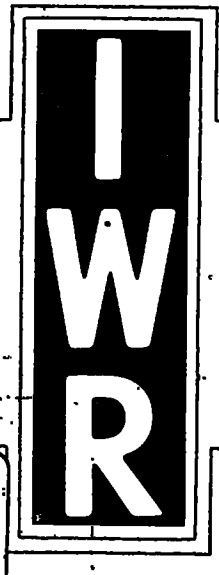
QUALITY OF LIFE AND INCOME REDISTRIBUTION: OBJECTIVES FOR WATER RESOURCES PLANNING



INSTITUTE FOR WATER RESOURCES

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

July 1972

IWR Report 72-4

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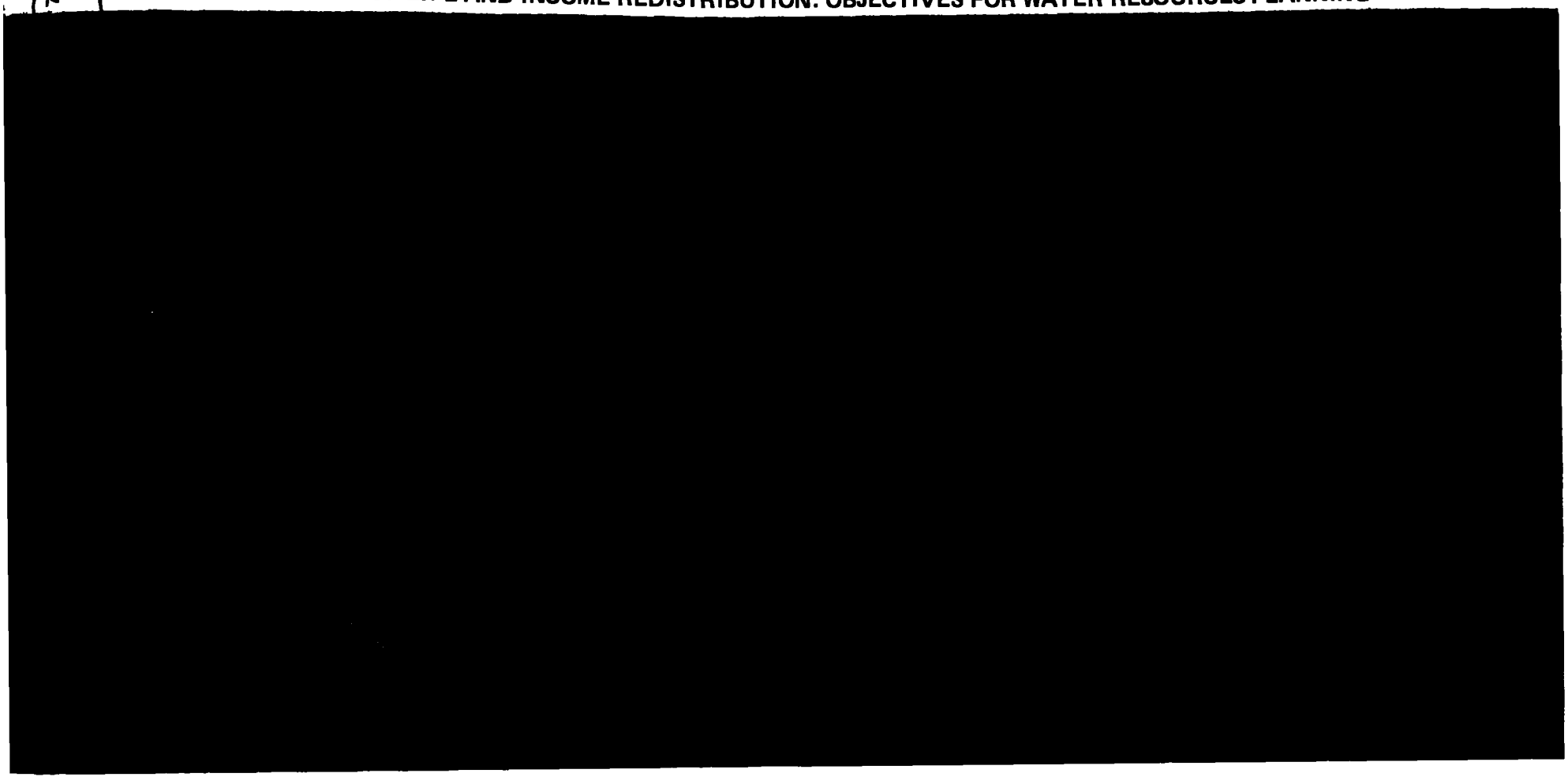

QUALITY OF LIFE AND INCOME REDISTRIBUTION: OBJECTIVES FOR WATER RESOURCES PLANNING

A Report

Prepared for

The Center for Economic Studies
Institute for Water Resources
Corps of Engineers
Department of the Army

by

Michael R. Krouse

July 1972

IWR Report 72-4

FOREWORD

Purpose

In 1970 a Special Task Force appointed by the Water Resources Council submitted a set of principles and standards which proposed a multi-objective approach to water resources planning. Among the four objectives designated was social well-being which included a variety of explicit component effects to be considered such as income redistribution, population redistribution, economic stability, security of life, health and safety, national defense and community and cultural amenities. A revised version of these procedures was released in December, 1971. Social well-being was placed in a non-objective status and the explicit components were considerably limited to include effects on incomes, life, health and safety, and emergency preparedness. Nevertheless, the proposed principles and standards require that social effects be considered and displayed in water resource plans.

This research effort was initiated and proceeded in the context of the principles and standards proposed by the task force which included social well-being as a full plan objective. The primary purpose of the research was to develop a practical procedure for evaluating and measuring the social well-being objective for water resource projects.

The study was conducted by the Ohio River Division, Corps of Engineers with Michael Krouse assuming primary responsibility for the research. Wayne Ehlers, Chief of Economics Branch and Don Williams, Chief of Planning Division, Ohio River Division gave individual support and review during the study.

Findings

As the research proceeded it quickly became apparent that the broad

"social" objective with its diverse components did not lend itself to a simple, single indicator measure. As a result, the procedural section deals primarily with measuring income effects which as it turned out became became the social effect component which recieved emphasis in the revised principles and standards.

The value of a particular water resources plan's income redistribution effect can be viewed generally in two ways:

(1) In terms of the net gain or loss in utility which results from increases or decreases in real income to various individuals of different income classes.

(2) By considering income redistribution as a "public good" analogous to a consumption externality. Here the redistribution "value" is a function of the public desire to transfer income to lower income classes (i.e. income transfer elasticity).

The income redistribution effects of a project are determined by: 1) allocation benefits to incidence groups. 2) determining incidence group incomes by class. 3) sub-allocating benefits to income class within these groups. 4) determining tax burden by income class and 5) calculating net incidence by income class and valuing it in terms of either marginal utility of income or in terms of income transfer elasticities. This research opts for a modified marginal utility of income approach which compares a project's income redistribution performance with the income effects of all federal expenditures and taxes.

The test of the procedure was applied to an urban flood control project which affects incomes of diverse incidence groups ranging from residential property owners to corporation stockholders. Direct income data was lacking

in some cases and broad regional or national income data had to be adapted to the local area. Suggested additional income data which could be gathered at the time of the study survey would increase the accuracy of the incidence estimates.

Assessment

While no satisfactory single all encompassing indicator for social effects was discovered the report fullfills an important purpose by bringing to light the conceptual issues involved in defining, measuring and placing a value on a social well-being objective. The discussion indicates that a plan objective must be clearly defined before it can be truly pursued.

The methodology and test provide a practical means for identifying benefit and cost incidence by user groups and income classes and the suggested method for comparing alternative income effects should prove to be a useful tool in assessing that important component of the social impacts.

Status

More work needs to be done in the area of benefit and cost incidence estimation for other types of project outputs and in defining clearly what the social well-being objective should be vis-a-vis water resources plans.

The research represents the independent findings of the author and are not necessarily those of the Corps of Engineers. Policy and procedural changes which may result from this research will be implemented by directives and guidance provided by the Chief of Engineers through appropriate channels.

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INTRODUCTION

The nation's continuing commitment to insure that all people or groups share in the nation's prosperity is embodied in the policy statements:

"Well–being of all of the people shall be the overriding determinant in considering the best use of water and related land resources. Hardships and basic needs of particular groups within the general public shall be of concern . . ."[1/] "The overall purpose of water and related land resource planning is to reflect society's preferences for attainment of the objectives defined below: . . . To enhance social well–being by the equitable distribution of real income, employment, and population, with special concern for the incidence of the consequences of a plan on affected persons or groups . . ."[2/] The term "well–being has been replaced by the term "quality of life" since the *Principles* were first published, but whatever the name, the nation's desire for measures of welfare in addition to GNP is apparent.

This report attempts to grapple with the problem of implementing that desire in the evaluation of water resources investments.* It deals with the conceptual considerations of quality of life, well–being and, specifically, income redistribution. Obviously, terms such as quality of life, well–being or income redistribution have different meanings to different individuals. The meaning of these terms must be clear so that both qualitative and quantitative aspects of the concepts can be presented when project evaluation is attempted. It is the non–economic aspects of these concepts which present the greatest problems in objective project evaluation.

A dimension of quality of life analysis which does include economic aspects is income redistribution. However, the problems in determining the value of a particular income redistribution are similar to those of establishing prices for other non–market goods. It is even more unique, though, because its value stems basically from the utility one group of individuals derive from another group's

1/ *Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources,* approved by the President, May 15, 1963, as Senate Document No. 97, 87th Congress, 2d Session, p. 2.

2/ *Principles for Planning Water and Land Resources,* Report to the Water Resources Council by the Special Task Force, July, 1970.

* The author wishes to express thanks to the many who helped in the preparation of this paper. Special thanks go to Dr. Charles A. Berry, Wayne F. Ehlers, John H. Parke and L. George Antle for their useful comments and suggestions. All errors and views expressed remain the responsibility of the author.

consumption. The problem is a difficult one and the attempts to determine its social value in the absence of an explicit social preference function becomes an exercise in determining a revealed preference from the legislation, the behavior of government or policy statements.

The report is divided into two parts. The first part contains three sections. The first section contains a review of some relevant literature to enlighten the unfamiliar, but does not resolve the basic problem of defining quality of life in terms of a single measure. The second section outlines an explicit procedure for measuring income redistribution among income classes as a result of a flood control project. Alternative means for comparing a redistribution with some "ideal" redistribution are suggested, but no absolute value measurement is proposed. The last section contains a generalized view of the operations described in the second section and describes specific data needs, substitutes and availability for the case study area; Mill Creek Valley, Hamilton County, Ohio.[3/]

Part two of this report is a test of the procedure for estimating benefit and cost incidence by income class for a flood control project which is described in Part I. The magnitude of the project and time limitations dictated that the test be concentrated on one reach, MC–3. However, the procedures would be the same for all reaches. Also, the project contains some recreational aspects, but only the flood control aspects were analyzed.

Reach MC–3 contains residential and business properties and stretches about 2 miles along the Mill Creek. There is considerable emphasis in the test on procedures for evaluating the incidence of benefits for commercial and industrial properties. This emphasis is necessary because of the industrialized nature of this project area and probably does not represent the property class mix of many less urbanized areas. Procedures for evaluating all property classes are discussed, however.

The Survey report economics appendix provides a sample of the analysis used to derive flood control benefits. Specific benefits and costs used in this report as well as project design features are subject to change as advanced planning continues.

3/ *Interim Survey Report on Mill Creek in Southwestern Ohio for Flood Damage Reduction and Recreation*, U.S. Army Corps of Engineers, Louisville, Kentucky, Jan. 1970.

Generally, the authorized project's flood protection features include levees, channel improvement and pumping facilities. The survey report reveals that under present circumstances the most advisable plan of improvement for flood protection in the Hamilton County portion of Mill Creek basin would be a combination of channel improvement and levees beginning at the barrier dam adjacent to the Ohio River and proceeding upstream for a distance of 18 miles to the Hamilton–Butler County line. This plan includes similar improvements on the East Fork of Mill Creek from its mouth upstream for a distance of 3/4 mile to the Hamilton–Butler County line. This flood protection plan has been designed to provide protection to Mill Creek flood plain areas for all floods having a frequency of one or more events per 100 years. The project consists of 19 miles of channel improvement, 12 miles of levees averaging in height from 4 to 5 feet, 9 pumping plants, modification of 38 bridge crossings, various other transportation and utility alterations and relocations, and other appurtenant works.

The test was made to determine procedural practicability and to find out what conceptual problems and data needs had not been anticipated during the development of the procedure. The numerical results presented are not so important as the method for obtaining them. Data and calculations of flood damages, benefits and costs which are in or underly the findings in the survey report were accepted at face value. It is not the intent of this study to review or change the survey findings. In essence, the problem was one of allocating direct benefits and costs reported in the survey document to income classes of the individuals who benefit or pay the costs and thereby determine the project's income redistribution effect.

The analysis was limited to finding the incidence of direct benefits resulting from flood damage reductions. Benefits were traced to the first individuals which receive them. The incidence of secondary benefits and costs were not traced because the survey document did not measure them and also because there are theoretical difficulties which are not fully resolved regarding measurement of changes in relative prices and production which result when the existing income distribution is altered.

PART I

QUALITY OF LIFE AND INCOME REDISTRIBUTION – CONCEPTS

Quality of Life

The concept, quality of life, is not well defined and it means different things to different individuals. For example, an intellectual considering quality of life might visualize great concert halls, vast libraries and art galleries available for all to enjoy, while the factory laborer might envision a life with free football tickets, a color TV in every room or a house in the suburbs. Some have attempted rather unsatisfactorily to define quality of life. One such proposed that quality of life is the sum of income per capita plus experiences, however, no satisfactory definition of the necessary qualitative characteristics to be measured was given.[1/] There is no *a priori* quality of life definition which applies in all cases. Even if there was a national consensus about a few components of quality of life it is likely to change over time as public opinion leads and is lead by the political sector and the information media. The idea of "quality" of life was no doubt a response to the American emphasis on material economic growth. In other words, the quantity of goods and services became an inadequate measure of our total welfare and emphasis has shifted to the qualitative characteristics of our output, environment and experiences.

The *Standards*[2/] which propose a multi–objective planning concept for public investments is in large part a result of the shifting emphasis toward including non–quantitative criteria. However, the planning process becomes a great deal more complex with the introduction of each additional dimension as alternatives increase and even further complexity is introduced with qualitative criteria.

The quality of life objective (QOL) as outlined in "Standards for Planning Water and Land Resources" includes specifically as major components (1) income redistribution, (2) population and employment dispersal, (3) economic stability, (4) security of life and health, (5) educational, cultural, recreational and community services effects and (6) national security. These components are, on the surface, commendable objectives of public investments. However, the effect each component has on the others or on other objectives is not well understood. Each component is not universally accepted as

1/ J. Alan Wagner, "Growth versus the Quality of Life,"*Science,* June 1970.

