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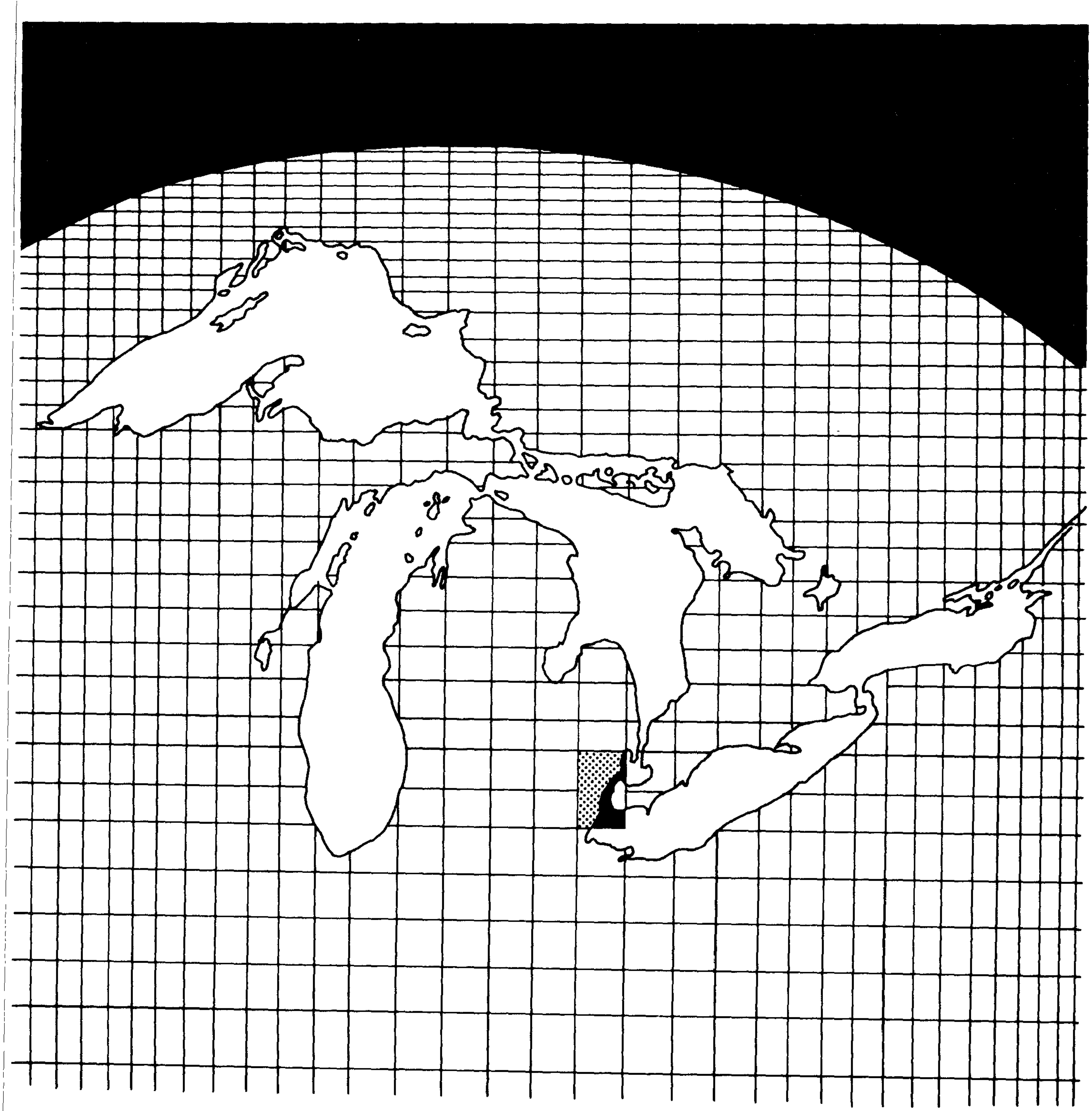
1982 Detroit, Michigan Area Sediment Survey



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1982 Detroit Michigan Area Sediment Survey

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FOREWORD

The Great Lakes National Program Office (GLNPO) of the United States Environmental Protection Agency was established in Region V, Chicago, to focus attention on the significant and complex natural resource represented by the Great Lakes.

GLNPO implements a multi-media environmental management program drawing on a wide range of expertise represented by universities, private firms, State, Federal, and Canadian governmental agencies, and the International Joint Commission. The goal of the GLNPO program is to develop programs, practices and technology necessary for a better understanding of the Great Lakes Basin ecosystem, and to eliminate or reduce to the maximum extent practicable the discharge of pollutants into the Great Lakes system. GLNPO also coordinates the United States' actions in fulfillment of the Agreement between Canada and the United States of America on Great Lakes Water Quality of 1978.

DISCLAIMER

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ABSTRACT

Twenty-eight sediment grab samples from the western bank of the Detroit River and three of its tributaries were chemically analyzed. Sampling sites were chosen to find worst-case conditions. High levels of conventional pollutants and metals were found throughout most of the study area. Hydrophobic organic contaminants found in a wide range of concentrations included: polynuclear aromatic hydrocarbons, polychlorinated biphenyls, various pesticides, and volatile organic compounds. Contaminant distributions suggest recent inputs from local sources. Highest contaminant levels were found in the Rouge River, the northern Trenton Channel and Conners Creek in the Belle Isle Area. The City of Detroit Wastewater Treatment Plant, combined sewer overflows, local steel and chemical industry and oil refineries are implicated as likely sources. Several contaminants including volatile organics, PCBs and hexachlorobenzene, seem to have major upstream sources, perhaps in Lake St. Clair or the St. Clair River.

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SUMMARY

The objective of the 1982 Detroit, Michigan Sediment Survey was to determine the degree of contamination of the river and harbor sediments by toxic substances. Sediments in areas of suspected contamination along the western side of the Detroit River, and in the major tributaries on the western shore of the Detroit River were sampled. Sediment contaminant data generated by this study will be used for reporting on the environmental status of the area and identification of problem areas requiring remedial activity.

Sampling site locations were chosen in areas where contaminanted sediments were most likely to be found. Locations of industrial and municipal outfalls and other suspected sources of contamination to river sediments strongly affected decisions, as did sedimentation patterns and existing sediment quality data. Sixty-five samples were retrieved. Of these, twenty-eight samples were analyzed. 1982 Detroit sediment contaminant levels were evaluated in terms of USEPA (1977) Sediment Guidelines for the Pollutional Classification of Great Lakes Harbor Sediments, Appendix A (Sediment Guidelines), where possible. However, these guidelines for pollutional classification have been set for only 18 of the 109 parameters which were analyzed. As no other guidelines exist, evaluation of the severity of contamination by the remaining 91 parameters required individual interpretation.

CONVENTIONAL POLLUTANTS

Comparison of the concentrations of conventional pollutants against the USEPA Sediment Guidelines indicates that sediments at all stations sampled and analyzed by EPA GLNPO in 1982 in the Detroit area were highly contaminated with a few exceptions: Some stations in the area from Belle Isle to downtown Detroit (DTR82-01, DTR82-05A, and DTR82-13), and all stations in the Huron River area had moderate to low levels of contamination. The highest levels of ammonia, total volatile solids, chemical oxygen demand (COD), total Kjeldahl nitrogen (TKN), and cyanide were found in the Rouge River downstream from the Dearborn Ford Plant. Phosphorus levels were highest in the southern Trenton Channel. Oil and grease levels were highest in the northern Trenton Channel, north of Belle Isle in Conners Creek, and in the Rouge River.

METALS

Comparison of concentrations of heavy metals against Sediment Guidelines shows that the sediments were highly contaminated throughout most of the study area. The only exceptions were stations DTR82-01 and DTR82-05A near Belle Isle, and the three stations in the Huron River area.

Three portions of the study area had particularly high levels of certain metals, possibly indicating sources in those areas or upstream: 1) Conners Creek, in the Belle Isle area, 2) Rouge River, 3) northern Trenton Channel. Lead and barium were very high in Conners Creek. Iron and cadmium concentrations were notably high in the Rouge River. The northern Trenton Channel had very high levels of chromium, mercury, nickel and zinc. Level of most metals in sediments at the Huron River mouth were low relative to the other stations in the study area. Huron River manganese levels, however, were far higher than elsewhere.

ORGANIC CONTAMINANTS

Polynuclear Aromatic Hydrocarbons (PAHs)

Total PAH values range from a low value of 620 ug/kg (ppb) in the Huron River to an area-wide high of 125,200 ug/kg in the lower Rouge River. The highest levels of total PAHs were found along the Detroit City riverfront and in the lower Rouge River. The greatest concentrations of hazardous PAHs were found in the lower Rouge River and in the main stem of the Detroit River below Belle Isle. Possible sources are the local steel industry and Detroit CSOs.

Polychlorinated Biphenyls (PCBs)

The highest concentrations of total PCBs were found near Belle Isle (9,897 ug/kg), below the mouth of the Rouge River (9,726 ug/kg), and in the Trenton Channel (13,870 ug/kg). The Aroclors PCB 1248 and PCB 1254 predominated. USEPA Sediment Guidelines for total PCBs were exceeded at three stations in the northern Trenton Channel.

DDT and Metabolities

The highest levels of total DDT and its metabolities were found at Belle Isle, (2,265 ug/kg) and were dominated by DDD. High levels of unmetabolized DDT were found at the Rouge River mouth and in the Trenton Channel, possibly indicating recent additions that have not yet been degraded.

Other Pesticides

Beta-BHC concentrations were elevated at Belle Isle (170 ug/kg), above the Ecorse River (195 ug/kg) and below the Ecorse River (160 ug/kg). Gamma-Chlordane was found throughout the study area with peaks at Conners Creek

(145 ug/kg) and in the Ecorse River (149 ug/kg). Concentrations of other pesticides did not show regular patterns.

Volatile Organics

Dichloromethane, trichloroethene, methyl benzene, ethyl benzene and dimethyl benzenes were widely present throughout the study area. Their high background levels may indicate upstream sources. Peak concentrations of these volatile substances were found in the Rouge River area, and down river, indicating probable sources in these areas such as Detroit CSOs and local steel and chemical industry.

Phenol and Phenolics

Concentrations of phenol and other phenolics ranged widely from zero to a high value of 25,100 ug/kg for 2,4 dimethyl phenol in the northern Trenton Channel.

Substituted Benzenes and Substituted Cyclic Ketones

Hexachlorobenzene (HCB) is widely present throughout the study area, implying upstream sources. Highest levels of HCB (106 ug/kg) and other benzenes and cyclic ketones were found in the Trenton Channel.

Other Polycyclic Aromatics and Phthalate Esters

Dibenzofuran concentrations are high below downtown Detroit (3,620 ug/kg) and in the lower Rouge River (1,910 ug/kg). Peaks for di-n-butyl phthalate (5,690 ug/kg) and Bis (2-ethyl hexyl) phthalate (47,000 ug/kg) are found in Conners Creek, the lower Rouge River, and below the Ecorse River.

CONCLUSIONS

Although Detroit River sediments are generally heavily polluted, three areas stand out as centers of contamination:

1) Rouge River sediments display high levels of every contaminant category indicating the proximity of sources.
2) Trenton Channel sediments also had high contaminant levels in all categories, indicating proximity of sources, or deposition of sediments contaminanted by upstream sources.
3) Conners Creek sediments had high levels of conventional pollutants, metals and several categories of organic contaminants: (i.e., PAH, DDT, PCBs, pesticides, phthalates). Conners Creek is thus a major source of contamination to the Detroit River.

In contrast, sediments in both the northern Detroit River near Belle Isle and in the Huron River had low to moderate contaminant levels.

Sources

It is unclear at this point what the relative impacts are from the many potential sources of contamination. Ambient, or background and historical levels of the various contaminants must be known before the load entering the Detroit River can be determined. Several contaminants, including volatile organics, HCB, and PCBs seem to have major upstream sources, perhaps in Lake St. Clair, or the St. Clair River.

The many industrial and municipal point sources clearly have strong impacts upon sediment quality. The City of Detroit Wastewater Treatment Plant and combined sewer overflows, and local steel and chemical industry and oil refineries are implicated as major contaminant sources. It is presently unclear whether most sediment contamination results from on-going discharges, historical discharges, or some combination of the two.

The effects of non-point sources, such as runoff and groundwater seepage to the river are even more difficult to evaluate. This would require a systematic study involving an inventory of these sources and monitoring of their releases.

Interpretation

Knowledge of sediment particle size and total organic carbon (TOC) content are essential for an understanding of solid state contaminant transport and estimation of releases to the water column. Normalization of sediment chemistry data by comparison to TOC, particle size, or conservative metals, such as aluminum or silicon, would enable one to interpret degrees of pollution of sediment in inhomogeneous substrates, based upon absolute chemical concentrations alone.

INTRODUCTION

This report evaluates sediment chemistry data from the Detroit River and its three major U.S. qtributaries; the Rouge River, the Ecorse River, and the Huron River. The sediment samples were collected October 26, through October 28, 1982 by Great Lakes National Program Office staff as part of its Harbor Sediment Program.

Harbor Sediment Program

Toxic substances are being introduced into the environment from many sources. Secondary compounds from these toxicants are often found in the environment. Some of these secondary compounds are more hazardous than the primary chemicals from which they came.

Sediments serve as a sink, as well as a potential source for toxic and conventional pollutants. Even if discharges of pollutants were completely eliminated, contaminated sediments could serve as a source of pollution to the Great Lakes, to aquatic life, and to the populations using the water supplies for many years to come. Sediments typically concentrate contaminants to many times their concentration in water or effluents because of the adsorptive properties of fine particles. Sediments can, therefore, serve as an early warning for the particular contaminants to be looked for in effluents, waste disposal or treatment lagoons, etc. If one names the toxic substances Areas of Concern around the Great Lakes, the "problem" is invariably linked with toxic substances in the sediments: Waukegan Harbor, Illinois; Indiana Harbor Canal/Grand Calumet River, Indiana; Ashtabula River, Ohio; Saginaw River and Bay, and the Titabawasee River, Michigan;

Sheboygan River, Green Bay, and Milwaukee Estuary, Wisconsin; Hamilton Harbor, Ontario; and the Buffalo and Niagara Rivers, New York.
The problem of assessing the sources of contaminants in Great Lakes Harbors is complicated because these harbors are often located at ributary mouths. The concentrations and distributions of toxic substances in the sediments reflect upstream contributions, as well as local industrial and municipal activity. Discharge of contaminated groundwater into surface waters is gaining recognition as a potentially significant source of sediment contamination. (Swain, 1985).

Some 10 million cubic meters of sediments are dredged annually to maintain navigation in Great Lakes' ports. Many of these ports contain sediment that is heavily contaminated with toxic substances. Environmentally safe dredging and disposal practices are necessary to protect the lakes, wildlife, and the public while maintaining the economic viability of waterborne commerce.

"In-Place" pollutants in the sediments have only recently been recognized as a major source of ecosystem degradation. Also, the analytical capability to allow meaningful analysis of sediments for toxic organic substances has improved significantly in recent years. This has resulted in a limited historical database for organic contaminant levels in sediments. To fill this void, GLNPO is implementing a multiyear effort to determine the degree of contamination of Great Lakes' river and harbor sediments by toxic substances. Sampling priorities are determined by examining fish flesh contaminant data, locations of likely industrial sources, and by review of USEPA and other agency data.

Nineteen surveys were completed in 1981, including a survey of the Buffalo River and the Niagara River. Ten surveys of Lake Erie harbors were completed in 1982, including surveys of the Cuyahoga River and Cleveland Harbor, and the Maumee River. This report summarizes the results from the 1982 survey of the Detroit River, Rouge River and Huron River, Michigan.

The information generated by this program will be used in making regulatory decisions on dredging and disposal. It will also help identify environmental "hotspots" requiring further remedial activity, including identification and control of sources. The chemicals monitored in the sediments will form a new information base for the Great Lakes. The GLNPO sediment data base may be the largest collection of sediment contaminant data in the United States that is based on consistent sampling and analytical methodology (Palmer, 1985).

SAMPLING METHODOLOGY

Sediment samples were collected in the manner described in the Methods Manual for Bottom Sediment Sample Collection (Palmer, 1985). This manual provides detailed procedures for survey planning, sample collection and handling, document preparation and quality assurance for sediment sampling surveys.

Each site survey was designated by determining and plotting, on a large scale map, the location of sewage treatment plant discharges, combined sewer discharges (particularly those carrying industrial waste), industrial discharges, and any other feature that may give rise to contaminated sediments. To this were added any data on sedimentation patterns that may exist from dredging records, and existing data on sediment quality. Supplementary information, for example, locations of areas of suspected contaminated ground water discharge, was used to help site sampling locations when available. All the above information was used to identify locations where contaminated sediments were most likely to be found. Since sample sites were chosen to find worst-case conditions, the analytical data do not represent the ambient sediment contaminant levels in the area. Site locations were determined in the field by triangulations to easily identifiable landmarks. The derived locations were then plotted on large-scale charts to determine latitude and longitude.

In general, sediments will deposit along the edges of a navigation channel, on the inside edge of a bend of a river, and on the down-drift side of the littoral drift beach zone. Samples were, therefore, generally collected in these areas rather than mid-channel. Sounding charts were extremely helpful for sample site selection since they show the areas requiring the most dredging and, therefore, areas where the shoal material is depositing. Areas most likely to show the pollutional effects of man's activity were sampled. Therefore, when applicable, sample sites were located in the vicinity of marinas, loading docks, and industrial or municipal outfalls.

SAMPLING EQUIPMENT

Grab samples were retrieved using a Ponar grab sampler. Core samples were taken using a Wildco brass corer, with a two foot long core tube having a 2" inner diameter, and a clear Lexan® plastic liner tube. The sediments were stored at 4°C. Grab samples were homogenized in a stainless steel tub prior to placement into one quart glass jars. Cores were extruded into a stainless steel tub, and the surficial portions of cores were homogenized prior to placement into one quart glass jars. A more detailed discussion of sampling methodology is available in "Methods Manual for Bottom Sediment Sample Collection," (Palmer, 1985).

ANALYTICAL METHODOLOGY

Prior to non-volatile organic analysis, the sediment samples were allowed to thaw to 15-25°C. Each sample was manually mixed and allowed to air dry. All samples were ground with a mortar and pestle. Any sample requiring further homogenation, at the analyst's discretion, was then passed through a 20 mesh polypropylene sieve. The percentage of solids of the sample was determined from a separate aliquot dried at 103-105°C.

Organic Contaminants

Samples were scanned for organic contaminants using gas chromatography techniques. Gas chromatography mass spectrometer (GC/MS) organic scans involve acid, base and neutral extractions of volatile and semi-volatile priority pollutants. Electron capture gas chromatographic analysis is the preferred method for quantitative determination of pesticides and PCBs. Detection limits for particular compounds vary from one sample to the next due to matrix effects presented by other compounds contained in the sample. Tables 1 and 2 list organic pollutants scanned for and their detection limits.

Metals

Total mercury concentrations were determined by first digesting the sediment samples in a mixture of concentrated nitric and sulfuric acid, then analyzing the acid extracts using USEPA cold vapor atomic absorption spectrometry methods. A scan for 24 additional metals was made using Inductively Coupled Argon Plasma (ICAP) techniques. Table 3 lists the analyzed metals and their detection limits. All metals values are reported as mg/kg dry weight.

The following eight analyses of conventional pollutants were also run on all sediments:

Chemical Oxygen Demand (COD)

COD was determined based on a catalyzed reaction with potassium dichromate. A homogenized, acidified wet sediment sample was mixed with standardized potassium dichromate, silver sulfate-sulfuric acid and mercuric oxide, and was refluxed for 2 hours. The COD of the sample is proportional to the amount of dichromate chemically reduced during the procedure. COD values are reported as mg/kg.

Oil and Grease

The acidified sediment is dried with magnesium sulfate monohydrate and extracted with freon in a soxhlet apparatus for four hours. This method is applicable to the measurement of freon extractable matter from sediments which contain relatively non-volatile hydrocarbons, vegebable oils, animal fats, soaps, waxes, greases and related compounds. This method is not applicable to the measurement of light hydrocarbons that volatilize at temparatures below 70°C. Petroleum fuels from gasoline through #2 fuel oil are completely, or substantially lost in the solvent extraction process. Oil and grease values are reported as mg Freon Extractables/kg dry sediment.

Cyanide

Cyanide was converted to HCN by means of a reflux-distillation catalyzed by copper chloride which decomposes metallic cyanide complexes. Cyanide was determined spectrophotometrically as the cyanide is absorbed in a 0.2 N NaOH solution. Cyanide concentrations are reported as mg CN/kg dry sediment.

Total Phosphorus

Phosphorus was determined using a Technicon II Auto Analyzer after block digestion of the sample. A 0.5 g dry weight sample was suspended in an HgO-K_2O_4-H_2SO_4 solution and digested at 200°C for 1 hour. Phosphate in the digestate was quantified using the Automated Ascorbic Acid procedure. Phosphorus concentrations were reported as mg/kg dry sediment.

Solids

A known weight of homogenized, moist sediment was dried at 105°C. The total solids were calculated as: $\% \text{ Solids} = \frac{\text{dry weight g}}{\text{wet weight g}} \times (100\%)$.

Volatile Solids

Volatile solids were determined by igniting the residue from the total solids determination at 550°C to a constant weight. Volatile solids were expressed as a percentage of the total solids in the sample.

Total Kjeldahl Nitrogen (TKN)

TKN was determined on the HgO-K_2SO_4-H_2SO_4 sediment digest analyzed for total phosphorus. Nitrogen was quantified as ammonia using the alkaline phenol hypochlorite procedure. Values are reported as mg TKN-N/kg dry weight.

Ammonia

Alkaline phenol and hypochlorite react with ammonia in the presence of sodium nitroprusside to form indophenol blue. The intensity of the blue color is proportional to the concentration of ammonia. Ammonia concentrations are reported as mg N/kg dry sediment.

Quality Assurance

Quality assurance procedures set variance limits for reference samples, sample splits, and spike samples. Any results obtained outside USEPA acceptance limits were flagged as out-of-control, and the samples rerun.

More detailed descriptions of the methodology for sediment analysis and quality assurance are available in the Upper Great Lakes Connecting Channels (UGLCC) Work/Quality Assurance Plan for: 1982 Detroit, Michigan Area Sediment Survey and in Appendix B of this report.

THE SETTING

Urban and Industrial Development

The Detroit River, one of the busiest commercial waterways in the world, flows thirty-two miles southeast from Lake St. Clair, past an area of intense urban and industrial development, to Lake Erie. The IJC has classified the river as an Area of Concern due to degraded water and sediment quality, primarily along the west bank below the Rouge River mouth. Steel, auto, and chemical industries are concentrated on the banks of the river and its tributaries, and utilize the waters for cooling and processing water. (Figure 1, Detroit area industry). The Detroit Rivers major tributary, the Rouge River, is also classified as an IJC Area of Concern primarily due to contaminated sediments (IJC, 1985).

Geology and Hydrogeology

Glacial drift, ranging in thickness from zero to over three hundred feet is the dominant surficial geological material in the Detroit area. The drift is underlain by bedrock of Early Mississippian to Early Devonian age, dipping gradually to the north and west. Rocks of the Devonian Detroit River Group and the Silurian Salina formation outcrop in the lower reaches of the Detroit River in Trenton, and on Grosse Ile. Glacial deposits, for the most part, are poorly sorted fine materials consisting mostly of lacustrine and morainal deposits and till plains, having low hydraulic conductivites. Distribution of the glacially-derived materials is non-homogeneous, however. Patches of beach sand and coarse-grained outwash deposits with high hydraulic conductivities are found scattered throughout the area. Other coarse-grained deposits, originating during pre-glacial conditions, or water-sorted deposits from earlier stages of glaciation in some areas underlie the most recent glacial materials, and are often good groundwater reservoirs. Coarse alluvial sediments, resulting from the pre-glacial drainage system, lie below Highland Park and Hamtramck, and extend out to Belle Isle (Figure 2, Bedrock Surface Topography). Such deposits may be important pathways for contaminant transport to Detroit River sediments. An area-wide groundwater study is necessary to determine the impacts of groundwater seepage upon the river sediments and the Detroit River as a whole.

Hydrology

Mean Detroit River discharge, from 1900 to 1978, is roughly 184,000 cfs (G.L. Water Levels Facts, 1984). The river falls about three feet from Lake St. Clair to Lake Erie, and average velocities vary from one to over two feet per second. Water depths and flow are dependent upon Lake St. Clair and Lake

Erie levels which fluctuate seasonally. Superimposed upon the seasonal fluctuation are storm-related short-term variations, which affect and may at times, even reverse the Detroit River flow (Figure 3, Detroit River study area).

The Detroit River has two well-defined reaches having distinct hydraulic characteristics. The upper stretch of the river, from Lake St. Clair to just above Fighting Island (above the Ecorse River) is a broad bend about thirteeen miles long flowing as a single channel 2,000 to 3,000 feet wide. The river is 30-50 feet deep mid-channel. Its narrowest section is at the Ambassador Bridge where it is 1900 feet wide. Maximum mid-channel velocities here approach four feet per second.

In the lower reaches, the river is one mile to two miles wide, and shallow. The flow here is considerably slower requiring continuous dredging. The river is divided by islands into several major channels. Depths are maintained at twenty-seven to twenty-eight feet by dredging. The Trenton Channel is a second major channel about one thousand feet wide between Grosse Isle and the Michigan mainland. Navigation depths are maintained at twenty-seven and twenty-one feet in the northern portion of the Trenton Channel, while natural, undredged depths at the southern end are less than ten feet (Station DTR82-45, and below). Rocks of the Detroit River Group outcrop in the lower reaches, and shipping channels have been cut through this exposed bedrock to a depth of thirty feet.

Flow information for the Detroit River and flow hydrographs for the Rouge and Huron Rivers indicate that the sampling period in late October is typically a time of relatively low flow (Figure 4, Hydrographs) implying net accretion of sediments, including some fine sediments. Similarly, Manuscripts for the 1982 Water Year indicate that October 1982 was a period of baseflow for the tributaries (USGS, 1983). Therefore the influence of groundwater discharge upon the streams, especially the Rouge River, was at a maximum at this time. Also, during periods of low flow, Detroit River water and sediments are carried up the Michigan tributaries, especially when winds are out of the east.

Mineralogy

A. Mudroch (1984), using non-quantitative powder x-ray diffraction techniques, found the mineralogy of the Detroit River sediments to be composed primarily of calcite and dolomite, quartz, feldspars and the clay minerals; illite, chlorite and kaolinite. Quartz and calcite comprise the >63 um, or sand size category. Dolomite and the feldspars largely made up the 4-63 um, or silt-sized category. Illite, chlorite, kaolinite and "other" minerals made up the <4 um, or clay-sized category.

RESULTS AND DISCUSSION

Sampling Sites and Reporting

Sediment grab samples were collected at sixty-five locations along the western bank of the Detroit River and three of its tributaries: the Rouge River, the Ecorse River, and the Huron River from October 26 to October 28, 1982 (Figure 5, USEPA Detroit 1982 Sediment Sampling Sites; Figure 6, Huron River Michigan Sediment Sampling Sites). In tables and figures throughout this report, sediment stations will be listed in a downstream order for easy geographical correlation. Although some of the parametric data displayed in histograms appears to be grouped in some way, the histograms are not intended to imply any kind of continuity from one sample to the next. Sediment data is rather patchy by nature. To further ease comparisons and correlations, the study area has been divided into eight sub-areas, each having rather distinct hydrological and cultural characteristics:

<u>BELLE ISLE</u> (Stations DTR82-01, DTR82-03, DTR82-05A)

Belle Isle itself is a recreational area. The channel west of the island is characterized by extensive shoal areas. Loading docks, marinas, light industry, a major tire company and a coal-fired power plant are located along the Michigan mainland. Conners Creek (DTR82-03) is below a major automobile assembly plant, and below a major structure of the City of Detroit Combined Sewer system, the Conners Creek Backwater Gate. (Figure 7, Detroit area CSOs).

<u>DOWNTOWN DETROIT</u> (Stations DTR82-08, DTR82-13)

This sub-area extends from the south end of Belle Isle, past downtown Detroit to the Ambassador Bridge. Land use along the shore of this fast flowing, narrow portion of the river is characterized by light industry and commercial/residential uses. Over thirty Detroit Combined Sewer Overflow (CSO) points are located along the Detroit River in this sub-area.

<u>ROUGE RIVER (Stations DTR82-19, ROR82-07, ROR82-06, ROR82-02)</u>

The Rouge River sub-area includes the Detroit River between the Rouge Old Channel and the Rouge Short-cut Canal, and the Rouge River itself below the Ford Dearborn plant. The entire area is heavily developed with automobile assembly, steel, paper and pulp, and oil refining industry. In addition, the Detroit waste water treatment plant (WWTP) and 180 CSOs discharge to the Rouge River.

ROUGE RIVER to ECORSE RIVER (Stations DTR82-22, DTR82-23, DTR82-25, DTR82-26, DTR82-27)

The portion of the Detroit River between the Rouge River mouth and the Ecorse River mouth is a transitional area where the river changes from a narrow fast-flowing channel to a broad channel divided by islands. It is characterized by heavy steel manufacturing and oil refining industry.

ECORSE RIVER (Stations DTR82-52, DTR82-53, DTR82-29, DTR82-30)

The north and south branches of the Ecorse River and the portion of the Detroit River immediately downstream of the Ecorse River mouth comprise this sub-area. Heavy steel manufacturing and chemical industry which discharges to the Detroit River are the major land uses. Fighting Island, Mud Island, Grassy Island and the northernmost point of Grosse Ile have been used for disposal of industrial waste and dredged material.

NORTHERN TRENTON CHANNEL (Stations DTR82-32, DTR82-38, DTR82-56, DTR82-49)

The northern portion of the Trenton Channel is dredged to a depth of twenty-seven feet to accommodate large ships. Chemical industry and residential areas characterize the mainland land use in the extreme northern portion of the channel above the northern tip of Grosse Isle. Heavy steel and chemical manufacturing is the characteristic land use below the town of Wyandotte. Huntington/Monguogon Creek drains a heavily industrialized area containing landfills into the Trenton Channel at station DTR82-38. Grosse Ile itself is largely residential, except the northern tip, which is a former waste disposal area.

SOUTHERN TRENTON CHANNEL (Stations DTR82-43, DTR82-45, DTR82-48)

The southern Trenton Channel is shallow and undredged. Although it is generally an industrial area, characterized by power, steel and chemical industry, the level of industrial activity is less than that in the northern Trenton Channel. Several small tributaries drain into the southern Trenton Channel. Extensive shallow sediment depositional areas are found at the southern end of Grosse Isle.

HURON RIVER (Stations HUR82-01, HUR82-02, DTR82-57)

This sub-area is comprised of the downstream reach and mouth of the Huron River. The river mouth and the surrounding wetlands comprise the Pointe Mouilee State Game Area. A confined disposal facility is under construction at the mouth of the river. Upstream sources of contamination on the Detroit River may impact this area when westerly winds on the Detroit River and Lake Erie move contaminated water and sediments upstream. In addition, the Huron River drains with potential municipal and rural sources of contamination.

Field Observation. (Table 4, Field Observations)

Field observations indicate sediment from about half of the stations contained sand or coarser-grained materials. Sediment from ten of twenty-eight stations was said to contain "muck" or "ooze", indicating input of recent and organic material. Gravel was observed in two stations in the study area below the Ecorse River mouth, and in the Huron River, perhaps indicating an energetic flow regime. An oily sheen, or an oily or chemical odor was observed in eleven of twenty-eight samples and in stations from all the sub-areas with the exception of the Huron River area.

