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# *Executive Summary*

# *Buckhorn Disinfection Byproducts / Backwash Disposal Project*

***Prepared for: Amador Water Agency*** ***June 1, 2012***

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This Executive Summary presented the key findings, results, and recommendations described in the *Disinfection Byproduct Compliance* and *Backwash Water Management Technical Memoranda*, which are attached as Appendix A and B.

## PROJECT PURPOSE

The Buckhorn Disinfection Byproducts / Backwash Disposal Project (Project) was initiated to (1) assure compliance with the Stage 2 Disinfection Byproduct (DBP) Rule and (2) develop an integrated spent backwash water management plan. Key issues for the Project include:

- **Basis of the Existing WDR:** Waste Discharge Requirements, Order No. R5-2005-0097 (WDR) allows for the discharge of microfiltration reject flows to Pond No. 7 in accordance with specific limitations. These limitations were based on achieving specific groundwater criteria/objectives and containing (storing in Pond No. 7) microfiltration reject flows under various conditions, up to and including 100-year annual levels of precipitation.
- **Insufficient Storage Capacity:** Amador Water Agency (Agency) staff has determined that the storage capacity of Pond No. 7 is insufficient to accommodate microfiltration reject flows and 100-year annual levels of precipitation. Recent observations by Agency field personnel indicate that Pond No. 7 may violate the 2-ft freeboard requirement during years of above-average precipitation even with the reduced backwash volumes associated with the use of the backwash recovery skid (BWRS).

  Typically, if a discharger cannot provide adequate storage capacity, the resulting effluent limitations will be based on surface water criteria/objectives, which are significantly more stringent than those required for groundwater.

  Costs associated with expanding the capacity of Pond No. 7 to accommodate 100-year levels of precipitation are estimated at $500,000 to $650,000. Due to these high costs, alternative solutions need to be analyzed and identified to more cost-effectively manage spent backwash water.
- **Elevated DBP Levels in Distribution System:** As described in the *Disinfection Byproduct Compliance Technical Memorandum,* the Agency currently monitors 4

locations within the WTP distribution system on a quarterly basis for Stage 1 DBP Rule compliance. Historic data[1] shows that running annual averages for three of the four sites would have been out of compliance with the Stage 2 DBP Rule for total trihalomethanes (TTHMs) and one of the four sites would have been out of compliance for haloacetic acids (HAA5). These results indicate that compliance with Stage 2 DBP Rule will be difficult to achieve without making modifications to the WTP and its distribution system.

- **Solids Disposal in Pond No. 7:** Based on our experience and understanding of discharge regulations, the discharge to Pond No. 7 of solids contained in the microfiltration reject, coupled with infrequent overflows, will be problematic from the standpoint of long-term regulatory compliance.

  Significant modifications to the WTP operations, increasing the amount of solids discharged to Pond No. 7, or altering the characteristics of discharged solids provide the opportunity for the Central Valley Regional Water Quality Control Board (RWQCB) to revisit and potentially alter WDR effluent limitations (e.g., modifying the basis to reflect surface water criteria/objectives). If the RWQCB were to revisit the WDR without the expansion of Pond No. 7, plausible outcomes would be the addition of priority pollutants, more stringent effluent limitations, and increased monitoring costs. It is likely that new limitations would be based on a comparison of historic backwash water quality data and numerical limitations derived from established human health and chronic and acute life water quality criteria/objectives, as opposed to a comparison of source water quality to groundwater criteria/objectives which was done previously for the current WDR.

  Moreover, the WTP source water has relatively low hardness which is problematic for hardness-dependent metals (priority pollutants). For example, based on a preliminary review of October 4, 2011 laboratory analysis results, it appears that the current spent backwash quality (without solids removal) would exceed numerical limitations[2] for copper, lead, and zinc.

Considering these issues, the continued discharge of solids contained in the microfiltration reject to Pond No. 7 will be problematic from the standpoint of cost (e.g., $500,000 to $650,000 to expand the capacity Pond No. 7) and long-term regulatory compliance. Therefore it is recommended that solids removal be provided prior to discharge. Removing solids will also provide the ability to better manage spent backwash water flows and Pond No. 7 water levels as the solids removal filtrate could be (1) recycled back to the WTP for subsequent treatment (depending on the performance of the selected solids removal process) (2) continued to be discharged to MMGCC, or (3) a combination thereof. If filtrate were to be recycled back to the WTP year-round, (1) WDR monitoring and reporting costs, estimated at approximately $20,000 per year, could be avoided altogether and (2) expansion to Pond No. 7 could be avoided.

## DBP REDUCTION ALTERNATIVES & RECOMMENDATIONS

A total of nineteen (19) DBP reduction alternatives were initially considered. These alternatives consisted of the following strategies: TOC removal (pre-oxidation, coagulation/filtration, and adsorption), chlorine dose reduction (reducing CT requirements and alternative disinfectants),

[1] First quarter 2009 through first quarter 2012.

and water age reduction strategies (reducing storage time and organic materials). The number of viable alternatives was reduced to six (6) based on the ability to implement the alternative (e.g., compatibility with existing microfiltration units, costs, public outreach requirements, etc.) at the WTP. The six alternatives were compared with respect to costs (construction and operating), estimated DBP reduction levels, and perceived complexity to install and operate the alternative. A summary of the scores received by each of the six viable alternatives is presented in Table 1.

