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Water Current

Volume 6 Number 5

May 1974

FROM THE DESK OF THE DIRECTOR . . .

Although great progress has been made by the Natural Resources Commission, Department of Environmental Control, Department of Water Resources and more recently the Natural Resources Districts in highlighting the importance of water to the state of Nebraska, relatively little has been done to advance the understanding of some of the most complex problems emerging today or identified as major issues of tomorrow. Economic hardships and losses associated with poor management, inadequate planning, improper timing, outmoded legal structures and simple lack of willingness to act are well documented in relationship to water and other important natural resources.

In terms of research, few dollars have been spent and even fewer individuals have taken time to consider the enormity of the payoff which could result from reliable quantitative information in advance of crisis situations. Once the well has gone dry, there is no need for study. Ten, fifteen, or twenty years in advance of that time, however, research can be the foundation for viable alternatives for rational problem solving.

In cooperation with the state's Natural Resources Districts and major agencies concerned with water, the Nebraska Water Resources Research Institute has identified and evaluated important contemporary issues in need of research for resolution. The nature of today's and many of tomorrow's problems is clear. The opportunity to impact on these in timely fashion is at hand. We are fortunate that many potential problems are yet far enough away that proper decisions can be made in time to avoid severe consequences. It is hoped that future enthusiasm for development of natural resources will be tempered by a realization of the necessity to support a dynamic research program. Hard facts in advance can help the state be master of its future rather than an improviser of stop-gap measures.

ON THE HOMEFRONT

1974 SUMMER INSTITUTE

The Nebraska Water Resources Research Institute will sponsor a one-week Summer Institute July 21-26, 1974 on "Quantitative Planning Techniques in Water Resources." The objective is to provide training in the application of simulation and optimization techniques to the planning and analysis of water resources systems. Primary emphasis will be given to application. Approximately 50 percent of the program will be devoted to workshops providing participants an opportunity to manipulate operational models. A case-study approach will be used to relate lecture materials to workshop activities. Both surface water and groundwater systems will be discussed. The role of quantitative models as practical planning tools will be considered.

Speakers and topics for the Institute program are as follows:

Introduction to Water Resources Systems	Warren Viessman, Jr., Director Water Resources Research Institute
Simulation Model Structuring - Surface Water Components	Gary L. Lewis, Assistant Professor Dept. of Civil Engineering University of Nebraska-Lincoln
Simulation Model Structuring - Ground Water Components	Peter W. Huntoon, Assistant Professor Department of Geology University of Wyoming
The Big Blue River Basin Model - A Case Study	Peter W. Huntoon
Screening Models for Water Resources Planning	D. Peter Loucks, Chairman Dept. of Environmental Engr. Cornell University
The Elkhorn River Basin - A Case Study	Gary L. Lewis
Simulation and Optimization - Combined Tools for Flood Control Planning	Gary L. Lewis, D. Peter Loucks, Isaac Yomtovian, Research Assoc. Water Resources Research Institute

For further information contact: Dr. Warren Viessman, Jr., Director, Water Resources Research Institute, 212 Ag. Engineering Building, University of Nebraska, East Campus, Lincoln, Nebraska 68503. Telephone (402) 472-3307.

DR. PETER HUNTOON TO WYOMING

Dr. Peter M. Huntoon, former Assistant Professor of Geology and principal Hydrogeologist of the Conservation and Survey Division, has become affiliated with the Geology Department and Water Resources Research Institute of the University of Wyoming.

Pete was active in research on groundwater systems while at Nebraska and worked closely with the Nebraska Water Resources Research Institute. He was instrumental in designing and supervising several important studies related to future trends in groundwater development in the state. Pioneering efforts relative to water resources planning in the Upper Big Blue and Republican River Basins were signal achievements.

DEADLINES FOR RESEARCH PROPOSALS

Deadlines for filing research proposals for fiscal year 1976 with the Water Resources Research Institute have been established. Matching grant proposals must be received not later than September 15, 1974 and annual allotment proposals not later than December 15, 1974.

