



March 25, 1998

To: Board of Directors (Special Committee on Water Quality, Desalination, and Environmental Compliance—Action)
(Engineering and Operations Committee—Action)
(Budget and Finance Committee—Action)
(Water Planning and Resources Committee—Action)

From: *for* General Manager

Edward J. Meo III

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Chief Engineer

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Subject: Decision on Acceleration of the Oxidation Retrofit Program at the Skinner, Weymouth and Diemer Filtration Plants

RECOMMENDATION

At its March 24, 1998 meeting, the Special Committee on Water Quality, Desalination, and Environmental Compliance approved adding **Option 4** and selected this option for recommendation to the full Board. It is recommended that your Board select one of the following four options:

Option 1—That your Board direct staff to accelerate the Oxidation Retrofit Program at the Skinner, Weymouth and Diemer plants to achieve an on-line date of 2005 for each plant.

Option 2—That the Oxidation Retrofit Program at the Skinner, Weymouth and Diemer plants maintain the current Capital Improvement Program schedule, with on-line dates of 2006 (Skinner), 2009 and 2012 (Weymouth and Diemer).

Option 3—That staff maintain the current schedule for Jensen and Mills but, prior to your Board deciding on Option 1 or Option 2, develop, for the Board’s consideration, alternative financial strategies to seek to mitigate treatment surcharge impacts of the Oxidation Retrofit Program.

Option 4—That your Board direct staff to accelerate the Oxidation Retrofit Program at the Skinner, Weymouth and Diemer plants to achieve an on-line date of 2005 for each plant and develop alternative financial strategies to seek to mitigate treatment surcharge impacts of the Oxidation Retrofit Program.

EXECUTIVE SUMMARY

At the Board's request, staff has prepared a schedule and a rate impact analysis on the potential acceleration of the Oxidation Retrofit Program at the Skinner, Weymouth and Diemer filtration plants. With an accelerated schedule, the on-line dates of the Skinner, Weymouth and Diemer filtration plants would be 2005. The Mills and Jensen filtration plants would continue with their scheduled on-line dates of 2002 and 2003, respectively. The treatment surcharge would increase at a faster rate with the accelerated schedule, but due to the effects of inflation, the total program cost would be less than with the current Capital Improvement Program (CIP) schedule.

DETAILED REPORT

Ozone is needed at Metropolitan's Jensen and Mills plants to comply with the proposed Stage I Disinfectants and Disinfection By-products Rule (D/DBP Rule). Final design of ozonation facilities at these two State Project Water plants is currently underway. (State Project Water produces significantly higher levels of disinfection by-products as compared to Colorado River Water.) Ozone implementation is currently on schedule with on-line dates of 2002 and 2003 for Mills and Jensen, respectively, ensuring that Metropolitan and its Member Agencies receiving water from these plants will be in compliance with Stage I of the D/DBP Rule.

The sequence of construction contracts for the Oxidation Retrofit Program at the Mills and Jensen plants has been scheduled such that several contracts will be brought to your Board for award following promulgation of Stage I of the D/DBP Rule, currently expected in late 1998. Staff are commencing the bidding and procurement process for these initial contracts in order to stay on schedule at Mills and Jensen.

Ozonation facilities at the Skinner plant are currently scheduled to be on-line by 2006, while the Diemer and Weymouth plants are scheduled for 2009 and 2012 (the sequencing of the Diemer and Weymouth plants has not been established) to comply with potential future, more stringent drinking water standards. Your Board requested an assessment of whether ozone implementation at these three plants could be accelerated. If implementation of ozone at the Skinner, Weymouth and Diemer plants were to proceed aggressively, the three plants could be on-line by 2005. Design and construction of the three plants would proceed simultaneously and would overlap work at the Jensen plant. At each of the three Colorado River plants (Skinner, Weymouth and Diemer), a series of projects would be initiated, first to relocate or modify facilities which will be impacted by ozone, and then to construct the ozonation facilities. Environmental documentation would also be required at each of these three plants. Figure 1 shows the current construction schedule, and Figure 2 illustrates an accelerated schedule.

