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AN ECONOMIC ASSESSMENT OF CENTRAL ARIZONA PROJECT AGRICULTURE

A Report Submitted to

The Office of the Governor

and the

Arizona Department of Water Resources

by

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PREFACE

In May 1992, the Department of Agricultural and Resource Economics was approached by representatives of state government concerning the need for a timely study which discussed and quantified (1) the current and possible future economic status of the agricultural subcontractors for Central Arizona Project (CAP) water and (2) CAP agriculture's economic contribution to the surrounding communities in Arizona. The need for such a study directly arose out of the discussions of the Governor's Task Force on CAP Issues which met during the first six months of 1992. Concern was expressed by several task force participants that the task force not propose solutions to CAP issues (e.g. underutilization of CAP water) before obtaining a shared understanding of the nature and magnitude of the problems, particularly those facing agriculture.

A precursor to this present study is the innovative Interagency Management Improvement Program initiated in the Maricopa-Stanfield Irrigation and Drainage District in 1991. Governmental agencies collaborating in this ongoing program include the U.S. Water Conservation Lab (ARS/USDA) as the lead agency, the Arizona Departments of Water Resources (ADWR) and Environmental Quality (ADEQ), Cooperative Extension (The University of Arizona), the Soil Conservation Service (USDA), and the Bureau of Reclamation (Interior). This multidisciplinary, multiagency program initially identified many of the economic challenges facing CAP agriculture which will be discussed in this report.

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The contents of this report are the findings of the author and do not represent necessarily the policies or opinions of these supporting organizations.

This report would not have been possible without the cooperation of many people in the agricultural sector, in municipal and county offices, attorneys, and professionals concerned with water management in the state. Over 60 individuals were interviewed and had an opportunity to contribute to this report. A special thanks is appropriate for the managers of the irrigation districts who spent valuable time answering the author's questions and responding to requests for more information.

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In no way are these individuals responsible for the final contents of this economic assessment. Nor is it presumed that they agree with its findings. Their input, however, did improve the final product.

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EXECUTIVE SUMMARY

Introduction

The imminent completion of the Central Arizona Project (CAP) represents the realization of a goal Arizona's civic and agricultural leaders have pursued for over 70 years. As a multi-use project serving the present and future water needs of municipal and industrial users (M&I), non-Indian agriculture and Indian communities, the successful evolution of the CAP required community-wide support and a unified voice in Washington, D.C.. Legal and political challenges to the CAP have been overcome through compromise and unity at the state level.

Following project completion, expectations were that non-Indian agriculture would buy approximately 60-80% of Arizona's Colorado River allotment of 1.5 million acre-feet (maf) over the next several decades. As central Arizona urbanized and Indian communities developed the infrastructure to accept delivery of CAP water, non-Indian agriculture would have access to less CAP water due to agriculture's lower priority right.

The first stage of this expected sequence of events has not materialized. Only 50% of the agricultural land in the three-county (i.e. Maricopa, Pinal and Pima) CAP service area ever contracted for CAP water. Lower cost sources of water (e.g. groundwater, surface water, effluent) and Reclamation Reform Act regulations involving farm size (960-acre limitation) and ownership requirements, deterred some landowners from contracting with the Central Arizona Water Conservation District (CAWCD). Non-Indian agricultural purchases of project water declined by 48% between 1989 and 1991 in those districts that did contract for CAP supplies.

This report, requested by the Office of the Governor and the Arizona Department of Water Resources, provides an independent source of information and

analysis on the agricultural issues surrounding the underutilization of CAP water. The report discusses the economics of CAP agriculture, economic interdependencies, the financial status of the CAP irrigation districts, and the economic implications of various scenarios for farmers, municipalities, CAWCD, and rate and taxpayers in the three-county CAP service area.

The Economics of CAP Agriculture

In recent years, basic economic factors have adversely affected CAP agriculture. Cotton is by far the most important crop in areas served by the CAP. However, both upland and Pima cotton yields have fluctuated significantly from year-to-year, exhibiting a downward trend since 1988. Cotton prices also have fluctuated widely, and real cotton prices have continued to decline, creating a cost-price squeeze for the cotton producer.

CAP water, at $52/af, is not competitively priced with groundwater pumped with preferentially priced hydroelectric power. Ability-to-pay for water for a representative Pinal County farm is approximately $38/af. Experience suggests that the actual willingness-to-pay for an additional acre-foot of water ranges from $20-40 across the districts. Growers and districts have substituted lower cost groundwater for CAP water, a decision which has created a major part of the underutilization problem. The 1992 indirect recharge program successfully priced CAP water more competitively with groundwater, increasing the demand for CAP water by 38%.

Increased regulatory scrutiny, stricter loan guidelines and an emphasis on cash flow rather than equity financing, have constrained the availability of credit to CAP agriculture. With increasing land values in the late 70s and early 80s, lenders were assured of repayment. Decreasing agricultural land values since the mid-1980s have forced lenders to stress the ability of the farm to repay the loan from agricultural production, not land sales. Loan grading systems and reserve

requirements have increased the cost of lending to financially marginal farms. Cotton ginning and merchandising firms have become the major lenders in the CAP districts; yet these non-bank lenders rapidly are coming under the same financial pressures as the banks since they also must borrow their loan funds from commercial banks. Relatively higher water costs in CAP districts make these growers higher risk borrowers in the eyes of lenders.

Original CAP feasibility studies which analyzed the economic viability of the major irrigation district distribution systems were flawed. First, the studies optimistically assumed that all the acreage in the districts would be cropped each year. Second, the analyses assumed much greater than historical average acreages of high-value crops (e.g. lettuce, potatoes). Third, the ability-to-pay methodology largely ignored the existence of groundwater as a substitute for CAP water and overstated the grower's willingness-to-pay for CAP water. Finally, the feasibility studies failed to include a sensitivity analysis to see how financially viable a distribution system would be given reasonable and normal fluctuations in acreage farmed, commodity prices, yields, etc.

Economic Interdependencies

There are two types of CAP irrigation districts: grower controlled (GC) and conjunctive use (CU). In the GC districts the growers control the use of their irrigation wells and purchase CAP water as a supplemental source. CU districts have control of most of the wells within the district and attempt to provide the lowest cost mix of groundwater and CAP water to the farmer subject to preferential power constraints and grower demand for water. Most of the operating costs of the GC districts are covered by property tax assessments while the CU districts rely on water sales to generate enough surplus to cover the district's operation, maintenance and replacement (OM&R) costs. Breakeven analysis demonstrates that the large CU

districts, as presently organized, are selling less water than necessary for them to survive in the medium term (i.e. 1-3 years).

Declining agricultural purchases of CAP water will have an adverse impact on CAWCD and M&I users. Take-or-pay provisions in the CAP agricultural contracts, under present water allocation percentages, will create a financial burden on both GC and CU districts. District management likely will opt first to pay private bondholders, which will produce a default on take-or-pay payments and on the CAP contracts. Lower than expected water sales raise questions regarding CAWCD's cashflow projections for debt repayment. New repayment studies should be completed soon using realistic water and power sales assumptions. And finally, limited or no purchases of CAP water by non-Indian agriculture will shift the fixed OM&R costs and an additional interest burden associated with the CAP system on the financial shoulders of the CAWCD and M&I users. Water prices of $150-200/af and an increase in ad valorem property taxes are likely consequences of further reductions in agricultural demand.

Structural change already has occurred in CAP agriculture due to the economic factors discussed previously. In 1992, only 49% of CAP-eligible acreage is being farmed. These remaining operations create employment for nearly 3,700 people and will contribute approximately $282 million to the economies of Maricopa and Pinal Counties this year. These economic contributions, estimated using the IMPLAN input-output model, reflect the direct, indirect and induced impacts. Although CAP agriculture is not a dominant part of either Maricopa or Pinal County's economy, its continued economic health should concern policymakers interested in maintaining a diversified economic base and in recovering from agriculture a portion of the fixed costs of the CAP.

Financial Status of CAP Irrigation Districts

The district's financial statements reveal organizations with high levels of debt relative to their ability to generate the necessary revenues through acreage assessments and water sales. Four districts have requested a deferment of their federal debt payments and one district is in arrears. One irrigation district came within several days of declaring Chapter 9 bankruptcy in 1991 and recently was rescued from that fate by becoming part of the an Indian water settlement agreement. To date, all districts have paid their private bond payments in a timely manner.

Non-payment of acreage assessments by individual farmers places increased stress on the districts to make their debt payments. Farm bankruptcies, delinquent assessments on State land within the external boundaries of the district, and delinquent tax payments reduce revenues available for debt service. Since irrigation districts are political subdivisions of the State of Arizona, akin to municipalities, a default on private bonds may have an adverse impact on the bond ratings of local public entities, particularly school, road, and fire districts within or near the boundaries of the irrigation districts.

Scenario Analysis

All or some combination of the following events may occur in the near future. First, the implementation of the take-or-pay provisions in the CAP contracts, as presently configured, will drive the largest districts to default on the contracts because the districts will opt to continue servicing their private bond debt and forego meeting the take-or-pay provisions. As a result, the districts will lose their right to CAP water. Without CAP contracts it is unclear how the water demands for

future economic and demographic growth of Pinal County will be met given the DWR's draft 100-year assured water supply rules (i.e. replenishable water supply requirement).

Second, higher prices for CAP water, brought on by formal project completion and continued low purchases by all contractors, will reduce further the demand for CAP water in the districts. Growers and districts cannot pay the projected costs of $65-100/af. Lower cost groundwater pumped with hydroelectric power will be used first by the grower or the CU district. Without some financial relief, agricultural demand for CAP water will decline to the point that the CAP may be only a supplemental water source during times of peak demand, e.g. June, July and August; and these purchases will occur only in cases when CAP water is priced at or below its marginal value in agricultural production.

Preferentially priced hydroelectric power is critical to the economic survival of the farmers in the CAP districts. However, the amount of preferential power is limited thereby putting pressure on the districts to either find alternative sources of electrical power or purchase CAP water. Approximately 100,000-120,000 acres in these districts could be farmed using only preferential power. Yet problems remain. Those growers who designed their level basin and level furrow fields for large heads of water may have trouble achieving these high-volume flows with only well water. Those growers without functioning wells and/or at the head end of the CAP distribution system may find it difficult to obtain any water in a cost effective manner.

A final scenario is the further reduction in CAP acreage. A one-third reduction from 1992 acreage levels would create an aggregate output loss of $94 million in Maricopa and Pinal Counties and represent a reduction in employment of

over 1,200 jobs. This economic loss is equivalent to a large manufacturing corporation leaving the State.

Concluding Remarks: A Vision of a Future

There is no simple solution to the CAP underutilization problem. Any resolution of these issues must be a composite solution, analogous to putting together a multi-piece puzzle. CAP agriculture should be a piece of the puzzle due to its economic and legal interdependencies with the other partners in the CAP system. A multi-agency task force should be formed to restructure the CAP, both operationally and financially. This group of technically qualified individuals should analyze the present value of the costs and benefits of alternative composite solutions. A timely search for a least cost solution is in the best interest of the rate and taxpayers in the three-county CAP service area. Equity questions surrounding the issues of: "Who pays?", "When do they pay?", and "How much do they pay?" need answers.

A vision of a future reveals CAP agriculture using the legal and economic means at its disposal to disengage itself further from the CAP. Most irrigation water will be obtained from wells with pumps using preferentially priced hydroelectric power. Other supplemental electrical power may be purchased. CAP water also may be purchased on the spot market at a price that covers all variable costs and a small portion of CAWCD's fixed OM&R costs. Growers will continue to produce cotton but efforts to diversify into higher value crops will be intensified. Continued improvement in on-farm water, production and marketing management will be necessary for central Arizona agriculture to remain competitive in national and world markets.

I. INTRODUCTION

A Brief History

The imminent completion of the Central Arizona Project (CAP) largely is due to the tenacity and perseverance of the political leaders and many citizens of the State of Arizona over the last 70 years. The realization of the dream - of transporting Colorado River water through a 335-mile aqueduct to farms and cities in Maricopa, Pinal and Pima counties - also required the financial and technical support of the federal government, primarily the U.S. Department of the Interior's Bureau of Reclamation (BOR). This collaborative effort, authorized by the U.S. Congress in 1968, will reach a milestone in one year when the U.S. Department of Interior declares the CAP completed and turns the project over to Arizona's Central Arizona Water Conservation District (CAWCD) for its operation and maintenance.[1] Federal debt repayment pursuant to the master repayment contract between BOR and CAWCD will begin at that time as well.

The road towards the realization of the CAP dream began in 1919 with the formation of the League of the Southwest, an organization of the Colorado River Basin States having the expressed purpose of promoting the development of the river.[2] In 1923, all the basin states, except Arizona, approved the Colorado River Compact. The Compact evolved into the Boulder Canyon Project Act (1928) which allocated 2.8 million acre-feet (maf) annually to Arizona. During the 1930s both Boulder (now Hoover) and Parker Dams were completed.

Arizona experienced a period of drought during the late 1930s and early 40s. In 1941, Arizona Senator Carl Hayden asked the BOR to study all the realistic proposals for transporting Colorado River water to central Arizona. To complement this effort, the Arizona State Legislature finally ratified the Colorado River Compact in 1944 and the State began to enlist the support of other basin states for the CAP.

That same year, the BOR recommended building the CAP and began engineering studies. Two years later, the Central Arizona Project Association (CAPA) was established solely for the purpose of insuring that the CAP dream would become a reality. The CAPA would become an important political force during critical periods of the CAP's history.

The 1950s were a decade of litigation. CAP authorization bills failed to pass Congress due to ongoing water rights disputes between Arizona and California. So in 1952 Arizona filed an interstate suit against California to adjudicate its rights to the use of Colorado River water. After 12 years of litigation, the U.S. Supreme Court decreed that Arizona had a right to 2.8 maf *(Arizona v. California, 373 U.S. 546)*. That same year CAPA opened an office in Washington, D.C. to assist the Arizona congressional delegation in securing authorization and appropriation legislation from Congress. After some deft political maneuvering by Senator Hayden, Representative Morris Udall, and other political leaders, Congress authorized the CAP as part of the Colorado River Basin Project Act (Public Law 90-357) in 1968.

Obtaining and maintaining federal funding for the CAP proved to be as rocky as the authorization process. By 1970, federal funding was finally authorized to begin CAP pre-construction planning. The Arizona State Legislature also provided $650,000 to supplement the federal funds. Construction began on the Havasu Pumping Plant in 1973 but the enthusiasm generated by this start-up event soon waned. In 1977, the CAP was placed on the Carter administration's "hit list" of federal water projects. Not only did current appropriated funds have to be justified, but the feasibility of the entire project was restudied by the Department of Interior, the Office of Management and Budget, the Council on Environmental Quality and the Corps of Engineers. To combat this threat to the future of the CAP, the CAPA mobilized 17 chambers of commerce, and 104 water companies, irrigation districts and public utilities to send petitions and supporting resolutions to Congress. This

community-wide effort was successful. Several months later, President Carter approved continued funding for the CAP contingent upon groundwater management legislation being passed and implemented by the State of Arizona.[3] In 1980, Interior Secretary Andrus announced that Indian reservations in Arizona would have a priority right to 309,810 acre-feet of CAP water, followed by 640,000 acre-feet for municipal and industrial (M&I) users, with the balance of the 1.5 maf going to non-Indian agriculture.

Since the crisis in 1977, the construction of the CAP has progressed with Harquahala Valley Irrigation District and Phoenix taking delivery of CAP water in 1985, irrigation districts in Pinal County taking initial small deliveries in 1987, and some citizens of Tucson scheduled to begin drinking CAP water in November 1992. The last 15 years have not been without legal challenges, engineering obstacles, environmental concerns and other forms of opposition to the CAP. Yet the State repeatedly was able to resolve these conflicts through negotiation and in most cases, unity.

Current Situation

The original CAP feasibility studies envisioned that the vast majority of the imported Colorado River water (60-80%) would be used in non-Indian agriculture during the initial 10-30 years of the project. M&I use initially would be a low percentage of the available supply. As the urban population of central Arizona grew and as the Indian reservations were able to use their CAP allocations, the allocation to non-Indian agriculture would decline due to its lower priority right. However, the expected levels of agricultural demand for CAP water have not materialized.

Sixty percent of the agricultural irrigation districts in central Arizona did not contract to accept delivery of CAP water. Table 1 compares agricultural acreage in

Table 1. Estimated CAP Acreage Relative to Total Irrigated Farmable Acres in Central Arizona.

	Irrigated Acres Served[1]	CAP Subcontractor
Maricopa County		
Adaman Mutual Water Co.	2,622	No
Arlington Canal Co.	4,630	No
Buckeye Water Cons. Dist.	18,818	No
Chandler Heights Citrus I.D.	1,116	Yes
Harquahala	33,200	Yes
MCMWCD #1	26,357	No
Peninsula Ditch Co.	2,018	No
Queen Creek I.D.	20, 404	Yes
Roosevelt I.D.	37,270	No [2]
Roosevelt Water Con. Dist.	31,037	Yes [3]
Salt River Project	86,052	No
San Tan I.D.	2,764	Yes
St. Johns I.D.	1,.821	No
Tonopah	9,225	Yes
Subtotal	**277,434**	
CAP Acreage as a Percent of Total Farmable Acres: 24%		
Pinal County		
Central Arizona I.D.	87,321	Yes
Hohokam I.D.D.	26,661	Yes
Maricopa-Stanfield I.D.D.	88,033	Yes
New Magma I.D.D.	30,115	Yes
San Carlos I.D.	45,276	No [2]
Subtotal	**277,406**	
CAP Acreage as a Percent of Total Farmable Acres: 84%		
Pima County		
Avra Valley I.D. (Excluding State Lands)	9,300	No
Cortaro-Marana I.D.	12,400	No
Farmers Investment Co.	6,200	No [2]
Arizona State Land Department	9,100	No [2]
Subtotal	**37,000**	
CAP Acreage as a Percent of Total Farmable Acres: 0%		
Total Acreage	**591,840**	
CAP Acreage as a Percent of Total Farmable Acres: 50%		

1 Potential acres, not acres actually farmed each year.
2 Has an allocation but has not been offered a subcontract.
3 Has a CAP contract but has not taken CAP water since 1988. May still sign a formal contract which would change the numbers in this table.

Note: The McMullen Valley Water Conservation District in La Paz County has an allocation for its 12,000 irrigated acres but has not been offered a subcontract.

Source: Arizona Department of Water Resources.

Maricopa, Pinal and Pima Counties with the CAP-eligible acreage for the subcontractors. Owners of only 50% of the agricultural acreage in central Arizona voted to accept CAP water. Why? The first reason is cost. Many districts have access to lower cost water, either by other surface supplies (e.g. the Salt, Verde and Gila Rivers), effluent, or low cost groundwater due to preferential electric power and/or shallow pumping lifts. Second, the owners of agricultural land recognized that CAP water would come within the scope of the Reclamation Reform Act of 1982 (RRA). Under the RRA, lands with non-resident alien owners or with 26 or more owners would not be eligible to receive CAP water at favorable prices (i.e. $52/af versus full-cost pricing of $250/af). The 960-acre limitation under the RRA also was a factor in the decisions of many farmers. Given the fragmented nature of the ownership of agricultural properties, particularly in Maricopa County, and the economies of size in Arizona agriculture, these RRA regulations discouraged contracting for CAP water.

The districts that have contracted for CAP water have found themselves under similar cost conditions and RRA pressures. Table 2 summarizes CAP water demand for these districts which will be referred to throughout this report as "CAP agriculture." Aggregate water sales increased each year from 1985 when the Harquahala Valley Irrigation District accepted the first delivery of CAP water until 1989 when all the district distribution systems were completed.[4] The decline in demand by some contractors began in 1988 with (1) the Roosevelt Water Conservation District (RWCD) becoming a party to the Salt-River Pima-Maricopa Indian Community Water Rights Settlement, thereby insuring its future water rights, and (2) with the reduction in water purchases by the Tonapah Irrigation District. In the 1989-90 period, changing economic conditions in agriculture and the state, combined with the lower cost of some sources of groundwater relative to CAP water, produced a decline in water sales of 20%. A further decline of 35% occurred

Table 2. Purchased Central Arizona Project Water by Agricultural Irrigation District Subcontractors, 1988-1992.

District	1988 Acre Feet	1988 % Change From Previous Year	1989 Acre Feet	1989 % Change From Previous Year	1990 Acre Feet	1990 % Change From Previous Year	1991 Acre Feet	1991 % Change From Previous Year	Percent Change 1989-1991	1992[2] Acre Feet	1992[2] % Change 1991-1992
Maricopa County:											
Chandler Heights Citrus I.D.	0	-	1,216	-	1,308	8	541	-59	-56	2,200	307
Harquahala Valley I.D.	83,365	-2	116,848	40	56,162	-52	34,802	-38	-70	30,000	-14
Queen Creek I.D.	2,445	977	5,292	116	6,191	17	7,220	17	36	30,000	316
RWCD[1]	16,573	-41	0	-100	0	-	0	-	-	0	-
San Tan I.D.D.	779	-	2,653	240	1,168	-56	1,483	27	-44	5,050	240
Tonopah I.D.	5,609	-39	3,042	-46	2,559	-16	523	-80	-83	15,300	2900
Subtotal	**108,771**	**-11**	**129,051**	**19**	**67,388**	**-48**	**44,569**	**-34**	**-65**	**82,550**	**85**
Pinal County:											
Central Arizona I.D.D.	31,863	138	110,551	247	112,213	2	81,948	-27	-26	81,000	-1
Hohokam I.D.D.	8,830	-	13,135	49	25,009	90	21,993	-12	67	50,000	127
Maricopa-Stanfield I.D.D.	116,615	322	193,151	66	166,767	-14	94,476	-43	-51	107,400	14
New Magma I.D.D.	39,836	70	55,686	40	27,371	-51	16,620	-39	-70	38,000	129
Subtotal	**197,144**	**206**	**372,523**	**89**	**331,360**	**-11**	**215,037**	**-35**	**-42**	**276,400**	**28**
Total	**305,915**	**64**	**501,574**	**64**	**398,748**	**-20**	**259,606**	**-35**	**-48**	**358,950**	**38**

[1] RWCD has signed a contract with CAWCD but is not taking any CAP water at this time.
[2] Estimated water purchases by irrigation districts. The in lieu or indirect recharge program substantially lowers CAP water prices for most districts. See text and Appendix A for details.

Source: Central Arizona Water Conservation District, and irrigation districts.

in 1991. The Pinal County purchases of CAP water declined by 42% between 1989 and 1991. Water sales rebounded in 1992 when CAWCD, in collaboration with ADWR, instituted the in lieu or indirect recharge program which lowered the price of water to farmers in these districts (Appendix A). Water prices in the range of $25-42/af (as compared to $52/af) have generated a projected sales increase of 38% in 1992 for CAP water.

Objectives

The overall goal of this report is to provide public policymakers at the local, state and national level with an independent source of information and analysis which will facilitate their timely decisions concerning the future status and viability of the non-Indian agriculture component of the CAP. This report is divided into four major sections. Section I analyzes the major factors influencing the profitability and sustainability of CAP agriculture. It also establishes the economic foundations for the analyses in the subsequent sections. The second section discusses the economic interdependencies in CAP agriculture and demonstrates the economic linkages between and among the farmers, the irrigation districts, CAWCD, the community and the state. The current financial status of the CAP irrigation districts is discussed in a brief, third section which explores issues surrounding financial viability, default and bankruptcy. In the final section, several realistic scenarios and their economic impacts are developed to illustrate the interdependencies within the CAP.

Additional supporting references and documentation are provided in the Endnotes and various Appendices. The source or sources of all information relied on in this report are cited clearly. Questions concerning these data should be directed to the cited sources or to the author for clarification.

