105890

Alkyllead Contaminations in the St. Lawrence River and St. Clair River (1981 - 1987)

P.T.S. Wong, Y.K. Chau, J. Yaromich,
P. Hodson, and M. Whittle

Department of Fisheries and Oceans
Bayfield Institute (GLLFAS)
Burlington, Ontario L7R 4A6

April 1988

Canadian Technical Report of Fisheries and Aquatic Sciences No. 1602

Fisheries and Oceans — Pêches et Océans

Canada

Canadian Technical Report of Fisheries and Aquatic Sciences

These reports contain scientific and technical information that represents an important contribution to existing knowledge but which for some reason may not be appropriate for primary scientific (i.e. *Journal*) publication. Technical Reports are directed primarily towards a worldwide audience and have an international distribution. No restriction is placed on subject matter and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries management, technology and development, ocean sciences, and aquatic environments relevant to Canada.

Technical Reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report will be abstracted in *Aquatic Sciences and Fisheries Abstracts* and will be indexed annually in the Department's index to scientific and technical publications.

Numbers 1-456 in this series were issued as Technical Reports of the Fisheries Research Board of Canada. Numbers 457-714 were issued as Department of the Environment, Fisheries and Marine Service, Research and Development Directorate Technical Reports. Numbers 715-924 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Technical Reports. The current series name was changed with report number 925.

Details on the availability of Technical Reports in hard copy may be obtained from the issuing establishment indicated on the front cover.

Rapport technique canadien des sciences halieutiques et aquatiques

Ces rapports contiennent des renseignements scientifiques et techniques qui constituent une contribution importante aux connaissances actuelles mais qui, pour une raison ou pour une autre, ne semblent pas appropriés pour la publication dans un journal scientifique. Il n'y a aucune restriction quant au sujet, de fait, la série reflète la vaste gamme des intérêts et des politiques du Ministère des Pêches et des Océans, notamment gestion des pêches, techniques et développement, sciences océaniques et environnements aquatiques, au Canada.

Les Rapports techniques peuvent être considérés comme des publications complètes. Le titre exact paraîtra au haut du résumé de chaque rapport, qui sera publié dans la revue *Aquatic Sciences and Fisheries Abstracts* et qui figurera dans l'index annuel des publications scientifiques et techniques du Ministère.

Les numéros 1-456 de cette série ont été publiés à titre de Rapports techniques de l'Office des recherches sur les pêcheries du Canada. Les numéros 457-714, à titre de Rapports techniques de la Direction générale de la recherche et du développement, Service des pêches et de la mer, ministère de l'Environnement. Les numéros 715-924 ont été publiés à titre de Rapports techniques du Service des pêches et de la mer, Ministère des Pêches et de l'Environnement. Le nom de la série a été modifié à partir du numéro 925.

La page couverture porte le nom de l'établissement auteur où l'on peut se procurer les rapports sous couverture cartonnée.

Canadian Technical Report of
Fisheries and Aquatic Sciences 1602

April 1988

Alkyllead Contaminations in the St. Lawrence River and St. Clair River (1981 - 1987)

by

P.T.S. Wong*
Y.K. Chau#
J. Yaromich*
P. Hodson*
M. Whittle*

*Department of Fisheries and Oceans, Bayfield Institute, Great Lakes Laboratory for Fisheries and Aquatic Sciences, Canada Centre for Inland Waters, Burlington, Ont. L7R 4A6.

#Department of Environment, National Water Research Institute, Canada Centre for Inland Waters, Burlington, Ont. L7R 4A6.

Minister of Supply and Services Canada 1988
Cat.No.Fs 97-6/1602 ISSN 0706-6457

Correct citation for this publication:

Wong, P.T.S., Y.K. Chau, J. Yaromich, P. Hodson and M. Whittle. 1988. Alkyllead Contaminations in the St. Lawrence River and St. Clair River (1981-1987). Can. Tech. Rep. Fish. Aquat. Sci. 1602: x+134p.

