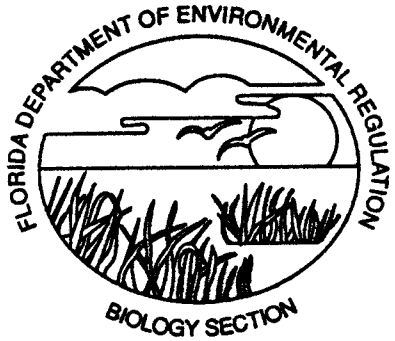


Bioassays of

Culligan Water Conditioning Service

St. Petersburg, Pinellas County, Florida

NPDES #FL0003069

Sampled 3/26/91

April 12, 1991

Biology Section
Division of Administrative and Technical Services

Bioassays of

Culligan Water Conditioning Service

St. Petersburg, Pinellas County, Florida

NPDES #FL0003069

Biology Section
Bureau of Laboratories
April 12, 1991

Introduction

Culligan Water Conditioning Service, Largo, Pinellas County, Florida, NPDES #FL0003069, on 27 to 29 March, 1991.

This facility is located at 13075 66th Street North in Largo. It is used to regenerate spent filter tanks employed to soften water for private homes and businesses. The facility discharges less than five thousand gallons per day of process reject water to the county drainage canal, and then to Old Tampa Bay via Cross Bayou. The receiving waters are all Class III waters of the State.

The toxicity tests discussed in this report were performed in accordance with methods described by Peltier and Weber, 1985, *Methods for Measuring the Acute Toxicity of Effluents to Aquatic Organisms*, 3rd Edition, and by the FDER Biology Section, 1985, *Quality Assurance Manual for Performing Acute Toxicity Tests*, 2nd Edition.

Results and Discussion

The Biology Section performed acute toxicity screening bioassays using the bioassay test organisms, the water fleas, *Ceriodaphnia dubia* and *Daphnia pulex,* and the fish, *Notropis leedsi*, on a sample of discharge from this facility. The sample was divided into four aliquots before testing. One aliquot was pH adjusted, a second dechlorinated, a third dechlorinated and pH adjusted, the fourth was unaltered.

Dechlorination was achieved by the sodium thiosulfate method. The pH adjustment was made by adding hydrochloric acid to the appropriate aliquot(s). A total of twelve tests were performed. Results of these tests indicated that the aliquots, both chlorinated (facility) and dechlorinated (lab), in which the pH was not adjusted were toxic to all three test organisms, causing complete mortality within two hours of test initiation. The chlorinated sample in which the pH was adjusted was toxic to *C. dubia* (80% mortality) and caused two deaths in *N. leedsi*. The dechlorinated, pH-adjusted aliquot showed no toxic effect on *C. dubia*, *D. pulex*, and *N. leedsi*. The total residual chlorine in the sample was 0.7 mg/l (Hach). No further chemical analyses were performed on the sample.

Conclusion

The sample of discharge from this facility was toxic on 26 March, 1991. We attribute the toxicity noted in these tests to the high pH and the total residual chlorine concentration in the sample. According to the permit conditions and requirements for this facility, the sample of discharge tested by the Biology Section was in violation of permit effluent limitations for both pH (11.7 s.u. measured versus 6.5 - 8.5 s.u. permitted) and conductivity (4150 µmhos/cm measured versus 1275 µmhos/cm maximum permitted). We recommend that this facility be required to monitor pH and conductivity in its discharge on a continuous basis and work to comply with the effluent limitations set forth in the State permit and Part I of their NPDES permit.

Table 1. Concentration Series and Volumes Used for These Static Bioassays.

Ceriodaphnia dubia (water flea)

Concentration	Dilution Water	Sample	Total Volume
Control	20.0 ml	0.0 ml	20 ml
100.0%	0.0 ml	20.0 ml	20 ml

Daphnia pulex (water flea)

Concentration	Dilution Water	Sample	Total Volume
Control	20.0 ml	0.0ml	20 ml
100.0%	0.0 ml	20.0 ml	20 ml

Notropis leedsi (bannerfin shiner)

Concentration	Dilution Water	Sample	Total Volume
Control	500 ml	0 ml	500 ml
100.0%	0 ml	500 ml	500 ml

Table 2. Data recorded during the static acute screening bioassay of a sample of discharge from the Culligan Water Conditioning Service facility, Largo, Pinellas County, Florida, NPDES#0003069, on 27 to 29 March, 1991.