The program estimate in the CIP for the Oxidation Retrofit Program at the Jensen and Mills plants is \$263,000,000 (Program 15173W). The program estimate for the Oxidation Retrofit Program at Skinner, Weymouth and Diemer (Program 95620W) based on the current CIP schedule is \$507,000,000 (**Option 2**). However, by accelerating the Oxidation Retrofit Program schedule, the latter program estimate would be reduced to \$437,000,000 (**Option 1**) due to reduced escalation. In summary, the program estimate for the Oxidation Retrofit Program at all five filtration plants is \$700,000,000 under **Option 1** and \$770,000,000 under **Option 2**.

A rate impact analysis based on estimated cash flows associated with the most aggressive construction schedule at the Skinner, Weymouth and Diemer filtration plants shows that the treatment surcharge may on average increase by about four percent per year between 2002 and 2007 versus about three percent per year under the current construction schedule. This assumes that all ozone costs continue to be collected through the treatment surcharge. The maximum annual increase during this period with the accelerated schedule would be about seven percent or \$6 per acre-foot. However, over the long-term, the increase in the treatment surcharge due to the Oxidation Retrofit Program is estimated to be about \$24 per acre-foot. Figure 3 illustrates the difference in the projected treatment surcharge attributed to the accelerated construction schedule at Skinner, Weymouth and Diemer. The difference in the treatment surcharge prior to 2007 is driven by the higher capital outlays associated with the accelerated construction schedule (Figure 4).

A third option was developed to respond to concerns expressed by some Member Agencies that accelerating ozone would severely impact their ability to market treated water from Metropolitan. **Option 3** would direct staff to develop, for the Board's consideration, alternative financing strategies to minimize treatment surcharge increases associated with the Oxidation Retrofit Program. These strategies could involve fixed charges, peaking charges, bond issues, etc. to discourage "rolling-off" to base-loaded local treatment plants. Staff would fold this analysis into the fundamental review of Metropolitan's rate structure that will occur over the next 12 months.

Option 4 is a hybrid of Options 1 and 3. **Option 4** directs staff to accelerate the Oxidation Retrofit Program at the Skinner, Weymouth and Diemer plants to achieve an on-line date of 2005 for each plant and develop alternative financial strategies to seek to mitigate treatment surcharge impacts of the Oxidation Retrofit Program. This option was recommended and approved by the Special Committee on Water Quality, Desalination, and Environmental Compliance at its March 24, 1998 meeting.

Attachment A includes a list of key questions and answers asked by your Board and others regarding acceleration of the Oxidation Retrofit Program at the Skinner, Weymouth and Diemer plants.