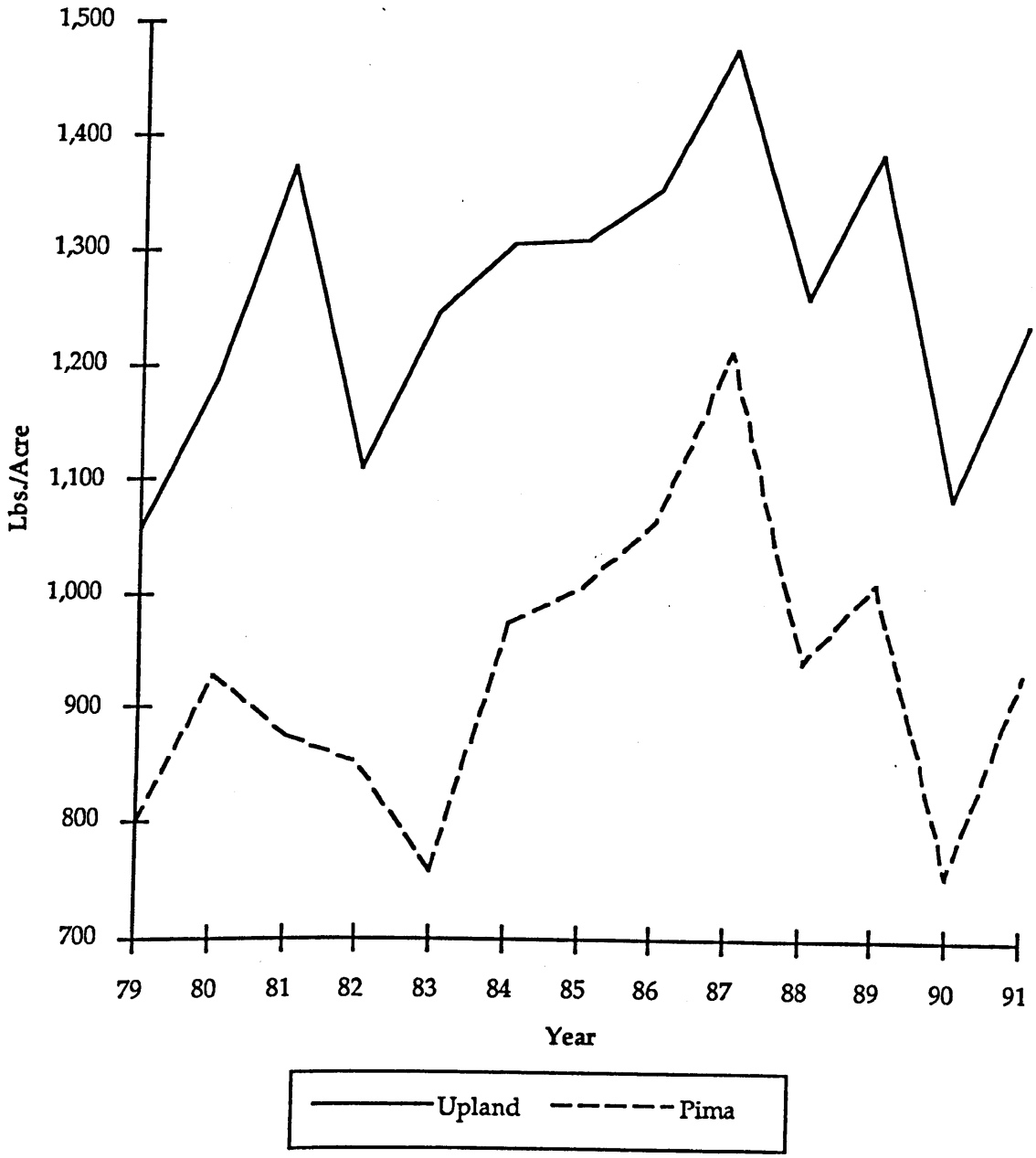
II. THE ECONOMICS OF CAP AGRICULTURE

Current Status

The profitability of CAP agriculture is dependent on numerous, interrelated factors that determine profitability levels over a multi-year planning horizon. Influential variables include input and output prices, yield levels, government policies and programs, the supply and cost of credit, and biological factors (e.g. pests). The fact that these factors are not stable, but exhibit unexpected fluctuations, produces an uncertain economic environment for the farmer. A grower's economic success is determined largely by the ability to manage uncertainty in the farming operation. This section will analyze four variables: cotton prices, cotton yields, water costs and financing requirements. Other factors are obviously important but due to space and time limitations an analysis focusing on these four factors will capture the current economic status of CAP agriculture.[5]

Cotton Yields. Upland or short staple cotton has been the major field crop in CAP districts for many years (see Appendix B for Harvested Acreage information for Maricopa and Pinal Counties). Figure 1 illustrates the trends in average upland cotton yields for the last 13 years. During the 1980s, average upland cotton yields demonstrated a gradual, upward trend, peaking in 1987. This trend can be attributed to better crop management, new cotton varieties, good weather during critical months of the growing season, and relatively low levels of pest infestations. However, since the 1987 crop season, average upland cotton yields have trended downward and demonstrated a high degree of variability from year to year.[6] These adverse events have been attributed to poor soil fertility conditions due to a cotton monoculture, poor growing weather and damaging pest infestations (e.g. boll weevil, pink bollworm, whitefly). The upland cotton yield for 1992 likely will continue this downward trend due to a serious whitefly outbreak in western Maricopa and Pinal Counties.

Figure 1. Yield Per Acre For Upland and Pima Cotton 1979 - 1991, Pinal County.



Source: Arizona Agricultural Statistics Service. *Arizona Agricultural Statistics*. Phoenix, Arizona (Various Years).

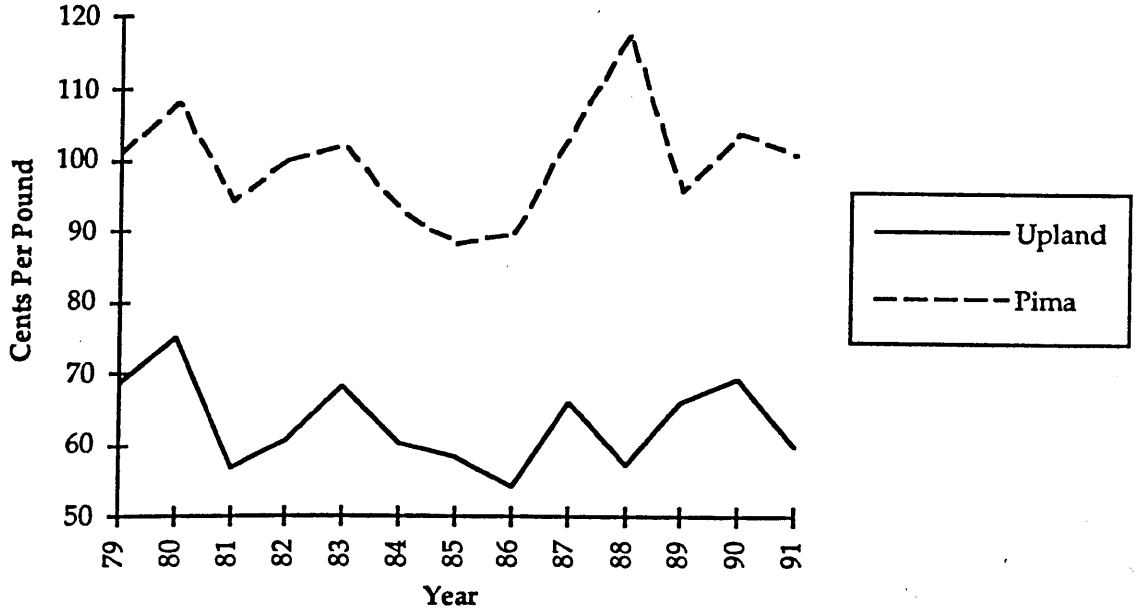
Average yield levels for Pima or extra long staple (ELS) cotton follow a similar trend (also Figure 1). As per acre yield levels and ELS prices increased during the 1980s, Pima cotton became relatively more profitable than upland cotton and significant acreage shifted from upland to Pima cotton in the late 1980s (see Appendix B for details). However, the devastating yield levels of 1990 for Pima cotton induced growers to shift more acreage back into upland cotton production (see Appendices B.1 and B.2).

It is important to note that the information presented in Figure 1 is average data. By definition, there are growers in a given year obtaining higher and lower yields than the average yield. The range of low to high yields around this mean can be 400-600 pounds of lint per acre even in a normal year. This variability implies that some growers, if they can consistently perform above the average level, have a better chance of economic survival. Those farmers with consistently below average yields will find it difficult to remain in farming.

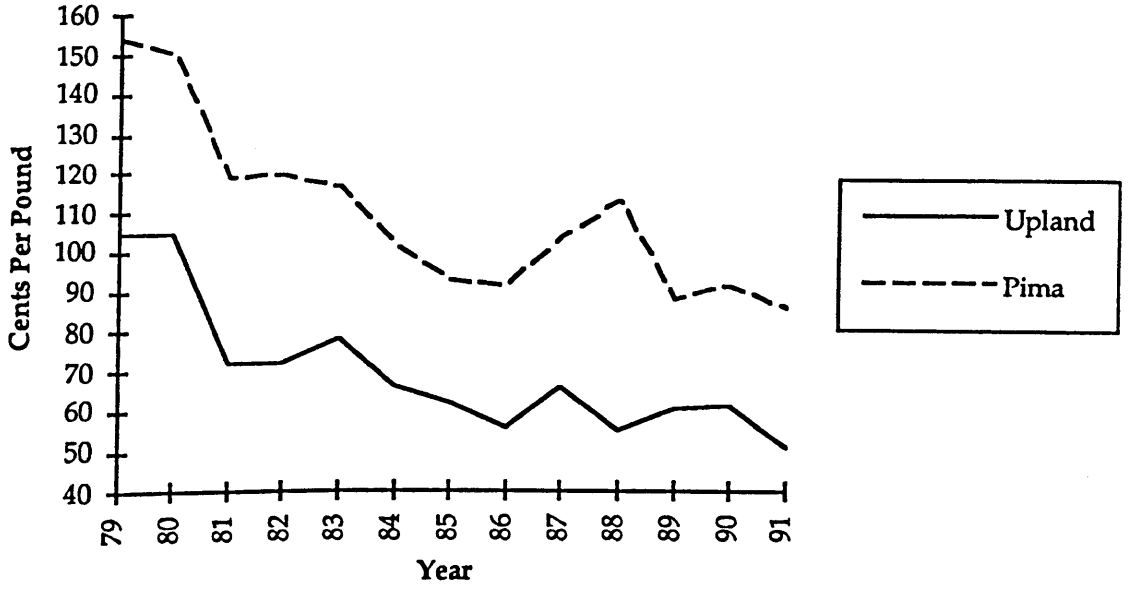
Cotton Prices. Yield and market price determine gross revenues for growers. Like yields, upland and Pima cotton prices increased rather steadily in nominal terms during the 1980s but have exhibited significant fluctuations in the last few years (Figure 2A). During September, 1992, the upland cotton price fluctuated around $0.58 per pound and Pima cotton was selling for approximately $0.95 per pound, both prices reflecting a sluggish world economy and a large amount of stored cotton in the world. These lower prices are attributed to increased world competition in cotton production. Many analysts do not see these fundamental demand and supply conditions changing in the near term. In the long run, the republics of the former Soviet Union, China and Pakistan will assume a more influential role in the world cotton markets. As China slowly opens up its economy, the sheer size of its cotton industry and consumer base will be a driving force in world cotton markets for years to come. Of course, a major shock to the world

Figure 2. Upland and Pima Cotton Prices, 1979 - 1991, Arizona.

A. Nominal Price



B. Real Prices (1987 = 100)



Source: Arizona Agricultural Statistics Service. *Arizona Agricultural Statistics*. Phoenix, Arizona (Various Years).

economy (e.g. war, trade disputes, widespread drought) would provide upward pressure on all commodity prices, including cotton.[7]

Even more critical for the long-term economic viability of CAP agriculture is the price information contained in Figure 2B. Real cotton prices (i.e. adjusted for inflation) have declined steadily since 1980. With real input prices remaining constant, the cotton grower faces a cost-price squeeze which threatens future economic viability. Yield-increasing or cost-reducing technological changes are the principal means for coping with this adverse price situation; yet as shown above, the cotton growers in central Arizona have not been able to increase or even maintain average yield levels over the last three years.

Upland cotton growers are assisted by the federal government through commodity price support programs. A deficiency payment is paid to the grower based on the farmer's yield history and the difference between a target price ($0.73/lb.) and the world market price. Although the federal program limits payments to a single operator to $50,000, growers in central Arizona have formed a wide array of legal business partnerships in order to qualify for and legally maximize these deficiency payments. These government payments have enabled many growers to remain in farming. Therefore, with the deficiency payment, the upland cotton price outlook remains bearish but not as discouraging as illustrated in either Figure 2A or 2B.

Water Costs. The underlying economic rationale for importing Colorado River water to central Arizona was, and is, the belief that new water supplies were necessary to sustain future economic development. In the case of agriculture, growers and others projected that the increasing costs for pump water would overtake the cost of CAP water during the early years following project completion, thereby making CAP water relatively less expensive. These projected higher costs for well water would be due to deeper pumping lifts, higher energy costs and

additional governmental restrictions on pumping groundwater. Therefore, to sustain agriculture in central Arizona many farmers believed that it was necessary to import Colorado River water.

Current economic reality does not support these projections, especially in Pinal County. At $52 per acre-foot ($36 in pumping costs + $16 in OM&R), CAP water generally is the highest cost source of water currently being utilized by CAP agriculture. Table 3 presents the variable and fixed costs of pumping from some representative wells in Pinal County. In only one case, the Eloy well, is the variable cost of an acre-foot of CAP water competitive with the total cost of pump water.[8] Therefore, it should come as no surprise that growers, or their irrigation districts, attempt to use their lower-cost source of water first (i.e. groundwater) and then supplement this supply with relatively higher-cost CAP water.

Relatively lower groundwater costs are obtainable due to preferential power contracts rural irrigation or electrical districts have with the Arizona Power Authority (APA) and the Western Area Power Administration (WAPA). These contracts are for a fixed quantity of hydroelectric power (kw) and energy (kwh) over the year. Although the price for this power is not fixed, it is significantly lower than electrical power purchased on the spot market or through most longer-term contracts. However, a critical point is that not all the existing acreage in the largest CAP districts can be irrigated with water pumped with preferential power. Preferential power carries with it quantity constraints that force irrigation or electrical districts to purchase power or water from other suppliers. Two useful examples of this optimizing process are the recent three-year histories of the Maricopa-Stanfield Irrigation and Drainage District (MSIDD) and the Central Arizona Irrigation and Drainage District (CAIDD) as they adjusted over three years towards using more groundwater in their aggregate water mix (see Appendix C for details). In the case of the MSIDD, the pump/CAP water ratio was 36/64 in 1989

Table 3. Estimated Cost of Pumping Irrigation Water With Electricity in Pinal County, Arizona, 1991.

Area	Average Energy Cost	Pump Lift (Ft)	Pump Rate (GPM)	Depth (Ft)	Well Cost	Annual Pump (AF)	Cost of Pumping Irrigation Water ($/AC-FT)					Total Cost
							Fixed Cost	Variable Cost			Total	
								Energy	Repairs	Pump Tax		
Coolidge	0.02900 $/kwh	410	1,150	600	$77,635	915	$10.46	$22.55	$4.92	$1.35	$28.82	$39.28
Eloy	0.02600 $/kwh	620	800	1,800	$150,140	636	$26.72	$30.57	$7.45	$1.35	$39.36	$66.08
Stanfield	0.01500 $/kwh	640	1,000	1,500	$152,686	795	$22.16	$18.20	$7.69	$1.35	$27.24	$49.40
Maricopa	0.01501 $/kwh	495	1,800	1,200	$131,135	1,432	$10.53	$14.09	$5.94	$1.35	$21.38	$31.91

Source: Wade, J.C., S. Stedman and J. Harper. *1991 Arizona Field Crop Budgets, Pinal County,* Cooperative Extension, The University of Arizona, Tucson, 1991.

and 1990, and 58/42 in 1991. The 1992 ratio was projected at 70/30 if CAWCD's indirect recharge program was not approved, funded and implemented.

Water costs for CAP agriculture cannot be discussed without recognizing that electrical power costs drive the cost calculation for water. When it takes 750-1,000 kwh to pump an acre-foot for an irrigation district or grower and approximately 1,600 kwh for the CAWCD to deliver an equal amount of Colorado River water, the relative cost of water is largely determined by the relative energy prices paid by the district, grower and the CAWCD. This relative price ratio will fluctuate depending on higher prices for coal, the cost of scubber installation at the Navajo Generating Station, and government policies towards the pricing of hydroelectric power. These factors dictate the preference for groundwater versus CAP water. As noted by the irrigation district officials in Appendix C , CAP water priced at $52/af is not competitive with groundwater being pumped with hydroelectric power.[9]

Accepting CAP water involves the fixed cost of constructing the distribution systems from the main canal to and within the boundaries of the irrigation districts. These distribution systems were funded by the federal government (approximately 80%) in the form of 9(d) loans (interest free) and by the irrigation district (at least 20%) through the sale of private, interest-bearing bonds. Both the public and private debt must be repaid, with the private debt being retired first. In order to meet these debt payments, each acre in the district with a grandfathered water right is assessed a tax, which is billed on the taxpayer's semi-annual tax statement and collected by the County Treasurer. These assessments vary widely across the CAP districts, ranging from $24 to $85 per acre (see Appendix C). All the irrigated acreage is assessed regardless of whether it is farmed or not. Estimates in some irrigation districts of the present value of the assessments over the repayment period of the CAP is approximately $1,000 per acre which often rivals or exceeds the purchase price paid for the land in the first place. This fixed financial cost adds $10-20/af to

the cost of CAP water to the grower.[10] When combined with the variable costs of $52/af, the total cost of CAP water in 1991 was $62-72/af.

The data presented earlier in Table 2 show an increase in the demand for CAP water in 1992 due to lower water prices attributed to the indirect recharge program. This decision making by the growers and the irrigation districts illustrates the concept of the price elasticity of demand for CAP water. Although a demand curve for water has not been estimated, the tabular data in Table 2 demonstrate that more CAP water will be purchased when it is priced at $25-40/af and, therefore, competitive with pump water. At higher prices less CAP water will be purchased as long as there is a lower cost source of water. The 1990 and 1991 experience bears this out. Revised projections of the demand for CAP water by non-Indian agriculture should recognize this economic reality in future sensitivity analyses.

A final aspect of water costs deals with the adoption of irrigation technologies in preparation for the arrival of CAP water. During the 1980s, particularly in Pinal County, growers laser leveled their fields, constructed higher capacity on-farm ditches, and constructed level basins at a cost of hundreds of thousands of dollars per farm (Appendix D).[11] With expectations of higher water costs and larger heads of water available because of CAP deliveries, many growers saw a need or opportunity to improve water uniformity across their fields, increase irrigation efficiency, reduce irrigation labor, and hopefully, increase yields. If CAP deliveries were to cease, the ability to deliver large heads of water to these innovative growers would be in doubt and many of the expected benefits of this water management technology under current field designs would be in jeopardy.

Financing Requirements. It is not news to anyone that the financial services industry has gone through tumultuous times and adjustments in the last five years. Deregulation, the savings and loan crisis, increased regulatory scrutiny, interstate banking, and the current recession have produced a lending environment which is

not conducive to risk taking. These events have had a dramatic impact on the lenders who finance CAP agriculture.

Until 1986, agricultural lenders loaned money to farmers based on repayment capacity and the market value of their assets, primarily land. With land values appreciating rapidly due to development and speculative market pressures, the lender was assured that even a bad loan could be repaid by selling the collateral. "Paper equity" financing produced loan portfolios that could not be sustained on the value of agricultural production alone.

By 1989, commercial lenders began to modify their lending practices to reflect the risk associated with agricultural loans. First, repayment capacity has become the dominant criterion for loan approval. The borrower must prove that the loan could be repaid based on the cash flow of the business, not on asset appreciation estimates. Secondly, most lenders require a margin on their loans. They will finance 75% of projected gross revenues, with the grower providing the remaining 25% margin. Thirdly, a risk grading system for loans is followed more closely where the rating attached to the loan reflects its riskiness to the lender. Loans which do not receive a "passing grade" require that the lender establish a reserve for that loan. Because these reserves represent bank capital upon which no return is earned, these reserves raise the cost to the lender of loaning money to a business which is experiencing financial difficulties. The more marginal the loan application, the higher the reserve requirement for the lender. As a result, loan officers are less enthusiastic about lending to a new or existing customer with marginal cash flow projections, who is operating in a declining industry, has low collateral values, already has a restructured loan, is out of margin on an existing loan, or has experienced recent carryovers.

This new lending environment has been an important factor in the decline in CAP agricultural acreage over the last three years. Without financing, a cotton

grower will have difficulty producing a crop. Most cotton growers cannot plant a crop without financing. Cotton ginning companies and cotton marketing companies have been somewhat more lenient in their lending practices, but even these creditors are under increased scrutiny by their home offices because the parent companies also borrow from commercial banks. CAP agriculture is viewed by many lenders as a high-risk customer due to relatively lower profit margins, which are due, in part, to the higher variable cost of CAP water and the acreage assessment. To compound matters further, the land values in the rural CAP districts are difficult to estimate beyond their agricultural production value due to the lack of demand for CAP land by developers, speculators or other farmers.

What Was Expected?: CAP District Feasibility Studies

Feasibility studies for constructing distribution systems in irrigation districts were conducted by the BOR and private engineering firms during the late 1970s and early 1980s.[12] These reports provided the basis for federal loan approval and the issuance of private securities (i.e. bonds) by the districts. Estimates of the ability to pay for CAP water ranged from $65 to $85 per acre-foot. The ability-to-pay figure represents the gross revenues that would be available to pay for water after deducting all other resource costs. These reports recognized that "in no case, however, should loan applicants be willing to pay more than 100% of the ability to pay estimates presented in this study." One should not expect that analysts in 1980 should have anticipated the events that have transpired in irrigated agriculture in central Arizona during the last five years. This report does have the benefit of hindsight. However, the assumptions and methodology used in these analyses were fundamentally flawed in four areas.

Acreage Farmed. The feasibility studies generally assumed that all the CAP-eligible acreage in the district would be farmed. These cropping levels were based upon comparable transitions made in other irrigation districts in California with

similar economic conditions. Profits from each of these acres would be available to cover the uncertainties associated with farming. This assumption inflated the ability-to-pay figure because in 1980 growers did not plant every acre of land, nor do they plant every acre in 1992. In "normal" times a reasonable and conservative assumption would be that 8 out of 10 acres are farmed. But with government set-aside programs, groundwater pumping constraints and financing restrictions, even 80% may be optimistic. Today, only 49% of CAP-eligible acreage is being farmed (see Table 6 in next section). Decreased acreage places a greater burden on each cropped acre to produce a return to water in order to cover the fixed costs of acreage assessments.

High-Value Crops. The selection of a representative cropping pattern is an important step in the development of a representative farm budget. The crop mix determines expected gross revenues and operating costs. If these representative farm acreages are aggregated to reflect district-level acreage, care must be taken to insure the aggregate acreage figure reflects reasonable conditions. Certain crops may be used as proxies for all specialty crops but the aggregate figures should reflect conservative conditions.

The feasibility studies for the largest CAP districts did not follow these guidelines. Lettuce and potatoes were used in acreages far beyond reasonable levels, even for a proxy crop. For example, in the MSIDD it was assumed that the representative farm (700 gross acres) harvested 70 acres of fall lettuce each year. With 133 representative farms in the MSIDD, the study assumed that there are 9,310 acres of lettuce planted each year in the MSIDD. To compound matters, a similar assumption was made in the CAIDD feasibility study thereby producing over 18,000 acres of lettuce in these two districts on an annual basis. However, between 1978-1981 only an average of 2,600 acres of fall *and spring* lettuce were planted in all of Pinal County.[13] Even if it is assumed that the lettuce acreage represents other crops

like pecans, pistachios, alfalfa, etc., the total acreage figure is far beyond reasonable levels of specialty acreage for these districts or for a feasibility study of this nature.

Groundwater Usage. By selecting the "Ability-to-Pay" methodology over the "Project Generated Payment Capacity", the BOR and the engineering firms working for the districts created a secondary role for groundwater in the feasibility studies. Project generated payment capacity would have calculated the additional income produced by the existence of the project which would be available to retire the debt associated with the CAP. Estimates of net farm income with and without the project over a 30-50 year planning horizon would have been generated.

The ability-to-pay procedure does not recognize the decision making process of the grower or the district when substitute resources are available at different prices. To increase profitability, one would expect a grower to use his or her lowest cost water source first and then supplement this supply with the next lowest cost source. In the case of the CAP districts, lower cost groundwater would be pumped up to the preferential power supply limitation and CAP water would be purchased to make up the difference. This is indeed what happened in CAP agriculture from 1989-1991. Yet the feasibility studies ignored this decision making process.

A clearer picture of the financial feasibility of the district distribution systems would have been obtained with the project-generated-payment capacity methodology.[14] In this case, explicit assumptions would have been made on future costs of groundwater relative to CAP water, the cost of financing the distribution systems, and the discounted rate of return on the projects.

Table 4 presents a recalculation of the ability-to-pay for a central Arizona farm using 1991 data. This farm is similar to the representative farms developed in the district feasibility studies. In this case, 20% of the land is assumed to be in fallow, a modest amount of non-planted acreage given the forgoing data and arguments. Under these assumptions the grower would be able to pay $38 per acre-

foot (variable cost only) for water. It is important to note how sensitive this result is to small declines in gross revenues for the representative farm. With a 5% decline in gross revenues, the grower's ability-to-pay drops to $28/af, which is $8 less than CAWCD's energy cost for delivering an acre-foot of CAP water. A not unrealistic 10% decline in gross revenues produces an ability-to-pay of $19 per acre-foot.

The ability-to-pay of $38 per acre-foot does not imply that a grower would be willing-to-pay that amount. The measure "ability-to-pay" is an average value whereas a farmer will equate the marginal value, not the average, with the cost of the resource. The marginal value is the economic contribution of the last acre-foot of water and is the appropriate measure of the willingness-to-pay. The willingness-to-pay for water will be less than the ability-to-pay, i.e. less than $38 per acre-foot.

Another related misconception is that growers will substitute CAP water for groundwater if cotton prices, yields or the availability of financing improve. Rational business people will use their lowest cost resource first no matter what happens to commodity prices. This decision increases profitability. So as long as groundwater is relatively less expensive it will be pumped first, and the underutilization of CAP water in the agricultural sector will continue. If both sources of water become more expensive than their marginal value, agriculture production will cease.

Uncertainty. There is no record of any sensitivity analysis being carried out in the district feasibility studies. Acreage planted, crop mix, yields and relative prices were assumed to be constant over the repayment period. Uncertainty was ignored. Yet variability inherent in agricultural production is a well-established fact which demands consideration in any feasibility study.[15] Consideration of uncertainty can produce information which gives policymakers a clearer and broader economic picture of their choices. In the case of the CAP districts, a simple sensitivity analysis using realistic scenarios would have demonstrated the tenuous economic future of these organizations.

