# CHEMICAL QUALITY OF BOTTOM SEDIMENT SAMPLES FROM MOBILE BAY, ALABAMA

Prepared for the
Alabama Coastal Area Board

Under Agreement No. CAB 80-08
and
GSA Contract No. 80-3052

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A. M. Malatino
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Geological Survey of Alabama
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## I. INTRODUCTION AND PURPOSE

Mobile Bay constitutes the primary depositional basin for more than two-thirds of the surface area of Alabama. The rivers discharging into the Bay drain a watershed of more than 43,000 square miles sending large amounts of water and sediment into a relatively small area.

A study was conducted in 1979 to determine the mineralogy and spatial variation of clay species within Mobile Bay (Isphording, 1979). The textural distribution of Bay sediments obtained in the Isphording, 1979, study was used in selecting the sampling stations for this investigation.

The purpose of this study was to determine the concentration and spatial trend of selected chemical constituents (metals, nutrients, organics, and pesticides) in the Mobile Bay sediments. An understanding of the chemical composition of the sediment will help provide basic information needed for a comprehensive picture of the quality of the estuarine environment.

## II. STUDY METHODS

The study area is defined as Mobile Bay, extending from U.S. Highway 90 on the north to Dauphin Island on the south. The sampling stations were located by the Loran C navigation map system. One-meter core samples of the Bay bottom were taken with a 3-inch diameter PVC plastic-lined Phleger core sampler at 60 sites in Mobile Bay (see location map in pocket). Samples collected at 20 of these sites were separated into top and bottom samples to provide

greater detail on the vertical distribution of chemical constituents. A total of 80 samples were collected, which included five additional samples in case of damage during transportation or while in the laboratory.

After the sediment samples were recovered, they were immediately transferred to polycarbonate bags and placed on ice at 4 degrees centigrade (°C) during transportation to the Geological Survey of Alabama Geochemical Laboratory in Tuscaloosa. The samples were then placed in a refrigerator and kept at 4°C until time of analysis.

The bottom sediment samples were analyzed for 19 metals, volatile solids, organic carbon, 12 pesticide species, and two nutrients (nitrogen (N) and phosphorus (P)).

Total recoverable metal analyses were performed by atomic absorption spectrophotometry after acid digestion, according to the U.S. Corps of Engineers (COE, 1976) and U.S. Environmental Protection Agency (USEPA, 1979) methods. Complete dissolution of all bottom material is not readily achieved by this digestion procedure and thus the determination represents less than 95% of the total amount present in the sample. Analyses for nutrients, organic carbon, and volatile solids followed EPA (USEPA, 1979) methods. Pesticides were analyzed by the U.S. Department of Health, Education and Welfare, Food and Drug Administration (USDHEW-FDA, 1977) procedures for detecting chlorinated hydrocarbons by Gas Chromatography equipped with dual electron capture.

## III. RESULTS

The metal analyses of the bottom sediments were tabulated to

show spatial trends within the Bay (table A-1).

The concentration of aluminum in the Bay sediment samples ranged from 10 to 50 micrograms per gram (µg/gm).[1]

Arsenic concentrations in the samples ranged from 1 to 14 µg/gm.

Barium concentrations in the sediment ranged from 10 to 640 µg/gm. The highest concentration (640 µg/gm) occurred in the top 20 centimeters of sediment from station 6A, whereas the concentration in the bottom portion of the sample was approximately one-third of the upper concentration (240 µg/gm).

Cadmium concentrations in the sediment ranged from less than 10 to 10 µg/gm.

Calcium concentrations ranged from not detectable (ND) to 67,000 µg/gm. The station with the highest calcium level corresponded to the station (station 6A - top) with the highest barium level.

The concentration of cobalt in the sediment ranged from less than 5 to 30 µg/gm.

Iron concentrations in the sediment samples ranged from 2,000 to 42,000 µg/gm. The station with the highest iron concentration was number 16. The lowest iron concentration (2,000 µg/gm) in the Bay sediment samples occurred at station 46 in the northwest portion of Mobile Bay.

Lead concentrations in the sediment samples ranged from ND to less than 10 µg/gm.

[1] Micrograms per gram (µg/gm) is equivalent to milligrams per kilogram (mg/kg) which is also equal to parts per million (ppm).

Mercury concentrations in the sediment samples ranged from less than 0.2 to 1.1 µg/gm. The highest values occurred at station 10 (1.1 µg/gm), station 9A - bottom (0.9 µg/gm) and station 11 - top (0.9 µg/gm). Station 10 is located 1 mile east of Heron Bay and stations 9A and 11 are located in Bon Secour Bay, 4.3 and 8.8 nautical miles, respectively, due west of Cypress Point (location map).

Manganese concentrations in the Bay samples ranged from 12 to 1,600 µg/gm. The highest level occurred at station 21 - bottom.

Magnesium concentrations in the Bay samples ranged from 80 to 7,200 µg/gm. The highest magnesium level occurred at three stations (1 - top, 21 - bottom, and 26 - top).

Selenium concentrations in the Bay samples ranged from less than 1 to 1.0 µg/gm.

Silicon concentrations in the Bay samples ranged from 1 to 10 µg/gm. Concentrations would probably be higher if a caustic soluble method or hydrofluoric acid digestion procedure were used. However, since nitric and hydrochloric acids were used in the acid digestible procedure, sands were not totally dissolved. This should be kept in mind when reviewing the silicon data in this report. Total silicon may be a factor of 10 or more than the reported acid dissolved concentration.

Silver and titanium concentrations in the Bay sediment samples were all less than 10 µg/gm.

Strontium concentrations in the Bay sediment samples ranged from 10 to 390 µg/gm. The highest concentration occurred at station 6A - top.

Zinc concentrations in the sediment samples ranged from 40 to 1,200 µg/gm. The highest concentration occurred at station 44.

