Florida

Department of Environmental Protection

Bioassays of

Cruise Ship *Carnivale*

Port Canaveral, Brevard County, Florida

No NPDES Number

Sampled 9/23/93

January, 1994

Biology Section
Division of Technical Services

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Biology Section
Bureau of Laboratories
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Introduction

Cruise ship *Carnivale*, Port Canaveral, Brevard County, Florida, no NPDES #, tests performed on 24 to 26 September, 1993.

The sample was collected from the cruise ship *Carnivale*, at the Carnival Cruise Lines dock, as it discharged wastewater into the harbor at Port Canaveral on 9/23/93. Treatment of wastewater consisted of four Coast Guard-approved marine sanitation devices (MSD's). The effluent came from MSD #2 (personal communication, Guy Hadley and Louis Ley, FDEP Central District office).

The toxicity tests discussed in this report were performed in accordance with methods described by Weber, 1991, *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*, 4th Edition, EPA/600/4-90/027.

Results and Discussion

The FDEP Biology Section performed two static acute screening toxicity bioassays on a sample of chlorinated effluent from this ship. Two additional screening tests were initiated with an aliquot which had been dechlorinated in the laboratory using sodium thiosulfate.

The salinity of the sample was 29.6 ppt, therefore, the test species used for these bioassays were the mysid shrimp, *Mysidopsis bahia*, and the inland silverside, *Menidia beryllina*. The control water for the tests was adjusted using an artificial sea salt mixture (Forty Fathoms®); the salinity of the sample was not altered.

The test results indicated 100% mortality in all organisms exposed to the chlorinated effluent within 24 hours of test initiation. The results of the tests using dechlorinated aliquots were invalidated due to insufficient dissolved oxygen found at 24 hours after test initiation. The cause of toxicity to the organisms in the chlorinated effluent was the total residual chlorine. Toxicity in the dechlorinated aliquot could not be determined.

Total residual chlorine of the sample was 1.5 mg/L in the laboratory and 1.3 mg/L in the field. Total residual chlorine levels have been found to be acutely toxic as low as 0.15 mg/L for marine shrimp and 0.13 µg/L for *Menidia menidia* (EPA *AQUIRE* toxicity database).

Total and unionized ammonia concentrations were 1.5 mg/L and < 0.01 mg/L, respectively. Further chemical analyses were performed on the sample. Pesticides and organics were not detected.

Of the eight metals which were present, five exceeded their respective Class III marine surface water quality standard (Table 2). Copper levels have been found to be acutely toxic as low as 5.8 µg/L for marine invertebrates (EPA *Ambient Water Quality Criteria*) and 280 µg/L for marine fish (EPA *AQUIRE* toxicity database).

Conclusion

The sample of chlorinated effluent collected from the cruise ship *Carnivale* MSD #2 on 23 September, 1993, caused 100% mortality to both *Mysidopsis bahia* and *Menidia beryllina*. The cause of mortality was attributed to total residual chlorine and copper.

The results of testing the dechlorinated effluent are not valid because of the decrease in dissolved oxygen which occurred during the tests. Toxicity in the dechlorinated aliquot could not be determined.

Table 1. Concentration series and volumes used for the static acute screening bioassays of the cruise ship *Carnivale* MSD #2 effluent, performed on 24 to 26 September, 1993.

Mysidopsis bahia (mysid shrimp)

Concentration	Control Water	Sample	Total Volume
Control	500 mL	0 mL	500 mL
100 %	0 mL	500 mL	500 mL

Menidia beryllina (inland silverside)

Concentration	Control Water	Sample	Total Volume
Control	500 mL	0 mL	500 mL
100 %	0 mL	500 mL	500 mL

Table 2. Results of chemical analyses of the effluent from the cruise ship *Carnivale* MSD #2 effluent, sampled on 23 September, 1993.

Pesticides & Herbicides

none detected

Base-Neutral & Acid Extractables

none detected

Metals

			Class III marine WQ Standards	
Aluminum	227	µg/L J		
Calcium	333	mg/L		
Copper	228	µg/L J	≤2.9	µg/L
Iron	1630	µg/L	≤300	µg/L
Lead	15	µg/L I	≤5.6	µg/L
Magnesium	924	mg/L		
Silver	0.33	µg/L I	≤0.05	µg/L
Zinc	107	µg/L	≤86.0	µg/L

I Value reported is less than the minimum quantitation limit, and greater than or equal to the minimum detection limit.