Table 4. Water Payment Capacity for a Representative CAP Farm.

A. Crop Mix	Acres
Upland Cotton	450
Pima Cotton	160
Wheat	80
Fallow	180
Farmstead	30
	900 Acres

B. Revenue

		Yield	Price	Revenue
Upland Cotton	**450 Acres**			
Lint		1,250 lb/A	$ .63/lb	$354,375
Seed		1.10T/A	$100/T	49,500
Gov. Payment		1,250 lb/A	$ .10/lb	56,250
Pima Cotton	**160 Acres**			
Lint		910 lb/A	$1.00/lb	145,600
Seed		.9 T/A	$100/T	14,400
Wheat	**80 Acres**	51 cwt	$6.00/cwt	24,480
Fallow	**180 Acres**	0	0	0
			Total Gross Revenue	**$644,605**

C. Costs (Excluding Water)

Cost (Excluding Water)	Per Acre Cost: Upland Cotton	Pima Cotton	Wheat
Paid Labor (Including Benefits)	$69.38	$74.54	$24.14
Chemicals & Custom Applications	152.62	160.17	58.71
Farm Machinery & Vehicles	103.57	105.31	26.76
Cotton Ginning	106.62	107.06	0
Other Expenses	20.20	17.75	26.92
Interest	44.60	68.56	10.69
Total Cash Operating Expenses	$469.99	$533.39	$147.22
Taxes, Housing & Insurance	12.91	13.07	3.73
Gen. & Office Overhead	38.60	41.79	14.69
Gen. Farm Maintenance	23.16	25.07	8.82
Capital Replacement	62.36	63.13	17.76
Management Services	61.76	66.87	23.51
Total Cost Per Acre	695.78	743.32	215.73
Total	$313,101	$118,931	$17,258

Total Crop Costs	$449,290
Other Overhead and Maintenance Costs	$20,545
Land Costs	
Property Taxes ($8.22/A)	$7,398
Water Assessment ($45/A)	40,500
Total Costs	$517,733
Total Revenue	$644,605
Returns to Water	$126,872

D. Returns to Water/Payment Capacity

Water Usage			Acre-feet
Upland Cotton	5.0 af/A	*450 Acres	2,250
Pima Cotton	5.5 af/A	*160 Acres	880
Wheat	2.7 af/A	*80 Acres	216
		Total Acre-feet	3,346

Payment Capacity ($126,872 ÷ 3,346) = $37.92/af

Data Source: Wade, J., S. Stedman and J. Harper. *1991 Arizona Field Crop Budgets, Pinal County*, Cooperative Extension Bulletin #191009, The University of Arizona, Tucson, April, 1991.

III. ECONOMIC INTERDEPENDENCIES

The general economic treatment of costs associated with farming assumes that the farmer is a "price taker" in the sense that the grower's purchases of an agricultural input do not affect the price for that good or service by other growers. Even price discounts for large purchasers of agricultural supplies do not change the national price for cotton seed, anhydrous ammonia fertilizer, credit, etc. Empirical evidence over the years has supported the claim that individual row crop farmers have little or no market power.

In contrast, at least where deep water wells are being used, the decisions associated with individual pumping may impact the decisions and costs of other farmers. There are several classic examples of second- and third-party effects due to groundwater pumping. In one case a grower's aggressive pumping program lowers the water table in the local acquifer, thereby increasing the neighbor's costs of pumping. A second example is the impact of groundwater pollution by nitrate leaching and its adverse impact on neighboring wells, both rural and urban. Society has recognized the existence of these "externalities" or interdependencies and has begun to regulate the quantity and quality components of groundwater pumping.

In central Arizona, another critical interdependency exists: the impact of overall acreage decisions on the cost of electrical power (kw) and energy (kwh). As noted earlier, the supply of preferential power and energy to CAP irrigation districts is limited. Therefore, if farmers plant more acres than can be served by preferential power contracts, the irrigation or electrical district must buy power and energy on the spot market or try to negotiate longer-term contracts. Several new sources of electricity may be necessary to meet the additional demand. These purchases raise the average cost of pumping groundwater. One example of this phenomenon occurred in the MSIDD during the mid-1980s. The expansion of cropped acreage

between 1983-1986 was a major factor in driving the average cost per kwh from $0.031 to $0.065, an increase of 110%. This interdependency no longer exists today because the MSIDD acquired the growers' wells in 1989 and limits groundwater pumping to the level of its hydroelectric power allocation.

This section will document the nature and magnitude of the economic interdependencies between and among the growers, irrigation districts, CAWCD, and the general taxpaying community in the three-county CAP service area. Although many of these relationships reflect traditional economic linkages (e.g. input suppliers, tax receipts, cotton gins), new interdependencies have been created (e.g. take-or-pay provisions, priority rights, fixed OM&R) due to the legal rules and obligations surrounding the CAP.

Grower-District

Most CAP irrigation districts were formed over two decades ago for the purpose of contracting with the U.S. government and the State of Arizona for the importation and use of CAP water. Today, the districts' goal is to supply their growers with a cost effective supply of CAP water or a blend of CAP and groundwater. These districts are political subdivisions of the State of Arizona, having taxing authority over the landowners within the external boundaries of the district. Legally, the irrigation districts are treated like municipalities. Table 5 provides a brief comparison of the CAP districts in terms of employment and operating costs for 1991 (Appendix C provides a more detailed summary of the operational and financial status of the nine CAP districts discussed in this study).

Two general models have been followed by the landowners in these districts. The first model is the "grower control approach" (GC). Five of the nine districts did not acquire the registered operable irrigation wells located within the district boundaries. The growers retained control of their on-farm wells. In these cases,

Table 5. A Brief Operational Summary of the CAP Districts.

County/District	Type	CAP Eligible Acres	Employees		1991	
			Full-time	Part-time	Total Revenues	Total Expenses
Maricopa County						
Chandler Heights Citrus I.D.	CU	1,140	2	4	338,950	325,568
Harquahala Valley	GC	33,200	Not Available			
Queen Creek I.D.	GC	20,648	1	2	1,658,018	799,560
San Tan	CU	2,037	4	2	819,149	682,360
Tonopah	GC	3,470	0	2	674,524	687,766
Pinal County						
Central Arizona	CU	87,081	27	0	17,255,179	17,341,563
Hohokam	GC	28,167	5	0	2,229,336	2,336,149
Maricopa-Stanfield	CU	87,363	40	0	20,549,099	22,058,291
New Magma	GC	26,640	5	1	2,414,861	2,908,054

1. GC = Grower Control, CU = Conjunctive Use

CAP water is used as a supplemental source of water. Demand for CAP water under this model is uncertain and quite sensitive to expected cotton prices and relative water prices. For example, the Hohokam Irrigation and Drainage District, a GC district, purchased only 22,000 af of CAP water in 1991. But with the indirect recharge program in 1992, the growers have pumped less groundwater and are projected to buy 50,000 af of CAP water. These GC districts are characterized by small district staffs (less than 5 employees) and low overhead costs. Since demand for CAP is uncertain, the overhead costs for the district often are included in the acreage assessment on the landowner's property tax bill.

The GC model represents a minor change from the pre-CAP interdependencies. Landowners in these districts, however, are interdependent with regard to the operations of the district. Policies concerning CAP water pricing, delivery scheduling, etc. affect all growers. Yet, the districts and their small staffs play only a supplemental role in providing irrigation water in normal years (e.g. see descriptions of the Queen Creek and Hohokam districts in Appendix C). Since the districts' operational budget is treated as a fixed cost, the volume of CAP water sold does not influence in a significant way the variable cost of water to the grower. A cash-flow concern arises only when property assessments are not paid by the landowners. In this situation, the district cuts costs by using part-time instead of full-time employees.

The second model, the conjunctive use approach (CU), is applicable to the two largest CAP districts (Central Arizona and Maricopa-Stanfield) and the two smallest districts (San Tan and Chandler Heights Citrus). This model of water management produces significantly more economic interdependencies in the water allocation process. The CU districts have obtained control over all or most of the irrigation wells within their boundaries. A lease payment is made to the well

owners which is based on the productivity of the well. Lease payments range from $20 to $65 per acre. Those growers with relatively new, properly maintained wells prior to 1988, and/or with relatively shallow pumping lifts, receive the highest lease payments. These payments offset in part the tax assessment associated with financing the district's distribution system.

Conjunctive use increases the operation, maintenance and replacement (OM&R) costs of the district. Wells must be maintained, managed and rebuilt during the normal operations of the district. Staff are needed to monitor and manage the electrical demands of the wells. In essence, the CU district makes the same types of decisions the grower makes in the GC model. The objective of the CU model is to make the overall water supply to the grower more cost effective than would otherwise be possible. Conjunctive use districts have used a higher ratio of CAP water to well water than the GC districts. Yet from 1989 to 1991, this ratio for CU districts was decreasing due to the relatively lower cost of groundwater.

CAP irrigation districts, especially CU districts, must sell water to justify their existence and to survive as operating entities. The OM&R costs included in the tax assessment for the GC districts can be reduced to reflect a downsizing of the district's responsibilities as CAP water demand declines. But in the case of the CU districts, OM&R costs are covered by the markup in the price of water. For example, if CAP water costs the district $52/af and groundwater $25/af, and the grower is charged $52/af, then the $27/af difference on the share of groundwater in the overall water mix covers the OM&R costs of the district. As demand for water declines, the CU district is left with three alternatives for economic survival, (1) reduce OM&R costs, (2) increase the share of relative less expensive groundwater in the water mix, or (3) do a combination of both.

A simple, but useful breakeven calculation for acre-feet of water sold by the district is shown in the following equation:

$$Q^* = \frac{TFC}{P - AVC} \tag{1}$$

where Q* is the acre-feet of water sold which produces sufficient revenues to cover all costs, TFC represents the costs which are fixed and are not subject to change based on the overall amount of water delivered (e.g. debt financing costs), P is the water price per acre-foot charged the grower by the district, and AVC the average variable cost per acre-foot, using those expense items that do vary with the volume of water delivered. Suppose a hypothetical district has $4.0 million in fixed costs, charges its customers $52/af for water, and has average variable costs of supplying that water of $38/af. The district would have to sell approximately 285,700 acre-feet of water to breakeven (Total Revenues = Total Costs). Assuming that on average 4.5 acre-feet per acre are used for irrigation, 63,400 acres of land would have to be farmed each year for the district to cover all its costs. As acreage declines due to the economic pressures discussed earlier, survival is dependent on the district taking action to reduce its water costs, its fixed obligations, or both. The district cannot survive in the long run by relying on financial reserves to finance the deficit that is created by selling lower than breakeven demand levels of water. Breakeven acreages for the largest CAP districts are larger than the acreages planted in recent years.

In summary, the growers in the districts, particularly in the CU districts, are dependent on the financial stability of their neighbors. Reductions in planted acreage due to bankruptcy or an inability to obtain financing raises the implicit costs of water to the remaining farmers and threatens the economic viability of their water distribution organization.

Grower-District-CAWCD

The Central Arizona Water Conservation District (CAWCD) is responsible for distributing Colorado River water to municipal and industrial (M&I) users, Indian reservations, and non-Indian agricultural users. CAWCD operates and maintains the main CAP aqueduct and is responsible for repaying the federal government the reimbursable costs (approximately $2.3 billion) of building the main CAP canal. Funds for repaying this debt are generated by the sale of water, the sale of power from the Navajo Generating Station in northern Arizona, a four mill surcharge on power sold in Arizona from Hoover Dam, and the $0.10 per $100 assessed value ad valorem property tax within the CAWCD's service area: Maricopa, Pinal and Pima Counties.

The economic interdependencies between the nine CAP irrigation districts and CAWCD are important. Discussions around the state revealed some degree of misunderstanding within the water community concerning the relationship between CAWCD and non-Indian irrigated agriculture. Thirty to fifty years from now this relationship may not be strong if a significantly larger urban population in central Arizona materializes as projected. But for the remainder of this decade and well into the next, the financial ability of CAWCD to meet its financial commitments with no increase in property taxes is closely linked to agriculture in at least three ways.

Take-or-pay Provisions. Non-Indian agriculture's contracts with CAWCD for CAP water include a provision which may require the districts to pay the OM&R costs on the amount of water allocated to the districts each year. M&I and Indian user contracts do not have this provision. For example, suppose a district is allocated 20% of the non-Indian agriculture allocation. If M&I and the Indian reservations take 500,000 af the available 1.4 maf, that leaves 0.9 maf for the districts.[16] The district in question will be responsible for 20% or 180,000 af. If the

actual demand for CAP water by the district is 100,000 af, the district must pay, according to the take-or-pay provision, the OM&R charge on the based entire 180,000 af, in other words $3.6 million assuming an OM&R charge of $20/af.[17] Because the district used only 100,000 af, the actual OM&R cost on that water is $36/af.

The potential impact of take-or-pay provisions on each irrigation district is calculated in Appendix C. Under reasonable conditions, this provision could cost between several hundred thousand dollars and over $2.0 million, depending on the district. The take-or-pay provision further increases the price of CAP water, thereby discouraging its use. More seriously, this fixed financial obligation could push most irrigation districts into Chapter 9 bankruptcy within two years after formal completion of the project. Many districts do not have the financial reserves or the profit margins from selling CAP water that would enable them to cover this additional cost.

Water Sales. The water sales data presented earlier in Table 2 reflect the agricultural demand picture for CAWCD. The indirect recharge program has been successful in bringing CAP water costs in line with well water costs at the district or grower level in 1992. This program has cost CAWCD $8-10 million and may not be reauthorized. For this reason, the demand figures for 1991 reflect a clearer picture of expected agricultural demand in a typical year. Given the CAP districts debt service and water costs, only with major supply shocks in the world cotton market will there be any significant change in water demand over the next five years. Therefore, CAWCD should base its plans on conservative water sales to agriculture of 225,000 to 275,000 af per year, assuming 1991 economic and water pricing conditions are reasonable for the future. A CAP water price beyond $52/af will drive these sales figures lower.

Lower water sales will create financial difficulties for CAWCD assuming that

power sales generate a small profit margin and that property tax rates will not be increased. Formal water sales projections developed by CAWCD in 1989 include an 80% increase in revenue between FY92 and FY93 and an additional increase of 68% the following year (Appendix E). Projected water sale revenues increase from $32.1 million to $97.4 million over those two years. No evidence was found to support these projections and they are clearly unattainable. Without these increased revenues, the ability of CAWCD to retire its debt without drawing down its financial reserves or raising ad valorem taxes is in serious doubt. Even with current financial reserves of $130-180 million, low sales to the non-Indian agricultural sector would create a financial situation where these funds would be exhausted within 4-5 years. An increase in the ad valorem tax may be necessary. New cashflow projections for CAWCD will reveal the magnitude of this potential revenue shortfall.

OM&R and Interest Payments: The M&I User. As noted in the Governor's Task Force report, M&I users of CAP water are concerned about the viability of CAP agriculture. This economic interdependency arises from the existence of CAWCD's fixed OM&R costs estimated at $30 million.[18] These costs are spread over the acre-feet of water delivered. As less water is delivered, each acre-foot of water pays a higher portion of the fixed OM&R costs. For example, if 1.0 maf are sold, then the OM&R would be $30/af. If only 500,000 af are sold, the cost is $60/af. If non-Indian agriculture ceases to take CAP water for any reason and is relieved of its take-or-pay provision, the fixed OM&R charges to the remaining M&I users could be $150/af, thereby driving their water costs close to $200/af. Presently subcontractors are paying $16/af in fixed OM&R, with an additional $16/af being capitalized into the debt obligation with the federal government.

Interest payments on the federal debt for the main canal also represent a form of economic interdependency. As presently formulated, the CAP repayment contract between the U.S. Government and the CAWCD specifies that no interest

will be paid on the federal loan for that portion of the system serving agriculture. However, the outstanding balance of that portion of the canal investment dedicated to serving M&I users will be charged a 3.342% interest rate over the life of the repayment period. If agriculture is delivered less than the projected amount of CAP water, the share of cost bearing interest increases. If non-Indian agriculture were to take no CAP water, then an additional interest cost of millions of dollars (recently estimated at $10-$60 million per year in the early repayment years depending on the assumptions used) would be shifted to the CAWCD.

Grower-District-Community

Significant structural changes have occurred in CAP agriculture in the last five years. The economic and regulatory forces documented earlier have led to a major contraction in farmed acreage. Data in Table 6 documents this shrinkage of the CAP agricultural sector. In 1992, only 49% of the CAP-eligible acreage is being farmed. In Maricopa and Pinal Counties CAP-eligible acreage is 41% and 51% respectively. The major reductions over the last few years have taken place in the Harquahala Valley, Central Arizona, and Maricopa-Stanfield districts. So in terms of economic impact on the local community, important downsizing and consolidation in supporting businesses and the service sector already have occurred.

What is the contribution of CAP agriculture to the economies of Maricopa and Pinal Counties? Using data from county government and the irrigation districts, the current economic contribution of CAP agriculture in these two counties has been estimated. Fiscal contributions in the form of property taxes were obtained from offices of the county treasurers (sales tax contributions are not included in fiscal impacts since they are included in the output analysis). Output and

Table 6. Acreage by CAP Irrigation District.[1]

	CAP Eligible Acres	Estimated Acres Planted (1992)	Planted as a Percent of Eligible
Maricopa County			
Chandler Heights Citrus I.D.	1,119	1,100	98
Queen Creek I.D.	18,112	12,930	71
Harquahala Valley	33,009	6,300	19
San Tan	2,026	1,983	98
Tonopah	3,470	2,555	74
Sub-Total	53,534	24,868	42
Pinal County			
Central Arizona	85,979	32,000	37
Hohokam	26,356	19,700	75
Maricopa-Stanfield	85,994	45,000	52
New Magma	27,310	17,650	65
Sub-Total	225,639	114,350	51
Total	284,173	139,218	49

[1] Acreage figures in this table differ slightly from those in Table 1 due to the different sources of information.

Sources: Irrigation Districts
ADWR Reallocation Analysis

employment estimates were made using 1992 acreages and crop mix. Each irrigation district and at least five growers were asked to complete a questionnaire dealing with the share of their costs and revenues as distributed in Maricopa and Pinal Counties. For example, some Pinal County growers work with lenders in Maricopa County while others borrow from financial organizations in Pinal County. These current data were used to update regional purchase coefficients and production relationships in IMPLAN, a regional input-output model.[19]

Fiscal Impacts. Records from the Pinal County Treasurer's Office indicate that for 1991-92 CAP agricultural land contributed about 4% of the property taxes paid in the county (Table 7).[20] This share of property taxes is not evenly distributed

Table 7: Fiscal Contribution of CAP Agricultural Land in Pinal County, 1991-92[1]

Description	Total Levy	Total Taxes Paid by CAP Agriculture	CAP Agriculture As a Percent of Total Taxes	IRRIGATION DISTRICTS CAIDD	HIDD	MSIDD	NMIDD	QCIDD
State-ARS 42-208	$2,596,398	$69,378	3	$24,523	$9,015	$26,092	$8,555	$1,192
School Equalization	$2,927,853	$78,235	3	$27,654	$10,166	$29,422	$9,647	$1,344
County General Fund	$23,885,201	$638,220	3	$225,601	$82,936	$240,016	$78,701	$10,965
County Library District	$269,643	$7,192	3	$2,512	$913	$2,722	$911	$134
Casa Grande	$669,472	$547	0	$166	$381			
Casa Grande Debt Service	$303,847	$246	0	$74	$172			
Eloy	$204,605	$11,182	5	$11,182				
Eloy Debt Service	$8,010	$433	5	$433				
Pinal County School Districts:								
Mary C. O'Brien Accom.	$161,032	$4,090	3	$1,449	$528	$1,537	$507	$69
Oracle Elementary No. 2 Debt	$164,993	$1,082	1	$1,082				
Casa Grande Elem. No. 4	$3,927,950	$42,830	1	$3,314	$15,551	$23,964		
Casa Grande Elem. No. 4 Debt	$1,203,243	$12,243	1		$4,748	$7,495		
Red Rock Elementary No. 5	$425,868	$4,460	1	$4,460				
Eloy Elem. No. 11	$475,603	$71,218	15	$71,218				
Eloy Elem No. 11 Debt	$270,003	$40,948	15	$40,948				
Toltec Elem. No. 22	$739,781	$27,102	4	$26,010		$1,092		
Toltec Elem. No. 22 Debt	$504,005	$18,640	4	$17,631		$1,010		
Stanfield Elem. No. 24	$223,772	$25,177	11			$24,177		
Stanfield Elem. No. 24 Debt/Override	$569,427	$64,904	11			$64,904		
Picacho Elem. No. 33	$157,384	$32,298	21	$32,298				
Picacho Elem. No. 33 Override	$42,282	$8,850	21	$8,850				
J.O. Combs Elem. No. 44	$265,842	$31,757	12				$20,923	$10,834
J.O. Combs Elem. No. 44 Debt	$53,999	$7,326	14				$4,656	$2,670
Union High School Districts:								
Casa Grande Un. High No. 82	$4,884,748	$115,534	2	$24,737	$14,858	$75,939		
Casa Grande Un. High No. 82 Debt/Override	$1,198,093	$28,784	2	$6,084	$3,630	$19,070		
Santa Cruz Valley Un. High No. 40	$1,190,851	$94,707	8	$94,707				
Santa Cruz Valley Un. High No. 40 Debt/Over.	$276,997	$22,041	8	$22.041				
Unified School Districts:								
Florence Unified District No. 1	$1,757,152	$65,650	4				$65,650	
Florence Unified Distr. No. 1 Debt	$414,002	$16,791	4				$16,791	
Maricopa Unified No. 20	$451,161	$75,097	17			$75,097		
Maricopa Unified No. 20 Debt	$373,003	$61,655	17			$61,655		
Coolidge Unified No. 21	$2,085,000	$92,866	4	$10,430	$76,372		$6,065	
Coolidge Unified No. 21 Debt/Override	$649,025	$28,985	4	$3,242	$23,846		$1,897	$3,966
Pinal County Junior College	$8,638,270	$230,820	3	$81,591	$29,994	$86,806	$28,463	$185
Pinal County Junior College Debt	$372,910	$9,946	3	$3,474	$1,263	$3,764	$1,261	$83
East Valley Institute of Technology	$29,744	$228	1				$145	
Fire Districts:								
Eloy	$245,000	$10,807	4	$10,807				
Stanfield	$12,100	$10	0			$10		
Maricopa Volunteer	$32,188	$8,810	27			$8,810		
County Fire Contributions	$522,398	$13,939	3	$4,869	$1,769	$5,275	$1,769	$259
Central Arizona Water Cons. District	$573,708	$15,303	3	$5,345	$1,942	$5,792	$1,939	$285
Flood Control Districts:								
Pinal County Flood Control	$474,060	$18,611	4	$5,761	$2,356	$7,613	$2,485	$396
Midway Flood Control	$12,000	$1,229	10	$616		$613		
Green Reservoir Flood Control	$80,000	$51,047	64	$51,047				
Maricopa Rural Road Improvement District	$1,199,000	$153,234	13			$153,234		
TOTAL	$65,521,623	$2,314,456	4	$824,155	$280,443	$927,112	$250,364	$32,382

[1] Implies agricultural land, not all lands within the external boundaries of the district.

Source: Pinal County Treasurer's Office and Pinal County Assessor's Office.

throughout the county; some public organizations are more dependent on CAP agriculture than others. For example, 64% of the funds for the Green Reservoir Flood Control District are derived from CAP agriculture taxes. The Maricopa Volunteer Fire District depends on CAP agriculture for 27% of its budget. Several schools (e.g. Maricopa Unified, Stanfield Elementary, and Eloy Elementary) derive 15-21% of their county tax funds from CAP agricultural land. However, generally the public organizations receiving support from the tax base of the county are not dependent on CAP acreage to maintain their tax revenues.

Output and Employment. Table 8 presents the estimated direct, indirect and induced effects of CAP agriculture on Maricopa and Pinal Counties. Direct impacts measure the economic contribution of the agricultural output produced in the county and are confined to within the agricultural sector. Indirect effects include the effects of purchases of farm-level inputs (e.g. seed, fertilizer, ginning, labor) and outputs (e.g. cotton, potatoes) on other businesses. The first round of indirect effects measure the economic contribution to suppliers and processors directly involved in the agricultural sector. These firms, in turn, purchase inputs from firms in other industries, some of which operate in the county. This represents a second round of indirect purchases. The amount of money that remains in the local economy with each round of indirect effects depends on the structure of the economy. In a small county like Pinal, much of what agricultural producers purchase comes from outside of the county and much of what they produce leaves the county once harvested. And finally, induced contributions are those which occur because workers in CAP agriculture spend part of their earnings or income in local businesses that service the general population with goods and services, e.g. food stores, clothing stores, restaurants, etc.

Table 8. CAP Agriculture's Contribution (in 1991 dollars).

Category	Direct	Indirect	Induced	Total
Output ($ millions)				
Maricopa County	33	11	11	55
Pinal County	148	42	37	227
Total	181	53	48	282
Employment				
Maricopa County	481	202	171	854
Pinal County	1,472	690	675	2,837
Total	1,953	892	846	3,691

Source: Data from CAP irrigation districts.
Model results from "IMPLAN: Input-Output Model, Version 91-09," U.S. Forest Service and the University of Minnesota.

