

ICR Treatment Study Summary Report

Evaluation of Membrane Technology Using the Pilot-Scale Study for Compliance with the Information Collection Rule

Conducted during the period of April 1, 1998 through April 1, 1999

Prepared by:
Boca Raton Utility Services Quality Control Division
1401 Glades Road
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In July 1999

For:
Boca Raton Water Treatment Facility, PWSID # FL4500130
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Boca Raton Water Treatment Facility, ICR # 306

Attachments: 1 diskette / *Data Collection Spreadsheets & Summary Report Spreadsheets*
1 diskette / *Summary Report*

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SECTION I: CONCLUSIONS AND RECOMMENDATIONS

Before the Information Collection Rule (ICR) Treatment Study requirements, the City of Boca Raton committed funds to fully evaluate membrane technology using pilot plant test equipment. The following water quality goals were established for the water treatment facility finished water consisting of a blend of lime softened water and membrane treated water:

1. Meet all U.S. EPA Safe Drinking Water Act (SDWA) standards including the recently promulgated Disinfection By-Products Rule (DBPR) Stage 1 maximum contaminant levels (MCLs) of 0.080 mg/l of total trihalomethane (TTHM) and 0.060 mg/l of five haloacetic acids (HAA5) with a 20 percent safety factor.
2. Reduce finished water color below the current standard of 15 color units (CU), with 8 CU established as the target to be achieved 90 percent of the time.
3. Maintain finished water hardness between 60 to 100 mg/l.
4. Maintain compliance with the Lead & Copper Rule (LCR).

The two-stage membrane study conducted over the past twelve months demonstrated several significant factors.

Nanofiltration (low pressure filtration) can be accomplished on a groundwater source such as the Biscayne Aquifer at a relatively competitive cost per thousand gallons of treated water when compared to conventional lime softened water. Both membranes produced water (permeate) that met Stage 1 and proposed Stage 2 DBP levels.

The two brands of membranes exhibited significantly different operating characteristics related to net driving pressure and passage of inorganic calcium carbonate hardness. Biscayne Aquifer groundwater however, presents a challenge for the nanofiltration process. Foulants in the source water represent significant obstacles for plant design and operations & maintenance.

With the SDWA DBPR compliance deadline set at December 2003, City of Boca Raton staff and engineering consultants used ICR Treatment Study data to recommend a membrane treatment addition to the City's existing water treatment facility. The advanced treatment process, designed with sufficient capacity, would bring the facility's finished water into compliance with new drinking water regulations. Engineering consultants presented to the Boca Raton City council, three level of service options that corresponded to membrane plant capacity (20, 30, 40 mgd) and specific water quality goals (DBP's, color). The council chose to construct the highest level of service, a 40 mgd membrane softening facility estimated to cost \$61,320,000.00. Design of the facility is currently underway, however additional pilot testing will be necessary to resolve outstanding issues such as pretreatment issues, cleaning event schedules, concentrate disposal and new membrane elements.

SECTION II: BACKGROUND INFORMATION

The Boca Raton Water Treatment Facility has several treatment challenges that need to be addressed within the next several years.

Figure1- Existing Full-Scale Treatment Plant

Table 1- Summary of Treatment Plant Design Data

Table 2- Summary of Treatment Plant Design Chemical Data

Table 3- Summary of Source & Finished Water Quality

Although the City's proximity to the ocean has not influenced its raw water supply, the potential for saltwater intrusion mandates a restrictive withdrawal policy for eastern wells. In addition, the relatively shallow Biscayne aquifer is vulnerable to contamination associated with development. Groundwater from the Biscayne Aquifer contains varying concentrations of iron, sulfide, silt, silica, organic carbon and bacteria. Some of the naturally occurring contaminants are reduced significantly by conventional lime softening treatment, however dissolved organic carbon reduction is insufficient.

Recent promulgation of the Disinfection By-Products (DBP) Rule established new trihalomethane and haloacetic acid limits that the existing treatment facility cannot meet without modifications. Anticipating the changes in drinking water regulations, Boca Raton's Utility Services Department conducted small scale pilot testing on a variety of treatment options in 1992, including but not limited to ozone, ferric chloride, free chlorination/air stripping, potassium permanganate, granulated activated carbon and membranes. In 1995 the City acquired a full-scale membrane pilot test unit that operated through the ICR compliance period and provided consultants with design data for a future full-scale plant addition.

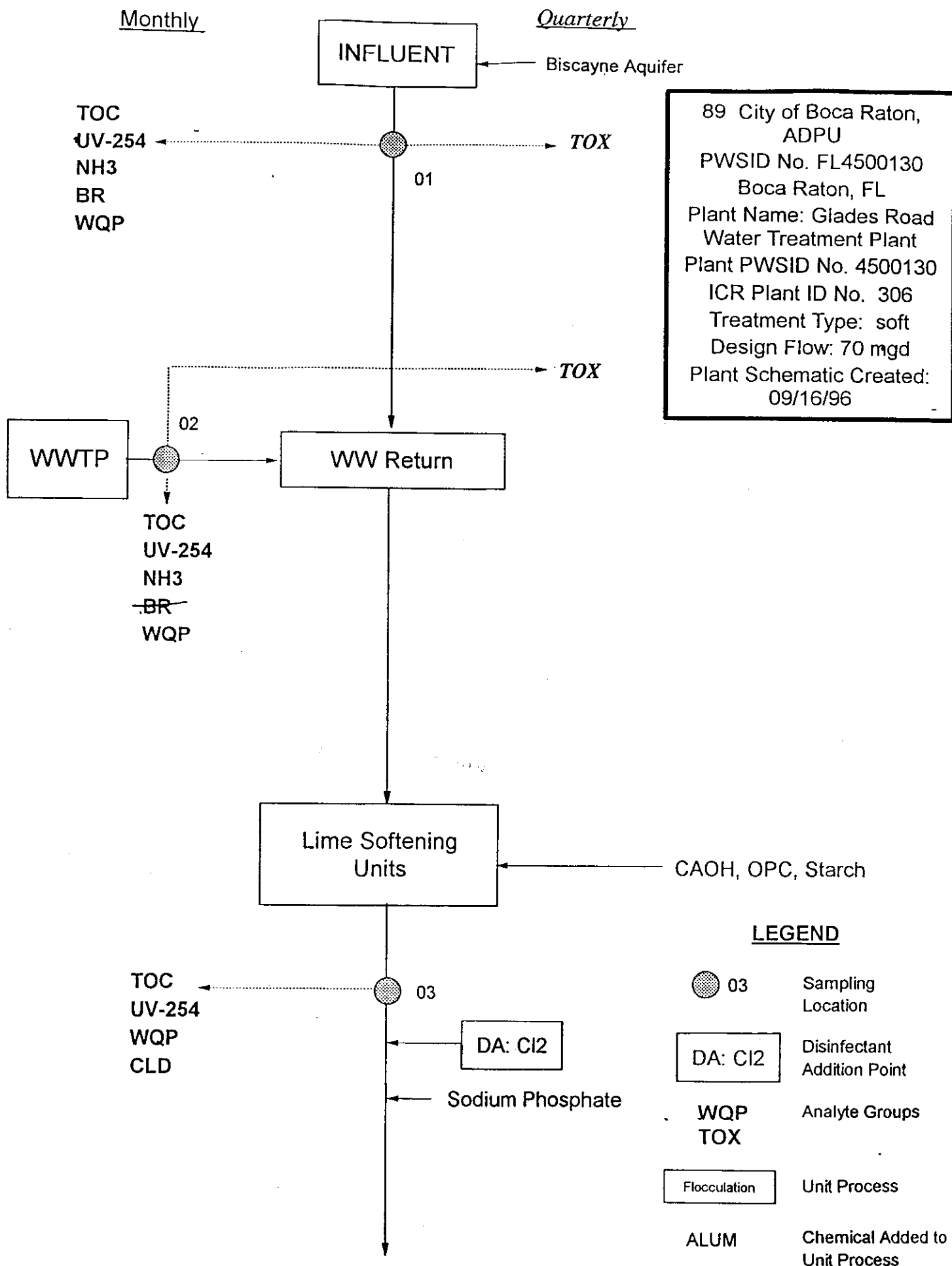


Figure 1 - Schematic of Existing Full Scale Treatment Plant

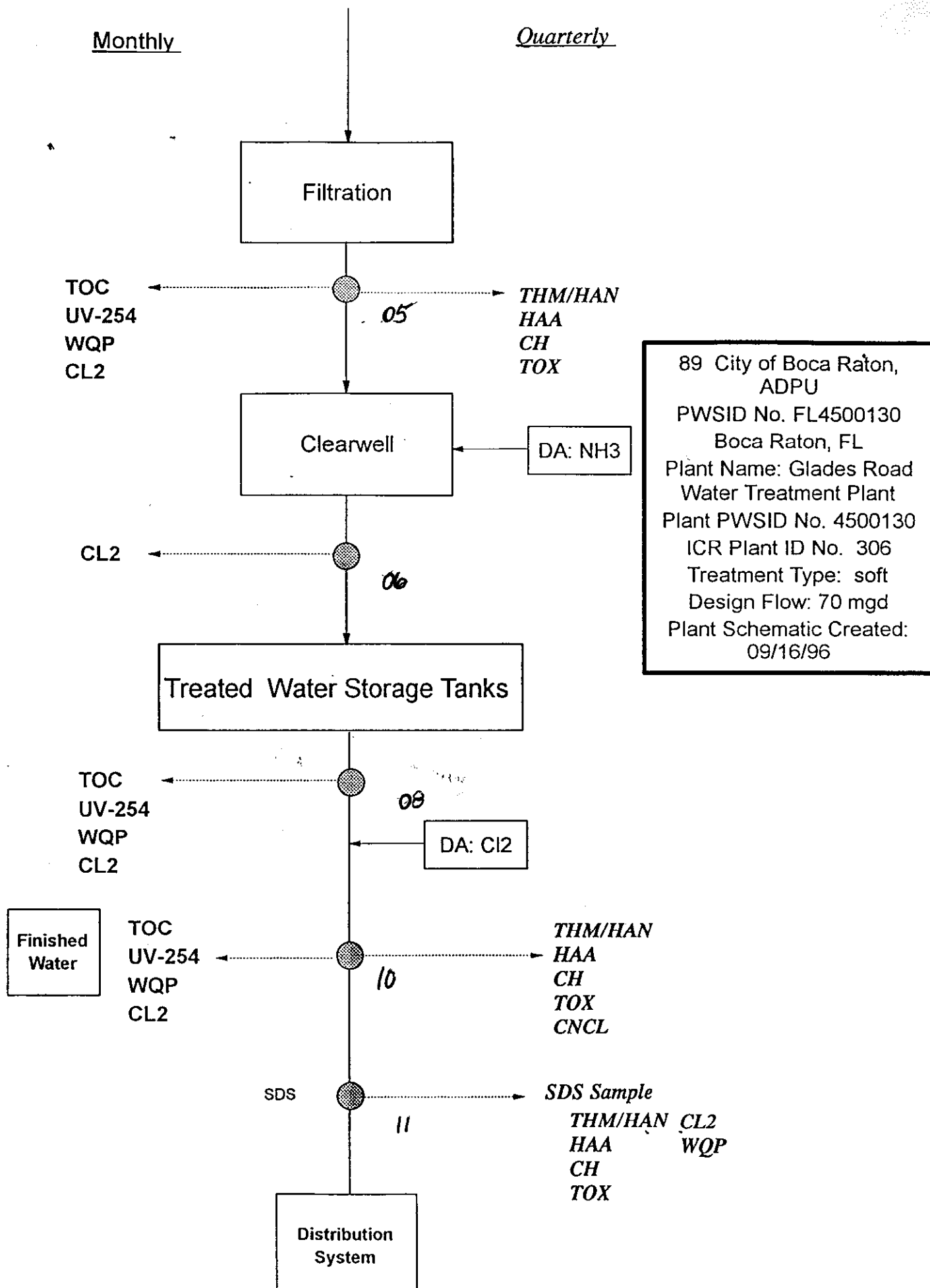


Figure 1 (continued) - Schematic of Existing Full Scale Treatment Plant

A.2 -- Design Plant Parameters

Date: 5/17/99

PWS Name: Boca Raton Water Treatment Facility

PWS ID: FL4500130

WIDB:

ICR Contact Person: Mr. Donald M. Kree

Sampling Period: Design

Design Sampling Start Date: 7/1/97

Design Sampling End Date: 12/31/98

Treatment Plant Name: Glades Road Water Treatment Plant

ICR Treatment Plant ID: 306

Treatment Plant PWS ID: FL4500130

Treatment Plant Category: SOFT

State Approved Plant Capacity (MGD): 70.0

Historical Min. Water Temperature (deg C): 20.0

Installed Sludge Handling Capacity (DTD): 56.00

Blending Indicator: N

Water Resource Name: Biscayne Aquifer

Water Resource Type: Ground water

Intake Name: Raw Water Intake Line

Wellhead Protection: Y

Hydrologic Unit Code:

Latitude (degrees, minutes, seconds): +26°22'4"

Longitude (degrees, minutes, seconds): -80°6'39"

Seq. Sample No. Location Name	Sample Location Type	Sample Loc. No.
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Influent	INF	1
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Process Train Name: Soft Train 1,2,3

Process Train Category: SOFT

1	WW Reclaim Basi	Washwater Return
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2	Washwater Treated: N	Coagulation/Sedimentation: Y
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Seq. Sample No. Location Name	Sample Location Type	Sample Loc. No.
-------------------------------------	----------------------------	-----------------------

Filtration: Y
Disinfectant Addition: N
Plain Sedimentation: N
Other Treatment:
24 hr average Water flow Returned (MGD): 1.2

2	Soft Units 1,2,3	Solids Contact Clarifier	3	Clarifier Type: UP Brand Name: Inflico/Degmunt Surface Area (ft2): 23,113 Liquid Volume (gal): 2,750,000 Short Circuiting Factor: Baffling Type: SP Plate Settler Surface Area (ft2): Tube Settler Surface Area (ft2): Plate Settler Brand Name: Tube Settler Brand Name:
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3	Filters 1--8	Filtration	5	Surface Area (ft2): 4,068 Liquid Volume (gal): 1,032,000 Total Media Depth (in): 96 Depth of GAC (in): Media Type: DUAL Type of Activated Carbon: Minimum Water Depth To Top of Media (ft): 3.0 Depth From Top of Media to Top of Backwash Trough (ft): 3.5
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Table 1 (continued) - Summary of Treatment Plant Design Data

Seq. Sample No. Location Name	Sample Location Type	Sample Loc. No.	
4 Clearwells 1,2,3	Clearwell	6	Surface Area (ft ²): 23,835 Liquid Volume (gal): 1,600,000 Minimum Liquid Volume (gal): 150,000 Baffling Type: UN Short Circuiting Factor: Covered Indicator Code: Y
5 F. Water Storage	Other Treatment Process	8	Surface Area (ft ²): 61,516 Liquid Volume (gal): 17,500,000 Short Circuiting Factor:
Finished Water	FIN	10	

End of Report A.2--Design Plant Parameters

A.3 -- Design Plant Chemical Parameters

Date: 5/17/99

PWS Name: Boca Raton Water Treatment Facility
PWS ID: FLA500130

WIDB:

ICR Contact Person: Mr. Donald M. Kree

Sampling Period: Design
Sampling Start Date: 7/1/97
Sampling End Date: 12/31/98

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

ICR Treatment Plant ID No: 306

Treatment Plant Category: SOFT

Process Train Name: Soft Train 1,2,3

Process Train Category: SOFT

1	WW Reclaim Basi	Washwater Return	2	Other chemical	Na ₂ PO ₄	2.00
2	Soft Units 1,2,3	Solids Contact Clarifier	3	Other chemical	Starch	0.60
				Organic polymer - coagulant aid	CatFlocT-2	4.00
				Calcium hydroxide	CaOH	180.00
3	Filters 1--8	Filtration	5	Other chemical	CL ₂	10.00
4	Clearwells 1,2,3	Clearwell	6	Other chemical	NH ₃	0.60

Sep. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
5	F. Water Storage	Other Treatment Process	8			

End of Report A.3 --Design Plant Chemical Parameters

Table 2 (continued) - Summary of Plant Design Chemical Data

Full-Scale Water Quality Data

Full-Scale Influent Water Quality Data

Item	Units	Average	Std Dev	Min	Max	Count
Temperature	C	25.4	0.3	25	25.8	4
pH	Unit	7.27	0.09	7.18	7.42	4
Turbidity	ntu	1.57	1.04	0.66	3.31	4
Alkalinity	mg/L as CaCO ₃	219	6	214	230	4
Total Hardness	mg/L as CaCO ₃	251	12	234	268	4
Calcium Hardness	mg/L as CaCO ₃	246	24	232	268	4
TOC	mg/L	13	0.5	11	14	4
UV ₂₅₄	1/cm	0.407	0.036	0.375	0.426	4
Bromide	µg/L	0.17	0.05	0.15	0.19	3
TSUVA*	L/(mg*m)	3.13	7.2	3.4	3	4

*TSUVA = [UV₂₅₄ (1/m) / TOC (mg/L)]. Summary information for TSUVA should only be calculated from TSUVA values with paired TOC and UV₂₅₄ measurements

Full-Scale Finished Water Quality Data

Item	Units	Average	Std Dev	Min	Max	Count
Temperature	C	25.5	1.02	24	26.6	4
pH	unit	8.49	0.74	7.29	9.19	4
Turbidity	ntu	1.73	2.64	0.14	6.3	4
TOC	mg/L	10	0.51	9	11	4
UV ₂₅₄	1/cm	0.262	0.008	0.25	0.272	4
DS-THM4	µg/L	123	23	94	157	4
DS-HAA5	µg/L	65	22	37	99	4
DS-HAA6	µg/L	71	24	39	107	4

Table 3 - Summary of Source/Finished Water Quality

Treatment Challenges Facing the Plant

The Boca Raton Water Treatment Facility faces several challenges in order to comply with mandated drinking water regulations. By 1982, the treatment plant had converted from free chlorine residual in distribution to chloramines. Trihalomethane (THM) levels were less than 100 ug/l, but slowly elevated very close to the regulatory limit. While attempting to control disinfection by-products (DBP's), finished water color approached and remained close to the secondary MCL of 15 color units which is very apparent to utility customers.

In recognition of expected changes to the Safe Drinking Water Act (SWDA) Disinfection By-Product (DBP) limits, the City evaluated a variety of water treatment process improvements in 1991. The small scale tests included GAC, Ozone, Ferric Chloride, Potassium Permanganate, Chlorination with Air Stripping, Organic Polymers and Membranes. Membrane treatment provided the highest quality of water but at a cost that was determined, in 1991, to be cost prohibitive. The organic polymer treatment is currently in use with lime softening to remove a portion of dissolved organic (color) at an approximate cost of \$300,000.00 per year.

By 1995, membrane technology advancements and reduced treatment costs changed the City's original evaluation of the process. The City purchased a 50,000 GPD membrane pilot test skid to provide current data on permeate and concentrate water quality, operating costs and membrane characteristics. The test skid also satisfied the mandatory ICR treatment study requirements.

Having re-evaluated membranes as a viable option to enhance lime softened water, the City has committed to constructing a 40 MGD nanofiltration facility. The facility is expected to be operational by December 2002, one year before the December 2003 DBP compliance deadline.

