

ECONOMIC AND ENVIRONMENTAL
PRINCIPLES AND GUIDELINES
FOR WATER AND RELATED LAND RESOURCES
IMPLEMENTATION STUDIES

March 10, 1983

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Foreword

These Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies have been developed to guide the formulation and evaluation studies of the major Federal water resources development agencies. This document is the product of extensive work by experts from a variety of professions and was developed with the help of hundreds of comments from the public. It contains the best currently available methods for calculating the benefits and costs of water resources development alternatives accurately and consistently, and is intended to ensure proper and consistent planning by the covered Federal agencies. **I am confident that these Principles and Guidelines will enhance our ability to identify and recommend to the Congress economically and environmentally sound water project alternatives.**

In accordance with section 103 of the Water Resources Planning Act, as amended (42 U.S.C. 1962a-2), the Water Resources Council voted on September 9, 1982, to repeal the existing Principles, Standards and Procedures (18 CFR, Parts 711, 713, 714, and 716) and to establish these Principles and Guidelines. The President approved the Principles on February 3, 1983. In accordance with Executive Order 11747 (38 FR 30993, November 7, 1973), I hereby approve the new Standards (Chapter I) and Procedures (Chapters II and III).

<Signature of James G. Watt>

James G. Watt
Chairman
U.S. Water Resources Council

Economic and Environmental Principles for Water and Related Land Resources Implementation Studies

These Principles are established pursuant to the Water Resources Planning Act of 1965 (Pub. L. 89-80), as amended (42 U.S.C. 1962a-2 and d-1). These Principles supersede the Principles established in connection with promulgation of principles, standards and procedures at 18 CFR, Parts 711, 713, 714 and 716.

1. Purpose and Scope

These principles are intended to ensure proper and consistent planning by Federal agencies in the formulation and evaluation of water and related land resources implementation studies.

Implementation studies of the following agency activities are covered by these principles:

- (a) Corps of Engineers (Civil Works) water resources project plans;
- (b) Bureau of Reclamation water resources project plans;
- (c) Tennessee Valley Authority water resources project plans;
- (d) Soil Conservation Service water resources project plans.

Implementation studies are pre- or post authorization project formulation or evaluation studies undertaken by Federal agencies.

2. Federal Objective

The Federal objective of water and related land resources project planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

- (a) Water and related land resources project plans shall be formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective.
- (b) Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the Nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also of those that may not be marketed.

3. State and Local Concerns

Federal water resources planning is to be responsive to State and local concerns. Accordingly, State and local participation is to be encouraged in all aspects of water resources planning. Federal agencies are to contact Governors or designated State agencies for each affected State before initiating studies, and to provide appropriate opportunities for State participation. It is recognized, however, that water projects which are local, regional, statewide, or even interstate in scope do not necessarily require a major role for the Federal Government; non-Federal, voluntary arrangements between affected jurisdictions may often be adequate. States and localities are free to initiate planning and implementation of water projects.

4. International Concerns

Federal water resources planning is to take into account international implications, including treaty obligations. Timely consultations with the relevant foreign government should be undertaken when a Federal water project is likely to have a significant impact on any land or water resources within its territorial boundaries.

5. Alternative Plans

Various alternative plans are to be formulated in a systematic manner to ensure that all reasonable alternatives are evaluated.

- (a) A plan that reasonably maximizes net national economic development benefits, consistent with the Federal objective, is to be formulated. This plan is to be identified as the NED plan.
- (b) Other plans which reduce net NED benefits in order to further address other Federal, State, local, and international concerns not fully addressed by the NED plan should also be formulated.
- (c) Plans may be formulated which require changes in existing statutes, administrative regulations, and established common law; such required changes are to be identified.
- (d) Each alternative plan is to be formulated in consideration of four criteria: completeness, effectiveness, efficiency, and acceptability. Appropriate mitigation of adverse effects is to be an integral part of each alternative plan.

- (e) Existing water and related land resources plans, such as State water resources plans, are to be considered as alternative plans if within the scope of the planning effort.

6. Plan Selection

A plan recommending Federal action is to be the alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment (the NED plan), unless the Secretary of a department or head of an independent agency grants an exception to this rule. Exceptions may be made when there are overriding reasons for recommending another plan, based on other Federal, State, local and international concerns.

7. Accounts

Four accounts are established to facilitate evaluation and display of effects of alternative plans. The national economic development account is required. ~~Other information that is required by law or that will~~ have a material bearing on the decision making process should be included in the other accounts, or in some other appropriate format used to organize information on effects.

- (a) The national economic development (NED) account displays changes in the economic value of the national output of goods and services.
- (b) The environmental quality (EQ) account displays non monetary effects on significant natural and cultural resources.
- (c) The regional economic development (RED) account registers changes in the distribution of regional economic activity that result from each alternative plan. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output, and population.
- (d) The other social effects (OSE) account registers plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

8. Discount Rate

Discounting is to be used to convert future monetary values to present values.

9. Period of Analysis

The period of analysis to be the same for each alternative plan.

10. Risk and Uncertainty

Planners shall identify areas of risk and uncertainty in their analysis and describe them clearly, so that decisions can be made with knowledge of the degree of reliability of the estimated benefits and costs and of the effectiveness of alternative plans.

11. Cost Allocation

For allocating total project financial costs among the purposes served by a plan, separable costs will be assigned to their respective purposes, and all joint costs will be allocated to purposes for which the plan was formulated. (Cost sharing policies for water projects will be addressed separately.)

12. Planning Guidelines

In order to ensure consistency of Federal agency planning necessary for purposes of budget and policy decisions and to aid States and the public in ~~evaluation of project alternatives, the Water Resources Council (WRC), in cooperation with the Cabinet Council on Natural Resources and Environment, shall issue standards and procedures, in the form of guidelines, implementing these Principles.~~ The head of each Federal agency subject to this order will be responsible for consistent application of the guidelines. An agency may propose agency guidelines which differ from the guidelines issued by WRC. Such agency guidelines and suggestions for improvements in the WRC guidelines are to be submitted to WRC for review and approval. The WRC will forward all agency proposed guidelines which represent changes in established policy to the Cabinet Council on Natural Resources and Environment for its consideration.

13. Effective Date

These Principles shall apply to implementation studies completed more than 120 days after issuance of the standards and procedures referenced in Section 12, and concomitant repeal of 18 CFR, Parts 711, 713, 714, and 716.

These economic and environmental Principles are hereby approved.

<Signature of the President of the United States,
Ronald Reagan>

February 3, 1983

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CHAPTER I — STANDARDS

Section I — Introduction

1.1.1 Purpose and Scope.

(a) These Guidelines establish standards and procedures for use by Federal agencies in formulating and evaluating alternative plans for water and related land resources implementation studies. These Guidelines implement the Principles for Water and Related Land Resources Implementation Studies.

(b) These Guidelines are for Federal administrative purposes and shall not create any substantive or procedural rights in private parties.

(c) Departures in an individual study from these Guidelines are to be documented and justified in the study report.

(d) Implementation studies are pre- or postauthorization project formulation or evaluation studies undertaken by a Federal agency. Studies for the following agency activities are covered:

(1) Corps of Engineers (Civil Works) water resources project plans.

(2) Bureau of Reclamation water resources project plans.

(3) Tennessee Valley Authority water resources project plans.

(4) Soil Conservation Service water resources project plans.