Prospective principal investigators should make an appointment to discuss their proposals with the Institute Director before they begin writing.

For further information, contact: Dr. Warren Viessman, Jr., Director, Water Resources Research Institute, 212 Ag. Engineering Building, University of Nebraska, Lincoln, Nebraska 68503. Telephone 472-3307.

TWO MATCHING GRANTS FUNDED

The Nebraska Institute is pleased to announce approval of two matching grants by the Office of Water Resources Research: "Herbicide Transport in Soil Under Center Pivot Irrigation Systems" (principal investigator Dr. Terry L. Lavy, Department of Agronomy), and "Validation and Implementation of a Simplified Streamflow Simulator" (principal investigator Dr. Alvin J. Surkan, Department of Computer Science).

The objectives of Dr. Lavy's project are to define soil moisture parameters governing herbicide mobility in sandy soils and devise methods for controlling the movement of these materials. Studies will be conducted to determine the rate and extent of herbicide leaching which may occur in sandy soils receiving ample supplemental moisture. By studying different combinations of herbicides, various amounts and intensities of supplemental moisture and different soil types, principal factors governing movement of herbicides through the soil profile will be determined.

Dr. Surkan's project will improve and extend the limits of application of a streamflow simulator (HYDRA) designed to model drainage networks. Documentation to facilitate and encourage implementation of the model by

potential users will be prepared. Development of an interactive version of HYDRA is also proposed. The project is designed to produce a simple yet reliable tool for hydrologic systems planning. It will provide persons concerned with the behavior of hydrologic networks a fundamental understanding of factors that must be considered in contemplating changes to natural or artificial systems.

OWRR SCIENTIST TO VIST NEBRASKA

L. Curt Davis, Staff Scientist of the Office of Water Resources Research, will visit the Institute June 3-5 to review Nebraska's research program and meet with principal investigators. Mr. Davis will also meet with the Institute Executive Committee to discuss OWRR's research goals and answer pertinent questions.

On June 5, a trip to the North Platte Station and the Sandhills Laboratory has been scheduled. Mr. Davis will visit on-going research projects, study results obtained and meet with project leaders at the Station.

NEBRASKA'S RESEARCH NEEDS

The Nebraska Institute will sponsor a one-day workshop on state water research needs on Monday, June 10. Participants will include Natural Resource District general managers, representatives of state water agencies and members of the Institute's Advisory Committee.

The objective of the workshop is to establish research priorities based on information obtained from participants. These will be used in planning the research program of the Institute for the coming year.

For further information contact: Dr. Warren Viessman, Jr., Director, Nebraska Water Resources Research Institute, 212 Ag. Engineering, University of Nebraska, Lincoln, Nebraska 68503. Telephone 472-3307.

WATER PERMIT PROGRAM CHANGES HANDS

Although unofficial, The Environmental Protection Agency (EPA) has advised the State Department of Environmental Control (DEC) that approval for their takeover of the National Pollutant Discharge Elimination System should be forthcoming no later than June 6 or 7.

After DEC receives approval from EPA, the first public notice of a pending permit will be issued one week later. After a 30-day comment period, the first permit will be given. A letter will also be sent notifying all permittees that the State has taken over the program and that all future correspondence should be mailed to DEC. Any permits issued by or pending with EPA will continue to be handled by them until the expiration date, at which time DEC should be contacted for a new permit.

EPA has issued 179 permits leaving about 400 to be granted before December 31.

MRBC ANNOUNCES PLANNING GOALS AND OBJECTIVES

General planning goals and objectives of the Missouri River Basin Commission were approved at a recent Omaha meeting. Commission plans and programs will be directed at influencing achievement of the following objectives through water resources management, planning, development and preservation:

- (1) Enhancing the overall quality of life of basin residents;
- (2) Encouraging the orderly population growth of basin cities and communities with emphasis on communities in the 5,000 to 200,000 population size range;
- (3) Expanding the agricultural production capability of basin farms;
- (4) Preserving rare and representative ecological areas and protecting unusually scenic water resources areas;
- (5) Providing ample water resources recreation opportunities;
- (6) Reducing to safe and reasonable levels the pollution and contamination of the water environments;
- (7) Stimulating private industrial development and securing a sound agricultural economy;
- (8) Holding annual flood damages at the present average annual level; and
- (9) Providing safe and economical domestic water supplies.

