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**DIRECT FILTRATION OF
LAKE SUPERIOR WATER FOR
ASBESTIFORM FIBER REMOVAL
Appendices B and C**



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DIRECT FILTRATION OF LAKE SUPERIOR
WATER FOR ASBESTIFORM FIBER REMOVAL

Appendix B

Design, Installation and Operation of Pilot Filters

Appendix C

Summary of Data for Individual Filter Runs

By

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FOREWORD

Man and his environment must be protected from the adverse effects of pesticides, radiation, noise and other forms of pollution, and the unwise management of solid waste. Efforts to protect the environment require a focus that recognizes the interplay between the components of our physical environment -- air, water, and land. The National Environmental Research Centers provide this multidisciplinary focus through programs engaged in

- studies on the effects of environmental contaminants on man and the biosphere, and
- a search for ways to prevent contamination and to recycle valuable resources.

This report and its appendices present the results of pilot plant filtration research for the removal of asbestos fibers from drinking water. The several appendices present detailed information on water quality, pilot plant equipment and operation, individual filter run data, asbestos fiber and amphibole mass concentrations in raw and filtered water, and diatomite filter optimization. Appendix B contains data on the pilot filters used and on operating techniques. Appendix C consists of tabulated operating data from all individual filter runs.

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ABSTRACT

Pilot plant research conducted in 1974 at Duluth, Minnesota, demonstrated that asbestos fiber counts in Lake Superior water could be effectively reduced by municipal filtration plants. During the study, engineering data were also obtained from making cost estimates for construction and operation of both granular and diatomaceous earth (DE) filtration plants ranging in size from 0.03 to 30 mgd.

Appendix B contains information on the pilot filters used in the study. Data are presented on the physical aspects of the units (dimensions and equipment configurations) and on the manner in which the filters were operated.

Appendix C contains data obtained during the individual pilot plant filter runs. This kind of information will be useful to persons needing to know about specific conditions such as raw water turbidity, filtration rate, and chemical doses or diatomaceous earth types and amounts used for precoat or body feed.

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EQUIPMENT DESIGN AND INSTALLATION

GENERAL

The pilot filtration study was conducted with two granular filters and four DE filters installed at the Lakewood Pumping Station in Duluth, Minnesota. The granular filters were a skid-mounted and a trailer mounted "WATER-BOY" unit as manufactured by Neptune MicroFLOC, Incorporated, Corvallis, Oregon. The DE filters were two pressure DE units supplied by the Corps of Engineers and two vacuum DE units as manufactured by the BIF Corporation, Providence, Rhode Island.

GRANULAR UNITS

The granular units used in the filtration study were designated MM-1 and MM-2 and are described in detail in the main report. Figures 1-7 are provided to illustrate the various features of the two units discussed in the report.

DIATOMACEOUS EARTH UNITS

The DE units used in the filtration study were designated as BIF (vacuum) and ERD-1 and ERD-2 (pressure). Although two vacuum filters were installed, only one unit was used for the study, with one unit provided as standby. The DE units are illustrated in Figures 8-13. Additional flow diagrams of the BIF and ERD units are presented in Figures 14-17. These diagrams show the alternative mixing modes that were utilized for some runs with the DE units.

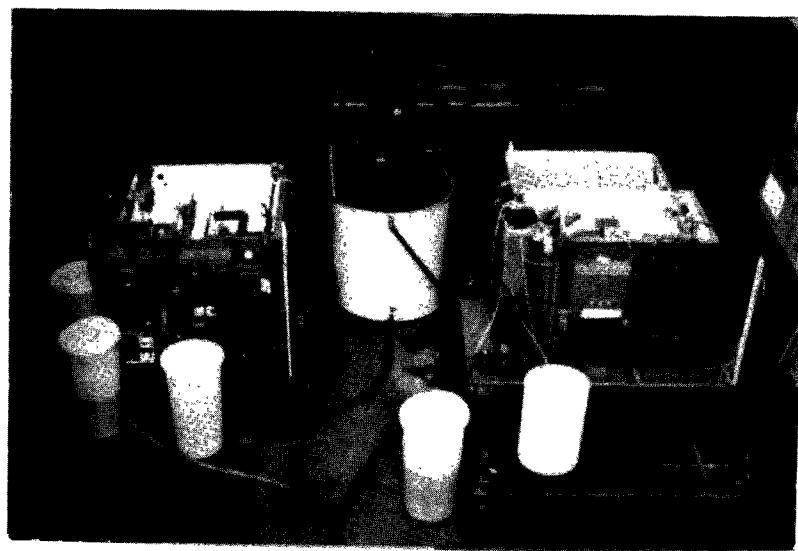


FIGURE 1 . GRANULAR UNITS, MM-1 AND MM-2 .

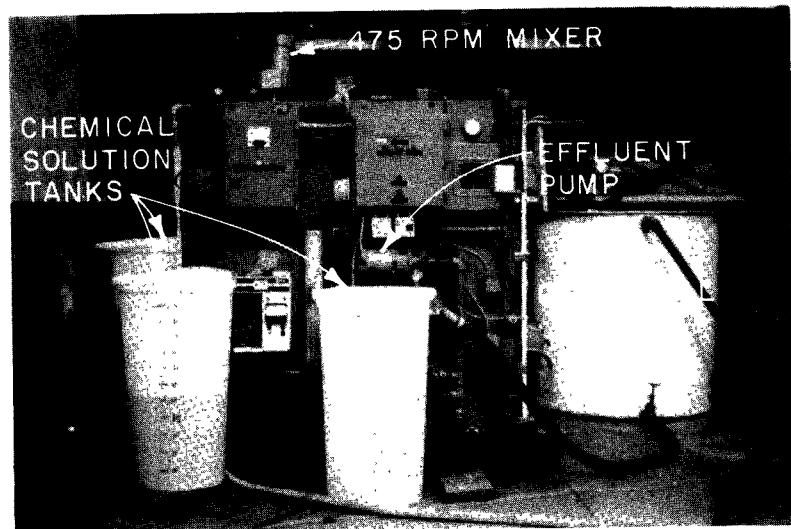


FIGURE 2 . FRONT VIEW MM-1 .

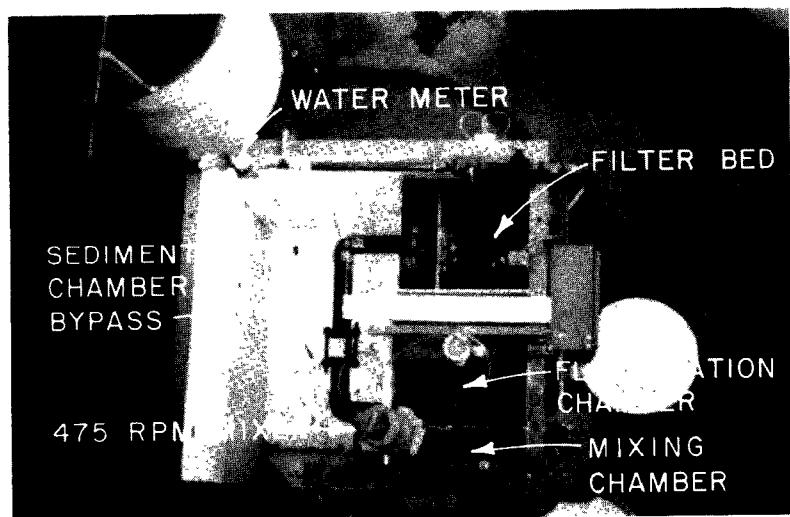


FIGURE 3 . TOP VIEW OF MM-1

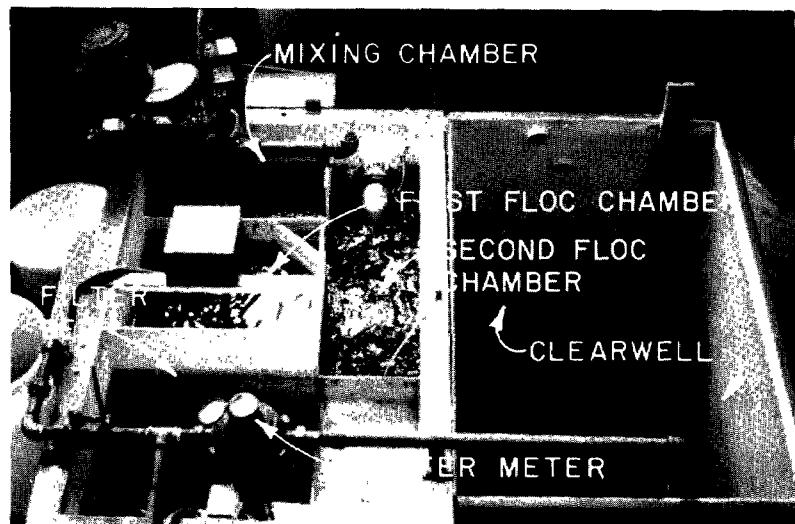


FIGURE 4 TOP VIEW MM-2

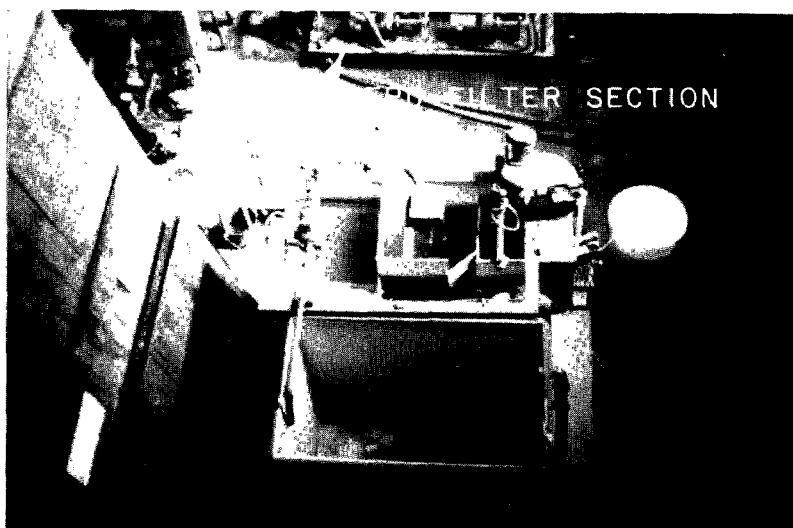


FIGURE 5 TOP VIEW OF MM-2 SHOWING LOCATION RELATIVE TO ERD.

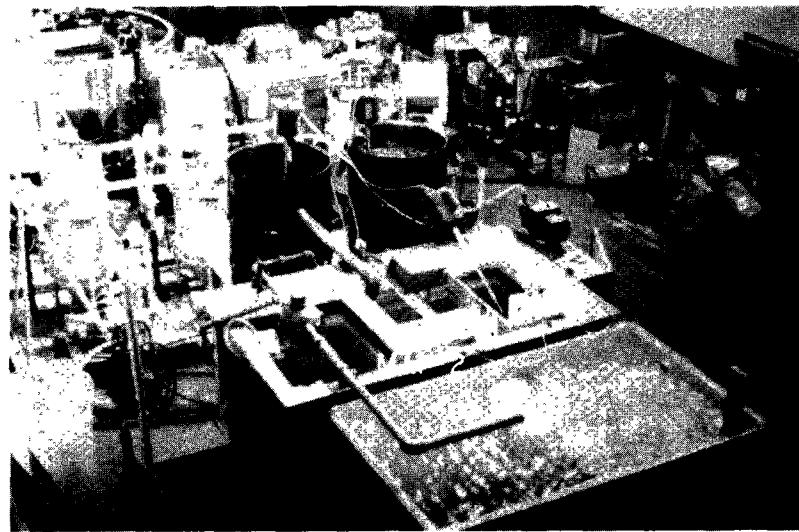


FIGURE 6 . TOP VIEW OF MM-2 SHOWING
LOCATION RELATIVE TO OTHER UNITS.

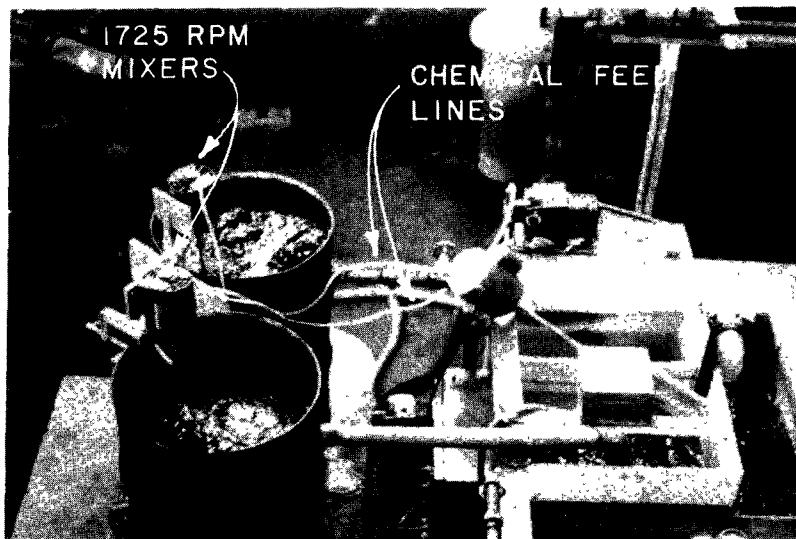


FIGURE 7 . 55-GALLON DRUMS USED FOR MIXING
CHAMBER WITH MM -2.

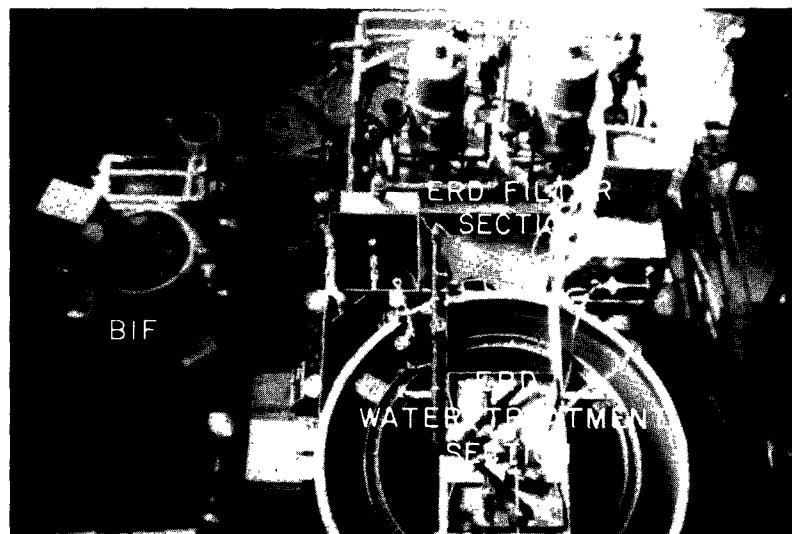


FIGURE 8 . TOP VIEW OF BIF AND ERD.

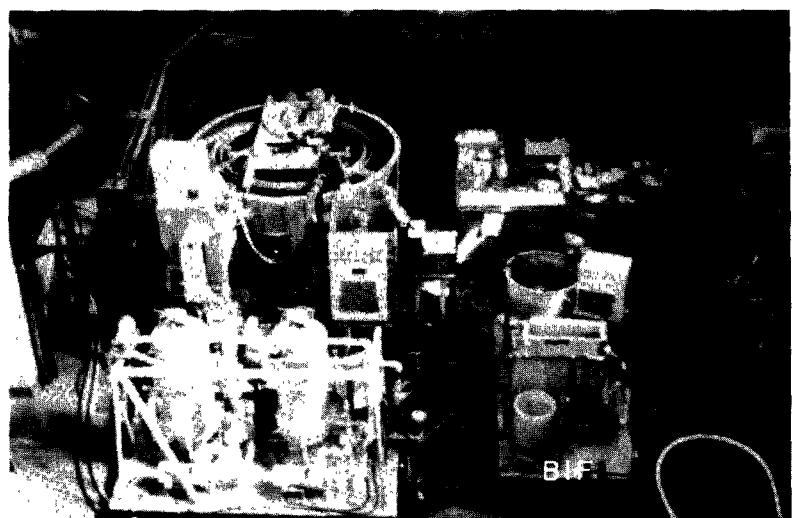


FIGURE 9 . TOP VIEW OF BIF AND ERD.

