MWMC Eugene-Springfield WPCF Facility Plan— Disinfection Alternatives

PREPARED FOR: Troy McAllister/MWMC Project Manager

COPIES: Janis Freeman/CH2M HILL
Project File – Task 4.2

PREPARED BY: Kristen Mathes/CH2M HILL
Shawn Clark/CH2M HILL

REVIEWED BY: Matt Noesen/CH2M HILL

DATE: April 1, 2004 (Revised November 2004 to incorporate DEQ comments)

Executive Summary

The Metropolitan Wastewater Management Commission (MWMC) Eugene-Springfield Water Pollution Control Facility (E-S WPCF) currently uses a liquid/gaseous chlorine disinfection system with sulfur dioxide for dechlorination. Because of growing concerns about operator and public safety, MWMC initiated an investigation to evaluate disinfection alternatives.

Three hundred mgd is the projected 2025 wet weather peak hour flow at the E-S WPCF that is being used for facility planning alternatives analysis. Once modified, the existing secondary treatment facility will have a peak wet weather capacity of 160 mgd. To accommodate the future peak flow, an additional 140 mgd of primary effluent (PE) must be diverted around secondary treatment and disinfected separately. Therefore, no more than 160 mgd will pass through the main plant flow disinfection system, and any flow greater than 160 mgd will be diverted and disinfected separately. Two alternatives have been evaluated, each containing an option for the main secondary treated plant flow and the PE diversion flow. Alternative 1 is to shift from liquid/gaseous chlorine disinfection to sodium hypochlorite disinfection with sodium bisulfite dechlorination for both flow streams. Alternative 2 is to convert the existing secondary plant flow to ultraviolet (UV) disinfection and shift to sodium hypochlorite for the PE diversion flow.

Capital costs associated with converting to sodium hypochlorite are approximately $4,100,000. Capital costs associated with UV disinfection of secondary effluent (SE) and hypochlorite disinfection of PE are $16,100,000. These capital costs, along with operations and maintenance (O&M) costs for labor, electricity, chemicals and other alternative-specific costs were used to prepare a present-worth cost for each of the two alternatives considered. A non-monetary evaluation of the two alternatives indicates that the alternatives are nearly equivalent; however, disinfection of both the SE and PE flow streams is slightly advantageous over UV disinfection of SE with hypochlorite disinfection of PE. Taking into account all of the selection criteria, it is recommended that the E-S WPCF shift to Alternative 1, hypochlorite for disinfection of both flow streams. Present-worth costs and non-monetary comparisons are summarized in Table 1.

TABLE 1
Summary of Disinfection Alternatives Comparison
MWMC Facility Plan, Eugene-Springfield

Alternative	20-yr Present Worth Cost (millions of dollars)	Non-Monetary Rating[a]
1 – Hypochlorite Disinfection of Secondary and Primary Effluent	11.1	25
2 – Ultraviolet Disinfection of Secondary Effluent and Hypochlorite Disinfection of Primary Effluent	23.0	24

Notes:
[a] Non-monetary score is out of a possible maximum score of 30 points.

Introduction

This technical memorandum has been prepared as part of the Metropolitan Wastewater Management Commission (MWMC) Eugene-Springfield Water Pollution Control Facility (E-S WPCF) Facility Plan Update and Predesign (Project No. 80010). The MWMC E-S WPCF currently uses a liquid/gaseous chlorine disinfection system. Because of growing concerns about operator and public safety, environmental issues, and long-term regulatory compliance of the existing chlorine disinfection system, MWMC initiated an investigation to evaluate disinfection alternatives. A 2025 projected wet weather peak hour flow of 300 mgd is being used for facility planning alternatives (see Technical Memorandum No. 3, Flow and Load Projections). The existing disinfection facility has a peak capacity of 215 mgd based on the criteria of one chlorine contact basin offline at peak conditions and a detention time of 20 minutes. The existing chlorine delivery system also has a firm capacity of 215 mgd, at peak conditions. This memorandum evaluates alternatives to the current liquid gaseous chlorination system and addresses additional disinfection capacity requirements at the E-S WPCF.

