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A chemical and biological survey of the lower Potomac River in the vicinity of Piney Point, Maryland

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FINAL REPORT

A Chemical and Biological Survey of the Lower Potomac River in the Vicinity of Piney Point, Maryland

Submitted to

Steuart Petroleum Company

by

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Biological Survey

Introduction

This report presents the results of a survey of benthic organisms in the lower Potomac River estuary in the vicinity of Steuart Petroleum Company's facilities at Piney Point, Maryland (Fig. 1). This survey was conducted to provide baseline data for the assessment of impact of the expansion of pier facilities at Steuart Petroleum. The environmental impact assessment is being made by Enviro Plan, Inc.

Methods

On 11 and 12 February 1975, triplicate sediment samples obtained with a 0.05 m^2 Ponar grab were collected at each of 15 stations designated by Enviro Plan, Inc. (Fig. 1). The contents of the grab were preserved in a formalin solution and returned to the laboratory where they were sieved through a 0.5 mm sieve. The material remaining on the sieve was preserved in formalin containing a stain, phloxine B, to assist in sorting. The contents of the sieved samples were carefully examined under a dissecting microscope and all animals removed and preserved in 70% ethanol. They were subsequently identified and enumerated.

Preliminary analysis of species diversity was performed. Diversity measures computed include Shannon's formula, $H' = -\sum p_i \log_2 p_i$, where the p_i's are the proportion of the i-th individual in the collection; a species richness measure S-1/lnN, where s is the number of species and N the number of individuals in the collection and species evenness, $J' = H'/\log_2 S$. These were computed on the pooled replicates at each station.

Results

A summary of the results is presented in Table 1. A total of 52 species and 27,249 individuals was collected at the 15 stations. Included were 16 species of polychaetes, 8 bivalves, 6 gastropods and 15 crustaceans.

The characteristic abundant species were polychaetous annelids; however juvenile bivalves belonging to the species Mulinia lateralis, Macoma balthica, and M. mitchelli were very abundant at all stations (Tables 1 and 2). The polychaetes Paraprionospio pinnata, Scolecolepides viridis, Pectinaria gouldii, Streblospio benedicti, Glycinde solitaria, Nereis succinea and Eteone heteropoda were wide-spread dominant species predominantly represented by mature individuals. The opisthobranch gastropods Acteocina canaliculata and Acteon punctostriatus were likewise ubiquitous and abundant. Juvenile bivalves were generally about 1 mm or less in length and their populations represent recent heavy set. Such dense populations of juvenile molluscs usually experience heavy mortality during spring and early summer.

Six of the stations 3, 7, 11, 17, A and L were located on inshore sandy sediments and the remainder on deeper muddy bottoms. However, little differences in the faunal assemblages are apparent between these two sediment types. Only the polychaete Heteromastus filiformis and the oligochaete Peloscolex gabriellae showed a distinct preference for one habitat over the other; both were more abundant in sand. The bivalve Mulinia lateralis seemed to be slightly more abundant in mud.

The composition of the benthic fauna of the lower Potomac River estuary is similar to other regions of the Chesapeake Bay system experiencing similar salinity conditions (mesohaline). No evidence of gross environmental alteration is apparent.

The mean faunal density is quite high (over 12,000/m^2) in comparison to existing data owing in part to the small screen size used and the dense populations of very young bivalves. If Mulinia are excluded the mean density is only 3,738/m^2. Biomass was likewise strongly dependent on the presence or absence of large numbers of a few species, in this case Nereis succinea, Paraprionospio pinnata and a few large (10-20 mm) bivalves.

The informational diversity as expressed by Shannon's formula is lower than that usually found for benthic infauna of the mesohaline zone (Boesch, 1972). However this is due to the influence on the index of the large numbers of juvenile bivalves, particularly *Mulinia*, which reduce the evenness (Table 1), and thus the diversity of the assemblages. The species richness expressed as the number of species per 0.15 m^2 or the S-1/lnN index is within the range usually found under these salinity conditions.

Literature Cited

Boesch, D. F. 1972. Species diversity of marine macrobenthos in the Virginia area. Ches. Sci. 13:206-211.

