

**Dublin Road Water Plant
ICR Treatment Study
Summary Report**

**Evaluation of GAC Technology for Compliance
with the Information Collection Rule**

Conducted during the period of February 1998 through September 1998

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ICR # 528

July 1999

Attachments:

1 diskette containing the *ICR Treatment Study Summary Report Spreadsheet*
and the *ICR Treatment Study Data Collection Spreadsheet*.

Outline For The Treatment Study Summary Report

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 - 1. Schematics and descriptions of the process equipment used to investigate the advanced treatment process
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Appendix A

I. Conclusions

- Recarbonated lime-softened water from the plant processes was used as feed water for the pilot study.
- The feed to the pilot GAC column was pretreated via sand filtration.
- No significant problems were encountered during the study.
- Pilot column was operated for 4000 hours without experiencing breakthrough of TOC.
- THM₄ breakthrough for Stage 2 levels of the Disinfectant/Disinfection By-Product Rule occurred at approximately 118 days for EBCT₁₀.
- THM₄ breakthrough for Stage 2 levels of the Disinfectant/Disinfection By-Product Rule occurred at approximately 208 days for EBCT₂₀.
- HAA₅ breakthrough for Stage 2 levels of the Disinfectant/Disinfection By-Product Rule did not occur during the study period for EBCT₁₀.
- HAA₅ breakthrough for Stage 2 levels of the Disinfectant/Disinfection By-Product Rule did not occur during the study period for EBCT₂₀.
- No cost analyses were performed as a part of this work.

II. Background Information

A. Treatment Plant Description

The Dublin Road Water Treatment Plant is a lime softening plant that is rated to produce 65 mgd. See Figure 1 for a schematic of the plant processes.

Treatment Plant Design Information: Reports G.1 and G.2 from the ICR Water Utility Database System are attached.

B. Tabular summary of source and finished water quality: Tables 1 and 2 contain the summary of source and finished water quality provided by the water treatment plant.

Water Quality Parameter	Average Yearly Concentration	Standard Deviation	Maximum Yearly Value	Minimum Yearly Value
Temperature (°C)	14.8	8.7	26.0	3.2
pH	8.0	0.1	8.2	7.9
Turbidity (ntu)	55	44	139	8
Alkalinity (mg/L as CaCO ₃)	151	17	183	127
Calcium Hardness (mg/L CaCO ₃)	176.5	15.5	207.5	150
Total Hardness (mg/L CaCO ₃)	259	26	315	218
TOC (mg/L)	6.42	0.59	7.65	5.56
UV ₂₅₄ (cm ⁻¹)	0.186	0.024	0.226	0.153
Bromide (µg/L)	0.025	0.013	0.055	0.008

Table 1 - Source Water Quality for Dublin Road Water Treatment Plant

Water Quality Parameter	Average Yearly Concentration	Standard Deviation	Maximum Yearly Value	Minimum Yearly Value
pH	7.8	0.1	7.9	7.8
Turbidity (ntu)	0.09	0.01	0.10	0.08
TOC (mg/L)	2.68	0.43	3.35	1.78
Distribution System THM ₄ (µg/L)	42.8	17.7	79.3	21.8

Table 2 - Finished Water Quality for Dublin Road Water Treatment Plant

III. Materials and Methods

A. Pretreatment Processes to the Advanced Treatment Process

Figure 1 outlines the full-scale processes used in the plant prior to the sampling point. Design data for each pretreatment process is shown in reports G.1 and G.2 from the ICR Water Utility Database System attached.

B. Advanced Treatment Process Information

Figure 2 is a schematic of the of the process equipment used to investigate the advanced treatment process. Table 3 provides a description of the process equipment used for the study. Table 4 discusses the design data used to for the GAC study.

The procedures outlined in the *ICR Manual for Bench- and Pilot-Scale Studies* were followed. Only stainless steel and teflon tubing were used in the apparatus to minimize contamination.

GAC Type	Calgon F-300 (8 x 30 U.S. Mesh)
GAC Column Type	Glass, 3 inch diameter
GAC Amount	1800 g / Column (3600 mL), 2 columns
Empty Bed Contact Time (each)	10 min
Empty Bed Contact Time (total)	20 min
Influent Sample Point	After Dual Media Filter
EBCT 10 Sample Point	After First GAC Column
EBCT 20 Sample Point	After Second GAC Column

Table 3: GAC Column Design Used During GAC Study

Design Data for GAC Treatment Process	
Loading	2.0 gpm/ft ²
Superficial Velocity	4.9 M/hr
Surface Area of Pilot Column	6.85 in ²
GAC Bed Depth for 10 min.	32 in.
Volumetric Flow Rate	5.72 gal/hr
10 min. EBCT Volume of GAC	220 in ³

Table 4 - Design Data for GAC Pilot-Scale Treatment Study

C. Experimental Design

The experimental design was to look at the effect of Empty Bed Contact Time and bed volumes contacted on removal of DBP precursors with GAC.

D. Analytical Methods

Table 5 outlines the analytical methods used during the treatment study as well as the minimum reporting level (MRL) for each analyte. Table 6 lists the laboratories involved in the treatment study and the analyses performed.

Analyte	Method	Minimum Reporting Level
pH	SM4500-H+	NA
Temperature	SM2550B	NA
Alkalinity	SM2320B	5 mg/L as CaCO ₃
Ammonia	SM4500-NH ₃ G	0.1 mg/L NH ₃ -N
Calcium Hardness	SM3500CaD	5 mg/L as CaCO ₃
Cl ₂ Residual	SM4500-ClD	0.2 mg/L
Total Hardness	SM2340C	5 mg/L as CaCO ₃
Turbidity	SM2130B	0.03 ntu
Bromide	EPA300	0.02 µg/L
UV ₂₅₄	SM5910	0.009 cm ⁻¹
TOC	SM310C	0.5 mg/L
TOX	SM5320B	25 µg/L
CHCl ₃ , BDCM, DBCM, CHBr ₃	EPA551	1 µg/L
MCAA, DCAA, TCAA, MBAA, DBAA, BCAA	EPA522.2	2 µg/L for MCAA 1 µg/L for other analytes

Table 5 -Summary of Analytical Methods and MRLs Used During GAC Study

Laboratory	Dates of Service	Analyses Performed
Water Quality Assurance Lab ICROH003 910 Dublin Road Columbus, OH 43215 Mr. Kenneth S. Button (614) 645-7691 (614) 645-3819 FAX	2/16/98 - 10/26/98	Alkalinity, Ammonia, Calcium Hardness, Cl ₂ Residual, pH, Temperature, Total Hardness, Turbidity, UV ₂₅₄ , Bromide, TOC, TOX, THM ₄ , HAA ₆

Table 6 - Summary of Laboratories Conducting Analyses During GAC Study

IV. Results and Discussions

A. Problems Encountered

There were no significant problems encountered in this study. Some operational problems were encountered, but none resulted in the plant being non-operational for more than seven (7) days. They are as follows:

- April 7, 1998 – Sedimentation basin used for pilot-plant influent taken out of service due to leak. Plant out of operation for 7 days.
- August 24, 1998 – No influent flow to pilot plant. Plant was operational on August 25, 1998

B. Water Quality Data

Table 7 outlines the water quality of the pretreated influent to the advanced treatment process.

