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WATER RESOURCES PLANNING IN APPALACHIA^a

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INTRODUCTION

The Appalachian Regional Development Act of 1965 established a program to challenge the isolation, poverty, lack of opportunity, and underdevelopment which had come to characterize the Appalachian Region. A primary objective of the Act has been to initiate a program of public investment to help overcome the Region's deficits in social overhead capital and infrastructure and to promote maximum development and utilization of its human and natural resources. The Region's revitalization will require that its assets be developed in a complementary and reinforcing manner and that deficiencies be overcome in an equally coordinated fashion. This task has necessitated the formulation of new techniques to assure that the dimensions of each factor capable of contributing to the Region's growth be fully understood. It is the purpose of this paper to examine the unique process and project evaluation procedures developed to permit a regionwide assessment of Appalachia's water resources and formulation of a development plan in a manner consistent with the Region's overall growth strategy.

APPALACHIA'S WATER RESOURCES AND SURVEY OBJECTIVES

Water is one of the Region's most abundant resources. The physiographic nature of the Region makes it an integral portion of most major watersheds in the eastern United States. The area's terrain provides the channels for many rivers and streams. However, much of the Region's developable land area lies along these waterways. The President's Appalachian Regional Com-

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mission reported that "of the land that is suited for development, approximately 23 percent is located on or adjacent to the flood plain and therefore is subject to flooding (1)." This situation has made flood control a primary need in the Region and one which is prerequisite to active physical and economic development. In addition to protection efforts, programs to develop water resources are necessary. The provision of water for industrial and municipal uses is vital to achieving the Region's full development potential. Water management can also contribute to the full realization of the Region's recreational potential.

Water resource planning in Appalachia cannot be undertaken in a vacuum. Extensive water resource investment has already occurred in the Region. It is reported in "The Development of Water Resources in Appalachia," to be released later this year, that the construction cost of the facilities currently operating within Appalachia is estimated at \$2.25 billion with additional projects costing \$2.35 billion either under construction or in advanced planning stages and anticipated to be operational by 1980. In spite of this heavy commitment to water resource development, much remains to be done.

In light of the continuing opportunities for water resource development and given the broad range of existing and authorized facilities, the Appalachian Regional Development Act provided for a comprehensive regional water resource survey to be undertaken by the Corps of Engineers to determine the proper role of water in the Region's development and to formulate plans to accomplish that objective (3). Section 206 (a) of the Act states:

"The Secretary of the Army is hereby authorized and directed to prepare a comprehensive plan for the development and efficient utilization of the water and related resources of the Appalachian region, giving special attention to the need for an increase in the production of economic goods and services within the Region as a means of expanding economic opportunities and enhancing the welfare of its people, which plan shall constitute an integral and harmonious component of the regional economic development program authorized by this Act."

As derived from the Act and stated in The Plan of Survey, the study objectives of the Appalachian Water Resource Survey are: (1) To develop a comprehensive plan for efficient utilization of Appalachia's water and related resources; (2) to key the plan to the overall economic development program for the region, and the nation; (3) to improve knowledge concerning the economic effects of water resource development; (4) to recommend any urgently needed programs and projects; and (5) to provide for continuity of water resource planning after the completion of the Survey (4).

The Appalachian Water Resource Survey, begun in 1965, is now complete and its final report is presently being reviewed by its participants prior to submission to the President for transmittal to Congress as required in the Act.

SURVEY RESPONSIBILITY AND PLANNING PROCESS

The multitude of jurisdictions and agencies in the Region having significant responsibility in planning and programming its water resource development has made coordination during the Survey essential to its success. The vehicle

established to insure planning coordination was the Water Development Coordinating Committee for Appalachia. This committee is composed of representatives from each Appalachian State, the Appalachian Regional Commission, the Tennessee Valley Authority, the Federal Power Commission, and the Departments of Agriculture, Commerce, Interior and Health, Education and Welfare. It has been the function of the Coordinating Committee to review deliberations and actions of the Survey. These review efforts have permitted the Survey to benefit from exposure to the concepts, procedures and plans of departments and agencies whose activities have an impact on water resource development. This type of coordination has been especially critical given the volume and variety of existing and planned water resource development activity in the Region and the regional and comprehensive nature of the Appalachian development program.

The management of the Survey has been the responsibility of the Office of Appalachian Studies, a special Corps of Engineers office established for that purpose by the Secretary of the Army. It has been the function of this office to prepare survey guidelines and procedures, to formulate the Plan of Survey, to budget, to monitor the Corps Districts and other agencies assigned Survey responsibilities, and to write, edit and publish the final reports of the Survey. To accomplish the major tasks of the Survey, the Office of Appalachian Studies designed and supervised a two-phased planning process which it formalized in the document Evaluation Procedures for Water Resource Planning (2).