Copper concentrations in the Bay sediments ranged from 5 to 120 µg/gm. The highest concentration occurred at station 1A.

Chromium concentrations ranged from ND to 90 µg/gm. The highest concentrations occurred at stations 9 - top and 9A - bottom.

The percent concentrations of nutrients (N and P), volatile solids, and organic carbon are given in table A-3. Nitrogen ranged from 0.0000 to .019 percent (%) in all 80 sediment samples. The highest percent nitrogen (.019%) or 190 µg/gm occurred at station 1 - bottom.

Organic carbon ranged from .02 to .12. The highest percentage (.12%) occurred at stations 6A - top and 8A - top and bottom.

Phosphorus ranged from .0000 to .0019% in all Bay sediment samples. The highest phosphorus percentage occurred at stations 9 - bottom and 9A - bottom.

Volatile solids ranged from 0.2 to 9.1%. The highest percentage of volatile solids occurred at station 9A - top.

Of the 12 pesticide species analyzed in the sediment samples, Lindane, Heptachlor, Aldrin; p, p'-DDD; p,p'-DDE; Polychlorinated biphenyl (PCB 1254), PCB 1260, Heptachlor epoxide, Pentachlorophenol (PCP), Dieldrin, and Endrin were the species identified and quantified by Gas Chromatography (table A-2).

Lindane concentrations ranged from ND to 2.01 µg/kg per dry weight. The highest level occurred at station 9A - top.

Heptachlor concentrations ranged from ND to 3.66 µg/kg. The highest level occurred at station 49.

Aldrin concentrations ranged from ND to 1.22 µg/kg. The highest value occurred at station 49, west of Little Sand Island at the mouth of the Mobile River.

The concentration of p, p'-DDD ranged from ND to .88 µg/kg. The highest value occurred at station 49 with station 47 having .87 µg/kg of DDD.

The p,p'-DDE concentrations for the Mobile Bay sediments ranged from ND to 2.66 µg/kg. The highest value occurred at station 9A - top. Only 5 of the 33 sediment samples had DDE present.

There was no DDT present in any of the 33 sediment samples.

The concentrations of PCB 1254 and PCB 1260 ranged from ND to 1.09 and ND to 1.02 µg/kg, respectively. The highest concentration of PCB 1254 occurred at station 37. The highest level of PCB 1260 occurred at station 9A - top.

The concentration of Heptachlor epoxide in the bottom sediment samples ranged from ND to .99 µg/kg. The highest Heptachlor epoxide concentration occurred at station 37.

The identification of PCP occurred at four sampling stations (16, 27, 35, and 45). Station 27 had the highest PCP level at 1.30 µg/kg.

Dieldrin concentrations ranged from ND to 4.18 µg/kg. The highest concentration occurred at station 45 approximately 2.8 miles south of the Causeway at Battleship Parkway (U.S. Highway 90) in the upper northwest section of the Bay.

Endrin was identified at seven stations. Stations 27 and 25 - bottom had the highest Endrin concentrations of 1.38 and 1.03 µg/kg, respectively.

## IV. DISCUSSION

The process of sedimentation in the Mobile Bay area is dependent on many physical variables such as fresh-water currents, tidal movements, depth, wind and bottom topography. The sediment samples were analyzed for a broad spectrum of metals and pesticides to identify areas that are high in deposits of toxic materials. The accumulation of such toxic materials over a period of time would be detrimental to the life of the estuarine environment.

The samples were found to consist primarily of compounds of four (4) elements: calcium, magnesium, iron, and manganese (Table A-1). These elements are naturally occurring and are classified as non-critical (Brownlow, 1979). The occurrence of high concentrations of these elements were uniformly distributed throughout the area. Concentrations of the toxic metals cobalt, copper, zinc, arsenic, selenium, silver, cadmium, mercury, and lead, were low and their occurrences were distributed uniformly throughout the study area.

Titanium was found in low concentrations in the samples. Low concentrations of barium were also noted in each sample. The remaining metals, aluminum, strontium, and silicon (noncritical elements), were found in low concentrations.

Nitrogen, phosphorous and carbon appeared in low concentrations and were equally distributed in all samples.

Volatile solids concentrations were found to be relatively uniform throughout the Bay area (Table A-2).

The pesticide analyses included identifying and quantifying 11 pesticide species that were widely distributed (Table A-3). Four pesticide species: Aldrin, PCB 1254, Dieldrin, and Endrin, were

dominant in occurrence. The occurrence may indicate less than ideal conditions of any pesticides, however, no spatial trends were established by the data.

This study provides reasonably comprehensive background data on present levels and concentration areas of chemical elements in the Bay sediments; future sampling and analysis might be done within the Bay as additional areas of inquiry are identified and funding permits.

## REFERENCES


Brownlow, Arthur H., 1979, Geochemistry: Boston University, Prentice-Hall, Englewood Cliffs, N.J., p. 256.

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U.S. Army Corps of Engineers, 1976, Ecological evaluation of proposed discharge of dredged or fill material into navigable waters: U.S. Army Corps of Engineers, Mobile, Alabama District, Misc. Paper D-76-17, 33 p.

U.S. Environmental Protection Agency, 1979, Method for chemical analysis of water and wastes: Cincinnati, Ohio, Environmental Monitoring and Support Laboratory, Environmental Research Center, 298 p.

