February 2012

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# Strategies to Address Colorado's Water Supply Future Reconnaissance Cost Estimates

The Colorado Water Conservation Board (CWCB) and the Interbasin Compact Committee (IBCC) are in the process of a continuing dialogue regarding Colorado's Water Supply Future. During the past year, their discussions have focused on how Colorado will meet its 2050 municipal and industrial (M&I) demands, agricultural demands, and environmental and recreational water needs. The CWCB and IBCC have agreed that a mix of strategies is needed to help meet our state's future water needs. Strategies include local water supplies, conservation, reuse, agricultural transfers, and development of additional Colorado River supplies.

As part of the technical work completed to assist the CWCB, IBCC, and Basin Roundtables in their discussions, CWCB developed reconnaissance level comparative cost estimates for the identified projects and processes, conservation strategies, coordinated agricultural transers, and development of additional Colorado River System supplies. These cost estimates were used to develop the cost estimate trade-off for CWCB's Porfolio and Trade-off Tool.

The following assumptions are used for estimating the portfolio costs and are summarized in **Table 1**:

- **IPPs:** for construction costs, tool uses $5,900 per acre-foot for West Slope projects and $14,000 per acre-foot for East Slope projects based on information gathered by CWCB during their effort to update the Basin Needs Decision Support System.
- **Conservation:** for passive conservation, assumes no cost to water providers and for active conservation, $7,200 based on information developed during SWSI 2010.
- **Agricultural Transfer:** Assumes a range of $33,500 per acre-foot to $34,200 per acre-foot construction costs based on size of agricultural transfer. These costs assume a coordinated agricultural transfer project and are based on the cost analysis included in SWSI 2010 and described in more detail below.
- **New Supply Development:** Assumes a range of $28,000 per acre-foot to $32,200 per acre-foot construction costs based on size of new supply development project for transfers to the East Slope. This range is based on costs developed as part of SWSI 2010 and described in more detail in the remainder of this fact sheet. New Supply Development on the West Slope assumes a cost of $5,900 per acre-foot based on the same cost assumptions as those associated with West Slope IPPs.

**Table 1.** Summary of Portfolio Unit Costs

| Strategy | West Slope[1] Unit Costs | East Slope Unit Costs |
|---|---|---|
| IPPs | $5,900 | $14,000 |
| Active Conservation | $7,200 | $7,200 |
| Ag Transfers[2] | $5,900 | $33,500 to $34,200 |
| New Supply[2] | $5,900 | $28,000 to $32,200 |

[1] Costs for the Rio Grande and North Platte Basins are the same as the West Slope and are integrated with the West Slope for the purpose of this costs analysis.

[2] The costs of reuse are incorporated into the cost associated with agricultural transfers or new supply development.

# Reconnaissance Level Capital, Operation and Maintenance, and Life Cycle Costs for Agricultural Transfer and New Supply Development Concepts

As part of SWSI 2010, the CWCB developed reconnaissance level comparative cost estimates for large scale agricultural transfer and new supply development concepts. Both capital and life cycle costs were developed as part of this effort.

**Figure 1** shows the geographic extent for the following concepts—agricultural transfers from the lower South Platte and Arkansas Basins and new supply development from Blue Mesa Reservoir, Flaming Gorge Reservoir, Green Mountain Reservoir, and the Yampa River Basin. The basic attributes of each concept shown in Figure 1—the water source, conveyance and storage, and water quality and treatment considerations—are presented in **Table 2**.