In Maricopa County, CAP agriculture represents a small (less than 24%) portion of the production agriculture sector in the county. With the decline in planted acreage in the Harquahala district, this percentage is closer to 10%. Yet, for a town like Queen Creek, CAP agriculture contributes to the local economy in an important manner. Output of $55 million can be attributed to CAP agriculture in the county and 854 people are employed due to the existence of these farming operations.

CAP agriculture in Pinal County has a direct output contribution of $148 million, employing 1,472 individuals. Indirect and induced output effects sum to $79 million. These are the dollars contributed to the county's economy beyond the direct purchasing and selling activities by farmers. CAP agriculture generates 690 jobs in the agricultural service and processing sector. An additional 675 jobs are attributable to CAP agriculture in the general economy. In summary, CAP agriculture in Pinal County in 1992 contributes approximately $227 million and

2,837 jobs to the local economy. Statewide, CAP agriculture contributes $282 million and nearly 3,700 jobs.

One impact that has not yet been accounted for is the purchase of inputs by Pinal County CAP farmers in Maricopa County (very little is spent by Maricopa County farmers in Pinal County). Pinal County CAP farmers purchased almost half of all inputs in Maricopa County; they will spend approximately $41 million dollars in Maricopa County in 1992. This spending generated between $50 and $80 million dollars in total economic impacts in Maricopa County. Hence, some businesses and the economy as a whole in Maricopa County will be affected by any declines in CAP agriculture in Pinal County. However, the size of these effects is fairly small relative to the size of the Maricopa County economy.

It is noteworthy that agriculture's direct plus indirect contribution to the local economy is greater, dollar for dollar, than any of the other sectors (Table 9). Agriculture's Type I multiplier from the IMPLAN model is 1.2361.[21] Every dollar of output produced in the agricultural sector means $1.24 of output for the local economy. Manufacturing follows at 1.2155 and then Transportation, Communication and Utilities with an output multiplier of 1.2061. However, Type III (direct, indirect and induced) multipliers for Retail Trade, Health and Education are significantly higher than the more manufacturingoriented sectors (e.g. agriculture, construction, manufacturing).

Relative Importance of Agriculture. CAP agriculture contributes over $2.3 million to the local tax base in Pinal County, generates $227 million in output, and produces over 2,800 jobs. In Maricopa County, these numbers are smaller but still

represent important levels for the local economy. But just how important is the agricultural sector in these two counties and the state relative to other sectors of Arizona's economy? First, we must recognize that Arizona is a metropolitan state, one of the most urbanized states in the nation (See Appendix F). Maricopa and Pima Counties, the largest metropolitan areas in Arizona, account for 76% of the State's population. If standard Bureau of Census definitions of urban and rural are used, nearly 88% of Arizona's population resides in urban areas (communities of greater than 2,500 people).

A second point is that Arizona's economy is diversified: the general economic health of the State is not overly dependent on any one sector. Figure 3 illustrates this point using employment data from the 1990 census. Production agriculture, having the high levels of labor productivity it does, employs only 2.5% of the people in Arizona's workforce. Recognizing that these figures represent a minimum share given what businesses are and are not included in the agriculture category, one is still hardpressed to claim an employment level for commercial agriculture above 5% for the State (complementary employment data for Maricopa and Pinal Counties can be found in Appendix F). This latter figure has been supported in recent studies by the Economic Research Service (USDA) and the Federal Reserve Bank.[22] If the definitional boundary is broadened to include businesses such as food processors, food distributors, and wholesale and retail grocery stores, then the employment share for agriculture climbs to approximately 15% at the State level. A reasonable argument for not including wholesale and retail food stores is that they would exist without commercial agriculture in the State.

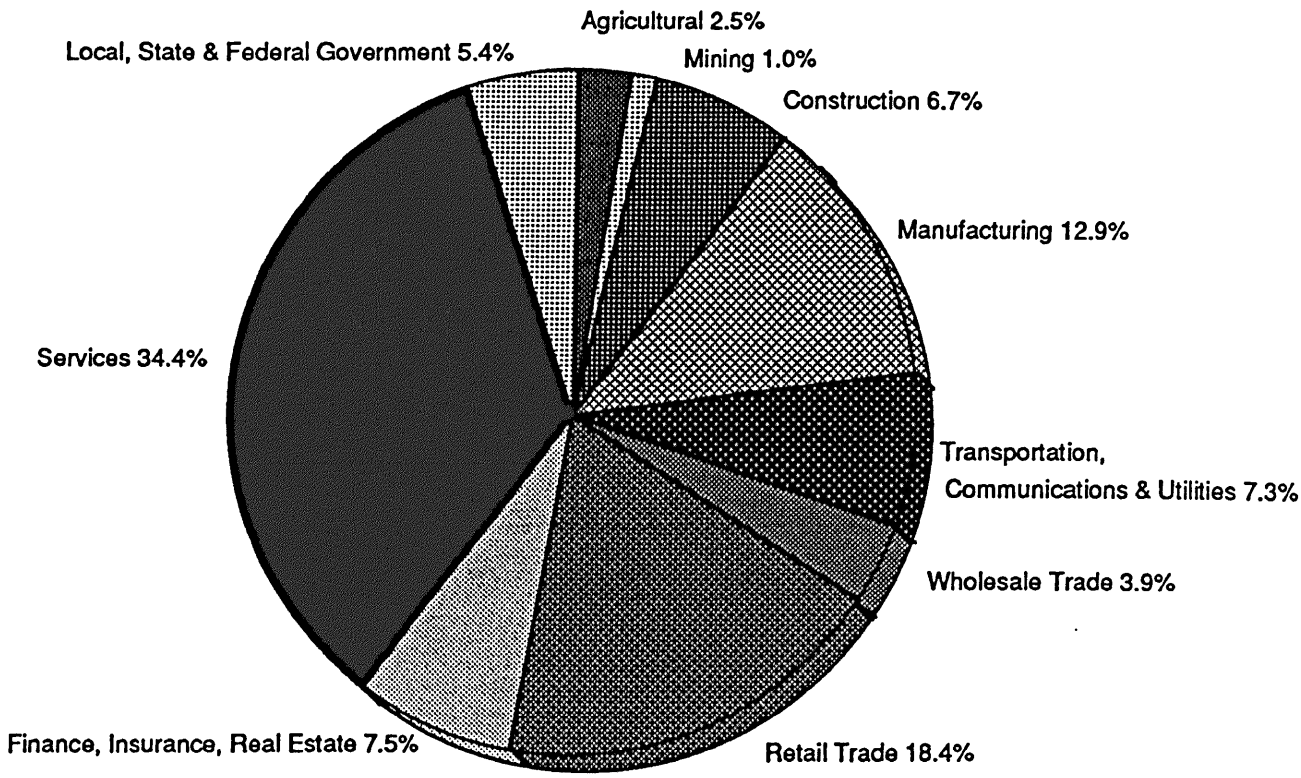
Table 9. Aggregate Output Multipliers for Pinal County.

Sector	Direct and Indirect (Type I)	Direct, Indirect and Induced (Type III)
Agriculture, Forestry and Fisheries	1.2361	1.3782
Mining	1.1939	1.3688
Construction	1.0965	1.2846
Manufacturing	1.2155	1.3480
Transportation, Communication, Utilities	1.2061	1.2999
Other Wholesale Trade	1.1411	1.3914
Retail Trade	1.1686	1.5049
Services	1.1262	1.4809
Health and Education	1.1602	1.5029
Government	1.0353	1.3033

Source: IMPLAN Model

In summary, CAP agriculture is an important, but not dominant, sector of Arizona's economy. Neither Maricopa or Pinal County are dependent upon CAP agriculture for their economic well-being. Nevertheless, any loss in the economic base dampens economic growth, particularly in Pinal County. But rather than claiming 20-30% of the local economy, CAP agricultural interests would be better advised to emphasize the economic interdependencies between M&I users and growers given the high fixed costs of the CAP. The tradeoff between a subsidy for agricultural water or significantly higher M&I taxes and urban water costs may form the basis of a partial, least cost solution to the underutilization issue.

Figure 3. Distribution of Total Employment by Sector, Arizona, 1990.



Source: U.S. Department of Commerce, Bureau of the Census

IV. FINANCIAL STATUS OF CAP IRRIGATION DISTRICTS

Financial Condition

Irrigation districts are entities of the State of Arizona with the same legal standing and taxing authority as municipalities. The nine CAP irrigation districts were formed to contract with the State of Arizona and the Federal Government for delivery of Colorado River water through the CAP aqueduct. The success or failure of these districts to remain as viable purveyors of CAP water will have an impact on the State's taxpayers, particularly those in the three-county CAP service area.

Irrigation districts provide a wide variety of services. In grower-controlled (GC) districts, the services revolve around the timely delivery of CAP water and, in some cases, the oversight and billing associated with electrical energy delivery. In most instances, however, the Salt River Project and Arizona Public Service provide wheeling and billing services. The large, conjunctive-use (CU) districts provide numerous services, ranging from the optimal mixing of well and surface water to completing reports for the growers which are required by the Bureau of Reclamation and the Arizona Department of Water Resources. As discussed earlier, these services are not free as is evident in Table 5. The highest expense districts per acre of CAP-eligible land are the CU districts because they pass on costs for their services which would otherwise be incurred directly by the grower.

Table 10 provides a comparison of several financial measures for the CAP districts: current ratio, debt ratio and net income for 1990 and 1991. These data are taken from Appendix C. The financial statements of the irrigation districts serve as the source of this information. The Current Ratio is a measure of liquidity, i.e. the ability of the district to pay its obligations as they come due. A Current Ratio of 2.0 is desirable for a private business since this level of working capital (Current Assets-Current Liabilities) provides the firm a cushion for unforeseen expenses. Irrigation

Table 10. Selected Financial Measures for CAP Irrigation Districts, 1990 and 1991.

	Current Ratio[1]		Debt Ratio[2]		Net Income (Loss)	
Maricopa County	1990	1991	1990	1991	1990	1991
Chandler Heights[3]	NA	NA	NA	NA	20,175	13,382
Harquahala Valley	—[4]	—[4]	—[4]	—[4]	—[4]	—[4]
Queen Creek	4.6	9.8	12.3	1.6	($968,394)	($858,458)
San Tan	8.9	7.7	1.4	1.5	$74,133	$136,789
Tonopah	1.6	2.3	1.2	1.2	($119,469)	($13,242)
Pinal County						
Central Arizona	1.0	1.2	1.0	1.0	($2,480,112)	($86,384)
Hohokam	1.5	2.0	1.1	1.1	$135,021	($106,813)
Maricopa-Stanfield	1.7	1.4	1.0	1.0	$985,134	($1,509,192)
New Magma	0.4	0.3	1.1	1.1	($124,502)	($493,193)

1 Current Assets ÷ Current Liabilities = Current Ratio.
2 Total Assets ÷ Total Liabilities = Debt Ratio
3 Chandler Heights has very little debt relative to assets.
4 Not Available.

districts, given their pricing authority, may not need to meet this standard but the analysis is useful in any case. In 1991, three of the four districts in Pinal County failed to reach this level. New Magma actually had fewer liquid assets than short-term liabilities at the end of the accounting period for both years. These measures illustrate the financial tension in district operations.

The Debt Ratio is a measure of financial solvency, i.e. the ability of the district to retire all its debt obligations. With new irrigation districts, there has been little time to build up reserves that would increase the value of the Debt Ratio. The Maricopa County districts have been more successful in building up some small reserves than the Pinal County districts. In these latter districts a Debt Ratio of 1.0 implies that all the assets of the district are spoken for by the district's creditors. In the case of a public entity like these CAP districts, low debt ratios are not necessarily

troublesome as long as the districts are not drawing down their financial reserves. The districts do rely on their financial reserves when operation costs are not met by water sales and other revenues.

The income picture in 1990 and 1991 for these districts is mixed. Two districts had positive net income in both years while four districts lost money both years. Two additional districts had positive income levels in 1990 but experienced losses in 1991. These financial losses can be managed by these districts for several years but losses of the magnitudes in Table 10 cannot be sustained over a longer operational horizon.

One of the contributing factors to the generally weak financial standing in the larger irrigation districts is the debt obligation associated with the construction of the districts' distribution systems. The federal government agreed to finance approximately 80% of the cost of these delivery systems. The remaining 20% was financed by private bonds. Table 11 summarizes these initial debt obligations as reported by the U.S. Bureau of Reclamation. As noted in an earlier section, funds to pay the principal and interest payments associated with this debt are obtained through the acreage assessments in each of these districts. Delinquent taxes place pressure on the districts to draw upon their reserves to cover the debt payments.

As of this date, no CAP district has defaulted on any of the private bonds. Bond payments have been made on time. In 1991, Harquahala Valley was in danger of defaulting on its bond obligation but with the assistance of the underwriter and local government, the default did not occur and the bond payment was made. The federal debt obligation is being repaid (Appendix G). However, four districts have requested deferments on their federal debt and one district (i.e. New Magma) is in arrears. Districts are more concerned about meeting the private bond obligations since they view the federal debt as more flexible in terms of repayment scheduling.

Table 11. Total Initial Debt Obligations by CAP District.

District	Federal Debt Amount	Repayment Period (Years) for Federal Debt	Private Bond Debt	Total Debt
Maricopa County:				
Chandler Heights	$620,000	27	$0	$620,000
Harquahala Valley	26,000,000	38	6,866,000	32,866,000
Queen Creek	9,960,000	26	2,557,000	12,517,000
San Tan	1,820,000	19	967,000	2,787,000
Tonopah	2,801,500	29	225,000	3,026,500
Subtotal	$41,201,500		$10,615,000	$51,816,500
Pinal County:				
Central Arizona	$66,900,000	26	$32,022,000	$98,922,000
Hohokam	24,704,530	30	8,307,000	33,011,530
Maricopa-Stanfield	78,000,000	26	32,425,000	112,425,000
New Magma	17,500,000	16	6,000,000	23,500,000
Subtotal	$187,104,530		$80,754,000	$267,858,530
Total	**$228,306,030**		**$91,369,000**	**$319,675,030**

Source: U.S. Bureau of Reclamation

Financial Interdependencies

The financial obligations of these public entities have the potential to produce the most significant interdependencies in the entire CAP system. These interdependencies will arise if the districts continue to experience financial difficulties due to unfavorable economic conditions in the agricultural sector. These financial interdependencies are due to non-payment of acreage assessments, default/bankruptcy, and bond ratings.

Non-payment of acreage assessments. One of the first indications of financial stress in CAP agriculture is the non-payment of the acreage assessments associated with the district's distribution system. Growers who do not pay the assessment in

November of one year theoretically are not eligible to receive district water during the next crop year. Delinquent taxes place increased pressure on the districts in their struggle to cover their fixed financial obligations with the private bondholders and the federal government. To date, tax delinquencies in the districts have not been significant except in the larger districts where delinquencies have surpassed $1.0 million in some years (Appendix C). In the fall of 1991, the MSIDD board used a portion of its financial reserves to pay the first-half of the acreage assessment for its growers to insure that sufficient acres would be planted in the district.

Not only does non-payment place stress on the districts, delinquent irrigation district taxes may place some financial stress on county government. State law (*ARS Chapter 19 Title 48*) requires that irrigation district assessments be paid before other county taxes. If the assessment is not paid, then county taxes are not paid. As was noted earlier, the contribution of agricultural land to the tax base is small (less than 4%) but any loss in revenue due to non-payment of assessments will be noticed by county government.

However, county leaders are not overly concerned about this potential loss in revenue for several reasons. First, the amount of the loss as a percentage of their total tax receipts is small. Second, delinquent taxes are charged an interest rate of 16% on an annual basis which is collected when the taxes eventually are paid. But suppose the property taxes are not paid? An interested individual can pick up the tax certificates on the subject property and pay the taxes for three years. After that time, this person can ask the county for a Treasurer's deed and initiate legal action to acquire a clear title. If no one pays the taxes for five years, the Treasurer will advertise the title search, then deed the land to the state in trust. The County Board of Supervisors then can sell state lands and the new owner will have a good title. This process works well and represents the third reason for the limited concern on the part of county officials regarding delinquent taxes on agricultural land.

Default/Bankruptcy. To the best knowledge of legal counsel and water officials, there has not been a case of irrigation district (municipal) default on general obligation bonds in the near or distant past. In the case of default, the legal proceedings could take two parallel paths. One path would be at the state level through the State Certification Board (SCB). The SCB would appoint a committee to work out the default. The committee would develop a plan with the objective of restoring the irrigation district in question to financial viability. The bondholders would participate in this process and a majority of the bondholders would have to agree to the work-out plan.

The second path would involve filing for Chapter 9 bankruptcy. These federal proceedings would have the same objective: the restoration of financial viability. A bankruptcy judge would have significant power in determining the future of the irrigation district and the legal and economic structure of the farms within the district. Due to the lack of experience with irrigation district defaults, it is not clear what impact these legal actions will have on the growers. However, reasonable speculation produces the scenario that default and bankruptcy would make it even more difficult for growers to obtain financing due to the uncertainty surrounding the district's water supplies.

Bond Ratings. Default and bankruptcy by one of the CAP irrigation districts in the two counties could serve as a "wake up call" to the financial community. Standard and Poors could downgrade the rating on new school district, fire district, road district and county bonds. School districts within or near the boundaries of the irrigation district might be especially vulnerable. Lower ratings would increase the interest cost to the county's taxpayers. The degree and magnitude of a rating slide is unclear. However, it is reasonable to expect that the impact would be more severe in Pinal County due to its smaller tax base.

Several bond attorneys involved with CAP district bond issues and the Maricopa and Pinal County Treasurer offices have expressed concern about the adverse impact a default would have on future bonding activity in the counties. Other individuals in the water community have downplayed the cost of default, especially for Maricopa County. Yet the concern and action in Maricopa County when Harquahala Valley neared default in 1991 indicates that this interdependency is real, important and should be investigated more thoroughly by the interested parties (i.e. districts, CAWCD, ADWR, bond underwriters, etc.).

V. SCENARIO ANALYSIS

An analysis of the likely events that will occur in CAP agriculture within the next two to three years can be extracted from the preceding information in this report. Yet no event can be analyzed in isolation from all others. In fact, several or all may occur. This section will attempt to create scenarios and to sketch potential economic impacts on rural communities due to these events.

Implementation of Take-or-Pay Provisions

The implementation of take-or-pay provisions in 1994, assuming no changes in water allocation percentages or a financial improvement at the farm and district level, will drive the nine irrigation districts into default faster than any other economic or policy event.[23] As noted in the individual descriptions of the irrigation districts (Appendix C), under realistic assumptions of water demand and take-or-pay pricing, most districts will have payments of over $1.0 million for water they will not use. An evaluation of the districts' financial statements does not reveal the level of liquidity or reserves necessary to sustain for long an annual payment of this magnitude on top of other fixed financial obligations.

Districts may default on their CAP contractural obligations before they choose to not make their private bond payments. In this case they will lose their CAP subcontracts. In either case, default and bankruptcy will drive the districts into a reorganization process whose outcome is unpredictable. The probable litigation surrounding a work-out could jeopardize the farming opportunities for growers. The best interests of the bondholders and federal government likely lie in keeping the remaining farms operating so that some level of repayment could be made, assuming a third party (e.g. CAWCD) does not become responsible for the irrigation districts' debt. Nevertheless, the outcome from a bankruptcy court will be uncertain

and surely will not occur in a timely enough manner to provide funds for uninterrupted crop production.

Continued Lower Than Expected Demand For CAP Water

Under planned pricing conditions, the declaration that the CAP is completed will force the price of CAP water farther beyond the ability of cotton growers to pay for this resource. As noted earlier, until the indirect recharge program was initiated, the two large CU districts were depending on wells for an increasing share of their overall water supplies. With project completion, the $24-30 million in fixed OM&R costs will be spread over no more than approximately 600,000 acre-feet of water for the remainder of this decade. Water to the irrigation districts then would be priced near $85/af, well over twice the ability-to-pay calculated for a representative farm in Table 4 (p.22) and even farther beyond the grower's willingness-to-pay.

The economic reality of continued low sales for CAP water is that reduced water purchases raise the cost of water for the remaining customers. The breakeven relationship in Equation 1 illustrates this concept quite well (p.28). One or a combination of three actions must be taken: either (1) the fixed OM&R and financial obligations are reduced substantially, (2) the variable costs associated with pumping the water are lowered, and/or (3) the price of the water is increased to the customer. The most likely response appears to be the latter action, an increase in CAP water costs. These higher prices will force CAP agriculture to reduce further, or eliminate entirely, its purchases of CAP water.

Limited Contracts for CAP Water

The allocated percentages of residual CAP water for agriculture far exceed the expected demand for this water at projected water prices. Current proposals to give up a portion or all of these allocations in return for debt reduction recognize

this fact. Additionally, it is understood that some of the districts wish to retain CAP water for at least a portion of their contribution to Indian water rights settlements. The remaining entitlement would be used to supplement groundwater during the June-July-August irrigation period when irrigation demand is at its highest or to provide for M&I conversions.

A key provision of this scenario is the ability of the districts to continue receiving preferential power from APA and WAPA. Under the current power contracts, the districts estimate that approximately 100,000-120,000 CAP-eligible acres could be irrigated at relatively low water costs (see Appendix C). Supplemental power could be obtained on the spot market which would produce water costs comparable to projected CAP costs. If medium- and long-term contracts could be signed with APS for Palo Verde power in the range of two to three cents per kwh, then there would be no need for CAP water in order to service this reduced acreage level.[24]

This final statement must be qualified with three important considerations. First, a return to wells could jeopardize the irrigation efficiencies of those growers who spent hundreds of thousands of dollars in the 1980s to shift from sloping furrow irrigation systems to level furrows and basins. These individuals made their investment plans based on the expectation of receiving large, sustained heads of water at the turnouts to their farms. Level basins, particularly, will be hard pressed to reach their design efficiencies without the large heads of water that the CAP can deliver. More intensive management and smaller borders (i.e. changes in field design) would be necessary if only small heads of water were available to the grower.

A second qualification is that some growers in the CU districts no longer have functioning wells. These districts may have chosen to shut down the older and more costly wells in favor of delivering 100% CAP water to these farms. A return to

wells by all districts would place these growers at an economic disadvantage. Old wells would need to be rebuilt or even redrilled. Neither the districts or the growers have the financial reserves at this time to invest $100,000 or more in a single well. And even if they do, these wells will be located in the highest cost pumping areas in the districts where the total cost per acre-foot of pumping may be more than the grower's willingness-to-pay under current and future economic conditions.

Finally, the reduction or elimination of formal agricultural contracts for CAP water may jeopardize the ability of the growers to demonstrate a 100-year assured water supply for M&I conversion in future years. It is evident from discussions with district officials that a 100-assured water supply was the most attractive characteristic of the CAP, particularly in eastern Maricopa County. Many growers are planning to sell their lands within 20-30 years as urban areas grow. Without a legal claim to CAP water, can their lands be developed for M&I purposes? What impact would an elimination of formal CAP contracts have on the future economic development of the communities in Pinal County?

A One-Third Reduction in CAP Planted Acreage

All of the above scenarios, and the underlying economics of agriculture, point to the distinct possibility of further declines in acreage in CAP agriculture. Whereas earlier declines have been gradual since 1988, possible further reductions could be abrupt. Local economies have been able to absorb the losses due to the earlier downsizing of agriculture in central Arizona, particularly in Pinal County. Yet it is not unreasonable to expect that CAP agriculture will shrink from its 1992 acreage level to approximately 93,000 acres in 1993 (a one-third reduction). This immediate decline in acreage could be a result of higher CAP water prices, lack of financing, farm bankruptcies, and decisions not to plant in 1993.

This analysis assumes that this reduction in acreage occurs in both Maricopa and Pinal Counties. Using the IMPLAN model discussed earlier, the impacts of this reduced agricultural output were estimated (Table 12). The local agricultural economy would lose $61 million in output in 1993. Businesses directly supporting the agricultural sector would experience a reduction in output of $18 million. Retail stores, services and other businesses would lose $16 million. The aggregate output loss of $95 million is substantial yet it represents a small part of the two-county economy. However, any loss in output during a recession should be a concern to policymakers.

Over 1,200 jobs would be lost in the two-county area with a one-third reduction in CAP acreage. Slightly over half would be on-farm jobs. But nearly an equal amount would be in the surrounding communities. This loss of jobs represents a cost to the local economy since it is not likely that (1) these people can enter non-agricultural positions with ease, or (2) this many job openings are available in the two counties anytime soon. In summary, the losses attributed to a one-third reduction in CAP acreage are analogous to a large manufacturing firm moving its assembly plant or plants out of the state.

Table 12. Losses Due to a 1/3 Reduction in CAP Acreage (in 1991 dollars).

Category	Direct	Indirect	Induced	Total
Output ($ millions)				
Maricopa County	11	4	4	19
Pinal County	50	14	12	76
Total	61	18	16	95
Employment				
Maricopa County	160	67	57	284
Pinal County	491	230	225	946
Total	651	297	282	1,230

VI. CONCLUDING REMARKS: A VISION OF A FUTURE

This report does not propose solutions to the CAP underutilization problem. Rather, the focus has been on economic analysis and possible impacts. The one overriding lesson from this analysis is that the economy of the three-county CAP service is highly interdependent due to debt obligations associated with the project. The recognition of this interdependency is the first step to any restructuring solution. I now take the liberty to propose a straightforward methodology for structuring a solution to this issue.