Existing Facilities

The existing E-S WPCF disinfection system uses liquid chlorine for disinfection and sulfur dioxide for dechlorination of the disinfected effluent. Chlorine is delivered to the plant in 1-ton cylinders. Chlorinators dispense chlorine in the desired quantities to each application point. Service water flows through the chlorine injector, which creates a vacuum. This vacuum draws the chlorine gas from the chlorinator to the injector, where the gas is transferred into the service water. The primary use of chlorine at the E-S WPCF is effluent disinfection. Additional uses of chlorine throughout the plant include controlling filamentous bulking organisms through addition to the return activated sludge (RAS) line. During average flows, all of the primary effluent (PE) is routed through the secondary system. Currently, during peak flows PE is diverted around the secondary system and recombined with the secondary effluent (SE) upstream of the disinfection facility. Chlorine solution is delivered to the flow stream through a diffuser at the influent box to each chlorine contact basin. Following chlorine addition, flow passes through a chlorine contact basin.

The addition of sulfur dioxide for dechlorination takes place before the final effluent flows to the outfall box. Sulfur dioxide is delivered to the plant in 1-ton cylinders. Sulfonators dispense the sulfur dioxide in the desired quantities. Sulfur dioxide injectors operate in a manner similar to the chlorine injectors. The sulfur dioxide solution is added to the effluent downstream of the chlorine contact basins as the effluent flows through a mixing orifice. Table 2 presents a summary of the existing equipment associated with the disinfection system.

The existing chlorine and sulfur dioxide systems have a sodium hydroxide wet scrubber system that is automatically started if a chemical leak is detected in the chlorine building. The wet scrubber has a 2-ton capacity, contains a 4,100-gallon tank of 12 percent NaOH, and is rated at 15,000 cfm. Because of its age, the existing scrubber requires replacement. The replacement scrubber will be a skid-mounted unit that is external to the existing unit and will be located outside. The new scrubber will have a 1-ton capacity, will contain 20 percent NaOH, and will be rated at 5,000 cfm.

TABLE 2
E-S WPCF Disinfection Facility Equipment
MWMC Facility Plan, Eugene-Springfield

Equipment	Type	Quantity	Capacity, (each/total firm[a]/total[b])
Evaporators (chlorine)	Wallace and Tiernan, Series 50-202	2	8,000 lb/day / 8,000 lb/day / 16,000 lb/day
Chlorinators	Portacel, AVP2, 2000 lb/day units running with 1000 lb/day rotometers	5	1,000 lb/day / 4,000 lb/day / 5,000 lb/day
Evaporators (sulfur dioxide)	Wallace and Tiernan, Series 50-202	2	8,000 lb/day / 8,000 lb/day / 16,000 lb/day
Sulfonator	Wallace and Tiernan, V2020	1	450 lb/day / 450 lb/day / 450 lb/day
Sulfonator	Portacel, AVP2, 2000 lb/day units running with a 1000 lb/day rotometer	1	1,000 lb/day / 1,000 lb/day / 1,000 lb/day
Chlorine Scrubber		1	10,000 cfm – airflow 12% NaOH solution
Chlorine Scrubber	Currently out for bid	1	5,000 cfm – airflow 20% NaOH solution

Notes:
[a] Total firm capacity is with largest unit out of service.
[b] Total capacity is with all units in service.

Regulatory Requirements

Table 3 presents a summary of the current National Pollutant Discharge Elimination System (NPDES) permit effluent limitations for the E-S WPCF. Outfall 001 is the submerged in-stream diffuser outfall that is required to be used from May 22 through October 31. Outfall 001A is the bank outfall, which may only be used for peak wet weather flows above the diffuser capacity from November 1 through May 21.

