Chapter 7.
Economic, Financial, and Environmental Considerations

This chapter summarizes significant economic, financial, and environmental considerations of the CRRP. More specifically, it presents general economic effects of the CRRP and compares the relative costs and benefits of the CRRP to the alternative water supply options identified in Chapter 2, presents a preliminary financial assessment of the CRRP and characterizes the environmental effects of the CRRP alternatives. Five alternative pipeline alignments are used in these evaluations; one alignment from the Northern corridor and two each from the Central and Southern corridors.

Pipeline Alignments Used for More Detailed Evaluation

Chapter 6 presented estimates of construction and operating cost for 31 pipeline alignments. Many of the alignments in each corridor have long reaches in common with short variations due to local conditions. ***Five of these initial alignments were selected as being representative examples of the range of possibilities in the three corridors and allowed more detailed assessment of likely economic, financial and environmental conditions.*** These five alignments should not be considered recommended alignments; they should be considered only as alignments that generally represent the broad range of alignments that could be considered in each of the corridors. The major distinguishing characteristics of the alignments in each corridor are presented next.

Northern Corridor

The northern corridor alignments share many common reaches with variances occurring in only a few localized areas such as near the Demaree Canyon Wilderness Study Area and between Dunckley and Kremmling as can be seen on Figure 6-1. Since variances are only in relatively localized areas, only one sample alignment was used from the northern corridor.

Central Corridor

The central corridor alignments follow a relatively common reach from the diversion area toward De Beque, where they begin to diverge into two categories of alignments as can be seen on Figure 6-3. The first category follows much of the I-70 corridor to the delivery points. The second category generally follows a more direct path to the delivery points along Plateau Creek to Carbondale and then along the Roaring Fork River to the delivery points. One alignment from each category was carried forward from the central corridor.

Southern Corridor

The southern corridor alignments follow a relatively common reach from the diversion area toward Delta, where they begin to diverge into two categories of alignments as can be seen on Figure 6-5. The first category stays

north of the West Elk Wilderness Area and heads east toward the delivery points. The second category travels south of the West Elk Wilderness Area and heads east towards the delivery points. Unlike the other corridors, opportunities for connection between the two categories of alignments were identified between the West Elk Wilderness Area and the Fossil Ridge Wilderness Area. This potential connection could result in many more combinations of alignments than were identified in the other corridors. One alignment from each of the two main categories were carried forward from the southern corridor.

Cost Summary

The project costs for five alternatives are listed in Table 7-1 below. Economic performance of the CRRP and comparisons with other alternatives that may be used to supply Colorado's future water needs are discussed in the following section titled Economic Considerations. The affordability of the CRRP is discussed in the Financial Considerations section of this chapter.

Table 7-1: Cost Summary

Alternative	Total Capital Cost ($ in Millions)	Unit Capital Cost* ($ per af)	Annual O&M Cost ($ in Millions)	Unit O&M Cost* ($ per af/year)
250,000 acre-feet per year Delivery Capacity				
Northern Alignment 1 - N01	$ 6,159	$ 24,637	$ 257	$1,026
Central Alignment 1 - C01	$ 3,667	$ 14,668	$ 221	$ 885
Central Alignment 2 - C05	$ 3,672	$ 14,689	$ 230	$ 920
Southern Alignment 1 - S01	$ 3,862	$ 15,449	$ 201	$ 803
Southern Alignment 2 - S02	$ 3,821	$ 15,286	$ 196	$ 784
500,000 acre-feet per year Delivery Capacity				
Northern Alignment 1 - N01	$ 10,117	$ 20,235	$ 488	$ 967
Central Alignment 1 - C01	$ 6,016	$ 12,032	$ 419	$ 838
Central Alignment 2 - C05	$ 6,137	$ 12,274	$ 445	$ 891
Southern Alignment 1 - S01	$ 6,613	$ 13,226	$ 375	$ 750
Southern Alignment 2 - S02	$ 6,546	$ 13,093	$ 365	$ 730
750,000 acre-feet per year Delivery Capacity				
Northern Alignment 1 - N01	$ 15,093	$ 20,124	$ 721	$ 961
Central Alignment 1 - C01	$ 8,687	$ 11,583	$ 618	$ 824
Central Alignment 2 - C05	$ 8,773	$ 11,697	$ 658	$ 877
Southern Alignment 1 - S01	$ 9,653	$ 12,871	$ 567	$ 756
Southern Alignment 2 - S02	$ 9,669	$ 12,892	$ 537	$ 717
Total Capital Cost – construction, land, engineering, and contingencies (including environmental permitting)				
Unit Capital Cost - total capital cost divided by the project delivery capacity				
O&M Cost - total annual operating and maintenance costs at full capacity				
Unit O&M Cost - total annual operating and maintenance costs at full capacity divided by the project delivery capacity				
Alternative Descriptions *- The alternatives consist of the following segments as shown on the figures in Chapter 6:*				
Northern Alignment 1 - N01 - NC1-NC2-NC4-NC5-NC7-NC8-NC11-NC13-NC15-NC17, NC18				
Central Alignment 1 - C01 - CC1-CC10-CC13-CC11-CC6-CC3-CC4, CC8				
Central Alignment 2 - C05 - CC1-CC10-CC14-CC12-CC16-CC17-CC18-CC22-CC23-CC20-CC21				
Southern Alignment 1 - S01 - SC1-SC16-SC18-SC25-SC26-SC28-SC22-SC24				
Southern Alignment 2 - S02 - SC1-SC2-SC4-SC5-SC7-SC8-SC10-SC11-SC13-SC14-SC15				

* See the Financial Considerations section of this chapter regarding the affordability of these unit costs.

Economic Considerations

General Economic Benefits of the CRRP

In terms of economic benefits, the chief and unique attribute of the CRRP is that it does not mean a sacrifice of water supplies for others in the state of Colorado. That is, the CRRP will not take water supplies away from existing agriculture, the West Slope, urban users or groundwater users. It is assumed these supplies for the CRRP are excess to Colorado's current water use, so there will be no charges or payment required to obtain these supplies. However, use of this supply for the CRRP precludes future use of this water elsewhere in Colorado. Colorado's total Colorado River Compact entitlement in relation to the amount of water available in the mainstem near the Utah state line is subject to interpretation; the amount of the total compact entitlement that is taken from the Colorado River mainstem will directly affect the developable compact entitlement for the Yampa, White, Dolores, and San Juan basins. It is assumed that the CRRP diversion would be accomplished under state water rights as a new appropriation.

Other economic benefits are noteworthy. The magnitude of construction expenditures on pipe, plant and equipment will generate considerable sales and use taxes of $390 million total over the five years of construction and property tax revenues of $12 million per year for state and local governments. Construction employment will be significant during the construction period, and indications are that workers skilled in the relevant trades will be absorbed first from the local workforce along the pipeline corridor and then throughout the state. Total employment gains of 18,000 persons are possible during the five years of construction and of 1,000 persons during operations. It is possible that a pipe construction plant will be built in Colorado to accommodate this project, representing a longer-term economic stimulus in terms of property taxes, sales and use tax, and employment. A major boost to aggregate mining activity may occur as the pipeline constructors search for bedding along the pipeline route. State personal income tax revenues will increase.

It is anticipated that the operations and maintenance crews and expenditures will be significant throughout the life of the CRRP, which will represent a significant ongoing economic benefit. Additionally, there will be a notable opportunity for the coal and natural gas sectors to boost employment and output in Colorado to provide energy for the operations of the CRRP, which will be another ongoing economic benefit of the project. This increase in energy production will also create additional personal and business income taxes for the State.

This pipeline corridor could also be used for multiple economic purposes. For example, telecommunications, such as fiber optics or other utilities, may wish to take advantage of this right-of-way across Colorado. Secondly, the excess water from the water treatment plant could be considered for use in advanced oil recovery techniques or as liquid medium in a coal slurry pipeline to in-state or out-of-state locations. Therefore, corollary benefits might occur outside the Front Range or the Pipeline Corridors.

Mixed Economic Effects of the CRRP

With the substantial construction workforce comes an economic stimulus in terms of their purchases of housing, goods and services up to a point, then becoming a cost. If the capacity of public facilities and services along the pipeline corridor are absorbed, the socioeconomic effects will represent costs in terms of expansion of public facility and service capabilities. Housing markets can also be overburdened if appropriate measures are not taken to provide temporary housing and other facilities during the construction of the CRRP.

Social costs of the CRRP will be evident as various stakeholders face the magnitude and the uncertainty that CRRP represents. There is no precedent in Colorado for a water resource development of this size. CRRP also has the opportunity of producing social benefits with a vast reduction in the conflicts, disagreements and competition associated with current water resource development. The extraordinary amount of planning time, studies, and litigation associated with water resource development over a period of many decades might be reduced and funneled into one, large project.

Environmental resource costs are unknown at this time but might be considerable. The pipeline right-of-way could cause a diverse set of environmental resource losses, some of which will be temporary and others of which might be permanent. Construction disturbance will have its own set of impacts on the environment. The water treatment plant and the removal and disposal of the sludge remain an environmental question, as does the disposal of excess excavated material.