First, policymakers must recognize that there is no one solution. The underutilization of CAP water requires a composite solution, analogous to solving a multi-piece puzzle. Numerous organizations in the state have a vested interest in the solution of this puzzle. The CAWCD and the BOR should work collaboratively with ADWR, irrigation districts, the business community, municipalities, Indian communities, Arizona Public Service and the Salt River Project, among others, to develop a multi-agency solution. Collaboration does not mean one agency writing proposals and releasing them to the public for comment. This "trial balloon" approach to policy formulation should be set aside in favor of intense, multi-agency discussions. Using a professional mediator or facilitator, a multi-agency task force of 12 to 15 people should develop a single proposal using a process which includes timely feedback from the leadership in each agency.

The task force should evaluate each alternative composite solution, using a shared understanding of the present value of costs and benefits. Questions concerning "Who pays?" "How much do they pay?" and "When do they pay it?" must be answered in these discussions. Non-Indian agriculture should be incorporated as a critical piece of this puzzle. The economic tradeoff between subsidizing agriculture or raising property taxes needs to be investigated and

evaluated. As this analysis and the recent CAWCD/BOR White Paper point out, without non-Indian agriculture the CAP will become a much more expensive source of water for M&I users. M&I users may or may not be able and willing to accept this added financial burden.

There are also significant equity issues in putting this CAP puzzle together. The incidence of costs and benefits, on this and future generations, must be a critical concern to the task force. In this regard the social cost of further downsizing of the agricultural sector should not be ignored in these discussions. However, a large amount of public funds may not be well spent in support of an agricultural industry that is in a period of economic transition anyway, i.e. from a dominant political and economic force in the state to one of partnership, albeit strained, with urban interests. All these considerations represent difficult, but necessary, public policy choices.

This report has documented the events within and outside the control of CAP agriculture that have initiated this period of transition. What is the future outlook? I see CAP agriculture attempting to shift as much of its CAP water allocation and associated debt as is legally and economically possible to other CAP water users, i.e. M&I and Native Americans. Without these changes in CAP contracts, a majority of the CAP districts, and a significant portion of the growers, will declare bankruptcy and surrender their economic fate to the bankruptcy courts. In either case, the districts/growers will return to their deep water wells as their primary, if not sole, source of water for irrigation. Power contracts will be negotiated with APS, or other sources, for energy during the high demand summer periods. CAP water will be purchased only on the margin, to supplement groundwater pumping. The agricultural demand for CAP water will be a function of the spot price established by the CAWCD. It appears that agriculture still would be able to pay a small

portion of the fixed OM&R costs and all the pumping costs for a limited number of acre-feet of CAP water.

Economic adjustments in the agricultural sector will be substantial. The large CU districts will restructure to a level of service resembling the GC districts. Wells may or may not be returned to the growers in the CU districts. This decision will depend on the relative economic costs between the grower control and conjunctive use models. In any case, CAP agriculture as defined in this report will disengage itself gradually from the CAP.

The growers with the least debt, highest yields, and low cost, high production wells will remain in business. But to ensure sustainable farming operations under conditions of increasingly more expensive groundwater, some managerial changes will be required. First, more attention will be paid to farming systems in central Arizona agriculture. Increased attention will be given to the biological and economic interactions between crop rotation, soil management, crop mix, integrated pest control and other factors. Second, the surviving growers will look in earnest for alternative crops in order to diversify their operations. Although there are dangers associated with non-traditional crop production activities, with assistance from the agricultural-support sector some marketing niches can be found to exploit Arizona's year-round growing season.[25] Finally, in order to remain viable, these farms will become the most modern in the world, both in the production and the marketing of their crops. After adjustments stimulated by current CAP problems, central Arizona agriculture will be more technologically intensive, involve smaller planted acreages, with more value produced per acre than has been true in the past. This vision of agriculture has the potential for economic sustainability in the desert.

ENDNOTES

1. The planned "declaration of substantial completion" date was December 15, 1992. January 1, 1993 and other dates one or two years hence had been proposed due to "unresolved issues" surrounding siphon and pumping plant repairs and financial matters involving terminal storage, uncontracted supplies, and take-orpay provisions. The Department of Interior officially has postponed the completion date for one year.

2. Most of this historical background is taken from Southern Arizona Water Resources Association, "Historical Highlights of the CAP," *WaterWords* 9(1991): 1-11.

3. This federal condition for future support for the CAP produced the 1980 Arizona Groundwater Management Act. This legislation established the Arizona Department of Water Resources, the four active management areas, the three irrigation non-expansion areas and the current planning process involving water resources on a state-wide basis.

4. This statement is not meant to imply that all contractual arrangements with engineering firms and the federal government had been agreed upon. Negotiations in several districts continue at this time. Nevertheless, all districts were receiving or had the capacity to receive allocated supplies of CAP water in 1989.

5. See Dedrick, A.R., A.J. Clemmens, W. Clyma, R.D. Gibson, D.B. Levine, J.A. Replogle, S.A. Rish, R.E. Ware, and P.N. Wilson, *The Diagnostic Analysis (DA) Report of the Performance of Irrigated Agriculture in the Maricopa-Stanfield Irrigation and Drainage District (MSIDD) Area*, Vols. I and II, U.S. Water Conservation Laboratory, ARS/USDA, Phoenix, Arizona, 1992, for an in-depth assessment of the current situation in a CAP irrigation district.

6. See Changping Chen, *Production Variability for Major Arizona Field Crops.* Unpublished M.S. Thesis, The University of Arizona, Tucson, Arizona, 1991 for a thorough analysis of long-term variability in Arizona's crop sector.

7. For a good overview of the current and future outlook for cotton see Economic Research Service, *Cotton and Wool: Situation and Outlook Yearbook,* CWS-69, U.S. Department of Agriculture, Washington, D.C., August; 1992.

8. These four wells are meant to be illustrative only. There are wells in the Eloy area that pump groundwater at a lower total cost than CAP water. There are wells in other regions that produce irrigation water at a higher cost than the CAP. Preferentially priced hydroelectric power is the principle reason groundwater is cheaper than CAP water.

9. Similar economic observations/predictions contained in this report were made beginning 25 years ago by R.A. Young and W. E. Martin, "The Economics of Arizona's Water Problem," *Arizona Review*, College of Business and Public Administration, The University of Arizona, Tucson, March, 1967; then by M.M. Kelso, W.E. Martin and L.E. Mack, *Water Supplies and Economic Growth in an Arid Environment: An Arizona Case Study*, The University of Arizona Press, Tucson, 1973; and then D.B. Bush and W.E. Martin, *Potential Costs and Benefits to Arizona Agriculture of the Central Arizona Project*, Arizona Agricultural Experiment Station Technical Bulletin, No. 254, Tucson, 1986.

10. This calculation is a function of the district assessment, the percent of grandfathered acreage actually farmed, and the number of acre-feet of CAP water used by the grower or district.

11. An analysis of the adoption of laser-leveled fields in the Pinal AMA is reported in P.N. Wilson, D.P. Anderson and G.D. Thompson, "The Adoption and Diffusion of Level Fields and Basins." Unpublished Paper, Department of Agricultural and Resource Economics, The University of Arizona, Tucson, 1991. Also see J. Daubert and H. Ayer, *Laser Leveling and Farm Profits*, Technical Bulletin, No. 244, Agriculture Experiment Station, The University of Arizona, Tucson, 1982 for an early economic analysis of laser leveling technology.

12. A representative feasibility study is Bookman-Edmonston Engineering, *Engineering Report in Support of Application for Federal Loan Under Public Law 130 for Construction of a Irrigation Distribution System (Central Arizona Irrigation and Drainage District)*, Phoenix, Arizona, December, 1982.

13. See the Arizona Agricultural Statistics Service. *1989 Arizona Agricultural Statistics*, Phoenix, Arizona, 1990.

14. There has been no attempt in this report to calculate the project generated payment capacity for the districts.

15. Incorporating uncertainty into project appraisals is a well-documented tool in economic feasibility studies. See Shlomo Reutlinger, *Techniques for Project Appraisal under Uncertainty*, World Bank Staff Occasional Papers No.10, The Johns Hopkins University Press, Baltimore, 1970 and Louis Y. Pouliquen, *Risk Analysis in Project Appraisal*, World Bank Staff Occasional Papers No.11, The Johns Hopkins University Press, Baltimore, 1970.

16. Assuming that 100,000 af of the 1.5 maf are lost due to evaporation, spills, etc. This figure was supplied by CAWCD staff.

17. Take-or-pay charges have been quoted at $16.70/af by other parties. Any charge between $15-20, or more, produces a similar financial outcome.

18. The breakeven equation (Equation 1) presented earlier in the paper can be applied to CAWCD as well. A new cost cutting program by CAWCD may lower this estimate to somewhere in the range of $24-28 million.

19. Dr. Julie Leones was instrumental in producing the estimates of the economic contribution and impact of CAP agriculture on the counties. She and Dr. Neil Conklin (SABER/ASU) are working cooperatively on a broader analysis of the contribution of agriculture to Arizona's economy using the same IMPLAN model. Their more general study will be available by the end of the year.

20. Comparable data for Maricopa County were not available in time to include them in this report.

21. Multipliers are hard to describe when starting with the industry because input-output models are demand driven, i.e., they start with the assumption that economic impacts are triggered by changes in demand. However, they are used extensively to examine impacts for changes in supply. A useful description of multipliers and how they can be used and abused is available from Julie Leones, "Multipliers for the Arizona Agriculture and Food Processing Cluster," Unpublished Paper, Department of Agricultural and Resource Economics, The University of Arizona, Tucson, 1992, and Eugene Lewis, et al. "Economic Multipliers: Can a Rural Community Use Them?" *Coping With Growth*, WREP 24, Western Rural Development Center, Oregon State University, Corvallis, October, 1979.

22. These papers are T. Alexander Majchrowicz, "The Importance of Farm and Farm-Related Industries in the U.S. West," ERS, USDA, Paper prepared for the Western Regional Science Association Meetings, February, 1992, and Ronald H. Schmidt and Stephen O. Dean, "Agricultural Production's Share of the Western Economy," *FRBSF Weekly Letter*, Number 92-20, May 15, 1992.

23. A recent joint BOR/CAWCD White Paper states that the non-Indian take-or-pay responsibilities may be allocated to M&I and Indian users. See the Bureau of Reclamation and Central Arizona Water Conservation District's "White Paper: A Joint Concept for the Central Arizona Project," Phoenix, Arizona, October 2, 1992. This proposal is under consideration but because of its extensive nature, the impacts associated with this "solution" were not evaluated.

24. These rates could only be guaranteed when Palo Verde is running near full capacity. Long-term APS contracts would have higher rates than these but may still produce groundwater at a lower cost than CAP water.

25. The potential opportunities and pitfalls of diversification in the agricultural sector are discussed in David L. Barkley and Paul N. Wilson, "Is Alternative Agriculture a Viable Rural Development Strategy?" *Growth and Change*, 23(1992):239-253, and Paul N. Wilson, "Nontraditional Agriculture As An Economic Development Alternative In Rural America," *Economic Adaptation: Alternatives for Nonmetropolitan Areas*, ed. D.L. Barkley, Westview Press, Boulder, Colorado (Forthcoming, 1993).

APPENDIX A

Agreement Between CAWCD and MSIDD for an Indirect Underground Storage and Recovery Project

AGREEMENT BETWEEN
THE CENTRAL ARIZONA WATER CONSERVATION DISTRICT
AND
MARICOPA-STANFIELD IRRIGATION & DRAINAGE DISTRICT FOR AN
INDIRECT UNDERGROUND STORAGE AND RECOVERY PROJECT

1. PREAMBLE: This Agreement is made this 3rd day of September, 1992, by and between the Central Arizona Water Conservation District ("CAWCD") and Maricopa-Stanfield Irrigation & Drainage District ("MSIDD") to create and implement an indirect underground storage and recovery project (IS&R Project). This Agreement supersedes the letter agreement between CAWCD and MSIDD regarding an indirect underground storage and recovery project dated January 9, 1992. Provided, however, the related letter agreement among CAWCD, Electrical District No. 3 ("ED-3") and the Western Area Power Administration dated December 24, 1992, is not superseded and shall remain in full force and effect.

2. EXPLANATORY RECITALS:

2.1 The parties hereto desire to maximize the use of Arizona's entitlement to the waters of the Colorado River.

2.2 The parties desire to preserve the groundwater underlying the Pinal AMA for use during periods of drought.

2.3 CAWCD desires to develop underground stored water credits for enhancing the reliability of CAP water deliveries.

2.4 MSIDD desires to obtain surface water for irrigation use at a price comparable to the cost of pumping groundwater.

3. DEFINITIONS:

3.1 "CAP" shall mean the Central Arizona Project.

3.2 "SLCA/IP" shall mean Salt Lake City Area Integrated Projects.

3.3 "PDP" shall mean Parker-Davis Project.

3.4 "In Lieu Water" shall mean CAP water purchased by CAWCD and delivered to MSIDD under this Agreement for use in lieu of pumped groundwater.

3.5 "Exchange Energy" shall mean PDP and SLCA/IP energy purchased by MSIDD from Electrical District No. 3 ("ED-3") and delivered to CAWCD at the Liberty and/or Pinnacle Peak Substations.

3.6 "Exchange Water" shall mean CAP water delivered to MSIDD using Exchange Energy.

3.7 "Interim Contract" shall mean the contract among MSIDD, CAWCD and the United States for interim CAP water service (Contract No. 9-07-30-W0208).

3.8 "CAP Subcontract" shall mean the contract among MSIDD, CAWCD and the United States for long-term CAP agricultural water service (Contract No. 4-07-30-W0044).

4. DELIVERY OF IN LIEU WATER: Pursuant to the Indirect Groundwater Storage and Recovery Project Permit issued by the Arizona Department of Water Resources to CAWCD on January 16, 1992, and any amendments thereto, CAWCD shall purchase up to 170,000 acre-feet of In Lieu Water annually and shall deliver that water to MSIDD at delivery rates and in quantities acceptable to MSIDD. CAWCD shall pay all charges and fees of any nature charged by the United States Bureau of Reclamation for such water. MSIDD shall use such water for agricultural

irrigation in lieu of pumped groundwater within MSIDD's service area. MSIDD shall use the In Lieu Water delivered under this Agreement in lieu of groundwater on a gallon-for-gallon substitute basis. CAWCD shall accrue stored water credits, in a storage account with DWR, for In Lieu Water delivered to MSIDD. If the Arizona Department of Water Resources subsequently makes a final determination that all or a portion of the In Lieu Water ordered by MSIDD and delivered by CAWCD to MSIDD was not used in lieu of groundwater, thus reducing the volume of stored water credits accrued by CAWCD, then MSIDD shall pay the CAP agricultural water price applicable at the time of delivery for that volume deemed ineligible for stored water credits.

5. PRICE OF IN LIEU WATER: During calendar year 1992, two types of In Lieu Water may be ordered by MSIDD at two different prices: (1) In Lieu Water for which MSIDD provides Exchange Energy to CAWCD at no cost to CAWCD; and (2) In Lieu Water for which MSIDD provides no Exchange Energy.

5.1 For each 850 kilowatt hours of Exchange Energy scheduled for delivery to CAWCD, CAWCD will deliver one acre-foot of In Lieu Water to MSIDD at no cost to MSIDD. Table 1 demonstrates the methodology and presents an estimate of the quantities of In Lieu Water which will be available for delivery under the Project during the January 1, 1992 through December 31, 1992 period:

* * *

* * *

TABLE 1
Calculation of Reduction in
Groundwater Pumping

Item & Period	Quantity
Exchange Energy Available January - December 1992	55,290,447 kw-hrs
Energy Required for MSIDD Groundwater Pumping	850 kw-hrs/AF
Quantity of In Lieu Water January - December 1992	65,048 AF

A related letter agreement among CAWCD, the Western Area Power Administration, and ED-3 describing the delivery of electrical energy and capacity associated with this IS&R Project is included as Enclosure 1. Enclosure 2 describes the amounts of energy estimated to be available for delivery to CAWCD under this IS&R Project. The amounts may change as they are affected by actual program start-up date and possible water delivery suspensions.

5.2 For each acre-foot of In Lieu Water delivered under this Agreement in addition to that delivered pursuant to Section 5.1 above, MSIDD shall pay to CAWCD $13.00 per acre-foot. The total volume of In Lieu Water delivered to MSIDD under this Agreement shall not exceed 170,000 acre-feet in any calendar year.

5.3 Payment shall be made in advance for all In Lieu Water ordered under this Agreement in accordance with the payment procedures outlined in Enclosure 3 to this Agreement. After 1992, the acre-foot charge for In Lieu Water shall be renegotiated each year by CAWCD and MSIDD.

* * *

6. DELIVERY OF EXCHANGE WATER: If ordered by MSIDD, CAWCD will deliver to MSIDD one acre-foot of Exchange Water for each 1,600 kilowatt hours of Exchange Energy transferred to CAWCD under 5.1 above. MSIDD will pay to CAWCD a fee to cover the operation and maintenance cost associated with the delivery of such Exchange Water at the rate of $16.00 per acre-foot. Table 2 demonstrates the methodology and presents an estimate of the quantity of Exchange Water which CAWCD will deliver to MSIDD in exchange for electricity delivered during the January 1, 1992 through December 31, 1992 period.

TABLE 2
Determination of Quantity of
Exchange Water Delivered to MSIDD

Item & Period	Quantity
Exchange Energy Delivered to CAWCD January - December 1992	55,290,447 kw-hrs
Energy-to-Water Conversion Rate	1,600 kw-hrs/AF
Exchange Water to be Delivered to MSIDD by CAWCD January - December 1992	34,557 AF

7. CURTAILMENTS: In addition to any interruptions, discontinuance, or reductions in water deliveries occurring as a result of the interruptible nature of the water to be furnished under this Agreement, CAWCD may temporarily discontinue or reduce the quantity of water to be delivered hereunder for the purposes of investigation, inspection, maintenance, repair or replacement of any of the Project facilities, but so far as feasible CAWCD will give reasonable

notice in advance of such discontinuance or reduction, except in case of emergency, in which case notice shall be given as promptly as practicable under the circumstances. If a suspension or curtailment of MSIDD's scheduled In Lieu Water deliveries becomes necessary because CAP canal capacity is required to deliver water for direct use, CAWCD will give reasonable notice in advance of such curtailment.

8. ORDERING AND BILLING:

8.1 Before the Secretary of the Interior issues the Notice of Completion for the CAP, all CAP water delivered to MSIDD, whether In Lieu Water, Exchange Water, or interim CAP water, will be delivered using procedures contained in MSIDD's Interim Contract. Provided, however, That MSIDD shall pay for its CAP interim water, if any, on the terms provided for in its Interim Contract, and MSIDD shall pay for its In Lieu Water and Exchange Water on the terms provided for in this Agreement. Enclosure 3 to this Agreement provides a description of how water orders, water deliveries, and billing under this Agreement will be handled on a day-to-day basis.

8.2 Should the Secretary of the Interior issue the Notice of Completion for the CAP during the period when In Lieu Water is being delivered under this Agreement, then In Lieu Water will be delivered using procedures to be negotiated by CAWCD and MSIDD.

9. RECOVERY OF CAWCD'S STORED WATER CREDITS:

9.1 CAWCD may recover its stored water credits upon verbal notification to MSIDD. Such verbal notification shall be

followed by written confirmation within three days.

9.2 MSIDD will allow CAWCD to recover CAWCD's stored water credits using MSIDD's wells, at CAWCD's expense. Such use shall be subject MSIDD's operational control of the wells, and shall be made only when, in the sole discretion of MSIDD, there is sufficient well capacity and water transportation facilities available to recover such stored water without disrupting delivery of irrigation water to MSIDD customers.

9.3 Should CAWCD desire to recover stored water credits at a rate greater than available wells within MSIDD can feasibly produce, CAWCD may install, own, operate and maintain new wells and related facilities or, at CAWCD's request, MSIDD will, under a separate agreement, install, own, operate and maintain new wells and related facilities, provided that CAWCD pays MSIDD in advance all construction costs associated with such new wells and facilities. All of the fixed and variable operating costs of such facilities shall be the sole responsibility of CAWCD as long as the wells are needed to recover stored water credits. Nothing herein requires MSIDD to construct facilities which, in MSIDD's judgment, would interfere with the operation of existing wells within MSIDD or MSIDD's water delivery system. CAWCD shall indemnify MSIDD from the cost of obtaining all permits required to drill new recovery wells identified by CAWCD for purposes of this Agreement.

9.4 CAWCD will pay all permit application fees and stored water recovery fees generated by this indirect underground storage and recovery project.

9.5 CAWCD will provide the pumping power and will pay

any additional power related costs necessary to recover its stored water credits. These costs include, but are not limited to, energy, capacity, wheeling service, scheduling costs and any other pumping power costs incurred by MSIDD to recover CAWCD's stored water credits.

9.6 CAWCD will pay MSIDD all incremental increases in the cost of operation, maintenance, and replacement of wells and/or pumps within MSIDD used for the recovery of CAWCD's stored water credits. In the event CAWCD notifies MSIDD of CAWCD's intent to recover stored water credits from wells within MSIDD, MSIDD will determine the incremental operation, maintenance and replacement costs applicable to such recovery, and notify CAWCD of such determination. Recovery will not commence until CAWCD has agreed to payment of the costs determined by MSIDD pursuant to this Section 8.6.

9.7 CAWCD may satisfy MSIDD's order for CAP water, under its Interim Contract or its CAP Subcontract, with recovered stored water credits. The price per acre-foot for such water shall be the then current price for CAP agricultural water.

9.8 Pursuant to applicable State law, CAWCD may assign its stored water credits. With the prior written consent of MSIDD, which consent shall not be unreasonably withheld, CAWCD may assign its rights and responsibilities under this Agreement to recover stored water to another person or entity.

10. <u>QUALITY OF WATER</u>: MSIDD does not warrant the quality of water produced from recovery wells and is under no obligation

to construct or furnish water treatment facilities to maintain or improve the quality of such water. CAWCD waives its right to make a claim against MSIDD because of changes in water quality caused by underground storage or the commingling of In Lieu Water with other water.

11. RECORDS AND REPORTING: CAWCD will maintain all records and accounts of deliveries, storage and uses of water under this Agreement. CAWCD will file all reports required by the Indirect Groundwater Storage and Recovery Project Permit. Copies of all such records, accounts and reports shall be made available to MSIDD upon request.

12. TERM OF AGREEMENT: This Agreement shall become effective on the date first written above. Indirect recharge activities under this Agreement will continue through December 31, 1995, unless such activities are terminated by either party with 14 days' advance written notice to the other party. This Agreement will terminate when all stored water credits which CAWCD has accrued pursuant to this Agreement have been recovered by CAWCD or its assignees.

13. NOTICES: Any notice, demand or request authorized or required by this Agreement shall be deemed to have been given when mailed, postage prepaid, or delivered to the Central Arizona Water Conservation District, 23636 North 7th Street, Phoenix, Arizona, 85024, and to the Maricopa-Stanfield Irrigation & Drainage District, c/o Mr. O. L. "Van" Tenney, General Manager, P.O. Box 870, Stanfield, Arizona, 85272. The

designation of the addressee or the address may be changed by notice given in the same manner as provided in this Section.

14. <u>ENCLOSURES</u>: By this reference, Enclosures 1, 2, and 3, are hereby made a part of this Agreement.

