ICR Treatment Study Summary Report

Evaluation of Granular Activated Carbon Technology For a Pilot Scale Test For Compliance with the Information Collection Rule

Conducted during the period from November 3, 1997 through April 10, 1998

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John E. Preston Water Treatment Plant, Plant ICR# 301

Attachments: Diskettes containing the Data Collection Spreadsheets and ICR Report

CONCLUSIONS AND RECOMMENDATIONS

The high color and total organic carbon (TOC) levels associated with the source water for the John E. Preston Water Treatment Plant (WTP) severely limit the feasibility of a granular activated carbon (GAC) process in controlling Simulated Distribution System (SDS) DPB formation. The organics that produce high color and TOC levels cause rapid breakthrough in a GAC filter. Implementation of ozonation prior to GAC treatment did not significantly improve the performance of the technology.

TOC breakthrough (as defined by the EPA Pilot Study criteria) occurred in the pilot GAC column after approximately fifty and twenty-five operating days for GAC and ozonation/GAC technology, respectively. Implementation of GAC technology alone would require media regeneration approximately eight times per year. Implementation of ozonation and GAC would require approximately fifteen GAC regenerations per year. These regeneration frequency estimates are based on TOC breakthrough from data collected during the pilot study.

The run times until Stage 1 and Stage 2 DBP breakthrough occurred, were primarily limited by THM concentrations in the GAC effluent. THM breakthrough occurred at a faster rate than HAA breakthrough in both ICR scenarios. The following table presents the run time to DBP breakthrough for each of the ICR scenarios conducted during the pilot study.

Scenario	Time to TOC Breakthrough	Time to DBP Stage 1[1] Breakthrough	Time to DBP Stage 2[2] Breakthrough
No. 1	50 days	5 days	2 days
No. 2	25 days	11 days	8 days

ICR Run Times to TOC and DBP Breakthrough in the GAC Effluent

The DBP breakthrough results indicate that GAC regeneration would be required more frequently than the TOC breakthrough data indicate. However, it is important to note that modifications would be made to the existing chlorination practice at the Preston WTP (i.e., free chlorine contact time would be significantly reduced) if GAC and/or ozone were implemented. For this reason,

[1] The maximum contaminant levels (MCL) for Stage 1 DBP compliance requires THMs < 80 mg/L and HAAs < 60 mg/L.
[2] The MCL for Stage 2 DBP compliance requires THM < 40 mg/L and HAAs < 30 mg/L.

TOC breakthrough data, not DBP breakthrough were used to estimate the cost of implementing GAC at the Preston WTP.

Based on the results of the study, the estimated capital cost of the GAC process used in Scenario No. 1 is $65,600,000. Assuming a capital recovery rate of 5-percent over a period of 30 years, the estimated annualized capital cost is $4,270,000. The estimated capital cost of the GAC and ozonation process used in Scenario No. 2 is $106,700,000. The estimated annualized capital cost is $6,950,000.

The combination of the limited effectiveness of GAC technology on the source water and the high cost required for implementation of this technology make GAC a non-feasible option for controlling SDS DBP formation at the John E. Preston WTP.

BACKGROUND

The raw water supply for the John E. Preston WTP is drawn from the Northwest wellfield in Dade County. The water is characterized as a highly colored groundwater that has average total organic carbon (TOC) levels of 16 mg/L. The Preston WTP treats on average, a total of 165 million gallons of raw water per day. The high TOC and high color in the raw water present the operators at the Preston WTP with the challenge of keeping finished water color below fifteen color units while minimizing DBP concentration.

The Preston WTP treat the influent groundwater by lime softening using silica as a coagulant aid, after which the water is fluoridated, recarbonated, chlorinated, filtered, and ammoniated prior to the air stripping process.

The Preston WTP has a total of six softening units, three-25 MGD Hydrotreators and three-30 MGD Accelators. Raw water flowing into the Preston WTP is essentially split into two treatment trains, one in which softening is achieved by the Hydrotreators, and the other softening process is achieved by the Accelators. The effluent from each group of softening units is combined in the clearwell, after the filtration process.

This section contains information about the Preston WTP. A site plan (**Figure 1**) of the Preston WTP along with the basic engineering data for each of the unit processes is presented. Additionally, a summary of various average source and finished water quality parameters is included in this section.

For the purpose of ICR study, softened water was pumped from Softener No.6 (refer to Figure 1) into a 60-gallon pH adjustment reservoir, housed in the Montgomery Watson pilot trailer. Water was pumped from this reservoir into three successive ozone contact chambers and then gravity fed into a holding tank located under the nose of the trailer. The water was then pumped through a dual media filter and then through the GAC column.

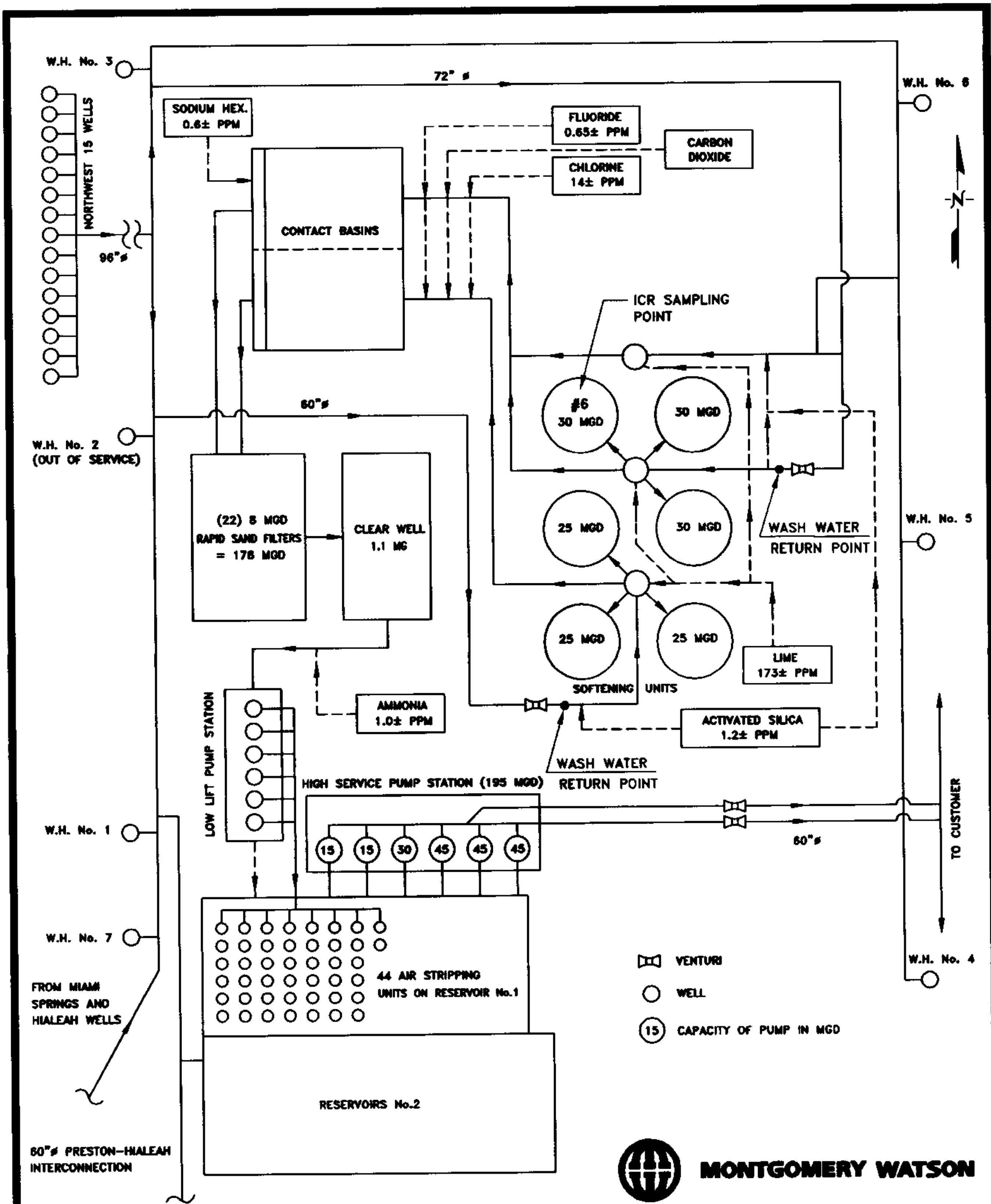

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Figure 1
JOHN E. PRESTON WATER TREATMENT PLANT
FLOW DIAGRAM

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A.2 -- Design Plant Parameters

Treatment Plant Name: John E. Preston Water Treatment Plant
ICR Treatment Plant ID: 301
Treatment Plant PWS ID: FL4130871
Treatment Plant Category: SOFT

State Approved Plant Capacity (MGD): 130.0
Historical Min. Water Temperature (deg C): 23.3
Installed Sludge Handling Capacity (GPD): 1,209,600.00
Blending Indicator: N

Water Resource Name: Biscayne Aquifer (N. W.)
Water Resource Type: Ground water
Intake Name: Biscayne Aquifer (N. W.)_
Wellhead Protection: Y

Hydrologic Unit Code:
Latitude (degrees, minutes, seconds): +25°49'37.8"
Longitude (degrees, minutes, seconds): -80°25'48.66"

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
	Influent	INF	1	

Process Train Name: John E. Preston Water Treatment Acc
Process Train Category: SOFT

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
1	Washwater Rec B	Washwater Return	11	Washwater Treated: N Coagulation/Sedimentation: N Filtration: N Disinfectant Addition: N Plain Sedimentation: N Other Treatment: 24 hr average Water flow Returned (MGD): 2.4
2	Washwater Rec B	Washwater Return Sample Point		
3	Accelators	Solids Contact Clarifier	2	Clarifier Type: UP

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
				Brand Name: Infilco Accelator Surface Area (ft2): 19,932 Liquid Volume (gal): 2,343,431 Short Circuiting Factor: Baffling Type: UN Plate Settler Surface Area (ft2): Tube Settler Surface Area (ft2): Plate Settler Brand Name: Tube Settler Brand Name:
4	Chlorine gas	Disinfectant Addition		Chemical Code: CL2 Measurement Formula: Cl2 Dose Rate (mg/L): 14.00
5	Recarbonation	Recarbonation Basin	3	Surface Area (ft2): 1,448 Liquid Volume (gal): 172,040 Baffling Type: PR Short Circuiting Factor:
6	Contact Basins	Disinfection Contact Basin		Surface Area (ft2): 22,500 Liquid Volume (gal): 3,000,000 Baffling Type: PR Short Circuiting Factor:
7	Chemical Add	Other Treatment Process	9	Surface Area (ft2): Liquid Volume (gal):

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
				Short Circuiting Factor: 0.0
8	Filtration	Filtration	5	Surface Area (ft2): 25,344 Liquid Volume (gal): 1,706,159 Total Media Depth (in): 36 Depth of GAC (in): Media Type: DUAL Type of Activated Carbon: Minimum Water Depth To Top of Media (ft): 4.0 Depth From Top of Media to Top of Backwash Trough (ft): 2.5
9	Anhydrous ammon	Disinfectant Addition		Chemical Code: NH3A Measurement Formula: NH3A Dose Rate (mg/L): 1.00
10	Packed Tower	Air Stripping		Horizontal Cross Sect. Area (ft2): 154 Packing Height (ft): 20.5 Air to Water Ratio (Vol/Vol): 100 Nominal Packing Size (in): 1.0 Air Flow (SCFM): 33,000 Packing Type: SAD Packing Type Description:
11	Clearwell	Clearwell		Surface Area (ft2): 196,000 Liquid Volume (gal): 1,510,000 Minimum Liquid Volume (gal): 7,500,000

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
				Baffling Type: SP Short Circuiting Factor: Covered Indicator Code: Y
	Finished Water	FIN	7	

Design Plant Chemical Parameters

Sep. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
Treatment Plant Name: John E. Preston Water Treatment Plant						
ICR Treatment Plant ID No: 301						
Treatment Plant Category: SOFT						
Process Train Name: John E. Preston Water Treatment Acc						
Process Train Category: SOFT						
1	Washwater Rec B	Washwater Return	11			
2	Washwater Rec B	Washwater Return Sample Point				
3	Accelators	Solids Contact Clarifier	2			
				Calcium oxide	CaO	172.00
				Sodium silicate	Na2Si02	1.20
4	Chlorine gas	Disinfectant Addition				
				Chlorine gas	Cl2	14.00
5	Recarbonation	Recarbonation Basin	3			
				Carbon dioxide	CO2	10.50
				Sodium fluoride	Na2SiF6	0.65
6	Contact Basins	Disinfection Contact Basin				
7	Chemical Add	Other Treatment Process	9			
				Sodium hexametaphosphate	(NaPO4)x	1.20
8	Filtration	Filtration	5			
9	Anhydrous ammon	Disinfectant Addition				
				Anhydrous ammonia	NH3A	1.00

Sep. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
10	Packed Tower	Air Stripping				
11	Clearwell	Clearwell				

Water Quality Parameter	Average Yearly Value	Standard Deviation	Maximum Yearly Value	Minimum Yearly Value
Temperature (°C)	24.7	1.4	27.0	23.0
pH	7.26	0.05	7.40	7.20
Turbidity (NTU)	0.3	N/A[1]	N/A	N/A
Alkalinty (mg/L as $CaCO_3$)	218.4	7.3	240.0	203.0
Calcium Hardness (mg/L as $CaCO_3$)	195.7	2.7	199.8	191.5
Total Hardness (mg/L as $CaCO_3$)	222.2	3.9	231.0	218.0
TOC (mg/L)	15.29	3.18	20.95	10.87
UV_{254} (cm^{-1})	0.555	0.094	0.687	0.410
Bromide (μg/L)	0.14	0.02	0.19	0.11

[1]N/A means data was not available

Source Water Quality – John E. Preston Water Treatment Plant

Water Quality Parameter	Average Yearly Value	Standard Deviation	Maximum Yearly Value	Minimum Yearly Value
Temperature (°C)	24.2	1.6	26.5	22.0
pH	9.10	0.10	9.40	8.70
Turbidity (NTU)	0.16	0.11	1.20	0.02
TOC (mg/L)	12.32	1.50	14.24	9.52
Distribution System THM4 (μg/L)	12.0	5.6	23.4	7.4

Finished Water Quality – John E. Preston Water Treatment Plant

MATERIALS AND METHODS

This section describes the pretreatment to the advanced process employed in the study, the equipment used, the experimental design, and the analytical methods used during the study. **Figure 2** shows a schematic of the Preston WTP lime softening process which features treatment study collection point. **Figure 3** depicts a schematic of the advanced treatment process utilized in the ICR study downstream of the plant-scale lime softening process. The study was conducted on softened water that was pumped from Softening Unit No. 6. Therefore, the advanced treatment process included lime softening, pH adjustment, ozonation, dual media filtration and finally GAC filtration. The softened water was pumped through the ozone contact chambers at a flowrate of 3 gpm and the flowrate through the dual media filter column and the GAC column were 0.25 gpm and 0.13 gpm respectively.

A discussion of the procedures and methods specific to the study is presented after Figure 3. This discussion is followed by an outline of the experimental methods. Information regarding the analytical methods and the participating laboratories as well as the minimum reporting level for each analyte are presented in this section.

