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Water Resources Planning and Social Goals: Conceptualization Toward a New Methodology

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WATER RESOURCES PLANNING AND SOCIAL GOALS:
CONCEPTUALIZATION TOWARD A NEW METHODOLOGY

Final Report
Project C-2194

Development of Techniques for Estimating
the Potential of Water Resources Development in
Achieving National and Regional Social Goals

by

The Technical Committee
of
The Water Resources Centers of the Thirteen Western States

for

The Office of Water Resources Research

U. S. Department of the Interior

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WATER RESOURCES PLANNING AND SOCIAL GOALS:
CONCEPTUALIZATION TOWARD A NEW METHODOLOGY

Prepared by the Technical Committee of the Water Resources Centers of the Thirteen Western States as a first year technical completion report for the Office of Water Resources Research funded project C-2194 entitled: Development of Techniques for Estimating the Potential of Water Resources Development in Achieving National and Regional Social Goals.

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SECTION I

CHAPTER I

INTRODUCTION

One would think that water is so essential to living that the goals served by its development would be straightforward and simple. If water is needed to drink, it should be captured and delivered; if lives and property are threatened by floods, protection should be erected. But the world of water is not that simple. Besides serving our basic needs, water developments are important in achieving social aspirations. Over one-hundred years ago, irrigation development was encouraged by public policy in order to settle the West. Navigation has been emphasized for an even longer period as a means of stimulating commerce and regional development; and water is valued for the spiritual uplift which its contemplation in an unspoiled vista can bring.

The linked phenomena of burgeoning development and pollution, the moderating motives of preservation and aesthetics, and the intuitive belief that there is some unique social mobilizing essence in water development have led to public investments in water whose motives and consequences are complex and little understood. Over the past two or three decades, systematic guidelines for evaluating water project proposals have been developed, but these are largely related to predicting effects on economic growth and national income. While explicitly recognized as objectives, no measures for assessing "well being of people" or "preservation" have been explicitly proposed.

Belief in the importance of water resources development coupled with the frustrations of assessing their social consequence led the Directors of the Water Resources Research Centers of the Thirteen Western States in September 1969, to propose research for:

Development of Techniques for Estimating the Potential of Water Resources Development in Achieving Regional and National Social Goals.

This proposal was subsequently funded by the Office of Water Resources Research. The first step in the investigation was an attempt to describe national social goals and to identify water resource connectives. A tentative formulation, which might be dignified by the appellation "social goals model," was devised by an interdisciplinary team representing political science, geography, philosophy, ecology, economics,

and engineering. The purpose of this paper is to lay this first step--conceptualization--and to present a preliminary example, which we call the "Straw Man."

In searching for explicit social goals, the team found the landscape only partially-reconnoitered, not mapped in detail. In the chapters that follow, we lay a background of history, philosophical viewpoints, and assumptions. Then we make a partial statement of planning methodology and describe the "Straw Man" in some detail. We attempt to extend the concept toward a more comprehensive planning methodology for water resources, and we discuss some of the problems recognized as important in achieving the project's objectives.

In Chapter II, a brief but systematic historical statement is offered which lays the groundwork for the Technical Committee's discussions and illustrates the evolution of thought on water resource planning and evaluation in recent years. Chapter III contains a statement of the philosophical premises and suppositions underlying the Technical Committee's proposed planning methodology, along with a discussion of the development of a set of overarching (or prime) goals, which hopefully give some meaning to the phrase "promoting the general welfare." Such a statement of value premises and the initial description of goals formation should provide the reader with the essence of the methodology as well as a record of potential inherent biases in the Technical Committee's thoughts. Chapter IV gives a simplified example of the building blocks supporting the methodology along with a scenario depicting how the planning methodology may and may not be utilized in the future. Chapter V contains a brief description of how both the "Straw Man" and the derivation of sub-goals were undertaken. Chapter VI compares the structure and content of the planning methodology described here with other recently proposed methodologies. Chapter VII contains an introductory statement on how environmental concepts may be interpreted within the "Straw Man" planning process. Chapter VIII offers a brief synopsis indicating future directions of research by the Technical Committee, along with a summary of this document.

Section II presents the complete but highly tentative "Straw Man" developed by the Technical Committee along with explanations of certain inconsistencies, omissions, and structural characteristics.

Congress clearly had in mind when it established flood control as a national, largely non-reimbursable project purpose--is the saving of human life. However, the great weight given by both the Office of Management and Budget (formerly the Bureau of the Budget) and the Congress (1) to a benefit-cost ratio in terms of tangible values (e. g., savings in property damage) and (2) to a ratio of one or greater as the basic criterion of authorization and funding of a water development project, has made all other goals secondary. Regional development per se, that is provision of settlement opportunities or improvement of underdeveloped areas, was a major objective of Congress in passage of the Reclamation Act of 1902 and the Tennessee Valley Act of 1933. But it, too, was made a secondary goal to that of national economic efficiency.

The Green Book was never adopted by the Federal Inter-Agency River Basin Committee or its successor committees. But, the basic philosophy and many of the explicit and implicit criteria and principles of the Green Book were embodied in Budget Circular A-47 issued by the U.S. Bureau of the Budget on December 31, 1952. The most fundamental standards and procedures of the Circular were these:

- (a) The most economical means of meeting needs in a region were to be set forth as an important consideration in reviewing proposed projects.
- (b) The relative economy of alternative means available on a national basis for meeting needs was to be set forth for consideration.
- (c) Benefits and costs, in total and separately for each purpose, were to be set forth. Where benefits and costs could not be estimated in monetary terms, their relative significance was to be stated in as precise and quantitative terms as possible.

Lastly, in the words of the Circular itself:

- (d) While it is recognized that a comparison of estimated benefits with estimated costs does not provide a precise measure of the absolute merits of any particular program or project, one essential criterion in justifying any program or project will, except in unusual cases where adequate justification is presented, be that its estimated benefits to whomsoever they may accrue exceed its estimated costs.

The Green Book called for the application of its criteria and principles within the framework of an agency's particular programs and responsibilities. In contrast, "A-47" called for analyses of proposed water projects by sponsoring departments and agencies in terms of its standards and procedures, with explicit

indications to where legal requirements or official agency views were at variance. The upshot of these standards and procedures was this: a program or project proposed for authorization or funding had to have a benefit-cost ratio greater than one in terms of tangible benefits and tangible costs from a national point of view. By implication, changes would be sought in those laws inconsistent with the standards and procedures of "A-47." Contrary views of departments and agencies would be accepted only in unusual cases that were adequately justified.

The Bureau of the Budget attempted rigorously to apply "A-47" to all projects presented for review in the 1950's. This effort led to great dissatisfaction with "A-47" within Congress beginning in about 1956. Few, if any, in Congress called for abandonment of benefit-cost analysis per se, but there was a widespread call for its liberalization. Specifically suggested changes in evaluation procedures were: change of the period of analysis from 50 to 100 years, recognition of secondary benefits of water projects, treatment of opportunities for enhancement of recreation and fish and wildlife as one of the primary purposes of water projects, and elimination of taxes foregone in costs allocated to public electric power.

"Policies, Standards and Procedures in the Formulation, Evaluation and Review of Plans for Use and Development of Water and Related Land Resources," an interdepartmental agreement approved by the President for application by the Federal departments concerned and the Bureau of the Budget, replaced Budget Bureau Circular A-47 on May 15, 1962. Although it was only a document of the Executive Branch and never approved formally by the Congress, Senator Clinton Anderson, then Chairman of the Senate Committee on Interior and Insular Affairs, saw to publication of the agreement by the Senate on May 29, 1962. In an introductory statement, he indicated the mood of many in Congress at that time:

The new policies and standards, established in an agreement of the four Department heads, replace Budget Bureau Circular A-47 which caused considerable contention, both as to content and as to the propriety of its source.

The publication has become widely known as "Senate Document 97." This appellation has led some to the mistaken belief that the new policies and standards set forth in this document had their origin in the Legislative rather than the Executive Branch.

The basic objective in the formulation of plans, according to Senate Document 97, "is to provide the best use, or combination of uses, of water and related land resources to meet all foreseeable short or long-term needs." In pursuit of this objective, full consideration is to be given to the following multiple objectives and "reasoned choices made

between them when they conflict':

Development - Water and related land resource development and management are taken to be essential to economic development and growth for all the various multiple-purposes including outdoor recreational and fish and wildlife enhancement. (Previously in "A-47," full consideration of outdoor recreation and fish and wildlife had not been given in project formulation with respect to possible specific enhancement measures involving joint facilities and in project analysis through estimation of tangible benefits and allocation of joint as well as separable costs.)

Preservation - Proper stewardship of the Nation's natural beauty is taken to require preservation in "particular instances" of open space; green space; wild areas of rivers, lakes, beaches and mountains; and areas of unique natural beauty or of historical and scientific interest. (To highlight "preservation" as an objective of water and related land "use," as distinct from "development," was new to water planning standards in 1962. This newness occurred despite the fact that conflicts between "development" and "preservation" had erupted in the past, most notably between Gifford Pinchot and John Muir in the Hetch Hetchy controversy involving Yosemite National Park in California in 1913.)

Well-being of people - Hardship and basic needs of particular groups are to be of concern, but development for "the benefit of the few to the disadvantage of the man" is to be avoided. In accord with this objective, socio-economic policy requirements established by the Congress are to be observed (e.g., the 160-acre rule in relation to Federal supply of water for irrigation and "preference clauses" relating to the sale of Federal power to local public and rural electric cooperatives).

Planning, according to Senate Document 97, is to include all relevant means to achieve proposed project objectives and purposes (including non-structural means) singly, in combination, or in "alternative combinations reflecting different basic choice patterns." Comprehensive plans are to be formulated initially to include all units and purposes which satisfy national economic efficiency criteria in terms of tangible benefits and costs. Thus Senate Document 97 clearly provides that optimum plans in terms of criteria of national economic efficiency are to be presented for consideration within the Executive Branch and to Congress. In addition, however, such optimum plans are to provide baselines from which alternative plans reflecting intangible values can be judged (e.g., by determining the developmental benefits foregone if preservation of a scenic river is relevant as an alternative to multiple purpose

development). And, according to Senate Document 97, when major differences arise among technically-possible plans seen as desirable for a river basin on the basis of intangible benefits and costs, in comparison to optimum plans based on tangible benefits and costs, alternative plans expressing these major differences are to be presented for consideration within the Executive Branch and to Congress.

Regional, state, and local points of view or objectives are to be considered as well as national points of view concerning the criterion of national economic efficiency or other national policy. A comparison of differences arising from these various points of view is also to be included in reports.

Finally, Senate Document 97 provides that general and specific judgments are to be made upon comprehensive plans, programs, and project proposals as a basis for recommendation to Congress. Review aimed at arriving at such judgments is to be based upon the provision of Senate Document 97 itself, applicable laws, their legislative intent, Executive policies and orders as well as recognized technical standards. In contrast to "A-47," no requirement is presented that says projects must have a benefit-cost ratio greater than one as a basis for recommendation to Congress. On the other hand, Senate Document 97 did not bar the Bureau of the Budget then, nor does it bar the Office of Management and Budget today, from adopting such a benefit-cost ratio requirement as its own administrative standard. This requirement has been the unwritten rule since promulgation of "Senate Document 97" on May 15, 1962.

In July, 1968, the Water Resources Council^{1/} proposed the amendment of Senate Document 97 to change the formula for determining discount rates used in the calculation of benefits and costs. This proposal precipitated a new Congressional call for liberalization which was supported by various developmental interest groups. This was due to the fact that the formula change would have the immediate effect of raising the discount rate resulting in a lowered benefit-cost ratio and making infeasible many borderline projects that formerly were considered feasible. Initially, in response to Congressional pressure, the Council directed its efforts toward developing specific improvements in analytical procedures for carrying out the policies and objectives that had not been well developed in Senate Document 97. These improvements would help meet certain specific criticisms. At that time, the Council also adopted the new discounting formula. Later, in view of the Council's obligation under Section 103 of the Water Resources Planning Act of 1965 to promulgate

^{1/} The Water Resources Council is a Cabinet-level body that was established in 1965 by the Water Resources Planning Act (Public Law 89-80) to coordinate policies and programs of Federal departments and agencies and to perform related functions.

its own "principles, standards, and procedures," with the approval of the President, the Council enlarged its attention span to this much broader task.

To serve as a basis for public hearings, a report of a Special Task Force of the Council was published in June, 1969, which reflected this broader task. This report came to be known as the "Blue Book." After the hearings, in June, 1970, reports of the Special Task Force on "Principles" and "Standards" for water and land resources planning were made available to the interested public. A third report, "Procedures" for water and land resources planning, is to be developed later. The first two are now known as the "Orange Books."

"The overall purpose of water and land planning," the Special Task Force asserts in the Orange Book on Principles, "is to reflect society's preferences for attainment of the objectives defined below":

- A. "To enhance national economic development by increasing the value of the Nation's output of goods and services and improving national economic efficiency.
- B. "To enhance the quality of environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.
- C. "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; by contributing to the security of life and health; by providing educational, cultural, and recreational opportunities; and by contributing to natural security.
- D. "To enhance regional development through increases in a region's income; increases in employment; and improvements of its economic base, environment, social well-being, and other specified components of the regional objective."

"No one objective," the Special Task Force further asserts, "has any inherently greater claim on water and land use than any other. These Principles do not imply the relative priorities to be assigned among the multi-objectives in plan formulation and evaluation."

In these general statements, the Special Task Force offers its conception of appropriate objectives of water and land resources planning. But it also makes clear its position, here and in subsequently more detailed provisions, that national economic efficiency should no longer be considered the primary objective.

Similar efforts to that of the Special Task Force have been made to identify national goals. Two such contributions are Goals for Americans by the President's Commission on National Goals (1960) and Toward Balanced Growth: Quantity with Quality in the Report of the National Goals Research Staff made public by the White House on July 4, 1970. General statements of national goals formulated independently of water resource objectives are clearly relevant; and, if adequate statements were available, it would have been more logical to go from general objectives to water-related objectives than to have proceeded independently--as was done by the Special Task Force.

Goals for Americans was initiated by President Eisenhower and was identified as "programs for action in the Sixties." It was largely policy-oriented, and confined goal identification to policy areas in the national government. Then it indicated preferred activities to improve the areas of education, economic sciences, technological change, agriculture, living conditions, health and welfare, the building of an open and peaceful world, the defense of the free world, disarmament, and the United Nations. The individual, equality, and the democratic process were also identified as concerns for the political process. The difficulty in using the procedure followed in this report as a model to evaluate resource development projects is the lack of order and completeness. Specific policy areas are defined, but the connection of activities to broad national goals is lacking. In essence, this report starts at the level of actions rather than at the more abstract level of primary goal identification.

Toward Balanced Growth: Quantity with Quality is similar in approach. The overriding issue is President Nixon's policy of "balanced growth" which confines the report to the areas of population growth, technology assessment, consumerism, and economic choice. The restriction to consideration of these areas is intentional in the National Goals Research Staff's effort to handle only those areas in which it has identified a national goal implicit in policy. Motivated by the President's call for the development of a national growth policy, the report covers especially well those areas where tradeoffs and second-order effects within each policy area are vital to the political decision-making process. However, the level of first order national goals is not considered.

A third approach, initiated by the National Planning Association supported by the Ford Foundation, is closely linked with the approach taken here.^{2/} The emphasis is on identifying goal-related activities in an effort to eliminate haphazard activities. However, while indicating the need for validation and assessment of the concepts used in both its analysis and the actual concerns of the people, the report is

^{2/} For an interim report, see "Measuring Possibilities of Social Change" by Nestor E. Terleckyj, in Looking Ahead, a monthly report of the National Planning Association, Vol. 18, No. 6, August, 1970.

primarily concerned with activities that affect goals and tradeoffs between goals. Six goal areas are identified in broad terms: "health and safety; education; skills and income; human habitat; finer things (i. e., environmental quality, leisure and the number of scientists and artists); freedom, justice and harmony; and gross national product." These might be compared to the objective set of nine objectives discussed later in this report.

Professor Harold Laswell in his work, Who Gets What, When, and How, identifies primary values or categories of "preferred events." He identifies eight categories: power, respect, affection, rectitude, well-being, wealth, skill, and enlightenment. The first four are cited as deference values and the final four as welfare values. Laswell's consideration of goals ends with a discussion of each area identified.

A final type of related effort is the identification of social indicators. Not claiming to be an attempt at broad goal identification, the report issued in 1969 by the Department of Health, Education and Welfare,

Toward a Social Report, deals with the identification of social indicators to measure the performance of society in meeting social needs. Social Indicators, edited by Raymond A. Bauer and published in 1966, also focuses on the adequacy of statistical information in decision-making related to social goals.

Not one or a combination of the foregoing general approaches to the treatment of social goals and social indicators presents a comprehensive goals methodology to which this water resources research project could relate. This conclusion, together with detailed examination of the Orange Books, has persuaded the Technical Committee that an applied comprehensive systems oriented approach is desirable strategy for further advance. The Orange Books and the general approaches to social decision-making identified above, as well as others, have brought us a long way. However, further advancement toward the development of a methodology for planning and evaluation of the social consequences of water resource developments appears to be achievable and necessary.

CHAPTER IV

PLANNING METHODOLOGY

The basic structure of hierarchical planning as visualized by the Technical Committee involves four major components: a hierarchical set of goals and sub-goals; a list of social indicators which generally should be quantifiable; a list of policy action variables, each describing some proposed water related governmental action; and a set of connectives. A relatively complete planning methodology as contrasted to present planning will ultimately involve more elements, particularly in the sphere of decision making, than are discussed in this chapter.

In the glossary, the five key words are defined: goal, sub-goal, social indicator, action variable, and connective. No further discussion of the first two is necessary here (see Chapters III and V). But further discussion of the others is necessary.

A social indicator is not necessarily defined according to the connotation of the word "social." Nor is it necessarily a scalar. Consider the case of a commonly used measure of water quality: dissolved oxygen or DO. If it is averaged over time and space, it is a scalar. If it is location specific it is a vector. If it is location specific in one sense and time specific in two senses, e. g., month of the year and point on the tidal cycle, it is a three-dimensional matrix.

An action variable somehow affects a member or members of either the social indicator set or sub-goal set without itself being a member of either set. In certain instances there will be a one-to-one correspondence between the action variable and the social indicator. One partial empirical measure of an irrigation project would be the number employed on the project. However, if those employed could not be employed elsewhere, there would be a one-to-one correspondence between this partial measure of an action variable set and a social indicator, employment. There apparently is no objective dividing line between action variable and social indicator except perhaps that the action variable is always the initial source [sometimes measurable] and the social indicator is a measure of effect.

The action variable may or may not be a "variable" in the usual sense of that word. For example: kilowatt-hours of electrical energy available per year is a variable in the usual sense; a change in electrical energy distribution policy is certainly an action which can be taken but is not usually defined as a variable in the algebraic sense. It is impossible

to define once and for all the limits or domain of the action variable set. The alternative actions that the planner may consider are limited by: administrative policy constraints he considers applicable to the situation; the geographic realities of the area for which actions are being considered; the legal interpretations extant and applicable at the time and place; and his ingenuity.

A connective is the link between: an action variable and a social indicator; two social indicators; or a social indicator and a sub-goal. Connectives have many different forms, but it is impossible to anticipate all of them since it is impossible to anticipate the complete composition of the alternatives which comprise the action variable set. The connective may be simple: if fertilization, cultivation, and irrigation practices are held constant quality, there would be linear relationship between water available and crop production. It may be of a binary nature: if a dam is built and no fish passage facilities are provided there will be no anadromous fish upstream. And a connective may be a mathematical programming routine: the cost of a scheme which has other effects on the social indicator set could be minimized in certain cases by using linear programming.

The three distinct entities to which connectives apply here are the action variable complex, social indicators, and objective sets. In this section an attempt will be made to illustrate how these four components can be integrated so that a potentially useful blueprint for planning emerges. In addition, an extended discussion of the planning process is offered to illustrate how the four synthesized components of planning might be applied under actual future planning conditions.

Basic Structure

The array of goals, sub-goals, social indicators, action variables and connectives constitute both the analytical device and the display mechanism proposed. In Figure 2, the formal structure is depicted. Inspection of Figure 2 should indicate strongly that the connectives define the interdependencies within and between the action variable set, the social indicator set, and the goal set. For the goal set, internal connectives emerge in five directions. These five types of connectives include:

- 1) connectives among the nine overall goals;

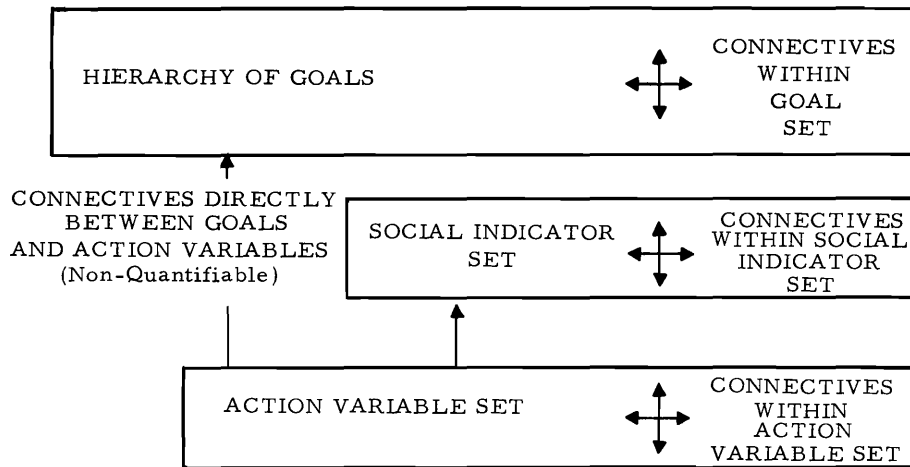


Figure 2.

- 2) connectives among sub-goals within one category;
- 3) connectives among sub-goals in different overarching goal categories;
- 4) connectives among sub-goals and the overall goal of a category;
- 5) connectives among sub-goals in one category and the overarching goal of a second category.