CENTRAL ARIZONA WATER
CONSERVATION DISTRICT

Attest: _____
Secretary

By: _____
President

MARICOPA-STANFIELD IRRIGATION
& DRAINAGE DISTRICT

By: _____
President

Attest: _____

Title: Secretary

Indirect.Rec.MSIDD#2

APPENDIX B

Supporting Agricultural Data

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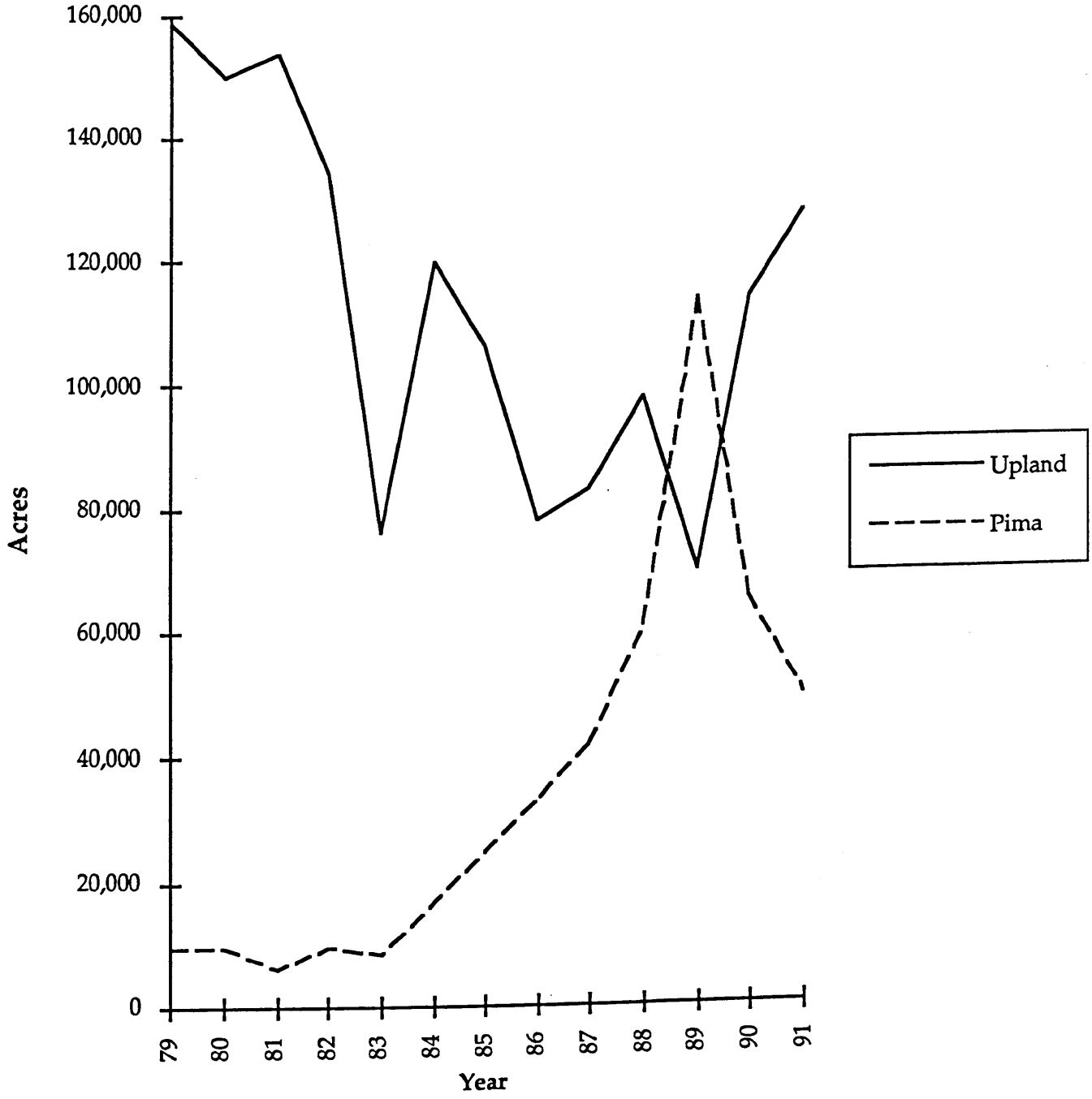
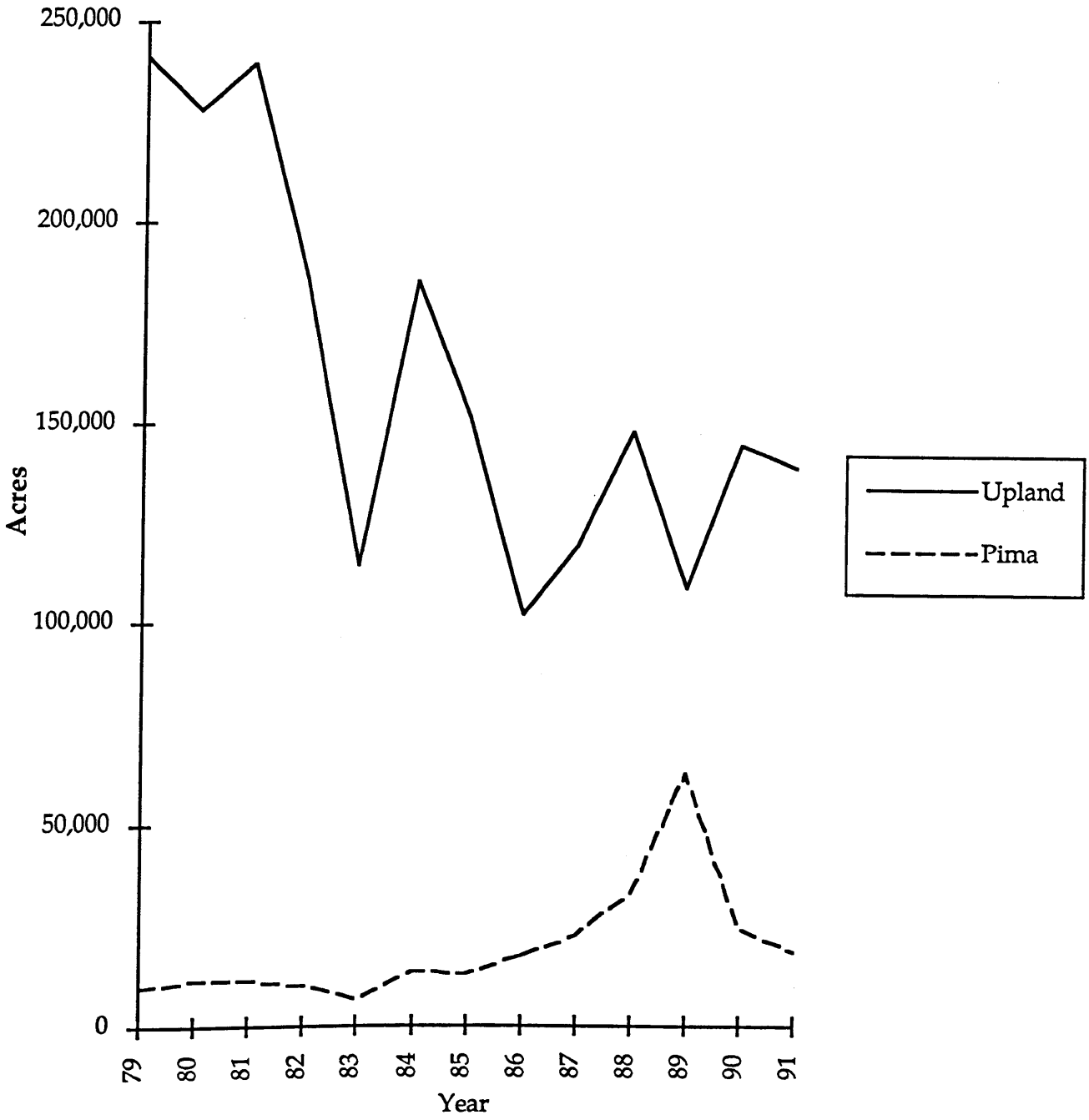
Source: Arizona Agriculture Statistics Service, *Arizona Agricultural Statistics*, Phoenix,Arizona, (various years).

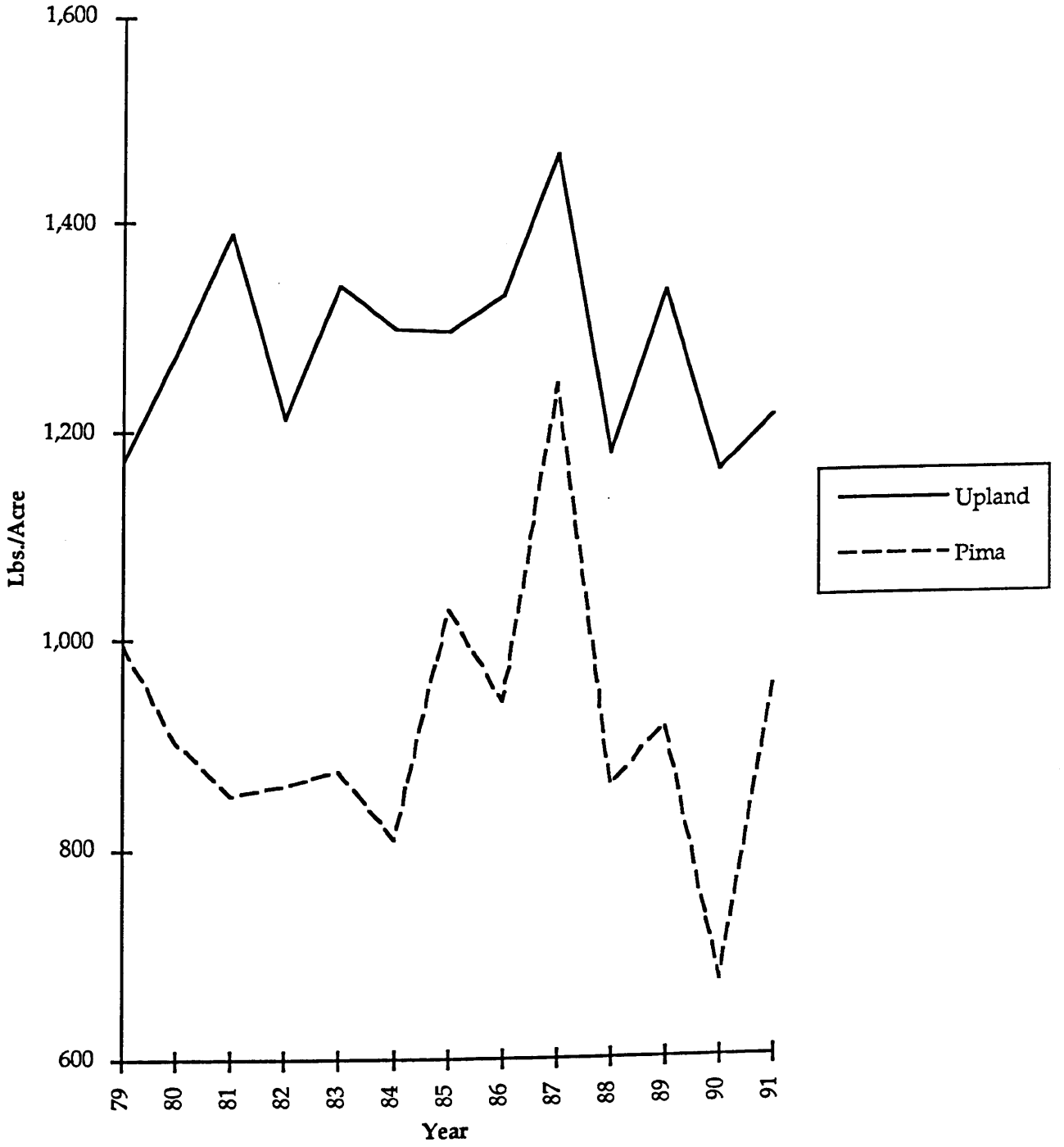
Appendix B.1: Harvested Acreage for Upland and Pima Cotton, 1979 - 1991 (Pinal County)



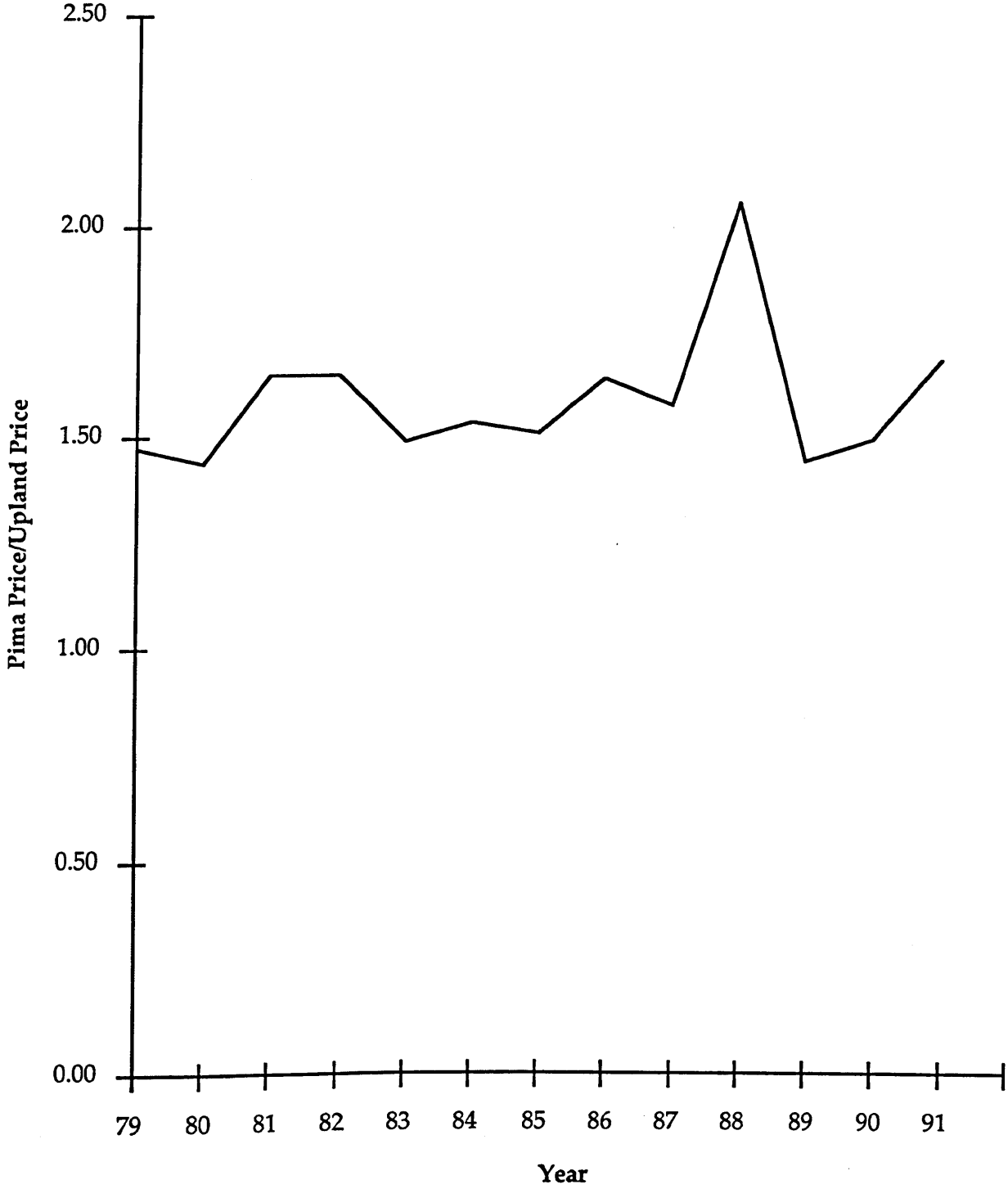
Appendix B.2: Harvested Acreage for Upland and Pima Cotton, 1979 - 1991 (Maricopa County)



Appendix B.3: Yield Per Acre for Upland and Pima Cotton, 1979 - 1991 (Maricopa County)



Appendix B.4: Relative Nominal Pima/Upland Cotton Prices (Arizona)



APPENDIX C

Summary of CAP Irrigation Districts

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Sources of Data: Irrigation Districts
U.S. Bureau of Reclamation
Central Arizona Water Conservation District
Arizona AgriBusiness Council

Appendix C. 1

Chandler Heights Citrus Irrigation District (CHCID)

Location: Located in and around the community of Chandler Heights in southeastern Maricopa County. CHCID is in the Phoenix AMA.

Gross Acres:	1,290
CAP Eligible Acres:	1,140
RRA Eligible Acres:	1,140
State Trust Land Within District Boundaries:	0
Percent CAP Allocation (After Reallocation):	0.30

Potential Take-or-Pay Responsibility Assuming 0.9 maf Available To non-Indian Agriculture

A.	Acre Feet:	2,700
B.	1991 CAP Demand:	541
C.	Non-Utilized Water (A-C)	2,159
D.	Approximate Cost of Non-Utilized Water ($20 /af* C)	$ 43,180

Number of Farmers/Customers Served: 92

Crop Mix in 1992:

Crop	Acres
Upland Cotton	
Pima Cotton	
Wheat	
Citrus	900
Other	200 (Alfalfa pasture for horses)
Total Acres	1,100

Comment:

CHCID is in a gradually urbanizing area. Land values have declined dramatically in the area in the last 3-5 years. Approximately 600 acres of the citrus are in oranges, tangelos and tangerines with the remaining acreage is in grapefruit (white and ruby).

Estimated Acres Farmed, 1989-1991

1989	1990	1991
Similar to the acreage figures for 1992		

Present Water Supply and Cost

Wells:

Ownership/Control:

CHCID owns the wells and supplies water to both agricultural and M & I users in the district.

Power Source:

CHCID has long term power contracts with the Arizona Power Authority (Hoover A) and the Western Area Power Authority (CRSP). The district has pumped up to 5,000 af of water but average demand is approximately 4,500 af per year. The power cost to lift water 500-600 feet is $32/af. Some power is purchased from the Salt River Project.

CAP:

CHCID is participating in CAWCD's in lieu program. As a result the use of CAP water has increased four times in 1992 over the 1991 level. CHCID's CAP distribution system was not completed until 1991.

Estimated Water Cost to Grower in 1992:	$25/af
Estimated O&M Cost in 1992:	$25,800

Debt Servicing Schedule Over Next Five Years:

Year	Private Bond Debt	9d Debt	Total Debt
1992	$ 0	$ 3,634	$3,634
1993	0	3,634	3,634
1994	0	3,634	3,634
1995	0	3,634	3,634
1996	0	3,634	3,634
Remaining	0	594,562	594,562

Assessment Per Gross Acre: $24

Delinquent Taxes:

1989-90	1990-91	1991-92 (First Half)
Not Available		

Selected Financial Measures	1989	1990	1991
Current Ratio(CA/CL)		No CLs of any significance	
Debt Ratio(TA/TL)		No TLs of any significance	
Net Income	(58,644)	20,175	13,382

Number of Employees: Full-time: 2 Part-time: 4

Ongoing Negotiations With External Entities:

The growers in the CHCID are parties to the Gila River Indian Community lawsuit. Apparently the Gila River Indian Community wants 30% of CHCID's CAP allocation which would mean a reduction of 30% in federal indebtedness for the district. Approximately $250,000 has been paid in legal and engineering fees to date concerning this issue. Negotiations are at an impasse at the present time.

General Comments:

CHCID's system was built under a joint project agreement with the San Tan Irrigation and Drainage District and the Queen Creek Irrigation and Drainage District. District officials question the economic viability of citrus production in the area if only CAP water was available at over $50/af.

Appendix C.2

Harquahala Valley Irrigation and Drainage District (HVIDD)

Location: Near the western boundary of Maricopa County. Approximately 60 miles west of Phoenix.

Gross Acres:	33,200
CAP Eligible Acres:	33,200
RRA Eligible Acres:	10,169
State Trust Land Within District Boundaries:	3,000
Percent CAP Allocation (After Reallocation):	8.73%

Potential Take-or-Pay Responsibility Assuming 0.9 maf Available To non-Indian Agriculture:

A.	Acre Feet:	78,570
B.	1991 CAP Demand:	34,802
C.	Non-Utilized Water(A-B)	43,768
D.	Approximate Cost of Non-Utilized Water ($20 /af* C)	$875,360

Number of Farmers/Customers Served:	6

Crop Mix in 1992:

Crop	Acres	
Upland Cotton	4,300	
Pima Cotton		
Wheat		
Citrus		
Other	2,000	(Produce)
Total Acres	6,300	

Comment:

One grower has approximately 1,500 A of melons and 500 A of grapes in the HVIDD. CAP water prices do not deter the planting of these higher value crops. Between 1986-1989 HVIDD averaged nearly 20,000 planted acres.

Estimated Acres Farmed, 1989-1991

1989	1990	1991
22,720	13,521	9,276

Present Water Supply and Cost

Wells:

Ownership/Control:

HVIDD does not own or control the wells in the district. Ownership and control are in the hands of the grower/owner.

Power Source:

Prior to 1986 the major source of power was natural gas supplied by Arizona Public Service (APS). There are approximately 70 natural gas wells in the district which have not been operated since the arrival of CAP water. A major overhaul on each of these wells would be necessary to return to pumping with natural gas. Thirty (30) wells powered by electricity are still in operation. Electrical power is purchased from the Arizona Power Authority (Hoover A) and APS acts as the wheeling agent. The Harquahala Valley Power District (HVPD) sets policies for the delivery of this energy. The HVPD Board of Directors is separate from the HVIDD board. Estimates are that only 8 - 10,000 af of water could be pumped with the preferentially priced Hoover A power (i.e. 2,200 acres).

CAP:

HVIDD does not have an in lieu contract for at least two reasons. First, HVIDD is not in an Active Management Area so there is no way ADWR can monitor the recharge. Secondly, CAWCD can not recover the in lieu water because ground water would have to be pumped uphill to the CAP canal.

Estimated Water Cost to Grower in 1992: $50.00/af

Estimated O&M Cost in 1992: $13.47/af

Included in the assessment and not charged as a variable cost.

Debt Servicing Schedule Over Next Five Years:

Year	Private Bond Debt	9d Debt	Total Debt
1992	$1,155,000	$104,000	$1,259,000
1993			
1994	——Other Data Not Available——		
1995			
1996			
Remaining			

Assessment Per Gross Acre: $50.00

Delinquent Taxes:

1989-90	1990-91	1991-92 (First Half)
$340,000	$510,000	$425,000

Selected Financial Measures	1989	1990	1991
Current Ratio(CA/CL)			
Debt Ratio(TA/TL)	——Not Available——		
Net Income			

Number of Employees: Full-time: Note Available Part-time: Not Available

Ongoing Negotiations With External Entities:

HVIDD is currently negotiating with the Secretary of Interior in order to become a party in the Ft. McDowell Indian Water Settlement Act. The federal government may take 14,000 af of HVIDD's CAP allotment in exchange for 9(d) debt reduction. Essentially, this would place the growers back to the water supply position which existed prior to the arrival of CAP water.

General Comments:

Lower water costs in the $25-30 range would bring 15 growers and 10,000 additional acres back into service in the district, according to district officials. HVIDD has been making its private bond payments but has only made good faith payments on its 9(d) debt since 1990.

Appendix C.3

Queen Creek Irrigation District (QCID)

Location: QCID is located in eastern Maricopa County and northern Pinal County. There is district acreage in both counties, although most of the acreage is in Maricopa County (Phoenix AMA).

Gross Acres:	21,622
CAP Eligible Acres:	20,648
RRA Eligible Acres:	11,317
State Trust Land Within District Boundaries:	107 acres
Percent CAP Allocation (After Reallocation):	4.83%

Potential Take-or-Pay Responsibility Assuming 0.9 maf Available To non-Indian Agriculture

A. Acre Feet:	43,470
B. 1991 CAP Demand:	7,220
C. Non-Utilized Water (A-B)	36,250
D. Approximate Cost of Non-Utilized Water ($20 /af* C)	$ 725,000

Number of Farmers/Customers Served: 41

Crop Mix in 1992:

Crop	Acres	
Upland Cotton	6,100	
Pima Cotton	2,300	
Wheat	600	
Citrus		
Other	3,930	(Potatoes, Alfalfa)
Total Acres	12,930	

Comment:

Due to favorable soil conditions and a long history of grower production and marketing success, potatoes remain an important crop in QCID. Approximately 3,700 acres of potatoes were planted in 1992. More small grains are being planted in 1992 due to lower water costs as a result of CAWCD's indirect recharge program.

Estimated Acres Farmed, 1989-1991

1989	1990	1991
	Similar to 1992	

Present Water Supply and Cost

Wells:

Ownership/Control

QCID does not own or control the on-farm wells. The growers have retained ownership of the wells.

Power Source

QCID is also a supplier of electrical power to district farmers. Power is purchased from the Arizona Power Authority (Hoover A) and the Western Area Power Authority (CRSP) via long-term contracts. Water pumped by hydro power and lifted approximately 600 feet costs $30.00/af in energy charges. In years when not all the hydro power is used, like in 1992, the Salt River Project assumes responsibility for QCID's surplus power. SRP handles all billing and line maintenance for QCID.

CAP:

In normal years (i.e. pre-1992), QCID has not been a major user of CAP water. The district's peak demand for CAP water at pre-1992 prices was approximately 7,000 af. However, in 1992 QCID has traded its CRSP power to CAWCD in exchange for low cost CAP water. In addition, the district is participating in the indirect recharge program. As a result, growers are purchasing CAP water from the district at $25.00/af which is lower than the cost of pump water. QCID expects to sell nearly 30,000 af of CAP water in 1992.

Estimated Water Cost to Grower in 1992: $25.00/af

Estimated O&M Cost in 1992: $890,614

Debt Servicing Schedule Over Next Five Years:

Year	Private Bond Debt	9d Debt	Total Debt
1992	$0		
1993	0		
1994	0	Not Available	
1995	0		
1996	0		
Remaining	0		

Assessment Per Gross Acre: $35.00

Delinquent Taxes:

1989-90	1990-91	1991-92 (First Half)
$ 196,567	$ 204,812	0

Selected Financial Measures	1989	1990	1991
Current Ratio(CA/CL)	3.6	4.6	9.8
Debt Ratio(TA/TL)	16.5	12.3	1.6
Net Income	($805,991)	($968,394)	($858,458)

Number of Employees: Full-time: 1 Part-time: 2

Ongoing Negotiations With External Entities:

No discussions are ongoing involving Native American water rights settlements and the growers of QCID.

General Comments:

QCID entered into a "Joint Project Agreement" with Chandler Heights Citrus Irrigation District and San Tan Irrigation District for the construction of their system of canals, pipelines and laterals to deliver CAP water. QCID has 44 miles of buried pipeline which it manages. Rather than issue private bonds, QCID used financial reserves of $2.557 million to meet QCID's portion of the construction costs. The district serves some M & I users and therefore must pay interest of 3.342% on 0.0293 times the amount of water delivered in the district for all purposes. There are ongoing discussions with the Bureau of Reclamation concerning the final 9 (d) debt obligation of the district. Only 60-70% of the land in the district is farmed in any one year. A major incentive for the QCID growers in contracting for CAP water was the forthcoming 100-year assured water supply requirement for future M & I development.

Appendix C.4

San Tan Irrigation District (STID)

Location:

The STID is located in southeastern Maricopa County (Phoenix AMA), northwest of the community of Chandler Heights. The Gila River Indian Community borders the STID to the south.

Gross Acres: 3,100

CAP Eligible Acres: 2,037

Can only deliver water to approximately 1,800 due to the design of the distribution system.

RRA Eligible Acres: Approximately 2,000 acres.

