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INTRODUCTION

Objective

In April, 1977 the President's statement on water projects recommended that a number of federal water development projects, including the Bonneville unit of the Central Utah Project, not be completed. The ensuing efforts of project supporters brought about a review of the projected costs, benefits, and other political, social and environmental factors and consequently, the current issue is not whether or not the project should be constructed. Rather, the objective of this report is to examine the following question:

> Given the fact that at least the 5 units of the CUP which have already been authorized will eventually be constructed, what is the most desirable rate of construction funding?

Study approach

As a first step in answering this question for the specific case of the Central Utah Project, it is helpful to list the general issues one needs to consider in setting a rate for funding the construction of a major water resources project. Factors favoring faster construction include:

1. Sooner realization of project benefits.
2. Savings of construction cost at at time of rapid inflation.
3. Savings in right-of-way cost at a time when land prices are also increasing very rapidly.
4. Sooner fulfillment of commitment to project beneficiaries and other project supporters to have a functioning project.

5. Sooner termination of the hassle associated with efforts of project opponents to halt construction of an uncompleted project.

Factors favoring slower construction include:

1. A reduced rate of project funding permits the funds instead to be used for other pressing needs or for tax reduction.
2. A project that provides water that is not yet really needed will have unused capacity until the demand increases; in other words, a project completed too soon will not realize a return on the investment until the demand for project output increases.
3. Once a project is completed, one has lost the flexibility of modifying the design to take advantage of developing technology or provide outputs and services more important to future generations.
4. Rapid construction requires more workers and may bring more construction workers into a local community than the available public services can absorb.

When one compares these lists of factors, some favoring faster construction and others favoring slower construction, one can visualize the possibility of an economic efficiency evaluation that will determine an optimal construction rate, the best possible (least cost) compromise between the factors favoring faster construction and those favoring slower construction. Economists have in fact, developed a model for this type of analysis. One computes the present worth of all the benefits

(this becomes larger the sooner the project is completed) and the present worth of all the costs (this becomes smaller the longer the project is delayed) for various rates of project construction and selects that rate which maximizes net project benefit.

Within such a model, however, one is not free to select any construction rate because of limitations to how rapidly or how slowly a project can be planned or constructed. The planning process requires people to do the work and a certain deliberation that cannot be done too quickly. If the planning requires a certain number of man-hours, the planning agency may not be able to hire the necessary staff quickly enough either because of personnel ceilings or because sufficient numbers of trained people may not be available. The technical reviews necessary to make sure that an engineering design will be physically safe, not be harmful to the environment, and be socially acceptable require time, and hurrying any of these processes too much could lead to serious mistakes. The construction process is subject to many of the same issues with respect to personnel and safety, but it can be speeded up by working longer shifts in a crash construction program. Such construction is, however, more costly because of the greater overtime required. In combination, these factors place a limit to the maximum feasible rate of project implementation.

While it is true that too rapid an implementation rate does increase costs of construction and dangers to the environment and to public safety, it is also true that many of the specific constraints of these sorts are imposed by legislation or administrative rules that may not be well supported by the facts. Planning processes could be accelerated by cutting red tape, but this may require special legislation. Personnel

ceilings limit the number of people that the Bureau of Reclamation can hire for planning, design, and construction supervision but Congress could either lift them or permit or require the Bureau to do more of this work through contracts with private engineering firms. Conceivably, Congress could also provide funds (either through cost sharing or other programs) to the State of Utah or some unit of local government to construct selected project units while the Bureau is concentrating all its forces on other units.

Other limitations pertain when construction becomes too slow. The fixed costs of program administration continue regardless of the rate of progress and become a larger and larger portion of the total the more the project is drawn out. Delays expose work to becoming out of date and having to be redone.

The approach of this study is to examine the question of optimal construction rate for the Central Utah Project and the factors constraining the maximum rate at which it can be constructed. The methodology is to examine the pertinent data within the files of the Bureau of Reclamation and other agencies involved in the project, discuss the issues with all the informed people who can be readily contacted, and make the best judgments possible based on the experience and independent judgment of the study team at the Utah Water Research Laboratory, the research arm of the water agencies in Utah State government.

Scope of report

The CUP consists of: four units which were authorized in 1956 by the Colorado River Storage Project Act - the Bonneville, Vernal, Jensen, and Upalco Units; the Uintah Unit which was authorized in 1968; and the

Ute Indian Unit which is being studied for feasibility but is not yet authorized.

The dominant unit of the CUP (more than 80% of the cost of the 5 currently authorized units) is the Bonneville Unit. This unit is itself a very complex project consisting of 12 reservoirs, and many water collection and distribution aqueducts, tunnels, canals, drains, and a major hydropower generating facility. Figure 1 is a map of the area involved which locates the various components of the Bonneville Unit. The purpose of this unit is to import water from the Uintah Basin in the Colorado River drainage to several Wasatch Front and Sevier River Basin counties. The other units will develop water entirely for use within the Uintah Basin. Because it so dominates the CUP with its size and complexity, this report will deal principally with the completion schedule of the Bonneville Unit. It should be noted, however, that because of interactions, both hydraulically and legally between units, either delays or speedup of the Bonneville Unit will likely produce proportional delays or speedup of the other units and therefore the analysis presented here can be applied in a general way to the entire CUP.