For the social indicator set, internal and external connectives emerge in three ways:

- 1) connectives between social indicators, e. g., the dependence between the rate of unemployment and the rate of inflation;
- 2) connectives between the social indicator set and the policy action variable set, e. g., the construction of a reservoir (policy action variable) influences the availability of water based recreation (social indicator);
- 3) connectives between the social indicator set and the goals set, e. g., availability of water based recreation (social indicator) influences the sub-goal of additional outdoor recreational opportunity.

The action variable set also contains two types of connectives in addition to those listed under social indicators:

- 1) connectives between the policy action variables, e. g., the construction of a reservoir precludes development (or non-development) of a wilderness area at the same location;
- 2) connectives between action variables and objectives directly where there is no mean-

ingful social indicator which defines the extent or domain of the objective. An example would be the effect of preserving a wilderness area (an action variable) on aesthetic appreciation (a sub-objective which apparently will be difficult, if not impossible, to measure by a set of social indicators).

A further step is to illustrate how the four basic components (connectives, objectives, social indicators, and action variables) might fit together. For illustrative purposes, all connectives will be assumed to be linear coefficients although not necessarily quantitatively measurable. We have assumed linearity and continuity for the ensuing discussion, but this does not mean we believe that a planning structure would necessarily have these properties.

Let \vec{G} denote a column vector of overarching (or prime) goals dimensionally $N \times 1$ where N is the number of such goals (nine in our tentative listing). Also, let A denote a matrix of coefficients relating the N overall goals to a set of M sub-objectives with dimensions $N \times M$. Finally, let V signify a column vector of sub-objectives with dimensions $M \times 1$. Then most of the connectives stated earlier between objectives within the objective set either directly (or indirectly) can be stated as:^{3/}

^{3/} Within a quantitative system, direct connectives between the overarching goals or between sub-goals may need to be analyzed separately as multipliers (or in some other way) in order to avoid overdeterminacy. The multiplier approach is basically to establish initial and ultimate changes in each layer of social indicators or goals, where the initial change is stimulated from outside of the particular layer. By proceeding upward layer by layer, the ultimate impact on social indicators and goals can be determined. Of course, such an approach implicitly presumes a hierarchical structure with no downward open-ended feedback.

$$\vec{AV} = \vec{G}.$$

Next, add a C matrix defining the connectives between sub-objectives and an LxL vector of social indicators defined as \vec{H} . Then,

$$\vec{CH} = \vec{V} \quad \text{with C dimensionally MxL.}$$

Finally, add a D matrix defining the connectives between social indicators and a RxL vector of governmental action variables \vec{K} . Then,

$$\vec{DK} = \vec{H} \quad \text{with D dimensionally LxR.}$$

Solving for \vec{G} in terms of \vec{K} , the following matrix system is obtained:

$$[ACD]\vec{K} = \vec{G} \quad \text{with [ACD] dimensionally NxR.}$$

The system yields N linear equations with R+N variables. Specifying the changes in the action variables \vec{K} thus will generally lead to semiquantitative (or purely qualitative if all connectives cannot be empirically measured) estimates of the changes in all overall objectives. Note also that a direct relationship between all sub-objectives and action variables is obtainable:

$$\vec{CH} = \vec{V};$$

$$\vec{H} = C^{-1}\vec{V};$$

$$\vec{DK} = C^{-1}\vec{V};$$

$$C\vec{DK} = \vec{V}$$

What this simple linear coefficient system indicates is that it is potentially feasible to construct a hierarchical model with some degree of consistency.

Hypothetical Example

In order to further clarify the previous discussion on methodology we will trace through a very simple and naive example. Assume that there are only two national objectives of a hypothetical social system called Portlandia. The policymakers of Portlandia have established two overriding objectives: social opportunity and the collective security of its citizenry. In giving social opportunity meaning, the policymakers have decided that the domain of social opportunity is identified by two sub-goals, namely aesthetic opportunity and economic opportunity. Let us momentarily presume that a satisfactory level of collective security has been achieved in Portlandia. But Portlandia policymakers are considering a set of water resource development plans which increase the income of residents and thus affect the system's objectives. In Figure 3, a description of this hypothetical system is presented.

In order to simplify the description even further we will also presume that Portlandia is a linear world,

i. e., all connectives in the social system are expressible by measured or non-measured linear coefficients. The following system of definitions and equations completely specifies the Portlandia world of decision making:

P = National goal of social opportunity.

S = National goal of collective security.

AP = Subordinate of social opportunity described as aesthetic opportunity.

EP = Subordinate of social opportunity described as economic opportunity.

ΔY = The change in income of Portlandia residents.

I = Amount of investment resulting from a particular water resource development plan.

Given the assumption of linear coefficients, although some are assumed to be nonquantifiable a priori, a system of simple equations can be written defining the connectives between subordinate goals and national goals where Δ denotes change in the realization of the goal:

$$a_{11} \Delta AP + a_{12} \Delta EP = \Delta P$$

$$a_{21} \Delta AP + a_{22} \Delta EP = \Delta S$$

As this equation set stipulates, both subordinate goals under social opportunity are expected to influence collective security. For example, if the residents of Portlandia exhibit too much economic opportunity residents from a neighboring social system may be tempted to immigrate illegally. And if Portlandia remains too aesthetically pleasing, camping tourists may turn into squatters.

Next, we want to add the equations specifying the connection between changes in objectives and changes in income of Portlandia's residents and finally between investment in water resources and changes in income:

$$\Delta Y = b_{11} \Delta AP + b_{12} \Delta EP$$

$$\Delta Y = c_1 I$$

While the system of connectives is identified by a set of linear coefficients, it is extremely doubtful that many of these connectives are quantifiable, particularly those between goals. For example, in the goals set, it seems almost ludicrous to presume that the connective between social opportunity per se and economic opportunity could ever be quantified. However, if the linkage can be identified as to sign (i. e., as economic opportunity increases so also does social opportunity), then some very

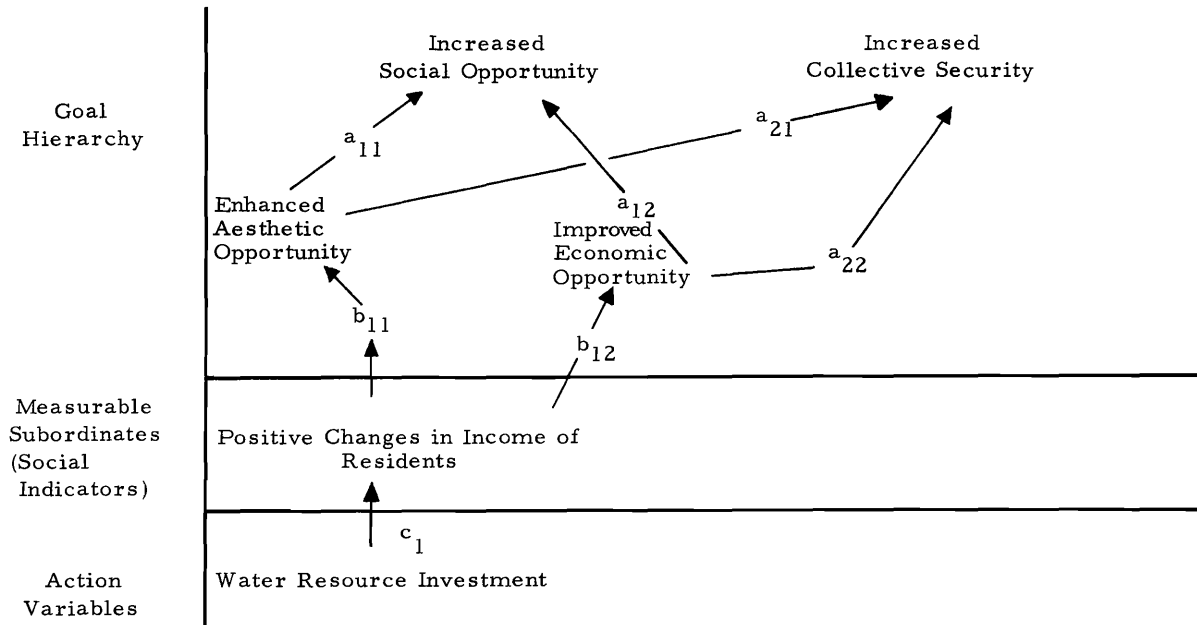


Figure 3.

useful qualitative planning information may be obtainable.

As an example, the signs of the coefficients a_{11} , a_{12} and a_{22} are likely to be positive as are the coefficients c_1 and b_{12} . If b_{11} equaled zero or was positive in sign, then it clearly could be established that a positive change in water resources investment in Portlandia would increase the overall goals of social opportunity and collective security. However, if the sign of b_{11} was negative, the change in realization of national goals may well be either positive or negative. Provided $a_{21} = 0$, even though the sign of b_{11} was negative, it could be asserted that the national goal of collective security is increased although the effect on social opportunity would remain ambiguous. This is true even though the system has fewer equations than variables.

Hopefully, what this extremely naive example illustrates is that it is sometimes possible to document the qualitative effects of water resource planning alternatives on national goals where linkages are not completely quantitatively determined but where signs of linkages are known a priori. Several algorithms have been identified which can be used for determining these effects (in terms of signs) on the goals set.^{4/} But even if a consistent qualitative

effect cannot be identified for some goals, the approach envisioned here would provide information about the reasons for ambiguity. Identification of key signs on linkages leading to ambiguities would also be illuminating for iterative analyses of the preliminary goals set.

Up to this point, we have described a single illustration of the planning structure developed by the Technical Committee. Next, we turn to a rather general discussion of perception of the current planning process and how this structure we specify might be used in the future.

The planning process ideally has three elements: perception of a problem or problems requiring attention; full or partial solutions to those problems; and decision about which, if any, solution to implement. The perception of problem phase may be very particular: flooding may be experienced in a specific area and the residents may request studies of the problem. It may also be very general: a national agency may seek and gain authority to inventory both resource availabilities and the needs for goods and services associated with those resources. Identification of alternative solutions to either kind of perceived problem may be done either on a highly detailed or a generalized basis. A set of sewage treatment plants with specific capacities and specific configurations of treatment units in particular locations is an example of a detailed alternative to a water quality problem. Planners with an engineering background tend to develop this kind of a solution. A

^{4/} See for example, K. Lancaster, "The Solution of Qualitative Comparative Static Problems," Quarterly Journal of Economics, May (1966).

generalized solution to a municipal water supply problem in the southwestern United States might be to modify water rights laws so that market forces could cause the reallocation of water now used in agriculture. Planners with a background in economics tend to present this kind of solution. In a given situation either kind of solution, both kinds of solutions, or neither kind of solution may resolve or ameliorate the perceived problem. A range in numbers of alternatives all the way from several of both of the above kinds to only one of one kind may have been considered in a given situation.

A decision about which, if any, solution to implement is sometimes regarded as a part of the political process and not a part of the planning process. In truth, it is a part of both processes. Robert R. Lee (1964) characterized the planning process this way:

- "1) the objectives of the public works program should be specified by the representatives of the people;
- "2) criteria must be developed to accomplish the objectives;
- "3) the engineers or planners using that criteria develop alternatives for meeting the objectives;
- "4) the decision makers review the alternatives perhaps changing the objectives because of the engineers' analysis;
- "5) the engineer arrives at a least cost solution for attaining the goals finally decided upon by the decision makers."

Lee's characterization implies that the detail planning is done twice (steps 3 and 5). But in fact it may be done many more than two times. In any case, we believe that it is a fair assertion that decisions about implementation are presently closely-linked to the solution development part of the process and are, therefore, a part of planning methodology.

The remainder of the discussion in this section is devoted to: a more detailed characterization of the present planning process; a set of speculations about how that process may be modified using the methodology described elsewhere in this report; an attempt to define those modifications which can probably never be made. It should be realized that the planning process is evolving. The description of the "present" planning process given herein will apply to some agencies better than others. It is really a partial description of both the past and the present.

The motivation for a planning study lies somewhere within limits specified earlier in a dichotomous fashion--a specific location or a general evaluation of a set of problems on a national basis. After some

reasonably clear charge is given to a planning agency or group, a team of professionals is assembled. The team may or may not be multi-disciplinary. The team leader ("project director," "project manager," "program manager," "project engineer," are among the titles used) is almost always an engineer. There may or may not be sub-leaders in the organization of the team. The job of defining the alternatives to be studied almost always falls to the engineers on the team. If other disciplines are involved, they are usually charged with studying the results of specified alternatives on physical or social processes: the fisheries biologist studies the effect of alternative flow regimes on fish populations; the economist estimates the benefits to be realized from supplying irrigation water. This is merely a statement of fact, and not an argument for what should be.

A great many alternative schemes of development and management may be considered at the detailed planning level. Economic efficiency, in the form of benefit-cost analysis, is an ever-present test criterion (which is not to say goal) to which schemes and management alternatives are subjected. The determination of alternatives is very much a rough ground problem. The physical and management alternatives considered will depend on the planning staff's experience and imagination. Many conventional water resources agencies are criticized for not considering either enough different kinds or enough of the same general type of alternatives. Although the first criticism is frequently valid the second almost never is. What is true is that many alternatives are considered but never reported. An evaluation is made at the team leader (or a lower) level concerning which of the alternatives considered is the best or which members of alternative sets are the better ones. This choice is made for two reasons: it is difficult to transcribe all the thoughts that the planning team ever had; designing (choosing) is a professional instinct of the engineering staff. The team leader reports information about the selected plan or plans to his superior. That superior may be dissatisfied with all alternatives or the one presented to him and require the development of new ones; if there are several alternatives he may select one of them for either further presentation to the chain of command or more detailed study. The superior will only infrequently report all the alternatives to his superior. He believes his function is to screen and select. The process may be repeated several times. In the California Department of Water Resources in 1965, seven levels of supervision from program manager to director were identified. Other planning agencies may or may not be as stratified; but some degree of stratification seems inevitable. In addition to the screening function the multiple levels of supervision seem also to have a rewriting function. Their intent may be to make the report clear and concise and to make the planning effort described therein seem to have been well managed. These intentions usually result in the presence of less and less hard information in the report as review processes

CHAPTER V

DERIVATION OF THE GOALS SET OR "STRAW MAN"

Disaggregation Principles

In order to develop a set of prime or overarching goals and sub-goals, the Technical Committee attempted first to identify a group of words generally defining the domain of social welfare. The nine word groups presented in Chapter III were tentatively selected. After much discussion, it was decided that egalitarian principles or equity questions were really considerations of social welfare at the sub-goal level. The reasoning went something like this: equality per se held little meaning unless attached to some other descriptive argument of social welfare. For example, equality in receiving health security offered a definitive goal under health security. Alternatively, if one included equality at the overall goal level, then all other overarching and sub-goals would need to be made sub-goals of the equality category. Consequently, to maintain a non-redundant consistent hierarchy, it was decided to treat equality propositions as sub-goals.

From the two qualities opportunity and security, the Technical Committee derived nine word groups which were not necessarily mutually exclusive. It felt that these adequately defined the domains of security and opportunity. These nine prime goals are listed as follows (not necessarily in order of importance):

- 1) environmental security
- 2) collective security
- 3) individual security
- 4) economic opportunity
- 5) cultural and community opportunity
- 6) aesthetic opportunity
- 7) recreational opportunity
- 8) individual freedom and variety
- 9) educational opportunity

Given this list of nine overarching goals--"the goals set"--the Technical Committee attempted to define each one's domain by identifying word groups which would form the contents of each overarching goal. Of course, such a procedure is fraught with subjectivity and the possibility of serious omissions. This procedure is obviously analogous to developing an outline.

Following the tentative listing of sub-goals, further disaggregations were made to identify each sub-goal's domain. The basis of these successive disaggregations was a) logical subordination and

b) completeness. At first, the Committee attempted to disaggregate as completely as possible. But very soon it became apparent that complete disaggregations would involve massive stratification of sub-goals. It was also found, as successive disaggregations were undertaken, the degree of arbitrariness in both strata and word group categories increased to a point exceeding human comprehension.

An alternative tack was taken which rested on the two following principles. The first was to disaggregate each goal until the emergence of a readily measurable subordinate or social indicator (or group of social indicators) which could be assumed to be closely associated with the last disaggregated sub-goal. The second was to stop disaggregating whenever there appeared to be practically no connection between the sub-goal set being disaggregated and public or private water resource activities. Of course, it can be asserted that water resource decisions both influence and are influenced by all social and private policy decision. In this case, the second principle introduces an error in disaggregation; hopefully, though, this error induced by omission will be relatively small.

In certain instances, disaggregation led to sub-goals which are clearly influenced by water policy plans but which have no well-defined social indicator(s). This was particularly true in the aesthetic opportunity and individual freedom and variety disaggregations. These cases will, by necessity, require only qualitative analysis and evaluation, unless meaningful quantitative indices are obtained in describing their domain.

A tentative list of social indicators was developed by applying the first principle, and these are listed in Table I along with the goal and sub-goal from which they were derived. It should be noted that each word group denoted as a social indicator may in fact have many different dimensions, e. g., per capita income may be divided into either regional income components or ethnic categories.

After developing a preliminary listing of disaggregated goals, the Technical Committee tried several classical water resource policy decisions and developments to see if the preliminary goals-set, or "Straw Man" as it became known, captured all identifiable facets of these cases. In the process, the "Straw Man" was modified for completeness. A final attempt at completeness and logical

Table 1. Selected listing of goals, sub-goals, and disaggregated national level social indicators by goal category.

Goal	Sub-goal	Partial Listing of Social Indicators
COLLECTIVE SECURITY	Internal Security	Revolutionary activities Mob violence Subversive activities Individual or isolated acts of violence Community cohesiveness Requirements for communication systems Internal transportation systems
	External Security	Role of water resources in defensive capabilities Electric power generation Alliances and international agreements Intelligence activities
	Health Security	Detection of health hazards Treatment of diseases and other health hazards Dissemination of health information Prevention of diseases
ENVIRONMENTAL SECURITY	Improvement in Air Quality	Concentrations of oxides of sulfur Concentrations of oxides of carbon Concentrations of ozone and PAN Concentrations of various hydrocarbons fly ash, particulate matter
	Improvement in Water Quality	Biochemical oxygen demand Enteroplucations products Suspended solids Alkaline liquids Thermal discharges
	Flora and Fauna	Variety of types Extent of types

Table 1. Continued.

Goal	Sub-goal	Partial Listing of Social Indicators
	Geographic Environmental Security	Extent of groundwater mining Climatic variation and temperature Rate of occurrence of earthquakes
INDIVIDUAL SECURITY	Security from Physical Violence	Criminal physical violence Accidental physical violence Intentional, non-criminal physical violence
	Security from Economic Violence	Extent of criminal economic violence Extent of accidental economic violence Intentional, non-criminal economic violence
	Security from Psychological Violence	Threats by authorities Threats by insurgent groups Threats by individuals
ECONOMIC OPPORTUNITY	Freedom of Contract	Employment and service contracts Contracts involving delivery and transfer of goods
	Investment Opportunity	Amount of public investment Investment opportunity created Energy use investment opportunity created Recreation investment opportunities Opportunity to invest in goods handling Investment in reducing effluent produced by industry Land available for investment
	Equality of Economic Opportunity	Government contract provisions Number of government employees Number of government contracts awarded by competitive bidding Number of people (or corporations) which have opportunity to invest

Table 1. Continued.

Goal	Sub-goal	Partial Listing of Social Indicators
ECONOMIC OPPORTUNITY CONT'D	Economic Choice by Consumers	Variety and price of foods Variety and location of housing Kinds of appliances usable Recreational services available Cultural services available Current personal income and interest rates
	Choice by Producers	Energy availability Assimilative capacity available "Free Market" capital and credit Subsidized capital and credit
	Standard of Living	Per capita income levels Distribution of income Stability of income Price stability Services and goods required to survive Rate of economic expansion
CULTURAL AND COMMUNITY OPPORTUNITY	Enjoyment of Amenities (Arts and Nature)	Transportation capabilities (location of and accessibility to the arts and nature)
	Preservation and Restoration of Areas of Natural Beauty	Number of areas of natural beauty
	Creativity	Number of areas of natural beauty
	Community Cooperation	Number of community projects
	Diversity of Cultural and Community Opportunity	Community size and population dispersion

Table 1. Continued.

Goal	Sub-goal	Partial Listing of Social Indicators
AESTHETIC OPPORTUNITY	Equality in Cultural and Community Opportunity	Participation levels Participation costs Transportation capabilities
	Aesthetic Enclosures	Location and accessibility Structure Public hearings Government research programs involved
	Aesthetic Developed Areas -- Areas in Various Stages of Development (Metropolitan, Agricultural, etc.)	Buildings Facilities Dams Waterways Costal facilities Erosion control Urbanization Storm drains Wastewater collection Air pollution Water pollution Pollution of soil mantle
	Natural Areas	Location and accessibility Amount of public interest Complementarity to natural surroundings Undeveloped areas - potential Developed areas - potential Undeveloped areas - damaged Capacity of routes Quality of routes Admission of public Routes for automobiles and other mechanized transport Trails for hiking Scenic stops Environmental pollution control Sanitation facilities Maintenance Types and quality (of wildlife and vegetation)

Table 1. Continued.

Goal	Sub-goal	Partial Listing of Social Indicators
	Equality of Aesthetic Opportunity	Distribution of government investments
RECREATIONAL OPPORTUNITY	Access-Availability	Population density and location Number of recreational opportunities Transportation facilities between recreations
	Quality	Water quality
	Equality of Recreational Opportunity	Participation levels Participation costs
	Variety	Numbers and categories of recreational alternatives
INDIVIDUAL FREEDOM AND VARIETY	Freedom of Choice	Existence of alternatives Communications systems
	Freedom of Movement	Availability of various modes of transportation Individual income
	Freedom of Expression	Legal guarantees and limitations Size of audience Communications systems
	Individual Opportunity for Accomplishment	Individual abilities and talent Individual resources Artificial barriers Education and training

Table 1. Continued.

