EPA-600/2-75-004
Control Schemes for the Activated-Sludge Process – REF. NO. EPA-670/2-74-069
Cost of Dissolved Air Flotation Thickening of Waste Activated Sludge at Municipal Sewage Treatment Plants – REF. NO. EPA-670/2-74-011
Cost-Effective Design Based Upon Field Derived Parameters – REF. NO. EPA-670/2-74-062
Costs of Filter Pressing Domestic Sewage Sludges – REF. NO. EPA-670/2-74-006
Costs of Hauling and Land Spreading of Domestic Sewage Treatment Plant Sludge – REF. NO. EPA-670/2-74-010
Countermeasures for Pollution From Overflow – The State of the Art – REF. NO. EPA-670/2-74-090
Demonstration of Waste Flow Reduction from Households – REF. NO. EPA-670/2-74-071
Design and Simulation of Equalization Basins – REF. NO. EPA-670/2-73-046
Design, Construction and Initial Evaluation of the El Lago, AWT Facility – REF. NO. EPA-670/2-73-101
Development of a Monthly Technology Bulletin – REF. NO. EPA-600/2-74-005
Development of Phosphate – Free Heavy Duty Detergents – REF. NO. EPA-600/2-74-003
Disinfection of Sewage Effluents – REF. NO. EPA-670/2-73-029
Dual Functioning Swirl Combined Sewer Overflow Regulator/ Concentrator – REF. NO. EPA-670/2-73-059
Effect of Carbon to Nitrogen Ratio on Activated Sludge Subsidence and Dewatering Characteristics – REF. NO. EPA-670/2-74-025
Electrochemical Carbon Regeneration – REF. NO. EPA-670/2-75-028
Enhancing Trickling Filter Plant Performance By Chemical Precipitation – REF. NO. EPA-670/2-73-060
Evaluation and Demonstration of the Capillary Suction Sludge Dewatering Device – REF. NO. EPA-670/2-74-017
Evaluation of the Bio-Disc Treatment Process for Summer Camp Application – REF. NO. EPA-670/2-73-022
Evaluation of Three Combined Sewage Overflow Treatment Alternatives – REF. NO. EPA-670/2-74-079
Extended Aeration Sewage Treatment in Cold Climate – REF. NO. EPA-660/2-74-070
Fate and Effects of Trace Elements in Sewage Sludge When Applied to Agricultural Lands: A Literature Review Study – REF. NO. EPA-670/2-74-005
Feasibility of Overflow Overland Flow Treatment of Feedlot Runoff – REF. NO. EPA-660/2-74-062
Feasibility of Overland Flow for Treatment of Raw Domestic Wastewater – REF. NO. EPA-660/2-74-087
Ferric Chloride and Organic Polyelectrolytes for the Removal of Phosphorus – REF. NO. EPA-670/2-73-103
Great Lakes Water Quality — Status of Pertinent EPA Research – REF. NO. EPA-660/9-74-002
Hydrogen Peroxide Cures Filamentous Growth in Activated Sludge – REF. NO. EPA-670/2-73-033
Hypochlorination of Pollution Stormwater Pumpage at New Orleans – REF. NO. EPA-670/2-73-067
Hypolimnetic Flow Regimes in Lakes and Impoundments – REF. NO. EPA-660/2-74-053

CURRENT PROGRAM AREA INDEX

MUNICIPAL POLLUTION CONTROL

Hypolimnion Aeration With Commercial Oxygen – Volume I – Dynamics of Bubble Plume – REF. NO. EPA-660/2-73-025a
Hypolimnion Aeration With Commercial Oxygen – Volume II – Bubble Plume Gas Transfer – REF. NO. EPA-660/2-73-025b
Instream Aeration to Control Dissolved Sulfide in Sanitary Sewers – REF. NO. EPA-670/2-73-024
Interim Report of Task Force on Phosphate Removal Sludges – REF. NO. EPA-670/2-75-013
Laboratory Ozonation of Municipal Wastewater – REF. NO. EPA-670/2-73-075
Land Application of Sludge Effluent and Sludges: Selected Abstracts – REF. NO. EPA-660/2-74-042
Lime Disinfection of Sewage Bacteria at Low Temperature – REF. NO. EPA-660/2-73-017
Lime Stabilized Sludge: Its Stability and Effect on Agricultural Land – REF. NO. EPA-670/2-75-012
Manual for Deicer Chemical Application Practices – REF. NO. EPA-670/2-74-045
Manual for Deicing Chemical Storage and Handling – REF. NO. EPA-670/2-74-033
Mathematical Model for Aerobic Digestion – REF. NO. EPA-670/2-73-045
Mathematical Model for Post Aeration – REF. NO. EPA-670/2-73-044
Methods for Improvement of Trickling Filter Plant Performance, Part I Mechanical and Biological Optima – REF. NO. EPA-670/2-73-047a
Methods for Improvement of Trickling Filter Plant Performance, Part II – REF. NO. EPA-670/2-73-047b
Microbiology of Sewage Sludge Disposal in Soil – REF. NO. EPA-670/2-74-074
Microstraining and Disinfection of Combined Sewer Overflows – Phase III – REF. NO. EPA-670/2-74-049
Multi-Purpose Combined Sewer Overflow Treatment Facility, Mount Clemens, Michigan – REF. NO. EPA-670/2-75-010
Municipal Water Pollution Control Abstracts for 1974 – REF. NO. EPA-600/2-75-005
New Microbial Indicators of Wastewater Chlorination Efficiency – REF. NO. EPA-670/2-73-082
Nitrate and Nitrite Volatilization By Microorganisms in Laboratory Experiments – REF. NO. EPA-660/2-73-002
Nitrogen Removal By Ammonia Stripping – REF. NO. EPA-670/2-73-040
Odors Emitted From Raw and Digested Sewage Sludge – REF. NO. EPA-670/2-73-098
Off-the-Shelf Analyzers for Measuring Adenosine Triphosphate (ATP) in Activated Sludge – REF. NO. EPA-670/2-74-034
On-Line Colorimetric Analyzers for Monitoring Nitrate-Nitrite, Ammonia, Orthophosphorus and Total Hydrolyzable Phosphorus in Wastewater-Treatment Process Streams – REF. NO. EPA-670/2-74-046
Optimization and Design of an Oil/Activated Sludge Concentration Process – REF. NO. EPA-670/2-74-004
Oxygenation of Aqueous Bodies Using Liquid Oxygen-Loxination – REF. NO. EPA-670/2-74-048
Phosphate Removal in an Activated Sludge Facility – REF. NO. EPA-670/2-74-061
Physical – Chemical Treatment of Raw Material Wastewater – REF. NO. EPA-670/2-73-070
Physical and Setling Characteristics of Particulates in Storm and Sanitary Wastewaters – REF. NO. EPA-670/2-75-011
Pilot – Demonstration Project for Industrial Reuse of Renovated Municipal Wastewater – REF. NO. EPA-670/2-73-064
Planned Maintenance Management System for Municipal Wastewater Treatment Plants – REF. NO. EPA-600/2-73-004
Portable Device for Measuring Wastewater Flow in Sewers – REF. NO. EPA-600/2-73-002
Relationship Between Diameter and Height for the Design of a Swirl Concentrator as a Combined Sewer Overflow Regulator – REF. NO. EPA-670/2-74-039
Renovation of Secondary Effluent for Re-use as a Water Resource – REF. NO. EPA-660/2-74-016
Reverse Osmosis of Treated and Untreated Secondary Sewage Effluent – REF. NO. EPA-670/2-74-077
Reverse Osmosis of Treated and Untreated Secondary Sewage Effluent; Appendix A-2 and Appendix A-6 – REF. NO. EPA-670/2-75-027
Role of Polyelectrolytes in Filtration Processes – REF. NO. EPA-670/2-74-032
Role of Trace Elements in Management of Nuisance Growths – REF. NO. EPA-660/2-75-008
Rotating Biological Disk Wastewater Treatment Process – Pilot Plant Evaluation – REF. NO. EPA-670/2-73-027
Second U.S. – Japan Conference on Sewage Treatment Technology December 1-6, 1972 – REF. NO. EPA-670/9-74-003
Selected Abstracts for Instrumentation and Automation of Wastewater Facilities – REF. NO. EPA-670/2-73-104
Selective Nutrient Removal Secondary Effluent – REF. NO. EPA-670/2-73-076
Sewerage System Monitoring and Remote Control – REF. NO. EPA-670/2-75-020
Sludge Conditioning Using SO2 and Low Pressure for Production of Organic Feed Concentrate – REF. NO. EPA-670/2-73-062
Storm Water Management Model: User's Manual – Version II – REF. NO. EPA-670/2-75-017
Stream Pollution Abatement by Supplement Pumping – REF. NO. EPA-670/2-75-035
Study of an Integrated Power, Water and Wastewater Utility Complex – REF. NO. EPA-670/2-74-080
Study of Upflow Filter for Tertiary Treatment – REF. NO. EPA-670/2-73-074
Summary Report – Pilot Plant Studies on Dewatering Primary Digested Sludge – REF. NO. EPA-670/2-73-043
Surge Facility for Wet and Dry Weather Flow Control – REF. NO. EPA-670/2-74-075
Suspended Solids Monitor – REF. NO. EPA-670/2-75-002
System Alternatives in Oxygen Activated Sludge – REF. NO. EPA-670/2-75-008
SWIRL Concentrator as a Grit Separator Device – REF. NO. EPA-670/2-74-026
Tertiary Treatment With a Controlled Ecological System – REF. NO. EPA-660/2-73-022
U-Tube Aeration – REF. NO. EPA-670/2-73-031
Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards – REF. NO. EPA-670/9-75-004
Urban Stormwater Management and Technology: An Assessment – REF. NO. EPA-670/2-74-040
Urban Stormwater Management Modeling and Decision-Making – REF. NO. EPA-670/2-75-022
Utilization of Trickling Filters for Dual Treatment of Dry and Wet Weather Flows – REF. NO. EPA-670/2-73-071
Wastewater Treatment and Reuse By Land Application, Volume I – Summary – REF. NO. EPA-660/2-73-006a
Wastewater Treatment and Reuse By Land Application, Volume II – Summary – REF. NO. EPA-660/2-73-006b
Wastewater Use in the Production of Food and Fiber—Proceedings of Conference held at Oklahoma City, OK March 5-7, 1974 – REF. NO. EPA-660/2-74-041
Water Quality Effect of Diking a Shallow Arid-Region Lake – REF. NO. EPA-660/2-75-007
Water Renovation of Municipal Effluents by Reverse Osmosis – REF. NO. EPA-670/2-75-009
200 MGD Activated Sludge Plant Removes Phosphorus by Pickle Liquor – REF. NO. EPA-670/2-73-050

INDUSTRIAL POLLUTION CONTROL

CURRENT PROGRAM AREA INDEX

INDUSTRIAL POLLUTION CONTROL

Activated Carbon Treatment of Unbleached Kraft Effluent for Reuse – REF. NO. EPA-660/2-75-004
Activated Sludge – Bio-Disc Treatment of Distillery Wastewater – REF. NO. EPA-660/2-74-014
Air Flotation – Biological Oxidation of Synthetic Rubber and Latex Wastewater – REF. NO. EPA-660/2-73-018
Biological Treatment of Concentrated Sugar Beet Wastes – REF. NO. EPA-660/2-74-028
Catalyzed Bio-Oxidation and Tertiary Treatment of Integrated Textile Wastewaters – REF. NO. EPA-660/2-74-039
Characterization of Waste Waters from the Ethical Pharmaceutical Industry – REF. NO. EPA-670/2-74-057
Chemical/Physical and Biological Treatment of Wool Processing Wastes – REF. NO. EPA-660/2-73-036
Coliform Bacteria Growth and Control in Aerated Stabilization Basins – REF. NO. EPA-660/2-73-028
Color Characterization Before and After Lime Treatment – REF. NO. EPA-660/2-74-029
Color Removal and Sludge Disposal Process for Kraft Mill Effluents – REF. NO. EPA-660/2-74-008
Color Removal From Kraft Mill Effluents By Ultrafiltration – REF. NO. EPA-660/2-73-019
Continuous Inplant Hot Gas Blanching of Vegetables – REF. NO. EPA-660/2-74-091
Copper Recovery from Brass Mill Discharge by Cementation with Scrap Iron – REF. NO. EPA-670/2-75-029
Demonstration of Thermal Water Utilization in Agriculture – REF. NO. EPA-660/2-74-011
Development of a Monthly Industrial Technology Bulletin – REF. NO. EPA-600/2-74-007
Dry Caustic Heating of Clingstone Peaches on a Commercial Scale – REF. NO. EPA-660/2-74-092
Effluents of the Inorganic Gas Industry – REF. NO. EPA-600/2-74-009c
Effluents of the Inorganic Pesticide Industry – REF. NO. EPA-600/2-74-009a
Evaluation of Polymeric Clarification of Meat-Packing and Domestic Wastewaters – REF. NO. EPA-660/2-74-020
Explicit Calibration of the Pills II System – REF. NO. EPA-660/2-73-011
Final Report Deep Water Pilot Plant Treatability Study – REF. NO. EPA-660/2-73-038
Granite Industry Wastewater Treatment – REF. NO. EPA-660/2-74-040
Improvement of Treatment of Food Industry Waste – REF. NO. EPA-660/2-74-035
Industrial Water Softener Waste Brine Reclamation – REF. NO. EPA-660/2-74-007
Information Resource: Final Report Water Pollution Control in Water Utilities – REF. NO. EPA-660/2-73-020
Infrared Dry Caustic vs. Wet Caustic Peeling of White Potatoes – REF. NO. EPA-660/2-74-088
Ion Exchange Process for Recovery of Chromate from Pigment Manufacturing – REF. NO. EPA-670/2-74-044
Laboratory Study of Continous Electro-oxidation of Dilute Cyanide Waste – REF. NO. EPA-670/2-74-059
Measurement of Residual Chlorine Levels in Cooling Water — Amperometric Method – REF. NO. EPA-660/2-73-039
Mercury Recovery from Contaminated Waste Waters and Sludges – REF. NO. EPA-660/2-74-086
Metallic Recovery From Waste Waters Utilizing Cementation – REF. NO. EPA-670/2-74-008
Modular Wastewater Treatment System Demonstration For the Textile Maintenance Industry – REF. NO. EPA-660/2-73-037
New Membranes for Reverse Osmosis Treatment of Metal Finishing Effluents – REF. NO. EPA-660/2-73-033
Nomographs for Thermal Pollution Control Systems – REF. NO. EPA-660/2-73-004
Paunch Manure as a Feed Supplement in Channel Catfish Farming – REF. NO. EPA-660/2-74-046
Physical-Chemical Treatment of Municipal Wastes by Recycled Magnesium Carbonate – REF. NO. EPA-660/2-74-055
Pilot Plant Optimization of Phosphoric Acid Recovery Process – REF. NO. EPA-670/2-75-015
Pilot Scale Treatment of Wine Stillage – REF. NO. EPA-660/2-75-002
Plant Scale Studies of the Magnesium Carbonate Water Treatment Process – REF. NO. EPA-660/2-75-006
Pollution Control in the Commercial Explosives Industry – REF. NO. EPA-600/2-74-009b
Pollution Control Technology for Pesticide Formulators and Packagers – REF. NO. EPA-660/2-74-094
Poultry Processing Wastewater Treatment and Reuses – REF. NO. EPA-660/2-74-060
Proceedings Fourth National Symposium on Food Processing Wastes – REF. NO. EPA-660/2-73-031
Proceedings: Fifth National Symposium on Food Processing Wastes – REF. NO. EPA-660/2-74-058
Projects in the Industrial Pollution Control Division – December 1974 – REF. NO. EPA-600/2-75-001
Protein Production from Acid Whey VIA Fermentation – REF. NO. EPA-660/2-74-025
Reclamation of Metal Values from Metal-Finishing Waste Treatment Sludges – REF. NO. EPA-670/2-75-018
Reclamation of Sulfuric Acid From Waste Streams – REF. NO. EPA-670/2-75-016
Recovery of Fatty Materials From Edible Oil Refinery Effluents – REF. NO. EPA-660/2-73-015
Regeneration of Chromated Aluminum Deoxidizers – REF. NO. EPA-660/2-73-023
Research Study of Coal Preparation Plant and By-Product Coke Plant Effluents – REF. NO. EPA-660/2-74-050
Rum Distillery Slops Treatment by Anaerobic Contact Process – REF. NO. EPA-660/2-74-074
Separation, Dewatering, and Disposal of Sugar Beet Transport Water Solids Phase I – REF. NO. EPA-660/2-74-093
Shrimp Canning Waste Treatment Study – REF. NO. EPA-660/2-74-061
Studies of Low Molecular Weight Lignin Sulfonates – REF. NO. EPA-660/2-74-069
Study of Feasibility of Herbicide Orange Chlorinolysis – REF. NO. EPA-600/2-74-006
Submerged Combustion Evaporator for Concentration of Brewery Spent Grain Liquor – REF. NO. EPA-660/2-74-059
Sulfuric Acid and Ferrous Sulfate Recovery From Waste Pickle Liquor – REF. NO. EPA-660/2-73-032
Technical and Economic Evaluation of Cooling Systems Blowdown Control Techniques – REF. NO. EPA-660/2-73-026
Test Method for Volatile Component Stripping of Wastewater – REF. NO. EPA-660/2-74-044
Treatment and Recovery of Fluoride Industrial Waste – REF. NO. EPA-660/2-73-024
Treatment of Cheese Processing Wastewaters in Aerated Lagoons – REF. NO. EPA-660/2-74-012
Treatment of Domestic Wastewater and NSSC Pulp and Paper Mill Wastes – REF. NO. EPA-660/2-73-010
Treatment of Packing House Waste by Anaerobic Lagoons in Plastic-Media Filters – REF. NO. EPA-660/2-74-027
Treatment of Sulfite Evaporator Condensates for Recovery of Volatile Components – REF. NO. EPA-660/2-73-030
Waste Citrus Activated Sludge As a Poultry Feed Ingredient – REF. NO. EPA-660/2-75-001
Waste Control and Abatement in the Processing of Sweet Potatoes – REF. NO. EPA-660/2-73-021
Waste Water Treatment and Reuse in a Metal Finishing Job Shop – REF. NO. EPA-670/2-74-042
Wastewater Abatement in Canning Vegetables by IQB Blanching – REF. NO. EPA-660/2-74-006
Wastewater Characterization for the Specialty Food Industry – REF. NO. EPA-660/2-74-075

CURRENT PROGRAM AREA INDEX

INDUSTRIAL POLLUTION CONTROL

Water and Waste Management in Poultry Processing – REF. NO. EPA-660/2-74-031
Water Recycle/Reuse Possibilities: Power Plant Boiler and Cooling System – REF. NO. EPA-660/2-74-089
Waterborne Wastes of the Paint and Inorganic Pigments Industries – REF. NO. EPA-670/2-74-030

NON-POINT POLLUTION CONTROL

Abatement of Mine Drainage Pollution By Underground Precipitation – REF. NO. EPA-670/2-73-092
Anaerobic-Aerobic Lagoon Treatment of Dairy Manure Wastes – REF. NO. EPA-660/2-74-030
Analysis of Pollution Control Costs – REF. NO. EPA-670/2-74-009
Applications of Reverse Osmosis to Acid Mine Drainage Treatment – REF. NO. EPA-670/2-73-100
Appraisal of Neutralization Processes to Treat Coal Mine Drainage – REF. NO. EPA-670/2-73-093
Assessing Effects on Water Quality by Boating Activity – REF. NO. EPA-670/2-74-072
Brine Disposal Treatment Practices Relating to the Oil Production Industry – REF. NO. EPA-660/2-74-037
Carbonate Bonding of Taconite Tailings – REF. NO. EPA-670/2-74-001
Characterization of Vessel Waste in Duluth-Superior Harbor – REF. NO. EPA-670/2-74-097
Combustion Toilet for Use on Small Boats – REF. NO. EPA-670/2-74-053
Conversion of Cattle Feedlot Wastes to Ammonia Synthesis Gas – REF. NO. EPA-660/2-74-090
Crankcase Drainage from In-Service Out-board Motors – REF. NO. EPA-670/2-74-092
Demonstration of a Non-Aqueous Sewage Disposal System – REF. NO. EPA-670/2-73-088
Demonstration of the Separation and Disposal of Concentrated Sediments – REF. NO. EPA-660/2-74-072
Demonstration of Three Recirculating Swine Waste Management Systems – REF. NO. EPA-660/2-74-009
Design Parameters for Animal Waste Treatment Systems – REF. NO. EPA-660/2-74-063
Development and Evaluation Report: Physical Chemical Marine Sanitation System – REF. NO. EPA-670/2-74-043
Development of Field Applied DDT – REF. NO. EPA-660/2-74-036
Development of On-Shore Treatent System for Sewage from Watercraft Retention System – REF. NO. EPA-670/2-74-056
Devices for On – Board Treatment of Waste from Vessels – REF. NO. EPA-670/2-74-091
Effects of Exhaust from Two-Cycled Outboard Engines – REF. NO. EPA-670/2-74-063
Electrochemical Removal of Heavy Metals from Acid Mine Drainage – REF. NO. EPA-670/2-74-023
Environmental Protection in Surface Mining of Coal – REF. NO. EPA-670/2-74-093
Evaluation of Drainage for Salinity Control in Grand Valley – REF. NO. EPA-660/2-74-084
Evaluation of Irrigation Scheduling for Salinity Control in Grand Valley – REF. NO. EPA-660/2-74-052
Evaluation of MTF for Testing Hazardous Material Spill Control Equipment – REF. NO. EPA-670/2-74-073
Evaluation of Tailings Ponds Sealants – REF. NO. EPA-660/2-74-065
Executive Summary of Three EPA Demonstration Programs in Erosion and Sediment Control – REF. NO. EPA-660/2-74-073
Fabric Boom Concept for Containment and Collection of Floating Oil – REF. NO. EPA-670/2-73-069
Feasibility of 5 gpm Dynactor/Flash Magnetic Separator System to Treat Spilled Hazardous Materials – REF. NO. EPA-670/2-75-004
Feasibility Study of a New Surface Mining Method "Longwall Stripping" – REF. NO. EPA-670/2-74-002
Gas Requirements to Pressurize Abandoned Deep Mines – REF. NO. EPA-670/2-73-054
Herbicide Runoff from Four Coastal Plain Soil Types – REF. NO. EPA-660/2-74-017
Investigation of Surface Films – Chesapeake Bay Entrance – REF. NO. EPA-670/2-73-099
Joint Construction Sediment Control Project – REF. NO. EPA-660/2-73-035
Laboratory Study of Self-Sealing Limestone Plugs for Mine Openings – REF. NO. EPA-670/2-73-081
Limestone and Limestone-Lime Neutralization of Acid Mine Drainage – REF. NO. EPA-670/2-74-051
Liquid Aerobic Composting of Cattle Wastes and Evaluation of Byproducts – REF. NO. EPA-660/2-74-034
Livestock and the Environment – A Bibliography without Abstracts – REF. NO. EPA-660/2-74-024
Livestock and the Environment—A Bibliography with Abstracts, Volume II – REF. NO. EPA-660/2-75-003
Losses of Fertilizers and Pesticides from Claypan Soils – REF. NO. EPA-660/2-74-068
Management Practices Affecting Quality and Quantity of Irrigation Return Flow – REF. NO. EPA-660/2-75-005
Mine Drainage Pollution Control Demonstration Grant Procedures and Requirement – REF. NO. EPA-670/2-74-003
Mine Spoil Potentials for Soil and Water Quality – REF. NO. EPA-670/2-74-070
Nitrogen and Phosphorus Losses from Agronomy Plots in North Alabama – REF. NO. EPA-660/2-74-033
North Fork Alluvial Decontamination Project, Hubbard Creek Reservoir Watershed – REF. NO. EPA-660/2-74-019
Odors from Confined Livestock Production – A State of the Art – REF. NO. EPA-660/2-74-023
Oil Recovery System Using Sorbent Material – REF. NO. EPA-670/2-73-068
Oil Recovery System Utilizing Polyurethane Foam—A Feasibility Study – REF. NO. EPA-670/2-73-084
Oil Spill and Oil Pollution Reports – REF. NO. EPA-670/2-75-003
On-Shore Treatment Systems for Sewerage from Watercraft Retention Systems – REF. NO. EPA-670/2-75-007
Pesticide Movement from Crop Lands into Lake Erie – REF. NO. EPA-660/2-74-032
Pesticide, Transport and Runoff Model for Agricultural Land – REF. NO. EPA-660/2-74-013
Pollution Aspects of Catfish Production—Review and Projections – REF. NO. EPA-660/2-74-064
Pollution Problems and Research Needs for an Oil Shale Industry – REF. NO. EPA-660/2-74-067
Prediction of Sub-soil Erodibility Using Chemical, Mineralogical and Physical Parameters – REF. NO. EPA-660/2-74-043
Programmed Demonstration for Erosion and Sediment Control Specialist – REF. NO. EPA-660/2-74-071
Quantification of Pollution in Agricultural Runoff – REF. NO. EPA-660/2-74-005
Removal of Heavy Metals from Mine Drainage by Precipitation – REF. NO. EPA-670/2-73-080
Removal of Manganese From Mine Drainage by Ozone and Chlorine – REF. NO. EPA-670/2-75-006
Selected Irrigation Return Flow Quality Abstracts: 1972–1973 – REF. NO. EPA-660/2-74-049
***Soil Modification for Denitrification and Phosphate Reduction of Feed Lot Wastes* – REF. NO. EPA-660/2-74-057**
Sources of Oil and Water in Bilges of Great Lakes Ships – REF. NO. EPA-670/2-74-054

CURRENT PROGRAM AREA INDEX

NON-POINT POLLUTION CONTROL

State of Maryland Waste Oil Recovery and Reuse Program – REF. NO. EPA-670/2-74-013
State-of-the-Art: Sand and Gravel Industry – REF. NO. EPA-660/2-74-066
State-of-the-Art: Uranium Mining, Milling, and Refining Industry – REF. NO. EPA-660/2-74-038
Storage and Disposal of Iron Ore Processing Wastewater – REF. NO. EPA-660/2-74-018
Treatment of Hazardous Material Spills With Floating Mass Transfer Media – REF. NO. EPA-670/2-73-078
Volatization of Losses of Pesticides from Soil – REF. NO. EPA-660/2-74-054
Waste Oil Recycling and Disposal – REF. NO. EPA-670/2-74-052
Waste Treatment System for Confined Hog Raising Operations – REF. NO. EPA-660/2-74-047

AIR POLLUTION CONTROL

Absorption of SO2 into Lime Slurries: Absorption Rates and Kinetics – REF. NO. EPA-650/2-73-047
Adsorption of Odorous Pollutants by Active Manganese Dioxide – REF. NO. EPA-650/2-74-063
Aerodynamic Control of Nitrogen Oxides and Other Pollutants from Fossil Fuel Combustion Volume II – Raw Data and Experimental Equipment – REF. NO. EPA-650/2-73-033b
Aerodynamic Control of Nitrogen Oxides and Other Pollutants From Fossil Fuel Combustion Volume I – Data Analysis and Summary of Conclusions – REF. NO. EPA-650/2-73-033a
Analysis of Test Data for NOX Control in Gas and Oil-Fired Utility Boilers – REF. NO. EPA-650/2-75-012
Andersen Filter Substrate Weight Loss – REF. NO. EPA-650/2-75-022
Applicability of the Meyers Process of Chemical Desulfurization of Coal: Initial Survey of Fifteen Coals – REF. NO. EPA-650/2-74-025
Application of Holographic Methods to the Measurement of Flames and Particulate – Volume II – REF. NO. EPA-650/2-74-031b
Application of Holographic Methods to the Measurement of Flames and Particulate – Volume 1 – REF. NO. EPA-650/2-74-031a
Applying Fabric Filtration to Coal Fired Industrial BoilersA Preliminary Pilot Scale Investigation – REF. NO. EPA-650/2-74-058
Assessment of the Applicability of Automotive Emission Control Technology to Stationary Engines – REF. NO. EPA-650/2-74-051
Assessment of the Potential of Clean Fuels and Energy Technology – REF. NO. EPA-600/2-74-001
Assessment of Catalysts for Control of NOX from Stationary Power Plants, Phase I, Volume I – Final Report – REF. NO. EPA-650/2-75-001a
Assessment of Catalysts for Control of NOX from Stationary Power Plants, Phase I, Volume II – Data Bank Citation Indices – REF. NO. EPA-650/2-75-001b
Assessment of Particle Control Technology for Enclosed Asbestos Sources – REF. NO. EPA-650/2-74-088
Atmospheric Emissions from the Asphalt Industry – REF. NO. EPA-650/2-73-046
Atmospheric Emissions from Asphalt Roofing Processes – REF. NO. EPA-650/2-74-101
Atmospheric Emissions From the Petroleum Refining Industry – REF. NO. EPA-650/2-73-017
Boiler Modification Cost Survey for Sulfur Oxides Control by Fuel Substitution – REF. NO. EPA-650/2-74-123
Braxton Sonic Agglomerator Evaluation – REF. NO. EPA-650/2-74-036
Catalytic Combustion, a Pollution-Free Means of Energy Conversion – REF. NO. EPA-650/2-73-018
Catalytic Oxidation of Sulfur Dioxide Using Isotopic Tracers – REF. NO. EPA-650/2-73-020
Changes in the Global Energy Balance – REF. NO. EPA-650/2-74-116
Characterization and Control of Asbestos Emissions from Open Sources – REF. NO. EPA-650/2-74-090
Characterization of Atmospheric Emissions from Polyurethane Resin Manufacture – REF. NO. EPA-650/2-74-107
Charged Droplet Scrubbing of Submicron Particulate – REF. NO. EPA-650/2-74-075
Chemically Active Fluid-Bed Process for Sulphur Removal During Gasification of Heavy Fuel Oil—Second Phase – REF. NO. EPA-650/2-73-039
Chemically Active Fluid-Bed Process for Sulphur Removal During Gasification of Heavy Fuel Oil – Second Phase – REF. NO. EPA-650/2-74-109
Coke Charging Pollution Control Demonstration – REF. NO. EPA-650/2-74-022
Coke Oven Charging Emission Control Test Program – Supplemental Observations – REF. NO. EPA-650/2-74-062a
Coke Oven Charging Emission Control Test Program—Volume I – REF. NO. EPA-650/2-74-062
Coke Oven Smokeless Pushing System Design Manual – REF. NO. EPA-650/2-74-076
Combustion Control of Pollutants from Multiburner Coal-fired System – REF. NO. EPA-650/2-74-038
Conditioning of Fly Ash with Sulfamic Acid, Ammonium Sulfate, and Ammonium Bisulfact – REF. NO. EPA-650/2-74-114
Continuous Measurement of Total Gas Flowrate from Stationary Sources – REF. NO. EPA-650/2-75-020
Control of Environmental Impacts From Advanced Energy Sources – REF. NO. EPA-600/2-74-002
Control of Sulfur Dioxide Emissions from Copper Smelters: Volume I Steam Oxidation of Pyritic Copper Concentrates – REF. NO. EPA-650/2-74-085a
Control of Sulfur Dioxide Emissions from Copper Smelters: Volume II Hydrogen Sulfide Production from Copper Concentrates – REF. NO. EPA-650/2-74-085b
Control Technology for Fine Particulate Emissions – REF. NO. EPA-650/2-74-027
Demetallization of Heavy Residual Oils – REF. NO. EPA-650/2-73-041
Demetallization of Heavy Residual Oils – Phase II – REF. NO. EPA-650/2-73-041a
Design of an Optimum Distillate Oil Burner for Control of Pollutant Emissions – REF. NO. EPA-650/2-74-047
Design Development and Fabrication of a Prototype High-Vol. Particulate Mass Sampling Train – REF. NO. EPA-650/2-74-067
Design Trends and Operating Problems in Combustion Modification of Industrial Boilers – REF. NO. EPA-650/2-74-032
Design, Development, and Field Test of a Droplet Measuring Device – REF. NO. EPA-650/2-75-018
Design, Fabrication, and Installation of a Particulate Aerodynamic Test Facility – REF. NO. EPA-650/2-74-103
Detailed Cost Estimates For Advanced Effluent Desulfurization Processes – REF. NO. EPA-600/2-75-006
Determination of Hazardous Elements in Smelter-Produced Sulfuric Acid – REF. NO. EPA-650/2-74-131
Development of an Approach to Identification of Emerging Technology and Demonstration Opportunities – REF. NO. EPA-650/2-74-048
Development of Sampling and Analytical Methods of Lime/Limestone Wet Scrubbing Tests – REF. NO. EPA-650/2-74-024
Disposal of By-products from Non-regenerable Flue Gas Desulfurization Systems: Initial Report – REF. NO. EPA-650/2-74-037a
Distributions of Industrial and Commercial-Institution External Combustion Boilers – REF. NO. EPA-650/2-75-021
Effect of Gas Turbine Efficiency and Fuel Cost on Cost Producing Electric Power – REF. NO. EPA-650/2-74-041
Effectiveness of Selected Fuel Additives in Controlling Pollution Emissions From Residual Oil-Fired Boilers – REF. NO. EPA-650/2-73-031
Effects of Design and Operating Variables on NOx from Coal-Fired Furnaces— Phase I – REF. NO. EPA-650/2-74-002a
Effects of Design and Operating Variables on NOX from Coal-Fired Furnaces – Phase II – REF. NO. EPA-650/2-74-002b

