Chapter 7

Multi-Barrier Approach Economic Evaluation

The relative economic merit of multi-barrier water delivery alternatives developed in Chapter 5 was evaluated based on a life-cycle cost present value analysis that included capital, O&M, and project financing costs.

A. Economic Evaluation Principles and Parameters

The economic analysis performed in this study was based on applying a common set of unit process and O&M costs to each BRWTF multi-barrier water delivery alternative. The Class 4 planning level cost opinions presented here reflect use of standard engineering practices and were prepared without the benefit of detailed engineering designs. As defined by The Association for the Advancement of Cost Engineering, Class 4 cost opinions of this type are generally considered to have an accuracy range of plus 50 to minus 30 percent. Any actual project cost would depend on current labor and material costs, competitive market conditions, final project scope, bid date, and other variable factors. These cost opinions are perhaps best used to compare relative multi-barrier water delivery alternative costs, rather than actual project costs.

A 30-year life-cycle was assumed for each water delivery alternative evaluated consistent with industry standard expected service lives for major drinking water treatment equipment. Because the expected useful life of large diameter subterranean transmission mains is considerably longer than 30 years, the residual value of the Carter Lake Pipeline beyond this time was credited to the net present value cost opinion for Alternative 6. Useful life for large diameter welded steel pipe of the type proposed for the Carter Lake Pipeline was conservatively estimated using representative survival functions to be 70 years (Quantifying Future Rehabilitation and Replacement Needs of Water Mains, AWWARF, 1998). Other common economic analysis parameters used include a 2007 baseline, an O&M inflation rate of 4 percent, a loan interest rate of 6 percent, and a present worth factor of 4 percent.

