

Designing a Water Conservation Program

An Annotated Bibliography of Source Materials

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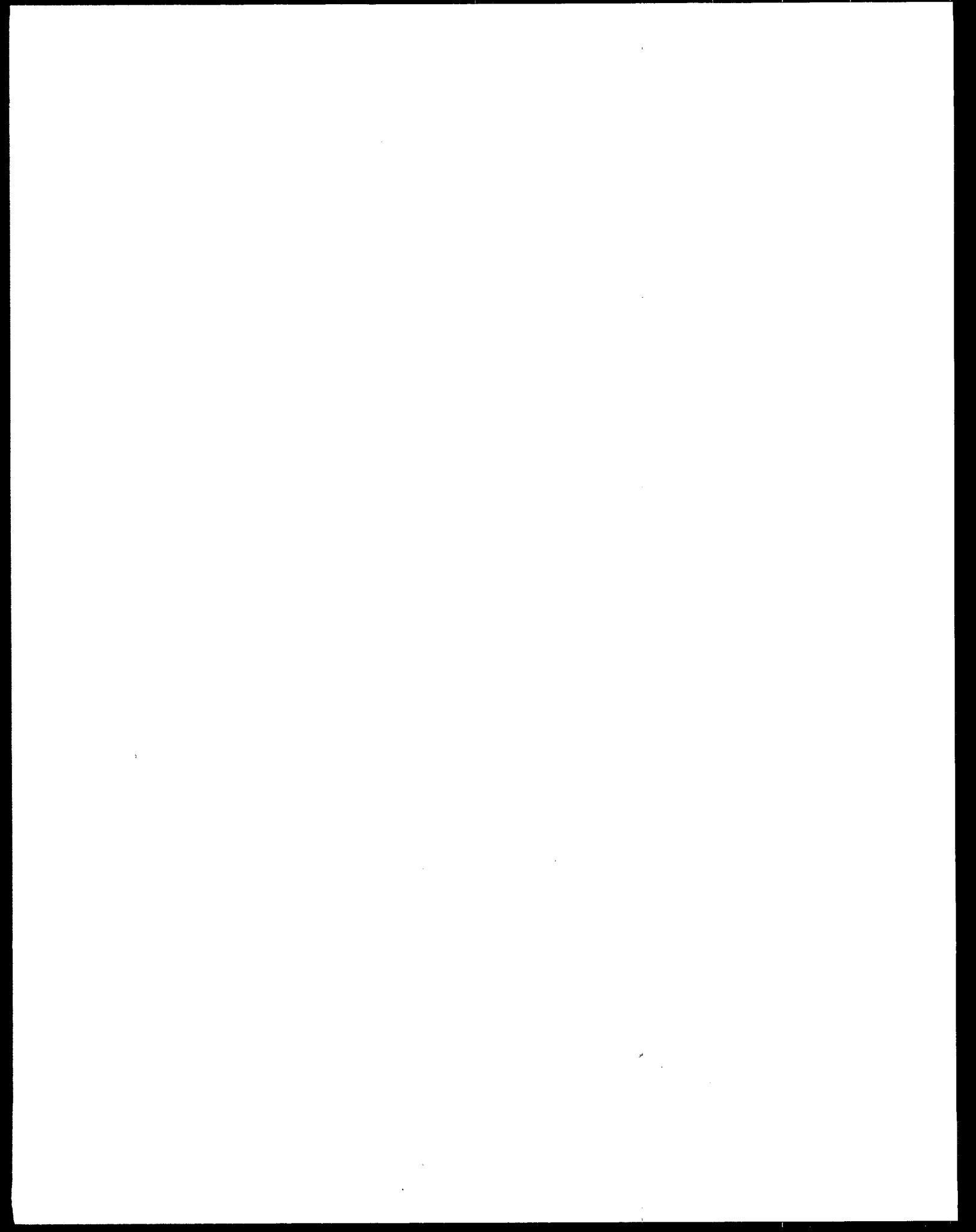
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Preface and Acknowledgements

This annotated bibliography of source materials has been prepared by Rutgers Cooperative Extension at Rutgers University/Cook College in New Jersey. The purpose of the bibliography is to give water planners, public officials, communities and community organizations, water utility managers, environmental organizations, and business and industry a starting point in their efforts to design a community water conservation program. The title, "Designing a Water Conservation Program -- An Annotated Bibliography of Source Materials," was conceived as a response to an expressed need by this audience for information on water conservation programs.

This work represents an exhaustive survey of the currently available literature on the water conservation subtopics listed in the contents. Information was sought from the major electronic databases including AGRICOLA (AGRICultural OnLine Access), CRIS (Current Research Information Systems), Enviroline™, Environmental Bibliography, Water Resources Abstracts, Waternet, Government Documents, ProSearch, Wilsondisc - Biological and Agricultural Index, CARL-UNCOVER (Colorado Alliance of Research Libraries), PENpages - through the Pennsylvania State University, QUERRI - Questions on University Extension Regional Resource Information, CERF (Cooperative Extension Reference Files), Water Quality Information Management System, Rutgers University card catalog, ERIC (Educational Resources Information Center), Business Periodical Index, PAIS (Public Affairs Information Service), Alternative Press Index, and RLIN (Research Libraries Information Network). The details of the electronic database search are included as a separate section entitled Bibliographic Search Methodology. In addition, information was sought from books in print, government manuals, pamphlets, research reports, and conference proceedings. Personal communication with many of the leading researchers and experts in the field led to many important sources of information.

The bibliography begins with the literature after 1980 through January 1, 1993. It builds on "An Annotated Bibliography on Water Conservation," produced for the U.S. Army Corps of Engineers, Institute for Water Resources by Planning and Management Consultants, Ltd., in April 1979. It includes some of the major work before 1980, and then selects the most important work in a variety of subtopics. The bibliography was designed to select those references and authors which have contributed to the advancement of knowledge in the field, but at the same time have presented the information in a form which can be used immediately by the targeted audiences. It is not designed to include all authors or references, but only major works and thus might better be called a selected bibliography. The subtopics presented are those the authors deemed to be of major value in designing a community water conservation program.

An additional criterion for inclusion for a particular reference was its availability. Each bibliographic entry has a section entitled Source:. Every effort was made to ensure that the reference has a complete address and in most cases a telephone number. This was done to allow easy access to the literature, avoiding wasted time and effort by the reader in obtaining the material.

If you find that some major gaps exist in the presentation of the literature, the authors would appreciate your communicating with them at the address below:

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1. Public Education Programs for Water Conservation

A Citizen's Guide to Community Water Conservation. National Wildlife Federation. 1989. 16 p.

Source: Water Resources Program, National Wildlife Federation, 1400 16th St. NW, Washington, DC 20036-2266, (202) 797-6800.

Abstract: This guide contains options available to meet community water demands. It also invites the reader to find water conservation solutions for the home and community and presents some key ideas that have proven effective for other communities.

A Guide to Designing a Community Water Conservation Program, Circular 378. National Agricultural Library Call Number S544.3.P4E8. Shelton, T.B. and W.E. Sharpe. Rutgers Cooperative Extension, Penn State Cooperative Extension--a joint effort. 1989. 15 p.

Source: Penn State Cooperative Extension, College of Agriculture, 112 Agricultural Administration Building, University Park, PA 16802, (814) 865-2541.

Abstract: This guide discusses water conservation strategies, gives sources of water conservation information, and relates practical advice on beginning a community conservation program. The guide should be of interest and value to water utilities, planners, environmental and citizens' organizations, and individuals concerned with increasing the efficiency of our nation's waters. Topics covered include public education programs, retrofit programs using water-saving devices, water rate structure revision, and reducing water loss in distribution systems.

A Sense of Water: Volume 1, Teaching Materials for Elementary Grades; Volume 2, Teaching Materials for Secondary Grades. Southern Arizona Water Resources Association, Inc. 1984. 132 p.

Source: Southern Arizona Water Resources Association, Inc., 48 N. Tucson Blvd., Tucson, AR 85075, (602) 881-3939.

Abstract: This book is designed to teach students about the limited water supplies in Arizona and teach them appropriate ways to deal with this knowledge. This book focuses on living in the desert, living with the desert, and understanding the limitations and possibilities open to us with water - a limited resource. The activities found at all grade levels present an opportunity for teachers to teach math, science, social studies, art, or language arts lessons with water as the subject material. The chapters cover such topics as why water is important, how water is distributed and used, why water becomes limited and polluted, and how to develop positive attitudes about water conservation.

American Water Works Association 1992 Publications Catalog. American Water Works Association. 1992. 80 p.

Source: American Water Works Association, 6666 W. Quincy Ave., Denver, CO 80235, (303) 795-2449.

Abstract: The American Water Works Association is a leading force in the development of water technology. For more than 100 years water professionals worldwide have looked to AWWA for new processes, innovations, and solutions. And, for more than 100 years, the association has responded-keeping the industry up-to-date and informed on important developments in drinking water technology. This catalog includes more than 400 titles covering all aspects of water treatment and distribution, utility management, training, safety, and more. There are also more than 50 new water conservation titles. The catalog supplies order information on AWWA periodicals, including the AWWA Journal and Mainstream, as well as their manuals and fact sheets.

American Water Works Association Publications.

Source: Journal American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235, (303) 794-7711.

A Public Education Campaign to Conserve Water. Brigham, A.P. December, 1976. Vol. 68, No. 12. p. 665-668.

Abstract: A sewer crisis prompted a water-saving program by the Washington Suburban Sanitary Commission. A series of efforts including extensive publicity and the mailing of water-saving kits has effected a substantial reduction in water use.

Back to Basics Guide to Water Conservation. Harmon, Rick. 1991. 13 p.

Abstract: This primer on drought or water shortage management for small water systems (10-1000 taps) is written for the general reader. Drought or a growing population can cause water shortages. This guide describes the basic steps an operator or water board must take before deciding if and when to start using water conservation strategies. First, one must determine the cause of the shortage: equipment failure, population growth outstripping new source development, weather, or other. A number of conservation strategies may be employed: retrofitting, metering, and water audits and leak detection are briefly described. Three sample operation plans are offered for handling shortages of various degrees of severity. The first entails voluntary conservation; the second mandatory conservation, and the third water rationing. Examples of restrictions are broken into two groups according to the severity; penalties and appeals are briefly discussed. As a longer-term alternative, the rate structure may be changed to encourage conservation. Factors to be considered when deciding whether a rate structure can encourage conservation, examples of modified rate equations, and policies that may be developed to support rate changes are also discussed. A sample flyer and press release to be used to encourage conservation are included. A bibliography refers readers to other works on specific subjects, such as rate making or water audits.

Community Relations Newsletter. June, 1977. 1P-1M-6/77-52006.

Abstract: This book contains a collection of Community Relations Newsletters dating from May 1975 to April 1977. The newsletters are for utility members of the American Water Works Association and stress specific ideas, techniques, programs, and materials that have proved successful in meeting public information challenges. Topics include the Safe Drinking Water Act, water quality issues, working with the news media, water rates, customer communication, as well as many others.

The Great Water Utility Cover-Up. 1992.

Abstract: This packet contains 3 different book covers that feature graphics and interesting facts about drinking water for school-age children. One cover lists water conservation ideas for school children, another discusses the water facts of life, and the third presents statistics about how much water is used for a variety of activities.

Water Conserving Landscapes Show Impressive Savings. Nelson, J.O. March, 1987. Vol. 79, No. 3. p. 35-42.

Abstract: A research project was conducted by the North Marin (CA) Water District to compare the use of key factors in traditional projects with those in water conserving projects on a monthly basis over the entire irrigation season. Factors included outside water, landscape labor, fertilizer, fuel, and herbicide. Microclimate data were collected to ensure the validity of the comparisons. The sample consisted of seven planned unit developments consisting of 548 dwelling units, all with mature landscapes, and was divided into two segments: traditionally landscaped projects and projects that met specific design criteria for water conservation. Results were examined by variance-regression analysis. It was concluded that, although the dollar savings attributed to fuel and herbicide were small, considerable savings could be achieved by the use of a water-conserving landscape design. An annual savings of \$75 per dwelling unit is possible in a condominium or townhouse development. The reduction in water and labor costs accounted for more than 80% of the total savings. A strong correlation was found between the perimeter of the turf and water use, indicating that turf perimeter may be the best parameter for defining a water-conserving landscape.

Xeriscape™ Programs for Water Utilities. Ball, K.

Abstract: The Conservation Management Committee of the American Water Works Association prepared this handbook to help utilities managers learn more about Xeriscape™ and its benefits. Topics covered include a

description of Xeriscape™ principles, a history of landscaping in the U.S., and how to organize a successful Xeriscape™ program.

Be Water-Wise--A Water and Energy Conservation Program (with instructor's guide). Virginia Water Resources Research Center. 1980. 49 p.

Source: Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University, 617 North Main Street, Blacksburg, VA 24060-3397, 703-231-8036.

Abstract: The primary aims of Be Water-Wise are to help users understand that water plays a critical role in our daily lives, to help them understand why water should be used wisely, and to make them more conscientious in responding to the need to conserve water. This activity booklet is designed to be used with middle school students. The printed information in the activity booklet is presented in a conversational mode and is accompanied by graphics that make it interesting and easily understood by young people. Student investigations are included to assist in keeping students actively involved in the learning activities and to help in reinforcing concepts introduced in the text of the booklet. Topics include the importance of water, water in the environment, getting water to and from our homes, the relationship between water and energy, water conservation in our homes, and water in the news.

Other publications available:

Be Water-Wise. 1983. 6 p.

Abstract: This illustrated brochure, a companion to the activity booklet, stresses ways to conserve water around the house.

Learning about Water Resources. October, 1989.

Abstract: This brochure lists the latest educational materials and publications developed by the Center.

Commercial Buildings, Water Conservation Bulletin 1. Massachusetts Water Resources Authority. 1989. 2 p.

Source: Massachusetts Water Resources Authority, Charlestown Navy Yard, 100 First Avenue, Boston, MA 02129, (617) 242-7110.

Abstract: The Massachusetts Water Resources Authority has produced a series of bulletins on water conservation issues for many different businesses and facilities. Other water conservation bulletins include:

- Hotels, Schools and Colleges, Water Conservation Bulletin 2
- Health Care Facilities, Water Conservation Bulletin 4
- Restaurants, Water Conservation Bulletin 5
- Laundry and Linen Suppliers, Water Conservation Bulletin 6
- Golf Courses, Water Conservation Bulletin 7
- Architects and Developers, Water Conservation Bulletin 8
- Laboratories, Water Conservation Bulletin 9
- Electroplating and Metal Finishing, Water Conservation Bulletin 10
- Athletic Facilities, Water Conservation Bulletin 11

Other publications available:

- A Renter's Guide to Water Conservation
- Appreciate our Liquid Assets
- Every Drop Counts
- Garden and Landscaping Water Conservation Tips
- Home Water Conservation Guide
- Rental Housing Owners and Managers: How to Save Millions of Gallons and Thousands of Dollars.
- Water Audit Guide

- Water Conservation Case Study: Cambridge Family YMCA
- Water Conservation Case Study: Digital Equipment Corporation
- Water Conservation Case Study: McCord-Winn Textron
- Water Conservation Case Study: Norton Company
- Water Conservation Case Study: Texas Instruments, Inc.
- Water Conservation Strategies for Industry, Retail Businesses, Schools, Hospitals, Utilities, Hotels, Restaurants, and Recreational Facilities

Communication Strategies for Heightening Awareness of Water: Report 2 of the IHP II Project C1 (On Heightening Awareness of the Socio-Economic Role of Water. Sadler, B.S. ed. 1987. 25 p.

Source: UNIPUB, Division of Kraus Organization, Ltd., 4611-F Assembly Drive, Lanham, MD 20706-4391, (301) 459-7666. ISBN 92-3-102469-8.

Abstract: (Book)

Community Water Supply - A Manual for User Education: A Community Participation Training Element for SPWP User Beneficiaries. 1987. 89 p.

Source: International Labour Office, 49 Sheridan Ave., Albany, NY 12210, (518) 436-9686. ISBN 92-2-105943-X.

Abstract: (Book)

Conserve Hot Water. Jenkins, Joyce H. March, 1979. 2 p.

Source: Clemson University Cooperative Extension Service, Bulletin Room, P & AS Building, Clemson University, Clemson, SC 29634-0310, (803) 656-3382.

Abstract: Fact Sheet

Conserving Water at Home. Heaton, L., Ilvento, T., Taraba, J. 1989. 4 p.

Source: University of Kentucky Cooperative Extension Service, College of Agriculture, Lexington, KY 40546-0064, (606) 257-7583.

Abstract: Fact Sheet

Department Publications of the California Department of Water Resources, 1990. April, 1991. 64 p.

Source: Department of Water Resources, State of California, Publications Counter, River City Bank Building, 1020 9th St., 3rd Floor, Sacramento, CA 95814, (916) 653-1097.

Abstract: This publication contains a list of all the resources available through California's Department of Water Resources. It also includes abstracts.

Other publications available:

A Pilot Water Conservation Program, Bulletin No. 191. October, 1978, 64 p.

Abstract: This bulletin reports on a study of the best and most cost-effective ways to introduce water-saving devices into homes. It is based on pilot programs conducted during the summer and fall of 1977 in six California communities of diverse characters and settings. The goals of the pilot program were: (1) to find out whether a significant amount of water and energy could be saved by installing water-saving devices in dwellings; (2) to determine which methods of distribution are most successful and cost-effective; (3) to evaluate the relative merits of offering devices free or selling them, and to determine which kinds of devices are most acceptable to the public; (4) to determine the feasibility of distributing water-saving devices throughout the state. The report also discussed the specific findings and conclusions from each separate community.

A Pilot Water Conservation Program, Appendix G and H, Device Testing. 1977. 300 p.

Abstract: This appendix contains the bidding and testing procedures used in the selection of water-saving devices for use in the Pilot Water Conservation program.

Agricultural Drought, Guidebook No. 6. June, 1988. 68 p.

Abstract: This guidebook has suggestions for managers in evaluating existing water supplies, developing emergency supplies, and reducing demands.

Case Studies of Industrial Water Conservation in the San Jose Area. February, 1990. 167 p.

Abstract: This report discusses 15 case studies of water-conserving companies, describing water uses, conservation measures, water-savings, and economic benefits.

Designing a Public Information Program for Water Conservation, Guidebook No. 3. October, 1984.

Abstract: This manual is a useful tool in developing a good water conservation public information program.

Drought Tips Series. 1992.

Abstract: This series covers many drought-related topics. Titles include:

- Central Coast Crop Coefficients for Field and Vegetable Crops
- Coping with Declining Groundwater Levels
- Deciding How Much to Plant During a Drought
- Field Use of Tensiometers
- Irrigation Water Management Made Simple
- Maintaining Water Quality for Irrigated Agriculture Under Drought Conditions
- Using Shallow Groundwater for Crop Production
- Water Balance Irrigation Scheduling Using CIMIS
- Water Quality Guidelines for Vegetable and Row Crops
- Water Quality Guidelines for Trees and Vines

Guidebook on Conservation-Oriented Water Rates. Guidebook No. 9. October, 1988. 16 p.

Abstract: This report contains information on water rates and rate making for those concerned with revising water rates.

How to do a Residential Retrofit Program, Guidebook No. 1. November, 1981.

Abstract: This manual focuses on the Office of Water Conservation's experience with distributing millions of water-saving kits to residences and draws on the experiences of others in California and other parts of the nation.

How to do an In-School Educational Program, Guidebook No. 2. January, 1984.

Abstract: This guidebook is designed to promote more widespread adoption of conservation education programs and help agencies develop their own programs.

How to Produce a Lawn Watering Guide, Guidebook No. 4. January, 1987. 14 p.

Abstract: The creation of effective lawn watering guides is discussed in this manual.

Industrial/Commercial Drought Guidebook for Water Utilities. June 1991. 31 p.

Abstract: This book describes effective programs for utility managers who provide specific conservation measures and conservation programs for on-site implementation.

Industrial Water Conservation Series. 1989.

Abstract: This series includes the following titles: Industrial Water Conservation (IWC) References of Textile Manufacturers and Dyers, IWC References of Paper and Packaging Manufacturers, IWC References of Food Processing, IWC References of Industrial Laundries, IWC References of Beverage Bottlers and Brewers, and IWC References of Electroplating.

Landscape Water Conservation, Guidebook No. 8. March, 1988, 23 p.

Abstract: The purpose of this guidebook is to help water districts institute landscape water conservation programs that will give consumers the information and techniques necessary to use our water wisely.

Managing Limited Urban Water Supplies. November, 1989. 122 p.

Abstract: This report contains the proceedings from the conference for California Water Agencies. It includes instructions on how to use the computer software entitled "Water Plan" and describes successful water conservation programs.

The Catalog of Water Conservation Public Information Materials. September, 1985.

Abstract: Includes listings of California's Department of Water Resources publications.

Water Audit and Leak Detection, Guidebook No. 5. August, 1986. 142 p.

Abstract: This guidebook provides practical methods and sample forms for conducting a water audit, as well as instructions for the most efficient way to detect leaks. This guidebook is also accompanied by Leak Audit Software, which quantifies distribution system losses. This software performs the calculations required by the guidebook's audit worksheet.

Water Conservation in California, Bulletin No. 198. July, 1984, 153 p.

Abstract: This bulletin reports on current water conservation developments in California in detail.

Water Conservation News.

Abstract: This newsletter, published quarterly since 1981, provides the latest information on urban and agricultural water conservation developments and activities. Write for information on how to be placed on the mailing list.

Water Plan SM.

Abstract: This is a computer software package designed to analyze the benefits and costs of water conservation programs.

Dollars Down the Drain: Saving Water, Energy, and Money in the Home. Glanville, T. July, 1989. 5 p.

Source: Cooperative Extension Service, Iowa State University, Ames, IA 50011, (515) 294-4576.

Abstract: Fact Sheet

Easy Ways to Save Water, Money, and Energy at Home, FRD-14. Wesely, E.F. 1980. 28 p.

Source: Dept. of Natural Resources, Cook College, Rutgers University, New Brunswick, NJ 08903-0231, (908) 932-9631.

Abstract: Easy Ways to Save Water, Money, and Energy at Home offers simple explanations on how consumers can purchase and install water-saving devices. The booklet begins with an explanation on why consumers should save water and where household water comes from and how homeowners use water. A water-saving program that includes low-flow showerheads, toilet dams, and faucet aerators, as well as behavior modification, is described. Other topics include leaks, reading the water meter, outdoor water conservation, figuring the cost of hot water, and where to buy water-saving devices.

Evaluating the Effectiveness of Promoting Residential Water Conservation through Exhibits.

Sevebeck, K.P., Walker, W.R. August, 1983. 254 p. PB 84140565.

Source: National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA, 22161, (703) 487-4650.

Abstract: This report discusses an exhibit program on residential water conservation designed and implemented by the Virginia Water Resources Research Center. The report describes five exhibits and includes information

on creating audio-visual displays, visitor participatory units, computer programs, and written educational materials to promote residential water conservation. It includes appendices with sources of equipment, describes computer programs, exhibits photographs, presents construction drawings, gives promotional materials, and provides sample evaluation and interview questionnaires. The exhibit proved to be very effective in changing attitudes and promoting residential water conservation

Extension's Role in Soil and Water Conservation. Hoag, D., Lilley, S., Smolen, M., Cook, M., Wright, J. March-April, 1988. Vol. 43, No. 2. p. 126-129.

Source: Journal of Soil and Water Conservation, 7515 Northeast Ankeny Road, Ankeny, IA 50021, (515) 289-2331.

Abstract: With many soil and water conservation programs comes responsibility. The responsibility of many of the managers of these programs is to take into account many variables at once, such as government intervention, pollution wildlife management, forestry, and agronomic and social factors. The wide variety and nature of these programs make it difficult for the Cooperative Extension System and other agriculturally based agencies to respond with accuracy. The Extension Service has recently increased its emphasis on the off-site problems related to agricultural productivity and has become involved in the area of education with new approaches, audiences, and training. Extension provides a bidirectional information flow between Extension users, county agents, on-campus specialists, and research providers; this allows the consumer to help guide the agenda of research providers at land-grant universities. Although few Extension programs address goals pertaining exclusively to soil and water use, Extension is committed to supporting such programs. In and through 1985, the primary soil or water related goals were soil conservation, water quality, and then water conservation.

Focus on Residential Water Conservation. Rubin, A. 1991.

Source: Agricultural Communications, Box 7603, North Carolina State University, Raleigh, NC 27695-7603, (919) 737-3113.

Abstract: Fact Sheet

Here's Your Leak Detection Kit. New Jersey-American Water Company. 1988. 4 p.

Source: American Water Works Service Company, Eastern Region, 500 Grove St., Haddon Heights, NJ 08035, (609) 547-3211.

Abstract: This leak detection kit is designed to save the consumer money and water in the home. The kit contains a packet of leak-tracing dye, a main valve shut-off tag and a brochure containing simple easy-to-follow instructions to help homeowners find and repair leaks. With a small amount of effort, the homeowner can find leaks that have been wasting water and money. The kit also describes how much water is wasted with different sized leaks. The American Water Works Service Company also has two short brochures entitled "Wise Water Ways" and Growing Wiser About Water." They offer homeowners several tips on how to grow wiser about their use of water, including household and personal water-saving tips and lawn and garden tips.

Home Lawn Watering Conservation Program. McCann, A., Gold, A. 1990.

Source: Rhode Island Cooperative Education Center, University of Rhode Island, Kingston, RI 02881, (401) 792-2900.

Abstract: Fact Sheet

Home Water-Saving Methods. Hermanson, Ronald E. May, 1991. 3 p.

Source: Washington State University Cooperative Extension Bulletins, Cooper Publications Building, Pullman, WA 99164-5912, (509) 335-2937.

Abstract: Fact Sheet

Household Demand for Water and Policies to Encourage Conservation. Clouser, R.L and Miller, W.L. August, 1979. 73 p. PB 80111891.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: Two rural Indiana communities were studied for methods of dealing with domestic water shortages. It was found that public awareness of water-saving devices is low. Distribution and use of domestic water-saving kits are advocated.

How Elmhurst Cut Water Use by 15%, Increased Existing Sewage Capacity by 4,800 People and Saved Itself \$400,000 in the Bargain. Fulton, N. 1978. 5 p.

Source: Dept. of Natural Resources, Cook College, Rutgers University, New Brunswick, NJ 08903-0231, (908) 932-9631.

Abstract: Discusses how a city of 50,000 reduced water consumption by 15 percent through consumer education, modification of plumbing codes requiring use of water-saving devices in new and replacement installations, and retrofitting existing toilets with displacement dams.

How to Conserve Water in your Home and Lawn. Solomon, D., Dersh, E. 1987.

Source: Michigan State Bulletins, 10B Agricultural Hall, MSU, East Lansing, MI 48824-1039, (517) 355-0240.

Abstract: Fact Sheet

How to Cut Your Water Use in Half and Still Stay Sane and Sanitary. Harrison, Randall. 1977.

Source: Communication Press., Box 22541, Sunset Station, San Francisco, CA 94122., (415) 386-0178. ISBN 0-918850-00-2.

Abstract: (Book)

Instructor's Guide to Water Education Activities. Commonwealth of Pennsylvania, Department of Environmental Resources, Water Conservation/Technical Assistance Program. 1982.

Source: State of Pennsylvania, Department of Environmental Resources, Water Conservation/Technical Assistance Program, PO Box 1467, Room 212, Harrisburg, PA 17120, (717) 541-7800.

Abstract: The purpose of this guide is to enhance student perception of the importance of our most valuable resource -- water. The information in this guide will enable instructors to effectively develop an understanding among students of the complexities of wise stewardship of our finite water sources. Within this guide, lesson concepts and associated activities have been developed under four topic areas: Why is water important?; How is water supplied and where does it go after it is used?; How do Pennsylvanians use water?; and residential water conservation. The guide does not provide the instructor with detailed lesson plans, but instead allows for a great deal of instructor flexibility and innovation. With this information, the instructor can develop a specialized program which satisfies the objectives of the class as well as individual student needs. Sources of further information are identified along with a key word listing for instructor use.

Irrigation Practices for Home Lawns. Throssell, C. 1990. 2 p.

Source: Purdue University Cooperative Extension Service, Agricultural Administration Building, West Lafayette, IN 47907, (317) 494-8489.

Abstract: Fact Sheet

Landscaping for Water Conservation - A Guide for New Jersey, E080. Shelton, T.B., Hamilton, B. 1987. 24 p.

Source: Publications Distribution Center, Cook College, Rutgers University, PO Box 231, New Brunswick, NJ 08903, (908) 932-9762.

Abstract: The purpose of this publication is to help the homeowner plan unique and pleasing landscapes that will use less water. By using the correct combination of design, plants, mulches, and watering techniques, the homeowner will be able to create landscapes that not only environmentally suit the specific locale, but also conserve water. The goal of the publication is to reach every person who is planning new landscapes or renovating older designs to improve outdoor water-use efficiency for New Jersey. Topics include a selection guide to woody and living ground covers, a selection guide to drought-tolerant plants, and a guide to the cost of watering.

Lawn management for conservation, NPS-11. Barton, S. 1989.

Source: New Castle Cooperative Extension Office, University of Delaware, 032A Townsend Hall, Newark, DE 19717-1303, (302) 831-1125.

Abstract: Fact Sheet

Lawn Watering. Duble, R., Knoop, B., McWilliams. 1991. 4 p.