Environmental benefits, if there are any, from CRRP can be found in the avoidance of numerous and fragmented water resource development projects across the state over the next 50 years. It is unknown whether the cumulative amount of such damage exceeds that of CRRP. Secondly, new waters to the consuming regions will mean more discharge, potentially improving habitat downstream.

Economic Costs

In economic terms, there is a potential opportunity cost to Colorado water users because the water that would be committed to the CRRP could not be used for other purposes. Since this study assumes that CRRP waters are excess Colorado River allocation supplies, this opportunity cost might not be a consideration, except for downstream water users outside of Colorado. The disturbance of rights-of-way and land for water treatment and diversion facilities, pipelines and pumping stations represents an opportunity cost to those landowners, but these costs would be compensated by CRRP owners. An important economic cost or effect might be a reduction in water prices for agricultural and other water rights. Demand will clearly diminish for these alternative water supplies, and those water rights owners might experience substantial declines in the value of their water rights assets.

Another important economic impact may be additional wear on the Federal, state and local transportation roadways. A large number of trucks will need to carry pipe and bedding material to the pipeline construction sites and haul away excess fill. Congestion and roadway damage might be considerable depending on the alternative chosen. Tax revenue increases related to CRRP might be available to pay for increased road costs.

Comparisons with Other Water Supply Alternatives

Following is discussion of the costs and benefits of the six water supply alternatives to the CRRP the Project Team evaluated. These alternatives are discussed as alternatives separate from CRRP, and the effects of CRRP on these alternatives are not considered. Chapter 8 presents conclusions regarding the comparisons of the CRRP with these alternative sources of water.

Agricultural To Municipal Water Rights Transfers

Agricultural to municipal water transfers can be viewed in two categories. Some occur as urbanization encroaches on historically irrigated lands. Others involve the retirement of land in rural, agricultural areas where socio-economic impacts can be significantly greater. The comments below focus on the second category.

Beyond the direct costs of acquiring senior agricultural water rights and conveying them to the point of municipal use, there are other economic costs of resources that occur when transferring agricultural water rights. The area near the water diversions may experience third-party economic effects or impacts. First, indirect effects may occur to businesses and employees that depend directly upon agriculture (i.e., farm employees, seed companies, implement dealers, etc.) from a loss of business or income as land is converted from irrigation to dryland. Secondly, induced economic impacts occur as retail businesses and services in the farming communities or service centers may experience a loss or a change in economic activity. This change could mean reduced business revenues, threatening the viability of businesses, a reduction in employment, and a loss in personal income. Other commitments of economic resources include decreases in local tax revenues.

Social costs of agriculture to municipal water rights transfers have received considerable attention in areas where water diversions are considered. The threat is that the so-called third-party impacts, or loss of business activity and economic viability, could mean the out-migration of businesses and individuals and related resources such that communities or even counties or regions become threatened. The elimination of local water institutions, such as ditch companies, can also have potentially negative social effects on community cohesiveness.

Environmental issues can also represent important costs or resource commitments. Changes in points of diversion and reduction of return flows can affect the dilution effects of downstream discharges or pollutants. The quality and timing of baseflows in streams and rivers downstream can also be affected if the transfer is not limited to historic crop water consumption or if augmentation plans are not adequately implemented. Effects can also include wetland losses and reduced groundwater recharge. The streamflow changes can also have adverse effects on wildlife habitat. The change in timing and magnitude of downstream flows can have negative effects on recreation and tourism. Further, dust, erosion and weed problems can also ensue when irrigated land is dried up and effective mitigation does not occur.

Conversely, environmental resource benefits can also accrue. Agricultural return flows, substantially reduced by agriculture to urban transfers, can include fertilizers and other polluting agents leached from the soil. In a cumulative stance, these flows can have negative impacts on the watershed.

Non-Potable Water Reuse

In terms of economic costs of non-potable reuse, farmers and other downstream users who might have availed themselves of effluent flows might now be cut off or limited in such use. Recreational water users and their associated economic benefits would be similarly affected.

Resource benefits of non-potable water reuse in economic terms are primarily related to efficiency: water that was allowed to go downstream for more marginal uses is redirected to higher-valued industrial and municipal uses, supplanting the need for treated potable water. The construction of local water reuse plants also provides an economic stimulus from construction-related expenditures.

Social benefits of non-potable water reuse are limited to public acceptability regarding the safety or desirability of utilizing this resource. This might change over time. Social resource benefits occur because the municipality is able to utilize more of its own resource without disturbing another entity's water supplies. No other basins or stakeholder groups are affected, other than downstream users.

Environmental resource costs for non-potable water reuse come into play with the changing of historical patterns of return flows; wildlife habitat and water quality might be affected. Environmental resource benefits will accrue to the facilitation of maintaining water supply for open space and other public lands, especially during times of

shortage. Since potable and non-potable resources are used for different purposes, water resource planners are not required to decide between irrigation of local parks versus other water uses in times of shortage.

Water Conservation

Economic costs of water conservation come in the form of reduced revenues for water utilities. In the long run, additional customers help pay the conservation costs, but in the short run, water rates must be increased to meet fixed utility costs.

From an economic standpoint, the efficiency benefit is most pronounced. Consumers are asked, convinced or offered incentives to save water and still accomplish the purposes of the water use. This evaluation assumes that austere conservation programs common in droughts are not applied as a baseload resource (i.e. basic conservation is always encouraged, but strong conservation campaigns are reserved for drought conditions); outdoor or indoor water uses are assumed to accomplish the goals of attractive lawns and sufficient indoor water needs. Water utilities and providers avoid the need for expanding water resource supplies, as well as municipal water systems, if the conservation programs are successful.

Social costs and benefits are relatively inconsequential with water conservation. Fairness issues are always possible with conservation as a cost or divisive element among different water users. For instance, saving water so that future users may avail themselves of the conserved water can be grating to existing customers. However, some sense of contributing to the public good might be attributable to water conservation, as well, which could balance any costs.

Environmental costs can result if the conservation efforts result in reduced return flows.

New Storage

As in past periods, many new storage projects are currently in various stages of planning, permitting, and design throughout Colorado. The costs and benefits vary, of course, by location and by project size and the nature of these resource commitments and benefits are well recognized.

Depletion of water resources is a common concern with new storage projects. The inundation of lands, disturbance of lands near the reservoir, and downstream effects represent economic resource commitments or costs. Inundated areas, in some instances, contain homes, businesses and other beneficial land uses that are lost with the project. Nearby lands, businesses and other activities might be adversely affected by the loss of stream-based activities or other land uses in the inundated areas. Third-party impacts might follow from the changes faced by those inundated or affected nearby. Property and sales tax revenues might be adversely affected, as well. Construction activities can also be disruptive to other businesses in the region.

The economic benefits from a new storage project include an efficiency consideration through capturing floodflows or excess runoff and storing the water for use when needed. The gain comes in the form of an absolute increase in firm annual yields for use in dry periods of the year or in drought or to meet baseload water demands. Additional economic contributions stem from the stimulus of construction expenditures, including employment and income benefits. Flood control, potential revenue from power generation, and recreational and tourism benefits from flat water recreation are other common benefits or contributions from new storage. During the operational phase, a small number of local employment opportunities are created to maintain and operate the water supply system, and potentially more employees are required to operate the flat water recreational facilities.

The social costs associated with increasing storage capacity revolve primarily around the displacement of homes and businesses in the inundated areas. There can be a loss of community and a disruption in the local social

structure with such a major physical change in a local area. In addition, the presence of construction workers can increase burdens on public facilities and services, including transportation networks and housing.

The environmental resource commitments from developing new water storage facilities are considered extensively in the NEPA process, which is often associated with the development of new water storage. Habitat losses, wildlife losses, loss of aquatic resources and other ecosystem resource commitments can occur in the inundation area. The change in downstream flow patterns can also result in environmental costs in terms of aquatic resources, habitat, vegetation and wildlife, although benefits can also accrue in the form of greater streamflow regulation. Environmental benefits with new storage are uncommon.

Transbasin Diversions

Transbasin diversions are a special case of water resource development. They may include agricultural to municipal water rights transfers and/or water storage, but these elements are discussed separately. In terms of resource commitments, transbasin diversions represent a special case that raises water resource issues apart from other alternatives. The primary consideration in evaluating resource commitments in transbasin diversions is that few, if any, benefits accrued to the diversion area, while almost all of the benefits accrue to the area of use.

The economic costs draw a distinction between diversion areas versus area of use. From the standpoint of the diversion area, the loss of this water can mean an opportunity cost in which future water use and related economic development does not occur.[1] Without water, the growth potential or economic evolution or even economic control of the diversion area can be perceived to be sacrificed to the area of use. From the standpoint of the area of use, this transbasin diversion appears to be a benefit or gain in economic efficiency where underutilized or unused water supplies are put to high-valued beneficial use.

The loss of control of water resources can lead to a social cost, or an altered social evolution as perceived by the diversion area. The social structure from a culture that highly values water resources for cultivation or recreational use may be modified or diminished without control over those water resources. For example, the attraction of visitors and Front Range individuals wanting a second home in the mountains might be dependent upon the aesthetic attraction of the headwater counties, which is partially attributable to their available water supplies. Further, simply loss of control over a region's fate can cause considerable social anxieties among its population.

