PHYSICAL AND CHEMICAL PROPERTIES OF POTOMAC RIVER AND ENVIRONS,

JANUARY 1978

Compiled and Edited by Richard E. Smith and Raynol E. Herndon

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of the Potomac River estuary

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UNITED STATES DEPARTMENT OF THE INTERIOR

CECIL D. ANDRUS, Secretary

GEOLOGICAL SURVEY

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OPEN-FILE REPORT

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ABSTRACT

Basic data on the physical and chemical properties measured during January 1978 on the tidally influenced Potomac River and estuary are presented herein. Three surface profiles and 19 vertical profiles were made of the distributions of salinity, temperature, chlorophyll-a fluorescence, dissolved oxygen,orthophosphate, nitrate+nitrite, nitrite, ammonia, and silicate. Additional analyses were performed on discrete samples collected for particulate organic carbon, alkalinity, pH, suspended particulate matter, total phosphate, total nitrogen, total dissolved phosphate, and total dissolved nitrogen.

INTRODUCTION

The broad goals of the U.S. Geological Survey's estuarine studies are to understand hydrodynamic, chemical and biological processes by which, and to measure rates at which, water, solutes, particulate matter, and organisms interact in a river-estuarine system, and to develop and verify conceptual and numerical models of these interactions. (See also Conomos et al. 1978).

Field activities in the Potomac River estuary (Fig. 1) were organized to provide a detailed overview as background for a five-year study of the estuary begun by the Geological Survey in 1977 (Bennett 1979). The sampling dates were chosen to examine the three major seasonal extremes:

1. The period of low river discharge and high insolation in late summer, when the maximum effects of nonconservative processes should occur;
2. The period of high river discharge and low insolation in winter, when rates of nonconservative processes are minimal; and
3. The period of moderate river discharge and high insolation in late spring, when maximum rates of biological production begin.

This report is based on observations made during period 2, January 1978. The measurements included here are salinity, temperature, concentrations of dissolved oxygen and carbon dioxide, pH of the water, abundance of plant nutrients, and abundance, size, and composition (organic and mineral) of suspended and sedimented particulate matter such as shown by such measurements as those of chlorophyll _a_ concentrations. Scientific personnel and their primary areas of responsibility are listed in Appendix A.

METHODS

Sampling System. - Because the study of estuarine-transport processes is extremely complex, a program which can adequately define a system that is influenced by widely varying factors such as basin morphology, river inflow, tidal and density-induced water movements, and short-term biochemical processes is difficult to design. A first step in the design was a comprehensive automated sampling system capable of continuous and rapid analyses. In many of the analyses somewhat less than "state-of-the-art" accuracy was accepted in favor of automation. Salinity, for example, is measured continuously and instantaneously as a function of conductivity, with precision and accuracy better than 0.2 $^{o}/oo$; this method is well suited for estuarine salinity ranges, giving better than 1-percent resolution in the range of values observed (2-25 $^{o}/oo$).

An automated sampling and data-acquisition system developed for work on San Francisco Bay (Schemel and Dedini, 1979a) was installed with modification on the R/V Aquarius, a 50-foot vessel operated by the Chesapeake Biological Laboratories. The system has two sampling modes, one for longitudinal or surface profiling and one for vertical profiling. In the surface-profiling mode, water was pumped from a through-hull fitting located at a depth of approximately one meter. Vertical profiles were performed by lowering a submersible pump with attached temperature and depth sensors. The pumped sample was split for the various continuous and discrete analyses (Table 1).

Position. - Station positions (Fig. 1, Table 2, Table 3) were determined using radar and visual sightings of local landmarks. They are reported herein to the nearest 0.1 kilometer, in the Universal Transverse Mercator system (UTM), which allows direct computation of distances.

(Richardus and Adler,1972). For convenience of entry and manipulation, only significant digits have been included and the kilometer has been assigned unit position (for example, a UTM position of 419,000 M North would appear as 190.ON). Discrete samples were generally collected within 30 seconds of a station mark. For stations sampled under way while profiling at maximum speed of 28 km/hr (15 knots), this converts to a potential relative error in station position of ±0.2 km. Vertical profiles of water properties were made after anchoring on station if currents or wind were excessive; the pump was then lowered to selected depths (usually 0, 2, 5, 10, 15 and 20 m if water depths permitted) and allowed to equilibrate (usually 3-5 min) before sampling. Readings were recorded and discrete samples collected for subsequent analysis. The procedure was then repeated for additional sampling depths.

Time. - All times are Eastern Standard Time (local time).

River Mile. - The axial distance, in nautical miles from the line drawn between Smith Point and Point Lookout at the mouth of the Potomac River (National Oceanographic and Atmospheric Administration Chart 12285). The river mile designation for stations not located along the axis were determined by drawing a line normal to the axis through the station.

Temperature. - Measurements were made using linearized thermistors mounted on a submersible pump and in line just after the deck pump, about 3 m from the intake. The temperature circuits were calibrated daily at the ice point ($0^{\circ}C$) and at room temperature ($20-30^{\circ}C$). Periodic checks with standard laboratory thermometers agreed within $\pm0.2^{\circ}C$.

Depth. - The pump depth was determined using a pressure transducer having an accuracy of ±1 m. Readings listed as zero meters are actually representative of a pump-intake depth of about 0.2 m. Samples taken via the surface-profiling intake are listed at a depth of 1 m. The actual depth varied at least 50 percent depending on sea state and ship speed.

Salinity.- A flow-through induction salinometer was used and calibrated at roughly 2-°/oo intervals by collecting discrete samples for subsequent analysis using a Beckman RS7-B laboratory salinometer.[1/] Under stable conditions, salinity differences of less than 0.05 °/oo were observed.

Sigma-t.- This oceanographic expression of density is calculated as a function of temperature and salinity according to Knudson's equation (Table 3).

Dissolved Oxygen.- Carpenter's (1965) modification of the Winkler titration was used for determinations of dissolved oxygen. Samples were collected in 125-ml titration flasks,with care taken to minimize atmospheric contamination, then fixed in the basic form and held up to two hours before acidification and titration to a starch end point with 0.2 N thiosulfate. Precision of analysis was ± 4 µg-at/L[2/]. Nitrite is known to interfere with the analysis. In comparisons made with the azide modification of the Winkler method (American Public Health Assoc., 1972), using San Francisco Bay water, the error was found to be stoichiometric, i.e., 1 µm (NO_2) is equivalent to 1 µg-at (O). Additional errors due to high content of dissolved organic material in the metropolitan Washington, D.C., area were observed. In these areas the titration end points drifted slowly positively as interfering reactions continued to release free iodine. All samples were titrated rapidly, but all samples collected in the vicinity of

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1/ The mention of brand names is for identification purposes and does not constitute endorsement by the U. S. Geological Survey.

2/ Conversion factors for concentration units are listed in Appendix B.

the Blue Plains outfall (river mile 90 to 95) probably have a positive bias.

AOU.-Apparent oxygen utilization (AOU) is calculated as the difference between the saturation concentration of dissolved oxygen at the sample temperature and salinity and the observed concentration of dissolved oxygen (Table 3). Samples having a concentration greater than the saturation concentration therefore have a negative AOU.

Percent Oxygen Saturation.-Similarly, percent saturation is an expression of the closeness of an observed oxygen concentration to the equilibrium or saturation concentration. Rather than a difference, percent saturation is the ratio of the observed value to the saturation value (Table 3).

Dissolved Oxygen Probe -In addition to discrete titration for dissolved oxygen, a polarographic-type oxygen probe was used to determine variations in oxygen saturation. The probe was on line with other continuous-measurement equipment and was used primarily to obtain instantaneous approximations of oxygen saturation. Each day the instrument output was adjusted to read 100 in air and 0 in a sodium sulfite solution. Correlation with oxygen percent saturation determined by titration agreed within 5 to 10 percent saturation.

Micronutrients.-All micronutrient analyses were performed using a Technicon AutoAnalyzer. The sample signal was referenced to single upscale standards and blanks which were analyzed at 2- and 4-hour intervals. The linearity of each of the analyses was confirmed before initial data collection and at times of suspected malfunction.