Source: Texas Agricultural Extension Service, The Texas A&M University System, College Station, TX 77843, (409) 845-3211.

Abstract: Fact Sheet

Also available:

Landscape Water Conservation...Xeriscape™, B-1584. Welsh, D., Wlech, W., Duble, R. 1991. 12 p.

Abstract: In an attempt to reduce excessive water use, the Texas Agricultural Experiment Station has produced this brochure to promote Xeriscape™ landscaping. Seven basic Xeriscape™ principles are discussed and appropriate Xeriscape™ landscape plants are listed.

LEPA Conversion and Management. New, L., Fipps, G.

Abstract: Fact Sheet

North Marin's Little Compendium of Water-saving Ideas. North Marin County Water District. March 1977. 273 p.

Source: North Marin County Water District, P.O.Box 146, Novato, CA 94947, (415) 897-4133.

Abstract: This softcover book is an expansive, nontechnical discussion of residential water-saving ideas, techniques, and methods. The book contains a detailed bibliography and a cross-referenced list of manufacturers of water-saving devices, such as faucet flow control devices, insulation for hot water pipes, pressure-regulating devices, shower-flow control devices, reduced water toilet devices and systems, and lawn and garden irrigation controls. Other water conservation alternatives include consumer education, water metering, water pricing, water-saving appliances, lawn and garden irrigation techniques, low-water-use landscaping, and mandatory regulation.

Our Water...It's Too Valuable to Waste, A Guide to Residential Water Conservation. Haralson, M.K., Sheard, R. 1987. 27 p.

Source: The South Carolina Water Resources Commission, 1201 Main Street, Suite 1100, Columbia, SC 29201, (803) 737-0800.

Abstract: This booklet explains why water conservation is important in South Carolina and what homeowners can do to conserve water and reduce water waste in the home. Water conservation tips for indoors and outdoors are listed, as well as explanations of water-saving devices. Other topics include the origin of water, ground and surface water, and what causes water shortages. Other water conservation references are also listed.

Residential Water Conservation: An Annotated Bibliography, FRD-16. U.S. Environmental Protection Agency, Office of Water Program Operations. February, 1980. 113 p.

Source: U.S. Environmental Protection Agency, Office of Water Program Operations, 401 M Street SW, Washington, DC 20460, (202) 260-5700.

Abstract: This publication is an annotated bibliography produced for USEPA and HUD to meet a June, 1978, federal policy emphasizing water conservation. A search of five carefully selected subjects has produced a comprehensive listing of publications on water conservation tips, devices, and projects, as well as economic and regional variables.

Residential Water Conservation Techniques '91 Software Program. U.S. Environmental Protection Agency. 1991.

Source: Alfred E. Krause, U.S. Environmental Protection Agency, 77 W. Jackson, WC-15J, Chicago, IL 60604, (312) 886-9379.

Abstract: With more than 100 color graphics screens and animation, this program shows effective ways to save water inside and outside the house. Topics include efficient toilets, showerheads, faucets; leak detection, water-efficient lawn care and gardening; car washing and pool operation. Save amazing amounts of money while protecting the environment. The expert system feature allows users to calculate how much they will save by installing water efficient devices in their homes. Useful for the general public, town and county officials or utility managers, on-site installers, sanitarians, junior high through college students and science teachers, homesteaders, hotel and motel managers. USEPA also offers 15 other software programs, including a Water-Efficient Landscape Planner. All software programs are free of charge and are compatible with IBM PCs.

Running Dry: How to Conserve Water Indoors & Out. Addikson, R., Sellick, D. 1982. 120 p.

Source: Scarborough House, 901 B. Taylor St., Chelsea, MI 48118, (313) 475-1210. ISBN 0-8128- 2836-4.

Abstract: (Book)

Rutgers Cooperative Extension Publications, Materials on Water Conservation.

Source: Publications Distribution Center, Cook College, Rutgers University, PO Box 231, New Brunswick, NJ 08903, (908) 932-9762.

The Conservative Ones, slides with tape. Shelton, T. 1984.

Abstract: Describes the various types of water conservation devices which can be refit in the home. Approximately 15 minutes long.

Water Conservation for Homes, Institutions and Business, FS 107. Shelton, T.B. Rutgers Cooperative Extension. 1986. 2 p.

Abstract: Fact Sheet

Water Conservation Reference Notebook. Shelton, T. 1986.

Abstract: This manual contains a collection of water conservation materials from a variety of sources which were used for a conference entitled "Water Conservation for New Jersey." Topics include water conservation, planning, analysis, and program design; regulatory initiatives; technology and retrofit programs; education and public awareness; and general references.

Watering Guide for Home Gardeners, NE-236. Shelton, T.B., Indyk, H.W., Lacey, D.B., Drinkwater, W.O. 1980. 9 p.

Abstract: This guide is designed to help home gardeners make more efficient use of outdoor water, which can exceed indoor water use during the summer months. By using outdoor water wisely, the homeowner can reduce peak water demand, prevent drops in water pressure which endanger a community's fire fighting ability, prevent watering restrictions, and save the energy needed to pump water into storage areas around town. All this

translates into money saved for the individual home gardener. Topics in this booklet include when to water, trickle or drip irrigation, mulches, lawn watering, and a garden watering guide.

Save Water, Every Drop Counts: A Water Conservation Activity Book. New Jersey Dept. of Environmental Protection and Energy. 1985. 32 p.

Source: New Jersey Department of Environmental Protection and Energy, Division of Water Resources, CN 029, Trenton, NJ 08625, (609) 292-5550.

Abstract: This book was designed by the NJ Department of Environmental Protection and Energy to help educate students in grades kindergarten through 6 about the importance of water conservation, and how they can wisely use this precious resource. This book contains educational activities, puzzles, and games designed to stimulate teachers and students to devise water conservation activities. It is divided into three sections: "Where Does Water Come From?"; "Water and You;" and "Water and Our Future." Each section begins with a basic teacher's plan and is followed by student activities.

Also available:

Save Water: Every Drop Counts. 2 p.

Abstract: This brief pamphlet lists 15 things homeowners can do to conserve water both in the home and garden.

Saving Water Around the House. The Pennsylvania Public Utilities Commission. April, 1991. 14 p.

Source: The Pennsylvania Public Utilities Commission, Bureau of Consumer Services, P.O. Box 3265, Harrisburg, PA 17105-3265, (717) 787-4970.

Abstract: This book is designed to be a practical guide to water-saving ideas for your home. It includes suggestions on how to save water while conserving water in the bathroom, kitchen, laundry, and outside the home. Low-flow showerheads, faucets, and water-saving toilets are discussed as means of conserving water. The book also offers suggestions on how to conserve water in the garden and while washing your car.

Saving Water - The Conservation Video. Water Environment Federation. 8 minutes.

Source: Water Environment Federation, 601 Wythe Street, Alexandria VA 22314, (703) 684-2400.

Abstract: This eight-minute video details the adventures of Dino Sorrus and his friend Roberto. They travel to a museum in the future, where Roberto is surprised to find an exhibit where the last remaining drops of clean water on earth are displayed. Dino Sorrus explains that the water currently on earth is all there is and if people use and pollute too much water, it will not be cleaned and recycled fast enough to save it for the future. Roberto is then taught ways to conserve water by Dino Sorrus.

South Florida Water Management District Publications. Office of Communications. 1989. 8 p.

Source: South Florida Water Management District, Office of Communications. PO Box 24680, West Palm Beach, FL 33416-4680, (407) 686-8800.

50 Ways To Turn it Off: How You Can Help Save Florida's Precious Water Supply. 1992. 10 p.

Abstract: This short brochure describes 50 water saving ideas that utilize simple common sense as well as new technology. Topics covered include saving water indoors and outdoors and general water-saving tips.

A Guide for Local Governments Water-Efficient Landscaping, Ordinance Model with Annotated Outline, Xeriscape™ Implementation Manual, and Cost-Benefit Analysis. July 1992. 96 p.

Abstract: The information in this guide has been designed to assist local governments in the creation and enactment of water-efficient landscaping regulations. The ordinance model section includes a summary of the various Florida statutes providing for local authority to enact certain local ordinances. The implementation

section discusses a series of various options or methods of implementing the recommended regulations presented in the model ordinance. The cost/benefit analysis addresses the issues that local governments and the public must assess when considering the effectiveness of a xeriscape™ ordinance.

An Evaluation of Wastewater Reuse Policy Options for the South Florida Water Management District, Technical Publication 84-6. Adams, B., Sample, D., Woehlcke, L. April, 1984. 86 p.

Abstract: This report looks at the potentially successful applications of wastewater reuse in south Florida and attempts to estimate the impacts that development of these applications would have on the goals of specific groups, including wastewater suppliers and users. It also analyzes alternative policy options which would promote the implementation of wastewater reuse.

How to Save Water...Xeriscape™.

Abstract: The fundamentals of Xeriscape™ are discussed in this brochure.

Living With Less. Sun Sentinel. 39 p.

Abstract: This booklet contains a collection of articles which originally appeared in the *Sun-Sentinel* newspaper. The articles examine South Florida's drought and the future of the region's water supply. Also discussed are conservation technologies and water rates.

Model Xeriscape™ Code. January, 1987. 74 p.

Abstract: The objective of this landscape code is to be an integral part of the Comprehensive Water Demand Management Program of the South Florida Water Management District. The purpose of the code is to provide local governments a set of guidelines that will assist in District-wide efforts to reduce landscape irrigation water use to the lowest and most efficient, practical level. It is designed to be used as a guide in the development of municipal and county landscape codes.

Orlando Retrofit Water Conservation Program - Evaluation by the South Florida Water Management District. Wood, S. March, 1988. 69 p.

Abstract: This document reports on the results and cost-effectiveness of a 1982 program for installation of water-conserving plumbing devices in the City of Orlando. Although no statistically significant reductions in water use were found, the evaluation has brought into focus the need for guidelines and statistical modeling approaches for future water conservation efforts.

South Florida Water Management District Water Conservation Program. July 1990. 24 p.

Abstract: This publication describes the water conservation program that has been implemented in South Florida.

St. Augustinegrass Lawn Watering Guide. 1990.

Abstract: This slide chart informs the public about scheduling irrigation for St. Augustinegrass. The goal is to improve lawn quality while reducing water waste.

Turn It Off Times. Published quarterly.

Abstract: This quarterly publication is a forum for Floridians who are concerned about water resources and are looking for practical, effective ways to conserve water. It is a vehicle for compiling and disseminating information about advances in technology or conservation efforts by local government, water utilities, industries, agriculture, developers, environmentalists, and the public.

Water: A Precious Commodity.

Abstract: This brochure explains why South Florida is vulnerable to drought and why it is important for Floridians to protect and conserve the water supply in times of shortage. This publication explains the weather and climate patterns present in Florida that cause water shortages and also offers information about the role of the South Florida Water Management District, whose mission is to protect against floods, protect water supplies and the quality of water, and enhance the environment. The brochure also details the four phases of the water shortage plan and offers suggestions on how to conserve water around the home.

Water Shortage Plan. February, 1991. 32 p.

Abstract: This is an update of the 1986 Plan.

Water Shortage Plan. January, 1986. 35 p.

Abstract: This report explains the guidelines under which the South Florida Water Management District operates.

WaterLines. Published quarterly.

Abstract: WaterLines is a quarterly news publication of the South Florida Water Management District. It is published to provide information to the public on water resource issues and District programs and goals.

What is Xeriscape™? Video. 12 min.

Abstract: Other videos available include "Xeriscape™ Maintenance" and "Principles of Xeriscape™ Irrigation."

Xeriscape™. 1991. 4 p.

Abstract: This 4-page fact sheet provides a brief overview of the basic principles of Xeriscape™. Also included is a sample Xeriscape™ Plan and plant list.

Xeriscape™, Plant Guide II. 1991. 48 p.

Abstract: This guide explains the principles of Xeriscape™, which is water conservation through creative landscaping. This publication lists the Xeriscape™ plants that are appropriate for Florida. It will enable those in the landscape industry to select the best possible plants while conserving essential water resources.

Xeriscape™, Plant it Smart. 1991. 2 p.

Abstract: This pamphlet describes the basis Xeriscape™ principles and lists the plants appropriate for Xeriscape™ landscaping in Florida.

State-of-The-Art Summary of Incentives for Residential Water Conservation. Elder, J. October, 1980. 39 p. PB 81-115958.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: Programs and techniques developed to encourage residential water conservation are presented. Consumer education and information programs, possible incentives in mass-metered residences, feedback techniques, and the impact of pricing on water consumption are discussed. Energy conservation techniques directly relevant to water conservation are also presented, and an extensive bibliography is included.

State Water Conservation Planning Guide. U.S. Water Resources Council. October, 1980. 102 p.

Source: Dept. of Natural Resources, Cook College, Rutgers University, New Brunswick, NJ 08903-0231, (908) 932-9631.

Abstract: This guide, produced by the Water Resources Council, provides information on water conservation activities by all levels of government concerned with water resources management. It also suggests a series of steps in the conduct of water conservation activities as an integral part of water resources planning. The guide contains a detailed bibliography of references that are useful in planning for more efficient use of water. A

number of optional planning procedures are described in this guide which can be selectively applied to match water resources conditions and the current stage of planning in any state.

Teaching Soil and Water Conservation, A Classroom and Field Guide. Program Aid 341. Soil Conservation Service. February, 1992. 30 p.

Source: Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, (202) 783-3238.

Abstract: As an aid to busy teachers, this publication gives some practical suggestions to help them carry out a conservation curriculum in the classroom and outdoors. Each activity is presented in two parts: A how-to section and an interpretation. Topics covered include water movement through soils, conservation on farms, and erosion.

The Adventures of Hydroforce Kids Comic/Activity Book. Abracadabra Educational Entertainment. 1993. 17 p.

Source: Whalen and Associates, Inc., Abracadabra Educational Entertainment, 31 W. Los Reales, Suite 164, Tucson, AZ 85706, (602) 573-0513.

Abstract: This colorful comic book style activity book details the adventures of Princess Hydrobia and the Hydroforce Kids. Children are invited to play games and solve puzzles about water conservation, water treatment, and other water-related issues. Although this book is recommended for grades K-4, parents are also involved at home with a water-audit checklist.

Other publications available:

Water Cycle Race Game.

Abstract: An interactive game that teaches the water cycle.

The Water Saver Card Game.

Abstract: A water-wise card game for grades K-4.

The Alternative is Conservation, FRD 12. U.S. Environmental Protection Agency, Office of Water Program Operations. August, 1980. 39 p.

Source: Environmental Quality Instructional Resource Center, 1200 Chambers Road, Room 310, Columbus, OH 43212, (614) 292-6717.

Abstract: The publication is a companion guide to a 20-minute color production in 3/4" videotape or 16-mm film. The film provides a forum for discussion among viewers. It visits eight communities, each of which has a different understanding of its water problem and a variety of ideas for solving them. Copies of film or video are available for loan or purchase from USER, Inc., 30 Bates Road, Watertown, MA 02172.

Some of the major ideas presented in the film are:

- benefits of water conservation to the community;
- role of conservation in helping solve specific problems such as water supply and collective wastewater management;
- role of conservation in helping solve individual on-lot problems;
- management requirements to make a community conservation program effective;
- devices homeowners can use to conserve water; and
- description of EPA's facility planning requirements and relationship to conservation program.

The Official Captain Hydro Water Conservation Workbook (with teacher's guide). Innovative Communications Inc. 1982. 39 p.

Source: Innovative Communications Inc., 207 Coggins Drive, Pleasant Hill, CA 94523, (510) 944-0923.

Abstract: The workbooks are written in comic book format and are designed to educate students in grades 5 through 8 about water and water conservation. "The general goals of the project are:

- To develop an appreciation of water's life-sustaining role in man's survival and an awareness of the limitations of its abundance.
- To acquire knowledge of water, its physical properties and its function in our environment.
- To identify the problems relating to water and its use.
- To select solutions, after examining the alternatives, which take into consideration all facets of life for both short and long term results.
- To demonstrate the application of knowledge and skills in functional water problem solving."

The study units are designed to provide a balance among demonstrations, classroom and homework exercises, and reading/discussion involvement. Topics include water cycles, the uses of water, and water conservation and management.

Other publications available:

The California Water Works and Why It Does. 1978. 16 p.

Abstract: California Water Works is an "information-type" book (without activities or a teacher's guide) which enlightens students about the state's natural and constructed water systems. The book also covers water treatment, distribution, and conservation.

The Further Adventures of Captain Hydro, Hero of Water Conservation (with teacher's guide). 1977. 16 p.

Abstract: This version of Captain Hydro is designed to be a bridge between the format and content of the upper elementary publication, The Official Captain Hydro Water Conservation Workbook, and the more heavily academic secondary materials.

The Seattle Water Works and Why It Does (with teacher's guide). 1982. 16 p.

Abstract: This book, created for the City of Seattle, is an adaptation of the California book.

Water Fun (with teacher's guide). 1982. 16 p.

Abstract: Water Fun, in a comic book format, contains activities for children in grades kindergarten through third designed to introduce basic water conservation principles and a variety of conservation strategies which they can implement with their families at home.

Water Play (with teacher's guide). 1976. 28 p.

Abstract: Water Play, with a format similar to Captain Hydro, is designed to increase appreciation and awareness of water in the primary grades.

Twenty-three Ways to Save Water in an Emergency, Special Circular 199. Sharpe, W. 1983. 4 p.

Source: Publications Distributions Center, 112 Agriculture Administration Building, The Pennsylvania State University, College of Agriculture, University Park, PA 16802, (814) 865-6713.

Abstract: Fact Sheet

Urban Water Conservation: Increasing Efficiency-in-Use Residential Water Demand. Flack, J.E. 1982. 111 p.

Source: American Society of Civil Engineers., 345 E. 47th St., New York, NY 10017, (212) 705-7288. ISBN 0- 87262-296-7.

Abstract: (Book)

Urban Water Management Plan. East Bay Municipal Utility District. February, 1991. 120 p.

Source: East Bay Municipal Utility District, Publications Office, P.O. Box 24055, Oakland, CA 94623, (415) 287-0138.

Abstract: In California, a Water Management Plan is required by the Urban Water Management Planning Act. This document presents the Water Management Plan developed by the East Bay Municipal Utility District. It describes the water conservation and reclamation measures that have been implemented by the District in the past, the current measures, and the measures being investigated as future strategies. It also outlines water conservation measures that are generally accepted by the water supply industry and the District's implementation of these measures. This document is designed not only to satisfy the requirements of the Urban Water Management Planning Act but also to provide the public with an account of the District's effort on conservation and reclamation. Topics include water use, water supply, water supply planning, current water reclamation programs, potential future water reclamation, current water conservation programs, and potential future water conservation.

Other publications available:

80 little things and one great big thing you can do to save water in the garden. Sunset Magazine. May, 1990. 2 p.

Abstract: Eighty water conserving gardening techniques are listed, such as getting rid of unused lawn and using less thirsty varieties of plants.

Drip, in Sunset Magazine. July, 1988. p. 69-76.

Abstract: This issue describes and explains how to set up a drip irrigation system, the most practical way to water plants.

Drought Survival Guide for Home and Garden. Sunset Magazine. May, 1991. 32 p.

Abstract: This 32-page report advises the homeowner how to save water in the home and garden during a time of drought.

How much water does your lawn really need? Sunset Magazine. June, 1987. p. 213-219.

Abstract: This publication offers suggestions on how to water lawns efficiently.

Meet Your Meter. April, 1989. 3 p.

Abstract: Meet Your Meter is a brief pamphlet that describes how to read straight-reading and round-reading water meters.

Puddle Stopper's Handbook, A Guide to Basic Home Plumbing. July, 1990. 39 p.

Abstract: This booklet provides tips that will enable the homeowner to make basic plumbing repairs in order to save money and water.

Questions and answers about water and gardens. Sunset Magazine. May, 1989. 4 p.

Abstract: In this article 15 horticulturists, water officials, nursery people, and landscape architects offer suggestions on how to conserve water and still keep the garden landscape intact.

The Thirsty 100. Sunset Magazine. October, 1988. p. 74-83.

Abstract: One-hundred plants that are native to the California area and require little or no summer watering are listed.

Water Conservation Today and Tomorrow.

Abstract: This pamphlet offers practical advice for personal water conservation.

Water is Life, Don't Waste It.

Abstract: This one-page fact sheet lists how water use during certain activities, such as taking a shower, brushing your teeth, using the dishwasher, and outdoor watering, can be reduced when conservation practices are used.

WaterWise Gardening. June, 1989. 11 p.

Abstract: WaterWise Gardening explains how to maintain your lawn and garden using water conservation principles.

Using Water Wisely: A Guide to Reducing Home Water Use. Peart, V., Walker, K. 1991. 2 p.

Source: Florida Cooperative Extension Service, University of Florida, Institute of Food and Agricultural Sciences, Gainesville, FL 32611, (904) 392-1761.

Abstract: Fact Sheet

Other publications available:

Using Water Wisely in the Bathroom

Using Water Wisely in Household Cleaning and Outdoor Uses

Water Conservation. Tennessee Valley Authority. 1991. 2 p.

Source: Tennessee Valley Authority, 1101 Market Street, Chattanooga, TN 37402, (615) 751-7338.

Abstract: Fact Sheet

Water Conservation: A Community Based Program. Herndon, S. January, 1985.

Source: Oklahoma State University Cooperative Extension Service, Oklahoma State University, Stillwater, OK 74078, (409) 466-3833.

Abstract: Fact Sheet

Water: Conservation and Reclamation, part of the Building Sustainable Communities, An Environmental Guide for Local Government series. The Global Cities Project. December, 1990. 136 p.
Source: The Global Cities Project, 2962 Fillmore Street, San Francisco, CA 94123, (415) 775-0791, (ISBN 1-880386-01-1).

Abstract: This handbook addresses actions local governments can take to conserve and reclaim water in their own facilities and in the community. Options discussed include standards and codes, demonstration projects, information programs, such as water audits, and conservation-oriented financing mechanisms, such as rebates. Specific programs are detailed, including home and business retrofitting, leak-detection services, education programs, water conservation requirements on new development, and revised landscape practices.

Water Conservation and Wastewater Reduction in the Home, Circular 184. Sharpe, W.E. 1975. 9 p.

Source: Pennsylvania State University Extension Service, University Park, PA 16802, (814) 865-2541.

Abstract: Extension Bulletin

Water Conservation Awareness and Activity Package. New Jersey Department of Environmental Protection. 1982.

Source: New Jersey Department of Environmental Protection and Energy, Office of Water Conservation, 1474 Prospect Street, PO Box 029, Trenton, NJ 08625, (609) 292-3753.

Abstract: This packet is a set of flashcards with water conservation activities designed for primary and intermediate grade levels. The cards include quizzes, writing assignments, diagrams, facts and figures, extended activities, games, and definitions. Topics include the hydrologic cycle, community water use, meter reading, and basic water-saving procedures.

Water Conservation Checklist For the Home. National Agricultural Library Call Number 275.29 M69C. Pifer, G., Spindler, E., Cox, W., Wearne, R. August, 1977. 7 p.

Source: University of Vermont Extension Service, Publications Office, Morrill Hall, Burlington, VT 05405-0106, (802) 656-2990.

Abstract: This publication contains a checklist for around the home that helps consumers see how effectively they are using their water and alerts them to conservation measures. The topics covered include plumbing, laundry, personal care, food preparation, meal service, dishwashing, household cleaning, house plants, and outside the home water use.

Water Conservation in the Home. Ordonez, Margaret. 1985. 4 p.

Source: Maryland Cooperative Extension Service, The University of Maryland, College Park, MD 20742, (301) 405-2903.

Abstract: Fact Sheet

Water Conservation Guides. City of Phoenix, Water Conservation and Resource Division.

Source: City of Phoenix, Water and Wastewater Division, Water Conservation and Resource Division, 455 North Fifth St., Third Floor, Phoenix, AZ 85004, (602) 261-8366.

Abstract: The City of Phoenix has produced a series of manuals on water conservation issues. They include:

Desert Ground Covers and Vines and Desert Shrubs. Arizona Native Plant Society, 1991, 25 p.

Abstract: In this booklet the Arizona Native Plant Society continues its goal of promoting the use of arid adapted plants in the landscape.

Highlights of the City of Phoenix, Water Conservation Program.

Abstract: Phoenix's water conservation plan, designed to increase the efficiency of water use to reduce groundwater pumping, is detailed in this report.

How to Become Water Wise. 8 p.

Abstract: Tips that will alert homeowners to serious water-wasting habits are offered, as well as suggestions on how to convert them to water-wise habits.

How to Save Water and Money by Finding and Fixing Leaks. 4 p.

Abstract: Homeowners are offered easy, inexpensive ways to find and fix household leaks in order to save water and money.

How to Save Water Outdoors. 4 p.

Abstract: Suggestions on how to reduce outdoor water use are listed in this fact sheet.

Industrial Water Conservation Information Sharing Network. 1990. 48 p.

Abstract: This guide describes INCON.NET-the Industrial Water Conservation Information Sharing Network, which joins the talents of water conservation professionals and allows them to share current work. The extensive list contains the names of important water conservation officials in states across the country. Each listing includes name, address, agency, existing or planned ordinances, current or planned projects, publications and articles produced by the department or individual, and conservation information needed by the department. Interested conservation officials can send the appropriate information to the address above.

Plumbing Retrofit Program. 1989.

Abstract: This report explains the current retrofit program in use in the City of Phoenix and also lists the manufacturers of ultra-low-volume toilets.

Toilet Leaks. 1989.

Abstract: The steps for testing for and repairing toilet leaks are explained in this pamphlet.

Water Conservation Guides.

Abstract: The following booklets contain checklists of suggested water conservation ideas, descriptions of ways in which water is used in different facilities, and explanations of possible water-conserving technologies.

- Water Conservation Guide for Buildings and Facilities Management
- Water Conservation Guide for Cooling Towers and other Cooling-Related Uses of Water
- Water Conservation Guide for Food Processors and Bottlers
- Water Conservation Guide for Hospitals and other Health-Care Facilities
- Water Conservation Guide for Hotels and Motels
- Water Conservation Guide for Metal Finishing, Electronics Fabrication, and other Process Rinse Uses of Water
- Water Conservation Guide for Restaurants
- Water Conservation Guide for Schools and Educational Facilities

Water Efficiency in the House. Sunset Magazine. September, 1987, p. 154-155.

Abstract: This special report explains how to increase water efficiency in the home by using ultra-low-volume toilets, low-flow showerheads, and checking for leaks.

Xeriscape™, Water Conservation Through Creative Landscaping. 14 p.

Abstract: This brochure explains how Xeriscape™ principles can be used to plan a new low-water-use landscape or convert a thirsty yard to a water-efficient one.

Water Conservation Video, "Save Water, Save Money." Water Education Foundation. 33 minutes.

Source: Water Education Foundation, 717 K Street, Suite 517, Sacramento, CA 95814, (916) 444-6240.

Abstract: Established in 1977, the Water Education Foundation is a nonprofit, nonpartisan, tax-exempt organization. Its mission is to develop and implement educational programs leading to a broader understanding of water issues and to a resolution of water problems. This video takes the viewer through a house and yard, giving 50 practical ways to save water. Information about water problems in the State of California is also given.

Other publications available:

Landscape Designs, Easy and Efficient.

Abstract: Explains how to design water-efficient landscapes.

Water Awareness Guide.

Abstract: This sheet helps Californians identify their water supply sources.

Water Education Foundation, Materials and Publications.

Abstract: Contains descriptions and ordering information for all publications produced by the Foundation.

Water Trivia Fact Sheet.

Abstract: Details the amount of water we use in our daily lives.

Western Water Magazine.

Abstract: This bimonthly magazine examines different aspects of the California water picture.

Water Education Grades K-6. Daus, D.R., Israelsen, C.E. 1985. 166 p.

Source: International Office for Water Education, UMC 82, Utah Water Research Laboratory, Logan, UT 84322, (801) 750-3155.

Abstract: This booklet includes a set of learning experiences that has been designed for teachers, teachers-in-training, and children. Each concept includes background information for the teacher and learning activities for the children. The goals of the program include providing a conceptual foundation of water properties, an understanding of the importance of water to all living things, and an understanding of how water is related to human activities.

Water Efficiency For Your Home. Woodwell, John C. 1991. 23 p.

Source: Rocky Mountain Institute, 1739 Snowmass Creek Road, Snowmass, CO 81645-9199, (303) 927-3851.

Abstract: This booklet is published to help individuals improve the water and energy efficiency of their own homes and save money in the process. New products and techniques allow today's households to use a third less water than those of a decade ago, without sacrificing comfort or changing lifestyles. Although this booklet is designed for homeowners and tenants, the ideas it advances can be applied on a larger scale: your neighbors, community, and water utility can all take advantage of the broad benefits which efficiency provides. It also explains how the wise use of showerheads, low-flow toilets, faucet aerators, and washing machines can conserve water in the home. Other publications that may be helpful in further explaining these methods are "Waterless Toilets: Guides, Manufacturers, and Plans" and "Performance of Residential Water-Efficient Fixtures: Notable Case-Studies." The Rocky Mountain Institute also offers an extensive publications listing which describes the many other aspects of resource conservation.

Other publications available:

Practical Home Energy Savings. Bill, David. 1992. 47 p.

Abstract: This detailed manual contains many suggestions on how to save energy and money in your home. It gives the practical information needed to cut energy and reduce energy consumption. It includes the latest energy-efficient technologies and descriptions of how to make them work. It also includes many references and sources for additional information.