Environmental costs or resource commitments follow from transbasin diversions. Historically, streamflow regimes have been altered, and associated ecosystem effects have occurred as water is managed for diversion to basins of use. Habitat, wildlife, aquatic resources and vegetation can be affected.

Non-Renewable Groundwater

Groundwater development can also be scaled to match water requirements unlike most other developments of physical supply. Groundwater can also be utilized as storage in a recharge or conjunctive use program with excess floodwaters. The chief drawback is the uncertain and finite availability of this water resource in areas where it can be put to beneficial use in Colorado.

The economic resource commitments or costs of groundwater development relate first to the use of a non-renewable resource. Some believe that such a resource should be saved for various high-valued uses and viewed as an insurance policy (i.e., when other resources are unavailable). To the extent that non-renewable groundwater is used not as a resource of last resort, it represents an opportunity cost to those higher-valued future uses and users. Furthermore, replacement supplies must be developed as groundwater sources are depleted.

[1] For example, transbasin diversions may dry up fruit orchards or vineyards or harm water quality in the Grand Valley.

Other economic costs can be expenditures or losses that accrue to other groundwater users drawing from the same aquifer. These costs can include increased pumping costs, redrilling or redevelopment of wells, or reduction in water quality as a result of additional groundwater development.

Social costs stem from this uncertainty. The utilization of a non-renewable resource with an uncertain quantity creates a sense of precarious water resource policy. For instance, when non-renewable groundwater is depleted, this creates new water supply needs just to meet the immediate needs of existing customers. This feeling may be compounded by the uncertain effects on others who depend upon the aquifer.

Environmental costs might relate to aquifer dewatering, although these issues might be slight if no interaction with the surface can be proven. In fact, environmental benefits or contributions might be demonstrated by increasing streamflows with the return flows of groundwater use. Aquatic resources, habitat, and wildlife and downstream users might benefit from such increased streamflows.

Financial Considerations

One of the key questions surrounding the CRRP is whether it is financially feasible. The capital and annual operating costs described at the end of Chapter 6 and the beginning of this chapter are of such a magnitude that the CRRP must be viewed in relation to its potential to supply much of Colorado's water needs for several decades. Since the CRRP could satisfy the bulk of Colorado's water demand into the foreseeable future, and preliminary water demand projections indicate that future water users in the three river basins will need this supply within the next 20 to 50 years, the more pressing questions become, "Can these water users pay for the CRRP?" and "Are the rate increases reasonable in relation to the system development charges (tap fees) and water rates that consumers will likely have to pay for increasingly expensive water sources?"

Methodology And Assumptions

The financial feasibility of the CRRP is initially characterized by evaluating present value costs and then by identifying the system development charges (SDCs) and water rate increases that would be required to pay for CRRP. This assumes no public funding; customers in the water consuming demand areas are assumed to pay all of the costs.

The financial analysis uses the capital and operating costs presented in Table 7-1, along with the household and water demand projections discussed in Chapter 3 and project financing assumptions identified in the subsequent paragraph. Interest during construction was capitalized into the bond issues which would begin repayment upon project completion. Annual debt service from capital repayment and interest was added to annual operating costs, whose pumping components increase as deliveries grow to meet demand. Annual operating costs are inflated by three percent per year. These total revenue requirements are met by an equal proportion of tap fees or system development charges (SDC) and water rates. The SDC's and the water rates are computed to equal the total revenue requirements.

A series of 40-year bond issues are staggered to meet the capital obligations during an estimated five-year construction period. The borrower is assumed to be the State of Colorado, although a water authority made up of water providers with sufficient bonding capacity could also serve as the borrower. A revenue bond will probably be required, pledging future revenues to retire the debt. As of early October 2003, the tax exempt interest rate is assumed to be 5.2 percent. An additional one-time charge of 3.25 percent in origination, underwriting and

insurance costs are also assumed to achieve an "A" credit rating. The repayment schedule assumes the creation and maintenance of a reserve fund to provide debt service coverage at a ratio of 1.25.[2]

In the analysis, revenue requirements projected in nominal or current dollars were then discounted back to constant 2003 dollars so that water rate and SDC increases could be compared meaningfully with 2003 charges that exist along the Front Range of Colorado. Based upon a survey of major Front Range water utility rates and SDCs, it was determined that typical annual water rates per single family tap equivalent are about $350, and typical SDC charges per single family tap amount to $5,000.[3] A single family tap equivalent, or SFTE, incorporates commercial water users (i.e., a commercial water user consuming five times as much water as a residential customer would pay five times as much of a water bill both in SDCs and monthly charges).

Present Value Costs

The CRRP capital costs and operating costs must both be considered for a complete picture of the project's financial performance. Two ways of expressing these combined are presented below:

1) capitalizing the operating costs and combining those with up-front project development costs into a single figure; or

2) annualizing the capital costs and combining those with annual operating costs.

In the first case, future operating and maintenance costs are discounted back to present value; in the second case, debt service for the up-front capital costs are added to annual operating costs, and then these annual costs are discounted back to present value and divided by water deliveries to arrive at an annual cost per acre foot, inclusive. The results are set forth in Table 7-2 below.

[2] The Project Team understands that there are numerous funding options for the CRRP but has chosen this one funding scheme to explore at this reconnaissance level the financial feasibility of the project. Other entities could fund this project at different interest rates using different bonding mechanisms. This one scheme is presented only by way of example.

[3] The Project Team did not perform a similar survey of water rates for Corridor water providers.

Table 7-2: Total Present Value CRRP Costs

Route and Delivery Capacity	Total Capitalized Costs (millions)	Average Annualized Cost per af
250,000 af/yr		
Northern Alignment 1 - NO1	$ 11,900	$ 3,600
Central Alignment 1 - CO1	$ 8,600	$ 2,600
Central Alignment 2 - CO5	$ 8,800	$ 2,700
Southern Alignment 1 - SO1	$ 8,100	$ 2,500
Southern Alignment 2 - SO2	$ 8,300	$ 2,500
500,000 af/yr		
Northern Alignment 1 - NO1	$ 20,600	$ 3,700
Central Alignment 1 - CO1	$ 14,700	$ 2,800
Central Alignment 2 - CO5	$ 15,000	$ 2,900
Southern Alignment 1 - SO1	$ 13,400	$ 2,500
Southern Alignment 2 - SO2	$ 13,900	$ 2,600
750,000 af/yr		
Northern Alignment 1 - NO1	$ 26,800	$ 5,000
Central Alignment 1 - CO1	$ 19,800	$ 3,700
Central Alignment 2 - CO5	$ 20,200	$ 3,700
Southern Alignment 1 - SO1	$ 18,300	$ 3,300
Southern Alignment 2 - SO2	$ 19,000	$ 3,400

For comparison purposes, water is currently being purchased for approximately $22,000/af of firm yield (Colorado-Big Thompson Project Water in the South Platte River Basin). Using the lowest capitalized cost for 500,000 af in Table 7-2 (Southern Alignment 1), the equivalent unit cost would be $26,800 per af or 22 percent higher than C-BT. Of course, there is not an additional 500,000 af of yield available from the C-BT project and by state law and contractual requirements, C-BT project water can only be used within the boundaries of the NCWCD. C-BT prices have significantly outpaced inflation compared with the price a couple decades ago. Therefore, future affordability of the CRRP may be competitive with other options. Another way of viewing the current price for water (using C-BT to represent the current marginal cost of water) is to consider that the total cost to acquire 500,000 af of yield from other sources would be $11 billion.

A key issue with the CRRP, is its long-term operating costs that extend beyond the 40-year financing period. Therefore, the financial feasibility of CRRP must be determined by water utilities and others needing water as they compare the costs and attributes of CRRP with the costs and attributes of other alternatives available to them, which differ from utility to utility. As of 2003, CRRP is more expensive on an apples to apples basis than most alternatives that are presently purchased by water purveyors. However, in reviewing the CRRP's financial feasibility one should also consider that:

- Colorado's long term future water needs are considerable;
- The real price of water will likely continue to rise;

- The prospects of available alternatives are unknown, but yields might be finite; and
- The planning period for a project of the CRRP magnitude will be long.

There have been other water and public works projects in the U.S. requiring major investments and long-term development programs. The Central Arizona Project cost four billion dollars in up-front costs alone with construction beginning in 1973; pumping costs are also substantial. The California Bay-Delta Program or CALFED has 2002 annual funding of approximately $800 million per year, similar to the annualized costs of the CRRP 500,000 af/yr delivery scenarios, exclusive of the northern routes.

Impacts on Water Rates and System Development Charges

The results of the financial analysis indicate that substantial, but perhaps not overwhelming, increases in water charges would be required to pay for the CRRP. By the year 2015,for the Central Corridor, annual revenues from water rates have to increase by $162 per SFTE in 2003 dollars for the 250,000 af delivery scenarios. The Northern Corridor would require greater water rates and SDC increases, but the Southern Corridor would require smaller increases. Tap fee or SDC charges would have to increase $2,316 over the current $5,000 dollar SDC amount. These changes would represent a 46 percent increase for customers in that year. As the customer base grows, the total increases per customer will decline so that in the year 2050, water consumers would experience 23 percent greater water rates and SDC charges as compared with the 2003 rates, expressed in 2003 dollars. The more costly, higher delivery capacity scenarios are more cost efficient on a dollar per acre foot basis, but create a greater financial burden for the customers who must pay for unused capacity in the early years of the project. Hence, the 250,000 af delivery scenario is the most affordable for its customers. Table 7-3 depicts results for the three different delivery scenarios.