FL

Facility: **Culligan Water Conditioning Service**
Location: 13075 66th Street, Largo
County: Pinellas
Sample Collection Date: **3/26/91** Time: 1210
Test Beginning Date: 3/27/91 Time: 1230
Test Ending Date: 3/29/91 Time: 1230

NPDES # **FL0003069**
Contact/District: P. Fricano
Test type: Static Screen
tests: 3, pH as received
Chlorination Type: **Chlorinated**
Dechlor Method: NA

Facility Type: **chemical processing**
Receiving Water: unnamed ditch to Cross Bayou Canal

Total Residual Cl2	mg/l	Method
Field:	1.2	Hach
Lab:	0.7	Hach
Lab:	0.5	Iodometric

Alk & Hardness	Alkalinity (mg/l)	Hardness (mg/l)
Control Water (fish):	115	120
Cond. Control Water (daphnids):	105	120
100% Sample:	418*	20

* phenolphthalein alkalinity

Organism: ***Ceriodaphnia dubia*** Life stage: <24 hours
LC50: <100%**

Concentrations	SURVIVAL # at 0 hr	Live at 24 hr	Live at 48 hr	Dissolved Oxygen 0 hour	24 hour	48 hour	pH 0 hour	24 hour	48 hour	Temperature 0 hour	24 hour	48 hour	Conductivity 0 hour	24 hour
Control	5	5	5	9.2	8.5	8.5	8.2	8.4	8.3	21.7	21.0	21.5	340	324
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
100%	5	0*	-	10.1	8.5	-	11.7	10.3	-	21.8	21.0	-	3710	2640
100%	5	0*	-	-	-	-	-	-	-	-	-	-	-	-
100%	5	0*	-	-	-	-	-	-	-	-	-	-	-	-
100%	5	0*	-	-	-	-	-	-	-	-	-	-	-	-

Organism: ***Daphnia pulex*** Life stage: <24 hours
LC50: <100% **

Concentrations	SURVIVAL # at 0 hr	Live at 24 hr	Live at 48 hr	Dissolved Oxygen 0 hour	24 hour	48 hour	pH 0 hour	24 hour	48 hour	Temperature 0 hour	24 hour	48 hour	Conductivity 0 hour	24 hour
Control	5	5	5	9.3	8.5	8.4	8.0	8.4	8.4	20.8	21.0	21.5	232	235
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	3	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	3	-	-	-	-	-	-	-	-	-	-	-
100%	5	0*	-	10.2	8.5	-	11.7	10.3	-	21.7	21.0	-	3810	2930
100%	5	0*	-	-	-	-	-	-	-	-	-	-	-	-
100%	5	0*	-	-	-	-	-	-	-	-	-	-	-	-
100%	5	0*	-	-	-	-	-	-	-	-	-	-	-	-

Organism: ***Notropis leedsi*** Age: 9 days
LC50: <100%**

Concentrations	SURVIVAL # at 0 hr	Live at 24 hr	Live at 48 hr	Dissolved Oxygen 0 hour	24 hour	48 hour	pH 0 hour	24 hour	48 hour	Temperature 0 hour	24 hour	48 hour	Conductivity 0 hour	24 hour
Control	5	5	5	9.1	7.7	8.6	7.6	8.2	8.3	20.4	21.0	21.0	-	-
Control	5	5	5	9.1	7.7	8.7	7.6	8.2	8.4	-	-	-	238	241
100%	5	0*	-	10.8	7.9	-	11.7	11.4	-	23.2	21.0	-	-	-
100%	5	0*	-	10.8	7.9	-	11.7	11.4	-	-	-	-	4150	3300

** 24 hour LC50 *dead within 2 hours of test initiation

"continued "

Table 2. Continued

Facility: **Culligan Water Conditioning Service** NPDES # **FL0003069** Facility Type: **chemical processing**
Location: 13075 66th Street, Largo Contact/District: P. Fricano
County: Pinellas Test type: Static Screen
Sample Collection Date: **3/26/91** Time: 1210 # tests: 3, pH as received Receiving Water: unnamed ditch to
Test Beginning Date: 3/27/91 Time: 1230 Chlorination Type: **Dechlorinated** Cross Bayou Canal
Test Ending Date: 3/29/91 Time: 1230 Dechlor Method: lab, sodium thiosulfate **Page 2 of 4**

Total Residual Cl2	mg/l	Method
Field:	1.2	Hach
Lab:	0.7	Hach
Lab:	0.5	Iodometric

Alk & Hardness	Alkalinity (mg/l)	Hardness (mg/l)
Control Water (fish):	115	120
Cond. Control Water (daphnids):	105	120
100% Sample:	418*	20