SECTION III: MATERIALS AND METHODS

Figure 2- Pretreatment to the Advanced Process

Table 4- Summary of Pretreatment Design Data

Figure 3- Schematic of Pilot-Scale Membrane Test System

Table 5- Experimental Design Summary for a Pilot-Scale Membrane Test

Table 6- Summary of Analytical Methods and MRLs Used During Study

Table 7- Summary of Laboratories Conducting Analyses During Study

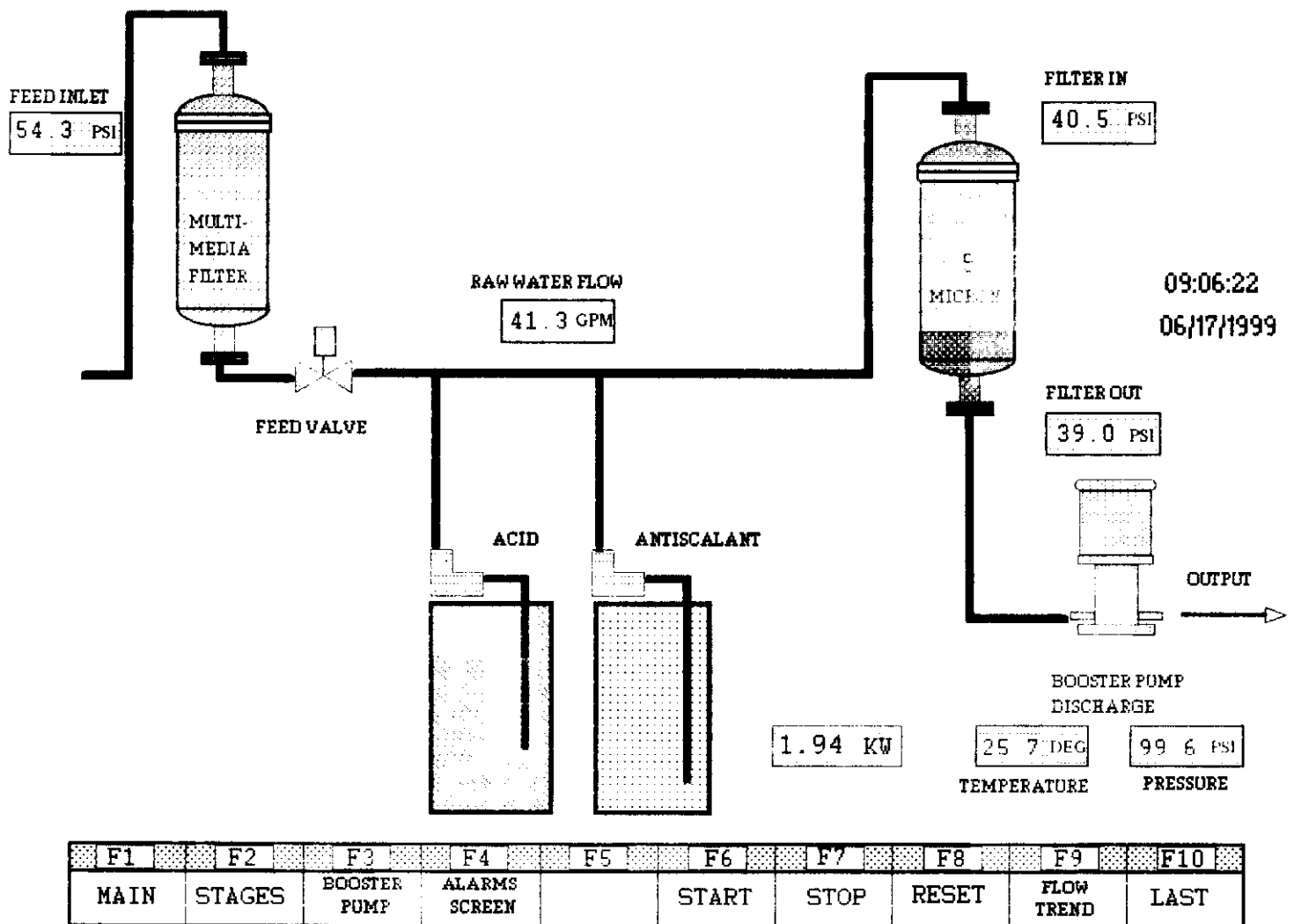


Figure 2 - Schematic of Pretreatment System Used Prior to Pilot Scale Nanofiltration System

Unit Process	Process Description
Multimedia Filtration (Pilot Scale)	Liquid Volume (gal): 119 Total Depth of Media (in): est. 4 ft. Media Type: Silica/Garnet Filtration Rate (gal/ft): est. 50 gal/ft
Scale Control (Pilot Scale)	Chemical Type: 93% Sulfuric Acid Adjusted pH: 6.0-6.3 Dose Rate: 80 mg/l Chemical Type: Scale Inhibitor Dose Rate: 4.0 mg/l
Cartridge Filtration (Pilot Scale)	Surface Area (ft): unknown Nominal Pore Size (um): 5.0 Filter Material: string wound/polypropylene core Filter Life (days operation): 60 to 75 days

Table 4 Summary Of Pretreatment Design Data

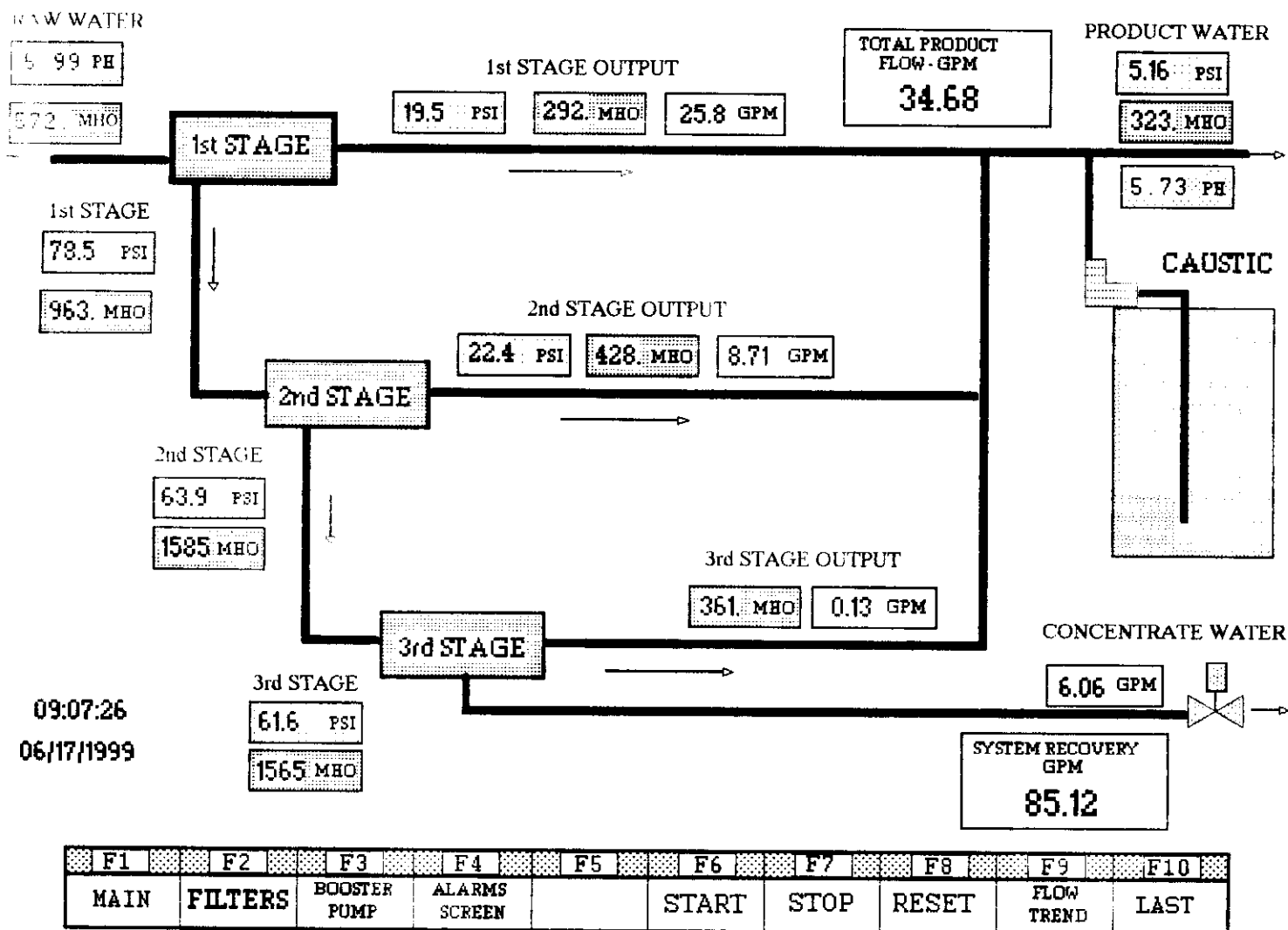


Figure 3 - Schematic of Pilot Scale Nanofiltration System

Experimental Design Discussion

The City's drinking water source is the Biscayne Aquifer with the majority of its wells installed to a depth between 110 – 150 feet. General raw water quality parameters are consistent throughout the year, therefore seasonal variation was not a consideration in the design of the pilot study.

Primary points of interest for the City were the fouling potential of the source water that may damage or shorten the life of membrane elements and operating pressures of various manufacturers' products. Testing revealed that the raw water contained significant levels of Total Organic Carbon (TOC), sulfides, iron, silt and bacteria. On July 9, 1997 the Office of Ground Water and Drinking Water Technical Support Center approved the City's Treatment Study Plan, which included piloting two membranes, each for six months.

Date of Pilot Operation	Membrane	Pretreatment	Water Flux gfd	Recovery, %
April 1,1998-Sept. 16, 1998	Hydranautics 4040-UHA-ESNA	Multimedia Filtration w/acid & scale inhibitor	30	85
Oct. 21,1998-April 7,1999	Filmtec NF200B-4040	Multimedia Filtration w/acid & scale inhibitor	16.5	85

Table 5 Experimental Design Summary For A Pilot Membrane Study

QA/QC Data - Sheet 1						
Analyte Identification	Units	Laboratory Identification	Start Service Date	End Service Date	Method	MRL
pH	unit	ICRFL011	4/1/98	4/1/99	EPA150.1	
Temperature	C	ICRFL011	4/1/98	4/1/99	SM2550 B	
Alkalinity	mg/L as CaCO ₃	ICRFL011	4/1/98	4/1/99	SM2320 B	2
Ammonia	mg NH ₃ -N/L	ICROR001	4/1/98	4/1/99	SM4500-NH ₃ D	0.1
Calcium Hardness	mg/L as CaCO ₃	ICRFL011	4/1/98	4/1/99	SM3500-CaD	2
SDS-Cl ₂ Residual	mg/L	ICRFL011	4/1/98	4/1/99	SM4500-ClF	0.1
Total Hardness	mg/L as CaCO ₃	ICRFL011	4/1/98	4/1/99	SM2340 C	2
Turbidity	ntu	ICRFL011	4/1/98	4/1/99	EPA 180.1	0.01
Bromide	µg/L	ICROR001	4/1/98	4/1/99	EPA 300	20
UV ₂₅₄	1/cm	ICROR001	4/1/98	4/1/99	SM5910	0.009
TOC	mg/L	ICROR001	4/1/98	4/1/99	SM5310C	0.5
SDS-TOX	µg Cl-/L	ICROR001	4/1/98	4/1/99	SM5320B	25
SDS-CHCl ₃	µg/L	ICRFL011	4/1/98	4/1/99	EPA502.2	1
SDS-BDCM	µg/L	ICRFL011	4/1/98	4/1/99	EPA502.2	1

Table 6 - Summary of Analytes, Methods, Dates, MRL's

SDS-DBCM	µg/L	ICRFL011	4/1/98	4/1/99 EPA502.2	1
SDS-CHBr ₃	µg/L	ICRFL011	4/1/98	4/1/99 EPA502.2	1
THM4	µg/L	ICRFL011	4/1/98	4/1/99 EPA502.2	
SDS-MCAA	µg/L	ICRFL011	4/1/98	4/1/99 EPA552.1	0.5
SDS-DCAA	µg/L	ICRFL011	4/1/98	4/1/99 EPA552.1	0.5
SDS-TCAA	µg/L	ICRFL011	4/1/98	4/1/99 EPA552.1	0.5
SDS-MBAA	µg/L	ICRFL011	4/1/98	4/1/99 EPA552.1	0.5
SDS-DBAA	µg/L	ICRFL011	4/1/98	4/1/99 EPA552.1	0.5
SDS-BCAA	µg/L	ICRFL011	4/1/98	4/1/99 EPA552.1	0.5
SDS-TBAA	µg/L				
SDS-CDBAA	µg/L				
SDS-DCBAA	µg/L				
HAA5	µg/L	ICRFL011	4/1/98	4/1/99 EPA552.1	
HAA6	µg/L	ICRFL011	4/1/98	4/1/99 EPA552.1	
HAA9	µg/L				

Table 6 (continued) - Summary of Analytes, Methods, Dates, MRL's

Boca Raton Quality Control Laboratory ICRFL001
1401 Glades Road
Boca Raton, Florida 33431
Donald M. Kree
561-338-7327
561-338-7345 FAX

pH, Temperature, Alkalinity, Calcium Hardness,
Cl2 Residual, Total Hardness, Turbidity, THM4,
HAA5, HAA6

CH2M Hill Laboratory ICROR001
2300 NW Walnut Blvd.
Corvallis, Oregon 97330-3538
Kathy McKinley
541-758-0235 x 314
541-752-0276 FAX

Ammonia, Bromide, UV254, TOC, TOX

Table 7 Summary Of Laboratories Conducting Analyses During Study

SECTION IV: RESULTS AND DISCUSSION

Study Observations – Hydranautics 4040 UHA-ESNA

3/25/98 Low pH alarm turning pilot unit off. Defective permeate pH probe replaced.

4/5/98 Low pH alarm turning pilot unit off. Defective influent pH probe replaced.

5/8/98 5 micron cartridges changed 83 days of service. Filters appeared discolored but in satisfactory condition. Some sand and particles observed on the surface.

6/2/98 76 days of service -Performed cleaning event on membranes of both stage 1 & 2. Stages cleaned independently with an acid wash (permeate with HCl to pH of 2.0) followed by a basic wash (permeate with surfactant/NaOH to pH of 12.0). Membranes were soaked overnight with basic cleaning solutions and flushed out the following day. Membranes were flushed for 45 minutes after cleaning.

7/13/98 5 micron cartridges changed – 65 days of service. Filters appeared discolored but in satisfactory condition.

8/25/98 83 days of service – Performed cleaning event on membranes of both stages according to the same procedure as 6/2/98.

9/18/98 End of six month evaluation of Hydranautics membranes. Membranes cleaned according to previous protocol and preserved with sodium bisulfite solution. Membranes were extracted and sealed in original plastic shipping bags. Five micron cartridges were replaced in preparation of new test period. One membrane element sent to ECOLAB for autopsy. Attachment 1.



Ecolab Inc.
370 Wabasha Street North
St. Paul, Minnesota 55102-1390

November 20, 1998

Mr. Donald Kree
City of Boca Raton
1401 Glades Road
Boca Raton, FL 33431

VIA FACSIMILE: 407-338-7345

Dear Mr. Kree:

Thank you for allowing American Fluid/Ecolab to perform an autopsy and cleaning of your Hydranautics 4040 UHA ESNA membrane elements. The analysis and cleaning of the membrane are now complete. The testing of these two membranes was performed utilizing the same technology as the membranes that you had tested last year. SEM Microscopy with EDX (X-ray) and (FTIR) Fourier Transform Infa-Red Spectroscopy were used to analyze the foulant and provide a recommendation for cleaning.

The SEM micrographs indicated that the membrane samples had foulant or soil present. There were two areas of the membranes that were tested. The first area had brown soil present and the second area was relatively clean to the eye. The following results were obtained through the SEM process:

SEM-EDX

<u>Element</u>	<u>Brown area</u>	<u>Clear area</u>
Sodium	3	2
Aluminum	7	2
Silicon	6	2
Phosphorus	5	--
Sulfur	73	94
Calcium	6	--
Organics	Medium/high	Medium/high

FTIR

Proteins	50-60%
Carbohydrates	5-10%
Inorganics	20-30%

RECEIVED

MAR 02 1999

**CITY OF BOCA RATON
UTILITIES DEPARTMENT**

The cleaning information that was derived from the foulants was as follows:

- Remove the sulfur with a low pH cleaner for in organic fouling
- High pH cleaning for the organic material (Filtrapure KX 2096 liquid)

A cleaning of the second membrane was then performed on-site in our membrane cleaning/test stand. The results were as follows:

Membrane Serial Number – X00635

	Pre-Clean	Acid Cleaner	FPKX2096
Primary pressure (psig)	200	200	200
Final Pressure (psig)	190	190	194
Differential pressure (psig)	10	10	6
Temp (C)	25	25	25
Permeate Flow (gpm)	1.0	1.6	1.6
Feed Conductivity (umhos)	1700	1700	2100
Permeate Conductivity (umhos)	27	17	25
% Rejection	94.4	99	98.8
Color of cleaning solution		Clear	Clear

Conclusion/recommendations –

It appears that the soil causing the fouling is almost entirely an organic material consistent with a biofilm. Although a significant amount of inorganic material is present, it is almost entirely sulfur. The sulfur can be removed with a low pH based acid cleaner or a specialty cleaner based on sulfate removal. The organic material was removed successfully with a high pH liquid cleaner (KX2096).

It is our recommendation for your facility to prevent these materials from reaching the membrane surface. Prefiltration and an anti-foulant can assist this. If the pressure drop should increase significantly or the flow rate decrease, the membranes should be cleaned with the two step process as soon as possible. This will help prevent layered build up on the membrane surface.

Please call if you should have any questions regarding the outcome.

Sincerely,

For: 

Michael Roesner

cc: Linda Murray, American Fluid/Ecolab

Membrane Test Report

FilmTec Corporation

City of Boca Raton
Utility Services
1401 Glades Road
Boca Raton, FL 33432

June 4, 1999
RA# SAM990323

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Published July, 1997.

Background:

One FILMTEC® NF200B-4040 element, serial number A4806538, was received at the Edina, Minnesota, manufacturing site on March 31, 1999 under Return Authorization # SAM990323. This element originally shipped from FilmTec on March 21, 1998.

The purpose in returning this element was to verify the current level of performance, and then autopsy for examination of the foulants. As the lead element in pressure vessel No. 1 (1st Stage) it had been subjected to 6 months operation of severe conditions due to well "upsets" where there had been SDI excursions <6. Autopsy had a dual purpose:

1. Determine nature of foulants.
2. Examine visually for possible explanation of suspected mechanical problems do to positive results for Colilert, a test for total coliform.

Explanation of Tests:

Physical Inspection:

A non-destructive test observing the physical appearance of the element and visually identifying the potential foulants. This is used to determine what steps to take in fully analyzing element performance. All elements are weighed and visually inspected noting any differences from new product. (Examples would be: cracked endcaps, discolored scrolls, fiberglass discoloration, accumulation of foreign material, etc.)

Performance Test:

Determination of element operating performance, with a comparison to typical properties and original production test data when available, (not applicable to dryship product). This is also a non-destructive test, used to determine how the element is performing at standard test conditions.

Cleaning:

Evaluation of the visual inspection as well as the performance test, indicates to the technician what type of cleaning is likely to be most effective. If the first cleaning is unsuccessful, further cleanings can be instituted using different chemicals in a further attempt to improve performance. A performance test should be run after each type or series of cleaning to evaluate the degree of success.

Element Autopsy:

A destructive test, in which the element is cut lengthwise to allow the membrane to be opened and unrolled for close scrutiny. Two cuts must be made, on opposite sides, just deep enough to penetrate the element casing. The element is then unrolled carefully so as to not damage the membrane surface. The surface is fully examined and sprayed with cleaning chemicals to check for reaction. In addition, the membrane leaf is visually inspected for mechanical damages, which can be caused by excessive, permeate backpressure or "water hammer."

Results of Test Performed:

The following are the results of the actual tests performed on the returned NF200B-4040 nanofiltration element.

Physical Inspection:

Visual inspection of element s/n A4806538 upon arrival revealed a "swollen" brine seal which was replaced for baseline test.

The weight of the element appeared to be the same as a new wet element, which ranges between 8.0-8.5 pounds. This indicated that there was not any gross accumulation of material trapped by the element.

Performance Testing:

The element was subjected to FilmTec's Standard Test Conditions for brackish (NF200B) elements. This test uses a 500 ppm CaCl_2 solution at 77°F with an applied pressure of 70 psi. The test results are reported below:

Comparison of Element Performance: s/n A2735160

	Original Wet Test	As Received
Flow (gpd)	1648	942
Rejection (%)	99.3	96.7
ΔP feed/conc. (psid)	3-4	0

Note! The flow has declined drastically in comparison to the original wet test data.

Element Autopsy Summary:

Visual inspection on 04 May 99, after unrolling the element revealed streaks of light and dark indicating an irregular flux condition. The feed/brine channel spacer was almost completely devoid of any material buildup and the brownish foulant on the membrane surface was easily removed with a caustic/detergent solution. There were also some "machine directional" scratches, however the overall element construction appeared sound.

Element Autopsy Summary, Cont.:

One leaf was removed and sent over to the lab to be analyzed for metals, silica and microscopic microbial examination.

Analytical Laboratory Report Summary:

The membrane surface was quite brown in color (in contrast to the typical rust color associated with iron) and did **not** feel especially slimy. Microscopy of the membrane surface at 40-100X magnification showed a thin layer of brown residue, which was finely divided and quite homogeneous. At 1000X magnification a water suspension of the residue showed mostly 1-10 μm particles, some non-biological and some microbial.

Metals, silicon and phosphorus, mg/m^2

Si	Al	Ba	Ca	Cu	Fe	K	Mg	Mn	Na	Ni	P	Sr	Zn
2.4	7.9	0.5	10	0.5	5.2	2.6	12	0.02	7.8	0.02	12.2	2.0	0.4

Only low to moderate amounts of Al, Ca, Fe and P were found. The brown discoloration may be largely due to natural organic matter (NOM), which may have also contributed to the flow loss. Unsure if phosphates are used in pretreatment, but at least part of the phosphorus is from the microbial residue. Didn't appear as if the element was rinsed after the MgSO_4 wet test, so the Mg may be from that.

Conclusions and Recommendations:

The opinion based on these test results is that the NF200B-4040 element (s/n A4806538) returned for evaluation and autopsy was fouled with a thin layer of brown residue consisting mainly of NOM. This probably contributed more to the 40% loss in flux than the low to moderate amounts of Al, Ca, Fe, and P. The "directional machine" scratches on the membrane surface could explain the positive for the Colilert test. However this does **not** necessarily explain the decrease (99.3% to 96.7%) in salt rejection, since the suspicion is that these scratches occurred during manufacture of the membrane. The NF200B is a recently commercialized membrane, used mainly at this point, for a 50 MGD project near Paris. Therefore, explanation for the loss in salt has been referred to FilmTec's Product Development Group.

Study Observations – Filmtec NF200B – 4040

10/6/98 Started second six month test period with Filmtec membranes.

11/20/98 Scale inhibitor pump making excessive grinding noise. No spare parts available, pump shut off until replacement arrives.

11/30/98 Broken scale inhibitor pump temporarily repaired and returned to service.

12/8/98 5 micron cartridges changed – 64 days of service. Filters appeared discolored but in satisfactory condition.

1/27/99 114 days of service – Performed cleaning event on membranes of both stages. Permeate with HCl to pH 2.0 followed by surfactant with NaOH to pH 12.0 and overnight soak.

1/28/99 5 micron cartridges changed – 50 days of service. Filters appeared discolored but in satisfactory condition.

3/4/99 35 days of service – Performed cleaning event according to previous protocol. First element of stage 1, pressure vessel #1 removed and sent to lab for autopsy. Attachment 2.

4/23/99 48 days of service – Performed cleaning event according to previous protocol. End of second test period, pilot unit shut off.