It was clearly not feasible within the scope of the study to develop independent data from which costs and benefits of this billion dollar project could be estimated. The quantitative information on costs and benefits used here were obtained from the USBR personnel in the Provo CUP office and the regional office in Salt Lake City. Additional background information was obtained from the Central Utah Water Conservancy District.

Previous Construction Schedule

The orignal construction schedule proposed for the Bonneville Unit in the definite plan report (1964) required 17 years and a cost of 309 million dollars. The project actually started in 1966 and after 13 years (end of FY78) 167 million will have been expended, but this amount now represents only 19% of the current total estimated cost of $862.7 million. The tremendous increase in cost is due primarily to inflation (85%) and secondarily to such things as design changes to accomodate more environmental considerations and other minor changes in scope (15%).

The current funding level is $33 million/year. At this level (plus increases for future inflation) it will take 22 additional years (34 total) to complete the Bonneville Unit. This is exactly twice the originally projected construction duration.

ECONOMIC ANALYSIS OF SPEEDUP IMPACT

In order to determine the effect on economic efficiency of various construction durations the total stream of future benefits and costs were reduced to present worth quantities. This analysis was based upon discounting at 6 5/8% interest, the current rate required by federal policy. The actual repayment of reimburseable costs by the water users through the Central Utah Water Conservancy District (CUWCD) will be at 3 1/8% (the rate specified by repayment contracts). However, the economic analysis presented here was viewed from the perspective, not of cost and benefits to local water users but rather from a national perspective. The costs to society are represented here as the total construction costs plus operating and maintenance costs all discounted at 6 5/8%. The ad valorem taxes and water user fee collected by the district are not considered in this portion of this analysis but are discussed later as part of an analysis of construction schedule impact upon user fees.

The economic analysis examines three potential construction schedules as follows:

(1) Continuation at an annual expenditure level of about $33 million/year for 22 additional years.

(2) Completion at a rate that would have matched the original (1964) schedule in terms of % completion per year for the remaining 79% of the project. Completion would require 13 years on a variable schedule reflecting an assumed timing of completion of certain major facilities and a maximum annual construction expenditure of $60 million.

(3) Completion in 8 years at a maximum annual construction expenditure of $112 million.

For each of these three schedules, the construction cost (Figure 2), the operation and maintenance cost (Figure 2), and the benefits (Figure 3) have been estimated for each year over the life of the project (approximately 100 years).

Annual benefits corresponding to these 3 schedules have been estimated, as have variations in O&M costs. The construction periods for individual program items of the 8 and 22 year schedules are displayed in Figure 4. In each case the analyses were made in terms of 1978 dollars. The total construction cost is taken as $653 million in each case because time did not permit analysis of the effects of speedup on unit prices.[1] This represents costs after FY1978. Previous costs are, of course, treated as sunk investments which do not impact future planning decisions.

Figure 5 displays the variation in present worth (1978 base) of the future streams of costs and benefits as construction schedules vary. Except for the top two lines (which will be discussed later) inflation was ignored. At a discount rate of 6 5/8% a slightly negative effect of speedup is observed in that costs increase at a faster rate than benefits. With the 22 year schedule the present worth of benefits and costs are essentially equal at $382 million (in agreement with the 1977 administrative review). The 13 year schedule would produce costs which exceed benefits by 1.8% ($463 and $454.8 million present worth). The 8 year schedule produces costs which exceed benefits by 2.4% (523.5 and 510.9 present worth).

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[1] A methodology for this type of analysis was submitted to the Bureau of the Budget by the Office of Water Research and Technology in 1975 under the title "Economic Impact of Fiscal constraints on Water Project Construction."

