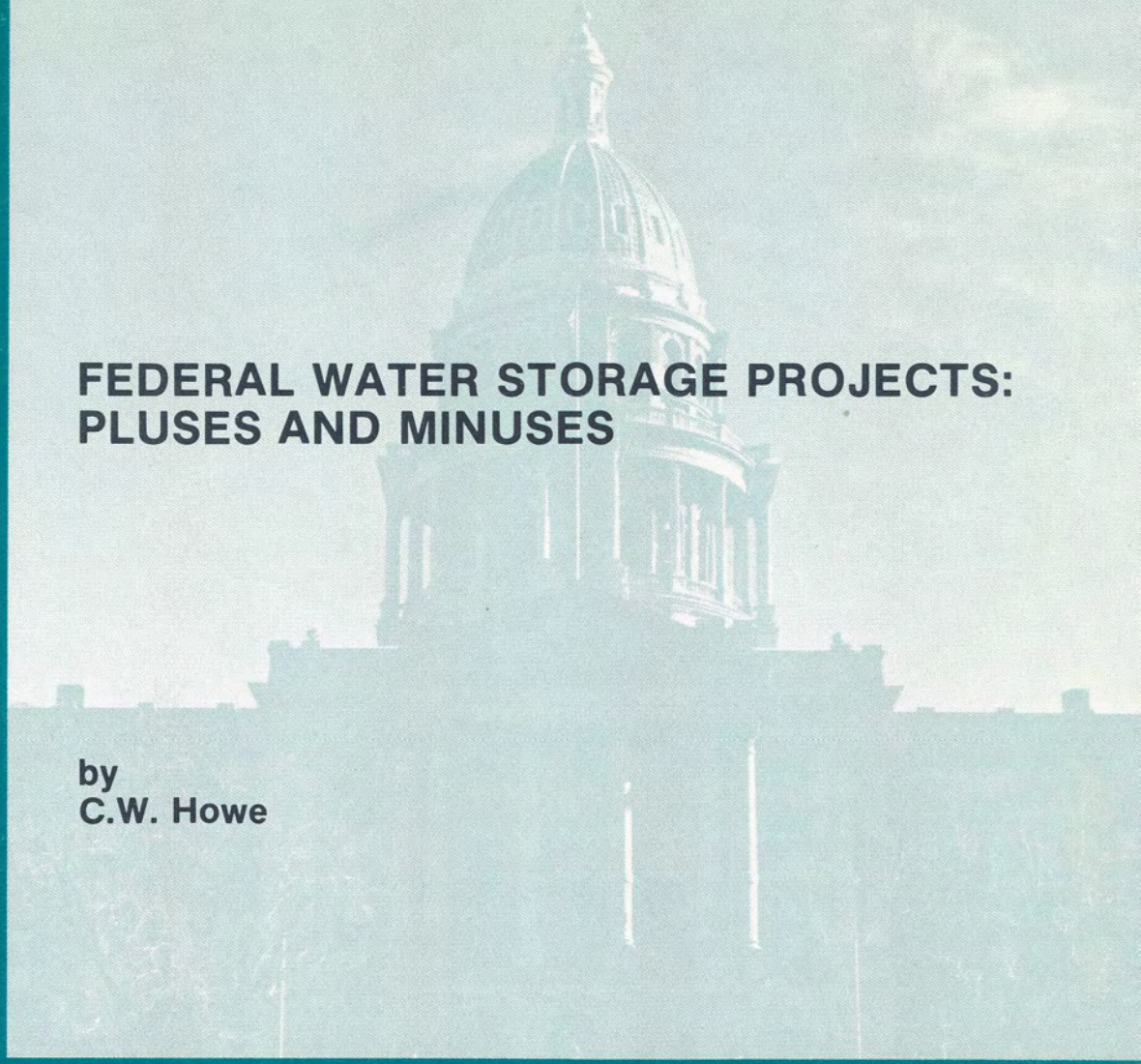

FEDERAL WATER STORAGE PROJECTS: PLUSES AND MINUSES

by
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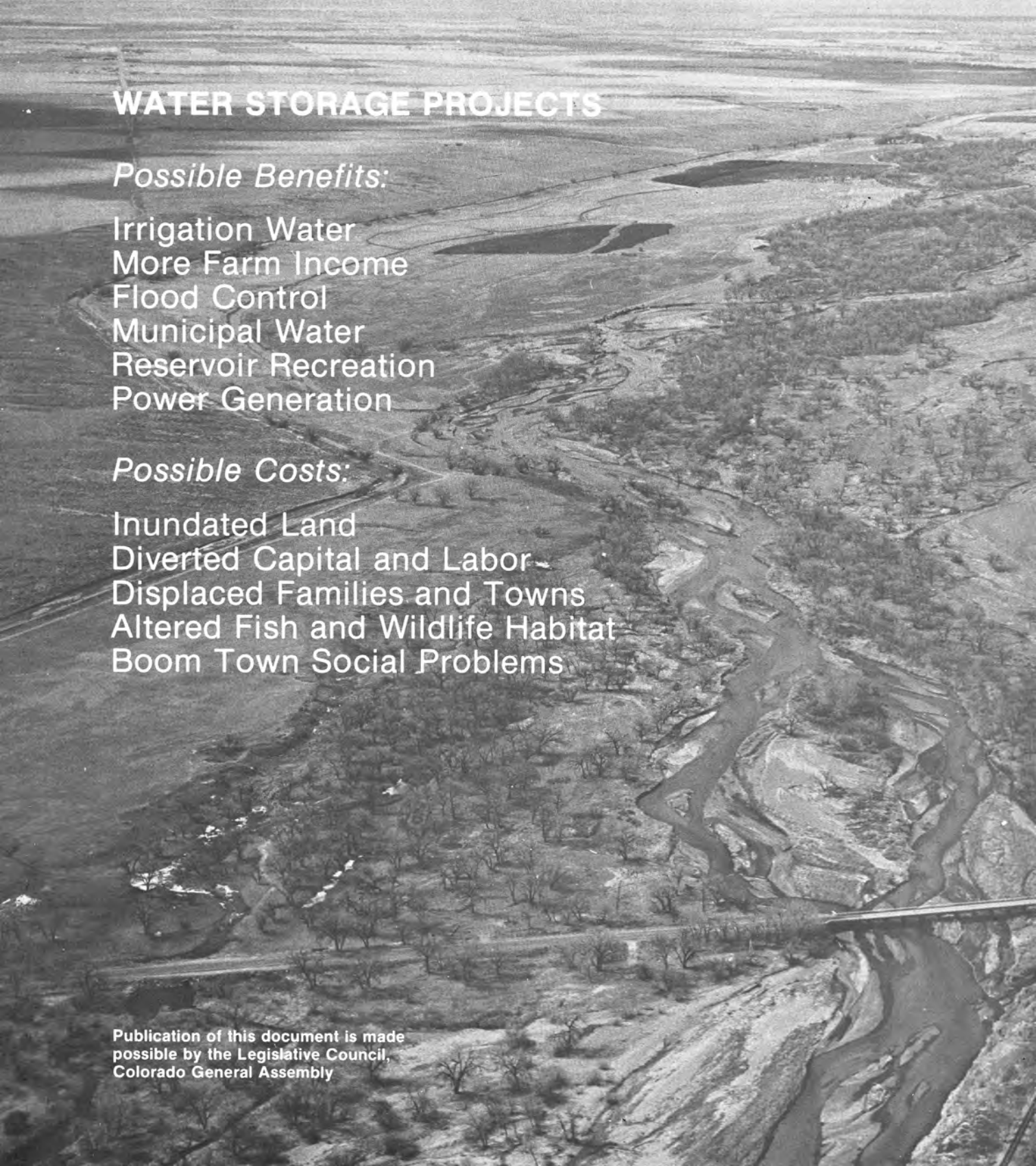

WATER STORAGE PROJECTS

Possible Benefits:

Irrigation Water
More Farm Income
Flood Control
Municipal Water
Reservoir Recreation
Power Generation

Possible Costs:

Inundated Land
Diverted Capital and Labor
Displaced Families and Towns
Altered Fish and Wildlife Habitat
Boom Town Social Problems

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The Narrows, on the South Platte River above Fort Morgan, has been proposed repeatedly as a site for a multi-purpose water development project. As with many such projects, many advantages and disadvantages have been enumerated.