Because of space constraints aboard ship our usual configuration, in which the AutoAnalyzer is placed on line via continuous filtration, was not used. Instead, discrete samples were collected at each location, filtered onboard ship, refrigerated, and returned to a dockside laboratory for analysis within 24 hours. Glass-fiber filters with a nominal pore size of 0.3u were used to remove suspended matter. High winds, ice flows, and high river discharge combined to increase the suspended sediment load from summer values of less than 50 mg/L (Smith 1979) to over 100 mg/L during this sampling period. Under these conditions our filtration was found to be inadequate (Harmon and Smith, 1980). It became necessary to rerun samples through the AutoAnalyzer, without reagents, to determine and account for the turbidity remaining after filtration. Specific analytical methods are as follows:

Silicate.- The method is an adaptation of Technicon Corporation (1976) method AII 105-71W. The sample tube has been reduced to half the normal delivery rate in order to extend the linear range to 320 μM/L. Absorbance is measured at 660 nm and a 3 percent precision is observed over a 2- to 300-μM/L range in concentration.

Orthophosphate.-The method is a modification of the method of Atlas et al. (1971), using ascorbic acid (70 g/L with 50 mL acetone/L) instead of hydrazine sulfate as a reductant. This change was made to enable analysis of samples predigested with hydrogen peroxide and ultraviolet light. Absorbance is measured at 660 nm and a 3 percent precision is observed over a 2- to 30-μM/L range in concentration.

Nitrate+nitrite.-The method is Technicon Corporation (1973) method number AII 100-70W with one additional 20-turn coil added for better stability with respect to room temperature. Nitrate is reduced to nitrite by passing the sample through a cadmium reduction column. Color reagent is then added and the absorbance is read at 540 nm. A precision of 3 percent is observed over a range in concentration of 1 to 80 μM/L.

Nitrite.- The Technicon Corporation (1973) method number AII 100-70W, for nitrate + nitrite, was used with the cadmium column removed. In order to fit all five analyses on a single Technicon proportioning pump, the sample/ammonium chloride mixture was drawn from the debubbler which precedes the cadmium column in the nitrate + nitrite analysis. Absorbance was measured at 540 nm and a precision of 3 percent was observed over the range 1 to 50 µM/L.

Ammonia.- The analysis is an automated version of the method of Solorzano (1969), similar to that of Head (1971). The absorbance of the phenolhypochlorite complex is measured at 630 nm and has a precision of 3 percent observed over the range 5 to 100 µM/L.

Total Particulate and Total Dissolved Nutrients.- In order to distinguish between the effects of conservative and nonconservative processes on the distribution of dissolved inorganic nutrients, the distribution of the particulate phase also must be known. Analysis for particulate phosphate, carbon, or nitrogen has traditionally involved high-temperature acid oxidation. Recently ultraviolet light has been used to catalyze the oxidation of dissolved organic matter (Armstrong, Williams and Strickland, 1966). Even though complete oxidation of particulate matter may not be achieved using ultraviolet radiation, we feel that it does provide an accurate and reproduceable estimate of the labile or rapidly oxidizable fraction available for mineralization and recycling by phytoplankton on a time scale of days to weeks. In addition, sample handling and sources of reagent contamination are reduced using UV digestion.

The system described by Armstrong et al. (1966) was used for irradiation. Two drops of peroxide was added to each of twelve samples placed at an equal distance surrounding a 1200-watt UV mercury-arc tube for a period of four to six hours. Irradiation of duplicate filtered and unfiltered samples was carried out using this apparatus. The irradiation time was determined by splitting a sample into twelve subsamples and analyzing at 30-min intervals for a period of irradiation of 1 to 6 hours. After one hour a stable concentration for phosphate was achieved; oxidation of ammonia to nitrate required three hours. To insure complete oxidation samples were digested for six hours. Standards supplied by the Quality Control Laboratories of the Environmental Protection Agency for organic phosphate and nitrogen were analyzed and better than 90 percent recovery was achieved.

The values given in this report for total particulates, total dissolved nitrogen, and total dissolved phosphate are averages of two digestions each for filtered and unfiltered portions of a sample. The unfiltered samples were digested as described above, filtered to remove refractory material, and then analyzed using the methods for dissolved inorganic materials documented above.

Turbidity. - This determination was made using a Turner Designs nephelometer, a device that measures light scattered at 90° by suspended particulate matter. All values presented here have been converted to a single scale for ease of comparison.

Fluorescence. -*In vivo* fluorescence was measured using a Turner Designs model 10 fluorometer equipped with a flow-through cell. As with turbidity, all readings have been converted to a single scale. Using discrete chlorophyll measurements on samples collected at nearby stations, fluorescence can be used to estimate chlorophyll *a*.

pH. -The pH measurements were made on discrete samples or are on-line measurements which have been corrected on the basis of calibration with discrete samples. As with oxygen samples, when pH samples were collected care was taken to eliminate all bubbles and the container was allowed to overflow. The sample was then placed in a constant-temperature bath and brought to within 1°C of the temperature of the buffer solution (usually 20 to 25°C). A combination electrode was used to determine the pH of the stirred sample within one hour of the sample collection. *In situ* pH is calculated as described in Strickland and Parsons (1972).

Total CO_2. - Water samples for ΣCO_2 analyses were collected in 125-mL amber glass bottles. Bottles were filled from the bottom, preserved with 0.2 mL saturated $HgCl_2$ solution, then refrigerated until analysis. Aliquots (approximately 1 mL) were injected into a gas-stripper cell, containing 0.5mL of 0.1M H_3PO_4 solution, in which evolved CO_2 is carried in the flow of nitrogen gas to a non-dispersive infrared analyzer and CO_2 peaks are related to standard solutions of Na_2CO_3. Computed areas for replicate injections of samples agreed within ±1 percent. The accuracy of the method is estimated to be ±2 to 3 percent of value.

Alkalinity. - Total alkalinity was determined by the pH method described by Culberson *et al* (1969). Samples were filtered using Gelman type A glass-fiber filters and stored up to 5 days before analysis. Precision of the analysis is ±0.02 meg/L.

Suspended Particulate Matter.- Gross suspended particulate material was estimated gravimetrically by filtering a known volume of water sample through a preweighed 0.45-μ silver filter. After drying in air for 2 to 4 weeks the filters were reweighed and concentrations calculated. The precision is 20 percent and is dependent on the mass of the filter cake.

Particulate Organic Carbon.- A modified Menzel and Vaccaro (1964) method was used to determine particulate organic carbon. Each sample was collected on a glass-fiber filter which has been prepared by being heated to 450°C. The sample was then wet oxidized in a sealed glass ampule using potassium persulfate. The CO_2 content of each ampule was determined using a Beckman model IR 215A infrared analyzer. Standard curves were prepared using sucrose solutions. The precision of the analysis is about 10 percent over a range of 5 to 800 uM/L (Schemel and Dedini, 1979b).

Chlorophyll a.- Discrete chlorophyll samples were analyzed according to Strickland and Parsons (1972). Calculations were based on the trichromatic equation recommended by SCOR-UNESCO Working Group 17 (1966). Precision of the analyses was ±10 percent, as calculated from replicates.

Extinction Coefficient.- Attenuation of incident radiation was determined while at anchor obtaining vertical profiles of water properties. Photosynthetically active radiation (400-700 nm) was determined using a Li Cor® 1925 quantum sensor. Quanta measurements were recorded at 6-7 depths over the photic zone. The resulting depth profile was fitted to an exponential curve. The exponential derivative of the log of light corresponds to the extinction coefficient of the water column.

DATA

Longitudinal, vertical, and single-station time-sequence data are presented in chronological order. Table 4 can be used as an index to the data.

ACKNOWLEDGMENTS

We thank the captain and the crew of the R/V *Aquarius* for their able assistance and cooperation in modifying and adapting the *Aquarius* to our requirements.

Our logistical and analytical problems would have been much greater without the laboratory space and cooperation given by the U.S. Coast Guard facility at Alexandria, Virginia.

Appreciation is also expressed for the logistical support provided by James P. Bennett and R. Edward Hickman.