CURRENT PROGRAM AREA INDEX

AIR POLLUTION CONTROL

Efficiencies in Power Generation – REF. NO. EPA-650/2-74-021
Electrostatic Precipitator Performance Model – REF. NO. EPA-650/2-74-132
Enclosed Coke Pushing and Quenching System Design Manual – REF. NO. EPA-650/2-73-028
Entrainment Separators for Scrubbers – Initial Report – REF. NO. EPA-650/2-74-119a
Environmental Consideration in Future Energy Growth – REF. NO. EPA-600/5-73-004
Environmental Considerations for Oil Shale Development – REF. NO. EPA-650/2-74-099
Equimolar NO2 Absorption into Magnesia Slurry – A Pilot Feasibility Study – REF. NO. EPA-650/2-73-015
Evaluation of the Fluidized-Bed Combustion Process Volume I Pressurized Fluidized-Bed Combustion Process Development and Evaluation – REF. NO. EPA-650/2-73-048a
Evaluation of the Fluidized-Bed Combustion Process Volume II – Fluidized Bed Boiler Combined-Cycle Power Plant Development—Volume I Appendices – REF. NO. EPA-650/2-73-048b
Evaluation of the Fluidized-Bed Combustion Process Volume III Pressurized Fluidized-Bed Boiler Development Plant Design – REF. NO. EPA-650/2-73-048c
Evaluation of the Fluidized-Bed Combustion Process Volume IV – Fluidized-Bed Gasification Desulfurization – REF. NO. EPA-650/2-73-048d
Evaluation of the Regenerative Pressurized Fluidized-Bed Combustion Process – REF. NO. EPA-650/2-74-012
Evaluation of Aeronetic Two-Phase Jet Scrubber – REF. NO. EPA-650/2-74-129
Evaluation of Equations for Designing Ammoniacal Scrubbers to Remove Sulfur Oxides from Waste Gas – REF. NO. EPA-650/2-74-035
Evaluation of Pollution Control in Fossil Fuel Conversion Processes Gasification; Section I: Synthane Process – REF. NO. EPA-650/2-74-009b
Evaluation of Pollution Control in Fossil Fuel Conversion Processes Gasification Section I: Koppers-Totzek Process – REF. NO. EPA-650/2-74-009a
Evaluation of Pollution Control in Fossil Fuel Conversion Processes Gasification; Section I: CO2 Acceptor Process – REF. NO. EPA-650/2-74-009d
Evaluation of Pollution Control in Fossil Fuel Conversion Processes Liquefaction: Section I. COED Process – REF. NO. EPA-650/2-74-009e
Evaluation of Pollution Control in Fossil Fuel Conversion Processess Gasification; Section I; Lurgi Process – REF. NO. EPA-650/2-74-009c
Evaluation of Prechamber Spark Ignition Engine Concepts – REF. NO. EPA-650/2-75-023
Evaluation of R&D Investment Alternatives for SOx Air Pollution Control Processes – REF. NO. EPA-650/2-74-098
Evaluation of Sulfur Dioxide Emission Control Options for Iowa Power Boilers – REF. NO. EPA-650/2-74-127
EPA Alkali Scrubbing Test Facility: Limestone Wet Scrubbing Test Result – REF. NO. EPA-650/2-74-010
EPA Alkali Scrubbing Test Facility: Sodium Carbonate and Limestone Test Results – REF. NO. EPA-650/2-73-013
EPA Fine Particle Scrubber Symposium (San Diego, 5/28–30/74) – REF. NO. EPA-650/2-74-112
Fabric Filter Cleaning Studies – REF. NO. EPA-650/2-75-009
Fate of Trace Constituents of Coal During Gasification – REF. NO. EPA-650/2-73-004
Feasibility of Flux Force/Condensation Scrubbing for Fine Particulate Collection – REF. NO. EPA-650/2-73-036
Federal Aircraft Noise Research, Development, and Demonstration Programs: FY 73 – FY 75 – REF. NO. EPA-600/2-75-003
Federal Noise Effects Research: FY 73 – FY 75 – REF. NO. EPA-600/1-75-001
Federal Surface Vehicle Noise Research, Development, and Demonstration Program: FY 73 – FY 75 – REF. NO. EPA-600/2-75-002
Field Measurements of Particle Size Distribution Sizing Devices – REF. NO. EPA-650/2-73-035
Field Testing: Application of Combustion Modifications to Control NOx Emissions for Utility Boilers – REF. NO. EPA-650/2-74-066
Field Testing: Application of Combustion Modifications to Control Pollutant Emissions from Industrial Boilers – Phase I – REF. NO. EPA-650/2-74-078a
Fine Particle Scrubber Performance Tests – REF. NO. EPA-650/2-74-093
Flame Characterization Probes – REF. NO. EPA-650/2-74-023
Fluidized Bed Combustion Process Evaluation (Phase I – Residual Oil Gasification/Desulfurization Demonstration at Atmospheric Pressure) Volume I – Summary – REF. NO. EPA-650/2-75-027a
Fluidized Bed Combustion Process Evaluation (Phase I – Residual Oil Gasification/Desulfurization Demonstration at Atmospheric Pressure) Volume II – Appendices – REF. NO. EPA-650/2-75-027b
Fluoride Emissions from Phosphoric Acid Plant Gypsum Ponds – REF. NO. EPA-650/2-74-095
Full-Scale Desulfurization of Stack Gas by Dry Limestone Injection: Volume 1 – REF. NO. EPA-650/2-73-019a
Full-Scale Desulfurization of Stack Gas by Dry Limestone Injection: Volume II – Appendices A through H – REF. NO. EPA-650/2-73-019b
Full-Scale Desulfurization of Stack Gas by Dry Limestone Injection: Volume III – Appendices I through L – REF. NO. EPA-650/2-73-019c
Gasification of Fossil Fuels Under Oxidative, Reductive, and Pyrolytic Conditions – REF. NO. EPA-650/2-73-042
Identification and Assessment of Asbestos Emissions from Incidental Sources of Asbestos – REF. NO. EPA-650/2-74-087
Identification and Characterization of the Use of Mixed Conventional and Waste Fuels – REF. NO. EPA-650/2-75-017
Improved Air Pollution Control for a Kraft Recovery Boiler: Recovery Boiler No. 4 – REF. NO. EPA-650/2-74-071b
Improved Air Pollution Control for Kraft Recovery Boiler: Modified Recovery Boiler No. 3 – REF. NO. EPA-650/2-74-071a
Indigester Black Liquor Oxidation for Odor Control in Kraft Pulping – REF. NO. EPA-650/2-74-005
Influence of Fiber Characteristics on Particulate Filtration – REF. NO. EPA-650/2-75-002
Influence of Fly Ash Compositional Factors on Electrical Volume Resistivity – REF. NO. EPA-650/2-74-074
Instrumental Analyses for Wet Scrubbing Processes – REF. NO. EPA-650/2-74-064
Interactions of Stack Gas Sulfur and Nitrogen Oxides on Dry Berkau – REF. NO. EPA-650/2-73-029
Interpretative Compilation of EPA Studies Related to Coal Quality and Cleanability – REF. NO. EPA-650/2-74-030
Investigation of Particulate Emission from Oil-Fired Residential Heating Units – REF. NO. EPA-650/2-74-026
Investigation of Surface Combustion Concepts for NOx Control in Utility Boilers and Stationary Gas Turbines – REF. NO. EPA-650/2-73-014
Iron Foundry Cupola Recuperative Emission Control Demonstration — Design Manual – REF. NO. EPA-650/2-74-004
Kinetic Mechanisms of Methane/Air Combustion with Pollutant Formation – REF. NO. EPA-650/2-74-045
Kinetic Mechanisms Governing the Fate of Chemically Bound Sulfur and Nitrogen in Combustion – REF. NO. EPA-650/2-74-017
Lime/Limestone Scrubbing in a Pilot Dustraxtor – Key West – REF. NO. EPA-650/2-74-077
Lone Star Steel Steam-Hydro Air Cleaning System Evaluation – REF. NO. EPA-650/2-74-028
Marketing H2 SO4 from SO2 Abatement Sources— The TVA Hypothesis – REF. NO. EPA-650/2-73-051
Mathematical Simulation of an Adsorber for Pollutant Removal – REF. NO. EPA-650/2-74-110
Measurement and Characterization of Particles in Wet Scrubbing Process for SOx Control – REF. NO. EPA-650/2-73-024
Measurement of Entrained Liquid Levels in Effluent Gases from Scrubber Demisters – REF. NO. EPA-650/2-74-050
Measurement of Sulfur Dioxide, Particulate, and Trace Elements in Copper Smelter Converter and Roaster/Reverberatory Gas Streams – REF. NO. EPA-650/2-74-111

CURRENT PROGRAM AREA INDEX

AIR POLLUTION CONTROL

Occurrence and Distribution of Potentially Volatile Trace Elements in Coal – REF. NO. EPA-650/2-74-054
Odor Removal from Air by Adsorption on Charcoal – REF. NO. EPA-650/2-74-084
Optical Measurements of Smoke Particle Size Generated by Electric Arcs – REF. NO. EPA-650/2-74-034
Particulate Collection Study, EPA/TVA Full-Scale Dry Limestone Injection Tests – REF. NO. EPA-650/2-74-053
Particulate Emissions from Alfalfa Dehydrating Plants — Control Costs and Effectiveness – REF. NO. EPA-650/2-74-007
Particulate Sizing Techniques for Control Device Evaluation – REF. NO. EPA-650/2-74-102
Pentapure Impinger Evaluation – REF. NO. EPA-650/2-75-024a
Petrograhpic Characteristics and Physical Properties of Marls, Chalks, Shells and Their Calcines Related to Desulfurization of Flue Gases – REF. NO. EPA-650/2-73-044
Pilot-Plant Study of an Ammonia Absorption Ammonium Bisulfate Regeneration Process, Topical Report Phases I and II – REF. NO. EPA-650/2-74-049a
Pollutant Analysis Cost Survey – REF. NO. EPA-650/2-74-125
Procedures for Measurement in Stratified Gases – Volume I – REF. NO. EPA-650/2-74-086a
Procedures for Measurement in Stratified Gases – Volume II, Appendices – REF. NO. EPA-650/2-74-086b
Proceeding, Coal Combustion Seminar, June 19-20, 1973 – REF. NO. EPA-650/2-73-021
Proceedings of Third International Conference on Fluidized-Bed Combustion – REF. NO. EPA-650/2-73-053
Proceedings, Symposium Control of Fine-Particulate Emissions from Industrial Sources, January 15–18, 1974 San Francisco, CA – REF. NO. EPA-600/2-74-008
Proceedings: Flue Gas Desulfurization Symposium 1973 – REF. NO. EPA-650/2-73-038
Proceedings: Symposium on the Use of Fabric Filters for the Control of Submicron Particulates (April 8–10, 1974, Boston, Ma.) – REF. NO. EPA-650/2-74-043
Proceedings: Symposium on Flue Gas Desulfurization – Atlanta, November 1974, Volume II – REF. NO. EPA-650/2-74-126b
Process Modifications for Control of Particulate Emissions from Stationary Combustion, Incineration, and Metals – REF. NO. EPA-650/2-74-100
Production of Clean Fuel Gas From Bituminous Coal – REF. NO. EPA-650/2-73-049
Production of Low-Sulfur Gasoline – REF. NO. EPA-650/2-74-130
Program for Reduction of NO_x from Tangential Coal-Fired Boilers Phase 1 – REF. NO. EPA-650/2-73-005
Properties of Ammonium Sulfate, Ammonium, and Sulfur Dioxide Solutions in Ammonia Scrubbing Processes – REF. NO. EPA-650/2-73-012
Reduction of Atmospheric Pollution by the Application of Fluidized-Bed Combustion – REF. NO. EPA-650/2-74-057
Reduction of Atmospheric Pollution by the Application of Fluidized-Bed Combustion and Regeneration of Sulfur-Containing Additives – REF. NO. EPA-650/2-74-104
Refinery Catalytic Cracker Reginerator SO_x Control Process Survey – REF. NO. EPA-650/2-74-082
Regenerative Limestone Process for Fluidized – Bed Coal Combustion and Desulfurization – REF. NO. EPA-650/2-74-001
Sasol Type Process for Gasoline, Methanol, SNG, and Low-BTU Gas from Coal – REF. NO. EPA-650/2-74-072
Selected Characteristics of Hazardous Pollutant Emissions – REF. NO. EPA-600/2-74-004
Seminar on Electrostatics and Fine Particles — September 1973 – REF. NO. EPA-650/2-74-081
Sodium Conditioning to Reduce Fly Ash Resistivity – REF. NO. EPA-650/2-74-092
Solid Waste Disposal Final Report – REF. NO. EPA-650/2-74-033
Source Assessment Prioritization of Air Pollution from Industrial Surface Coating Operations – REF. NO. EPA-650/2-75-019a
Sources and Characterization of Fine Particulate Test Dusts – REF. NO. EPA-650/2-74-117
St. Louis/Union Electric Refuse Firing Demonstration Air Pollution Test Support – REF. NO. EPA-650/2-74-073
State-of-the-Art Report on Sampling of Particulates in Combustion Gases from Fossil Fuels – REF. NO. EPA-650/2-74-018
Statistical Concepts for Design Engineers – REF. NO. EPA-650/2-74-080
Study of Air Pollutant Emissions from Residential Heating Systems – REF. NO. EPA-650/2-74-003
Study of Combustor Flow Computations and Comparison with Experiment – REF. NO. EPA-650/2-73-045
Study of Potential Problems and Optimum Opportunities in Retrofitting Industrial Processes to Low and Intermediate Energy Gas from Coal – REF. NO. EPA-650/2-74-052
Sulfur and Nitrogen Balances in the Solvent Refined Coal Process – REF. NO. EPA-650/2-75-011
Sulfur Oxide Throwaway Sludge Evaluation Panel (SOTSEP), Volume I: Final Report – Executive Summary – REF. NO. EPA-650/2-75-010a
Sulfur Oxide Throwaway Sludge Evaluation Panel (SOTSEP), Volume II: Final Report – Technical Discussion – REF. NO. EPA-650/2-75-010b
Symposium on Electrostatic Precipitators for the Control of Fine Particles – REF. NO. EPA-650/2-75-016
Symposium on Flue Gas Desulfurization – Atlanta, November 1974 Volume I – REF. NO. EPA-650/2-74-126a
Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology (May 1974, St. Louis, Missouri) – REF. NO. EPA-650/2-74-118
System Analysis of Air Pollutant Emissions from the Chemical/ Plastics Industry – REF. NO. EPA-650/2-74-106
Systems Analysis Requirements for Nitrogen Oxide Control of Stationary Sources – REF. NO. EPA-650/2-74-091
Techniques for Measuring Fly Ash Resistivity – REF. NO. EPA-650/2-74-079
Testing of a Molecular Sieve Used to Control Mercury Emission From A Chlor-Alkali Plant, Volume I – REF. NO. EPA-650/2-75-026a
Testing of a Molecular Sieve Used to Control Mercury Emission From A Chlor-Alkali Plant, Volume II – Appendices – REF. NO. EPA-650/2-75-026b
Theoretical and Experimental Study of the Lime/Limestone Wet Scrubbing Process – REF. NO. EPA-650/2-75-006
Thermal Radiation Modeling for Pollution Predictions – REF. NO. EPA-650/2-74-011
Trace Pollutant Emissions from the Processing of Metallic Ores – REF. NO. EPA-650/2-74-115
Trace Pollutant Emissions from the Processing of Non-Metallic Ores – REF. NO. EPA-650/2-74-122
Vinyl Chloride – An Assessment of Emissions Control Techniques and Costs – REF. NO. EPA-650/2-74-097
Wet Scrubber Liquid Utilization – REF. NO. EPA-650/2-74-108

DATA AND INFORMATION RESEARCH

Accumulation of Tritium in Various Species of Fish Reared in Tritiated Water – REF. NO. EPA-680/4-74-001
Directory of EPA, State and Local Environmental Quality Monitoring and Assessment Activities – REF. NO. EPA-600/4-75-001
Ground Water Pollution Features of Federal and State Laws and Regulations – REF. NO. EPA-600/4-73-001a
Handbook of Radiochemical Analytical Methods – REF. NO. EPA-680/4-75-001
Polluted Groundwater: A Review of the Significant Literature – REF. NO. EPA-600/4-74-001
Polluted Groundwater: Estimating the Effects of Man's Activities (Formerly 600/4-74-002) – REF. NO. EPA-680/4-74-002

CURRENT PROGRAM AREA INDEX

DATA AND INFORMATION RESEARCH

Polluted Groundwater: Some Causes, Effects, Controls and Monitoring – REF. NO. EPA-600/4-73-001b
Rationale and Methodology for Monitoring Groundwater Polluted by Mining Activities (Formerly 600/4-74-003) – REF. NO. EPA-680/4-74-003
Summary Report, Trail-Marking and Alarm Pheromones of Some Ants of the Genus Atta – REF. NO. EPA-660/2-74-081

EQUIPMENT AND TECHNIQUES

Absorption of SO_2 by Alkaline Solutions in Venturi Scrubber Systems – REF. NO. EPA-650/2-73-003
Advanced Prototype Direct Reading Instrument for Particulate Mass Measurement – REF. NO. EPA-650/2-74-065
Analysis of Coprostanol, An Indicator of Fecal Contamination – REF. NO. EPA-660/2-74-021
Analytical Methodology Information Center: Activities for 1973 – 1974 – REF. NO. EPA-670/4-74-003a
Application of Odor Technology to Mobil Sources Emission Instrumentation – REF. NO. EPA-650/2-73-025
Aqueous Odor Thresholds of Organic Pollutants in Industrial Effluents – REF. NO. EPA-660/4-75-002
Atomic Absorption Analysis of Phosphates in Water – REF. NO. EPA-670/2-73-079
Automated Analysis of Individual Refractory Organics in Polluted Water – REF. NO. EPA-660/2-74-076
Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents – REF. NO. EPA-670/4-73-001
Chemical and Physical Characterization of Automotive Exhaust Particulate Matter in the Atmosphere (Year Ending June 30, 1972) – REF. NO. EPA-650/2-73-001
Chemical and Physical Characterization of Automotive Exhaust Particulate Matter in the Atmosphere (Year Ending June 30, 1973) – REF. NO. EPA-650/2-73-002
Compact Sampling System for Collection of Particulates from Stationary Sources – REF. NO. EPA-650/2-74-029
Comparison of Germanium Detectors for Neutron Activation Analysis for Mercury – REF. NO. EPA-660/2-74-045
Design, Construction, and Testing of a Commercial Prototype Disc Diluter – REF. NO. EPA-650/2-74-055
Design, Fabricate, and Demonstrate an Instrument for Assaying Benzo (a) Pryrene – REF. NO. EPA-650/2-74-068
Determination of Coronal Ozone Production by High Voltage Power Transmission Lines – REF. NO. EPA-650/4-73-003
Determination of Molecular Hydrogen Sulfide – REF. NO. EPA-660/4-75-001
Determination of Volatile Organic Compounds at the UG/l Level in Water by Gas Chromatography – REF. NO. EPA-670/4-74-009
Development and Fabrication of Mass Emission Data and Control System for the Stationary Source Simulator – REF. NO. EPA-650/2-73-009
Development of a High-Purity for High Temperature Particulate Sampling and Analysis – REF. NO. EPA-650/2-73-032
Development of a Prototype Nitrate Detector – REF. NO. EPA-650/2-74-133
Development of a Prototype Sulfuric Acid Monitor – REF. NO. EPA-650/2-75-013a
Development of a Supplementary Emission Measurements Monitoring System – REF. NO. EPA-650/2-73-008
Development of an Instrumental Monitoring Method for Measurement of Asbestos Concentrations in or Near Sources – REF. NO. EPA-650/2-73-016
Development of A Gas Laser System to Measure Trace Gases by Long Path Absorption Techniques: Volume II – Field Evaluation of Gas Laser System for Ozone Monitoring Final Report – REF. NO. EPA-650/2-74-046b
Development of Gas Laser System to Measure Trace Gases by Longpath Absorption Techniques:Volume I – Gas Laser System Modification for Ozone Monitoring Final Report – REF. NO. EPA-650/2-74-046a
Development of Instrumentation for Measurement of Stationary Source Aldehyde Organic Acid and Amine Emissions – REF. NO. EPA-650/2-73-010
Development of Instrumentation for Quantitative Collection of Total Atmospheric Mercury From Ambient Air-Final Report – REF. NO. EPA-650/2-73-052
Development of Low Pressure Impactor – REF. NO. EPA-650/2-74-014
Development of Method for Carcinogenic Vapor Analysis in Ambient Atmospheres – REF. NO. EPA-650/2-74-121
Development of Range Squared and Off-Gating Modifications for a Lidar System – REF. NO. EPA-650/2-73-040
Development of Sampling Method for Total Atmospheric Selenium – REF. NO. EPA-650/2-74-124
Development of Sampling Procedures for Polycyclic Organic Matter and Polychlorinated Biphenyls – REF. NO. EPA-650/2-75-007
Development of X-Ray Fluorescence Spectroscopy in Element Analysis of Particulate Matter Phase II: Evaluation of Commerical Multiple Crystal Spectrometer Instruments – REF. NO. EPA-650/2-73-006
Device Collection and Assay of Ambient Gases – REF. NO. EPA-650/2-74-006
Direct Determination of Metals in Air – REF. NO. EPA-650/2-73-011
Effects of Nozzle Design and Sampling Techniques on Aerosol Measurements – REF. NO. EPA-650/2-74-070
Environmental Applications of Advanced Instrumental Analyses: Assistance Projects, FY '73 – REF. NO. EPA-660/2-74-078
Environmental Applications of Advanced Instrumental Analysis: Assistance Projects, FY 72 – REF. NO. EPA-660/2-73-013
Environmental Exposure System for Studying Air Pollution Damage to Materials – REF. NO. EPA-650/3-75-001
Environmental Requirements and Pollution Tolerance of Freshwater Diatoms – REF. NO. EPA-670/4-74-005
Estimation of Polychlorinated Biphenyls in the Presence of Dot-Type Compounds – REF. NO. EPA-670/4-74-004
Evaluation and Modification of Fluoride Sampling and Analytical Methods – REF. NO. EPA-650/2-73-007
Evaluation of a Computer Program for GC-MS Specific Ion Monitoring – REF. NO. EPA-660/2-74-002
Evaluation of a Microwave-Induced Plasma Spectrometer for Trace Analysis – REF. NO. EPA-660/2-73-009
Evaluation of Flame Emission Determination of Phosphorus in Water – REF. NO. EPA-660/2-73-007
Evaluation of Instrumentation for Monitoring Total Mercury Emissions from Stationary Sources – REF. NO. EPA-650/2-74-039
Evaluation of Odor Measurement Techniques Volume I – Animal Rendering Industry – REF. NO. EPA-650/2-74-008a
Fabrication and Installation of the Stationary Source Simulator – REF. NO. EPA-650/2-75-015
Feasibility of a CW Lidar Technique for Measurement of Plume Opacity – REF. NO. EPA-650/2-73-037
Feasibility Study of the Use of Resonance Scattering for the Remote Detection of SO_2 – REF. NO. EPA-650/2-74-020
Implementation of a Computer Based Information System for Mass Spectral Identification – REF. NO. EPA-660/2-74-048
Improvement of Instrumentation and Methodology for Collection and Analysis of Mercury – REF. NO. EPA-650/2-75-028
In-Stack Transmissometer Evaluation and Application to Particulate Opacity Measurement – REF. NO. EPA-650/2-75-008
In-Stack Transmissometer Measurement of Particulate Opacity and Mass Concentration – REF. NO. EPA-650/2-74-120
Infrared Fourier Transform Spectrometry of Gas Chromatography Effluents – REF. NO. EPA-660/2-73-034
Infrared Gas Filter Correlation Instrument for In-Situ Measurement of Gaseous Pollutants – REF. NO. EPA-650/2-74-094
Instrument for Simultaneous Monitoring NO_x and SO_2 in Stationary Sources – REF. NO. EPA-650/2-73-027

CURRENT PROGRAM AREA INDEX

EQUIPMENT AND TECHNIQUES

Instrument to Monitor CH4, CO and CO2 in Auto Exhaust – REF. NO. EPA-650/2-73-030
Instrumentation and Methodology for the Assay of Polynuclear Aromatic Hydrocarbons – REF. NO. EPA-650/2-74-069
Interferometric Instrumentation For Particle Size Analysis – REF. NO. EPA-650/2-73-034
Investigation of Extractive Sampling Interface Parameters – REF. NO. EPA-650/2-74-089
Investigation of Remote Sensing Techniques for Agricultural Feedlot Pollution Detection – REF. NO. EPA-670/4-73-002
Ion-Selective Membranes Electrodes for Water Pollution Water Monitoring – REF. NO. EPA-660/2-74-079
Isolation of Hayfever Antigens from Short Ragweed Pollen – REF. NO. EPA-650/2-74-044
Manual Methods for Sampling and Analysis of Particulate Emissions From Municipal Incinerators – REF. NO. EPA-650/2-73-023
Measurement of the Opacity and Mass Concentration of Particulate Emissions by Transmissometry – REF. NO. EPA-650/2-74-128
Mercury in the Environment – REF. NO. EPA-660/2-73-008
Methodology for Assignment of a Hydrocarbon Photochemical Reactivity Index for Emissions From Mobile Sources – REF. NO. EPA-650/2-75-025
Methods for Rapid and Accurate Measurement of Nitrate and Sulfate in Atmospheric Particulates – REF. NO. EPA-650/2-73-050
Multielement Analyses of Environmental Samples by Spark Source Mass Spectrometry – REF. NO. EPA-660/2-74-001
NO2 Measuring System – REF. NO. EPA-650/2-74-059
Occurrence of Organohalides in Chlorinated Drinking Waters – REF. NO. EPA-670/4-74-008
Performance Specifications for Stationary-Source Monitoring Systems for Gases and Visible Emissions – REF. NO. EPA-650/2-74-013
Proceedings of Seminar on Methodology for Monitoring the Marine Environment – REF. NO. EPA-600/4-74-004
Progress in Instrumentation and Techniques for Measurement of Air Pollutants – REF. NO. EPA-650/2-74-015
Quantitative Analysis of Airborne Asbestos by X-Ray Diffraction: Final Report on Feasibility Study – REF. NO. EPA-650/2-75-004
Remote Sensing of Air Pollution in Urban Areas – REF. NO. EPA-650/2-73-026
Remote Sensing of Pollutants – Computerized Reduction of Long-Path Absorption Data – REF. NO. EPA-650/2-74-113
Reviews of Current Literature on Analytical Methodology and Quality Control – Activities for 1973 through 1974 – REF. NO. EPA-670/4-74-003b
Sampling Interface for Quantitative Transport of Aerosols – REF. NO. EPA-650/2-74-016
Seminar Summary: Sampling and Analysis of the Various Forms of Atmospheric Lead – REF. NO. EPA-650/2-75-003
Simplified Atomic Absorption Determination of Stable Strontium in Milk and Hay – REF. NO. EPA-680/4-73-002
Simultaneous and Automated Determination of Total Phosphorous and Total Kjeldahl – REF. NO. EPA-670/4-74-002
Specific Ion Mass Spectrometric Detection for Gas Chromatographic Pesticide Analysis – REF. NO. EPA-660/2-74-004
State-of-the-Art: 1971 Instrumentation for Measurement of Particulate Emissions from Combustion Sources – REF. NO. EPA-650/2-73-022
Study of Indoor Air Quality – REF. NO. EPA-650/4-74-042
Synthesis and Purification of Carcinogenic Polynuclear Aromatic Hydrocarbon Standards – REF. NO. EPA-650/2-74-040
Synthesis of Trifluoromethylsulfur Pentafluoride (CF3SF5) – REF. NO. EPA-650/4-74-010
Taxonomy and Ecology of Aspenonena Mayflies of the Ohio River Basin – REF. NO. EPA-670/4-74-006
Tissue Enzyme Assay for Chlorinated Hydrocarbon Insecticides – REF. NO. EPA-660/2-73-027
Virus in Waste, Renovated, and Other Waters – 1973 Literature Abstracts – REF. NO. EPA-670/9-74-005
Viruses in Waste Renovated and Other Viruses – 1972 Literature Abstracts – REF. NO. EPA-670/2-73-003

QUALITY ASSURANCE

Application and Procurement of Automatic Wastewater Samplers – REF. NO. EPA-670/4-75-003
Collaborative Study of EPA Methods 5,6, and 7 in Fossil Fuel-Fired Steam Generators – REF. NO. EPA-650/4-74-013
Collaborative Study of Method for the Determination of Nitrogen Oxide Emissions from Stationary Sources (Fossil Fuel-Fired Steam Generators) – REF. NO. EPA-650/4-74-025
Collaborative Study of Method for the Determination of Nitrogen Oxide Emissions from Stationary Sources (Nitric Acid Plants) – REF. NO. EPA-650/4-74-028
Collaborative Study of Method for the Determination of Particulate Matter Emissions From Stationary Sources (Fossil Fuel-Fired Steam Generators) – REF. NO. EPA-650/4-74-021
Collaborative Study of Method for the Determination of Particulate Matter Emissions from Stationary Sources (Municipal Incinerators) – REF. NO. EPA-650/4-74-022
Collaborative Study of Method for the Determination of Particulate Emissions from Stationary Sources (Portland Cement Plants) – REF. NO. EPA-650/4-74-029
Collaborative Study of Method for the Determination of Sulfur Dioxide Emissions From Stationary Sources (Fossil Fuel-Fired Steam Generators) – REF. NO. EPA-650/4-74-024
Collaborative Study of Method for the Determination of Sulfuric Acid Mist and Sulfur Dioxide Emissions from Stationary Sources – REF. NO. EPA-650/4-75-003
Collaborative Study of Method for Determination of Stack Gas Velocity and Volumetric Flow Rate in Conjunction with EPA Method 5 – REF. NO. EPA-650/4-74-033
Collaborative Study of Method for Stack Gas Analysis and Determination of Moisture Fraction with Use of Method 5 – REF. NO. EPA-650/4-74-026
Collaborative Study of Method 10 – Reference Method for Determination of Carbon Monoxide Emissions from Stationary Sources – Report of Testing – REF. NO. EPA-650/4-75-001
Collaborative Study of Method 104 – Reference Method for Determination of Beryllium Emission from Stationary Sources – REF. NO. EPA-650/4-74-023
Collaborative Study of Reference Method for Determination of Sulfur Dioxide in the Atmosphere (Pararosaniline Method) (24-hour Sampling) – REF. NO. EPA-650/4-74-027
Collaborative Test of the TGS-ANSA Method for Measurement of Nitrogen Dioxide in Ambient Air – REF. NO. EPA-650/4-74-046
Collaborative Testing Methods for Measurements of NO2 in Ambient Air Volume I – Report of Testing – REF. NO. EPA-650/4-74-019a
Concepts for Development of Field Usable Test Atmosphere Generating Devices – REF. NO. EPA-650/4-74-016
Development of Technical Specifications for Standard Gas-Diluent Mixtures for Use in Measurement of Mobile Source Emissions – REF. NO. EPA-650/4-74-020
Environmental Radioactivity Laboratory Intercomparison Studies Program, 1973 – 1974 – REF. NO. EPA-680/4-73-001b
Evaluation and Collaborative Study of Method for Visual Determination of Opacity of Emissions from Stationary Sources – REF. NO. EPA-650/4-75-009