FEDERAL WATER STORAGE PROJECTS: Pluses and Minuses

SUMMARY

Water storage projects in Colorado are the subject of much concern because of an emerging change in federal water resources financing policy. New federal policy is based on the premise that national benefits are not as great as heretofore determined. The new objectives of federal support to western water storage projects call for a greater proportion of the costs to be borne by nonfederal sources. This changing perspective places attention on benefits and costs — who benefits, who pays, and to what extent. Multiple-purpose projects generally contain some benefits which are clearly national in scope and some benefits which accrue only to the residents of the project area or state.

This paper discusses — through the avenue of benefits and costs — the impacts Colorado is likely to experience from the delay or cancellation of federal water storage projects. The approach is to discuss benefits and costs to the state from federal multi-purpose projects.

"most income and employment benefits accrue locally while many . . . costs are spread nationally by federal cost sharing"

Direct and indirect income and employment impacts are described with the observation that most income and employment benefits accrue locally, while many of the costs are spread nationally by federal cost sharing on some of the project purposes. This makes such projects economically attractive to the state, regardless of the national benefit-cost viewpoint.

Irrigated agriculture produces high income and employment per cultivated acre. On the other hand, it does not produce high income or employment per unit of water consumed in comparison to most other industries. Construction of large projects produces high incomes but also imposes disruptive and temporary burdens for services upon the local community.

The quality of urban life, opportunities in agriculture, and water-based recreation generally are favorable impacts from water storage projects, while in some cases social and environmental costs are substantial.

This paper has been prepared as a primer on assessing impacts due to the delay or cancellation of water storage projects in Colorado. The state economic viewpoint is emphasized, but the national economic viewpoint is not ignored. The paper explains the rationale for assessing project benefits and costs from both viewpoints.

INTRODUCTION

With the Reclamation Act of 1902, federal participation in the development of western water supplies became an important and expected part of water planning and investment. The Reclamation Program made it possible to plan, build, and finance on a scale required by the main stem river projects needed in the West. It was able to bring irrigation and flood control to regions which could not pay the full cost. This federal role has come to be expected by regional, state, and local interests.

Attempts to change this federally assisted water development process arouse alarm, especially when the changes are proposed without giving regions opportunities for advice and guidance. The recent federal "hit list" and subsequent studies and hearings relating to changes in federal water policy have aroused concern about the future of Reclamation-served regions, a concern compounded by prospects of large-scale energy resource developments. Increasingly stringent environmental regulations also have resulted in modification and delay of water projects. Officials and citizens alike have raised questions concerning the likely impacts on the state of water project cancellations and delays.

The basic approach for analyzing the effect of a project cancellation or delay is to project the impacts on state objectives as they would evolve with the project in place in contrast to the likely impacts without the project or with the project significantly delayed. This is the "with-without" principle which is the common basis for water project evaluation.

Objectives[1] to be met by Colorado water storage projects include:

1. Improve economic well-being
2. Increase employment opportunities
3. Enhance the aesthetic quality of urban surroundings.
4. Provide opportunities for a rural agricultural lifestyle
5. Create water-based recreational opportunities
6. Minimize other dimensions of social impacts
7. Minimize other environmental impacts
8. Minimize legal impacts, implications, or risks.

The Process of Water Project Evaluation

Modern water storage projects usually are multiple-purpose in nature. They are designed to produce several outputs simultaneously, frequently including irrigation water supply, municipal and industrial water supply, flood control, hydroelectric power, water quality management, and recreation. The advantage of multiple-purpose design and operation is cost savings from the joint use of the project's active storage, plus low incremental costs of services such as recreation once the storage capacity is in place. This cost advantage increases if demands for the several services occur in different seasons.