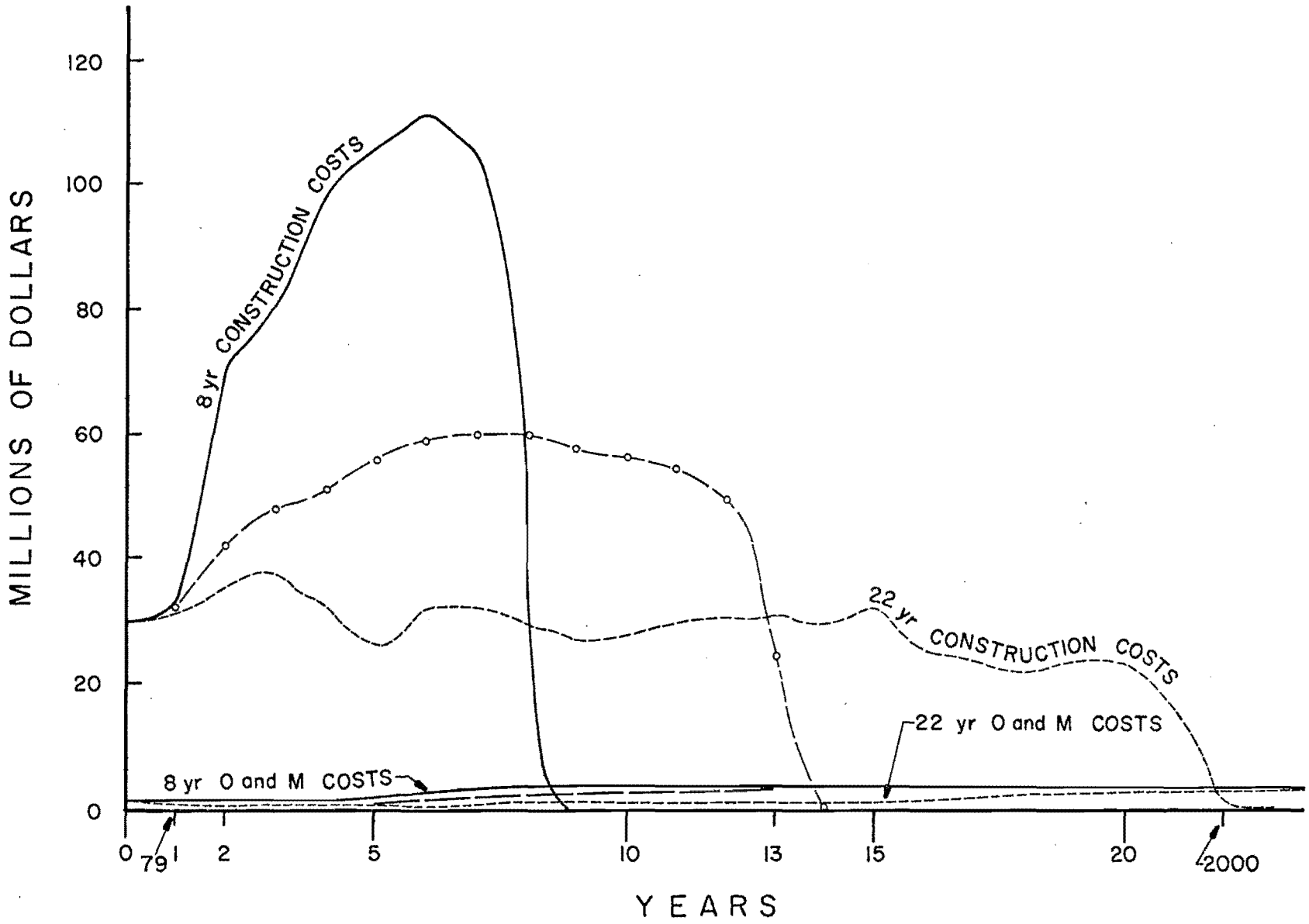

Figure 2. Timing of costs for various construction schedules.

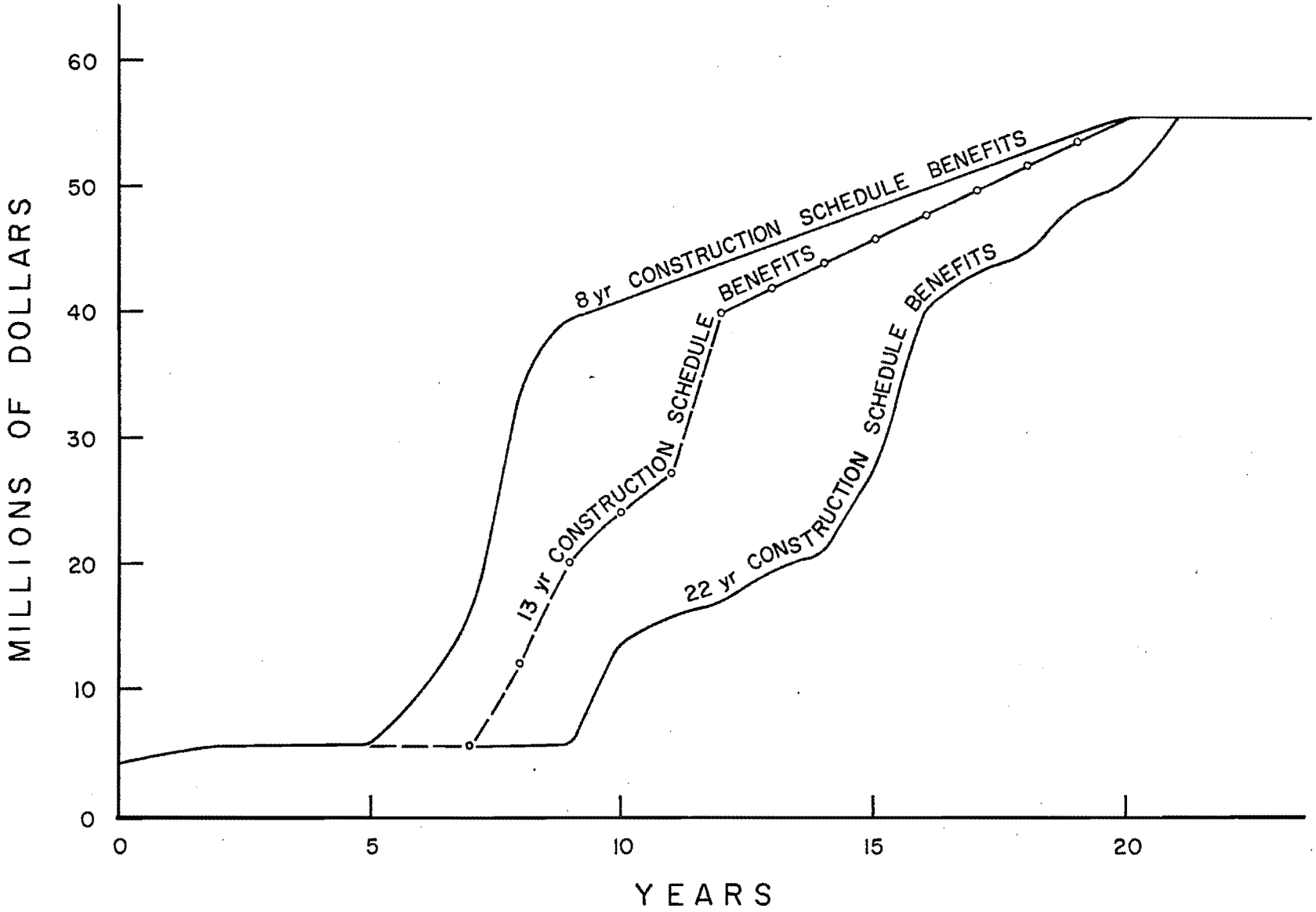

Figure 3. Timing of benefits for various construction schedules.