**Figure 1.** Overview of New Supply Development and Agricultural Transfer Concepts

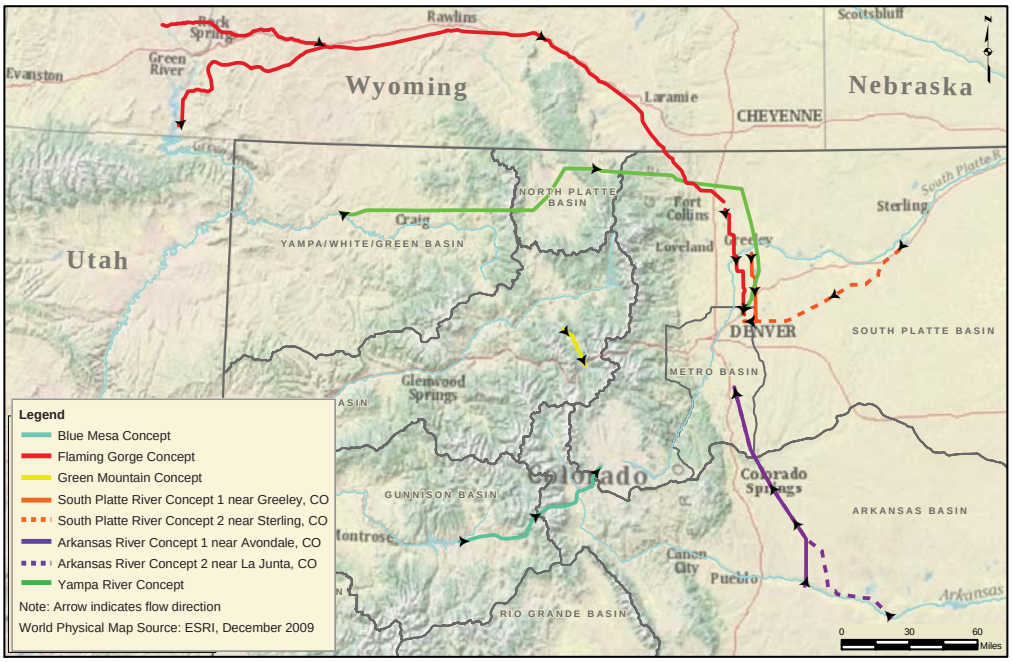


**Table 2.** New Supply Development and Agricultural Transfer Concept Attributes

| Concept | Water Source / Water Rights | Conveyance and Storage | Water Quality and Treatment Costs |
|---|---|---|---|
| **Lower South Platte** | • South Platte agricultural rights | • 36- to 84-mile pipeline with static pumping requirement of 700 to 1,300 feet<br>• Firming storage required | • Reverse osmosis or advanced water treatment will be required |
| **Lower Arkansas** | • Arkansas agricultural rights | • 96- to 133-mile pipeline with static pumping requirement of 3,100 to 3,600 feet<br>• Firming storage required | • Reverse osmosis or advanced water treatment will be required |
| **Green Mountain** | • Blue River water in the Colorado River Basin as well as new South Platte water rights | • 22-mile pipeline with static pumping requirement of 1,100 feet<br>• Firming storage required | • Conventional treatment technology |
| **Yampa** | • New water rights appropriation | • 250-mile pipeline with static pumping requirement of 5,000 feet<br>• Firming storage required | • Conventional treatment technology |
| **Flaming Gorge** | • Contract with Bureau of Reclamation for water from the Flaming Gorge marketable pool | • 357- to 442-mile pipeline with static pumping requirements of 1,400 to 3,100 feet<br>• Firming storage required | • Conventional treatment technology |
| **Blue Mesa Reservoir** | • Contract with Bureau of Reclamation for water from the Aspinall marketable pool | • 81-mile pipeline with static pumping requirement of 3,400 feet<br>• Firming storage required | • Conventional treatment technology |

For the Lower South and Lower Arkansas concepts, the cost of water rights will likely decrease the further downstream the diversion is from urban areas; however, conveyance and treatment costs will increase accordingly.

With exception of the Green Mountain concept, which was assumed to deliver 68,000 acre-feet per year (AFY) in a single phase, reconnaissance level cost estimates were developed for each of the concepts described above based on three options:

- **Option 1:** delivery of 100,000 AFY constructed in a single phase
- **Option 2:** delivery of 250,000 AFY constructed in a single phase
- **Option 3:** delivery of 250,000 AFY constructed with the first phase delivering 100,000 AFY and the second phase delivering the remaining 150,000 AFY

Key elements for each water supply concept were identified and evaluated using uniform assumptions to determine infrastructure requirements and sizing for the reconnaissance level cost estimates. The following key elements were considered for each option—water rights; firming storage; transmission facilities (including pipelines, pump stations, and tunnels); diversion structures; water treatment; reuse; and engineering, legal, and administrative costs including permitting.

**Figure 2** shows the summary of the reconnaissance level capital costs for each of the concepts. The range of capital costs for all of the concepts is $840 million (Green Mountain) to $9.8 billion (Flaming Gorge Option 3). For the agricultural transfer concepts, the majority of the capital cost is comprised of water rights acquisitions. For the new supply development concepts, the majority of the capital costs are associated with pipeline and pump stations.