Project Costs

Table 8 – Membrane Softening Conceptual Design Capital Costs for 1999

Table 9 - Membrane Softening Conceptual Design O & M Costs

Table10 – Total Capital Cost Impact on Rates

10.4 Project Costs

10.4.1 Capital and O&M Costs

Capital costs associated with the addition of a 20, 30 or 40 mgd membrane softening plant for the Glades Road Water Treatment Plant are presented in Section 8, and range from about \$38 million to \$61 million as summarized in Table 10-1. The individual components of the plant are discussed in Sections 4 and 5 with potential cost savings alternatives. Individual unit costs were developed from manufacturer's information, previous bids for similar projects, prior work at the Glades Road WTP complex and other CDM reports. Building costs are based on a dollar per square foot basis. General conditions, contingency and related services are calculated as a percentage of construction costs.

Projected O&M costs for the membrane softening treatment plant are influenced largely by capacity, recovery rate and power requirements. Membrane replacement is based on replacing a percentage of the membranes every year for an average 7-year life cycle. Personnel services/staffing costs of operation are assumed to be the same as the existing lime softening plant. It is anticipated that an additional equivalent maintenance person will be needed for the membrane treatment facilities due to cartridge filter and membrane replacement labor requirements and the additional pumps and other mechanical equipment.

Historical O&M costs for the Glades Road lime softening plant operation are provided in Section 8 on a dollars per 1,000 gallons basis. The cost categories considered include personal services/staffing, electricity, miscellaneous costs, repair and replacement and chemical costs. The lime softening /membrane softening blend O&M costs will be a combination of the existing O&M costs plus the additional costs related to the membrane softening addition. The new O&M costs are based on the same cost categories as the historical costs. The direct impact of the membrane softening operation on existing lime softening plant O&M costs will depend somewhat on how the two softening process trains are operated. To meet water quality requirements and goals, the City will run the membrane softening at full capacity as the base load plant and lime softening as appropriate to meet demands. The relative cost impact for an average annual daily flow (AADF) of about 43 mgd as in 1998, the plant O&M costs would be about \$0.44/1,000 gallons for 20 mgd, \$0.49/1,000 gallons for 30 mgd and \$0.54/1,000 gallons for 40 mgd of MS compared to a historical cost of \$0.33/1,000 gallons or slightly less, for lime softening alone.

10.4.2 Impact on Rates/Project Funding

The City has already included \$4.5 MM of the total project cost in the Water and Sewer Revenue Bonds, Series 1998 for funding starting in FY1999. The remaining project costs must be financed from additional sources of funds. Additional project capital costs are assumed to be split evenly between FY 2000 and FY 2001, with related additional operation and maintenance costs beginning in FY 2002. Of the total remaining project capital costs, approximately \$33 million is expected to be funded from cash on hand in excess of required reserves and working capital needs. The remainder would be debt-financed using 20-year revenue bonds at an interest rate of about six percent. Under these assumptions, if the City proceeds with construction of the improvements, the additional rate increase required in FY 2000 to maintain debt service coverage at about 1.75 of net revenue or 2.5 of total revenues (including allowable system development charges), would be as presented in Table 8-4, for various total project costs. For a 20-mgd capacity membrane softening process, a rate increase of approximately 7 percent would be needed and similarly, 12.3 percent for a 30-mgd and 17.6 percent for a 40-mgd process size.

TABLE 8

MEMBRANE SOFTENING CONCEPTUAL DESIGN CAPITAL COSTS FOR 1999

Component	Conceptual Costs			Comments
	20 mgd	30 mgd	40 mgd	
<i>Raw Water Pretreatment</i>				
Raw Water Booster Pump Station	\$910,000	\$1,610,000	\$1,750,000	Includes pumps, pipes, electrical and controls.
Multimedia Filters	\$4,510,000	\$5,950,000	\$7,290,000	Includes pumps, pipes, electrical and controls.
<i>Membrane Softening Equipment</i>				
Membranes	\$1,764,000	\$2,646,000	\$3,528,000	2.5 mgd units (40 mgd = 16; 30 mgd = 12; 20 mgd = 8)
RO Skids w/ Piping and Valves	\$3,528,000	\$5,292,000	\$7,056,000	
Membrane Booster Pumps	\$714,000	\$1,000,000	\$1,143,000	
Cartridge Filters w/Piping and Valves	\$292,000	\$420,000	\$544,000	
Sulfuric Acid/Antiscalant System	\$414,000	\$497,000	\$566,000	
Cleaning System	\$242,000	\$363,000	\$484,000	
Process Piping & Valves	\$1,271,000	\$1,906,000	\$2,541,000	
<i>Membrane Treatment Building</i>	\$2,540,000	\$3,140,000	\$3,840,000	
<i>Product Degasifier/Scrubbers</i>	\$1,456,000	\$2,155,000	\$2,761,000	Four to six degasifiers and one scrubber per two degasifiers.
Degasifier Slab & Piping	\$382,000	\$589,000	\$764,000	
<i>Transfer Pump No. 4</i>	\$450,000	\$450,000	\$450,000	For filtered water located in existing building, 200 hp.
<i>Washwater Recovery Basin No. 2</i>	\$420,000	\$420,000	\$420,000	Structural modifications and 2 recovery pumps
<i>High-Service Pump Station</i>	\$1,300,000	\$1,300,000	\$1,300,000	Two pumps, a 15 and a 25 mgd with diesel drive
<i>Hypochlorite System</i>	\$1,400,000	\$1,400,000	\$1,400,000	To replace existing gas chlorination system at WTP
<i>Site Work</i>	\$1,412,000	\$2,118,000	\$2,824,000	(Including Site Electrical)
<i>Landscaping and Irrigation</i>	\$200,000	\$215,000	\$230,000	
<i>Yard Piping</i>	\$550,000	\$725,000	\$900,000	Include concentrate line to WWTP
<i>Electrical</i>				
Membrane Treatment Process	\$1,691,000	\$2,278,000	\$2,678,000	Includes VFDs, MCCs, etc.
Generator/Switchgear (4160V)	\$2,000,000	\$2,200,000	\$2,400,000	Two 2000 KW or three 1500 KW
Transformer/Switchgear Distribution	\$600,000	\$670,000	\$750,000	
<i>Instrumentation and Controls</i>	\$1,000,000	\$1,200,000	\$1,400,000	Includes Main Control Room Modifications
Subtotal	\$29,046,000	\$38,544,000	\$47,019,000	
<i>General Conditions, Bonds, etc. @ 6 %</i>	\$1,743,000	\$2,313,000	\$2,821,000	Mobilization, bonds, insurance, general conditions, demobilization
Total Construction Cost	\$30,789,000	\$40,857,000	\$49,840,000	
<i>Contingency @ 10 %</i>	\$3,080,000	\$4,090,000	\$4,980,000	
<i>Related Technical and Other Services</i>	\$4,000,000	\$5,300,000	\$6,500,000	
Total Project Cost (1999)	\$37,869,000	\$50,247,000	\$61,320,000	

TABLE 9

**MEMBRANE SOFTENING WATER PLANT
CONCEPTUAL DESIGN O&M COST**

System Component	O&M (\$/1000 gal) (of membrane product)
<i>Personnel Services/Staffing</i> ^(a)	
Operations	\$0.09
Maintenance	\$0.01
<i>Electricity</i> ^(b)	
Membrane Process	\$0.12
Other	\$0.10
<i>Renewal and Replacement</i>	
Membrane Replacement	\$0.06
Cartridge Filter/Misc Repairs and Replacement	\$0.05
Miscellaneous ^(c)	\$0.01
<i>Chemical</i>	
Acid	\$0.036
Antiscalant	\$0.043
Chlorine/Cleaning Chemicals	\$0.041
	\$0.12
TOTAL MEMBRANE SOFTENING PROCESS O&M ^(c)	\$0.56
<p>Notes:</p> <p>^(a) Staffing of one equivalent maintenance person for membrane softening. All other operations staffing or personnel costs assumed equal to the lime softening plant, Table 8-2.</p> <p>^(b) At \$0.05/kWh Membrane process includes, raw water booster pumps and membrane booster pumps. Other electrical costs include power such as for wellfield pumpage, filtered water transfer pumping and high-service pumpage which is assumed equal to the lime softening plant electrical costs shown in Table 8-2.</p> <p>^(c) These costs include costs already included in the lime softening plant (see Table 8-2) that would be applicable to the membrane plant.</p>	

SECTION V: QA/QC SUMMARY

Table 11 – QA/QC Summary of Laboratory WQP Duplicates

Table 12 – QA/QC Summary of Laboratory WQP QC Checks

Table 13 – QA/QC Summary ICR PE Results, THM & HAA QC Checks/Duplicates/Spikes

Calibration Procedures – THM, HAA, TOX, TOC, Bromide

TABLE 11

	BOCA RATON QA/QC LABORATORY	TREATMENT SUMMARY		STUDY	
		WQP	DUPLICATE	ANALYSIS (mg/l)	
Date	Turbidity	CaHardness	Alkalinity	pH	T.Hardness
4/15/98	1.23	1400	282	6.59	14
4/29/98	0.046	12	140	6.51	256
5/13/98	0.052	18	30	8.84	26
5/28/98	0.044	16	20	5.86	84
6/10/98	0.056	24	16	5.42	26
6/24/98	0.033	240	15	5.4	26
7/8/98	0.069	20	20	5.77	20
7/22/98	0.047	16	20	5.75	28
8/5/98	1.42	18	20	5.58	22
8/19/98	0.11	11	19	5.54	22
9/2/98	0.057	18	18	5.74	26
9/16/98	0.068	20	16	5.55	22
10/21/98	1.49	80	144	6.65	162
11/4/98	0.042	128	134	6.7	150
11/18/98	0.044	130	126	6.67	148
12/3/98	1.37	122	110	6.59	132
12/16/98	0.049	74	64	6.37	82
12/28/98	0.158	74	63	6.36	140
1/13/99	0.064	138	154	6.9	166
1/27/99	0.045	138	128	6.62	142
2/10/99	0.8	196	194	6.84	204
3/10/99	0.262	136	154	6.84	164
3/24/99	0.077	126	126	6.64	146
4/7/99	0.136	140	130	6.61	152

TABLE 12

BOCA RATON QA/QC LABORATORY		TREATMENT SUMMARY WQP QC CHECKS		STUDY result / TV (true value)	
Date	Turbidity	CaHardness	Alkalinity	pH	T.Hardness
4/15/98	0.70/0.72	84/80		3.93/3.90	260/251
4/29/98	0.70/0.72	77/80		3.94/3.90	244/251
5/13/98	1.74/1.71	84/80	172/180	8.69/8.82	250/256
5/28/98	1.73/1.71	82/80	182/180	8.75/8.82	252/251
6/10/98			178/180	8.76/8.82	244/251
6/24/98	3.00/2.98	84/80	180/180	8.69/8.82	259/251
7/8/98	1.73/1.71	82/80	178/180	8.72/8.82	250/251
7/22/98	1.73/1.71	84/80	180/180	8.65/8.82	254/251
8/5/98		51/50	180/180	8.55/8.82	256/251
8/19/98	3.47/3.00	52/50	180/180	8.64/8.82	52/50
9/2/98			180/180	8.71/8.82	
9/16/98	1.70/1.69		180/180	8.66/8.82	
10/21/98	5.82/5.89	210/210	148/142	9.10/9.04	230/226
11/4/98		84/80	140/142	9.08/9.04	228/226
11/18/98	1.57/1.56	78/80	138/142	9.09/9.04	230/226
12/3/98			142/142	9.06/9.04	
12/16/98	0.94/0.72		144/142	9.06/9.04	
12/28/98	1.40/1.54	50/50	146/142	9.11/9.04	52/50
1/13/99	1.71/1.69	99.9/100.1	140/142	9.12/9.04	352/353
1/27/99	1.69/1.69	99.25/100.1	140/142	9.05/9.04	350/353
2/10/99	1.52/1.54	276/282	142/142	9.06/9.04	352/353
3/10/99	1.70/1.69	252/282.4	141/142	9.00/9.04	352/353
3/24/99	1.70/1.69	242/282.4	140/142	9.01/9.04	356/353
4/7/99	1.54/1.52	72/70.5	140/142	9.06/9.04	280/282.4

Table 13

PRECISION OR DUPLICATE RESULTS FOR Chloroform MATRIX WATER 07/12/99

No.	DATE	RESULT1	RESULT2	RPD	CUMULATIVE		RPD IS			COMMENT
					RPD	STD DEV	<WL	<CL	>CL	
1	04/22/97	18.95	18.80	0.79	0.00	0.00				
2	04/22/97	31.7	30.6	3.53	0.79	0.00				
3	09/19/97	8.79	8.74	0.57	2.16	1.94	X			
4	09/25/97	84.1	85.6	1.77	1.63	1.65	X			
5	12/12/97	25.5	26.0	1.94	1.67	1.35	X			
6	12/25/97	59.4	61.7	3.80	1.72	1.17	X			
7	02/19/98	51.8	52.0	0.39	2.07	1.35	X			
8	03/23/98	121	118	2.51	1.83	1.39	X			
9	04/08/98	16.1	16.5	2.45	1.91	1.31	X			↓
10	04/08/98	43.0	46.0	6.74	1.97	1.23			X	
11	04/16/98	46.4	42.9	7.84	2.45	1.90		X		
12	04/29/98	21.2	22.6	6.39	2.94	2.43	X			
13	05/13/98	23.6	22.9	3.01	3.23	2.52	X			
14	06/04/98	20.5	21.6	5.23	3.21	2.42	X			
15	06/10/98	20.7	20.3	1.95	3.35	2.38	X			
16	06/30/98	70.9	74.5	4.95	3.26	2.32	X			
17	07/08/98	21.8	21.4	1.85	3.37	2.29	X			
18	07/22/98	22.2	23.0	3.54	3.28	2.24	X			
19	08/17/98	64.2	60.7	5.60	3.29	2.18	X			
20	08/17/98	21.6	21.7	0.46	3.41	2.18	X			
21	08/20/98	21.8	20.9	4.22	3.27	2.22	X			
22	09/02/98	20.6	21.1	2.40	3.31	2.18	X			
23	09/16/98	21.7	21.1	2.80	3.27	2.13	X			
24	09/28/98	184	208	12.24	3.25	2.09			X	
25	10/21/98	22.5	23.2	3.06	3.62	2.74	X			
26	11/02/98	31.1	32.7	5.02	3.60	2.69	X			
27	11/04/98	392	392	0.00	3.66	2.65	X			
28	11/04/98	.55	.47	15.69	3.52	2.69			X	
29	11/04/98	21.3	22.2	4.14	3.95	3.50	X			
30	11/19/98	388	372	4.21	3.96	3.44	X			
31	11/19/98	10.6	10.9	2.79	3.97	3.38	X			
32	12/07/98	432.57	396.13	8.79	3.93	3.33	X			
33	12/16/98	394	436	10.12	4.08	3.39	X			
34	12/16/98	405	368	9.57	4.27	3.49	X			
35	12/22/98	152	140	8.22	4.42	3.56	X			
36	12/28/98	391	420	7.15	4.53	3.56	X			
37	12/28/98	.26	.22	16.67	4.60	3.54			X	
ALL DATA BELOW WITHIN 180 DAYS OF CURRENT DATE										
38	01/13/99	398	410	2.97	4.93	4.02	X			
39	01/27/99	405.50	428.35	5.48	4.88	3.97	X			
40	02/10/99	498	444	11.46	4.89	3.92	X			
41	02/24/99	414	448	7.89	5.06	4.01	X			
42	02/24/99	.27	.22	20.41	5.13	3.98			X	
43	02/24/99	439	415	5.62	5.49	4.59	X			
44	02/24/99	.29	.25	14.81	5.49	4.53		X		
45	03/10/99	472	456	3.45	5.71	4.69	X			
46	03/10/99	.37	.30	20.90	5.66	4.65			X	
47	03/26/99	379	391	3.12	5.99	5.12	X			
48	04/07/99	422	432	2.34	5.93	5.08	X			↑
					5.85	5.05				↑

PRECISION OR DUPLICATE RESULTS FOR Bromodichl MATRIX WATER 07/12/99

No.	DATE	RESULT1	RESULT2	RPD	CUMULATIVE		RPD IS			COMMENT
					RPD	STD DEV	<WL	<CL	>CL	
1	04/22/97	19.0	18.4	3.21	0.00	0.00				
2	04/22/97	27.6	27.7	0.36	3.21	0.00				
3	09/19/97	14.2	14.6	2.78	1.78	2.02	X			
4	09/25/97	18.1	19.3	6.42	2.12	1.54		X		
5	12/12/97	18.0	18.0	0.00	3.19	2.49	X			
6	12/25/97	13.1	12.6	3.89	2.55	2.59	X			
7	02/19/98	20.2	19.7	2.51	2.78	2.38	X			
8	03/23/98	19.6	18.7	4.70	2.74	2.17	X			
9	04/08/98	10.8	11.1	2.74	2.98	2.13	X			
10	04/08/98	42.0	43.3	3.05	2.96	1.99	X			
11	04/16/98	46.4	44.1	5.08	2.97	1.88	X			
12	04/29/98	20.5	22.4	8.86	3.16	1.89			X	
13	05/13/98	22.2	22.2	0.00	3.63	2.44	X			
14	06/04/98	20.5	20.9	1.93	3.35	2.55	X			
15	06/10/98	21.3	20.2	5.30	3.25	2.48	X			
16	06/30/98	8.1	7.7	5.06	3.39	2.44	X			
17	07/08/98	21.1	20.4	3.37	3.49	2.40	X			
18	07/22/98	21.9	21.9	0.00	3.49	2.32	X			
19	08/17/98	25.2	25.4	0.79	3.29	2.40	X			
20	08/17/98	21.5	22.0	2.30	3.16	2.40	X			
21	08/20/98	22.2	20.4	8.45	3.12	2.34		X		
22	09/02/98	20.4	20.7	1.46	3.37	2.56	X			
23	09/16/98	21.1	21.6	2.34	3.28	2.53	X			
24	09/28/98	20.5	20.9	1.93	3.24	2.48	X			
25	10/21/98	21.2	21.8	2.79	3.19	2.44	X			
26	11/02/98	13.8	14.7	6.32	3.17	2.39	X			
27	11/04/98	74.6	66.7	11.18	3.29	2.43			X	
28	11/04/98	.65	.68	4.51	3.59	2.82	X			
29	11/04/98	21.5	22.4	4.10	3.62	2.77	X			
30	11/19/98	68.8	68.4	0.58	3.64	2.73	X			
31	11/19/98	.56	.56	0.00	3.53	2.74	X			
32	12/07/98	66.71	65.70	1.53	3.42	2.76	X			
33	12/16/98	68.1	59.3	13.81	3.36	2.74			X	
34	12/16/98	57.3	57.5	0.35	3.68	3.25	X			
35	12/22/98	21.4	19.4	9.80	3.58	3.25	X			
36	12/28/98	63.5	75.9	17.79	3.76	3.37			X	
37	12/28/98	.37	.36	2.74	4.15	4.06	X			
ALL DATA BELOW WITHIN 180 DAYS OF CURRENT DATE										
38	01/13/99	68.3	70.1	2.60	4.11	4.01	X			
39	01/13/99	.29	.29	0.00	4.07	3.97	X			
40	01/27/99	88.50	78.41	12.09	3.96	3.97		X		
41	02/10/99	83.5	81.5	2.42	4.17	4.12	X			
42	02/24/99	66.6	68.6	2.96	4.13	4.08	X			
43	02/24/99	.37	.38	2.67	4.10	4.03	X			
44	02/24/99	65.4	64.6	1.23	4.06	3.99	X			
45	02/24/99	.42	.42	0.00	4.00	3.97	X			
46	03/10/99	77.0	65.8	15.69	3.91	3.97		X		
47	03/10/99	.49	.50	2.02	4.17	4.29	X			
48	03/26/99	57.4	56.5	1.58	4.12	4.26	X			
49	04/07/99	77.3	77.3	0.00	4.07	4.23	X			
50	04/07/99	.58	.54	7.14	3.99	4.22	X			
					4.05	4.20				