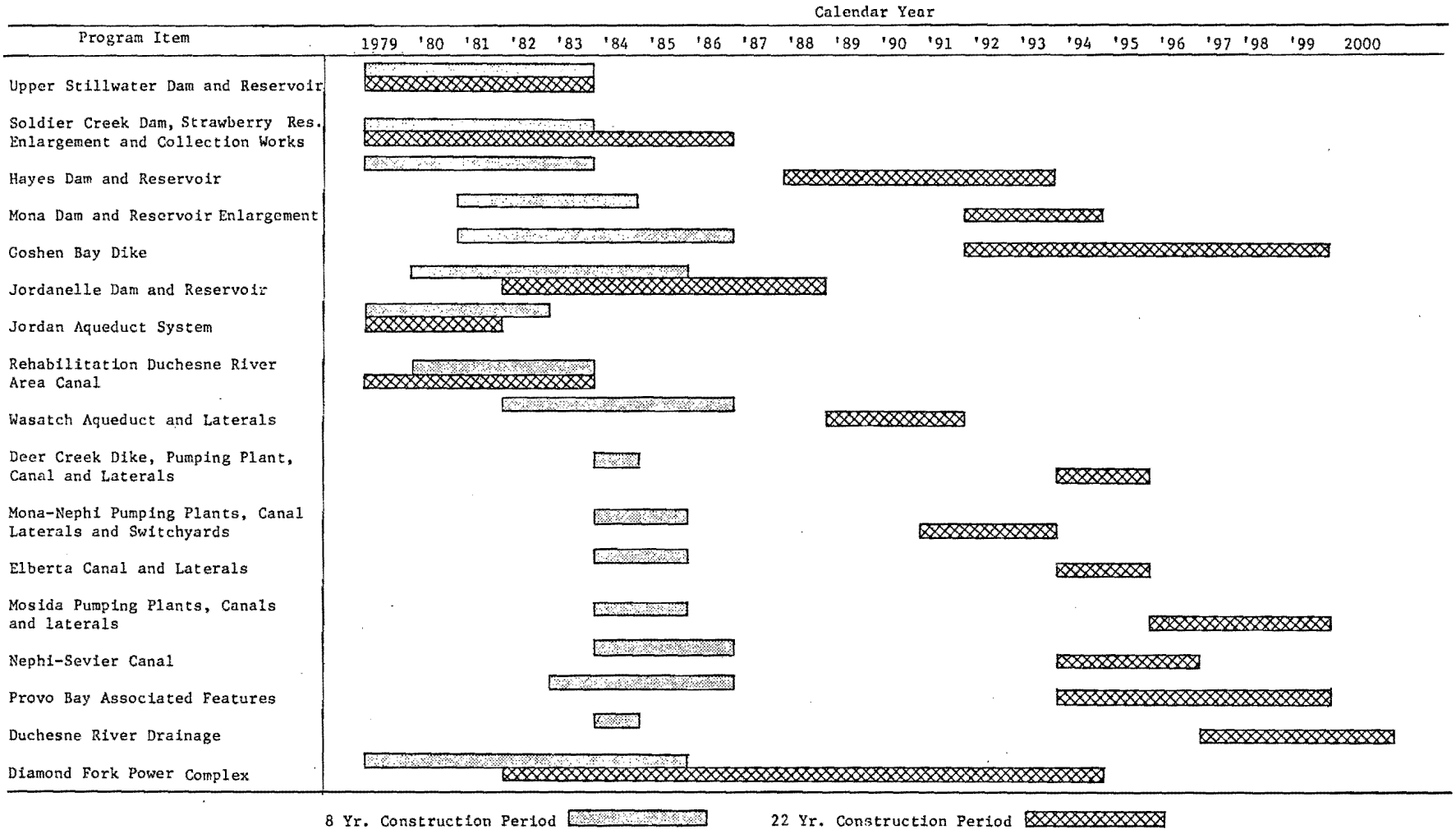

Figure 4. Time Frame For Various Uncompleted Components of the Bonneville Unit.