Water Quality Parameter	Average	Standard Deviation
Temperature (°C)	20.0	6.2
pH	7.20	0.60
Turbidity (ntu)	0.09	0.04
Alkalinity (mg/L as CaCO ₃)	52	7
Calcium Hardness (mg/L CaCO ₃)	89	13
Total Hardness (mg/L CaCO ₃)	114	7
TOC (mg/L)	2.45	0.32
UV ₂₅₄ (cm ⁻¹)	0.046	0.007
Bromide (µg/L)	20	8
SDS-THM ₄ (µg/L)	64.7	16.9
SDS-HAA ₅ (µg/L)	40.7	8.4
SDS-HAA ₆ (µg/L)	45.4	9.8
SDS-TOX (µg Cl-/L)	205	43
SDS-Chlorine Demand (mg/L)	2.4	0.2

Table 7 - Average Pretreated Feed Water Quality for Dublin Road Water Treatment Plant During GAC Study

Table 8 outlines the DBP data collected during the study.

Break-through Criterion	Value of Listed Parameter When Breakthrough Criterion is Met						
	Run Time (days)	Throughput (Bed Vol.)	TOC (mg/L)	SDS -THM4 (ug/L)	SDS-HAA5 (ug/L)	SDS-HAA6 (ug/L)	SDS-TOX (ug Cl-/L)
SDS-THM4 = 90 ug/L	NA	NA	NA	NA	NA	NA	NA
SDS-THM4 = 72 ug/L	NA	NA	NA	NA	NA	NA	NA
SDS-THM4 = 54 ug/L	NA	NA	NA	NA	NA	NA	NA
SDS-THM4 = 36 ug/L	109	15696	1.0	36	21	26	119
SDS-HAA5 = 54 ug/L	NA	NA	NA	NA	NA	NA	NA
SDS-HAA5 = 27 ug/L	NA	NA	NA	NA	NA	NA	NA
SDS-HAA6 = 54 ug/L	NA	NA	NA	NA	NA	NA	NA
SDS-HAA6 = 27 ug/L	120	17280	1.7	42	23	42	112

Table 8 - Summary of Times to Reach Various Breakthrough Criteria for the Dublin Road Water Treatment Plant and The Water Quality of the GAC Effluent When Those Criteria Are Met

C. Impact of Specific Variables on Performance

Included in this final report are several tables and graphs that illustrate important aspects of the study. They are as follows:

1. Breakthrough curves for TOC and UV₂₅₄

Figure 3: TOC concentration as a function of operation time

Figure 4: UV₂₅₄ absorption as a function of operating time

Figure 3
Dublin Road Water Treatment Plant
TOC Breakthrough Curve For GAC Study

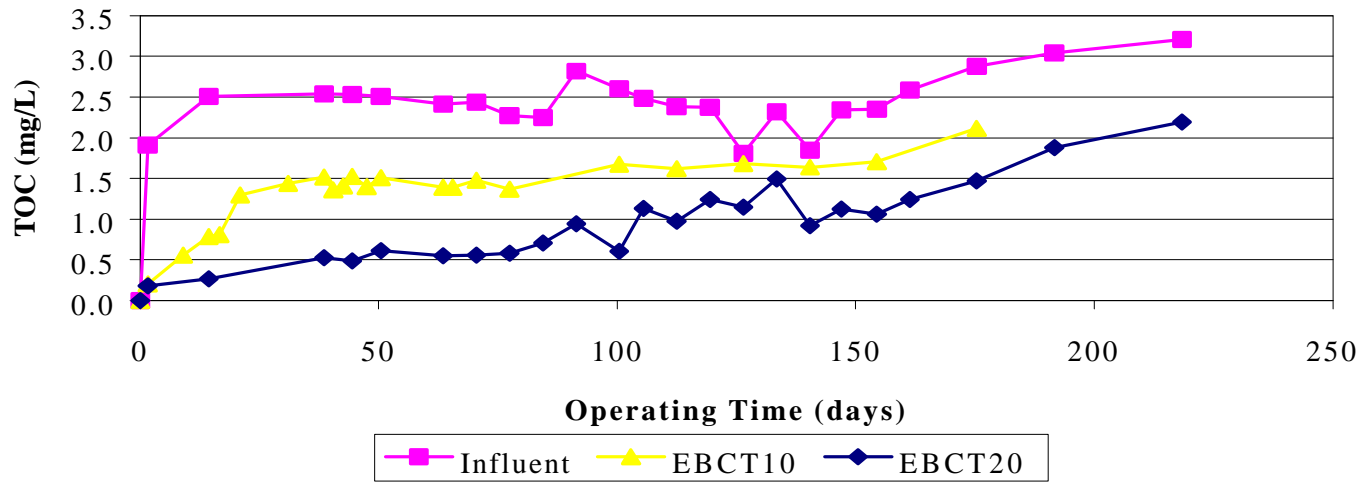
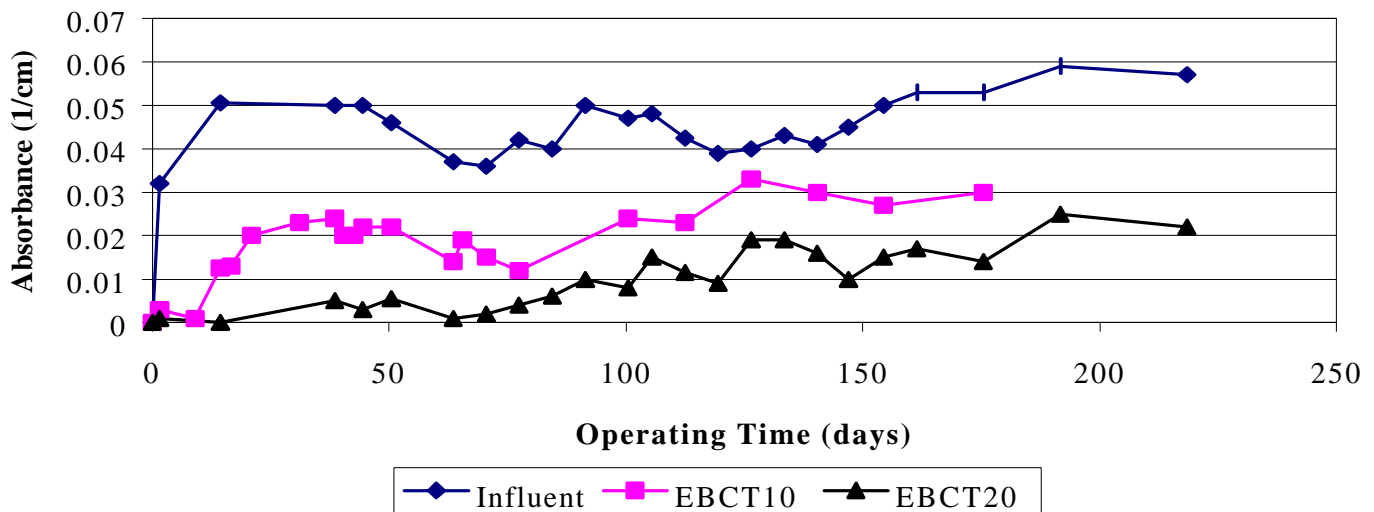