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Figure 1. Hydrographic Sampling Stations

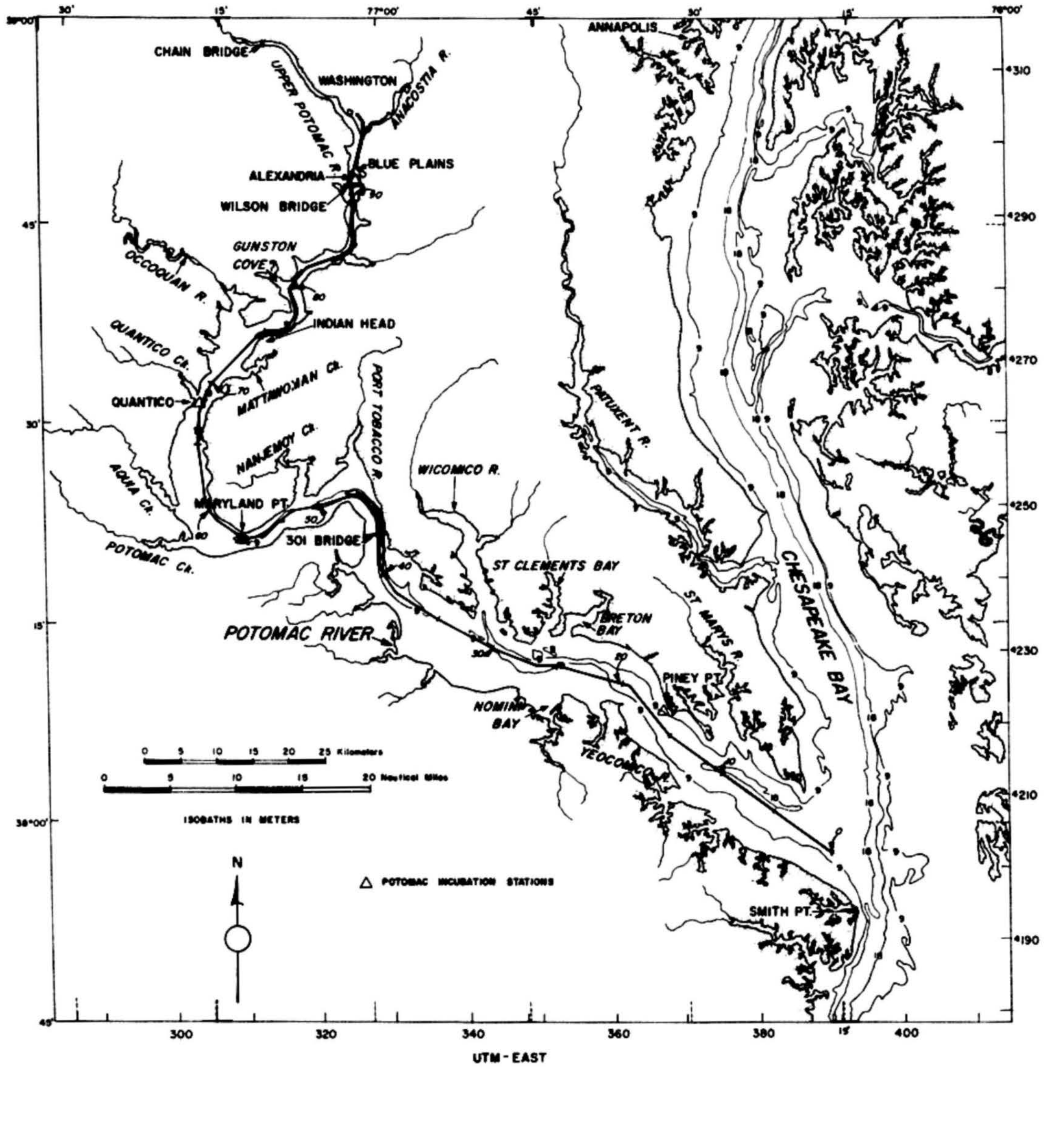

Table 1. Summary of analytical methods

Variable (ABBREVIATION)	Primary Reference or Manufacturer of Instrument	Units	Precision[1/]
Time		local	± min
Station (STA)			
River Mile (RIV MI)	NOAA Chart 12285	n mi	±0.01
Position (UTM-N & UTM-E)		UTM	±0.2 km
Depth	Gentran Inc.	meters	±0.2 m
Temperature (TEMP)	Yellow Springs Inst. Co.	deg C	±0.1 deg C
Salinity (SALIN)	W. Peterson (consultant)	ppt	0.05 °/oo
Dissolved oxygen (DIS OXY)	Carpenter (1965)	µg-at/L	±4
Dissolved oxygen (o2 PROB)	Schemel and Dedini, 1979a		±7 percent
Silicate (SiO_2)	Technicon Corporation (1976)	µM/L	3 percent over range 20 to 300
Orthophosphate (PO_4)	Atlas et al. (1971)	µM/L	3 percent over range 2 to 50
Total phosphate (TOTAL PHOSPH)	Armstrong et al. (1966)	µM/L	5 percent over range 2 to 100
Total dissolved phosphate (DISSOL PHOSPH)	Armstrong et al (1966)	µM/L	5 percent over range 2 to 100
Nitrate+nitrite (NO_3+NO_2)	Technicon Corporation (1973)	µM/L	3 percent over range 1 to 80
Nitrite (NO_2)	Technicon Corporation (1973)	µM/L	3 percent over range 1 to 50

1/ Where possible estimates of precision are based on splits of discrete samples

Table 1 - Cont'd.

Variable (ABBREVIATION)	Primary Reference or Manufacturer of Instrument	Units	Precision[1/]
Ammonia (NH_3)	Solorzano (1969)	µM/L	3 percent over range 5 to 100
Total nitrogen (TOTAL NITROG)	Armstrong et al. (1966)	µM/L	5 percent over range 1 to 200
Total dissolved nitrogen (DISSOL NITROG)	Armstrong et al. (1966)	µM/L	5 percent over range 1 to 200
Turbidity (TURB)	G. K. Turner Associates		5 percent
Chlorophyll-a (FLUOR)	G. K. Turner Associates		5 percent
Extinction coefficient (EXT COEFF)	LiCor Corporation		
Particulate organic carbon (POC)	Menzel and Vaccaro (1964)	µM/L	10 percent over range 5 to 250
Discrete chlorophyll (DIS CHL)	Strickland and Parsons (1972)		±10 percent
Alkalinity (ALKALIN)	Culberson et al. (1969)	meg/L	±0.02
pH	Strickland and Parsons (1972)		±0.005 units
Total CO2	Schemel (in prep.)		±1 percent
Suspended particulate matter (SPM)		mg/L	20 percent

[1/] Where possible estimates of precision are based on splits of discrete samples

Table 2. Locations of Hydrographic Stations

STA. #	RM[a/]	UTM Station N	UTM Station E	Sampling Area	N. Latitude		W. Longitude	
1		314.2	379.4	Chesapeake Bay	38°	58.2'	76°	23.5'
2		241.9	384.5	Chesapeake Bay	38	19.2	76	19.3
3		199.0	400.0	Chesapeake Bay	37	56.1	76	8.3
4	4.4*	207.8	382.1	Potomac River	38	0.7	76	20.6
5	12.5	213.2	366.8	Potomac River	38	3.5	76	31.1
6	11.9*	215.0	369.7	Potomac River	36	4.5	76	29.1
7	12.0	217.2	371.2	Potomac River	38	5.7	76	28.1
8	11.0	222.3	372.9	St. Marys River	38	8.5	76	27.0
9	11.0	227.3	373.9	St. Marys River	38	11.2	76	26.4
10	24.7	225.3	350.9	Potomac River	38	9.9	76	4?.1
11	24.9*	228.2	350.5	Potomac River	38	11.5	76	42.4
12	24.8	231.8	351.0	Potomac River	38	13.4	76	42.1
13	30.5	238.6	340.1	Wicomico River	38	17.0	76	49.7
14	32.4*	234.6	338.3	Potomac River	38	14.8	76	50.9
15	32.6	232.2	336.3	Potomac River	38	13.5	76	52.2
16	33.3	229.3	333.9	Potomac River	38	11.9	76	53.8
17	43.0*	246.7	326.0	Potomac River	38	21.3	76	59.4
18	47.4*	253.2	322.2	Potomac River	38	24.7	77	2.2
19	52.5	248.8	313.0	Potomac River	38	22.2	77	8.4
20	52.9*	249.6	312.6	Potomac River	38	22.6	77	8.7
21	56.3*	246.7	306.7	Potomac River	38	21.0	77	12.6
22	59.6	250.9	302.7	Potomac River	38	23.2	77	15.5
23	59.6*	251.0	299.5	Potomac River	38	23.2	77	17.7
24	62.9	256.7	301.9	Potomac River	38	26.7	77	16.4
25	63.8	256.7	386.4	Potomac River	38	27.2	77	18.1
26	67.8*	265.7	301.7	Potomac River	38	31.2	77	16.5
28	70.9	270.1	305.2	Potomac River	38	33.6	77	14.1
29	75.4*	275.3	311.2	Potomac River	38	36.5	77	10.1
30	78.0	277.8	315.2	Potomac River	38	37.9	77	7.4
31	81.0*	283.0	315.0	Potomac River	38	40.7	77	7.6
32	85.1*	286.0	321.8	Potomac River	38	42.4	77	2.9
33	89.5	293.4	323.3	Potomac River	38	46.2	77	2.0
34	91.8*	297.8	323.3	Potomac River	38	48.8	77	2.1
35	93.9*	301.5	324.4	Potomac River	38	50.8	77	1.4
36	95.4	303.5	325.7	Anacostia River	38	51.7	77	0.5
37	95.0*	303.2	323.9	Potomac River	38	51.9	77	1.8