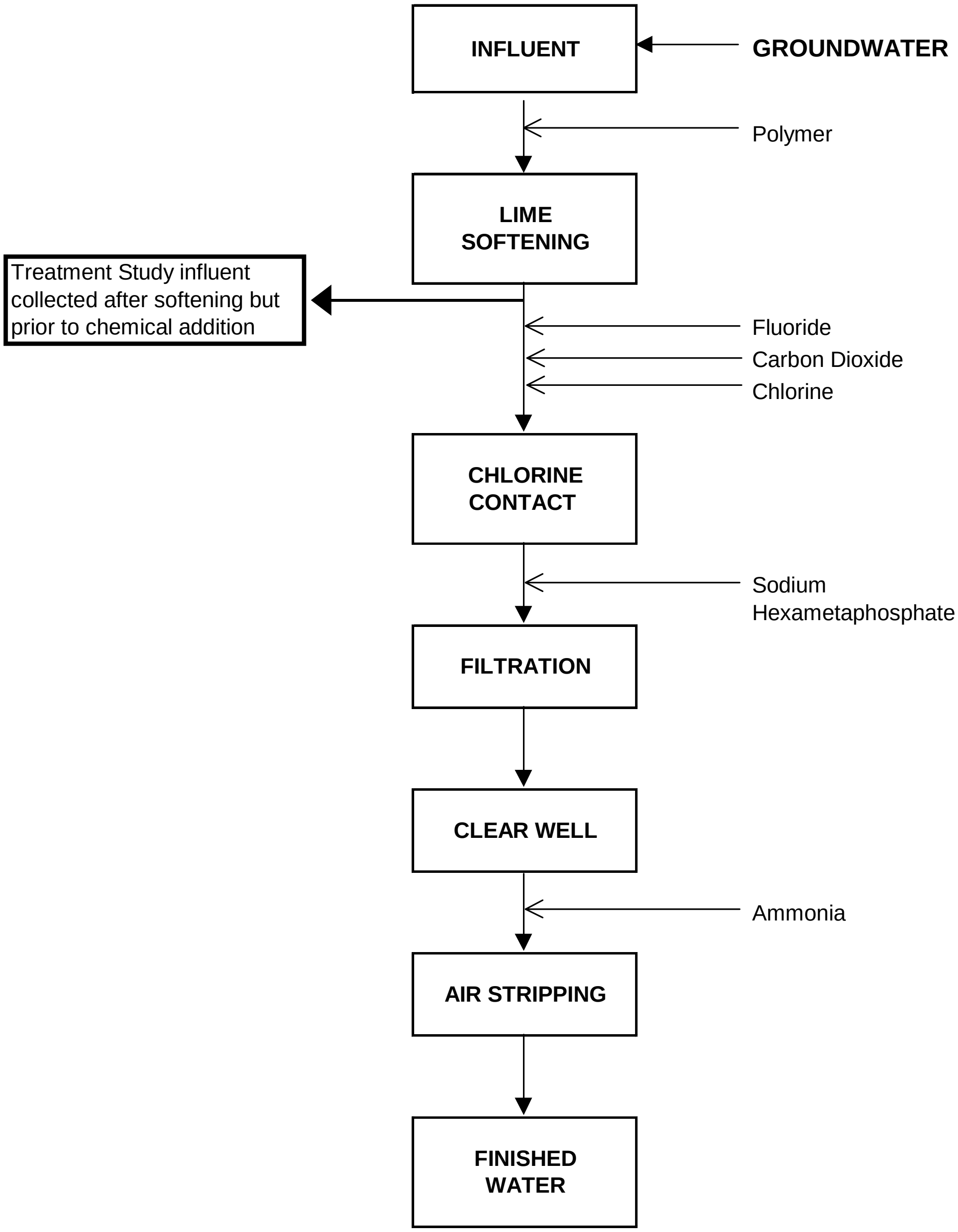
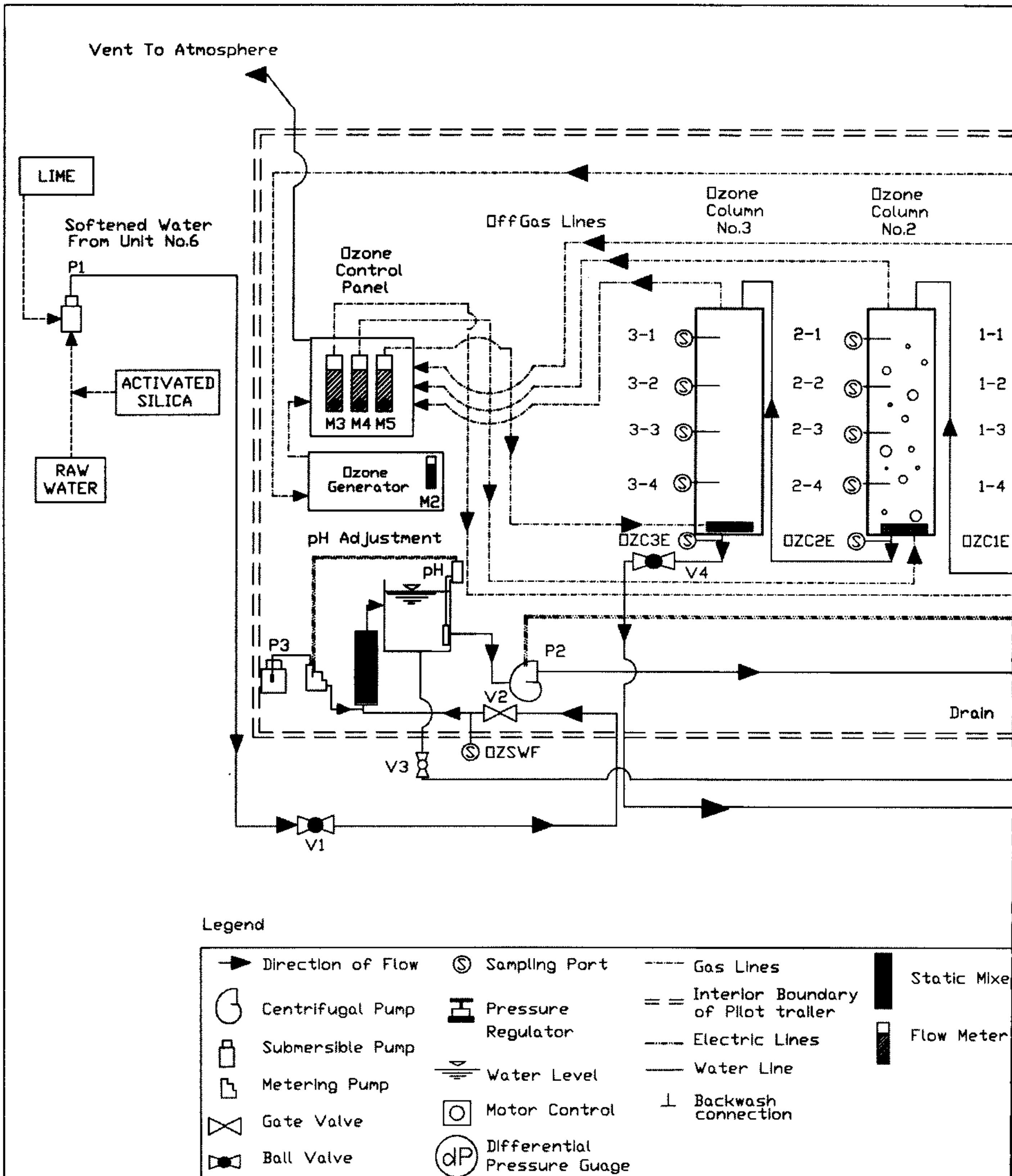


Figure 2 Schematic of Preston WTP with Treatment Study Location Point



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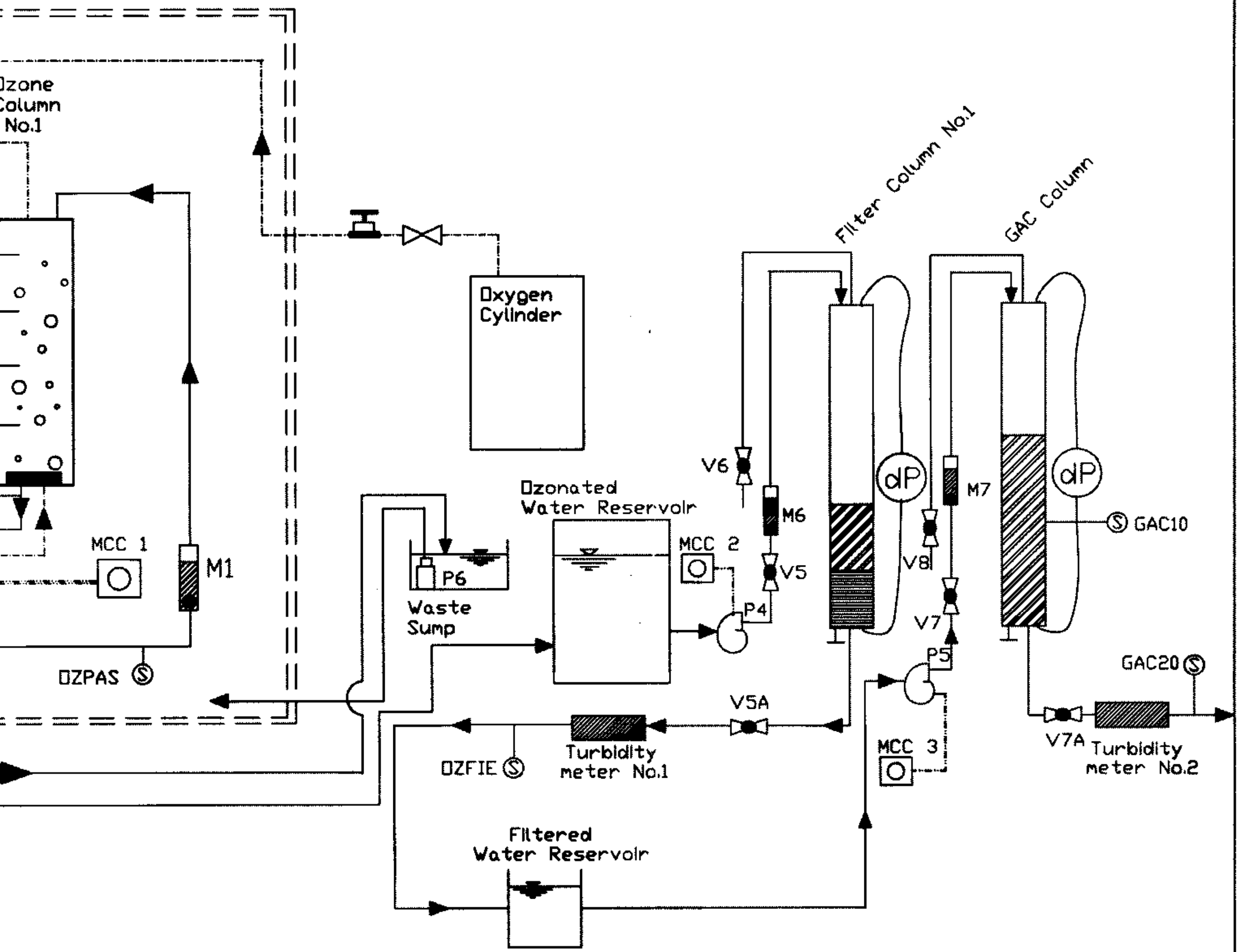

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FIGURE 3

Ozone/GAC
ICR Equipment Schematic

Unit Process	Process Description
Lime Softening (Full-Scale)	Type of Softening Unit: Hydrotreator/Accelator No. of Softening Units: 3 / 3 Total Hydraulic Capacity (MGD): 75 / 90 Tank Diameter (ft.): 90 / 92 Surface Loading (gals./sq.ft./min.): 2.73 / 3.91 Motor Drive (hp): 7.5 / Variable Frequency (40) Chemical Addition: Pebble or Quick Lime Chemical Dose (mg/L): 173 Chemical Addition: Activated Sodium Silicate Chemical Dose (mg/L): 1.2
pH Adjustment (Pilot-Scale)*	Chemical Type: Sulfuric Acid Chemical Purity: Commercial Grade (98%) Adjusted pH: 7.00 – 8.30
Ozonation (Pilot-Scale)*	Chemical Type: Oxygen No. of Columns: 3 Chemical Dose (mg/L): 12 Water Feed Rate (MGD): 3 HRT @ Max. Flowrate (min.): 13 Generator Output Rating (lb./day @ 2% ozone): 2
Filtration (Pilot-Scale)	Surface Area (in^2): 7.06 Column Height (ft.): 10 Filter Loading Rate (gpm/sq.ft.): 5 Media Type: Sand / Anthracite Media Depth (in.): 12 / 24 Effective Size (mm): 0.55 / 1.0 Uniformity Coefficient: 1.5 / 1.5

* These pretreatment processes apply only to the second scenario investigated.

<u>Discussion of Experimental Design for Pilot GAC Study:</u>

A schematic of the ozone, filter and GAC pilot equipment is shown in **Figure 3**. The pilot equipment is located at MDWASD's John E. Preston Water Treatment Plant (WTP). The pilot treatment train consists of a pH adjustment system, ozone generation equipment, three ozone contact chambers in series, one dual media filter column, one GAC column, and various meters, gages, and sample ports. As **Figure 3** illustrates, the Preston WTP softened water is pH adjusted to a pH of 7.0, ozonated (in the case of the second ICR run), filtered and then introduced to the GAC column.

The softened water (from the Preston WTP) is supplied to the pH adjustment system inside the pilot trailer via a submersible pump located in the effluent channel of Softening Unit No. 6. The softened water is extracted from the softening unit prior to filtration and prior to the addition of pre-filtration chemicals (e.g. fluorine, chlorine, carbon dioxide, and sodium hexametaphosphate). In the first phase of the pilot process, the pH of the softened water is adjusted using sulfuric acid to achieve the desired pH prior to ozonation. A pH adjustment reservoir equipped with an automatic pH control system is used to achieve the desired pH in the softened water. The pH control system consists of a pH probe (immersed in the pH adjustment reservoir), a programmable pH controller, and an acid feed pump.

The pH-adjusted water is fed into the top of the first ozone contact chamber at a flowrate of 3 gpm. The flow rate into the ozone chambers is controlled with the pump speed control (MCC1) located in front of Ozone Column No. 1. Ozone gas is generated from oxygen gas supplied to the ozone generator. The ozone gas is produced by the ozone generator and then introduced counter-currently into the pH-adjusted water via gas diffusers located at the base of the contact chambers. This provides a maximum ozone contact time of 13 minutes. An on-line ozone monitor is used to determine the concentrations of ozone feed-gas and ozone off-gas. The feed-gas and off-gas concentrations are digitally displayed on the front panel of the ozone control monitor and are used to determine the total ozone dose transferred to the pH adjusted softened water.

For the purpose of this study, ozone was fed into the first and second contact chambers only. After the water has traveled through each contact chamber, the effluent from the third ozone contact chamber flows to an open reservoir located under the nose of the pilot trailer. Any excess flow resulting from the ozone contact chambers and the ozonated water reservoir is directed to a waste sump and pumped to the lime sludge pit (for the accelators) located to the south of the pilot trailer. From the ozonated water reservoir, the water is pumped to Filter Column No. 1 which contains anthracite and sand filter media. The filter column is 10 feet tall with a 3-inch inside diameter. The flowrate to the filter column is controlled using the pump speed control (MCC2) and the filter effluent valve (V5A). The flowrate through the dual media filter column was 0.25 gallons per minute (gpm). The pilot filter has the components required to monitor effluent turbidity and headloss, and to control the rate of flow during the filtration and backwash cycles. A backwash module equipped with a flow meter is connected to the base of the filter for backwashing events.

