

Number 50

March, 1970

INSTITUTE ADVISORY COMMITTEE MEETING

The Fifth Annual Meeting of the Institute Advisory Committee was held in Raleigh on March 18, 1970.

Dr. Ralph E. Fadum, Chairman of the Board of Directors chaired the meeting. The Committee was welcomed by Dr. C. E. Bishop, Vice President, Consolidated University of North Carolina.

Progress reports on selected projects were presented by the following Principal Investigators:

Dr. J. K. Sherwani - "Use of Computers in Management of Ground Water Supply in Lower Coastal Plain"

Dr. T. J. Sheets - "Contamination of Surface and Ground Water with Pesticides Applied to Cultivated Crops"

Dr. John E. Hobbie - "Nutrients and Eutrophication in a North Carolina Estuary"

Dr. Charles M. Weiss - "Water Quality Management of Impoundments"

Dr. Edward H. Bryan - "Effect Urban Land Runoff on Water Quality"

Professor Shirley F. Weiss - "Multipurpose Reservoirs and Urban Development"

The luncheon speaker was Professor Charles Smallwood, Jr., Department of Civil Engineering, N. C. State University, who spoke on the University's Growing Program in Industrial Water Use and Waste Control.

During the afternoon Director Howells reviewed additional projects now underway and new studies proposed for FY 1971. Considerable discussion centered around means for increasing the interchange between the University and research users, and two new suggestions for improving this were warmly endorsed. These included having a member of the Committee participate in project reviews with the Director and the formation of Study Committees on a selective basis to deal more effectively with problem definition and research and extension needs.

A great deal of interest was shown in land use problems associated with water resource management. This ranged from the need for restrictions on lot size for septic tank waste disposal systems to the problems associated with the implementation of land use control measures required for proper water resource management.

The Advisory Committee concurred with the composition of the Institute's present and proposed programs as to balance and priorities.

OWRR MATCHING GRANTS APPROVED

The Office of Water Resources Research has notified the Institute of the approval of \$101,070 in new federal funds for the partial funding of the following projects starting July 1, 1970. Because of limited funds, the first two projects (S. Weiss and Moreau) have been funded for only the first year and supplemental proposals will have to be submitted for subsequent support. Non-federal matching funds will be provided from state appropriations to the Institute.

Planning of Regional Water Resources Systems for Urban Needs

The upper Piedmont region of North Carolina is typical of many urbanizing multi-river basin economic regions in which the hydrologic system is no longer a satisfactory planning framework. The problem is particularly acute in North Carolina where the major cities are located on upstream tributaries and regional systems for water supply and pollution control are almost imperative. Here, the problems of flood plain management, encroachment on reservoirs, water supply and pollution converge in a context which defies conventional analysis and planning on a river basin basis.

This study includes:

1. identification of emerging water and related land resource needs,
2. examination of existing planning and analytical models for determining courses of action,
3. exploration of a limited set of alternative system designs to serve urban areas,
4. examination of capacity of existing institutional structures to respond to the task, and
5. recommendations for appropriate modifications.

Principal Investigator: Dr. David H. Moreau, Department of City and Regional Planning, University of North Carolina at Chapel Hill

Starting Date: July 1, 1970

Completion Date: June 30, 1972

Urban Land Dynamics in Authorized Reservoirs

The changes which take place in land ownership around federal reservoir sites following initial announcement create endless problems for the construction agencies and local government. This project will extend present work by the principal investigator to include the development of guide lines for local government to counter land speculation and price escalation subsequent to announcement and prior to project completion. It will focus attention on two authorized prototypes -- Falls of the Neuse and New Hope Reservoirs.

Principal Investigator: Prof. Shirley F. Weiss, Associate Research Director, Center for Urban and Regional Studies, University of North Carolina at Chapel Hill

Starting Date: July 1, 1970

Completion Date: June 30, 1973

An Economic Study of the Effects of Municipal Surcharges on Industrial Wastes

Municipal water and sewer rates, as presently constituted, do not provide an economic incentive for the control of industrial wastes at the plant. Present attention is largely focused on treatment of the aggregate municipal waste flows with little or no attention to opportunities for reductions in industrial waste flows within the municipal system prior to waste treatment. Conventional treatment is already insufficient to maintain water quality of head water streams in many areas of the Piedmont. This study will develop an operational theory of industrial response to sewer surcharges. Using this theory and samples of industrial plants across time periods, elasticities of industrial response to surcharges and changes in water rates will be estimated. Social gains from surcharges will be appraised and publications for guidance of local officials prepared.