a/ river mile

*/ Sampled this cruise

Table 3. Calculations

Sigma-t (Knudson, 1901; modified for salinity rather than chlorinity input)

$$\sigma_T = \Sigma_T + (\sigma_O + 0.1324)\ (1 - A_T + B_T\ [\sigma_O - 0.1324])$$

$$\sigma_O = -0.069 + 0.8141S - 0.0004811S^2 + 0.00000675S^3$$

$$\Sigma_T = \frac{-(T - 3.98)^2 (T + 283)}{503.57(T + 67.26)}$$

$$A_T = T(4.7867 - 0.098185T + 0.0010843T^2)10^{-3}$$

$$B_T = T(18.030 - 0.8164T + 0.01667T^2)10^{-6}$$

S = Salinity, $^o/oo$

T = Temperature, ^oC

Apparent oxygen utilization

$$AOU = O_2' - O_2$$

where oxygen saturation concentration (O_2') is calculated using the equation of Weiss (1970)

$$Ln(O_2') = A_1 + A_2\ (100/T) + A_3 Ln(T/100) + A_4(T/100) + S\ [B_1 + B_2(T/100) + B_3(T/100^2]$$

For O_2' in mL/L

T = absolute temperature

S = salinity

A_1 = -173.4292 B_1 = -0.033096

A_2 = 249.6339 B_2 = 0.014259

A_3 = 143.3483 B_3 = -0.0017000

A_4 = -21.8492

O_2' µg-at/L = O_2' mL/L (89.13)

Oxygen percent saturation

$$POS = O_2/O_2' \times 100\%$$

Table 4. Summary of sample collections

Date	Vessel	River Mile	Vertical	Station Range	(Anchor Sta) Name Time Series	Report Page No.
24 January 1978	*Aquarius*	95.4-31.3	Yes	-	-	1
25 January 1978	*Aquarius*	32.5-95.8	Yes	-	-	5
31 January 1978	*Aquarius*	94.6-6.0	No	-	-	9

APPENDIX A

LIST OF SCIENTIFIC PERSONNEL

	Primary Areas of Responsibility
Andrea E. Alpine	C-14, chlorophyll, light
Brian E. Cole	C-14, chlorophyll, light
T. John Conomos	Chief Scientist
Lee A. Dedini	Hydrographic data
Stephen W. Hager	Micronutrients
Dana D. Harmon	Micronutrients
Raynol E. Herndon	Data reduction
Anne Hutchinson	Dissolved oxygen, zooplankton
David H. Peterson	Chief Scientist
Laurence E. Schemel	Carbon, hydrographic data
Richard E. Smith	Data reduction, suspended particulate matter
Elliott C. Spiker	Carbon isotopes
Sally M. Wienke	Drafting

APPENDIX B

CONVERSION TABLE

	From	To	Factor
Dissolved oxygen	μg-at	mg(O)	0.016
Dissolved oxygen	μg-at	mL(O_2)	0.0112
Nitrate + nitrite	μM/L[1/]	mg/L(N)	0.0140
Nitrite	μM/L	mg/L(N)	0.0140
Ammonia	μM/L	mg/L(N)	0.0140
Phosphate	μM/L	mg/L(P)	0.0310
Silicate	μM/L	mg/L(Si)	0.0281
Carbon	μM/L	mg/L(C)	0.0120

[1/] For any element, 1 gram atom = 1 Mole = 10^6 microgram atoms (μg-at), and for elements which occur in a ratio of one atom per molecule, which is the case for the nutrients listed above, 1 μM = 1 μg-at.

For elements which occur as diatomic species, such as oxygen, 1 μM(O_2) = 2 μg-at(O).

APPENDIX C

DATA TABLES

U.S. GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

ESTUARINE STUDIES GROUP

DATE	JULIAN DATE	CRUISE #	LOCATION	VESSEL
24 JAN 78	78024	2	POTOMAC R	AQUARIUS

TIME	RIV MI n mi	UTM-N	UTM-E	DEPTH m	TEMP C	SALIN o/oo	SIG-T	DIS OXY ug-at/l	AOU ug-at/l	DIS OXY % SAT	O2 PROD	TURBID	EXT COEF	SPM mg/l	POC uM/l
750	95.4	304.3	323.2	1	0.0	0.1	0.0	978	-66	107	95	0.400	-	4.2	59
800	93.6	300.8	324.2	1	0.5	0.1	0.0	912	-13	101	81	0.430	-	-	-
810	91.6	297.3	323.3	1	0.5	0.0	0.0	901	0	100	84	0.500	-	11.2	59
820	89.9	293.9	323.1	1	0.5	0.1	0.0	880	18	97	82	0.490	-	-	-
830	87.4	289.7	323.0	1	0.2	0.1	0.0	857	49	94	82	0.590	-	16.0	69
840	85.3	286.0	322.3	1	0.2	0.1	0.0	857	49	94	82	0.620	-	-	-
850	83.2	284.8	318.5	1	0.1	0.1	0.0	848	61	93	80	0.820	-	25.2	-
900	80.1	281.3	315.2	1	0.0	0.1	0.0	843	68	92	82	-	-	-	-
910	78.3	278.0	322.4	1	0.0	0.0	0.0	848	63	93	81	1.012	-	43.0	100
920	76.6	275.8	313.5	1	0.0	0.1	0.0	829	82	90	83	0.949	-	-	-
930	74.8	275.0	310.3	1	0.0	0.0	0.0	855	56	93	81	1.013	-	39.0	103
940	72.9	273.0	307.6	1	0.0	0.1	0.0	858	53	94	83	1.044	-	-	-
950	71.3	270.7	304.1	1	0.0	0.0	0.0	864	47	94	83	1.139	-	43.0	124
1000	69.2	267.8	303.4	1	0.0	0.0	0.0	811	100	88	80	1.456	-	-	-
1010	67.0	264.3	301.9	1	0.0	0.0	0.0	825	86	90	79	1.867	-	75.2	171
1020	63.9	258.7	301.6	1	0.0	0.0	0.0	823	88	90	78	2.151	-	-	-
1030	62.3	255.8	301.8	1	0.0	0.0	0.0	823	89	90	80	2.215	-	84.0	173
1040	60.5	252.4	302.2	1	0.0	0.0	0.0	840	72	92	81	2.089	-	-	-
1050	58.9	249.8	303.3	1	0.0	0.0	0.0	826	86	90	83	1.709	-	-	-
1100	57.9	248.5	304.9	1	0.0	0.0	0.0	887	25	97	84	2.452	-	-	-
1110	55.8	247.1	308.0	1	0.0	0.1	0.0	853	58	93	86	1.551	-	63.5	158
1120	54.1	248.3	310.7	1	0.3	0.4	0.3	832	70	92	83	1.203	-	-	-
1130	51.2	251.2	315.3	1	0.2	0.8	0.6	830	72	92	82	0.823	-	35.0	-
1140	49.1	252.2	319.1	1	0.3	1.5	1.2	824	71	92	79	0.633	-	-	-
1150	47.3	252.5	322.3	1	0.3	2.0	1.6	829	62	92	81	0.690	-	98.0	-
1200	44.5	251.5	325.6	1	0.3	2.3	1.6	837	53	93	79	0.550	-	-	-
1210	43.1	247.0	326.1	1	0.4	2.7	2.1	830	55	93	80	0.440	-	17.2	53
1220	39.9	238.5	328.1	1	0.8	4.6	3.7	869	-4	100	84	0.240	-	-	-
1230	37.0	236.2	330.6	1	0.6	4.0	3.2	888	-15	101	83	0.240	-	8.0	58
1240	34.2	236.1	335.2	1	1.0	3.7	3.0	891	-26	103	83	0.240	-	-	-
1250	31.5	233.4	339.5	1	0.7	4.0	3.2	889	-18	102	84	0.220	-	7.8	79
1300	29.7	231.6	342.3	1	0.6	4.6	3.7	903	-33	103	83	0.170	-	-	-
1310	25.9	228.8	348.6	1	1.0	4.8	3.9	915	-56	106	83	0.150	-	-	-
1320	23.3	227.1	353.3	1	0.7	5.2	4.2	953	-89	110	83	0.120	-	-	-
1330	20.4	225.5	358.4	1	1.3	6.5	5.2	934	-92	110	80	0.111	-	-	-
1340	18.0	223.0	361.8	1	1.0	6.3	5.1	950	-100	111	80	0.101	-	4.7	93
1350	15.2	219.3	365.6	1	1.0	6.6	5.3	949	-100	111	75	0.101	-	-	-
1400	12.3	215.9	369.3	1	1.1	7.1	5.7	943	-100	111	71	0.098	-	3.6	-
1410	9.7	212.9	375.0	1	1.2	7.3	5.9	944	-104	112	70	0.092	-	-	-
1420	7.2	209.9	377.0	1	1.4	8.0	6.5	927	-96	111	68	0.082	-	3.2	-