Figure 4
Dublin Road Water Treatment Plant
UV₂₅₄ Curve for GAC Study



2. SDS Breakthrough curves analysis

Figure 5: THM₄ concentration as a function of operating time

Figure 6: HAA₅ concentration as a function of operating time

Figure 7: HAA₆ concentration as a function of operating time

Figure 8: TOX concentration as a function of operating time

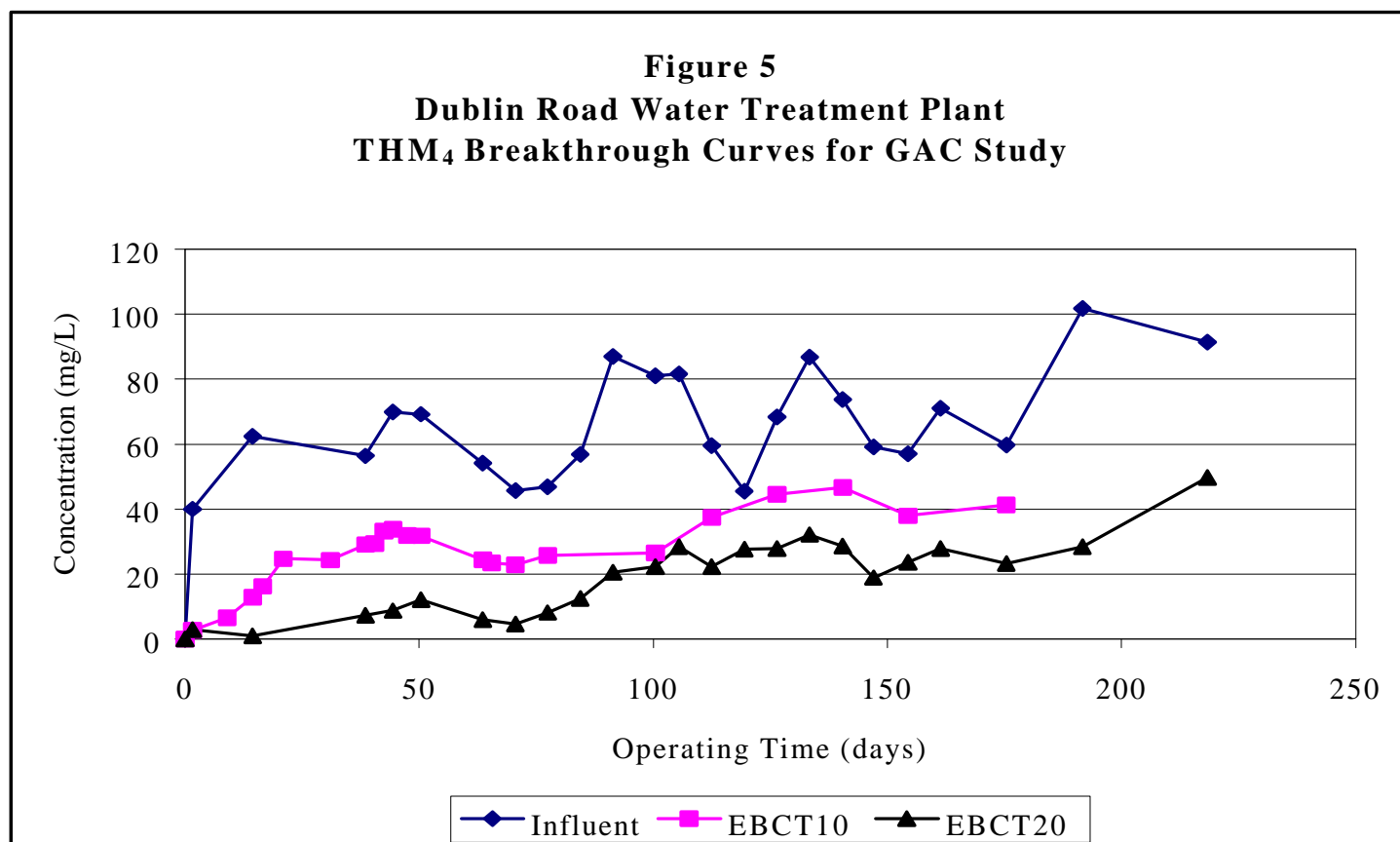


Figure 6
Dublin Road Water Treatment Plant
HAA₅ Breakthrough Curves for GAC Study

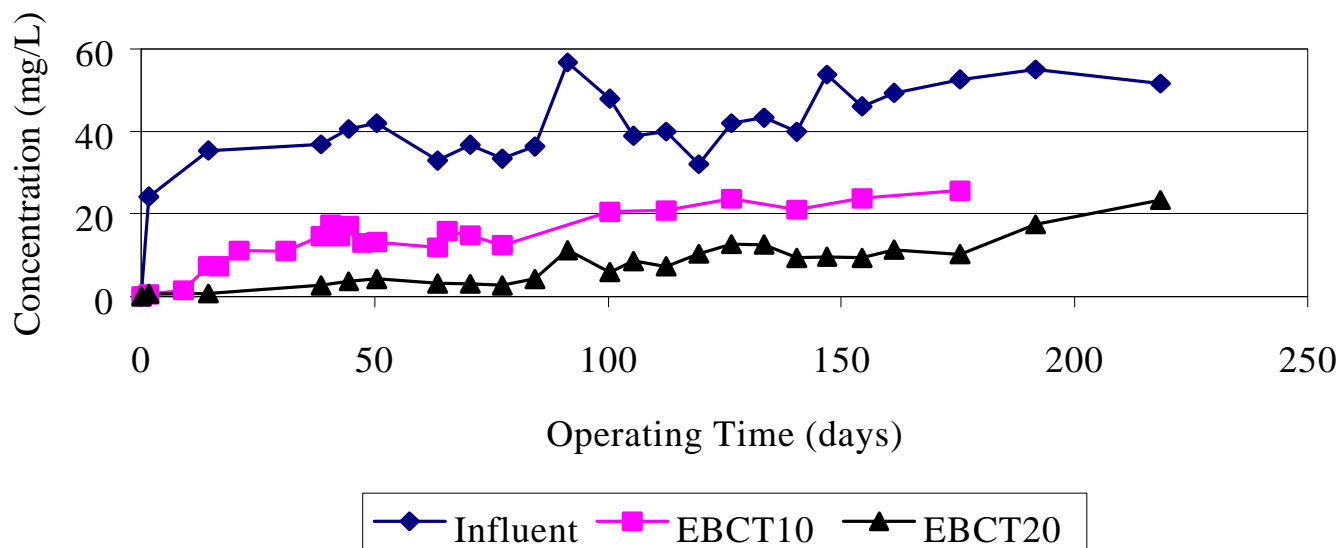


Figure 7
Dublin Road Water Treatment Plant
HAA₆ Breakthrough Curves for GAC Study