Table 7-3: Summary of Preliminary Financial Impacts of CRRP, Assuming the Central Corridor, by Delivery Scenario

	Years After Project Completion		
	Five	Twenty	Forty
Required Increases per SFTE 2003 Constant Dollars			
250,000 af/yr			
Water Rates	$162	$121	$82
SDCs	$2,316	$1,726	$1,166
500,000 af/yr			
Water Rates	$297	$221	$150
SDCs	$4,248	$3,166	$2,139
750,000 af/yr			
Water Rates	$397	$296	$200
SDCs	$5,663	$4,220	$2,851
Percent Increases Required in Water Rates and SDCs per SFTE, Compared to 2003*			
250,000 af/yr	46%	34%	23%
500,000 af/yr	85%	63%	43%
750,000 af/yr	113%	84%	57%

* Applies required dollar increases to typical 2003 water rates of $350 per SFTE and $5,000 SDCs per SFTE.

Note: SFTE is single family tap-equivalents. SDCs are system development charges or tap fees. The least expensive central corridor alternative was selected for this financial evaluation. The other alternatives would involve greater financial impacts than presented here.

Assuming the Central Corridor is selected for the 250,000 af delivery scenario, present and future customers in the water demand areas would pay water rates and SDCs strictly to pay for the CRRP that increase one percent per year.

It is important to note that the total financial burden on a per customer basis decreases with the growth of new customers and total water use in the demand areas in Colorado. The financial challenge is the debt service burden of the project in the earlier years. This burden is less as the delivery scenarios diminish in size.

Environmental Considerations

Several significant environmental issues could be constraints to development of the CRRP (see Table 7-4). Some of these issues, could be resolved with changes in the location of CRRP features (e.g., adjustments to preliminary pipeline alignments or diversion location). Other significant environmental issues are unavoidable and likely would create substantial hurdles to CRRP development (e.g., changes in flows in designated critical habitat of federally listed fish species, and issues associated with water treatment facilities). Presented below are a summary of the most significant environmental constraints and additional information related to ESA, NEPA, and CWA compliance.

At the reconnaissance level of this preliminary environmental evaluation, the following environmental issues appear to be potentially significant environmental constraints for the CRRP:

- Potential conflicts with the current management of some public lands that the preliminary alignment alternatives would cross. The most significant of the potential public land management constraints are wilderness areas, roadless areas, and lands designated for no surface occupancy. Although all of the preliminary pipeline alignments pass through some of these restricted lands, it appears that the preliminary alignments can be refined to avoid public lands with these restrictions.

- One of the preliminary diversion location occurs within the Colorado Canyons National Conservation Area, which is designated for no surface occupancy. It may be possible to receive a variance from this designation from the BLM for construction and operation of the diversion and construction of the pipeline that will connect to the diversion. It also may be feasible to move the diversion location upstream and outside of the Colorado Canyons National Conservation Area.

- Diversions from the Colorado River will affect flows and potentially affect designated critical habitat for federally listed fish species below the diversion. At any of the diversion rates, the diversions would affect U.S. Fish and Wildlife Service flow recommendations for the recovery of the listed fish. Any level of diversion during less than average or average peak flow events would affect the peak flow recommendations. This means that in most years diversions would need to be curtailed in June to meet the peak flow recommendations. The maximum potential rate of diversion (1,050 cfs) would impact the flow recommendations during January and February, and would need to be curtailed if the flow recommendations are to be met.

- Federally listed fish, particularly larval life stages, could be entrained in the diversion constituting "take" under ESA. Entrainment could be minimized through the use of screens.

- The diversion could form a barrier to the movement of federally listed fish. It is possible to design the diversion to minimize its effects as a barrier. Fish passages have been successfully implemented for diversions on the Colorado and Gunnison Rivers.

- The importation of water diverted from the Colorado River potentially could affect receiving waters on the east side of the Continental Divide. These potential impacts could include changes in water quality (including temperature, increased flows that alter aquatic habitats, erosion and effects to channel stability, and importation of aquatic organisms and disease).

- Water treatment Alternatives 1 and 3 would involve about 22 square miles of evaporative ponds. These extensive evaporative ponds will attract waterfowl and shorebirds. The ponds will concentrate contaminants in the treated waste stream. It is likely that the evaporative ponds will concentrate selenium, which at concentrated levels is known to be deleterious to waterfowl. In similar situations, such as the Kesterson National Wildlife Refuge in California, it has been infeasible to keep waterfowl and shorebirds from using the contaminated evaporative ponds.

- Water treatment Alternatives 2 and 4 do not perform as well in meeting the treatment goals as the membrane processes. The ability of these processes to meet overall treatment goals may be dependant on dilution ratios obtained with the receiving waters. If desirable blending ratios cannot be obtained, it is possible the processes will not meet treatment goals.

Table 7-4: Potential Significant Environmental Issues

Facility/Issue	Potential Project Constraint	Potential to Resolve Constraint
Diversion		
Location	Occurs in Colorado Canyons NCA; no surface occupancy.	Obtain variance or move location upstream outside NCA.
Critical Habitat	Would affect flows in designated critical habitat.	Develop ways to mitigate any significant impacts to critical habitat.
Flow Recommendations	All evaluated flow rates would affect recommendations for average peak flows.	Curtail diversions during peak flows.
Entrainment	Would entrain federally listed fish.	Use fish screens to minimize entrainment.
Barrier	Could form a barrier to movements of listed fish species.	Design diversion structures for fish passage.
Pipeline Alignments		
USFS Lands		
North Alignment (NO1)	Passes through 72 acres of designated roadless area.	Revise alignment to avoid roadless areas or request variance.
Central Alignment 1 (CO1)	Passes through 130 acres of designated roadless area.	Revise alignment to avoid roadless areas or request variance.
Central Alignment 2 (CO5)	Passes through 290 acres of designated roadless area and 103 acres of wilderness area.	Revise alignment to avoid roadless and wilderness areas or request variance.

Facility/Issue	Potential Project Constraint	Potential to Resolve Constraint
South Alignment 1 (SO1)	Passes through 658 acres of designated roadless area and 21 acres of wilderness area.	Revise alignment to avoid roadless and wilderness areas or request variance.
South Alignment 2 (SO2)	Passes through 137 acres of designated roadless area.	Revise alignment to avoid roadless areas or request variance.
BLM Lands		
North Alignment (NO1)	Passes through 802 acres of sensitive BLM lands.	Revise alignment to avoid lands designated as no surface occupancy or request variance.
Central Alignment 1 (CO1)	Passes through 57 acres of sensitive BLM lands.	Revise alignment to avoid lands designated as no surface occupancy or request variance.
Central Alignment 2 (CO5)	Passes through 199 acres of sensitive BLM lands.	Revise alignment to avoid lands designated as no surface occupancy or request variance.
South Alignment 1 (SO1)	Passes through 70 acres of sensitive BLM lands.	Revise alignment to avoid lands designated as no surface occupancy or request variance.
South Alignment 2 (SO2)	Passes through 143 acres of sensitive BLM lands.	Revise alignment to avoid lands designated as no surface occupancy or request variance.
Hazardous Materials Site (no sites were identified for the North Corridor alignments)		
Central Alignment 1 (CO1)	Passes through the Eagle Mine Superfund Site.	Due to location and surrounding topography, this site may be difficult to avoid. Special soil handling and construction techniques would be required.
Central Alignment 2 (CO5)	Passes through the California/Yak Tunnel Superfund Site.	Revise alignment to avoid Leadville area and site or incorporate special soil handling and construction techniques.
South Alignment 1 (SO1)	Passes through two treatment, storage, and disposal facilities.	Revise alignment to avoid treatment, storage, and disposal facilities.
South Alignment 2 (SO2)	Passes through two treatment, storage, and disposal facilities.	Revise alignment to avoid treatment, storage, and disposal facilities.
Outfalls		
Water Quality	Colorado River water quality differs significantly from the receiving bodies of water.	Treat water to standards of receiving bodies of water.
Temperature	Colorado River water is warmer than the cold water aquatic environment of receiving streams.	Determine temperature of water at outfalls; cool water prior to entry into receiving streams if needed.
Channel Maintenance	Increased flows in receiving streams may cause erosion and channel instability.	Determine impacts; mitigate as appropriate.
Increased Flows	Increased flows may alter aquatic habitat.	Mitigate as feasible and appropriate by enhancing aquatic habitat.