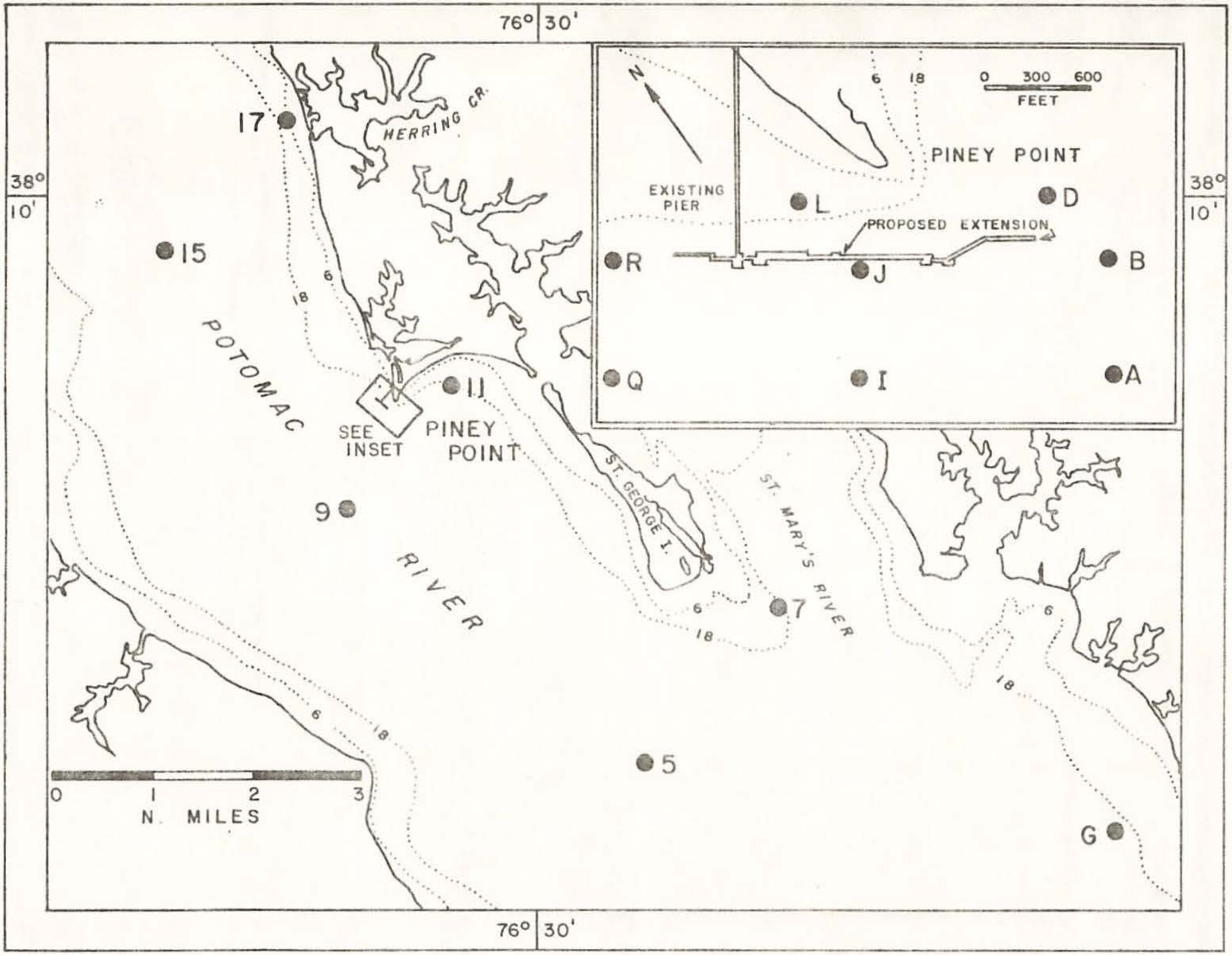

Figure 1. Location of benthic sampling stations in the vicinity of Piney Point, lower Potomac River estuary. Isobaths of 6 and 18 feet are indicated.

Table 1. Benthic data summary from the 15 Piney Point stations. For each station are given the total number of each species in three 0.05 m^2 grabs and the total number of species, number of individuals, species diversity, evenness, richness, and biomass.

