



ARIZONA WATER RESOURCES NEWS BULLETIN

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SEPTEMBER-DECEMBER 1977

OWRT FY-1979 ALLOTMENT GRANT PROPOSALS

Preliminary proposals seeking funding during FY-1979 from the U.S. Office of Water Research and Technology (OWRT) Annual Allotment Grant are being invited by the Water Resources Research Center (WRRC) at the University of Arizona.

"For consideration and inclusion in our presentation to OWRT, Washington, D.C., 12 copies of each preliminary proposal were to be in my office by the end of the working day, March 1, 1978," said WRRC Director Sol Resnick.

"Projects proposing to solve pressing State-level water problems will no doubt receive strong consideration," Resnick said.

Water-related research needs suggested by State agencies fall under the categories of economic, social and legal aspects; water supply and use; and water quality and pollution control. A complete listing is available from WRRC. The Arizona Water Commission, Arizona State Department of Health Services, Arizona State Legislature, Arizona State Land Department, Arizona Game and Fish Department, and Arizona Water Resources Committee submitted suggested water research categories.

"Proposals are invited from personnel of the three State universities and from State agency personnel who would collaborate with personnel from any of the three universities in a project," Resnick said.

"The amended Federal Water Resources Research Act of 1964 authorizes \$250,000 nationwide for the Annual Allotment Grant," Resnick said, "but the appropriation has been only \$110,000 for each of the past five years.

"The amendment to the Act also extended activities to include prototype operations and information dissemination, and particularly called for greater interaction with State agencies," Resnick explained.

"To comply with the last point," Resnick said, "State officials and members of the Arizona Water Resources Committee again will assist in evaluating submitted proposals. Only projects approved by this group will be submitted formally to OWRT," Resnick added.

The WRRC director suggested that proposals be relatively informal documents not to exceed ten pages. Proposal format and content guidelines, and examples of proposals previously submitted successfully are available from WRRC, Old Psychology Building #28, College of Earth Sciences, University of Arizona, Tucson 85721.

OWRT HAS \$1.3 MILLION FOR WATER REUSE RESEARCH

The Office of Water Research and Technology (OWRT) has budgeted \$1.3 million for water reuse research during FY-1979. Priority will be given to funding research and development efforts for the following major reuse applications: groundwater recharge; industrial process water; industrial cooling water; aquaculture; irrigation; domestic reuse; and energy conversion. Industrial research and development efforts should focus primarily on industries which use large amounts of water, according to Gary D. Cobb, OWRT director.

Proposals must be submitted with executive summaries. Each summary should identify clearly and concisely the water reuse techniques or methodologies addressed in the proposal, describe the general approach to be taken, define specific project objectives and state anticipated results, the target audience, and how the results can be used.

"These summaries facilitate our initial screening for relevance and responsiveness to the priority interests under consideration," Cobb explained.

Proposals postmarked after March 15, 1978 will not be considered. Please write or call Mr. Robert Madancy regarding technical aspects of the program. Telephone (202) 343-6481, or write to him at OWRT, Department of the Interior, Washington, D.C. 20240.

FLOODPLAIN DWELLER SURVEY

Persons living in Tucson 100-year floodplains "have no real appreciation of the flood danger" inherent in the areas where they dwell, according to a recent study.

Furthermore, residents threatened by the Rillito, Santa Cruz, Pantano and Tanque Verde rivers have a misplaced faith that dams, levees and other structural works will lessen the toll of death and damages.

Thomas P. Saarinen, University of Arizona geography professor, and Harold J. McPherson, University of Alberta (Canada), conducted the study during late 1974 and early 1975. Their analysis of "Floodplain Dwellers' Perception of the Flood Hazard in Tucson, Arizona" was published in a recent issue of *The Annals of Regional Science*.

Interviewed were 162 residents from all four 100-year floodplains who represented a balance of ethnic origin, occupation, age and sex. The interviews and the study were



completed before the heavy rains in southern Arizona during early October 1977 that produced damaging floods in many study areas.

"Floodplain users in Tucson in general were very satisfied with their neighborhoods and believe that the floodplain is an excellent place to live with no real disadvantages," according to Saarinen and McPherson. "A high proportion, 61 percent, do not appreciate that their area is in a flood danger zone while only 35 percent believe they would personally be affected.

