



Chapter 6

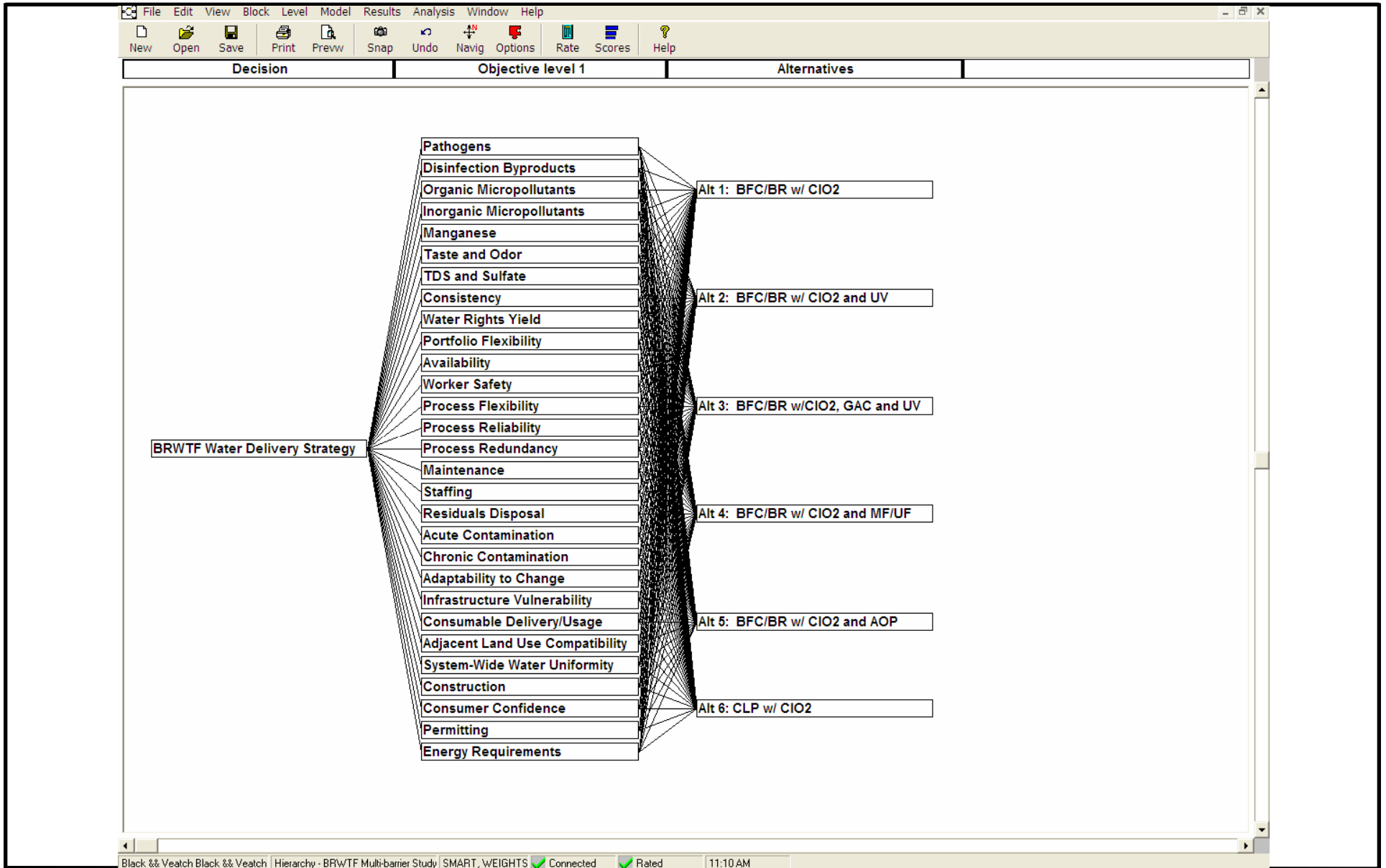
Non-Economic Performance Evaluation

The relative performance of multi-barrier water delivery alternatives developed in Chapter 5 was evaluated using the K-T[®] decision analysis procedure outlined in Chapter 1. The complete non-economic performance decision model including decision statement, criteria developed in Chapter 4, and multi-barrier water delivery alternatives developed in Chapter 5 is shown on Figure 6-1. Each water delivery alternative was ranked by its ability to satisfy the non-economic performance criteria relative to all other alternatives.

A. Non-Economic Performance Criteria Weighting

The set of non-economic performance criteria developed in Chapter 4 were evaluated for their relative importance in selecting a multi-barrier water delivery alternative for BRWTF. City staff assigned each performance criteria a weight between 1 and 10, with the highest value for the most important criteria. An ad hoc City staff committee (BRWTF Multi-Barrier Project Working Group) representing drinking water quality, water resources, operations, and senior management functions held a series of informal meetings and communications to develop a preliminary set of performance criteria weights based on the collective expertise and experience of the committee members. These preliminary criteria weights were formalized based on the dialog of a workshop held on December 14, 2006 between working group members and B&V. Table 6-1 lists the relative weights assigned to each decision criteria.