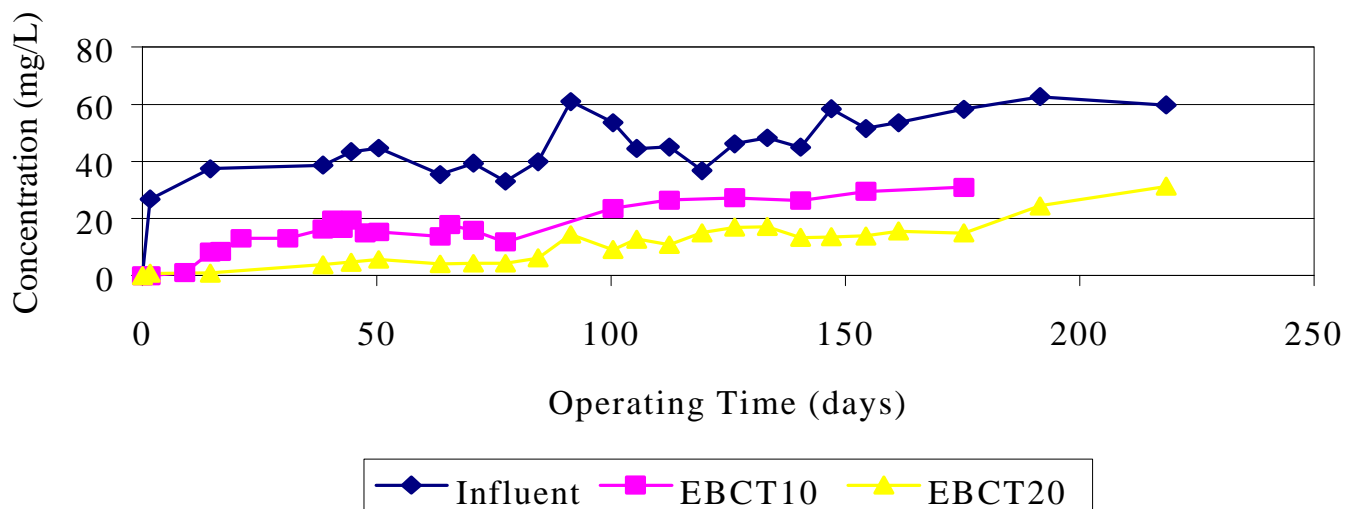
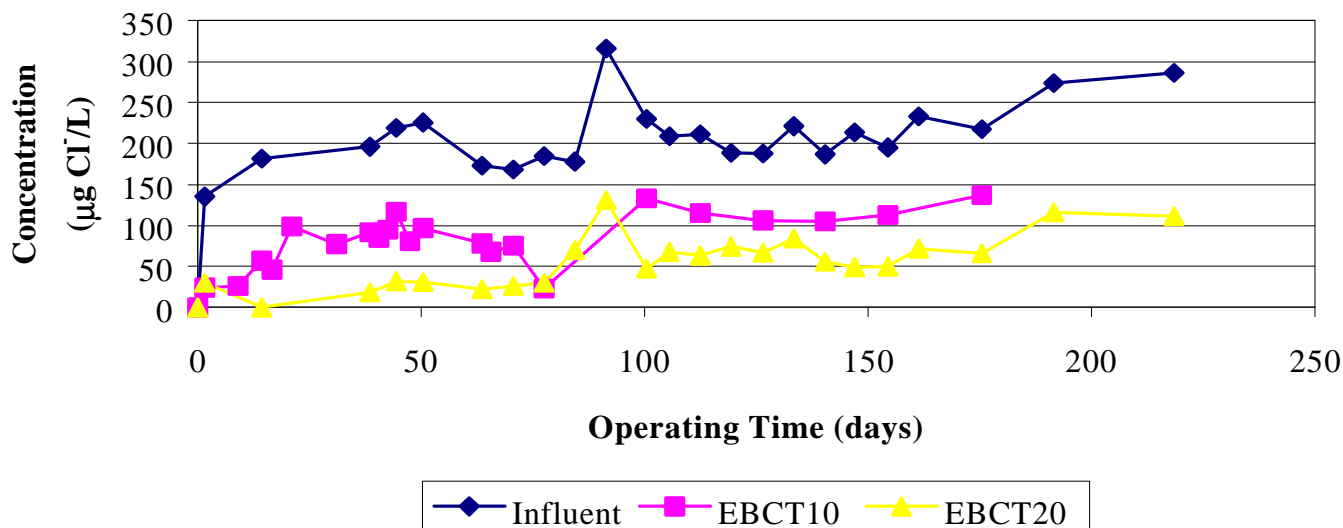


