

# The Secondary Impacts of Rural Water System Installation

Rural water systems have been welcomed by many North Carolina citizens seeking a dependable source of high quality water. There is a growing concern, however, that the installation of rural water systems may induce sprawl development with negative social, environmental, and fiscal repercussions for rural areas. This report examines the relationships between public investments and rural growth, and then analyses the potential impacts induced by that growth. It assumes that explicit consideration of secondary impacts during preproject evaluation will help avoid undesired and unplanned outcomes of rural capital improvements.

The pace of rural development has been influenced by a number of significant economic and social changes. Nationally, alterations in farm methods and technology have increased farming efficiency and resulted in a decline in the farm population. The demographic shifts to urban and nonfarm rural populations, while rapid, have not been neatly balanced. Some agricultural areas have experienced sudden and severe population losses accompanied by the retreat of business firms and a loss of nonfarm employment opportunities. Those local governments have had to cope with declining tax revenues and increasing costs per capita for necessary public services (Maddox, 1973:3). In North Carolina these trends are reflected in rural residents' perceptions of community problems. Rural North Carolinians are concerned about: employment opportunities, health care, social services, cultural opportunities, and community services, including the adequacy of water and sewage facilities (Christenson, 1974:10).

Paralleling this general decline has been a sense of profound regret that rural options are being closed to those who prefer traditional rural values over those of urban areas. In response to these problems, organizations representing rural interests have urged public action to help raise rural incomes and introduce educational, health, and recreational opportunities to depressed areas. Under the administrations of Presidents Kennedy and Johnson, a series of federal programs have been launched to improve the quality of rural life. With the Agricultural Act of 1970, rural

development was adopted as a national objective: "Highest priority must be given to the revitalization and development of rural areas" (Maddox, 1973:14). The Rural Development Act of 1972 took steps towards fulfilling this commitment. It proposed to speed economic growth, create job opportunities, improve the quality of life, and protect the environment of the small towns, villages, and farm communities in rural America.

A special provision of the 1972 act authorized the Farmer's Home Administration (FmHA) to encourage growth by increasing the available supply of business and capital improvement loans to rural communities. As a result, funds for rural water systems have been readily available. However, the distribution of private investments following the installation of the water systems is left to the market processes of the free enterprise system, with no procedure to insure optimal public/private development planning. This approach to development decisions is shortsighted and is now receiving more intensive scrutiny than when the Rural Development Act was first considered.

Other rural areas in North Carolina, particularly those in proximity to urban areas, have experienced rapid development in recent times. This growth has resulted in new jobs, schools, hospitals, and increased tax revenues for rural counties and small towns. Because most of the rural population increases represent nonfarm residents, there is also greater economic, social, and cultural diversity in many small

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communities and less pressure for talented rural residents to seek urban opportunities. For these reasons, rural development has been applauded and encouraged.

Rural growth, however, may also exact a toll. Haphazard rural residential sprawl may be aesthetically unappealing and can lead to environmental degradation. Sudden demands for services may require unexpected capital outlays by local government. Pressures on land values can result in the conversion of tracts of productive agricultural land to residential uses. Finally, tension can form between long-term residents who have a strong sense of community pride and newcomers who may know little of local customs or history.

In North Carolina, the Rural Land Use Planning Committee (1978:1) is concerned about the trend of unguided rural growth. According to the Committee, "The rapid rise of the rural nonfarm population has created vast acreage of low density rural sprawl across North Carolina. Rural sprawl is a major contributor to rural land use problems." The problem of rural growth and sprawl is, by nature, a subjective one. Growth, per se, is neither good nor bad, but must be viewed in terms of eventual secondary impacts. Growth-induced changes can then be evaluated as positive, such as increased income, or negative, such as crowded schools or failing septic tanks. Usually the total effect of these impacts is mixed, often unclear, and disputed. Although the installation of public infrastructure has been blamed for directly causing rural residential sprawl, the relationship is more complex. Depending upon local conditions, infrastructure will induce a particular mix of impacts, which then must be judged according to an appropriate set of criteria.