Water Efficiency, A Resource for Utility Managers, Community Planners, and other Decisionmakers. The Water Program. 1991. 114 p.

Abstract: This document discusses the benefits and costs of water efficiency and summarizes available technologies. It also provides further contacts, listings, and examples to supplement the main text.

Water Efficiency Sampler. Chaplin, S. 1991. 2 p.

Abstract: Contained in this fact sheet are brief case studies of water efficiency projects under way throughout the country.

Water for Millions: At What Cost? Scenic Hudson, Inc. June, 1989. 8 p.

Source: Scenic Hudson, Inc., 9 Vassar Street, Poughkeepsie, NY 12601, (914) 473-4440.

Abstract: Scenic Hudson was founded in 1963 to preserve, restore, and enhance the ecological, scenic, historical, and recreational resources of the Hudson River (New York) in an effort to protect the River and its valley from haphazard, unplanned development posing threats to air, water, and land, while encouraging well-planned development where appropriate to meet the needs of residents and visitors. "Water for Millions" is a series of six bulletins on regional water-supply issues, covering such topics as water supply and demand, low-flow fixtures, retrofitting, and leak detection and repair. Each bulletin also includes reading suggestions and bibliographies.

Also available:

West meets East: A Resource book on Water-saving Strategies for the 21st Century. 1991

Abstract: This resource book has been designed to highlight the rationale and benefits of water-use efficiency as a management and planning tool. The Northeast, a region traditionally considered water-rich, now faces enormous costs at both ends - either in terms of expanding supplies or enlarging waste-water facilities to handle greater loads. The papers included in this book cover such topics as water-saving techniques, mesicape, and water recycling. It also contains a bibliography for further reading.

Water Wheel: Your Guide to Home Water Conservation. ECOS, Inc. 1977.

Source: U.S. Environmental Protection Agency, Public Information Center, Washington, DC 20460, (202) 260-7287.

Abstract: This chart in a moving wheel format contains tips on how to conserve water at home. It lists potential water-wasting activities and offers water-saving techniques to cut down on water waste. It also ranks the relative water saved if the water-saving measures are put into effect. The Wheel suggests water-saving techniques for the lawn and garden, the kitchen, the bathroom, household cleaning, drinking water, faucets, pipes, and the washing machine. It also lists how much water is used for various activities and gives reasons why we should save water.

Wise Appliance Use Conserves Water. Jenkins, Joyce H. January, 1978. 3 p.

Source: Cooperative Extension Service, Room 103, Barre Hall Clemson University, Clemson, SC 29631, (803) 656-3382.

Abstract: Fact Sheet

Wise Water Use: A Curriculum Supplement for Teachers. Illinois Department of Transportation, Division of Water Resources. 18 p.

Source: Illinois Department of Transportation, Division of Water Resources, 310 South Michigan Avenue, Room 1606, Chicago, IL 60604, (312) 793-3123.

Abstract: This booklet provides three curriculum guides for grade levels 4-12 dealing with: Wastewater treatment processes (Grades 4-6), how to inspect for leaks (Grades 7-8), and how the government addresses water conservation problems through a variety of agencies (Grades 9-12). The goals of the booklet are to promote an understanding of the way our waterways are polluted, to learn how to detect and repair common leaks in home water systems, and to become aware of how the government addresses water conservation problems through a variety of agencies. Each grade section includes assignments and activities for the students, as well as discussion questions.

Xeriscape™, A Guide to Developing a Water-wise Landscape. Wade, G.L., et al. February, 1992. 40 p.

Source: The University of Georgia Cooperative Extension Service, College of Agriculture, Athens, GA 30602, (404) 542-2713.

Abstract: This publication, introduces Xeriscape™, quality landscaping that conserves water and protects the environment. The term Xeriscape™ was coined in Colorado in 1981 in response to a prolonged drought. It was derived from the Greek word "Xeros," meaning dry, with the word "landscape." Today there are Xeriscape™ programs in over 40 states throughout the United States. A National Xeriscape™ Council is headquartered in Atlanta, Georgia. Xeriscape™-type landscaping is a package of seven common-sense steps for making a landscape more water-efficient. These include planning and design, soil analysis, appropriate plant selection, practical turf areas, efficient irrigation, use of mulches, and appropriate maintenance. Each of these steps is good gardening practice. However, the more steps that are implemented, the more water-efficient the landscape becomes.

Xeriscape™ Gardening, Water Conservation for the American Landscape. Ellefson, C., Stephens, T., Welsh, D. 1992. 300 p.

Source: Texas A&M, 211 Suffolk Ave., College Station, TX 77840, (409) 845-7341.

Abstract: (Book) Ideal for every area of the country, this new book provides an ecological approach to garden design, watering methods, region-specific plant selection, and landscape maintenance. The fundamentals of water-wise, low maintenance landscaping are outlined and the tools for creating a healthy lawn and garden while conserving water are described.

Yard and Garden Water Management. Hoffman, L., et. al. 1990. 4 p.

Source: Cooperative Extension Service, Montana State University, Bozeman, MT 59717, (406) 994-5685.

Abstract: Fact Sheet

Yes, You Can: Two Small Towns Show How to Save Money and Water. National Small Flows Clearinghouse. April, 1991, 2 p.

Source: U.S. Environmental Protection Agency, WH-595, 401 M Street SW, Washington, DC 20460, (202) 260-7287.

Abstract: This brochure is directed toward small community officials who are attempting to solve their town's water problems. The brochure describes how officials in two small towns saved water and money through carefully designed water conservation plans. It explains how they reduced energy costs as well because less water was pumped and treated and less heated for home and industrial use. The simple steps included in this brochure can be the key to success for other small towns.

Other publications available:

Saving Money with Home Water Conservation Devices. Sharpe, W.E., Tsong, S.

Abstract: This pamphlet offers the homeowner methods of conserving water in the home by describing popular water conservation devices.

21 Water Conservation Measures for Everybody. EPA 570/9-91-100.

Abstract: This brief fact sheet lists 21 water conservation measures for homeowners.

2. Community Water Conservation Programs

A Drop in the Bucket. Ricci, J.F., Julian, A.J.. January 1978. 2 p.

Source: Hamilton Township, Department of Public Works, 2090 Greenwood Avenue, CN 00150, Hamilton, NJ 08650-0150, (609) 890-3560.

Abstract: In an effort to extend the treatment capacity of its already overloaded sewage treatment plant, the Township of Hamilton, New Jersey, has undertaken an unusual water conservation program. Through the distribution of water-saving showerheads and toilet partitions, the Township hoped to save 2 million gallons of water a day. After implementation, 65% of the respondents were using their aerators and found them to give acceptable showers, and 51% were using their toilet tank partitions. The project on a whole seems to be successful on a short-term basis, and in time, the Township should get a substantial return on the capital expended for the project.

An Analysis of Seattle's Multi-Family Pilot Retrofit Program. Flory, Bruce E., Dietemann, Allan. June 1992. 27 p.

Source: Seattle Water Department, Conservation Office, 710 2nd Ave., 11th Floor, Seattle, WA 98104, (206) 684-5879.

Abstract: With the retrofit of multi-family buildings with water conserving devices occurring all over the United States, there needs to be a detailed statistical analysis of the actual savings from these retrofitted buildings. There is a lack of information on the persistence of savings from retrofits over time, as well as the cost/benefit information vital to setting retrofit priorities and budgets. This paper provides an analysis of Seattle's Pilot Retrofit Program, which began in 1989. The study indicates that a multi-family retrofit program should be highly cost-effective, with a payback period of less than a year.

Achieving Urban Water Conservation--A Handbook. Flack, J.E., Weakley, W.P. Hill, D.W. September, 1977. 207 p. PB-278.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: The feasibility of using various water conservation measures to reduce urban water demand was studied. Ten residential water conservation techniques were found to be of value. Meters, recycle systems, water-saving devices, and flow and pressure reducers were evaluated. Distribution system and household leakage detection and water-use restrictions were investigated. Codes, public education, pricing, and landscaping changes were studied. Water demand reductions of 40% were demonstrated using combinations of these conservation methods. It was concluded that demand reduction techniques could successfully be incorporated in a water utilities management program.

Achieving Urban Water Conservation. Part II: Testing Community Acceptance. Snodgrass, R.W.; Hill, D.W. September 1977. 219 p., PB 278189.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: The usefulness of survey research in delineating viable water conservation programs is considered. The communities of Lafayette and Louisville, Colorado, are used to define socially and politically acceptable water conservation policies. Policies with the highest potential for acceptance include legal restrictions on water use and restrictions on growth and development. Reuse for agricultural purposes, and various horticultural and economic techniques that also hold some political feasibility.

American Water Works Association Publications.

Source: Journal American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235, (303) 794-7711.

Effects of Conservation on Daily Water Use. Shaw, D.T., Maidment, D.R. September, 1988. Vol. 80, No. 9. p. 71-77.

Abstract: Compulsory restrictions on water used outdoors and water rationing were instituted in stages during the course of a regional drought lasting through most of 1984 in Corpus Christi, Texas. An intervention model for separating the effects of conservation on daily water use from concurrent effects of weather and seasonal variation is presented, enabling an estimate of the conservation restrictions effectiveness to be made. These restrictions reduced water use by an average of 29 when compared to the peak water-use. More stringent restrictions resulted in little additional savings because water use had already decreased to winter base levels. The residual effects of conservation extended beyond the drought period, even after the restrictions were lifted.

Long-Term Options for Municipal Water Conservation. Grisham, A., Fleming, W.M. March, 1989. Vol. 81, No. 3. p. 34-42.

Abstract: Water conservation measures, traditionally a short-term technique, are now being reassessed as long-term methods of reducing municipal water use in addition to protecting a valuable natural resource for future needs. To be successful over the long-term, the program must be carefully planned, well-managed, and properly monitored, and must include a comprehensive public education effort. Most communities facing long term water supply concerns can benefit from a water conservation program. Each community will need to examine its specific situation and plan its own conservation program composed of the water conservation measures that best fit its needs. Some of the actions that communities can take are: (1) public education, (2) metering and leak repair, (3) establishment of building code revisions, (4) implementation of water rate schemes that encourage water conservation, (5) landscaping changes to conserve water, (6) water-use restrictions, and (7) water reuse.

Noncrisis Use of Household Water-Saving Devices. Palmimi, D.J., Shelton, T.B. July, 1983. Vol. 75, No. 7. p. 336-341.

Abstract: A limited domestic water conservation program was undertaken in East Brunswick, NJ, in anticipation of a severe water supply shortfall. The implementation of the first phase of the water supply master plan is described and analyzed. The report concludes the public will cooperate in a water conservation program, even in the absence of strong external incentives, such as a drought. Two-thirds of the households in the study group installed at least one water-saving device when told of the benefits to the township and the private monetary benefits to them, along with receiving two letters from municipal officials urging their cooperation. The study suggests that this strategy should be more seriously and more widely used in the long-run management of water resources.

Public Attitudes toward Water Conservation. Flack, J.E., Greenberg, J. March 1987. Vol. 79, No. 3. p. 46-51.

Abstract: Consumer attitudes toward water conservation were surveyed in seven northeastern Colorado communities to determine whether relationships exist between (1) attitudes and type of community or (2) attitudes and socioeconomic variables. The water conservation alternatives presented included metering, price increases, restrictions on water use, restrictions on lawn size, controls on population growth, and reuse of treated wastewater for potable purposes. Preferences for development of additional water supplies were also included in the survey. All but one of the conservation alternatives (reuse for drinking purposes) were favored by more than half of the respondents. Consumers in communities with lawn-watering restrictions were more willing to install water-saving devices or to change landscaping than were consumers in unrestricted communities. Respondents who were metered strongly favored meters, and flat-rate customers preferred the flat rate. Metered users favored price increases, whereas flat-rate users did not. Restrictions on population growth were preferred more strongly by rural and flat-rate consumers than by urban and metered consumers. Respondents with less than a high school education or earning incomes of less than \$15,000 per year more often opposed the various

water conservation alternatives. Retired or disabled persons did not approve of such alternatives as price increases or installation of water-saving devices.

The Effectiveness of Residential Water Conservation Measures. Maddaus, W.O. March 1987. Vol. 79, No. 3. p. 46-53.

Abstract: Residential water conservation potential was studied in an HUD-sponsored demonstration project in several cities. The amount of water saved was documented in homes where water-conserving fixtures and devices were installed, including low-flush toilets, low-flow showerheads, retrofit of toilets and showerheads, and installation of water meters.

The Emerging Demand-Side Era In Water Management. Vickers, A. October 1, 1991. Vol. 83, No. 10. p. 38-43.

Abstract: Decreasing sources are resulting in a trend for demand-side alternatives in water management and toward striking a balance between new source development and conservation. This article describes some steps that are being taken across the United States to restrict demand, including the setting up of water conservation offices, committees, coordinators, and conferences; the planning of conservation programs by utilities and water districts; and the implementation of conservation measures by the residential, commercial, industrial, and agricultural sectors.

Water Conservation - A Practical Approach. Rice, I.M., Shaw, L.G. September, 1978. Vol. 70, No. 9. p. 480-482.

Abstract: This publication details the aspects of the water conservation program of Dallas, Texas. Although Dallas used educational and informational materials in their water conservation program, their main tool was to use pricing policy to achieve conservation of water resources. This policy placed a surcharge on residential customers during their peak water-demand periods. The program seems to have been effective in the Dallas area.

Water Conservation Strategies--AWWA Resource Book. 1980. 100 p.

Abstract: Water Conservation Strategies is a compilation of 21 selected articles from the Journal of the American Water Works Association. A management resource handbook, this AWWA publication features a subject of growing importance throughout the world-resource conservation. Increasingly aware that water supply is not exhaustible and keenly sensitive of the high fixed costs that characterize water treatment and distribution systems, water utility personnel in many locales have been taking a close look at water conservation strategies. This compilation is not all-inclusive. It encourages the reader to examine references found within the individual articles and to review the literature through use of the AWWA Technical Library computer search service. It refers the reader to the index at the back of this handbook, which provides useful information available in the various articles.

Barriers to Water-Efficiency Programs. Kunka, J. July-August, 1989. Vol. 6, No. 4. p. 10.

Source: Home Energy, 2124 Kittredge Street, No. 95, Berkeley, CA 94704, (415) 524-5405.

Abstract: The barriers to water efficiency are not a lack of reliable, cost-effective technologies, but institutional and educational shortcomings. Various local water-efficiency programs are discussed, but most institutional structures usually tend to discourage least-cost water management due to the initial cost and energy involved. Nationally, things are beginning to change, with the introduction of two bills in Congress this past term, the National Water Conservation Act and the National Plumbing Fixtures Efficiency Act. They encourage research and development of demand-side solutions to water problems affecting U.S. cities, towns and agriculture, and set minimum standards for the full range of water-using appliances. Water utilities must learn that they can promote conservation and still cover fixed costs.

Before the Well Runs Dry: A Handbook for Designing a Local Water Conservation Plan, in Geological Survey Resources and Land Investigations Program Report. New England River Basins Commission. October, 1980. 95 p.

Source: U.S. Geologic Survey, District Branch Text Product Section, 604 S. Pickett St, Alexandria, VA 22304, (703) 648-4000.

Abstract: A seven-step procedure for designing a water conservation plan is described. This procedure allows the water supplier to consider the full range of options available and the potential impacts of each option on the utility, the users, and the community. The handbook presents five supply management programs which can reduce water loss and waste within the supply system. Three demand management programs, pricing, education, regulation and their impacts are also discussed. The five-step program includes:

Step 1: Identify problem/establish conservation goal;

Step 2: Assess potential of supply management;

Step 3: Analyze cost-effectiveness and impacts of management programs;

Step 4: Identify actions to minimize adverse impacts;

Step 5: Choose management program/design the specifics of each management program;

Step 6: Evaluate and select hardware/software; and

Step 7: Summarize conservation plan.

Before the Well Runs Dry: A Handbook on Drought Management. New England River Basins Commission. August, 1981. 60 p.

Source: New England River Basins Commission, 55 Court St., Boston, MA (617) 223-6244.

Abstract: This handbook describes a five-step process designed to provide water suppliers and local government officials with information and guidance on how to develop a plan for coping with a serious drought. The process uses the resources typically available in New England communities: leadership and cooperation from local government officials and the community at large; technical know-how from the local businesses; sparse limited hydrologic data, and small size typical of small water utilities.

The handbook describes a case study where a community can use measures designed to augment supply or reduce consumption to alleviate the problems of a drought.

Before the Well Runs Dry: A Seven-Step Procedure for Designing a Local Water Conservation Plan, Volume II. New England River Basins Commission. July, 1980. 173 p.

Source: New England River Basin Commission. 55 Court St., Boston, MA 02108, (617) 223-6244.

Abstract: The report presents a seven-step procedure for designing a water conservation plan. This procedure was developed through an extensive literature search. The findings of the literature search were applied and tested in New England through two case studies. Also included are surveys of 218 New England suppliers and interviews with water supply engineers and policy makers. The combined search and test has yielded a procedure that is flexible, can be used by local water supply planners, and can meet multiple goals, including reduced water use and maintenance of water resources. The procedure is designed to respond to a problem within a supply system that can be solved by water conservation, solely or in conjunction with other water supply management methods. There are many problems that conservation can help, including (but not limited to) the following:

- loss of supply through contamination;
- inadequate supply to meet future demands;
- inadequate supply to meet annual peak demands;
- temporary shortages, due to drought;
- excessive energy consumption;
- excessive waste water flows; and
- water loss or waste within the system.

Conserving Water, Plan on It!: Long-term Water Conservation Programs For Public Water Suppliers. Gimbrone, C. March, 1987. 56 p.

Source: Connecticut Department of Health Services, Water Suppliers Section, 150 Washington St., Hartford, CT 06106, (203) 566-1251.

Abstract: This report is intended to facilitate development of long term water conservation programs by water companies and public water suppliers. Water conservation programs and planning are a requirement of section 25-32d-1 of the Regulations of Connecticut State Agencies concerning water supply plans. This report contains many useful references and background material concerning water conservation programs.

Demonstration of Waste Flow Reduction From Households. Cohen, S, Wallman, H. 1974. 111 p. PB 236904.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: A two-year demonstration program evaluated water-savings, costs, performance, and acceptability of various water-saving devices for households. Meters were attached to water-using fixtures in order to monitor water use. Detailed results are given including extensive data on performance of components used and flow reductions achieved.

Developing and Assessing a Model of Residential Water Conservation. Bruvold, W.H., Smith, B.R. June, 1988. Vol. 24, No. 3. p. 661-670.

Source: Water Resources Bulletin, American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814, (301) 493-8600.

Abstract: Relevant literature was reviewed from which a model of residential water conservation was developed. Four residential conservation program interventions were posited: public education; pricing variables; water use restrictions; and building code requirements. Four exogenous variables affecting residential water use were also posited: temperature; rainfall; household income; and household size. The impacts of these eight variables on residential per capita daily use were assessed by cross-sectional and time-series analysis. Study results generally supported the proposed model.

Directions in Water Conservation and Management in Massachusetts. Garrigan, Patricia A. June, 1989. Vol. 6, No. 2. p. 69-73.

Source: Journal of the New England Water Works Association, 42A Dilla St., Milford, MA 01757, (508) 478-6996.

Abstract: This paper discusses how Massachusetts is implementing water conservation. Various statutes and regulations, such as the Water Management Act, the Interbasin Transfer Act, and the Water Resources Planning Regulations are described. The statutes and regulations are designed to implement policies adopted by the Massachusetts Water Resources Commission, the State's water policy and planning body.

East Bay Municipal Utility District Water Conservation Study. Aher, A., Chouthai, A., Chandrasekar, L., Corpening, W., Russ, L., Vijapur, B. October, 1991. 4 p.

Source: East Bay Utility District, P.O. Box 24055, Oakland, CA 94623, (415) 287-0138.

Abstract: As part of the East Bay Municipal Utility District's water conservation program, this study was organized to determine the actual savings achieved in the field by installing Ultra Low Flush water closets and low flow shower heads. Other goals were to investigate the impact of ULF on the movement of wastes in drain lines and to determine customer satisfaction with the low flow fixtures.

Every Last Drop: A Guide to Water Conservation. Paradise, L., Bobrowski, M. 1983. 93 p.

Source: The Rural Community Assistance Program of Rural Housing Improvement Inc., 218 Central St., Box 429, Winchendon, MA 01475, (508) 297-1376.

Abstract: This booklet is designed to help community officials design and implement an effective water conservation program. Chapters include: Why start a water conservation program; Why conserve water; Solutions (water conservation techniques and strategies); Implementation (procedures to use); Funding strategies; and an appendix containing information on water conservation devices, films, and educational information. Whether or not a water shortage exists, the techniques presented may provide valuable assistance to those who wish to preserve and maintain a valuable resource.

Flow Reduction: Developing a Public Information Program. U.S. Environmental Protection Agency, Office of Water Program Operations, Facility Requirements Division. August, 1982. PB 83150508.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: This is the third volume of a three volume series pertaining to wastewater flow reduction analysis and program planning. This volume is a package of flow reduction public information material designed to supplement a community's flow reduction program and provide general guidance in developing a public information program.

Flow Reduction: Methods, Analysis, Procedures, Examples. U.S. Environmental Protection Agency, Office of Water Program Operations, Facility Requirements Division. March, 1981. PB 81203713.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: This is the first volume in a three volume series. It provides information on flow reduction, including its role in facilities planning, its relationship to water and wastewater programs, and case examples of communities which have implemented programs. It also includes descriptions of various flow reduction measures, along with an assessment of their cost effectiveness.

How Much Water Can You Save With Conservation Measures? Walski, Y.M., Richards, W.G., McCall, D.J., Deb, A.K., Morgan, J.M. September, 1984. Vol. 115, No. 9. p. 96-97.

Source: Public Works, 200 South Broad Street, Ridgewood, NJ 07451, (210) 445-5800.

Abstract: This short article describes a technique for preparing quick estimates of the effectiveness of water conservation measures. Effectiveness is defined as the change in water use and is given in units of flow, while the term reduction is defined as the fractional change in effectiveness. The procedure for estimating effectiveness in a community consists of four basic parts: determine flow estimates of the separate uses; look up the appropriate reduction factor from the table for each combination of measures and sector being considered; multiply the values; and sum the products to obtain the total estimated effectiveness. The examples used to illustrate the use of the method are in Westchester County, New York, and in Hamilton Township, New Jersey.

Local System Responses to Water Shortage. Hoban, Thomas J. 1990. Vol. 3, No. 1. p. 63-71.

Source: Society & Natural Resources, Taylor & Francis Ltd., Rankine Rd., Basingstoke, Hants RG24 0PR, England, 0256-840366.

Abstract: Decisions made within local water systems set constraints within which individual water-use behavior occurs. Under conditions of water shortage, consumers are often asked to change their water-use behavior. The experiences of 28 local water systems in North Carolina in responding to water shortage are examined. Results of the research are based on personal interviews with the main decision maker for each water system. Results indicate that institutional arrangements and information exchange will be important determinants of how effectively local systems respond to natural resource problems. Improved coordination among organizations will help ensure effective and equitable response to water resource shortages. Social scientists can help resource managers evaluate and improve their communication and coordination.

Managing Public Water Supplies During Droughts, Experiences in the United States in 1986 and 1988. Moreau, D., Little, K. September, 1989. 149 p. PB90-165192/AS.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: The results of two surveys of drought management in municipal water supply systems are outlined in this research. The drought in the Southeast in 1986 and the nationwide drought in 1988 were reviewed. Some of the major findings of the surveys include: (1) 50% of all urban water supplies in the country were adversely affected by the drought of 1988; (2) slightly less than 50% of all the utilities had drought contingency plans in place before 1988; (3) less than 30% of the respondents in the survey had any kind of quantitative method to support making of decisions during droughts; (4) the existence of a drought policy had a positive effect on the effectiveness of conservation programs; and (5) the existence of a decision support system had a positive effect on the level of satisfaction with decisions. The case studies showed that a wide range of practices in drought management exists, but for the most part, municipalities are still basing plans on historical droughts. The study revealed the kinds of errors that are commonly made in estimating the effectiveness of conservation programs in the absence of appropriate models. It is important to compare water use with and without conservation when using these models.

Municipal Officials Guide to Water Conservation. New England Interstate Water Pollution Control Commission. January, 1980. 14 p.

Source: New England Interstate Water Pollution Control Commission, 85 Merrimac Street, Boston, MA 02114, (617) 367-8522.

Abstract: This guide is designed to provide municipal officials with information on water conservation programs. It explains why water conservation is beneficial, how water conservation can be achieved, and who should be involved in a local conservation effort. It also offers details on established water conservation programs in other communities throughout New England. A list of information sources on water conservation is also included.

Residential Water Conservation. Flack, J.E. March, 1981. Vol. 107, No. WR1. p. 85-95.

Source: Journal of the Water Resources Planning and Management Division, American Society of Civil Engineers, Water Resource and Planning Division, 345 E. 47th St., New York, NY 10017-2398, (212) 705-7288.

Abstract: Different options that reduce water demand are described as part of water conservation programs. The techniques and knowledge to implement them are also discussed. Water conservation strategies evaluated include restrictions on use, installation of water-saving devices, metering, horticultural changes, pressure reduction, reuse, and public education. The effects of metering, water-saving devices, and price increases on residential water demand are described for several communities. Secondary impacts of conservation on water revenue and return flow are also described. The combined water conservation programs discussed can decrease overall usage by 33 percent in the programs reviewed.

Residential Water Conservation in a Noncrisis Setting: Results of a New Jersey Experiment. Palmini, D.J., Shelton, T.B. August, 1982. Vol. 18, No. 4. p. 697-704.

Source: Water Resources Research, 2000 Florida Avenue NW, Washington, DC 20009, (202) 462-6900.

Abstract: East Brunswick Township, New Jersey, conducted a water conservation program in 1980 by distributing to 564 households free packets of water-saving devices purchased with municipal funds. The program was not a response to a current water supply crisis, and appeals for cooperation were based on the private economic benefits of water conservation. Statistical procedures were developed to measure the proportions of households installing each of the devices distributed, water-savings, and program costs. Two-thirds of the households receiving the packets installed at least one device. Average annual water savings per home receiving a packet were estimated at 5010 gallons. Amortized over ten years at a 10% discount rate, the program cost approximately 35 cents per 1000 gallons of water saved. The East Brunswick results compare

well to the results obtained from similar conservation programs in a pair of California communities during the 1976-1977 drought.

Residential Water Conservation: The Suburban Maryland Experience 1970-1975. In Proceedings; Conference on Water Conservation and Sewage Flow Reduction with Water-saving Devices, Pennsylvania State University. U.S. Department of Commerce. July, 1975. p. 1-22. PB 250 999.

Source: National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

Abstract: The Washington Suburban Sanitary Commission is a state chartered bi-county public utility that provides water and sewer service for over 1.2 million individuals living in a 1,000 square mile section of suburban Maryland. In May of 1970 the WSSC faced two major crises: a potential water supply shortage and a State Board of Health "sewer moratorium" due to the low capacity in local sewage treatment facilities. These two crises, plus a genuine interest in the improvement of the natural environment, led to the creation of a Water Conservation/Wastewater Reduction/Customer Education Program. This paper describes the projects within this Water Conservation/Customer Education Program during the past five years. Some projects have been profitable, but others have not produced measurable results. Some of the larger projects include: the assembly and distribution of a Water Conservation Handbook; a water conservation device test project covering 2,400 homes in the Cabin John, Maryland area; the distribution of 300,000 toilet displacement "Bottle Kits" and leak detection pills; the distribution of free shower-flow control devices and the assembly of a 20 minute water conservation film entitled "Drip."

Residential Water Conservation Projects: Summary Report, HUD -PDR-903. Brown and Caldwell. June 1984. 57 p.

Source: U.S. Department of Housing and Urban Development, Office of Policy Development and Research, Building, and Technology Division, Washington, DC 20410, (202) 708-1422.

Abstract: The U.S. Department of Housing and Urban Development (HUD) sponsored the demonstration projects described in this report in order to document the water savings in homes of people who installed water-conserving fixtures and devices. In the past, water engineers and planners had to rely on estimates based mostly upon laboratory tests of low-flow fixtures. These estimates have caused confusion in the water field and a general lack of confidence in water conservation techniques. Now that the HUD projects are complete, the water planners have a better basis for calculating the benefits of water conservation programs with more confidence that predicted savings will be realized.

State Water Conservation Strategies and Activities. Sawyer, S.W. October, 1984. Vol. 20, No. 5. p. 679-685.

Source: Water Resources Bulletin, American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814, (301) 493-8600.

Abstract: State governments have the potential to move water conservation from the theoretical to actual application. This report categorizes the states' approaches toward water conservation into four stages: (1) reliance on agricultural advisors; (2) leverage incentives; (3) performance standards; and (4) mandatory actions. Four levels of state conservation activity exist, with California and Florida maintaining the most extensive programs; Arizona, Massachusetts, New Jersey, North Carolina, and Oklahoma with numerous programs, but significantly lower staff commitment; and eight additional states maintaining some type of conservation effort. Most of the remaining states have minimal water conservation activities, with agricultural advice being most prominent. The research suggests water supply planners generally support water conservation activities.

Stretching the Drops: Making a Little Water Go a Long Way. Freifelder, R. July-August, 1988. Vol. 5, No. 4. p. 14.

Source: Home Energy, 2124 Kittredge Street, No. 95, Berkeley, CA 94704, (415) 524-5405.