Figure 8
Dublin Road Water Treatment Plant
TOX Curves for GAC Study



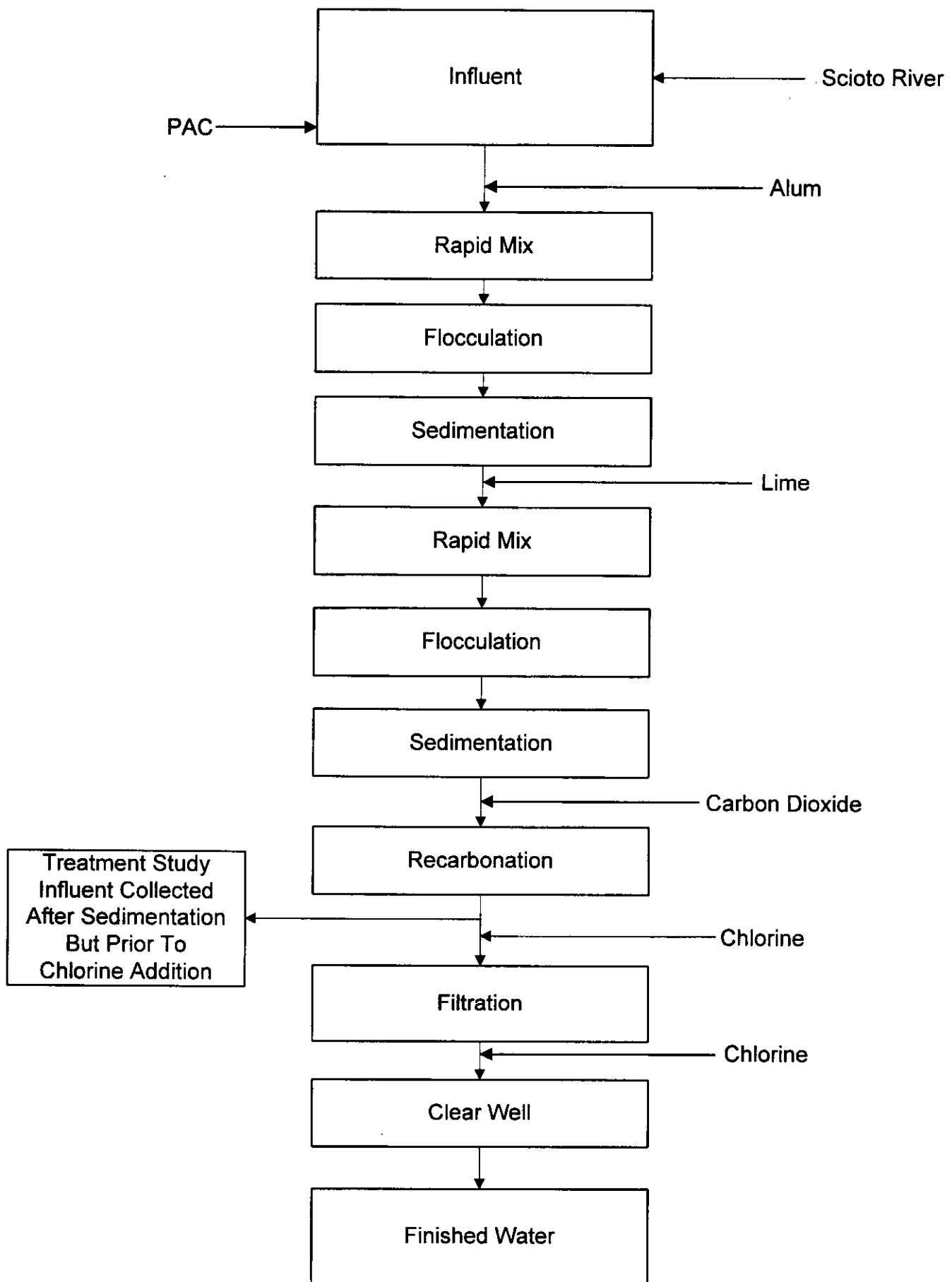
D. Summary of Significant Results

- The columns performed very near to the predictions for TOC breakthrough.
- Sustained THM₄ breakthrough to > 80 % of the Second Stage Placeholders was at a runtime of about 2400 hours for the EBCT₁₀ column; HAA₅ and HAA₆ breakthroughs were longer.
- Sustained THM₄ and HAA₅ breakthrough to > 80% of the Second Stage Placeholders did not occur in the EBCT₂₀ Column.

V. QA/QC Summary

All QA/QC procedures and requirements were followed as described in the *DBP/ICR Analytical Methods Manual*. All of the data collected was used to generate the graphs, even if it was measured below the stated MRL. In the Data Collection Spreadsheets these samples were marked BMRL.

The calibration procedures used during the study are consistent with those outlined in the *DBP/ICR Analytical Methods Manual*. Appendix A contains a listing of the procedures and calibration curves used by the laboratory during this study.



**Figure 1: Dublin Road Water Treatment Plant
Full Scale Treatment Plant Schematic**

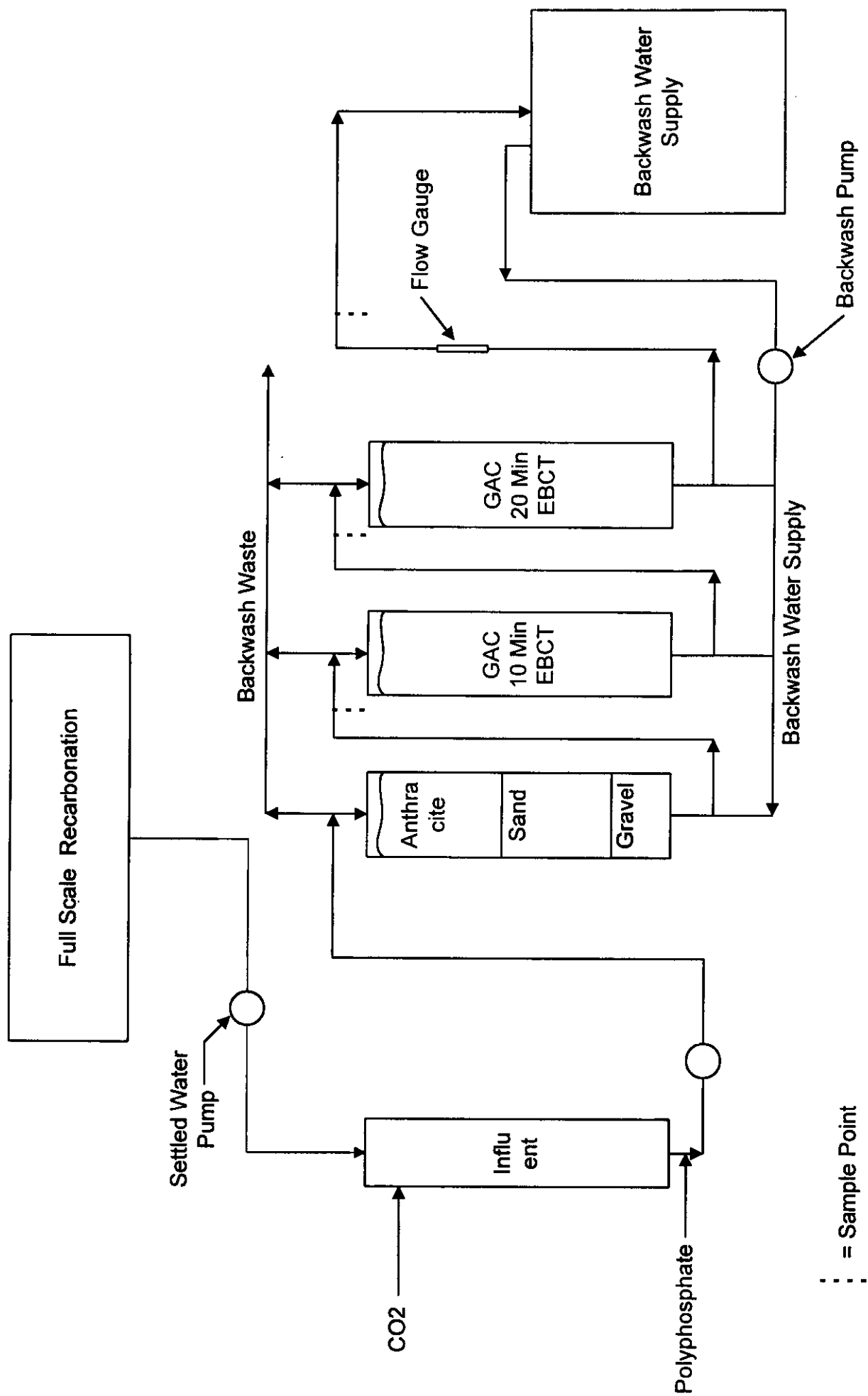


Figure 2 - Schematic of Pilot-Scale GAC Testing System

G.1 -- Final Design Plant Parameters

Date: 4/27/99

PWS Name: City of Columbus, Dept. Public Utilities

PWS ID: OH2500411

WIDB:

ICR Contact Person: Dr. Kenneth S. Button

Sampling Period: Final

Design Sampling Start Date: 7/7/97

Design Sampling End Date: 12/31/98

Treatment Plant Name: Hap Cremean Water Plant

ICR Treatment Plant ID: 527

Treatment Plant PWS ID: OH2500421

Treatment Plant Type: CS/SOFT

State Approved Plant Capacity (MGD): 100

Historical Min. Water Temperature (deg C): 0.1

Installed Sludge Handling Capacity (GPD): 1,500,000.00

Blending Indicator: N

Water Resource Name: Hoover Reservoir

Water Resource Type: Reservoir/lake

Average Residence Time (Days): 177

Intake Name: Big Walnut Creek

Watershed Control: N

Hydrologic Unit Code:

River Reach:

Latitude (degrees, minutes, seconds): +40°3'43"

Longitude (degrees, minutes, seconds): -82°53'21"

River Reach Miles:

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

INF

1

Process Train Name: Hap Cremean Process Train

Process Train Category: CS/SOFT

1 HC WW Return

Washwater Return

7

Washwater Treated: N

Seq. Sample
No. Location
Name

Sample
Location
Type

Sample
Loc.
No.