The planning process is a means for systematically analyzing possible growth patterns and induced impacts, and attaching values to the outcomes. The first planning priority is to identify and establish local goals and objectives. This provides a framework for comparison during the impact analysis, which translates growth projections and development scenarios into a statement of expected economic, social, and environmental impacts. As a final step, public action can influence the type or timing of development to avoid or lessen negative impacts.

Rural water system installation, as a public capital improvement project, influences the community growth pattern. By applying the rural planning process before deciding to proceed with water system investments, public agencies could insure that an investment to solve a water supply problem does not unexpectedly spawn others. Rural planning,

however, has not been widely practiced in North Carolina. As a discipline, rural planning is still in its early stages, largely because of a bias towards research in urban planning methods. Planners have tended to ignore rural growth problems, concentrating instead on urban issues which seem more urgent. Frederic Sargent (1976:1) has described a typical urban planning approach in which, "The first step is a projection of growth, jobs needed, and proposed industrial and commercial growth. Land use is then planned to satisfy those projected needs. Any land left over is colored green and labeled open space."

Citizen opposition to rural planning has been another obstacle. A prime factor in rural residential choice is the avoidance of what is perceived as governmental interference. Any public action which might limit future options or decrease the value of private property is traditionally viewed with suspicion. However, the rapid population growth in rural areas is now leading to an awareness that foresight and planning may be necessary in "green areas" so that the very amenities which rural residents treasure are not destroyed.

## RURAL DEMAND FOR WATER

Recent North Carolina demographic trends indicate that major changes in the rural population profile have been taking place (see Table 1). The urban fraction of the population has increased since 1940, partly reflecting the drastic decline in the percentage of the rural farm population. The farm population fell from nearly 47 percent of the total state population in 1940 to only 7 percent in 1970. During those same years, the rural nonfarm segment rose from 26 percent to 48 percent. In 1970, rural nonfarm residents represented 87 percent of the rural North Carolina population. Experts expect this trend to continue (Danielson, 1978:3).

The rural population relies heavily on individual wells for its water supply. The North Carolina Department of Natural and Economic Resources (DNER) estimated in 1977 that 40 percent of the state population obtains water from individually-owned wells or springs. Projections of rural water demand consider two trends. Although the total population served by individual systems will decrease as rural areas invest in public supply systems, an increase in water use per capita will result in slightly increased individual system water demand. The State estimates that total domestic rural water requirements will rise from 104 million gallons per day (mgd) in 1970 to 121 mgd in 1990 (North Carolina Department of Natural and Economic Resources, 1977: 3-C-13).

TABLE 1

## TRENDS IN NORTH CAROLINA POPULATION DISTRIBUTION

<u>Population Distribution</u>	<u>Percent of Total Population</u>			
	<u>1940</u>	<u>1950</u>	<u>1960</u>	<u>1970</u>
Urban	27.3	33.7	39.5	45.0
Rural Farm	46.4	33.9	17.7	7.3
Rural Nonfarm	26.3	32.4	42.8	47.7
Total	100.0	100.0	100.0	100.0

Source: U.S. Census.

The ability to obtain high quality water in rural areas is being strained as increased demands are placed on the water table. Although no health hazard is usually involved, complaints of taste and odor are commonly reported problems in the state. Since correction is expensive and is the responsibility of the individual household, most rural families adapt to the situation.

A far more serious threat, however, is the problem of groundwater contamination. The greatest risk comes from poorly sited septic tanks that leak effluent into the water supply. The State report cited above notes, "This problem does not affect large numbers of people." An altogether different view of the North Carolina situation is taken by the North Carolina Department of Administration (1973-1975) in a series of plans which assesses future water resource needs for each region in the State. A review of six of the plans reveals that county sanitarians in four of the six regions reported that "a significant" number of families within their region were without safe water supplies and were subject to health hazards associated with polluted water.

An unreliable water source may also be detrimental to local growth and an impediment to the attraction of commercial and industrial development. Many rural communities have a positive attitude towards growth and the accompanying jobs, establishments, tax revenues and sense of vigor. A demand for a dependable, high quality water system is understandable in terms of high priorities attached to economic growth, as well as public health standards.