Abstract: On a national average, Americans use 77 gpd per person. A home retrofitted with advanced water-conserving devices inside and out saves 20-55% of the daily total. The greatest potential for savings lies in lawn sprinklers, which account for nearly 50% of the water bill. Inside the house, the biggest consumer is the toilet, using 40% of the inside total. Water-conserving products and retrofits applicable to toilets, faucets, showerheads, automatic washers, and lawn sprinklers are recommended. Savings of several hundreds of dollars per year can be realized by the installation of low-flow showerheads and low-flush toilets. This whole issue of *Home Energy* magazine contains articles about conservation measures that are designed to save water and energy in the home. Other articles include "Water Retrofit Programs: Beyond Rationing" and "In Search of the Perfect Flush."

Survey of State Water Conservation Programs in the U.S. Deb, T.N., Rogers, N. February, 1984. Vol. 20, No. 1. p. 67-74.

Source: Water Resources Bulletin, American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814, (301) 493-8600.

Abstract: A community's health and economic livelihood is dependent upon adequate water supplies. As the demand increases and communities compete with one another for limited water resources, state governments are being asked to solve problems. Water conservation is one solution which can be used. A mailed survey was used to detail water conservation programs and the characteristics of the different programs were documented. Responses to the survey were cataloged from all 50 states. Information was gathered on laws and restricted use, community assistance, education, research, and other services. Eighteen of the 50 states indicated that they had some level of a water conservation program in operation. The need for state level programs was expressed by 36 states. Eighteen states had programs under development or study at the time of the survey. In addition, seven states had emergency or drought water conservation programs. Seven other states had plans for emergency programs. The 36 states which had either established a water conservation program or are developing programs can be a valuable resource to states with no program.

Survey of the Water Conservation Programs in the Fifty States: Model Water Conservation Program for the Nation. Blackwelder, B., Carlson, P. August, 1982. 140 p. PB83-167866.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: A survey was made of the water conservation programs in each of the fifty states to determine whether each state had a water conservation program or requirement in each of the following thirteen areas: public education, plumbing codes, retrofitting with flow-water-use fixtures, metering, leak detection, rate structures, drought contingency planning, reuse and recycling, outdoor use, groundwater management, industrial use, agricultural use, and government buildings and grants. A brief description of statewide or local programs of significance was prepared for each state. While awareness of water conservation measures is increasing, there is still substantial room for increases in efficiency in water use. The most comprehensive programs are being carried out in California, Massachusetts, Minnesota, and Maryland. Drawing upon the most successful water conservation programs around the country, a model water conservation program for domestic and municipal use, industrial use, and agricultural use was prepared. This model program can cut domestic and municipal use between 15% and 70%. The model program for industrial use categorizes various methods for reducing industrial withdrawals and consumption of water and outlines success stories in the steel, chemical, and paper industries. The model program for agricultural use identifies the various techniques for improving the efficiency of water use, describes the potential savings from instituting such measures, points out barriers to efficient use, and suggests ways to overcome the barriers.

Techniques for Saving Water in Homes and Businesses. Community Water Management for the Drought and Beyond: A Handbook for Local Government. Lawson, C. May, 1977. p. 63-70.

Source: California Office of Emergency Services, 2800 Meadowview Rd., Sacramento, CA 95814, (916) 427-4990.

Abstract: This article lists water-saving techniques that have been tried in California for toilet water savings, bath/shower/sink savings, kitchen savings, laundry savings, landscape water savings, and other outdoor savings such as washing the car and driveway. Business water savings include serving water only upon request in restaurants, turning off fountains, and reduced water use for cleaning and maintenance. Some potential problems have been presented such as toilet bottles floating and toilet dams not fitting. A chart on how much water various conservation tactics save is presented.

The Evaluation of Water Conservation for Municipal and Industrial Water Supply: Procedures Manual. Baumann, D., Boland, J., Sims, J. April, 1980. 73 p. AD 092989.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: This report describes the concepts, procedures, and measurement techniques which can be used in developing and evaluating water conservation proposals applicable to municipal and industrial uses of water. Water conservation measures may be classified as regulatory practices, management practices, or education efforts. The evaluation procedure may be used to determine if water-supply plans can be using a water conservation element. Based on this evaluation, water conservation proposals are developed, which can be integrated into water-supply plans, yielding alternative water-supply/conservation plans. The social acceptability of conservation measures is an important factor in predicting results, and interviews and surveys used to delineate social ideologies are important to this effort.

The Evaluation of Water Conservation for Municipal and Individual Water Supply, Volume II: Illustrative Examples. Planning and Management Consultants, Ltd. February, 1981. 376 p.

Source: Institute for Water Resources, Water Resources Support Center, Kingman Building, Fort Belvoir, VA 22060, (703) 664-6071.

Abstract: This volume describes the application of two different sets of proposed water conservation procedures, which were described in Volume I. These procedures would standardize the preparation of water conservation proposals for projects supplying water to municipal and industrial users. Volume II contains illustrative applications of the water conservation procedures based on data from the Atlanta, Georgia, and Tucson, Arizona metropolitan areas. The applications are not intended to develop water conservation proposals for the two communities. Rather, they illustrate the application of certain of the proposed procedures in a realistic setting. The illustrative applications are provided to illustrate process, not substance. They show methods, approaches, and techniques; they do not show results or conclusions.

The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use. Sharpe, W.E., Young, E.E., Kinsley, K.R. April, 1982. 49 p.

Source: Institute for Research on Land & Water Resources, Land and Water Research Building, Pennsylvania State University, University Park, PA 16802, (814) 863-0291.

Abstract: This report documents a 1978 study of 545 residential customers of the Washington Sanitary Commission to determine the impacts of mass water conservation device distribution and a water conservation rate on their long-term demand for water. The study showed a 17 percent decline in the quantity of water demanded over the study period. A majority of customers reported changing their habits to use less water and 42 percent reported installing water conservation devices.

Water Conservation Devices and Distribution Strategies. New York City Department of Environmental Protection, Management Services. July, 1985. 29 p.

Source: New York City Department of Environmental Protection, Management Services, Municipal Bldg., 1 Center St., New York, NY 10007, (718) 595-6600.

Abstract: This report outlines New York City's program to reduce water consumption. The program's success has been achieved through restricting and banning non-essential water use, restrictions placed on commercial and municipal accounts, and the voluntary cooperation of New York City citizens. Further substantial

reductions must come from residential consumers, who account for 75 percent of the City's water use. This report focuses on the benefits derived from water-saving devices and strategies for distributing them. It outlines in table format various conservation devices, delivery systems, ways in which programs can be packaged, and the experience of other cities. The programs discussed in this paper will operate most efficiently with an ongoing complimentary effort involving publicity, community outreach, and education.

Water Conservation Kit Distribution Program. Gradilone, F., Schlenger, D.L., Ciufo, L. August, 1981. 59 p.

Source: Hackensack Water Co., 200 Old Hook Rd., Harrington Park, NJ 07640, (800) 422-5987.

Abstract: The report outlines the water conservation kit distribution program conducted by Spring Valley Company in June and July 1981 throughout its territory in Rockland County, New York. A free water conservation kit containing two types of shower flow restrictors, two water displacement bags for toilet tanks, dye tablets for use in detecting toilet leaks, and a brochure containing step-by-step instructions for using the devices and additional tips for saving water in and around the house was mailed to each residence in the service territory. The objectives of the program were to encourage Spring Valley Water Company's customers to be "conservation conscious," to help them save water, energy, and money, and to see if they would respond sufficiently to impact on the timing or need for expensive new water supply facilities. The report outlines: how the kit was selected and distributed; the accompanying publicity campaign; the development and execution of the follow-up survey; the results of the survey, including response to the kit; an analysis of the response; and characteristics of the served population and their attitudes toward conservation; the approximate costs of the project; and the estimated potential impact on system demands.

Water Productivity and Development: Strategies for More Efficient Use, Proceedings of a Meeting of Water Efficiency Professionals. Menke, K., Woodwell, J. May 1990. 29 p.

Source: Rocky Mountain Institute, 1739 Snowmass Creek Road, Snowmass CO 81654-9199, (303) 927-3851.

Abstract: The purpose of these Proceedings is to summarize information and ideas that developed from a meeting of water-efficiency professionals who were exploring strategies for more efficient use of water resources. This information is to serve as a stepping stone in the process of coordinating dissemination of information, gathering feedback, and developing further ideas, papers, and procedures. Topics covered include the principles of demand management, water-efficient hardware and methods, implementing water efficiency, and other sources of supply related to efficiency.

Water Use in Eight Central Pennsylvania Homes, Water Use Data for Water Resources Management. Seaker, E.M., Sharpe, W.E. August, 1988.

Source: American Water Resources Association, 5410 Grosvenor Lane, Bethesda, MD 20814, (301) 493-8600.

Abstract: The water use of eight central Pennsylvania homes was monitored during the spring and summer of 1980 as part of a study to determine the impact of water conservation devices on waste water flow. Key water-using fixtures and appliances, outside hose bibbs, and total household water use were monitored for a 28 day period in each home. Mean daily per capita water use for toilet flushing, showering and bathing and clothes washing were higher than literature values, and mean per capita water use for all water using activities combined were higher than that for any study reporting comparable data. As expected, outdoor water use for homes without swimming pools was small relative to other uses. The value of homes was strongly correlated with water use, but family size was not. Water use did not appear to be affected in a major way by use of on-lot sewage disposal systems.

Water Use Management for Dollars and Sense: The Time is Now! Guidelines for Establishing Water Management Programs for Industry, Business, and Hotels and Motels. Resource Management Associates, Inc. 1982. 46 p.

Source: Resource Management, Inc., Fieldstone Building, PO Box 251, West Barnstable, MA 02668, (508) 362-9232.

Abstract: This booklet is designed to make water conservation a realistic and attainable goal. It provides reliable, accessible, "hands-on" information required to implement real water conservation programs in two distinct settings: industries/businesses and hotel/motel/resort facilities. The suggested practices are based upon existing technology and proven experience, and the savings which can be realized will directly reflect the involvement and dedication of the individuals and groups who adopt them. Proper management of water usage is emphasized in the most important areas of water consumption: sanitary usage; heating and cooling usage; process usage; and outdoor usage. By adopting instantaneous and long-term techniques which guarantee measurable savings - materially and economically - each water usage site will be able to audit its own water consumption as well as implement thoroughly workable water conservation practices. Thorough checklists and step-by-step procedures aid the user in making sound water conservation choices and developing creative alternative solutions.

Water Use Reductions From Retrofitting Indoor Water Fixtures. Whitcomb, J. December, 1990. Vol. 26, No. 6. p. 921-926.

Source: Water Resources Bulletin, American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814, (301) 493-8600.

Abstract: This paper describes a water use model which was developed to estimate water-savings resulting from installation of low-flow showerheads and toilet devices in residential housing. The model measures household water use in per capita terms with adjustments for age of occupants, household income, whether or not occupants are responsible for direct payments for water bill, and type of water fixtures. The report describes data from 308 single family residences involved with a pilot retrofit program in Seattle, Washington.

WATER 2000: Conservation Program, Volume IV, Conservation Program. New Castle County Water Resources Agency, DE. April, 1982. 64 p.

Source: New Castle County Water Resources Agency, 2701 Capital Tr., Newark, DE 19711, (302) 731-7670.

Abstract: WATER 2000 is a cooperative planning effort between water suppliers and state and local agencies. The plan is designed to meet the area's needs to the year 2000 and beyond. The foundation of this program is a long-term collaborative effort between both public and private sectors on a community-wide basis. The recommendations for the conservation program are broken into three segments: 1) an on-going program that is designed to reinforce the conservation message continually at all times of the year; 2) a peak use program, a supplement to the on-going program, that emphasizes conservation measures when water use is highest; and 3) a voluntary drought emergency program that would be put into effect in times of severe water shortages. The means to carry out the program include printed material, the news media, personal contact, special events and school programs undertaken by a number of different jurisdictions, agencies and organizations in the public and private sectors.

3. Reducing Water Losses in Distribution Systems

American Water Works Association Publications.

Source: Journal American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235, (303) 794-7711.

Increasing Water System Efficiency Through Control of Unaccounted-For Water. Hudson, W.D. July, 1978. Vol. 70, No. 7 . p. 362-365.

Abstract: The author discusses the metered ratio as a measure of water utility system efficiency and describes how to locate and deal with sources of unaccounted-for water.

Reduction of Unaccounted-for Water. Hudson, W. D. 1964. Vol. 56, No. 1. p. 143-148.

Abstract: The article discusses the causes of unaccounted-for water and describes the range of the amount of unaccounted-for water that may arise due to problems pertaining to master meters, domestic meters, industrial and commercial meters, unauthorized uses, underground leakage, leaks from hydrants, and unavoidable leaks. The author recommends the checking, servicing, and replacement of inaccurate meters, minimizing use of unauthorized water usage, leak-detection campaigns, and recording water use by hydrants and public trucks. Audit of the distribution system should be made if the percentage for water remains high after most obvious checks have been made. This technically oriented article discusses the range and causes of unaccounted-for water. Ten to fifteen percent unaccounted-for water is about average for a well-operated system with consumption of approximately 100-125 gpcd. As far as conservation, the article is useful only in the causal factors of unaccounted-for water and what can be done to change this.

Leak Detection in Water Mains. Hudson, W. D. April 30, 1975. Vol. 122. p. R104-R106.

Source: Water and Sewage Works, Scranton Gillette Communications, Inc., 380 E. Northwest Highway, Des Plaines, IL 60016, (312) 298-6622.

Abstract: This article presents a good review of the methods to detect leaks in water utility transmission and distribution systems. Two methods of determining whether there is a need for large-scale leak detection are: the minimum use ratio and the unaccounted-for water ratio. It is stated that a ratio greater than 35 percent of the minimum night use rate to the average use rate indicates further investigation is necessary. Industrial and commercial night use must be taken into account. For fully metered utilities, if the unaccounted water is greater than 15 percent of the water produced, then intensified leak detection is usually justified. Seven factors affecting the unaccounted-for water use are given. These include accuracy of master meters measuring total water produced, under-registration of industrial and domestic meters, unauthorized use, use from hydrants, unavoidable leakage and underground leakage. For both methods of determining the need for leak detection, consideration must be made for the number of miles of the distributive system and the cost of producing water. The article also provides a good description of three major methods of locating leaks: hydraulic measurements along mains, visual inspection, and audible inspection with mechanical or electrical amplifiers.

Leak Detection Repair/Service Metering Report. NJ Department of Environmental Protection and Energy. 1990. 31 p.

Source: NJ Department of Environmental Protection and Energy, Office of Regulatory Policy, CN 029, Trenton, NJ 08625-0029, (609) 633-7021.

Abstract: This report lists the purveyors in New Jersey who submitted leak detection and repair plans to NJDEPE in 1990. The report summarizes the information supplied by the purveyors.

Role of Water Audits in Water Conservation. Gagnon, G. A. April, 1984. Vol. 110, No. 2. p. 129-140. Source: Journal of Water Resources Planning and Management, American Society of Civil Engineers, 345 East 47 Street, New York, NY 10017-2398, (212) 705-7288.

Abstract: By controlling leakage from a water distribution system, significant levels of water conservation can be achieved. A complete water audit is recommended as the best method of determining the potential level of water conservation. Conservation of water using a leakage control program may exceed the level of conservation available through the use of consumer-oriented water conservation devices. The three phases of a water audit are master meter testing, leak detection and quantification, and system inventory. The scope of water audits is often varied in order to meet an individual community's needs. Six case histories of successful water audit/leakage control programs are presented. These programs resulted in water savings ranging from approximately 12% to as high as 75% of the average daily pumpage.

4. Economics of Water Conservation

Alternative Conservation Rates. Woodcock, C. June, 1992. 25 p.

Source: Camp Dresser and McKee Inc., One Cambridge Center, Cambridge, MA (617) 621-8181.

Abstract: This paper, presented at the 1992 American Water Works Conference, discusses the growing tendency among water utilities to examine alternative rate structures. Utilities are moving away from declining block rate systems in favor of alternative rate systems. The author addresses the reasons utilities may choose to adopt rates that encourage conservation and the types of uses the utility may target. Alternative rate structures described include higher summer rates, summer surcharge rates, increasing block rates, ratchet rates, and penalty rates.

American Water Works Association Publications.

Source: Journal American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235, (303) 794-7711.

Conserving water through pricing. Renshaw, E.F. January, 1982. Vol. 74, No. 1. 4 p.

Abstract: The problem of water conservation is examined from the perspective of basic economic theory. In some cases it may be appropriate to tax water usage for purposes of conservation rather than for financing additional capacity. Excess revenues could be used as credits on business property taxes to encourage economic expansion or could be rebated to low-income families and nonprofit institutions.

Cost-Benefit Analysis of Conservation Programs. Macy, P., Maddaus, W. Vol. 81, No. 3. p. 43-47.

Abstract: A carefully planned and implemented conservation program can reduce water consumption by 10-30 percent. This reduction will help meet demand, may postpone the construction of capital facilities, and can also help alleviate problems such as overburdened wastewater treatment facilities.

Demand Management Factors in Residential Water Use: The Southern Arizona Experience. Billings, R.B., Day, W.M. March 1989. Vol. 81, No. 3. p. 58-64.

Abstract: Two models of residential water demand were run with data from three water utilities in the Tucson, Arizona, metropolitan area to estimate the response of water use to variations in price, household income, and a variety of socioeconomic and climatic variables. The study covered a period when all three utilities experienced substantial reductions in residential water use. All three utilities examined imposed availability-of-service charges, and the largest utility used increasing-block rates and seasonal rates. Because of disagreement in the literature about the proper specification of price under these conditions, demand models were estimated using both the traditional average-price variable and the marginal price plus rate premium. Estimated long-term price elasticities were also estimated. Several principles of conservation pricing and other aspects of demand management for water utilities are discussed in this article.

Effectiveness of Conservation-Oriented Water Rates in Tucson. Cuthbert, R. Vol. 81, No. 3. p. 65-73.

Abstract: In arid regions such as the American Southwest, various measures have been implemented to help reduce water use. In this article, the author examines the effectiveness of an inverted rate structure as a means of enhancing an already ambitious water conservation program in Tucson, Arizona.

Full-Cost Water Pricing. Goldstein, J., February, 1986. p. 52-61.

Abstract: Many municipal water systems have traditionally priced water at far less than the cost of the service, thereby requiring subsidies from general funds. Conversely, some water revenues have been diverted to meet other expenses of the city. The author cites the benefits of separate accounting for water revenues and expenses and full-cost pricing, drawing on the situation in Massachusetts. Increased efficiency and ultimate economies can be realized from allocation of sufficient funds to undertake rehabilitation and maintenance programs. Methods of

structuring rates and implementing full-cost rates are reviewed, and Boston's recent restructuring of water and sewer services is given as an example of improvements made possible by full-cost pricing.

Integrating Conservation and Water Master Planning. Macy, Peter P. October 1991. Vol. 83, No. 10. p. 44-47.

Abstract: Incorporating conservation into a master plan involves a risk of lost revenues, uncertainty as to exact long-term savings, and increased operating budgets to implement the programs. Utilities should, however, see a net decrease in costs because properly designed and implemented conservation programs help maximize efficiency of existing supplies, which decrease operation and maintenance expenses and capital costs. Conservation can also help satisfy environmentalists and regulators whose cooperation may be needed to obtain future water projects.

Leak Detection Programs Recover Revenues. Sowby, S. 1981. Vol. 73, No. 11. p. 562-564.

Abstract: This article briefly reviews seven case histories of leak detection that has reduced water losses significantly. Examples of flow measurement techniques, location and detection methods, costs for typical studies, and benefits of repair are included. The examples illustrate the economic benefits of leak investigations and water audits.

Policing demand through pricing. Griffith, F.P. June, 1982. Vol. 74, No. 6. 4 p.

Abstract: By concentrating on the peak-use season, the Fairfax County (VA) Water Authority developed a rate structure that reduced demands and equitably charged its customers. Practical improvements were made in traditional rate schedules by approaching marginal costs on a more refined basis.

Proceedings of the 1991 Annual Conference: Management and Regulations for the New Decade. June 23-27, 1991. ISBN: 0-89867-590-X.

Abstract: Some of the papers presented at the Conference include the following:

Goal Billing A Water Conservation Surcharge/Discounts System. Duecker, L., Regli, P.

Life-Line Rates/Low Income Discounts and Increasing Block Rates. Woodcock, C.

Residential Water Audit. Nelson, J.

Seasonal Rates. Clark, D.

State Programs Incorporating Water Conservation. Dyballa, C., Connelly, C.

Using Production Costing to Evaluate Conservation Projects or Alternative Supplies. Ratchye, J.

Water Demand Management Through Rate Structure. Lehman, P.

Water Rate Surcharges as a Conservation Mechanism. Schlette, T.

Water-savings from Water Conservation Best Management Practices in Southern California. Maddaus, W.O., Thornhill, E., Opitz, E.

Reducing Water Demand During Drought Years. Gilbert, J.B., Bishop, W.J., Weber, J.A. 1990. Vol. 82, No. 5. p. 34-39.

Abstract: During the summer of 1988, following one year of drought, the East Bay Municipal Utility in Oakland, CA instituted mandatory water conservation measures which included strict ordinances on water use, an inclining-block rate structure, and an extensive public relations program. The primary thrust of the drought program was to reduce water consumption by 25% from June through September. The substantial education and promotion programs that accompanied the mandatory conservation targets and the inclining-block rate schedules are believed to have had a major influence on the performance achieved by diverse areas and customer groups.

The Economics of Leak Detection and Repair--a Case Study. Moyer, E.E., Male, J.W., Moore, C.I., Hock, J.G. 1983. Vol. 75, No. 1. 7 p.

Abstract: The advantages and drawbacks of a leak detection and repair program for a publicly owned water utility are cited. Characteristics of different types of leaks and the accuracy of the detection method applied are described. The results of the analysis revealed that the benefits outweigh the costs, and the program has led to a decrease in unaccounted-for water without greater repair costs for the system. The Westchester Joint Water Works in Mamaroneck, NY is examined for its leak detection and repair program. The accuracy of sonic

detection methods and the largest expenses for such programs were studied. The study revealed that leak detection and repair is an effective means of water conservation.

The Effects of Water Conservation Kits on Water Use. Morgan, D.W., Pelosi, P. 1980. Vol. 72, No. 3. 3 p.

Abstract: During an intense drought in 1977, the city of Oxnard, California distributed a free household water conservation kit to 600 households. According to a subsequent survey, sixty-three percent of the households installed at least part of the kit, which included a water dam to reduce the quantity of water flushed in the toilet, a plastic shower head flow restrictor, and a dye to test toilets storage tank leaks. Households that installed the conservation kits had greater average water use, more bathrooms, and more water-using appliances than non-installers. Households headed by craftsmen and professionals installed at a slightly higher than average rate, while those headed by equipment operators and laborers installed at lower rates. The total kit reduced water use by slightly more than 3 percent, enough to pay for itself in a year at the winter rate then in effect.

Tomorrow's Rate Structures Today. Phillips, R.V. February, 1977. Vol. 69, No. 2. 3 p.

Abstract: In the changing social and economic climate of today, utility rate structures are a popular concern. The three major approaches to rate setting are rates based on historical costs, rates based on true cost, and rates based on social and political considerations. To deal with the myriad of pressures in the rate-making process, utility managers must understand old and new philosophies and their applicability to their systems.

Water Rates, American Water Works Association Manual of Water Supply Practices, AWWA Manual M1. American Water Works Association. 1983. 83 p.

Abstract: This third edition of the Water Rates manual contains traditional rate-making concepts and methodologies endorsed by AWWA in previous editions, as well as providing expanded discussion of topics currently relevant to the evaluation and design of equitable rates. Section 1 presents a more detailed description of the development of revenue requirements and suggestions for recognizing inflationary factors in projecting water utility revenue requirements. Sections 2 and 3, which present methodologies for allocation of total costs of service to various classes of customers served, have also been expanded to present additional considerations in determining costs of serving customers. Section 4 discussed and illustrates the design of a schedule of water rates to derive allocated costs of service. In addition, the section includes some discussion of alternative rate forms that have been proposed during the past decade as a result of inflationary and conservation concerns. Section 5 has been added in this edition, addressing the simplified development of water rates for small utilities. Finally, an appendix that briefly sets forth a bill tabulation methodology has been added.

Water Rates and Residential Water Conservation. Lippiatt, B.C., Weber, S.F. 1982. Vol. 74, No. 3. 4 p.

Abstract: Five kinds of water rate schedules are described. A sample of rater schedules in force throughout the U.S. are analyzed to determine the effects of water pricing policies on homeowners. The dollar value of a unit of conserved water was found to be lower than the average price of water.

Cost of Industrial Water Shortages. Wade, W., Hewitt, J., Nussbaum, M. October 25, 1991. 10 p.

Source: Spectrum Economics, Inc., Suite 1776, 120 Montgomery Street, San Francisco, CA 94104, (415) 391-3558.

Abstract: A survey was performed on industries most affected by water policy and those whose activities have the greatest impact on the health of the California economy: high volume water using industries with a large employment base. The purpose of the summary was to determine industrial water use patterns, the extent of water conservation measures, and the potential for plant production losses due to seasonal and year-long reductions in water supplies. The report concludes that California's economy is being eroded as a result of unreliable water supplies.

Creating Economic Incentives for Conservation: Guidelines for Private Water Companies and Public Utility Commissions. Vickers, A., Markus, E. June, 1992. 9 p.

Source: Amy Vickers & Associates, 100 Boylston St., Suite 1015, Boston, MA 02116-4610, (617) 728-9112.

Abstract: This paper, presented at the 1992 Conference of the American Water Works Association, discusses various economic incentives and disincentives which utilities face in the pursuit of conservation programs. Some disincentives include revenue shortfalls, more frequent rate adjustments, and difficulties in predicting future customer demands. Reduced investment costs, reduced operating costs associated with pumping and treatment, and the conservation of environmental assets are potential incentives for adopting a conservation program.

Electric and Water Utilities: Building Cooperation and Savings. Dyballa, C., Connelly, C. 1992. 11 p.

Source: Cynthia Dyballa, Office of Policy Analysis, U.S. Environmental Protection Agency, PM-221, 401 M St. SW, Washington, DC (202) 382-2756.

Abstract: Energy and water conservation are both current issues of great concern to utilities and government officials. Only a few electric and water suppliers have cooperated in joint conservation projects, despite the great potential for success. Although industry communication has been limited, similarities between the two fields make joint programs highly possible. This paper addressed three areas where electric and water utilities can cooperate and learn from each other.

Estimating Urban Residential Water Demand: Effects of Price Structure, Conservation, and Education. Nieswiadomy, M. March, 1992. Vol. 28, No. 3. p. 609-615.

Source: Water Resources Research, 2000 Florida Avenue NW, Washington, DC 20009, (202) 462-6900.

Abstract: This paper estimates urban water demand in the United States using a survey of 430 U.S. utilities. Using water demand equations, it also tests if consumers respond to average prices or marginal prices. The results show that prices are more elastic in the South and West. Also, conservation does not appear to reduce water use, but public education appears to have reduced water usage in the West.

Impact of Conservation on Rates and Operating Costs. Bhatt, N.R., Cole, C.A. April, 1985. Vol. 111, No. 2. p. 192-206.

Source: Journal of Water Resources Planning and Management, American Society of Civil Engineers, 345 East 47 Street, New York, NY 10017-2398, (212) 705-7288.

Abstract: When abrupt conservation measures are taken, there are usually increases in unit costs of water. This report describes how a 20% water usage reduction through water conservation can affect a rural residential community. When the short-term impact is explained, it is found that there would be a 16% drop in the average bill and only a 2% reduction in operating costs of the company. There is also a comparison between source and storage facilities in the year 2020 with and without conservation. With a comprehensive and continued 20% water conservation, there would be a postponed source and storage facilities expansion of 3 and 4 years respectively and would save \$71,280 in present worth (1976) for storage and source facilities and operating costs. With the savings in operating and maintenance costs, there would eventually be a savings in water bills for the customers and the additional money could be directed towards other types of public works for the community.

Improving Profitability Through Water Conservation. Sartorio, Anthony T. July 1991. p. 70.

Source: Beverage World, 150 Great Neck Rd., Great Neck, NY 11021, (516) 829-9210.

Abstract: Recently beverage manufacturers have been forced to institute water conservation measures in response to the local drought conditions in the North Central U.S. and California. This article explains the different types of measures implemented and how these measures can be profitable for the company. Water conservation methods discussed include the recovery of cooling water, the recovery of steam condensate, and the replacement of water cooled equipment.

National Water and Wastewater Rate Survey, 1992. Ernst & Young National Environmental Consulting Group. 1992. 45 p.

Source: Ernst & Young, 2100 Gaslight Tower, 235 Peachtree Street N.E., Atlanta, GA 30303, (404) 581-1300.

Abstract: This fourth edition of Ernst and Young's biennial report provides data on rates and related policies employed by U.S. utilities. New for this year's edition is a discussion on conservation pricing. The survey targets the major water and wastewater utilities serving the central and, as applicable, surrounding cities of the 100 largest Metropolitan Statistical Areas (MSAs) in the United States. The MSAs were ranked according to population estimates developed by the U.S. Office of Management and Budget. This survey is intended to provide a handy reference to rates and related policies adopted by the utilities throughout the United States. This survey is not intended to compare the cost of service among surveyed utilities.