PRECISION OR DUPLICATE RESULTS FOR Dibromochl MATRIX WATER 07/12/99

No.	DATE	RESULT1	RESULT2	RPD	CUMULATIVE		RPD IS			COMMENT
					RPD	STD DEV	<WL	<CL	>CL	
1	04/22/97	18.9	18.4	2.68	0.00	0.00				
2	04/22/97	20.8	20.4	1.94	2.68	0.00				
3	09/19/97	33.7	31.8	5.80	2.31	0.52			X	
4	09/25/97	3.21	3.14	2.20	3.47	2.05	X			
5	12/12/97	14.5	14.5	0.00	3.16	1.79	X			
6	12/25/97	2.74	2.69	1.84	2.52	2.10	X			
7	02/19/98	3.96	3.69	7.06	2.41	1.90		X		
8	03/23/98	1.72	1.89	9.42	3.07	2.47		X		
9	04/08/98	29.8	31.1	4.27	3.87	3.20	X			
10	04/08/98	43.2	44.0	1.83	3.91	3.00	X			
11	04/16/98	44.6	43.7	2.04	3.70	2.90	X			
12	04/29/98	21.9	22.9	4.46	3.55	2.80	X			
13	05/13/98	23.8	24.0	0.84	3.63	2.68	X			
14	06/04/98	20.8	21.4	2.84	3.41	2.68	X			
15	06/10/98	21.3	21.0	1.42	3.37	2.58	X			
16	06/30/98	1.1	1.0	9.52	3.24	2.54		X		
17	07/08/98	21.3	21.5	0.93	3.63	2.91	X			
18	07/22/98	22.3	21.7	2.73	3.48	2.89	X			
19	08/17/98	15.6	16.4	5.00	3.43	2.81	X			
20	08/17/98	22.2	22.0	0.90	3.52	2.76	X			
21	08/20/98	22.2	21.3	4.14	3.39	2.75	X			
22	09/02/98	21.1	20.9	0.95	3.42	2.68	X			
23	09/16/98	21.6	22.7	4.97	3.31	2.67	X			
24	09/28/98	3.25	3.49	7.12	3.38	2.63	X			
25	10/21/98	21.7	22.5	3.62	3.54	2.68	X			
26	11/02/98	9.34	9.41	0.75	3.54	2.63	X			
27	11/04/98	10.0	8.23	19.42	3.43	2.63			X	
28	11/04/98	1.56	1.54	1.29	4.03	4.02	X			
29	11/04/98	22.3	22.5	0.89	3.93	3.97	X			
30	11/19/98	8.26	8.12	1.71	3.82	3.94	X			
31	11/19/98	1.36	1.35	0.74	3.75	3.89	X			
32	12/07/98	8.50	8.11	4.70	3.66	3.87	X			
33	12/16/98	7.41	7.87	6.02	3.69	3.81	X			
34	12/16/98	7.69	7.16	7.14	3.76	3.77	X			
35	12/22/98	2.65	2.25	16.33	3.86	3.76			X	
36	12/28/98	7.6	10.2	29.21	4.21	4.26			X	
37	12/28/98	1.19	1.16	2.55	4.91	5.91	X			
ALL DATA BELOW WITHIN 180 DAYS OF CURRENT DATE										
38	01/13/99	8.20	7.13	13.96	4.85	5.84	X			
39	01/27/99	9.71	10.02	3.14	5.09	5.95	X			
40	02/10/99	10.07	9.66	4.16	5.04	5.88	X			
41	02/24/99	8.87	9.22	3.87	5.01	5.81	X			
42	02/24/99	1.14	1.15	0.87	4.99	5.74	X			
43	02/24/99	8.86	8.46	4.62	4.89	5.70	X			
44	02/24/99	1.25	1.26	0.80	4.88	5.63	X			
45	03/10/99	7.51	7.84	4.30	4.79	5.60	X			
46	03/10/99	1.63	1.58	3.12	4.78	5.54	X			
47	03/26/99	6.96	7.21	3.53	4.74	5.48	X			
48	04/07/99	8.94	9.15	2.32	4.72	5.42	X			
49	04/07/99	1.33	1.28	3.83	4.67	5.38	X			
					4.65	5.32				

PRECISION OR DUPLICATE RESULTS FOR Bromoform MATRIX WATER 07/12/99

No.	DATE	RESULT1	RESULT2	RPD	CUMULATIVE		RPD IS			COMMENT
					RPD	STD DEV	<WL	<CL	>CL	
1	04/22/97	19.4	18.8	3.14	0.00	0.00				
2	04/22/97	17.1	17.1	0.00	3.14	0.00				
3	09/19/97	9.24	8.90	3.75	1.57	2.22	X			
4	12/12/97	12.3	12.1	1.64	2.30	2.01	X			
5	02/19/98	3.94	3.96	0.51	2.13	1.68	X			
6	04/08/98	20.8	20.7	0.48	1.81	1.62	X			
7	04/08/98	41.5	41.8	0.72	1.59	1.55	X			
8	04/16/98	43.6	41.9	3.98	1.46	1.45	X			
9	04/29/98	20.2	22.5	10.77	1.78	1.61			X	
10	05/13/98	24.0	23.4	2.53	2.78	3.36	X			
11	06/04/98	19.9	20.4	2.48	2.75	3.16	X			
12	06/10/98	20.3	20.0	1.49	2.73	3.00	X			
13	07/08/98	20.3	20.0	1.49	2.62	2.89	X			
14	07/22/98	20.4	20.9	2.42	2.54	2.78	X			
15	08/17/98	8.31	8.68	4.36	2.53	2.67	X			
16	08/17/98	21.0	21.3	1.42	2.65	2.62	X			
17	08/20/98	20.9	19.2	8.48	2.57	2.55		X		
18	09/02/98	20.0	20.6	2.96	2.92	2.85	X			
19	09/16/98	21.3	21.4	0.47	2.92	2.77	X			
20	09/28/98	48.9	40.8	18.06	2.79	2.75			X	
21	10/21/98	24.3	26.2	7.52	3.56	4.34	X			
22	11/02/98	3.22	3.18	1.25	3.75	4.31	X			
23	11/04/98	23.1	24.0	3.82	3.63	4.24	X			
24	11/19/98	2.75	2.80	1.80	3.64	4.15	X			
25	11/19/98	13.61	13.96	2.54	3.56	4.07	X			
26	12/07/98	2.90	2.83	2.44	3.52	3.99	X			
27	12/16/98	2.17	2.49	13.73	3.48	3.92		X		
28	12/16/98	2.32	2.18	6.22	3.86	4.32	X			
29	12/28/98	1.56	1.58	1.27	3.95	4.26	X			
ALL DATA BELOW WITHIN 180 DAYS OF CURRENT DATE										
30	01/13/99	1.94	1.87	3.67	3.85	4.21	X			
31	01/27/99	1.30	1.14	13.11	3.85	4.14		X		
32	02/10/99	3.64	3.01	18.95	4.15	4.40			X	
33	02/24/99	1.79	1.80	0.56	4.61	5.06	X			
34	02/24/99	2.02	2.08	2.93	4.49	5.03	X			
35	03/10/99	2.98	2.97	0.34	4.44	4.96	X			
36	03/26/99	1.56	1.57	0.64	4.32	4.93	X			
37	04/07/99	.34	.38	11.11	4.22	4.90	X			
38	04/07/99	3.80	3.84	1.05	4.41	4.96	X			
					4.32	4.92				

SPIKE
ACCURACY RESULTS FOR Chloroform MATRIX WATER 07/12/99

NO.	DATE	PCT. REC.	CUMULATIVE		STD. DEV.	PERCENT RECOVERY IS			COMMENT
			PCT. REC.			<WL	<CL	>CL	
1	04/22/97	95.00	0.00		0.00				
2	04/22/97	94.00	95.00		0.00				
3	09/25/97	82.00	94.50		0.71			X	
4	12/25/97	109.00	90.33		7.23		X		
5	02/19/98	104.00	95.00		11.05	X			
6	03/23/98	134.00	96.80		10.38			X	
7	04/08/98	108.00	103.00		17.80	X			
8	04/16/98	111.00	103.71		16.36	X			
9	04/29/98	108.00	104.63		15.36	X			
10	05/13/98	112.00	105.00		14.41	X			
11	06/04/98	102.00	105.70		13.77	X			
12	06/04/98	108.00	105.36		13.11	X			
13	06/10/98	102.00	105.58		12.52	X			
14	06/30/98	105.00	105.31		12.03	X			
15	07/08/98	103.00	105.29		11.56	X			
16	07/22/98	112.00	105.13		11.15	X			
17	08/17/98	103.00	105.56		10.91	X			
18	08/20/98	103.00	105.41		10.58	X			
19	09/02/98	100.00	105.28		10.28	X			
20	09/16/98	103.00	105.00		10.07	X			
21	09/28/98	96.00	104.90		9.81	X			
22	10/21/98	107.00	104.48		9.76	X			
23	11/04/98	106.00	104.59		9.54	X			
24	11/19/98	102.00	104.65		9.32	X			
25	12/07/98	101.00	104.54		9.13	X			
26	12/16/98	94.00	104.40		8.97	X			
27	12/16/98	100.00	104.00		9.02	X			
28	12/28/98	97.00	103.85		8.88	X			
ALL DATA BELOW IS WITHIN 180 DAYS OF CURRENT DATE									
29	01/13/99	105.00	103.61		8.81	X			
30	01/27/99	107.00	103.66		8.65	X			
31	02/10/99	108.00	103.77		8.52	X			
32	02/24/99	108.00	103.90		8.42	X			
33	02/24/99	106.00	104.03		8.31	X			
34	03/10/99	107.00	104.09		8.19	X			
35	03/26/99	102.00	104.18		8.08	X			
36	04/07/99	110.00	104.11		7.97	X			
			104.28		7.91				

SPiKE

ACCURACY RESULTS FOR Bromodichl MATRIX WATER 07/12/99

NO.	DATE	PCT. REC.	CUMULATIVE PCT. REC.	STD. DEV.	PERCENT RECOVERY IS			COMMENT
					<WL	<CL	>CL	
1	04/22/97	95.00	0.00	0.00				
2	04/22/97	92.00	95.00	0.00				
3	09/25/97	116.00	93.50	2.12			X	
4	12/25/97	92.00	101.00	13.08	X			
5	02/19/98	100.00	98.75	11.59	X			
6	03/23/98	106.00	99.00	10.05	X			
7	04/08/98	105.00	100.17	9.43	X			
8	04/16/98	109.00	100.86	8.80	X			
9	04/29/98	100.00	101.88	8.64	X			
10	05/13/98	104.00	101.67	8.11	X			
11	06/04/98	100.00	101.90	7.68	X			
12	06/04/98	103.00	101.73	7.31	X			
13	06/10/98	100.00	101.83	6.98	X			
14	06/30/98	100.00	101.69	6.70	X			
15	07/08/98	99.00	101.57	6.45	X			
16	07/22/98	107.00	101.40	6.25	X			
17	08/17/98	104.00	101.75	6.20	X			
18	08/20/98	102.00	101.88	6.03	X			
19	09/02/98	98.00	101.89	5.85	X			
20	09/16/98	102.00	101.68	5.75	X			
21	09/28/98	106.00	101.70	5.60	X			
22	10/21/98	104.00	101.90	5.54	X			
23	11/04/98	106.00	102.00	5.42	X			
24	11/19/98	106.00	102.17	5.37	X			
25	12/07/98	101.00	102.33	5.31	X			
26	12/16/98	93.00	102.28	5.20	X			
27	12/16/98	93.00	101.92	5.41	X			
28	12/22/98	118.00	101.59	5.58		X		
29	12/28/98	101.00	102.18	6.29	X			
ALL DATA BELOW IS WITHIN 180 DAYS OF CURRENT DATE								
30	01/13/99	108.00	102.14	6.18	X			
31	01/27/99	110.00	102.33	6.17	X			
32	02/10/99	111.00	102.58	6.22	X			
33	02/24/99	111.00	102.84	6.29	X			
34	02/24/99	116.00	103.09	6.36		X		
35	03/10/99	108.00	103.47	6.64	X			
36	03/26/99	94.00	103.60	6.59	X			
37	04/07/99	106.00	103.33	6.68	X			
				103.41	6.61			

SPIKE

ACCURACY RESULTS FOR Dibromochl MATRIX WATER 07/12/99

NO.	DATE	PCT. REC.	CUMULATIVE		STD. DEV.	PERCENT RECOVERY IS			COMMENT
			PCT. REC.	PCT. REC.		<WL	<CL	>CL	
1	04/22/97	95.00	0.00	0.00	0.00				
2	04/22/97	92.00	95.00	0.00	0.00				
3	09/25/97	108.00	93.50	2.12				X	
4	12/25/97	95.00	98.33	8.50	X				
5	02/19/98	96.00	97.50	7.14	X				
6	03/23/98	105.00	97.20	6.22	X				
7	04/08/98	108.00	98.50	6.41	X				
8	04/16/98	106.00	99.86	6.87	X				
9	04/29/98	104.00	100.63	6.72	X				
10	05/13/98	112.00	101.00	6.38	X				
11	06/04/98	101.00	102.10	6.95	X				
12	06/04/98	105.00	102.00	6.60	X				
13	06/10/98	100.00	102.25	6.36	X				
14	06/30/98	101.00	102.08	6.12	X				
15	07/08/98	100.00	102.00	5.88	X				
16	07/22/98	106.00	101.87	5.69	X				
17	08/17/98	105.00	102.13	5.60	X				
18	08/20/98	103.00	102.29	5.46	X				
19	09/02/98	98.00	102.33	5.30	X				
20	09/16/98	103.00	102.11	5.25	X				
21	09/28/98	107.00	102.15	5.11	X				
22	10/21/98	104.00	102.38	5.09	X				
23	11/04/98	104.00	102.45	4.98	X				
24	11/19/98	108.00	102.52	4.88	X				
25	12/07/98	106.00	102.75	4.90	X				
26	12/16/98	96.00	102.88	4.84	X				
27	12/16/98	95.00	102.62	4.93	X				
28	12/22/98	92.00	102.33	5.05			X		
29	12/28/98	98.00	101.96	5.33	X				
ALL DATA BELOW IS WITHIN 180 DAYS OF CURRENT DATE									
30	01/13/99	109.00	101.83	5.29	X				
31	01/27/99	108.00	102.07	5.36	X				
32	02/10/99	104.00	102.26	5.37	X				
33	02/24/99	109.00	102.31	5.29	X				
34	02/24/99	112.00	102.52	5.34	X				
35	03/10/99	113.00	102.79	5.50	X				
36	03/26/99	87.00	103.09	5.69			X		
37	04/07/99	102.00	102.64	6.22	X				
			102.62	6.13					

Spike

ACCURACY RESULTS FOR Bromoform MATRIX WATER 07/12/99

NO.	DATE	PCT. REC.	CUMULATIVE PCT. REC.	STD. DEV.	PERCENT RECOVERY IS			COMMENT
					<WL	<CL	>CL	
1	04/22/97	97.00	0.00	0.00				
2	04/22/97	94.00	97.00	0.00				
3	09/25/97	141.00	95.50	2.12			X	
4	02/19/98	99.00	110.67	26.31	X			
5	03/23/98	102.00	107.75	22.26	X			
6	04/08/98	104.00	106.60	19.45	X			
7	04/16/98	103.00	106.17	17.43	X			
8	04/29/98	98.00	105.71	15.96	X			
9	05/13/98	108.00	104.75	15.02	X			
10	06/04/98	96.00	105.11	14.09	X			
11	06/04/98	98.00	104.20	13.60	X			
12	06/10/98	93.00	103.64	13.03	X			
13	06/30/98	98.00	102.75	12.80	X			
14	07/08/98	94.00	102.38	12.33	X			
15	07/22/98	99.00	101.79	12.05	X			
16	08/17/98	102.00	101.60	11.64	X			
17	08/20/98	94.00	101.63	11.24	X			
18	09/02/98	102.00	101.18	11.04	X			
19	09/16/98	101.00	101.22	10.71	X			
20	09/28/98	102.00	101.21	10.41	X			
21	10/21/98	108.00	101.25	10.14	X			
22	11/04/98	112.00	101.57	9.99	X			
23	11/19/98	110.00	102.05	10.00	X			
24	12/07/98	109.00	102.39	9.91	X			
25	12/16/98	95.00	102.67	9.78	X			
26	12/16/98	95.00	102.36	9.70	X			
27	12/22/98	95.00	102.08	9.61	X			
28	12/28/98	89.00	101.81	9.52	X			
ALL DATA BELOW IS WITHIN 180 DAYS OF CURRENT DATE								
29	01/13/99	102.00	101.36	9.65	X			
30	01/27/99	104.00	101.38	9.48	X			
31	02/10/99	108.00	101.47	9.33	X			
32	02/24/99	111.00	101.68	9.25	X			
33	02/24/99	112.00	101.97	9.24	X			
34	03/10/99	110.00	102.27	9.26	X			
35	03/26/99	81.00	102.50	9.22		X		
36	04/07/99	112.00	101.89	9.78	X			
			102.17	9.79				

Q.C. CHECKS

REFERENCE SAMPLE RESULTS FOR Bromodichl MATRIX WATER 07/12/99

NO.	DATE	SAMPLE ID	TARGET	FOUND	CUMULATIVE			PERCENT			RECOVERY IS	COMMENT
					PCT. REC.	PCT. REC.	STD. DEV.	<WL	<CL	>CL		
1	04/22/97	WS037	12.7	12.9	102.00	0.00	0.00				R= [10.2-15.2]	
2	04/22/97	ICR2	13.8	14.0	101.00	102.00	0.00				R= [11.0-16.6]	
3	09/19/97	ICR004	26.9	28.9	107.00	101.50	0.71			X	R= [21.5-32.3]	
4	12/12/97	WS038	32.2	28.7	89.00	103.33	3.21			X	R= [21.2-31.8]	
5	12/25/97	ICR PE 5	16.3	14.7	90.00	99.75	7.63	X			R= [13-19.6]	
6	02/19/98	WS037	12.7	11.8	93.00	97.80	7.92	X			R= [10.2-15.2]	
7	03/23/98	ICR 006	22.8	20.3	89.00	97.00	7.35	X			R= [18.2-27.4]	
8	04/08/98	ICR006	22.8	20.1	88.00	95.86	7.36	X			R= [18.2-27.4]	
9	04/29/98	PE #6	22.8	19.6	86.00	94.88	7.36	X			R= [18.2-27.4]	
10	05/13/98	ICR PE#6	22.8	19.6	86.00	93.89	7.49	X			R= [18.2-27.4]	
11	06/04/98	PE #6	22.8	26.8	118.00	93.10	7.49			X	R= [18.2-27.4]	
12	06/10/98	ICR PE6	22.8	19.7	86.00	95.36	10.34	X			R= [18.2-27.4]	
13	06/30/98	ICR PE7	11.0	10.0	91.00	94.58	10.22	X			R= [8.79-13.3]	
14	07/08/98	ICR PE7	11.0	9.85	90.00	94.31	9.84	X			R= [8.79-13.3]	
15	08/17/98	ICR PE7	11.0	10.1	92.00	94.00	9.52	X			R= [8.79-13.3]	
16	08/20/98	ICR PE7	11.0	9.4	85.00	93.87	9.19	X			R= [8.79-13.3]	
17	09/02/98	CIR PE7	11.0	9.68	88.00	93.31	9.15	X			R= [8.79-13.3]	
18	09/16/98	ICR PE7	11.0	10.5	95.00	93.00	8.95	X			R= [8.79-13.3]	
19	09/28/98	ICR PE7	11.0	10.0	91.00	93.11	8.70	X			R= [8.79-13.3]	
20	10/21/98	ICR PE8	25.0	25.5	102.00	93.00	8.47	X			R= [19.9-30.1]	
21	11/02/98	ICR PE6	22.8	20.0	88.00	93.45	8.48	X			R= [18.2-27.4]	
22	11/02/98	ICR PE7	11.0	9.52	86.00	93.19	8.35	X			R= [8.79-13.3]	
23	11/02/98	ICR PE8	25.0	23.5	94.00	92.86	8.29	X			R= [19.9-30.1]	
24	11/04/98	ICR PE8	25.0	23.7	95.00	92.91	8.11	X			R= [19.9-30.1]	
25	11/19/98	ICR PE8	25.0	24.1	96.00	93.00	7.94	X			R= [19.9-30.1]	
26	12/07/98	ICR PE8	25.0	25.8	103.00	93.12	7.80	X			R= [19.9-30.1]	
27	12/16/98	ICR PE8	25.0	23.7	95.00	93.50	7.88	X			R= [19.9-30.1]	
28	12/22/98	ICR PE8	25.0	22.7	91.00	93.56	7.73	X			R= [19.9-30.1]	
29	12/28/98	ICR PE8	25.0	24.2	97.00	93.46	7.60	X			R= [19.9-30.1]	
30	01/13/99	ICR PE9	15.0	16.3	109.00	93.59	7.50			X	R= [11.9-18.1]	
31	01/19/99	ICR PE9	15.0	15.9	106.00	94.10	7.88	X			R= [11.9-18.1]	
32	01/27/99	ICR PE9	15.0	16.0	107.00	94.48	8.04	X			R= [11.9-18.1]	
33	02/10/99	ICR PE9	15.0	15.6	104.00	94.88	8.21	X			R= [11.9-18.1]	
34	02/24/99	ICR PE9	15.0	15.6	104.00	95.15	8.24	X			R= [11.9-18.1]	
35	03/10/99	ICR PE9	15.0	15.6	104.00	95.41	8.25	X			R= [11.9-18.1]	
36	04/07/99	ICR PE9	15.0	15.1	101.00	95.66	8.26	X			R= [11.9-18.1]	

