Executive Summary

Purpose of the CRRRS

This study addresses the general physical, environmental, financial, and institutional aspects of a large-scale water delivery system to partially satisfy future water needs in Colorado. Because this potential water system would pump or "return" water from the Colorado River near the Utah border for upstream uses in the South Platte, Arkansas and Colorado River basins, it is called the Colorado River Return Project or CRRP. This study is the first analysis of this concept and is, therefore, called the Colorado River Return Reconnaissance Study (CRRRS or Study). The CRRRS was authorized under Senate Bill 110 passed by the 64th Colorado General Assembly in the spring of 2003.

The CRRRS is a reconnaissance-level investigation conducted in sufficient detail to: determine whether a need exists for the water made available from the CRRP; establish operational requirements and the preliminary size, type and location of CRRP facilities; identify the most significant environmental and water quality issues; distinguish the major differences between alternative CRRP configurations and the advantages and disadvantages of those configurations; provide a preliminary indication of technical and economic feasibility for each configuration; and identify the types of potential CRRP sponsors and funding alternatives.

The CRRP would help supply water needs using water that is potentially available to the State in accordance with the Colorado River Compact, a long standing agreement between the seven states within the Colorado River Basin. The CRRRS identifies and evaluates CRRP configurations for three levels of water diversion and demand: 250,000, 500,000 and 750,000 acre-feet/year (af/yr).

Alternative CRRP Configurations

The major factors affecting the size, location, and type of facilities that would be required for the CRRP include: 1) the amount of water that could be delivered each year; 2) the location of the diversions; and 3) the areas to which the water is delivered. The three annual average CRRP delivery capacities evaluated in this study are: 250,000, 500,000 and 750,000 af/yr. Diversion locations are generally downstream of the last currently used water right on the Colorado River within the State of Colorado (downstream of Grand Junction). An advantageous termination point for the CRRP is the upper Eagle basin, where Eagle County, Summit County, Park County, and Lake County nearly meet, because, from this point, the CRRP could deliver water to the South Platte, Arkansas, and Colorado River basins (through deliveries to the Eagle and Blue River basins). Returning water into the Colorado system above Green Mountain Reservoir, Dillon Reservoir, and the rapidly growing population centers in Summit County offers the possibility of meeting both east and west slope needs in a variety of ways. Delivery alternatives that merit further study include making East slope deliveries partially through existing facilities serving the Denver metropolitan area as well as the Colorado Springs area.

Three conveyance corridors were identified based on considerations of land use, wilderness and national park boundaries, and terrain, with the overall objective of minimizing the length of the delivery pipeline. These

alternative corridors have been identified as the Northern, Central, and Southern Corridors. Within each corridor, a variety of specific alignments were evaluated.

All three of the corridors begin on the Colorado River near the Utah State line:

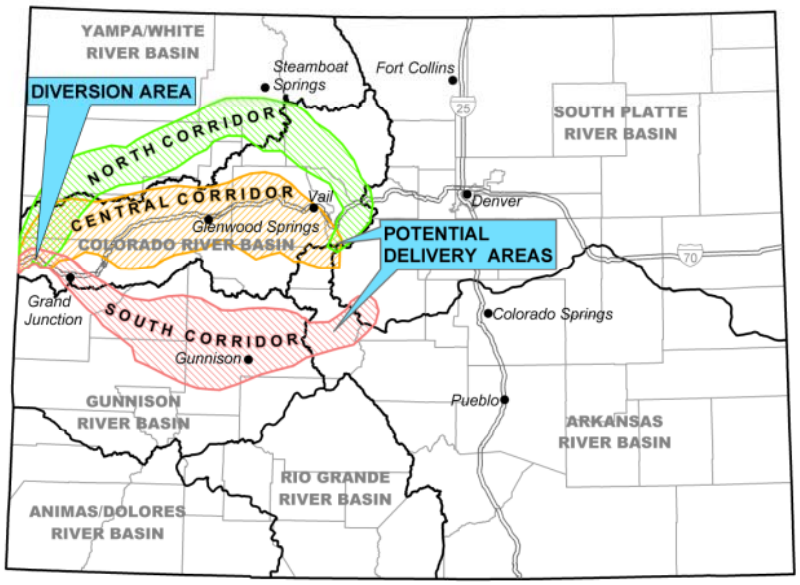
1) The Northern Corridor traverses the White/Yampa river basin before turning south into the upper Colorado River basin and on to the South Platte and Arkansas basins;

2) The Central Corridor extends up the Colorado River mainstem and its upper basin tributaries and on to the South Platte and Arkansas basins; and

3) The Southern Corridor traverses the Gunnison River basin before entering the Arkansas basin and extending on to the South Platte basin.

The general locations of the diversion points, delivery areas, and alternative conveyance corridors are shown in Figure ES-1.