2/ *Standards for Planning Water and Land Resources,* United States Water Resources Council, Washington, D.C., 1970.

national objectives (i.e. income redistribution). Also, one is left with the impression that the Social Well–Being Objective[3/] was a catch–all for a few of the seemingly appropriate goals which didn't quite fit into the national development, environmental or regional accounts used in project evaluation.

Each component of the QOL objective is a special way of looking at a national concern. Equitable distribution of income as an objective has been and is considered in implementing public policy and is manifest in the progressive income tax, "poverty" legislation, subsidies and regional development programs.[4/] But, exactly what is "equitable" is not agreed upon. Surely few Americans would favor equal income for all. Probably the most one can say about it is that there is a consensus that no one should be "too" poor, however, what constitutes "too" poor, is debated. So, while the income redistribution objective is legitimate, the proper redistribution is an open question and this problem is the focus of a later section of this report (pp. 9–15).

The redistribution of population is another component of the quality of life objective. What is the appropriate distribution of population? At least one writer suggests that a national objective for population dispersal is counter to the strong population movement to cities for over a generation and that we would do well to concentrate on making the existing centers of population concentration more livable rather than promote population dispersion.[5/] Population redistribution for urban balance is listed as a goal but little explanation is provided for either desirability or methods for accomplishing it. If it is not desirable because of negative returns to scale and external economic and social costs outweigh the benefits of further concentration then clearly the problem is one of efficiency and can conceivably be handled by the current evaluation methods and results placed in appropriate project evaluation accounts. However, if population dispersal is a goal because of some psychological benefit individuals derive, not related to material welfare, then this component of Quality of Life is qualitative and becomes exceptionally difficult to measure and display.

Economic stability as an objective is probably not so controversial as is the method of achieving it. While volumes have been written about economic stability there is little general agreement as to what the real causes of instability are and less agreement about what remedies to apply. Certainly it is evident

3/ Quality of life was originally termed Social Well–Being in the Standards.

4/ R. A. Musgrave, *The Theory of Public Finance*, New York, 1959

5/ John Friedmann, "The Feasibility of a National Settlement Policy," *Growth and Change*, April 1971, pp. 18–21.

that policy and action to achieve economic stability must minimize arbitrary fluctuations in income and the anxieties that it creates, but what effects reduced instability has on other aspects of total welfare are unknown.

Security of life and health objectives are, of course, founded on basic values, but their worth to society is not easily evaluated. While the value of a human life has been measured in terms of earning power, many believe this to be too narrow a view and that loss of life is an infinite cost. Educational, cultural, community services and recreational effects are potentially measurable in dollars and could conceivably be included in the national and regional accounts.

National defense is an important objective and has been considered in planning public works since the nation's beginning. With the present state of the art it is unlikely that methods for analyzing and incorporating it into a total objective measure such as quality of life is feasible. In fact, its inclusion under the quality of life concept is questionable until some criterion is developed for a limit to spending on national defense, for without such a limit it is always worth at least what is paid for it and could be included under the national development objective since national security is a prerequisite for economic or other development.

The preceding discussion of the components of quality of life points out the complexity and ambiquity of the objective as described in the *Standards*. However, Margolis has written that "Logical niceties and intellectual curiosity insist that we seek the objective function, but in the short run there will be a great payoff in partitioning the activities of government, searching out objective functions for specific problems . . ."[6/]

The components of social well being need to be considered in the planning public investments in land and water resources, but a single objective measure of quality of life is not within our grasp as yet. Later in this report, the income redistribution component is examined and a method for measuring it is presented (pp. 16–31). No attempt is made to calculate a single measure which incorporates all components. As was argued previously it is likely that many of the components as listed in the *Standards* can be presented in the national development account. However, the income redistribution aspect is a different dimension of welfare and is treated in detail later.

6/ Julius Margolis, in Samual B. Chase ed., *Problems in Public Expenditure Analysis*, The Brookings Institution, Washington, D.C., 1966. A comment in McKean's "Use of Shadow Prices," p. 75.

National Goals

In 1960, at the request of President Eisenhower, the report of the President's Commission on National Goals entitled *Goals for Americans* was published. The report presented an attempt to "develop a broad outline of coordinated national activity."[7/] This early attempt at verbalizing a national consensus contained fourteen stated goals in general terms, such as, increasing equality, improving living conditions, economic growth, etc. Little was mentioned of the necessity for tradeoffs between goals and the section on "Quality of American Culture" dealt primarily with the arts but hinted at the current connotation of quality of life: "The ultimate dedication to our way of life will be won not on the basis of economic satisfactions alone, but on the basis of an inward quality and an ideal."[8/] The National Goals Research Staff produced a report for President Nixon which attempted to deal with national objectives. It is presented in the form of debates and seeks to "open issues to discussions within a particular theme . . ."[9/] It also indicates that "We have rising expectations and changing values concerning the goals we should set for ourselves both in resolving existing inequities and improving the quality of our lives."[10/] Reports, such as those mentioned, state the multiplicity of things which seem to be important to the Nation in general terms. Documents such as the *Standards* attempt to lay the operational ground work for the government to evaluate and implement the objectives.

There have been attempts to evaluate social well–being by compiling a series of social indicators and combining them into a single index.[11/] The problem, beyond definition of what should be in the index, is that weights need to be determined for each social indicator. For example, a hypothetical index might include average educational attainment, per capita income, doctors per capita, crime rate and condition of housing and the like. But, what is the relationship between say, per capita income and the crime rate; that is, what weight does one assign each component. The weight assigned must reflect the importance of the particular component, using a decision rule. Without the rule the assignment of weights is the worst kind of subjective exercise, because at best the weights would have meaning to the particular committee or persons working the weight assignment, and at worst it would confuse the issue further since no rationale for assignment would be apparent. This approach if limited to a display or

7/ *Goals for Americans*, The American Assembly, Columbia University, 1960, p. xi.

8/ *Ibid.*, p. 145.

9/ *Toward Balanced Growth: Quantity with Quality*, Report of the National Goals Research Staff, Washington, D.C., 1970.

10/ *Ibid.*, p. 36.

11/ *Toward a Social Report*, Department of Health, Education and Welfare, Washington, 1969.

listing, with the weight rationale, could be informative but not really satisfactory for evaluating public investments. Justification for such an index would exist if, say, the Congress could agree on all the components' relative importance and the index considered a revealed social preference function.

Economic and Social Well–Being

Some aspects of welfare economics shed further light on what is needed to evaluate multi–objectives and their components. A traditional welfare model[12/] can be adapted to illustrate conceptually what is involved in quality of life and economic welfare.

FIGURE 1

Income – Quality of Life Function

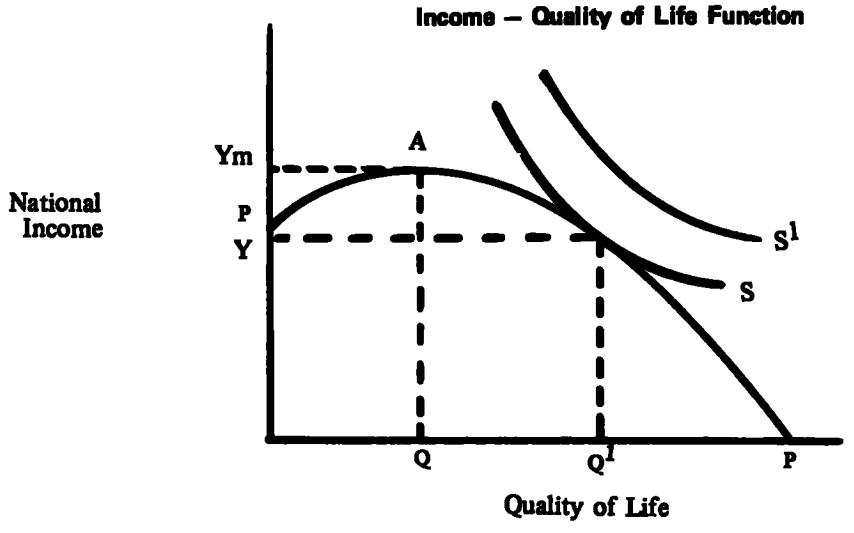


Figure I shows a welfare model which indicates the possible and desired levels of national income (economic welfare) and quality of life (that welfare not related to economic satisfactions). Curve PP is the welfare transformation or possibility curve and it indicates those combinations of national income and quality of life which are possible given constant technology and resources. The curve drawn here contains a section which is upward sloping (PA) which means that increases in both national income and quality of life are possible.[13/] From point A, rightward, gains in quality of life are possible only with concurrent decreases in national income. Point A shows the maximum national income level Ym and the corresponding possible quality of life, Q.

The curve SS is a hypothetical social indifference function which describes combinations of national income and quality of life which yield the same level of total satisfaction to society. It is

12/ See for example, F. M. Bater, "The Simple Analytics of Welfare Maximization," *American Economic Review*, March 1957, pp. 22–59.

13/ This is, of course, not a Pareto Optimal section.

assumed that social indifference curves do not overlap, are convex to the origin and, as one shifts to higher indifference curves, higher levels of total social welfare are obtained. Curve S'S' represents a level of satisfaction greater than that shown by SS. However, S'S' is not obtainable in our model because of technological and resources limitations shown by PP. Point M then, (level Ym, Q) represents the highest level of satisfaction since any other point would be impossible or on a lower indifference curve. Hence, if we are now at point A (maximum national income) total satisfaction would be increased if activities were undertaken which increased quality of life even at the necessary expense of total national income. Of course, a dynamic analysis could demonstrate that gains in quality of life and national income are possible to the right of point A if PP is assumed to shift outward with changes in technology. The model presented is useful only at a conceptual level because of the obvious difficulties involved in empirically determining a social indifference function or the configuration of the welfare possibility function or in defining quality of life.

We can, however, imagine that total welfare is comprised of two broad classes from an individual standpoint, those which relate to income, wealth and material things and those which simply are not affected by redistribution, decreased or increased output, shuffling and reshuffling of resources; such as individual "fulfillment." This latter group of welfare aspects which could be included in quality of life are set aside and the operational aspect of study concentrates on the aspects we can conceivably measure or evaluate in a more conventional sense.

It is not the intent, here, to suggest that only national economic factors are important to quality of life. However, studies have shown for example that there is a positive relationship between quality of housing (an economic factor) and physical and mental health and social adjustment of individuals.[14/] It is suggested that even things such as environmental factors could be included appropriately in the traditional welfare criterion of national development if externalities were adequately accounted for. Public opinion, though, apparently considers environmental aspects so important that they deserve separate consideration as an environmental account. The point is that the maligned national income as a surrogate for welfare is not so much inadequate because it stresses the material aspects but that those who measure it have not included all costs and output. Machlup points out that "We must not put economic values to one side and other values – say ethical, aesthetic, social, political or 'human' – to

14/ Daniel M. Wilner and Rosabelle Price Walkley, "Effects of Housing on Health and Performance," *The Urban Condition*, ed. L. J. Duhl, New York, 1963, pp. 215–228.

the other. The economic valuation of benefits and costs of an institution, plan or activity must attempt to take account of values of any sort and apply reasoned argument and rational weighting to problems commonly approached only by visceral emoting."[15/]

Measures of well–being and social welfare functions have been proposed in hundreds of writings. For example, income, net worth, life expectancy, and aspirations have been evaluated in order to derive a measure of well–being.[16/] However, the subjective nature of so many variables makes it difficult to accept such evaluations as "the" measure. Others have proposed that a social welfare function derives from vote trading models, group interaction theory and the like. As an operational tool the assumption that what has occured is preferred necessitates planning activities which preserve the status quo, but the knowledge of what has occurred may provide a frame of reference with what is planned.

Income Redistribution

Investment decisions based on the efficiency criterion are generally accepted as rational and little moral connotation is attached to them. But, the problem of determining the proper distributional effect of an activity is essentially an ethical one. While the clergy might be more appropriate for the task, the economist, as a social scientist, is usually the one charged with evaluating income distributional effects of government activities. In this capacity, the economist can at least, describe the redistributional consequences of alternative actions for decision makers who must attempt to comply with the people's desires.

As previously mentioned the *Standards* describe the equitable distribution of income as an objective component of quality of life. Income redistribution can be considered as a proxy for wealth distribution, and as Arthur Lewis stated, "The advantage of economic growth is not that wealth increases happiness, but that it increases the range of human choice."[17/] An increase in the choices available to individuals via income distribution often occurs as a consequence of governmental activities. Fiscal, monetary, and tax policies implemented by all levels of government, do have income redistribution consequences and while there is no formal income redistribution policy (to secure some

15/ Fritz Machlup, in Dorfman's edition, *Measuring Benefits of Government Investments*, Brookings Institution, Washington, D.C., 1966, p. 175.

16/ See for example, Burton A. Weisbrod and W. Lee Hansen, "An Income–Net Worth Approach to Measuring Economic Welfare," *American Economic Review*, Dec. 1968, pp. 1315–1329, or James D. Smith and James N. Morgan "Variability of Economic Well–Being and its Determinants," *American Economic Review*, May 1970, pp 268–295.

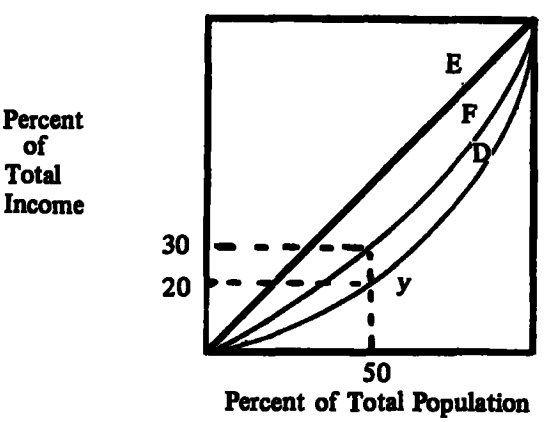
17/ W. Arther Lewis, *The Theory of Economic Growth*, Homewood, Illinois, 1955, p. 478.

desired income distribution), the redistributional aspects of fiscal and monetary policies have long been observed by analysts. The size of wealth or income as represented by GNP is, of course, our main measure of all well–being but the way that wealth is distributed is also important to society as a whole. If quality of life means anything it means enabling individuals to effect their choices. While income redistribution is not the sole significant aspect of quality of life it does have the potential for objective measurement beyond mere description and hence it is a potential tool for decision making about which public investments to implement from among public investment alternatives or opportunities.

If it is accepted that income redistribution is an appropriate objective then how much should income be redistributed, and to whom? Consider the following Lorentz curves which show hypothetical distributions of income.