The economic and financial evaluation of multiple-purpose projects is complicated by the difficulty of assigning the dam and reservoir costs to any one particular purpose. Naturally, project costs which are clearly identified with a specific purpose, such as

turbines and generators or pumps, canals, and pipelines, can be clearly assigned.

Where do Impacts Occur?

We can distinguish three types of project impacts on geographical areas:

1. modification of hydrologic flows;
2. changes in prices of project inputs and outputs;
3. impacts which occur because of the methods chosen to finance the project.

Hydrologic impacts occur at the project site on all lands receiving water supply from the project and at all downstream points where flow quantities and timing are affected, including groundwater areas where recharge is affected.

Price changes affect project inputs and outputs. For instance, during construction, wages may be bid up by a large project or concrete and steel prices may be forced up. Land prices in the reservoir area, and areas receiving project services, are usually raised. (But this generally reflects the capitalized net value of services received and should not be counted twice.) Prices of project outputs may be significantly affected if the project is large. For example, in the mid-1960s, large acreages of irrigated potatoes were brought into production along the Snake River in Idaho, increasing annual output approximately 50 million hundredweight. Average Idaho potato prices fell $1.90 per hundredweight. While farmers on the new lands were able to make a profit, it is estimated that existing potato farmers experienced a loss of gross income of $400 million per year. Such market-transmitted impacts may be felt nationally or even world-wide.

"under current practices, significant portions of project costs are . . . thereby picked up by the general taxpayer"

Tax impacts through project financing are felt nationwide because, under current practices, significant portions of multipurpose project costs are paid from the federal treasury and thereby picked up by the general taxpayer.

The affected areas of these three types of impacts never correspond to the boundaries of political decision-making units such as states. Thus, when a state considers one of "its projects," it frequently confines its attention to project impacts within state lines, overlooking effects in neighboring states or even nationwide. We say that a "state accounting stance" has been adopted for purposes of project evaluation and recognize that significant benefits or costs may have been omitted.

When do Impacts Occur?

Current benefits and costs or receipts and expenditures are more valuable today than future benefits and costs. That is, future values should be "discounted." A salary bonus received this Christmas is worth more (even during non-inflationary times) than the same amount if received next Christmas since, at a minimum, the money could be placed in a savings account where it would expand to a higher value by next year. The business manager recognizes that a net cash flow received today is worth more than the same amount received in the future since it usually can be profitably re-invested in the business or used to retire debt.

"Future values of project benefits and costs should not simply be added to present benefits and costs"

This means that future values of project benefits and costs should not simply be added to present benefits and costs, but each year's benefits and costs during the life of the project should be weighted inversely with its distance in the future. This is handled by choosing a discount rate equalling the interest rate applicable to long-term loans and forming the following discount factor for year t in the life of the project:

$$d_t = \frac{1}{(1 + r)^t}$$

where r might be 6 percent or 7 percent per year. After applying the discount factor for each year, we can add future benefits and costs to current benefits and costs. For example, today's value (called the "present value") of a sequence of 10 annual payments of $100 each received at the end of ten succeeding years would be

$$PV = \frac{\$100}{(1.06)} + \frac{\$100}{(1.06)^2} + \ldots + \frac{\$100}{(1.06)^{10}}$$

$$PV = \$736,$$

not $1000, as we would get by simply adding the 10 payments.

This principle is important in project evaluation from the state's viewpoint because any project involves a long string of annual benefits and annual costs accruing to the state over project lifetimes up to 100 years (the standard assumed project life for Reclamation Act projects). *The state must recognize that it gains an advantage by expediting state benefits (thus maximizing their present value) and by delaying state costs (thus minimizing present value of costs).*

The following section discusses and illustrates potential impacts of water storage projects, including delay or cancellation, on state objectives suggested in the water policy proposal of the Department of Natural Resources.