TABLE 3
Current NPDES Permit Effluent Limitations (Outfalls 001 and 001A)
MWMC Facility Plan, Eugene-Springfield

Parameter	May 1 – October 31				November 1 – April 30			
	Average Monthly		Average Weekly		Average Monthly		Average Weekly	
	mg/L	lb/day	mg/L	lb/day	mg/L	lb/day	mg/L	lb/day
Biochemical Oxygen Demand (5-day)	25	16,000	40	24,000	10	4,100	15	6,100
Total Suspended Solids	30	19,000	45	28,000	10	4,100	15	6,100
E. coli Bacteria (organisms/100 mL)	126[3]		406[1]		126[3]		406[1]	
pH (range)	6.0 – 9.0		6.0 – 9.0		6.0 – 9.0		6.0 – 9.0	
Total Residual Chlorine	0.05		0.12[2]		0.05		0.12[2]	

Notes:
1. Single sample maximum concentration
2. Daily average concentration
3. 30-day geometric mean

Existing Disinfection Data Analysis

To establish criteria for alternatives comparison, chlorine usage and flow data from January 2000 through November 2003 were analyzed and used in conjunction with the projected flow data. This allows better definition of current and projected chlorine usage for the disinfection conditions. The resulting dosages are presented in Table 4. Technical Memorandum No. 3, Flow and Load Projections, presents the historical flow data used in this analysis.

TABLE 4
E-S WPCF Chlorine Dosages from January 2000 through November 2003
MWMC Facility Plan, Eugene-Springfield

	Chlorine Usage (lb/MG)	Chlorine Dosage (mg/L)
Average	26.9	3.25
Maximum	33.6	4.94
Minimum	14.6	1.76

Preliminary Screening of Alternatives

A preliminary screening of pretreatment processes produced the following ideas:

- Convert existing system to sodium hypochlorite disinfection with sodium bisulfite for dechlorination of both SE and PE
- Convert existing system to ultraviolet (UV) disinfection of SE and sodium hypochlorite disinfection with sodium bisulfite dechlorination of PE

The candidate processes were given scores of 1 to 5 based on various performance, operations and maintenance (O&M), and implementation criteria. The ideas receiving the highest combined scores were given more consideration for inclusion in disinfection alternatives to be evaluated. "Convert to UV Disinfection" received the highest score of 53 (see Technical Memorandum No. 2, Preliminary Screening of Alternatives, for the complete assessment).

Selection of Design Criteria

Flow

Flow projections for 2025 were developed in the Flow and Load Projections technical memorandum. The modified secondary treatment capacity at the E-S WPCF has been estimated at 160 mgd on a peak flow basis. Flows greater than 160 mgd (up to 140 mgd) will be diverted around the secondary system and receive only preliminary and primary treatment prior to disinfection.

Effluent *E. coli* Limitations

For the purpose of comparing disinfection alternatives in this investigation, the current NPDES permit *E. coli* limitations are used:

- Monthly geometric mean *E. coli* count = 126 MPN/100 mL
- Maximum single sample *E. coli* count = 406 MPN/100 mL

Chlorine Dosage

Chlorine dosages were selected based on the past 4 years of historical usage data. An average annual chlorine dose of 3.5 mg/L was used for SE disinfection. For PE disinfection, an average chlorine dosage of 7 mg/L was used for the purposes of alternatives development. Treatability testing at a range of chlorine doses could be done to further determine the expected chlorine dose required.

Sodium Hypochlorite and Sodium Bisulfite Storage

The following chemical storage requirements will be used for the chlorine-based alternative:

- 30 days at average annual flow
- 14 days at maximum month flow
- 6 days at maximum week flow

Selected storage volumes are based on a balance between realistic tank sizes, delivery recurrence, and the chemical manufacturer's recommendation for chemical storage life. These storage times are sufficiently conservative to account for unexpected delivery delays resulting from road/railroad closures, weather, etc.