95.81 8.19

Q.C. CHECKS

REFERENCE SAMPLE RESULTS FOR Chloroform MATRIX WATER 07/12/99

NO.	DATE	SAMPLE ID	TARGET	FOUND	CUMULATIVE		PERCENT		RECOVERY IS	COMMENT
					PCT. REC.	PCT. REC.	STD. DEV.	<WL <CL >CL		
1	04/22/97	WS037	22.3	22.5	101.00	0.00	0.00			R=[17.8-26.8]
2	04/22/97	ICR2	12.0	13.4	112.00	101.00	0.00			R=[9.59-14.5]
3	09/19/97	ICR004	29.1	31.5	108.00	106.50	7.78	X		R=[23.2-35.0]
4	12/12/97	WS038	36.5	32.9	90.00	107.00	5.57		X	R=[29.2-43.8]
5	12/25/97	ICR PE 5	11.1	9.94	90.00	102.75	9.64	X		R=[8.87-13.4]
6	02/19/98	WS037	22.3	21.6	97.00	100.20	10.11	X		R=[17.8-26.8]
7	03/23/98	ICR 006	16.2	14.4	89.00	99.67	9.14	X		R=[12.9-19.5]
8	04/08/98	ICR006	16.2	14.2	88.00	98.14	9.26	X		R=[12.9-19.5]
9	04/29/98	PE #6	16.2	13.7	85.00	96.88	9.30	X		R=[12.9-19.5]
10	05/13/98	ICR PE#6	16.2	13.6	84.00	95.56	9.55	X		R=[12.9-19.5]
11	06/04/98	PE #6	16.2	19.9	123.00	94.40	9.72		X	R=[12.9-19.5]
12	06/10/98	ICR PE6	16.2	13.6	84.00	97.00	12.63	X		R=[12.9-19.5]
13	06/30/98	ICR PE7	17.0	16.1	95.00	95.92	12.61	X		R=[13.5-20.5]
14	07/08/98	ICR PE7	17.0	15.6	92.00	95.85	12.08	X		R=[13.5-20.5]
15	08/17/98	ICR PE7	17.0	15.9	94.00	95.57	11.65	X		R=[13.5-20.5]
16	08/20/98	ICR PE7	17.0	26.8	158.00	95.47	11.23		X	R=[13.5-20.5]
17	09/02/98	ICR PE7	17.0	14.2	83.00	99.38	19.03	X		R=[13.5-20.5]
18	09/16/98	ICR PE7	17.0	16.1	95.00	98.41	18.85	X		R=[13.5-20.5]
19	09/28/98	ICR PE7	17.0	15.1	89.00	98.22	18.30	X		R=[13.5-20.5]
20	10/21/98	ICR PE8	54.1	67.9	125.00	97.74	17.91	X		R=[43.2-65.0]
21	11/02/98	ICR PE6	16.2	14.5	90.00	99.10	18.47	X		R=[12.9-19.5]
22	11/02/98	ICR PE7	17.0	15.8	93.00	98.67	18.11	X		R=[13.5-20.5]
23	11/02/98	ICR PE8	54.1	52.3	97.00	98.41	17.72	X		R=[43.2-65.0]
24	11/04/98	ICR PE8	54.1	57.3	106.00	98.35	17.31	X		R=[43.2-65.0]
25	11/19/98	ICR PE8	54.1	62.7	116.00	98.67	17.00	X		R=[43.2-65.0]
26	12/07/98	ICR PE8	54.1	65.0	120.00	99.36	17.00	X		R=[43.2-65.0]
27	12/16/98	ICR PE8	54.1	62.2	115.00	100.15	17.14	X		R=[43.2-65.0]
28	12/22/98	ICR PE8	54.1	57.0	105.00	100.70	17.05	X		R=[43.2-65.0]
29	12/28/98	ICR PE8	54.1	58.1	107.00	100.86	16.75	X		R=[43.2-65.0]
30	01/13/99	ICR PE9	32.2	37.3	116.00	101.07	16.49	X		R=[25.7-38.7]
31	01/19/99	ICR PE9	32.2	37.1	115.00	101.57	16.43	X		R=[25.7-38.7]
32	01/27/99	ICR PE9	35.2	34.7	98.00	102.00	16.33	X		R=[25.7-38.7]
33	02/10/99	ICR PE9	32.2	34.3	106.00	101.88	16.08	X		R=[25.7-38.7]
34	02/24/99	ICR PE9	32.2	34.5	107.00	102.00	15.85	X		R=[25.7-38.7]
35	03/10/99	ICR PE9	32.2	34.3	106.00	102.15	15.63	X		R=[25.7-38.7]
36	04/07/99	ICR PE9	32.2	34.3	106.00	102.26	15.41	X		R=[25.7-38.7]
					102.36	15.20				

Q.C. CHECKS

REFERENCE SAMPLE RESULTS FOR Dibromochl MATRIX WATER 07/12/99

NO.	DATE	SAMPLE ID	TARGET	FOUND	CUMULATIVE			PERCENT		RECOVERY IS	COMMENT
					PCT. REC.	PCT. REC.	STD. DEV.	<WL	<CL	>CL	
1	04/22/97	WS037	14.2	15.0	106.00	0.00	0.00				R=[11.4-17.0]
2	04/22/97	ICR2	18.6	18.3	98.00	106.00	0.00				R=[14.8-22.4]
3	09/19/97	ICR004	17.9	19.4	108.00	102.00	5.66	X			R=[14.3-21.5]
4	12/12/97	WS038	14.7	13.1	89.00	104.00	5.29		X		R=[11.8-17.6]
5	12/25/97	ICR PE 5	34.9	33.0	94.00	100.25	8.66	X			R=[27.9-41.9]
6	02/19/98	WS037	14.2	13.3	107.00	99.00	8.00	X			R=[11.4-17]
7	03/23/98	ICR006	28.6	28.1	98.00	100.33	7.87	X			R=[22.8-34.4]
8	04/08/98	ICR006	28.6	28.9	101.00	100.00	7.23	X			R=[22.8-34.4]
9	04/29/98	PE #6	28.6	28.6	100.00	100.13	6.71	X			R=[22.8-34.4]
10	05/13/98	ICR PE#6	28.6	26.7	93.00	100.11	6.27	X			R=[22.8-34.4]
11	06/04/98	PE #6	28.6	33.0	115.00	99.40	6.33		X		R=[22.8-34.4]
12	06/10/98	ICR PE6	28.6	26.8	94.00	100.82	7.63	X			R=[22.8-34.4]
13	06/30/98	ICR PE7	28.1	27.3	97.00	100.25	7.53	X			R=[22.4-33.8]
14	07/08/98	ICR PE7	28.1	28.6	102.00	100.00	7.27	X			R=[22.4-33.8]
15	08/17/98	ICR PE7	28.1	29.0	103.00	100.14	7.00	X			R=[22.4-33.8]
16	08/20/98	ICR PE7	23.8	27.1	96.00	100.33	6.79	X			R=[22.4-33.8]
17	09/02/98	ICR PE7	28.1	26.2	93.00	100.06	6.65	X			R=[22.4-33.8]
18	09/16/98	ICR PE7	28.1	29.2	104.00	99.65	6.66	X			R=[22.4-33.8]
19	09/28/98	ICR PE7	28.1	28.8	102.00	99.89	6.54	X			R=[22.4-33.8]
20	10/21/98	ICR PE8	14.0	15.4	110.00	100.00	6.38	X			R=[11.1-16.9]
21	11/02/98	ICR PE6	28.6	26.3	92.00	100.50	6.60	X			R=[22.8-34.4]
22	11/02/98	ICR PE7	28.1	28.6	102.00	100.10	6.69	X			R=[22.4-33.8]
23	11/02/98	ICR PE8	14.0	14.9	106.00	100.18	6.54	X			R=[11.1-16.9]
24	11/04/98	ICR PE8	14.0	14.3	102.00	100.43	6.51	X			R=[11.1-16.9]
25	11/19/98	ICR PE8	14.0	15.5	111.00	100.50	6.37	X			R=[11.1-16.9]
26	12/07/98	ICR PE8	14.0	15.7	112.00	100.92	6.58	X			R=[11.1-16.9]
27	12/16/98	ICR PE8	14.0	13.6	97.00	101.35	6.81	X			R=[11.1-16.9]
28	12/22/98	ICR PE8	14.0	13.9	99.00	101.19	6.73	X			R=[11.1-16.9]
29	12/28/98	ICR PE8	14.0	13.5	96.00	101.11	6.61	X			R=[11.1-16.9]
30	01/13/99	ICR PE9	9.10	9.36	103.00	100.93	6.56	X			R=[7.27-11.0]
31	01/19/99	ICR PE9	9.10	9.94	109.00	101.00	6.46	X			R=[7.27-11.0]
32	01/27/99	ICR PE9	9.10	9.42	104.00	101.26	6.51	X			R=[7.27-11.0]
33	02/10/99	ICR PE9	9.10	8.91	98.00	101.34	6.42	X			R=[7.27-11.0]
34	02/24/99	ICR PE9	9.01	8.80	97.00	101.24	6.35	X			R=[7.27-11.0]
35	03/10/99	ICR PE9	9.10	8.47	93.00	101.12	6.29	X			R=[7.27-11.0]
36	04/07/99	ICR PE9	9.10	9.16	101.00	100.89	6.35	X			R=[7.27-11.0]
					100.89	6.26					

Q. C. CHECKS

REFERENCE SAMPLE RESULTS FOR Bromoform MATRIX WATER 07/12/99

NO.	DATE	SAMPLE ID	TARGET	FOUND	CUMULATIVE			PERCENT			RECOVERY IS	COMMENT
					PCT. REC.	PCT. REC.	STD. DEV.	<WL	<CL	>CL		
1	04/22/97	WS037	18.6	19.8	106.00	0.00	0.00					R=[14.9-22.3]
2	04/22/97	ICR2	16.4	18.2	111.00	106.00	0.00					R=[13.1-19.7]
3	09/19/97	ICR004	12.0	13.7	114.00	108.50	3.54	X				R=[9.59-14.5]
4	12/12/97	WS038	26.5	24.1	91.00	110.33	4.04			X		R=[21.2-31.8]
5	02/19/98	WS037	18.6	19.4	104.00	105.50	10.21	X				R=[14.9-22.3]
6	03/23/98	ICR 006	20.2	19.7	98.00	105.20	8.87	X				R=[16.1-24.3]
7	04/08/98	ICR006	20.2	21.8	108.00	104.00	8.46	X				R=[16.1-24.3]
8	04/29/98	PE #6	20.2	19.6	97.00	104.57	7.87	X				R=[16.1-24.3]
9	05/13/98	ICR PE#6	20.2	18.1	90.00	103.63	7.76	X				R=[16.1-24.3]
10	06/04/98	PE #6	20.2	23.8	118.00	102.11	8.57	X				R=[16.1-24.3]
11	06/10/98	ICR PE6	20.2	19.4	96.00	103.70	9.51	X				R=[16.1-24.3]
12	06/30/98	ICR PE7	18.2	18.2	100.00	103.00	9.32	X				R=[14.5-21.9]
13	07/08/98	ICR PE7	18.2	18.3	100.00	102.75	8.93	X				R=[14.5-21.9]
14	08/17/98	ICR PE7	18.2	19.4	106.00	102.54	8.58	X				R=[14.5-21.9]
15	08/20/98	ICR PE7	18.2	18.3	100.00	102.79	8.29	X				R=[14.5-21.9]
16	09/02/98	ICR PE7	18.2	16.9	93.00	102.60	8.02	X				R=[14.5-21.9]
17	09/16/98	ICR PE7	18.2	19.2	105.00	102.00	8.12	X				R=[14.5-21.9]
18	09/28/98	ICR PE7	18.2	19.1	105.00	102.18	7.89	X				R=[14.5-21.9]
19	10/21/98	ICR PE8	7.0	7.0	100.00	102.33	7.68	X				R=[5.59-8.41]
20	11/02/98	ICR PE6	20.2	20.1	100.00	102.21	7.49	X				R=[16.1-24.3]
21	11/02/98	ICR PE7	18.2	19.6	108.00	102.10	7.30	X				R=[14.5-21.9]
22	11/02/98	ICR PE8	7.00	7.68	110.00	102.38	7.24	X				R=[5.59-8.41]
23	11/04/98	ICR PE8	7.00	7.32	105.00	102.73	7.25	X				R=[5.59-8.41]
24	11/19/98	ICR PE8	7.00	7.25	104.00	102.83	7.09	X				R=[5.59-8.41]
25	12/07/98	ICR PE8	7.00	7.42	106.00	102.88	6.94	X				R=[5.59-8.41]
26	12/16/98	ICR PE8	7.00	6.79	97.00	103.00	6.83	X				R=[5.59-8.41]
27	12/22/98	ICR PE8	7.00	6.45	92.00	102.77	6.79	X				R=[5.59-8.41]
28	12/28/98	ICR PE8	7.00	5.93	85.00	102.37	6.97			X		R=[5.59-8.41]
29	01/13/99	ICR PE9	2.98	2.50	84.00	101.75	7.59			X		R=[2.38-3.58]
30	01/19/99	ICR PE9	2.98	2.63	88.00	101.14	8.15	X				R=[2.38-3.58]
31	01/27/99	ICR PE9	2.98	2.54	85.00	100.70	8.36	X				R=[2.38-3.58]
32	02/10/99	ICR PE9	2.98	2.51	84.00	100.19	8.69	X				R=[2.38-3.58]
33	02/24/99	ICR PE9	2.98	2.23	75.00	99.69	9.01			X		R=[2.38-3.58]
34	03/10/99	ICR PE9	2.98	2.17	73.00	98.94	9.86			X		R=[2.38-3.58]
35	04/07/99	ICR PE9	2.98	2.80	94.00	98.18	10.68	X				R=[2.38-3.58]

98.06 10.54

PRECISION OR DUPLICATE RESULTS FOR MCAA01

MATRIX WATER 07/12/99

No.	DATE	RESULT1	RESULT2	RPD	CUMULATIVE		RPD IS			COMMENT
					RPD	STD DEV	<WL	<CL	>CL	
1	01/30/97	11.9	8.61	32.08	0.00	0.00				
2	02/28/97	8.25	7.80	5.61	32.08	0.00				
3	04/10/97	7.09	10.7	40.58	18.84	18.72	X			
4	04/25/97	33.7	33.8	0.30	26.09	18.24	X			
5	06/05/97	6.89	7.31	5.92	19.64	19.70	X			
6	07/04/97	9.93	10.06	1.30	16.90	18.13	X			
7	07/23/97	7.92	7.84	1.02	14.30	17.42	X			
8	09/10/97	6.52	7.57	14.90	12.40	16.68	X			
9	09/30/97	1.81	8.05	126.57	12.71	15.46			X	
10	12/29/97	9.00	12.3	30.99	25.36	40.62	X			
11	12/30/97	10.8	9.79	9.81	25.93	38.33	X			
12	03/24/98	30.0	32.0	6.45	24.46	36.69	X			
13	04/10/98	5.88	5.80	1.37	22.96	35.37	X			
14	04/10/98	1.87	1.82	2.71	21.30	34.39	X			
15	04/21/98	13.9	14.6	4.91	19.97	33.41	X			
16	05/06/98	12.4	12.0	3.28	18.97	32.43	X			
17	05/19/98	15.8	11.3	33.21	17.99	31.57	X			
18	06/10/98	13.3	19.2	36.31	18.88	30.79	X			
19	06/15/98	8.44	8.49	0.59	19.85	30.15	X			
20	06/30/98	2.96	2.46	18.45	18.84	29.64	X			
21	07/14/98	11.1	10.7	3.67	18.82	28.85	X			
22	07/23/98	9.68	9.73	0.52	18.10	28.31	X			
23	08/24/98	14.1	17.6	22.08	17.30	27.88	X			
24	09/03/98	15.6	14.5	7.31	17.51	27.26	X			
25	10/06/98	22.7	24.6	8.03	17.08	26.74	X			
26	10/26/98	18.8	15.8	17.34	16.72	26.24	X			
27	11/03/98	10.2	10.3	0.98	16.74	25.71	X			
28	11/05/98	8.34	6.44	25.71	16.16	25.39	X			
29	11/05/98	18.7	18.5	1.08	16.50	24.98	X			
30	11/23/98	10.5	8.65	19.32	15.97	24.70	X			
31	11/23/98	19.6	23.6	18.52	16.08	24.28	X			
32	12/10/98	15.75	15.91	1.01	16.16	23.87	X			
33	12/10/98	20.45	21.10	3.13	15.69	23.64	X			
34	12/17/98	12.2	14.5	17.23	15.30	23.37	X			
35	12/17/98	14.9	15.5	3.95	15.36	23.01	X			
36	12/23/98	3.44	3.64	5.65	15.04	22.75	X			
37	01/06/99	8.61	7.95	7.97	14.77	22.48	X			
ALL DATA BELOW WITHIN 180 DAYS OF CURRENT DATE										
38	01/14/99	8.99	9.08	1.00	14.59	22.19	X			
39	01/27/99	6.99	6.94	0.72	14.23	22.00	X			
40	02/10/99	7.39	7.04	4.85	13.89	21.82	X			
41	02/25/99	8.31	7.86	5.57	13.66	21.58	X			
42	02/25/99	7.78	7.78	0.00	13.46	21.35	X			
43	02/25/99	5.27	4.94	6.46	13.14	21.19	X			
44	03/10/99	6.45	6.92	7.03	12.99	20.96	X			
45	03/26/99	6.96	8.12	15.38	12.85	20.74	X			
46	04/08/99	12.4	11.7	5.81	12.91	20.50	X			
47	05/05/99	.41	.50	19.78	12.75	20.30	X			
					12.90	20.10				

PRECISION OR DUPLICATE RESULTS FOR MBAA01

MATRIX WATER 07/12/99

No.	DATE	RESULT1	RESULT2	RPD	CUMULATIVE		RPD IS			COMMENT
					RPD	STD DEV	<WL	<CL	>CL	
1	01/30/97	11.4	10.4	9.17	0.00	0.00				
2	02/28/97	11.5	11.0	4.44	9.17	0.00				
3	04/10/97	7.5	6.6	12.77	6.80	3.34	X			
4	04/25/97	9.59	9.67	0.83	8.79	4.18	X			
5	07/04/97	10.6	10.8	1.87	6.80	5.24	X			
6	07/23/97	12.6	12.1	4.05	5.82	5.05	X			
7	09/10/97	16.3	13.6	18.06	5.52	4.57		X		
8	12/29/97	47.3	44.5	6.10	7.31	6.32	X			
9	12/30/97	9.00	9.18	1.98	7.16	5.86	X			
10	03/24/98	0.42	0.42	0.00	6.59	5.75	X			
11	04/10/98	14.0	14.0	0.00	5.93	5.81	X			
12	04/21/98	6.25	6.80	8.43	5.39	5.79	X			
13	05/06/98	30.9	32.2	4.12	5.64	5.59	X			
14	05/19/98	32.4	29.9	8.03	5.52	5.37	X			
15	06/10/98	23.2	31.8	31.27	5.70	5.20			X	
16	06/15/98	11.5	11.5	0.00	7.41	8.29	X			
17	07/14/98	6.7	6.4	4.58	6.94	8.22	X			
18	07/23/98	19.0	18.9	0.53	6.81	7.98	X			
19	08/24/98	21.8	22.0	0.91	6.46	7.88	X			
20	09/03/98	17.0	15.9	6.69	6.17	7.76	X			
21	10/06/98	35.6	39.3	9.88	6.19	7.56	X			
22	10/26/98	1.41	1.32	6.59	6.37	7.41	X			
23	11/03/98	9.60	8.30	14.53	6.38	7.23	X			
24	11/05/98	2.31	1.29	56.67	6.73	7.27			X	
25	11/05/98	16.2	15.8	2.50	8.81	12.43	X			
26	11/23/98	.85	.89	4.60	8.56	12.23	X			
27	11/23/98	19.3	21.0	8.44	8.41	12.01	X			
28	12/10/98	.94	.89	5.46	8.41	11.78	X			
29	12/10/98	20.2	20.8	2.93	8.30	11.57	X			
30	12/17/98	.87	.82	5.92	8.12	11.40	X			
31	12/17/98	.85	.87	2.33	8.04	11.21	X			
32	12/23/98	.37	.37	0.00	7.86	11.07	X			
33	01/06/99	.86	.88	2.30	7.62	10.98	X			
ALL DATA BELOW WITHIN 180 DAYS OF CURRENT DATE										
34	01/14/99	.78	.79	1.27	7.45	10.85	X			
35	01/20/99	5.51	5.17	6.37	7.27	10.73	X			
36	01/27/99	.86	.86	0.00	7.25	10.58	X			
37	02/10/99	.80	.79	1.26	7.05	10.49	X			
38	02/25/99	.80	.82	2.47	6.89	10.39	X			
39	02/25/99	.84	.77	8.70	6.77	10.27	X			
40	02/25/99	.34	.28	19.35	6.82	10.14	X			
41	03/10/99	.76	.83	8.81	7.14	10.21	X			
42	03/26/99	.81	.85	4.82	7.18	10.08	X			
43	04/08/99	.95	.94	1.06	7.12	9.96	X			
44	05/05/99	.16	.16	0.00	6.98	9.89	X			
					6.82	9.83				

PRECISION OR DUPLICATE RESULTS FOR DCAA01

MATRIX WATER 07/12/99

No.	DATE	RESULT1	RESULT2	RPD	CUMULATIVE		RPD IS			COMMENT
					RPD	STD DEV	<WL	<CL	>CL	
1	01/30/97	10.0	9.16	8.77	0.00	0.00				
2	02/28/97	8.99	8.93	0.67	8.77	0.00				
3	04/10/97	30.9	27.5	11.64	4.72	5.73	X			
4	04/25/97	32.4	32.8	1.23	7.03	5.69	X			
5	06/05/97	8.28	8.70	4.95	5.58	5.48	X			
6	07/04/97	11.1	11.0	0.90	5.45	4.75	X			
7	07/23/97	8.51	8.45	0.71	4.69	4.64	X			
8	09/10/97	10.3	10.7	3.81	4.12	4.49	X			
9	09/30/97	31.0	44.2	35.11	4.08	4.16			X	
10	12/29/97	34.6	32.3	6.88	7.53	11.05	X			
11	12/30/97	18.5	20.1	8.29	7.47	10.42	X			
12	03/24/98	37.8	34.5	9.13	7.54	9.89	X			
13	04/10/98	22.2	20.7	6.99	7.67	9.44	X			
14	04/21/98	83.6	84.7	1.31	7.62	9.04	X			
15	05/06/98	20.4	20.4	0.00	7.17	8.85	X			
16	05/19/98	20.8	19.9	4.42	6.69	8.72	X			
17	06/10/98	19.3	19.2	0.52	6.55	8.45	X			
18	06/15/98	18.3	18.6	1.63	6.20	8.31	X			
19	06/30/98	27.1	27.2	0.37	5.94	8.13	X			
20	07/14/98	19.0	18.6	2.13	5.65	8.01	X			
21	07/23/98	15.0	14.5	3.39	5.47	7.83	X			
22	08/24/98	25.3	25.5	0.79	5.37	7.65	X			
23	09/03/98	27.8	26.6	4.41	5.17	7.53	X			
24	10/06/98	75.4	75.1	0.40	5.13	7.36	X			
25	10/26/98	104	112	7.41	4.94	7.26	X			
26	11/03/98	8.45	8.15	3.61	5.03	7.12	X			
27	11/05/98	99.2	97.9	1.32	4.98	6.98	X			
28	11/05/98	15.6	15.2	2.60	4.84	6.88	X			
29	11/23/98	112	105	6.45	4.76	6.77	X			
30	11/23/98	19.4	19.7	1.53	4.82	6.65	X			
31	12/10/98	114	117	2.60	4.71	6.57	X			
32	12/10/98	20.3	21.0	3.39	4.64	6.47	X			
33	12/17/98	99.9	108	7.79	4.60	6.37	X			
34	12/23/98	38.7	35.2	9.47	4.70	6.29	X			
35	01/06/99	109	113	3.60	4.84	6.25	X			
ALL DATA BELOW WITHIN 180 DAYS OF CURRENT DATE										
36	01/14/99	95.9	123	24.76	4.81	6.16			X	
37	01/20/99	21.81	20.46	6.39	5.36	6.92	X			
38	01/27/99	101.95	93.07	9.11	5.39	6.83	X			
39	02/10/99	114.30	116.36	1.79	5.49	6.76	X			
40	02/25/99	116	115	0.87	5.39	6.70	X			
41	02/25/99	118	120	1.68	5.28	6.65	X			
42	02/25/99	38.3	39.1	2.07	5.19	6.59	X			
43	03/10/99	99.8	99.4	0.40	5.12	6.53	X			
44	03/26/99	108	111	2.74	5.01	6.49	X			
45	04/08/99	113	123	8.47	4.96	6.42	X			
46	05/05/99	27.2	28.9	6.06	5.03	6.37	X			
					5.06	6.30				