CHEMICAL DATA

(Tables A-1 through A-3)

Table A-1 - Chemical Concentrations of Bottom Sediment Samples
Collected from Mobile Bay, Alabama, June 15 through 21, 1980.

| STATION IDENTIFICATION NUMBER | | Aluminum ug/g** | Arsenic ug/g | Barium ug/g | Cadmium ug/g | Calcium ug/g | Cobalt ug/g | Iron ug/g | Lead ug/g | Mercury ug/g | Manganese ug/g | Magnesium ug/g | Selenium ug/g | Silicon ug/g | Silver ug/g | Strontium ug/g | Zinc ug/g | Titanium ug/g | Copper ug/g | Chromium ug/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24626-M | 1-A | 10 | 10 | 20 | <10 | 2200 | 30 | 34000 | <10 | 0.5 | 620 | 5200 | 1 | 1 | <10 | 40 | 160 | <10 | 120 | 40 |
| 24627-M | 1-TOP | 20 | 11 | 20 | <10 | 3200 | 30 | 37000 | ND* | 0.4 | 1000 | 7200 | 1 | 1 | <10 | 50 | 180 | <10 | 100 | 30 |
| 24628-M | 1-BOTTOM | 20 | 9 | 20 | <10 | 12000 | 20 | 31000 | ND | 0.4 | 720 | 6600 | 1 | 2 | <10 | 110 | 130 | <10 | 70 | 20 |
| 24629-M | 2-TOP | 20 | 7 | 100 | <10 | 8200 | 20 | 33000 | ND | 0.4 | 920 | 6600 | 1 | 1 | <10 | 80 | 100 | <10 | 40 | 10 |
| 24630-M | 2-BOTTOM | 10 | 7 | 60 | <10 | 12000 | 20 | 40000 | ND | 0.3 | 720 | 5800 | 1 | 1 | <10 | 90 | 90 | <10 | 40 | 5 |
| 24631-M | 3 | 21 | 11 | 100 | <10 | 4000 | 20 | 36000 | ND | 0.2 | 640 | 7000 | 1 | 1 | <10 | 60 | 120 | <10 | 50 | 10 |
| 24632-M | 3-A TOP | 20 | 11 | 30 | <10 | 4000 | 30 | 41000 | ND | 0.2 | 620 | 7000 | 1 | 2 | <10 | 50 | 110 | <10 | 80 | 10 |
| 24633-M | 3-A BOTTOM | 22 | 12 | 30 | <10 | 3800 | 20 | 41000 | ND | 0.4 | 940 | 6600 | 1 | 1 | <10 | 50 | 150 | <10 | 20 | 5 |
| 24634-M | 4A | 20 | 11 | 50 | <10 | 2200 | 20 | 35000 | ND | 0.3 | 920 | 5800 | 1 | 1 | <10 | 40 | 100 | <10 | 40 | ND |
| 24635-M | 4 TOP | 20 | 12 | 50 | <10 | 3000 | 30 | 39000 | ND | <0.2 | 700 | 6600 | <1 | 1 | <10 | 50 | 160 | <10 | 20 | <5 |
| 24636-M | 4-BOTTOM | 20 | 10 | 40 | <10 | 3200 | 30 | 38000 | <10 | 0.3 | 1300 | 7000 | 1 | 2 | <10 | 60 | 140 | <10 | 70 | 30 |
| 24637-M | 5-TOP | 20 | 8 | 50 | <10 | 3800 | 20 | 38000 | ND | 0.3 | 1100 | 6400 | 1 | 2 | <10 | 60 | 240 | <10 | 20 | 30 |
| 24638-M | 5-BOTTOM | 10 | 11 | 50 | <10 | 6600 | 20 | 31000 | ND | 0.2 | 800 | 5800 | <1 | 2 | <10 | 70 | 340 | <10 | 20 | 20 |
| 24639-M | 6 | 20 | 11 | 50 | <10 | 5400 | 20 | 35000 | ND | 0.2 | 800 | 6400 | 1 | 2 | <10 | 70 | 140 | <10 | 60 | 30 |
| 24640-M | 6A-TOP | 10 | 3 | 640 | <10 | 67000 | 10 | 21000 | ND | <0.2 | 460 | 4600 | 1 | 1 | <10 | 390 | 80 | <10 | 30 | 10 |
| 24641-M | 6A-BOTTOM | 10 | 9 | 240 | <10 | 27000 | 20 | 26000 | ND | 0.3 | 580 | 5600 | 1 | 2 | <10 | 180 | 110 | <10 | 30 | 10 |
| 24642-M | 7-TOP | 10 | 6 | 320 | <10 | 36000 | 10 | 24000 | ND | 0.2 | 920 | 5200 | <1 | 2 | <10 | 180 | 80 | <10 | 20 | 20 |

*ND - Specifically analyzed for but not detectable.
**ug/g - micrograms per gram.