The planning process conceived and utilized during the Survey has been unique and innovative. This process has involved two basic and distinct levels of analysis conducted primarily at the Corps of Engineers' District level. First, detailed subregional analyses were undertaken to determine the physical, social and economic characteristics and potentials of each sub-region, their opportunities for water resource development, and the interface of such efforts with those of related investment programs towards achieving the objectives of the Act.

To prepare estimates of the Region's economic potential the Office of Business Economics (OBE) of the Department of Commerce delineated 27 economic subregions based on trade and commuting patterns. For each of these subregions, projections of population, employment, and income for the years 1980, 2000 and 2020 were developed. However, as the method employed in making these projections was based on historical trends and did not account for the development efforts being carried out by the Appalachian Regional Commission and other Federal and state agencies designed to substantially alter the Region's economic future, the projections continued to be pessimistic. To provide estimates which better reflected the Region's anticipated revitalization, the Office of Appalachian Studies revised OBE's estimates on the assumption that the Region's economy would approach parity with that of the nation by the year 2020. These adjusted projections become the planning benchmarks for the Survey and were aggregated into water planning sub-regions for use in the Survey's second phase. Thus upon completion of the first phase analysis, an economic profile of each subregion had been prepared identifying its growth areas, its obstacles preventing economic growth, its industrial potentials, and its water needs.

Once these subregional determinations had been completed but prior to embarking on the Survey's second phase, the results of the first phase were aggregated to permit assessment of these findings on a regionwide basis. This

aggregate analysis served to verify the subregional analyses while permitting a comparison of needs and potentials throughout the Region. This evaluation also identified inter-subregional water resource development opportunities which might have been overlooked on the district-by-district approach employed initially. Similarly, the Region's needs and potentials relative to the nation were reviewed at this point prior to specific project and plan formulation.

The second phase of the planning process identified the type and scale of water resource projects required to meet the objectives of the Act and the needs and potentials of the Region as identified in Phase 1 and verified through the aggregate analysis. Initial attention in the second phase involved screening water projects to identify those appearing to merit more intensive investigation. The screening criteria reflected the need for projects: (1) To possess substantial economic development implications as required in the Act; (2) to have state approval to assure correspondence with its plans and priorities; (3) to have local support; and (4) to have a manageable scope permitting its evaluation studies to be completed within the time frame of the Survey.

The existence of a substantial data base compiled from previous studies permitted the screening of proposed projects early in the second phase and thus allowed greater emphasis in the Survey to be placed on detailed examination of projects having passed the initial screening. These detailed studies were essential to assuring the projects' compatibility to efficiency and developmental criteria, and the plans and programs of the States and the Appalachian Regional Commission.

PROJECT EVALUATION PROCEDURES

Project formulation and evaluation was carried out at the basin level during the second phase of analysis. During this phase specific water resource projects were identified and their costs and benefits determined and evaluated. In addition, project proposals were also to be tested against alternative water resource investment opportunities and their relationship to current and anticipated public investments was to be assessed to insure complementarity and mutual reinforcement. The result of these detailed evaluations was the formulation of basin plans. These plans consisted of projects found to satisfy the objectives of the Appalachian Act. Thus, they reflected both existing and estimated needs while serving to enhance the Region's economic potential.

The evaluation procedures formulated in this phase of the planning process departed substantially from those traditionally used to evaluate water resource projects. As the purpose of the Appalachian Program and therefore that of its water resource component has been the stimulation of regional development, investment under this program has had to consider purposes other than those commonly associated with water resource investment. For example, while flood control efforts are normally justified on the basis of reduction in damages and increased utilization benefits, evaluation of flood control projects in the context of the Appalachian Program must also consider their effects on stimulating private investment, employment opportunities, increased wages, gains in national income, environmental enhancement, and so on. More specifically, the evaluation procedure employed in the Survey differs from the traditional approach in several significant aspects: "(1) it

proposes to trace the benefit flow beyond the initial users in order to gain a greater comprehension of the impact of water resource investment on the regional and national economies; (2) it provides for two separate accounts—a regional account and a national account in which to place benefit estimates; (3) it suggests a new benefit terminology based on a distinction between user and expansion benefits; (4) it provides for the apportionment of benefits among development plans; and (5) it suggests methods for presenting regional and national benefits in several indices of project performance."