IMPACTS ON COLORADO OBJECTIVES

Economic Well-Being and Employment

The discussion of with-without project impacts on these objectives will be combined here since state income, a primary measure of economic well-being, is closely linked to employment. Impacts on these two objectives are reflected in changes of income or employment. The two impacts are not identical, of course, for an income change could correspond to many different patterns of change in employment. In the following discussion, the impacts (changes) are identified in terms of benefits and costs. Economic benefits and costs are defined as positive and negative impacts to which monetary values can reasonably be assigned.

Impacts During Construction

The construction period of a large storage project is a period of rapid change for the project locality. Acquiring project lands and constructing the project takes 7 to 10 years, with expenditures starting at a low level, rising to a peak during the 5th or 6th years, then dropping off sharply. The local project area experiences a boom town cycle.

Land acquisition is the phase during which land is purchased or condemned. Project lands which supported agriculture, forestry, commerce, and residences are taken out of production at this point. The level of economic activity falls during this period. A great deal depends on where people move and how they use the money received in compensation for their land and their resettlement costs. If project benefits accrue largely to areas other than the "lake" area (for example, far downstream or in other basins to which water is diverted), the economy of the local project area may be permanently depressed.

Compensation for land usually is made at market value, but many sellers leave their lands unwillingly — evidence that compensation is not sufficient to offset the loss of income, loss of their accustomed lifestyle, and disruption of community life.

Transportation route relocation prior to starting construction frequently has major impacts on the local area, with some properties gaining new highway or rail access and other properties losing.

"If project benefits accrue . . . far downstream or in other basins, . . . the local project area may be permanently depressed"

Communities near the construction site are likely to experience a rapid but temporary expansion of population and income when construction begins. During this period, local services such as schools and hospitals often are overextended.

Social change is rapid, with the influx of construction personnel often altering established lifestyles. Property values and rents may rise rapidly, benefiting local property owners but adversely affecting local

people who do not participate in the increased income stream.

Effects of the construction period on the state economy depend on the mix of local versus imported manpower and materials used in the project. States with little industry import most materials, and the contractor brings the highly paid part of the skilled labor force into the state. Heavy machinery used on the project also is imported. Any multiplier effects on state incomes are restricted to the increased expenditure by the work force and the acquisition of materials from state industries.

On balance, the construction period usually yields no net benefits to the state, the temporary spurt in incomes being offset by the high costs to local and state services.

"With Project" Impacts

Increase in net farm income from supplying irrigation water is an obvious benefit from reclamation projects.

Flood control benefits, while not having a market price, can be calculated from estimates of changes in flood flow profiles and related property damage reductions. Additional benefits from longer-term improvements, such as converting field crop lands to orchards or converting low value industrial to high value commercial properties, also can be estimated but the process is difficult.

The value of water-based recreation per user day has no explicit market price, but certain conventions or methods can establish reasonable values. The U.S. Water Resources Council uses a range of values per user-day that depend on the type of recreation,[3] although they provide no method for estimating user-days. The travel-cost method of Clawson and Knetsch[4] has become a widely accepted method for estimating both user days and values per user day.

Excepting recreation related both to natural streams and to reservoirs, aesthetic values are not easily monetized. However, survey studies have shown that citizens apparently are willing to pay for higher water quality.[5] Most aesthetic and environmental impacts are, with the present state of the arts, better described physically, omitting attempts at monetary values.

Direct benefits (from a state accounting stance) are those accruing to state residents from the direct use of project outputs. Examples would be:

1. increases in net farm income from irrigation water;
2. reduced average annual flood damage to in-state areas;
3. cost saving of hydroelectric power over the alternative of thermal electric generation for project power used within the state;
4. cost savings of providing needed additional municipal and industrial water over the cost of the alternative method of supply; and,
5. the value to state users of the recreational services provided by the project.