\- DATA NOT AVAILABLE

DATE	JULIAN DATE	CRUISE #	LOCATION	VESSEL
24 JAN 78	78024	2	POTOMAC R	AQUARIUS

TIME	RIV MI n mi	SiO2 uM/l	PO4 uM/l	NO3+NO2 uM/l	NO2 uM/l	NH3 uM/l	TOTAL NITROG	DISSOL NITROG	TOTAL PHOSPH	DISSOL PHOSPH	FLUOR	DIS CHL ug/l	ALKALIN meq/l	TOT CO2 uM/l	pH
750	95.4	116	-	124.2	0.50	3.97	-	-	-	-	0.051	0.40	1.32	-	-
800	93.6	114	3.44	114.5	0.73	59.80	-	-	-	-	0.045	-	-	-	-
810	91.6	120	3.03	113.4	0.74	45.20	-	-	-	-	0.042	0.50	1.30	-	-
820	89.9	118	2.98	112.6	0.77	47.20	-	-	-	-	0.042	-	-	-	-
830	87.4	121	2.81	109.5	0.90	53.80	-	-	-	-	0.044	0.40	1.11	-	-
840	85.3	122	2.45	107.4	0.93	55.10	-	-	-	-	0.045	-	-	-	-
850	83.2	119	1.36	106.6	0.91	52.60	-	-	-	-	0.047	0.90	1.07	-	-
900	80.1	-	-	106.5	-	-	-	-	-	-	0.049	-	-	-	-
910	78.3	114	1.67	106.4	0.81	47.00	-	-	-	-	0.050	1.30	1.13	-	-
920	76.6	114	1.44	105.9	0.82	46.10	-	-	-	-	0.049	-	-	-	-
930	74.8	114	1.62	106.8	0.81	48.40	-	-	-	-	0.050	-	1.16	-	-
940	72.9	114	1.87	106.7	0.78	49.00	-	-	-	-	0.051	-	-	-	-
950	71.3	112	1.69	104.6	0.77	44.00	-	-	-	-	0.054	1.60	1.13	-	-
1000	69.2	108	1.55	100.0	0.67	39.20	-	-	-	-	0.058	-	-	-	-
1010	67.0	107	1.15	102.8	0.57	39.00	-	-	-	-	0.062	1.90	1.08	-	-
1020	63.9	106	1.57	105.4	0.70	41.20	-	-	-	-	0.064	-	-	-	-
1030	62.3	106	1.60	103.4	0.60	39.20	-	-	-	-	0.066	1.40	1.04	-	-
1040	60.5	111	1.38	105.0	0.47	42.90	-	-	-	-	0.064	-	-	-	-
1050	58.9	117	1.43	105.2	0.45	45.50	-	-	-	-	0.060	-	-	-	-
1100	57.9	118	2.60	106.9	0.89	44.30	-	-	-	-	0.066	-	-	-	-
1110	55.8	118	1.36	105.6	0.56	44.20	-	-	-	-	0.060	-	1.00	-	-
1120	54.1	118	1.41	103.2	0.52	44.00	-	-	-	-	0.057	1.90	-	-	-
1130	51.2	115	1.32	99.1	0.53	40.80	-	-	-	-	0.053	-	1.05	-	-
1140	49.1	111	1.32	93.9	0.53	36.50	-	-	-	-	0.052	-	-	-	-
1150	47.3	104	1.08	88.1	0.54	31.00	-	-	-	-	0.057	-	1.07	-	-
1200	44.5	104	1.13	88.0	0.58	30.00	-	-	-	-	0.059	-	-	-	-
1210	43.1	101	1.03	83.7	0.58	26.70	-	-	-	-	0.058	-	1.09	-	-
1220	39.9	86	0.48	69.3	0.53	13.80	-	-	-	-	0.026	-	-	-	-
1230	37.0	90	0.57	73.5	0.54	15.80	-	-	-	-	0.072	7.80	1.12	-	-
1240	34.2	92	0.59	75.0	0.52	16.70	-	-	-	-	0.054	-	-	-	-
1250	31.5	91	0.56	73.9	0.52	15.20	-	-	-	-	0.085	9.60	-	-	-
1300	29.7	86	0.38	69.1	0.50	11.60	-	-	-	-	0.074	-	-	-	-
1310	25.9	84	0.34	67.1	0.48	10.40	-	-	-	-	0.060	5.80	1.10	-	-
1320	23.3	79	0.01	63.5	0.47	5.67	-	-	-	-	0.101	-	-	-	-
1330	20.4	72	0.00	55.0	0.47	2.73	-	-	-	-	0.066	-	-	-	-
1340	18.0	78	0.01	52.2	0.47	1.97	-	-	-	-	0.076	-	1.14	-	-
1350	15.2	71	0.00	53.5	0.47	1.59	-	-	-	-	0.066	-	-	-	-
1400	12.3	67	0.03	49.4	0.43	0.30	-	-	-	-	0.073	-	1.13	-	-
1410	9.7	65	0.04	46.8	0.45	0.16	-	-	-	-	0.058	5.80	-	-	-
1420	7.2	62	0.03	43.8	0.44	0.26	-	-	-	-	0.052	-	-	-	-

- DATA NOT AVAILABLE

DATE	JULIAN DATE	CRUISE #	LOCATION	VESSEL
24 JAN 78	78024	2	POTOMAC R	AQUARIUS

TIME	RIV MI n mi	UTM-N	UTM-E	DEPTH m	TEMP C	SALIN o/oo	SIG-T	DIS OXY ug-at/l	AOU ug-at/l	DIS OXY % SAT	O2 PROD	TURBID	EXT COEF	SPM mg/l	POC uM/l
1430	4.3	206.8	381.3	1	1.1	8.5	6.9	926	-90	110	68	0.079	-	-	-
1441	4.0	206.8	381.8	0	1.4	8.5	6.9	927	-98	111	69	0.054	-	-	-
1445	4.0	206.8	381.8	2	1.1	9.4	7.6	934	-103	112	69	0.051	0.68	5.0	113
1452	4.0	206.8	381.8	5	1.3	10.0	8.0	906	-83	110	69	0.056	-	-	-
1457	4.0	206.8	381.8	12	1.4	10.5	8.4	848	-30	103	65	0.056	-	-	-
1515	7.0	208.0	377.2	1	1.1	8.7	7.1	914	-80	109	73	0.082	-	-	-
1525	9.6	212.7	373.5	1	1.3	7.6	6.2	938	-102	112	74	0.092	-	-	-
1540	12.0	215.2	369.8	0	1.5	7.4	6.0	944	-112	113	73	0.060	-	-	-
1545	12.0	215.2	369.8	2	1.3	7.6	6.1	-	-	-	76	0.063	-	4.2	99
1547	12.0	215.2	369.8	2	1.5	7.5	6.1	953	-121	114	76	0.063	0.91	-	74
1554	12.0	215.2	369.8	5	1.2	9.3	7.5	906	-78	109	66	0.063	-	-	-
1558	12.0	215.2	369.8	10	1.4	10.7	8.7	873	-57	107	65	0.054	-	-	-
1602	12.0	215.2	369.8	15	1.5	11.1	9.0	851	-39	104	63	0.055	-	5.2	104
1652	18.5	223.8	361.3	1	0.8	6.5	5.3	965	-111	113	79	0.111	-	-	-
1720	25.0	228.1	350.2	0	1.4	5.6	4.5	966	-121	114	78	0.095	-	-	-
1724	25.0	228.1	350.2	2	1.3	5.6	4.6	969	-122	114	80	0.098	1.17	5.4	85
1731	25.0	228.1	350.2	7	1.7	10.9	8.8	801	7	99	58	0.082	-	-	-
1803	31.3	232.5	339.7	1	0.7	4.2	3.4	958	-88	110	76	0.171	-	-	-