Goal	Sub-goal	Partial Listing of Social Indicators
EDUCATIONAL OPPORTUNITY	Quality in Education	Degree of attainment or performance: Excellence in educational facilities Excellence in educational programs Excellence in research facilities Excellence in research programs
	Variety in Education	Degree of attainment or performance: Variety of educational facilities Variety of educational programs Variety of research facilities Variety of research programs
	Availability of Opportunity to Pursue Education	Degree of attainment or performance: Enhancement of income available for education Enhancement of income available for research Proximity of educational facilities to users Availability of transportation to educational facilities
	Equality of Educational Opportunity	Degree of attainment or performance: Enhancement of individual capacities to offer social contributions Equitable distribution of financial aid to students Tax-based differentials to enhance dispersion of income available for students Tax-based differentials to enhance dispersion of income available for researchers

subordination was tried by independently reworking each category of sub-goals. The Technical Committee does not view the "Straw Man" as it now stands as either a finished or an even ultimately finishable product because of changes in goals and social institutions. However, after continuous reworking, we anticipate that the "Straw Man" will have a reasonable amount of stability and applicability. The preliminary goals-set or "Straw Man" is presented in Section II.

Perhaps a diagram can illuminate most clearly the methodological underpinnings of the "Straw Man's" construction. In a methodological sense, it is assumed there are a small number of word groups which generally define the overall goals of society. Further defining the domain of these goals requires an ever-widening-and-deepening process of identifying layers of sub-goals. At some point, which is not necessarily equal for each goal, many sub-goals become identifiable by measurable subordinates or social indicators. The domain of social indicators is assumed to be measurable by quantifiable variables. The quantification may only be of a semi-quantitative type, i. e., ordinal in character.

Weaknesses of the Disaggregation Approach

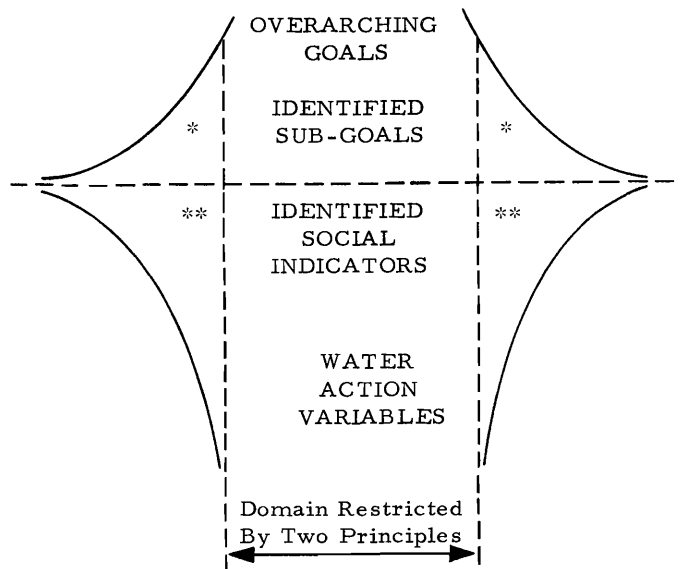
The disaggregation approach taken here has several major weaknesses which are partially illustrated in Figure 4. Essentially, the application of the two principles adopted to expedite the process of disaggregation had the effect of narrowing or compressing the domains of both the set of sub-goals and the set of social indicators. First, there may be water planning actions which affect social indicators not identified by the process of disaggregation of sub-goals; there also may be unidentified connectives between the identified social indicators and sub-goals. This problem results from the decision to apply the first principle described earlier to reduce the number of sub-goal categories and layers. This problem could be partially resolved by repeated testing with a variety of water resources projects commencing with the action variables and working up through the hierarchy,^{5/} although the potential for error will always continue to exist.

A second, related problem arises from looking only at those social indicators which emerge from the disaggregation process itself. This problem can partially be compensated for by comparisons between the list of social indicators resulting from the "Straw Man" and other lists of social indicators. Such comparisons have been undertaken on a limited basis.

Numerical Coding of the Goals Set

A numerical coding system was developed so that, at a later stage, the complete goals set could

^{5/} [Editor's Note] For additional commentary on this point, see the comments by William Lord in Appendix II.



*Domain of sub-goals not identified by disaggregation process.

**Domain of social indicators not identified by disaggregation process.

Figure 4.

easily be placed in a storage and retrieval system for computer analysis. The overarching goals are each numbered with one numeral followed by a period. A sub-goal is identified by a numeral denoting the category of the prime goal in which the sub-goal is logically subordinate, and by a numeral identifying the sub-goal. Thus, the first sub-goal under the first prime goal carries the numerical connotation 1.1., and the second sub-goal is indicated by 1.2. Letting X's denote the numerals:

- X. prime goal
- X.X. sub-goal
- X.X.X. social indicator or measurable subordinate
- X.X.X.X. action variable

This system was sufficient in most cases for coding the structure of disaggregations. In certain instances, however, there were more or fewer categories of sub-goals and social indicators than specified above. In these cases, other modifications were utilized. A numeral in parentheses denotes an added layer of sub-goals or social indicators, and a zero indicates a missing or empty layer of sub-goals or social indicators. An (X) following X.X., i. e., X.X.(X)., denotes the addition of a sub-sub-goal layer. Similarly, X.X.0. denotes that there is no social indicator layer.

As an example of this coding system, take the listing of the goals set for the numeral one and assume

there are five additional sub-goal layers before one reaches the social indicator numbered 78 and action variable 2. For this case, the numerical coding system identifies the action variable as:

1. 1. (1). (1). (1). (1). (1). 78. 2.

and the last sub-goal as:

1. 1. (1). (1). (1). (1). (1).

Alternatively, if the listing of the goals set for the numeral two does not contain a sub-goal set, the social indicator 4 related to the second overarching goal would be identified as:

2. 0. 4.

Example of a Disaggregated
Goals Set

In order to clarify the disaggregation process developed by the Technical Committee, an example of disaggregation is briefly described here. The example is much more inclusive and extended than its counterpart which is specified in the "Straw Man" described in Section II under the overarching goal environmental security.

- | | |
|--------------------------|---|
| 2. | Increased environmental security |
| 2.1. | Improvement in air quality |
| 2.1.(1). | Changes in gaseous concentrations |
| 2.1.(1).1. | Change in concentrations of sulfur oxides (nation-wide index) |
| 2.1.(1).1.(1). | Regional index of changes in sulfur oxides |
| 2.1.(1).1.(1).(1). | Measured effect of construction of steam electric generation plant on local and thereby regional indices of sulfur oxides |
| 2.1.(1).1.(1).(1).(1). | Measured effect of construction at alternative sites within region |
| 2.1.(1).1.(1).(1).(1).1. | Effects of alternative water resources plans on location possibilities for steam electric generation plant. |

Quite obviously, this is an extreme narrow ribbon of cause-effect between local water resource plans to concentrations of sulfur oxides and ultimately to environmental security. Clearly, measurement of the relationship between 2.1.(1).1.(1).(1).1 (the action variable) and 2.1.(1).1 (the national social

indicator) is possible, and perhaps even achievable at a reasonable cost. However, because of aggregation and many components in the definitional domain of improved air quality it is impossible to conceive of measurements between 2. 1. (1). 1 (the national social indicator) and 2. (the overarching goal). However, reasonable qualitative relationships by sign can be subjectively established. If sulfur oxides concentrations increased nationally, then it could be supposed that air quality had deteriorated. Consequently, a negative sign between changes in 2.1.(1) or 2. 1. (1). 1. (1) would appear defensible. Likewise, improvement in air quality, would by definition generally imply an improvement in environmental security. Thus, if the structure is transitive, a positive change in 2. 1. (1). 1 would imply a negative, but unmeasured, change in environmental security.

Given the methodological structure which is obvious upon reflection, this example also underscores most of the inherent problems in disaggregation.

Definitional problems associated with timing, locational, and other aspects of the social indicators are not clearly specified, even in the preceding disaggregation. The index number or series of index numbers specifying changes in sulfur oxide concentrations must connote not only average but also peak concentrations and length of exposure. Thus, each social indicator can be viewed as a vector of more specific social indicators giving content to the initial one. But with greater precision in the set of social indicators comes greater ambiguity in the signs of the relationships between those indicators and sub-goals. This problem can be resolved potentially in two ways. First, a set of weights could be established to relate the specific social indicators to their more general counterparts. For example, if weights (explicit) were established on the basis of health statistics indicating the trade-off between length of exposure, peak concentration, and average concentrations, these weights would resolve the possible problem of incongruity in signs. This is so since with transitivity, only a single sign need be specified between the sub-goal of improved air quality and a weighted index of sulfur oxide.

A second approach would relate each of the specific social indicators to the sub-goal set through signs, and then enumerate the impacts and possible incongruities induced by different signs. Both approaches will undoubtedly be used when the planning methodology is implemented since weights may exist in certain instances, but not in others.

In order to identify important direct and cross connectives or linkages between social indicators, action variables, and sub-goals, two tables were constructed with a partial list of these entities on the axes. (See Tables 2 and 3 which follow.) Of course, these linkages are not known at this time, but during the second year of research the Technical Committee anticipates measurement of many of these linkages. Efforts will be concentrated on the connectives between local and national social indicators and on connectives among national social indicators.

TABLE 3
CONNECTIONS BETWEEN
SUB OBJECTIVES AND SOCIAL
INDICATORS

SUB OBJECTIVES **SOCIAL INDICATORS**

1	INTERNAL SECURITY	XXXXXXXXXX	REVOLUTIONARY ACTIVITIES	
2	EXTERNAL SECURITY	XXXXXXXXXX	MOB VIOLENCE	
3	ENVIRONMENTAL SECURITY	XXXXXXXXXX	SUBVERSIVE ACTIVITIES	
4	HEALTH SECURITY	XXXXXXXXXX	ISOLATED ACTS OF VIOLENCE	
5	SECURITY FROM PHYSICAL VIOLENCE	XXXXXXXXXX	COMMUNITY COHESIVENESS	
6	SECURITY FROM ECONOMIC VIOLENCE	XXXXXXXXXX	INTERNAL COMMUNICATION	
7	SECURITY FROM PSYCHOLOGICAL VIOLENCE	XXXXXXXXXX	INTERNAL TRANSPORTATION	
8	FREEDOM OF CONTRACT	XXXXXXXXXX	DEFENSE CAPABILITY	
9	INVESTMENT OPPORTUNITY	XXXXXXXXXX	INTERNATIONAL ALLIANCES AND AGREEMENTS	
10	ECONOMIC CHOICE FOR CONSUMERS	XXXXXXXXXX	INTELLIGENCE	
11	" " PRODUCERS	XXXXXXXXXX	DAMAGE FROM NATURAL DISASTERS	
12	STANDARD OF LIVING	XXXXXXXXXX	DAMAGE TO THE ENVIRONMENT	
13	EMPLOYMENT OF ARTS AND NATURE	XXXXXXXXXX	CONTAMINATION OF THE ENVIRONMENT	
14	CREATIVITY	XXXXXXXXXX	DETECTION OF HEALTH HAZARDS	
15	COMMUNITY COOPERATION	XXXXXXXXXX	TREATMENT OF DISEASE	
16	DIVERSITY IN CULTURAL OPPORTUNITY	XXXXXXXXXX	HEALTH INFORMATION	
17	CULTURAL EQUALITY	XXXXXXXXXX	EPIDEMICS AND OTHER HEALTH HAZARDS	
18	SOLITUDE	XXXXXXXXXX	DISEASE PREVENTION	
19	EMPLOYMENT OF NATURE	XXXXXXXXXX	CRIMINAL PHYSICAL VIOLENCE	
20	EMPLOYMENT OF ARTS	XXXXXXXXXX	VIOLENCE CAUSED BY FLOODS	
21	EQUALITY IN AESTHETIC OPPORTUNITY	XXXXXXXXXX	" " " POWER FAILURES	
22	EMPLOYMENT OF DESIGN	XXXXXXXXXX	" " " WATER SUPPLY FAILURES	
23	ACCESS TO RECREATION OPPORTUNITIES	XXXXXXXXXX	" " " TRANSPORTATION FAILURES	
24	QUALITY OF RECREATION OPPORTUNITIES	XXXXXXXXXX	INTENTIONAL NON-CRIMINAL PHYSICAL VIOLENCE	
25	EQUALITY OF RECREATION OPPORTUNITIES	XXXXXXXXXX	CRIMINAL ECONOMIC VIOLENCE	
26	VARIETY OF RECREATION OPPORTUNITIES	XXXXXXXXXX	PROPERTY DAMAGE CAUSED BY FLOODS	
27	FREEDOM OF CHOICE	XXXXXXXXXX	" " " POWER FAILURES	
28	FREEDOM OF MOVEMENT	XXXXXXXXXX	" " " WATER SUPPLY FAILURES	
29	FREEDOM OF EXPRESSION	XXXXXXXXXX	" " " TRANSPORTATION FAILURES	
30	INDIVIDUAL OPPORTUNITY FOR ACCOMPLISHMENT	XXXXXXXXXX	INTENTIONAL NON-CRIMINAL PROPERTY DAMAGE	
31	ACCESS TO EDUCATIONAL ALTERNATIVES	XXXXXXXXXX	THREATS BY AUTHORITIES	
32	EXCELLENCE OF EDUCATION	XXXXXXXXXX	THREATS BY INSURGENT GROUPS	
33	EQUALITY IN EDUCATION	XXXXXXXXXX	THREATS BY INDIVIDUALS	
34	VARIETY IN EDUCATION	XXXXXXXXXX	ABILITY OF FIRMS TO EMPLOY	
35			ABILITY OF INDIVIDUALS TO BE EMPLOYED	
36			NATURE OF CONTRACTS FOR SERVICES	
37			" " " TANGIBLE GOODS AND ASSETS	
38			" " " FINANCIAL ASSETS	
39			INDIVIDUALS' ACCESS TO INVESTMENT	
40			DEGREE OF EQUALITY IN INVESTMENT OPPORTUNITY	
41			AVAILABILITY OF VARIOUS GOODS	
42			PER CAPITA INCOME	
43			INDIVIDUALS' EXPECTED FUTURE INCOME	
44			NUMBER OF FIRMS GOING INTO AND OUT OF BUSINESS	
45			WHAT GOODS ARE PRODUCED	
46			AVAILABILITY OF INPUTS	
47			TYPE OF PRODUCTION TECHNOLOGY	
48			AMOUNT OF OUTPUT	
49			QUALITY OF OUTPUT	
50			DISTRIBUTION OF PRODUCT	
51			INVESTMENT BY PRODUCERS	
52			LOCATION OF PRODUCTION FACILITIES	
53			DISTRIBUTION OF INCOME	
54			CHANGE IN PER CAPITA INCOME	
55			STABILITY OF PER CAPITA INCOME	
56			ACCESSIBILITY OF ARTS	
57			" " " NATURE	
58			PRESERVATION OF NATURAL BEAUTY	
59			RESTORATION OF NATURAL BEAUTY	
60			AIR POLLUTION	
61			WATER POLLUTION	
62			COMMUNITY SIZE	
63			POPULATION DENSITY	
64			EXISTENCE OF REMOTE AREAS	
65			PRESERVATION OF REMOTE AREAS	
66			TRANSPORTATION TO REMOTE AREAS	
67			" " " AREAS OF NATURAL BEAUTY	
68			ARTISTIC ACTIVITY	
69			APPEARANCE OF STRUCTURES	
70			LOCATION OF STRUCTURES	
71			USE OF SPACE IN STRUCTURES	
72			DENSITY OF STRUCTURES	
73			NUMBER OF PARKS AND OPEN SPACES	
74			LANDSCAPING	
75			DESIGN OF TRANSPORTATION SYSTEMS	
76			DISTANCE FROM POPULATED CENTERS TO RECREATION AREAS	
77			POPULATION SIZE IN A REGION	
78			NUMBER OF RECREATION OPPORTUNITIES	
79			TRANSPORTATION TO RECREATION FACILITIES	
80			TYPES OF RECREATION OPPORTUNITY	
81			EXISTENCE OF ALTERNATIVES	
82			AVAILABILITY OF INFORMATION	
83			ABILITY TO SELECT CHOICE CRITERION	
84			NUMBER OF MODES OF TRANSPORTATION	
85			LEGAL GUARANTEES	
86			LEGAL LIMITATIONS	
87			INDIVIDUAL ABILITY	
88			INDIVIDUAL RESOURCES	
89			ARTIFICIAL BARRIERS TO INDIVIDUALS	
90			EDUCATION AND TRAINING	
91			NUMBER OF STUDENTS	
92			REGIONAL INCOME	
93			LOCATION OF SCHOOLS	
94			TRANSPORTATION TO SCHOOLS	
95			INSTITUTIONAL REQUIREMENTS	
96			RESEARCH FUNDS	
97			RESEARCH ASSISTANTS	
98			RESEARCH GRANTS	
99			EMPLOYMENT	
100			RATE OF INFLATION	

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

CHAPTER VI
INTRODUCTORY COMPARISON OF THE METHODOLOGY
WITH OTHER APPROACHES

A cursory examination of relevant literature dealing with goals on an abstract level has been given in Chapter II. This literature is highlighted by the work of Harold Laswell. He identified eight "values" or "preferred events" which include power, respect, affection, rectitude, well-being, wealth, skill, and enlightenment. These are acted upon in the social process, which he indicated is comprehensible as man's striving for values through institutions which determine the utilization and management of resources.

Only four of the eight values (well-being, wealth, skill, and enlightenment) are identified as welfare values and seem more receptive to effect by public activity. The other four (power, respect, affection, and rectitude) are deference values and seem individually rather than publicly or societally oriented.

While offering a beginning effort to identify national goals, Laswell ends with only a very general overview. The identified goal set of the Technical Committee--"The Straw Man"--incorporates Laswell's "values" at several levels with both welfare values (identifiable at the primary and sub-goal strata) and deference values (implied within activities undertaken to promote individual freedom and variety).

More recently, there has been widespread recognition of the need to identify social goals in order to initiate more effective national planning procedures. Several authorities decry the absence of any well-defined goal identification, and some offer rudimentary beginnings.

One significant article, by Lyle C. Fitch, President of the Institute of Public Administration, is found in Environment and Policy: The Next Fifty Years. In this article, entitled "National Development and National Policy," Mr. Fitch offers an exploratory, but not definitive, agenda focusing on two broad goals and several supporting sub-goals. One of his broad goals, the eradication of poverty, encompasses "equipping individuals with the essentials of productivity--good health, aspiration and incentive, life-long opportunities for education and training, jobs for everyone who wishes to work."

Environmental improvement, a second major goal, "includes all the things that need to be done to make urban (and rural) areas most efficient, convenient, and aesthetically pleasing." Sub-goals

include a variety of ways of life and opportunities to choose among them: elimination of aggression (criminal and environmental); maintenance of central cities as vital and health centers of knowledge and culture, management and commerce, and residence for city-lovers; and planned metropolitan development outside central cities with population and activities grouped in urban sub-centers designed for efficiency and aesthetic appeal.

While Mr. Fitch's work is one of the more detailed considerations of the need to identify and utilize a comprehensive list of social goals in the development of national planning, he only begins to lay the groundwork. He gives priorities neither between the two major goals, nor among the sub-goals. He only makes a plea for immediate attention to the areas listed.

The "Straw Man" does not attempt to establish priorities; however, the hierarchical structure allows subsequent weighting by the policy-maker as he attempts to evaluate alternative programs. A comparison of Mr. Fitch's goal "agenda" and the "Straw Man" demonstrates one basic difference: there is an increased resolution of disaggregation from the broad goal areas through social indicators to action variables found within the "Straw Man." Fitch's agenda moves directly from two broad goals to policy action variables leaving out the sub-goal and social indicator strata.

Other efforts by individuals attempting to outline basic societal goals include a brief statement by Joel Bernstein, Assistant Administrator of Technical Assistance for AID. He outlines the "principal needs of people everywhere." Their well-being includes productive employment, health, and psychological adjustment, all of which Mr. Bernstein regards as basic goals of developmental activity ("Fundamental Goals of Development," Washington, D. C., 1970).

Within each of the areas are additional sub-goals. Sub-goals under productive employment provide for food, shelter, clothing, etc., and generate community income to finance services such as education, sanitation, and public safety. Considerations within health include a strong resistance to environmental conditions such as disease agents, ignorance, and insecurity as well as the reduction and elimination of such conditions. The objective

of psychological adjustment includes a sense of security, equity, or propriety of events. It also includes the feeling that one has adequate opportunities to participate in decision-making matters that determine his own and his family's future, as well as opportunities for himself and his family to improve their positions in society.

Mr. Bernstein also identifies intermediate goals, or means of achieving the three fundamental needs of people. These include improving education, accelerating GNP growth, improving income distribution, and broadening human participation in society's activities.

Falling short of a usable tool for national planning, this list is, again, only an indication of where research might lead. It is basically policy-oriented in that values implicit in current national policy are accepted as "goals." Growth is suggested as an intermediate goal while, in fact, it is merely a means or tool to achieve goals. This becomes increasingly evident as scholars begin to suggest that to save the environment society may be forced to accept a "no-growth" future.

In addition to efforts of individual scholars, researchers, and administrators officialdom has made some attempts toward social reporting. These were briefly mentioned in Chapter II. Goals for Americans was the result of the work initiated by President Eisenhower. Administered by the American Assembly, Columbia University, the report was completed in November, 1960. The Chairman of the Commission was Henry M. Wriston, who, at that time, was President of the Assembly.

The Commission made an evaluation of the conditions of American societal conditions and then proposed policies. The basis of their goal identification follows the previously-mentioned procedure of national goals being defined by policy areas already in existence.

The goals identified in this study include the "individual," with emphasis on the preservation of freedoms and equality in the civil rights tradition. The following were given equal standing as major goals rather than sub-goals in the attainment of equality and individual freedoms; the democratic process, emphasizing the strengthening of governmental institutions; public service and federalism; proposals for improving education, arts, and sciences; a democratic and growing economy; technological change; agriculture; living conditions; and health and welfare. Also noted in the report were the goals in foreign relations; to help build an open and peaceful world; to defend the free world; to pursue disarmament; and to strengthen the United Nations. Thus, because government deals with these objectives as policy areas in national government, they become "the" goals of Americans. To

quantify or give relative weights in a trade-off situation is not attempted.