UV Disinfection Criteria

Based on average wastewater characteristics, the following disinfection design parameters will be used for the SE portion of Alternative 2:

- UV transmittance: 65 percent
- Maximum SE suspended solids concentration: 20 mg/L at the design flow of 160 mgd

Disinfection Alternatives

This section develops the two identified disinfection options. Alternative 1 entails converting the existing system to sodium hypochlorite disinfection with sodium bisulfite dechlorination of both effluent streams. Alternative 2 uses UV disinfection of the SE flow stream and sodium hypochlorite disinfection of PE that is diverted during peak flows.

Alternative 1: Hypochlorite Disinfection of Secondary and Primary Effluent

This alternative involves conversion to sodium hypochlorite for disinfection. Figure 1 is a schematic of the treatment train for Alternative 1. The sodium hypochlorite solution strength will be 12.5 percent; sodium bisulfite will be 38 percent. This alternative will require the installation of the following equipment:

- Three 20,000-gallon horizontal bulk storage tanks for hypochlorite
- One 7,000-gallon vertical bulk storage tank for bisulfite
- Five hypochlorite metering pumps for main plant flow chlorination
- Two hypochlorite metering pumps for diversion flow chlorination
- Two bisulfite metering pumps for main plant flow dechlorination

- Two bisulfite metering pumps for diversion flow dechlorination
- Piping, valves, mechanical, electrical and control systems associated with chemical feed and storage for both the main plant flow and the diversion flow
- 1.3-million-gallon total chlorine contact basin volume for PE diversion flow

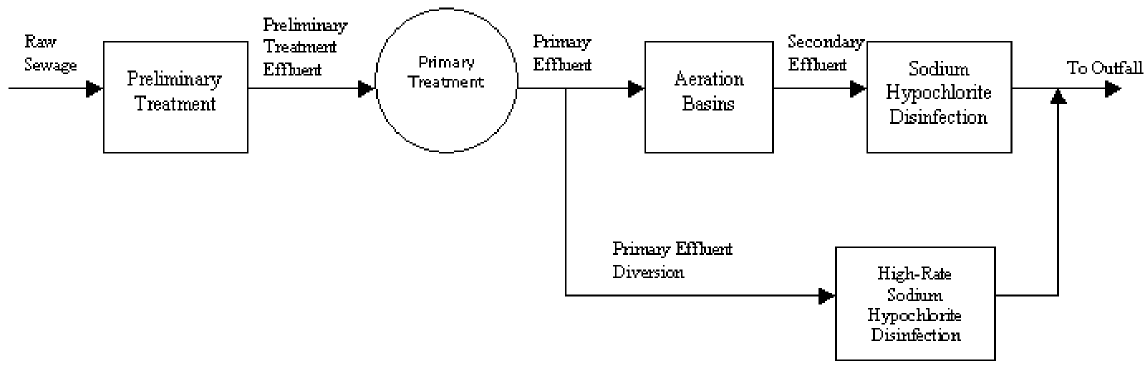


FIGURE 1
Treatment Train for Alternative 1
MWMC Facility Plan, Eugene-Springfield

The existing chlorine and sulfur dioxide feed and storage rooms can be used for liquid chemical feed and storage. The existing chlorine contact basins will not need major modifications and will be used for disinfection of the main plant flow. At peak flow, the Oregon Department of Environmental Quality (DEQ) requires 20 minutes of contact time for PE disinfection. A combination of 0.6 million gallons of volume in the diversion pipeline and 1.3-million-gallon total contact basin volume will be used to meet the contact time requirement. The existing chlorine feed and storage facility will require remodeling to accommodate the new equipment. Additionally, walled secondary containment will be required for the bulk chemical storage tanks.

Preliminary design criteria and cost estimates are based on a combination of historical chlorine usage data and projected flows for 2025.