Direct costs of a project during its operating life are those direct money payments and other forms of cost required of state citizens each year. Examples would include:

1. repayments to the reclamation fund by irrigation districts as required by the contracts between the district and the Bureau of Reclamation;
2. project operating and maintenance costs;
3. payments to the federal government for municipal and industrial water supply;
4. payment of state cost share of flood control, fish and wildlife, and recreational management; and,
5. inadequately compensated removals of land and related resources from formerly productive activities.

Several of these direct costs to the state are determined primarily by the cost-sharing and repayment rules established by, or negotiated with, the federal government. Whether or not these repayments fully cover actual costs of construction and operation is subject to debate.

Secondary benefits and costs. Certain secondary benefits will be stimulated by the existence of the project. Suppliers of farm equipment will find more sales, and processors of farm output such as livestock feed will find their businesses expanded. Other state economic activities may be adversely affected by the project if investible funds, human resources, and construction industry capacity are diverted to the project.

It is difficult to determine what portions of secondary benefits and costs are new to the state rather than changes in location of pre-project activities. Suppose that after an irrigation project is started, a new elevator and feed mill is built nearby to handle some of the new grain. Assuming the private investments in the new activity came from within the state, we can take the net income generated in the elevator-mill operation as a secondary benefit. However, if the investment came from outside the state, this income should not be counted as a benefit.

Costs of secondary activities are rarely estimated because they generally occur away from the project area and are difficult to identify. Thus, there is a bias toward overstatement of secondary benefits and understatement of secondary costs. Certainly, gross sales in project-linked activities cannot be taken as indirect benefits since that measure makes no allowance for associated costs. On the other hand, if the expansion of secondary activities employs resources that would not have been used otherwise over the long term, the net income from secondary activities may understate the actual secondary benefits.

"there is a bias toward overstatement of secondary benefits and understatement of secondary costs"

A new project may attract activities from other states to the project area. A more reliable water supply, for example, might cause such a shift. From a national accounting stance, the only gain would be the increase in the net income of business firms. From the state accounting stance, however, the full value-added[6] by the new businesses would be appropriately counted.

For example, the Bureau of Reclamation estimated annual direct benefits of the Narrows Unit on the South Platte River to be approximately $8,500,000 with secondary benefits of $1,200,000 per year raising this to $9,700,000 per year.[7] The secondary benefits are 14 percent of direct benefits in this case. No attempt should be made to apply this ratio to other projects, however, since each project is likely to be unique in its linkages with secondary activities.

The major economic tool for analyzing the impact of secondary activities associated with water projects is the state input-output model.[8] In the hands of a knowledgeable practitioner, this model can be used to estimate secondary project effects.

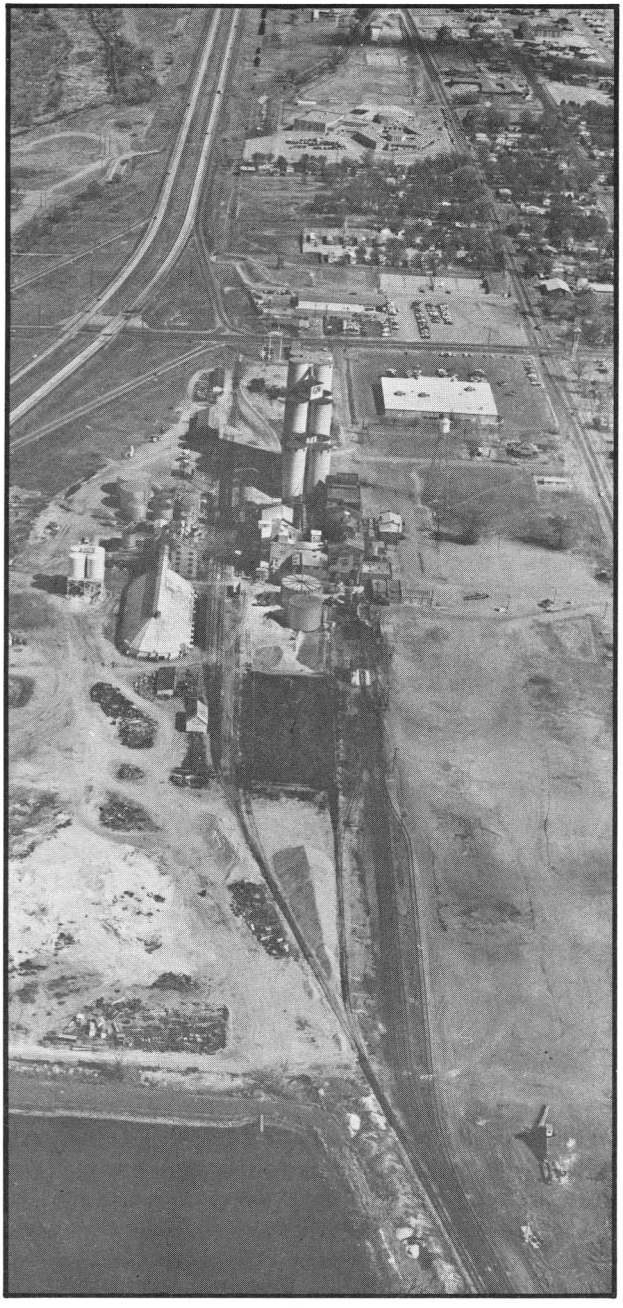
Employment impacts occur with the creation of both direct and secondary project benefits. Care must be taken in estimating employment impacts because future growth may involve different employment-to-output relationships than those shown in the past. Further, the growth of employment in expanding sectors may be accomplished by drawing workers from less dynamic sectors of the economy. The net increase for the state, then, would be less than the increase in the expanding sectors.