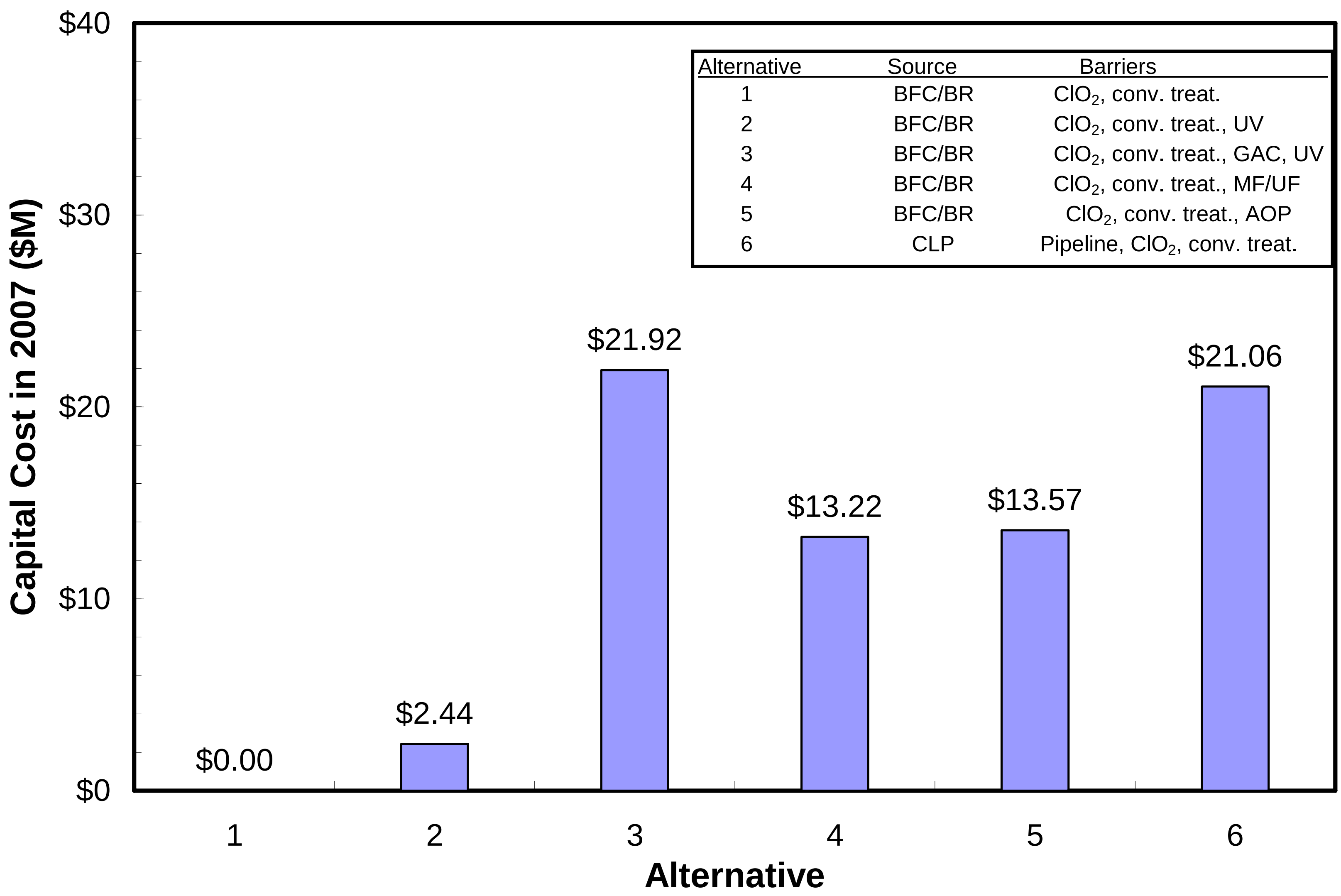
B. Capital Cost Opinions

Capital cost opinions include material and construction estimates for process equipment and basins, any additional structures needed to house process equipment, electrical service, instrumentation and control, site work, yard piping, and general contracting. Engineering, legal, and administrative expenses were estimated to be 20 percent of the material and construction cost subtotal. Similarly, a contingency factor of 25 percent was applied to the material and construction subtotal. Present value life-cycle capital cost opinions were generated using the economic parameters given above for a firm capacity of 16 mgd at BRWTF.

The capital cost opinions for BRWTF multi-barrier water delivery alternatives evaluated as part of this study are given in 2007 dollars as shown in Figure 7-1, and the associated life-cycle present value of these capital costs are given in Figure 7-2. As shown in Figure 7-1, the capital costs varied widely between no additional capital expenditure for Alternative 1 and $22M for Alternative 3. The present value of these capital costs are slightly higher due to project financing at 6 percent interest over the 30-year project life-cycle. The present value of Alternative 6 is substantially less than its estimated cost in 2007 dollars because the residual value of the pipeline beyond 30 years was credited to this alternative. It should be noted that these capital costs estimates are in addition to any capital costs related to planned mid-term improvements including chlorine dioxide pre-oxidation and finished water pH adjustment.

C. O&M Cost Opinions

O&M costs were determined for the 30-year life-cycle used for economic evaluation purposes. These O&M estimates included treatment chemical, other consumables such as UV lamp and ballast replacement, GAC replacement, pumping and other energy costs, and scheduled equipment maintenance. An average daily flow rate of 5 mgd was used to calculate variable consumable and energy O&M costs. This production rate was slightly higher than the 4.55 mgd average daily flow in 2006 to account for future growth in the BRWTF service area.