TAXON	STATION 3	5	7	9	11	15	17	A	B	D	I	J	L	Q	R
CNIDARIA															
Diadumene leucolena					7										
PLATYHELMINTHES															
Euplana gracilis					1										
Stylochus ellipticus					14										
RHYNCHOCOELA															
Nemertean (unident.)	5	2	2		3	4	6	4	2	2	2	2	3	4	4
OLIGOCHAETA															
Peloscolex gabriellae	4	1			35	1	26			18		2	11		56
POLYCHAETA															
Asabellides oculata		1													
Eteone heteropoda		13	15	5	16	30	12		10	10	4	11	1	7	99
Glycera dibranchiata							1								
Glycinde solitaria	20	23	1	4	40	39	38	19	10	19	17	1	12	20	29
Heteromastus filiformis	5	6	1		23	1	28			1	1	1	6		13
Laeonereis culveri													6		4
Loimia medusa					1										
Microphthalmus sczelkowii													1		
Nereis succinea		21	3	2	62	68	22	11	18	4	11	67	16	30	66
Paraprionospio pinnata	8	49	2	9	150	82	15	36	12	30	20	2	2	13	21
Pectinaria gouldii	5	21	2		3	11	18	7	4	3	6	3		4	2
Polydora ligni	1	14	3		235	9	12		1		2	191	3		34
Sabellaria vulgaris					2										
Scolecolepides viridis	69	7	3	1	3		71	7	5	29	4	163	80	17	1142

Table 1 (Continued)

	STATION														
TAXON	3	5	7	9	11	15	17	A	B	D	I	J	L	Q	R
POLYCHAETA (cont.)															
Scoloplos robustus			1		1					1				4	
Streblospio benedicti	3	8	106	43	3	57	67	5	107	34	40	8	8	33	10
GASTROPODA															
Acteocina canaliculata	112	45	1		14	3	6	21	1	10	9		1		2
Acteon punctostriatus	9	21	2	14	3	12	12	22	30	14	25	1	1	5	22
Cratena pilata						1						2			1
Doridella obscura					3	1						1			
Haminoea solitaria	1		3		2										174
Pyramidella sp.	1	2						1							
BIVALVIA															
Brachidontes recurvis	1				10		1								
Ensis directus		4					1		2	2	4	3		3	7
Gemma gemma	3						2						1	1	
Lyonsia hyalina	18	62			1		1	4	1		3		1		1
Macoma balthica	13	47	55	86	155	38	277	68	222	183	67	94	39	136	547
Macoma mitchelli	32	3	49	14	58	2	52	29	54	94	74	9	8	76	376
Mulinia lateralis	56	2994	154	2197	176	3212	206	2377	1456	1726	2305	33	60	756	1130
Mya arenaria			5		6		13	2	5	4	1	23	20	5	37
CIRRIPEDIA															
Balanus improvisus					3								1		
MYSIDACEA															
Neomysis americana	1		1	2					8			1	1	2	1
CUMACEA															
Cyclaspis varians					1							1			3

Table 1 (Continued)

TAXON	STATION 3	5	7	9	11	15	17	A	B	D	I	J	L	Q	R
TANAIDACEA															
Hargeria rapax													1		
ISOPODA															
Edotea triloba		1													11
Sphaeroma quadridentatum												1			
AMPHIPODA															
Corophium sp.	1	1	2		1	1	1			1		24	3		7
Gammarus mucronatus													1		
Leptocheirus plumulosus			11						1	1	2	2	10		3
Melita nitida								1				1	1		
Monoculodes edwardsi	3												5	1	7
DECAPODA															
Crangon septemspinosa						1			1						1
Callinectes sapidus						1									
Neopanope sayi												1			
Ovalipes ocellatus											1				
UROCHORDATA															
Molgula manhattensis	1														
PISCES															
Anguilla rostrata											1				
Total Number of Species	23	22	21	11	30	20	23	16	20	20	21	26	28	18	29
Total Number of Individuals	372	3346	422	2377	1032	3576	888	2614	1950	2186	2599	648	303	1117	3819
DIVERSITY (H')	3.19	0.86	2.65	0.56	3.36	0.80	3.18	0.73	1.46	1.34	0.87	2.92	3.50	1.84	2.75
H' without *Mulinia*		3.60		2.24		3.15		3.17	2.56	2.86	3.21			2.87	
EVENNESS (J')	0.71	0.19	0.60	0.16	0.68	0.19	0.70	0.18	0.33	0.31	0.20	0.62	0.73	0.44	0.57
SPECIES RICHNESS (S-1/lnN)	3.71	2.59	3.31	1.29	4.18	2.32	3.20	1.91	2.51	2.47	2.54	3.86	4.73	2.42	3.39
Total Biomass (grams wet weight)	0.75	3.53	1.49	6.40	4.75	4.79	2.0	2.95	3.25	3.10	6.22	5.40	3.35	3.30	11.20

Table 2. Dominant species ranked in terms of percent of total abundance at all 15 stations.