CURRENT PROGRAM AREA INDEX

QUALITY ASSURANCE

Evaluation of the Arsenite Procedure for the Determination of Nitrogen Dioxide in Ambient Air – REF. NO. EPA-650/4–74–048
Evaluation of the Ryan's Waterproof Thermograph (Model F-30) – REF. NO. EPA-670/4–74–007
Evaluation of the Triethanolamine Procedure for the Determination of Nitrogen Dioxide in Ambient Air – REF. NO. EPA-650/4–74–031
Evaluation of TGS-ANSA Procedure for Determination of Nitrogen Dioxide in Ambient Air – REF. NO. EPA-650/4–74–047
Fortran Programs for Analyzing Collaborative Test Data: Part I General Statistics – REF. NO. EPA-670/4–75–004a
Fortran Programs for Analyzing Collaborative Test Data: Part II Scatter Plots – REF. NO. EPA-670/4–75–004b
Guide for the Evaluation of Atmospheric Analyzers – REF. NO. EPA-650/4–74–014
Guidelines for Determining Performance Characteristics of Altimated Methods for Measuring Nitrogen Dioxide and Hydrocarbons, Corrected for Methane in Ambient Air – REF. NO. EPA-650/4–74–018
Guidelines for Development of a Quality Assurance Program: Volume XII – Determination of Phosphorus in Gasoline – REF. NO. EPA-650/4–74–005L
Guidelines for Development of a Quality Assurance Program: Volume XIII – Test for Lead in Gasoline by Atomic Absorption Spectrometry – REF. NO. EPA-650/4–74–005m
Guidelines for Development of a Quality Assurance Program: Volume I-Determination of Stack Gas Velocity and Volumetric Flow Rate (Type-S Pitot Tube) – REF. NO. EPA-650/4–74–005a
Guidelines for Development of a Quality Assurance Program: Volume II Gas Analysis for Carbon Dioxide, Excess Air, and Dry Molecular Weight – REF. NO. EPA-650/4–74–005b
Guidelines for Development of a Quality Assurance Program: Volume III Determination of Moisture in Stack Gases – REF. NO. EPA-650/4–74–005c
Guidelines for Development of a Quality Assurance Program: Volume IV Determination of Particulate Emissions from Stationary Sources – REF. NO. EPA-650/4–74–005d
Guidelines for Development of a Quality Assurance Program: Volume VIII Determination of CO Emissions from Stationary Sources by NDIR Spectrometry – REF. NO. EPA-650/4–74–005h
Interfacing a 24-Point Analog Recorder to a Computer Controlled Telemetry Line – REF. NO. EPA-670/4–75–002
Laboratory and Field Evaluations of EPA Methods 2, 6 and 7 – REF. NO. EPA-650/4–74–039
Literature Survey of Instrumental Measurements of Biochemical Oxygen Demand for Control Application, 1960–1963 – REF. NO. EPA-670/4–74–001
Performance of the OSCO Model 1391 Water Wastewater Sampler – REF. NO. EPA-670/4–75–001
Performance of the Union Carbide Dissolved Oxygen Sensor – REF. NO. EPA-670/4–73–018
Radioactivity Standards Distribution Program, 1973 – 1974 – REF. NO. EPA-680/4–73–001A
Summary Report: Workshop on Ozone Measurement by the Potassium Iodide Method – REF. NO. EPA-650/4–75–007
Survey of Manual Methods of Measurements of Asbestos, Beryllium, Lead, Cadmium, Selenium, and Mercury in Stationary Source Emissions – REF. NO. EPA-650/4–74–015
Survey of Users of the EPA – Reference Method for Measurement of Non-Methane Hydrocarbons in Ambient Air – REF. NO. EPA-650/4–75–008

SOCIOECONOMIC RESEARCH

Aesthetics in Environmental Planning – REF. NO. EPA-600/5–73–009
Aluminum as a Component of Solid Waste and a Recoverable Resource – REF. NO. EPA-670/5–74–005
Analysis of Cost Sharing Programs for Pollution Abatement of Municipal Wastewater – REF. NO. EPA-600/5–74–031
Analysis of Nonpoint-Source Pollutants in the Missouri Basin Region – REF. NO. EPA-600/5–75–004
Assessment of Economic Impact of Air Pollutants on Vegetation in the United States, 1969 and 1971 – REF. NO. EPA-650/5–73–002
Assessment Methodology for the Environmental Impact of Water Resource Projects – REF. NO. EPA-600/5–74–016
Benefit of Water Pollution Control on Property Values – REF. NO. EPA-600/5–73–005
Bibliography of the Cat – REF. NO. EPA-650/3–74–001
Bibliography of Water Pollution Control Benefits and Costs – REF. NO. EPA-600/5–74–028
California Environmental Quality Act: Innovation in State and Local Decision making – REF. NO. EPA-600/5–74–023
Can Federal Procurement Practices be Used to Reduce Solid Waste – REF. NO. EPA-670/5–74–003
Carrying Capacity in Regional Environmental Management – REF. NO. EPA-600/5–74–021
Case Study and Business Analysis of the Scrap Industry – REF. NO. EPA-670/5–74–002
Comprehensive Management of Phosphorus Water Pollution – REF. NO. EPA-600/5–74–010
Cost Evaluation of Alternative Air Quality Strategies – REF. NO. EPA-600/5–74–003
Cost-Effectiveness of a Uniform National Sulfur Emissions Tax – REF. NO. EPA-600/5–74–009
Criteria for Regional Solid Waste Management Planning – REF. NO. EPA-670/5–74–006
Critique of Pollution Time Allocation in River Basin Model – REF. NO. EPA-600/5–73–007
Crop Insurance and Information Services to Control Use of Pesticides – REF. NO. EPA-600/5–74–018
Demonstration of a State Water Quality Management Information System – REF. NO. EPA-600/5–74–022
Design of Cost-Effective Water Quality Surveillance Systems – REF. NO. EPA-600/5–74–004
Development of a Decision Room For Environmental Studies – REF. NO. EPA-600/5–73–011
Development of Predictions of Future Pollution Problems – REF. NO. EPA-600/5–74–005
Economic and Environmental Benefits from Improving Electrical Rate Structures – REF. NO. EPA-600/5–74–033
Economic and Technological Impediments to Recycling Obsolete Ferrous Solid Waste – REF. NO. EPA-670/5–73–021
Economic Damages of Air Pollution – REF. NO. EPA-600/5–74–012
Economic Damages to Household Systems From Water Supply Use – REF. NO. EPA-600/5–73–001
Economic Disincentives for Pollution Control: Legal Political and Administrative Dimensions – REF. NO. EPA-600/5–74–026
Enforcement Economics in Air Pollution Control – REF. NO. EPA-600/5–73–014
Environment: A Bibliography of Social Science and Related Literature – REF. NO. EPA-600/5–74–011
Environmental Impact Requirements in the States: NEPA's Offspring – REF. NO. EPA-600/5–74–006
Environmental Management and Local Government – REF. NO. EPA-600/5–73–016
Estimating Water Quality Benefits – REF. NO. EPA-600/5–74–014
Evaluation of Adjustment Assistance Program with Application for Pollution Control – REF. NO. EPA-600/5–74–029
Evaluation of Alternative Methods For Financing Municipal Waste Treatment Works – REF. NO. EPA-600/5–75–001

CURRENT PROGRAM AREA INDEX

SOCIOECONOMIC RESEARCH

Evaluation of Feasibility and Economic Implication of Pricing Mechanisms in Solid Waste Management – REF. NO. EPA-670/5-75-001
Evaluation of Marketable Effluent Permit Systems – REF. NO. EPA-600/5-74-030
Feasibility of Emission Standards Based on Particle Size – REF. NO. EPA-600/5-74-007
Guide to Models in Governmental Planning and Operations – REF. NO. EPA-600/5-74-008
Hospital Solid Waste: An Annotated Bibliography – REF. NO. EPA-670/5-74-001
Influences of Wastewater Management on Land Use: Tahoe Basin 1950-1972 – REF. NO. EPA-600/5-74-019
Integrated Multi-media Pollution Model – REF. NO. EPA-600/5-74-020
Intermedia Aspects of Air and Water Pollution Control – REF. NO. EPA-600/5-73-003
Land Use Forms and the Environment – An Executive Summary – REF. NO. EPA-600/5-75-003
Managing the Environment – REF. NO. EPA-600/5-73-010
Model Cities – REF. NO. EPA-600/5-74-027
Model for Optimal Design and Operation of Solid Waste Transfer Stations – REF. NO. EPA-670/5-74-009
Optimal Configuration of a Regional Solid Waste Management System – REF. NO. EPA-670/5-74-007
Optimization Models for Regional Public Systems – REF. NO. EPA-670/5-74-008
Outpatient Medical Costs Related to Air Pollution in the Portland, Oregon Area – REF. NO. EPA-600/5-74-017
Performance Controls for Sensitive Lands – REF. NO. EPA-600/5-75-005
Promoting Environmental Quality Through Urban Planning and Control – REF. NO. EPA-600/5-73-015
Regional Governmental Arrangements in Metropolitan Areas: Nine Case Studies – REF. NO. EPA-600/5-74-024
Research Needs and Priorities: Water Pollution Control Benefits and Cost – Volume II – REF. NO. EPA-600/5-73-008b
Review of Environmental Impact Assessment Methodologies – REF. NO. EPA-600/5-74-002
Secondary Fiber Recovery Incentive Analysis – REF. NO. EPA-670/5-74-004
Secondary Impact of Transportation and Wastewater Investments: Review and Bibliography – REF. NO. EPA-600/5-75-002
Simulation City Approach for Preparation of Urban Area Data Bases – REF. NO. EPA-600/5-74-001
Socio-Economic Factors Affecting Demand for Municipal Collection of Household Refuse – REF. NO. EPA-670/9-73-035
State of the System (SOS) Model – REF. NO. EPA-600/5-73-013
State-of-the-Art Review: Water Pollution Control Benefits and Costs Volume I – REF. NO. EPA-600/5-73-008a
Studies in Environment – Volume I – Summary Report – REF. NO. EPA-600/5-73-012a
Studies in Environment – Volume II – Quality of Life – REF. NO. EPA-600/5-73-012b
Studies in Environment – Volume III – Pollution and the Municipality – REF. NO. EPA-600/5-73-012c
Studies in Environment – Volume IV – Consumption Differentials and the Environment – REF. NO. EPA-600/5-73-012d
Studies in Environment – Volume V – Outdoor Recreation and the Environment – REF. NO. EPA-600/5-73-012e
Study of the Economics of Hospital Solid Waste Systems – REF. NO. EPA-670/5-73-020
Systems Simulation and Solid Waste Planning: A Case Study – REF. NO. EPA-670/5-73-012
Use of Environmental Analyses on Wastewater Facilities by Local Government – REF. NO. EPA-600/5-74-015
Used Oil Law in the U.S. and Europe – REF. NO. EPA-600/5-74-025
Waste Automotive Lubricating Oil Reuse as a Fuel – REF. NO. EPA-600/5-74-032
Water Quality Model for a Conjunctive Surface – Groundwater System – REF. NO. EPA-600/5-74-013

SCIENCE ADVISORY BOARD

Nitrogenous Compounds in the Environment – REF. NO. EPA-SAB-73-001

MISCELLANEOUS REPORTS

Active Research Tasks Report, Fiscal Year 1973 – REF. NO. EPA-670/9-73-056
Annual Report for Calendar Year 1972, Environmental Toxicology Research – REF. NO. EPA-670/1-73-036
Annual Report, 1972, NERC – Cincinnati – REF. NO. EPA-670/9-73-055
Bibliography of Publications and Reports of the Pacific Northwest Environmental Research Laboratory – REF. NO. EPA-660/9-74-001
Bibliography of R&D Research Reports – July 1973 – REF. NO. EPA-600/5-73-002
Environmental Research in 1973, Annual Report – REF. NO. EPA-670/9-74-001
Environmental Research Publications – REF. NO. EPA-670/9-73-004
Environmental Research Publications 1971-1975 – REF. NO. EPA-670/9-75-001
Excerpts from Control of Infiltration and Inflow into Sewer Systems and Prevention and Correction of Excessive Infiltration and Inflow into Sewer Systems – REF. NO. EPA-670/9-74-004
Indexed Bibliography of Office of Research and Development Reports – Updated to January 1975 – REF. NO. EPA-600/9-74-002
Indexed Bibliography of Office of Research and Development Reports – REF. NO. EPA-600/9-74-001
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News of Environmental Research in Cincinnati, January – December 1974 – REF. NO. EPA-670/9-75-003
NERC-Cincinnati Annual Report, 1974 – REF. NO. EPA-670/9-75-002
Pollution Control Technology Assessment – Proceedings of an Environmental Resources Conference, May 1-3, 1974 – REF. NO. EPA-670/9-74-006

PERFORMING ORGANIZATION INDEX

A.P.T., Inc. Riverside, CA – **REF. NO. EPA**-650/2-74-093
A.P.T., Inc. Riverside, CA – **REF. NO. EPA**-650/2-74-112
A.P.T., Inc. Riverside, CA – **REF. NO. EPA**-650/2-74-119a
A.P.T., Inc. Riverside, CA – **REF. NO. EPA**-650/2-73-036
Abcor, Incorporated, Walden Research Division Cambridge, MA – **REF. NO. EPA**-650/2-74-086a
Abcor, Incorporated, Walden Research Division Cambridge, MA – **REF. NO. EPA**-650/2-74-086b
Abcor, Incorporated, Walden Research Division Cambridge, MA – **REF. NO. EPA**-650/2-74-089
Abcor, Incorporated, Walden Research Division Cambridge, MA – **REF. NO. EPA**-650/2-74-105
Abcor, Incorporated, Walden Research Division Cambridge, MA – **REF. NO. EPA**-650/2-74-133
Academy of Natural Sciences of Philadelphia Philadelphia, PA – **REF. NO. EPA**-660/2-75-008
Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2-73-003
Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2-73-044
Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2-73-045
Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2-73-046
Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2-74-006
Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2-74-010
Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2-74-011
Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2-74-034
Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2-74-046
Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2-75-001
Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2-75-008
Advanced Waste Treatment Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2-75-013
Aerospace Corporation El Segundo, CA – **REF. NO. EPA**-650/2-74-037a
Aerospace Corporation Los Angeles, CA – **REF. NO. EPA**-650/2-74-051
Aerospace Corporation Los Angeles, CA – **REF. NO. EPA**-650/2-74-059
Aerospace Corporation El Segundo, CA – **REF. NO. EPA**-650/3-74-007
Aerospace Corporation El Segundo, CA – **REF. NO. EPA**-650/2-75-012
Aerospace Corporation El Segundo, CA – **REF. NO. EPA**-650/2-75-023
Aerotherm/Acurex Corporation Mountain View, CA – **REF. NO. EPA**-650/2-74-067
Aerotherm/Acurex Corporation Mountain View, CA – **REF. NO. EPA**-650/2-74-091
Aerotherm/Acurex Corporation Mountain View, CA – **REF. NO. EPA**-650/2-74-103
Aerotherm/Acurex Corporation Mountain View, CA – **REF. NO. EPA**-650/2-74-123
Aerotherm/Acurex Corporation Mountain View, CA – **REF. NO. EPA**-650/2-75-015
Air and Industrial Hygiene Laboratory, California State Department of Health Berkeley, CA – **REF. NO. EPA**-650/4-74-014
Air Pollution Control Division, ORD, EPA Washington, DC – **REF. NO. EPA**-600/2-74-008
Alabama A&M College Normal, AL – **REF. NO. EPA**-660/2-74-033
Alan M. Voorhees and Associates McLean, VA – **REF. NO. EPA**-600/5-74-001
Alaska, University of Fairbanks, AK – **REF. NO. EPA**-660/3-73-018
Allied Chemical Corporation Morristown, NJ – **REF. NO. EPA**-650/2-74-040
American Crystal Sugar Company Denver, CO – **REF. NO. EPA**-660/2-74-093
American Dehydrators Association Mission, KS – **REF. NO. EPA**-650/2-74-007
American Distilling Company Pekin, IL – **REF. NO. EPA**-660/2-74-014
American Iron and Steel Institute New York, NY – **REF. NO. EPA**-650/2-74-022
American Public Works Association Chicago, IL – **REF. NO. EPA**-670/2-74-026
American Public Works Association Chicago, IL – **REF. NO. EPA**-670/2-74-039
American Public Works Association Chicago, IL – **REF. NO. EPA**-670/2-75-011
American Society of Planning Officials Chicago, IL – **REF. NO. EPA**-600/5-75-005
American Standards, Inc. New Brunswick, NJ – **REF. NO. EPA**-670/2-75-002
American Water Works Association Research Foundation New York, NY – **REF. NO. EPA**-660/2-73-020
Ames Laboratory, U.S. Atomic Energy Commission, Metallurgy Division, Iowa State University Ames, IA – **REF. NO. EPA**-670/2-73-091
Anaconda American Brass Company Waterbury, CT – **REF. NO. EPA**-670/2-74-008
Anaconda Company Waterbury, CT – **REF. NO. EPA**-670/2-75-029
Analytical Research Laboratories, Inc. Monrovia, CA – **REF. NO. EPA**-650/4-74-050
Anderson 2000, Inc. Atlanta, GA – **REF. NO. EPA**-650/2-74-014
Anheuser Busch St. Louis, MO – **REF. NO. EPA**-660/2-74-059
Applied Technology Corporation Pittsburgh, PA – **REF. NO. EPA**-670/2-74-001
Arctic Environmental Research Laboratory, EPA Fairbanks, AK – **REF. NO. EPA**-660/2-73-005
Arctic Environmental Research Laboratory, EPA College, AK – **REF. NO. EPA**-660/2-74-070
Arctic Environmental Research Laboratory, EPA College, AK – **REF. NO. EPA**-660/3-74-008
Arctic Environmental Research Laboratory, EPA College, AK – **REF. NO. EPA**-660/3-74-009
Argonne National Laboratory Argonne, IL – **REF. NO. EPA**-650/2-74-057
Argonne National Laboratory Argonne, IL – **REF. NO. EPA**-650/2-74-104
Arkansas, University of, College of Engineering Fayetteville, AR – **REF. NO. EPA**-660/2-74-044
Armageddon Chemical Company Durham, NC – **REF. NO. EPA**-650/4-74-010
Arnold Research Organization, Inc. Arnold Air Force Station, TN – **REF. NO. EPA**-650/2-73-034
Arthur D. Little, Inc. Cambridge, MA – **REF. NO. EPA**-650/2-73-023
Arthur D. Little, Inc. Cambridge, MA – **REF. NO. EPA**-650/2-73-025
Arthur D. Little, Inc. Cambridge, MA – **REF. NO. EPA**-650/2-73-032
Arthur D. Little, Inc. Cambridge, MA – **REF. NO. EPA**-670/2-74-033
Arthur D. Little, Inc. Cambridge, MA – **REF. NO. EPA**-670/2-74-045

PERFORMING ORGANIZATION INDEX

Arthur D. Little, Inc. Cambridge, MA – **REF. NO. EPA**-670/2-74-086
Arthur D. Little, Inc. Cambridge, MA – **REF. NO. EPA**-670/5-74-003
Arthur D. Little, Inc. Cambridge, MA – **REF. NO. EPA**-670/2-75-024
Auburn University Auburn, AL – **REF. NO. EPA**-660/3-73-005
Autotrol Corporation Milwaukee, WI – **REF. NO. EPA**-670/2-74-050
ABT Associates, Inc. Cambridge, MA – **REF. NO. EPA**-600/5-74-018
ABT Associates, Inc. Cambridge, MA – **REF. NO. EPA**-670/5-75-001
ARO Inc. Arnold Air Force Station, TN – **REF. NO. EPA**-650/2-74-070
Babcock and Wilcox Company Alliance, OH – **REF. NO. EPA**-650/2-74-002b
Babcock and Wilson Company Alliance, OH – **REF. NO. EPA**-650/2-73-015
Babcock and Wilson Company Alliance, OH – **REF. NO. EPA**-650/2-74-002a
Bacardi Company San Juan, PR – **REF. NO. EPA**-660/2-74-074
Baird-Atomic, Inc. Bedford, MA – **REF. NO. EPA**-670/4-74-004
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-650/2-73-001
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-650/2-73-002
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-670/2-73-032
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-670/9-73-035
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-600/2-74-001
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-600/5-74-002
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-600/5-74-005
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-600/5-74-016
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-650/2-74-018
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-650/2-74-026
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-650/2-74-032
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-650/2-74-048
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-650/2-74-052
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-650/2-74-087
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-650/2-74-099
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-650/2-74-100
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-650/3-74-002
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-650/4-74-009
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-670/2-74-014
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-670/2-74-083
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-670/2-74-084
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-670/4-74-003a
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-670/4-74-003b
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-670/9-74-006
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-650/3-75-002
Battelle Columbus Laboratories Columbus, OH – **REF. NO. EPA**-670/2-75-018
Battelle Memorial Institute Columbus, OH – **REF. NO. EPA**-600/5-73-004
Battelle Memorial Institute Richland, WA – **REF. NO. EPA**-670/2-73-078
Battelle Memorial Institute Columbus, OH – **REF. NO. EPA**-650/2-74-011
Battelle Memorial Institute Columbus, OH – **REF. NO. EPA**-650/3-74-011
Battelle Memorial Institute Columbus, OH – **REF. NO. EPA**-660/2-74-004
Battelle Memorial Institute Columbus, OH – **REF. NO. EPA**-660/2-74-048
Battelle Memorial Institute Richland, WA – **REF. NO. EPA**-670/2-75-012
Battelle Pacific Northwest Laboratories Richland, WA – **REF. NO. EPA**-650/2-74-085a
Battelle Pacific Northwest Laboratories Richland, WA – **REF. NO. EPA**-650/2-74-085b
Battelle Pacific Northwest Laboratories Richland, WA – **REF. NO. EPA**-650/3-74-005
Battelle Pacific Northwest Laboratories Richland, WA – **REF. NO. EPA**-670/2-75-014
Bechtel Corporation San Francisco, CA – **REF. NO. EPA**-650/2-73-013
Bechtel Corporation San Francisco, CA – **REF. NO. EPA**-650/2-74-010
Beckman Instruments, Inc. Anaheim, CA – **REF. NO. EPA**-650/2-74-056
Beet Sugar Development Foundation Fort Collins, CO – **REF. NO. EPA**-660/2-74-028
Bendix Research Laboratories Southfield, MI – **REF. NO. EPA**-650/2-73-010
Bendix Research Laboratories Southfield, MI – **REF. NO. EPA**-650/2-74-006
Biospherics, Inc. Rockville, MD – **REF. NO. EPA**-600/2-75-004
Black Hill Conservancy Sub-District Rapid City, SD – **REF. NO. EPA**-670/2-73-088
Black, Crow and Eidsness, Inc. Montgomery, AL – **REF. NO. EPA**-660/2-75-006
Boeing Commercial Airplane Company Seattle, WA – **REF. NO. EPA**-660/2-73-023
Booz-Allen Applied Research, Inc. Bethesda, MD – **REF. NO. EPA**-670/2-73-013
Booz-Allen Applied Research, Inc. Bethesda, MD – **REF. NO. EPA**-670/2-73-014
Booz-Allen Applied Research, Inc. Bethesda, MD – **REF. NO. EPA**-670/2-73-015
Booz-Allen Applied Research, Inc. Bethesda, MD – **REF. NO. EPA**-670/2-73-016
Bowdoin College Brunswick, ME – **REF. NO. EPA**-600/5-74-029
Bowling Green State University Bowling Green, OH – **REF. NO. EPA**-670/4-74-005
Brigham Young University Provo, UT – **REF. NO. EPA**-660/2-75-007
Byrne Engineering Corporation New Orleans, LA – **REF. NO. EPA**-670/2-73-067
C. F. and T. Steel Corporation Pueblo, CO – **REF. NO. EPA**-660/2-74-050
California Air Resources Board, State of El Monte, CA – **REF. NO. EPA**-650/4-74-052
California Department of Health Berkeley, CA – **REF. NO. EPA**-650/1-75-001
California Institute of Technology Pasadena, CA – **REF. NO. EPA**-660/3-73-010
California Public Affairs, Center for Claremont, CA – **REF. NO. EPA**-600/5-74-006

PERFORMING ORGANIZATION INDEX

California Public Affairs, Center for Claremont, CA – **REF. NO. EPA**-600/5-74-023
California, University of Irvaine, CA – **REF. NO. EPA**-660/3-73-015
California, University of Santa Cruz, CA – **REF. NO. EPA**-600/5-74-019
California, University of Berkeley, CA – **REF. NO. EPA**-650/4-74-004
California, University of Riverside, CA – **REF. NO. EPA**-660/2-74-054
California, University of Berkeley, CA – **REF. NO. EPA**-660/3-74-016
California, University of Davis, CA – **REF. NO. EPA**-660/3-74-034
California, University of Riverside, CA – **REF. NO. EPA**-670/2-74-005
California, University of Berkeley, CA – **REF. NO. EPA**-670/5-74-007
California, University of Berkeley, CA – **REF. NO. EPA**-670/5-74-008
California, University of Berkeley, CA – **REF. NO. EPA**-670/5-74-009
California, University of Davis, CA – **REF. NO. EPA**-660/2-75-002
California, University of Santa Barbara, CA – **REF. NO. EPA**-670/2-75-003
Calspan Corporation Buffalo, NY – **REF. NO. EPA**-650/3-73-002
Center for the Environment and Man, Inc. Hartford, CT – **REF. NO. EPA**-650/4-73-001
Chase, Rosen and Wallace, Inc. Alexandria, VA – **REF. NO. EPA**-600/5-73-013
Chemistry and Physics Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-74-015
Chemistry and Physics Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-74-128
Chemistry and Physics Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/3-74-008
Chemistry and Physics Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/3-74-009
Chemistry and Physics Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/3-74-010
Chemistry and Physics Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-75-003
Chemistry and Physics Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-75-025
Chemistry and Physics Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/3-75-001
Chemistry and Physics Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/4-75-006
Chemistry and Physics Laboratory, EPA, Research Triangle Park, NC – **REF. NO. EPA**-650/2-74-046b
Chicago, University of Chicago, IL – **REF. NO. EPA**-600/5-75-003
Chino Basin Municipal Water District Cucamonga, CA – **REF. NO. EPA**-660/2-74-034
Clemson University, Environmental Systems Engineering Department Clemson, NC – **REF. NO. EPA**-670/2-73-061
Colorado State University Fort Collins, CO – **REF. NO. EPA**-660/2-73-017
Colorado State University Fort Collins, CO – **REF. NO. EPA**-650/2-74-034
Colorado State University Fort Collins, CO – **REF. NO. EPA**-650/3-74-003
Colorado State University Fort Collins, CO – **REF. NO. EPA**-660/2-74-049
Colorado State University Fort Collins, CO – **REF. NO. EPA**-660/2-74-052
Colorado State University Fort Collins, CO – **REF. NO. EPA**-660/2-74-084
Colorado State University, Department of Avian Science Fort Collins, CO – **REF. NO. EPA**-670/2-73-009
Columbia University, Division of Environmental Health Sciences New York City, NY – **REF. NO. EPA**-650/1-74-001
Combustion Engineering, Inc. Windsor, CT – **REF. NO. EPA**-650/2-73-005
Commonwealth of Pennsylvania Harrisburg, PA – **REF. NO. EPA**-600/5-74-022
Cone Mills Corporation Greensboro, NC – **REF. NO. EPA**-660/2-74-039
Consolidation Coal Company, Incorporated, Research Division Library, PA – **REF. NO. EPA**-650/2-73-049
Consultec, Inc. Rockville, MD – **REF. NO. EPA**-670/2-73-069
Continental Can Company Hodge, LA – **REF. NO. EPA**-660/2-74-008
Control Data Corporation Minneapolis, MN – **REF. NO. EPA**-650/4-74-051
Control Systems Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-73-012
Control Systems Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-73-029
Control Systems Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-73-031
Control Systems Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-73-038
Control Systems Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-73-046
Control Systems Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-73-053
Control Systems Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-74-003
Control Systems Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-74-126a
Control Systems Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-74-126b
Control Systems Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-75-010a
Control Systems Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2-75-010b
Copley International Corporation La Jolla, CA – **REF. NO. EPA**-650/5-73-001
Cornell University Ithaca, NY – **REF. NO. EPA**-660/2-74-063
Cottrell Environmental Systems, Inc. Division of Research-Cottrell, Inc. Bound Brook, NJ – **REF. NO. EPA**-650/2-74-053
Crown Mine Drainage Control Field Site, EPA Rivesville, WV – **REF. NO. EPA**-670/2-73-100
Crown Zellerbach Corporation Camas, WA – **REF. NO. EPA**-660/2-73-028
Culligan International Company Northbrook, IL – **REF. NO. EPA**-660/2-74-007
Curran Associates, Inc. Northampton, MA – **REF. NO. EPA**-670/2-74-037
Curran Associates, Inc. Northampton, MA – **REF. NO. EPA**-670/2-74-038
Curran Associates, Inc. Northampton, MA – **REF. NO. EPA**-670/2-74-065
Curran Associates, Inc. Northampton, MA – **REF. NO. EPA**-670/2-74-066
Curran Associates, Inc. Northampton, MA – **REF. NO. EPA**-670/2-74-068
Cyrus Wm. Rice Division, NUS Corporation Pittsburgh, PA – **REF. NO. EPA**-670/2-73-054
Cyrus Wm. Rice Division, NUS Corporation Pittsburgh, PA – **REF. NO. EPA**-670/2-73-081
Cyrus Wm. Rice Division, NUS Corporation Pittsburgh, PA – **REF. NO. EPA**-670/2-74-003
D.C. Pilot Plant, EPA, and D.C. Department of Environmental Services Washington, DC – **REF. NO. EPA**-670/2-73-040
D.C. Pilot Plant, EPA, and D.C. Department of Environmental Services Washington, DC – **REF. NO. EPA**-670/2-73-058
D.C. Pilot Plant, EPA, and D.C. Department of Environmental Services Washington, DC – **REF. NO. EPA**-670/2-73-073
D.C. Pilot Plant, EPA, and D.C. Department of Environmental Services Washington, DC – **REF. NO. EPA**-670/2-73-075