BARBAROSSA NAMED MRBC DIRECTOR OF PLANNING

Nicholas L. Barbarossa, chief regional planner for the U.S. Water Resources Council, Washington, D.C., has been named director of planning for the 10-state Missouri River Basin Commission.

John W. Neuberger, MRBC chairman, said Barbarossa would begin duties with the Commission July 1, replacing Edgar A. Imhoff, who resigned in April to join the U.S. Geological Survey in Washington, D.C.

Barbarossa served as the first state director of water resources planning for the State of New York from 1962 to 1965, when his responsibilities were enlarged to include regulatory and management responsibilities as assistant director, Division of Water Resources. He joined the Water Resources Council in 1971.

Barbarossa is returning to Omaha, where he lived for 16 years until 1962 while he was chief of the hydraulics section, Missouri River Division, Corps of Engineers and supervisory hydraulic engineer, Omaha District Office, Corps of Engineers.

FEDERAL HIGHLIGHTS

NATION'S WATER QUALITY - GETTING BETTER OR WORSE?

Dr. V. E. McKelvey, Director of the U.S. Geological Survey, noted that not enough data has been collected to provide quantitative information on the state of the nation's water quality.

Speaking before the Seventh International Water Quality Symposium in Washington, D. C., McKelvey revealed the difficulties in characterizing the quality of the nation's water:

"First, we have not generally agreed upon single set of criteria that can be used as a yardstick to characterize natural water supplies. Secondly, in many places in the United States we lack the baseline data from which we can begin to measure changes in water quality resulting on the one hand from pollution control programs and on the other from continued agricultural, industrial and urban development.

"The gross way of examining the question of trends in water quality is to examine trends in total withdrawal of water. Between 1950 and 1970, the total withdrawal of water in the United States increased from 200 to 370 billion gallons a day--an 85 percent increase in withdrawal over a 20-year period. Considering that most of the water returned to the environment is of lower quality than when it was withdrawn, and that the amount withdrawn and returned has been increasing at the rate of about three percent per year, we say with some confidence that water quality in the overall has been declining. However, to simply say that water quality is declining in the overall is not very helpful.

"We need to know much more about the character, extent and magnitude of the decline and to be able to assess also the accelerated efforts of recent years to abate pollution. On a case study basis we can provide such information in many areas; many examples could be cited of water quality improvement or degradation, but to attack the question on a more comprehensive basis, we find ourselves stymied by the lack of an adequate data base.

"Data inadequacies result primarily from three factors: past practices in measuring water quality, state-of-the-art technology and funding constraints. Now that we recognize the inadequacies, the federal government is today establishing the data base required to determine trends in water quality.

"The state-of-the-art technology and the data base of information are advancing rapidly, and hopefully, in the near future, we can be quantitative in answers to the question, 'Water quality--is it

getting better or worse?' Hopefully, also, those quantitative answers will help guide us to the remedial measures and practices that will make possible the overall answer an affirmative one in the years ahead."

WATER RESOURCES DEVELOPMENT ACT SIGNED

P. L. 93-251 (the Water Resources Development Act) was passed by Congress and signed by President Nixon. The bill authorized \$1.3 billion for new and continuing water resources projects under the Army Corps of Engineers.

In promoting the bill, Congressman Bob Jones (D-Ala) said that "whole regions of the country could, in the near future, be struck by shortages as crippling as today's energy shortages. The bill provides a major step forward ensuring the nation sufficient water of the proper quality to support the livelihood of all our citizens."

The Water Resources Development Act sets the interest rate in evaluating costs and benefits of water resources projects at 5-5/8 percent instead of the 6-7/8 percent proposed by the Administration. The President is required to study and report to Congress recommendations on principles and standards including interest rate formula and appropriate federal and non-federal cost sharing for water resource projects.