- DATA NOT AVAILABLE

U.S. GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

ESTUARINE STUDIES GROUP

DATE	JULIAN DATE	CRUISE #	LOCATION	VESSEL
24 JAN 78	78024	2	POTOMAC R	AQUARIUS

TIME	RIV MI n mi	SiO2 uM/1	PO4 uM/1	NO3+NO2 uM/1	NO2 uM/1	NH3 uM/1	TOTAL NITROG	DISSOL NITROG	TOTAL PHOSPH	DISSOL PHOSPH	FLUOR	DIS CHL ug/1	ALKALIN meq/1	TOT CO2 mM/1	pH
1430	4.3	58	0.00	38.4	0.45	0.00	-	-	-	-	0.063	-	-	-	-
1441	4.0	58	0.25	38.1	0.49	0.29	-	-	-	-	0.070	-	-	-	8.52
1445	4.0	52	0.25	32.2	0.50	0.15	54.6	44.2	0.73	0.25	0.117	17.90	1.22	-	8.56
1452	4.0	50	0.03	27.4	0.49	0.03	-	-	-	-	0.170	-	-	-	8.54
1457	4.0	47	0.00	28.2	0.56	0.06	-	-	-	-	0.139	-	-	-	8.35
1515	7.0	56	0.00	39.3	0.60	0.12	-	-	-	-	0.066	-	-	-	-
1525	9.6	64	0.00	46.0	0.47	0.24	-	-	-	-	0.061	-	-	-	-
1540	12.0	65	0.00	47.0	0.53	0.14	-	-	-	-	0.085	-	-	-	8.57
1545	12.0	-	-	-	-	-	-	-	-	-	0.104	-	1.16	-	8.61
1547	12.0	63	0.22	44.4	0.45	0.21	65.7	59.2	0.74	0.27	0.114	12.50	-	-	8.53
1554	12.0	54	0.02	31.9	0.41	0.06	-	-	-	-	0.180	-	-	-	8.42
1558	12.0	45	0.00	27.2	0.47	0.06	-	-	-	-	0.133	-	-	-	8.38
1602	12.0	44	0.18	24.4	0.52	0.24	50.3	38.7	0.75	0.26	0.139	-	1.22	-	-
1652	18.5	71	0.00	53.6	0.47	1.85	-	-	-	-	0.142	-	-	-	-
1720	25.0	77	0.04	60.1	0.49	4.80	-	-	-	-	0.158	-	-	-	8.54
1724	25.0	77	0.03	60.0	0.49	4.70	85.8	72.0	1.05	0.40	0.155	15.50	1.10	-	8.57
1731	25.0	46	0.03	27.1	0.51	0.13	-	-	-	-	0.241	-	-	-	8.22
1803	31.3	87	0.37	60.9	0.51	-	-	-	-	-	0.240	-	-	-	-

- DATA NOT AVAILABLE

DATE	JULIAN DATE	CRUISE #	LOCATION	VESSEL
25 JAN 78	78025	2	POTOMAC R	AQUARIUS

TIME	RIV MI n mi	UTM-N	UTM-E	DEPTH m	TEMP C	SALIN o/oo	SIG-T	DIS OXY ug-at/l	AOU ug-at/l	DIS OXY % SAT	O2 PROD	TURBID	EXT COEF	SPM mg/l	POC uM/l
735	32.5	233.7	337.0	0	0.7	3.9	3.1	906	-35	104	88	0.220	-	-	-
744	32.5	233.7	337.0	2	0.8	4.6	3.7	906	-41	104	83	0.210	1.09	6.8	125
750	32.5	233.7	337.0	6	1.6	9.7	7.8	762	55	93	61	0.139	-	4.4	79
831	37.4	239.2	330.5	1	0.8	3.9	3.2	875	-6	100	69	0.260	-	-	-
855	42.9	246.7	326.1	0	1.0	3.8	3.1	836	28	96	75	0.350	-	-	-
859	42.9	246.7	326.1	2	1.0	4.3	3.5	808	3	99	76	0.310	1.37	10.0	89
905	42.9	246.7	326.1	5	1.2	5.0	4.1	835	17	97	72	0.280	-	-	-
909	42.9	246.7	326.1	11	1.1	6.1	4.9	806	42	94	68	0.450	-	-	137
929	43.5	247.8	326.0	1	0.9	3.8	3.1	-	-	-	73	0.290	-	-	-
949	47.1	253.0	322.6	0	0.6	2.8	2.2	809	71	91	75	0.510	-	-	-
953	47.1	253.0	322.6	2	0.7	2.8	2.3	806	71	91	75	0.520	1.98	19.5	61
959	47.1	253.0	322.6	5	0.9	4.0	3.2	799	66	92	74	0.460	-	-	-
1004	47.1	253.0	322.6	12	1.1	5.3	4.3	792	61	92	72	0.440	-	55.6	173
1025	50.0	251.7	317.5	1	0.4	2.0	1.6	808	81	90	78	0.640	-	-	-
1045	53.0	249.8	312.3	0	0.5	1.1	0.9	810	82	90	81	0.820	-	-	-
1049	53.0	249.8	312.3	2	0.5	1.2	0.9	804	80	90	80	0.820	2.87	30.8	88
1054	53.0	249.8	312.3	6	0.6	2.1	1.7	803	81	90	78	1.035	-	-	-
1121	56.5	247.1	306.7	0	0.4	0.3	0.2	817	83	90	84	1.772	-	-	-
1125	56.5	247.1	306.7	2	0.4	0.3	0.2	817	83	90	83	1.772	6.37	93.3	245
1132	56.5	247.1	306.7	5	0.4	0.2	0.2	816	84	90	84	2.152	-	-	-
1147	59.5	250.9	302.8	1	0.1	0.0	0.0	809	100	88	84	2.025	-	-	-
1209	63.0	253.2	301.5	0	0.4	0.0	0.0	815	86	90	83	2.152	-	-	-
1213	63.0	253.2	301.5	2	0.4	0.0	0.0	815	86	90	83	2.215	8.31	98.0	234
1218	63.0	253.2	301.5	4	0.4	0.0	0.0	814	87	90	82	2.247	-	-	-
1252	68.0	265.9	302.2	0	0.5	0.0	0.0	806	93	89	80	1.456	-	-	-
1255	68.0	265.9	302.2	2	0.5	0.0	0.0	808	91	89	80	1.519	4.74	66.5	169
1259	68.0	265.9	302.2	5	0.5	0.0	0.0	807	92	89	79	1.551	-	-	-
1332	71.5	271.0	306.0	1	0.0	0.1	0.0	815	96	89	75	1.076	-	-	-
1358	75.1	275.4	310.6	0	0.6	0.1	0.0	817	79	91	74	0.823	-	-	-
1401	75.1	275.4	310.6	2	0.5	0.1	0.0	815	83	90	74	0.949	2.89	39.6	118
1407	75.1	275.4	310.6	5	0.5	0.1	0.0	816	82	90	74	0.901	-	-	-
1411	75.1	275.4	310.6	10	0.6	0.1	0.0	817	79	91	75	0.981	-	-	-
1451	81.0	283.0	315.1	0	0.8	0.1	0.1	826	65	92	74	0.560	-	-	-
1455	81.0	283.0	315.1	2	0.8	0.1	0.1	826	65	92	74	0.560	2.21	18.8	69
1458	81.0	283.0	315.1	5	0.8	0.1	0.1	829	62	93	75	0.640	-	-	-
1501	81.0	283.0	315.1	12	0.8	0.1	0.1	828	63	92	75	0.700	-	-	-
1529	85.0	285.6	321.7	0	1.4	0.1	0.1	840	36	95	75	0.400	-	-	-
1531	85.0	285.6	321.7	2	1.4	0.1	0.1	838	38	95	75	0.410	1.71	13.2	71
1535	85.0	285.6	321.7	5	1.4	0.1	0.1	838	38	95	75	0.410	-	-	-
1539	85.0	285.6	321.7	10	1.4	0.1	0.1	840	36	95	73	0.410	-	-	-