The Survey's procedure deviates from the traditional approach for two basic reasons. First, reliance on measures of efficiency in the evaluation of water projects was determined to present an incomplete project assessment in an economically depressed region, and secondly, the distributive impacts of these projects were determined to be an essential component of the evaluation process. Thus, two types of benefits were identified: user and expansion. User benefits represent the value of goods and services flowing directly from the project. Expansion benefits were defined as the total change in income associated with the project; that is, the aggregate resulting from both direct and indirect economic response. The principal sources of expansion benefits include: (1) Income expansion; (2) employment expansion; and (3) induced investment. To better measure the expansion effects of water resource investment, both the Appalachian Regional Commission and the Office of Appalachian Studies have conducted research which culminated in the derivation of multipliers for each economic sub-region. These multipliers were employed to help determine the economic impact of specific project proposals on the Region's economy.

Both classes of benefits can be divided into national and regional income accounts. National benefits derive largely from the employment of formerly unemployed or underdeveloped resources. In contrast, regional benefits accrue from economic stimulation and economic growth. The former reflects changes in income and employment while the latter accounts for investment induced by the project. Generally, the magnitude of regional benefits associated with water resource projects will be greater than their national benefits. Yet, project evaluation must still reflect the efficiency concepts which guide the national allocation of investment for natural resource development.

With the exception of expansion costs, the costs considered in project evaluation have been defined and estimated following the traditional approach and include the expenses associated with project development and operation. Expansion costs have been defined as the private and public costs of accommodating induced economic activity resulting from the water project. Thus, cost calculations have accounted for the project's economic, installation, operational, maintenance, and replacement costs, as well as those classified as induced and associated. Induced costs include uncompensated negative effects related to the construction and operation of the project whereas associated costs include those effects of private and other public efforts related to the water project and incurred while securing the development objectives of the Appalachian Program.

As the definition of benefits has been appropriately expanded to permit the measurement of water projects' contribution to securing the objectives of the Appalachian Program, with both user and expansion benefits being identified, the traditional benefit-cost ratio was judged to be inappropriate as the sole measure of project performance. Consequently, two performance indices were

jointly employed for evaluation purposes. The conventional user benefit to project cost ratio was retained with the benefits including those defined as redevelopment benefits. These represent the value of formerly unemployed resources utilized in the project's construction and operation. A second ratio was formulated to relate the change in total wage and salary flows accruing to the Region, to total project costs plus those additional public and private costs related to the induced and associated economic activity stimulated by the project.

Independently, both ratios represent incomplete measures of a project's contribution to national and regional income. The first ratio does not account for all expansion benefits and the second ratio, while indicating incremental changes in national and regional wages, excludes benefits associated with gains from profits, rents, taxes and income of a similar nature. National expansion effects were purposefully excluded in deriving the first ratio due to the numerous uncertainties related with quantifying the components of economic growth. However, income deriving from water projects and accruing to the Region as indicated in the second ratio has national income implications which cannot properly be ignored in the overall evaluation process.

APPALACHIAN WATER RESOURCE PLAN

The Appalachian Water Resource Survey was designed to consider the water needs and potentials of the Appalachian Region on a comprehensive basis and in such a manner that the development of this resource would enhance the Region's capacity to accommodate economic growth. In this context, the Survey has considered a full range of project purposes including: (1) Flood control; (2) water supply; (3) soil and forest conservation and development; (4) pollution abatement; (5) fish and wildlife enhancement; and (6) general recreation, power, navigation, irrigation, and economic development. The Survey examined more than 100 major projects during its evaluation process. However, the economic development objectives inherent in the Appalachian Program and the Survey purpose of selecting urgent projects to be implemented early to overcome critical developmental barriers has resulted in a final plan for early action recommending only 19 major multipurpose and 42 upstream watershed projects.

In combination, these projects do not provide for the Region's complete water resource development nor do they satisfy the Region's total water needs. In fact, it is estimated by the Office of Appalachian Studies that this plan will only satisfy 12% of the Region's annual flood control requirements, 11% of its water quality deficiencies, 3% of its water supply demand, 1% of its recreational needs, and 18% of its land treatment requirements as projected to the year 2020. Consequently, an extensive research program is also recommended in the Plan including proposals that were eliminated from consideration in this plan for "early action" due to the extended study which would be required for their evaluation.

Specifically, the Plan ("The Development of Water Resources in Appalachia") includes 13 mainstem multiple purpose projects and 42 upstream watershed projects having flood control as a major component. In addition to the 42 upstream projects recommended by the Department of Agriculture, 200 other similar projects were studied and found to have merit. Consequently,

the Department recommended that planning and installation of these additional projects be accelerated. Water supply considerations have been included in nine multiple purpose and 20 upstream projects. Eleven multiple purpose projects and one upstream project include water storage provisions for water quality control purposes. Fish and wildlife enhancement benefits are included in 16 mainstem and two upstream projects. In addition, the major projects increase the Region's water surface area for recreational use by 93,000 acres while the 42 upstream projects add another 4,500 acres of surface area having recreational potential.

