EVOLVING WATER RESOURCES INFRASTRUCTURE MANAGEMENT ISSUES IN NEBRASKA

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Introduction

Traditional water resources infrastructure has developed in a demand-driven environment. Systems were built in response to real and anticipated needs: municipal/industrial collection, distribution, and treatment systems, agricultural storage and distribution systems, and multipurpose reservoirs to for flood control, hydropower, and navigation benefits. These systems often endure longer than their anticipated design life of 50 to 100 years. During such long lives, water needs, demands and uses can change significantly. For example, demand on municipal water supply systems will exceed capacity if the population increases more rapidly than expected. Some changes are even driven by the infrastructure itself -- for example, the appearance of recreational-related business in the vicinity of reservoirs. How should such project-induced changes be managed? The purpose of this paper is to discuss water resources management issues under changing demands that are of particular interest in Nebraska. The extensive irrigation infrastructure of Western Nebraska will serve as the focus of the discussion.

Irrigation Infrastructure in Western Nebraska

Western Nebraska farmlands have been irrigated since being settled in the late 1800s. The three primary rivers entering the western part of the state (North Platte, South Platte, and Republican) have been fully appropriated since that time. Several storage reservoirs have been constructed to supplement irrigation water supplies. Total reservoir storage in Western Nebraska is about 2.8 million acre feet (Bentall and Shaffer, 1979). The stored water is delivered through a complex distribution system of more than 1,000 miles of canals and several off-channel reservoirs to 750,000 irrigated acres (Central Nebraska Public Power and Irrigation District, undated, and Bentall and Shaffer, 1979).

Project Induced Changes

Operating the irrigation system for more than 50 years has induced profound changes in the ground water and surface waters of the region. Ground water levels, for example, have risen more than 50 feet in the vicinity of unlined canals, while significant declines are occurring in the Republican River basin in the western portion of south central Nebraska (see Figure 1). Surface waters have also been affected. Several formerly small ephemeral surface water streams now flow year-round. On a larger scale, peak flows have decreased by two-thirds and total flow has decreased by three-fourths on the North Platte River at North Platte Nebraska (Federal Energy Regulatory Commission, 1990).

Implications for Management

These changes, induced by the existence of the irrigation infrastructure, pose difficult water management problems -- problems that have been called "wicked" by Berton Lamb, leader of the Water Resource Analysis Section of the U.S. Fish and Wildlife Service's National Ecology Research Center in Fort Collins, Colorado (Rundquist, 1991).

Ground Water Issues

Rising ground water levels. Leaking canals have created a significant source of water in the irrigated region by recharging the ground water reservoir. It is estimated that recharged ground water currently in storage exceeds the cumulative storage capacity of all surface water reservoirs in the region. Local farmers have learned to tap the

resource using low-head pumps to supply their own irrigation water. This dependence is highlighted in a statement from a recent water conservation report (CH2M Hill, 1991): "Thousands of acres of farmland not directly served by Central [the irrigation company] depend on ground water as their source of irrigation." So far Central Nebraska Public Power and Irrigation District, the irrigation company mentioned above, has lined over 250 miles of their canals. If canal lining continues, what will happen to the significant ground water resource currently replenished by the leaking canals? How should such a system be managed, and by whom?

Declining ground water levels. Storage reservoirs constructed in the Republican River basin in the south central part of the state were designed to intercept regional ground water and store incoming surface waters. Two shifts in water use, however, have dramatically reduced the amount of water entering the reservoirs. First, on-the-farm water conservation techniques such as contour plowing and the use of terraces to encourage infiltration have reduced the amount of surface water leaving local watersheds. Secondly, ground water pumping has significantly increased upstream from the reservoirs. The combined effect of these two practices has been painfully evident in area reservoirs for years: water levels are consistently low and becoming lower. This past summer, for example, a large fish kill was recorded at Harlan County Reservoir, the largest in the system (Lincoln Star, 1991). This incident and reduced recreation at this lake and others has left local irrigators "battling for water with lakeside property owners and others who want as much water as possible" (Hovey, 1991). How should this changing infrastructure system be managed?

Surface Water

Ephemeral-to-perennial streams. Several previously ephemeral streams now flow year-round as a result of increased ground water recharge from upstream irrigation return flow. In some cases the flow increases have created fisheries and significant riparian habitat for waterfowl and other species. The Nebraska Game and Parks Commission has been given the authority to maintain and protect these new wetland environments. What if more irrigation canals are lined in the region? Ground water recharge would be reduced and groundwater levels would likely decline as a result. What options would be available to the Game and Parks Commission to protect the threatened wetlands? Can a water right be assigned for instream flow use on a reach that is supplied as a result of upstream infrastructure? Must that infrastructure be managed to maintain newly created downstream habitats at the expense of not improving the upstream system?