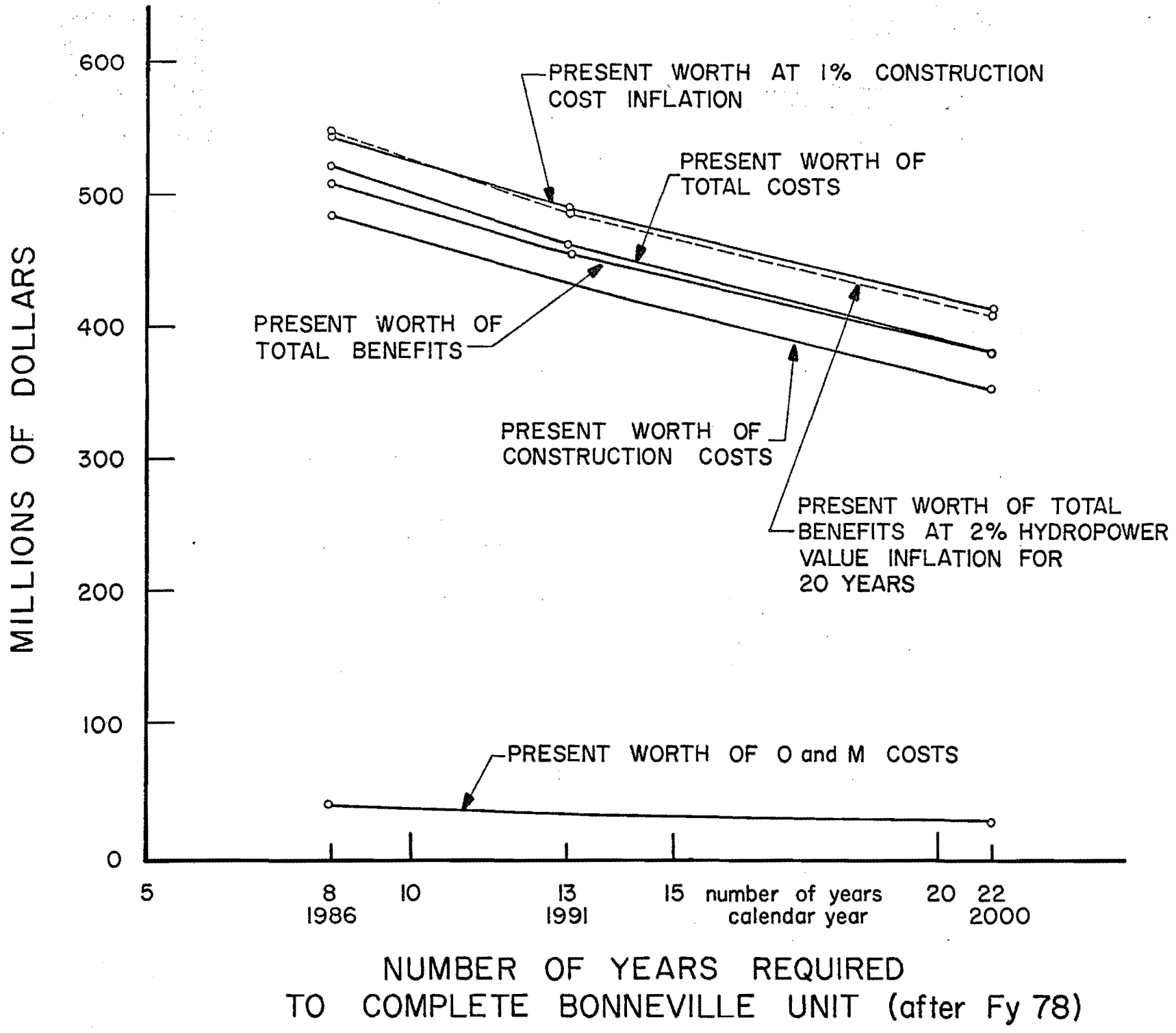

Figure 5. Present worth analysis.

This analysis shows that at the current federal interest rate, providing costs closer to the front end of the 100 year life of the project has a larger impact (less discounting) than the effect on speeding up benefits (which always lag the costs), but that the effect is relatively minor compared with uncertainties which are inherent in this type of analysis (for example, the assumption that costs and benefits inflate at the same rate).

The analysis presented here was based upon a 100 year (1979-2078) stream of future benefits and O&M costs. Whether or not one agrees with this assumed project life is of little consequence since at 6 5/8% interest, the difference in present worth between a 75 year life and infinity is less than 1%.

Effect of differential inflation rates

The present worth analysis discussed previously was made in terms of 1978 dollars. Its validity rests upon the assumption that future inflation will change costs at the same rate as it changes the value of benefits and therefore can be ignored. Inflation during the last decade, however, has impacted heavy construction costs at a consistantly higher level than inflation of consumer prices in general. Inflation in consumer prices is considered to represent the best available index of inflation of CUP benefits. Table 1 compares the USBR construction composite bid price index to the consumer price index over the last decade.

Table 1. Price Indices.

Year	USBR INDEX	CPI INDEX	RATIO (USBR/CPI)
1967	1.0	1.0	1.0
1970	1.16	1.12	1.036
1975	1.87	1.69	1.106
1976	2.01	1.80	1.110

Table 1 indicates that construction costs have increased 11% more than the general cost of living during this decade (about 1% per year difference in rate of inflation).

In order to quantify the impact that this difference would have upon the present worth figures discussed previously, the following revised analysis was made: rather than assuming some inflation rate for benefits and a higher rate for costs, benefits were kept in terms of 1978 dollars but consturction costs (not O&M costs) were inflated by 1% per year. The types of benefits included (listed in order of decreasing magnitude) are municipal and industrial, irrigation, hydropower, recreation, flood control, fish and wildlife, and water quality.

The results of the 1% inflation differential applied to costs is shown near the top of Figure 5. The present worth of costs under these conditions is greater than that of benefits for any construction schedule, but a speedup of the construction narrows this gap. For instance, with the 22 year schedule the present worth of the stream of construction costs was increased by $32.1 million while comparable increases for the 13 and 8 year schedules were only $27.7 and $22.4 million. This suggests a $10 million arguement in favor of speedup to the 8 year schedule if the current 1% differential in inflation rates continues. A higher differential would of course increase the advantage of completing construction as quickly as possible.