**Table 1. Scoring of DBP Reduction Alternatives**

| DBP Reduction Alternative | Capital Cost (1-5, 5 = Lowest) | Operating Cost (1-5, 5 = Lowest) | DBP Reduction (1-5, 5 = Greatest) | Complexity (1-5, 5 = Simplest) | Total Score |
|---|---|---|---|---|---|
| Chlorine Dioxide | 2 ($180,000) | 1 ($30,000/yr) | 3 | 3 | 10 |
| Aluminum Chlorohydrate (ACH) | 4 ($25,000) | 3 ($20,000/yr) | 4 | 5 | 16 |
| Ferric Chloride | 3 ($45,000) | 2 ($25,000/yr) | 3 | 3 | 11 |
| Clearwell Baffling | 1 ($160,000) | 3 ($20,000/yr) | 5 | 1 | 10 |
| pH Adjustment Location | 4 ($20,000) | 5 ($0/yr) | 3 | 5 | 17 |
| Reduce CT Provided | 5 ($0) | 5 ($0/yr) | 3 | 5 | 18 |
| Tank Mixing | 3 ($175,000) | 5 ($0/yr) | 2 | 4 | 14 |

To assure Stage 2 DBP Rule compliance, the following methods for DBP reduction are recommended, based on a combination of the highest scoring alternatives shown in Table 1:

- **TOC Removal Using Aluminum Chlorohydrate (ACH):** Construction costs associated with the installation of an ACH feed and storage system is approximately $25,000. Annual operating costs, based on an average production of 1.0 MGD and a dose of 4.5 mg/L, is approximately $20,000 per year.
- **Reduced CT Provided (Minimize Chlorine Dose):** The chlorine dose at the WTP should be minimized to maintain a measurable residual throughout the distribution system. It is recommended that the minimal chlorine dose, which resulted in a measurable chlorine residual throughout the distribution system, be determine by incrementally reducing the chlorine dose at the WTP and measuring the response throughout the distribution system (e.g., going from a measured chlorine residual of 1.3 to 1.2, then to 1.1 mg/L, and so on until the minimum desired chlorine residual is achieved).

It is likely that this full-scale testing will need to be conducted multiple times (e.g., 3 times) by plant operators to determine the best chlorine residual set point throughout the year with and without ACH addition, as chlorine residual levels in the distribution system vary with changes in water temperature, water age, and TOC.

- **Provide Tank Mixing:** It is recommended that the Agency start with Tank A in order to determine its impact on the overall distribution system. It is recommended that the Agency budget $50,000 for this particular effort.

## BACKWASH MANAGEMENT PROCESS ALTERNATIVES & RECOMMENDATIONS

As described in the *Backwash Water Management Technical Memorandum*, Agency staff have previously developed and compared several methods for compliance with the Stage 2 DBP Rule and continued disposal of spent backwash water. A set of proposed design criteria was developed for the Project. These criteria served as the basis for identifying and comparing suitable alternatives.

A total of ten (10) alternatives were identified and compared based on their relative advantages and disadvantages, estimated costs, ability to remove fine particulates (which are problematic for microfiltration operation) and previous study results. All but one of the alternatives were eliminated due to concerns regarding high polymer use (which is not compatible with long-term operation of the microfiltration membranes), fine particulates causing microfiltration plugging, long-term WDR compliance, costs, or a combination thereof.

The recommended alternative[2] includes thickening/chemical conditioning of spent backwash water and delivery to proprietary Deskins™ sludge drying beds. Estimated construction costs associated with the installation of the recommended alternative is $355,000. The selection of this alternative is based on the fact that this particular technology has successfully demonstrated the ability to cost-effectively dewater microfiltration reject at the City of Clovis Water Treatment Plant. Moreover, of the alternatives considered for this particular application, Deskins™ was the only alternative which provided the ability to:

- Recycle filtrate back to the WTP or discharge it to MMGCC for subsequent disposal. This flexibility allows the Agency to:
    - Avoid expansion of Pond No. 7 and the associated costs by recycling filtrate during above-average and/or high precipitation events.
    - Eliminate the discharge to MMGCC altogether thereby reducing monitoring and ongoing regulatory compliance costs (estimated to be $20,000 per year).
- Serve as a backup to the BWRS, given that reject from the primary microfiltration units could be routed directly to the Deskins™ system. Under these circumstances, additional spent backwash water storage may be required as well as increased labor to maintain the hydraulic loading rate on the drying beds for a longer period of time.

Estimated operations and maintenance (O&M) requirements for the recommended alternative were developed based on discussions with the manufacturer and Mr. Leon Penney, Water Production Manager at the City of Clovis. Altogether, it is estimated that 225 hours will be

[2] Alternative 6 as described in the *Backwash Water Management Technical Memorandum.*

required annually to properly operate and maintain the Deskins™ system. The total O&M costs estimated for the recommended alternative is $3,250 per year.

## RECOMMENDED PHASING PLAN

Figure 1 describes the phasing plan for the recommended improvements. The California Department of Health Services has indicated that Stage 2 DBP compliance testing could start as late as October 2013. However, to counteract higher DBP formation associated with elevated source water temperatures, it is recommended that both the ACH and solids removal systems be in service by May 2013.

**Figure 1. Recommended Phasing Plan**

| Step / Activity | Estimated Construction Costs ($) | 2012 June | July | Aug. | Sept. | Oct. | Nov. | Dec. | 2013 Jan. | Feb. | March | April | May |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Solids Removal Project | 355,000 | | Planning and Design | | | Bidding | Construction | | | | | | Startup |
| 2. Conduct Full Scale Testing to Minimize Chlorine Dose | 0[a] | | | | | | | | | | | | |
| 3. Tank A Modifications | 50,000 | | | | Design | | Bidding | Construction | | | | | |
| 4. ACH Feed and Storage System Improvements | $25,000 | | | | | | | Design | | Bidding | Installation | | Startup |
| Total Estimated Construction Cost | $430,000 | | | | | | | | | | | | |

a Testing assumed to be conducted by Agency operators and staff.