Principal Investigator: Dr. James A. Seagraves, Department of Economics North Carolina State University at Raleigh

Starting Date: July 1, 1970

Completion Date: June 30, 1972

Effects of Mosquito Control Ditching on High Salt Marshes in North Carolina

The North Carolina Board of Health has requested the Institute to initiate studies at the ecological effects of mosquito ditching in estuarine marshes. Some 15-20,000 acres of Juncus marsh have been drained to date with plans to drain approximately 100,000 acres in the future.

Study will include changes in dominant organisms and supporting system of food chains for unditched and ditched Juncus marsh and new aquatic ecological systems in the ditches. Will characterize and compare principal contributors to productivity, the principal larger animals supported and the food-nutrient exchanges between marsh and water.

Principal Investigator: Dr. Howard T. Odum, Institute of Marine Science, University of North Carolina at Chapel Hill

Starting Date: July 1, 1970

Completion Date: June 30, 1972

Effectiveness of Ditching in Estuarine Marshes for Mosquito Control

See previous related project.

This phase of the study will be concerned primarily with determination of the effects of ditching upon the production of mosquitoes in Juncus marsh.

Principal Investigator: Dr. Kenneth Knight, Head, Department of Entomology, N. C. State University at Raleigh

Starting Date: July 1, 1970

Completion Date: June 30, 1972

STATE OF THE ART REPORT ON METROPOLITAN WATER RESOURCES MANAGEMENT

The Center for Urban Studies, University of Chicago, has just released a State of the Art Report on Metropolitan Water Resources Management produced under contract with the Office of Water Resources Research, U. S. Department of the Interior. A copy is available on loan from the Institute. A summary of findings and research needs is presented as follows:

The results give evidence of the evolution of metropolitan water resource management as an emerging specialized technical area. Although there are variations regarding specific scope and focus, a consensus does exist among the water researchers and managers regarding some criteria of metropolitan water resource management which define the current state of development. A review of the range of concepts identified as characteristic of metropolitan water resource management makes it apparent that the development of integrating mechanisms presents the greatest challenge for future research. Until such mechanisms are made workable, the state-of-the-art will tend to remain in its current position and fragmentation will continue to typify metropolitan efforts. The common thread is the recognition of regional integration as an important element.

Another observation that merits attention is the paucity of studies which embrace metropolitan water resource management characteristics. Only a few of the 250 defined metropolitan areas have had preliminary analyses.

The findings of this report substantiate Gilbert F. White's thesis as to the present state of American water management strategy--the evolution toward the concept of regional integration, the implementation of which awaits the formulation and development of integrative devices and a workable methodology. The hopeful aspect of these findings is that, with the apparent growing agreement on what constitutes metropolitan water resource management, the way is now open for a commitment of resources toward the development of such methodology. To this can be added the subscript that broad management programs must be launched in many of the metropolitan regions to provide frameworks for analysis and improved management.

The deficiencies uncovered in the analysis of metropolitan water resource management point to the following possible fruitful lines of research:

1. The development of workable methodologies to achieve regional integration for a range of management efforts encompassing both the land and water resources;
2. The formulation of approaches to bridge or narrow the gap between normative and descriptive metropolitan water resource management;
3. The application of metropolitan water resource management strategies to all metropolitan areas to provide a framework for unified land and water management.

Widespread recognition has been given to the need for identifying and systematizing or measuring the various considerations--a blending of social, economic, and political factors--which are peculiar to metropolitan areas. Efforts to proceed, however, have been stymied by uncertainties and lack of methodology. The scarcity of literature which directly confronts metropolitan water resource

management reflects, in part, (1) the existing narrow objectives of many of the operating agencies, and (2) the general absence of federal funds which would support such efforts.