Planning Tool for Water Conservation. Salgaonkar, J. 1989. p. 13B-5--13- B-11.

Source: Water: Laws and Management, American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814, (301) 493-8600.

Abstract: This report discusses a spreadsheet program which was developed to evaluate total watershed savings and the cost-effectiveness of water conservation measures. When information regarding specific utilities is added to the spreadsheet, the program calculates cost-benefit ratios and total water-savings over the project period. The results for the South Florida Water Management District are discussed.

Rate Structures to Promote Conservation: Proceedings of A Conference Organized by the Delaware River Basin Commission and the New York City Water Board. Bloome, M., ed. November 1, 1990. 90 p.

Source: Delaware River Basin Commission, 25 State Police Drive, West Trenton, NJ 08628, (609) 883-9500.

Abstract: The papers in this collection were presented to a conference entitled "Innovative Rate Structures to Promote Water Conservation." This publication contains the following full-text reports:

Forms of Utility Ratemaking. Olstein, M.

Estimating Price Elasticity of Demand for Water. Dziegielewski, B.

Constraints to Deviations from Cost of Service Pricing. Russell, J.

Pricing Water Uses: Lessons from the Electric Industry. Sterzinger, G.

Regulatory Policy and the Funding of Conservation Programs. Mann, P.

Water Supply, Wastewater Treatment and Water Conservation in the Hudson and Delaware River Basins.

Tripp, J.

Peak Use Charge: Customer Relations. Griffith Jr., F.

Water Conservation Using Structural Methods in Reno-Sparks, Nevada. Gonzales, J.

The Impact of Conservation Rate Structures on Financial Planning and Budgeting. Wilson, R.

Experience in Mandating Water Conservation Pricing in Palm Beach County. Federico, K.

Revenue Neutral Water Conservation: Marginal Cost Pricing with Discount Coupons. Collinge, R. March, 1992. Vol. 28, No. 3. p. 617-622.

Source: Water Resources Research, 2000 Florida Avenue NW, Washington, DC 20009, (202) 462-6900.

Abstract: This paper points out how a system of marketable discount coupons used for the sale of water can satisfy both redistributive and revenue constraints without compromise to economic efficiency, creating marketable multipart pricing.

Selling Water Efficiency. Jones, A. May/June, 1992. p. 52-53.

Source: In Business, 419 State Ave., Emmaus, PA, 18049, (215) 967-4135.

Abstract: This article points out the benefits of water service companies, or WASCOS. WASCOS invest in water efficiency by agreeing to fix leaks and install water-efficient equipment for free in schools and housing developments. As payment, the WASCOS take 50 to 80 percent of the metered water-savings over several years.

to pay back its capital investment and profit, leaving the rest of the savings - and all of it after the initial repayment period - for the water customer. Examples of water service companies and their success stories are given.

Setting Rates to Encourage Water Conservation. Schlette, Theodore C., Kemp, Diane C. May 1991. Vol. 138, No. 3. p. 25-29.

Source: WATER/Engineering and Management, 380 E. Northwest Highway, Des Plaines, IL 60016-2282, (708) 298-6622.

Abstract: Submetering is being recognized as an effective water conservation strategy in the U.S.. By using separate meters to indicate individual usage in apartments, condominiums, and trailer homes, consumers are made aware of their use of water and its cost. Each unit is billed for the amount of water it uses, allowing customers to pay for only what they use and inducing them to conserve water so as to reduce bills. Although the installation and monitoring raise costs for utilities, submetering is typically reported to reduce water usage 20-40%, and is sensitive enough to record low-flow system leakage.

The Effect of Price on the Residential Demand for Water in New Jersey. Kronyak, Denise J. A paper submitted to Economics Department of Rutgers University in partial fulfillment of requirement of Senior Honors Seminar. NJ Public Interest Research Foundation, 1982. 89 p.

Source: Douglass Library, Rutgers University, New Brunswick, NJ 08903, (908) 932-9411.

Abstract: This study estimates the effect that price has on residential water consumption in New Jersey. The current water supply situation in the state is discussed, as well as the historical and forecasted water-usage rates. Current policies and their economic implications are presented. This study also presents the model chosen to estimate the residential demand for water in the state, as well as discussing the implications of the results of the estimated model. Alternative water rate structures that can lead to a more efficient allocation of water as a scarce resource are suggested. An area where alternative rate structure has been used successfully is also discussed.

The Enhanced Role of Water Conservation in the Cost-Benefit Analysis of Water Projects. Griffin, R.C., Stoll, J.R. 1983. Vol. 19, No. 3. 11 p.

Source: Water Resources Bulletin, American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814, (301) 493-8600.

Abstract: A brief survey of the recent changes in water regulations that promulgate requirements concerning water conservation and willingness to pay measures is conducted, and a working definition of water conservation is presented. A specific procedure for conducting cost-benefit analyses that satisfy recently enacted federal requirements is developed, integrating the concepts of water conservation and willingness to pay. The economic superiority of marginal cost pricing is demonstrated.

The Real Price of Water. Schwartz, Joe. September 1988. p. 29-32.

Source: American Demographics, 127 W. State St., Ithaca, NY 14850, (800) 828-1133.

Abstract: This article discusses how the demand and use of water has increased and will steadily increase in the future. Water supply issues in large metropolitan areas such as New York City, Los Angeles, and Phoenix are discussed. Many areas are dealing with a lack of water and must face limits to urban growth, as well as questions of allocating and protecting current water supplies. The author concludes that economic growth is closely tied to potable water supplies.

Trading Water: An Economic and Legal Framework for Water Marketing. Smith, R.T. 1988. 95 p.

Source: National Governor's Association, Council of Governors' Policy Advisors, 444 North Capitol Street, Suite 250, Washington, DC 20001-1572, (202) 624-5880.

Abstract: This article describes the issues state policy makers must deal with when setting terms for surface and groundwater use, as well as conservation issues. The management of these valuable resources is directly affected by the economic climate, and policy makers must understand this and also the role legal institutions play in establishing the terms and conditions for voluntary water transactions. The primary challenge for policy makers is to shape a legal framework that allows for solutions to water-management problems while also effectively protecting the legitimate interests of third parties.

Urban Water Pricing and Drought Management. Moncur, J.E. 1987. Vol. 23, No. 3. p. 393-398.

Source: Water Resources Research, 2000 Florida Avenue NW, Washington, DC 20009, (202) 462-6900.

Abstract: In this article, there was a study done on single-family residential customers of the Honolulu Board of Water Supply (1982) using pooled cross-sectional and time series observations where demand for water is estimated as a function of price, income, household size, rainfall, and a dummy variable denoting a water restrictions program. From the study, it is suggested that a 40% increase in the marginal price would achieve a 10% reduction in water use, even during a period of drought.

Water conservation and the assessment of municipal and industrial water supplies, National Agricultural Library Call Number 100 T31M. Griffin, R., Stoll, J. September, 1982. 50 p.

Source: Department of Agricultural Economics, Texas Agricultural Experiment Station, Texas A&M University, 348 Soil and Crop Science, College of Agriculture, College Station, TX 77843-2474, (409) 845-3211.

Abstract: The report addresses recent revisions to the federal "Principles and Standards" for planning municipal and industrial water development. Revisions include a requirement that nonstructural and water conservation measures be incorporated into project cost-benefit analyses. A specific cost-benefit methodology accommodating the revisions is constructed and discussed. Informational requirements for applying this methodology are identified. Water supply and demand functions are required for the empirical application of this technique. Estimations of these functions for a particular project enable the project to be evaluated. In addition to being consistent with federal mandates, this technique offers important advantages over the traditional "requirements" approach to project evaluation.

5. Agricultural Water Conservation

A Study in Xeriscaping™, National Agricultural Library Call Number 80-AM37. Karlik, J. July 15, 1992. p. 72-77.

Source: American Nurseryman, 111 N. Canal St., Chicago, IL 60606-7276, (312) 782-5505.

Abstract: This article describes a test the author performed at his own residence to investigate the effects of a water-conserving landscape on irrigation and maintenance. The author reduced irrigation rates, installed zone and drip irrigation, and replaced water-thirsty sod with drought-tolerant plants. The author did reduce his water use by 25 percent and also learned that irrigation, rather than the types of plants used, is often the most important factor in water conservation.

Agricultural Irrigation and Water Use, U.S. Department of Agriculture Information Bulletin Number 638. Bajwa, R.S., Crosswhite, W.M., Hostetler, J.E., Wright, O.W. January, 1992. 116 p.

Source: ERS-NASS, PO Box 1608, Rockville, MD 20849-1608, (800) 999-6779.

Abstract: The 17 Western States, plus Arkansas, Florida, and Louisiana, account for 91 percent of all U.S. irrigated acreage, with the Western States alone contributing over 85 percent. This report integrates data on the distribution, characteristics, uses, and management of water resources from a wide variety of data sources. This report includes charts and tables on water use in irrigation; farm data comparing selected characteristics of irrigated and nonirrigated farms; and data on water application systems, sources of water, pump energy expenses by energy type, values of irrigated and nonirrigated land, and cash rents.

Basic Drip Irrigation Design for Landscaping. The Toro Company. 1985. 4 p.

Source: The Toro Company, Irrigation Division, PO Box 489, Riverside, CA 92502, (800) FOR-TORO.

Abstract: This bulletin explains the basics and benefits of drip and trickle irrigation. Drip irrigation provides reduced run-off, weed control and accelerated plant growth. Drip emitters flow very little water, so more plants and plant area can be irrigated with less water. This manual describes plant water requirements, emitter requirements, and water quantity and duration needed for different situations.

Other publications available:

Automatic Sprinkler System Scheduling

Rainfall-Evapotranspiration Data for the United States and Canada

Conservation in Arabian Gulf Countries. Akkad, A.A. May, 1990. Vol. 82, No. 5. p. 40-50.

Source: Journal American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235, (303) 794-7711.

Abstract: In the Persian Gulf countries of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates, demand for water has increased dramatically as a result of rapid development, an improved standard of living, and diversification of economic activity. This article discusses important means of conserving agricultural water resources in these countries. These methods include covers, linings, and automation systems to reduce seepage and evaporation losses during conveyance and in the fields. A reduction in agricultural water demand can also be achieved by developing means to reduce transpiration losses, such as (1) breeding plant varieties that transpire less, (2) reducing air movement by using windbreaks, and (3) applying chemicals. Residential conservation can be accomplished by various means such as: (1) water auditing and leak detection; (2) public awareness campaigns; (3) retrofitting; and (4) economic incentives to those who conserve and enforcement of penalties against those who waste the resources. Conservation of natural resources in general, and water resources in particular, is a principal component of Islamic teaching; the most important and effective

way to make the public aware of conservation from an Islamic perspective is through the media and the educational system.

Conserving Water: The Untapped Alternative, Worldwatch Paper 67. Postel, S. September, 1985. 66 p.

Source: Worldwatch Institute, 1776 Massachusetts Ave., NW, Washington, DC 20036, (202) 452-1999.

Abstract: As water supplies around the world are decreasing, water shortages will limit agricultural output and economic growth. This article describes how alternative investments in efficiency and improved management can produce more usable water per dollar than do conventional water supply projects. Presently, the efficiency of irrigation systems averages only 37% worldwide. When the low-energy precision application (LEPA) method of irrigation is used conventional sprinkler designs can be increased to 70% to 95% efficiency. In developing countries, better management could reduce water withdrawals for most canal systems by 10-15%, which allows new land to be brought under irrigation at a much lower cost than developing new water supplies. When charged more for water, farmers use water more efficiently. This paper also discusses impressive gains in water efficiency in industry. Recycling rates in the major water-using manufacturing industries in the United States have risen, with the paper industry recycling its water 5.3 times, petroleum refineries about 7 times, and chemical product manufacturers about 3 times. Recycling is becoming more economically attractive as wastewater discharge standards and costs increase. Economic incentives can also spur water efficiency in urban areas and water conservation measures in domestic use have already been implemented in some areas. If conservation standards were set at the federal level the conversion to a water-efficient economy could be made more quickly and efficiently.

Drip and Trickle Irrigation for Water Conservation, Quick Bibliography Series QB 91-23. MacLean, J.T. November, 1990. 80 p.

Source: U.S. Department of Agriculture, National Agricultural Library, Public Services Division, Room 111, Beltsville, MD 20705, (301) 344-3755.

Abstract: This publication is a quick bibliography on drip and trickle irrigation. Although it is not an in-depth, exhaustive bibliography, the citations are a substantial resource for recent investigations on this topic. They also serve the purpose of bringing the literature of agriculture to the interested user who, in many cases, could not access it by any other means. This bibliography is derived from computerized on-line searches of the AGRICOLA data base. Timeliness of topic and evidence of extensive interest are the selection criteria.

Efficiency in Irrigation: The Conjunctive Use of Surface and Groundwater Resources. O'Mara, G.T. ed. 1988. 196 p.

Source: Winrock International, 1611 North Kent Street, Arlington, VA 22209-2134, (703) 525-9455. ISBN 0-8213-1030-5.

Abstract: (Book) The results of a conference held to examine the economic effects of the physical externality that is created when agricultural producers in developing countries rely on a common aquifer or stream system for their water supply are presented. The additional costs producers impose on one another in pumping water from the aquifer can destroy the social efficiency of the individual's decisions on resource allocation. The consensus of the conference participants was that the available remedies for coping with the gap between private and social costs induced by such an externality may perform tolerably well in most situations and that several innovative approaches may improve the allocation of resources in more difficult cases. Models which simulate the behavior of economic agents under conditions including complex groundwater-surface water interactions and specific institutional arrangements are reviewed. Several special cases that illustrate significant aspects of the conjunctive use of aquifer and stream-aquifer resources are examined. An evaluation was made of the effects of physical interdependence among agents on their economic behavior in several institutional contexts. Although the situation can be difficult when different sets of agents control surface water and groundwater, there are conceptual and practical grounds for expecting that the problem can be resolved even in difficult cases. In particular, the exclusion of farmers from active participation in the process has doomed past efforts to solve the

problems. Farmers must be brought into the picture if the requisite cooperation and coordination are to be achieved.

Winrock International is a private non-profit organization that works to strengthen agricultural institutions, develop human resources, design sustainable agricultural systems and strategies, promote sound renewable energy systems, and improve policies for agricultural and rural development. Their catalog, entitled "Agribookstore," lists all publications available through Winrock International, including many water conservation and irrigation resources.

Gray Water Use in the Landscape: How to Use Gray Water to Save Your Landscape During Droughts. Kourik, R., Hill, A., ed. 1988.

Source: Metamorphic Press, P.O. Box 1841, Santa Rosa, CA 95402, (707) 874-2606. ISBN 0-9615848-1-5.

Abstract: (Book)

Handbook of Water Harvesting, Agricultural Handbook # 600. Frasier, G., Myers, L.E. June 1983. 45 p.
Source: Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, (202) 783-3238.

Abstract: This handbook describes some of the methods and materials being used to collect and store precipitation runoff to provide drinking water and to present a stepwise guide for the design, selection of materials, installation, and maintenance of water-harvesting systems. All methods and materials described are being used in operational systems to provide water for domesticated animals, wildlife, and, with modifications, domestic and household use. Sufficient information is available from research and operational catchments to permit reasonable predictions of expected performance and to identify conditions of climate, soil, and topography that can affect the final performance of the systems. With suitable filtration and chlorination, the described systems can provide water for household purposes.

Health Guidelines and Standards for Wastewater Reuse in Agriculture: Historical Perspectives.

Shuval, H. I. 1991. Vol. 23, No. 10/2. p. 2073-2080.

Source: Water, Science, and Technology, Pergamon Press, Inc., Journals Division, Maxwell House, Fairview Park, Elmsford, NY 10523, (914) 592-7700.

Abstract: Although wastewater reuse has been practiced for well over 100 years as a strategy for water conservation and water pollution prevention, health regulations have developed erratically under the influence of varying historical forces and social trends. In the earliest periods there was little or no regulation. Early in the 20th century, with the growing awareness and fear of environmental transmission of communicable diseases, there were many severe, and often unenforceable, health regulations, some of which lacked a firm epidemiological basis. Recent research studies and policy reviews sponsored by the World Bank and the World Health Organization have provided a sound scientific basis for re-evaluating the health risks associated with wastewater reuse. This approach, based on credible epidemiological evidence, has led to the development by the World Health Organization of new health guidelines allowing for unrestricted agricultural irrigation of all crops including vegetables eaten raw, with an effluent standard of 1 or fewer helminths/L and a mean of 1000 fecal coliform/100 ml.

Improving Your Irrigation With Gypsum Blocks. (Video Cassette). Richardson, Gail; Mueller-Beilschmidt, Peter. 1989.

Source: Inform, 381 Park Avenue South, New York, NY 10016, (212) 689-4040.

Abstract: Inform, founded in 1974, is a nonprofit research organization that identifies and reports on practical actions for the preservation and conservation of natural resources and public health. This tape is an excellent visual tool. Colorful slides of gypsum block installation, meter reading, and field strip testing are presented. Charts and graphs clearly demonstrate problems brought to light in test cases and show how farmers altered their irrigation practices to bring about money-saving solutions.

Incentives for Agricultural Water Conservation. Sonnen, M.B., Dendy, B.B., Lindstrom, K.P. 1980. 118 p. PB 81-109787.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: This report details interviews with four water districts and thirteen individual farmers who were interviewed about their current water conservation methods and possible additional means that might encourage still further water-savings. All interviewees farmed in central California and west Texas, and all were using both federally supplied surface water and local groundwater. Several methods of conservation were being used, with tail-water return systems and laser-controlled land leveling being the most prevalent. One of many conclusions drawn in this report was that water conservation as one element in overall water management planning policy was worthwhile, but a policy of having water conservation take the place of needed additional water development projects was not possible. Also, water-savings among western U.S. irrigators through conservation could not be relied upon to reduce total water withdrawals over current amounts by more than roughly 15%, due to the fact that western farmers have been using water sparingly for many years.

Incidental Effects of Agricultural Water Conservation. Davenport, D.C., Vaux, H.J. Jr., Hagan, R.M., March 1983. Vol. 37, No. 3 and 4. p. 28-31.

Source: California Agriculture, 1220 N Street, Room 243, Sacramento, CA 95814, (916) 445-6076.

Abstract: This article identifies over 400 potential incidental effects of agricultural water conservation actions. In general, the most important on-farm effects are those related to farm net returns including production input factors, such as energy, fertilizer, labor, management, and other production costs and those related to production output, namely crop responses to water quantity and quality, to pathogens, to pests and the risks associated with conservation actions that affect the yield of marketable produce. The effects are divided into 23 categories which have both private and external impacts. The recognition of some incidental effects may give growers additional incentives to conserve water.

Irrigation: When? How Much? How? Halderman, A.D. 1981. 6 p.

Source: Arizona Cooperative Extension Service, University of Arizona, College of Agriculture, Frobes Building, Room 301, Tucson, AZ 85721, (602) 621-7209.

Abstract: Fact Sheet

Other publications available:

Alternative Irrigation Systems. 1986. 4 p.

Abstract: Fact Sheet

Drip Irrigation for Orchards. undated. 1 p.

Abstract: Fact Sheet

Drip or Trickle Irrigation for Ornamentals. 1978. 3 p.

Abstract: Fact Sheet

Irrigating Citrus, Deciduous Fruit Trees, Pecan and Grapes. 1980. 2 p.

Abstract: Fact Sheet

Using Large Irrigation Flows Efficiently. 1990. 3 p.

Abstract: Fact Sheet

Landscaping for Water Conservation: Xeriscape™! Knox, K.M., ed. 1989. 94 p.

Source: City of Aurora, 1470 S. Havana, Aurora, CO 80012, (303) 695-7381. ISBN 0-9622900-1-7.

Abstract: (Book)

Managing Irrigation With Gypsum Blocks: A Step-By-Step Guide for Farmers. Richardson, G., Mueller-Beilschmidt, P. 1989. 36 p.

Source: Inform, 381 Park Avenue South, New York, NY 10016., (212) 689-4040. ISBN 0-918780-52-7.

Abstract: (Book) Ideal for on-field guidance, this report tells farmers how good an irrigation job they are doing by monitoring changes in soil-moisture levels in crop root zones, using low-cost, buried electronic sensors called gypsum blocks. The method is easy to learn in a short time, works well for surface or sprinkler irrigation, and identifies water distribution problems. It is adaptable to all soil types and crops and requires no prior analysis of soils.

Mobile Labs Help Farmers Conserve Water. Greenberg, A. July-August, 1992. Vol. 13, No. 2. p. 9-10.

Source: Soil and Water Conservation News, Soil Conservation Service, U.S. Department of Agriculture, PO Box 2890, Washington, DC 20013-7954, (202) 720-5505.

Abstract: This article describes an SCS Project in Florida in which technicians use two mobile laboratories to help citrus and vegetable growers improve irrigation efficiency and conserve water. The mobile lab team assists water users by determining the costs and methods to improve management of existing systems or convert to higher efficiency systems. The actions of the mobile labs translated into a yearly savings of 6.2 billion gallons of water.

Recommended Minimum Design Standards for Water Conservation. Irrigation Association of New Jersey. 2 p.

Source: Irrigation Association of New Jersey, 285 School House Road, Jamesburg, NJ 08831, (908) 521-2333.

Abstract: This document describes the minimum standards for the design and management of Water Conserving Landscape Irrigation Systems. They are a uniform reference to which designers, suppliers, installers, and owners may refer.

Role of Crop Residues--Improving Water Conservation and Use, ASA Special Publication Number 51. Unger, P.W., Langdale, G.W., Papendick, R.I. 1988. p. 69-100.

Source: Cropping Strategies for Efficient Use of Water and Nitrogen, American Society of Agronomy, Inc., 677 S. Segoe Rd., Madison, WI 53711-1086, (608)273-8080. ISBN 0-89118-097-4.

Abstract: (Book) Crop residue management or conservation tillage systems are widely recognized for their soil conservation benefits, but they also effectively conserve water. Unfortunately, water that could be reused is lost through runoff, evaporation, or transpiration by noncrop plants. To prevent this, the following suggestions and research needs are described: (1) more effective herbicides--highly effective and specific herbicides are needed to control weeds and volunteer crop plants; (2) improved equipment--vast improvements in equipment capable of operation under high-residue conditions have been made in recent years; (3) improved residue maintenance--crop residues often are limited and subject to decay; (4) improved cropping sequences--research is needed to develop cropping sequences that result in more effective timing among periods of soil water shortage, water availability, and crop growing seasons; and (5) an improved understanding of basic soil-water-plant relationships.

Taylor's Guide to Water-Saving Gardening. 1990.

Source: Houghton Mifflin., Wayside Rd.. Burlington, MA 01803, (617) 272-1500. ISBN 0-395-54422-x.

Abstract: (Book)

Technological Developments in the United States, Proceedings of a Workshop held at the World Bank; Technological and Institutional Innovation in Irrigation, Technical Paper No. 94. Burt, C. April 1989. p. 37-71.

Source: Winrock International, 1611 North Kent Street, Arlington, VA 22209-2134, (703) 525-9455.

Abstract: Technological developments in California irrigation methods are discussed in detail. In California, virtually every surface and pressurized irrigation method is used. Six different irrigation systems employed in California are evaluated for water and energy conservation. Irrigation efficiency is evaluated by ranking energy use, spray and evaporation losses, uniformity of water distribution, fertilizer leaching, and runoff.

Turfgrass Water Conservation. Gibeault, V.A. 1985. 184 p.

Source: ANR Publications CA., 6701 San Pablo Ave., Oakland, CA 94608-1239, (415) 642-2431. ISBN 0-931876-69-9, 21405.

Abstract: (Book)

Water Conservation. Bouwer, H. August, 1988. Vol. 14, No. 1-4. p. 233-241.

Source: Agricultural Water Management, Elsevier Science Publishers, Box 211, 1000 AE, Amsterdam, Netherlands, 020-5803-911.

Abstract: In this publication the author defines water conservation as the minimization of the transfer of water to a place or condition which diminishes its usefulness for the intended user. This can be achieved through the reduction of evaporation, transpiration, and quality degradation, and also by cloud seeding, enhancing groundwater recharge, and treating or reusing sewage or other contaminated waters. By irrigation efficiency and scheduling, altering cropping patterns, and using antitranspirants, evaporation can be minimized. In water-short areas a broad approach should be used, such as saving water, using water more efficiently, and reusing it whenever possible.

Water Conservation for Drought Management, in Water-Use Data for Water Resources Management, Proceedings of a Symposium. Bouwer, H. August, 1988. p. 499-505.

Source: American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814, (301) 493-8600.

Abstract: There are many ways of conserving water during a drought. Some of these measures include reduction of evaporation, transpiration, and quality degradation, cloud seeding, enhancing groundwater recharge, and treating or reusing sewage or other contaminated waters. In many of the arid or semi-arid regions, there is hardly ever one single solution to inadequate water supplies, due to fluctuating seasonal or annual rainfall. There usually has to be a broader approach to the situation such as saving water, using water more efficiently, and reusing water as much as possible.

Water Use Efficiency Under Drip Irrigation: Some Findings From Hawaii. Shrestha, R.B., Gopalakrishnan, C. September, 1989. p. 13B-15--13B-26.

Source: Water: Laws and Management. American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814, (301) 493-8600.

Abstract: This article describes how drip irrigation has been adopted in Hawaii's sugar industry as a better alternative to furrow or sprinkler irrigation in order to increase yield and conserve water. It is also reported that the success of drip technology depends heavily on land quality characteristics such as soil type, water holding capacity, and field gradient. Drip irrigation is found to augment land quality characteristics, especially in the water retention function of soil. Sugar yield has increased under drip irrigation. Drip irrigation has proven to be a preferred alternative to furrow irrigation due mainly to demonstrated increases in yield of about 1.7 tons of sugar/acre (15%) and about a 12% reduction in water usage.

Winning With Water: Soil-Moisture Monitoring for Efficient Irrigation. Richardson, Gail, Mueller-Beilschmidt, Peter. 1988. 192 p.

Source: Inform, 381 Park Avenue South, New York, NY 10016, (212) 689-4040. ISBN 0-918780-42-X.

Abstract: (Book) This report documents results of Inform's research on 32 commercial fields in California over a three-year period, showing how farmers can detect and correct uneven and inefficient irrigation by using an old tool - small gypsum blocks - in a new, systematic way to monitor soil moisture. The report details individual farmers' experiences and is liberally illustrated with photographs and charts which explain the method and results.

6. Miscellaneous Publications on Water Conservation

A Guide To Water Conservation For Cooling Towers. Black & Veatch. 28 p.

Source: City of Los Angeles, Department of Water and Power, Los Angeles, CA (213) 481-8751.

Abstract: This guidebook was created in order to help industrial and commercial customers reduce their water use in cooling towers. Reducing water use is beneficial to the company because it reduces costs and preserves water supplies. Companies and industries also conserve water to decrease sewer service, pretreatment, and energy bills. This booklet contains guidelines and water-conserving technologies which enable the users to evaluate cooling tower systems and make their company or industry more efficient.

A Risk-Based Model For Drought Contingency Planning. Moreau, David H. February 1991. p. 117-123.

Source: Water Resources Bulletin, American Water Resources Association, 5410 Grosvenor Ln., Suite 220, Bethesda, MD 20814, (301) 493-8600, Vol 27, No. 1.

Abstract: This paper presents a model that determines real-time operating policies of public water supplies under drought conditions. The model employs a universally adopted structure for drought management. The paper concludes that the model can be used to derive rule curves for guiding management of public water supplies during droughts. Results are presented for the city of Raleigh, North Carolina.

A Study of Flow Reduction and Treatment of Wastewater from Households: Project Report for Federal Water Quality Administration. Bailly, Benoit, Dodson, Robb, Wallman. December, 1969. PB 197599.

Source: National Technical Information Services, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: This study was conducted to find practical means of waste flow reduction or waste treatment for the ordinary household. First the present water quality and quantity requirements were reviewed to determine the areas where better water and waste management would be most beneficial. Much helpful material was gathered from review of previous studies on the problems of individual household waste treatment. More recent information was obtained from manufacturers of plumbing devices and waste treatment equipment who were surveyed for available water-saving plumbing devices and individual waste treatment units. Also, the literature on advanced water and waste treatment was reviewed for processes that might be applicable for individual home usage. The information collected was then analyzed to determine the most practical method for decreasing the waste volume flow from individual households. Homeowners, plumbers, architect-engineers, and equipment manufacturers were surveyed to obtain representative opinions from the people who would control the use of any flow reduction or treatment schemes. The results of the study and the consumer survey show that the water used in household functions such as bathing and toilet flushing can be substantially reduced by the use of more efficient appliances and plumbing devices. The use of most advanced waste-treatment techniques and the reuse of waste waters is not considered practical except for cases of unusual problems and extremely high water or waste-disposal costs.

A Study of Residential Water Use. Linaweaver, F.P., Geyer, J.C., Wolff, J.B. 79 p.

Source: Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, (202) 783-3238.

Abstract: This is the final report of a study conducted by the Johns Hopkins University in cooperation with sixteen water utilities. Data from forty-one typical subdivisions representing all important climatic regions throughout the country are included. All major factors influencing water use, including climate, economic level of users, and types of pricing systems have been considered and incorporated into this study. The results of this research show that residential water demands in any given area are influenced by the total number of consumers, their economic level based on the market value of their homes, the average irrigable area of their lawns, the rate

of moisture loss through evapotranspiration, and the quantity of effective precipitation. The authors of this report recommend that all central water systems be designed with individual meters and for use with public sewer systems; study results support this recommendation. This report provides sound design criteria that can be used by engineers and others responsible for the establishment and expansion of urban water distribution systems. The study results also provide a basis for more equitable water-rate structures.