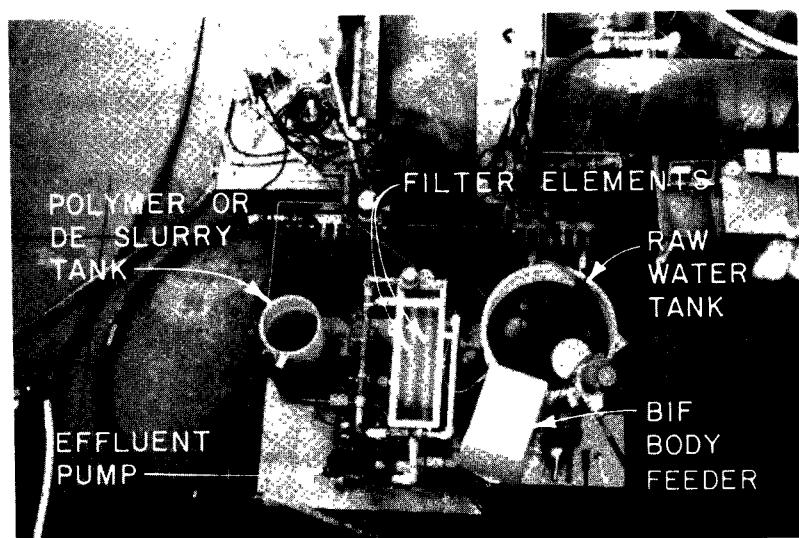


FIGURE 10 . TOP VIEW BIF .

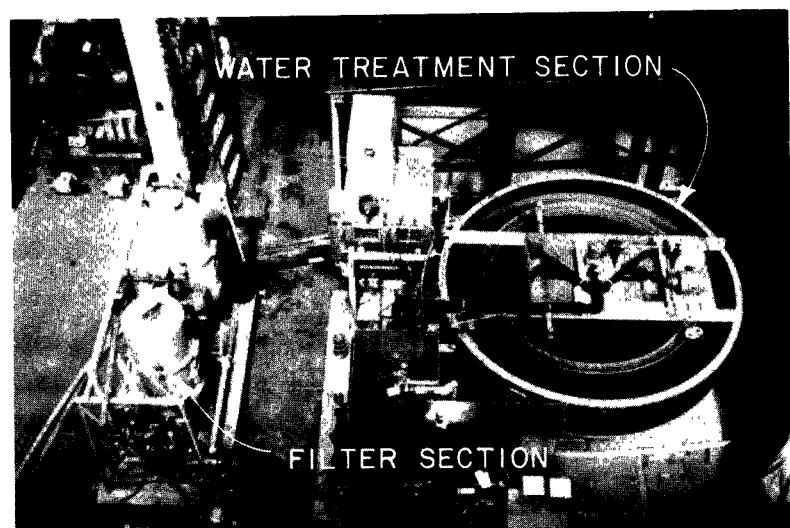


FIGURE 11 . TOP VIEW ERD .

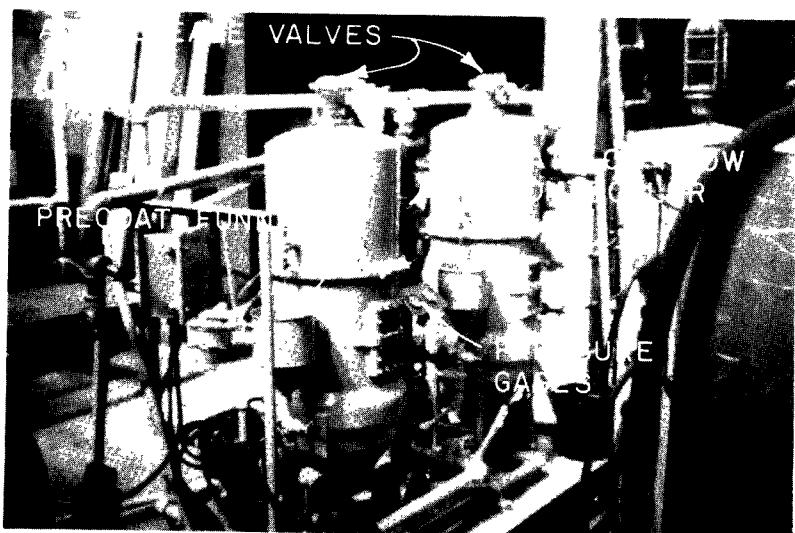


FIGURE 12 . FILTRATION SECTION OF ERD.

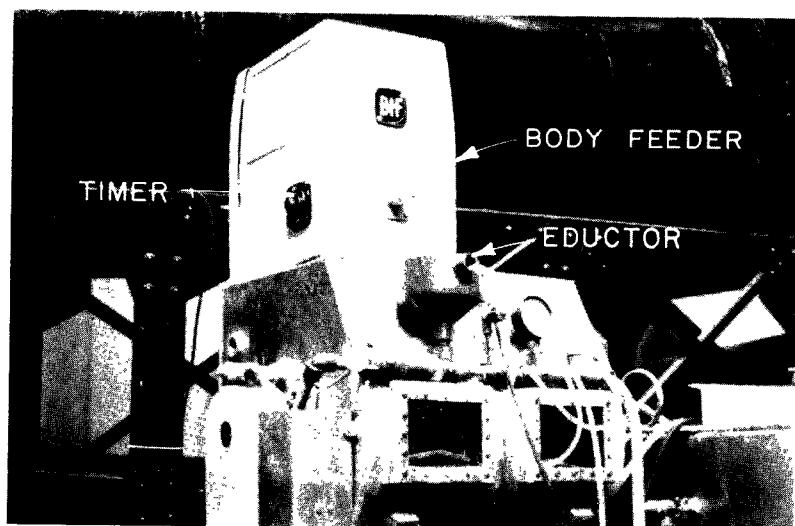


FIGURE 13 . BIF BODY FEEDER AND EDUCTOR
USED WITH ERD.

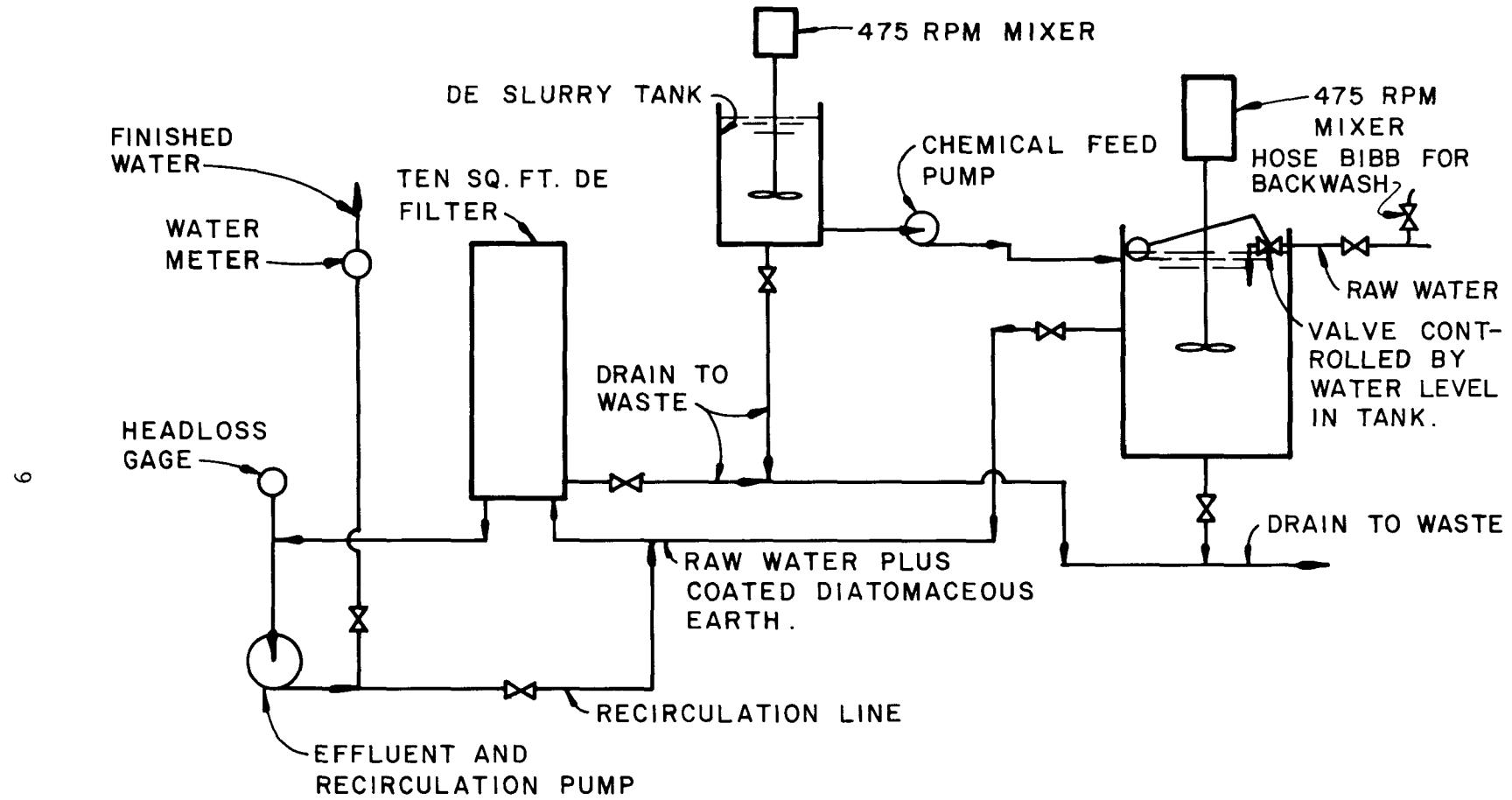


FIGURE 14 . FLOW DIAGRAM FOR BIF (ALT. 2)

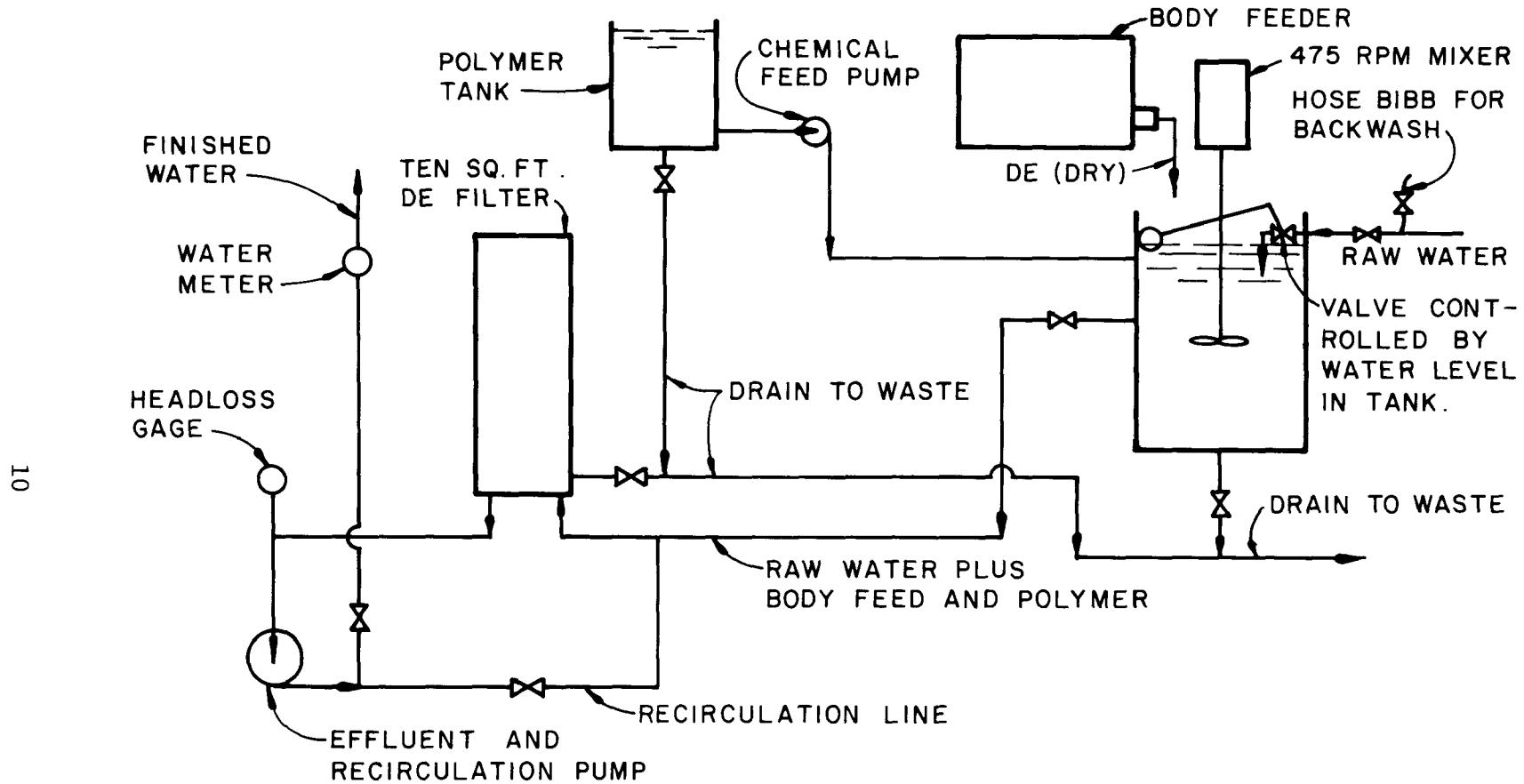


FIGURE 15 . FLOW DIAGRAM FOR BIF (ALT.3)

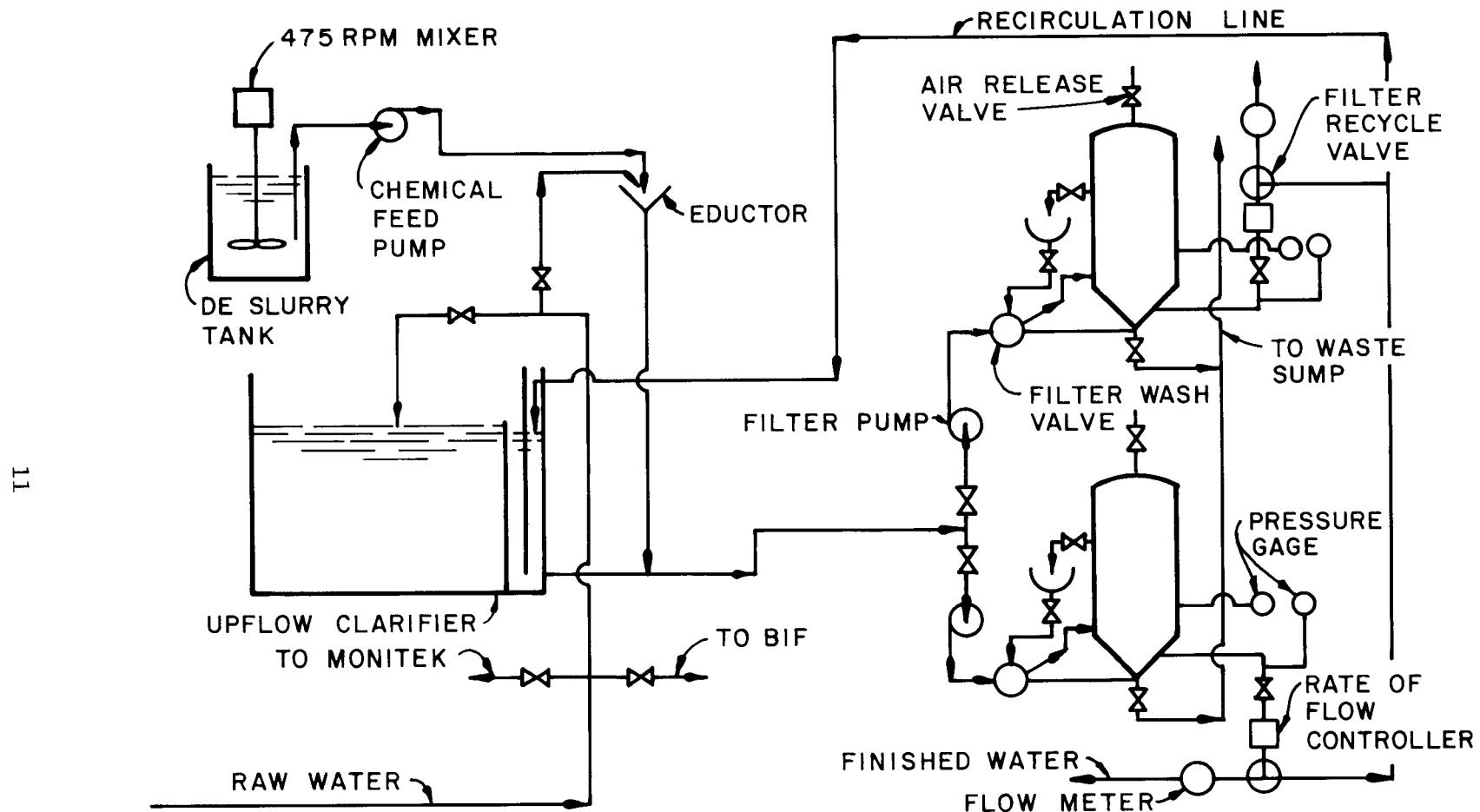


FIGURE 16 . FLOW DIAGRAM FOR ERD (ALT. 2)