Hydropower inflation

The present worth analyses presented previously assumed a value of energy at 1978 levels (except that the 1% differential increase in construction costs indirectly reflects the impact of rapid inflation of

energy costs). Hydropower is an important fraction of total benefits (11 out of 55 million per year at full capacity) for the Bonneville Unit. The Diamond Fork Power Complex will generate 133 megawatts of power from the 2000 foot drop in elevation from Strawberry Reservoir to the valley floor in the Bonneville Basin. A pumped storage (recycling) alternative design which is currently being evaluated would increase this capacity dramatically and would have a very favorable impact on project benefits.

The benefits from power generation are therefore a very important part of this project. In order to evaluate the impact of a continued rate of inflation in energy costs (hydropower value) which is greater than that of consumer prices in general, the following present worth analysis was made: hydropower benefits were increased by 2% per year for 20 years (beginning in 1978) and other costs were kept unchanged. These results are also displayed in Figure 5. The hydropower benefits are increased by $30.5 million for the 22 year construction schedules and by $36 and $41 million for the 13 and 8 year schedules. This implies a $10.5 million advantage for speedup to 8 years at the assumed 2% inflation differential. If the pumped storage alternative is constructed, the earlier beginning of power benefits would have a much greater impact.

OTHER FACTORS EFFECTED BY CONSTRUCTION SCHEDULE

The above analysis from the economic efficiency perspective suggests an advantage to speeding up project construction to an annual funding rate reaching $112 million annually (solid line on Fig. 2). The question at this point is then whether the constraints to very rapid construction outlined in the introductory section would make it unadvisable to attempt this rate of construction in the case of the Central Utah Project.

USBR manpower considerations

The USBR work force assigned to the CUP consists of 120 persons total in the Provo and Duchesne (field offices). In addition, design administration work for the CUP is done by the Denver Center (major design) and the SCL Regional Office (administration and minor design items). The current annual cost chargeable to the CUP which is generated by this work force is about $4 million, about 3/4 of which is produced by the Provo and Duchesne Offices. This work force is currently administering a $30 million annual program (which includes the $4 million overhead).

USBR officials estimate that in order to gear up to construction at the $100 million plus level required by an 8 year completion schedule would require (during a 3 year transition period) 155 persons in the Provo and Duchesne offices (and comparable emphasis of CUP work in the SLC and Denver Offices).

The current federal manpower ceiling under which the USBR is operating clearly imposes an important constraint to such major staff increases in these offices. Adoption of the 8 year schedule would require either 1) special federal (congressional ?) approval for new hires in violation of

the manpower ceiling or 2) a major shift of personnel within the USBR region plus a shift between regions (requiring a lower level of effort in some other region). These measures would be required in addition to contracting as much design work as possible to private consultants. One additional approach to expediting preconstruction work would be to give the funds and responsibility for some portions of the project to the State of Utah, The Central Utah Water Conservancy District, or some other governmental entity. These more radical departures from past USBR practice, however, would in themselves take some time to arrange as a number of difficulties could be expected in working out the details.

Safety constraints

New USBR policy requires a technical review of all USBR dam designs by a non-federal organization. Also, under current policy some elements of actual design can be contracted to private consultants but the design of major dams cannot. These policies greatly limit the use of private consultants to expedite schedules on a project such as the Bonneville Unit which includes 12 dams. Rather, current policy requires USBR design plus a non USBR review--which implies longer than historic periods for final design.

The issue here is whether or not these restrictions (design must be done by USBR staff and outside reviews) with their associated time delays are really the most effective way to protect public safety. Certainly it would be possible for congress to revise these procedures, and surely there are faster ways to complete project design without endangering the public, but the development and implementation of a faster and yet safe design procedure is in itself a difficult and time consuming task.

Environmental Impact Statements and Other Pre-construction Work

Environmental Impact Statements are currently requiring at least one year to write and another year for approval. This assumes no challenges in the courts by environmental interests.

Again potentially, as in the case of the safety policy, congress could short cut these procedures, but it would be difficult to develop and implement quicker methods that would ensure protection of the environment.

One might expect that during the recent slow down in the level of construction appropriations, that the engineering force would have proceeded with such things as EIS preparation, gathering of design data (Provo Office), procurement of right-of-way, and final design (Denver Office) and that a back log of project design, would exist, in a form almost ready for construction bids. Unfortunately this is not the case. Funds to do these tasks are not made available to USBR until the funds for the facilities themselves have been appropriated. As a result, most of the remaining facilities still require development of design and environmental data, preparation of final designs and statements of the environmental impacts of those designs, review of the designs for safety and the statements for adequacy, and procurement of right-of-way before construction can begin. These tasks fall in a progression with each one building on the one before, and consequently much of the work on the later tasks must wait until the former tasks are completed.

This situation suggests that one way for congress to accelerate the construction schedule would be to appropriate all the money necessary to complete the above tasks as quickly as possible so that the entire project does not have to wait for their completion. Speeding up processes

where haste could threaten public safety or the environment is an altogether different matter than preventing delays caused solely by the agency waiting for the necessary funds to be appropriated.