An Annotated Bibliography on Water Conservation, Contract Report 79-3. U.S. Army Corps of Engineers, Institute of Water Resources. April, 1979. 171 p.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703)487-4650.

Abstract: This bibliography represents a survey of literature on water conservation measures. Information from published and unpublished sources including government manuals, pamphlets, research reports, masters' theses, doctoral dissertations, and conference proceedings can be found in this bibliography. The studies reported here represent the major problems involved in evaluating water conservation: the technical effectiveness of available conservation measures, the evaluation of economic efficiency, and the question of social acceptability.

About Drought. Colorado Division of Disaster Emergency Services. October, 1989. 18 p.

Source: Colorado Division of Disaster Emergency Services, Camp George West, Golden, CO 80401-3997, (303) 273-1622.

Abstract: During 1988, the Colorado Division of Disaster Emergency Services and the Colorado Drought Availability Task Force identified a need for a pamphlet which would create a level of public awareness about the drought hazard. This pamphlet, although very generic in describing the drought threat, is designed to be used nationwide in areas of drought threat or disaster. It allows other states to insert pages of text pertaining to their state into the overall generic document. Topics covered include a U.S. drought history; drought impacts; prediction, mitigation, and planning; and water conservation.

Achieving Residential Water Conservation by Improving the Efficiency of Installed Water Closets.

Konen, T.P., Van Dyck, R., Sedlak, C. February, 1983. 59 p.

Source: Stevens Institute of Technology, Davidson Laboratory, Hoboken, NJ 07030, (201) 216-5345. (prepared for the New Jersey Department of Environmental Protection and Energy)

Abstract: This investigation and field study, consistent with the NJ Statewide Water Supply Master Plan, provides input for near-term future policy planning and guidance for the retrofitting of installed water closets as an effective residential water conservation technique. Laboratory tests of many water-saving units revealed the uniqueness of each design and the different measured quantitative opportunity for savings. This report recommends the immediate exploitation of the cumulative water-saving potential of retrofit water closets and the further development of an expendable kit-distribution medium. The report also urges a water audit concept to permit homeowners to assess their water use with that of their peers.

American Water Works Association Publications.

Source: American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235, (303) 794-7711.

Conservation: An Expanding View. October 1991. Vol. 83, No. 10. p. 26-30.

Abstract: This article includes excerpts from a wide-ranging conversation on water conservation issues among consultants and utility and industrial representatives. Topics covered include: reasons to conserve, the bottom line as determinant of industrial water conservation, the role of water rates, the problem of debt and revenues, competition between agricultural and urban users, and the role of government in encouraging or mandating water conservation.

Conservation Legislation. Pontius, Frederick W., Warburton, Albert E. October 1991. Vol. 83, No. 10. p. 10-12.

Abstract: This article provides current information about legislative and regulatory developments in water conservation. It addresses needs and concerns of water utilities from a practical standpoint. The article discusses topics such as plumbing product efficiency, municipal water conservation, tax incentives, and other incentives such as changes in metering and rates.

Proceedings of the 1992 Annual Conference. June 1992. 881 p.

Abstract: This publication includes full-text copies of all the papers presented at AWWA's 1992 Annual Conference. Many water conservation topics are covered. Topics include retrofit programs and devices, toilets, xeriscaping™, irrigation control, and rate structures.

Analytical Bibliography on Water Supply and Conservation Techniques, Contract Report 82-C07. U.S. Army Corps of Engineers, Institute for Water Resources. 1982. AD-A1141268.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: The information contained in this volume is designed to assist planners in the application of the planning methodology described in "The Evaluation of Water Conservation for Municipal and Industrial Water Supply : Procedures Manual." The primary objectives of this volume are to update and revise the existing "Annotated Bibliography on Water Conservation," making it a more useful reference for planners, and also to identify, describe, and discuss the underlying rationale, special problems, and useful sources of information for each of the required steps in the "Procedure Manual."

Compendium on Water Supply, Drought, and Conservation, NRRI 89-15. Beecher, J., Laubach, A. October, 1989, 388 p.

Source: The National Regulatory Research Institute, 1080 Carnack, Rd., Columbus, OH 43210-1002, (614) 292-9404.

Abstract: This report reviews the literature and leading research findings on water supply, drought, and conservation in a framework that is relevant for regulators and anyone concerned about contemporary water supply issues.

Other publications available:

1992 NRRI Survey on Commission Ratemaking Practices for Water Utilities. Beecher, J., Zearfoss, N. 1992. 71 p.

Abstract: This report presents data on ratemaking practices for water utilities provided by staff members of the 45 state public utility commissions with ratemaking jurisdiction over water utilities.

Integrated Resource Planning for Water Utilities. Beecher, J., Landers, J., Mann, P. October, 1991. 303 p.

Abstract: This detailed report discusses integrated resource planning as it applies to water resources. Integrated resource planning subsumes the goals of least-cost planning while emphasizing the integration of the many institutions involved in water resource policy and planning and the many public policy issues they address. Because government roles in water policy remain fragmented, a fully integrated approach is not yet possible. Topics covered include federal and state roles in water resource planning, public utility roles in water resource planning, planning tools, and integrated planning evaluation methods.

Water Service: Regulation and Rate Reform. Mann, P. 1981. 110 p.

Abstract: The author reviews water utility regulation issues and examines the usefulness of marginal cost pricing principles as a basis for rate setting for water utilities.

Consumer Adoption of Water Conservation Measures: Perceptions and Incentives. Simms, J.H., Baumann, D.D., Boland, J.J., Alley, A., Kranzer, B. 1982. 200 p. PB83-180349.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: This study identifies factors that influence consumer adoption of water conservation measures and determines the effectiveness of adopted measures by measuring the extent of reduction in water use.

Conservation measures were classified as voluntary residential, either behavioral (such as reduced lawn watering) or technological (such as low-flow toilets), or as community-imposed (mandatory). The sample group included 1383 residents from four cities who were interviewed during the summer of 1980. Data on 56 variables were obtained which included water management/conservation policies of the site and personality traits of the resident, such as socio-economic and demographic characteristics, personal ideology, personality, experience, perception of conservation measures, pricing policy, and crisis situation. The cities were selected on the basis of climate and water conservation policy.

Cooperative Extension Reference File (CERF), On-Line Database.

Source: Agricultural Computer Network, Purdue Research Foundation, Ag Communication Department, Purdue University, West Lafayette, IN 47907, (317) 494-8396.

Abstract: This on-line resource database allows one to search for materials (such as publications, documents, films, slides, videos) based on a number of keywords. It is capable of operating in interactive menu-driven mode, or in batch mode. The interactive mode allows you to (1) view a matched material record on screen, (2) request and receive in a number of different printing forms through electronic mail (e-mail) a copy of the matched material if it is a document, or (3) view the U.S. mail address and, whenever available, e-mail address of the Media Distribution Center of the state issuing the material, for eventual hard copy order and delivery. The availability of the material for delivery through e-mail as well as its associated printing forms are displayed in a clear manner for you to choose. The Internet address for this database is hermes.ecn.purdue.edu. The login is "cerf" and the password is "purdue." This database also allows you to access QUERRI (see Questions on University Extension Regional Resource Information).

Delaware River Basin Drought Contingency Plan. NJ Department of Environmental Protection, Division of Water Resources. December, 1983.

Source: NJ Department of Environmental Protection and Energy, Office of Regulatory Policy, CN 029, Trenton, NJ 08625, (609) 633-7021.

Abstract: This paper discusses the Delaware River Basin Contingency Plan for New Jersey, which was designed to achieve a 15 percent reduction in depletive water use at the drought stage. An explanation of the regulations established is followed by procedures for the initiation and coordination of public controls.

Delaware River Basin, Drought Management. Whitall, W. July, 1984. p.32-39.

Source: Delaware River Basin Commission, 25 State Police Drive, Trenton, NJ 08628, (609) 883-9500.

Abstract: This paper describes an agreement designed to improve drought preparedness. Management steps are included which are organized around a long-term salinity standard which is to be achieved in stages by means of new water storage and flow augmentation capacity, water conservation, drought management plans, regulation of depletive water used, and other measures. The commission's salinity standard, which was adopted in 1967, is to be replaced by a new operating objective designed to limit salinity in the estuary to a maximum 30 day average of 180 mg/l of chlorides and 100 mg/l of sodium at a control point. A series of structural measures is scheduled over the next twelve years to provide new capacity required by the salinity control objectives. During periods of water shortage, diversions to New York City and New Jersey, and compensating downstream releases to the Delaware from the city's three headwater reservoirs will be reduced. A regulatory program will limit future depletive water uses in order to balance existing, new, or expanded uses with the availability of flow augmentation capacity sufficient to maintain salinity control objectives. A general basinwide policy is to be adopted that would require conservation measures to be placed into effect during drought periods to reduce water use by 15%.

Determinants of Household Water Conservation Retrofit Activity: A Discrete Choice Model Using Survey Data. Cameron, T., Wright, M. February, 1990. Vol. 26, No. 2. p. 179-188.

Source: Water Resources Research, 2000 Florida Avenue NW, Washington, DC 20009, (202) 462-6900.

Abstract: Economic analyses of residential water demand have concentrated on price and income elasticities. A large change in water prices might induce only small changes in consumption levels. Households will have the opportunity to 'retrofit' existing water-using equipment to make it less water-intensive. This produces medium-run to long-run demand elasticities that are higher than short-run studies suggest. This report examines responses to water conservation questions that appeared on the Los Angeles Department of Water and Power's 1983 residential energy survey. The decision of a household to install shower retrofit devices is influenced by the potential to save money on water heating bills.

Drought Planning and State Government: Current Status. Wilhite, Donald A. October 1991. Vol. 72, No. 10. p. 1531-1536.

Source: Bulletin of the American Meteorological Society, 45 Beacon St., Boston, MA 02108-3693, (617) 227-2425.

Abstract: State governments in the United States have made great progress in developing drought contingency plans, due in large part to recent droughts, call for action by regional, national, and international organizations, and the availability of model plans. In 1982 only three states had prepared drought plans; in 1991, 23 states had completed plans. Usually the state's overall water management planning initiative contained drought contingency plans. States are increasingly viewed as policy innovators in the field of drought planning. The atmospheric science community should play a prominent role in the planning process at all levels of government.

Efforts by AWWA Utilities to Conserve Water. Featherstone, J. October, 1992. 11 p.

Source: Delaware River Basin Commission, PO Box 7360, West Trenton, NJ 08628, (609) 883-9500.

Abstract: This paper was presented at a seminar entitled "Encouraging Water Use Efficiency in Government Buildings." Six initiatives being advanced by many water utilities are discussed in the paper. Those initiatives are automatic meter reading systems, monthly billing, water conservation rate structures, nonresidential water audits, residential retrofitting, and leak detection and repair. Also briefly discussed is integrated resource planning, a new concept receiving increased attention by the utility industry.

Gathering Dust, The Bureau of Reclamation's Failure to Enforce Statutory Water Conservation Requirements. Howard, T., Cain, J. February, 1991. 27 p.

Source: Water Resources Program, National Wildlife Federation, 1400 16th St. NW, Washington, DC 20036-2266, (202) 797-6800.

Abstract: This report focuses on the National Wildlife Federation's belief that the Bureau of Reclamation, the agency charged with constructing and delivering water from federal irrigation projects in 17 Western states, has shrunk from its responsibility to reduce the waste of water and promote conservation in the arid West. In spite of a Congressional directive, a serious drought, and its 1987 pledge to improve management of existing facilities, the Bureau is not requiring irrigation districts to develop and carry out effective water conservation plans. The National Wildlife Federation has reviewed the actions of the Bureau and found that it has placed the water conservation plan requirements of the 1982 Reclamation Reform Act at the very lowest level of priority during the last eight years. This report includes descriptions of the Bureau's actions as well as recommendations from the National Wildlife Federation. NWF recommends that the Bureau of Reclamation:

- rewrite and strengthen its water conservation requirements setting a goal of at least 10% water-savings over the next ten years;
- promote markets for water that will enable its irrigation customers to profit from conservation;
- modify its pricing policies to eliminate unwarranted subsidies to irrigation water users;
- devote a portion of saved water to fish and wildlife restoration efforts; and

- apply conservation techniques to quickly reduce the threat to water quality from contaminated irrigation drainwater.

Grants and Loans for Municipal Water Supply and Wastewater Treatment Systems: Water Conservation Provisions. July 30, 1979. 33 p.

Source: U.S. Environmental Protection Agency, Office of Water, Office of Wastewater Enforcement and Compliance, 401 M Street SW, Washington, DC 20460, (202) 260-5700.

Abstract: This document is a final report and summary of Task Force number 11. This Task Force charged the EPA Administrator with the responsibility of coordinating the review of appropriate programs of EPA, Housing and Urban Development, Commerce, and Agriculture and reporting on the results of program modifications which would encourage water conservation in grant and loan programs for water supply and wastewater treatment. The Task Force was also required to remove any disincentives to water conservation found in any programs. This report details the findings of the Task Force and also describes implementation plans.

Also available:

Directory of Federal Programs Related to Water Conservation.

Guidelines for Water Reuse, EPA 625/R-92/004. U.S. Environmental Protection Agency. September, 1992. 247 p.

Source: Office of Water, Office of Wastewater Enforcement and Compliance, 401 M Street SW, Washington, DC 20460, (202) 260-5700.

Abstract: The U.S. Environmental Protection Agency and the U.S. Agency for International Development cosponsored preparation of water-reuse projects. The guidelines reflect the significant technical and institutional developments in water reuse over the last decade, present a planning approach, and address technical criteria for different reuse applications, economic issues, funding alternatives, and legal, regulatory, and institutional issues. Current state reuse regulations and guidelines are presented, as are suggested treatment, water quality, monitoring, and other controls for various types of reclaimed water applications. The Guidelines for Water Reuse is not a formal regulatory document, but it provides information and recommendations that will be useful to state agencies and others for evaluating the requirements and benefits of reuse.

Municipal and Industrial Water Use in the Metropolitan Water District Service Area: Interim Report No. 4. Dziegielewski, B., Opitz, E. June, 1991. 53 p.

Source: Metropolitan Water District of California, 1111 Sunset Blvd., P.O. Box 54153, Los Angeles, CA 90054, (213) 250-6000.

Abstract: Since 1987 the Metropolitan Water District has worked to develop accurate forecasts of future water use. Accurate prediction of future water use is essential for the development and implementation of water conservation programs, for evaluating the need for facilities, and for determining the adequacy of current and future water supplies. This Interim Report describes ongoing research aimed at improving the information base for water use forecasting. This report includes an analysis of historical water use data, a revised water use model, recent socioeconomic projections used for future growth assumptions, and the most recent information for estimating the effects of water conservation.

Other publications available:

Commercial and Industrial Water Conservation: Program Coordinator Workshop Notes.

Abstract: This workshop packet contains information on the proceedings of the Program Coordinator Workshop held on January 25, 1993. The training course includes a brief history of the water supply system, information on program management, marketing and sales, technology, assessment, and a practice evaluation.

Commercial and Industrial Water Use in Southern California. March, 1990.

Abstract: This report describes the results of water use in commercial and industrial establishments in Southern California that was conducted in 1988.

Drought Water Conservation Plan. May, 1988.

Abstract: This report lists the results of a plan that was developed to reduce water demand during a drought.

Urban Water Conservation Best Management Practices. June, 1991.

Abstract: This memorandum describes and explains Best Management Practices (BMPs) in which urban water suppliers would agree to use "good-faith efforts" to implement proven water conservation measures and to study additional conservation measures.

Municipal Wastewater Reuse: Selected Readings on Water Reuse, EPA 430/09-91-022. U.S.

Environmental Protection Agency. September, 1991. 74 p.

Source: U.S. Environmental Protection Agency, Office of Water, Office of Wastewater Enforcement & Compliance, 401 M Street SW, Washington, DC 20460, (202) 260-5700.

Abstract: This document contains reprints of the following articles from the Water Pollution Control Federation's Water Environment & Technology Journal:

- WPCF's Commitment to Water Reuse - Completing the Cycle. Ron Young (Chairman, WPCF Water Reuse Committee). October, 1990.
- Guidelines for Developing a Project. Raymond R. Longoria, David C. Lewis, Dwayne Hargesheimer. October, 1990.- Keys to Better Water Quality. Kenneth J. Miller. November, 1990.
- CONSERV'90 brings together experts on water reuse. Alan B. Nichols. November, 1990.
- Water Reuse in Riyadh, Saudi Arabia. James M. Chansler. November, 1990.
- Realizing the Benefits of Water Reuse in Developing Countries. Daniel A. Okun. November, 1990.
- U.S. Water Reuse: Current Status and Future Trends. Kenneth J. Miller. November, 1990.
- On-site Wastewater Reclamation and Recycling. John Irwin. November, 1990.
- Wastewater Reuse Gains Public Acceptance. J. Gordon Milliken. December, 1990.
- Obstacles to Implementing Reuse Projects. Scott B. Ahlstrom. December, 1990.
- Irvine Ranch's Approach to Water Reclamation. John Parsons. December, 1990.
- Florida's Reuse Program Paves the Way. David W. York & James Crook. December, 1990.
- Economic Tool for Reuse Planning. J. Gordon Milliken. December, 1990.
- Water Reuse: Potable or Nonpotable? There is a Difference! Daniel A. Okun. January, 1991.
- Report Sets New Water Reuse Guidelines. Christopher Powicki. January, 1991.
- Clarification and Filtration to Meet Low Turbidity Reclaimed Water Standards. Joel A. Faller & Robert A. Ryder. January, 1991.
- Potable Water Reuse. Carl L. Hamann & Brock McEwen. January, 1991.
- Potable Water via Land Treatment and AWT. Sherwood Redd & Robert Bastian. August, 1991.
- Groundwater Recharge with Reclaimed Water in California. James Crook, Takashi, Asano & Margaret Nollor. August, 1990.

National Conference on Water Conservation and Municipal Wastewater Flow Reduction.

Environmental Protection Agency, Facility Requirements Division. August, 1979. 288 p. PB 80125065.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: This Proceedings includes papers that are grouped into six major topic area sessions, covering regulation of water resource, water conservation technology, education and public participation, water and waste water management issues, and case studies of water resource management, with each section comprised of 4-6 papers. The text of President Carter's June 6, 1978 message to the Congress on Federal Water Policy, an overview paper by J. G. Speth of the Council on Environmental Quality, and five papers from EPA representatives are also included. The document includes the following papers:

- Federal Water Policy. Carter, J.

- The Water Conservation Challenge. Robie, R.B.
- Water Conservation: Prospects and Problems. Sampler, D.L.
- The Need for Water Conservation: The National Viewpoint. Eisel, L.M.
- Legislative Impacts, EPA and Water Conservation. Jorling, T.C.
- Water Conservation and the Environment. Speth, J.G.
- Plumbing Codes and Water Use. Bechtel, C.R.
- Conservation Elements in Areawide Planning. Wise, P.L.
- Conservation and the Safe Drinking Water Act. McDermott, J.H.
- The Conservation Connection: The Clean Water Act of 1977 and EPA's Construction Grants Program. Cook, M.B.
- Water Conservation Through Leak Detection. Gros, W.F.
- Infiltration/Inflow. Pfefferle, R.R.
- Selection of Water Conservation Devices for Installation in New or Existing Dwellings. Sharpe, W.E.
- Decreasing the Household Water Demand by Design. Karls, R.F.
- The Role of Water Conservation in the Construction Grants Program. Tiemens, M.F., Graham, P.
- Guidelines for Planning a Citizen Participation Program. Toner, N.C.
- Mandate and/or Marketing: Implementing Water Conservation in the Private Sector. DelPorto, D.A.
- Public Support for Water Conservation: The League Experience. McNulty, H.
- Wise Water Use-A Program for Children. Brewster, K.L.
- Development of a Water Conservation Program in the Regional Municipality of Waterloo, Ontario, Canada. Robinson, J.E., W. Ashton. W.
- Economics and Water Conservation. Schaefer, R.K.
- Residential Water Conservation and Community Growth. Wade, D.A.
- Water Conservation Through Wastewater Reuse. Wasserman, K.
- Water Conservation and Land Use Planning. Alderfer, R.G.
- An Equitable Rate Structure's Relation to Conservation and Wastewater Flow Reduction. Griffith, F. P.
- Water Resource Management: Marin County, California. Stroeh, J.D.
- Elmhurst Water Conservation Program. Fulton, N.R.
- Water Resources Management in New York. Horne, W.W.
- Water and Sewer Conservation-Oriented Rate Structure. McGarry, R.S.

National Small Flows Clearinghouse 1991-1992 Guide to Products and Services. National Small Flows Clearinghouse. 1991. 15 p.

Source: National Small Flows Clearinghouse, West Virginia University, PO Box 6064, Morgantown, WV 26506-6064, (800) 624-8301.

Abstract: The National Small Flows Clearinghouse gathers and distributes information about small community wastewater systems. This guide lists 170 products that the Clearinghouse offers, ranging from brochures and case studies to design manuals and videotapes. Topics include innovative and alternative technologies, financial management, public education, operation and maintenance, drinking water, and water conservation. Water conservation materials include brochures about home water conservation, low-flush toilets, and computer searches on water conservation and reuse.

New Jersey Water Supply Master Plan. New Jersey Department of Environmental Protection, Division of Water Resources. April, 1982. 138 p.

Source: NJ Department of Environmental Protection and Energy, Office of Regulatory Policy, CN 029 Trenton, NJ 08625, (609) 633-7021.

Abstract: This document describes New Jersey's first water supply plan, which clearly defines New Jersey's water supply problems and the issues surrounding them. This document lays a framework for sound water supply planning designed to clearly identify responsibility, needs, and resource capability and to develop the tools essential to meet those responsibilities in order to satisfy the needs in a total acknowledgment of the

resource capability. The existing conditions and plan of action are described in detail. There is a section on water conservation included as part of the Master Plan.

New Jersey Water Supply Master Plan - Water Conservation: Alternative Strategies, Task 6A. New Jersey Department of Environmental Protection, Division of Water Resources. 1979. 114 p.

Source: NJ Department of Environmental Protection and Energy, Office of Regulatory Policy, CN 029 Trenton, NJ 08625, (609) 633-7021.

Abstract: This report identifies and describes alternative means of conserving public water supplies. The alternatives identified in this report will be evaluated in other phases of this study. The focus of this report is on long-range conservation efforts, rather than short-term measures. Conservation plans are intended to make efficient use of water resources without adversely affecting lifestyles or industrial development. It investigates six major occurrences that may effect more efficient use of water resources. These are residential water conservation devices, water loss reduction in distribution systems, water pricing modifications, industrial water use reductions, reuse of wastewater effluents, and public education programs. The report identifies alternative conservation strategies or scenarios for each of these categories. An evaluation of these alternatives and a recommended conservation program are also provided. A summary of the major findings of this report is also included.

New Jersey's Water Emergency: September 1980-April 1982. Arbesman, P., Hofman, D., Fenster, S., Graham, D. May, 1983. 15 p.

Source: NJ Department of Environmental Protection and Energy, Office of Regulatory Policy, PO Box 029, Trenton, NJ 08625, (609) 633-7021.

Abstract: This document provides an account of the activities and accomplishments of the Water Emergency Task Force during the 1980-82 water shortage in New Jersey. In addition to a compilation of the activities of the Task Force, this report presents both positive and negative issues encountered during the operation of the water crisis. Included are recommendations for action should a similar situation occur in the future. This report should also serve as a valuable guide and reference for contending with future water emergencies.

PENPages, On-Line Information Service.

Source: Computer Services, Penn State College of Agricultural Sciences, 405 Ag Admin Bldg, University Park, PA 16802, (814) 863-3449.

Abstract: PENpages is a full-text information service containing thousands of research-based fact sheets, news articles, newsletters, programs, and reports. Information is entered daily by researchers and experts in all areas of The Cooperative Extension System in the United States. PENpages is available on an international basis with no subscription fee charges. The Internet address for PENpages is psupen.psu.edu. At the username prompt type your state's 2-letter abbreviation. Most publications, including water conservation topics such as home water-saving tips and drought-resistant landscaping, are available as full on-line documents.

Planning for Drought: A Process for State Government. Wilhite, D. June, 1990. 15 p.

Source: International Drought Information Center, University of Nebraska, Lincoln, NE 68583-0728, (402) 472-6707.

Abstract: This executive summary outlines a ten-step process which provides a methodology to facilitate the preparation of drought contingency plans by state government leaders. Seven states participated in the development of the ten-step process by providing specific information about their experiences with drought and their response procedures. This document describes a step-by-step approach that government decisionmakers can follow to develop and implement plans to improve drought mitigation efforts.

Planning Guide for Water Consumption. Wooding, N.H. 1 p.

Source: Cooperative Extension Service, The Pennsylvania State University, 323 Agricultural Administration Building, University Park, PA 16802, (814) 865-2541.

Abstract: Fact Sheet

Proceedings - Conference on Water Conservation and Sewage Flow Reduction with Water - Saving Devices, Information Report No. 74. Sharpe, W.E., Fletcher, P.W., Eds. July, 1975. 216 p.

Source: Institute for Research on Land and Water Resources, Land and Water Research Building, Pennsylvania State University, University Park, PA 16802, (814) 863-0291.

Abstract: These proceedings are a current state-of-the-art assessment of water-saving device technology in the United States. The papers that are included address themselves to the major questions associated with water-saving device development and use.

This report contains the following 20 papers:

- Residential Water Conservation: The Suburban Maryland Experience, 1970-1975. Gear, M.J.
- Residential and Commercial Water Conservation and Wasteflow Reduction with Water-Saving Devices. Sharpe, W.E.
- Water Price-Quantity Relationships and Their Effect on Water Conservation. Coelen, S. P.
- The Cost-Effectiveness of Pricing Schemes and Water-Saving Devices. Cham, M.L. and S. Heare.
- Field Experiences in Water-saving Programs of the Washington Suburban Sanitary Commission. Bishop, W.J.
- Impact of Home Water-saving Devices on Collection Systems and Waste Treatment. Cole, C.A.
- Impact of Flow Reduction on On-Lot Sewage Systems. Bennett, E.R.
- Household Water Conservation Effects on Water Energy and Wastewater Management. Baker, L.K., H.E. Baily, and R.A. Sierka.
- The Potential for Energy Saving Through Reduction in Hot Water Consumption. Muller, J.G.
- Research on Water-saving Devices at Virginia polytechnic and State University. Moses, H.L.
- A Recycle System for Conservation of Water in Residences. McLaughlin, E.R.
- The Testing of Clivus-Multrum (Sewage) System in a Limited Use Campground. Smith, Khervin.
- Maine's Experiences with Reduced-Water Waste Disposal Systems. Hoxie, D.C. and W.C. Toppan.
- An Investigation of the Performance and the Effects of Reduced Volume Water Closets on Sanitary Drainage. Sewers and Sewage Treatment Plants. Konen, T.P.
- Water-savings with the Save-It Water Saver. Montgomery, C.E.
- Future Research in Water-savings. Sittler, E.L.
- Socioeconomic Considerations for Domestic Water Conservation. Schaefer, R.K.
- A Plumbingware Manufacturer's Viewpoint on Water-saving Devices. Wertz, R.J.
- Impact of Conservation on Water Industry. DeArment, W.E.

Proceedings of Conserv 90, The National Conference and Exposition Offering Water Supply Solutions for the 1990's. 1990. 1310 p.

Source: American Society of Civil Engineers, American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814., (301) 493-8600.

Abstract: This book includes the proceedings from the Conserv 90 conference, which addressed the following water supply issues: agricultural, municipal, industrial, residential, educational, reuse, drought management, watershed management, planning, water transfer, and water resource management. It is designed for use by municipal water resources planners, consulting engineers and water supply professionals, agriculture and irrigation practitioners, turf and landscape professionals, environmentalists, lawmakers and government officials, reporters, and citizens concerned with the quality of life in the 1990's.

Proceedings of the National Water Conservation Conference on Publicly Supplied Potable Water, Special Publication No. 624. Dynamac Corporation. June, 1982. p. 492. PB83-185249.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: This Proceedings includes papers presented at the National Water Conservation Conference. These papers discuss techniques for, and analysis of, potable water conservation and wastewater flow reduction. Topics addressed include plumbing fixtures, testing and performance of low-flow devices, leak detection and repair, potential problems in wastewater flow reduction, and landscaping with native vegetation. Other topics are water conservation in rental complexes, enhanced water education, and information and consumer adoption of water conservation measures. Papers on economics examine water pricing systems, analysis of cost/benefits, and development and management of data. Papers on planning cover state and local urban planning efforts for conservation and federal programs and incentives. Case studies are also provided which present water conservation efforts tried in California, Washington, Utah, Arizona, North Carolina, Maryland, New Jersey, and Massachusetts.

Proposed Pennsylvania Drought Contingency Plan for The Delaware River Basin. Commonwealth of Pennsylvania Department of Environmental Resources, Office of Resources Management, Bureau of Water Resources Management. December, 1983. 76 p.

Source: Commonwealth of Pennsylvania Department of Environmental Resources, Office of Resources Management, Bureau of Water Resources Management, D Park, Suite 6010, 555 North Lane, Conshohocken, PA 10428, (215) 832-6000.