Alternative 2: Ultraviolet Disinfection of Secondary Effluent and Hypochlorite Disinfection of Primary Effluent

This alternative involves the development of a UV/sodium hypochlorite-based disinfection system. Figure 2 is a schematic of the treatment train for Alternative 2. In this alternative, a medium-pressure, high-intensity UV system would be used to disinfect SE flows, up to 160 mgd, which is the capacity of the secondary treatment process. UV is a viable alternative for SE because the flow has low total suspended solids (TSS) concentrations and a high percentage of transmittance. The following equipment will be required for this alternative:

- UV package system
- 800 kW back-up power generator
- One 20,000-gallon horizontal bulk storage tank for hypochlorite
- One 6,000-gallon vertical bulk storage tank for bisulfite
- Two hypochlorite metering pumps for diversion flow chlorination
- Two bisulfite metering pumps for diversion flow dechlorination
- Piping, valves, mechanical, electrical and control systems associated with chemical feed and storage for the diversion flow
- 1.3-million-gallon total chlorine contact basin volume for PE diversion flow

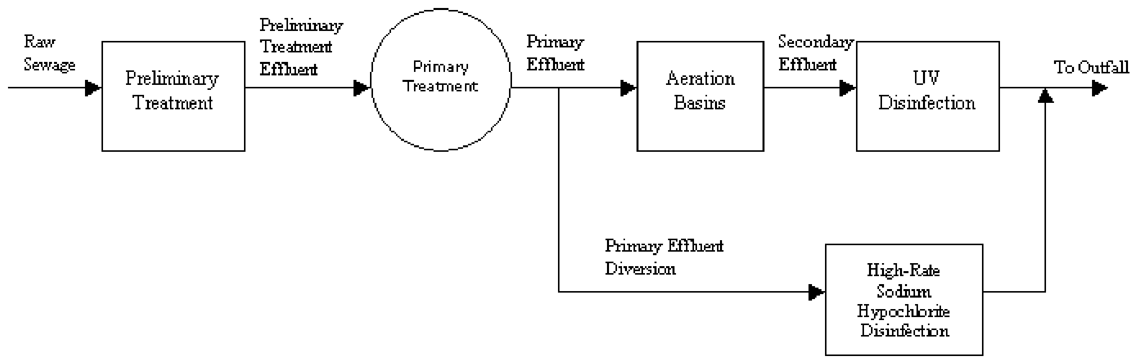
PE flow has a low percentage of transmittance and high TSS concentrations. Because of these factors, a disproportionate amount of equipment would be required for acceptable disinfection. Therefore, UV is not a viable option for PE diversion disinfection. PE flow, up to 140 mgd, will be diverted around secondary treatment and disinfected using sodium hypochlorite.

A medium-pressure, high-intensity UV system would be built for SE disinfection. This UV system was selected because it has fewer lamps than low-pressure, low-intensity and low-pressure, high-intensity systems. This system is capable of incremental turndown of lamps in order to match output with plant flow. For ease of O&M, the system contains an automatic in-channel lamp-cleaning system.

This option would require the construction of a new UV facility with UV channels, channel isolation gates, and level control gates. The existing chlorine contact basins are wider than acceptable for the UV channel; therefore, retrofitting would require the construction of new UV channels inside the existing chlorine contact basins. Experience at other facilities has proven there is very little cost savings gained through retrofitting existing chlorine contact channels over the construction of new channels. In addition, with the existing chlorine contact basins unused for SE disinfection, the basins can provide the required 90-minute modal contact time to produce 38 mgd of Level IV reuse water at some time in the future.

Electrical room space requirements vary for different manufacturer's systems. Use of the existing chemical building should be considered for required electrical room space. Flow measurement would be incorporated into the UV facility to allow for UV dose pacing. A standby power source would be required for redundancy. The UV system does not require chemical handling. The footprint required for this facility is relatively small. The existing chlorine contact basins would still be available for filter backwash supply or backwash waste equalization.