(e) These Guidelines establish the basic process for Federal agencies in carrying out implementation studies. Activities conducted pursuant to the requirements of the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321, *et. seq.*) are to be fully integrated with this process.

(f) The accounts described in these Guidelines encompass and are consistent with the concept of human environment as used in NEPA and the appropriate portions of the NEPA regulations established by the Council on Environmental Quality (CEQ) in 40 CFR Parts 1500-1508.

1.1.2 Authority.

These Guidelines are established pursuant to Section 103 of the Water Resources Planning Act (Pub. L. 89-80) and Executive Order 11747.

1.1.3 Applicability.

(a) These Guidelines apply to implementation studies completed more than 120 days after issuance of the Guidelines. Studies completed within 120 days should be concluded in accordance with the guidance applicable to them prior to issuance of these Guidelines.

(b) Preauthorization or postauthorization studies are considered completed when the appropriate planning documents have been approved by the responsible agency's field office.

(c) In the case of reevaluation studies in which there is no reformulation of the plan, the portions of this chapter dealing with plan formulation do not apply.

(d) The administrator of each Federal or Federally assisted program covered is responsible for applying these Guidelines.

Section II —The Federal Objective.

(a) The Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

(b) Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also of those that may not be marketed.

(c) The Federal objective for the relevant planning setting should be stated in terms of an expressed desire to alleviate problems and realize opportunities related to the output of goods and services or to increased economic efficiency.

(d) Each statement of a problem or opportunity should be expressed in terms of a desired output. Example statements are—

(1) Reduce flood losses in the Red River floodplain to increase agriculture production;

(2) Reduce the cost of agricultural production in the irrigated sector of Tolland County; and

(3) Increase the value of the recreational experience at Lake Zoar.

Section III — Summary of the Planning Process

1.3.1 Introduction.

The planning process consists of a series of steps that identifies or responds to problems and opportunities associated with the Federal objective and specific State and local concerns, and culminates in the selection of a recommended plan. The process involves an orderly and systematic approach to making determinations and decisions at each step so that the interested public and decisionmakers in the planning organization can be fully aware of: the basic assumptions employed; the data and information analyzed; the areas of risk and uncertainty; the reasons and rationales used; and the significant implications of each alternative plan.

1.3.2 Major Steps.

(a) The planning process consists of the following major steps:

(1) Specification of the water and related land resources problems and opportunities (relevant to the planning setting) associated with the Federal objective and specific State and local concerns.

(2) Inventory, forecast, and analysis of water and related land resource conditions within the planning area relevant to the identified problems and opportunities.

(3) Formulation of alternative plans.

(4) Evaluation of the effects of the alternative plans.

(5) Comparison of alternative plans.

(6) Selection of a recommended plan based upon the comparison of alternative plans.

(b) Plan formulation is a dynamic process with various steps that should be iterated one or more times. This iteration process, which may occur at any step, may sharpen the planning focus or change its emphasis as new data are obtained or as the specification of problems or opportunities changes or becomes more clearly defined.

1.3.3 Specification of the Problems and Opportunities Associated With the Federal Objective and Specific State and Local Concerns.

(a) The desire to alleviate problems and realize opportunities should be specified for the planning area in terms of the Federal objective and specific State and local concerns. The problems and opportunities should be defined so that their definition does not dictate a narrow range of alternatives.

(b) The problems and opportunities should be defined in such a way that meaningful levels of achievement can be identified. This will facilitate the formulation of alternative plans in cases in which there may be financial, environmental, technical, legislative, or administrative constraints on the total alleviation of a problem or realization of an opportunity.

(c) The problems and opportunities should be stated for both current and future conditions. Desired conditions for the future should be explicitly stated.

(d) The problems and opportunities should reflect the specific effects that are desired by groups and individuals as well as the problems and opportunities declared to be in the national interest by the Congress or the Executive Branch. This identification and detailing of problems and opportunities is the process of making explicit the range of preferences and desires of those affected by resource development. It should be understood that the initial expressions of problems and opportunities may be modified during the planning process.

1.3.4 Inventory and Forecast of Water and Related Land Resource Conditions.

The potential for alleviating problems and realizing opportunities is determined during inventorying and forecasting. The inventory and forecast of resource conditions should be related to the problems and opportunities previously identified.

1.3.5 Formulation of Alternative Plans.

Alternative plans are to be formulated in a systematic manner to insure that all reasonable alternatives are evaluated. Usually, a number of alternative plans are identified early in the planning process and become more refined through additional development and through subsequent iterations. Additional alternative plans may be introduced at any time.

1.3.6 Evaluation of Effects.

(a) *General.* The evaluation of the effects of each alternative plan consists of assessment and appraisal.

(b) *Assessment.* Assessment is the process of measuring or estimating the effects of an alternative plan. Assessment determines the difference between without-plan and with-plan conditions for each of the categories of effects.

(c) *Appraisal.*

(1) Appraisal is the process of assigning social values to the technical information gathered as part of the assessment process.

(2) Since technical data concerning benefits and costs in the NED account are expressed in monetary units, the NED account already contains a weighting of effects; therefore, appraisal is applicable only to the EQ, RED, and OSE evaluations.

(d) *Displays.* The results of the evaluation should be displayed according to the directions provided in Section VIII—Displays.

1.3.7 Comparison of Alternative Plans.

(a) The comparison of plans focuses on the differences among the alternative plans as determined in the evaluation phase.

(b) The differences should be organized on the basis of the effects in the four accounts or on a combination of the NED account and another appropriate format for other significant effects.

1.3.8 Plan Selection.

After consideration of the various alternative plans, their effects, and public comments, a plan is selected following the general guidance in Section X—Plan Selection.

Section IV—General Planning Considerations

1.4.1 Federal-State Relationship in Planning.

(a) The responsible Federal planning agency is to contact the Governor or designated agency for each affected State before initiating a study and enter into such agreements as are appropriate to carry out a coordinated planning effort.

(b) The State agency or agencies responsible for or concerned with water planning are to be provided with appropriate opportunities to participate in

defining the problems and opportunities, in scoping the study, and in review and consultation.

1.4.2 International Consultations.

When a Federal water project is likely to have a significant impact on any land or resources situated in a foreign country or to affect treaty obligations, the responsible Federal planning agency, through the Department of State, should enter into consultations with the government of the affected country, with a view to determining the international implications of the project under consideration.

1.4.3 General Public Participation.

(a) Interested and affected agencies, groups, and individuals should be provided opportunities to participate throughout the planning process. The responsible Federal planning agency should contact and solicit participation of: other Federal agencies; appropriate regional, State, and local agencies; national, regional and local groups; other appropriate groups such as affected Indian tribes; and individuals. A coordinated public participation program should be established with willing agencies and groups.

(b) Efforts to secure public participation should be pursued through appropriate means such as public hearings, public meetings, workshops, information programs, and citizen committees.

1.4.4 Review and Consultation.

Review and consultation with interested and affected agencies, groups, and individuals are needed in the planning process. Reviews are to be consistent with the requirements of applicable Federal statutes and the CEQ NEPA regulations (40 CFR Parts 1500-1508). The planning process described in these Guidelines and the CEQ and NEPA regulations are complementary.

1.4.5 Interdisciplinary Planning.

An interdisciplinary approach should be used in planning to ensure the integrated use of the natural and social sciences and the environmental design arts. The disciplines of the planners should be appropriate to the issues identified in the scoping process. The planning agency should supplement its available expertise, as necessary, with knowledgeable experts from cooperating agencies, universities, consultants, etc.