ABSTRACT

Wong, P.T.S., Y.K. Chau, J. Yaromich, P. Hodson and M. Whittle. 1988. Alkyllead Contaminations in the St. Lawrence River and St. Clair River (1981-1987). Can. Tech. Rep. Fish Aquat. Sci. 1602: x+134p.

The environmental occurrence of alkyllead compounds is derived mainly from anthropogenic sources such as effluents from alkyllead production plants. There were 2 plants in Ontario in 1981: DuPont Canada Inc. in Maitland (St. Lawrence River) and Ethyl Canada Inc. in Corunna (St. Clair River). We surveyed the extent of alkyllead contamination in environmental samples (fish, clams, macrophytes, sediments and water) in areas upstream and downstream from these sources of alkylleads. For comparison, fish were taken from Lake St. Lawrence and Lake St. Francis, 76 and 112 Km respectively downstream of Maitland. Alkylleads were determined by a gas chromatograph-atomic absorption spectrometer method with detection limits for biota (8 ug/Kg), sediment (15 ug/Kg) and water (8 ng/L).

Analyses of fish samples from the Maitland area between 1981 and 1987 indicate that the levels of alkylleads were highest in 1981 with geometric means of 4207 ug/Kg for carp and 216 ug/Kg for white sucker. A carp from downstream of Maitland contained 138999 ug/Kg of alkylleads, the highest level ever detected or reported in the literature. There was a clear indication of elevated alkyllead levels in fish near the plant. Since 1981, the levels of alkylleads in fish have declined, and in 1987 the geometric means of alkylleads were below 150 ug/Kg. In general the most contaminated fish species were carp, yellow perch, white sucker and brown bullhead while the least contaminated were bass, pike, redhorse sucker and pumpkinseed. Compared to the whole fish, alkyllead levels were consistently lower in muscle and carcass but higher in fatty tissues and intestine. The spectrum of di-, tri- and tetraalkyllead species in fish corresponded most closely to the spectrum of alkylleads in water but not to that in sediments. The most common forms in fish were tri- and tetraethylleads. Alkylleads represented 0-100% of total lead, depending on the location and fish species sampled; most fish from the contaminated area contained 50-75% of total lead as alkylleads.

Alkylleads were determined in clams in 1982 and 1983 but only 1 sample in 1983 had 330 ug/Kg of

alkylleads from area downstream from the plant Macrophytes near the factory contained high levels of alkylleads with a geometric mean of 2092 ug/Kg in 1982 but the levels declined sharply to 194 ug/Kg in 1983 and to 53 ug/Kg in 1984. The predominant forms in macrophytes were tri- and tetraethylleads.

Alkylleads were found in sediments close to the plant. The levels have dropped from 703 ug/Kg in 1982 to 216 ug/Kg in 1983, 89 ug/Kg in 1984 and finally to nondetectable levels in 1986. In addition to tetraethyllead and triethyllead, sediments also contained appreciable amounts of trimethyllead and dimethyllead compounds, suggesting lead methylation in sediments. Alkylleads in water samples were determined only in 1983. The levels in subsurface water were 0.33 ug/L and 0.09 ug/L immediately below and 2 Km downstream from the plant respectively. Alkyllead was nondetectable (less than 8 ng/L) in Lily Bay, upstream from DuPont. Alkyllead and total lead were higher in the surface microlayer than in subsurface water.

Fish samples from the St. Clair River area were analyzed for alkylleads in 1983, 84 and 87. The levels of alkylleads were elevated in fish near Ethyl Canada Inc. However, due to the faster water flow rate in this river, the levels of alkylleads in fish were generally lower than in the same species from the Maitland area. In 1983 alkylleads were determined in both muscle and carcass samples of several fish species. Carcass samples generally contained higher levels than did the muscle samples. Carp, sucker and northern pike had more alkylleads than did yellow perch, walleye, bowfin and garpike. The highest level was 3607 ug/Kg in a sucker sample. The most frequently found alkyllead compounds were tri- and tetraethyllead. The ratios of alkyllead to total lead varied with fish species but generally were between 0.3 to 0.6. Only 1 out of 6 water samples in 1983 contained detectable alkyllead levels. Higher levels were found in the surface microlayer than in subsurface samples (0.68 and 0.42 ug/L respectively).

