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A Study of the Economic Impact of Water Impoundment Through the Development of a Comparative-Projection Model

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Texas Water Resources Institute

Texas A&M University

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A STUDY OF THE ECONOMIC IMPACT OF WATER IMPOUNDMENT THROUGH THE DEVELOPMENT OF A COMPARATIVE-PROJECTION MODEL

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The development of a computer simulation model which attempts to measure and predict a complex phenomena such as economic impact demands the analytical skills and critical thinking of scholars from several disciplines. New paths must be explored which integrate the fields of economics, mathematics, statistics, and computer science with the behavioral and commercial sciences. These disciplines must have the challenge of a central focus, free communication, and a common goal.

The central focus of the study reported here was the economic impact which results from water impoundment, and the common goal was the development of a model which could simulate and forecast this impact. The principal investigator was fortunate in having the assistance of talented researchers and graduate students from several disciplines. This assistance was valuable in structuring the research problem and necessary to the analysis.

A large part of the work identifying macro economic variables and data representing these variables was done by Dr. Richard T. Cherry, Head of the Department of Finance at Texas A&M University, and now Professor of Business Administration at Lamar State Institute of Technology. Also, Dr. John M. Glascow, Assistant Professor of Economics, assisted in this phase of the project. Dr. George H. Rice, Management Department Head at Texas A&M University, made valuable contributions to the model structure.

The two young Assistant Researchers, Kenneth Z. Scott and Kenneth E. Heideman, proved early a talent for research and quickly assumed responsibility for data collection and analysis. They worked closely with the Research Assistants and faculty in the training phase of the project, and co-ordinated work with the Water Resources Institute and Data Processing Center. In addition, Scott made valuable contributions to the land-value and Somerville surveys, and Heideman made a major contribution in computerizing the model and survey data.

The Research Assistants, who were graduate students in the School of Business Administration, contributed much to the success of the research. Joel E. Thompson and Arthur Whatley worked primarily with the collection and presentation of data, particularly the recreation survey. David J. Rainey worked primarily with the analysis of data and the mathematical expression of the model.

Secretarial assistance was provided, at different times, by Alice Higgins, Theresa Ruffino, and Jacqueline Mitchell. The heaviest part of this responsibility was handled in a professional way by Mrs. Mitchell, who typed this report in addition to her regular secretarial duties.

The research project attempted to organize and express in symbolic form the elusive concept of economic impact, and to develop a routine way of measuring it. It has been complicated and challenging; but, in working with colleagues and students from different disciplines, it has also been an exciting learning experience.

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ABSTRACT

Using two established reservoir projects, an economic simulation model for reservoir development was constructed. The two comparative areas used for the model development are both reservoirs in central Texas and were constructed during approximately the same time period.

The simulation model divides reservoir development into three stages--Construction, Fill-Up and Post Fill-Up. For each of the stages economic variables were chosen which reflected economic activity attributable to the reservoir. Inputs of construction money, operations and maintenance, recreation and investments were related to each respective stage and then used to determine the economic impact of the reservoir on the local area economy.

A synthetic index based on economic inputs other than those used for the model was developed utilizing a control area. The index served as guideline to the mathematical development of the model and as a measure of the predictive accuracy of the model.

A recreational survey was conducted to arrive at average recreational expenditures and develop the Post Fill-Up Stage of the model. Overall recreational attendance was projected, and to this figure experience ratios of the survey were applied.

After the simulation model was developed and applied to two established reservoir projects, it was utilized to generate prediction data for the primary study area. Checks were made on reliability of the data since the primary area is only in the second stage of development.

The project data, the results, and recommendations of the study are published as Technical Report No. 8 of the Water Resources Institute, Texas A&M University. Copies of the report have been sent to all persons cooperating and furnishing data for the study.

Pearson, John E.

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KEYWORDS--*Economics/*Projection Model/Computer Model/*Recreation/
Synthetic Index/*Economic Impact/Economic Prediction/Texas/

Part I

INTRODUCTION

The impoundment of water in a lake or reservoir has an immediate and significant economic impact on the surrounding area, but it is a difficult phenomenon to identify, measure, or predict. Estimates of economic impact on a surrounding area, made by businessmen or potential investors, range from unsupported optimism to myopic indifference. Even impartial investigators are subject to a similar range of errors in prognostications because information about what is taking place, or is about to take place, in a water impoundment project must be collected from the landowners and businessmen in the surrounding area. And the extremes of optimism and pessimism by residents prevail.

Evidence gathered throughout the development of a multipurpose, water-impoundment project indicates there is a resulting economic impact and it is a beneficial one. The construction itself usually costs millions of dollars and represents an immediate boost to the local economy, because a large portion of this money is spent or retained locally. Building an earthen dam usually takes several years; during which time heavy equipment operators, truck drivers, unskilled laborers, and others are living in close proximity to the dam site. Much of the construction payroll is spent for rent, medical services, etc., supplied by the supporting communities. Other types of dams may require large amounts of cement, steel supports, frame lumber, etc., and are usually furnished by the surrounding communities if competitive suppliers are available. In addition to the dam construction workers, other equipment operators and laborers are employed for clearing timber, constructing service roads, and moving homes or buildings on land to be inundated. Although some workers may be brought in from some distances, many workers are employed from the immediate communities if they are available.

Other economic activities begin after a dam is constructed and the reservoir begins filling with water. Some of the most fertile lands available are reclaimed from flood damage possibilities. Water impoundments also claim fertile farmland; but almost without exception, more land is reclaimed from flood damaged areas than is covered by water. Also, as impounded water becomes available, various types of businesses explore possible location sites. Recreationally related businesses--such as boat marinas, boat dealers, boat supply stores, motor shorps, fishing supply businesses, restaurants, etc.,--begin to locate and build facilities as water fills the basin.

The economic activity resulting from the completed water impoundment can be observed in business services to such activities as swimming, fishing, boating, picnicking, and camping. Permanent homes as well as commercial lakeside cabins for summer and weekend occupants are built near a completed lake. Even before the dam is completed and water completely impounded, real estate development begins near the impoundment. Established real estate offices from nearby cities establish branch offices for near-lake developments, and compete with new professional and amateur realtors. All these represent types of economic activity which have an economic impact on the surrounding area.

Water supply industries (i.e., those industries that supply water to others for hydroelectric power, municipal use, and for irrigation) contribute to the accelerated economic activity in water impoundment areas. In some areas the largest water supply industry is irrigation. With a sufficient water supply for irrigation purposes businesses engaged in selling irrigation equipment and irrigation services seek new markets in the areas surrounding the reservoir. The new enterprises have an economic impact on the area in addition to indirect benefits derived from increased agricultural production.

ECONOMIC IMPACT MEASUREMENT

Economic impact is difficult to measure, and even more difficult to predict. Single theory models and single impoundment models have been seriously limited in forecasting because of wide differences in impoundment areas which make each impoundment unique. Distances between reservoirs and urban centers vary from one impoundment to another in addition to differences in agricultural products, available industry, climate, level of income, etc.

The lack of accurate data places still another limitation on measuring impact. Much information gathered from local businessmen is not reliable. Furthermore, secondary sources, which would contain aggregate data for an area, are limited when the regional economy being studied is composed of only a few counties. Even data on land prices is deceptive because much land is traded under purchase options, an active and changing market, but options may not be exercised until the dam is completed and water fills the reservoir.

Few structural adjustments in the national economy result in more inaccurate prediction as the impoundment of water; and with the increased shortage of suitable water, few areas are in greater need of accurate prediction than reservoir development. The industrial and commercial potential surrounding water impoundment developments are far too great for economic prediction to be left to unsupported speculation.

STATEMENT OF PURPOSE

The purpose of the research reported here was twofold: (1) to develop a theoretical model which would predict with reasonable accuracy the economic impact of water impoundment on the surrounding areas, and (2) to show the practical application of the model by partially testing it on a single impoundment project.

The model to be developed was named a *comparative-projection model* because it was to compare a primary study project with two completed impoundment projects and generate prediction data for the primary study area. This approach assumed an economic relationship between the two completed projects and the proposed reservoir, but this assumption was considered tenable since the projects were closely located, similar in size, similar in preconstruction economies, and, with one exception, were similarly located to urban centers.

The primary study area selected to partially test the comparative-projection model was the Somerville Dam and Reservoir; which, at the start of the research, was under construction. It has just recently started the deliberate impoundment of water. This project is located on the Yegua Creek and other small streams in central Texas. On the basis of data obtained from comparable water impoundments in central Texas -- namely, Lake Whitney and Lake Belton -- the economic impact of the Somerville Dam and Reservoir was to be predicted.

The approach used in developing the comparative-projection model was to follow a logical order. First, the theoretical model was to be described and related to economic variables of income, agricultural income, population density and urban proximity. The economic variables, considered characteristics of the economic system, were to be joined with the inputs to the model. Direct economic impact (e.g., payrolls from construction contracts) was not to be distinguished from indirect economic impact except by descriptive identification, because the multiplier effect on income is not measurable separately from the inflow of new economic activity. This phase of the model was then to be tested against the economic history of the two comparable impoundments and to be adjusted for general economic activity. A comparable economic sub-region, also in central Texas but without an impoundment project, was to be used as a control area so that net differentials in economic activity could be attributable to water impoundment.

A *synthetic* index based on the variables, income, retail sales, postal receipts, and bank deposits, was to be used to identify differentials in economic activity. More important, the index was to serve as an accuracy test for the comparative-projection model throughout the history of the two completed projects, from inception to several years following reservoir completion.

After the model was developed, and tested on the two existing projects, data were to be collected on the Somerville Dam and Reservoir project. An economic comparison was to be made between the Sommervill project and the other two projects. The comparative-projection model was then to be applied to the Somerville project as a partial test of the prediction accuracy of the model, and the prediction data was to be adjusted for observable economic differences. The anticipated results were a reasonably accurate measuring and prediction model for economic impact, whose reliability would increase with future applications and adjustments.

Part II

COMPARATIVE-PROJECTION MODEL

Building a dam in river basin development takes a period from a few years to five or ten years, depending on the size of the project. In addition, filling the basin takes a period of one to five years. The filling period is also a function of basin size, watershed size, and climatic conditions. Once dam gates are closed and deliberate water impoundment begins, another type of economic activity -- that associated with water recreation -- becomes possible. As filling proceeds, shorelines are more accurately determined, rules governing construction of buildings and business establishments are known, and the accessibility of recreational sites is realized. Three stages of reservoir development, each possessing unique economic characteristics, evolve. These three stages are referred to as: (1) *construction*, (2) *fill-up*, and (3) *post fill-up*. This classification allows a periodic analysis of economic activity associated with reservoir development. Although each stage has specific economic impact indicators, the total impact of a water impoundment must be viewed as the cumulative effect of all three stages.

IMPOUNDMENT DEVELOPMENT STAGES

Construction

Numerous preliminary planning activities, such as surveys, the establishment of appropriate agencies, money appropriations, and other planning-related activities are necessary prior to the actual breaking of ground on a water impoundment project. Also, the establishing of water districts, cutting of ribbons by political leaders, and other ceremonies -- none of these activities prior to the arrival of constr tion equipment, concrete forms, and workers are part of the construct period. Only when wages are paid, fuels purchased, materials and supplies bought, and equipment put into action, are construction costs executed into the flow of money of the local economy to a significant extent.

Frequently during early periods of construction, brush and timber must be cleared from the dam site and access roads must be built befor the heavy equipment employed in dam construction can be used. In such cases the land clearing and building of access roads would signal the start of construction.

Once construction money is appropriated and made available by the appropriate agency, bids are accepted, contracts awarded, and commitments reviewed, actual dam construction begins. The construction period continues until the dam, dikes, and access roads are completed. At the same time construction of the dam and other facilities is taking place, the remaining lands for inundation are purchased, brush in the basin is cleared, earthen embankments are raised, channels are cut, and other basin preparations are made to meet the requirements of the particular reservoir. Frequently, not all funds are appropriated and available at the beginning of the project, and construction is sometimes delayed until funds become available for specific parts of the project. When money is made available sporadically, many different contracts cove the construction of the dam, dikes, and roads, and basin preparation.

Some contracts might cover only certain parts of the dam, other contracts are for the spillway and discharge channel, and still others are for the moving of roads or other existing structures.

Reservoir gates are closed and water is allowed to accumulate when construction on the dam and basin have been completed and contract work is accepted. Even with the gates closed some construction, such as construction of peripheral roads, parks, and installation of hydroelectric generators (if the dam is designed for such) continues. Even with these activities underway, the construction period is considered ended when the gates are closed.

Economic impact associated with the construction stage of water impoundment results mainly from the construction and related activities. Wages paid (although not separately defined) to equipment operators, unskilled laborers, timber and brush crews, and truck drivers have a direct economic impact on the area. In addition to payrolls, purchases of supplies and materials for dam construction, brush clearing, and earth moving generates money for the local economy. The extent to which payrolls and purchasing affect the local economy depends on available manpower and available supplies in the area which meet construction demands.

There is also a secondary economic impact associated with construction resulting from increased payrolls and purchasing--the effect of circulated income on local businesses such as grocery stores, living establishments, stores with household goods, etc. Increases in sales generally reflect a secondary impact felt by the local economy because impoundment facilities are under construction.

A measurement of economic impact in the construction stage mus include all reservoir generated money. Model inputs should conside money attributable to the construction of the dam from the beginnin construction to the closing of water gates.

Fill-Up

Following dam construction, the building of roads, land clearing etc., the gates are closed and water begins to accumulate; and the second stage in water impoundment begins. The impoundment project remains in the fill-up stage until water reaches desirable levels. The filling period varies from one to several years depending on rain fall, size of the watershed, and basin size.

During the fill-up period various economic activities begin to take place. The major portion of construction is completed and the construction equipment and crews have been removed from the area. The immediate effect is a loss of payroll income to the area. However, th indirect impact of the construction stage is still being felt through the multiplier effect of the income flow. The indirect impact can stabilize the local economy and offset the loss of construction income, but other economic activity must generate new income, or the stability of the economy cannot be sustained.

During this stage, new and additional income flows into the area through a variety of activities. Access roads, park, or recreational facilities may still be incomplete, and these small projects continue to generate income. Also, as the water begins to fill the basin, people begin to sense, perhaps for the first time, that a reservoir wil actually exist with predictable shorelines, parks, access roads and private areas. Negotiations are held with the governing agency of the reservoir, purchase options on commercial property are exercised, and new businesses -- restaurants, grocery stores, service stations, motels, bait and fishing supply shops -- are planned in anticipation of lake visitors.

Interest in commercial acreage stimulates the real estate market, and it is probably more active in this stage than at any other time. In addition to commercial real estate, developers of lakeside lots and cottages are more active in marketing small lots. The fill-up stage is an exciting time during reservoir development, especially if large areas of surface water have heretofore been distant to the locality. The anticipation of enjoying the water and water sports generates enthusiasm in both buyers and sellers.

The measurement of economic activity during the fill-up stage is more difficult than that during construction. This is due to the diverse nature of economic activity during this stage. First, there is a problem in deciding which activities, attributable to the reservoir, are having a direct impact on the local economy; and secondly, there is the problem of determining where secondary impact is taking place. Certain data are available for measurement of economic activity -- land prices, bank deposits, personal income, new business starts, business expansions, and capital improvements -- but location, adjustment, and analysis of such data is difficult.

Theoretically, the fill-up continues until the reservoir reaches desired levels, but in actual practice this is difficult to determine. A more meaningful limit to this stage would be when the reservoir is officially open to the public. For the purposes of analysis and use in the comparative-projection model, the fill-up stage has been selected as two years after closing the gates.

Post Fill-Up

Throughout the time the reservoir is filling with water, the economy receives money inputs from a variety of sources. Once the reservoir has filled, however, the initial investment is over. Now businessmen are concerned with making an adequate return on investment. Capital to this point has been invested in expectation of returns, but if these returns are not adequate, and business ventures fail, there will be a net loss of economic impact. Conversely, returns which enable the business to survive or expand, represent a net gain in economic impact. Further, the success of businesses induces additional investment.

The primary factor determining the economic impact of the reservoir during the post fill-up stage is the number of lake visitors and their expenditures. Not all visitors come to a lake or recreational area for the same purpose, and their expenditures in the impoundment area vary with their purpose. Lake visitors who come to fish will not spend the same as visitors who come to picnic. Ideally, to measure and understand the impact fostered by visitors in this stage, it is necessary to analyze the types of visitors, their expenditure patterns, and the number represented in the area.

An adequate procedure for analyzing recreation visitors by types has been developed by James R. Gray.[1] Gray uses an approach which evolved

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[1] James R. Gray, "The Economics of Recreation as Measured in the Ruidosa Ranger District of New Mexico", Journal Article 210 of the Agricultural Experimental Station, New Mexico State University, University Park, N.M.

from other methods and basically uses an empirical approach of different recreationist groups and their expenditures.[2] In this study, visiting groups were generally classified according to the major uses of the recreational area, namely general recreation (primarily camping and picnicking), primarily fishing, cabin owning, and race-track patrons. Each type of consumer need, such as camping trailers, tents, special clothing, sleeping equipment, cooking equipment and others was estimated for each recreationist group by field sampling.

When unit expenditures are estimated for each recreationist group, it is possible to make realistic estimates of total expenditures on recreation. The average man-day expenses of recreationist groups may be multiplied by the average number to obtain the total impact of that particular group, and the total of all such groups gives a composite of the recreational input into the local economy. For example, Gray estimated that average dollar expenses of all general recreationist needs was approximately $6.62 per man-day.[3] If 1,000 people visited the area for 60 days, the total input to the economy from this group would be estimated to be $400,000. When the other recreational groups are added to this, the total economic input from recreation can be approximated.

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[2] The Other Methods -- expenditure method, gross national-, state-, or local-product method, consumer surplus method, etc., are described and evaluated by Lionel J. Lerner in "Economics in Outdoor Recreation Policy," Water Resources and Economic Development of the West, conference proceedings at the Committee on the Economics of Water Resources Development of the Western Agricultural Economics Research Council (University of Nevada, Reno, Nevada, August 6-8, 1965), pp. 55-75.

[3] Gray, op. cit., p. 11.

The group method of measuring economic effect of recreation on an economy is too unrealistic to be used in long range projections. The groups will never remain the same from reservoir to reservoir because of varying facilities, different reservoir sizes, varying accessibility to the shorelines, different distances to sizeable metropolitan areas, and other differing characteristics. Thus, the total potential recreationist figure, broken down into broad activity categories, can be easier projected as opposed to the group method. Then, using the Gray sampling technique, average expenditures can be estimated. From this data the total economic effect of recreationist activity can be approximated.

The post fill-up stage has no end. This stage exists from the end of the defined fill-up period to a point in time when the reservoir ceases to exist, but for purposes of analysis and measurement in the comparative-projection model, post fill-up has been defined as five years following the fill-up. This period covers the initial and sustained growth attributable to recreational activity into the reservoir area.

In each of the three stages of reservoir development, specific types of economic activity take place which have an impact on the local area. Each stage has unique economic characteristics and certain types of data measure and reflect these characteristics. In the construction stage, the contracts covering the major construction provide payrolls for construction workers, fuel to operate the machinery, and building supplies for the construction of facilities. These contracts furnish measures of the economic inflows into the area. In the fill-up stage, business investments, continued construction, real estate development, and the start of the recreation activity serve as measures of the diverse inflows into the economy. During the post fill-up stage visitors are attracted to the area for varying types of recreation. Here the investment has slowed, with operation and maintenance of existing facilities taking over from previous construction dollars. These activities provide the measure of economic inflow for the final stage of development. Each stage is analyzed separately and measured separately to provide an adequate picture of the total impact water impoundment has on the surrounding area.

ECONOMIC VARIABLES

The analysis of reservoir development lends itself well to the three-stage method of measuring economic impact. However, the problem of obtaining reliable data, adequate for a general model, is not solved by merely breaking the development into stages. The problem is two-fold: reliable data must be obtained on a county basis, and the data must be available in all situations and be common to all reservoir areas.

Securing accurate data on a county basis is in many cases impractical. Economic studies have been principally for geographical regions large enough so that breakdowns of national data were possible. As an analysis progresses from national to state, to county, to city, the availability of pertinent economic data is stringently limited for the proof or disproof of economic theories. The task of selecting variables common to all reservoir projects is equally difficult. The variables chosen for a projection model should represent the local economy at the time of projections; and, in addition, usable data on existing reservoir projects must be analyzed to determine the variables common and available on all projects.

The variables for the comparative-projection model had to meet a demanding criteria before acceptance. First, the variable had to be readily available for all small economies at the time a projection was proposed. Secondly, the inclusion of a variable must be based on the contribution and effect of that variable to the economy. Thirdly, not only must the variable be a contributing factor in the economy, but it must also, in combination with the others, reflect the present state of the economy. Fourth, the variables in some way must be related to the inputs which are generated by reservoir development. And finally, the variable must be such that it contributes to making the economy unique.

Population

The first variable selected was population. The population used in the model was defined as the total of all inhabitants in the counties continguous to the proposed reservoir. The population of contiguous counties is readily available in some form. Annual county population estimates can be obtained from primary sources; i.e. local officials, specific studies, or from reliable secondary sources. If annual population figures are not available, they may be estimated from figures released by the U. S. Bureau of the Census. Whether the data is found in primary or secondary sources, or whether it must be estimated, the figure most recent to the date of projection is used.

In order to obtain population figures which can be used on a comparative basis in the model, population is converted to a density number of inhabitants per square mile. This conversion represents the local economy in several other characteristics. A high density coefficient indicates, in the contiguous area, high urbanization, local employment, and available manpower.

The population density coefficient relates itself directly to the inputs into the economy which a water impoundment generates. The density coefficient can give indirectly an indication of available manpower to receive construction payrolls during construction. During the other two stages the density indicates how employment may be filled, the degree of urbanization, what supplies and materials may be available, and the numbers of water recreators. A high density reflecting a high potential for economic growth as a result of water impoundment.

Income Level

To further localize the economy surrounding a proposed reservoir, the income has been included as a variable. Income has been defined as the aggregate income level of all contiguous counties at the time when a projection is made. To facilitate the use of this variable, the most recent aggregate figure is used.

In order to obtain the most recent and best estimate of income, several sources are used, each manipulated and calculated to provide an individual income estimate. Sources include local officials and businessmen of the respective counties, composite indices, and Sales Management's Survey of Buying Power.

Income as a variable to the model provides an additional measure of the economy. This measure is the base from which impact during the development of the project is projected. *Impact* is now defined as the percentage change in existing levels of income at the time of projections. A high income, when combined with the other variables, may not necessarily indicate a large impact attributable to the water impoundment project.

On the other hand, a low income relative to the expected inflows of money resulting from the project, combined with the other variables, may not indicate a large impact. This latter result can be attributed to the fact that a given economy only utilizes a certain amount of money and the rest is lost through "leakage" to other economies which utilize the additional inflows. As a result, even though income measures a present economy, it cannot stand alone as a base for future projections of economic impact.

The use of income as a variable is necessary to the model, because it establishes a base for economic projections, and the income contributes to making the local economy unique. Income combined with the other variables is used to inject the dynamic nature of the economy; which reflects, among other things, the degree of industrialization in the local economy.

Agricultural Income

A third variable which is used as a companion to aggregate income is agricultural income. This further localizes the economies of counties contiguous to a proposed reservoir by reflecting the agrarian nature of the economy. The projects used in the present study have shown that the degree of commercial-agricultural activity in the economy at the time of projections is a significant determinant of the economic impact that new monetary inflows have on a local economy.

The percentage of agricultural income partially determines the expansion capabilities in the economy. A high percentage indicates that output from the local economy is derived from agriculture. When new money is available to be put into the economy, there are no facilities which readily receive and capitalize this money. As a result, the money will pass through the economy quickly and find its way to other economic systems. Or, since facilities are not available, the money may never enter the local economy. On the other hand, the low percentage reflects that facilities exist for industrial output. As the money generated by a water impoundment project becomes available, commodities, equipment, materials, and supplies can be bought in the local area. The expenditures in the economy remain and participate in generating new sources of income. The use of agricultural income provides an additional measure of the economic expansion capabilities.

The three variables, population, income, and agricultural income, succeed in satisfactorily defining and localizing an economy. A fourth variable, the distance from a metropolitan area, is pertinent also to the proportion of monetary inputs flowing into and remaining in the local economy.

Distance to a Metropolitan Area

One variable which localizes an economic system when the other three have failed, is the distance between the proposed dam and a major metropolitan area. The use of distance from the nearest city with a population of 25,000 inhabitants or more as a variable is both valuable and convenient. After exploring several forms of this data, e.g., driving time, average distance measuring all routes, commercial transit costs, etc., highway miles along the shortest route were selected.

The distance from an impoundment project to a metropolitan area has an effect on the economic impact of the facility throughout the three stages of its development. During the construction stage the closeness to a city affects the income flows through materials available to actual construction. During construction, a large city provides a labor source, but if the city lies outside the contiguous counties large parts of the resulting payrolls never enter the local economy. Many workmen, especially foremen and supervisors brought into the area from outside will trade in a nearby city even though they may live in the contiguous counties.

In the fill-up and post fill-up stages the distance to a metropolitan area also influences the economy of the contiguous counties. As water recreators and lake residents seek supplies, materials, and equipment, large cities provide a variety of these at low prices. This money spent in the metropolitan area does not reach the local economy and its impact is lost. The result is that economic impact produced by money inflows is inversely proportional to the distance from a metropolitan area.

Each variable used in developing the comparative-projection model contributes to making the sub-economy of contiguous counties around an impoundment project unique. Population density identifies the distributive use of money and manpower availability. The income level of the sub-economy provides a base for the projections. Agricultural income, delineating between an agrarian and urban economy, indicates the capabilities of the present economy for exploiting commercial potential. And last, the distance to a metropolitan area from a proposed reservoir project estimates money inflows that probably remain in the local economy. Each variable measures a particular area, and in composite form, represents the relative overall impact of water impoundment.

The preceding discussions have listed variables which affect additional inflows of money into a local economy. The inflows must be defined in a more specific form in order to use them as model inputs.

ECONOMIC INPUTS

During each stage of development, inputs into the local economy are a result of a variety of activities. Some of these activities are unique to a particular stage, (e.g., construction expenditures during this stage), while others prevail through two or more stages. The model has been designed to measure only that economic impact attributable to impoundment. As a result, only money income generated by the project is considered as an input to the system. These inputs are construction expenditures, operations and maintenance, investment expenditures, and recreational expenditures.

Construction Expenditures

The largest single, and most accurately estimated inflow into the economy of the area surrounding a proposed water impoundment project is money expended for the construction of the dam and reservoir. This input usually averages several millions of dollars a year for a period of three to ten years. This provides a decided stimulus to the economy surrounding the proposed reservoir, and the degree of this boost depends upon the existing economy and its capabilities.

At the time an impoundment proposal is made, construction dollars have been estimated. Construction expenditures are not broken down into specific jobs until actual contracts are submitted for complete jobs.

As a result, estimates must be accepted in the aggregate, and the yearly aggregate figures serve as model inputs. No other major inputs can be attributed to the reservoir during the construction stage of reservoir development. Toward the end of construction additional inputs are made, but these are insignificant in relation to the amounts flowing into the economy from construction contracts.

Operations and Maintenance

Operations and maintenance inputs begin almost immediately following the close of reservoir gates. This money flow may include some remaining construction work but most of it comes from activities which continue for the life of the project, moving from the fill-up stage directly into the post fill-up stage. Money inputs mainly include salaries for the governing agency staff and supply purchases. The input size is estimated as an annual figure when plans are made for the construction of a reservoir, and flows mostly into the local area if materials, supplies, repair equipment, etc., are available.

Expenditures for operation and maintenance appear to be insignificant when compared to construction expenditures. However, when construction money additions have stopped flowing into the economy, operation and maintenance inputs help stabilize the local economy. An annual estimated operation and maintenance input of $150,000[4], has been used in the model, but this amount can be varied with larger or smaller projects.

[4] Letter from Mr. M. W. Hampton, Chief, Office of Operations Branch, Operations Division, Fort Worth District, Corps of Engineers, Fort Worth, Texas, January 30, 1967.

Investment

Investment expenditures which flow into a local economy begin during the end of the construction period and even though they continue at some rate throughout the life of the reservoir, they have their largest impact during the fill-up stage. Investment usually begins slowly during the last years of construction. Although land for the reservoir basin has been cleared, exact shorelines have not yet been realized. Most developers tend to adopt a "wait and see" attitude during these years, although plans are in process for resort house subdivisions, new commercial establishments, and business expansions. A few small businesses begin operations in expectation of reservoir visitors, but most business actions are in land and location options.

During fill-up investment expenditures are greatly increased. The reservoir now takes shape, shorelines become distinguishable, and people start visiting the area. Investors begin implementing plans and private investment expenditures perhaps reach their peak during the last year of the fill-up stage and the initial years of the post fill-up period.

Private investment expenditures continue throughout the life of an impoundment project as new home sites and new businesses are developed, but housing developments are limited by the availability of suitable land. Also, commercial investments reach their peak during late fill-up, and relatively little aggregate commercial establishment expansion occurs after five years of the post fill-up period.

Investment expenditures are separated into two divisions, commercial and private, for the projection model. This breakdown was used on the basis of two assumptions. First, the pattern for commercial expenditures is a function of different economic variables than those determining private or residential investment. Secondly, the average expenditure per investment is usually higher for commercial enterprises than for residential investment.

The development of residential investment is dependent on several variables, but few, if any of these, can be quantified at the beginning of construction. From observation of the two established projects, the model utilized a physical characteristic, a factor based on miles of shoreline, to project residential investment expenditure. Although this technique considers only one limiting factor of residential development, it produces results closely approximating residential expenditure patterns of the two comparative reservoirs.

During the last year of construction the number of residential investment projects is projected by the following:

$$RESINV_i = 2.0 \cdot (SHORE/10.0).$$

The variables are:

$RESINV_i$ = the number of investments in year i, and

SHORE = the number of miles of shoreline.

For succeeding years of fill-up and the initial year of the post fill-up the number of residential investments increases at an increasing rate, or

$$RESINV_i = 2.0 \cdot RESINV_{i-1}.$$

In the later years of post fill-up the number begins to decrease at a decreasing rate. For this period the number is projected by:

$$RESINV_i = RESINV_{i-1} - .3 \cdot RESINV_{i-1}$$

From the projected yearly residential investment numbers, the dollar model input is estimated. Based on experiences of the two established reservoirs, an average expenditure per residence was made. Although considered somewhat low in relation to the many homes identified around the lake in later years of development, the average figure used in the model considers all cabins, trailers, etc., and was $6,000.

Commercial development around a new reservoir follows a somewhat different pattern and is a function of different variables than residential investment. Commercial investors expect an adequate return on their outlay of capital funds, and the model employs a number of variables which reflect anticipated return.

Commercial investment is entered in the model the first year of fill-up. At this stage, recreational attendance has started and residential investment activity is underway. As a result, commercial investment projections are based on expected attendance and total number of residential investments for the seven years following construction. Commercial investment also is increased in the model during the first years and later decreased at a decreasing rate. One other factor enters into the commercial projection; namely, the availability of commercial establishments in nearby towns. To incorporate this factor, distance from the reservoir to a city over 25,000 population was used.

For the initial two years of commercial investment the projection is as follows:

$$COMINV_i = \frac{((TOTATT + TOTRIN)/1000.0) \cdot (DIST/100.0)}{SHORE/2.0}, \quad (i = 1)$$

and

$$COMINV_i = COMINV_{i-1} \cdot 2.0. \qquad (i = 2)$$

where

$COMINV_i$ = Number of commercial investments during year i,

TOTATT = total projected attendance for the first seven years,

TOTRIN = total number of projected residential investments for the first seven years,

DIST = distance in miles to the nearest city over 25,000,

SHORE = total miles of shoreline.

For the next five years the number begins to decrease at a decreasing rate.

$$COMINV_i = COMINV_{i-1} - .4 \cdot COMINV_{i-1}$$

Considering all commercial investments such as bait houses, general stores, lodges and eating establishments erected during the first seven years, the average investment was $31,000. As a result, the dollar input for commercial investment for each year is calculated by multiplying the projected number by the average investment.

Investment expenditures, especially commercial, depend more on a fourth input to the economy as time passes. Some investment during the early stages is in expectation of recreation expenditures, but as the reservoir ages new investments occur only after there appears to be an established demand. Private investment expenditures are a function of recreational expenditures only to the extent that satisfied recreators return to the area.

Recreation

One monetary inflow, not yet considered a justification for a reservoir project, is recreational expenditures. As society enjoys more leisure and the interest in water sports continues to increase, recreational expenditures become the single largest inflow of money into an impoundment economy during the post fill-up period.[5] But the projection of this expenditure is difficult. The measurement must deal with social behavior, and both the number of reservoir visitors and expenditures of each represents data not readily available.

Recreation money begins coming into an impoundment economy when visitors begin coming to the reservoir. This may be even before construction is completed, but this represents a limited expenditure inflow. However, once the gates have closed and deliberate impoundment begins, the visitor rate increases. Visitors may be expected to continue to increase at a decreasing rate until it levels off at a point approximately seven years after the gates have been closed.

Various methods of projecting the stream of visitors have been proposed. The Corps of Engineers' method bases the recreation attendance on population, distance, and an individual visitation factor.[6] The Bureau of Outdoor Recreation uses a procedure similar to that of the Corps, but with somewhat less detail.[7] In addition, the National Park Service employs a method using zones of demand, distance traveled

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[5] Outdoor Recreation Resources Review Commission, Study Report #24, Economic Studies of Outdoor Recreation, (Washington, D.C., 1962) p. 54.

[6] Letter from Mr. Jack W. Butler, Acting Executive Officer, Fort Worth District, Corps of Engineers, Fort Worth, Texas, March 3, 1967.

[7] Letter from Mr. Maurice D. Arnold, Regional Director, Bureau of Outdoor Recreation, U. S. Department of Interior, Denver, Colorado, March 16, 1967.

and visitors per car.[8] All of these in some way attempt to relate several variable factors pertaining to an area included in a one hundred or one hundred and fifty mile concentric circle around a proposed reservoir.

The recreation attendance combined with the average dollar figure serves as a direct input into the comparative-projection model. The technique utilizes certain aspects of the above methodologies but adds other variables. A one hundred mile circle was drawn using the impoundment project as a center, and all counties which touched this circle were considered to be a part of the demand area. A growth factor is determined for the total population of the counties in the one hundred mile circle from census data. This growth factor is calculated by the use of logarithms and does not concern itself with a categorical breakdown of the population. Population is projected from the growth factor to seven years after the gates have been closed and are presented in Table 1.

Projected populations are the primary determinant of potential recreational demand for the area within the circle of a one hundred mile radius, but several other factors are significant. The potential demand is for all recreation, and the proposed reservoir recreational facilities must be considered in relation to other reservoirs in size and facilities available.

Only two impoundment projects were used for empirically testing hypotheses, but specific patterns were found in attendance records during the first years of fill-up. The first year attendance was measured at both lake areas, it was the same percentage of population in the circle

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[8] OWRRC Study Report #24, _op. cit._, p. 106.

TABLE 1

POPULATION FIGURES FOR THE
RESERVOIR RECREATIONAL DEMAND AREAS*

Lake Whitney		Lake Belton	
Year	Population	Year	Population
1952	1,967,146	1954	2,517,889
1953	1,999,969	1955	2,552,316
1954	2,033,339	1956	2,587,214
1955	2,067,266	1957	2,622,590
1956	2,101,758	1958	2,658,448
1957	2,136,827	1959	2,694,798
1958	2,172,481	1960	2,731,644
		1961	2,768,994

*Projections are based on the decennial statistics for the 100-mile radius around the lake, 1940 and 1950.

Source: U. S. Bureau of the Census, 1940 and 1950.

of each respective lake. From this observation the first year's attendance at a proposed reservoir was set at thirty percent of the total population within a one hundred mile radius.

Attendance follows a different pattern for succeeding years at each lake. Investigations were made to determine what unique factors influenced patterns of attendance. The pattern appeared to be the same for both areas, but on a different scale. The following attendance factor was established for second year projections:

$$\text{ATTFAC}_2 = \frac{\sqrt{(\text{RESAR}/\text{TOTLAK})} \cdot (\text{SHORE}/10)}{1.45 \cdot \sqrt{\text{RESNO}}} - (\text{DIST}/60)$$

The general factor, up to year seven following the closing of the gates, is

$$ATTFAC_i = ATTFAC_{i-1} + .5 \cdot (ATTFAC_{i-1} - ATTFAC_{i-2})$$

$$ATTFAC_0 = 0.$$

The variables are:

RESAR = surface area of the proposed reservoir,

TOTLAK = total surface area of all lakes over 2,500 acres within the area encompassed,

SHORE = shoreline of the proposed lake,

RESNO = number of lakes used to calculate TOTLAK, and

DIST = distance from the proposed reservoir to the nearest city over 25,000 population.

After population projections have been made, and the attendance factor established for each year, projections for lake attendance can be made. The attendance projections are based on the assumption that all water recreation demand can be satisfied by the existing facilities and the proposed lake. Total projections for each area are presented in Tables 2 and 3.

A wide variation was observed in the number of people participating in different recreational activities, and the resulting variations in respective expenditure patterns. In order to reduce this variation, and the existing error of projection, total lake attendance was divided into two geographical categories and a breakdown was made in recreational activities. The specific method and results of this survey are presented in Appendix E.

Three points were incorporated for a recreational input to the model as a result of the recreational survey. First, in the projection of lake attendance, the survey yielded a ratio for a broad geographical breakdown. Attendance was projected from the area outside the contiguous

TABLE 2

ACTUAL ATTENDANCE AND PROJECTED
ATTENDANCE AT LAKE WHITNEY, TEXAS, 1952-1958

Year	Projected Population*	Attendance Factor	Projected Attendance	Recorded Attendance**
1952	1,967,146	.300	590,144	548,869
1953	1,999,969	.835	1,670,434	1,684,607
1954	2,033,339	1.253	2,547,458	2,478,943
1955	2,067,266	1.462	3,021,624	2,984,141
1956	2,101,758	1.566	3,291,472	2,899,770
1957	2,136,827	1.618	3,457,937	3,030,850
1958	2,172,481	1.644	3,572,338	3,231,784

*See Table 1.

**Figures furnished by U. S. Corps of Engineers, Fort Worth District.

Source: Derived from population projections and attendance factors for Lake Whitney.

counties on the basis of existing population at the time of projection. An equation,

$$OUTATT_i = ((-27.31 \cdot POPPER) + 1.6147) \cdot ATTEND_i,$$

was derived for this projection. In the equation the variables are:

$OUTATT_i$ = attendance from outside the contiguous counties,

POPPER = population of the contiguous counties as a percent of the population for the 100-mile radius, and

$ATTEND_i$ = total yearly attendance as projected by combining the attendance factor and projected population.

With outside attendance established, the survey yielded broad categorical breakdowns for the outside attendance. Such breakdowns were put into broad groups to gain accuracy, and yet not have the projection

TABLE 3

ACTUAL ATTENDANCE AND PROJECTED
ATTENDANCE AT LAKE BELTON, TEXAS, 1954-1961

Year	Projected Population*	Attendance Factor	Projected Attendance	Recorded Attendance**
1954	2,517,889	.300	755,366	768,000
1955	2,552,316	.418	1,065,848	1,190,000
1956	2,587,214	.626	1,620,632	1,685,000
1957	2,622,590	.731	1,916,590	2,214,000
1958	2,658,448	.783	2,081,566	2,376,000
1959	2,694,798	.809	2,180,362	2,407,000
1960	2,731,644	.822	2,245,822	1,607,400
1961	2,768,994	.829	2,294,597	2,213,800

*See Table 2.

**Figures furnished by U. S. Corps of Engineers, Fort Worth District.

Source: Derived from population projections and attendance factors for Lake Belton.

groups unnecessarily detailed. Groups used for outside attendance were (1) camping, (2) boating and fishing, and (3) skiing, swimming, picnicking and sightseeing.

Based on a population analysis of the contiguous counties in relationship to the 100-mile radius population, equations were derived for each of the categorical groups by the same method employed for the derivation of outside attendance. These projection equations are as follows: For the number in camp activity,

$$CAMPAT_i = ((-12.38 \cdot POPPER) + 1.0472) \cdot ATTEND_i;$$

For the boat and fish activity,

$$BOATAT_i = ((-1.124 \cdot POPPER) + .2411) \cdot ATTEND_i;$$

For the swim, ski, picnic and sightsee activity,

$$OTHATT_i = ((13.50 \cdot POPPER) -.2894) \cdot ATTEND_i.$$

The variables are defined the same as in the equation for outside attendance.

The third aspect of recreational activity obtained from the survey was the average local expenditure of outside visitors. Camping activity had the highest average expenditure of \$4.09, boating and fishing activity was second with an average expenditure of \$3.26 per visitor, and the third category (swimming, skiing, picnicking and sightseeing) had an average per visitor expenditure of \$1.75.

The recreational input to the model is calculated from the group breakdown of projected recreational activity and the average expenditure per visitor for each group. The number in each activity multiplied by the respective average expenditure provides the recreational input into the local economy. This model input is expressed by the equation:

$$REC_i = \$4.09 \cdot CAMPAT_i + \$3.26 \cdot BOATAT_i + \$1.75 \cdot OTHATT_i.$$

The recreational dollar figure derived above, is that money which the reservoir generates from sources outside the contiguous counties. As the local economy utilizes this money, and more facilities become available, the growth can exceed the projections of the model. The recreational input, as defined above, is based on certain known factors early in the life of a reservoir. Based on the observation of established projects, the recreational inputs begin either the last year of construction or during the first year of the fill-up. These inputs are then combined with the other inputs described above and the expected increase in income is derived.