PERFORMING ORGANIZATION INDEX

D.C. Pilot Plant, EPA, and D.C. Department of Environmental Services Washington, DC – **REF. NO. EPA**-670/2-73-033
D.C. Pilot Plant, EPA, and D.C. Department of Environmental Services Washington, DC – **REF. NO. EPA**-670/2-73-037
D.C. Pilot Plant, EPA, and D.C. Department of Environmental Services Washington, DC – **REF. NO. EPA**-670/2-73-070
Dartmouth College Hanover, NH – **REF. NO. EPA**-670/2-73-011
Dartmouth College Hanover, NH – **REF. NO. EPA**-600/5-74-027
Data Metric Corporation McLean, VA – **REF. NO. EPA**-600/5-73-011
David M. Dornbusch and Company San Francisco, CA – **REF. NO. EPA**-600/5-73-005
Dayton Research Institute, University of Dayton, OH – **REF. NO. EPA**-670/2-75-033a
Dayton Research Institute, University of Dayton, OH – **REF. NO. EPA**-670/2-75-033b
Dayton Research Institute, University of Dayton, OH – **REF. NO. EPA**-670/2-75-033c
Dayton Research Institute, University of Dayton, OH – **REF. NO. EPA**-670/2-75-033d
De Laureal Engineers, Inc. New Orleans, LA – **REF. NO. EPA**-670/2-73-024
De Laureal Engineers, Inc. New Orleans, LA – **REF. NO. EPA**-670/2-73-074
Delaware River Basin Commission Trenton, NJ – **REF. NO. EPA**-660/2-73-038
DelMonte Corporation San Francisco, CA – **REF. NO. EPA**-660/2-74-092
Denver, University of Denver, CO – **REF. NO. EPA**-670/2-73-080
Detroit Metro Water Department Detroit, MI – **REF. NO. EPA**-670/2-75-020
Development Planning and Research Associates, Inc. Manhattan, KS – **REF. NO. EPA**-600/5-73-008a
Development Planning and Research Associates, Inc. Manhattan, KS – **REF. NO. EPA**-600/5-73-008b
Development Planning and Research Associates, Inc. Manhattan, KS – **REF. NO. EPA**-600/5-74-014
Development Planning and Research Associates, Inc. Manhattan, KS – **REF. NO. EPA**-600/5-74-028
Diamond Shamrock Corporation, T. R. Evans Research Center Painesville, OH – **REF. NO. EPA**-600/2-74-006
Dominque, Szabo and Associates, Inc. Lafayette, LA – **REF. NO. EPA**-660/2-74-061
Dow Chemical Company Freeport, TX – **REF. NO. EPA**-660/3-73-006
Dow Chemical Company Midland, MI – **REF. NO. EPA**-650/2-74-060
Dow Chemical Company Midland, MI – **REF. NO. EPA**-650/2-74-061
Dow Chemical Company Freeport, TX – **REF. NO. EPA**-660/3-74-019
Drexel University, Environmental Engineering Program Philadelphia, PA – **REF. NO. EPA**-670/2-73-057
E.D. Appolonia Consulting Engineers, Inc. Pittsburgh, PA – **REF. NO. EPA**-670/2-73-081
East Central Oklahoma State University Ada, OK – **REF. NO. EPA**-660/2-75-003
East Central State College Ada, OK – **REF. NO. EPA**-660/2-74-024
East Tennessee State University Johnson City, TN – **REF. NO. EPA**-670/2-75-023
Eastern Michigan University Ypsilanti, MI – **REF. NO. EPA**-660/3-74-029
Eastern Municipal Water District Hemet, CA – **REF. NO. EPA**-670/2-74-077
Eastern Municipal Water District Hemet, CA – **REF. NO. EPA**-670/2-75-027
Ecotrol, Inc. Columbia, MD – **REF. NO. EPA**-670/2-74-023
Edison Water Quality Laboratory, EPA Edison, NJ – **REF. NO. EPA**-670/2-73-059
Edison Water Quality Laboratory, EPA Edison, NJ – **REF. NO. EPA**-670/2-73-077
Elson T. Killam Associates, Inc. Milburn, NJ – **REF. NO. EPA**-670/2-73-071
Engineering-Science, Inc. McLean, VA – **REF. NO. EPA**-650/2-74-077
Engineering-Science, Inc. McLean, VA – **REF. NO. EPA**-650/2-75-026a
Engineering-Science, Inc. McLean, VA – **REF. NO. EPA**-650/2-75-026b
Envirex, Inc. Milwaukee, WI – **REF. NO. EPA**-660/2-73-037
Envirex, Inc. Milwaukee, WI – **REF. NO. EPA**-670/2-74-025
Enviro Plan, Inc. College Park, MD – **REF. NO. EPA**-600/2-73-004
Enviro-System and Research, Inc. Roanoke, VA – **REF. NO. EPA**-650/2-74-058
Envirogenics Company, Division of Aerojet-General Corporation El Monte, CA – **REF. NO. EPA**-660/2-74-036
Environics, Inc. Huntington Beach, CA – **REF. NO. EPA**-670/2-75-028
Environmental Impact Center Newton, MA – **REF. NO. EPA**-600/5-75-002
Environmental Law Institute Washington, DC – **REF. NO. EPA**-600/5-74-025
Environmental Law Institute Washington, DC – **REF. NO. EPA**-600/5-74-026
Environmental Measurements, Inc. San Francisco, CA – **REF. NO. EPA**-650/2-75-005a
Environmental Quality Systems, Inc. Rockville, MD – **REF. NO. EPA**-670/2-74-013
Environmental Quality Systems, Inc. Rockville, MD – **REF. NO. EPA**-670/2-74-097
Environmental Research Institute of Michigan Ypsilanti, MI – **REF. NO. EPA**-660/3-74-028
Environmental Science and Engineering, Inc. Gainesville, FL – **REF. NO. EPA**-650/2-73-007
Environmental Systems Corporation Knoxville, TN – **REF. NO. EPA**-660/2-73-011
Environmental Systems Laboratory, Inc. Sunnyvale, CA – **REF. NO. EPA**-660/2-73-003
Environmental Systems Laboratory, Inc. Sunnyvale, CA – **REF. NO. EPA**-650/4-74-043
Esso Research and Engineering Company Linden, NJ – **REF. NO. EPA**-650/2-74-001
Esso Research and Engineering Company Linden, NJ – **REF. NO. EPA**-650/2-74-009a
Esso Research and Engineering Company Linden, NJ – **REF. NO. EPA**-650/2-74-009b
Esso Research and Engineering Company Berkshire, England – **REF. NO. EPA**-650/2-74-109
Esso Research and Engineering Company Linden, NJ – **REF. NO. EPA**-670/2-74-004
Esso Research Company Linden, NJ – **REF. NO. EPA**-650/2-73-039
Eugene Water and Electric Board Eugene, OR – **REF. NO. EPA**-660/2-74-011
Exxon Research and Engineering Company Linden, NJ – **REF. NO. EPA**-650/2-74-009c
Exxon Research and Engineering Company Linden, NJ – **REF. NO. EPA**-650/2-74-009d
Exxon Research and Engineering Company Linden, NJ – **REF. NO. EPA**-650/2-74-009e
Exxon Research and Engineering Company Linden, NJ – **REF. NO. EPA**-650/2-74-066
Exxon Research and Engineering Company Linden, NJ – **REF. NO. EPA**-650/2-74-069
Family and Foods, Inc. Denison, IA – **REF. NO. EPA**-660/2-74-027
Fecker Systems, Owens-Illinois, Inc. Pittsburgh, PA – **REF. NO. EPA**-650/2-75-008

PERFORMING ORGANIZATION INDEX

Firestone Synthetic Rubber and Latex Company Lake Charles, Louisiana – **REF. NO. EPA**-660/2-73-018
Fitzsimmons Steel Company Youngstown, OH – **REF. NO. EPA**-660/2-73-032
Florida Atlantic University Boca Raton, FL – **REF. NO. EPA**-660/3-74-007
Florida Technological University Orlando, FL – **REF. NO. EPA**-670/2-74-072
Florida, University of Gainesville, FL – **REF. NO. EPA**-660/3-73-002
Florida, University of Gainesville, FL – **REF. NO. EPA**-670/2-73-063
Florida, University of Gainesville, FL – **REF. NO. EPA**-600/5-74-013
Florida, University of Gainesville, FL – **REF. NO. EPA**-660/2-74-021
Florida, University of Gainesville, FL – **REF. NO. EPA**-670/2-75-017
Florida, University of Gainesville, FL – **REF. NO. EPA**-670/2-75-022
Flow Research, Inc. Kent, WA – **REF. NO. EPA**-650/4-74-044
Flynn and Emrich Company Baltimore, MD – **REF. NO. EPA**-650/2-74-004
Ford Motor Company Dearborn, MI – **REF. NO. EPA**-650/2-74-076
Foster D. Snell, Inc. Florham Park, NJ – **REF. NO. EPA**-670/2-73-062
Foster D. Snell, Inc. Florham Park, NJ – **REF. NO. EPA**-650/2-74-106
Foster-Miller Associates, Inc. Waltham, MA – **REF. NO. EPA**-670/2-74-019
Foster-Miller Associates, Inc. Waltham, MA – **REF. NO. EPA**-670/2-74-020
Foster-Miller Associates, Inc. Waltham, MA – **REF. NO. EPA**-670/2-74-021
Fram Corporation Pawtucket, RI – **REF. NO. EPA**-660/2-74-039
Franklin Institute Research Laboratories Philadelphia, PA – **REF. NO. EPA**-650/2-73-016
Franklin Institute Research Laboratories Philadelphia, PA – **REF. NO. EPA**-600/2-74-005
Franklin Institute Research Laboratories Philadelphia, PA – **REF. NO. EPA**-600/2-75-005
Franklin Institute Research Laboratory Philadelphia, PA – **REF. NO. EPA**-600/2-74-007
FMC Corporation, Advanced Products Division San Jose, CA – **REF. NO. EPA**-670/2-74-056
Gainesville, City of Gainesville, FL – **REF. NO. EPA**-660/2-74-055
General American Transportation Corporation Niles, IL – **REF. NO. EPA**-670/2-74-043
General American Transportation Corporation Niles, IL – **REF. NO. EPA**-670/2-75-007
General Dynamics Corporation San Diego, CA – **REF. NO. EPA**-650/2-73-026
General Dynamics Corporation Groton, CT – **REF. NO. EPA**-670/2-74-071
General Electric Company Philadelphia, PA – **REF. NO. EPA**-650/2-74-029
General Electric Company Pittsfield, MA – **REF. NO. EPA**-650/2-74-046a
General Electric Company Pittsfield, MA – **REF. NO. EPA**-650/2-74-046b
General Electric Company Philadelphia, PA – **REF. NO. EPA**-660/3-74-022
General Electric Company, Center for Advanced Studies, TEMPO Santa Barbara, CA – **REF. NO. EPA**-600/4-73-001a
General Electric Company, Center for Advanced Studies, TEMPO Santa Barbara, CA – **REF. NO. EPA**-600/4-73-001b
General Electric Company, Center for Advanced Studies, TEMPO Santa Barbara, CA – **REF. NO. EPA**-600/4-74-001
General Electric Company, Space Sciences Laboratory Philadelphia, PA – **REF. NO. EPA**-650/2-73-040
General Electric Company, Tempo, Center for Advanced Studies Santa Barbara, CA – **REF. NO. EPA**-680/4-74-002
General Electric Company, Tempo, Center for Advanced Studies Santa Barbara, CA – **REF. NO. EPA**-680/4-74-003
Geomet, Inc. Rockville, MD – **REF. NO. EPA**-650/2-73-052
Geomet, Inc. Gaithersburg, MD – **REF. NO. EPA**-650/4-74-049
Geomet, Inc. Pomona, CA – **REF. NO. EPA**-650/2-75-028
Georgetown University Washington, DC – **REF. NO. EPA**-600/5-74-020
Georgia Pacific Corporation Bellingham, WA – **REF. NO. EPA**-660/2-74-086
Georgia State University Atlanta, GA – **REF. NO. EPA**-660/3-75-001
Georgia, University of Athens, GA – **REF. NO. EPA**-660/3-73-016
Georgia University of Athens, GA – **REF. NO. EPA**-660/3-73-022
Georgia University of Athens, GA – **REF. NO. EPA**-660/3-73-025
Georgia, University of Athens, GA – **REF. NO. EPA**-660/2-74-064
Georgia, University of Athens, GA – **REF. NO. EPA**-660/4-75-002
Geraghty and Miller, Inc. Port Washington, NY – **REF. NO. EPA**-600/4-73-001a
Geraghty and Miller, Inc. Port Washington, NY – **REF. NO. EPA**-660/2-74-056
Gillette Research Institute Rockville, MD – **REF. NO. EPA**-670/2-73-052
Gillette Research Institute Rockville, MD – **REF. NO. EPA**-600/2-74-003
Gold Kist, Inc. Durham, NC – **REF. NO. EPA**-660/2-74-031
Gram/Phillips Associates, Inc. Water District Calabasas, CA – **REF. NO. EPA**-660/2-73-022
Grand Rapids, City of Grand Rapids, MI – **REF. NO. EPA**-670/2-73-103
Grosse Ile Laboratory, EPA Grosse Ile, MI – **REF. NO. EPA**-660/3-73-021
Grumman Aerospace Corporation Bethpage, NY – **REF. NO. EPA**-660/2-73-024
Gulf Breeze Environmental Research Laboratory Gulf Breeze, FL – **REF. NO. EPA**-660/3-74-024
Gulf Breeze Environmental Research Laboratory, EPA Gulf Breeze, FL – **REF. NO. EPA**-660/3-74-013
Gulf Breeze Environmental Research Laboratory, EPA Gulf Breeze, FL – **REF. NO. EPA**-660/3-75-001
Gulf Environmental Systems Company San Diego, CA – **REF. NO. EPA**-670/2-75-009
Gulf South Research Institute Baton Rouge, LA – **REF. NO. EPA**-670/2-73-021
Gulf South Research Institute New Iberia, LA – **REF. NO. EPA**-650/2-74-068
Gulf Southern Research Institute for Pharmaceutical Associates Washington, DC – **REF. NO. EPA**-670/2-74-057
GCA Corporation Bedford, MA – **REF. NO. EPA**-600/5-74-032
GCA Corporation Bedford, MA – **REF. NO. EPA**-650/2-74-036
GCA Corporation Bedford, MA – **REF. NO. EPA**-650/2-74-043
GCA Corporation Bedford, MA – **REF. NO. EPA**-650/2-75-009
GCA Corporation Bedford, MA – **REF. NO. EPA**-650/2-75-024a
Hancock Company Bay St. Louis, MS – **REF. NO. EPA**-670/2-74-073
Harriman Utility Board Harriman, TN – **REF. NO. EPA**-660/2-73-010

PERFORMING ORGANIZATION INDEX

Harris County Water Control and Improvement District #50 El Lago, TX – **REF. NO. EPA**-670/2-73-101
Harvard University School of Public Health Boston, MA – **REF. NO. EPA**-670/2-73-017
Harvard University, Guggenheim Center for Aerospace Health and Safety, Boston, MA – **REF. NO. EPA**-650/1-74-006
Hittman Associates, Inc. Columbia, MD – **REF. NO. EPA**-600/2-73-002
Hittman Associates, Inc. Columbia, MD – **REF. NO. EPA**-660/2-73-004
Hittman Associates, Inc. Columbia, MD – **REF. NO. EPA**-660/2-73-035
Hittman Associates, Inc. Columbia, MD – **REF. NO. EPA**-660/2-74-072
Hittman Associates, Inc. Columbia, MD – **REF. NO. EPA**-660/2-74-073
Hoerner Waldorf Corporation St. Paul, MN – **REF. NO. EPA**-650/2-74-071a
Hoerner Waldorf Corporation St. Paul, MN – **REF. NO. EPA**-650/2-74-071b
Homer Hoyt Institute Washington, DC – **REF. NO. EPA**-600/5-73-012a
Homer Hoyt Institute Washington, DC – **REF. NO. EPA**-600/5-73-012b
Homer Hoyt Institute Washington, DC – **REF. NO. EPA**-600/5-73-012c
Homer Hoyt Institute Washington, DC – **REF. NO. EPA**-600/5-73-012d
Homer Hoyt Institute Washington, DC – **REF. NO. EPA**-600/5-73-012e
Hope College Holland, MI – **REF. NO. EPA**-660/2-73-008
Human Resources Research Organization Columbus, GA – **REF. NO. EPA**-670/2-73-086
Human Studies Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/1-74-004
Hydrocarbon Research, Inc. Trenton, NJ – **REF. NO. EPA**-650/2-73-041
Hydrocarbon Research, Inc. Trenton, NJ – **REF. NO. EPA**-650/2-73-041a
Hydrocarbon Research, Incorporated, Research and Development Laboratory Trenton, NJ – **REF. NO. EPA**-670/2-73-066
Hydrocomp, Inc. Palo Alto, CA – **REF. NO. EPA**-660/2-74-013
Idaho, University of Moscow, ID – **REF. NO. EPA**-660/3-73-017
Illinois Environmental Protection Agency Chicago, IL – **REF. NO. EPA**-660/3-74-002
Illinois Institute of Technology Chicago, IL – **REF. NO. EPA**-600/2-74-009a
Illinois Institute of Technology Chicago, IL – **REF. NO. EPA**-600/2-74-009b
Illinois Institute of Technology Chicago, IL – **REF. NO. EPA**-600/2-74-009c
Illinois State Geological Survey Urbana, IL – **REF. NO. EPA**-650/2-73-044
Illinois State Geological Survey Springfield, IL – **REF. NO. EPA**-650/2-74-054
Illinois, University of Urbana, IL – **REF. NO. EPA**-670/2-73-082
Illinois, University of Urbana, IL – **REF. NO. EPA**-670/2-74-035A
Illinois, University of Urbana, IL – **REF. NO. EPA**-670/2-74-035B
Illinois, University of Urbana, IL – **REF. NO. EPA**-670/2-74-036A
Illinois, University of Urbana, IL – **REF. NO. EPA**-670/2-74-036B
Illinois, University of, Department of Civil Engineering Urbana, IL – **REF. NO. EPA**-670/2-74-016
Illinois, University of, Illinois Natural History Survey Urbana, IL – **REF. NO. EPA**-660/3-74-025
Illinois, University of, Illinois State Water Survey Urbana, IL – **REF. NO. EPA**-670/2-73-029
Illinois, University of School of Chemical Sciences Urbana, IL – **REF. NO. EPA**-650/2-74-063
Industrial Bio-Test Laboratories, Inc. Northbrook, IL – **REF. NO. EPA**-670/2-75-004
Industrial Nucleonics Corporation Columbus, OH – **REF. NO. EPA**-650/2-74-065
Industrial Pollution Control Division, EPA Washington, DC – **REF. NO. EPA**-600/2-75-001
Industrial Waste Treatment Research Laboratory, EPA Rivesville, WV – **REF. NO. EPA**-670/2-74-051
Industrial Waste Treatment Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2-74-093
Institute for Community Studies Kansas City, MO – **REF. NO. EPA**-600/5-74-024
Institute of Gas Technology, IIT Center Chicago, IL – **REF. NO. EPA**-650/2-73-004
Institute of Gas Technology, IIT Center Chicago, IL – **REF. NO. EPA**-650/2-73-033a
Institute of Gas Technology, IIT Center Chicago, IL – **REF. NO. EPA**-650/2-73-033b
Institute of Paper Chemistry Appleton, WI – **REF. NO. EPA**-660/2-73-030
Institute of Paper Chemistry Appleton, WI – **REF. NO. EPA**-660/2-74-029
International City Management Association Washington, DC – **REF. NO. EPA**-600/5-73-016
International Research and Technology Corporation Washington, DC – **REF. NO. EPA**-670/2-73-056
International Research and Technology Corporation Arlington, VA – **REF. NO. EPA**-670/2-74-078
Iowa State University Ames, IA – **REF. NO. EPA**-660/2-74-009
Iowa State University, Department of Agricultural Engineering Ames, IA – **REF. NO. EPA**-670/2-73-025
IIT Research Institute Chicago, IL – **REF. NO. EPA**-650/1-73-002
IIT Research Institute Chicago, IL – **REF. NO. EPA**-650/2-74-016
IIT Research Institute Chicago, IL – **REF. NO. EPA**-650/2-74-088
IIT Research Institute Chicago, IL – **REF. NO. EPA**-650/2-74-090
Jack Faucett Company Chevy Chase, MD – **REF. NO. EPA**-600/5-74-033
JRB Associates, Inc. La Jolla, CA – **REF. NO. EPA**-650/4-74-006
Kaman Sciences Corporation Colorado Springs, CO – **REF. NO. EPA**-650/4-75-005
Kansas State University Manhattan, KS – **REF. NO. EPA**-650/2-74-084
Kansas State University Manhattan, KS – **REF. NO. EPA**-650/2-74-110
Kenosha, City of Kenosha, WI – **REF. NO. EPA**-670/2-75-019
Kent Cheese Company Melrose Park, IL – **REF. NO. EPA**-660/2-74-012
Kentucky, University of, Department of Entomology Lexington, KY – **REF. NO. EPA**-650/1-74-002
KLD Associates, Inc. Huntington, NY – **REF. NO. EPA**-650/2-75-018
KVB Engineering, Inc. Tustin, CA – **REF. NO. EPA**-650/2-74-078a
Lake Herman Development Associates, Inc. Madison, SD – **REF. NO. EPA**-660/3-74-017
Lake Tahoe Area Council South Lake Tahoe, CA – **REF. NO. EPA**-660/3-75-003
Lancy Laboratories Zelienople, PA – **REF. NO. EPA**-670/2-75-015
Langston Laboratories, Inc. Leawood, KS – **REF. NO. EPA**-650/2-75-007
Lawrence Berkeley Laboratories Berkeley, CA – **REF. NO. EPA**-650/4-74-030

PERFORMING ORGANIZATION INDEX

Lockheed Missiles and Space Company, Inc. Sunnyvale, CA – **REF. NO. EPA**-650/3–74–004a
Los Angles County Sanitation District Los Angeles, CA – **REF. NO. EPA**-670/2–73–043
Louisiana State University Baton Rouge, LA – **REF. NO. EPA**-660/3–75–001
Louisiana State University Baton Rouge, LA – **REF. NO. EPA**-670/2–75–032
Louisiana State University, Department of Chemistry Baton Rouge, LA – **REF. NO. EPA**-650/2–73–011
Louisiana State Unversity, Department of Chemical Engineering Baton Rouge, LA – **REF. NO. EPA**-670/2–73–095
M. W. Kellogg Company Houston, TX – **REF. NO. EPA**-650/2–74–012
M. W. Kellogg Company Houston, TX – **REF. NO. EPA**-650/2–74–028
M. W. Kellogg Company Houston, TX – **REF. NO. EPA**-650/2–74–072
M. W. Kellogg Company Houston, TX – **REF. NO. EPA**-650/2–74–098
M. W. Kellogg Company Houston, TX – **REF. NO. EPA**-650/2–74–116
M. W. Kellogg Company Houston, TX – **REF. NO. EPA**-650/2–74–127
M. W. Kellogg Company Houston, TX – **REF. NO. EPA**-650/2–74–130
M. W. Kellogg Company Houston, TX – **REF. NO. EPA**-650/2–75–017
Manhattan College Bronx, NY – **REF. NO. EPA**-660/3–73–009
Manhattan College Bronx, NY – **REF. NO. EPA**-660/3–75–005
Maryland, State of, Department of Health and Mental Hygiene Baltimore, MD – **REF. NO. EPA**-660/2–74–060
Maryland, State of, Water Resources Administration Annapiois, MD – **REF. NO. EPA**-660/2–73–035
Maryland, State of, Water Resources Administration Annapolis, MD – **REF. NO. EPA**-660/2–74–071
Massachusetts Institute of Technology Cambridge, MA – **REF. NO. EPA**-650/2–74–075
Massachusetts Institute of Technology Cambridge, MA – **REF. NO. EPA**-670/2–75–026a
Massachusetts Institute of Technology Cambridge, MA – **REF. NO. EPA**-670/2–75–026b
Massachusetts Institute of Technology, Chemical Engineering Department Cambridge, MA – **REF. NO. EPA**-670/2–73–089A
Massachusetts Institute of Technology, Chemical Engineering Department Cambridge, MA – **REF. NO. EPA**-670/2–73–089B
Massachusetts Institute of Technology, Department of Chemical Engineering Cambridge, MA – **REF. NO. EPA**-650/2–73–047
Mathematica, Inc. Bethesda, MD – **REF. NO. EPA**-600/5–74–008
Medical College of Wisconsin, Department of Environmental Medicine Milwaukee, WI – **REF. NO. EPA**-650/1–73–004
Medical College of Wisconsin, Department of Environmental Medicine Milwaukee, WI – **REF. NO. EPA**-650/1–74–005
Meloy Laboratories, Inc. Springfield, VA – **REF. NO. EPA**-670/2–73–068
Messer Associates, Inc. Silver Spring, MD – **REF. NO. EPA**-670/2–74–082
Meta Systems, Inc. Cambridge, MA – **REF. NO. EPA**-600/5–74–030
Meta Systems, Inc. Cambridge, MA – **REF. NO. EPA**-600/5–75–001
Metcalf and Eddy, Inc. Palo Alto, CA – **REF. NO. EPA**-660/2–73–006a
Metcalf and Eddy, Inc. Palo Alto, CA – **REF. NO. EPA**-660/2–73–006b
Metcalf and Eddy, Inc. Boston, MA – **REF. NO. EPA**-660/2–73–036
Metcalf and Eddy, Inc. Palo Alto, CA – **REF. NO. EPA**-670/2–74–040
Meteorology Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/4–74–008
Meteorology Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/4–75–004
Methods Development and Quality Assurance Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/4–74–001
Methods Development and Quality Assurance Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/4–74–002
Methods Development and Quality Assurance Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/9-74–005
Methods Development and Quality Assurance Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/4–75–001
Methods Development and Quality Assurance Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/4–75–002
Methods Development and Quality Assurance Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/4–75–003
Methods Development and Quality Assurance Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/4–75–004a
Methods Development and Quality Assurance Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/4–75–004b
Metropolitan Sewer Board St. Paul, MN – **REF. NO. EPA**-660/2–74–020
Miami, University of Coral Gables, FL – **REF. NO. EPA**-650/1–74–012
Miami, University of Coral Gables, FL – **REF. NO. EPA**-660/3–74–003
Miami, University of, School of Medicine Miami, FL – **REF. NO. EPA**-650/1–74–009
Michael Baker Jr., Inc. Beaver, PA – **REF. NO. EPA**-670/2–74–009
Michigan State University East Lansing, MI – **REF. NO. EPA**-600/5–74–011
Michigan State University East Lansing, MI – **REF. NO. EPA**-660/2–74–057
Michigan State University East Lansing, MI – **REF. NO. EPA**-670/2–74–076a
Michigan State University East Lansing, MI – **REF. NO. EPA**-670/2–74–076b
Michigan Technological University Houghton, MI – **REF. NO. EPA**-660/2–74–018
Michigan, University of Ann Arbor, MI – **REF. NO. EPA**-670/2–73–049
Michigan, University of Ann Arbor, MI – **REF. NO. EPA**-650/1–74–007
Michigan, University of Ann Arbor, MI – **REF. NO. EPA**-650/2–74–096
Michigan, University of Ann Arbor, MI – **REF. NO. EPA**-660/3–75–004
Michigan, University of, College of Engineering Ann Arbor, MI – **REF. NO. EPA**-670/2–74–012
Michigan, University of, Department of Naval Architecture and Marine Engineering Ann Arbor, MI – **REF. NO. EPA**-670/2–74–054
Michigan, University of, Environmental and Water Resources Engineering Ann Arbor, MI – **REF. NO. EPA**-670/2–74–047
Middlebury College, Physics Department Middlebury, VT – **REF. NO. EPA**-670/2–74–031
Midwest Research Institute Kansas City, MO – **REF. NO. EPA**-600/5–74–007
Midwest Research Institute Kansas City, MO – **REF. NO. EPA**-650/2–74–027
Midwest Research Institute Kansas City, MO – **REF. NO. EPA**-650/2–74–073
Midwest Research Institute Kansas City, MO – **REF. NO. EPA**-650/2–74–107
Midwest Research Institute Kansas City, MO – **REF. NO. EPA**-650/4–74–019a
Midwest Research Institute Kansas City, MO – **REF. NO. EPA**-650/4–74–023
Midwest Research Institute Kansas City, MO – **REF. NO. EPA**-650/4–74–046
Midwest Research Institute Kansas City, MO – **REF. NO. EPA**-660/2–74–047
Midwest Research Institute Kansas City, MO – **REF. NO. EPA**-660/2–74–094

PERFORMING ORGANIZATION INDEX

Midwest Research Institute Kansas City, MO – **REF. NO. EPA**-670/2–74–048
Midwest Research Institute Kansas City, MO – **REF. NO. EPA**-600/5–75–004
Midwest Research Institute Kansas City, MO – **REF. NO. EPA**-650/4–75–001
Milbrew, Inc. Juneau, WI – **REF. NO. EPA**-660/2–74–025
Milwaukee, Sewerage Commission of the City of Milwaukee, WI – **REF. NO. EPA**-670/2–73–050
Mineral Pigments, Corporation Beltsville, MD – **REF. NO. EPA**-670/2–74–044
Minnesota, University of St. Paul, MN – **REF. NO. EPA**-660/2–73–027
Minnesota, University of St. Paul, MN – **REF. NO. EPA**-670/2–73–051
Minnesota, University of Minneapolis, MN – **REF. NO. EPA**-660/3–75–014
Minnesota, University of, Division of Environmental Health Minneapolis, MN – **REF. NO. EPA**-670/5–73–020
Minnesota, University of, School of Public Health Minneapolis, MN – **REF. NO. EPA**-670/5–74–001
Minnesota, University of, Division of Environmental Health Minneapolis, MN – **REF. NO. EPA**-670/2–73–048
Missouri, University of Columbia, MO – **REF. NO. EPA**-660/2–74–068
Missouri, University of, Department of Civil Engineering Rolla, MO – **REF. NO. EPA**-670/2–73–038
Mitre Corporation Washington, DC – **REF. NO. EPA**-600/2–74–004
Mitre Corporation McLean, VA – **REF. NO. EPA**-650/2–74–030
Mitre Corporation McLean, VA – **REF. NO. EPA**-650/2–74–062
Mitre Corporation McLean, VA – **REF. NO. EPA**-650/2–74–062a
Monsanto Research Corporation Dayton, OH – **REF. NO. EPA**-650/2–73–027
Monsanto Research Corporation Dayton, OH – **REF. NO. EPA**-650/2–74–021
Monsanto Research Corporation Dayton, OH – **REF. NO. EPA**-650/2–74–041
Monsanto Research Corporation Dayton, OH – **REF. NO. EPA**-650/2–74–055
Monsanto Research Corporation Dayton, OH – **REF. NO. EPA**-650/2–74–082
Monsanto Research Corporation Dayton, OH – **REF. NO. EPA**-650/2–74–117
Monsanto Research Corporation Dayton, OH – **REF. NO. EPA**-650/2–74–131
Monsanto Research Corporation Dayton, OH – **REF. NO. EPA**-650/2–75–019a
Montana, University of Missoula, MT – **REF. NO. EPA**-660/3–74–023
Montana, University of, Wood Chemistry Laboratory Missoula, MT – **REF. NO. EPA**-670/2–74–015
Mount Clemens, City of Mount Clemens, MI – **REF. NO. EPA**-670/2–75–010
National Bureau of Standards Washington, DC – **REF. NO. EPA**-600/5–73–012a
National Bureau of Standards Washington, DC – **REF. NO. EPA**-600/5–74–031
National Canners Association Berkeley, CA – **REF. NO. EPA**-660/2–74–091
National Center for Resource Recovery, Inc. Washington, DC – **REF. NO. EPA**-670/2–75–034
National Ecological Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/3–74–011
National Ecological Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/3–74–012
National Ecological Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/3–74–018
National Ecological Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/3–74–024
National Environmental Research Center, Analytical Quality Control Laboratory Cincinnati, OH – **REF. NO. EPA**-670/4–73–018
National Environmental Research Center, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2–73–017
National Environmental Research Center, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2–73–018
National Environmental Research Center, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2–73–021
National Environmental Research Center, EPA Cincinnati, OH – **REF. NO. EPA**-670/1–73–036
National Environmental Research Center, EPA Cincinnati, OH – **REF. NO. EPA**-670/4–73–001
National Environmental Research Center, EPA Las Vegas, NV – **REF. NO. EPA**-680/4–73–002
National Environmental Research Center, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2–74–013
National Environmental Research Center, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2–74–035
National Environmental Research Center, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2–74–050
National Environmental Research Center, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/2–74–081
National Environmental Research Center, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/3–74–001
National Environmental Research Center, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/4–74–002
National Environmental Research Center, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/4–74–031
National Environmental Research Center, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/4–74–034
National Environmental Research Center, EPA Corvallis, OR – **REF. NO. EPA**-660/9–74–002
National Environmental Research Center, EPA Cincinnati, OH – **REF. NO. EPA**-670/2–74–069
National Environmental Research Center, EPA Cincinnati, OH – **REF. NO. EPA**-670/2–74–088
National Environmental Research Center, EPA Cincinnati, OH – **REF. NO. EPA**-670/2–74–090
National Environmental Research Center, EPA Cincinnati, OH – **REF. NO. EPA**-670/4–74–006
National Environmental Research Center, EPA Cincinnati, OH – **REF. NO. EPA**-670/4–74–007
National Environmental Research Center, EPA Cincinnati, OH – **REF. NO. EPA**-670/4–74–008
National Environmental Research Center, EPA Cincinnati, OH – **REF. NO. EPA**-670/4–74–009
National Environmental Research Center, EPA Cincinnati, OH – **REF. NO. EPA**-670/5–74–005
National Environmental Research Center, EPA Cincinnati, OH – **REF. NO. EPA**-670/9–74–001
National Environmental Research Center, EPA Cincinnati, OH – **REF. NO. EPA**-670/9–74–002
National Environmental Research Center, EPA Las Vegas, NV – **REF. NO. EPA**-680/4–74–001
National Environmental Research Center, EPA Corvallis, OR – **REF. NO. EPA**-660/3–75–008
National Environmental Research Center, EPA Las Vegas, NV – **REF. NO. EPA**-680/4–75–001
National Environmental Research Center, Office of Program Coordination Cincinnati, OH – **REF. NO. EPA**-670/5–73–012
National Environmental Research Center, Office of Research and Development Cincinnati, OH – **REF. NO. EPA**-670/9–73–056
National Environmental Research Center, Program Coordination Staff Cincinnati, OH – **REF. NO. EPA**-670/1–74–001
National Environmental Research Center, Quality Assurance Branch, EPA, Las Vegas, NV – **REF. NO. EPA**-680/4–73–001A
National Environmental Research Center, Technical Information Office Cincinnati, OH – **REF. NO. EPA**-670/9–73–004
National Environmental Research Center, Technical Information Office Cincinnati, OH – **REF. NO. EPA**-670/9–73–055
National Environmental Research Center, Technical Information Staff Cincinnati, OH – **REF. NO. EPA**-670/9–74–004

