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An Analysis of the Effects of Sociodemographic Factors on Daily Per Capita Residential Water Use in Texas Cities

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Water is a key resource of concern to residents and decision makers in the State of Texas and in many other parts of the United States. Careful planning for its use is of utmost importance for the State and the Nation. Such planning requires careful consideration of numerous factors including hydrologic and physiographic factors, engineering feasibility and economic feasibility. At the same time, it is increasingly evident that water needs are closely tied to population growth and to the social, economic and demographic characteristics of the population (Murdock et al., 1985). Thus, attempts to plan for the use of water resources have become increasingly inclusive of socioeconomic as well as physical variables as the costs of incorrectly projecting water demand and misallocating funds for facility construction and management have become apparent (Stees et al., 1976; McFarland and Hyatt, 1973; Reid, 1971; Texas Department of Water Resources, 1984).

To date, however, water-related socioeconomic research has concentrated on:

1. water use policy and water use planning
2. the demographic and social correlates of water and other resource use
3. the effects of water use and availability on demographic and social patterns
4. methodologies for projecting demands for resources and the implications of the use of resources

An extensive body of research addresses both the need for, and the dimensions that must be considered in, water use policy formation and planning (Markusen, 1978; U.S. Water Resources Council, 1978; Council for Agriculture Science and Technology, 1982; National Water Commission, 1973; Office of Technology Assessment, 1983; Texas Department of Water Resources, 1984). Such analyses persuasively argue for the use of comprehensive,

multidisciplinary planning formats, but as several recent reviews of water resources research efforts have noted (Francis, 1982; Napier et al., 1983), much of the basic research necessary to establish the relationships that should form the bases of the information used in such planning has not been completed.

The demographic and social correlates of water use have not been sufficiently established. Although total population and demographic structure characteristics are often used in projecting demands for water resources (Mercer and Morgan, 1978; Texas Department of Water Resources, 1984), several recent efforts evaluating the use of demographic and social variables in water use planning have noted that few of the relationships between demographic and social factors and water use have been established empirically (Murdock et al., 1985; Korsching and Nowak, 1983; Francis, 1982). Thus, it is unclear what effects differences in household or family composition patterns or the age structure of a population have on usage of water and related resources. In like manner, although given some attention in the literature (Larson and Hudson, 1951; Bogue, 1963; Kubat et al., 1968; Francis, 1982; Napier et al., 1983), the relationships between such crucial social variables as socioeconomic status, ethnic status and perceptions of water conservation requirements and water use have not been adequately examined. Since other resource uses, such as energy use (Morrison, 1976), show substantial variation across demographic, social and cultural variables, similar effects are likely to be found between demographic, social and cultural variables and water use.

The effects of water use and availability on population and social patterns have been given considerable attention (Williford et al., 1976; Doeksen and Pierce, 1976; Albrecht et al., 1984; Murdock et al., 1984; Albrecht and Hurdock, 1985). Such analyses suggest that changes in water resource availability or in the use of water-related forms of technology may lead to substantial changes in the population bases of areas (Albrecht and Murdock, 1985; Fitzsimmons and Salama, 1977) and may lead to related economic and community service changes (Williford et al., 1976). However, such analyses have tended to use only general and very unrefined assumptions concerning the relationships between water availability, use and technology and demographic and social factors.

An extensive body of research has also developed related to the modeling of economic and demographic factors associated with resource use and development (Leistriz and Murdock, 1981; Murdock and Leistriz, 1980; Ford, 1976; Stenehjem and Metzger, 1976; Dunn and Larson, 1963; Nercer and Morgan, 1978). Although such models have become increasingly complex, several recent reviews of these models suggest that validation of the parameter assumptions underlying them is needed (Leistriz and Murdock, 1981; Markusen, 1978). In particular, most such models project water demand and use on the basis of per capita or per population unit factors. Population composition is not taken into account.

Overall, then, although a few studies have attempted to include demographic variables--age, household size and patterns, race/ethnicity--and social, cultural and behavioral variables--such as water use preferences and cultural patterns of water use--in planning and projection efforts (Kubat et al., 1968; Dunn and Larson, 1963; Korsching and Nowak, 1983; Portney, 1982), water planning and analyses efforts have largely ignored the effects of demographic factors (other than total population size) and social factors in planning for water use and facility construction. Such neglect is particularly unfortunate in states, such as Texas, where populations display wide demographic and social diversity (Skrabanek et al., 1985) and where per capita water use varies widely from one area to another (Texas Department of Water Resources, 1984). Only if analyses of the relationships between demographic and social variables and water use and demand are completed, will it be possible to adequately employ such variables in

projections of water demand. Because the inclusion of such variables in projection models should increase the accuracy of projections and improve our understanding of the numerous factors that determine patterns of water use, studies of the effects of demographic and social factors on water use and on projections of water demand deserve additional consideration.

This report presents the results of one such study sponsored by the Texas Water Resources Institute. The study has two major objectives:

1. to determine the relationships between key demographic, social and cultural variables and water use in Texas
2. to analyze the implications of the relationships between demographic, social and cultural variables and water use and demand for projections of water use and demand in Texas

Specifically, this report presents the results of an analysis of secondary and primary data in which the relationships between water use and other sociodemographic variables are examined, and it reports the effects of using sociodemographic characteristics to project water use. These relationships are of intrinsic interest to professionals involved in water planning and policy formulation, and the results will hopefully be of utility to a wide range of policy and decision makers.

The report is organized into five sections. Section I describes the data and methodologies employed in the analysis. Section II presents and discusses the results of the secondary analysis. Section III examines the results of our analysis of survey data from over 800 respondents from 8 communities selected from across the State of Texas. Section IV describes the implications of using demographic and social factors in projecting water use. The final section, Section V, presents generalizations regarding the overall effects of demographic and social factors on water use and demand and presents our preliminary recommendations regarding the use of such variables in formulating water use and demand projections. Throughout the report, it should be recognized that the fact that the study is limited to one period of time and to only selected areas of the State, clearly limits the ability to formulate generalizations that have statewide applicability. The fact that the study is limited in several regards must be recognized.

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