Inputs into the local economy during the three stages of reservoir development have been defined and discussed so far in their relation to causing economic expansion. As one input diminishes another starts to increase, sustaining or expanding the sub-economy around a reservoir.

THE COMPOSITE MODEL

An exponential curve was employed to incorporate an economic growth factor and a time function acting upon the inflows. By integrating the exponential, the model has the facility to measure impact over specified intervals of time.

$$\int_{a}^{b} e^{gt}\, dt$$

Here the limits of integration are the period of time over which impact is to be determined, g is a composite of the variables described above and t denotes the parameter, time, of integration.

The employment of this function as a model is based on two assumptions. One, the inflows designated for a particular period will be arriving in the economic system at a constant rate over the given period of time. This inflow will then follow the exponential curve determined by the elements of g. The measurement of the area under this curve determines the multiplier effect relative to a single unit of input. A second assumption is that after the first year of an input a residual of this input is carried over into the next time period. This residual impact is determined in much the same method as the first, except that g is altered and the integral is over a negative power of e.

$$\int_{\gamma}^{\delta} e^{-gt}\, dt$$

The limits of integration are again the time limits, in this integral, for the secondary time interval.

Graphically, the function is shown in Figure 1. The total impact is obtained by summing over the entire time interval, i.e. construction, fill-up, and post fill-up.

Certain notation and indexes must be defined before a complete description of the model is possible. First, n is used to denote the number of years estimated for construction. The fill-up stage, although ranging from two to five years is assumed to be two years in length, $n+1$, and $n+2$. Finally, m is used to define the total period considered for projection purposes. It may be explained in either of two ways: one, m is a five-year period after the close of the fill-up stage plus the time for construction and fill-up, or two, m is simply, in symbolic terms, $n+7$.

The primary time units for the model are years, and secondary units are the stages. The general form of the model is as follows:

$$E_i = \left(M_i \int_0^1 e^{g_{1,i}t}\, dt + \sum_{j=1}^{i-1} E_{i-j} \int_{j-1}^{j} e^{g_{2,j}t}\, dt\right)/N$$

where,

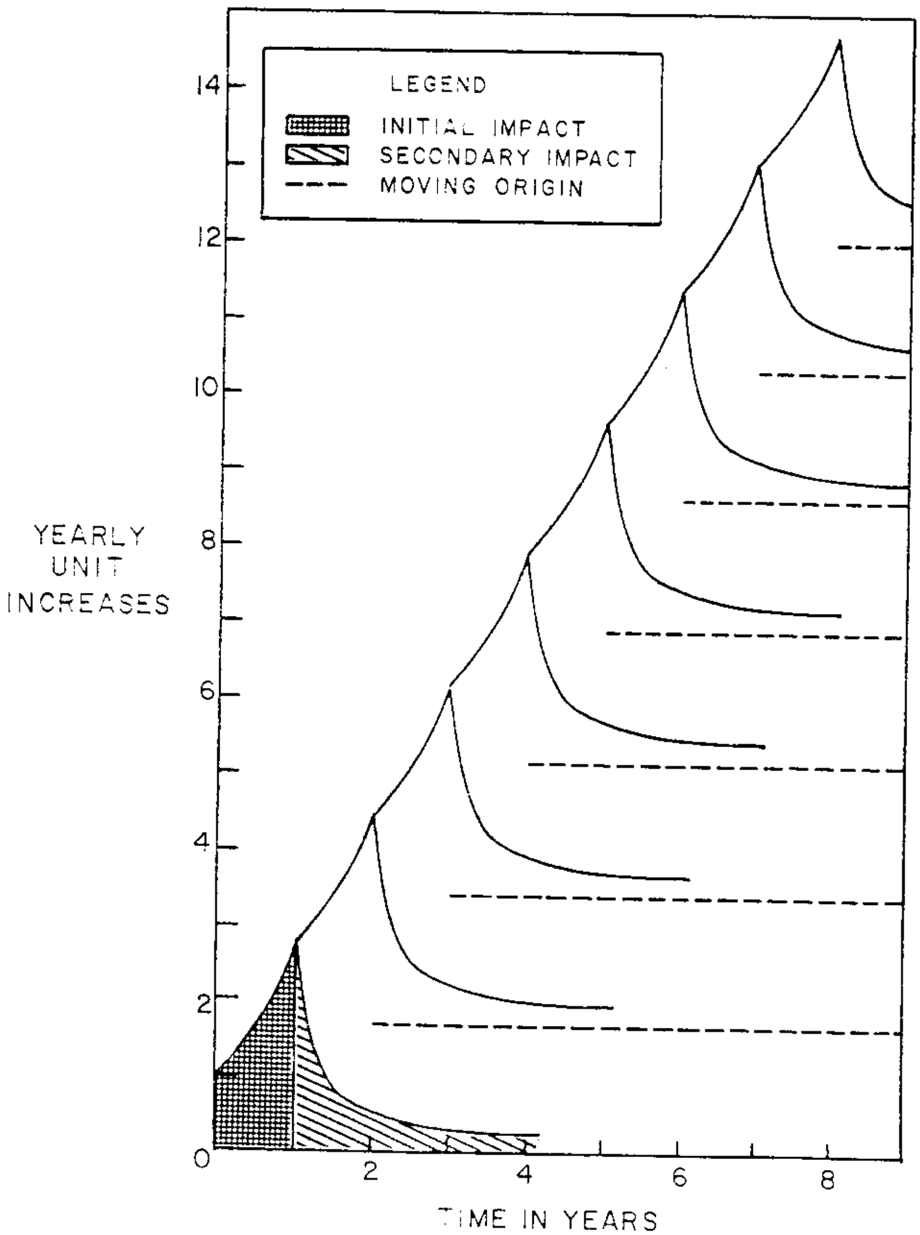
i = the year of reservoir development $(1,2,3,\ldots,m)$

$j = 1, \ldots, m$

$E_0 = 0$

FIGURE I

GRAPHIC REPRESENTATION OF THE EXPONENTIAL FUNCTION FOR THE COMPARATIVE-PROJECTION MODEL



NOTE: THE GROWTH FACTOR, G, IS ASSUMED TO BE A CONSTANT OF 1. IN APPLICATION THIS IS A VARIABLE.

Or, to obtain total impact over the entire development period,

$$E_T = \sum_{i=1}^{m} E_i .$$

$$\overline{N}$$

The symbols used within the model are defined as follows:

N = existing level of aggregate income,

E_i = yearly impact for a individual year during the development,

E_T = total impact over the defined period m,

M_i = money inputs into the economy during the three stages of development (in thousands of dollars),

$g_{1,i}$ = the economic growth factor, the first subscript denoting initial year growth factor, and the second indexing the year of development,

$g_{2,i}$ = the economic growth factor, the first subscript denoting the residual growth factor and the second indexing the year of development,

t = the integration parameter time.

The general form of the model may be broken down by years as follows:

$$E_1 = \left(M_1 \int_0^1 e^{g_{1,1} t} \, dt\right)/N, \qquad (i=1)$$

$$E_2 = \left(M_2 \int_0^1 e^{g_{1,2} t} \, dt + E_1 \int_0^1 e^{-g_{2,1} t} \, dt\right)/N, \qquad (i=2)$$

$$E_3 = \left(M_3 \int_0^1 e^{g_{1,3} t} \, dt + E_2 \int_0^1 e^{-g_{2,2} t} \, dt + E_1 \int_0^2 e^{-g_{2,1} t} \, dt\right)/N, \qquad (i=3)$$

$$\vdots \qquad\qquad \vdots \qquad\qquad \vdots$$

$$E_m = \Big(M_m \int_0^1 e^{g_{1,m} t}\, dt + E_{m-1} \int_0^1 e^{-g_{2,m-1} t}\, dt +$$

$$\cdots + E_1 \int_{m-2}^{m-1} e^{-g_{2,1} t}\, dt\Big)/N. \qquad (i=m)$$

Perhaps a serious limitation to the model's use is its notation, because it becomes quite cumbersome. In addition, the last terms for a particular year can be disregarded when the results of the integral become insignificant, i.e., less than 10^{-4}.

The model was first perceived theoretically with a universal applicability but a localization criteria. The model had to be modified in some way to meet the demands imposed by the empirical data. The major portion of these modifications have been directed toward g, the economic growth factor, since it serves as a composite for the variables, population density, income, agricultural income and distance to a metropolitan area.

The decision point for modifications within the model is following the calculation of the initial g. This initial $g_{1,1}$ combines the variables in the following manner:

$$g_{1,1} = \frac{P^2 A^2}{D^2/4} - 1$$

with

P = population density for the contiguous counties at the time of projections,

A = percent of agriculture in the local economy at the time of projections, (A = agricultural income/total income)

D = distance (miles) from the proposed reservoir to the nearest population center of 25,000 or more population.

At this point the $g_{1,1}$ is tested for negative or positive results. If $g_{1,1}$ is positive, this is an indication of a progressive economic system. In such a system the exponential curve requires little dampening. The dampening is accomplished through altering the $g_{1,i}$ for succeeding years.

The g remains the same for the year two through the year $n-2$, or

$$g_{1,i} = g_{1,1} + .5. \qquad (i = 2,\ldots,n-2)$$

However, the phasing out years of construction pose a problem. During these years, a large portion of the appropriations are spent in the purchasing of facilities for the impoundment and for specialized labor to install the facilities. These expenditures, for example, are for final construction and installation of flood control gates, the completion of the embankment and the building of recreational facilities. Because the inflow of money from construction is decreasing during the last two years the g is modified.

$$g_{1,n-1} = g_{1,1} - 1.5, \text{ and}$$

$$g_{1,n} = g_{1,1} - 2.0.$$

The fill-up and post fill-up stages require further modifications. Money inflows during these periods are of a different type than construction expenditures, which were payrolls and purchases of supplies and equipment. The fill-up and post fill-up period expenditures are for recreational supplies, investment, and a small amount of payrolls. To incorporate the changes occurring in the local economy attributable to the loss of the construction money and increase of other expenditures, a further change is made to the g.

$$g_{i,i} = g_{1,1} - (2.5 + .5j) \qquad (i = n+1,\ldots,m) \quad (j = 0,\ldots,6)$$

Thus far consideration has been given only to the computation of g for the year in which the initial inflow of money occurred, and the residual effect has not been defined. The development of g in the integral of the negative exponential is readily computed once $g_{1,1}$ has been determined. The residual or secondary impact resulting from the initial inflows $g_{2,i}$ is based on the $g_{1,1}$, or

$$g_{2,i} = g_{1,1} + 2.0. \qquad (i = 2,\ldots,m)$$

This g indicates the impact expected in succeeding years once money has been interjected into the sub-economic system.

A relatively slow or nonprogressive economy would be represented with a negative $g_{1,1}$. Such an economy would be characterized by a high percentage of agriculture, low population density and relatively long distance from a metropolitan center. That economic system would not be able to fully utilize the expenditures resulting from an impoundment project. The labor pool would be insufficient to meet the demand created by new jobs. The industrial segment of this type of local economy would not be able to supply the increased demand for materials and equipment, and existing enterprises could not meet the new demand of consumer buying power. As a result of these possible weaknesses in the local sub-economy, a large portion of the new inputs would overflow into other systems, and impact on the local area would be less.

The model, in order to simulate such a slow economy, must not only be modified in terms of g, but the integral also must be altered. During the construction stage g takes the form:

$$g_{1,i} = \frac{P^2 \quad A^2}{D^2 /4} - (1 + 2i). \qquad (i = 2,\ldots,n)$$

For fill-up and post fill-up periods the changes in expenditure patterns are considered by the model with one further change in g.

$$g_{1,i} = g_{1,n} \qquad (i = n+1,\ldots,m)$$

The g for these periods takes on a constant value since the economy is undergoing very little expansion.

Again, as with a positive $g_{1,1}$, a growth factor for the secondary or residual effect of the money inflows must be determined. Since the economic conditions are set by the $g_{1,1}$, the $g_{2,i}$ is determined in the same manner as that described for a positive $g_{2,i}$.

To provide the uniqueness required for a slow moving local economy, the integral is modified throughout the three stages of development. The first year of the construction stage employs the model in its original form:

$$E_i = \left(M_i \int_0^1 e^{g_{1,i} t} \, dt\right)/N. \qquad (i = 1)$$

However, for succeeding years the model takes the following forms:

$$E_i = \left(I_i - 1/3 \; M_i\right)/N, \qquad (i = 2,\ldots,n)$$

$$E_i = \left(I_i - 1/2 \; M_i\right)/N, \qquad (i = n+1 \;\&\; n+3)$$

and

$$E_i = \left(I_i - 1/3\ M_i\right)/N. \qquad (i = n+2\ \&\ n+4,\ldots,m)$$

In all of these the term I is defined as:

$$I_i = M_i \int_0^1 e^{g_{1,i}t}\,dt + \sum_{j-1}^{i-1} E_{i-j} \int_{j-1}^{j} e^{g_{2,j}t}\,dt. \qquad (i = 2,\ldots,m)$$

The model has not yet mentioned other special characteristics sometimes associated with an impoundment project. For example, one such aspect of reservoir development is the installation of hydroelectric facilities during the latter years of the construction stage. These installations alter the inflow of money during this stage and greatly increase the expenditures for construction. The model takes into account these differences in construction expenditure patterns through descriptive techniques, but other differences which might exist during any or all stages are assumed to be negligible in the determination of economic impact.

The model *en toto* provides a transformation of valid macro economic theory into a workable simulator of a micro economic system. It measures economic impact in terms of its relationship to a similar economic system, but one which has not been subjected to an outside stimulus. The model, because of its simplicity, is easily applied.

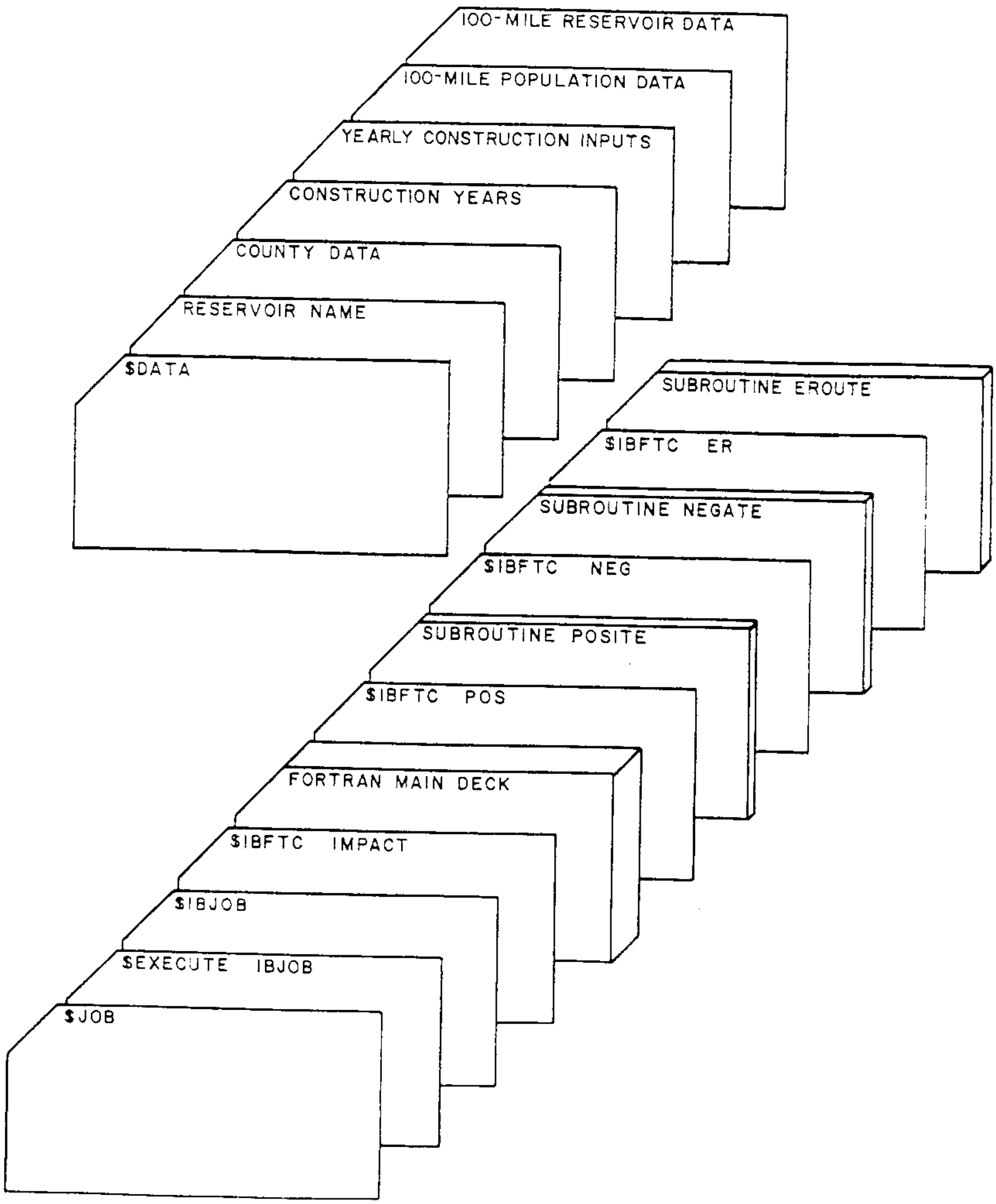
PROGRAMMED MODEL FORM

The application of the comparative-projection model is facilitated by the availability of data and logical methodology, but computations associated with its applications can be quite laborious. In developing the model long computations were made, relationships between variables changed, and some inputs and variables had to be re-evaluated. Some of these time consuming labors were reduced by using an IBM 7094 computer. The descriptive and mathematical model was converted to a FORTRAN IV program and the data and variables arranged to meet program specifications. A complete listing of the program is provided in Appendix A.

The computer program is actually a collection of sub-programs, each relating to a specific part of the model. The first part of the program (or basic program) is a data initialization section and an input-output facility for the entire program. The organization of the localization data is laid out in Figure 2, and specific formats for the data are presented in Appendix B. The basic program takes data inputs, determines the initial g, and from this result makes necessary decisions for the g to be used during later stages of the reservoir development project. Following this the program also utilizes the initial g to compute the g for the determination of secondary impact. Next, after yearly construction inputs are stored, the program projects the hundred mile population for the years of recreational attendance, calculates the attendance factor for the lake, and makes attendance projections. The attendance projections are then converted into attendance expenditure figures and stored for the particular years along with the other economic inputs. The investment expenditures are projected and calculated in essentially the same manner.

FIGURE 2

COMPARATIVE-PROJECTION MODEL IBM 7094 DECK ORGANIZATION



The economic impact can be determined after inputs have been established in an array Y(I). The branch to either of the sub-programs is determined by the sign of $g_{1,1}$ -- if $g_{1,1}$ is negative the program gives control to the sub-program NEGATE, and if positive control passes to sub-program POSITE. Both of these sub-programs in turn employ a sub-program which calculates the integral of the exponential for each year of the reservoir development.

Control returns to the main program after the impact factors have been determined. The results of the sub-programs NEGATE and POSITE are returned to the main program in dollar amounts of impact for each year. The main program takes these dollar figures, determines impact as a percentage of the base income in each year and cumulates the total impact of the impoundment project. This impact information along with the respective data inputs for each year are then outputed in a form which can be easily read and interpreted.

Calculations necessary for the use of the simulation model can become difficult and for this reason the model was expressed in the form of a computer program. The program is in FORTRAN IV, but the model can be converted into other languages.

Part III

COMPARABLE WATER IMPOUNDMENT PROJECTS AND THE CONTROL AREA

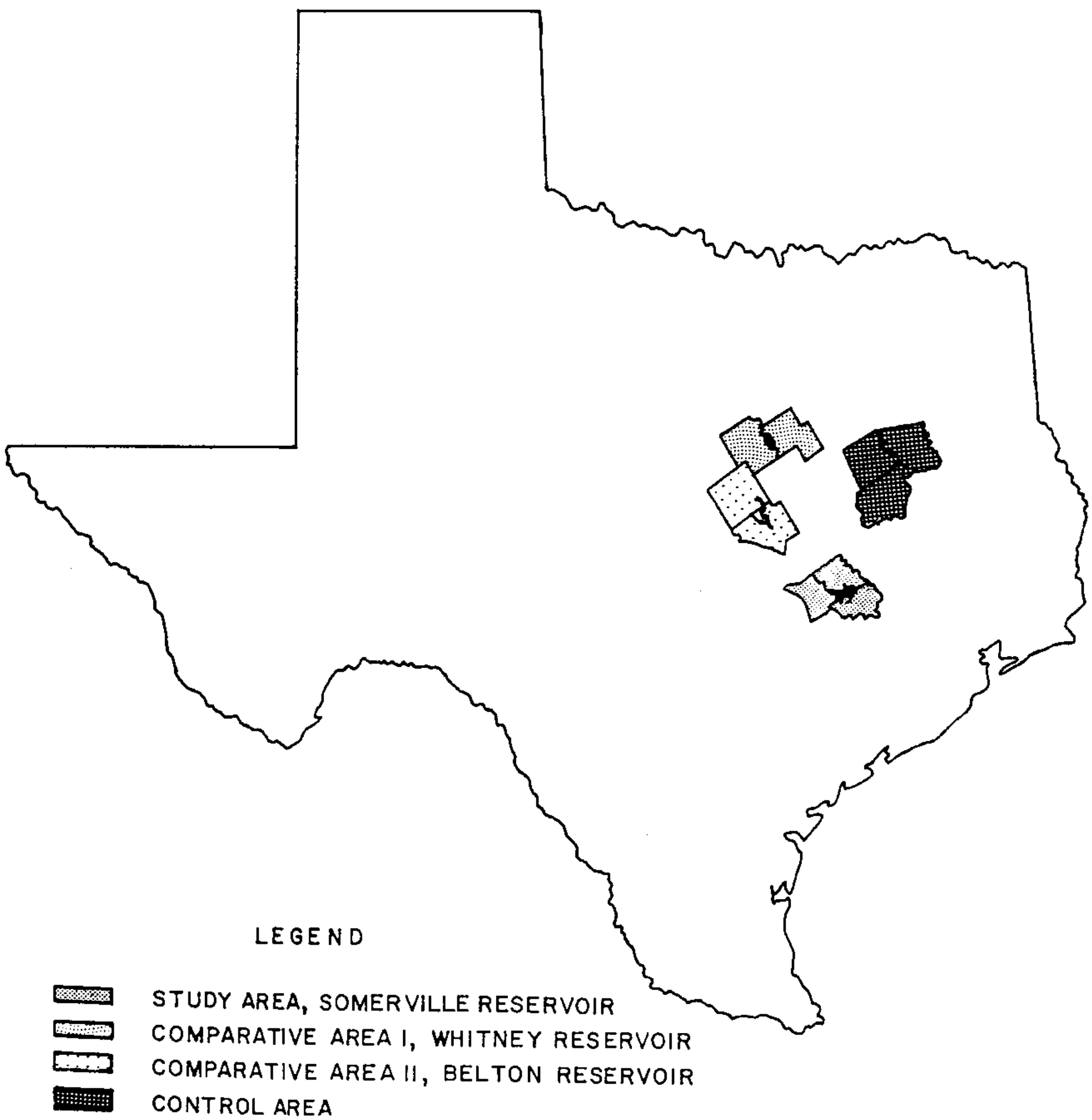
A prerequisite to the development and application of a comparative-projection model is a collection of data from comparable impoundment projects and a control area. This prerequisite was met in applying the model to the Somerville Reservoir Project by collecting data for a period of time from two older reservoirs. The time period encompasses construction through several years after the lakes have been filled. By measuring the economic impact in these comparable water-impoundment areas attributable to the dams, projections may be made in the Somerville area.

COMPARATIVE STUDY AREAS

Two reservoirs were selected for the comparison, the Whitney Dam and Reservoir located in Bosque and Hill Counties, and the Belton Dam and Reservoir located in Bell and Coryell Counties. The Whitney area identified as Comparative Area I, and the Belton area identified as Comparative Area II are located in Figure 3 with the control area and the Somerville Dam and Reservoir. These two established reservoir areas were selected for three primary reasons: location, reflecting similar physical variables and economy; similar construction times, making stage comparisons easier; and approximations in size and in distance from the high density population centers to the Somerville Reservoir project.

FIGURE 3

LOCATION MAP OF STUDY AREAS AND COMPARATIVE AREAS



Whitney Area

The Whitney Dam and Reservoir is located on the Brazos River 5.5 miles southwest of the small town of Whitney, Texas, and 38 miles upstream from Waco, Texas. The construction of this project was authorized by Flood Control Acts of August 18, 1941, and December 22, 1944. Lake Whitney straddles the Hill-Bosque County line, and at the top of the power pool the lake covers about 25 square miles of land. The power pool has a shoreline of approximately 190 miles and a maximum depth near the outlet works of 95 feet. The reservoir's size, relatively clear water, accessibility, and the existence of 17 well-equipped park areas and over 30 commercial camps make it a popular recreational area in the state of Texas.

Work on the Whitney Dam was initiated by the Corps of Engineers, U. S. Army, in May, 1947. The dam was sufficiently completed so that deliberate impoundment of water was begun December, 1951. The dam was designed for hydroelectric facilities, and these installations were completed June, 1953.[9]

Despite the increasing competition from new Texas lakes, Lake Whitney has averaged four million visitors a year for the past five years. This high attendance may be attributable primarily to the lake's location relative to major metropolitan areas (Figure 4). Equally important to attendance has been the extensive development in the immediate

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[9] "Whitney Dam and Reservoir", U. S. Army Corps of Engineers, Fort Worth District (Fort Worth, Texas, May, 1963.)

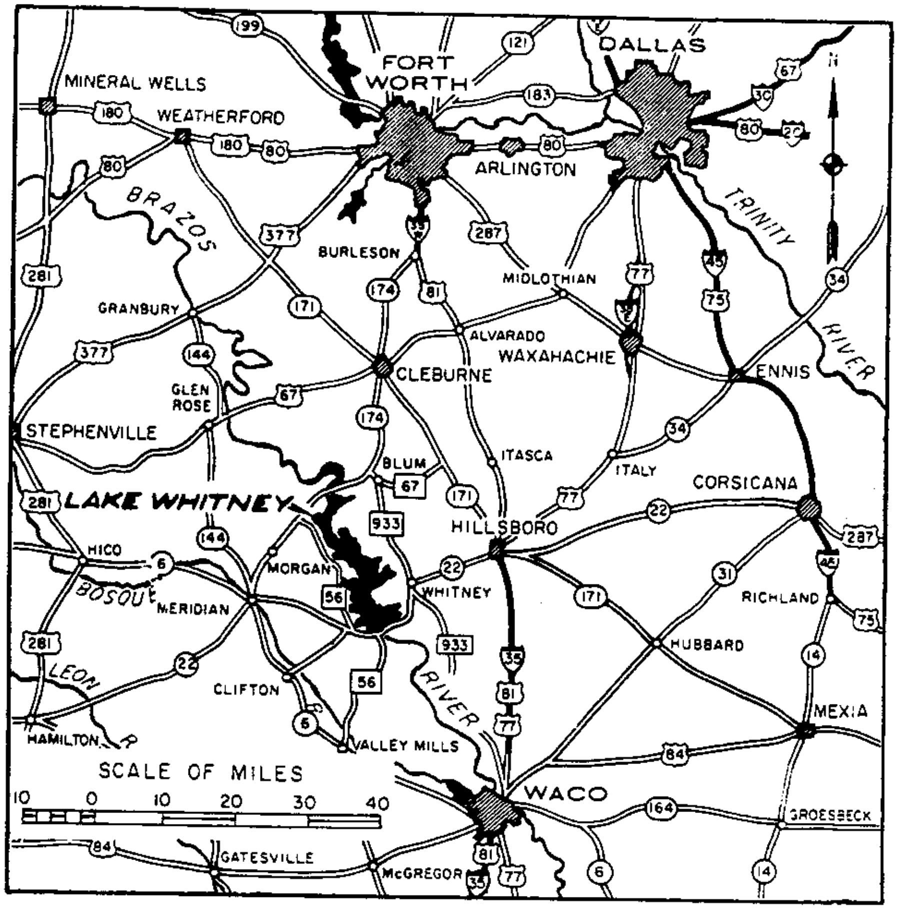

FIGURE 4

LAKE WHITNEY AND SURROUNDING AREA

vicinity of the lake. More than 10,000 private homesites have been purchased and some 62 subdivisions have been created since construction began in 1947.[10] Lake-shore development has had a strong and continued growth.

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[10] Letter from Mr. Bill Woodside, Manager Lake Whitney Association, February 24, 1967.

The regional economy surrounding Lake Whitney has not enjoyed high growth. Hill and Bosque Counties may be described as predominantly agricultural. Bosque County is made up largely of limestone soil, while Hill County is primarily blackland clay. The terrain in both counties is quite hilly, but not mountainous. Farm income is the largest percentage of income in both counties. Farm income in Bosque County for 1965 was a reported $6,853,331 out of an estimated total county income of $15,499,000, and Hill County had a similar percentage of 11 to 12 million for farm income out of an estimated total income of $28,328,000.[11]

The net populations of both counties have been steadily decreasing annually. Within the two counties which surround the lake, Hillsboro is the largest town, with a 1965 population of 7,830, and is the county seat of Hill County. The largest town in Bosque County, Clifton, had an estimated 1965 population of 2,230.[12]

Given the agrarian base of the economy and declining populations of the two counties, the area has lagged behind the state in overall growth. The presence of Lake Whitney has assisted in diversifying and stabilizing the local economy.

<u>Belton Area</u>

The Belton Reservoir is located on the Leon River in Bell County with northwestern ends of the lake extending well into Coryell County. The dam is approximately three miles north of Belton, Texas. At the top

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[11] Dallas Morning News, <u>Texas Almanac</u>, "Counties, Cities, and Towns of Texas", 1966-67 ed.

[12] <u>Ibid</u>.

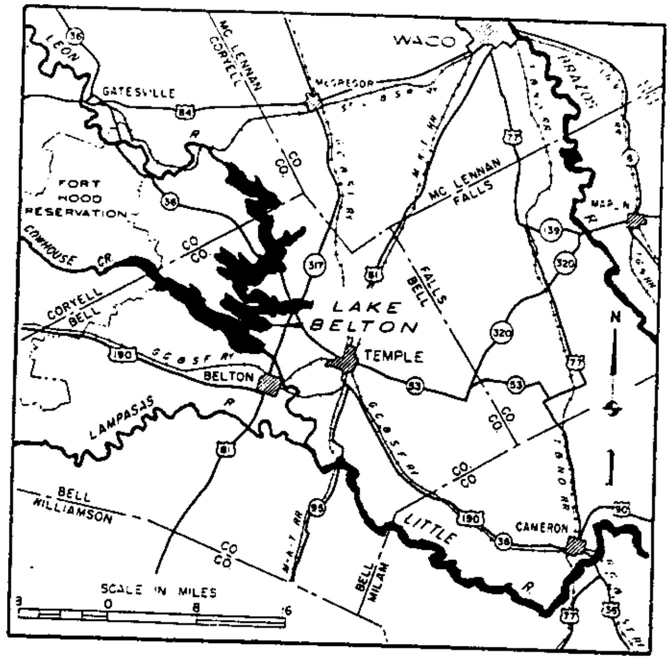

FIGURE 5

LAKE BELTON AND SURROUNDING AREA

of its conservation pool Lake Belton covers 7,400 acres and has a shoreline of approximately 110 miles.[13] Although smaller than Lake Whitney, the Belton Reservoir is built in similar terrain and offers basically the same types of services and recreational attractions as Lake Whitney.

Construction of the Belton Reservoir was authorized by Congress in July, 1946, and construction was initiated in July, 1949. The deliberate impoundment of water began in March, 1954.[14]

Lake Belton has not attracted as many visitors as Lake Whitney for several reasons. During the last several years Lake Belton has averaged

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[13] "Belton Dam and Reservoir," U. S. Army Corps of Engineers, Fort Worth District (Fort Worth, Texas, August, 1965).

[14] *Ibid.*

something over 1.5 million visitors.[15] One reason for lower attendance rates is that Lake Belton is smaller than Lake Whitney. Also, as seen in Figure 5, the metropolitan centers near Whitney are not as close as those near Lake Belton. Lake Belton serves the local needs as a water supply for a military post (Fort Hood) and parks for the towns in close proximity to the lake. Lake Whitney, on the other hand, has attempted to attract more outside recreators.

The economy of the counties surrounding Lake Belton resemble those surrounding Lake Whitney, but there are significant differences. In the Lake Belton area farming and livestock provide a contribution to the economy, and the total income from this source ($17,852,368 in 1965) is relatively small in terms of total income receipts ($235,300,000). The major portion of the income comes from the military post in the area, several large industrial plants, a college for girls, a state correctional institution, and similar activities.[16] The economy in the Lake Belton area appears dynamic, progressive and diversified, and that of the Lake Whitney area more stabilized.

A similarity between the areas surrounding Lake Whitney and Lake Belton is the overall trend in population. The two counties around Lake Belton have experienced a steady decrease in population for the last twenty years, but Temple, the largest town in the area with an estimated 1965 population of 34,730,[17] has not shared this decline. The area

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15 U. S. Corps of Engineers attendance statistics for the years 1954 to 1966.

16 Texas Almanac, <u>op</u>. <u>cit</u>.

17 <u>Ibid</u>.

immediately around Lake Belton has experienced an increase in permanent residents as was the case with Lake Whitney, but the magnitude of development at Lake Whitney has been much larger.

CONTROL AREA

Adjustments for influencing external factors, such as general prosperity, was accomplished through a control area. Ideally, a control area would be identical to the study area except for the variable to be measured, a water impoundment project. Though not ideal, three counties in the same general area were selected as the control area. The three counties used were Anderson, Freestone, and Leon, all located to the east of Lake Whitney and Lake Belton as shown in Figure 3.

The control area closely resembles the two study areas in land area, topography, resources, and population trends. The three counties have gently sloping hills and are heavily timbered. Their soils tend to be black in the bottomlands, becoming sandy and clay in the uplands. They are basically a farming area, with farm income about one-fifth of the total income in the combined area. The region also includes a small college for girls, a railroad division center, lumber manufacturing plants, furniture industries, a state prison farm, a series of small lakes and resort camps, and a variety of small manufacturing industries. Palestine, has a population (1965 estimate of 14,000) approximately the average of those larger towns in the comparative study areas.[18]

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[18] *Ibid*.

The control area has population trends similar to those of the comparative areas. However, portions of the comparative areas have shown localized increases not noted in the control area.

Population

A population change over a relatively short period of time can reflect increases attributable to dam construction employment and business services. Population changes from 1945 to 1961 for the comparative areas and the control area, are shown in Table 4. It can be noted that all three areas have experienced an overall decrease in population for the sixteen year period, although there have been increases for specific years. Using 1945 as a base, the Whitney area and the control area experienced a much lower percentage decrease for the period than did the Belton area, which shows a substantially higher percent decrease in population.

Civic leaders of the towns of Belton and Whitney indicate that the lakes have actually increased the population in the immediate vicinity of the lakes. The Belton Chamber of Commerce reveals that since the construction of the Belton Reservoir and Dam an increase of about six hundred people and an increase of two to three hundred new residences have occurred, in the immediate area of the lake.[19] Although the Whitney Chamber of Commerce does not estimate the number of people who have moved to the lake, the Lake Whitney Association indicates that over 3,000 electrical connections have been made during the period from

[19] Letter from Mr. H. E. Merrifield, President of the Chamber of Commerce, Belton, Texas, November 16, 1964.

TABLE 4

POPULATION IN STUDY AREAS AND CONTROL AREA
FOR YEARS 1945 - 1961
(Figures in Thousands)

Year	Projection Area I		Projection Area II		Control Area	
	Number	Percent Change	Number	Percent Change	Number	Percent Change
1945	43.2		131.6		57.3	
1946	47.8	+10.6	122.7	- 6.8	68.2	+19.0
1947	46.1	- 3.6	124.0	+ 1.0	66.0	- 3.2
1948	43.6	- 5.5	119.1	- 4.0	65.4	- 1.0
1949	44.4	+ 1.8	128.2	+ 7.6	66.9	+ 2.3
1950	43.7	- 1.6	112.6	-12.2	60.0	-10.3
1951	42.3	- 3.3	109.9	- 2.4	58.2	- 3.0
1952	42.0	- .08	113.9	+ 3.6	57.9	- 0.5
1953	40.0	- 4.8	109.9	- 3.6	56.1	- 3.1
1954	39.5	- 1.3	106.1	- 3.5	54.0	- 3.7
1955	37.6	- 4.9	106.3	+ .01	52.3	- 3.1
1956	36.6	- 2.7	102.0	- 4.1	50.6	- 3.3
1957	35.5	- 3.1	95.4	- 6.5	49.5	- 2.2
1958	34.6	- 2.6	91.6	- 4.0	48.2	- 2.6
1959	38.4	+10.9	87.1	- 4.9	59.7	+23.9
1960	33.8	-12.0	86.5	- .01	49.9	-16.4
1961	32.9	- 2.7	76.6	-11.5	49.1	- 1.6
1945-61		-23.9		-41.8		-14.3

Source: Derived from <u>Sales Management's</u>, <u>Survey of Buying Power</u>, (for the years 1945 - 1961).

construction to 1961.[20] The control area showed a greater decrease for the comparable time periods, attributable in part to the abnormal decrease in 1950.

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[20] Interview with Mr. Bill Woodside, Publicity Manager of the Lake Whitney Association, Whitney, Texas, November 23, 1964.

Population can reflect present economic conditions, but the use of population data alone does not reflect economic activity generated by a reservoir. Further measures were considered in describing the economies of the two study areas.

<u>Personal Income</u>

An indicator which reflects changes in population and measures economic activity is personal income data. In order to obtain comparable data for each of the areas, the total estimated personal income was adjusted for population, giving income data on a per capita basis for each year. Then the data for each area was adjusted by a 1947-49 consumer price index to eliminate changes in the value of a dollar. The reciprocal of the index provides an estimate of the actual purchasing power per dollar of income per person.

Increases which occurred during the sixteen years for the two study and control areas are presented in Tables 5 and 6 and Figures 6 and 7. The figures show temporal changes in personal income through the stages of reservoir development. Visual comparisons show that both study areas had increases in per capita income in 1950 and 1952, as did the control area to a somewhat lesser degree. The greater increases in the study areas can be attributed to the dam being under construction.

The Whitney Reservoir was well along with construction in 1950. There was no notable increase in per capita income during the first years of construction, but one in the later construction stage. The Belton Reservoir, on the other hand, had just begun the construction stage in 1950, and the economic reaction to the outside stimulus was much faster than Whitney.

TABLE 5

ADJUSTED PERSONAL INCOME*PER CAPITA FOR THE COMPARATIVE AREAS
FOR THE YEARS 1945 - 1961

Year	Projection Area I				Projection Area II			
	Personal Income* Per Capita	Consumer Price Index**	Reciprocal of Price Index	Adjusted Personal Income	Personal Income* Per Capita	Consumer Price Index**	Reciprocal of Price Index	Adjusted Personal Income
1945	697.6	76.9	1.300	906.9	652.9	76.9	1.300	848.7
1946	705.4	83.4	1.200	846.5	658.9	83.4	1.200	790.7
1947	770.9	95.5	1.047	807.1	805.5	95.5	1.047	843.4
1948	803.6	102.8	0.973	781.7	851.4	102.8	0.973	828.4
1949	763.7	101.8	0.982	749.9	866.1	101.8	0.982	850.5
1950	858.2	102.8	0.973	835.0	981.7	102.8	0.973	955.2
1951	919.7	111.0	0.901	828.6	1,057.5	111.0	0.901	952.8
1952	956.7	113.5	0.881	842.0	1,063.9	113.5	0.881	937.3
1953	1,143.4	114.4	0.874	999.3	1,434.5	114.4	0.874	1,253.8
1954	1,099.4	114.8	0.871	957.6	1,386.9	114.8	0.871	1,208.0
1955	1,147.6	114.5	0.873	1,001.8	1,385.5	114.5	0.873	1,209.5
1956	1,172.3	116.2	0.861	1,009.3	1,451.4	116.2	0.861	1,249.7
1957	1,227.3	120.2	0.832	1,021.1	1,489.7	120.2	0.832	1,239.4
1958	1,360.6	123.5	0.810	1,102.1	1,589.2	123.5	0.810	1,287.3
1959	1,361.8	124.6	0.803	1,093.5	1,558.2	124.6	0.803	1,251.2
1960	1,404.5	126.5	0.791	1,110.9	1,638.7	126.5	0.791	1,375.3
1961	1,294.4	127.9	0.782	1,012.2	1,470.5	127.9	0.782	1,149.9

*Personal income is actual estimated effective buying income, a similar term.

**1947-49=100.

Source: Income data: Sales Management's, Survey of Buying Power, 1946 - 1961; Consumer price index: National Industrial Conference Board, Economic Almanac, 1962.