PERFORMING ORGANIZATION INDEX

National Research Corporation Billerica, MA – **REF. NO. EPA**-650/2–75–013a
National Steel Corporation, Weirton Steel Division Weirton, WV – **REF. NO. EPA**-650/2–73–028
National Water Quality Laboratory, EPA Duluth, MN – **REF. NO. EPA**-660/3–75–009
Naval Research Laboratory Washington, DC – **REF. NO. EPA**-650/2–73–006
Naval Research Laboratory Washington, DC – **REF. NO. EPA**-650/2–75–004
New Hampshire, University of Durham, NH – **REF. NO. EPA**-660/3–74–031
New Jersey Zinc Company Palmerton, PA – **REF. NO. EPA**-670/2–75–016
New York State Atomic and Space Development Authority New York, NY – **REF. NO. EPA**-670/2–74–080
New York University, Chemistry Department New York, NY – **REF. NO. EPA**-650/1–74–010
New York University, School of Engineering New York City, NY – **REF. NO. EPA**-650/2–73–020
New York University, School of Engineering and Science, Department of Chemical Engineering Bronx, NY – **REF. NO. EPA**-670/2–73–023
New York, State University of Buffalo, NY – **REF. NO. EPA**-660/2–74–079
New York, State University of Syracuse, NY – **REF. NO. EPA**-660/2–74–081
New York, State University of Albany, NY – **REF. NO. EPA**-650/3–75–003
New York, University of Buffalo, NY – **REF. NO. EPA**-660/3–74–027
Noise Technology Staff, EPA Washington, DC – **REF. NO. EPA**-600/1–75–001
Noise Technology Staff, EPA Washington, DC – **REF. NO. EPA**-600/2–75–002
Noise Technology Staff, EPA Washington, DC – **REF. NO. EPA**-600/2–75–003
North American Rockwell Corporation Canoga Park, CA – **REF. NO. EPA**-670/2–73–031
North Carolina State University Raleigh, NC – **REF. NO. EPA**-660/2–73–021
North Carolina State University Raleigh, NC – **REF. NO. EPA**-650/2–74–095
North Carolina State University Raleigh, NC – **REF. NO. EPA**-660/2–74–031
North Carolina State University, Department of Animal Science Raleigh, NC – **REF. NO. EPA**-670/2–73–090
North Carolina State University, Department of Wood and Paper Sciences Raleigh, NC – **REF. NO. EPA**-650/2–74–005
North Carolina, University of Chapel Hill, NC – **REF. NO. EPA**-600/5–73–015
North Carolina, University of Chapel Hill, NC – **REF. NO. EPA**-670/2–73–047a
North Carolina, University of Chapel Hill, NC – **REF. NO. EPA**-670/2–73–047b
North Carolina, University of Greensboro, NC – **REF. NO. EPA**-650/3–74–008
North Carolina, University of Chapel Hill, NC – **REF. NO. EPA**-650/4–74–038
North Carolina, University of Chapel Hill, NC – **REF. NO. EPA**-670/2–74–032
North Carolina, University of Raleigh, NC – **REF. NO. EPA**-670/2–74–096
North Carolina, University of, Center for Urban and Regional Studies Chapel Hill, NC – **REF. NO. EPA**-600/5–73–007
North Dakota, University of Grand Forks, ND – **REF. NO. EPA**-660/3–73–001
North Star Research Corporation Minneapolis, MN – **REF. NO. EPA**-660/2–73–033
Notre Dame, University of Notre Dame, IN – **REF. NO. EPA**-650/4–74–041
Oak Ridge National Laboratory Oak Ridge, TN – **REF. NO. EPA**-660/2–74–076
Ocean Systems, Inc. Reston, VA – **REF. NO. EPA**-670/2–74–053
Oceanic Foundation Waimanalo, HI – **REF. NO. EPA**-660/3–75–015
Office of Monitoring Systems, EPA Washington, DC – **REF. NO. EPA**-600/4–74–004
Office of Monitoring Systems, EPA Washington, DC – **REF. NO. EPA**-600/4–75–001
Office of Research and Development, Environmental Studies Division, EPA Washington, DC – **REF. NO. EPA**-600/5–73–010
Office of Research and Development, Implementation Research Division, EPA Washington, DC – **REF. NO. EPA**-600/5–73–001
Office of Research and Development, Office of International Affairs Washington, DC – **REF. NO. EPA**-670/9-74–003
Office of Research and Development, Publications Staff, Office of Program Management, EPA Washington, DC – **REF. NO. EPA**-600/5–73–002
Office of Research and Development, Science Advisory Board, EPA Washington, DC – **REF. NO. EPA**-SAB-73–001
Ohio Agricultural Research and Development Center Wooster, OH – **REF. NO. EPA**-670/2–74–074
Ohio State University Columbus, OH – **REF. NO. EPA**-660/2–74–023
Ohio State University Research Foundation Columbus, OH – **REF. NO. EPA**-650/1–73–003
Ohio State University, Department of Entomology Columbus, OH – **REF. NO. EPA**-660/2–74–032
Oklahoma State University Stillwater, OK – **REF. NO. EPA**-650/2–74–080
Oklahoma State University Stillwater, OK – **REF. NO. EPA**-660/2–74–046
Oklahoma Water Resources Board Oklahoma City, OK – **REF. NO. EPA**-660/3–74–033
Oklahoma, University of Norman, OK – **REF. NO. EPA**-660/2–74–037
Oklahoma, University of Norman, OK – **REF. NO. EPA**-660/2–74–077
Oklahoma, University of Norman, OK – **REF. NO. EPA**-660/3–74–006
Oregon State University Corvallis, OR – **REF. NO. EPA**-660/3–73–020
Oregon State University Corvallis, OR – **REF. NO. EPA**-600/5–74–017
Oregon State University Corvallis, OR – **REF. NO. EPA**-670/2–74–027
Oregon State University, School of Forestry Corvallis, OR – **REF. NO. EPA**-670/2–73–005
OR&D, Publication Staff, EPA Washington, DC – **REF. NO. EPA**-600/9-74–001
OR&D, Publication Staff, EPA Washington, DC – **REF. NO. EPA**-600/9-74–002
Pacific Northwest Environmental Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/2–73–001
Pacific Northwest Environmental Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/2–73–016
Pacific Northwest Environmental Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/2–73–031
Pacific Northwest Environmental Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/2–73–039
Pacific Northwest Environmental Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/3–73–013
Pacific Northwest Environmental Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/2–74–058
Pacific Northwest Environmental Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/2–74–089
Pacific Northwest Environmental Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/3–74–015
Pacific Northwest Environmental Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/3–74–032
Pacific Northwest Environmental Research Laboratory, EPA Corvallis, OR – **REF. NO. EPA**-660/9-74–001
Pacific Northwest Environmental Research Laboratory,EPA Corvallis, OR – **REF. NO. EPA**-660/3–73–014
Pennsylvania State University University Park, PA – **REF. NO. EPA**-660/2–73–002

PERFORMING ORGANIZATION INDEX

Pennsylvania State University University Park, PA – **REF. NO. EPA**-670/2-73-093
Pennsylvania State University University Park, PA – **REF. NO. EPA**-650/4-74-032
Pennsylvania State University University Park, PA – **REF. NO. EPA**-660/2-74-003
Pennsylvania State University University Park, PA – **REF. NO. EPA**-660/2-74-016
Pennsylvania State University University Park, PA – **REF. NO. EPA**-670/2-74-018
Pennsylvania State University, Department of Meteorology and Center for Air, Environmental Studies University Park, PA – **REF. NO. EPA**-650/4-74-045a
Pennsylvania State University, Department of Meteorology and Center for Air, Environmental Studies University Park, PA – **REF. NO. EPA**-650/4-74-045b
Pennsylvania, State of, Department of Environmental Resources Pittsburgh, PA – **REF. NO. EPA**-670/2-73-054
Pennsylvania, University of Philadelphia, PA – **REF. NO. EPA**-660/2-74-053
Pennsylvania, University of, Towne School of Civil and Mechanical Engineering Philadelphia, PA – **REF. NO. EPA**-670/2-73-072
Pesticides and Toxic Substances Effects Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/1-73-001
Philadelphia Water Department Philadelphia, PA – **REF. NO. EPA**-670/2-74-049
Philco-Ford Corporation Newport Beach, CA – **REF. NO. EPA**-650/2-74-094
Philco-Ford Corporation Newport Beach, CA – **REF. NO. EPA**-650/2-74-120
Philco-Ford Corporation Newport Beach, CA – **REF. NO. EPA**-650/4-74-036
Philco-Ford Corporation, Aeronutronic Division Newport Beach, CA – **REF. NO. EPA**-650/2-73-030
Polytechnic Institute of Brooklyn Brooklyn, NY – **REF. NO. EPA**-670/2-75-030
Potato Service, Inc. Presque Isle, ME – **REF. NO. EPA**-660/2-74-088
Potomac Engineering and Surveying Petersburg, WV – **REF. NO. EPA**-670/2-74-002
Princeton, Incorporated, Aeronautical Research Associates Princeton, NJ – **REF. NO. EPA**-650/4-74-035
Process Research, Inc. Cambridge, MA – **REF. NO. EPA**-670/2-73-076
Purdue University Lafayette, IN – **REF. NO. EPA**-660/2-74-043
Purdue University Lafayette, IN – **REF. NO. EPA**-660/3-74-004a
Purdue University Lafayette, IN – **REF. NO. EPA**-660/3-74-004b
PEDCo-Environmental Specialists, Inc. Cincinnati, OH – **REF. NO. EPA**-650/2-74-101
PEDCo-Environmental Specialists, Inc. Cincinnati, OH – **REF. NO. EPA**-650/2-74-115
PEDCo-Environmental Specialists, Inc. Cincinnati, OH – **REF. NO. EPA**-650/2-74-122
Quality Assurance and Environmental Monitoring Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/4-74-018
Quality Assurance and Environmental Monitoring Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/4-74-047
Quality Assurance and Environmental Monitoring Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/4-74-048
Quality Assurance and Environmental Monitoring Laboratory, EPA Research Triangle Park, NC – **REF. NO. EPA**-650/4-75-007
Quality Assurance Research Laboratory, EPA Las Vegas, NV – **REF. NO. EPA**-680/4-73-001b
Radian Corporation Austin, TX – **REF. NO. EPA**-650/2-74-024
Radian Corporation Austin, TX – **REF. NO. EPA**-650/2-74-033
Radian Corporation Austin, TX – **REF. NO. EPA**-650/2-75-006
Ralph M. Parsons Company Los Angeles, CA – **REF. NO. EPA**-670/2-73-092
Ralph Stone and Company, Inc. Los Angeles, CA – **REF. NO. EPA**-600/5-73-003
Ralph Stone and Company, Inc. Los Angeles, CA – **REF. NO. EPA**-670/2-74-095a
Ralph Stone and Company, Inc. Los Angeles, CA – **REF. NO. EPA**-670/2-74-095b
Raytheon Company Portsmouth, RI – **REF. NO. EPA**-600/5-74-004
Raytheon Company Protsmouth, RI – **REF. NO. EPA**-670/2-74-087
Raytheon Company, Environmental Systems Center Portsmouth, RI – **REF. NO. EPA**-670/2-73-104
Recon Systems, Inc. Princeton, NJ – **REF. NO. EPA**-670/2-74-052
Regional Science Research Institute Philadelphia, PA – **REF. NO. EPA**-670/5-74-006
Rensselaer Polytechnic Institute Troy, NY – **REF. NO. EPA**-660/3-73-003
Rensselaer Polytechnic Institute Troy, NY – **REF. NO. EPA**-670/2-74-063
Research Corporation of New England Wethersfield, CT – **REF. NO. EPA**-650/2-74-008a
Research Corporation of New England Wethersfield, CT – **REF. NO. EPA**-650/4-74-042
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-600/5-74-009
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/2-74-019
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/2-74-097
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/2-74-111
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/2-74-118
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/2-74-121
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/4-74-005a
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/4-74-005b
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/4-74-005c
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/4-74-005d
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/4-74-005h
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/4-74-005L
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/4-74-005m
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/4-74-012
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/4-74-016
Research Triangle Institute Research Triangle Park, NC – **REF. NO. EPA**-650/2-75-021
Resource Planning Institute Cambridge, MA – **REF. NO. EPA**-670/2-74-024A
Resource Planning Institute Cambridge, MA – **REF. NO. EPA**-670/2-74-024B
Resource Planning Institute Cambridge, MA – **REF. NO. EPA**-670/5-74-002
Resource Planning Institute Cambridge, MA – **REF. NO. EPA**-670/5-74-004
Richardson, City of Richardson, TX – **REF. NO. EPA**-670/2-73-060
Richmond, City of Richmond, VA – **REF. NO. EPA**-670/2-75-035
Robert S. Kerr Environmental Research Laboratory, EPA Ada, OK – **REF. NO. EPA**-660/2-73-014
Robert S. Kerr Environmental Research Laboratory, EPA Ada, OK – **REF. NO. EPA**-660/2-74-038
Robert S. Kerr Environmental Research Laboratory, EPA Ada, OK – **REF. NO. EPA**-660/2-74-041

PERFORMING ORGANIZATION INDEX

Robert S. Kerr Environmental Research Laboratory, EPA Ada, OK – **REF. NO. EPA**-660/2–74–042
Robert S. Kerr Environmental Research Laboratory, EPA Ada, OK – **REF. NO. EPA**-660/2–74–046
Robert S. Kerr Environmental Research Laboratory, EPA Ada, OK – **REF. NO. EPA**-660/2–74–062
Robert S. Kerr Environmental Research Laboratory, EPA Ada, OK – **REF. NO. EPA**-660/2–74–065
Robert S. Kerr Environmental Research Laboratory, EPA Ada, OK – **REF. NO. EPA**-660/2–74–066
Robert S. Kerr Environmental Research Laboratory, EPA Ada, OK – **REF. NO. EPA**-660/2–74–067
Robert S. Kerr Environmental Research Laboratory, EPA Ada, OK – **REF. NO. EPA**-660/2–74–087
Rocketdyne, Division of Rockwell International Corporation *Canoga Park, CA* – **REF. NO. EPA**-650/2–74–023
Rocketdyne, Division of Rockwell International Canoga Park, CA – **REF. NO. EPA**-650/2–74–047
Rockwell International Thousand Oaks, CA – **REF. NO. EPA**-650/3–75–004
Rohnert Park, City of Rohnert Park, CA – **REF. NO. EPA**-670/2–74–075
Rosenstiel School of Marine and Atmospheric Science, University of Miami Miami, FL – **REF. NO. EPA**-660/3–74–014
Rutgers University New Brunswick, NJ – **REF. NO. EPA**-670/2–73–027
Rutgers University New Brunswick, NJ – **REF. NO. EPA**-670/2–74–094
Rutgers University, College of Agriculture and Environmental Science New Brunswick, NJ – **REF. NO. EPA**-670/2–73–085
RAI Research Corporation Haupage, Long Island, NY – **REF. NO. EPA**-660/2–74–035
S.K. Williams Company Wauwatosa, WI – **REF. NO. EPA**-670/2–74–042
San Diego Utilities Department San Diego, CA – **REF. NO. EPA**-670/2–73–039
San Jose Public Works Department, City of San Jose, CA – **REF. NO. EPA**-670/2–73–096
Scientific Research Instruments Corporation Baltimore, MD – **REF. NO. EPA**-650/2–73–042
Scott Environmental Technology Plumsteadville, PA – **REF. NO. EPA**-650/4–75–008
Scott Research Laboratories, Inc. Plumsteadville, PA – **REF. NO. EPA**-650/4–74–020
Seattle, Municipality of Metropolitan Seattle, WA – **REF. NO. EPA**-670/2–74–022
Seattle, Municipality of Metropolitan Seattle, WA – **REF. NO. EPA**-670/2–74–061
Shelbyville, City of Shelbyville, IL – **REF. NO. EPA**-670/2–74–079
Shell Development Company Houston, TX – **REF. NO. EPA**-670/2–73–084
Shell Development Company Emeryville, CA – **REF. NO. EPA**-650/2–74–017
Smithsonian Institution Cambridge, MA – **REF. NO. EPA**-600/4–75–001
Solid and Hazardous Waste Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/5–73–021
Solid and Hazardous Waste Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2–74–007
Solid and Hazardous Waste Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2–75–005
Solid and Hazardous Waste Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2–75–025
Solid Waste Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2–73–001
South Dakota State University Brookinger, SD – **REF. NO. EPA**-670/4–73–002
South Dakota State University Brookings,, SD – **REF. NO. EPA**-660/2–74–005
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/2–73–007
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/2–73–009
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/2–73–013
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/2–73–034
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/3–73–007
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/3–73–012
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/2–74–001
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/2–74–002
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/2–74–017
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/2–74–045
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/2–74–078
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/3–74–021
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/3–75–007
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/3–75–012
Southeast Environmental Research Laboratory, EPA Athens, GA – **REF. NO. EPA**-660/4–75–001
Southern Piedmont Conservation Research Center Watkinsville, GA – **REF. NO. EPA**-660/2–74–017
Southern Research Institute Birmingham, AL – **REF. NO. EPA**-650/2–73–035
Southern Research Institute Birmingham, AL – **REF. NO. EPA**-650/2–74–074
Southern Research Institute Birmingham, AL – **REF. NO. EPA**-650/2–74–079
Southern Research Institute Birmingham, AL – **REF. NO. EPA**-650/2–74–092
Southern Research Institute Birmingham, AL – **REF. NO. EPA**-650/2–74–102
Southern Research Institute Birmingham, AL – **REF. NO. EPA**-650/2–74–114
Southern Research Institute Birmingham, AL – **REF. NO. EPA**-650/2–74–124
Southern Research Institute Birmingham, AL – **REF. NO. EPA**-650/2–74–129
Southern Research Institute Birmingham, AL – **REF. NO. EPA**-650/2–74–132
Southern Research Institute Birmingham, AL – **REF. NO. EPA**-670/2–74–030
Southern Research Institute Birmingham, AL – **REF. NO. EPA**-650/2–75–016
Southern Research Institute Birmingham, AL – **REF. NO. EPA**-650/2–75–022
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/1–74–003
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/1–74–008
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/4–74–013
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/4–74–021
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/4–74–022
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/4–74–024
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/4–74–025
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/4–74–026
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/4–74–027
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/4–74–028

PERFORMING ORGANIZATION INDEX

Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/4-74-029
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/4-74-033
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/4-74-039
Southwest Research Institute Houston, TX – **REF. NO. EPA**-660/3-74-026
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-670/2-74-092
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/4-75-003
Southwest Research Institute San Antonio, TX – **REF. NO. EPA**-650/4-75-009
Special Studies Staff, EPA Research Triangle Park, NC – **REF. NO. EPA**-600/6-75-001
Special Studies Staff, EPA Research Triangle Park, NC – **REF. NO. EPA**-600/6-75-002
St. Louis Sewer District, Metropolitan St. Louis, MO – **REF. NO. EPA**-670/2-73-098
St. Louis Sewer District, Metropolitan St. Louis, MO – **REF. NO. EPA**-670/2-74-062
St. Regis Paper Company Pensacola, FL – **REF. NO. EPA**-660/2-75-004
Stanford Research Institute Menlo Park, CA – **REF. NO. EPA**-600/5-73-009
Stanford Research Institute Menlo Park, CA – **REF. NO. EPA**-650/2-73-037
Stanford Research Institute Menlo Park, CA – **REF. NO. EPA**-650/2-73-043
Stanford Research Institute Menlo Park, CA – **REF. NO. EPA**-650/3-73-001
Stanford Research Institute Menlo Park, CA – **REF. NO. EPA**-650/4-73-002
Stanford Research Institute Menlo Park, CA – **REF. NO. EPA**-650/5-73-002
Stanford Research Institute Menlo Park, CA – **REF. NO. EPA**-600/2-74-002
Stanford Research Institute Menlo Park, CA – **REF. NO. EPA**-650/1-74-013
Stanford Research Institute Menlo Park, CA – **REF. NO. EPA**-650/2-74-108
Stanford Research Institute Menlo Park, CA – **REF. NO. EPA**-650/4-74-007
Stanford Research Institute Menlo Park, CA – **REF. NO. EPA**-650/4-74-015
Stanford Research Institute Menlo Park, CA – **REF. NO. EPA**-650/4-74-037
Stanford University Pacific Grove, CA – **REF. NO. EPA**-660/3-75-013
Stanford University, Department of Civil Engineering Stanford, CA – **REF. NO. EPA**-670/2-73-010
Stanley Consultants, Inc. Muscatine, IA – **REF. NO. EPA**-660/2-74-014
Swift and Company Oakbrook, IL – **REF. NO. EPA**-660/2-73-015
Syracuse University Syracuse, NY – **REF. NO. EPA**-670/2-75-021
Syracuse University Research Corporation Syracuse, NY – **REF. NO. EPA**-670/2-73-087
Syracuse University, Department of Civil Engineering Syracuse, NY – **REF. NO. EPA**-670/2-73-065
System Development Corporation Santa Monica, CA – **REF. NO. EPA**-650/4-75-002
Systems Applications, Inc. San Rafael, CA – **REF. NO. EPA**-650/4-74-011
Systems Applications, Inc. San Rafael, CA – **REF. NO. EPA**-650/4-74-040
Systems Technology Associates Falls Church, VA – **REF. NO. EPA**-650/2-73-009
Systems, Science and Software La Jolla, CA – **REF. NO. EPA**-650/4-74-003
SCS Engineers Long Beach, CA – **REF. NO. EPA**-660/2-74-075
Technical Information Staff, NERC Cincinnati, OH – **REF. NO. EPA**-670/9-75-001
Technical Information Staff, NERC Cincinnati, OH – **REF. NO. EPA**-670/9-75-002
Technical Information Staff, NERC Cincinnati, OH – **REF. NO. EPA**-670/9-75-003
Technology Service Corporation Santa Monica, CA – **REF. NO. EPA**-650/4-74-001
Teknekron, Inc. Washington, DC – **REF. NO. EPA**-600/5-74-015
Tennessee Valley Authority Chattanooga, TN – **REF. NO. EPA**-650/2-73-019a
Tennessee Valley Authority Chattanooga, TN – **REF. NO. EPA**-650/2-73-019b
Tennessee Valley Authority Chattanooga, TN – **REF. NO. EPA**-650/2-73-019c
Tennessee Valley Authority Chattanooga, TN – **REF. NO. EPA**-650/2-74-049a
Tennessee Valley Authority Muscle Shoals, TN – **REF. NO. EPA**-600/2-75-006
Tennessee Valley Authority, Office of Agricultural and Development Muscle Shoals, AL – **REF. NO. EPA**-650/2-73-051
Tetra Technology, Inc. Pasadena, CA – **REF. NO. EPA**-660/2-73-029
Texas A&M University College Station, TX – **REF. NO. EPA**-670/2-73-041
Texas A&M University College Station, TX – **REF. NO. EPA**-650/3-74-006
Texas Municipal Water District, West Central Abilene, TX – **REF. NO. EPA**-660/2-74-019
Texas Technical University Lubbock, TX – **REF. NO. EPA**-660/2-74-090
Texas, University of Austin, TX – **REF. NO. EPA**-660/2-73-025a
Texas, University of Austin, TX – **REF. NO. EPA**-660/2-73-025b
Textile Research Institute Princeton, NJ – **REF. NO. EPA**-650/2-75-002
Thermo-Systems, Inc. St. Paul, MN – **REF. NO. EPA**-650/2-73-022
Thermo-Systems, Inc. St. Paul, MN – **REF. NO. EPA**-650/4-74-017
Thiokol Corporation Brigham City, UT – **REF. NO. EPA**-670/2-74-091
Thunder Scientific Corporation Albuquerque, NM – **REF. NO. EPA**-650/2-73-008
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2-73-053A
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2-73-053B
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2-73-053C
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2-73-053D
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2-73-053E
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2-73-053F
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2-73-053G
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2-73-053H
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2-73-053I
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2-73-053J
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2-73-053K
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2-73-053L
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2-73-053M

PERFORMING ORGANIZATION INDEX

TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2–73–053N
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2–73–053O
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2–73–053P
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-670/2–73–053A-P
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-650/2–74–025
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-650/2–74–031a
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-650/2–74–031b
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-650/2–74–064
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-650/2–75–001a
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-650/2–75–001b
TRW Systems Group Redondo Beach, CA – **REF. NO. EPA**-650/2–75–020
U.S. Bureau of Mines Pittsburgh, PA – **REF. NO. EPA**-650/2–74–038
U.S. Bureau of Mines Bartlesville, OK – **REF. NO. EPA**-660/2–74–010
U.S. Bureau of Mines Bartlesville, OK – **REF. NO. EPA**-650/2–75–014
U.S. Department of the Interior Washington, DC – **REF. NO. EPA**-650/2–75–011
U.S. Department of Commerce Washington, DC – **REF. NO. EPA**-650/2–74–125
U.S. Department of Health, Education, and Welfare, National Institute for Occupational Safety and Health Rockville, MD – **REF. NO. EPA**-680/4–73–002
U.S. Department of Interior Columbia, MO – **REF. NO. EPA**-660/3–75–011
U.S. Fish and Wildlife Service Yankton, SD – **REF. NO. EPA**-660/3–75–010
U.S. Forest Service Fairbanks, AK – **REF. NO. EPA**-660/3–74–009
U.S. Plywood-Champion Paper, Inc. Hamilton, OH – **REF. NO. EPA**-660/2–73–019
Ultrasystems, Inc. Irvine, CA – **REF. NO. EPA**-650/2–74–045
Union Carbide Corporation *Tonawanda, NY* – ***REF. NO. EPA****-670/2–73–042*
United Aircraft Research Laboratories East Hartford, CT – **REF. NO. EPA**-650/2–73–045
United Aircraft Research Laboratories East Hartford, CT – **REF. NO. EPA**-650/2–74–020
Urban Programs Division El Segundo, CA – **REF. NO. EPA**-650/2–73–014
Utah State University Logan, UT – **REF. NO. EPA**-660/3–73–019
Utah State University Logan, UT – **REF. NO. EPA**-600/5–74–010
Utah State University Logan, UT – **REF. NO. EPA**-600/5–74–021
Utah State University Logan, UT – **REF. NO. EPA**-660/2–75–005
Utah State University Logan, UT – **REF. NO. EPA**-670/9-75–004
Utah, University of Salt Lake City, UT – **REF. NO. EPA**-660/3–73–004
Vanderbilt University Nashville, TN – **REF. NO. EPA**-660/2–73–012
Vanderbilt University Nashville, TN – **REF. NO. EPA**-660/2–74–085
Vanderbilt University Nashville, TN – **REF. NO. EPA**-660/3–75–002
Vermont, State of, Department of Water Resources Montpelier, VT – **REF. NO. EPA**-660/2–74–040
Versar, Inc. Springfield, VA – **REF. NO. EPA**-650/4–73–003
Virginia Institute of Marine Science Gloucester Point, VA – **REF. NO. EPA**-670/2–73–099
Virginia Polytechnic Institute Blacksburg, VA – **REF. NO. EPA**-600/5–73–014
Virginia, University of Charlottesville, VA – **REF. NO. EPA**-670/2–73–030
Walden Research Division of Abcor, Inc. Cambridge, MA – **REF. NO. EPA**-650/2–73–050
Walden Research Division of Abcor, Inc. Walden, MA – **REF. NO. EPA**-650/2–74–039
Walnut Creek Central Control Sanitary District Walnut Creek, CA – **REF. NO. EPA**-670/2–73–064
Walter C. McCrone Associates, Inc. Chicago, IL – **REF. NO. EPA**-650/2–73–024
Washington Environmental Research Center, EPA Washington, DC – **REF. NO. EPA**-600/5–74–012
Washington Environmental Research Center, EPA *Washington, DC* – ***REF. NO. EPA****-600/5–74–017*
Washington Environmental Research Center, Implementation Research Division, EPA Washington, DC – **REF. NO. EPA**-600/5–73–014
Washington Environmental Research Center, Implementation Research Division, EPA Washington, DC – **REF. NO. EPA**-600/5–74–003
Washington State University Pullman, WA – **REF. NO. EPA**-660/2–74–030
Washington, University of Seattle, WA – **REF. NO. EPA**-660/3–73–005
Washington, University of Seattle, WA – **REF. NO. EPA**-660/3–73–008
Washington, University of Seattle, WA – **REF. NO. EPA**-670/2–73–034
Washington, University of Seattle, WA – **REF. NO. EPA**-660/2–74–069
Water Supply Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2–74–067
Water Supply Research Laboratory, EPA Cincinnati, OH – **REF. NO. EPA**-670/2–75–036
Waterloo, University of Waterloo, Ontario, Canada – **REF. NO. EPA**-660/3–73–011
Waterloo, University of Ontario, Canada – **REF. NO. EPA**-660/2–74–082
Waterloo, University of Ontario, Canada – **REF. NO. EPA**-660/2–74–083
Waterloo, University of, Department of Chemical Engineering Waterloo, Ontario, Canada – **REF. NO. EPA**-670/2–74–059
Wave Propagation Laboratory, NOAA/ERL Boulder, CO – **REF. NO. EPA**-650/2–74–113
West Virginia University Morgantown, VA – **REF. NO. EPA**-670/2–73–022
West Virginia University Morgantown, WV – **REF. NO. EPA**-670/2–74–070
West Virginia University Medical Center Morgantown, WV – **REF. NO. EPA**-650/1–74–011
West Virginia University, Department of Chemical Engineering Morgantown, WV – **REF. NO. EPA**-650/2–73–003
West Virginia University, Department of Civil Engineering Morgantown, WV – **REF. NO. EPA**-670/2–73–083
Western Potato Service, Inc. Grand Forks, ND – **REF. NO. EPA**-660/2–74–088
Westinghouse Electric Corporation, Research and Development Center Pittsburgh, PA – **REF. NO. EPA**-670/2–74–017
Westinghouse Research Laboratories Pittsburgh, PA – **REF. NO. EPA**-650/2–73–048a
Westinghouse Research Laboratories Pittsburgh, PA – **REF. NO. EPA**-650/2–73–048b
Westinghouse Research Laboratories Pittsburgh, PA – **REF. NO. EPA**-650/2–73–048c
Westinghouse Research Laboratories Pittsburgh, PA – **REF. NO. EPA**-650/2–73–048d
Westinghouse Research Laboratories Pittsburgh, PA – **REF. NO. EPA**-670/2–73–006
Westinghouse Research Laboratories Pittsburgh, PA – **REF. NO. EPA**-650/2–75–027a