* phenolphthalein alkalinity

Organism: ***Ceriodaphnia dubia*** Life stage: <24 hours
LC50: <100%**

Concentrations	SURVIVAL # at 0 hr	Live at 24 hr	Live at 48 hr	Dissolved Oxygen 0 hour	24 hour	48 hour	pH 0 hour	24 hour	48 hour	Temperature 0 hour	24 hour	48 hour	Conductivity 0 hour	24 hour
Control	5	5	5	9.2	8.5	8.5	8.2	8.4	8.3	21.7	21.0	21.5	340	324
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
100%	5	0*	-	9.8	8.5	-	11.7	10.2	-	21.7	21.0	-	3440	2780
100%	5	0*	-	-	-	-	-	-	-	-	-	-	-	-
100%	5	0*	-	-	-	-	-	-	-	-	-	-	-	-
100%	5	0*	-	-	-	-	-	-	-	-	-	-	-	-

Organism: ***Daphnia pulex*** Life stage: <24 hours
LC50: <100%**

Concentrations	SURVIVAL # at 0 hr	Live at 24 hr	Live at 48 hr	Dissolved Oxygen 0 hour	24 hour	48 hour	pH 0 hour	24 hour	48 hour	Temperature 0 hour	24 hour	48 hour	Conductivity 0 hour	24 hour
Control	5	5	5	9.3	8.5	8.4	8.0	8.4	8.4	20.8	21.0	21.5	232	235
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	3	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	3	-	-	-	-	-	-	-	-	-	-	-
100%	5	0*	-	9.8	8.4	-	11.7	10.3	-	21.7	21.0	-	3570	2880
100%	5	0*	-	-	-	-	-	-	-	-	-	-	-	-
100%	5	0*	-	-	-	-	-	-	-	-	-	-	-	-
100%	5	0*	-	-	-	-	-	-	-	-	-	-	-	-

Organism: ***Notropis leedsi*** Age: 9 days
LC50: <100%**

Concentrations	SURVIVAL # at 0 hr	Live at 24 hr	Live at 48 hr	Dissolved Oxygen 0 hour	24 hour	48 hour	pH 0 hour	24 hour	48 hour	Temperature 0 hour	24 hour	48 hour	Conductivity 0 hour	24 hour
Control	5	5	5	9.1	7.7	8.6	7.6	8.2	8.3	20.4	21.0	21.0	-	-
Control	5	5	5	9.1	7.7	8.7	7.6	8.2	8.4	-	-	-	238	241
100%	5	0*	-	10.6	7.9	-	11.7	11.3	-	22.5	21.0	-	-	-
100%	5	0*	-	10.6	7.9	-	11.7	11.3	-	-	-	-	3840	3170

** 24 hour LC50 *dead within two hours of test initiation

"continued"

Table 2. Continued

Facility: **Culligan Water Conditioning Service** NPDES # **FL0003069** Facility Type: **chemical processing**
Location: 13075 66th Street, Largo Contact/District: P. Fricano
County: Pinellas Test type: Static Screen
Sample Collection Date: **3/26/91** Time: 1210 # tests: 3, pH adjusted Receiving Water: unnamed ditch to Cross Bayou Canal
Test Beginning Date: 3/27/91 Time: 1230 Chlorination Type: **Chlorinated**
Test Ending Date: 3/29/91 Time: 1230 Dechlor Method: NA

Total Residual Cl2	mg/l	Method
Field:	1.2	Hach
Lab:	0.7	Hach
Lab:	0.5	Iodometric

Alk & Hardness	Alkalinity (mg/l)	Hardness (mg/l)
Control Water (fish):	115	120
Cond. Control Water (daphnids):	105	120
100% Sample:	418*	20

* phenolphthalein alkalinity

Organism: ***Ceriodaphnia dubia*** Life stage: <24 hours
LC50: <100%

Concentrations	SURVIVAL # at 0 hr	Live at 24 hr	Live at 48 hr	Dissolved Oxygen 0 hour	24 hour	48 hour	pH 0 hour	24 hour	48 hour	Temperature 0 hour	24 hour	48 hour	Conductivity 0 hour	48 hour
Control	5	5	5	9.2	8.5	8.5	8.2	8.4	8.3	21.7	21.0	21.5	340	342
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
100%	5	3	2	10.1	8.5	8.7	8.4	8.8	8.4	22.2	21.0	21.5	3120	3190
100%	5	2	1	-	-	-	-	-	-	-	-	-	-	-
100%	5	4	1	-	-	-	-	-	-	-	-	-	-	-
100%	5	1	0	-	-	-	-	-	-	-	-	-	-	-