FIGURE 2

INCOME DISTRIBUTION



Line E shows a distribution in which all incomes are equal while line D shows an unequal income distribution. For example, at point Y the lower 50% of the population has only 20% of total income which conversely means that the upper 50% of the population has 80% of the income. If it is agreed that income redistribution downward is desirable then the new distribution would shift the curve inward toward E. Curve F shows a more equal distribution in that the lower 50% of the population has about 30% of the total income. The income redistribution can be observed and displayed, as above, but it doesn't help in determining how much income to redistribute and to whom the redistribution should occur.

Income redistribution occurs with transfers of money between income classes or with transfers of income in–kind in the form of project outputs. It is the latter case which is the main concern of public

investment in water resources. However, something should be said about the consumption choice aspect of income in–kind transfers. It should be realized that when the redistribution is in the form of project outputs via taxes, the gain in satisfaction to the recipient may not be as great as it would be if the transfer were money since the utility received from, say, a public recreation opportunity may not be as great as a private expenditure of the individual's choice. There are instances of income redistribution via project outputs which are not so restrictive in the above sense since flood damage reduction allows the individual to use the income released as he wishes. If the individual had to repair flood damage immediately after the flood, then having a flood control public investment would free income from the repair expenditure.

What of the value of income redistribution as a government activity? There are two extreme views regarding the distribution of income; incomes should be equal or individuals should receive income equal to their imputed productivities. Of the former, Samuelson points out that this ". . . implies a certain relative well–being as between vegetarians and non–vegetarians; at different relative prices between vegetables and non–vegetables an equal distribution of income can no longer be optimal." Regarding the latter extreme he writes that "perhaps the bourgeois penchant for *laissez–faire* is the only case on record where a substantial number of individuals have made idols of partial derivatives, i.e., imputed marginal productivities."[18/]

Tullock[19/] discusses the value of income distribution and argues that it derives from two types of externalities: (1) the satisfaction gained by all of society when a poor individual is helped by a single individual i.e., a simple consumption externality and (2) the situation where two or more individuals agree to combine their gift to an individual. For example, suppose one is willing to increase a poor individual's income by $10. However, he enters into an agreement with another individual who has the same desire to increase the poor man's income. They each give the poor man $5 and receive the same satisfaction as if they had each given him $10. Tullock contends that redistribution has value due only to these two externalities. He argues that the satisfaction gain to the recipient is not the appropriate measure of the value of income redistribution since many or most people would gladly receive an income transfer. "The reason we help the poor is not that they wish to be helped, for after all, I would like to be helped, but that other people wish to help them."[20/]

18/ Paul A. Samuelson, *Foundations of Economic Analysis*, Cambridge, Massachusetts, 1947, p. 225.

19/ Gordon Tullock, *Private Wants, Public Means, An Economic Analysis of the Desirable Scope of Government*, New York, 1970, pp. 247–257.

20/ *Ibid.*, p. 253.

Tullock discusses redistribution in terms of "charity", however, there is a motive for income redistribution which is little discussed in the literature, that is, to "purchase" social order. The extent to which the "haves" attempt to placate the "have nots" through redistributive activities has not been analyzed to any extent. The optimum redistribution under a "placation" criterion would of course, be quite different than that based on a "charity" criterion. The optimum here would be the purchasing of a desired level of social order at the lowest price rather than the optimal satisfaction of the giver.

Several ways of measuring the value of income redistribution under varying assumptions about society's preferences have been proposed. One of the most widely discussed techniques for measuring the appropriate income redistribution is the utilization of the marginal federal income tax rate as a surrogate for the marginal utility of income. This technique, suggested by Eckstein[21/] and tested by Haveman[22/] and others, is based on the assumption that the marginal utility of income function is implicitly perceived in the political process and it is implied by the effective rate of the personal income tax. The government is assumed to act on the equi–marginal sacrifice principle. Given, the marginal tax rate and hence the marginal utility of income, weights can be derived to apply to a dollar benefit to a particular income class. However, another assumption not stated by Eckstein is necessary if the tax rate is to be used as an indicator of the marginal utility of income; that the benefits of government expenditures accrue equally to all individuals. If not, then the actual effect of an entire government program is ignored. That is, if benefits accrue unequally then the final "fiscal incidence" may indicate sacrifices are not equal and hence, society's real preference is not manifest in the income tax rate. This also points up the necessity of viewing both sides of the coin of government activity; benefits and costs. Suffice it to say that, given varying local and national effective tax rates and benefit incidence, the revealed preference of society for income distribution is rather more complicated than indicated by marginal income tax rate.

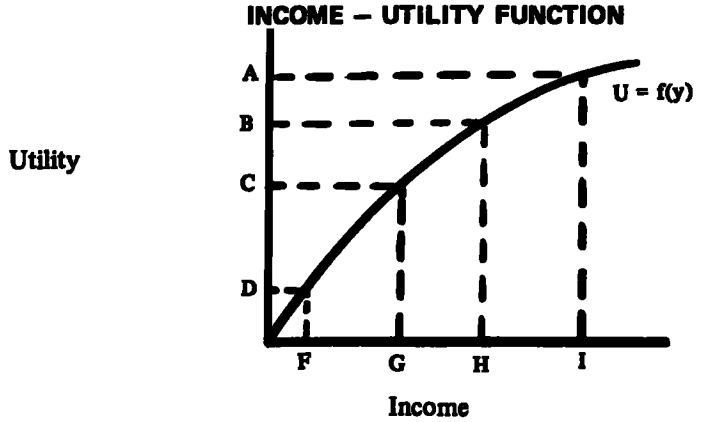
Recall Tullock's view on the worth of redistribution; that the preference of the recipient is not the relevant criterion. If so, then he is assuming that the marginal utility of income is constant, otherwise there could be an increase in total utility by taking money from the rich and giving it to the

21/ Otto Eckstein, "A Survey of the Theory of Public Expenditure Criteria," Universities – National Bureau Committee for Economic Research, *Public Finances; Needs, Sources and Utilization*, Princeton University Press, 1961, pp. 439–505.

22/ Robert H. Haveman, *Water Resources Investment and the Public Interest*, Vanderbilt Press, Nashville, Tenn., 1965, pp. 125–155.

poor and measuring the net difference in total utility. Consider a hypothetical income–utility curve (Fig. 3) with diminishing marginal utility of income, assumed to apply to everyone.

FIGURE 3
INCOME – UTILITY FUNCTION



The graph will illustrate the point that if individual 1 has income to level I and is forced to give a part of his income to individual 2 whose income is at level F, 1's income is reduced by I–H while 2's income is increased by that amount (or G–F). The vertical axis shows the changes in utility for each individual. 1, losses A–B utility and 2 gains C–D utility, which is clearly greater. Hence, a gain in total satisfaction is possible under the assumption of diminishing marginal utility even if the giver is unwilling.

The marginal income tax rate technique of evaluating the worth of income redistribution was used by Rosenbaum in the evaluation of benefits (ex post) of Dewey Reservoir, Kentucky.[23/] Essentially, efficiency benefits (national income change) were allocated to income classes and weights based on the inverse of the tax rate schedule were multiplied by each benefit value. The resulting total benefit was a combination of efficiency gain and redistribution value. The main problem with such a number is that it no longer represents a dollar value of anything which is related to the price system. It ignores Tullock's externalties and also assumes that the efficiency benefit value has the same marginal utility function as the marginal utility of income. It is difficult to accept a combined efficiency and redistribution figure giving the shortcomings discussed. The idea that income redistribution is important to those other than the recipient must be dealt with.

23/ David H. Rosenbaum, *Review of the Economic Benefits and Costs Resulting from Dewey Reservoir*, University of Kentucky, Water Resources Institute, Lexington, Kentucky, 1967.

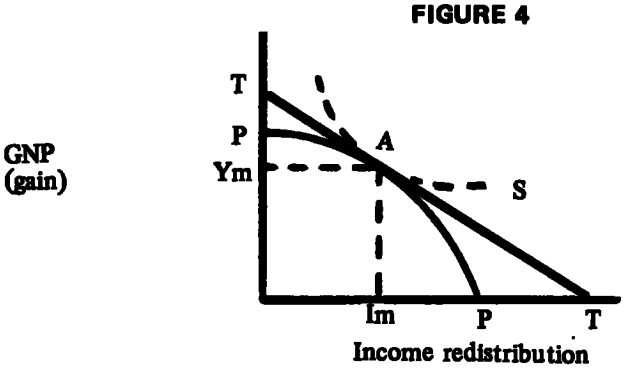
Weisbrod[24/] also argues for integration of efficiency and equity, but he proposes a method which utilized past project construction order as related to the B/C ratio as a measure of society's preference for redistribution gains. Essentially, Weisbrod proposed that implicitly the government (or decision makers) weight redistribution, as indicated by the construction of public works, not in order of highest B/C ratio. That is, the implication is that weights can be derived by comparing "ex post", the order of projects constructed after allowing for B/C differences. However, the major assumption that the project construction order is implicitly affected by redistributional considerations is open to question. It is difficult to accept the idea that decision makers are even aware of the redistributional effects of projects other than in the sense of political maneuvering to get a project in a particular geographic region.

Another approach to the problem of income redistribution and public projects has been suggested by Marglin[25/] and others. Marglin proposed that a project be designed in order to maximize some objective subject to a minimum constraint. For example, a project might be designed to maximize the income redistribution to a certain group subject to a minimum efficiency B/C ratio of 1:1. Rather than attempting to weight redistribution and combine it, this approach proposes that the objective be considered for each project or system. Alternatives are then assessed during the decision making process.

The setting of the minimum value for the constrained variable and the selection of a given alternative implies a certain trade–off ratio between the two objectives. The relative valuation between the two objectives is administratively determined.

Consider a model similar to that in Figure 1:

FIGURE 4



24/ Burton A. Weisbrod, "Income Redistribution Effects and Benefit – Cost Analysis," in *Problems in Public Expenditure Analysis*, Samual B. Chase ed., The Brookings Institution, Washington, D.C., 1968.

25/ Stephen A. Marglin, "Objectives of Water Resource Development: A General Statement" Mass, et. al., *Design of Water Resource Systems*, Cambridge: Harvard University Press, 1962.

The axes represent measures of two objectives. The vertical axis shows the gain in GNP and the horizontal axis shows the amount of redistribution to a designated group. PP is the transformation curve or the technically possible combinations of GNP gain and income redistribution given available project alternatives. Ym is the administratively determined minimum acceptable gain in GNP; Im the corresponding maximum redistribution. Then, the slope of line TT, which is a tangent to PP at point A, represents the implied trade–off ratio between GNP gain and redistribution given the minimum selected. Note, that point A implies a tangency point between PP and an indifference curve, S, with an unknown configuration. Marglin's suggestion is a practical solution to multi–objective project planning but it does not resolve the basic problem of determining a revealed social preference function.

Hochman and Rodgers[26/] suggest that a "Pareto Optimal Redistribution" can be justified and measured "without a social welfare function that makes interpersonal comparisons, (e.g., marginal utility of income via tax rates) provided that utility interdependence is recognized and taken into account in formulating social policy." If, because increases in individual (or group) A's income affect individual (or group) B's utility favorably, "gains from trade through redistribution are possible . . ."

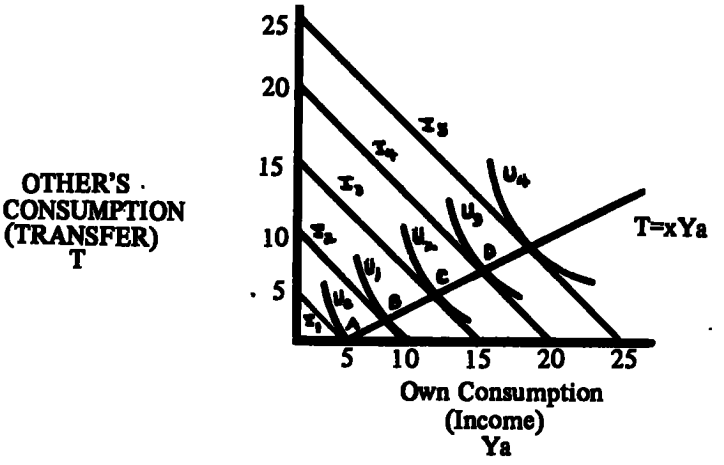
The idea is related to Tullock's discussion on externalities, specifically, that helping lower income groups generates benefit to higher income groups regardless of who is the giver. Hochman and Rodgers suggest that an "optimal" redistribution can be estimated through analysis of the demand for income transfers, the income level differences and the shape of the size distribution of income. Hochman and Rodgers assumed that the desire to transfer income to those with less income is a function of the size of the difference between incomes. The analysis can proceed under other assumptions about the transfer function. A project or system could be evaluated under an array of transfer-elasticities, which in the absence of empirical support, for "the" correct one, could be useful to the decision makers. Section II will contain more on the specific operations of applying these concepts to project evaluation.

The idea of a preference function for income redistribution can be illustrated by the following graph:

26/ Harold M. Hochman and James D. Rodgers, "Pareto Optimal Redistribution." *American Economic Review*, September 1969.

FIGURE 5

INCOME REDISTRIBUTION PREFERENCE FUNCTION



The above indifference map shows a hypothetical relationship between one's own income and the desire to give it away to those in lower income brackets. The horizontal axis indicates one's income and the vertical axis shows the amount of income transfered to other individuals. The U curve indicates those combinations of own consumption and others' consumption which provide the same level of utility to the donor. Utility increases as one shifts to higher level indifference curve (from A to B to C, for example). The diagonal lines represent the individual's income constraint line (I_1 I_2 I_3 I_4 I_5) for given levels of income. For example at I_1 the individual can retain all his income or give away any portion up to 5 as represented in the vertical axis by 5. Hence, at points A, B, C and D the individual is maximizing his satisfaction for each level of income. In this hypothetical example the individual is willing to give away a constant share of his income as his absolute income level increases. At I_1 the individual is unwilling to give away any of his income. Line A B C D (T = xYa) shows the own–others consumption path. T equals the total desired transfer given a level of income Ya. Here it is assumed that a constant percent of total income is to be transfered (x). The actual function would depend on the actual configuration of U curves.