Hydropower possibilities at each proposed multiple purpose project were evaluated but were found to be feasible only in one. Future water needs for cooling thermal plants were not considered and only minor effort was made to determine the feasibility of pumped storage power generation as a component of any major multiple purpose project. While future power requirements of the Region have been projected by the Federal Power Commission to triple by

TABLE 1.—SOURCES OF NATIONAL BENEFITS: PERCENT BY PURPOSE

Purpose (1)	Multiple purpose projects (2)	Upstream watershed projects (3)
Flood Control	13.1	29.3
Power	13.5	
Navigation	15.5	
Water Supply	5.0	4.3
Water Quality	10.0	.3
Recreation	32.5	47.2
Redevelopment	7.5	18.9 ^a
Other	2.9	
Total	100.0	100.0

^a Secondary benefits are included with redevelopment benefits for the upstream watershed projects.

1980 and increase seven times that level by the year 2020, the Plan assumes that the private sector will expand its capacity sufficiently to meet these increasing power demands.

Improvement and expansion of navigation on the Ohio, Tenn. and Black Warrior River Systems are proposed in the Plan as is the extension of navigation on the Coosa River above Montgomery, Ala. Early construction of the already authorized Tennessee-Tombigbee Waterway is also stressed.

The national efficiency index for the nineteen major multiple purpose projects recommended in the plan for early action is only 1.1 with it falling below 1.0 for six of these. However, the composite regional income expansion index is 3.1. Annual user and redevelopment benefits are estimated at \$62,688,000 while annual regional expansion benefits are placed at \$573,734,000 compared to annual project costs of \$56,010,000 and project and associated costs of \$179,288,000. While the B/C ratio associated with the 42 upstream watershed projects is 1.8, the percentage distribution of national benefits by major pur-

pose for both groups of projects, as shown in Table 1 indicates a heavy reliance on recreation benefits for project justification.

PLAN IN PERSPECTIVE

The relatively high proportion of benefits allocated to recreational purposes in the plan's projects, 32.5 % and 47.2 % respectively for the multiple purpose and upstream watershed projects, the low B/C ratios associated with individual projects (six of the 19 projects have national efficiency indices below 1.0), and the major projects' heavy reliance for justification on annual regional expansion benefits, suggest that some of these projects may be marginal. Even though the planning process and the evaluation procedures used and developed in the Survey have been innovative, the magnitude of two sources of benefits, recreation and regional expansion, each characterized by imprecise measures of economic value in terms of both empirical data and analytical experience, raises legitimate questions as to these projects' true quality. However, since a principal objective of water resource development in the context of the Appalachian Program has been to contribute to the Region's economic viability and inasmuch as these projects indicate a major contribution in this regard (\$573,734,000 annually), they merit objective consideration.

Project priority cannot be determined without considering the Region's total public investment needs. Water projects involve major capital expenditures, capital which could similarly fund schools, hospitals, site development, roads, housing, water supply and pollution control facilities, industrial modernization and other social overhead and infrastructural projects, critical to the Region's economic and social revitalization. No distinct effort has been made to evaluate the proposed water projects in light of the Region's other and quite possibly more pressing deficits. Furthermore, the continuing existence of these deficits raises doubts regarding the realization of the expansion benefits claimed to accrue to the Region from implementation of the Plan's proposals. Consequently, there appears to be sufficient uncertainty regarding the relative priority of water resource projects in Appalachia's development program to suggest great care in selecting water projects for construction.

CONCLUSIONS

The principal contribution of the Appalachian Water Resource Survey, in addition to identifying projects which apparently can add substantially to the Region's economic revitalization, has been the formulation and application of a process and procedure for developing water resource proposals which reflect in their accounts the associated economic expansion of the area in which they are to be located. While these procedures are crude, it has been demonstrated that the traditional derivation of benefits and costs does not provide for complete or sound project assessment. Consequently, the science of water resource project evaluation has been substantially advanced in this Survey. It is most important, however, that the value of these procedural advances be assessed on their own merit and not be diminished by the somewhat uncertain nature of water resource projects proposed as a result of this Survey.

APPENDIX.—REFERENCES

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2. *Evaluation Procedures for Water Resource Planning*, Office of Appalachian Studies, Cincinnati, Ohio, 1967.
3. House Committee on Public Works, *Economic Development Acts*, Committee Print 90-17, 90th Congress, 1st Session, October 1967, pp. 20-46.
4. *Plan of Survey for Development of Water Resources in Appalachia*, Office of Appalachian Studies, Cincinnati, Ohio, 1966.