An Economic Analysis of the Central Arizona Project
(and Other Papers & Notes)

By: U.S. Bureau of Reclamation, Thomas M. Power
Alan P. Kleinman

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REVIEW OF: "An Economic Analysis of the Central Arizona Project - U.S. Bureau of Reclamation" by Thomas M. Power, 1978

BY: Alan P. Kleinman, A.W.C.

The purported "analysis" is a very unprofessional attack on the Central Arizona Project (CAP) in particular and the U.S. Bureau of Reclamation (USBR) in general. Embodied therein are the same tired old arguments against water resource development which have been rehearsed an untold number of times over the past two decades. The phrasing of the report often mirrors public relation articles directly published and released by Citizens Concerned About the Project (CCAP) and the Maricopa Audubon Society. The task of reviewing and providing constructive comments is extremely difficult because of the nature and format of the "analysis". Mr. Power (it would be an insult to the economics profession to recognize his professorship) takes a very negative approach and repeatedly makes unfounded assertions which are not subject to reader verification. The presentation is poorly organized and shows a complete lack of understanding by Mr. Power of basic analytical procedures required for water resource project evaluations. The very convenient approach of shifting between opposing lines of logic is employed frequently in attempts to discredit all features of the project and the USBR.

Since Mr. Powers views his work as a new "revelation" concerning the value of CAP, it should be pointed out that no new light is shed on the project by this most recent "objective

analysis". It is essentially a rehash of CCAP writings and reworked pleadings from the CCAP Federal District Court Suit against the USBR over the Salt River Siphon. The report is replete with errors and false assertions and it is hardly worth the effort to list all problem areas here, hence only the most significant details will be discussed.

A curious presentation is made in the introductory section. It is asserted that the project will cost U.S. taxpayers more than $5.4 billion in subsidies and will cost Arizonans more than $5.1 billion in cash outlays. Added together this yields a total project cost of $10.5 billion. This total is not discussed anywhere in the analysis that follows. How a total project cost of $1.7 billion is ballooned by more than 6 times alerts one to the "level of integrity" associated with the report.

Considerable criticism is directed to the benefit value of municipal and industrial water suggesting that lower cost sources of M & I water were ignored. Earlier consultant reports documented costs for individual cities of developing single purpose systems to provide water. In each instance it was concluded that the CAP would be a more inexpensive alternative. One alternative suggested by Power would eliminate almost all of the agricultural production in the project area and convert that water supply to M & I use. Power's proposed conversion briefly mentions the need for substantial transfer facilities to move water to areas of demand but then conveniently ignores the very substantial investment necessary to make the physical

transfer in his cost comparisons. CAP M & I water costs of $120 per acre-foot are inappropriately compared to the cost of groundwater extraction of $20 per acre-foot with no additions for collection and conveyance pipelines from remote groundwater basins, treatment or distribution costs.

The implication repeatedly surfaces that the provision of M & I water by CAP is proposed by supporters without any reference to M & I water demands or willingness to pay and concludes it has no value (page 3). Power does not understand the method of analysis employed in supplying water to meet M & I demands. He also conveniently forgets the more than $100/Ac. Ft. value of M & I water which is introduced on page 45 as the current value to Southern California of using Arizona's water. It is a bit puzzling how the same water suddenly loses all value when pumped out of the opposite side of the river.

Item 4 on page 3 asserts the Bureau erred by ignoring the cost of distribution systems for agricultural water. Actually the costs of these systems have been recognized in the determination of payment capacity for CAP lands.

Also, on page 3 it is purported that salinity damage costs of CAP water have been ignored. Later reference indicates a salinity damage of $22 per acre-foot (page 40). The procedure employed to calculate water quality damages is totally in error. Rather than $22 per acre-foot, the expected cost is only pennies per acre-foot.

The assertion, page 16, that the Navajo generating plant

has no connection whatever with CAP, fails to recognize the federal requirement that a source of energy must be supplied for all project pumping requirements and further that existence of the plant would be problematic if it had not been authorized and constructed as part of CAP.

The material presented in item 11, page 25 and items 3 and 4, page 31 is another attempt to rewrite the history of the Colorado River development ~~as has been attempted in the past~~ by the Imperial Irrigation District and the Metropolitan Water District. It is an overt attempt to legitimize the perpetual use in California of Arizona's Colorado River entitlement confirmed by the U.S. Supreme Court in Arizona v. California.

On pages 25-27 and 42-45 a number of alternative water supplies are suggested. While perhaps making economic sense to some, the proposals fail to recognize political and institutional constraints and real world conditions. For example, the Western Arizona Project, (page 43, item 4), is a hydrologically and environmentally irresponsible suggestion put forth originally by antagonists to CAP. There is not sufficient groundwater to support agriculture during low flow periods of the Colorado. To see its transfer from an obfuscating pleading ploy introduced into a Federal Court suit to publication as a new idea is indeed revealing about the origin of most of the "Power Economic Analysis" report.

Mr. Power says there is over 600 million acre-feet of groundwater in storage in Central Arizona, enough to supply the needs of Arizona for 3 centuries. He fails to consider whether

it is economically or environmentally recoverable or whether it is of usable quality (page 8). Pumping from the Papago Indian Reservation, Organ Pipe National Monument, Cabeza Prieta Game Range and the Air Force Gunnery Range is not a realistic suggestion.

The USBR computation of agricultural benefits for the CAP treated present farm lands as new lands which is severely criticized by Power. This procedure was used because of the projected decrease in groundwater supplies and subsequent elimination of most productive lands (page 12).

The CAP agricultural analysis arrives at benefits which Power says are totally out of line - $42.91 versus about $8 per acre-foot. Empirical studies at the University of Arizona, which Power repeatedly uses as reference, show the value of water could be over $100 per acre-foot in 1966 dollars. Estimates of the average value of water in the cited studies reveals a value of 50 to 60 dollars per acre-foot, thus, the CAP analysis is not in conflict as Power asserts (page 10). For agricultural use it is obvious Mr. Power does not quite grasp how to conduct a proper economic analysis.

The argument that increasing agricultural production in Arizona will drive farmers out of business elsewhere in the nation ignores regional production differentiation, expanding domestic and foreign markets, the dynamic nature of our "surplus production" situation, and the persistent worldwide shortage of "surplus products". It should be noted that products grown in

Arizona often go to different markets than products produced in other states (page 19). However, the only increased production due to the CAP will be on Indian lands so the extensive argument is a moot point. Page 21 - The first paragraph implies subsidized water has depressed domestic price of cotton and driven producers in the South out of business. As mentioned above different markets are served by different producing areas--not necessarily a conflict in markets. The study also implies that the CAP will expand agricultural output and thus cause a nationwide decline in farm prices. If the CAP were to decrease farm prices this would be considered a national benefit to consumers which would be reflected in lower food prices.

On page 23, Power states: "Diverting the revenues of the Navajo Plant to CAP is no different than diverting tax revenues to CAP". The logical extension of this concern is that the Federal Government made a mistake in not purchasing the entire plant because this would have provided more national revenues rather than let them go to the private sector. Obviously, this would not have been an additional national benefit but a substitute for the intended private venture. The Federal share of Navajo is essential in order to realize the benefits of the CAP.

Further "diverting" implies a change from original intent which definitely is not the case.

Mr. Power also asserts on page 23 that the more profitable features of the CAP are subsidizing some unspecified "non-justified" project components. The Central Arizona Project analysis, as shown during the President's Water Projects Review of 1977, was conducted in accordance with Senate Document 97 with each separable

project feature included in the recommended plan economically justified.

Considerable consternation is evidenced in the report because allegedly the Bureau uses inappropriate interest rates for project analysis and repayment. The authorized interest rates for the analysis of Central Arizona Project was established in accordance with the Water Supply Act of 1958 and is reaffirmed by provisions of the WRC's Principles and Standards.

Contrary to the implications of this study, the Central Arizona Project does not simply serve a few special interest groups but the final project formulation attempts to allocate a scarce resource (water) to achieve the maximum economic, environmental, and social benefit of the citizens of Arizona.

Power has stated on page 27, "augmentation projects are necessary to realize the projected benefits of CAP". This is incorrect. The CAP benefits are calculated exclusive of any augmentation projects. However, one rather attractive augmentation alternative not mentioned in his study is weather modification which if utilized could provide additional water at perhaps a cost of $5/acre-foot--an extremely economical source of water ignored by this study.

Mr. Power decrees the fact that the State of Arizona has a completely outdated water law and implies there is no inclination to change. Any informed observer knows the State is in the process of rewriting groundwater laws in an attempt to manage this scarce resource to the betterment of all Arizona citizens.

It is stated that "almost an entire Indian reservation" will be flooded by the proposed Orme Dam (page 28, item 7). However it should be recognized that although significant portions of the reservation would be impacted by Orme Reservoir, under no circumstances would "almost an entire reservation" be flooded. The entire reservation population is estimated to be about 300 individuals of a total Yavapai tribal enrollment of more than 1,400 and authorizing legislation provides significant economic benefits to these individuals so as to improve the Indians situation and to prevent any violation of the Government's trust obligations to these peoples. The McDowell Reservation branch of Yavapai Indians would have 2,500 acres added officially to enlarge their reservation. Additionally the greatly expanded recreation management potential on Forest lands (about 6500 acres) occupied by adjacent to the Orme Reservoir area will be under Indian control if they exercise their options to handle the recreation management.

Perhaps the pinnacle of absurdity is reached when Mr. Power suggests the Yuma Desalting Plant costs of $160 per acre-foot must be added to CAP's costs (page 27) and that because the present use of Arizona's water by California has a value in excess of $100 per acre-foot, such costs of "lost benefits" should be deducted from CAP benefits. Finally he suggests that the price of water, if increased, would equate demand with supply in Arizona and eliminate any shortages. The rational conclusion of such an argument is that if anyone ever imagines there is a need for additional water, all that is required is to raise the price and

the shortage will disappear (page 8). Thus if the price is high enough, one gallon of water will satisfy the entire state.

This sophomoric approach to Arizona's water problems with its ivory tower prognostications is hardly worth the paper upon which it is printed. It is unfortunate so much misguided effort went into the report and valuable resources are used for naught. It is sad indeed that a Chairman of an economics department can be "bought" in attempts to validate preconceived biases.

DRAFT APK/fah
4/4/79

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The implication repeatedly surfaces that the provision of M & I water by CAP is proposed without any reference to M & I water demands or willingness to pay (page 3). Power does not understand the method of analysis employed in supplying water to meet M & I demands. We [illegible] the $100 value of M&I water which is enhanced on page 55 as the value to Southern California and for which farmers should sell the water.

Item 4 on page 3 asserts the Bureau errored by ignoring the cost of distribution systems for agricultural water. Actually the costs of these systems have been recognized in the determination of payment capacity for CAP lands.

Also, on page 3 it is purported that salinity damage costs of CAP water have been ignored. Later reference indicates a salinity cost of $22 per acre foot (page 40). The procedure employed to calculate water quality damages is totally in error. Rather than $22 per acre-foot, the expected cost is only pennies per acre-foot.

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farm prices this would be considered a national benefit to consumers which would be reflected by lower food prices.

On page 23, Power states: "Diverting the revenues of the Navajo Plant to CAP is no different than diverting tax revenues to CAP." The logical extension of this concern is that the Federal Government made a mistake in not purchasing the entire plant because this would have provided more national benefits. Obviously, this would not have been an additional national benefit but a substitute for a private venture. The Federal share of Navajo is only a net national benefit when coupled with the CAP.

It should be clarified that the tax dollars needed to finance construction of the Central Arizona Project are not simply diverted "like tax revenues" and lost because a major portion of CAP capital expenditures are returned to the U.S. Treasury as provided for in the repayment contract for the CAP.

Mr. Power asserts on page 23 that the more profitable features of the CAP are subsidizing some unspecified "non-justified" project components. The Central Arizona Project analysis as shown during the President's Water Projects Review of 1977, was conducted in accordance with Senate Document 97 and indicated that each separable project feature is economically justified.

Considerable consternation is evident because the Bureau uses inappropriate interest rates for project analysis and repayment.

The authorized interest rate for the analysis of Central Arizona Project was established in accordance with the Water Supply Act of 1958 and is reaffirmed by provisions of the WRC's Principles and Standards.

Contrary to the implications of this study, the Central Arizona Project does not serve special interest groups but the project formulation attempts to allocate a scarce resource (water) to achieve the maximum economic, environmental, and social benefit of the citizens of Arizona.

Stated on page 27, augmentation projects are necessary to realize the projected benefits of CAP. This is incorrect. CAP benefits are calculated exclusive of any augmentation projects. However, one augmentation alternative not mentioned in this study is weather modification and if utilized could provide additional water at a cost of $5/acre foot--an extremely low cost completely ignored by this study.

Mr. Power accuses the State of Arizona as having a completely outdated water law and implies the State is not inclined to change. Any informed observer knows the State is in the process of rewriting groundwater laws and is attempting to manage the resource to the betterment of all Arizona citizens.

It is stated that an entire Indian reservation will be flooded (Page 28 item 7) however it should be recognized that although significant portions of the reservations would be impacted by Orme Reservoir under no circumstances would the almost entire reservation be flooded. Also, the entire reservation population is estimated to be ~~less~~ about than 300 individuals and authorizing legislation provides

of a Havasupai tribal enrollment of more than 1400.

significant economic benefits to these individuals so as to protect the Indians rights and to prevent violation of the Governments trust obligation to these peoples.

Perhaps the pinnacle of absurdity is reached when Mr. Power suggests the Yuma Desalting Plant costs must be added to CAP's costs (page 27) and the present use of Arizona's water by California has a value in excess of $100 per acre foot, thus such costs of lost benefits should be deducted from CAP benefits. Finally he suggests that the price of water, if increased, would equate demand with supply in Arizona and eliminate any shortages. The rational conclusion of such an argument is that if anyone ever imagines someone is in need of additional water, all that is required is to raise the price and the shortage will disappear (page 8). Thus if the price is high enough, one gallon of water will satisfy the entire state.

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David E. Creighton, Jr.

an economic analysis of the central arizona project u.s. bureau of reclamation

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1978

AN ECONOMIC ANALYSIS OF THE CENTRAL ARIZONA PROJECT U.S. BUREAU OF RECLAMATION

by
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University of Montana

1978

Copies of this publication may be purchased for $6.00 from: CAP Publications, P.O. Box 15451, Phoenix, Arizona 85060.

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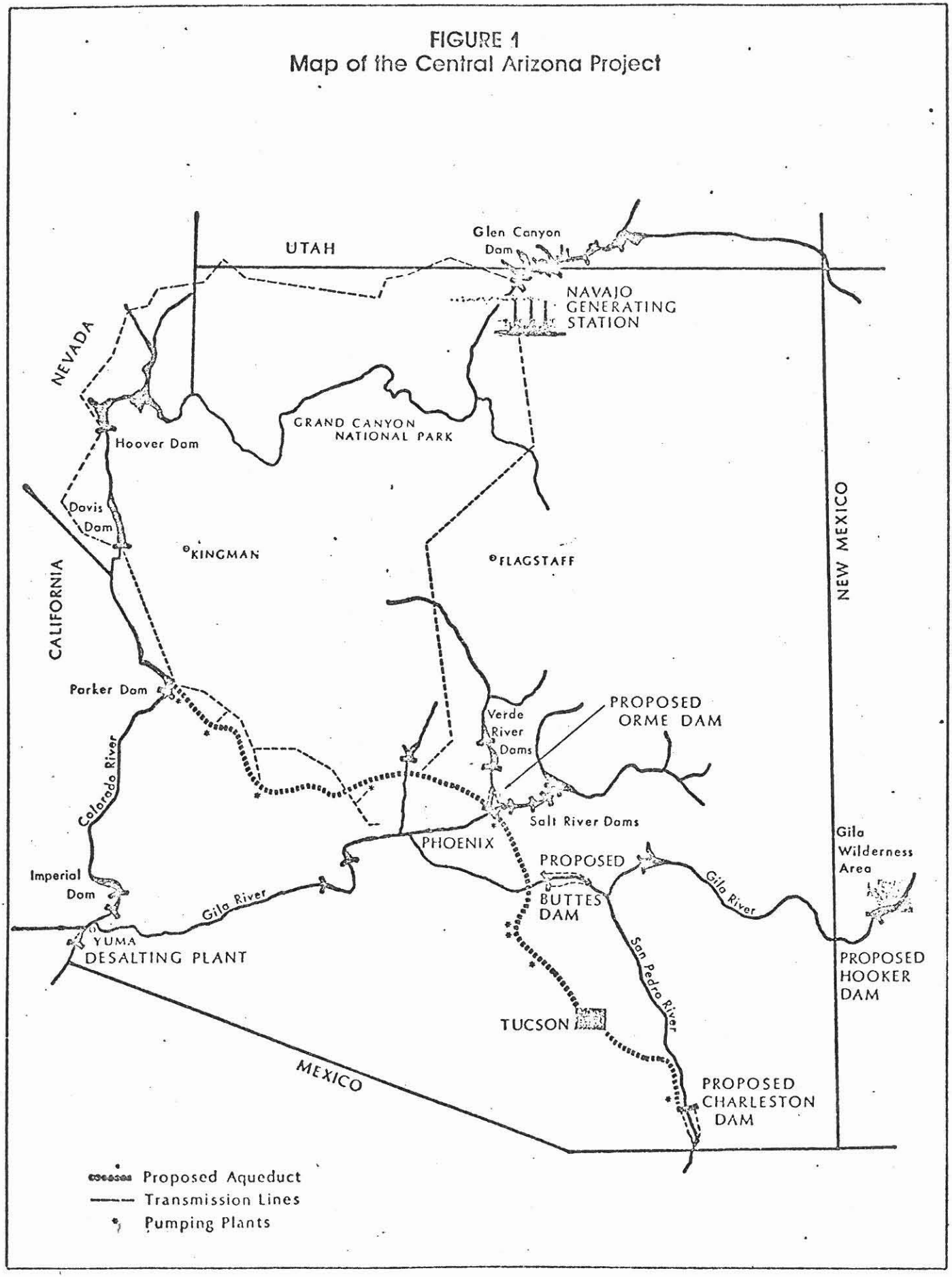
Map of the Central Arizona Project



INTRODUCTION AND CONCLUSIONS

This report looks at the socioeconomic logic of the Central Arizona Project (CAP). This Bureau of Reclamation (BR) Project would divert water from the lower Colorado River, lift it over 2,000 vertical feet and deliver it to municipalities, industries and farms in central Arizona (see figure 1).

Chapter I looks at CAP as an investment of national funds and asks what the economic return will be. It finds that the project will cost the U.S. taxpayer more than $5.4 billion in subsidies while yielding no positive net return to the nation. It's benefit-cost ratio is less than 0.35 to 1.0, not 1.6 to 1.0 as claimed by the Bureau of Reclamation. It may well only return a few cents of each dollar invested in it.

Chapter II looks at CAP from the point of view of national socioeconomic objectives such as supporting family farms, conserving scarce natural resources, and rationally coordinating the use of interstate waters. It concludes that CAP will work in opposition to these objectives.

Chapter III looks at CAP from the point of view of the residents of central Arizona. It finds that although the project represents a substantial temporary investment gift, most of the gift is wasted in the sense that Arizonans receive almost no value from it. Given the undependable, temporary water supply CAP provides irrigators and the substantial cost of the required distribution system, many irrigators will never accept the gift. It also finds that CAP will cost Arizonans more than $5.1 billion.

CAP may be primarily a municipal and industrial (M&I) water project disguised in farm reclamation terms. But it is a very costly "construction" solution to water problems for which there are cheaper non-construction local solutions. In addition, by supplying additional water but no reform in Arizona's very wasteful water laws, CAP does not contribute to a solution to excessive groundwater mining in central Arizona.

Chapter IV very briefly looks at alternatives to CAP as well as alternative uses of the federal money which would be good investments or at least efficient gifts and which minimize the socioeconomic and environmental costs while pursuing a variety of national social objectives.

CHAPTER I

THE CAP AS AN EFFICIENT USE OF NATIONAL INVESTMENT FUNDS

The estimated capital cost of CAP is $1.7 billion[1]. M&I water recipients will repay this federal loan at the rate of 3.342% while irrigation recipients will pay no interest on the loan. Assuming a market interest rate of 7% and a 50 year repayment schedule, the total Federal subsidy to Arizona will amount to at least $5.4 billion. This includes interest during construction and non-reimbursable costs, as well as the interest subsidy. Since construction costs are rising more rapidly than the rate of inflation, the real capital cost of the project will rise significantly before its scheduled completion in 1987. Thus the subsidy from the U.S. taxpayer is likely to be significantly higher than calculated below.

Type of Federal Subsidy	Total cumulative subsidy	Value of subsidy in 1977 dollars
Irrigation — interest (7% - 0%)	$ 3,056,410,000	$ 602,728,000
Irrigation interest during construction*	315,000,000	315,000,000
M&I — interest (7% - 3.342%)	461,610,000	215,280,000
Non-irrigation interest during construction*	140,072,000	140,072,000
Non-reimbursable cost (Indian water, flood control, etc.)	1,498,000,000	427,647,000
Federal Subsidy	$ 5,471,092,000	$ 1,700,727,000

*Compounded forward to first year of operation which is year of present values — explaining why the entries are identical in both columns.

Much of the debate over the economic rationality of CAP centers on the benefit-cost analysis. The BR claims that the analysis indicates the project will return $1.60 for each dollar invested in it, while critics argue that it will only return 58 cents for each dollar invested.[2] Benefit-cost analysis asks whether a particular commitment of resources results in a return greater than could be realized from the best alternative use of those resources. If it does, the benefit-cost ratio is greater than 1.0.

The frame of reference is the entire nation. The benefits are judged in terms of the nation. Thus if Arizona gains only by reducing benefits elsewhere in the nation, there is no net benefit counted. In this type of situation only a *transfer* of benefits has taken place, leaving the nation no better or worse off. Similarly, the alternative investment opportunities considered can be anywhere in the nation. The question is asked: What investments elsewhere in the nation are displaced as a result of funds being committed to CAP? It is important to keep this national focus of conventional benefit-cost analysis in mind for it signifi-

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[1]BR, "Preliminary Information and Data Sheets for CAP," March 15, 1977, p. 4 lists total project cost as $1,777,939,000. The Arizona Water Commission projected a total project cost of $2,100,000 at the 1974 rate of escalation of 6.75% while the Tucson City Staff estimated a cost of $3,100,000,000 with a 13% rate of construction cost escalation. City of Tucson, "The Central Arizona Project," 1974, p. 56.