An additional variable in the redistribution model would need to include a relationship between willingness to transfer income and the income level of the recipient. Consider a three person model where:

Ya = the level of A's income and Ya Ym (some minimum level)

x = a share of income A is willing to give away to lower income people

Y1 = income of the 1st recipient and Y1< Ya

Y2 = income of the 2nd recipient and Y2 < Ya

T, T1, T2 = the total transfer from A, to individual 1, to individual 2

(1) $T = x\ Ya$ (from the preceding graphic analysis)

(2) $$T1 = \frac{Ya-Y1}{(Ya-Y1) + (Ya-Y2)} \quad (x\ Ya)$$

(3) $$T2 = \frac{Ya-Y2}{(Ya-Y1) + (Ya-Y2)} \quad (x\ Ya)$$

or $T = T1 + T2$

The Hochman and Rodgers assumption that the willingness to transfer income is a function of the income differential between the donor and recipient is continued here. Hence, equations (2) and (3) show that total transfer is distributed to individuals 1 and 2 according to the differences in their incomes and the donor's income. The preceding is, of course, an over simplification, but it makes the point that society's desired redistributional activity is a function of both income level and differences among incomes. This helps to conceptualize the problem of valuing a redistribution effect of a project.

Hochman and Rodgers studies do indicate that if the total effects of actual government expenditures[27/] are examined and are accepted as preferred, the ratio of the marginal utility of own–consumption to the marginal utility of other's consumption declines over the income range considered. It is implied that, as people's income increases, they are willing to give greater percentage amounts to those in lower income classes. Their conclusion is based on the assumption that the total government expenditure effects (costs and benefits) represent a social revealed preference. Fiscal incidence can be considered as the change in economic position of individuals after a government expenditure. In other words, after a federal expenditure people find their income level altered relative to others, by the tax paid and the benefits received. This is essentially the problem discussed in the following sections; not with the regard to all expenditures but with regard to a single project. However, the Hochman and Rodgers findings based on Gillespie's estimates of fiscal incidence are based on all government expendtures.

27/ The data and determination of "fiscal incidence" of all government expenditures is based on the work of W. Irwin Gillespie, "Effect of Public Expenditures on the Distribution of Income" in *Essays in Fiscal Federalism*, Richard Musgrave, ed., Brookings, Washington, D.C., 1965, pp. 122–169.

The problem of determining the appropriate redistribution hinges on the value judgment of the decision maker or upon the value judgment of those who form a social consensus. Even though analyses like that of Hochman and Rodgers simplify the assumptions necessary to justify redistribution activities they do not offer a rationale for *the* right income redistribution. It may be that income redistribution to individuals in some minimum income class is the preferred tack. There is considerable legislation which deals with subsidies to individuals who fall below a certain income level. Perhaps redistribution among income classes above this minimum should be considered of no particular value, however, there are examples of legislation providing redistribution to higher income individuals, i.e., non–taxable bond income, subsidies to firms, farm subsidy.

The preceding should indicate that there is almost no end to the possible criteria by which income redistribution could be evaluated. The researcher can suggest ways which seem to be meaningful but ultimately, the standard for judgment must come from the policy making level. We have to infer social preference from acts of Congress or government behavior but a specific Act dealing with income redistribution would be clearer. There are examples of such acts, viz. The Full Employment Act of 1946 and the recent law creating specific kinds of jobs and others. While comment and research about appropriate income redistribution activities would surely continue, consideration of income redistribution in project evaluation could begin in earnest with the passage of a law or the issuance of a directive.

SECTION II

A PROCEDURE FOR MEASURING THE INCOME REDISTRIBUTION EFFECT OF A WATER RESOURCES PROJECT

In order to determine the redistributional effects of a project, four steps must be undertaken. The first step is the allocation of project efficiency benefits to incidence groups by income class. This means that the final incidence of the benefit must be determined, i.e., whether the benefit accrues to a household, a stockholder, customers, etc. Once the incidence by recipient group is identified then the income distribution of that group must be measured or estimated and benefits allocated to the income class.

The second step is the determination of the project cost incidence by income class. The federal income tax distribution by income and class, excise, corporation tax and local tax distribution, in cases where reimbursement is necessary, can be used as guides in estimating the project cost incidence.

Third, the net income redistribution by income class needs to be calculated. Income redistribution is related to the value of project benefits and cost. The accrual of benefits is considered income "in–kind." Net redistribution will be the difference between benefits received by a particular income class and the costs paid by that class. The net figure will show an amount of dollars lost or gained by an income class as a result of a project. While the preceding 3 steps are obvious, there are many problems in determining final incidence of benefits and costs which will be discussed throughout Section II.

The final step is to determine the worth or value to society of the redistribution. Step 3 will provide a number of dollars transferred from/to an income class but the question remains as to what is a dollar of transfer worth to society. The answer, of course, depends on assumptions made in the analysis, since worth is essentially a value judgment as was indicated in Section I. It is suggested that income redistribution resulting from a project be judged in the light of varying assumptions about society's income – transfer preferences as discussed in the previous section.

Incidence Groups

Since the flood control sample project area studied is the Mill Creek Valley, the benefit allocation is discussed here in terms of flood damage reduction benefits. This section will treat the application of the procedures to other types of water resources project purposes below. The reader should keep in mind that the area is highly urbanized and data is probably more readily available than for a small rural town. However, the procedure will apply generally but data substitutes need to be located.

The Mill Creek Project Survey report data includes damage reduction benefits listed by type of property, residential, industrial, commercial and the like. The income class of individuals or groups needs to be determined and we must find out which groups receive the benefits and pay the costs. That is, in order to get from benefits listed by property type to value of benefits received by income class, more needs to be known about the characteristics of the individuals living on or owning the properties affected by the project. As in this case, where there are several types of property, the determination of final benefit incidence by income class is no simple matter.

The following table will be useful in organizing the allocation of the benefits to income classes. Table I is presented as a sample and will be discussed further in Section III to show the data needs for a project such as the Mill Creek.

It is likely that the damage reduction benefits will accrue to the following groups:

Residential property –
owner and/or renter

Commercial property –
Proprietor or stockholders and/or
customers

Industrial property –
Proprietor or stockholders and/or
customers

Public property –
Taxpayer local or federal

Transportation and Utilities property –
Stockholders and Public

TABLE 1

ALLOCATION OF BENEFITS TO INCOME CLASS

PROPERTY TYPE	Residential		Commercial		Industrial		Public	TOTAL
Incidence Group	Owner	Renter	Proprietor	Customer	Stockholder	Customer	Taxpayer	Incidence
INCOME CLASS								
$								
A								
B								
C								

NOTE: A table such as this one is not proposed for display in a project report. It is suggested here merely as an operational tool for organizing the allocation of benefits to income classes. The problem in this discussion is limited to determining income redistribution among people with different income levels and what that is worth to society. A related problem, that of determining the incidence of benefits to various segments of the population classed by other criteria, has been discussed at some length by Wiesbrod and others.

There are other benefits to groups which could be included under each property class, such as the Red Cross which aids, with donated funds, the clean–up and emergency activities which need to be undertaken during and after a flood. These need to be accounted for in any real project analysis and the income distribution of donors would need to be estimated. However, data for Mill Creek does not include a separate listing for clean–up and emergency activities. Hence, charity and public aid is not specifically treated here.

Residential

There are three groups of individuals who might benefit from the reduction of flood damage to residential property. They are (a) owners who occupy the dwelling, (b) renters of dwellings owned by non–residents and (c) the non–resident owners. The starting point in the evaluation of residential benefits must be the determination of a distribution of owner occupied and rented dwellings on the flood plain. This can be accomplished by assumption, by examining tax records or by survey. Some who have experience in flood plain surveying indicates that this information would be obtainable during the normal flood damage survey. If a survey is not to be made then, local property tax records would indicate properties which are rented. The assumption that all single unit dwellings,. one–half of a 2 family and none of multi–unit dwellings are owner–occupied has been used by the city of Cincinnati in some studies. Other sources for estimates of the owner/renter relationship include local real estate firms, banks, or savings and loan associations.

Once the determination of the owner–renter occupied breakdown is made an estimation of the income distribution of the owner–occupied group is necessary. Some of the numerous ways to estimate or measure the group's income distribution are indicated below:

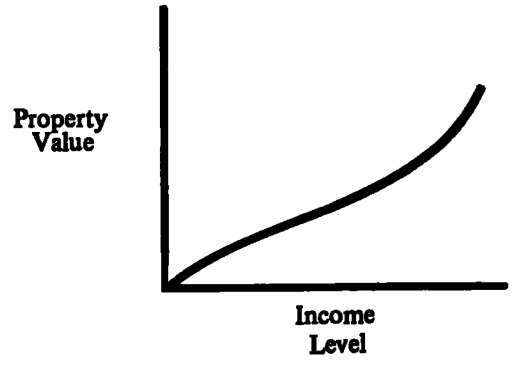
(a) Assume property value and income are related and use the distribution of property value as a proxy.

(b) Assume the flood plain income distribution is related in some consistent way to the regional income distribution.

(c) Direct survey during flood damage survey.

The flood damage survey contains property value for nearly all units. This information can be used to estimate the income distribution in flood plain. Rosenbaum[28/] used assessed property valuation and census county income figures to obtain a property value income function on a county basis. For example, the property value figure that exceeds forty percent of all values is plotted against the income level which exceeds forty percent of all incomes. A function such as the one below is obtained.

FIGURE 6



Hence, property value data is translated into income data. The important assumption here is that the county property value income function applies to those owner–occupied properties in the flood plain. Differences between assessed values and full values in the flood plain can be reconciled by determining the assessment rate for the locality and converting the vertical axis on Figure 6 to full values. Income distribution in the flood plain is then derived by multiplying the value income ratio corresponding to a given property value by the corresponding actual property value in the flood plain (from the existing flood survey). The array of incomes then can be put in the form of a distribution. A simpler, but highly questionable method of estimating the distribution of income in the flood plain is to assume that the county income distribution applies to the flood plain. The Cornell Study[29/] used this approach in testing the "objectives" on the Stonewall Jackson Lake Project in West Virginia. They allocated benefits to income classes in proportion to the income distribution of the region. This method has the advantage of simplicity, however, given the relatively small area of a flood plain it is likely that there is wide divergence between the income distribution in the region and in the flood plain. Finally, direct interview during the flood survey would seem to be the surest way of getting an accurate income

28/ Rosenbaum, *op cit.*

29/ "Federal Evaluation of Resource Investments: A CASE STUDY" Cornell University Water Resources and Marine Sciences Center, Technical Report No. 24, February, 1970.

distribution for each group. Experienced flood damage survey interviewers indicate that accurate income data would be difficult, if not impossible to get from interviews. Data sources will be discussed more fully in the "data availability" section of this report.

Allocation of Benefits to Income Class

After the income distribution for the group is determined, the next step is to allocate the flood control benefits to the income classes of the group. There are three likely ways for allocating flood damage reduction benefits; allocate equally, by property value, or by flood susceptability. It could be assumed that benefits accrue equally to each unit. This would seem unlikely given varying values of properties and varying susceptabilities to flooding of properties. The latter two factors do need to be considered if a realistic allocation by income class is to be made.

If the data in the flood damage survey and observation indicate that the properties representing income classes are evenly distributed over the range of flood frequencies, then an allocation of average annual benefits to income classes in proportion to value of property is adequate. However, if income class stratification is "lumpy," then some adjustment for income and flood frequency must be made since flood damage is a function of property value and elevation. If data are adequate, damage frequency curves for two or more elevation ranges could be constructed according to the distribution of property value over the flood plain. The result would give an average annual benefit for a particular elevation range which could be distributed to income classes according to the distribution of property value within that range. This fine adjustment would, of course, be indicated only if there were obvious disparities in property values at different elevations.

Thus far the discussion has dealt with the allocation of residential benefits to the income classes of the owner–occupied group. The next step involves the allocation of benefits to the renter–occupied group. Benefits will accrue to either the renter, the property owner or both. How the benefits are estimated to accrue depends upon the assumptions which are made. Benefits due to reduction in damage to "contents" will likely be realized by the renter while benefits from the reduction in structural damage are received by the owner. This argument assumes that the owner will not lower the rent by the amount structural damage is reduced and that he will not raise the rent up to the amount of the reduced personal property damage (contents) realized by the tenant. Of the two possibilities it is more

likely that the rent would be raised since the tenant would be willing to pay up to the amount of reduced damages to his property. However, the market plays an important part in the rent determination and housing with certain qualitative characteristics commands a given rent range, hence rent changes are unlikely unless the flood reduction benefit is very high and is perceived in the market as a significant qualitative change in the house. It is argued here that the owner and renter will divide the benefit according to the structural contents damage ratio.

We come, now, to the difficult problem of determining the incomes of renters and owners so that the benefits can be allocated to these groups by income class. The preceding analysis of owner–occupied residential property contains the implicit assumption that renter–occupied properties were not included in owner–occupied property value distributions and hence, must be individually broken out. If they are not broken out the analysis must be modified and different assumptions apply. For example, if there are 30 units in the flood plain and we assume that 1/3 are rented and the total residential average annual benefit is $6,000 then we must assume that $4,000 average annual benefit accrue to the owner–occupied group. But since it isn't known which specific ones are owned another assumption must follow; that the distribution of property value among the rented and owner–occupied units is the same and is dispersed over the flood plain in a similar way. Once this determination is made then we can proceed with determining incomes of the owner–occupied group. If specific knowledge, through the survey or tax records, is available the incomes of the groups can be estimated without assumption about the similarity of property value distribution between the owner–occupied and renter–occupied groups.

In the absence of specific information about incomes of rented property owners and renters, evaluation based on indirect means or assumption must be made. It is likely that the renter's income is related to property value in much the same way as the owner–occupied group. That is, their income distribution can be considered to fall in proportion to the value of the property they rent. It may be that the relationship between income and property value for renters is not exactly the same as for the non–renter. Banks, savings and loans and data on consumption (viz. expenditures on housing and household goods) will provide a guide. However, it is likely that families maintain a similar relationship between income and value of housing regardless of whether they rent or buy a house. The relation between owner's income and the value of the property he rents out is not apparent. Information about the income distribution of those receiving rental income is available from the Internal Revenue statistics.

Given the estimate of owner's and renter's incomes we can now allocate the owner and renter portion of benefits. As in the owner–occupied situation, distribution of benefits to renters should be made in proportion to property value distribution. A ratio of structural to contents damage may be used to separate owner and renter benefits if it is fairly consistent over the range of properties. For example, if average annual benefits for non–owner occupied residential property are estimated at $3,000, and the structural damage to contents damages run about 50–50 then it can be assumed that $1,500 of the benefit accrues to the owners and $1,500 will accrue to renters and is distributed to income classes in proportion to the distribution of property value. The owner's $1,500 will accrue to the income class according to the data about rental income by income class. Up to now, the procedure for estimating the incidence of benefits reported for residential property has been given. The following table shows a portion of Table 1 in order to illustrate what allocation has been made.

Table 2

$ Benefit to Residential by class

Income Class $	owner–occupied owner	renter–occupied renter	renter–occupied owner	RESIDENTIAL TOTAL
1	X	X	X	XX
2	X	X	X	XX
3	X			X
4		X	X	XX
				XXX

Referring to Table 1, it is understood that a similar procedure is necessary in order to apply benefits to income classes within the other groups such as industrial stockholders, proprietors, customers, etc.