Coagulation/Sedimentation: N

Filtration: N

Disinfectant Addition: N

Plain Sedimentation: N

Other Treatment:

24 hr average Water flow Returned (MGD): 25.12

2 Rapid Mix

Rapid Mix

Type of Mixer: ME

Baffling Type: UN

Liquid Volume (gal): 26,611

Short Circuiting Factor: 0.0

Mean Velocity Gradient (sec-1): 30.0

3 Flocculation

Flocculation Basin

Type of Mixer: ME

Liquid Volume (gal): 1,500,000

Short Circuiting Factor:

Baffling Type: PR

Stage Sequence Number: 1

Stage Mean Velocity Gradient (sec-1): 30

Stage Liquid Volume (gal): 750,000

4 Sedimentation-2

Sedimentation

Surface Area (ft²): 41,064

Liquid Volume (gal): 4,600,000

Baffling Type: PR

Short Circuiting Factor:

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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Plate Settler Surface Area (ft²):
 Plate Settler Brand Name:
 Tube Settler Surface Area (ft²):
 Tube Settler Brand Name:

Type of Mixer: ME
 Liquid Volume (gal): 1,500,000
 Short Circuiting Factor: 0.0
 Baffling Type: PR

Stage Sequence Number: 1
 Stage Mean Velocity Gradient (sec-1): 30
 Stage Liquid Volume (gal): 1,500,000

Surface Area (ft²): 69,600
 Liquid Volume (gal): 7,809,120
 Baffling Type: PR
 Short Circuiting Factor:
 Plate Settler Surface Area (ft²):
 Plate Settler Brand Name:
 Tube Settler Surface Area (ft²):
 Tube Settler Brand Name:

Surface Area (ft²): 34,800
 Liquid Volume (gal): 3,900,000
 Baffling Type: PR

5 Flocculation

6 Sediment-5,6

7 HC Recarbon-7

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
8	Inter Chlorine	Disinfectant Addition		Short Circuiting Factor: 0.0 Chemical Code: CL2 Measurement Formula: cl2 Dose Rate (mg/L): 2.33
9	Filtration	Filtration	4	Surface Area (ft2): 16,920 Liquid Volume (gal): 621,417 Total Media Depth (in): 42 Depth of GAC (in): Media Type: DUAL Type of Activated Carbon: Minimum Water Depth To Top of Media (ft): 4.5 Depth From Top of Media to Top of Backwash Trough (ft): 2.7
10	Post Chlorine	Disinfectant Addition		Chemical Code: CL2 Measurement Formula: cl2 Dose Rate (mg/L): 1.17
11	Clearwells, 1-6	Clearwell		Surface Area (ft2): 309,072 Liquid Volume (gal): 40,920,000 Minimum Liquid Volume (gal): 18,495,000 Baffling Type: AV Short Circuiting Factor: Covered Indicator Code: N

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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Finished Water	FIN	5
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Treatment Plant Name: Dublin Road Water Plant
ICR Treatment Plant ID: 528
Treatment Plant PWS ID: OH2500411
Treatment Plant Type: CS/SOFT

State Approved Plant Capacity (MGD): 65
Historical Min. Water Temperature (deg C): 0.5
Installed Sludge Handling Capacity (GPD): 3,168,000.00
Blending Indicator: N

Water Resource Name: Scioto River
Water Resource Type: Flowing stream
Intake Name: Scioto River Intake Structure
Watershed Control: N
Hydrologic Unit Code: 0506001

On River Reach Code:
Latitude (degrees, minutes, seconds): +39°58'5"
Longitude (degrees, minutes, seconds): -83°2'5"
River Reach Miles:

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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Influent	INF	1
Process Train Name:	Dublin Road Process Train	
Process Train Category:	CS/SOFT	
1 DR WW Return	Washwater Return	7
	Washwater Treated: N	
	Coagulation/Sedimentation: N	
	Filtration: N	
	Disinfectant Addition: N	
	Plain Sedimentation: N	
	Other Treatment:	
	24 hr average Water flow Returned (MGD): 0.42	

2 Rapid Mix-RAW	Rapid Mix	
	Type of Mixer: ME	
	Baffling Type: UN	
	Liquid Volume (gal): 1,197	

Seq. No. Sample Location Name

Sample Location Type

Sample Loc. No.

Short Circuiting Factor: 0.0
Mean Velocity Gradient (sec-1): 1,200.0

3 COAG

Flocculation Basin

Type of Mixer: ME

Liquid Volume (gal): 2,000,000

Short Circuiting Factor:

Baffling Type: AV

Stage Sequence Number: 1

Stage Mean Velocity Gradient (sec-1): 70

Stage Liquid Volume (gal): 2,000,000

4 Coagulated

Sedimentation

Surface Area (ft2): 44,415

Liquid Volume (gal): 5,000,000

Baffling Type: PR

Short Circuiting Factor:

Plate Settler Surface Area (ft2):

Plate Settler Brand Name:

Tube Settler Surface Area (ft2):

Tube Settler Brand Name:

5 Rapid Mix-SOFT

Rapid Mix

Type of Mixer: ME

Baffling Type: UN

Liquid Volume (gal): 6,754

Short Circuiting Factor: 0.0

Mean Velocity Gradient (sec-1): 714.0

Seq. Sample
No. Location
Name

Sample
Location
Type

Sample
Loc.
No.