JMB/GLJ/mi

Attachments

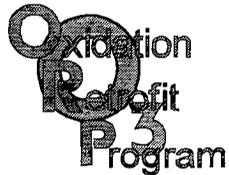
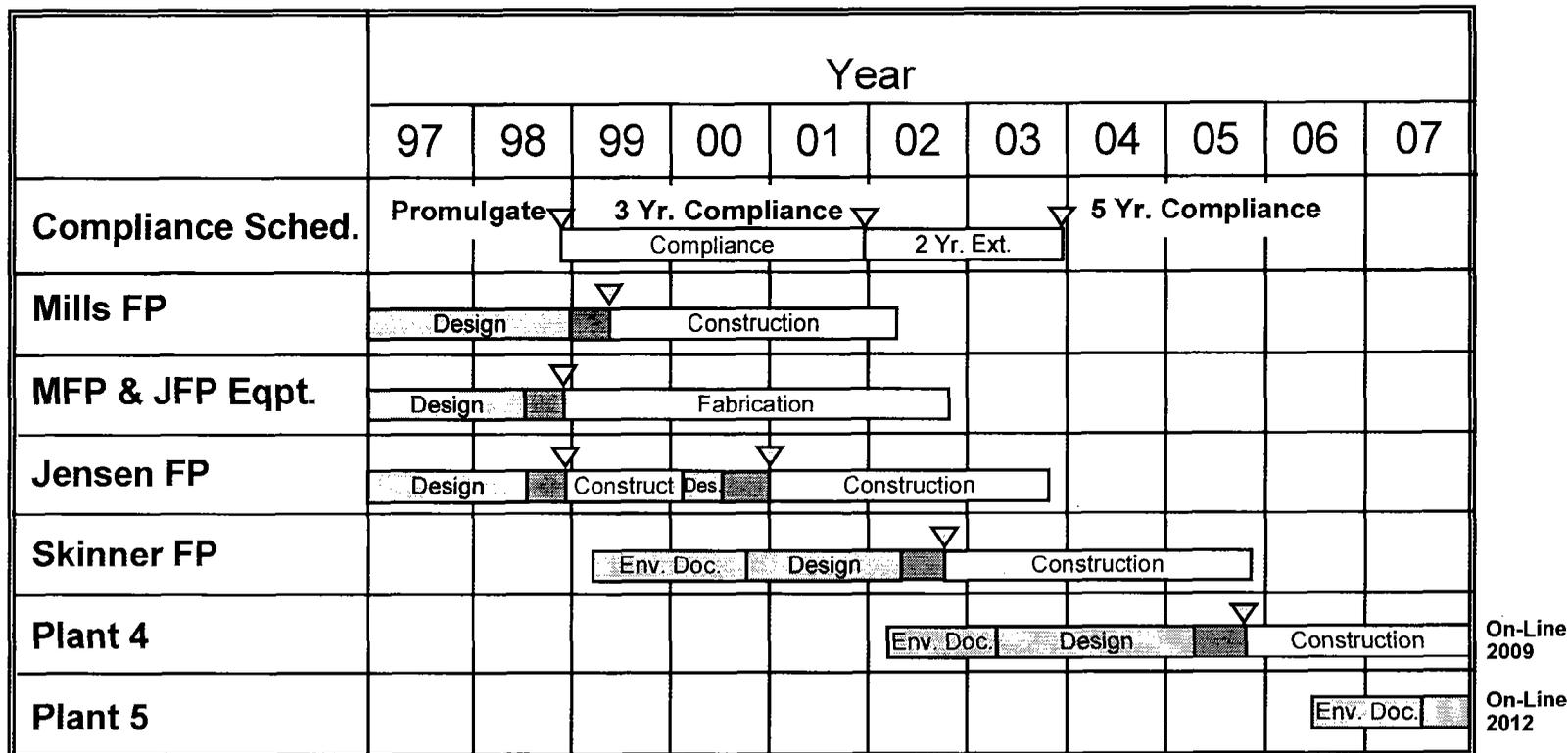


FIGURE 1

ORP Implementation Schedules Current CIP



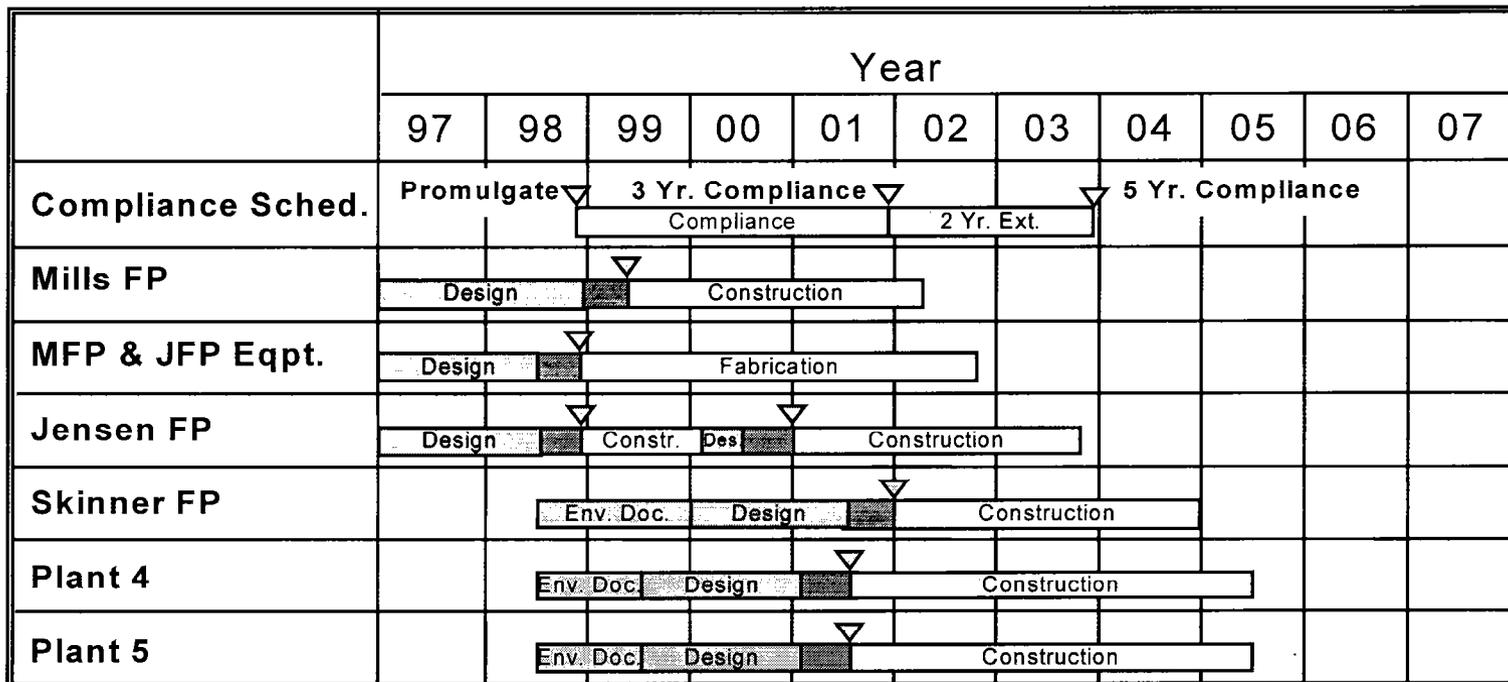
Compliance
 Design
 Environ. Documentation
 Bid Period
 Fabrication
 Construction