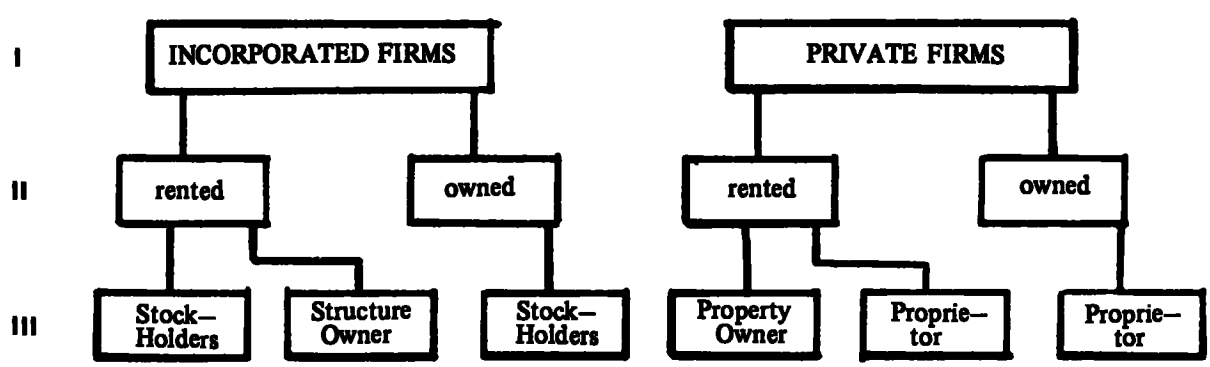
Commercial or Industrial

There are several possible groups under the commercial property category which could benefit from a flood control project: (a) the owners, (b) the property owner (if rented), (c) stockholders (if

incorporated), (d) or the customers. At the survey stage it is necessary to determine whether a firm is incorporated or privately owned in order that the appropriate income distribution of the beneficiary can be assigned. In addition, whether or not the property is rented must be determined. A chart similar to Table 1 will help to illustrate what breakdown of incidence groups is necessary.

CHART I

Incidence Groups
Industrial or
Commercial Property



The chart shows that there are three stages in the analysis. Stage I requires the determination of firm ownership. Stage II indicates that a portion of the properties may be rented and this must be determined in order to allocate the appropriate portion of benefits to the property owner. Stage III shows the beneficiary group for which the income distribution needs to be known. The determination in Stage I and II can be made at the flood damage survey stage. If not, then some assumptions need to be made about the breakdown of property between incorporated and private and rented and firm owned.

The properties which are rented will require an extra data manipulation. As with rented residential properties the amount of benefit can be divided between the renting firm and the structure owner according to the structural to contents damage ratio. With those properties owned by the firm, the benefit will accrue to either the proprietor, if privately owned, or the stockholder, if publicly owned.[30/]

30/ Note: The implicit assumption is that market forces determine the price level and benefits accrue as net income to the firm or property owner and not to the customers. This assumption is open to question, however since the analysis is illustrative, specific knowledge to the contrary will not invalidate the technique suggested. It is likely that the flood control benefits of the entire program provide considerable benefit to customers and hence, redistribution among consumers. However, the difficulties in tracing this effect would likely be quite time consuming and costly in relation to the significance of the findings. The whole question of changes in relative prices and consequential changes in income distribution is still in the theoretical realm at the present state of the art.

The next step then, is to determine the income distribution of the incidence groups. The statistics available from IRS on income distribution of stockholders, business owners and those receiving rental income will provide a guide in the absence of actual data for the flood plain. Hence, benefits can be allocated by income class for commercial and industrial properties.

Other Property

Transportation and utilities will present an analytical problem similar to that for industrial and commercial. It is more likely though, that the customers will share in the benefit, particularly in the case of public utilities which set rates based on costs. Benefits to public properties can be distributed to income classes according to proportion of taxes paid by income class. If the property is local government owned, then a determination of the incidence of local taxes will need to be made. The distribution of federal income taxes paid by income class can be used to allocate benefits in cases where federal properties are affected.

Time Aspect of Benefit Incidence

There is a time dimension aspect to the calculation of the incidence of benefits which should be considered. First, benefits to future development in the flood plain may not accrue to income classes in the same way as present development benefits. For example if growth in residential properties is expected, then the value of properties could increase which would indicate higher income beneficiaries. Or, conversely, if residential development is expected to be phased out during the life of the project then, it could be argued that benefits will accrue to generally lower income classes than presently affected. The obvious consequence of this time aspect is that projections will need to be carefully analyzed during project evaluation. The planner will have to spell out, in more detail than formerly, the types of development expected and its implication for income distributions. For an "ex post" analysis of the Mill Creek it will be assumed that future benefits accrue to income classes in the same way as present annual benefits although an effort will be made to ascertain what changes will occur.

A second consideration regarding the time aspect or flow of benefits, is that generally income levels are lower and people in the present pay the costs of a project which benefit people expected to have higher incomes in the future as personal income increases. This indicates a disadvantage of long term investments as a redistributive tool. However, for practical purposes it is assumed that the present

income distribution will prevail or at least the relative distribution will remain constant. That is, the incomes within all classes are assumed to increase by the same proportion.

Another point which needs to be discussed is that of final benefit incidence. For example, consider a flood control benefit to a corporation which is realized as income. Actually a percentage will return to the government in the form of corporate income taxes. A similar situation occurs when a proprietor realizes a flood control benefit. A portion will be taxed as income tax. However, a benefit received in the residential sector will be realized "in–kind" by the recipient and not subject to income tax. Ideally, it would be appropriate to account for the real gain to income classes. In the case of a corporation benefit, one–half would accrue to stockholders or be held in the firm and one–half to the taxpayers. However, there remains a further complication because if the taxpayers' portion is distributed according to the general income distribution then the incidence of benefits of those returned tax dollars is ignored, say in the next round. Hence, as a practical matter measurement of benefit incidence will be carried to the point of initial incidence groups as discussed (i.e. stockholder, renter, etc.).

A few words about enhancement benefits are necessary. It is likely that those benefits considered enhancement will accrue to property owners recipients in the form of rents or higher sale value and therefore benefits allocated to income class, in this case, would be according to the income distribution of those receiving rents.

Cost Incidence

After benefits are distributed by income class, the allocation of costs to income classes must be determined. In cases where reimbursement is not required, the project costs will be borne by the nation at large. Thus, a practical means of distributing project costs would be according to taxes paid by income class. Personal income taxes and Social Security taxes account for about 67% of the revenues collected by the Federal government in the United States, therefore, it is proposed that project costs (non–reimbursable) be allocated to income classes in proportion to the federal income tax paid by that class. This information is available for recent years from the Treasury Department. In situations where project purposes call for reimbursement by the local people, allocation of these costs can be based on local tax incidence figures which are generally available from the city or county governmental unit concerned. Studies which deal with the incidence of local taxes in general, can be used in the absence of specific information.

Gillespie's[31] study as mentioned previously (p. 18), is an example of the type of information which can be used in cost incidence studies. It contains tables which show the distribution of taxes by income class on both a federal and local level and could be used for allocating to income class both federal and non–federal project costs. Studies like this and procedures for estimating tax incidence are commonly found in the literature and will not be elaborated on in this study.

Net Redistribution

Once project benefits and costs are distributed to income classes calculation of the net redistribution is possible as in Table 3 below.

TABLE 3

PROJECT NET REDISTRIBUTION

INCOME CLASS $	COSTS	BENEFITS	NET DISTRIBUTION
A	$ 10	$ 30	+ 20
B	20	20	–
C	30	10	– 20
TOTAL	60	60	0

B/C = 1:1

The information will appear much as in the sample above and the net redistribution can be indicated by a + or – transfer.

There are a few conceptual problems which need to be discussed. First, exactly what does the + or – figure really indicate? In its ideal form it means that X dollars of income has been transferred from individuals in class C to those in class A. In the example above, income taxes paid by a richer group have been transferred (in the form of flood control) to a poorer group. This is a net figure, and is the

31/ Gillespie, *op cit.*

result of netting out costs and benefits for each income class. Up to this point there is no reason to assume that $20 transferred to A from C is worth $20 to society. In fact, it might be worth $0 or $–20; recall this idea is discussed in Section I of this report (p. 10 to 19).

A problem concerning the presentation of the net redistribution arises with regard to the fact that a relatively small number of persons in the local area gain at the expense of a large number of individuals (the nation as a whole). Table 3 could be modified and presented as follows:

TABLE 4

NET REDISTRIBUTION – NATIONAL AND REGIONAL

INCOME CLASS $	NATION PROJECT COSTS	LOCAL PROJECT COSTS	BENEFITS	NET	REGIONAL NET
A	10	1	30	+ 20	+ 29
B	20	2	20	–	+ 18
C	30	5	10	– 20	+ 5
	60	8	60		+ 52

B/C = 1:1

Table 4 shows that when viewed from a national–regional standpoint the net redistribution tells a different story. Note that the individuals in high income class C gain from a regional point of view, while overall from the national view individuals in that class get a negative redistribution. The point is that when projects or alternatives are compared both the regional and national view needs to be considered. Keep in mind too that the primary value of redistribution is the national effect without regard to location of the recipient. Recall from Section I, Tullock's externality which describes the gain in satisfaction every man may feel from raising a poor man's income by so many dollars even though they contribute to only a part of that gain. Thus, it seems that the gain to a relatively few (in a region) at the expense of many (the nation's taxpayers) is important and justifies considering "the net" column in Table 4 of prime importance.

Another point which needs to be examined is the allocation of benefits and costs in cases where the project B/C ratio is greater than 1:1. That is, what are the redistributional effects of a project with a positive total net benefit. A hypothetical example will serve to illustrate this point and the proposed method for dealing with it. Consider the following table.

TABLE 5

ADJUSTED NET REDISTRIBUTION

INCOME CLASS $	PROJECT COSTS (1)	BENEFITS (2)	Y (3)	NB (4)	Y* (5)
A	5	80	+ 75	+ 5	+ 70
B	20	40	+ 20	+ 20	0
C	75	80	+ 5	− 75	− 70
	100	200	+100		0

B/C = 2:1

Table 5 shows that costs and benefits of a project which has a B/C ratio of 2:1. Benefits and costs are distributed by income classes A, B and C in columns (1) and (2). Column (3), Y shows the net change in the classes' income positions. That is, in the example income class A is $75 richer since he paid $5 toward the project (via taxes) and receives $80 in benefits. Income class B is $20 better off while income class C gained $5 because of the project. It is seen that there is a total positive net benefit of $100 and the question is how do we account for it. It is proposed that the net benefit be considered as a social return above the normal return (reflected by the discount rate) which should be allocated to each class according to its share of costs. That is, assume that the "return" initially belongs to each class according to its "investment." Hence, column (4), the allocated net benefit ("return") is subtracted from the gain in column (3) resulting in an adjusted net redistribution in column (5). Again, the rationale is based on the assumption that the net benefits would normally accrue to a class in proportion to his cost (investment) and are not transfers between income classes as such but implicit costs. Column (3) Y, represents not only the sums redistributed but the initial distribution of net efficiency benefits.

Another point for discussion is the definition of the income base from which income classes are determined. The real income is determined by money income, transfers, public goods and services, etc. For example, an individual in a low income class might have non–monetary income worth $2,000 more than measured money income or added income in transfer payments. Hence, when we measure the net redistribution say to a $2,000 class, the real base may be $4,000 which will affect our evaluation of the "worth" of the transfer.

The availability of income data will limit the ability to determine real income of the recipient groups since most income information is derived from tax records or indirectly based on property value.

The measured redistribution can be compared with an ideal distribution based on some assumption about social preference. However, the redistribution effects of a single project have little meaning by themselves. The entire program or system must be evaluated in terms of the total redistribution which occurs. What constitutes a better or worse redistribution needs to be analyzed. In spite of its shortcomings the marginal income tax rate provides some rationale for a weighting system for evaluating redistribution on a single project basis. It should not be lumped with the efficiency B/C ratio since the question of whether or not it is the revealed marginal utility of money function is open to debate. Gillespie's "fiscal incidence" could also provide a rational weighting system and it also has the advantage of including the total effects of government expenditures. The following example illustrates the derivation of redistributional weights based on Gillespie's fiscal incidence.

Consider a hypothetical national fiscal incidence (TABLE 6):[32/]

TABLE 6

Income Class	Net Fiscal Incidence	%
A	+ 4000	1.00
B	– 1000	– .25
C	– 3000	– .75

The above example shows that when all taxes and expenditures are considered income class A gets 100% of the positive transfer at the expense of class B and C. Next consider a hypothetical project with a net redistribution effect as follows:

32/ Actual figures are available from Gillespie, *op cit.*

Project 1

Income Class	Net Redistribution	%	Absolute Difference
A	+ 200	+ .5	.5
B	+ 200	+ .5	.75
C	− 400	−1	.25
			1.50

Project 2

Income Class	Net Redistribution	%	Absolute Difference
A	1600	1.00	0
B	− 400	− .25	0
C	−1200	− .75	0
			0

The two projects' redistribution effects are compared with the actual national "fiscal incidence." A "O" indicates that the project redistribution effect corresponds with the national effect in terms of the distribution of the amount of transfer. The number 1.5 for project indicates that the redistribution deviates from national result. The value of the number merely indicates the deviation between the national redistribution and the project result. The higher the number the greater the variance. It is simply an arbitrary comparison tool and implies no particular dollar value of a redistribution. However, if a standard for comparison were set up, a means, such as this for comparing project redistribution effects, could be useful. In the absence of a tradeoff function which shows the worth of a dollar redistributed in terms of say, a dollar of GNP, there is no rationale for assigning a dollar value such as is derived by applying weights from income tax rates to efficiency benefits as discussed. However, the dollars transfered as determined by the proposed procedure in Section II will be of interest to decision makers, Congressmen, etc.

SECTION III

DATA AND OPERATIONS SUMMARY

The following chart will illustrate, generally, the operations in determining the incidence of benefits by income class for a flood control project:

CHART II

STEP		TYPE OF UNITS
I	Benefits to Property Class	Residential, Industrial, Public, etc.
II	Benefits to Incidence Group	Stockholders, renters, owners, etc.
III	Income Distribution of Incidence Group	Income class, number or percent distribution
IV	Allocation of Benefits to Income Class	Dollars to income class

From Section II, it is indicated that the procedure for implementing each of the steps varies with the property category and the incidence group. Hence, the data needs and sources also vary. A general list of sources for each step follows:

Step I – Benefits are normally calculated for general property categories such as residential, commercial and industrial, etc. These are found in the survey report and derived from the flood damage survey and economic analysis.