| STATION IDENTIFICATION NUMBER | | Aluminum ug/g | Arsenic ug/g | Barium ug/g | Cadmium ug/g | Calcium ug/g | Cobalt ug/g | Iron ug/g | Lead ug/g | Mercury ug/g | Manganese ug/g | Magnesium ug/g | Selenium ug/g | Silicon ug/g | Silver ug/g | Strontium ug/g | Zinc ug/g | Titanium ug/g | Copper ug/g | Chromium ug/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24643-M | 7-BOTTOM | 10 | 9 | 80 | <10 | 11000 | 20 | 30000 | ND | <0.2 | 860 | 6200 | 1 | 2 | <10 | 80 | 110 | <10 | 20 | 20 |
| 24644-M | 8 | 20 | 11 | 20 | <10 | 4400 | 20 | 38000 | ND | <0.2 | 760 | 5800 | 1 | 2 | <10 | 60 | 110 | <10 | 30 | 30 |
| 24645-M | 8A-TOP | 20 | 11 | 20 | <10 | 1800 | 20 | 34000 | ND | 0.2 | 840 | 4800 | <1 | 2 | <10 | 50 | 140 | <10 | 30 | 30 |
| 24646-M | 8A-BOTTOM | 50 | 10 | 20 | 10 | ND | 20 | 33000 | <10 | 0.2 | 520 | 6000 | 1 | 8 | <10 | 20 | 170 | <10 | 90 | 80 |
| 24647-M | 9-TOP | 40 | 11 | 30 | <10 | 200 | 20 | 35000 | <10 | 0.2 | 600 | 4800 | 1 | 8 | <10 | 30 | 160 | <10 | 40 | 90 |
| 24648-M | 9 BOTTOM | 50 | 10 | 20 | <10 | 200 | 20 | 39000 | <10 | <0.2 | 640 | 5000 | 1 | 8 | <10 | 30 | 190 | <10 | 60 | 80 |
| 24649-M | 9A-TOP | 50 | 12 | 20 | <10 | 200 | 20 | 38000 | <10 | 0.2 | 520 | 6200 | 1 | 4 | <10 | 70 | 190 | <10 | 40 | 80 |
| 24650-M | 9A-BOTTOM | 50 | 12 | 20 | 10 | 200 | 20 | 40000 | <10 | 0.9 | 600 | 5200 | 1 | 5 | <10 | 20 | 180 | <10 | 40 | 90 |
| 24651-M | 10 | 50 | 11 | 20 | <10 | 200 | 20 | 36000 | <10 | 1.1 | 760 | 6600 | 1 | 3 | <10 | 40 | 180 | <10 | 50 | 80 |
| 24652-M | 11-TOP | 50 | 12 | 20 | <10 | 200 | 20 | 39000 | ND | 0.9 | 560 | 6000 | 1 | 10 | <10 | 30 | 300 | <10 | 60 | 80 |
| 24653-M | 11-BOTTOM | 50 | 11 | 20 | <10 | ND | 20 | 40000 | ND | 0.5 | 520 | 5200 | 1 | 9 | <10 | 30 | 160 | <10 | 50 | 80 |
| 24654-M | 12 | 40 | 11 | 20 | <10 | 20 | 20 | 36000 | ND | 0.4 | 740 | 6000 | 1 | 6 | <10 | 30 | 220 | <10 | 40 | 70 |
| 24655-M | 13A | 10 | 3 | 10 | <10 | 20 | 20 | 7200 | ND | 0.2 | 120 | 1600 | <1 | 1 | <10 | 20 | 60 | <10 | 60 | 30 |
| 24656-M | 13-TOP | 40 | 12 | 30 | 10 | 20 | 20 | 37000 | ND | 0.3 | 500 | 4800 | 1 | 5 | <10 | 20 | 480 | <10 | 70 | 60 |
| 24657-M | 13-BOTTOM | 40 | 11 | 30 | 10 | 200 | 30 | 36000 | ND | 0.2 | 500 | 4600 | 1 | 5 | <10 | 20 | 260 | <10 | 60 | 50 |
| 24658-M | 14 | 40 | 13 | 30 | 10 | 200 | 30 | 36000 | ND | 0.6 | 640 | 4600 | 1 | 4 | <10 | 20 | 160 | <10 | 30 | 60 |
| 24659-M | 15-TOP | 40 | 11 | 40 | 10 | 200 | 30 | 36000 | ND | 0.5 | 660 | 5200 | 1 | 5 | <10 | 30 | 220 | <10 | 40 | 70 |
| 24660-M | 15 BOTTOM | 50 | 14 | 30 | 10 | 200 | 30 | 41000 | ND | 0.2 | 680 | 5400 | 1 | 5 | <10 | 20 | 440 | <10 | 40 | 80 |

Table A-1 Cont'd

| STATION IDENTIFICATION NUMBER | | Aluminum ug/g | Arsenic ug/g | Barium ug/g | Cadmium ug/g | Calcium ug/g | Cobalt ug/g | Iron ug/g | Lead ug/g | Mercury ug/g | Manganese ug/g | Magnesium ug/g | Selenium ug/g | Silicon ug/g | Silver ug/g | Strontium ug/g | Zinc ug/g | Titanium ug/g | Copper ug/g | Chromium ug/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24661-M | 16 | 40 | 13 | 30 | 10 | 200 | 30 | 42000 | ND | 0.4 | 920 | 5200 | <1 | 5 | <10 | 20 | 220 | <10 | 70 | 70 |
| 24662-M | 17 | 40 | 13 | 30 | 10 | 200 | 30 | 39000 | ND | 0.3 | 640 | 5000 | 1 | 5 | <10 | 30 | 180 | <10 | 50 | 70 |
| 24663-M | 17A | 20 | 6 | 20 | <10 | 200 | 10 | 18500 | ND | <0.2 | 340 | 2400 | <1 | 4 | <10 | 20 | 170 | <10 | 10 | 20 |
| 24664-M | 18-TOP | 30 | 13 | 30 | 10 | 200 | 30 | 32000 | ND | 0.2 | 840 | 5000 | <1 | 3 | <10 | 20 | 300 | <10 | 90 | 50 |
| 24665-M | 18 BOTTOM | 40 | 12 | 30 | <10 | 200 | 10 | 36000 | ND | 0.2 | 880 | 5600 | 1 | 6 | <10 | 20 | 230 | <10 | 30 | 70 |
| 24666-M | 19 | 10 | 11 | 50 | 10 | 200 | 20 | 34000 | ND | 0.3 | 480 | 4000 | 1 | 3 | <10 | 20 | 200 | <10 | 70 | 60 |
| 24667-M | 20-TOP | 50 | 12 | 30 | 10 | 200 | 20 | 37000 | ND | 0.2 | 560 | 4600 | 1 | 3 | <10 | 20 | 190 | <10 | 50 | 70 |
| 24668-M | 20-BOTTOM | 50 | 11 | 20 | <10 | 1200 | 10 | 31000 | ND | 0.4 | 480 | 5200 | 1 | 1 | <10 | 40 | 120 | <10 | 70 | 40 |
| 24669-M | 21-TOP | 50 | 8 | 50 | <10 | 2400 | 20 | 33000 | ND | 0.3 | 940 | 5800 | 1 | 1 | <10 | 50 | 150 | <10 | 30 | 30 |
| 24670-M | 21-BOTTOM | 50 | 11 | 30 | <10 | 3000 | 20 | 40000 | ND | 0.2 | 1600 | 7200 | 1 | 1 | <10 | 60 | 230 | <10 | 30 | 50 |
| 24671-M | 22-TOP | 40 | 12 | 100 | <10 | 5400 | 20 | 38000 | ND | <0.2 | 680 | 6000 | 1 | 1 | <10 | 70 | 170 | <10 | 30 | 50 |
| 24672-M | 22-BOTTOM | 40 | 12 | 70 | <10 | 4800 | 20 | 39000 | ND | 0.2 | 640 | 5800 | <1 | 1 | <10 | 60 | 50 | <10 | 30 | 50 |
| 24673-M | 23 | 40 | 7 | 100 | <10 | 7400 | 10 | 28000 | ND | 0.2 | 420 | 4200 | <1 | 1 | <10 | 60 | 140 | <10 | 40 | 40 |
| 24674-M | 24-TOP | 40 | 2 | 20 | <10 | 56000 | 10 | 6000 | ND | <0.2 | 260 | 1300 | <1 | 1 | <10 | 190 | 110 | <10 | 30 | 20 |
| 24675-M | 24-BOTTOM | 20 | 3 | 20 | <10 | 36000 | 10 | 6400 | ND | <0.2 | 220 | 1400 | <1 | 1 | <10 | 140 | 50 | <10 | 30 | 20 |
| 24676-M | 25-TOP | 30 | 11 | 20 | <10 | 48000 | 20 | 34000 | ND | 0.2 | 700 | 5000 | 1 | 1 | <10 | 60 | 170 | <10 | 80 | 50 |
| 24677-M | 25-BOTTOM | 30 | 11 | 30 | <10 | 2200 | 30 | 37000 | ND | <0.2 | 760 | 5600 | 1 | 1 | <10 | 50 | 240 | <10 | 40 | 50 |
| 24678-M | 26-TOP | 40 | 10 | 80 | <10 | 4000 | 20 | 38000 | ND | 0.2 | 540 | 7200 | 1 | 1 | <10 | 60 | 270 | <10 | 70 | 50 |