At a period in time which is often characterized by credibility gaps, it might be wise to borrow a phrase from the students and "tell it like it is." Gilbert F. White also observed:

The shelves are bursting with plans and with normative studies of what would be optional solutions. A few inches will suffice to record what is known, in fact, to have happened.

Keeping these two admonitions in mind, metropolitan water resources management must be viewed as an emerging specialized technical area which, at present, does not lend itself to precise technical definitions. Metropolitan water resource management cannot long endure in its current state of development unless it is revived by new methodologies and hypotheses. Therefore, its future lies in the magnitude and success of future research efforts.

FWPCA GRANT TO START TRAINING PROGRAM FOR NATION'S HIGH SCHOOL STUDENTS IN WATER POLLUTION CONTROL

Secretary of the Interior Walter J. Hickel has announced a \$75,714 Federal Water Pollution Control Administration grant that will help launch an eventual nationwide training program for junior and senior high school students in water pollution control.

The grant awarded to the Tilton School, Tilton, New Hampshire, will double the number of schools and students who took part in the initial training and curriculum development project last year. Eighty students and teachers representing 40 schools will take part in the 1970-71 program.

In the second year of the program, the high school biology and science teachers and the students will gain additional experience in field and water laboratory testing techniques.

They will also modify and rewrite the 1969 preliminary Learning Guide in order to provide objectives, procedures and teachers' plans for scientific analysis of water, as well as to study social, legislative, and historical factors.

W. DON MAUGHAN NAMED EXECUTIVE DIRECTOR OF WATER RESOURCES COUNCIL

Secretary of the Interior Walter J. Hickel, Chairman of the Water Resources Council, has announced the appointment of W. Don Maughan, 47, Carmichael, Calif., as Executive Director of the Council.

Maughan has spent the past 23 years in water resources planning, and since

the mid-1950's has participated continuously in interstate and Federal-State studies. Beginning in 1963 he helped arrange negotiations which resulted in western State endorsement for the Colorado River Basin Project, which finally was authorized in 1968. He aided in drafting organizational rules for the 11-State Western States Water Council and has been technical adviser to the California delegation on that Council since its creation in 1965.

Before accepting the Federal appointment, Maughan was Chief, Interstate Planning Branch, California Department of Water Resources. Prior to his State service he was employed several years by the Bureau of Reclamation in Carson City, Nev., and Salt Lake City, Utah.

Mr. Maughan received his bachelor of science degree in civil engineering from the University of Utah in 1944. He is a registered professional engineer in California and Utah and a member of the American Society of Civil Engineers.

The Water Resources Council was established in 1965 to provide more effective Federal leadership and coordination of Federal water planning and action programs and to encourage comprehensive water and related land resource planning on the basis of Federal-State cooperation. It has no construction program.

In addition to the Secretary of the Interior, the Council consists of the Secretaries of Agriculture; Health, Education, and Welfare; Army; and Transportation, and the Chairman of the Federal Power Commission. The Secretaries of Commerce and Housing and Urban Development are Associate Members. The Attorney General and the Director, Bureau of the Budget are observers.

SECRETARY HICKEL ASKS LEGAL ACTION AGAINST FLORIDA POWER COMPANY

Secretary of the Interior Walter J. Hickel has requested the Justice Department to take legal action against Florida Power and Light Company after learning that the firm would not cease digging a canal to carry heated water into Card Sound and Biscayne Bay.

The Secretary served notice at a Federal-State enforcement conference in Miami, that he would take court action, if necessary, to prevent the thermal pollution of Biscayne Bay. The company later indicated its unwillingness to meet his demands.

Marine life in Biscayne Bay National Monument, which lies immediately south of the City of Miami, would be adversely affected by the inflow of the heated water. Estimates are that 5.5 billion gallons a day will flow through the canal when the nuclear power plant at Turkey Point reaches full operation.

Biscayne Bay was established as a national monument on October 18, 1968, and includes nearly 200,000 acres of islands and their adjoining bay and ocean

waters. The national monument is within easy reach of millions of people and lies between Key Biscayne and Key Largo. Its waters and lands are described as "brimming" with tropical plant and animal life.

KASHEF WATER RESOURCES EDITOR

Dr. Aziz I. Kashef, Professor of Civil Engineering, N. C. State University has assumed editorship of the Water Resources Bulletin, Journal of the American Water Resources Association. The first issue of the Journal in its new format was published in February, 1970.