1.4.6 Agency Decisionmaking.

Decisionmaking is a dynamic process that leads to selection of a recommended plan. Decision making begins at the field level and occurs at different levels through subsequent reviews and approvals as required by the agency until it reaches the level having authority to approve the project (final level). The individual in the responsible planning agency making the decisions at each level is referred to as the "agency decisionmaker." The identity of the agency decisionmaker depends upon the level of project development and review. For projects requiring congressional authorization, the final agency decisionmaker is the Secretary of the Department or head of the independent agency. For projects that do not require congressional approval, the final decisionmaker is the Secretary of the Department, head of the agency, or such other official as appropriately delegated.

1.4.7 Planning Area.

The planning area is a geographic space with an identified boundary that includes:

- (a) The area identified in the study's authorizing document;
- (b) The locations of alternative plans, often called "project areas"; and
- (c) The locations of resources that would be directly, indirectly, or cumulatively affected by alternative plans, often called the "affected area."

1.4.8 Scoping.

(a) Planning should include an early and open process termed "scoping" to identify both the likely significant issues to be addressed and the range of those issues. This process is complementary with the scoping process described in the CEQ NEPA regulations (40 CFR Parts 1500-1508). The agency should begin scoping as soon as practicable after a decision to begin planning. The scoping process should include affected Federal, State, and local agencies and other interested groups or persons. Scoping should be used as appropriate throughout planning to ensure that all significant - decisionmaking factors are addressed and that unneeded and extraneous studies are not undertaken.

(b) As part of the scoping process, the agency should:

- (1) Determine the extent to which the likely significant issues will be analyzed.

(2) Define the planning area based on the problems and opportunities and the geographic areas likely to be affected by alternative plans.

(3) Identify and eliminate from detailed study any issues that are not significant or that have been adequately covered by prior study. However, important issues, even though covered by other studies, should still be considered in the analysis.

(4) Identify any current or future planning that is related to but not part of the study under consideration.

(5) Identify review and consultation requirements so that cooperating agencies (as defined in 40 CFR 1508.5) may prepare required analyses and studies concurrently with the study under consideration.

(6) Indicate the tentative planning and decision-making schedule.

(7) The scoping process should be integrated with other early planning activities.

(c) Scoping may be used to combine or narrow the number of problems and opportunities, measures, plans, effects, etc., under consideration so that meaningful and efficient analysis and choice among alternative plans can occur.

(d) Scoping should include consideration of ground water problems and opportunities, including conjunctive use of ground and surface water, and in stream flow problems. Appropriate consideration should be given to existing water rights in scoping the planning effort.

1.4.9 Forecasting.

(a) Formulation and evaluation of alternative plans should be based on the most likely conditions expected to exist in the future with and without the plan. The without-plan condition is the condition expected to prevail if no action is taken. The with-plan condition is the condition expected to prevail with the particular plan under consideration.

(b) The forecasts of with- and without-plan conditions should use the inventory of existing conditions as the baseline, and should be based on consideration of the following (including direct, indirect, and cumulative effects)—

(1) National regional projections of income, employment, output, and population prepared and published by the Department of Commerce.

(2) Other aggregate projections such as exports, land use trends, and amounts of goods and services likely to be demanded;

(3) Expected environmental conditions; and

(4) Specific, authoritative projections for small areas.

Appropriate national and regional projections should be used as an underlying forecasting framework, and inconsistencies therewith, while permissible, should be documented and justified.

(c) National projections used in planning are to be based on a full employment economy. In this context, assumption of a full employment economy establishes a rationale for general use of market prices in estimating economic benefits and costs, but does not preclude consideration of special analyses of regions with high rates of unemployment and underemployment in calculating benefits from using unemployed and underemployed labor resources.

(d) National and State environmental and health standards and regulations should be recognized and appropriately considered in scoping the planning effort. Standards and regulations concerning water quality, air quality, public health, wetlands protection, and floodplain management should be given specific consideration in forecasting the with- and without-plan condition.

(e) Other plans that have been adopted for the planning area and other current planning efforts should be considered.

(f) Forecasts should be made for selected years over the period of analysis to indicate how changes in economic and other conditions are likely to have an impact on problems and opportunities.

1.4.10 Prices.

(a) The prices of goods and services used for evaluation should reflect the real exchange values expected to prevail over the period of analysis. For this purpose, relative price relationships of outputs and inputs prevailing during, or immediately preceding, the period of planning generally represent the real price relationships expected over the life of the plan, unless specific considerations indicate real exchange values are expected to change.

(b) The general level of prices for outputs and inputs prevailing during or immediately preceding the period of planning is to be used for the entire period of analysis. In the case of agricultural planning, normalized prices prepared by the Department of Agriculture should be used.

1.4.11 Discount Rate.

Discounting is to be used to convert future monetary values to present values. Calculate

present values using the discount rate established annually for the formulation and economic evaluation of plans for water and related land resources plans.

1.4.12 Period of Analysis.

(a) The period of analysis is to be the same for each alternative plan. The period of analysis is to be the time required for implementation plus the lesser of—

(1) The period of time over which any alternative plan would have significant beneficial or adverse effects; or

(2) A period not to exceed 100 years.

(b) Appropriate consideration should be given to environmental factors that may extend beyond the period of analysis.

1.4.13 Risk and Uncertainty— Sensitivity Analysis.

(a) Plans and their effects should be examined to determine the uncertainty inherent in the data or various assumptions of future economic, demographic, social, attitudinal, environmental, and technological trends. A limited number of reasonable alternative forecasts that would, if realized, appreciably affect plan design should be considered.

(b) The planner's primary role in dealing with risk and uncertainty is to identify the areas of sensitivity and describe them clearly so that decisions can be made with knowledge of the degree of reliability of available information.

(c) Situations of risk are defined as those in which the potential outcomes can be described in reasonably well-known probability distributions such as the probability of particular flood events. Situations of uncertainty are defined as those in which potential outcomes cannot be described in objectively known probability distributions.

(d) Risk and uncertainty arise from measurement errors and from the underlying variability of complex natural, social, and economic situations. Methods of dealing with risk and uncertainty include:

(1) Collecting more detailed data to reduce measurement error.

(2) Using more refined analytic techniques.

(3) Increasing safety factors in design.

(4) Selecting measures with better known performance characteristics.

(5) Reducing the irreversible or irretrievable commitments of resources.

(6) Performing a sensitivity analysis of the estimated benefits and costs of alternative plans.

(e) Reducing risk and uncertainty may involve increased costs or loss of benefits. The advantages and costs of reducing risk and uncertainty should be considered in the planning process. Additional information on risk and uncertainty can be found in Supplement I to this chapter.

1.4.14 Documentation.

Planning studies are to be documented in a clear, concise manner that explains the basic assumptions and decisions that were made and the reasons for them. The documentation should be prepared in a manner to expedite review and decisionmaking.

Section V — Inventory and Forecast of Conditions Without a Plan

1.5.1 Resource Conditions.

(a) An inventory should be made to determine the quantity and quality of water and related land resources of the planning area and to identify opportunities for protection and enhancement of those resources. The inventory should include data appropriate to the identified problems and opportunities, as determined by scoping, and the potential for formulating and evaluating alternative plans. The inventory does not necessarily include an exhaustive listing of resources of the area. This inventory should describe the existing conditions and should be the baseline for forecasting with- and without-plan conditions.

(b) The most likely future condition without a plan should be used for evaluating the effects of alternative plans.