Employment directly created when the output of a particular sector of the state economy expands differs considerably sector by sector. This is illustrated from Gray *et al*[9] in Table 1 which shows employment created directly and indirectly throughout the state economy when each sector increases output by $1 million in sales.

Enhance Aesthetic Quality of Urban Surroundings

Parks, open space, green lawns, trees and shrubs enhance the aesthetic quality of the urban center. Cancellation or delay in water storage projects that provide water for these purposes can be considered a negative impact. However, there is no accepted measure of value in meeting this state objective.

North and Neely[11] have concluded that municipal water users supplied by federal projects repay only 64 percent of full costs. If this is correct, there is a substantial local cost advantage which evidently would be lost under revised federal policy. However, in the last few years, many municipalities have elected to finance water supply storage projects by revenue bonding rather than through federal loan programs because of lengthy and expensive federal regulations and pre-construction requirements associated with the latter. This has been especially common in the period of high inflation.



The increased availability of irrigation water can lead to more agricultural product processing facilities such as this sugar mill at Fort Morgan, Colorado. New farm production, however, can displace farms and processing facilities located elsewhere.

Provide Opportunities for a Rural Agricultural Lifestyle

Currently, most of the prospective water storage projects in Colorado are intended to furnish irrigation water to newly irrigated lands. The net increase in acreage is the acreage newly served, less acreage lost to reservoirs, canals, and other structures.

There is no question that new irrigation projects opening up new irrigated lands have the potential for new "opportunities for a rural lifestyle." Irrigated agriculture produces higher and more reliable crop yields than dryland agriculture. Whether or not net income sufficient to support the rural lifestyle can be realized on water storage projects financed by other than Federal Reclamation Act loans is uncertain. If North and Neely[11] are correct in concluding that irrigation water users on Reclamation Act projects repay only 19 percent of all costs, then the outlook under private financing is not good.

Create Water-Based Recreation Opportunities

In assessing the recreational value of a proposed reservoir, two impacts should be noted. The first is that added reservoir surface comes at the cost of reducing the mileage of the remaining natural river. Where rivers are currently used for white water kayaking and fishing, the loss of recreation space must be counted as a cost of storage projects. Increased recreational pressure can be projected for remaining open river suitable for these uses. If the resulting quality of experience is unsatisfactory, this too should be counted as cost.

"irrigation water users on Reclamation Act projects repay only 19 percent of . . . all costs"

A second impact is that some new reservoirs will draw a significant part of their recreational business from existing reservoirs. For example, the Narrows would draw from clientele of Jackson Reservoir, Sterling Reservoir, and Lake McConaughy. This would be improved, but not new, recreation for those

participants and should be valued as a benefit accordingly.