The effluent from Filter Column No. 1 flows into a five-gallon reservoir from which influent to the second filter column (packed with GAC) is drawn. Effluent is pumped from the small reservoir to the top of the column and then flows down through the GAC bed. The GAC column is also 10 feet tall with an inside diameter of 3 inches. The flowrate through the GAC bed was 0.13 gpm and this was controlled using the pump speed control (MCC3) and the effluent valve

(V7A). The GAC column is constructed such that empty bed contact times (EBCTs) of 10 minutes and 20 minutes can be tested at the same time. The 10-minute EBCT sample was obtained from a sample tap that was placed at the midpoint of the GAC bed, and the 20-minute EBCT sample was collected at the base of the GAC column.

The ozone/GAC pilot consists of seven primary sample points along the treatment train and these are presented in Figure 3. These sample points are listed in the following table.

Ozone/GAC Sampling Points

POINT NO.	DESCRIPTION	SCHEMATIC DESIGNATION
1	Softened Water	OZSWF
2	PH-Adjusted Softened Water	OZPAS
3	Ozone Column No. 3 Effluent	OZC3E
4	Filter Column No. 1 Influent	V5
5	Filter Column No. 1 Effluent	OZF1E
6	GAC Column EBCT 10 Effluent	GAC10
7	GAC Column EBCT 20 Effluent	GAC20

Water samples were collected from these points at various times during the ICR evaluation. Sampling and analysis was conducted as specified by the USEPA. OZF1E is located on the effluent end of the dual media filter and represents the filtered water. Samples collected at GAC10 (midway along the length of the GAC bed) represent a GAC EBCT of 10 minutes and samples collected at GAC20 (located at the bottom of the GAC bed) represent a GAC EBCT of 20 minutes. This configuration allows data from both the 10 and 20 minute EBCTs to be collected during the same run (while utilizing one column). During sampling events, GAC20 was sampled first and then GAC10 was sampled.

<u>Simulated Distribution System (SDS) Testing</u>

The Simulated Distribution System (SDS) tests were performed on the collected samples in order to simulate the temperature and detention time conditions of the plant distribution system. The analytical results of the SDS sample were be compared with the Distribution System Equivalent (DSE) to determine how well the SDS sample predicts disinfection byproduct formation in the actual distribution system (sample).

The focus of the testing was to examine DBP formation at the three stages in the treatment process (i.e., GAC influent, EBCT 10 and EBCT 20). These sample locations correspond to OZF1E, GAC10 and GAC20 respectively. The comparison of the DBP formation in the waters will indicate the effectiveness of GAC in reducing DBP formation. One-gallon samples were collected from sample locations OZF1E, GAC10, and GAC20. Sample bottles and sampling instructions were provided by the Applied Research Department (ARD) of Montgomery Watson. The SDS tests were conducted by the ARD using the UFC SDS Chlorination study methods.

Preliminary chlorination studies were performed using various chlorine doses to determine the chlorine demand of the waters. The SDS chlorine doses were then chosen in order to obtain a free chlorine residual of approximately 0.5 to 1.0 mg/L after 9 hours of incubation. The SDS samples were incubated at approximately 29.0^{o}C and a pH of 8.9. The detention time, temperature and pH reflect the average values in the distribution system.

Simulated Distribution System (SDS) Conditions
Water samples obtained from the OZF1E, GAC10, and GAC20 sample points were subjected to similar SDS conditions based on the preliminary chlorination studies. The following table presents the average chlorine doses used for each water sample during the two ICR scenarios.

SDS Chlorine Dose Used During the ICR Scenarios

Sample Location	Scenario No. 1 (GAC only)	Scenario No. 2 (Ozone and GAC)
OZF1E	13.0 mg/L	12.6 mg/L
GAC10	6.2 mg/L	6.8 mg/L
GAC20	5.8 mg/L	6.5 mg/L

During each of the ICR runs, the SDS samples were buffered, chlorinated, and after the 9-hour incubation period, the following table features the SDS tests that were conducted.

ICR Related SDS Tests

Trihalomethanes Haloacetic Acids Total Organic Halides Chlorine Demand

Operating Parameters

A total of two runs were conducted during the ICR evaluation. However a "blank run demonstration" was conducted prior to the ICR runs. This purpose of this blank run was to demonstrate that no leaching from, or adsorption to the materials used to construct the GAC column will occur, since this may affect the TOC or DBP formation analyses.

The blank run was performed by feeding the softened water into the empty GAC column. The empty column was placed into operation as it was to be operated during the ICR testing. No ozone was used during the blank run. The flowrate into the dual media filter (upstream of the empty GAC column) was set at 5 gpm/sf and the GAC column was loaded at a rate of 2.65 gpm/sf. Following approximately one hour of operation, samples were collected from OZF1E and GAC20. The samples were analyzed for TOC concentration. The results indicated that the TOC concentration in the column influent was essentially the same as the TOC concentration in the effluent. Therefore it was concluded that no organic adsorption or desorption was occurring in the empty column and the testing could proceed.

Blank Run TOC Results

Date	Influent TOC (mg/L)	GAC20 TOC (mg/L)
10/22/97	12.4	12.4
10/22/97	12.4	12.4
10/22/97	12.3	12.4

Due to the high concentration of TOC in the source water, two individual ICR runs were required to satisfy the rule. The following two runs each contained different operating scenarios and were both used for ICR testing. The first scenario represented the treatment process that is currently utilized at the

Preston WTP (i.e., no ozone was used). The first ICR run was conducted from November 3, 1997 through January 20, 1998.

The second ICR run began on February 6, 1998 and was completed on March 25, 1998. An ozone dose of 12 mg/L at a pH of 7.0 was selected for the second ICR run. The ozone was introduced to the pH adjusted softened water upstream of both the filter and GAC column. The following table provides a synopsis of the two ICR runs.

Experimental Design Summary of ICR Test Runs

	Season	Pretreatment	EBCT, minutes
Run 1	No Variability	Softened, Filtered (dual media)	10 & 20
Run 2	No Variability	Softened, pH Adjusted, Ozonated, Filtered (dual media)	10 & 20

The design parameters for each unit component of the pilot system are presented in the following table. Since ozone was only fed to the first and second contact chambers during the ICR study, the total ozone contact time was approximately nine minutes.

Pilot System Design Parameters

OZONE SYSTEM		
Number of Ozone chambers	=	3
Ozone Chambers Maximum Water Flowrate	=	3 gpm
Hydraulic Retention Time at Maximum Flowrate	=	13 min, total 4.33 min, per column
Ozone Generator Output Rating (w/oxygen feed)	=	2.0 lb/day at (2% ozone)
FILTRATION SYSTEM		
Filter Media	=	12″ of Sand (e.s. = 0.55 mm, u.c. 1.5) 24″ of Anthracite (e.s. = 1.0 mm, u.c. 1.5)
Filter Loading Rate	=	5 gpm/sf (0.25 gpm)
GAC SYSTEM		
GAC	=	85″ of 12x40 mesh (APD = 1.1 mm)
Loading Rate	=	2.65 gpm/sf (0.13 gpm)

The following table summarizes the differences between the first and second ICR runs. The difference was attributed to pH levels and the utilization of ozone in each scenario.

Ozone Dose Application For First and Second ICR Runs

pH ADJUSTMENT		
pH During Scenario No. 1	=	9.8 to 10.2 (not adjusted)
pH During Scenario No. 2	=	7.0
OZONE		
Dose During Scenario No. 1	=	0 mg/L
Dose During Scenario No. 2	=	12 mg/L
FILTER		
Loading Rate for Scenarios Nos. 1 and 2	=	5 gpm/sf (0.25 gpm)
GAC		
Loading Rate for Scenarios Nos. 1 and 2	=	2.65 gpm/sf (0.13 gpm)

Evaluation of Seasonal Variability

MDWASD's raw water is supplied from a groundwater source and is not subject to significant seasonal variability. Therefore, no additional testing was conducted to evaluate seasonal variability.

ICR Sampling Schedule

Each set of samples was collected eighteen times during each of the operating scenario; fifteen of which were referred to as "primary" samples and the remaining three were "duplicate" samples. The sampling schedule was based on the estimated amount of TOC breakthrough in the GAC effluent.

Procedures and Methods Specific to MDWASD GAC Pilot Study

The only deviation from the methods specified in the EPA guidelines occurred with the column and components utilized in the GAC pilot study. The piping is constructed of PVC, and the tubing and water storage tanks are constructed of polypropylene. Pump materials consist of brass housings, stainless steel shafts and rubber stators. The GAC contactors are constructed of plexiglass. These components have been used in various other studies for a number of years with no leaching observed; therefore, it is not anticipated that that organic leaching or adsorption will occur.

A "blank run demonstration" was performed prior to initiating the pilot study in order to confirm the absence of leaching. The empty GAC column was placed in operation at the identified flowrate for a period of approximately one hour. Then TOC samples were collected from the influent to and the effluent from the column. The influent and effluent TOC values agreed to within 0.8%.

The carbon loading procedures were done in accordance with the standards specified in the ICR manual. Backwash events for the dual media filter (Filter Column No.1) was based on headloss across the media bed, which was consistent with the procedures specified in the ICR manual.

Laboratory	Dates of Service	Analyses Performed
Utility Lab A	11/3/97 - 4/10/98	Temperature, pH, Turbidity
Utility Lab B	11/22/97 - 4/10/98	UV254 (SM 5910B)
Commercial Lab A	10/22/97 - 4/10/98	Alkalinity (ML/S 2320B), Bromide (ML/EPA 300), Total Hardness (ML/SM 2340B), Calcium Hardness (ML/EPA 200.7), Ammonia (ML/EPA 350.1), TOC (ML/SM 5310C), UV254 (SM 5910), TOX (ML/9020/SM 5320), THM4 (ML/EPA 524.2), HAA5 (ML/S 6251B), HAA6 (ML/S 6251B)

Laboratories Conducting Analyses for ICR Study
John E. Preston Water Treatment Plant

Analyte	Method	Minimum Reporting Level
Alkalinity	S 2320 B	2 mg/L as $CaCO_3$
Ammonia	EPA 350.1	0.05 mg/L as NH_3-N
Bromide	EPA 300	20 µg/L
Calcium Hardness	EPA 200.7	5 mg/L as CaCO3
Chlorine Residual	SM 4500 Cl-G	0.1 mg/L as Cl_2
BCAA, DBAA, DCAA, MBAA, TCAA, BDCAA	S 6251 B	1 µg/L
MCAA, DBCAA	S 6251 B	2 µg/L
THAA	S 6251 B	4 µg/L
pH	SM 4500 H+	**Not Applicable**
Temperature	SM 2550 B	Not Applicable
$CHCl_3$, BDCM, DBCM, $CHBr_3$	EPA 502.2	0.5 µg/L
Total Hardness	SM 2340 B	5 mg/L
TOC	SM 5310 C	0.5 mg/L
TOX	SM 5320	10 µg/L
Turbidity	SM 2130 B	0.02 NTU
UV_{254}	SM 5910	0.009 cm^{-1}
UV_{254}	SM 5910 B	0.001 cm^{-1}

Minimum Reporting Levels for Analytes

Laboratories Involved with ICR Study
John E. Preston Water Treatment Plant

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RESULTS AND DISCUSSION

This section contains information needed to interpret the data generated by the ICR study at the John E. Preston Water Treatment Plant. This information includes a summary of study observations and problems encountered during pilot operation. Operating parameters are discussed with attention to their impact on process performance. A cost analysis for implementation of the treatment technique was also investigated as part of the ICR study.

Study Observations, Problems Encountered and Factors for Interpretation

John E. Preston WTP – Scenario 1 (GAC only)

- For a total operating time of 32.5 hours between 11/13/97 to 11/14/97 there was air in the pilot scale GAC column. Additionally, a clogged transfer line produced a low flow condition between the dual-media filter and the GAC column during a total of 65.5 additional hours over various days (11/22/97, 12/19/97 – 12/22/97). Neither of these conditions required downtime in excess of 60 minutes and therefore no time was deducted from the operation time.
- During a pilot scale GAC run, the system feed pump failed on 11/11/97 and again from 11/28/97 through 12/8/97, resulting in a total downtime of approximately 193 hours.
- Electricity interruptions resulted in a short GAC pilot downtime on 11/24/97 and again on 12/26/97.
- During the operation of the GAC pilot, the flowmeter controlling the flow to the GAC column had to be replaced (11/19/97) and recalibrated (12/24/97).
- On 1/17/98, a leak was observed on the GAC column near the differential pressure line. No downtime was required to eliminate the leak.
- Flow across the GAC filter ranged from 0.10 to 0.18 gpm during the operation of the GAC pilot run and was adjusted three times per day to maintain the target flowrate of 0.13 gpm.

John E. Preston WTP – Scenario 2 (Ozonation and GAC)

- On numerous occasions during the operation of the GAC pilot, sufficient acid was unavailable to attain the target pH adjustment of 7.0. Acid levels in the reservoir were limited on the following occasions: 2/6/98 through 2/9/98, 2/25/98, 2/27/98 through 2/28/98, 3/2/98 through 3/3/98, 3/16/98 through 3/17/98, and 3/25/98 through 3/27/98. No downtime was required in any case.

- The ozonation system was down occasionally during the operation of the GAC pilot. This downtime is attributable to faulty oxygen tanks or the oxygen canisters emptying overnight and not being replaced until the next day. This condition occurred on 2/10/98, 2/20/98, 2/25/98 and 3/25/98. The pilot study was not interrupted in any of these cases. In general these episodes were brief and sampling was adjusted to accommodate these occurrences.
- The entire GAC pilot was down a total of approximately 10.5 hrs. due to problems with the pump controlling the water feed to the GAC column. Difficulties with this pump also resulted in low flow to the GAC column and air in the column.

The following tables present the average water quality for the GAC influent (OZF1E) and the GAC effluent (GAC20) samples for each scenario. The GAC influent for Scenario No. 1 was the plant-softened water without the addition of ozone. Scenario No. 1 was conducted for approximately 1688 hours (with downtime deducted).

Summary of Influent Water Quality
Scenario No. 1 (GAC Only)

Water Quality Parameter	Average	Standard Deviation
Temperature (^oC)	24.1	1.9
PH	10.2	0.4
Turbidity (NTU)	0.92	1.9
Alkalinity (mg/L as $CaCO_3$)	57.3	13.9
Calcium Hardness (mg/L as $CaCO_3$)	44.6	13.6
Total Hardness (mg/L as $CaCO_3$)	63.3	15.0
Ammonia (mg NH_3-N/L)	0.3	0.0
Bromide (µg/L)	0.17	0.02
TOC (mg/L)	14.2	2.8
UV_{254} (cm^{-1})	0.393	0.061
SDS-THM4 (µg/L)	343.9	60.7
SDS-HAA5 (µg/L)	119.3	34.3
SDS-TOX (µg Cl-/L)	851.2	186.4
SDS- Chlorine Demand (mg/L)	11.9	2.1

Summary of GAC Effluent Water Quality (20 min EBCT)
Scenario No. 1 (GAC Only)

Water Quality Parameter	Average	Standard Deviation
Temperature (^oC)	23.6	2.7
PH	10.0	0.4
Turbidity (NTU)	0.31	0.47
Ammonia (mg/L)	0.21	0.05
TOC (mg/L)	6.7	4.2
UV_{254} (cm^{-1})	0.163	0.109
SDS-THM4 (μg/L)	154.8	119.7
SDS-HAA5 (μg/L)	33.5	27.0
SDS-TOX (μg Cl-/L)	330.0	257.0
SDS- Chlorine Demand (mg/L)	5.8	2.5

During Scenario No.2, the plant-softened water was pH adjusted to 7.0 and ozone was applied at a dose of 12 mg/L. Scenario No. 2 was conducted for approximately 1147 hours.