"Chances of a flood are placed by half of the residents as low—low is defined as one or two floods a century—with another 25 percent assessing a higher probability," according to the researchers.

The geographers concluded from their study "that residents appreciate the risk for the floodplain as a whole, but do not recognize the danger in their own neighborhoods."

When floodplain residents were asked what they would do if they knew their neighborhoods would flood, Saarinen and McPherson said, "Over half had no response whatever, indicating that they had probably not considered the possibility seriously."

"Overall reaction to a flood would be to get out as quickly as possible. Very few people (responding to the study) would try to do anything to protect their property or make adjustments to reduce loss," according to the geographers.

"The residents are aware of a very narrow and restricted range of adjustments to flood hazards," they also reported. "Almost all consider the appropriate solution to be some form of engineering construction. . . . Few mentioned any type of individual adjustment and only a small percentage (14.8 percent) intend to purchase flood insurance.

"The most significant result is that very few people (seven percent) feel that the individual has any responsibility to do something to protect himself. The general consensus is that it is solely the concern of the government," Saarinen and McPherson reported.

"Residents will have to be informed and convinced of the real magnitude of the flood danger before they will accept management strategies," they pointed out. "They need to be made aware of the wide range of nontechnical alternatives such as flood proofing, insurance, zoning, warning systems and emergency evacuation procedures and to accept more personal responsibility in preventing flood loss," they added.

"Perhaps most of all, as long as floodplain users maintain their pessimistic attitude toward government action and their personal apathy, it would be extremely difficult, if not impossible, to successfully implement nontechnological flood protection strategies," Saarinen and McPherson concluded.

(This article was excerpted from a University of Arizona News Bureau Release written by Lori Stiles.)

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DROUGHT, SUNSPOT ACTIVITY STUDIED

Two University of Arizona researchers have discovered that drought areas in the U.S. West expand and contract rhythmically. Drought areas are largest every 21 to 22 years, about two years after every other period of minimum sunspot activity, or "the alternate minima," according to the researchers, Dr. Charles W. Stockton, assistant professor of dendrochronology, and graduate student David Meko.

Only once since 1700 was the drought rhythm interrupted, but it was quickly re-established. However, Stockton and Meko caution against making the assumption that lack of sunspots is responsible for drought.

Stockton used tree-ring data collected from 40 sites west of the Mississippi River to reconstruct drought patterns back to 1700. Drought severity was not considered in the study, only the size of the area affected within the western two-thirds of the United States.

"If drought has a periodic tendency, the most common approach is to try to relate (its occurrence) to geophysical time series. And the geophysical time series that corresponds best to this is the sunspot cycle," Stockton explained.

Stockton was very cautious in relating drought to sunspot activity. "When we started this project this was the last thing on our mind," he said. But at the suggestion of National Oceanic and Atmospheric Administration Climatologist J. Murray Mitchell, Stockton and Meko, along with Mitchell, compared their drought cycle reconstructions against those of sunspots.

Stockton said one important factor gleaned from the tree-ring studies and climate reconstructions is that climate fluctuates. For instance, a wet period preceded the Great Plains drought of 1934, the dust bowl year, which Stockton described as "severe." Great Plains farmers accepted the wet period as normal and expanded their farms by cultivating marginal areas. When drought struck in 1934, its impact was magnified because the marginal areas had been brought into cultivation.

"I think we can give some insights into the long-term picture so we know how the present situation stacks up when compared with the long term," Stockton said.

Drought severity is determined with the Palmer Drought Severity Index. Precipitation, temperature, soil moisture and other data are applied to the Index to determine drought severity; a minus two is a moderate drought, minus three is severe and a minus four is extreme. Stockton said the present drought in the San Francisco area has been as extreme as minus eight and parts of Northwest registered minus nine on the Palmer Index.

(This article was excerpted from a University of Arizona News Bureau Release written by Jim Lamb.)

CONDENSATION

Las Vegas Land Subsidence Revisited

A brief article about land subsidence in the Las Vegas, Nevada, area was presented in the *Arizona Water Resources News Bulletin*, 77-4, July-August 1977, which elicited a letter from Nevada Division of Colorado River Resources Administrator Donald L. Paff.

