

Midtown Water Utility Disinfection Options

Expanded Social Cost-Effectiveness Analysis

INCIDENT:	INCIDENT DAMAGES			
Chlorine Intentional Release	\$ 25,000,000			
Risk Management Options		Incident Risk		
Annual Probability	2.0%	1.0%	0.1%	
Recurrence Interval (years)	50	100	1,000	
Gas Cl2 + Scrubber				
Cost of Security Improvements	28,368	28,368	28,368	
Cost of Disinfection Option	88,459	88,459	88,459	
Expected Value of Damages from Attack	15,000	7,500	750	
Total Social Cost	131,827	124,327	117,577	
Regret	6,698	0	0	
Hypochlorite - Purchased				
Cost of Security Improvements	3,000	3,000	3,000	
Cost of Disinfection Option	122,129	122,129	122,129	
Expected Value of Damages from Attack	0	0	0	
Total Social Cost	125,129	125,129	125,129	
Regret	0	802	7,552	
Hypochlorite - Onsite Generation				
Cost of Security Improvements	3,000	3,000	3,000	
Cost of Disinfection Option	169,838	169,838	169,838	
Expected Value of Damages from Attack	0	0	0	
Total Social Cost	172,838	172,838	172,838	
Regret	47,709	48,511	55,261	
UV + Hypochlorite				
Cost of Security Improvements	3,000	3,000	3,000	
Cost of Disinfection Option	201,197	201,197	201,197	
Expected Value of Damages from Attack	0	0	0	
Total Social Cost	204,197	204,197	204,197	
Regret	79,068	79,870	86,620	
Ozone + Hypochlorite				
Cost of Security Improvements	3,000	3,000	3,000	
Cost of Disinfection Option	614,581	614,581	614,581	
Expected Value of Damages from Attack	0	0	0	
Total Social Cost	617,581	617,581	617,581	
Regret	492,452	493,253	500,003	
Minimum Maximum Regret		\$ 6,698		

Capital and Financing Terms	5.5%	20
-----------------------------	------	----

Maximum Regret

Annual Cost	Capital Cost	O&M Cost	Effectiveness
-------------	--------------	----------	---------------

\$28,368	\$100,000	\$ 20,000	97%
\$ 88,459	\$ 364,000	\$ 58,000	

\$ 6,698

\$ 3,000	\$ -	\$ 3,000	100%
\$ 122,129	\$ 372,000	\$ 91,000	

\$ 7,552

\$ 3,000	\$ -	\$ 3,000	100%
\$ 169,838	\$ 1,217,000	\$ 68,000	

\$ 55,261

\$ 3,000	\$ -	\$ 3,000	100%
\$ 201,197	\$ 1,532,000	\$ 73,000	

\$ 86,620

\$3,000	\$ -	\$ 3,000	100%
\$ 614,581	\$ 5,050,000	\$ 192,000	

\$ 500,003

\$ 6,698

Midtown Water Utility Disinfection Options

Expanded Social Cost-Effectiveness Analysis

INCIDENT:	INCIDENT DAMAGES		
Chlorine Intentional Release	\$ 50,000,000		
Risk Management Options	Incident Risk		
Annual Probability	2.0%	1.0%	0.1%
Recurrence Interval (years)	50	100	1,000
Gas Cl2 + Scrubber			
Cost of Security Improvements	48,718	48,718	48,718
Cost of Disinfection Option	69,735	69,735	69,735
Expected Value of Damages from Attack	50,000	25,000	2,500
Total Social Cost	168,454	143,454	120,954
Regret	42,021	17,021	0
Hypochlorite - Purchased			
Cost of Security Improvements	3,000	3,000	3,000
Cost of Disinfection Option	123,433	123,433	123,433
Expected Value of Damages from Attack	0	0	0
Total Social Cost	126,433	126,433	126,433
Regret	0	0	5,479
Hypochlorite - Onsite Generation			
Cost of Security Improvements	3,000	3,000	3,000
Cost of Disinfection Option	174,104	174,104	174,104
Expected Value of Damages from Attack	0	0	0
Total Social Cost	177,104	177,104	177,104
Regret	50,671	50,671	56,150
UV + Hypochlorite			
Cost of Security Improvements	3,000	3,000	3,000
Cost of Disinfection Option	206,567	206,567	206,567
Expected Value of Damages from Attack	0	0	0
Total Social Cost	209,567	209,567	209,567
Regret	83,134	83,134	88,613
Ozone + Hypochlorite			
Cost of Security Improvements	3,000	3,000	3,000
Cost of Disinfection Option	632,282	632,282	632,282
Expected Value of Damages from Attack	0	0	0
Total Social Cost	635,282	635,282	635,282
Regret	508,849	508,849	514,328
Minimum Maximum Regret			\$ 5,479