Summary of Influent Water Quality
Scenario 2 (Ozone and GAC)

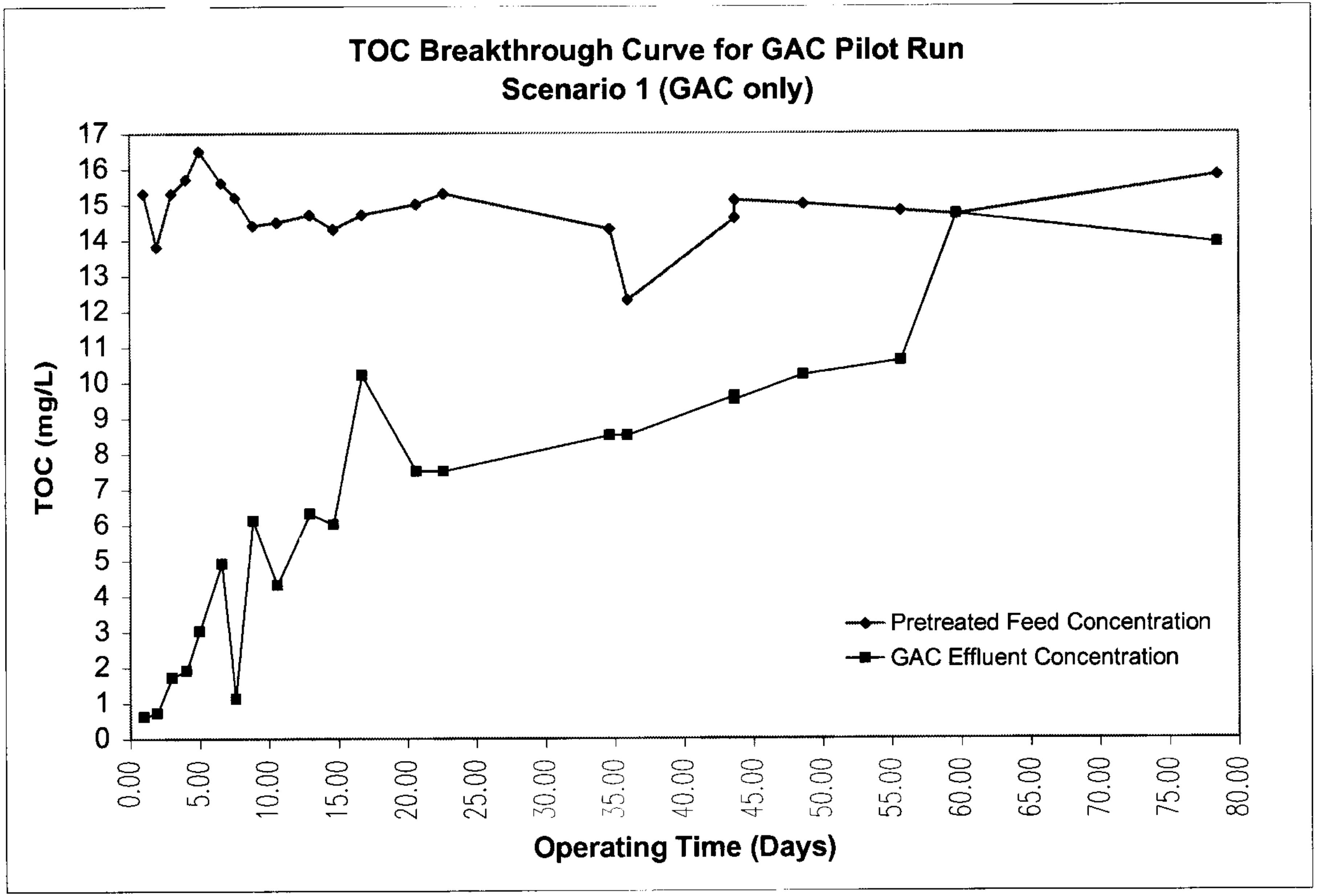
Water Quality Parameter	Average	Standard Deviation
Temperature (^oC)	22.3	1.7
PH	8.2	0.4
Turbidity (NTU)	4.5	3.3
Alkalinity (mg/L as $CaCO_3$)	47.6	11.7
Calcium Hardness (mg/L as $CaCO_3$)	91.3	15.4
Total Hardness (mg/L as $CaCO_3$)	111.4	16.8
Ammonia (mg NH_3-N/L)	0.3	0.1
Bromide (μg/L)	0.1	0.0
TOC (mg/L)	11.8	1.8
UV_{254} (cm^{-1})	0.208	0.044
SDS-THM4 (μg/L)	401.2	101.5
SDS-HAA5 (μg/L)	136.5	23.2
SDS-TOX (μg Cl-/L)	993.4	209.3
SDS- Chlorine Demand (mg/L)	12.2	0.5

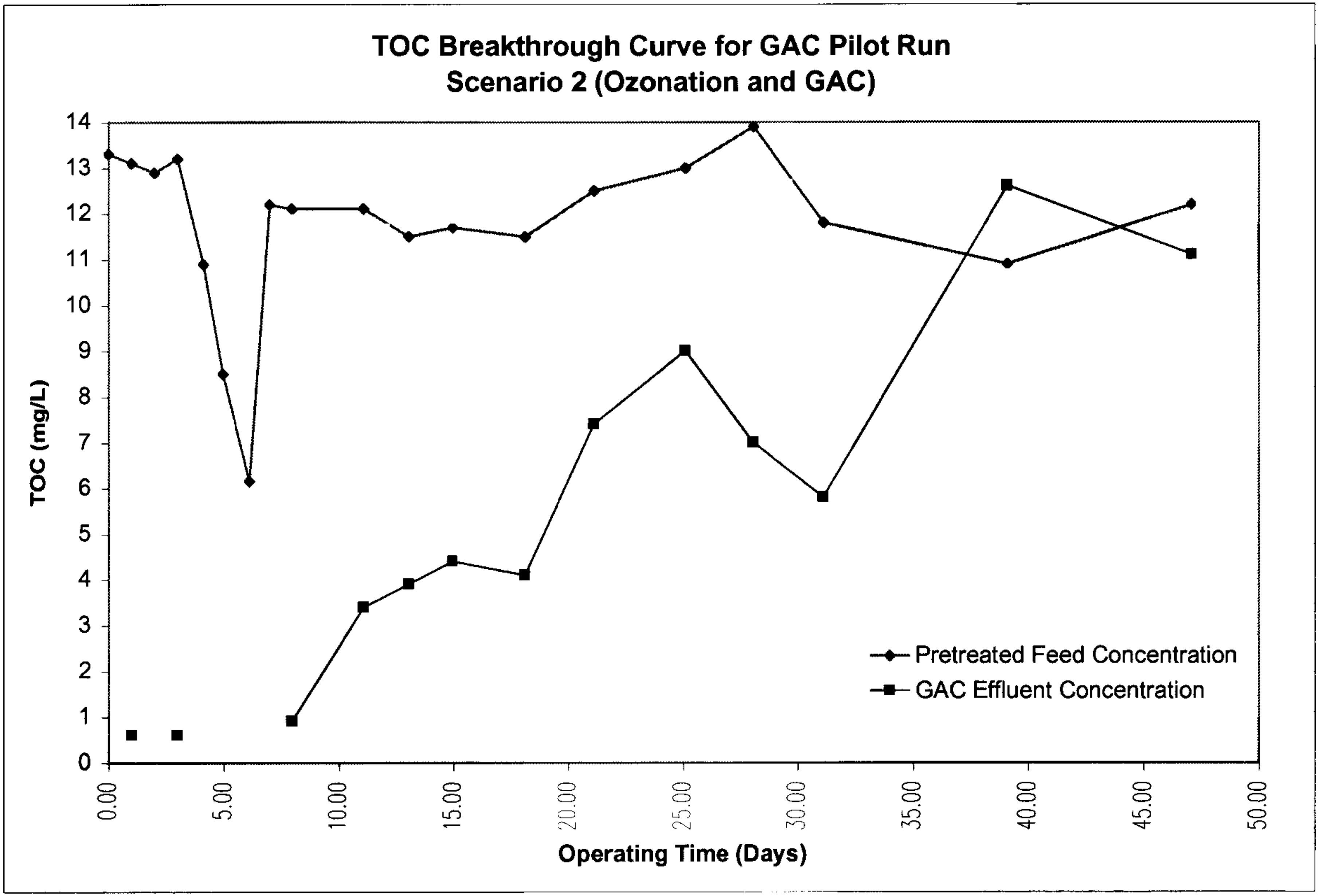
Summary of GAC Effluent Water Quality (20 min EBCT)
Scenario 2 (Ozone and GAC)

Water Quality Parameter	Average	Standard Deviation
Temperature (^oC)	22.6	2.8
PH	7.8	0.3
Turbidity (NTU)	0.21	0.17
Ammonia (mg/L)	0.3	0.1
TOC (mg/L)	5.3	4.0
UV_{254} (cm^{-1})	0.079	0.075
SDS-THM4 (μg/L)	87.0	99.2
SDS-HAA5 (μg/L)	23.5	31.7
SDS-TOX (μg Cl-/L)	205.5	182.7
SDS- Chlorine Demand (mg/L)	3.9	2.0

Impact of Seasonal Variations of Source Water on Process Performance

Source water for Miami-Dade Water and Sewer Department's John E. Preston Water Treatment Plant is supplied from a groundwater source and has not, historically, been subject to significant seasonal variability. Therefore, no testing was conducted to evaluate seasonal variability.


TOC Breakthrough Curve for GAC Pilot Run
Scenario 1 (GAC only)
TOC (mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
55.00
60.00
65.00
70.00
75.00
80.00
Operating Time (Days)
Pretreated Feed Concentration
GAC Effluent Concentration


TOC Breakthrough Curve for GAC Pilot Run
Scenario 2 (Ozonation and GAC)
TOC (mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
Operating Time (Days)
Pretreated Feed Concentration
GAC Effluent Concentration

Breakthrough Criterion	Estimated Value of Listed Parameter When Breakthrough Criterion is Met Scenario No. 1						
	Run Time (days)	*Throughput (Bed Volume)*	*TOC (mg/L)*	*SDS-THM4 (ug/L)*	*SDS-HAA5 (ug/L)*	*SDS-HAA6 (ug/L)*	*SDS-TOX (ug Ct/L)*
SDS-THM4 = 90 ug/L	7	500	4.9	84.7	21.0	29.0	150
SDS - THM4 = 72 ug/L	5	360	3.0	53.1	8.6	12.2	140
SDS - THM4 = 54 ug/L	5	360	3.0	53.1	8.6	12.0	140
SDS - THM4 = 36 ug/L	2	145	0.7	4.6	0.0	0.0	ND
SDS - HAA5 = 54 ug/L	35	2500	8.5	135.5	54.3	68.3	360
SDS - HAA5 = 27 ug/L	9	650	6.1	107.5	27.4	37.3	200
SDS - HAA6 = 54 ug/L	15	1080	6.0	126.0	35.6	48.6	265
SDS - HAA6 = 27 ug/L	7	500	4.9	84.7	21.0	29.0	150

Summary of Times To Reach Various Breakthrough Criteria and the Water Quality of the GAC Effluent When Those Criteria are Met - Scenario No. 1

Breakthrough Criterion	Estimated Value of Listed Parameter When Breakthrough Criterion is Met Scenario No. 2						
	Run Time (days)	*Throughput (Bed Volume)*	*TOC (mg/L)*	*SDS-THM4 (ug/L)*	*SDS-HAA5 (ug/L)*	*SDS-HAA6 (ug/L)*	*SDS-TOX (ug Ct/L)*
SDS-THM4 = 90 ug/L	11	800	3.4	79	14	20	120
SDS - THM4 = 72 ug/L	11	800	3.4	79	14	20	120
SDS - THM4 = 54 ug/L	11	800	3.4	79	14	20	120
SDS - THM4 = 36 ug/L	11	800	3.4	26	3	4	43
SDS - HAA5 = 54 ug/L	25	1800	9.0	220	54	69	415
SDS - HAA5 = 27 ug/L	18	1300	4.1	125	27	38	250
SDS - HAA6 = 54 ug/L	18	1300	4.1	125	27	38	250
SDS - HAA6 = 27 ug/L	13	940	3.9	107	21	30	230

Summary of Times To Reach Various Breakthrough Criteria and the Water Quality of the GAC Effluent When Those Criteria are Met - Scenario No. 2

Cost Ananlysis for Implementation of GAC Technology at the John E. Preston WTP

Flowrate in the Pilot Plant	0.13 gpm
Capacity of the WTP	165 mgd
GAC in the Pilot Column	11 lbs
GAC required for the WTP	4800 tons
Required Surface Area of Contac	28600 sf
(assume loading of 4 gpm/sf)	
No. of Contactors	20
Required Area of Each Contacto	1430 sf
Length and Width	40 ft
Actual Area of Each Contactor	1600 sf
Total Actual Surface Area	32000 sf
Velocity	0.5 ft/min
Required Height of GAC Bed	10 ft
Capacity of the Ozone System	17400 lb/day

Unit Cost of GAC (Regeneration Inlcuded)	$	3	per lb
Unit Cost of Concrete Contactors (inlcuding mechanical & electrical)	$	400	per sf
Unit Cost of Ozone System (including contactor & oxygen system)	$	1,500	per lb

Scenario No. 1 Capital Cost Estimate

Component	Capital Cost	
Cost of GAC	$	28,800,000
Cost of Concrete Contactors	$	12,800,000
Cost of Ozone System	n/a	
Subtotal	**$**	**41,600,000**
Site Work (5%)	$	2,100,000
Subtotal	**$**	**43,700,000**
General Conditions (25%)	$	10,900,000
Contingency (10%)	$	4,400,000
Engineering Services (15%)	$	6,600,000
Total Estimated Capital Cost	$	**65,600,000**

Annualized Capital Cost Over 30 Years at 5-Percent Interest Rate = $ 4,270,000

Scenario No. 2 Capital Cost Estimate

Component	Capital Cost	
Cost of GAC	$	28,800,000
Cost of Concrete Contactors	$	12,800,000
Cost of Ozone System	$	26,100,000
Subtotal	**$**	**67,700,000**
Site Work (5%)	$	3,400,000
Subtotal	**$**	**71,100,000**
General Conditions (25%)	$	17,800,000
Contingency (10%)	$	7,100,000
Engineering Services (15%)	$	10,700,000
Total Estimated Capital Cost	**$**	**106,700,000**