6 SOFT

Flocculation Basin

Type of Mixer: ME
Liquid Volume (gal): 2,000,000
Short Circuiting Factor: 0.0
Baffling Type: AV

Stage Sequence Number: 1
Stage Mean Velocity Gradient (sec-1): 70
Stage Liquid Volume (gal): 2,000,000

7 Softened

Sedimentation

Surface Area (ft2): 88,830
Liquid Volume (gal): 10,000,000
Baffling Type: PR
Short Circuiting Factor:
Plate Settler Surface Area (ft2):
Plate Settler Brand Name:
Tube Settler Surface Area (ft2):
Tube Settler Brand Name:

8 DR Recarbon

Recarbonation Basin

3
Surface Area (ft2): 44,415
Liquid Volume (gal): 5,000,000
Baffling Type: AV
Short Circuiting Factor: 0.0

9 Chlorine gas 1

Disinfectant Addition

Chemical Code: CL2
Measurement Formula: cl2

Treatment Plant Name: Parsons Avenue Water Plant
ICR Treatment Plant ID: 529
Treatment Plant PWS ID: OH2500442
Treatment Plant Type: SPLIT/SOFT

State Approved Plant Capacity (MGD): 50
Historical Min. Water Temperature (deg C): 12.0
Installed Sludge Handling Capacity (GPD): 4,320,000.00
Blending Indicator: N

Water Resource Name: South Wellfield 4
Water Resource Type: Ground water
Intake Name: Collector Well 115
Wellhead Protection: Y

Hydrologic Unit Code:
Latitude (degrees, minutes, seconds): +39°50'30"
Longitude (degrees, minutes, seconds): -82°59'1"

Water Resource Name: South Wellfield 3
Water Resource Type: Ground water
Intake Name: Collector Well 104
Wellhead Protection: Y

Hydrologic Unit Code:
Latitude (degrees, minutes, seconds): +39°50'23"
Longitude (degrees, minutes, seconds): -83°0'32"

Water Resource Name: South Wellfield 2
Water Resource Type: Ground water
Intake Name: Collector Well 103
Wellhead Protection: Y

Hydrologic Unit Code:
Latitude (degrees, minutes, seconds): +39°50'46"
Longitude (degrees, minutes, seconds): -83°0'31"

Water Resource Name: South Wellfield 1
Water Resource Type: Ground water
Intake Name: Collector Well 101
Wellhead Protection: Y

Hydrologic Unit Code:
Latitude (degrees, minutes, seconds): +39°51'11"
Longitude (degrees, minutes, seconds): -83°0'16"

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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Influent	INF		1
Process Train Name: Parsons Avenue Process Train			
Process Train Category: SOFT			
1	PA WW Return	Washwater Return	8
			Washwater Treated: N
			Coagulation/Sedimentation: N
			Filtration: N
			Disinfectant Addition: N
			Plain Sedimentation: N
			Other Treatment:
			24 hr average Water flow Returned (MGD): 0.4
2	Rapid Mix	Rapid Mix	
			Type of Mixer: ME
			Baffling Type: PR
			Liquid Volume (gal): 25,700
			Short Circuiting Factor:
			Mean Velocity Gradient (sec-1): 350.0
3	Primary	Solids Contact Clarifier	
			Clarifier Type: Not specified
			Brand Name: Peabody-Wells
			Surface Area (ft ²): 16,238
			Liquid Volume (gal): 2,451,000
			Short Circuiting Factor:
			Baffling Type: UN
			Plate Settler Surface Area (ft ²):
			Tube Settler Surface Area (ft ²):

Seq. Sample
No. Location
Name

Sample
Location
Type

Sample
Loc.
No.

4 Secondary

Solids Contact Clarifier

Plate Settler Brand Name:
Tube Settler Brand Name:

Clarifier Type: Not specified
Brand Name: Peabody Wells
Surface Area (ft2): 16,238
Liquid Volume (gal): 2,451,000
Short Circuiting Factor:
Baffling Type: UN
Plate Settler Surface Area (ft2):
Tube Settler Surface Area (ft2):
Plate Settler Brand Name:
Tube Settler Brand Name:

5 CO2 Feed

Other Treatment Process

7

Surface Area (ft2): 300
Liquid Volume (gal): 31,236
Short Circuiting Factor:

6 Chlorine gas

Disinfectant Addition

Chemical Code: CL2
Measurement Formula: cl2
Dose Rate (mg/L): 1.45

7 Filtration

Filtration

4

Surface Area (ft2): 6,564
Liquid Volume (gal): 736,000
Total Media Depth (in): 36
Depth of GAC (in):

Seq. Sample
No. Location
Name

Sample
Location
Type

Sample
Loc.
No.

Media Type: DUAL
Type of Activated Carbon:
Minimum Water Depth To Top of Media (ft): 2.3
Depth From Top of Media to Top of Backwash Trough (ft): 3.3

8 Chlorine gas Disinfectant Addition

Chemical Code: CL2
Measurement Formula: cl2
Dose Rate (mg/L): 0.84

9 Main Clearwell Clearwell

Surface Area (ft2): 112,500
Liquid Volume (gal): 12,400,000
Minimum Liquid Volume (gal): 6,000,000
Baffling Type: PR
Short Circuiting Factor:
Covered Indicator Code: Y

Process Train Name: Bypass
Process Train Category: CONV

1 Secondary t2 Solids Contact Clarifier

Clarifier Type: Not specified
Brand Name: Peabody Wells
Surface Area (ft2): 16,238
Liquid Volume (gal): 2,451,000
Short Circuiting Factor:
Baffling Type: UN
Plate Settler Surface Area (ft2):
Tube Settler Surface Area (ft2):

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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2	CO2 Feed t2	Other Treatment Process	Plate Settler Brand Name: Tube Settler Brand Name: Surface Area (ft2): 300 Liquid Volume (gal): 31,236 Short Circuiting Factor: Chemical Code: CL2 Measurement Formula: cl2 Dose Rate (mg/L): 1.45
3	Chlorine gas t2	Disinfectant Addition	Surface Area (ft2): 8,752 Liquid Volume (gal): 736,000 Total Media Depth (in): 36 Depth of GAC (in): Media Type: DUAL Type of Activated Carbon: Minimum Water Depth To Top of Media (ft): 2.3 Depth From Top of Media to Top of Backwash Trough (ft): 3.3
4	Filtration t2	Filtration	Chemical Code: CL2 Measurement Formula: cl2 Dose Rate (mg/L): 0.84
5	Chlorine gas t3	Disinfectant Addition	Surface Area (ft2): 112,500 Liquid Volume (gal): 12,400,000
6	Main Clearwell t2	Clearwell	

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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Minimum Liquid Volume (gal): 6,000,000
 Baffling Type: PR
 Short Circuiting Factor:
 Covered Indicator Code: Y

Finished Water	FIN	5
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End of Report G.1 -- Final Design Plant Parameters

G.2 -- Final Design Plant Chemical Parameters

Date: 10/28/99

PWS Name: City of Columbus, Dept. Public Utilities

PWS ID: OH2500411

WIDB:

ICR Contact Person: Dr. Kenneth S. Button

Sampling Period: Final

Sampling Start Date: 7/7/97

Sampling End Date: 12/31/98

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
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Treatment Plant Name: Hap Cremean Water Plant

ICR Treatment Plant ID No: 527

Treatment Plant Category: CS/SOFT

Process Train Name: Hap Cremean Process Train

Process Train Category: CS/SOFT

1	HC WW Return	Washwater Return	7	Ferric chloride	fec13	0.00
2	Rapid Mix	Rapid Mix		Potassium permanganate	ppm	0.00
				Powdered activated carbon	pac	0.00
				Aluminum sulfate (Alum)	Al2(so4)3	42.00
3	Flocculation	Flocculation Basin				
4	Sedimentation-2	Sedimentation				
5	Flocculation	Flocculation Basin				
6	Sediment-5,6	Sedimentation				
7	HC Recarbon-7	Recarbonation Basin	3	Calcium hydroxide	caoh	81.00
				Carbon dioxide	co2	17.00