The levels of alkylleads in fish decreased in 1984. Carp, sucker and northern pike again contained more alkylleads than yellow perch, walleye and brown trout. Two subsurface water samples from Ethyl Canada Inc. had 0.51 and 0.82 ug/L of alkylleads. The alkyllead levels in fish were further decreased in 1987. Only 2 of 7 carp samples contained detectable levels of 51 and 236 ug/Kg while 1 of 2 suckers had 41 ug/Kg. Two samples of walleye did not contain detectable alkylleads (less than 8 ug/Kg).

Carp and yellow perch from Lake St. Lawrence and Lake St. Francis were analyzed in 1983. Only 1 of 4 yellow perch had 95 ug/Kg alkylleads while 12 carp samples had nondetectable alkyllead level.

In conclusion, fish, clam, macrophyte, sediment and water samples contained elevated alkyllead levels near the 2 sources with levels much higher in samples from Maitland area. Levels have decreased since 1981 reflecting the improved reduction of alkylleads in the effluents and the closure of DuPont Canada Inc. at Maitland in 1985.

RESUME

Wong, P.T.S., Y.K. Chau, J. Yaromich, P. Hodson and M. Whittle. 1988. Alkyllead Contaminations in the St. Lawrence River and St. Clair River (1981-1987). Can. Tech. Rep. Fish Aquat. Sci. 1602: x+134p

Les composés de type alkylplomb de l'environnement proviennent principalement de sources anthropiques, par exemple des effluents d'usine de production de plomb-tétraalkyle. Il y avait 2 de ces usines en Ontario en 1981, celle de DuPont Canada Inc. à Maitland (sur le fleuve St-Laurent) et celle d'Ethyl Canada Inc. à Corunna (rivière Ste-Claire). Nous avons étudié l'importance de la contamination par les dérivés alkylplomb d'échantillons prélevés dans l'environnement (poissons, bivalves, macrophytes, sédiments et eau) dans des zones en amont et en aval de ces sources de dérivés d'alkylplomb. Pour établir des comparaisons, on a prélevé des poissons des lacs St-Laurent et St-François, à 76 et 112 km respectivement en aval de Maitland. Les dérivés alkylplomb ont été dosés par chromatographie gazeuse-spectrométrie d'absorption avec des limites de détection de 8 ug/kg pour le biote, de 15 ug/kg pour les sédiments et de 8 ng/L pour l'eau.

Des analyses d'échantillons de poissons de la région de Maitland effectuées en 1981 et 1987 indiquent que les teneurs en dérivés alkylplomb atteignaient les valeurs les plus élevées en 1981 avec des moyennes géométriques de 4207 ug/kg pour la carpe et de 216 ug/kg pour le meunier noir. Une carpe pêchée en aval de Maitland contenait 138 999 ug/kg de dérivés alkylplomb, ce qui constitue la plus forte teneur jamais décelée ou signalée dans la documentation. Il y avait une nette indication de teneurs élevées en dérivés alkylplomb chez les poissons du voisinage de l'usine. Depuis 1981, les teneurs en dérivés alkylplomb des poissons ont diminué et en 1987, la moyenne géométrique des dérivés alkylplomb était inférieure à 150 ug/kg. En général, les espèces de poissons les plus contaminées étaient la carpe, la perchaude, le meunier noir et la barbotte, alors que les espèces les moins contaminées étaient l'achigan, le brochet, le suceur et le crapet-soleil, par rapport aux valeurs obtenues pour le poisson entier, les valeurs mesurées dans les muscles et la carcasse étaient régulièrement inférieures, mais celles des tissus adipeux et de l'intestin étaient plus élevées. Le spectre des espèces de di, tri et tétraalkylplomb des poissons correspondait de très près à celui de ces mêmes