[2]BR, "Preliminary Information and Data Sheets for CAP," March 15, 1977, p. 5 gives a b/c ratio of 1.42 at the current discount rate of 6 3/8% and 1.61 at the authorized rate of 3¼%. The Department of Interior, "Water Projects Review: CAP," April 1977, p. 5 lists the b/c ratio as 0.93 at the current rate and 0.58 at the authorized rate.

cantly affects the results and the relevancy of the benefit/cost (B/C) ratio to various groups. It might well be that many Arizonans do not care to ask what CAP is costing the nation. They may only be interested in what Arizonans gain, whatever the cost to others. This narrower, Arizona focus will be taken in a later section of this report.

Here, we analyze, criticize, and modify the BR's benefit-cost ratio using standard economic principles which include a national opportunity cost perspective. The conclusions of this analysis will be that the BR has, in fact, grossly overstated the benefits of the project. CAP will, in fact, return only pennies in benefits for each dollar invested. The BR has exaggerated the benefits by:

1. Estimating the value of municipal and industrial (M&I) water in a way that guarantees positive net benefits no matter what the demand for or cost of the M&I water
2. Ignoring lower cost sources of M&I water
3. Treating CAP irrigation as if it were going to be used to bring new lands under cultivation when it will bring little *additional* water to any lands
4. Ignoring the costs of concrete-lined distribution systems that farmers will have to install
5. Using average water availability rather than dependable supply and thus ignoring the erratic nature of the agricultural water supply
6. Ignoring treatment and damage costs associated with the quality of CAP water
7. Treating an already built and operating power plant which in no way depends upon CAP as a benefit of CAP
8. Combining separable projects into one large project so that those yielding net benefits can obscure the net losses associated with others
9. Using an unreasonably low cost of capital and obscuring the real impact a higher capital cost would have
10. Ignoring the fact that CAP diverts water currently in productive use; it does not deliver "new" or currently "surplus" water
11. Ignoring major additional costs which will be necessary if CAP is to get its water through augmentation of the Colorado River

Each of these objections to the BR benefit-cost analysis will be taken up in turn below. The analysis will not be as precise as we would like. This is partially because CAP is a constantly changing project. Over the years, it has steadily shifted water from agricultural to M&I water uses. Even now it is not clear what the allocation is. The Department of Interior Water Projects Review lists 400,000 acre-feet (af) to M&I. In February 1978, the BR testimony to Congress listed 510,000 af annually to M&I.[3] In a February 24, 1978, meeting with the BR in Phoenix, 638,000 af was given as the new M&I allocation. Since no actual allocation has been made, the actual benefits that CAP would generate are indeterminant. Since the BR assigns a higher value to a unit of M&I water than to a unit of irrigation water, small M&I allocations such as the original allocation produce low B/C ratios.

Adding to this confusion is the fact that one major CAP feature, Orme Dam (as well as Hooker and Charleston Dams), has had its funding deleted but has not been deauthorized. The BR is now considering

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[3]*Department of Interior, "Water Projects Review: CAP," April 1977, p. 15. 1/1/78 Project Data Sheet, p. 613 of Hearings on the Public Works for Water and Power Development and Energy Research Appropriation Bill, 1979, listed 510,000 af annually to M&I use. The BR, "Preliminary Information and Data Sheets for CAP," March 15, 1977, p. 7 lists only 766,700 af for irrigation and 210,000 af for mining and electrical generation. When it was authorized in 1968, the BR assumed 312,000 af for M&I.*

several alternatives to the dam. No dam may be built.

Finally, the BR has no formal economic analysis of CAP available for review. Its economic figures are based upon a 1966 analysis. The BR never did a Definite Plan Report or some similar overall analysis of the project. Thus the analyst has only bits and pieces of the BR's ad hoc patchwork of economic analysis with which to work. These data problems guarantee a certain amount of guesswork and error in the following analysis and provides the BR with a dodge for almost every criticism. However, although modifications of CAP may change some of the numbers significantly, all of the conceptual criticisms developed below hold with full force.

1. THE CALCULATION OF MUNICIPAL AND INDUSTRIAL WATER BENEFITS

The benefits of municipal and industrial (M&I) water, like agricultural water, are the value of that water in its various uses. The direct way to estimate this would be to measure what the maximum was that individual residential users, municipal users, and industrial users were willing to pay to obtain additional water. Since a market for such water does not exist, this is not easily done. Faced with this difficulty, the BR does something which has nothing to do with estimating the values mentioned above and which guarantees that no matter what is being proposed, the M&I portion of it will produce positive net benefits on paper.

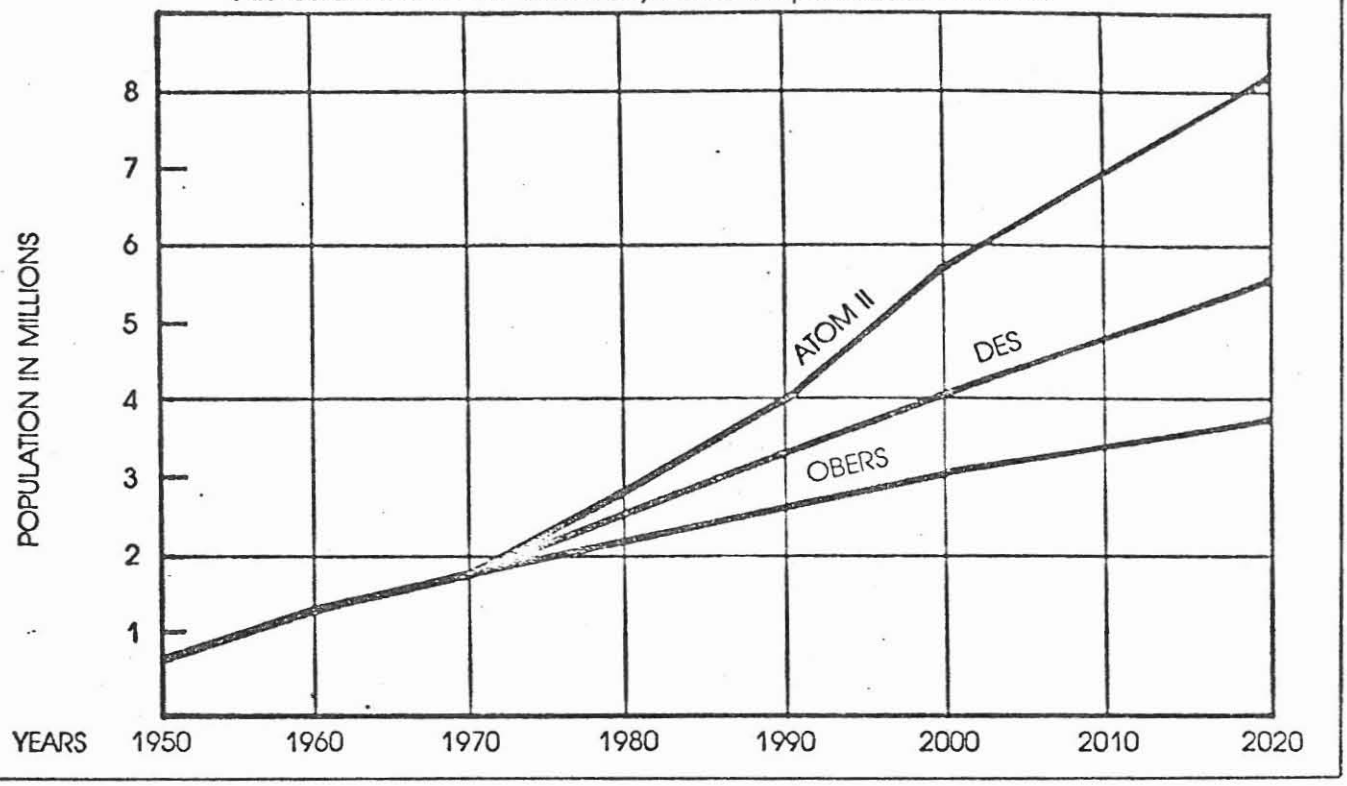
What the BR does to establish the M&I benefits of the CAP is to ask what it would cost to privately build a small CAP which would deliver to Central Arizona the same amount of M&I water but had none of the other functions in mind, such as power or irrigation. These costs of a "mini-CAP" are taken as the "benefits" of CAP; i.e., it is assumed that this mini-CAP *would* be built if CAP were not and that the water it delivered to M&I use would be worth at least what it cost to deliver it.

Since the privately built unit would not be able to get capital from the government at a subsidized 3.25 percent but would have to borrow the money at market rates and since parts of the capital construction costs could not be shared by an almost completely federally subsidized agricultural project, the costs of this "single purpose alternative" are guaranteed to be higher. Thus no matter what the rationality of the M&I portion, no matter whether the water is needed or not, a high positive benefit can be calculated by the BR. Almost one-half of the CAP's direct benefits are arbitrarily created in this way.

The objections to this method are twofold. First, the number arrived at has absolutely nothing to do with the value created by the water in this use. Secondly, the "single purpose alternative" chosen by the BR is an expensive creation of their own imagination which would never be the alternative chosen by the municipalities in central Arizona. As will be discussed below, the rational solution to central Arizona's M&I water problem is a mixed strategy which emphasizes non-construction alternatives and does not involve moving Colorado water to central Arizona. If the construction of a privately financed, single purpose, M&I mini-CAP is not an actual alternative and, as argued below, is far more costly than the alternative municipalities will in fact choose, these BR M&I benefits, which make up 48 percent of CAP's annual benefits, must be rejected. A complete loss of them would reduce the B/C ratio 48 percent.

The assumption that a "mini-CAP" would be built only for M&I water ignores

FIGURE 2
Arizona Historical and Projected Population Growth



statements that the locally available supply is adequate for all future M&I needs.[4] According to the Arizona Water Commission, the 20% consumption of central Arizona's renewable supply by urban users in 1970 could increase to 62% by the year 2020 under the high population projection (see figure 2). Under the official Arizona Department of Economic Security (DES) projection, urban consumption would amount to only 45% of the renewable water in 2020. This renewable supply does not include the CAP or the hundreds of millions of acre feet of groundwater in storage under central Arizona.[5]

2. THE REALISTIC ALTERNATIVES TO CAP'S M&I WATER

In trying to establish the economic rationality of a project like CAP, accurate consideration of alternatives is crucial, for it is the costs associated with these alternative ways of accomplishing the same end (e.g., provision of a certain number of gallons of M&I water of given quality) that determine the actual net benefits of the project. Net benefits are calculated by subtracting costs from gross benefits. Thus the net M&I benefits of CAP, looked at in isolation, are ($B_{CAP} - C_{CAP}$). But if CAP is built,

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[4]*As far back as 1962, a Vice President of Valley National Bank, writing in* Arizona Highways, *February-March, p. 57, stated that "Arizona's water supply for normal domestic and industrial usage is one of the best in the country," and there is no M&I problem in the lowland areas. The Arizona Department (now Office) of Economic Planning and Development in "Facts About Living in Arizona", circa 1970, p. 4 stated: "Arizona has Water!... There is adequate water for all current and future domestic and industrial needs." In an October, 1972 letter to* Arizona Living, *then Governor Williams said: "By careful planning we have enough water in central Arizona to support a population of ten million people."*

[5]*Arizona Water Commission, "Phase II, Arizona State Water Plan," February, 1977, pp. 109, 121, 125.*

the benefits which might accrue if an alternataive M&I water development project (such as groundwater pumping) were used will be lost. These lost net benefits of a non-CAP alternative are a cost associated with CAP too. Thus the real net benefit is the advantage CAP has over its alternative: $(B_{CAP} - C_{CAP}) - (B_{ALT} - C_{ALT})$. If both projects produce the same M&I benefits, then $B_{CAP} = B_{ALT}$, and the real net benefits of CAP reduce to the difference in the cost of the two projects ($C_{ALT} - C_{CAP}$).

This underlines the crucial role the costs of alternatives (which provide equivalent M&I water) play in determining the real net M&I benefits of the CAP.

The BR does not analyze alternatives to CAP for M&I water except to invent a privately financed mini-CAP. This alternative provides M&I water at approximately $200 per acre-foot ignoring transmission, treatment, and salinity costs.[6] CAP water itself will cost approximately $50 per acre-foot. But if we add the costs of transmission, treatment, and salinity damage in, the cost comes to $120.50 per acre-foot.[7] The current cost of supplying M&I water is $20 in Tucson and $15 in the Salt River Project area of Phoenix.[8] Thus the BR is proposing an alternative which will provide M&I water at costs five times current costs and examines an alternative to that which will provide water at ten times the current cost.

The realistic alternatives to CAP include:

A. Conservation, including a water-saving price structure for water
B. Buying out the more marginal farm operations
C. Some groundwater mining
D. Location of energy conversion facilities (power plants) where there is water
E. Reuse of municipal waste water after treatment
F. Legal changes in water law and management

No one of these provides *the* answer, but a combination of them would provide M&I water far more cheaply than CAP. Each will be discussed briefly below.

A. Water-Saving Price Structure

In 1970, urban users consumed less than 7 percent of the State's water, agriculture consumed 89 percent, mining 3 percent and steam electric power and fish and wildlife uses totalled a little over 1 percent. Because of this distribution, it is evident that the more significant savings must be realized through improvements in management of agricultural water supplies. Nevertheless, in certain areas of the State, urban water use is relatively large, and reduced consumption will serve an important role in achieving meaningful water management.[9]

Water is not carefully used in Central Arizona now. There are few economic or legal incentives to conserve the resource. This is largely because no price is attached to water except the cost of obtaining it. This cost does not reflect the scarcity value of the water, and, as a result, the water goes to

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[6] *BR, "Preliminary Information and Data Sheets, p. 6 gives annual M&I costs as $80,953,000. Page 7 indicates 443,300 af going to M&I. If there are 10 percent losses in transmission, 400,000 af would be delivered for a cost of $202.38.*

[7] *City of Tucson, "The Central Arizona Project," 1974, p. 61. This would be somewhat lower in the Phoenix area where surface water predominates and water quality is generally poorer.*

[8] *Ibid. Water users are charged $5 per acre foot. This price is subsidized by electric revenues. Thus it is below the $15 cost.*

[9] *Arizona Water Commission, "Water Conservation in Arizona," Draft June 1977, p. 2.*

very low valued uses. A pricing structure which attached a price to water which accurately reflected its scarcity value would lead many low valued uses to be abandoned.[10] A pumping tax on all groundwater users would reduce marginal agricultural uses. A municipal water rate structure which made modest amounts of domestic water available at very low cost but then imposed sharply rising rates for additional use would encourage conservation in lawn watering, etc. Currently in the Phoenix area, residents can flood-irrigate their lawns at a few dollars per acre-foot while the city considers buying CAP water which will cost twenty times as much. This sort of pricing system encourages grossly irrational uses of water which then impose very costly solutions on the entire population. Water use, like any economic activity, *is* sensitive to price. Currently (and with CAP) the price of water does not reflect full costs and people are thus encouraged to act irrationally.

B. The Conversion of Farm Land and Water to Urban Uses

Each year many acres of farmland are subdivided for urban use, releasing the agricultural water to M&I use. As a result, a recent engineering report for the Phoenix area shows an increasing reduction in the groundwater overdraft through 1995 with a surplus of water before the year 2000 — without the CAP.[11]

In addition, Tucson, through both its government and industries, is buying out more distant farms to obtain the groundwater rights. The intent is to both reduce the drain on the aquifer and provide water for M&I use. This method could provide M&I water at $7.00 to $14.00 per acre-foot, ignoring transmission costs.[12]

Tucson has considerable water resources available to meet its future needs. Groundwater can support urban needs for several centuries. Losses which may result from the Papago litigation are relatively small in comparison to available supplies.[13]

C. Groundwater Mining

While there is general agreement that the current rate of depleting the groundwater aquifers is too high, this does not mean that all net depletions are objectionable. We mine coal, oil, copper, etc. It is only rational to also mine water. As with the other resources, the concern is the optimal *rate* of mining, not the wisdom of mining or not mining. Too rapid a depletion of water or oil or copper would impose high costs on future generations. The rational strategy is not to reduce the rate of groundwater depletion to zero but to a substantially lower level than the present one.

At $100 per acre-foot (CAP water costs) one could afford to pump from over 1000

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[10] *See James L. Barr and David E. Pingry, "Rational Water Pricing in the Tucson Basin,"* Arizona Review, *October 1976.*

[11] *Arthur Beard Engineers, Inc., and Camp Dresser & McKee, Inc., EIS MPFP, 1978, Phase I, Future Environmental Setting, 4/15/78, p. 2-30.*

[12] *George W. Barr, Jr., P.E., January 1975 memo to Tucson Mayor and City Council, cites lands purchased at $700/a which produced 3.5 af/a of water. If this land had no value at 7 percent and over 50 years this would amount to $14.49 af/yr. If the land had a $350/a value without the water, the cost would be about $7.00 per acre-foot.*

[13] *Black and Veatch Consulting Engineers, Kansas City, Mo., "Offering Statement for Tucson's $49,875,000 Water System Refunding and Improvement Revenue Bonds," May 1977, p. 59. 39 million acre feet are available under the Santa Cruz Basin alone. In 1970, Pima County urban consumption was 69,000 acre feet and mines consumed 53,000 acre feet.*

feet.[14] There are approximately 600 million acre feet of groundwater in storage under central Arizona within that depth.[15] Since the overdraft is less than 2 million acre feet a year, mining groundwater could continue at the present rate for several centuries.

D. The Location of Electric Generating Facilities

The location of electric generating facilities using wet tower evaporative cooling in an area of water scarcity does not seem very rational. It is cheaper to move electricity over transmission lines than to use electricity to pump water thousands of feet uphill to electric generating facilities located in the desert. Those located there could use dry tower cooling. If they had to pay the full cost of CAP water instead of the subsidized cost, they probably would.

Location of generating facilities where there is water would reduce industrial demand for water considerably. Phase II of the Arizona State Water Plan projects an increase of water consumption for power plant cooling in the Phoenix area of 270,000 acre feet by the year 2020.[16] This is approximately one quarter of the projected CAP water supply.

E. Wastewater Reuse

In a water scarce area, recycled water is an economic source of industrial water. Compared to the high cost of transporting CAP water, it could also be an economic source of domestic water. Federal water quality standards require treatment of the waste water to make it suitable for industrial and agricultural use. Further treatment and mixing would allow its use for domestic purposes. Mining interests in the Tucson area already are purchasing waste water. Barr and Pingry calculate that waste water reuse for M&I would cost only three-fourths of what CAP water would cost.[17]

F. Legal Changes

If a market for water existed, a real scarcity price would come to be attached to all water in Central Arizona. Given the right of individuals to pump almost without limit from the common groundwater aquifer, such a market is unlikely to develop. If there were limits (tax or regulatory) on groundwater pumping and sale of water rights were facilitated, the scarcity price that would come to be attached to water would, by itself, solve many of Central Arizona's water problems. The high price would lead those farmers raising low valued crops to sell their water to higher valued uses. Some of these uses are agricultural. Others are municipal and industrial. Water would automatically move to the highest valued use and the water shortage would disappear. Municipalities and industry are clumsily mimicking this in their land purchases.

A good example of a human-created (legal) scarcity is the situation in the Phoenix metropolitan area where the Salt River Project (SRP) boundaries include only part of the city (see figure 3). SRP does not sell water outside of its boundaries. As a result, there is a theoretical drought in one-fifth of Phoenix (that is not in SRP) requiring CAP as a solution, while 78 percent of Phoenix has no need for CAP.[18] The removal of this

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[14] *U.S. Department of Interior, "Water Projects Review: Central Arizona Project," p. 7 and footnote 13.*

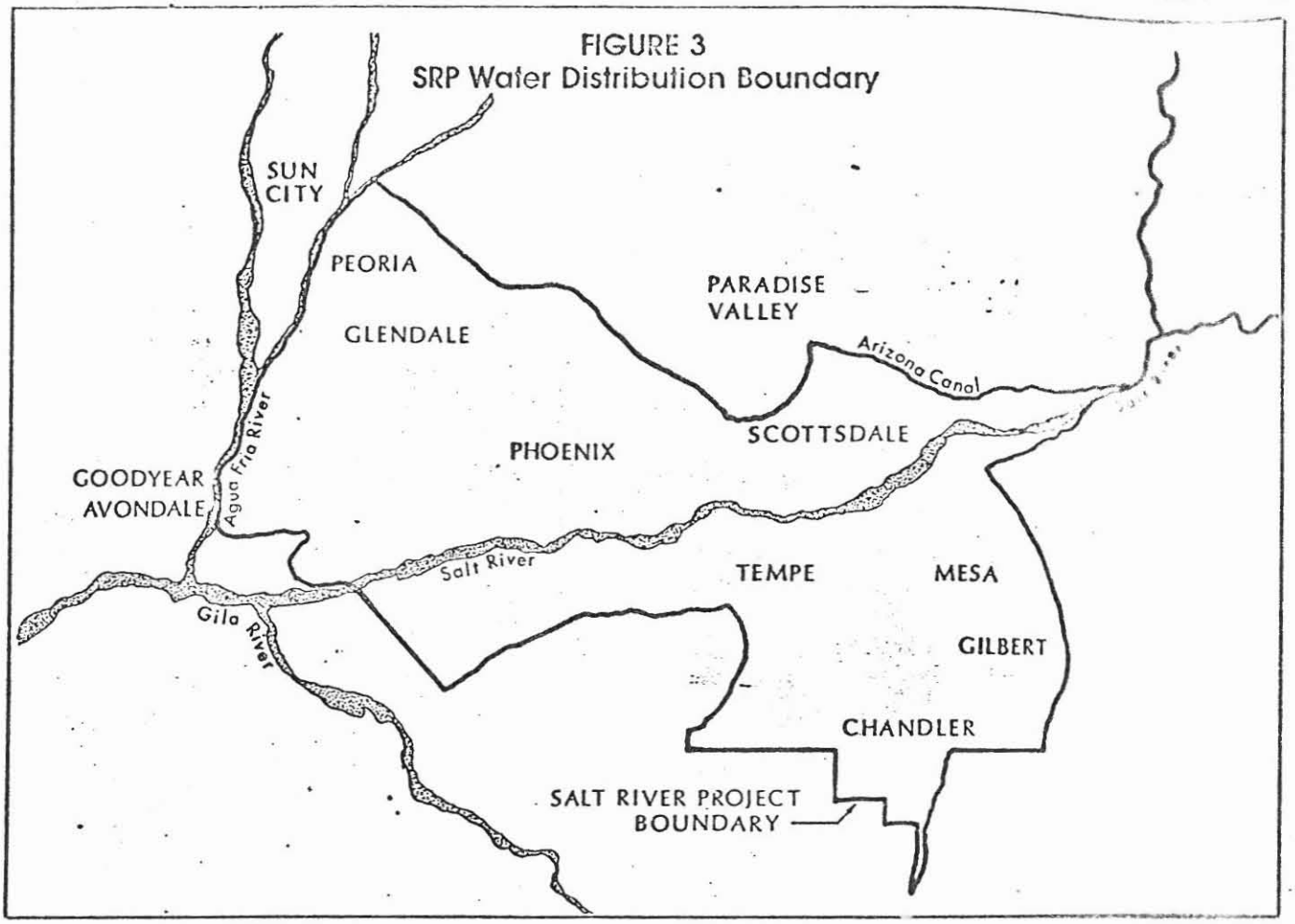
[15] *Arizona Water Commission, "Phase I, Arizona State Water Plan," July 1975, p. 9. Of course, this groundwater is not necessarily stored under the specific lands that are now overdrafting but could be transported to them. This is being done for the Ak Chin Reservation. As for subsidence, see pp. 79 to 82 of the City of Tucson CAP Report, which concludes: "The use of the 'scare tactic' by CAP proponents such as projecting giant cracks opening up in the City of Tucson due to subsidence is a gross misuse of facts.*

[16] *Arizona Water Commission, "Phase II Water Plan," p. 109.*

[17] *Barr and Pingry, "Water Pricing," p. 9.*

[18] *Art Vondrick, Phoenix Director of Water and Sewers Department. Quote in Arizona Republic, February 27, 1977, p. 1.*

FIGURE 3
SRP Water Distribution Boundary



constraint would solve the human-created scarcity and eliminate the need for CAP M&I water in the Phoenix area. There is enough renewable water in the Phoenix area to support 4.5 million people and more than 100,000 acres of agriculture.[19] The present population of the area is 1.3 million.