FIGURE 2
Treatment Train for Alternative 2
MWMC Facility Plan, Eugene-Springfield



Preliminary design criteria and cost estimates are based on the Trojan UV4000 Plus system. Design parameters for the medium-pressure, high-intensity system are summarized in Table 5.

TABLE 5
Sizing of the Ultraviolet System for Secondary Effluent Disinfection
MWMC Facility Plan, Eugene-Springfield

Parameter	Value
Average Flow Rate, mgd	70
Maximum Flow Rate, mgd	160
No. of Channels	2
No of banks per channel	2
No. of modules per bank	7
No. of lamps per module	24
Total no. of lamps required	672
Channel length, feet	38.7
Channel width, inches	96
Channel depth, inches	160
Connected power load, kW	1,882
Estimated average power, kW	790
Average Power Consumed, kWh/day	18,960

PE flows in excess of the secondary treatment capacity (160 mgd) would be disinfected separately with sodium hypochlorite. This would take place in the PE diversion flow stream. Additional chlorine contact basins would be required to ensure that the chlorine contact time will meet anticipated DEQ contact time requirements of 20 minutes at peak flow. The sodium hypochlorite solution strength would be 12.5 percent and the sodium bisulfite would be 38 percent. The existing chlorine and sulfur dioxide feed and storage rooms could be used for liquid chemical feed and storage.

Alternatives Analysis

Analysis of the alternatives is based on a non-monetary and monetary comparison.

Non-Monetary Comparison

A non-monetary comparison between the two alternatives evaluates issues other than cost that may influence the selection of one alternative over the other. Issues include constructability, O&M, performance, siting, etc. Table 6 summarizes the preliminary results of the non-monetary comparison.

TABLE 6
Non-Monetary Considerations for Alternatives 1 and 2
MWMC Facility Plan, Eugene-Springfield

	Alternative 1 Hypochlorite	**Alternative 2 UV-Hypochlorite**
Siting	5	3
Constructability	5	3
Disinfection Performance	5	5
Effect on Performance of Downstream Equipment	4	5
Operational Flexibility	4	4
Maintenance	2	4
Total Score (30 points maximum)	25	24

Scoring: 1 = Negative/Difficult
5 = Beneficial

Cost Estimates

Order-of-magnitude capital cost estimates were developed for the two alternatives. An order-of-magnitude cost estimate is an approximate estimate made without detailed engineering data. Examples of such estimates are an estimate from cost capacity curves, an estimate using scale-up factors, and an approximate ratio estimate. The cost estimates were developed for the purpose of conducting relative comparisons between the alternatives and are based on very limited design information.

The cost estimate for each disinfection alternative reflects the proposed alternative, as described in previous sections, and is based on current permit conditions. In general, equipment costs were estimated based on budgetary pricing provided by manufacturers. The costs of other items were estimated based on approximate quantities and allowances. Contingency costs are factored into the total capital costs as well. For both alternatives, a

25 percent factor was included for a construction contingency and an additional 25 percent for the engineering, legal, and administration allowance.

The order-of-magnitude estimates were used for relative cost comparisons to select the most cost-effective alternative. Once a particular alternative is selected, further project definition and predesign work will be required to better define the scope and prepare a more complete cost estimate of the selected alternative. For example, further predesign work will be required to identify specific modifications to the existing buildings and systems, and what improvements, if any, are needed for the power distribution system. The capital cost comparisons are provided in Table 7. The annual O&M costs are presented in Table 8 and include labor, electricity, chemicals and other alternative-specific costs. Cost background information is provided in Attachment 1.