CONVENTIONAL POLLUTANTS

Conventional pollutant levels (total volatile solids, oil and grease, COD, TKN, ammonia, phosphorus and cyanide) indicate severe sediment contamination throughout most of the study area. Sampling sites near Belle Isle to the north, and in the Huron River to the south, have less extreme contaminant levels. The Rouge River sediments stand out as the most contaminated by conventional pollutants: the very highest levels in the study area of total volatile solids, COD, TKN, ammonia and cyanide are all found in one sample upstream on the Rouge River (ROR82-07). The highest levels of phosphorus and oil and grease are found in sediments from the central portion of the Trenton Channel (Table 5, Conventional Pollutants).

Total Volatile Solids. Total volatile solids levels are high throughout most of the study area, and range from 2.4% to 23.4%. The USEPA Sediment Guidelines for the "heavily polluted" categories were exceeded in 71% of the samples, 14% are moderately polluted and 14% are "unpolluted." The mean % total volatile solids level is 9.53%, and falls in the "heavily polluted" category. Highest levels are found in the Rouge River sub-area. (Figure 8, %Total Volatile Solids.)

Oil and Grease

Determinations of oil and grease levels were performed as supplemental analyses in 1985. Only eighteen of the samples had sufficient material for analysis. Of these eighteeen, sixteen, or 89% exceeded USEPA Sediment Guidelines for the the "heavily polluted" category. The remaining two sites, in the Huron River subarea, had "moderately polluted" oil and grease levels. The range in values values was very broad, from 1,752 mg/kg to 38,990 mg/kg. The mean oil and grease level is 16,225 mg/kg, falling well into the "heavily polluted" category. The highest levels were found in the northern Trenton Channel, in Connors Creek, above the Ecorse River mouth and in the Rouge River (Figure 9, Oil and Grease).

Chemical Oxygen Demand. COD levels are high throughout most of the study area, ranging from 31,000 mg/kg to 300,000 mg/kg. USEPA Sediment Guidelines for "heavily polluted" are exceeded in 75% of the samples, 18% are moderately polluted, and 7% are "unpolluted." The mean COD level of the study is 142,000 mg/kg and falls in the "heavily polluted" category. Highest levels are found in the Rouge River and the northern Trenton Channel sub-areas (Figure 10, COD).

Total Kjeldahl Nitrogen. TKN levels are high in many of the study area sediment samples, and range from 640 mg/kg to 8600 mg/kg. 54% of the samples have TKN levels which exceed USEPA Sediment Guidelines for "heavily polluted," 35% are moderately polluted, and 10% are "unpolluted." The mean TKN level in the study area is 2472 mg/kg and falls in the "heavily polluted" category. The highest TKN level is found in the Rouge River (Figure 11, TKN).

Ammonia. Ammonia levels are very high in most of the study area, and range from 50 mg/kg to 1400 mg/kg. 57% of the samples exceed USEPA Sediment Guidelines for "heavily polluted," 25% are "moderately polluted" and 18% of the samples are "unpolluted." The mean ammonia level in the study area is 365 mg/kg, which is in the "heavily polluted" category. The highest ammonia levels were found in the Rouge River, and downstream in the area between the Rouge and Ecorse Rivers, perhaps indicating a major source in the Rouge River (Figure 12, Ammonia).

Phosphorus. Phosphorus levels are very high throughout most of the study area, exceeding USEPA Sediment Guidelines for "heavily polluted" in 86% of the samples. 7% of the sediment samples are "moderately polluted," and another 7% are "unpolluted." The mean phosphorus level of 2604 mg/kg falls in the "heavily polluted" category. Phosphorus values range from 350 mg/kg to 6700 mg/kg, and the highest levels are found above the Ecorse River mouth and in the Trenton Channel (Figure 13, Phosphorus).

Cyanide. Cyanide levels are very high throughout most of the study area ranging from 0.1 mg/kg to 33.0 mg/kg. USEPA Sediment Guidelines for "heavily polluted" were exceeded in 71% of the samples. The mean cyanide level over the whole study area is 5.85 mg/kg, and falls in the "heavily polluted" category. Peak levels are seen in Conners Creek, in the Rouge River, above the Ecorse River mouth, and in the northern Trenton Channel. Detection levels for cyanide exceed the "heavily polluted" category, therefore, caution should be excerised in interpreting these data (Figure 14, Cyanide).

DISCUSSION

Figures 8 - 14 illustrate clearly that all the sub-areas with the exception of the Ecorse River and the Huron River are heavily polluted. Furthermore, three sub-areas seem to be exceptionally polluted: the Rouge River, the area between the Rouge and the Ecorse River mouths, and the northern Trenton Channel. The largest concentrations of heavy industry in the study area are found in these sub-areas. The large number of CSOs in the Rouge River undoubtedly affect conventional pollutant levels there. The anomalously high levels of conventional pollutants in Conners Creek relative to the other Belle Isle area stations indicate the influence of the automobile assembly plant and Detroit CSO's upon sediment quality. The levels of all the individual conventional pollutants, averaged over the whole study area, fall in the "heavily polluted" category.

METALS

The levels of heavy metals, for which USEPA Sediment Guidelines have been set, indicate that metals contamination of sediments in the Detroit area is both severe and wide-spread. Mean levels for all ten of these metals (cadmium, chromium, mercury, nickel, zinc, cooper, barium, iron, lead and maganese) exceed the USEPA Sediment Guidelines for "heavily polluted." Metals contamination is less significant in two sub-areas: two stations in the Belle Isle area, and three stations in the Huron River area have low to moderate metals contamination levels (Table 6, Metals).

Lead. Lead levels are very high throughout most of the study area, and range from 21.0 mg/kg to 810 mg/kg. USEPA Sediment Guidelines for "heavily polluted" are exceeded in 89% of the samples. 7% are "moderately polluted", and only 4% are unpolluted. The mean lead level is 335 mg/kg, and falls in the heavily polluted category. The highest lead levels are found near Belle Isle in Conners Creek, in the Rouge River, in the Ecorse River, and in the northern Trenton Channel (Figure 15, Lead).

Zinc. Zinc levels are high throughout most the study area, and range from 76 mg/kg to 3500 mg/kg. USEPA Sediment Guidelines for the "heavily polluted" category are exceeded in 82% of the samples, 14% are "moderately polluted," and 4% are "unpolluted." The mean zinc level is 891 mg/kg, and falls in the "heavily polluted" category. The highest zinc levels are found in the Belle Isle area in Conners Creek, in the Rouge River area, and in the northern Trenton Channel (Figure 16, Zinc).

Iron. Iron levels are high throughout most of the study area, and USEPA Sediment Guidelines for "heavily polluted" are exceeded in 68% of the samples. 18% are "moderately polluted" and 14% are "unpolluted." Iron levels range from 10,000 mg/kg to 89,000 mg/kg, and the mean level is 38,392 mg/kg falling in the "heavily polluted" category. Highest levels are found in the Rouge River area, in the area between the Rouge and Ecorse River mouths, and in the Trenton Channel, thus implicating the local steel industry as a source of this contamination (Figure 17, Iron).

Nickel. Nickel levels are high throughout most of the study area and range from 15 mg/kg to 300 mg/kg. The USEPA Sediment Guidelines for the "heavily polluted" category are exceeded in 68% of the samples, 25% are "moderately polluted," and 7% are "unpolluted." The mean nickel level is 105.7 mg/kg, and falls in the "heavily polluted" category. Highest levels are found in the Rouge River area, between the Rouge and Ecorse River mouths, and in the northern Trenton Channel; a distribution very much like the iron levels in Detroit area sediments (Figure 18, Nickel).

Manganese. Manganese levels are high throughout most of the study area. USEPA Sediment Guidelines for the "heavily polluted" category are exceeded in 71% of the Detroit samples, 18% are "moderately polluted", and 11% are "unpolluted." The mean sediment manganese level is 750 mg/kg, and falls in the "heavily polluted" category. Manganese levels range widely, from a low of 160 mg/kg in the Belle Isle area to a high of 2800 mg/kg in the Huron River sediments (Figure 19, Manganese). The high manganese level in the Huron River sediments may reflect the high high oxidation state of sandy sediments at this site.

Cadmium. Cadmium levels are rather high in a large part of the study area. USEPA Sediment Guidelines for "heavily polluted" are exceeded in 57% of the samples, and 43% are "unpolluted." The mean cadmium level in the sediments is 11.1 mg/kg, and falls in the "heavily polluted" category. Values range from 0.2 mg/kg to a high of 96 mg/kg in the Rouge River. Cadmium levels are consistently high in the Trenton Channel. (Figure 20, Cadmium).

Chromium. Chromium levels are very high throughout most of the study area. USEPA Sediment Guidelines for the "heavily polluted" category are exceeded in 71% of the study area sediment samples. 14% are "moderately polluted," and 14% are "unpolluted." The range in values is from 9.8 mg/kg in Huron River sediments to a high of 680 mg/kg in the northern Trenton Channel. The highest levels are found in the Rouge River, between the Rouge and Ecorse River mouths, and in the northern Trenton Channel, again implicating the local steel industry as a source (Figure 21, Chromium).

Barium. Barium levels are very high throughout almost the entire study area, and range from a low of 36 mg/kg to a high of 500 mg/kg. USEPA Sediment Guidelines for "heavily polluted" are exceeded in 93% of the samples, and the remaining 7% are "moderately polluted." The mean barium level of 194.5 mg/kg is well above the "heavily polluted" level. Peak barium levels are found in the Belle Isle area in Conners Creek, in the Rouge River, between the Rouge and and the Ecorse River mouths, and in the northern Trenton Channel (Figure 22, Barium).

Copper. Copper levels are high throughout most of the study area, and range widely, from 17 mg/kg in the Huron River to a high of 720 mg/kg in the Rouge River. USEPA Sediment Guidelines for "heavily polluted" are exceeded in 79% of the samples, 14% are "moderately polluted," and 7% are "unpolluted." The mean copper level is 159 mg/kg, and falls in the "heavily polluted" category. Copper level peaks are found in the Rouge River, above the Ecorse mouth, and in the northern Trenton Channel, again implicating the local steel industry as a major source. (Figure 23, Copper).

Mercury. Mercury levels are high in much of the study area sediments. Values range from a low of 0.2 mg/kg in the Huron River to a high of 3.6 mg/kg in the northern Trenton Channel. USEPA Sediment Guidelines for "polluted" are exceeded in 52% of the samples, rendering sediments from these areas unsuitable for open lake disposal, regardless of what other data indicate. The mean mercury level of 1.16 mg/kg falls in the "polluted" category. Peak values are found in the Trenton Channel and the Rouge River, thus implicating the local steel and chemical industry as sources of contamination. (Figure 24, Mercury).

DISCUSSION

Figures 15 - 24 indicate widespread, high level contamination of sediments by the metals for which Sediment Guidelines have been set. The highest levels for the individual metals define four problem areas: the most serious contamination is seen in the Rouge River area. The area between the Rouge and Ecorse Rivers, Conners Creek in the Belle Isle area, and the Trenton Channel also have significant metals contamination problems.

Levels of the other trace metals follow roughly the same trends as the metals for which USEPA Sediment Guidelines have been set. (Table 7, Trace Metals, Figures 25-33). It appears that local steel and chemical industry and perhaps the Detroit CSOs are responsible for the elevated levels of trace metals in the study area.

Levels of the major metals (Ca, K, Mg, NA and Al) are a function of particle size and mineralogy: Ca and Mg levels are attributable to dolomite particles in the sediment. K and Al originate with the dominant clay mineral illite. Na is derived from sodic, feldspathic rocks, but other sources (chemical industry, road salt) may have localized effects. (Table 8, Figures 34-37, Major Metals) (Tables 9, Metals Summary).

A. Mudroch (1984) analyzed the metals content of the individual size fractions of Detroit sediments, and found that the heavy metals correlate well with the fine size fraction: Zn, Ni, Cr, and Pb were found in both the <13 um and the 48-63um fractions. Our field observations confirm the close relationship between metals and particle size: all of the highest metals values were found in samples composed predominantely of fine materials (Table 4, Field Observations). Therefore, to derive meaningful interpretations of sediment metals analyses, one needs accurate particle-size information.

Most metals are present in soil and natural sediments in significant concentrations, and even trace metals are naturally present to some degree. It is important, therefore, to be able to distinguish between constituents derived from natural, or ambient conditions, such as erosion or weathering of natural materials, and anthropogenic inputs. Several methods to normalize sediment metals data are presently in use, including comparison to silicon levels, aluminum levels, or particle size. While such normalization may yield meaningful information, this report merely presents metals levels as they were found.

ORGANIC CONTAMINANTS

Hydrophobic organic substances are rather easily adsorbed from aqueous solutions onto available surfaces, the amount adsorbed being dependent upon the nature of the surface. The adsorption is strongly correlated with the Total Organic Carbon (TOC) content, and the surface area of the particles, with TOC dominating over surface area in importance by three to one. In sedimentary deposits with a high organic content, especially those with significant amounts of organic solvents, hydrophobic substanes can be highly mobile (Griffin & Chian, 1980).

In the aquatic environment, the fate of hydrophobic organic contaminants in the absence of nonpolar organic solvents, is strongly linked to sediments as they are deposited, resuspended, and transported as bedload or suspended load. Two other transport pathways are available to these compounds once they enter the aquatic environment: 1) dissolution in water, the magnitude of which is determined by sediment/water partition coefficients for the individual organic compounds, or 2) direct ingestion by benthic organisms and bottom feeding fishes, and nektonic or planktonic organisms in the water column which ingest suspended sediments. These latter two pathways provide the link with the food chain.

Polynuclear Aromatic Hydrocarbons (PAHs). Polynuclear aromatic hydrocarbons (PAHs) are widely recognized components of fossil fuels and of fossil fuel combustion products. They occur naturally in forest fires, volcanoes, degraded biological materials, and also in fireplaces, coal furnaces, auto emissions and incinerators (Eldridge et al., 1984). Other common sources of PAHs include steel mill foundry sand, coal-pile runoff, coal-ash leachate, coke, coal-tar deposits and urban street runoff. Many PAH compounds are carcinogenic to humans and thus are on the EPA Priority Pollutants list. Naphthalene is widely used as a starting material for various dye intermediates and has found some use as a solvent and lubricant. Other PAHs have very limited or no industrial significance.

Organisms evolutionarily above the level of insect/invertebrate readily metabolize PAHs, and these metabolites, especially epoxides and diolepoxides, are believed to be the ultimate carcinogens for PAHs (Toxic Chemicals Issues and Research Priorities, 1984).

PAHs are hydrophobic organic compounds, and thus readily adsorb onto suspended particulate matter in an aquatic environment. They have a close association with the TOC content of soils and sediments. PAHs are associated with fine particles (<63um), and higher PAH concentrations are evident with increasing silt/clay content (Griffin & Chian, 1980).

Sources of PAHs. There are many potential sources of PAHs in the Detroit area: hydrocarbon refineries in Detroit, and upstream in Sarnia, shipping, and spills of fossil fuels on the Detroit River, steel and coking operations in Michigan, production of coal tar, and urban runoff from both sides of the river all contribute to the PAH content of the sediments.

Total PAH. Fourteen PAH compounds, ranging from low molecular weight naphthalene to high molecular weight benzo(a)pyrene, have been found in the Detroit 1982 Sediment Survey. (Figure 38-47, PAHs). A convenient method to examine PAH distribution along the river is simply to sum the values for the individual compounds and compare total PAH values (Table 10, Summary Table). Total

PAH values in the study area range from 620 ug/kg on the Huron River to 125,200 ug/kg in the lower Rouge River (ROR82-02). Along the river, locations of total PAH "hotspots" in the sediments help identify major source areas. Urban runoff and shipping spills in downtown Detroit, industry and municipal projects on the Rouge River, the steel industry above the Ecorse River mouth, and the steel and chemical industry in the Trenton Channel all appear to be likely sources of PAHs. Overall mean PAH values are lower in the downstream portions of the Detroit River.

Fossil Fuels Vs. Fossil Fuel Combustion Products. Closer inspection of the distribution of individual PAH compounds yields additional information which allows more definitive judgements concerning sources. PAHs derived from fossil fuels, or non-combustion PAHs, are characteristically of lower molecular weight (e.g., naphthalene) than high molecular weight PAHs originating from fossil fuel combustion products (e.g. benzo(a) pyrene). Therefore, compositional profiles of PAH distributions provide a useful means of monitoring changes in PAH content and sources between the sediment stations (Boehm and Farrington, 1984).

The Detroit area PAH compositions are dominated by the heavier 3,4 and 5-ringed PAHs over the lighter two-ringed naphthalenes. Thus, the overall PAH assemblage is dominated by fossil fuel combustion PAHs indicating either greater additions of high molecular weight PAHs, or their preferential adsorption by sediments. (Table 11, PAH). In certain areas along the Detroit River, the greater dominance of lower molecular weight PAHs over the higher molecular weight PAHs may indicate differing sources of total PAHs. Dominance by low molecular weight PAHs is evident at a number of sampling stations: DTR82-01,

DTR82-03, DTR82-05A, ROR82-07, ROR82-06, DTR82-52, DTR82-53, HUR82-02, HUR82-01 DTR82-57 (in the Belle Isle, Rouge River, Ecorse River and Huron River areas). These stations, with the exception of the Rouge River stations, also tended to have lower than average total PAH values. DTR82-19, near the mouth of the Rouge River, has a rather singular PAH distribution, having the highest concentration of naphthalene in the study area, coupled with reduced levels of high molecular weight PAHs, suggesting fossil fuel spills as the major source of PAHs here. Station DTR82-32, in the Wyandotte Yacht Club, shows the highest relative amounts of both naphthalene and high molecular weight PAHs. Overall sediment PAH levels are highest in the Rouge River.

Generally, the important sources seem to be industrial (fossil fuel combustion products) and municipal (urban runoff) discharges to the Detroit River. Fossil fuel spills are probably locally important sources at DTR82-03, DTR82-19, ROR8206, ROR82-02, and DTR82-32 (Wyandotte Yacht Club). The absence of high molecular weight PAHs, and overall low total PAH values found upstream from Belle Isle, and up from the mouths of tributary streams, indicate that the predominant sources of PAH are industrial and municipal sources along the Detroit River.

PAH Hazard Ranking. Distribution of PAHs along the Detroit River was also evaluated in terms of a hazard ranking of individual PAH compounds. The mutagenic and carcinogenic activity of a small number of specific PAH compounds, for example, benzo(a)pyrene, is well known. However, synergistic and antagonistic effects between PAH compounds, and uncertainties about carcinogenic and mutagenic effects of PAH metabolites complicates evaluation of the hazards associated with PAHs. At best, a first order approximation of hazard can be made based on linear combinations of individual PAH values. The six most hazardous PAHs analyzed for in this study, as per Milliken et al, are: benzo(a)pyrene, benz(a)anthracene and chrysene, indeno(1,2,3,c,d)pyrene, benzo-(b&k)fluoranthene, and phenanthrene. Two methods of estimating the PAH hazard assocated with sediments were used: 1) summation of the six most hazardous PAH and, 2) inspection of benzo(a)pyrene values (Tables 12, Hazardous PAHs).

Inspection of Table 12 shows: 1) hazardous PAHs are pervasive throughout the study area 2) less, or none of the most hazardous PAH compounds are found in the tributaries, and upstream from Belle Isle on the Detroit River, 3) the highest hazardous PAH values are seen at ROR82-02, in the Rouge River, and DTR82-13 and DTR82-08, near downtown Detroit, indicating sources in urban run-off or CSOs and industrial sources in the Rouge River.

Thus, we conclude that a few major sources of PAHs impact upon the Detroit River in the upstream portion. Downstream sources may be continuous, while transport and deposition of sediments in the lower river effectively homogenizes PAH distribution.

PCBs

Total PCBs Detroit sediments exceed USEPA Sediment Guidelines for total PCBs (greater than 10 mg/kg) at three stations in the northern Trenton Channel: DTR82-32, DTR82-38, and DTR82-49. Eighteen stations widely distributed over the study area had elevated levels of total PCBs (1 to 10 mg/kg). Seven stations, mainly in the Belle Isle area and upstream on the Huron River, had low total PCB levels (less than 1 mg/kg) (Table 13, PCBs).

Generally, the highest PCB values are found in the areas of heavy industry in Ecorse, Wayndotte and Riverview on the northern Trenton Channel. However, the high levels of total PCBs in Conners Creek in the Belle Isle area and in the downtown Detroit area may implicate Detroit CSOs as major sources to the system.

Although PCB loadings in the study area appear to be high, upstream sources may also add a significant load upon Detroit River sediments. PCB-tainted sediments from Saginaw Bay and Lake St. Clair are resuspended by storms, and the sediment bound-PCBs are entrained in the dynamic fluvial environment of the Detroit River (Thornley and Hamdy, 1984).

Inspection of the distribution of the Aroclor components of the PCBs may yield some information about sources of PCBs. The PCB mixtures (Aroclors) which were analyzed by GC/EC, range from PCB-1242, with 42% chlorination, to PCB-1260, with 60% chlorination. The less-chlorinated Aroclors are much more soluble in water than the highly-chlorinated Aroclors which are more hydrophobic. The highly chlorinated Aroclor 1260, thus, has greater adsorption potential than the less-chlorinated Aroclor-1242 (Eisenreich et al., 1983). PCB-1242 levels are generally low, ranging from zero to 956 ug/kg. Significant levels are found at sites immediately above and below the Ecorse River (Figure 48, PCB-1242).

The highest levels of the four PCB mixtures are found for PCB-1248 on the Detroit River, between the Rouge and Ecorse River mouths. PCB-1248 ranges from zero to 6940 ug/kg. Strong peaks of PCB-1248 are also found at all stations in the northern Trenton Channel, and in Conners Creek in the Belle Isle area (Figure 49, PCB-1248).

PCB-1254 levels range from zero to 3638 ug/kg. Peak levels are found in the northern Trenton Chanel, in the Belle Isle area in Conners Creek, in the Detroit area, and between the Rouge and Ecorse River mouths (Figure 50, PCB-1254).

PCB-1260 ranges from zero to 3946 ug/kg. Peak levels are found in the northern Trenton Channel, on the Detroit River in Downtown Detroit, and between the Rouge and Ecorse River mouths (Figure 51, PCB-1260).

Generally, PCB levels are highest in the northern Trenton Channel, between the Rouge and Ecorse River mouths, and in Conners Creek in the Belle Isle area, and in the northern Detroit River. The Rouge River did not exhibit high levels of any of the PCB mixtures, nor did either of the other two tributaries to the Detroit River, or most of the stations on the northern Detroit River. This may signify the relative importance of the contributions of PCBs from CSOs and the chemical industry along the Detroit River.

Oliver and Bourbonierre (1984), from comparison of Lake Huron/Lake St. Clair and Lake Erie sediments, observed that the PCB concentration increases between Lake Huron/Lake St. Clair and Lake Erie, indicating major sources along the Detroit River. Also they noted that the degree of chlorination increases substantially over the same length: the predominant Aroclor in Lake Huron/Lake St. Clair is PCB-1242 while in western Lake Erie it is PCB-1260. Modelling of dilution factors led them to conclude that a disproportionately high concentration of Aroclor-1260 is contained in the Detroit River and that the Detroit River is the major source of PCBs to western Lake Erie. Although a considerable amount of PCBs were found by the 1982 Detroit Sediment Survey to be be entering the river, they tended to be Aroclor-1248 rather than Aroclor-1260.

Summations of the levels of the four PCB mixtures over the whole study area give an indication of their relative importance in the Detroit sediments. PCB-1248 comprises almost 43% of the total PCBs, PCB-1254 is 30%, PCB-1260 is 26%, and PCB-1242 accounts for only 1.5%. Thus, overall, PCB-1248 is the dominant PCB mixture observed in the sediments. However, not all the stations exhibit the same proportions of PCB mixtures (Table 13, PCB).

Inspection of the distribution of Aroclors in the Detroit River sediments shows that there are three characteristic types of sediments in terms of chlorination: the majority of the sediment samples were heavily weighted toward either PCB-1248 or PCB-1260. The rest show approximately equal proportions of of the various isomers. Furthermore, all the stations exceeding USEPA Sediment Guidelines for total PCBs are highly skewed towards the less chlorinated Aroclors (PCB-1248). Those samples having total PCB levels in the range from 1,000 ug/kg to 10,000 ug/kg are skewed either towards PCB-1248, or PCB-1260. Samples with low total PCB levels represent background levels and tend to have a more even distribution of the PCB mixtures. Thus, PCB-1248 dominates the sediments having the highest total PCB levels.

This appears to contradict Oliver and Bourbonnierre's conclusions that Detroit is the major source of PCB-1260 to western Lake Erie. Although a heavy PCB load enters the Great Lakes at Detroit, these PCBs are of lower % chlorination than those found in western Lake Erie.

A possible cause of this discrepancy may be subsequent weathering of PCBs by volatilization and degradation, which would alter the composition of PCB mixtures (Armstrong and Swackhammer, 1983). Aroclor-1248 is much more soluble in water, and thus more susceptible to volatilization out of the system. Also, lower-chlorinated isomers are more easily degraded by micro-organisms than higher-chlorinated isomers (Griffin and Chian, 1980). The increase in percentage of chlorination going downstream from Lake Huron/Lake St. Clair to western Lake Erie may be mostly a function of residence time in the system. Therefore, use of Aroclor 1260 as a conservative tracer of Detroit inputs is inappropriate. The effects of residence time upon chlorination of PCBs may indicate a larger contribution of PCBs to western Lake Erie from sources upstream from Detroit than were previously suspected.

In Detroit the sediments violating the USEPA Sediments Guidelines which are relative lower in chlorination, are relatively recent additions to the sediments. Those with lesser PCB concentrations and having greater degree of chlorination have spent more time being subjected to volatilization and degradation in the aquatic system, either in transport from St. Clair River/Lake St. Clair, or within the Detroit River system. The higher chlorinated isomers are less soluble in water, preferentially adsorbed by sediments, less degradable by micro-organisms, and less volatile from water than lower chlorinated isomers (Griffin and Chian, 1980). The samples showing the low PCB levels represent ambient conditions and may signify substantial upstream sources.

PESTICIDES

DDT and its Metabolites. DDT, although usually considered to be very resistant to metabolic breakdown, does metabolize nonetheless to DDD and to DDE, DDE being the more resistant of the two (Tinsley, 1979). Levels of DDT and of these metabolites were summed to arrive at total DDT levels. Total DDT ranges from zero to 2265 ug/kg with a mean total DDT level of 360 ug/kg in the Detroit study area. As DDT is metabolized to DDD, or more completely to DDE, the configuration of the parent material (p,p or o,p) is maintained. Overall, the p,p configuration is encountered in 62% and o,p in 39% of the total DDT. (Table 14, DDT and Metabolites).

In fish total DDT is dominated by DDE (DDE>DDT>DDD), which is the more completely metabolized product (DeVault, 1985). Detroit sediments, however, are dominated by DDD overall (DDT-12.2%, DDD-52.8%, DDE-34.9%), indicating less complete metabolism, or a different metabolic pathway than in fish.

The highest total DDT value occurs at DTR82-03, near Belle Isle (2265 ug/kg), and is predominantly DDD (69.3%). Stations DTR82-19 and DTR82-38 call attention to themselves because their distributions of DDT and metabolites are predominantly DDT (>50%). Station DTR82-38 contains the second highest concentration of total DDT in the study area. The predominance of DDT at these two sites seems to indicate a more recent addition of DDT which has not yet been metabolized. Thus, the greater proportion of DDT may indicate a source of the contaminant in the study area. Alternately, conditions here may not be favorable for DDT metabolism.

Other Pesticides

Gamma-chlordane is the only other pervasive pesticide in the Detroit area. Gamma-chlordane peaks are found in Conners Creek (145 ug/kg), in the Belle Isle area (95 ug/kg), and in the Ecorse River (149 ug/kg). Relatively high levels are evident in the northern Trenton Channel and the Rouge River (Figure 52, Gamma Chlordane).

Beta-BHC levels are generally low but peaks were found in Conners Creek (170 ug/kg) and above, and below the Ecorse River (195 ug/kg)(Figure 53, Beta-BHC). Low levels of the other pesticides appear sporadically in the study area (Table 15, Pesticides).

Volatile Organics. Dichloromethane ranges from 4 ug/kg to 91 ug/kg and is present almost everywhere in low concentrations. Highest concentrations were found between the Rouge and Ecorse Rivers (Figure 54, Dichloromethane). Trichloroethene is widely present, and ranges from 3 ug/kg to 50 ug/kg. The highest levels are just above the entrance to the Trenton Channel (Figure 55, Trichloroethene). Methyl benzene, ethyl benzene, 1,-3-dimethylbenzene and 1,2 and 1,4-dimethylbenzene were frequently found in the study area. Upstream on the Rouge River, all four of these volatile organic compounds exhibit values over an order of magnitude higher than elsewhere in the study area, indicating the proximity of a source. (Table 16, Volatile Organics).

High background levels of dichloromethane, trichloromethane, methyl benzene, ethyl benzene and dimethyl benzenes may indicate upstream sources of volatiles, perhaps on the St. Clair River. Concentrations of other volatile contaminants in Detroit sediments are consistently lower. Of the thirteen volatile organic contaminants found in the study area, nine are present near the mouth of the Huron River where levels of most other groups of contaminants have been rather low. In general, however, the various volatile organics were found mainly in the Rouge River area and the northern Trenton Channel. Sources originating from the steel and chemical industry, CSOs and sewage treatment plants are implied.

Phenols. Phenol, p-cresol and 2,4-dimethyl phenol are present in the Detroit study area. Phenol ranges widely from 30 ug/kg to 9500 ug/kg. Relatively high values are observed in Conners Creek in the Belle Isle area, in the Rouge River and very high values are observed in the northern Trenton Channel. (Figure 56, Phenol). P-cresol similarly has highs at Belle Isle, at the mouth of the Rouge River, and in the northern Trenton Channel. Levels range from 20 ug/kg to 9910 ug/kg. (Figure 57, P-cresol).

2,4-dimethyl phenol is found primarily in the northern Trenton Channel. The occurence of the enormously high values in this area (up to 25,100 ug/kg) implicate coking and casting operations as a probable source of these contaminants to the sediments (Table 17, Phenols).

Substituted Benzenes and Substituted Cyclic Ketones

Aniline, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichlorobenzene, 1,2,4-trichlorobenzene and isophorone are present in varying quantities in the Detroit area sediments. Their highest levels occur in Conners Creek in the Belle Isle area, in the Rouge River and in the Trenton Channel (Table 18, Substituted Benzenes).

Hexachlorobenzene (HCB) is widely present throughout the Detroit area. Its values range from trace levels to 106 ug/kg (Figure 58, HCB). Highest concentrations are found in the Trenton Channel. HCB concentrations are fairly uniform throughout the study area implying major sources upstream from Detroit, possibly in the Sarnia area. Local sources from the chemical industry would explain the elevated levels in the Trenton Channel. Dibenzofuran levels range range from zero to 3620 mg/kg. Highest levels are found in the Rouge River area (Figure 59, Dibenzofuran).

Phthalate Esters

Di-n-butyl phthalate and Bis(2-ethylhexyl)phthalate levels are rather high throughout most of the study area; however, the laboratory analytical reports indicate that impurities may have been introduced in the course of analysis. Blanks contained up to 420 ug/kg Di-n-butyl phthalate and up to 540 ug/kg Bis(2-ethyl hexyl phthalate). The results should therefore be used with a degree of caution. Di-n-butyl phthalate levels range from zero to 5690 ug/kg. Peaks are found in Conners Creek in the Belle Isle area, in downtown Detroit (DTR82-08) and above the Ecorse River mouth.