- DATA NOT AVAILABLE

DATE	JULIAN DATE	CRUISE #	LOCATION	VESSEL
25 JAN 78	78025	2	POTOMAC R	AQUARIUS

TIME	RIV MI n mi	SiO2 uM/l	PO4 uM/l	NO3+NO2 uM/l	NO2 uM/l	NH3 uM/l	TOTAL NITROG	DISSOL NITROG	TOTAL PHOSPH	DISSOL PHOSPH	FLUOR	DIS CHL ug/l	ALKALIN meq/l	TOT CO2 uM/l	pH
735	32.5	90	0.46	72.6	0.73	13.90	-	-	-	-	0.111	-	-	-	8.24
744	32.5	85	0.64	60.8	0.57	11.10	98.0	74.4	1.52	0.48	0.152	23.70	1.10	-	8.30
750	32.5	52	0.44	30.0	0.36	0.62	59.8	48.2	1.15	0.59	0.152	-	1.22	-	8.11
831	37.4	90	0.81	73.1	0.44	15.80	-	-	-	-	0.130	-	-	-	-
855	42.9	121	-	105.4	0.68	56.00	-	-	-	-	0.089	-	-	-	8.01
859	42.9	88	0.58	69.8	0.44	15.00	-	-	-	-	0.107	10.70	1.10	-	8.11
905	42.9	83	0.49	63.9	0.37	11.90	-	-	-	-	0.101	-	-	-	8.08
909	42.9	75	0.43	56.9	0.40	8.58	-	-	-	-	0.089	-	-	-	8.05
929	43.5	-	-	-	-	-	-	-	-	-	0.089	-	-	-	-
949	47.1	99	1.15	80.6	0.47	26.30	-	-	-	-	0.065	-	-	-	7.81
953	47.1	98	1.08	80.0	0.47	26.00	126.7	121.3	2.20	1.33	0.063	3.00	1.08	-	7.84
959	47.1	90	0.49	72.3	0.34	19.20	-	-	-	-	0.072	-	-	-	7.89
1004	47.1	82	0.67	63.8	0.40	13.60	84.7	85.4	3.56	0.92	0.084	-	1.11	-	7.93
1025	50.0	105	1.29	86.1	0.48	31.30	-	-	-	-	0.062	-	-	-	-
1045	53.0	112	1.46	92.7	0.49	37.20	-	-	-	-	0.059	-	-	-	7.79
1049	53.0	112	1.32	92.3	0.55	36.80	137.6	133.3	3.05	1.75	0.060	1.30	1.04	-	7.77
1054	53.0	104	0.82	86.9	0.37	31.20	-	-	-	-	0.073	-	-	-	7.78
1121	56.5	116	1.32	100.7	0.39	42.00	-	-	-	-	0.067	-	-	-	7.62
1125	56.5	116	1.13	100.9	0.36	42.00	154.6	145.0	3.15	1.85	0.068	1.90	0.99	-	7.75
1132	56.5	117	1.25	101.5	0.45	42.10	-	-	-	-	0.071	-	-	-	7.75
1147	59.5	112	1.55	101.6	0.41	42.50	-	-	-	-	0.068	-	-	-	-
1209	63.0	107	1.96	102.1	0.63	39.60	-	-	-	-	0.069	-	-	-	7.69
1213	63.0	108	1.98	102.6	0.74	39.90	168.3	147.8	3.37	2.16	0.070	1.20	1.67	-	7.70
1218	63.0	108	1.75	102.0	0.69	38.90	-	-	-	-	0.070	-	-	-	7.69
1252	68.0	109	1.96	101.4	0.67	40.60	-	-	-	-	0.063	-	-	-	7.62
1255	68.0	109	1.72	101.4	0.67	40.50	155.0	146.9	3.41	2.27	0.064	1.10	1.05	-	7.63
1259	68.0	109	1.84	101.1	0.67	41.30	-	-	-	-	0.064	-	-	-	7.64
1332	71.5	113	2.41	102.7	0.68	46.30	-	-	-	-	0.058	-	-	-	-
1358	75.1	116	1.72	100.1	0.66	51.60	-	-	-	-	0.054	-	-	-	7.61
1401	75.1	116	1.80	102.6	0.72	49.90	153.7	149.6	1.02	2.07	0.055	1.60	0.98	-	7.62
1407	75.1	116	1.81	103.0	0.80	49.80	-	-	-	-	0.056	-	-	-	7.61
1411	75.1	116	1.92	102.6	0.79	49.70	-	-	-	-	0.056	-	-	-	7.62
1451	81.0	120	2.07	107.4	0.77	54.90	-	-	-	-	0.049	-	-	-	7.62
1455	81.0	120	2.05	107.2	0.74	54.80	-	-	-	-	0.049	1.10	1.04	-	7.64
1458	81.0	120	2.05	106.6	0.74	54.50	-	-	-	-	0.051	-	-	-	7.65
1501	81.0	91	0.98	75.3	0.50	17.70	-	-	-	-	0.052	-	-	-	7.65
1529	85.0	122	3.65	108.6	0.73	66.30	-	-	-	-	0.047	-	-	-	7.69
1531	85.0	121	3.58	108.8	0.73	65.60	179.5	175.0	4.82	3.77	0.046	0.50	1.18	-	7.71
1535	85.0	122	3.70	108.9	0.75	66.00	-	-	-	-	0.047	-	-	-	7.71
1539	85.0	122	3.99	108.9	0.78	65.90	-	-	-	-	0.046	-	-	-	7.71

- DATA NOT AVAILABLE

DATE	JULIAN DATE	CRUISE #	LOCATION	VESSEL
25 JAN 78	78025	2	POTOMAC R	AQUARIUS

TIME	RIV MI n mi	UTM-N	UTM-E	DEPTH m	TEMP C	SALIN o/oo	SIG-T	DIS OXY ug-at/l	AOU ug-at/l	DIS OXY % SAT	O2 PROB	TURBID	EXT COEF	SPM mg/l	POC uM/l
1544	85.0	285.6	321.7	13	1.4	0.1	0.1	840	36	95	74	0.440	-	16.8	66
1619	90.1	294.3	323.2	0	0.9	0.1	0.0	907	-18	102	77	0.020	-	-	-
1624	90.1	294.3	323.2	2	0.9	0.1	0.0	906	-17	101	78	0.290	1.38	8.8	33
1657	91.9	297.8	323.3	0	0.7	0.1	0.0	910	-16	101	82	0.240	-	-	-
1701	91.9	297.8	323.3	2	0.8	0.1	0.1	907	-15	101	82	0.260	1.40	8.0	35
1705	91.9	297.8	323.3	5	1.0	0.1	0.1	901	-14	101	82	0.270	-	-	-
1723	94.0	301.7	324.4	0	0.4	0.1	0.0	923	-21	102	80	0.210	-	-	-
1726	94.0	301.7	324.4	2	0.4	0.1	0.0	917	-15	101	80	0.250	-	6.2	25
1747	95.4	304.1	323.4	0	0.2	0.0	0.0	937	-30	103	84	0.220	-	-	-
1750	95.4	304.1	323.4	2	0.2	0.1	0.0	937	-30	103	86	0.250	-	10.4	66
1824	95.8	304.0	326.8	0	2.6	0.4	0.3	764	82	90	79	1.994	-	-	-
1827	95.8	304.0	326.8	2	3.0	0.4	0.4	730	107	87	77	1.772	-	69.3	201
1830	95.8	304.0	326.8	4	3.2	0.4	0.4	726	107	87	76	1.392	-	-	-