Organism: ***Daphnia pulex**** Life stage: <24 hours
LC50: -

Concentrations	SURVIVAL # at 0 hr	Live at 24 hr	Live at 48 hr	Dissolved Oxygen 0 hour	24 hour	48 hour	pH 0 hour	24 hour	48 hour	Temperature 0 hour	24 hour	48 hour	Conductivity 0 hour	48 hour
Control	5	5	5	9.3	8.5	8.4	8.0	8.4	8.4	20.8	21.0	21.5	232	235
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	3	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	3	-	-	-	-	-	-	-	-	-	-	-
100%	5	5	3	10.2	8.5	8.5	8.4	8.8	8.7	22.0	21.0	21.5	3230	3270
100%	5	5	3	-	-	-	-	-	-	-	-	-	-	-
100%	5	4	1	-	-	-	-	-	-	-	-	-	-	-
100%	5	5	1	-	-	-	-	-	-	-	-	-	-	-

* test invalidated at 48 hours

Organism: ***Notropis leedsi*** Age: 3 days
LC50: -

Concentrations	SURVIVAL # at 0 hr	Live at 24 hr	Live at 48 hr	Dissolved Oxygen 0 hour	24 hour	48 hour	pH 0 hour	24 hour	48 hour	Temperature 0 hour	24 hour	48 hour	Conductivity 0 hour	48 hour
Control	5	5	5	9.1	7.7	8.6	7.6	8.2	8.3	20.4	21.0	21.0	-	-
Control	5	5	5	9.1	7.7	8.7	7.6	8.2	8.4	-	-	-	238	241
100%	5	4	4	10.4	7.8	8.7	8.4	8.5	8.5	23.8	21.0	21.0	-	-
100%	5	4	4	10.4	7.8	8.6	8.4	8.5	8.5	-	-	-	3420	3220

"continued "

Table 2. Continued

Facility: **Culligan Water Conditioning Service** NPDES # **FL0003069** Facility Type: **chemical processing**
Location: 13075 66th Street, Largo Contact/District: P. Fricano
County: Pinellas Test type: Static Screen
Sample Collection Date: **3/26/91** Time: 1210 # tests: 3, pH adjusted Receiving Water: unnamed ditch to
Test Beginning Date: 3/27/91 Time: 1230 Chlorination Type: **Dechlorinated** Cross Bayou Canal
Test Ending Date: 3/29/91 Time: 1230 Dechlor Method: lab. sodium thiosulfate **Page 4 of 4**

Total Residual Cl2	mg/l	Method
Field:	1.2	Hach
Lab:	0.7	Hach
Lab:	0.5	Iodometric

Alk & Hardness	Alkalinity (mg/l)	Hardness (mg/l)
Control Water (fish):	115	120
Cond. Control Water (daphnids):	105	120
100% Sample:	418*	20

* phenolphthalein alkalinity

Organism: ***Ceriodaphnia dubia*** Life stage: <24 hours
LC50: -

Concentrations	SURVIVAL # at 0 hr	Live at 24 hr	Live at 48 hr	Dissolved Oxygen 0 hour	24 hour	48 hour	pH 0 hour	24 hour	48 hour	Temperature 0 hour	24 hour	48 hour	Conductivity 0 hour	48 hour
Control	5	5	5	9.2	8.5	8.5	8.2	8.4	8.3	21.7	21.0	21.5	340	342
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
100%	5	5	5	9.7	8.5	8.5	8.5	8.6	8.6	21.9	21.0	21.5	3020	3130
100%	5	5	5	-	-	-	-	-	-	-	-	-	-	-
100%	5	5	5	-	-	-	-	-	-	-	-	-	-	-
100%	5	5	4	-	-	-	-	-	-	-	-	-	-	-

Organism: ***Daphnia pulex**** Life stage: <24 hours
LC50: -

Concentrations	SURVIVAL # at 0 hr	Live at 24 hr	Live at 48 hr	Dissolved Oxygen 0 hour	24 hour	48 hour	pH 0 hour	24 hour	48 hour	Temperature 0 hour	24 hour	48 hour	Conductivity 0 hour	48 hour
Control	5	5	5	9.3	8.5	8.4	8.0	8.4	8.4	20.8	21.0	21.5	232	235
Control	5	5	5	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	3	-	-	-	-	-	-	-	-	-	-	-
Control	5	5	3	-	-	-	-	-	-	-	-	-	-	-
100%	5	5	2	9.7	8.5	8.5	8.5	8.6	8.6	21.4	21.0	21.5	3080	3180
100%	5	5	5	-	-	-	-	-	-	-	-	-	-	-
100%	5	5	5	-	-	-	-	-	-	-	-	-	-	-
100%	5	5	5	-	-	-	-	-	-	-	-	-	-	-