| STATION IDENTIFICATION NUMBER | Aluminum ug/g | Arsenic ug/g | Barium ug/g | Cadmium ug/g | Calcium ug/g | Cobalt ug/g | Iron ug/g | Lead ug/g | Mercury ug/g | Manganese ug/g | Magnesium ug/g | Selenium ug/g | Silicon ug/g | Silver ug/g | Strontium ug/g | Zinc ug/g | Titanium ug/g | Copper ug/g | Chromium ug/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24679-M 26 BOTTOM | 10 | 10 | 110 | <10 | 2200 | 30 | 38000 | ND | 0.2 | 640 | 6600 | <1 | 1 | <10 | 60 | 140 | <10 | 30 | 50 |
| 24680-M 27 | 10 | 9 | 140 | <10 | 2800 | 30 | 41000 | ND | 0.3 | 1500 | 7000 | 1 | 1 | <10 | 60 | 210 | <10 | 30 | 60 |
| 24681-M 28 | 20 | 7 | 70 | <10 | 2000 | 10 | 23000 | ND | <0.2 | 580 | 3000 | <1 | 1 | <10 | 30 | 160 | <10 | 20 | 30 |
| 24682-M 29 | 20 | 5 | 50 | <10 | ND | 10 | 9200 | ND | 0.2 | 180 | 1300 | <1 | 1 | <10 | 20 | 100 | <10 | 30 | 20 |
| 24683-M 30 | 20 | 11 | 50 | <10 | 9400 | 20 | 37000 | ND | 0.2 | 640 | 4200 | <1 | 1 | <10 | 60 | 170 | <10 | 30 | 30 |
| 24684-M 31 | 40 | 8 | 40 | <10 | 4800 | 30 | 35000 | ND | 0.2 | 640 | 6000 | <1 | 1 | <10 | 60 | 220 | <10 | 40 | 50 |
| 24685-M 32 | 40 | 8 | 40 | <10 | 6400 | 20 | 23000 | ND | 0.2 | 400 | 4000 | 1 | 1 | <10 | 50 | 660 | <10 | 20 | 20 |
| 24686-M 32 A | 10 | 9 | 10 | <10 | 2000 | 20 | 32000 | ND | 0.2 | 800 | 4800 | 1 | 1 | <10 | 40 | 320 | <10 | 70 | 50 |
| 24687-M 33 | 20 | 2 | 20 | <10 | 6000 | < 5 | 32000 | ND | 0.3 | 66 | 400 | <1 | 1 | <10 | 40 | 40 | <10 | 40 | 10 |
| 24688-M 34 | 20 | 9 | 20 | <10 | 2400 | 20 | 17000 | ND | 0.3 | 180 | 4400 | <1 | 1 | <10 | 40 | 640 | <10 | 40 | 40 |
| 24689-M 35 | 20 | 7 | 20 | <10 | 600 | 10 | 34000 | ND | <0.2 | 660 | 2600 | <1 | 2 | <10 | 20 | 130 | <10 | 20 | 20 |
| 24690-M 36 | 20 | 11 | 20 | <10 | 4200 | 20 | 25000 | ND | 0.2 | 460 | 6200 | 1 | 1 | <10 | 60 | 290 | <10 | 40 | 50 |
| 24691-M 37 | 20 | 8 | 20 | <10 | 5200 | 10 | 6600 | ND | <0.2 | 110 | 3600 | 1 | 1 | <10 | 50 | 140 | <10 | 30 | 30 |
| 24692-M 38 | 20 | 3 | 20 | <10 | 1800 | < 5 | 3200 | ND | <0.2 | 820 | 840 | 1 | 1 | <10 | 20 | 570 | <10 | 20 | 10 |
| 24693-M 39 | 20 | 10 | 20 | <10 | 1600 | 20 | 29000 | ND | <0.2 | 980 | 4400 | 1 | 1 | <10 | 40 | 210 | <10 | 40 | 40 |
| 24694-M 40 | 20 | 10 | 20 | <10 | 1800 | 20 | 17000 | ND | 0.2 | 480 | 4400 | 1 | 1 | <10 | 40 | 420 | <10 | 30 | 40 |
| 24695-M 41 | 40 | 5 | 20 | <10 | 1000 | 10 | 17000 | ND | 0.2 | 420 | 2000 | 1 | 1 | <10 | 20 | 750 | <10 | 10 | 20 |
| 24696-M 42 | 40 | 6 | 20 | <10 | 2800 | 30 | 29000 | ND | <0.2 | 720 | 4200 | 1 | 2 | <10 | 40 | 250 | <10 | 40 | 40 |

