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WATER MANAGEMENT AND CONSERVATION  
RECLAMATION'S HYDRAULIC RESEARCH

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RECLAMATION'S HYDRAULIC RESEARCH

by  
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INTRODUCTION - The topic of water management and conservation brings to mind the drawing by Escher entitled The Jardin de Arts. The drawing depicts an open conduit in a Middle Eastern garden where the water continually circulates with no losses. To the casual observer it appears the water flows over the water wheel and returns to repeat the process in a never ending pattern. Unfortunately, we know this is not reality. As the demand for water increases, there is a growing need to improve the operating efficiencies of water deliver systems. Efficiencies can be realized in better management practices as well as improved technologies for monitoring and control of water deliveries. Reclamation is involved in three hydraulic research projects to develop and evaluate technical and management methods in support of water management and conservation.

Reclamation's new Water Technology and Environmental Research (WATER) program has identified five study areas:

1. Environmental Restoration and Enhancement
2. Water Supply Alternatives
3. Resource Optimization
4. New Methods and Materials
5. Power Systems

The three Water Management and Conservation research projects lie in the Water Supply Alternatives program area and are entitled:

1. Water Measurement
2. Water Management Research
3. Water Operations Technology

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This paper will present results to date and describe future plans for the projects.

**WATER MEASUREMENT** - The measurement of water flow is normally accomplished by an indirect measurement of head loss across a flow control device, such as a weir, or with the measurement of flow velocity through a control area, such as with a propeller meter at the end of a pipe. Although we know a lot about water measurement, the practice of accurate water measurement in the field is often difficult to achieve. This difficulty is usually caused by an inadequate appreciation for the critical water measurement concepts resulting in poor "technique" and/or poor placement and maintenance of water measurement devices in the field. Practically all flow measurement devices, when improperly installed, deliver more water than they indicate they are delivering. The very nature of most measuring devices makes it impossible for a device to deliver less water than it indicates.

In the 1960's, Reclamation instituted the Irrigation Operators' Workshop to present the fundamentals of water measurement to field personnel engaged in irrigation. Today the workshop, which is conducted annually, has expanded to 5 days and is called Water Systems Operation and Maintenance Workshop.

Many irrigation districts are in the process of changing from traditional means of charging for water, such as total acres irrigated, to actual volume of water used as a means of more accurately charging for water usage and thus encouraging conservation. Reclamation has recently assisted irrigation projects in the states of Washington and Texas in evaluating existing water delivery and measurement systems and recommending new alternatives. As water conservation policies gain added importance, and in turn acceptance, the accurate measurement of water volume over time becomes very important to the user as well as the supplier.

In an effort to measure water at some 2,000 turnouts on the Lower Colorado River Authority (LCRA) project near Austin, Texas, the LCRA decided to convert turnout structures called water boxes to water measurement devices. The LCRA has historically charged for water use by the acre of land under irrigation. In the future, the cost structure will be transformed from a surface area to a water volume basis. Over the next 3 years, the LCRA will progress from a demonstration project where 10 percent of the irrigators participate, to 50 percent participation in the next year, and 100 percent participation by the end of the third year.

The LCRA water box is a simple weir/orifice device formerly used only as a turnout structure. Before using these turnout structures

as flow measurement devices, a full scale model was constructed in Reclamation's hydraulic laboratory. Four-ft- and six-ft-wide water boxes were laboratory tested to evaluate their operation and limits as measurement devices.

A major emphasis of the water measurement project is instruction in better measurement "technique". In 1990 a 13-minute video tape entitled "Understanding Water Measurement" was produced to help individuals involved in water measurement better understand the critical elements of accurate water measurement. The video reviews the use of a number of water measurement devices and the difficulties in achieving accurate measurement if proper consideration is not given to the details of measurement technique.

In addition to the video tape, a portable water measurement flume was designed and fabricated to demonstrate the proper use of weirs, measurement flumes, and meters. The 3-ft by 12-ft demonstration flume is completely self contained and can be shipped to field sites for workshops. The flume will also be used for general public education in water conservation and measurement practices.