Step II – The appropriate incidence groups are derived intuitively but their share of the benefit must be determined from the flood damage survey or assumption based on general studies dealing with regions larger than the flood plain. For example, the owner–occupied or renter–occupied breakdown could be estimated based on the entire urban area breakdown and a sample of the flood plain. This information would be ideally gathered at the time of the flood damage survey. The interviewer could merely ask whether the unit was rented or owned.

Step III – Determination of the income distribution of the incidence groups – This is perhaps the most difficult one to implement since actual income data is difficult to gather. Hence, it is necessary in most cases to derive it indirectly. For example, recall in Section II that the income distribution of the residential owner–occupied group was estimated on the basis of the property value distribution and its relationship to income on a regional basis. The income distribution of widely dispersed incidence groups will need to be derived from income tax statistics which list source of income and cover the nation as a whole.

Step IV – Allocation of benefits to income class is accomplished by analyzing how the benefit accrues to a particular income class within an incidence group. It is unlikely that the benefit will be equal for all individuals in each class. For example, it was assumed that flood control benefits will accrue to home owners according to the value of the property. Since property value is also used to estimate income it becomes a matter of allocating benefits according to property value. An example calculation will illustrate this point.

TABLE 7

DISTRIBUTION OF AVERAGE ANNUAL BENEFIT TO INCOME CLASS

Property Value Distribution (000) $	No.	%	Benefit
5–10	30	30	$ 300
10–20	50	50	500
20	20	20	200
	100		$1000

TABLE 7 (cont'd)

DISTRIBUTION OF AVERAGE ANNUAL BENEFIT TO INCOME CLASS

Income Class* (000) $	Benefit
2.5–5	$300
5–10	500
10	200

* based on hypothetical constant income – property value ratio or 1:2

For another example, consider the benefit to a corporation as income. The stockholders receive some part of this in the form of dividends and hence, the benefit would be allocated to stockholders of a given income class according to the portion of dividends received by that class. The data will come from income tax statistics which show the income distribution of all stockholders. The preceding should orient the reader to the type of analysis which is needed for estimating benefit incidence and generally at what stage it should proceed.

It is likely that much of the procedure described could be incorporated into the present procedures for developing flood control benefits. For example, the determination of income or property value distributions at various elevation ranges and subsequent frequency–damage curves (see pp 20–21) could be incorporated into the present computer procedure of deriving average annual flood control benefits.

Data Sources:

Income Tax, City of Cincinnati – contains business and individual net income figures.

Master Properties Record, Hamilton County – tax and market values of land, buildings and utilities.

Community Chest & Community Action Commission Information System for Neighborhood Agencies – Cincinnati Metropolitan Area – needs of cases, income and source. Useful to determine frequency of charity uses, say in a flood plain.

Master Welfare File, Hamilton County – earnings and characteristics of recipients, etc. – useful in identifying low income areas.

Computerized Data Files In Cincinnati, Office of Management Services, Community Renewal Program, City of Cincinnati, 1971 – contains a listing of various data files available on computer tape, which would be useful in project studies, not only for redistribution assessments, but for economic and social evaluations in general. Data listed include: Land use file – updated every 6 months, Vital Statistics, Economic Indicators, Neighborhood Business District File, Business Firm Information File, Building Permit Applications, and Housing Inspections File.

Federal Government Sources:

1970 Census Tapes – by tract, by block. Contains information on: value of housing units, rents, units in structure, income (family), value – income ratio, gross rent by income relationship, and gross rent as a percent of income.

IRS – Statistics of Income – Individual Income Tax Returns (recent years) information on: gross income, dividends received, and rental income.

Other Empirical Studies:

W. Irwin Gillespie, *The Effects of Public Expenditures on the Distribution of Income: An Empirical Investigation,* Johns Hopkins, 1963.

Peter Newman, "An Empirical Study of the Distribution of the Tax Burden in the United States, 1955–59" unpub., 1961.

G. A. Bishop, "The Tax Burden by Income Class, 1958," *National Tax Journal,* Vol. 14 (March 1961) pp. 1–53.

Tax Foundation, *Tax Burdens and Benefits of Government Expenditures by Income Class, 1961 and 1965,* New York, 1967.

Herman P. Miller, *Income of the American People,* Wiley & Sons, New York, 1955.

Data normally gathered at time of flood damage survey useful in the analysis: Property values by property category and structure – contents value breakdown.

Additional information required at time of survey: owner–occupied/rented breakdown, and incorporated/private business breakdown.

Application to Other Project Purposes

Section II outlines a procedure for estimating the incidence of costs and benefits to income classes for a flood control project. The type of analysis needed for other purposes is similar but the incidence groups will likely differ and the method for determining the income distribution for the groups will vary.

Recreation

Benefits to income classes of recreation users would involve estimating the income distribution of the users. This can be accomplished by direct survey of the users at the site or estimated from Department of Commerce data relating income to consumer recreation expenditure.

Navigation

The benefits from navigation are so widely dispersed it is difficult to determine the proper incidence group. The problem is the same as previously discussed for flood control benefits to industries; that of changing relative commodity prices due to transportation savings which accrue to the firms. Ultimately consumers should benefit but which ones would be extremely difficult to determine. Research to study the final incidence of navigation benefits is needed in order to determine the income redistributional effects.

Other Purposes

The income redistribution effects of project purposes such as power, water quality and supply need to be evaluated in terms of incidence groups also. Some of these purposes require substantial local cost sharing, which is financed by the taxpayers who are generally the beneficiaries so the redistribution will occur according to the progressivity of local tax structure.

It is clear that the economic analyses in determining income redistribution for multi–purpose projects will increase in complexity and detail necessary to identify the specific groups who benefit. The actual test of the proposed procedure which follows will, of course, indicate problem areas not foreseen, as well as point out additional data needs and availability.

PART II

TEST OF PROCEDURE FOR ESTIMATING BENEFIT AND COST INCIDENCE AND INCOME REDISTRIBUTION EFFECTS OF MILL CREEK VALLEY FLOOD CONTROL PROJECT

OPERATIONS OVERVIEW

The test involved using the survey benefits and costs and classifying them by family income class of the benefit recipients and cost bearers. The procedure proposed is essentially a system for successive allocations, in that benefits are compartmentalized into incidence groups so that the income classes of the recipients can be determined from available data. (Income class as used in this report refers to family income.) Costs are allocated to income class according to distribution of the tax burden.

The steps used to determine benefit incidence by income class are as follows: (1) determine average annual benefits by type of property affected. (2) determine the incidence group associated with the property type, (3) determine distribution of benefits by income class for each incidence group, (4) allocate average annual benefits to income class.

Cost incidence by income class is estimated as follows: (1) determine local and federal project cost shares, (2) determine the distribution of the tax burdens by income class; (3) allocate cost shares to income classes.

Once incidence by income class was determined, a method of comparing alternative projects in terms of well being or redistribution effect as outlined in Part I was utilized.

OPERATIONS

The following section outlines the four procedures used in the test. The resulting benefit and cost incidence and the net redistribution are also displayed:

Benefit Incidence of Flood Damage Reduction to Residential Property

Owner–occupied residential property benefits were allocated to income class by (1) determining the relationship between property value and income and (2) calculating average annual benefits separately for specific property (income) class.

Benefits to rental property were allocated to income class by (1) determining incomes of the owners and renters based on property value and rent in relation to income, and (2) allocating benefits to owners according to the amount of structural damage and to renters according to the damage to building contents.

Property values and characteristics, flood frequencies and damage data were provided in the Mill Creek survey report. Census and Bureau of Labor Statistics data provide the necessary income–property value information.[1/] Estimation of owner–occupied residential property benefit incidence requires an income–property value function in the absence of direct income information based on interview.

Table 1 shows the relationship between income and housing values for census tract 60 which contains the sample reach.

The family income distribution and housing value distribution data taken from the census were used to calculate the cumulative distributions shown in Table 1. The housing value–income ratio in the last column of Table 1 is the housing value at each cumulative percentage divided by respective cumulative percentage income value. Note that as incomes increase the ratio declines over the range presented.

1/ Bureau of the Census, *Census Tract Reports* Series PHC(1) 1960, Cincinnati, SMSA. Contains family income and housing values by census tract.

Bureau of Labor Statistics, *Survey of Consumer Expenditures and Income, Urban United States*, 1961–1961 (BLS Report 237–38, 1964). Contains data on consumption expenditures by type of consumption by income class.

The flood plain property value class distribution and the corresponding housing value–income ratio is shown in Table 2. The ratios for the specific value classes shown were interpolated from the ratios given in Table 1. The property value classes are not continuous because the value of properties surveyed do not increase continuously.

In order to get income classes from property values, the property value–income ratio is divided into the corresponding property value class. Table 3 shows the income class distribution in reach MC–3. The study area contains two multi–unit dwellings which were considered rental property. Benefits to renters were assigned to the \$5.4 – 7.4 thousand income class based on an imputed annual rental value of \$700 per unit.[2/] The Bureau of Labor Statistics study provided the proper income class corresponding to a \$700 annual rent. The property owners were assumed to fall into the greater than \$15,000 income class.

Table 4 shows the distribution of average annual benefits to residential property by income class. Total benefits to residential property amount to about \$50,000 annually. Average annual benefits were calculated for each class of properties corresponding to the income class using the standard frequency–damage method. Information about flood frequencies, stage–damages and projections of future development by property class was available in the survey document and backup data at the Louisville district office.

Benefit Incidence of Flood Damage Reduction to Non–residential Property

Average annual benefits to non–residential property are shown in Table 5. Each type was computed separately on a frequency–damage basis and the annual figure includes discounted future development as well as existing development.

Industrial Property

There are three industrial firms which are located within the design flood plain limit. A total of 11 industrial firms were surveyed, but the additional firms are located within a very low frequency flood limit area and have little effect on the average annual benefit calculation. The firms are all incorporated

2/ Annual imputed rent = property value x $\left(\frac{i}{1-\frac{1}{(1+i)^n}}\right)$ + annual maintenance and taxes.

assume: n = 25 years

i = .05 return on investment.

and benefits were assumed to accrue as increases in earnings. Thus, corporation stockholders are assumed to receive the benefits to industrial property. The federal corporation income tax (50%) was deducted, however, and 50% of industrial benefits were allocated to the public at large by income class in proportion to all federal expenditure benefits received.

The stockholders' benefits were allocated to the income classes using statistics compiled by the Internal Revenue Service which show the distribution of income by source by income class.[3/] Dividend income and income from sales of capital assets were combined to reflect stockholders' income. That is, for example, if 2.9% of the total nation's dividend and capital gains income accrues to the $6000-7,499 income class, then that percentage was used to allocate industrial flood control benefits to stockholders via gains in net earnings.

The portion of industrial benefits which go to the corporate income tax and therefore, to the public are distributed by income class in proportion to all federal expenditure benefits received by income class. The Tax Foundation study provided estimates of the incidence of all government expenditure benefits and costs by income class.[4/] These estimates were used as the basis for allocating the public's share of industrial benefits by income class. Absolute dollar values were converted to a percent distribution.

Table 6 shows the allocation of industrial benefits to stockholders and the public. The percent figures column for stockholders' share is derived from the distribution of stock income by income class. The percent figures for the public's share are, as indicated, based on the distribution of federal government expenditure benefits by income class.

Table 7 shows the sum of the stockholders' and public's share of industrial benefits. Note that the largest portion of these benefits accrue to the $15,000 income class. This is due primarily to the large proportion of high income families which have stock holdings. If the benefits were assumed to accrue to say, customers instead of equity holders then, of course, benefits would fall to a greater extent on lower income classes in proportion to their consumption expenditures.

3/ Treasury Dept., Internal Revenue Service, *Statistics of Income, Individual Income Tax Returns.* 1967.

4/ Tax Foundation, *Tax Burdens and Benefits of Government Expenditures by Income Class 1961 and 1965.* New York, 1967.

Commercial Property

The analysis used in allocating commercial property benefits to income classes was the same as that for industrial property. The majority of commercial type benefits accrue to incorporated firms and these benefits were assumed to accrue to stockholders and the public. The distribution of benefits to income classes was based on the same percentages as those used to allocate industrial benefits to income class; that is, those percentages based on the national distribution of stock income and the distribution of federal expenditure benefits by income class. Table 8 shows the distribution of commercial benefits to stockholders and to the public by income class. Again, the high income class receives the greatest proportion of commercial benefits as is indicated in Table 9 which contains the sum of public and stockholder benefits for commercial property.

Transportation and Utility Property

These benefits were assumed to accrue to (a) local consumers in the form of reduced utility rates and transportation rates, (b) industrial customers in the form of decreased costs and hence, increased earnings and, (c) to the public in the form of government expenditure benefits via the corporation income tax on the benefits which go to the industrial customers in (b) above. Table 10 shows the allocation to incidence groups by income class. Shares of benefits to the consumers are based on consumption expenditures by income class for transportation and utilities.[5/] Shares of benefits for stockholders are based on stock income in the analysis of industrial benefits above. Benefit to shares to the public via taxes are based again on the distribution by income class of federal expenditure benefits.

It was assumed that one–half of the transportation and utility benefit went to local consumers and one–fourth to the nation's stockholders and one–fourth to the public. Table 11 shows the sum of transportation and utility benefits by income classes. The total benefit is $11,600 annually and is distributed in generally increasing amounts as income classes increase.

5/ The BLS Study on consumer expenditures provides a figure for average expenditure on transportation and utilities by income class. This figure when multiplied by the number of families in that class in Hamilton County will provide a distribution of total county expenditures on transportation and utilities by income class which is converted to a percent distribution which is used to allocate the local consumer's share of transportation and utility benefits to income class. For example, the percent figure 1.9% in Table 10 for the < $2000 income class is the percent of Hamilton County consumer expenditures on transportation and utilities which is expended by those with incomes of less than $2000.

Project Cost Incidence

Table 12 shows the distribution of federal and local costs based on estimates of tax incidence by income class. Federal costs are distributed by income class according to the total federal tax burden based on the Tax Foundation study. Local costs are distributed according to local tax burdens found in the Foundation study.

The Tax Foundation study shows tax burdens by income class for both all federal taxes and all local taxes. These absolute dollar amounts were converted to a percent distribution which was used to allocate project costs to income classes. In actuality, the local cost share will be financed by the conservancy district which receives its funds from various means. Assessment, bond issue or other means of raising funds are used by the conservancy district and at this time, it is not clear just how the project is to be financed for the local share. Thus, the Foundation's figures are used as a substitute estimate. They apply to all localities and their applicability, in this case, may or may not be justified. The actual population from which the source of funds will come must be known before any accurate distribution by income class can really be made. Table 13 shows the combined federal and local cost incidence by income class.