dérivés dans l'eau, mais non à celui observé dans les sédiments. Les dérivés les plus communs observés dans les poissons étaient le tri et le tétraalkylplomb. Les dérivés alkylplomb représentaient 0-100 % du plomb total, selon l'emplacement et l'espèce des poissons échantillonnés. La plupart des poissons de la zone contaminée contenaient 50-75% du plomb total sous forme de dérivés alkylplomb.

On a également décelé la présence de dérivés alkylplomb dans des bivalves en 1982 et 1983 mais seulement un échantillon (en 1983) contenait 330 ug/kg de dérivés alkylplomb provenant d'une zone en aval de l'usine. Les macrophytes près de l'usine présentaient également de fortes teneurs en dérivés alkylplomb avec une moyenne géométrique de 2092 ug/kg en 1982, mais les teneurs ont accusé une forte diminution, descendant à 194 ug/kg en 1983 et à 53 ug/kg en 1984. Les espèces prédominantes chez les macrophytes étaient le tri- et le tétraéthylplomb.

On a constaté la présence de dérivés alkylplomb dans les sédiments près de l'usine. Les teneurs ont diminué de 703 ug/kg en 1982 à 216 ug/kg en 1983, à 89 ug/kg en 1984 et finalement, à des teneurs sous le seuil de détection en 1986. En plus du tétraéthylplomb et du triméthylplomb, les sédiments contenaient également des quantités appréciables de triméthylplomb et de diméthylplomb, ce qui laisse supposer des réactions de méthylation du plomb dans les sédiments. Les dérivés alkylplomb dans les eaux de surface n'ont été dosés qu'en 1983. Les teneurs dans la couche d'eau subsuperficielle n'étaient que 0.33 ug/L et de 0.09 ug/L immédiatement au pied de l'usine et à 2 km en aval de l'usine, respectivement. Les dérivés alkylplomb étaient sous le seuil de détection (moins de 8 ng/L) dans la baie Lily, en amont de l'usine DuPont. Les teneurs en alkylplomb et en plomb total étaient plus élevées dans la microcouche superficielle que dans l'eau subsuperficielle.

On a dosé les dérivés alkylplomb d'échantillons de poissons provenant de la rivière Ste-Claire en 1983, 84 et 87. Ces teneurs étaient élevées dans le poisson près d'Ethyl Canada Inc. Toutefois, à cause de l'écoulement plus rapide de cette rivière, les teneurs alkylplomb des poissons étaient généralement inférieures à celles observées chez les mêmes espèces dans la région de Maitland. En 1983, on a dosé les dérivés alkylplomb d'échantillons de muscle et de carcasse de plusieurs espèces de poissons. Les échantillons de carcasse comportaient généralement des teneurs supérieures par rapport aux échantillons de muscle. La carpe, le meunier et le grand brochet présentaient des teneurs plus élevées en dérivés alkylplomb que la perchaude, le doré, le poisson-castor et le lépisosté. La teneur la plus élevée, mesurée dans un échantillon de meunier, atteignait 3607 ug/kg. Les composés d'alkylplomb les plus fréquemment détectés étaient le tri- et le tétraéthylplomb. Les rapports des dérivés alkylplomb et du plomb total variaient selon les espèces de poissons, mais ils étaient généralement compris entre 0.3 et 0.6. Seulement un échantillon d'eau sur 6 prélevé en 1983 contenait des teneurs décelables de dérivés alkylplomb. On observait des teneurs plus élevées dans la microcouche de la surface que dans les échantillons subsuperficiels (0.68 et 0.42 ug/L, respectivement).