FIGURE 2

ORP Implementation Schedules Most Aggressive Approach



Compliance
 Design
 Environ. Documentation
 Bid Period
 Fabrication
 Construction



Figure 3.
TREATMENT SURCHARGE
UNDER ALTERNATIVE ORP CONSTRUCTION SCHEDULES

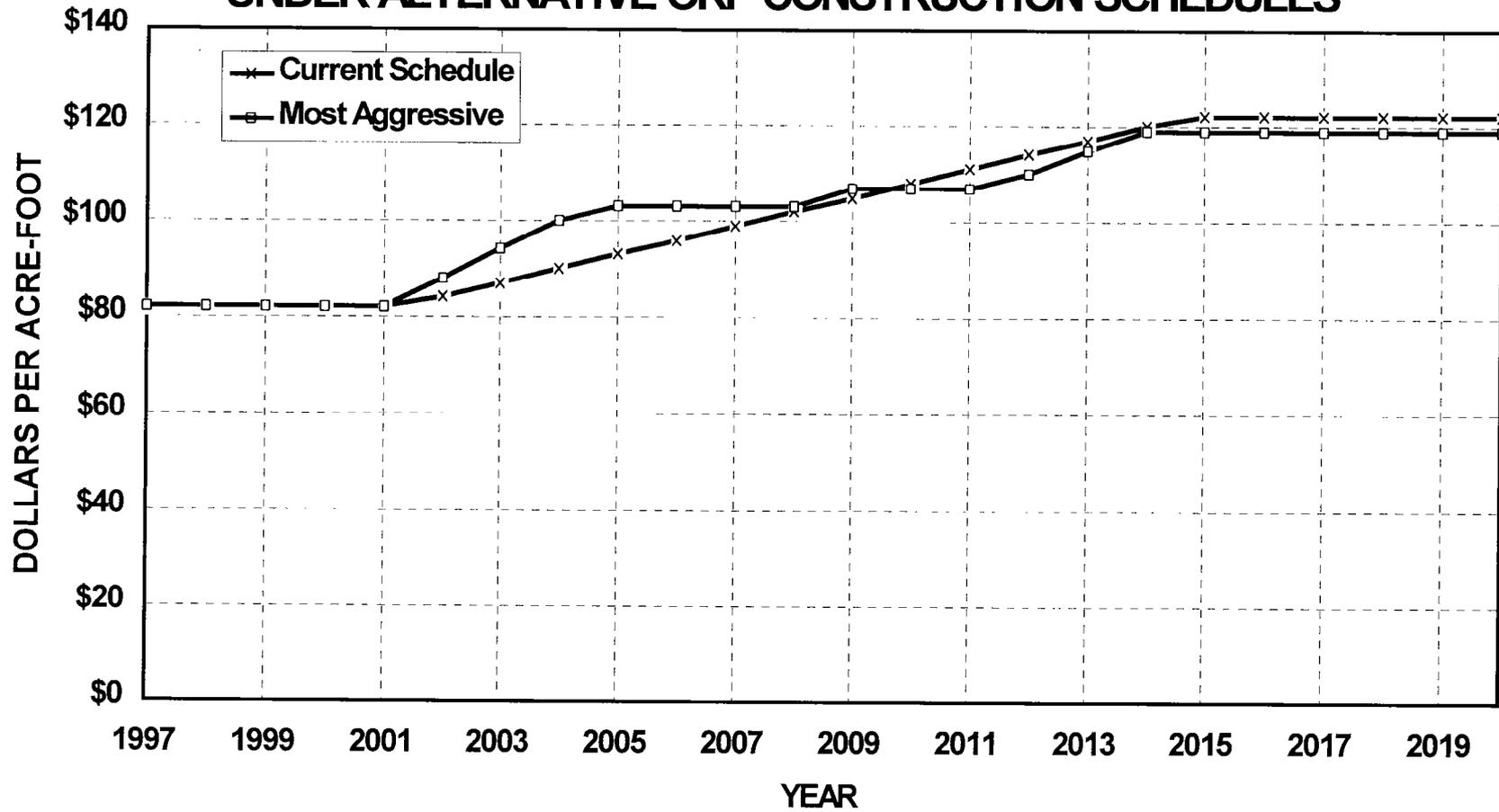
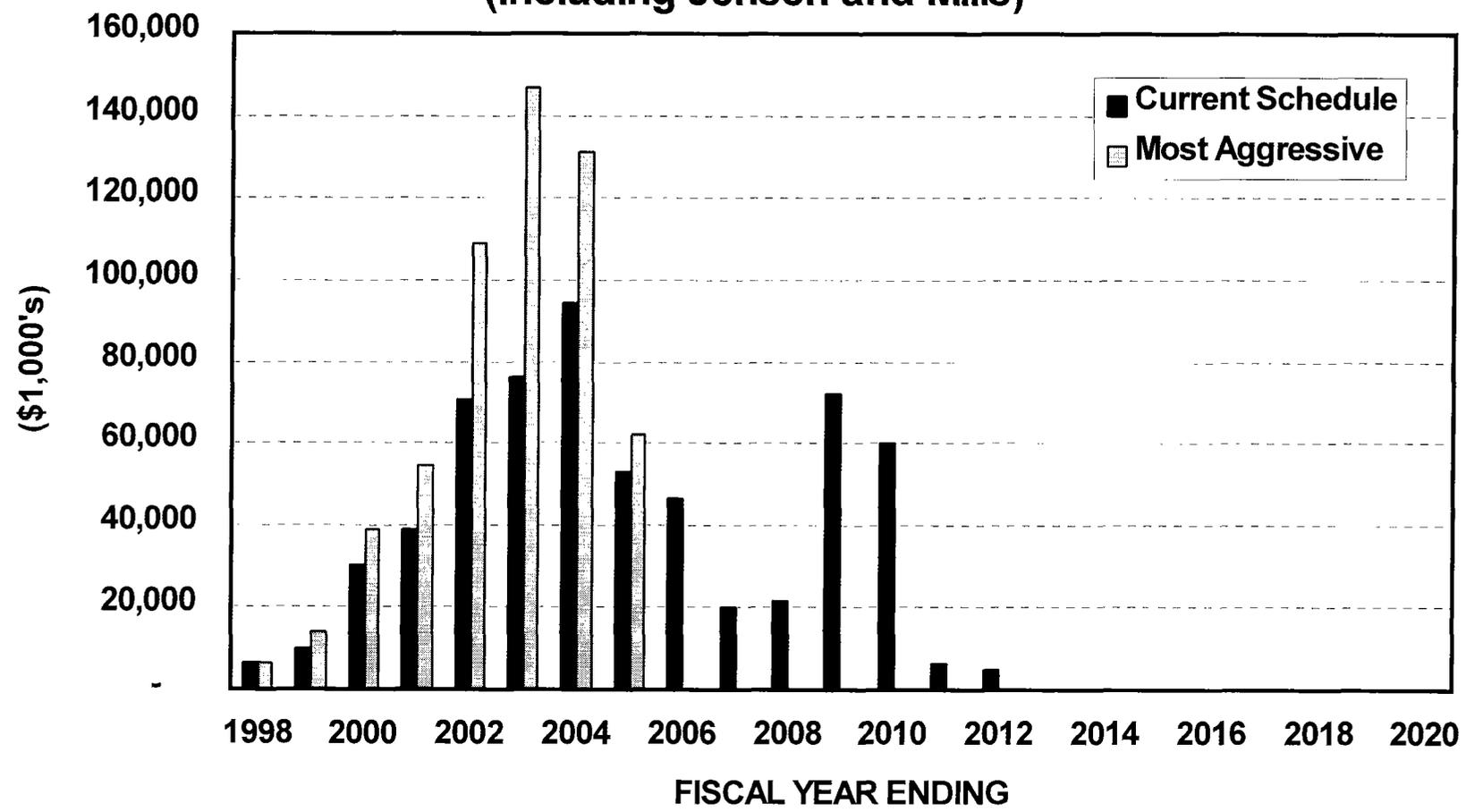