OSW FUNDS CUT (AGAIN!)

For fiscal year 1975, the administration is reducing funds for the Office of Saline Water to \$3,029,000. Using carryover funds, the total program will amount to \$4,869,000. During fiscal 1975, particular emphasis will be placed on laboratory solutions for specific non-cellulosic improved membranes and eutectic freezing and hydrate processes.

In recent hearings before the House Subcommittee on Water Resources, a number of witnesses opposed the reduction of the program and strongly recommended that additional funds be authorized, on the order of \$15 or \$16 million, to maintain a viable program.

EPA AND WPCF TO RECOMMEND CHANGES TO PL 92-500

Workshops to discuss changes in P.L. 92-500 (the 1972 Federal Water Pollution Control Act) were called by the Water Pollution Control Federation. Resolutions and case histories presented in the eight workshops will now be assembled and translated into specific legislative recommendations by the Federation's officers, Government Affairs Committee and staff. Proposals will then be submitted to congressional committees, their staffs and the National Commission on Water Quality. In particular, workshop participants cited examples of unreasonable and inflexible standards, poor administration and confusion over many of the law's requirements which should be changed.

The Environmental Protection Agency will also recommend that certain changes be made in the 1972 Act. John T. Rhett, deputy assistant administrator for water program operations, said that recommendations will suggest a delay in the 1977 deadline for municipalities to install secondary treatment facilities and a relaxation of the requirement for secondary treatment for ocean discharges.

MORE FLEXIBILITY FOR EFFLUENT GUIDELINES

Since February, effluent guidelines issued by EPA have given regional administrators some flexibility in applying the effluent limitations representing best practicable treatment to specific discharges.

The new guidelines allow "an individual discharger or other interested persons" to submit evidence that the factors related to a particular discharge are "fundamentally different from the factors considered in the establishment of the guidelines." If the regional administrator finds that such differences exist, the effluent limitations in the NPDES permit may be made more or less stringent than the guidelines specify.

At the present time, guidelines for the following industries have incorporated the new language: feed lots; glass, phosphate, cement, ferroalloy and asbestos manufacturing; rubber processing; and meat packing.

CONFERENCES

ENVIRONMENTAL ENGINEERING CONFERENCE

A specialty conference on "Environmental Engineering Research, Development and Design" will be held July 8-11, 1974 at Pennsylvania State University. Sponsored by the Environmental Engineering Division of the American Society of Civil Engineers and Penn State University, the conference will provide a forum for professionals to share the latest knowledge in the field of environmental engineering. Areas of high-rate water treatment, wastewater treatment, air pollution control and solid waste management will be emphasized.

The registration fee of \$30 includes a copy of preprint summaries of the technical papers to be distributed during the final registration period. A special registration fee of \$5 for students does not include a copy of the preprints. Participants are urged to register in advance.

For further information, contact the general program chairman: Dr. R. W. Regan, 212 Sackett Building, Penn State University, University Park, Pennsylvania 16802. Telephone (814) 863-0601 or 865-8391.

WATER RESOURCE SYSTEMS SHORT COURSE

A five-day short course, "Multi-Objective Analyses of Complex Water Resource Systems," will be held at Utah State University August 5-9, 1974.

The seminar should provide participants with basic knowledge of systems analysis and simulation, as applied to water resource systems; some appreciation of the capabilities and usefulness of systems analysis techniques in water resource planning; and present the state-of-the-art of multi-objective systems analysis in relation to planning, development and management of water resource systems.

Guest instructor will be Dr. Yacov Y. Haimes, Associate Professor of Engineering in the Systems Engineering Department, School of Engineering, Case Western Reserve University. Guest lecturers will include: Dr. Warren A. Hall, Director, Office of Water Resources Research; and Dr. Gary Cobb, Assistant Director, U.S. Water Resources Council.

Classes will be conducted morning and afternoon of each day. Two optional evening "tutorial" sessions will be available to interested participants.