1.5.2 Problems and Opportunities.

(a) Inventory and forecasting should include an analysis of the identified problems and Opportunities and their implications for the planning setting. Resource inventories should be limited to resources affecting the problems and opportunities or likely to be affected by the alternative plans. As alternative plans are developed or refined, the adequacy of these resource inventories should be reassessed. This analysis should be used to redefine the specific problems and opportunities associated with the Federal objective and other State and local concerns.

(b) Based on this analysis, an appraisal should be made of the potential for alleviating the problems and realizing the opportunities. The appraisal provides guidance on the possible scope and magnitude of actions needed to address each problem or opportunity. This appraisal should identify possibilities for management, development, preservation, and other opportunities for action. Resource inventories and forecasts may suggest additional problems or opportunities. These possibilities will indicate the resource capabilities relative to specific commodities, services, or environmental amenities desired by the public. By proper selection of these development or management possibilities, alternatives may be formulated for each problem or opportunity.

Section VI — Alternative Plans

1.6.1 General.

(a) An alternative plan consists of a system of structural and/or nonstructural measures, strategies, or programs formulated to alleviate specific problems or take advantage of specific opportunities associated with water and related land resources in the planning area.

(b) Alternative plans should be significantly differentiated from each other.

(c) Alternative plans should not be limited to those the Federal planning agency could implement directly under current authorities. Plans that could be implemented under the authorities of other Federal agencies, State and local entities, and nongovernment interests should also be considered.

(d) Alternative plans may either—

(1) Be in compliance with existing statutes, administrative regulations, and established common law; or

(2) Propose necessary changes in such statutes, regulations, or common law.

(e) A range of measures that can, over time, balance water demand for various purposes with water availability should be considered, including measures that will—

(1) Reduce the demand for water;

(2) Improve efficiency in use and reduce losses and waste;

(3) Improve land management practices to conserve water; and/or

(4) Increase the available supply of water.

(f) Nonstructural measures should be considered as means for addressing problems and opportunities.

(1) Nonstructural measures are complete or partial alternatives to traditional structural measures. Nonstructural measures include modifications in public policy, management practice, regulatory policy, and pricing policy.

(2) A nonstructural measure or measures may in some cases offer a complete alternative to a traditional structural measure or measures. In other cases, nonstructural measures may be combined with fewer or smaller traditional structural measures to produce a complete alternative plan.

(g) Protection of the Nation's environment is to be provided by mitigation (as defined in 40 CFR 1508.20) of the adverse effects (as defined in 40 CFR 1508.8) of each alternative plan. Accordingly, each alternative plan should include mitigation determined to be appropriate by the agency decision-maker.

(1) Appropriate mitigation to address effects on fish and wildlife and their habitat should be determined in consultation with Federal and State fish and wildlife agencies in accordance with the Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 661-666(c)), or other appropriate authority.

(2) Appropriate mitigation to address other adverse effects should be determined in accordance with applicable laws, regulations, and Executive Orders.

(3) Mitigation measures determined to be appropriate should be planned for concurrent implementation with other major project features, where practical.

(h) Other existing water and related land resource plans, such as State water resource plans, should be considered as alternative plans if within the scope of the planning effort.

(i) Various schedules, including staged construction, for implementing alternative plans should be considered.

1.6.2 Formulation

(a) Alternative plans which contribute to the Federal objective should be systematically formulated, in addition to a plan which reasonably maximizes contributions to NED, other plans may be formulated which reduce net NED benefits in order to further address other Federal, State, local, and international concerns not fully addressed by the NED plan. These additional plans should be

formulated in order to allow the decisionmaker the opportunity to judge whether these beneficial effects outweigh the corresponding NED losses.

(b) In general, in the formulation of alternative plans, an effort is made to include only increments that provide net NED benefits after accounting for appropriate mitigation costs. Include appropriate mitigation of adverse environmental effects, as required by law, in all alternative plans. Increments that do not provide net NED benefits may be included, except in the NED plan if they are cost-effective measures for addressing specific concerns.

(c) Alternative plans, including the NED plan, should be formulated in consideration of four criteria: Completeness; effectiveness; efficiency; and acceptability.

(1) Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective.

(2) Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

(3) Efficiency is the extent to which an alternative plan is the most cost effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.

(4) Acceptability is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies.

1.6.3 The NED Plan

A plan that reasonably maximizes net national economic development benefits, consistent with the Federal objective, is to be formulated. This plan is to be identified as the national economic development plan.

1.6.4 Other Alternative Plans

(a) Other alternative plans should be formulated to adequately explore opportunities to address other Federal, State, local, and international concerns not fully addressed by the NED plan.

(b) The number and variety of alternative plans should be governed by—

(1) The problems and opportunities associated with the water and related land resources in the study area;

(2) The overall resource capabilities of the study area;

(3) The available alternative measures; and

(4) Preferences of and conflicts among State and local entities and different segments of the public.

(c) When institutional barriers would prevent implementation of an economically attractive plan, alternative plans which include removal of those barriers should be presented where such plans are implementable.

Section VII — Accounts

1.7.1 General.

(a) Four accounts are established to facilitate evaluation and display of the effects of alternative plans. These accounts are: national economic development (NED), environmental quality (EQ), regional economic development (RED), and other social effects (OSE). These four accounts encompass all significant effects of a plan on the human environment as required by the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 *et seq.*). They also encompass social well-being as required by Section 122 of the Flood Control Act of 1970 (Pub. L. 91-611, 84 Stat. 1823). The EQ account shows effects on ecological, cultural, and aesthetic attributes of significant natural and cultural resources that cannot be measured in monetary terms. The OSE account shows urban and community impacts and effects on life, health and safety. The NED account shows effects on the national economy. The RED account shows the regional incidence of NED effects, income transfers, and employment effects.

(b) The NED account is the only required account. Other information that is required by law or that will have a material bearing on the decisionmaking process should be included in the other accounts (EQ, RED, and OSE) or in some other appropriate format used to organize information on effects.

(c) The same effect may be shown only once within a given account except that the OSE account may show the incidence of an effect from more than one point of view. Beyond this exception, claiming the same benefit, cost, change in a resource attribute, or effect more than once in a given account would constitute double counting.

(d) Relationships between short-term use of the human environment and the maintenance and en-

hancement of long-term productivity should be displayed. Any irreversible or irretrievable commitments of resources should be displayed.

(e) Effects on the values and attributes of ground water and instream flow should be displayed.

(f) Effects of an alternative plan in the displays are the differences between the forecasted conditions with the plan and forecasted conditions without the plan.

(g) Effects in the NED account are to be expressed in monetary units. EQ effects are to be expressed in appropriate numeric units or non-numeric terms. RED and OSE effects are to be expressed in monetary units, other numeric units, or non-numeric terms.

(h) Monetary values are to be expressed in average annual equivalents by appropriate discounting and annualizing techniques using the applicable discount rate.

1.7.2 National Economic Development Account.

(a) General.

(1) The NED account describes that part of the NEPA human environment, as defined in 40 CFR 1508.14, that identifies beneficial and adverse effects on the economy.

(2) Beneficial effects in the NED account are increases in the economic value of the national output of goods and services from a plan; the value of output resulting from external economies caused by a plan; and the value associated with the use of otherwise unemployed or under-employed labor resources.

(3) Adverse effects in the NED account are the opportunity costs of resources used in implementing a plan. These adverse effects include: Implementation outlays, associated costs, and other direct costs.