Annualized Capital Cost Over 30 Years at 5-Percent Interest Rate = $ 6,950,000

QA/QC SUMMARY

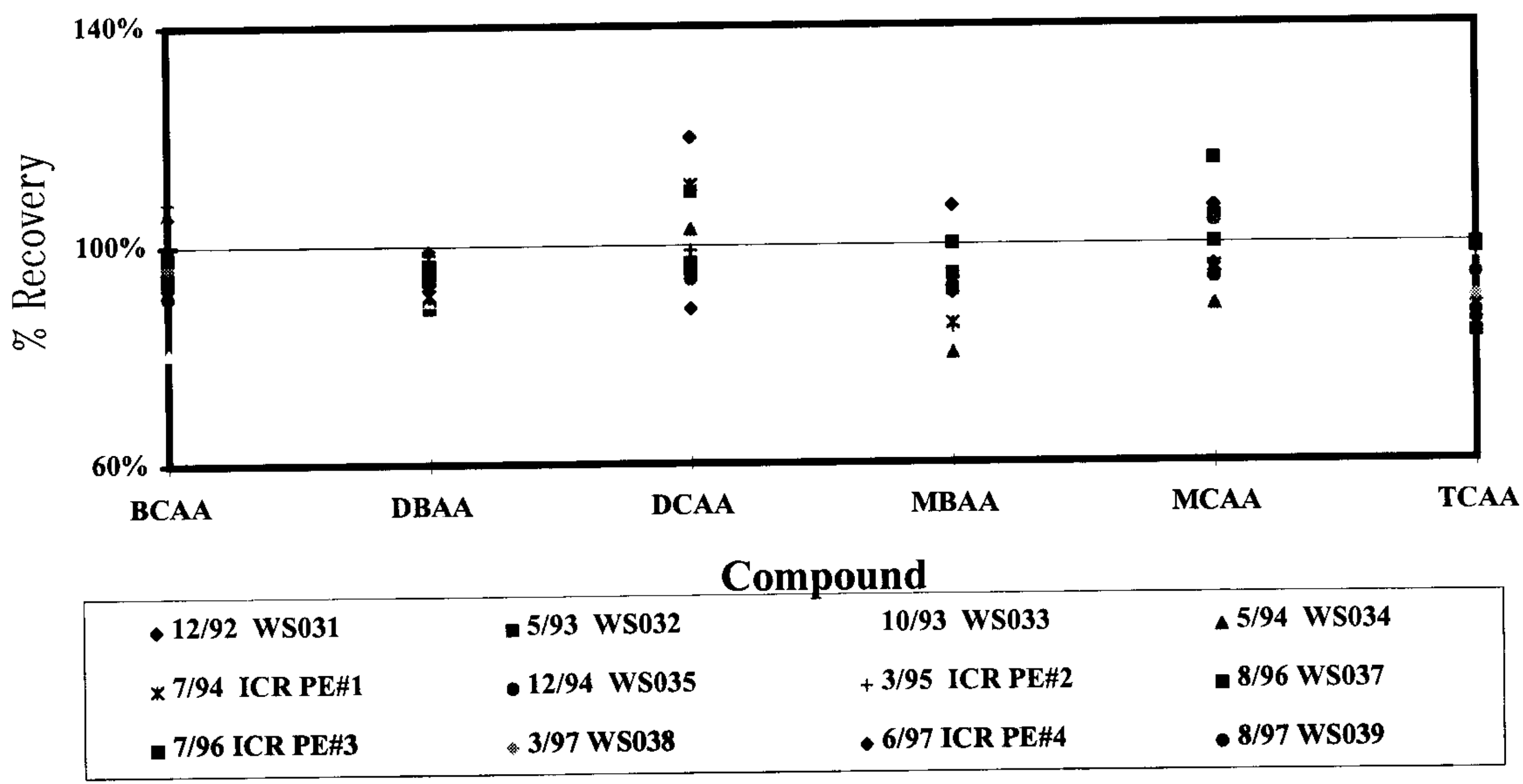
This section presents a summary of the QA/QC procedures used during the study. A summary of the calibration procedures for DBP, bromide, TOX, TOC and UV_{254} analyses is presented. All calibrations were conducted following standard practice. QA/QC information relevant to the ICR study is provided in the Montgomery Laboratories PE studies figure and the HAA historic table.

The results of all laboratory duplicates and fortified matrix sample analyses are presented in the tables following the QA/QC calibration procedures. Finally, copies of the data collection spreadsheets used during the course of the ICR study are presented in **Attachment A**.

CALIBRATION VERIFICATION AND QUALITY CONTROL PROCEDURES - METHOD SPECIFIC

Performance Criteria	Method	THMs EPA 551.1	TOC SM 5310 C	TOX SM 5320B	EPA300.0 A, B *Br*	SM 6251B Haloacetic Acids	*UV 254* SM 5910 B
	Analytes	***THM***	***TOC***	***TOX***		***(HAA)***	***UV 254***
	Target Analytes	**Trihalomethanes (THMs)** Chloroform (CHCl3) Bromodichloromethane (BDCM) Dibromochloromethane(DBCM) Bromoform (CHBR3)	**Total Organic Carbon**	**Total Organic Halide** **(Dissolved Organic Halogen)** **(DOX)**	**Bromide (Br⁻)**	**Haloacetic Acids (HAAs)** Monochloroacetic (MCAA) Dichloroacetic acid (DCAA) Dibromoacetic acid(TCAA) Trichloroacetic acid (TCAA) Monobromoacetic acid (MBAA) Bromochloroacetic acid (BCAA)	**UV Absorbance at 254 nm**
Calibration Verification	**Verification Frequency**	Lowest level std. analyzed at the beginning of each 24 hr before the first sample Mid level and high level analyzed alternately after every 10th sample and last sample	Lowest level std. analyzed at the beginning of each 24 hr before the first sample Mid level and high level analyzed alternately after every 10th sample and last sample	3 microcoulometer titration cell checks with NaCl std at start of 8-10 hr. work shift. Lowest level std. analyzed before the first sample. Mid level and high level analyzed alternately after every 7th sample and last sample	Lowest level std. analyzed at the beginning of each 24 hour- before first sample run Mid level and high level analyzed alternately after 10th sample and after the last sample.	Lowest level std. analyzed at the beginning of each 24 hour- before first sample run Mid level and high level analyzed alternately after 10th sample and after the last sample.	Lowest level std. analyzed at the beginning of each 24 hour- before first sample run Mid level and high level analyzed alternately after every 10th sample and after the last sample.
Calibration Verification Concentrations and Acceptance Criteria		***THM*** *(ug/L) (% rec)*	*TOC* *(mg/L) (% rec)*	***TOX*** (ug Cl-/L) **(% rec)**	*Br-* *(mg/L) (% rec.)*	***MCAA*** *(ug/L) (% rec.)*	***UV254*** *(cm⁻¹) (% rec.) (%RPD)*
	Low	1.0 50-150	0.7 (0.5) 50-150	50 (25) 75-125	0.02 50-150	2.0 50-150	0.009 75-125 </= 20
	Mid-level	20 80-120	4 90-110	200 85-115	0.10 90-110	20 80-120	0.088 85-115 </= 10
	High	40 80-120	9 90-110	500 85-115	0.30 90-110	32 80-120	0.866 85-115 </= 10
							All others ***(ug/L) (% rec.)*** 1 50-150 20 80-120 32 80-120
Method Calibration Procedures Trihalomethane	**Initial Calibration Curve**	THMs: CHCL3, BDCM Concentration (ug/L)	Conc. (mg/L)		Bromide Concentration (mg/L)	MCAA Concentration (ug/L)	NA
	Standard 1	0.5	0.5		0	2	
	Standard 2	1	1.0		0.02	5	
	Standard 3	2	5		0.05	10	
	Standard 4	5	10		0.1	20	
	Standard 5	10	20		0.3	40	
	Standard 6	20			0.5	-	
	Standard 7	30					
	Standard 8	40					
	Standard 9	50					
		THMs: DBCM, CHBR3 Concentration (ug/L)				All others Concentration (ug/L)	
	Standard 1	0.25				1	
	Standard 2	0.5				2	
	Standard 3	1				5	
	Standard 4	2.5				10	
	Standard 5	5				20	
	Standard 6	10				40	
	Standard 7	15					
	Standard 8	20					
	Standard 9	25					

Montgomery Watson Laboratories
HAA Historic Performance on PE Studies (1992-1997)



Montgomery Watson Laboratories Results of EPA ICR PE Samples

Parameter being tested	ICR 3/94 PE (PE Study #1)			ICR 3/95 PE (PE Study #2)			ICR 7/96 PE (PE Study #3)			ICR 4/97 &6/97 PE (PE-Study-#4/4m)			ICR 9/97 PE (PE-Study #5)			Status	Acceptance Limits
	Result	True Value	% Diff	Result	True Value	% Diff	Result	True Value	% Diff	Result	True Value	% Diff	Result	True Value	% Diff		
UV Absorbance																	
UV absorbance at 254 nm	0.324	0.308	5%	0.083	0.084	-1%	0.190	0.189	1%	0.300	0.323	-7%	0.410	0.435	-6%	**Pass**	25%
TOC																	
Total Organic Carbon	2.3	2.4	-4%	3.99	4.1	-3%	3.37	3.59	-6%	1.7	1.6	6%	4.4	4.7	-6%	**Pass**	25%
TOX																	
Total Organic Halogen	73	99.7	-27%	25.7	30.3	-15%	46.5	50.1	-7%	93.1	103	-10%	51.5	50.5	2%	**Pass**	25%
Haloacetic Acids (passing criteria = 4 of 5, excluding MCAA)																**Pass**	
Bromochloracetic acid (BCAA)	12.8	13.2	-3%	19	20.1	-5%	12.8	13.1	-2%	8.3	9.0	-8%	5.2	6.0	-13%		40%
Dibromoacetic acid (DBAA)	9.81	10.8	-9%	14	14.3	-2%	10.6	11.0	-4%	6.5	7.0	-7%	13.0	15.1	-14%		40%
Dichloroacetic acid (DCAA)	19.3	17.4	11%	29	29.3	-1%	14.5	15.0	-3%	21.2	24.0	-12%	10.0	12.0	-17%		40%
Monobromoacetic acid (MBAA)	7.46	8.73	-15%	12	12.2	-2%	6.3	??	??	9.1	10.0	??	10.0	11.9	-16%		40%
Monochloroacetic acid (MCAA)	7.08	7.41	-4%	11	10.2	8%	8.4	8.0	5%	11.5	12.0	-4%	5.5	6.1	-9%		Not Applic
Trichloroacetic acid (TCAA)	17.9	21.1	-15%	29	34.2	-15%	20.9	21.0	0%	12.8	15.0	-15%	8.0	9.0	-11%		40%
Haloacetonitriles (passing criteria = 4 of 5, excluding TCAN)																**Pass**	
1,1,1-Trichloropropanone (1,1-TCP)	11	10	10%	20.4	14.7	39%	6.1	6.0	2%	16.6	15.0	11%	6.3	??	??		40%
1,1-Dichloropropanone (1,1-DCP)	5.9	7.3	-19%	10.1	9.6	6%	3.1	3.0	2%	10.2	8.9	14%	7.8	6.0	30%		40%
Bromochloroacetonitrile (BCAN)	18.5	18.4	1%	18.6	17.0	9%	11.1	12.0	-8%	14.7	14.0	5%	9.0	7.1	27%		40%
Dibromoacetonitrile (DBAN)	13.3	13.1	2%	12.3	10.8	14%	9.9	10.0	-1%	10.5	8.0	31%	7.3	6.2	18%		40%
Dichloroacetonitrile (DCAN)	17.1	18	-5%	21.6	19.6	10%	17.6	17.0	4%	12.2	11.0	11%	16.0	14.0	14%		40%
Trichloroacetonitrile (TCAN)	8.34	8.95	-7%	10.2	6.3	63%	7.3	8.0	-9%	17.2	15.0	15%	20.0	18.0	11%		Not Applic
Bromide																	
Bromide	**Not included in study 1**			0.031	0.031	0%	0.076	0.078	-3%	0.241	0.253	-5%	0.167	0.169	-1%	**Pass**	30%
Chloral Hydrate																	
Chloral Hydrate	16.8	15.5	8%	27.3	22.4	22%	24.4	18.3	33%	10.2	10.0	2%	15.0	17.0	-12%	**Pass**	40%
Inorganic DBPS (passing = 3 of 3)																**Pass**	
Bromate by IC	7.3	7.52	-3%	13.2	14.0	-6%	11.3	12.1	-7%	23.6	23.0	3%	9.0	8.7	3%		40%
Chlorate by IC	74.3	70	6%	129	130	-1%	352	351	0%	190	184	3%	446	457	-2%		40%
Chlorite by IC	257	260	-1%	560	570	-2%	169	175	-3%	352	375	-6%	213	226	-6%		40%
THMs by 551.1 (passing criteria = 3 of 4)																**Pass**	
Bromodichloromethane	26.8	31.1	-14%	17.1	13.8	24%	22.3	24.0	-7%	23.1	26.9	-14%	16.0	16.3	-2%		20%
Bromoform	13.4	14.4	-7%	18.7	16.4	14%	5.9	6.1	-3%	11.7	12.0	-3%	11.0	??	??		20%
Chloroform (Trichloromethane)	34.6	42.9	-19%	14.6	12.0	22%	38.9	38.0	2%	23.1	29.1	-21%	11.0	11.1	-1%		20%
Dibromochloromethane	20.8	22.9	-9%	18.7	18.6	1%	11.2	12.0	-7%	16.5	17.9	-8%	36.0	34.9	3%		20%
THMs ICR PE analyzed by 502.2																**Pass**	
Bromodichloromethane	32.9	31.1	6%	12.9	13.8	-7%				26.8	26.9	0%	17.9	16.3	10%		20%
Bromoform	15.8	14.4	10%	15.6	16.4	-5%				12.1	12.0	1%	10.4	??	??		20%
Chloroform (Trichloromethane)	43.6	42.9	2%	12.7	12.0	6%				26.6	29.1	-9%	12.0	11.1	8%		20%
Dibromochloromethane	24.2	22.9	6%	17.7	18.6	-5%				17.5	17.9	-2%	35.3	34.9	1%		20%

Note: EPA approval requires acceptable performance on the most current PE and submission of an acceptable Initial Demonstration of Capabilitiy (IDC), along with following all method QC.