Reconnaissance level operation and maintenance (O&M) costs for each concept are summarized in **Figure 3**. Annual O&M costs range from $29 million per year (Green Mountain) to $273 million per year (Arkansas Option 3). The variability between concepts is due primarily to conveyance costs but differences between conventional treatment and reverse osmosis with zero liquid discharge also contribute to the variation.

CWCB also developed reconnaissance level life cycle costs for all concepts. Life cycle costs allow present value comparison of the capital and operational costs in order to evaluate the long-range economic feasibility of each concept. CWCB utilized the following key assumptions for the life cycle cost analysis:

- Planning period – 50 years after completion of construction
- Present worth – capital and operating costs brought based to 2009
- Capital costs expended in 2020, with O&M starting in 2021 for Options 1 and 2
- Capital costs expended in 2020, with O&M starting in 2021 for Phase 1 of Option 3 and 2040, with O&M starting in 2041 for Phase 2 of Option 3
- Discount rate, or cost of money – 6 percent
- Escalation – Capital items (3 percent), annual O&M (3 percent), and energy (5 percent)
- 2009 energy costs ($/kilowatt hour) – $0.08

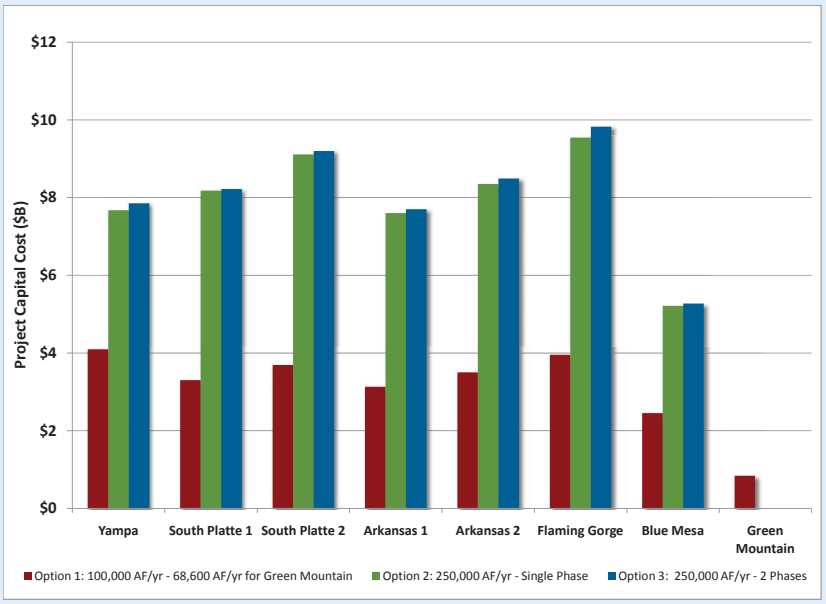


**Figure 2.** Summary of Reconnaissance Capital Costs

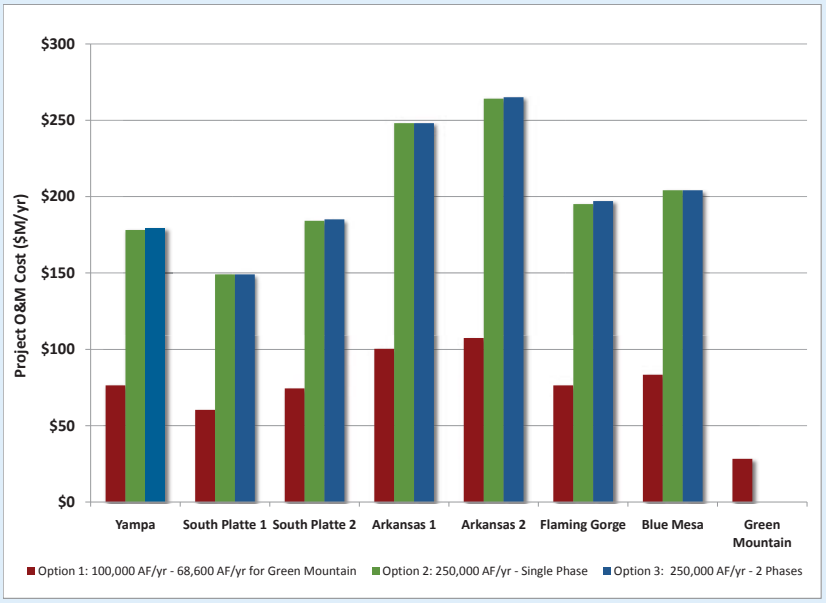


**Figure 3.** Summary of Reconnaissance Operations and Maintenance Costs

In addition to initial capital costs, CWCB considered replacement costs for the constructed facilities if the replacement was required during the 50-year planning period.