J Estimated value.

Table 3. Data recorded during the 48-hour static acute screening bioassays of a sample of effluent from the cruise ship Carnivale, Port Canaveral, Brevard County, Florida, no NPDES number, performed on 24 to 25 September, 1993.

Facility:	**Cruise ship Carnivale**		**NPDES #**	**None**	Facility Type: **marine sanitation device on ship**
Location:	Port Canaveral		Contact/District:	Louis Ley / C	
County:	Brevard		Test type:	static acute screen	
Sample Collection Date:	**9/23/93**	Time: 1340	# tests:	2	Receiving Water: Port Canaveral
Test Beginning Date:	9/24/93	Time: 1400	Chlorination Type:	**chlorinated**	
Test Ending Date:	9/25/93	Time: 1120			**Page 1 of 1**

Organism: ***Mysidopsis bahia*** Life stage: 4 days

Concentrations	SURVIVAL * # at 0 hr	Live at 24 hr	Live at 48 hr		pH 0 hour	pH 24 hour	pH 48 hour	Temperature 0 hour	Temperature 24 hour	Temperature 48 hour	Dissolved Oxygen 0 hour	Dissolved Oxygen 24 hour	Dissolved Oxygen 48 hour	Conductivity 0 hour	Conductivity 24 hour
Control	5	5	*		8.3	8.3	-	23.7	23.7	-	7.0	7.1	-	33.3	33.5
Control	5	5	*		8.3	8.3	-	23.7	23.7	-	7.0	7.2	-	33.4	33.7
100%	5	0	*		6.9	7.7	-	22.7	23.5	-	5.3	7.0	-	43.9	44.8
100%	5	0	*		6.9	7.7	-	22.6	23.5	-	5.3	7.0	-	43.9	44.9

* test terminated at 24 hours due to 100% mortality

Organism: ***Menidia beryllina*** Age: 12 days

Concentrations	SURVIVAL * # at 0 hr	Live at 24 hr	Live at 48 hr		pH 0 hour	pH 24 hour	pH 48 hour	Temperature 0 hour	Temperature 24 hour	Temperature 48 hour	Dissolved Oxygen 0 hour	Dissolved Oxygen 24 hour	Dissolved Oxygen 48 hour	Conductivity 0 hour	Conductivity 24 hour
Control	5	5	*		8.3	8.3	-	23.7	23.5	-	7.0	6.9	-	33.3	33.4
Control	5	5	*		8.3	8.3	-	23.6	23.5	-	7.0	7.0	-	33.3	33.4
100%	5	0	*		7.0	7.7	-	22.6	23.5	-	5.5	6.6	-	43.9	45.1
100%	5	0	*		7.0	7.7	-	22.6	23.6	-	5.5	6.4	-	44.0	45.2

* test terminated at 24 hours due to 100% mortality

Total Residual Cl2	mg/L	Method
Field:	1.5	-
Lab:	1.3	DR-100

Ammonia	Total (mg/L)	Unionized (mg/L)
Control Water:	<0.017	0.00
100% Sample:	1.3	< 0.01

Alk & Hardness	Alkalinity (mg/L)	Hardness (mg/L)
Control Water:	242	not measured
100% Sample:	155	not measured

Salinity	(ppt) **
Control Water:	21.5
100% Sample:	29.6

** Salinity converted from conductivity readings (mmhos/cm).

Table 4. Data recorded during the 48-hour static acute screening bioassays of a dechlorinated aliquot of effluent from the cruise ship Carnivale, Port Canaveral, Brevard County, Florida, no NPDES number, performed 24 to 26 September, 1993.