A second report, initiated by the Johnson administration in 1966, is not truly in the arena of attempts to identify national goals. Its explicit purpose was to develop a system of social reporting. It was written under the co-chairmanship of Daniel Bell and Alice M. Rivlin. Submitted in January, 1969, the report, entitled Toward a Social Report, was identified by the Commission as a "preliminary" step toward the evolution of a regular system of social reporting.

Rather than dealing with policy formulation, as in the earlier report, or with social goals, this report is largely a study of the conditions at that time. It does offer a discussion of the elementary problems (the identification of conditions and goals) that must be dealt with in any attempt at social reporting.

The most recent effort to identify goals is the report of President Nixon's National Goals Research Staff. This report, Toward Balanced Growth: Quantity with Quality, identified several goal areas. The "goal" areas (including population growth and distribution, environment, education, basic natural science, technology assessment, consumerism and economic choice, and balanced growth) are broader than in the earlier Goals for Americans. Still, as the introduction indicates, the report has not considered all areas. The pervading theme of the report is President Nixon's objective of balanced growth.

The skillful handling of each policy area is demonstrated in the recognition of second-order effects and trade-offs, but again, policy alternatives, and not goals, are the subjects of discussion.

The areas discussed are identifiable in the "Straw Man," and they are primarily within the level of social indicators. The "Straw Man," however, does not imply that an increase in the quantity of all relevant, measurable social phenomena (social indicators) is equated with "good" as is made explicit in the policy oriented "goal" listing of Goals for Americans and Toward Balanced Growth: Quantity with Quality.

A separate approach toward goal identification initiated by the National Planning Association and funded through the private auspices of the Ford Foundation was also previously mentioned. The emphasis of this work is the identification of goal-related activities in order to eliminate haphazard efforts. However, while indicating the need for validation and assessment of the concepts used in the analysis and identification of the actual concerns of people, the report is primarily concerned with activities that affect goals and trade-offs between goals. Six goal areas are identified: health and safety; education skills and income; human habitat;

finer things; leisure and production; and freedom, justice, and harmony. This study stresses the need of still further work on the identification of a complete list of goals. In relation to the "Straw Man," this study could develop into a valuable asset which attempts to quantify social indicators and identify the progress of connectives.

The field of water resources research, in its search for improved evaluation techniques, also seeks to identify intangible social benefits derived from resource development projects. In addition to political aspects of budget allocations, there has been an increasing awareness that the public sector of the economy demands project evaluation beyond basic economic efficiency criteria. It is evident that future evaluations must encompass all of society's goals.

One of the first indications that broad social considerations were to become increasingly relevant to project evaluations was Senate Document 97, published May 29, 1962. It has been outlined in detail in Chapter II and relates to the "Straw Man" as an impetus to the development of the regional social goals project. An extension of Senate Document 97 has been the efforts of the Water Resources Council and associated task forces.

Amplification of the need to study national goals was witnessed in a report to the Water Resources Council by the Special Task Force, published by the Water Resources Council, June, 1969, and referred to as the "Blue Book." The report contends that the "evaluation of benefits and costs within the . . . report requires a recognition of definite goals and the appraisal of alternative measures and combinations of measures to achieve them."

The effect of any proposed program on multiple objectives prompted the Special Task Force to attempt a broad delineation of the most visible national goals. The "Blue Book" outlines four national goals: the national income objective, which measures the nation's output as the aggregate earnings of labor and property which arise from current and future production; the regional development objective, which includes increased regional income, increased regional employment, an improved regional economic base, and improved distribution within the region; the environmental objective, which includes conservation, preservation, creation, and/or restoration of national scenic and cultural resources to enhance or maintain the quality of the environment; and the well-being objective, which includes security of life, health, national defense, personal income distribution, and inter-regional employment and population distribution for the individual and community.

This further attempt to establish a broad outline of national goals brings into focus an additional problem: once these goals are verbalized, a measurement base must be created for "objectives that are not directly translatable to income changes as measured

by values of goods and services or whose value cannot fully be mirrored in such a change." A new system for national objective accounts is proposed where "all national objectives are to be stated in quantitative terms to the extent possible, but not necessarily in national income terms." This system of national accounts would add validity to the choices among objectives or alternative means to achieve objectives.

The outline of the initial Task Force report was expanded in a subsequent document published by the Task Force of July, 1970. This document, entitled Standards for Planning Water and Land Resources, reasserts the four basic objectives of enhancing 1) national economic development, 2) the quality of the environment, 3) social well-being, and 4) regional development. However, in this document, new elements for consideration are pinpointed within each of the broad areas. In addition to the measurement of the nation's output, the objective of improving national economic efficiency is subsumed under national economic development. The quality of the environment is broadened to include management or improvement of ecological systems, as well as the earlier identified areas of conservation, preservation, creation, restoration, and/or improvement of national and cultural resources. In addition to security of life and health, national security, equitable distribution of real income, employment, and population, the objective of enhancing social well-being is expanded to include educational, cultural, and recreational opportunities for persons or groups affected by the consequences of any plan.

Principles for Planning Water and Land Resources recognizes the truism that "plans for the use of water and land resources will have benefits and costs that affect more than one of the multi objectives." The benefits (positive beneficial contributions) under each broad goal can be outlined and followed by costs (negative or adverse effects). The creation of appropriate measurement devices would assure that plan evaluations would at least attempt to recognize the entire paradigm of society's goals. Thus, national economic efficiency would no longer be considered the primary objective.

While present procedure and standards still place basic emphasis in actual practice on national and regional economic development, the "Orange Book" provides in detail for the examination of environmental well-being objectives and stresses equality. Regional development is examined separately but within the same analytical framework as national development. Environmental well-being and equality objectives are analyzed both regionally and nationally. Environmental considerations include ecological systems as well as preservation and restoration or improvement of national and cultural resources. Social well-being includes educational, cultural, and recreational opportunities as well as economic security, population distribution, and individual and national security.

One difference between the "Orange Book" and the "Straw Man" approach is in the hierarchical arrangement of their objectives. In the latter case, a set of nine social goals is identified which might be considered to be "extrinsic value elements" related to the large abstract human goal. In this goal set, economic opportunity is located alongside the other eight. There is no implied ranking in terms of location in the hierarchical structure. While there is some difference in basic approach, the "Straw Man" is not an alternate method to the "Orange Book." Rather, the Technical Committee hopes that it may eventually replace the "Orange Book" water resource planning methodology.

In the "Straw Man," the hierarchical arrangement proceeds from goal to sub-goal sets to social indicators and then to action variables. In the "Orange Book," this hierarchical arrangement is not clear. Goals and indicators are implicitly at the same level. The "Straw Man" includes essentially the same exhaustive set of goal elements--of primary or secondary order--that are implied or stated in the "Orange Book."

Regional analysis is neither implicit nor explicit in the "Straw Man." A separate regional accumulation could be read out of the "Straw Man" if regional information is desired.

The arrangement of the "Straw Man" should permit a much more rigorous approach to the problem of interaction. It promises a greater level of resolution than any present comprehensive planning methodology known to the Committee members. The hope is to provide specific information about a large number of sub-objectives in a systematic way--quantized if possible, but at least specified according to sign. The planning methodology's hierarchical arrangement should be capable of displaying information at several

levels of resolution in chosen categories upon interrogation responding to the interrogator's specific needs.

In Table 3, the disaggregation of the "Orange Book" and the "Straw Man" are listed in comparative form, to illustrate the potential informational content of the "Straw Man" arrangement. The "Orange Book" goals are divided into the content indicated by the Task Force of the Water Resources Council. Where there are parallel considerations to be found in the "Straw Man," they are listed by number and phraseology. In many instances, similar goals or sub-goals are considered. However, the "Orange Book" consistently deals with the action variable level and moves directly from top level objectives, without logical subordination, into social indicator levels. For example, "water investment programs to expand economic opportunity" is directly under the concept "achieve desirable population dispersal (urban-rural balance)" of social well-being. If social well-being is a top level objective, the achievement of a desirable population dispersal, although phrased as though indicating action, could be defined as a sub-goal. From there, the disaggregation proceeds directly to an action variable "water investment programs." An additional step, social indicators, is added in the "Straw Man." It is at this level that quantization can potentially be made to enhance the possibilities of objectively considering alternatives and evaluating the project through the use of computer modeling.

The great importance of studying alternatives was emphasized by the National Academy of Sciences' report Alternatives in Water Management. Analysis of alternatives can be made under the "Straw Man" approach as well as under that of the "Orange Book" and its predecessors. But with a systematic, quantized modeling approach, the information produced about alternatives should be more substantial.

Table 3. A comparison of the disaggregation of the "Orange Book" and the "Straw Man."

Objective	Orange Book	Straw Man	
	Disaggregation	Number	Descriptive Phase
National Economic Development	Government development plans to increase nation's output of goods and services -National product and income accounts (GNP) -Improve market conditions -Investment to increase resource input productivity -Availability of public goods	4. 6. 6. (1). 4. 4. 4. 4. (1). 8. 1. 1.	Promote growth in GNP Increase economic choice of consumers Increase choice among services Increase existence of alternatives
	-Resource development for increased crop yields -Resource development for increased recreational use	4. 2. 4. 4. 4. (2). 1. (1). 7. 1. 2. 1.	Increase opportunities of recreational investment Development of recreation facilities Water policy action variables which will affect the number of recreational opportunities
	-Resource development for increased power	3.2.2.(2).(1).1.(1). 4.2.3.(1).1. 4. 5. (1). 1. 1.	Government water resource investment related to hydro-electric generation systems Government investment in hydro-electric facilities Investment in hydro-electric power
	-Resource development for increased water supplies	2.1.2.1. (1).(1).(1). 4.4.(1).1.(1).1. 4.5.(1).4.(1).	Increase water available for irrigation Activities to increase and/or improve irrigation projects Increased irrigation water available
	Government investment to improve national economic efficiency -External gains to non-users of output of resource development plan -Increased use of unemployed or underemployed resources	4.4.4.(1).(1).	Increased amounts of water made available to enhance potential productivity of new investment
Social Well-Being	Increase in real income of disadvantaged persons or groups -Family or per capita income -Equitable distribution of income Achieve desirable population dispersal (urban-rural balance)	4. 6. 2. (1). 1. 4. 6. 1. 4. 6. 2. 4. 4. (2). 2. 2. (1).	Welfare decisions to increase income through income distribution Increase in per capita income levels Improve distribution of income Optimize size of metropolitan areas

Table 3. Continued.

Orange Book		Straw Man	
Objective	Disaggregation	Number	Descriptive Phase
		5. 5. 1.	Activities to achieve optimum community size and population dispersion
	-Noise level		
	-Congestion		
	-Crime	3. 2. 1.	Reduce extent of criminal economic violence
	-Housing	4. 4. (1). 2.	Promote variety and improve location aspects of housing
	-Physical and mental health	3. 3.	Insure security from psychological violence
	-Education	9. 1. (1).	Excellence in educational facilities
	-Open spaces	7. 1. 2.	Increase number of recreational opportunities
	-Environmental deterioration	6. 2. (4).	Reduction of environmental pollution
	-Distribute population	5. 5. 1. 1.	Water policy action variable which will affect community size and population dispersion
	-Distribute employment opportunities	8. 4. 3. 1.	Promote equal employment opportunity legislation
	-Water investment programs to provide goods and services	4. 4.	Increase economic choice by consumers
		4. 6. 5.	Make services and goods required to survive available
		8. 1. 1. 1.	Water policy action variable which increases alternative goods
	-Water investment programs to expand economic opportunity	4.2.2.(1).(1).	Water made available to create investment opportunities
	Improve conditions contributory to attainment of economic stability		
	-Rate of capital accumulation	4. 5. (2).	Increase capital and credit available
	-Advances in technology		
	-Steady growth-relative full-employment economy		
	-Flow of goods and services	4. 1. 2.	Contracts involving delivery and transfer of goods
	-Stabilized price levels	4. 6. 4.	Increase of price stability
	-Absence of cyclical fluctuation	4. 6. 4. (1).	Reduce fluctuations in future market prices
	-Accommodation of weather abnormalities and erratic short-term occurrences	4.6.3.(1).(1).	Reduce degree of risk due to natural occurrences
	-Public investments in conservation of resources to attain economic growth and stability		
	-Public investment in development of resources to attain economic growth and stability	4.2.2.(1).(1).	Water made available to increase the potential productivity of new investment

Table 3. Continued.

Orange Book		Straw Man	
Objective	Disaggregation	Number	Descriptive Phase
	-Public investment in use of resource to attain economic growth and stability	1.	Collective security
	Enhance security of life	1. 1.	Increase internal security
		1. 2.	Increase external security
		1. 2. (1).	Responsive, flexible, and varied defensive security
		3.	Increase individual security
	-Reduce risks of floods	3. 1. 2. (1).	Reduce probability of damage due to floods
		4. 6. 3. (1). (1). (1).	Increase of flood protection
	-Formulation of flood control measures	3. 1. 2. (1). 1.	More effective government measures to control floods
		3. 2. 2. (1). (1). 1.	Water policy action variable to increase flood control
	-Reduce risks of droughts	3. 1. 2. (2). (2).	Reduce water supply failures
		4. 6. 3. (1). (1). (2).	Increase drought protection
	-Reduce risks of other disasters		
	-Minimize health and safety hazards	1. 2. (1). 1. (2).	Increase supplies of fresh water
		2. 2.	Improve water quality
		1. 4.	Increase health security
		1. 4. 1.	Increase activity to detect health hazards
		1. 4. 3.	Promote the dissemination of health information
		1. 4. 4.	Prevention of diseases
	-Water development meeting or exceeding sanitation standards on watercourses and reservoirs	2. 3. (1). 1. (1). 1.	Increase and/or improve treatment facilities provided
		2. 3. (1). 3. (1). 1.	Waste treatment and disposal action to reduce spread of diseases
		2. 3. (2). 1. 1.	Treatment capacity provided to reduce dissolved or suspended solids
		2. 3. (3). 2. (1). 1.	Improved drainage to prevent impoundments (acids, alkaline liquid)
	-Water development to provide a wide year-round choice of foods	1. 1. 7. (1).	Improve internal waterway systems
		1. 3. (4). 2. (1). 1.	Policies to preserve the variety and types of flora
		4. 4. (1). 1.	Increase variety and reduce price of foods
	Enhance educational, cultural, recreational opportunities	4. 4. (2). 2.	Increase cultural services available
		5.	Cultural and community opportunity
	Enhance educational, cultural, recreational opportunities cont'd	8. 4. 4. 1.	Improve government education and training programs
		9. 2. (2). 1. 1.	Water policy action variable to increase the variety of educational programs

Table 3. Continued.

Orange Book		Straw Man	
Objective	Disaggregation	Number	Descriptive Phase
	-Improved community services		
	-Better schools	9. 1. (1). 1. 1.	Water policy action variable to promote excellence in educational facilities
		9. 1. (2). 1. 1.	Water policy action variable to promote excellence in educational programs
	-More cultural, recreational opportunities	5. 1. (1). 1.	Transportation capabilities to affect location and thereby increasing accessibility of the arts and nature
		5. 6. 3.	Transportation capabilities to create equality in cultural and community opportunity
		7. 1. 2. 1.	Water policy action variable to increase the number of recreational opportunities
		7. 4. 1. 1.	Water policy action variable to increase the numbers and categories of recreational alternatives
	Improve national security	1.	Collective security
		1. 1.	Increase internal security
		1. 2.	Increase external security
	-Provide reserve capabilities of water resource system outputs	1. 2. (1).	Responsive, flexible and varied defensive capabilities
		1. 2. (1). (1).	Role of water resources in increasing defensive capabilities
		1. 2. (1). (1). 1.	Increase electric power generation
		1. 2. (1). 1. (2).	Increase supply of fresh water
	-Protect against interruption of flow of essential goods and services	1. 1. (6). 0. 1.	Government water resource investments to provide requirements for communication systems
		1. 1. 7. (1).	Improve internal waterway systems
		1. 2. (1). 1.	Role of water resources of increase defensive capabilities
		2.1.2.(2).(3).1.	Government navigation systems investments to increase defensive capabilities
Environmental Quality		2.	Environmental security
	Management of areas of natural beauty and human enjoyment (open and green space, wild and scenic rivers, lakes, beaches, shores, mountains and wilderness areas, and estuaries)	5. 2. 1. 1.	Water policy action variable to preserve and restore areas of natural beauty
		6. 3. (1). 1. 1.	Development of areas of natural beauty

Table 3. Continued.

Objective	Orange Book	Straw Man	
	Disaggregation	Number	Descriptive Phase
Regional Development	Protection of areas of natural beauty and human enjoyment	5. 2. 1. 1.	Water policy action variable to preserve and restore areas of natural beauty
		6. 3. (1).	Development of natural areas
	Enhancement of areas of natural beauty and human enjoyment	6. 3. (1). 1.	Enhancement of natural beauty
	Management of especially valuable or outstanding archaeological, historical, biological and geological resources and selected ecological systems	6. 3. (1). (2). 6. 3. (4). 1. (1).	Preservation of natural beauty Protection to promote the existence of wildlife and vegetation
	Enhancement of especially valuable or outstanding archaeological, historical, biological and geological resources and selected ecological systems		
	Enhancement of water, land and air by control of pollution	2. 1. 2. 2. 6. 3. (3). 1.	Improvement of air quality Improvement of land quality Increase environmental pollution control
		6. 2. (4). 2. 6. 2. (4). 3. 6. 2. (4).	Reduce water pollution Reduce pollution of soil mantles Reduction of environmental pollution
		6. 2. (4). 1.	Reduce air pollution
	Prevention of erosion	2. 2. (2). 1. 1. 2. 2. (2). 1. 2. 6. 2. (2). 4.	Land management practices to reduce erosion Flood protection provisions to reduce erosion Increased erosion control
	Restoration of eroded areas for economic use		
	Development plans with minimum of irreversible environment change		
	Increase in regional income		
	-Value of increased outputs to users residing in region		
	-Value of output in region from external economies		
	-Value of output in region from use of resources otherwise unemployed or underemployed		
	-Net income accruing to region from construction or implementation of plan		
	-Net income accruing to region from economic activities induced by operation of the plan		
	Increase in regional employment	4.1.1.(2).1.	Water policy action variable to reduce regional unemployment
-Base population	5. 5. 1.	Activities to achieve optimum community size and population dispersion	

Table 3. Continued.

Objective	Orange Book Disaggregation	Number	Straw Man Descriptive Phase
		7. 1. 1	Optimization of community size and location
	-Viable economic community	4.	Economic opportunity
	-Viable social community	1. 1. (4).	Promote community cohesiveness
		5. 4.	Promote community cooperation
	Regional economic stability	4. 6. 3.	Promote stability of income
		4. 6. 4.	Increased price stability
	-Flexible, responsive economic posture		
	-Able to withstand changing composition of economy because of technology		
	-Able to withstand changing composition of economy because of changes in production		
	-Investment in water and land resources to broaden economic base	4. 2. 2.	Investment opportunity created
	Enhancement of environmental and social well-being conditions of the region	2.	Environmental security
		4.	Economic opportunity
		5.	Cultural and community opportunity
		6. 2. (2).	Promotion of regional aesthetic considerations
		7.	Recreational opportunity
		8.	Individual freedom and variety
		9.	Educational opportunity
	-Water-land resources plan to contribute to economic and social well-being objectives of the region.*		

*The concept of social well-being is so broad as to encompass virtually all of the "Straw Man" objectives under opportunity. Thus, specification of nearly all of the social indicators in the "Straw Man" would be required to indicate the impact on the social well-being of a region stemming from water resources plans. Repetitive listing was not included.

CHAPTER VII

THE ENVIRONMENTAL SPHERE AND THE STRAW MAN: SOME GENERAL OBSERVATIONS

The terms environment and ecology are rapidly becoming household words. Scientists are talking about the "Environmental Revolution." Politicians are wont to speak of the 1970's as the "Decade of the Environment." Project planners look at "Environmental Quality." Industry is attempting to produce such products as bio-degradable detergents and lead-free gasoline. In short, the concern for environment has become what may be described as a national crusade.

What, then, are we speaking of when we use the term "environment"? A review of recent literature brings to light some revealing statements. Consider a comment in Special Task Force Report to the Water Resources Council (1970). This Task Force has the charge of evaluating the principles for planning water and land resources as they relate to the defined objectives of national income efficiency, environmental quality, social well-being and regional development.

They state:

A major criticism of the Task Force report was that it does not provide an adequate definition of environment or environmental quality. The lack of definitions or uniform interpretations of what constitutes environmental quality has led to disagreements as to what environmental objectives, gains, and losses should be included in the environmental account.

Along these same lines, a conclusion drawn in the First Annual Report of the Council of Environmental Quality (1970) states in part:

The major portion of this report has dealt separately with interrelated environmental problems, but only because of the inadequacy of our current framework for considering the environment and the need to focus attention on particular problem areas.

Similarly, a statement contained in "One Third of the Nations Lands," a report to the President and to Congress by the Public Land Law Review Commission (1970) states:

The National Environmental Policy Act does not define the term "environment," nor is it defined in any other Federal statute, although there are many of them that are addressed to environmental matters. We think that clarifications of the term would be desirable as a general principle, and would be particularly appropriate in setting forth the environmental factors to be considered in Federal land use planning.

From the preceding comments, it is clear that there is no common consensus about the concepts and components inherent in the term "environment."

The Technical Committee has identified a primary goal of environmental security. Thus, we are faced with the crucial task of defining what this goal means, and then of integrating environmental concepts into the methodology. Any functional definition must include the identification of the components of, relationships between components of, and specification of measures of environmental security.