Facility/Issue	Potential Project Constraint	Potential to Resolve Constraint
Importation of Organisms	Aquatic organisms and/or disease may be imported to the receiving waters.	Determine if treatment of diverted water will avoid importation of aquatic organisms or disease. Additional treatment may be needed.
Treatment		
Evaporative Ponds Required for Membrane Processes (Alternatives 1 and 3)	Concentrated minerals and salts removed from treated water may occur in toxic amounts and enter food chain.	Model to determine accumulated concentrations of potentially toxic elements in evaporative ponds. No feasible means known to keep wildlife from using evaporative ponds.
Process Effectiveness of Alternatives 2 & 4	If desirable blending ratios with the receiving waters cannot be obtained, it is possible the processes will not meet treatment goals.	Future studies to model variations in diversion location water quality, receiving water quality, predicted treatment process performance and predicted final combined stream water quality after blending.
Permitting		
Section 404 Permit	May be difficult to demonstrate that the CRRP is the least environmentally damaging practicable alternative to meet future Front Range water needs.	Extensive alternatives analysis.

Endangered Species Act Compliance – (Colorado River Fishes)

Section 7(a)(2) of the ESA requires consultation with the USFWS for any Federal action which may affect a species listed as threatened or endangered (listed species). This consultation process may result in the Service issuing a biological opinion identifying actions to be undertaken to avoid jeopardizing a species, adversely modifying critical habitat, or an acceptable level of incidental take resulting from the proposed action and reasonable and prudent measures to offset the incidental take. Implementation of reasonable and prudent measures is non-discretionary by the federal action agency.

CRRP will affect endangered fish species and critical habitat for those species in the Colorado River and, possibly, depending on the route, terrestrial endangered species as well. As a result, consultation under Section 7 of the Endangered Species Act will occur, and reasonable and prudent alternatives and measures will likely be specified.

This section provides detailed information on the endangered fish species in the Colorado River. ESA compliance for impacts on those species is discussed below.

The upper Colorado River subbasin and its major tributaries upstream from its confluence with the Green River in Utah historically supported populations of four native fishes — humpback chub, bonytail, Colorado pikeminnow, and razorback sucker — that are currently listed as endangered under the 1973 Endangered Species Act (ESA), as amended. Self-sustaining, wild populations of Colorado pikeminnow and humpback chub still occur in the subbasin, but wild razorback suckers have not been collected since 1995 and wild bonytails have been extirpated. Repatriation programs are underway for razorback sucker and bonytail. (Flow Recommendations to Benefit Endangered Fishers in the Colorado and Gunnison Rivers, July 2003, Charles W. McAda, USFWS).

According to U.S. Fish and Wildlife Service (USFWS), the factors causing the endangered status of these species include habitat loss from dike construction, riparian encroachment in the main channel, and construction of water-diversion structures that restrict movement; regulation of river flow, water temperature, and sediment regimes resulting from diversion and/or depletion of water; introduction of nonnative fishes that are predators or competitors of the native species; and other human-induced perturbations. Modified water-release patterns alter temperature regimes, increase base flows, and decrease peak flows. Another important change has been the introduction of more than 42 nonnative fishes into the upper Colorado River basin; 21 of these introduced species coexist with one or more of the endangered fishes in at least part of their range in the upper Colorado River subbasin.

Critical Habitat for Endangered Fish Species

Critical habitat has been designated for all endangered species (50CFR part 17; Federal Register, March 21, 1994). The critical habitat for these species is listed below:

- Colorado pikeminnow: Colorado River from Rifle, Colorado to Lake Powell in Utah.
- Razorback sucker: Colorado River from Rifle, Colorado to Lake Powell and the 100-year flood plain of the Colorado River in this reach.
- Humpback chub and Bonytail: Colorado River from Black Rocks (5 miles upstream of the Colorado state line) to Fish Ford River, Utah; and Colorado River from Brown Betty Rapid River (Utah) to Imperial Canyon, downstream of the confluence of the Green River and Colorado River in Utah.

According to USFWS, the critical habitat includes the known constituent elements such as water, physical habitat, and biological environment as required for each particular life stage for each species occuring in the designated critical habitat. All life stages for all four species exist within the critical habitat i.e., from larval to adult, including spawning habitat.

Flow Recommendations for Endangered Fish

In accordance with the Recovery Program, the U.S. Fish and Wildlife Service is responsible for developing flow recommendations. The flow recommendations are subject to approval by the Biology Committee, Recovery Program. Flow recommendations have been developed for the Gunnison River, the Colorado River at the Colorado state line. Separate flow recommendations have been developed for the Colorado River upstream of the Gunnison River. These flow recommendations have been approved by the Recovery Program. The flow recommendations are subject to review and modification as the recommendations are implemented, and more is learned about their impacts on endangered fish. The current flow recommendations discussed herein will likely be modified as additional information becomes available, and the response of the species to recovery actions, including modification of flow regimes become known.

Development of Colorado River and Gunnison River Flow Recommendations

Flow recommendations to benefit endangered fish have been developed for the Colorado and Gunnison rivers. *(Flow Recommendations to Benefit Endangered Fishes in the Colorado and Gunnison Rivers, July, 2003, Charles W. McAda, USFWS).* The goal of the recommendations is to provide the annual and seasonal patterns of flow in the Gunnison River and in the Colorado River downstream from their confluence to enhance populations of the four endangered fishes. Base flow and peak flow recommendations are provided. The objectives are to create and maintain the variety of habitats used by all life stages of the four endangered fishes:

- provide habitats and conditions that enhance gonad maturation and provide environmental cues for spawning movements and reproduction;
- form low-velocity habitats for adult staging, feeding, and resting areas during snowmelt runoff;
- inundate floodplains and other off-channel habitats at the appropriate time and for an adequate duration to provide warm, food-rich environments for fish growth and conditioning, and to provide river-floodplain connections for restoration of ecosystem processes;
- restore and maintain in-channel habitats used by all life stages: (1) spawning areas for adults, (2) spring, summer, autumn and winter habitats used by subadults and adults, and (3) nursery areas used by larvae, young-of-the-year, and juveniles; and
- provide base flows that promote growth and survival of young fish during summer, autumn, and winter.

Peak flow recommendations were developed for six hydrologic categories ranging between "dry" and "wet" and corresponding to unregulated April–July inflow based on the 1937–1997 period of record. Peak flow recommendations are for the Gunnison River at the USGS river gage near Grand Junction, Colorado (09152500) and for the Colorado River at the USGS river gage near the Colorado-Utah state line (09163500). Peak-flow recommendations include two components: (1) threshold levels and (2) the number of days (duration) that flows should equal or exceed these levels. Recommended durations are presented as a range of days. In general, spring flows recommended for the dry categories provide small peaks used as spawning cues by endangered fish, but contribute little to habitat maintenance; spring flows recommended for average categories promote scouring of cobble and gravel bars and provide localized flooding of short duration; and spring flows for the wet categories promote wide-spread scouring of cobble and gravel bars, flushing of side channels, removal of encroaching vegetation, and inundation of floodplain habitats.

Base-flow recommendations also vary with hydrologic category and are designed to allow fish movement among river segments and to provide maximum amounts of warm, quiet-water habitats to enhance growth and survival of young endangered fish.

The flow recommendations were developed using information currently available; however, it is recognized that uncertainties exist. Biological and physical uncertainties are described in the recommendations, (McAda, 2003) and additional studies are proposed.

Biological and physical uncertainties include:

- The relationships among reproductive success of Colorado pikeminnow and humpback chub and peak river flows are based on limited data.
- The relationships among fine sediments and primary/secondary production in the two rivers needs to be further assessed, and it remains to be determined whether food availability is limiting abundance of endangered fishes and any or all of the Upper Colorado River system.
- Long time periods will be required for the populations of endangered fish to respond to flow recommendations and other management actions implemented by the Recovery Program. Monitoring programs should be developed to evaluate their response to all management actions, and then management actions will need to be modified as more information is accumulated and the response of endangered fish is assessed.

- Duration of flows necessary to accomplish in-channel and out-of-channel maintenance objectives is not known.
- The frequency (recurrence interval) and duration (number of days) that flows need to exceed one-half bank full and bank full discharge to maintain the habitats required by endangered fishes is uncertain.
- The amount and quality of habitat necessary to maintain endangered fish populations at levels identified in the recent developed recovery goals for the four species is uncertain.

As a result of these uncertainties, flow recommendations will be implemented using adaptive management. Monitoring of flows and responses of habitat and endangered fish will take place over time. Modifications of the flow recommendations are expected as more information is gained.

Impact of 15-mile Reach Flow Recommendations

The Colorado River immediately upstream from the confluence with the Gunnison River (15-mile reach) is currently operating under a programmatic biological opinion (PBO) that provides ESA compliance for 1,000,000 af/year of existing depletions, and 120,000 af/year of new depletions as a result of additional water development in the upper sub-basin, provided that progress is made toward recovery of the four endangered fishes. The PBO provides for coordinated operation of upstream reservoirs to assist in meeting flow recommendations made for the 15-mile reach.

Ultimately, flows in the lower reaches of the upper Colorado River will depend on the combination of 1) flows provided in the Gunnison River following re-operation of the Aspinall Unit, and 2) flows provided in the Colorado River under the PBO. Until there is more definitive evidence as to where and how much water is needed for recovery, recommendations at the Colorado-Utah state line do not override agreements already in place for the upper Colorado River. Therefore, the currently recommended flows at the state line gauge for endangered fish are actually the combination of the flows recommended for the Gunnison (McCarla, 2003) and the flows recommended for the 15-mile reach (Osmundson, 1995).