WATER RESOURCES RESEARCH ACT AMENDMENTS

On February 17, 1970 Representatives Saylor of Pennsylvania and Robison of New York, introduced H.R.15957 to amend the Water Resources Research Act of 1964 to provide for an increase in the authorized annual allotments to State Water Resources Research Institutes from \$100,000 to \$250,000 and to authorize programs for the extension of research results into practice. Shortly thereafter, Senator Moss of Utah, Representative Johnson of California and Representative Morse of Massachusetts introduced identical bills, S.3553, H.R.16285 and H.R.16274.

Senator Moss and Representatives Saylor and Johnson are senior members of the Senate and House Committees on Interior and Insular Affairs -- the Committees which would handle the proposed legislation.

The legislation is very important to the North Carolina program and has been endorsed by President William Friday in letters to North Carolina Senators and Representatives.

LEAGUE OF WOMEN VOTERS PUBLICATIONS ON WATER POLLUTION

Where Rivers Meet the Sea is the latest League publication concerning the protection and conservation of the nation's water resources. It presents, concisely and comprehensively, the complex issues facing planners and people regarding the future use of estuarine areas -- the coastal stretches of land and water where fresh water rivers enter the ocean.

The booklet points out that choices must be made NOW. The next decade will be critical in terms balancing the competing demands on the use of estuarine areas which: "mean different things to different people; wonderland or wasteland; scenic area or dumping area for dredging spoil and solid wastes; nursery for fin-fish or shellfish; or site for marinas, homes and industry."

To help individuals make a.. informed choice, Where Rivers Meet the Sea presents a balanced view of: the commercial and conservation potential of estuarine areas; their role in marine and wildlife ecology; current administrative and legislative controls; and alternatives for state and national policies aimed at obtaining maximum long-term social and economic benefits.

Who Pays for a Clean Stream? looks at the question of pollution control of the nation's rivers with specific emphasis on the question of financing water quality programs. It explains, in understandable and readable form, the "who" and "how" of financing sewer systems and treatment plant facilities; recent trends in local, state and federal financing; and the pros and cons of providing anti-pollution incentives to industry.

So You'd Like to Do Something About Water Pollution is written for the citizen who is concerned about the pollution problem. It offers specific information on what people can do about water pollution both as individuals and as part of an organization or group. The booklet also contains a bibliography of available pamphlets, books and films.

Copies of the three publications can be ordered from the League of Women Voters, 1730 M-Street, N.W., Washington, D.C. 20036, at the prices quoted below. (orders must be prepaid.)

Where Rivers Meet the Sea - \$0.50/copy (10 copies for \$4.00)

Who Pays for a Clean Stream - \$0.15/copy (10 copies for \$1.00)

So You'd Like to Do Something About Water
Pollution - \$0.20/copy (10 copies for \$1.80)

FEDERAL FUNDS FOR POLLUTION CONTROL IN NORTH CAROLINA INCREASE

North Carolina will receive almost \$20 million in Federal funds this year to fight water pollution, the Federal Water Pollution Control Administration has announced. This represents a 300 percent increase over fiscal year 1969.

Communities in North Carolina can qualify for Federal financing of up to 33 percent of the total cost of a water pollution control project. In some States, however, the FWPCA can pay up to 55 percent of the total cost. The difference is that if a State agrees to pay 25 percent, the Federal Government can pay an additional 25 percent, or a total of 55 percent.

The community of Stoneville, N. C. received a grant of \$132,090 under this program during the past month toward the construction of interceptor sewers and three secondary sewage treatment plants.

LEGAL CONSULTANTS TO NATIONAL WATER COMMISSION

The National Water Commission has announced the appointment of the following legal consultants to its staff:

Edward W. Clyde, practicing attorney, water resources law,
Charles E. Corker, Professor of Law, University of Washington,
Ernest Liebman, former legal advisor to the Water Resources Council,
Charles J. Meyers, Professor of Law, Stanford University, and
Frank J. Trelease, Dean of the College of Law, University of Wyoming.