Figure ES – 1: Locations of Diversion Points, Delivery Points, and Conveyance Corridors



Future Water Demands and Sources of Supply

Water demand projections indicate that an additional 784,000 acre feet (af) of raw water will be required from structural and nonstructural resources in the Front Range between the year 2000 and 2060 based on State Demographer's population forecasts. Additional demands in corridors on the western slope potentially served by the CRRP increase the total to 887,000 af of additional water needed by the year 2060. The CRRP supply at the 250,000 AF per year delivery level could be needed by new market demand as early as year 2014. The 500,000 af per year delivery level could be needed by the year 2027, and the 750,000 af delivery level could be needed by the year 2048. The Front Range Demand Area alone could absorb the high 750,000 af delivery scenario by 2057.

While current or planned structural and non-structural projects may diminish the need for CRRP's water supply, there are several other sources of potential future water demand in the study areas that were not explicitly addressed as part of this study. One future source of demand is replacement of current supplies that are likely to become unavailable in the future. Present groundwater use in the urbanized Front Range, for example, might be unsustainable as a base load supply without new sources of water to augment these groundwater resources. Other sources might be limited on a long-term basis if water quality standards become more stringent.

Water Quality Issues and Treatment Options

The following levels of treatment for the project water were considered during the study:

- No Treatment – This "option" is inconsistent with environmental regulations and the study.
- Treatment Level One (Drinking Water Quality) – Treatment to finished drinking water quality of typical Front Range municipal systems (Safe Drinking Water Act, USEPA primary and secondary standards as well as typical front range aesthetics issues such as hardness)
- Treatment Level Two (Receiving Water Quality) – Treatment to match average receiving water quality

Each level of treatment would result in a specific set of water quality parameters that would characterize the project water discharged into the delivery area. Four water treatment technologies were considered, each producing some form of residual byproducts that must be processed and disposed of in some manner.

Construction and Operating Costs

Opinions of probable costs based on 2003 US dollars were compiled for 31 alignments representing all three corridors. Total capital costs including construction, easements, engineering, administration and contingencies for the least costly alternatives are as follows:

- For 250,000 af/yr – approximately $3.7 billion or about $14,700 per acre foot
- For 500,000 af/yr – approximately $6.0 billion or about $12,000 per acre foot
- For 750,000 af/yr – approximately $8.7 billion or about $11,600 per acre foot

Total annual operation and maintenance costs including net energy purchases and operation of physical facilities are as follows:

- For 250,000 af/yr – approximately $220 million or about $890 per acre foot
- For 500,000 af/yr – approximately $420 million or about $840 per acre foot
- For 750,000 af/yr – approximately $620 million or about $820 per acre foot

Five of the 31 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 project costs for the five alternatives are listed in Table ES-1 below.

Table ES-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

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. The magnitude of construction expenditures on pipe, plant and equipment will generate considerable sales and use taxes estimated at $390 million total over 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. A boost to aggregate mining activity may occur to supply bedding along the pipeline route. State personal income tax revenues will increase. This pipeline corridor could also be used for multiple economic purposes. For example, telecommunications, such as fiber optics or other utilities, may wish to utilize of this right-of-way across Colorado.

Once the capacity of public facilities and services along the pipeline corridor has been 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.

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.

Financial Considerations

The financial feasibility of the CRRP was characterized by identifying the tap fee or system development charges (SDCs) and water rate increases for “single family tap equivalents” (SFTE) that would be required to pay for CRRP. Table ES-2 summarizes the increases in water rates over typical water rates required to pay for the project’s capital, operations and maintenance costs.

Table ES-2: Summary of Preliminary Financial Impacts of CRRP, Assuming the Central Corridor, by Delivery Scenario

Required Increases per SFTE 2003 Constant Dollars	Years After Project Completion		
	Five	Twenty	Forty
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%

Environmental Considerations

Environmental benefits of 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. However, several significant environmental issues could be constraints to development of the CRRP. Some of these issues could be resolved with refinements to the location of CRRP features. Other significant environmental issues are unavoidable and likely would create substantial hurdles to CRRP development. Following are potentially significant environmental issues:

- Potential conflicts with the current management and restrictions on use of some public lands.
- Reduction of flows in the main stem Colorado River and the attendant impacts to designated critical habitat for federally listed fish species below the diversion.
- Impacts to U.S. Fish and Wildlife Service flow recommendations for the recovery of the listed fish.
- Fish entrainment, constituting "take" under the federal Endangered Species Act.
- Impacts to receiving waters on the east side of the Continental Divide.
- Concentration of contaminants in the treated waste streams and the storage and disposal of these contaminants.

Further investigation will be needed to identify ways in which these potentially significant impacts can be avoided or mitigated.

Conclusions

This reconnaissance study of the CRRP demonstrates that the project may be financially feasible under certain conditions, but many economic, institutional and environmental issues need further assessment. Anticipated population growth in the Arkansas and South Platte river basins combined with municipal and industrial needs in the Colorado River basin would provide sufficient future water demands to fully utilize the project's developed water supply. The project's supply must be treated sufficiently for discharge into existing water bodies and/or raw water collection systems. The CRRP could have significant impacts on the target flows established for the recovery of endangered fish species in the area designated by the U.S. Fish and Wildlife Service as "critical habitat" extending downstream of the potential diversion near the Utah state line. The impacts to these target flows might be mitigated or avoided with sufficient storage in the CRRP collection system to allow the project to cease diversions when such impacts are anticipated. Advanced treatment processes utilizing membrane filtration or reverse osmosis technologies would likely be required. The potential size of the CRRP treatment facilities combined with the existing water quality of the Colorado River water near the Utah state line requires that the handling of the residual waste stream of the water treatment plant be given special consideration in future studies. The electrical energy to pump water from a point downstream of Grand Junction to the South Platte and Arkansas River basins is significant. The power requirements should be considered in the context of the additional electrical generation resources that will be needed to supply the future Colorado population and economy.