For additional information, contact: Dr. Trevor C. Hughes, Utah Water Research Laboratory, UMC 82, Utah State University, Logan, Utah 84322.

PUBLICATIONS

EPA ANNOUNCES FACILITIES PLANNING GUIDE

The Environmental Protection Agency has published a guide book entitled "Guidance for Facilities Planning" to help states and municipalities obtain federal grants for construction of publicly owned waste treatment plants. The report is designed mainly for engineers, officials and planners directly involved in preparing facilities plans and includes procedural guidance and technical data.

Emphasis is placed on the process of facilities planning, rather than on the prescription of detail, to allow more flexibility in meeting local conditions. Systematic economic and environmental evaluation of feasible alternatives and public involvement in the choice among alternatives is featured in the planning process.

Copies may be obtained from EPA's regional offices or by writing: EPA Office of Water Programs, Water Planning Division (AW-454), Waterside Mall, Washington, D. C. 20460.

EXPRO SECOND EDITION PUBLISHED

The Environmental Protection Agency announces publication of a second edition of EXPRO, a listing of \$35 million in research, development and demonstration projects scheduled to be funded during the remainder of fiscal year 1974.

The document lists specific projects to be funded in FY 1974 by EPA's Office of Research and Development and gives general guidelines for working with EPA under grant or contract support.

Hand-out copies of EXPRO '74 are available from the Research and Development representative in EPA's 10 regional offices and from the Allowance Staff, RD 674, Office of Research and Development, EPA, Washington, D. C. 20460.

Expro '74 may be obtained on loan from the Nebraska Water Resources Research Institute, 212 Ag. Engineering, East Campus, Lincoln, Nebraska 68503. Telephone (402) 472-3307.

WASTEWATER TREATMENT METHODS DISCUSSED

In response to the requirement of the Federal Water Pollution Control Act Amendments of 1972 calling upon EPA to announce best practical waste treatment methods, the Environmental Protection Agency has released a draft report concerning land application of wastewater, reuse of wastewater and the traditional methods for treatment and discharge of wastes.

The report describes alternative methods of wastewater disposal and will be helpful to municipalities which are required to prove that the system they have selected does offer the best practical treatment. The report is quite specific about prohibiting any land treatment project unless it complies with criteria designed to protect groundwater. Restrictions on the reuse of wastewaters will be kept to a minimum in order to encourage the construction of facilities capable of treating water to a degree of purity suitable for reuse for a variety of purposes. However, it is also noted that reuse would not be permitted if pollutants discharged were detrimental to groundwater quality or would impair the quality of surface streams.

Copies of the report are available for public review in Room 232, West Tower, EPA Headquarters, Washington, D. C. and at EPA regional offices.

EMPLOYMENT OPPORTUNITIES

GRADUATE RESEARCH ASSISTANTSHIPS AVAILABLE

The Institute of Water Resources at the University of Alaska has a limited number of graduate research assistantships available in the following water-related fields: Civil Engineering, Environmental Quality Engineering and Science, Geology, Hydrology, Land Resources and Interdisciplinary Studies.

Interested applicants should write: Director, Institute of Water Resources, University of Alaska, College, Alaska 99701.

FACULTY POSITION AT YALE

The School of Forestry and Environmental Studies at Yale University invites applications for a position as Assistant Professor of Forest Hydrology. Duties will include teaching a course in fundamental hydrology and forest watershed management to professional students in the school, as well as an advanced course in a related specialty. Supervision of doctoral students and research will also be involved. Engineering hydrology is essential and candidates should also have training and interest in biology of watershed management.

Interested persons should send curriculum vitae and three letters of recommendation, to Professor William E. Reifsnyder, Search Committee Chairman, Yale School of Forestry and Environmental Studies, Marsh Hall, 360 Prospect Street, New Haven, Connecticut 06511.

FACULTY POSITION AT MICHIGAN STATE UNIVERSITY

The Department of Civil and Sanitary Engineering at Michigan State University is seeking a person to teach and conduct research in the area of fluid mechanics and hydrology for the 1974-75 academic year.