Figure 4.
CONSTRUCTION OUTLAYS FOR ORP (\$1,000's)
(Including Jensen and Mills)



Attachment A

POTENTIAL TO ACCELERATE THE OXIDATION RETROFIT PROGRAM AT THE SKINNER, WEYMOUTH AND DIEMER FILTRATION PLANTS QUESTIONS AND ANSWERS

Key questions asked by the Board and others regarding acceleration of the Oxidation Retrofit Program at the Skinner, Weymouth and Diemer Filtration Plants are answered below.

1. *How does ozone work to reduce disinfection by-products?*

Ozone is a very strong disinfectant that oxidizes organic materials. Unlike chlorine, ozone does not react with humic materials and certain natural organic materials to produce chlorinated by-products (e.g., trihalomethanes), some of which are believed to be carcinogenic. Although ozonation does produce some by-products such as aldehydes, assimilable organic carbon, and bromate, these by-products can be removed through existing filtration or controlled through pH adjustment. Ozone also provides additional benefits over chlorine including inactivation of *Cryptosporidium* and taste and odor control. To obtain the maximum benefit, ozonation must be followed by biological filtration and then the combination of chlorine and ammonia (chloramination). The use of chlorine alone following ozonation will still produce substantial levels of trihalomethanes.

2. *Are levels identified in the California Department of Health Services (CDHS) study on "Trihalomethanes in Drinking Water and Spontaneous Abortion" currently being exceeded by Metropolitan's treatment plants?*

In the CDHS study, there was an association between women with high personal exposure to trihalomethanes (5 or more glasses of water with trihalomethanes greater than 75 micrograms/liter ($\mu\text{g/L}$)) during their first trimester of pregnancy and miscarriages (15.7 percent compared to a miscarriage rate of 9.5 percent among women with low trihalomethanes exposure). High exposure to one of the four trihalomethanes, bromodichloromethane (BDCM), was associated with miscarriages when the BDCM level was 18 $\mu\text{g/L}$ or more. Metropolitan's system-wide annual trihalomethanes average for 1997 was 44 $\mu\text{g/L}$, well below the exposure level of 75 $\mu\text{g/L}$ cited in the CDHS study. Metropolitan also takes samples from more than 40 sites. Only two samples out of 160 taken in the distribution system in 1997 exceeded 75 $\mu\text{g/L}$.

Monthly samples of trihalomethanes and bromodichloromethane levels at the treatment plants sometimes exceed the levels noted in the CDHS report (see Table 1). Generally in the summer months, the trihalomethanes and BDCM levels increase. Also during the drought, bromide levels were higher in State Project Water and contributed to higher levels of BDCM.

The study is widely regarded as not definitive and repeat studies have been recommended by the CDHS researchers.

Table 1
Monthly Variability in Trihalomethanes and BDCM in
Metropolitan's Filtration Plant Effluents, 1990-97

Filtration Plant	Total Trihalomethanes Median (µg/L) *	Total Trihalomethanes 75 Percentile (µg/L) **	Bromodichloromethane Median (µg/L) *	Bromodichloromethane 75 Percentile (µg/L) **
Mills	64	81	21	26
Jensen	65	74	18	21
Weymouth	44	55	15	18
Skinner	43	54	14	18
Diemer	41	58	14	19

* Half of the monthly measurements were below this value.