12

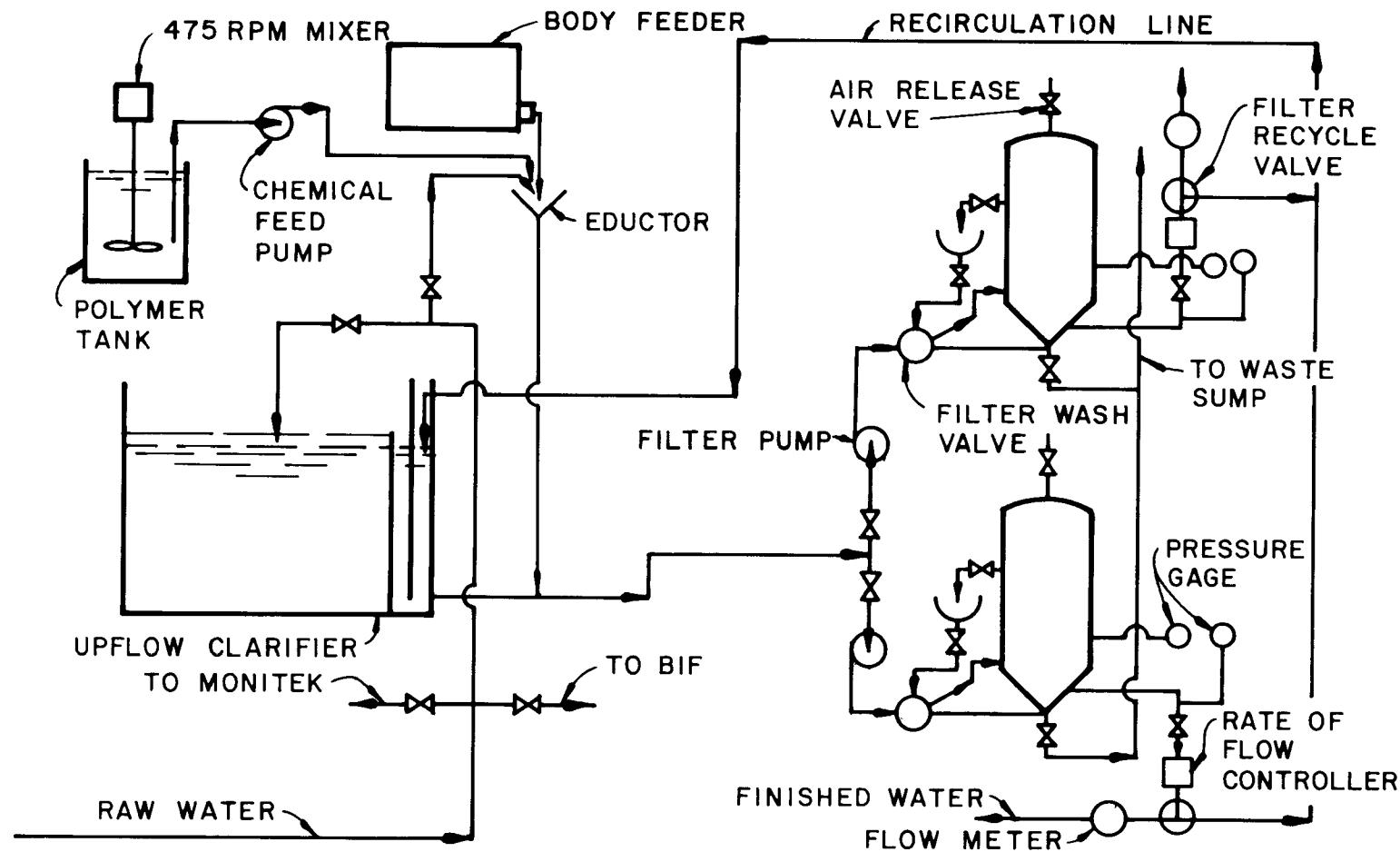


FIGURE 17 . FLOW DIAGRAM FOR ERD (ALT.3)

APPENDIX B-2

OPERATION OF PILOT FILTERS

RAW WATER SOURCES

With the exception of three runs on the MM-2 unit, all runs on the pilot filtration units were made using the Lakewood wetwell as the raw water source. The intake of the Lakewood Pumping Station extended approximately 1,500 ft out into Lake Superior and was about 70 ft below the surface of the lake. Suction hoses were placed directly in the wetwell and raw water was pumped to each of the filter units so that the raw water supplied to the units was the same as that being supplied to the City of Duluth.

Raw water from the Cloquet Pipeline Intake was used for three runs on the MM-2 units. The Cloquet raw water was transported from the Cloquet raw water pumping station on Minnesota Point to the Lakewood Pumping Station in a 4,800 gal tank truck. The suction of one of the pilot plant raw water pumps was connected to the discharge from the tank truck and the water pumped to the MM-2 unit. An illustration of the tank truck and raw water pump is given in Figure 18.

GRANULAR UNITS - CHEMICAL ADDITIONS

The solution concentration and point of application of the polymers were varied during the testing of the MM-1 unit, but the most common points of chemical application were the flocculation chamber when no sedimentation was provided, and the entrance to the sedimentation chamber when the tube settlers were installed. Several runs at the beginning of the study were conducted with the polymer added into the

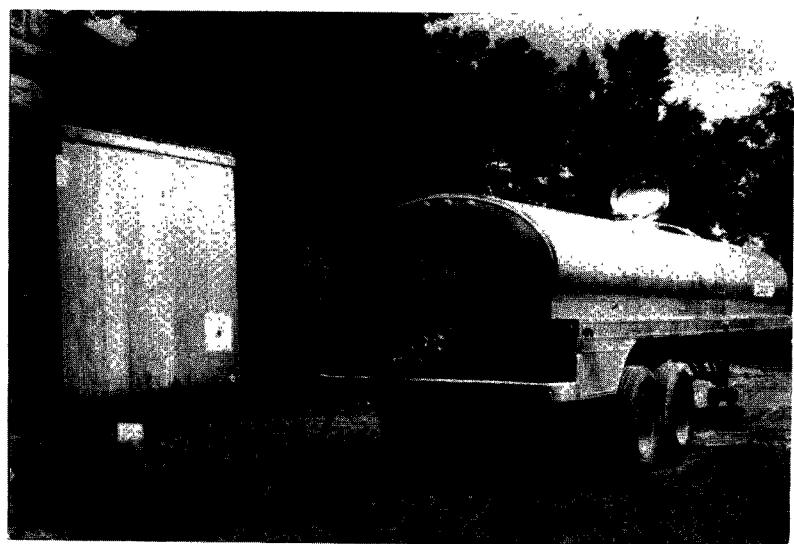


FIGURE 18 . 4800 GALLON TANK TRUCK TRANS-
PORT CLOQUET PIPELINE WATER
TO PILOT PLANT.

mixing chamber with the alum. However, the purpose of the polymer as used during the pilot filter studies was to strengthen the floc produced by the primary coagulant and it was decided this could best be accomplished by adding the polymer subsequent to the coagulation step in the process. A summary of chemical solution strengths and points of application is given in Table 1.

TABLE 1. SUMMARY OF CHEMICAL ADDITIONS TO MM-1

Chemical	Solution concentration, per cent	Run No.	Point of application
Alum	1.19	1-44	Mixing chamber
	1.19	45-63	Mixing chamber
	1.19	64-87	Mixing chamber
FeCl ₃			
NP-10	0.0299	1-2	Mixing chamber
N-17	0.0599	4-11	Mixing chamber
N-17	0.0599	12-19	Flocculation chamber
847A	0.0567	20-24	Flocculation chamber
985N	0.0299	25-29	Flocculation chamber
985N	0.0149	30-49	Flocculation chamber
985N	0.0149	50-64	Just prior to filter
985N	0.0149	65-87	Entrance to sedimentation basin

Alum was used as the primary coagulant in 117 of the runs conducted on the unit and FeCl₃ in 23 runs. Alum dosages ranged from 5.44 mg/l to 37.86 mg/l with an average dosage of about 15 mg/l. FeCl₃ dosages ranged from 6.22 mg/l to 17.4 mg/l with an average dosage of about 11 mg/l. Numerous polymer solution concentrations and points of application were used during the pilot studies with the MM-2 unit, and are summarized in Table 2.

TABLE 2. SUMMARY OF CHEMICAL ADDITIONS TO MM-2.

Chemical	Solution Concentration, per cent	Run No.	Point of Application
FeCl ₃	1.19	1-23	Mixing Chamber
Alum	1.19	24-92	Mixing Chamber
Alum	1.19	93-120, 138-140	1st mixing tank
Alum	1.19	121-123, 129-137	Prior to 1st Kenics mixer
Alum	1.19	124-128	Prior to 2nd Kenics mixer
C-31	0.119	1-16	Mixing Chamber
N-17	0.0599	17-18	Mixing Chamber
N-17	0.0599	20, 22-27, 34-41	1st floc Chamber
N-17	0.0599	19, 21	2nd floc Chamber
985N	0.0599	28-33, 42-51	1st floc Chamber
985N	0.0299	52-53	1st floc Chamber
985N	0.0149	54-92	1st floc Chamber
985N	0.0149	93-115, 119, 120, 138, 140	2nd mixing tank
A-23	0.0599	116, 118	1st mixing tank
Catfloc B	0.119	116, 117, 118	2nd mixing tank
A-23	0.0299	119, 120, 138, 139	1st mixing tank
985N	0.0149	121-123, 129-133	Prior to 2nd Kenics mixer
A-23	0.0599	124-128	Prior to 1st Kenics mixer
985N	0.0149	124, 127, 128	Prior to 3rd Kenics mixer
C-31	0.119	125, 126	Prior to 3rd Kenics mixer
C-31	0.119	134	Prior to 2nd Kenics mixer
C-31	0.119	135-137	Prior to 2nd pair of Kenics mixers
C-31	0.119	139	2nd mixing tank

APPENDIX C-1 GRANULAR MEDIA FILTRATION (MM-1) SUMMARY OF INDIVIDUAL RUNS

Run No.	Date	Filter rate, gpm/ft ² (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lb/1000 gal.	Polymer, lb/1000 gal.	Backwash solids, lb/1000 gal.			B.W. vol., as % of treated water	ORF Fibersx10 ⁶ /l		NWQL Amphibole mg/l		UMD Fibersx10 ⁶ /l		Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)	
							Sedi.	Filter	Total		Raw	Filter	Raw	Filter	Raw	Filter				
17	Dual media 5/13	filtration w/o sedi.	Alum & polymer added to mixing chamber	Lakewood water.													8.0	0.73	9.23	
	2	5/13	3.89 (228.23)	Alum 12.3	Separan NP-10 0.17	0.102	0.0014	—	—	—	4.97%	0.90	0.40					8.0	0.38	10.25
	3	5/14	4.18 (245.24)	Alum 12.3	Separan NP-10 0.26	0.103	0.0022	—	—	—	3.43%	0.90	0.32					8.0	0.14	7.50
	4	5/14	4.04 (237.03)	Alum 16.61	N-17 0.22	0.139	0.0018	—	—	—	4.94%	2.4	0.24					8.0	0.58	10.75
	5	5/15	3.28 (192.44)	Alum 18.6	N-17 0.35	0.155	0.0029	—	—	—	5.18%	1.3	0.20					8.0	0.26	8.33
	6	5/15	3.19 (187.16)	Alum 20.48	N-17 0.39	0.171	0.0032	—	—	—	6.30%	1.4	0.21					8.0	0.16	6.75 (4.9)
	7	5/16	3.46 (203.00)	Alum 17.88	N-17 0.38	0.149	0.0031	—	—	—	3.61%	0.80 (0.74)	0.20 (0.15)	A=2.61 C=1.35	A=BDL C=0.130	0.14	0.005	8.0	0.11	7.17
	8	5/16	3.64 (213.56)	Alum 17.82	N-17 0.286	0.149	0.0024	—	—	—	2.66%	1.1	0.21					8.0	0.32	8.73
	9	5/17	3.57 (209.45)	Alum 18.1	N-17 0.25	0.151	0.0021	—	—	—	3.09%	1.14	0.15					8.0	0.19	6.08
	10	5/17	3.61 (211.80)	Alum 17.5	N-17 0.23	0.146	0.0019	—	—	—	3.25%	0.85	0.25					8.0	0.15	7.83
	11	5/18	3.72 (218.25)	Alum 17.6	N-17 0.27	0.147	0.0023	—	—	—	5.52% ^a	0.95	0.30					8.0	0.11	6.07
	Polymer feed moved to influent of flocc. chamber																	8.0	0.26	7.71
	12	5/20	3.77 (221.19)	Alum 16.96	N-17 0.272	0.142	0.0023	—	—	—	2.53%	0.85	0.23					8.0	0.11	6.07
	13	5/20	3.83 (224.71)	Alum 16.2	N-17 0.33	0.135	0.0028	—	—	—	3.66%	1.09	0.14					8.0	0.26	7.71
	14	5/21	3.99 (234.09)	Alum 18.28	N-17 0.293	0.152	0.0025	—	0.034	0.034	2.72%	0.90	0.25					8.0	0.15	7.25

APPENDIX C-1 (CONTINUED).

Run No.	Date	Filter rate (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lb 1000 gal.	Polymer, lb 1000 gal.	Backwash solids, lb /1000 gal. Sedi. Filter Total			B.W. vol., as % of treated water	Avg. turb. (Turb @ time of sample), TU		ORF Fibersx10 ⁶ /l Raw Filter	NWQL Amphibole mg/l		UMD Fibersx10 ⁶ /l Raw Filter	Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)
							Raw	Filter	Raw		Raw	Filter		Raw	Filter				
15	5/21	3.44 (201.83)	Alum 15.51	N-17 0.35	0.130	0.0029	—	0.022	0.022	2.59%	0.80	0.32				8.0	0.22	8.28	
16	5/22	3.86 (226.47)	Alum 14.32	N-17 0.339	0.119	0.0028	—	0.055	0.055	4.09%	0.89 (0.94)	0.30 (0.42)			0.20	< 0.01	8.0	0.41	7.85 (6.1)
17	5/22	3.92 (229.99)	Alum 14.79	N-17 0.37	0.123	0.0027	—	0.022	0.022	3.70%	0.85	0.45					8.0	0.33	6.60
18	5/22	3.98 (233.51)	Alum 15.42	N-17 0.41	0.129	0.0034	—	0.036	0.036	3.78%	0.92	0.35					8.0	0.25	6.70
19	5/23	4.16 (244.07)	Alum 14.23	N-17 0.418	0.119	0.0035	—	0.069	0.069	5.31%	0.90	0.42					8.0	0.47	6.09
20	5/23	3.96 (232.33)	Alum 15.71	847-A 0.232	0.131	0.0019	—	0.028	0.028	3.00%	1.4	0.15					8.0	0.15	8.49
21	5/23	3.83 (244.71)	Alum 15.51	847-A 0.260	0.129	0.0022	—	0.049	0.049	2.43%	0.95	0.15					8.0	0.11	8.93
22	5/24	3.79 (222.36)	Alum 16.65	847-A 0.098	0.139	0.00082	—	0.044	0.044	1.56%	1.2	0.15					8.0	0.34	14.00
23	5/28	3.82 (224.12)	Alum 21.36	847-A 0.110	0.178	0.00092	—	0.062	0.062	2.13%	0.82	0.16					8.0	0.38	13.02
24	5/28	4.13 (242.31)	Alum 16.04	847-A 0.099	0.134	0.00083	—	0.039	0.039	1.31%	0.85	0.20					8.0	1.50	17.33
25	5/29	3.83 (224.71)	Alum 13.18	985-N 0.123	0.110	0.0010	—	0.021	0.021	2.59%	0.83	0.15					8.0	0.13	13.70
26	5/30	3.65 (214.15)	Alum 14.15	985-N 0.123	0.118	0.0010	—	0.037	0.037	2.62%	0.82 (0.80)	0.15 (0.15)	A=1.43 C=1.83	A=BDL C=0.261	0.19	< 0.01	8.0	0.19	16.33 (2.6)
27	5/31	4.14 (242.89)	Alum 12.46	985-N 0.054	0.104	0.00045	—	0.030	0.030	1.13%	0.85	0.19					8.0	0.15	20.16
28	6/3	4.05 (237.61)	Alum 13.3	985-N 0.061	0.111	0.00051	—	0.025	0.025	1.45%	0.78	0.11					8.0	0.07	19.75
29	6/4	4.01 (235.27)	Alum 14.2	985-N 0.062	0.118	0.00052	—	0.018	0.018	1.42%	0.82 (0.86)	0.10 (0.10)	A=1.74 C=2.91	A=BDL C=0.475	0.26	< 0.006	8.0	0.12	18.68 (3.2)

