Antelope Valley East Kern Water Agency

DBP Control Strategies

Presentation by MWH
March 24, 2004

MWH

MWH's Scope of Work

- Description of alternative DBP control strategies
- Opinion of probable costs
- Identification of major water quality considerations
- Presentation to the Board

DBP Control Strategies

Approach	#	Description	Primary Disinfection	Secondary Disinfection
Removal of Organic DBP Precursors	0	Enhanced Coagulation	Chlorine	Chlorine
	1	Peroxide/BAC	Chlorine	Chlorine
	2	GAC in existing filters	Chlorine	Chlorine
	3	GAC in new filters	Chlorine	Chlorine
	4	GAC adsorbers	Chlorine	Chlorine
	5	Nanofiltration	Chlorine	Chlorine
	6	Ozone/BAF	Chlorine	Chlorine
	7	Ozone/BAC	Chlorine	Chlorine
	8	MIEX ion exchange	Chlorine	Chlorine
Alternative Disinfectants and/or Conditions	9	Chlorine Dioxide/BAC	Chlorine Dioxide	Chlorine
	10	Chlorine Dioxide	Chlorine Dioxide	Chloramines
	11	Ozone/BAF	Ozone	Chloramines
	12	Ozone/BAC	Ozone	Chloramines
	13	Enhanced Coagulation	Chlorine	Chloramines
	14	Enh. Coagulation/BAC	Chlorine	Chloramines
Remove after Formation	15	Air Stripping	Chlorine	Chlorine
	16	GAC in dist. system	Chlorine	Chlorine

Water Quality Considerations

- TTHM Compliance (Stage 2 DBP Rule)
  - Anticipated TTHMs after 7 days
- Other WQ Improvements
  - Disinfection
  - Turbidity/Particle Removal
  - Taste & Odor Control
  - Barrier against micropollutants
- Other DBPs
    - Bromate: from ozonation (w/bromide and high ozone dose)
    - NDMA: from chloramines (at high chloramine dose)
    - Chlorite: from chlorine dioxide

DBP Control Strategies – Non-Cost Issues

#	Description	Disinfection	TTHMs >7 days	Other WQ Improvement	Risk
0	Enhanced Coagulation	Chlorine/Chlorine	High	N/A	TTHMs
1	Peroxide/BAC	Chlorine/Chlorine	Mod	+	Unproven
2	GAC in existing filters	Chlorine/Chlorine	Low	+	Operation
3	GAC in new filters	Chlorine/Chlorine	Low	+	
4	GAC adsorbers	Chlorine/Chlorine	Low	+	
5	Nanofiltration	Chlorine/Chlorine	Low	++	Brine
6	Ozone/BAF	Chlorine/Chlorine	Mod	+	TTHMs
7	Ozone/BAC	Chlorine/Chlorine	Mod	++	TTHMs
8	MIEX ion exchange	Chlorine/Chlorine	Low	+	Unproven
9	Chlorine Dioxide/BAC	Cl Dioxide/Chlorine	Mod	Slight	Chlorite
10	Chlorine Dioxide	Cl Dioxide/Chloramines	Very Low	None	Chlorite
11	Ozone/BAF	Ozone/Chloramines	Very Low	+	Bromate
12	Ozone/BAC	Ozone/Chloramines	Very Low	++	Bromate
13	Enhanced Coagulation	Chlorine/Chloramines	Low	None	NDMA, Nitrification
14	Enh. Coagulation/BAC	Chlorine/Chloramines	Low	Slight	
15	Air Stripping	Chlorine/Chlorine	Mod	None	Unproven
16	GAC in dist. system	Chlorine/Chlorine	Mod	Slight	Re-chlor