* test invalidated at 48 hours

Organism: ***Notropis leedsi*** Age: 9days
LC50: -

Concentrations	SURVIVAL # at 0 hr	Live at 24 hr	Live at 48 hr	Dissolved Oxygen 0 hour	24 hour	48 hour	pH 0 hour	24 hour	48 hour	Temperature 0 hour	24 hour	48 hour	Conductivity 0 hour	48 hour
Control	5	5	5	9.1	7.7	8.6	7.6	8.2	8.3	20.4	21.0	21.0	-	-
Control	5	5	5	9.1	7.7	8.7	7.6	8.2	8.4	-	-	-	238	241
100%	5	5	5	9.9	7.6	8.6	8.4	8.5	8.5	22.7	21.0	21.0	-	-
100%	5	5	5	9.9	7.6	8.6	8.4	8.5	8.5	-	-	-	3240	3170

DER Biology Section — Acute Bioassay Bench Sheet

(102)

Sample Source: Culligan R/O WATER CONDITIONING
Address/City: 13075 62ST St. Petersburg Fl 33543
County: Pinellas
Contact/District: Pat Fincno
NPDES Permit #: FL0003064 Outfall #: 001

Sample Collection: Date 3/26/91 Time 1210
Test Beginning: Date 3/27/91 Time 1230
Test Ending: Date 3/29/91 Time 1230
Test Organism: N. tenuis, C. dubia, D. pulex
Life Stage/Age: 9 DAYS <24hr <24hr

Test Number: ___ of ___ Test Type: Screening | Definitive
Static | Static Renewal | Flow-through

Instrument Calibrations:

	pH	DO	Cond	Temp
0 hr	7@7.9@9	8.7@22.5	1516@24.7	22@24.6
24 hr	7@7.9@9	8.7@22.5	1495@24.1	21.5@23.6
48 hr	7@7.9@9	8.7@22.5	1519@24.8	22@24.7

Remarks:
DE-CL pH ADJUSTED FROM 11.7 TO 8.2 w/1.38mL 1.2N HCl +0.40mL 1.0N NaOH
CL pH ADJUSTED FROM 11.5 TO 8.2 w/1.03mL 1.2N HCl +0.21mL 1.0N NaOH
white precipitate - bottom of

Conc.	Chamber #	Number Live 0	24	48	DO (mg/l) 0	24	48	pH 0	24	48	Temp. (°C) 0	24	48	Cond. (µmhos/cm) 0	24	48
CONTROL	86	5	5	5	9.1	7.7	8.6	7.6	8.2	8.3	20.4	21.0	21.0			
CONTROL	87	5	5	5	9.1	7.7	8.7	7.6	8.2	8.4				238	241	246
Cl neg pH	75	5	OA		10.8	7.9		11.7	11.4		23.2	21.0				
Cl Neg pH	188	5	OA		10.8	7.9		11.7	11.4					4150	3300	
de-Cl Neg pH	37	5	OA		10.6	7.9		11.7	11.3		22.5	21.0				
de-Cl Neg pH	63	5	OA		10.6	7.9		11.7	11.3					3540	3170	
Cl, ADJ pH	39	5	4	4	10.4	7.8	8.7	8.4	8.5	8.5	23.8	21.0	21.0			
Cl, ADJ pH	7	5	4	4	10.4	7.8	8.6	8.4	8.5	8.5				3420	3170	3220
deCl ADJ pH	28	5	5	5	9.9	7.6	8.6	8.4	8.5	8.5	22.7	21.0	21.0			
deCl ADJ pH	25	5	5	65	9.9	7.6	8.6	8.4	8.5	8.5				3340	3290	3170
CONTROL	A	5	5	5	9.2	8.5	8.5	8.2	8.4	8.3	21.7	21.0	21.5	340	324	342
|	B	5	5	5												
|	C	5	5	5												
↓	D	5	5	5												
Cl neg	A	5	OA	–	10.1	8.5		11.7	10.3		21.8	21.0		3410	2640	
pH	B	5	OA	–												
|	C	5	OA	–												
↓	D	5	OA	–												
de-Cl	A	5	OA	–	9.8	8.5		11.7	10.2		21.7	21.0		3440	2720	
neg pH	B	5	OA	–												
|	C	5	OA	–												
↓	D	5	OA	–												
Cl, ADJ	A	5	3	2	10.1	8.5	8.7	8.4	8.3	8.4	22.2	21.0	21.5	3420	2690	3190
| pH	B	5	2	1												
|	C	5	4	1												
↓	D	5	1	0												
Measured/Loaded by		MF	AR	KP	MF	AJ	KD	MF	AJ	AR	MF	AJ	AR	MF	AJ	KP
Recorded by		MF	MF	AJ	KP	MF	AJ	KP	MF	AJ	KP	MF	AJ	KP	MF	AJ