Facility:	**Cruise ship Carnivale**		**NPDES #**	**None**	Facility Type: **marine sanitation device on ship**
Location:	Port Canaveral		Contact/District:	Louis Ley / C	
County:	Brevard		Test type:	static acute screen	
Sample Collection Date:	**9/23/93**	Time: 1340	# tests:	2	Receiving Water: Port Canaveral
Test Beginning Date:	9/24/93	Time: 1400	Chlorination Type:	**sample dechlorinated using sodium thiosulfate**	**Page 1 of 1**
Test Ending Date:	9/26/93	Time: 1320			

Total Residual Cl2	mg/L	Method
Field:	1.5	-
Lab:	0.04	DR-100

Ammonia	Total (mg/L)	Unionized (mg/L)
Control Water:	<0.017	0.00
100% Sample:	1.50	< 0.01

Organism: ***Mysidopsis bahia*** Life stage: 4 days

	SURVIVAL			pH			Temperature			Dissolved Oxygen			Conductivity	
Concentrations	# at 0 hr	Live at 24 hr	Live at 48 hr	0 hour	24 hour	48 hour	0 hour	24 hour	48 hour	0 hour	24 hour	48 hour	0 hour	48 hour
Control	5	5	5	8.3	8.3	8.5	23.7	23.7	22.9	7.0	7.1	8.3	33.3	34.4
Control	5	5	5	8.3	8.3	8.5	23.7	23.7	22.9	7.0	7.2	8.5	33.4	34.5
100%	5	1 *	0 *	7.0	7.5	8.2	23.0	23.6	23.4	5.5	3.1 *	7.6	44.2	46.0
100%	5	0 *	0 *	7.0	7.5	8.1	22.9	23.6	23.2	5.5	3.0 *	7.8	44.2	46.6

* test results invalidated due to DO crash below 4.0 mg/L.

* test results invalidated due to DO crash below 4.0 mg/L.

Alk & Hardness	Alkalinity (mg/L)	Hardness (mg/L)
Control Water:	242	not measured
100% Sample:	155	not measured

Organism: ***Menidia beryllina*** Age: 12 days

	SURVIVAL			pH			Temperature			Dissolved Oxygen			Conductivity	
Concentrations	# at 0 hr	Live at 24 hr	Live at 48 hr	0 hour	24 hour	48 hour	0 hour	24 hour	48 hour	0 hour	24 hour	48 hour	0 hour	24 hour
Control	5	5	-	8.3	8.3	-	23.7	23.5	-	7.0	6.9	-	33.3	33.4
Control	5	5	-	8.3	8.3	-	23.6	23.5	-	7.0	7.0	-	33.3	33.4
100%	5	0 *	-	7.0	7.4	-	22.9	23.5	-	5.5	1.2 *	-	44.1	44.7
100%	5	0 *	-	7.0	7.4	-	22.9	23.5	-	5.5	1.1 *	-	44.2	44.8

* test results invalidated due to DO crash below 4.0 mg/L.

* test results invalidated due to DO crash below 4.0 mg/L.

Salinity	(ppt) **
Control Water:	21.5
100% Sample:	29.6

** Salinity converted from conductivity readings (mmhos/cm).

Table 5. 24-hour LC_{50} Data for Bioassay of effluent from the cruise ship Carnivale performed on 24 to 26 September, 1993.

Organism	Method of Data Analysis	24-Hour LC_{50} (95% Confidence Intervals)
Chlorinated effluent		
Mysidopsis bahia	non-calculated	< 100% [a]
Menidia beryllina	non-calculated	< 100% [a]

[a] The LC_{50} is < 100% since all the organisms died in the lowest test concentration (100%). The test ran for 24 hours.

FDEP Biology Section — Acute Bioassay Bench Sheet

Sample Source: Carnival Cruise Ship MSD #2
Location: PORT CANAVERAL
County:
Contact/District: GUY HADLEY / C
NPDES Permit #: FL00 n/a Outfall #:

Sample Collection: Date 9/23/93 Time 1340
Test Beginning: Date 9/24/93 Time 1400
Test Ending: Date 9/25/93 Time 1120
Organism Batch #: 112 Diluent Batch #: 37
Organism Age: 4 days
Test Organism: Mysidopsis bahia

62703
93-SEP-24-17

Test Type: Screening | Definitive
Static | Static Renewal | Flow-through
Test Number: 3 of 4

Remarks:
- chlorinated sample
- test terminated @ 24 hrs

Oh DO decided at 1600
holding @ 5.5 and 5.5 MF

Instrument Calibrations:	pH	Temperature °C	D.O. mg/L	Conductivity µmhos/cm
meter #	7851	90H018262	90H018262	G9005749
0 hr	7.0 @ 7.0 9.0 @ 9.0	24.1 @ 24.1	8.3 @ 24.3	1002 @ 1,000 9690 @ 10,000 @ 24.0 °C
24 hr	7.0 @ 7.0 9.0 @ 9.0	24.7 @ 24.8	5.4 @ 24.3	1003 @ 1,000 9680 @ 10,000 @ 24.3 °C
48 hr	___ @ 7.0 ___ @ ___	___ @ ___	___ @ ___	___ @ 1,000 ___ @ 10,000 @ ___ °C