Teaching duties will include undergraduate hydraulics and hydrology, and selected courses on the graduate level. The research assignment will be on a project involving the hydrological aspects of waste water recharge, supported by the Institute of Water Research. Projects already underway include prediction of groundwater movement and contamination, and surface hydrology. Additional research opportunities exist in areas of watershed management.

Qualified persons are encouraged to phone or write to: Dr. William C. Taylor, Chairman, Department of Civil and Sanitary Engineering, Michigan State University, East Lansing, Michigan 48824 or phone 517-355-5107.

POSTDOCTORAL POSITIONS AVAILABLE: MICHIGAN STATE UNIVERSITY

Two postdoctoral positions are available at Michigan State University for the 1974-75 academic year, jointly sponsored by the Department of Civil and Sanitary Engineering, and the Institute of Water Research. The research will be concerned with groundwater flow and surface hydrology in relation to wastewater recharge. Additional research opportunities exist in areas of watershed analysis and management.

Interested persons should contact: Dr. D. C. Wiggert, Assistant Professor, Department of Civil & Sanitary Engineering, or Dr. T. G. Bahr, Director, Institute of Water Research, Michigan State University, East Lansing, Michigan 48824.

RESEARCH REVIEW

PROJECT TITLE: "Biological Control of Sphaerotilus natans and Other Related Species in Waste Waters"

PRINCIPAL INVESTIGATOR: T. L. Thompson
Department of Microbiology

The objective of this project is to determine the feasibility of biological control of Sphaerotilus natans and related species in waste treatment plants and surface water subject to organic waste.

Sphaerotilus natans is an aquatic sheath-forming bacterium found as a normal inhabitant of surface waters. This organism is well adapted to growth in an aquatic environment. It is highly efficient in removing nutrients from dilute solution, and capable of employing a wide spectrum of organic compounds as sources of energy. Moreover, it can exist under conditions of reduced oxygen tension. The sheath material is not readily susceptible to biological degradation and also serves to protect these organisms from control by natural predators such as protozoa. Because of the adhesive characteristic of the sheath material, they act as a focal point for accumulation of other microorganisms and of various debris from the water. As a result, the organism tends to form extensive slime, cottony white plumes adhering to submerged surfaces in the contaminated water. In activated sludge tanks, growth is normally found as floating leathery debris. Accumulation of Sphaerotilus slime adversely affects all water life by severely reducing oxygen levels. It is estimated that the oxygen consumption per dry weight of Sphaerotilus slime was 10 to 20 times greater than that of normally occurring aquatic macrophytes.

The major problem in this area is "bulking" in industrial sewage treatment plants. Massive slimy accumulation occurs in Salt Creek for miles below the entrance of sewage effluent from our municipal sewage disposal plant. Moreover, all water samples examined from sewage lagoons in this area contain massive numbers of Sphaerotilus. It is probable that they contribute substantially to the odor and decreased efficiency of these lagoons.

An ideal agent for the control of *Sphaerotilus* would have the following characteristics: (1) a high degree of specificity; (2) stability in diverse and changing aquatic environments; (3) self-perpetuating in the environment; and (4) non-contributing to pollution. A *Sphaerotilus* virus (bacteriophage) would satisfy these requirements. In this study the feasibility of employing specific *Sphaerotilus natans* bacteriophages to control the massive growth of *Sphaerotilus natans* is being investigated.

During the coming year control of *Sphaerotilus* under simulated field conditions will be attempted. A 6-liter extended aeration unit of the type used to simulate the conditions of an activated sludge type of sewage treatment plant will be employed. The apparatus will be seeded with activated sludge from the sewage disposal plant of the State Highway Department. To date, various types of synthetic wastes have been used. Presently a stabilized system of synthetic dairy waste consisting of equal amounts of powdered cheese whey and powdered dry milk is being employed. This waste is not conducive to the establishment of *Sphaerotilus*.