The costs associated with each of these alternatives and with the rational mix of these alternatives is considerably below the costs associated with CAP. Thus, the net benefit of CAP, as indicated by the difference between the costs of CAP, is negative. CAP would impose a net loss from the national perspective, not generate net benefits.[20]

3. THE CALCULATION OF AGRICULTURAL BENEFITS

With the exception of Indian lands, CAP irrigation water, under terms of the Master Contract, can only be used on lands which have a history of irrigation. No new lands can be brought into production. In addition, those farms or irrigation districts which receive water will have to reduce their groundwater pumping by an amount equal to the CAP water they have received. This means that CAP provides no additional irrigation water; it simply substitutes a surface source for a groundwater source.

In calculating the benefits to agriculture of this sort of change in water source, one

[19]*Arizona Water Commission, "Arizona State Water Plan, Phase II," February 1977, p. 109.*

[20]*Recall that we are looking at the total costs of constructing CAP not the subcontracts municipalities or industries would have to pay*

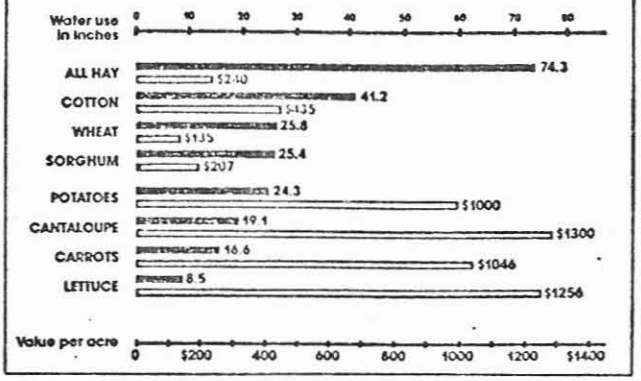
would assume that the BR would compare two farms: one irrigating with pumped groundwater, the other receiving water from CAP. The difference in net income between the two under projected conditions in the future would represent the irrigation benefits of CAP.

The BR did nothing even remotely connected with this in their benefit calculation. What they did was draw up farm budgets for a variety of new irrigated farms which brought land into agricultural use for the first time. The entire net income of these farms was assumed to be the benefits of CAP water.

This is objectionable for several reasons. First, the farms receiving CAP water will not be receiving water for the first time. They have been irrigated for some time and already enjoy the benefits of irrigation. These benefits cannot be credited to CAP. The only benefit that can be attributed to CAP is the real cost difference between the two water sources. This should not be the difference between the private costs of pumping and the subsidized cost of CAP water. It must be based on the full social cost of CAP water. It is likely, given that CAP's irrigation water costs are projected to be $43.00 to $76.00, that there is no improvement in real costs over groundwater pumping, and thus there are no net benefits associated with substitution of CAP water.[21]

Second, the CAP water will be additional water brought into central Arizona. Although recipients will have to reduce pumping, their neighbors need not and under current Arizona law could, with a reduced rate of aquifer depletion, increase their groundwater pumping. Basic economic theory (the principle of diminishing returns), well borne out by many empirical studies, suggests that the value added or created by additional units of water is less than the average value

FIGURE 4
Crop Value & Water Use



of existing units used. When water is scarce, it is shifted by the farmer to its most highly productive uses. Farm management is built around that quantity of water the farm can regularly count on. Acreage and crops are adjusted in a profit maximizing way to the limited water supply. When more water becomes regularly available, it is used in the next most (but less) valuable uses. As more and more water becomes available, it is put to use as supplemental water or used to irrigate less valuable crops. Figure 4 amply illustrates this situation.[22]

Empirical studies of Arizona's farms in each of its counties confirms this pattern.[23] Kelso and his colleagues at the University of Arizona found that the productivity of water (its value) in various uses varied from over a hundred dollars per acre-foot to less than a dollar per acre-foot. When water is cheap and readily available, it is put to low valued uses. When it is expensive and in short supply, it is restricted to higher valued uses. This same pattern of diminishing marginal productivity and value of water as more is made regularly available has also been found by researchers in other arid states of the West such as Colorado and Utah.[24]

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[21] *BR, "Preliminary Information and Data Sheets, p. 6 gives the annualized irrigation costs as $32,904,000 using 3¼ percent interest. At 7 percent interest over 50 years this would be $58,537,000 per year. This does not include the costs of the distribution system to carry the water to the farm. CAP irrigation water is given at 766,700 af/yr on p. 7.*

[22] *City of Tucson, "The Central Arizona Project," 1974, p. 43.*

[23] *M. Kelso et al.*, Water Supplies and Economic Growth in an Arid Environment: An Arizona Case Study, *University of Arizona Press, 1973.*

[24] *For Utah, see M.H. Anderson et al.*, The Demand for Agricultural Water, Utah Water Research Laboratory, September 1973 (PRWG 100-4). For Colorado, see Marginal Value of Irrigation Water, *Technical Bulletin 70, Agricultural Experiment Station, Colorado State University, 1960.*

Kelso calculated that the value of an additional acre-foot of water in 1985 when CAP water might be available was $8.72 in 1966 dollars. In current (1977) dollars this would be $15.96. He used an 8 percent discount rate and included the calculated indirect benefits associated with the additional farm output stimulating the local economy. In carrying out this calculation, he did not guess or assume what the impact would be. Instead he used an elaborate input-output model of the Arizona economy to determine exactly how each type of farm operation tied into the larger economy.[25] The BR, ignoring the principle of diminishing returns, calculates the average value of water when water is used to irrigate new land to raise an average mix of crops. The BR comes up with $42.91 per acre-foot in direct benefits and another $55.24 per acre-foot in indirect benefits for a total of $98.15.[26] The BR gets a figure six times as large as Kelso. Kelso's figure gets support from other sources. The U.S. Forest Service Chaparral Conversion Project in Arizona calculated a $15.57/af value for additional water in Arizona.[27]

One can use the costs of groundwater pumping in situations where one can obtain all the water for which one is willing to pay the pumping costs as an estimate of the marginal value of water. If, when the variable pumping costs are $15.79/af, one uses a certain amount of water on one's crops but no more, it is because the value of the additional output is less than the cost of the additional water. Thus the variable pumping costs can be used as a measure of the marginal value of water. In the Salt River Project this is the $15.79/af quoted above.[28] Howe and Young in Utah found the last units of water used to be worth $15/af.[29] Similar results ($2.73 to $26.27 for an average of $14.50 in 1976 dollars) have been found in Colorado.[30]

Thus, there seems to be considerable evidence that the value of additional units of water in Arizona agriculture is $15 to $16 per acre-foot, not $45 to $100 as the BR claims.

The BR elsewhere in their analysis of supplemental water has argued:

> The whole purpose of supplemental irrigation is to provide the farmer with the stability and diversity he needs in optimizing the efficiency of his farming operation. The last increment of water, that needed to provide a full and dependable supply, is the most valuable water the farmer owns. It frequently is the difference between success and failure.[31]

Thus, the BR argues, supplemental units of water are *more* valuable than previous units. This type of argument assumes regular farm mismanagement. It assumes that farmers, knowing they have limited water supplies bring under irrigation so many acres of crops that they cannot regularly provide the crops with sufficient moisture and as a result the crops regularly suffer from moisture stress. No rational farmer would do this. Farms adjust their

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[25] *Kelso, p. 42.*

[26] *BR, "Report on Single Purpose Alternatives for CAP Regulation," September 1977, p. 6. BR, "Preliminary Information," gives $45.63/af direct benefits on p. 6. This would give over a hundred dollars in total benefits per acre-foot.*

[27] *Thomas C. Brown et al.*, Chaparral Coversion Potential in Arizona, Part II: An Economic Analysis, U.S. Forest Service Research Paper, RM-127, *August 1974, p. 12 adjusted to 1977 dollars.*

[28] *Salt River Project Letter to U.S. Army Corps of Engineers, May 31, 1977, by D.E. Womack.*

[29] *Howe and Young, "The Measurement of Income Effects of Increasing Salinity in the Colorado River," Center for Water Resources Research, Utah State University, June 1975.*

[30] *Memo to Dave Carlson, Colorado Department of Agriculture from R.A. Young, Department of Economics, Colorado State University, March 23, 1976.*

[31] *BR, Upper Colorado Regional Office, Salt Lake City, Utah, "Bonneville Unit" (a reply to the President's criticism of the Bonneville Unit, dated 3/21/77, no page numbers).*

irrigated acreage and type of crop to the dependable supply of water. When additional water becomes available on a regular basis, they readjust to make use of it. They do not hold that supplemental water in reserve, unused, for that one year in five or ten when drought hits. They use the water regularly, and when drought hits, they are still short of water.

CAP will not collect and store water for use only in drought years. Thus one does not estimate the value of supplemental water by looking at drought years. *If* one could make available, cheaply, additional water in drought years in late season, that water would be terrifically valuable for, as the BR says, these additional units could save the whole crop. But in non-drought years or in wet years that water would be worth nothing. To estimate the value of water by studying drought years makes no more sense than estimating the value of supplemental water by studying wet years. The supplemental water will be provided in all years, wet, dry, and average. Its value is established by looking at all of these years or an average year.

One possible justification for the method the BR uses to calculate the irrigation benefits of CAP water is that Arizona farms which receive the water would have failed without the water. CAP is seen as rescuing these farms from failure. Thus one can claim the whole of the net income of the farm as a benefit of CAP water. Rising groundwater pumping costs are putting increasing pressue on farms. Some are already failing. By 1985, and later, without CAP water, still more would fail. However, despite the reality of this problem, the BR method is still basically incorrect.

If the problem is that over the next 50 years, more and more farms will fail because of declining water tables and CAP will prevent this, then we need to analyze over time the amount of water needed each year to prevent this and the amount of net farm income saved. This will start as a small amount and increase with time. The discount rate will reduce these later values and the projected rise in M&I demand and fall in available Colorado water will shrink the water available to agriculture later in the 50-year life. Thus some careful calculations of supply and demand over time would have to be carried out. The BR did not and has not done this analysis.

Kelso et al.[32] have done exactly this. They demonstrate that it will be farms producing the lowest value crops which will fail first. Those producing the higher valued crops (fruit, nuts, cotton, etc.) will be able to afford the higher pumping costs and will not need to be rescued. Thus all the CAP water would save are the lower valued operations. It is the marginal value of water ($16.00 per acre-foot) that is relevant — not the BR's $100 per acre-foot.

If we use the actual value of CAP water as a substitute for pumped groundwater, we must assign it either a zero value (it is more expensive than the groundwater it replaces) or if groundwater pumping does not decline and CAP water is supplemental water (or if CAP saves marginal farms), we must assign it water's marginal value, $16.00/af. This reduces irrigation benefits to at least one-third of what the BR claims. Since irrigation benefits make up 21 percent of the total benefits, this reduces the B/C ratio 21 percent if the marginal value of the water is zero or 16 percent if the value is $16.00/af.

4. THE COST OF THE DISTRIBUTION SYSTEM

The Master Contract requires irrigators who receive CAP water to take it from canalside to their farm headgates in concrete-lined ditches. Since the value of water calculated above was the value on the

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[32]*Kelso,* Water Supplies.

farm, the cost of the distribution system must be subtracted from it. This would reduce further the irrigation benefit.

In a 1967 economic analysis of irrigation using CAP water, the BR estimated that the concrete-lined distribution systems which would take CAP water from the main delivery canals to the farms would cost $340 per irrigated acre in construction costs and $11.84 per irrigated acre in annual OM&R costs.[33] If these are doubled to take into account inflation and the rapid rise in the relative cost of construction over the last ten years, these become $680 per irrigated acre in construction costs and $24 per irrigated acre in annual OM&R costs.[34] To the capital costs must be added interest during construction. At 7 percent, the annual capital cost is $56 per year. Combined with the annual OM&R costs, this means that the total annual cost of the distribution system will be $80 per irrigated acre. Thus a farm with 320 irrigated acres would face an annual cost of $25,600 per year. The total investment the farm would have to make would be $248,000.

Even if one uses the BR 1967 figures but a 7 percent interest rate, the annual cost of the distribution system which farms will have would be $12,160 for a 320 irrigated acre farm. This entails a capital investment of $116,480 per 320 irrigated acre farm. These costs are startlingly high. If these BR figures are accurate, many farms and irrigation systems will not be able to afford the distribution systems that would make CAP water available to them.

5. THE RELIABILITY OF THE AGRICULTURAL WATER SUPPLY

The BR in its calculations uses the *average* water CAP will deliver. In doing this they ignore the fact that irrigation systems are built around dependable supply, not average supply. What is lost by using averages is the wide fluctuations in water available to CAP. Since municipal and industrial users will have priority claims on the CAP water, all the adjustment during low flow years will have to be made by irrigators.

If one simulates the future by repeating the past 50 years of fluctuations in the flow in the Coloradro River in various sequences and one gives California and Mexico their priority claims, one finds the the dependable residual left to Arizona CAP irrigators disappears altogether within 10 to 20 years after the start of the project. That is, if weather patterns of the past repeat themselves, there will be a dependable supply of CAP water for irrigators only early in CAP's life. Then as M&I demands grow and Coloradro flows decline, agriculture gets squeezed out.

Figures 5 through 8 show this squeeze on CAP irrigation.[35] Plotted on the figures at the bottom are the Arizona Water Commission Staff's proposed allocations of M&I water. The fluctuating line indicates the CAP deliveries under a variety of circumstances. The vertical distance between the M&I allocation line and the CAP delivery line is the water available to agriculture. Figure 5 shows what the BR's "average" figures suggest: a large but somewhat shrinking CAP supply available to agriculture. Figure 6 indicates what the picture looks like for irrigation if the BR estimate of dependable supply is used instead of average supply. After ten years there is no dependable supply available to agriculture. In Figure 7 non-Indian irrigators have 20 years of dependable supply if one uses the Arizona Water Commission's estimate. Figure 8 uses

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[33] *BR, "Future Economy," section 6 of a larger document, title unknown; circa 1966, mailed to the author by the Regional Economist, Lower Colorado Region, Bureau of Reclamation, p. 124.*

[34] *Construction costs over this period have more than doubled. The GNP index of inflation has increased by a factor of 1.9.*

[35] *Taken from W.S. Gookin and Associates, Proposed Arizona Water Commission Staff Allocations of CAP Water," Scottsdale, Arizona.*

FIGURE 5
Arizona Water Commission Staff Proposed Allocations and Average CAP Deliveries (AWC)

SOURCES:

Indian Allocation based upon, "Allocation of Project Water for Indian Irrigation Use", Fed. Reg., Oct. 18, 1976.

Municipal & Industrial Allocations from, "Staff Recommendations Re-Allocation of Arizona's Remaining Entitlement in the Colorado River and Specific Recommendations Concerning Allocation of M&I Water Supplies", Nov. 18, 1976.

CAP Deliveries from the same source as above dated, Nov. 18, 1976.

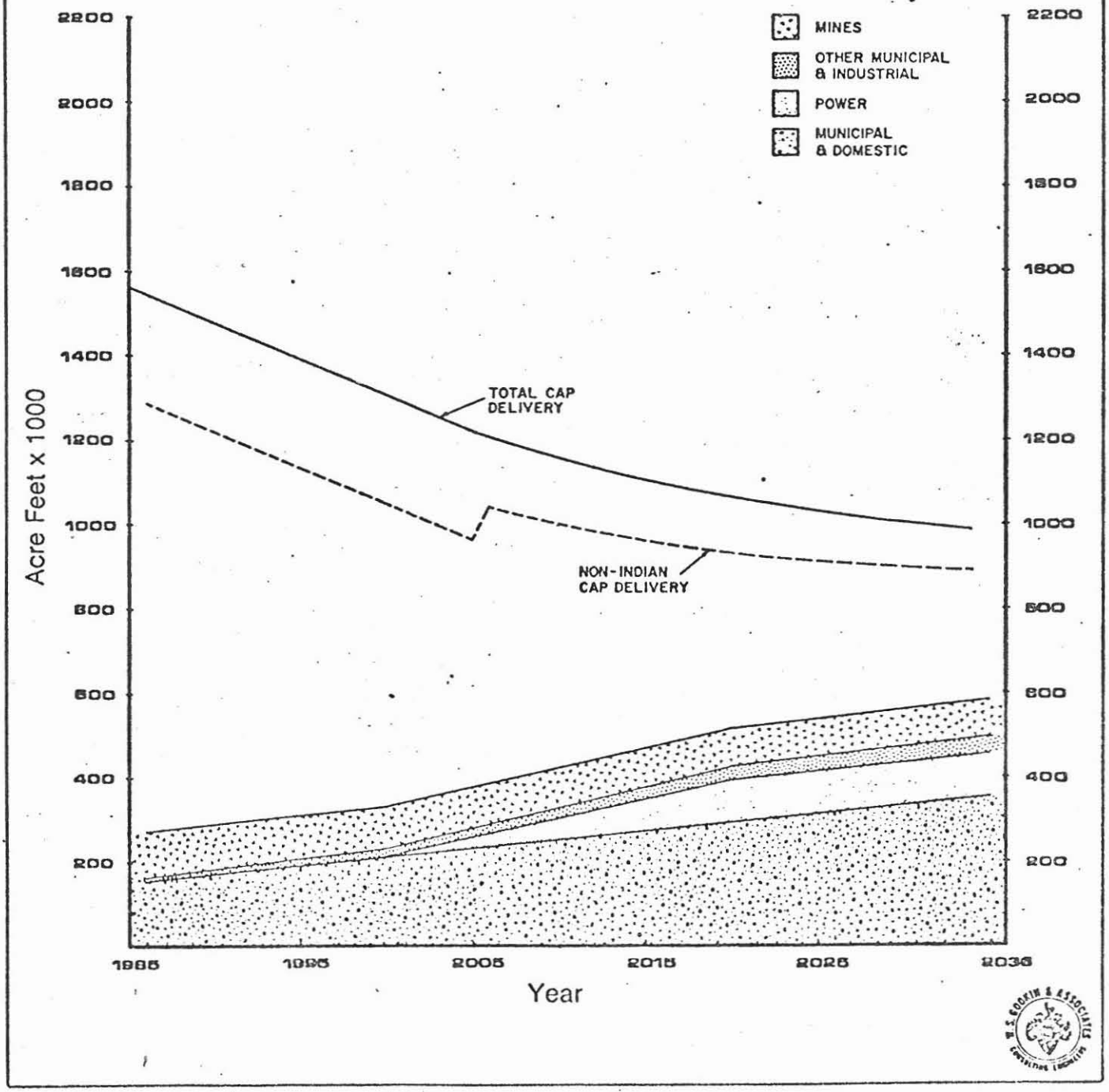


FIGURE 6
Arizona Water Commission Staff Proposed Allocations and Dependable Supply (USBR)

SOURCES:

Indian Allocation based upon, "Allocation of Project Water for Indian Irrigation Use", Fed. Reg., Oct. 18, 1976.

Municipal & Industrial Allocations from, "Staff Recommendations Re-Allocation of Arizona's Remaining Entitlement in the Colorado River and Specific Recommendations Concerning Allocation of M&I Water Supplies", Nov. 18, 1976.

CAP Deliveries from United States Bureau of Reclamation "Central Arizona Project Water Delivery Schedule, Sequential Hydrologic Base", April, 1975.