STATUS OF STREAMFLOWS AND GROUND WATER IN NORTH CAROLINA

The February report of the U. S. Geological Survey on Water Resources Conditions in North Carolina reported streamflow slightly below normal in the eastern Piedmont. This varied from normal in the western Coastal Plain to excessive in the east.

Ground water levels in selected observation wells rose in most areas throughout the State.

DATES TO REMEMBER

April 9-10, 1970

19th Southern Water Resources and Pollution Control Conference,
Duke University

May 7, 8 & 9, 1970

Technical Seminar on Ground Water Resources of North Carolina,
N.C. State University at Raleigh

WATER RESOURCES LEGISLATION IN THE CONGRESS

Bills Passed:

S. 2701 To establish a Commission on Population Growth and the American
H.R. 15900 Future
H.R. 15954

S. Con. Res. 53, authorizing the printing as a Senate document the national estuarine pollution study.

S. J. Res. 172, to authorize the President to proclaim the first full calendar week in May of each year as "Clean Waters for America Week."

Bills Introduced:

S. 3354 To amend the Water Resources Planning Act (79Stat. 244) to include provisions for a national land use policy by broadening the authority

of the Water Resources Council and river basin commissions and by providing financial assistance for statewide land use planning.

- S. 3388 To establish an Environmental Quality Administration.
- S. 3401 To prohibit the sale or shipment for use in the U.S. of the chemical compound known as aldrin.
- S. 3402 "chlordane
- S. 3403 "DDD/TDE
- S. 3404 "dieldrin
- S. 3405 "endrin
- S. 3406 "heptachlor
- S. 3407 "lindane
- S. 3408 "toxaphene
- S. 3410 To establish a structure that will provide integrated knowledge and
H.R. 15778 understanding of the ecological, social and technological problems associated with air pollution, water pollution, solid waste disposal, general pollution and degradation of the environment, and other related problems.
- S. 3468 To establish an Environmental Financing Authority to assist in the
H.R. 15903 financing of waste treatment facilities.
H.R. 16020
H.R. 16103
H.R. 16112
H.R. 16143
- S. 3500 To amend the FWPC Act to protect the navigable waters of the U.S. from
H.R. 15566 further pollution by requiring that synthetic petroleum-base detergents
H.R. 15682 manufactured in the U.S. or imported into the U.S. be free of phosphorus.
- S. 3507 To amend the FWPC Act to ban polyphosphates in detergents and to establish standards and programs to abate and control water pollution by synthetic detergents.
- H.R. 15583 To provide a program of pollution control in selected river basins and waterways of the U.S. through comprehensive planning and financial assistance to municipalities and regional management associations for the construction of waste treatment facilities.
- H.R. 15605 To provide for a National Laboratory for Environmental Science.
- H.R. 15770 To provide for conserving surface waters; to preserve and improve habitat for migratory waterfowl and other wildlife resources; to reduce runoff, soil and wind erosion, and contribute to flood control.
- H.R. 15873 To amend the FWPC Act, as amended, to provide financial assistance
H.R. 15904 for the construction of waste treatment facilities.
H.R. 16104
H.R. 16113
H.R. 16142
- H.R. 15933 To authorize the U.S. Commissioner of Education to establish educational programs to encourage understanding of policies and support of activities designed to enhance environmental quality and maintain ecological balance.

- H.R. 15940 To provide for advance notice to the Secretary of the Interior and
H.R. 15967 certain State agencies before the beginning of any Federal program
H.R. 16223 involving the use of pesticides or other chemicals to eradicate or
control animal and plant pests.
- H.R. 15957 To amend the Water Resources Research Act of 1964, to increase the
H.R. 16274 authorization for water resources research and institutes and for other
H.R. 16285 purposes.
S. 3553
- H.R. 15969 To be known as the Pollution Abatement Act of 1970, to establish the
National Environmental Control Commission as an independent agency of
the government, and to vest in that Commission jurisdiction over
environmental pollution programs.
- H.R. 16072 To amend the Federal Power Act in order to provide for the regulation
of the amount of project reservoirs storage capacity that may be allotted
for water quality control.
- H.R. 16137 Requiring the Secretary of HEW to study and report annually to the
Congress on the health hazards of environmental pollution and the
availability of medical and other assistance to persons affected by
such pollution, especially when such pollution reaches emergency levels.