TABLE 6

ADJUSTED RETAIL SALES AND PERSONAL INCOME PER CAPITA FOR THE CONTROL AREA FOR THE YEARS 1945 - 1961

	Retail Sales				Personal Income			
Year	Retail Sales*	Consumer Price Index**	Reciprocal of Price Index	Adjusted Retail Sales*	Personal Income Per Capita	Consumer Price Index**	Reciprocal of Price Index	Adjusted Personal Income
1945	21,497	76.9	1.300	27,954	728.1	76.9	1.300	946.8
1946	29,276	83.4	1.200	35,103	578.7	83.4	1.200	693.9
1947	31,055	95.5	1.047	32,518	669.4	95.5	1.047	701.3
1948	32,216	102.8	0.973	31,339	743.0	102.8	0.973	722.8
1949	32,505	101.8	0.982	31,930	661.4	101.8	0.982	649.7
1950	37,863	102.8	0.973	36,832	743.4	102.8	0.973	723.2
1951	40,574	111.0	0.901	36,553	798.5	111.0	0.901	719.4
1952	38,331	113.5	0.881	33,772	825.0	113.5	0.881	726.9
1953	38,021	114.4	0.874	33,235	1,001.6	114.4	0.874	875.5
1954	35,905	114.8	0.871	31,276	969.9	114.8	0.871	844.9
1955	40,591	114.5	0.873	35,451	988.1	114.5	0.873	863.0
1956	40,973	116.2	0.861	35,261	1,043.5	116.2	0.861	898.0
1957	41,682	120.2	0.832	34,677	1,065.5	120.2	0.832	886.4
1958	41,046	123.5	0.810	33,236	1,206.9	123.5	0.810	977.2
1959	44,945	124.6	0.803	36,071	1,190.3	124.6	0.803	955.3
1960	44,669	126.5	0.791	35,311	1,211.2	126.5	0.791	957.5
1961	44,981	127.9	0.782	35,169	1,224.2	127.9	0.782	957.2

*In thousands of dollars.

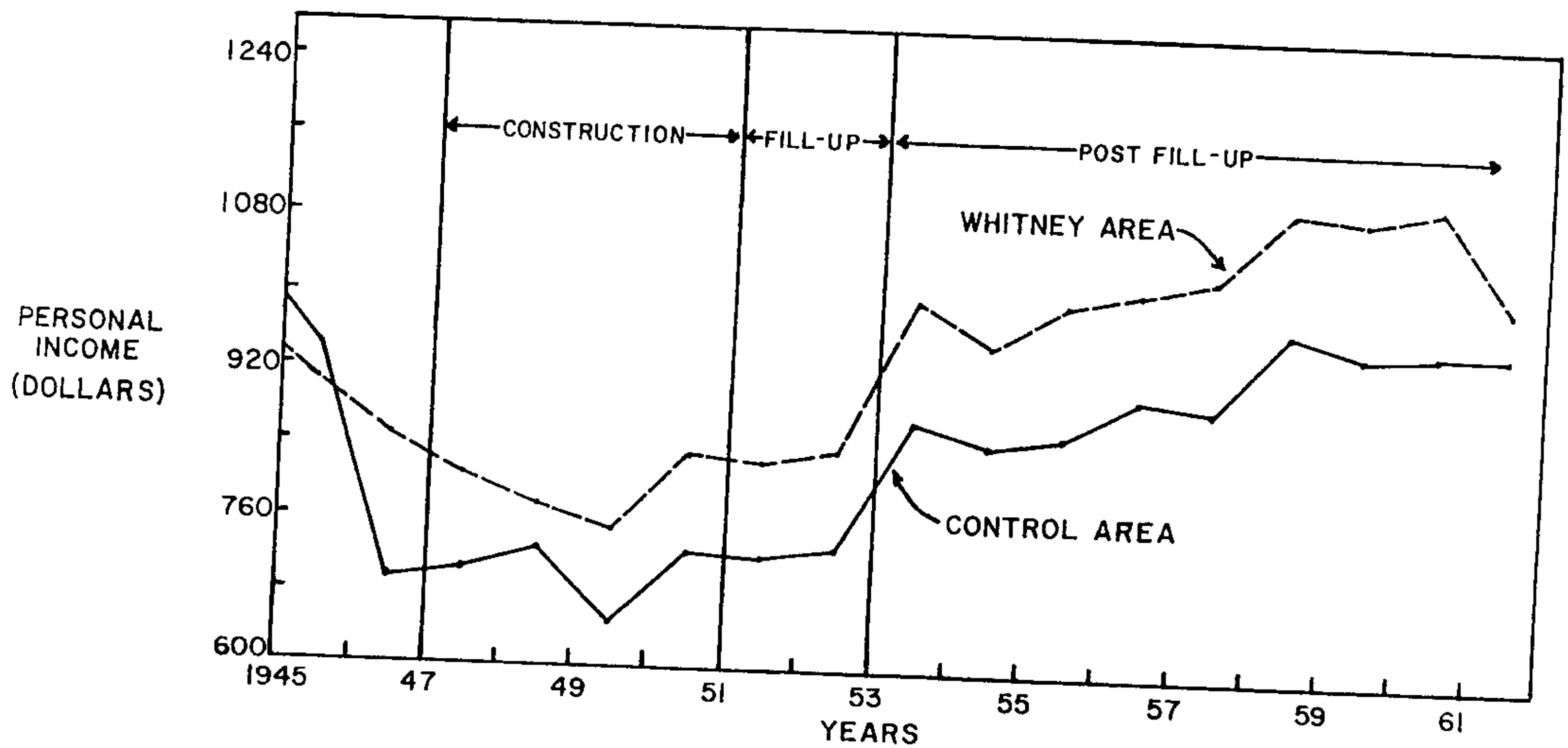
**1947-49=100.

Source: Income and retail sales data: Sales Management's, Survey of Buying Power, 1946 - 1961; Consumer price index: National Industrial Conference Board, Economic Almanac, 1962.

Income and retail sales data: Sales Management's, Survey of Buying Power, 1946 - 1961;
Consumer price index: National Industrial Conference Board, Economic Almanac, 1962.

FIGURE 6

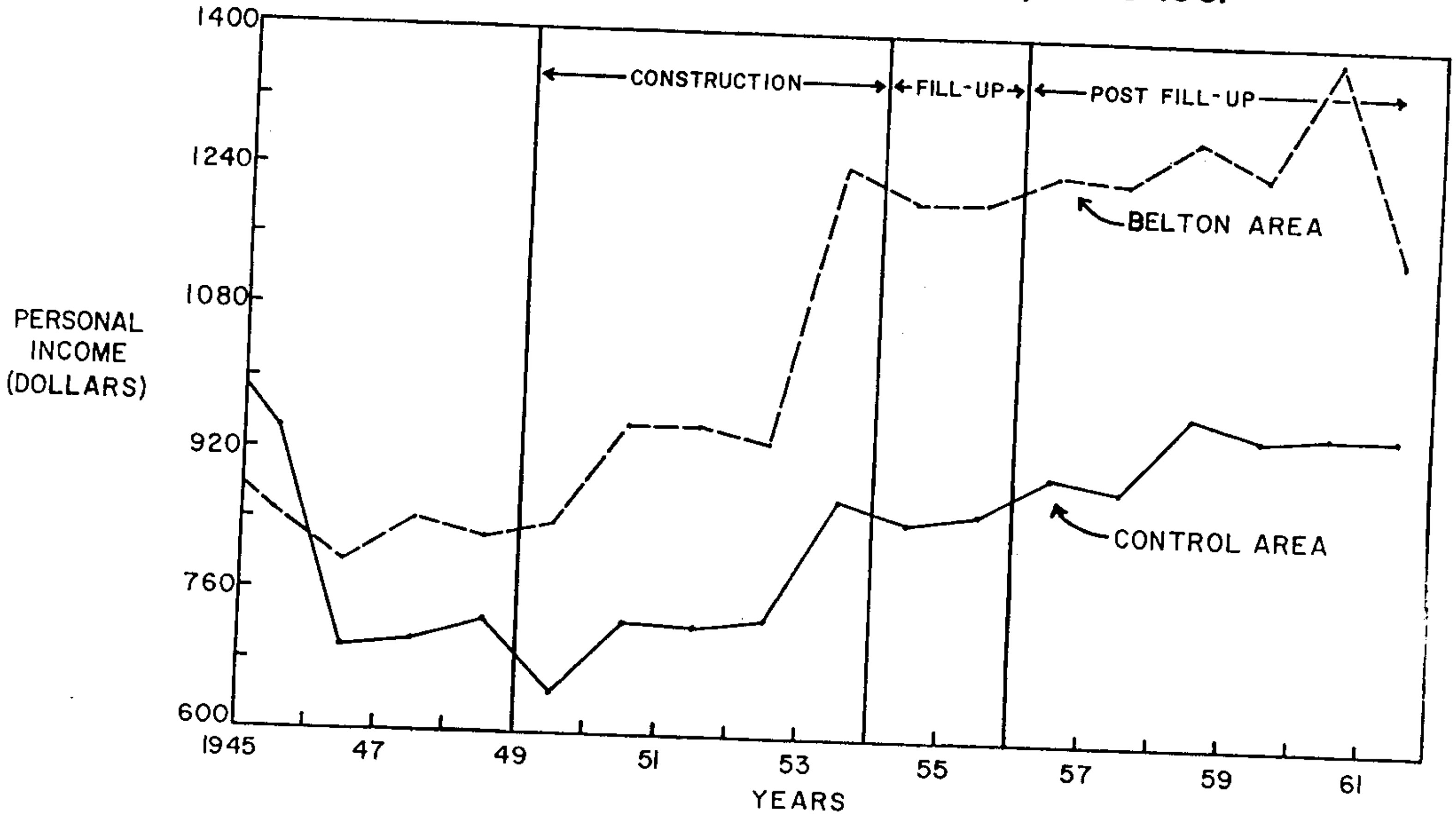
ADJUSTED PERSONAL INCOME PER CAPITA FOR THE WHITNEY AREA AND THE CONTROL AREA, 1945-1961



SOURCE: TABLES 5 AND 6.

FIGURE 7

ADJUSTED PERSONAL INCOME PER CAPITA FOR THE BELTON AREA AND THE CONTROL AREA, 1945-1961



SOURCE: TABLES 5 AND 6.

During fill-up both comparative study areas experienced first a slight decline in personal income. But as the reservoirs filled, personal income began to increase. Personal income in the control area followed a similar pattern, and it is probable that this movement was a regional trend not attributable to the dams.

Both areas experienced a slight decline in personal income after the reservoirs filled with water. After this initial decrease, the Whitney area experienced a consistent upward trend. The Belton area also had an upward trend, but with somewhat more erratic movement. The control area again showed a similar pattern during the same periods, indicating limited increases in personal income due to reservoir development.

Personal income analysis provided no immediate conclusions and other types of data were investigated. Retail sales give another type of pertinent information about all three stages of reservoir development.

Retail Sales

Retail sales reflect economic activity during all three stages of development and are particularly important during the two final stages. Tables 6 and 7 show adjusted retail sales for the control area and both comparative study areas during each of the years 1945 - 1961. The sales data have been adjusted by the 1947 - 1949 consumer price index in the same way personal income data were adjusted. Figures 8 and 9 provide a visual analysis of the data.

Retail sales show movements similar to those of personal income for the construction period. In the initial years retail sales for the Whitney area decreased, and as construction continued, began to increase.

SOURCE: TABLES 5 AND 6.

The Belton area experienced an overall upward trend in retail sales throughout the construction period.

Figure 8, comparing retail sales in the control area and the Whitney area, show similar variations in the respective economies. Both have similar population sizes, similar economic bases, and similar sized towns. Retail sales after 1953, the year the lake filled with water, remained at the increased level reached during the construction period.

Figure 9 shows adjusted retail sales for the Lake Belton and control area. These two areas could not be compared by the volume of sales, since the control area has less than half the population of the Belton area. Thus, comparisons were made by the direction and degree of movement during the time series. The Belton area had continued growth, with sharp increases in 1950 and 1955.

Retail sales provide a more accurate measure of reservoir impact in the post fill-up period. The control area declined in retail sales, but the Whitney area maintained a level above that of pre-construction. The Belton area showed a large increase but outside variables of the Belton area may distort the comparisons.

None of these three avenues, explored for possibly measuring impact of reservoir development on a local economy, proved accurate through all stages. Retail sales, provided a sufficient measure if there was only one major source of income to measure. However, with the Belton project and its surrounding area, other outside variables were present which could not be isolated by employing retail sales data.

Land Prices

Changes in land values is of particular importance when a dam is

TABLE 7

ADJUSTED RETAIL SALES FOR COMPARATIVE AREAS,
1945 - 1961

	Projection Area I (Whitney)				Projection Area II (Belton)			
Year	Retail Sales*	Consumer Price Index**	Reciprocal of Price Index	Adjusted Retail Sales	Retail Sales*	Consumer Price Index**	Reciprocal of Price Index	Adjusted Retail Sales
1945	15,710	76.9	1.300	20,423	23,507	76.9	1.300	30,559
1946	21,392	83.4	1.200	25,670	31,013	83.4	1.200	37,216
1947	22,692	95.5	1.047	23,758	34,958	95.5	1.047	36,601
1948	23,540	102.8	0.973	22,904	43,072	102.8	0.973	41,909
1949	23,752	101.8	0.982	23,324	44,205	101.8	0.982	43,409
1950	32,676	102.8	0.973	31,794	62,044	102.8	0.973	60,368
1951	35,015	111.0	0.901	31,548	66,485	111.0	0.901	59,902
1952	35,250	113.5	0.881	31,055	74,624	113.5	0.881	65,743
1953	34,965	114.4	0.874	30,559	74,021	114.4	0.874	64,694
1954	32,117	114.8	0.871	27,974	73,031	114.8	0.871	63,610
1955	34,376	114.5	0.873	30,010	99,888	114.5	0.873	87,202
1956	33,335	116.2	0.861	28,701	97,571	116.2	0.861	84,008
1957	33,994	120.2	0.832	28,283	104,614	120.2	0.832	87,038
1958	32,956	123.5	0.810	26,694	112,167	123.5	0.810	90,855
1959	35,454	124.6	0.803	28,469	103,431	124.6	0.803	83,055
1960	34,541	126.5	0.791	27,322	107,332	126.5	0.791	84,899
1961	33,897	122.9	0.782	26,577	112,119	127.9	0.782	87,677

*In thousands of dollars.

**1947-49=100.

Source: Income and retail sales data: <u>Sales Management's</u>, <u>Survey of Buying Power</u>, 1946 - 1961; Consumer price index: National Industrial Conference Board, <u>Economic Almanac</u>, 1962.

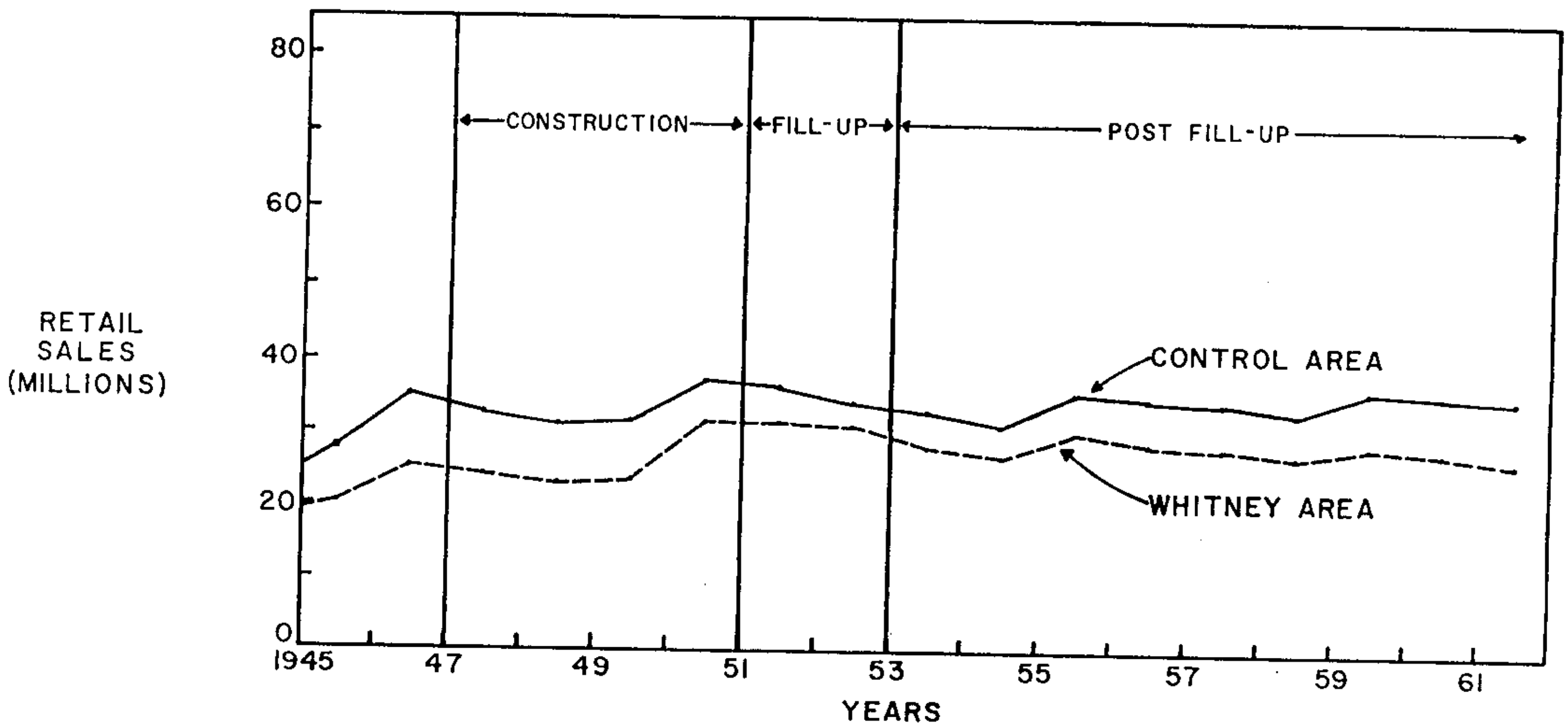
constructed and the reservoir begins to fill. These changes are most apparent for land immediately around the lake. This source of impact data was explored in the hopes that by analyzing the two comparative areas projections could be made for the primary study area.

A sample of land sales was taken from subdivisions in each of the comparative areas. Such an approach has one major weakness, the land prices will not indicate the effects of improvements. Two lots, exactly alike as far as soil, slope, and location with respect to water may command different prices because of landscaping, boat docks, and improved roads. Interviews with real estate developers of the Lake Whitney area and the tax assessor of Bell County were used to aid in the analysis of land values.

According to Mr. G. G. Murray, who has twenty-three different real estate developments around Lake Whitney, the average price per acre for large tracts before construction was between $40 and $100. After the start of construction prices jumped to an average price of $300 per acre for large tracts. One development, Woodland Hills, was started in 1948 with land abutting the water selling for $1,000 per acre, and land located back from the water selling for $450 an acre. In 1956, this land in the subdivision sold for an average of $15 a square foot along the water front and the secondary lots located back from the shoreline sold for $1,000 an acre. Since all land in this subdivision was sold by 1956, the conclusion can be drawn that the lake more than doubled the prices of some land between 1948 and 1956. A majority of the land had been developed and sold by 1964, and lots as far as three miles from the

FIGURE 8

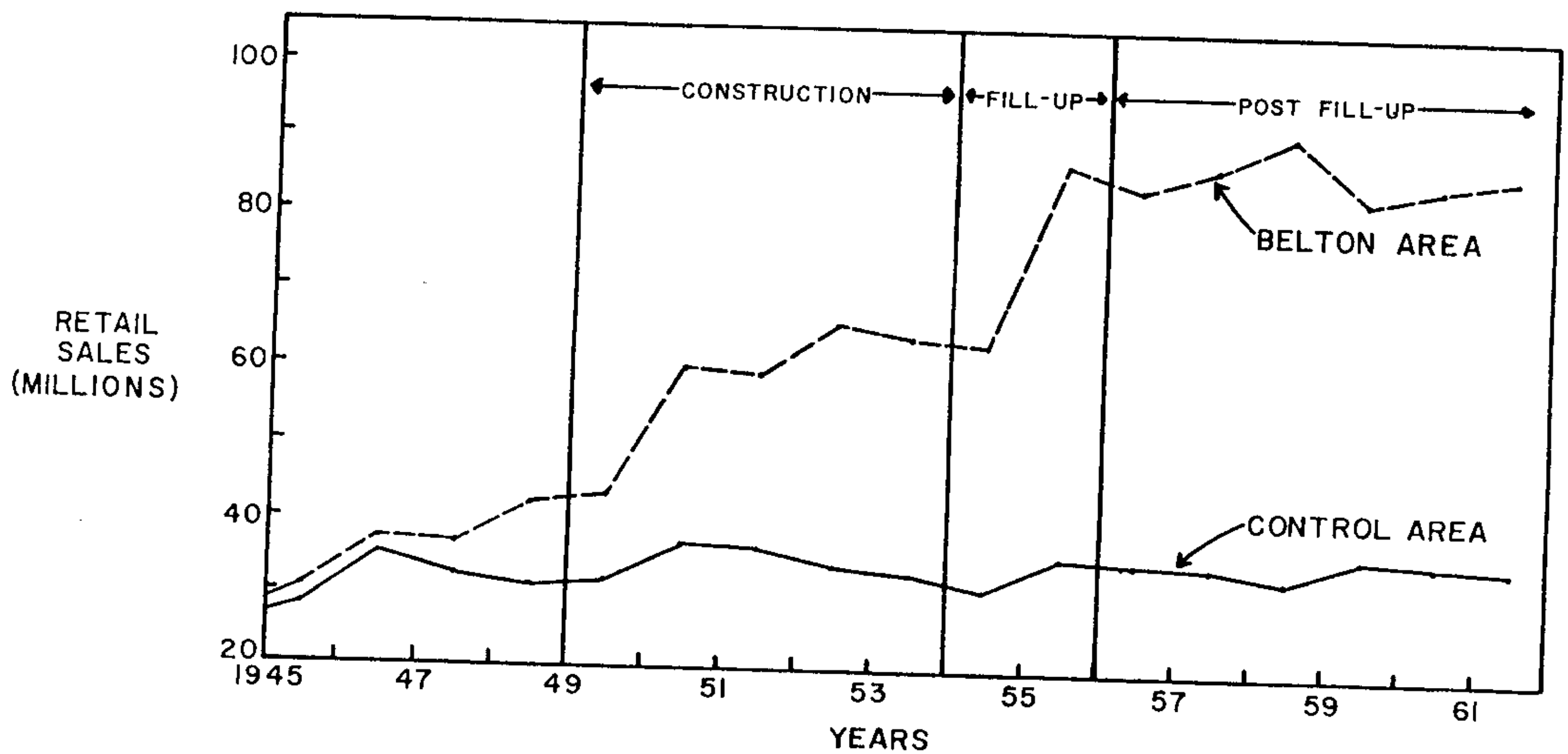
ADJUSTED RETAIL SALES FOR
WHITNEY AND CONTROL AREAS, 1945-1961



SOURCE: TABLES 6 AND 7.

FIGURE 9

ADJUSTED RETAIL SALES FOR
BELTON AND CONTROL AREAS, 1945-1961



SOURCE: TABLES 6 AND 7.

lake were being developed and sold for $150 an acre.[21]

Changes in land price around Lake Belton increased in a pattern similar to that of Lake Whitney. Mr. William Duke, Tax Assessor of Bell County, verified that land around Lake Belton sold in large tracts for about $150 an acre before construction. Table 8 shows some price changes in lots chosen at random, sold in the Woodland Hills Addition. Some of the lots have houses on them, and the sales price includes the value of the houses as well as other improvements made on the property. For example, in 1958, lot number four sold for $1,000, $1,200 in 1960, $1,450 in 1962, and with a house on it, $16,000 in 1963.[22]

Land prices, if generalized from both comparative areas, may reflect the economic impact reservoirs have on surrounding areas. In the two comparative areas the price for lots almost doubled after construction began. However, the accuracy of this measurement is limited, and the use of the data as a basis of projection is not satisfactory.

The economic systems selected to develop the comparative-projection model were examined for overall geographical and economic characteristics. Then, to isolate the effect of a reservoir on an area, a control area was selected and similarly described. Two comparative study areas were related to the control area by stages using an analysis of population, personal income, retail sales and land

SOURCE: TABLES 6 AND 7.

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[21] Interview with Mr. C. G. Murray, owner of Lake Whitney Enterprises, Whitney, Texas, December 12, 1964.

[22] Interview with Mr. William Duke, Tax Assessor of Bell County, Belton, Texas, December 18, 1964.

TABLE 8

LAND PRICES IN BLOCK 3 OF WOODLAND HILLS ADDITION,
LAKE BELTON, 1956 - 1963

Lot No.	Year of Sale								
	1956	1957	1958	1959	1960	1961	1962	1963	1964
1			$1,100						
2		$ 800	1,000					$ 3,950	
4			1,000		$1,200		$1,450	16,000*	
5					1,200				
6					1,200			17,000*	
8		1,100							
9		1,200							
10		1,000			6,000*		7,200		
11		1,200							
12	$1,500					$2,100	2,500		
14		1,000						5,900*	
16		800		$1,200					
17		1,000		1,000					

*Sales price includes value house built on the property.

Source: Interview with Mr. William Duke, Tax Assessor of Bell County, Belton, Texas, December 18, 1964.

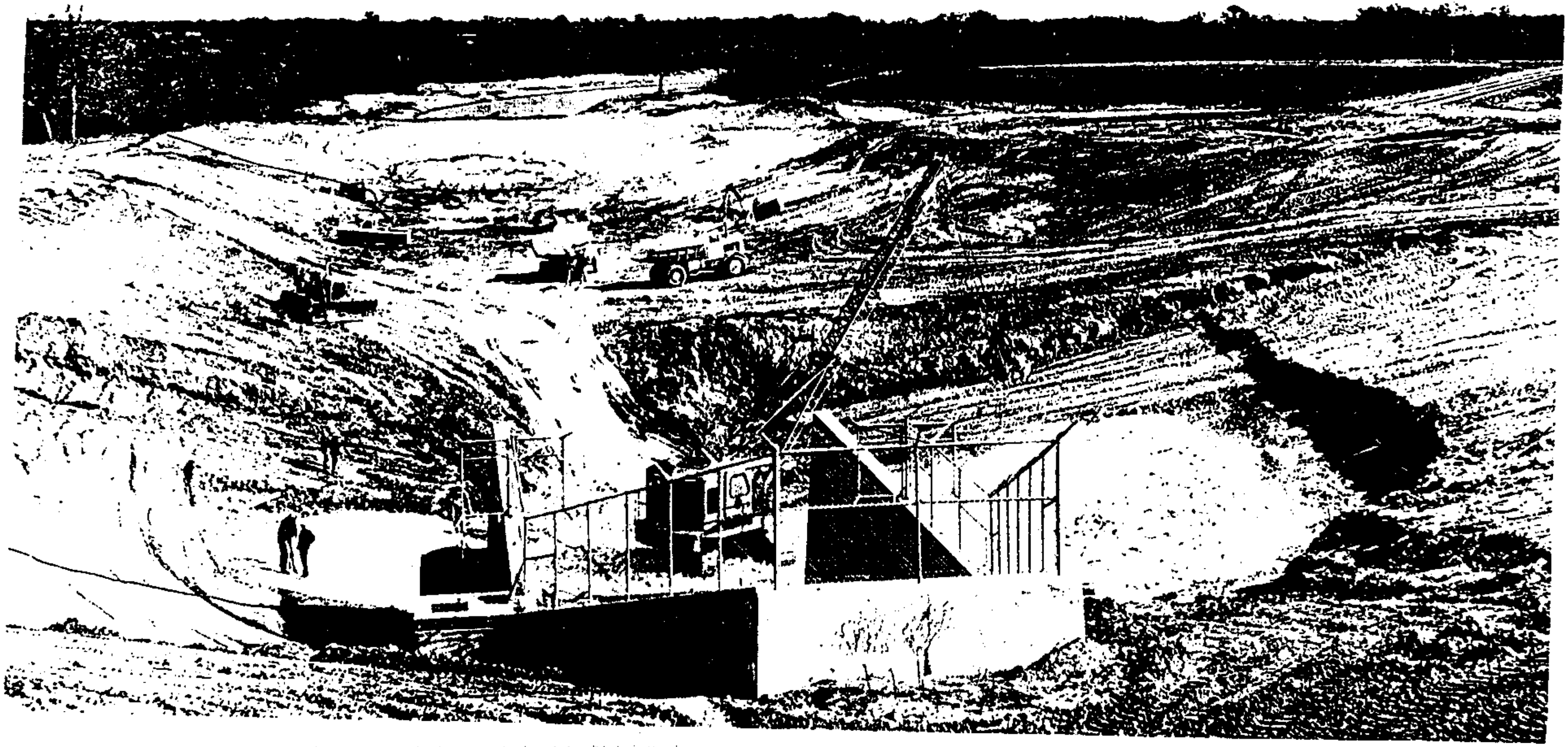
prices. An analysis of these data yielded inconclusive results regarding the overall impact of a reservoir.

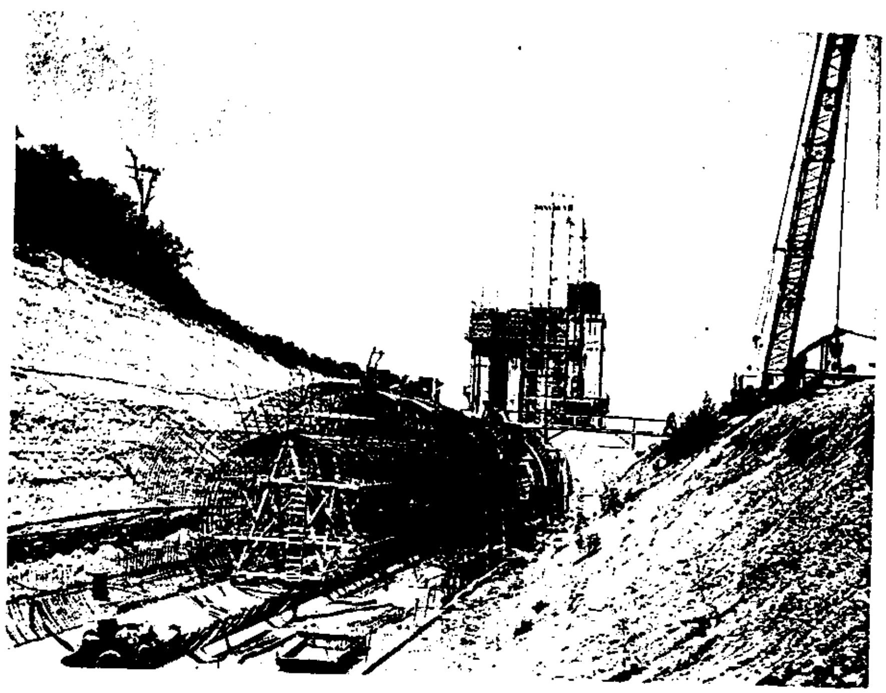
Additional attempts to use related secondary data for measuring economic impact are included in the appendices.

CONSTRUCTION STAGE, FLOOD CONTROL
CONDUIT, LAKE BELTON, TEXAS, 1950
(Source: Corps of Engineers, U. S. Army, Fort Worth, Texas)

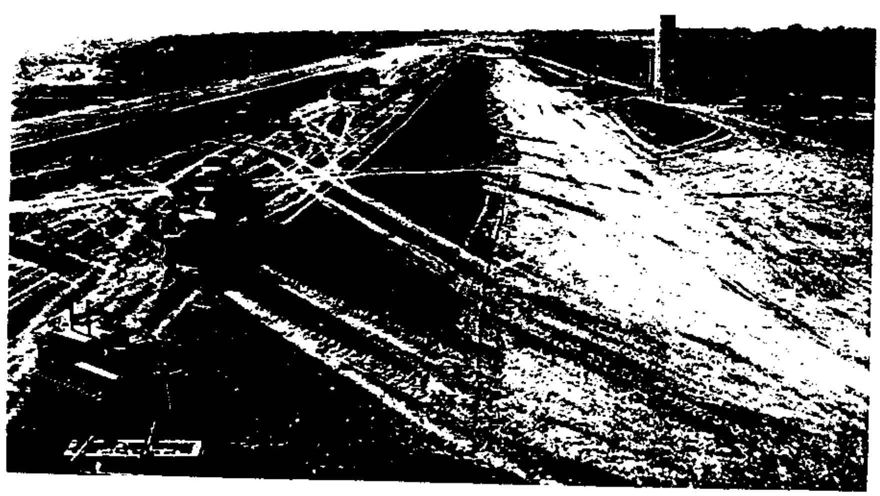
CONSTRUCTION STAGE, EARTHEN DAM,
LAKE BELTON, TEXAS, 1953
(Source: Corps of Engineers, U. S. Army, Fort Worth, Texas)

CONSTRUCTION STAGE, OUTLET WORKS,
LAKE SOMERVILLE, TEXAS, 1963
(Source: Gene Dennis, Bryan, Texas)



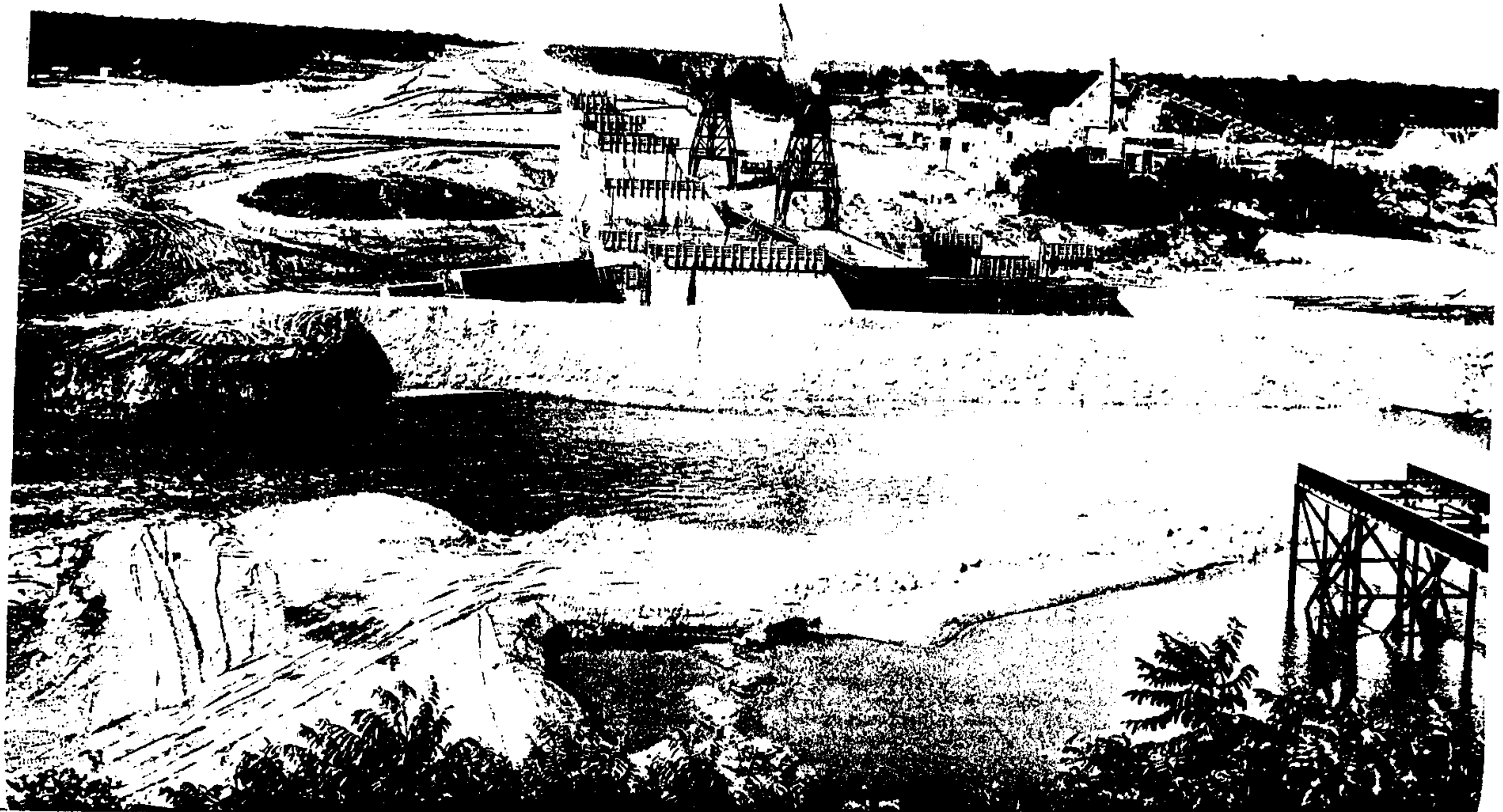


CONSTRUCTION STAGE, FOREGROUND: FLOOD CONDUIT, BACKGROUND:
INTAKE TOWER, LAKE BELTON, TEXAS, 1951
(Source: Corps of Engineers, U. S. Army, Fort Worth, Texas)

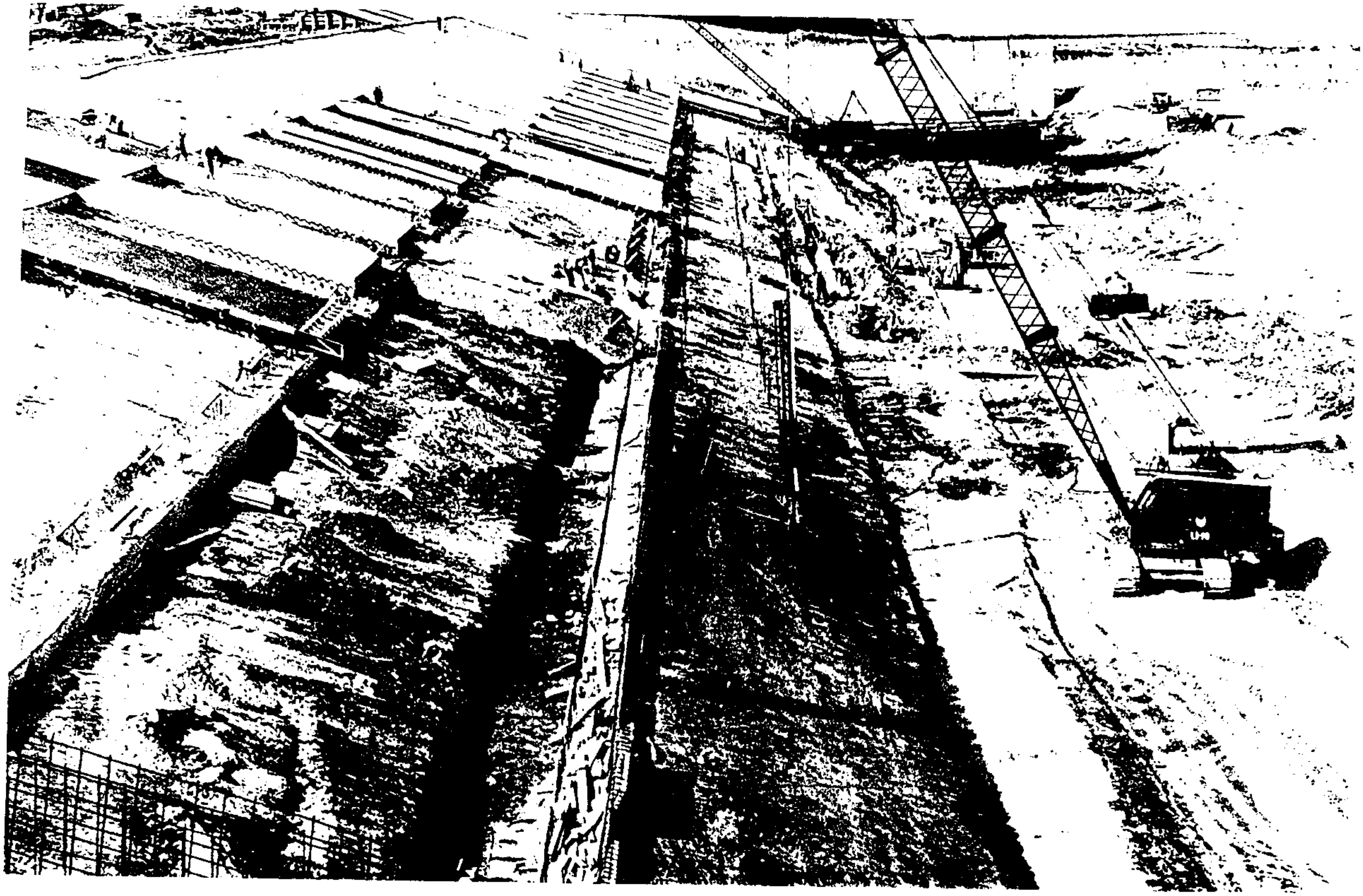


CONSTRUCTION STAGE, EARTHEN DAM AND INTAKE TOWER,
LAKE BELTON, TEXAS, 1953
(Source: Corps of Engineers, U. S. Army, Fort Worth, Texas)

CONSTRUCTION STAGE, CONCRETE DAM,
LAKE WHITNEY, TEXAS, 1949
(Source: Bill Woodside, Whitney, Texas)



CONSTRUCTION STAGE, LOWERING OF
FLOOD GATE, LAKE BELTON, TEXAS, 1952
(Source: Temple Daily Telegram, Temple, Texas)



CONSTRUCTION STAGE, CONCRETE SPILLWAY,
LAKE SOMERVILLE, TEXAS, 1963

Part IV

A TEST OF THE COMPARATIVE-PROJECTION MODEL

The accuracy of the comparative-projection model can be tested only with an elaborate parallel system designed specifically for measurement. Such a parallel system of measurement was designed to be independent of the model.

THE PARALLEL SYSTEM

Economic impact was defined in Part II as that increase in income attributable to the development of a reservoir. The model calculated this increase and then expressed it as a percentage of the base year income for an area. If aggregate income figures were available for the two comparative areas, the parallel system would need only to index these in order to test the model. This would provide a simple and accurate method of testing the predictability of the comparative-projection model. However, accurate aggregate income figures for the comparative areas were unavailable.