Integrating "Environment" into the Methodology

The term environment conjures up for most people a concept which pertains to the ties between natural resources and living organisms. Ecosystems, oil pollution, biospheres, endangered species all somehow intuitively fit into the picture. The study of these complex interrelationships and problems has traditionally come under the heading of ecology. How then should ecological concepts fit into the framework we are structuring with our "Straw Man"?

The question for consideration is--can a comprehensive disaggregation be formulated that would identify the essential relationships between the physical and biological aspects of the environment? Such a disaggregation would enable project planners to identify factors of the physical/biological environment that must be considered. If a decision is made that the project may produce significant environmental effects, the question of how and to what degree the environment will be influenced can then be researched.

A logical place to start structuring a physical/biological framework is with principles inherent in Shelford's "law" of tolerance:

The presence and success or failure of an organism depends upon the completeness of a complex of conditions. The occurrence of an organism can be controlled by the qualitative and/or quantitative deficiency or excess with respect to any one of several factors which may approach the limits of tolerance for that organism.

This "law" contains two basic concepts that are very pertinent to the hypothesis that environmental security is of primary concern in the goal set. First, there are minimum requirements of certain elements in the physical/biological environment essential to the survival and well being of any organism. Second, an excess of certain elements in the physical/biological environment may have severe or fatal consequences. This is particularly relevant in light of today's pollution problems.

Building from the tolerance limit concept, a next logical step is to identify and incorporate into the "Straw Man" concept essential biogeochemical cycles. Chemical elements, including all those essential for living organisms, circulate in the biosphere in characteristic paths from the physical/biological environment to organisms and back to the environment. These more or less circular patterns are also known as "inorganic - organic cycles," a good example of which is the nitrogen cycle. Nitrogen continuously enters the air by the action of denitrifying bacteria, and continuously returns to the cycle through the action of nitrogen-fixing bacteria, blue-green algae and electrification. By delineating the relationships between organisms and such factors as amino-acids, ammonia, nitrites, nitrates, and nitrogen gas, we can ask if any step of the cycle would be affected by a particular water resources project.

From these basic cycles, other aspects important to environmental security, such as fundamental concepts related to energy in the ecosystem, could be incorporated into the "Straw Man" and the "connectives" and "action variables" identified. In this way a significant contribution might be made toward structuring a uniform framework for assessing the increasingly-critical problem of establishing a "sustainable relationship of Man in Nature."

The Nitrogen Cycle

Let us look in more detail at the nitrogen cycle to demonstrate the potential for utilizing the "Straw Man" concept to structure a functional definition of "environment." Odum (1959) has illustrated how nitrogen cycles from inorganic to organic and back again (Figure 5). Although there are many complex biochemical processes involved in various aspects of the cycle, each major segment of the cycle and

relationships between segments can be clearly delineated. Equally important, the potential exists to measure and quantify many of the cycle's components. Atmospheric nitrogen can, for example, be measured precisely, as can the rate of industrial fixation and the amount of nitrogen tied up in protoplasmic organic compounds. Considerable knowledge is also available about the action of various bacteria in the cycle under varying ecological conditions.

Therefore, using the terminology of the Technical Committee's methodology, there is a "connective" (or relationship) between nitrates and nitrites. The amount of nitrate present in a given situation can be described as a "social indicator," i. e., something that can be socially significant. All other segments of the cycle can also be linked and described in terms of connectives, action variables, and social indicators.

Method of Analysis

Utilizing the concepts inherent in the "Straw Man" technique, the nitrogen cycle can be related to the much broader spectrum of the physical/biological environment. A number of action variables can be identified that directly influence the cycle (Table 4). Many quantifiable social indicators may be developed that relate to the nitrogen cycle. As an example, a brief listing of social indicators is also given in Table 1.

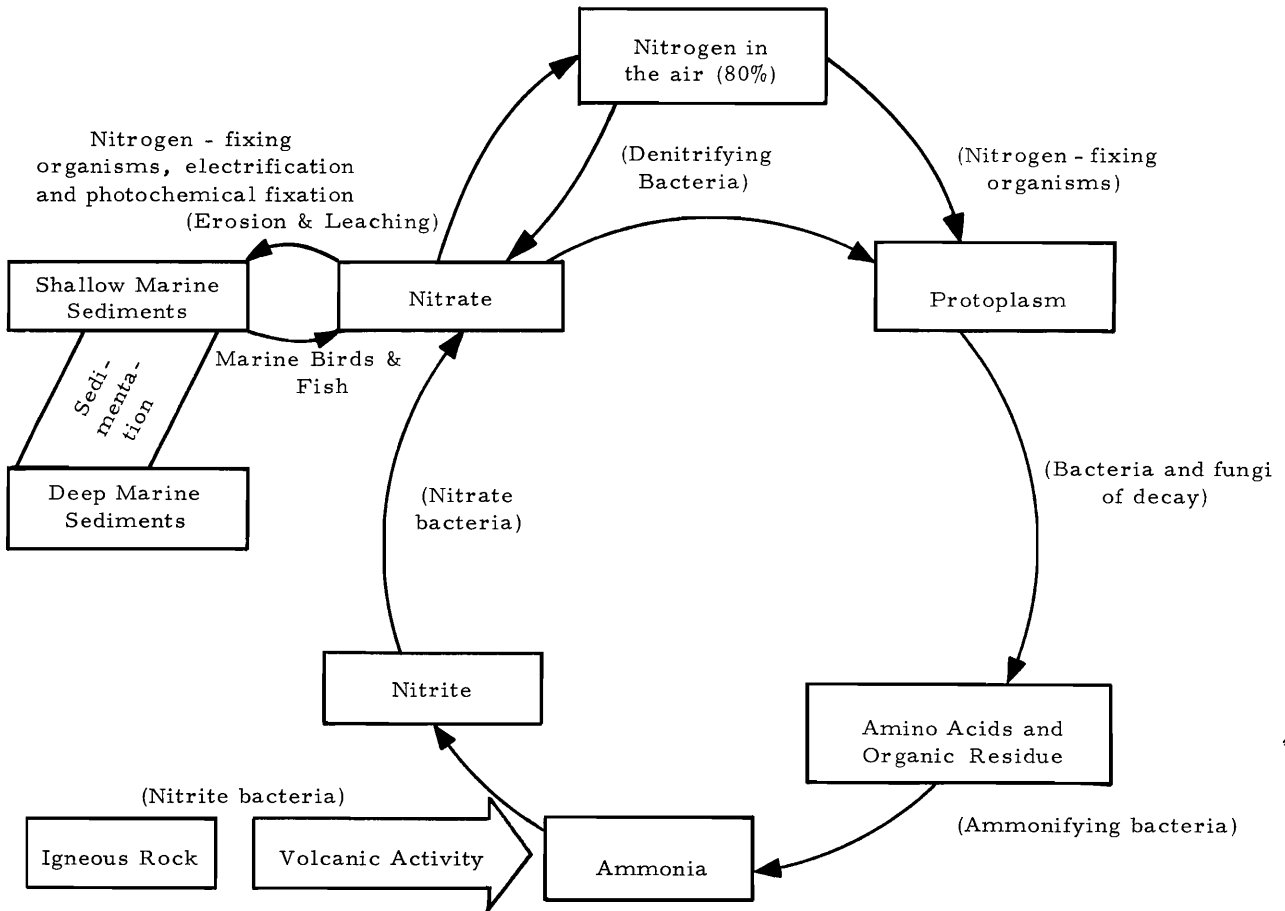
An inquiry system organized along taxonomic principles can readily be structured relating biogeochemical cycles to the environment, and thereby, the environment in physical terms to the "Straw Man."

There are direct linkages between the nitrogen cycle and the organic/inorganic cycles of oxygen, sulphur, carbon, and phosphorus to name a few. By expanding this analytical procedure and identifying the cycles and the interrelationships between cycles of all important chemical elements essential to life, we potentially can structure a logical framework for considering the physical/biological environment. Specific disaggregations of such parameters as pollutants, energy relationships, and species number and abundance can be readily integrated into the system.

There is, conceptually at least, a logical basis for relating the physical/biological environment to the total environment. Table 5 illustrates how biogeochemical disaggregations might be related to the other social goal disaggregations. Again using nitrogen as an example, the cycle is related to the present "Straw Man." Only a few of the possible action variables and social goals are listed, and connectives are not specified except by arrows.

A Basis for Structuring a Functional Definition of "Environment"

If we define a set of social goals such as "collective security," "economic opportunity," or



adapted from Odum, E. P. (1959), *Fundamentals of Ecology*. Second edition, W. B. Saunders, Co., Philadelphia.

Figure 5. Nitrogen cycle.

"aesthetic opportunity," we take the first step in identifying (disaggregating) some of the major components inherent in, and which helped delineate, the concept of environmental security. By disaggregating these goals and delineating important interrelationships, we identify significant environmental influences. If we make this "Straw Man" comprehensive enough, we provide the framework for considering the final step in responding to the need made evident by the "Orange Book" disaggregations on Table 3.

To put it somewhat crudely, the final version of the "Straw Man" can be looked upon as a comprehensive "check list" identifying those factors that should be considered in the decision-making process. The disaggregation could thus become, in a very real sense, a basic step toward a functional definition of environment, a concept whose inherent components we have delineated.

Numerous research institutions and federal and state agencies are presently involved in monitoring

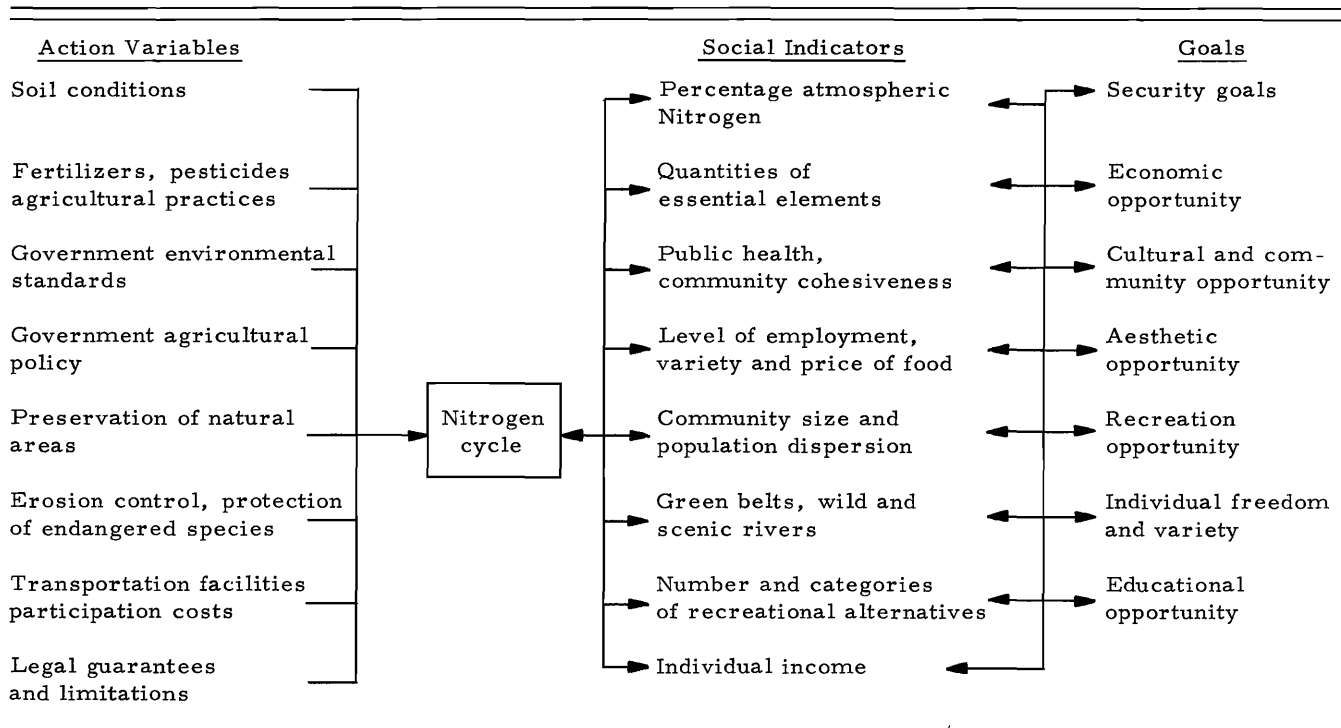
quality aspects of the physical/biological environment. Although the Council on Environmental Quality intends to develop a system for monitoring the nation's environment (which would tie these efforts together), no systematic method exists at present for measuring either the environment's condition or its rate of change.

Establishing a system to monitor environmental quality, however, requires an operational definition of environmental quality itself. Our physical/biological disaggregations can provide such a functional definition. To start with, the basic biogeochemical cycles and their interrelationships will have been identified. This will provide a framework for base line data to be obtained and could readily lead to a system whereby trends in the critical cycles, such as nitrogen, carbon, basic minerals, and energy, can be monitored. Other environmental features including trophic levels and species numbers and abundance can be tied into the monitoring system.

Table 4. Preliminary list of action variables and social indicators which relate to the nitrogen cycle.

Action Variables	Social Indicators
Sedimentation induced by man	Air Pollutants
Erosion & leaching induced by man	Gaseous
Bacterial action induced by man	CO
Decay	NO
Ammonifying	NO ₂
Nitrite	SO ₂
Nitrate	CO ₂
Denitrifying	Ozone
	Other Hydrocarbons
	Toxic Pesticides
	Particulates
	Radionuclides
	SR. 90
	Noise
	Aeroallergens
	Pollen

Table 5. Relationship of the nitrogen cycle to the social goal set.



CHAPTER VIII

SUMMARY AND FUTURE DIRECTIONS

Introduction

That a people or a nation will utilize its natural resources to bring a measure of fruition to its goals is an implicit concept of organized society. But the relationships among resource uses and particular goals become extremely complex and even devious within relatively simple social systems. Indeed, overarching goals of great nations are articulated only in the most general and abstract terms. Water and water-related development in the United States is an advanced and important example of resource utilization for desired social achievement. A significant portion of our annual national capital/expenditure is allocated to this purpose, and the list of anticipated social gains is a long one.

The operational objective of this research project, simply stated, is to advance the rationale for relating water use actions to social goals. We have explored the territory lying between goals on one hand and water use actions on the other. What we propose is essentially a "general welfare" model, but one adapted to be particularly responsive to water use actions. While our use of the appellation "general welfare" may dangerously imply that we believe we now fully understand society's aspirations and the means by which these are achieved, such is not, by any means, the case. The appellation means only that we have found our rationale within the domain of "general welfare." Ours is clearly a crude exploratory venture. The Technical Committee of the Thirteen Western States Water Resources Research Centers, who formulated the model, are most aware of the model's shortcomings.

In broader terms our objective is to narrow the great gap which exists between the definition of national goals on one hand, and the implementation of action programs to achieve such goals on the other. We believe our methodology, if it accomplishes its operational objective, will do this in a general informational sense by definition. Beyond that, and just as importantly, there are two arenas of application of the common goal-oriented methodology which we propose to bridge the definition-implementation gap: 1) its use by field planners, within whatever policy constraints they may find imposed upon them and, 2) its use in policy analysis and reformation.

Basis for a New Methodology

Our model, which at this point is only in its conceptual stage, consists of a hierarchical array of

general-goals described in words, one or more layers or sub-goals contained within those goals (or "next-above-layer sub-goals") and "social indicators" linking lowest-level sub-goals to water action "variables." The primary goals set consists of 1) Collective Security, 2) Environmental Security, 3) Individual Security, 4) Economic Opportunity, 5) Cultural and Community Opportunity, 6) Aesthetic Opportunity, 7) Recreational Opportunity, 8) Individual Freedom and Variety, and 9) Educational Opportunity. A large number of sub-goals (107 at the present stage of development) that satisfied our criteria for inclusion under the prime set were identified; these are listed in the tentative array (called the "Straw Man") in Appendix I. Each element is numerically coded so that the hierarchical category is apparent. The following example which is described in Chapter V, will illustrate sub-goals, social indicators and action variables as well as the numerical coding system.

- 2. Increased environmental security
 - 2.1. Improvement in air quality
 - 2.1.(1). Changes in gaseous concentrations
 - 2.1.(1).1. Change in concentrations of sulfur oxides (nation-wide index)
 - 2.1.(1).1.(1). Regional index of changes in sulfur oxides
 - 2.1.(1).1.(1).(1). Measured effect of construction of steam electric generation plant on local and thereby regional
 - 2.1.(1).1.(1).(1).1. Effects of alternative water resource plans on location possibilities for steam electric generation plant

Numbers in parentheses indicate additional layers of sub-goals or social indicators; thus 2.1.(1) is a sub-sub-goal, 2.1.(1).1.(1).(1) is a third-level social indicator and 2.1.(1).1.(1).(1).1 is a first-level action variable.

The primary goal universe could be described in an unlimited number of ways. We wanted to be certain that our descriptive word set was comprehensive, that each goal and its implied value were warranted on the basis of past social developments, that each appeared to represent a major object of present social aspirations, and that each warranted some degree of confidence in its estimated continuation as an ideal aspiration for our society's future. Comprehensiveness was not sought in the lesser

sub-goal sets where the search ended when no further water-connected action could be imagined. An extensive listing--albeit partial one--of identified social indicators and related sub-goals and goals has been made. For example, one such thread runs:

Goal	Sub-Goal	Social Indicators
Economic Opportunity	Standard of Living	Per capita income levels Distribution of income Stability of income Price stability Services and goods required to survive

The present array lists a total of 264 social indicators.

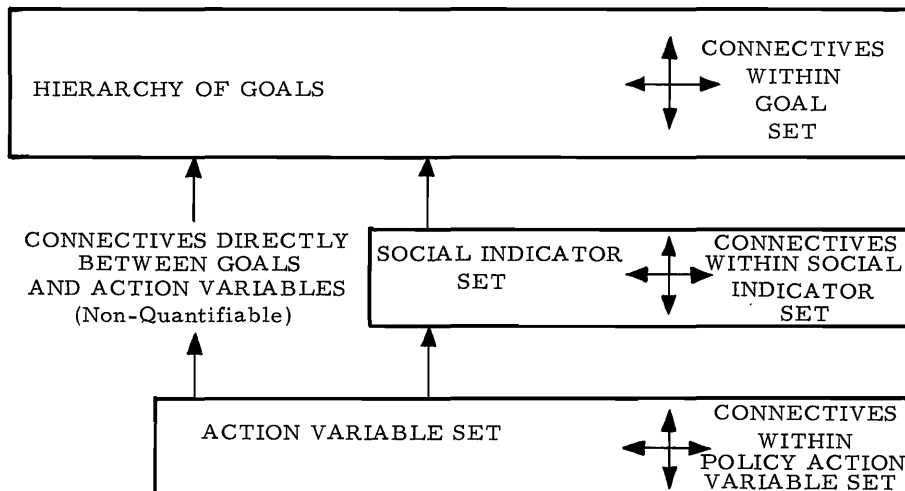
Connectives could be imagined among all elements of any hierarchical level or between any two levels. Diagrammatically, then, the conceptual arrangement of goals, social indicators, action variables and connectives is as shown in the diagram below. Identification of connectives becomes essential to make the model predictive. We do not expect that such a task will ever be fully completed. But we are confident that a sufficient number of connectives can soon be identified and quantified; this will make significant predictivity possible, and will allow for a greater number of connectives which are simultaneously more highly refined in definition. This part of our task, and the identification or construction of appropriate algorithms to be used in policy analysis and evaluation remains for future effort. In the meantime, our methodology implies a significantly more comprehensive list of social dimensions to be considered in the evaluation of water resources alternatives and in formulation of policy than any previous one known to us.

We well understand that a computational construct or even a total array of possible issues and actions, even if operational, is not the total content of planning and decision. But our concept, though hopefully pervasive both operationally and intellectually

in its influence, will have to be imbedded within much broader contexts of real-world policy and decision making procedure. Exploration of these contexts under present dynamic United States conditions will be included within the next phase of our efforts.

Background of Water Resources Policy and Goals Evolution

Fortuitously for our cause, formal association of goals and water and related land development at the Federal level in the United States enjoys a long and thoughtful history. Chapter II of our report outlines this. This history dates back to at least as early as 1808 when Gallatin's report proposing a comprehensive plan of canals and navigable waterways identified goals of economic development, furthering political unity, and military defense. Perhaps the modern era began with the Reclamation Act of 1902, followed almost immediately by the Conservation Movement and a broadening attention to multiple purpose development. Common, but never exclusive, among all goal sets was economic development. Following the Flood Control Act of 1936, procedures for evaluation, particularly within the Executive Branch, stressed the economic efficiency objective as measured by the benefit-cost ratio. Efforts to develop planning procedures along these lines, after various evolutionary steps, culminated in formulation of the Bureau of the Budget Circular A-47 issued in December, 1952. The Congress in particular recognized broader goals and the overriding position that the ratio of tangible benefits to tangible costs exceeds unity as a basic prerequisite led to widespread call for liberalization recognizing other goals. Efforts within the Executive Branch to respond led finally to development of "Policies, Standards and Procedures for Formulation, Evaluation and Review of Plans for Use and Development of Water and Land Related Resources" by interdepartmental agreement and Presidential approval. This document replaced the Budget Bureau's "A-47" in 1962. While never formally approved by Congress, the document was published by the Senate in 1962 and thereby became



known, somewhat misleading, as "Senate Document 97." The following objectives were prescribed by S. D. 97: Development, Preservation, and Well Being of People. While optimal plans for national economic efficiency were to be developed, alternatives relating to the other objectives were also to be presented to both the Executive Branch and Congress in comprehensive plans. Even so, the Executive Branch was not barred from requiring a ratio of tangible benefits and costs equal to or greater than unity for the plans presented.

Discussion of water policy objectives continued during the decade through a cabinet-level body of concerned departments designated by the President. This body eventually was given statutory existence as the Water Resources Council under the Water Resources Planning Act of 1965. Among the many tasks assigned to the Council was promulgation of its own "principles, standards and procedures." Efforts of the Council's Task Force led, through public hearings, to publication of the Council's "Orange Books" on "principles" and "standards." The stated overall purpose of water and land planning was to reflect society's preference for attainment of the objectives: A. To enhance national economic development; B. To enhance quality of the environment; C. To enhance social well being; D. To enhance regional development. The Task Force stated that no objective has an inherent claim to priority over any other. Clearly national economic efficiency is no longer considered the primary objective.