Les teneurs des dérivés alkylplomb du poisson ont présenté une diminution en 1984. La carpe, le meunier et le grand brochet contenaient à nouveau plus de dérivés alkylplomb que la perchaude, le doré et la truite brune. Deux échantillons d'eau subsuperficielle provenant d'Ethyl Canada Inc. présentaient des teneurs en alkylplomb de 0.51 et de 0.82 ug/L. Les teneurs en dérivés alkylplomb des poissons ont accusé une autre diminution en 1987. Seulement 2 des 7 échantillons de carpes contenaient des teneurs au-dessus du seuil de détection (51 et 236 ug/kg), alors qu'un des deux meuniers avaient des teneurs de 41 ug/kg. Deux échantillons de dorés ne contenaient pas de quantités décelables de dérivés alkylplomb (moins de 8 ug/kg).

Des carpes et des perchaudes des lacs St-Laurent et St-François ont été analysées en 1983. Seulement une des quatre perchaudes présentait des concentrations de 95 ug/kg, alors que 12 échantillons de carpes contenaient des teneurs non décelables de dérivés alkylplomb.

Pour conclure, on peut dire que les échantillons de poissons, de bivalves, de macrophytes, de sédiments et d'eau contenaient des teneurs en alkylplomb élevées près des deux sources, les valeurs observées étant supérieures à celles mesurées dans des échantillons de la région de Maitland. Les teneurs ont diminué depuis 1981, ce qui reflète des mesures améliorées de réduction des teneurs en dérivés d'alkylplomb dans les effluents et la fermeture de DuPont Canada Inc. à Maitland en 1985.

TABLE OF CONTENTS

INTRODUCTION

Lead exists in two valence states: Pb(II) in inorganic forms such as lead chloride, lead sulphate, and Pb(IV) mostly in organic forms such as triethyllead, tetraethyllead. Lead contamination of the environment is usually measured as inorganic Pb(II). The occurrence of organic Pb(IV) in the environment had rarely been reported probably because of the lack of suitable analytical techniques specific for these compounds at very low sensitivity levels (Chau et al. 1980). During the last decade, great advances have been made in the development of speciation techniques. As a result, organic lead can now be speciated to its molecular forms at environmental concentrations (Chau and Wong, 1984).

There are two types of organolead compounds of environmental concern. One type is tetraalkyllead (R4Pb) compounds which are volatile and water-insoluble and their presence in water is only transient. They will finally be partitioned into the lipids of living organisms, adsorbed onto particulates or volatilized to the atmosphere. They include tetraethyllead (Et4Pb) and tetramethyllead (Me4Pb) and their mixed alkyls. The second type is ionic, water-soluble and includes trialkyllead (R3Pb) and dialkyllead (R2Pb) compounds. Monoalkyllead (RPb) compounds are extremely unstable and their existence has not been established. The dominant use of organolead compounds has been in the form of R4Pb as antiknock additives to gasoline since 1923. Tetraethyllead has been the principal additive in Canadian gasoline since 1926. Consumption of Et4Pb used in gasoline in Canada has declined from 16000 tons in 1975 to 9100 tons in 1982 as a result of a federal standard of 0.77 g/L for Pb in leaded gasoline imposed in 1974 and an increasing number of cars designed for non-leaded gasolines (Royal Society of Canada, 1986). About 1% of R4Pb in gasoline is emitted into the atmosphere via the automobile exhaust and further emissions are caused by evaporative losses of fuel from fuel tanks, carburetors and spillage during the manufacture and transfer of antiknock compounds (Hewitt and Harrison, 1986). The significant anthropogenic inputs of R4Pb to the environment may be compounded by a natural methylation of lead compounds (Wong et al. 1975). In addition to their use as gasoline additives, alkyllead compounds also have minor industrial and commercial applications such as in the manufacturing of fungicides, pesticides, lubricant oil additives, antifouling agents and polyurethane foam catalysts (Shapiro and Frey, 1968).