Cost and Benefit Incidence by Income Class

Once project benefits and costs are allocated to income classes the net difference for each class can be calculated. Table 14 shows the benefits by property type, by income class; total benefits by income class; total costs by income class and the difference between costs and benefits for each class. Note that the < $3000 income class and the > $15,000 class are the major beneficiaries. For those in $5–$15 thousand classes, their costs exceeded their benefits even though there was a positive total net benefit of $28.5 thousand.

Some additional analyses of the results are presented in Tables 15 and 16. Table 15 shows the percent share of benefits and costs which fall on each income class in addition to a summary of dollar amounts. Also, column 6 shows the distribution of benefits which would occur had they fallen in proportion to costs. Column 7 shows the difference between actual benefit incidence and the "cost proportioned" benefits. The resulting difference for each class labeled "transfer effect" shows the relative redistribution of income between classes after taking out the net benefit of $28.5 thousand. In other words, had the project cost equalled the benefits (BC=1:1) the transfer of income between classes would be as shown in Column 7. The "difference" column in Table 14 includes the initial distribution

of the social return or net benefit while the "transfer effect" column in Table 15 shows only the redistribution of income via project expenditure. In terms of transfer effect, note that the middle income classes ($5–$14,999) lose more relative to the gaining classes when the net benefit is taken out.

Table 16 contains a breakdown of costs and benefits by geographic incidence. Local benefits are those which accrue directly to individuals in the flood plain or in the immediate area. Specifically, they are the residential benefits and the consumer's share of transportation and utility benefits. Costs are divided into local and federal, as in Table 12. Local benefits amount to $55,200 annually while widespread benefits are $96,300. The local share of costs amounts to $9,000 and the federal or widespread costs amount to $114,000 annually. Thus, the local area receives about $46,200 annually more than their cost and the nation as a whole pays about $17,700 more than it receives in benefits. This analysis serves to illustrate that there is a redistribution of income geographically as well as among income classes.

Social Value of the Redistribution

Recall that in the procedures section of this report, (pp 10–18), various ways of measuring the social worth of income redistribution were discussed. In the test, a method for comparing the redistribution effect of the project with other projects is presented which is essentially the same as that shown on pp 34–35 of the procedure. Here the total effect of all federal expenditures is used to weight the gain or loss to an income class. As indicated in the procedure the use of a marginal tax rate as a proxy for the marginal utility of income is incomplete since the entire burden of taxes and benefit incidence by income class must be considered.

Table 17 shows the results of the analysis of the value of redistribution. (The "Net Benefit Column" is the difference between project costs and benefits to each class from Table 14.) In order to measure the relative importance of each gain or loss, a system of weights is derived. The "utility factor" or weights (utility factor column) are based on the Tax Foundation study which determined the ratio of all federal government expenditure benefits to tax burden, by income class.[6/] For example, the $7500–9999 income class receives federal expenditure benefits which amount to about 80% of their tax burden. If it is assumed that the relative differences in these ratios represent society's preference for the

[6/] Tax Foundation figures used in lieu of proposed source cited in procedure (p. 34).

distribution of all federal benefits and costs, then there is a standard by which we can measure the distribution of benefits and costs for a project. This is analogous the society's view of the utility–income function. Thus, if society distributes benefits to the < $3000 class at 4.4 times what that class pays in taxes, then an implicit weight is available when that ratio is compared to the ratio of other income groups. In this case, the $5000–$7,499 class which contains the national median income receives benefits about equal to what it pays and therefore, net benefits to all other classes can be weighted in relation to this median class based on their benefit–cost ratio.

The results of this project show a total positive "relative utility value" of 104.1 which means that the gain in utility from the redistribution is positive. The higher the value, the greater the utility gain. In this way, both separate projects and project alternatives can be compared for "well being" benefits. It is emphasized that the figure 104.1 is not a dollar value related to the real price system, but is merely a tool to be used to compare projects and alternatives being considered for a well–being objective. The weight given it in relation to economic efficiency, environmental enhancement, and other objectives, is a question which requires a great deal more study and discussion and is not within the scope of this report.

OPERATIONAL PROBLEMS

The major data problems which limit the accuracy of the benefit incidence estimates fall into two main categories: (a) the lack of explicit information about the actual incidence groups and (b) the lack of direct and consistent incidence group income data.

Incidence Group Information

Regarding (a) above; consider that in the survey data, flood reduction benefits are classed by property type and not by characteristics of the individuals affected. Then, it becomes necessary to determine what individuals benefit. For example, where benefits fall directly upon the property owner, as in most residential benefits, the task becomes one of determining the income of the residents. However, as indicated in other sections of the report, when benefits accrue to non–residential property, reasoned assumptions are necessary in order to define the individual incidence groups.

Income Data Consistency

Income data which applies directly to the incidence groups is also scarce. Even for residential property, it is necessary to approximate incomes based on a general property value–income function.

For non–residential property, it becomes necessary to use national income data. There are times when the income data are based on net income (after taxes) while other sources use income before tax. Data used in the test involved both income bases but indications are that for the income ranges considered, the median income for that range fell within the class whether or not income before taxes or after taxes was stipulated.

Another consistency problem involves differences in the years the data were compiled. For example, the BLS consumption by income class data which was used to allocate a portion of transportation and utility benefits, was compiled for 1961 and based on the income distribution for that year. The IRS tax data, by income class was for 1968 and was used for allocating industrial benefits to stockholders.

Survey Information

There is no clear cut answer to these data problems short of asking additional questions of each property owner directly at the time of the flood damage survey. Ideally, two questions could be asked of residential property occupants: (1) your family income (by broad range) and (2) do you rent?

Likewise, a few additional questions need to be asked of non–residential property occupants: (1) is the firm incorporated and (2) is it widely or locally held? (3) Would a flood reduction savings lead to a price reduction, increased earnings or higher wages?

Answers to those types of questions at survey time, would be helpful and eliminate the need for broad assumptions about incidence groups and income patterns. But, in reality, it would be difficult to get answers to those types of questions by interview. As a practical matter, broad national data or in some cases, county data will need to be used to some extent.

Future Benefits Incidence

There are a few important unresolved conceptual problems which need to be considered in future studies of this kind. One significant problem involves the future development benefits and their allocation to future incidence groups and income classes. For the test, it was assumed that the future incidence groups were the same as in the present and they received future benefits in the same proportions as the present groups. Also, the income classes are displayed as they presently are which is, in reality, quite unlikely since personal incomes are expected to increase significantly in the future and the income distribution will change. For example, by the year 2020, it is unlikely that anyone will have an income of less than $3000 per year; hence, the problem of how to display benefit incidence becomes apparent. If it can be assumed that the relative distribution of income in the future is about the same as it is presently, then displaying benefit incidence by income classes based on current income levels will still have significance if it is recognized that actual income levels in the future will be higher. It is implied that the significance of income redistribution is based primarily on the relative income differences of the beneficiaries and cost bearers and not on changes in absolute levels.

If this idea is acceptable, then the test method is appropriate; if not, then a projected income distribution is needed and benefits must be allocated accordingly over time.

Number of Families Affected

Another conceptual problem involves the lack of knowledge about how many families are beneficiaries and what amount of benefit accrues to each. Tables 15–17 show benefits and costs for income classes and the significance of the redistribution in terms of a quasi–marginal utility of income approach but the specific gain or loss per family is not known.

This lack of knowledge is a result of the widespread benefit incidence. It can be estimated, for example, that the benefit to stockholders will accrue to families in income classes according to the average national distribution of stock income. However, the specific number of families and thus, the gain per family, can not be specified. Therefore, for an individual project analysis, it seems we must be satisfied with identifying gains or losses to income classes without specific information about members of families. It became apparent as the test proceeded that the externality approach to valuing income redistribution would be impossible to implement without knowing the number of families who were affected. For without the number of families and their exact cost or gain the utility to the donor could not be known. Hence, the marginal utility of income weights, based on the ratio of all government expenditure benefit to tax burden by income class was used. If we can accept the notion that the marginal utility of income to all families within an income range is consistent, then the results as displayed have some significance to decision makers.

CONCLUSIONS

From the analysis, it is apparent that benefits accrue to different groups and are distributed over different geographical areas. Hence, there are two types of initial incidence groups: (1) individuals or (2) organizations. In the case of prevention of flood losses to residential property, the beneficiary is either the structure owner and/or a renter. They, as individuals, directly benefit and measurement by income class becomes a matter of measuring directly the income of those identified recipients either by direct survey, regional income data interpretations, or by proxy using the value of the residence. However, in the case of flood damage reduction which benefits industrial property for example, the direct or initial beneficiary is the corporate entity, or organization.

The Mill Creek project is somewhat atypical in that over 80% of benefits accrue to non–residential properties hence, the analysis had to deal considerably with industrial and commercial properties. Here the analysis must go further to determine benefit incidence to individuals and to income classes since it is clear, that all specific individuals who gain cannot be readily identified. It is even often difficult to ascertain which group of individuals associated with the organization are beneficiaries. Is it the customers, employees, stockholders, board of directors. . .? It depends on many factors, for example, whether the firm is publicly held, the nature of the industry market structure, the nature of the tax system, etc. The benefit from flood damage reduction becomes a cost savings to the firm, but whether it is reflected in price decreases, increased earnings, increased wages or increased executive bonuses is not readily known. There are many studies which attempt to assess the final incidence of the various taxes which fall on corporations, which could be useful in determining the incidence of benefits, but depending on the aforementioned factors, the results differ.

The dispersion and indirectness of the non–residential benefit incidence necessitates a more general and less precise method for allocating these benefits to individual's income classes. For example, if stockholders of a firm are assumed to be the beneficiaries, we can only use general data concerning all stockholder incomes since the specific stockholders cannot be identified. That is, we can only estimate the income class of these beneficiaries based on a national pattern of stockholders' income and assume that the benefits accrue to each income class in proportion to their income from stocks.

In this case, those estimates of benefit incidence by income class for the study area are only valid if stockholders of firms affected have total incomes and stock incomes in the same proportion as all the nation's stockholders. The assumption is not so heroic if the specific firms' stock in the area is widely held.

In the case of public properties, the incidence of benefits can be allocated according to the distribution of tax burden.

Once the incidence of benefits and costs by income class was determined and a net redistribution among income classes was calculated, a means for evaluating the relative merit of this net redistribution is necessary. The approach used involved considering the relative way that the benefits and costs of all government projects are distributed among income classes. Thus, the project's income redistribution or "well being" effect can be compared with the present way all benefits and costs are distributed and with the effects of alternative projects. It should be emphasized that while the present distribution of all Federal benefits and costs is used as a standard or reference point, there is normative significance to it. But, it is useful in comparing the direction of the deviation caused by the project.

Despite the data and conceptual shortcomings indicated by the test the procedure is a practical means of assessing the incidence of project benefits and costs. Even without redistributional weights, the information about incidence of benefits and costs by income class should prove useful to decision makers. Of course, as primary data from surveys about incidence groups and incomes becomes available the analysis will become more refined. In the event that Congress agrees to an explicit income redistribution objective the procedure offers a means for project formulation toward that objective.

TABLE 1

RELATIONSHIP BETWEEN HOUSING VALUE AND FAMILY INCOME CENSUS TRACT 60 CINCINNATI, 1960

Cumulative % of Total *	Family Income $(000)	Housing Value $(000)	Housing Value–Income Ratio
5	1.0	7.6	7.6
10	2.1	9.4	4.3
20	3.8	11.6	3.1
30	4.8	12.4	2.6
40	5.4	13.6	2.5
50	6.0	14.2	2.4
60	6.6	14.6	2.2
70	7.6	15.1	2.0
80	8.8	15.9	1.8
90	10.3	17.9	1.7
95	13.0	19.6	1.5

* Values for family income and housing value represent the % of those units or incomes which are that value or less.

TABLE 2

PROPERTY VALUE DISTRIBUTION
FLOOD PLAIN REACH MC–3 (REAL PROPERTY)
SINGLE UNIT DWELLINGS

Property Value Class ($000)	Number	Housing Value–Income Ratio
$ 8–10	51	6.7–4.2
11–13	65	3.3–2.6
13.5–15	72	2.5–2.0
18–18.5	18	1.7–1.6
	206	

TABLE 3

INCOME CLASSES REACH MC–3
BASED ON PROPERTY VALUE–INCOME RATIOS

Family Income Class (000)	No. of Families
$1.2–2.4	51
3.3–4.9	65
5.4–7.4	80**
10.5–11.4	18
> 15*	2

* Estimated class of multi–unit dwelling owners.

** Renters put in this class based on imputed annual rental value of $700/unit.

TABLE 4

AVERAGE ANNUAL BENEFITS TO RESIDENTIAL PROPERTY BY INCOME CLASS OF RECIPIENT.* FOR REACH MC–3

Family Income Class (000)	Average Annual Benefit (000)
$1.2–2.4	$20.9
3.3–4.9	10.5
5.4–7.4	12.5
10.5–11.4	4.6
> 15	.9
Total	$49.4

* Calculations based on frequency–damage computation for specific property classes.

TABLE 5

NON–RESIDENTIAL PROPERTY BENEFITS. REACH MC–3

	Average Annual Benefits (000)	Existing Firms*
INDUSTRIAL	$73.3	3
COMMERCIAL	17.2	8
TRANSPORTATION	6.7	–
	11.6	
UTILITY	4.9	–

* Within design flood limit, 1968.