TABLE 7
Capital Cost Comparison of Disinfection Alternatives (cost in millions)
MWMC Facility Plan, Eugene-Springfield

Item	Hypochlorite	UV-Hypochlorite
Construction Costs	$2.25	$8.3
+ General Conditions	$0.37	$2.0
Subtotal	$2.62	$10.3
+ Contingency (25%)	$0.65	$2.57
Subtotal	$3.27	$12.9
+ Engineering, Legal, and Administration (25%)	$0.83	$3.2
Project Cost Total	**$4.1**	**$16.1**

TABLE 8
Annual O&M Cost Comparison of Disinfection Alternatives
MWMC Facility Plan, Eugene-Springfield

Item	Hypochlorite	UV-Hypochlorite
Chemicals/Materials		
Sodium Hypochlorite	$393,400	$20,400
Sodium Bisulfite	$35,900	$1,000
UV Lamp Replacement	$0	$28,600
UV Ballast Replacement	$0	$9,100
Spare Parts Allowance	$8,000	$23,000
Labor		
Operations[1]	$17,000	$17,000

TABLE 8
Annual O&M Cost Comparison of Disinfection Alternatives
MWMC Facility Plan, Eugene-Springfield

Item	Hypochlorite	UV-Hypochlorite
Maintenance[1]	$17,000	$17,000
Power		
Electric Usage[2]	$1,500	$346,000
Total Annual Costs	**$472,800**	**$462,100**

1. Operations and maintenance costs are based on 0.25 times $68,000/full-time equivalent (FTE).
2. Power costs are based on $0.05 per kilowatt-hour.

The present worth and annualized cost is based on an interest rate of 3 percent over 20 years. Present worth costs are shown in Table 9. The remainder of this section discusses alternative-specific assumptions used in developing the initial and annual costs.

TABLE 9
Present Worth Cost Comparison of Disinfection Alternatives at 5 Cents per Kilowatt-hour (cost in millions)
MWMC Facility Plan, Eugene-Springfield

Item	Hypochlorite	UV-Hypochlorite
Capital Costs	$4.1	$16.1
Annual Costs	$0.47	$0.46
Present Worth of Annual Costs	$7.0	$6.9
Total Present Worth	$11.1	$23.0

Present worth analysis period of 20 years at 3 percent, resulting series factor = 14.88

Alternative 1: Conversion to Sodium Hypochlorite for Secondary and Primary Effluent

If the SE disinfection system is converted to sodium hypochlorite, it is assumed that the existing chlorine building would be retrofitted and that no major modifications to the chlorine contact basins would be required. The existing chlorine building would house the sodium hypochlorite and sodium bisulfite storage tanks. Sodium hypochlorite and sodium bisulfite metering equipment would be installed in the area where the existing evaporators, chlorinators, and sulfonators are located. The existing chlorine delivery piping system would need to be replaced with double-walled polyvinyl chloride (PVC) piping to deliver sodium hypochlorite to the SE and PE diversions. A pipeline and additional chlorine contact basins would be required for the PE diversion.

Alternative 2: Conversion to Ultraviolet Disinfection of Secondary Effluent and Hypochlorite Disinfection of Primary Effluent

Capital costs for the medium-pressure, high-intensity UV disinfection portion of this alternative were developed based on the equipment cost quotation for the Trojan UV4000 Plus system. Based on overall costs from other UV projects, it is assumed that construction costs (including all sitework, concrete basins, metals, finishes, mechanical, and electrical work) would be approximately equal to the equipment cost. Retrofitting the existing chlorine contact basins was not considered because building the UV channels inside the existing contact basins would not result in a significantly lower cost than building a new facility. The cost of a back-up power generator was included.

Capital costs for the sodium hypochlorite portion of this alternative are greater than for the conversion to sodium hypochlorite for the diversion flow in Alternative 1. The additional cost for Alternative 2 is attributed to the need for bulk storage tanks for sodium hypochlorite and sodium bisulfite. Alternative 1 is able to share storage tank volume with the supply of chemicals for SE flow. Sodium hypochlorite and sodium bisulfite metering equipment would be installed in the area where the existing evaporators, chlorinators, and sulfonators are located. The existing chlorine delivery piping system would need to be replaced with double-walled PVC piping to deliver sodium hypochlorite to the PE diversion. A pipeline and additional chlorine contact basins would be required for the PE diversion. This alternative does not include expansion of the existing chlorine building.