Abstract: In January, 1983, New York, New Jersey, Pennsylvania, Delaware, and New York City agreed on an interstate water management plan that provided for a long-term salinity standard for the Delaware River Estuary to be achieved through the development of new reservoir storage, water conservation action, a drought management plan, and the regulation of any new or expanded depletive water uses. This report details Pennsylvania's drought management plan, which provides drought response actions called for by the Delaware River Basin Commission, drought actions needed for a specific region of Pennsylvania, and actions necessary to respond to a water shortage incurred by one or a group of water suppliers in a very localized area.

Questions on University Extension Regional Resource Information (QUERRI), On-Line Database.

Source: Iowa State University, B-10 Curtiss Hall, Ames, IA 50011, (515) 294-8802.

Abstract: QUERRI is a database maintained by the North Central Region Educational Materials Project and is located at Iowa State University. It allows online access to bibliographic information, including more than 12,000 Extension written and audio-visual resources. The entries include abstracts and all the resources are produced by NCR specialists. The database is updated daily and covers all program areas: agriculture, home economics, 4-H and youth, and community resource development. The database was developed by Sorrel Brown, Mark Flannery, and Pam Patterson. For login information, see citation for Cooperative Extension Reference Files.

Readings in Water Conservation. McGhee, R., Reardon, M., Shulman, A., Eds. 1977. 332 p.

Source: Rutgers University Libraries, New Brunswick, NJ 08903 (908) 932-7509, DOC X, TD 353.N36

Abstract: This anthology presents a series of articles designed to acquaint the reader with a variety of issues surrounding the topic of water conservation. Section 1 presents the federal laws and regulations pertaining to water conservation; it also includes a sample of local ordinances and one state law which promotes conservation. Section 2 reviews briefly the hardware of water conservation and potential savings from each type. Section 3 details the components of a public education program which may be run by a water utility or local government. Section 4 addresses a broad array of economic, management, and planning issues which arise from efforts to conserve water or alter water-use patterns. Section 5 is a case study of the water conservation program developed by the city of Westminster, Colorado.

Residential Water Conservation. Milne, M. March, 1976. 468 p. PB 253253.

Source: National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: This is a non-technical report for homeowners, builders, developers, architects, planners, utility company managers, plumbingware manufacturers, and lawmakers who are seeking new ways to reduce residential water consumption. A "typical" residential consumption profile is presented, along with a brief history of how water has been used in the home. Water conservation is not simply a matter of inventing new fixtures; in fact there are four types of constraints which must be satisfied before any innovation in water conservation can be implemented: economic, institutional, sociocultural, and technological. The impact of each of these factors is discussed. Over four dozen commercially available devices which affect water consumption in the home are evaluated. In an attempt to discover future trends, a survey was made of relevant aerospace technology, including *Apollo* and *Skylab* systems, as well as the systems installed in commercial jet aircraft, trains, and ships. Recent patent applications were searched and dozens of new water-conserving fixtures and appliances were discovered. Four scenarios are laid out to show the homeowner different strategies for reducing water consumption. Finally, a series of recommendations is made defining specific actions that can be taken by utility companies, lawmakers, and plumbingware manufacturers to reduce residential water consumption. The Appendix contains a 250-item annotated bibliography and a directory of manufacturers.

Residential Water Conservation: Casa Del Agua. Karpiscak, M. Foster, K. Schmidt, N. December, 1990. Vol. 26, No. 6. p. 939-948.

Source: Water Resources Bulletin, American Water Resources Association, 5410 Grosvenor Ln., Suite 220, Bethesda, MD 20814, (301) 493-8600.

Abstract: This paper describes a study in which a single-family residence in Tucson, Arizona, was retrofitted with water conservation fixtures, as well as rainwater harvesting, and graywater reuse systems. This study demonstrated that water consumption could be reduced without affecting the residents' quality of life.

Saving Water in a Desert City. Martin, W.F., Ingram, H.M., Laney, N.K., Griffin, A.H. 1984. 111 p.

Source: Resources for the Future, 2200 Girard Avenue, Baltimore, MD 21211, (410) 516-6955, ISBN 0-915707-04-7.

Abstract: (Book) This book analyzes a political battle over water pricing by a municipal system. It provides improved methods for demand function estimation where block rates are involved, suggests procedures for rational pricing of municipal water, and attempts to explain how politics can dominate when real decisions are made. It also shows how the emotionally powerful water use and development issues can stand in for economically larger concerns like the pace and character of urban growth and change. It should be of wide interest to those involved with municipal services and resource management in general.

Selected Works in Water Supply, Water Conservation and Water Quality Planning: Water Conservation and Supply, Information Transfer and Analysis Program, IWR Research Report 81-R10. U.S. Army Corps of Engineers, Water Resources Support Center. May, 1981. 444 p.

Source: U.S. Army Corps of Engineers, Water Resources Support Center, Fort Belvoir, VA 22060, (703) 664-6071.

Abstract: This document represents the first output of the water supply and conservation Information Transfer and Analysis Program that was established at the Institute for Water Resources to disseminate technology transfer and provide one-stop information assistance. The overall objectives of the Institute's research are to gain a better understanding of the major problems and opportunities related to water supply and quality management and to find better ways to solve the problems and capture opportunities. The research results are presented in the form of articles written by individual authors for the Institute on the subject of water supply, water quality, and conservation planning.

Submetering=Water Conservation. Rathnau, M. March, 1991. Vol. 138, No. 2. p. 24-43.

Source: WATER/Engineering and Management, 380 E. Northwest Highway, Des Plaines, IL 60016-2282, (708) 298-6622.

Abstract: This article discusses the state-of-the-art metering technology of submetering as a viable strategy for conserving water. Submetering is the use of separate meters to indicate individual water usage in apartments, condominiums, and trailer homes, while the entire complex of units continues to be metered by the main supplier. The beneficial aspect is achieved through submetering's monthly bills in which the landlord and tenant are aware of how much water is being used.

The Benefits of Managing Urban Water Demands. Dziegielewski, B., Bauman, D. November, 1992. Vol. 34, No. 9. p. 7-41.

Source: Environment, Scientists' Institute for Public Information, 355 Lexington Ave., New York, NY 10017 (212) 661-9110.

Abstract: Because the average water demand in southern California's Metropolitan Water District exceeds locally available supplies, water planners are turning to water-demand management as a promising alternative. By 2010, conserved water will constitute the largest single source of additional water in southern California. This article discusses the alternative ways of increasing water supply and water-demand management programs in southern California. Examples of such programs are educational campaigns, plumbing retrofit campaigns, conservation audits, conservation ordinances, water-supply system efficiency programs, landscape replacement, and conservation-oriented pricing.

The National Study of Water Management During Drought: A Research Assessment, IWR Report 91-NDS-3. August 1991. 174 p.

Source: U.S. Army Corps of Engineers, Water Resources Support Center, Institute for Water Resources, Casey Building, 7701 Telegraph Rd., Fort Belvoir, VA 22060-5568, (703) 355-3055.

Abstract: This report is part of a comprehensive study that has been undertaken in response to recommendations of the U.S. Army Corps of Engineers made after the drought of 1988 and 1989. The main purpose of this report is to describe the United States' water resources management responses during drought and to highlight the critical inadequacies of national and regional policies for drought management. The report summarizes research on water management during drought and makes recommendations for additional research areas that offer the most promise for improving the drought management response at federal, regional, state, and local levels of government. Included in this report is a reference section which provides bibliographic notes for previous federal studies. This report is the third of a series of reports which will be published during the study. Other reports include: Report on the First Year of Study (IWR Report 91-NDS-1) and A Preliminary Assessment of Corps of Engineers Reservoirs, Their Purposes and Susceptibility to Drought (IWR Report 91-NDS-2).

The Role of Conservation in Water Supply Planning. Bauman, D., Boland J., Sims, J., Kranzer, B., Carver, P. April, 1979. 117 p.

Source: U.S. Army Corps of Engineers, Institute for Water Resources, Fort Belvoir, VA 22060, (703) 664-6071.

Abstract: This is a report prepared by the Southern Illinois University Department of Geography for the Army Corps of Engineers. The report has three major sections: First, it establishes a definition of water conservation; second, it reviews the state-of-the-art information on conservation measures; and, finally, it identifies requirements and needs for implementation. In its review of conservation methods, residential, industrial, and agricultural uses are examined. Data are presented on the costs and potential savings associated with various methods and mechanisms.

The Water Quality Catalog. Water Environment Federation. 49 p.

Source: U.S. Environmental Protection Agency, WH-595, Office of Water Programs, 401 M Street SW, Washington, DC 20460, (202) 260-7378.

Abstract: The Water Quality Catalog is an education resource for schools, local governments, professional organizations, the general public, and any other groups that would like information on water quality. The catalog includes booklets, books, fact sheets, newsletters, computer software, videos, and student activity books covering

various water quality topics, including water conservation issues. Titles include "Municipal Officials' Guide to Water Conservation, "Water Efficiency for Your Home," and "Project Water Science."

The W-Index for Residential Water Conservation. Decook, K.J., Foster, K.E., Karpiscak, M.M. December, 1988. Vol. 24, No. 6. p. 1295-2302.

Source: Water Resources Bulletin, American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814, (301) 493-8600.

Abstract: The W-Index, an index of residential water efficiency, can serve as a measure of effectiveness of water conservation features in the home. The Index provides a calculated numerical value for each dwelling unit, derived from the number and kind of water-saving features present.

U.S. Water News, Water Conservation Issue. April, 1991. Vol. 7, No. 10. 24 p.

Source: U.S. Water News, Co-published by U.S. Water News, Inc., and The Freshwater Foundation, 230 Main St., Halstead, KS 67056, (316) 835-2222.

Abstract: This monthly newspaper covers all types of water resource issues, with this issue focusing on water conservation. Topics covered include xeriscape™, golf course conservation, California's experience, and new legislation efforts.

Water Books Catalog. agAccess. 9 p.

Source: agAccess, 603 Fourth Street, Davis, CA 95616, (916) 756-7177.

Abstract: This catalog offers an extensive collection of hard-to-find water resource books on topics such as irrigation, waste water treatment, restoration, drought, water quality, water conservation, and more. Available resources on water conservation include titles from the American Water Works Association, the National Academy of Sciences, the National Research Council, and the U.S. Committee on Irrigation and Drainage.

Water Conservation and Reuse Search. National Small Flows Clearinghouse. 1990. 42 p.

Source: National Small Flows Clearinghouse, West Virginia University, 466 High Street, Morgantown, WV 26506, (800) 624-8301.

Abstract: This document contains a search of water conservation materials performed by the National Small Flows Clearinghouse. Each citation contains the title of the document, the author, year of publication, source, and a brief abstract. A wide variety of water conservation topics are covered, including water conservation devices, alternative wastewater systems, and residential water conservation.

Water Conservation at Wastewater Treatment Plants. Gerardi, M.H., DeParasis, O.A., Falk, W.H. March, 1982. Vol. 113, No. 3. p. 59-60.

Source: Public Works, 200 South Broad Street, Ridgewood, NJ 07451, (210) 445-5800.

Abstract: The two wastewater treatment plants in Williamsport, Pennsylvania, were able to reduce water consumption by 60% during a 1981 drought. The techniques to save water included minimizing use of potable water and maximizing use of secondary effluent. Potable water was saved by using flow restrictors, new water faucet washers, and three-minute showers. Treated effluent was used to wash equipment, floors, vehicles and treatment tanks, launder rags, sprinkling scum on secondary clarifiers, concrete curing, cleaning bar screens, hosing foam, flushing lines, and lubricating sludge pump pistons. Not only was water conservation achieved, but monetary savings were also experienced.

Water Conservation in New Jersey. Public Interest Research Group Report. 1984. 369 p.

Source: NJ Public interest Group, 204 W. State St., Trenton, NJ 08608, (609) 393-7474.

Abstract: This report by NJ Public Interest Research Group, a non-profit, politically non-partisan research corporation, examines water conservation as an alternative. It contains chapters on the purpose of water conservation, water conservation and drought management in NJ residential water conservation and the advantages of water conservation, community refit programs, the role of public education in a community water conservation campaign, the effect of price on demand for water, water use in NJ institutions, water conservation in the private sector, agricultural water conservation and conclusions and recommendations for NJ.

Water Conservation Methods in Urban Landscape Irrigation: An Exploratory Overview. Ferguson, B. K. February, 1987. Vol. 23, No. 1. p. 147-152.

Source: Water Resources Bulletin, American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814, (301) 493-8600.

Abstract: The need for efficient watering systems has expanded due to the increased use of irrigation for urban landscapes. This paper reviews methods of urban landscape water conservation, while keeping in mind the complexity of urban environments. Topics discussed include site layout and planting design, as well as irrigation hardware that delivers the required volume of water to the specified landscape efficiently by implementing a number of physical and operational principles. The potential for conserving urban irrigation water is large, without dramatically compromising other qualities of the urban environment such as aesthetics, screening, or shade.

Water Conservation, Recycling, and Reuse: U.S. Northeast. Kaplan, E. October, 1984. Vol. 110, No. 4. p. 455-477.

Source: Journal of Water Resources Planning and Management, American Society of Civil Engineers, 345 East 47 Street, New York, NY 10017-2398, (212) 705-7288.

Abstract: This paper reviews present and future possibilities for water conservation, recycling, and reuse in New England and the Middle Atlantic states. Water intake and consumptive demands in 1980 were calculated for industrial, electric utility, agricultural, and residential sectors. Data for the year 2000 was estimated using information from utilities, public utility commissions, and the U.S. Bureau of Economic Affairs. Even assuming reductions in water use by industries, agriculture, and private residences in the year 2000, it was discovered that many users, particularly the electric utility sector, would still experience serious water supply shortfalls in several industrialized states.

Water Conservation: Theory, Practice, and Results, Quick Bibliography Series QB 91-23. Schneider, K. April, 1986. 17 p.

Source: U.S. Department of Agriculture, National Agricultural Library, Public Services Division, Room 111, Beltsville, MD 20705, (301) 344-3755.

Abstract: This quick bibliography focuses on water conservation. Although it is not an in-depth, exhaustive bibliography, the citations are a substantial resource for recent investigations on this topic. They also serve the purpose of bringing the literature of agriculture to the interested user who, in many cases, could not access it by any other means. This bibliography is derived from computerized on-line searches of the AGRICOLA data base. Timeliness of topic and evidence of extensive interest are the selection criteria.

Water for the Future: On Tap or Down the Drain? Postel, S. March-April, 1986. 5 p.

Source: Department of Natural Resources, Cook College, Rutgers University, New Brunswick, NJ 08903, (908) 932-9631.

Abstract: This article from a Worldwatch Institute researcher discusses the fate of water supplies in the future. With predictions that water supplies will fall short of needs within two decades, the author believes that keeping water on tap will depend more on controlling demand than on meeting it. Today's planning practices will not work well in an age of water scarcity. Several solutions to water-supply problems are discussed, and they include recycling and reusing water, the encouragement of conserving water, and making used water safe.

Water Policies for the Future: Final Report to the President and to the Congress of the United States. National Water Commission. June, 1973. 579 p. U.S. Y3 N21/24:1.

Source: Rutgers University Libraries, New Brunswick, NJ 08903, (908) 932-3854.

Abstract: This report contains the findings and recommendations of the National Water Commission. Included in the chapters are the areas of (1) "pricing as means of motivating better use"; (2) water rights and riparian law; (3) reducing water losses; and (4) reuse of municipal and industrial waste water. The commission recommends that water pricing be based on the principle of incremental or marginal cost pricing. This should include the states imposing withdrawal charges on self-supplies, but may not be possible because of prior contracts or rights. The failure to price properly is demonstrated most in irrigation, which is responsible for 83% of all water consumption. The commission advocates free bargaining of water rights as a means of allocating water more efficiently. Establishing the right to sell salvaged water is also recommended. Within the existing system of water rights it is desirable for Western States to quantify the "duty of water" by crop and region. Similar quantification should be applied to conveyance losses. Uses beyond these amounts should not be included in the water right. Other methods of improving irrigation efficiency include choice of reservoir site, lining of irrigation canals, trickle and sprinkle irrigation, and eradication of streambank vegetation (here environmental effects must be considered). Improved efficiency in municipal use can be obtained by leak detection, installation of meters, price policy, encouraging water-efficient fixtures (38% and 50% possible savings for household and commercial-business establishments cited), and public relations. The potential for reuse of treated municipal and industrial wastewater is judged encouraging (cost estimates are included). It is recommended that direct reuse for human consumption be deferred. Sewage effluent-irrigation water exchanges hold considerable promise.

Water Resource Management and Conservation for the Future. Smith, F.J., Gordon, S.P., Powers, T.M. July, 1982. 168 p. PB83-139931.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: The focus of this report is using water conservation in planning for appropriate water resource management for the future. Surveys of water use in homes and industries, evaluation of a community incentives program for conservation, and systems analysis of conservation behavior are included in this study. Data for the study were drawn from 54 communities across North Carolina where 544 scientific interviews which yielded new information on 726 different variables relating to water resources management and conservation were conducted. The survey concluded that shortages of water supply represent a serious threat to the well-being of many North Carolina communities. In the past five years, 28% of households and 20% of industries sampled have suffered the effects of water supply shortages. On the positive side, the survey revealed significant citizen and industry support for water conservation. The study also indicated that present conservation activities are merely a peripheral part of management responsibility, while they need to be an integral part of water resource management.

Water Use, Reuse and Abuse. Roen, N., Murali, R. S. September, 1989. p. 5B-13--5B-21.

Source: Water: Laws and Management. American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814, (301) 493-8600.

Abstract: This paper discusses the complex technical, legal, regulatory, political, socio-economic, financial, public health, and environmental issues involving the use, reuse, and conservation of ground and surface water resources. These factors must be adequately addressed or potentially serious damage can be caused to the resource, economic development and growth management. This paper reviews the current legal and regulatory framework with respect to water use and reuse; the impact of political, socioeconomic, and public health issues; the technical, environmental, and economic constraints on opportunities for wastewater reuse; and specific disincentives in the current approaches to water use and reuse. This paper calls for a broad-based funding mechanism which would undertake viable, large-scale conservation and reuse projects. Topics such as more environmentally acceptable disposal technologies, changes in domestic and irrigation practices toward utilizing drought-tolerant species, low-volume irrigation technologies, and retrofitting are also discussed.

7. Water Conservation Devices/Products

A Handbook of Water Conservation Devices. Feldman, S.L. November, 1977. 79 p. PB-283018.

Source: National Technical Information Services, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: Current water supply problems and projected near-future shortages in the United States have created interest in methods of reducing domestic water demand. The techniques included in this handbook include education of consumers to alter their water-using behavior, metering, pricing, and/or installation of water-saving devices. Devices included are: (1) water-saving toilets and accessories, waterless toilets, bidets, and urinals; (2) flow limiting devices for faucets and showers; (3) alternative plumbing systems; (4) domestic recycling systems; (5) piping insulation; (6) dishwashers and clothes washers; and (7) lawn and garden irrigation control systems. A description of each type of device is followed by a list of manufacturers of that device and any special details that may pertain to their particular versions. The handbook is intended to guide consumers in product identification and selection.

A Report to the Delaware River Basin Commission Concerning Water Conservation Performance Standards for Plumbing Fixtures and Fittings. Delaware River Basin Commission. January, 1989.

Source: Delaware River Basin Commission, 25 State Police Drive, West Trenton, NJ 08628, (609) 883-9500.

Abstract: This report presents the findings of the initial review of newly adopted water conservation performance standards for plumbing fixtures and fittings. The regulations apply to fixtures and fittings installed in new construction and renovations and affect faucets, showerheads, urinals, and water closets.

A Summary of Marin Municipal Water District's Ultra-Low Flush Toilet Pilot Program. Marin Municipal Water District. August, 1990. 4 p.

Source: Marin Municipal Water District, 220 Nellen Avenue, Corte Madera, CA 94925-1169, (415) 927-4953.

Abstract: The report details the MMWD's Ultra-Low Flush toilet program. Seven different types of toilets were installed and their performance was monitored. Consumer acceptability of the low-flow toilets was also noted. The MMWD study found that the seven types of toilets performed well and very few needed double-flushes to be effective. The study summarizes the types of toilets used and how well each performed in the tests.

Abridged List of Certified Water-saving Plumbing Fixtures. New York State Department of Environmental Conservation. April, 1992. 98 p.

Source: New York State Department of Environmental Conservation, 50 Wolf Rd., Albany, NY 12233, (518) 457-8681.

Abstract: This abridged list of certified water-saving plumbing fixtures was prepared by the New York State Department of Environmental Conservation. This list supersedes all previous lists and supplements.

All plumbing fixtures on the list were certified by the manufacturers as meeting the following performance standards specified in Section 15-0314 of the Environmental Conservation Law, including recent changes:

1. for lavatory faucets maximum flow shall not exceed 2 gallons of water per minute; and
2. for sink faucets maximum flow shall not exceed 3 gallons of water per minute; and
3. for shower heads, at a constant water pressure of 60 pounds per square inch, maximum flow shall not exceed 3 gallons of water per minute; and
4. for urinals and associated flush valve, if any, each flush shall not exceed 1 gallon of water; and
5. for toilets and associated flush valve, if any, each flush shall not exceed 3 1/2 gallons of water.

This list is divided into two sections. Section A consists of all guidelines and rulings pertaining to the plumbing fixtures law that have been issued to date by the Department of Environmental Conservation. Section B consists of the lists of products certified by manufacturers as meeting the standards of the law.

Alternative Flushing and Retrofit Devices for the Toilet. Konen, T., Kannan, R., Cao, L., Nainarpandian, K. June, 1992. 68 p.

Source: Department of Civil, Ocean and Environmental Engineering, Stevens Institute of Technology, Hoboken, NJ 07030, (201)216-5345.

Abstract: To date Stevens has gathered information on thirty-four commercially available products and has categorized them into six distinct categories. The six categories are:

- I. Fixed Volume Displacement Devices
- II. Variable Volume Displacement Devices
- III. Mechanical Devices with Fixed Cycle Times
- IV. Mechanical Devices with Variable Cycle Times
- V. Mechanical Devices with User Controlled Cycle Times
- VI. Dual Flush Devices

Stevens has determined the potential for savings for these devices based on two fundamental criteria. These criteria are:

Function. The toilet shall retain a flushing efficiency of not less than 85 percent based on the ASME/ANSI waste removal ball test.

Health and Safety. The toilet shall retain a 2.5 inch minimum trap seal to prevent sewer gas from entering the inhabitable areas of the building, and shall not increase the risk of contaminating the supply through backflow.

American Water Works Association Publications.

Source: Journal American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235, (303) 794-7711.

Minimum-flow plumbing fixtures. Siegrist, R. July 1983. Vol. 75, No.7. p. 342-347.

Abstract: This paper gives a report on minimum-flow plumbing fixtures and household appliances and describes their function, service, compatibility, and cost-effectiveness.

New Massachusetts Toilet Standard Sets Water Conservation Precedent. Vickers, A. Vol. 81, No. 3. p. 48-51.

Abstract: A new plumbing code in Massachusetts requires all two-piece tank-type and floor-mounted flush-valve toilets installed during new construction or as replacements of existing toilets to use no more than 1.6 gal/flush. The code change is the first of its kind on a statewide basis and has served as an incentive for proposed federal legislation to establish conservation-oriented water-use standards for plumbing fixtures. Low-volume toilets, whose performance is equal to or better than that of conventional toilets, have the potential to be a significant factor in water demand management.

The Performance of Ultra-Low-Volume Flush Toilets in Phoenix. Anderson, D., Siegrist, R. Vol. 81, No. 3. p. 52-57.

Abstract: The performance of ultra-low-volume (ULV) toilet fixtures was studied under field conditions in Phoenix, Arizona. Two residential subdivisions were compared, one utilizing conventional fixtures and one using ULV fixtures. The study evaluated the water-savings and wastewater flow reduction provided by the ULV fixtures, their effect on drainage and sewer transport, and their in-house performance and acceptance by users compared with their conventional counterparts.

Water Conservation Devices for New or Existing Dwellings. Sharpe, W.E. March, 1981. Vol. 73, No. 3. p. 144.

Abstract: Data concerning the performance of various water conservation devices in new and existing dwellings are presented. Because of differences in measurement methods, individual water use, device distribution methods, and other variables, these data must be carefully interpreted. Devices examined include pressure-reducing valves and spray taps for faucets, front-loading automatic washing machines that allow for

wash cycle adjustments based on load size and other factors, showerhead flow restrictors, water-saving toilets, and leak detection tablets.

Directory of Certified Showerheads and Faucets, P400-91-020. California Energy Commission. 78 p. 1991.

Source: California Energy Commission, 1516 9th Street, Sacramento, CA 95814, Publications Office MS 13, (916) 654-4294.

Abstract: This directory identifies showerheads and faucets which are certified to the California Energy Commission as complying with the January 1, 1987, standards. The 1987 regulations consist of six requirements: 1) the fittings must comply with the flow rate requirements of the standard A112.18.1M-1979; 2) a representative sample must have been tested in an approved laboratory; 3) the fittings must be marked with the flow rate or other equivalent marking; 4) the carton in which the fitting is shipped for retail sale must be marked with the flow rate or other equivalent marking; 5) the flow-restricting mechanism (of a showerhead) must be difficult (or impossible) to remove; and 6) the manufacturer must certify that the model complies with all the requirements listed above.

Directory of Water Conserving Plumbing Products. International Association of Plumbing & Mechanical Officials (IAPMO). September, 1992. 51 p.

Source: International Association of Plumbing & Mechanical Officials, 20001 Walnut Drive South, Walnut, CA 91789-2825.

Abstract: This Directory lists the findings of several committees whose activities include the examination of standards and the evaluation of independent test results performed to determine whether listed products and products proposed for listing meet the minimum standards of the Association. However, all materials conforming to the standard of the Uniform Plumbing Code may not necessarily be listed in the Directory.

How to Save Water. Consumer Reports. July, 1990. p. 465-473.

Source: Consumer Reports, 256 Washington Street, Mount Vernon, NY 10553, (914) 667-9400.

Abstract: This article presents the results of tests performed by Consumer Reports on low-flush toilets and low-flow showerheads. Consumer Reports ranked the toilets by price, gallons per flush, bulkwaste, bowl cleaning, floating waste, dilution ratio, and drain-line carry. The low-flow showerheads are ranked by price, maximum flow rate, spray and pulse settings, materials/finish, warranty, and in order of preference as determined by a panel of users. The products that are suggested cut down on home water use without making consumers change their habits.

Laboratory Performance Testing of Low-Consumption Water Closets for Manufactured Housing, HUD Contract No. HC-15744, Task Order No. 5., Project No. 5460. Dewey, Robert C. January, 1992. 60 p.

Source: U.S. Department of Housing and Urban Development, Office of Manufactured Housing and Regulatory Functions, Washington, DC, 20410, (202) 708-1422.

Abstract: Codes or regulations have recently been proposed in some regions of the country that would require low-consumption water closets in manufactured homes. The manufactured housing industry has expressed concern regarding the adequacy of these fixtures to transport waste material through their wastewater piping system compared to the higher volume "water-saving" fixtures now used, since pipe diameters and slopes are typically less than those used for other types of construction due to space limitations in the floors of manufactured housing units. As a result, the NAHB Research Center (Research Center) was requested by the Department of Housing and Urban Development (HUD) to test the performance of low-consumption water closets in comparison to the standard "water-saving" water closets normally used in manufactured homes.

Listing of Water-saving Plumbing Fixtures. Water Conservation Technical Assistance Program. January, 1982. 16 p.

Source: Commonwealth of Pennsylvania, Department of Environmental Resources, Office of Resources Management, D Park, Suite 6010, 555 North Ln., Conshohocken, PA 10428, (215) 832-6000.

Abstract: This booklet was created to increase the awareness of local officials, plumbers, builders, and consumers of the availability of water-saving hardware. The information in this book is the result of an intensive survey of over 300 plumbing fixture manufacturers. This booklet is meant to be used as a guide for homeowners considering the installation of water-saving hardware, officials proposing the adoption of water conservation ordinances, and builders required to install water-saving hardware in new structures. Manufacturers and product specs are listed for toilet and flush valves, toilet displacement devices, showerheads, aerators, flow restrictors, and faucets.

Low-flow showerheads. Consumer Reports. June, 1985. p. 369-371.

Source: Consumer Reports, 256 Washington Street, Mount Vernon, NY 10553, (914) 667-9400.

Abstract: Consumer Reports ranked the performance of low-flow showerheads to discover which low-flow heads save water without sacrificing a good shower. Because low-flow showerheads can cut down on water use in the shower by 50 percent, they are very useful in reducing the water bill by 15 percent or more. Consumer Reports tested both regular and aerating showerhead types, measuring the water flow and scoring each of 33 models for its range of sprays and for how easily those sprays could be adjusted. They also judged the forcefulness and body coverage of the sprays and noted the noise the tested showerheads generated. Also ranked is price and ease of cleaning.

National Plumbing Products Efficiency Act Fact Sheet. National Wildlife Federation. 1992. 1 p.

Source: National Wildlife Federation, 1400 16th St., NW, Washington, DC 20036-2266, (202) 797-6800.

Abstract: This fact sheet briefly describes the National Energy Policy Act, which was signed into law on October 24, 1992. This bill establishes standards for the manufacture and labeling of showerheads, toilets, urinals, and faucets.