SECONDARY IMPACTS OF  
RURAL WATER SYSTEMS

Review of previous research on problems associated with uncoordinated rural water system installation reveals that although the issue is of concern, a general consensus of the nature and the scope of the problem does not emerge. In accordance with the general model of secondary impact analysis (see Figure 1), studies can be divided into two types for analysis. The first type attempts to determine the strength of the relationship between water system installation and induced growth. These studies include a group that attempts to examine the relationship in a descriptive manner (nonsystematic), and a group that quantifies the relationship through the use of statistical models (systematic).

A second type of research is the result of attempts to estimate the impact of growth. These studies are all of the "nonsystematic" type due to the location-specific nature of growth impact analysis. The final step in the research, evaluation of impacts, must come on the local level and be based on comparison between local growth objectives and an analysis of the expected impacts.

WATER SYSTEM INSTALLATION  
AND INDUCED GROWTH

There is a relationship between public infrastructure investment and growth, but, in the case of water systems, the strength of that relationship is not well understood. Much more attention has been given to explaining and understanding the associations between sewer, highway and mass transit ex-

tensions and induced growth patterns (see Urban Systems Research and Engineering, 1976; and Tabors, et al., 1976). Much of the literature concerning rural water systems and induced rural population growth draws on previous research into the general nature of secondary impacts.

Individual decisions which, in aggregate, lead to particular land use patterns are highly complex in nature. A household considering a move to a rural area will weigh many factors, including employment opportunity, property values and convenience, as well as the

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"A PRIME FACTOR IN RURAL RESIDENTIAL CHOICE IS THE AVOIDANCE OF WHAT IS PERCEIVED AS GOVERNMENTAL INTERFERENCE."

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availability of public services, such as water, sewer, schools and well-maintained roads. Grey (1978:11) identifies another factor, the "rural mystique," as important in the decision process, based on the finding that a non-quantifiable factor seems to favor rural location. In North Carolina, Christenson (1974) found in a statewide survey that 17 percent of the people living in the state prefer to live in the country and another 57 percent want to live outside the corporate limits of a town, but within a 15 minute drive. Thus, there seems to be a strong preference for rural living.

In an analysis of the growth inducement effects of various public investments and policies, Urban Systems Research and Engineering (1975:38) concluded that land use patterns, "... are the result of a complex set of historical, economic, social, and political interactions. No single factor can be isolated as the cause of current land use practices, nor is it likely that modifying any particular governmental policy would result in radical changes in future land use patterns. The role of (infrastructure) must be seen as contributory rather than decisive."

Because the significance of a water system in determining land use patterns is highly affected by other variables, it is difficult to determine precisely the growth inducement effect of an individual investment decision. Nevertheless, it is generally felt that some process exists. As such, the problem of predicting growth is one of "attribution--the determination of what part, if any, of urban growth can be ascribed to public investment" (Environmental Impact Center, 1974:3).

A *New York Times* article in 1975 examined rural growth stemming from the Farmer's Home Administration financing of rural water systems and reported a very strong relationship between the installation of water lines and growth. According to this report:

...the new water systems, which have multiplied spectacularly in the last ten years because of an expanded Federal program have brought more than pure water to the American countryside. They have also brought growth...speculators have discovered that a rural water system is a sure fire way of speeding development and selling lots (Reed, 1975).

A survey of rural water system managers operating FmHA financed systems found a strong perception of growth directly attributable to water line extension. Survey respondents felt that rural water systems had facilitated increased housing in rural areas (Landry, et al., 1973:20). In addition, the study indicated that water systems were viewed as producing increases in the price of real estate.

Specific locational factors are important before growth predictions can be formulated. In particular, when water supplies in a region are generally inadequate and individual wells are less feasible, growth is more dependent upon centrally supplied water. The impact of water systems on development in areas operat-

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ing under this constraint is more likely to be significant and predictable (American Society of Planning Officials, 1977:42). In view of the fact that many county sanitarians in rural North Carolina counties report that an increasing number of families are without a safe water supply, the expected increase in rural nonfarm residents may be constrained to areas serviced by water systems. This could make the placement of water lines of crucial interest to prospective rural real estate developers.

Empirical tests of the relationship between various locational influence factors and the actual location of rural growth are few. Although factors which influence growth are identifiable, they are difficult to separate and weigh. It is also difficult to generalize empirical results from one region to another (American Society of Planning Officials, 1977:42).