TABLE 6

ALLOCATION OF INDUSTRIAL PROPERTY BENEFITS TO INCOME CLASS

INDUSTRIAL (NET EARNINGS INCREASE TO STOCKHOLDERS)

Income Class	Percent of Benefit	Annual Benefit (000)
< 2000	0	$ .00
2000–2999	1.0	.37
3000–3999	1.0	.37
4000–4999	1.8	.66
5000–5999	2.2	.81
6000–7499	2.9	1.06
7500–9999	4.6	1.68
10000–14999	9.5	3.48
> 15000	77.0	28.22
	Total	$36.65

INDUSTRIAL (CORPORATE INCOME TAX TO PUBLIC)

Income Class	Percent of Benefit	Annual Benefit (000)
< 2000	9.3	$ 3.41
2000–2999	8.7	3.19
3000–3999	9.7	3.56
4000–4999	10.9	3.99
5000–5999	11.8	4.32
6000–6999	15.8	5.79
7500–9999	16.5	6.05
10000–14999	11.2	4.10
> 15000	6.1	2.24
	Total	$36.65

TABLE 7

TOTAL BENEFITS TO INDUSTRIAL PROPERTY BY INCOME CLASS

Income Class		Annual Benefit (000)
< 2000		$ 3.41
2000–2999		3.56
3000–3999		3.93
4000–4999		4.65
5000–5999		5.13
6000–7499		6.85
7500–9999		7.73
10000–14999		7.58
> 15000		30.46
	Total	$73.30

TABLE 8

ALLOCATION OF COMMERCIAL PROPERTY BENEFITS TO INCOME CLASS

50% IN NET EARNINGS INCREASE TO STOCKHOLDERS

Income Class	Percent	Annual Benefit (000)
< $2000	0	$ .00
2000–2999	1.0	.09
3000–3999	1.0	.09
4000–4999	1.8	.15
5000–5999	2.2	.19
6000–7499	2.9	.24
7500–9999	4.6	.40
10000–14999	9.5	.82
> 15000	77.0	6.62
	100.0	$8.6

50% IN CORPORATE INCOME TAX TO PUBLIC

Income Class	Percent	Annual Benefit (000)
< $2000	9.3	$ .80
2000–2999	8.7	.75
3000–3999	9.7	.83
4000–4999	10.9	.94
5000–5999	11.8	1.01
6000–7499	15.8	1.37
7500–9999	16.5	1.42
10000–14999	11.2	.96
> 15000	6.1	.52
	100.0	$8.6

TABLE 9

TOTAL BENEFITS TO COMMERCIAL PROPERTY BY INCOME CLASS

Income Class	Annual Benefit (000)
< $2000	$ .80
2000–2999	.84
3000–3999	.92
4000–4999	1.09
5000–5999	1.20
6000–7499	1.61
7500–9999	1.82
10000–14999	1.78
> 15000	7.14
Total	$17.20

TABLE 10

ALLOCATION OF TRANSPORTATION AND UTILITY PROPERTY BENEFITS

50% TO HAMILTON CO. CONSUMERS VIA REDUCED UTILITY RATES AND LOWER TRANSPORTATION COSTS

Income Class	Percent	Annual Benefit (000)
< $2000	1.9	.1
2000–2999	1.4	.1
3000–3999	4.7	.3
4000–4999	8.0	.5
5000–5999	12.1	.7
6000–7499	13.6	.8
7500–9999	25.2	1.4
10000–14999	21.7	1.2
> 15000	11.3	.7
	100.0	5.8

25% TO STOCKHOLDERS VIA INCREASE IN NET INCOME TO CORPORATIONS DUE TO REDUCED UTILITY RATES AND LOWER TRANSPORTATION COSTS

Income Class	Percent	Annual Benefit (000)
< $2000	0	$ .00
2000–2999	1.0	.03
3000–3999	1.0	.03
4000–4999	1.8	.05
5000–5999	2.2	.06
6000–7499	2.9	.08
7500–9999	4.6	.13
10000–14999	9.5	.28
> 15000	77.0	2.23
	100.0	$2.90

TABLE 10 (Cont'd)

25% TO PUBLIC VIA CORPORATE INCOME TAX

Income Class	Percent	Annual Benefit (000)
< $2000	9.3	.27
2000–2999	8.7	.25
3000–3999	9.7	.28
4000–4999	10.9	.32
5000–5999	11.8	.34
6000–7499	15.8	.46
7500–9999	16.5	.48
10000–14999	11.2	.32
> 15000	6.1	.18
		$2.90

TABLE 11

COMBINED TRANSPORTATION AND UTILITY PROPERTY BENEFITS BY INCOME CLASS

Income Class	Annual Benefit (000)
< $2000	.38
2000–2999	.38
3000–3999	.61
4000–4999	.87
5000–5999	1.10
6000–7499	1.34
7500–9999	2.01
10000–14999	1.80
> 15000	3.11
	$11.6

TABLE 12

ALLOCATION OF ANNUAL COSTS TO

INCOME CLASSES–REACH MC–3

Income Class	Federal Percent	Annual Cost (000)
< $2000	1.7	1.9
2000–2999	2.9	3.3
3000–3999	5.5	6.3
4000–4999	8.0	9.1
5000–5999	10.5	12.0
6000–7499	15.9	18.1
7500–9999	19.8	22.6
10000–14999	17.3	19.7
> 15000	18.4	21.0
		114.0

Income Class	Local Percent	Annual Cost (000)
< $2000	4.1	.4
2000–2999	5.3	.5
3000–3999	7.8	.7
4000–4999	10.6	1.0
5000–5999	12.9	1.1
6000–7499	18.3	1.6
7500–9999	19.9	1.8
10000–14999	13.7	1.2
> 15000	7.4	.7
		9.0

$123,000 total

TABLE 13

PROJECT AVERAGE ANNUAL COST DISTRIBUTED BY INCOME CLASS–REACH MC–3

Income Class	Annual Average Cost (000)
< $2000	$ 2.3
2000–2999	3.8
3000–3999	7.0
4000–4999	10.1
5000–5999	13.1
6000–7499	19.7
7500–9999	24.4
10000–14999	20.9
> 15000	21.7
	$123.0

TABLE 14

INCIDENCE OF PROJECT AVERAGE ANNUAL BENEFITS AND COSTS REACH MC–3 $(000) BY INCOME CLASS

Income Class	BENEFITS Residential	Industrial	Commercial	Transportation And Utilities	Benefit Total	Project Cost	(Net Benefit) Difference
< $3000	20.9	6.97	1.64	.76	30.27	6.10	24.17
3000–4999	10.5	8.58	2.01	1.48	22.57	17.10	5.47
5000–7499	12.5	11.98	2.81	2.44	29.73	32.80	–3.07
7500–9999	–	7.73	1.82	2.01	11.56	24.40	–12.84
10000–14999	4.6	7.58	1.78	1.80	15.76	20.90	–5.14
> 15000	.9	30.46	7.14	3.11	41.61	21.70	19.91
TOTAL	49.4	73.30	17.20	11.60	151.50	123.00	28.50

$$B/C = \frac{151.5}{123.0} = 1.23$$

TABLE 15

SUMMARY BENEFITS AND COSTS, PERCENT DISTRIBUTION AND TRANSFER EFFECT BY INCOME CLASS REACH MC–3

Income Class	(1) Benefits (000)	(2) Costs (000)	(3) Difference	(4) % Dist. Benefits	(5) % Dist. Costs	(6) (151.5)x(column 5) Proportional Benefits	(7) (1)–(6) Transfer Effect
< $3000	$ 30.27	$ 6.10	24.17	20.0	5.0	7.57	22.70
3000–4999	22.57	17.10	5.47	14.9	13.9	21.06	1.51
5000–7499	29.73	32.80	–3.07	19.6	26.7	40.45	–10.72
7500–9999	11.56	24.40	–12.84	7.6	19.8	30.00	–18.44
10000–14999	15.76	20.90	–5.14	10.4	17.0	25.76	–10.00
> 15000	41.61	21.70	19.91	27.5	17.6	26.66	14.95
TOTAL	$151.50	$123.00	+28.50	100.0	100.0	151.50	0

TABLE 16

LOCAL AND WIDESPREAD BENEFITS AND COSTS BY INCOME CLASS–REACH MC–3

Income Class	(1) Local Benefits (000)	(2) Widespread Benefits (000)	(3) Local Costs (000)	(4) Widespread Costs (000)	(5) (1)–(3) Local Diff. (000)	(6) (2)–(4) Widespread Diff. (000)
< $3000	$21.10	$ 9.17	$ .9	$ 5.2	+$20.2	$ 3.97
3000–4999	11.30	11.27	1.7	15.4	9.6	– 4.13
5000–7499	14.00	15.73	2.7	30.1	11.3	–14.37
7500–9999	1.40	10.16	1.8	22.6	–.4	–12.44
10000–14999	5.80	9.96	1.2	19.7	4.6	– 9.74
> 15000	1.60	40.01	.7	21.0	.9	19.01
TOTAL	$55.20	$96.30	$9.0	$114.0	$46.20	–$17.7

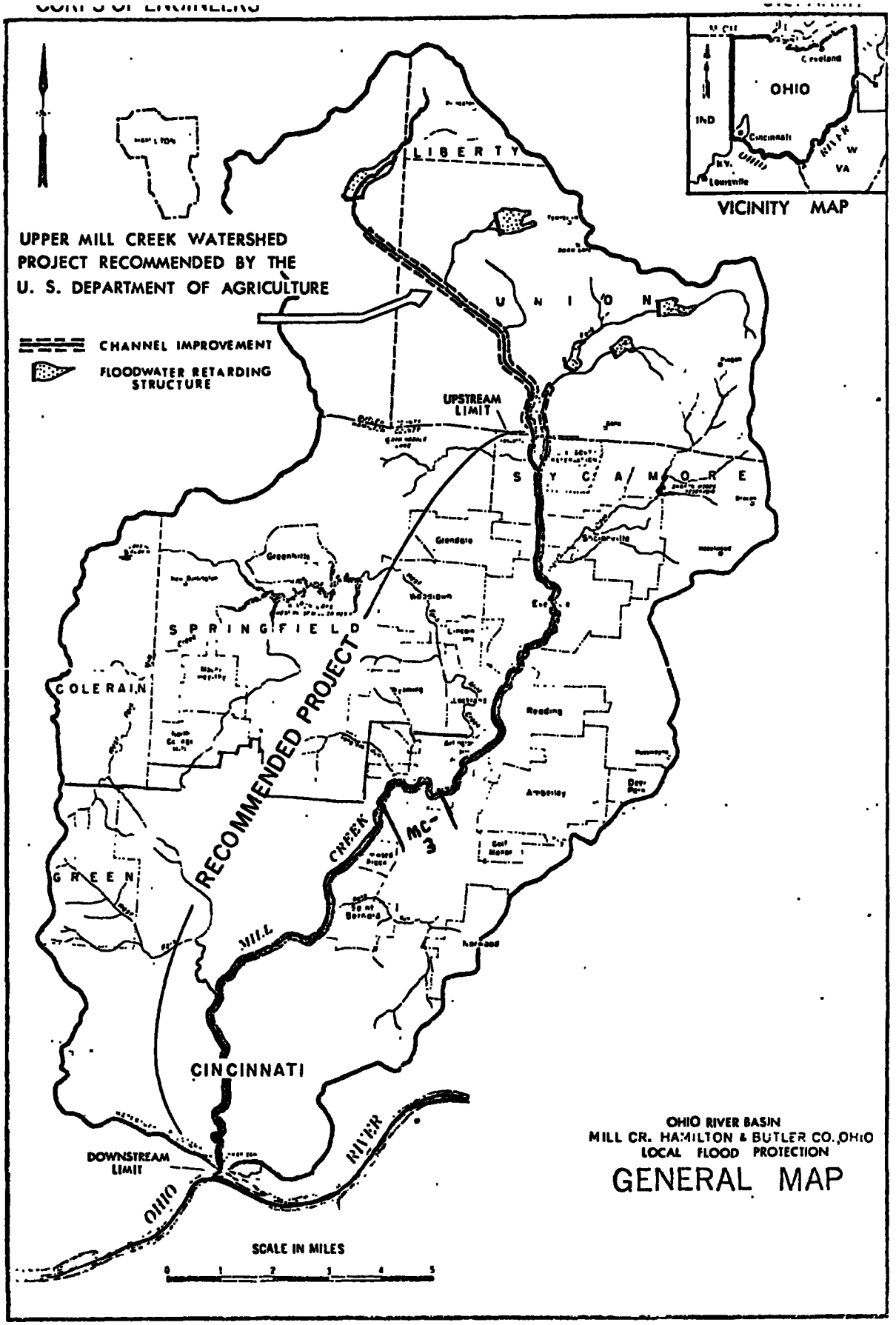
46.20 –17.7 = 28.5 (net benefit)

TABLE 17

RELATIVE UTILITY VALUE OF NET BENEFIT INCIDENCE BASED ON RATIO OF ALL FEDERAL BENEFITS TO TAX BURDEN BY INCOME CLASS

Income Class	Net Benefit $(000)	Utility Factor*	Relative Utility Value
< $3000	+24.17	4.4	106.35
3000–4999	+ 5.47	1.5	8.20
5000–7499	– 3.07	1.00	– 3.07
7500–9999	–12.84	.80	– 10.27
10000–14999	– 5.14	.60	– 3.08
> 15000	+19.91	.30	5.97
	+28.50		104.1

* Based on ratio of all Federal government expenditure benefits to tax burden.


UPPER MILL CREEK WATERSHED
PROJECT RECOMMENDED BY THE
U. S. DEPARTMENT OF AGRICULTURE
CHANNEL IMPROVEMENT
FLOODWATER RETARDING STRUCTURE
VICINITY MAP
OHIO
IND
W VA
KY.
LIBERTY
UNION
UPSTREAM LIMIT
SYCAMORE
SPRINGFIELD
COLERAIN
RECOMMENDED PROJECT
MILL CREEK
MC-3
GREEN
CINCINNATI
DOWNSTREAM LIMIT
OHIO RIVER
SCALE IN MILES
0 1 2 3 4 5
OHIO RIVER BASIN
MILL CR. HAMILTON & BUTLER CO., OHIO
LOCAL FLOOD PROTECTION
GENERAL MAP

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Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
Institute for Water Resources	Unclassified
	2b. GROUP NA

3. REPORT TITLE

Quality of Life and Income Distribution: Objectives for Water Resource Planning

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Report

5. AUTHOR(S) (First name, middle initial, last name)

Michael R. Krouse

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
July 1972	75	66

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
NA	
b. PROJECT NO.	IWR Report 72-4
c. NA	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) None
d.	

10. DISTRIBUTION STATEMENT

This document has been approved for public release and sale, its distribution is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
None	US Army Engineer Instit. for Water Resources 2461 Eisenhower Avenue Alexandria, Va. 22314

13. ABSTRACT

This research was initiated to develop a practical procedure for evaluating and measuring the social well-being objective from water resource projects. As the research proceeded it quickly became apparent that the broad "social" objective with its diverse components did not lend itself to a simple, single indicator measure. As a result, the procedural section deals primarily with measuring income effects which as it turned out became the social effect component which received emphasis in the revised principles and standards.

The income redistribution effects of a project are determined by: 1) allocation benefits to incidence groups. 2) determining incidence group incomes by class. 3) sub-allocating benefits to income class within these groups. 4) determining tax burden by income class and 5) calculating net incidence by income class and valuing it in terms of either marginal utility of income or in terms of income transfer elasticities. This research opts for a modified marginal utility of income approach which compares a project's income redistribution performance with the income effects of all federal expenditures and taxes.

The test of the procedure was applied to an urban flood control project which affects incomes of diverse incidence groups ranging from residential property owners to corporation stockholders. Direct income data was lacking in some cases and broad regional or national income data had to be adapted to the local area. Suggested additional income data which could be gathered at the time of the study survey would increase the accuracy of the incidence estimates.

DD FORM 1 NOV 68 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

Unclassified

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Water Resources Planning Evaluation Process Multiobjective Planning Social Well-Being Objective Income Redistribution Effects Incidence Groups						