Flow Recommendations for the 15-Mile Reach of the Upper Colorado River

The flow recommendations are data specific to the 15-mile reach and relate to adult Colorado squawfish habitat preferences, stage vs. habitat quantity and quality relationships, and discharge thresholds for sediment transport. As additional studies are completed, knowledge of this relationship between discharge and fish habitat will continue to evolve and recommendations will continue to be refined.

Impacts of the CRRP on Endangered Species and Habitat

The potential impacts of the CRRP on endangered species are as follows:

- impacts on peak flows and corresponding impacts on cleaning of gravels in spawning areas, formation of gravel bar spawning habitat, and formation of backwater habitats for nursery areas, and flooding of bottomlands,
- impact on base flows that provide habitat for all life stages of endangered fishes during non-peak flow seasons,
- mortality of adults, young adults, juveniles and larval fish resulting from the fish being taken into the diversion structure, and

- interference with passage of migrating Colorado pikeminnow and razorback sucker from downstream to upstream habitats.

Each of these potential impacts is discussed below.

Impacts on Flows and Flow Recommendations

Although the flow recommendations for the Gunnison and Colorado Rivers (McAda, 2003) state that the actual flows to be achieved at the Colorado state line are the combination of 15-mile reach flows and flow recommendations for the Gunnison, the bases for these flow recommendations is not consistent. Therefore, for the purpose of impact analysis, the flow recommendations from the McAda Report the Colorado River near the Colorado-Utah state line are used for both base flow and peak flow impact analysis. The gage at the Colorado state line is the gauge for which the flow recommendations are made. It is very close to the critical habitat for razorback chub and bonytail downstream of Fruita, yet upstream of the Dolores River and other major inflows.

Impact on Base Flows

The base flow recommendations for the wet period range from 3,000 to 6,000 cfs, and for the moderately wet and average wet periods 3,000 to 4,000 cfs. A simplified analysis of the mean monthly flow data for the USGS gage at the Colorado River near Colorado-Utah state line (09163500) indicate that in the wet period, historic flows fall below 3,000 cfs in one year out of five. For the moderately wet to average wet periods, the 3,000 cfs minimum average monthly flow is maintained for all months in nine out of the twenty years, but mean monthly flows fall below 3,000 cfs from one to six months in eleven out of twenty years. Imposing depletions at the maximum 1,050 cfs proposed for CRRP will cause mean monthly flows to fall below 3,000 cfs on numerous occasions during the moderately wet and average wet periods.

For the average dry and moderately dry years, base flows are recommended at 2,500 to 4,000 cfs. For the 20 years of record that fall within these categories, mean monthly flow is above 2,500 cfs for six of these years, and in 14 years, mean monthly flows fall below 2,500 cfs in one to five months. Imposition of additional flows by CRRP (again, at the maximum 1,050 cfs) will cause base flows to go below 2,500 cfs in the six years mentioned above, and will further deplete flows below 2,500 cfs in all years that fall within these ranges.

For the dry year (90 percent exceedence) the base flow recommendation is 1,800 cfs. In two out of five of these years in the historic record, the 1,800 cfs is exceeded in all months, but for the other three years, the flows fall below 1,800 cfs. Imposition of depletions in the range of 350 to 1,000 cfs by CRRP will cause the base flows to decline in some months of all years to less than the recommended base flow of 1,800 cfs.

Impacts on Peak Flows

Peak flows are recommended at 35,000 cfs for wet, moderately wet, and average wet periods, and 18,500 cfs for average dry and moderately dry periods. No peak flow recommendations are made for the dry period. As an indicator of potential impacts, mean monthly flows were reviewed in terms of whether or not the 18,500 cfs or 35,000 cfs levels were achieved over a 50 year period of record. Recommended durations were not considered. The evaluation involved only mean monthly flows, not daily flows.

For the wet period, the 35,000 cfs mean monthly flows were achieved in three out of five years, and the 18,500 cfs flow was achieved in four out of five years. For the moderately wet and average wet years, 35,000 cfs of mean monthly flow was achieved in one out of nineteen years. The 18,500 cfs mean monthly flows was achieved in fourteen out of twenty years.

For average dry and moderately dry years, the recommended flow of 18,500 cfs was achieved, on a mean monthly basis, in one out of twenty years.

McAda (McAda, 2003) conducted an analysis of flows over the period of 1978 to 1997 at the Colorado-Utah Stateline with respect to the flow recommendations. He considered durations as well as magnitudes of the peak flows. For the wet period, the 18,500 cfs flow was achieved for an average of 66 days, as opposed to the recommended 80 to 100 days. The 35,000 cfs flow was achieved for an average of 29 days, as opposed to the recommended 30 to 35 days.

For the moderately wet period, the recommended flow of 18,500 cfs was achieved for 50 days, with a recommended target being 50 to 65 days. The 35,000 cfs flow was achieved on an average of 5.4 days as opposed to the recommended 15 to 18 days.

For the average wet period, 18,500 cfs flow was achieved for 13.7 days as opposed to the recommended 30 to 40 days, and the 35,000 cfs flow was not achieved, compared to the 6 to 10 day recommendation.

For the average dry period the 18,500 cfs flow was achieved for 3.5 days compared to the 20 to 30 day recommendation. For the moderately dry period, the 18,500 cfs flow was not achieved, compared to the low target of 0 to 10 days.

Comments on CRRP and achievement of flow recommendations

The following comments are offered with respect to the potential impact of the CRRP on achievement of flow recommendations for endangered fish:

1. Use of mean monthly flows for impact analysis is somewhat simplified, but indicates that the peak and base flow recommendations are not currently achieved in most years using a long term 50-year period of record.

2. The flow-duration analysis for 1975-1997 indicates that the peak flow recommendations are often not achieved.

3. Some augmentation of base flows will occur as a result of reoperation of the Aspinall unit after 2007, and has occurred as a result of releases for the 15-mile reach from various water sources in the Upper Basin.

4. Augmentation of peak flows will occur as a result of reoperation of the Aspinall unit in 2007, voluntary efforts to enhance peak flows among water users in the 15-mile reach of the Colorado River subbasin, and may occur due to the possible construction of a new project solely for the purpose of augmenting flows in the 15-mile reach for the benefit of endangered species.

5. CRRP, as presently envisioned, with constant diversion rates of 350, 750, or 1,000 cfs may preclude attainment of peak flows and base flows on a more frequent basis. This may result in recommendations by USFWS to refine operations to avoid impacts during lower flow periods.

6. Flow recommendations are subject to adaptive management and will change as additional information becomes available. Therefore, it is impossible to accurately predict the outcome of impacts associated with CRRP on the ultimate flow recommendations, or the terms of a biological opinion issued by USFWS.

7. If recovery of any of the species is achieved prior to construction of the CRRP, an element of the recovery is a conservation agreement with the states, wherein the states agree to maintain the conditions that led to recovery. This would include some form of protection for the flows that are deemed necessary for recovery. If CRRP were to

interfere with the maintenance of flows agreed upon by the state, CRRP may have to augment those flows or modify its operations to ensure that those flows are maintained.

Impacts of Direct Mortality Due to Induction into Diversion Structure

Impacts due to induction of fish into diversion intakes are mitigated by installing fish screens on the intakes. The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) will be constructing fish screens at major diversions on the Gunnison River and the Colorado River including the Redlands Diversion (850 cfs), the Grand Valley Irrigation Company (600 cfs) and the Government Highline Canal (800 cfs). These screens are designed to prevent entrainment of adults and sub-adults of both pikeminnow and razorback sucker. Experience in other river basins shows that for maintenance purposes, the screen openings should be no larger than 3/32 of an inch. This prevents large objects from becoming embedded in the screens, and makes the screens easier to clean.

In developing the 15-mile reach (Colorado River) programmatic biological opinion (PBO) the Service anticipated incidental intake of larval and young fish by diversions when Colorado pikeminnow and razorback sucker begin spawning above the 15-mile reach. The Service determined that the level of anticipated incidental intake will not likely result in jeopardy of the species or destruction of adverse modification of critical habitat with full implementation of Recovery actions. The Service also specified reasonable prudent measures that included having the Recovery Program design and construct, and maintain fish preclusion devises to prevent or reduce adult and sub-adult fish (greater than 300 mm total length) from entering existing major irrigation diversion systems i.e., Grand Valley Irrigation Company and Grand Valley Project Diversion Dam.

These fish screens do not provide ESA compliance for new diversion structures in occupied habitat below the Gunnison.

Razorback suckers normally spawn on the ascending limb of the hydrograph when river temperatures reach 14 to 18 degree centigrade. In the Colorado River, this normally occurs in April or May. Any larval fish that spawn upstream of the CRRP diversion that were not consumed by predators, or deposited in backwaters or flooded bottom lands would be subject to diversion by CRRP, roughly in proportion to the flow being diverted vs. total flow in the river, assuming random dispersion of larvae in the river.