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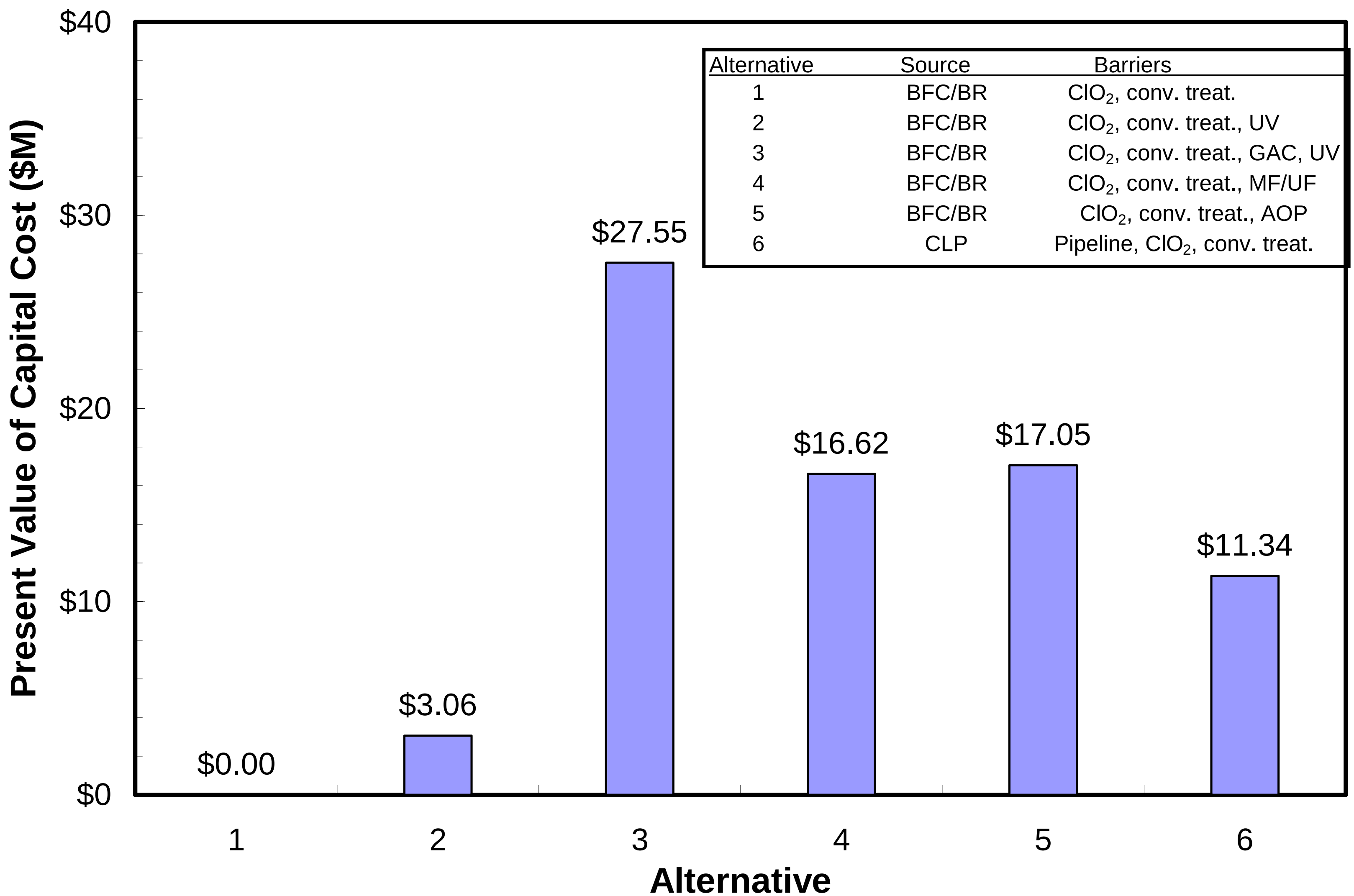
Capital Costs for BRWTF Multi-Barrier Approach Water Delivery Alternatives in 2007 Dollars