We searched for broader, more general national goals statements. Only two such documents were found: Goals for Americans, by the President's Commission on National Goals, 1960; and Toward Balanced Growth: Quantity with Quality, made public July 4, 1970, in the report of the White House Goals Research Staff. Goals for Americans was initiated by President Eisenhower and is largely policy-oriented, identifying topics for preferred activities both domestic and international. The overriding issue in Toward Balanced Growth: Quantity with Quality is President Nixon's policy of "balanced growth." The difficulties of using these sources as basic goal statements are the lack of homogeneity and completeness in the first instance; in the second, first-order national goals are not considered. While thus not a basis for our choice of goal set, these documents nevertheless were the source of many ideas useful to the Technical Committee.

A closely linked approach has been taken by a Ford Foundation-supported project initiated by the National Planning Association. Six goal areas are identified in broad terms: "health and safety; education, skills and income; human habitat; finer things; freedom, justice and harmony; and gross national product." We found some basis for our choices also in Professor Harold Laswell's work, Who Gets What, When and How, which identifies eight primary value categories: power, respect, affection, rectitude, well-being, wealth, skill and enlightenment. A

definition of the term "social indicator" implies the existence of social goals. Toward a Social Report, issued in 1969 by the Department of Health, Education and Welfare and Social Indicators, edited by Raymond A. Bauer in 1966, deal with statistical information relating to social accomplishment, but do not identify or even imply any overarching goal set.

Amplified discussion in the "Orange Books" of the content and meaning of their four major objectives brings out much that is contained in our listing. Our methodology is not, therefore, an exclusive alternative, but hopefully another step in the evolution of planning for water resource use and of water resource policy. A systematic attempt was made to relate word descriptors of "Orange Book" objectives to specific goals, sub-goals, or social indicators appearing in the "Straw Man." This collation is given in detail in Chapter VI.

Philosophical Views and Presuppositions

Discussion of goals leads directly to a consideration of human values. That there is no intrinsic priority implied among the four objectives of the "Orange Books" reflects recent value shifts that seem to recognize that economic development does not insure quality either of life or of the environment. More than conceiving a formal, clear-cut model, our intent is also to facilitate clearer and more systematic evaluations of goals and goal structures. The tentative overarching goal is "promotion of general welfare" and our nine goals are grouped into maintenance of security and enhancement of opportunity. Although not included as a primary goal, welfare distribution effects are considered presuppositions applying to all goals.

Our set of primary goals is not conceived of as timeless or of universal application to all societies; we do not know the broad extent of its generality but we do know it is contemporary American. Its selection is thus not totally value free, but relative weights are not inherent in the methodology itself; that is, achieving one sub-goal is, intrinsically, equally as "good" as achieving any other. Introduction of relative value weights enters at the point where planning decisions are made; indeed, if there are no relative values--if there are no preferences--there are no decisions to make.

In terms of both value theory and methodology, our position embodies aspects of pragmatism, critical empiricism, and a limited rationalism. Although the Technical Committee reflects the typical American pragmatic concern with consequences, part of our evaluative system's intention is to reduce the detrimental aspects of the pragmatic approach by seeking, for example, to insure that planners will not so readily overlook secondary and side effects and the longer-range social and environmental consequences.

If we are seriously trying to obtain a realistic view of physical, biological, and social realities, then we must base our interpretations and our plans on the best available relevant facts. Granted that derivation of meaningful statistical data--e. g., social indicators--is easier said than done, we hope to develop a systematic empirical methodology applicable to water resource developments. While the work of science may be said to begin and end on an empirical base, the elements in between are of the essence in advanced science. But the complexity is so great, the goal statements so abstract, and the measurements so difficult that only a limited rationalism seems achievable.

We have called the specific array of goals, sub-goals, social indicators and action variables which we now present in this document, "The Straw Man." This does not imply that we are not confident about the concept in structure and hierarchical stratification, but rather that we recognize that the hundreds of specific elements in the array and their descriptions are neither entirely complete or logical in their arrangement nor reflective of all technological or value concepts. A great danger is that any methodology may be set in concrete; the appellation "Straw Man" implies the need for continual challenge to content and for continual change. Thus the label is a permanent one; however, it applies to the specific content of the array, which will be dynamic, and not to the general concept of our methodology.

Planning Methodology

As stated, the new methodology foresees a hierarchical array of goals and sub-goals, social indicators, action variables and connectives. A social indicator is a measure of a socially significant variable. An action variable is something which affects one or more members of the social indicator set. A connective is a link between any of these elements, whether of the same hierarchy or not. Social indicators may not be inherently "social." For example, dissolved oxygen level is an entirely physical measurement, but if it is made in the context of a sub-goal to improve the quality of a river, it is a social indicator. Any specific action--for example, treatment of waste inflows not previously treated--is an action variable. The action is variable not only in that its size might be varied but also in that there is a range of kinds of alternatives as well.

Connectives may take many forms ranging from simple linear coefficients, to highly complex functions. In some cases, only the direction (+) or (-) may be estimated. Mathematically, goals and sub-goals, social indicators, and action variables may be thought of as multi-dimensional vectors linked by dimensional matrices of connectives. The predictive question (If A is varied what happens to B?) is answered by inverting the matrix. The limitations placed on a complete solution by the complexity or lack of knowledge of connectives is formidable and we are not so

naive as to believe that an all-embracing, rigorous quantitative model will be achieved. On the other hand, computerized information--arranged in the "Straw Man" format, albeit incomplete--and displayed on a cathode ray tube would be invaluable to planners and other decision makers in considering both alternatives and consequences at all levels of decision making.

In many instances the decision makers may be assured only that the results of an action is positive or negative, but even this level of information about the effects of a complex process can be invaluable, particularly if the descriptive set for the universe of effects is comprehensive. The planning process is a reiterative one. Within some defined program objectives, criteria to meet objectives are defined: planners develop means to meet the objectives; later decision-makers review the alternatives, perhaps changing the objectives as the result of the analysis; and the planner seeks a least-cost solution for attaining the new goals decided upon. The process may be repeated many times; there are decision makers at several levels so that lesser planning cycles may exist within larger ones and these again within still larger ones. These decision points relate, of course, to a context of public opinion and influence which is a part of the decision making process. The information system expected as an eventual product of our work should ameliorate this cycling since planners will be motivated to generate more alternatives initially and decision makers, as a consequence, will have more alternatives to choose from and less need to request more planning work.

The Technical Committee visualizes a broad role for the "Straw Man" as a way of thinking about water, but has yet not explored in detail the contexts in which this role may be served. Two such contexts that can be delineated now are: 1) a basin or regional group of basins in which a planning group develops plans involving possible Federal, State, and local public and private actions such as a river basin commission as authorized by Title II of the Water Resources Planning Act of 1965 (i. e., all possible means of use within the purview of the planning group); and 2) a National setting, such as the present Water Resources Council in which the effects of all regional plans taken together can be assessed along with the effects of altering value weights or policies in any or all plans.

Environmental Quality and Security

The question of how best to handle the concepts expressed by the words "environmental quality" and "environmental security" was debated at length. To some of us there first appeared to be sub-goals under such general goals as Economic, Recreational, Aesthetic Opportunities, and Freedom of Choice with the latter as a sub-goal descriptor of Collective Security. To others, Environmental Security seemed of particularly paramount importance because it is

a prerequisite even for life itself. Originally the first view prevailed; eventually, however, the Technical Committee changed its decision and raised Environmental Security to the primary set. When we considered concepts of "threshold" values of environmental variables which exceed the normal stability limits of ecological systems and that may reach intolerable levels, this approach seemed desirable.

A discussion of how the environmental security issue might be approached within the "new methodology" model is included in Chapter VII along with some discussion of how the hierarchical and disaggregative techniques used in formulating the "Straw Man" might be applied generally to environmental information or modeling. Shelford's "law" of tolerance states two principles: (1) that there are minimum requirements of certain elements in the physical environment that are essential for the survival and well-being of any organism; and (2) that an excess of certain elements of the physical environment may have severe or fatal consequences. Examination of cycles of the elements required in the first instance could be incorporated into the "Straw Man" through such basic aspects as energy in the ecosystem for example, thus identifying "connectives" and "action variables" common to the cycle and the "Straw Man."

For example, how nitrogen cycles from inorganic to the organic and back has been well treated by biologists. Although many complex interactions are involved, each major segment of the cycle and its interactions can be delineated. The amount of nitrite, or a surrogate, in any such segment might thus be a relevant social indicator. A very preliminary example is presented in the text.

Such an approach, i. e., study of a specific elemental cycle, also leads to an attractive potential for identifying connectives between environmental security-linked action variables, through appropriate social indicators to other goals in the primary set. An illustrative list of action variables and social indicators derived by thinking about the nitrogen cycle is presented in Chapter VII. A similar approach would also appear to be a very fruitful way to approach the design of an optimal environmental monitoring system. It could add security against inadvertent but important omission, and provide a social framework for assessing priorities.

In a more general way, operational definitions of the broad term "environment" and its various facets, useful for policy formulation and management, are lacking. Basically the term is all-pervasive including everything external to the individual who views it. In the policy change context in which the word has come to be used prominently since 1965, it relates only to the out-of-doors and to man's surroundings: physical, biological, and aesthetic. Its use, particularly in the form "environmental quality," represented an attempt to get away from the semantic limitations of conservation of natural resources and "natural beauty."

In the light of this semantic development, using the basic goal and sub-goal sets, and thinking about social indicators and action variables within the universe described by the word "environment" instead of that described by "water resources development," could perhaps lead to definitions and sub-definitions having more clearly-delineated present and future social significance.

If this be the case, perhaps there is a general lesson to be learned from the last paragraph: if systematic social action across a broad spectrum of general welfare "action variables" is ever to be achieved, then broad, pervasive policy word descriptors,^{6/} around which political policy makers often rally in "band-wagon" fashion, ought to be defined in socially-significant goal language and related to other such descriptors in the same language.

Panel Review

During March and April, a select group reviewed an abbreviated, more primitive draft of our efforts and were asked to make comments. Members of the Panel were: Dr. Walter Lynn, Cornell University, Chairman; Mr. Albert Dolcini, California Department of Water Resources, Vice Chairman; Dr. C. S. Holling, University of British Columbia; Mr. Jeffrey Ingram, Massachusetts Institute of Technology; Mr. G. J. Karabatsos, Corps of Engineers; and Dr. William Lord, University of Wisconsin. The Panel offered both separate individual comments and a single consensus document. These papers provided many helpful suggestions regarding both the methodology itself and emphasis for future research effort. The individual comments proved particularly helpful in discovering the clarifying inherent weaknesses in the planning methodology as envisioned by the Technical Committee. Generally, the Technical Committee concurred with most of the Panel's critical comments and these will impact upon our evolving development of planning methodology.

Some significant comments were made regarding the goal set. Mr. Ingram preferred that "environmental action variables" should stipulate the levels that are feasible for "social indicators of economic development." Mr. Ingram also pointed out the implicit interrelationships between water resource decisions and their effects on political institutions, particularly citing resulting shifts in political power. He suggested that a tenth goal, the opportunity for political decisions and institutional adaptation be added.

While the Committee has not restructured its "Straw Man" it is introducing concepts into the

^{6/} Some examples within the decade: the atmosphere, everything touched by or within the air; the oceans, besides the deep oceans, the Great Lakes and everything within the terrestrial coastal zone--i. e., within 100 miles of the shore; pollution, any different substance mixed with some other substance.

methodology "resiliency," for example, which might provide a partial alternative to the first suggestion.

The consensus document suggested that the Technical Committee soon exercise its methodology on a demonstration of a real or hypothetical case in order to reduce semantic and conceptual problems. Such an effort is now under way by the group at the University of California, Riverside.

The Panel distinguished two classes of planning: reactive or situation planning and comprehensive or resource development planning. It discussed the application of the "Straw Man" to the former class in some detail and suggested emphasis on the action variables and their connectives to already-identified social indicators, pointing out that these connectives would be "technical or scientific" ones. It foresaw these as being largely site-specific; in parametric if not, necessarily, in functional form. It viewed planning and plan evaluation--an iterative process--as requiring only action variables and social indicators and concluded that a "Straw Man" focused on predominantly national aggregates would be of little use in the practical water resource planning process. Rather the planner would rely on feedback in terms of political dissatisfaction with specific plans for guiding the adjustments of social indicators. The "Straw Man" could provide a mechanism for evolving extensive information displays through measurements and rigorous examination of action variables and social indicators. Application to comprehensive planning was viewed as similar to the reactive planning process expanded to insure that all actions are analyzed. The Panel felt that some restructuring of the "Straw Man" would be necessary to accommodate the procedural framework suggested.

The other principal point raised by the Panel was the concept of resiliency and its implementation in the methodology. Generally natural systems, ecological, economic and social, are not in a state of delicate balance but are inherently stable; this domain of stability is quantized or described as "resiliency." It is often reduced by intervention of one kind or another to a point where further trauma may cause the system to "flip" into another state. Because of past great natural resiliency, planning has operated with the presumption of knowledge, and with the consequences of ignorance being absorbed by the resiliency. Knowing the limits or threshold becomes increasingly important with increasing development. The consensus document extends this concept not only to social and environment capital, but to systems boundaries and to social and economic costs as well. It recommends that the Technical Committee include resiliency dimensions either in existing social indicators or disaggregate a separate class of resiliency--social indicators.

The Panel's discussion of use of the "Straw Man" in planning, however, seems to the Technical Committee to leave open the question of choosing

social indicators. The Technical Committee's view is that a relatively mature social indicator involves three elements: actual data; an explicit identification of a goal; and measuring devices which connect the data and the goal in terms of some sort of measure of achievement. Without explicit goal identification functioning in an interconnected system, such measurements could not be made or at least would be based on totally implicit and subjective delineation of the social indicator. In this context the Technical Committee tends not to separate reactive and comprehensive planning.

Future Directions

Development of the planning methodology including implementation of an operational model was visualized in the original proposal as consisting of three phases: 1) identifying and defining explicit national and regional goals and seeking connectives between these goals and water related activities, 2) specifying and quantizing these connectives and analyzing other important resource constraints to achieve consistency in the model framework, and 3) estimating the degree of substitution between alternative goals; given the physical, biological, institutional, and political fabric of western regional resources.

Work completed so far satisfies essentially Phase I, thus Phase II will be concerned primarily with specifying and quantizing connectives within the "Straw Man" array. To think that all possible connectives can be completed to any common level of understanding is, of course, unrealistic; we will proceed by attacking sectors--normally the contents under a goal or sub-goal. Increased attention will also be given to the procedural and policy context within which the "Straw Man" model will operate as a tool in planning. Sectors tentatively identified for detailed emphasis are economic opportunity, environmental security, recreational opportunity, and population dispersion. Efforts will be made to formulate, tentatively, an algorithm which can reflect, at least in terms of signs, the consequences of actions on the primary and secondary goal categories. Limited testing by application to specific or hypothetical cases will continue.

Benefits involving water resource use are attributable only jointly to water; other important investments also are necessary. Phase III will include analysis of other important resource constraints, and estimate degrees of substitution between alternative goals. A high priority objective is to actually apply the methodology to one or more reasonably comprehensive water resource planning exercises; this test may be undertaken as part of Phase III, or if of sufficient scale, initiated concurrently with Phase III in cooperation with a basin or regional planning agency.

Eventually the scenario should lead to policy analysis at the regional and national level. Policy

analysis per se has not been included specifically within the objectives of our three-phase project, but consideration and discussion of policy analysis poten-

tial and requirements in our methodology, and documentation of an appropriate procedure, will continue concurrently in both Phases II and III.

SECTION II

A TENTATIVE "STRAW MAN"

The Technical Committee, after developing the structure of the methodology discussed in Section I, decided that it might be fruitful to attempt a preliminary disaggregation of the selected overarching goals set. Applying the two principles set forth in Chapter V, a preliminary disaggregation or "Straw Man" was delineated. The "Straw Man" is listed in numerical coded form at the end of this section. However several preliminary comments may help in understanding and explaining the first attempt at disaggregation.

First, in developing the descriptor list of the domains of each overarching goal, words consisting of change in direction, quality and quantity, were omitted. For example, a sub-goal under collective security, "detecting health hazards," does not contain the descriptive adjective "better" or "improved" in describing detecting. It was presumed that such descriptive words could be added or omitted without loss of clarity in the "Straw Man."

Second, many sub-goals or social indicators appear under more than one overarching goal disaggregation. This is to be expected in an essentially non-mutually exclusive goals system. For example, change in the level of industrial production appears as a social indicator under both collective security and economic opportunity goals. In addition, there are sub-goals and social indicators with slightly different words identifying them, but with identical meanings. This anomaly crept in because different members of the Technical Committee disaggregated different goals. In later revisions of the "Straw Man," it is hoped that through "key word analysis" and comparison of the informational value of different social indicator reentries in last situations, such anomalies will be removed.

A third difficulty one will encounter in studying the "Straw Man" as now presented, is the rather arbitrary point where sub-goals were identified as social indicators. In some cases, the social indicator is identified by code as soon as any elements defining the domain of the last sub-goal are even remotely measurable. In other cases, the social indicator is only identified when a precise quantitative measure emerges. In future revisions of the "Straw Man," a consistent demarcation between sub-goals and social indicators will be developed.

Fourth, and perhaps most importantly, is the degree of aggregation implicit in the current "Straw Man." During its construction, only very broad

national aggregates were characterized except at the lower layer level of social indicators and action variables. This was intentional, since the Technical Committee thought it best to proceed from general to specific, and a disaggregation containing location-specific and time-specific components appeared to be beyond our first year capabilities. Only after several empirical tests is the best method of specifying general to specific layers likely to be discovered. At this time, it appears that specificity will be monotonically increasing within the social indicator set, both in a locational and timing sense, as one proceeds from sub-goals to action variables. Whether this monotonicity will also appear in the goals set per se remains to be seen.

Fifth, given the second principle of disaggregation discussed in Chapter V, domains of sub-goals were not identified if the sub-goal had no apparent direct relation with Federal or local water resource activities. In the "Straw Man," one will often encounter a sub-goal which is not further disaggregated, such as "mob violence" under collective security. It was decided to retain those sub-goals in the "Straw Man" listing even though they are not disaggregated. This illustrates the extent of disaggregation, and possibly in the future will identify misconceptions in the original choices.

It must be re-emphasized that the "Straw Man" is not a complete or, perhaps, even a completable identification of all relevant goals and social indicators. In its present state, it is nothing more than an example--and a highly abbreviated and simple one--of the determinants of a realistic social welfare function or description. The Technical Committee in no way wishes to convey the impression or view that the "Straw Man" which follows is yet, in any way, an adequate, complete, or useful description of the determinants of social welfare.