One systematic study by Weiss and Kaiser (1968) analysed five factors which tend to influence regional residential location decisions. Their study of the North Carolina Piedmont Triad region found that the relative importance of the five independent variables could be grouped as follows:

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First rank: Highly significant influence

Access to major road  
Contiguity to urban use

Second rank: Significant influence

Agricultural capability of undeveloped land  
Access to public water system  
Distance to nearest high value corner

The five variables explained 89.5 percent of the regional land use pattern; however, as the authors note, the findings relate to one regional cluster for one period of time and may not reflect other areas even of similar size. Nevertheless, it is noteworthy that in a study of rural residential location in the vicinity of major multipurpose reservoirs, Burby, Donnelly, and Weiss (1972) found that access to a water system was a major factor shaping the location of residential development. In the Lake Sidney Lanier, Georgia area, for example, access to a water system explained more of the location of residential development than any other factor considered, including topography, ground cover, distance to major roads, schools, employment and nearby urban centers, and access to a public sewerage system. In a related study of land value changes around an authorized reservoir near Durham and Raleigh, North Carolina, Burby, Donnelly and Weiss (1973) found that the availability of a water system was a major factor in determining the price of rural land.

In a pilot study of rural residential choice, Gray (1978:11) asked exurbanites to rate the importance of the availability of public services, lot size and arrangement, monthly mortgage, and distance to work and shopping in terms of desirability, economy, and convenience. The survey, which included water and sewer facilities and improved public roads, found that within the public service category, hard surfaced public roads were more important in determining residential location than the presence or absence of public water and sewer.

A study of conversion of rural land to residential uses in the metropolitan fringe of Denver, Colorado used the EMPIRIC model to

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"...HARD SURFACED PUBLIC ROADS WERE MORE IMPORTANT IN DETERMINING RESIDENTIAL LOCATION THAN THE PRESENCE OR ABSENCE OF PUBLIC WATER AND SEWER."

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find the importance of public investment relative to other factors influencing land use change. Results showed that new water service explained 6.8 percent of the change, as com-

pared with 23 percent of the change attributable to new sewer service, and 4.6 percent to the existing highway pattern. In the analysis, however, the authors suggest that these proportions are likely to change so that, "With a growing concern over water, public systems have begun to play an increasingly important role in the urban development process" (Environmental Impact Center, 1974:5).

In summary, it appears that rural water system investments, while not the major factor accounting for rural development, contribute to rural growth and the location of new residences outside of built-up areas. The effects of this population distribution are discussed below.

### THE EFFECTS OF INDUCED GROWTH

The issue of secondary impacts which result from rural growth is of critical interest to planners, public officials and rural residents. Concentration on one set of impacts, either the good or the bad, leads to a misrepresentation of the implications of growth. For this reason, it is important that the connection between growth and secondary effects is understood, and that the range of effects is explored.

In instances of induced sprawl, environmental degradation may result when rural housing density is increased. Although a public water system is designed, in part, to protect households from contaminated or depleted groundwater, extensive sprawl development attracted to the serviced land will create

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"RURAL RESIDENTS DO NOT DEMAND THE SAME HIGH LEVEL OF PUBLIC SERVICE AS URBAN DWELLERS."

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several other environmental problems. Storm-water runoff is greatly increased following the conversion of land from an undisturbed or agricultural state to residential uses. This increases the threat of surface water pollution and flooding. Serious erosion problems and local stream sedimentation can be the eventual result. Lawnmowing activity and the use of lawn fertilizer can increase the eutrophication rates of area ponds. Fragile or unique habitats are impacted by shifts in land use patterns. Since conversion of land from residential to wilderness or agricultural uses rarely occurs, a loss of habitat or farmland is a permanent impact.

Another major concern is the effect of growth on the future demand for costly public services, such as police and fire protection, sewer service, schools, and hospital facilities. Below certain threshold densities, dependent upon a variety of geographical, institutional

and perceptual values, the demand for public services in rural areas does not initially increase rapidly with population growth. As Alan Atschuler (1977:207) has noted, rural residents do not demand the same high level of public service as urban dwellers; for example, they get along well without sidewalks and lighted streets. By choosing to reside in a country setting, individuals accept that urban public services are often not readily available.