Bis(2-ethyl hexyl) phthalate levels range from zero to 47,100 ug/kg. Peaks are found in the Rouge River, below the mouth of the Ecorse River, and in the northern Trenton Channel. (Figure 60, Bis(2-ethylhexyl) phthalate).

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Appendix A

Guidelines for the Pollutional Classification of Great Lakes Harbor Sediments

U.S. Environmental Protection Agency

Region V

Chicago, Illinois

April, 1977

Guidelines for the evaluation of Great Lakes harbor sediments, based on bulk sediment analysis, have been developed by Region V of the U.S. Environmental Protection Agency. These guidelines, developed under the pressure of the need to make immediate decisions regarding the dispoal of dredged material, have not been adequately related to the impact of the sediments on the lakes and are considered interim guidelines until more scientifically sound guidelines are developed.

The guidelines are based on the following facts and assumptions:

1. Sediments that have been severely altered by the activities of man are most likely to have adverse environmental impacts.

2. The variability of the sampling and analytical techniques is such that the assessment of any sample must be based on all factors and not on any single parameter with the exception of mercury and polychlorinated biphenyls (PCBs).

3. Due to the documented bioaccumulation of mercury and PCBs, rigid limitations are used which override all other considerations.

Sediments are classified as heavily polluted, moderately polluted, or nonpolluted by evaluating each parameter measured against the scales shown below. The overall classification of the sample is based on the most predominant classification of the individual parameters. Additional factors such as elutriate test results, source of contamination, particle size distribution, benthic macroinvertebrate populations, color, and odor are also considered. These factors are interrelated in a complex manner and their interpretation is necessarily somewhat subjective.

The following ranges, used to classify sediments from Great Lakes harbors are based on compilations of data from over 100 different harbors since 1967.

	NONPOLLUTED	MODERATELY POLLUTED	HEAVILY POLLUTED
Volatile Solids (%)	<5	5-8	>8
COD (mg/kg dry weight)	<40,000	40,000-80,000	>80,000
TKN (mg/kg dry weight)	< 1,000	1,000- 2,000	> 2,000
Oil and Grease (Hexane Solubles) (mg/kg dry weight)	< 1,000	1,000- 2,000	> 2,000
Lead (mg/kg dry weight)	<40	40-60	>60
Zinc (mg/kg dry weight)	<90	90-200	>200

The following supplementary ranges used to classify sediments from Great Lakes harbors have been developed to the point where they are usable but are still subject to modification by the addition of new data. These ranges are based on 260 samples from 34 harbors sampled during 1974 and 1975.

	NONPOLLUTED	MODERATELY POLLUTED	HEAVILY POLLUTED
Ammonia (mg/kg dry weight)	<75	75-200	>200
Cyanide " "	<0.10	0.10-0.25	>0.25
Phosphorus " "	<420	420-650	>650
Iron " "	<17,000	17,000-25,000	>25,000
Nickel " "	<20	20-50	>50
Manganese " "	<300	300-500	>500
Arsenic " "	<3	3-8	>8
Cadmium " "	*	*	>6
Chromium " "	<25	25-75	>75
Barium " "	<20	20-60	>60
Copper " "	<25	25-50	>50

*Lower limits not established

The guidelines stated below for mercury and PCB's are based upon the best available information and are subject to revision as new information becomes available.

Methylation of mercury at levels $\geq$ 1 mg/kg has been documented (1,2). Methyl mercury is directly available for bioaccumulation in the food chain.

Elevated PCB levels in large fish have been found in all of the Great Lakes. The accumulation pathways are not well understood. However, bioaccumulation of PCBs at levels $\geq$ 10 mg/kg in fathead minnows has been documented (3).

Because of the know bioaccumulation of these toxic compounds, a rigid limitation is used. If the guidelines values are exceeded, the sediments are classified as polluted and unacceptable for open lake disposal, no matter what the other data indicate.

	POLLUTED
Mercury	$\geq$ 1 mg/kg dry weight
Total PCBs	$\geq$ 10 mg/kg dry weight

The pollutional classification of sediments with total PCB concentrations betbetween 1.0 mg/kg and 10.0 mg/kg dry weight will be determined on a case-by-case basis.

a. Elutriate Test Results

The elutriate test was designed to simulate the dredging and dispoal process. In the test, sediment and dredging site water are mixed in the ratio of 1:4 by volume. The mixture is shaken for 30 minutes, allowed to settle for 1 hour, centrifuged, and filtered through a 0.45 u filter. The filtered water (elutriate water) is then chemically analyzed.

A sample of the dredging site water used in the elutriate test is filtered through a 0.45 u filter and chemically analyzed.

A comparison of the elutriate water with the filtered dredging site water for for like constituents indicates whether a constitutent was or was not released in the test.

The value of elutriate test results are limited for overall pollutional classification because they reflect only immediate release to the water column under aerobic and near neutral pH conditions. However, elutriate test results can be used to confirm releases of toxic materials and to influence decisions where bulk sediment results are marginal between two classifications. If there is release or non-release, particularly of a more toxic constituent, the elutriate test results can shift the classification toward the more polluted or the less polluted range, respectively.

b. Source of Sediment Contamination

In many cases the sources of sediment contamination are readily apparent. Sediments reflect the inputs of paper mills, steel mills, sewage discharges, and heavy industry very faithfully. Many sediments may have moderate or high concentrations of TKN, COD, and volatile solids yet exhibit no evidence of man made pollution. This usually occurs when drainage from a swampy area reaches the channel or harbor, or when the project itself is located in a low lying wetland area. Pollution in these projects may be considered natural and some leeway may be given in the range values for TKN, COD, and volatile solids provided that toxic materials are not also present.

c. Field Observations

Experience has shown that field observations are a most reliable indicator of sediment condition. Important factors are color, texture, odor, presence of detritus, and presence of oily material.

Color. A general guideline is the lighter the color the cleaner the sediment. There are exceptions to this rule when natural deposits have a darker color. These conditions are usually apparent to the sediment sampler during the survey.

Texture. A general rule is the finer the material the more polluted it is. Sands and gravels usually have low concentrations of pollutants, while silts usually have higher concentrations. Silts are frequently carried from polluted upstream areas, whereas, sand usually comes from lateral drift along the shore of the lake. Once again, this general rule can have exceptions and it must be applied with care.

Odor. This is the odor noted by the sampler when the sample is collected. These odors can vary widely with temperature and observer and must be used carefully. Lack of odor, a beach odor, or a fishy odor tends to denote cleaner samples.

Detritus. Detritus may cause higher values for the organic parameter COD, TKN, and volatile solids. It usually denotes pollution from natural sources. Note: The determination of the "naturalness" of a sediment depends upon the establishment of a natural organic source and a lack of man made pollution sources with low values for metals and oil and grease. The presence of detritus is not decisive in itself.

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APPENDIX B

Analytical Method Documentation

Parameters	Units	Title/Description
Non-volatile organics: acidic & base neutrals, other organics by GC/MS	mg/kg dry weight	"Standard Operating Procedure for the analysis of sediments for Non-volatile Organic Compounds: Embayment and Nearshore Program CRL Method No.: "TOX105631" Based on USEPA Method 625 [Federal Register 1979]. Sediments are air dried, sieved and soxhlet extracted with 1:1 acetone/hexane for 16 hours. Extracts are screened by GC/FID and diluted or concentrated as needed. GC/MS protocol found in "Standard Operation Procedure GC/MS/DS Analysis of Non-Volatile Organic Compounds CRL Method No.: TOX9561, TOX9571, TOX95631, TOX95731". Compounds are quantitated against standards when available or an estimated concentration is reported on the basis of the response of the internal standard, D-10 phenanthrene.
Volatile organic by/purge & trap GC/MS	ug/kg dry weight basis	"Analysis of Volatile Organic Compounds in Fish, Sediment, and Water Samples Using GC/MS, CRL Method No. TOX105631, 105731, 10561, 10571" Based on USEPA Method 624 [Federal Register 1979]. Wet samples are purged with helium for 4 minutes and the organics are trapped on a Tenax trap. The trap is desorbed onto the GC column for analysis. Compounds are quantified using standards when available, or are estimated against the response of the internal standard 2-bromo-1-chloropropane.
PCBs Pesticides GC/EC	mg/kg dry weight basis	"Analysis of Pesticides, Phthalates, and Polychlorinated Biphenyls in Soils and Bottom Sediments, CRL Method No. PES1262-84, 17119-17125" Based on USEPA Method 608 [Federal Register 1979]. Samples are air dried, sieved and soxhlet extracted with 1:1 acetone/hexane for 16 hours. Extracts are cleaned up by Florisil column chromatography. Further separation of PCBs from Pesticides is done with silica gel column chromatography. The extracts are screened by GC/EC. Samples are quantified and confirmed by GC/EC. GC/MS analysis of the ABN extracts is used for additional confirmation.

Parameters	Units	Title Description
Ag, Al, B, Ba, Be, Cd, Co, Cr Cu, Fe, Li, Mn Mo, Ni, Pb, Sn Sr, V, Y, Zn, Ca, K, Mg, Na	mg/kg dry weight basis	"Preparation of Sediments and Other Solids for ICAP Analysis" Central Regional Laboratory (CRL) Method #MET 413. "Standard Operative Procedure (SOP) for the Determination of Total Metals in Water by ICAP CRL Method #MET 111" Reference USEPA 1979a.
CN	mg/kg dry weight basis	"SOP for Total Cyanide, CRL Method #MIN 71919" Reference USEPA 1979b.
Phenol	mg/kg dry weight basis	"SOP: Phenols, Total Recoverable, CRL Method #MIN74818" Reference USEPA 979b.
Ammonia as N		CRL SOP for preparation of sediment and solids fo Ammonia - N, TKN, TP and COD
Sediment Sample preparation Total Phosphorus Total Phosphorus Kjeldahl Nitrogen as N	mg/kg dry weight basis mg/kg dry weight basis	"SOP: Ammonia Nitrogen, CRL Method #MIN 7294" Reference USEPA 1979b. "SOP for Total Phosphorus and Total Kjeldaahl Nitrogen, CRL Method #MIN 7315, MIN 7304," Reference USEPA 1979b.
Chemical Oxygen Demand	mg/kg dry weight basis	"SOP: COD, CRL Method #MIN 7336" Reference USEPA 1979b.
Mercury	mg/kg dry weight basis	"SOP: Total Mercury in Fish and Sediments, CRL Method #Min 7336" Reference USEPA 1979b.
Arsenic Selenium	mg/kg dry weight basis	"SOP for the Determination of Arsenic and Seleniu in sediments and Other Solids by Furnace AA, CRL Method #MET 463, Met 4213" Reference USEPA 1979b
Volatile Solids	% of total solids	"SOP for Total Volatile Solids (%) in Sediments and Solids, CRL Method #447" Gravimetric determination at 550°C + 50°C.
% Solids	% dry weight (g) / wet weight (g)	"SOP for Total Residue (% Solids), CRL Method #444" Gravimetric determination.
Oil & Grease	mg/kg dry weight	PES 10423643

Data Quality Requirements and Assessments

Parameter	Sample Matrix	Detection Limit	Estimated Accuracy	Accuracy Protocol	Estimated Precision	Precision Protocol
Total solids	Sediment	1%	10%	1 Spike	10%	One Duplicate For Every 10 Samples
Volatile solids		1%	10%	For	10%	
COD		100 mg/kg	20%	Every	20%	
Total Kjeldahl N		0.05 mg/kg	20%	10	20%	
Total P		0.02 mg/kg	20%	Sample	20%	
Hg		0.1 mg/kg	20%		20%	
Ammonia N		0.1 mg/kg	20%		20%	
Cyanide		0.1 mg/kg	20%		20%	
ICAP metals		*	5%		20%	
Acid, Base, Neutral Priority Pollutants		*	50%		50%	
Pesticides PCBs		*	50%		50%	
Volatile Priority Pollutants		*	50%		50%	
Oil & Grease		650 mg/kg			To be estab-lished	
Arsenic		2 mg/kg	± 10%		2 ug/kg	

* See Table 1

Table 1. Organic Compounds Sought in Sediments by the GC/MS Method and Maximum Detection Limits

(Actual detection limits for individual samples may vary as a function of interferences present, aliquot size, degree of pre-concentration, etc. Actual detection limits for some subsets of the overall data base were up to an order to magnitude less than the maximum detection limits listed here.)

BASE AND NEUTRAL NON-VOLATILE ORGANICS (GC/MS)

NAME	MAXIMUM DETECTION LIMIT (ug/kg)
Aniline	50
Bis(2-Chloroethyl)ether	50
1,3-Dichlorobenzene	60
1,4-Dichlorobenzene	60
1,2-Dichlorobenzene	60
Benzyl Alcohol	150
Bis(2-Chloroisopropyl)ether	160
Hexachloroethane	140
N-nitrosodipropyl amine	90
Nitrobenzene	70
Isophorone	30
Bis(2-Chloroethoxy)methane	50
1,2,4-Trichlorobenzene	70
Naphthalene	20
4-Chloroaniline	60
Hexachlorobutadiene	120
2-Methylnapthalene	30
Hexachlorocyclopentadiene	230
2-Chloronaphthalene	40
Acenaphthylene	30
Dimethylphthalate	30
2,6-Dinitrotoluene	160
Acenaphthene	40
3-Nitroaniline	250
Dibenzofuran	40
2,4-Dinitrotoluene	170
Fluorene	50
4-Chlorophenyl phenyl ether	90
Diethylphthalate	40
4-Nitroaniline	570
Diphenylamine (N-Nitroso-)	80
1,2-Diphenylhydrazine	50
4-Bromophenylphenyl ether	160
Hexachlorobenzene	130
Phenanthrene	70
Anthracene	70
Di-N-butylphthalate	260

TABLE 1 (con't)

BASE AND NEUTRALNON-VOLATILE ORGANICS (GC/MS

NAME	MAXIMUM DETECTION LIMIT (ug/kg)
Fluoranthene	150
Pyrene	170
Benzylbutyl phthalate	420
Benzo(a)anthracene & Chrysene	830
Bis(2-ethylhexyl)phthalate	270
Di-N-octylphthlate	370
Benzo(B&/K)fluoranthene	1260
Benzo(A)pyrene	1500
Indeno[1,2,3-CD]pyrene	1570
Dibenzo(A,H)anthracene	2030
Benzo(GHI)perylene	1570

ACIDIC NON-VOLATILE ORGANICS (GC/MS)

Phenol	50
2-Chlorophenol	60
2-Methylphenol	70
4-Methylphenol	50
2-Nitrophenol	120
2,4-Dimethylphenol	70
2,4-Dichlorophenol	70
Benzoic Acid	160
4-Chloro-3-methylphenol	90
(2,4,5 & 2,4,6)-Trichlorophenol	150
2,4-Dinitrophenol	1360
4-Nitrophenol	680
2-Methyl-4,6-Dinitrophenol	770
Pentachlorophenol	720

TABLE 1 (con't)

VOLATILE ORGANICS (GC/MS)

Name	Maximum Detection Limit (ug/kg)
Dichloromethane	0.3
1,1-Dichloroethene	0.2
1,1-Dichloroethane	0.1
1,2-Dichloroethene	0.2
Trichloromethane	0.1
1,2-Dichloroethane	0.3
1,1,1-Trichloroethane	0.2
Tetrachloromethane	0.2
Bromodichloromethane	0.2
1,2-Dichloropropane	0.2
1,3-Dichloro-1-propene (Trans)	0.1
Trichloroethene	0.2
Benzene	0.1
Dibromochloromethane	0.2
1,1,2-Trichloroethane	0.3
1,3-Dichloro-1-Propene (Cis)	0.3
Tribromomethane	0.5
1,1,2,2-Tetrachloroethane	0.2
Tetrachloroethene	0.2
Methylbenzene	0.1
Chlorobenzene	0.1
Ethylbenzene	0.1
1,3-Dimethylbenzene	0.1
1,2-&1,4-Dimethylbenzene	0.1

TABLE 1 (con't)

PESTICIDES

Name	Maximum Detection Limit (ug/kg)
Triflan(Trifluralin)	180
Alpha-BHC	330
Hexachlorobenzene	150
2,4-D, Isopropyl ester	400
Gamma-BHC	3140
Beta-BHC	540
Heptachlor	450
Di-butylphthalate	240
Zytron	280
Aldrin	470
DCPA	220
Isodrin	410
Heptachlor epoxide	660
Oxychlordane	2860
Gamma chlordane	490
o,p DDE	250
Endosulfan-I	1900
p,p DDE	380
Dieldrin	150
o,p DDD	230
Endrin	1120
Chlorobenzilate	300
Endosulfan-II	2620
o,p-DDT & p,p-DDD	530
Kepone(chlordecone)	950
p,p DDT	400
Methoxychlor	330
Tetradifon	2730
Mirex	480

TABLE 1 (con't)

PCBs (GC/MS)

Name	Maximum Detection Limit (ug/kg)
Monochlorobiphenyls (total)	410
Dichlorobiphenyls (total)	290
Trichlorobiphenyls (total)	390
Tetrachlorobiphenyls (total)	520
Pentachlorobiphenyls (total)	520
Hexachlorobiphenyls (total)	330
Heptachlorobiphenyls (total)	580

Table 2. Pesticides and PCBs Sought in Sediments by the GC/EC Method

Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
o,p-DDE
p,p-DDE
o,p-DDD
p,p-DDD
o,p-DDT
p,p-DDT
G-Chlordane
Oxychlordane
Heptachlor epoxide
Zytron
B-BHC
G-BHC
Hexachlorobenzene
Trifluralin
Aldrin
Mirex
Heptachlor
Methoxychlor
Endrin
DCPA
Endosulfan-I
Endosulfan-II
Dieldrin

Table 3. Metals Analyzed and Their Detection Limits

Metal	Detection Limit (mg/kg)
Silver	0.3
Aluminum	8
Boron	8
Barium	0.5
Beryllium	0.1
Cadmium	0.2
Cobalt	0.6
Chromium	0.8
Copper	0.6
Iron	8
Lithium	1
Manganese	0.5
Molybdenum	1
Nickel	1.5
Lead	7
Tin	4
Strontium	1
Vanadium	0.5
Yttrium	0.5
Zinc	4
Calcium	50
Potassium	100
Magnesium	10
Sodium	100
Mercury	0.2

TABLE 4 DETROIT 1982 FIELD OBSERVATIONS

STATION #	LATITUDE	LONGITUDE	DATE	TIME	DEPTH (FEET)	COLOR	DESCRIPTION	ODOR	OIL
DTR82-01	42 21 24	82 56 10	82/10/28	11 15	05	-	-	-	-
DTR82-03	42 21 22	82 57 13	82/10/28	11 00	17	DK GRA/BLK	ST/CL	O	Y
DTR82-05A	42 21 20	82 58 22	82/10/28	10 30	11	GRA/BRN	ST/CL	E	N
DTR82-08	42 20 04	83 01 08	82/10/28	09 45	09	BRN/BLK	SD/ST	O	Y
DTR82-13	42 18 48	83 04 41	82/10/27	17 30	10	GRA/BRN	CL	C	N
DTR82-19	42 16 41	83 06 30	82/10/27	16 40	16	BLK	MK/CO	O	Y
ROR82-07	42 17 23	83 10 04	82/10/28	13 40	05	BLK	BUB.MK	-	-
ROR82-06	42 17 45	83 09 12	82/10/28	13 50	17	-	-	-	-
ROR82-02	42 16 53	83 07 07	82/10/28	12 35	21	BRN	SD/MK	-	N
DTR82-22	42 15 39	83 07 02	82/10/27	16 45	14	BLK/BRN	MK	O	Y
DTR82-23	42 15 35	83 07 06	82/10/27	16 30	21	GRA/BLK	MK	E/O	Y
DTR82-25	42 15 21	83 07 16	82/10/27	16 10	05	GRA	ST/SD	E	N
DTR82-26	42 14 37	83 08 01	82/10/27	15 14	23	GRA	CL	E	N
DTR82-27	42 14 31	83 08 13	82/10/27	15 05	08	GRA	ST/CL	O	N
DTR82-52	42 14 38	83 09 35	82/10/28	15 55	0	BLK/GRA	SD/ST	O	Y
DTR82-53	42 14 00	83 09 45	82/10/28	16 10	0	BLK	MK	O/C	-
DTR82-29	42 14 06	83 08 51	82/10/27	14 56	04	GRA/BRN/BLK	SD/CL	E	N
DTR82-30	42 13 38	83 08 49	82/10/27	14 45	03	BRN	CL/SD/GRV	E	N
DTR82-32	42 12 36	83 08 39	82/10/27	14 20	04	GRA	CL/SD	N	N
DTR82-38	42 10 25	83 09 53	82/10/27	12 35	01	GRA/BLK	MK	O	Y
DTR82-56	42 03 02	83 12 48	82/10/27	12 05	02	BLK/DK GRA	CL/SD/MK	E	N
DTR82-49	42 08 53	83 10 25	82/10/27	11 59	02	BLK	CL/ORG OZ	S	N
DTR82-43A	42 07 15	83 10 55	82/10/26	17 04	29	BLK	ST/CL	E	Y
DTR82-45	42 06 51	83 10 53	82/10/26	15 52	04	BLK	ST/SD	E	N
DTR82-48	42 03 42	83 11 23	82/10/26	15 00	03	BRN/GRA	SD/ST/CL	E	N
HUR82-02	42 03 39	83 14 48	82/10/28	17 49	02	GRA/BRN	SD	E	N
HUR82-01	42 02 31	83 12 50	82/10/28	17 29	01	GRA/BRN	CL/SD/GRV	E	-
DTR82-57	42 03 02	83 12 48	82/10/28	17 20	02	DK GRA	ORG OZ/CL	E	N

COLOR	DESCRIPTION	ODOR	OIL
BLK=BLACK	CL=CLAY	E=EARTHY	Y=YES
GRA=GRAY	SD=SAND	O=OILY	N=NO
BRN=BROWN	ST=SILT	C=CHEMICAL	
DK=DARK	MK=MUCK	S=SEPTIC	
	CO=COAL	N=NONE	
	BUB=BUBLING		
	ORG=ORGANIC		
	OZ=OOZE		
	GRV=GRAVEL		

TABLE 5 CONVENTIONAL POLLUTANTS IN DETROIT 1982 SEDIMENTS (1977 USEPA SEDIMENT GUIDELINES)

STATION #	TOTAL SOLIDS (PERCENT)	TOTAL VOLATILE SOLIDS (PERCENT)	OIL & GREASE (mg/kg)	CHEMICAL OXYGEN DEMAND (mg/kg)	TOTAL KJELDAHL NITROGEN (mg/kg)	AMMONIA -N (mg/kg)	PHOSPHORUS -P (mg/kg)	CYANIDE (mg/kg)
DTR82-01	65.7	5.6+		46000+	870.0	50.0	350.0	0.10W+
DTR82-03	37.7	11.6*	36390*	180000*	3300.0*	530.0*	2100.0*	12.00 *
DTR82-05A	43.5	4.2	5215*	65000+	1000.0+	70.0	480.0+	0.10W+
DTR82-08	28.7	10.0*		160000*	2800.00*	470.0+	2100.0*	7.90 *
DTR82-13	58.4	5.6+		67000+	1200.0+	110.0+	540.0+	7.10 *
DTR82-19	40.7	18.4*		150000*	2400.0*	190.0+	910.0*	15.00 *
ROR82-07	25.2	23.4**	31100*	300000**	8600.0**	1400.0**	3300.0*	33.00 **
ROR82-06	39.9	10.4*		190000*	2600.0*	470.0*	2000.0*	5.80 *
ROR82-02	50.4	8.1*	5769*	130000*	2800.0*	60.0	1200.0*	3.00T*
DTR82-22	51.3	9.5*	22350*	170000*	1900.0+	300.0*	2900.0*	3.00T*
DTR82-23	43.9	10.2*	15060*	180000*	3100.0*	640.0*	2200.0*	4.00T*
DTR82-25	37.6	10.1*		170000*	3700.0*	970.0*	2300.0*	3.00T*
DTR82-26	49.8	3.6		33000	720.0	50.0	670.0*	0.10W+
DTR82-27	51.4	11.2*	35550*	200000*	3400.0*	1000.0*	6400.0*	19.00 *
DTR82-52	49.4	10.4*	5407*	180000*	3100.0*	100.0+	1300.0*	2.00T*
DTR82-53	33.3	10.3*		130000*	3300.0*	340.0*	1400.0*	0.10W+
DTR82-29	46.5	10.0*	12040*	150000*	2800.0*	510.0*	2700.0*	4.00T*
DTR82-30	52.2	7.4+		150000*	1900.0+	310.0*	2600.0*	4.00T*
DTR82-32	49.9	10.0*	23400*	170000*	1900.0+	370.0*	3300.0*	5.10 *
DTR82-38	36.9	12.2*	15250*	230000*	3200.0*	510.0*	4700.0*	12.00 *
DTR82-56	49.9	12.7*	13940*	220000*	3300.0*	650.0*	6200.0*	14.00 *
DTR82-49	49.0	10.6*	38990**	170000*	2000.0+	260.0*	4800.0*	3.00T*
DTR82-43A	58.1	8.1*	8345*	110000*	1400.0+	210.0*	6700.0**	1.00T*
DTR82-45	45.5	10.0*	14830*	150000*	1500.0+	230.0*	6200.0*	5.00 *
DTR82-48	48.4	9.6*	3087*	140000*	2500.0*	180.0+	3700.0*	0.10W+
HUR82-02	62.6	2.4		31000	640.0	60.0	370.0	0.10W+
HUR82-01	50.5	6.4+	1752+	54000+	1300.0+	100.0+	790.0*	0.10W+
DTR82-57	48.8	4.9	1795+	56000+	2000.0+	90.0+	720.0*	0.10W+

LEGEND: HEAVILY POLLUTED = *
MODERATELY POLLUTED = +
NON-POLLUTED =

HIGHEST LEVEL IN STUDY AREA =**

T=Value reported is less than criteria of detection
W=Value reported is less than lowest value reported under "T" code.

TABLE 6 METALS IN DETROIT 1982 SEDIMENTS (mg/kg)
(1977 USEPA GUIDELINES)

STATION #	LEAD	ZINC	IRON	NICKEL	MANGANESE	CADMIUM	CHROMIUM	BARIUM	COPPER	MERCURY
DTR82-01	67.0*	90.0+	10000.0	16.0	160.0	0.3	18.0	36.0+	28.0+	0.3
DTR82-03	810.0**	1300.0*	26000.0*	130.0*	930.0*	24.0*	210.0*	500.0**	160.0*	1.2*
DTR82-05A	86.0*	170.0*	13000.0	27.0+	220.0	2.0	30.0+	64.0*	42.0+	0.4
DTR82-08	600.0*	1100.0*	25000.0+	83.0*	450.0+	11.0*	150.0*	260.0*	160.0*	1.4*
DTR82-13	210.0*	230.0*	19000.0+	26.0+	450.0+	0.6	65.0+	120.0*	99.0*	0.3
DTR82-19	670.0*	2900.0*	66000.0*	84.0*	1500.0*	7.9*	86.0*	120.0*	110.0*	0.8
ROR82-07	590.0*	1100.0*	42000.0*	200.0*	720.0*	96.0**	630.0*	370.0*	720.0**	2.4*
ROR82-06	500.0*	1100.0*	40000.0*	65.0*	790.0*	10.0*	270.0*	210.0*	280.0*	1.1*
ROR82-02	230.0*	470.0*	20000.0+	84.0*	410.0+	4.2*	95.0*	130.0*	130.0*	0.7
DTR82-22	340.0*	1300.0*	89000.0**	220.0*	1100.0*	6.9*	230.0*	170.0*	200.0*	0.6
DTR82-23	360.0*	1100.0*	71000.0*	130.0*	830.0*	6.9*	180.0*	140.0*	180.0*	0.8
DTR82-25	220.0*	580.0*	42000.0*	96.0*	630.0*	4.9	130.0*	130.0*	140.0*	-
DTR82-26	46.0+	160.0+	30000.0*	34.0+	580.0*	0.4	32.0+	99.0*	46.0+	0.3
DTR82-27	510.0*	1300.0*	44000.0*	290.0*	760.0*	16.0*	560.0*	410.0*	270.0*	1.0*
DTR82-52	620.0*	750.0*	25000.0+	35.0+	820.0*	4.4	99.0*	170.0*	99.0*	0.4
DTR82-53	380.0*	470.0*	28000.0*	42.0+	580.0*	2.2	56.0+	190.0*	110.0*	0.7
DTR82-29	330.0*	650.0*	40000.0*	89.0*	560.0*	4.9	170.0*	180.0*	130.0*	1.2*
DTR82-30	280.0*	750.0*	49000.0*	150.0*	540.0*	8.4*	280.0*	230.0*	180.0*	1.1*
DTR82-32	340.0*	930.0*	43000.0*	150.0*	630.0*	13.0*	320.0*	240.0*	220.0*	1.3*
DTR82-38	570.0*	3500.0**	39000.0*	190.0*	750.0*	19.0*	440.0*	300.0*	220.0*	3.6**
DTR82-56	490.0*	1500.0*	63000.0*	300.0**	1100.0*	25.0*	680.0**	370.0*	290.0*	1.8*
DTR82-49	400.0*	1000.0*	50000.0*	180.0*	880.0*	15.0*	420.0*	260.0*	190.0*	3.0*
DTR82-43A	210.0*	710.0*	59000.0*	97.0*	810.0*	8.1*	160.0*	160.0*	120.0*	1.6*
DTR82-45	280.0*	970.0*	61000.0*	110.0*	850.0*	13.0*	240.0*	250.0*	190.0*	3.4*
DTR82-48	99.0*	420.0*	25000.0+	67.0*	430.0+	5.4	92.0*	110.0*	75.0*	1.2*
HUR82-02	42.0+	140.0+	11000.0	15.0	410.0+	0.6	9.8	48.0+	17.0	0.2T
HUR82-01	21.0	76.0	29000.0*	22.0+	2800.0**	0.2T	15.0	110.0*	22.0	0.3
DTR82-57	73.0*	190.0+	16000.0	28.0+	290.0	1.0	22.0	70.0*	28.0+	0.2T

LEGEND: HEAVILY POLLUTED = *
MODERATELY POLLUTED = +
NON-POLLUTED =

HIGHEST LEVEL IN STUDY AREA =**

T=Value reported is less than criteria of detection

TABLE 7 TRACE METALS IN DETROIT 1982 SEDIMENTS (mg/kg)

STATION #	SILVER	BORON	BERYLIUM	COBALT	LITHIUM	MOLYB DENUM	TIN	STRONTIUM	VANADIUM	YTTRIUM
DTR82-01	0.3T	8.0T	0.2	5.0	13.0	1.0T	5.4	25.0	14.0	5.6
DTR82-03	2.5	18.0	0.1T	13.0	27.0	7.7	62.0**	93.0	28.0	10.0
DTR82-05A	0.3T	9.5	0.1T	8.2	16.0	1.0T	5.3	34.0	17.0	7.5
DTR82-08	1.5	27.0**	0.1	12.0	22.0	3.9	27.0	75.0	26.0	8.9
DTR82-13	0.3T	9.2	8.9	17.0**	21.0	7.3	31.0	84.0	34.0	8.9
DTR82-19	0.3T	9.8	0.1T	9.9	16.0	2.1	46.0	79.0	22.0	7.4
ROR82-07	4.9	14.0	0.9	12.0	26.0	10.0	29.0	110.0	40.0**	10.0
ROR82-06	2.3	13.0	0.8	10.0	24.0	16.0**	37.0	80.0	31.0	10.0
ROR82-02	1.8	11.0	0.5	10.0	22.0	3.2	12.0	47.0	23.0	8.5
DTR82-22	0.3T	25.0	9.8**	16.0	20.0	14.0	14.0	59.0	22.0	7.7
DTR82-23	0.3T	8.8	0.1T	13.0	22.0	8.7	23.0	50.0	23.0	8.7
DTR82-25	0.3T	11.0	0.1T	12.0	25.0	3.4	15.0	54.0	25.0	9.3
DTR82-26	0.3T	12.0	0.1T	11.0	28.0**	1.9	6.0	160.0	22.0	10.0
DTR82-27	5.9**	15.0	0.3	14.0	27.0	8.7	41.0	78.0	28.0	9.3
DTR82-52	0.3T	13.0	1.0	9.5	24.0	2.6	14.0	120.0	36.0	12.0**
DTR82-53	0.8	8.6	0.8	12.0	25.0	4.2	16.0	110.0	33.0	11.0
DTR82-29	1.0	11.0	0.1T	11.0	21.0	7.0	19.0	76.0	26.0	9.1
DTR82-30	1.7	12.0	0.1T	11.0	23.0	5.8	16.0	81.0	26.0	9.0
DTR82-32	3.0	13.0	0.4	11.0	22.0	7.0	29.0	160.0	23.0	9.1
DTR82-38	3.9	14.0	0.3	12.0	28.0**	5.7	45.0	220.0	32.0	9.9
DTR82-56	5.4	14.0	0.1T	13.0	25.0	9.7	55.0	120.0	30.0	8.9
DTR82-49	2.7	13.0	0.1	11.0	25.0	6.7	32.0	110.0	27.0	8.9
DTR82-43A	0.3T	14.0	0.1T	9.0	16.0	7.5	13.0	100.0	22.0	7.5
DTR82-45	0.3T	11.0	0.4	11.0	21.0	6.1	21.0	230.0**	23.0	8.0
DTR82-48	0.3T	8.0T	0.3	7.9	16.0	2.2	8.0	57.0	17.0	9.0
HUR82-02	0.3T	8.0T	0.2	4.7	14.0	1.6	4.0T	90.0	12.0	6.9
HUR82-01	0.3T	8.3	0.5	9.2	21.0	3.3	4.0T	94.0	22.0	9.8
DTR82-57	0.3T	12.0	0.5	7.5	19.0	1.8	8.1	190.0	20.0	8.8

** Highest value in study area.

T=Value reported is less than criteria of detection.