APPENDIX C-1 (CONTINUED)

Run No.	Date	Filter rate (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lb /1000 gal.	Polymer, lb /1000 gal.	Backwash solids, lb /1000 gal. Sedi. Filter Total			B.W. vol., as % of treated water	Avg. turb. (Turb @ time of sample), TU		ORF Fibersx10 ⁶ /l Raw Filter		NWQL Amphibole mg/l		UMD Fibersx10 ⁶ /l Raw Filter		Terminal HL Ft. H ₂ O Turb. TU-		Run Length, Hrs. (Time to Sample)
							Raw	Filter	Raw		Raw	Filter	Raw	Filter	Raw	Filter	Raw	Filter	Raw	TU-	
30	6/5	4.03 (236.44)	Alum 13.7	985-N 0.047	0.114	0.00039	—	0.038	0.038	1.95%	0.80	0.11							8.0	0.09	18.25'
31	6/6	3.93 (230.57)	Alum 12.6	985-N 0.062	0.105	0.00053	—	0.026	0.026	1.62%	1.53 (0.74)	0.12 (0.09)	A=1.5 C=2.3	A=BDL C=0.35	0.18	< 0.005			8.0	0.15	19.73 (6.7)
32	6/7	4.09 (239.96)	Alum 11.95	985-N 0.022	0.100	0.00018	—	0.048	0.048	1.50%	3.6	0.16							8.0	0.12	21.58
33	6/10	3.89 (228.23)	Alum 12.43	985-N 0.055	0.104	0.00046	—	—	—		3.9	0.19							6.8	1.7	24.75
34	6/11	3.92 (229.99)	Alum 12.21	985-N 0.08	0.102	0.00067	—	—	—		2.98 (1.90)	0.15 (0.25)	A=1.0 C=1.6	A=0.17 C=0.17	0.18	0.006			8.0	0.16	17.92 (1.0)
35	6/12	4.10 (240.55)	Alum 13.08	985-N 0.074	0.109	0.00062	—	0.046	0.046	1.25%	2.2	0.12							8.0	0.11	17.50
36	6/13	4.07 (238.79)	Alum 16.13	985-N 0.071	0.134	0.00059	—	0.028	0.028	2.85%	2.1 (2.1)	0.13 (0.16)	A=0.48 C=0.41	A=BDL C=0.57	33.25	0.53	8.0	0.14	11.75 (8.0)		
37	No Alum added - Mechanical failure																				
38	6/14	4.07 (238.79)	Alum 14.48	985-N 0.063	0.121	0.00053	—	0.048	0.048	1.81%	1.8	0.12							8.0	0.07	16.18
39	6/17	4.06 (238.20)	Alum 16.85	985-N 0.057	0.141	0.00048	—	—	—		0.95 (0.96)	0.11 (0.10)	A=0.61 C=2.15	A=BDL C=0.44	0.17	< 0.006	10.64	0.23	8.0	0.11	14.71 (1.9)
40	6/18	3.91 (229.40)	Alum 17.01	985-N 0.048	0.142	0.00040	—	0.050	0.050	1.93%	0.90	0.12							5.1	0.85	16.53
41	6/19	3.81 (223.53)	Alum 19.01	985-N 0.054	0.159	0.00046	0.015	—	0.015	1.63%	0.90	0.09							6.1	0.80	26.83
42	6/20	3.75 (220.01)	Alum 18.28	985-N 0.085	0.152	0.00071	0.021	—	0.021	1.22%	1.25	0.10							8.0	0.10	25.03
43	6/21	4.05 (237.61)	Alum 14.27	985-N 0.066	0.119	0.00055	0.022	—	0.022	3.53% ^a	1.1	0.09							3.6	0.07	11.66
44	6/24	3.98 (233.51)	Alum 14.81	985-N 0.078	0.124	0.00065	0.014	—	0.014	1.16%	0.66 (0.66)	0.09 (0.11)	A=1.0 C=3.9	A=BDL C=0.13			6.03	0.92	8.0	0.04	25.83 (3.7)

APPENDIX C-1 (CONTINUED)

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lb 1000 gal.	Polymer, lb 1000 gal.	Backwash solids, lb /1000 gal. Sedi. Filter Total	B.W. vol., as % of treated water	Avg. turb. (Turb @ time of sample), TU	ORF Raw	Filter	NWQL Amphibole mg/l	UMD Fibersx10 ⁶ /l Raw Filter	Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)					
Now using Ferric Chloride as a coagulant added to mixing chamber.																					
45	6/25	4.06 (238.20)	FeCl ₃ 12.16	985-N 0.058	0.101	0.00048	0.021	—	0.021	1.45%	0.66	0.25			5.8	0.78	21.22				
46	6/26	4.28 (251.11)	FeCl ₃ 11.42	985-N 0.071	0.095	0.00060	0.026	—	0.026	2.70%	0.68	0.12			3.7	0.33	15.33				
47	6/27	4.10 (240.55)	FeCl ₃ 11.81	985-N 0.073	0.098	0.00062	0.059	—	0.059	2.33%	0.73	0.11			4.3	0.65	18.58				
48	6/28	4.12 (241.72)	FeCl ₃ 12.0	985-N 0.094	0.100	0.00078	0.083	—	0.083	2.50%	0.65 (0.64)	0.09 (0.14)	A=1.11 C=8.12	A=BDL C=1.37	0.16	0.007	5.54	0.51	3.8	0.38	16.17 (13.3)
49	6/28	4.11 (241.13)	FeCl ₃ 12.24	985-N 0.094	0.102	0.00079	0.066	—	0.066	3.14% ^a	0.69	0.10			2.9	0.08	12.42				
Polymer input just ahead of filter bed.																					
50	7/1	4.06 (238.20)	FeCl ₃ 12.21	985-N 0.103	0.102	0.00086	0.028	—	0.028	1.53%	0.78	0.12			8.0	0.49	19.43				
51	7/2	3.69 (216.49)	FeCl ₃ 12.25	985-N 0.105	0.102	0.00088	0.042	—	0.042	1.92%	0.77	0.09			8.0	0.10	14.59				
52	7/3	3.86 (226.47)	FeCl ₃ 16.49	985-N 0.087	0.138	0.00073	0.040	—	0.040	3.81%	0.77 (0.69)	0.07 (0.07)	A=0.56 C=3.57	A=BDL C=0.28	0.07	<0.004	2.99	0.91	8.0	0.07	9.09 (9.0)
53	7/3	4.08 (239.37)	FeCl ₃ 13.78	985-N 0.057	0.115	0.00048	0.036	—	0.036	2.87%	0.73	0.11			8.0	0.10	9.18				
54	7/4	4.10 (240.55)	FeCl ₃ 14.97	985-N 0.062	0.125	0.00052	0.039	—	0.039	3.74%	0.67	0.08			8.0	0.07	10.90				
55	7/4	4.08 (239.37)	FeCl ₃ 14.77	985-N 0.035	0.123	0.00029	0.044	—	0.044	2.31%	0.62	0.11			8.0	0.11	11.02				
56	7/8	4.08 (239.37)	FeCl ₃ 14.29	985-N 0.055	0.119	0.00046	0.106	—	0.106	2.52%	0.67	0.09			8.0	0.08	13.23				
57	7/9	3.98 (228.23)	FeCl ₃ 16.35	985-N 0.048	0.136	0.00040	0.077	—	0.077	2.15%	0.65	0.09			8.0	0.14	12.53				

APPENDIX C-1 (CONTINUED)

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lb			Polymer, lb			Backwash solids, lb /1000 gal. Sedi. Filter Total			B.W. vol., as % of treated water	Avg. turb. (Turb @ time of sample), TU		ORF		NWQL Amphibole		UMD		Terminal		Run Length, Hrs. (Time to Sample)																				
					1000 gal.		1000 gal.		1000 gal.		1000 gal.		1000 gal.		Fibersx10 ⁶ /l Raw Filter	Fibersx10 ⁶ /l Raw Filter	Raw Filter	Raw Filter	Fibersx10 ⁶ /l Raw Filter	Fibersx10 ⁶ /l Raw Filter	HL Ft. H ₂ O	Turb. TU																							
58	7/9	3.68 (215.91)	FeCl ₃ 17.54	985-N 0.069	0.146	0.00057	0.070	—	0.070	3.66%	0.97	0.14	—	—	—	—	—	—	—	8.0	0.44	i0.73																							
59	7/10	4.08 (239.37)	FeCl ₃ 7.36	985-N 0.061	0.061	0.00051	0.151	—	0.151	2.18%	1.23	0.21	—	—	—	—	—	—	—	8.0	0.06	12.81																							
60	7/11	3.64 (213.56)	FeCl ₃ 14.79	985-N 0.054	0.123	0.00045	0.055	—	0.055	3.23%	1.01	0.10	—	—	—	—	—	—	—	8.0	0.11	10.25																							
61	7/11	3.94 (231.16)	FeCl ₃ 12.81	985-N 0.059	0.107	0.00050	0.071	—	0.071	2.76%	1.81	0.10	—	—	—	—	—	—	—	8.0	0.08	13.20																							
62	7/12	3.93 (230.57)	FeCl ₃ 12.36	985-N 0.065	0.103	0.00055	0.061	—	0.061	2.38%	1.15	0.10	—	—	—	—	—	—	—	8.0	0.10	11.23																							
63	7/12	3.89 (228.23)	FeCl ₃ 12.73	985-N 0.067	0.106	0.00056	0.084	—	0.084	4.47% ^a	0.77	0.12	—	—	—	—	—	—	—	4.1	0.11	9.58																							
64	7/15	3.89 (228.23)	Alum 12.99	985-N 0.041	0.108	0.00034	0.045	—	0.045	2.00%	0.68	0.09	—	—	—	—	—	—	7.1	0.49	21.92																								
Changed to Alum as a coagulant to mixing chamber.																																													
Polymer discharge moved from filter to Sedimentation Basin																																													
65	7/16	3.90 (228.81)	Alum 11.82	985-N 0.037	0.099	0.00031	0.015	—	0.015	1.81%	0.70	0.11	—	—	—	—	—	—	—	—	8.0	0.17	22.76																						
66	7/17	3.87 (227.05)	Alum 12.10	985-N 0.039	0.101	0.00033	0.027	—	0.027	1.83%	0.72	0.10	—	—	—	—	—	—	—	—	8.0	0.12	21.05																						
67	7/19	3.85 (225.88)	Alum 10.99	985-N 0.039	0.092	0.00033	0.024	—	0.024	1.67%	0.83 (0.90)	0.11 (0.10)	A=0.52 C=0.35	A=BDL C=0.15	0.13	< 0.003	266.0	0.66	8.0	0.12	21.03 (20.1)																								
68	7/19	3.93 (230.57)	Alum 11.67	985-N 0.050	0.097	0.00042	0.039	—	0.039	2.62% ^a	0.68	0.10	—	—	—	—	—	—	—	5.8	0.10	14.17																							
69	7/22	3.97 (232.92)	Alum 11.86	985-N 0.025	0.099	0.00021	0.030	—	0.030	1.93%	0.65	0.09	—	—	—	—	—	—	—	8.0	0.14	20.08																							
70	7/23	3.88 (227.64)	Alum 12.20	985-N 0.026	0.102	0.00022	0.019	—	0.019	2.02%	0.60 (0.57)	0.08 (0.07)	A=0.54 C=0.09	A=BDL C=0.07	0.09	< 0.003	26.0	0.35	8.0	0.10	19.72 (4.5)																								
71	7/24	3.83 (224.71)	Alum 11.24	985-N 0.025	0.094	0.00021	0.027	—	0.027	—	0.82	0.09	—	—	—	—	—	—	—	8.0	0.11	18.49																							

APPENDIX C-1 (CONTINUED)

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lb 1000 gal.	Polymer, lb 1000 gal.	Backwash solids, lb /1000 gal.			B.W. vol., as % of treated water	Avg. turb. (Turb @ time of sample),		ORF Fibersx10 ⁶ /l		NWQL Amphibole mg/l		UMD Fibersx10 ⁶ /l		Terminal HL Ft. H ₂ O		Run Length, Hrs. (Time to Sample)
							Sedi.	Filter	Total		TU Raw	TU Filter	Raw	Filter	Raw	Filter	Raw	Filter	Raw	Filter	
Z2	7/25	3.86 (226.47)	Alum 10.71	985-N 0.029	0.089	0.00024	0.076	—	0.076	1.85%	0.73 (0.66)	0.11 (0.07)	A=0.11 C=1.43	A=BDL C=0.37	0.04	<0.005	60.5	0.46	8.0	0.12	22.58 (7.8)
	7/26	3.31 (194.20)	Alum 13.09	985-N 0.041	0.109	0.00034	0.046	0.032	0.078	1.93%	0.66	0.10							8.0	0.14	24.58
	7/30	3.27 (191.85)	Alum 15.56	985-N 0.034	0.130	0.00028	0.060	0.024	0.084	1.48%	0.73 (0.69)	0.10 (0.08)	A=0.11 C=0.11	A=BDL C=BDL	0.06	<0.003	26.6	0.18	6.6	0.31	34.33 (22.8)
	7/30	3.31 (194.20)	Alum 15.28	985-N 0.034	0.127	0.00029	0.057	0.049	0.106	1.70%	0.79	0.09							5.0	0.35	29.67
	8/1	3.13 (183.64)	Alum 15.73	985-N 0.037	0.131	0.00031	0.024	0.037	0.061	1.63%	1.07 (0.87)	0.09 (0.07)	A=0.22 C=0.15	A=BDL C=0.22	0.08	<0.004	30.0	0.72	8.0	0.12	32.06 (7.3)
	8/2	3.08 (180.70)	Alum 16.30	985-N 0.031	0.136	0.00026	0.060	0.025	0.085	3.96%	0.97	0.09							8.0	0.10	9.78
	8/6	3.28 (192.44)	Alum 15.08	985-N 0.039	0.126	0.00033	0.009	0.039	0.048	1.35%	0.64 (0.58)	0.09 (0.07)	A=0.6 C=0.3	A=BDL C=0.06	0.09	<0.004	10.2	0.20	8.0	0.09	30.92 (23.3)
	8/6	3.44 (201.825)	Alum 15.43	985-N 0.035	0.129	0.00029	0.006	0.058	0.064	1.50%	0.65	0.10							5.1	0.42	32.33
	8/8	3.81 (223.53)	Alum 13.69	985-N 0.038	0.114	0.00032	0.004	0.059	0.063	1.83%	1.12 (0.68)	0.12 (0.08)	A=0.06 C=0.09	A=0.04 C=0.2	0.05	<0.003	15.1	0.45	4.7	0.40	23.97 (2.7)
	8/9	3.82 (224.12)	Alum 13.35	985-N 0.034	0.111	0.00028	0.012	0.076	0.088	1.82%	1.12	0.14							7.9	0.21	24.00
	8/13	3.69 (216.49)	Alum 15.49	985-N 0.033	0.129	0.00028	0.010	0.051	0.061	1.62%	0.66 (0.60)	0.09 (0.10)	A=0.13 C=0.2	A=BDL C=0.03	0.06	<0.003	20.0	0.38	8.0	0.15	25.83 (22.5)
	8/13	3.76 (220.60)	Alum 14.72	985-N 0.033	0.123	0.00027	0.009	0.045	0.054	1.57%	0.71	0.08							7.5	0.32	28.08
	8/15	3.74 (219.43)	Alum 15.13	985-N 0.036	0.126	0.00030	0.020	0.045	0.065	1.36%	0.61 (0.71)	0.06 (0.06)	A=0.09 C=0.17	A=BDL C=0.52	0.06	<0.003	8.98	0.55	8.0	0.07	30.87 (12.3)
	8/16	3.61 (211.80)	Alum 14.62	985-N 0.033	0.122	0.00027	0.022	0.021	0.043	1.86% ^a	0.76	0.09							4.8	0.11	24.83
	8/21	3.75 (220.01)	Alum 17.96	985-N 0.060	0.150	0.00050	0.014	0.028	0.042	2.00%	0.65 (0.58)	0.08 (0.08)	A=0.13 C=0.37	A=BDL C=0.13	0.03	<0.003	13.6	0.31	8.0	0.06	20.25 (0.8)