Another indicator, with independent inputs, was sought. More data is available for larger cities, and an attempt was made to find an economic indicator using simple correlation methods. Data for this type of analysis was collected from two sources: (1) bank debits, bank deposits, and postal receipt figures for the years 1945-1963 from The Texas Business Review for seventeen cities and (2) estimated income and retail sales figures for the same cities from Sales Management's, Survey of Buying Power. A correlation analysis, using income as the dependent variable, and bank debits, bank deposits, and postal receipts as the independent variables, was made. A library computer program, Wilson's Multiple Regression Program, was used to make the analysis. The results are given in Table 9. The indicator most consistently reflecting the movement of income was bank debits. The other combinations provide high correlations for some cities, but the degree of variation for all seventeen cities is greater than that of bank debits and income.

Bank debits could not be used as a reliable parallel set of data. Even though a significant correlation existed for some cities, there still existed a large amount of unexplained variation. Further, upon investigation of the data available for the comparative areas, it was found that bank debit figures are not kept for all small banks. Since the majority of the banks in the comparative areas were small, the search for a parallel system of economic measure had to be further modified.

Attention was directed toward developing a synthetic index which would reflect the movement of income. The seventeen cities used in the initial investigations were reduced to six: the three largest, Houston, Dallas, San Antonio, and the three smallest, Lamesa, Henderson, Brenham. The data for each city was the same as that used in the earlier analysis. Data for the six cities for the period 1953-63 are listed in Appendix C.

An analysis of the six cities was made using every combination of the other three independent variables to correlate them against the dependent variable income. Again, the Wilson Multiple Regression Program was used. Two of the relationships which showed high correlations are

TABLE 9

CORRELATION COEFFICIENTS OF SPECIFIED RELATIONSHIPS FOR SEVENTEEN SELECTED CITIES, TEXAS, 1950 - 1963*

City	Bank Debits and Income	Postal Receipts and Income	Bank Deposits and Income	Retail Sales and Income
1	.8712	.8520	.6950	.6263
2	.9889	.9777	.3229	.9667
3	.8929	.9119	.8294	.8291
4	.0622	-.0965	.3168	.2045
5	.5196	.6265	.2264	.2270
6	.9366	.9685	.8822	.9826
7	.9783	.9413	.4157	.8681
8	.9554	.9277	.3825	.8802
9	.9802	.9380	.4886	.9207
10	.9677	.9800	.6817	.9569
11	.8370	.8001	.7023	.8367
12	.8589	.8161	-.5204	.7651
13	.7332	.6136	-.5727	.7407
14	.9789	.9538	.7645	.9502
15	.7123	.7511	.5608	.5118
16	.8234	.6365	.7065	.9018
17	.7337	.6653	.2855	.4338

*Further calculations in Appendix C.

Source: Original income and retail sales data: Sales Management's, Survey of Buying Power, 1950 - 1963; Original bank debit, postal receipt, and bank deposit data: Texas Business Review, 1950 - 1963.

shown in Table 10. The results showed high correlations for four of the six cities, but low correlations for the other two. Such inconsistencies could not provide a satisfactory parallel system.

Another change was proposed and tested. Since bank debits are claimed to be an acceptable measure of economic activity,[23] and earlier correlations

[23] See George Garvey, Debits and Clearings Statistics and Their Use, Board of Governors of the Federal Reserve System, Washington, D.C., 1959.

TABLE 10

CORRELATIONS OF SELECTED VARIABLES AND INCOME AS DEPENDENT VARIABLE, SIX TEXAS CITIES, 1950-63

VARIABLE	CORRELATION					
	Houston	Dallas	San Antonio	Lamesa	Henderson	Brenham
Deposits, Retail Sales vs. Income	.9660	.9715	.9545	.5831	.9020	.6950
Postal Receipts, Retail Sales, Deposits vs. Income	.9699	.9849	.9623	.7962	.9090	.8728

Source: Data tables, Appendix C.

between the debit and income figures had been moderately high, bank debits were used as the dependent variable. The independent variables were postal receipts, bank deposits, and estimated income and retail sales, and the same computer program was used for all possible combinations of variables. Results are shown in Table 11. The selected relationships of the table show that a composite of estimated income, postal receipts, estimated retail sales and bank deposits yield the highest r for all six cities. Thus, a synthetic index yielded a higher r than any of the simple correlations tried.

A further modification of the relationship of the variables was tested. Differences from year to year of the gross figures were used rather than gross bank deposit figures. On the basis of the results listed in Table 11, only two combinations were tested for an increase or decrease in r. The results of this change in variables are shown in Table 12, and the increases in r are shown in Table 13. A decrease

TABLE 11

CORRELATIONS OF SELECTED VARIABLES AND BANK DEBITS AS DEPENDENT VARIABLE, SIX TEXAS CITIES, 1950-63

VARIABLE	CORRELATION					
	Houston	Dallas	San Antonio	Lamesa	Henderson	Brenham
Income vs. Debits	.9677	.9889	.9789	.7124	.8234	.8712
Postal Receipts vs. Debits	.1887	.9739	.9661	.9796	.8708	.9602
Income, Postal Receipts vs. Debits	.9725	.9895	.9848	.9803	.9381	.9655
Postal Receipts, Deposits vs. Debits	.8037	.9749	.9662	.9849	.9110	.9648
Postal Receipts, Retail Sales vs. Debits	.9921	.9904	.9842	.9808	.9270	.9716
Deposits, Retail Sales vs. Debits	.9924	.9853	.9814	.9227	.9405	.7015
Postal Receipts, Deposits, Retail Sales vs. Debits	.9924	.9906	.9842	.9886	.9407	.9726
Income, Postal Receipts, Deposits, Retail Sales vs. Debits	.9942	.9945	.9923	.9887	.9485	.9751

Source: Data tables, Appendix C.

TABLE 12

CORRELATIONS OF SELECTED VARIABLES INCLUDING BANK DEPOSIT DIFFERENCES AND BANK DEBITS AS THE DEPENDENT VARIABLE, SIX TEXAS CITIES, 1950-63

VARIABLE	CORRELATION				
	Houston	Dallas	San Antonio	Lamesa	Henderson
Postal Receipts, Deposit Differences vs. Debits	.9627	.9834	.9758	.9888	.8767
Postal Receipts, Income, Retail Sales, Deposit Differences vs. Debits	.9944	.9972	.9951	.9920	.9873

Source: Data tables, in Appendix C.

occurred in only one of the coefficients.

The availability of pertinent economic data was the limiting to build a parallel system. This problem was first encountered simple correlation analysis and continued until a synthetic inde: eloped. The final synthetic index was composed of estimated ret postal receipts, bank deposit differences, and estimated income. combination of these four variables, as seen by the results in T approximates the movement of bank debits, and data for the four was available for each of the comparative areas and for the contr

INPUTS OF THE TWO MEASUREMENT METHODS

The synthetic index was to provide a reasonable target for th

TABLE 13

COMPARISON OF TWO SELECTED CORRELATIONS,
SIX TEXAS CITIES, 1950-63

VARIABLE	CORRELATION					
	Houston	Dallas	San Antonio	Lamesa	Henderson	Brenham
Postal Receipts, Deposits vs. Debits	.8037	.9749	.9662	.9849	.9110	.9648
Postal Receipts, Deposit Differences vs. Debits	.9627	.9834	.9758	.9888	.8767	.9776
Income, Postal Receipts, Deposits, Retail Sales vs. Debits	.9942	.9945	.9923	.9887	.9485	.9751
Postal Receipts, Income Retail Sales, Deposit Differences vs. Debits	.9944	.9972	.9951	.9920	.9873	.9935

Source: Data tables, Appendix C.

based on the two comparative areas. The projections of the model, to be influenced only by those inputs into the economy attributable to the development of the reservoir, were to be identical to the index.

Information from the control area is used to measure net increases or decreases in the economies surrounding the reservoirs in the comparative areas. Since the economic base for each area differed, the only basis for removing normal economic growth (as denoted by the control area) was to index the area totals to a base year.

Inputs for each area were totaled (by the method established with earlier correlations) and the first year of construction was used as the index base year. The year 1947 is used and the data for Comparative Area I and the control area were indexed to this base. The results of this indexing are shown in Table 14. For comparison of Comparative Area II and the control area the base year was established as 1949, and the results are shown in Table 15.

Net economic activity attributable to the reservoirs in the comparative areas can be isolated by establishing an index to a corresponding base for the comparative areas and the control area. Tables 14 and 15 show these net differences expressed by the synthetic index.

The initial concept for a parallel measure of the comparative-projection model was to obtain aggregate income figures for the respective areas; and, from these figures the movement of aggregate income could have been computed. This attempt met with little success. A synthetic index was developed to reflect the movement of aggregate income through a combination of several variables. The index for each comparative area and the control area was based to remove effects of

TABLE 14

SYNTHETIC INDEX DATA FOR
COMPARATIVE AREA I AND THE CONTROL AREA

	Comparative Area I		Control Area		
Year	Total*	Index/	Total**	Index/	Difference
1947	$174,959	100.0	$253,897	100.0	0.0
1948	211,140	120.7	260,462	102.6	18.1
1949	214,861	122.8	262,772	103.5	19.3
1950	235,419	134.6	270,701	106.6	28.0
1951	229,988	131.5	280,114	110.3	21.2
1952	251,312	143.6	301,977	118.9	24.7
1953	257,217	147.0	312,923	123.2	23.8
1954	247,221	141.3	314,284	123.7	17.6
1955	254,205	145.3	323,529	127.4	17.9
1956	252,761	144.5	328,392	129.3	15.2
1957	256,969	146.9	329,278	129.7	17.2
1958	271,373	155.1	331,524	130.6	24.5
1959	268,902	153.7	350,426	138.0	15.7
1960	280,300	160.2	345,449	136.1	24.1
1961	281,463	160.9	354,944	139.8	21.1
1962	292,542	167.2	356,342	140.3	26.9
1963	300,257	171.6	377,498	148.7	22.9

/Base year 1947.

Source: *Summation of Tables 7d and 8d, Appendix D.
**Summation of Tables 11d - 13d, Appendix D.

normal economic growth. The results were changes in income expressed as a percentage of the existing levels of income during the year construction began.

The existing level of income in each local economy was described in Part II as an input to the model. This input was used, to establish the agrarian-industrial make-up of the economy and to provide a base for the percentage calculations so that index results and the model were on a similar scale. These percentage increments were developed in the model for year by year analysis, and also for a total change from the

TABLE 15

SYNTHETIC INDEX DATA FOR
COMPARATIVE AREA II AND THE CONTROL AREA

Year	Comparative Area II Total*	Comparative Area II Index/	Control Area Total**	Control Area Index/	Difference
1949	$ 561,241	100.0	$262,772	100.0	0.0
1950	660,495	117.7	270,701	103.1	14.5
1951	832,182	148.3	280,114	106.6	41.6
1952	943,789	168.2	301,977	114.9	53.2
1953	886,490	158.0	312,923	119.1	38.8
1954	1,040,575	185.4	314,284	119.6	65.8
1955	1,087,275	193.7	323,529	123.1	70.6
1956	954,328	170.0	328,392	125.0	45.0
1957	1,039,039	185.1	329,278	125.3	59.8
1958	1,120,666	199.7	331,524	126.1	73.5
1959	1,102,236	196.4	350,426	133.4	62.9
1960	1,160,206	206.7	345,449	131.5	75.2
1961	1,170,027	208.5	354,944	135.1	73.3
1962	1,307,095	232.9	356,342	135.6	97.2
1963	1,388,916	247.5	377,498	143.7	103.7

/Base year 1949.

Source: *Summation of data in Tables 9d and 10d, Appendix D.
**Summation of data in Tables 11d - 13d, Appendix D.

initial year of construction.

The comparative-projection model was converted to a computer program so that inputs could be in basic form. The internal computations of the program adjust data to the form required for inputs to the final model. Basic characteristics about each reservoir and the economy surrounding it are necessary for the initiation of the program. Table 16 gives these specifics for each of the comparative areas.

The program makes preliminary projections for the four major in

TABLE 16

BASIC INPUT DATA TO THE MODEL
FOR THE TWO COMPARATIVE AREAS

Type	Comparative Area I	Comparative Area II
Name of project	Whitney Dam	Belton Dam
Total Land Area of Contiguous Counties	2,023 sq. mi.	2,087 sq. mi.
Population of Contiguous Counties for year of construction	47,800	87,100
Estimated income of the Contiguous Counties (000)	$32,000	$75,440
Estimated Agricultural Income of the Contiguous Counties (000)	$17,440	$16,025
Distance to nearest city over 25,000 population	30 mi.	10 mi.
Year Construction began	1947	1949
Year Construction ended	1951	1954
Yearly Construction expenditures (000)		
year 1	$3,552	$1,885
year 2	6,307	1,690
year 3	14,100	1,918
year 4	8,689	4,419
year 5		2,911
Construction expenditures during Fill-Up		
year 1	5,769	
year 2	2,191	
Yearly Average O&M expenditures (000)	$ 150	$ 150
Population 100-mile radius of Reservoir beginning last decennial census	1,612,866	2,081,929
Population 100-mile radius of Reservoir ending of last decennial census	1,903,109	2,384,762
Area of present reservoir	15,800 ac.ft.	9,400 ac.ft.
Shoreline of present reservoir	190 mi.	110 mi.
Area of all lakes* within 100-mile radius of present reservoir	157,600 ac.ft.	139,150 ac.ft.
Number of lakes* within 100-mile radius of present reservoir	14	13

*Lakes are defined as bodies of water consisting of over 2,500 acre feet.

Source: Corps of Engineers statistics, Texas Almanac, Agricultural Census, 1945, Sales Management's, Survey of Buying Power, U. S. Census, 1940 and 1950.

to the economic model. These preliminary projections include the population for the area within a one hundred mile radius of the reservoir, expected attendance based on this population, and expected commercial and residential investment attracted to a given reservoir. Table 17 gives preliminary projection statistics for Comparative Area I and Table 18 gives the same information for Comparative Area II.

An accuracy check is available only for the attendance projections. These projections are compared in Figures 10 and 11 with the attendance data furnished by the Corps of Engineers. The investment projections were developed with certain trends observed in the two comparati areas and personal interviews with local businessmen.[24] Businessmen o: the areas could not provide accurate year by year investment analysis. However, five-year totals[25] were secured for Comparative Area I througl the efforts of local businessmen. The average per unit investment was estimated on the basis of observation and the interviews.

COMPARISON OF RESULTS

Two methods of measuring economic activity were proposed and test Both measure the same activity, but the inputs to each method are diff ent. The first, a synthetic index, established through use of known economic indicators, utilizes the inputs of postal receipts, bank depc differences and estimated retail sales and income. These inputs, summ for each comparative area and for the control area, yield a net econor

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[24] Letter from Mr. Bill Woodside, Manager Lake Whitney Associatio: February, 1967.

[25] Ibid., The five totals for the area around Lake Whitney were 1,100 dwellings and 73 commercial camps, baitstands, stores, etc.

TABLE 17

RECREATIONAL AND INVESTMENT PROJECTIONS,
BY YEAR AND TYPE, WHITNEY RESERVOIR,
1951 - 1958

			RECREATION							INVESTMENT			
			CAMP		BOAT FISH		SWIM, PICNIC, SKI, SIGHTSEE			RESIDENTIAL		COMMERCIAL	
Yr.	Total Projected Attend-ance	Total Outside Attend-ance	#	Expendi-tures*	#	Expendi-tures*	#	Expendi-tures*	Total Expendi-tures*	#	Expendi-tures*	#	Expendi-tures*
4										38	$ 228		
5	590,144	537,133	390,941	$1,596	113,928	$ 371	31,618	$ 55	$ 2,022	76	456	14	$ 434
6	1,670,434	1,520,384	1,106,578	4,526	322,479	1,051	89,497	157	5,734	152	912	29	899
7	2,547,458	2,318,627	1,687,562	6,902	491,789	1,603	136,486	239	8,744	304	1,824	17	527
8	3,021,624	2,750,200	2,001,673	8,187	583,328	1,902	161,890	283	10,372	213	1,278	10	310
9	3,291,472	2,995,808	2,180,434	8,918	635,422	2,071	176,348	309	11,298	149	894	6	186
10	3,457,937	3,147,321	2,290,709	9,369	667,558	2,176	185,267	324	11,869	104	624	4	124
11	3,572,338	3,251,445	2,366,493	9,679	689,644	2,248	191,396	335	12,262	73	438	2	62

*In thousands of dollars.

Source: Projections generated by comparative-projection model.

TABLE 18

RECREATIONAL AND INVESTMENT PROJECTIONS, BY YEAR AND TYPE, BELTON RESERVOIR, 1954 - 1961

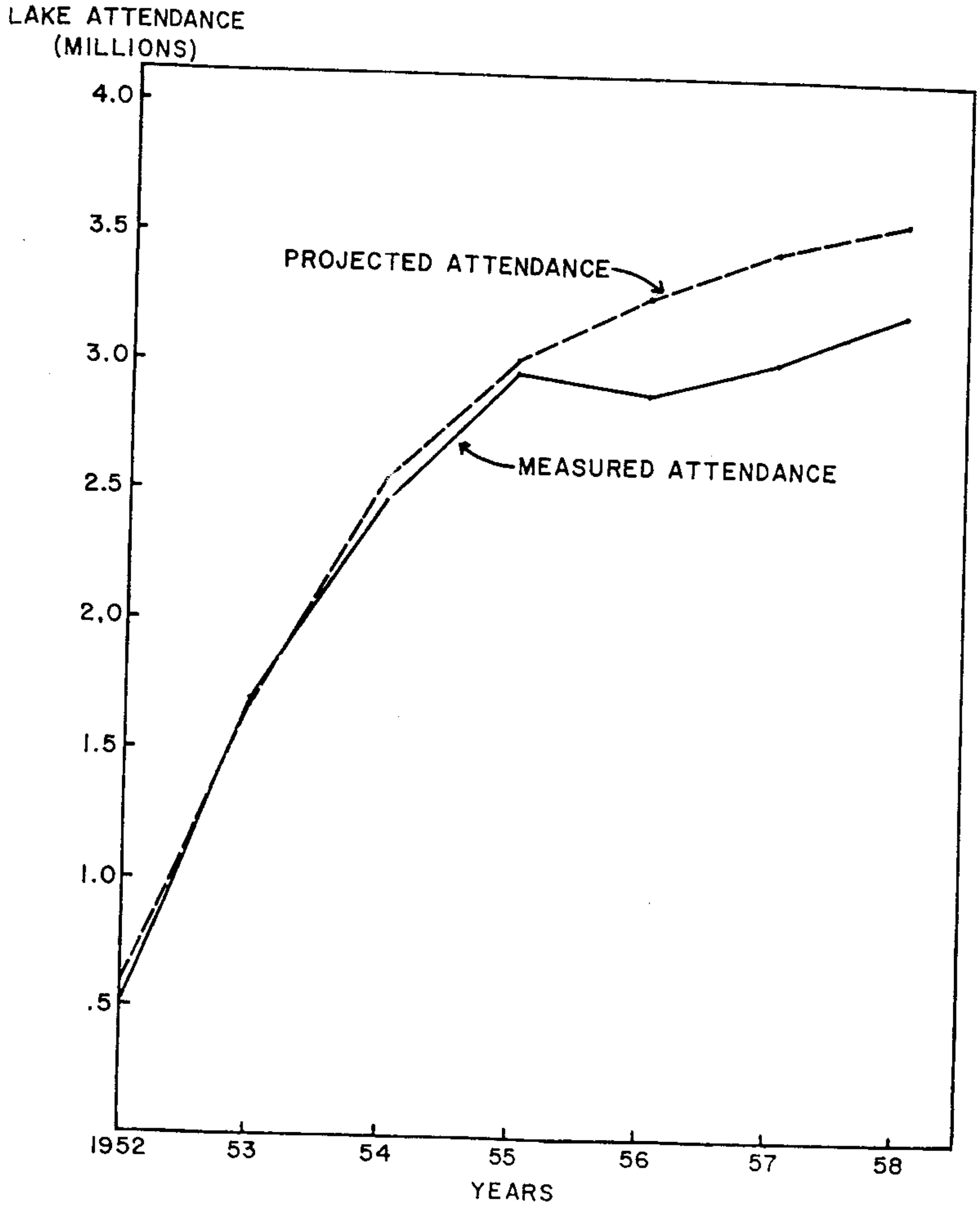
			RECREATION							INVESTMENT			
			CAMP		BOAT FISH		SWIM, PICNIC, SKI, SIGHTSEE			RESIDENTIAL		COMMERCIAL	
Yr.	Total Projected Attend-ance	Total Outside Attend-ance	#	Expendi-tures*	#	Expendi-tures*	#	Expendi-tures*	Total Expendi-tures*	#	Expendi-tures*	#	Expendi-tures*
5	755,367	405,410	226,434	$ 926	79,757	$260	98,709	$173	$1,359	22	$ 132		
6	1,065,848	572,047	319,506	1,307	112,541	367	139,281	244	1,918	44	264	6	$186
7	1,620,632	869,803	485,812	1,987	171,119	558	211,778	371	2,916	88	528	13	403
8	1,916,590	1,028,645	574,530	2,350	202,368	660	250,453	438	3,448	176	1,064	8	248
9	2,081,566	1,117,189	623,984	2,552	219,788	717	272,012	476	3,745	123	738	5	155
10	2,180,362	1,170,214	653,600	2,673	230,220	751	284,922	499	3,923	86	516	3	93
11	2,245,822	1,205,347	673,223	2,753	237,131	773	293,476	514	4,040	60	360	2	62
12	2,294,597	1,231,524	687,844	2,813	242,281	790	299,850	525	4,128	42	252	1	31

*In thousands of dollars.

Source: Projections generated by comparative-projection model.

FIGURE 10

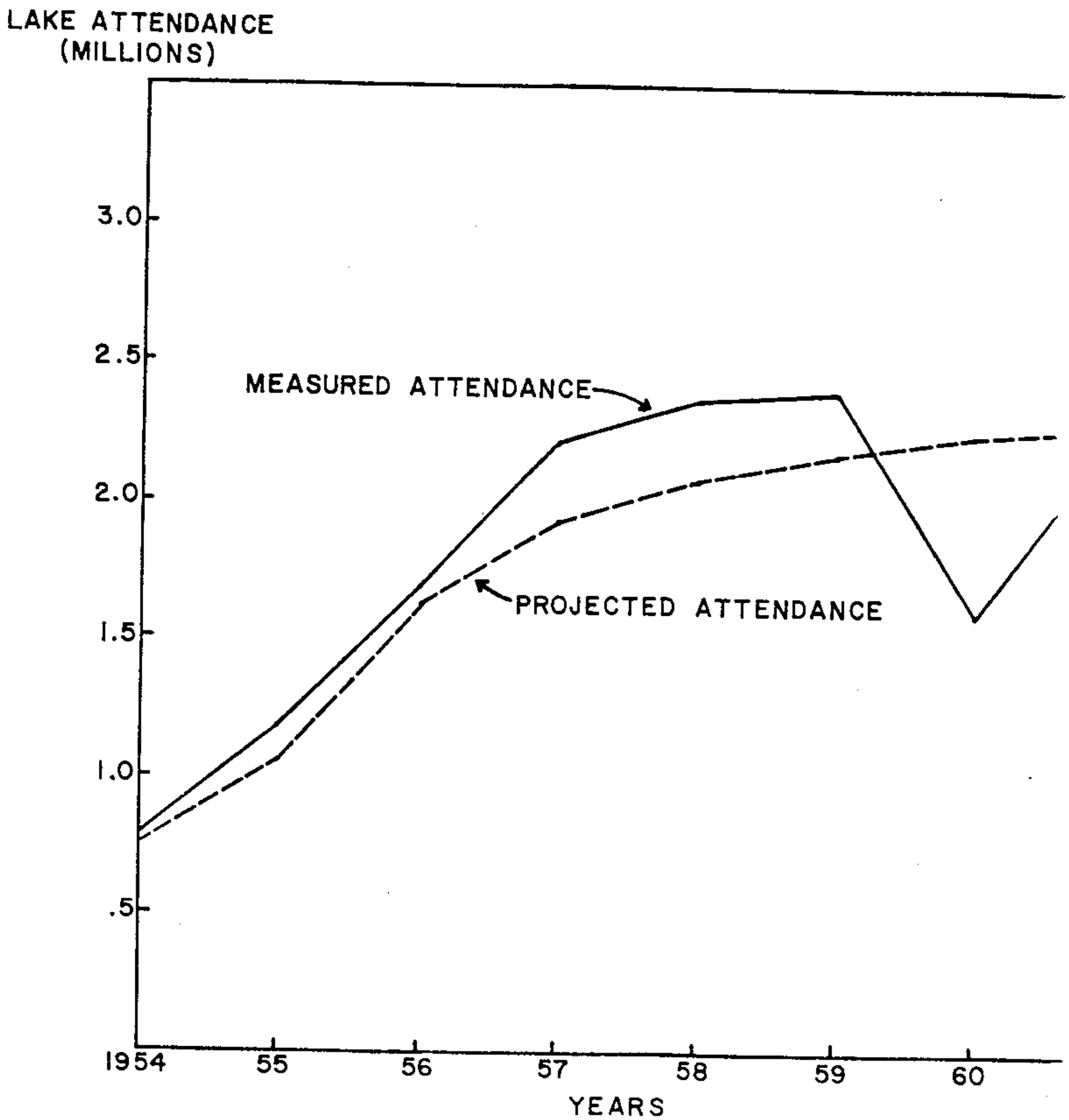
COMPARISON OF ATTENDANCE RESULTS IN THE PROJECTION MODEL WITH ACTUAL ATTENDANCE LAKE WHITNEY, TEXAS, 1952-58



SOURCE: TABLE 2.

FIGURE II

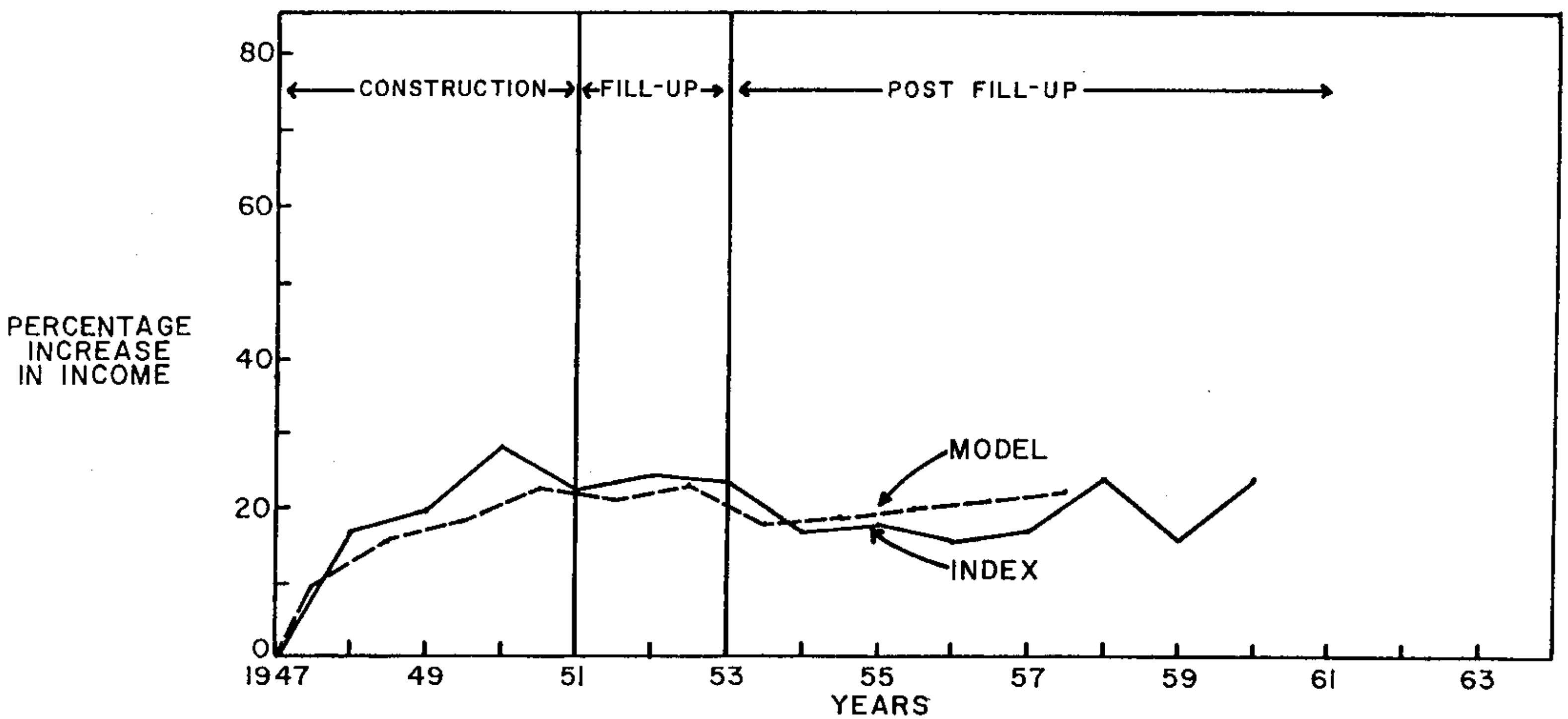
COMPARISON OF ATTENDANCE RESULTS IN THE PROJECTION MODEL WITH ACTUAL ATTENDANCE LAKE BELTON, TEXAS, 1954-6



SOURCE: TABLE 3.

FIGURE 12

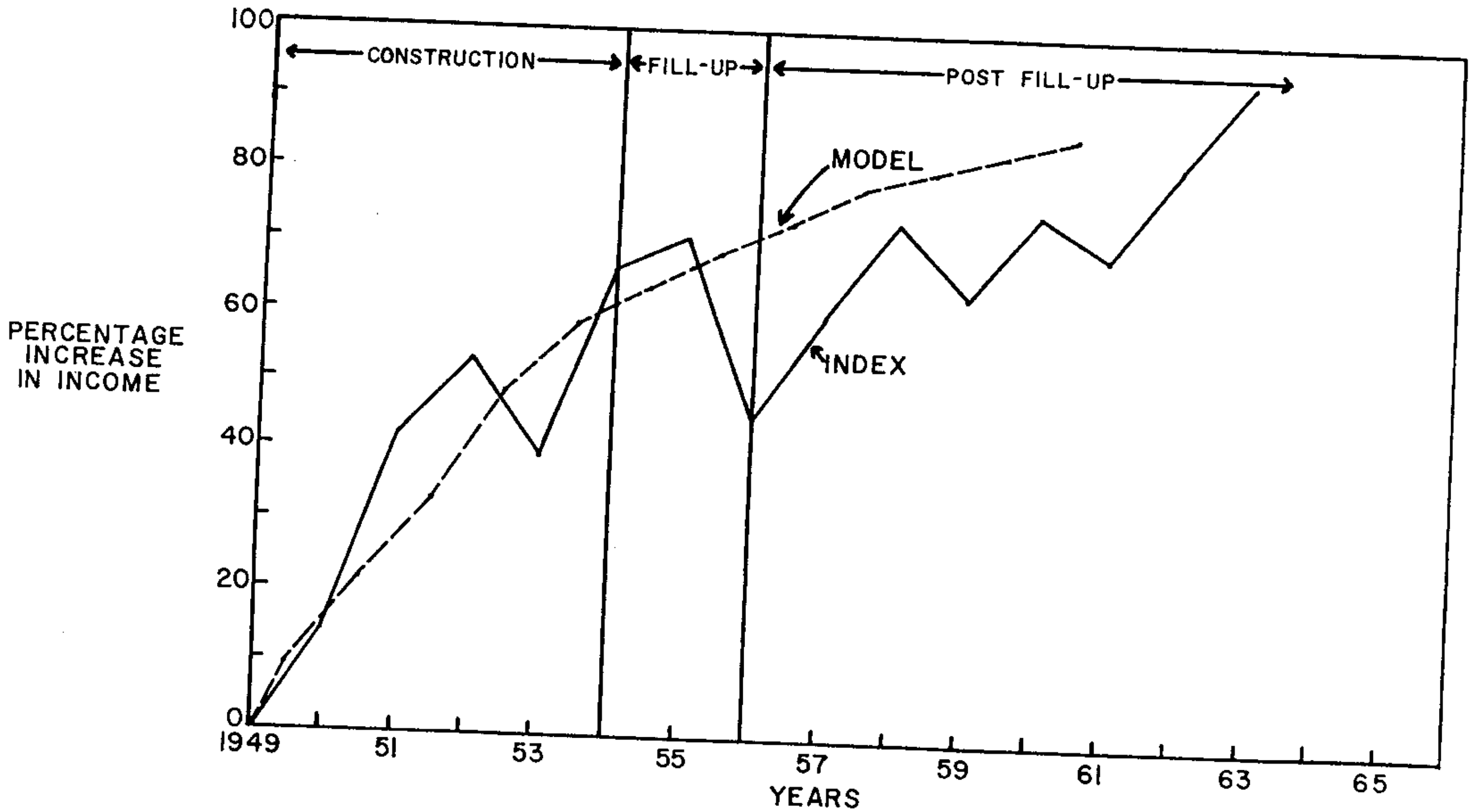
ECONOMIC IMPACT AS MEASURED BY
THE INDEX AND MODEL FOR THE WHITNEY AREA



SOURCE: TABLE Ig, APPENDIX G.

FIGURE 13

ECONOMIC IMPACT AS MEASURED BY THE INDEX AND MODEL FOR THE BELTON AREA



SOURCE: TABLE 2g, APPENDIX G.

activity which can be attributed to reservoir development, expressed as a percentage of the base year.

The model measures this same net economic effect by using parameters of income, agricultural income, population and the distance to a metropolitan area. With the combination of these parameters and money inflows attributable to a reservoir project, the percentages similar to the index are determined.

Results of the synthetic index and the comparative-projection model for both areas are shown on the same scale in Figures 12 and 13. The index curve reflects net differences between each of the comparative areas and the control area. The model expresses the economic impact of the reservoir in terms of a percentage of the aggregate income during the beginning construction year.

Figure 12 shows the Whitney economy and reflects the conclusions drawn in Part III. The net effect of the reservoir in the local economy shows that the economy sustained an initial growth during the early years of construction. Following the initial years the net effect dropped, but the economy remained at a point above the normal growth as defined by the control area.

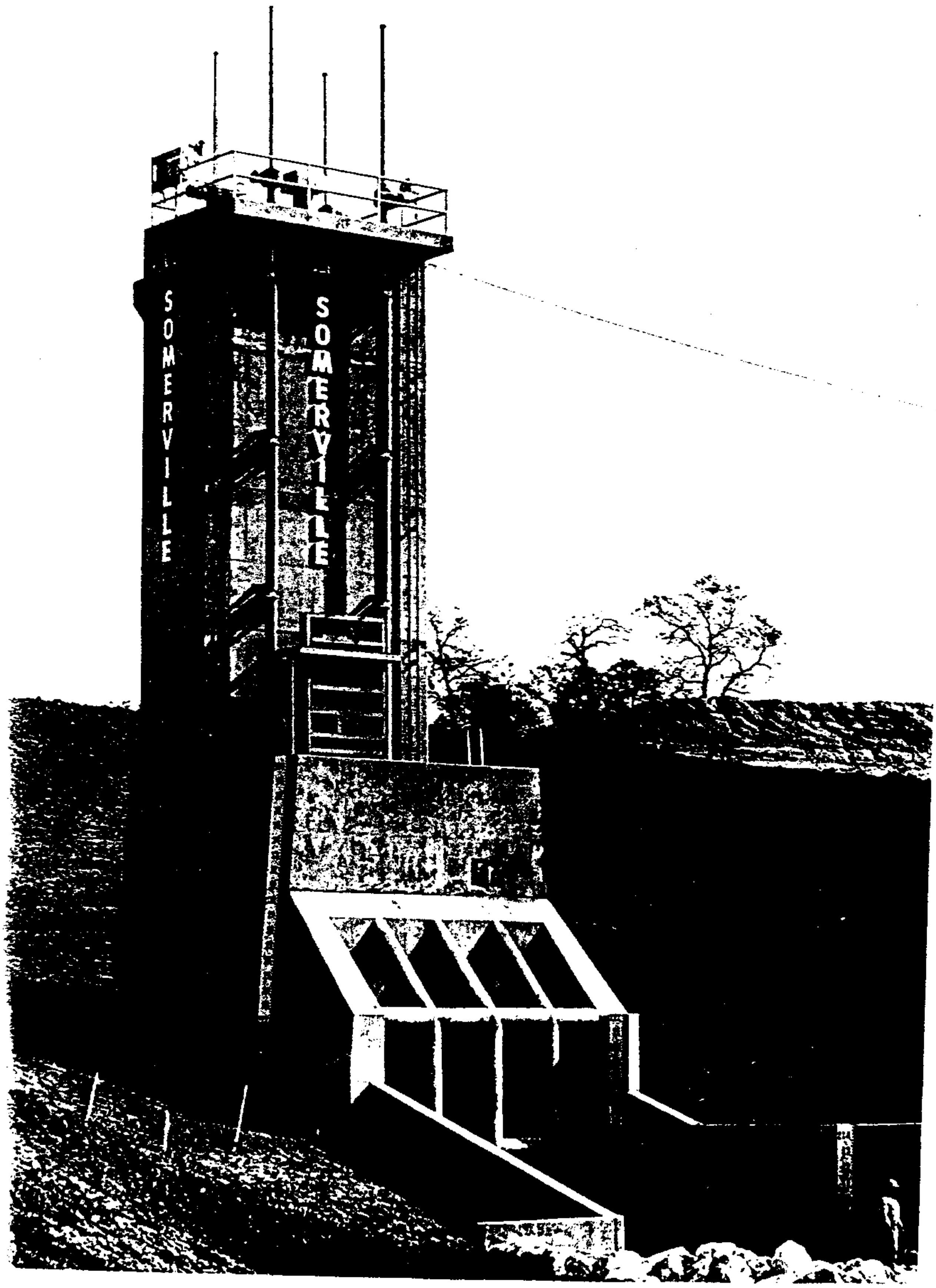
Some differences exist between the curves of the model and the index for the Whitney area. Due to slowness of the economy at construction time, the model underprojects the activity measured by the index. During fill-up and post fill-up the model projects very closely the economic activity measured by the index. For the economy surrounding Lake Whitney the projection accuracy of the model shows very little variation from the index.

The Lake Belton area, shown in Figure 13, provides a contrast to that of the Lake Whitney area. The model and index both reflect a progressing and growing economy. The index reflects a somewhat sporadic movement, but overall growth is quite apparent. Broken points in the index curve may be attributed to the more diversified economy in the area surrounding Lake Belton than the Whitney area.

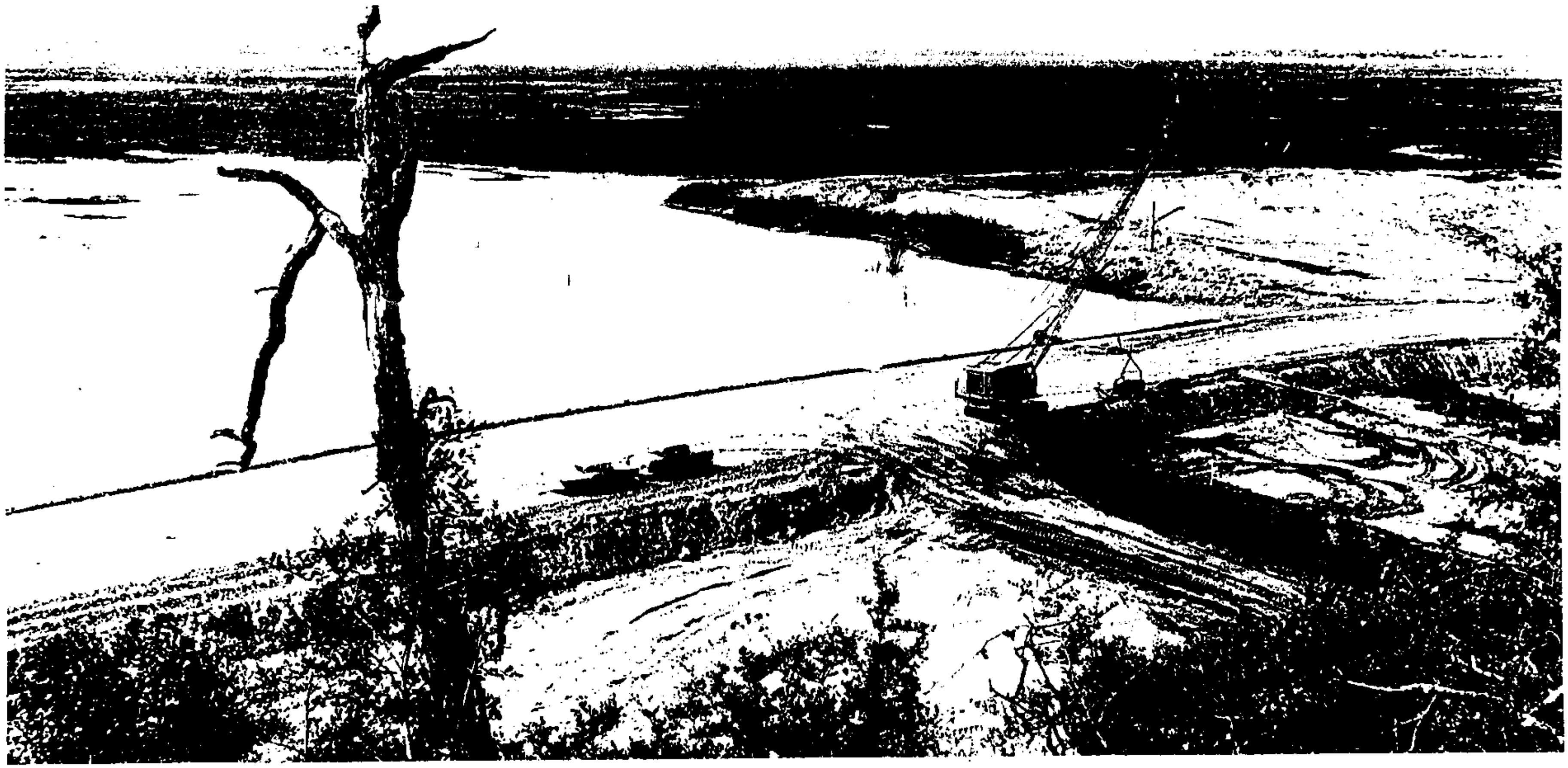
Differences between the curves of the index and the model reflect difficulties involved in projecting an economy with many inflows. For the years of construction the model very closely projects the growth of the economy. But, as in the case of Lake Whitney, the model underprojects. During the fill-up stage the model errs due to an unusual decline in the curve of the index for 1956. The differences between the model and index during the post fill-up period can also be attributed to the decline experienced in 1956. This slowdown in growth of an economy has not been projected by the model due to the underlying assumption that growth will continue at an established rate.