Conc.	Chamber #	Number Live 0 hr	24 h	48 h	pH 0 hr	24 h	48 h	Temperature (°C) 0 hr	24 h	48 h	D.O. (mg/L) 0 hr	24 h	48 h	UNCORRECTED Cond. (mmhos/cm) 0 hr	24 h	48 h
Control	86	5	5		8.3	8.3		23.7	23.7		7.0	7.1		33.3	33.5	
Control	3	5	5		8.3	8.3		23.7	23.7		7.0	7.2		33.4	33.7	
100%	63	5	0		6.9	7.7		23.0	23.5		5.3	7.0		43.9	44.8	
100%	10	5	0		6.9	7.7		22.9	23.5		5.3	7.0		43.9	44.9	
								KP								
								22.7								
								22.6								
								recorded AbCE								
								#5 by accident								
								KP 9/24/93								
Measured/Loaded by:		MF	MF		MF	MF		MF	MF		MF	MF		MF	MF	
Recorded by:		MF	MF		KP	MF		KP	MF		KP	MF		KP	MF	

Investigators' Signatures

Michael Faulkner
Kim Pearce

Reviewer

form updated 7/8/93

Water Quality Parameters (Salt Water / Well Water / 20% Min Water)

	Sample	Method	Measured by
Field Total Residual Cl2:	1.5	—	Lay
Lab Total Residual Cl2: <0.03	1.3	DR100	KP
Alkalinity: 242	155	Hach	KP
Hardness: n/m	n/m	—	—
Total Ammonia: <0.017	1.5	ORION	MF

Ammonia Meter #98136 Ammonia Meter Slope: 57.6 Ammonia Blank: <0.017 Control Salinity: 21.5 ppt Sample Salinity: 29.6 ppt

FDEP Biology Section — Acute Bioassay Bench Sheet

Sample Source: Carnival Cruise Ship MSD #3
Location: PORT CANAVERAL
County:
Contact/District: GUY HADLEY / C
NPDES Permit #: FL00 n/a
Outfall #:

Sample Collection: Date 9/23/93 Time 1340
Test Beginning: Date 9/24/93 Time 1400
Test Ending: Date 9/25/93 Time 1120
Organism Batch #: 22 Diluent Batch #: 37
Organism Age: 12 days
Test Organism: Menidia beryllina
62703
93-SEP-24-17

Test Type: (Screening) | Definitive
(Static) | Static Renewal | Flow-through

Test Number: 2 of 4

Remarks:
- Dechlorinated in lab
- test terminated @ 24 hrs

0 hr DO started at 1600 holding @ 5.5 and 5.6 MF

Instrument Calibrations:

	pH	Temperature °C	D.O. mg/L	Conductivity µmhos/cm
meter #	7851	90H018262	90H018262	G9005749
0 hr	7.0 @ 7.0	24.1 @ 24.1	8.3 @ 24.3	1002 @ 1,000
	9.0 @ 9.0			9690 @ 10,000 @ 24.0 °C
24 hr	7.0 @ 7.0	24.7 @ 24.8	8.4 @ 24.3	1008 @ 1,000
	9.0 @ 9.0			9680 @ 10,000 @ 24.3 °C
48 hr	___ @ 7.0	___ @ ___	___ @ ___	___ @ 1,000
	___ @ ___			___ @ 10,000 @ ___ °C