Tetraalkyllead compounds decompose after entry into the environment to trialkyl-, dialkyl- and inorganic Pb species. The rates of photolysis for Me4Pb and Et4Pb range from 8% and 26% per h respectively in bright summer sunlight to 0.2% and 0.7% per h respectively in the dark (Harrison and Laxen, 1978). Tetraalkyllead compounds also decompose in aqueous systems, forming primarily trialkyllead species. Jarvie et al. (1981) reported that Et_4Pb was very stable in water in the dark with only 2% decomposition after 77 days. When exposed to sunlight, almost 100% of Et_4Pb was decomposed after 15 days. Trialkyllead compounds are very stable in water with virtually no decomposition for up to 6 months.

To date few measurements have been made of alkyllead levels in the environment. Rainwater samples at six locations in or near Antwerp, Belgium, were found to contain 28-330 ng/L R_3Pb with an apparent correlation with local traffic density (De Jonghe et al., 1983). Et_4Pb was detected in several samples of surface microlayer but not in the water of the St. Clair River (Chau et al., 1985). Due to their high vapor pressures and lipophilicity, R_4Pb would tend to bind to the hydrophobic compounds in the surface microlayer and lipid fraction in fish. The presence of R_4Pb compounds in fish was first reported by Sirota and Uthe (1977) who found high ratios of alkyllead to total Pb in several fishery products in Halifax, Nova Scotia. The source of alkyllead was not known; however, the possibility of environmental methylation of Pb compounds was suggested. Mor and Beccaria (1977) reported high concentrations of R_4Pb in mussels collected near the "SS Cavtat" incident in the Adriatic Sea where a shipload of R_4Pb (about 200 tons) was sunk. Chau et al.(1980) in an extensive survey of lakes and rivers in Ontario, found 17 out of 107 fish samples contained R_4Pb. No detectable amount of R_4Pb was found in the water, macrophytes and sediments. Unfortunately, analysis of other forms of organic Pb was not carried out in this survey.

Lead is readily accumulated from water by fish. Bioconcentration factors for inorganic lead are generally between 100 and 1000 but are 10 times higher for alkyllead compounds (Hodson, 1986). The reason is likely the higher lipid solubility of alkyllead compounds relative to inorganic lead. Therefore, fish should reflect the pattern of environmental contamination by lead.

In 1979, surveys were initiated in our laboratory to study the degree of Pb contamination in a number of fish species in the lower Great Lakes (Hodson et al., 1983). Several sites were monitored, ranging from Sarnia on the St. Clair River to Maitland on the St. Lawrence River. Blood Pb concentrations in fish increased from a geometric mean of 59 ug/L at Sarnia to a high of 456 ug/L at Maitland. The erythrocyte enzyme δ-aminolevulinic acid dehydratase (ALA-D) activities were only marginally inhibited in the high-lead containing fish. Published information indicated that ALA-D was only sensitive to inorganic Pb and insensitive to alkyllead compounds (Hodson et al., 1983). Hence an investigation was carried out to analyze both total Pb and alkylleads in fish, particularly in fish from areas where alkyllead compounds were produced. At that time, there were two alkyllead manufacturers in Ontario: DuPont Canada Inc. in Maitland, St. Lawrence River and Ethyl Canada Inc. in Corunna, St. Clair River. DuPont Canada Inc. is located approximately 4 km east of Maitland. It produced Et4Pb, nylon intermediates, chlorinated fluorocarbons and spandex fibres. Ethyl Canada Inc. just upstream of Corunna, also produced Et4Pb. However, the St. Clair River has a higher water-flow rate than does the St. Lawrence River so that the Pb compound would be more rapidly dispersed.

In this report, we present data on the occurrence of various alkyllead compounds in samples (fish, clams, macrophytes, sediments and water) from St. Lawrence River and St. Clair River from 1981 to 1987.