He points out that plans to alleviate groundwater overdraft in southern Nevada "were initiated in 1960 and culminated in the Southern Nevada Water System in 1971." The System can deliver up to 304 cubic feet per second (cfs) of Colorado River water to the Las Vegas Valley and Boulder City areas. Paff

adds, "Construction is under way to enlarge the capacity of the system to 638 (cfs) to allow further alleviation of groundwater pumping and meet water requirements.

"I believe that an investment of \$60,000,000 in the first stage facilities and an anticipated investment of approaching \$200,000,000 for the facilities now under construction and scheduled for completion in 1981 is more than . . . 'arrangements to begin pumping from the Colorado River.'"

The editors agree.

Paff concludes, in part, by noting that the "State of Nevada, the Federal government and the local community are acutely aware of and continue to take action to reduce and/or eliminate detrimental environmental impacts of the groundwater overdraft."

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Water Quality Standards Meetings

The Arizona Department of Health Services began a series of public meetings February 8, 1978 to solicit public opinion related to establishing water quality standards for Arizona.

Arizona is in the process of developing water quality standards for all surface waters in the State, standards necessary for constructing a water quality management program.

The water quality standard assigned to a lake or stream will affect the treatment level of any effluent to be discharged into that lake or stream. More importantly, the water quality standard imposed on a body of water will determine use of the water.

For further information, contact Lyndon Hammond, Arizona Department of Health Services, Environmental Services, Water Quality Control, 1740 W. Adams St., Phoenix, AZ.

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Lower Santa Cruz Basin Uplift

Groundwater pumpage in the Lower Santa Cruz River Basin, Arizona, may have caused a crustal uplift of about 2.4 inches between 1948 and 1967, according to a study by Thomas J. Holzer, U.S. Geological Survey, Menlo Park, CA.

Some 95.7 trillion pounds of water have been pumped from aquifers underlying the 3,228 square-mile basin since large-scale withdrawals began after World War II, Holzer says. He determined that the uplift of land over basement bedrock corresponds with the amount of uplift expected according to theory when a similar amount of weight is removed from under the earth's crust.

Crustal uplift apparently began with large-scale groundwater pumping in the basin, reversing a half-century of tectonic subsidence. When comparative dimensions are considered, Holzer's uplift figures correspond agreeably with the 6.8-inch crustal depression that followed filling Lake Mead.

USGS Director resigns

Dr. Vincent E. McKelvey resigned from his post as director of the U.S. Geological Survey (USGS) Jan. 1, 1978, according to Secretary of the Interior Cecil D. Andrus.

"Dr. McKelvey has made a significant contribution to the Nation's scientific advancement while serving as Director of the Survey since 1971," Andrus said. "I am pleased that Dr. McKelvey has expressed a desire to remain in the Interior Department and to return to his work as a research scientist after a new Director is selected."

An expanded role for USGS, including additional responsibilities for environmental protection, energy development and mineral leasing, makes a change in leadership desirable for the years ahead, Andrus said.

The Department of the Interior asked the National Academy of Sciences to select a panel of candidates for the directorship, according to Joan M. Davenport, assistant secretary for energy and minerals.

McKelvey, 61, has been a career scientist with USGS since 1941. He became the ninth USGS director in 1971 after serving as USGS chief geologist.

Created in 1879, the USGS employs nearly 12,000 scientific, engineering, technical and administrative personnel in support of a wide range of natural resource and environmental missions and responsibilities.

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WRC Director

Dr. Leo M. Eisel was appointed director of the U.S. Water Resources Council (WRC) by Secretary of the Interior Cecil D. Andrus, who serves as WRC chairman.

Dr. Eisel serves under Secretary Andrus and his WRC alternate, Guy Martin, assistant secretary of the interior for land and water resources. In addition to managing the WRC staff, Eisel is responsible for administering WRC functions established in 1965 by P.L. 89-80.

From 1973 to 1977 Eisel was Illinois Division of Water Resources director. In February 1977 he became director of the Illinois Environmental Protection Agency, responsible for water, air, noise and land pollution control and for implementing an Illinois public water program.

The WRC is composed of the secretaries of the Interior, Agriculture, Army, Commerce, Housing and Urban Development, and Transportation; director, Office of Management and Budget; Attorney General; administrators of the Environmental Protection Agency, Federal Energy Administration, and Tennessee Valley Authority; chairman, Council on Environmental Quality; chairmen and vice chairmen of river basin commissions; and chairmen of interagency committees.