Colorado pikeminnow spawn when the water reaches 18 to 20 degrees, following spring runoff. In the Colorado River, this would normally occur in late June and July. Any larval fish that were not consumed by predators or that drifted into the backwaters above the CRRP diversion would be subject to the diversion roughly in proportion to the ratios CRRP diversion to the total inflow.

It is likely that fish screens would have to be installed to avoid adult and sub-adult entrainment with the standard 3/32 inch screen. The cost of these diversions is estimated at approximately $3,500/cfs of intake. Therefore, for a 350 cfs intake the cost would be $1,220,000; for a 700 cfs intake the cost would be $2,500,000; and for a 1,050 cfs, intake the cost would be $3,700,000. These costs are highly generalized and could fluctuate significantly with the characteristics of the particular sites.

If the spawning characteristics of increased populations result in significant numbers of larval fish being entrained, CRRP might face additional and more costly screening efforts than heretofore experienced in the Upper Colorado River Basin.

Impacts on fish migration

Both the Colorado pikeminnow and razorback sucker are long-distance migrants. Razorback suckers have been documented to migrate over 200 miles. Interchange of razorback sucker between the Green River population and the Colorado River population has been documented. Colorado River pikeminnow are also long-distance migrants, particularly when moving to spawning grounds, as documented in the Green and Yampa Rivers.

In the Colorado River, larval and young-of-the-year Colorado pikeminnow drift downstream. On achieving sub-adult status, they migrate upstream and replenish the population of adults in the Colorado River. As habitat is opened through fish passages in the upper 15-mile reach, these phenomena will likely become more frequent. There may be additional spawning above the 15-mile reach. Construction of a fish passage to allow upstream passage of both razorback sucker and Colorado pikeminnow will be required by USFWS for ESA compliance by CRRP.

Both species are known to use fish passages, based on experience at passages at the Redlands Diversion on the Gunnison River and in the San Juan River. Fish passages are designed as a series of steps and pools or as low-slope channels with pools that allow the fish to migrate around diversion structures. Cost of fish passages is variable. It has been running in the rage of $1 million to $2 million. Costs are highly dependent upon site-specific characteristics of the individual site.

The Recovery Program pays for fish passages and fish screens at existing structures, but does not pay for fish passages at new structures in occupied habitat. Therefore the CRRP would bear the cost of the fish passage.

ESA Compliance in the Upper Colorado River Basin

ESA compliance in the Upper Colorado River basin takes place in accordance with the Upper Colorado River Endangered Fish Recovery Program and the agreement under pinning the Program.

Upper Colorado River Endangered Fish Recovery Program - Recovery of the endangered fishes in the upper Colorado River basin is being addressed by the Upper Colorado River Endangered Fish Recovery Program (Recovery Program). The Recovery Program was initiated under a Cooperative Agreement signed by the Governors of Colorado, Utah, and Wyoming; the Secretary of the Interior; and the Administrator of Western Area Power Administration in 1988. It is a coordinated effort of State and Federal agencies, water users, energy distributors, and environmental groups that functions under the general principles of adaptive management (i.e., management actions are identified, implemented, evaluated, and revised based on results of research and monitoring). The Recovery Program operates in compliance with state and federal laws related to the Colorado River system, including state water law, interstate compacts, and federal trust responsibilities to American Indian tribes, thereby recognizing water rights under state law. A broad range of activities is conducted by the Recovery Program in order to recover the four endangered species. These include habitat management (including water management), nonnative fish control, research and monitoring, habitat development, stocking of nonnative fish, and information and education.

ESA Compliance under the Recovery Program - One of the fundamental terms of the Recovery Program regarding ESA compliance is that the U.S. Fish and Wildlife Service will consider actions taken by the Recovery Program as reasonable and prudent alternatives to avoid jeopardy for endangered fish, and to avoid adverse impact to critical habitat. In order to clarify these commitments, the Recovery Program developed an agreement (Section 7 agreement) regarding “Section 7 Consultation, Sufficient Progress, and Historic Projects” (USFWS, 1993; Revised March 8, 2000). Per the Section 7 agreement**,** the Recovery Program is intended to provide the

reasonable and prudent alternatives for projects undergoing Section 7 consultation in the Upper Basin. The basic terms of the Section 7 agreement and its application to CRRP are:

1. Activities and accomplishments under the Program are intended to provide reasonable and prudent alternatives for the depletion impacts of new projects and all existing or past impacts relating to historic projects, with the exception of discharge of pollutants, such as trace metals, heavy metals, and pesticides.

2. The Recovery Program is intended to offset both the direct and depletion impacts of existing projects. Depletion impacts include flow reductions and corresponding changes in temperature, salinity, and turbidity (USFWS, 1987). Direct impacts include obstructions to migration routes, alteration of physical occupied habitat, construction, inundation, or temperature modification from reservoir releases, etc. (USFWS, 1987) The Recovery Program offsets the direct impact of projects constructed prior to January 21, 1988, the date the program was initiated, but does not offset direct impact of projects constructed after that date. Therefore the CRRP would be responsible for development of fish passages, fish screens and other reasonable prudent alternatives or measures necessary to offset direct impacts resulting from construction and operation of the project.

3. Under the Section 7 agreement, FWS assesses the impacts of projects that require Section 7 consultation and determines if progress towards recovery has been sufficient for the Program to serve as the reasonable and prudent alternative. The Service also considers whether the probable success of the Recovery Program is compromised as a result of specific depletion or cumulative impacts of depletions. The consultation on CRRP will take into account reasonably foreseeable actions in the base line for the consultation. This would include the 120,000 af/year of new depletions that are covered in the Colorado River programmatic biological opinion (USFWS, 1999), as well as any other foreseeable depletions. It is highly likely that these new depletons will affect only peak flows, rather than base flows. In the Gunnison basin, a programmatic biological opinion is likely to be completed by 2007. The impacts of the CRRP would also be added to any future depletion included in the Gunnison River PBO to determine the cumulative effects of the CRRP.

4. If sufficient progress by the Program is being achieved, biological opinions will identify the activities and accomplishments of the Recovery Program that support serving as a reasonable and prudent alternative.

5. If sufficient progress is not achieved, biological opinions for new and historic projects will identify which actions the Program must complete in order to avoid jeopardy or adverse modification. These activities must be incorporated into the Recovery Program's long-range plan. For new projects, such as CRRP, these actions serve as reasonable and prudent alternatives, so long as they are completed before the impact of the project occurs.

6. If the Program cannot provide the reasonable and prudent alternative, as a last resort, FWS will develop a reasonable and prudent alternative, if available, with the lead federal agency and the project proponent that must be implemented by the project proponent.

Through June 30, 2003, the Recovery Program has provided the reasonable and prudent alternative for 729 water projects depleting 1.72 million af of water in the Colorado, Utah, and Wyoming portions of the Upper Basin. Depletions for individual projects range in size from 425,000 af/year to less than 10 af/year. Historic depletions account for approximately 1.5 million af of these depletions, while new projects account for about 220,000 af of depletions.

None of the projects consulted on to date have been new depletions in occupied habitat that have had direct impacts on endangered fish, such as the CRRP.

When the CRRP undergoes Section 7 consultation for ESA compliance, USFWS will review the depletion impacts and determine if progress by the Recovery Program has been sufficient to offset those impacts. If so, the biological opinion will rely on actions by the Recovery Program, either past or future, to provide ESA compliance for depletion impacts. If the Service determines that the Program provides, or will in the future provide, reasonable and prudent alternatives, it will so state in the biological opinion and identify those alternatives. If the Service determines that Recovery Program actions, current or planned, will not provide the reasonable and prudent alternative, it will specify additional activities that will have to be incorporated into the Recovery Action Plan for depletion impacts.

Modification of the long-range plan for the Recovery Program requires unanimous consent of the Recovery Program participants. Should the participants agree to incorporate actions to serve as reasonable and prudent alternatives for CRRP, then the Program will be modified to incorporate those actions. However, if these turn out to be extremely costly and include significant projects that would require additional substantial financial contributions by the states, federal agencies, or power users, there may be resistance to having the Recovery Program provide these reasonable and prudent alternatives for depletion impacts.

For example, U.S. Bureau of Reclamation will likely reoperate the Aspinall Unit to provide additional peak flows and certain base flows for the Gunnison River that will also accrue to the Colorado River. In addition, the Recovery Program is reoperating reservoirs on a voluntary basis to enhance peak flows, and is considering additional storage to augment peak flows and base flows in the Colorado River. If CRRP were to significantly impact peak or base flows, and the augmentation provided by upstream reservoirs, there could be considerable resistance from Program participants to providing additional reasonable and prudent alternatives, such as additional storage to augment flows for CRRP. In this case, CRRP would likely have to provide those reasonable and prudent alternatives for depletion impacts.

National Environmental Policy Act Compliance

The National Environmental Policy Act (NEPA), signed into law in 1969, directs that, “all policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act” (Section 102, 42 U.S.C. § 4332). The intent of NEPA is to have Federal agencies consider environmental issues in all decision-making.

Compliance with NEPA is a Federal responsibility and involves the participation of Federal, state, tribal, and local agencies and concerned and affected publics in the planning process. The act requires full disclosure about major actions taken by Federal agencies and accompanying alternatives, impacts, and possible mitigation. This act also requires that environmental concerns and impacts be evaluated during planning and decision-making.