TABLE 8 MAJOR METALS IN DETROIT 1982 SEDIMENTS (mg/kg)

STATION #	CALCIUM	POTASSIUM	MAGNESIUM	SODIUM	ALUMINUM	IRON
DTR82-01	28000.0	600.0	14000.0	100.0T	5000.0	10000.0
DTR82-03	62000.0	1500.0	17000.0	300.0	12000.0	26000.0
DTR82-05A	31000.0	0.0	17000.0	100.0	7000.0	13000.0
DTR82-08	58000.0	1200.0	14000.0	200.0	11000.0	25000.0
DTR82-13	46000.0	900.0	17000.0	200.0	9400.0	19000.0
DTR82-19	46000.0	1000.0	13000.0	300.0	7300.0	66000.0
ROR82-07	44000.0	2000.0	14000.0	700.0	15000.0	42000.0
ROR82-06	43000.0	1500.0	14000.0	200.0	12000.0	40000.0
ROR82-02	43000.0	1100.0	20000.0	200.0	8500.0	20000.0
DTR82-22	43000.0	1100.0	17000.0	200.0	8200.0	89000.0
DTR82-23	41000.0	1000.0	19000.0	200.0	9200.0	71000.0
DTR82-25	41000.0	1100.0	17000.0	200.0	10000.0	42000.0
DTR82-26	92000.0	1800.0	18000.0	200.0	10000.0	30000.0
DTR82-27	50000.0	1800.0	17000.0	300.0	12000.0	44000.0
DTR82-52	47000.0	1500.0	15000.0	500.0	13000.0	25000.0
DTR82-53	42000.0	1400.0	14000.0	600.0	12000.0	28000.0
DTR82-29	41000.0	1300.0	15000.0	200.0	10000.0	40000.0
DTR82-30	44000.0	1500.0	15000.0	200.0	9600.0	49000.0
DTR82-32	92000.0	1300.0	16000.0	400.0	8700.0	43000.0
DTR82-38	87000.0	1600.0	17000.0	500.0	12000.0	39000.0
DTR82-56	54000.0	1400.0	18000.0	300.0	11000.0	63000.0
DTR82-49	59000.0	1500.0	22000.0	300.0	10000.0	50000.0
DTR82-43A	54000.0	1000.0	16000.0	1600.0	7000.0	59000.0
DTR82-45	81000.0	1000.0	19000.0	500.0	8100.0	61000.0
DTR82-48	31000.0	900.0	10000.0	200.0	8100.0	25000.0
HUR82-02	86000.0	700.0	14000.0	200.0	4500.0	11000.0
HUR82-01	66000.0	700.0	17000.0	200.0	9700.0	29000.0
DTR82-57	44000.0	1300.0	9400.0	200.0	9200.0	16000.0

T=Value reported is less than criterion of detection.

TABLE 9 DETROIT 1982 METALS SUMMARY (mg/kg)

METAL	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
CD	28	11.118*	18.029	311.3	0.2	96.0
CR	28	203.207*	189.189	5689.8	9.8	680.0
HG	27	1.159*	0.952	31.3	0.2	3.6
NI	28	105.714*	79.941	2960.0	15.0	300.0
ZN	28	891.286*	783.299	24956.0	76.0	3500.0
AG	28	1.496	1.718	41.9	0.3	5.9
B	28	12.543	4.543	351.2	8.0	27.0
CU	28	159.143*	135.142	4456.0	17.0	720.0
BA	28	194.536*	114.708	5447.0	36.0	500.0
CA	28	53428.571	18470.053	1496000.0	28000.0	92000.0
K	28	1203.571	419.419	33700.0	0	2000.0
MG	27	15907.143	2730.612	445400.0	9400.0	22000.0
NA	28	332.143	289.384	9300.0	100.0	1600.0
FE	28	38392.857*	19846.334	1075000.0	10000.0	89000.0
BE	28	0.964	2.387	27.0	0.1	9.8
CO	28	10.818	2.750	302.9	4.7	17.0
PB	28	334.786*	218.247	9374.0	21.0	810.0
LI	28	21.750	4.248	609.0	13.0	28.0
MN	28	749.286*	494.705	20980.0	160.0	2800.0
MO	28	5.718	3.801	160.1	1.0	16.0
SN	28	22.779	16.050	637.8	4.0	62.0
SR	28	99.500	51.624	2786.0	25.0	230.0
V	28	25.143	6.468	704.0	12.0	40.0
Y	28	8.918	1.285	249.7	5.6	12.0

* Mean values for 10 metals, for which USEPA 1977 Guidelines exist, exceed guidelines for heavily polluted.

TABLE 10 SUMMARY TABLE (ug/kg)

STATION #	TOTAL PAH's	TOTAL DDT & - METABO LITES	TOTAL PCB's
DTR82-01	5150.0	373.0	116.0
DTR82-03	25820.0	2265.0	9133.0
DTR82-05A	2350.0	122.0	290.0
DTR82-08	80660.0	361.0	9897.0
DTR82-13	60700.0	58.0	1229.0
DTR82-19	97302.0	116.0	5041.0
ROR82-07	60800.0	645.0	1546.0
ROR82-06	66000.0	487.0	2838.0
ROR82-02	125200.0	-	-
DTR82-22	70000.0	308.0	5160.0
DTR82-23	40300.0	242.0	9726.0
DTR82-25	35300.0	227.0	5220.0
DTR82-26	39300.0	16.0	322.0
DTR82-27	33600.0	118.0	7486.0
DTR82-52	23700.0	597.0	1410.0
DTR82-53	8820.0	30.0	1177.0
DTR82-29	62800.0	445.0	3693.0
DTR82-30	20600.0	830.0	7963.0
DTR82-32	60910.0	54.0	11329.0
DTR82-38	55800.0	847.0	13870.0
DTR82-56	48170.0	235.0	9173.0
DTR82-49	44300.0	341.0	10106.0
DTR82-43A	55770.0	142.0	3332.0
DTR82-45	41170.0	238.0	6326.0
DTR82-48	32960.0	79.5	2827.0
HUR82-02	620.0	68.0	22.0
HUR82-01	1000.0	-	-
DTR82-57	1150.0	35.0	106.0
MEAN=	42866.0	360.0	4618.0

TABLE 11(A) POLYNUCLEAR AROMATIC HYDROCARBONS (PAH) IN DETROIT 1982 SEDIMENTS
(UG/KG)

STATION #	NAPTHA-LENE	2-METHYL NAPTHA-LENE	ACENAPH THYLENE	ACENAPH THENE	FLUORENE	ANTHRA CENE	PHENAN-THRENE
DTR82-01	120.0			90.0	160.0	180.0	880.0
DTR82-03	980.0	4610.0			2800.0		6480.0
DTR82-05A	120.0			40.0	60.0		460.0
DTR82-08	1430.0	1580.0	510.0	860.0	1020.0	1260.0	4610.0
DTR82-13	3960.0	1190.0	140.0	1570.0	2000.0	2140.0	8620.0
DTR82-19	11040.0	2780.0	1340.0	3370.0	4420.0	3650.0	15320.0
ROR82-07	1300.0	1500.0	300.0	900.0	1500.0	1600.0	10200.0
ROR82-06	3300.0	1800.0		1500.0	1900.0		8200.0
ROR82-02	6500.0		310.0	2200.0	2310.0	3940.0	9800.0
DTR82-22	1100.0	700.0	200.0	200.0	500.0	1000.0	2900.0
DTR82-23	800.0	300.0		100.0	200.0	700.0	1600.0
DTR82-25	1400.0	400.0				800.0	1700.0
DTR82-26	1200.0	200.0	100.0	300.0	300.0	1300.0	2800.0
DTR82-27	1100.0	600.0					3600.0
DTR82-52	400.0	500.0			300.0		2000.0
DTR82-53	180.0	190.0		130.0	150.0	220.0	940.0
DTR82-29	800.0	700.0		400.0	400.0	1300.0	3700.0
DTR82-30	400.0	200.0					800.0
DTR82-32	7490.0	3960.0			1670.0	840.0	4410.0
DTR82-38	1500.0	500.0		500.0	800.0		4200.0
DTR82-56	5210.0	3240.0					1790.0
DTR82-49	1790.0	1840.0				750.0	2710.0
DTR82-43A	550.0	300.0	70.0	170.0	260.0	680.0	3220.0
DTR82-45	900.0	530.0	90.0	110.0	260.0	380.0	1650.0
DTR82-48	370.0	170.0	150.0	70.0	90.0	450.0	1020.0
HUR82-02	50.0	40.0		20.0	20.0		100.0
HUR82-01	100.0	100.0					200.0
DTR82-57	50.0	70.0					120.0

TABLE 11(B) POLYNUCLEAR AROMATIC HYDROCARBONS (PAH) IN DETROIT 1982 SEDIMENTS
(ug/kg)

STATION #	FLUORAN- THRENE	PYRENE	CHRYSENE &BENZO(A) ANTHRACENE	BENZO (B/K)FLUO RANTHENE	BENZO (GHI) PERYLENE	BENZO (A) PYRENE	INDENO (123-CD) PYRENE	TOTAL PAH's
DTR82-01	1240.0	1010.0	1470.0					5150.0
DTR82-03	1860.0	1950.0	7140.0					25820.0
DTR82-05A	600.0	500.0	570.0					2350.0
DTR82-08	4100.0	5340.0	9210.0	13840.0	10610.0	19230.0	7060.0	80660.0
DTR82-13	9320.0	8530.0	8060.0	57900.0	2060.0	5950.0	1370.0	60700.0
DTR82-19	13040.0	9440.0	5620.0	9080.0	4120.0	10720.0	3362.0	97302.0
ROR82-07	13600.0	14300.0	15600.0					60800.0
ROR82-06	13800.0	16200.0	19300.0					66000.0
ROR82-02	11440.0	9350.0	14850.0	20080.0	12600.0	23670.0	8150.0	125200.0
DTR82-22	7200.0	7000.0	14900.0	12600.0	4200.0	13900.0	3600.0	70000.0
DTR82-23	3900.0	4000.0	9300.0	7000.0	3100.0	7400.0	1900.0	40300.0
DTR82-25	3700.0	3600.0	8500.0	7200.0		8000.0		35300.0
DTR82-26	3900.0	4300.0	8700.0	5700.0	1900.0	7100.0	1500.0	39300.0
DTR82-27	4200.0	3800.0	6200.0	4500.0	2500.0	5200.0	1900.0	33600.0
DTR82-52	6200.0	6000.0	8300.0					23700.0
DTR82-53	2390.0	2000.0	2620.0					8820.0
DTR82-29	5600.0	7100.0	12900.0	11100.0	3900.0	11900.0	3000.0	62800.0
DTR82-30	1400.0	1500.0	4100.0	3900.0	1800.0	4800.0	1700.0	20600.0
DTR82-32				12580.0	7700.0	16800.0	5460.0	60910.0
DTR82-38	4300.0	3600.0	8000.0	11000.0	5400.0	12200.0	3800.0	55800.0
DTR82-56	1780.0	1760.0	5300.0	9270.0	5560.0	10360.0	3900.0	48170.0
DTR82-49	2010.0	1980.0	6180.0	8720.0	5510.0	9040.0	3770.0	44300.0
DTR82-43A	5080.0	4550.0	11600.0	10050.0	3900.0	12120.0	3220.0	55770.0
DTR82-45	2400.0	2450.0	10100.0	3510.0	3420.0	12970.0	2400.0	41170.0
DTR82-48	2630.0	3030.0	8510.0	6100.0	1800.0	7010.00	1560.0	32960.0
HUR82-02	210.0	180.0						620.0
HUR82-01	300.0	300.0						1000.0
DTR82-57	230.0	200.0	480.0					1150.0

TABLE 12 "HAZARDOUS" PAH's IN DETROIT 1982 SEDIMENTS
(ug/kg)

STATION #	BENZO (A) PYRENE	CHRYSENE &BENZO(A) ANTHRACENE	INDENO (123-CD) PYRENE	BENZO (B/K)FLUO RANTHENE	PHENAN-THRENE	SUM OF "HAZARDOUS" PAH's
DTR82-01		1470.0			880.0	2350
DTR82-03		7140.0			6480.0	13620*
DTR82-05A		570.0			460.0	1030
DTR82-08	19230.0**	9210.0	7060.0	13840.0	4610.0	53950*
DTR82-13	5950.0*	8060.0	1370.0	57900.0	8620.0	81900**
DTR82-19	10720.0*	5620.0	3362.0	9080.0	15320.0	44102*
ROR82-07		15600.0			10200.0	25800*
ROR82-06		19300.0			8200.0	27500*
ROR82-02	23670.0**	14850.0	8150.0	20080.0	9800.0	76550**
DTR82-22	13900.0*	14900.0	3600.0	12600.0	2900.0	47900*
DTR82-23	7400.0*	9300.0	1900.0	7000.0	1600.0	27200*
DTR82-25	8000.0*	8500.0		7200.0	1700.0	25400*
DTR82-26	7100.0*	8700.0	1500.0	5700.0	2800.0	25800*
DTR82-27	5200.0*	6200.0	1900.0	4500.0	3600.0	21400*
DTR82-52		8300.0			2000.0	10300*
DTR82-53		2620.0			940.0	3560
DTR82-29	11900.0*	12900.0	3000.0	11100.0	3700.0	42600*
DTR82-30	4800.0*	4100.0	1700.0	3900.0	800.0	15300*
DTR82-32	16800.0*		5460.0	12580.0	4410.0	39250*
DTR82-38	12200.0*	8000.0	3800.0	11000.0	4200.0	39200*
DTR82-56	10360.0*	5300.0	3900.0	9270.0	1790.0	30620*
DTR82-49	9040.0*	6180.0	3770.0	8720.0	2710.0	30420*
DTR82-43A	12120.0*	11600.0	3220.0	10050.0	3220.0	40210*
DTR82-45	12970.0*	10100.0	2400.0	3510.0	1650.0	30630*
DTR82-48	7010.0*	8510.0	1560.0	6100.0	1020.0	24200*
HUR82-02					100.0	100
HUR82-01					200.0	200
DTR82-57		480.0			120.0	600

* = >1,000 (BENZO (A) PYRENE)

** = HIGHEST CONCENTRATIONS

* = >10,000 (SUM OF "HAZARDOUS" PAH's)

** = HIGHEST CONC.

TABLE 13 PCB'S IN DETROIT 1982 SEDIMENTS (ug/kg)

STATION #	PCB-1242	%	PCB-1248	%	PCB-1254	%	PCB-1260	%	TOTAL PCB's
DTR82-01			58.0	50	58.0	50			116.0
DTR82-03			5034.0	55	3482.0	38	617.0	7	9133.0
DTR82-05A			109.0	38	119.0	41	62.0	21	290.0
DTR82-08			2612.0	26	3467.0	35	3818.0	39	9897.0
DTR82-13			154.0	13	294.0	24	781.0	63	1229.0
DTR82-19			940.0	19	1584.0	31	2517.0	50	5041.0
ROR82-07			552.0	36	593.0	38	401.0	26	1546.0
ROR82-06			911.0	32	1072.0	38	855.0	30	2838.0
ROR82-02									-
DTR82-22			1150.0	22	1620.0	31	2390.0	46	5160.0
DTR82-23	79.0	1	6940.0	71	987.0	10	1720.0	18	9726.0
DTR82-25	75.0	1	605.0	12	1930.0	37	2610.0	50	5220.0
DTR82-26			199.0	62	123.0	38			322.0
DTR82-27	956.0	13	3630.0	48	2900.0	39			7486.0
DTR82-52			363.0	26	492.0	35	555.0	39	1410.0
DTR82-53			435.0	37	411.0	35	331.0	28	1177.0
DTR82-29	253.0	7	2280.0	62	1160.0	31			3693.0
DTR82-30	563.0	7	4950.0	62	2450.0	30			7963.0
DTR82-32			6562.0	58	2863.0	25	1904.0	17	11329.0*
DTR82-38			6397.0	46	3638.0	26	3835.0	28	13870.0*
DTR82-56			2943.0	32	2284.0	25	3946.0	43	9173.0
DTR82-49			4082.0	40	3076.0	30	2948.0	29	10106.0*
DTR82-43A			871.0	26	994.0	29	1467.0	44	3332.0
DTR82-45			2507.0	39	2194.0	34	1625.0	25	6326.0
DTR82-48			708.0	25	1012.0	36	1107.0	39	2827.0
HUR82-02			22.0	100					22.0
HUR82-01									-
DTR82-57			62.0	58	44.0	42			106.0
TOTALS	1926		55076		38847		33489		129338
AVERAGE LEVELS	68		1967		1387		1196		4618

*=Polluted (USEPA 1977 Guidelines)

TABLE 14 DDT & METABOLITES IN DETROIT 1982 SEDIMENTS (ug/kg)

STATION #	p,p'DDT	p,p'DDD	p,p'DDE	o,p'DDT	o,p'DDD	o,p'DDE	TOTAL DDT & METABOLITES
DTR82-01	14.0	212.0	43.0	9.0	46.0	49.0	373.0
DTR82-03	95.0	1255.0	262.0	52.0	309.0	292.0	2265.0
DTR82-05A	4.0	26.0	89.0		3.0		122.0
DTR82-08	15.0	177.0	67.0	18.0	32.0	52.0	361.0
DTR82-13	23.0	30.0	5.0				58.0
DTR82-19	39.0	37.0	9.0	18.0	13.0		116.0
OR82-07	107.0	205.0	37.0	37.0	77.0	182.0	645.0
OR82-06	180.0	63.0	23.0	63.0	158.0		487.0
OR82-02							-
DTR82-22	111.0	49.0		38.0	110.0		308.0
DTR82-23	70.0	73.0	25.0		8.0	66.0	242.0
DTR82-25	44.0	62.0	28.0		7.0	86.0	227.0
DTR82-26					16.0		16.0
DTR82-27		60.0	24.0			34.0	118.0
DTR82-52	37.0	158.0	47.0	42.0	50.0	263.0	597.0
DTR82-53			28.0			2.0	30.0
DTR82-29		166.0	61.0		65.0	153.0	445.0
DTR82-30		324.0	202.0		173.0	131.0	830.0
DTR82-32		8.0	21.0	18.0		7.0	54.0
DTR82-38		268.0	57.0	431.0	11.0	80.0	847.0
DTR82-56		66.0	46.0		9.0	114.0	235.0
DTR82-49		157.0	94.0		37.0	53.0	341.0
DTR82-43A	13.0	63.0	34.0		32.0		142.0
DTR82-45		94.0	122.0		22.0		238.0
DTR82-48		35.0	16.0	6.0	17.5	5.0	79.5
HUR82-02	19.0	27.0	18.0		4.0		68.0
HUR82-01							-
DTR82-57		19.0	10.0		3.0	3.0	35.0

TABLE 15 PESTICIDES IN DETROIT 1982 SEDIMENTS (ug/kg)

STATION #	BETA BHC	ENDOSULFAN -II	DCPA	DIELDRIN	GAMMA-CHLORDANE	OXY-CHLORDANE	HEPTACHLOR-EPOXIDE	TRI-FLURALIN
DTR82-01	29.0	6.0			24.0			
DTR82-03	170.0	6.0		14.0	145.0			
DTR82-05A	15.0	1.0						
DTR82-08	74.0	7.0		14.0	17.0			
DTR82-13		12.0						
DTR82-19	20.0	10.0						
ROR82-07					95.0			
ROR82-06					63.0			
ROR82-02								
DTR82-22					39.0			25.0
DTR82-23					21.0			
DTR82-25					47.0			18.0
DTR82-26	39.0				13.0			
DTR82-27	195.0					81.0	61.0	
DTR82-52					149.0			9.0
DTR82-53								
DTR82-29	83.0		11.0	4.0	64.0	44.0		
DTR82-30	160.0				10.0	87.0	106.0	
DTR82-32		14.0			10.0			
DTR82-38					90.0		74.0	
DTR82-56					45.0			
DTR82-49					14.0			
DTR82-43A		10.0			39.0			
DTR82-45					21.0			
DTR82-48					6.0			
HUR82-02								
HUR82-01								
DTR82-57								

TABLE 16(A) VOLATILE ORGANICS IN DETROIT 1982 SEDIMENTS (ug/kg)

STATION #	1,1,2,2-TETRA-CHLORO-ETHANE	TETRA-CHLORO-ETHENE	METHYL BENZENE	CHLORO-BENZENE	ETHYL BENZENE	1,3-DIMETHYL BENZENE	1,2&1,4 DIMETHYL BENZENE
DTR82-01							51.0
DTR82-03							
DTR82-05A			3.0				17.0
DTR82-08					27.0		
DTR82-13			214.0		3.0	8.0	9.0
DTR82-19			107.0		201.0	181.0	170.0
ROR82-07	10.0		5.0		3.0	4.0	15.0
ROR82-06	16.0						
ROR82-02	14.0		2.0		2.0	2.0	8.0
DTR82-22			4.0		3.0		
DTR82-23			6.0		2.0		
DTR82-25		2.0	4.0		3.0		
DTR82-26							
DTR82-27			6.0				
DTR82-52			3.0				
DTR82-53			4.0				4.0
DTR82-29	27.0		6.0	3.0	3.0	3.0	5.0
DTR82-30	20.0						18.0
DTR82-32			42.0		12.0	24.0	29.0
DTR82-38			4.0	1.0	8.0	10.0	21.0
DTR82-56					6.0		
DTR82-49			13.0		8.0		
DTR82-43A							
DTR82-45							
DTR82-48					6.0		
HUR82-02	13.0						
HUR82-01	21.0			2.0	3.0		3.0
DTR82-57			2.0				

TABLE 16(B) VOLATILE ORGANICS IN DETROIT 1982 SEDIMENTS (ug/kg)

STATION #	DICHLORO METHANE	TRICHLRO METHANE	CHLORO-FORM	1,2-DI CHLORO-PROPANE	TRI CHLORO ETHENE	BENZENE
DTR82-01	4.0				10.0	
DTR82-03	4.0				4.0	
DTR82-05A	6.0	3.0			27.0	
DTR82-08	5.0					
DTR82-13	4.0					
DTR82-19	6.0					21.0
ROR82-07	5.0					17.0
ROR82-06	7.0	6.0		2.0	26.0	
ROR82-02	6.0				22.0	
DTR82-22	6.0	3.0			32.0	
DTR82-23	59.0					
DTR82-25	60.0					
DTR82-26	91.0	1.0			3.0	3.0
DTR82-27						
DTR82-52	5.0				4.0	
DTR82-53	5.0					
DTR82-29	16.0				5.0	
DTR82-30	20.0	10.0			41.0	
DTR82-32	11.0	7.0			50.0	
DTR82-38	10.0					
DTR82-56	10.0				6.0	
DTR82-49	10.0	23.0			29.0	
DTR82-43A	4.0	22.0			28.0	
DTR82-45	5.0		17.0		20.0	
DTR82-48		19.0			26.0	
HUR82-02	5.0		4.0		27.0	
HUR82-01	6.0		6.0	3.0	20.0	
DTR82-57	6.0				14.0	

TABLE 17 PHENOLS IN DETROIT 1982 SEDIMENTS (ug/kg)

STATION #	PHENOL	P-CRESOL	2,4-DIMETHYL PHENOL
DTR82-01	580.0	1980.0	
DTR82-03	90.0		
DTR82-05A	480.0	630.0	
DTR82-08	110.0	160.0	80.0
DTR82-13	370.0	1390.0	
DTR82-19		1500.0	
ROR82-07	1100.0	600.0	
ROR82-06	470.0	490.0	
ROR82-02			
DTR82-22			
DTR82-23		800.0	
DTR82-25			
DTR82-26		200.0	
DTR82-27			
DTR82-52	80.0	190.0	
DTR82-53		500.0	
DTR82-29			
DTR82-30	1490.0	4140.0	530.0
DTR82-32			
DTR82-38	9500.0	9910.0	25100.0
DTR82-56	2460.0	3200.0	20400.0
DTR82-49	320.0	280.0	160.0
DTR82-43A	650.0	750.0	700.0
DTR82-45	100.0	90.0	150.0
DTR82-48	30.0	20.0	
HUR82-02			
HUR82-01			
DTR82-57			

TABLE 18 SUBSTITUTED BENZENES, SUBSTITUTED CYCLIC KETONES, AND POLYCYCLIC AROMATICS IN DETROIT 1982 SEDIMENTS (ug/kg)

STATION #	ANILINE	1,3-DI CHLORO BENZENE	1,4-DI CHLORO BENZENE	1,2-DI CHLORO BENZENE	1,2,4-TRI CHLORO BENZENE	HEXA-CHLORO-BENZENE	4-CHLORO ANILINE	DIBENZO FURAN	ISO-PHORONE	DIETHYL PHTHALATE	DI-N-BUTYL PHTHALATE	BIS (2-EH) PHTHALATE
								50.0			2540	490
DTR82-01											5690	15640
DTR82-03		940.0				21.0					540	650
DTR82-05A						2.0		290.0			5470	11280
DTR82-08			300.0			14.0		1150.0			320	8900
DTR82-13			50.0			3.0		3620.0			2320	5870
DTR82-19			150.0			15.0		300.0	900.0		2700	33000
ROR82-07			500.0	500.0		30.0		400.0			4900	2100
ROR82-06			200.0			14.0		1910.0			780	4790
ROR82-02			130.0					200.0				23300
DTR82-22			100.0			8.0						16300
DTR82-23						9.0						14300
DTR82-25						14.0		100.0				
DTR82-26						0.0T						28000
DTR82-27						33.0					4200	12000
DTR82-52						12.0			70.0		1350	4540
DTR82-53			70.0			17.0		200.0				47100
DTR82-29			100.0			5.0						4900
DTR82-30						9.0					930	11390
DTR82-32	80.0		350.0	180.0		18.0					1300	25500
DTR82-38			200.0			106.0	1000.0					30220
DTR82-56			470.0		520.0	92.0						21310
DTR82-49		160.0	190.0	110.0	110.0	46.0		160.0			660	3120
DTR82-43A						71.0		200.0			140	5430
DTR82-45		70.0	110.0	60.0		98.0		70.0			170	1580
DTR82-48						35.0				20.0	520	460
HUR82-02											2000	1000
HUR82-01										30.0	1730	640
DTR82-57						0.0T						

T=Value reported is less than criteria of detection.