Comparisons and explanations of this section have been for the purpose of testing the reliability of the comparative-projection model. A synthetic index was first developed to give conceptualization guidelines for subsequent development of the model. The inputs employed to measure the change in aggregate income attributable to a reservoir development project for the index were independent of those used in the model. As a result, the study employed two parallel systems to measure the economic impact of two established and operating reservoir projects. The results of these two measurements very closely approximated each other and on the basis of these conclusions, projections are made for the primary study area.

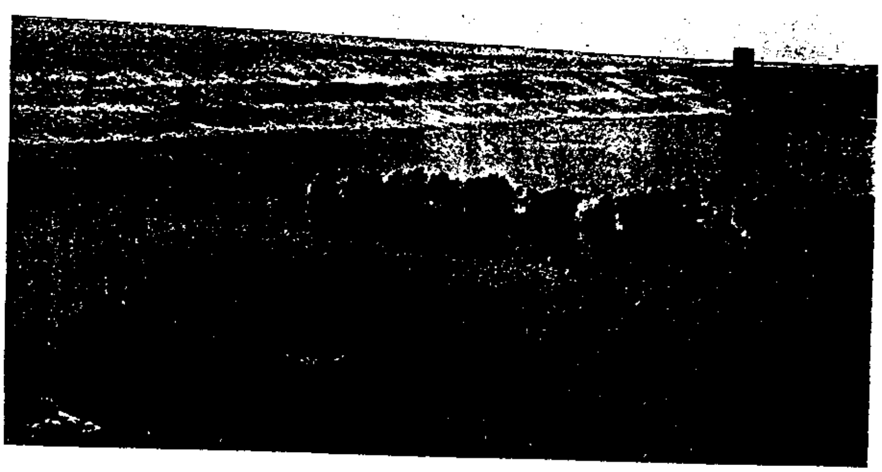
FILL-UP STAGE, INTAKE TOWER
AND EMBANKMENT, LAKE SOMERVILLE, TEXAS, 1967
(Source: Gene Dennis, Bryan, Texas)



FILL-UP STAGE, EARTHEN EMBANKMENT,
LAKE SOMERVILLE, TEXAS, 1967
(Source: Gene Dennis, Bryan, Texas)

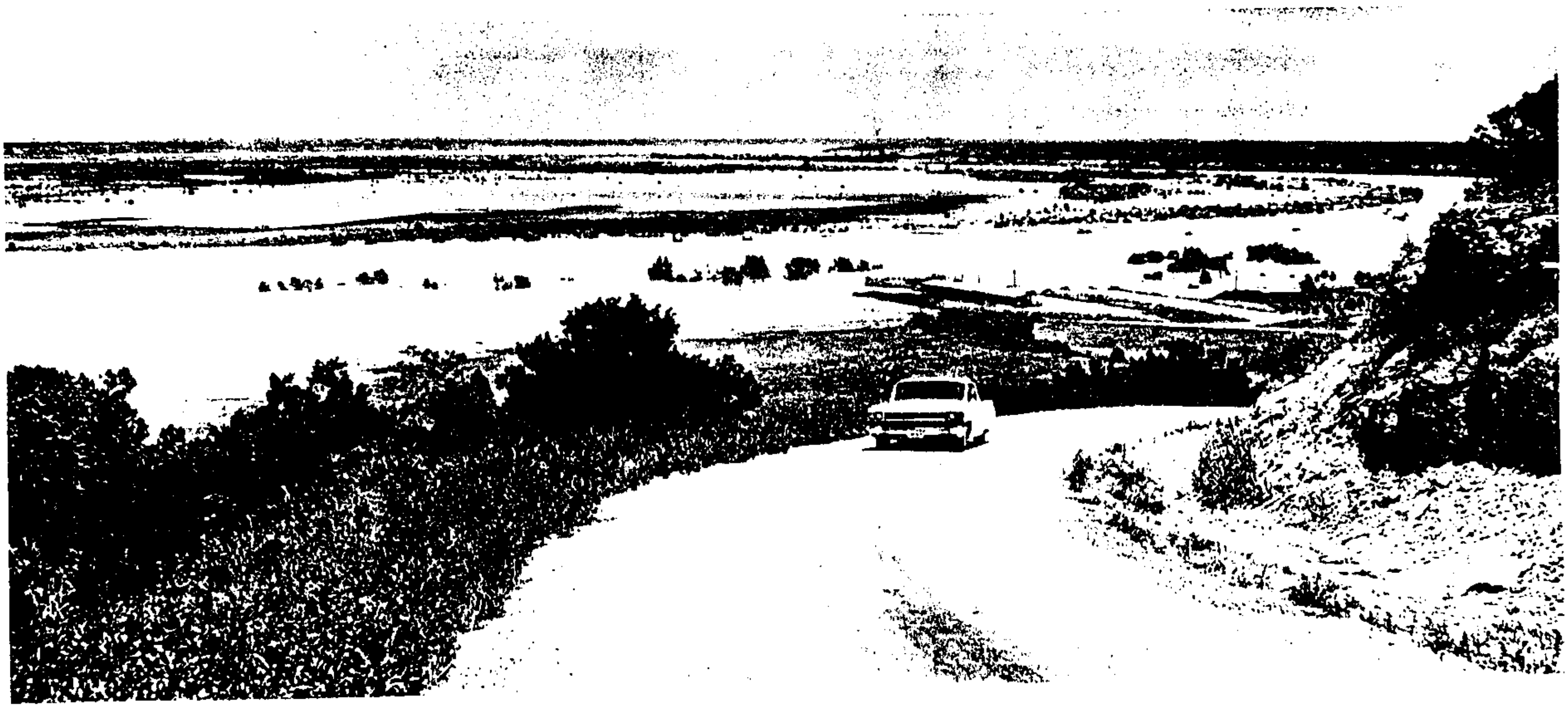


FILL-UP STAGE, COMMERCIAL ESTABLISHMENT,
LAKE WHITNEY, TEXAS, 1953
(Source: Bill Woodside, Whitney, Texas)



FILL-UP STAGE, DAM IN BACKGROUND,
LAKE BELTON, TEXAS, 1954
(Source: Corps of Engineers, U. S. Army, Fort Worth, Texas)

FILL-UP STAGE, PARK FACILITIES,
LAKE WHITNEY, TEXAS, 1954
(Source: Bill Woodside, Whitney, Texas)



Part V

PRIMARY STUDY AREA

An empirical study of the Somerville Dam and Reservoir, which started filling in early 1967, was made to partially test the comparative-projection model. The Somerville Dam and Reservoir is one of ten multiple-purpose reservoirs designed for flood control and allied purposes, in the Brazos River Basin. Authorization for the project was granted by the Flood Control Act of 1954, which provided for a cooperative program between federal, state, and local interests to build the dam and reservoir for flood control, water conservation, and other beneficial uses for the surrounding area.[26]

ECONOMY BEFORE CONSTRUCTION

The Somerville Reservoir, when filled, will extend into Burleson, -eon, and Washington Counties in central Texas. Access to the completed .akes will be possible through any of the three counties, and these coun-ies were considered to be the primary target for local economic impact. he total land in the three-county area is 1,934 square miles[27] and the eservoir will inundate areas approximately equal in all three counties.

Population of the primary study area has been somewhat erratic during e past seven years. In 1955, the population was estimated to be 38,100, d estimates for the years 1954-58 indicated an annual decrease of

[26] "Somerville Dam and Reservoir", U. S. Army Corps of Engineers, t Worth District (Fort Worth, Texas, July, 1963).

[27] Texas Almanac, op. cit.

between 2.5 and 4.7 percent. In 1959 and 1960, population increased followed by a tapering off in 1961, 1962, and 1963. In 1962, Washington County had an estimated 49.3 percent of the area's population, Burleson County 28.1 percent, and Lee County 22.6 percent (See Table 19).

Table 20 shows an analysis of the population by towns based on Bureau of the Census data. The data are total population of each census tract in the counties and combine both the rural and urban populations of each town in the area. Brenham, the county seat of Washington County, is the largest town in the area, and Caldwell and Giddings, both less than half the size of Brenham, are the next largest.

The basic industry for Burleson, Lee, and Washington counties is agriculture. According to USDA figures the area had 5,064 farms[28] in 1960. Total farm income the same year was approximately $18.9 million, and about 35 percent of the labor force was concerned with producing agricultural commodities.[29] A breakdown of employment is provided in Table 21 for the study area by industries and counties for the year before construction began on the dam. The railroad industry, although not specifically listed in the table, plays an important part in the local economy. A Santa Fe railroad wood preserving plant at Somerville is a significant employer. Official unemployment for 1962 was less than the national average of 5.6 percent.[30]

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[28] Rand McNally, Commercial Atlas and Marketing Guide (94th ed.; New York: Rand McNally and Company, 1963), pp. 419-423.

[29] U. S. Department of Commerce, Bureau of Census, County and City Data Book: 1962 (Washington: U. S. Government Printing Office), pp. 340, 350 and 360.

[30] National Industrial Conference Board, The Economic Almanac (New York: The Conference Board, 1964), p. 38.

TABLE 19

POPULATION ESTIMATES, PRIMARY STUDY AREA
BY COUNTIES, 1954 - 1963

	County							
	Burleson		Lee		Washington		Total	
Year	Number	Percent	Number	Percent	Number	Percent	Number	Percent Change of Previous Year
1954	11,600	29.0	9,500	23.7	18,900	47.3	40,000	
1955	11,000	28.9	9,100	23.9	18,000	47.2	38,100	-4.7
1956	10,700	28.8	8,900	24.0	17,500	47.2	37,100	-2.6
1957	10,300	28.6	8,700	24.2	17,000	47.2	36,000	-3.0
1958	10,000	29.3	8,500	24.9	16,000	46.8	34,100	-5.3
1959	10,500	28.0	9,400	25.1	17,600	46.9	37,500	+9.9
1960	11,000	28.3	8,900	22.9	19,000	48.8	38,900	+3.8
1961	10,800	28.1	8,700	22.7	18,900	49.2	38,400	-1.3
1962	10,600	28.1	8,500	22.6	18,600	49.3	37,700	-1.9
1963	10,500	28.1	8,400	22.4	18,500	49.5	37,400	-1.4

Source: Derived from Sales Management's, Survey of Buying Power, (for the years 1955 - 1964).

Disposable income for the area has been growing, but the average growth rate has not been equal to the national average during the same period. This comparison is shown in Table 22. The geometric mean of the data for 1957 (1957 base) through 1962 shows the study area had an average growth of 1.3 percent per year, while the nation experienced a 3.7 percent increase for the same period. Although the data for the study area is estimated effective buying income, it is comparable to disposable personal income and may be treated in the same manner.

Estimated retail sales for the area, shown in Table 23 for six years preceding construction, stayed between $850 and $915. Total retail sales

TABLE 20

POPULATION OF COUNTIES AND PRINCIPAL TOWNS,*
PRIMARY STUDY AREA, 1960

Towns and Counties	Population	Percent of Total
Burleson County		
Caldwell	5,086	
Cooks Point	1,255	
Old River	2,558	
Somerville	2,278	
Total	11,177	28.3
Lee County		
Giddings	4,654	
Lexington	1,817	
Dime Box	2,478	
Total	8,949	22.9
Washington County		
Brenham	10,397	
Burton	2,541	
Chappel Hill	1,603	
Gay Hill	2,403	
Washington on the Brazos	2,203	
Total	19,147	48.8
GRAND TOTAL	39,273	100%

*Population of towns include rural population included in the census tract.

Source: U. S. Department of Commerce, Bureau of Census, Population: 1960, (Washington: U. S. Government Printing Office), pp. 472 and 478.

for each county as well as the entire area have shown little growth since 1959. Also, per capita sales have not increased substantially during the same years.

The economy of the study area before construction began may be described as primarily agricultural, growing at either a slow rate or none at all. Although the area appeared to be a full employment sub-economy, the population and disposable, personal income lagged behind

TABLE 21

EMPLOYMENT BY INDUSTRIES AND COUNTIES,
PRIMARY STUDY AREA,
1962

County	Total Labor Force		Unemployment		Agriculture		Construction		Manufacture		Public Administration & Education		Wholesale & Retail Trade		Finance Insurance & Real Estate		Other*	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
urleson	3,581	100.0	147	4.1	1,322	36.9	194	5.4	201	5.6	310	8.7	266	7.4	533	14.9	608	17.0
ee	3,121	100.0	116	3.7	1,100	35.2	253	8.1	192	6.2	185	5.9	152	4.9	589	18.9	534	17.1
ashington	7,154	100.0	257	3.6	2,313	32.3	473	6.6	221	3.1	529	7.5	222	3.1	1,302	18.2	1,837	25.6
otal	13,856	100.0	520	3.8	4,735	34.2	920	6.6	614	4.4	1,024	7.4	640	4.6	2,424	17.5	2,979	21.5

Includes those employed by transportation, communications, public utilities, and unclassified.

urce: Derived from U. S. Department of Commerce, Bureau of the Census, City and County Data Book: 1962 (Washington: U. S. Government Printing Office), pp. 340, 350 and 360.

TABLE 22

DISPOSABLE PERSONAL INCOME,
PRIMARY STUDY AREA AND THE UNITED STATES,
1957 - 1962

Year	Study Areas* (Thousands)	United States (Billions)
1957	33,657	308.8
1958	30,174	317.9
1959	34,228	337.1
1960	33,421	349.9
1961	33,072	364.4
1962	33,623	384.4
Average growth**	1.3 percent	3.7 percent

*Data for the study area is estimated buying income, which is comparable to disposable personal income.

**The average was obtained by calculating the geometric mean for each series of data.

Source: Derived from Sales Management's, Survey of Buying Power, 1958 - 1963, and National Industrial Conference Board, The Economic Almanac, 1962, p. 132.

the national average. This lagging is also reflected in retail sales.

The basic question is what happens to the total economy of the three counties when a dam and reservoir are built in an area such as this. Before attempting to answer this question, an exact analysis was made of the proposed project.

PROPOSED DAM AND RESERVOIR

The Somerville Dam and Reservoir is located in the south central part of Texas on the Yegua Creek, a tributary of the Brazos River. The dam

TABLE 23

ESTIMATED TOTAL AND PER CAPITA RETAIL SALES, PRIMARY STUDY AREA BY COUNTIES, 1957 - 1962*

	County							
	Burleson		Lee		Washington		Study Area	
Year	Total	Per Capita	Total	Per Capita	Total	Per Capita	Total	Per Capita
1957	7,492	727.4	6,869	789.5	16,341	961.2	30,702	852.1
1958	7,448	749.8	6,509	765.8	16,217	1,013.6	30,174	884.9
1959	7,321	697.2	8,757	931.6	18,150	1,031.2	34,228	912.7
1960	6,984	634.9	8,515	956.7	17,922	943.3	33,421	859.2
1961	6,787	628.4	8,337	958.3	17,946	949.5	33,072	861.3
1962	6,674	629.6	8,489	998.7	18,460	992.5	33,623	891.9

*Total retail sales in thousands, per capita in dollars.

Source: Derived from Sales Management's, Survey of Buying Power, 1958 - 1963.

site is twenty miles upstream from the confluence of the Yegua Creek with the Brazos River and two miles southwest of Somerville, Texas. When the reservoir is filled, it will straddle the Washington-Burleson County line with the upper reaches extending into Lee County. Figure 14 shows the location of the dam and reservoir relative to the counties, towns, and major highways.

The reservoir is collecting water from a watershed approximately 32 miles long on each side, having a drainage area of 1,331 square miles. The reservoir will be able to store 143,900 acre feet of water for conservation purposes and 377,700 acre feet for flood control giving the reservoir a total capacity of 507,500 acre feet. When the water is at maximum flood control level, the reservoir surface will be 258 feet above mean sea level and will cover approximately 24,400 acres of land.[31]

The project includes plans for the construction of six public parks located at various positions abutting the reservoir. The parks, to be controlled by the Corps of Engineers, will be contracted to local government agencies who may further lease the land to various priority groups. Although private concessions are a part of the project, a specified percent of gross sales will be taken by the government agencies for maintenance and improvement of the park areas.

DAM AND RESERVOIR CONSTRUCTION

Federal and state agencies have been cooperating in the Somerville area to complete the $18,000,000 project since May, 1962. Contract bids were reviewed and awarded in the latter part of 1962, and construction of the dam was well underway during 1963. The early construction contracts were for the outlet works, a visitor's overlook area, and an access road to the dam site. A $7.5 million contract on the main embankment was started in mid-1964, and was completed during 1966. The access road and overlook area were completed in late 1964, and a contract was then awarded on a $600,000 brush-clearing job in the basin. All these contracts were completed by late 1966 and the gates to the dam were closed in January, 1967. The total construction expenditure schedule is given in Table 24.

The construction of the dam is completed at this time except for

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[31] U. S. Corps of Engineers, Somerville Dam and Reservoir, (Fort Worth, Texas, July, 1963).

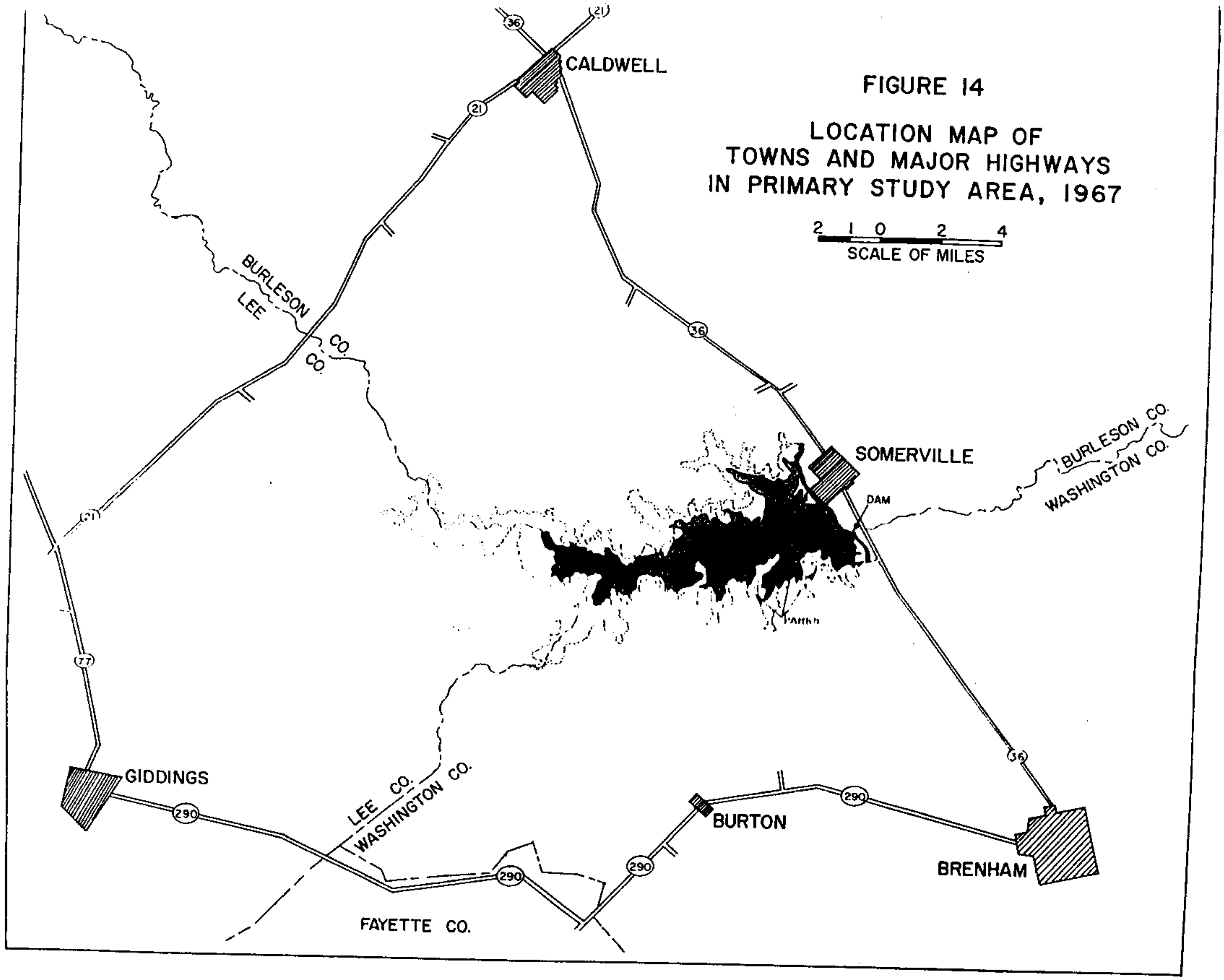

FIGURE 14

LOCATION MAP OF
TOWNS AND MAJOR HIGHWAYS
IN PRIMARY STUDY AREA, 1967

TABLE 24

CONSTRUCTION EXPENDITURES FOR THE SOMERVILLE RESERVOIR PROJECT, 1963-67

Fiscal Year*	Amount**
1963	$2,073
1964	3,777
1965	6,244
1966	8,254
1967	1,617

*Federal government fiscal year July 1 to June 30.

**Figures are rounded to the nearest thousand.

Source: U. S. Army Corps of Engineers, Fort Worth District, March, 1967.

access roads to the lake, park facilities, and concession contracts. The Brazos River Authority will pay approximately $4.9 million toward the total cost of construction, and a pro rata share of the cost for maintenance and operation. The benefit-cost ratio of the project has been set by the Corps of Engineers at 2.0 to 1 for a fifty-year term, and 2.4 to 1 for a one hundred-year term.[32]

ECONOMIC IMPACT

The comparative-projection model was used to measure economic impact during construction and the beginning of the fill-up. The model is used to measure what has happened and what can be expected to happen

[32] U. S. Corps of Engineers, op. cit.

in the economic system surrounding the Somerville Reservoir. The necessary information about the area for use in the model is provided in Table 25, and all data used in actual observations is presented with discussions of each stage.

Construction Stage

The Somerville Reservoir had an immediate impact on the local economy during construction. Created jobs were filled by local men, though many were filled from outside the area when quantity and skill in the local area were not sufficient to meet the requirements. However, the varying type of work, and the number of independent contracts started and terminated at different times, increased the difficulty of determining the direct labor employed in construction. The labor force fluctuated from week to week, but a conservative estimate placed 110 men working at all times during the construction period. The type of jobs ranged from project superintendent to common laborer.[33]

No more than one-half of the required laborers were employed from the local manpower pool. Almost all engineers and heavy equipment operators were moved into the area. Some of the unskilled jobs were filled by previously employed agricultural labor because the construction wages were higher and employment for the dam construction was more stable.[34]

In addition to workers, dam construction brought about an increased demand for service and professional workers. Studies conducted in eight

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[33] Interviews with payroll clerks of Markham, Brown, and Gibraltar Construction Company, and Clement Brothers Construction Company, Somerville, Texas, October 15, 1964.

[34] Ibid.

TABLE 25

BASIC INPUT DATA TO THE MODEL, PRIMARY STUDY AREA

Type	Primary Study Area
Name of Project	Somerville Dam
Total Land Area of Contiguous Counties	1,934 sq. mi.
Population of Contiguous Counties for year of construction	37,700
Estimated income of the Contiguous Counties (000)	$46,319
Estimated agricultural income of the Contiguous Counties (000)	$18,940
Distance to the nearest city over 25,000 population	25 mi.
Year Construction began	1962
Year Construction ended	1967
Yearly Construction expenditures (000)	
year 1	$2,073
year 2	3,777
year 3	6,244
year 4	8,254
year 5	1,617
Yearly Average O&M expenditures (000)	$150
Population 100-mile radius of Reservoir beginning of last decennial census	2,243,604
Population 100-mile radius of Reservoir ending of last decennial census	2,839,054
Area of present reservoir	11,460 ac. ft.
Shoreline of present reservoir	85 mi.
Area of all lakes* within 100-mile radius of present reservoir	120,470 ac. ft.
Number of lakes* within 100-mile radius of present reservoir	11

*Lakes are defined as bodies of water consisting of over 2,500 acre feet.

Source: Corps of Engineers statistics, Texas Almanac, Agricultural Census, 1961, Sales Management's, Survey of Buying Power, U. S. Census, 1950 and 1960.

counties of the Southeastern United States and one Pennsylvania county indicate that one hundred new manufacturing jobs resulted in the net increase of 174 new workers.[35] Applying such a ratio to the Somerville area, adjustments were made to account for a specific time length, the lack of housing, less favorable employment opportunities, and other towns in the area.

Evidence indicates that a large influx of service workers, as figured with the national ratio, did not occur during construction of the Somerville Reservoir. A major portion of the demand by the direct workers for personal and professional services was met by two larger towns in the area, Brenham and Caldwell; and by two towns outside the local area, Bryan and Navasota. All of these towns are within thirty miles of the project. Due to these distance factors, three indirect workers were estimated for every ten workers directly employed in construction.

Half of the construction workers were supplied from outside the area, and the local population probably increased by the fifty-five workmen who were directly employed plus thirty-two who were indirectly employed. Estimates range as high as 2.3 per employee,[36] but two is a reasonable figure for this study because some employees did not bring families. The estimated increase in population during construction is shown in Table 26.

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[35] "What New Industrial Jobs Mean to a Community," Prepared by the Chamber of Commerce of the United States (Washington, D.C., 1954) p.2.

[36] Economic Impact of the Construction of the Oroville Dam and Power Plant Upon the Oroville Area, State of California (Department of Water Resources, 1956) p.5.

TABLE 26

POPULATION INCREASE,
PRIMARY STUDY AREA DURING THE CONSTRUCTION,
THE SOMERVILLE DAM AND RESERVOIR

Description of Populace	Estimated Increase
Direct workers	55
Direct workers' families	110
Indirect workers	32
Indirect workers' families	64
Total	261

Source: Derived from "What New Industrial Jobs Mean to a Community," Prepared by the Chamber of Commerce of the United States, (Washington, D.C., 1954) p. 2. (Mimeographed).

The influx of population did not offset earlier total population declines in the three-county area. The increase was restricted to the area immediately around the town of Somerville. But, after construction was completed, the Somerville area again suffered the expected population decline. The Somerville area experienced a small population increase which was limited mostly to the completed construction.

Another indicator of economic impact is business activity. An increase in business activity in Somerville would suggest that dam construction caused more money to be generated. In addition, business activity during the latter part of construction gives an indication of the secondary impact resulting from payrolls.

The Somerville dam was completed during the early months of 1967, and significant data on business activity is not yet available from secondary sources. But the town of Somerville, was subjected to a detailed study during construction so that changes in business activity could be detected.

Somerville is located less than two miles from the dam site, and is located nearer the dam than any other town. Most of the change in the area's economic activity attributable to the dam's construction was found here. Because the town is small, a comprehensive study of the businesses was possible. Furthermore, few external forces, found in larger surrounding towns influenced the total business activity in Somerville during construction.

There are serious limitations to this type of approach. When interviews with businessmen and civic leaders are used for information sources, data might be approximated to conceal absolute sales figures. Also, some information was given in physical units and these were later converted to dollar amounts.

Eight new business establishments were begun and two were terminated in Somerville from the beginning of construction to the beginning of 1965. Of the eight business starts all but one indicated that construction of the dam had an influence on beginning business in Somerville.

The two businesses which closed were a cafe and a real estate company. The real estate company was a subsidiary office of a firm located in Bryan, and although the doors were closed in Somerville, the company was still selling through independent agents. The cafe, which terminated its business in 1963, was located along the main highway of Somerville and was in a building badly needing repair. The general condition of the building was given as the major reason for termination.

Businesses started and terminated and approximate retail sales are listed in Table 27. The midpoint of the retail sales range is used to make a point estimate of retail sales, and the net increase in sales is estimated at $200,000. Four of the businesses listed have annual sales over $30,000 a year. One cafe shows low annual sales, but the business is small, it is open only a short time each day, and it does not serve meals every day.

Four businesses made significant improvements after construction of the dam started. Two businesses were new, starting since 1963, and had made remodeling improvements to their buildings. These two, the combined cafe-drug store and the hardware-furniture store, had almost doubled floor space since opening in Somerville. Two of the older businesses, an insurance agency and a variety store, had made improvements since 1963. New businesses, improved commercial and residential buildings are located relative to the business section of Somerville in Figure 15.

Change in retail sales since 1963 was estimated by sampling older businesses. The twelve businesses selected for the sample are listed in Table 28. Of the twelve businesses, two refused to cooperate to any extent, and two would only reveal percentage increases. Interviews with the ten cooperating businesses show that all but two experienced increases in sales during the period 1962 to 1964. The businesses showing the greatest percentage increases were two cafes and two service stations. This increase was expected because of the service increase for the dam-construction workers. The two businesses which reported no increases for the period were beer taverns.

TABLE 27

BUSINESSES STARTED OR TERMINATED SINCE 1963, BY TYPE OF BUSINESS AND ESTIMATED ANNUAL SALES, SOMERVILLE, TEXAS

	Type of Business	Range of Annual Sales	Midpoint
Businesses Started	Cafe	$ 5,000 - 10,000	$ 7,500
	Beauty Salon	10,000 - 15,000	12,500
	Service Station	55,000 - 60,000	57,500
	Motel	30,000 - 35,000	32,500
	Drive-In Grocery	35,000 - 40,000	37,500
	Furniture and Appliance	20,000 - 25,000	22,500
	Cafe and Drug	35,000 - 40,000	37,500
	Real Estate*	Not Available	-
Businesses Terminated	Cafe	$ 5,000 - 10,000	$ 7,500
	Real Estate*	Not Available	-
Estimated Net Increase In Sales			$200,000

*Business terminated before interviews were made.

Source: Field Study collected October, 1964, K. Z. Scott.

The major portion of every-day services were supplied by the town since it is located near the dam site. Because the town is small and it is in close proximity to the dam, the inflow of money resulting from construction produced a marked increase in the business activity of Somerville. This increase has continued throughout the entire construction stage. Further increases will depend upon outside money attracted to the reservoir and town.

Another aspect of economic activity explored was the effects the dam had on the value of land immediately surrounding the reservoir. A comparison of land values was undertaken to validate the principle that any

TABLE 28

ESTIMATED INCREASE IN GROSS SALES OF SELECTED BUSINESSES, SOMERVILLE, TEXAS, 1962-64

Type of Business	Approximate Sales for 1962 (Dollars)	Midpoint (Dollars)	Sales in 1964 Over Sales in 1962 (Percent)	Estimated Increase (Dollars)
Appliance	$50,000 - 55,000	$52,500	5%	$ 2,625
Cafe*	65,000 - 70,000	67,500	10	6,750
Grocery & Cafe	20,000 - 25,000	22,500	20	4,500
Grocery*	50,000 - 55,000	52,500	5	2,625
Service Station**	55,000 - 60,000	57,500	20	10,500
Service Station**	60,000 - 65,000	62,500	15	9,375
Jewelry	15,000 - 20,000	17,500	5	875
Variety Store	10,000 - 15,000	12,500	10	1,250
Beer	5,000 - 10,000	7,500	0	0
Beer & Liquor	5,000 - 10,000	7,500	0	0
Lumber***	-----	-----	-----	-----
Grocery***	-----	-----	-----	-----
Net Increase				$38,500

*Refused to give sales data, but gave percentage increase. Sales for 1962 estimated.

**Dollar sales estimated from gallons pumped.

***Refused to cooperate.

Source: Field Study in Somerville, Texas, October, 1964, K. Z. Scott.

enhancement or damage to property finally accrues to land.[37]

The best use of the land around the reservoir will probably change once a basin has filled with water.[38] Land located on rocky hills or ridges, formerly used for grazing livestock, may have had a low

[37] William G. Adkins and Alton W. Teekin, Economic Impact of Expressways in San Antonio (Texas Transportation Institute, College Station, Texas, August, 1958), p. 14.

[38] Interview with Mr. Paul Haines, independent land appraiser, Bryan, Texas, November 22, 1964.

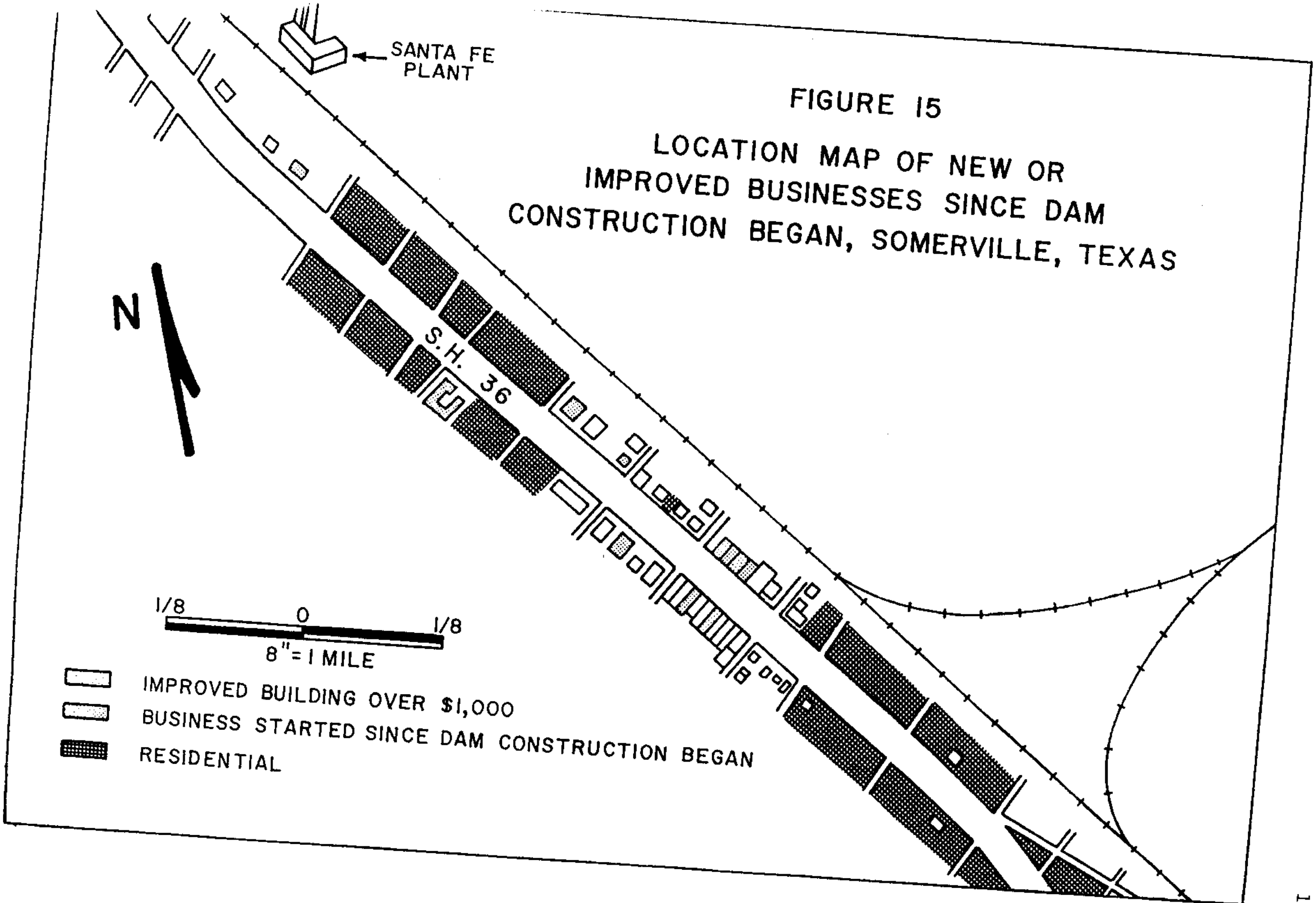

FIGURE 15

LOCATION MAP OF NEW OR IMPROVED BUSINESSES SINCE DAM CONSTRUCTION BEGAN, SOMERVILLE, TEXAS productivity value before dam construction started. However, when construction starts, is completed, and the reservoir begins to fill, land moves from inexpensive agricultural land to valuable shore property.

Average land values in the primary study area before construction were determined. Since some land had improvements on it, several tracts of land were chosen because they were in the flood control plain of the Yegua Creek, and had little or no improvements on them. Sixteen tracts were used to estimate the average price of land in the primary study area before construction of the dam. The average price of land in the sample was $231.56 per acre. This land is identified in Table 29 by county, acreage, price, and sale date.

The number of tracts of land abutting the water and available for private ownership will be limited. Land located close to the park areas has exchanged for a price in excess of one thousand dollars per acre. Land which will not abutt the water, but which will have easy access to the water exchanges for a price of approximately five hundred dollars an acre.[39] Development companies sold improved land early for lakeside resorts. This land was cleared of underbrush and marked off into lots of various sizes. Two of these developments had approximately ninety acres and another has one hundred and thirty acres. Prices for lots in these developments have a wide range depending on the location and accessibility, but interviews reported prices of $1,000 to $2,000.[40]

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[39] Interview with Mr. Paul Haines, op. cit.

[40] Interviews with Mr. Mitt Lee of Lee Real Estate Company, Bryan, Texas, and Mrs. Roy Meadows, landowner, Lyons, Texas, October, 1964.

TABLE 29

LAND PRICES BEFORE CONSTRUCTION, PRIMARY STUDY AREA BY SIZE, LOCATION AND DATE OF SALE

Tracts N	Total Sale Price x	Number of Acres n	Price Per Acre $\bar{x}$	Location by County	Sale Date
1	$ 20,448.00	85.2	$ 240.00	Washington	January, 1963
2	48,048.00	200.2	240.00	Washington	December, 1962
3	6,000.00	40.0	150.00	Burleson	December, 1962
4	117,000.00	58.5	200.00	Burleson	January, 1963
5	35,700.00	119.0	300.00	Washington	January, 1963
6	561,120.00	1,870.4	300.00	Washington	February, 1963
7	52,015.00	101.0	515.00	Washington	May, 1963
8	41,650.00	17.5	238.00	Washington	February, 1962
9	253,183.70	1,008.7	251.00	Washington	March, 1963
10	93,288.00	276.0	338.00	Burleson	November, 1962
11	17,123.50	148.9	115.00	Burleson	October, 1962
12	13,356.00	10.6	126.00	Burleson	July, 1962
13	52,400.00	262.0	200.00	Burleson	August, 1963
14	2,204.00	14.5	152.00	Burleson	August, 1963
15	4,690.40	28.6	164.00	Burleson	August, 1963
16	1,513.60	8.6	176.00	Burleson	August, 1963
			$3,705.00		

$N = 16$

$\sum \bar{x} = \$3,705.00$

$\bar{X} = \frac{\bar{x}}{N} = \$231.56$

Source: Deed records of Burleson and Washington Counties obtained from Mr. Paul G. Haines, Bryan, Texas, November 22, 1964.

The Somerville area has experienced an inflation of land prices during the construction just as the two comparative areas experienced. Near expected water lines of the reservoir, land prices have climbed to levels comparable to those of both Lake Whitney and Lake Belton. Since construction has just recently been completed, prices are expected to closely follow patterns established by earlier reservoirs.

The economy around the Somerville Reservoir has followed a pattern similar to that of Comparative Area I (see Table 30). The only major input into the economy during the construction stage was money utilized for construction purposes. As the reservoir continues to fill, water recreational attendance and residential construction should have an impact. The net impact attributable to the reservoir, as indicated by the projection measurements of the model, are not as large as those experienced by the two comparative areas; but, the total growth resulting from the reservoir should be continual.

The reservoirs in the two comparative areas caused large initial increases in the local economies. These large increases were not evident during the construction period of the Somerville Reservoir, but descriptive adjustments explain some of the lower percentage increases.

Both Lake Whitney and Lake Belton are larger than the Somerville Reservoir, and the expected impact from construction of the dams for both reservoirs would be larger. For the Whitney Reservoir, dam construction was almost entirely concrete. At the Belton Reservoir the dam was earth filled and similar to Somerville, but the outlet works were larger than those at Somerville. With the smaller, earth filled dam at Somerville, construction dollars would not be expected to have an impact during construction as large as the other two projects.