1.	<u>Collective Security</u>
1.1.	Internal Security
1.1.(1).	Revolutionary Activities
1.1.(2).	Mob Violence
1.1.(3).	Subversive Activities
1.1.(4).	Individual or Isolated Acts of Violence
1.1.(5).	Community Cohesiveness

1.1.(5).0.1.	Water Policy Action Variable	2.1.(1).2.(2).1.	Water Policy Action Variable
1.1.(6).	Requirements for Communications Systems	2.1.(1).2.(3).	Transportation Policy
1.1.(6).0.1.	Government Water Resource Investments (i. e. , generation of electricity)	2.1.(1).3.	Concentrations of Ozone and PAN
1.1.(7).	Availability of Internal Transportation Systems	2.1.(1).3.(1).	Development Investment
1.1.(7).(1).	Internal Waterway Systems	2.1.(1).3.(1).1.	Water Policy Action Variable
1.1.(7).(1).1.	Water Policy Action Variable	2.1.(1).3.(2).	Transportation Policy
1.2.	External Security	2.1.(1).4.	Concentrations of Various Hydrocarbons
1.2.(1).	Responsive, Flexible and Varied Defensive Capabilities	2.1.(1).4.(1).	Development Investment
1.2.(1).(1).	Role of Water Resources in Defensive Capabilities	2.1.(1).4.(2).	Hydro-electric Power
1.2.(1).(1).1.	Electric Power Generation	2.1.(1).4.(3).	Transportation Policy
1.2.(1).(1).1.1.	Water Policy Action Variable	2.1.(1).5.	Organic Compounds
1.2.(1).1.(2).	Supplies of Fresh Water	2.1.(1).5.(1).	Nitrogenated Organics
1.2.(1).1.(2).1.	Water Policy Action Variable	2.1.(1).5.(1).1.	Development Investment
1.2.2.	Alliances and International Agreements	2.1.(1).5.(1).1.(1).	Water Policy Action Variable
1.2.2.1.	International Water Resource Agreements	2.1.(1).5.(2).	Halogenated Organics
1.2.3.	Intelligence Activities	2.1.(1).5.(2).1.	Development Investment
1.3.	Health Security	2.1.(1).5.(2).2.	Transportation Policy
1.3.1.	Detection of Health Hazards	2.1.(1).5.(3).	Sulfur Compounds
1.3.2.	Treatment of Diseases and other Health Hazards	2.1.(1).5.(3).1.	Development Investment
1.3.2.(1).	Public Water Supplies	2.1.(1).5.(3).2.	Transportation Policy
1.3.2.(1).1.	Water Policy Action Variable	2.1.(1).5.(4).	Gaseous Metallic Forms (e. g. , lead, mercury)
1.3.3.	Dissemination of Health Information	2.1.(1).5.(4).1.	Development Investment
1.3.4.	Prevention of Diseases	2.1.(1).5.(4).1.(1).	Water Policy Action Variable
1.3.4.(1).	Prevention of Water Borne Diseases	2.1.(1).5.(4).2.	Environmental Standards
1.3.4.(1).1.	Water Policy Action Variable	2.1.(1).5.(5).	pH of Precipitation
		2.1.(2).	Solids, Particulates in Air
		2.1.(2).1.	Dust
		2.1.(2).1.(1).	Agricultural Practices
		2.1.(2).1.(1).(1).	Acres of Land in Semi-Arid Area Farmed but not Irrigated
		2.1.(2).1.(1).(1).(1).	Water Available for Irrigation
<u>2.</u>	<u>Environmental Security</u>	2.1.(2).1.(1).(1).(1).1.	Water Policy Action Variable
2.1.	Improvement of Air Quality	2.1.(2).1.(2).	Industrial Activity
2.1.(1).	Changes in Gaseous Concentrations	2.1.(2).1.(2).(1).	Measures of Change in Industrial Production
2.1.(1).1.	Concentrations of Oxides of Sulphur	2.1.(2).1.(2).(1).1.	Water Policy Action Variable
2.1.(1).1.1.	Hydro-electric Power	2.1.(2).1.(3).	New Construction
2.1.(1).1.1.1.	Water Policy Action Variable	2.1.(2).1.(3).(1).	Level of Activity
2.1.(1).2.	Concentrations of Oxides of Carbon	2.1.(2).1.(3).(2).	Rate of Growth
2.1.(1).2.(1).	Development Investment	2.1.(2).1.(3).(2).1.	Water Policy Action Variable
2.1.(1).2.(1).1.	Water Policy Action Variable	2.1.(2).1.(4).	Land Clearing
2.1.(1).2.(2).	Hydro-electric Power		

2.1.(2).1.(4).(1).	Acres Cleared	2.3.(1).	Dissolved Gases
2.1.(2).1.(4).(1).1.	Water Policy Action Variable	2.3.(1).1.	Dissolved Oxygen
2.1.(2).2.	Fly Ash, Similar Particulate Matter	2.3.(1).1.(1).	Biochemical Oxygen Demand
2.1.(2).2.(1).	Level and Changes in Industrial Production	2.3.(1).1.(1).1.	Treatment Facilities Provided
2.1.(2).2.(1).1.	Water Policy Action Variable	2.3.(1).2.	Poisonous Gases
2.1.(2).2.(2).	Electric Power Generation	2.3.(1).2.(1).	Number of Barge Accidents
2.1.(2).2.(2).(1).	Percent of Energy Generated by Hydro-electric Installations	2.3.(1).2.(1).1.	Water Policy Action Variable
2.1.(2).2.(2).(1).1.	Water Policy Action Variable	2.3.(1).2.(2).	Amount of Waste Buried at Sea
2.1.(3).	Temperature Changes	2.3.(1).2.(2).1.	Water Policy Action Variable
2.1.(3).1.	Percent of Energy Generated by Hydro-activity	2.3.(1).3.	Eutrophication Products
2.1.(3).1.1.	Water Policy Action Variable	2.3.(1).3.(1).	Species Present in Water Body
2.2.	Land Quality	2.3.(1).3.(1).1.	Waste Treatment and Disposal Action
2.2.(1).	Chemical Buildup in Soil	2.3.(2).	Dissolved or Suspended Solids
2.2.(1).1.	From Fertilizers, Herbicides and Pesticides	2.3.(2).1.	Biodegradable Solids
2.2.(1).1.(1).	Level under Cultivation	2.3.(2).1.1.	Treatment Capacity Provided
2.2.(1).1.(1).1.	Water Policy Action Variable	2.3.(2).1.2.	Provision of Impoundments
2.2.(1).1.(2).2.	Land Protected from Flooding	2.3.(3).	Liquids
2.2.(1).2.	From Use of Wastes for Irrigation	2.3.(3).1.	Oil Slicks
2.2.(1).2.1.	Recycling Investments	2.3.(3).1.1.	Transportation Investments
2.2.(1).2.1.(1).	Water Policy Action Variable	2.3.(3).1.1.(1).	Water Policy Action Variable
2.2.(1).3.	Deposition During Floods	2.3.(3).2.	Acid, Alkaline Liquid
2.2.(1).3.1.	Provision of Flood Protection	2.3.(3).2.(1).	pH
2.2.(1).4.	From Wind Transported Particulate Matter	2.3.(3).2.(1).1.	Drainage, Preventive Impoundments
2.2.(1).4.(1).	Level and Changes in Industrial Production	2.3.(3).2.(1).1.(1).	Water Policy Action Variable
2.2.(1).4.(1).1.	Development Investment	2.3.(3).2.(1).2.	Development Investment
2.2.(1).4.(1).1.(1).	Water Policy Action Variable	2.3.(3).2.(1).2.(1).	Water Policy Action Variable
2.2.(1).4.(2).	pH of Precipitation	2.3.(4).	Temperature
2.2.(2).	Amount of Erosion	2.3.(4).1.	Thermal Discharges
2.2.(2).1.	Topography of Land	2.4.	Flora
2.2.(2).1.1.	Land Management Practices	2.4.(1).	Variety of Types
2.2.(2).1.1.(1).	Water Policy Action Variable	2.4.(1).1.	Inventory of Types
2.2.(2).1.2.	Flood Protection Provision	2.4.(2).	Extent of Types
2.2.(2).1.2.(1).	Water Policy Action Variable	2.4.(2).1.	Inventory of Areas not Subject to Human Interaction
2.2.(2).2.	Depth of Organic Layer	2.4.(2).1.1.	Preservation Policies
2.2.(2).2.1.	Land Management Practices	2.4.(2).1.1.(1).	Water Policy Action Variable
2.2.(2).2.1.(1).	Water Policy Action Variable	2.5.	Fauna ^{7/}
2.2.(2).2.2.	Flood Protection Provision		
2.2.(2).2.2.(1).	Water Policy Action Variable		
2.3.	Water Quality		

^{7/} Note: Number of species and species population levels seem to be the appropriate social indicators. These factors may be, in any particular case, influenced by almost any aspect of water resource policy. The only action variables of particular significance would be areas and streams preserved in an untouched state and compensatory encouragement of endangered species thought to be valuable or ecologically desirable.

2.5.(1).	Variety of Species	3.1.2.(2).(2).1.	Water Policy Action Variable
2.5.(2).	Species Population Levels	3.1.2.(2).(3).	Transportation Failures
2.5.(2).1.	Habitat Availability	3.1.2.(2).(3).1.	Government Navigation Systems Investments
2.5.(2).2.	Migration Opportunity		
2.5.(2).3.	Food Availability	3.1.3.	Intentional, Non-criminal Physical Violence
2.5.(2).3.(1).	Flora	3.2.	Security from Economic Violence
2.5.(2).3.(2).	Other Fauna	3.2.1.	Extent of Criminal Economic Violence
2.5.(2).4.	Mating Opportunity	3.2.2.	Extent of Accidental Economic Violence
2.6.	Geographic Environmental Security	3.2.2.(1).	Property Damage
2.6.(1).	Earthquakes	3.2.2.(1).(1).	Flood Induced Property Damage
2.6.(1).1.	Rate of Occurrence	3.2.2.(1).(1).1.	Water Policy Action Variable
2.6.(1).1.(1).	Heavy Loads	3.2.2.(1).(2).	Probability of Power Failures
2.6.(1).1.(2).	Waste Injection in Deep Formation	3.2.2.(1).(2).1.	Government Actions to Reduce Likelihood of Power Failures
2.6.(2).	Land Subsidence	3.2.2.(1).(3).	Probability of Water Supply Failures
2.6.(2).1.	Extent of Groundwater Mining	3.2.2.(1).(3).1.	Water Policy Action Variable
2.6.(2).1.1.	Water Policy Action Variable	3.2.2.(1).(4).	Transportation Failures
2.6.(2).2.	Oil and Gas Pumping	3.2.2.(1).(4).1.	Government Navigation Systems Investment
2.6.(2).2.1.	Energy Policy	3.2.3.	Intentional, Non-criminal Economic Violence
2.6.(2).3.	Irrigation of Unconsolidated Soils	3.2.3.(1).	Property Damage
2.6.(2).3.1.	Water Policy Action Variable	3.2.3.(1).(1).	Uncontrolled Waste Disposal in Bodies of Water Resulting in "Downstream" Property Damage
2.6.(3).	Climatic Changes	3.2.3.(1).(1).1.	Water Policy Action Variable
2.6.(3).1.	Temperature, Climatic Variation	3.3.	Security from Psychological Violence
2.6.(3).1.1.	Area Development Limitations	3.3.1.	Threats by Authorities
2.6.(3).1.2.	Weather Modification	3.3.2.	Threats by Insurgent Groups
		3.3.3.	Threats by Individuals
<u>3.</u>	<u>Individual Security</u>	<u>4.</u>	<u>Economic Opportunity</u>
3.1.	Security from Physical Violence	4.1.	Freedom of Contract
3.1.1.	Criminal Physical Violence	4.1.1.	Employment and Service Contracts
3.1.1.(1).	Reported Criminal Physical Violence	4.1.1.(1).	Number of People Employed
3.1.1.(2).	Unreported Criminal Physical Violence	4.1.1.(2).	Percentage Unemployment by Region or Demographic Groups
3.1.2.	Accidental Physical Violence	4.1.1.(2).1.	Water Policy Action Variable (Regional Distribution of Projects)
3.1.2.(1).	Floods	4.1.1.(3).	Opportunity for Corporations
3.1.2.(1).1.	Government Measures to Control Floods	4.1.1.(3).(1).	Number of Different Corporations Involved in Building Different Projects
3.1.2.(2).	Systems Failures		
3.1.2.(2).(1).	Power Failures		
3.1.2.(2).(1).1.	Government Actions to Reduce Likelihood of Power Failures		
3.1.2.(2).(1).1.(1).	Government Water Resource Investment (related to hydro-electric generation systems)		
3.1.2.(2).(2).	Water Supply Failures		

4.1.1.(3).(1).1.	Water Policy Action Variable	4.3.(1).1.	Government Contract Provisions
4.1.2.	Contracts Involving Delivery and Transfer of Goods	4.3.(1).1.1.	Water Policy Action Variable
4.1.2.(1).	Transaction Matrix Between Water Project Construction and Remainder of Industrial Complex	4.3.(1).2.	Number of Government Employees
4.1.2.(2).	Effect of Government Investment in Water Projects on Credit Markets	4.3.(1).2.1.	Water Policy Action Variable
4.1.2.(2).1.	Water Policy Action Variable	4.3.(2).	Equality in Opportunities for Corporations
4.2.	Investment Opportunity	4.3.(2).1.	Number of Government Contracts Awarded by Competitive Bidding
4.2.(1).	Investment Opportunities Foregone	4.3.(2).1.1.	Water Policy Action Variable
4.2.(1).1.	Amount of Public Investment	4.3.(3).	Equality in Investment Opportunity
4.2.(1).1.1.	Water Policy Action Variable	4.3.(3).1.	Number of People (or Corporations) which have Opportunity to Invest
4.2.2.	Investment Opportunity Created	4.3.(3).1.1.	160 Acre Limitation
4.2.2.(1).	Potential Productivity of New Investments	4.3.(3).1.2.	Preference for Certain Hydro-electric Customers
4.2.2.(1).(1).	Water Made Available	4.3.(3).1.3.	Recreation Land Speculation Restrictions
4.2.2.(1).(1).1.	Water Policy Action Variable	4.3.(3).1.4.	Common Carrier Regulatory Policy
4.2.3.	Energy Use Investment Opportunity Created	4.3.(3).1.5.	Risks Assumed by Government
4.2.3.(1).	Energy Available (KWH)	4.4.	Economic Choice by Consumers
4.2.3.(1).1.	Government Investment in Hydro-electric Facilities	4.4.(1).	Choice Among Goods
4.2.4.	Recreation Investment Opportunities	4.4.(1).1.	Variety and Price of Foods
4.2.4.(1).	Estimated Visitor-day Potential Worth of Recreation	4.4.(1).1.(1).	Location and Amount of Irrigation
4.2.4.(1).(1).	Visitor-days Made Available	4.4.(1).1.(1).1.	Irrigation Projects
4.2.4.(1).(1).1.	Water Policy Action Variable	4.4.(1).1.(1).2.	Water Reallocated from Irrigation
4.2.5.	Opportunity to Invest in Goods Handling	4.4.(1).1.(1).3.	Subsidies to Irrigators
4.2.5.(1).	Water Transport Capability Available	4.4.(1).2.	Variety and Location of Housing
4.2.5.(1).1.	Investment in Navigation Facilities	4.4.(1).2.1.	Flood Protection Zoning
4.2.6.	Investment in Reducing Effluent Produced by Industry	4.4.(1).3.	Kinds of Appliances Usable
4.2.6.(1).	Assimilative Capacity Available	4.4.(1).3.(1).	Availability of Energy Sources
4.2.6.(1).1.	Investment in Water Regulative Systems	4.4.(1).3.(1).1.	Water Policy Action Variable
4.2.6.(2).	Availability of Treatment Facilities	4.4.(2).	Choices Among Services
4.2.6.(2).1.	Investment in Treatment Plants	4.4.(2).1.	Recreational Services Available
4.2.7.	Land Available for Development	4.4.(2).1.1.	Development of Recreation Facilities
4.2.7.(1).	Amount of Flood Protection Provided for an Area	4.4.(2).1.1.(1).	Water Policy Action Variable
4.2.7.(1).1.	Investment in Flood Protection	4.4.(2).2.	Cultural Services Available
4.2.7.(1).2.	Flood Plain Zoning	4.4.(2).2.(1).	Size of Metropolitan Area
4.3.	Equality of Economic Opportunity	4.4.(2).2.(1).1.	Water Policy Action Variable
4.3.(1).	Equal Employment Opportunity	4.4.(3).	Choice Between Current and Future Consumption
		4.4.(3).1.	Current Personal Income and Interest Rates
		4.4.(3).1.1.	Tax Levels and Provisions for Investment
		4.4.(3).1.1.(1).	Financing of Government Water Projects

4.5.	Choice by Producers	4.6.3.(1).(1).(1).	Flood Protection
4.5.(1).	Infrastructure Choices and Availability	4.6.3.(1).(1).(1).1.	Water Policy Action Variable
4.5.(1).1.	Energy Availability	4.6.3.(1).(1).(2).	Drought Protection
4.5.(1).1.1.	Investment in Hydro-electric Power	4.6.3.(1).(1).(2).1.	Water Policy Action Variable
4.5.(1).1.2.	Subsidy or Preference Decisions	4.6.4.	Price Stability
4.5.(1).2.	Assimilative Capacity Available	4.6.4.(1).	Fluctuation in Futures Market Prices
4.5.(1).2.1.	Investment in Assimilative Capacity	4.6.5.	Services and Goods Required to Survive
4.5.(1).2.1.(1).	Water Policy Action Variable	4.6.5.(1).	Climate
4.5.(1).2.2.	Provision of Treatment Capacity	4.6.5.(1).(1).	Heating, Cooling Costs
4.5.(1).2.2.(1).	Water Policy Action Variable	4.6.5.(1).(1).1.	Investment in Low Cost Energy Sources
4.5.(1).2.3.	Transportation Alternatives	4.6.5.(1).(1).1.(1).	Water Policy Action Variable
4.5.(1).2.3.(1).	Water Policy Action Variable	4.6.5.(2).	Living Space
4.5.(1).3.	Shipping Capacity	4.6.5.(2).(1).	Population Density
4.5.(1).3.1.	Navigation Enhancement	4.6.5.(2).(1).1.	Water Policy Action Variable
4.5.(1).3.1.(1).	Water Policy Action Variable	4.6.5.(3).	Transportation
4.5.(1).4.	Potential Irrigable Land	4.6.5.(3).1.	Water Policy Action Variable
4.5.(1).4.(1).	Irrigation Water Available	4.6.6.	Rate of Economic Expansion
4.5.(1).4.(1).1.	Water Policy Action Variable	4.6.6.(1).	GNP Increase
4.5.(2).	Capital and Credit Available	4.6.6.(1).1.	Water Policy Action Variable
4.5.(2).1.	"Free Market" Capital and Credit	4.6.6.(2).	Application of Economic Efficiency Criteria
4.5.(2).1.(1).	Money Supply and Credit and Liquidity		
4.5.(2).2.	Subsidized Capital and Credit		
4.5.(2).2.(1).	Funds Allotted to Special Programs (e. g., REA, SBA)	5.	<u>Cultural and Community Opportunity</u>
4.5.(2).2.(1).1.	Water Policy Action Variable	5.1.	Enjoyment of Amenities (Arts and Nature)
4.6.	Standard of Living	5.1.(1).	Location and Accessibility
4.6.1.	Per Capita Income Levels	5.1.(1).1.	Transportation Capabilities
4.6.1.(1).	Disposable Personal Income Level	5.1.(1).1.1.	Water Policy Action Variable
4.6.1.(1).1.	Level of Income Taxes	5.2.	Preservation and Restoration of Areas of Natural Beauty
4.6.1.(1).1.(1).	Water Policy Action Variable	5.2.1.	Number of Areas of Natural Beauty
4.6.2.	Distribution of Income	5.2.1.1.	Water Policy Action Variable
4.6.2.(1).	Disposable Personal Income Variance, Skew	5.3.	Creativity
4.6.2.(1).1.	Welfare Decisions	5.3.(1).	Encouragement of Creative Endeavors
4.6.2.(1).1.(1).	Water Policy Action Variable	5.3.(1).1.	Number of Areas of Natural Beauty
4.6.2.(1).2.	Subsidy Level for Essential Services	5.3.(1).1.1.	Government Water Resource Investment--Providing Areas Which Inspire Creative Acts
4.6.2.(1).2.(1).	Water Policy Action Variable	5.4.	Community Cooperation
4.6.3.	Stability of Income	5.4.1.	Number of Community Projects
4.6.3.(1).	Personal Bankruptcies	5.4.1.1.	Water Policy Action Variable
4.6.3.(1).(1).	Degree of Regulation of Risk Due to Natural Occurrences	5.5.	Diversity of Cultural and Community Opportunity

5.5.1.	Community Size and Population Dispersion	6.2.(1).1.(4).1.	Water Policy Action Variable
		6.2.(1).2.	Facilities
5.5.1.1.	Water Policy Action Variable	6.2.(1).2.(1).	Reclamation
5.6.	Equality in Cultural and Community Opportunity	6.2.(1).2.(1).1.	Water Policy Action Variable
5.6.1.	Participation Levels	6.2.(1).2.(2).	Water Treatment Facilities
5.6.2.	Participation Costs	6.2.(1).2.(2).1.	Water Policy Action Variable
5.6.3.	Transportation Capabilities	6.2.(1).2.(3).	Waste Water Treatment Facilities
5.6.3.1.	Water Policy Action Variable	6.2.(1).2.(3).1.	Water Policy Action Variable
		6.2.(2).	Regional Aesthetic Considerations
6.	<u>Aesthetic Opportunity</u>	6.2.(2).1.	Dams
6.1.	Aesthetic Enclosures	6.2.(2).1.1.	Water Policy Action Variable
6.1.(1).	Appearance	6.2.(2).2.	Waterways
6.1.(1).1.	Location and Accessibility	6.2.(2).2.1.	Water Policy Action Variable
6.1.(1).1.(1).	Complimentarity of Structure to Surroundings	6.2.(2).3.	Coastal Facilities
6.1.(1).1.(1).(1).	Government Structures	6.2.(2).3.1.	Water Policy Action Variable
6.1.(1).1.(1).(1).1.	Water Policy Action Variable	6.2.(2).4.	Erosion Control
6.1.(1).2.	Structure	6.2.(2).4.1.	Water Policy Action Variable
6.1.(1).2.(1).	Professional Design	6.2.(2).5.	Urbanization
6.1.(1).2.(2).	Relationship of Structure to Purpose	6.2.(2).5.(1).	Density
6.1.(1).2.(2).1.	Water Policy Action Variable	6.2.(2).5.(1).1.	Water Policy Action Variable
6.1.(2).	Optimum Use of Space	6.2.(2).5.(2).	Greenbelts, Parks, Golf Courses
6.1.(2).(1).	Careful Planning	6.2.(2).5.(2).1.	Water Policy Action Variable
6.1.(2).(1).0.1.	Water Policy Action Variable	6.2.(2).5.(3).	Landscaping Around Structures
6.1.(2).(2).	Education of Public	6.2.(2).5.(3).1.	Water Policy Action Variable
6.1.(2).(2).1.	Public Hearings	6.2.(2).5.(4).	Rural Aesthetic Considerations
6.1.(2).(2).1.1.	Water Policy Action Variable	6.2.(2).5.(4).1.	Water Policy Action Variable
6.1.(2).(3).	Utilization of Innovations	6.2.(3).	Sanitation
6.1.(2).(3).1.	Government Research Programs Involved	6.2.(3).1.	Storm Drains
6.1.(2).(3).1.1.	Water Policy Action Variable	6.2.(3).1.1.	Water Policy Action Variable
6.2.	Aesthetic Developed Areas--Areas in Various Stages of Development (Metropolitan, Agricultural, etc.)	6.2.(3).2.	Wastewater Collection
6.2.(1).	Design	6.2.(3).2.1.	Water Policy Action Variable
6.2.(1).1.	Buildings	6.2.(4).	Reduction of Environmental Pollution
6.2.(1).1.(1).	Governmental Buildings	6.2.(4).1.	Air Pollution
6.2.(1).1.(1).1.	Water Policy Action Variable	6.2.(4).1.1.	Water Policy Action Variable
6.2.(1).1.(2).	Educational Buildings	6.2.(4).2.	Water Pollution
6.2.(1).1.(2).1.	Water Policy Action Variable	6.2.(4).2.1.	Water Policy Action Variable
6.2.(1).1.(3).	Water Management Buildings	6.2.(4).3.	Pollution of Soil Mantle
6.2.(1).1.(3).1.	Water Policy Action Variable	6.2.(4).3.1.	Water Policy Action Variable
6.2.(1).1.(4).	Flood Resistant Buildings	6.3.	Natural Areas
		6.3.(1).	Development
		6.3.(1).1.	Location and Accessibility