National Standard Plumbing Code-Illustrated. National Association of Plumbing-Heating-Cooling Contractors. 1984.

Source: National Association of Plumbing-Heating-Cooling Contractors, PO Box 6808, Falls Church, VA 22046, (703) 237-8100.

Abstract: This publication explains the specific components of the National Standard Plumbing Code in order to satisfy the demand for greater understanding of the Code requirements. It contains illustrations, commentaries, and pertinent cross-references to explain and clarify the majority of Code entries.

Performance of Ultra-Low Volume Flush Toilets in Phoenix, Arizona. Anderson, D.L., Siegrist, R.L. February, 1986. 39 p.

Source: Ayres Associates, 2445 Darwin Road, Madison, WI 53704, (608) 249-0471.

Abstract: The problems and impacts associated with water consumption are stimulating more interest in water conservation. In-house water-consuming activities in residential dwellings throughout the United States contribute to a yearly per capita consumption of potable water that exceeds 18,000 gallons, of which over 33 percent is from toilet flushing alone. In response to this, ultra-low volume (ULV) toilet fixtures have been developed that use less than 1.5 gallons and appear to offer comparable user service levels, similar operation, and compatibility with existing utility systems. The objective of this study was to enhance the existing database on the operation and performance of ULV toilet fixtures and to evaluate the water-savings provided by the ULV toilets, determine their effect on sewer transport and wastewater composition, and to evaluate the user acceptance of the ULV fixtures in comparison to conventional toilet fixtures.

ULF Water Closets Study, Final Report, Research Report 92-01. Stevens Institute of Technology. November, 1992. 60 p.

Source: American Society of Plumbing Engineers Research Foundation, 3617 Thousand Oaks Blvd. #210, Westlake, CA 91362, (805) 495-4926.

Abstract: This report describes the results of a study performed on 1.6 GPF water closets. The performance of ULF water closets was compared with the performance of more traditional 3.5 GPF units. The performance and user acceptance of the ULF water closets were also evaluated using several consumer groups. Also included in this report is the identification and development of mathematical models describing the transport of wastes in drains and sewers. The researchers also examined several field sites to explore the performance of ULF water closets.

Ultra-Low-Flush Toilet Rebate Programs in Southern California: Lessons for Water Managers and Planners. Chesnutt, T., Moynahan, M., Bamezai, A. June, 1992. 7 p.

Source: Metropolitan Water District of Southern California, PO Box 54153, Los Angeles, CA 90054, (213) 250-6097.

Abstract: This paper, which was originally presented at the 1992 American Water Works Conference, summarizes what water managers and planners can learn from a detailed evaluation of ultra-low-flush (ULF) toilet rebates. Lessons learned from the Southern California experience are discussed. The evaluation of water conservation programs and the achievements of rebate programs are addressed.

Water Conservation Devices: Residential Water Conservation. Office of Water Research and Technology. 1977. 9 p. PB-281499.

Source: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650.

Abstract: This is one of a series of consumer-oriented capsule reports highlighting findings of research projects funded through the Office of Water Research and Technology. It outlines the significance, economics, and application of water conservation. Water conservation measures and devices, e.g., plastic bottles, toilet inserts, improved ballcocks, dual flush cycle modifications, water-saving toilets, faucet aerators, spray taps, flow-control devices, pressure-reducing valves, water-conserving applications, and landscape-irrigation equipment, are very briefly described. The economic advantages of water conservation devices are estimated, and in no case were they found to be negative.

Water-Efficient Technologies, A Catalog for the Residential/Light Commercial Sector, 2nd Edition. Laird, C. 1991.

Source: Rocky Mountain Institute, Water Program, 1739 Snowmass Creek Rd, Snowmass, CO 81654-9199, (303)927-3851.

Abstract: This catalog was developed as part of a multi-year effort to produce a Water-Savers' Handbook (WASH) Series. In the residential, commercial, and agricultural sectors, WASH will provide practical tools to determine the multiple benefits of saved water, what hardware is available to save water, how much water can be saved at what cost, and how to implement those potential savings through a variety of market and regulatory mechanisms. The goal of this catalog is to provide basic technical and commercial data on the major types of advanced water-efficient technologies now available for residential and light commercial use in the United States.

Water-saving/Safe Water Product Directory. Plumbing, Heating, and Piping Magazine. 1990.

Source: Plumbing, Heating, and Piping Magazine (formerly Domestic Engineering Magazine) 400 North Michigan Ave., Chicago, IL 60611, (312) 222-2000.

Abstract: This annual publication contains a list of water quality and water conservation products. Intended to help jurisdictions across the United States that are implementing water conservation measures, it lists specific products from several dozen manufacturers that mechanical and plumbing contractors can install to reduce water

usage. The manufacturers are listed with addresses, along with the general types of water quality and water conservation products available from each. Categories include flow-regulating devices, faucets and sinks, flush valves and retrofit kits, plumbing fixtures, showerheads, toilet tank retrofit units, and water-pressure regulators. Directories from 12 previous years are also available.

Water: Time To Start Saving? Consumer Reports. May, 1978. p. 294-295.

Source: Consumer Reports, 256 Washington Street, Mount Vernon, NY 10553, (914) 667-9400.

Abstract: This article explains the importance of conservation and how to live with less water. Consumer Reports tested 28 water-saving devices for toilets, including dams, weights, dual-flush units, air bleeds, replacement tanks, and flush valve stops. However, they concluded that a bottle in the toilet tank or a homemade weight (described in article) would be just as effective as all the products tested, and therefore didn't recommend any of them. Consumer Reports also tested shower devices, such as flow restrictors, regular low-flow showerheads, and aerating low-flow showerheads. They concluded that a flow restrictor will conserve water and, priced at \$2 or less each, will cost less to buy than a completely new showerhead. Low-flow showerheads, however, do not decrease enjoyment of the shower as much as flow restrictors. Aerators, although unadjustable, save more water than the regular low-flow showerheads.

8. Listing of Companies Selling Water Conservation Devices

Each of the companies listed below was contacted by mail for a listing of its water conservation devices. The companies were placed in specialty categories according to the product information which was returned to Rutgers Cooperative Extension. All addresses and specialty categories were derived from the return information. The categories are delineated and numbered as follows:

SPECIALTY CATEGORIES:

- 1 - Sink/Lavatory Faucets and Accessories*
- 2 - Showerheads*
- 3 - Toilets and Accessories*
- 4 - Other Water Conservation Products*

Acorn Engineering Company, Sprattford Sales Assoc., Atlas Building, 120 West 7th St., PO Box 1445, Plainfield, NJ 07061-1445, (908) 757-9121.

Category: 3, 4

ALB/Select-A-Flush Water Savers, PO Box 444, Hamburg, PA 19526, (215) 562-0735.

Category: 3

Alsons Corporation, 42 Union Street, PO Box 282, Hillsdale, MI 49242, (517) 439-1411.

Category: 2

The American Brass Mfg. Co., 5000 Superior Avenue, Cleveland, OH 44103.

Category: 1, 2

American Standard, Inc., P.O. Box 8305, Trenton, NJ 08650, (800) 821-7700, ext. 4023.

Category: 1, 2, 3

Ametek, 502 Indiana Ave., PO Box 1047, Sheboygan, WI 53082-1047, (414) 457-9435.

Category: 4

Artesian Industries, 201 East Fifth Street, Mansfield, OH 44901

Category: 3

Artistic Brass, 4100 Ardmore Ave., South Gate, CA 90280, (213) 564-1100.

Category: 1, 2

BPC Manufacturing Operations, Division of Bristol Corporation, State Road 15 South, Bristol, IN 46507, (219) 848-7681.

Category: 1, 2, 3, 4

Bradley Corporation, P.O. Box 309, W142 N9101 Fountain Blvd., Menomonee Falls, WI 53051, (414) 251-6000.

Category: 1, 2, 4

Briggs Industries, Inc., 4350 W. Cypress Street, Suite 800, Tampa, FL 33607, (813) 878-0178.
Category: 1, 2, 3

The Broadway Collection, 1010 W. Santa Fe, Olathe, KS 66061-3116, (800) 766-1661.
Category: 1, 2

Burke Rubber Company, 2250 South Tenth Street, San Jose, CA 95112, (800) 669-7010.
Category: 4

Campbell Manufacturing, Inc., Spring and Railroad Streets, Bechtelsville, PA 19505, (800) 523-0224.
Category: 4

Central Brass Manufacturing Co., 2950 East 55th Street, Cleveland, OH 44127, (216) 883-0220.
Category: 1

Chatham Brass Co., Inc., 5 Olsen Avenue, Edison, NJ 08817, (800) 526-7553.
Category: 2

The Chicago Faucet Company, 2100 South Clearwater Drive, Des Plaines, IL 60018-5999, (708) 803-5000.
Category: 1, 2

Chronomite Labs, Inc., 21011 South Figueroa St., Carson, CA 90745, (800) 447-4963.
Category: 1, 2, 4

Coast Foundry and Manufacturing Co., PO Box 1788, Pomona, CA 91769-1788, (800) 521-4021.
Category: 3

Comco Faucet Corporation, 21-07 40th Avenue, Long Island City, NY 11101, (800) 227-0013.
Category: 1

Con-Tech Industries, 2780 Loker Ave. West, Carlsbad, CA 92008, (619) 438-5559.
Category: 2, 3

Coyne & Delany Co., 110 Jericho Tpke., Floral Park, NY 11001, (516) 437-5977.
Category: 1

C/P Utility Services Company, 119 Sanford Street, Hamden, CT 06514, (203) 248-8612.
Category: 4

Crane Plumbing Division, CR/PL Inc., 1235 Hartrey Ave., Evanston, IL 60202, (708) 864-7600.
Category: 3

Crest/Good Mfg. Co., 325 Underhill Blvd., Syosset, NY 11791, (800) 645-1251.
Category: 1, 2, 3

Cuno, 400 Research Parkway, Meriden, CT 06450, (800) 243-6894.
Category: 4

Danfoss Mfg. Co. LTD, 2 El Dorado Ct., Hampton, VA 23669, (804) 851-7318.
Category: 1, 2

Davis & Warshow, Inc., 57-22 48th St., Maspeth, NY 11378, (718) 937-9500.
Category: 4

Delany Flush Valves, 110 Jericho Turnpike, Suite 101, Floral Park, NY 11001, (516) 437-5977.
Category: 3, 4

Delta Faucet Co., 55 E. 111th St., Indianapolis, IN 46280, (317) 848-1812.
Category: 1, 2

E.C. Geiger, Inc., Box 285, Rt. 63, Harleysville, PA 19438-0332, (215) 256-6511.
Category: 4

Eljer Plumbingware, 3 Gateway Center, Pittsburgh, PA 15222, (800) 753-5537.
Category: 1, 3

Elkay Manufacturing Company, 2222 Camden Court, Oakbrook, IL 60521, (708) 574-8484.
Category: 1, 2, 4

Energy Technology Laboratories, 1127 Kansas Avenue, Modesto, CA 95351, (800) 344-3242.
Category: 2, 3

Envirovac Inc., 1260 Turret Drive, Rockford, IL 61111, (800) 435-6951.
Category: 3

Fisher Manufacturing Company, 5332 Santa Fe, Los Angeles, CA 90058, (213) 585-0161.
Category: 1, 4

Fluidmaster, PO Box 4264, 1800 Via Burton, Anaheim, CA 92803, (714) 774-1444.
Category: 1, 2, 3, 4

Frugal Flush, Inc., 1209 East Washington, Suite 4, Phoenix, AZ 85034, (602) 253-6275.
Category: 3

Gardener's Supply Company, 128 Intervale Road, Burlington, VT 05401, (802) 863-1700.
Category: 4

Geberit Manufacturing, Inc., 1100 Boone Drive, PO Box 2008, Michigan City, IN 46360, (800) 225-7217.
Category: 3, 4

Gerber Plumbing Fixtures Corp., P.O. Box 278, Delphi, IN 46923, (317) 564-2547.
Category: 1

Grohe America, Inc., 900 Lively Boulevard, Wood Dale, IL 60191, (708) 350-2600.
Category: 1, 2

Gundle Lining Systems, 19103 Gundle Road, Houston, TX 77073, (800) 435-2008.
Category: 4

Halsey-Taylor, PO Box 510, Freeport, IL 61032, (815) 235-0066.
Category: 4

Hansgrohe Inc., 2840 Research Park Dr., Suite 100, Soquel, CA 95073, (408) 479-0515.
Category: 1, 2

Heath Consultants, 100 Tosca Drive, PO Box CS-200, Stoughton, MA 02072, (617) 344-1400.
Category: 4

Honeywell-Braukmann, 1885 Douglas Drive North, Golden Valley, MN 55422-3992, (612) 542-7106.
Category: 4

In-Sink-Erator Division, Emerson Electric, 4700 21st Street, Racine, WI 53406, (800) 558-5712.
Category: 1, 4

Indiana Brass, PO Box 369, Frankfort, IN 46041, (317) 659-3341.
Category: 1, 2

Interbath, Inc., Ondine Division, 427 N. Baldwin Park Blvd., City of Industry, CA 91746, (818) 369-1841.
Category: 2

ISTA Energy Systems Corporation, PO Box 618, Roselle, NJ 07203, (908) 241-8880.
Category: 4

Just Manufacturing Co., 9233 King Street, Franklin Park, IL 60131, (708) 678-5150.
Category: 1

KBI Industries, Inc., PO Box 2096, Michigan City, IN 46360, (219) 879-5000.
Category: 1

Keystone Filter Division, 2385 North Penn Road, Box 380, Hatfield, PA 19440, (215) 822-1963.
Category: 4

Kirkhill Inc., 12021 Woodruff Avenue, P.O. Box 7013, Downey, CA 90241, (213) 803-3421.
Category: 1, 2, 3

Kohler Co., 44 Kohler Memorial Drive, Kohler, WI 53044,
Category: 1, 2

Leonard Valve Company, 1360 Elmwood Avenue, Cranston, RI 02910, (401) 461-1200.
Category: 2, 4

Lifetime Faucets, 5050 Poplar Ave., Suite 2403, Memphis, TN 38157, (901) 681-0521.
Category: 1, 2

Lynnwood Industries, Inc., 76 Ethel Avenue, PO Box 501, Hawthorne, NJ 07506, (201) 427-0500.
Category: 1, 2, 4

Mansfield Plumbing Products, 150 First Street, Perrysville, OH 44864, (419) 938-5211.
Category: 3

Manville Manufacturing Corporation, 342 Rockwell Ave., Pontiac, MI 48341-2458, (313) 334-4583.
Category: 1

Melard Manufacturing Corporation, 153 Linden Street, PO Box 58, Passaic, NJ 07055, (201) 472-8888.
Category: 1, 2, 3, 4

Microphor, Inc., P.O. Box 1460, Willits, CA 95490, (800) 358-8280.
Category: 1, 2, 3

Moen Inc., 377 Woodland Ave., Elyria, OH 44036-2111, (800) 347-6636.
Category: 1, 2

Newport Brass, Inc., 320 E. Alton Ave., Santa Ana, CA 92707, (714) 436-0805.

Category: 1, 2

Niagara Conservation Corp., 230 Route 206, Flanders, NJ 07836, (800) 831-8383.

Category: 1, 2, 3, 4

NIBCO Inc., 1510 Gehman Rd., PO Box 1387, Kulpsville, PA 19443, (800) 836-4260.

Category: 1

Norca Corporation, P.O. Box 427, 185 Great Neck Road, Great Neck, NY 11022, (516) 466-9500.

Category: 1, 4

Omni Products, Inc., 21011 South Figueroa St., Carson, CA 90745, (800) 447-4962.

Category: 1,2

Palco Linings, Inc., 2624 Hamilton Blvd., PO Box 526, South Plainfield, NJ 07080, (908) 753-6262.

Category: 4

Peerless Faucet Co., 55 E. 111 St., PO Box 40980, Indianapolis, IN 46280, (317) 848-7933.

Category: 1, 2

Phoenix Products, Inc., 583 Miller Rd., Avon Lake, OH 44012, (800) 222-6041.

Category: 1, 2

Powers Process Controls, 3400 Oakton, Stokie, IL 60076, (708) 673-6700.

Category: 2, 4

Price Pfister Brass Mfg. Co., 13500 Paxton Street, PO Box 4518, Pacoima, CA 91333-4518, (818) 896-1141.

Category: 1, 2

Resources Conservation, Inc., PO Box 71, Greenwich, CT 06836, (203) 964-0600.

Category: 1, 2, 3

Rohl Corporation, 1559 Sunland, Costa Mesa, CA 92626, (714) 557-1933.

Category: 1, 2

Royal Brass Manufacturing Co., 1420 East 43rd Street, Cleveland, OH 44103, (216) 361-3175.

Category: 1

Sepco Industires Inc., 491 Wortman Ave., Spring Creek, NY 11208, (718) 257-2800.

Category: 1, 2

Sloan Valve Company, 10500 Seymour Avenue, Franklin Park, IL 60131, (708) 671-4300.

Category: 3

Sonoma Woodworks, 133 Copeland Street, Petaluma, CA 94952, (707) 762-5548.

Category: 3

Speakman Company, P.O. Box 191, 301 E. 30th Street, Wilmington, DE 19899-0191, (302) 764-9100.

Category: 1, 2, 4

Sterling Faucet Company, P.O. Box 798, Morgantown, WV 26505, (708) 843-5400.

Category: 1, 2

Sunroc Corporation, Route 452, Glen Riddle, PA 19037, (215) 459-1100.
Category: 4

Symmons Industries, A.G. Fehrm, President, 31 Brooks Drive, Braintree, MA 02184, (617) 848-2250.
Category: 1, 2

T & S Brass and Bronze Works, Inc., 2 Saddleback Core Road, PO Box 1088, Travelers Rest, SC 29690-1088, (803) 834-4102.
Category: 1, 4

TC Sales Company, PO Box 4985, Orange, CA 92613-4985, (714) 633-2164.
Category: 3

Teledyne Water Pik, 1730 East Prospect Street, Fort Collins, CO 80525, (800) 525-2774.
Category: 2

Therm-O-Disc, Inc., H & H Product Group, 1320 South Main Street, Mansfield, OH 44907, (419) 525-8500.
Category: 4

Toto Kiki USA, Inc., 415 West Taft Ave., Unit A, Orange, CA 92665, (714) 282-8686.
Category: 3

Ultraflo Corporation, 4515 South Columbus Avenue, Sandusky, OH 44870, (419) 626-8182.
Category: 1, 4

U.S. Brass, PO Box 869037, Plano, TX 75086-9037.
Category: 1

Universal-Rundle Corporation, 217 North Mill Street, PO Box 29, New Castle, PA 16103-0029.
Category: 1, 3

Valley Ceramic Supply, Inc., 5304 Farm Road 802, PO Box 3572, Brownsville, TX 78520, (512)831-7101.
Category: 1, 2, 3

Water Control International, 51155 Grand River Ave., Wixom, MI 48393-8710.
Category: 3

Whedon Products, Inc., 21A Andover Dr., W. Hartford, CT 06110, (800) 541-2184
Category: 1, 2

Wilkins Regulator Company, 1747 Commerce Way, Paso Robles, CA 93446, (805) 238-7100.
Category: 4

Wolverine Brass Works, 2951 Hwy 501 East, Conway, SC 29526-9515, (800) 944-9292.
Category: 1, 2, 3, 4

WPM, Inc., 407 Brookside Road, Waterbury, CT 06720, (203) 756-8895.
Category: 1

Zin Plas Corporation, P.O. Box Q, Grand Rapids, MI 49501, (800) 253-1567.
Category: 1, 2

Zurn Industries, Inc., Flush Valve Operations, 201 Williams Street, Sanford, NC 27330, (919) 776-0921.
Category: 3

DISCLAIMER:

Rutgers Cooperative Extension does not endorse any companies or water conservation products or devices on this list. Every effort has been made to ensure the accuracy of this list. If errors or omissions are noted, please contact Theodore B. Shelton or Susan E. Lance at the Department of Natural Resources, Cook College, Rutgers University, New Brunswick, NJ 08903-0231.

9. Bibliographic Search Methodology

The keyword search using "water conservation" was conducted on the electronic and printed databases listed below. The search dates were January 1980 through December 1992 for all databases (unless otherwise noted). From this information the bibliographic citations were selected by the authors.

Our appreciation and acknowledgment are given to the following electronic database and printed materials suppliers for granting permission to cite bibliographic entries.

1. AGRICOLA

AGRICOLA (AGRICultural OnLine Access) is an extensive bibliographic database consisting of records for literature citations of journal articles, monographs, theses, patents, translations, microforms, audiovisuals, software, and technical reports. Available since 1970, AGRICOLA serves as a document locator and bibliographic access and control system for the National Agricultural Library (NAL) collection, but since 1984 the database has also included some records produced by cooperating institutions for documents not held by NAL. AGRICOLA records are used to produce the printed Bibliography of Agriculture, CDROM versions of the database, and various bibliographic series and other products of NAL. This extensive database has been maintained since 1970 to provide selective worldwide coverage of primary information sources in agriculture and related fields. Since 1985, the CAB Thesaurus has been utilized to select controlled vocabulary terms for subject indexing. Library of Congress Subject Headings are used as controlled vocabulary for cataloging records. Over 500,000 current records from File 10 (1979 to present) employ controlled vocabulary.

CD-ROM at Douglass Library, Rutgers University

2. CRIS (Current Research Information Systems)

CRIS (Current Research Information System)/USDA provides access to information on federal and state supported research in agriculture, food and nutrition, forestry, and related fields. The projects described in CRIS/USDA cover current research sponsored or conducted by the United States Department of Agriculture (USDA), the state agricultural experiment stations and land-grant universities, state forestry schools, colleges and schools of veterinary medicine, and other cooperating state institutions. The database includes the HNRIMS subfile, which contains project information on human nutrition research of USDA, NIH, and other federal agencies. CRIS records include summaries of the objectives and approach used in the research. Annual progress and publication reports are also included for most records.

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3. ENVIROLINE™ (40)

ENVIROLINE™, produced by the R.R. Bowker (a Reed Reference Publishing Company), provides interdisciplinary coverage of the scientific, technical, and socio-economic aspects of the major English and non-English language environmental and resources literature. The printed equivalent is entitled *Environment Abstracts*. ENVIROLINE™ includes informative abstracts approximately 100 words long for records from 1971 forward.

DIALOG

4. ENVIRONMENTAL BIBLIOGRAPHY (68)

ENVIRONMENTAL BIBLIOGRAPHY provides access to the contents of periodicals dealing with the environment. Coverage includes periodicals in water, air, soil, and noise pollution; solid waste management; health hazards; urban planning; global warming; and many other specialized subjects of environmental consequence. ENVIRONMENTAL BIBLIOGRAPHY, the machine-readable database derived from *Environmental Periodicals Bibliography*, is published by the Environmental Studies Institute of the International Academy at Santa Barbara, 800 Garden Street, Suite D, Santa Barbara, CA 93101, USA.

DIALOG

5. WATER RESOURCES ABSTRACTS (117)

WATER RESOURCES ABSTRACTS offers a comprehensive range of water-related topics in the life, physical, and social sciences, as well as the engineering and legal aspects of the conservation, control, use, and management of water. The database, initiated in 1968, is produced by the Water Resources Scientific Information Center, Water Resources Division, U.S. Geological Survey, United State Department of the Interior, and is the online counterpart to the print Selected Water Resources Abstracts (SWRA). Coverage emphasizes English-language materials, and each record contains an informative abstract. Records are indexed using controlled vocabulary from the Water Resources Thesaurus and other index terms where needed.

DIALOG

6. WATERNET™ (245)

WATERNET™ provides a comprehensive index of publications relating to drinking water and wastewater. Coverage comprises all American Water Works Association and AWWA Research Foundation published materials, including books, proceedings, journals, newsletters, manuals, and standards. In addition to AWWA/AWWARF publications, a core grouping of North American and international journals on drinking water and wastewater topics are abstracted. Technical reports and studies from water utilities, government agencies, and research groups worldwide are included on a selected basis. Each record contains a brief abstract. Records are indexed using controlled vocabulary from the AWWA WATERNET™ Thesaurus.

DIALOG

7. Government Documents

This is a monthly bibliography of the U.S. government publications issued by all agencies and branches of the U.S. government. Entries are arranged by issuing agencies. Each monthly issue includes author, title, subject, series/report, contract number, stock number, and title keyword indexes. Includes lists of special materials, list of government authors, list of federal depository libraries, and instructions for ordering publications.

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8. Newspaper Abstracts Ondisc (ProQuest)

Newspaper Abstracts Ondisc consists of abstracts and indexing to the *New York Times*, *The Wall Street Journal*, *Washington Post*, *Atlanta Constitution*, *Atlanta Journal*, *Boston Globe*, *Los Angeles Times*, *Chicago Tribune*, *Christian Science Monitor*, and *USA Today*. The database is updated monthly with coverage beginning in 1985 for all newspapers except *The New York Times* (1987) and the *Washington Post* (1989). For the purposes of this bibliography only the *Los Angeles Times*, *The New York Times*, and *The Wall Street Journal* were used.

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9. Wilsondisc - Biological and Agricultural Index

This index is a cumulated subject index covering over 200 international periodicals in the English language. It contains over 4000 citations per month and 45% of the subject coverage is in agriculture. Subjects such as biochemistry, environmental sciences, ecology, microbiology, and nutrition are given extensive coverage. The index is cumulated quarterly and annually.

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10. CARL-UNCOVER - Colorado Alliance of Research Libraries (Fall 1988 - Dec. 1992)

UnCover, the article access database from the Colorado Alliance of Research Libraries (CARL), is a database of information taken from the tables of contents of over 10,000 journals in many disciplines. UnCover includes citation information about more than 1,800,000 articles which have appeared since fall 1988. If the contents page includes summaries, they will appear in the UnCover record.

via Internet

11. PENpages - through Penn State

PENpages is a full-text information service containing thousands of research-based fact sheets, news articles, newsletters, programs, and reports. Information is entered daily by researchers and experts in all areas of Cooperative Extension from around the nation. PENpages is available on an international basis with no subscription fee charges.

via Internet

12. QUERRI - Questions on University Extension Regional Resource Information (North Central Region)

QUERRI is a database maintained by the North Central Region Educational Materials Project and is located at Iowa State University. It allows online access to bibliographic information, including more than 12,000 Extension written and audio-visual resources. The entries include abstracts and all the resources are produced by NCR specialists. The database is updated daily and covers all program areas: agriculture, home economics, 4-H and youth, and community resource development.

via Internet

13. CERF - Cooperative Extension Reference Files -Water Quality Information Management System

The CERF program will allow you to: 1) search a database of Extension Publications entries; 2) view on line matched publications; and 3) obtain requested publications through electronic mail in a variety of formats. The database system is produced by the Agricultural Computer Network, Purdue Research Foundation.

via Internet

14. Social Sciences Index

The Social Sciences Index is a cumulative index of English language periodicals. Entries in the following fields are included: anthropology, area studies, community health and medical care, economics, geography, gerontology, international relations, law and criminology, minority studies, planning and public administration, police science and corrections, policy science, political science, psychiatry, psychology, social work and public welfare, sociology, urban studies, and related subjects.

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15. Educational Resources Information Center (ERIC)

ERIC is the database of educational materials collected by the Educational Resources Information Center of the U.S. Department of Education. ERIC consists of two subfiles: 1) Resources in Education (RIE), covering documents, and 2) Current Index to Journals in Education (CIJE), covering approximately 750 journals and serial publications. Most records in ERIC contain informative abstracts.

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16. Business Periodicals Index

The Business Periodicals Index is a cumulative index of English language periodicals. Subject fields indexed include accounting, advertising and marketing, agriculture, banking, building, chemical industry, communications, computer technology and applications, drug and cosmetic industries, economics, electronics, finance and investments, industrial relations, insurance, international business, management, personnel administration, occupational health and safety, paper and pulp industries, petroleum and gas industries, printing and publishing, public relations, public utilities, real estate, regulation of industry, retailing, taxation, transportation, and other specific businesses, industries, and trades.

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17. Public Affairs Information Service (PAIS) Index

The PAIS Index aims to identify the public affairs information likely to be most useful and interesting to legislators, administrators, the business and financial community, policy researchers and students. The PAIS indexes list publications on all subjects that bear on contemporary public issues and the making and evaluation of public policy, irrespective of source or traditional disciplinary boundaries. This includes the policy-oriented literature of the academic social sciences: economics, political science, public administration, international law

and relations, sociology and demography. Also included are professional publications in fields such as business, finance, law, education and social work, and reports and commentary on public affairs from the serious general press.

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18. Alternative Press Index

The Alternative Press Index includes alternative and radical publications compiled and published quarterly by the Alternative Press Center. The subject headings are revised regularly by the APC staff and are based on an initial list developed by the Social Responsibilities Roundtable of the American Library Association. The APC tries to use subject headings that are up-to-date and reflect the terminology used in the periodicals indexed.

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19. RLIN - the Research Libraries Information Network

RLIN, the Research Libraries Information Network, contains records that describe printed books, journals, journal articles, manuscript and archival materials, photographs, films, maps, sound recordings, and computer files. Records are searched by subject, title, series, author, illustrator, or translator. Results can be restricted by language, place, and date of publication. RLIN is used by Research Libraries Group (RLG) member libraries, non-member institutions, and individual researchers to create catalogs and bibliographies, to identify works on a subject or works of an author, to find translations and other editions of a title, to verify bibliographic citations, and to locate copies and call numbers.

via Internet

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