PRECISION OR DUPLICATE RESULTS FOR TCAA01

MATRIX WATER 07/12/99

No.	DATE	RESULT1	RESULT2	RPD	CUMULATIVE		RPD IS			COMMENT
					RPD	STD DEV	<WL	<CL	>CL	
1	01/30/97	8.01	9.80	20.10	0.00	0.00				
2	02/28/97	10.4	10.7	2.84	20.10	0.00				
3	04/10/97	22.6	17.6	24.88	11.47	12.20	X			
4	04/25/97	33.5	33.8	0.89	15.94	11.59	X			
5	06/05/97	9.82	10.3	4.77	12.18	12.09	X			
6	07/04/97	13.0	12.7	2.33	10.70	10.98	X			
7	07/23/97	7.50	7.40	1.34	9.30	10.40	X			
8	09/10/97	8.36	10.1	18.85	8.16	9.96	X			
9	09/30/97	38.1	51.5	29.91	9.50	9.97		X		
10	12/29/97	19.7	20.3	3.00	11.77	11.54	X			
11	12/30/97	31.1	32.5	4.40	10.89	11.23	X			
12	03/24/98	39.2	34.7	12.18	10.30	10.83	X			
13	04/10/98	14.4	12.0	18.18	10.46	10.34	X			
14	04/21/98	80.8	82.5	2.08	11.05	10.13	X			
15	05/06/98	20.5	22.6	9.74	10.41	10.02	X			
16	05/19/98	22.3	24.8	10.62	10.37	9.66	X			
17	06/10/98	21.0	20.0	4.88	10.38	9.33	X			
18	06/15/98	16.6	16.7	0.60	10.06	9.13	X			
19	06/30/98	13.8	11.4	19.05	9.53	9.14	X			
20	07/14/98	16.6	16.4	1.21	10.03	9.14	X			
21	07/23/98	14.4	14.3	0.70	9.59	9.12	X			
22	08/24/98	31.6	31.8	0.63	9.17	9.10	X			
23	09/03/98	29.3	28.0	4.54	8.78	9.06	X			
24	10/06/98	52.9	58.1	9.37	8.60	8.90	X			
25	10/26/98	117	124	5.81	8.63	8.70	X			
26	11/03/98	11.9	11.2	6.06	8.52	8.54	X			
27	11/05/98	129	122	5.58	8.42	8.38	X			
28	11/05/98	12.7	12.4	2.39	8.32	8.23	X			
29	11/23/98	126	113	10.88	8.10	8.16	X			
30	11/23/98	16.4	16.4	0.00	8.20	8.03	X			
31	12/10/98	158	167	5.54	7.93	8.03	X			
32	12/10/98	20.8	21.5	3.31	7.85	7.91	X			
33	12/17/98	122	135	10.12	7.71	7.82	X			
34	12/23/98	40.9	48.3	16.59	7.78	7.71	X			
35	01/06/99	139	136	2.18	8.04	7.74	X			
ALL DATA BELOW WITHIN 180 DAYS OF CURRENT DATE										
36	01/14/99	119	156	26.91	7.87	7.69		X		
37	01/20/99	12.17	11.32	7.24	8.40	8.21	X			
38	01/27/99	146.38	131.46	10.74	8.37	8.10	X			
39	02/10/99	113.66	125.73	10.08	8.43	8.00	X			
40	02/25/99	123	128	3.98	8.47	7.90	X			
41	02/25/99	141	148	4.84	8.36	7.83	X			
42	02/25/99	18.6	19.5	4.72	8.28	7.75	X			
43	03/10/99	148	142	4.14	8.19	7.68	X			
44	03/26/99	174	187	7.20	8.10	7.61	X			
45	04/08/99	121	134	10.20	8.08	7.52	X			
46	05/05/99	11.3	12.2	7.66	8.12	7.44	X			
					8.11	7.36				

PRECISION OR DUPLICATE RESULTS FOR BCAA01

MATRIX WATER 07/12/99

No.	DATE	RESULT1	RESULT2	RPD	CUMULATIVE		RPD IS			COMMENT
					RPD	STD DEV	<WL	<CL	>CL	
1	01/30/97	8.14	8.60	5.50	0.00	0.00				
2	02/28/97	9.16	9.35	2.05	5.50	0.00				
3	04/10/97	10.9	9.7	11.65	3.77	2.44				
4	04/25/97	16.2	15.9	1.87	6.40	4.86	X			X
5	06/05/97	8.28	8.11	2.07	5.27	4.57	X			
6	07/04/97	11.4	11.1	2.67	4.63	4.21	X			
7	07/23/97	7.91	7.82	1.14	4.30	3.85	X			
8	09/10/97	4.68	4.90	4.59	3.85	3.71	X			
9	09/30/97	6.87	9.65	33.66	3.94	3.45				X
10	12/29/97	6.65	6.12	8.30	7.24	10.42	X			
11	12/30/97	12.5	11.9	4.92	7.35	9.83	X			
12	03/24/98	9.06	8.08	11.44	7.13	9.35	X			
13	04/10/98	11.7	10.2	13.70	7.49	9.00	X			
14	04/21/98	22.6	24.9	9.68	7.97	8.79	X			
15	05/06/98	21.3	21.4	0.47	8.09	8.46	X			
16	05/19/98	22.9	24.3	5.93	7.58	8.38	X			
17	06/10/98	19.7	20.2	2.51	7.48	8.11	X			
18	06/15/98	18.2	18.3	0.55	7.19	7.94	X			
19	06/30/98	4.0	3.9	2.53	6.82	7.86	X			
20	07/14/98	18.1	17.5	3.37	6.59	7.71	X			
21	07/23/98	12.4	12.3	0.81	6.43	7.53	X			
22	08/24/98	25.8	26.0	0.77	6.16	7.45	X			
23	09/03/98	25.9	24.8	4.34	5.92	7.36	X			
24	10/06/98	39.5	44.2	11.23	5.85	7.19	X			
25	10/26/98	13.1	12.9	1.54	6.07	7.12	X			
26	11/03/98	7.49	7.24	3.39	5.89	7.03	X			
27	11/05/98	11.6	11.0	5.31	5.80	6.91	X			
28	11/05/98	13.8	13.4	2.94	5.78	6.77	X			
29	11/23/98	12.6	12.5	0.80	5.68	6.67	X			
30	11/23/98	17.5	17.9	2.26	5.51	6.61	X			
31	12/10/98	13.1	13.5	3.01	5.40	6.52	X			
32	12/10/98	18.6	21.4	14.00	5.32	6.43	X			
33	12/17/98	11.0	12.0	8.70	5.59	6.51	X			
34	12/17/98	12.2	13.0	6.35	5.69	6.43	X			
35	12/23/98	5.04	6.06	18.38	5.71	6.33		X		
36	01/06/99	17.6	17.1	2.88	6.07	6.59	X			
ALL DATA BELOW WITHIN 180 DAYS OF CURRENT DATE										
37	01/14/99	14.7	14.9	1.35	5.98	6.52	X			
38	01/20/99	9.04	8.49	6.27	5.86	6.47	X			
39	01/27/99	16.24	15.87	2.30	5.87	6.39	X			
40	02/10/99	17.2	17.5	1.73	5.78	6.33	X			
41	02/25/99	17.3	17.6	1.72	5.67	6.28	X			
42	02/25/99	17.4	17.7	1.71	5.58	6.23	X			
43	02/25/99	4.39	4.62	5.11	5.49	6.18	X			
44	03/10/99	15.6	15.1	3.26	5.48	6.11	X			
45	03/26/99	15.01	16.48	9.34	5.43	6.05	X			
46	04/08/99	16.2	18.2	11.63	5.51	6.01	X			
47	05/05/99	2.74	2.94	7.04	5.65	6.01	X			
					5.68	5.94				

PRECISION OR DUPLICATE RESULTS FOR DBAA01

MATRIX WATER 07/12/99

No.	DATE	RESULT1	RESULT2	RPD	CUMULATIVE		RPD IS			COMMENT
					RPD	STD DEV	<WL	<CL	>CL	
1	01/30/97	7.93	9.14	14.18	0.00	0.00				
2	02/28/97	9.79	10.2	4.10	14.18	0.00				
3	04/10/97	8.24	6.72	20.32	9.14	7.13	X			
4	04/25/97	12.2	12.1	0.82	12.87	8.19	X			
5	06/05/97	8.62	8.67	0.58	9.86	9.00	X			
6	07/04/97	11.6	11.7	0.86	8.00	8.83	X			
7	07/23/97	7.42	7.19	3.15	6.81	8.42	X			
8	09/10/97	14.6	16.2	10.39	6.29	7.81	X			
9	09/30/97	.788	1.09	32.16	6.80	7.37			X	
10	12/29/97	0.6	0.5	18.18	9.62	10.91	X			
11	12/30/97	5.63	5.40	4.17	10.47	10.64	X			
12	03/24/98	1.00	0.84	17.39	9.90	10.27	X			
13	04/10/98	14.7	12.7	14.60	10.53	10.03	X			
14	04/21/98	1.68	1.79	6.34	10.84	9.67	X			
15	05/06/98	21.8	22.3	2.27	10.52	9.36	X			
16	05/19/98	23.9	31.7	28.06	9.97	9.27	X			
17	06/10/98	20.8	20.3	2.43	11.10	10.03	X			
18	06/15/98	17.4	17.6	1.14	10.59	9.94	X			
19	07/14/98	17.2	16.6	3.55	10.06	9.90	X			
20	07/23/98	12.1	12.0	0.83	9.72	9.73	X			
21	08/24/98	28.1	28.2	0.36	9.28	9.68	X			
22	09/03/98	25.5	24.4	4.41	8.85	9.63	X			
23	10/06/98	35.7	40.6	12.84	8.65	9.45	X			
24	10/26/98	1.37	1.12	20.08	8.83	9.27	X			
25	11/03/98	5.62	5.38	4.36	9.30	9.36	X			
26	11/05/98	1.26	1.17	7.41	9.10	9.21	X			
27	11/05/98	12.2	11.8	3.33	9.04	9.03	X			
28	11/23/98	1.33	1.29	3.05	8.83	8.92	X			
29	11/23/98	18.0	18.4	2.20	8.62	8.83	X			
30	12/10/98	1.27	1.25	1.59	8.40	8.75	X			
31	12/10/98	20.9	21.4	2.36	8.17	8.68	X			
32	12/17/98	1.07	1.16	8.07	7.98	8.60	X			
33	12/17/98	1.16	1.28	9.84	7.99	8.46	X			
34	12/23/98	.61	.72	16.54	8.04	8.34	X			
35	01/06/99	1.75	1.67	4.68	8.29	8.34	X			
ALL DATA BELOW WITHIN 180 DAYS OF CURRENT DATE										
36	01/14/99	1.4	1.4	0.00	8.19	8.24	X			
37	01/20/99	6.34	6.07	4.35	7.96	8.23	X			
38	01/27/99	1.70	1.64	3.59	7.86	8.14	X			
39	02/10/99	1.67	1.71	2.37	7.75	8.06	X			
40	02/25/99	1.68	1.72	2.35	7.61	8.00	X			
41	02/25/99	1.65	1.70	2.99	7.48	7.94	X			
42	02/25/99	.74	.77	3.97	7.37	7.87	X			
43	03/10/99	1.49	1.47	1.35	7.29	7.79	X			
44	03/26/99	1.41	1.52	7.51	7.15	7.75	X			
45	04/08/99	1.2	2.0	50.00	7.16	7.66			X	
46	05/05/99	.40	.44	9.52	8.11	9.91	X			
					8.14	9.80				

SPIKE

ACCURACY RESULTS FOR MCAA01

MATRIX WATER 07/12/99

NO.	DATE	PCT. REC.	CUMULATIVE		PERCENT RECOVERY IS			COMMENT
			PCT. REC.	STD. DEV.	<WL	<CL	>CL	
1	01/30/97	54.00	0.00	0.00				
2	02/28/97	80.00	54.00	0.00				
3	04/10/97	55.00	67.00	18.38	X			
4	04/25/97	117.00	63.00	14.73			X	
5	06/05/97	33.00	76.50	29.56	X			
6	07/04/97	100.00	67.80	32.15	X			
7	07/23/97	43.00	73.17	31.62	X			
8	09/30/97	7.00	68.86	31.03	X			
9	12/29/97	20.00	61.13	36.11	X			
10	03/24/98	24.00	56.56	36.45	X			
11	04/10/98	30.00	53.30	35.88	X			
12	04/21/98	140.00	51.18	34.75			X	
13	05/06/98	60.00	58.58	41.90	X			
14	05/19/98	75.00	58.69	40.12	X			
15	06/10/98	81.00	59.86	38.79	X			
16	06/15/98	42.00	61.27	37.77	X			
17	06/30/98	39.00	60.06	36.81	X			
18	07/14/98	47.00	58.82	36.00	X			
19	07/23/98	24.00	58.17	35.04	X			
20	08/24/98	78.00	56.37	34.94	X			
21	09/03/98	75.00	57.45	34.35	X			
22	10/06/98	57.00	58.29	33.70	X			
23	11/05/98	84.00	58.23	32.89	X			
24	11/23/98	98.00	59.35	32.58	X			
25	12/10/98	101.00	60.96	32.83	X			
26	12/17/98	112.00	62.56	33.12	X			
27	12/17/98	114.00	64.46	33.87	X			
28	12/23/98	93.00	66.30	34.55	X			
29	01/06/99	80.00	67.25	34.28	X			
ALL DATA BELOW IS WITHIN 180 DAYS OF CURRENT DATE								
30	01/14/99	73.00	67.69	33.74	X			
31	01/20/99	108.00	67.87	33.17	X			
32	01/27/99	83.00	69.16	33.40	X			
33	02/10/99	114.00	69.59	32.95	X			
34	02/25/99	80.00	70.94	33.34	X			
35	02/25/99	73.00	71.21	32.87	X			
36	03/10/99	76.00	71.26	32.38	X			
37	03/26/99	64.00	71.39	31.92	X			
38	04/08/99	104.00	71.19	31.50	X			
39	05/05/99	112.00	72.05	31.53	X			
			73.08	31.76				

SPIKE

ACCURACY RESULTS FOR MBAA01 MATRIX WATER 07/12/99

NO.	DATE	PCT. REC.	CUMULATIVE PCT. REC.	STD. DEV.	PERCENT RECOVERY IS			COMMENT
					<WL	<CL	>CL	
1	01/30/97	106.00	0.00	0.00				
2	02/28/97	112.00	106.00	0.00				
3	04/10/97	70.00	109.00	4.24			X	
4	04/25/97	96.00	96.00	22.72	X			
5	06/05/97	80.00	96.00	18.55	X			
6	07/04/97	107.00	92.80	17.58	X			
7	07/23/97	126.00	95.17	16.76	X			
8	09/30/97	80.00	99.57	19.23	X			
9	12/29/97	111.00	97.13	19.10	X			
10	03/24/98	110.00	98.67	18.46	X			
11	04/10/98	70.00	99.80	17.77	X			
12	04/21/98	106.00	97.09	19.10	X			
13	05/06/98	101.00	97.83	18.39	X			
14	05/19/98	136.00	98.08	17.63		X		
15	06/10/98	137.00	100.79	19.74	X			
16	06/15/98	58.00	103.20	21.20		X		
17	06/30/98	82.00	100.38	23.39	X			
18	07/14/98	34.00	99.29	23.08		X		
19	07/23/98	95.00	95.67	27.17	X			
20	08/24/98	106.00	95.63	26.41	X			
21	09/03/98	72.00	96.15	25.81	X			
22	10/06/98	89.00	95.00	25.70	X			
23	11/05/98	79.00	94.73	25.11	X			
24	11/23/98	99.00	94.04	24.75	X			
25	12/10/98	102.00	94.25	24.23	X			
26	12/17/98	102.00	94.56	23.77	X			
27	12/17/98	103.00	94.85	23.34	X			
28	12/23/98	92.00	95.15	22.94	X			
29	01/06/99	95.00	95.04	22.51	X			
ALL DATA BELOW IS WITHIN 180 DAYS OF CURRENT DATE								
30	01/14/99	86.00	95.03	22.11	X			
31	01/20/99	102.00	94.73	21.79	X			
32	01/27/99	93.00	94.97	21.46	X			
33	02/10/99	102.00	94.91	21.11	X			
34	02/25/99	101.00	95.12	20.82	X			
35	02/25/99	93.00	95.29	20.53	X			
36	03/10/99	98.00	95.23	20.23	X			
37	03/26/99	92.00	95.31	19.94	X			
38	04/08/99	108.00	95.22	19.67	X			
39	05/05/99	98.00	95.55	19.51	X			
			95.62	19.26				

SPIKE

ACCURACY RESULTS FOR DCAA01

MATRIX WATER 07/12/99

NO.	DATE	PCT. REC.	CUMULATIVE		PERCENT RECOVERY IS			COMMENT
			PCT. REC.	STD. DEV.	<WL	<CL	>CL	
1	01/30/97	39.00	0.00	0.00				
2	02/28/97	90.00	39.00	0.00				
3	04/10/97	97.00	64.50	36.06	X			
4	04/25/97	33.00	75.33	31.66	X			
5	06/05/97	85.00	64.75	33.41	X			
6	07/04/97	110.00	68.80	30.32	X			
7	07/23/97	103.00	75.67	31.91	X			
8	09/30/97	114.00	79.57	30.91	X			
9	12/29/97	82.00	83.88	31.10	X			
10	03/24/98	90.00	83.67	29.09	X			
11	04/10/98	104.00	84.30	27.50	X			
12	04/21/98	86.00	86.09	26.76	X			
13	05/06/98	102.00	86.08	25.51	X			
14	05/19/98	104.00	87.31	24.82	X			
15	06/10/98	96.00	88.50	24.26	X			
16	06/15/98	92.00	89.00	23.46	X			
17	06/30/98	66.00	89.19	22.68	X			
18	07/14/98	95.00	87.82	22.67	X			
19	07/23/98	74.00	88.22	22.05	X			
20	08/24/98	127.00	87.47	21.68	X			
21	09/03/98	136.00	89.45	22.88		X		
22	10/06/98	125.00	91.67	24.50	X			
23	11/05/98	76.00	93.18	24.95	X			
24	11/23/98	95.00	92.43	24.64	X			
25	12/10/98	103.00	92.54	24.10	X			
26	12/17/98	88.00	92.96	23.68	X			
27	12/17/98	90.00	92.77	23.23	X			
28	12/23/98	75.00	92.67	22.78	X			
29	01/06/99	84.00	92.04	22.60	X			
ALL DATA BELOW IS WITHIN 180 DAYS OF CURRENT DATE								
30	01/14/99	85.00	91.76	22.25	X			
31	01/20/99	91.00	91.53	21.89	X			
32	01/27/99	93.00	91.52	21.53	X			
33	02/10/99	113.00	91.56	21.18	X			
34	02/25/99	107.00	92.21	21.18	X			
35	02/25/99	98.00	92.65	21.01	X			
36	03/10/99	99.00	92.80	20.71	X			
37	03/26/99	94.00	92.97	20.44	X			
38	04/08/99	108.00	93.00	20.16	X			
39	05/05/99	94.00	93.39	20.03	X			
			93.41	19.77				

SPIKE

ACCURACY RESULTS FOR TCAA01

MATRIX WATER 07/12/99

NO.	DATE	PCT. REC.	CUMULATIVE		STD. DEV.	PERCENT RECOVERY IS			COMMENT
			PCT. REC.			<WL	<CL	>CL	
1	01/30/97	11.00	0.00		0.00				
2	02/28/97	106.00	11.00		0.00				
3	04/10/97	103.00	58.50		67.18	X			
4	04/25/97	56.00	73.33		54.00	X			
5	06/05/97	100.00	69.00		44.94	X			
6	07/04/97	128.00	75.20		41.31	X			
7	07/23/97	82.00	84.00		42.78	X			
8	09/30/97	120.00	83.71		39.06	X			
9	12/29/97	76.00	88.25		38.37	X			
10	03/24/98	88.00	86.89		36.12	X			
11	04/10/98	97.00	87.00		34.06	X			
12	04/21/98	91.00	87.91		32.45	X			
13	05/06/98	114.00	88.17		30.95	X			
14	05/19/98	111.00	90.15		30.49	X			
15	06/10/98	102.00	91.64		29.82	X			
16	06/15/98	83.00	92.33		28.86	X			
17	06/30/98	67.00	91.75		27.98	X			
18	07/14/98	82.00	90.29		27.75	X			
19	07/23/98	77.00	89.83		26.99	X			
20	08/24/98	152.00	89.16		26.39		X		
21	09/03/98	131.00	92.30		29.28	X			
22	10/06/98	105.00	94.14		29.76	X			
23	11/05/98	61.00	94.64		29.14	X			
24	11/23/98	80.00	93.17		29.32	X			
25	12/10/98	105.00	92.63		28.80	X			
26	12/17/98	92.00	93.12		28.30	X			
27	12/17/98	91.00	93.08		27.73	X			
28	12/23/98	73.00	93.00		27.20	X			
29	01/06/99	87.00	92.29		26.95	X			
ALL DATA BELOW IS WITHIN 180 DAYS OF CURRENT DATE									
30	01/14/99	92.00	92.10		26.49	X			
31	01/20/99	103.00	92.10		26.03	X			
32	01/27/99	99.00	92.45		25.66	X			
33	02/10/99	120.00	92.66		25.27	X			
34	02/25/99	126.00	93.48		25.33	X			
35	02/25/99	110.00	94.44		25.55	X			
36	03/10/99	112.00	94.89		25.31	X			
37	03/26/99	99.00	95.36		25.11	X			
38	04/08/99	102.00	95.46		24.77	X			
39	05/05/99	107.00	95.63		24.45	X			
			95.92		24.20				