Reclamation's Water Measurement Manual, first published in 1953, has gained broad acceptance with thousands of copies distributed throughout the world. It has been revised a number of times, and again is in the process of a major update to further improve its usefulness to the water measurement community and introduce new water measurement devices such as the ramp flume.

The ramp flume, developed by the Agricultural Research Service, provides an accuracy comparable to the Parshall flume (3 to 5 percent), can measure accurately under relatively high submergence conditions, and costs considerably less to install. This flume is receiving broad acceptance as an inexpensive alternative to the Parshall flume.

Advancements in numerical methods (computer modeling) will be applied to water measurement devices to permit analytical evaluation of devices that are not standard. This would greatly assist in the evaluation of field sites where a flume has settled or the walls are not plumb. These numerical techniques may also be used in the evaluation of new and improved water measurement devices.

**WATER MANAGEMENT RESEARCH** - Water management research will concentrate on best management practices to assure the most efficient use of irrigation water, fertilizer, and agricultural chemicals. The project will focus on reducing water supply requirements by improving and developing new techniques for better management of irrigation water. Improving efficiency of water use

and reducing non-point source pollution requires an understanding of the balance between water application rates, fertilizer, pesticides, and crop yields. A water management research team will be established to coordinate and disseminate information regarding best management practices between field offices, irrigation districts, other Government agencies, and Reclamation's Denver Office.

Reclamation's Oakes Research Test Area on the Garrison Diversion Project best illustrates the concept of the water management research effort. The primary objective of the research project is to evaluate water quality from irrigated areas in North Dakota. The research plan outlines several study areas:

1. Surface and ground water monitoring
2. Irrigation best management practices
3. Soil studies
4. Nitrogen studies
5. Fish studies and closed wasteway systems
6. Wetlands and wildlife

The study involves the cooperation of a number of Federal and local government agencies and is managed by North Dakota State University. The research data are being gathered under actual field conditions with farmers utilizing prescribed "best management practices".

The water management research project is new, and one of the goals is to organize a workshop in the fall of 1991. The workshop will focus on best management practices where irrigators and water conservation engineers from across the West will have a forum to discuss problems and success in water management. The forum would identify, assess, and prioritize research needs in water management.

**WATER OPERATIONS TECHNOLOGY** - Many present day water systems must provide timely deliveries to users with little or no waste in the system. The purpose of the Water Operations Technology project is to use advance automation control methods to conserve water, improve control of delivery systems, and to improve response and prediction of water delivery systems.

The economic and operational benefits of upgrading canal systems by automation are well recognized. However, there are also many difficulties in transforming an existing conventional system to a modern automated system. Reclamation's first effort in canal

automation occurred in 1954 with development and implementation of a device for local automatic control of the Friant-Kern Canal check gates in California. Its immediate success led to application at other sites and the commitment by Reclamation to a research and development program for implementation of canal automation where appropriate. The program is directed toward modernization and upgrading existing systems and full supervisory control on new systems. Some manually controlled canal systems have an overall efficiency of 40 percent, exclusive of the use of return flows. Efficiencies in water delivery systems can be increased by 10 percent and crop yields by 15 percent with the use of modern control methods.

One of the recent products of this research is the Canal Systems Automation Manual. This 100-page document presents practical aspects of canal operation, control, and automation and is primarily designed for managers, operators, and users of water delivery systems.

A water operations technology team has been established to function as a resource in performing additional research in supervisory automatic control technology; continue testing and evaluating control equipment; and develop, evaluate, and implement macro control systems, including crop information, weather conditions and water availability. The team will also provide field support to implement and transfer technology to water users. This will be accomplished through direct assistance at field sites and through canal automation training workshops.

SUMMARY - Reclamation is responsible for the development and conservation of the Nation's water resources in the Western United States. Development is often stated in terms of structural improvements; conservation in terms of nonstructural improvements. Our goal in better water management and conservation is to provide "new" water (nonstructural) that can be produced at considerably less cost than the development of new sources (structural). Reclamation's hydraulic research program is directed toward the accomplishment of better water management through improved water measurement, water management, and water operations technology.

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