Recreational attendance for the initial year of projection at Somerville is expected to be large in relation to the comparative areas. This may be an overprojection, but field observations in the Somerville area indicate this is a realistic projection (see Table 31). Already

TABLE 30

ECONOMIC IMPACT OF
SOMERVILLE RESERVOIR DURING
CONSTRUCTION, 1962 - 1967

Year	Reservoir Generated Input (000)	Impact	
		Yearly	Total
1	$2,073	.0338	.0338
2	3,777	.0203	.0540
3	6,244	.0143	.0684
4	8,254	.0071	.0755
5	5,075	.0215	.0969

Source: Measurements generated by comparative-projection model.

populations of the contiguous areas are making use of this newly constructed recreational facility.

The economies of contiguous counties to the Somerville Reservoir ave experienced an impact also. This impact as a percentage of the xisting level of the economy in 1962 has not been large, but a degree growth is measurable for each year. If the three-county economy plements its opportunities, the area will continue to experience economic growth as a direct result of the reservoir.

<u>ll-Up Stage</u>

This stage of development has just begun for the Somerville Reser-r. Early in 1967 embankments and the basin were sufficiently completed lose the outlet gates. By definitions established earlier, the parative-projection model assumes that construction is completed. Somerville dam was completed to the extent that major contracts for

TABLE 31

GENERATED MODEL INPUTS FOR
THE SOMERVILLE DAM AND RESERVOIR

			RECREATION							INVESTMENT			
			CAMP		BOAT FISH		SWIM, PICNIC, SKI, SIGHTSEE			RESIDENTIAL		COMMERCIAL	
Yr.	Total Projected Attend-ance	Total Outside Attend-ance	#	Expendi-tures*	#	Expendi-tures*	#	Expendi-tures*	Total Expendi-tures*	#	Expendi-tures*	#	Expendi-tures*
5	1,004,278	863,322	608,575	$ 2,489	181,318	$ 591	72,383	$ 127	$ 3,207	17	$ 102		
6	821,763	706,423	497,974	2,037	148,366	484	59,228	104	2,625	34	204	17	$ 527
7	1,262,004	1,084,874	764,752	3,128	227,850	743	90,959	159	4,030	68	408	34	1,054
8	1,507,406	1,295,832	913,461	3,736	272,156	887	108,646	190	4,813	136	816	21	651
9	1,653,545	1,421,460	1,002,019	4,098	298,541	973	119,179	209	5,280	95	570	12	372
10	1,749,360	1,503,827	1,060,081	4,336	315,840	1,030	126,085	221	5,587	67	402	7	217
11	1,819,914	1,564,478	1,102,836	4,511	328,578	1,071	131,170	230	5,812	47	282	4	124
12	1,878,048	1,614,453	1,138,064	4,655	339,074	1,105	135,360	237	5,997	33	198	3	93

*In thousands of dollars.

Source: Projections generated by comparative-projection model.

embankment, the outlet works, basin clearing and many of the access roads were fulfilled. Since these compose the major portion of the project's budget, the input of construction dollars greatly decreased.

Small contracts for the building of a road across the dam, brush clearing around proposed parks, etc., are either being executed or negotiated with the Corps of Engineers. The road across the dam is presently under construction, and Corps of Engineers employees and contractors are installing park facilities in two of the six proposed parks. The Corps of Engineers has awarded one contract for a marina on the northeast side of the reservoir, and bids are still being reviewed for a similar installation on the south side.[41]

The reservoir is far from being filled to its designed conservation capacity of 143,900 acre feet covering 11,460 acres, but the public has already begun to use the water surface for recreation. The lake is not officially open, and no traffic counters are in the area. This will be done when the water level meets set requirements.

The impact so far felt in the surrounding local economy is from construction work still being completed and a limited number of new water recreators. Apparently the recreators utilizing the partially-filled reservoir so far are from counties surrounding the lake. Once the reservoir is filled and officially opened, outside attendance is expected to increase very rapidly.[42] This outside attendance should generate a new

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[41] Interview with Mr. Billie Gaines, Project Engineer, Corps of Engineers, Somerville Dam and Reservoir, June, 1967.

[42] Interview with Mr. Billie Gaines, op. cit.

inflow of income into the area, and the income void created by construction termination will be filled. These overall inflows are increases which the model measures. Attendance for the Somerville Reservoir, projected on a basis established in the comparative areas, times expenditures per visitor estimates money inflow to the local area.

Projections for the local economy of the Somerville Reservoir for eight years are shown in Table 31. Year five is the year 1967, and years six and seven are projected as those in which the reservoir will be filling. Total attendance is estimated and categorical projections are made from experiences in the comparative areas.

Formula projections, derived from the comparative areas, were applied to the characteristics of the Somerville Reservoir. Projections of outside attendance and the categorical breakdown were modified because of field observations. Attendance from a large metropolitan city was used to weight the degree of outside attendance. When this weighting factor was used, attendance from the contiguous counties was increased. This change to the basic projecting formula adjusted the projections to within observed characteristics of the present attendance at the reservoir.

Recreational attendance to the Somerville Reservoir is expected to follow a pattern similar to that of Comparative Area I. The majority of attendance will be an influx of recreators from outside the contiguous counties, and if facilities are available, the largest recreational group is expected to be campers. Other recreators will exert a direct influence on the economy during fill-up, but on a smaller scale than campers.

Investment expenditures, which start during the final year of construction and continue in the fill-up period, have been slow in starting in the Somerville area. However, if subdivision developments proceed at the present rate, residential investment expenditures should meet expectations of the model. On the basis of the projected recreational activity in the area and the commercial investment during the construction stage, the Somerville area is expected to have an increase in commercial investment expenditures during the fill-up stage.

The projections (shown in Table 31) reflect a slow start in both residential and commercial investments when compared to the results experienced in the comparative areas. Residential investment, which has already started, is expected to increase more rapidly than commercial. Also, residential investment is expected to reach its peak later than the commercial investments. During the fill-up period residential investment is expected to continue to increase at an increasing rate.

Slow increases in commercial investments were anticipated in the Somerville area because the area is relatively isolated, and businesses are reluctant to locate in such an area until there is a recognizable demand. The closing year of the construction stage and the initial year of fill-up provide a basis for future commercial investment. If the recreational expenditures and residential investment follow the pattern simulated in the model, commercial investment is expected to follow the projected figures.

Operations and maintenance expenditures will help replace some of the lost construction expenditures during the fill-up period. Although small in relation to the expenditures for recreation and investment, yearly totals of the three inputs during the fill-up stage gives an annual impact as shown in Table 32. This impact is the sum of the secondary impact remaining from construction dollars and impact of the yearly inputs for this period.

The fill-up stage indicates a continuation of the growth begun during construction. The increase from year to year will begin to decrease, but overall growth is expected to remain.

Post Fill-Up Stage

The fill-up stage for the Somerville Reservoir has recently begun, and expectations of the post fill-up can be measured only through projections established by the model. Although the model simulates the activity expected from the economy around the Somerville Reservoir, the projections depend largely on the actions taken by individuals in seizing economic opportunities during the fill-up stage. The development of a reservoir, as shown by the comparative areas, can produce net economic returns to the local economy during this latter stage of reservoir development.

The same basic expenditures of the fill-up period continue in the post fill-up. During the latter portion of this five-year stage, recreational expenditures are expected to level off at an established rate. The large metropolitan area of Houston is expected to provide many of the water recreators. Also, a sizable number of visitors are expected from the nearby towns of Bryan and College Station.

Investment in residential areas will also continue during the post fill-up stage, but with limited land suitable for subdivision development, these expenditures are expected to increase at a decreasing rate. If recreational and residential expenditures exceed the fill-up

TABLE 32

ECONOMIC IMPACT OF
SOMERVILLE DAM AND RESERVOIR DURING
FILL-UP STAGE, 1968 - 1969

Year	Reservoir Generated Inputs (000)	Impact	
		Yearly	Total
6	$3,505	.0257	.1226
7	5,641	.0113	.1339

Source: Projections generated by comparative-projection model.

projections, the area could experience an increasing rate of commercial investment during the post fill-up stage. Projections of the model are based on a predetermined rate, and if investment changes, projections may be altered.

Recreational and investment expenditures for this last period are shown in Table 33. Expenditures are expected to have a decided leveling even though outside attendance is expected to continue to increase (Figure 16). Between years eleven and twelve a small increment of recreational expenditures is expected, and this pattern is expected to continue in the latter years of the period.

Residential expenditures are expected to reach a peak during the first and second years of post fill-up. Commercial investment, on the other hand, should continue to slow down during this period since predictions are net investment projections. Commercial investment depends on existing demand and until the market becomes attractive, additional investments will be delayed. Investors who have ventured

TABLE 33

PROJECTED ECONOMIC IMPACT OF SOMERVILLE DAM AND RESERVOIR DURING POST FILL-UP STAGE, 1970 - 1974

Year	Reservoir Generated* Inputs (000)	Impact	
		Yearly	Total
8	$6,430	.0071	.1410
9	6,372	.0078	.1488
10	6,355	.0083	.1571
11	6,367	.0085	.1656
12	6,437	.0085	.1740

*In thousands of dollars.

Source: Projections generated by comparative-projection model.

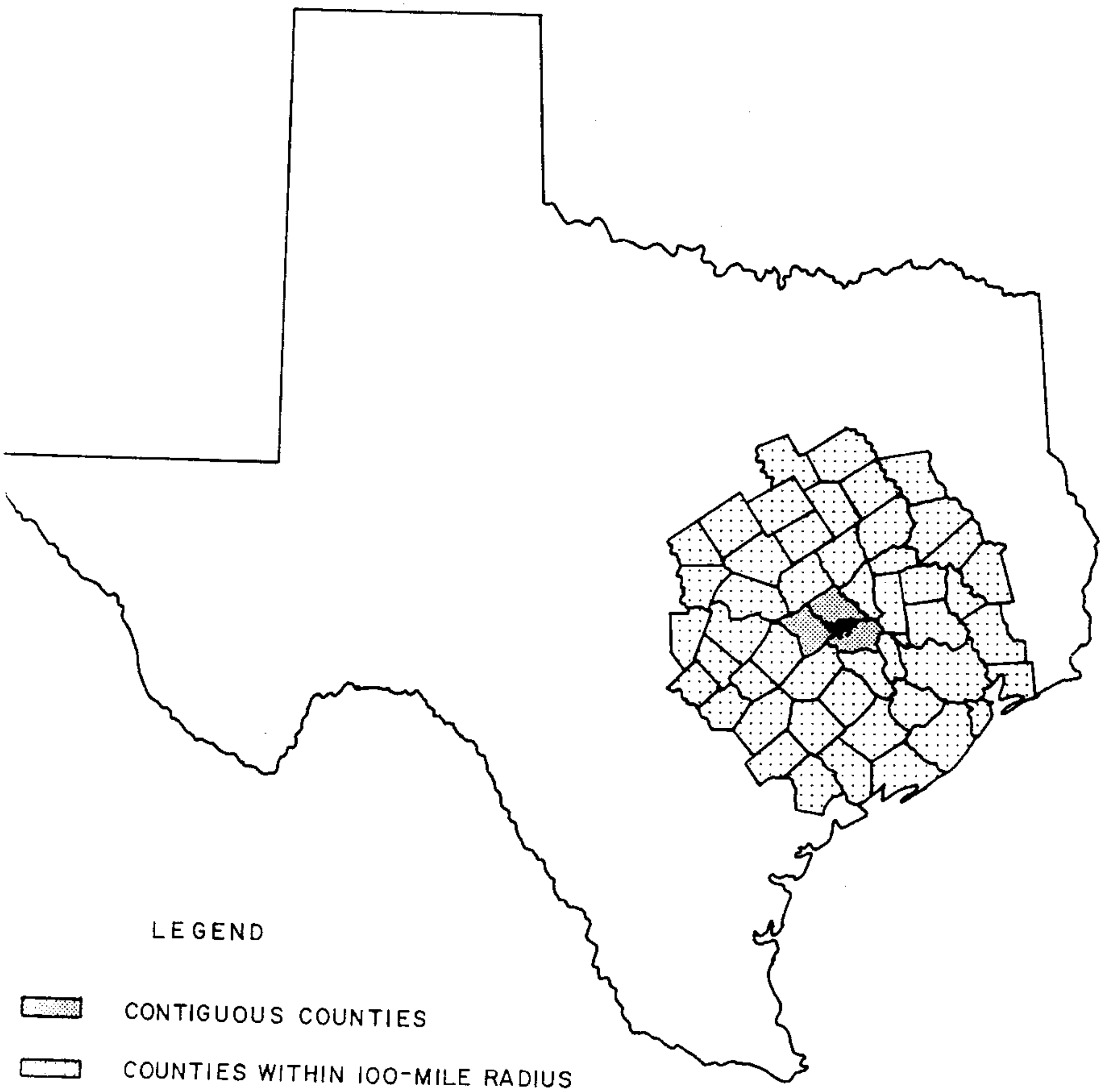
a business and have failed have not been included as such in the projections. Both forms of investment expenditure will continue to increase in total, but annual marginal increments are expected to decline.

The total area economic projections are for a slow increase during the post fill-up because a large percentage of the base economy of 1962 was agriculture. With the basic agrarian economy, new inputs will take several years to produce large economic gains. Economic sectors of the economy are assumed to remain in the same proportion throughout the period projected.

The model was developed with two other central Texas reservoir projects and checked for accuracy against a synthetic economic index. The Somerville Reservoir project was used as a partial empirical test. In applying the model to the economy around the Somerville Reservoir,

FIGURE 16

MAP OF SOMERVILLE RESERVOIR RECREATIONAL DEMAND AREA



assumptions and modifications were made. The Somerville area was assumed to have an economy similar to those of the comparative areas. Also, it was assumed that the economic make-up existing at the time construction began will continue throughout the projection periods. One modification was made from observation to reflect the effects of the heavily-populated Houston area on recreational activity at the new lake. Except for this change, the model was used entirely to generate data of the Somerville Reservoir economic impact; and has functioned exceptionally well so far in forecasting.

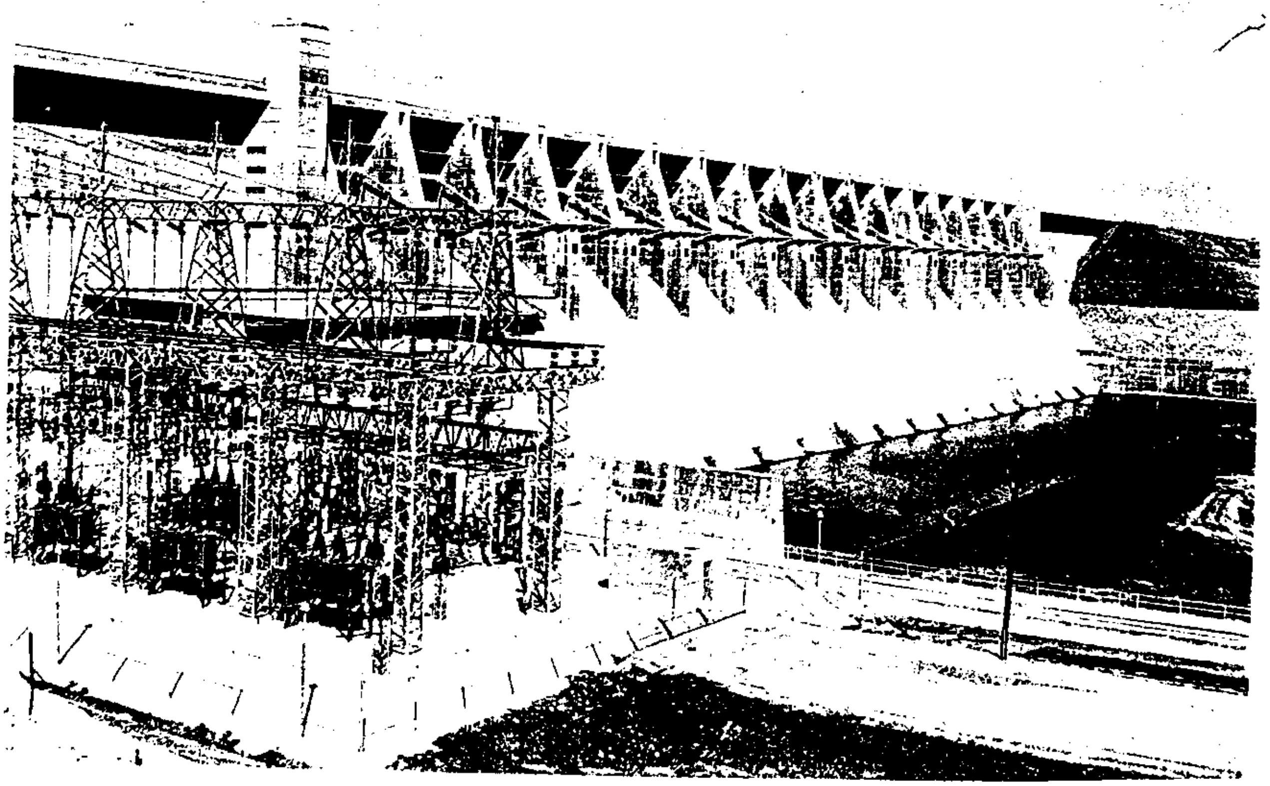
POST FILL-UP STAGE, PICNICKING,
LAKE BELTON, TEXAS, 1959
(Source: Corps of Engineers, U. S. Army, Fort Worth, Texas)

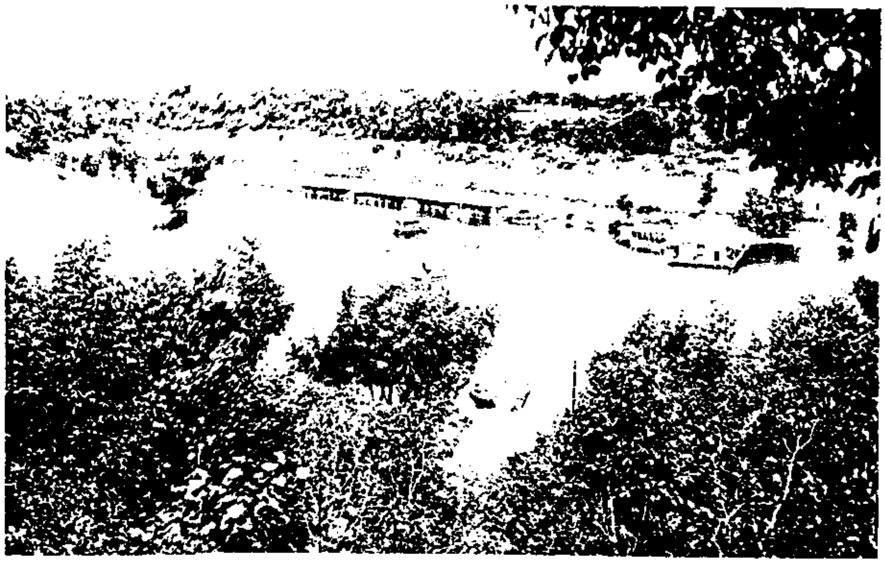
POST FILL-UP STAGE, SWIMMING,
LAKE BELTON, TEXAS, 1964
(Source: Corps of Engineers, U. S. Army, Fort Worth, Texas)

POST FILL-UP STAGE, FISHING,
LAKE BELTON, TEXAS, 1966
(Source: Corps of Engineers, U. S. Army, Fort Worth, Texas)

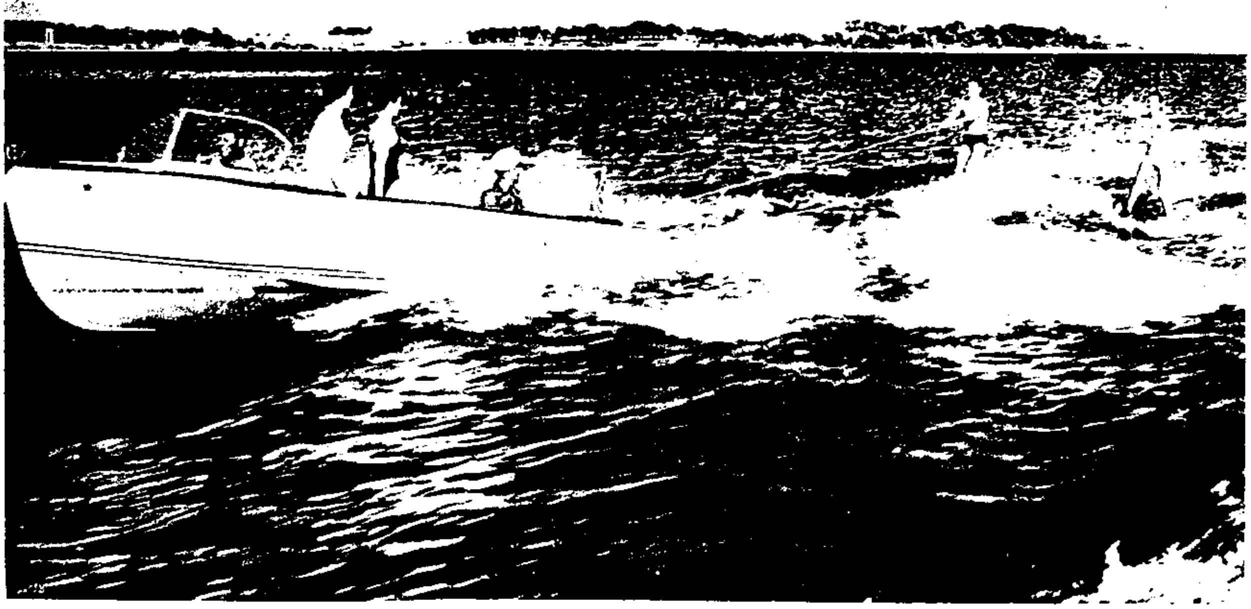
POST FILL-UP STAGE, CAMPING,
LAKE WHITNEY, TEXAS, 1965

POST FILL-UP STAGE, COMPLETED DAM AND
FULL RESERVOIR, LAKE BELTON, TEXAS, 1956
(Source: Corps of Engineers, U. S. Army, Fort Worth, Texas)



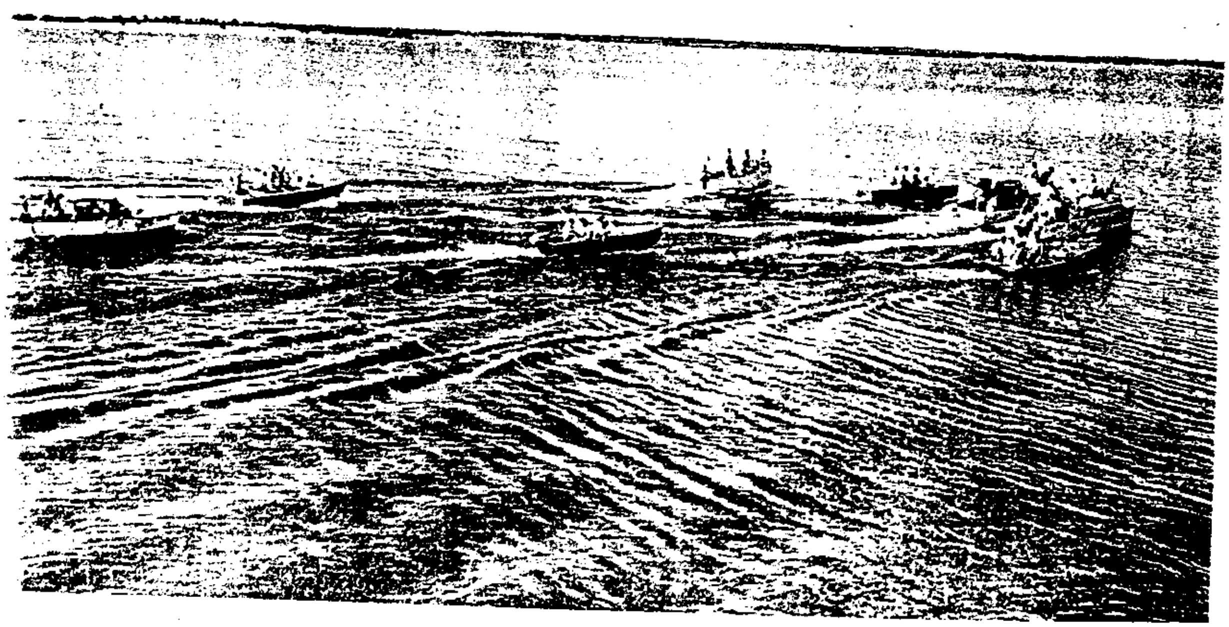


POST FILL-UP STAGE, MARINA AND BOAT
STORAGE, LAKE BELTON, TEXAS, 1966
(Source: Corps of Engineers, U. S. Army, Fort Worth, Texas)



POST FILL-UP STAGE, WATER RECREATION,
LAKE WHITNEY, TEXAS, 1959
(Source: Bill Woodside, Whitney, Texas)

POST FILL-UP STAGE, FISHING FROM
COMMERCIAL BARGE, LAKE BELTON, TEXAS, 1959
(Source: Corps of Engineers, U. S. Army, Fort Worth, Texas)



POST FILL-UP STAGE, BOATING
LAKE WHITNEY, TEXAS, 1959
(Source: Bill Woodside, Whitney, Texas)

POST FILL-UP STAGE, QUIET COVE,
LAKE WHITNEY, TEXAS, 1964
(Source: Bill Woodside, Whitney, Texas)

Part VI

SUMMARY AND CONCLUSIONS

A proposed dam and reservoir is most commonly met with mixed reactions from the communities most affected. Some citizens look upon the project favorably because the new facility will improve business or provide a recreational area to fish, ski, and relax. On the other hand, some people might be expected to object to the project because it will inundate acres of productive agricultural land and possibly move people from their homes and businesses. Both of these viewpoints are valid, but primary priority must be given to the reservoir's total influence on the local population and economy. Specific benefits are realized for the overall area even at the expense of individuals. The reservoir provides social and economic benefits such as water conservation, flood control, water for irrigation purposes, hydro-electric power, and an additional recreational facility. And, the reservoir provides definite support to the local economy.

The support or stimulus to the local economy is noticed first in the construction phase of the dam. New jobs are created by the dam construction project. Filling these new jobs means employment or better employment for local manpower and movement of people to the project site from outside areas. Accompanying the new jobs will be new income poured into the local economy. If materials, supplies, etc., for construction are available locally, these will add income to the local area. These income increases will lead to an increase in business activity and a multiplier effect of the income assures further increases in income.

Business activity can be expected to be sustained at a higher level as the reservoir development project proceeds from the construction phase to the fill-up phase. Additional inputs of recreational and investment expenditures help sustain the economy at a higher level as construction dollars begin to diminish. Parallel with higher business activity is an increase in the value of land, because land use shifts from agricultural to residential or recreational purposes. Prices of near-lake land may increase as much as fifteen times pre-construction prices.

The economy will feel the filled reservoir's impact from vacationers, weekend campers, hunters, fishermen, and other area visitors. The presence of visiting recreators will support business activity and generate new money inflows from investments. In turn, more jobs are created, more income generated, and new investment expenditures made.

The present study was undertaken to prove this general hypothesis of impact from water impoundment projects, to identify the detailed schedule of impact, and to develop a model which would predict economic impact with reasonable accuracy. An economic simulation model was developed to measure the impact of a water impoundment project on a local economy. Using two established reservoirs in central Texas, Lake Whitney and Lake Belton, the model was adjusted, tested, and readjusted. Measurement accuracy of the model was tested for net impact by comparing it with a synthetic index constructed as a parallel economic measure. The index removed normal economic growth and isolated economic growth attributable to a reservoir project. The simulation model and index traced the development of the two respective reservoirs from conception to seven years following the completion of construction. The model passed this test after some slight modifications.

The best test for the model, a practical application, was made with a primary study area under construction, the Somerville Dam and Reservoir. By employing the model on this reservoir, comparisons between the model predictions and on-site observations could be made as the project developed. In addition, the feasibility of applying the model to any particular reservoir project could be determined.

The model projections indicated the Somerville Dam and Reservoir has already had a favorable economic impact on the local economy and this will continue. Field observations and secondary data support the predictions so far. The rate of future growth from the initial impact will depend in large part on development efforts within the surrounding communities.

The comparative-projection model has proved to be a logical, orderly, way of simulating and projecting the economic impact of a water impoundment project. It is a useful tool which, when utilized with other decision criteria can make a valuable contribution to the planning and locating of water reservoirs. Further testing and experimentation of the model can make it a sharper and more accurate tool.

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APPENDIX A

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$EXECUTE       IBJOB
$IBJOB
$IBFTC IMPACT
C
C
C  IBM 7090/7094 COMPUTER PROGRAM IN FORTRAN 4, IBJOB VERSION 5
C  (IBSYS VERSION 13) FOR THE CALCULATION OF ECONOMIC IMPACT OF A
C  WATER IMPOUNDMENT PROJECT.
C
C
C
C THIS PROGRAM IS DESIGNED TO CALCULATE THE IMPACT WHICH A WATER
C IMPOUNDMENT PROJECT HAS ON THE AREAS IMMEDIATELY SURROUNDING THE NEW
C RESERVOIR.
C
C THE PROGRAM IS DESIGNED GENERAL ENOUGH SO THAT IT MAY SATISFY ANY
C SITUATION, BUT YET THE INPUTS ARE VERY LOCALIZED FOR EACH IMPACT
C CALCULATION.  THESE LOCALIZED INPUTS ARE, THE TOTAL AREA OF THE
C COUNTIES CONTIGUOUS TO THE PROPOSED LAKE, THE POPULATION OF THESE
C COUNTIES, THE ESTIMATED INCOME OF THE COUNTIES FOR THE YEAR WHEN
C CONSTRUCTION IS TO BEGIN, THE AGRICULTURAL INCOME FOR THE AREA DURING
C THE SAME YEAR, THE DISTANCE FROM THE PROPOSED DAM TO THE NEAREST CITY
C OF 25,000 POPULATION(IN MILES).  OTHER INPUTS ALSO INCLUDE THE YEAR
C WHEN CONSTRUCTION BEGINS AND WHEN CONSTRUCTION ENDS.
C
C THE INPUTS WHICH ARE THE BASIS FOR THE IMPACT CALCULATION DURING
C CONSTRUCTION ARE THE ESTIMATED YEARLY INPUTS OF THE FEDERAL GOVERNMENT
C FOR CONSTRUCTION OF THE DAM.  THERE MUST BE ONE MONETARY INPUT FOR
C EACH YEAR OF CONSTRUCTION.
C
C TWO SUBPROGRAMS ARE WRITTEN TO SOLVE THE PROBLEM DEPENDING ON THE
C RESULTS OF THE INITIAL LOCALIZED CONDITIONS.
C
C A THIRD SUBPROGRAM DOES THE CALCULATIONS FOR THE MULTIPLIERS TO BE
C
```

```
C USED IN THE OTHER TWO SUBPROGRAMS.
C
C THE MAIN PROGRAM SERVES BASICALLY AS AN INITIALIZATION PROGRAM AND AN
C INPUT OUTPUT PROGRAM.
C
C
      DIMENSION D(2,15),EMP(15),E(2,15),Y(15),B(15),A(15),C(15),ALPHA(4)
      DIMENSION ESTPOP(25), ATTEND(20), AT(20), REC(20)
 150  READ (5,99) (ALPHA(I),I=1,4)
 99   FORMAT (4A6)
C
C  THE ECONOMIC VARIABLES OF TOTAL AREA, POPULATION, AGGREGATE INCOME,
C  AGRICULTURAL INCOME, TOTAL POPULATION OF THE 100-MILE RADIUS AND THE
C  DISTANCE FROM A METROPOLITAN CENTER ARE READ.
C
      READ (5,100) AR,P,ENC,AGINC,POP100,DIST
 100  FORMAT (5F10.0,F5.0)
C
C  THE PROPOSED YEARS OF CONSTRUCTION--BEGINNING YEAR AND ENDING YEAR--
C  ARE READ.  ALSO, AN INDICATOR IS READ WHICHGIVES INFORMATION ON THE
C  INSTALLATION OF HYDROELECTRIC FACILITIES.  A 1 INDICATES SUCH AN
C  INSTALLATION AND A BLANK INDICATES NO INSTALLATION.
C
      READ (5,101) IEG,INP,INDICT
 101  FORMAT (2I4,I1)
      POPPER = P/POP100
      N=INP-IEG
      N=N+7
      NP2=N+2
C
C  THE VARIOUS ARRAYS ARE SET EQUAL TO ZERO.
C
      DO 1 I=1,15
      Y(I)=0.0
```

```
C USED IN THE OTHER TWO SUBPROGRAMS.
C
C THE MAIN PROGRAM SERVES BASICALLY AS AN INITIALIZATION PROGRAM AND AN
C INPUT-OUTPUT PROGRAM.
C
C
      DIMENSION G(2,15),EMP(15),E(2,15),Y(15),B(15),A(15),C(15),ALPHA(4)
      DIMENSION ESTPOP(25), ATTEND(20), AT(20), REC(20)
 150  READ (5,99) (ALPHA(I),I=1,4)
 99   FORMAT (4A6)
C
C  THE ECONOMIC VARIABLES OF TOTAL AREA, POPULATION, AGGREGATE INCOME,
C  AGRICULTURAL INCOME, TOTAL POPULATION OF THE 100-MILE RADIUS AND THE
C  DISTANCE FROM A METROPOLITAN CENTER ARE READ.
C
      READ (5,100) AR,P,ENC,AGINC,POP100,DIST
 100  FORMAT (5F10.0,F5.0)
C
C  THE PROPOSED YEARS OF CONSTRUCTION--BEGINNING YEAR AND ENDING YEAR--
C  ARE READ.  ALSO, AN INDICATOR IS READ WHICHGIVES INFORMATION ON THE
C  INSTALLATION OF HYDROELECTRIC FACILITIES.  A 1 INDICATES SUCH AN
C  INSTALLATION AND A BLANK INDICATES NO INSTALLATION.
C
      READ (5,101) IEG,IND,INDICT
 101  FORMAT (2I4,I1)
      POPPER = P/POP100
      N=IND-IEG
      M=N+7
      NP2=N+2
C
C  THE VARIOUS ARRAYS ARE SET EQUAL TO ZERO.
C
      DO 1 I=1,15
      Y(I)=0.0
```

```
      G(1,I)=0.0
      G(2,I) = 0.0
      B(I)=0.0
      A(I)=0.0
      C(I)=0.0
      EMP(I)=0.0
      E(1,I)=0.0
      E(2,I)=0.0
 1    CONTINUE
C
C  DEPENDING ON THE INDICATOR, THE YEARLY INPUTS FOR CONSTRUCTION ARE
C  READ.
C
      IF (INDICT.EQ.1) READ (5,102) (Y(I),I=1,NP2)
      IF (INDICT.NE.1) READ (5,102) (Y(I),I=1,N)
 102  FORMAT (8F10.0)
      DEN=P/AR
      PER=AGINC/ENC
C
C  THE INITIAL G IS CALCULATED.
C
      G(1,1)=(((DEN**2)*(PER**2))/((DIST**2)/4.0))-1.0
C
C  A TEST IS MADE FOR THE SIGN OF G.  IF POSITIVE, THE PROGRAM CONTINUES.
C  IF G IS NEGATIVE, THE PROGRAM CONTINUES WITH STATEMENT 3.
C
      IF (G(1,1).LT.0.0) GO TO 3
      L = N-2
      DO 6 I=2,L
      G(1,I) = G(1,1) +.5
 6    CONTINUE
      G(1,N-1) = G(1,1)-1.5
      G(1,N) = G(1,1)-2.0
      LOW = N+1
```

```
      X = 2.5
      DO 130 I=LOW,M
      G(1,I)=G(1,1)-X
      X = X + .5
 130  CONTINUE
      GO TO 7
 3    X=2.0
      DO 8 I=2,N
      JJ = I-1
      G(1,I) = G(1,JJ)-X
 8    CONTINUE
      LOW = N+1
      DO 140 I=LOW,M
      G(1,I)=G(1,N)
 140  CONTINUE
C
C  G(2,I) IS CALCULATED.
C
 7    G(2,1) = G(1,1)+2.0
C  THIS SECTION OF THE PROGRAM INCORPORATES THE RECREATIONAL PROJECTION
C  MODEL.  THE INITIAL STEPS ESTABLISH THE POPULATION GROWTH RATE BASED
C  ON THE POPULATION GIVEN BY THE U. S. BUREAU OF THE  CENSUS.  THIS
C  GROWTH FACTOR IS BASED ON THE FIGURES GIVEN FOR ALL COUNTIES WITHIN
C  A CIRCLE OF 100-MILE RADIUS AND ITS CENTER THE PROPOSED RESERVOIR.
C  FROM THESE POPULATION PROJECTIONS THE PROJECTIONS ARE MADE FOR
C  THE RECREATIONAL ATTENDANCE AT THE NEW RESERVOIR.
C
C  STATISTICS ABOUT THE PROPOSED RESERVOIR AND ALL RESERVOIRS IN THE 100-MILE
C  RADIUS ARE READ.
C
      DIMENSION OUTATT(20), BOATAT(20), CAMPAT(20), OTHATT(20)
      READ(5,105) USEXP,POP1,POP2
 105  FORMAT (3F10.0)
C
```

```
C  THE AVERAGE YEARLY MAINTENANCE AND OPERATION EXPENDITURE IS READ.
C  IN ADDITION THE POPULATION OF THE COUNTIES WITHIN THE 100-MILE RADIUS
C  FOR THE BEGINNING YEAR AND ENDING YEAR OF THE LAST DECENNIAL U. S.
C  CENSUS IS READ.
C
      READ(5,106) RESAR,SHORE,TOTLAK,RESNO,METIND,DISTME
 106  FORMAT (F10.0,F5.0,F10.0,F4.0,I1,F10.0)
C
C  THE GROWTH FACTOR IS CALCULATED USING LOGRITHMS PROVIDED BY A LIBRARY
C  SUBROUTINE.
C
      POPBEG = ALOG10(POP1)
      POPEND = ALOG10(POP2)
      POWR=(POPEND-POPBEG)/10.0
      GROW=(10.0**POWR)-1.0
      LI1=IBG-1900
 107  LI2=LI1-10
      LI1=LI2
      IF(LI2.GT.10) GO TO 107
      POPHOL=POP2
      MPL = M+LI2
C
C  POPULATION PROJECTIONS ARE ESTABLISHED FOR THE YEARS OF RECREATIONAL
C  ATTENDANCE UP TO FIVE YEARS AFTER FILL-UP.
C
      DO 108 I=1,MPL
      ESTPOP(I) = POPHOL + (POPHOL*GROW)
      POPHOL=ESTPOP(I)
 108  CONTINUE
      CAMPAT(N) = 0.0
      BOATAT(N) = 0.0
      OTHATT(N) = 0.0
      REC(N) = 0.0
C
```

```
C  USING THE RESERVOIR STATISTICS, AN ATTENDANCE FACTOR IS ESTABLISHED.
C
      ATTFAC = ((((RESAR/TOTLAK)**.5)*(SHORE/10.0))/((1.45*RESNO)**.5))
     1- (DIST/60.0)
      NP1=N+1
C
C  THE INSTALLATION OF HYDROELECTRIC FACILITIES DETERMINES THE INITIAL
C  YEAR OF ATTENDANCE PROJECTION.
C
      IF (INDICT.EQ.1) GO TO 109
      ISTART = LI2+N
      ATTEND(N) = .30*ESTPOP(ISTART)
      AT(N) = .30
      NSTART = N
      JEND=LI2+M
      ISTART = LI2+N+1
      GO TO 111
 109  ISTART = LI2+N+1
      ATTEND(NP1) = .30*ESTPOP(ISTART)
      AT(NP1) = .30
      NSTART = NP1
      JEND = LI2+M
      ISTART = LI2+N+2
 111  PREATT = 0.0
C
C  THE SUCCESSIVE YEARS OF ATTENDANCE ARE PROJECTED.
C
      DO 110 I=ISTART,JEND
      J=I-LI2
      ATTEND(J) = ATTFAC*ESTPOP(I)
      AT(J) =ATTFAC
      ATTFAC = ATTFAC + (.5*(ATTFAC-PREATT))
      PREATT = AT(J)
 110  CONTINUE
```

```
C
C   THIS SECTION OF THE PROGRAM IS TO CALCULATE THE INVESTMENT EXPENDITURES
C   THAT ARE INDUCED BY A WATER IMPOUNDMENT PROJECT.  THE FOLLOWING GROUP
C   OF INSTRUCTIONS CALCULATES THESE PROJECTED INVESTMENT EXPENDITURES
C   ON THE BASIS OF THE PHYSICAL FACILITIES OF THE PROPOSED RESERVOIR AND
C   THE EXPECTED ACTIVITY THE RESERVOIR WILL GENERATE.
C
C
      DIMENSION COMINV(15),COMDOL(15), RESINV(15),RESDOL(15)
      NP3=N+3
C
C   BASED ON THE CHARACTERISTICS OF THE PROPOSED RESERVOIR, RESIDENTIAL
C   INVESTMENT IS PROJECTED.  THESE PROJECTIONS ARE THEN CONVERTED INTO
C   DOLLAR FIGURES.
C
      RESINV(N) = (SHORE/10.)*2.0
      DO 115 I=NP1,NP3
      II = I-1
      RESINV(I) = RESINV(II)*2.0
115   CONTINUE
      NP4=N+4
      DO 116 I=NP4,M
      II=I-1
      RESINV(I) = RESINV(II) -(.3*RESINV(II))
116   CONTINUE
      DO 117 I=N,M
      RESINV(I) = RESINV(I) + .5
      JHOLD = RESINV(I)
      RESINV(I) = JHOLD
      RESDOL(I) = RESINV(I)*6000.0
117   CONTINUE
      COMDOL(N)=0.0
      TOTRIN =0.0
```