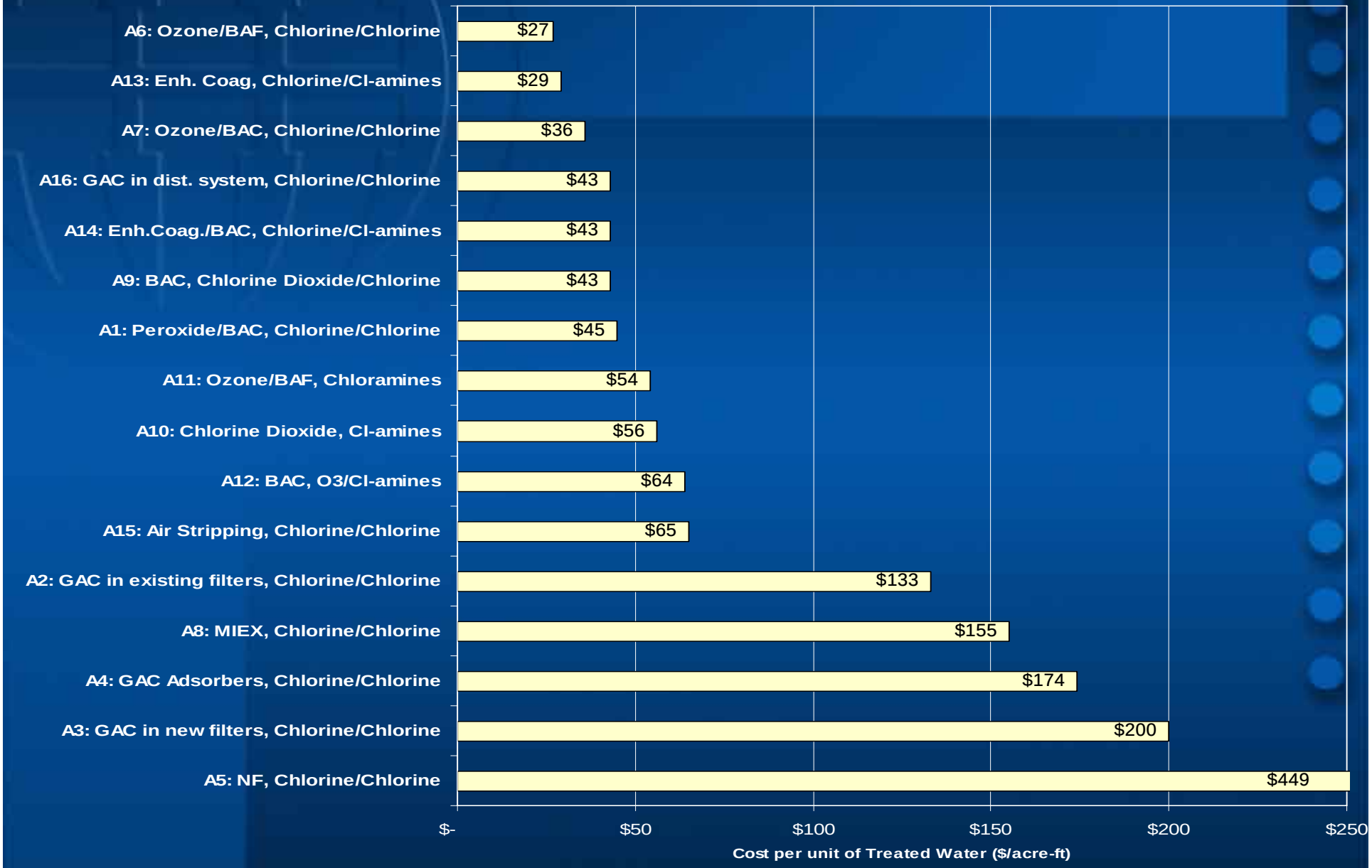
Cost Assumptions

- 20-year return period; 5 percent discount rate
- 65 mgd capacity; 36,400 AF/yr (50% average)
  - 80 mgd; 44,800 AF/yr for ozonation alternatives
- Capital Costs
  - Major equipment and installation
  - 20% for sitework and piping
  - 10% for electrical and I&C
  - 20% engineering & administration
  - 20% contingency
- O&M Costs
  - Chemical costs
  - Power for major equipment ($0.12/KW-Hr)
  - 3% for materials, labor, & maintenance

DBP Control Strategies – Opinion of Probable Cost

#	Description	Disinfection	Capital Mil $	O&M Mil $	$/AF
0	Enhanced Coagulation	Chlorine/Chlorine	--	--	--
1	Peroxide/BAC	Chlorine/Chlorine	7.0	1.1	45
2	GAC in existing filters	Chlorine/Chlorine	2.7	4.2	133
3	GAC in new filters	Chlorine/Chlorine	29	4.9	200
4	GAC adsorbers	Chlorine/Chlorine	20	4.7	174
5	Nanofiltration	Chlorine/Chlorine	101	8.2	449
6	Ozone/BAF	Chlorine/Chlorine	7.0	0.4	27
7	Ozone/BAC	Chlorine/Chlorine	9.9	0.5	36
8	MIEX ion exchange	Chlorine/Chlorine	27	3.4	155
9	Chlorine Dioxide/BAC	Cl Dioxide/Chlorine	10	0.7	43
10	Chlorine Dioxide	Cl Dioxide/Chloramines	10+7.0	0.6	56
11	Ozone/BAF	Ozone/Chloramines	10+7.0	0.6	54
12	Ozone/BAC	Ozone/Chloramines	13+7.0	0.7	64
13	Enhanced Coagulation	Chlorine/Chloramines	3.3+7.0	0.2	29
14	Enh. Coagulation/BAC	Chlorine/Chloramines	6.3+7.0	0.5	43
15	Air Stripping	Chlorine/Chlorine	16	1.1	65
16	GAC in dist. system	Chlorine/Chlorine	5.1	1.1	43

Unit Cost in $/AF for 65 mgd



Screening of Alternatives

- Eliminate “unproven” alternatives
  - Alternatives 1, 8, 15
- Eliminate alternatives with major operational problems
  - Alternatives 2, 5, 9, and 10
- Eliminate alternatives > $100/AF
  - Alternatives 3 and 4 (also 2, 5, and 8)
- Seven alternatives on shortlist
  - Alternatives 6, 7, 11, 12, 13, 14, and 16

Shortlist of Alternatives for 65 mgd

- Chloramines
  - Enhanced coagulation (Alt 13) $29/AF
  - Enhanced coagulation/BAC (Alt 14) $43/AF
- Ozone/Chlorine
  - Ozone/BAF (Alt 6) $27/AF
  - Ozone/BAC (Alt 7) $36/AF
- Ozone/Chloramines
  - Ozone/BAF (Alt 11) $54/AF
  - Ozone/BAC (Alt 12) $64/AF
- GAC in the Distribution System
  - GAC for 20% of production (Alt 16) $43/AF

Ozone Alternatives for 80 mgd

- Ozonation can improve filter performance, thus allowing higher filter loading rates
- A conventional expansion from 65 to 80 mgd would cost approximately $15 million
- The “avoided cost” of not building floc/sed/filters is approximately $10 million
- The savings for 80 mgd including the avoided cost is approximately $20/AF

$/AF for Ozonation at 65 & 80 mgd