Analyte	ICR Criteria % Bias	12/92 WS031 % Bias	5/93 WS032 % Bias	10/93 WS033 % Bias	5/94 WS034 % Bias	7/94 ICR PE#1 % Bias	12/94 WS035 % Bias	3/95 ICR PE#2 % Bias	7/96 ICR PE#3 % Bias
	Results								
Bromochloracetic acid (BCAA)	40%	NA	-1%	-20%	6%	-3%	-5%	8%	-2%
Dibromoacetic acid (DBAA)	40%	-7%	-11%	-10%	-5%	-9%	-6%	-2%	-4%
Dichloroacetic acid (DCAA)	40%	20%	10%	11%	3%	11%	-5%	-1%	-3%
Monobromoacetic acid (MBAA	40%	7%	-9%	-6%	-20%	-15%	-8%	-15%	
Monochloroacetic acid (MCAA	40%	7%	15%	3%	-11%	-4%	4%	-5%	5%
Trichloroacetic acid (TCAA)	40%	NA	-17%	-2%	-10%	-15%	-13%	-2%	0%

Analyte	BCAA	DBAA	DCAA	MBAA	MCAA	TCAA
ICR Criteria % Bias	40%	40%	40%	40%	40%	40%
12/92 WS031	NA	-7%	20%	7%	7%	NA
5/93 WS032	-1%	-11%	10%	-9%	15%	-17%
10/93 WS033	-20%	-10%	11%	-6%	3%	-2%
5/94 WS034	6%	-5%	3%	-20%	-11%	-10%
7/94 ICR PE#1	-3%	-9%	11%	-15%	-4%	-15%
12/94 WS035	-5%	-6%	-5%	-8%	4%	-13%
3/95 ICR PE#2	8%	-2%	-1%	-15%	-5%	-2%
7/96 ICR PE#3 % Bias	-2%	-4%	-3%		5%	0%

Analyte	BCAA	DBAA	DCAA	MBAA	MCAA	TCAA
12/92 WS031		93%	120%	107%	107%	
5/93 WS032	99%	89%	110%	91%	115%	83%
10/93 WS033	80%	90%	111%	94%	103%	98%
5/94 WS034	106%	95%	103%	80%	89%	90%
7/94 ICR PE#1	97%	91%	111%	85%	96%	85%
12/94 WS035	95%	94%	95%	92%	104%	87%
3/95 ICR PE#2	108%	98%	99%	85%	95%	98%
8/96 WS037	94%	95%	96%	94%	100%	99%
7/96 ICR PE#3	98%	96%	97%	100%	105%	100%
3/97 WS038	96%	99%		92%	104%	90%
6/97 ICR PE#4	92%	93%	88%	91%	96%	85%
8/97 WS039	91%	94%	94%	92%	94%	94%

Fortified Matrix Sample Results

Parameter Name	Result	Units	Batch #	QC Type	DUP Result	%RPD	Spike Amt	%REC	Method
Bromochloroacetic acid	0.9	ug/l	71899	MS			1	90	ML/S6251B
Bromochloroacetic acid	1.1	ug/l	72015	MS			1	110	ML/S6251B
Bromochloroacetic acid	1.2	ug/l	72190	MS			1	120	ML/S6251B
Bromochloroacetic acid	1.2	ug/l	72395	MS			1	120	ML/S6251B
Bromochloroacetic acid	1.7	ug/l	71641	DUP	1.5	12			ML/S6251B
Bromochloroacetic acid	1.7	ug/l	71793	DUP	1.7	0			ML/S6251B
Bromochloroacetic acid	1.8	ug/l	71899	DUP	1.4	25			ML/S6251B
Bromochloroacetic acid	18	ug/l	71793	MS			20	90	ML/S6251B
Bromochloroacetic acid	2.6	ug/l	71795	DUP	2.9	11			ML/S6251B
Bromochloroacetic acid	20	ug/l	71108	MS			20	100	ML/S6251B
Bromochloroacetic acid	20	ug/l	71795	MS			20	100	ML/S6251B
Bromochloroacetic acid	21	ug/l	71902	MS			20	105	ML/S6251B
Bromochloroacetic acid	29	ug/l	72556	MS			32	91	ML/S6251B
Bromochloroacetic acid	3.2	ug/l	72556	DUP	3.4	6			ML/S6251B
Bromochloroacetic acid	30	ug/l	71552	MS			32	94	ML/S6251B
Bromochloroacetic acid	30	ug/l	72172	MS			32	94	ML/S6251B
Bromochloroacetic acid	32	ug/l	71107	MS			32	100	ML/S6251B
Bromochloroacetic acid	33	ug/l	71350	MS			20	165	ML/S6251B
Bromochloroacetic acid	33	ug/l	71641	MS			32	103	ML/S6251B
Bromochloroacetic acid	34	ug/l	72082	MS			32	106	ML/S6251B
Bromochloroacetic acid	5.7	ug/l	71552	DUP	5.8	2			ML/S6251B
Bromochloroacetic acid	6	ug/l	71902	DUP	6.2	3			ML/S6251B
Bromochloroacetic acid	6	ug/l	72015	DUP	6.4	6			ML/S6251B
Bromochloroacetic acid	6.5	ug/l	72172	DUP	6.7	3			ML/S6251B
Bromochloroacetic acid	ND	ug/l	71107	DUP	ND	0			ML/S6251B
Bromochloroacetic acid	ND	ug/l	71108	DUP	ND	0			ML/S6251B
Bromochloroacetic acid	ND	ug/l	71350	DUP	ND	0			ML/S6251B
Bromochloroacetic acid	ND	ug/l	72082	DUP	ND	0			ML/S6251B
Bromochloroacetic acid	ND	ug/l	72190	DUP	ND	0			ML/S6251B
Bromochloroacetic acid	ND	ug/l	72395	DUP	ND	0			ML/S6251B
Bromodichloroacetic acid	1	ug/l	71641	DUP	1.2	18			ML/S6251B
Bromodichloroacetic acid	1	ug/l	71899	MS			1	100	ML/S6251B
Bromodichloroacetic acid	1	ug/l	72015	DUP	ND	0			ML/S6251B
Bromodichloroacetic acid	1	ug/l	72082	DUP	1	0			ML/S6251B
Bromodichloroacetic acid	1.1	ug/l	72015	MS			1	110	ML/S6251B
Bromodichloroacetic acid	1.2	ug/l	72395	MS			1	120	ML/S6251B
Bromodichloroacetic acid	1.3	ug/l	71795	DUP	1.3	0			ML/S6251B
Bromodichloroacetic acid	1.5	ug/l	71902	DUP	1.5	0			ML/S6251B
Bromodichloroacetic acid	1.6	ug/l	71793	DUP	1.6	0			ML/S6251B
Bromodichloroacetic acid	1.7	ug/l	72190	MS			1	170	ML/S6251B
Bromodichloroacetic acid	1.8	ug/l	72556	DUP	1.8	0			ML/S6251B
Bromodichloroacetic acid	20	ug/l	71793	MS			20	100	ML/S6251B
Bromodichloroacetic acid	21	ug/l	71108	MS			20	105	ML/S6251B
Bromodichloroacetic acid	21	ug/l	71795	MS			20	105	ML/S6251B
Bromodichloroacetic acid	23	ug/l	71902	MS			20	115	ML/S6251B
Bromodichloroacetic acid	31	ug/l	71107	MS			32	97	ML/S6251B
Bromodichloroacetic acid	32	ug/l	71552	MS			32	100	ML/S6251B
Bromodichloroacetic acid	33	ug/l	72556	MS			32	103	ML/S6251B
Bromodichloroacetic acid	34	ug/l	71641	MS			32	106	ML/S6251B
Bromodichloroacetic acid	35	ug/l	71350	MS			20	175	ML/S6251B
Bromodichloroacetic acid	36	ug/l	72082	MS			32	112	ML/S6251B
Bromodichloroacetic acid	5.6	ug/l	71552	DUP	5.4	4			ML/S6251B
Bromodichloroacetic acid	ND	ug/l	71107	DUP	ND	0			ML/S6251B
Bromodichloroacetic acid	ND	ug/l	71108	DUP	ND	0			ML/S6251B
Bromodichloroacetic acid	ND	ug/l	71350	DUP	ND	0			ML/S6251B
Bromodichloroacetic acid	ND	ug/l	71899	DUP	ND	0			ML/S6251B
Bromodichloroacetic acid	ND	ug/l	72190	DUP	ND	0			ML/S6251B

Fortified Matrix Sample Results

Parameter Name	Result	Units	Batch #	QC Type	DUP Result	%RPD	Spike Amt	%REC	Method
Bromodichloroacetic acid	ND	ug/l	72395	DUP	ND	0			ML/S6251B
Bromodichloroacetic acid	NR	ug/l	72172	DUP	NR	0			ML/S6251B
Bromodichloroacetic acid	NR	ug/l	72172	MS			32	0	ML/S6251B
Bromodichloromethane	0.93	ug/l	72568	DUP	0.88	6			ML/EPA 524.2
Bromodichloromethane	11.9	ug/l	72080	DUP	12	1			ML/EPA 524.2
Bromodichloromethane	14.6	ug/l	71438	MS			20	73	ML/EPA 524.2
Bromodichloromethane	14.8	ug/l	71582	MS			20	74	ML/EPA 524.2
Bromodichloromethane	17.7	ug/l	71582	DUP	21	17			ML/EPA 524.2
Bromodichloromethane	18.7	ug/l	70767	MS			20	94	ML/EPA 524.2
Bromodichloromethane	18.7	ug/l	70768	MS			20	94	ML/EPA 524.2
Bromodichloromethane	19.5	ug/l	71894	MS			20	98	ML/EPA 524.2
Bromodichloromethane	192	ug/l	72599	MS			200	96	ML/EPA 502.2
Bromodichloromethane	2.27	ug/l	71449	DUP	2.38	5			ML/EPA 524.2
Bromodichloromethane	20	ug/l	71449	MS			20	100	ML/EPA 524.2
Bromodichloromethane	204	ug/l	72600	MS			200	102	ML/EPA 502.2
Bromodichloromethane	21.2	ug/l	72568	MS			20	106	ML/EPA 524.2
Bromodichloromethane	21.5	ug/l	71639	MS			20	108	ML/EPA 524.2
Bromodichloromethane	211	ug/l	72776	MS			200	106	ML/EPA 502.2
Bromodichloromethane	24	ug/l	72080	MS			20	120	ML/EPA 524.2
Bromodichloromethane	24.4	ug/l	71894	DUP	24.7	1			ML/EPA 524.2
Bromodichloromethane	25.3	ug/l	71599	MS			20	126	ML/EPA 524.2
Bromodichloromethane	25.3	ug/l	71633	MS			20	126	ML/EPA 524.2
Bromodichloromethane	27.4	ug/l	71765	MS			20	137	ML/EPA 524.2
Bromodichloromethane	27.4	ug/l	72077	MS			20	137	ML/EPA 524.2
Bromodichloromethane	30.1	ug/l	71598	MS			20	150	ML/EPA 524.2
Bromodichloromethane	30.6	ug/l	71639	DUP	31.4	3			ML/EPA 524.2
Bromodichloromethane	33.8	ug/l	71438	DUP	33.8	0			ML/EPA 524.2
Bromodichloromethane	34.9	ug/l	71599	DUP	29.1	18			ML/EPA 524.2
Bromodichloromethane	34.9	ug/l	71633	DUP	29.1	18			ML/EPA 524.2
Bromodichloromethane	42.4	ug/l	71765	DUP	40.1	6			ML/EPA 524.2
Bromodichloromethane	42.4	ug/l	72077	DUP	40.1	6			ML/EPA 524.2
Bromodichloromethane	7.43	ug/l	70767	DUP	7.89	6			ML/EPA 524.2
Bromodichloromethane	7.43	ug/l	70768	DUP	7.89	6			ML/EPA 524.2
Bromodichloromethane	7.7	ug/l	71598	DUP	7.45	3			ML/EPA 524.2
Bromodichloromethane	NA	ug/l	72599	DUP	ND	0			ML/EPA 502.2
Bromodichloromethane	NA	ug/l	72600	DUP	ND	0			ML/EPA 502.2
Bromodichloromethane	NA	ug/l	72776	DUP	ND	0			ML/EPA 502.2
Bromoform	0.94	ug/l	70767	DUP	0.89	5			ML/EPA 524.2
Bromoform	0.94	ug/l	70768	DUP	0.89	5			ML/EPA 524.2
Bromoform	1.09	ug/l	72080	DUP	1	9			ML/EPA 524.2
Bromoform	1.27	ug/l	71765	DUP	1.27	0			ML/EPA 524.2
Bromoform	1.27	ug/l	72077	DUP	1.27	0			ML/EPA 524.2
Bromoform	11.3	ug/l	72600	MS			10	113	ML/EPA 502.2
Bromoform	11.4	ug/l	72776	MS			10	114	ML/EPA 502.2
Bromoform	11.7	ug/l	72599	MS			10	117	ML/EPA 502.2
Bromoform	12	ug/l	71438	DUP	11.9	1			ML/EPA 524.2
Bromoform	16.1	ug/l	71449	DUP	21.8	30			ML/EPA 524.2
Bromoform	16.9	ug/l	71449	MS			20	84	ML/EPA 524.2
Bromoform	19.3	ug/l	71582	DUP	21.6	11			ML/EPA 524.2
Bromoform	19.7	ug/l	71582	MS			20	98	ML/EPA 524.2
Bromoform	2.99	ug/l	71599	DUP	2.35	24			ML/EPA 524.2
Bromoform	2.99	ug/l	71633	DUP	2.35	24			ML/EPA 524.2
Bromoform	20.2	ug/l	71894	MS			20	101	ML/EPA 524.2
Bromoform	20.7	ug/l	70767	MS			20	104	ML/EPA 524.2
Bromoform	20.7	ug/l	70768	MS			20	104	ML/EPA 524.2
Bromoform	21.8	ug/l	71438	MS			20	109	ML/EPA 524.2
Bromoform	22.8	ug/l	71639	MS			20	114	ML/EPA 524.2