Conc.	Chamber #	Number Live 0 hr	Number Live 24 h	Number Live 48 h	pH 0 hr	pH 24 h	pH 48 h	Temperature (°C) 0 hr	Temperature (°C) 24 h	Temperature (°C) 48 h	D.O. (mg/L) 0 hr	D.O. (mg/L) 24 h	D.O. (mg/L) 48 h	UNCORRECTED Cond. (mmhos/cm) 0 hr	Cond. 24 h	Cond. 48 h
Control	86 25	5	5		8.3	8.3		23.7	23.5		7.0	6.9		33.3	33.4	
Control	3 85	5	5		8.3	8.3		23.6	23.5		7.0	7.0		33.3	33.4	
100%	163	5	0		7.0	7.4		22.9	23.5		5.5	1.2		44.1	44.7	
100%	20	5	0		7.0	7.4		22.9	23.5		5.6	1.1		44.2	44.8	
Measured/Loaded by:		MF	MF		MF	MF		MF	MF		MF	MF		MF	MF	
Recorded by:		MF	MF		KP	MF		KP	MF		KP	MF		KP	MF	

Invalid

Investigators' Signatures
Marshall Finchelt
Kim Pearce

Reviewer

form updated 7/8/93

Water Quality Parameters

	(Salt Water) / Well Water	20% Min Water	Sample	Method	Measured by
Field Total Residual Cl2:			1.5	—	Lou Ley/C
Lab Total Residual Cl2:	<0.03	—	0.04	DR100	MF
Alkalinity:	242	—	155	Hach	KP
Hardness:	n/m	—	n/m	n/a	n/a
Total Ammonia:	<0.017	—	1.5	ORION	MF

Ammonia Meter #98136 Ammonia Meter Slope: -57.6 Ammonia Blank: <0.017 Control Salinity: 21.5 ppt Sample Salinity: 29.6 ppt

FDEP Biology Section — Acute Bioassay Bench Sheet

Sample Source: Carnival Cruise Ship MSD #2 — Sample Collection: Date 9/23/93 Time 1340
Location: PORT CANAVERAL — Test Beginning: Date 9/24/93 Time 1400
County: — Test Ending: Date 9/25/93 Time 1120
Contact/District: GUY HADLEY / C — Organism Batch #: 22 Diluent Batch #: 37
NPDES Permit #: FL00 n/a Outfall #: — Organism Age: 12 Days
Test Organism: Menidia beryllina
62703 93-SGP-24-17

Test Type: (Screening) | Definitive
(Static) | Static Renewal | Flow-through

Test Number: 4 of 4

Remarks:
- chlorinated sample
- test terminated @ 24 hrs

Other DO checked @ 1600 holding @ 5.6 & 5.5 MF

Instrument Calibrations:	pH	Temperature °C	D.O. mg/L	Conductivity µmhos/cm
meter #	7851	90H018262	90H018262	G9005749
0 hr	7.0 @ 7.0 9.0 @ 9.0	24.1 @ 24.1	8.3 @ 24.3	1002 @ 1,000 9690 @ 10,000 @ 24.0
24 hr	7.0 @ 7.0 9.0 @ 9.0	24.7 @ 24.8	8.4 @ 24.3	1009 @ 1,000 9680 @ 10,000 @ 24.3
48 hr	___ @ 7.0 ___ @ ___	___ @ ___	___ @ ___	___ @ 1,000 ___ @ 10,000 @ ___

Conc.	Chamber #	Number Live 0 hr	Number Live 24 h	Number Live 48 h	pH 0 hr	pH 24 h	pH 48 h	Temperature (°C) 0 hr	Temperature (°C) 24 h	Temperature (°C) 48 h	D.O. (mg/L) 0 hr	D.O. (mg/L) 24 h	D.O. (mg/L) 48 h	UNCORRECTED Cond. (mmhos/cm) 0 hr	UNCORRECTED Cond. (mmhos/cm) 24 h	UNCORRECTED Cond. (mmhos/cm) 48 h
control	25	5	5		8.3	8.3		23.7	23.5		7.0	6.9		33.3	33.4	
control	85	5	5		8.3	8.3		23.6	23.5		7.0	7.0		33.3	33.4	
100%	37	5	0		7.0	7.7		22.6	23.5		5.5	6.6		43.9	45.1	
100%	77	5	0		7.0	7.7		22.6	23.6		5.5	6.4		44.0	45.2	
Measured/Loaded by:		MF	MF		MF	MF		MF	MF		MF	MF		MF	MF	
Recorded by:		MF	MF		KP	MF		KP	MF		KP	MF		KP	MF	