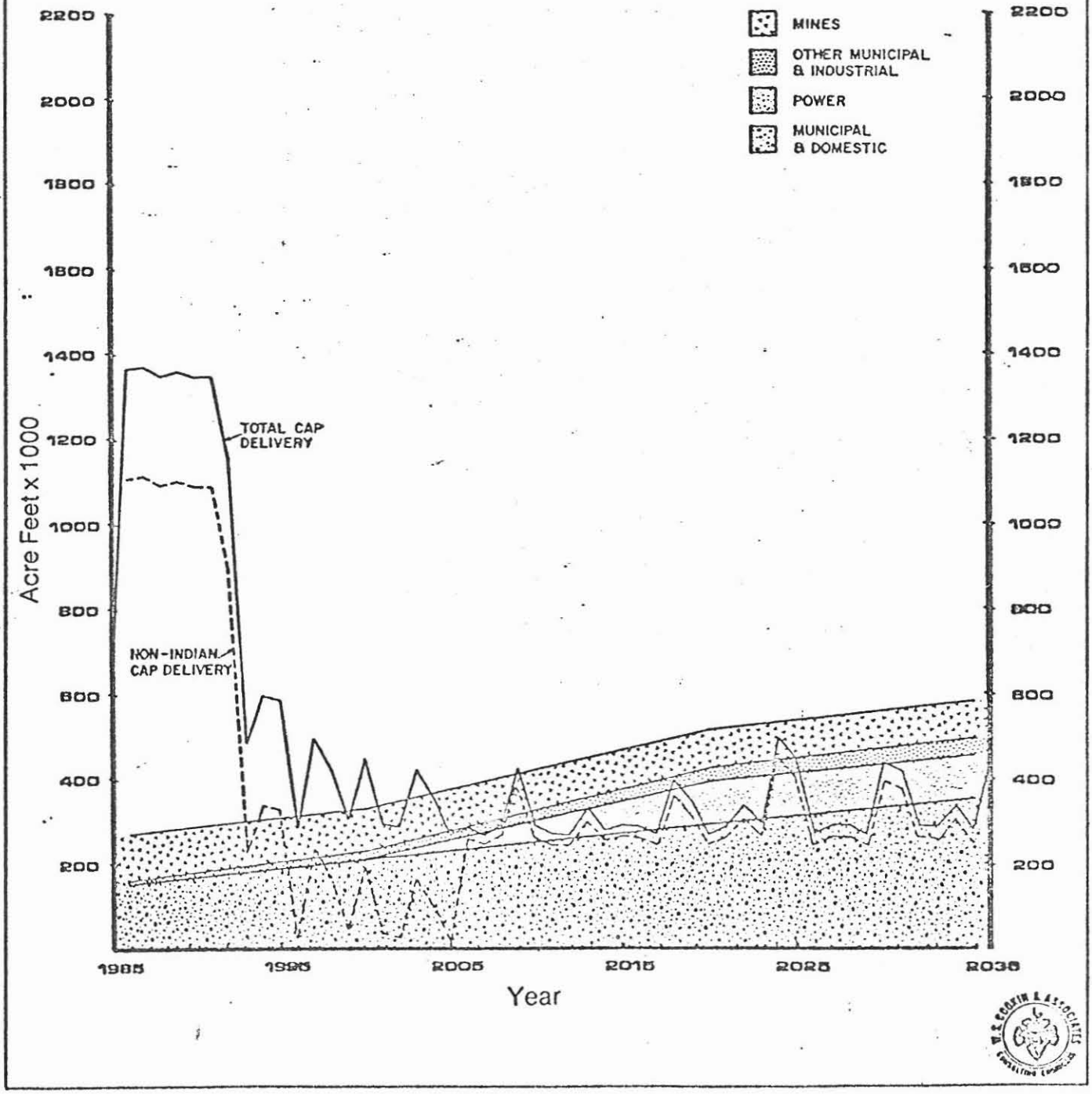


FIGURE 7

Arizona Water Commission
Staff Proposed Allocations and
Dependable Supply (AWC)

SOURCES:

Indian Allocation based upon, "Allocation of Project Water for Indian Irrigation Use", Fed. Reg., Oct. 18, 1976.

Municipal & Industrial Allocations from, "Staff Recommendations Re-Allocation of Arizona's Remaining Entitlement in the Colorado River and Specific Recommendations Concerning Allocation of M&I Water Supplies", Nov. 18, 1976.

CAP Deliveries from the same source as above dated, Nov. 18, 1976.

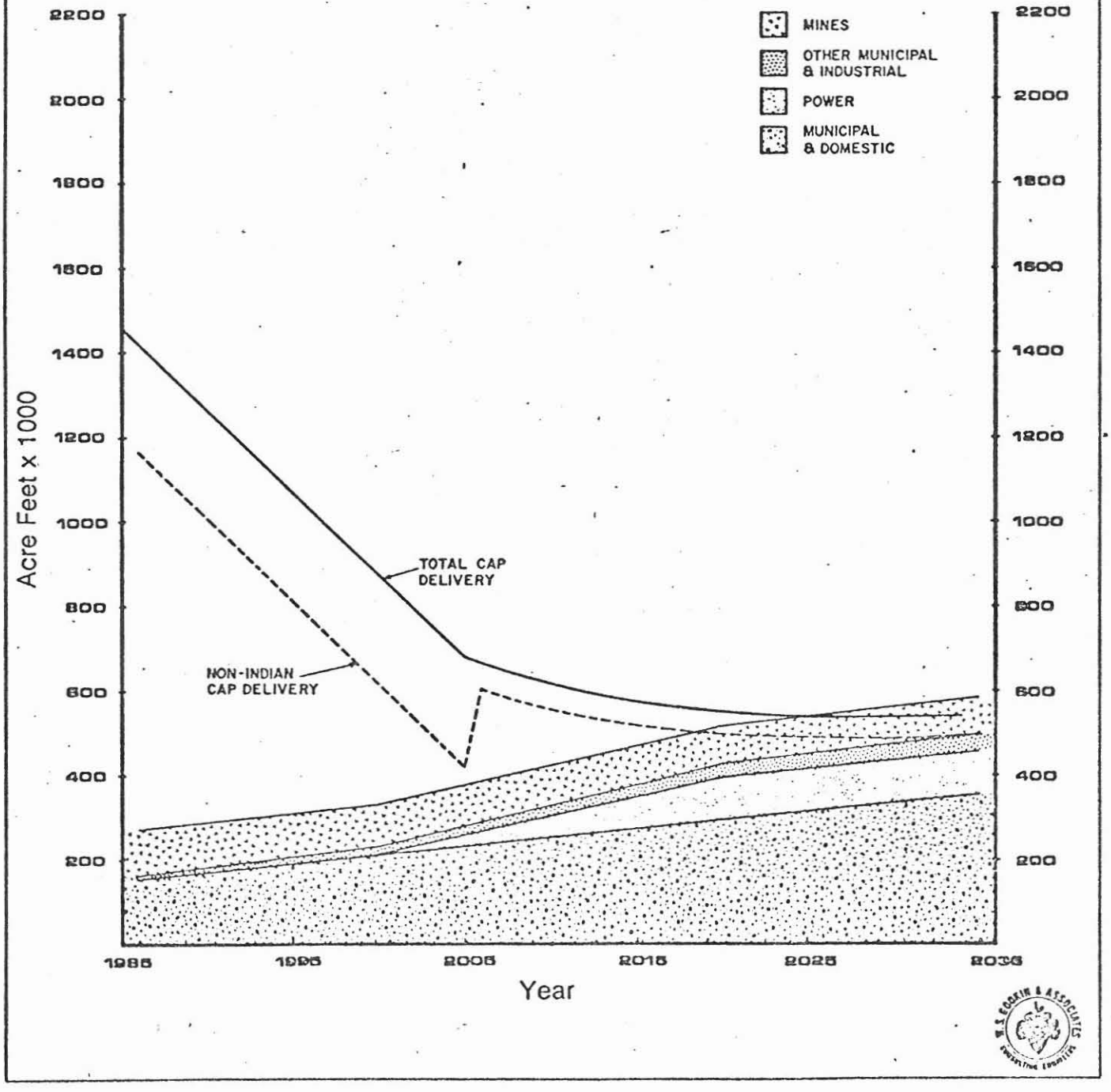


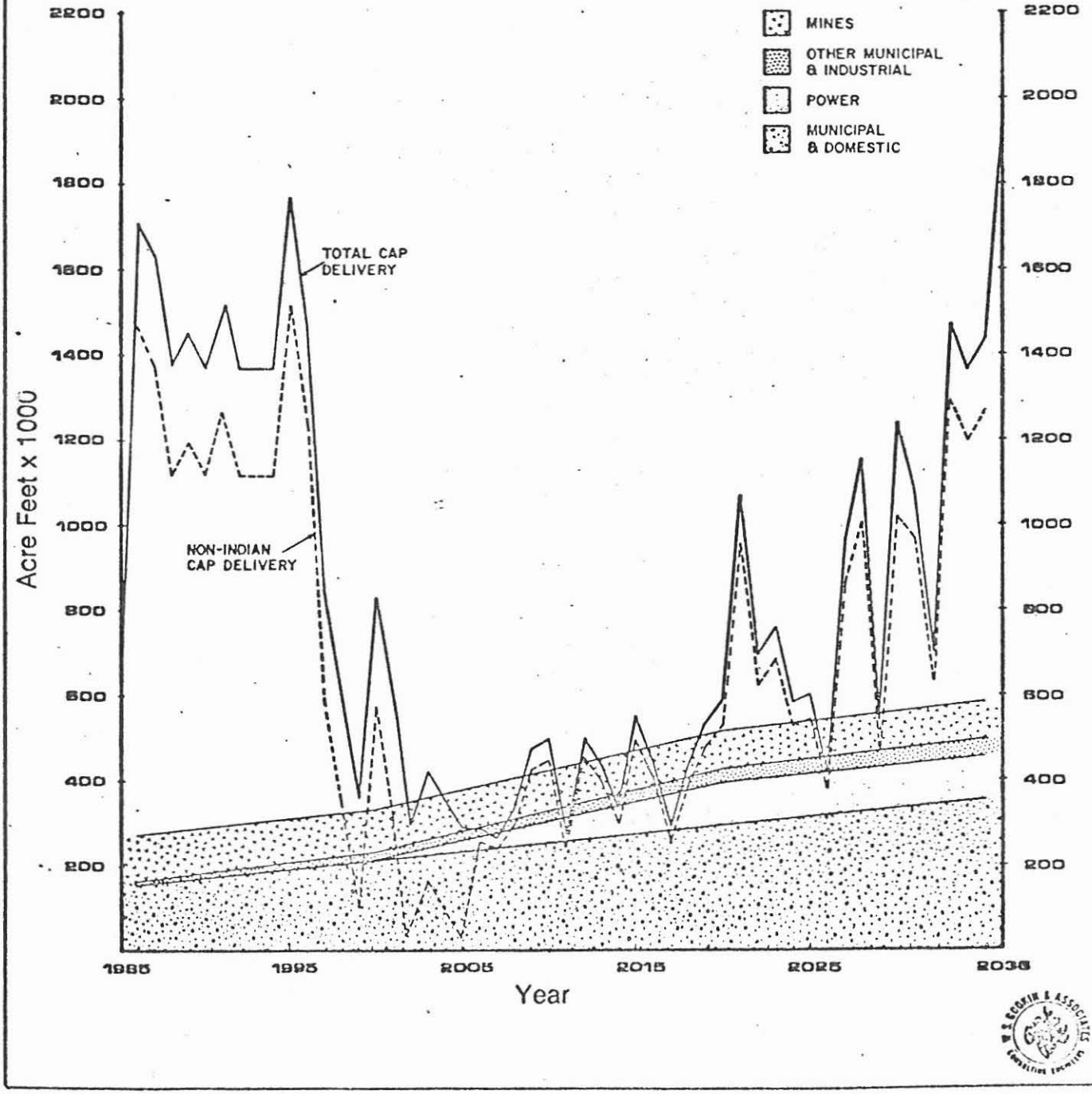
FIGURE 8
Arizona Water Commission
Staff Proposed Allocations and
Most Adverse Sequence (USBR)

SOURCES:

Indian Allocation based upon, "Allocation of Project Water for Indian Irrigation Use", Fed. Reg., Oct. 18, 1976.

Municipal & Industrial Allocations from, "Staff Recommednations Re-Allocation of Arizona's Remaining Entitlement in the Colorado River and Specific Recommendations Concerning Allocation of M&I Water Supplies", Nov. 18, 1976.

CAP Deliveries from United States Bureau of Reclamation "Central Arizona Project Water Delivery Schedule, Sequential Hydrologic Base", April, 1975.



the BR's most adverse sequencing of past hydrological conditions to indicate dependable supply. Irrigation loses access to CAP water after 15 years.

Given the investment CAP irrigators would have to make in concrete-lined distribution systems and given the lack of a dependable supply available past the first 10 to 20 years, very little irrigation is going to take place with CAP water. The irrigation districts adjacent to the main CAP canals who already have concrete-lined distribution systems will be able to afford to "temporarily" use the CAP water to replace pumped water or for groundwater recharge, but most other areas will simply not be able to afford the gamble associated with undependable supply and will get none of the water for irrigation. Thus, again, the agricultural benefits of the CAP have been exaggerated and much of the undependable supply may have to go to very low value temporary uses.

As Arizona's State Water Engineer said in 1975; "Obviously the project (CAP) is now municipal and industrial oriented. Agriculture's use of project water will only be temporary."[36]

One response to the conclusion discussed above that CAP will not provide a dependable water supply to agriculture is that a dependable supply from CAP is not needed to make irrigation with CAP water viable. Current irrigators already have in place wells and pumps which could continue to be used to pump groundwater to "back-up" the unreliable supply. Thus, this response says, the combination of the two would provide a long run dependable water supply to agriculture even if neither of them taken alone could do so.

Technically this is a solution to CAP's undependable service to irrigation, but economically it is not a likely or viable solution for it imposes the costs of both systems on the irrigator. The irrigator who takes CAP's water besides paying the CAP water and OM&R charges will have to invest considerable money in a distribution system to carry the CAP water from the main canals to the farm. BR 1967 figures indicate that the capital and OM&R costs of such a distribution system would be $12,160 per year for 320 irrigated acres. In 1977 dollars this would be $25,600 per year. If the irrigator also maintains his/her well and pump, the annual capital costs associated with them would continue. In addition, the electric or natural gas utility imposes a demand or hook-up charge each month that is proportional to the horsepower of any motor tied into its system. This charge is imposed regardless of how much the motor is used. Thus the irrigator would continue to face a sizable "utility" bill for an unused (except during low CAP flows) pump.

Conversion to diesel powered pumps would avoid this charge but only by incurring an additional large capital cost for the diesel generator, a high maintenance cost on the unit and with a critical oil shortage, a high fuel cost. Finally the CAP delivery system and the existing wells may be located at entirely different points on the irrigated fields requiring additional investment in pipes, ditches, pumps, etc. Taken together, the cost of maintaining both systems to back each other up is likely to be far too costly to be a viable solution.

6. THE IMPACT OF SUBSIDIZED INCREASES IN FARM PRODUCTION ON OTHER FARMERS

Even if the contention of the BR of a reliable 50 year agricultural water supply were valid, the project cannot be justified on the basis of national economic

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[36] *"Notes for Presentation to Western States-Water Council: Status of the CAP," dated January 17, 1975, cited in W.S. Gookin and Associates, "Water Allocations, CAP, Status Report," March 3, 1975, p. 31.*

development. The BR counts as benefits all of the additional net income they project will result from the addtional crop production CAP will allow. In addition, they count the indirect benefits of the additional net income non-agricultural business firms and individuals will earn as a result of the more prosperous farms irrigated by CAP water.

This would be quite appropriate if this additional agricultural output and income were a net gain to the nation, However, if it is obtained at the expense of driving farmers out of business elsewhere in the nation and depressing the economies where those farms are located, clearly what the BR is counting is not a net gain to the nation. They are exaggerating the benefits by ignoring indirect losses.

Agriculture in Arizona is not carried out in isolation from the rest of the nation and its agricultural markets. It is closely tied to them and changes brought on by the CAP will be transmitted to the rest of the country by the market. In any normal year, there is not an unlimited demand for agricultural products. The demand for food and fiber products does not increase significantly with rising incomes or relatively lower food and fiber prices. Nearly the opposite, an "insufficient" demand or "over supply," has usually been the case since the early part of this century if not before. This certainly is the case now for cotton, wheat, forage, and other products.

The usual situation, as now, has been that the government has had to intervene in agricultural markets to reduce the supply and increase the demand so as to protect farm product prices and incomes. It has done this by providing incentives for farmers to retire land; by paying per unit subsidies, by purchasing crops, by subsidizing private expenditures on food, and by restricting imports. These have been massive programs costing the public billions of dollars. The current cotton price support program is a good example.

But if the demand for agricultural products is not unlimited, and government projects are committed to limiting production, any subsidized increased agricultural output via subsidized irrigation water will *displace* agricultural production elsewhere. The increased value of crops in Arizona will be largely offset by a decrease in the value of crops grown elsewhere (see figure 9).

This is not idle speculation. Studies of the *national* impact of federal irrigation projects such as CAP document exactly this sort of agricultural displacement.[37] The Bureau suggests that the CAP will lead to the increased production of cotton, wheat and alfalfa on the farms receiving water. Howe's and Easter's study of *Interbasin Transfers of Water* attempted to estimate the displacement effects of irrigation projects which boosted the production of just such crops as cotton, which the BR projects will account for the largest percentage of increased farm income made possible by CAP: about 34 percent of total farm sales.[38]

As Howe and Easter point out:[39]

> Reclamation projects have simultaneously added directly to U.S. cotton surplus problems and provided subsidized competition to other cotton-producing regions . . .
>
> Part of the reason the West could increase its share of cotton production at low cotton prices (as

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[37]*See Howe and Easter,* Interbasin Transfers of Water; *and Heady et al.,* Agricultural and Water Policies, and the Environment, *CARD Report 40T (Center for Agricultural and Rural Development, Iowa State University, Ames, Iowa, June 1972).*

[38]*BR, "Future Economy," section 6 of a larger document, title unknown; circa 1966, mailed to the author by the Regional Economist, Lower Colorado Region, Bureau of Reclamation, p. 124.*

[39]*Ibid., pp. 148-154.*

imexon

David E. Creighton, Jr.

DEPARTMENT OF ANTHROPOLOGY • UNIVERSITY OF FLORIDA
GAINESVILLE • FLORIDA • 32611

30 September 1977

Gene Rogge, Archeologist
U. S. Bureau of Reclamation
201 North Central Avenue - Suite 2200
Phoenix, AZ 85073

Dear Mr. Rogge,

Having come to Florida in something of a rush to reinforce the senior level in the anthropology department here, I did not bring a copy of "Who Killed the Gila River?"

The paper is in press at THE JOURNAL OF ARIZONA HISTORY. Tracy Row and C. L. Sonnichsen are preparing a thematic issue on Arizona rivers that will include the Gila River piece. It will probably appear next spring. As an archeologist with the Bureau of Reclamation, you will very likely find all of the papers in the issue of interest.

That paper is a very brief summary of the book-length analysis I am completing on riverine oasis destruction and vegetational change in the Sonoran Desert. I think that there are some important lessons for future policy to be learned from a multi-variant analysis of the past impact of Anglo-American and Indoamerican land management patterns.

Thank you for your interest.

Sincerely,

Henry F. Dobyns

Inexon

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Henry F. Dobyns

PRINCIPAL ARIZONA CROPS IN 1977: Preliminary estimated acreage by counties and production in the State

CROP	STATE TOTAL	Apache	Cochise	Coconino	Gila	Graham	Greenlee	Maricopa	Mohave	Navajo	Pima	Pinal	Santa Cruz	Yavapai	Yuma
Alfalfa: Acres cut for hay	210,000	2,500	10,000	400	500	8,000	2,000	90,000	1,200	4,900	2,500	15,000	1,000	4,000	68,000
Hay production, tons	1,365,000														
Cotton: Upland, acres harvested	515,000		32,100			11,700	1,000	234,800	2,800		19,400	123,700			89,400
Bales (480 lbs. net wt.), 1977 crop	1,050,000														
Cotton: American Pima, acres harvested	41,500		3,700			10,200		9,350			3,950	9,200			5,100
Bales (480 lbs. net wt.), 1977 crop	60,000														
Barley: Acres harvested for grain	55,000		800		*	2,500	*	26,000		*	1,800	20,000	600		3,000
Grain production, tons	100,320														
Corn: Acres harvested for grain	50,000	3,000	34,000	*	*	1,800	500	*	*	7,500	*	*	*	1,000	600
Grain production, tons 1/	84,000														
Sorghums: Acres harvested for grain	90,000	400	18,000			16,800	400	26,500	1,100	900	2,600	6,100			17,200
Grain production, tons 1/	201,600														
Winter Wheat: Acres harvested for grain	55,000		2,500	*		1,300	500	16,500	600	500	1,000	9,500		600	22,000
Grain production, tons	118,800														
Durum Wheat: Acres harvested for grain	85,000		2,600		*	1,200	300	28,000			4,800	41,000			7,000
Grain production, tons	183,600														
Sugarbeets: Acres harvested	12,800		2,200			*		5,540				3,630			1,410
Production, tons	285,000														
Vegetables: Acres harvested 2/	65,600		1,600					21,690			3,200	6,300			32,810
Production, commercial cwt.	13,145,000														
Grapefruit: Total bearing acres	9,750							6,260			*	*			3,000
Production, 1976-77 crop, ctns.	6,000,000														
Oranges: Total bearing acres	26,660							13,750			*	*			12,360
Production, 1976-77 crop, ctns. 3/	9,200,000														
Lemons: Total bearing acres	19,900							3,100			*	*			16,800
Production, 1976-77 crop, ctns.	10,000,000														
Other Crops: Acres harvested 4/	91,460	4,270	7,190	1,450	900	1,600	500	28,110	1,140	1,700	6,000	14,080	1,320	3,870	19,330
TOTAL: Acres harvested	1,327,670	10,170	114,690	2,050	1,700	55,100	5,300	509,900	6,940	15,700	45,770	249,650	3,220	9,470	298,010

1/ Does not include grain from acreage harvested for silage and forage.
2/ County acreages based on data from Arizona Fruit and Vegetable Standardization Service and County Agents.
3/ Includes tangerines and tangerine types.
4/ Includes miscellaneous fruits, vegetables and field crops not listed above. Does not include pasture.
*Acres harvested too small to warrant quantitative estimate. Acres, if any, are included in State totals.