MATERIALS AND METHODS

a) Sampling areas:

Fish, clams, macrophytes, sediments and water were collected periodically from 1981 to 1987 from two areas of prime concern: 1. Maitland, St. Lawrence River and 2. Sarnia, St. Clair River. Two other areas (Lake St. Lawrence and Lake St. Francis) were sampled in 1983 for comparison.

I. ST. LAWRENCE RIVER (Appendix = map #1) --

1.	Maitland-	80 km east of Kingston
2.	Johnstown-	14 km east of Maitland
3.	Blue Church Bay-	6 km east of Maitland
4.	DuPont-	4 km east of Maitland
5.	Wells Creek-	2 km east of Maitland
6.	Lily Bay-	14 km west of Maitland

II. ST. CLAIR RIVER (Appendix = map #2) --

1.	Lake Huron-	3.5 km north of Sarnia
2.	Corunna-	9.3 km south of Sarnia
3.	South of Stag Is.-	10.6 km south of Sarnia
4.	St. Clair-	15.8 km south of Sarnia
5.	Marine City-	26 km south of Sarnia
6.	Algonac-	36 km south of Sarnia
7.	Walpole Is.-	37 km south of Sarnia

III. LAKE ST. LAWRENCE- 76km east of Maitland

IV. LAKE ST. FRANCIS- 112km east of Maitland

Water samples were collected in 4 L acid-washed and solvent-rinsed amber glass sample bottles. Sediments were obtained by means of an Ekman grab sampler or plastic scoop and placed in acid-washed glass jars. Most fish species were collected with overnight sets of bottom gill nets. Some smaller species were obtained with nearshore seining methods. Macrophytes and clams were collected by divers and placed in polyethylene bags. Samples were collected by Great Lakes Laboratory for Fisheries and Aquatic Sciences (GLLFAS) or Fishing and Industrial Services (FIS). Sampling year, location, type of samples and agency collecting the samples were listed in the Appendix.

Water samples were stored untreated in amber glass bottles at 4 C until analyses. Fish samples were frozen, thawed, homogenized in a meat grinder and refrozen at -25 C. Sediments, clams and macrophytes were also stored frozen at -25 C.

b) Chemicals:

Trimethyllead acetate (Me3PbOAc), triethyllead acetate (Et3PbOAc), tetramethyllead (Me4Pb) and tetraethyllead (Et4Pb) were obtained from Alfa Chemicals (Danvers, MA). Dimethyllead dichloride (Me2Cl2) and diethyllead dichloride (Et2Cl2) were gifts from Associate Octel Co. (S. Wirral, Great Britain). Tetramethylammonium hydroxide (TMAH) was from Fisher Chemicals; sodium diethyldithiocarbamate (NaDDTC) from Baker Co.; n-butyl Grignard reagent in tetrahydrofuran from Alfa Co. All other reagents and solvents were commercially available in high purity grade.

The species determination of alkyllead in water, fish, macrophytes and sediment were carried out according to the methods of Chau et al (1983, 1984). The following sections are brief description of the procedures.

c) Preparation of stock solutions:

1. A 0.5M solution of sodium diethyldithiocarbamate (NaDDTC) was prepared by adding 11 g of NaDDTC into double distilled water and made to volume with double distilled water in an 100-mL volumetric flask. The mixture was stirred using a stirring rod until the NaDDTC was completely dissolved in water.

2. A 20% solution of tetramethylammonium hydroxide (TMAH) was prepared by dissolving 100 g of TMAH into double distilled water and made to volume with double distilled water in a 500-mL volumetric flask.

3. A 1000 ppm stock solution of trimethyllead acetate (Me3PbOAC) was prepared by weighing out 150.2 mg of Me3PbOAc on an analytical balance and dissolving the compound into double distilled water and made to volume with double distilled water in a 100-mL volumetric flask.