(4) Procedures which should be used for evaluating NED effects are in Chapter II of these Guidelines.

(i) When an alternative procedure provides a more accurate estimate of a benefit, the alternative estimate may also be shown if the procedure is documented.

(ii) Steps in a procedure may be abbreviated by reducing the extent of the analysis and amount of data collected where greater accuracy or detail is clearly not justified by the cost of the plan components being analyzed. The steps abbreviated and the reason for abbreviation should be documented.

(iii) Proposals for additions to or changes in the procedures in Chapter II may be made when an agency head determines that the new technique will improve plan formulation and evaluation. These proposals are to be submitted to the Water Resources Council for review and approval for inclusion in Chapter II. Procedures which represent changes in established policy are to be referred to the Cabinet Council on Natural Resources and Environment for its consideration.

(b) *Goods and services*: General measurement standard. The general measurement standard of the value of goods and services is defined as the willingness of users to pay for each increment of output from a plan. Such a value would be obtained if the "seller" of the output were able to apply a variable unit price and charge each user an individual price to capture the full value of the output to the user. Since it is not possible in most instances for the planner to measure the actual demand situation, four alternative techniques can be used to obtain an estimate of the total value of the output of a plan: Willingness to pay based on actual or simulated market price; change in net income; cost of the most likely alternative; and administratively established values.

(1) *Actual or simulated market price*. If the additional output from a plan is too small to have a significant effect on price, actual or simulated market price will closely approximate the total value of the output and may be used to estimate willingness to pay. If the additional output is expected to have a significant effect on market price and if the price cannot be estimated for each increment of the change in output, a price midway between the price expected with and without the plan may be used to estimate the total value.

(2) *Change in net income*. The value of the change in output of intermediate goods and services from a plan is measured by their total value as inputs to producers. The total value of intermediate goods or services to producers is properly measured as the net income received by producers with a plan compared to net income received without a plan. Net income is defined as the market value of producers' outputs less the market value of producers' inputs exclusive of the cost of the intermediate goods or services from a plan. Increased net income from reduced cost of maintaining a given level of output is considered a benefit since released resources will be available for production of other goods and services.

(3) *Cost of the most likely alternative*. The cost of the most likely alternative may be used to estimate NED benefits for a particular output if non-Federal entities are likely to provide a similar output in the absence of any of the alternative plans under consideration and if NED benefits

cannot be estimated from market price or change in net income. This assumes, of course, that society would in fact undertake the alternative means. Estimates of benefit should be based on the cost of the most likely alternative only if there is evidence that the alternative would be implemented. In determining the most likely alternative, the planner should give adequate consideration to nonstructural and demand management measures as well as structural measures.

(4) *Administratively established values*. Administratively established values are proxy values for specific goods and services cooperatively established by the water resources agencies. An example of administratively established values is the range of unit-day values for recreation.

(c) *Goods and services: Categories*. The NED account includes goods and services in the following categories:

- (1) Municipal and industrial (M&I) water supply
- (2) Agricultural floodwater, erosion and sedimentation reduction
- (3) Agricultural drainage
- (4) Agricultural irrigation
- (5) Urban flood damage reduction
- (6) Power (hydropower)
- (7) Transportation (inland navigation)
- (8) Transportation (deep draft navigation)
- (9) Recreation
- (10) Commercial fishing

(11) Other categories of benefits for which procedures are documented in the planning report and which are in accordance with the general measurement standards in paragraph (b) of this section.

(d) *Other direct benefits*. The other direct benefits in the NED benefit evaluation are the incidental direct effects of a project that increase economic efficiency and are not otherwise accounted for in the evaluation of the plan or project. They are incidental to the purposes for which the water resources plan is being formulated. They include incidental increases in output of goods and services and incidental reductions in production costs. For example, a project planned only for flood damage reduction and hydropower purposes might reduce downstream water treatment costs; this reduction in costs would be shown as another direct benefit in the NED account.

(e) *Use of otherwise unemployed or underemployed labor resources*.

(1) The opportunity cost of employing otherwise unemployed and underemployed workers is equal to their earnings under the without plan conditions

(2) Conceptually, the effects of the use of unemployed or underemployed labor resources should be treated as an adjustment to the adverse effects of a plan on national economic development. Since this approach leads to difficulties in cost allocation and cost sharing calculations, the effects from the use of such labor resources are to be treated as an addition to the benefits resulting from a plan.

(3) Beneficial effects from the use of unemployed or underemployed labor resources are limited to labor employed on site in the construction or installation of a plan. This limitation reflects identification and measurement problems and the requirement that national projections are to be based on a full employment economy.

(4) If the planning region has substantial and persistent unemployment and these labor resources will be employed or more effectively employed in installation of the plan, the net additional payments to the unemployed and underemployed labor resources are defined as a benefit.

(f) *Adverse NED effects: Measurement standards.*

(1) In evaluating NED costs, resource use is broadly defined to include all aspects of the economic value of the resource. This broad definition requires consideration of the direct private and public uses that producers and consumers are currently making of available resources or are expected to make of them in the future.

(2) If market prices reflect the full economic value of a resource to society, they are to be used to determine NED costs. If market prices do not reflect these values, then an estimate of the other direct costs should be included in the NED costs.

(3) NED costs may reflect allowance for the salvage value of land, equipment, and facilities that would have value at the end of the period of analysis.

(g) *NED cost categories.* For convenience of measurement and analysis, NED costs should be classified as implementation outlays, associated costs and other direct costs.

(1) *Implementation outlays.* These are the financial outlays (including operation, maintenance and replacement costs) incurred by the responsible Federal entity and by other Federal or non-Federal entities for implementation of the plan in accordance with sound management principles. These costs do not include transfer payments such as replacement housing assistance payments as specified in 42 U.S.C. 4623 and 4624.

(2) *Associated costs.* These are the costs in addition to implementation outlays for measures needed to achieve the benefits claimed during the period of analysis. For example, associated costs would include the cost of irrigation water supply laterals if they are not accounted for in the benefit estimate.

(3) *Other direct costs.* These are the costs of resources directly required for a project or plan, but for which no implementation outlays are made. These costs are uncompensated, unmitigated NED losses caused by the installation, operation, maintenance, or replacement of project or plan measures. Examples of other direct costs include increased downstream flood damages caused by channel modifications, dikes, or the drainage of wetlands, increased water supply treatment costs caused by irrigation return flows, and displaced public recreation.

1.7.3 Environmental Quality Account.

(a) *General*

(1) The EQ account is a means of displaying and integrating into water resources planning that information on the effects of alternative plans on significant EQ resources and attributes of the NEPA human environment, as defined in 40 CFR 1507.14, that is essential to a reasoned choice among alternative plans. Significant means likely to have a material bearing on the decisionmaking process.

(2) Beneficial effects in the EQ account are favorable changes in the ecological, aesthetic, and cultural attributes of natural and cultural resources.

(3) Adverse effects in the EQ account are unfavorable changes in the ecological, aesthetic, and cultural attributes of natural and cultural resources.

(4) A suggested procedure which may be used for evaluating effects included in the EQ account appears in Chapter III of these Guidelines.

(b) *Significant EQ resources and attributes.*

(1) An EQ resource is a natural or cultural form, process, system, or other phenomenon that—

(i) Is related to land, water, atmosphere, plants, animals, or historic or cultural objects.

(ii) Has one or more EQ attributes (ecological, cultural, aesthetic).