Fortified Matrix Sample Results

Parameter Name	Result	Units	Batch #	QC Type	DUP Result	%RPD	Spike Amt	%REC	Method
Bromoform	22.8	ug/l	72080	MS			20	114	ML/EPA 524.2
Bromoform	23	ug/l	72077	MS			20	115	ML/EPA 524.2
Bromoform	23.5	ug/l	71765	MS			20	118	ML/EPA 524.2
Bromoform	25.8	ug/l	71599	MS			20	129	ML/EPA 524.2
Bromoform	25.8	ug/l	71633	MS			20	129	ML/EPA 524.2
Bromoform	25.8	ug/l	72568	MS			20	129	ML/EPA 524.2
Bromoform	28.6	ug/l	71598	MS			20	143	ML/EPA 524.2
Bromoform	8.69	ug/l	71894	DUP	8.03	8			ML/EPA 524.2
Bromoform	9.56	ug/l	71598	DUP	8.66	10			ML/EPA 524.2
Bromoform	9.67	ug/l	71639	DUP	8.63	11			ML/EPA 524.2
Bromoform	NA	ug/l	72599	DUP	ND	0			ML/EPA 502.2
Bromoform	NA	ug/l	72600	DUP	ND	0			ML/EPA 502.2
Bromoform	NA	ug/l	72776	DUP	ND	0			ML/EPA 502.2
Bromoform	ND	ug/l	72568	DUP	ND	0			ML/EPA 524.2
Chlorodibromoacetic acid	1.1	ug/l	71899	MS			2	55	ML/S6251B
Chlorodibromoacetic acid	1.9	ug/l	72395	MS			2	95	ML/S6251B
Chlorodibromoacetic acid	2	ug/l	71552	DUP	2	0			ML/S6251B
Chlorodibromoacetic acid	2	ug/l	71641	DUP	2	0			ML/S6251B
Chlorodibromoacetic acid	2.2	ug/l	71793	DUP	2.1	5			ML/S6251B
Chlorodibromoacetic acid	2.5	ug/l	72015	MS			2	125	ML/S6251B
Chlorodibromoacetic acid	2.5	ug/l	72190	MS			2	125	ML/S6251B
Chlorodibromoacetic acid	20	ug/l	71108	MS			20	100	ML/S6251B
Chlorodibromoacetic acid	20	ug/l	71793	MS			20	100	ML/S6251B
Chlorodibromoacetic acid	21	ug/l	71795	MS			20	105	ML/S6251B
Chlorodibromoacetic acid	23	ug/l	71902	MS			20	115	ML/S6251B
Chlorodibromoacetic acid	32	ug/l	71107	MS			32	100	ML/S6251B
Chlorodibromoacetic acid	32	ug/l	71552	MS			32	100	ML/S6251B
Chlorodibromoacetic acid	34	ug/l	71641	MS			32	106	ML/S6251B
Chlorodibromoacetic acid	35	ug/l	71350	MS			20	175	ML/S6251B
Chlorodibromoacetic acid	36	ug/l	72556	MS			32	112	ML/S6251B
Chlorodibromoacetic acid	37	ug/l	72082	MS			32	116	ML/S6251B
Chlorodibromoacetic acid	ND	ug/l	71107	DUP	ND	0			ML/S6251B
Chlorodibromoacetic acid	ND	ug/l	71108	DUP	ND	0			ML/S6251B
Chlorodibromoacetic acid	ND	ug/l	71350	DUP	ND	0			ML/S6251B
Chlorodibromoacetic acid	ND	ug/l	71795	DUP	ND	0			ML/S6251B
Chlorodibromoacetic acid	ND	ug/l	71899	DUP	ND	0			ML/S6251B
Chlorodibromoacetic acid	ND	ug/l	71902	DUP	ND	0			ML/S6251B
Chlorodibromoacetic acid	ND	ug/l	72015	DUP	ND	0			ML/S6251B
Chlorodibromoacetic acid	ND	ug/l	72082	DUP	ND	0			ML/S6251B
Chlorodibromoacetic acid	ND	ug/l	72190	DUP	ND	0			ML/S6251B
Chlorodibromoacetic acid	ND	ug/l	72395	DUP	ND	0			ML/S6251B
Chlorodibromoacetic acid	ND	ug/l	72556	DUP	ND	0			ML/S6251B
Chlorodibromoacetic acid	NR	ug/l	72172	DUP	NR	0			ML/S6251B
Chlorodibromoacetic acid	NR	ug/l	72172	MS			32	0	ML/S6251B
Chlorodibromomethane	13.5	ug/l	71449	MS			20	68	ML/EPA 524.2
Chlorodibromomethane	14	ug/l	71598	DUP	12.8	9			ML/EPA 524.2
Chlorodibromomethane	15.5	ug/l	71438	MS			20	78	ML/EPA 524.2
Chlorodibromomethane	17	ug/l	70767	MS			20	85	ML/EPA 524.2
Chlorodibromomethane	17	ug/l	70768	MS			20	85	ML/EPA 524.2
Chlorodibromomethane	17.7	ug/l	71765	DUP	16.7	6			ML/EPA 524.2
Chlorodibromomethane	17.7	ug/l	72077	DUP	16.7	6			ML/EPA 524.2
Chlorodibromomethane	18.1	ug/l	71582	MS			20	90	ML/EPA 524.2
Chlorodibromomethane	20.3	ug/l	71894	MS			20	102	ML/EPA 524.2
Chlorodibromomethane	21.4	ug/l	72568	MS			20	107	ML/EPA 524.2
Chlorodibromomethane	23	ug/l	71599	DUP	19.4	17			ML/EPA 524.2
Chlorodibromomethane	23	ug/l	71633	DUP	19.4	17			ML/EPA 524.2
Chlorodibromomethane	24	ug/l	71639	MS			20	120	ML/EPA 524.2

Fortified Matrix Sample Results

Parameter Name	Result	Units	Batch #	QC Type	DUP Result	%RPD	Spike Amt	%REC	Method
Chlorodibromomethane	24.5	ug/l	71765	MS			20	122	ML/EPA 524.2
Chlorodibromomethane	24.5	ug/l	72077	MS			20	122	ML/EPA 524.2
Chlorodibromomethane	25.3	ug/l	71599	MS			20	126	ML/EPA 524.2
Chlorodibromomethane	25.3	ug/l	71633	MS			20	126	ML/EPA 524.2
Chlorodibromomethane	25.8	ug/l	72080	MS			20	129	ML/EPA 524.2
Chlorodibromomethane	26.8	ug/l	71582	DUP	28	4			ML/EPA 524.2
Chlorodibromomethane	28.4	ug/l	71894	DUP	27.5	3			ML/EPA 524.2
Chlorodibromomethane	33	ug/l	71639	DUP	32.2	2			ML/EPA 524.2
Chlorodibromomethane	33.6	ug/l	71598	MS			20	168	ML/EPA 524.2
Chlorodibromomethane	39.7	ug/l	71438	DUP	38.6	3			ML/EPA 524.2
Chlorodibromomethane	6.54	ug/l	71449	DUP	6.95	6			ML/EPA 524.2
Chlorodibromomethane	6.59	ug/l	70767	DUP	7.06	7			ML/EPA 524.2
Chlorodibromomethane	6.59	ug/l	70768	DUP	7.06	7			ML/EPA 524.2
Chlorodibromomethane	9.1	ug/l	72080	DUP	8.78	4			ML/EPA 524.2
Chlorodibromomethane	ND	ug/l	72568	DUP	ND	0			ML/EPA 524.2
Chloroform	132	ug/l	72599	MS			200	66	ML/EPA 502.2
Chloroform	179	ug/l	72776	MS			200	90	ML/EPA 502.2
Chloroform	187	ug/l	72600	MS			200	94	ML/EPA 502.2
Chloroform	NA	ug/l	72599	DUP	ND	0			ML/EPA 502.2
Chloroform	NA	ug/l	72600	DUP	ND	0			ML/EPA 502.2
Chloroform	NA	ug/l	72776	DUP	ND	0			ML/EPA 502.2
Chloroform (Trichloromethane)	0.59	ug/l	71449	DUP	0.67	13			ML/EPA 524.2
Chloroform (Trichloromethane)	12.4	ug/l	71582	DUP	14	12			ML/EPA 524.2
Chloroform (Trichloromethane)	12.9	ug/l	72080	DUP	12	7			ML/EPA 524.2
Chloroform (Trichloromethane)	13	ug/l	71582	MS			20	65	ML/EPA 524.2
Chloroform (Trichloromethane)	13.9	ug/l	71438	MS			20	70	ML/EPA 524.2
Chloroform (Trichloromethane)	16.5	ug/l	72568	MS			20	82	ML/EPA 524.2
Chloroform (Trichloromethane)	17.2	ug/l	71449	MS			20	86	ML/EPA 524.2
Chloroform (Trichloromethane)	17.3	ug/l	71894	DUP	18.2	5			ML/EPA 524.2
Chloroform (Trichloromethane)	18.8	ug/l	71894	MS			20	94	ML/EPA 524.2
Chloroform (Trichloromethane)	19.2	ug/l	71639	MS			20	96	ML/EPA 524.2
Chloroform (Trichloromethane)	19.8	ug/l	70767	MS			20	99	ML/EPA 524.2
Chloroform (Trichloromethane)	19.8	ug/l	70768	MS			20	99	ML/EPA 524.2
Chloroform (Trichloromethane)	19.9	ug/l	72568	DUP	19.2	4			ML/EPA 524.2
Chloroform (Trichloromethane)	21.3	ug/l	71599	MS			20	106	ML/EPA 524.2
Chloroform (Trichloromethane)	21.3	ug/l	71633	MS			20	106	ML/EPA 524.2
Chloroform (Trichloromethane)	21.6	ug/l	72080	MS			20	108	ML/EPA 524.2
Chloroform (Trichloromethane)	22.5	ug/l	71639	DUP	24.7	9			ML/EPA 524.2
Chloroform (Trichloromethane)	24.4	ug/l	71438	DUP	24.4	0			ML/EPA 524.2
Chloroform (Trichloromethane)	25.6	ug/l	71598	MS			20	128	ML/EPA 524.2
Chloroform (Trichloromethane)	25.9	ug/l	71765	MS			20	130	ML/EPA 524.2
Chloroform (Trichloromethane)	25.9	ug/l	72077	MS			20	130	ML/EPA 524.2
Chloroform (Trichloromethane)	3.48	ug/l	71598	DUP	3.74	7			ML/EPA 524.2
Chloroform (Trichloromethane)	4.3	ug/l	70767	DUP	4.17	3			ML/EPA 524.2
Chloroform (Trichloromethane)	4.3	ug/l	70768	DUP	4.17	3			ML/EPA 524.2
Chloroform (Trichloromethane)	47	ug/l	71633	DUP	40.1	16			ML/EPA 524.2
Chloroform (Trichloromethane)	47.1	ug/l	71599	DUP	40.1	16			ML/EPA 524.2
Chloroform (Trichloromethane)	88.3	ug/l	71765	DUP	85.1	4			ML/EPA 524.2
Chloroform (Trichloromethane)	88.3	ug/l	72077	DUP	85.1	4			ML/EPA 524.2
Dibromoacetic acid	0.8	ug/l	72395	MS			1	80	ML/S6251B
Dibromoacetic acid	0.9	ug/l	71899	MS			1	90	ML/S6251B
Dibromoacetic acid	1	ug/l	72015	MS			1	100	ML/S6251B
Dibromoacetic acid	1.1	ug/l	71552	DUP	1.1	0			ML/S6251B
Dibromoacetic acid	1.1	ug/l	72172	DUP	1.1	0			ML/S6251B
Dibromoacetic acid	1.5	ug/l	72190	MS			1	150	ML/S6251B
Dibromoacetic acid	1.6	ug/l	71793	DUP	1.6	0			ML/S6251B
Dibromoacetic acid	1.7	ug/l	71641	DUP	1.8	6			ML/S6251B

Fortified Matrix Sample Results

Parameter Name	Result	Units	Batch #	QC Type	DUP Result	%RPD	Spike Amt	%REC	Method
Dibromoacetic acid	18	ug/l	71793	MS			20	90	ML/S6251B
Dibromoacetic acid	19	ug/l	71108	MS			20	95	ML/S6251B
Dibromoacetic acid	2	ug/l	72556	DUP	2	0			ML/S6251B
Dibromoacetic acid	20	ug/l	71795	MS			20	100	ML/S6251B
Dibromoacetic acid	21	ug/l	71902	MS			20	105	ML/S6251B
Dibromoacetic acid	30	ug/l	72556	MS			32	94	ML/S6251B
Dibromoacetic acid	31	ug/l	71552	MS			32	97	ML/S6251B
Dibromoacetic acid	32	ug/l	71107	MS			32	100	ML/S6251B
Dibromoacetic acid	32	ug/l	71641	MS			32	100	ML/S6251B
Dibromoacetic acid	33	ug/l	71350	MS			20	165	ML/S6251B
Dibromoacetic acid	33	ug/l	72172	MS			32	103	ML/S6251B
Dibromoacetic acid	34	ug/l	72082	MS			32	106	ML/S6251B
Dibromoacetic acid	6	ug/l	72015	DUP	6.1	2			ML/S6251B
Dibromoacetic acid	6.9	ug/l	71902	DUP	6.7	3			ML/S6251B
Dibromoacetic acid	ND	ug/l	71107	DUP	ND	0			ML/S6251B
Dibromoacetic acid	ND	ug/l	71108	DUP	ND	0			ML/S6251B
Dibromoacetic acid	ND	ug/l	71350	DUP	ND	0			ML/S6251B
Dibromoacetic acid	ND	ug/l	71795	DUP	ND	0			ML/S6251B
Dibromoacetic acid	ND	ug/l	71899	DUP	ND	0			ML/S6251B
Dibromoacetic acid	ND	ug/l	72082	DUP	ND	0			ML/S6251B
Dibromoacetic acid	ND	ug/l	72190	DUP	ND	0			ML/S6251B
Dibromoacetic acid	ND	ug/l	72395	DUP	ND	0			ML/S6251B
Dibromochloromethane	9.3	ug/l	72599	MS			10	93	ML/EPA 502.2
Dibromochloromethane	9.6	ug/l	72776	MS			10	96	ML/EPA 502.2
Dibromochloromethane	9.6	ug/l	72600	MS			10	96	ML/EPA 502.2
Dibromochloromethane	NA	ug/l	72599	DUP	ND	0			ML/EPA 502.2
Dibromochloromethane	NA	ug/l	72600	DUP	ND	0			ML/EPA 502.2
Dibromochloromethane	NA	ug/l	72776	DUP	ND	0			ML/EPA 502.2
Dichloroacetic acid	0.7	ug/l	71899	MS			1	70	ML/S6251B
Dichloroacetic acid	1	ug/l	72015	MS			1	100	ML/S6251B
Dichloroacetic acid	1.1	ug/l	71793	DUP	1.1	0			ML/S6251B
Dichloroacetic acid	1.1	ug/l	72395	MS			1	110	ML/S6251B
Dichloroacetic acid	1.3	ug/l	71641	DUP	1.3	0			ML/S6251B
Dichloroacetic acid	1.5	ug/l	72190	MS			1	150	ML/S6251B
Dichloroacetic acid	12	ug/l	71795	DUP	11	9			ML/S6251B
Dichloroacetic acid	14	ug/l	71552	DUP	14	0			ML/S6251B
Dichloroacetic acid	16	ug/l	72172	DUP	16	0			ML/S6251B
Dichloroacetic acid	18	ug/l	71793	MS			20	90	ML/S6251B
Dichloroacetic acid	19	ug/l	71108	MS			20	95	ML/S6251B
Dichloroacetic acid	20	ug/l	71795	MS			20	100	ML/S6251B
Dichloroacetic acid	20	ug/l	71902	MS			20	100	ML/S6251B
Dichloroacetic acid	29	ug/l	71552	MS			32	91	ML/S6251B
Dichloroacetic acid	3.7	ug/l	72082	DUP	3.8	3			ML/S6251B
Dichloroacetic acid	30	ug/l	72556	MS			32	94	ML/S6251B
Dichloroacetic acid	32	ug/l	71107	MS			32	100	ML/S6251B
Dichloroacetic acid	32	ug/l	71641	MS			32	100	ML/S6251B
Dichloroacetic acid	33	ug/l	71350	MS			20	165	ML/S6251B
Dichloroacetic acid	33	ug/l	72172	MS			32	103	ML/S6251B
Dichloroacetic acid	34	ug/l	72082	MS			32	106	ML/S6251B
Dichloroacetic acid	4.1	ug/l	71899	DUP	4.2	2			ML/S6251B
Dichloroacetic acid	4.9	ug/l	72015	DUP	5.2	6			ML/S6251B
Dichloroacetic acid	5	ug/l	71902	DUP	4.9	2			ML/S6251B
Dichloroacetic acid	7.5	ug/l	72556	DUP	7.8	4			ML/S6251B
Dichloroacetic acid	ND	ug/l	71107	DUP	ND	0			ML/S6251B
Dichloroacetic acid	ND	ug/l	71108	DUP	ND	0			ML/S6251B
Dichloroacetic acid	ND	ug/l	71350	DUP	ND	0			ML/S6251B
Dichloroacetic acid	ND	ug/l	72190	DUP	ND	0			ML/S6251B