Investigators' Signatures
Kim Pearce
Marshall Faircloth

Reviewer

Water Quality Parameters	(Salt Water) Well Water	20% Min Water	Sample	Method	Measured by
Field Total Residual Cl2:			1.5	—	LLey
Lab Total Residual Cl2:	<0.03	—	1.3	DR100	KP
Alkalinity:	242	—	155	Hach	KP
Hardness:	n/m	—	n/m	—	—
Total Ammonia:	<0.017	—	1.5	ORION	MF

Ammonia Meter #98136 — Ammonia Meter Slope: -57.6 — Ammonia Blank: <0.017 — Control Salinity: 21.5 ppt — Sample Salinity: 29.6 ppt

form updated 7/8/93

Sample Source: Carnival Cruise Ship MSD ≤ | Sample Collection: Date 9/23/93 Time 1340
Location: PORT CANAVERAL | Test Beginning: Date 9/24/93 Time 1400
County: | Test Ending: Date 9/26/93 Time 1320
Contact/District: G44 HADLEY / C | Organism Batch #: 112 Diluent Batch #: 37
NPDES Permit #: FL00 n/a Outfall #: | Organism Age: 48 hrs
Test Organism: Mysidopsis bahia 112

62703 93-SEP-24-17

Test Type: (Screening) | Definitive
(Static) | Static Renewal | Flow-through

Test Number: 1 of 4

Remarks: Dechlorinated in Lab

On DO. rad at 1600. holding at 5.5 - 5.6 mf

Instrument Calibrations:	pH	Temperature °C	D.O. mg/L	Conductivity µmhos/cm
meter #	7851	90H018262	90H018262	G9005749
0 hr	7.0 @ 7.0 9.0 @ 9.0	24.1 @ 24.1	8.3 @ 24.3	1002 @ 1,000 9690 @ 10,000 @ 24.0 °C
24 hr	7.0 @ 7.0 9.0 @ 9.0	24.7 @ 24.8	8.4 @ 24.3	1005 @ 1,000 9650 @ 10,000 @ 24.3 °C
48 hr	7.0 @ 7.0 9.0 @ 9.0	24.5 @ 24.6	8.4 @ 24.4	1006 @ 1,000 9700 @ 10,000 @ 24.2 °C

Conc.	Chamber #	Number Live 0 hr	Number Live 24 h	Number Live 48 h	pH 0 hr	pH 24 h	pH 48 h	Temperature (°C) 0 hr	Temperature (°C) 24 h	Temperature (°C) 48 h	D.O. (mg/L) 0 hr	D.O. (mg/L) 24 h	D.O. (mg/L) 48 h	UNCORRECTED Cond. (mmhos/cm) 0 hr	UNCORRECTED Cond. (mmhos/cm) 24 h	UNCORRECTED Cond. (mmhos/cm) 48 h
Control	86	5	5	5	8.3	8.3	8.5	23.7	23.7	22.9	7.6	7.1*	8.3	33.3	33.5	34.4
Control	3	5	5	5	8.3	8.3	8.5	23.7	23.7	22.9	7.0	7.2*	8.5	33.4	33.7	34.5
100%	13	5	1	0	7.0	7.5	8.2	23.0	23.6	23.4	5.5	3.1*	7.6	44.2	44.7	46.0
100%	183	5	0	0	7.0	7.5	8.1	22.9	23.6	23.2	5.5	3.0*	7.8	44.2	45.0	46.6
Measured/Loaded by:		MF	MF	MF	MF	MF	MF	MF	MF	MF	MF	MF	MF	MF	MF	MF
Recorded by:		MF	MF	MF	KP	MF	MF	KP	MF	MF	KP	MF	MF	KP	MF	MF

* Recalc at 24 hour MF 9/25/93

Investigators' Signatures

Marshall Faircloth

Kim Pearce

Reviewer

form updated 7/8/93

Water Quality Parameters	(Salt Water/) Well Water	20% Min Water	Sample	Method	Measured by
Field Total Residual Cl2:			1.5	Hach	MF 9/24 & JB Jan 24
Lab Total Residual Cl2:	<0.03	—	0.04	DR100	MF
Alkalinity:	242	—	155	Hach	KP
Hardness:	n/m	—	n/m	—	—
Total Ammonia:	0.017	—	1.5	Orion	MF

Ammonia Meter #98136 Ammonia Meter Slope: -57.6 Ammonia Blank: 0.017 Control Salinity: 21.5 ppt Sample Salinity: 29.6 ppt