APPENDIX C-1 (CONTINUED)

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lbs. 1000 gal.	Polymer, lbs. 1000 gal.	Backwash solids, lbs/1000 gal.			B.W. vol., as % of treated water	Avg. turb. (Turb @ time of sample), TU		ORF Fibersx10 ⁶ /l		NWQL Amphibole mg/l		UMD Fibersx10 ⁶ /l		Terminal HL Ft. H ₂ O		Run Length, Hrs. (Time to Sample)	
							Sedi.	Filter	Total		Raw	Filter	Raw	Filter	Raw	Filter	Raw	Filter	TU	TU		
	8/22										(0.68)	(0.06)	A=0.13 C=0.37	A=BDL C=0.22	0.03	<0.003	13.6	0.49				(16.1)
	8/22										(0.76)	(0.15)	A=0.13 C=0.37	A=BDL C=0.80	0.03	<0.003	13.6	0.37				(22.0)
Used coagulant aid. Backwash solids calculated from Chem. Additions.																						
87	9/18	3.49 (204.76)	Alum 21.46	985-N 0.067			—	—	0.403	2.39%	0.55 (0.52)	0.12 (0.10)	A=0.6 C=0.09	A=1.0 C=0.7	0.10	<0.003	13.8	1.46	8.0	0.10	18.53 (18.1)	
			Coagulant Aid Bentonite 26.83			0.224																

^a Run did not reach terminal H_L or turbidity.^b A=amphibole, C=chrysotile

APPENDIX C-2 GRANULAR MEDIA FILTRATION (MM-2) SUMMARY OF INDIVIDUAL RUNS

Run No.	Date	Filter rate (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lb 1000 gal.	Polymer, lb 1000 gal.	B.W. solids, lb 1000 gal.	B.W. vol. as % of treated water ^a	Avg. turb. (Turb. @ time of sample), TU	ORF Fibersx10 ⁶ /l Raw	NWQL Amphibole mg/l	UMD Fibersx10 ⁶ /l Raw	Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)		
Filtration w/o sedimentation, dual media, 450 rpm mixer in mixing chamber FeCl ₃ , & polymer added to mixer																	
1	4/19	4.96 (291.00)	FeCl ₃ 6.22	C-31 0.518	0.052	0.0043	—	—	1.0 (1.3)	0.35 (0.22)	A= 304 C=.217	A=BDL C=.0435	0.1	< 0.02	6.2	1.1	14.58 (6.5)
2	4/22	4.5 (264.02)	FeCl ₃ 6.82	C-31 0.682	0.057	0.0057	—	—	1.3	0.30					6.4	0.82	16.25
3	4/23	4.2 (246.41)	FeCl ₃ 7.66	C-31 0.725	0.064	0.0061	—	—	1.3	0.64					5.3	0.68	14.25
4	4/24	3.66 (214.73)	FeCl ₃ 9.91	C-31 0.595	0.083	0.0050	—	—	1.1	0.55					4.3	1.10	10.33
5	4/24	5.48 (321.51)	FeCl ₃ 10.11	C-31 0.59	0.084	0.0049	—	—	1.0	0.52					3.3	0.95	5.42
6	4/25	4.56 (267.54)	FeCl ₃ 11.35	C-31 0.486	0.095	0.0041	—	—	1.0	0.25					3.8	0.88	6.75
7	4/25	4.26 (249.93)	FeCl ₃ 8.61	C-31 0.626	0.072	0.0052	—	—	0.90 (1.0)	0.31 (0.10)	A=.348 C=.174	A=BDL C=.348	0.12	< 0.02	4.4	0.95	15.00 (4.5)
8	4/26	3.89 (228.23)	FeCl ₃ 11.29	C-31 0.678	0.094	0.0057	—	—	0.90	0.06					2.1	0.15	6.00
9	4/26	4.19 (245.83)	FeCl ₃ 8.67	C-31 0.64	0.072	0.0053	—	—	0.85	0.28					3.9	0.96	13.08
10	4/26	4.22 (247.59)	FeCl ₃ 8.53	C-31 0.62	0.071	0.0052	—	—	0.95	0.50					2.9	0.45	7.62
11	4/29	4.18 (245.24)	FeCl ₃ 7.90	C-31 0.526	0.066	0.0044	—	—	0.85	0.31					4.2	0.87	13.66
12	4/30	4.25 (249.35)	FeCl ₃ 8.75	C-31 0.583	0.073	0.0049	—	—	0.85	0.27					4.3	0.65	12.10
13	4/30	4.1 (240.55)	FeCl ₃ 17.21	C-31 0.573	0.144	0.0048	—	—	0.84	0.63					2.4	1.3	4.25
14	Run too short for calculations																
15	Run too short for calculations																

APPENDIX C-2 (CONTINUED)

Run No.	Date	Filter rate	Coag., mg/l	Polymer, mg/l	Coag.,	Polymer,	B.W. solids,	B.W. vol. as % of treated water ^a	Avg. turb. (Turb. @ time of sample), TU	ORF Fibersx10 ⁶ /l Raw Filter	NWQL Amphibole Fibersx10 ⁶ /l Raw Filter	UMD Fibersx10 ⁶ /l Raw Filter	Terminal HL Ft. H ₂ O Turb. TU	Run Length, Hrs. (Time to Sample)
		gpm/ft ² (m ³ /m ² day)			lb 1000 gal.	lb 1000 gal.	lb 1000 gal.	TU Raw Filter						
16	5/1	4.285 (251.40)	FeCl ₃ 16.75	C-31 0.492	0.140	0.0041	—	—	0.77 0.39				2.9 1.1	5.92
17		Run too short for calculations.												
18		Effluent turbidity too high.												
		Polymer added to 2nd floc. chamber.												
19	5/2	4.2 (246.41)	FeCl ₃ 11.71	N-17 0.320	0.098	0.0027	—	—	0.80 0.34				6.4 0.33	5.58
		Polymer added to 1st floc. chamber.												
20	5/2	4.21 (247.00)	FeCl ₃ 11.36	N-17 0.317	0.095	0.0027	—	—	0.60 0.23				6.3 0.64	13.03
		Polymer added to 2nd floc. chamber.												
21	5/3	4.21 (247.00)	FeCl ₃ 12.21	N-17 0.106	0.102	0.00089	—	—	0.75 0.39				6.8 1.75	11.17
		Polymer added to 1st floc. chamber.												
22	5/3	3.82 (224.12)	FeCl ₃ 11.48	N-17 0.121	0.096	0.0010	—	—	0.75 0.51				4.0 1.50	10.83
23	5/6	4.24 (248.76)	FeCl ₃ 11.78	N-17 0.330	0.098	0.0028	—	—	0.70 0.33				6.0 1.5	12.50
		Now using Alum as coag. added to mixing chamber.												
24	5/6	4.25 (249.35)	Alum 16.74	N-17 0.20	0.140	0.0017	—	—	0.70 0.24				6.2 0.70	14.75
25	5/7	3.82 (224.12)	Alum 18.85	N-17 0.269	0.157	0.0022	—	—	0.70 0.12				6.5 0.17	17.0
26	5/8	3.8 (222.95)	Alum 18.54	N-17 0.394	0.155	0.0033	—	—	0.68 0.16				7.0 0.80	16.66
27	5/9	3.67 (215.32)	Alum 19.62	N-17 0.48	0.164	0.0040	—	—	0.80 0.12				7.0 0.11	17.00

APPENDIX C-2 (CONTINUED)

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lb 1000 gal.	Polymer, lb 1000 gal.	B.W. solids, lb 1000 gal.	B.W. vol. as % of treated water ^a	Avg. turb. (Turb. @ time of sample), TU		ORF Fibersx10 ⁶ /l Raw	NWQL Amphibole mg/l	UMD Fibersx10 ⁶ /l Raw	Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)		
									Raw	Filter								
28	5/9	3.47 (203.59)	Alum 21.59	985-N 0.968	0.180	0.0081	—	—	0.70	0.11				6.6	0.15	9.66		
29	5/10	3.96 (232.33)	Alum 18.93	985-N 0.710	0.158	0.0059	—	—	0.75	0.13				6.6	0.10	8.0		
30	5/10	5.28 (309.78)	Alum 10.54	985-N 0.251	0.088	0.0021	—	—	0.65	0.11				6.3	0.09	9.42		
31	5/13	3.78 (221.37)	Alum 14.75	985-N 0.148	0.123	0.0012	—	—	0.95	0.49				5.8	1.8	8.95		
32	5/13	3.614 (212.03)	Alum 20.0	985-N 0.25	0.167	0.0021	—	—	0.95	0.48				6.1	0.12	8.3		
33	5/14	3.75 (220.01)	Alum 18.65	985-N 0.175	0.156	0.0015	—	—	0.80	0.17				7.0	0.15	11.41		
34	5/14	3.91 (229.40)	Alum 18.57	N-17 0.133	0.155	0.0011	—	—	2.3	0.24				5.8	0.20	9.63		
35	5/15	3.95 (231.75)	Alum 18.5	N-17 0.15	0.154	0.0013	—	—	1.5	0.30				6.8	0.25	12.65		
36	5/15	3.52 (206.52)	Alum 20.44	N-17 0.265	0.170	0.0022	—	5.68% ^b	1.3	0.24				7.0	0.11	9.38		
37	5/16	3.86 (226.47)	Alum 18.62	N-17 0.24	0.155	0.0020	—	3.46% ^b	1.0 (0.8)	0.19 (0.19)	A=2.61 C=1.35	A=BDL C=.174	0.14	0.003		6.4	0.20	12.16 (9.8)
38	5/16	4.13 (242.31)	Alum 17.46	N-17 0.22	0.146	0.0018	—	4.09% ^b	1.1	0.23				6.3	0.21	11.08		
39	5/17	3.876 (227.41)	Alum 19.4	N-17 0.194	0.162	0.0016	—	2.80% ^b	1.0	0.19				6.5	0.11	14.95		
40	5/17	3.93 (230.57)	Alum 18.77	N-17 0.156	0.157	0.0013	—	4.59% ^b	1.0	0.20				4.0	0.24	10.15		
Polymer fed @ entrance to 1st floc. chamber.																		
41	5/20	3.85 (225.88)	Alum 17.92	N-17 0.132	0.149	0.0011	—	1.80%	0.88	0.20				6.9	0.15	19.57		

APPENDIX C-2 (CONTINUED)

Run No.	Date	Filter rate (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lb 1000 gal.	Polymer, lb 1000 gal.	B.W. solids, lb 1000 gal.	B.W. vol as % of treated water	Avg. turb. (Turb. @ time of sample), TU		ORF Fibersx10 ⁶ /l Raw	NWQL Amphibole mg/l Raw	UMD Fibersx10 ⁶ /l Raw	Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)		
									Raw	Filter								
42	5/21	4.03 (236.44)	Alum 19.6	985-N 0.28	0.163	0.0024	0.057	3.79% ^b	0.85	0.17					6.6	0.08	12.00	
43	5/22	3.84 (225.29)	Alum 19.09	985-N 0.108	0.159	0.00090	0.025	2.89% ^b (0.94)	0.88 (0.15)	0.16		0.20	<0.003		6.7	0.15	15.00 (10.0)	
44	5/22	3.87 (227.05)	Alum 19.02	985-N 0.116	0.157	0.00097	0.032	2.32% ^b	0.92	0.13					7.0	0.10	13.92	
45	5/23	3.71 (217.67)	Alum 19.24	985-N 0.093	0.160	0.00078	0.050	4.14% ^b	1.0	0.14					4.8	0.10	10.83	
46	5/23	3.87 (227.05)	Alum 19.1	985-N 0.093	0.159	0.00078	0.110	3.11% ^b	1.3	0.15					6.6	0.05	13.83	
47	5/24	3.95 (231.75)	Alum 18.77	985-N 0.074	0.157	0.00061	0.051	1.84% ^b	1.1	0.12					6.9	0.15	17.17	
48	5/28	3.88 (227.64)	Alum 18.46	985-N 0.053	0.154	0.00044	0.115	2.72%	0.86	0.23					6.0	1.0	18.13	
49	5/29	3.88 (227.64)	Alum 18.85	985-N 0.067	0.157	0.00056	0.083	2.36%	0.85	0.20					5.2	0.83	19.13	
50	5/30	4.01 (235.27)	Alum 16.05	985-N 0.054	0.134	0.00045	0.065	2.01% (0.80)	0.82 (0.12)	0.16	A=1.43 C=1.83	A=BDL C=.913	0.19	0.005		6.8	0.68	23.68 (7.5)
51	5/31	5.09 (298.63)	Alum 10.48	985-N 0.031	0.087	0.00026	0.031	1.77%	0.85	0.44					7.0	0.80	28.08	
52	6/3	4.51 (264.60)	Alum 11.1	985-N 0.048	0.093	0.00040	0.031	1.18%	0.79	0.12					6.8	0.10	21.91	
53	6/4	4.15 (243.48)	Alum 11.19	985-N 0.053	0.110	0.00045	0.011	1.27% (0.86)	0.85 (0.09)	0.10	A=1.74 C=29.0	A=BDL C=1.87	0.26	<0.006		6.7	0.05	24.03 (4.7)
54	6/6	1.97 (115.58)	Alum 12.8	985-N 0.052	0.107	0.00043	0.066	1.26% ^b (0.74)	2.0 (0.05)	0.09	A=1.5 C=2.3	A=0.09 C=0.09	0.18	<0.005		4.3	0.11	.67.33 (25.6)
55	6/11	1.86 (109.13)	Alum 13.72	985-N 0.050	0.114	0.00042	0.059	2.19% ^b (1.9)	3.5 (0.06)	0.15	A=1.0 C=1.6	A=BDL C=2.3	0.18	<0.004		1.2	0.11	33.13 (26.9)
56	6/11	1.97 (115.58)	Alum 12.23	985-N 0.076	0.102	0.00064	0.017	4.25% ^b	2.5	0.18					1.5	0.11	24.91	

APPENDIX C-2 (CONTINUED)

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lb 1000 gal.	Polymer, lb 1000 gal.	B.W. solids, lb 1000 gal.	B.W. vol. as % of treated water	Avg. turb. (Turb. @ time of sample), TU		ORF Fibersx10 ⁶ /l Raw	NWQL Amphibole mg/l Raw	UMD Fibersx10 ⁶ /l Raw	Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)			
									Raw	Filter									
57	6/13	6.31 (370.21)	Alum 11.17	985-N 0.051	0.093	0.00042	0.028	1.48%	2.15 (2.1)	0.3 (0.34)	A=0.48 C=0.41	A=0.15 C=2.02			33.25	0.07	6.7	0.99	15.58 (13.5)
58	6/13	5.33 (312.71)	Alum 13.2	985-N 0.075	0.111	0.00062	0.029	1.52%	1.9	0.10							8.0	0.10	12.90
59	6/14	5.65 (331.49)	Alum 13.6	985-N 0.061	0.113	0.00051	0.080	2.91%	1.95	0.19							8.0	0.09	12.05
60	6/14	6.82 (400.13)	Alum 10.43	985-N 0.042	0.087	0.00035	0.032	1.55%	1.7	0.21							6.6	0.20	9.83
61	6/17	6.77 (397.20)	Alum 10.25	985-N 0.037	0.085	0.00031	0.058	2.11%	0.95 (0.96)	0.20 (0.14)	A=0.61 C=2.15	A=0.04 C=0.37	0.17	< 0.01	10.64	0.41	8.0	0.20	11.57 (4.0)
62	6/18	6.84 (401.30)	Alum 10.033	985-N 0.064	0.084	0.0028	0.095	2.20%	0.95	0.20							8.0	0.35	12.68
63	6/18	6.91 (405.41)	Alum 9.46	985-N 0.089	0.079	0.00074	0.022	1.97%	0.90	0.17							8.0	0.14	11.02
64	6/19	6.86 (402.48)	Alum 9.35	985-N 0.058	0.078	0.00048	0.021	1.46%	0.95	0.18							8.0	0.11	10.80
65	6/19	6.87 (403.06)	Alum 14.98	985-N 0.084	0.125	0.00070	0.053	3.03%	0.89	0.14							8.0	0.10	7.58
66	6/20	7.82 (458.80)	Alum 16.12	985-N 0.082	0.134	0.00068	0.049	3.90%	0.90	0.13							8.0	0.13	6.32
67	6/20	6.82 (400.13)	Alum 12.29	985-N 0.086	0.102	0.00072	0.014	1.80%	0.92	0.13							8.0	0.12	7.47
68	6/20	6.89 (404.24)	Alum 11.86	985-N 0.082	0.099	0.00069	0.034	2.93%	1.1	0.15							8.0	0.17	7.87
69	6/21	7.47 (438.27)	Alum 6.99	985-N 0.058	0.058	0.00049	0.027	1.22%	1.3	0.22							8.0	0.16	10.20
70	6/21	6.78 (397.78)	Alum 8.175	985-N 0.068	0.068	0.00057	0.027	2.14%	1.1	0.20							8.0	0.27	10.64
71	6/24	6.86 (402.48)	Alum 7.10	985-N 0.079	0.059	0.00066	0.042	1.98%	.70 (0.66)	0.16 (0.20)	A=1.0 C=3.9	A=0.02 C=0.98			6.03	0.825	8.0	0.10	12.75 (4.3)