ALL COTTON: Acreage, yield, and production, Arizona, by counties, 1968-75 1/ (cont'd)

COUNTY	1974				1975			
	Planted	Harvested	Yield Per Acre	Production	Planted	Harvested	Yield Per Acre	Production
	Acres		Lbs.	Bales	Acres		Lbs.	Bales
Apache								
Cochise	23,400	23,400	693	33,760	13,550	13,550	553	15,600
Coconino								
Gila	*				*			
Graham	14,900	14,900	761	23,610	9,250	9,250	580	11,170
Greenlee	900	900	640	1,200	*			
Maricopa	159,750	159,750	1,316	437,900	117,600	117,600	1,151	282,000
Mohave	950	950	1,137	2,250	1,050	1,050	987	2,160
Navajo								
Pima	22,200	22,200	938	43,400	14,150	14,150	882	26,000
Pinal	145,150	145,150	1,113	336,540	107,650	107,650	767	172,000
Santa Cruz	*				*			
Yavapai	*				*			
Yuma	58,800	58,800	1,369	167,690	34,500	34,500	1,230	88,400
ARIZONA	426,700	426,700	1,179	1,047,700	298,000	298,000	962	597,500

ALL COTTON: Acreage, yield, production, and value, Arizona, 1968-75 1/

Year	Planted	Harvested	Yield Per Harvested Acre	Lint	
				Production	Value
	1,000 Acres		Lbs.	1,000 Bales	1,000 Dol.
1968	299.0	298.0	1,180	732.4	86,276
1969	311.0	310.0	979	632.2	70,886
1970	276.1	273.8	859	489.9	58,316
1971	286.5	285.4	854	508.1	75,838
1972	314.3	310.9	1,006	651.8	94,409
1973	310.0	310.0	1,012	653.3	146,691
1974	426.7	426.7	1,179	1,047.7	226,459
1975 2/	298.0	298.0	962	597.5	151,896

ALL COTTONSEED: Production, season average price, and value, Arizona, 1968-75

Year	Cottonseed			Combined Value of Lint & Seed
	Production	Price/Ton	Value	
	1,000 Tons	Dollars	1,000 Dol.	1,000 Dol.
1968	307.0	52.50	16,118	102,394
1969	253.0	39.80	10,069	80,955
1970	200.0	60.00	12,000	70,316
1971	221.0	60.00	13,260	89,098
1972	278.0	50.20	13,956	108,365
1973	290.0	108.00	31,320	178,011
1974	439.0	147.00	64,533	290,992
1975 2/	257.5	102.00	26,265	178,161

1/ 1975 county estimates are unofficial preliminary estimates. Official estimates will be published in July. Production estimates are for 480-lb. net weight bales.

2/ Preliminary.

*Acres planted and/or harvested too small to warrant quantitative estimate or not published to avoid disclosing individual operations. Acres and production, if any, are included in State totals.

PRINCIPAL ARIZONA CROPS IN 1975: Preliminary estimated acreage by counties and production in the State

CROP	STATE TOTAL	Apache	Cochise	Coconino	Gila	Graham	Greenlee	Maricopa	Mohave	Navajo	Pima	Pinal	Santa Cruz	Yavapai	Yuma
Alfalfa: Acres cut for hay	215,000	2,600	9,600	400	400	8,100	1,800	96,000	4,700	4,800	2,100	16,000	1,000	1,500	66,000
Hay production, tons	1,505,000														
Cotton: Upland, acres harvested	268,000		10,750		*	3,450	*	112,300	1,050		11,500	99,200	*	*	29,500
Bales (480 lbs. net wt.), 1975 crop	560,000														
American Pima, acres harvested	30,000		2,800		*	5,800		5,300	*		2,650	8,450	*	*	5,000
Bales (480 lbs. net wt.), 1975 crop	37,500														
Barley: Acres harvested for grain	115,000	*	6,200	*	*	13,600	*	50,000	*	*	7,400	32,000	500	*	4,500
Grain production, tons	207,000														
Corn: Acres harvested for grain	12,000	2,500	500	1,000	*	*	*	1,400	*	4,000	500	*	*	500	1,000
Grain production, tons 1/	11,090														
Sorghums: Acres harvested for grain	165,000	500	61,000	*		33,300	800	35,000	400	600	8,800	12,000	400	*	12,000
Grain production, tons 1/	314,160														
Wheat: Acres harvested for grain	320,000	*	51,300	*	*	7,400	1,400	89,000	*	600	12,400	73,400	*	500	83,300
Grain production, tons	681,600														
Sugarbeets: Acres harvested	17,000		4,330			360		4,370				4,890			3,050
Production, tons	366,000														
Safflower: Acres harvested	44,500							14,800				24,700			5,000
Production, tons	54,500														
Vegetables: Acres harvested 2/	63,370		900					21,890			2,780	4,860			32,940
Production, commercial cwt.	12,214,000														
Grapefruit: Total acres	11,530							6,940			*	430			4,160
Production, 1974-75 crop, ctns.	5,540,000														
Oranges: Total acres	31,820							15,500			*	570			15,750
Production, 1974-75 crop, ctns. 3/	11,160,000														
Lemons: Total acres	24,240							3,040			*	*			21,200
Production, 1974-75 crop, ctns.	14,400,000														
Other Crops: Acres harvested 4/	59,360	600	10,100	400	500	650	450	16,200	400	1,700	4,750	6,700	300	970	15,640
TOTAL: Acres harvested	1,376,820	6,600	157,480	2,000	1,100	72,860	5,000	471,740	6,950	11,900	52,880	283,300	2,300	3,670	299,040

1/ Does not include grain from acreage harvested for silage and forage.
2/ County acreages based on data from Arizona Fruit and Vegetable Standardization Service and County Agents.
3/ Includes tangerines and tangerine types.
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Alfalfa: Acres cut for hay	210,000	2,500	10,000	400	500	8,000	2,000	90,000	1,200	4,900	2,500	15,000	1,000	4,000	68,000
Hay production, tons	1,365,000														
Cotton: Upland, acres harvested	515,000		32,100			11,700	1,000	234,800	2,800		19,400	123,700			89,400
Bales (480 lbs. net wt.), 1977 crop	1,050,000														
Cotton: American Pima, acres harvested	41,500		3,700			10,200		9,350			3,950	9,200			5,100
Bales (480 lbs. net wt.), 1977 crop	60,000														
Barley: Acres harvested for grain	55,000		800		*	2,500	*	26,000		*	1,800	20,000	600		3,000
Grain production, tons	100,320														
Corn: Acres harvested for grain	50,000	3,000	34,000	*	*	1,800	500	*	*	7,500	*	*	*	1,000	600
Grain production, tons 1/	84,000														
Sorghums: Acres harvested for grain	90,000	400	18,000			16,800	400	26,500	1,100	900	2,600	6,100			17,200
Grain production, tons 1/	201,600														
Winter Wheat: Acres harvested for grain	55,000		2,500	*		1,300	500	16,500	600	500	1,000	9,500		600	22,000
Grain production, tons	118,800														
Durum Wheat: Acres harvested for grain	85,000		2,600		*	1,200	300	28,000			4,800	41,000			7,000
Grain production, tons	183,600														
Sugarbeets: Acres harvested	12,800		2,200			*		5,540				3,630			1,410
Production, tons	285,000														
Vegetables: Acres harvested 2/	65,600		1,600					21,690			3,200	6,300			32,810
Production, commercial cwt.	13,145,000														
Grapefruit: Total bearing acres	9,750							6,260			*	*			3,000
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Production, 1976-77 crop, ctns. 3/	9,200,000														
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Production, 1976-77 crop, ctns.	10,000,000														
Other Crops: Acres harvested 4/	91,460	4,270	7,190	1,450	900	1,600	500	28,110	1,140	1,700	6,000	14,080	1,320	3,870	19,330
TOTAL: Acres harvested	1,327,670	10,170	114,690	2,050	1,700	55,100	5,300	509,900	6,940	15,700	45,770	249,650	3,220	9,470	298,010

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1975

Cotton - USBR. Sch. Appdx. I -

Region.	Acres Irrig Rob.	Irrigable	Harvested Cotton Acres	Yield B/A.	Bales.
Full Supp. & Temp. (2) Mid Pac. Reg 9 CVP	2,668,335	4,008,503	298,816.	1.94.	580,781
CA: OR, ED, OR, WN, WY; MN (1) NV	2,8[illegible]4,204	3,926,079	Ø	Ø	Ø
AZ, CA (3) Lower Colo.	938,794	2,274,727	UPR. 103,818	2.16	224,242
			MMP. 1613	1.27	2046
			45,571	2.11	95,819
Full. Blw Canyon Summer	549,046	666,522			
Coachella			1400	1.80	2520
Imper. Dist			43,000	2.10	90,300
Mohave Valley			1111	2.70	2999
			80	1.50	120
Bard Cons. (Sm Proj)	874	979	120	1.00	120
Gila	100,544	117,129	8150	2.00	16,972
RED.	35,242	38,152	10,876	2.20	24,797
			17	1.06	18
Duco	32,780	39,415	4922	2.25	11,075
			247	1.50	371
SRP. Summ	140,068.	242,979	27,664	2.20	60860
			1,154	1.25	1442
Yuma	52,425	66,120	6615	2.21	14,599
			75	1.27	95
	367,941	526,780	59,920		
			44,889		
UT, WY, ID, CO, NM (4) UPR.CO.	627,889	1,504,646	Ø	Ø	Ø
CO, NM, OK, TX (5) SW	528,876	820,052	77,382	.91	70,126
			28,860	.46	12,857
MN, ND, SD-WY (6) UPR MO.	657,029	1,176,237	Ø	Ø	Ø
(7) Lw-MO	1,282,731	2,244,601	Ø	Ø	Ø

	Harvested (1975)	(1977)			
(8) ARIZONA.	1,376,820	1,327,670	515,000 / 41,500 / 556,500	268,000 / 30,000	54,000 / 37,500
MAR.	509,900 / 471,740			112,300	234,800 / 9350 / 224,150
PINAL	249,650 / 283,300 / 45,770	805,320	239,400	59,200 / 8,450	132,900 / 38,400 / 805,320 = 47.
PIMA.	53,880	807,920 29.6%		11,500 / 2,650	23,350
Yum				29,500	
				5,000	
COCH.	157,480			10,750	
GRM.	72,860			2800	
MOH.	6950			3450	
				5800	
				1050	

44,880 / 807,920 = 5.56%

USBR. 44,880 / 239,400 = 59,920 / 298,000 = 20.1%

18.7%

Cotton

World Almanac Pg 161.

US 1972 Bales (1000's)

State	Bales (1000's)	
AL	570	
AZ	165/610	* 27.0%
ARK	15/1465	
CA	708.5/1750	* 40.9%
FL	13	
GA	360	
IL	1	
KT	4	
LA	715	
MISS	2040	
MO	425	
NV	0/3	* 0%
NM	10/160	* 6.3%
NC	130	
OK	21.3/320	* 6.7%
SC	320	
TENN	535	
TX	185.8/4050	* 4.6%
VA	2	
Σ US	1,057/13,473	= 7.8%

REG.		Acres	Bales
PNW		ϕ	ϕ
MP	1.93	321,571	621,304
LC	2.38	104,018	247,318
	1.10	4284	4,771
			252,089
UC	ϕ	ϕ	
SW	1.09	138,190	150,456
	.88	038,030	33,435
			183,891
Uu	ϕ	ϕ	ϕ
LIM		ϕ	ϕ ϕ
		Acres 606,093	Bales 1,057,284
		1.744	

RC. 252,089
~~247,318~~

PC CA. − 87,208

AZ. 164,881

AZ. 165/640 = 27.0%

CA − 87.2
621.3
708.5 / 1750 = 40.5%

* Reclamation States − 6,893,000

SW Reg. 183,891

TX.

Bal...?	2,183	(1.50)
Cameron	17,175	(1.05)
Donna	5779	(.91)
Low RG	33,023	(.82)
La Feria	9,285	0.75
Mercedes	23,736	(0.85)
RG N. Tx Full.	87,076	(1.54 / .82)
RG Tex Supp.	3062	1.14 / 1.46
San Angelo	1470	.42
		185.8

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NMX.
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FIGURE 9
Irrigated Acreage in Central Arizona *

			1977* Acres	%
Eligible for Federal "Set-Aside" Subsidies				
Cotton	50%		460,400	49.7
Wheat	13%		100,800	12.5
Barley	6%		47,800	5.9
Grain Sorghum	4%		35,200	4.4
Subtotal	73%		584,200	72.5
Other Crops				
Hay (including Alfalfa)	16%		107,500	13.3
All Vegetables	4%		31,190	3.8
Citrus	3%		23,110	2.9
Other	4%		48,190	6.0
Subtotal	27%		209,990	26.0
TOTAL	100%		805,320	99.6

SOURCE: *1977 Arizona Agricultural Statistics*, compiled by the Arizona Crop & Livestock Reporting Service, a cooperative function of the U.S. Department of Agriculture and the University of Arizona.

*Maricopa, Pinal and Pima Counties.

it has been doing over the years) is the competitive advantage provided by low-priced reclamation water. Data from an analysis of the costs of producing upland cotton in the United States indicate that Southern California and Southwest Arizona are enabled to stay in production at lower cotton prices only because of the low price they pay for reclamation irrigation water — about $3 per acre-foot . . .

If irrigators currently paying approximately $3 per acre-foot for Colorado River water delivered to the Imperial Valley and other districts in Southern California had to pay the average cost of providing new water, their costs of production would be raised substantially, and they would no longer have average returns of $16 per bale. Instead, as shown below, there would be an average loss ranging from $36 to $96 per bale depending on the price of the water and the efficiency with which it is used . . .

The claim that reclamation regions have a cost-efficiency advantage over other areas in producing cotton is not supported by the data. The California-Arizona reclamation-served region has costs uniformly higher than the Mississippi Delta, even under conditions of highly subsidized water . . .

This means that the United States fails to produce its cotton at the lowest cost and in the most efficient manner . . .

The impact of this low-cost reclamation water on increased cotton production has been felt in many areas of the United States. The acreage of cotton harvested on reclamation-served land increased over 3½ times between

1944 and 1954 and since then has remained fairly constant due to the federally established acreages. In contrast, total acreage harvested in the non-reclamation portion of the West declined between 1949 and 1964, and other major cotton producing areas also experienced declines. In 1964, the acreage harvested in the South was 50 percent lower than in 1949 and one-third lower than in 1944.

Thus BR subsidization of cotton production through subsidized water has depressed the domestic price of cotton, driven other cotton producers in the South out of business, and brought costly government programs. Given this type of impact elsewhere in the country, further subsidization of Western cotton producers cannot be treated as a "benefit" to the nation.

Howe and Easter concluded their study:

> Substantial evidence of production displacement by western irrigated agriculture has been presented (in this study) suggesting that increased reclamation irrigation over the period 1944-1964 has displaced millions of acres of farm land in non-reclamation areas: somewhere between 8 and 26 percent of the 66 million-acre decline in harvested cropland during 1944-64, depending upon the assumed productivity of the retired lands.[40]

The point is, given a demand which except in crisis years grows only slowly with income and population and is not much influenced by prices, subsidized increases in supply can only be at the expense of farmers elsewhere and the taxpayer who supports farm incomes (see figure 9).

Farmers are currently lobbying and protesting, demanding higher government support prices or policies which would dramatically raise agricultural prices so that costs of production could be covered. Surplus agricultural produce has severely depressed farm prices while agricultural input costs have risen substantially. Federal government reaction, while it has been substantially less than what many farmers would like, is still costing billions of dollars and has led the government to force moderate *reduction* in cropland under cultivation. One hand of the government is doing this reducing while another, the BR, is doing the opposite, expanding agricultural output. CAP and similar BR projects are in conflict with the national program to support reasonable levels of farm prices. The BR and the Department of Agriculture are working at cross purposes making the citizen pay twice in increased taxes.

The benefit-cost analysis, by ignoring this aspect of subsidized agriculture, overstates the benefits of the project. As Lewis et al. concluded in their study *Regional Growth and Water Resource Investment*:[41]

> The relevant point is that the net impacts of an irrigation project can be positive or negative in terms of the effect on farm income . . . It is a rather complex problem that requires very thorough analysis of a number of factors. One thing is clear, however, merely multiplying an estimate of increased production by the going market price is a very poor estimate of the true primary benefits of an irrigation project.

It is just this method that the Bureau uses on all of its projects. The net effect is to substantially exaggerate the benefits of its projects and obscure the real damage it is

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[40] *Ibid*, p. 173.

[41] *Lexington Books, D.C. Heath and Company, 1973, p. 161.*

doing to farm incomes and the viability of family farms. Thus the BR, in calculating the benefits of irrigation with CAP water, should (a) subtract out of the "direct benefits" the value of crops displaced or lost elsewhere in the nation, and (b) subtract out of "indirect benefits" the losses to businesses and individuals serving the farms in the unsubsidized areas depressed by BR subsidized expansions in farm output.

7. SALINITY COSTS ASSOCIATED WITH CAP

The BR benefit-cost analysis includes no analysis of the costs that the salt content of the CAP water will cause in individual households.

BR studies indicate that CAP water when mixed with Salt and Verde River water behind Orme Dam will raise the total dissolved solids (TDS) concentration 65 parts per million (ppm). They also estimate that the costs in terms of increased detergent use, corrosion of plumbing, softening costs, etc. amount to thirteen cents per household per year for each part per million increase in TDS.[42] Earlier BR studies indicated seven and one-half cents per household per year per part per million in the CAP service area assuming the municipality was softening the water.[43] In the Tucson area, the rise in TDS would be much greater because of the higher water quality at the present time. TDS is now 400 ppm but CAP water would be at least 800 ppm.[44] The increase in concentration would depend upon what proportion of Tucson water came from CAP water.

In the Phoenix area, if one uses the Arizona Water Commissioner's (AWC) middle population projection, the number of households in the year 2010 will be about 700,000.[45] This will mean a cost of $5,915,000 per year due to the increased TDS if one uses the more recent BR data. If Tucson's TDS increases 150 ppm and the AWC's median population projection is used, there will be 350,000 households in 2010.[46] If all Tucsonians use CAP water, the cost associated with the TDS increase will be $6,825,000 per year. Total TDS cost is $12,740,000 per year. This must be subtracted from the M&I benefits or added to the costs. Ignoring it biases the B/C ratio upward significantly.

8. THE ELECTRIC POWER PORTION OF CAP

CAP will deliver water from the Colorado River to Central Arizona. To do this it will have to pump water 2100 feet uphill. This will take a tremendous amount of electricity. Once pumped uphill, the water will flow by gravity to farms and cities, supplying irrigation, municipal and industrial water. Given this summary, but quite accurate description, one might be surprised to find that CAP will produce almost $35,000,000 a year worth of *net* electric power *benefits*. This magic which transforms a major electric cost into a major electric benefit is possible because lumped in with CAP is an electric generating facility which already exists and which has nothing to do with CAP. The federal government purchased one-quarter interest in the Navajo generating facility at Page, Arizona, and assigned it to CAP. That facility exists now. It or a similar facility would have existed even if CAP had never been imagined. It has no causal connection with CAP. Yet, since it provides a 2.25 to 1.0 B/C ratio and $22,000,000 a year in net benefits, it was lumped in with CAP to make CAP look better. From an economical point of view there is no logic to relating the Navajo Plant

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[42] *Alan Kleinman, Economist, Lower Colorado Regions, Bureau of Reclamation, personal communication, February 24, 1977.*

[43] *Cited in City of Tucson, p. 59.*

[44] *Ibid., p. 59.*

[45] *"Arizona State Water Plan: Phase II," p. 108, assuming 4 persons per household.*

[46] *Ibid., p. 124.*

with CAP. If CAP were never built the Navajo Plant would produce the same benefits as it would with CAP. Clearly the benefits and costs of Navajo are separable from CAP. Nothing links them together except the federal assignment. Removing these non-CAP "benefits" reduces the B/C ratio 23 percent. To remove them is not to challenge Congress's right to assign these revenues to any use it wishes. The point is that although this assignment may assist in *financing* CAP it has no impact on the economic logic of CAP. Diverting the funds of the Navajo Plant to CAP is no different than diverting tax revenues to CAP. Both remove monies from the federal treasury. Yet, hopefully, no one would claim federal tax revenues as a benefit of CAP.

9. AGGREGATION OF SEPARABLE PROJECTS

The Navajo Plant is just one example of the aggregation of separable projects into one large project. The function of this aggregation is to combine projects which cannot stand on their own with ones which clearly can. Thus the Navajo Plant, which produces sizable net benefits, covers for the irrigation project which produces net losses. Irrigation (using BR figures) produces $34,987,000 per year in benefits, but it costs $46,570,000 per year in capital costs, operations, maintenance, and repair (OM&R) costs to do this.[47] The B/C ratio here is 0.75 with a net loss of $11,583,000 per year. This, given the discussion above criticizing BR calculations of agricultural benefits, is a very optimistic view. Electric power, on the other hand, produces $39,293,000 per year in benefits but only produces annual costs of $17,469,000 including OM&R costs. This produces a B/C ratio of 2.25. Combining these two clearly unrelated projects helps cover up the net loss that irrigation produces.

These are not the only separable projects. Orme Dam, Buttes Dam, Charleston Dam and Hooker Dam are separable in the sense that one can analyze their economic rationality separately. Without any of them, 81 percent of CAP water can still be delivered and used. The B/C ratio would be as high as for the whole of CAP.[48] What needs to be done by BR and has not been done is to do a marginal benefit-cost analysis. This would compare the additional benefits of each additional feature with the additional costs. This is a standard technique to discover the optimal level of investment in a larger project and screen out irrational segments. BR has not provided this.

The problem is simply described. If an inefficient, mismanaged firm which produced ice cream cones worth 25 cents at a cost of $1.00 were combined with an efficient bread company which produces loaves worth $1.00 at a cost of 25 cents, the combined enterprise might appear to be rational. However, any business person would immediately see that it was not. The accounting combination of the two does not eliminate the net loss the ice cream company is creating. CAP needs to be critically analyzed, project part by project part, to determine what is rational and what is not. Until then, even if CAP's B/C ratio were greater than one (which it is not), one could not conclude anything about its rationality.

10. THE COST OF CAPITAL OR THE DISCOUNT RATE

The BR, in order to include in its analysis the cost of the capital used to build the CAP, rightly "discounts" future benefits back to the present. No one would pay a dollar today for an offer of a dollar 50 years from now. They would have to be offered a sum of money quite a bit larger than one dollar before they would agree to give up control

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[47] *BR, "Preliminary Information and Data Sheets," pp. 4-6.*

[48] Ibid., p. 36.

and use of a dollar for fifty years. The discount rate is used to make this adjustment, to establish the equivalency between benefits in the future and their present worth.