The nature of the Federal action may be construction of a project, the granting of a permit or rights-of-way to a third party, the provision of Federal funding in a third-party project, or any other action where a Federal decision is required. CRRP will be subject to NEPA compliance. Once it has been established that there is a proposed Federal action, the next step is to determine: 1) relevant environmental issues; 2) potential magnitude of environmental impacts, and 3) appropriate level of NEPA documentation.

Granting federal permits or rights-of-way to allow construction of CRRP will be a major federal action requiring an environmental impact statement. Impact analyses will address both construction and operation of the project. The EIS on CRRP will likely need to address impacts on:

Land use	Socio economics	Hydrology, water rights and stream flows
• Water quality	• Vegetation of wetlands	• Wildlife
• Fisheries	• Threatened and endangered plant and animal species	• Cultural resources
• Recreation	• Transportation	• Sensitive environmental areas
• Water supply	• Hydropower	• Energy consumption
• State species of special concern	• Flood control	• Soils
• Geology	• Air quality	• Noise

Other environmental issues may be raised in the scoping process as well. For CRRP, this process will likely take a minimum of three years, and could take up to five or six years.

Integrating Related Legislation, Executive Orders, and Guidance

The NEPA process must integrate the requirements of other statutes, such as the Fish and Wildlife Coordination Act, National Historic Preservation Act, Endangered Species Act, other laws, and Executive Orders (EO) including those on Indian Trust assets, Indian sacred sites, and environmental justice. Guidance on pollution prevention issued by the Council on Environmental Quality must be followed.

Record of Decision

On completion of the NEPA process, the federal action agency will issue a record of decision. The record of decision incorporates all of the environmental commitments made by the applicant in order to mitigate the impacts of the project and to comply with other federal laws, including the Fish and Wildlife Coordination Act, National Historic Preservation Act, Endangered Species Act, other laws, and Executive Orders. The environmental commitments are also incorporated into any permits issued by the Corps of Engineers, or other agencies, that are needed to implement the project, and those commitments become enforceable terms of the permit.

Limitations on Actions before Decisions

NEPA requires that no actions that have adverse impacts or that limit the choice of alternatives occur until the appropriate process is completed. These include committing funds, personnel resources, or materials that will advance the proposal to a point where alternatives are constrained, where impacts to the environment begin to occur, or where retreat may be impossible or impractical. These actions do not include the reasonable commitment of resources to carry out the necessary studies upon which the EIS and decision document will be based. Non-federal applicants are also reasonably subject to these limitations.

Clean Water Act Compliance

Two sections of the Clean Water Act will apply to CRRP development. Section 404 regulates the discharge of dredged and fill materials into the waters of the United States, including wetlands. A permit from the U.S. Corps of

Engineers is needed to conduct these activities. Section 401 requires that any applicant for a federal permit will obtain a certificate that any such discharge will comply with state regulations, including water quality standards and other element regulations. These sections are discussed below.

Section 404

Section 404 of the Federal Clean Water Act establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands. Activities in waters of the United States that are regulated under this program include fills for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry. In 1972, amendments to the Federal Water Pollution Control Act added what is commonly called "section 404 authority" to the Department of the Army regulatory program. The Secretary of the Army, acting through the Chief of Engineers, is authorized to issue permits, after notice and opportunity for public hearings, for the discharge of dredged or fill material into waters of the United States at specified disposal sites. Selection of such sites must be in accordance with guidelines developed by the Environmental Protection Agency (EPA) in conjunction with the Secretary of the Army. These guidelines are known as the 404(b)(1) Guidelines.

The basic premise of the program is that no discharge of dredged or fill material can be permitted if a practicable alternative exists that is less damaging to the aquatic environment or if the nation's waters would be significantly degraded. In other words, in applying for a permit, the applicant must show that:

- steps have been taken to avoid wetland impacts where practicable,
- potential impacts to wetlands have been minimized, and
- compensation for any remaining, unavoidable impacts through activities to restore or create wetlands has been provided.

The basic form of authorization used by the Department of the Army Corps of Engineers (Corps or COE) districts is the individual permit. Processing such permits involves evaluation of individual, project-specific applications in what can be considered three steps: pre-application consultation (for major projects), formal project review, and decision making.

Of great importance to the project evaluation is the Corps public interest balancing process. The public benefits and detriments of all factors relevant to each case are carefully evaluated and balanced. Relevant factors may include conservation, economics, aesthetics, wetlands, cultural values, navigation, fish and wildlife values, water supply, water quality, and any other factors judged important to the needs and welfare of the people.

The Corps is required to comply with NEPA prior to issuing a 404 permit. However, if an EIS is developed by another federal agency, separate NEPA compliance by the Corps is not required. The following general criteria for the public interest review will be considered in the evaluation of the CRRP permit application (33 CFR 320.4(a)(2)):

- the extent of the public and private need for the project;
- whether there are practicable alternative locations or methods that may be used to accomplish the objective of the proposed project, where unresolved conflicts exist as to the use of a resource; and
- the extent and permanence of the beneficial or detrimental effects the proposed work is likely to have on the private and public uses of impacted lands and water.

The decision on whether to authorize or deny the permit application is determined by the outcome of this evaluation. The Corps may perform an alternatives analysis, and require compensatory mitigation, or other conditions, to address environmental impacts for all permits.

Conditioning Permits. Special conditions are placed on Corps permits to comply with the Federal law, while affording appropriate and practicable environmental protection, including offsetting aquatic impacts with compensatory mitigation (see 33 CFR 325.4). Corps-imposed conditions are substantially related to the impacts. Permit conditions relate to issues raised in the public interest review process (e.g., the aquatic environment, the ESA, navigation, cultural resources). Conditions specified in State 401 water quality certifications are included as conditions of all Section 404 permits.

Compensatory Mitigation. Mitigation is a component of the Corps regulatory program. Following is a summary of the mitigation policies under which the Corps operates, as well as some basic concepts that districts consider in formulating compensatory mitigation. The following guidance and regulations apply to mitigation determination by the Corps:

- *Corps 1986 Consolidated Rule (33 CFR 320.4(r))*
- *CEQ Mitigation Policy (CEQ 1978 Regulation (Definitions Section at 1508.20)) and 40 Questions*:
- *The Department of the Army – EPA 1990 MOA on Mitigation*
- *1995 Mitigation Banking Guidance (Federal Register site)*
- *NWP Regulation (33 CFR 330)*:

In addition to the above, the following mitigation concepts will be considered in determining mitigation requirements:

- The amount of mitigation required should be commensurate with the anticipated impacts of the project. The goal of mitigation is to replace resource functions and mitigate other impacts.
- The Corps depends upon the review, by regulators, of relevant agency and public comments, and the application of their best professional judgment in requiring appropriate and practicable mitigation for unavoidable, authorized aquatic resource impacts. The bottom line for mitigation is whatever is best for the overall aquatic environment.
- The Corps decides on appropriate and practicable mitigation. The Corps may consult with other agencies in determining appropriate mitigation, but since agencies operate under varying mandates and may have conflicting recommendations, it is up to the Corps to review comments and reach a defendable and reasonable conclusion.

Duration of Permits. The timeframe for which an individual permit is valid is at the discretion of the district engineer. The time limit commonly used when construction is involved is three to five years. The regulations state that the duration of a permit should be reasonable, commensurate with the nature of the work, and thus allow for flexibility on this issue.

Section 401

Section 401 of the Federal Clean Water Act states that any applicant for a federal permit to conduct any activity which may result in any discharge into the navigable waters, shall provide the permitting agency with a certification from the state that any such discharge will comply with state regulations. Thus, anyone needing a 404 permit must also obtain 401 certification from the state to ensure maintenance of state water quality standards by the activity, both during construction and operation. The primary purpose of 401 certification is to assure that the issuance of these federal permits and licenses will result in compliance with state water quality requirements.

In Colorado, the state Department of Public Health and Environment – Water Quality Control Commission – Regulation No. 82 – 401 Certification Regulation authorizes the Water Quality Control Division to certify, conditionally certify, or deny certification of Federal licenses and permits in accordance with Section 401 of the Federal Clean Water Act and sets forth Best Management Practices (BMPs) applicable to all certifications except for Federal 402 permit certifications, and the procedures for developing conditions to be included with certification, where necessary. Certification means the determination by the Division that the project will comply with the Basic Standards and Methodologies for Surface Water, Regulation No. 31 (5 CCR 1002-31), the Basic Standards for Ground Water, Regulation No. 41 (5 CCR 1002-41), surface and ground water classifications and water quality standards, and all other applicable water quality requirements for the affected waters. Such certification is subject to section 25-8-104, C.R.S. Any certification issued by the Division pursuant to these regulations shall apply to both the construction and operation of the project for which a federal license or permit is required, and shall apply to the water quality impacts associated with the project.

The main body of Regulation No. 82 sets forth the process to apply for 401 certification in Colorado, and identifies the procedures and criteria that will be used by the Water Quality Control Division in acting on certification requests. Based upon the information provided by an applicant, the Division may approve, conditionally approve or deny 401 certification requests. Denial of certification triggers denial of the Federal permit or license for which certification is requested.