```
      TOTATT = 0.0
      IF(METIND.NE.1) GO TO 118
      POPPER = POPPER + (DISTME * .001)
  118 DO 120 J=NSTART,M
C
C  BASED ON THE TOTAL PROJECTED ATTENDANCE, THE PROJECTIONS ARE BROKEN
C  DOWN INTO LOCAL ATTENDANCE FROM THE CONTIGUOUS COUNTIES AND THE OUT-
C  SIDE ATTENDANCE.  THE OUTSIDE ATTENDANCE, USING THE RESULTS OF THE
C  SAMPLE, IS FURTHER BROKEN DOWN BY THREE BROAD RECREATION CATEGORIES
C  WHICH INCLUDE
C      1.  CAMP
C      2.  BOAT AND FISH
C      3.  SWIM, SKI, SIGHTSEE, PICNIC
C  THESE GROUPINGS WERE DEVELOPED THROUGH THE ANALYSIS OF THE SAMPLE DATA.
      OUTATT(J) = ((-27.31*POPPER) + 1.6147) * ATTEND(J)
      CAMPAT(J) = ((-12.38 * POPPER) + 1.0472) * OUTATT(J)
      BOATAT(J) = ((-1.124*POPPER) + .2411) * OUTATT(J)
      OTHATT(J) = ((13.50 * POPPER) - .2894) * OUTATT(J)
C
C  TOTAL PROJECTED ATTENDANCE FOR THE RESERVOIR IS CALCULATED.
C
      TOTATT = TOTATT + ATTEND(J)
  120 CONTINUE
C
C  BASED UPON TOTAL EXPECTED ATTENDANCE AND THE RESEDENTIAL INVESTMENT,
C  THE COMMERCIAL INVESTMENT IS PROJECTED.  THESE PROJECTIONS ALSO
C  UTILIZE THE LIMITING CHARACTERISTICS OF THE PROPOSED RESERVOIR.  THE
C  COMMERCIAL INVESTMENT IS THEN CONVERTED TO DOLLAR AMOUNTS.
C
      DO 121 I=N,M
      TOTRIN = TOTRIN + RESINV(I)
  121 CONTINUE
      COMINV(NP1) =((((TOTATT + TOTRIN)/1000.0)*(DIST/100.0))/SHORE)/2.0
      NP2 = N+2
```

```
      COMINV(NP2) = COMINV(NP1)*2.0
      DO  122 I=NP3,M
      II=I-1
      COMINV(I) = COMINV(II) - .4*COMINV(II)
  122 CONTINUE
      DO 123 I=NP1,M
      COMINV(I) = COMINV(I) +.5
      NHOLD = COMINV(I)
      COMINV(I) = NHOLD
      COMDOL(I) = COMINV(I)*31000.0
  123 CONTINUE
C
C  USING THE YEARLY PROJECTED ATTENDANCE AND THE AVERAGE LOCAL EXPENDITURE
C  OF RECREATORS, THE RECREATIONAL INPUT FOR THE MODEL IS CALCULATED.
C
      DO 112 J=N,M
C
C
C  THESE AVERAGE RECREATIONAL EXPENDITURES, OBTAINED FROM THE SAMPLE,
C  ARE COMBINED WITH THE RESPECTIVE ACTIVITY.  THE AVERAGE EXPENDITURES
C  USED ARE AS FOLLOWS
C       CAMP                          $ 4.09
C       BOAT, FISH                      3.26
C       SWIM, PICNIC
C       SKI, SIGHTSEE
C                                       1.75
C
      REC(J) = (4.09 * CAMPAT(J)) + (3.26 * BOATAT(J)) + (1.75 *
     1OTHATT(J))
C
C
C  THE FOLLOWING EQUATION COMBINES ALL OF THE INPUTS ATTRIBUTABLE TO
C  A RESERVOIR DEVELOPMENT PROJECT.  DURING THE RESPECTIVE STAGES THESE
C  INPUTS ARE CONSTRUCTION EXPENDITURES, OPERATIONS AND MAINTENANCE,
```

```
C  RECREATIONAL EXPENDITURES, PRIVATE INVESTMENT, AND COMMERCIAL
C  INVESTMENT.  THIS COMBINATION OF INPUTS IS NECESSARY FOR THE SUBPRO-
C  GRAMS TO CALCULATE THE ECONOMIC IMPACT FOR EACH YEAR OF THE DEVELOP-
C  MENT.
C
C
      Y(J) = Y(J) + (REC(J)/1000.) + USEXP + (RESDOL(J)/1000.)
     1+ (COMDOL(J)/1000.)
 112  CONTINUE
C
C  BASED ON THE INITIAL G, THE MAIN PROGRAM TRANSFERS CONTROL TO EITHER
C  OF THE TWO SUBPROGRAMS WHICH CALCULATE THE DOLLAR IMPACT ON  A
C  YEARLY BASIS.
C
      IF (G(1,1).LT.0.0) CALL NEGATE(E,G,EMP,B,Y,2,15,N,M,INDICT)
      IF (G(1,1).GT.0.0) CALL POSITE(E,G,EMP,B,Y,2,15,M)
      TOT = 0.0
C
C  TAKING THE DOLLAR IMPACT CALCULATIONS RETURNED TO THE MAIN PROGRAM
C  FROM THE RESPECTIVE SUBPROGRAM, THESE ARE EXPRESSED AS A PERCENTAGE OF
C  THE BASE YEAR INCOME.
C
      DO 41 I=1,M
      A(I) = EMP(I)/ENC
      TOT = TOT+EMP(I)
      C(I) = TOT/ENC
 41   CONTINUE
C
C  THE FOLLOWING OUTPUT SECTION WRITES THE INFORMATION GENERATED BY THE
C  MODEL AND ITS SUBPROGRAMS.  FIRST THE IMPACT INFORMATION IS WRITTEN,
C  THEN THE RECREATIONAL PROJECTIONS ARE GIVEN AND LASTLY THE INVESTMENT
C  PROJECTIONS ARE WRITTEN.
C
      WRITE (6,1000) (ALPHA(I), I=1,4)
```

```
1000 FORMAT(1H1,31X,23HTHE ECONOMIC IMPACT OF ,4A6,18H RESERVOIR PROJEC
    1T)
     WRITE (6,1001)
1001 FORMAT(1H0,30X,5HMONEY,19X,6HYEARLY,26X,6HYEARLY,21X,5HTOTAL/10X,4
    1HYEAR,16X,6HINPUTS,16X,13HDOLLAR IMPACT,16X,17HPERCENTAGE IMPACT,1
    26X,6HIMPACT/)
     WRITE (6,1003) IEG,IND
     WRITE (6,1002) (I,Y(I),EMP(I),A(I),C(I),I=1,N)
1002 FORMAT(1H0,10X,I2,11X,1H$,F15.2,9X,1H$,F15.2,14X,E18.8,10X,E18.8)
1003 FORMAT (1H0,46X,13HCONSTRUCTION ,I4,4H TO ,I4)
     IND1 = IND+1
     IND2 = IND+2
     LP1 = N+1
     LP2 = N+2
     WRITE (6,1004) IND1, IND2
1004 FORMAT(1H0,48X,8HFILL-UP ,I4,5H AND ,I4)
     WRITE(6,1002) (I,Y(I),EMP(I),A(I),C(I),I=LP1,LP2)
     IND3=IND+3
     INDN=IND+7
     WRITE (6,1005) IND3,INDN
1005 FORMAT(1H0,37X,24HPOST FILL-UP CONSIDERED ,I4,4H TO ,I4)
     NP3=N+3
     WRITE(6,1002) (I,Y(I),EMP(I),A(I),C(I),I=NP3,M)
     WRITE (6,1006)
1006 FORMAT(1H1,48X,31HLAKE AREA PROJECTION STATISTICS)
     WRITE (6,1007)
1007 FORMAT(1H0,10X4HYEAR,14X,10HPOPULATION,12X,17HATTENDANCE FACTOR,17
    1X,10HATTENDANCE,13X16HRECREATION MONEY)
     DO 113 I=NSTART,M
     J=I+LI2
     WRITE(6,1011)  I,ESTPOP(J),AT(I),ATTEND(I),REC(I)
113  CONTINUE
1011 FORMAT(1H0,10X,I2,11X,F15.0,8X,E18.8,13X,F15.0,12X,1H$,F15.2)
     WRITE(6,1008)
```

```
1008 FORMAT(1H1,1H ,55X,22HINVESTMENT PROJECTIONS//1H0,36X,11HRESIDENTI
    1AL,42X,10HCOMMERCIAL//12X,4HYEAR,9X,6HNUMBER,4X,7HAVERAGE,6X,13HTO
    1TAL DOLLARS,15X,6HNUMBER,5X,7HAVERAGE,8X,13HTOTAL DOLLARS)
      WRITE(6,1009) N,RESINV(N), RESDOL(N)
1009 FORMAT(1H0,10X,I4,10X,F5.0,4X,9H$6,000.00,3X,1H$,F15.2)
      WRITE(6,1010)(I,RESINV(I),RESDOL(I),COMINV(I),COMDOL(I), I=NP1,M)
1010 FORMAT(1H0,10XI4,10XF5.0,4X9H$6,000.00,3X1H$,F15.2,15X,F5.0,4X,10H
    1$31,000.00,4X,1H$,F15.2)
      WRITE (6,1112)
1112 FORMAT(1H1)
      WRITE(6,1111) (J,OUTATT(J), CAMPAT(J), BOATAT(J), OTHATT(J),
    1J=NSTART,M)
1111 FORMAT (1H0,I4,5X,F15.0,5X,F15.0,5X,F15.0,5X,F15.0)
14    GO TO 150
      END
$IBFTC POS
      SUBROUTINE POSITE(E,G,EMP,B,Y,K,L,M)
C
C THIS SUBPROGRAM IS FOR THE DOLLAR IMPACT CALCULATION IF THE INITIAL
C CONDITIONS GIVE A POSITIVE G.
C
      DIMENSION G(2,15),E(2,15),EMP(15),B(15),Y(15)
      CALL EROUTE(E,G,2,15,M)
      DO 10 I=1,M
      EMP(I) = Y(I)*E(1,I)
      IF (I.EQ.1) GO TO 10
      LL = I-1
      DO 11 J=1,LL
      KK = I-J
      EMP(I) = EMP(I) + EMP(KK)* E(2,J)
11    CONTINUE
10    CONTINUE
      RETURN
      END
```

```
$IBFTC NEG
      SUBROUTINE NEGATE(E,G,EMP,B,Y,K,L,N,M,ID)
C
C THIS SUBPROGRAM IS FOR THE DOLLAR IMPACT CALCULATION IF THE
C INITIAL CONDITIONS GIVE A NEGATIVE G.
C
      DIMENSION G(2,15),E(2,15),EMP(15),B(15),Y(15)
      CALL EROUTE (E,G,2,15,M)
      DO 20 I=1,M
      EMP(I) = Y(I)*E(1,I)
      B(I)= EMP(I)
      IF (I.EQ.1) GO TO 20
      LI = I-1
      DO 21 J=1,LI
      KI = I-J
      EMP(I) = EMP(I) + EMP(KI)* E(2,J)
 21   CONTINUE
      IF (ID.NE.1) GO TO 40
      IF (I.LT.N) GO TO 40
      IF (I.EQ.N) GO TO 40
      IF (I.EQ.N+2) GO TO 40
      IF (I.GT.N+3) GO TO 40
      B(I) = EMP(I) - .5*Y(I)
      GO TO 20
 40   B(I) = EMP(I) - .33*Y(I)
 20   CONTINUE
      DO 31 I=1,M
      EMP(I) = B(I)
 31   CONTINUE
      RETURN
      END
$IBFTC ER
      SUBROUTINE EROUTE(E,G,K,L,M)
C
```

```
C THIS SUBPROGRAM IS FOR THE CALCULATION OF THE MULTIPLIER DEPENDENT
C ON THE INITIAL CONDITIONS OF G.
C
      DIMENSION G(2,15),E(2,15)
      DO 10 I=1,M
      X = G(1,I)
      E(1,I) = (EXP(X)-1.0)/G(1,I)
 10   CONTINUE
      DO 11 I=1,M
      R = 0-I
      Y = R*G(2,1)
      IF (I.GT.1) GO TO 12
      E(2,I) = (1.0-EXP(Y))/G(2,1)
      GO TO 11
 12   IF (E(2,I-1).LT..01) GO TO 14
      S = 0 -(I-1)
      Z = S*G(2,1)
      E(2,I) = (EXP(Z)-EXP(Y))/G(2,1)
 11   CONTINUE
 14   RETURN
      END
$DATA
```

APPENDIX B

INPUT FORMATS TO FORTRAN IV PROGRAM FOR THE COMPARATIVE-PROJECTION MODEL

Card Number	Card Column	Input Format	Description
1	1-24	4A6	Name of the project.
2	1-10	F10.0	Land area of the contiguous counties in square miles.
	11-20	F10.0	Population of the contiguous counties for the base year.
	21-30	F10.0	Aggregate income of the contiguous counties for the base year. (given in 000's)
	31-40	F10.0	Aggregate agricultural income of the contiguous counties for the base year (given in 000's)
	41-50	F10.0	Population of all counties in 100-mile radius.
	51-55	F 5.0	Distance from the nearest population center over 25,000. (in miles)
3	1-4	I4	Year construction will begin.
	5-8	I4	Year construction will end.
	9	I1	A 1 if hydroelectric facilities will be installed as a part of construction, blank if none are to be installed.
4	1-10 11-20 21-30 31-40 41-50 51-60 61-70 71-80	F10.0 F10.0 F10.0 F10.0 F10.0 F10.0 F10.0 F10.0	In as many fields as necessary, the yearly construction expenditures given in thousands of dollars. Must be one field for every year of construction. If hydroelectric facilities are installed after construction, must have yearly inputs for these expenditures.
5	1-10	F10.0	Estimated average yearly expenditure for operations and maintenance.
	11-20	F10.0	Total population of all counties within 100-mile radius of the proposed reservoir at the beginning of the last decennial census.

Card Number	Card Column	Input Format	Description
	21-30	F10.0	Total population for same area at the end of the last decennial census.
6	1-10	F10.0	Surface area of the proposed reservoir at its normal operating level.(acres)
	11-15	F 5.0	Miles of shoreline for the proposed reservoir at its normal operating level.
	16-25	F10.0	Total surface area of all reservoirs over 2,500 acres located within the 100-mile radius of the proposed reservoir. All taken at normal operating level.
	26-29	F 4.0	Number of reservoirs used in calculating the total area.
	30	I1	An indication whether a major metropolitan area lies within the 100-mile radius. A blank indicates no such area and a 1 indicates there is such an area and it is over 80 miles from the reservoir.
	31-40	F10.0	The difference between the distance of the city within the 100-mile radius and the 80-mile minimum.

APPENDIX C

TABLE 1c

DATA FROM THE CITY OF HOUSTON USED IN THE CORRELATION ANALYSIS TO DEVELOP A SYNTHETIC INDEX, 1953 - 1963

Year	Income*	Debits*	Postal Receipts	Bank Deposit Differences*	Retail Sales*
1953	1,283,621	20,163,255	11,444,551	- 891,744	1,028,780
1954	1,361,029	21,219,565	12,380,956	172,968	1,012,525
1955	1,336,667	23,400,383	12,722,808	3,660,672	1,163,572
1956	1,412,840	26,883,213	13,183,518	-2,438,004	1,213,573
1957	1,744,006	28,058,919	15,336,647	- 7,548	1,271,522
1958	1,786,262	27,750,385	16,538,138	- 145,752	1,269,946
1959	1,879,622	30,206,880	19,326,969	541,500	1,348,789
1960	2,023,080	30,913,925	20,870,362	206,964	1,355,722
1961	2,106,512	32,968,719	21,313,699	795,036	1,380,591
1962	2,246,990	37,292,484	22,411,992	1,163,172	1,516,061
1963	2,358,907	39,935,728	27,189,860	823,104	1,623,207

*In thousands of dollars.

Source: Income and retail sales data: Sales Management's Survey of Buying Power, 1953-63; Debit, postal receipt, and deposit data: Texas Business Review, University of Texas, 1953-63.

TABLE 2c

DATA FROM THE CITY OF DALLAS USED IN THE CORRELATION ANALYSIS TO DEVELOP A SYNTHETIC INDEX, 1953 - 1963

Year	Income*	Debits*	Postal Receipts	Bank Deposit Differences*	Retail Sales*
1953	1,106,196	19,846,785	18,298,159	-1,788,048	952,912
1954	1,135,650	21,494,670	19,345,839	152,757	873,977
1955	1,147,109	24,168,394	19,427,929	742,436	1,044,216
1956	1,248,541	25,580,204	19,832,973	- 47,498	1,079,457
1957	1,278,456	27,016,545	21,369,396	- 31,538	1,138,095
1958	1,339,518	27,973,942	21,901,932	931,462	1,152,271
1959	1,368,075	31,527,323	26,780,367	920,256	1,234,044
1960	1,511,715	34,681,589	28,958,808	84,043	1,280,802
1961	1,639,668	37,429,400	30,138,856	786,974	1,303,681
1962	1,748,186	41,316,580	31,364,256	1,067,179	1,413,871
1963	1,883,337	42,760,526	37,037,400	35,298	1,488,684

*In thousands of dollars.

Source: Income and retail sales data: <u>Sales Management's Survey of Buying Power</u>, 1953-63; Debit, postal receipt, and deposit data: <u>Texas Business Review</u>, University of Texas, 1953-63.

TABLE 3c

DATA FROM THE CITY OF SAN ANTONIO USED IN THE CORRELATION ANALYSIS TO DEVELOP A SYNTHETIC INDEX, 1953 - 1963

Year	Income*	Debits*	Postal Receipts	Bank Deposit Differences*	Retail Sales*
1953	642,005	4,602,609	5,983,525	-744,312	527,814
1954	614,410	4,856,856	6,381,014	-180,864	533,673
1955	666,810	5,520,730	6,497,137	284,808	622,215
1956	719,456	5,808,583	6,715,230	113,964	586,279
1957	753,085	6,145,961	6,469,404	- 88,752	597,550
1958	783,189	6,498,530	7,434,528	375,468	628,671
1959	827,873	7,223,239	8,376,990	182,236	686,068
1960	919,303	7,220,697	8,826,899	-222,396	679,756
1961	898,320	7,607,684	9,152,042	225,900	686,484
1962	997,684	8,286,816	9,548,908	233,028	761,383
1963	1,006,099	8,966,733	11,253,890	152,196	817,086

*In thousands of dollars.

Source: Income and retail sales data: Sales Management's Survey of Buying Power, 1953-63; Debit, postal receipt, and deposit data: Texas Business Review, University of Texas, 1953-63.

TABLE 4c

DATA FROM THE CITY OF LAMESA USED IN THE CORRELATION ANALYSIS TO DEVELOP A SYNTHETIC INDEX, 1953 - 1963

Year	Income*	Debits*	Postal Receipts	Bank Deposit Differences*	Retail Sales*
1953	21,117	90,399	91,805	-25,980	23,805
1954	21,328	112,914	95,686	-11,232	23,003
1955	21,939	127,695	102,753	14,016	23,300
1956	23,066	136,602	104,093	12,024	21,673
1957	24,420	151,209	122,591	- 5,556	22,410
1958	22,011	178,264	142,161	24,384	21,911
1959	21,740	227,421	172,832	23,136	24,430
1960	28,470	235,237	174,123	-12,012	24,384
1961	24,248	242,829	175,060	17,304	24,507
1962	26,373	234,501	169,241	21,228	25,734
1963	28,844	239,795	197,779	-19,164	26,553

*In thousands of dollars.

Source: Income and retail sales data: _Sales Management's Survey of Buying Power_, 1953-63; Debit, postal receipt, and deposit data: _Texas Business Review_, University of Texas, 1953-63.

TABLE 5c

DATA FROM THE CITY OF HENDERSON USED IN THE CORRELATION ANALYSIS TO DEVELOP A SYNTHETIC INDEX, 1953 - 1963

Year	Income*	Debits*	Postal Receipts	Bank Deposit Differences*	Retail Sales*
1953	8,771	71,336	97,161	312	17,045
1954	10,025	70,120	97,228	3,096	16,494
1955	13,471	76,743	100,046	5,976	21,788
1956	15,975	81,034	103,286	3,768	21,160
1957	17,918	85,557	104,733	- 1,980	23,013
1958	18,447	88,109	117,424	15,456	21,845
1959	18,521	90,661	135,813	2,736	22,667
1960	17,117	87,590	136,990	- 3,576	22,622
1961	16,150	86,030	136,707	- 4,896	22,660
1962	16,636	86,451	133,165	10,476	23,869
1963	17,100	97,320	166,671	15,360	24,692

*In thousands of dollars.

Source: Income and retail sales data: Sales Management's Survey of Buying Power, 1953-63; Debit, postal receipt, and deposit data: Texas Business Review, University of Texas, 1953-63.

TABLE 6c

DATA FROM THE CITY OF BRENHAM USED IN THE CORRELATION ANALYSIS TO DEVELOP A SYNTHETIC INDEX, 1953 - 1961

Year	Income*	Debits*	Postal Receipts	Bank Deposit Differences*	Retail Sales*
1953	8,134	71,244	78,332	3,900	12,351
1954	8,466	73,567	76,666	3,252	11,493
1955	8,825	75,229	79,835	17,676	14,446
1956	9,176	76,430	69,919	- 6,660	14,213
1957	9,426	83,424	78,906	3,049	14,082
1958	9,594	88,273	87,685	4,685	13,909
1959	9,849	103,999	100,560	359	14,686
1960	11,536	105,308	101,699	- 1,722	14,523
1961	14,008	111,716	107,850	541	14,535

*In thousands of dollars.

Source: Income and retail sales data: Sales Management's Survey of Buying Power, 1953-63; Debit, postal receipt, and deposit data: Texas Business Review, University of Texas, 1953-63.

APPENDIX D

TABLE 1d

SYNTHETIC INDEX INPUT DATA FOR
BELL COUNTY,
1949 - 1963

Year	Income*	Retail Sales*	Bank Deposit Differences*	Postal Receipts*	Total
1949	59,644	36,993	2,811	394,623	494,071
1950	75,802	52,711	8,222	454,849	591,584
1951	86,117	56,484	5,636	608,055	756,292
1952	93,809	64,842	5,636	688,491	852,778
1953	135,804	64,318	- 138	598,855	798,839
1954	131,536	63,917	- 138	748,577	943,890
1955	136,874	85,632	- 3,645	765,094	983,955
1956	149,712	82,696	- 1,963	622,647	853,092
1957	147,192	88,070	534	699,030	934,828
1958	161,813	95,235	6,923	746,803	1,010,774
1959	175,949	88,436	3,388	722,762	989,535
1960	174,774	91,955	373	766,133	1,033,235
1961	144,854	96,668	3,031	788,137	1,032,690
1962	153,681	105,076	6,197	888,279	1,153,233
1963	160,669	112,673	13,537	938,123	1,225,002

*In thousands of dollars.

Source: Income and retail sales data: Sales Management's Survey of Buying Power, 1947-63; Debit and deposit data: Texas Business Review, University of Texas, 1947-63; Postal receipt data: U. S. Post Office, Postal Data Center, 1947-63.

TABLE 2d

SYNTHETIC INDEX INPUT DATA FOR
CORYELL COUNTY,
1949 - 1963

Year	Income*	Retail Sales*	Bank Deposit Differences*	Postal Receipts*	Total
1949	15,796	7,212	268	43,894	67,170
1950	14,120	9,333	405	45,053	68,911
1951	14,774	10,001	258	50,857	75,890
1952	14,718	9,781	185	66,327	91,011
1953	16,680	9,703	- 22	61,290	87,651
1954	15,615	9,114	- 322	72,278	96,685
1955	15,347	14,256	- 219	73,936	103,320
1956	15,598	14,873	- 195	70,960	101,236
1957	15,634	16,544	674	71,359	104,211
1958	17,127	16,932	1,342	74,491	109,892
1959	23,813	14,995	342	73,551	112,701
1960	32,303	15,377	179	79,112	126,971
1961	37,495	15,948	664	83,230	137,337
1962	39,504	17,043	1,435	95,880	153,862
1963	41,313	18,014	758	103,829	163,914

*In thousands of dollars.

Source: Income and retail sales data: Sales Management's Survey of Buying Power, 1947-63; Debit and deposit data: Texas Business Review, University of Texas, 1947-63; Postal receipt data: U. S. Post Office, Postal Data Center, 1947-63.

TABLE 3d

SYNTHETIC INDEX INPUT DATA FOR
HILL COUNTY,
1949 - 1963

Year	Income*	Retail Sales*	Bank Deposit Differences*	Postal Receipts*	Total
1949	24,699	17,625	- 10	111,889	154,203
1950	27,389	23,725	3,789	114,133	169,036
1951	28,440	25,424	- 2,847	112,093	163,110
1952	30,676	25,497	507	121,255	177,935
1953	34,993	25,291	- 840	124,408	183,852
1954	32,766	23,415	- 841	126,961	182,301
1955	32,590	23,600	172	121,026	177,388
1956	33,207	22,593	917	122,079	176,962
1957	32,973	22,972	- 425	120,486	176,006
1958	35,270	22,069	547	128,901	186,787
1959	37,788	25,033	373	119,231	182,425
1960	33,178	24,267	- 725	131,537	188,257
1961	26,928	23,861	1,048	132,332	184,169
1962	26,995	24,309	1,618	139,298	192,220
1963	27,503	24,367	1,845	143,809	197,524

*In thousands of dollars.

Source: Income and retail sales data: Sales Management's Survey of Buying Power, 1947-63; Debit and deposit data: Texas Business Review, University of Texas, 1947-63; Postal receipt data: U. S. Post Office, Postal Data Center, 1947-63.

TABLE 4d

SYNTHETIC INDEX INPUT DATA FOR
BOSQUE COUNTY,
1949 - 1963

Year	Income*	Retail Sales*	Bank Deposit Differences*	Postal Receipts*	Total
1949	9,242	6,487	- 11	44,940	60,658
1950	10,116	8,951	673	46,643	66,383
1951	10,466	9,591	- 417	47,238	66,878
1952	9,508	9,753	828	53,288	73,377
1953	11,431	9,674	- 108	52,368	73,365
1954	10,650	8,762	- 107	45,615	64,920
1955	10,561	10,776	78	55,402	76,817
1956	10,700	10,742	582	53,775	75,799
1957	10,590	11,022	301	59,050	80,963
1958	11,805	10,887	791	61,103	84,586
1959	14,505	10,421	454	61,097	86,477
1960	14,293	10,174	318	67,258	92,043
1961	14,034	10,036	387	72,837	97,294
1962	14,424	10,298	828	74,772	100,322
1963	14,862	10,427	1,068	76,376	102,733

*In thousands of dollars.

Source: Income and retail sales data: Sales Management's Survey of Buying Power, 1947-63; Debit and deposit data: Texas Business Review, University of Texas, 1947-63; Postal receipt data: U. S. Post Office, Postal Data Center, 1947-63.

TABLE 5d

SYNTHETIC INDEX INPUT DATA FOR
ANDERSON COUNTY,
1949 - 1963

Year	Income*	Retail Sales*	Bank Deposit Differences*	Postal Receipts*	Total
1949	25,330	18,113	657	119,996	164,096
1950	23,979	22,416	188	119,739	166,322
1951	25,214	24,021	- 22	123,076	172,289
1952	30,225	23,237	1,120	137,597	192,179
1953	34,546	23,049	246	139,723	197,564
1954	32,287	21,764	246	144,088	198,385
1955	31,670	23,606	981	148,593	204,760
1956	32,574	23,894	1,025	154,481	211,974
1957	32,600	24,230	285	152,730	209,845
1958	35,003	23,668	1,228	149,547	209,446
1959	41,182	24,958	741	153,229	220,110
1960	36,275	24,795	- 79	158,763	219,754
1961	35,981	24,963	994	167,374	229,312
1962	36,312	25,625	20	164,427	226,384
1963	36,594	26,074	2,358	175,464	240,490

*In thousands of dollars.

Source: Income and retail sales data: Sales Mangement's Survey of Buying Power, 1947-63; Debit and deposit data: Texas Business Review, University of Texas, 1947-63; Postal receipt data: U. S. Post Office, Postal Data Center, 1947-63.

TABLE 6d

SYNTHETIC INDEX INPUT DATA FOR
LEON COUNTY,
1949 - 1963

Year	Income*	Retail Sales*	Bank Deposit Differences*	Postal Receipts	Total
1949	8,257	6,152	- 441	24,163	38,131
1950	8,567	5,870	348	23,779	38,584
1951	8,853	6,290	60	25,102	40,305
1952	6,890	5,497	155	27,277	39,819
1953	8,795	5,453	137	28,052	42,438
1954	8,146	5,234	138	28,624	42,022
1955	8,005	6,599	328	29,236	44,168
1956	8,131	6,799	35	28,539	43,504
1957	8,172	6,973	337	28,927	44,409
1958	9,696	7,091	- 183	28,042	44,646
1959	12,548	7,511	- 16	26,695	46,738
1960	10,333	7,409	- 90	28,751	46,403
1961	9,562	7,425	490	27,567	45,044
1962	9,532	7,652	617	29,329	47,040
1963	9,512	7,833	438	29,691	47,474

*In thousands of dollars.

Source: Income and retail sales data: Sales Management's Survey of Buying Power, 1947-63; Debit and deposit data: Texas Business Review, University of Texas, 1947-63; Postal receipt data: U. S. Post Office, Postal Data Center, 1947-63.

TABLE 7d

SYNTHETIC INDEX INPUT DATA FOR
FREESTONE COUNTY,
1949 - 1963

Year	Income*	Retail Sales*	Bank Deposit Differences*	Postal Receipts	Total
1949	10,663	8,240	61	41,581	60,545
1950	12,055	9,577	664	43,499	65,795
1951	12,407	10,263	274	44,576	67,520
1952	10,653	9,597	342	49,387	69,979
1953	12,846	9,519	- 563	50,819	72,921
1954	11,939	8,907	185	52,846	73,877
1955	12,001	10,386	122	52,092	74,601
1956	12,095	10,280	106	50,433	72,914
1957	11,971	10,479	592	51,982	75,024
1958	13,476	10,287	- 43	53,712	77,432
1959	17,333	12,476	- 41	53,810	83,578
1960	13,832	12,465	- 126	53,121	79,292
1961	14,565	12,593	761	52,669	80,588
1962	14,622	12,930	93	55,273	82,918
1963	14,657	12,181	398	62,298	89,534

* In thousands of dollars.

Source: Income and retail sales data: <u>Sales Management's Survey of Buying Power</u>, 1947-63; Debit and deposit data: <u>Texas Business Review</u>, University of Texas, 1947-63; Postal receipt data: U. S. Post Office, Postal Data Center, 1947-63.

APPENDIX E

MEASURING RECREATIONAL IMPACT

The essential purpose of the project's recreational phase was to obtain average per visitor expenditures. A questionnaire was designed to collect: (1) the origin zone (distance) of the recreation party, (2) the number of people in each party, (3) the length of their stay, (4) the primary purpose of their visit, and (5) the expenditure amount made in the lake area. The phrase, "this lake area only," was capitalized and underlined (as illustrated in the questionnaire at the end of Appendix E) to insure against the respondent listing all the expenditures made from his point of origin to the lake area.

Procedure

Personal interviews and mail questionnaires were used to collect recreational data at the two comparative areas. The questionnaires were pretested during the summer of 1966 at Sam Houston State Park, Huntsville, Texas and in the state park on Lake Whitney. Several changes were made in the original questionnaire as a result of the pretest. A stratified sample was designed and working schedules planned in accordance with accepted sampling procedures for area surveys.

The state park contiguous to Lake Whitney proved to be a good place for mail questionnaires because each entering party must stop at the entrance building to pay fees and obtain information regarding rules and regulations. The Park Superintendent gave the investigators permission to leave mail questionnaires in an open, opportune place in the building (with self-addressed envelopes attached) starting April 15, 1967, and ending July 1, 1967. Over two hundred questionnaires were taken by park visitors and approximately twenty-five percent were returned in useable form.

Personal interviews were made in all picnic, fishing, and concentrated visitor areas around Lake Whitney and Lake Belton. However, no location was found favorable for placing mail questionnaires at Lake Belton since a state park, or another highly frequented indoor location, was not available. All data collected at this comparative area (Lake Belton) was through personal interviews.

Some mail questionnaires were unusable due to misinterpretations of questions six and seven, which dealt with recreation purpose and expenses. Often, more than one recreation activity was selected as purpose in question six. In question seven, some respondents listed all expenditures since their trip began, rather than only expenditures made in the lake area.

Interviewing was conducted on a random schedule during the week, on week-ends, during the spring, summer, and during all hours of the day. Not all samples were collected from the most frequented places on the lake but accurate area representation could be assured.

Findings

Information from each questionnaire was tabulated on an IBM card and the appropriate calculations were made with an IBM 7094 computer--one of the computing facilities in the Data Processing Center of Texas A&M University. Since the calculations for each lake were the same, only the program and Input Card Format for the Whitney area is reported, and is presented in detail in Appendix F. The format describes how the data was punched and gives a short description of the particular input field.

Information used in the computation of an average expenditure figure by recreational activity is presented in summary Tables 1e and 2e for

Lake Whitney and Lake Belton. However, upon completion of these two tables, the recreational activities were revised from eight activities to three to reduce unnecessary classifications. The sample was not representative of all eight specific activities, but it was representative of the three general categories. The revision classes were: (1) Camp, (2) Boat and fish, and (3) Ski, swim, picnic, sightsee. After the categories were revised, net economic impact was measured by subtracting out expenditures made by local visitors, (i.e., people from contiguous counties) because these expenditures constituted transfer payments rather than inputs into the local economy.

Camping was found to be the most popular activity at both lakes. In the case of Lake Whitney, campers were represented heavily from the hundred mile radius, primarily due to campers from the Dallas-Fort Worth metropolitan area. At Lake Belton, the largest segment of campers came from the fifty mile radius instead of the hundred. This may be attributed to the location of Waco and several other fairly large cities in the fifty mile area. Campers spent on the average more than the other two activities (see Table 3e), boaters and fishermen were next in average expenditures, and skiers, swimmers, picnickers, and sightseers had the lowest expenditure for both areas.

Input Data

Expenditure data for each activity were constants in the model, and this information for both Belton and Whitney was combined. Expenditures in each activity were weighted by the corresponding number of visitors, and weighted averages were made. Calculations for each activity are shown in Table 5e.

TABLE 3e

AVERAGE AREA EXPENDITURES BY THREE RECREATION CLASSES, LAKE WHITNEY AND LAKE BELTON, TEXAS, 1966-67 (Based on Stratified Sample, n=476,329)

Activity	Lake Whitney	Lake Belton
Camp	$3.56	$5.13
Boat and Fish	2.83	3.95
Ski, Swim, Sightsee, Picnic	1.48	1.84

Source: Field survey, 1966-67.

The computer program was designed to compile the data by contiguous, fifty, and hundred mile areas; but, after the collection data was analyzed this categorization appeared questionable. The high-density contiguous population seemed to carry with it low attendance figures from the area outside the contiguous area. Plotting points for both Belton and Whitney, with the x coordinate the population in the contiguous area as a percent of the total population in the hundred mile radius and the percent of recreators in the sample outside the contiguous area on the y coordinate, a line drawn between the two points indicated a negative slope (illustrated in Figure 3e). Thus, the hundred mile radius was considered total population since the percent of the sample outside this area was small.

The degree of the inverse relationship between population in contiguous counties and attendance from outside this contiguous area is indicated by the line slope in Figure 3e. The two-point equation used was

$$\frac{y - y_1}{x - x_1} = \frac{y_2 - y_1}{x_2 - x_1}$$

One set of points was used to derive that line needed to determine the percentage of recreators from outside the contiguous area. This substitution was

$$y= -27.31x + 1.6147$$

y = percent of attendenace from outside contiguous area,

x = population of contiguous counties expressed as a percentage of the population within the 100-mile radius for the year of projection.

The formulation of the equation to determine the attendance from outside the contiguous area is based on the assumption that the relationship is linear.

The linear relationship was accepted for breaking down attendance from outside the contiguous area into the three recreational categories. A percentage of the camp, boat and fish, and swim, ski, picnic and sightsee for the attendance from outside the contiguous area was computed (Table 4e). Using the two-point equation, a line was derived for each activity with percentage of population in contiguous counties serving as the independent variable. These lines were as follows:

$y= -12.38x + 1.0472$ for camping,

$y= -1.124x + .2411$ for boating and fishing,

and

$y= 13.50x - .2894$ for swimming, skiing, sightseeing and picnicking.

The results of the sample were utilized for determining the experience ratios as in the initial breakdown of total attendance. Since two reservoirs were used, only a linear relationship could be assumed.

TABLE 1e

RECREATIONAL VISITORS AND AVERAGE EXPENDITURES,
BY ACTIVITY AND ZONE, LAKE WHITNEY, TEXAS, 1966-67
(based on Stratified Sample, n=565)

	CONTIGUOUS COUNTIES			FIFTY MILE COUNTIES			HUNDRED MILE COUNTIES			OVER HUNDRED MILES			TOTAL WHITNEY AREA		
-	No. Visitors	Length Stay (Days)	Amt. Expnd.	No. Visitors	Length Stay (Days)	Amt. Expnd.	No. Visitors	Length Stay (Days)	Amt. Expnd.	No. Visitors	Length Stay (Days)	Amt. Expnd.	No. Visitors	Length Stay (Days)	Amt. Expnd.
	0	0	$ 0.00	4	8	$ 14.50	25	33	$ 77.50	0	0	$ 0.00	29	41	$ 92.00
	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
	42	44	67.67	21	33	31.00	47	83	149.15	4	8	13.40	114	168	261.22
t-															
	0	0	0.00	4	4	6.00	6	6	6.00	0	0	0.00	10	10	12.00
	0	0	0.00	4	4	5.00	0	0	0.00	0	0	0.00	4	4	5.00
	5	10	17.00	45	98	133.55	291	657	1,055.74	11	29	44.90	352	794	1,251.19
ic	0	0	0.00	9	14	10.00	5	8	14.40	0	0	0.00	14	22	24.40
c	2	6	14.50	0	0	0.00	31	82	193.69	9	9	10.00	42	97	218.19
l	49	60	$99.17	87	161	$200.05	405	869	$1,496.48	24	46	$68.30	565	1,136	$1,864.00
	*2.58	**1.22	†$2.02	*3.78	**1.85	†$2.30	*4.26	**2.15	†$3.69	*3.00	**1.92	†$2.84	*3.90	**2.01	†$3.30

: average number of visitors figure is calculated by dividing the total visitors for each category by the parties in each ;ory.

: average length of stay per visitor is calculated by dividing the total visitor days by the total number of people in each ;ory.

average expenditure per visitor is calculated by dividing the total expenditures by the total visitors for each category.

:e: Field survey, 1966 - 1967.

TABLE 2e

RECREATIONAL VISITORS AND AVERAGE EXPENDITURES,
BY ACTIVITY AND ZONE, LAKE BELTON, TEXAS, 1966-67
(based on Stratified Sample, n=565)

CONTIGUOUS COUNTIES			FIFTY MILE COUNTIES			HUNDRED MILE COUNTIES			OVER HUNDRED MILES			TOTAL BELTON AREA		
No. Visitors	Length Stay (Days)	Amt. Expnd.	No. Visitors	Length Stay (Days)	Amt. Expnd.	No. Visitors	Length Stay (Days)	Amt. Expnd.	No. Visitors	Length Stay (Days)	Amt. Expnd.	No. Visitors	Length Stay (Days)	Amt. Expnd.
49	49	$101.50	30	44	$106.50	17	19	$ 70.00	6	2	$ 10.00	102	114	$ 288.00
83	83	42.50	8	8	12.00	0	0	0.00	0	0	0.00	91	91	54.50
14	22	43.50	10	18	62.10	0	0	0.00	0	0	0.00	24	40	105.60
0	0	0.00	13	13	33.00	0	0	0.00	9	18	50.00	22	31	83.00
12	12	35.00	5	5	10.00	5	5	11.00	0	0	0.00	22	22	56.00
14	33	59.50	139	369	691.00	24	66	148.50	16	38	79.00	193	506	978.00
105	105	205.10	47	49	44.00	0	0	0.00	0	0	0.00	152	154	249.10
9	9	16.00	0	0	0.00	0	0	0.00	0	0	0.00	9	9	16.00
286	313	$503.10	252	506	$958.60	46	90	$229.50	31	58	$139.00	615	967	$1,830.20
*3.86	**1.09	/$1.76	*4.42	**2.01	/$3.80	*4.6	**1.95	/$4.98	*3.88	**1.87	/$4.48	*4.07	**1.57	/$2.97

average number of visitors figure is calculated by dividing the total visitors for each category by the parties in each ory.

average length of stay per visitor is calculated by dividing the total visitor days by the total number of people in each ory.

iverage expenditure per visitor is calculated by dividing the total expenditures by the total visitors for each category.

e: Field survey, 1966-67.

TABLE 4e

VISITOR ATTENDANCE BY RECREATIONAL ACTIVITY GROUPS AND, DISTANCE TRAVELED, LAKE WHITNEY AND LAKE BELTON, TEXAS 1966-67 (Based on Stratified Sample, n=476,329)

Activity	Number of Visitors									
	Lake Whitney					Lake Belton				
	Fifty Miles	Hundred Miles	Over 100 Miles	Activity Total	% of Total Visitors	Fifty Miles	Hundred Miles	Over 100 Miles	Activity Total	% of Total Visitors
amp	45	291	11	347	72.90	139	24	16	179	54.41
oat and Fish	25	72	4	101	21.22	40	17	6	63	19.15
im, Ski, icnic, Sightsee	17	11	0	28	5.88	73	5	9	87	26.44
otal	87	374	15	476	100.00	252	46	31	329	100.00

ource: Field survey, 1966-67.

FIGURE Ie

MAP OF WHITNEY RESERVOIR RECREATIONAL DEMAND AREA

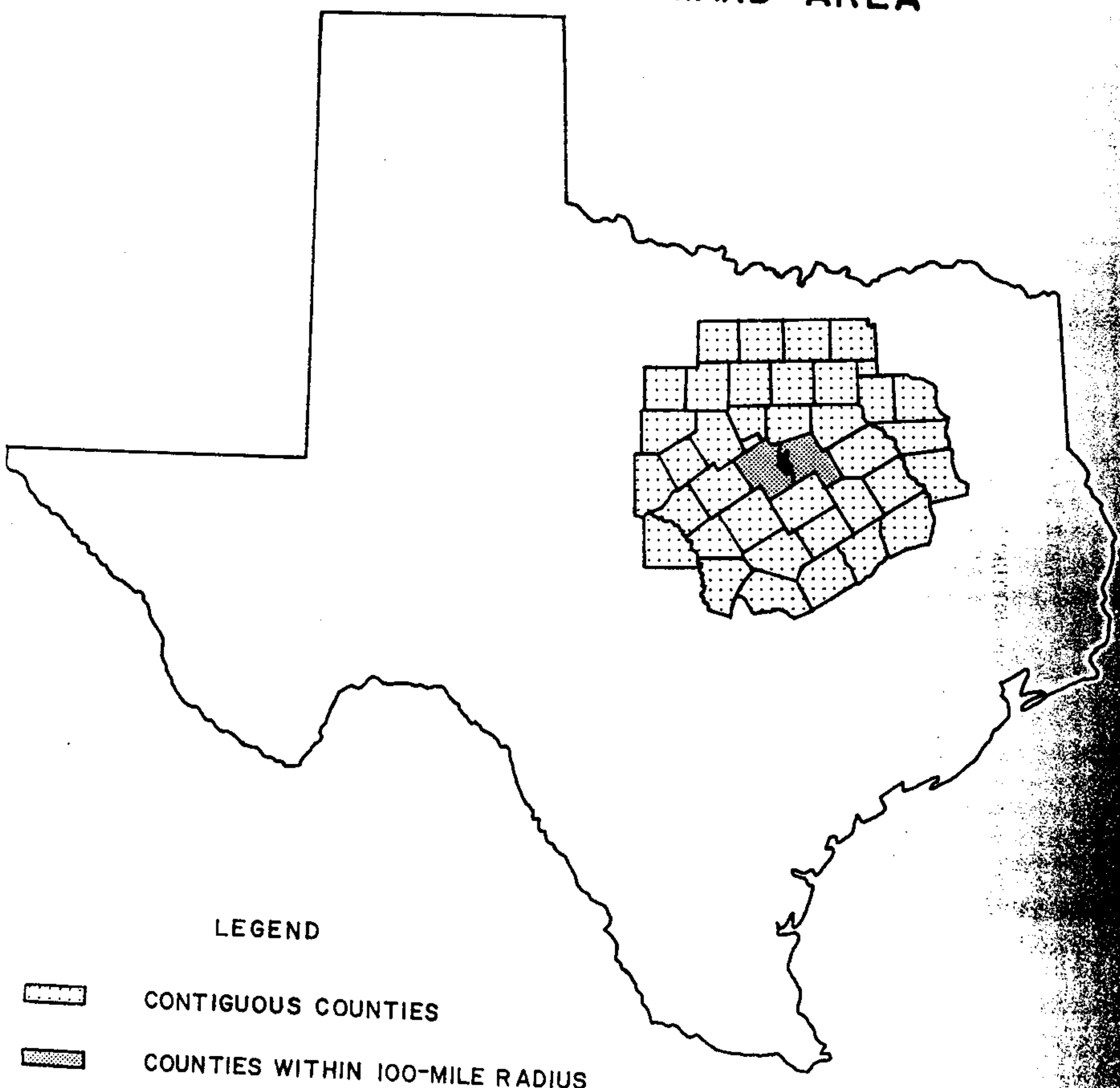


TABLE 5e

WEIGHTED AVERAGE EXPENDITURES BY RECREATION ACTIVITY GROUP,
LAKE WHITNEY AND LAKE BELTON, TEXAS, 1966-67
(Based on Stratified Sample, n=476,329)

Activity	Lake Whitney		Lake Belton		Total Whitney and Belton		Weighted Average
	Total Expenditures (A1)	Total Visitors (B1)	Total Expenditures (A2)	Total Visitors (B2)	Total Expenditures (A1 + A2)	Total Visitors (B1 + B2)	Total Expnd. ÷ Total Visitors
Camp	$ 1,234.19	347	$ 918.50	179	$ 2,152.69	526	$ 4.09
Boat and Fish	285.55	101	248.60	63	534.15	164	3.26
Ski, Swim, and Picnic, Sightsee	41.40	28	159.85	87	201.25	115	1.75
Total		476		329		805	

Source: Field survey, 1966-67.

FIGURE 2e

MAP OF BELTON RESERVOIR RECREATIONAL DEMAND AREA

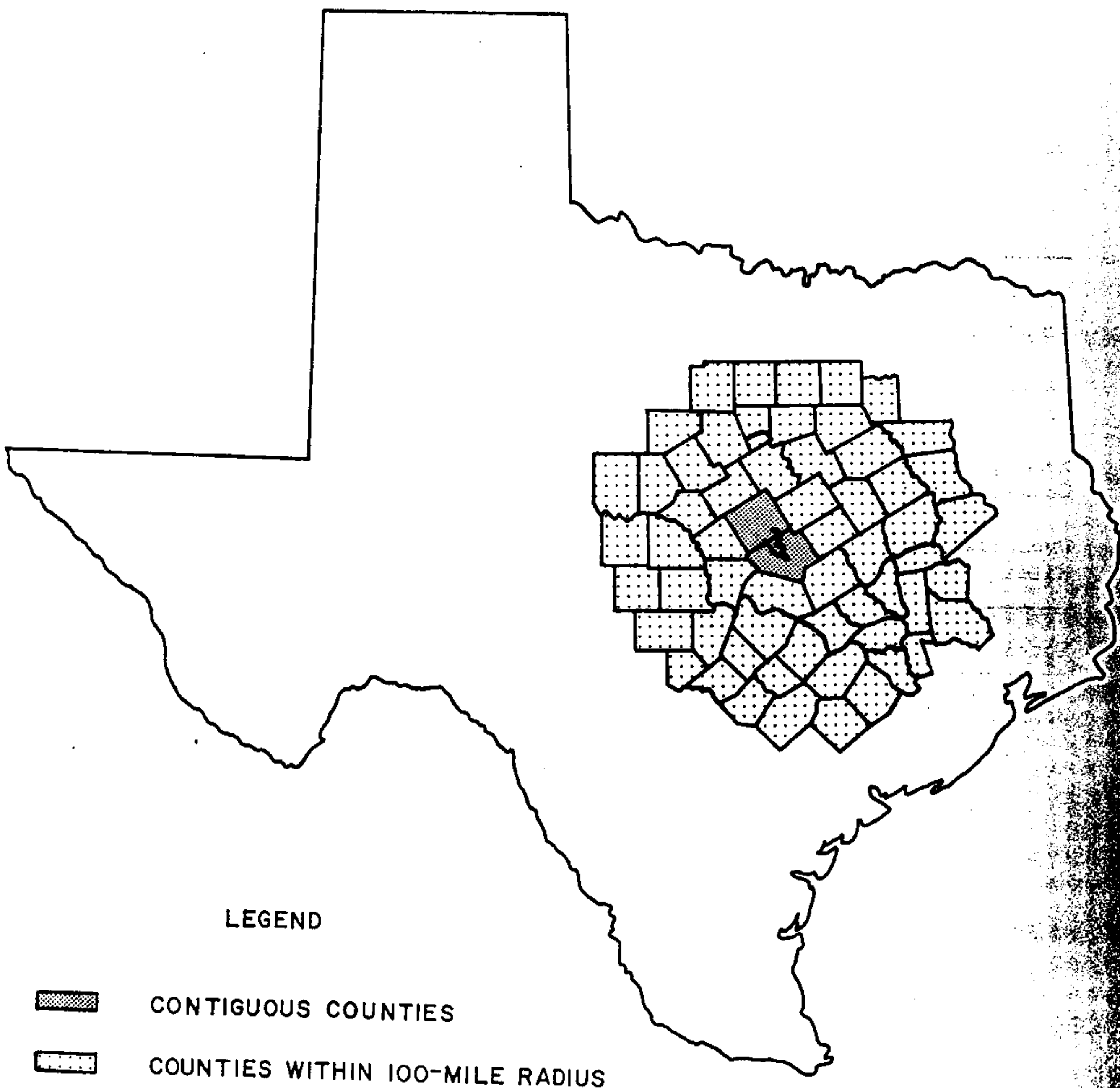


TABLE 6e

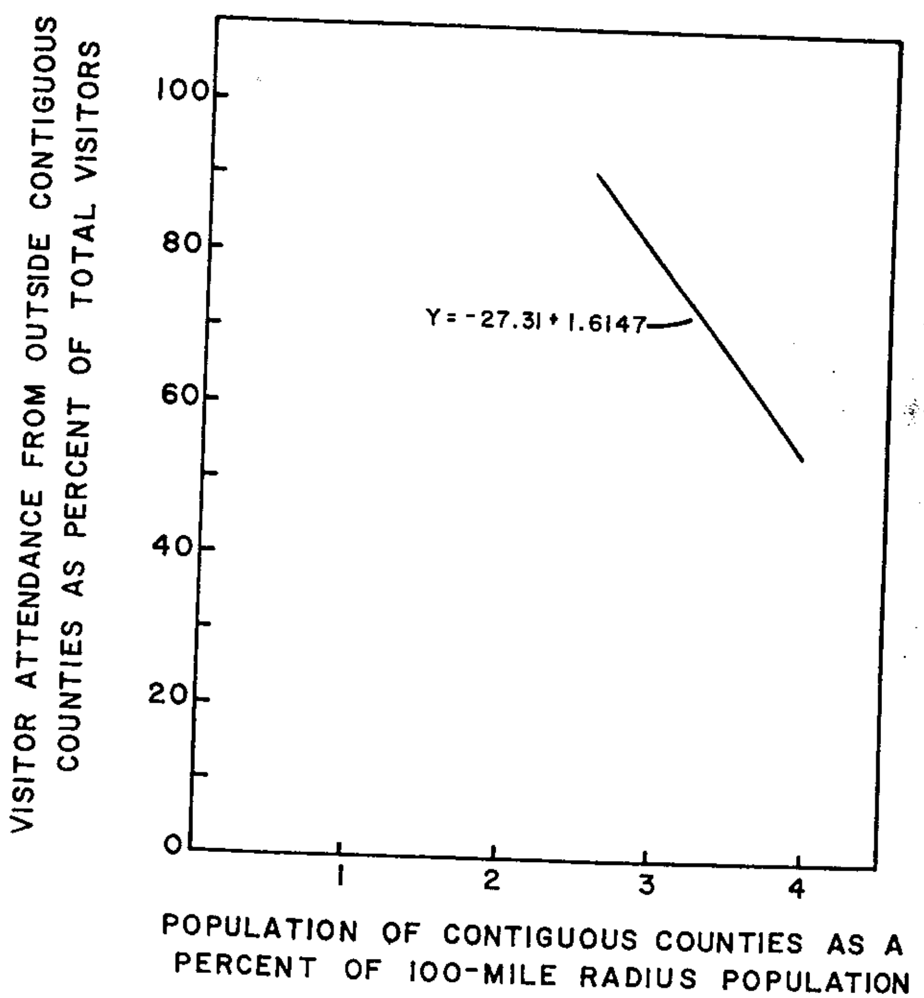
VISITOR ATTENDANCE BY DISTANCE TRAVELED, LAKE WHITNEY AND LAKE BELTON, TEXAS, 1966-67 (Based on Stratified Sample, n=523,606)

Geographical Area	Lake Whitney		Lake Belton	
	Number of Visitors	Percent of Total	Number of Visitors	Percent of Total
Contiguous Counties	47	8.99	277	45.71
Fifty Mile Counties	87	16.63	252	41.58
Hundred Mile Counties	374	71.51	46	7.59
Over Hundred Miles	15	2.87	31	5.12
Total	523	100.00	606	100.00

Source: Field survey, 1966-67.

FIGURE 3e

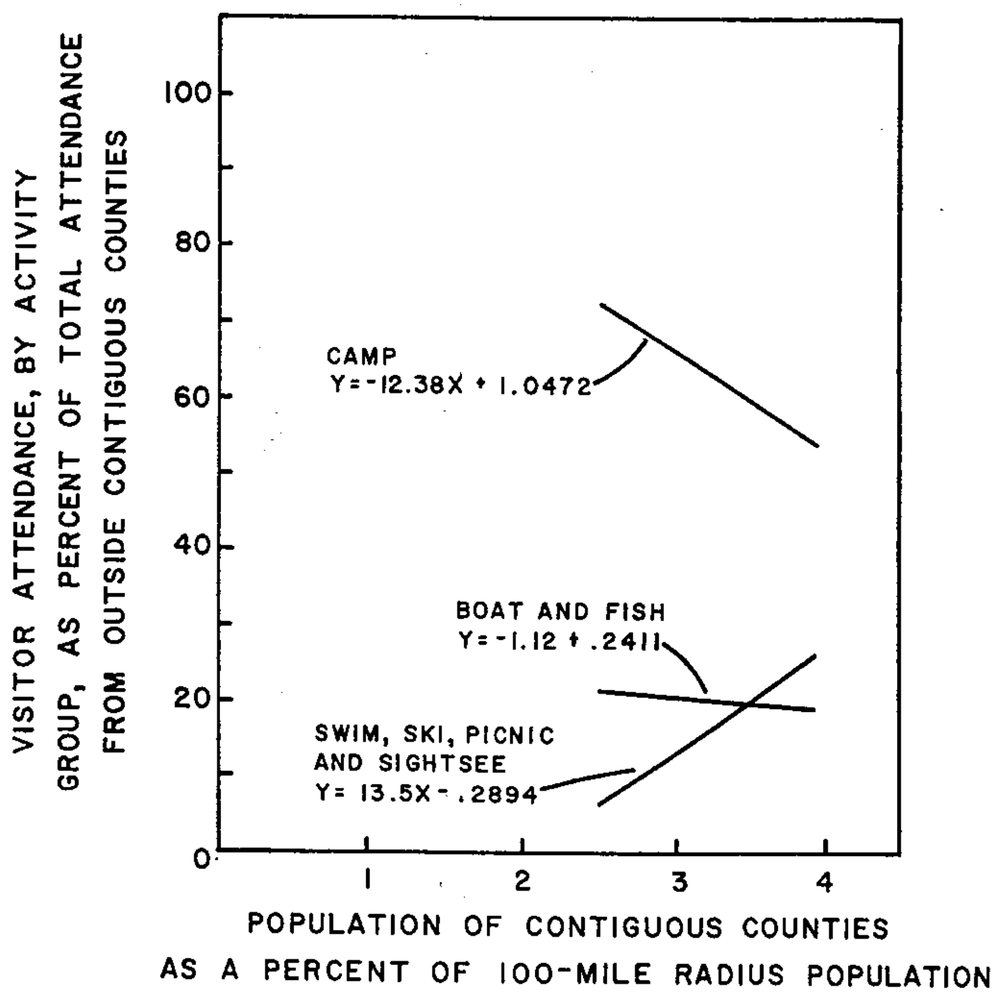
VISITOR ATTENDANCE, OUTSIDE CONTIGUOUS COUNTIES, VERSUS POPULATION OF CONTIGUOUS COUNTIES AS A PERCENT OF 100-MILE RADIUS POPULATION, LAKE WHITNEY AND LAKE BELTON, TEXAS, 1966-67 (BASED ON STRATIFIED SAMPLE, n= 476, 329)



SOURCE: TABLES 16 AND 6e.

FIGURE 4e

VISITOR ATTENDANCE BY RECREATIONAL ACTIVITY GROUP FROM OUTSIDE CONTIGUOUS COUNTIES VERSUS POPULATION OF CONTIGUOUS COUNTIES AS A PERCENT OF 100-MILE RADIUS POPULATION, LAKE WHITNEY AND LAKE BELTON, TEXAS, 1966-67
(BASED ON STRATIFIED SAMPLE, n=476, 329)



SOURCE: TABLES 16 AND 4e.

TEXAS A&M UNIVERSITY
Research Questionnaire

ATTENTION PLEASE!!!

Could we have 5 minutes of your most valuable time?

This questionnaire is part of a research project currently undertaken by Texas A&M University. Its purpose is to measure the economic effect the presence of a large lake has on its surrounding area.

Would you please answer the questions below? Notice that you are not asked to identify yourself in any way.

Once you have completed the questionnaire, please stuff it in the attached envelope and mail.

Thank you. Hope you enjoy your visit.

1. In what town, county, and state do you live?

   Town________________ County________________ State ________________

2. How far is the town from here? _______Miles

3. How many people are in your party? _______People

4. How many times do you come to this area during the year? _______Times

5. How long do you intend to stay this trip? _______Days

6. What was your primary purpose in coming here? (CHECK ONE ONLY)

   Boat____ Swim____ Fish____ Sightsee____

   Ski____ Camp____ Picnic____ Other (Specify)____

7. Please estimate the actual amount of money that you will spend on the following items in THIS LAKE AREA ONLY for the duration of your stay.
   a) Lodging (includes camping fees, motel bills, etc.) $__________
   b) Food and Refreshments (includes ice, food stuffs) $__________
   c) Fishing equipment including bait and licenses $__________
   d) Fees of all types $__________
   e) Clothing $__________
   f) Equipment rentals $__________
   g) Other $__________
   $__________

8. What are your reasons for selecting this area for recreational purposes?
   ____
   ____

9. What facilities do you recommend to improve this area? ____________
   ____
   ____
   ____

Interviewer________________________ Date________

Lake________________________ Questionnaire #________

Lake Area________________________

RECREATIONAL QUESTIONNAIRE

1. In what town, county, and state do you live?

   Town____________ County____________ State____________

2. How far is the town from here? ______Miles

3. How many people are in your party? ______People

4. How many times do you come to this area during the year?

   Number of times______

5. How long do you intend to stay this trip? ______Days

6. What was your primary purpose in coming here? (CHECK ONE ONLY)

   Boat____ Swim____ Fish____ Sightsee____

   Ski____ Camp____ Picnic____ Other (Specify)____

7. Please estimate the actual amount of money that you will spend on the following items in THIS LAKE AREA ONLY for the duration of your stay.

   a) Lodging (includes camping fees, motel bills, etc.) $________
   b) Food and Refreshments (includes ice, food stuffs) $________
   c) Fishing equipment including bait & licenses $________
   d) Fees of all types $________
   e) Clothing $________
   f) Equipment rentals $________
   g) Other $________

8. What are your reasons for selecting this area for recreational purposes? ________________________________

9. What facilities do you recommend to improve this area? ________________________________

APPENDIX F

INPUT CARD FORMAT FOR THE
RECREATION PROGRAM

Card Column	Type Format	Description
1-6	A6	The first six characters of a county name.
7-12	A6	The second six characters of a county name.
13-17	5X	Blank
18-23	F6.0	The number of people in a party.
24-28	5X	Blank
29-34	F6.0	The number of days the party intends to stay.
35-39	5X	Blank
40-45	F6.0	The number of estimated trips to the lake area per year by the party.
46-51	A6	The primary recreation activity.
52-56	5X	Blank
57-62	F6.2	The amount of expenditures made in the lake area.