The discount rate is *not* just an interest rate. It is a measure of what productive uses of resources in the private economy are lost as a result of the federal government taking the resources needed for CAP from private individuals and employing these resources in Arizona.[49] Productive private investments are displaced by the federal government when it taxes or borrows the money away from private individuals to build the CAP. The approximate discount rate is established by asking what the before-tax rate of return was on those displaced private investments and then subtracting from it the projected rate of inflation. This currently results in a 8.6 percent to 14.8 percent range, with an average of 11.7 percent. This is why economists and the President's Office of Management and Budget urge that 10 percent be the minimum rate used. The Water Resources Council *allows* a lower rate, around 7 percent, to be used but does not claim that is the correct rate. The BR uses a rate that is only one-third of the correct rate, namely 3¼ percent. This grossly understates the costs to the economy of the BR using scarce capital funds on the CAP instead of leaving it to be used elsewhere in the economy and thus significantly boosts the apparent size of the net benefits.

Use of the current *minimum* discount rate allowed by law only reduces the B/C ratio from 1.6 to 1.4, according to the BR. This stability of the benefit-cost ratio to a 100 percent increase in discount rate is unusual. Since most of the costs are incurred early, during the construction phase, and benefits are distributed over the assumed 50-year life of the project, one would expect the change in discount rate would drastically affect the present value of this stream of benefits. For instance, if we summarize the project as costing $1,777,939,000 in year one, having OM&R costs of $40 million a year, and as providing benefits of $169 million a year for 50 years, the B/C ratio at 3¼ percent would be 1.78. At 7 percent, it would only be 1.00. That is, the B/C ratio would be reduced by almost one-half (46 percent) by a 115 percent increase in the discount rate.[50]

The BR calculation does not show this because of the method they use to calculate M&I and power benefits. These benefits make up 71 percent of all the project's benefits and are calculated in such a way that they are virtually unaffected by changes in the discount rate even if the benefits are not enjoyed until 100 years from now. This happens because, as pointed out above, these "benefits" are not measured by estimating the value of the goods (M&I water or electricity) provided but by using the cost of providing them via a BR contrived single-purpose alternative. Thus the "benefits" are the construction costs of the single-purpose mini-CAP. If capital costs go up, so do the construction costs of the single-purpose alternative and thus the "benefits" of the project. A rise in the discount rate has offsetting impacts: it increases the benefits of M&I water and power and then decreases the value of the more distant water and electrical benefits. The result is that the B/C changes hardly at all.

This is an artificial result. If the BR has accurately calculated the benefits of these CAP-supplied goods and if they are provided over a 50-year period, then in fact a doubling of the discount rate cuts the value of these benefits in half.

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[49]*This oversimplifies the problem. The government intervention also reduces private consumption, raises interest rates, finances more risky investments, etc. However, no gross error results with the above approach.*

[50]*These are the numbers used by the BR in its "Preliminary Information and Data Sheets," pp. 4, 6.*

11. THE DISPLACEMENT OF CURRENT USES OF CAP WATER

The Lower Colorado River is already fully used. There is almost no "surplus" water in it. CAP will not bring "new" or currently unused Colorado water to Central Arizona. It will divert 800,000 acre-feet of water currently being used in California BR facilities. The remainder of the average 1,200,000 acre-feet will come from the hope that Utah does not develop its share of Colorado water. This amounts to the BR in Arizona hoping that the BR in Utah does not rapidly finish the Central Utah Project, and to the taking of 800,000 acre-feet from the BR in California.

Thus CAP's "benefits" are built around the BR preventing current and future uses of BR-developed Colorado River water. Clearly then, CAP's benefits are not net benefits from the national point of view. They "rob Peter to pay Paul." They impose losses in one area to create benefits in another. Unfortunately, it is the BR robbing the BR. These costs in California have been estimated to be in excess of $100 per acre-foot.[51] These are the same order of magnitude as the gains projected by BR in Arizona. Thus CAP provides no net gains on two-thirds of the water it will provide. The B/C ratio should be reduced 67 percent. Whatever other gains it provides are temporary or at the expense of upstream developments.

12. AUGMENTATION OF THE COLORADO RIVER

The above indicates the basic problem with CAP. There is not enough Lower Colorado River water to support it.

16.5 million acre-feet (maf) have been apportioned among the Upper and Lower Basin States and Mexico. The River's flow is 13.8 maf or less (see fig. 10).[52] Shortly after 1985, when the CAP is supposed to begin deliveries, Upper Basin use could result in the release of only the required 8.25 maf to the Lower Basin.[53] 4.7 maf of this goes to California and Nevada and 1.25 maf will be used along the river by Arizona. Losses in excess of 0.65 maf and the Mexican commitment (1.5 maf) leave virtually no water for the CAP.

To make CAP feasible in the long run, the flow in the Colorado must be augmented. The BR and Congress clearly have had in mind some scheme to augment the Colorado, as they have advocated and approved projects which require more water than the Colorado now carries. CAP is designed to carry almost two times the average water available from the Colorado.[54] The BR already plans to build the Yuma desalinization plant on the Colorado. This will allow over 130,000 acre-feet of irrigation return flows to be salvaged for use in fulfilling the Mexican treaty obligation and thus release an additional 130,000 af for upstream (CAP) use.

Other, more ambitious projects involve diverting water from the Columbia Basin into

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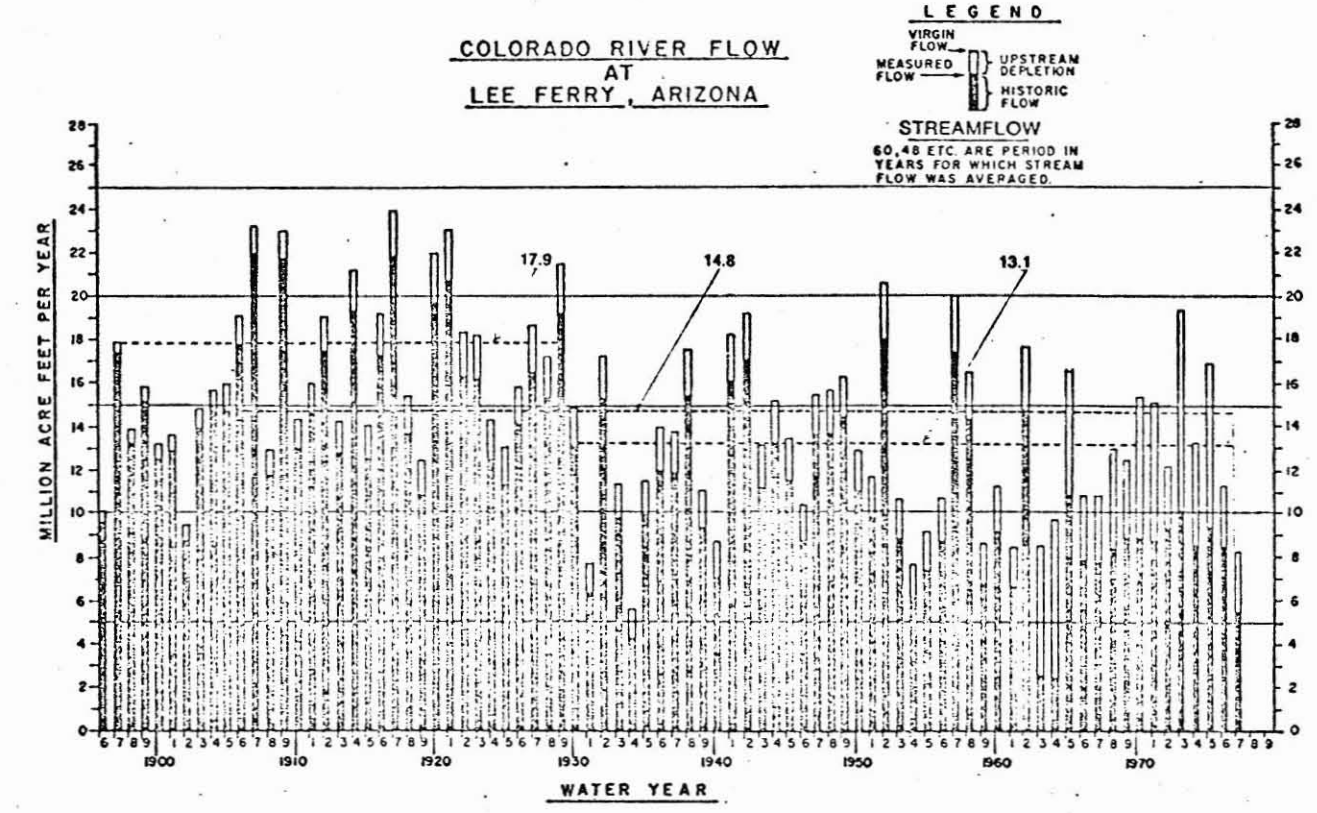
[51] *W.S. Gookin and Associates, "Water Allocations, CAP: Status Report," March 8, 1975, Scottsdale, Arizona, p. 34.*

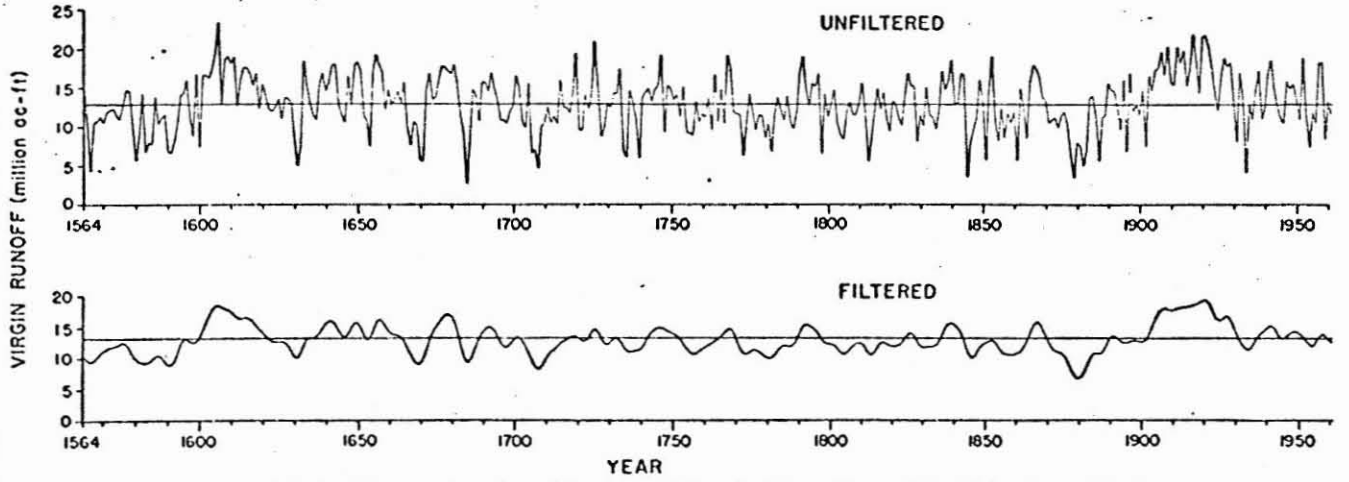
[52] *C. Bowden, "The Impact of Energy Development on Water Resources in Arid Lands," Office of Arid Lands Study, Univ. of Arizona, 1972, p. 54. BR uses 14.8 maf, which is the 72 year recorded flow from 1906 through 1977. C.W. Stockton, "Long-term Streamflow Records Reconstructed From Tree Rings," 1975, Univ. of Arizona Press, 400 year analysis indicates the high flow between 1906 and 1930 was unusual and the long-term flow is only 13.5 maf.*

[53] *U.S. Department of Interior,* Report on Water for Energy in the Upper Colorado River Basin, *Washington, D.C., July, 1974, shows Upper Basin demand of 5.8 maf around 1990, but they must release 8.25 (7.5 + 0.75) maf to the Lower Basin.*

[54] *City of Tucson, p. 92.*

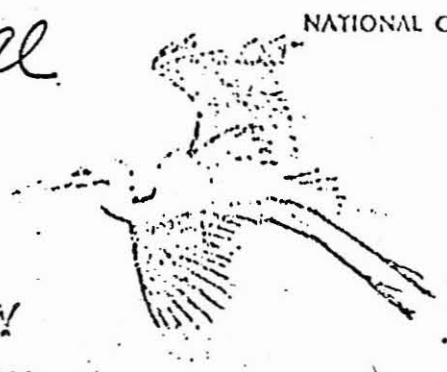
FIGURE 10
Colorado River Flows





Long-Term Reconstruction of the Annual Runoff at Lees Ferry, Ariz., Using Tree-Ring Data.

al



NATIONAL CAPITAL OFFICE

NATIONAL AUDUBON SOCIETY

1511 K STREET N.W., WASHINGTON, D. C. 20005 202/466-6600

March 26, 1979

The President
The White House
Washington, D.C. 20500

Dear Mr. President:

The National Audubon Society, with more than 400,000 members, has supported and will continue to support your forthright efforts to reform our Nation's water resource policy. We are, however, becoming increasingly perturbed by seeming inconsistencies in that reform effort. At this time, I would like to bring to your attention a matter of grave concern to our membership and especially to our members and chapters in the state of Arizona.

I am enclosing the latest economic analysis of the massive Central Arizona Project (CAP). The report by Dr. Thomas Power, Chairman of the Department of Economics, University of Montana, brings to light distressing information on benefit/cost miscalculations by the Bureau of Reclamation.

At a time when Americans are concerned about excess federal spending, about energy conservation, and about our dwindling natural resources, we are directing to you and your staff a series of questions regarding this Administration supported project, questions that continue to plague us. We hope we may look forward to your expeditious response.

*Following a 1977 review, the Department of Interior recommended continuing construction of the Central Arizona Project even though its benefit cost ratio was less than 1.0 (0.93 based on the outdated 3.25% authorized discount rate and 0.58 based on the current 6.375% discount rate). Why was this project reinstated?

*The review stated that "these benefit cost ratios may still be overestimated in some respects." Have you continued to review this project? In light of Dr. Power's 0.35 b/c ratio, will you recommend another review of the CAP?

*The Department of Interior's analysis of the CAP found one of the serious issues which remained unresolved was the general lack of water conservation in the state. Yet the equivalent of at least half the CAP supply can be realized through conservation. Has Arizona implemented water conservation measures during the 2 years following reinstatement of the CAP? Should not federal funding be contingent on the state's taking appropriate conservation measures?

*The CAP will consume tremendous quantities of energy to pump water uphill more than 2000 vertical feet (547,000 kilowatts). It will not produce any energy. We are unable to conceive of a justification for federally financing the diversion of water from the Colorado River to power plants in central Arizona. Why are the power plants not being located near the river? misleading What Power Plants?

*Since two-thirds of CAP's water supply will come from water California is already using, this will require Los Angeles to bring more water from the north. Won't this require tremendous amounts of energy consumption? Why should the federal government use U.S. tax dollars to build a project that will merely change water use from California to Arizona?

*Since there is not enough water in the Colorado River to support the CAP if all planned projects in the Colorado River basin are completed, does the federal government plan to eliminate some of the other planned projects? Or is the plan to keep building projects until the supply exceeds demand, and then rely on interbasin transfers to increase the supply? What is the status of the $200 billion project to bring water from Alaska to Arizona? Assumption Red Herring -

*Continued federal funding for the CAP was conditioned on the institution of groundwater regulation practices by the state of Arizona. Have these been implemented and, if so, are they adequate?

*Should U.S. taxpayers' money be used to provide $140/acre-foot water to an area that presently has water available for less than $6/acre-foot?

*Agriculture consumes 89% of Arizona's water and three-quarters of the crops grown are eligible for federal set-asides. Should the citizenry nationwide spend billions of dollars to enable Arizona to continue to grow surplus crops?

*In 1977 the Secretary of Interior recommended the deletion of Orme, Hooker and Charleston dams, yet these parts of the project are still authorized. Do you plan to initiate action to deauthorize these dams?

Mr. President, our desire to support water policy reform is sincere and firm. Our deep concern about the incompatibility of the Central Arizona Project with sound water policy is genuine. We earnestly hope that you will give us the answers to the questions we have raised herein.

Respectfully,

Elvin J. Stahr
President

EJS:tat

The playbook NAS is to use a figure to their liking to support their positions. At times figures are developed on the basis of their own pet values and procedures which denigrate the Federal policy mandated procedures for analysis of certain water resource projects. water resource projects proposed by RPA do not have to comply with comparable economic evaluation criteria. Dr. Powers. 0.35 B/C ratio is a "pet economic theory" and expresses his consulting expertise for his clients.

Mr. Stebbins letter and the supposed "economic analysis" report published by CAP Publications - P.O. Box 15451, Phx 85060.

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water stolen or preempted by litigation processes to delay recapture by the rightful owner and then to flog the plaintiff when he attempts to recover his properties is the theory

Desert of hypocrisy.

From experience of years of explanation — words fall on deaf ears and frozen minds —

8.

II. Current use of CAP.

600, 000 af that currently being used in Cent. AZ facilities False MWD.

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4 — No Pollutions — except — News Paper Reporters

IV — 3. Retire AZ Land —
4. western AZ. Prog —

5. Calif

Principles & Standards

CAP water Allocation:
M&I 3/77 – 210,000 AF   112,000
317,000
700,000
USPI – 400,000 AF
2/78 to – Congr. 510,000
2/24/78 BR Phx – 638,000

100's of 10^6 AF
GW ~~Storage~~ under CAP – Az WC – Phase II –
pp 109–121, 125.

Az is using Reuse of M&I H_2O –
If it were not there would be out flow from
Area –

E. Wastewater Reuse –
pg 8 – GW – transfer of miles "across" "pristine desert"
would excite NAS opposition – Two faced.
Audubon Society is on record as in opposition
to reuse of Phx Sewage effluents. (PVNGS)
Best & Pingry –

pg 8 · F. Legal Changes –
Sale of Water Rights – (Tucson Position on
GW SC.)
SRP Fig 3 Boundaries –
Human created scarcity is due to people moving outside
SRP as a result of choice ~~not~~ Property rights
mean nothing to AUS – NAS –

pg 8 15) AkChin Reser "This is now being done" – False –
May be within language of law but is not
reality – .
pg 22 #8 Electric Power –
Steam plant – "which has nothing to do w/ CAP"
Like reading a new edition of history as
written by the Kremlin –

#60 / Camp CAP Publications — PO. 1545, Phx 85060. Arcadia P.O. 3939 E. Campbell
FSW 1445 E. Mabel Brook RAW 4619 E. Arcadia

FIGURE 11
North America Water
and Power Alliance Plan

the Colorado, and importing water from Alaska's Yukon River (see fig. 11). The former would cost well over $18 billion while the latter's price tag is $200 billion.[55]

From the point of view of the economic rationality of CAP, what is important is that if these augmentation projects are necessary to realize the projected benefits of CAP, then their costs must now be included. For instance, the Yuma plant water will cost (in 1978 dollars) almost $160 per acre-foot.[56] If this water is indirectly delivered to CAP, $160/af must be added to CAP's costs; similarly with more large-scale augmentation projects. To do otherwise is to segment a project and look at all of its benefits but only part of its costs. This inflates the B/C ratio.

13. THE ADJUSTED BENEFIT-COST RATIO

If the B/C ratio is serially adjusted as suggested above, the results are as follows:

	Percent Change	Adjusted B/C Ratio
BR B/C Ratio	0	1.6
The Benefits from Irrigation	-21%	1.26
Marginal value of water		
Distribution costs		
Lack of dependable supply		
Displaced agriculture eslewhere		
M&I Benefits		
Miscalculation		
Cheaper alternative	-23%	0.97
Salinity costs	-7%	0.90
Electric Power Benefits	-23%	0.69
Discount Rate	-50%	0.35
Colorado Augmentation Costs	not adj.	not adj.

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[55]*National Water Commision, Water Policies for the Future, Final Report to the President and to the Congress of the United States, p. 317. Proposals include transporting 2.4 and 15 million acre feet from the Snake River in Idaho and the Columbia above the Dalles at costs of 2.1 and $18.6 billion in 1972 dollars. The North American Water and Power Alliance proposal would import 110 million acre feet annually from Alaska and Canada. A March 1977 Time magazine article placed its cost at $200 billion.*

[56]*BR, "Colorado River International Salinity Control Project Special Report," September 1973.*

CHAPTER II
CAP AS A SOCIAL RATHER THAN AN ECONOMIC PROJECT

It may well be the case that Congress never intended projects like CAP to be a rational investment of federal funds. Its objectives may well have been social: the support of family farms and the rational development of interstate waters in arid areas. If this is the case, accurate benefit-cost analysis is still needed, for it is only such analysis which reveals the full size of the expenditure that Congress is making in support of these social objectives. Biased economic analysis such as the BR has provided obscures the real cost of the social aspect of the project and thus renders rational decision making about the size and cost effectiveness of the project impossible.

A reading of the Reclamation Act of 1902 (as amended) certainly suggests that the creation and maintenance of family farms, not simply the increase in the level of agricultural output nor the cultivation of western lands nor the stimulation of the local economy, were to be the primary objectives of federal reclamation projects. The objective was social not economic. Discussion and justification of federal reclamation projects since then has continued to emphasize these social objectives.

Thus the CAP has to be discussed also in terms of how well it meets these social objectives. The analysis below suggests that the CAP will not contribute to the social objective of the creation and maintenance of family farming opportunities or rational use of interstate water because:

1. CAP may not be an agricultural project at all. It may, instead, be an M&I project serving some of the most prosperous suburban areas and industries in the nation, which do not really need it
2. CAP will displace farmers outside of central Arizona
3. CAP will displace current water users
4. CAP will add to the contradictory BR plans for the use of Coloradro River water
5. CAP will encourage continued wasteful uses of water in central Arizona
6. CAP is not necessary to "rescue" the Arizona economy
7. In addition, CAP as now designed, will flood almost an entire Indian reservation and not support development of Indian water resources, thus violating the Department of Interior's trust obligations
8. Finally, CAP will give priority water rights to large industrial corporations who could provide their own water without federal subsidy

1. CAP AS AN M&I WATER PROJECT, NOT AN IRRIGATION PROJECT

The provisions of the CAP Master Contract allow irrigation only temporary use of CAP water. Low flows in the Colorado will go first to California and then to M&I water users. Irrigators, including Indian irrigators, in Central Arizona have lowest priority claims on CAP. As explained by the State

Water Engineer:[57]

> Municipalities and industries may contract for water on a growth schedule . . . *During the interim,* the water will be used by agriculture. Costs will not be allocated to M&I use and interest charges will not be levied until the *water* is actually *transferred from agricultural to M&I use* . . . (T)his will result in substantial savings in interest charges . . . The fact that *agriculture will be using the water not needed by cities* in the early years and the costs associated therewith will be interest-free, permits water deliveries to the cities at substantially lower rates than would be the case were the project constructed solely to deliver water to the cities . . . M&I water users will have a 100% priority *in the event of shortage, agricultural uses will be dried up completely before M&I users are called upon to share a shortage* . . . (A)ll contracts and agreements for CAP water, *including those with the Indians,* will include this priority . . ." (Emphasis added.)