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
8	Inter Chlorine	Disinfectant Addition				
9	Filtration	Filtration	4	Chlorine gas	cl2	2.33
10	Post Chlorine	Disinfectant Addition				
11	Clearwells, 1-6	Clearwell		Chlorine gas	cl2	1.17
				Zinc orthophosphate	Zn	0.30
				Hydrofluorosilicic acid	F	0.90

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
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Treatment Plant Name: Dublin Road Water Plant

ICR Treatment Plant ID No: 528

Treatment Plant Category: CS/SOFT

Process Train Name: Dublin Road Process Train

Process Train Category: CS/SOFT

1	DR WW Return	Washwater Return	7			
2	Rapid Mix-RAW	Rapid Mix		Ferric chloride	fecl3	59.20
				Aluminum sulfate (Alum)	Al2(so4)3	0.00
				Calcium oxide	CAO	0.00
				Sodium hydroxide	naoh	0.00
				Sodium carbonate	Na2(CO3)	0.00
				Potassium permanganate	ppm	0.50
				Powdered activated carbon	pac	0.00
3	COAG	Flocculation Basin				
4	Coagulated	Sedimentation				
5	Rapid Mix-SOFT	Rapid Mix		Ferric chloride	fecl3	226.58
				Calcium oxide	CAO	18.70
				Aluminum sulfate (Alum)	Al2(so4)3	0.00
				Powdered activated carbon	pac	97.20
				Sodium carbonate	Na2(CO3)	0.00
				Calcium hydroxide	caoh	0.00
				Sodium hydroxide	naoh	0.00
6	SOFT	Flocculation Basin				
7	Softened	Sedimentation				

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
8	DR Recarbon	Recarbonation Basin	3	Carbon dioxide	co2	43.67
9	Chlorine gas 1	Disinfectant Addition	4	Chlorine gas	cl2	2.29
10	Filtration	Filtration		Hydrofluorosilic acid	F	0.61
11	Chlorine gas 2	Disinfectant Addition		Chlorine gas	cl2	0.98
12	Dublin Rd WP	Clearwell		Zinc orthophosphate	Zn	0.31

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
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Treatment Plant Name: Parsons Avenue Water Plant
 ICR Treatment Plant ID No: 529
 Treatment Plant Category: SPLIT/SOFT

Process Train Name: Parsons Avenue Process Train
 Process Train Category: SOFT

1	PA WW Return	Washwater Return	8			
2	Rapid Mix	Rapid Mix				
3	Primary	Solids Contact Clarifier		Sodium carbonate	Na2(CO3)	89.00
4	Secondary	Solids Contact Clarifier		Sodium hydroxide	naoh	0.00
				Calcium hydroxide	caoh	278.00
5	CO2 Feed	Other Treatment Process	7			
6	Chlorine gas	Disinfectant Addition		Carbon dioxide	co2	2.90
7	Filtration	Filtration	4	Chlorine gas	cl2	1.45
8	Chlorine gas	Disinfectant Addition				
9	Main Clearwell	Clearwell		Chlorine gas	cl2	0.84
				Hydrofluorosilic acid	F	0.80
				Zinc orthophosphate	Zn	0.29

Process Train Name: Bypass
 Process Train Category: CONV

1	Secondary t2	Solids Contact Clarifier				
2	CO2 Feed t2	Other Treatment Process				

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
3	Chlorine gas t2	Disinfectant Addition		Carbon dioxide	co2	2.90
4	Filtration t2	Filtration		Chlorine gas	cl2	1.45
5	Chlorine gas t3	Disinfectant Addition				
6	Main Clearwell t2	Clearwell		Chlorine gas	cl2	0.84
				Hydrofluorosilic acid	F	0.80
				Zinc orthophosphate	Zn	0.29

End of Report G.2 -- Final Design Plant Chemical Parameters

Appendix A

October 29, 1999

Mr. Steve Allgeier
ICR Treatment Study Coordinator
US EPA Office of Ground Water and Drinking Water
26 W. MLK Drive
Cincinnati, Ohio 45268

Re: City of Columbus ICR Treatability Study - Dublin Road Water Treatment Plant

Dear Mr. Allgeier:

This letter is in response to the preliminary review of the ICR Treatment Study Data Collection Spreadsheet and the ICR Treatment Study Summary Report Spreadsheet conducted by the EPA. We have reviewed the comments and addressed them as follows:

ICR Treatment Study Summary Report Spreadsheet

File Name: 1009-528_srss.xls

Full-Scale Water Quality (FS WQ) Data Sheet:

- SUVA data from the ICR monitoring database was collected and inserted into the spreadsheet. ✓
- Bromide values were changed to µg/L. ✓
- Temperature data from the ICR monitoring database was collected and inserted into the spreadsheet. ✓
- HAA₆ data from the ICR monitoring database was collected and inserted into the spreadsheet. ✓

QA and QC Data Sheet 1:

- MRLs for Alkalinity, Ammonia, Calcium Hardness, SDS-Cl₂ Residual, Total Hardness, and Turbidity have been reported. ✓
- Bromide values were changed to µg/L. ✓
- MRL for TOC was changed to 0.5 mg/L ✓
- MRL for TOX was changed to 25 mg Cl-/L ✓
- MRL for CHCL₃ was changed to 1.0 µg/L ✓

Check on QC Analyses:

- Verified for all RPE QC results that only results above MRL have been reported in the summary statistics
- UV RPE values verified as entered in spreadsheet. The count was misreported and has been corrected.
- The count was misreported and has been corrected.
- The count was misreported and has been corrected.
- CHBr₃ RPE values verified as entered in spreadsheet.

ICR Treatment Study Data Collection Spreadsheet

File Name: 1009-528_dcsc.xls

I. Missing Data

- NA has been entered in all blank fields ✓
- Pretreatment processes have been matched between the DCSS and the summary report
- "Y" or "N" has been reported in the "Sample Duplicate ?" column for all of the samples.
- Data or NA has been entered into all of the cells for Field 1-4
- Data or NA has been entered into all of the cells for Field 1-5 pH 8.43
- Data or NA has been entered into all of the cells for Field 1-6
- NA has been placed in the cell for the fuel oil rate because the plant does not use fuel oil

II. Corrections/Errors

- The entry in cell E16 has been corrected ✓
- UV results in cell AD50 was corrected ✓
- Entries in cell BX50 and BZ50 were verified as entered in the spreadsheet ✓

III. QA/QC Information

- DBP where the Cl₂ residual <0.1 mg/L have been reported as NR
- Entries in cells AC25 and AC27 have been verified as reported. Cell AL20

October 29, 1999

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has been reported as NR since it seems to be an outlier. THM and HAA results have been verified as reported in the spreadsheet.

- The outlier in the TOX 10-minute curve has been reported as an outlier.

Every effort has been made to address the comments on the ICR Treatment Study Data Collection Spreadsheet and the ICR Treatment Study Summary Report Spreadsheet as completely and accurately as possible. If you have any questions regarding the above information please call me at (614) 430-2639.

Very truly yours,

MALCOLM PIRNIE, INC.

Kristin D. Knight

Kristin Knight
Engineer

ksk

0228-713