```
$EXECUTE      AGGIE
$IBFTC
C     IBM 7090/7094 COMPUTER PROGRAM IN AGGIE (A SUBSET OF FORTRAN 4, IBJOB
C     VERSION 5).
C
C     THIS PROGRAM IS DESIGNED TO COMPILE DATA FROM QUESTIONNAIRES IN APRENDIX E
C     ACCORDING TO THE CARD FORMAT IN APPENDIX F.
C
      DIMENSION CONTIG(2), FIFTY(13), HUNRED(40), COUNTY(40),
     1XPEOPL(40), XSTAY(40), XTRIPS(40),XCOSTS(40),
     2XMADAY(40), XTOTCT(40), AVCOST(40), COUNT(40), KOUNTY(40)
C
      DIMENSION TACTIV(8), YPEOPL(4,8), YSTAY(4,8), YTRIPS(4,8),
     1YCOSTS(4,8), YMADAY(4,8), YCOUNT(4,8), YAVCOS(4,8)
C
C     THE DATA STATEMENT BELOW IS FOR COUNTIES IN THE CONTIGUOUS AREA.
      DATA (CONTIG(I), I=1,2)/6HBOSQUE, 4HHILL/
C
C     THE DATA STATEMENT BELOW IS FOR COUNTIES IN THE FIFTY-MILE AREA.
      DATA (FIFTY (I), I=3,13)/6HCORYEL, 5HELLIS, 5HERATH,
     15HFALLS, 6HHAMILT, 6HJOHNSO, 6HLIMEST, 6HMCLENN,
     24HHOOD, 6HNAVARR, 6HSOMERV/
C
C     THE DATA STATEMENT BELOW IS FOR COUNTIES IN THE HUNDRED-MILE AREA.
      DATA (HUNRED (I), I=14,40)/6HANDERS, 4HBELL, 5HBROWN,
     16HBURNET,6HCOMANC,6HCOLLIN,6HDALLAS,6HDENTON,6HEASTLA,
     26HFREEST,6HHENDER,4HJACK,6HKAUFMA,6HLAMPAS,4HLEON,
     35HMILAM,5HMILLS,6HPARKER,6HPALO P,6HROCKWE,6HROBERT,
     46HSAN SA,6HSTEPHE,6HTARRAN,6HVAN ZA,6HWILLIA,4HWISE/
C
C     THE DATA STATEMENT BELOW IS FOR THE SECOND SIX CHARACTERS IN THE COUNTY
C     NAMES.
      DATA (KOUNTY (I), I=1,40)/1H ,1H ,1HL,1H ,1H ,1H ,2HON,1HN,3HONE,
     12HAN,1H ,1HO,4HILLE,2HON,1H ,1H ,1H ,2HHE,1H ,1H ,1H ,2HND,3HONE,
     23HSON, 1H ,1HN,2HAS,1H ,1H ,1H ,1H ,4HINTO,2HLL,3HSON,2HBA,2HNS,
```

```
     31HT,3HNDT,4HMSCN,1H /
C
C     THE DATA STATEMENT BELOW IS FOR THE COUNTIES IN THE ENTIRE AREA.
      DATA (COUNTY (I), I = 1,40)/6HBOSQUE, 4HHILL, 6HCORYEL,
     15HELLIS, 5HERATH, 5HFALLS, 6HHAMILT, 6HJOHNSO, 6HLIMEST, 6HMCLENN,
     24HHOOD, 6HNAVARR, 6HSOMERV, 6HANDERS, 4HBELL, 5HBROWN, 6HBURNET,
     36HCOMANC, 6HCOLLIN, 6HDALLAS, 6HDENTON, 6HEASTLA, 6HFREEST,
     46HHENDER, 4HJACK, 6HKAUFMA, 6HLAMPAS, 4HLEON, 5HMILAM, 5HMILLS,
     56HPARKER, 6HPALO P, 6HROCKWE, 6HROBERT, 6HSAN SA, 6HSTEPHE,
     66HTARRAN, 6HVAN ZA, 6HWILLIA, 4HWISE/
C     THE DATA STATEMENT BELOW IS FOR THE EIGHT RECREATIONAL ACTIVITIES.
      DATA(TACTIV(J), J=1,8)/4HBOAT, 4HSWIM, 4HFISH, 6HSIGHTS, 3HSKI,
     14HCAMP, 6HPICNIC, 5HOTHER/
C
      DO 4 I = 1,40
      XPEOPL(I) = 0.0
      XSTAY(I) = 0.0
      XTRIPS(I) = 0.0
      XCOSTS(I) = 0.0
      XMADAY(I) = 0.0
      AVCOST(I) = 0.0
      COUNT(I) = 0.0
    4 CONTINUE
      DO 1001 I = 1,4
      DO 1002 J = 1,8
      YPEOPL(I,J) = 0.0
      YSTAY (I,J) = 0.0
      YTRIPS(I,J) = 0.0
      YCOSTS(I,J) = 0.0
      YMADAY(I,J) = 0.0
      YCOUNT(I,J) = 0.0
      YAVCOS(I,J) = 0.0
 1002 CONTINUE
 1001 CONTINUE
```

```
   10 FORMAT(A6,A6,5X,F6.0,5X,F6.0,5X,F6.0,A6,5X,F6.2)
    5 READ(5,10) ANAME1, ANAME2, PEOPLE, STAY, TRIPS,ANAME3,COSTS
      DO 15 I=1,40
      IF(COUNTY(I) .EQ. ANAME1)  GO TO 20
C     THE ABOVE DO LOOP IS DESIGNED TO COMPARE THE COUNTY NAME ON THE DATA CARD
C     WITH THE ARRAY OF COUNTY NAMES.  ONCE THE SAME NAME HAS BEEN FOUND,
C     CALCULATIONS FOR THAT COUNTY ARE MADE AND STORED.
   15 CONTINUE
   20 COUNT(I) = COUNT(I) + 1.0
      XPEOPL(I) = XPEOPL(I) + PEOPLE
      XSTAY(I) = XSTAY(I) + STAY
      XTRIPS(I) = XTRIPS(I) + TRIPS
      XCOSTS(I) = XCOSTS(I) + COSTS
      XMADAY(I) = XMADAY(I) + (STAY*PEOPLE)
      IF(I.GT.13)  GO TO 1003
      IF(I.GT.2)  GO TO 1004
      LL = 1
 1005 DO 1006 J = 1,8
      IF (TACTIV(J) .EQ. ANAME3)  GO TO 1010
 1006 CONTINUE
C     THE ABOVE DO LOOP IS DESIGNED TO COMPARE THE ACTIVITIES FROM THE DATA
C     CARD WITH THE ARRAY TACTIV.  ONCE THE ACTIVITY NAME IS COMPARED TO THE
C     APPROPRIATE ARRAY NAME, CALCULATIONS FOR THAT ACTIVITY ARE MADE AND STORED
      GO TO 60
 1003 LL = 3
      GO TO 1005
 1004 LL = 2
      GO TO 1005
 1010 YCOUNT(LL,J) = YCOUNT(LL,J) + 1.0
      YPEOPL(LL,J) = YPEOPL(LL,J) + PEOPLE
      YSTAY(LL,J) = YSTAY(LL,J) + STAY
      YTRIPS(LL,J) = YTRIPS(LL,J) + TRIPS
      YCOSTS(LL,J) = YCOSTS(LL,J) + COSTS
      YMADAY(LL,J) = YMADAY(LL,J) + (STAY*PEOPLE)
```

```
      IF(EOF(5))60,5,25
   25 DO 16 I = 1,40
      AVCOST(I) = XCOSTS(I)/XMADAY(I)
   16 CONTINUE
      K = 4
 2000 XNOPER = 0.0
      ESTTPS = 0.0
      PARTYS = 0.0
      SPENT = 0.0
      PERSON = 0.0
      XENGST = 0.0
      XANDAY = 0.0
      GO TO (18,19,21,99),K
C     COMPUTATIONS FOR THE CONTIGUOUS COUNTY AREA
   99 DO 101 I = 1,2
      XNOPER = XNOPER + XPEOPL(I)
      PARTYS = PARTYS + COUNT(I)
      XENGST = XENGST + XSTAY(I)
      ESTTPS = ESTTPS + XTRIPS(I)
      IF(I.EQ.2)AVPERT = XNOPER/PARTYS
C     THE ABOVE CALCULATION GIVES THE NUMBER OF PEOPLE PER PARTY
      SPENT = SPENT + XCOSTS(I)
C     THE ABOVE CALCULATION GIVES THE TOTAL EXPENDITURE FOR THE AREA
      XANDAY = XANDAY + XMADAY(I)
C     THE ABOVE CALCULATION GIVES TOTAL MANDAYS FOR THE AREA
      IF(I.EQ.2)AVEXMD = SPENT/XANDAY
C     THE ABOVE CALCULATION GIVES THE AVERAGE EXPENDITURE PER MANDAY
      IF(I.EQ.2)AVEXPT = SPENT/PARTYS
C     THE ABOVE CALCULATION GIVES THE AVERAGE EXPENDITURE PER PARTY
  101 CONTINUE
      AVEXVI = SPENT/XNOPER
      AVSTPT = XENGST/PARTYS
      WRITE(6,24)
C     THIS STATEMENT WRITES THE TITLE FOR THE CONTIGUOUS COUNTIES
```

```
      WRITE(6,200)AVPERT
      WRITE(6,400)SPENT
      WRITE(6,900)AVEXVI
      WRITE(6,975)ESTTPS
      WRITE(6,925)AVSTPT
      WRITE(6,600)AVEXMD
      WRITE(6,700)AVEXPT
      WRITE(6,500)XANDAY
      WRITE(6,300)PARTYS
      K = 1
      GO TO 17
C     COMPUTATIONS FOR THE FIFTY MILE COUNTIES
   18 DO 102I = 3,13
      XENGST = XENGST + XSTAY(I)
      ESTTPS = ESTTPS + XTRIPS(I)
      XNOPER = XNOPER + XPEOPL(I)
      PARTYS = PARTYS + COUNT(I)
      IF(I.EQ.13)AVPERT = XNOPER/PARTYS
C     THE ABOVE CALCULATION GIVES THE AVERAGE NUMBER OF PEOPLE PER PARTY
      SPENT = SPENT + XCOSTS(I)
C     THE ABOVE CALCULATION GIVES THE TOTAL EXPENDITURE FOR THE AREA
      XANDAY = XANDAY + XMADAY(I)
C     THE ABOVE CALCULATION GIVES THE TOTAL MANDAYS FOR THE AREA
      IF(I.EQ.13)AVEXMD = SPENT/XANDAY
C     THE ABOVE CALCULATION GIVES THE AVERAGE EXPENDITURE PER MANDAY
      IF(I.EQ.13)AVEXPT = SPENT/PARTYS
C     THE ABOVE CALCULATION GIVES THE AVERAGE EXPENDITURE PER PARTY
  102 CONTINUE
      AVSTPT = XENGST/PARTYS
      AVEXVI = SPENT/XNOPER
      WRITE(6,27)
C     THIS STATEMENT WRITES THE TITLE FOR THE FIFTY MILE COUNTIES
      WRITE(6,200)AVPERT
      WRITE(6,400)SPENT
```

```
      WRITE(6,900)AVEXVI
      WRITE(6,975)ESTTPS
      WRITE(6,925)AVSTPT
      WRITE(6,600)AVEXMD
      WRITE(6,700)AVEXPT
      WRITE(6,500)XANDAY
      WRITE(6,300)PARTYS
      K = 2
      GO TO 17
C     COMPUTATIONS FOR THE HUNDRED MILE COUNTIES
   19 DO 103 I = 14,40
      XENGST = XENGST + XSTAY(I)
      ESTTPS = ESTTPS + XTRIPS(I)
      XNOPER = XNOPER + XPEOPL(I)
      PARTYS = PARTYS + COUNT(I)
      IF(I.EQ.40)AVPERT = XNOPER/PARTYS
C     THE ABOVE CALCULATION GIVES THE AVERAGE NUMBER OF PEOPLE PER PARTY
      SPENT = SPENT + XCOSTS(I)
C     THE ABOVE CALCULATION GIVES THE TOTAL EXPENDITURE FOR THE AREA
      XANDAY = XANDAY + XMADAY(I)
C     THE ABOVE CALCULATION GIVES THE TOTAL MANDAYS FOR THE AREA
      IF(I.EQ.40)AVEXMD = SPENT/XANDAY
C     THE ABOVE CALCULATION GIVES THE AVERAGE EXPENDITURE PER MANDAY
      IF(I.EQ.40)AVEXPT = SPENT/PARTYS
C     THE ABOVE CALCULATION GIVES THE AVERAGE EXPENDITURE PER PARTY
  103 CONTINUE
      AVEXVI = SPENT/XNOPER
      AVSTPT = XENGST/PARTYS
      WRITE(6,28)
C     THIS STATEMENT WRITES THE TITLE FOR THE HUNDRED MILE COUNTIES
      WRITE(6,200)AVPERT
      WRITE(6,400)SPENT
      WRITE(6,900)AVEXVI
      WRITE(6,975)ESTTPS
```

```
      WRITE(6,925)AVSTPT
      WRITE(6,600)AVEXMD
      WRITE(6,700)AVEXPT
      WRITE(6,500)XANDAY
      WRITE(6,300)PARTYS
      K = 3
      GO TO 17
C     COMPUTATIONS FOR THE ENTIRE WHITNEY AREA
   21 DO 104 I = 1,40
      ESTTPS = ESTTPS + XTRIPS(I)
      XENGST = XENGST + XSTAY(I)
      XNOPER = XNOPER + XPEOPL(I)
      PARTYS = PARTYS + COUNT(I)
      IF(I.EQ.40)AVPERT = XNOPER/PARTYS
C     THE ABOVE CALCULATION GIVES THE AVERAGE NUMBER OF PEOPLE PER PARTY
      SPENT = SPENT + XCOSTS(I)
C     THE ABOVE CALCULATION GIVES THE TOTAL EXPENDITURE FOR THE AREA
      XANDAY = XANDAY + XMADAY(I)
C     THE ABOVE CALCULATION GIVES THE TOTAL MANDAYS FOR THE AREA
      IF(I.EQ.40)AVEXMD = SPENT/XANDAY
C     THE ABOVE CALCULATION GIVES THE AVERAGE EXPENDITURE PER MANDAY
      IF(I.EQ.40)AVEXPT = SPENT/PARTYS
C     THE ABOVE CALCULATION GIVES THE AVERAGE EXPENDITURE PER PARTY
  104 CONTINUE
      AVEXVI = SPENT/XNOPER
      AVSTPT = XENGST/PARTYS
      WRITE(6,29)
C     THIS STATEMENT WRITES THE TITLE FOR THE TOTAL WHITNEY AREA
      WRITE(6,200)AVPERT
      WRITE(6,400)SPENT
      WRITE(6,900)AVEXVI
      WRITE(6,925)AVSTPT
      WRITE(6,975)ESTTPS
      WRITE(6,600)AVEXMD
```

```
      WRITE(6,700)AVEXPT
      WRITE(6,500)XANDAY
      WRITE(6,300)PARTYS
      K = 4
      GO TO 17
   17 DO 1112 J = 1,8
      AVSTPT= YSTAY(K,J)/YCOUNT(K,J)
      AVPERT = YPEOPL(K,J)/YCOUNT(K,J)
      AVEXMD = YCOSTS(K,J)/YMADAY(K,J)
      AVEXPT = YCOSTS(K,J)/YCOUNT(K,J)
      AVEXVI = YCOSTS(K,J)/YPEOPL(K,J)
      YPERTO = YPEOPL(K,J)/XNOPER
      IF(K.EQ.4)  GO TO 113
      YPEOPL(4,J) = YPEOPL(4,J) + YPEOPL(K,J)
      YCOSTS(4,J) = YCOSTS(4,J) + YCOSTS(K,J)
      YCOUNT(4,J) = YCOUNT(4,J) + YCOUNT(K,J)
      YMADAY(4,J) = YMADAY(4,J) + YMADAY(K,J)
      YTRIPS(4,J) = YTRIPS(4,J) + YTRIPS(K,J)
      YSTAY(4,J) = YSTAY(4,J) + YSTAY(K,J)
  113 WRITE(6,800) TACTIV(J)
      WRITE (6,200)AVPERT
      WRITE(6,300)YCOUNT(K,J)
      WRITE(6,400)YCOSTS(K,J)
      WRITE(6,500) YMADAY(K,J)
      WRITE (6,600) AVEXMD
      WRITE (6,700) AVEXPT
      WRITE (6,900) AVEXVI
      WRITE (6,925) AVSTPT
      WRITE (6,950) YPERTO
      WRITE (6,975) YTRIPS(K,J)
 1112 CONTINUE
      IF(K.LT.4) GO TO 2000
  105 WRITE(6,24)
      WRITE(6,26)
```

```
      WRITE(6,40) (CONTIG(I), KOUNTY(I),  XPEOPL(I), XSTAY(I),
     1XTRIPS(I), XCOSTS(I), XMADAY(I), COUNT(I),  AVCOST(I), I=1,2)
      WRITE(6,27)
      WRITE(6,26)
      WRITE (6,40)(FIFTY(I), KOUNTY(I),   XPEOPL(I), XSTAY(I),
     1XTRIPS(I), XCOSTS(I), XMADAY(I), COUNT(I),  AVCOST(I), I=3,13)
      WRITE(6,28)
      WRITE(6,26)
      WRITE (6,40) (HUNRED(I), KOUNTY(I), XPEOPL(I), XSTAY(I),
     1XTRIPS(I), XCOSTS(I), XMADAY(I), COUNT(I),  AVCOST(I), I = 14,40)
      WRITE(6,29)
      WRITE(6,26)
      WRITE (6,40) (COUNTY(I), KOUNTY(I), XPEOPL(I), XSTAY(I),
     1XTRIPS(I), XCOSTS(I), XMADAY(I), COUNT(I),  AVCOST(I), I=1,40)
   24 FORMAT(1H1, 47X, 37HC O N T I G U O U S   C O U N T I E S///)
   26 FORMAT(16X, 11HCOUNTY NAME, 7X, 8HVISITORS, 5X, 4HDAYS,
     16X, 5HTRIPS, 7X, 5HCOSTS, 6X, 8HMAN DAYS, 6X, 5HCOUNT,
     25X, 9HAVG COSTS//)
   27 FORMAT(1H1, 47X, 37HF I F T Y   M I L E   C O U N T I E S///)
   28 FORMAT(1H1, 46X, 41HH U N D R E D   M I L E   C O U N T I E S///)
   29 FORMAT(1H1, 49X, 35HT O T A L   W H I T N E Y   A R E A///)
   40 FORMAT     (16X,A6,A6,5X,F6.0,5X,F6.0,5X,F6.0,5X,F8.2,5X,F6.0,8X,
     1F4.0,6X,F6.2)
  600 FORMAT(47X,37HTHE AVERAGE EXPENDITURES PER MANDAY =,F6.2//)
  700 FORMAT(47X,35HTHE AVERAGE EXPENDITURE PER PARTY =,F6.2//)
  200 FORMAT(46X,40HTHE AVERAGE NUMBER OF PEOPLE PER PARTY =,F6.2//)
  400 FORMAT(46X,38HTHE TOTAL EXPENDITURES FOR THIS AREA =,F8.2//)
  300 FORMAT(50X,32HTHE TOTAL PARTYS FOR THIS AREA = F6.2//)
  500 FORMAT(49X,33HTHE TOTAL MANDAYS FOR THIS AREA =,F8.2//)
  800 FORMAT(/51X,6H******, A6, 2X, 14HACTIVITY******///)
  900 FORMAT(46X, 37HTHE AVERAGE EXPENDITURE PER VISITOR =, F8.2//)
  925 FORMAT(51X, 28HTHE AVERAGE STAY PER PARTY =, F8.2//)
  950 FORMAT(45X,42HTHE NUMBER OF PEOPLE AS PERCENT OF TOTAL =, F8.2//)
  975 FORMAT(46X, 37HTHE TOTAL NUMBER OF ESTIMATED TRIPS =, F8.2//)
```

```
   60 STOP
      END
$DATA
```

APPENDIX G

TABLE 1g

ECONOMIC MEASUREMENTS FOR THE WHITNEY AREA AS PRODUCED BY THE SYNTHETIC INDEX AND THE PROJECTION MODEL*

Year	Reservoir Generated Input**	Index Measure***	Model Measure	
			Yearly	Total
1	$ 3,552	.181	.0976	.0976
2	6,307	.193	.0593	.1569
3	14,100	.280	.0236	.1805
4	9,067	.212	.0436	.2242
5	8,834	.247	-.0128	.2114
6	9,885	.238	.0210	.2323
7	11,245	.176	-.0485	.1839
8	12,109	.179	.0082	.1921
9	12,528	.152	.0091	.2012
10	12,767	.172	.0108	.2120
11	12,912	.245	.0126	.2246
12		.157		
13		.241		
14		.211		
15		.269		
16		.229		

*Base year 1947.

**In thousands of dollars.

***Index figures are net after normal growth has been removed.

TABLE 2g

ECONOMIC MEASUREMENTS FOR THE
BELTON AREA AS PRODUCED BY THE
SYNTHETIC INDEX AND THE PROJECTION MODEL*

Year	Reservoir Generated Input**	Index Measure***	Model Measure	
			Yearly	Total
1	$1,835	.145	.0855	.0855
2	1,690	.416	.1310	.2165
3	1,913	.532	.1568	.3732
4	4,419	.388	.1200	.4932
5	4,551	.658	.0940	.5871
6	2,517	.706	.0508	.6380
7	3,996	.450	.0480	.6860
8	4,901	.598	.0472	.7331
9	4,787	.735	.0402	.7734
10	4,681	.629	.0336	.8070
11	4,612	.752	.0283	.8352
12	4,560	.733	.0242	.8595
13		.972		
14		1.037		

*Base year 1949.

**In thousands of dollars.

***Index figures are net after normal growth has been removed.