Species	Percent of total individuals collected	Cumulative percent
Mulinia lateralis	69.1	69.1
Macoma balthica	7.4	76.5
Scolecolepides viridis	5.9	82.4
Macoma mitchelli	3.4	85.8
Streblospio benedicti	2.0	87.8
Polydora ligni	1.9	89.7
Paraprionospio pinnata	1.6	91.3
Nereis succinea	1.2	92.5
Glycinde solitaria	1.2	93.7
Eteone heteropoda	0.8	94.5
Acteocina canaliculata	0.8	95.3
Acteon punctostriatus	0.7	96.0

Chemical Survey

Methods and Procedures

Salinity

Salinities were measured in terms of electrolytic conductivity (relative to standard seawater) on a Beckman model RS-7B Induction Salinometer, with subsequent conversion to salinity.

Dissolved Oxygen

This parameter was determined by the azide modification of the Winkler iodometric method (American Public Health Association, et al., 1971, p. 477). The titration endpoint was detected visually using a starch indicator.

Total Kjeldahl Nitrogen (TKN)

The samples were digested with a solution containing sulfuric acid, potassium sulfate and mercuric sulfate, converting organic nitrogen to ammonium sulfate. The digested samples were steam-distilled into a saturated boric acid solution and titrated with standard hydrochloric acid.

Dissolved and Particulate Organic P (TP)

Unfiltered samples were digested by the persulfate oxidation technique and run by the single solution method, employing ascorbic acid as the reducing agent. The developed samples were read on a Klett-Summerson Photoelectric Colorimeter, model 900-3.

Orthophosphate (OP)

This phosphorus fraction was determined using an automated single solution method (Technicon Autoanalyzer II, industrial method No. 155-71W).

Nitrite and Nitrate -N

These nitrogen forms were determined using an automated copper-cadmium reduction method (Technicon Autoanalyzer II, industrial method No. 158-71W). In this method nitrate is first reduced to nitrite by a copper-cadmium reduction column. The nitrite then reacts with sulfanilamide under acidic conditions to form a diazo compound, which then couples with N-1-napthyl-ethylene diamine dihydrochloride, forming a reddish-purple azo dye which is read on a colorimeter. Omission of the reduction column permits determination of the initial concentration of nitrite which is subtracted from the final concentration (following reduction) to yield the initial nitrate concentration.

Chlorophyll *a*

Concentrations of this phytopigment were measured by the fluorescence method, (Yentsch and Menzel, 1963) employing a Turner Fluorometer, model 111. The seston in aliquots of the preserved samples was concentrated on glass fiber filters, homogenized with 90% acetone, and centrifuged to yield

Chlorophyll a (cont'd.)

extracts that could be read on the instrument.

Sediment

Total and Volatile Solids

The sediment samples were dried in an oven at 103°C to constant weight, (dry weight/wet weight x 100 = % total solids). The dried samples were placed in a muffle furnace for one hour at 550-600°C. The decrease in weight after ashing was reported as volatile soilds.

Chemical Oxygen Demand (COD)

The parameter was determined by the dichromate reflux method. The oxidizable substances were oxidized by a standard solution of potassium dichromate in sulfuric acid. The excess dichromate was titrated with standard ferrous ammonium sulfate. Silver sulfate was used as a catalyst; mercuric sulfate was used to eliminate the interference of chloride ions.

Total Kjeldahl Nitrogen (TKN)

The samples were digested with a solution containing sulfuric acid, potassium sulfate, and mercuric sulfate converting organic nitrogen to ammonium sulfate. The digested samples were steam-distilled into a saturated boric acid solution and titrated with standard hydrochloric acid.

Total Phosphorus (TP)

The samples were digested in concentrated HNO_3 and evaporated to dryness; concentrated H_2SO_4 was added and heated until the solution cleared. Water was added and the samples were filtered through a glass filter. The filtrates were analyzed for total phosphorus by the single solution method, using ascorbic acid as the reducing agent. The developed samples were read on a Klett-Summerson Photoelectric colorimeter, model 900-3.

Metals (Cd, Cr, Cu, Zn and Pb)

One gram of sample was heated to fuming with ten milliliters of concentrated HNO_3 acid. After cooling, ten additional milliliters of acid were added, heated and cooled. The samples were centrifuged and the supernatants measured for volume and analyzed on a Varian Atomic Absorption Spectrophotometer, model AA-5.