State Trust Land Within District Boundaries: 0

Percent CAP Allocation (After Reallocation): 0.77%

Potential Take-or-Pay Responsibility Assuming 0.9 maf Available To non-Indian Agriculture

A.	Acre Feet	6,930
B.	1991 CAP Demand	1,483
C.	Non-Utilized Water (A-B)	5,447
D.	Approximate Cost of Non-Utilized Water ($20 /af* C)	$108,940

Number of Farmers Served: 37 part-time mini-farm operations plus 50 farms

Crop Mix in 1992:

Crop	Acres
Upland Cotton	438
Pima Cotton	
Wheat	
Citrus	1,520
Other	25
Total Acres	1,983

Comment:

The STID is an area of rural to urban transition. Is becoming a suburb of the Mesa-Chandler-Gilbert region.

Estimated Acres Farmed, 1989-1991

1989	1990	1991
Same as the acreage figure for 1992		

Present Water Supply and Cost:

Wells:

Ownership/Control: STID owns all the wells in the district.

Power Source:

STID purchases its power from the Arizona Power Authority (Hoover A Power) and the Western Area Power Administration (CRSP). Supplemental power also is purchased from the Salt River Project. SRP provides all wheeling services for the STID.

CAP: STID is participating in the indirect recharge program.

Estimated Water Cost to Grower in 1992:

$55/af (Lowered to $50/af in July, 1992 due to the indirect recharge program).

Estimated O&M Cost in 1992: $250,000

Debt Servicing Schedule Over Next Five Years:

Year	Private Bond Debt	9d Debt	Total Debt
Remaining	$150,000	$2,500,830	$2,650,830

Assessment Per Gross Acre: Approximately $77

Delinquent Taxes:

1989-90	1990-91	1991-92 (First Half)
	Not Available	

Selected Financial Measures	1989	1990	1991
Current Ratio(CA/CL)	5.8	8.9	7.7
Debt Ratio(TA/TL)	1.4	1.4	1.5
Net Income $44,711		$74,133	$136,789

Number of Employees: Full-time: 4 Part-time: 2

Ongoing Negotiations With External Entities:

Negotiations are ongoing with the Gila River Indian Community. The STID has made several offers of right of way, CAP water and RRA relief. To date the parties are not close to an agreement. The STID is concerned about maintaining its 100-year assured water supply.

General Comments:

In 1985, the STID along with the Queen Creek Irrigation District and the Chandler Heights Citrus Irrigation District jointly entered into a contract with the BOR to construct a pipeline to provide CAP water to the three districts. The project was completed $151,447 over budget. As noted earlier, the STID is an increasing urbanized district. Most all of the land is investor owned and for sale.

Appendix C.5

Tonopah Irrigation District (TID)

Location:

Located in western Maricopa County (Phoenix AMA) approximately 40 miles west of Phoenix, just north of I-10.

Gross Acres:	3,550
CAP Eligible Acres:	3,470
RRA Eligible Acres:	2,852
State Trust Land Within District Boundaries:	0
Percent CAP Allocation (After Reallocation):	1.98%

Potential Take-or-Pay Responsibility Assuming 0.9 maf Available To non-Indian Agriculture

A.	Acre Feet:	17,820
B.	1991 CAP Demand:	523
C.	Non-Utilized Water (A-B)	17,297
D.	Approximate Cost of Non-Utilized Water ($20 /af* C)	$345,940

Number of Farmers/Customers Served: 4

There are 11-12 landowners in the TID.

Crop Mix in 1992:

Crop	Acres	
Upland Cotton	985	
Pima Cotton	970	
Wheat		
Citrus		
Other	600	(Alfalfa)
Total Acres	2,555	

Comment:

In the initial stages of planning for the CAP, approximately 30,000 acres were to be included in the district. However, the vast majority of these acres dropped out of the project due to the projected cost of the distribution system and CAP water and the farming history required for CAP eligibility. More recently (1982), 3,000 acres dropped out of TID due to the anticipated cost of the distribution system and CAP water. This action reduced the size of TID by half. In better economic times for the cotton industry there may be 7-8 growers receiving water from TID. But with water at $52/af it is difficult for these "in and out" growers to get financing.

Estimated Acres Farmed, 1989-1991

1989	1990	1991
Similar to the acreage figures for 1992		

Present Water Supply and Cost:

Wells:

Ownership/Control:

The TID does not own the wells, nor does it lease the wells from the growers. This option was not considered by the district.

Power Source:

The TID is an irrigation district with contracts for Hoover power and CAP water. Power is purchased from the Arizona Power Authority (Hoover A) and from Arizona Public Service. It takes approximately 700 kwh to pump an acre foot of water, costing the grower using hydroelectric power $32/af. The growers expected CAP water to be competitive with these costs when well repairs and upkeep were taken into consideration. APS does the wheeling for the TID.

CAP:

In 1992, the TID is taking almost all indirect recharge water from CAWCD at a cost of $13/af. The district is charging the growers $32/af.

Estimated Water Cost to Grower in 1992: $32/af

Estimated O&M Cost in 1992: $120,000 ($8/af)

Debt Servicing Schedule Over Next Five Years:

Year	Private Bond Debt	9d Debt	Total Debt
1992	$106,875	$10,000	$116,875
1993	110,438	10,000	120,438
1994	107,870	10,000	117,870
1995	109,690	10,000	119,690
1996	110,400	10,000	120,400
Remaining	0	2,721,500	2,721,500

Assessment Per Gross Acre: $27.30

Delinquent Taxes:

1989-90	1990-91	1991-92 (First Half)
$194	$10,067	$ 7,586

Selected Financial Measures	1989	1990	1991
Current Ratio(CA/CL)	NA	1.65	2.27
Debt Ratio(TA/TL)	NA	1.18	1.18
Net Income	NA	($119,469)	($13,242)

Number of Employees: Full-time: 0 Part-time: 2

Ongoing Negotiations With External Entities: None

General Comments:

The "take or pay" provision of the CAP contract presents major problems for the TID. With CAP water priced at over $50/af the district has no economic incentive to purchase CAP water. Yet the TID does not have the financial reserves to cover the "take or pay" costs. If the "take or pay" provisions were implemented as presently written in the contracts and CAP water were priced at over $50/af, the TID would probably declare Chapter 9 bankruptcy. Of course, this legal action would not be unique to the TID; the other CAP districts would find themselves in similar circumstances.

Appendix C.6

Central Arizona Irrigation and Drainage District (CAIDD)

Location:

CAIDD is located in Pinal County (Pinal AMA) near the town of Eloy. Irrigated lands extend north and south of I-10.

Gross Acres: 87,581

CAP Eligible Acres: 87,081

RRA Eligible Acres: 50,280

State Trust Land Within District Boundaries: Approx. 13,000 Acres

The delinquent acreage assessments are not being paid on this land at this time.

Percent CAP Allocation (After Reallocation): 22.74%

Potential Take-or-Pay Responsibility Assuming 0.9 maf Available To non-Indian Agriculture

A. Acre Feet:	204,660
B. 1991 CAP Demand:	81,948
C. Non-Utilized Water (A-B)	122,712
D. Approximate Cost of Non-Utilized Water ($20 /af* C)	$2,454,240

Number of Farmers/Customers Served: 40-60

Presently serving 130 of the 190 turnouts.

Crop Mix in 1992:

Crop	Acres
Upland Cotton	16,800
Pima Cotton	12,400
Wheat	1,400
Citrus	
Other	1,400
Total Acres	32,000

Comment:

Planted acreage in CAIDD has declined from approximately 48,000 acres in 1990 to 32,000 acres in 1992, a reduction of one-third. The 1,400 acres in "Other" crops are pecans for the most part. Note the monoculture cropping pattern in CAIDD. Only 4% of the planted acreage is in a rotation crop (wheat).

Estimated Acres Farmed, 1989-1991

1989	1990	1991
Not Available	48,000	40,000

Present Water Supply and Cost:

Wells:

Ownership/Control

CAIDD signed long-term well lease agreements with most of its growers in April-May, 1990. The owners of approximately 6,000 acres of crop land did not agree to lease their wells to the district and thereby they retain control over these wells. The lease payments average about $40/A and range from $20-70/A depending on the quantity and quality of the leased wells. As a result, the net property tax assessment ranges from less than $15/A to $60/A.

Power Source

CAIDD purchases the greatest portion of its power from Electrical District No. 2, Electrical District No. 4 and Electrical District No. 5. These districts purchase Hoover A and CRSP hydroelectric power and also purchase a small amount of more expensive, supplemental steam power. CAIDD estimates that it costs $29 to pump an acre foot of water with preferential power and $75 with steam power. CAIDD is the operating agent for ED 4 and ED 5. CAIDD owns its own line trucks and bills the electrical districts for its services.

CAP:

Prior to the indirect recharge program in 1992, CAIDD was shifting its overall water mix to ground water. The figures for the 90-91 crops years are:

Year	Well Water	CAP Water	Total AF
1990	58,000	112,000	170,000
1991	88,600	82,600	171,200

This effort, to achieve the lowest cost mix of water for its growers, is observed in districts which control wells and by growers who control their own wells. In 1992, CAIDD estimates that it will purchase 81,000 AF of CAP water, with slightly over one-third of that quantity being in lieu water. Approximately an additional 89,000 AF will be well water.

Estimated Water Cost to Grower in 1992: $42/af

Note: This price level is primarily made possible by the indirect recharge program.

Estimated O&M Cost in 1992: $2,321,000

Debt Servicing Schedule Over Next Five Years:

Year	Private Bond Debt	9d Debt	Total Debt
1992	$ 3,036,375	$ 800,000	$ 3,836,375
1993	3,057,400	800,000	3,857,400
1994	3,070,375	800,000	3,870,375
1995	3,586,750	873,000	4,459,750
1996	3,589,950	873,000	4,462,950
Remaining	23,442,075	61,154,000	84,596,075

Assessment Per Gross Acre: $83.80

Delinquent Taxes:

1989-90	1990-91	1991-92 (First Half)
$ 50,590	$1,184,291	$2,865,598

Selected Financial Measures	1989	1990	1991
Current Ratio(CA/CL)	0.9	1.0	1.2
Debt Ratio(TA/TL)	1.0	1.0	1.0
Net Income	($2,743,770)	($2,480,112)	($86,384)

Number of Employees: Full-time 27 Part-time 0

Ongoing Negotiations With External Entities:

Negotiations with the Gila River Indian Community are not making any progress at this time. Discussions have been going on for over three years. CAIDD feels that it can't afford to continue discussions with no concrete resolution in sight.

General Comments:

CAIDD management estimates that approximately 65,000 acres could be farmed in the district if water costs were $25/af. With the existing power contracts, the growers in CAIDD could farm 25,000 acres without CAP water, just relying on well water. That is reduction of 7,000 acres from the 1992 planted acreage figure. Meeting the requirements of the RRA takes the equivalent of a full-time position in CAIDD. Delays in eligibility determinations on the part of the BOR is a major problem. These delays primarily involve sale price approvals and decisions regarding land held in trust or involuntary acquisitions.

Appendix C.7

Hohokam Irrigation & Drainage District (HIDD)

Location:

Located in eastern Pinal County on lands around the town of Coolidge. (Pinal AMA)

Gross Acres:	29,600
CAP Eligible Acres:	28,167
RRA Eligible Acres:	17, 047
State Trust Land Within District Boundaries:	0

The City of Mesa owns 6,000 Acres in the HIDD.

Percent CAP Allocation (After Reallocation):	6.97%

Potential Take-or-Pay Responsibility Assuming 0.9 maf Available To non-Indian Agriculture

A.	Acre Feet	62,730
B.	1991 CAP Demand	21,993
C.	Non-Utilized Water (A-B)	40,737
D.	Approximate Cost of Non-Utilized Water ($20 /af* C)	$ 814,740

Number of Farmers/Customers Served:	85

Crop Mix in 1992:

Crop	Acres	
Upland Cotton	12,300	
Pima Cotton	6,000	
Wheat	800	
Citrus		
Other	600	(Alfalfa)
Total Acres	19,700	

Comment:

Historically, 18,000-20,000 A have been planted each year in the district.

Estimated Acres Farmed, 1989-1991

1989	1990	1991
Not Available		

Present Water Supply and Cost:

Wells:

Ownership/Control:

Growers control their own wells. HIDD only sells CAP water to the growers in the district.

Power Source:

Growers buy their electrical power from Electrical District No. 2. ED 2 purchases hydroelectric power through long-term contracts with the Arizona Power Authority (Hoover A) and the Western Area Power Authority (CRSP and Parker-Davis). Pumping lifts vary from 200 feet in the eastern section of the district to 600 feet in the western part of the district. On average, the growers are paying approximately $20/af for power.

CAP:

HIDD tries to breakeven on its CAP water sales. The district is participating in CAWCD's indirect program in 1992.

Estimated Water Cost to Grower in 1992: $25/af (March-September)
$20/af (October-December)

Estimated O&M Cost in 1992: $ 407,500 (Included in assessment)

Debt Servicing Schedule Over Next Five Years:

Year	Private Bond Debt	9d Debt	Total Debt
1992	$ 860,300	$ 86,000	$ 956,300
1993	859,450	86,000	$ 945,450
1994	858,350	86,000	944,350
1995	861,330	86,000	947,330
1996	857,640	86,000	943,640
Remaining	852,240	24,570,000	25,422,240

Assessment Per Gross Acre: $46.00

Delinquent Taxes:

1989-90	1990-91	1991-92 As of 9/1/92
$9,704	$ 33,236	$60,103

Selected Financial Measures	1989	1990	1991
Current Ratio(CA/CL)	1.3	1.5	2.0
Debt Ratio(TA/TL)	1.1	1.1	1.1
Net Income	$186,865	$135,021	($106,813)

Number of District Employees: Full-time: 5 Part-time: 0

Ongoing Negotiations With External Entities:

HIDD has initiated discussions with the AMWUA cities to exchange a portion of the districts CAP allocation for financial assistance in making private bond and 9 (d) debt payments. Possibly 25-30,000 af per year would be involved. Part of HIDD's CAP allocation would be retained by the district for M & I conversion and Indian water rights settlements (e.g. Gila River). These AMWUA discussions have a high probability of succeeding, according to district officials.

General Comments:

Agricultural land prices have been driven down because of the assessment, according to district officials. Growers with high production, low cost wells in the district have very little incentive to buy CAP water at $52/af.

Appendix C.8

Maricopa-Stanfield Irrigation and Drainage District (MSIDD)

Location: MSIDD is located in western Pinal County (Pinal AMA) near the small communities of Maricopa and Stanfield. District lands completely surround the Ak Chin Indian Reservation. MSIDD is responsible for water delivery to the turnout for the Ak Chin farm. Ak Chin has been taking approximately 70,000 af of CAP water per year over the last three years.

Gross Acres:	87,363
CAP Eligible Acres:	87,363
RRA Eligible Acres:	45,163

The lands that are not in compliance with the RRA are charged an additional $4/af commingling fee. Trust eligibility and sales price approvals have taken the U.S. Bureau of Reclamation up to three years from the date of submission.

State Trust Land Within District Boundaries:

8,800 acres where assessment is not being paid at the present time.

Percent CAP Allocation (After Reallocation): 22.75%

Potential Take-or-Pay Responsibility Assuming 0.9 maf Available To non-Indian Agriculture

A.	Acre Feet	204,750
B.	1991 CAP Demand	94,476
C.	Non-Utilized Water (A-B)	110,274
D.	Approximate Cost of Non-Utilized Water ($20 /af* C)	$2,205,480

Number of Farmers/Customers Served: 50

89 customer accounts

Crop Mix in 1992:

Crop	Acres	
Upland Cotton	33,000	
Pima Cotton	9,200	
Wheat	1,300	
Citrus		
Other	1,500	(Alfalfa, Pecans)
Total Acres	45,000	

Comment:

Small grain rotation crops represent three percent of the acreage farmed in 1992.

Estimated Acres Farmed, 1989-1991

1989	1990	1991
60,000	61,000	49,000

Present Water Supply and Cost:

Wells:

Ownership/Control:

MSIDD controls the wells in the district. The wells are leased from the growers. There are 410 deep water wells. Only 80 of these wells are directly tied in to the CAP distribution system. The remaining wells are operated in order to supply individual farms with water which is supplemental to CAP water. Lease payments average $36/A and range from $20-64/A.

Power Source:

MSIDD purchases its power from Electrical District No. 3. ED 3 has long-term contracts with the Arizona Power Authority (Hoover A) and the Western Area Power Authority (CRSP and Parker-Davis). Selected members of the staff of MSIDD serve as staff for ED 3. There is some overlap between the membership of the MSIDD and ED 3 Boards of Directors. Some supplemental steam power is purchased when needed from Arizona Public Service which provides the line services for ED 3. Ground water can be pumped with the preferential power for approximately $20/af. MSIDD/ED 3 management makes an important time commitment to optimizing the use of its ground water and electrical power resources. Evidence of this process is the water mix for the district during the 1989-1991 period:

Year	Well Water	CAP Water	Total AF
1989	106,790	193,720	300,510
1990	93,200	163,850	257,050
1991	128,910	92,280	221,190

CAP:

MSIDD management was an active early advocate for CAWCD's indirect recharge program and is presently an active participant as well. MSIDD will purchase approximately 107,000 af of CAP water in 1992 which represents a 13% increase over 1991's figure.

Estimated Water Cost to Grower in 1992: $42.00/af

Estimated O&M Cost in 1992: $3,178,500

Debt Servicing Schedule Over Next Five Years:

Year	Private Bond Debt	9d Debt	Total Debt
1992	$3,326,750	$ 900,000	$4,226,750
1993	3,352,800	900,000	4,252,800
1994	3,364,925	900,000	4,264,925
1995	4,227,150	936,500	5,163,650
1996	4,231,850	973,000	5,204,850
Remaining	23,852,700	71,140,500	94,993,200

Assessment Per Gross Acre: $85.00

Delinquent Taxes:

1989-90	1990-91	1991-92 (First Half)	
$503,453	$1,151,865	0	(Paid by MSIDD)

Selected Financial Measures:	1989	1990	1991
Current Ratio(CA/CL)	2.1	1.7	1.4
Debt Ratio(TA/TL)	1.0	1.0	1.0
Net Income	($1,085,774)	$985,134	($1,509,192)

Number of Employees: Full-time: 40 Part-time: 0

Ongoing Negotiations With External Entities:

MSIDD is still negotiating with the Gila River Indian Community concerning a water settlement which will benefit both the Indian community and MSIDD. Some of MSIDD's allotment may be "sold" in an agreement.

General Comments:

With its preferential power, MSIDD estimates that it could pump 150,000 af of ground water. This water could irrigate 30-35,000 acres in the district. But since only 80 of the 410 deep wells in the district are tied into the distribution system, it is not clear how the water would be delivered to all the remaining growers. In this scenario, some of the potential acreage would not receive water.

In 1991, MSIDD began an intensive Interagency Management Improvement Program in collaboration with the U.S. Water Conservation Lab (ARS/USDA) in Phoenix. This ongoing program is an attempt to improve the sustainability of agriculture in MSIDD. Those interested in a detailed description of CAP agriculture in central Arizona should read:

Dedrick, A.R., A.J. Clemmens, W. Clyma, R.D. Gibson, D.B. Levine, J.A. Replogle, S.A. Rish, R.E. Ware, and P.N. Wilson. *The Diagnostic Analysis (DA) Report of the Performance of Irrigated Agriculture in the Maricopa-Stanfield Irrigation and Drainage District (MSIDD) Area*, Vols. I and II., U.S. Water Conservation Laboratory, ARS/USDA, Phoenix, Arizona, 1992.

Appendix C.9

New Magma Irrigation and Drainage District (NMIDD)

Location: Northwest of Florence in Pinal County near the boundary between Maricopa and Pinal Counties. NMIDD is in the Phoenix Active Management Area.

Gross Acres:	26,900
CAP Eligible Acres:	26,640
RRA Eligible Acres:	4,700
State Trust Land Within District Boundaries:	5,300
Percent CAP Allocation (After Reallocation):	7.23%

Potential Take-or-Pay Responsibility Assuming 0.9 maf Available To non-Indian Agriculture

A. Acre Feet:	39,060
B. 1991 CAP Demand:	16,620
C. Non-Utilized Water (A-B)	22,440
D. Approximate Cost of Non-Utilized Water ($20 /af* C)	$448,800

Number of Farmers/Customers Served: 41

Crop Mix in 1992:

Crop	Acres	
Upland Cotton	6,750	
Pima Cotton	3,600	
Wheat	400	
Citrus	800	
Other	6,000	(Potatoes, Pecans, Melons)
Total Acres	17,650	

Comment:

Potatoes are an important crop in the NMIDD. Sandier soils in the northern half of the district are ideal for potato production. Most of the potato growers have marketing contracts with Frito-Lay. More small grains are being planted in 1992 due to lower water prices.

Estimated Acres Farmed, 1989-1991

1989	1990	1991
19,516	15,280	16,115

Present Water Supply and Cost:

Wells:

Ownership/Control:

NMIDD does not own or control the wells; the growers do.

Power Source:

Electrical power is purchased from Electrical District #6. ED #6 obtains its power from the Arizona Power Authority (Hoover B) and Western Area Power Authority (CRSIP). Additonal power is purchased on the spot market from the Salt Rive Project and Arizona Public Service. Currently, water pumped with hydro power costs approximately $36.75/af and steam power $77.75/af. Pumping lifts vary from 400-600 feet.

CAP:

NMIDD is participating in the indirect recharge program with CAWCD and with the City of Tempe.

Estimated Water Cost to Grower in 1992: $33.00/af

Estimated O&M Cost in 1992: $450,000

Debt Servicing Schedule Over Next Five Years:

Year	Private Bond Debt	9d Debt	Total Debt
1992	$1,132,470	$375,000	$1,507,470
1993	1,134,555	375,000	1,509,555
1994	1,134,410	375,000	1,509,410
1995	1,136,990	375,000	1,511,990
1996	1,135,350	399,000	1,534,350
Remaining	1,849,525	4,476,000	16,325,525

Assessment Per Gross Acre: $40.88

Delinquent Taxes:

1989-90	1990-91	1991-92 (First Half)
$525,233	$779,767	$280,135

Selected Financial Measures	1989	1990	1991
Current Ratio(CA/CL)	.47	.39	.31
Debt Ratio(TA/TL)	1.05	1.08	1.10
Net Income	($260,789)	($124,502)	($493,193)

Number of Employees: Full-time: 5 Part-time: 1

Ongoing Negotiations With External Entities:

No ongoing discussions at this time. NMIDD would like to restructure its 9(d) debt. NMIDD has been negotiating with the BOR since 1989.

General Comments:

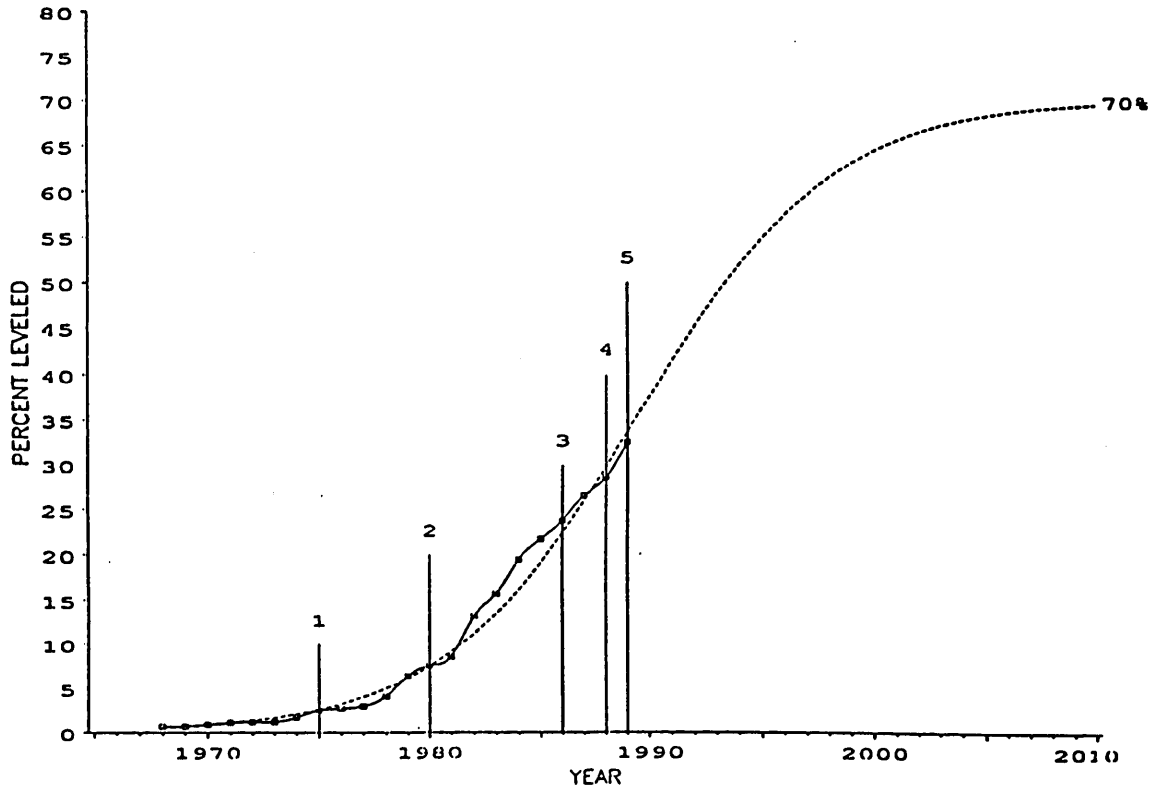
Technically, NMIDD is in default on its 9(d) debt. Good failth payments are being made each year but as of January 1992 only $61,006.44 was paid of the $2,499,800 federal bill. O & M charges are being used to pay a small portion of the 9(d) debt. The acreage assessment is being used to retire the private bond debt. The first priority of the NMIDD is to retire the private bonds. The RRA's requirements concerning non-resident alien citizenship and less than 26 owners/partners constrain the NMIDD's ability to deliver CAP water to all the acreage in the district in a cost efficient manner.