(2) EQ attributes are the ecological, cultural, and aesthetic properties of natural and cultural resources that sustain and enrich human life.

(i) Ecological attributes are components of the environment and the interactions among all its living (including people) and nonliving components that directly or indirectly sustain dynamic, diverse, viable ecosystems. In this category are functional and structural aspects that require special consideration because of their unusual characteristics.

(ii) Cultural attributes are evidence of past and present habitation that can be used to reconstruct or preserve human lifeways. Included in this category are structures, sites, artifacts, environments, and other relevant information, and the physical contexts in which these occur.

(iii) Aesthetic attributes are perceptual stimuli that provide diverse and pleasant surroundings for human enjoyment and appreciation. Included in this category are sights, sounds, scents, tastes, and tactile impressions and the interactions of these sensations, of natural and cultural resources.

(3) Significant EQ resources and attributes should be identified based on institutional, public, and technical recognition.

(c) *Significant effects.*

(1) An effect on an EQ resource occurs whenever estimates of future with- and without-plan conditions of the resource are different.

(2) An effect may be described in terms of duration, frequency, location, magnitude, and other characteristics, such as reversibility, retrievability, and the relationships to long-term productivity, where their description is relevant and useful to decisionmaking.

(3) The significance of an effect may be established based on institutional, public, and technical recognition.

(d) *Summary.* There should be an overall summary of significant beneficial and adverse effects on EQ resources.

1.7.4 Regional Economic Development Account.

(a) *General*

(1) The RED account registers changes in the distribution of regional economic activity that result from each alternative plan. Two measures of the effects of the plan on regional economies are used in the account: Regional income and regional employment

(2) The regions used for RED analysis are those regions within which the plan will have particularly significant income and employment effects. Effects of a plan not occurring in the significantly affected regions are to be placed in a "rest of nation" category.

(3) Effects that cannot be satisfactorily quantified or described with available methods, data, and information or that will not have a material bearing on the decisionmaking process may be excluded from the RED account.

(b) *Positive effects on regional economic development.*

(i) *Regional income.* The positive effects of a plan on a region's income are equal to the sum of the NED benefits that accrue to that region, plus transfers of income to the region from outside the region.

(ii) Regional incidence of NED benefits. Because of the definition of region used for the RED account, all or almost all of the NED benefits for the plan will accrue to that region, plus transfers of income to the region from outside the region.

(ii) Transfers. Income transfers to a region as a result of a plan include income from: Implementation outlays, transfers of basic economic activity, indirect effects, and induced effects. In each case income transfers refer to increases in net income within the region rather than to increases in total expenditure.

(A) Income from implementation outlays is that portion of project outlays that becomes net income in the regional economy, exclusive of NED benefits from use of otherwise unemployed or underemployed labor resources.

(B) Income from transfers of basic economic activity is net income from economic activity that locates in the region as a direct result of differences between the with- and without-plan conditions.

(C) Income from indirect effects is regional net income resulting from expansion in the production of inputs to industries supplying increased final products and regional exports.

(D) Income from induced effects is regional net income resulting from changes in consumption expenditures generated by increases in personal income.

(2) *Regional employment.*

(i) The positive effects of a plan on regional employment are directly parallel to the positive effects on regional income, so that analysis of regional employment effects should be organized in the same categories using the same conceptual bases as the analysis of positive regional income effects. Regional employment associated with each of the regional income categories should be calculated and listed accordingly.

(ii) To the extent practical, planning reports should provide reasonable estimates of the composition of increased employment according to relevant service, trade, and industrial sectors,

including a separate estimate for agriculture. The nature of the employment increase to each sector should be classified as to the level of skill required—unskilled, semiskilled, and highly skilled.

(c) *Negative effects on regional economic development.*

(1) Regional income. The negative effects of a plan on a region's net income are equal to the sum of the NED costs of the plan that are borne by the region, plus transfers of income from the region to the rest of the Nation.

(i) Regional incidence of NED costs. The NED costs of a plan that are borne by a region should be organized in the same categories used in the cost section of the NED account. Information from the cost allocation and cost sharing analysis undertaken as a part of the planning process will be needed to estimate these direct expenditures.

(ii) Transfers. Income transfers from the region include net income losses from plan-induced shifts of economic activity from the region to the rest of the Nation and losses in existing transfer payments, plus any impacts that may affect the region as a result of NED costs or transfers from the region.

(2) *Regional employment.*

(i) The negative effects of a plan on regional employment should be organized and analyzed using the same categories and conceptual bases used for negative regional income effects (paragraph (c)(1) of this section).

(ii) The incidence of negative regional employment effects should be shown in a manner similar to that required for the positive regional employment effects.

(d) *Relationship between RED and NED effects.* Income information in the RED account should be organized in the same categories as the NED effects. The relationship between the affected regional economies and the national economy should be recognized. Since the NED account registers all effects on the national economy, any differences between the regional and national economic effects of a plan take the form of transfers from the rest of Nation. The effects of these transfers should be listed in a "rest of Nation" category. The effects in the rest of Nation category are equal to the difference between the RED effects and NED effects of a plan. This rest of nation category should be displayed in the RED account together with the RED and NED effects.

1.7.5 Other Social Effects Account.

(a) *General.*

(1) The OSE account is a means of displaying and integrating into water resource planning information on alternative plan effects from perspectives that are not reflected in the other three accounts. The categories of effects in the OSE account include the following: Urban and community impacts; life, health, and safety factors; displacement; long-term productivity; and energy requirements and energy conservation.

(2) Effects may be evaluated in terms of their impacts on the separate regions and communities affected.

(3) Effects on income, employment, and population distribution, fiscal condition, energy requirements, and energy conservation may be reported on a positive or negative basis. Effects on life, health, and safety may be reported as either beneficial or adverse. Other effects may be reported on either a positive negative basis or a beneficial adverse basis.

(4) Effects that cannot be satisfactorily quantified or described with available methods, data, and information or that will not have a material bearing on the decisionmaking process may be excluded from the OSE account.

(b) *Urban and community impacts.*

(1) A formal treatment of urban related impacts is not required for implementation studies. However, types and locations of significant impacts, broken down by salient population groups and geographic areas, may be reported in the OSE account.

(2) The principal types of urban and community impacts are—

(i) Income distribution;

(ii) Employment distribution, especially the share to minorities;

(iii) Population distribution and composition;

(iv) The fiscal condition of the State and local governments; and

(v) The quality of community life.

(c) *Life, health, and safety.* Effects in this category include such items as risk of flood, drought, or other disaster affecting the security of life, health, and safety; potential loss of life, property, and essential public services due to structural failure; and other environmental effects such as changes in air or water quality not reported in the NED and EQ accounts.

(d) *Displacement.* Effects in this category include the displacement of people, businesses, and farms.

(e) *Long-term productivity.* Effects in this category include maintenance and enhancement of the

productivity of resources, such as agricultural land, for use by future generations.

Section VIII—Displays

1.8.1 General.

(a) Displays are graphs, tables, drawings, photographs, summary statements, and other graphics in a format that facilitates the analysis and comparison of alternative plans. Concise, understandable displays are helpful during the planning process and provide documentation in compliance with NEPA.

(b) Displays should facilitate the evaluation and comparison of alternative plans necessary to make the following determination:

(1) The effectiveness of given plans in solving the problems and taking advantage of the opportunities identified in the planning process.

(2) What must be given up in monetary and non monetary terms to enjoy the benefits of the various alternative plans.