Table A-1 Cont'd

| STATION IDENTIFICATION NUMBER | Aluminum ug/g | Arsenic ug/g | Barium ug/g | Cadmium ug/g | Calcium ug/g | Cobalt ug/g | Iron ug/g | Lead ug/g | Mercury ug/g | Manganese ug/g | Magnesium ug/g | Selenium ug/g | Silicon ug/g | Silver ug/g | Strontium ug/g | Zinc ug/g | Titanium ug/g | Copper ug/g | Chromium ug/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24697-M 43 | 40 | 3 | 20 | <10 | 1400 | 5 | 6000 | ND | <0.2 | 220 | 680 | 1 | 1 | <10 | 10 | 990 | <10 | 5 | 10 |
| 24698-M 44 | 50 | 5 | 20 | <10 | 4600 | 10 | 14000 | ND | <0.2 | 340 | 1900 | 1 | 1 | <10 | 30 | 1200 | <10 | 25 | 20 |
| 24699-M 45 | 10 | 9 | 20 | <10 | 3600 | 20 | 28000 | ND | 0.2 | 560 | 4200 | 1 | 1 | <10 | 40 | 220 | <10 | 20 | 40 |
| 25700-M 46 | 10 | 2 | 10 | <10 | 3600 | 5 | 2000 | ND | <0.2 | 240 | 4400 | <1 | 1 | <10 | 120 | 210 | <10 | 30 | 10 |
| 25701-M 47 | 10 | 2 | 10 | <10 | 9200 | 5 | 3000 | ND | <0.2 | 68 | 440 | <1 | 1 | <10 | 40 | 180 | <10 | 30 | 10 |
| 25702-M 47A | 10 | 1 | 10 | <10 | 5400 | 10 | 3000 | ND | <0.2 | 18 | 600 | <1 | 1 | <10 | 20 | 230 | <10 | 10 | < 5 |
| 25703-M 48 | 10 | 2 | 10 | <10 | 600 | < 5 | 2600 | ND | <0.2 | 12 | 80 | <1 | 1 | <10 | 10 | 410 | <10 | 20 | < 5 |
| 24704-M 49 | 10 | 4 | 10 | <10 | 6800 | 10 | 5400 | ND | <0.2 | 86 | 260 | <1 | 1 | <10 | 40 | 170 | <10 | 30 | 10 |
| 24705-M 50 | 10 | 2 | 10 | <10 | 2200 | 10 | 2400 | ND | <0.2 | 34 | 180 | <1 | 1 | <10 | 10 | 60 | <10 | 20 | 5 |

Table A-2 - Pesticide Concentrations in Micrograms Per Kilogram (µg/kg) Dry Weight, from Bottom Sediments Collected at 33 Stations in Mobile Bay, Alabama, June 15 through 21, 1980.

| STATION IDENTIFICATION NUMBER | Lindane | Heptachlor | Aldrin | p,p'-DDD | p,p'-DDE | p,p'-DDT | PCB 1254 | PCB 1260 | Heptachlor epoxide | PCP | Dieldrin | Endrin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-A | ND | .81 | .40 | ND | ND | ND | ND | ND | ND | ND | .29 | ND |
| 3-A BOTTOM | .38 | ND | .15 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 7 TOP | .12 | ND | .34 | ND | ND | ND | .26 | ND | ND | ND | .57 | ND |
| 9-A TOP | 2.01 | .31 | ND | ND | 2.66 | ND | ND | 1.02 | ND | ND | ND | ND |
| 11 TOP | ND | .21 | .77 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 13 TOP | ND | ND | .44 | ND | ND | ND | .46 | .28 | ND | ND | .18 | ND |
| 14 | ND | ND | .15 | ND | ND | ND | .62 | ND | ND | ND | .61 | .68 |
| 15 TOP | ND | ND | .29 | ND | ND | ND | ND | ND | ND | ND | .36 | ND |
| 16 | ND | ND | ND | ND | ND | ND | ND | ND | ND | .36 | 1.38 | ND |
| 17 | ND | ND | .39 | ND | ND | ND | .26 | ND | ND | ND | .48 | .29 |
| 19 | ND | ND | ND | ND | ND | ND | .68 | .51 | ND | ND | ND | ND |
| 23 | ND | ND | .22 | ND | .13 | ND | .65 | .45 | .43 | ND | ND | .59 |
| 25 BOTTOM | ND | ND | .36 | ND | ND | ND | .86 | ND | .12 | ND | 1.00 | 1.03 |
| 27 | .24 | 3.40 | .48 | ND | ND | ND | ND | ND | ND | 1.30 | .42 | 1.38 |
| 28 | ND | ND | .29 | ND | ND | ND | ND | ND | ND | ND | .72 | ND |
| 29 TOP | .11 | .28 | .28 | ND | .46 | ND | ND | ND | ND | ND | .90 | ND |

*ND - Specifically analyzed for but not detectable.