Social impacts

Some have expressed concern that a dramatic speedup in the rate of project construction would not allow sufficient time for orderly economic growth. This would result in a large influx of transient workers into construction areas and would increase crime rates, insurance rates and problems associated with providing temporary housing, schooling, police and fire protection, waste treatment, etc.

The main advantages brought about by this rapid influx of people would be economic ones such as increased tax base, imployment and income. It would appear that the most desirable mix of indirect economic benefits to communities involved, minimization of social problems related to construction, and realization of direct benefits to local water users would be produced from a moderately accelerated but not overly rapid construction schedule.

Cost of Administrative Review of Projects

A very significant component of the total cost to society of such projects is the annual effort to justify a budget level and particularly the occasional major effort which is expended (by both pro and anti groups) when the question of whether to proceed or terminate the project is raised. For example, some of the cost generated by the administrative review of the Bonneville Unit during 1977 includes:

(1) Time and travel by CUPWCD personnel - $100,000

(2) Time and personnel of the USBR Provo Office (over 6 month period)- $200,000.

(3) An unknown amount spent by project opponents, by government officials at higher levels in the administration, and decision makers all the way up through the congress.

(4) Cost of inflation due to delay of construction ($653 million balance delayed 6 months at 6 percent annual inflation) = $19,590,000. The last item is a stream of future costs which should be discounted at 6 5/8% to determine a present worth (which would be much smaller than the $19 million shown but still would be millions of dollars). Very large projects such as the Bonneville Unit seem to experience major reviews periodically (usually 4 to 8 year intervals when new administrations begin). The major costs represented particularly by delays during inflationary periods would appear to represent an important reason to speed up completion, thereby minimizing the number of these reviews.

Geographic jealousies

Under the present construction schedule, the completion dates (and thus beginning of the accrual of benefits) of the various units of the CUP are spread over a long period of time. Because of this fact, feelings and jealousies have arisen among the groups of people to whom the benefits accrue, and these feelings are likely to grow and increase in severity until the project is completed. Some have already started to receive benefits, while others aren't scheduled to receive any until after the year 2000, and they consider this to be discriminatory. Some feelings exist also among people in the Uintah Basin about transporting their water to communities on the Wasatch Front. The sooner the construction can

be completed so that all concerned with the project start to realize actual benefits, the sooner these geographical jealousies can be laid to rest.

Of particular concern are the feelings and relationships between the Indians and non-Indians. Any acceleration of the construction schedule will serve to improve the delicate relationship that now exists, as a result of written but as yet unfulfilled promises to deliver to the Ute Indian Tribe the water to which it is entitled under the Winter Doctrine as recognized by the Deferral Agreement of 1965.

Unit notices and effect of inflation

Reclamation projects authorized during the past 25 years or so have tended to benefit agricultural users less than municipal or industrial users. The reason is the higher repayment capacity of the municipal and industrial sectors coupled with the rapid growth rates of urban areas in the Western U.S. The Bonneville Unit of the Central Utah Project is no exception in that the municipal and industrial benefits exceed the agricultural benefits ($24.3 as compared to $15.8 million per year). The repayment contracts for M&I waters reflect a high cost per unit of water used, generally higher than alternative local sources of water available for development by M&I users. Eventually with further growth, however, these sources will be exhausted, and the imported water will be needed. Any extra present cost may therefore be justified by inflation making future construction much more expensive.

It is the practice of the USBR to issue unit or block notices when parts of the project are completed and ready to be used. These notices inform those required to pay for the project that repayment is about to

begin and specifies the amount of payment and the due dates. The District is allowed a development period of from 10 to 20 years to sell the water and then has a time period to complete payment (usually 60 years from beginning of 1st payment). At the present rate of construction the Bonneville Unit would not be completed until the year 2000 and no block notices for M&I water could be issued before that time. The Jordanelle Dam, the Utah Lake dikes, and the Diamond Fork Plant must all be finished in proper sequence before any water can be supplied for M&I uses. There would appear to be a definite financial advantage if the project could be completed as soon as possible, thereby fixing the repayment structure at a level resulting from construction with less inflated dollars.

In order to determine the impact of speedup on cost of water the 8 and 22 year construction schedules will be examined. Rather than using 1978 dollar quantities, it will be necessary to estimate future inflated dollar final costs and income to the CUWCD.

If construction costs continue to inflate at a rate similar to the average rate since beginning the project (about 6 percent compounded) final construction costs will be $1,374 million for the 8 year schedule (1978) or $3,107 million for the 22 year schedule (2000).

With a 60 year repayment for reimbursible costs the annual quantities will be as follows:

Year	Annual Payment
1986	$22.9 million
2000	51.8 million

In order to meet these payments, the District will use income from their ad valorem taxing authority plus user fees. The annual income to

the District (at 2 mills) is currently about $4 million. If the tax base inflates at the same rate as the above costs, this tax will produce the following future amounts:

Year	Annual Tax Income
1986	$ 6.7 million
2000	15.1 million
2006*	21.5 million

*20 years after issuing unit notice for 8 year construction schedule.