(3) The differences among alternative plans.

1.8.2 Content and Format.

The content and format of the displays should be determined by the planning agency according to the following guidance:

(a) Existing and forecasted resource conditions without any of the alternative plans and the problems and opportunities related to the planning setting should be reported.

Table 1.8.2.—Effects of the Recommended Plan on Natural and Cultural Resources

Types of resources	Authorities	Measurement of effects
Air Quality.....	Clean Air Act, as amended (42 U.S.C. 1857h-7 <i>et seq.</i>).	Enter area in square miles where State air quality classifications would change for each affected classification.
Areas of particular concern within the costal zone.	Costal Zone Management Act of 1972, as amended (16 U.S.C. 1451 <i>et seq.</i>)	Enter gains and losses in appropriate units.

Table 1.8.2.—Effects of the Recommended Plan on Natural and Cultural Resources

Types of Resources	Authorities	Measurement of effects ¹
Endangered and threatened species	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 <i>et seq.</i>).	(Enter list of species affected and area of each critical habitat type gained and lost in acres.)
Fish and Wildlife habitat	Fish and Wildlife Coordination Act (16 U.S.C. 661 <i>et seq.</i>)	(Enter area of each habitat type gained and lost, in acres.)
Floodplains.....	Executive Order 11988, Floodplain Management.	(Enter area gained and lost, in acres.)
Historic and Cultural properties	National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 <i>et seq.</i>).	(Enter number and type of National Register [listed or eligible] properties affected.)
Prime and Unique farmland	CEQ Memorandum of August 1, 1980: Analysis of Impacts on Prime or Unique Agricultural lands in implementing the National Environmental Policy Act.	(Enter area of each farmland type gained and lost, in acres.)
Water quality.....	Clean Water Act of 1977, as amended (42 U.S.C. 1857h-7 <i>et seq.</i>).	(Enter length in miles of water course, and area in acres for water bodies, where state water quality classifications would change for each classification.)
Wetlands.....	Executive Order 11990, Protection of Wetlands; Clean Water Act of 1977, as amended (42 U.S.C. 1857h-7 <i>et seq.</i>).	Enter area of each wetland type gained and lost, in acres.)
Wild and Scenic Rivers	Wild and Scenic Rivers Act, as amended (16 U.S.C. 1271 <i>et seq.</i>).	(Enter length of each river type gained and lost, in miles.)

¹ If a type of resource is not present in the planning area, enter "Not present in planning area." If a type of resource is not affected, enter "No effect."

(b) Displays regarding reasonable alternatives, including those required by NEPA, should include the following items:

(1) Measures in each plan.

(2) Effects in the NED account.

(3) Other effects, when shown in either the EQ, RED, and OSE accounts, or in some other appropriate format.

(c) For the recommended plan, an aggregate display of effects on natural and cultural resources, in the format of Table 1.8.2, should be included.

(d) A matrix should be included which shows existing or planned Federal and non-Federal projects or facilities having significant economic, environmental, or physical interactions with the recommended plan together with a brief narrative description of these interactions.

(e) Alternative actions that were considered but were not developed into plans should be described briefly. The descriptions should include the measures and effects and the reasons for not proceeding further.

Section IX — Cost Allocation

1.9.1 General.

(a) The need for cost allocation stems from pricing and cost-sharing policies that vary among purposes. Cost allocation is the process of apportioning total project financial costs among purposes served by a plan.

(b) Financial costs are implementation outlays, transfer payments such as replacement housing assistance payments as specified in 42 U.S.C. 4623 and 4624, and the market value of contributions in kind, e.g., lands.

(c) Financial costs are to be allocated to those purposes for which the plan is formulated. These purposes do not include other direct benefits (see Section 1.7.2(d)) and use of otherwise unemployed or underemployed labor resources. All purposes are to be treated comparably

1.9.2 Definitions.

(a) Separable cost for each purpose in a plan is the reduction in financial cost that would result if that purpose were excluded from the plan. This reduction in cost includes—

(1) The financial cost of measures serving only the excluded purpose; and

(2) Reductions in the financial cost of measures serving multiple purposes. In some cases removal of a purpose would result in selection of different measures to address the remaining purposes.

(b) Joint cost is the total financial cost for a plan minus the sum of separable financial costs for all purposes.

(c) Alternative cost for each purpose is the financial cost of achieving the same or equivalent benefits with a single-purpose plan.

(d) Remaining benefit for each purpose is the amount, if any, by which the NED benefit or, when appropriate, the alternative financial cost exceeds the separable financial cost for that purpose. The use of alternative cost is appropriate when alternative financial cost for the purpose is less than the NED benefit, or when there are project purposes that do not address the NED objective.

1.9.3 Cost Allocation Standard.

Costs allocated to each purpose are the sum of the separable cost for the purpose and a share of joint cost as specified below:

(a) Joint cost may be allocated among purposes in proportion to remaining benefits.

(b) Joint cost may be allocated in proportion to the use of facilities, provided that the sum of allocated joint cost and separable cost for any purpose does not exceed the lesser of the benefit or the alternative cost for that purpose.

1.9.4 Allocation of Constituent Cost.

Cost-sharing policies for some purposes pertain to cost constituents such as construction costs, and operation and maintenance costs. Costs for each cost constituent specified in the relevant cost sharing policy should be allocated among purposes.

Section X — Plan Selection

1.10.1 General.

The planning process leads to the identification of alternative plans that could be recommended or selected. The culmination of the planning process is the selection of the recommended plan or the decision to take no action. The selection should be based on a comparison of the effects of alternative plans. (See Section 1.6.2—Alternative Plans, Formulation.)

1.10.2 Selection.

(a) The alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment (the NED plan) is to be selected unless the Secretary of a department or head of an independent agency grants an exception when there is some overriding reason for selecting another plan, based upon other Federal, State, local, and international concerns.

(b) The alternative of taking no action, i.e., selecting none of the alternative plans, should be fully considered.

(c) Plan selection is made by the agency - decisionmaker for Federal and Federally-assisted plans. Agency officials and State and local sponsors may recommend selection of a plan other than the NED plan. The agency decisionmaker (the Secretary of a department or the head of an independent agency) will determine whether the reasons for selecting a plan other than the NED plan merit the granting of an exception.

(d) The basis for selection of the recommended plan should be fully reported, including considerations used in the selection process.

(e) Plans should not be recommended for Federal development if they would physically or economically preclude non-Federal plans that would likely be undertaken in the absence of the Federal plan and that would more effectively contribute to the Federal objective when comparably evaluated.

Supplement I

Risk and uncertainty—Sensitivity analysis

Uncertainty and variability are inherent in water resources planning. For example, there is uncertainty in projecting such factors as stream flows, population growth, and the demand for water. Therefore, the consideration of risk and uncertainty is important in water resources planning.

This supplement provides guidance for the evaluation of risk and uncertainty in the formulation of water resources management and development plans.

S1 Concepts.

(a) *Risk*. Situations of risk are conventionally defined as those in which the potential outcomes can be described in reasonably well known probability distributions. For example, if it is known that a river will flood to a specific level on the average of once in

20 years, a situation of risk, rather than uncertainty, exists.

(b) *Uncertainty*. In situations of uncertainty, potential outcomes cannot be described in objectively known probability distributions. Uncertainty is characteristic of many aspects of water resources planning. Because there are no known probability distributions to describe uncertain outcomes, uncertainty is substantially more difficult to analyze than risk.