Mercury

The samples were digested with concentrated H_2SO_4 overnight. The digested samples were oxidized with 5% $KMNO_4$ and transferred to 300 ml BOD bottles. After the addition of reductant * solution the BOD bottles were immediately attached to the aeration apparatus of a Coleman Mercury

Mercury (cont'd.)

Analyzer MAS-50. Mercury concentrations were determined from standard curves.

* Composition of reductant solution:

H_2O	600 ml
H_2SO_4	100 ml
NaCl	5 grams
$(NH_2OH)_2SO_4$	20 grams

q.s. to 1 liter

Oil and Grease

The sediment samples were dried with magnesium sulfate monohydrate, then soxhlet-extracted with hexane (Standard Methods for the Examinations of Water and Wastewater, 12th Ed., APHA, Inc., N.Y., 1965; 531-532). The hexane was then evaporated to dryness. The weight of solid residue from the solvent evaporation yields oil and grease.

Piney Point Bottom Sediment Samples

February, 1975

Sample No.	Type	TS %	VS %	COD %	TKN mg/kg	TP mg/kg	Zn ppm	Cu ppm	Pb ppm	Cd ppm	Cr ppm	O&G mg/kg	Hg ppm
1	Core	27.26	8.13	10.6	2710.	360.	108.	20.3	27.7	1.5	16.7	460.	0.55
2	"	28.60	8.15	8.7	2870.	394.	123.	18.5	31.6	1.1	14.1	490.	0.42
3	Grab	76.16	0.35	0.2	62.	27.5	4.7	0.4	5.4	0.4	Trace	32.8	0.12
4	Core	22.03	9.00	9.6	3620.	497.	147.	22.9	37.4	1.7	17.2	2450.	0.64
5	Grab	74.15	1.32	1.3	395.	136.	40.	2.5	7.9	0.5	3.9	290.	0.13
6	"	77.13	0.26	0.3	86.	53.	1.8	Trace	2.4	0.3	Trace	45.4	0.16
7	"	47.12	4.31	4.6	1600.	194.	49.1	8.2	15.5	0.6	5.9	615.	0.21
8	"	74.09	1.30	1.4	360.	110.	21.6	2.1	7.9	0.2	2.7	20.2	0.11
9	"	19.95	10.66	10.8	3750.	485.	134.	21.9	44.8	0.7	15.4	3460.	0.60
10	"	46.86	4.21	4.7	1630.	214.	75.7	11.1	22.8	0.6	7.8	350.	0.28
11	"	65.92	1.70	1.7	702.	123.	29.5	2.5	9.1	0.4	2.7	387.	0.33
12	"	30.62	7.48	8.7	2530.	414.	73.4	13.8	26.9	1.1	14.8	490.	0.49
15	"	27.03	7.86	6.7	2590.	380.	55.1	12.1	24.0	0.8	16.5	1150.	0.48
16	"	27.95	9.02	9.2	3340.	367.	130.	20.6	32.5	1.0	15.2	1070.	0.29
17	"	71.51	1.04	0.8	385.	133.	22.0	1.2	7.9	0.4	0.8	210.	0.03
A	"	46.07	3.85	4.8	1940.	235.	68.2	10.	17.5	0.7	7.3	282.	0.24
B	"	46.59	4.15	4.7	1490.	229.	66.5	7.9	21.5	0.9	7.4	376.	0.28
C	"	32.71	6.42	7.8	2670.	354.	80.6	14.4	16.8	0.2	10.6	367.	0.55
D	"	50.80	4.28	4.0	1460.	208.	53.5	7.7	16.8	0.8	3.6	768.	0.26
E	Grab	70.34	1.65	1.7	462.	170.	40.5	2.6	18.2	0.1	3.6	114.	0.20
F	"	40.48	4.96	4.6	2040.	268.	58.5	9.8	17.9	0.7	6.1	753.	0.25
G	"	62.63	2.39	2.2	945.	175.	45.4	4.2	10.2	Trace	4.5	287.	0.19
H	"	64.67	1.98	1.8	762.	198.	22.6	3.0	9.0	0.2	2.8	425.	0.17
I	"	25.25	8.65	8.7	3250.	435.	111.	17.2	35.2	1.1	10.7	1090.	0.59
J	"	46.76	4.58	4.2	1300.	244.	47.4	9.1	16.6	0.6	6.4	364.	0.30