Figure 7-1



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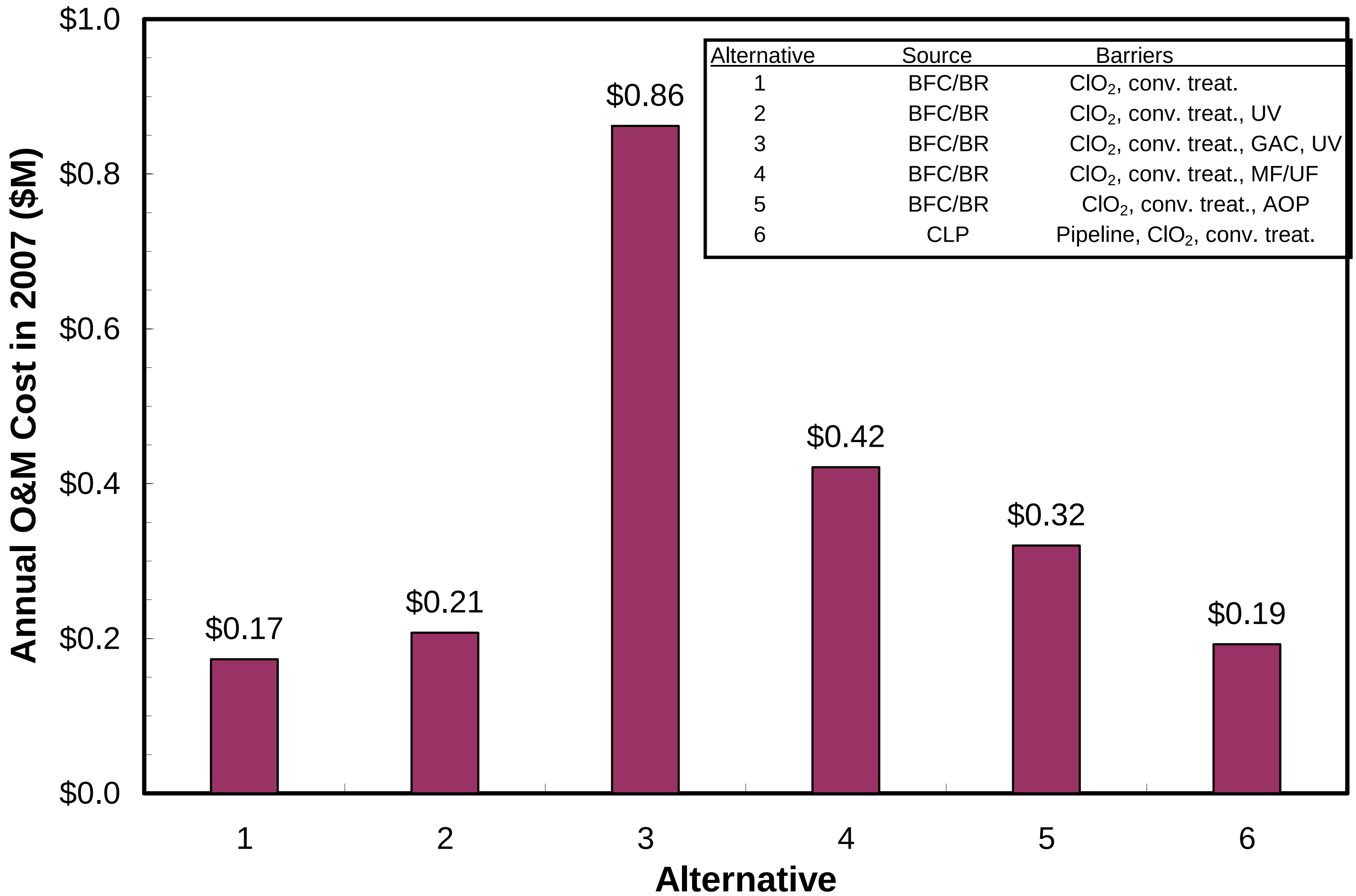
Present Value of Capital Costs for BRWTF Multi-Barrier Approach Water Delivery Alternatives

Figure 7-2

Annual O&M cost opinions for BRWTF multi-barrier water delivery alternatives evaluated as part of this study are given in 2007 dollars as shown on Figure 7-3, and the associated life-cycle present value of these O&M costs are given in Figure 7-4. Annual O&M costs for Alternatives 1, 2, and 6 were clustered between $170k and $210k, with considerably higher values of $860k, $420k, and $330k for Alternatives 3, 4, and 5. The higher annual O&M estimates for Alternatives 3, 4, and 5 reflect costs associated with semi-annual GAC replacement, membrane replacement and cleaning chemicals, and precursor chemicals for advanced oxidation, respectively. The present value of these O&M costs reflects an annual inflation rate of 4 percent, applied each year throughout the project life-cycle. The additional O&M costs for chlorine dioxide preoxidation and pH adjustment planned as mid-term improvements were include for all water delivery alternatives.

D. Net Present Value Opinions

The total net present value cost opinions for BRWTF multi-barrier water delivery alternatives were calculated as the sum of net present capital and O&M costs, as shown on Figure 7-5. Water delivery alternative net present value estimates varied widely between $5.2M and $53.4M, based largely on the number and type of additional contaminant barriers. The comparatively lower net present values for Alternatives 1 and 2 reflect the lack of an effective barrier for organic micropollutants, and a less robust set of barriers for taste and odor control. The comparatively higher net present values for Alternatives 3 and 5 reflect a premium required when organic micropollutant and taste and odor control are provided by treatment rather than source water protection, whereas Alternative 4 has a higher net present value due primarily to membrane replacement costs.