** Three out of four monthly measurements were below this value.

3. *How are Metropolitan Member Agencies currently affected by the CDHS report on "Trihalomethanes in Drinking Water and Spontaneous Abortion"?*

Member Agencies have been studying their own operational practices to determine if any short-term changes can be made to reduce trihalomethanes. Some Member Agencies have asked Metropolitan to look at steps that could be taken to reduce trihalomethanes formation in the short-term. Metropolitan is analyzing the operational practices at each Metropolitan plant and is implementing changes where practical.

4. *What information has been provided to the Board regarding the current timing of the Oxidation Retrofit Program at Skinner?*

The current timing of the Oxidation Retrofit Program at the Skinner, Diemer, and Weymouth plants was established during the rate refinement process in 1996. The capital program for the Oxidation Retrofit Program at these three plants is cited on Page C-3 of the FY 97/98 Capital Program Appendix. This table lists programs which are scheduled to commence within the next three fiscal years. Initial activities for the Oxidation Retrofit Program at the Skinner plant are budgeted to commence within FY 99/00.

5. ***What are the justifications to accelerate the Oxidation Retrofit Program prior to the promulgation of Stage II of the Disinfectants and Disinfection By-products Rule (D/DBP Rule)?***

Acceleration of the Oxidation Retrofit Program would provide uniformity in treatment quality at all filtration plants. The levels of trihalomethanes and BDCM would be significantly reduced at all treatment plants (assuming chloramines are maintained in the distribution system). It is anticipated that ozonation would help meet any future lower disinfection by-product regulations to be developed in Stage II of the D/DBP Rule. Also, ozone provides additional disinfection protection against *Cryptosporidium* and other microorganisms as well as better control of taste and odors. Having ozone at all the treatment plants will allow greater flexibility in blending State Project Water and Colorado River Water at Weymouth, Skinner, and Diemer.

6. ***How will an accelerated Oxidation Retrofit Program be coordinated with Member Agencies' plans for Oxidation Retrofit Program? What are Metropolitan's Member Agencies' plans?***

Our Member Agencies will be involved in the Oxidation Retrofit Program planning and activities. Metropolitan is willing to work with the Member Agencies in the development of their plans.

7. ***How will the current and accelerated Oxidation Retrofit Program affect the ability of Member Agencies to receive a blend of supplies from Metropolitan, given proposed and/or possible new regulations and standards?***

The Stage I D/DBP Rule requires enhanced coagulation for the removal of total organic carbon in water that is amenable to enhanced coagulation. (It also sets lower trihalomethanes standards and standards for other disinfection by-products.) State Project Water is amenable to enhanced coagulation and, as a result, Mills and Jensen must comply with the provisions of the D/DBP Rule. Enhanced coagulation can be avoided by implementing ozone as long as source water total organic carbon levels are less than 4.0 mg/L. Colorado River Water is not amenable to enhanced coagulation because of the higher alkalinity contents and compliance with treatment requirement of the Stage I D/DBP Rule is not required. Depending on the proportion of State Project Water and Colorado River Water in blended supplies, enhanced coagulation may be required at Metropolitan's other three plants (Diemer, Weymouth and Skinner) which treat a blend of Colorado River Water and State Project Water. Preliminary bench-scale work conducted in 1994 and 1995 showed that State Project Water blends of 50 percent or more were considered amenable to enhanced coagulation. Blends from 25 to 50 percent appeared to be amenable sometimes (depending on the water quality at the time). Blends less than 25 percent State Project Water would not require enhanced coagulation. An accelerated Oxidation Retrofit Program will allow the regulatory flexibility to treat higher blends of State Project Water at the Diemer, Weymouth, and Skinner plants. Failure to retrofit these plants could place blending restrictions of as low as 25 percent. Higher blends

could require treatment plants receiving Metropolitan water to use both alternative disinfectants and enhanced coagulation at considerable costs. The Stage II D/DBP Rule may lower the disinfection by-product standards to levels that would require treatment for disinfection by-product control at all treatment plants. Negotiation on Stage II standards will commence early next year. A "Backstop" Stage II trihalomethanes standard of 40 µg/L has already been proposed as part of Stage I to ensure the negotiators will revisit the standards. Whether the 40 µg/L will be affirmed is unclear at this time, but appears to be the direction USEPA is heading.