| STATION IDENTIFICATION NUMBER | Lindane | Heptachlor | Aldrin | p,p'-DDD | p,p'-DDE | p,p'-DDT | PCB 1254 | PCB 1260 | Heptachlor epoxide | PCP | Dieldrin | Endrin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | .21 | ND | .27 | ND | ND | ND | .34 | ND | ND | ND | .40 | ND |
| 31 | ND | ND | .28 | ND | .13 | ND | .37 | ND | ND | ND | ND | ND |
| 33 | ND | ND | .17 | ND | ND | ND | ND | ND | ND | ND | .15 | ND |
| 34 | ND | ND | .21 | ND | ND | ND | ND | ND | ND | ND | .50 | ND |
| 35 | ND | ND | .25 | ND | ND | ND | ND | ND | ND | .46 | ND | ND |
| 36 | ND | ND | .14 | ND | ND | ND | ND | .43 | ND | ND | .23 | ND |
| 37 | .36 | .25 | .26 | ND | ND | ND | 1.09 | .22 | .99 | ND | .17 | ND |
| 38 | ND | ND | .14 | ND | ND | ND | ND | ND | .10 | ND | .38 | .47 |
| 39 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .60 | ND |
| 40 | .11 | .25 | .32 | ND | ND | ND | ND | ND | ND | ND | .76 | ND |
| 41 | ND | ND | .89 | ND | .92 | ND | ND | ND | .86 | ND | ND | ND |
| 43 | ND | .15 | .71 | ND | ND | ND | ND | ND | ND | ND | .12 | ND |
| 44 | .21 | ND | .75 | ND | ND | ND | ND | ND | .63 | ND | ND | ND |
| 45 | ND | ND | .47 | .62 | ND | ND | ND | ND | ND | .87 | 4.18 | .36 |
| 47 | ND | ND | .49 | .87 | ND | ND | .18 | .65 | ND | ND | .55 | ND |
| 48 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 49 | ND | 3.66 | 1.22 | .88 | ND | ND | ND | ND | ND | ND | .40 | ND |

Organic Carbon Present in the Bottom Sediment Collected from Mobile Bay, Alabama, June 15 through 21, 1980

| STATION IDENTIFICATION NUMBER | | % Organic Nitrogen | % Volatile Solids | % Phosphorus | % Organic Carbon |
|---|---|---|---|---|---|
| 24626-M | 1-A | .0006 | 2.1 | .0004 | .07 |
| 24627-M | 1 TOP | .0015 | 1.7 | .0004 | .07 |
| 24628-M | 1 BOTTOM | .0190 | 3.1 | .0004 | .07 |
| 24629-M | 2 TOP | .0017 | 3.1 | .0004 | .10 |
| 24630-M | 2 BOTTOM | .0025 | 3.2 | .0003 | .07 |
| 24631-M | 3 | .0007 | 2.5 | .0004 | .11 |
| 24632-M | 3-A TOP | .0014 | 3.0 | .0004 | .07 |
| 24633-M | 3-A BOTTOM | .0022 | 4.9 | .0004 | .08 |
| 24634-M | 4-A | .0019 | 4.1 | .0003 | .09 |
| 24635-M | 4 TOP | .0023 | 5.2 | .0006 | .11 |
| 24636-M | 4 BOTTOM | .0008 | 4.8 | .0007 | .08 |
| 24637-M | 5 TOP | .0003 | 6.6 | .0006 | .11 |
| 24638-M | 5 BOTTOM | .0002 | 2.9 | .0005 | .10 |
| 24639-M | 6 | .0008 | 6.9 | .0005 | .09 |
| 24640-M | 6-A TOP | .0027 | 3.5 | .0007 | .12 |
| 24641-M | 6-A BOTTOM | .0004 | 2.6 | .0007 | .10 |
| 24642-M | 7 TOP | .0028 | 3.0 | .0006 | .10 |

| STATION IDENTIFICATION NUMBER | | % Organic Nitroge | % Volatil Solids | % Phosphc | % Organic Carbon |
|---|---|---|---|---|---|
| 24643-M | 7 BOTTOM | .0008 | 3.6 | .0003 | .09 |
| 24644-M | 8 | .0014 | 4.0 | .0005 | .09 |
| 24645-M | 8-A TOP | .0024 | 3.5 | .0008 | .12 |
| 24646-M | 8-A BOTTOM | .0021 | 4.0 | .0005 | .12 |
| 24647-M | 9 TOP | .0008 | 1.2 | .0007 | .09 |
| 24648-M | 9 BOTTOM | .0016 | 3.7 | .0019 | .11 |
| 24649-M | 9-A TOP | .0015 | 9.1 | .0008 | .10 |
| 24650-M | 9-A BOTTOM | .0019 | 4.6 | .0019 | .09 |
| 24651-M | 10 | .0008 | 2.8 | .0004 | .09 |
| 24652-M | 11 TOP | .0024 | 4.1 | .0010 | .09 |
| 24653-M | 11 BOTTOM | .0015 | 3.9 | .0009 | .08 |
| 24654-M | 12 | .0016 | 2.8 | .0005 | .09 |
| 24655-M | 13-A | .0013 | 1.0 | .0002 | .06 |
| 24656-M | 13 TOP | .0015 | 4.2 | .0007 | .08 |
| 24657-M | 13 BOTTOM | .0012 | 3.1 | .0006 | .08 |
| 24658-M | 14 | .0017 | 2.8 | .0005 | .08 |
| 24659-M | 15 TOP | .0014 | 2.9 | .0003 | .09 |
| 24660-M | 15 BOTTOM | .0017 | 3.1 | .0005 | .08 |
| 24661-M | 16 | .0017 | 3.3 | .0005 | .07 |