Recommendations

Additional work would be required in the following categories to advance the CRRP concept:

- Presentation of CRRRS Findings to Affected Parties
- Examine Variations in Layout of CRRP Structural Components
- Examine Methods to Enhance Economic and Financial Feasibility
- Perform Additional Environmental Evaluations
- Investigate Future Water Demands in the Three River Basins
- Evaluate Alternatives to the CRRP

The CRRP offers certain advantages and disadvantages over other water resource alternatives. The CRRP is less well understood than other water resource alternatives, but the comparison of the advantages and disadvantages indicate a mixed picture compared with alternatives. Table ES-3 presents a comparison between CRRP and alternatives in terms of costs and benefits from an economic, social and environmental perspective.

Next Steps

The general process of developing a public infrastructure project includes the following general sequence:

- Reconnaissance Studies;
- Feasibility Studies;
- Pre-Design Studies;

- Regulatory Compliance;
- Final Design;
- Construction Bidding;
- Construction; and
- Project Start-up.

The minimum time expected to implement the CRRP would be about 15 years if all the implemented phases were performed sequentially (without any overlap) and no special measures were taken to expedite the phases. Alternatively, if all the phases could be accomplished without significant delays; certain design activities were overlapped (fast-tracked), eliminated or combined; purchase of long-lead-time electro-mechanical equipment (for example, pumps and turbines) were expedited, and innovative project delivery methods (for example, design-build approaches versus traditional design-bid-build) were used, the absolute minimum time for CRRP implementation would be on the order of 10 to 12 years. Alternatively, a time frame of 27 years would be required to implement the project if all phases are performed sequentially and none of the methods discussed above are used to advance the schedule.

Table ES-3: A Comparison of CRRP vs. Alternatives

Water Resource Categories	Potential Yield	Certainty of Yield	Direct Cost per af	Flexibility to Follow Demand Curve	Economic Costs and Benefits	Social Costs and Benefits	Environmental Costs and Benefits
CRRP	Can meet projected demands through 2050	Once developed, very high degree of certainty, except at 750,000 af/year delivery	$12-$22k per af depending on corridor and scenario	Inability to follow demand curve with present configuration	Very large up-front capital cost; roadway impacts; no loss to other Colorado water suppliers; major economic stimulus	Creates uncertainty and risk for all stakeholders; will consolidate and maybe reduce future water conflicts	Disposal of treatment residuals and excess fill removal primary concerns; consolidation of environmental conflicts; more supply in consuming regions
CRRP Alternatives*:							
Agricultural to Municipal Water Transfers	Limited senior rights in locations useful to municipalities	High degree of certainty, assuming senior rights	Much less than CRRP, excluding conveyance costs	Relatively flexible in following demand curve	Basin of origin, third-party costs; efficiency gains from transfers	Potential out-migration of population; loss of community institutions	Reduced return flows in basin of origin; as related pollutants reduced; wetland impacts and lower base flows
Non-Potable Water Reuse	Limited to non-native flows, location of demand	Very high degree of certainty	Less than CRRP	Somewhat flexible in following demand curve	Effluent use downstream reduced; efficiency gains	Public acceptability can be limited; providers use own source (less conflict)	Downstream habitat affected; open space better maintained if irrigated with reuse water
Water Conservation	Finite as a base resource	Uncertain yield due to market response	Most conservation programs much less than CRRP	Very flexible in following demand curve	Reduced resources for utilities short term; efficiency benefits	Common public purpose; fairness issues	Negligible environmental effects with exception of less return flows, lower base flows and expansion of use
New Storage	Can meet projected demands only if suitable water rights are obtainable	Once developed, high degree of certainty specific to project	Less than or comparable with, CRRP	Inflexible in following demand curve	Displacement of land use; third party effects; economic, tax stimulus including recreation benefits	Potential displacement of homes and businesses; construction effects	Habitat losses; wildlife, aquatic resource losses; ecosystem changes; impact water quality reduces dilution flows
Transbasin Diversions	Can meet projected demands only if suitable water rights are obtainable	Degree of certainty specific to project	Less than or comparable with, CRRP	Inflexible in following demand curve	Present and future economic losses to basin of origin without adequate measures	Third party impacts	Change in stream flow regime; loss in basin of origin, gain in basin of use
Non-Renewable Groundwater	Limited yield	Somewhat uncertain yields	Much less than CRRP	Highly flexible in following demand curve	Economic costs of depletion, future use; financial burdens follow beneficiaries closely	Potential conflicts over aquifer depletions; precarious water resource policy	Increased stream flows

* Combinations may be required to achieve similar levels of yield.