The costs allocated to recreation are largely non-reimbursable to the federal government, with state government financing only shoreline facilities and their maintenance. North and Neely[11] have concluded that water-based recreation repays only 19 percent of its full costs. Thus, the federal storage project is a locally attractive way of getting flat water for recreational purposes.

Unfortunately, few prospective federal projects are so located that they could provide recreation to sizeable population centers. Among prospective projects, only the Narrows Project and the Two Forks Dam are located sufficiently close to the metropolitan area to attract significant recreational use. Distances to those sites are great enough, however, that the urban poor would be unlikely to use them.

END NOTES

1. The first five objectives are from "Directions for the Future", Colorado Department of Natural Resources, Oct. 1978. 19 p.
2. Howe, C. W., Benefit Cost Analysis for Water Systems Planning, Am. Geophysical Union Water Resources Monograph No. 2., Washington, D.C., 1971.
3. Principles and Standards for Planning Water and Related Land Resources, *Federal Register,* Vol. 38, No. 174, Sept. 10, 1973, p. 52.
4. Knetsch, Jack L., Outdoor Recreation and Water Resources Planning, Am. Geophysical Union Water Resources Monograph No. 3, Washington, D.C., 1974.
5. Walsh, R., R. K. Ericson, J. R. McKean, R. A. Young, Recreation Benefits of Water Quality: Rocky Mountain National Park, Colorado, Technical Report No. 12. Colorado Water Resources Research Institute, Colorado State University, May 1978.
6. The value added by an industry is the market value of its output less the cost of materials purchased from other industries. Value added thus consists of the payments made to labor, management, government, and debt and equity capital.
7. Addendum to the Definite Plan Report, June 1976, Bureau of Reclamation.
8. The state I/O model was developed by the Colorado Water Resources Research Institute with funds provided by the U.S. Office of Water Research and Technology and the Colorado Water Conservation Board. See C.W.R.R.I. Completion Report 70, 1975.
9. Gray, S. L., J. R. McKean, J. C. Weber, and E. M. Sparling, Use of the Colorado Input-Output Model to Analyze the Impacts of Alternative Energy Scenarios, Report to Colo. Energy Research Institute, Sept. 1975.
10. Anderson, J. C., et al., Salinity Management Options for the Colorado River, Water Resources Planning Series P-78-003, Utah Water Research Laboratory, Utah State University, Logan, Utah 84322, June 1978. Research conducted by joint effort of Water Resources Research Institutes of Colorado, Arizona, Utah and California.
11. North, Ronald W. and W. P. Neely, A Model for Achieving Consistency for Cost Sharing in Water Resource Programs, Water Resources Bulletin, Vol. 13, No. 5, Oct. 1977, pp. 995-1005.

Table 1. **Workers employed per million dollars of direct output and per million dollars of sales to final consumers, various sectors of the Colorado economy, 1970.**

	Workers per million dollars of	
Sector	*Direct output*	*Sales to final consumers*
livestock	31	87
dryland agriculture	32	56
irrigated agriculture	62	92
food processing	12	47
metal mining	28	42
coal mining	27	38
petroleum production	33	42
electric power generation	16	26
transport, communications, and public utilities	42	60
wood products	34	42
services	49	72
elementary & secondary education	83	90

This report is one in a series of publications designed to help meet the challenge of providing information on how the natural water system works and how it can be reconciled to the complex demands placed on water by society today. It was prepared by the Colorado Water Resources Research Institute to assist legislators, policy makers, and water resources planners and managers to better understand specific problems and issues.

The most predictable feature of water policy at the present time is change. Changes are occurring in the demands on water supplies, in the values people place on water resources and also in the institutional and legal foundations of public water administration.

This era of change emphasizes water resources administration and management rather than water resources project development. The focus is upon *improving management* of existing water supplies rather than on the development of new supplies.

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