Thus irrigation is being used as a temporary recipient of the CAP water so that CAP can be built before it is actually needed by M&I users without Arizona suffering the wasted investment costs. The interest-free loan provision for agriculture is being used to lower the costs of a prematurely built M&I water supply system.

As indicated above, these provisions guarantee that CAP will deliver only a ten to twenty year dependable water supply to irrigation. Given that irrigators will have to both install concrete-lined distribution systems and reduce their groundwater pumping before they are eligible to receive CAP water, CAP water may be no bargain at all. Only those water conservation districts on the main canal who already have concrete-lined distribution systems may take CAP irrigation water. Only Maricopa County Water Conservation District No. 1, Roosevelt Water Conservation District, and Salt River Agricultural Improvement District may take water. Together they have requested 459,165 af/yr of CAP water. M&I requests for the initial years are low, while the initial delivery CAP can make is high, 1,600,000 af/yr. Thus as much as 700,000 af may remain unused in the early years of the project. An enormous investment would sit half idle.[58]

The BR admits this problem. In a letter dated May 23, 1975, to Representative James Sossaman, a member of Arizona's legislature, the BR stated:

> We recognize there will be considerable expense involved by the irrigation districts to build distribution systems to take CAP water . . . Perhaps *only those districts with existing improved distribution systems* that are located near the main CAP conveyance system *will find it feasible to contract for irrigation water.*
>
> The Secretary must consider each request for a distribution system Federal expenditure (whether it be under the $100 million authorization mentioned above or any other program) on the merits of that particular application. *The Secretary would need assurance,* under any application for Federal expenditure, *that there is an adequate water supply* to sustain the agricultural production or to serve M&I purposes provided by a district

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[57]*Mr. Wesley Steiner's presentation made to the Mayor and Council of Tucson, February 8, 1974. Reprinted in City of Tucson, "The Central Arizona Project," pp. 67-70 (emphasis added).*

[58]*W.S. Gookin, "Status Report,"* op. cit., *p. 33.*

at a level sufficient to repay the cost. (Emphasis added.)

This same problem was also admitted by the Executive Director of the Arizona Water Commission in a letter dated March 25, 1975, to Representative James Sossaman in response to a question concerning the ability of irrigation districts to finance irrigation distribution systems. Among other things, the Executive Director stated: "This is not to belittle the problem. It is a serious problem. *Some districts may well find it an impossible one.*" (Emphasis added.)

The Secretary of Interior has admitted the same problem:[59]

> The non-Indian agricultural interests have also expressed a concern that because of the M&I priority, the supply of project water after the first 20 years for non-Indian irrigation uses will be contingent, and it will be difficult for any of them to finance the construction of the distribution facilities necessary to take advantage of the project water supply. Unfortunately, this problem is inherent in the fact that the Central Arizona Project was not planned to nor can it provide a total solution to all of the water-user problems in the region.

Thus, irrigators may not be able to afford to use CAP water during the early years when it is available and in the later years will have access only to a contingent supply of surplus water, i.e., to no dependable supply of irrigation water. To again quote the Arizona State Water Engineer: "Obviously the project (CAP) is now municipal and industrial oriented. Agriculture's use of project water will only be temporary."

This was not always the case with CAP. As originally designed in 1947 only 12,000 af/yr were to go to M&I water. In 1962, the BR upped this to 112,000 af/yr. In the 1967 "Summary Report" prepared for congressional authorization, the total amount of M&I water rose to 312,000 af/yr. The BR now talks of over 600,000 af/yr of M&I water.

Clearly, the current design of CAP and its water priorities and allocations are not aimed at maintaining and supporting family farms.

Despite the lack of dependable water supply delivered to irrigators CAP may still be conceived of as primarily providing benefits to agriculture if one accepts the earlier discussion that CAP is not needed by the Metropolitan areas in order to guarantee an adequate supply of M&I water. In that case CAP may be conceived primarily as delaying the pressure on irrigated farms surrounding the Metropolitan areas to sell their water (or have it taken by condemnation). In this situation CAP removes the cities as competitors of the water currently used by agriculture and allows some farm operations which would otherwise sell out to municipalities to continue in operation.

In this sense CAP supports continued irrigated agricultural pursuits, but it does not "save" farmers any more than restrictions which forbid residential subdivision of agricultural lands "save" farmers. Farmers are handsomely rewarded for their "loss". Economic patterns and life styles are, however drastically modified and many Arizonans may wish to avoid this if possible. CAP would be an ineffective and very expensive way of doing this. Water conservation (improved efficiency in water use) on farms, in cities and in industry would be far more cost effective. In addition, as will be pointed out below, only those farms

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[59]*Federal Register, Vol. 41, No. 202, p. 45886, October 18, 1976.*

producing low valued crops will not be able to compete for water. Agriculture producing highly valued products will not be threatened. Thus agriculture as a whole in Arizona is not threatened by urban demands for water. Low farm prices and suburban growth and spawl over fertile bottom lands have been in the past and are now far more serious threats.

2. DISPLACEMENT OF FAMILY FARMS ELSEWHERE

As pointed out above, BR projects which subsidize the expansion of the production of crops whose prices are already depressed due to over-production do not help family farming in the United States. Such projects do the opposite: they depress farm prices and threaten unsubsidized farms. They are in direct conflict with U.S. Department of Agriculture programs which seek to support farm prices by reducing acreage in production. The chief threat to family farms in the past, now, and in the future, is inadequate commodity prices. BR projects make this problem worse and thus are not consistent with the Reclamation Act's intention of supporting and stabilizing family farms.

3. DISPLACEMENT OF CURRENT WATER USERS

California cities are currently using the water CAP will divert into Central Arizona. Thus the support CAP gives Arizona cities is at the expense of California cities. This may be a byproduct of a conscious social policy: the equitable sharing of the Colorado River's waters by the states through which it flows. CAP was intended to provide Arizona with its "fair share," although the authorizing legislation by giving California a priority claim on the Colorado may prevent this. Even if this was the intention, the cost to California users should not be hidden or ignored, nor should the costs of any Colorado augmentation scheme needed to support various BR projects be accounted for only later, after CAP, CUP, etc. are built.

4. FEDERAL WATER PLANNING AND BR PROJECTS

The federal government is committed to encouraging rational water resource planning especially for interstate waters. BR projects such as CAP work against such rational water planning.

With Department of Interior and BR help, and based upon contracts with the Secretary of the Interior, California water projects were constructed to put to use 5,362,000 af/yr of water from the mainstream of the Colorado River. California is currently using over 5,200,000 af/yr of that expected supply of Colorado River water.[60] The BR, through CAP, will now reduce California's supply of Colorado water 20 percent below the design capacity of the California projects. Meanwhile, the BR urges the rapid development of the Central Utah Project which would divert Colorado water to use in the Bonneville and Uinta Basins of Central Utah. The rapid development of Utah's share of Colorado water would leave CAP short of water. The BR's CUP and CAP are in conflict just as the BR's CAP and existing BR California projects are in conflict. What the BR is doing is proceeding in a patchwork sort of way, proposing one project after another, treating each as an independent, unrelated project. The result is the opposite of water resource planning: gross confusion and the waste of billions of dollars of investment funds.

The BR has an answer to the mess its projects have created on the Colorado. That is to build still another project, one far larger than any previously built: the diversion of

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[60]W.S. Gookin, p. 34.

Columbia River water into the Colorado to "rescue" its Utah, Colorado, California, and Arizona projects. The cost of this project, of course, has not been included in the economic analysis of any of these other projects. Instead, the salvaging of these investments and the political influence of those who have come to depend upon them will be used to justify and support Colorado augmentation plans.

This is the worst sort of piecemeal, contradictory, patchwork planning. The federal agency which could best assist in water planning in the West, is doing the opposite. CAP is a piece and product of this irrationality.

5. WATER CONSERVATION AND GROUNDWATER DEPLETION

Arizona's economy is water "short" not only or primarily because of its arid environment but because of its water law. As the City of Tucson's CAP Report stated:[61] "Arizona's water supply issue is not so much one of a limited amount of water, it is a legal problem . . . ." Although this contradicts one of the most fundamental articles of faith in the West, Arizona's current water problems are human-made, not nature imposed.

CAP is intended to rescue Central Arizona from excessive groundwater pumping which is depleting the underground aquifers and threatens to leave Arizona with either costly deep-pumped water, or, in a few areas, almost no groundwater. From the very beginning the BR and Department of Interior realized that the groundwater problem was at least partially a legal one: under Arizona law groundwater belongs to whomever owns the land above it. That person (if they have a legally established well) may pump as much water as they wish. Since the aquifer from which they pump is a common aquifer shared by many different groundwater users, landowners know that if they individually conserve in their use of water, this is not likely to save any water for the future. If they do not pump the water out, others will, and those conserving will simply lose the water. Thus there is no incentive (other than the cost of pumping) to conserve in the use of water. In earlier years, when the groundwater table was high and energy costs were low, groundwater was almost free and was squandered on uses of marginal value. This problem continues.

CAP by itself not only does not solve the problem. It may delay the day in which Arizona is forced to adjust its water law to conserve its dwindling groundwater supplies. By providing water at a low, subsidized price (with much of the cost hidden in property taxes and electric power rates) CAP encourages continued wasteful uses of water. Some irrigators for instance, will pay $2.00/af plus $18.00/af in OM&R costs for water which costs more than $110/af to provide.[62] Although agricultural recipients of CAP water must reduce pumping, their neighbors may well increase their pumping. Municipal and industrial CAP customers need not reduce their pumping at all. Thus CAP offers no solution to Arizona's groundwater problems except to temporarily reduce the pressure for change in its water law.

Congress did not intend this. It has always linked funding of CAP with reform of Arizona water law so as to encourage

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[61] *City of Tucson, p. 27.*

[62] *Seven percent capital costs, 50-year life af/yr delivered, OM&R costs included; interest during construction included. BR "Preliminary Data and Information Sheets," March 15, 1977, p. 4 is the source of the capital cost and OM&R costs allocated to agriculture. For the total CAP delivery system including M&I water, the annual cost per acre-foot is $110 capital cost and $31 OM&R costs for a total of $141 per acre-foot. (U.S. Department of Interior Water Projects Review, CAP, April, 1977, p. 7) 1-1-78 BR Project Data Sheet show annual charges of $25.26 for O&M and $2.00 for construction for a total of $27.26.*

conservation. The public law authorizing CAP required conservation practices as a condition for CAP water.[63] Arizona has not responded with the required water law reform but neither has the federal government enforced these legal pre-conditions for the building of CAP.

As a result, billions of U.S. tax dollars will be spent so that some of the richest and fastest growing suburban communities in the West can be provided with water they could provide more cheaply themselves, and Arizona farmers can grow alfalfa hay in the desert, paying less than 1/5th the cost of that water. The subsidized low prices encourage waste both on the farm and in the cities. This commitment of federal resources serves no known national social objective. It seems to do the opposite.

6. ECONOMIC GROWTH AND STABILITY

The primary explanation given for CAP is to rescue the Central Arizona economy from a dangerous dependence on groundwater mining and avoid the inevitable collapse of the economy when that groundwater "runs out." This would seen to be a reasonable national social objective. It is, however, a false justification for several reasons.

A) There is no impending water crisis.

The Executive Director of the Arizona Water Commission, who is also the State Water Engineer, in a recent position paper, has started:[64]

> The fact that we have a water problem is undeniable. Arizonans are consuming water at almost twice the natural replenishment rate. This is possible only through the overdrafting or mining of groundwater reserves . . . .
>
> *The state's water problem, then, while serious, is long-term in nature. It is not immediate.* It is cause for intelligent planning and corrective action, but not for panic.
>
> Fortunately, however, the state's groundwater reserves are of very great magnitude, sufficient to support growth in most developed areas for a long period of time even though no remedial actions are taken. (Emphasis added.)

B) Arizona will not "run out" of groundwater.

The limits of Arizona's groundwater are unknown. But it is known that they go to depths of over 1,000 feet and involve hundreds of millions of acre-feet. What will happen if Arizona does nothing and CAP is not built is that groundwater levels will continue to fall and the cost of pumping water will rise. Water will not "run out," it will get more and more expensive to obtain. This will lead some low-valued uses of water to be abandoned. Alfalfa and feed grain production will be among the first to be affected.[65]

C) The growth of the Arizona economy will not be stopped by the water "shortage."

As water costs rise, water will shift from low-valued uses to higher valued uses. An increasingly scarce resource will move to more productive uses. Orchard, fresh produce, cotton, and cattle-fattening (feed lots) as well as municipal and industrial water users will be able to bid the water away from other uses. But the higher cost of water will also lead farmers, municipalities, households, and industries to use the water more carefully. Some water-intensive but low-valued economic activities will move out of Arizona or grow more slowly as Arizona's economy focuses on economic

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[63] *U.S.C. 1524 (a), (c) and (d).*

[64] *Quoted in* Arizona Republic story, p. B-1, September 4, 1977. Emphasis added.

[65] *Kelso et al.*, Water Supplies and Economic Growth in an Arid Environment: An Arizona Case Study, *University of Arizona Press, 1973.*

activities in which they can best compete. Just as Montana does not try to grow citrus fruit for export (it could under a huge, heated dome), Arizona will cease producing water-intensive, low-valued crops in its deserts. This does not represent a disaster from which Arizona needs to be rescued. It represents a rational adjustment to Arizona's resource and climatic limits. As Kelso concluded his study of the effects of a limited water supply on Arizona's economic growth:[66]

> Water supplies in the state are adequate for continuous growth of the state's economy. What are needed are policy actions to facilitate changing structure of the state's economy and the transferability of water among uses and locations of use. Currently, the water problem is a management, an institutional, a policy problem — a problem of demands for water more than one of supplies — a problem of man-made rather than of nature-made restraints.

D) CAP will make only a minor contribution to solving the groundwater depletion problem.[67]

With water delivery at the projected (if uncertain) rate of 1.2 million acre-feet per year, the Central Arizona Project would be able to supply about 55 percent of the existing groundwater overdraft. Projections of the Arizona Water Commission indicate that, assuming a 10 percent decline in agriculture by 2020 and continued rapid growth of population and industry, the overdraft in 2020 will be 80 percent of its current level even with the water from the Central Arizona Project.[68]

If Central Arizona Project water deliveries were to fall to their possible low of 380 thousand acre-feet per year, they would represent only 17 percent of the existing overdraft. Hence, the issue of mining of groundwater in Central Arizona will not be resolved by or in the very long run even significantly affected by the Central Arizona Project. Rather, the groundwater mining issue is one of what levels of groundwater depletion are acceptable or appropriate, and when will Arizona take the actions needed to achieve these levels.

E. It is not just or primarily "family farms" that will be saved.

Corporate investor-owned agriculture has made substantial inroads into Arizona's agricultural economy. For instance, in 1973 ten large corporate farms controlled more than 50 percent of all the irrigated acreage in Pima County (Tucson). Much of the other half of the irrigated acreage was also owned by corporate entities such as Tucson Gas and Electric and Transamerica Trust Number 7207, etc.[69] It is not at all clear that it is a national social objective to support this sort of corporate agriculture with heavily tax-subsidized irrigation water.

7. INDIAN IRRIGATED AGRICULTURE

CAP would flood the Yavapai Reservation at Fort McDowell. These Indians struggled for a long period to have part of their homeland given back to them.[70] The federal government, through the BR, would now forcibly take it from them and flood it with the Orme Dam. The tribe has voted to oppose CAP's Orme Dam.

Arizona's Water Commission interprets the contract between the Secretary of Interior and the Central Arizona Water Conservation District as giving Indian as well as non-Indian irrigators a water priority second to all M&I uses. Thus non-Indian

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[66] *Ibid., p. 256.*

[67] *Taken from U.S. Department of Interior, "Water Projects Review: CAP," p. 1.*

[68] *Arizona Water Commission, "Arizona State Water Plan, Phase II, Alternative Futures," February, 1977.*

[69] *City of Tucson, p. 35.*

[70] *Sigrid Khera, ed.,* The Yavapai of Fort McDowell. *Arizona State University, Anthropology Department.*

municipal and industrial water uses can deprive Indians of any dependable water supply from CAP.

Both of these would seem to violate the Department of Interior's trust responsibilities and undermine the pursuit of a major national social objective.

8. INDUSTRIAL WATER USE

Large mining companies and very profitable energy corporations would, under CAP, receive priority rights to subsidized water, while family farms go without water. It is not at all clear that it is a national social objective to subsidize any large industrial corporations, especially if this subsidy comes under the Reclamation Act and is at the expense of family farms.

CHAPTER III
THE LOCAL BENEFITS AND COSTS OF CAP

The above analysis looks at the CAP from the point of view of the nation: the efficiency of the investment and the attainment of national social objectives. This is certainly appropriate given that hundreds of millions of federal dollars are proposed to be spent on it. However, farmers and business firms in Central Arizona may not care about what the nation or Congress intended. They may care only about the benefits and costs they will face and may disregard that part of the cost which has to be paid by the rest of the nation. Although this is a very understandable point of view and the point of view which will be adopted in this section of the report, it is a point of view which in a larger perspective may lead the residents of Central Arizona and all other American citizens to be worse off.

The benefits of federal expenditures usually go to a fairly small, easily identifiable group. The tax costs are spread over the whole population and per taxpayer, for any given project, are quite small. Thus the support for the project is likely to be strong and vocal, for individuals see a "free lunch." But those taxpayers who will pay for the "free lunch" never organize in opposition. They are too diffused and the tax costs appear small. The results are a proliferation of hundreds or thousands or such projects benefitting special interest groups and very sizable and growing federal tax bills. The narrow focus on the "free lunch" which ignores the tax bill someone pays means that all taxpayers, including those in Central Arizona, face much higher taxes than they otherwise would. Only if all taxpayers take a "statesperson" type perspective and reject the "free lunch" perspective can this negative result (often called "pork barrel") be avoided and gross waste of federal tax funds be reduced.

However, in order to understand both the local support for and opposition to the CAP, one must look at it from a local, central Arizona perspective.

1. THE FEDERAL INVESTMENT GIFT TO AGRICULTURE

The BR estimates the irrigation investment to be $658,266,000.[71] At 7 percent capital cost it would take a payment of $47,695,000 per year to pay this investment off. Irrigators will pay only $58,470,000 over the entire 50 years or an average of $1,169,400 per year. Thus CAP will be conferring on the irrigators an annual investment gift worth $46,529,000 a year for 50 years. This, at 7 percent capital costs, is a capital gift of $642,127,000. If the average size of a farm receiving CAP water is 400 acres and if 600,000 af are available to agriculture on the average and 4.4 a^{f}/a is the canalside water requirement, then 341 farms will receive an investment gift of

[71] *BR, "Preliminary Information and Data Sheets," p. 4.*

$1,883,000 per farm.[72]

All of this investment gift does not come from the federal government. Property taxes, mostly paid by municipal residents and industry, contribute $328,933,000 over the 50 years. This amounts to an annual payment of $23,840,000 or 50 percent of the investment gift to irrigators. Thus the gift is provided on a "fifty-fifty" basis by urban residents and the federal government.

The size of the federal gift or subsidy is clearly huge. This takes some explanation, for it is not obvious why the federal government should be making such substantial subsidies to such a few farm families.

The explanation is that the size of the subsidy is obscured to both Congress and the general public by the BR accounting techniques. The BR seems to be acting in such a way as to maximize the flow of federal tax dollars to the farms the BR projects serve rather than as a rational investor of public monies. Since the size of the flow of funds might be objected to by congressional representatives from other areas, a variety of devices are used to obscure it.

a. The BR calculates "repayment capacity" at the beginning of the project when crop yields, farm size, and net income are low. On the basis of this a fixed water charge is set. This charge per acre-foot then remains constant over the 50-year repayment period. The benefits of the project which are used to justify the project are calculated at a time half-way through the life of the project when yields are assumed to be very high and net income is too. Thus repayment capacity is *not* based on the actual projected increase in net incomes the farms receiving the BR water earn. It is based upon a substantially lower amount. The BR, in 1966, calculated that the repayment capacity per acre-foot as only $10.88 per acre-foot but that the actual benefits (additional net income) per acre-foot was over $33.00. The charge for the water was to be less than one-third of the value claimed for the water.

b. In indicating what part of the total cost of the project will be repaid by the recipients, the BR simply multiplies the investment repayment by the total number of acre-feet and this times 50 years. The total sum of repayments turns out to be 9 percent of the capital investment. Thus the BR suggests 9 percent of the cost is being repaid. As seen above, the truth is that just a little over 2 percent is being repaid. The BR gets the larger estimate by equating the value of a dollar paid out now to build the CAP with a dollar received 50 years from now. In fact, a dollar to be paid 50 years from now is worth only three cents, not a dollar, at the current minimal discount rate of 7 percent. Thus the stream of annual repayments is worth $13,165,900, not the BR's $58,470,000.

c. In an inflationary period, to set repayments in fixed dollar amounts is to assure that those making the payments pay back dollars of substantially less value than the dollars invested in the project. Inflation at 5 percent for 20 years will make a dollar 20 years from now worth only 38 cents. Thus the actual value of the repayment is substantially reduced.

d. All of this "investment" in irrigation is not really for irrigation purposes. The reason that the "gift" to irrigators seems so large is that much of the M&I (and possibly power) investments are being classified as irrigation investments. This is possible because many of the facilities are joint facilities, serving several purposes. The

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[72] *The average size farm in Pima County in 1973 was 520 acres. The BR estimated in 1966 that "the most economical farm size in the project area was around 480 acres of cultivated land. This size farm would permit full use of the machinery necessary to operate the farm." Due to the 160 acreage limitation, the BR has used the fiction of a 320-acre farm even though the acreage limitation is regularly ignored.*

costs of these have to be divided among the various functions. This is done on the basis of "remaining benefits." If agricultural benefits are exaggerated relatively more than M&I and power benefits, more of the joint investment costs are assigned to agriculture. The advantages of doing this are two-fold. First, the agricultural investment is interest-free. So that the more of the CAP capital costs assigned to it, the lower are the total repayment costs. Second, the use of revenues produced by other federal electric generating facilities to subsidize agriculture has far more support than the use of those funds to subsidize private energy companies or urban lawn watering. Most of the investment costs allocated to agriculture are not paid by area residents at all but by federal power funds.