- DATA NOT AVAILABLE

DATE	JULIAN DATE	CRUISE #	LOCATION	VESSEL
25 JAN 78	78025	2	POTOMAC R	AQUARIUS

TIME	RIV MI n mi	SiO2 uM/l	PO4 uM/l	NO3+NO2 uM/l	NO2 uM/l	NH3 uM/l	TOTAL NITROG	DISSOL NITROG	TOTAL PHOSPH	DISSOL PHOSPH	FLUOR	DIS CHL ug/l	ALKALIN meq/l	TOT CO2 mM/l	pH
1544	85.0	122	3.54	109.7	0.78	66.40	180.5	176.7	4.83	3.40	0.044	-	-	-	7.71
1619	90.1	115	1.50	121.0	0.67	16.30	-	-	-	-	0.045	-	-	-	7.91
1624	90.1	115	1.43	120.9	0.73	16.00	146.7	144.8	1.99	1.60	0.045	0.20	1.25	-	7.94
1657	91.9	112	1.16	121.7	0.71	9.34	-	-	-	-	0.044	-	-	-	7.97
1701	91.9	113	1.49	121.8	0.72	15.00	-	-	-	-	0.044	0.30	1.29	-	7.96
1705	91.9	114	1.80	121.8	0.72	23.60	-	-	-	-	0.044	-	-	-	7.94
1723	94.0	111	1.09	123.1	0.61	4.98	-	-	-	-	0.043	-	-	-	8.09
1726	94.0	111	1.05	122.4	0.64	5.47	136.5	136.4	1.41	1.06	0.044	0.30	1.30	-	8.02
1747	95.4	110	1.17	127.2	0.61	4.16	-	-	-	-	0.044	-	-	-	8.15
1750	95.4	110	1.26	126.9	0.66	4.76	-	-	-	-	0.044	0.80	1.35	-	-
1824	95.8	100	1.39	102.6	2.25	22.60	-	-	-	-	0.060	-	-	-	7.18
1827	95.8	107	1.45	103.2	2.24	27.00	141.0	140.6	1.50	1.16	0.059	0.50	-	-	7.21
1830	95.8	111	1.79	103.9	2.34	30.00	-	-	-	-	0.057	-	-	-	7.21

- DATA NOT AVAILABLE

DATE	JULIAN DATE	CRUISE #	LOCATION	VESSEL
31 JAN 78	78031	2	POTOMAC R	AQUARIUS

TIME	RIV MI n mi	UTM-N	UTM-E	DEPTH m	TEMP C	SALIN o/oo	SIG-T	DIS OXY ug-at/l	AOU ug-at/l	DIS OXY % SAT	O2 PROD	TURBID	EXT COEF	SPM mg/l	POC uM/l
1114	94.6	302.8	324.7	1	0.0	0.0	0.0	-	-	-	99	2.531	-	54.5	147
1148	88.6	291.7	323.3	1	0.0	0.0	0.0	999	-86	109	98	2.531	-	69.5	124
1211	85.4	286.4	322.2	1	0.0	0.0	0.0	975	-62	106	94	2.215	-	-	315
1319	79.9	281.4	314.4	1	0.0	0.0	0.0	961	-48	105	96	2.531	-	89.0	225
1455	65.1	260.8	301.5	1	0.0	0.0	0.0	899	12	98	87	2.468	-	77.3	259
1510	62.2	255.6	301.8	1	0.0	0.0	0.0	908	4	99	87	2.531	-	-	-
1525	59.5	250.7	302.7	1	0.0	0.0	0.0	898	14	98	85	2.700	-	107.0	-
1553	55.1	247.3	309.2	1	0.0	0.0	0.0	884	28	96	85	2.600	-	-	-
1608	52.6	250.3	312.8	1	0.0	0.0	0.0	870	42	95	84	2.700	-	-	304
1615	51.1	251.4	315.4	1	0.0	0.0	0.0	859	53	94	82	3.000	-	-	-
1630	46.7	252.7	322.9	1	0.0	0.2	0.1	838	72	91	77	2.400	-	104.0	276
1640	43.6	248.0	326.0	1	0.0	0.6	0.4	830	70	92	77	2.200	-	-	-
1655	40.7	242.4	326.6	1	0.0	1.3	1.0	839	65	92	79	1.300	-	43.5	118
1710	35.8	236.9	332.5	1	0.0	1.3	1.0	850	54	94	80	1.076	-	-	-
1725	31.2	232.9	340.0	1	0.0	2.7	2.1	866	29	96	80	0.791	-	23.5	86
1735	28.1	230.2	344.9	1	0.0	4.3	3.4	876	9	98	79	0.506	-	-	99
1746	25.1	228.3	350.2	1	0.0	5.3	4.3	866	13	98	77	0.400	-	10.0	-
1800	20.6	225.5	358.2	1	0.0	3.5	2.8	886	4	99	80	0.590	-	-	-
1810	17.6	222.9	362.9	1	0.0	6.0	4.8	885	-9	101	79	0.340	-	10.0	102
1820	14.4	219.6	367.5	1	0.0	8.5	6.9	888	-27	103	76	0.220	-	-	-
1830	11.4	216.2	371.8	1	0.0	9.4	7.6	878	-22	102	74	0.220	-	4.7	-
1840	8.5	213.4	376.4	1	0.0	10.1	8.1	871	-19	102	74	0.210	-	-	-
1850	6.0	211.3	380.5	1	0.0	10.5	8.4	889	-39	104	75	0.600	-	5.8	140

- DATA NOT AVAILABLE

DATE	JULIAN DATE	CRUISE #	LOCATION	VESSEL
31 JAN 78	78031	2	POTOMAC R	AQUARIUS

TIME	RIV MI n mi	SiO2 uM/l	PO4 uM/l	NO3+NO2 uM/l	NO2 uM/l	NH3 uM/l	TOTAL NITROG	DISSOL NITROG	TOTAL PHOSPH	DISSOL PHOSPH	FLUOR	DIS CHL ug/l	ALKALIN meq/l	TOT CO2 mM/l	pH
1114	94.6	100	0.83	96.7	0.52	7.49	-	-	-	-	0.065	-	0.76	0.84	7.93
1140	88.6	99	0.89	89.0	0.49	25.80	-	-	-	-	0.062	1.90	0.74	0.86	7.72
1211	85.4	96	1.21	86.4	0.48	18.00	-	-	-	-	0.067	0.60	0.70	-	7.75
1319	79.9	90	0.97	80.1	0.53	17.20	-	-	-	-	0.062	3.80	0.70	-	-
1455	65.1	77	0.82	73.2	0.11	24.80	-	-	-	-	0.079	5.30	0.76	0.88	-
1510	62.2	77	0.78	75.4	0.51	25.30	-	-	-	-	0.082	-	-	-	7.86
1525	59.5	75	0.74	77.1	0.53	24.70	-	-	-	-	0.082	6.90	0.75	0.89	7.79
1553	55.1	72	0.79	76.8	0.70	23.80	-	-	-	-	0.076	5.80	-	-	7.67
1600	52.6	73	0.79	75.3	0.62	23.20	-	-	-	-	0.076	4.80	-	-	7.62
1615	51.1	76	0.76	75.2	0.61	23.70	-	-	-	-	0.076	-	-	-	7.60
1630	46.7	98	0.96	82.3	0.65	29.40	-	-	-	-	0.070	3.20	0.65	-	7.68
1640	43.6	101	1.24	87.2	0.61	34.60	-	-	-	-	0.063	-	-	-	7.78
1655	40.7	104	1.46	86.6	0.61	34.90	-	-	-	-	0.063	4.80	0.92	0.99	7.87
1710	35.8	105	1.46	89.2	0.70	36.60	-	-	-	-	0.062	-	-	-	7.92
1725	31.2	95	1.06	81.5	0.50	27.10	-	-	-	-	0.086	6.40	-	1.04	8.02
1735	28.1	86	0.57	70.3	0.52	18.30	-	-	-	-	0.123	13.30	-	1.04	8.09
1746	25.1	80	0.40	65.0	0.52	14.30	-	-	-	-	0.149	14.60	-	1.07	8.17
1800	20.6	92	0.59	77.0	0.54	21.30	-	-	-	-	0.111	10.30	-	-	8.11
1810	17.6	76	0.43	60.8	0.48	10.80	-	-	-	-	0.165	14.10	-	1.12	8.30
1820	14.4	59	0.14	40.9	0.45	1.02	-	-	-	-	0.196	-	-	1.10	8.40
1830	11.4	53	0.10	34.7	0.44	0.16	-	-	-	-	0.203	23.10	1.17	-	8.45
1840	8.5	49	0.26	31.7	0.47	0.18	-	-	-	-	0.193	-	-	-	8.45
1850	6.0	47	0.18	30.5	0.53	0.12	-	-	-	-	0.206	18.30	1.20	1.14	8.44

- DATA NOT AVAILABLE