Conclusions and Recommendations

By far the most cost-effective alternative on a capital cost basis is Alternative 1, sodium hypochlorite for both SE and PE diversion flows. If O&M costs are taken into consideration, Alternative 1 may actually be more sensitive to fluctuating energy prices (electricity and natural gas) than Alternative 2 because of the large amounts of electricity and natural gas required to produce sodium hypochlorite. However, it is unlikely that the variability of the O&M costs will overcome the capital cost differences. Alternative 2 would be easy to operate because sodium hypochlorite disinfection would be limited to the PE diversion, which typically occurs only one or two weeks per year. The alternatives have nearly equal non-monetary ratings.

Based on the analysis presented above, it is recommended that the E-S WPCF proceed with Alternative 1, conversion of the existing gaseous chlorine system to sodium hypochlorite chlorination for both SE and the PE diversion flows. The recommendation is based on the following key points:

- The capital cost of Alternative 1 is significantly less than Alternative 2 and it is unlikely that variances in O&M costs for Alternative 1 will make up for the initial investment of Alternative 2 over time
- The existing infrastructure, including chlorine contact basins, electrical rooms, and the use of the chlorination building for chemical storage, is available and already in place
- The non-monetary evaluation of the two alternatives indicates Alternative 1 is slightly more advantageous than Alternative 2 (although they are essentially equal)

Based on the above conclusions, it is recommended that Alternative 1, sodium hypochlorite for all flow, be carried forward for further predesign development. Selection and comparison of specific equipment associated with the selected alternative will be evaluated during predesign.

At some future time the E-S WPCF will want to implement Level IV reuse water on a relatively large scale, and this will drive the expansion of the recommended disinfection system. Regulatory requirements for Level IV reuse water will require either the construction of a new UV system or the addition of chlorine contact basins providing a 90-minute modal contact time. This will make the construction of a new UV facility much more cost- competitive with the chlorine system.

The existing four chlorine contact basins have enough volume to provide 90 minutes of modal contact time for approximately 38 mgd, making it perfectly suitable for disinfection of the planned 30 mgd of Level IV reuse water in the year 2015. The sodium hypochlorite system and existing chlorine contact basins currently recommended for SE disinfection may be easily converted and used for the Level IV reuse water at some time in the future. It will also continue to be used for the PE peak flow diversion disinfection. At that time it will make sense and it is recommended that the E-S WPCF consider and plan for converting SE disinfection to UV.

Attachment A
Disinfection Alternatives -
Cost Background Information

Disinfection Alternatives - Cost Background Information

Costing Approach

Two potential alternatives were identified to disinfect projected plant flows. Table 1 summarizes the major costs associated with each of the alternatives and the major differences between the alternatives.

Table 1
Disinfection Cost Comparison

Costs	Hypochlorite Disinfection of Secondary and Primary Effluent	Ultraviolet Disinfection of Secondary Effluent and Hypochlorite disinfection of Primary Effluent
Earthwork/Yard Piping/Demolition	$307,000	$70,000
UV Facility Site Work and Structure	N/A	$3,400,000
Structures	$542,185	$630,000
Equipment / Process Support	$1,163,000	$4,200,000
Landscape / Visual Screening	$238,219	N/A
Subtotal	**$2,250,404**	**$8,300,000**
General Conditions	$370,000	$2,000,000
Construction Subtotal	**$2,620,404**	**$10,300,000**
Assumed Construction Contingency Percentage	25%	25%
Construction Total	$3,275,505	$12,875,000
Assumed Engineering, Legal and Administration Percentage	25%	25%
Total Cost	**$4,094,381**	**$16,093,750**