SPIKE

ACCURACY RESULTS FOR BCAA01

MATRIX WATER 07/12/99

NO.	DATE	PCT. REC.	CUMULATIVE		PERCENT RECOVERY IS			COMMENT
			PCT. REC.	STD. DEV.	<WL	<CL	>CL	
1	01/30/97	84.00	0.00	0.00				
2	02/28/97	92.00	84.00	0.00				
3	04/10/97	74.00	88.00	5.66		X		
4	04/25/97	92.00	83.33	9.02	X			
5	06/05/97	82.00	85.50	8.54	X			
6	07/04/97	112.00	84.80	7.56			X	
7	07/23/97	107.00	89.33	13.00	X			
8	09/30/97	120.00	91.86	13.62		X		
9	12/29/97	88.00	95.38	16.06	X			
10	03/24/98	104.00	94.56	15.22	X			
11	04/10/98	106.00	95.50	14.66	X			
12	04/21/98	100.00	96.45	14.26	X			
13	05/06/98	99.00	96.75	13.64	X			
14	05/19/98	107.00	96.92	13.07	X			
15	06/10/98	100.00	97.64	12.85	X			
16	06/15/98	95.00	97.80	12.39	X			
17	06/30/98	80.00	97.63	11.99	X			
18	07/14/98	90.00	96.59	12.37	X			
19	07/23/98	62.00	96.22	12.11		X		
20	08/24/98	130.00	94.42	14.14		X		
21	09/03/98	125.00	96.20	15.90	X			
22	10/06/98	91.00	97.57	16.72	X			
23	11/05/98	67.00	97.27	16.38	X			
24	11/23/98	87.00	95.96	17.20	X			
25	12/10/98	99.00	95.58	16.92	X			
26	12/17/98	88.00	95.72	16.58	X			
27	12/17/98	89.00	95.42	16.32	X			
28	12/23/98	92.00	95.19	16.05	X			
29	01/06/99	98.00	95.07	15.76	X			
ALL DATA BELOW IS WITHIN 180 DAYS OF CURRENT DATE								
30	01/14/99	100.00	95.17	15.49	X			
31	01/20/99	109.00	95.33	15.24	X			
32	01/27/99	110.00	95.77	15.18	X			
33	02/10/99	123.00	96.22	15.15	X			
34	02/25/99	128.00	97.03	15.62	X			
35	02/25/99	119.00	97.94	16.27	X			
36	03/10/99	115.00	98.54	16.42	X			
37	03/26/99	110.00	99.00	16.42	X			
38	04/08/99	108.00	99.30	16.29	X			
39	05/05/99	87.00	99.53	16.13	X			
			99.21	16.04				

SPIKE

ACCURACY RESULTS FOR DBAA01

MATRIX WATER 07/12/99

NO.	DATE	PCT. REC.	CUMULATIVE		PERCENT RECOVERY IS			COMMENT
			PCT. REC.	STD. DEV.	<WL	<CL	>CL	
1	01/30/97	83.00	0.00	0.00				
2	02/28/97	100.00	83.00	0.00				
3	04/10/97	74.00	91.50	12.02	X			
4	04/25/97	118.00	85.67	13.20		X		
5	06/05/97	86.00	93.75	19.43	X			
6	07/04/97	116.00	92.20	17.18	X			
7	07/23/97	105.00	96.17	18.18	X			
8	09/30/97	122.00	97.43	16.93	X			
9	12/29/97	88.00	100.50	17.92	X			
10	03/24/98	108.00	99.11	17.27	X			
11	04/10/98	104.00	100.00	16.53	X			
12	04/21/98	94.00	100.36	15.72	X			
13	05/06/98	105.00	99.83	15.10	X			
14	05/19/98	120.00	100.23	14.53	X			
15	06/10/98	103.00	101.64	14.93	X			
16	06/15/98	87.00	101.73	14.39	X			
17	06/30/98	80.00	100.81	14.38	X			
18	07/14/98	86.00	99.59	14.81	X			
19	07/23/98	60.00	98.83	14.72		X		
20	08/24/98	140.00	96.79	16.85		X		
21	09/03/98	123.00	98.95	19.04	X			
22	10/06/98	89.00	100.10	19.28	X			
23	11/05/98	57.00	99.59	18.97		X		
24	11/23/98	88.00	97.74	20.55	X			
25	12/10/98	103.00	97.33	20.20	X			
26	12/17/98	89.00	97.56	19.80	X			
27	12/17/98	89.00	97.23	19.48	X			
28	12/23/98	100.00	96.93	19.16	X			
29	01/06/99	105.00	97.04	18.81	X			
ALL DATA BELOW IS WITHIN 180 DAYS OF CURRENT DATE								
30	01/14/99	104.00	97.31	18.53	X			
31	01/20/99	109.00	97.53	18.25	X			
32	01/27/99	117.00	97.90	18.06	X			
33	02/10/99	125.00	98.50	18.09	X			
34	02/25/99	133.00	99.30	18.39	X			
35	02/25/99	124.00	100.29	19.01	X			
36	03/10/99	119.00	100.97	19.15	X			
37	03/26/99	116.00	101.47	19.11	X			
38	04/08/99	108.00	101.86	19.00	X			
39	05/05/99	96.00	102.03	18.77	X			
			101.87	18.54				

Q.C. CHECKS

REFERENCE SAMPLE RESULTS FOR MCAA01 MATRIX WATER 07/12/99

NO.	DATE	SAMPLE ID	TARGET	FOUND	CUMULATIVE			PERCENT			COMMENT
					PCT. REC.	PCT. REC.	STD. DEV.	RECOVERY	IS	<WL <CL >CL	
1	01/30/97	ERA29001	18.1	16.3	90.00	0.00	0.00				R=[4.33-27.7]
2	02/28/97	ERA29001	18.1	12.7	70.00	90.00	0.00				R=[4.33-27.7]
3	04/10/97	ERA 29001	18.1	15.0	83.00	80.00	14.14	X			R=[4.33-27.7]
4	04/25/97	ERA 29001	18.1	19.2	106.00	81.00	10.15		X		R=[10.9-25.3]
5	06/05/97	ERA29001	18.1	11.9	66.00	87.25	15.00	X			R=[10.9-25.3]
6	07/04/97	ERA29001	18.1	16.9	93.00	83.00	16.09	X			R=[10.9-25.3]
7	07/23/97	ERA29001	18.1	18.9	104.00	84.67	14.96	X			R=[10.9-25.3]
8	09/10/97	ICR PE5	12.0	10.5	88.00	87.43	15.49	X			R=[7.19-16.9]
9	12/29/97	ICR PE 5	6.05	5.78	96.00	87.50	14.34	X			R=[3.62-8.48]
10	12/30/97	ICR PE 5	6.05	5.78	96.00	88.44	13.71	X			R=[3.62-8.48]
11	03/24/98	ICR 006	9.04	11.5	127.00	89.20	13.15		X		R=[5.42-12.7]
12	04/10/98	icr006	9.04	9.33	103.00	92.64	16.90	X			R=[5.42-12.7]
13	04/10/98	ICR006	9.04	9.33	103.00	93.50	16.38	X			R=[5.42-12.7]
14	05/06/98	ICR PE6	9.04	7.91	88.00	94.23	15.91	X			R=[5.42-12.7]
15	05/19/98	ICR PE7	5.94	5.90	99.00	93.79	15.37	X			R=[3.56-8.32]
16	06/10/98	ICR PE7	5.94	6.62	111.00	94.13	14.88	X			R=[3.56-8.32]
17	06/15/98	ICR PE7	5.94	4.76	80.00	95.19	14.98	X			R=[3.56-8.32]
18	06/30/98	ICR PE7	5.94	4.44	75.00	94.29	14.96	X			R=[3.56-8.32]
19	07/14/98	ICR PE7	5.94	5.3	90.00	93.22	15.21	X			R=[3.56-8.32]
20	07/23/98	ICR PE7	5.94	6.46	109.00	93.05	14.80	X			R=[3.56-8.32]
21	09/03/98	ICR PE6	9.04	9.76	108.00	93.85	14.84	X			R=[5.42-12.7]
22	10/26/98	ICR PE8	13.0	12.6	97.00	94.52	14.79	X			R=[7.79-18.3]
23	11/03/98	ICR PE6	9.04	8.95	99.00	94.64	14.44	X			R=[5.42-12.7]
24	11/03/98	ICR PE7	5.94	7.01	119.00	94.83	14.14	X			R=[3.56-8.32]
25	11/03/98	ICR PE8	13.0	16.3	125.00	95.83	14.68	X			R=[7.79-18.3]
26	11/05/98	ICR PE8	13.0	13.2	102.00	97.00	15.51	X			R=[7.79-18.3]
27	11/23/98	ICR PE8	13.0	12.4	95.00	97.19	15.23	X			R=[7.79-18.3]
28	12/10/98	ICR PE8	13.0	14.3	110.00	97.11	14.94	X			R=[7.79-18.3]
29	12/17/98	ICR PE8	13.0	16.6	128.00	97.57	14.86		X		R=[7.79-18.3]
30	12/23/98	ICR PE9	11.1	10.8	97.00	98.62	15.65	X			R=[6.65-15.6]
31	01/06/99	ICR PE9	11.1	9.55	86.00	98.57	15.38	X			R=[6.65-15.6]
32	01/14/99	ICR PE9	11.1	9.03	81.00	98.16	15.29	X			R=[6.65-15.6]
33	01/20/99	ICR PE9	11.1	9.74	88.00	97.63	15.34	X			R=[6.65-15.6]
34	01/27/99	ICR PE9	11.1	8.53	77.00	97.33	15.20	X			R=[6.65-15.6]
35	02/10/99	ICR PE9	11.1	8.52	77.00	96.74	15.36	X			R=[6.65-15.6]
36	02/25/99	ICR PE9	11.1	10.1	91.00	96.17	15.50	X			R=[6.65-15.6]
37	02/25/99	ICR PE9	11.1	10.8	97.00	96.03	15.30	X			R=[6.65-15.6]
38	03/10/99	ICR PE9	11.1	9.88	89.00	96.05	15.09	X			R=[6.65-15.6]
39	03/26/99	ICR PE9	11.1	8.29	75.00	95.87	14.93	X			R=[6.65-15.6]
40	04/08/99	ICR PE9	11.1	7.46	67.00	95.33	15.10	X			R=[6.65-15.6]
41	05/05/99	ICR PE9	11.1	10.4	93.00	94.63	15.57	X			R=[6.65-15.6]
					94.59	15.37					

Q.C. CHECKS

REFERENCE SAMPLE RESULTS FOR MBAA01 MATRIX WATER 07/12/99

NO.	DATE	SAMPLE ID	TARGET	FOUND	CUMULATIVE			PERCENT			RECOVERY IS	COMMENT
					PCT. REC.	PCT. REC.	STD. DEV.	RECOVERY	<WL	<CL	>CL	
1	01/30/97	ERA29001	13.8	11.0	80.00	0.00	0.00					R=[6.39-19.2]
2	02/28/97	ERA29001	13.8	8.13	59.00	80.00	0.00					R=[6.39-19.2]
3	04/10/97	ERA 29001	13.8	10.0	72.00	69.50	14.85	X				R=[6.39-19.2]
4	04/25/97	ERA 29001	13.8	12.2	88.00	70.33	10.60	X				R=[8.28-19.3]
5	06/05/97	ERA29001	13.8	7.17	52.00	74.75	12.37	X				R=[8.28-19.3]
6	07/04/97	ERA29001	13.8	11.1	80.00	70.20	14.77	X				R=[8.28-19.3]
7	07/23/97	ERA29001	13.8	24.3	176.00	71.83	13.80		X			R=[8.28-19.3]
8	09/10/97	ICR PE5	10.0	7.81	78.00	86.71	41.34	X				R=[5.99-14.1]
9	12/29/97	ICR PE 5	11.9	10.4	87.00	85.63	38.40	X				R=[7.13-16.7]
10	12/30/97	ICR PE 5	11.9	10.4	87.00	85.78	35.92	X				R=[7.13-16.7]
11	03/24/98	ICR 006	8.10	12.1	149.00	85.90	33.87	X				R=[4.85-11.4]
12	04/10/98	ICR006	8.10	6.63	82.00	91.64	37.34	X				R=[4.85-11.4]
13	04/10/98	ICR006	8.10	6.63	82.00	90.83	35.71	X				R=[4.85-11.4]
14	05/06/98	ICR PE6	8.10	5.40	67.00	90.15	34.28	X				R=[4.85-11.4]
15	05/19/98	ICR PE7	11.1	16.3	147.00	88.50	33.51	X				R=[6.65-15.6]
16	06/10/98	ICR PE7	11.1	13.1	118.00	92.40	35.65	X				R=[6.65-15.6]
17	06/15/98	ICR PE7	11.1	8.25	74.00	94.00	35.03	X				R=[6.65-15.6]
18	06/30/98	ICR PE7	11.1	5.2	47.00	92.82	34.26	X				R=[6.65-15.6]
19	07/14/98	ICR PE7	11.1	16.3	147.00	90.28	34.95	X				R=[6.65-15.6]
20	07/23/98	ICR PE7	11.1	12.4	111.00	93.26	36.37	X				R=[6.65-15.6]
21	09/03/98	ICR PE6	8.10	10.6	131.00	94.15	35.62	X				R=[4.85-11.4]
22	10/26/98	ICR PE8	16.0	18.8	118.00	95.90	35.64	X				R=[9.59-22.5]
23	11/03/98	ICR PE6	8.10	7.89	97.00	96.91	35.10	X				R=[4.85-11.4]
24	11/03/98	ICR PE7	11.1	14.7	132.00	96.91	34.29	X				R=[6.65-15.6]
25	11/05/98	ICR PE8	16.0	14.6	91.00	98.38	34.30	X				R=[9.59-22.5]
26	11/23/98	ICR PE8	16.0	17.5	109.00	98.08	33.61	X				R=[9.59-22.5]
27	12/10/98	ICR PE8	16.0	17.04	106.00	98.50	33.00	X				R=[9.59-22.5]
28	12/17/98	ICR PE8	16.0	18.5	116.00	98.78	32.39	X				R=[9.59-22.5]
29	12/23/98	ICR PE9	9.11	8.42	92.00	99.39	31.95	X				R=[5.46-12.8]
30	01/06/99	ICR PE9	9.11	8.13	89.00	99.14	31.40	X				R=[5.46-12.8]
31	01/14/99	ICR PE9	9.11	7.61	84.00	98.80	30.91	X				R=[5.46-12.8]
32	01/20/99	ICR PE9	9.11	8.36	92.00	98.32	30.51	X				R=[5.46-12.8]
33	01/27/99	ICR PE9	9.11	7.48	82.00	98.13	30.03	X				R=[5.46-12.8]
34	02/10/99	ICR PE9	9.11	7.47	82.00	97.64	29.69	X				R=[5.46-12.8]
35	02/25/99	ICR PE9	9.11	8.94	98.00	97.18	29.36	X				R=[5.46-12.8]
36	02/25/99	ICR PE9	9.11	8.70	95.00	97.20	28.93	X				R=[5.46-12.8]
37	03/10/99	ICR PE9	9.11	8.28	91.00	97.14	28.51	X				R=[5.46-12.8]
38	03/26/99	ICR PE9	9.11	7.60	83.00	96.97	28.13	X				R=[5.46-12.8]
39	04/08/99	ICR PE9	9.11	6.26	69.00	96.61	27.84	X				R=[5.46-12.8]
40	05/05/99	ICR PE9	9.11	7.89	87.00	95.90	27.83	X				R=[5.46-12.8]
					95.67	27.50						

Q.C. CHECKS

REFERENCE SAMPLE RESULTS FOR DCAA01

MATRIX WATER 07/12/99

NO.	DATE	SAMPLE		TARGET	FOUND	CUMULATIVE			PERCENT		RECOVERY IS	COMMENT
		ID				PCT. REC.	PCT. REC.	STD. DEV.	<WL	<CL	>CL	
1	01/30/97	ERA29001		5.24	4.66	89.00	0.00	0.00				R=[4.19-6.97]
2	02/28/97	ERA29001		5.24	4.56	87.00	89.00	0.00				R=[4.19-6.90]
3	04/10/97	ERA 29001		5.24	4.5	86.00	88.00	1.41	X			R=[4.19-6.97]
4	04/25/97	ERA 29001		5.24	6.89	133.00	87.33	1.53		X		R=[3.14-7.34]
5	06/05/97	ERA29001		5.24	4.82	92.00	98.75	22.87	X			R=[3.14-7.34]
6	07/04/97	ERA29001		5.24	6.19	118.00	97.40	20.03	X			R=[3.14-7.34]
7	07/23/97	ERA29001		5.24	6.76	131.00	100.83	19.79	X			R=[3.14-7.34]
8	09/10/97	ICR PE5		24.0	19.5	81.00	105.14	21.37	X			R=[14.3-33.7]
9	12/29/97	ICR PE 5		12.0	11.0	92.00	102.13	21.54	X			R=[7.19-16.9]
10	12/30/97	ICR PE 5		12.0	11.0	92.00	101.00	20.43	X			R=[7.19-16.9]
11	03/24/98	ICR 006		18.1	21.9	121.00	100.10	19.47	X			R=[10.8-25.4]
12	04/10/98	ICR006		18.1	17.4	96.00	102.00	19.52	X			R=[10.8-25.4]
13	04/10/98	ICR006		18.1	17.4	96.00	101.50	18.69	X			R=[10.8-25.4]
14	05/06/98	ICR PE6		18.1	16.4	91.00	101.08	17.96	X			R=[10.8-25.4]
15	05/19/98	ICR PE7		24.0	22.8	95.00	100.36	17.46	X			R=[14.3-33.7]
16	06/10/98	ICR PE7		24.0	20.4	85.00	100.00	16.89	X			R=[14.3-33.7]
17	06/15/98	ICR PE7		24.0	19.3	80.00	99.06	16.74	X			R=[14.3-33.7]
18	06/30/98	ICR PE7		24.0	15.9	66.00	97.94	16.85	X			R=[14.3-33.7]
19	07/14/98	ICR PE7		24.0	19.1	80.00	96.17	18.00	X			R=[14.3-33.7]
20	07/23/98	ICR PE7		24.0	28.5	119.00	95.32	17.88	X			R=[14.3-33.7]
21	09/03/98	ICR PE6		18.1	24.0	133.00	96.50	18.19		X		R=[10.8-25.4]
22	10/26/98	ICR PE8		14.2	16.4	115.00	98.24	19.44	X			R=[8.51-19.9]
23	11/03/98	ICR PE6		18.1	19.5	108.00	99.00	19.30	X			R=[10.8-25.4]
24	11/03/98	ICR PE8		14.2	19.2	135.00	99.39	18.95	X			R=[8.51-19.9]
25	11/05/98	ICR PE8		14.2	12.2	86.00	100.88	19.91	X			R=[8.51-19.9]
26	11/23/98	ICR PE8		14.2	14.9	105.00	100.28	19.72	X			R=[8.51-19.9]
27	12/10/98	ICR PE8		14.2	16.3	115.00	100.46	19.34	X			R=[8.51-19.9]
28	12/17/98	ICR PE8		14.2	14.2	100.00	101.00	19.17	X			R=[8.51-19.9]
29	12/23/98	ICR PE9		8.01	8.50	106.00	100.96	18.81	X			R=[4.80-11.3]
30	01/06/99	ICR PE9		8.01	7.47	93.00	101.14	18.50	X			R=[4.80-11.3]
31	01/14/99	ICR PE9		8.01	7.21	90.00	100.87	18.24	X			R=[4.80-11.3]
32	01/20/99	ICR PE9		8.01	8.08	101.00	100.52	18.04	X			R=[4.80-11.3]
33	01/27/99	ICR PE9		8.01	6.96	87.00	100.53	17.74	X			R=[4.80-11.3]
34	02/10/99	ICR PE9		8.01	7.36	92.00	100.12	17.62	X			R=[4.80-11.3]
35	02/25/99	ICR PE9		8.01	8.67	108.00	99.88	17.41	X			R=[4.80-11.3]
36	02/25/99	ICR PE9		8.01	8.54	107.00	100.11	17.21	X			R=[4.80-11.3]
37	03/10/99	ICR PE9		8.01	7.91	99.00	100.31	17.00	X			R=[4.80-11.3]
38	03/26/99	ICR PE9		8.01	7.41	92.00	100.27	16.76	X			R=[4.80-11.3]
39	04/08/99	ICR PE9		8.01	5.42	68.00	100.05	16.59	X			R=[4.80-11.3]
40	05/05/99	ICR PE9		8.01	6.78	85.00	99.23	17.15	X			R=[4.80-11.3]