A synthetic waste will be compounded which will yield a stabilized system and allow establishment of *Sphaerotilus*. The wash-out rate of bacteriophage SN-1 in the absence of host *Sphaerotilus* will be determined. The system will be seeded by *S. natans* ATCC 13338 and the system monitored at intervals over several weeks. The following will be checked: (1) average weight of suspended solids in effluent; (2) sedimentation rate of solids; (3) sludge volume index; and (4) the effect of the *Sphaerotilus* seed on the flora and fauna of the system. Bacteriophage SN-1 will then be added to the *Sphaerotilus*-seeded tank and the system checked as above. In addition, the bacteriophage titer will be followed for the duration of the experiment.

The outcome of these experiments will dictate possible modifications of the test system and further areas of investigation.

PUBLICATIONS RECEIVED BY THE INSTITUTE

1. Process Control Model for Oxygen Regeneration of Polluted Rivers, Phases IV and V, Dr. B. Davidson, New Jersey Water Resources Research Institute, Rutgers University, The State University of New Jersey, January 1974. (C. Y. Thompson Library)
2. Unrecorded Pollution and Dynamics of Biochemical Oxygen Demand, William Whipple, Jr., Joseph V. Hunter, Shaw L. Yu, John P. Hewitt, and John Cirello, New Jersey Water Resources Research Institute, Rutgers University, The State University of New Jersey, March 1974. (C. Y. Thompson Library)
3. Distribution of Autotrophic Nitrifying Bacteria in a Polluted Stream, M.S. Finstein and V.A. Matulewich, New Jersey Water Resources Research Institute, Rutgers University, The State University of New Jersey, February 1974. (C.Y. Thompson Library)

4. Survey of Oregon's Water Laws, Chapin D. Clark, Water Resources Research Institute, Oregon State University, Corvallis, Oregon, March 1974. (C.Y. Thompson Library)
5. Seasonal Changes in Water Quality and Primary Productivity in Doe Valley Lake, Edmond J. Bacon, Stuart E. Neff, University of Kentucky, Water Resources Research Institute, Lexington, Kentucky, March 1974. (C.Y. Thompson Library)
6. Sensitivity of Vertebrate Embryos to Heavy Metals as a Criterion of Water Quality, Phase I, Wesley J. Birge, John J. Just, University of Kentucky, Water Resources Research Institute, Lexington, Kentucky, 1974. (C.Y. Thompson Library)
7. Ammonia - Nitrogen Removal by Breakpoint Chlorination, Thomas A. Pressley, Dolloff F. Bishop, Adolf P. Pinto, Alan F. Cassel, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., September 1973. (C.Y. Thompson Library)
8. Laboratory Ozonation of Municipal Wastewaters, Stephanie G. Roan, Dolloff F. Bishop, Thomas A. Pressley, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., September 1973. (C.Y. Thompson Library)
9. Activated Sludge Treatment Systems with Oxygen, John B. Stamberg, Dolloff F. Bishop, Alan B. Hais, Office of Research and Monitoring, U.S. Environmental Protection Agency, Washington, D.C., September 1973. (C.Y. Thompson Library)
10. Regeneration of Chromated Aluminum Deoxidizers - Phase I Report, Harry C. Hicks, Robert A. Jarmuth, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., December 1973. (C.Y. Thompson Library)
11. An Oil Recovery System Utilizing Polyurethane Foam -- A Feasibility Study, R. A. Cochran, J. P. Fraser, D. P. Hemphil, J. P. Oxenham, P. R. Scott, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., October 1973. (C.Y. Thompson Library)
12. Management of Saline Water, C. V. Moore, J. H. Snyder, Water Resources Center, University of California, Davis, California, March 1974. (C.Y. Thompson Library)
13. Buffer Capacity in Aquatic Ecosystems, Frederick G. Pohland, William R. Bolton, School of Civil Engineering, in cooperation with Environmental Resources Center, Georgia Institute of Technology, Atlanta, Georgia, March 1974. (C.Y. Thompson Library)