PERFORMING ORGANIZATION INDEX

Westinghouse Research Laboratories Pittsburgh, PA – **REF. NO. EPA**-650/2-75-027b
Wilkes College Wilkes Barre, PA – **REF. NO. EPA**-670/2-75-006
Winter Garden Citrus Products Cooperative Winter Garden, FL – **REF. NO. EPA**-660/2-75-001
Wisconsin, University of Madison, WI – **REF. NO. EPA**-660/3-73-023
Wisconsin, University of Madison, WI – **REF. NO. EPA**-660/3-73-024
Wisconsin, University of Milwaukee, WI – **REF. NO. EPA**-670/2-73-079
Wisconsin, University of Madison, WI – **REF. NO. EPA**-660/2-74-006
Wisconsin, University of Madison, WI – **REF. NO. EPA**-660/3-74-020
Wisconsin, University of Madison, WI – **REF. NO. EPA**-660/3-75-006
Worcester Polytechnic Institute Worcester, MA – **REF. NO. EPA**-670/2-75-031
Worthington Biochemical Corporation Freehole, NJ – **REF. NO. EPA**-650/2-74-044
WAPORA, Inc. Washington, DC – **REF. NO. EPA**-660/2-73-026

PERSONAL AUTHOR INDEX

Agnew, R. W. EPA-670/2-75-019
Ahearn, D. G. EPA-660/3-75-001
Akinbami, S. O. EPA-670/2-73-042
Albrecht, O. W. EPA-670/5-73-021
Albrecht, R. M. EPA-650/1-74-001
Albred, E. R. EPA-670/2-73-051
Aleti, A. EPA-600/5-75-004
Alford, A. L. EPA-660/2-73-013
Alford, A. L. EPA-660/2-74-002
Alford, A. L. EPA-660/2-74-078
Alger, G. R. EPA-660/2-74-018
Allan, G. G. EPA-670/2-73-034
Allen, R. J. EPA-650/4-73-002
Allwood, J. K. EPA-600/5-73-008b
Alspaugh, T. A. EPA-660/2-74-039
Alter, H. EPA-670/2-75-034
Anasoulis, R. F. EPA-650/2-73-045
Anastas, M. Y. EPA-670/2-74-083
Andersen, J. C. EPA-600/5-74-010
Andersen, J. R. EPA-660/2-74-005
Andersland, O. B. EPA-670/2-74-076b
Andersland, O. B. EPA-670/2-74-076a
Anderson, G. E. EPA-650/4-73-001
Anderson, J. L. EPA-660/2-73-012
Andrews, J. F. EPA-670/2-73-061
Antoni, C. M. EPA-670/2-73-065
Appleman, R. EPA-660/3-73-015
Aresco, S. J. EPA-650/2-74-030
Arkle Jr, T. EPA-670/2-74-070
Armento, W. J. EPA-650/2-74-002a
Armstrong, D. E. EPA-660/3-75-006
Armstrong, T. A. EPA-670/2-74-076a
Atkinson, S. E. EPA-600/5-74-003
Ayars, J. EPA-660/2-74-084
Azarraga, L. V. EPA-660/2-73-034
Bagley, M. EPA-600/5-73-009
Baierl, K. W. EPA-660/2-73-030
Bailey, G. W. EPA-660/2-74-017
Baillod, C. R. EPA-660/2-74-018
Baity Jr., F. W. EPA-650/2-74-046b
Baker, D. A. EPA-660/2-74-027
Ball, G. EPA-670/2-73-049
Ballay, J. M. EPA-660/2-73-002
Balouskus, R. A. EPA-670/2-74-023
Bannerman, R. T. EPA-660/3-75-006
Barotz, B. EPA-660/2-73-026
Barbour, J. F. EPA-670/2-74-027
Barker, J. C. EPA-660/2-74-064
Barnett, A. P. EPA-660/2-74-017
Barnett, Jr., J. T. EPA-660/3-75-007
Barrager, S. M. EPA-600/5-73-005
Barrett, J. J. EPA-670/2-74-030
Barry, J. P. EPA-670/2-75-028
Barth, E. F. EPA-670/2-73-101
Barth, J. EPA-680/4-73-002
Barton, J. R. EPA-660/2-75-007
Bartsch, A. F. EPA-660/9-74-002
Bascom, S. B. EPA-600/5-75-002
Bass, T. D. EPA-670/2-74-048
Bateman, T. W. EPA-660/2-74-063
Battista, C. A. EPA-670/2-73-066
Baugham, G. L. EPA-660/3-73-012
Baughman, G. L. EPA-660/3-75-007
Baumgardner Jr., R. E. EPA-650/2-74-046b
Becker, B. C. EPA-660/2-73-035
Becker, B. C. EPA-660/2-74-073
Becker, E. R. EPA-670/2-73-096
Beckers, C. V. EPA-600/5-74-004
Beckman, J. E. EPA-670/2-75-009
Bellar, T. A. EPA-670/4-74-008
Bellar, T. A. EPA-670/4-74-009
Bender, D. F. EPA-670/2-73-001
Benedict, B. A. EPA-660/2-73-012
Benedict, H. M. EPA-650/5-73-002
Bennet, S. M. EPA-670/2-75-008
Bennett, R. S. EPA-660/2-74-084
Bennett, R. S. EPA-660/2-74-052
Bennett, R. S. EPA-660/2-74-049
Benson, A. L. EPA-650/2-73-032
Berg, G. EPA-670/2-73-003
Berg, G. EPA-670/9-74-005
Bergstedt, L. EPA-660/3-75-014
Berkau, E. E. EPA-650/2-73-031
Berkau, E. E. EPA-650/2-73-029
Berkau, E. E. EPA-650/2-74-003
Berkowitz, J. B. EPA-670/2-75-024
Bernstein, S. EPA-660/2-74-025
Berry, B. J. EPA-600/5-75-003
Berry, J. W. EPA-660/2-74-011
Bevege, E. EPA-670/2-75-009
Beyers, R. J. EPA-660/3-73-025
Bhagwat, A. EPA-660/3-73-005
Bhatt, G. EPA-670/2-74-009
Bickelhaupt, E. E. EPA-600/5-73-012d
Bienstock, D. EPA-650/2-74-038
Bildstein, K. EPA-600/5-73-012e
Billedeau, S. M. EPA-650/2-74-068
Bingham, T. H. EPA-600/5-74-009
Bird Jr., A. V. EPA-650/2-73-035
Birks, L. S. EPA-650/2-73-006
Bishop, A. B. EPA-600/5-74-021
Bishop, A. B. EPA-600/5-74-010
Bishop, D. F. EPA-670/2-73-073
Bishop, D. F. EPA-670/2-73-070
Bishop, D. F. EPA-670/2-73-075
Bishop, D. F. EPA-670/2-73-040
Bishop, D. F. EPA-670/2-73-037
Bishop, D. F. EPA-670/2-73-033
Bishop, D. F. EPA-670/2-75-008
Black, A. P. EPA-660/2-74-055
Black, A. P. EPA-660/2-75-006
Blakeslee, C. E. EPA-650/2-73-005
Bode, J. D. EPA-650/2-73-010
Boen, D. F. EPA-670/2-74-077
Boen, D. F. EPA-670/2-75-027
Boettner, E. A. EPA-670/2-73-049
Bolton, R. E. EPA-670/2-74-068
Bolton, R. E. EPA-670/2-74-038
Bond, R. G. EPA-670/2-73-048
Bond, R. G. EPA-670/5-73-020
Bonz, P. E. EPA-670/2-73-069
Boone, J. E. EPA-650/2-73-012
Booth, R. L. EPA-670/4-74-002
Borgos, J. A. EPA-650/2-73-022
Bories, D. B. EPA-660/2-73-026
Borror, A. C. EPA-660/3-74-031
Bott, T. EPA-660/2-75-008
Bourquin, A. W. EPA-660/3-75-001
Bowman, M. M. EPA-660/3-75-004
Boyd, W. W. EPA-670/2-74-084
Bradford, R. R. EPA-660/2-74-033
Bradshaw, J. S. EPA-660/2-75-007
Bradway, R. EPA-650/2-74-036
Bragg, G. M. EPA-660/2-74-083
Brand, B. G. EPA-670/2-74-014
Braughan, D. A. EPA-670/2-74-083
Braughan, D. A. EPA-670/2-74-084
Brauhn, J. L. EPA-660/3-75-011
Brezonik, P. L. EPA-660/3-73-002
Bricewell, L. EPA-660/3-74-016
Broadfoot, W. J. EPA-600/2-75-006

PERSONAL AUTHOR INDEX

Brommenschenkel Jr., F. EPA-660/2-74-034
Brooks, N. G. EPA-660/3-73-010
Brown, J. C. EPA-670/2-73-047b
Brown, J. C. EPA-670/2-73-047a
Brown, J. W. EPA-650/2-73-029
Brows, D. EPA-670/2-74-095b
Bruckner, B. H. EPA-680/4-73-002
Bujak, P. EPA-600/5-73-012e
Burch, D. E. EPA-650/2-73-030
Burchfiled, H. P. EPA-650/2-74-068
Burchinal, J. C. EPA-670/2-73-083
Burns, R. EPA-670/2-74-003
Burton, J. EPA-660/2-74-007
Byerley, J. J. EPA-670/2-74-059
Caldwell, E. EPA-650/1-74-004
Caldwell, E. EPA-650/4-74-008
Callaway, R. J. EPA-660/3-73-014
Callihan, C. D. EPA-670/2-73-095
Calvert, S. EPA-650/2-73-036
Campbell, T. L. EPA-670/2-73-103
Canter, L. EPA-660/2-74-037
Capper, J. EPA-670/2-74-044
Carawan, R. E. EPA-660/2-74-031
Cardin, F. A. EPA-670/5-74-004
Carlson, D. A. EPA-670/2-74-061
Carlson, O. N. EPA-670/2-73-091
Carpenter, B. H. EPA-650/2-74-097
Carroll, J. EPA-600/5-74-032
Carter, S. EPA-600/5-73-016
Case, O. P. EPA-670/2-74-008
Case, P. O. EPA-670/2-75-029
Cass, R. EPA-650/2-74-036
Cassel, A. H. EPA-670/2-73-040
Caster, R. EPA-660/3-74-016
Chagy, Y. C. EPA-660/2-73-029
Chamberlain, S. G. EPA-600/5-74-004
Chambers, M. D. EPA-600/5-74-021
Chan, F. K. EPA-650/2-74-072
Chang, N. L. EPA-660/2-73-030
Chansky, S. EPA-600/5-74-032
Charlie, W. A. EPA-670/2-74-076b
Chase, G. EPA-670/2-74-044
Chasse, J. EPA-660/2-73-001
Chatterjee, S. EPA-600/5-74-016
Chaung, S. C. EPA-660/3-74-004b
Chernoff, N. EPA-650/1-73-001
Cherry, Jr., R. H. EPA-670/2-75-018
Chesness, J. L. EPA-660/2-74-064
Chin, F. Y. EPA-600/5-75-004
Choi, P. EPA-600/2-74-001
Christianson, A. G. EPA-660/2-73-016
Christianson, C. B. EPA-660/2-74-070
Chung, J. EPA-650/2-73-027
Citron, R. EPA-600/4-75-001
Clar, M. L. EPA-660/2-74-071
Clark, D. A. EPA-660/2-74-038
Clark, D. A. EPA-660/2-74-065
Clark, M. J. EPA-670/2-75-019
Clark, R. M. EPA-670/1-74-001
Clark, R. M. EPA-670/2-74-067
Clark, R. M. EPA-670/5-73-012
Clements, E. V. EPA-660/2-74-075
Clesceri, N. L. EPA-660/3-73-003
Clesceri, N. L. EPA-670/2-74-063
Cliese, J. D. EPA-660/2-74-060
Cobian, K. E. EPA-660/2-73-033
Cochran, R. A. EPA-670/2-73-084
Cohen, I. M. EPA-660/2-74-053
Cohen, S. EPA-670/2-74-071
Cohn, M. M. EPA-670/2-74-026
Cohn, M. M. EPA-670/2-74-039
Cohn, S. EPA-600/5-73-015
Cole, C. A. EPA-670/2-73-033
Collins, A. G. EPA-660/2-74-010
Collins, D. C. EPA-650/4-74-001
Collins, J. EPA-660/2-74-069
Colston, N. V. EPA-670/2-74-096
Conden Jr., R. L. EPA-670/2-73-024
Conner, W. EPA-650/2-74-013
Converse, A. O. EPA-670/2-73-011
Cooley, A. M. EPA-660/2-74-093
Cooley, P. C. EPA-600/5-74-009
Cooper, D. EPA-600/5-74-016
Cooper, K. G. EPA-600/5-75-002
Cooper, P. C. EPA-600/5-73-012c
Counts, C. A. EPA-670/2-75-012
Coursey, J. F. EPA-650/2-74-004
Courtney, K. D. EPA-650/1-73-001
Coutts, H. J. EPA-660/2-74-070
Cox, M. F. EPA-660/3-74-021
Craig, S. E. EPA-650/2-74-046a
Crawford, N. H. EPA-660/2-74-013
Crites, R. W. EPA-660/2-73-006b
Crites, R. W. EPA-660/2-73-006a
Crosswhite, W. M. EPA-660/2-74-031
Crowder, D. G. EPA-670/2-73-067
Cruver, J. E. EPA-670/2-75-009
Csanady, G. T. EPA-660/2-74-083
Csanady, G. T. EPA-660/2-74-082
Csanady, G. T. EPA-660/3-73-011
Cummings, F. H. EPA-600/5-74-018
Currier, R. A. EPA-670/2-73-005
Curtin, C. EPA-650/2-73-050
Cushing, K. M. EPA-650/2-73-035
Cutkomp, L. K. EPA-660/2-73-027
Cyr, J. W. EPA-660/2-74-088
Dalrymple, R. J. EPA-670/2-75-011
Daly, W. H. EPA-670/2-75-032
Damron, B. L. EPA-660/2-75-001
Dangel, R. A. EPA-670/2-75-036
Daniels, S. L. EPA-670/2-73-103
Darling, J. E. EPA-670/2-75-022
Daul, F. R. EPA-660/2-74-012
Davanzo, A. C. EPA-670/2-75-020
Davenport, C. V. EPA-660/2-73-005
Davis, A. E. EPA-600/2-74-003
Dawson, G. W. EPA-670/2-73-078
Day, D. E. EPA-670/2-73-038
De Primo, M. J. EPA-670/2-73-098
Dearby, R. L. EPA-670/4-74-003a
Decker, C. E. EPA-650/2-74-019
Demerjian, K. L. EPA-650/3-73-002
Demeter, J. EPA-650/2-74-038
Dennis, R. EPA-650/2-74-036
Derrington, R. E. EPA-670/2-73-060
DeBose, A. T. EPA-660/2-74-055
DeDecker, F. J. EPA-670/2-75-010
DeLuca, F. A. EPA-660/2-74-056
DeLucia, R. J. EPA-600/5-74-030
DeLucia, R. J. EPA-600/5-75-001
DeWitt, Jr., F. A. EPA-670/2-75-003
Dickson, E. M. EPA-600/2-74-002
Diesch, S. L. EPA-670/2-73-051
Dimouro, P EPA-650/2-73-009
Ditoro, D. M. EPA-660/3-73-009
Ditsworth, G. R. EPA-660/3-73-014
Dixon, P. S. EPA-660/3-73-015
DiToro, D. M. EPA-660/3-75-005
Dodds, H. EPA-650/2-73-009
Donigian, A. S. EPA-660/2-74-013
Dorion, G. EPA-660/2-74-074
Dornbusch, D. M. EPA-600/5-73-005
Dornbush, J. N. EPA-660/2-74-005
Dorough, U. W. EPA-650/1-74-002

PERSONAL AUTHOR INDEX

Dostal, K. A. EPA-660/2-74-058
Douglas, G. EPA-660/2-73-037
Downing, P. B. EPA-600/5-73-014
Doyle, A. EPA-650/2-73-023
Doyle, F. J. EPA-670/2-74-009
Doyle, J. R. EPA-670/2-75-022
Drake, J. A. EPA-650/2-73-014
Driscoll, J. EPA-650/2-73-050
Drost-Hansen, W. EPA-660/3-74-003
Duchene, A. G. EPA-670/5-74-001
Duffee, R. A. EPA-650/2-74-008a
Dugal, H. S. EPA-660/2-74-029
Duncan, L. J. EPA-600/2-74-004
Dunlap, C. E. EPA-670/2-73-095
Dunlap, W. J. EPA-660/2-73-014
Durfre, R. L. EPA-650/4-73-003
Duvall, D. S. EPA-670/2-75-033d
Duvall, D. S. EPA-670/2-75-033b
Duvall, D. S. EPA-670/2-75-033a
Duvall, D. S. EPA-670/2-75-033c
Edinger, J. EPA-660/2-74-053
Ehreth, D. J. EPA-670/9-75-004
Eilers, R. G. EPA-670/2-73-046
Eilers, R. G. EPA-670/2-73-045
Eilers, R. G. EPA-670/2-73-044
Eilers, R. G. EPA-670/2-74-069
Eisenmann, J. L. EPA-670/2-73-076
Elfers, K. EPA-600/5-73-015
Eliassen, R. EPA-670/2-73-010
Ellis, W. J. EPA-660/2-74-057
Emerson, D. B. EPA-660/2-73-035
Emerson, M. J. EPA-600/5-73-008a
Englebrecht, R. S. EPA-670/2-73-082
Enns, K. EPA-670/2-74-059
Epstein, M. EPA-650/2-73-013
Epstein, M. EPA-650/2-74-010
Erickson, A. E. EPA-660/2-74-057
Erley, D. EPA-600/5-75-005
Ernst, E. EPA-670/5-75-001
Ernst, U. F. EPA-600/5-74-018
Evans, W. E. EPA-650/4-73-002
Everson, T. C. EPA-660/2-74-025
Falkenborg, D. H. EPA-670/9-75-004
Falter, C. M. EPA-660/3-73-017
Farmer, W. J. EPA-660/2-74-054
Farnham, W. B. EPA-660/2-74-040
Farquhar, J. EPA-660/2-74-075
Farrah, S. R. EPA-670/2-74-018
Farrell, J. B. EPA-670/2-75-013
Farrell, P. J. EPA-660/2-73-010
Felder, M. EPA-600/5-73-012a
Feldman, M. H. EPA-660/3-73-013
Fensterstock, J. C. EPA-600/5-74-015
Fenters, J. D. EPA-650/1-73-002
Ferens, M. C. EPA-660/3-73-022
Ferguson, R. A. EPA-650/2-73-037
Ferguson, T. L. EPA-660/2-74-094
Field, R. EPA-670/2-73-059
Field, R. EPA-670/2-74-090
Finger, R. E. EPA-670/2-74-061
First, M. W. EPA-670/2-73-017
Fischer, J. R. EPA-660/2-74-036
Fisette, G. R. EPA-670/2-74-066
Fisher, J. H. EPA-660/2-74-028
Fisk, A. T. EPA-670/2-74-020
Fitzgerald, G. P. EPA-660/3-73-023
Flegal, C. A. EPA-650/2-74-025
Fleischer, L. R. EPA-670/2-73-006
Flinn, J. E. EPA-600/5-74-005
Fober, H. A. EPA-660/2-73-020
Fogel, M. E. EPA-600/5-74-009
Fookson, A. EPA-670/2-73-052
Foran, J. F. EPA-670/2-74-024A
Foran, J. F. EPA-670/2-74-024B
Fordyce, I. V. EPA-660/2-74-093
Forso, K. EPA-660/2-74-069
Foster, D. H. EPA-670/2-73-082
Francesco, D. E. EPA-670/2-73-047b
Francey, G. J. EPA-670/2-75-002
Franco, N. B. EPA-670/2-74-023
Frank, C. EPA-660/9-74-002
Fraser, J. P. EPA-670/2-73-084
Frast, M. EPA-600/5-73-016
Freed, V. H. EPA-670/2-74-027
Freeman III, A. M. EPA-600/5-74-029
Fremount, H. A. EPA-660/2-73-019
Frohnsdorff, G. EPA-670/2-73-052
Frost, R. R. EPA-650/2-73-044
Fryer, J. L. EPA-660/3-73-020
Fuhriman, D. K. EPA-660/2-75-007
Fullerton, H. H. EPA-600/5-74-021
Funkhouser, J. T. EPA-650/2-73-023
Gaby, W. L. EPA-670/2-75-023
Gahler, A. R. EPA-660/3-74-015
Gales, M. E. EPA-670/4-74-002
Garner, W. EPA-670/2-74-048
Gass, P. J. EPA-600/5-74-008
Gaufin, A. R. EPA-660/3-73-004
Gaufin, A. R. EPA-660/3-74-023
Gehrs, C. W. EPA-660/3-74-006
Geinapolos, A. EPA-670/2-74-025
Gerber, N. N. EPA-670/2-74-094
Gerhard, J. EPA-650/3-74-009
Giever, P. EPA-650/2-73-023
Gilfrich, J. V. EPA-650/2-73-006
Gillean, J. I. EPA-670/5-73-012
Gillett, J. W. EPA-660/3-74-024
Gillmeister, R. J. EPA-650/2-74-046b
Glasser, W. G. EPA-660/2-74-069
Glueckert, A. J. EPA-670/2-75-007
Goddard, H. C. EPA-670/1-74-001
Goldman, C. R. EPA-660/3-74-034
Goldschmidt, V. W. EPA-660/3-74-004b
Goldschmidt, V. W. EPA-660/3-74-004a
Goldshmid, J. EPA-650/2-73-036
Goldsmith, R. L. EPA-660/2-73-019
Gordon, R. C. EPA-660/2-73-005
Gorman, P. G. EPA-600/5-74-007
Gove, C. S. EPA-670/2-73-065
Gram, A. L. EPA-660/2-73-022
Grant, F. EPA-660/2-74-034
Gratzl, J. S. EPA-650/2-74-005
Gratzl, J. S. EPA-660/2-74-069
Gray, A. F. EPA-660/2-74-036
Gray, R. A. EPA-650/2-74-046b
Green, A. C. EPA-670/2-74-056
Green, E. E. EPA-650/2-74-068
Green, O. EPA-670/2-73-103
Greening, E. D. EPA-670/2-73-082
Gresswell, R. E. EPA-660/3-73-019
Grethlein, H. E. EPA-670/2-73-011
Griffin, L. I. EPA-650/2-74-035
Grim, E. C. EPA-670/2-74-093
Grimsley, D. H. EPA-600/5-73-012d
Groner, R. R. EPA-670/2-74-027
Groseclose, J. L. EPA-670/2-73-098
Grossman, D. S. EPA-670/2-75-026b
Grossman, D. S. EPA-670/2-75-026a
Grube Jr, W. E. EPA-670/2-74-070
Grupenhoff, B. L. EPA-670/2-74-067
Gumtz, G. D. EPA-670/2-73-068
Gumtz, G. D. EPA-670/2-74-013
Gumtz, G. D. EPA-670/2-74-097
Guttman, J. EPA-600/5-73-012b

PERSONAL AUTHOR INDEX

Guzdar, A. R. EPA-670/2-74-020
Guzdar, A. R. EPA-670/2-74-019
Guzdar, A. R. EPA-670/2-74-021
Haderlie, E. E. EPA-660/3-75-013
Hais, A. B. EPA-670/2-73-073
Hais, A. B. EPA-670/2-75-008
Hale, A. M. EPA-660/2-74-083
Hall, C. F. EPA-670/2-73-041
Hall, E. EPA-600/2-74-001
Hall, E. D. EPA-670/2-73-044
Hall, E. D. EPA-670/2-73-045
Hall, E. D. EPA-670/2-73-046
Hall, R. E. EPA-650/2-73-031
Hall, R. E. EPA-650/2-74-003
Halligan, J. E. EPA-660/2-74-090
Hamersma, J. W. EPA-650/2-74-025
Hamil, H. F. EPA-650/4-74-022
Hamil, H. F. EPA-650/4-74-021
Hammer Jr., P. G. EPA-600/5-73-007
Hammond, V. L. EPA-670/2-75-014
Hanks, R. J. EPA-660/2-75-005
Hansen, C. A. EPA-670/2-75-019
Hansen, C. M. EPA-660/2-74-057
Happel, J. EPA-650/2-73-020
Hardin, B. D. EPA-660/3-74-006
Hare, C. P. EPA-670/2-74-092
Harmon, D. J. EPA-670/9-73-056
Harms, L. L. EPA-660/2-74-005
Harrington, J. EPA-600/5-74-020
Harris, R. F. EPA-660/3-75-006
Harstkatte Jr., G. A. EPA-670/2-73-064
Harvey, R. D. EPA-650/2-73-044
Hatch, L. T. EPA-660/2-73-036
Hawkins, B. K. EPA-660/2-74-031
Haynie, F. H. EPA-650/3-74-009
Hazen, T. E. EPA-660/2-74-009
Heaney, J. P. EPA-600/5-74-013
Heaney, J. P. EPA-670/2-75-022
Heaney, J. P. EPA-670/2-75-017
Hebert, R. EPA-650/2-73-050
Heble, L. R. EPA-660/2-73-010
Hecht, N. L. EPA-670/2-75-033a
Hecht, N. L. EPA-670/2-75-033c
Hecht, N. L. EPA-670/2-75-033d
Hecht, N. L. EPA-670/2-75-033b
Heenan, A. T. EPA-670/2-74-024A
Heenan, A. T. EPA-670/2-74-024B
Heeney, J. M. EPA-670/2-74-043
Heimburg, R. W. EPA-670/2-73-087
Hein, C. J. EPA-600/5-74-024
Helmers, A. E. EPA-660/3-74-009
Hemphill, D. P. EPA-670/2-73-084
Henson, L. J. EPA-600/2-75-006
Herkert, E. C. EPA-670/2-73-071
Herzog, K. L. EPA-660/2-74-090
Heukelekian, H. EPA-670/2-73-027
Hicks, H. C. EPA-660/2-73-023
Hill IV, J. EPA-660/3-74-024
Hill, R. D. EPA-670/2-74-093
Himmelstein, H. L. EPA-600/5-73-012b
Hnatow, M. EPA-650/2-73-020
Hodd, S. L. EPA-670/2-75-011
Hoffman, D. A. EPA-670/2-73-039
Hoffman, L. EPA-650/2-74-030
Hogan, C. M. EPA-660/2-73-003
Hoke, R. C. EPA-650/2-74-001
Holdren, G. C. EPA-660/3-75-006
Holm, H. W. EPA-660/3-73-007
Holm, H. W. EPA-660/3-74-021
Holm, R. A. EPA-660/2-73-030
Holvec, I. EPA-670/2-73-081
Honack, P. EPA-670/2-73-071
Hong, S. EPA-670/2-74-035B
Hoover, A. W. EPA-650/1-74-001
Hoover, T. B. EPA-660/4-75-001
Hopkins, H. T. EPA-660/2-74-071
Horne, R. EPA-670/2-75-024
Hornsback, K. E. EPA-600/5-74-011
Horowitz, A. EPA-650/4-74-001
Horsnback, K. E. EPA-600/5-73-012b
Hortenstine, C. C. EPA-670/2-73-063
Horton, W. EPA-600/5-73-012e
Hosenfeld, J. M. EPA-650/1-74-003
Householder, M. K. EPA-660/2-73-032
Howell, M. P. EPA-600/5-75-002
Howes, J. R. EPA-670/2-73-041
Hoyland, J. R. EPA-660/2-74-004
Hoyland, J. R. EPA-660/2-74-048
Hoyt, A. EPA-650/2-75-003
Hrutfiord, B. F. EPA-660/2-74-069
Hubber, C. O. EPA-670/2-73-079
Huber, W. C. EPA-600/5-74-013
Huber, W. C. EPA-670/2-75-017
Huber, W. C. EPA-670/2-75-022
Hudson, J. F. EPA-670/2-75-026b
Hudson, J. F. EPA-670/2-75-026a
Hufschmidt, M. M. EPA-600/5-73-015
Hughes Jr., E. E. EPA-600/2-74-002
Humbel, D. E. EPA-660/2-73-017
Hunt, G. W. EPA-660/3-74-006
Ifeader, C. EPA-600/5-74-016
Iglar, A. F. EPA-670/2-73-048
Ingersoll, R. B. EPA-650/2-73-043
Irwin, W. A. EPA-600/5-74-026
Irwin, W. A. EPA-600/5-74-025
Iura T. EPA-650/2-73-014
Jabb, D. C. EPA-660/3-74-014
Jackson, K. EPA-660/2-74-087
Jacob, B. L. EPA-660/2-74-019
Jacobs, T. O. EPA-670/2-73-086
Jahnig, C. E. EPA-650/2-74-009a
Jaksch, J. A. EPA-600/5-74-017
Jarmuth, R. A. EPA-660/2-73-023
Jaryinen, A. W. EPA-660/3-74-024
Jaworski, E. EPA-660/3-74-029
Jaye, F. EPA-650/2-74-013
Jedlicka, C. EPA-660/2-73-004
Jhaveri, N. EPA-650/2-73-036
Johannsen, G. L. EPA-670/2-75-027
Johannson, G. L. EPA-670/2-74-077
Johanson, L. N. EPA-660/2-74-069
Johns, F. B. EPA-680/4-75-001
Johnson, D. E. EPA-650/1-74-003
Johnson, L. D. EPA-650/2-74-050
Johnson, T. E. EPA-650/2-74-012
Johnson, W. B. EPA-650/4-73-002
Johnston, D. R. EPA-600/5-74-009
Johnston, H. S. EPA-650/4-74-004
Jokela, A. EPA-600/5-74-023
Jolley, R. EPA-660/2-74-076
Jones, I. S. F. EPA-660/2-74-082
Jones, R. H. EPA-660/2-75-001
Jones, R. S. EPA-660/3-73-005
Jordan, D. M. EPA-670/2-74-097
Jordening, D. L. EPA-600/5-74-028
Jordening, D. L. EPA-600/5-74-014
Jordening, D. L. EPA-600/5-73-008a
Jordening, D. L. EPA-600/5-73-008b
Jorgensen, R. EPA-600/5-74-019
Jorque, M. A. EPA-660/2-74-077
Joyce, J. M. EPA-670/2-74-037
Julian, E. C. EPA-670/4-75-004a
Julian, E. C. EPA-670/4-75-004b
Justice, C. A. EPA-660/3-73-015