Fortified Matrix Sample Results

Parameter Name	Result	Units	Batch #	QC Type	DUP Result	%RPD	Spike Amt	%REC	Method
Dichloroacetic acid	ND	ug/l	72395	DUP	ND	0			ML/S6251B
Monobromoacetic acid	1	ug/l	71899	MS			1	100	ML/S6251B
Monobromoacetic acid	1	ug/l	72015	MS			1	100	ML/S6251B
Monobromoacetic acid	1.1	ug/l	72556	DUP	1.2	9			ML/S6251B
Monobromoacetic acid	1.2	ug/l	72395	MS			1	120	ML/S6251B
Monobromoacetic acid	1.4	ug/l	72190	MS			1	140	ML/S6251B
Monobromoacetic acid	1.7	ug/l	71902	DUP	1.6	6			ML/S6251B
Monobromoacetic acid	19	ug/l	71108	MS			20	95	ML/S6251B
Monobromoacetic acid	19	ug/l	71793	MS			20	95	ML/S6251B
Monobromoacetic acid	21	ug/l	71795	MS			20	105	ML/S6251B
Monobromoacetic acid	21	ug/l	71902	MS			20	105	ML/S6251B
Monobromoacetic acid	29	ug/l	72556	MS			32	91	ML/S6251B
Monobromoacetic acid	31	ug/l	71552	MS			32	97	ML/S6251B
Monobromoacetic acid	32	ug/l	71107	MS			32	100	ML/S6251B
Monobromoacetic acid	33	ug/l	71641	MS			32	103	ML/S6251B
Monobromoacetic acid	33	ug/l	72172	MS			32	103	ML/S6251B
Monobromoacetic acid	34	ug/l	71350	MS			20	170	ML/S6251B
Monobromoacetic acid	35	ug/l	72082	MS			32	109	ML/S6251B
Monobromoacetic acid	ND	ug/l	71107	DUP	ND	0			ML/S6251B
Monobromoacetic acid	ND	ug/l	71108	DUP	ND	0			ML/S6251B
Monobromoacetic acid	ND	ug/l	71350	DUP	ND	0			ML/S6251B
Monobromoacetic acid	ND	ug/l	71552	DUP	ND	0			ML/S6251B
Monobromoacetic acid	ND	ug/l	71641	DUP	ND	0			ML/S6251B
Monobromoacetic acid	ND	ug/l	71793	DUP	ND	0			ML/S6251B
Monobromoacetic acid	ND	ug/l	71795	DUP	ND	0			ML/S6251B
Monobromoacetic acid	ND	ug/l	71899	DUP	ND	0			ML/S6251B
Monobromoacetic acid	ND	ug/l	72015	DUP	ND	0			ML/S6251B
Monobromoacetic acid	ND	ug/l	72082	DUP	ND	0			ML/S6251B
Monobromoacetic acid	ND	ug/l	72172	DUP	ND	0			ML/S6251B
Monobromoacetic acid	ND	ug/l	72190	DUP	ND	0			ML/S6251B
Monobromoacetic acid	ND	ug/l	72395	DUP	ND	0			ML/S6251B
Monochloroacetic acid	1.1	ug/l	71899	MS			2	55	ML/S6251B
Monochloroacetic acid	1.6	ug/l	72015	MS			2	80	ML/S6251B
Monochloroacetic acid	17	ug/l	71108	MS			20	85	ML/S6251B.
Monochloroacetic acid	18	ug/l	71902	MS			20	90	ML/S6251B
Monochloroacetic acid	2.5	ug/l	71899	DUP	2.3	7			ML/S6251B
Monochloroacetic acid	2.6	ug/l	72172	DUP	2.7	4			ML/S6251B
Monochloroacetic acid	2.6	ug/l	72190	MS			2	130	ML/S6251B
Monochloroacetic acid	2.9	ug/l	72015	DUP	2.1	32			ML/S6251B
Monochloroacetic acid	20	ug/l	71793	MS			20	100	ML/S6251B
Monochloroacetic acid	23	ug/l	71795	MS			20	115	ML/S6251B
Monochloroacetic acid	3.5	ug/l	71902	DUP	3.9	11			ML/S6251B
Monochloroacetic acid	3.5	ug/l	72395	MS			2	175	ML/S6251B
Monochloroacetic acid	31	ug/l	72172	MS			32	97	ML/S6251B
Monochloroacetic acid	33	ug/l	71107	MS			32	103	ML/S6251B
Monochloroacetic acid	34	ug/l	71350	MS			20	170	ML/S6251B
Monochloroacetic acid	34	ug/l	71552	MS			32	106	ML/S6251B
Monochloroacetic acid	35	ug/l	71641	MS			32	109	ML/S6251B
Monochloroacetic acid	35	ug/l	72082	MS			32	109	ML/S6251B
Monochloroacetic acid	36	ug/l	72556	MS			32	112	ML/S6251B
Monochloroacetic acid	ND	ug/l	71107	DUP	ND	0			ML/S6251B
Monochloroacetic acid	ND	ug/l	71108	DUP	ND	0			ML/S6251B
Monochloroacetic acid	ND	ug/l	71350	DUP	ND	0			ML/S6251B
Monochloroacetic acid	ND	ug/l	71552	DUP	ND	0			ML/S6251B
Monochloroacetic acid	ND	ug/l	71641	DUP	ND	0			ML/S6251B
Monochloroacetic acid	ND	ug/l	71793	DUP	ND	0			ML/S6251B
Monochloroacetic acid	ND	ug/l	71795	DUP	ND	0			ML/S6251B

Fortified Matrix Sample Results

Parameter Name	Result	Units	Batch #	QC Type	DUP Result	%RPD	Spike Amt	%REC	Method
Monochloroacetic acid	ND	ug/l	72082	DUP	ND	0			ML/S6251B
Monochloroacetic acid	ND	ug/l	72190	DUP	ND	0			ML/S6251B
Monochloroacetic acid	ND	ug/l	72395	DUP	ND	0			ML/S6251B
Monochloroacetic acid	ND	ug/l	72556	DUP	ND	0			ML/S6251B
Total Organic Halogen	165	ug/l	72184	MSD			200	82	ML/9020/SM5320
Total Organic Halogen	170	ug/l	72184	MS			200	85	ML/9020/SM5320
Total Organic Halogen	175	ug/l	72808	MSD			200	88	ML/9020/SM5320
Total Organic Halogen	180	ug/l	72299	MSD			200	90	ML/9020/SM5320
Total Organic Halogen	180	ug/l	72300	MSD			200	90	ML/9020/SM5320
Total Organic Halogen	181	ug/l	72299	MS			200	90	ML/9020/SM5320
Total Organic Halogen	181	ug/l	72300	MS			200	90	ML/9020/SM5320
Total Organic Halogen	188	ug/l	71436	MSD			200	94	ML/9020/SM5320
Total Organic Halogen	188	ug/l	72808	MS			200	94	ML/9020/SM5320
Total Organic Halogen	190	ug/l	72044	MSD			200	95	ML/9020/SM5320
Total Organic Halogen	195	ug/l	72044	MS			200	98	ML/9020/SM5320
Total Organic Halogen	198	ug/l	71436	MS			200	99	ML/9020/SM5320
Total Organic Halogen	205	ug/l	72037	MSD			200	102	ML/9020/SM5320
Total Organic Halogen	205	ug/l	72037	MS			200	102	ML/9020/SM5320
Total Organic Halogen	205	ug/l	72038	MSD			200	102	ML/9020/SM5320
Total Organic Halogen	205	ug/l	72038	MS			200	102	ML/9020/SM5320
Total Organic Halogen	210	ug/l	72293	MSD			200	105	ML/9020/SM5320
Total Organic Halogen	210	ug/l	72293	MS			200	105	ML/9020/SM5320
Total Organic Halogen	210	ug/l	72297	MSD			200	105	ML/9020/SM5320
Total Organic Halogen	210	ug/l	72297	MS			200	105	ML/9020/SM5320
Total Organic Halogen	222	ug/l	72966	MSD			200	111	ML/9020/SM5320
Total Organic Halogen	233	ug/l	72966	MS			200	116	ML/9020/SM5320
Total Organic Halogen	432	ug/l	72807	MSD			500	86	ML/9020/SM5320
Total Organic Halogen	433	ug/l	72809	MSD			500	87	ML/9020/SM5320
Total Organic Halogen	44.3	ug/l	72289	MSD			50	89	ML/9020/SM5320
Total Organic Halogen	44.3	ug/l	72290	MSD			50	89	ML/9020/SM5320
Total Organic Halogen	441	ug/l	72807	MS			500	88	ML/9020/SM5320
Total Organic Halogen	441	ug/l	72809	MS			500	88	ML/9020/SM5320
Total Organic Halogen	46.6	ug/l	72289	MS			50	93	ML/9020/SM5320
Total Organic Halogen	46.6	ug/l	72290	MS			50	93	ML/9020/SM5320
Total Organic Halogen	465	ug/l	72181	MSD			500	93	ML/9020/SM5320
Total Organic Halogen	465	ug/l	72182	MSD			500	93	ML/9020/SM5320
Total Organic Halogen	465	ug/l	72183	MSD			500	93	ML/9020/SM5320
Total Organic Halogen	470	ug/l	72181	MS			500	94	ML/9020/SM5320
Total Organic Halogen	470	ug/l	72182	MS			500	94	ML/9020/SM5320
Total Organic Halogen	470	ug/l	72183	MS			500	94	ML/9020/SM5320
Total Organic Halogen	51.1	ug/l	73153	MSD			50	102	ML/9020/SM5320
Total Organic Halogen	512	ug/l	71284	MS			500	102	ML/9020/SM5320
Total Organic Halogen	514	ug/l	71284	MSD			500	103	ML/9020/SM5320
Total Organic Halogen	54.6	ug/l	73153	MS			50	109	ML/9020/SM5320
Total Organic Halogen	57	ug/l	72806	MSD			50	114	ML/9020/SM5320
Total Organic Halogen	58	ug/l	72806	MS			50	116	ML/9020/SM5320
Tribromoacetic acid	23	ug/l	71108	MS			20	115	ML/S6251B
Tribromoacetic acid	24	ug/l	71795	MS			20	120	ML/S6251B
Tribromoacetic acid	24	ug/l	71902	MS			20	120	ML/S6251B
Tribromoacetic acid	3	ug/l	72395	MS			4	75	ML/S6251B
Tribromoacetic acid	3.1	ug/l	72190	MS			4	78	ML/S6251B
Tribromoacetic acid	3.2	ug/l	71899	MS			4	80	ML/S6251B
Tribromoacetic acid	3.5	ug/l	72015	MS			4	88	ML/S6251B
Tribromoacetic acid	35	ug/l	71552	MS			32	109	ML/S6251B
Tribromoacetic acid	37	ug/l	71641	MS			32	116	ML/S6251B
Tribromoacetic acid	40	ug/l	71107	MS			32	125	ML/S6251B
Tribromoacetic acid	40	ug/l	72082	MS			32	125	ML/S6251B

Fortified Matrix Sample Results

Parameter Name	Result	Units	Batch #	QC Type	DUP Result	%RPD	Spike Amt	%REC	Method
Tribromoacetic acid	ND	ug/l	71107	DUP	ND	0			ML/S6251B
Tribromoacetic acid	ND	ug/l	71108	DUP	ND	0			ML/S6251B
Tribromoacetic acid	ND	ug/l	71350	DUP	ND	0			ML/S6251B
Tribromoacetic acid	ND	ug/l	71552	DUP	ND	0			ML/S6251B
Tribromoacetic acid	ND	ug/l	71641	DUP	ND	0			ML/S6251B
Tribromoacetic acid	ND	ug/l	71795	DUP	ND	0			ML/S6251B
Tribromoacetic acid	ND	ug/l	71899	DUP	ND	0			ML/S6251B
Tribromoacetic acid	ND	ug/l	71902	DUP	ND	0			ML/S6251B
Tribromoacetic acid	ND	ug/l	72015	DUP	ND	0			ML/S6251B
Tribromoacetic acid	ND	ug/l	72082	DUP	ND	0			ML/S6251B
Tribromoacetic acid	ND	ug/l	72190	DUP	ND	0			ML/S6251B
Tribromoacetic acid	ND	ug/l	72395	DUP	ND	0			ML/S6251B
Tribromoacetic acid	NR	ug/l	71350	MS			20	0	ML/S6251B
Tribromoacetic acid	NR	ug/l	71793	DUP	ND	0			ML/S6251B
Tribromoacetic acid	NR	ug/l	71793	MS			20	0	ML/S6251B
Tribromoacetic acid	NR	ug/l	72172	DUP	NR	0			ML/S6251B
Tribromoacetic acid	NR	ug/l	72172	MS			32	0	ML/S6251B
Tribromoacetic acid	NR	ug/l	72556	DUP	ND	0			ML/S6251B
Tribromoacetic acid	NR	ug/l	72556	MS			32	0	ML/S6251B
Trichloroacetic acid	0.9	ug/l	72395	MS			1	90	ML/S6251B
Trichloroacetic acid	1.1	ug/l	71899	DUP	1	10			ML/S6251B
Trichloroacetic acid	1.1	ug/l	72015	MS			1	110	ML/S6251B
Trichloroacetic acid	1.2	ug/l	71899	MS			1	120	ML/S6251B
Trichloroacetic acid	1.4	ug/l	72190	MS			1	140	ML/S6251B
Trichloroacetic acid	12	ug/l	71552	DUP	11	9			ML/S6251B
Trichloroacetic acid	14	ug/l	72172	DUP	14	0			ML/S6251B
Trichloroacetic acid	19	ug/l	71108	MS			20	95	ML/S6251B
Trichloroacetic acid	19	ug/l	71793	MS			20	95	ML/S6251B
Trichloroacetic acid	2.7	ug/l	71795	DUP	2.6	4			ML/S6251B
Trichloroacetic acid	21	ug/l	71795	MS			20	105	ML/S6251B
Trichloroacetic acid	21	ug/l	71902	MS			20	105	ML/S6251B
Trichloroacetic acid	28	ug/l	71552	MS			32	88	ML/S6251B
Trichloroacetic acid	28	ug/l	72556	MS			32	88	ML/S6251B
Trichloroacetic acid	29	ug/l	72172	MS			32	91	ML/S6251B
Trichloroacetic acid	3.1	ug/l	72556	DUP	3.1	0			ML/S6251B
Trichloroacetic acid	32	ug/l	71641	MS			32	100	ML/S6251B
Trichloroacetic acid	33	ug/l	71107	MS			32	103	ML/S6251B
Trichloroacetic acid	33	ug/l	71350	MS			20	165	ML/S6251B
Trichloroacetic acid	34	ug/l	72082	MS			32	106	ML/S6251B
Trichloroacetic acid	4.1	ug/l	72082	DUP	4.3	5			ML/S6251B
Trichloroacetic acid	ND	ug/l	71107	DUP	ND	0			ML/S6251B
Trichloroacetic acid	ND	ug/l	71108	DUP	ND	0			ML/S6251B
Trichloroacetic acid	ND	ug/l	71641	DUP	ND	0			ML/S6251B
Trichloroacetic acid	ND	ug/l	71793	DUP	ND	0			ML/S6251B
Trichloroacetic acid	ND	ug/l	71902	DUP	ND	0			ML/S6251B
Trichloroacetic acid	ND	ug/l	72015	DUP	ND	0			ML/S6251B
Trichloroacetic acid	ND	ug/l	72190	DUP	ND	0			ML/S6251B
Trichloroacetic acid	ND	ug/l	72395	DUP	ND	0			ML/S6251B
Trichloroacetic acid	NR	ug/l	71350	DUP	NR	0			ML/S6251B