Continued next page

C. dubia only

Investigators' Signatures

Water-quality Parameters

	Well Water	Cond. Water	Sample	Method	Measured by
Field Tot. Resid. Cl2:			1.2	HACH	[illegible]
Lab Tot. Resid. Cl2:			0.7	HACH	MF
Alkalinity:					
Hardness:					
Total Ammonia:					

Ammonia meter slope

Rev 1/97

DER Biology Section — Acute Bioassay Bench Sheet

Sample Source: CULLIGAN/PINELLAS H2O CONDITIONING Sample Collection: Date 3/26/91 Time 1210
Address/City: _____ Test Beginning: Date 3/27/91 Time 1230
County: _____ Test Ending: Date 3/29/91 Time 1230
Contact/District: _____ Test Organism: N. leedsi, C. dubia, D. pulex
NPDES Permit #: FL0003064 Outfall #: _____ Life Stage/Age: 9 DAYS <24 hr <24 hr

Test Number: 1 of 2 Test Type: (Screening) Definitive
(Static) Static Renewal | Flow-through

Remarks: USING WELL WATER FOR C. DUBIA AND D. PULEX CONTROLS

Instrument Calibrations:

	pH	DO	Cond	Temp
0 hr				
24 hr				
48 hr				

F = DEAD AT 24HRS

		Number Live			DO (mg/l)			pH			Temp. (°C)			Cond. (µmhos/cm)		
Conc.	Chamber #	0	24	48	0	24	48	0	24	48	0	24	48	0	24	48
C. dubia																
de-Cl	A1	5	5	5	9.7	8.5	8.5	5.5	8.6	8.6	21.9	21.0	21.5	3020	3010	3130
ADJ pH	B	5	5	5			8.5									
	C	5	5	5												
↓	D	5	5	4				8.KP								
CONTROL	A	5	5	5	9.3	8.5	8.4	8.0	8.4	8.4	20.3	21.0	21.5	232	235	479
	B	5	5	5												
	C	5	5	3												
↓	D	5	5	3												
Cl, neg	A	5	C/A	–	10.2	8.5		11.7	10.3		21.7	21.0		3310	2420	
pH	B	5	C/A	–												
	C	5	C/A	–												
↓	D	5	C/A	–												
de-Cl	A	5	C/A	–	9.8	8.4		11.7	10.3		21.7	21.0		3370	2420	
neg pH	B	5	C/A	–												
	C	5	C/A	–												
↓	D	5	C/A	–									21.7			
Cl, ADJ	A	5	C/A	2	10.2	8.5	8.5	8.4	8.3	8.7	22.0	21.0	21.5	3230	3150	3270
pH	B	5	C/A	5									21.5			
	C	5	C/A	5												
↓	D	5	C/A	5												
de-Cl	A	5		3	9.7	8.5	8.5	8.5	8.6	8.6	21.7	21.0	21.5	3050	3090	3150
ADJ pH	B	5		3												
	C	5		1												
↓	D	5		1												
Measured/Loaded by:		AJ	MF	AJ/KP	MF	AJ	KP	MF	AJ	KP	MF	AJ	KP	MF	AJ	KP
Recorded by:		AJ	MF	AJ/KP	KP	MF	AJ	KP	MF	AJ	KP	MF	AJ	KP	MF	AJ

Investigators' Signatures

Kim Pearce
Alison Jordan
Marshall Faircloth

Reviewer

** Phenol phthalein added

Water-quality Parameters

	Well Water	Cond. Water	Sample	Method	Measured by
Field Tot. Resid. Cl:					
Lab Tot. Resid. Cl:					
Alkalinity:	115	105	115 **	Hach	MF
Hardness:	120	120	20	Hach	MF
Total Ammonia:					

Ammonia meter slope: _____