However, as residential density passes some threshold, many expensive public projects are required to meet new public service demands. Water and sewer system installation, while not necessarily the determinant of growth and secondary impacts, may be a key element because it tends to come first and accelerate the need for other services. Wilson (1968:85) has observed, "Water and sewer facilities stimulate and encourage development, and they are the framework on which the urban type community is built." Water lines, therefore, may be regarded as key indicators of the location of further population growth and future requirements for capital outlays.

In a social sense, the rapid growth of the rural nonfarm population relative to the established farm population can lead to problems resulting from conflicts in lifestyles. The local government must deal with any tension aroused against new residents who may not have a sense of local character and cultural values.

The Rural Land Use Planning Committee in North Carolina is aware of the impact of changing rural real estate values which are creating pressure for the conversion of agricultural land to residential uses in some areas at a rapid rate. This indirectly

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raises the cost of farm and forestry operations and influences farmers to leave their profession. According to the Committee (1978:4), "Farmers that desire to maintain their farms and forests have little protection from these land use intrusions."

An inherent problem for planners concerned with rural land use impacts is the hesitancy of farmers in North Carolina to seek or trust any form of governmental intervention that affects the value of their property. Again, according to the Rural Land Use Planning Committee, "Many farmers probably dispute the notion that their lands are part of the rural land use problem and are skeptical about governmental interference." The pervasiveness of this

sentiment is also reported by the *New York Times*,

The long term solution (to the problems of rural growth) is land use planning. But those are fighting words in rural North Dakota, as they are in the other areas of the nation. Many farmers see land use planning as an encroachment on their property rights. They say they want no one telling them what they can or cannot do with their property (Reed, 1975).

## RURAL WATER PLANNING IN NORTH CAROLINA

North Carolina has committed itself to a goal of balanced growth. The state government plans to work toward a higher statewide standard of living by maintaining a balance of population and jobs between small towns and larger cities. One stated policy is to "... provide adequate public services equitably and at least possible cost" (North Carolina Department of Administration, 1978:7). The state feels that good public services are necessary for more and better jobs and should be provided in order that growth may take place. A multiple objective approach is apparent in a second policy statement which advocates maintaining the state's environmental heritage while accommodating growth. There is an inherent conflict at the base of the two policy objectives which must be resolved at a local or regional planning level.

Two statewide comprehensive studies of water resource planning and capital improvements projects for North Carolina have been conducted. The *North Carolina Water Resources Framework Study* (North Carolina Department of Natural and Economic Resources, 1977) takes a broad overview of the total water resource needs of the state. As the first state comprehensive water resources policy statement, it functions as an official guideline for preparing water resource plans. The study assesses the current water resource situation and charts a general outline of future problem areas, but does not deal with specific impacts on local levels.

From 1973 through 1975, the North Carolina Department of Administration, with the assistance of the FmHA, prepared a series of water resource management plans for ten regions. The plans detail the present water

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## "ENVIRONMENTAL AND SOCIAL IMPACT MEASUREMENT IS IN ITS FLEDGLING STATE."

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situation, future needs, and recommended investments for each town and water association in the state. Although the problems of small town water provision are well defined, two shortcomings in the document are evident.

First, the needs and goals of residents beyond existing water systems are not addressed --in a sense these areas are "colored green" and forgotten. Also, there is no discussion of what the recommended system extension might mean in terms of growth and what that growth might bring in terms of induced impacts. The official stand of the FmHA is that its role is to help provide services to areas lacking dependable water in a manner that is consistent with local objectives. Land policy ought to be up to other agencies. This approach carries with it the obvious dilemma of an eventual mismatch of responsibilities. The FmHA and the state fund water system organizations as a wide variety of administrative levels, so that the agency responsible for installing and maintaining the water system is not necessarily the one which will have to cope with the eventual impacts induced by that investment. More communication and coordination among the agencies will be necessary to prevent future trouble.

#### FUTURE NEEDS FOR WATER PLANNING IN NORTH CAROLINA

Two areas of planning need attention in rural North Carolina to avoid unnecessary problems in the future. First, local needs, goals, and objectives should be carefully considered and analyzed. Second, the evaluative criteria and process involved in planning and funding major public investments, including rural water systems, should be strengthened.