NEW PUBLICATIONS RECEIVED BY THE INSTITUTE

(These may be borrowed from the Institute for a two-week period or may be ordered from the organization issuing the publication.)

Water Resources Planning

"A Study of the Expenditures for Urban Water Services," ASCE Urban Water Res. Res. Prog., Technical Memorandum No. 7, by LeRoy H. Clem of the Travelers Res. Corp., Feb. 1969, ASCE, N.Y., N.Y.

"Methods Systemization Manual - Preparation of Hydrologic Engineering Computer Programs," Corps of Engineers, U.S. Army, Jan. 1970.

Water Quality Management

"Bulletin 32: Removal of Selected Contaminants from Water by Sorption of Coal," by Paul H. King, et al, Water Res. Res. Center, VPI, Blacksburg, Va., Nov. 1969.

"Appraisal of Granular Carbon Contacting, Phase III," by A. E. Cover, et al, USDI, FWPCA, Ohio Basin Region, Cinn., Ohio, May 1969.

"Appraisal of Granular Carbon Contacting, Phase I & Phase II," by A. E. Cover, et al, USDI, FWPCA, Ohio Basin Region, Cinn., Ohio, May 1969.

"Final Report - Economic Evaluation of Water Quality," by Univ. of California, Berkeley, Sanitary Engr. Res. Lab., College of Engr. & School of Public Health, Nov. 1969.

"Design and Cost of Liquid-Waste Disposal Systems," Report 692, Natural Res. Center, Univ. of Ala., University, Ala. 35468, by Charles D. Haynes & David M. Grubbs, Dec. 1969.

"Cleaning Oil Contaminated Beaches," by Northeast Region Res. and Development Program, Planning and Res. Office, Office of Res. and Dev., FWPCA, USDI, Wash., D.C., 20242, Aug. 1969.

- "Report of the Secretary's Commission on Pesticides and Their Relationship to Env. Health," Parts I and II, U.S. Dept. of HEW, Dec. 1969.
- "Interaction of Pesticide Pollutants and Aquatic Food-Chain Organisms," Report No. 13, Water Res. Res. Inst., Clemson Univ., Clemson, S.C., Nov. 1969 by John K. Reed, Dept. of Ent. & Zoology.
- "Photolysis Mechanisms for Pollution Abatement," by L. C. Kinney, et al, USDI, FWPCA, Ohio Basin Region, Cinn., Ohio, Oct. 1969.
- "Current Practice in Potato Processing Waste Treatment," by Kristian Guttormsen, et al, Publications Office, USDI, FWPCA, Wash., D.C., Oct. 1969.
- "Mathematical Model of Sewage Sludge Fluidized Bed Incinerator Capacities and Costs," by G. J. Ducar, et al, USDI, FWPCA, Ohio Basin Region, Cinn., Ohio, Sept. 1969.
- "Research Report No. 19 - Solution Geochemistry of the Water of Limestone Terrains," by John Thraikill, 1970, Univ. of Kentucky, Water Res. Inst., Lexington, Ken.
- "Mathematical Model of Tertiary Treatment by Lime Addition," by L. Seiden, et al, USDI, FWPCA, Ohio Basin Region, Cinn., Ohio, Sept. 1969.
- "Cost and Performance Estimates for Tertiary Wastewater Treating Processes," by Robert Smith, et al, USDI, FWPCA, Ohio Basin Region, Cinn., Ohio, June 1969.
- "Effects of Thermal and Other Forms of Pollution on Some Anadromous Fishes, Part 1," by Marke E. Chittenden, Jr., et al, Rutgers - The State Univ., New Brunswick, N.J. 08903, Jan. 1970.
- "Biological Aspects of Thermal Pollution," by Peter Krenkel & Frank L. Parker, Proceedings of the National Symposium on Thermal Pollution, Sponsored by FWPCA and Vanderbilt Univ., Portland, Oregon, June 3-5, 1968.
- "Engineering Aspects of Thermal Pollution," by Frank L. Parker & P. A. Krenkel, Proceedings of the National Symposium on Thermal Pollution Sponsored by FWPCA and Vanderbilt Univ., Nashville, Tenn., Aug. 14-16, 1968.
- "A Study of the Economic Impact of Water Impoundment Through Validity Testing of a Comparative-Projection Model," by John E. Pearson, Tech. Report No. 20, Water Res. Inst., Texas A&M Univ., Aug. 1969.
- "Water Quality and Value of Homesites on the Rockaway River, N.J.," by Jacquelyn Beyer, Rutgers - The State Univ., New Brunswick, N.J. 08903, Dec. 1969.
- "Proceedings Water Quality Management Symposium," sponsored by Adv. Council, Univ. Cal., Water Res. Ctr. & State of Cal., State Water Res. Control Bd., Report No. 16, Univ. of Cal., Water Res. Center, Dec. 1969.