Bottom Sediment Samples (cont'd)

Sample No.	Type	TS %	VS %	COD %	TKN mg/1	TP mg/1	Zn ppm	Cu ppm	Pb ppm	Cd ppm	Cr ppm	O&G mg/kg	Hg ppm
K	Grab	39.43	5.09	6.0	2380.	331.	65.7	12.3	16.8	0.2	7.2	1200.	0.71
L	"	79.86	0.77	1.5	262.	31.	4.6	0.8	4.5	0.3	Trace	106.	0.10
M	"	31.27	6.69	6.5	2900.	413.	80.9	13.5	24.5	1.2	9.5	1920.	0.54
N	"	47.47	4.52	4.8	1100.	250.	96.4	8.7	27.4	0.8	36.8	432.	0.02
O	"	36.59	5.37	5.5	2260.	268.	74.0	11.0	20.1	0.4	6.9	2470.	0.82
P	"	69.92	1.13	0.9	439.	252.	34.2	2.4	6.4	0.3	0.9	107.	0.17
Q	"	34.00	5.99	6.0	2420.	299.	76.9	13.9	24.3	0.5	8.4	1120.	0.12
R	"	55.45	3.02	3.5	1540.	215.	36.7	6.0	11.5	0.6	2.8	532.	0.25

TS - Total Solids
VS - Volatile Solids
COD - Chemical Oxygen Demand
TKN - Total Kjeldahl Nitrogen
TP - Total Phosphorus
O&G - Oil and Grease

Values reported on a dry weight basis

Water Samples
February, 1975

Sample No.	Sal. ‰	DO mg/l	BOD mg/l	TKN mg/l	TP ugAt/l	OP ugAt/l	NO_2 ugAt/l	NO_3 ugAt/l	Chl a u.g/l	Coliforms Total 100 ml	Coliforms Fecal 100 ml
1	10.99	12.3	8.3	0.87	0.59	0.27	0.53	27.02	2.5		
3	10.99	12.2	7.7	0.44	0.49	0.24	0.50	25.65	1.6		
5	11.12	12.1	8.5	0.47	0.45	0.18	0.50	25.45	2.7		
7	12.37	11.8	8.0	0.39	0.41	0.18	0.45	20.15	2.7		
9	11.27	12.3	7.2	0.47	0.45	0.16	0.52	25.68	1.5	$<1.8x10^0$	$<1.8x10^0$
11	11.35	12.0	7.9	0.47	0.29	0.13	0.50	25.25	1.0	$2.0x10^0$	$<1.8x10^0$
13	12.25	11.8	7.7	0.69	1.00	0.39	0.52	23.13	8.4	$4.5x10^0$	$4.5x10^0$
14	12.03	11.8	7.4	0.58	1.08	0.32	0.51	20.99	11.5	$7.8x10^0$	$2.0x10^0$
15	11.42	12.5	8.4	0.55	0.49	0.18	0.52	24.68	2.1	$2.0x10^0$	$<1.8x10^0$
17	10.93	12.1	6.4	0.45	0.37	0.12	0.52	25.63	0.8	$4.5x10^0$	$<1.8x10^0$
B	11.77	11.8	8.4	0.55	0.73	0.22	0.49	23.01	7.4		
I	12.18	11.6	6.6	0.65	1.08	0.30	0.50	23.53	7.0		
J	12.35	11.2	7.3	0.60	0.88	0.21	0.47	20.03	5.4	$7.8x10^0$	$2.0x10^0$
R	12.14	11.5	4.9	0.62	1.29	0.24	0.52	22.88	7.4		

Mr. Frank Steuart
Piney Point, Maryland
Feb., 1975

Results of Water Samples

	Mouth	Mid	Head
Tkn mg/1	0.57	0.48	0.61
TP ugAt/1	1.71	0.71	1.08
OP ugAt/1	0.24	0.24	0.39
NO_2 ugAt/1	0.49	0.47	0.45
NO_3 ugAt/1	21.01	21.23	20.10
Chl "a" ug "a"/1	18.4	17.1	10.1
Total Coliforms 100 ml	--	--	$3.3x10^3$
Fecal Coliforms 100 ml	--	--	$7.9x10^1$

TKN - Total Kjeldahl Nitrogen

TP - Total Phosphorus

OP - Inorganic Phosphorus

NO_2 - Nitrite

NO_3 - Nitrate

Chl "a" - Chlorophyll "a"