As part of the K-T[®] decision analysis process, the weight assigned to each criterion was normalized such that the sum of normalized criteria weights is equal to 1.0. Normalized criteria weights are termed priorities, as shown in Table 6-1. It should be noted that this normalization process does not change the relative importance of each criterion weight in determining water delivery alternative scores.





Decision Statement	Criteria	Model Weights		Alternative Ranking Against Criteria						Alternatives:
		Weights	Priorities	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	
Select a Multi-Barrier Water Delivery Approach for BRWTF	Pathogens	10	0.056	2	10	10	10	3	6	Alt 1: BFC/BR w/ ClO2 Alt 2: BFC/BR w/ ClO2 and UV Alt 3: BFC/BR w/ ClO2, GAC and UV Alt 4: BFC/BR w/ ClO2 and MF/UF Alt 5: BFC/BR w/ ClO2 and AOP Alt 6: CLP w/ ClO2
	Disinfection Byproducts	7	0.039	9	9	9	9	10	9	
	Organic Micropollutants	6	0.033	2	3	7	2	10	8	
	Inorganic Micropollutants	4	0.022	6	6	6	6	8	10	
	Manganese	6	0.033	8	8	8	8	8	10	
	Taste and Odor	6	0.033	5	5	7	5	10	8	
	TDS and Sulfate	6	0.033	3	3	3	3	3	10	
	Consistency	6	0.033	2	2	2	2	2	10	
	Water Rights Yield	10	0.056	5	5	5	5	5	10	
	Portfolio Flexibility	8	0.044	5	5	5	5	5	10	
	Availability	9	0.050	5	5	5	5	5	10	
	Worker Safety	10	0.056	10	7	6	6	6	10	
	Process Flexibility	6	0.033	6	8	8	8	10	6	
	Process Reliability	9	0.050	7	6	5	6	6	10	
	Process Redundancy	9	0.050	6	8	9	6	10	10	
	Maintenance	3	0.017	10	7	4	8	6	10	
	Staffing	3	0.017	8	7	7	9	5	10	
	Residuals Disposal	5	0.028	7	7	5	5	5	10	
	Acute Contamination	10	0.056	3	3	3	3	3	10	
	Chronic Contamination	10	0.056	2	5	7	5	8	10	
	Adaptability to Change	8	0.044	2	5	7	5	8	10	
	Infrastructure Vulnerability	2	0.011	4	4	4	4	4	10	
	Consumable Delivery/Usage	1	0.006	10	8	5	4	4	10	
Adjacent Land Use Compatibility	8	0.044	4	4	4	4	3	10		
System-Wide Water Uniformity	3	0.017	3	3	3	3	3	10		
Construction	1	0.006	10	7	4	7	6	4		
Consumer Confidence	8	0.044	6	7	10	7	7	10		
Permitting	1	0.006	10	8	6	8	8	6		
Energy Requirements	5	0.028	5	3	3	4	2	10		
				0.512	0.573	0.606	0.554	0.603	0.942	Alternative Performance Scores



B. BRWTF Multi-Barrier Alternative Performance Scores

The multi-barrier alternatives developed in Chapter 5 were ranked against the weighted decision criteria listed in Table 6-1. B&V established the relative performance of each water delivery alternative against each decision criterion in turn by assigning scores between 1 and 10, with the highest value for the alternative(s) that best satisfied the intent of the criterion. It is important to note that assigning a score of 10 to an alternative for any given criterion does not imply that the alternative satisfies the criterion perfectly, but rather that it most closely satisfies the intent of the criterion. Remaining alternatives were assigned lower scores based on their ability to satisfy the given criterion relative to the alternative that best satisfies that criterion.

The general approach taken in ranking BRWTF water delivery alternatives against each criterion was that wherever possible prevention of contamination during raw water delivery to BRWTF is a superior strategy to subsequent treatment at BRWTF. The working group developed a preliminary set of guidelines for scoring alternatives against each criterion, as listed in Appendix 2. Minor changes discussed in a workshop held January 18, 2007 with the project Working Group and B&V were incorporated with the preliminary guidelines to formalize the multi-barrier water delivery scoring process. Worksheets used during BRWTF multi-barrier water delivery alternative scoring are given in Appendix 2.

In the K-T[®] decision analysis process performance scores for each alternative are calculated as the sum of the products of decision model criteria priorities and each set of respective alternative scores. These performance scores are expressed on a scale of 0 to 1, with higher values indicating better alternative performance. As shown in Table 6-1, non-economic performance scores for the BRWTF water delivery alternatives evaluated in this study were clustered between 0.5 and 0.6 for all but Alternative 6, which had a performance score of 0.942.