8. *What were the assumptions made in the rate impact analysis?*

The analysis of impacts to the treatment surcharge assumed that the Oxidation Retrofit Program is debt financed with revenue bonds at an interest rate of 6 percent for 30 years. Projected capital costs are escalated at 5 percent per year and direct operating and maintenance costs at the five treatment plants were escalated at 3 percent per year. Metropolitan's sales of treated water are currently expected to increase from about 1.25 million acre-feet per year to about 1.44 million acre-feet per year by 2007, or about 1.5 percent annually over the next ten years.

9. *How does MWD propose to finance the Oxidation Retrofit Program?*

The analysis assumes that revenue bonds are used to finance the capital costs of the Oxidation Retrofit Program. Consistent with the current policy of recovering capital and operating costs necessary to provide treated water through the treatment surcharge, it is further assumed that the additional debt service and operating costs for the Oxidation Retrofit Program are recovered through the treatment surcharge. The impact of the Oxidation Retrofit Program on the treatment surcharge, given the above assumptions, is estimated to be about \$24 per acre-foot by the year 2020. At the Board's direction, staff may evaluate other methods of recovering the costs of the Oxidation Retrofit Program (e.g., General Obligation bond debt or benefit assessments).

Some Member Agencies have expressed concerns that rising treatment surcharges may encourage Member Agencies to build their own base-loaded treatment plants to avoid Metropolitan surcharges and peak off of Metropolitan facilities. (It is much cheaper to operate a base-loaded plant than a "peaking plant".)

10. *Are there other technologies that would be more appropriate to treat Colorado River Water?*

There are several treatment alternatives for controlling disinfection by-products: removing disinfection by-product precursors, using alternative oxidants, or removing disinfection by-products after formation. Removing precursors can be accomplished by using technologies such as granular activated carbon or membranes or by using enhanced coagulation. The installation and operation of granular activated carbon systems are extremely expensive. The regeneration of carbon is of questionable feasibility in

Southern California due to air quality restrictions. Membrane technology is also costly and would result in a 10-15% water loss due to brine disposal. Enhanced coagulation for disinfection by-product control typically involves using relatively high coagulant dosages. The degree of removal of precursors is dependent on the nature of organics. The studies conducted on Colorado River Water indicate that the precursors in Colorado River Water are not well removed through enhanced coagulation, unlike State Project Water. Enhanced coagulation is more expensive than ozone treatment at the Skinner, Weymouth and Diemer plants.

Using an alternative disinfectant in Colorado River Water, such as ozone followed by chloramines in the distribution system, has been shown to be effective in minimizing the formation of disinfection by-products, as well as providing a number of other water quality benefits.

Removing disinfection by-products after formation may be done through physical, chemical, or biological means. Again, the costs of granular activated carbon and membranes are prohibitively high. Air stripping on such a large scale would also be very costly.

11. *Does an isolated facility for the Bay-Delta fix negate the need for ozone at our treatment plants?*

An isolated Bay-Delta facility that bypasses the major contributors of trihalomethanes precursors (agricultural drainage and saltwater intrusion) will significantly improve influent water quality to our water treatment plants. Even with an isolated facility however, alternative treatment would be required to meet the total organic carbon removal requirements of the disinfection by-product regulations (total organic carbon will be reduced about 10 percent, not enough to avoid enhanced coagulation). With a Delta fix, it is expected that additional treatment technologies (such as granular activated carbon or membranes) beyond ozonation will not be required to meet future, more stringent drinking water regulatory scenarios. Also, operational costs of alternative treatment (including ozone) would be higher without a Delta fix.

12. *How was the ozone design dose selected?*

Ozone was recommended for implementation at Metropolitan's filtration plants to control trihalomethanes levels, comply with future disinfection by-product regulations, and avoid implementation of enhanced coagulation. Staff initially recommended an ozone dosage of 3 mg/L to remove tastes and odors, control *Cryptosporidium* as well as reduce disinfection by-product formation. In 1993, the ozone dosage was reduced from 3 to 2 mg/L to comply with disinfection by-product standards only, and reduce overall program costs. According to the literature, the current design ozone dose of 2 mg/L would result in a *Cryptosporidium* reduction of approximately 37 percent whereas a 3 mg/L dose would provide about 70 percent reduction.