14. Factors Controlling the Dynamics of Non-Ionic Synthetic Organic Chemicals in Aquatic Environments, J. L. Hemelink, R. C. Maybrant, Purdue University, Water Resources Research Center, West Lafayette, Indiana, December 1973. (C.Y. Thompson Library)
15. The Use of Questionnaires in Collection Information for Urban Flood Control Planning, L. Douglas James, Environmental Resources Center, Georgia Institute of Technology, Atlanta, Georgia, February 1974. (C.Y. Thompson Library)
16. Calculation of Soil Hydraulic Conductivity from Soil-Water Retention Relationships, A. E. Reisenauer, Battelle, Pacific Northwest Laboratories, Richland, Washington, 1973. (C.Y. Thompson Library)
17. Denitrification as a Pathway for Nitrate Removal in Aquatic Systems, D. W. Nelson, L. B. Owens, R. E. Terry, Purdue University, Water Resources Research Center, West Lafayette, Indiana, December 1973. (C.Y. Thompson Library)
18. Annual Report (July 1, 1972 to June 30, 1973), J. Herbert Snyder, Director, Water Resources Center, University of California, Davis, California, March 1974. (C.Y. Thompson Library)
19. Geomorphology, Hydrology, and Soils in Karst, Southern Indiana - Field Conference (April 24 - 25, 1974), Water Resources Research Center, Indiana University, Bloomington, Indiana. (C.Y. Thompson Library)
20. User Charges and Industrial Cost Recovery - Denver SMSA, George H. Aull, Jr., Thomas F. Jones, William G. Stringfellow, Environmental Protection Agency, Rocky Mountain-Prairie Region, January 1974. (C.Y. Thompson Library)
21. Aerial Spill Prevention Surveillance During Sub-Optimum Weather, Robin I. Welch, Allan D. Marmelstein, Paul M. Maughan, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., September 1973. (C.Y. Thompson Library)
22. Effects of Crude Oil and Some of Its Components on Young Coho and Sockeye Salmon, James E. Morrow, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., January 1974. (C.Y. Thompson Library)
23. Economic Evaluation of the Effect of Selected Crop Practices on Nonagricultural Uses of Water, H. Onishi, A. S. Narayanan, T. Takayama, E. R. Swanson, University of Illinois, Water Resources Center, 2535 Hydrosystems Laboratory, Urbana, Illinois, March 1974. (C.Y. Thompson Library)

24. Determination of the Fate of Polynuclear Aromatic Hydrocarbons in Natural Water Systems, Paul R. McGinnes, Vernon L. Snoeyink, University of Illinois, Water Resources Center, 2535 Hydrosystems Laboratory, Urbana, Illinois, March 1974. (C.Y. Thompson Library)
25. Water Resources Research in Virginia - Annual Report for Fiscal Year 1972, Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, February 1973. (C.Y. Thompson Library)
26. Water Resources Management for Metropolitan Washington: Analysis of the Joint Interactions of Water and Sewage Service, Public Policy, and Land Development Patterns in an Expanding Metropolitan Area, U.S. Department of Interior, Washington, D.C. (C.Y. Thompson Library)
27. Ozone in Water and Waste Water Treatment - A Bibliography, Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of the Interior, Washington, D.C., April 1974. (C.Y. Thompson Library)
28. Quality of Surface Water in Illinois, 1966 - 1971, Robert H. Harmeson, T. E. Larson, Laurel M. Henley, R. A. Sinclair, J. C. Neill, Illinois State Water Survey, Urbana, Illinois, 1973. (C.Y. Thompson Library)
29. Planning a Domestic Groundwater Supply System, James P. Gibb, Illinois State Water Survey, Water Resources Building, P.O. Box 232, Urbana, Illinois, 1973. (C.Y. Thompson Library)
30. Wells and Pumping Systems for Domestic Water Supplies, James P. Gibb, Illinois State Water Survey, Water Resources Building, P.O. Box 232, Urbana, Illinois, 1973. (C.Y. Thompson Library)
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QUESTIONS AND INQUIRIES

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