APPENDIX C-2 (CONTINUED)

Run No.	Date	Filter rate (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lb 1000 gal.	Polymer, lb 1000 gal.	B.W. solids, lb 1000 gal.	B.W. vol. as % of treated water	Avg. turb. (Turb. @ time of sample), TU		ORF Fibersx10 ⁶ /l Raw	NWOL Amphibole mg/l Raw	NWOL Amphibole mg/l Filter	UMD Fibersx10 ⁶ /l Raw	UMD Fibersx10 ⁶ /l Filter	Terminal HL Ft. H ₂ O	Terminal Turb. TU	Run Length, Hrs. (Time to Sample)
									Raw	Filter								
72	6/25	6.17 (361.99)	Alum 15.50	985-N 0.086	0.129	0.00072	0.025	1.80%	0.64	0.12						8.0	0.23	8.63
73	6/25	6.64 (389.57)	Alum 11.81	985-N 0.083	0.098	0.00069	0.031	2.76%	0.66	0.14						8.0	0.27	8.67
74	6/25	6.91 (405.41)	Alum 17.25	985-N 0.050	0.144	0.00041	0.063	3.31%	0.66	0.21						7.2	1.50	8.78
Cloquet water.																		
75	6/26	4.08 (239.37)	Alum 26.48	985-N 0.110	0.221	0.00092	0.066	7.36% ^b	3.48	0.11						1.7	0.25	4.17
1725	p.m.	mixer in mixing chamber.																
76	6/28	1.79 (105.02)	Alum 26.89	985-N 0.159	0.224	0.0013	0.029	12.21% ^b	2.9 (2.9)	0.07	A=0.91 C=3.35	A=BDL C=0.52	0.11 <0.005	5.54	0.53	1.5	0.13	9.35 (4.9)
Lakewood water. Tri-Media.																		
77	7/2	3.86 (226.47)	Alum 12.03	985-N 0.048	0.108	0.00040	0.0010	2.01% ^b	0.77	0.10						5.2	0.10	10.75
78	7/3	3.15 (184.81)	Alum 14.66	985-N 0.079	0.122	0.00066	—	2.50% ^b	0.75 (0.69)	0.10 (0.12)	A=0.56 A=3.57	A=0.02 C=0.5	0.07 <0.003	2.99	0.16	7.5	0.06	23.73 (3.3)
79	7/4	3.75 (220.01)	Alum 12.09	985-N 0.052	0.101	0.00043	—	2.97%	0.62	0.11						8.0	0.05	20.09
80	7/8	4.06 (238.20)	Alum 11.15	985-N 0.040	0.093	0.00033	—	—	0.67	0.09						8.0	0.09	14.77
81	7/9	4.77 (279.86)	Alum 10.38	985-N 0.032	0.087	0.00027	0.027	4.33% ^b	0.65	0.11						7.4	0.15	10.08
82	Effluent turbidity too high.																	
83	Effluent turbidity too high.																	
84	7/10	4.78 (280.44)	Alum 16.23	985-N 0.042	0.135	0.00035	0.027	2.63%	1.51	0.10						8.0	0.06	11.21

APPENDIX C-2 (CONTINUED)

Run No.	Date	Filter rate (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lb 1000 gal.	Polymer, lb 1000 gal.	B.W. solids, lb 1000 gal.	B.W. vol. as % of treated water	Avg. turb. (Turb. @ time of sample), TU		ORF Fibersx10 ⁶ /l Raw Filter	NWQL Amphibole mg/l Raw Filter	UMD Fibersx10 ⁶ /l Raw Filter	Terminal HL Ft. H ₂ O Turb. TU	Run Length, Hrs. (Time to Sample)	
									Raw	Filter						
85	7/10	4.85 (284.55)	Alum 14.84	985-N 0.045	0.124	0.00037	0.020	3.60%	0.86	0.09				8.0	0.09	9.91
86	7/11	4.91 (288.07)	Alum 9.52	985-N 0.040	0.070	0.00033	0.027	4.19%	1.9	0.08				8.0	0.07	8.82
87	7/11	4.94 (289.83)	Alum 9.37	985-N 0.045	0.078	0.00038	0.020	4.01%	1.46	0.13				8.0	0.13	9.62
88	7/12	4.86 (285.14)	Alum 9.69	985-N 0.048	0.081	0.00040	0.016	4.41%	1.2	0.12				8.0	0.08	7.97
89	7/12	4.79 (281.03)	Alum 11.26	985-N 0.058	0.094	0.00048	0.019	4.64%	0.88	0.09				8.0	0.11	6.86
90	7/15	4.22 (247.59)	Alum 13.59	985-N 0.059	0.113	0.00050	0.020	4.53%	0.70	0.07				8.0	0.06	8.04
91	7/15	3.23 (189.50)	Alum 16.54	985-N 0.069	0.138	0.00057	0.019	4.66%	0.67	0.06				8.0	0.06	9.60
92	7/16	4.30 (252.28)	Alum 10.82	985-N 0.042	0.090	0.00035	0.020	4.51%	0.67	0.08				8.0	0.05	8.11
55 gal	flash mix tanks with one 1725 rpm mixer in each installed ahead of floc. cham.								Alum added to first tan							
93	7/17	3.70 (217.08)	Alum 12.55	985-N 0.046	0.105	0.00038	0.024	3.58%	0.72	0.07				8.0	0.07	11.92
94	7/18	3.89 (228.23)	Alum 10.20	985-N 0.052	0.085	0.00044	0.033	3.02%	0.76	0.09				8.0	0.09	12.75
95	7/18	4.52 (265.19)	Alum 5.54	985-N 0.042	0.046	0.00035	0.017	2.68% ^b	0.85	0.59				3.7	0.58	13.75
96	7/19	3.75 (220.01)	Alum 6.98	985-N 0.060	0.058	0.00050	0.038	5.39% ^b	0.85 (0.90)	0.31 (0.16)	A=0.52 C=0.35	A=0.02 C=0.04	0.13 <0.005	266.0	0.95	3.1 (2.1) 0.60
97	7/19	3.51 (205.93)	Alum 9.08	985-N 0.060	0.076	0.00050	0.026	3.56% ^b	0.70	0.29				4.7	0.19	13.33
98	7/22	3.68 (215.91)	Alum 10.72	985-N 0.036	0.089	0.00030	0.019	2.38%	0.62	0.08				8.0	0.12	16.74

APPENDIX C-2 (CONTINUED)

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lbs. 1000 gal.	Polymer, lbs. 1000 gal.	B.W. solids, lbs. 1000 gal.	B.W. vol. as % of treated water	Avg. turb. (Turb. @ time of sample), TU Raw Filter	ORF Fibersx10 ⁶ /l Raw Filter	NWQL Amphibole mg/l Raw Filter	UMD Fibersx10 ⁶ /l Raw Filter	Terminal HL Ft. H ₂ O Turb. TU	Run Length, Hrs. (Time to Sample)	
99	7/23	4.41 (258.74)	Alum 8.77	985-N 0.029	0.073	0.00025	0.023	1.96%	0.60 (0.57) 0.12 (0.11)	A=0.54 C=0.09 A=BDL C=0.20	0.09 <0.004	26.0	0.23	8.0 0.09	17.95 (7.9)
100	7/24	4.23 (248.71)	Alum 10.80	985-N 0.031	0.090	0.00026	0.057	2.05%	0.75 (0.66) 0.09	A=0.11 C=1.43 A=BDL C=0.15	0.04 <0.005	60.5	0.43	8.0 0.08	18.25
101	7/25	4.55 (266.95)	Alum 9.99	985-N 0.013	0.083	0.00011	0.033	2.30%	0.75 (0.66) 0.14 (0.09)	A=0.11 C=1.43 A=BDL C=0.15	0.04 <0.005	60.5	0.43	8.0 0.10	14.68 (13.1)
102	7/25	4.43 (259.91)	Alum 10.84	985-N 0.0014	0.090	0.000012	0.069	1.90%	0.73 (0.76) 0.13	A=BDL				4.5 0.36	19.75
103	7/26	4.32 (253.45)	Alum 10.89	985-N 0.0076	0.091	0.000063	0.014	2.03%	0.60 (0.69) 0.13	A=BDL				4.8 0.45	19.00
104	7/30	4.32 (253.45)	Alum 11.00	985-N 0.0016	0.092	0.000013	0.023	2.16%	0.73 (0.76) 0.15 (0.40)	A=BDL			0.10 0.02	3.4 0.40	17.87 (17.7)
105	7/30	4.41 (258.74)	Alum 10.97	985-N 0.029	0.091	0.00024	0.018	1.46%	0.75 (0.69) 0.10 (0.09)	A=0.11 C=0.11 A=BDL C=BDL	0.06 <0.005	26.6	0.10	5.5 0.36	25.83 (4.3)
Clay water															
106	7/31	4.17 (244.65)	Alum 20.97	985-N 0.122	0.175	0.0010	0.018	10.00% ^b	3.68 (4.00) 0.06 (0.06)	A=0.33 C=0.22 A=BDL C=BDL	0.10 <0.003	106.6	0.64	2.2 0.05	4.00 (2.4)
Lakewood water															
107	8/1	3.20 (187.74)	Alum 16.19	985-N 0.040	0.135	0.00033	0.041	1.69%	0.90 (0.87) 0.08 (0.08)	A=0.22 C=0.15 A=BDL C=BDL	0.08 <0.003	30.0	0.14	5.0 0.35	30.83 (17.9)
108	8/2	4.01 (235.27)	Alum 13.11	985-N 0.032	0.109	0.00026	0.032	1.59%	1.11 (0.58) 0.08 (0.06)	A=0.6 C=0.3 A=BDL C=BDL				8.0 0.07	24.63
109	8/6	3.38 (198.31)	Alum 15.10	985-N 0.043	0.129	0.00036	0.069	1.19%	0.62 (0.58) 0.10 (0.06)	A=0.6 C=0.3 A=BDL C=BDL	0.09 <0.003	10.2	0.19	8.0 0.17	34.26 (23.5)
110	8/7	4.07 (238.79)	Alum 13.63	985-N 0.031	0.114	0.00026	0.067	1.59%	0.66 (0.68) 0.12 (0.08)	A=0.06 C=0.09 A=BDL C=BDL	0.05 <0.003	15.1	0.16	5.1 0.48	22.50
111	8/8	4.47 (232.26)	Alum 11.73	985-N 0.034	0.098	0.00028	0.019	1.40%	0.92 (0.68) 0.11 (0.08)	A=0.06 C=0.09 A=BDL C=BDL	0.05 <0.003	15.1	0.16	8.0 0.12	25.55 (9.9)

APPENDIX C-2 (CONTINUED)

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lbs. 1000 gal.	Polymer, lbs. 1000 gal.	B.W. solids, lbs 1000 gal.	B.W. vol. as % of treated water	Avg. turb. (Turb. @ time of sample), TU		ORF Fibersx10 ⁶ /l Raw	NWQL Amphibole mg/l Raw	UMD Fibersx10 ⁶ /l Raw	Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)
									Raw	Filter						
112	8/9	4.18 (245.24)	Alum 12.76	985-N 0.041	0.106	0.00034	0.026	1.80%	1.23	0.18				8.0	0.15	20.51
113	8/13	3.88 (227.64)	Alum 15.30	985-N 0.041	0.128	0.00034	0.032	1.82%	0.64 (0.60)	0.07 (0.06)	A=0.13 C=0.2	A=BDL C=1.4	0.06 <0.003	20.0	0.37	8.0 0.06 (22.3)
114	8/15	1.97 (115.58)	Alum 18.93	985-N 0.042	0.158	0.00035	0.078	1.37%	0.65 (0.71)	0.05 (0.04)	A=0.09 C=0.17	A=0.02 C=0.22	0.06 <0.003	8.98	0.43	8.0 0.04 (45.7)
115	8/16	4.25 (249.35)	Alum 14.67	985-N 0.030	0.122	0.00025	0.095	1.58%	0.77	0.09				8.0	0.35	22.68
Alum and anionic polymer added to first tank, cationic polymer added to second tank.																
116	8/19	3.88 (227.64)	Alum 15.32	A-23 0.385	0.128	0.00032	0.090	2.23%	0.57	0.07				3.5	0.39	19.25
Alum added to first tank, cationic polymer added to second tank.																
117	8/19	3.95 (231.75)	Alum 16.08	Catfloc B 0.533	0.134	0.0044	0.073	2.22%	0.71	0.06				1.7	0.23	14.25
Alum and anionic polymer added to first tank, cationic or nonionic polymer added to second tank.																
118	8/20	4.01 (235.27)	Alum 15.43	A-23 0.648	0.129	0.0054	0.130	2.06%	0.82 (0.84)	0.11 (0.08)	A=0.30 C=0.72	A=0.02 C=2.1	0.02 <0.003	25.3	0.15	7.4 0.20 (1.9)
119	8/23	4.24 (248.76)	Alum 14.24	A-23 0.281	0.119	0.0023	0.124	1.70%	0.59 (0.63)	0.08 (0.08)	A=0.72 C=0.44	A=BDL C=0.28	0.04 <0.003	17.0	0.26	8.0 0.06 (18.5)
120	8/23	3.75 (220.01)	Alum 12.90	985-N 0.042	0.108	0.0026	0.018	5.12% ^b	0.53	0.09				1.4	0.11	8.67
Alum and anionic polymer added to first tank, cationic polymer added to second tank.																