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UCOWR Board Members and Officers

The Universities Council on Water Resources (UCOWR) elected the following persons to serve on its Executive Board for three-year terms expiring July 1980: J. Ernest Flack, University of Colorado; John C. Frey, Pennsylvania State

University; and William Whipple Jr., Rutgers-The State University.

Elected Board chairman and vice chairman for the current year were William Whipple Jr., Rutgers-The State University; and Daniel D. Evans, University of Arizona.

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PUBLICATIONS

USGS Annual Arizona Groundwater Report

The "Annual summary of ground-water conditions in Arizona—spring 1976 to spring 1977," *U.S. Geological Survey (USGS) Water-Resources Investigations 77-106*, has been published. The map report was prepared by USGS staff under the direction of H.M. Babcock, then USGS Arizona district chief, in cooperation with the Arizona Water Commission (AWC).

Groundwater pumpage in Arizona during 1976 was about 5.5 million acre-feet, bringing the total pumpage from Arizona aquifers since the beginning of record to some 165 million acre-feet. These large withdrawals have resulted in water-level declines in many of the State's aquifers.

Maps show potential well production, depth to water in selected wells during spring 1977, water-level change in selected wells during 1972-1977, and 1976 groundwater pumpage. Annual and accumulated pumpages since the beginning of record are tabulated.

Copies are available for distribution at the AWC office, 222 N. Central Ave., Suite 800, Phoenix, and at USGS offices in Room 5-A, Federal Building, 301 W. Congress St., Tucson; Suite 1880, Valley Center, Phoenix; 2255 N. Gemini Drive, Building 3, Flagstaff; 1940 S. 3rd Ave., Yuma; and Room 5312, National Center, 12201 Sunrise Valley Drive, Reston, VA.

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Arizona Water Resources Report Available

"Water Resources Data for Arizona, Water Year 1976" is a compilation of data about surface water, water chemical quality and groundwater prepared by the U.S. Geological Survey (USGS) in cooperation with the State of Arizona and various agencies within the State.

Contained in the report are discharge records from 237 gauging stations, 81 crest-stage, partial-record stations, and discharge measurements from 48 miscellaneous sites across the State. Stage records from three gauging stations along with stage and content records taken at 10 lakes and reservoirs are presented. Fifteen supplementary records are included with gauging-station records which consist of month and/or monthly stage, content, and evaporation amounts from lakes and reservoirs, diversions and return flows.

Water-quality records for 69 continuous-record stations, five partial-record stations and 46 miscellaneous sites are given in the report along with water levels in 89 observation wells selected for study around the State.

The report is identified as *U.S. Geological Survey Water-Data Report AZ-76-1* for ordering by the public at a nominal fee from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

Copies of the report are available for perusal at USGS offices in Room 5-A, Federal Building, 301 W. Congress St., Tucson; Suite 1880, Valley Center, Phoenix; Building 3, 2255 N. Gemini Drive, Flagstaff; 1940 S. 3rd Ave., Yuma; and Room 5312, National Center, 12201 Sunrise Valley Drive, Reston, VA.

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Groundwater Report on Lower Verde River Area Released

Groundwater resources in the lower Verde River area are small; water from the wells and springs is used mainly for domestic, stock and public supplies, according to the *Map showing ground-water conditions in the lower Verde River area, Maricopa, Yavapai, and Gila Counties, Arizona-1976*.

The map report was prepared by U.S. Geological Survey (USGS) staff under the direction of H.M. Babcock, then USGS Arizona district chief, in cooperation with the Arizona Water Commission (AWC). The maps shows the wells from which data were collected, including water level, depth to water, depth of well, specific conductance in micromhos and fluoride concentrations.

Spring data and information concerning irrigated fields as of 1974 in the mapped area are shown. Although few consecutive, long-term water-level measurements have been made in the area, available information indicates little or no water-level changes.

A limited number of copies are available from AWC, 222 N. Central Ave., Suite 800, Phoenix 85004. Copies are available for perusal in USGS offices in Room 5-A, Federal Building, 301 W. Congress St., Tucson; Suite 1880, Valley Center, Phoenix; 2255 N. Gemini Drive, Building 3, Flagstaff; 1940 S. 3rd Ave., Yuma; and Room 5312, National Center, 12201 Sunrise Valley Drive, Reston, VA.