As pointed out above, this "gift" to agriculture may just be a ploy to assign CAP M&I water interest free to agriculture until M&I needs it. If agriculture never uses the water, clearly this is a gift to M&I, not agriculture.

2. THE FEDERAL INVESTMENT GIFT TO M&I

BR assigns $560,179,000 to M&I investment. This amounts to $40,590,000 per year at 7 percent over 50 years. Water users repay directly $486,985,000 over 50 years with 3.342 percent interest. This amounts to an average annual repayment on capital of $20,420,000 per year, a capital value of $281,811,000. However, all of this is not a contribution from the federal government. Ad valorem taxes pay $73,194,000 over 50 years or $5,304,000 a year in annualized payments (using 7 percent capital costs). Thus one-quarter of the subsidy to M&I water users comes from property taxes. If property taxes are distributed approximately the way water use is, this may not be a subsidy. The federal subsidy to M&I reduces to a capital value of $208,530,000.[73] The federal subsidy is about $30 per acre-foot per year if 500,000 af/yr of M&I water are available.

3. THE EFFICIENCY OF GIFT GIVING

The above figures underline the size of the "subsidy" to the local area and no doubt explain some of the strong local support. However, there is also local opposition. The reason there is not unanimous support for the project is that the above numbers exaggerate the benefits, understate the full costs, and say nothing about the distribution of costs and benefits.

A federal investment of one dollar is not necessarily a local benefit of one dollar. If the federal government invests in a totally useless or duplicative project, the dollars may become benefits to no one for they provide no valuable goods and services to anyone. Thus to say the federal government is investing almost two million dollars per full-service farm in CAP is not to say the farm gets those millions of dollars worth of benefits. If the project does not dependably deliver water or the water is not needed, there may be no gain to any farms and, in fact, may make the farm worse off. The point is that there are efficient and inefficient ways to give gifts. A highly efficient gift would provide the recipient with as many, or more, benefits as the cost of the gift. An inefficient gift is one which provides pennies in benefits for each dollar of cost or actually leaves individuals worse off as a result of the gift.

As argued above, irrigators receive the equivalent of a $1,883,000 investment gift per 400-acre farm, or an *annual* investment gift[74] of $136,450 per farm for 50 years.

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[73] *In fact, repayment will be carried out in a more complex way than indicated above. Since the irrigation investment is interest-free while M&I requires 3.342 percent interest, all of M&I will be paid off first, then the irrigation portion will be paid off. This however, is merely an accounting trick to minimize interest charges. It does not change real costs.*

[74] *The payment which would be required if this capital investment were to be paid off at 7 percent interest over 50 years.*

The BR estimate of the annual benefits from irrigation is $102,600 per 400-acre farm. That is, even using the BR's inflated estimate of irrigation benefits, 25 percent of the gift is lost. If we use the $16/af marginal value of irrigation water, the present value of the benefits of water is $335,360 per farm as opposed to the $1,833,000 free investment CAP makes. Here 82 percent of the gift is lost in the transfer because it provides such a low valued benefit at such a high capital cost. It is a very inefficient gift.

4. THE B/C RATIO FROM A CENTRAL ARIZONA PERSPECTIVE

Given that irrigators will only have to pay back 2 percent of the investment cost of the irrigation portion of the project, irrigation benefits can be extremely low compared to the BR estimates, and the B/C ratio as seen by farmers would still be greater than 1.0. When one pays only two cents of each dollar of costs, benefits do not have to be very high to calculate a net benefit. This explains why projects which are extremely irrational from the national perspective often have considerable local support. As will be seen below, however, there are significant additional costs irrigators and M&I water users will have to pay besides capital costs. These additional costs may significantly modify the attractiveness of CAP to local residents.

5. LOCAL COSTS OF CAP IRRIGATION WATER

Although the CAP irrigation water will be sold at canal-side for the extremely low price of $2/af, these are not the only costs paid by irrigators for the CAP water. The operations and maintenance (O&M) charge is likely to be over $25.00 per acre-foot.[75] In addition, each farm or irrigation district will have to build a concrete-lined distribution system. In 1967, the BR calculated that such a system would cost $340 per irrigated acre. If construction costs have doubled and one uses 7 percent interest rates instead of 3¼ percent, the annual cost, as the BR calculates it, would now be $80.00 per acre per year, or $21.05 per acre-foot per year (assuming the BR's water requirement of 3.8 af/a at the farm headgate). Thus the total annual cost per acre-foot comes to over $48.00. This is not cheap water. More importantly, a 400-acre farm would face hundreds of thousands of dollars worth of investment to provide a farm delivery system for a very undependable supply of water. To many farmers or their bankers the costs and risks are likely to be too great, despite the support from the urban property tax and the federal subsidy.

6. THE LOCAL COSTS OF M&I WATER

The City of Tucson has calculated that CAP M&I water would cost the city $134.50 per acre-foot — even though CAP will directly charge only $32.50 per acre-foot at canalside. In addition to the canalside charge, there are O&M costs, the property tax levy, transmission costs, treatment costs, and household damage done by the increased salinity.[76] This $134.50 compares with the current cost of $20 per acre-foot. Again, despite the substantial federal subsidy, the costs of M&I water are high enough to generate considerable doubt on the city's part about the advantages of CAP and some considerable opposition among some of the urban residents. As the City of Tucson's Staff Report on CAP concluded: "CAP is a heavy cart before the horse of water law reform."[77]

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[75] *BR, "Project Data Sheet", January 1, 1978, lists annual O&M charges as $25.26 ($13,630,000/yr divided by 766,700 af). The Water Projects Review Team calculated the annual OM&R costs associated with total CAP water delivery at $31.00/af, p. 7.*

[76] *City of Tucson, p. 61.*

[77] *Ibid., p. 128.*

7. A SUMMARY OF THE COST OF CAP WATER TO ARIZONA

We list here the out-of-pocket expenses Arizonans will face to use CAP water and then total them up to get an annual total cost. The ad valorem tax is listed under irrigation, even though it will be paid primarily by urban residents, because BR assigns most of the tax revenues to payment for the irrigation portion of the CAP.

Irrigation[78]

Water Charge	$2/af
O&M	$25/af
Distribution System	$21/af
Total	$48/af

M&I[79]

Water Charge	$51 /af
O&M	$25 /af
Distribution	$15 /af
Treatment	$25 /af
Salinity Damage	$22 /af
Total	$138/af

If the 1,200,000 af average annual CAP supply is split 510,000 af to M&I, 450,000 af to irrigation, and 240,000 af to Indian irrigation (on which no water charge is levied), the total average annual cost to Arizonans will be $103,020,000. Again, despite the sizable federal gift and subsidy, CAP will cost Arizonans a terrific amount of money. Its water will not be cheap. The present value (in 1977 dollars) of these annual costs incurred for fifty years by Arizonans is almost one and a half billion dollars, $1,421,753,000. The total dollars paid out will be $5,151,000,000.[80]

8. THE AD VALOREM TAX BURDEN

Given the uncertainty about whether CAP serves agriculture at all, it is difficult to discuss the equity of having urban property taxpayers help subsidize the irrigation investment. When one looks at how little of the property tax is paid by farms and how little of the reimburseable CAP costs paid by Arizona residents are paid by agriculture (5 percent) while the Arizona Water Commission Report, Phase II, projects that agriculture will receive almost two-thirds of the CAP water, it is easy to conclude that urban residents are being unfairly treated. However, agriculture may really be indirectly subsidizing M&I water and urban areas because:

A. A large part of the joint construction costs are attributed to agriculture where no interest need be paid on them; this lowers the cost of M&I water.

B. Agriculture will be assigned the water until M&I needs it; this too cuts interest costs on an M&I project to zero in the interim.

C. BR may not have been able politically to get authorization to build only an M&I water project to prosperous cities and profitable industries; agriculture may have been used as the cover to get the federal dollars for an M&I project.

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[78] *BR, "Preliminary Information and Data Sheets," p. 4. The OM&R charge listed there is $17.28/af but the Project Data Sheets dated Jan. 1, 1978, lists $25.26/af, while the Dept. of Interior's "Water Projects Review: CAP", April 1977, p. 7 projects $31.00/af. The BR assigns much of the ad valorem tax levied on Arizona property to help finance CAP to irrigation repayment. Since this falls mainly on urban residents, it is not listed here as a cost to irrigators.*

[79] *Taken from Barr and Pingry, "The Central Arizona Project,"* Arizona Review, *April, 1977, pp. 19-20 and p. 47. their figure is very close to the City of Tucson's estimate. Their figure is very close to the City of Tucson's estimate,* op. cit. *The $51 M&I water charge implicitly includes the ad valorem property tax levied on Arizona property to support CAP. Since this falls mainly on urban residents, it seems more appropriate to list it as a cost to M&I water users.*

[80] *((Irrigation: 450,000 af x $48/af) + (M&I: 510,000 af x $138/af + interest)) x 50 years.*

The earlier discussion presents the possibility that CAP will "save" farms while providing water to cities which do not really need it. This suggests that CAP is primarily an agricultural project, which uses the tax on urban property and the higher water rates paid by urban residential, commercial, and industrial users to subsidize agricultural water. Thus it is not clear who is subsidizing whom within Arizona's population.

9. THE DISLOCATION OF THE YAVAPAI INDIANS

Payment of "fair market value" for Indian lands to be flooded and relocation costs of families to be moved does not fully compensate a people for the loss of their homes and homeland. Thus listing the cost of this relocation and property purchase understates the real costs involved. Given the Yavapai refusal to accept the BR offer, one knows that it is not full compensation. From an economic point of view, the amount of compensation which would convince the Yavapai to *voluntarily* surrender their lands and homes would be the appropriate measure of the costs involved.

10. ENVIRONMENTAL COSTS

The BR does not attempt to quantify any environmental costs and benefits except to calculate impacts and "recreations days" to which are assigned a given value. The incalculable environmental costs of lost and irreplaceable riverine habitat for wildlife (including endangered bald eagles) and live water recreation were not included by BR. Thus most environmental costs, especially of the CAP dams go unaccounted for. What is not quantified is no less real. The environmental losses are as real a cost as the costs of concrete or electric pumps. Their absence is another indication of the underestimation of the costs of the project to Arizona and an overestimation of the net local benefits.

CHAPTER IV
ALTERNATIVES TO CAP

Given that CAP is a grossly inefficient investment from a national point of view, does not support the pursuit of the national social objectives, is a very inefficient gift, and imposes costs on many individuals and municipalities, one has to ask what alternatives there are and to what alternative uses these federal funds could be put which would avoid the problems detailed above. The nation, through Congress, has indicated its willingness to invest almost two billion dollars in supporting agriculture and water development in Arizona. Can this be done better than with CAP?

We list here and briefly discuss several alternatives to the CAP as a concept as well as other alternatives which, in combination, would represent a far better use of those billions of dollars which CAP would consume.

1. WATER CONSERVATION

Since it consumes 89% of the State's water, agriculture should be the obvious target for water conservation. The equivalent of half of the CAP supply can be realized through more efficient use of Arizona's present water resources.[81] There is little incentive to conserve, however, both because water is so cheap and the State's laws actually discourage it. As measured by its price, water is the cheapest commodity in Arizona. The price of surface water in the Salt River Project, where it is subsidized with electrical revenues, is only $5 an acre foot. The rising cost of energy has caused some conservation of groundwater.[82] However, Arizona's groundwater code generally encourages a "race to the bottom of the well." Adjoining landowners will pump water from under a farmer's land if he doesn't use it before they do. Under the State's surface water law, an owner loses the right to water not used for a period of five years.[83] Thus water saved is water lost. A new concept, known as water banking, could permit the owner to sell his conserved water to the highest bidder without losing his water right.[84]

2. A TRUST FUND AND INCOME SUPPLEMENTS

If the $658,266,000 to be invested in irrigated agriculture were put in a trust

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[81] *Arizona Water Commission, Water Conservation in Arizona (Draft), June 1977. 430,000 to 640,000 acre feet per year can be saved through a 10 to 15% reduction.*

[82] *Arizona Farmer-Ranchman, July 1975, p. 14. Farmers in southeastern Arizona (Cochise County) are shifting to center pivot sprinklers and realizing a water savings of more than one third.*

[83] *Arizona Revised Statues 45-101(c). ARS 45-172 (1962) does provide a means of transferring water rights. A 1966 case held that water realized through water saving practices could not be used on immediately adjacent lands of the same ownership (441 P2d 201).*

[84] *Angelides and Bardach, Water Banking: How to Stop Wasting Agricultural Water, Institute for Contemporary Studies, 1978.*

account which earned 7 percent interest ("A" rated industrial bonds are now earning 9 percent), $46,078,620 a year would be available to distribute in a way that supported family farms. Six hundred thousand af of water at 5 af/a can irrigate three hundred 400-acre farms. Thus each farm could receive an income supplement of $115,200 per year indefinitely into the future. Or, there would be $384 per irrigated acre available each year as an income supplement. Almost 1200 one-hundred acre farms could receive $38,400 a year as an income supplement.

This would certainly stabilize those family farms and have a major stimulating effect on the businesses and towns which support the farms. If the irrigation water, as we have argued above is worth only $15 per acre-foot, CAP offers uncertain annual irrigation benefits of $9,000,000, while this trust account offers certain, perpetual benefits over five times as large with none of the environmental, social, or opportunity (displaced agriculture elsewhere) costs.

However, income supplements may be rejected as politically infeasible "handouts." It may be that the subsidies have to be hidden and tied to "meritorious" work before they are politically acceptable.

3. RETIREMENT OF AGRICULTURAL LAND

With the surplus of America's crops and the present set-aside programs, retirement of agricultural land that is depleting the groundwater should be considered. Approximately 75% of Arizona's irrigated acreage is in crops that are in surplus. Dr. Kelso has pointed out that retirement could be accomplished for a fraction of the cost of the CAP.[85]

The so-called Kennedy Bill[86] proposed such an approach to solve Indian water rights in Arizona. The Federal Government would pay $250 million to gradually acquire 170,000 acres of land with surface water rights for transfer of one million af to the central Arizona Indian tribes.

4. A WESTERN ARIZONA PROJECT

There are hundreds of thousands of acres of irrigable land in western Arizona near the Colorado River (see fig. 12). Using CAP water on these lands would save energy, water and tax dollars while increasing the State's agricultural production. It would also encourage the dispersal of central Arizona's growth. A recent poll by the City of Phoenix showed 69% of its residents believe that the city is growing too rapidly.[87]

Much of the irrigable land is underlain by groundwater deposits. The ownership is varied, with much of it under the control of the Bureau of Land Management. This is the remnant of the original homestead lands. Since the 1902 Reclamation Act, which authorizes projects like the CAP, is essentially a Homestead Law, use of CAP water on these lands seems more justified and sensible than the current plan.

Should the Federal Government open these lands to homesteading, Arizona would benefit with more private land on its tax roles. If this is not feasible, Arizona still has 200,000 acres of State land to select from these same BLM lands. These lands were granted Arizona as school trust lands upon statehoood. At 5 acre feet per acre, the average agricultural use in Arizona, these lands would use one million acre feet, roughly the CAP supply.

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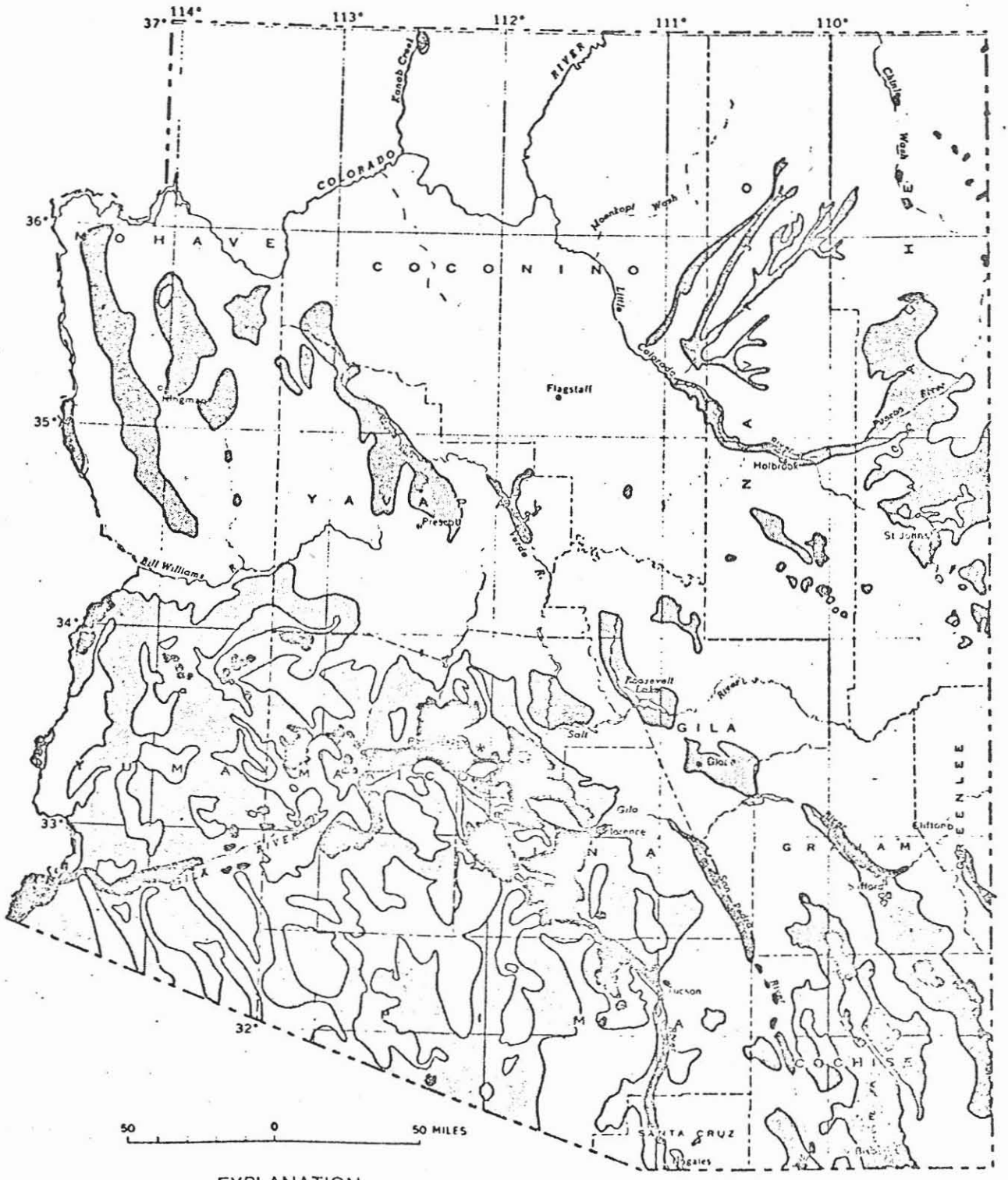
[85] *Maurice M. Kelso, Letter to Editor, Arizona Daily Star, Tucson, circa 1975. 300,000 acres using 5 acre feet would release 1.5 acre feet per year. At a $1000/acre this would cost only $300 million.*

[86] *Senate Bill 3298 (1976), Senate Bill 905 (1977) Central Arizona Indian Tribal Water Rights Settlement Act.*

[87] *City of Phoenix, "Community Attitude Survey, Urban Form Directions, Phase II," July 3, 1978, Summary Report, p. 12.*

FIGURE 12
Irrigated and Potential Irrigable Lands in Arizona



A variation of the two concepts could see the Federal or State government making land near the Colorado River available to central Arizona farmers whose groundwater supplies are being depleted too rapidly. This trade would obviously be the least expensive approach and would have the additional benefit of encouraging dispersal of Arizona's population.

5. MARKET PLACE ALTERNATIVES

In the CAP Impact Statement, the Bureau states that the CAP will have little, if any, effect upon population growth and that absolute levels of urban population and economic activity will not be affected significantly by the project.[88] Agriculture, which consumes 89% of the State's water, returned only 3.2% to Arizona's personal income in 1970. Kelso projects an 18% reduction in irrigated acreage by the year 2015 but only a 9% decline in agricultural income. Water consumption would be reduced by 906,000 acre-feet, almost the entire CAP supply but Arizona's income would decline by only 0.07%.[89] Over a 50 year period this amounts to $160 million, while the CAP will cost $1.6 *billion*.

California is presently paying more than $100 an acre foot for water and has demands for developing new water which will cost even more. She presently enjoys the free use of Arizona's CAP water. Selling that water to California could result in an enormous profit for Arizona — possibly more than $100 million a year. Both states and the nation would realize a substantial saving in money and energy, as both the CAP and the Delta Peripheral Canal in California could be deferred. The legal requirements for this transaction, as outlined by the National Water Commission, have already been analyzed.[90] An even greater profit might be made in the future by selling water to the Upper Basin states for energy production. Some of these profits could be used to help Arizona farmers conserve water.

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[88] *Bureau of Reclamation, Final Enviromental Statement, Proposed Central Arizona Project, September 26, 1972, p. 155.*

[89] *M. Kelso et al,* Water Supplies and Economic Growth in an Arid Environment: an Arizona Case Study, *University of Arizona Press, 1973, p. 237 and 238.*

[90] *Ralph W. Johnson, National Water Commission, Major Interbasin Transfers Legal Aspects - Legal Study, 26 July 1971. An apportionment compact or interstate litigation or congressional apportionment are required. See also Chapter 8 of the National Water Commission's "Water Policies for the Future," June 1973.*