6.3.(1).1.1.	Water Policy Action Variable	6.4.(1).1.	Distribution of Government Investments
6.3.(1).2.	Amount of Public Interest	6.4.(1).1.1.	Water Policy Action Variable
6.3.(1).2.1.	Water Policy Action Variable	6.4.(2).	Aesthetic Developed Areas
6.3.(1).(1).	Enhancement of Natural Beauty	6.4.(2).1.	Distribution of Government Investments
6.3.(1).(1).1.	Complimentarity to Natural Surroundings	6.4.(2).1.1.	Water Policy Action Variable
6.3.(1).(1).1.1.	Water Policy Action Variable	6.4.(3).	Natural Areas
6.3.(1).(2).	Preservation of Natural Beauty	6.4.(3).1.	Distribution of Government Investments
6.3.(1).(2).1.	Undeveloped Areas--Potential	6.4.(3).1.1.	Water Policy Action Variable
6.3.(1).(2).1.1.	Water Policy Action Variable		
6.3.(1).(3).	Restoration of Natural Beauty	7.	<u>Recreational Opportunity</u>
6.3.(1).(3).1.	Undeveloped Areas--Damaged	7.1.	Access--Availability
6.3.(1).(3).1.1.	Water Policy Action Variable	7.1.1.	Population Density and Location
6.3.(1).(3).2.	Developed Areas--Damaged	7.1.1.1.	Water Policy Action Variable
6.3.(1).(3).2.1.	Water Policy Action Variable	7.1.2.	Number of Recreational Opportunities
6.3.(2).	Access	7.1.2.1.	Water Policy Action Variable
6.3.(2).(1).	Accessible Routes to Location	7.1.3.	Transportation Facilities Between Recreations
6.3.(2).(1).1.	Capacity of Routes	7.1.3.1.	Government Navigation Investments
6.3.(2).(1).1.1.	Water Policy Action Variable	7.2.	Quality
6.3.(2).(1).2.	Quality of Routes	7.2.1.	Water Quality
6.3.(2).(1).2.1.	Water Policy Action Variable	7.2.1.1.	Water Policy Action Variable
6.3.(2).(2).	Enhancement Control	7.3.	Equality of Recreational Opportunity
6.3.(2).(2).1.	Admission of Public	7.3.1.	Participation Levels
6.3.(2).(2).1.(1).	Economic Considerations	7.3.2.	Participation Costs
6.3.(2).(2).1.(2).	Solitude Considerations	7.3.2.(1).	Income Distribution
6.3.(2).(3).	Adequacy of Facilities Throughout Areas	7.3.2.(1).(1).	Funding of Government Projects
6.3.(2).(3).1.	Routes for Automobiles and Other Mechanized Transport	7.3.2.(1).(1).1.	Water Policy Action Variable
6.3.(2).(3).2.	Trails for Hiking	7.4.	Variety
6.3.(2).(3).3.	Scenic Stops	7.4.1.	Numbers and Categories of Recreational Alternatives
6.3.(3).	Pollution Reduction	7.4.1.1.	Water Policy Action Variable
6.3.(3).1.	Environmental Pollution Control		
6.3.(3).2.	Sanitation Facilities	8.	<u>Individual Freedom and Variety</u>
6.3.(3).3.	Maintenance	8.1.	Freedom of Choice
6.3.(4).	Existence of Wildlife and Vegetation	8.1.1.	Existence of Alternatives
6.3.(4).1.	Types and Quality	8.1.1.1.	Water Policy Action Variable
6.3.(4).1.(1).	Protection	8.1.(1).	Dissemination of Information Necessary for Choice
6.3.(4).1.(1).1.	Water Policy Action Variable	8.1.(1).1.	Communications Systems
6.3.(4).1.(2).	Control	8.1.(1).1.1.	Water Policy Action Variable
6.3.(4).1.(2).1.	Water Policy Action Variable		
6.4.	Equality of Aesthetic Opportunity		
6.4.(1).	Aesthetic Enclosures		

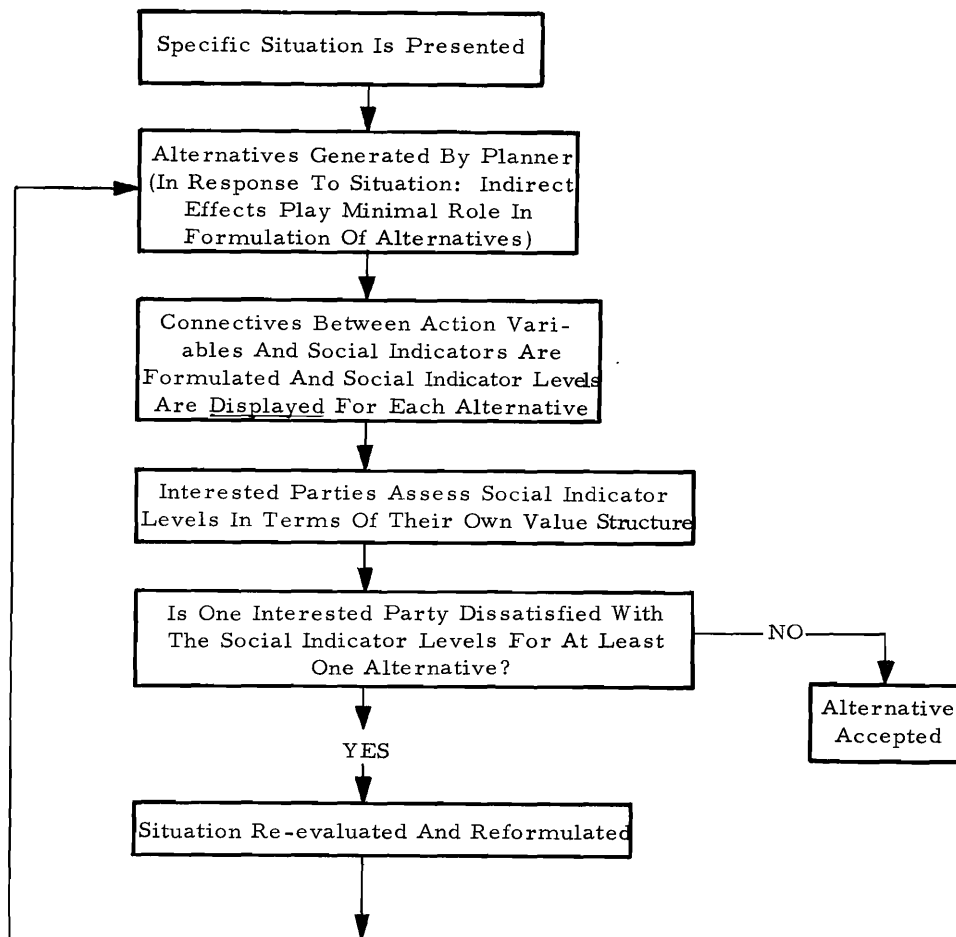


Figure 1. Reactive planning process.

Given the double role as physical or policy components of a plan (output) and as action variables for the "Straw Man's" evaluation (inputs), it is important that these variables be defined and listed to fill both roles. It is essential to know what action variables are related by a connective to each social indicator. As has been emphasized, getting on with the job of establishing connectives should clarify the exact formulation of each action variable, keeping in mind that each is also a physical or policy component of a plan devised by a planner to meet a situation.

Technical Connectives

Given the definition of water policy action variables which the Panel has suggested, it is then necessary to establish the connectives between variables and the various social indicators. These social indicators, we believe the Committee will agree, are the measurable and socially significant effects of adopting one or more water policy action variables.

Connectives between water policy action variables and social indicators (and those between social

indicators) are functional relationships of a scientific or technical nature. They are not definitions or value statements. Expressed another way, they are statements that if something is done (action variable) then something will happen (social indicator). The "Straw Man" cannot be operational until these connectives are specified. The Panel feels that the Committee should assign high priority to the specification of at least some of these connectives.

The Panel believes that the Committee has not fully recognized the extent to which connectives will be specific to the individual planning setting. However, we expect that it will be possible to specify the functional form of many connectives for general use with the individual parameters to be estimated for the individual planning setting. In other words, we expect that the Committee can enumerate generally most of the factors which will affect the relationship between a particular kind of input (action variable) and the effects which it will have on social indicators, but that the importance of most factors will vary in different situations. Thus, the Committee can specify most, but not all, of the functional forms of a set of

connectives while the field planner must estimate most, but not all, of the parameters within those functional forms.

The Panel's emphasis on the location-specific nature of connectives between water policy action variables and social indicators and between social indicators themselves is partly a result of the Panel's view that the social indicators should be location-specific and group-specific at a less aggregative level than that apparently envisioned by the Technical Committee. The Panel does not believe that a "Straw Man" which is focused predominantly on national aggregates will be very useful in the water resource planning process. This belief stems directly from our previously described understanding of that planning process.

As a corollary of its emphasis on fuller specification of water policy action variables and their connectives with social indicators, the Panel suggests that the Committee defer its attempts to identify additional social indicators. The existing list, while far from exhaustive, is already a long one. The Committee will have more than enough to do in developing an extensive list of water policy action variables and specifying the connectives between those variables and the social indicators which it has already identified.

Higher Order Connective

In the process of constructing the "Straw Man," the objectives and sub-objectives were necessarily generated to arrive at the set of social indicators. Planning and evaluating plans, however, only require social indicators and the action variables that affect them. The Technical Committee should, therefore, declare a moratorium on the problem of generating connectives above the social indicator level, and concern itself with the tremendous task of formulating the more technical connectives between action variables and social indicators.

This recommendation is based upon the following arguments. A sub-objective is defined as the set of social indicators that give it empirical substance. For the planner, therefore, knowing the level of the social indicators is enough.

Secondly, in the planning process we have described, the interested parties will select out those social indicators that they are concerned with, depending on their own value systems. Thus it is not necessary that weights and connectives for sub-objectives be generated by or for the planner. If an interest or politician is dissatisfied with the level of a social indicator, he will feed this back to the planner and an adjustment can be made. Thus the planner is freed from worry about judging whether a set of social indicator levels satisfy a sub-objective, and the Technical Committee is freed from making up functions that will weight and relate social indicators.

Use of the "Straw Man"

The depth and detail required for application of the "Straw Man" in the planning process will depend on the type of planning undertaken and the degree to which the investigation is location-specific. It is obvious that all planning is concerned with total or partial attainment of certain objectives. The "Straw Man" does provide a mechanism for evolving extensive information displays through measurements and values of action variables and social indicators (within the definitional context presented above). Although the operational planner recognizes and is concerned with objectives (and sub-objectives), and since he is not in the real sense the final decision-maker of plan implementation, the greatest service he can perform is through a rigorous investigation of the action variables, the articulation of the social indicators (and the associated connectives) and the preparation of information displays that are understood by the public and its elected political representatives. It is from these displays that the public can respond in terms of their values, thus setting in motion a feedback process that eventually results in a plan which is viable and can be implemented.

As illustrated in the flow diagram in the section on the planning scenario, much water resource planning is a reaction type in that it responds to a situation or want expressed by some interested group. If these are limited situations (such as "remove or minimize a flood hazard") the alternatives and their associated action variables will also be limited and social indicators should display the values and consequences of each alternative. As shown in the flow diagram, feedback loops from public reaction would, through an iterative process, establish the (value) weights from which a supportable plan could be formulated and implemented.

However, a distinction must be made between comprehensive river basin planning and the more limited reactive type previously described. There are regional situations in which a multiplicity of wants may be expressed by interested groups (non-governmental as well as governmental) in which a complex competitive situation is created. This situation could be similar to "reactive planning" aimed at near term solutions or it could be aimed at both near and long-term plans. In this case the planning process is further expanded to insure that all actions (the action variables in the "Straw Man" methodology) are carefully analyzed to define consequences in terms of degree of competitiveness, positive values created, negative impacts, and again the formulation of an understandable comprehensive information display. The iterative process described for the more simple planning situation would then be brought into play through the public responses and a viable plan eventually formulated. There is no reason that the essence of the "Straw Man" could not be an operational device and thus improve the planning as well as the subsequent decision-making process. The

Panel is of the view, however, that the structure of the "Straw Man," as envisioned by the Committee, would have to be re-oriented along the procedural framework presented in this report. It is through the restructuring that the Panel believes the "Straw Man" can be of the greatest use to the operational planner, the planning process in general, and to the public.

Concept and Implementation of Resiliency

Natural systems, ecological, economic and social, are not in a state of delicate balance. They have experienced traumas and shocks over the period of their existence, and the ones that have survived have explicitly been those that have been able to absorb these changes. They have, therefore, an internal resiliency. So long as the resiliency is great, unexpected consequences of an intervention of man can be absorbed without profound effects. But with each such intervention, the price often paid is a contraction in the domain of stability (equals resiliency) until an additional incremental change can flip the system into another state. In a development scheme this would generate certain kinds of "unexpected" consequences - a freeway that changes the morphology of a city so that the urban core erodes; an insecticide that destroys an ecosystem structure and produces new pest species. We seem now to be faced with problems that have emerged simply because we have used up so much of the resiliency of social and ecological systems. Up to now the resiliency of these systems has allowed us to operate on the presumption of knowledge with the consequence of our ignorance being absorbed by the resiliency. Now that the resiliency has contracted, traditional approaches to planning might well generate unexpected consequences that are more frequent, more profound and more global.

Traditional approaches plan on the presumption of knowledge--knowledge that is certainly not complete but which is presumed to be sufficient. The "Straw Man" is by no means traditional, yet it makes the same assumption. But our knowledge of the interactions between individuals and between man and the environment is minute in relation to our ignorance. In the past this presumption has not been dangerous and indeed has allowed a dramatic improvement in the quality of life through technical developments. But, to repeat, the past resiliency of social and ecological systems has absorbed the potentially disastrous consequences of our ignorance. We now need a planning philosophy that explicitly recognizes the area of our ignorance rather than the area of our knowledge. We must replace the lost resiliency in our approach to planning, and, in this way, eventually return flexibility and stability to the total system.

The key requirement for this new planning philosophy is to keep options open. In the event of an unexpected problem, we must not be limited only

to those solutions that will perpetuate the problem or set in motion new and more global problems. One way to keep options open is to explicitly identify social indicators that monitor the resiliency of the system. Rather than first indicating the absolute magnitude of an indicator, its amount should be measured in relation to a boundary of stability. The resiliency indicators would therefore measure the unused resiliency and would be a measure of the number of future options available after a plan was implemented.

There are three mutually-exclusive classes of resiliency indicators:

I Resiliency in Social and Environmental Capital

At any point in time there exists a reserve capital of dollars or resources that are drawn upon for any development. This reserve capital has a certain existing quantity and quality. Therefore, those social indicators that measure the amount and kind of dollars or resources used, should also be given a resiliency dimension, so that the remaining dollar or environmental capital can be measured. It is this remaining capital inventory that buffers the development in case of the appearance of unexpected and unhappy consequences. Modified developments or new developments of the future draw from this reserve. Example: A recreational land development will produce certain effects on the development as evaluated by recreational social indicators existing in the "Straw Man." But the land used is drawn from a reserve of a certain size and with certain intrinsic qualities for absorbing recreation. These quantities and qualities of the remaining reserve should be measured by adding a resiliency dimension to existing recreation social indicators.

II Resiliency with Respect to Systems Boundaries

Socio-ecological systems are dynamic systems in which the structure and functional interrelations themselves establish intrinsic boundaries of stability. Phosphates added to an aquatic ecosystem are incorporated into existing biogeochemical cycles. But there is a limit to the amount that can be added and still retain the integrity of the cycle. Therefore, a measure of a social indicator that expresses the absolute amount of phosphate added should be matched with one that expresses the total amount in relation to the system boundary for phosphate. In some cases the knowledge exists in the form of models to measure this boundary. In other cases, with less knowledge, the boundary

would be expressed as a guess--a standard or threshold similar to public health standards. Again the task for the Technical Committee is first to identify those social variables that are state variables for the system and second to add a resiliency dimension that measures the amount in relation to the system boundary or standard.

III · Resiliency of Social and Economic Costs

There are, or should be, social indicators that explicitly measure the economic and social costs of a development. But there is a resiliency counterpart to these costs as well. If, after the development takes place, it proves to be "bad," we can modify the existing development, add a new one or remove the development entirely and start from scratch once again. But this latter possibility can only be assessed if a cost is attached to the removal, not just to the establishment of the development. Removal costs should therefore be expressed as a resiliency dimension to cost social indicators at the time of assessing alternate plans. Example: Imagine two possible rapid transit schemes--one requires subways, monorails and a heavy investment in concrete and steel; the other uses existing or modified streets and establishes exclusive bus routes, increases the stock of buses, minimizes the waiting time and adds minibuses to connect homes with major bus routes. In the first scheme the removal costs would be so high that once established it could never be practically removed. The other has low costs of removal and therefore keeps future options open.

In summary, therefore, we are proposing that the Technical Committee either disaggregate a class of resiliency social indicators under the three headings above or review the existing indicators in light of these three classes and add a resiliency dimension to each. Either approach is not a trivial exercise and both would result in the addition of a new dimension to the existing set, changing from a one-dimensional to a two-dimensional array.

Discussion of Panel Document by the Technical Committee

The first consensus position of the Panel is that the background paper of the Technical Committee is deficient in defining and describing the domain of the planning methodology. The Technical Committee agrees. Its emphasis upon developing the "Straw Man" as a way of thinking about water use has meant that it has neglected, relatively, both the development of various assumed contexts in which the "Straw Man" could be used and the procedures for its use in each such context. Two such contexts now delineated

are: 1) a basin or regional group of basins in which a planning group develops plans involving possible Federal, State and local public and private actions (i. e., presumably all possible means of use would be within the purview of the planning group); 2) a National setting in which the effects of all regional plans taken together and the effects of altering value weights or policies in any or all plans can be assessed. As it proceeds into its second year, the Technical Committee proposes to give substantially greater attention to methodological options in this more inclusive sense.

The Technical Committee does not endeavor to divide planning types into reactive and comprehensive basic planning classes. It appears defensible to assert, provided the reactive plans are relatively large, that basin and situational or reactive planning are not separable. Decisions in one domain determine policies and technical options in the other. In consequence, the planning methodology was structured to be able to accommodate and make consistent both types of planning. Without attempting to accommodate both reactive and comprehensive basin planning into a single, consistent whole, the water resource planning process would be little more than the sum of its "reactive" parts.

The Panel made much of the distinction between "Situational Planning" and "Comprehensive Planning." It then elected to concentrate its reflections on the situational type. This quite naturally led to a devaluation of the function of the goal hierarchy in the "Straw Man" methodology, and to certain implications about how we ought to proceed. If the intent of the Panel Report is to propose that we emphasize situational planning, then there remains little basis for our enterprise, which is to develop an analytic system for evaluating water resource projects in terms of their impacts on regional and national goals. All planning appears, by definition, to require the specification or stipulation of goals or objectives. Anything approaching a system for evaluating the broad ranges of national social effects of water resource projects will require development of some sort of systematic presentation of goals, sub-goals, etc. Quite surely the situational or reactive planner will not, and need not, find all of the elements of the goal array relevant to his work. But unless he is responsive to the local implications of a full array of social goals, his own planning could not be tied in with more comprehensive assessments. The range of analysis in both types of planning (though not necessarily its degree of completeness) should be quite identical; only the selections of action variables and technical connectives should be expected to differ markedly.

The "Straw Man" methodology involves the development and listing of social indicators which, hopefully, will allow fairly objective measurements of the effects of water planning actions upon goals. It would appear quite essential that the same types and sets of indicators be used in both situational and

comprehensive planning. The situational planner will be concerned with estimating the attainment of objectives directly tied to a specific project. The comprehensive planner would use these indicators (along with any new additions) to assess the broader ranges of social effects in relation to goals. The need is to develop one comprehensively structured indicator system useful for all levels of planning, and capable of coherent interaction. The system of indicators should permit development of commensurable connectives adaptable in form, but not necessarily applicable in content, to all levels of planning.

On another related point, the apparent position of the Panel is untenable. The Report concluded that situational planning requires only two elements: analysis of the action variables and social structure. But consider the nature of a relatively mature social indicator. It consists of three identifiable elements: 1) actual data (generally in quantified form); 2) an explicit identification with a goal; and 3) measuring devices which connect the data and the goal in terms of some measure of achievement. Without explicit goal identification functioning in an interconnected system such measurements could not be made, or at least they would be based on totally implicit and subjective delineation of the social indicator. But, then the question arises as to whom identifies the relevant social indicators. If a systematic, relatively complete and coherent system of evaluation is desired, the same goal structure, once identified, is necessary for all levels of situational and comprehensive planning.

Especially in the water resource field, reactive planning will be increasingly constrained by comprehensive planning and will have to be defended within

the good framework of comprehensive plans and tested against alternative resource allocation opportunities. Associated and far-reaching impacts will have to be judged. Hopefully, comprehensive planning will retain the broadest possible format for situational planning, but, it is unlikely that it can escape the same standard of justification either directly or by its consistency with those situational plans.

Also, in suggesting that a sub-objective or goal is defined by the "set of social indicators that give it empirical substance," the Panel excludes all qualitative or non-measurable cause-effect relationships in resources planning. This we feel they did not intend to imply, or if they did, the Technical Committee does not concur with their position. One of the building blocks of the "Straw Man" methodology is the mixing, within the context of a consistent systems framework, of qualitative and quantitative goals, sub-goals, connectives, and social indicators. Is there a quantitative measure or measures of the magnitude of aesthetic enjoyment in viewing a smogless sunset or unobstructed natural vista? Perhaps there will be in the future but for now the Technical Committee believes that "qualitative" planning is preferred to no planning for non-measurable goals and sub-goals.

The Technical Committee is in agreement with the Panel regarding the other comments and suggestions, including the "resiliency indicator set," and will attempt to alter the planning methodology's structure accordingly. Further definition and refinement of the environmental security goal and its general conceptualization within the planning methodology outlined here adds insurance that there will be continuing attention given to the environmental area.

APPENDIX IV

TECHNICAL COMMITTEE AND PANEL PERSONNEL

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