APPENDIX C-2 (CONTINUED)

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lbs. 1000 gal.	Polymer, lbs. 1000 gal.	B.W. solids, lbs. 1000 gal.	B.W. vol. as % of treated water	Avg. turb. (Turb. @ time of sample), TU		ORF Fibersx10 ⁶ /l Raw	NWQL Amphibole mg/l Raw	NWQL Amphibole mg/l Filter	UMD Fibersx10 ⁶ /l Raw	UMD Fibersx10 ⁶ /l Filter	Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)	
									Raw	Filter									
3 In-Line Kinetcs mixers installed, Alum added ahead of first mixer, polymer added ahead of second mixer.																			
121	8/27	4.32 (253.45)	Alum 10.13	985-N 0.041	0.084	0.00035	0.025	1.74%	0.46	0.07	A					5.5	0.32	20.57	
122	8/28	4.33 (254.04)	Alum 11.58	985-N 0.049	0.097	0.00040	0.031	1.69%	0.47 (0.43)	0.06 (0.04)	A=0.39 C=0.48	A=BDL C=0.04	0.09	< 0.003	10.4	0.11	6.2	0.30	19.92 (3.7)
123	8/29	3.79 (222.36)	Alum 13.13	985-N 0.065	0.110	0.00055	0.034	1.55%	0.50	0.06						5.8	0.33	24.22	
Anionic polymer added ahead of first mixer, Alum added ahead of second mixer, nonionic or cationic polymer																			
124	8/30	3.92 (229.99)	Alum 14.93	A-23 0.160	0.125	0.0013	0.044	1.63%	0.69 (0.39)	0.07 (0.05)	A=0.78 C=0.33	A=0.02 C=0.30	0.07	< 0.003	17.8	0.18	4.8	0.34	19.55 (3.7)
125	9/3	4.14 (242.89)	Alum 13.92	985-N 0.064		0.00053	0.052	2.16%	0.62	0.09					3.2	1.0	16.28		
				C-31 0.437	0.116	0.0036													
126	9/4	4.00 (234.68)	Alum 16.95	A-23 0.133	0.141	0.0047	0.107	2.92%	0.66 (0.71)	0.08 (0.06)	A=1.61 C=0.3	A=BDL C=BDL	0.10	< 0.003	30.3	0.33	2.8	0.65	17.82 (9.6)
127	9/5	4.33 (254.04)	Alum 13.86	C-31 0.567	0.116	0.0047	0.011	2.63%	0.68	0.08						3.3	0.34	14.33	
128	9/6	4.12 (241.72)	Alum 13.38	A-23 0.158	0.112	0.00050	0.017	2.39%	0.51 (0.51)	0.08 (0.10)	A=0.72 C=0.39	A=BDL C=0.37	0.07	< 0.003	13.6	0.17	8.0	0.39	21.00 (8.7)
Alum added ahead of first mixer, polymer added ahead of second mixer.																			
129	9/9	6.16 (361.41)	Alum 15.59	985-N 0.051	0.130	0.00042	0.039	2.08%	0.51	0.09						7.8	0.58	13.00	

APPENDIX C-2 (CONTINUED)

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Coag., mg/l	Polymer, mg/l	Coag., lbs.		B.W. solids, lbs. 1000 gal.	B.W. vol. as % of treated water	Avg. turb. (Turb. @ time of sample), TU		ORF Fibersx10 ⁶ /l		NWQL Amphibole mg/l		UMD Fibersx10 ⁶ /l		Terminal HL Ft. H ₂ O		Run Length, Hrs. (Time to Sample)		
					1000 gal.	1000 gal.			Raw	Filter	Raw	Filter	Raw	Filter	Raw	Filter	Raw	Filter	Raw	Filter	
130	9/10	6.09 (357.30)	Alum 12.56	985-N 0.085	0.105	0.00071	0.050	2.40%	0.51	0.07									8.0	0.08	11.06
131	9/10	6.18 (362.58)	Alum 13.36	985-N 0.053	0.111	0.00044	0.031	2.35%	0.58 (0.64)	0.07 (0.06)	A=0.6 C=0.5	A=BDL C=0.5	0.05	<0.003			0.27	8.0	0.23	10.05 (2.8)	
132	9/11	5.97 (350.26)	Alum 24.17	985-N 0.051	0.202	0.00042	0.037	2.64% ^b	0.83	0.11								5.2	0.20	9.25)	
133	9/11	5.98 (350.85)	Alum 24.56	985-N 0.077	0.205	0.00065	0.034	3.85%	0.60 (0.45)	0.16 (0.07)	A=0.3 C=0.3	A=0.02 C=0.3	0.06	<0.003	13.0	0.30	4.6	0.43	7.40 (4.3)		
134	9/11	4.12 (241.72)	Alum 16.63	C-31 0.586	0.139	0.0049	0.061	3.21%	0.47	0.07								3.1	9.0	12.62	
3 additional In-Line Kinecs mixers installed, Alum added ahead of first pair, polymer added ahead of second pair																					
135	9/12	4.02 (235.85)	Alum 18.97	C-31 0.628	0.158	0.0053	0.061	4.62%	0.42	0.07									2.8	0.25	8.97
136	9/13	4.05 (237.61)	Alum 37.86	C-31 0.793	0.316	0.0066	0.086	7.89%	0.47	0.06									2.1	0.55	5.22
137	9/13	3.98 (233.51)	Alum 19.66	C-31 0.790	0.164	0.0066	0.051	4.92% (0.40)	0.44 (0.05)	0.07 (0.05)	A=0.02 C=0.06	A=0.02 C=0.1	0.09	<0.003	30.0	0.24	2.6	0.21	9.6 (5.3)		
55 gal. flash mix tanks installed, Alum and anionic polymer added to first tank, cationic or nonionic polymer added to second tank																					
138	9/16	4.29 (251.69)	Alum 14.62	985-N 0.065	0.122	0.00054		1.61% (0.37)	0.42 (0.04)	0.06 (0.04)	A=0.9 C=0.1	A=0.02 C=0.3	0.08	<0.003	20.3	0.51	8.0	0.06	21.84 (1.9)		
139	9/17	4.35 (255.21)	Alum 14.70	C-31 0.622	0.123	0.0052	0.022	2.01% (0.47)	0.51 (0.05)	0.07 (0.05)	A=0.2 C=0.1	A=BDL C=0.1	0.06	<0.003	12.8	0.64	6.8	0.24	21.41 (1.5)		

APPENDIX C-2 (CONTINUED)

Run No.	Date	Filter rate	Coag., mg/l	Polymer, mg/l	Coag., lbs. 1000 gal.	Polymer, lbs. 1000 gal.	B.W. solids, lbs. 1000 gal.	B.W. vol. as % of treated water	Avg. turb. (Turb. @ time of sample), TU		ORF Fibersx10 ⁶ /l Raw	NWQL Amphibole mg/l Raw	UMD Fibersx10 ⁶ /l Raw	Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)			
		gpm/ft ² (m ³ /m ² day)							Raw	Filter									
Sedimentation tube settlers installed. Alum added to first tank, polymer added to second tank.																			
140	9/19	3.85 (225.88)	Alum 14.02	985-N 0.066	0.117	0.00055	From Sed. 0.0065 From B.W. 0.014 Total Solids 0.020	1.45%	0.47 (0.52)	0.06 (0.06)	A=0.6 C=0.09	A=BDL C=0.3	0.10	0.003	13.8	0.33	8.0	0.10	31.98 (1.8)

^a B.W. volume was not measured in Runs 1-35.^b Runs did not reach terminal H_L or turbidity.^c A=amphibole, C=chrysotile

APPENDIX C-3 VACUUM DIATOMACEOUS EARTH FILTRATION (BIF) SUMMARY OF INDIVIDUAL RUNS

Run No.	Date	Filter rate (gpm/ft ² (m ³ /m ² day))	Precoat, lbs./ft ²	Precoat, lbs. 1000 gal.	Polymer or coag. in precoat, g./g. of D.E.	Polymer or coag. in precoat, lbs. 1000 gal.	Other chem. in precoat, lbs. 1000 gal.	Body feed, mg/l	Body feed, lb. 1000 gal.	B.W. solids, lbs		(B.W. vol. as % of treated water) ^a	Avg. turb. (Turb. @ time of sample), TU	ORF Fibersx10 ⁶ /l Raw Filter	NWQL Amphibole mg/l	UMD Fibersx10 ⁶ /l Raw Filter	Terminal HL Ft H ₂ O	Turb. TU	Run Length, Hrs (Time to Sample)	
										1000 gal.	TU Raw Filter									
One step precoat, E.P. FW-50 to precoat, J.M. Celite 512 to body feed.																				
1-T	4/24	0.843 (49.46)	FW-50 0.1	0.055	—	—	—	89.09	512 0.743	0.798	0.98	0.61	—	—	—	—	—	16.9	0.45	36.00
J.M.	Celite 512 to precoat.																			
2-T	4/26	0.913 (53.57)	512 0.1	0.059	—	—	—	82.30	512 0.686	0.746	0.85	0.65	—	—	—	—	—	15.3	2.5	30.75
E.P.	FW-50 to precoat.																			
3-T	4/29	1.015 (59.55)	FW-50 0.1	0.071	—	—	—	73.99	512 0.617	0.688	0.81	0.65	—	—	—	—	—	16.2	0.83	23.08
4-T	4/30	0.895 (52.51)	FW-50 0.1	0.061	—	—	—	67.01	512 0.559	0.620	0.79	0.33	—	—	—	—	—	17.0	0.33	30.50
J.M.	Hyflo Super Cel to precoat.																			
5-T	5/2	0.915 (53.68)	Super Cel 0.15	0.082	—	—	—	65.54	512 0.547	0.628	0.65	0.18	—	—	—	—	—	16.4	0.15	33.50
6-T	Run failed due to high HL.																			
7-T	Run failed due to high HL.																			
J.M.	Hyflo Super Cel & anionic polymer to precoat.																			
8-T	5/3	0.927 (54.39)	Super Cel 0.1	0.093	A-23 0.00005	A-23 4.67x10 ⁻⁶	—	64.68	512 0.539	0.633	0.69	0.16	—	—	—	—	—	11.6	0.15	19.50
J.M.	Celite 512 & anionic polymer to precoat																			
9-T	5/6	1.019 (59.785)	512 0.1	0.084	A-23 0.00003	A-23 2.51x10 ⁻⁶	—	48.05	512 0.401	0.485	0.69	0.19	—	—	—	—	—	16.8	0.18	19.50
10-T	5/7	1.035 (60.72)	512 0.1	0.070	A-23 0.00003	A-23 2.1x10 ⁻⁶	—	57.90	512 0.483	0.553	0.72 (0.76)	0.19 (0.18)	A=0.522 C=0.130 A=BDL C=1.43	0.06	< 0.01	—	—	16.3	0.24	22.92 (2.2)
Dicalite Speed flow & anionic polymer to precoat																				
11-T	5/8	1.065 (62.48)	Speed flow 0.1	0.104	A-23 0.00003	A-23 3.13x10 ⁻⁶	—	56.27	512 0.469	0.574	0.68	0.15	—	—	—	—	—	16.8	0.12	15.00

APPENDIX C-3 (CONTINUED)

Run No.	Date	Filter rate	Precoat,	Polymer or coag. in precoat,	Polymer or coag. in precoat,	Other chem. in precoat,	Body feed,	Body feed,	B.W. solids,	Avg. turb. (Turb. @ time of sample), TU	ORF Fibersx10 ⁶ /l	NWQL Amphibole mg/l	UMD Fibersx10 ⁶ /l	Terminal HL Ft. H ₂ O	Run Length, Hrs. (Time to Sample)				
		gpm/ft ² (m ³ /m ² day)	lbs./ft ²	1000 gal.	g./g. of D.E.	1000 gal.	1000 gal.	1000 gal.	lbs. 1000 gal. (B.W. vol. as % of treated water) ^a										
J.M.	Hyflo	Super Cel to first step of precoat.																	
60	7/12	0.958 (56.21)	Super Cel 0.1	0.220	Al+++ 0.005	Alum 0.012	Soda Ash 0.013	52.66	512 0.439	0.903	0.72	0.32				11.7	0.29	7.92	
			512 0.1	0.220															
61	7/15	0.893 (52.69)	Super Cel 0.1	0.081	Al+++ 0.005	Alum 0.0045	Soda Ash 0.0046	72.96	512 0.609	0.780	0.70	0.38					15.8	0.32	22.92
			512 0.1	0.081															
J.M.	Celite	512 & Alum & Soda Ash to body feed.																	
62	7/16	0.950 (55.74)	Super Cel 0.1	0.264	Al+++ 0.005	Alum 0.015	Soda Ash 0.015	87.21	512 0.727	1.368	0.66	0.52					15.9	0.36	6.63
			512 0.1	0.264															
E.P.	FW-20	to first step of precoat.	J.M. Hyflo	Super Cel & anionic polymer to second step of precoat.															
63	7/16	0.920 (53.98)	FW-20 0.1	0.199	A-23 0.00002	A-23 3.99x10 ⁻⁶		19.12	512 0.159	0.576	0.68	0.13					10.2	0.08	9.08
			Super Cel 0.1	0.199															
64	7/17	0.888 (52.10)	FW-20 0.1	0.169	A-23 0.00002	A-23 3.38x10 ⁻⁶		76.04	512 0.634	1.015	0.69	0.16					16.5	0.12	11.15
			Super Cel 0.1	0.169															
65	7/17	0.859 (50.40)	FW-20 0.1	0.182	A-23 0.00002	A-23 3.64x10 ⁻⁶		108.02	512 0.901	1.366	0.73	0.15					16.4	0.21	10.67
			Super Cel 0.1	0.182															

APPENDIX C-3 (CONTINUED)

APPENDIX C-3 (CONTINUED)

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Precoat, lbs./ft ²	Precoat, 1000 gal.	Polymer or coag. in precoat, g./g. of D.E.	Polymer or coag. in precoat, lbs. 1000 gal.	Other chem. in precoat, lbs. 1000 gal.	Body feed, mg/l	Body feed, lb. 1000 gal.	B.W. solids, lbs 1000 gal. (B.W. vol. as % of treated water)	Avg. turb. (Turb. @ time of sample), TU		ORF Fibersx10 ⁶ /l Raw	NWQL Amphibole mg/l Raw	UMD Fibersx10 ⁶ /l Raw	Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)		
											Raw	Filter								
J.M.	Aqua	Cel to body feed, Catfloc B to raw water.																		
117	9/13	0.930 (54.56)	FW-50 0.15	0.130	Al+++ 0.01	Alum 0.0095	Soda Ash 0.0048	70.46	Aqua Cel 0.588	0.821 (0.074%)b	0.45 (0.40)	0.06 (0.08)	A=0.02 C=0.06	A=0.02 C=0.4	0.09 <0.003	30.0	0.47	7.4	0.04	20.75 (2.7)
			512 0.1	0.086				0.414	Catfloc B 0.0035											
118	9/16	0.826 (48.46)	FW-50 0.15	0.141	Al+++ 0.01	Alum 0.010	Soda Ash 0.0052	54.74	Aqua Cel 1.291	1.545 (0.210%)b	0.42 (0.37)	0.08 (0.08)	A=0.9 C=0.15	A=BDL C=1.3	0.08 <0.004	20.3	4.89	6.9	0.07	21.53 (4.5)
			512 0.1	0.094				0.584	Catfloc B 0.0049											
J.M.	Aqua	Cel to body feed for first half of run, E.P. FW-20 to body feed for remainder of run, Catfloc B to raw water.																		
119	9/17	0.8445 (49.55)	FW-50 0.15	0.120	Al+++ 0.01	Alum 0.0088	Soda Ash 0.0044	283.05	Aqua Cel FW-20 2.361	2.579 (0.239%)b	0.49	0.07	A=0.6 C=0.09	A=0.02 C=1.8	0.10 <0.004	13.8	0.76	7.4	0.10	24.67
			512 0.1	0.080				0.566	Catfloc B 0.0047											
120	9/19	0.861 (50.52)	FW-50 0.15	0.207	Al+++ 0.01	Alum 0.015	Soda Ash 0.0076	22.66	503 0.189	0.589 (0.207%)b	0.50 (0.52)	0.08 (0.11)	A=0.6 C=0.09	A=0.02 C=1.8	0.10 <0.004	13.8	0.76	14.2	0.07	14.00 (2.0)
			512 0.1	0.138				2.4905	Alum 0.021											
121	9/20	0.864 (50.69)	FW-50 0.15	0.235	Al+++ 0.01	Alum 0.017	Soda Ash 0.0086	1.248	Soda Ash 0.010	0.902 (0.054%)	0.45	0.06	A=0.6 C=0.09	A=0.02 C=1.8	0.10 <0.004	13.8	0.76	14.2	0.07	14.00 (2.0)
			512 0.1	0.156				49.99	503 0.417											
122	9/20	0.795 (46.61)	FW-50 0.15	0.297	Al+++ 0.01	Alum 0.022	Soda Ash 0.011	5.495	Alum 0.046	1.259 (0.222%)	0.46	0.09	A=0.6 C=0.09	A=0.02 C=1.8	0.10 <0.004	13.8	0.76	14.2	0.07	14.00 (2.0)
			512 0.1	0.198				2.753	Soda Ash 0.023											
								75.26	503 0.628											
								8.272	Alum 0.069											
								4.144	Soda Ash 0.035											

^a B.W. volume was not measured until Run 79.^b Runs did not reach terminal H_L or turbidity.^c A=amphibole, C=chrysotile

APPENDIX C-4 PRESSURE DIATOMACEOUS EARTH FILTRATION (ERD-1) SUMMARY OF INDIVIDUAL RUNS

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Precoat, lbs./ft ²	Precoat, 1000 gal.	Polymer or coag. in precoat, g./g. of D.E.	Polymer or coag. in precoat, 1000 gal.	Other chem. in precoat, lbs. 1000 gal.	Body feed, mg/l	Body feed, lb. 1000 gal.	B.W. solids, lbs 1000 gal.		Avg. turb. (Turb. @ time of sample), TU	ORF Fibersx10 ⁶ /l Raw	NWQL Amphibole mg/l Raw	UMD Fibersx10 ⁶ /l Raw	Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)			
										Body feed, lb. 1000 gal.	B.W. solids calc. from chem. & D.E. additions.										
One step precoat, E.P FW-50 & J.M. Celite 503 & cationic polymer to precoat, Dicalite Speedflow to body feed. B.W. solids calc. from chem. & D.E. additions.																					
1A	6/11	1.189 (69.76)	FW-50 0.1	0.027	573-C 0.0005	573-C 2.7x10 ⁻⁵		30.88	Speedflow 0.258	0.312	2.7 (1.9) (2.1)	0.25 (0.36) (0.15)	A=1.0 C=1.6 A=0.48 C=0.41	A=1.0 C=9.3 A=0.09 C=0.71	0.12	< 0.01	33.25	6.93	104.0	0.14	49.80 (2.8) (49.8)
	6/13		503 0.1	0.027																	
	J.M. Celite 503 & J.M. Celite 545 & cationic polymer to precoat, J.M. Celite 503 to body feed.																				
2A	6/13	1.358 (79.67)	503 0.1	0.091	573-C 0.0005	573-C 9.14x10 ⁻⁵		110.20	503 0.919	1.102	1.9	0.55						9.2	0.55	13.42	
			545 0.1	0.091																	
	J.M. Celite 503 & Dicalite Speedflow & cationic polymer to precoat, Dicalite Speedflow to body feed.																				
3A	6/14	1.215 (71.28)	503 0.1	0.069	573-C 0.0007	573-C 7.29x10 ⁻⁵		122.96	Speedflow 1.025	1.130	1.9	0.17						63.5	0.10	19.75	
			Speed flow 0.05	0.035																	
4A	6/17	1.227 (71.99)	503 0.05	0.028	573-C 0.0008	573-C 6.81x10 ⁻⁵		41.34	Speedflow 0.345	0.430	0.91 (0.96)	0.14 (0.15)	A=0.61 C=2.15	A=BDL C=1.37	0.17	0.005	10.64	7.07	55.4	0.11	23.90 (4.9)
			Speed flow 0.1	0.057																	
5A	6/18	1.213 (71.17)	503 0.05	0.034	573-C 0.0008	573-C 8.04x10 ⁻⁵		195.98	Speedflow 1.635	1.735	0.91	0.10						98.1	0.07	20.5	
			Speed flow 0.1	0.067																	
6A	6/19	1.199 (70.35)	503 0.05	0.042	573-C 0.0008	573-C 10.16x10 ⁻⁵		37.68	Speedflow 0.314	0.441	0.90	0.16						47.3	0.15	16.42	
			Speed flow 0.1	0.085																	

^a B.W. volume was not measured.