| STATION IDENTIFICATION NUMBER | | % Organic Nitrogen | % Volatile Solids | % Phosphorus | % Organic Carbon |
|---|---|---|---|---|---|
| 24662-M | 17 | .0021 | 3.3 | .0013 | .04 |
| 24663-M | 17-A | .0009 | 1.7 | .0003 | .07 |
| 24664-M | 18 TOP | .0013 | 3.6 | .0008 | .09 |
| 24665-M | 18 BOTTOM | .0012 | 3.0 | .0007 | .09 |
| 24666-M | 19 | .0014 | 3.7 | .0016 | .07 |
| 24667-M | 20 TOP | .0007 | 3.0 | .0005 | .08 |
| 24668-M | 20 BOTTOM | .0018 | 2.7 | .0007 | .07 |
| 24669-M | 21 TOP | .0018 | 3.1 | .0017 | .09 |
| 24670-M | 21 BOTTOM | .0008 | 4.0 | .0006 | .09 |
| 24671-M | 22 TOP | .0004 | 3.8 | .0009 | .08 |
| 24672-M | 22 BOTTOM | .0010 | 4.0 | .0010 | .09 |
| 24673-M | 23 | .0007 | 2.0 | .0003 | .08 |
| 24674-M | 24 TOP | .0002 | 0.6 | .0001 | .06 |
| 24675-M | 24 BOTTOM | .0002 | 0.6 | .0001 | .05 |
| 24676-M | 25 TOP | .0011 | 2.5 | .0003 | .07 |
| 24677-M | 25 BOTTOM | .0012 | 2.2 | .0002 | .07 |
| 24678-M | 26 TOP | .0009 | 2.2 | .0002 | .06 |
| 24679-M | 26 BOTTOM | .0009 | 2.7 | .0004 | .07 |
| 24680-M | 27 | .0021 | 4.1 | .0005 | .07 |

Table A-3 Cont'd

| STATION IDENTIFICATION NUMBER | | % Organic Nitrogen | % Volatile Solids | % Phosphorus | % Organic Carbon |
|---|---|---|---|---|---|
| 24681-M | 28 | .0011 | 2.2 | .0003 | .07 |
| 24682-M | 29 | .0013 | 1.1 | .0003 | .05 |
| 24683-M | 30 | .0019 | 3.4 | .0004 | .06 |
| 24684-M | 31 | .0000 | 3.8 | .0005 | .07 |
| 24685-M | 32 | .0001 | 1.7 | .0002 | .06 |
| 24686-M | 32-A | .0000 | 3.5 | .0008 | .08 |
| 24687-M | 33 | .0000 | 0.4 | .0001 | .04 |
| 24688-M | 34 | .0000 | 4.3 | .0006 | .08 |
| 24689-M | 35 | .0000 | 1.4 | .0002 | .05 |
| 24690-M | 36 | .0004 | 2.7 | .0005 | .06 |
| 24691-M | 37 | .0000 | 2.7 | .0007 | .05 |
| 24692-M | 38 | .0001 | 0.9 | .0001 | .04 |
| 24693-M | 39 | .0000 | 2.7 | .0008 | .06 |
| 24694-M | 40 | .0007 | 2.7 | .0006 | .06 |
| 24695-M | 41 | .0002 | 1.2 | .0002 | .04 |
| 24696-M | 42 | .0002 | 2.0 | .0003 | .05 |
| 24697-M | 43 | .0000 | 0.5 | .0002 | .02 |
| 24698-M | 44 | .0001 | 1.6 | .0004 | .06 |
| 24699-M | 45 | .0000 | 2.7 | .0003 | .07 |

Table A-3 Cont'd

| STATION IDENTIFICATION NUMBER | | % Organic Nitrogen | % Volatile Solids | % Phosphorus | % Organic Carbon |
|---|---|---|---|---|---|
| 24681-M | 28 | .0011 | 2.2 | .0003 | .07 |
| 24682-M | 29 | .0013 | 1.1 | .0003 | .05 |
| 24683-M | 30 | .0019 | 3.4 | .0004 | .06 |
| 24684-M | 31 | .0000 | 3.8 | .0005 | .07 |
| 24685-M | 32 | .0001 | 1.7 | .0002 | .06 |
| 24686-M | 32-A | .0000 | 3.5 | .0008 | .08 |
| 24687-M | 33 | .0000 | 0.4 | .0001 | .04 |
| 24688-M | 34 | .0000 | 4.3 | .0006 | .08 |
| 24689-M | 35 | .0000 | 1.4 | .0002 | .05 |
| 24690-M | 36 | .0004 | 2.7 | .0005 | .06 |
| 24691-M | 37 | .0000 | 2.7 | .0007 | .05 |
| 24692-M | 38 | .0001 | 0.9 | .0001 | .04 |
| 24693-M | 39 | .0000 | 2.7 | .0008 | .06 |
| 24694-M | 40 | .0007 | 2.7 | .0006 | .06 |
| 24695-M | 41 | .0002 | 1.2 | .0002 | .04 |
| 24696-M | 42 | .0002 | 2.0 | .0003 | .05 |
| 24697-M | 43 | .0000 | 0.5 | .0002 | .02 |
| 24698-M | 44 | .0001 | 1.6 | .0004 | .06 |
| 24699-M | 45 | .0000 | 2.7 | .0003 | .07 |

Table A-3 Cont'd

| STATION IDENTIFICATION NUMBER | | % Organic Nitrogen | % Volatile Solids | % Phosphorus | % Organic Carbon |
|---|---|---|---|---|---|
| 24700-M | 46 | .0003 | 0.5 | .0000 | .03 |
| 24701-M | 47 | .0006 | 0.3 | .0001 | .02 |
| 24702-M | 47-A | .0003 | 0.2 | .0000 | .02 |
| 24703-M | 48 | .0012 | 0.2 | .0000 | .04 |
| 24704-M | 49 | .0004 | 0.5 | .0001 | .04 |
| 24705-M | 50 | .0005 | 0.2 | .0001 | .02 |