98.88 17.08

Q.C. CHECKS

REFERENCE SAMPLE RESULTS FOR TCAA01

MATRIX WATER 07/12/99

NO.	DATE	SAMPLE ID	TARGET	FOUND	CUMULATIVE			PERCENT			RECOVERY IS	COMMENT
					PCT. REC.	PCT. REC.	STD. DEV.	<WL	<CL	>CL		
1	01/30/97	ERA29001	9.56	7.51	78.00	0.00	0.00					R=[2.93-12.6]
2	02/28/97	ERA29001	9.56	6.44	67.00	78.00	0.00					R=[2.93-12.6]
3	04/10/97	ERA 29001	9.56	6.3	66.00	72.50	7.78	X				R=[2.93-12.6]
4	04/25/97	ERA 29001	9.56	7.42	77.00	70.33	6.66	X				R=[5.74-13.4]
5	06/05/97	ERA29001	9.56	5.45	57.00	72.00	6.38		X			R=[5.74-13.4]
6	07/04/97	ERA29001	9.56	7.18	75.00	69.00	8.69	X				R=[5.74-13.4]
7	07/23/97	ERA29001	9.56	6.94	72.00	70.00	8.15	X				R=[5.74-13.4]
8	09/10/97	ICR PE5	15.0	8.99	60.00	70.29	7.48	X				R=[8.99-21.1]
9	12/29/97	ICR PE 5	9.03	7.80	86.00	69.00	7.82		X			R=[5.41-12.7]
10	12/30/97	ICR PE 5	9.03	7.80	86.00	70.89	9.25	X				R=[5.41-12.7]
11	03/24/98	ICR 006	26.2	35.8	137.00	72.40	9.95			X		R=[15.7-36.7]
12	04/10/98	ICR006	26.2	23.1	88.00	78.27	21.64	X				R=[15.7-36.7]
13	04/10/98	ICR006	26.2	23.1	88.00	79.08	20.83	X				R=[15.7-36.7]
14	05/06/98	ICR PE6	26.2	23.5	90.00	79.77	20.09	X				R=[15.7-36.7]
15	05/19/98	ICR PE7	15.0	14.4	96.00	80.50	19.50	X				R=[8.99-21.1]
16	06/10/98	ICR POE7	15.0	12.8	85.00	81.53	19.21	X				R=[8.99-21.1]
17	06/15/98	ICR PE7	15.0	12.6	84.00	81.75	18.58	X				R=[8.99-21.1]
18	06/30/98	ICR PE7	15.0	9.5	63.00	81.88	18.00	X				R=[8.99-21.1]
19	07/14/98	ICR PE7	15.0	11.1	74.00	80.83	18.02	X				R=[8.99-21.1]
20	07/23/98	ICR PE7	15.0	19.1	127.00	80.47	17.58		X			R=[8.99-21.1]
21	09/03/98	ICR PE6	26.2	29.4	112.00	82.80	20.03	X				R=[15.7-36.7]
22	10/26/98	ICR PE8	8.03	7.46	93.00	84.19	20.53	X				R=[4.81-11.3]
23	11/03/98	ICR PE6	26.2	25.5	97.00	84.59	20.12	X				R=[15.7-36.7]
24	11/03/98	ICR PE7	15.0	15.3	102.00	85.13	19.83	X				R=[8.99-21.1]
25	11/03/98	ICR PE8	8.03	10.2	128.00	85.83	19.70		X			R=[4.81-11.3]
26	11/05/98	ICR PE8	8.03	6.52	81.00	87.52	21.05	X				R=[4.81-11.3]
27	11/23/98	ICR PE8	8.03	6.24	78.00	87.27	20.66	X				R=[4.81-11.3]
28	12/10/98	ICR PE8	8.03	8.95	112.00	86.93	20.34	X				R=[4.81-11.3]
29	12/17/98	ICR PE8	8.03	7.06	88.00	87.82	20.51	X				R=[4.81-11.3]
30	12/23/98	ICR PE9	12.0	12.6	105.00	87.83	20.14	X				R=[7.19-16.9]
31	01/06/99	ICR PE9	12.0	10.5	88.00	88.40	20.04	X				R=[7.19-16.9]
32	01/14/99	ICR PE9	12.0	10.6	88.00	88.39	19.70	X				R=[7.19-16.9]
33	01/20/99	ICR PE9	12.0	11.4	95.00	88.38	19.38	X				R=[7.19-16.9]
34	01/27/99	ICR PE9	12.0	9.39	78.00	88.58	19.11	X				R=[7.19-16.9]
35	02/10/99	ICR PE9	12.0	9.87	82.00	88.26	18.91	X				R=[7.19-16.9]
36	02/25/99	ICR PE9	12.0	12.9	108.00	88.09	18.66	X				R=[7.19-16.9]
37	02/25/99	ICR PE9	12.0	12.5	104.00	88.64	18.69	X				R=[7.19-16.9]
38	03/10/99	ICR PE9	12.0	12.94	108.00	89.05	18.60	X				R=[7.19-16.9]
39	03/26/99	ICR PE9	12.0	11.2	93.00	89.55	18.60	X				R=[7.19-16.9]
40	04/08/99	ICR PE9	12.0	8.35	70.00	89.64	18.36	X				R=[7.19-16.9]
41	05/05/99	ICR PE9	12.0	9.66	80.00	89.15	18.39	X				R=[7.19-16.9]
					88.93	18.21						

Q.C. CHECKS

REFERENCE SAMPLE RESULTS FOR BCAA01

MATRIX WATER 07/12/99

NO.	DATE	SAMPLE ID	TARGET	FOUND	CUMULATIVE			PERCENT			COMMENT
					PCT. REC.	PCT. REC.	STD. DEV.	RECOVERY	IS		
1	01/30/97	ERA29001	8.18	7.63	93.00	0.00	0.00				R=[2.46-11.3]
2	02/28/97	ERA29001	8.18	6.11	74.00	93.00	0.00				R=[2.46-11.3]
3	04/10/97	ERA 29001	8.18	6.07	74.00	83.50	13.44	X			R=[2.46-11.3]
4	04/25/97	ERA 29001	8.18	9.03	110.00	80.33	10.97		X		R=[4.91-11.5]
5	06/05/97	ERA29001	8.18	6.42	78.00	87.75	17.33	X			R=[4.91-11.5]
6	07/04/97	ERA29001	8.18	8.29	101.00	85.80	15.63	X			R=[4.91-11.5]
7	07/23/97	ERA29001	8.18	9.02	110.00	88.33	15.29	X			R=[4.91-11.5]
8	09/10/97	ICR PE5	9.00	6.95	77.00	91.43	16.18	X			R=[5.39-12.7]
9	12/29/97	ICR PE 5	5.96	4.89	80.00	89.63	15.83	X			R=[3.57-8.35]
10	12/30/97	ICR PE 5	5.96	4.89	80.00	88.56	15.15	X			R=[3.57-8.35]
11	03/24/98	ICR 006	11.1	14.7	132.00	87.70	14.54		X		R=[6.65-15.6]
12	04/10/98	ICR006	11.1	11.3	102.00	91.73	19.20	X			R=[6.65-15.6]
13	04/10/98	ICR006	11.1	11.3	102.00	92.58	18.54	X			R=[6.65-15.6]
14	05/06/98	ICR PE6	11.1	10.8	97.00	93.31	17.95	X			R=[6.65-15.6]
15	05/19/98	ICR PE7	12.1	12.0	97.00	93.57	17.27	X			R=[7.25-17.0]
16	06/10/98	ICR PE7	12.1	11.0	91.00	93.80	16.67	X			R=[7.25-17.0]
17	06/15/98	ICR PE7	12.1	10.6	88.00	93.63	16.12	X			R=[7.25-17.0]
18	06/30/98	ICR PE7	12.1	8.6	71.00	93.29	15.66	X			R=[7.25-17.0]
19	07/14/98	ICR PE7	12.1	10.0	83.00	92.06	16.08	X			R=[7.25-17.0]
20	07/23/98	ICR PE7	12.1	13.3	110.00	91.58	15.76	X			R=[7.25-17.0]
21	09/03/98	ICR PE6	11.1	12.9	116.00	92.50	15.89	X			R=[6.65-15.6]
22	10/26/98	ICR PE8	5.07	5.27	104.00	93.62	16.31	X			R=[3.04-7.10]
23	11/03/98	ICR PE6	11.1	11.8	106.00	94.09	16.07	X			R=[6.67-15.6]
24	11/03/98	ICR PE7	12.1	14.5	120.00	94.61	15.90	X			R=[7.25-17.0]
25	11/03/98	ICR PE8	5.07	7.02	140.00	95.67	16.39		X		R=[3.04-7.10]
26	11/05/98	ICR PE8	5.07	4.40	87.00	97.44	18.33	X			R=[10.7-25.3]
27	11/23/98	ICR PE8	5.07	5.32	105.00	97.04	18.08	X			R=[3.04-7.10]
28	12/10/98	ICR PE8	5.07	6.02	118.00	97.33	17.79	X			R=[3.04-7.10]
29	12/17/98	ICR PE8	5.07	5.35	106.00	98.07	17.89	X			R=[3.04-7.10]
30	12/23/98	ICR PE9	7.05	8.04	114.00	98.34	17.63	X			R=[4.22-9.88]
31	01/06/99	ICR PE9	7.05	7.29	103.00	98.87	17.56	X			R=[4.22-9.88]
32	01/14/99	ICR PE9	7.05	7.13	101.00	99.00	17.28	X			R=[4.22-9.88]
33	01/20/99	ICR PE9	7.05	7.91	112.00	99.06	17.00	X			R=[4.22-9.88]
34	01/27/99	ICR PE9	7.05	6.94	98.00	99.45	16.88	X			R=[4.22-9.88]
35	02/10/99	ICR PE9	7.05	7.20	102.00	99.41	16.63	X			R=[4.22-9.88]
36	02/25/99	ICR PE9	7.05	8.24	117.00	99.49	16.39	X			R=[4.22-9.88]
37	02/25/99	ICR PE9	7.05	7.88	112.00	99.97	16.41	X			R=[4.22-9.88]
38	03/10/99	ICR PE9	7.05	7.90	112.00	100.30	16.30	X			R=[4.22-9.88]
39	03/26/99	ICR PE9	7.05	7.05	100.00	100.61	16.19	X			R=[4.22-9.88]
40	04/08/99	ICR PE9	7.05	8.15	73.00	100.59	15.98	X			R=[4.22-9.88]
41	05/05/99	ICR PE9	7.05	5.75	82.00	99.90	16.37	X			R=[4.22-9.88]
					99.46	16.40					

Q.C. CHECKS

REFERENCE SAMPLE RESULTS FOR DBAA01

MATRIX WATER 07/12/99

NO.	DATE	SAMPLE ID	TARGET	FOUND	CUMULATIVE		PERCENT		RECOVERY IS	COMMENT
					PCT. REC.	PCT. REC.	STD. DEV.	<WL <CL >CL		
1	01/30/97	ERA29001	15.8	18.5	117.00	0.00	0.00			R=[10.7-20.2]
2	02/28/97	ERA29001	15.8	15.8	100.00	117.00	0.00			R=[10.7-20.2]
3	04/10/97	ERA 29001	15.8	14.8	94.00	108.50	12.02	X		R=[10.7-20.2]
4	04/25/97	ERA 29001	15.8	19.9	126.00	103.67	11.93	X		R=[9.48-22.1]
5	06/05/97	ERA29001	15.8	14.3	90.00	109.25	14.82	X		R=[9.48-22.1]
6	07/04/97	ERA29001	15.8	18.5	117.00	105.40	15.45	X		R=[9.48-22.1]
7	07/23/97	ERA29001	15.8	20.0	126.00	107.33	14.61	X		R=[9.48-22.1]
8	09/10/97	ICR PE5	7.00	5.41	77.00	110.00	15.09		X	R=[4.19-9.81]
9	12/29/97	ICR PE 5	15.1	14.7	97.00	105.88	18.20	X		R=[9.05-21.2]
10	12/30/97	ICR PE 5	15.1	14.7	97.00	104.89	17.28	X		R=[9.05-21.2]
11	03/24/98	ICR 006	4.97	6.81	137.00	104.10	16.48	X		R=[2.98-6.76]
12	04/10/98	ICR006	4.97	5.16	104.00	107.09	18.52	X		R=[2.98-6.96]
13	04/10/98	ICR006	4.97	5.16	104.00	106.83	17.68	X		R=[2.98-6.96]
14	05/06/98	ICR PE6	4.97	5.00	100.00	106.62	16.94	X		R=[2.98-6.96]
15	05/19/98	ICR PE7	14.0	15.6	111.00	106.14	16.37	X		R=[8.39-19.7]
16	06/10/98	ICR PE7	14.0	12.7	91.00	106.47	15.83	X		R=[8.39-19.7]
17	06/15/98	ICR PE7	14.0	12.6	90.00	105.50	15.77	X		R=[8.39-19.7]
18	06/30/98	ICR PE7	14.0	9.8	70.00	104.59	15.73		X	R=[8.39-19.7]
19	07/14/98	ICR PE7	14.0	11.5	82.00	102.67	17.30	X		R=[8.39-19.7]
20	07/23/98	ICR PE7	14.0	15.4	110.00	101.58	17.47	X		R=[8.39-19.7]
21	09/03/98	ICR PE6	4.97	6.53	131.00	102.00	17.11	X		R=[2.98-6.96]
22	10/26/98	ICR PE8	18.0	19.3	107.00	103.38	17.83	X		R=[10.7-25.3]
23	11/03/98	ICR PE6	4.97	6.10	122.00	103.55	17.42	X		R=[2.98-6.96]
24	11/03/98	ICR PE7	14.0	17.3	124.00	104.35	17.45	X		R=[8.39-19.7]
25	11/03/98	ICR PE8	18.0	25.5	141.00	105.17	17.53		X	R=[10.7-25.3]
26	11/05/98	ICR PE8	18.0	15.1	84.00	106.60	18.60	X		R=[10.7-25.3]
27	11/23/98	ICR PE8	18.0	21.1	117.00	105.73	18.75	X		R=[10.7-25.3]
28	12/10/98	ICR PE8	18.0	23.5	130.00	106.15	18.52	X		R=[10.7-25.3]
29	12/17/98	ICR PE8	18.0	19.5	108.00	107.00	18.72	X		R=[10.7-25.3]
30	12/23/98	ICR PE9	5.00	5.92	118.00	107.03	18.39	X		R=[2.99-7.01]
31	01/06/99	ICR PE9	5.00	5.70	114.00	107.40	18.18	X		R=[2.99-7.01]
32	01/14/99	ICR PE9	5.00	5.78	116.00	107.61	17.91	X		R=[2.99-7.01]
33	01/20/99	ICR PE9	5.00	6.27	125.00	107.88	17.68	X		R=[2.99-7.01]
34	01/27/99	ICR PE9	5.00	5.46	109.00	108.39	17.66	X		R=[2.99-7.01]
35	02/10/99	ICR PE9	5.00	5.22	104.00	108.41	17.39	X		R=[2.99-7.01]
36	02/25/99	ICR PE9	5.00	5.98	12.00	108.29	17.15		X	R=[2.99-7.01]
37	02/25/99	ICR PE9	5.00	5.86	117.00	105.61	23.30	X		R=[2.99-7.01]
38	03/10/99	ICR PE9	5.00	5.98	120.00	105.92	23.05	X		R=[2.99-7.01]
39	03/26/99	ICR PE9	5.00	5.37	107.00	106.29	22.86	X		R=[2.99-7.01]
40	04/08/99	ICR PE9	5.00	3.58	72.00	106.31	22.55	X		R=[2.99-7.01]
41	05/05/99	ICR PE9	5.00	4.62	92.00	105.45	22.91	X		R=[2.99-7.01]
					105.12	22.72				

Calibration Procedures for THM using Method 502.2

Calibration consisted of the creation of aqueous standards using ICR stock solutions provided by EPA, carrying these standards through the preparation process used for samples, and generating a standard curve for each compound.

Standard preparation:

Dilute 100 uL THM mix(1.0mg/mL) to 5 mL methanol for Intermediate std @ .1ug/uL.

Dilute .5/1/2/5/20/40/80 uL Intermediate to 100 mL Laboratory pure water for calibration levels of .5/1/2/5/20/40/80 ug/L each THM.

Fill and cap 40 mL VOC vials containing dechlorinating agent with the standards.

Standard extraction:

The standards were loaded into an autosampler which added 5 uL internal standard(1-Chloro-2fluorobenzene @ 10ug/uL) to 5mL sample and standard as each was transfered to the purge and trap apparatus.

Instrument calibration:

The trapped analytes were swept onto a stabilized GC column and the resultant area of each compound and level of concentration was used to create a standard curve. The internal standard was used for both retention reference and quantitation. The first order curve was not forced through the origin and was acceptable if the R-squared value was >0.995.

Calibration was performed when the results of either Quality Control Samples or Continuing Calibration Standards indicated >10% deviation from the true value.

Calibration Procedures for HAA using Method 552.1

Calibration consisted of the creation of aqueous standards using ICR stock solutions provided by EPA, carrying these standards through the preparation process used for samples, and generating a standard curve for each compound.

Standard preparation:

Dilute 40 uL each HAA mix (1.0mg/mL) + MCAA(1.0mg/mL) + 20 uL Absolute Standards #31056 (surrogate)(1.0mg/mL) to 10 mL MTBE to create Intermediate 'A'.

Dilute 12.5/25/50/250/500/1000 uL 'A' to 100 mL Laboratory pure water for calibration levels of .5/1/2/10/20/40 ug/L HAAs and .25/.5/1/5/10/20 ug/L surrogate.

Standard extraction:

The aqueous standards were extracted using solid phase technology as detailed in Method 552.1, revision 1.0, August, 1992. Liquid-solid extraction disks(Empore#7469-06) were used. Internal standard(Supelco#4-8355) was added to the final extract of all samples and standards.

Instrument calibration:

The standard extracts were injected into a stabilized GC and the resultant height of each compound and level of concentration was used to create a standard curve. The surrogate was used as a retention reference and the internal standard used for quantitation. The second order curve was not forced through the origin, and was acceptable if the R-squared value was >0.995.

Calibration was performed when the results of either Quality Control Samples or Continuing Calibration Standards indicated >10% deviation from the true value.

TOX Calibration Procedure

Develop a standard curve by analyzing aqueous solutions of 2,4,6-trichlorophenol or another appropriate halogenated organic compound over the dynamic range of the microcoulometer. This dynamic range typically is from 0.5 to 50 ug Cl⁻. Because of the limited throughput of the DOX procedure, use single instrument calibration standards at 50, 30, 15, 10, 5, 2.5, and 0.5 ug organic chloride to construct a standard curve ONLY after changes in an instrument's configuration, such as replacement of a titration cell or major instrument maintenance. If the recovery of the standard is within 90% of the true standard value, the instrument performance is acceptable and sample values can be read directly from the instrument without reprocessing according to a calibration curve.

The sodium chloride standard is used to check functioning of the titration cell and to insure that the cell and microcoulometer are accurately measuring the mass of halide introduced into the cell. Use this standard at startup each day and after cell cleaning throughout the day. At daily startup consecutive duplicates should be within 3% of the historical mean.

A low level calibration verification must be performed after blanks and before analysis of samples. If performing ICR analysis, a 50-ug/L standard must be analyzed. The standard is prepared by injection of 1 uL of the ICR stock standard in to 100 mL of deionized water. The standard is then run through the same adsorption process used for the system blank above. After analysis of seven samples a mid-level calibration check of 200 ug/L is performed by injection of 4 uL of ICR stock standard into 100 mL of deionized water. If seven more samples are to be analyzed or if analysis is performed on the following day, a high calibration standard of 500 ug/L must be analyzed by injection of 10 uL of standard into 100 mL deionized water. ICR acceptance limits for the low-level calibration check are 75-125% and 85-115% for the mid- and high-level calibration check.

TOC Calibration

The calibration curve is set up so that the concentrations are the x-axis and the millivolt readings are the y axis. Find the equation of the line, solve the equation for x and plug in the sample results in millivolts (y).

$$y=mx+b$$

where y=millivolt reading, m=slope, x=standard concentration, and b=the y-intercept.

Calibration verification is done daily. For each loop the low level standard is analyzed at the beginning of each 24-hour period. This verification must be within $\pm 50\%$ of the predicted response. The mid- and high-level standards are alternately analyzed after every 10th sample and as the last analysis run on the instrument for the remainder of the 24-hour period. The response should be within $<10\%$ of the predicted response and have an RPD $<10\%$ for the ICR and high level loop. The response should be within $<20\%$ of the predicted response and have an RPD $<20\%$ for the low-level loop.

Bromide Initial Calibration

Analyze a method blank to verify that none of the analytes are present at levels of 50% of the MRL or greater. If any are, the source of the contamination must be found and eliminated before calibrating. The method blank is reagent water that has been subjected to the same pre-analysis treatment that the samples are subjected to.

Analyze the three calibration standards listed below and calibrate the instrument based on area of the analyte peaks. The external standard method is used. Verify the accuracy of the calibration curves by analyzing a quality control sample provided by an external source (i.e.: ERA). Analyte recovery should be within $\pm 20\%$ of the expected value. If these criteria are not met, the standards should be re-prepared from scratch and a new calibration created.

Calibration Standard Levels for anions

<u>Analyte</u>	<u>Low</u>	<u>Mid</u>	<u>Upper</u>
Chlorite	20 ug/L	250 ug/L	750 ug/L
Bromate	5 ug/L	10 ug/L	30 ug/L
Bromide	0.02 mg/L	0.1 mg/L	0.3 mg/L
Chlorate	20 ug/L	250 ug/L	750 ug/L

An initial calibration check must be analyzed with each batch. This initial check contains the analytes at the MRL concentration. After every tenth sample (or 8 hours) and after the last sample another calibration check must be performed. For these subsequent calibration checks, alternate between the mid and upper-level concentrations listed below. At the beginning of each new 24-hour period, the low-level standard must again be analyzed.