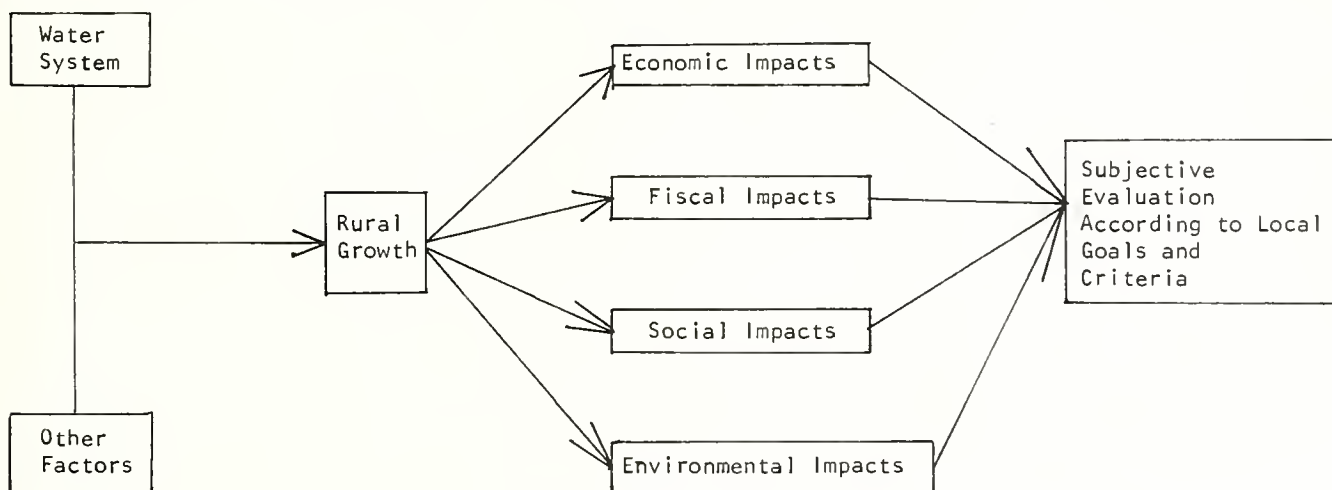
At present there is no set of plans dealing specifically with rural growth issues

in North Carolina. The councils of government have adopted a land classification system which defines areas as developed, transition, community, conservation, or rural. The rural category, however, tends to be poorly defined and is treated as a catch-all after the other areas are delineated. The ambiguous definition results in "shades" of rural classification. The issue is further clouded by the official council of government interpretation of rural areas as being land that will not be serviced by sewer and water. This appears to conflict with official federal and state policies that

**"THE RURAL CATEGORY TENDS TO BE POORLY DEFINED AND IS TREATED AS A CATCH-ALL AFTER OTHER AREAS ARE DELINEATED."**

encourage rural growth and development. A clear expression of community growth objectives on a local level, with goals stated as explicitly as possible, helps to guarantee that issues are brought into the open. This clears the path for consideration of a variety of future scenarios and gives citizens an opportunity to express their preferences for development. It also allows public officials to give consideration to the capacity of all public facilities and to plan for coordination to their distribution as growth brings increases in demand.

What seems most lacking in rural planning is a formalized evaluative procedure. Although it is true that federal and state funds cannot be used to finance projects which conflict with regional land use plans, the lack of specific criteria for judging



IMPACT ANALYSIS MODEL

FIGURE 1

the impact and attractiveness of water resource investments makes the judgement process an ambiguous one. Development proposals are too often judged on an ad hoc basis, which does not ensure consistency and fairness from one proposal to the next.

The problem is by no means a small one, for it is rooted in the difficulty of weighing and comparing impacts which are measured on noncomparable scales and are in many cases subject to perceptual distortion. Although economic costs and benefits can be computed and compared, environmental and social impact measurement methodology is in its fledgling stages and requires more study.

The relative permanence and potential impact of water system investment makes further research on appropriate rural plan design and criteria specification of extreme importance. To properly guide rural growth while maintaining rural character and identity, haphazard rural development must give way to a planned approach.

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