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Manual of Water Well Construction Practices outlines construction standards developed by a committee of persons involved in well technology and contracting.

Described standards are aimed at educating the public and upgrading construction techniques to protect groundwater supplies.

The 178-page manual, PB-267 371/3WP, costs \$7.50 from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

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Construction of Linings for Reservoirs, Tanks and Pollution Control Facilities, by William B. Kays, describes the technology of linings designed for controlling seepage in reservoirs, lakes, ponds, canals and other hydraulic facilities used for conserving water and for pollution control.

The author emphasizes cut-and-fill earthen reservoirs because of economy and use of lining, but concrete and steel tanks are discussed. The advantages of flexible lining materials, or plastic and elastomeric membranes, such as zero permeability, good economics and large-sheet capabilities are detailed.

The 379-page book costs \$25 from John Wiley and Sons, Inc., 605 3rd Ave., New York, NY 10016.

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Rural Water Supply and Sanitation, by Forrest B. Wright, emphasizes water conservation and the importance of water in ecosystems.

The first part of the two-part publication discusses the importance of water; nature and resources; source development; treatment; head and pressure problems; pumps; and operation types and principles. Also covered are water systems: types and principles of operation; typical installations; maintenance; and sewage and garbage disposal.

A "how-to" guide comprises the second part of the book. It describes cutting to measure, reaming and threading steel pipe; "making" a threaded joint in steel pipe and joints in copper and plastic tubing; laying sewer and drain tile; and leveling to determine gravity head on water systems.

The 320-page publication is available for \$12.50 from Robert E. Krieger Publishing Company, Inc., 645 New York Ave., Huntington, NY 11743.

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The Effect of Land-Use Management on Flood Prediction, by Rod W. Smith, Donald K. Jamison and John W. Knapp, reports means of evaluating alternatives applicable to a watershed flood-management program.

The research investigated the effects of changes in land-use practices and hydrological parameters on urbanized area flooding. Study sponsors were the Virginia Military Institute, Central Shenandoah Planning District Commission and Virginia Polytechnic Institute and State University.

Soil Conservation Service modeling techniques were adapted to study-facility computing equipment and applied to flooding problems in the South River Watershed in and above Waynesboro, VA.

Bulletin 103 is free to Virginia residents. Cost to nonresidents is \$4 prepaid from T.W. Johnson, Virginia Water Resources Research Center, 617 N. Main St., Blacksburg, VA 24060.

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Preliminary Bibliography on Ground Water in Developing Countries, 1970-1976, by D.A.V. Stow, J. Skidmore and A.R. Berger, is a guide to recent subsurface water-resource work. References to 1,574 reports published in 1970 or later are included which deal wholly or in part with groundwater.

A questionnaire seeking critical comments, corrections and additions about or to the bibliography is included in the book. Organizations involved in groundwater research and technology are invited by the authors to provide a brief assessment of information needs and capabilities.

Further information about the publication is available from the Secretary-Treasurer, AGID, c/o Department of Geology, Memorial University, St. John's, Newfoundland, Canada.

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Public Opinion and Sociology of Water Resource Development (A Bibliography with Abstracts), by Edward J. Lehmann, contains 167 abstracts portraying citizen and official opinions about water resource programs involving water quality management, reservoirs, irrigation and drinking water. Effects of water resource development on regional or community social conditions also are presented.

The 172-page bibliography, NTIS/PS-77/0432/3WP, costs \$25 and is available from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

Please address your news items or comments on the News Bulletin to any of the three editors:

Phil Briggs, Arizona Water Commission, Suite 800, 222 North Central Avenue, Phoenix, Arizona 85004.

Jim DeCook, Water Resources Research Center, University of Arizona, Tucson, Arizona 85721.

Ken Foster, Office of Arid Lands Studies, University of Arizona, Tucson, Arizona 85721.

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CONFERENCES

The Cordilleran Section, Geological Society of America, will hold its 74th annual meeting this year in conjunction with the 65th annual meeting of the Paleontological Society, Pacific Coast Section, in the Geology/Physics Building, Arizona State University, Tempe, March 29-31.