PERSONAL AUTHOR INDEX

Kah, R. C.Y. EPA-660/2-73-029
Kaiser, E. J. EPA-600/5-73-015
Kaiser, E. L. EPA-670/2-73-023
Kalfadelis, C. D. EPA-650/2-74-009b
Kambhu, K. EPA-670/2-73-061
Kania, H. J. EPA-660/3-73-025
Kaplovsky, A. J. EPA-670/2-73-027
Karandikar, S. EPA-670/2-73-011
Kardos, L. T. EPA-660/2-74-016
Kardos, L. T. EPA-660/2-74-003
Karuvian, J. F. EPA-680/4-74-002
Katz, S. EPA-660/2-74-076
Kaufman, J. A. EPA-670/2-75-031
Keeney, D. R. EPA-660/3-73-024
Keier, P. M. EPA-670/2-74-037
Keitz, E. L. EPA-600/2-74-004
Kelly, J. A. EPA-670/2-73-030
Kendall, D. A. EPA-650/2-73-025
Kenney, B. C. EPA-660/2-74-082
Kent, G. C. EPA-670/2-74-067
Kern, P. L. EPA-670/2-75-016
Kesselring, R. C. EPA-650/2-74-023
Ketchum, L. A. EPA-670/2-74-047
Keys, J. M. EPA-600/5-74-024
Kimmelstein, B. EPA-600/5-73-012e
Kincannon, B. EPA-600/5-74-032
King, A. H. EPA-660/2-73-018
King, L. G. EPA-660/2-75-005
Kingston, J. C. EPA-660/3-75-004
Kirchmer, C. J. EPA-660/2-74-021
Kittelson, D. B. EPA-650/3-73-002
Klein, D. H. EPA-660/2-73-008
Knudson, W. EPA-660/2-74-088
Kobayashi, S. EPA-670/2-74-063
Kocmond, W. C. EPA-650/3-73-002
Koehrsen, L. G. EPA-660/2-74-014
Koogler, J. B. EPA-650/2-73-007
Kopp Jr., C. V. EPA-660/2-73-033
Koppel, L. M. EPA-600/5-75-001
Kos, P. EPA-670/2-74-037
Kraft, M. L. EPA-650/2-74-025
Krajeski, E. P. EPA-600/2-74-004
Kramer, M. EPA-670/2-74-078
Krause, H. H. EPA-670/2-74-083
Krause, H. H. EPA-670/2-74-084
Kreusch, E. EPA-660/2-74-007
Kroner, R. C. EPA-670/4-74-008
Krope, E. EPA-600/2-74-001
Krueger, W. F. EPA-670/2-73-041
Kuhner, J. EPA-670/2-74-038
Kuhner, J. EPA-670/2-74-065
Kuhner, J. EPA-670/2-74-068
Kuhrtz, S. EPA-670/2-73-011
Kurg, E. K. EPA-670/2-74-043
Kursch, S. J. EPA-600/5-73-012c
La Rosa, P. J. EPA-670/2-74-001
Lackey, L. L. EPA-670/2-73-086
Lager, J. A. EPA-670/2-74-040
Lager, J. A. EPA-670/2-74-090
Lakomski, T. D. EPA-670/2-74-091
Lamb, J. C. EPA-670/2-73-047b
Lancy, L. E. EPA-670/2-75-015
Landreth, R. EPA-670/2-75-005
Landreth, R. E. EPA-670/2-74-088
Lang, E. W. EPA-660/2-75-004
Larson, D. H. EPA-650/2-73-033b
Larson, D. H. EPA-650/2-73-033a
Larson, R. EPA-660/2-75-008
Larson, T. E. EPA-670/2-73-029
Lassiter, R. R. EPA-660/3-75-012
Laster, L. L. EPA-650/2-73-046
Lauch, R. P. EPA-670/4-74-007
Lauch, R. P. EPA-670/4-75-001
Lauch, R. P. EPA-670/4-75-003
Laughlin, J. E. EPA-670/2-73-060
Laver, M. L. EPA-670/2-73-005
Lavergne, E. A. EPA-600/2-74-006
Lawhon, W. EPA-600/5-74-016
LaBeau, B. EPA-670/2-73-103
Leary, R. D. EPA-670/2-73-050
Leatherwood, J. M. EPA-670/2-73-090
Leckie, J. O. EPA-670/2-73-010
Lee J. H. EPA-660/3-75-015
Lee, A. A. EPA-650/2-74-025
Lee, S. H. EPA-670/2-73-082
Lee, W. L. EPA-660/3-75-013
Leekley, R. M. EPA-660/2-74-029
Leiro, C. C. EPA-650/2-74-010
Leith, D. EPA-650/2-73-036
Lemer, A. EPA-600/5-74-001
Lenny, J. EPA-660/2-74-054
Leonard, J. W. EPA-670/2-74-002
Levia, J. E. EPA-660/2-73-026
Levins, P. L. EPA-650/2-73-032
Levins, P. L. EPA-650/2-73-025
Levins, P. L. EPA-650/2-73-023
Levins, P. L. EPA-670/2-74-086
Levis, A. H. EPA-670/2-75-030
Lewis, C. S. EPA-600/5-73-012d
Lewis, D. H. EPA-600/5-74-003
Lewis, D. L. EPA-660/3-75-007
Lewis, P. A. EPA-670/4-74-006
Lewis, R. F. EPA-670/9-75-004
Lezenga, D. R. EPA-660/3-74-028
Libby Jr., K. EPA-670/2-74-044
Lichtenberg, J. J. EPA-670/4-74-009
Lichtenberg, J. J. EPA-670/4-74-008
Liebman, J. C. EPA-670/2-74-036A
Lillard, D. A. EPA-660/4-75-002
Lippert, T. E. EPA-670/2-74-017
Liroff, R. A. EPA-600/5-74-025
Liroff, R. A. EPA-600/5-74-026
Liskowitz, J. W. EPA-670/2-75-002
Little, L. W. EPA-670/2-73-047b
Little, R. L. EPA-670/4-74-003a
Liu, D. H. W. EPA-660/2-74-036
Llewellyn, L. EPA-600/5-73-012a
Loehu, P. Y. EPA-660/2-74-063
Lotspeich, F. B. EPA-660/3-74-009
Lovell, H. L. EPA-670/2-73-093
Lowe, R. L. EPA-670/4-74-005
Ludwig, C. B. EPA-650/2-73-026
Ludwig, F. L. EPA-650/3-73-001
Lueck, B. F. EPA-660/2-73-030
Luecke, D. F. EPA-600/5-75-001
Lund, D. B. EPA-660/2-74-006
Lunsford, J. H. EPA-650/3-74-006
Macon, J. EPA-660/2-74-031
MacIntyre, W. G. EPA-670/2-73-099
Magee, E. M. EPA-650/2-74-009a
Magee, E. M. EPA-650/2-74-009b
Maher, M. EPA-670/2-74-049
Mahida, V. U. EPA-670/2-75-010
Maigetter, R. Z. EPA-650/1-73-002
Makrides, A. C. EPA-600/5-75-002
Malisch, W. R. EPA-670/2-73-038
Manabe, R. EPA-660/2-73-039
Mancuso, R. L. EPA-650/3-73-001
March, F. EPA-670/2-75-024
Marcus, H. J. EPA-660/2-74-036
Marks, D. H. EPA-670/2-75-026b
Marks, D. H. EPA-670/2-75-026a
Marrone, W. A. EPA-650/2-74-008a
Marshall, D. W. EPA-670/2-74-076b

PERSONAL AUTHOR INDEX

Marshall, H. E. EPA-600/5-74-031
Martel, C. J. EPA-670/2-74-065
Martin, D. B. EPA-660/3-75-010
Martin, E. J. EPA-670/2-74-013
Martin, E. J. EPA-670/2-74-073
Martin, G. B. EPA-650/2-73-031
Martin, K. L. EPA-660/2-73-017
Mason, G. J. EPA-670/2-74-061
Massaro, E. J. EPA-660/3-74-027
Massucco, A. A. EPA-650/2-73-032
Matthew, F. L. EPA-670/2-73-088
Maudlin, A. F. EPA-660/2-74-061
Maxwell, M. A. EPA-650/2-73-038
Mayes, J. EPA-670/2-74-057
McCain, J. D. EPA-650/2-73-035
McCain, J. D. EPA-650/2-74-028
McCall, A. C. EPA-660/2-73-034
McCann, C. EPA-650/2-74-038
McCann, R. A. EPA-650/2-74-011
McCarthy, J. L. EPA-660/2-74-069
McCauley, B. EPA-660/9-74-001
McClenny, W. A EPA-650/2-74-046b
McCoy, J. EPA-650/2-73-023
McDermott, R. G. EPA-670/5-73-021
McDonald, H. EPA-650/2-73-045
McElroy, A. D. EPA-600/5-75-004
McElroy, S. W. EPA-600/5-74-020
McGarvey, R. J. EPA-670/2-74-001
McGlamery, G. G. EPA-600/2-75-006
McIlhenny, W. F. EPA-660/3-74-019
McIlhenny, W. F. EPA-660/3-73-006
McIntyre, C. EPA-670/2-74-015
McKean, W. T. EPA-650/2-74-005
McKee, H. C. EPA-660/3-74-026
McKee, M. EPA-600/5-74-021
McMahon, T. S. EPA-670/2-74-053
McMichael, W. F. EPA-670/2-74-011
McMichael, W. F. EPA-670/2-74-006
McMichael, W. F. EPA-670/2-74-010
McMichael, W. F. EPA-670/2-75-001
McNabb, J. F. EPA-660/2-73-014
McNelis, D. N. EPA-680/4-74-001
Meadows, E. U. EPA-650/2-73-007
Meakin, J. D. EPA-650/2-73-016
Medina, M. A. EPA-670/2-75-017
Medina, M. A. EPA-670/2-75-022
Meier, P. M. EPA-670/2-74-038
Meier, P. M. EPA-670/2-74-066
Meier, P. M. EPA-670/2-74-065
Meier, P. M. EPA-670/2-74-068
Meisel, W. S. EPA-650/4-74-001
Mekinda, M. EPA-660/2-74-083
Meloy, T. P. EPA-670/2-73-068
Melvin, P. EPA-670/2-75-003
Mercer, B. W. EPA-670/2-73-078
Mercer, W. A. EPA-660/2-74-091
Merritt, L. B. EPA-660/2-75-007
Merryman, L. EPA-660/2-75-003
Meyer, C. F. EPA-600/4-73-001b
Meyers, R. A. EPA-650/2-74-025
Meyers, S. P. EPA-660/3-75-001
Middlebrooks, E. J. EPA-670/9-75-004
Milgrom, J. EPA-670/5-74-003
Miller Jr., H. H. EPA-660/2-74-011
Miller, B. F. EPA-670/2-73-009
Miller, C. J. EPA-650/5-73-002
Miller, D. W. EPA-660/2-74-056
Miller, E. C. EPA-660/2-74-057
Miller, P. D. EPA-670/2-73-032
Miller, R. H. EPA-670/2-74-074
Miller, R. L. EPA-660/2-75-004
Mills, T. R. EPA-660/2-74-071
Miner, J. R. EPA-660/2-74-009
Miner, J. R. EPA-660/2-74-023
Miner, J. R. EPA-670/2-73-025
Minton, G. L. EPA-670/2-74-061
Mitchell, R. C. EPA-670/2-73-031
Miura, R. EPA-660/2-74-021
Moffa, P. E. EPA-670/2-75-021
Moghissi, A. A. EPA-680/4-74-001
Mole, J. W. EPA-670/2-74-036B
Molvar, A. E. EPA-670/2-73-104
Molvar, A. E. EPA-670/2-74-087
Monaghan, D. A. EPA-670/2-74-021
Moomau, H. F. EPA-670/2-74-002
Moore, D. O. EPA-650/2-74-012
Moore, J. EPA-600/5-74-016
Moore, J. G. EPA-600/5-73-011
Moore, R. V. EPA-660/2-74-045
Morgan, D. R. EPA-650/2-74-046a
Morin, D. C. EPA-670/2-75-011
Mornea, G. A. EPA-670/2-74-030
Morrison, D. E. EPA-600/5-74-011
Morrison, J. E. EPA-670/2-73-074
Morrison, S. M. EPA-660/2-73-017
Morrow, J. E. EPA-660/3-73-018
Moyer, J. E. EPA-660/2-74-065
Moyer, J. E. EPA-660/2-74-066
Mrosla, E. EPA-660/3-75-014
Mudge, L. K. EPA-670/2-75-014
Mueller, H. F. EPA-670/2-73-029
Mullen, K. T. EPA-600/4-75-001
Munday, J. C. EPA-670/2-73-099
Murfee, G. EPA-660/2-73-025b
Murphy, J. S. EPA-600/2-74-007
Murphy, J. S. EPA-600/2-75-005
Myers, E. EPA-660/2-74-016
Myranowski, J. A. EPA-600/5-74-018
Nader, J. S. EPA-650/2-74-013
Narbozgi, A. D. EPA-660/2-73-020
Nash, C. E. EPA-660/3-75-015
Nawrocki, M. A. EPA-600/2-73-002
Nawrocki, M. A. EPA-660/2-73-035
Nawrocki, M. A. EPA-660/2-74-072
Nawrocki, M. A. EPA-660/2-74-071
Nawrocki, M. A. EPA-660/2-74-073
Neel, J. K. EPA-660/3-73-001
Neher, M. B. EPA-660/2-74-048
Nelson Jr., A. C. EPA-650/4-74-005a
Nelson, D. EPA-660/2-74-043
Nelson, G. R. EPA-660/2-74-089
Nelson, O. F. EPA-670/2-75-019
Nesbitt, J. EPA-660/2-74-016
Neshein, E. E. EPA-670/2-73-088
Neveril, R. B. EPA-670/2-74-043
Newher, M. B. EPA-660/2-74-004
Newport, B. D. EPA-660/2-74-066
Novotny, J. F. EPA-660/3-75-010
Nutkis, M. S. EPA-650/2-74-001
O'Brien, P. J. EPA-670/2-74-086
O'Connor, D. J. EPA-660/3-73-009
O'Farrell, T. P. EPA-670/2-73-040
O'Grady, T. J. EPA-670/2-74-091
O'Herron, R. J. EPA-670/4-73-018
O'Herron, R. J. EPA-670/4-74-001
O'Melia, C. R. EPA-670/2-74-032
Oberacker, D. A. EPA-670/2-75-025
Ogea, J. EPA-660/2-73-018
Ojala, C. EPA-660/3-74-029
Olsen, M. B. EPA-600/5-73-012d
Ongerth, R. H. EPA-670/5-74-005
Ottinger, R. S. EPA-670/2-73-053C
Ottinger, R. S. EPA-670/2-73-053O
Ottinger, R. S. EPA-670/2-73-053A-P

PERSONAL AUTHOR INDEX

Ottinger, R. S. EPA-670/2-73-053D
Ottinger, R. S. EPA-670/2-73-053I
Ottinger, R. S. EPA-670/2-73-053P
Ottinger, R. S. EPA-670/2-73-053J
Ottinger, R. S. EPA-670/2-73-053N
Ottinger, R. S. EPA-670/2-73-053A
Ottinger, R. S. EPA-670/2-73-053G
Ottinger, R. S. EPA-670/2-73-053E
Ottinger, R. S. EPA-670/2-73-053B
Ottinger, R. S. EPA-670/2-73-053F
Ottinger, R. S. EPA-670/2-73-053M
Ottinger, R. S. EPA-670/2-73-053H
Ottinger, R. S. EPA-670/2-73-053K
Ottinger, R. S. EPA-670/2-73-053L
Owen, P. H. EPA-670/2-75-028
Pade, B. EPA-660/2-74-083
Page, A. L. EPA-670/2-74-005
Paik, I. EPA-600/5-74-020
Pamatmat, M. M. EPA-660/3-73-005
Pantazelos, T. G. EPA-670/2-75-004
Paris, D. F. EPA-660/3-75-007
Park, W. R. EPA-600/5-74-007
Park, W. R. EPA-660/2-74-047
Parkasam, T. B. S. EPA-660/2-74-063
Parker, F. L. EPA-660/2-73-012
Parker, G. B. EPA-660/2-74-009
Parker, H. W. EPA-660/2-74-090
Parkhurst, J. D. EPA-670/2-73-043
Parks, J. W. EPA-670/2-74-079
Pathak, A. A. EPA-670/5-74-007
Patmore, L. C. EPA-660/2-73-003
Patrick, R. EPA-660/2-75-008
Patterson, J. EPA-600/2-74-009b
Patterson, J. EPA-600/2-74-009a
Patterson, J. EPA-600/2-74-009c
Pattnaik, A. EPA-650/2-73-016
Patzer, R. G. EPA-680/4-74-001
Pavia, E. H. EPA-670/2-73-067
Payne, W. R. EPA-660/2-74-017
Peabody, F. P. EPA-660/2-74-057
Pearson, E. F. EPA-660/2-74-050
Peltz, W. A. EPA-670/2-75-017
Peltz, W. A. EPA-670/2-75-022
Pembrook, J. D. EPA-650/2-73-030
Pengidore, D. A. EPA-650/2-73-028
Penose Jr., R. G. EPA-670/2-73-081
Penrod, L. EPA-660/2-74-087
Pepper, J. EPA-600/5-74-019
Perez, A. I. EPA-600/5-74-013
Perrotte, W. EPA-670/2-74-063
Pershing, D. W. EPA-650/2-73-029
Pershing, D. W. EPA-650/2-73-031
Peters, E. T. EPA-650/2-73-023
Peterson, H. C. EPA-670/2-75-016
Peterson, M. L. EPA-670/2-73-001
Peterson, S. EPA-660/9-74-002
Peterson, S. A. EPA-660/3-73-001
Peterson, S. A. EPA-660/3-74-032
Pfeffer, F. M. EPA-660/2-74-067
Pfeffer, J. T. EPA-670/2-74-016
Phillips, J. H. EPA-660/3-75-013
Phillips, S. A. EPA-670/2-73-022
Pidot, G. EPA-600/5-74-027
Pievge, J. D. EPA-660/2-74-057
Pilcher, K. S. EPA-660/3-73-020
Pitt, W. EPA-660/2-74-076
Plyler, E. L. EPA-650/2-73-038
Polcyn, F. C. EPA-660/3-74-028
Pomeroy, B. S. EPA-670/2-73-051
Pontuies, U. R. EPA-670/2-73-067
Porcella, D. B. EPA-600/5-74-010
Pound, C. E. EPA-660/2-73-006b
Pound, C. E. EPA-660/2-73-006a
Powers, C. F. EPA-660/3-74-032
Powers, C. F. EPA-660/3-74-015
Powers, J. J. EPA-660/4-75-002
Pows, B. L. EPA-660/3-73-006
Prescott, G. W. EPA-660/3-74-023
Pressley, T. A. EPA-670/2-73-058
Pressley, T. A. EPA-670/2-73-075
Preston, E. H. EPA-600/5-74-002
Pringer, C. J. EPA-670/2-74-092
Proctor, D. E. EPA-660/2-74-030
Propheter, O. W. EPA-660/2-74-045
Purdom, P. W. EPA-670/2-73-057
Putmann, A. A. EPA-650/2-74-011
Pyatt, E. E. EPA-600/5-74-013
Rabe, F. T. EPA-600/5-75-002
Raben, I. EPA-650/2-73-013
Rains, B. A. EPA-670/2-73-098
Rainwater, F. H. EPA-660/2-73-016
Ralls, J. W. EPA-660/2-74-091
Ramos, E. EPA-660/2-74-074
Ramsey, R. H. EPA-660/2-75-003
Ramsey, R. J. EPA-660/2-74-024
Raphael, C. N. EPA-660/3-74-029
Rapp, J. R. EPA-670/2-74-009
Rappaport, A. EPA-600/5-73-012b
Ratsch, H. C. EPA-660/3-74-012
Ratsch, H. C. EPA-660/3-74-018
Rayyan, Fawzi EPA-660/2-73-025a
Rechnitz, G. A. EPA-660/2-74-079
Reeves, W. R. EPA-670/2-75-034
Refrancois, P. A. EPA-650/2-74-012
Register, J. W. EPA-650/1-74-003
Reh, C. W. EPA-670/2-75-035
Reichert, P. A. EPA-600/5-73-015
Reid, G. W. EPA-660/2-74-037
Reimers, R. EPA-600/5-74-016
Reiner, R. EPA-650/2-73-009
Reiners, R. S. EPA-600/5-74-005
Remus, G. A. EPA-670/2-74-043
Reyna, R. EPA-600/5-73-012b
Rhee, S. S. EPA-670/2-74-019
Ricciardella, K. A. EPA-670/2-74-001
Rich, S. R. EPA-670/2-75-004
Richardson, D. L. EPA-670/2-74-033
Richardson, D. L. EPA-670/2-74-045
Richardson, S. L. EPA-670/2-75-021
Richardson, W. H. EPA-670/2-75-019
Riley, R. G. EPA-660/2-74-081
Ringe, R. R. EPA-660/3-73-017
Roan, S. G. EPA-670/2-73-075
Robbins, G. M. EPA-600/5-74-024
Robbins, J. H. EPA-670/2-74-056
Roberts, D. L. EPA-650/2-74-046a
Robertson, A. EPA-660/3-74-006
Robertson, J. EPA-660/2-74-077
Robins, J. D. EPA-670/2-73-054
Robinson, D. EPA-670/2-74-044
Robinson, G. M. L. EPA-670/2-74-073
Robinson, J. W. EPA-650/2-73-011
Robinson, S. J. EPA-600/5-75-001
Roden III, J. J. EPA-670/2-74-030
Rodriguez, J. EPA-660/2-74-074
Roesler, J. F. EPA-670/2-73-104
Roessler, M. EPA-660/3-74-014
Roessler, W. U. EPA-650/2-73-014
Rogers, C. EPA-670/2-75-005
Rogers, C. J. EPA-670/2-74-088
Romkens, M. J. M. EPA-660/2-74-043
Rosenblatt, T. M. EPA-670/2-74-004
Ross, L. W. EPA-670/2-73-080
Roth, C. EPA-660/2-74-043

PERSONAL AUTHOR INDEX

Rothwell, D. F. EPA-670/2-73-063
Rovesti, W. C. EPA-650/2-73-041
Rowe, M. L. EPA-660/2-75-003
Royal, T. M. EPA-650/2-74-019
Rozelle, R. EPA-670/2-75-006
Rozielle, L. T. EPA-660/2-73-033
Rubin, C. EPA-600/5-73-016
Ruegg, R. T. EPA-600/5-74-031
Ruich, D. A. EPA-600/2-73-004
Ruiz, Jr., L. P. EPA-670/2-75-032
Ruth, L. A. EPA-650/2-74-001
Ryan, B. W. EPA-670/2-73-101
Ryans, B. EPA-650/4-74-002
Ryland, D. W. EPA-670/4-73-002
Sack, W. A. EPA-670/2-73-022
Sadler, W. W. EPA-670/2-75-035
Sahagian, J. EPA-600/5-74-032
Saigh, P. A. EPA-670/2-75-007
Salvin, V. S. EPA-650/3-74-008
Sanborn, H. EPA-660/3-73-005
Sanborn, J. R. EPA-660/3-74-025
Sanders, R. G. EPA-670/2-75-004
Sandoski, D. A. EPA-600/2-74-007
Sandoski, D. A. EPA-600/2-74-005
Sanville, W. D. EPA-660/3-74-015
Sanville, W. D. EPA-660/3-74-032
Sargent, D. H. EPA-600/2-73-004
Sarofim, A. F. EPA-670/2-73-089A
Sarofim, A. F. EPA-670/2-73-089B
Savino, M. EPA-600/5-73-012e
Saxton, J. C. EPA-670/2-74-078
Schacht, R. A. EPA-660/3-74-002
Schaedel, A. L. EPA-660/3-75-004
Schafer, P. H. EPA-600/5-75-001
Scherifig, J. EPA-660/3-73-015
Schmer, F. A. EPA-670/4-73-002
Schmidt, C. J. EPA-660/2-74-075
Schmidt, F. A. EPA-670/2-73-091
Schmidt, R. A. EPA-600/2-74-002
Schoenberger, R. J. EPA-670/2-73-057
Schoettger, R. A. EPA-660/3-75-011
Schoor, W. P. EPA-660/3-74-024
Schoor, W. P. EPA-660/3-74-013
Schroeder, E. D. EPA-660/2-75-002
Schultz, G. R. EPA-670/9-73-056
Schwartz, A. M. EPA-600/2-74-003
Schwartz, W. EPA-650/3-74-011
Schweikhardt, R. G. EPA-670/2-74-024B
Schweikhardt, R. G. EPA-670/2-74-024A
Scott, P. EPA-600/5-73-012d
Scott, T. W. EPA-660/2-74-063
Scotton, J. W. EPA-600/4-75-001
Seidman, H. EPA-660/2-73-003
Seitz, W. R. EPA-660/2-73-007
Seitz, W. R. EPA-660/2-73-009
Selker, A. P. EPA-650/2-73-005
Selleck, R. E. EPA-660/3-74-016
Sem, G. J. EPA-650/2-73-022
Seng, W. C EPA-660/2-73-015
Seyler, J. K. EPA-660/2-73-032
Shafizadeh, F. EPA-670/2-74-015
Shaheen, D. G. EPA-600/2-75-004
Shannon, L. J. EPA-600/5-74-007
Shareskin, M. EPA-600/5-74-033
Sharpin, R. E. EPA-660/2-73-036
Shaw, H. EPA-650/2-74-001
Shaw, H. EPA-650/2-74-009a
Shea, T. EPA-660/2-74-074
Sheikh, H. EPA-670/2-75-017
Sheikh, H. EPA-670/2-75-022
Shirazi, M. A. EPA-660/2-73-016
Shoffstall, D. R. EPA-650/2-73-033b
Shoffstall, D. R. EPA-650/2-73-033a
Shofner, F. M. EPA-660/2-73-011
Sholtes, R. S. EPA-650/2-73-007
Shuckrow, A. J. EPA-670/2-73-078
Shuckrow, A. J. EPA-670/2-75-012
Shuster, W. W. EPA-670/2-74-063
Sibbett, D. J. EPA-650/2-73-052
Silverstein, R. M. EPA-660/2-74-081
Simpson, J. P. EPA-600/2-75-006
Siner, R. D. EPA-670/5-74-001
Singley, J. E. EPA-660/2-74-021
Sisson, R. L. EPA-600/5-74-008
Sitek, G. EPA-660/2-74-073
Skogerboe, G. EPA-660/2-74-084
Skogerboe, G. V. EPA-660/2-74-049
Skogerboe, G. V. EPA-660/2-74-052
Skrentner, R. G. EPA-670/2-75-020
Skriba, M. C. EPA-670/2-74-017
Sliger, A. G. EPA-650/2-74-012
Smallwood, C. EPA-660/2-73-021
Smallwood, H. EPA-600/5-73-003
Smith, C. L. EPA-670/2-73-099
Smith, C. N. EPA-660/2-74-017
Smith, D. V. EPA-600/5-75-001
Smith, F. EPA-650/4-74-005a
Smith, F. A. EPA-660/3-73-007
Smith, G. E. EPA-660/2-74-068
Smith, G. F. EPA-670/2-75-017
Smith, J. EPA-660/2-74-037
Smith, J. D. EPA-670/2-73-076
Smith, J. E. EPA-670/2-75-021
Smith, J. S. EPA-650/5-73-002
Smith, K. D. EPA-650/2-74-007
Smith, R. EPA-670/2-73-044
Smith, R. EPA-670/2-73-045
Smith, R. EPA-670/2-73-046
Smith, R. EPA-670/2-74-069
Smith, R. EPA-670/2-75-001
Smith, R. E. EPA-660/2-74-064
Smith, R. J. EPA-660/2-74-009
Smith, R. M. EPA-670/2-74-070
Smith, W. B. EPA-650/2-74-028
Smith, W. G. EPA-670/2-74-040
Smith, W. L. EPA-660/3-73-001
Smithson Jr., G. R. EPA-670/2-75-018
Snedden, R. EPA-650/2-74-038
Snowman, L. R. EPA-650/2-74-046b
Snowman, L. R. EPA-650/2-74-046a
Snyder, A. J. EPA-660/2-74-039
Sobek, A. EPA-670/2-74-070
Solls Jr., F. W. EPA-670/2-73-029
Sommer, J. EPA-600/5-74-027
Sopper, W. E. EPA-660/2-74-003
Sopper, W. E. EPA-660/2-74-016
Speaker, D. M. EPA-600/5-74-015
Speece, R. E. EPA-660/2-73-025a
Speece, R. E. EPA-660/2-73-025b
Sproul, O. EPA-660/2-74-088
Spruill, E. L. EPA-660/2-74-008
Squire, G. R. EPA-660/2-74-071
Staebler Jr., C. J. EPA-660/2-73-024
Stalnaker, C. B. EPA-660/3-73-019
Stamberg, J. B. EPA-670/2-73-033
Stamberg, J. B. EPA-670/2-73-037
Stanbery, J. B. EPA-670/2-73-073
Stanland, R. EPA-600/5-73-015
Starkey, R. J. EPA-660/3-74-022
Statnick, R. M. EPA-650/2-74-050
Stay, F. S. EPA-660/3-74-032
Stefan, H. EPA-660/3-75-014
Stein, J. L. EPA-660/2-74-059
Stenhser, A. G. EPA-660/2-73-010

PERSONAL AUTHOR INDEX

Sternling, C. V. EPA-650/2-74-017
Stevens, B. H. EPA-670/5-74-006
Stevens, D. H. EPA-670/2-73-060
Stevenson, M. K. EPA-670/2-73-010
Stevenson, W. S. EPA-660/3-74-004a
Steward, F. A. EPA-670/2-75-015
Stewart, R. D. EPA-650/1-73-004
Stewart, S. R. EPA-670/2-73-086
Stierli, H. EPA-670/2-73-001
Stoddard, C. K. EPA-670/2-73-092
Stoermer, E. F. EPA-660/3-75-004
Stoevener, H. H. EPA-600/5-74-017
Stone, H. E. EPA-660/2-74-092
Stone, R. EPA-600/5-73-003
Stone, R. EPA-670/2-74-095a
Stone, R. EPA-670/2-74-095b
Streebin, L. E. EPA-660/2-74-037
Streiff, M. L. EPA-650/2-73-026
Stucky, D. J. EPA-670/2-74-050
Sturrock, T. EPA-660/3-74-007
Sullivan, R. H. EPA-670/2-74-026
Sullivan, R. H. EPA-670/2-74-039
Sumark, L. EPA-600/5-73-016
Summerfelt, R. C. EPA-660/2-74-046
Summers, C. H. EPA-670/2-74-086
Surprenant, N. EPA-600/5-74-032
Sutton, J. W. EPA-660/2-73-018
Swaezy, R. M. EPA-660/2-74-090
Swain, H. EPA-670/2-75-006
Swanson, J. W. EPA-660/2-74-029
Sweeny, K. H. EPA-660/2-74-036
Sybert, L. EPA-650/2-73-013
Sybert, L. EPA-650/2-74-010
Sylvester, J. R. EPA-660/3-75-015
Szabo, A. J. EPA-660/2-74-061
Talley, R. J. EPA-670/5-74-005
Tang, J. Y. EPA-650/3-73-002
Taras, M. J. EPA-660/2-73-020
Tarazi, D. S. EPA-660/3-74-026
Tarzynski, J. EPA-670/2-75-002
Tate, D. C. EPA-660/2-73-019
Taub, F. B. EPA-660/3-73-008
Taylor, C. E. EPA-660/2-74-001
Taylor, J. EPA-660/2-74-084
Taylor, J. H. EPA-660/2-74-052
Taylor, W. J. EPA-660/2-74-001
Tessier, T. L. EPA-660/2-74-056
Teuschler, J. M. EPA-670/4-75-002
Thackston, E. L. EPA-660/3-75-002
Thaxton, E. L. EPA-660/2-74-085
Thibodeaux, L. J. EPA-660/2-74-044
Thomann, R. V. EPA-660/3-73-009
Thomann, R. V. EPA-660/3-75-005
Thomas Jr., J. EPA-650/2-73-044
Thomas, C. R. EPA-670/2-74-073
Thomas, J. L. EPA-660/2-74-014
Thomas, J. W. EPA-660/2-74-057
Thomas, R. E. EPA-650/4-74-022
Thomas, R. E. EPA-650/4-74-021
Thomas, R. E. EPA-660/2-74-062
Thomas, R. E. EPA-660/2-74-087
Thompson, C. G. EPA-660/2-75-006
Thorhaug, A. EPA-660/3-74-003
Thornton, W. E. EPA-660/2-73-032
Thurnau, R. C. EPA-670/2-75-025
Thurow, C. EPA-600/5-75-005
Tibbs, J. F. EPA-660/3-74-023
Tichenor, B. A. EPA-660/2-73-016
Tifft, Jr., E. C. EPA-670/2-75-021
Tihansky, D. P. EPA-600/5-73-001
Tillery, J. B. EPA-650/1-74-003
Tilton, B. EPA-650/2-73-053
Tilton, B. EPA-650/2-74-015
Timpe, W. G. EPA-660/2-75-004
Tinsley, C. H. EPA-660/3-74-004a
Todd, D. K. EPA-600/4-74-001
Tomlinson, S. V. EPA-600/2-75-006
Tommerdahl, J. B. EPA-650/2-74-019
Toner, W. EPA-600/5-75-005
Torpey, W. N. EPA-670/2-73-027
Torstrick, R. L. EPA-600/2-75-006
Toussaint, G. R. EPA-660/2-74-077
Tripler Jr., A. B. EPA-670/2-75-018
Troxler, R. W. EPA-660/3-75-002
Truett, J. B. EPA-650/2-74-030
Trzyna, T. C. EPA-600/5-74-023
Trzyna, T. C. EPA-600/5-74-006
Tsang, P. EPA-650/2-74-006
Tucker, U. C. EPA-650/2-73-027
Tulumello, A. EPA-670/2-74-087
Turner, D. S. EPA-660/3-74-029
Turner, J. H. EPA-650/2-73-012
Tuwiner, S. B. EPA-660/2-74-035
Uchida, S. EPA-650/2-73-003
Ulmer, N. S. EPA-670/2-74-007
Ung, R. F. EPA-670/2-74-018
Unger, S. G. EPA-600/5-73-008a
Unger, S. G. EPA-600/5-74-028
Upham, J. B. EPA-650/3-74-008
Usinowicz, P. J. EPA-670/2-74-012
Uttormark, P. D. EPA-660/3-74-020
Uttormark, P. D. EPA-660/3-73-023
Valentine, J. R. EPA-650/2-73-032
Vallee, R. P. EPA-670/2-74-076a
Vallee, R. P. EPA-670/2-74-076b
Van Dam, D. EPA-670/2-73-103
Van Der Leeden, F. EPA-600/4-73-001a
Van Winkle, M. EPA-600/5-73-012c
Vandergrift, A. E. EPA-670/2-74-048
Vasan, K. S. EPA-670/5-74-008
Vaughan, D. A. EPA-670/2-73-032
Vennes, J. EPA-660/2-74-088
Vick, N. J. EPA-670/5-74-001
Vivian, J. E. EPA-650/2-73-047
Vlastelicia, J. EPA-660/3-73-014
Vogh, R. P. EPA-660/2-74-055
Waddell, T. E. EPA-600/5-74-012
Wade, R. C. EPA-650/2-73-052
Wagner, J. J. EPA-600/5-75-001
Wagoner, D. E. EPA-650/4-74-005a
Wahl, J. A. EPA-650/2-74-008a
Wakeland, J. R. EPA-600/5-73-012c
Waldron, A. C. EPA-660/2-74-032
Walker, W. R. EPA-660/2-74-052
Walker, W. R. EPA-660/2-74-049
Walker, W. R. EPA-660/2-74-084
Wallace, J. B. EPA-660/3-73-016
Waller, R. EPA-670/2-74-097
Wallman, H. EPA-670/2-74-071
Waltz, F. A. EPA-670/4-73-002
Wang, S. C. EPA-650/2-74-010
Warner, D. L. EPA-680/4-74-003
Warner, M. EPA-600/5-74-002
Warner, M. EPA-600/5-74-016
Warner, W. K. EPA-600/5-74-011
Wasser, J. H. EPA-650/2-74-003
Wasser, J. U. EPA-650/2-73-029
Wathne, M. EPA-670/2-74-035A
Watkins, S. W. EPA-660/2-73-028
Watson Jr., W. D. EPA-600/5-73-014
Watt, T. R. EPA-670/2-75-020
Weber Jr., W. J. EPA-670/2-74-047
Weber Jr., W. J. EPA-670/2-74-012
Weber, C. I. EPA-670/4-73-001