C. Alternative Performance Sensitivity Analysis

The non-economic analysis performed here indicates that Alternative 6 is the highest ranked BRWTF multi-barrier water delivery alternative, followed by Alternatives 1 through 5 with non-economic performance scores that were

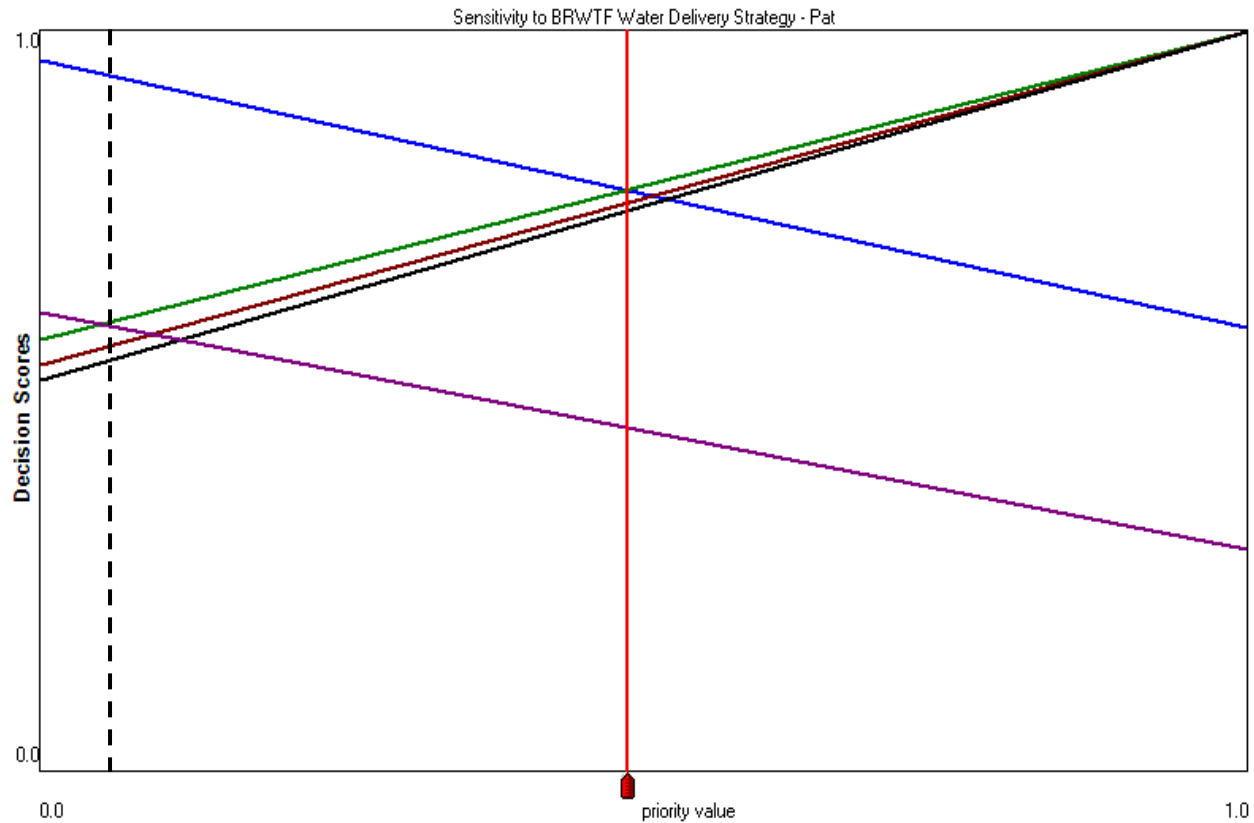


grouped in a substantially lower range. The sensitivity of this alternative ranking to the criteria weights assigned was evaluated using the sensitivity analysis feature of the Criterium DecisionPlus[®] software package used to perform decision analysis calculations. The change in each decision model criteria weight required to alter the ranking of alternatives was determined, as illustrated graphically in Figure 6-2 for the Pathogens criterion. In this figure, the dashed vertical line shows the criterion weight assigned by the Project Working Group, and the vertical solid red line indicates the *critical priority value* (critical normalized weight) required to alter the BRWTF water delivery alternative ranking. Thus, if the Pathogens criterion assigned priority value of 0.056 were increased to 0.49 or greater then Alternative 3 would be the highest ranked alternative. However, the Pathogens criterion was assigned the maximum weight of 10, so a critical priority value of 0.49 would correspond to a criterion weight substantially greater than 10 (161 in this case). Because adjusting any assigned criterion weight to a value outside the 0 to 10 range used in the decision analysis procedure would be meaningless, the ranking of BRWTF multi-barrier water delivery alternatives was not sensitive to the weight assigned to the Pathogens criterion. Similar analysis of all other decision model criteria indicates that the ranking of alternatives was not sensitive to the weight assigned to any criterion.

Criterion DecisionPlus - [SMART Sensitivity by Weights]

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Alternatives:
 Alt 6: CLP w/ ClO2
 Alt 3: BFC/BR w/ClO2, GA
 Alt 2: BFC/BR w/ ClO2 an
 Alt 4: BFC/BR w/ ClO2 an
 Alt 5: BFC/BR w/ ClO2 an

Temp Value:
 0.49(out of range-OS)
 Current Value:
 0.06(Critical)