Capital and Financing Terms	6%	20
------------------------------------	-----------	-----------

Maximum Regret

Annual Cost	Capital Cost	O&M Cost	Effectiveness
--------------------	---------------------	---------------------	----------------------

\$ 48,718.46	\$100,000	\$ 40,000	95%
\$ 69,735	\$ 364,000	\$ 38,000	

\$ 42,021

\$ 3,000	\$ -	\$ 3,000	100%
\$ 123,433	\$ 372,000	\$ 91,000	

\$ 5,479

\$ 3,000	\$ -	\$ 3,000	100%
\$ 174,104	\$ 1,217,000	\$ 68,000	

\$ 56,150

\$ 3,000	\$ -	\$ 3,000	100%
\$ 206,567	\$ 1,532,000	\$ 73,000	

\$ 88,613

\$ 3,000.00	\$ -	\$ 3,000.00	100%
\$ 632,282	\$ 5,050,000	\$ 192,000	

Midtown Water Utility Disinfection Options

Expanded Social Cost-Effectiveness Analysis

INCIDENT:	INCIDENT DAMAGES			
Chlorine Intentional Release	\$ 25,000,000			
Risk Management Options		Incident Risk		
Annual Probability	2.0%	1.0%	0.1%	
Recurrence Interval (years)	50	100	1,000	
Gas Cl2 + Scrubber				
Cost of Security Improvements	48,718	48,718	48,718	
Cost of Disinfection Option	69,735	69,735	69,735	
Expected Value of Damages from Attack	25,000	12,500	1,250	
Expected Value of Pathogen Outbreak Damages	30,000	30,000	30,000	
Total Social Cost	173,454	160,954	149,704	
Regret	17,021	4,521	0	
Hypochlorite - Purchased				
Cost of Security Improvements	3,000	3,000	3,000	
Cost of Disinfection Option	123,433	123,433	123,433	
Expected Value of Damages from Attack	0	0	0	
Expected Value of Pathogen Outbreak Damages	30,000	30,000	30,000	
Total Social Cost	156,433	156,433	156,433	
Regret	0	0	6,729	
Hypochlorite - Onsite Generation				
Cost of Security Improvements	3,000	3,000	3,000	
Cost of Disinfection Option	174,104	174,104	174,104	
Expected Value of Damages from Attack	0	0	0	
Expected Value of Pathogen Outbreak Damages	30,000	30,000	30,000	
Total Social Cost	207,104	207,104	207,104	
Regret	50,671	50,671	57,400	
UV + Hypochlorite				
Cost of Security Improvements	3,000	3,000	3,000	
Cost of Disinfection Option	206,567	206,567	206,567	
Expected Value of Damages from Attack	0	0	0	
Expected Value of Pathogen Outbreak Damages	10,000	10,000	10,000	
Total Social Cost	219,567	219,567	219,567	
Regret	63,134	63,134	69,863	
Ozone + Hypochlorite				
Cost of Security Improvements	3,000	3,000	3,000	
Cost of Disinfection Option	632,282	632,282	632,282	
Expected Value of Damages from Attack	0	0	0	
Expected Value of Pathogen Outbreak Damages	30,000	30,000	30,000	
Total Social Cost	665,282	665,282	665,282	
Regret	508,849	508,849	515,578	
Minimum Maximum Regret				\$ 6,729

Outbreak Damages	\$ 50,000,000
------------------	---------------

Pathogen Illness Outbreak	\$ 50,000,000
---------------------------	---------------

Capital and Financing Terms	6%
-----------------------------	----

Annual Cost	Capital Cost	O&M Cost
-------------	--------------	----------

\$ 48,718.46	\$100,000	\$ 40,000
\$ 69,735	\$ 364,000	\$ 38,000

Maximum Regret

\$ 17,021

\$ 3,000	\$ -	\$ 3,000
\$ 123,433	\$ 372,000	\$ 91,000

\$ 6,729

\$ 3,000	\$ -	\$ 3,000
\$ 174,104	\$ 1,217,000	\$ 68,000

\$ 57,400

\$ 3,000	\$ -	\$ 3,000
\$ 206,567	\$ 1,532,000	\$ 73,000

\$ 69,863

\$ 3,000.00	\$ -	\$ 3,000.00
\$ 632,282	\$ 5,050,000	\$ 192,000

\$ 515,578

\$ 6,729

Annual OutbreakRisk
2%

20

Effectiveness

95%
97%

100%
97%

100%
97%

100%
99%

100%
97%