Figure 1
Detroit Area Industry
(Reprinted by Permission from Thornley and Hamdy, 1984)

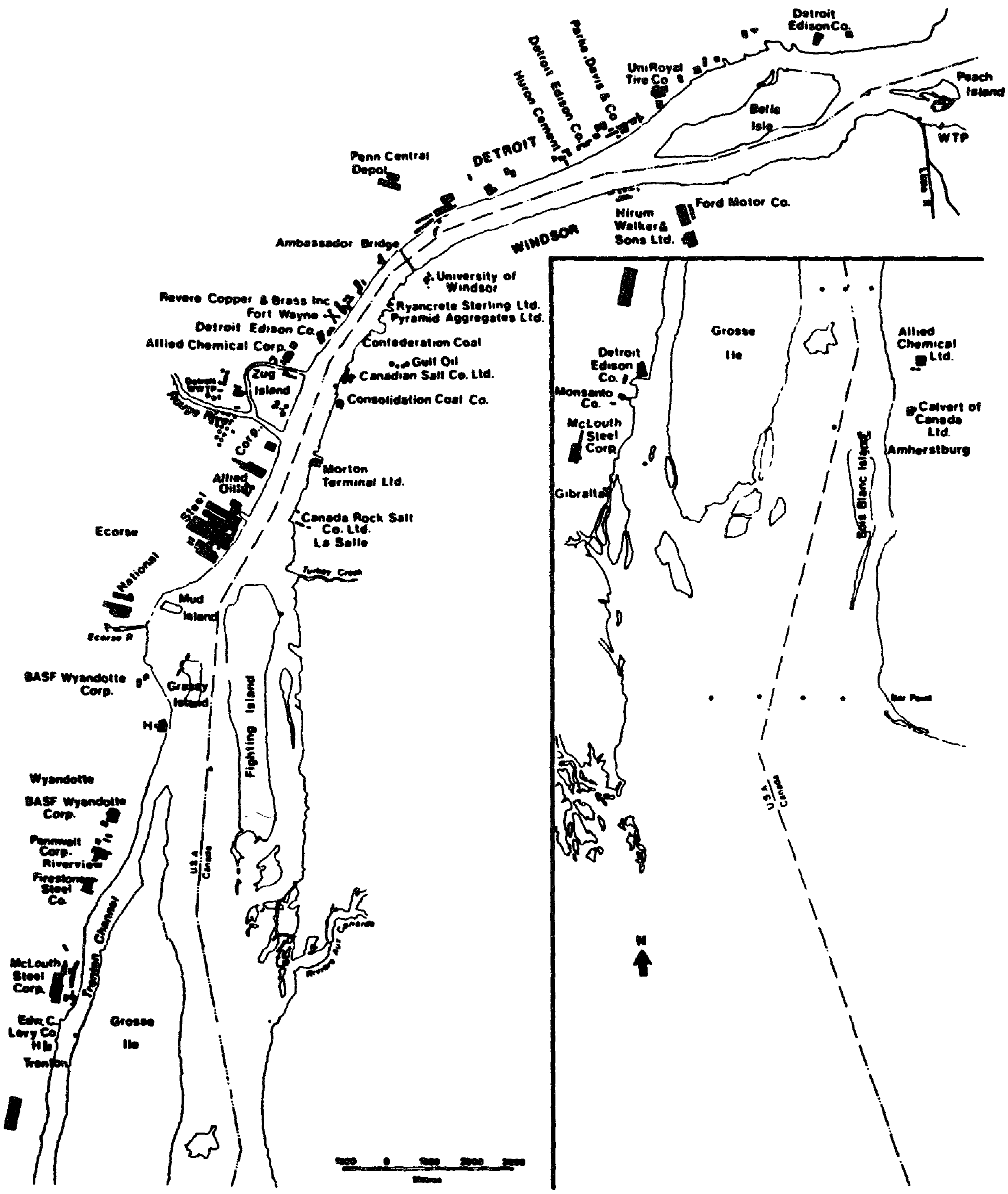


Figure 2
Bedrock Surface Topography
Reprinted From Mozola, 1969

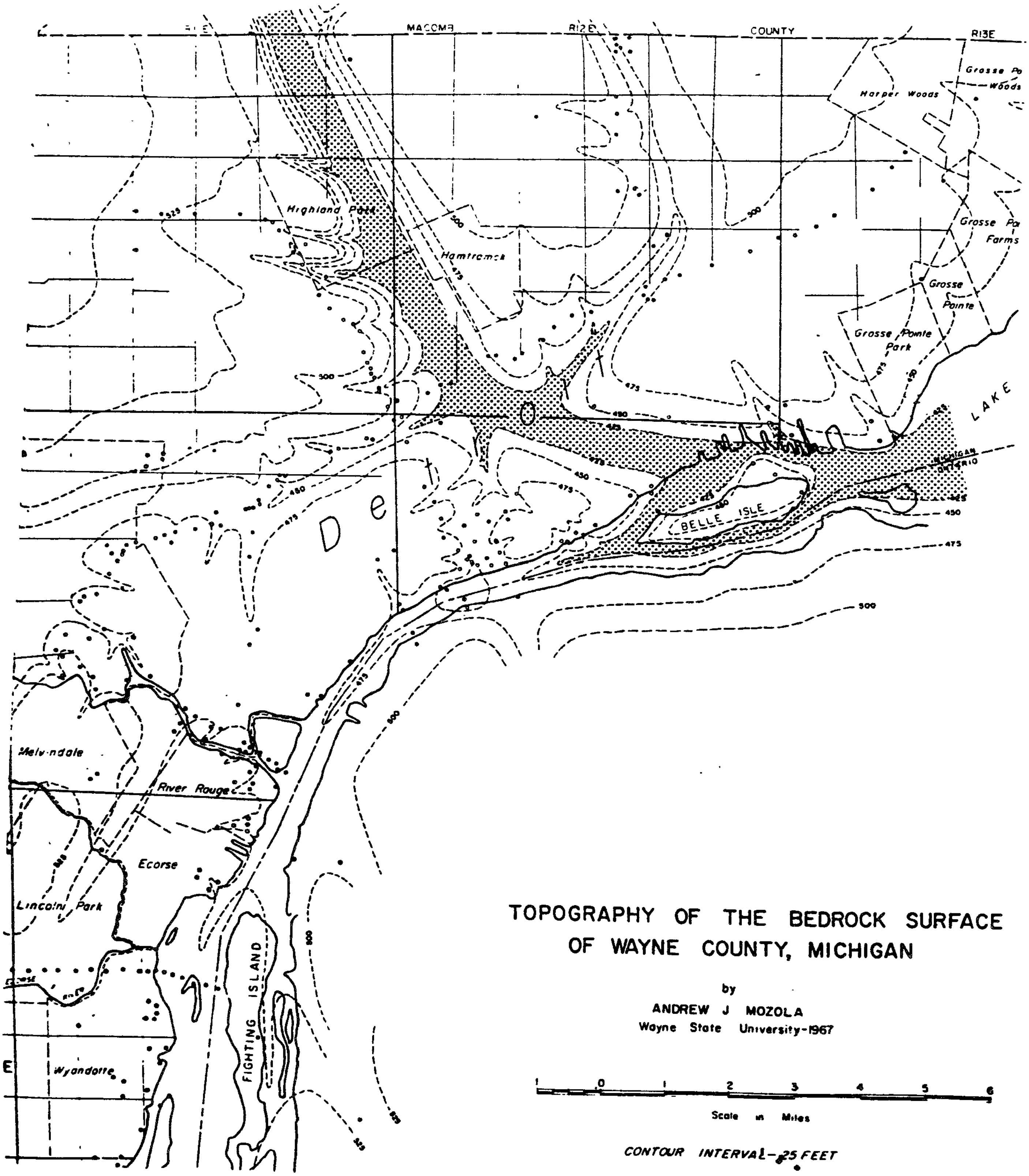


Figure 3
Detroit River Study Area
(Reprinted by Permission from Thornley and Hamdy, 1984)

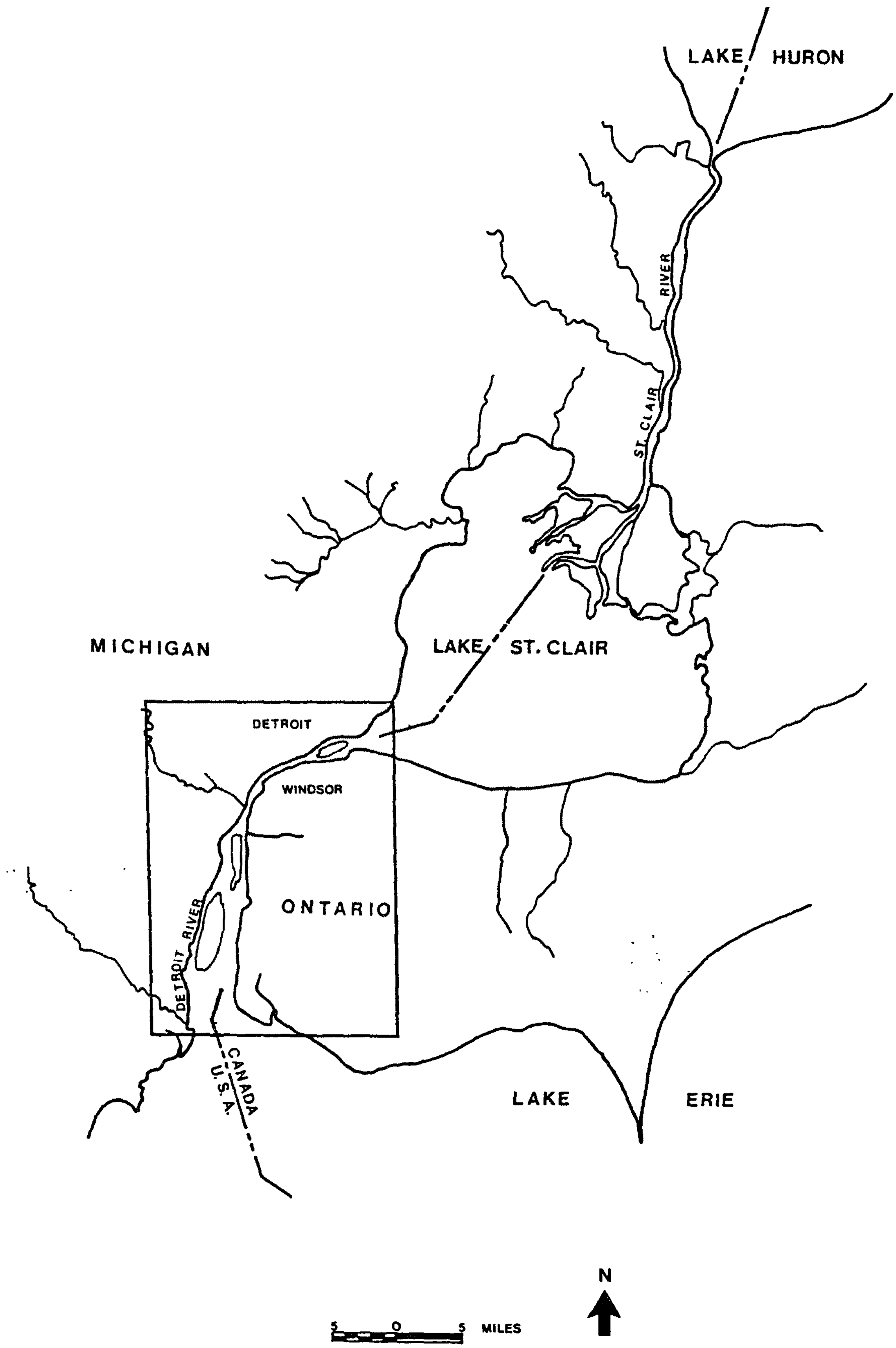
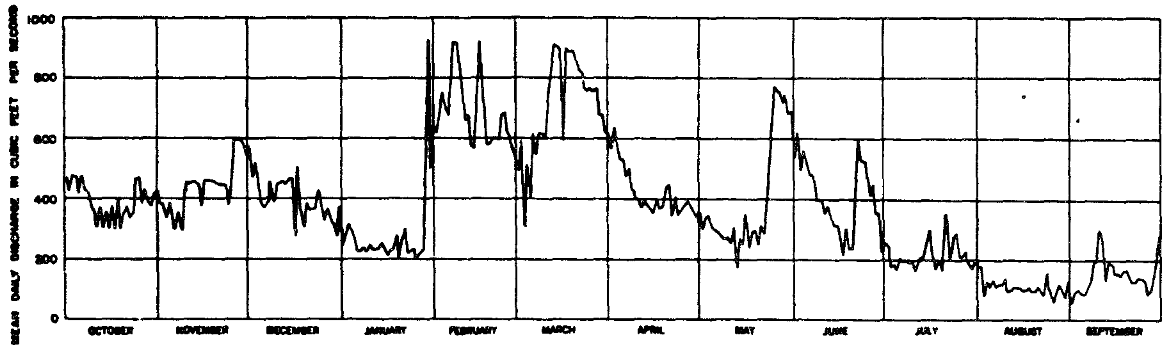
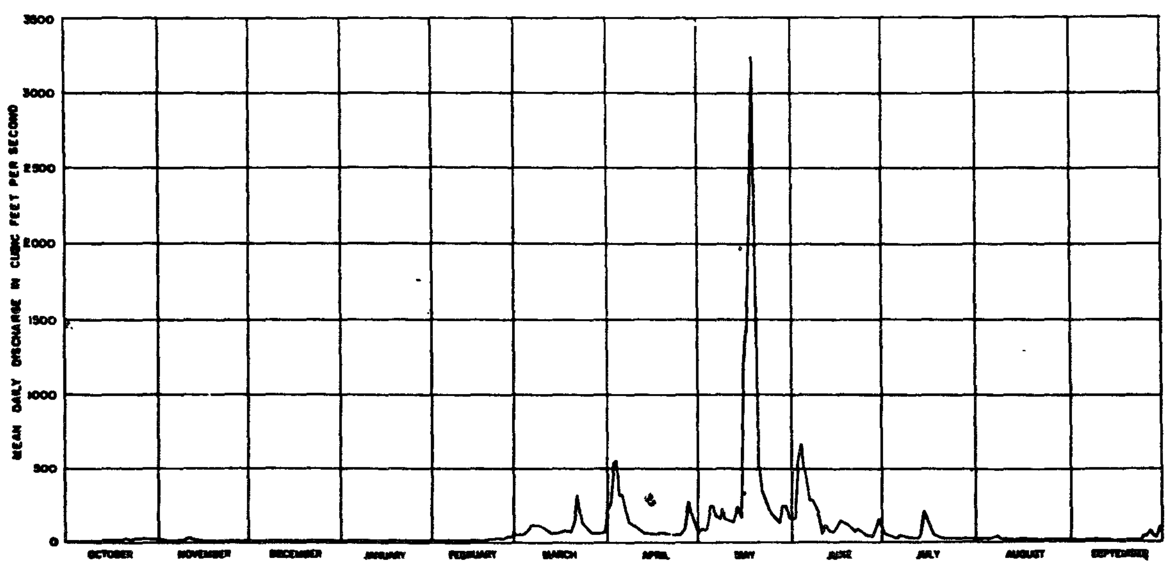


Figure 4
Hydrographs
(Reprinted from Wisler et al, 1952)



Hydrograph of Huron River at Barton for a median year.



Hydrograph of River Rouge at Detroit for a median year.

FIGURE 5

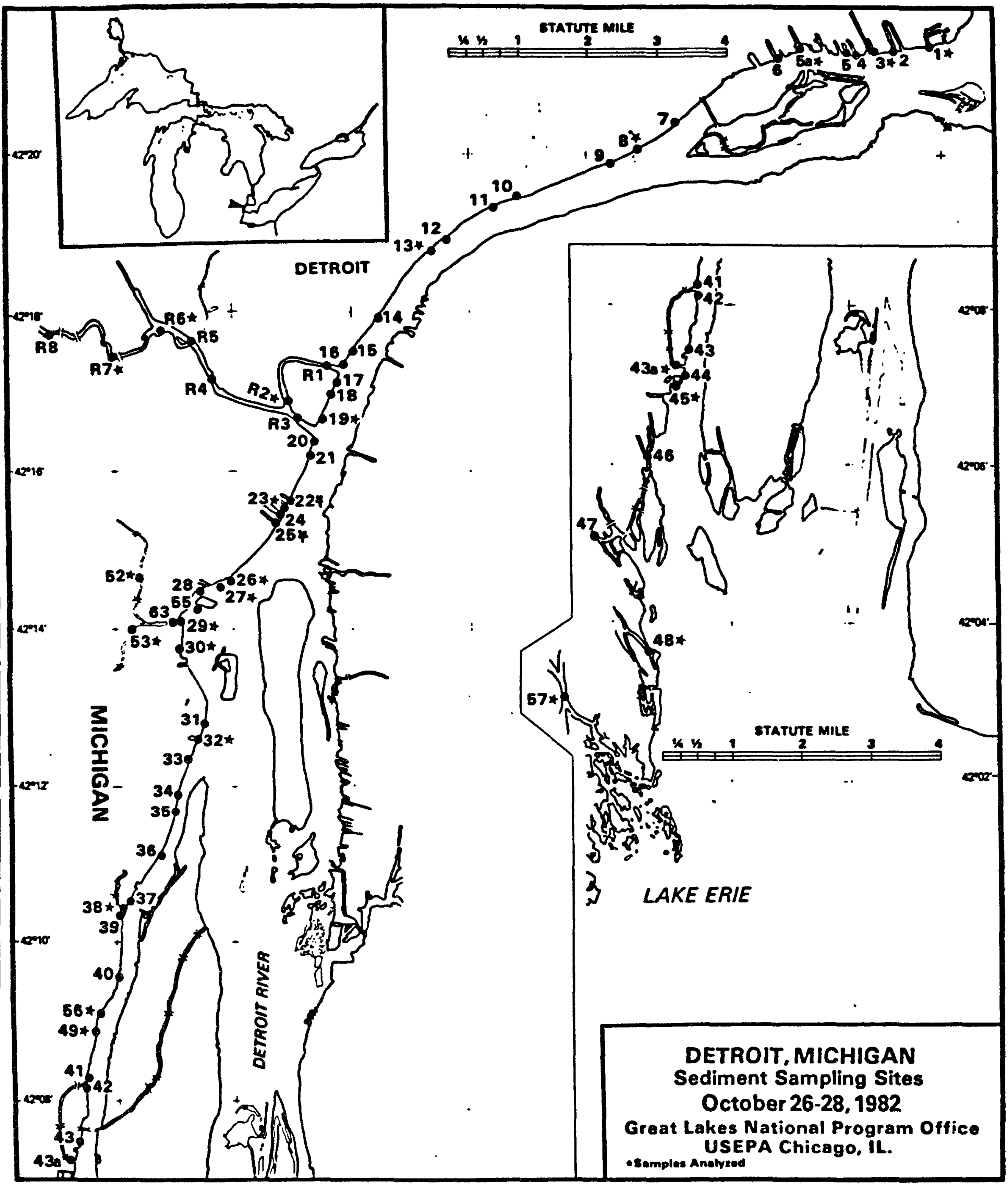

STATUTE MILE
¼ ½ 1 2 3 4
DETROIT
MICHIGAN
DETROIT RIVER
LAKE ERIE
DETROIT, MICHIGAN
Sediment Sampling Sites
October 26-28, 1982
Great Lakes National Program Office
USEPA Chicago, IL.
*Samples Analyzed

FIGURE 6

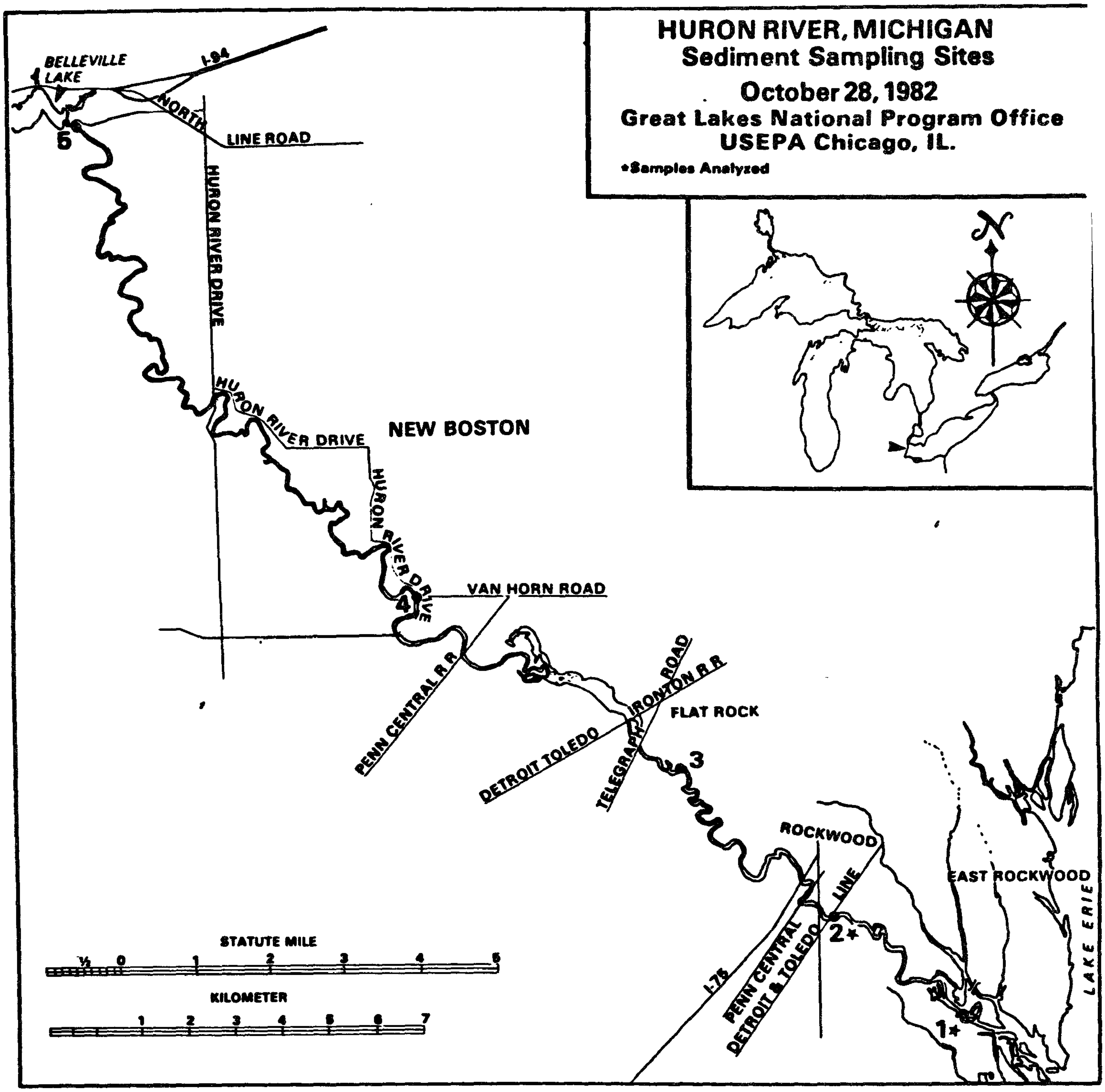

HURON RIVER, MICHIGAN
Sediment Sampling Sites
October 28, 1982
Great Lakes National Program Office
USEPA Chicago, IL.
*Samples Analyzed
BELLEVILLE LAKE
I-94
NORTH LINE ROAD
HURON RIVER DRIVE
NEW BOSTON
VAN HORN ROAD
PENN CENTRAL R.R.
DETROIT TOLEDO
IRONTON R.R.
ROAD
TELEGRAPH
FLAT ROCK
ROCKWOOD
EAST ROCKWOOD
LINE
PENN CENTRAL
DETROIT & TOLEDO
I-75
LAKE ERIE
5
4
3
2*
1*
STATUTE MILE
KILOMETER

Figure 7

Detroit Area Municipal and Combined Storm Sewer Facilities

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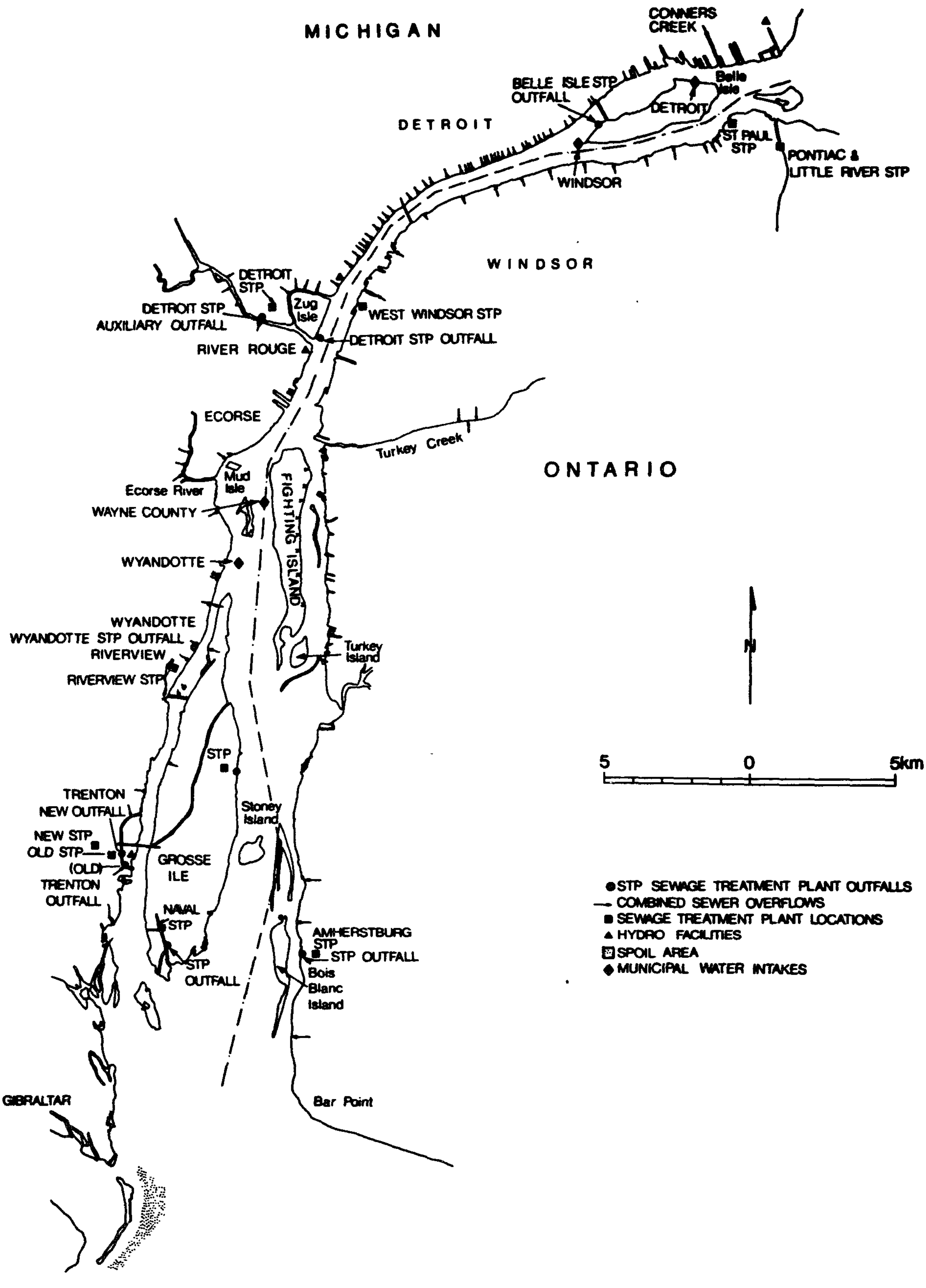