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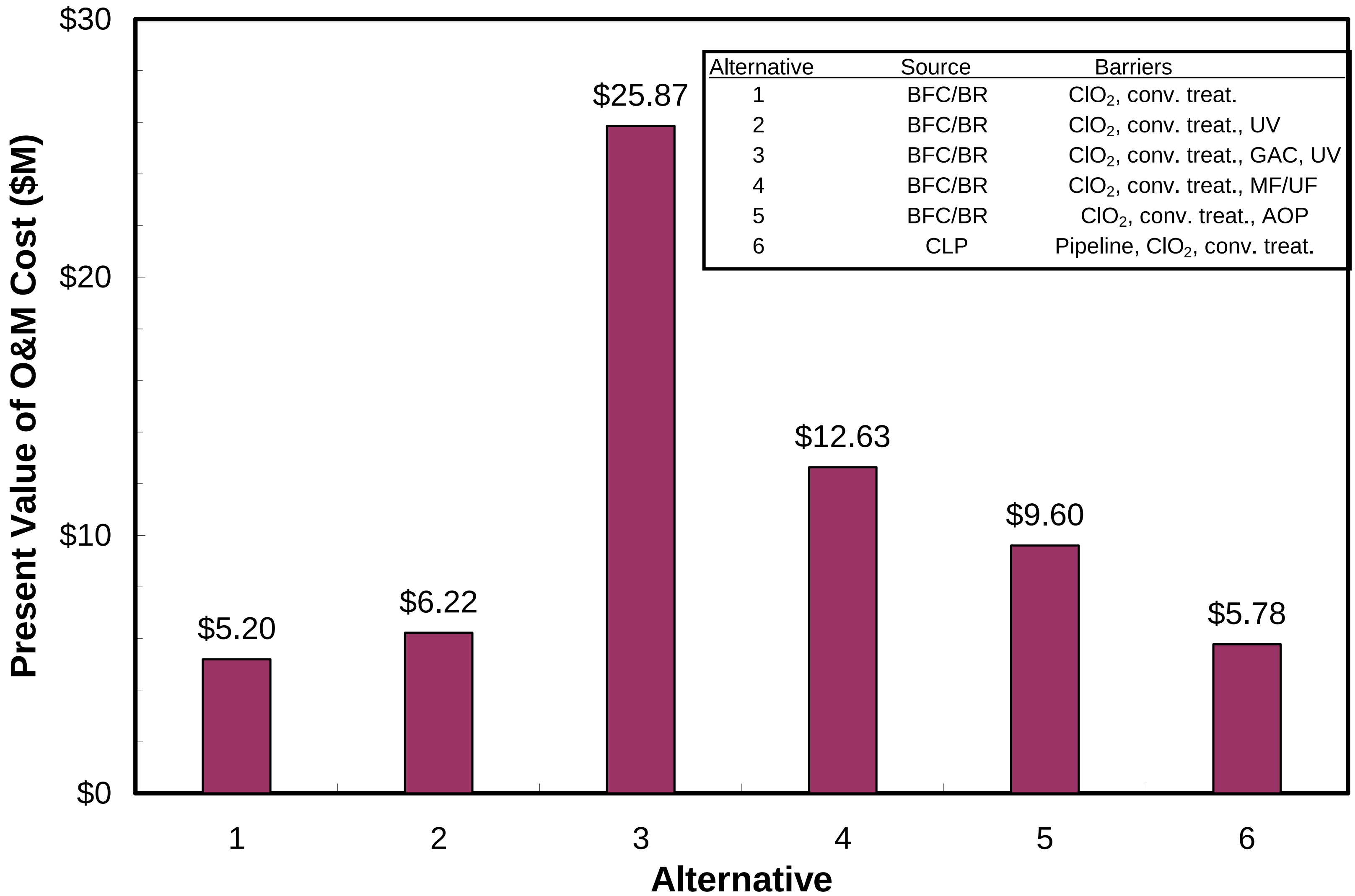
Annual O&M Costs for BRWTF Multi-Barrier Approach Water Delivery Alternatives in 2007 Dollars

Figure 7-3



Alternative	Source	Barriers
1	BFC/BR	ClO_2, conv. treat.
2	BFC/BR	ClO_2, conv. treat., UV
3	BFC/BR	ClO_2, conv. treat., GAC, UV
4	BFC/BR	ClO_2, conv. treat., MF/UF
5	BFC/BR	ClO_2, conv. treat., AOP
6	CLP	Pipeline, ClO_2, conv. treat.