APPENDIX D

Actual and Predicted Diffusion for Level Fields and Basins 1968-89

APPENDIX D

Actual and Predicted Diffusion for Level Fields and Basins 1968-89



Key

1. Laser-leveling technology introduced in Wellton-Mohawk (1975).
2. Passage of the Groundwater Management Act (1980).
3. First Central Arizona Project (CAP) water arrives in the Pinal AMA for irrigation (1986).
4. Initiation in the Pinal AMA of publicly-funded grower education program concerning irrigation management (1988).
5. Initiation of a federally and state supported cost share program for farmers investing in level basins in the Central Arizona (CA) region (1989).

Source: Wilson, P.N., D.P. Anderson and G.D. Thompson. "The Adoption and Diffusion of Level Fields and Basins." Unpublished Manuscript. Department of Agricultural and Resource Economics, The University of Arizona, Tucson, 1992.

APPENDIX E

Projected Operating Results for Fiscal Years 1992-1999 for the Central Arizona Water Conservation District

Source: Document for Contract Revenue Bonds, Series B 1991 for the Central Arizona Water Conservation District, August 13, 1991, pp. C31-C32.

OFFICIAL STATEMENT

In the opinion of Bond Counsel, under existing laws, regulations, rulings and judicial decisions, interest on the Series B 1991 Bonds (including any original issue discount properly allocable to a Beneficial Owner thereof), assuming compliance with certain restrictions, conditions and requirements, is excluded from gross income of the Beneficial Owners of such Series B 1991 Bonds for federal income tax purposes and is exempt from income taxes imposed by the State of Arizona. (See "TAX MATTERS" herein).

NEW ISSUE — BOOK ENTRY ONLY

RATINGS: (See "Ratings" herein)

$110,671,353.90

CENTRAL ARIZONA WATER CONSERVATION DISTRICT

(Central Arizona Project)

Contract Revenue Bonds, Series B 1991

Current Interest Bonds Dated: August 1, 1991
Capital Appreciation Bonds Dated: Date of Original Delivery

Due May 1 and November 1, as shown on the inside cover hereof

This cover page contains certain information for general reference only. It is not a summary of this issue. Investors are advised to read the entire Official Statement to obtain information essential to the making of an informed investment decision.

Interest evidenced and represented by the Current Interest Bonds is payable semiannually on May 1 and November 1 of each year, commencing May 1, 1992. No payments are due to the owners of the Capital Appreciation Bonds until the maturity dates of the respective Capital Appreciation Bonds or the earlier prepayment thereof. The Series B 1991 Bonds will be prepared as fully registered bonds and, when delivered, will be registered in the name of Cede & Co., as nominee of The Depository Trust Company, New York, New York ("DTC"). DTC will act as securities depository of the Series B 1991 Bonds. Ownership interests in the Current Interest Bonds will be in denominations of $5,000 and integral multiples thereof, and ownership interests in the Capital Appreciation Bonds will be in denominations such that the Matured Value of each such Capital Appreciation Bond on the stated maturity date thereof will be $5,000 or an integral multiple thereof. Beneficial Owners of the Series B 1991 Bonds will not receive physical bonds representing the Series B 1991 Bonds purchased, but will receive a credit balance on the books of the nominees of such purchasers. Principal, prepayment premium, if any, and interest due with respect to the Series B 1991 Bonds will be paid by Citibank (Arizona), Phoenix, Arizona, as Trustee, or its successor (see "INTRODUCTORY STATEMENT" herein), to DTC, which will in turn remit such principal, prepayment premium, if any, and interest due with respect to the Series B 1991 Bonds to the DTC Participants (as such term is herein defined) for subsequent disbursement to the Beneficial Owners of the Series B 1991 Bonds as described herein.

The proceeds of the sale of the Series B 1991 Bonds are to be used to (i) fund advances to the United States of America to finance a portion of the cost of construction of New Waddell Dam, (ii) reimburse the Central Arizona Water Conservation District (the "District") for prior advances for New Waddell Dam, (iii) pay interest accruing on the Series B 1991 Bonds through and including November 1, 1993, (iv) make an initial deposit to the Reserve Fund created under the Indenture and (v) pay costs of issuance.

The payments when due (other than by reason of acceleration or optional redemption) of principal of and interest (or accreted value) on the Series B 1991 Bonds maturing May 1, 1999 through and including November 1, 2006 will be insured in accordance with a financial guaranty insurance policy to be issued simultaneously with the delivery of the Series B 1991 Bonds by Municipal Bond Investors Assurance Corporation.

MBIA

The Series B 1991 Bonds are limited obligations of the District payable solely out of the Revenues and other security pledged under the Indenture and do not constitute an indebtedness nor a general obligation of the District within the meaning of any state constitutional provision or statutory limitation and do not constitute, and will not give rise to, a pecuniary liability of the District or be a charge against its credit or general taxing powers. The source of payment for the Series B 1991 Bonds is more fully described herein.

The Series B 1991 Bonds are subject to optional and mandatory redemption prior to maturity as described herein.

Maturity Schedule
(See Inside Front Cover)

The Series B 1991 Bonds are offered when, as and if issued and accepted by the Underwriters and subject to delivery of the approving legal opinion of Gust, Rosenfeld & Henderson, Phoenix, Arizona, Bond Counsel. Certain legal matters will be passed upon for the District by its General Counsel, Douglas K. Miller, Esq. Certain legal matters will be passed upon for the Underwriters by their counsel, Chapman and Cutler, Phoenix, Arizona. It is expected that delivery of the Series B 1991 Bonds will be made in New York, New York on or about August 27, 1991 against payment therefor.

PaineWebber Incorporated

Dean Witter Reynolds Inc.

John Nuveen & Co. Incorporated

Boettcher & Company
a division of Kemper Securities Group, Inc.

August 13, 1991

Exhibit B

The Series B 1991 Bonds are limited obligations of the District payable solely out of the Revenues, as defined in the Indenture, and other security pledged under the Indenture.(1)

CENTRAL ARIZONA WATER CONSERVATION DISTRICT
PROJECTED OPERATING RESULTS
FOR 12 MONTHS ENDING JUNE 30
CASH BASIS
($000)

	FY1992	FY1993	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999
Operating Revenues								
Water Sales	32,100	57,900	97,400	106,700	117,700	121,600	130,400	134,600
Other Operating Revenues(2)	10,000	4,700	6,100	1,600	0	0	0	0
Total Operating Revenues	42,100	62,600	103,500	108,300	117,700	121,600	130,400	134,600
Operating Expenses								
Power for CAP Operations(3)	0	24,000	56,800	59,100	61,400	63,900	66,400	69,100
Other Operating Expenses(4)	31,100	35,200	38,100	40,300	42,300	44,700	47,200	50,000
Total Operating Expenses	31,100	59,200	94,900	99,400	103,700	108,600	113,600	119,100
Net Operating Income	11,000	3,400	8,600	8,900	14,000	13,000	16,800	15,500
Other Income and Expenses								
Property Taxes Received(5)	25,000	26,000	26,900	28,000	29,100	21,700	22,600	23,400
Investment & Miscellaneous Income(6)	12,600	13,200	13,200	14,000	14,700	15,000	14,900	14,900
Total Other Income	37,600	39,200	40,100	42,000	43,800	36,700	37,500	38,300
Net Income	48,600	42,600	48,700	50,900	57,800	49,700	54,300	53,800
Capital Expenditures:								
Operations & Maintenance Funds(7)	11,300	2,900	3,400	2,800	6,600	4,400	6,900	4,700
District Funds(8)	5,200	9,200	7,500	7,800	8,100	0	0	0
Total Capital Expenditures	16,500	12,100	10,900	10,600	14,700	4,400	6,900	4,700
Income Available for CAP Repayment and Other Purposes	32,100	30,500	37,800	40,300	43,100	45,300	47,400	49,100
CAP Repayment Expenditures:								
CAP Repayment Obligation(9)	0	34,200	33,800	33,500	33,100	51,400	50,800	50,300
Less: Transfers from Trustee, Series A & B(10)	0	0	(200)	(1,000)	(1,000)	(1,000)	(1,000)	(1,000)
Remaining Long-Term Navajo Surplus(11)	0	0	(2,400)	(3,600)	(3,600)	(3,600)	(3,600)	(3,600)
Other Navajo Surplus Revenues(12)	0	(10,100)	(20,900)	(16,900)	(17,600)	(18,300)	(19,000)	(19,800)
Hoover Plant Revenues(13)	0	(1,900)	(3,900)	(3,900)	(3,900)	(3,900)	(3,900)	(3,900)
CAP Repayment Expenditure	0	22,200	6,400	8,100	7,000	24,600	23,300	22,000
Income Available for Other Purposes	32,100	8,300	31,400	32,200	36,100	20,700	24,100	27,100

Exhibit B (continued)

Notes to Exhibit B:

(1) The Bonds constitute neither an indebtedness nor a general obligation of the District within the meaning of any state constitutional provision or statutory limitation and do not constitute, and will not give rise to, a pecuniary liability of the District or be a charge against its credit or general taxing powers.

(2) Reimbursement by Reclamation for services performed by the District.

(3) Assumes that the water supply system will be transferred to repayment status January 1, 1993. Power costs for CAP operations are paid by Reclamation prior to that date. Also assumes recapture of Hoover B Power effective October 1992. Power costs are projected to escalate at 4% annually.

(4) Operations and Maintenance expenses have been forecast by the District by expense category based on projected personnel, equipment and outside service requirements, as well as scheduled construction-related costs. Costs are projected at annual escalation rates of 6% for labor and 5% for other expenses.

(5) Assumes continuation of current levy at the maximum rate of ten cents per $100 of assessed valuation. Also assumes a levy at the maximum rate of four cents per $100 of assessed valuation for certain groundwater storage and recovery projects for Maricopa and Pima Counties during the period 1991 through 1995. Assessed property value is projected to grow at the approximate composite rate of 4% annually.

(6) Includes investment income and miscellaneous income. Assumes that the full amount reimbursed for prior Plan Six advances remains invested and is not expended for capital projects.

(7) Based on an analysis of need for acquisition of special major items of equipment and provision for miscellaneous acquisitions. Escalation projected at the rate of 5% annually.

(8) Includes recharge project and other capital expenditures. Excludes net effect of Plan Six advances to Reclamation and reimbursement of prior advances.

(9) Assumes the water supply system is transferred to repayment status January 1, 1993; New Waddell, January 1, 1997.

(10) Transfers of funds to Reclamation from the Trustee under the terms of the Indenture. The projected operating results assume that the sale of the Committed Series A and Committed Series B Navajo Surplus will begin October 1, 1993. Amounts are assumed to be transferred on November 1 of each year.

(11) Assumes long-term sale of remaining 50 MW of Long-Term Navajo Surplus without an associated bond issue.

(12) Short-term sales of Navajo Surplus energy. Revenues from such short-term sales will not be available for repayment of Bonds.

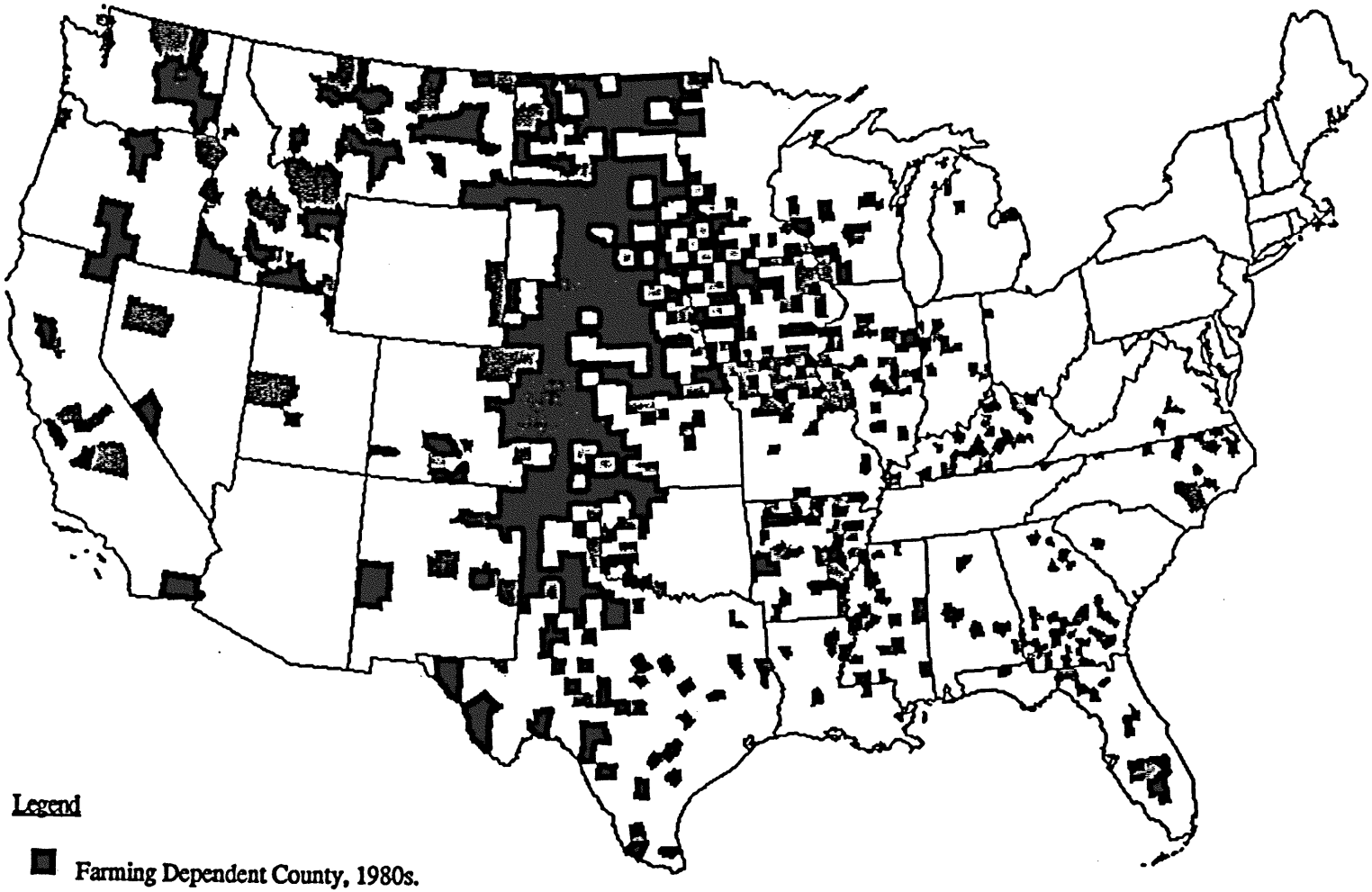
(13) Derived from a surcharge on certain energy sales from the Hoover Power Plant pursuant to the Hoover Power Plant Act.

APPENDIX F

Economic Importance of Production Agriculture

		Page
Appendix F.1:	Geographical Distribution of Farming-Dependent Counties, United States	118
Appendix F.2:	Distribution of Total Employment by Sector, Maricopa County, 1990	119
Appendix F.3:	Distribution of Total Employment by Sector, Pinal County, 1990	120

Figure F.1: Geographical Distribution of Farming-Dependent Counties



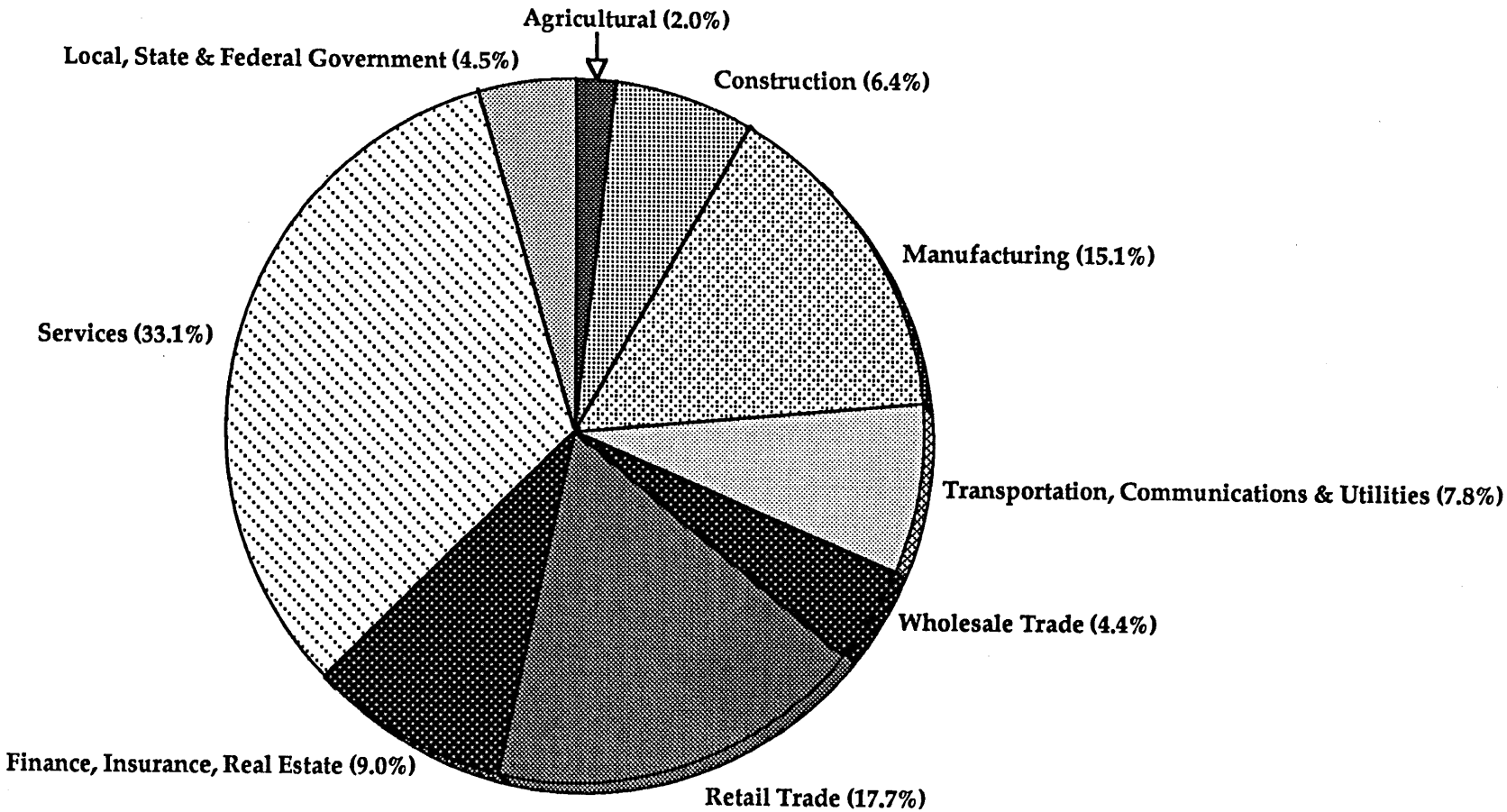
Legend

Farming Dependent County, 1980s.

Farming Dependent County in 1970s but not in 1980s.

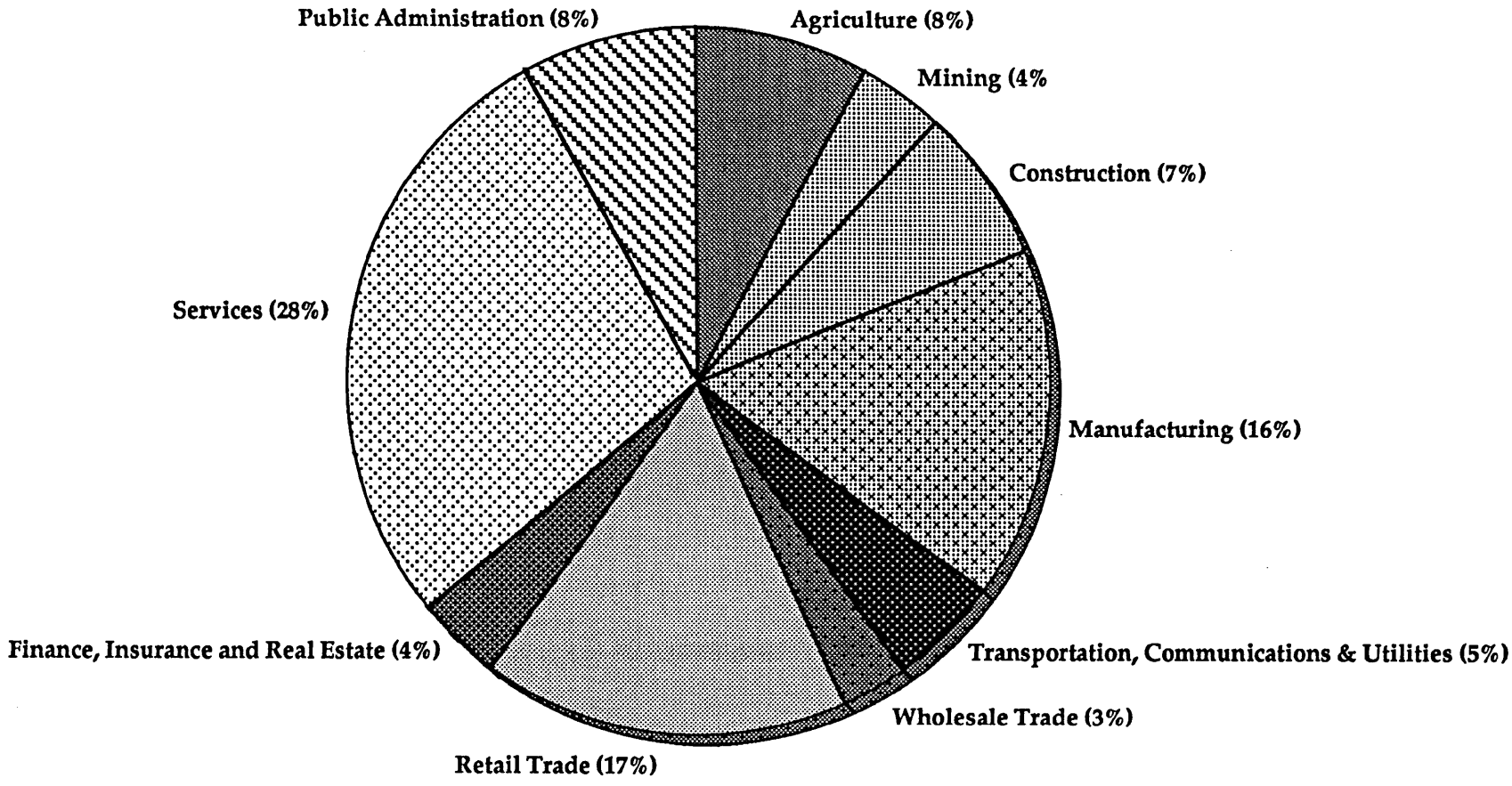
Susan Bentley (ERS/USDA) was instrumental in generating Figure F.1. Farming-dependent counties in the 1970's are the 703 nonmetro counties (as of the 1974 OMB metro designation) where farming contributed a weighted annual average of 20 percent or more to total labor and proprietor income over the five-year period from 1974 to 1979. Farming-dependent counties in the 1980's are the 512 nonmetro counties (as of the 1983 OMB metro designation) where farming contributed a weighted annual average of 20 percent or more of total labor and proprietor income in 1981, 1982, 1984, 1985, and 1986. The year 1983 was an extremely aberrant year for farm income and was dropped. The 1980's farming-dependent counties include 58 counties that were not farming-dependent in the 1970's.

Figure F.2: Distribution of Total Employment by Sector, Maricopa County 1990.



Source: U.S. Department of Commerce, Bureau of the Census

Figure F.3: Distribution of Total Employment by Sector, Pinal County, 1990



Source: U.S. Department of Commerce, Bureau of Census

APPENDIX G

Federal 9(d) Debt Balances

Appendix G. Federal 9(d) Debt Balance for CAP Agricultural Irrigation Districts

Contractor	Repayment Obligation	Billed - Principal Only[1]	Paid	Outstanding[1]	Balance
Maricopa County:					
Chandler Heights	620,000	7,368	5,501	1,867	614,499
Harquahala Valley	26,000,000	416,000	360,806	55,194	25,639,194
Queen Creek	9,960,000	19,396	14,477	4,919	9,945,523
San Tan	1,820,000	8,558	6,339	2,219	1,813,661
Tonopah	2,801,500	40,000	35,000	5,000	2,766,500
Pinal County:					
Central Arizona	66,900,000	1,600,000	1,200,000	400,000	65,700,000
Hohokam	24,704,530	86,000	43,000	43,000	24,661,530
Maricopa-Stanfield	78,000,000	1,800,000	1,350,000	450,000	76,650,000
New Magma	17,500,000	3,266,400	61,077	3,205,323	17,438,922
Total	**228,306,030**	**7,243,722**	**3,076,200**	**4,167,522**	**225,229,829**

Source: Report on Governor's Task Force on Central Arizona Project Issues, July 31, 1992.

1 Includes amounts billed 07/01/92, due 08/01/92