Symposia scheduled during the meetings are "Meteorites and Impact Craters," "Basin and Range and Colorado Plateau Relationships," "Skarn Mineralization in Porphyry and Non-Porphyry Environments," "Ground Failure Caused by Groundwater Withdrawal from Tectonic Basins," "Upper Paleozoic Biostratigraphy and Paleontology in the Southwest," and "Behavior and Evolution of Composite Volcanoes."

Pre-meeting field trips and dates follow: "Pinacate Volcanic Field, Sonora, Mexico," March 26-28; "Terraces of the Lower Salt River Valley, Arizona," March 28; "White Picacho Lithium Pegmatites, Arizona," March 28; "Precambrian Pikes Peak Iron Formation, Arizona," March 28; and "Sacaton Porphyry Copper Deposit, Arizona," March 28.

Post-meeting field trips and dates are: "Superstition Volcanic Field, Arizona," April 1; "Groundwater Recharge with Sewage Effluent, Phoenix," April 1; "Squaw Peak Precambrian Metavolcanics and Kyamite-Viridine Locality, Arizona," April 1; "Land Subsidence and Earth-Crack Formation, Arizona," April 1; Geology of the Palo Verde Nuclear Site, Arizona," April 1; "Paleozoic Biostratigraphy and Paleontology along the Mogollon Rim, Arizona," April 1; "Barringer Meteorite Crater, Arizona," March 31-April 1; and "Peridotite Nodules and Peridot Mesa Vent, San Carlos, Arizona," April 1.

For further information contact Troy L. Péwé, Local Cochairman, Geology Department, Arizona State University, Tempe 85281, (602) 965-2883.

The Arizona Bureau of Geology and Mineral Technology will have a display area and will have publications for sale during the Cordilleran Section meeting. Of particular interest is the Bureau's Special Paper No. 2, *Geology of Central Arizona*, which contains literature about all of the pre- and post-meeting field trips.

A "Symposium on the Ground Water Effects of Power Production Activities" will be held during the week of April 17, 1978 in conjunction with American Geophysical Union (AGU) annual spring meeting in Miami Beach, FL. The Symposium is sponsored by the Ground Water and Water Quality Committees, Section of Hydrology, AGU.

The Symposium will address the effects produced, or which could be produced, on groundwater by power production activities, including radioactive waste disposal, and fossil fuel plant cooling tower brine disposal. Also to be discussed are treatments for and solutions to contaminant problems.

For further information contact Jack Robertson, AGU Ground Water Committee, U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025.

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The "3rd World Congress on Water Resources" is scheduled to be held in Sao Paulo, Brazil, June 2-7, 1978. For further information contact Secretary, Brazilian Committee, Terceiro Congresso Mundial de Recursos Hidricos, Caixa Postal 9721, Sao Paulo, Brazil.

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The "Fifth International Symposium on Urban Storm Water Management" is scheduled to be held at the University of Kentucky, Lexington, July 24-27, 1978.

Papers to be presented will include research results, design and analysis techniques and/or case studies related to quantifying rainfall, runoff, nonpoint water quality and/or sediment production in urban areas; economic trade-offs and legal implications associated with urban storm water management; techniques and case studies of innovative

systems for managing urban storm water runoff and sediment; hydraulics of urban drainage facilities; and application of remote sensing techniques to urban storm water management.

The Symposium is designed to provide practicing engineers with information usable by them in storm water management work. A limited number of more theoretical papers will be given. Waste water treatment will **not** be addressed in this Symposium.

For further information contact Ms. Elizabeth Haden, Symposium Coordinator, Office of Continuing Education, College of Engineering, University of Kentucky, Lexington 40506.

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The Water Resources Planning and Management, and the Irrigation and Drainage divisions of the American Society of Civil Engineers will sponsor a specialty conference on "Legal, Institutional, and Social Aspects of Irrigation and Drainage and Water Resources Planning and Management" at Virginia Polytechnic Institute and State University, Blacksburg, July 26-28, 1978 in cooperation with the Virginia Water Resources Research Center.

Sessions will include such topics as competition for water resources in metropolitan areas, legal problems in developing and using water supplies, enhancing environment in land and water development, legal problems involved in associated surface water and groundwater resources—in short, a wide range of topics which consider integrating social, legal and institutional factors with those of technology and engineering.

Further information is available from William R. Walker, Director, Virginia Water Resources Center, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

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