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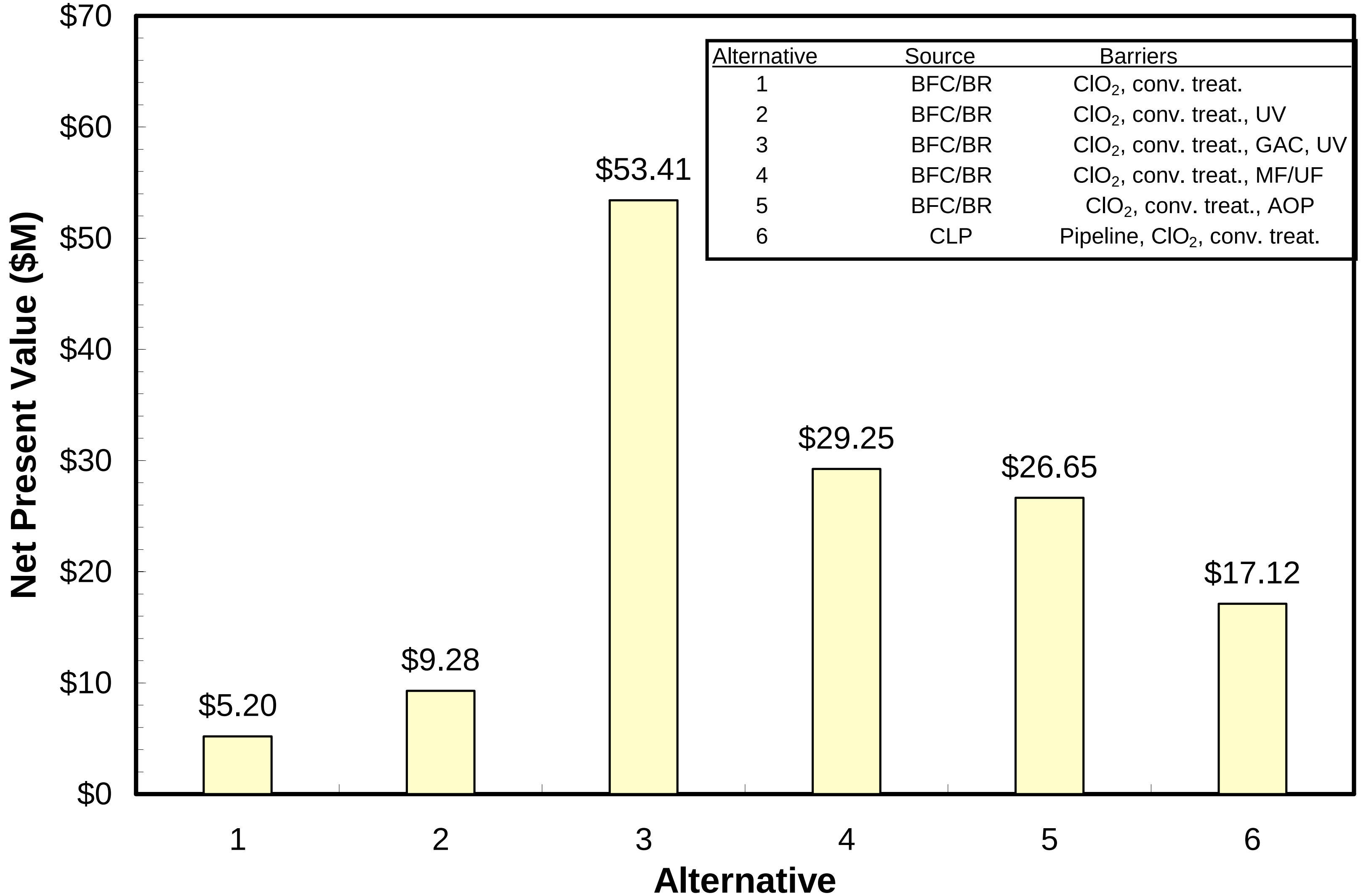
Present Value of O&M Costs for BRWTF Multi-Barrier Approach Water Delivery Alternatives

Figure 7-4



Alternative	Source	Barriers
1	BFC/BR	ClO_2, conv. treat.
2	BFC/BR	ClO_2, conv. treat., UV
3	BFC/BR	ClO_2, conv. treat., GAC, UV
4	BFC/BR	ClO_2, conv. treat., MF/UF
5	BFC/BR	ClO_2, conv. treat., AOP
6	CLP	Pipeline, ClO_2, conv. treat.

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Net Present Value of BRWTF Multi-Barrier Approach Water Delivery Alternative Selection

Figure 7-5