Figure 8 TOTAL VOLATILE SOLIDS IN DETROIT SEDIMENTS

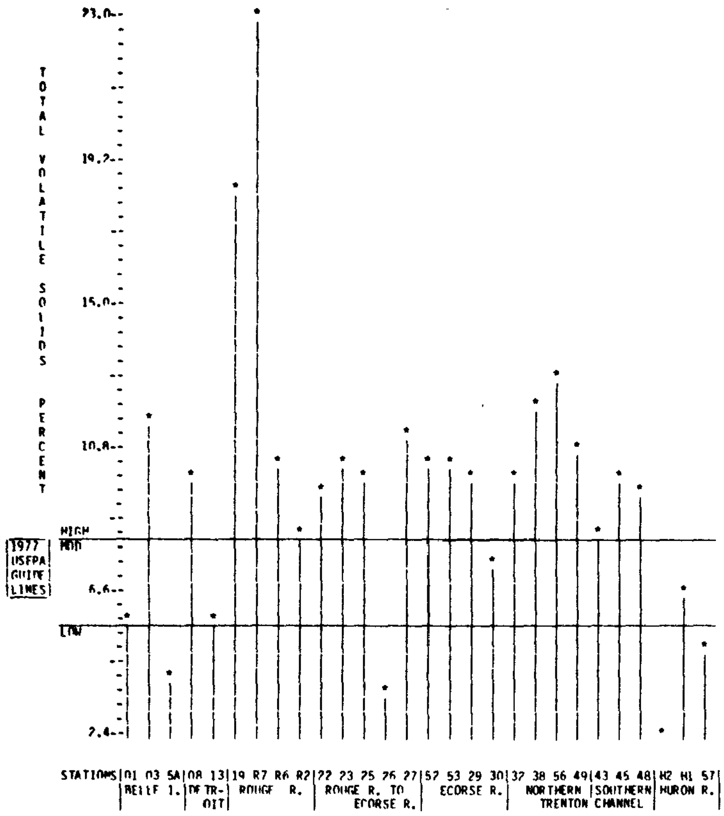


Figure 9 OIL AND GREASE IN DETROIT SEDIMENTS

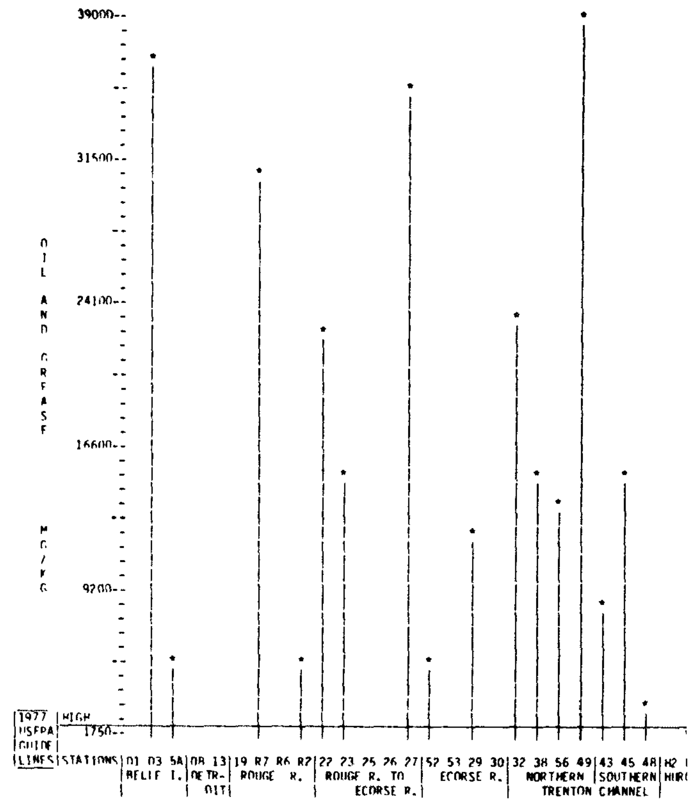


Figure 10 COD IN DETROIT SEDIMENTS

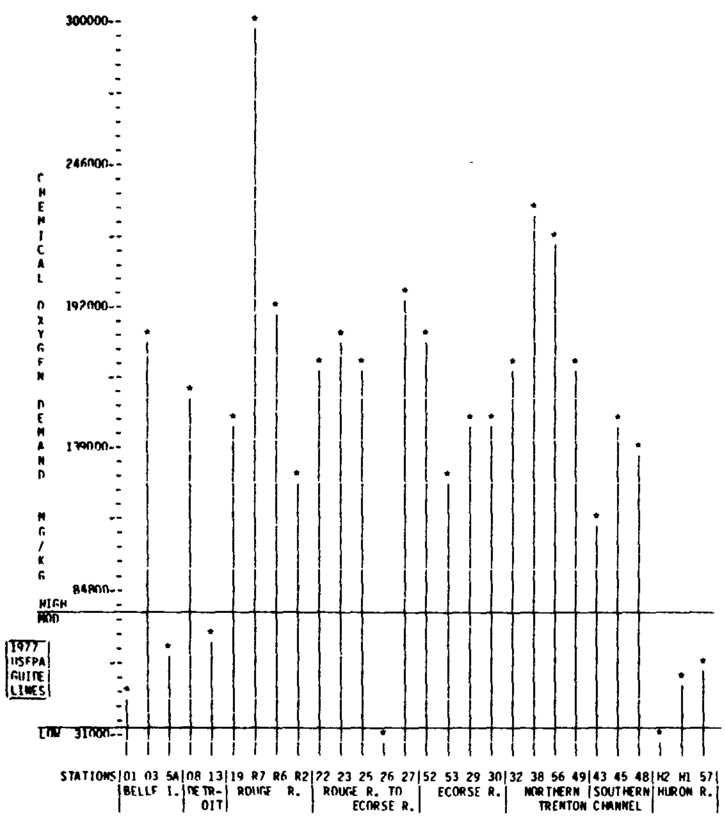


Figure 11 TKN IN DETROIT SEDIMENTS

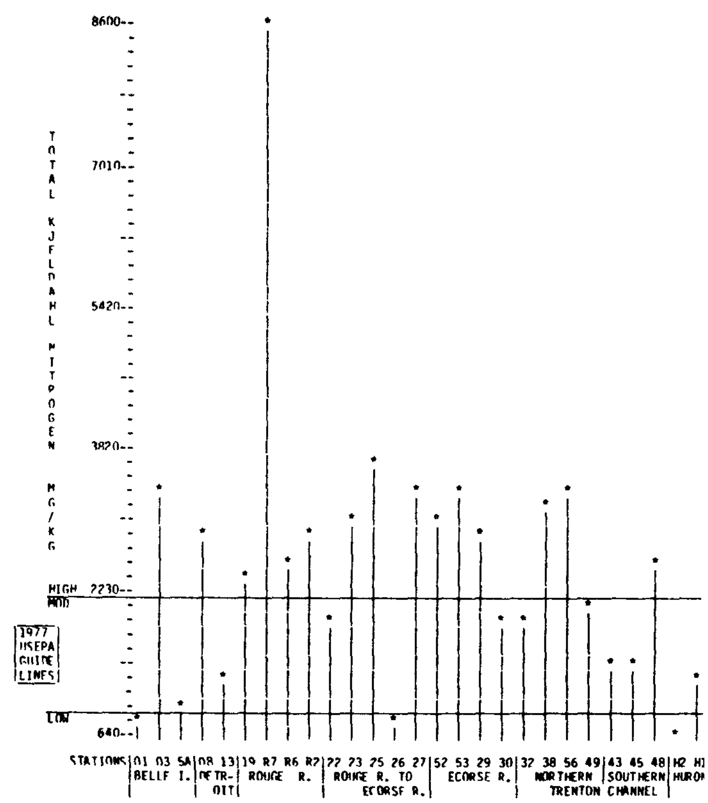


Figure 12 AMMONIA IN DETROIT SEDIMENTS

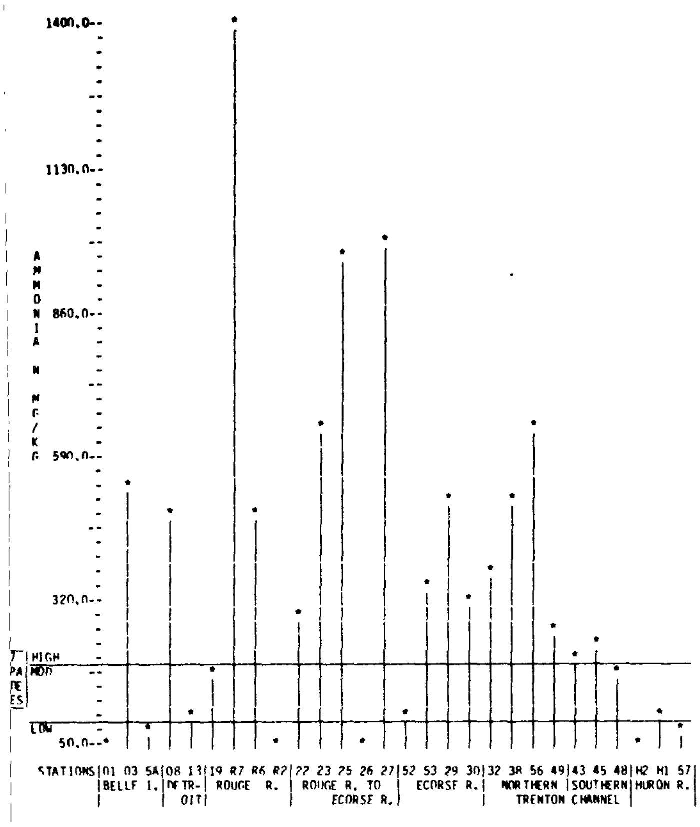


Figure 13 PHOSPHORUS IN DETROIT SEDIMENTS

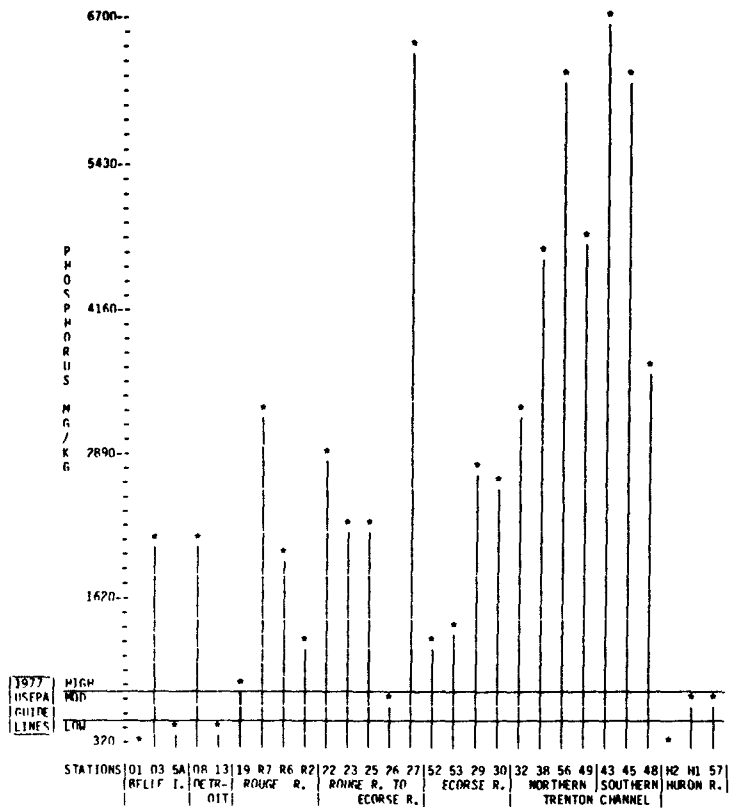


Figure 14 CYANIDE IN DETROIT SEDIMENTS

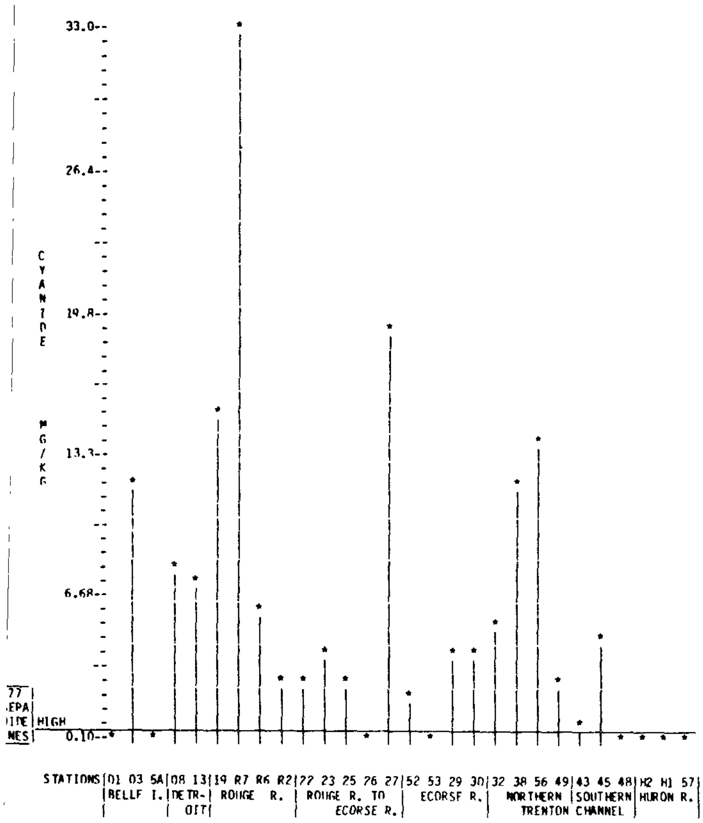


Figure 15 LEAD IN DETROIT SEDIMENTS

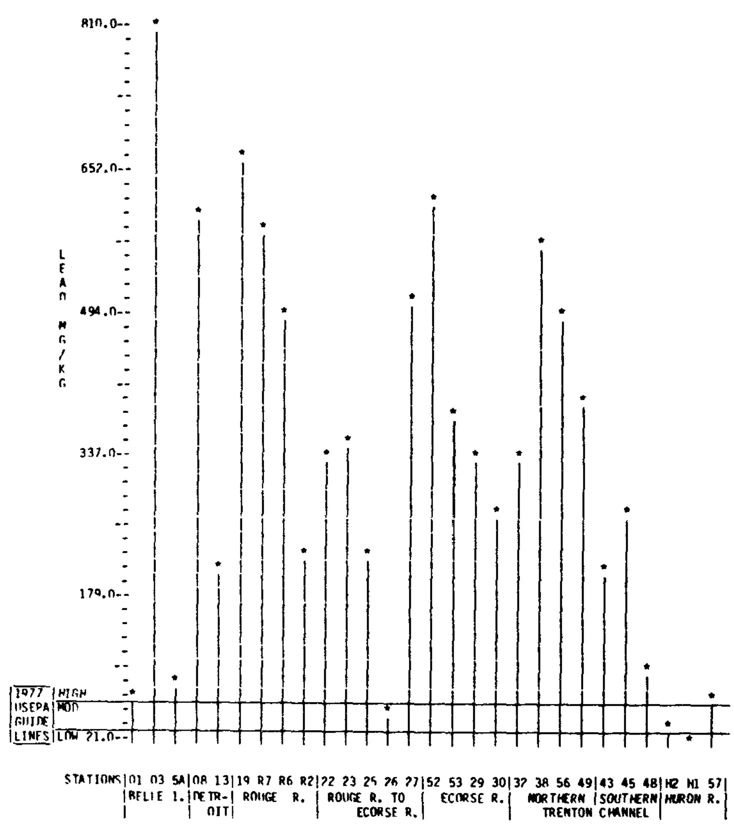


Figure 16 ZINC IN DETROIT SEDIMENTS

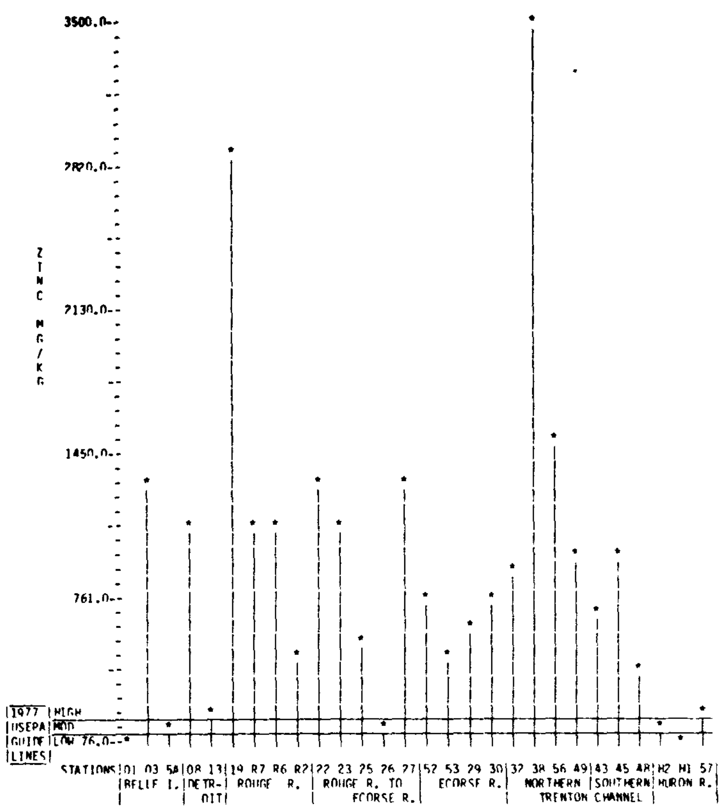


Figure 17 IRON IN DETROIT SEDIMENTS

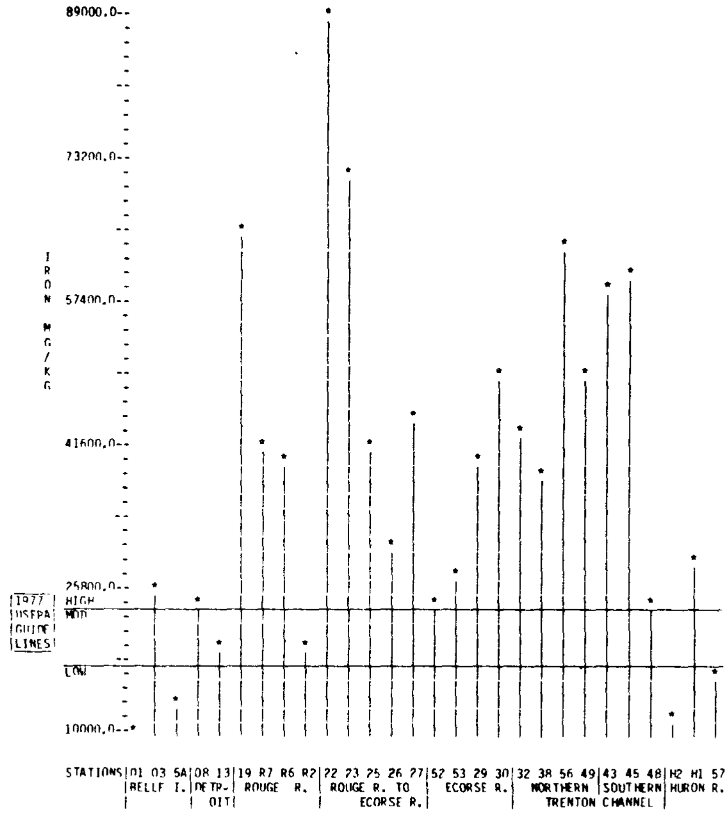


Figure 18 NICKEL IN DETROIT SEDIMENTS

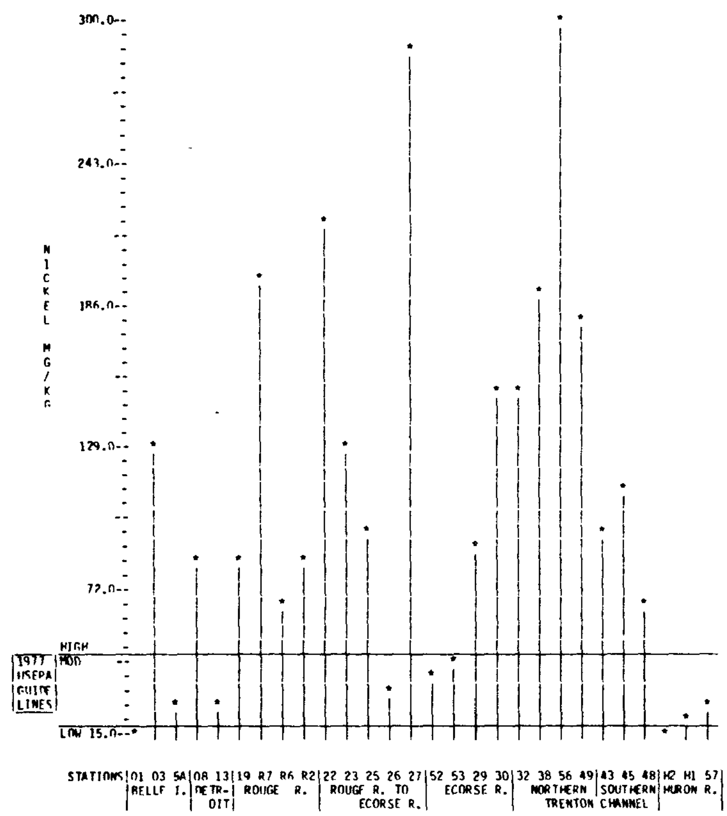


Figure 19 MANGANESE IN DETROIT SEDIMENTS

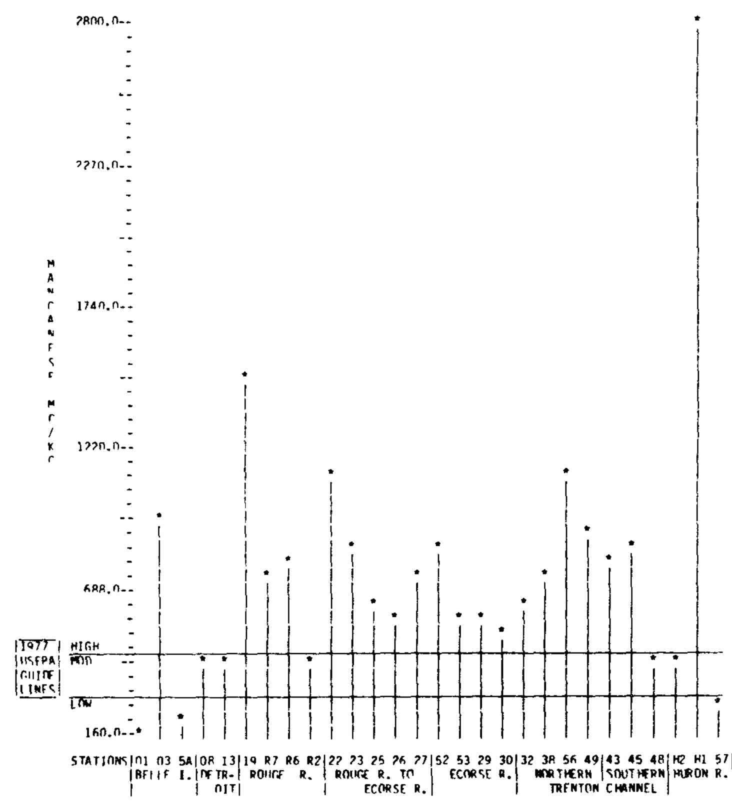


Figure 20 CADMIUM IN DETROIT SEDIMENTS

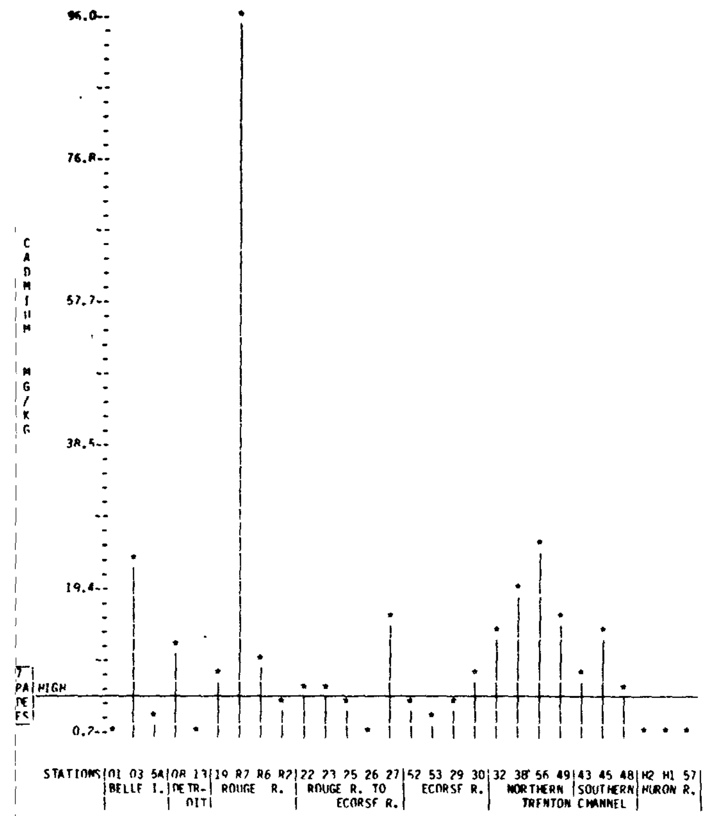


Figure 21 CHROMIUM IN DETROIT SEDIMENTS

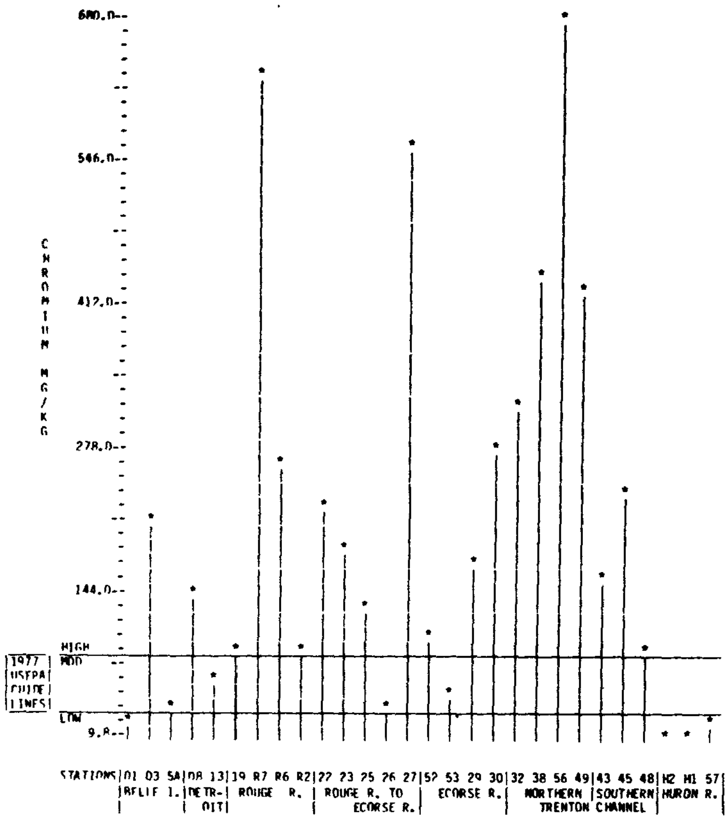


Figure 22 BARIUM IN DETROIT SEDIMENTS

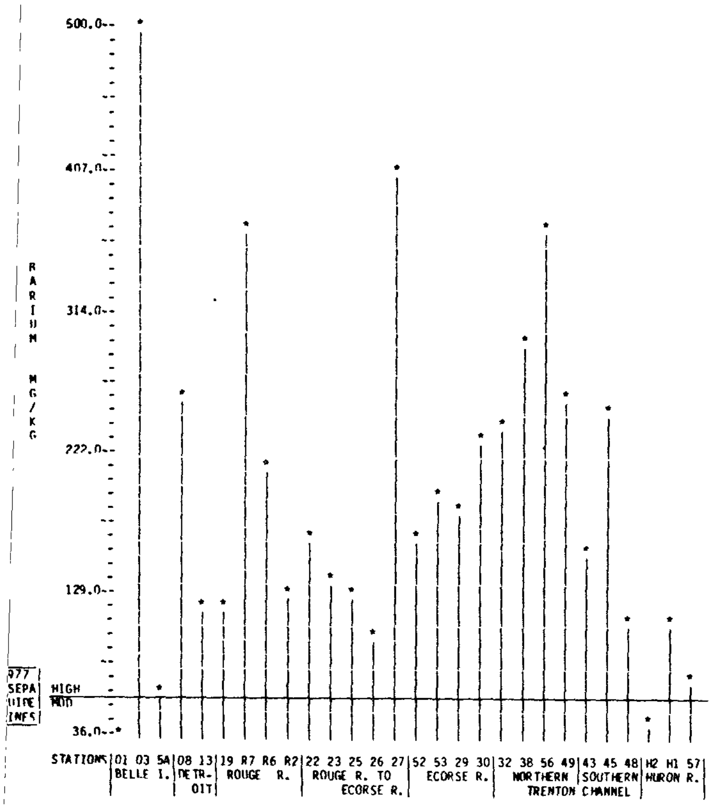


Figure 23 COPPER IN DETROIT SEDIMENTS

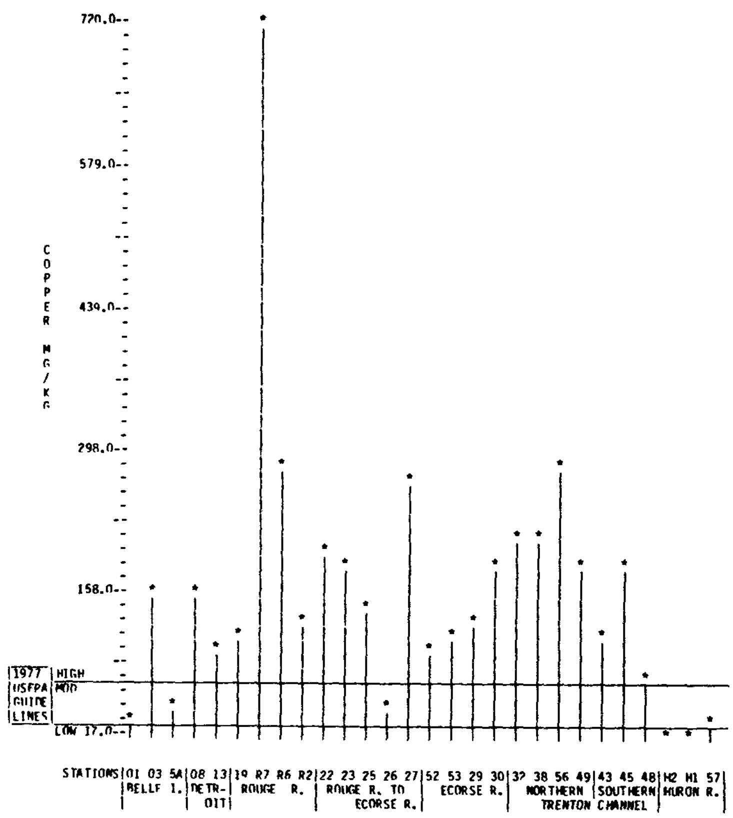


Figure 24 MERCURY IN DETROIT SEDIMENTS

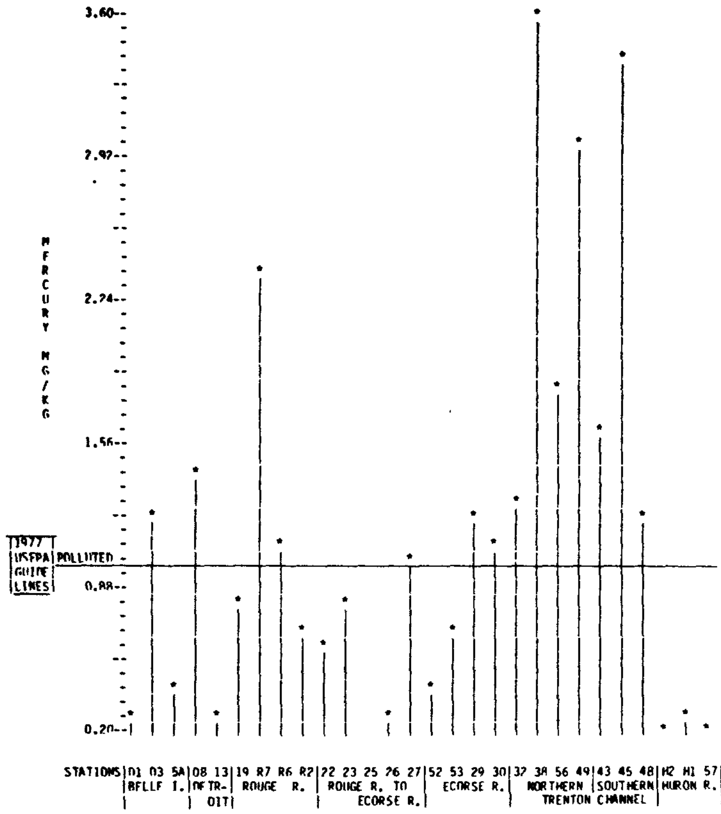


Figure 25 SILVER IN DETROIT SEDIMENTS

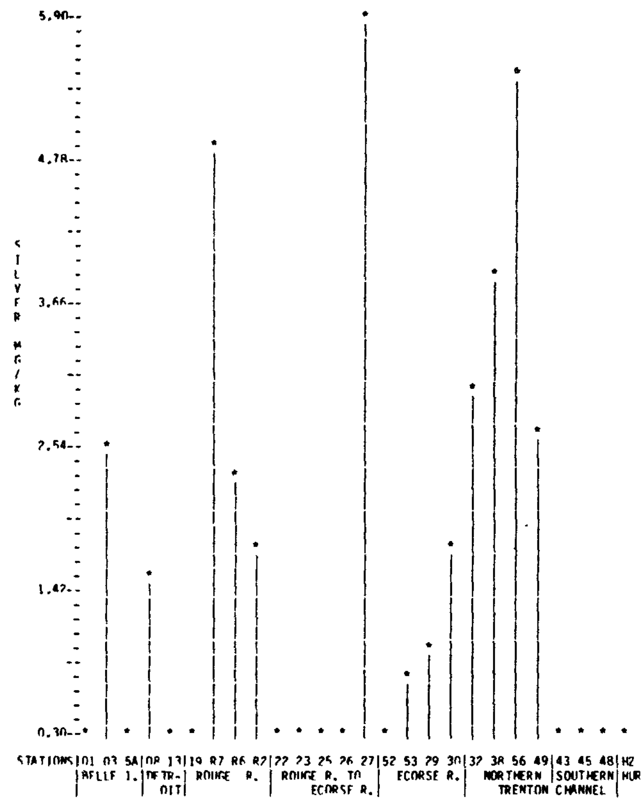


Figure 26 BORON IN DETROIT SEDIMENTS

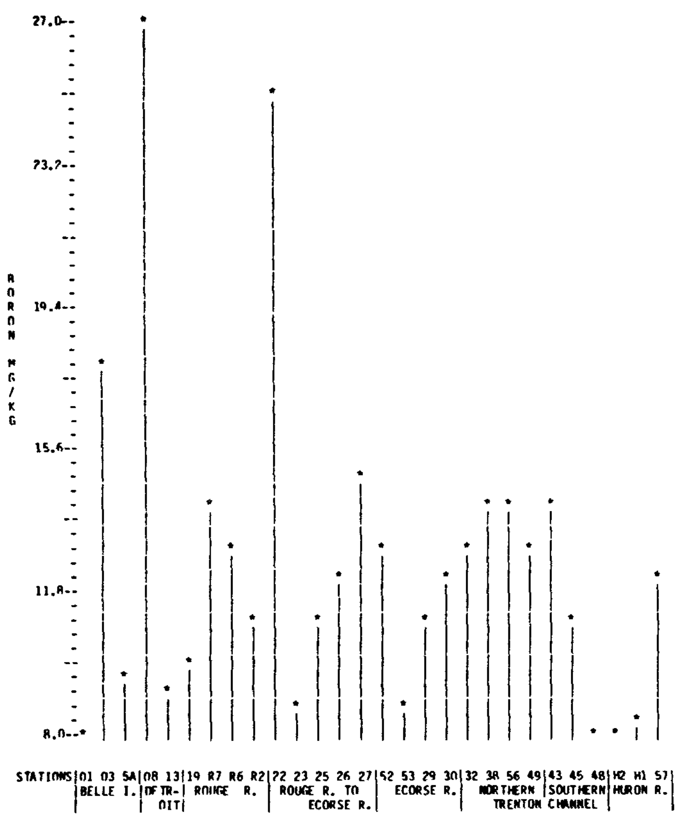


Figure 27 BERRYLIUM IN DETROIT SEDIMENTS

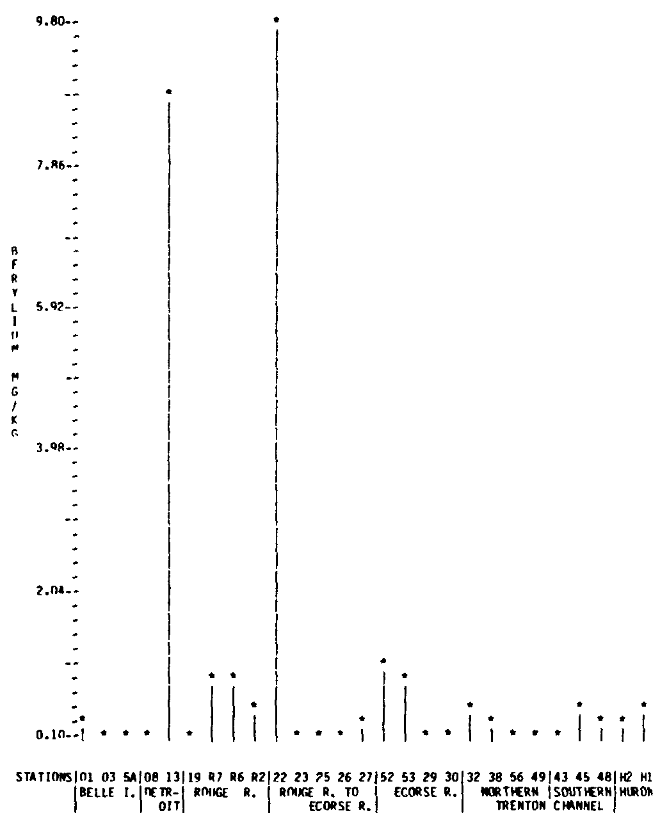


Figure 28 COBALT IN DETROIT SEDIMENTS

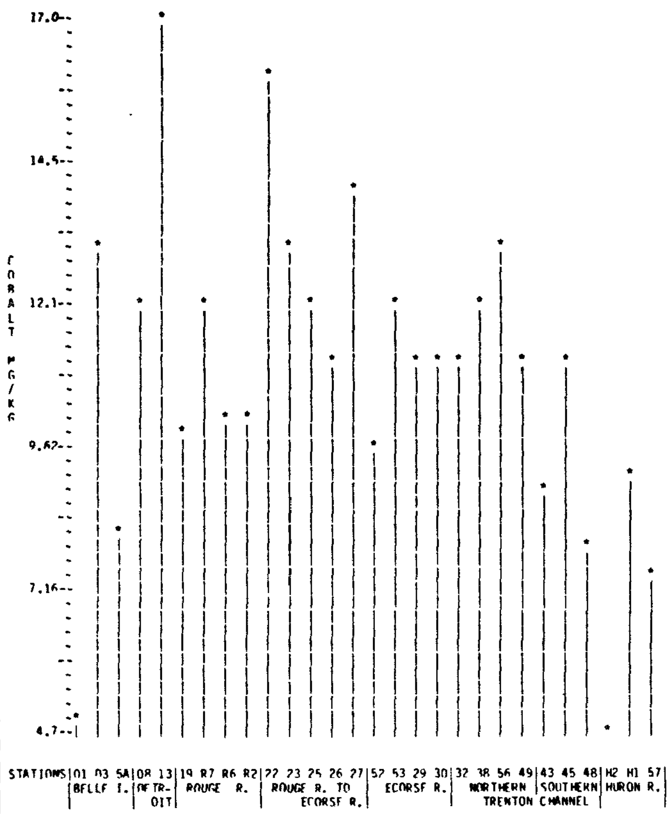


Figure 29 LITHIUM IN DETROIT SEDIMENTS

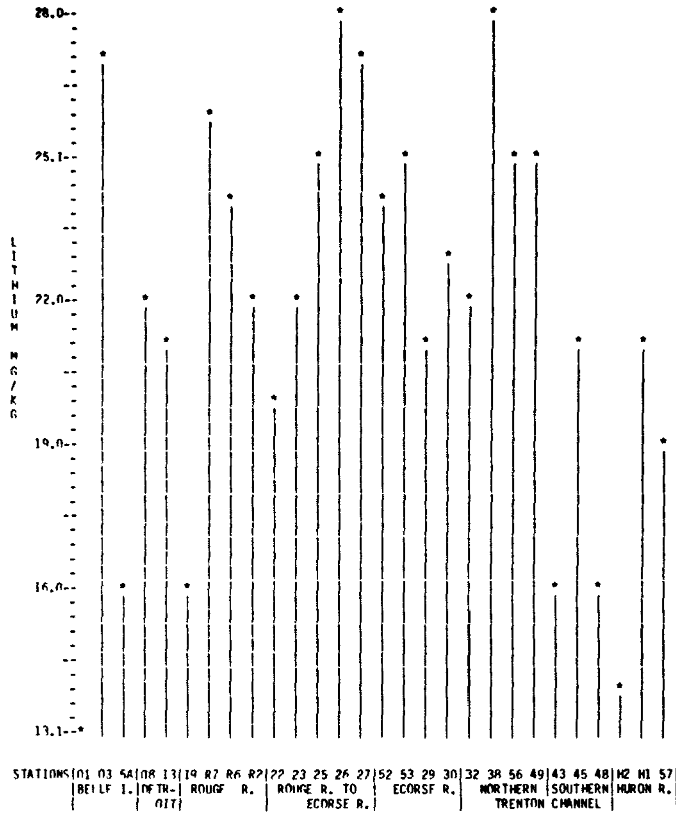


Figure 30 MOLYBDENUM IN DETROIT SEDIMENTS

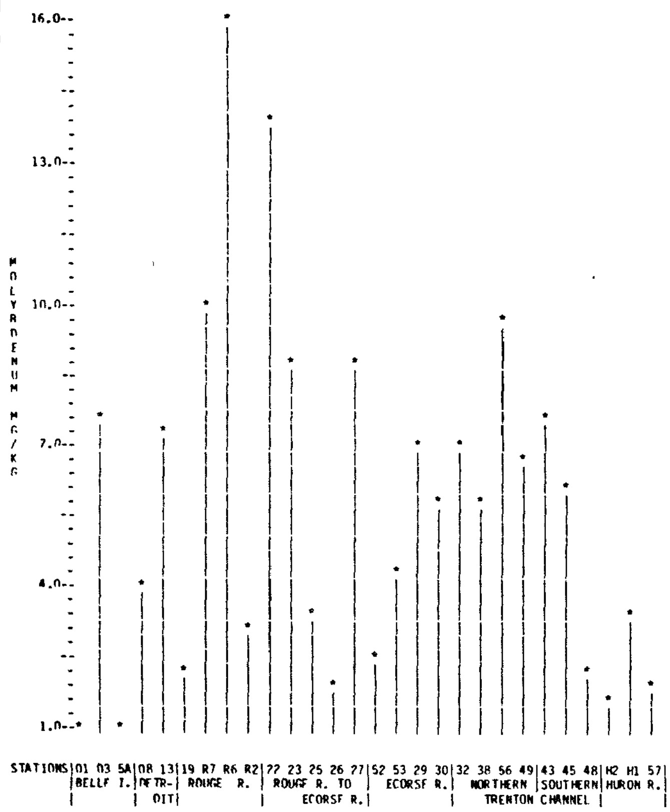


Figure 31 TIN IN DETROIT SEDIMENTS

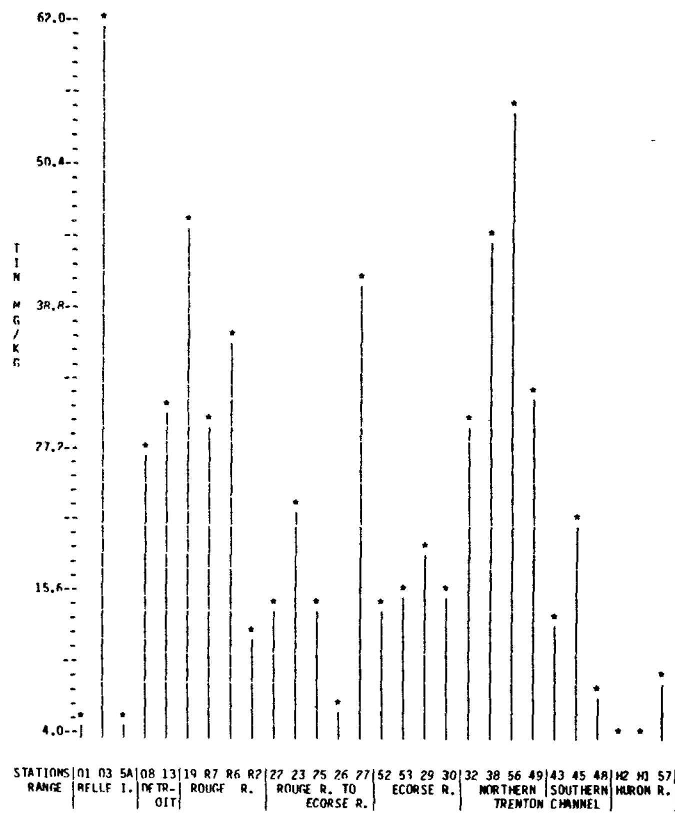


Figure 32 STRONTIUM IN DETROIT SEDIMENTS

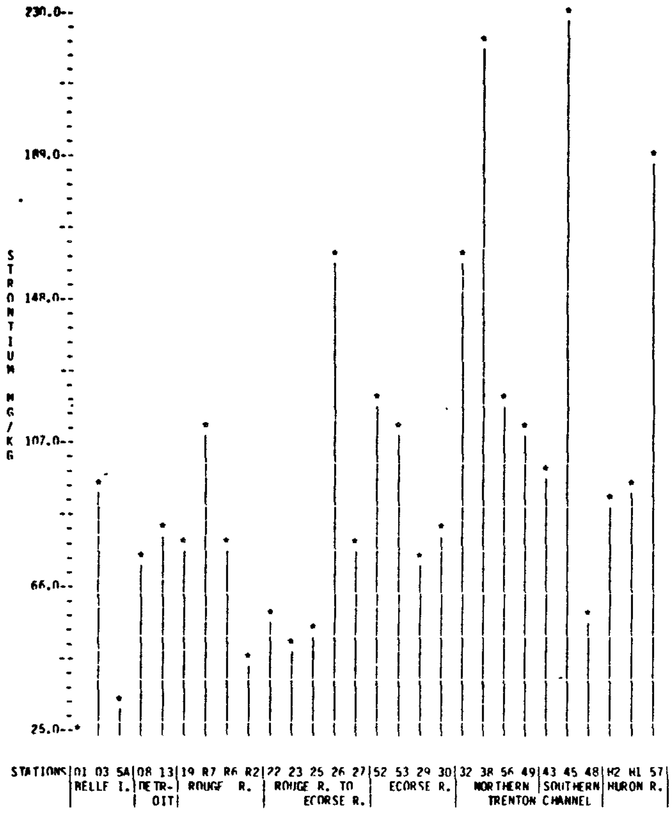


Figure 33 VANADIUM IN DETROIT SEDIMENTS

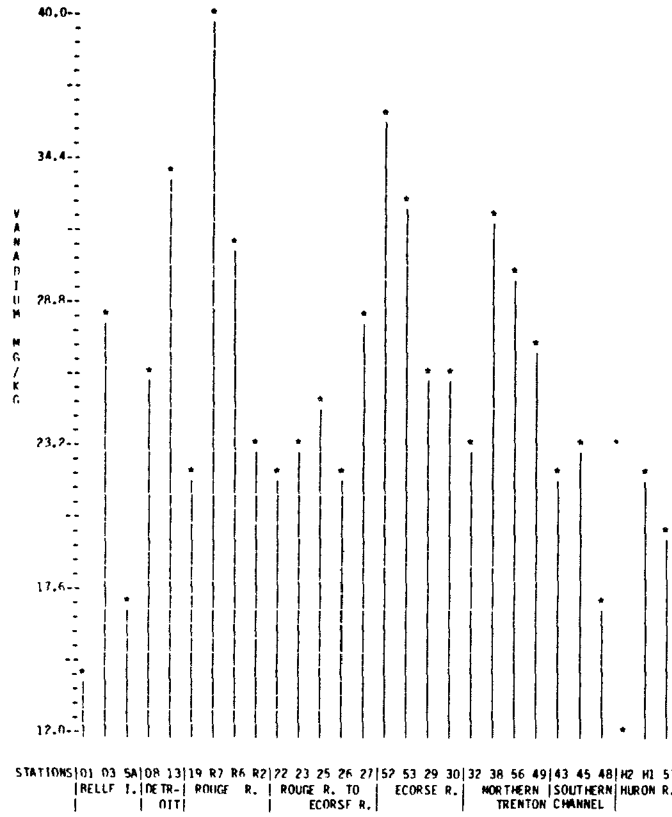


Figure 34 CALCIUM IN DETROIT SEDIMENTS

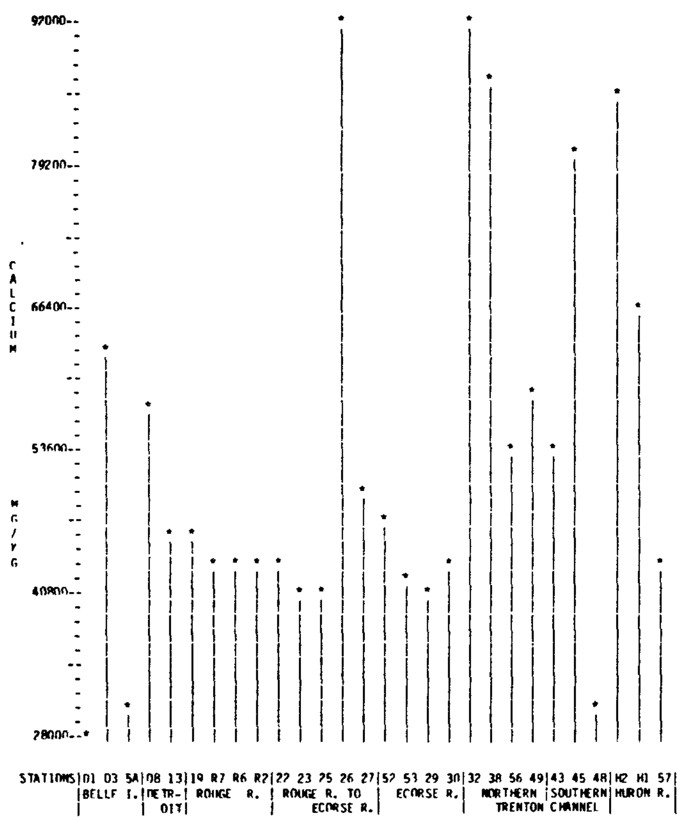


Figure 35 POTASSIUM IN DETROIT SEDIMENTS