Platte River issues. Wildlife habitat in a 250 mile long reach of the Platte River in Western and Central Nebraska has changed dramatically since the inception of irrigation 100 years ago. Permanent vegetation about a half mile wide now borders the river where previously none existed. This vegetated corridor has provided a natural access to Western Nebraska for several species previously restricted to the eastern part of the state. Conversely, habitat for other species has been greatly reduced. The once wide, braided, shallow Platte River in this region is now narrower and deeper and tends to flow in a single channel. Each year tens of thousands of migratory waterfowl use the region as a stopover to feed and build energy reserves for continued migration. The waterfowl prefer to roost in wide, shallow, braided channels to decrease the exposure to predators. Reduced habitat means more crowding as the birds compete for the remaining braided reaches of the river. How should such a system be managed? Should society's growing desire to maintain wildlife habitat result in decreased irrigation benefits? How can all needs be satisfied?

These questions have been part of the intense litigation that has accompanied the Federal Energy Regulatory Commission's relicensing process of dams and canals owned by the state's two largest irrigation companies. The issue is still in question and continues to frustrate involved parties who grapple with complex issues.

Conclusions

Water resources managers must realize that water needs can change dramatically during the life of an infrastructure system. Some of these changes occur as a result of the system itself. How should operations be managed to accommodate the changes? How are such decisions made? What are the legal implications, for example, of maintaining wetland habitats that depend upon upstream use patterns, themselves subject to change as the infrastructure system is modified? Truly these are difficult problems that merit open discussion as our water infrastructure systems continue to age.

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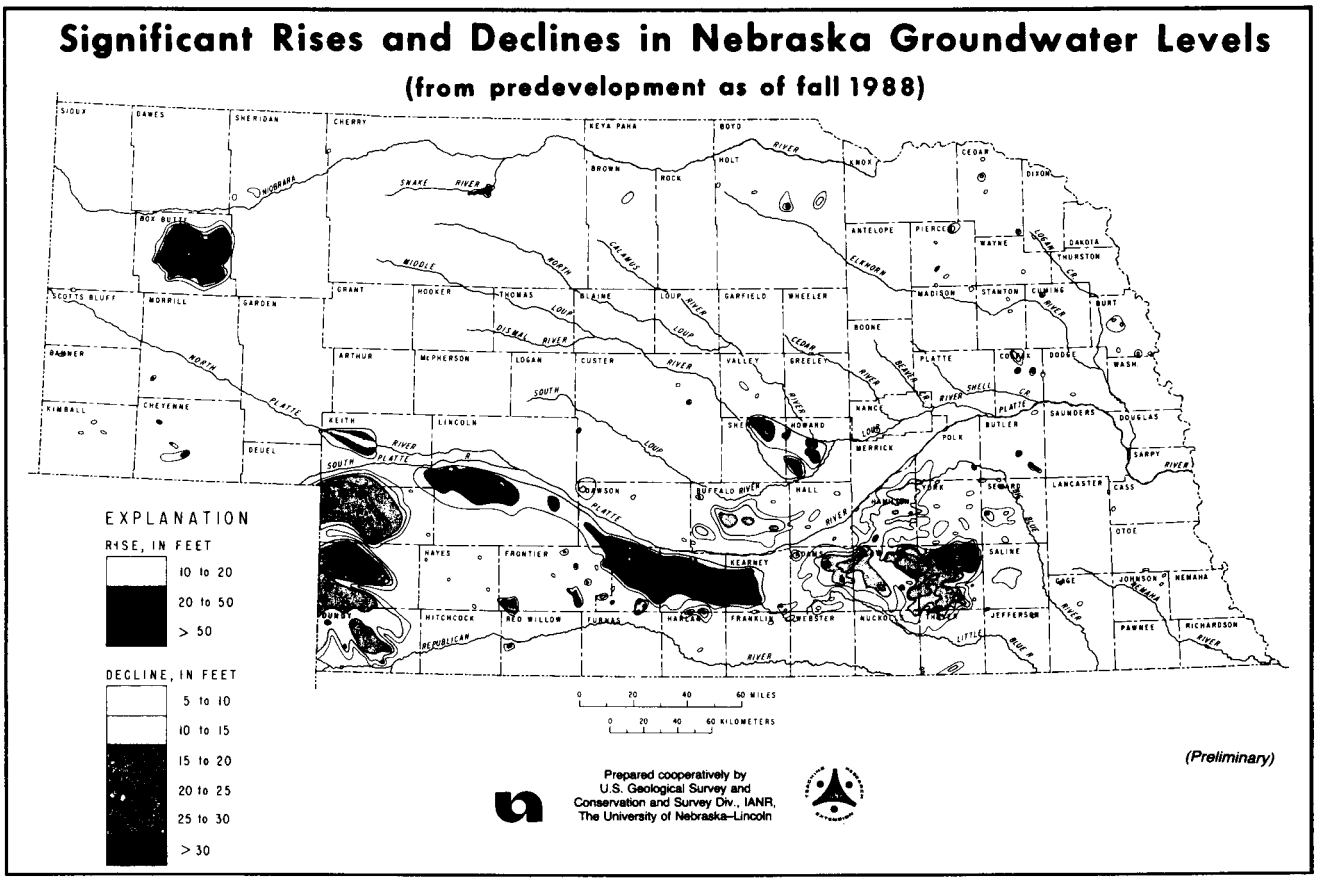

Figure 1. Significant Rises and Declines in Nebraska Ground Water Levels (From Nebraska Department of Environmental Control, undated)