(c) *Sources of risk and uncertainty*. (1) Risk and uncertainty arise from measurement errors and from the underlying variability of complex natural, social, and economic situations. If the analyst is uncertain because the data are imperfect or the analytical tools crude, the plan is subject to measurement errors. Improved data and refined analytic techniques will obviously help minimize measurement errors.

(2) Some future demographic, economic, hydrologic, and meteorological events are essentially unpredictable because they are subject to random influences. The question for the analyst is whether the randomness can be described by some probability distribution. If there is an historical data base that is applicable to the future, distributions can be described or approximated by objective techniques.

(3) If there is no such historical data base, the probability distribution of random future events can be described subjectively, based upon the best available insight and judgment.

(d) *Degrees of risk and uncertainty*. The degree of risk and uncertainty generally differs among various aspects of a project. It also differs over time, because benefits from a particular purpose or costs in a particular category may be relatively certain during one time period and uncertain during another. Finally, the degree of uncertainty differs at different stages of the analysis—for example, between rough screening and final detailed design, when more precise analytic methods can be applied.

(e) *Attitudes*. The attitudes of decisionmakers toward risk and uncertainty will govern the final selection of projects and of adjustments in design to accommodate risk and uncertainty. In principle, the government can be neutral toward risk and uncertainty, but the private sector may not be. These differences in attitudes should be taken into account in estimating the potential success of projects.

S2 Application.

(a) *The role of the planner*. (1) The planner's primary role in dealing with risk and uncertainty is to characterize to the extent possible the different degrees of risk and uncertainty and to describe them clearly so that decisions can be based on the best

available information. The planner should also suggest adjustments in design to reflect various attitudes of decisionmakers toward risk and uncertainty. If the planner can identify in qualitative terms the uncertainty inherent in important design, economic, and environmental variables, these judgments can be transformed into or assigned subjective probability distributions. A formal model characterizing the relationship of these and other relevant variables may be used to transform such distributions to exhibit the uncertainty in the final outcome, which again is represented by a probability distribution.

(2) At all stages of the planning process, the planning can incorporate any changes in project features that, as a result of information gained at that stage, could lead to a reduction in risk and uncertainty at a cost consistent with improvement in project performance.

(b) Some risk and uncertainty are assumed in nearly every aspect of a water resources project. Some types of risk and uncertainty are dealt with in terms of national planning parameters—for example, ranges of population projections and other principal economic and demographic variables. Other types of risk and uncertainty are dealt with in terms of project or regional estimates and forecasts. When projects are related to other projects and programs in their risk and uncertainty aspects (e.g., interrelated hydrologic systems), reasonable attempts should be made to see that the same analyses and presumed probability distributions are used for all of them.

(c) The risk and uncertainty aspects of projects are likely to be seen and analyzed differently as planning proceeds from rough screening to detailed project proposals. An effort should be made, therefore, to relate the techniques used in characterizing and dealing with risk and uncertainty to the stage of the planning process.

(d) The resources available for analyzing aspects of risk and uncertainty should be allocated to those assessments that appear to be the most important in their effects on project and program design. Rather than assuming in advance that one or another variable is a more important source of risk and uncertainty, the planner should make a thorough effort to determine which variables will be most useful in dealing with measurement errors and natural sources of risk and uncertainty.

(e) The aspects of project evaluation that can be characterized by a probability distribution based on reasonably firm data, such as hydrologic risk, can be treated by standard methods of risk evaluation developed by Federal agencies and others.

(f) Most risk and uncertainty aspects of projects cannot be characterized by probability distributions based on well established empirical data. A first step in dealing with this problem is to describe why the

project or specific aspects of it are uncertain, as well as the time periods in which different degrees of uncertainty are likely. A range of reasonably likely outcomes can then be described by using sensitivity analysis—the technique of varying assumptions as to alternative economic, demographic, environmental, and other factors, and examining the effects of these varying assumptions on outcomes of benefits and costs. In some cases and in some stages of planning, this approach, when accompanied by a careful description of the dimensions of uncertainty, will be sufficient. It can be accompanied by descriptions of design adjustments representing various attitudes toward uncertainty.

(g) It may be appropriate in some cases to characterize the range of outcomes with a set of subjective probability estimates, but the project report should make clear that the numerical estimates are subjective. Moreover, subjective probability distributions should be chosen and justified case by case, and some description of the impact on design of other subjective distributions should be given. Design alternatives reflecting various attitudes toward uncertainty may be suggested.

(h) Utility functions may be used in conjunction with assessments of uncertainty to explore design adaptations reflecting specific preferences. Public preferences, if well known, may be used to illustrate to decisionmakers what the best design would be, given the uncertainties and preferences in a particular case. If public preferences are not well known, justification could be given for the selection of various utility functions, which can be used only to illustrate the effects on design of various preferences.

(i) At each level of analysis, the planner should take into account the differences in risk and uncertainty among project purposes and costs, among various time periods, and among different stages of planning.

(j) Adjustments to risk and uncertainty in project evaluation can be characterized as general or specific. General adjustments include the addition of a premium rate to the interest, overestimation of costs, underestimation of benefits, and limitations on the period of analysis. Such general adjustments are usually inappropriate for public investment decisions because they tend to obscure the different degrees of uncertainty in different aspects of projects and programs. Specific adjustments—including explicit assessments of different degrees of risk and uncertainty in specific aspects of a project or program and specific adjustments to them—are preferable. Additional information on methods of dealing with risk and uncertainty can be found in Section 1.4.13(d) of Chapter 1.

(k) One guide to the use of the techniques discussed here is displayed in Table S-2. In general, more complex techniques are appropriate as planning proceeds from the initial development and the screening of alternatives to the analysis and presentation of the final set of alternative plans. For example, sensitivity analysis—testing the sensitivity of the outcome of project evaluation to variation in the magnitude of key parameters—may be most useful and applicable in the early stages of planning, when the concern is to understand single factors or relatively general multiple-factor relationships. Multiple-factor sensitivity analysis, in which the joint effects or correlations among underlying parameters are studied in greater depth, may be more appropriate in the detailed analytic stage than in the screening stage.

(l) Similarly, analysis of risk and uncertainty based on objective or subjective probability distributions would be more appropriate in the detailed analytic stage than in the early screening stage. Although hydrologic and economic probabilities may be used in the screening stage, the full use of independent and joint probability distributions, possibly developed from computer simulation methods, to describe expected values and variances, is more appropriately reserved for the detailed stage.

Table S-2 — Planning Task and Approaches to Risk and Uncertainty

	Planning Tasks		
	Screening alternatives	Detailed analysis of projects	Final presentation of alternatives
Sensitivity analysis.....	X	X	X
Use of objective and subjective probability distributions.....		X	X
Illustrative application of public preferences and decision-makers' attitudes.....		X	X

(m) Although decisionmakers' attitudes and decision rules can be used to give perspective on alternative designs throughout the planning process, they are more appropriate at the stage of displaying alternative designs.

(n) The differences among the underlying degrees of risk and uncertainty, the design adaptations to them, and the preferences of decisionmakers should be kept clear throughout the analysis. The first two depend primarily on technical expertise; the last is the set of preferences based on various attitudes toward risk and uncertainty.

S3 Report and display.

The assessment of risk and uncertainty in project evaluation should be reported and displayed in a manner that makes clear to the decisionmaker the types and degrees of risk and uncertainty believed to characterize the benefits and costs of the alternative plans considered.

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