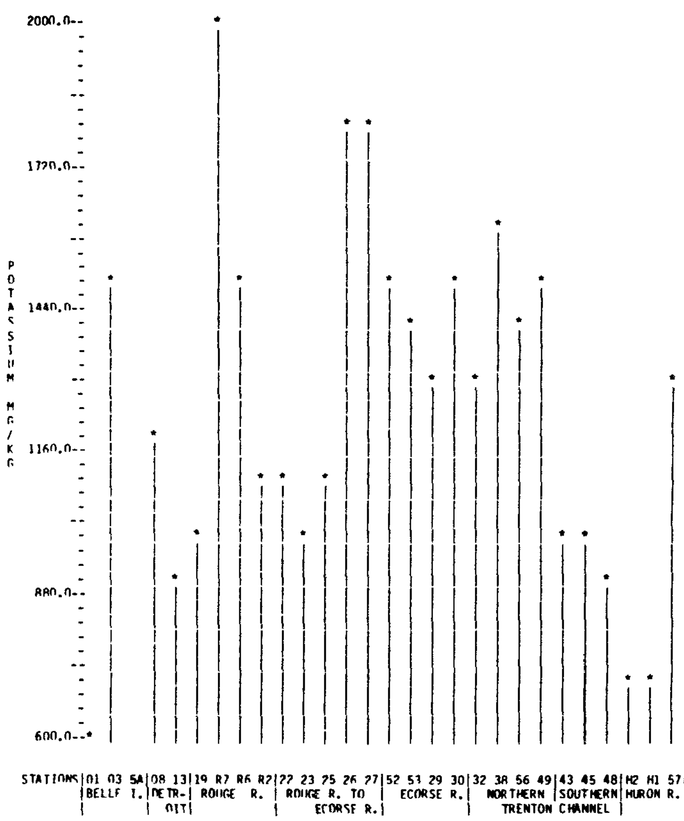


Figure 36 SODIUM IN DETROIT SEDIMENTS

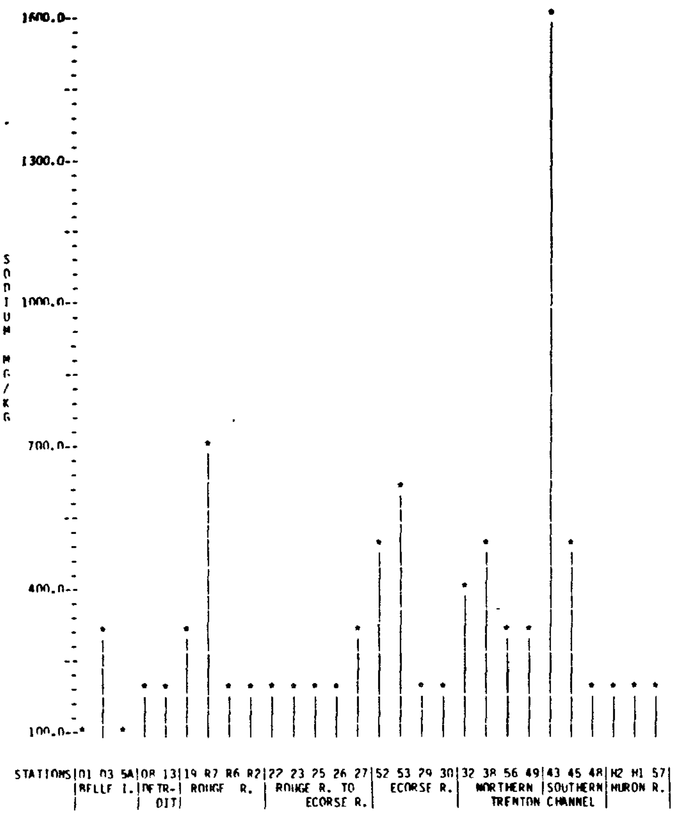


Figure 37 ALUMINUM IN DETROIT SEDIMENTS

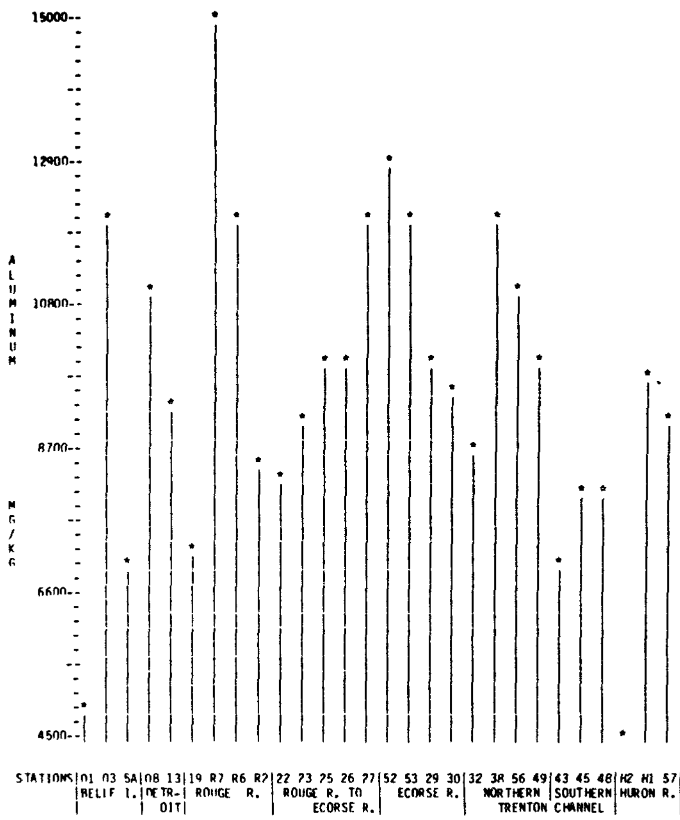


Figure 38 NAPHTHALENE IN DETROIT SEDIMENTS

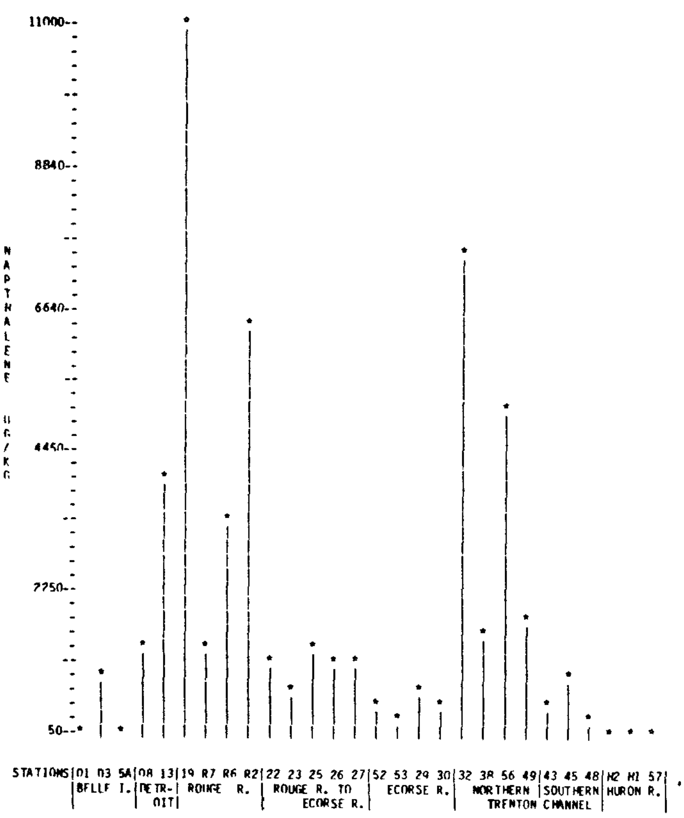


Figure 39 2-METHYL NAPHTHALENE IN DETROIT SEDIMENTS

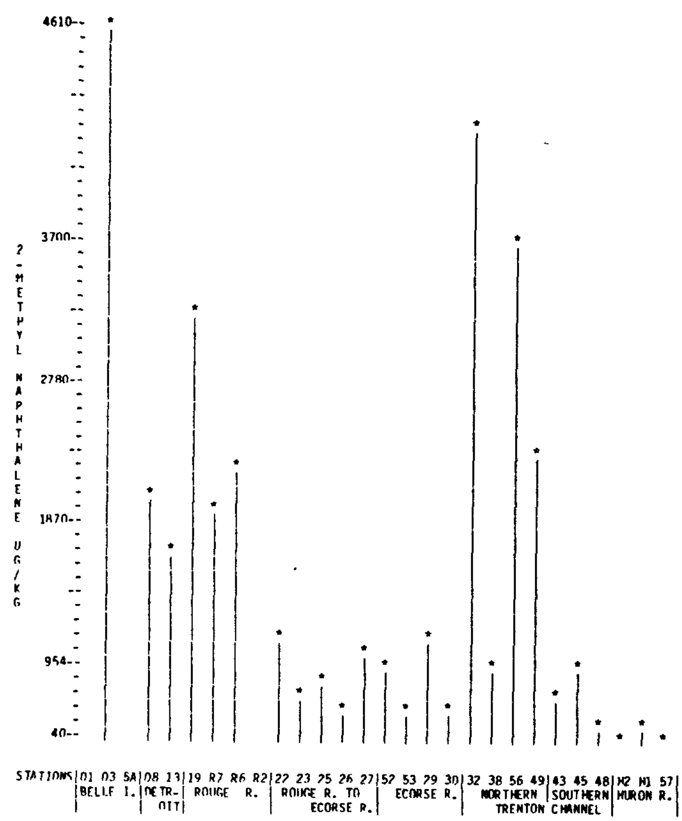


Figure 40 FLUORENE IN DETROIT SEDIMENTS

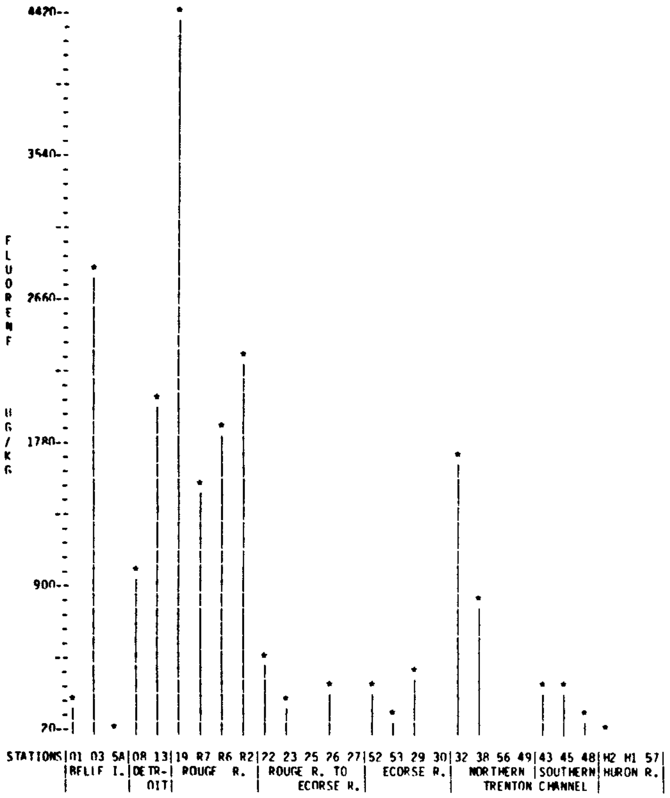


Figure 41 ANTHRACENE IN DETROIT SEDIMENTS

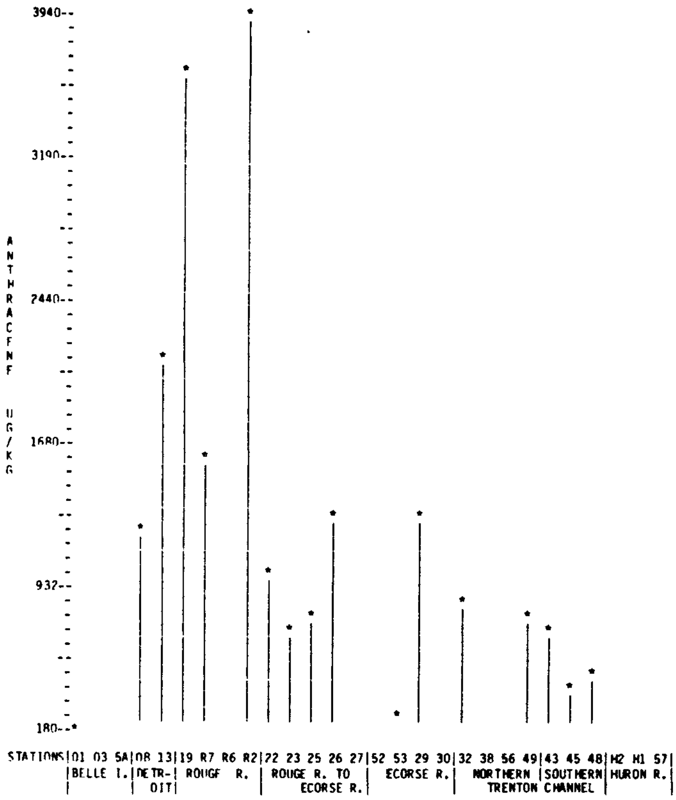


Figure 42 PHENANTHRENE IN DETROIT SEDIMENTS

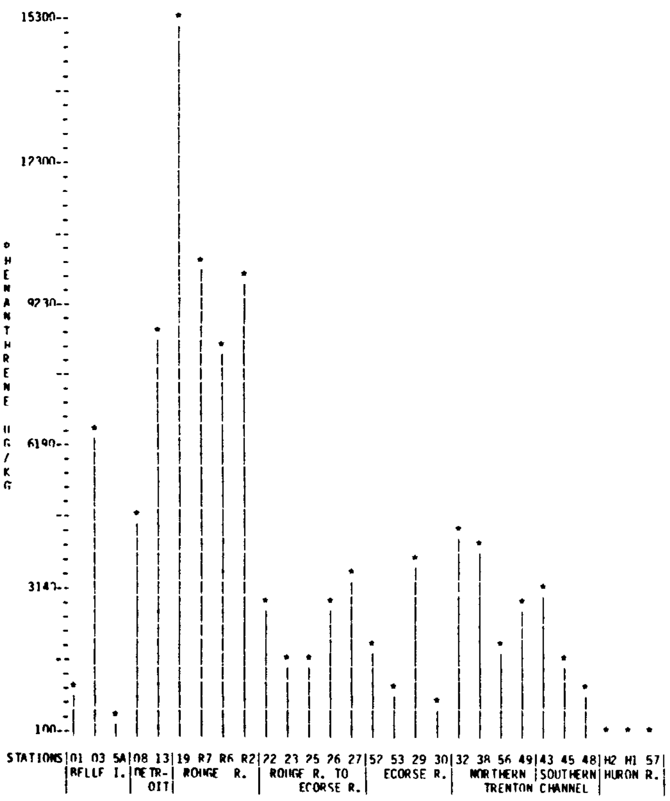


Figure 43 FLUORANTHENE IN DETROIT SEDIMENTS

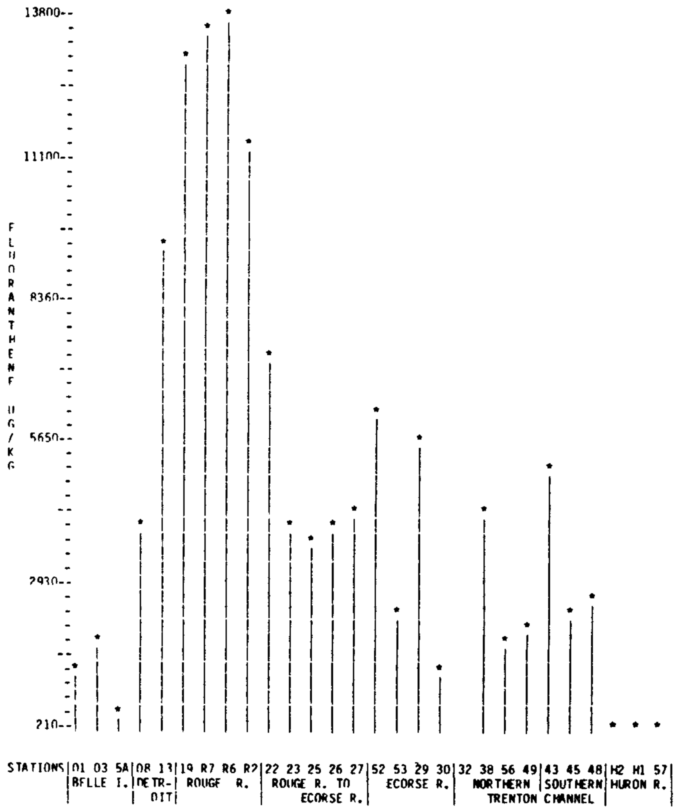


Figure 44 PYRENE IN DETROIT SEDIMENTS

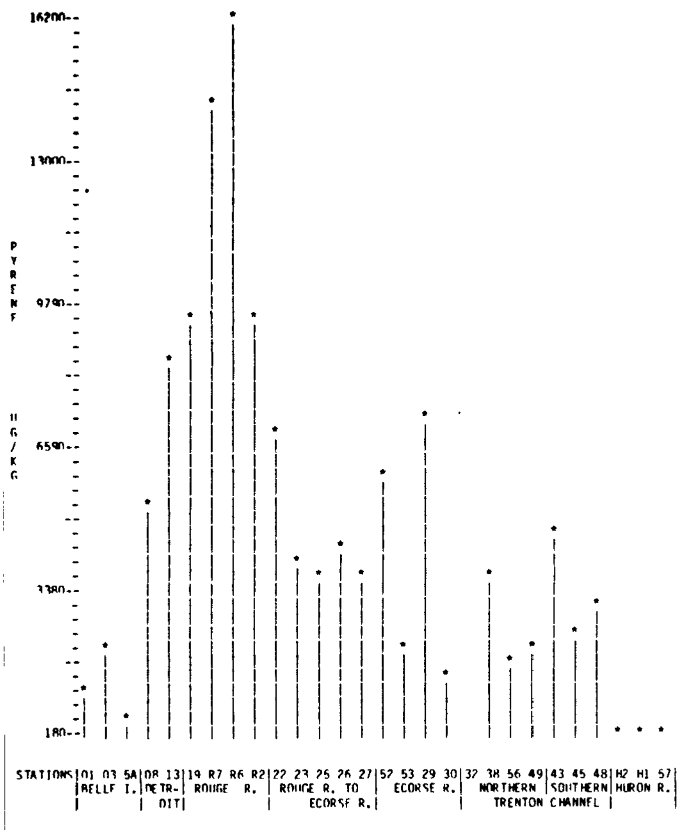


Figure 45 CHRYSENE AND BENZO(A) ANTHRACENE IN DETROIT SEDIMENTS

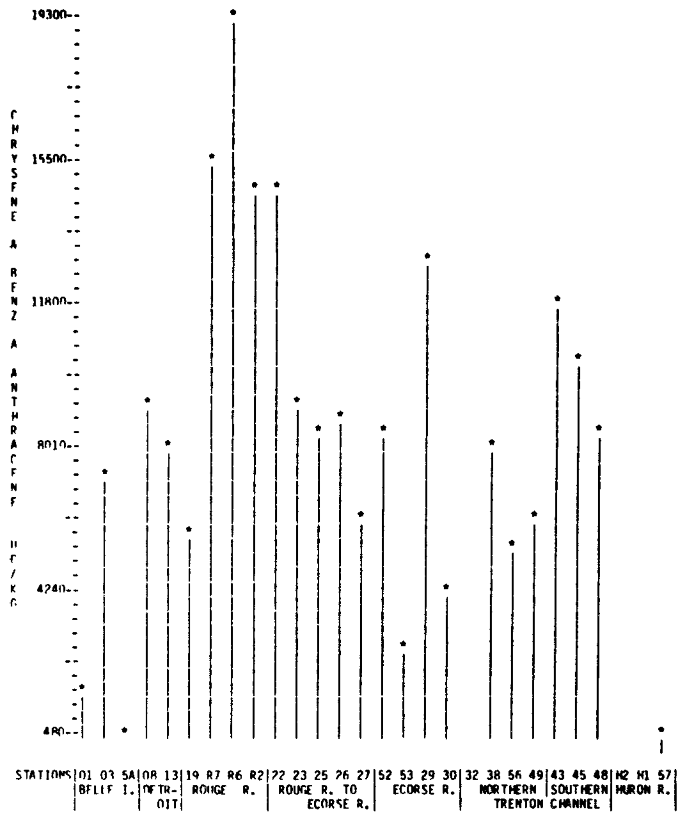


Figure 46 BENZO(GHI)PERYLENE IN DETROIT SEDIMENTS

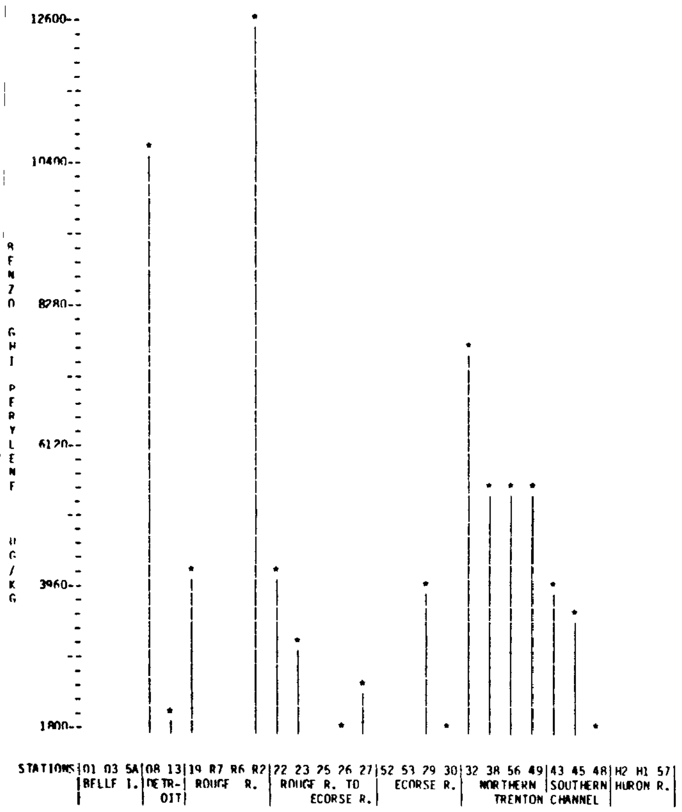


Figure 47 BENZO(A)PYRENE IN DETROIT SEDIMENTS

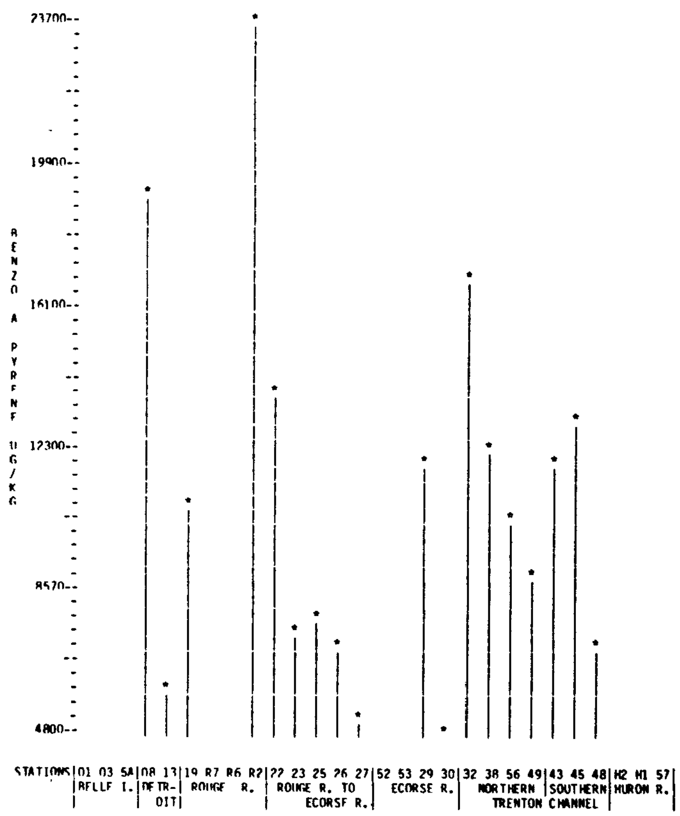


Figure 48 PCB 1242 IN DETROIT SEDIMENTS

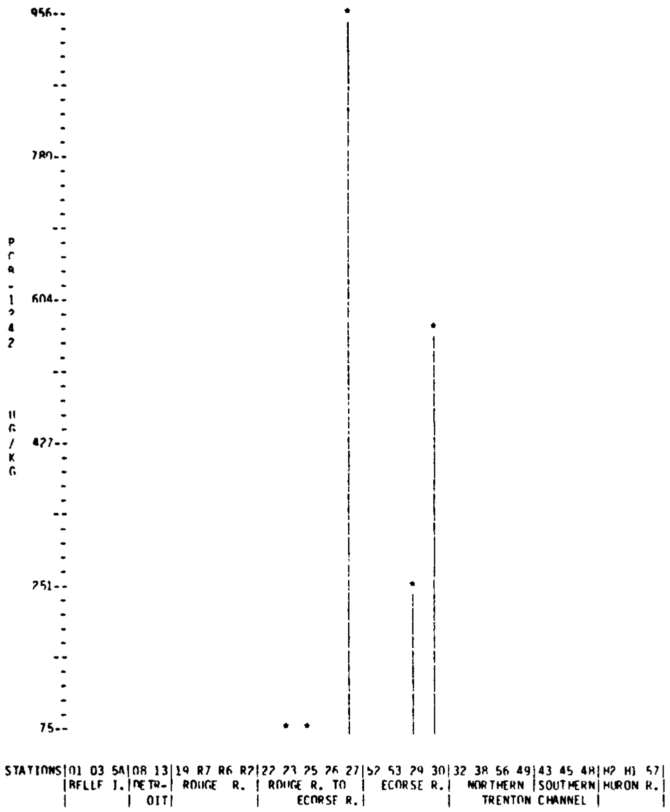


Figure 49 PCB 1248 IN DETROIT SEDIMENTS

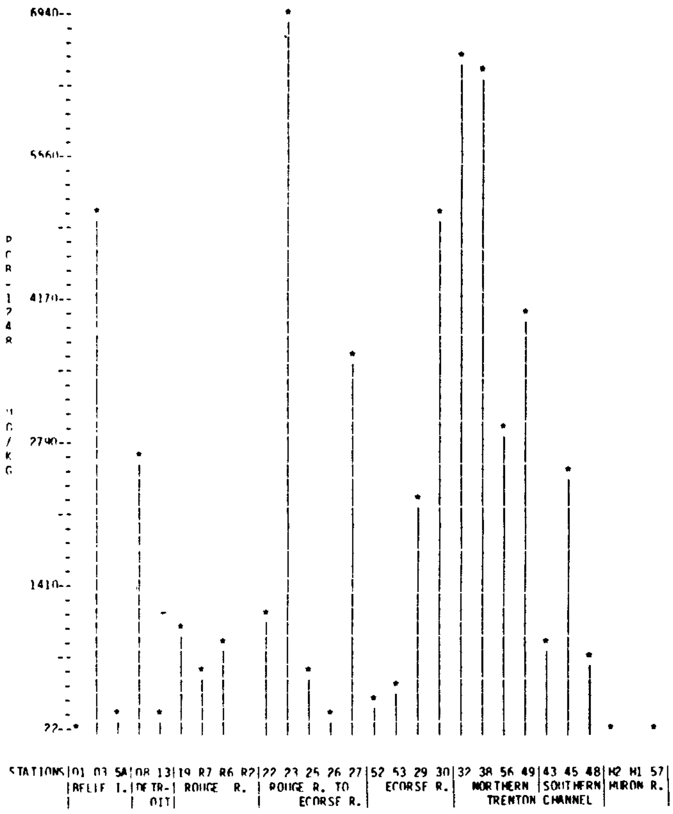


Figure 50 PCB 1254 IN DETROIT SEDIMENTS

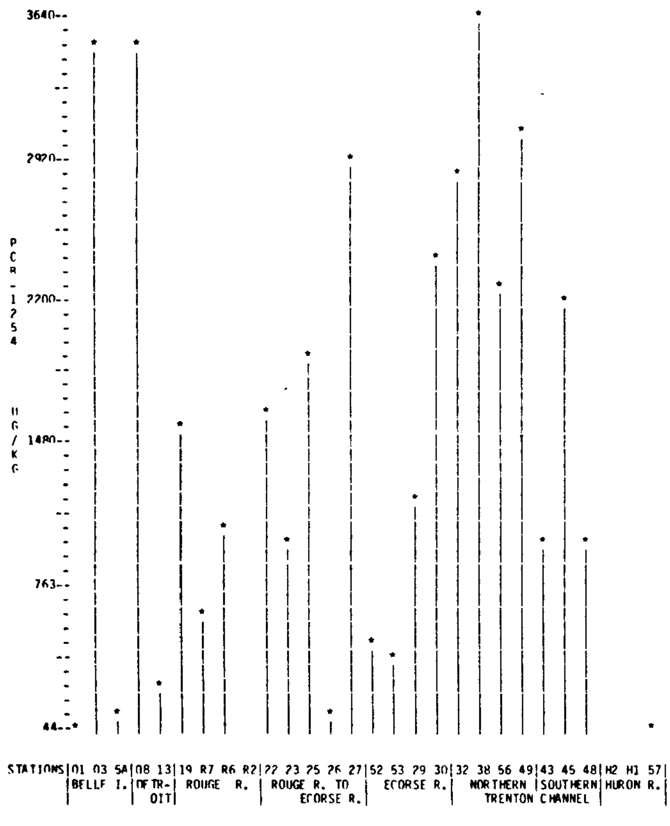


Figure 51 PCB 1260 IN DETROIT SEDIMENTS

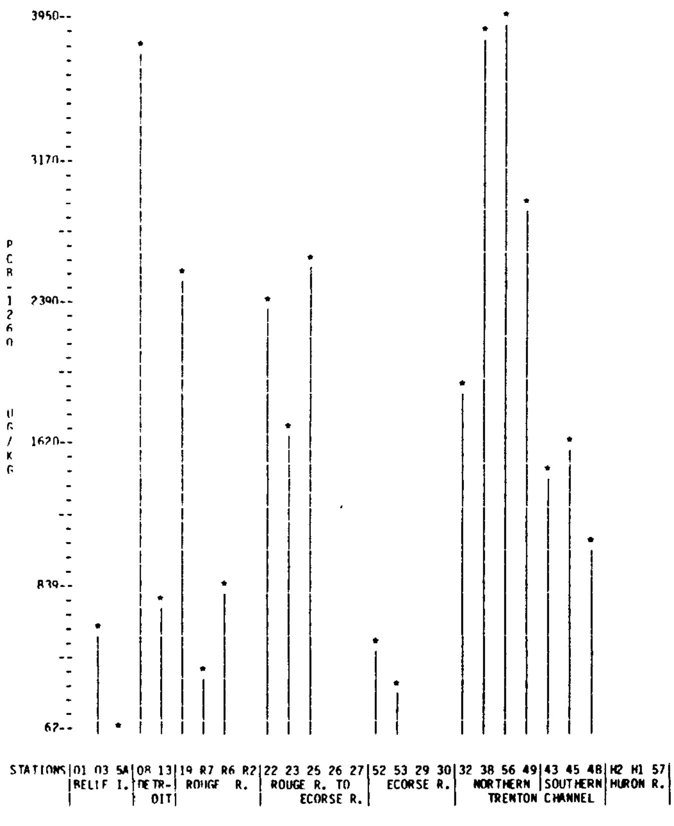


Figure 52 GAMMA CHLORDANE IN DETROIT SEDIMENTS

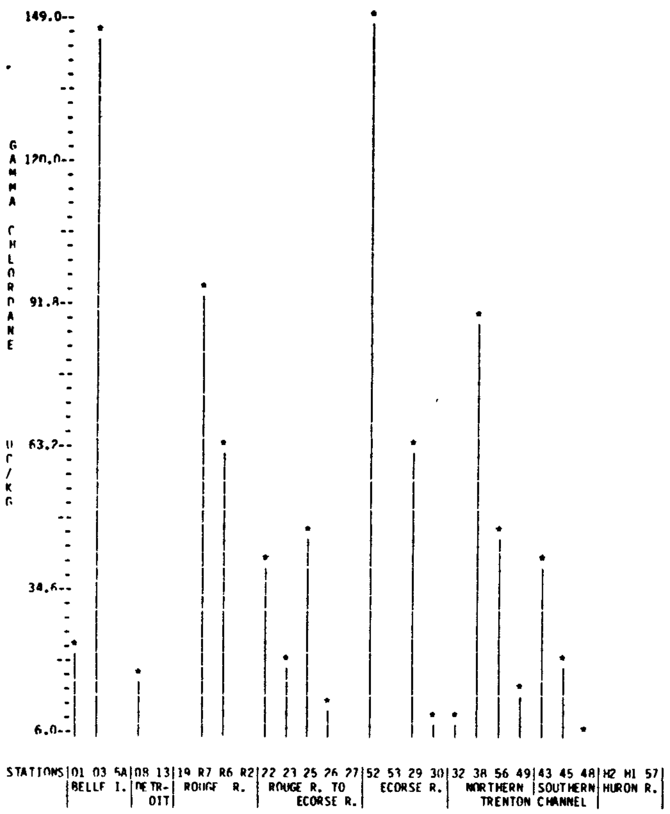


Figure 53 BETA BHC IN DETROIT SEDIMENTS

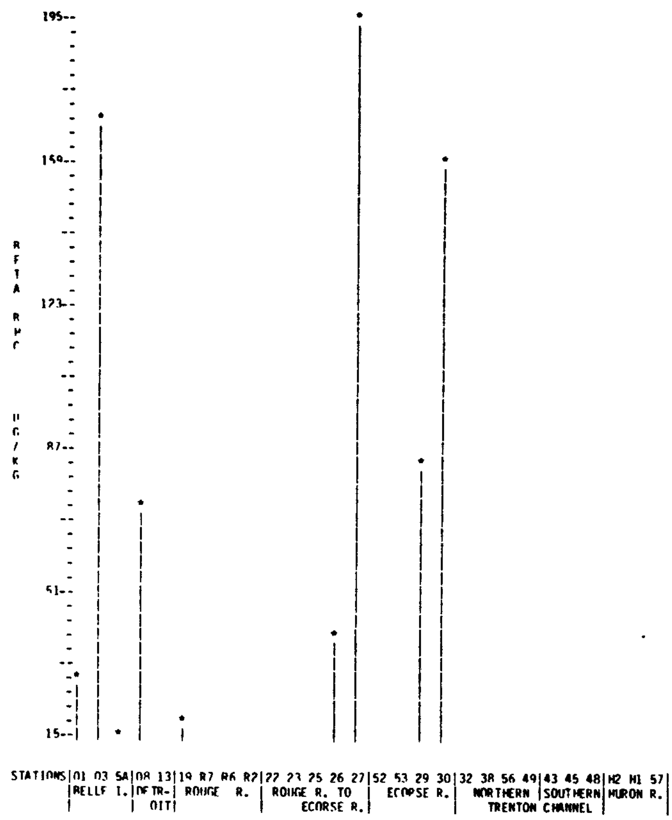


Figure 54 DICHLOROMETHANE IN DETROIT SEDIMENTS

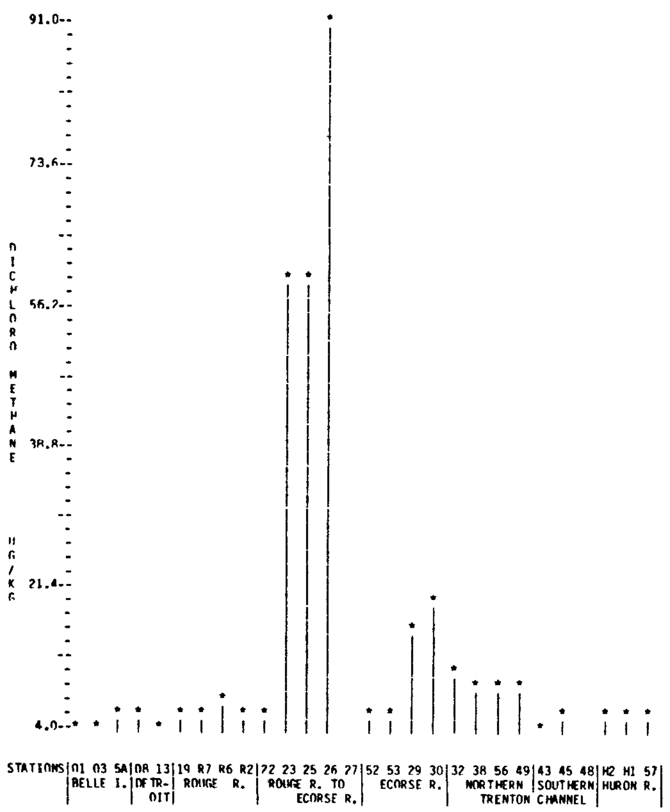


Figure 55 TRICHLOROETHENE IN DETROIT SEDIMENTS

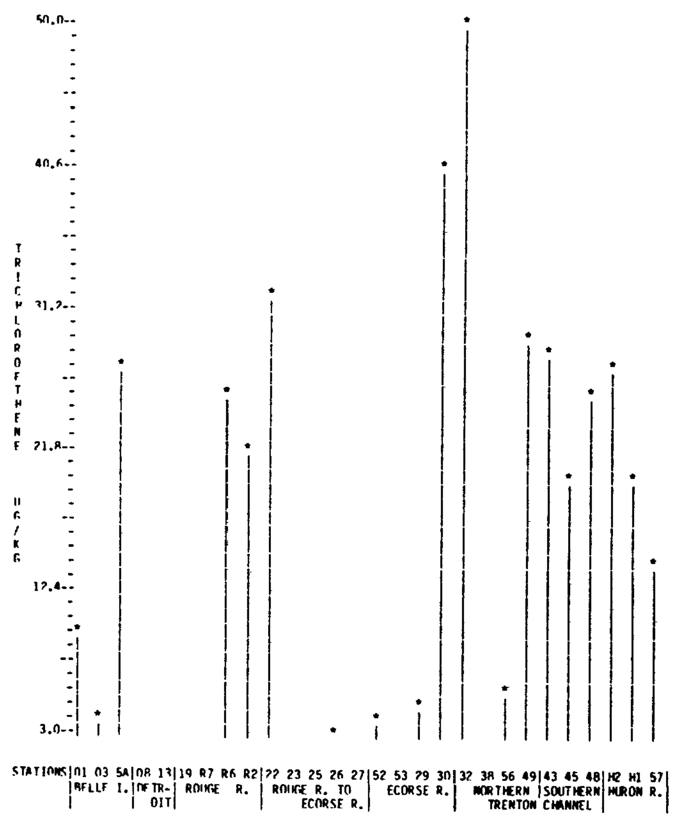


Figure 56 PHENOL IN DETROIT SEDIMENTS

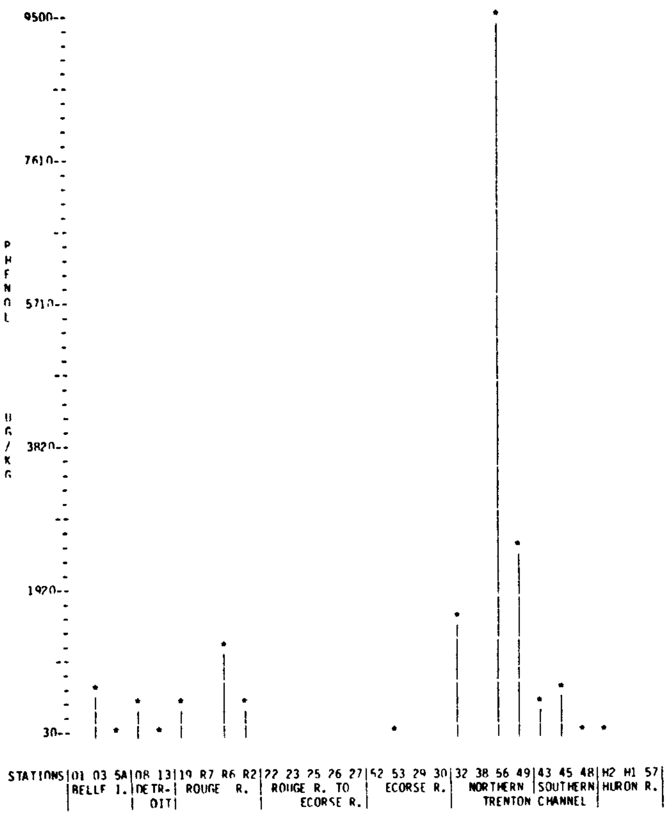


Figure 57 PARA-CRESOL IN DETROIT SEDIMENTS

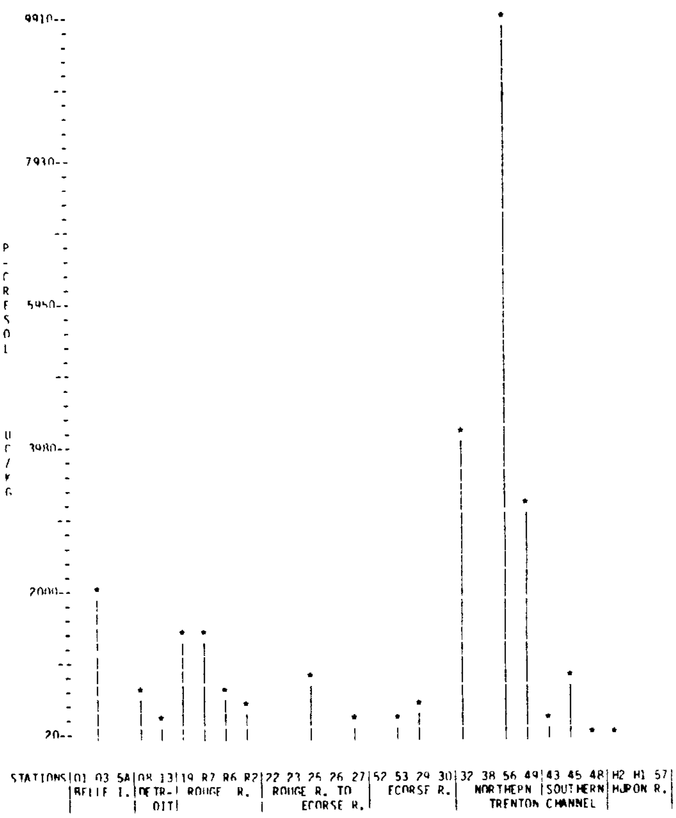


Figure 58 HEXACHLOROBENZENE IN DETROIT SEDIMENTS

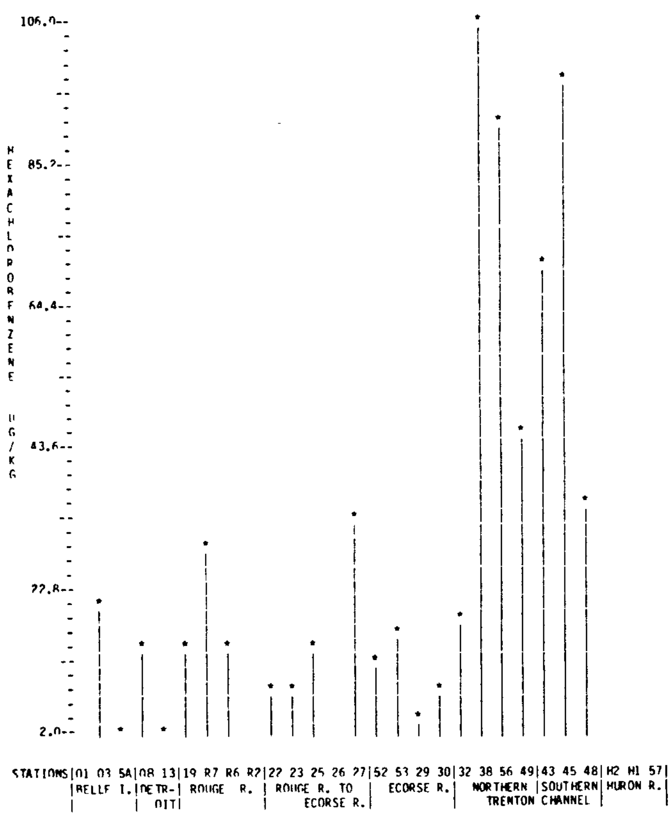


Figure 59 DIBENZOFURAN IN DETROIT SEDIMENTS

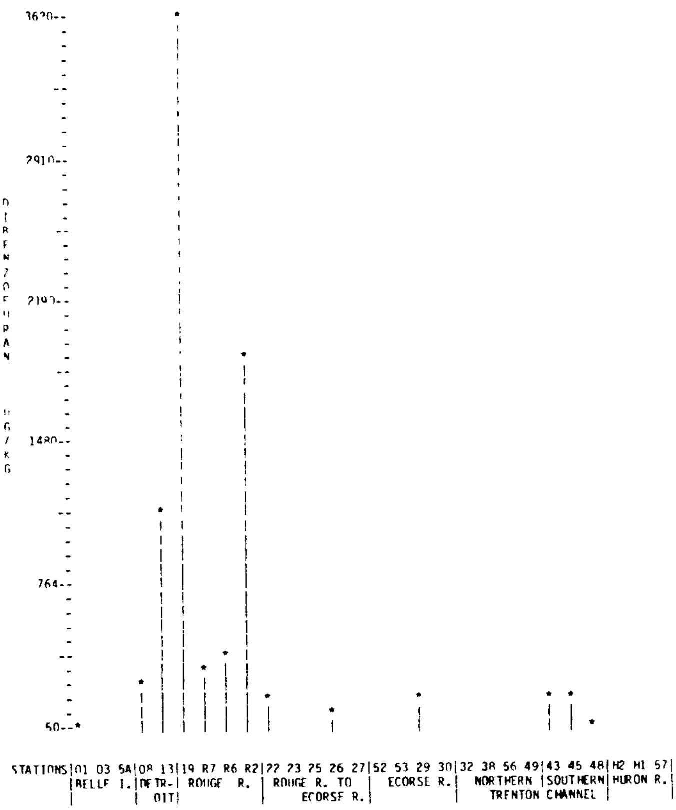
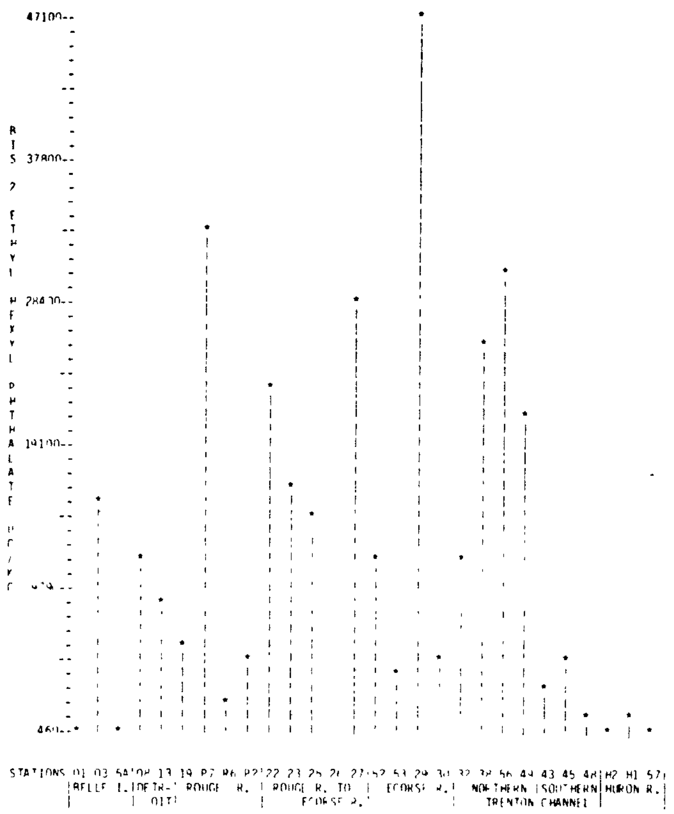


Figure 60 BIS 2 ETHYL-HEXYL PHTHALATE IN DETROIT SEDIMENTS



TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-905/4-003	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE 1982 Detroit, Michigan Area Sediment Survey		5. REPORT DATE July 1987
		6. PERFORMING ORGANIZATION CODE 5GL
7. AUTHOR(S) Pranas E. Pranckevicius		8. PERFORMING ORGANIZATION REPORT NO. GLNPO Report No. 87-11
9. PERFORMING ORGANIZATION NAME AND ADDRESS Great Lakes National Program Office, U.S. Environmental Protection Agency, 230 South Dearborn, Chicago, IL 60604		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Great Lakes National Program Office, U.S. Environmental Protection Agency, 230 South Dearborn, Chicago, IL 60604		13. TYPE OF REPORT AND PERIOD COVERED Sediment 1982
		14. SPONSORING AGENCY CODE Great Lakes National Program Office - USEPA - Region V

15. SUPPLEMENTARY NOTES

16. ABSTRACT

Twenty-eight sediment grab samples from the western bank of the Detroit River and three of its tributaries were chemically analyzed. Sampling sites were chosen to find worst-case conditions. High levels of conventional pollutants and metals were found throughout most of the study area. Hydrophobic organic contaminants found in a wide range of concentrations included: Polynuclear aromatic hydrocarbons, Polychlorinated biphenyls, various pesticides, and volatile organic compounds. Contaminant distributions suggest recent inputs from local sources. Highest contaminant levels were found in the Rouge River, the northern Trenton Channel and Conners Creek in the Belle Isle Area. The City of Detroit Wastewater Treatment Plant, combined sewer overflows, local steel and chemical industry and oil refineries are implicated as likely sources. Several contaminants including volatile organics, PCBs and hexachlorobenzene, seem to have major upstream sources, perhaps in Lake St. Clair or the St. Clair River.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Sediment, conventional pollutants, metals, organic contaminants, Detroit, Michigan	Detroit River Rouge River Huron River Conners Creek Monguogon Creek Trenton Channel	

18. DISTRIBUTION STATEMENT Document is available through the National Technical Information Service Springfield, VA 22161	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 116
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE

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