^b A=amphibole, C=chrysotile

APPENDIX C-4 PRESSURE DIATOMACEOUS EARTH FILTRATION (ERD-2) SUMMARY OF INDIVIDUAL RUNS

APPENDIX C-4 (CONTINUED)

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Precoat, lbs./ft ²	Precoat, lbs. 1000 gal.	Polymer or coag. in precoat, g./g. of D.E.	Polymer or coag. in precoat, lbs. 1000 gal.	Other chem. in precoat, lbs. 1000 gal.	Body feed, mg/l	Body feed, lb. 1000 gal.	B.W. solids, lbs		Avg. turb. (B.W. vol. as % of treated water) ^a	ORF Fibersx10 ⁶ /l Raw	NWQL Amphibole mg/l Raw	UMD Fibersx10 ⁶ /l Raw	Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)		
										1000 gal.	1000 gal.									
10	5/16	1.553 (91.12)	Speed flow 0.1	F - C 0.028	C-31 0.0005	FW-50 0.05	Speed flow 0.1	F - C 0.060	70.8	Super Cel 0.590	0.633	1.2 (0.8)	0.29 (0.13)	A=2.61 C=1.35	A=0.261 C=1.04	0.14	0.003	104.0	0.35	37.43 (30.6)
11			FW-50 0.05	0.014						63.59	Super Cel 0.530	0.621	1.1	0.35						
Cationic polymer also added to precoat.			Speed flow 0.05	0.030													103.9	0.25	16.00	
12	5/17	1.204 (70.64)	Speed flow 0.1	F - C 0.094	C-31 0.0005	7.06x10 ⁻⁵	91.30	F - C 0.094	7.06x10 ⁻⁵	Super Cel 0.761	0.903	0.87	0.32			25.4	0.25	14.7		
13			FW-50 0.05	0.047						79.40	Super Cel 0.662	0.682	0.98 (0.94)	0.18 (0.17)						
14	5/30	1.153 (67.65)	Speed flow 0.1	F - C 0.013	C-31 0.0005	0.96x10 ⁻⁵	55.17	F - C 0.0064	1.51x10 ⁻⁵	Super Cel 0.460	0.490	0.85 (0.80)	0.175 (0.14)	A=1.43 C=1.83	A=BDL C=0.0435	0.19	0.004	104.0	0.20	71.84 (46.0)
J.M.			FW-50 0.05	0.010						55.17	Super Cel 0.460	0.490								
Celite		503 & Dicalite	Speedflow & cationic polymer to precoat, Dicalite Speedflow to body feed.																	
15	6/4	1.069 (62.72)	503 0.1	MC-F 0.019	573C 0.0006	1.7x10 ⁻⁵	86.01	Speed plus 0.717	0.746	Speed plus 0.717	0.746	0.75 (0.86)	0.15 (0.15)	A=1.74 C=2.91	A=.0391 C=1.00	0.26	0.003	104.0	0.12	78.97 (27.7) (75.4)
15	6/6		Speed flow 0.05	0.0095						86.01	Speed plus 0.717	0.746	0.746 (0.74)	0.15 (0.15)	A=1.5 C=2.3	A=0.1 C=0.4	0.18	<0.004		

APPENDIX C-4 (CONTINUED)

APPENDIX C-4 (CONTINUED)

APPENDIX C-4 (CONTINUED)

APPENDIX C-4 (CONTINUED)

Run No.	Date	Filter rate gpm/ft ² (m ³ /m ² day)	Precoat, lbs./ft ²	Precoat, lbs.	Polymer or coag. in precoat, g./g. of D.E.	Polymer or coag. in precoat, lbs. 1000 gal.	Other chem. in precoat, lbs. 1000 gal.	Body feed, mg/l	Body feed, lb. 1000 gal.	B.W. solids, lbs. 1000 gal. (B.W. vol. as % of treated water) ^a	Avg. turb. (Turb. @ time of sample), TU		ORF Fibersx10 ⁶ /l Raw	NWQL Amphibole mg/l Raw	UMD Fibersx10 ⁶ /l Raw	Terminal HL Ft. H ₂ O	Terminal Turb. T.U.	Run Length, Hrs. (Time to Sample)			
											1000 gal.	%									
39	7/17	1.075 (63.07)	FW-50 0.1	C-MC 0.056	Al+++ 0.01	0.0062	Soda Ash 0.0065	63.89	FW-20 0.533	0.658	0.71	0.10				16.2	0.11	27.5			
			FW-20 0.1	0.056																	
40	7/19	1.155 (67.76)	FW-50 0.1	C-MC 0.050	Al+++ 0.01	0.0055	Soda Ash 0.0057	116.62	FW-20 0.974	1.083	0.78 (0.90)	0.11 (0.12)	A=0.52 C=0.35	A=0.11 C=0.22	0.13	<0.003	266.0	4.16	18.5	0.14	29.08 (9.9)
			FW-20 0.1	0.050																	
41	7/23	1.195 (70.11)	FW-50 0.1	C-MC 0.049	Al+++ 0.01	0.0052	Soda Ash 0.0056	200.51	FW-20 1.672	1.781	0.59 (0.57)	0.12 (0.09)	A=0.54 C=0.09	A=0.09 C=0.09	0.09	<0.003	26.0	2.04	23.1	0.09	28.52 (27.5)
			FW-20 0.1	0.049																	
J.M.	Celite	512 & Alum	Soda Ash to second step of preccat, J.M. Celite 545 to body feed.																		
42	7/23	1.11 (65.24)	FW-50 0.1	C-F 0.054	Al+++ 0.01	0.0060	Soda Ash 0.0062	26.12	545 0.218	0.339	0.71	0.12					21.9	0.18	27.52		
			512 0.1	0.054																	
43	7/25	1.024 (60.08)	FW-50 0.1	C-F 0.073	Al+++ 0.01	0.0080	Soda Ash 0.0043	42.04	545 0.351	0.509	0.73 (0.66)	0.13 (0.09)	A=0.11 C=1.43	A=BDL C=0.44	0.04	<0.003	60.5	0.964	47.4	0.14	22.33 (13.8)
			512 0.1	0.073																	
44	7/25	1.018 (59.73)	FW-50 0.1	C-F 0.049	Al+++ 0.01	0.0054	Soda Ash 0.0029	60.16	545 0.502	0.603	0.66	0.15					18.5	0.21	33.42		
			512 0.1	0.049																	
J.M.	Celite	545	to first step of precoat, J.M. Celite 512 to second step of precoat, J.M. Celite 545 to body feed, Catfloc B to raw water.																		
45	7/30	1.01 (59.26)	545 0.1	VC-F 0.036	-	-		58.29	545 0.486	0.563	0.73 (0.69)	0.11 (0.10)	A=0.1 C=0.11	A=BDL C=0.07	0.06	<0.003	26.6	0.87	18.5	0.08	45.42 (21.5)
			512 0.1	0.036																	

APPENDIX C-4 (CONTINUED)

APPENDIX C-4 (CONTINUED)

APPENDIX C-4 (CONTINUED)

APPENDIX C-4 (CONTINUED)

APPENDIX C-4 (CONTINUED)

Run No.	Date	Filter rate (m ³ /m ² day)	Precoat, lbs./ft ²	Precoat, 1000 gal.	Polymer or coag. in precoat, g./g. of D.E.	Polymer or coag. in precoat, lbs. 1000 gal.	Other chem. in precoat, lbs. 1000 gal.	Body feed, mg/l	Body feed, lb. 1000 gal.	B.W. solids, lbs 1000 gal. (B.W. vol. as % of treated water) ^a		Avg. turb. (Turb. @ time of sample), TU Raw Filter		ORF Fibersx10 ⁶ /l Raw Filter		NWQL Amphibole mg/l Raw Filter		UMD Fibersx10 ⁶ /l Raw Filter		Terminal HL H ₂ O Turb. Ft. TU		Run Length, Hrs. (Time to Sample)	
										1000 gal.	1000 gal.	Raw	Filter	Raw	Filter	Raw	Filter	Raw	Filter	Raw	Filter		
75	9/11	1.181 (69.29)	FW-50 0.1	C-F 0.067	Al+++ 0.01	Alum 0.0074	Soda Ash 0.0037	130.78	Super Cel 1.091	1.241	0.68	0.06									23.1	0.04	21.05
			512 0.1	0.067				0.5786	Catfloc B 0.0048														
J.M.	Celite	512 to body feed, Catfloc B to raw water.																					
76	9/12	0.940 (55.15)	FW-50 0.1	C-F 0.085	Al+++ 0.01	Alum 0.0093	Soda Ash 0.0047	22.22	512 0.185	0.374	0.40	0.06									13.9	0.06	20.92
			512 0.1	0.085				0.6605	Catfloc B 0.0055														
77	Pump	Malfunction																					
78	9/13	1.093 (64.13)	FW-50 0.1	C-F 0.111	Al+++ 0.01	Alum 0.012	Soda Ash 0.0061	48.80	512 0.407	0.652	0.44 (0.40)	0.05 (0.08)	A=0.02 C=0.06	A=BDL C=0.06	0.09	<0.003	30.0	0.51	32.3	0.04	13.75 (1.7)		
		512 0.1	0.111				0.5983	Catfloc B 0.0050															
J.M.	Aqua	Cel to body feed, Catfloc B to raw water.																					
79	9/16	1.092 (64.07)	FW-50 0.1	C-F 0.077	Al+++ 0.01	Alum 0.0085	Soda Ash 0.0042	27.33	Aqua Cel 0.228	0.397	0.42 (0.37)	0.05 (0.04)	A=0.9 C=0.1	A=0.02 C=0.06	0.08	<0.003	20.3	0.81	25.4	0.06	19.83 (1.5)		
			512 0.1	0.077				0.3323	Catfloc B 0.0028														
80	9/17	1.120 (65.71)	FW-50 0.1	C-F 0.085	Al+++ 0.01	Alum 0.0093	Soda Ash 0.0047	71.57	Aqua Cel 0.597	0.783	0.50	0.06								18.5	0.05	17.53	
			512 0.1	0.085				0.3455	Catfloc B 0.0029														
81	9/18	1.062 (62.31)	FW-50 0.1	C-F 0.074	Al+++ 0.01	Alum 0.0081	Soda Ash 0.0041	135.23	Aqua Cel 1.128	1.290	0.52	0.07								18.5	0.07	21.28	
			512 0.1	0.074				0.3094	Catfloc B 0.0026														

APPENDIX C-4 (CONTINUED)

Run No., Date	Filter rate gpm/ft ² (m ³ /m ² day)	Precoat, lbs./ft ²	Precoat, lbs. 1000 gal.	Polymer or coag. in precoat, g./g. of D.E.	Polymer or coag. in precoat, lbs 1000 gal.	Other chem. in precoat, lbs 1000 gal.	Body feed, mg/l	Body feed, lb. 1000 gal.	B.W. solids, lbs 1000 gal. (B.W. vol. as % of treated water) ^a		Avg. turb. (Turb. @ time of sample), TU Raw	ORF Fibersx10 ⁶ /l Raw	NWQL Amphibole mg/l Raw	UMD Fibersx10 ⁶ /l Raw	Terminal HL Ft. H ₂ O	Turb. TU	Run Length, Hrs. (Time to Sample)					
									1000 gal.	%												
J.M. Celite	512 & Alum & Soda Ash to body	feed, no Catfloc	B.																			
82	9/19	1.054 (61.84)	FW-50 0.1	C-F 0.238	Al+++ 0.01	Alum 0.026	Soda Ash 0.013	97.15	512 0.810		1.460	0.53	0.06	A=			101.6	0.05	6.62			
			512 0.1	0.238					10.68 Alum 0.089													
									5.35 Soda Ash 0.045													
83	Run terminated due to overheated motor.																					
84	Run terminated due to overheated motor.																					
J.M. Celite	503 & Alum & Soda Ash to body	feed.																				
85	9/20	1.069 (62.72)	FW-50 0.1	C-F 0.153	Al+++ 0.01	Alum 0.017	Soda Ash 0.0084	61.10	503 0.510		0.925	0.45	0.05	A=1.3 C=0.2	A=0.02 C=0.33	0.07	0.003	19.1	0.45	46.2	0.05	10.2 (5.5)
			512 0.1	0.153					6.716 Alum 0.056													
									3.365 Soda Ash 0.028													
86	9/20	1.043 (61.19)	FW-50 0.1	C-F 0.143	Al+++ 0.01	Alum 0.016	Soda Ash 0.0079	62.93	503 0.525		0.921	0.49	0.06							37.0	0.06	11.17
			512 0.1	0.143					6.917 Alum 0.058													
									3.465 Soda Ash 0.029													

^a B.W. volume was not measured.^b A=amphibole, C=chrysotile

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

TECHNICAL REPORT DATA (Please read Instructions on the reverse before completing)			
1. REPORT NO. EPA-670/2-75-050c	2.	3. RECIPIENT'S ACCESSION NO.	
4. TITLE AND SUBTITLE DIRECT FILTRATION OF LAKE SUPERIOR WATER FOR ASBESTIFORM FIBER REMOVAL Appendixes B and C		5. REPORT DATE June 1975; Issuing Date	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Black & Veatch, Consulting Engineers		8. PERFORMING ORGANIZATION REPORT NO.	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Black & Veatch, Consulting Engineers 1500 Meadow Lake Parkway Kansas City, Missouri 64114		10. PROGRAM ELEMENT NO. 1CB047; ROAP 21AQB; Task 024	11. CONTRACT GRANT NO. DACW 37-74-C-0079 IAG #EPA-IAG-D4-0388
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15. SUPPLEMENTARY NOTES This work conducted through interagency agreement between EPA Region V and the Corps of Engineers, St. Paul District. See also EPA-670/2-75-050a, b, d, e, f, and g.			
16. ABSTRACT Pilot plant research conducted in 1974 at Duluth, Minnesota, demonstrated that asbestos fiber counts in Lake Superior water could be effectively reduced by municipal filtration plants. During the study, engineering data were also obtained for making cost estimates for construction and operation of both granular and diatomaceous earth (DE) filtration plants ranging in size from 0.03 to 30 mgd. Appendix B contains information on the pilot filters used in the study. Data are presented on the physical aspects of the units (dimensions and equipment configuration) and on the manner in which the filters were operated. Appendix C contains data obtained during the individual pilot plant filter runs. This kind of information will be useful to persons needing to know about specific conditions such as raw water turbidity, filtration rate, and chemical doses or diatomaceous earth types and amounts used for precoat or body feed.			
17. KEY WORDS AND DOCUMENT ANALYSIS			
a. DESCRIPTORS Asbestos Amphiboles Serpentine Water supply Filtration Water treatment Pilot plants	b. IDENTIFIERS/OPEN ENDED TERMS Mixed media filtration Diatomaceous earth filtration Asbestiform Chrysotile Fiber removal Duluth (Minnesota) Lake Superior	c. COSATI Field/Group 13B	
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