Groundwater along the Wasatch Front currently represents an alternative source of water to CUP water. In Salt Lake County, this groundwater presently costs about $24 per acre foot. If energy costs inflate at the same rate assumed for other costs this source will cost $38/ac ft by 1986 and $86/ac ft by 2000. In order to meet the repayment schedule estimated above, CUP water will cost $73/ac ft if costs are fixed at the end of the 8 year schedule (1986) or $165 if fixed at the end of the 22 year schedule. These figures include only USBR construction costs, thereby ignoring treatment and other O&M district costs but do show the dramatic impact of construction speedup. The district tax itself will almost meet total federal reimbursible costs 20 years after the 8 year completion (repayment doesn't normally begin until 10 to 20 years after issuing block notices). The user fee charges would in this case be needed only for operating costs and additional treatment and distribution system construction costs. Also, it appears that CUP water could compete with local groundwater costs by the year 2000 <u>if</u> the project is complete and costs are frozen after the 8 year completion schedule but would not compete for many more years if a 22 year schedule is followed.

SUMMARY

Factors Favoring Speedup in Funding Level

From the perspective of the residents of the 10 counties in Utah which will receive water from CUP facilities, there are very compelling reasons why the project should be constructed at an accelerated schedule (see the discussion of cost of project water as impacted by timing of unit block notices). This report, however, has for the most part approached the economic analysis from the perspective of the United States taxpayers rather than that of Utah residents. Even from this national perspective, given the decision that the CUP will be completed, there are economic efficiency and non-economic reasons to complete it more rapidly than the current funding level will allow. These factors include the following:

(1) The economic efficiency analysis included in this report shows that if the inflation rate differentials between heavy construction, consumers prices and energy costs continue either at the rates of the last decade or at increased relative rates, the project should be completed as rapidly as is practical. If the economy were shifted to a non-inflationary or deflationary mode, then the present worth analysis would no longer provide a reason for speed up but employment of manpower might then become a dominant reason for speedup. The above economic analysis (given persistance of current inflation trends) would suggest that the optimal completion schedule is the shortest possible (such as the eight year schedule identified in Figure 2). However, the difficulties in achieving such rapid construction suggest a more moderate acceleration may be optimal.

(2) An important social difficulty related to any major water importation scheme is the negative reaction of residents of the basin in which

water is produced. The approach to ameliorating these feelings in the case of the CUP has been the promise of additional development within the water source region (the Uintah Basin) as part of the overall development. However, when these promises were made based upon one schedule and then appropriations are not forthcoming to meet that schedule, many kinds of intrabasin as well as interbasin jealousies are generated. Within the Uintah Basin a CUP ad valorem tax protest is currently in progress, the objective of which is to produce higher priority for the Upalco and Uintah Units relative to the Bonneville Unit (the exporting unit). Whether or not this is justified (the Bonneville Unit also includes many developments for the Uintah Basin, some of which are already completed) the intrabasin jealousies represent a serious problem. Other sources of friction are related to the relative progress on the Indian and non-Indian facilities and on Duchesne County vs. Uintah County facilities. The common factor which ties all of these social difficulties together is that accelerated construction of all units of the CUP would minimize such problems. This seems to represent a major arguement for rapid construction.

(3) Delays which generate additional overhead costs and major inflation in construction costs are caused by occasional major administration reviews of long term projects such as CUP. These can be minimized by completing the project as rapidly as possible.

Factors which tend to constrain very rapid completion of the project include the following:

(1) The current federal manpower ceiling represents a major deterrent to the 8 year completion schedule. Adoption of this schedule would require federal approval to ignore the limitation on new hires or some other special arrangement. The 13 year schedule, however, could likely be accomplished by merely changing personnel assignments within the USBR.

(2) Even without a manpower ceiling, an important constraint to extremely rapid but safe design and construction of the many dams required, is the availability of many additional highly trained specialists in soils and structural engineering. The increased emphasis on safety of USBR dams requires that most of this work be done "in-house" by the Bureau and that outside design reviews then be accomplished. Since the eight year schedule would require almost simultaneous design of all facilities, including dams, this appears to represent a major constraint.

(3) The eight year schedule could be achieved only if there are no environmental or water right challenges or that any litigation be quickly decided in favor of the project. This does not appear to be a reasonable assumption.

(4) An extremely rapid construction schedule would undoubtedly limit time for coordination with other developments such as energy production facilities and recreation facilities which otherwise could use project water, and could have a negative social impact upon small communities which would have to temporarily supply services for construction workers.

CONCLUSIONS

It appears that a realistically achievable level of financing for the Bonneville Unit (in 1978 dollars) is $60 to $70 million per year until completion. Even so pre-construction planning, design reviews to protect public safety, environmental analysis, right-or-way purchase, etc. will cause a two-year delay before this rate can be achieved. This construction rate represents a schedule between the 8 and 13 year curves of Figure 2 and would complete the unit in 10 to 11 years (about 1988). Other units of the CUP which were not analyzed in this report should receive comparable

acceleration in schedules. This recommendation is based upon what appears to be a reasonable compromise between economic efficiency, quicker realization of benefits, adequate time for the deployment of personnel to make sound and safe design decisions, and adequate consideration of environmental issues.

A very important point to make here is that it will not be possible to achieve a faster rate of project construction than that recommended in the preceding paragraph by simply increasing the annual funding authorization. Special actions will be needed to overcome the manpower limitations placed on the USBR for necessary planning and construction supervision, to expedite currently required reviews to ensure dam safety and protect the environment, and to provide for construction workers at remote sites. Threatening court cases will have to be closely watched; and unless they can be forestalled, the effort to complete the project sooner will be in vain. Possible actions for overcoming some of these difficulties are discussed in the body of the report.