PERSONAL AUTHOR INDEX

Weet, J. H.	EPA-670/2-75-015
Weinberg, E. K.	EPA-650/2-73-014
Weinburg, M. S.	EPA-670/2-73-062
Weinstein, M. J.	EPA-670/2-74-052
Weisberg, H.	EPA-670/2-74-044
Weiss, A. H.	EPA-670/2-75-031
Weiss, B.	EPA-670/2-73-049
Welborn, H. L.	EPA-670/2-74-075
Welsh, F. L.	EPA-670/2-74-050
Wen, C. Y.	EPA-650/2-73-003
Wendt, J. O.	EPA-650/2-74-017
Wezernak, C. T.	EPA-660/3-74-028
Wheeler, R. J.	EPA-650/2-74-068
Whitacre, G. R.	EPA-650/2-74-011
White, J. E.	EPA-660/2-74-027
White, J. T.	EPA-660/2-75-001
White, U. M.	EPA-650/2-73-014
White, W.	EPA-650/2-73-017
Whitman, J.	EPA-600/4-75-001
Whitmore, F. J.	EPA-650/4-73-003
Wilcox, E. A.	EPA-670/2-73-042
Wiley, A. J.	EPA-660/2-73-030
Williams, D.	EPA-650/2-73-050
Williams, E. R.	EPA-600/5-73-013
Wilmoth, R. C.	EPA-670/2-73-100
Wilmoth, R. C.	EPA-670/2-74-051
Winfield, R. P.	EPA-660/3-75-005
Winiarski, L.	EPA-660/2-73-001
Winkler, P. F.	EPA-670/2-74-031
Wirtanen, W. T.	EPA-660/2-73-036
Wise, R. H.	EPA-670/2-74-034
Wise, R. H.	EPA-670/2-74-046
Wixson, B. G.	EPA-670/2-73-038
Wolcott, A. R.	EPA-660/2-74-057
Wolk, R. H.	EPA-650/2-73-041
Wolk, R. H.	EPA-670/2-73-066
Woodward, J. B.	EPA-670/2-74-054
Wren, E. J.	EPA-670/2-73-021
Wymore, A. H.	EPA-660/2-74-027
Yaffe, H. J.	EPA-670/5-74-009
Yanagida, N.	EPA-660/2-74-053
Yang, P. Y.	EPA-660/2-74-063
Yin, S. C.	EPA-660/2-74-046
Young, J. F.	EPA-600/2-75-006
Yousef, Y. A.	EPA-670/2-74-072
Zachar, F. R.	EPA-670/2-74-002
Zakely, B. J.	EPA-660/2-74-049
Zandi, I.	EPA-670/2-73-072
Zaval, F. J.	EPA-670/2-74-003
Zippler, K. L.	EPA-670/2-73-071
Zoller, M. A.	EPA-600/5-73-012c

GRANT, CONTRACT, INTERAGENCY AGREEMENT NUMBERS

PROJECT NO.	REPORT NO.
CONTRACTS	
CPE-70-129	670/2-73-010
EHS 70-108	670/2-74-092
GS-03S-38351	600/5-73-013
10-12-0007	650/1-74-005
10-12-0019	650/2-74-001
10-12-0023	650/2-73-022
10-12-0040	650/4-74-027
10-12-0049	650/4-73-002
10-12-0061	650/2-74-077
10-12-0088	650/2-74-012
10-12-0134	650/1-74-006
10-12-0143	650/2-74-024
10-12-0162	650/2-74-022
10-12-0166	650/2-74-132
12-12-0097	650/1-74-001
12-12-0139	650/2-74-053
14-12-0024	660/2-74-050
14-12-0024	670/2-74-050
14-12-0168	670/2-74-048
14-12-0179	670/2-73-076
14-12-0494	670/2-75-002
14-12-0505	670/2-73-047a
14-12-0505	670/2-73-047b
14-12-0813	670/2-73-062
14-12-0818	660/2-73-033
14-12-0818	670/2-73-033
14-12-0818	670/2-73-037
14-12-0818	670/2-73-040
14-12-0818	670/2-73-058
14-12-0818	670/2-73-070
14-12-0818	670/2-73-073
14-12-0818	670/2-73-075
14-12-0831	670/2-75-009
14-12-0833	660/2-74-076
14-12-0846	670/2-73-042
14-12-0909	600/2-73-002
14-12-0922	660/2-74-036
22-68-0002	650/3-74-008
22-69-0064	650/3-73-001
22-69-108	650/4-75-002
24-12-0004	650/2-74-084
24-12-0015	650/2-73-049
24-12-0025	650/2-73-024
24-12-0027	650/2-73-023
24-12-0029	650/2-74-018
24-12-0045	650/2-74-017
35-12-0067	650/2-73-013

PROJECT NO.	REPORT NO.
CONTRACTS	
35-12-0067	650/2-74-010
43-12-0142	650/1-74-007
68-01-0040	670/2-75-028
68-01-0067	670/2-73-084
68-01-0068	670/2-73-068
68-01-0076	660/3-73-006
68-01-0082	670/4-74-004
68-01-0094	670/2-74-017
68-01-0095	670/2-74-004
68-01-0115	670/2-74-091
68-01-0120	670/2-73-031
68-01-0124	670/2-73-078
68-01-0135	670/2-73-081
68-01-0139	670/2-73-069
68-01-0167	660/2-73-003
68-01-0171	660/2-73-004
68-01-0195	670/2-74-001
68-01-0197	600/2-75-004
68-01-0276	650/3-74-002
68-01-0279	650/2-73-002
68-01-0423	600/5-74-017
68-01-0426	600/5-74-009
68-01-0428	600/5-74-007
68-01-0438	600/2-74-004
68-01-0457	600/2-74-006
68-01-0470	600/5-73-004
68-01-0483	600/2-74-002
68-01-0550	650/2-74-068
68-01-0666	650/1-73-002
68-01-0703	600/5-74-004
68-01-0728	600/5-74-010
68-01-0729	600/5-73-003
68-01-0741	660/2-73-006a
68-01-0741	660/2-73-006b
68-01-0743	660/2-74-072
68-01-0743	660/2-74-073
68-01-0744	600/5-73-008a
68-01-0744	600/5-73-008b
68-01-0744	600/5-74-014
68-01-0753	600/5-73-005
68-01-0759	600/4-73-001a
68-01-0759	600/4-73-001b
68-01-0759	600/4-74-001
68-01-0759	680/4-74-002
68-01-0759	680/4-74-003
68-01-0763	670/2-74-002
68-01-0777	660/2-74-056

PROJECT NO.	REPORT NO.
CONTRACTS	
68-01-0782	660/3-74-019
68-01-0788	600/5-74-008
68-01-0887	660/2-74-013
68-01-0904	660/3-74-022
68-01-1805	600/5-74-001
68-01-1818	600/5-74-006
68-01-1818	600/5-74-023
68-01-1832	670/4-74-003a
68-01-1832	670/4-74-003b
68-01-1837	600/5-74-005
68-01-1842	600/5-74-019
68-01-1850	600/5-74-033
68-01-1859	600/5-74-032
68-01-1863	600/5-75-004
68-01-1870	670/2-74-052
68-01-1871	600/5-74-002
68-01-1871	600/5-74-016
68-01-1882	600/5-74-030
68-01-1888	600/5-74-018
68-01-1898	600/5-74-015
68-01-2114	600/2-74-001
68-01-2203	600/5-74-025
68-01-2203	600/5-74-026
68-01-2411	600/5-75-001
68-01-2442	600/4-75-001
68-01-2637	600/5-74-028
68-02-0007	650/2-74-064
68-02-0010	650/4-74-037
68-02-0017	650/2-74-047
68-02-0018	650/2-73-047
68-02-0020	650/2-73-026
68-02-0022	650/2-73-015
68-02-0023	650/2-75-006
68-02-0025	650/2-74-085a
68-02-0054	650/2-73-027
68-02-0080	650/1-73-004
68-02-0083	650/1-75-001
68-02-0095	650/5-73-001
68-02-0205	650/2-73-001
68-02-0206	650/2-73-042
68-02-0213	650/5-73-002
68-02-0214	650/4-74-014
68-02-0216	650/2-73-033a
68-02-0216	650/2-73-033b
68-02-0217	650/2-73-048a
68-02-0217	650/2-73-048b
68-02-0217	650/2-73-048c

PROJECT NO.	REPORT NO.
CONTRACTS	
68-02-0217	650/2-73-048d
68-02-0218	650/2-74-105
68-02-0223	650/4-73-001
68-02-0226	650/2-74-131
68-02-0227	650/2-74-066
68-02-0228	650/2-74-107
68-02-0230	650/2-74-026
68-02-0230	650/2-74-087
68-02-0246	650/2-74-054
68-02-0247	650/2-74-071a
68-02-0247	650/2-74-071b
68-02-0250	650/2-74-075
68-02-0256	650/2-73-036
68-02-0264	650/2-73-005
68-02-0268	650/2-75-009
68-02-0270	650/2-74-045
68-02-0272	650/4-74-003
68-02-0273	650/2-73-035
68-02-0273	650/2-74-102
68-02-0273	650/2-75-022
68-02-0277	650/2-73-004
68-02-0279	650/2-73-003
68-02-0284	650/2-74-074
68-02-0284	650/2-74-092
68-02-0285	650/2-74-093
68-02-0286	650/2-74-004
68-02-0287	650/3-74-004a
68-02-0293	650/2-73-041
68-02-0293	650/2-73-041a
68-02-0300	650/2-73-039
68-02-0300	650/2-74-109
68-02-0307	650/2-73-043
68-02-0310	650/4-74-015
68-02-0329	650/1-73-003
68-02-0332	650/2-74-061
68-02-0335	650/4-74-012
68-02-0543	650/2-73-037
68-02-0544	650/2-73-016
68-02-0545	650/2-74-040
68-02-0546	650/2-74-029
68-02-0551	650/2-73-010
68-02-0553	650/4-73-003
68-02-0557	650/3-73-002
68-02-0561	650/2-73-025
68-02-0563	650/2-74-014
68-02-0564	650/2-73-050
68-02-0566	650/2-74-044

PROJECT NO.	REPORT NO.
CONTRACTS	
68-02-0570	650/2-73-040
68-02-0574	650/4-74-009
68-02-0575	650/2-74-094
68-02-0578	650/2-73-052
68-02-0579	650/2-74-016
68-02-0580	650/4-74-011
68-02-0580	650/4-74-040
68-02-0581	650/2-74-060
68-02-0584	650/2-75-015
68-02-0585	650/2-73-032
68-02-0587	650/2-73-030
68-02-0588	650/2-73-008
68-02-0590	650/2-74-039
68-02-0591	650/2-74-133
68-02-0592	650/2-75-013a
68-02-0595	650/1-74-003
68-02-0600	650/2-73-007
68-02-0603	650/2-74-031a
68-02-0603	650/2-74-031b
68-02-0605	650/2-75-027a
68-02-0605	650/2-75-027b
68-02-0622	650/2-73-028
68-02-0623	650/4-74-013
68-02-0623	650/4-74-021
68-02-0623	650/4-74-024
68-02-0623	650/4-74-025
68-02-0625	650/2-74-103
68-02-0626	650/4-74-022
68-02-0626	650/4-74-026
68-02-0626	650/4-74-028
68-02-0626	650/4-74-029
68-02-0626	650/4-74-033
68-02-0626	650/4-74-039
68-02-0626	650/4-75-003
68-02-0626	650/4-75-009
68-02-0628	650/2-74-023
68-02-0629	650/2-74-009a
68-02-0629	650/2-74-009b
68-02-0629	650/2-74-009c
68-02-0629	650/2-74-009d
68-02-0629	650/2-74-009e
68-02-0630	650/2-74-076
68-02-0634	650/2-74-002a
68-02-0634	650/2-74-002b
68-02-0636	650/2-75-020
68-02-0637	650/2-74-119a
68-02-0647	650/2-74-025

PROJECT NO.	REPORT NO.
CONTRACTS	
68-02-0648	650/2-75-001a
68-02-0648	650/2-75-001b
68-02-0650	650/2-74-062
68-02-0650	650/2-74-062a
68-02-0652	650/4-74-020
68-02-0653	650/2-74-069
68-02-0654	650/4-74-017
68-02-0656	650/2-74-020
68-02-0657	650/2-74-006
68-02-0658	650/2-73-009
68-02-0660	650/2-75-008
68-02-0662	650/2-74-008a
68-02-0665	650/4-74-049
68-02-0680	650/4-74-010
68-02-0699	650/4-75-005
68-02-0713	650/1-74-013
68-02-0716	650/2-74-055
68-02-0742	650/2-74-089
68-02-0745	650/4-74-042
68-02-0757	650/2-74-046a
68-02-0757	650/2-74-046b
68-02-0760	650/4-74-051
68-02-0771	650/3-75-004
68-02-0778	650/2-74-056
68-02-0782	650/2-74-065
68-02-0788	650/4-74-052
68-02-0798	650/4-74-036
68-02-0800	650/4-74-044
68-02-0994	650/4-74-038
68-02-1010	650/2-74-037a
68-02-1011	650/2-74-019
68-02-1015	650/4-74-007
68-02-1068	650/2-74-106
68-02-1074	650/2-74-078a
68-02-1079	650/2-74-108
68-02-1093	650/2-74-058
68-02-1098	650/4-74-023
68-02-1098	650/4-75-001
68-02-1145	650/1-74-009
68-02-1206	650/4-75-008
68-02-1207	650/4-74-001
68-02-1217	650/3-75-002
68-02-1225	650/2-74-059
68-02-1228	650/2-74-121
68-02-1229	650/2-74-120
68-02-1233	650/4-74-043
68-02-1234	650/4-74-005a

PROJECT NO.	REPORT NO.
CONTRACTS	
68-02-1234	650/4-74-005b
68-02-1234	650/4-74-005c
68-02-1234	650/4-74-005d
68-02-1234	650/4-74-005h
68-02-1234	650/4-74-005m
68-02-1234	650/4-74-005L
68-02-1235	650/4-74-050
68-02-1238	650/4-74-006
68-02-1242	650/4-74-016
68-02-1255	650/2-75-007
68-02-1274	650/1-74-008
68-02-1282	650/2-75-028
68-02-1303	650/2-74-079
68-02-1303	650/2-74-114
68-02-1303	650/2-74-124
68-02-1306	650/2-74-085b
68-02-1306	650/2-74-086a
68-02-1306	650/2-74-086b
68-02-1308	650/2-74-028
68-02-1308	650/2-74-072
68-02-1308	650/2-74-098
68-02-1308	650/2-74-116
68-02-1308	650/2-74-127
68-02-1308	650/2-74-130
68-02-1308	650/2-75-016
68-02-1308	650/2-75-017
68-02-1309	650/2-75-018
68-02-1310	650/4-74-035
68-02-1316	650/2-74-036
68-02-1316	650/2-74-043
68-02-1318	650/2-74-091
68-02-1318	650/2-74-123
68-02-1319	650/2-74-033
68-02-1320	650/2-74-021
68-02-1320	650/2-74-041
68-02-1320	650/2-74-082
68-02-1320	650/2-74-117
68-02-1320	650/2-75-019a
68-02-1321	650/2-74-101
68-02-1321	650/2-74-115
68-02-1321	650/2-74-122
68-02-1323	650/2-74-052
68-02-1323	650/2-74-099
68-02-1323	650/2-74-100
68-02-1324	650/2-74-073
68-02-1325	650/2-74-097
68-02-1325	650/2-74-118

PROJECT NO.	REPORT NO.
CONTRACTS	
68-02-1325	650/2-75-021
68-02-1328	650/2-74-112
68-02-1339	650/2-74-067
68-02-1348	650/2-74-090
68-02-1352	650/2-74-030
68-02-1353	650/2-74-088
68-02-1363	650/4-74-019a
68-02-1363	650/4-74-046
68-02-1406	650/2-75-026a
68-02-1406	650/2-75-026b
68-02-1480	650/2-74-129
68-02-1487	650/2-75-024a
68-02-1851	650/2-75-005a
68-02-1973	650/2-73-045
68-02-2012	650/2-73-044
68-03-0006	670/2-73-052
68-03-0047	670/5-74-003
68-03-0049	670/2-73-006
68-03-0050	670/2-73-066
68-03-0060	670/2-73-056
68-03-0089	670/2-73-053A
68-03-0089	670/2-73-053A-P
68-03-0089	670/2-73-053B
68-03-0089	670/2-73-053C
68-03-0089	670/2-73-053D
68-03-0089	670/2-73-053E
68-03-0089	670/2-73-053F
68-03-0089	670/2-73-053G
68-03-0089	670/2-73-053H
68-03-0089	670/2-73-053I
68-03-0089	670/2-73-053J
68-03-0089	670/2-73-053K
68-03-0089	670/2-73-053L
68-03-0089	670/2-73-053M
68-03-0089	670/2-73-053N
68-03-0089	670/2-73-053O
68-03-0089	670/2-73-053P
68-03-0123	670/2-75-024
68-03-0128	670/2-75-023
68-03-0138	670/2-74-078
68-03-0145	670/2-75-014
68-03-0154	670/2-74-045
68-03-0156	670/2-73-086
68-03-0179	670/2-74-040
68-03-0183	670/2-74-068
68-03-0193	670/5-75-001
68-03-0203	670/2-75-012

PROJECT NO.	REPORT NO.
CONTRACTS	
68-03-0221	670/2-75-007
68-03-0228	670/2-75-004
68-03-0233	660/2-73-026
68-03-0244	670/2-74-095a
68-03-0244	670/2-74-095b
68-03-0260	670/2-74-082
68-03-0262	670/2-74-087
68-03-0268	670/2-74-003
68-03-0272	670/2-75-011
GRANTS	
AP 01186	650/3-74-003
AP-01269-02	650/2-74-005
EC-0030-03	670/2-73-089A
EC-0030-03	670/2-73-089B
EP-00248	670/2-73-023
EP-00250	670/2-73-063
EP-00257	670/2-73-065
EP-00259	670/2-73-072
EP-00262-02	670/2-73-009
EP-00265	670/2-73-083
EP-00268	670/2-73-061
EP-00274	670/2-73-090
EP-00276-04	670/2-73-005
EP-00279	670/2-73-011
EP-00302	670/2-73-051
EP-00304	670/2-73-087
EP-00316	670/2-73-041
EP-00329	660/2-73-038
EP-00329	670/2-73-038
EP-00362	670/2-73-030
EP-00386	670/2-73-049
EP-00393	670/2-73-021
EP-00500-01	670/2-74-014
EP-01030	670/5-74-006
UI-00509	670/2-73-057
WP 01351-01	660/3-74-014
WP-01322-02	670/2-73-027
WPD 184-01-67	660/2-74-030
WPRD 121-01-68	670/2-73-024
WPRD 185-01-68	660/2-73-015
WPRD 23-01-68	670/2-73-098
WPRD 242-01	670/2-73-092
WPRD 247-01	670/2-74-061
WPRD 3-01-68	660/2-74-035
WPRD 30-01-0067	670/2-73-096
WPRD 4-01-67	670/2-74-077
WPRD 4-01-67	670/2-75-027

PROJECT NO.	REPORT NO.
GRANTS	
01EP00829	660/2-74-081
11010 ELP	670/2-73-024
11010 ENK	670/2-73-103
11010 EZQ	670/2-73-098
11010 FLQ	670/2-73-050
11010 FYM	670/2-73-033
11010 GWI	600/2-73-004
11020 FAM	670/2-74-079
11020 FAN	670/2-73-071
11020 FAX	670/2-75-020
11022 FLV	670/2-75-035
11023 EKC	670/2-75-019
11023 FAR	670/2-75-010
11023 FAS	670/2-73-067
11024 EVF	600/2-73-002
11030 HJP	670/2-74-096
11060 DRO	660/2-73-038
12010 DNF	660/2-74-050
12010 DRH	660/2-73-033
12010 FNM	660/2-73-032
12010 FXD	670/2-75-018
12040 DEH	660/2-74-069
12040 DRY	660/2-74-008
12040 EJU	660/2-75-004
12040 GQD	660/2-73-028
12040 HDU	660/2-74-086
12060 DFF	660/2-74-027
12060 DQV	660/2-73-015
12060 EGV	660/2-74-031
12060 EIG	660/2-74-088
12060 EKQ	660/2-74-012
12060 ESC	660/2-74-093
12060 ESY	660/2-74-035
12060 FAK	660/2-74-028
12060 FLL	660/2-74-014
12060 FRW	660/2-73-020
12060 FRW	660/2-73-021
12060 FYG	660/2-74-060
12060 HCW	660/2-74-059
12060 HFY	660/2-74-092
12060 HNG	660/2-74-046
12060 HPC	660/2-75-002
12070 HEK	660/2-73-023
12080 GCH	660/2-74-040
12090 HLO	660/2-74-039
12110 GLP	660/2-73-018
12120 FYV	660/2-73-037

PROJECT NO.	REPORT NO.
GRANTS	
12120 GLE	660/2-74-007
12120 HMZ	660/2-75-006
12130 DBF	660/2-73-010
12130 EKK	660/2-74-020
12130 HFX	660/2-73-036
12130 HRA	660/2-74-055
13020 DTV	660/2-74-005
13020 DWH	660/2-74-033
13020 EBL	660/2-74-032
13040 DFN	660/2-74-030
13040 ERR	660/2-74-009
13040 EVM	660/2-74-047
13040 FYK	660/2-74-057
14010 EFJ	670/2-73-092
14010 EFL	670/2-73-054
14010 EFN	670/2-73-093
14010 HQC	670/2-74-009
14020 EHW	660/2-74-019
14020 FVW	660/2-74-037
14040 FVD	660/2-74-018
14040 FZC	670/2-73-080
15010 PBK	670/2-73-088
15030 FMZ	660/2-73-035
15030 HIX	660/2-74-043
15080 EJQ	670/2-73-099
15080 HET	670/2-73-068
16010 DBU	660/3-74-034
16010 DCK	660/3-73-002
16010 DFI	660/3-73-001
16010 DHN	660/3-73-003
16010 EDJ	660/3-73-006
16010 EJH	660/3-73-015
16010 ELF	660/3-74-017
16010 EQQ	660/2-74-010
16020 DHD	670/2-73-079
16020 EDG	660/2-74-021
16020 EGG	660/3-74-026
16020 GIY	670/4-74-004
16030 ELZ	660/2-73-027
16040 FRL	660/2-73-008
16050 DDK	660/3-73-009
16050 DIL	660/3-73-011
16050 DXM	660/3-73-008
16050 ESP	660/3-74-002
16050 GQQ	660/3-73-025
16070 DEP	660/3-74-004a
16070 DEP	660/3-74-004b

PROJECT NO.	REPORT NO.
GRANTS	
16070 DGY	660/3-73-010
16070 EKZ	660/3-73-005
16070 FBY	660/2-73-029
16080 DYJ	660/2-74-016
16080 FBH	660/2-73-022
16080 FWE	600/2-74-003
16080 FYW	660/2-73-025a
16080 FYW	660/2-73-025b
16100 FWQ	660/3-73-018
16100 PAK	660/2-73-017
16110 GEW	600/5-74-013
16130 FDQ	660/2-73-012
16130 GNK	660/2-73-011
16130 GSD	660/2-73-003
16130 HKK	660/2-73-004
17010 EBM	670/2-73-027
17020 EPF	670/2-74-012
17030 DMA	670/2-73-074
17030 DUW	670/2-74-047
17040 DSR	670/2-74-077
17050 EEY	670/2-74-048
17060 DNU	670/2-73-029
17060 EYZ	670/2-73-082
17070 HDA	670/2-74-004
17080 FSF	670/2-73-064
17080 HHV	670/2-74-080
18050 DET	660/3-74-003
18050 DFQ	660/3-73-016
18050 DIJ	660/3-73-020
18050 DMB	660/3-73-017
18050 DPL	660/3-73-019
18050 ELT	660/3-74-006
18050 FLS	660/3-73-004
18080 DFU	660/3-74-014
18080 FBW	660/3-74-031
800042	650/2-75-002
800055	660/2-73-032
800055	670/2-73-032
800055	670/2-74-083
800055	670/2-74-084
800150	650/2-74-034
800250	660/2-74-091
800261	660/2-73-019
800278	660/2-74-052
800278	660/2-74-084
800316	650/2-74-110
800351	670/2-74-032

PROJECT NO.	REPORT NO.
GRANTS	
800365	660/3-75-013
800369	660/3-73-009
800373	660/3-74-016
800397	650/4-74-032
800397	650/4-74-045a
800397	650/4-74-045b
800400	660/2-74-005
800401	660/2-74-033
800432	670/2-75-033a
800432	670/2-75-033b
800432	670/2-75-033c
800432	670/2-75-033d
800435	660/3-75-014
800510	660/3-73-022
800602	670/2-74-030
800605	660/3-75-004
800609	660/3-75-006
800610	660/3-75-005
800613	660/2-73-012
800613	660/2-74-085
800613	660/3-75-002
800650	670/2-74-013
800674	670/5-74-004
800677	650/3-75-003
800678	660/2-74-003
800680	660/2-73-024
800685	670/2-73-060
800688	670/2-75-031
800707	670/2-73-022
800731	660/2-75-008
800736	660/3-74-025
800745	670/2-74-070
800746	660/2-74-046
800747	660/2-74-025
800766	670/2-74-016
800767	660/2-74-063
800778	660/3-74-028
800842	650/2-74-011
800853	660/2-74-029
800854	660/2-74-071
800857	600/2-74-009a
800857	600/2-74-009b
800857	600/2-74-009c
800866	650/2-73-011
800904	660/2-74-061
800909	660/2-74-004
800921	660/2-74-048

PROJECT NO.	REPORT NO.
GRANTS	
800935	660/2-74-074
800938	670/2-75-030
800943	660/2-74-053
800950	650/2-74-095
800989	660/3-74-027
800991	660/2-74-079
800994	660/3-74-033
800997	660/2-73-002
801000	600/5-74-022
801003	660/3-75-003
801029	660/2-73-027
801036	660/3-74-007
801039	660/3-73-018
801040	660/2-75-005
801062	660/3-74-029
801065	660/2-74-090
801120	650/4-74-004
801136	650/3-74-006
801174	650/3-74-011
801207	660/2-73-030
801226	600/5-74-027
801234	600/5-74-011
801236	670/2-75-006
801282	670/2-74-076a
801282	670/2-74-076b
801289	670/2-74-035A
801289	670/2-74-035B
801289	670/2-74-036A
801289	670/2-74-036B
801303	670/2-73-091
801321	650/2-73-020
801340	650/3-74-007
801343	660/3-74-020
801349	670/2-75-016
801361	660/3-73-023
801362	660/3-73-024
801374	600/5-73-016
801376	600/5-73-015
801393	650/1-74-010
801400	660/2-75-007
801411	600/5-74-020
801417	660/2-74-077
801419	600/5-75-003
801432	660/2-75-001
801446	650/2-74-007
801454	660/2-75-003
801454-01	660/2-74-024

PROJECT NO.	REPORT NO.
GRANTS	
801470	650/1-74-012
801473	600/5-73-012a
801473	600/5-73-012b
801473	600/5-73-012c
801473	600/5-73-012d
801473	600/5-73-012e
801481	600/5-74-029
801484	660/2-74-006
801490	650/2-73-014
801500	600/5-74-024
801521	600/5-73-007
801522	600/5-73-011
801577	660/2-74-094
801603	650/2-74-063
801615	650/2-74-027
801622	670/2-75-034
801628	600/2-74-005
801633	670/2-75-026a
801633	670/2-75-026b
801647	660/2-74-034
801650	650/1-74-011
801658	670/2-73-043
801662	660/2-74-064
801666	660/2-74-068
801684	660/2-74-075
801835	660/2-74-054
801870	670/5-74-007
801870	670/5-74-008
801870	670/5-74-009
801876	660/2-74-044
801944	670/2-75-032
801945	650/4-74-041
802005	650/1-74-002
802009-01	660/2-74-023
802032	660/2-74-011
802219	670/2-75-022
802254	670/2-73-104
802254	670/2-74-008
802269	650/2-74-080
802270	650/2-74-051
802291	650/2-74-048
802348	660/3-75-015
802366	650/2-75-012
802400	670/2-75-021
802402	650/2-74-032
802411	670/2-75-017
802419-01	650/2-74-096

PROJECT NO.	REPORT NO.
GRANTS	
802441	600/5-73-009
802444	600/5-74-021
802495	670/4-74-005
802499-01	650/2-75-023
802637	670/2-75-015
802980-01	660/4-75-002
803046-01	600/2-75-005
803063-01	670/2-75-003
803226-01	670/2-75-029
803294	670/9-75-004
INTER-AGENCY	
IAG-D4-0454	650/2-75-011
IAG-097(D)	650/2-75-014
IAG-134(D)	600/2-75-006
IAG-141(D)	660/3-75-011
IAG-148(D)	600/5-75-002
IAG-152(D)	660/3-75-010
IAG-323	650/3-74-005
IAG0020(D)	650/2-74-038
IAG0077(D)	650/2-74-113
IAG0085(D)	650/2-73-006
IAG0134(D)	650/2-73-051
IAG0139(D)	650/2-74-070
IAG0149(D)	650/2-74-104
IAG0177(D)	650/2-73-034
IAG0199(D)	650/2-74-057
IAG0215	650/2-74-125
IAG085(D)	650/2-75-004
IAG31990A	650/2-74-049a
IAG4H374(D)	600/5-74-031
IAG40377(D)	650/4-74-030
TV-30541A	650/2-73-019a
TV-30541A	650/2-73-019b
TV-30541A	650/2-73-019c

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