**Figure 4** and **Figure 5** provide a summary of the total life cycle costs and the total life cycle costs per acre-foot of water developed by each concept. These figures show that the least expensive concept is Green Mountain and most expensive is either Arkansas concept. The Arkansas concepts are most expensive due to the annual treatment costs that would be associated with them.

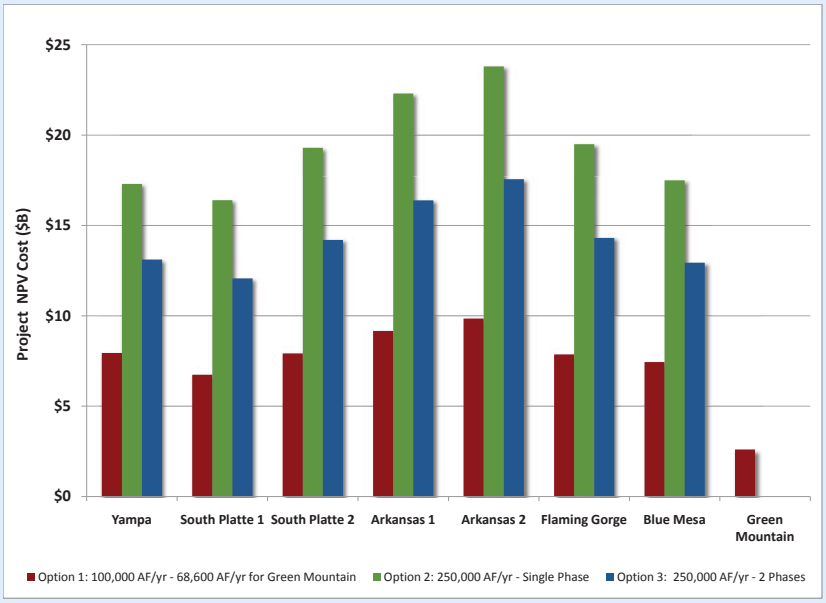


**Figure 4.** Summary of Reconnaissance Life Cycle Costs

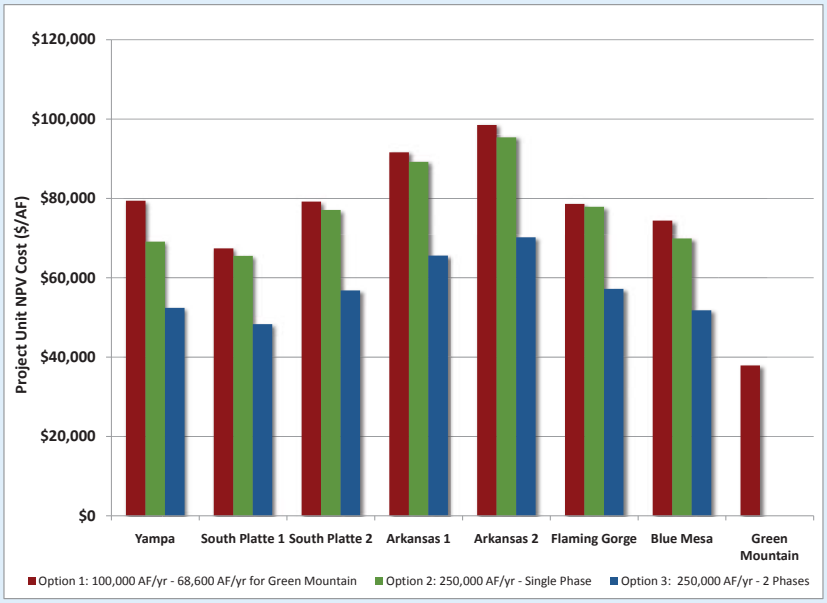


**Figure 5.** Summary of Reconnaissance Life Cycle Unit Costs


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