Water Quantity Management

- "Feasibility Study of Electrical Geophysical Methods in the Determination of Sub-surface Hydrogeologic Environments in the Piedmont Area of South Carolina," Report No. 11, Water Res. Res. Inst., Clemson Univ., Clemson, S.C., July 1969, T. L. Drake, Dept. of Elec. Engr.
- "Investigation of a Linear Model to Describe Hydrologic Phenomenon of Drainage Basins," by Fred A. Schmer, Tech. Report 19, Water Res. Inst., Texas A&M Univ., Dec. 1969.
- "Evaluation and Application of a Digital Hydrologic Simulation Model," Report No. 12, Water Res. Res. Inst., Clemson Univ., Clemson, S.C., Nov. 1969, by James T. Ligon, et al.
- "Provisional Time-of-Travel for Illinois Streams," By John B. Stall and Douglas W. Hiestand, Ill. State Water Survey, Urbana, Ill., Report 63, State of Ill., Dept. of Registration and Education.

- "Availability of Rainfall-Runoff Data for Sewered Drainage Catchments," by L. S. Tucker, ASCE, Urban Water Res. Res. Program, Technical Memo No. 8, Mar. 3, 1969, ASCE, N.Y., N.Y.
- "Rainage Networks in the Largest Cities," ASCE Urban Water Res. Res. Prog., Tech. Memo No. 9, by L. S. Tucker, Mar. 17, 1969, N.Y., N.Y.
- "Some Notes on the Rational Method of Storm Drain Design," ASCE Urban Water Res. Res. Program, Tech. Memo. No. 6, By M. B. McPherson, Jan. 22, 1969, ASCE, 345 East 47th St., N.Y., N.Y.
- "Sewered Drainage Catchments in Major Cities," ASCE Urban Water Res. Res. Prog., Tech. Memo. No. 10, by L. S. Tucker, Mar. 31, 1969, N.Y., N.Y.
- "Metropolitan Water Resource Management," by John R. Sheaffer, et al, Center for Urban Studies, Univ. of Chicago, 1969.

Miscellaneous

- "1970 N.C. Agr. Chemicals Manual," Pesticide Fertilizer School, N.C.S.U., Jan. 12-13, 1970, Div. of Continuing Ed., Box 5125, Raleigh, N.C., Price - \$2.00.
- "1968 Annual Report of The Chief of Engineers on Civil Works Activities," Dept. of The Army, Corps of Engrs., Volume I, Supt. of Doc., USGPO, Wash., D.C. 20402, Price - \$1.75.
- "Pacific Northwest Laboratory Annual Report for 1968 to the USAEC, Div. of Biology and Medicine," Volume I Life Sciences, Part 1 Biological Sciences, AEC Res. Dev. Report, Jan. 1970.
- "State Government Organization: Agencies Dealing with Marine Resources," Univ. of Maine, School of Law, 1969.
- "An Inventory of Water Resources Developments in Texas," by Warren L. Trock, Water Resources Inst., Texas A&M Univ., August, 1969.
- "Oceanographic Ship Operating Schedules," Published by the Marine Sc. Affairs Staff of the Office of the Oceanographer of the Navy for the National Council on Marine Resources & Engr. Dev., Pamphlet #38, Feb. 1970.
- "Requirements for Effective Use of the Water Resources Scientific Info. Ctr.," (WRSIC) - Determined by Field Evaluation, Vol. 1, by J. B. Herbich, et al, Water Resources Inst., Texas A&M Univ., Nov. 15, 1969.

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