4. A 1000 ppm stock solution of triethyllead acetate (Et3PbOAC) was prepared by dissolving 170.7 mg of Et3PbOAC into double distilled water and made to volume with double distilled water in a 100-mL volumetric flask.

d) Sample clean-up procedure:

Fish and clam samples had to be "cleaned up" prior to analyses because of their high protein and lipid content which might clog the GC column as well as the transfer line from the GC to AAS. The clean-up, although slow and tedious, was critical.

1. Preparing column:

Glass wool was placed in the bottom of a 50-mL buret (1.5cm I.D.). A 1-cm layer of sodium sulphate was laid on top of the glass wool. A slurry mixture of pentane and kiesel-gel 60 was poured into the column. A vibrator was used against the sides of the buret to pack the gel tightly. Packing must be 48-cm deep. The packing was sealed with 1-cm layer of anhydrous sodium sulphate.

2. Sample loading:

Before sample was loaded, 2 mL of biological sample extracted with benzene was first butylated with 0.2 mL of Grignard reagent (butyl magnesium chloride) for 10 min. 3 mL of 1N sulphuric acid was then added to destroy the excess Grignard reagent. The level of pentane was drained to the top of the packing in the column. Exactly 1 mL of butylated sample was added to the top of the column with a 1-mL graduated pipette. The sample level was drained to the top of the sulphate layer and the interior walls of the column were rinsed with a few drops of pentane. The rinse pentane should then be drained to the top of the sulphate layer. The stopcock was closed. The reservoir (separatory funnel) was filled with 60 mL of pentane. A 3-4 mL of pentane was slowly drained into the column. A 100-mL round bottom flask was placed under the column and the flow of pentane through the column was adjusted to 1 drop every 2 seconds. The reservoir opening and the round bottom flask were covered with aluminum foil. When approximately 55-mL of pentane had been eluted through the column, the stopcock was closed.

3. Volume reduction:

600 ul of iso-octane was added to each sample to prevent the volatilzation of the Pb compounds from the sample during volume reduction. The sample was concentrated in a rotary evaporator at 20 C. The volume was reduced to approximately 2 mL and then transferred to a 15-mL graduated centrifuge tube. The sample was vortexed on an unheated sample block to exactly 1 mL. The sample was placed into a small vial and sealed tightly. A syringe was used to remove the sample and to inject it into the GC-AAS.

e) The GC-AAS system:

The sample was injected directly into the chromatographic column by a syringe. The chromatographic columnn was of glass, 1.8 m long, 6 mm diameter, packed with 10% OV-1 on Chromosorb W, (80-100 mesh) with a carrier gas (N2) flow rate of 65 mL/min. The temperatures of the injection port and transfer line were at 150 and 160 C, respectively. The column was programmed from 80 C to 200 C at a rate of 5 C/min. The 217 nm line from a lead electrodeless discharge lamp at 10W was used with an electrically heated quartz furnace at 900 C, with H2 flowing at 85 mL/min and a deuterium lamp was used for background correction. Peak areas were integrated with an Hewett Packard integrator (HP3392A).

f) Determination of alkyllead and Pb species in water:

Water samples (1 L) were extracted with 50 mL of 0.5 M NaDDTC, 50 g of NaCl and 50 mL of benzene for 30 min. The benzene phase was carefully evaporated in a rotary evaporator to 1 mL in a 15-mL centrifuge tube to which 0.2 mL of n-butyl Grignard reagent was added. The mixture was gently mixed for one minute and washed with 2 mL of 1 N sulfuric acid. The organic phase was dried in anhydrous sodium sulfate. Appropriate amounts (10-20 ul) were injected into the GC-AAS system for analysis. Sum of total Pb was determined by adding the concentrations of individual alkylleads and inorganic Pb. Detection limit for water was 8 ng/L.

g) Determination of alkyllead and Pb species in fish, clams and macrophytes:

Several types of fish samples were used for analyses. These included whole fish, carcass (headless and gutted), muscle (skinless dorsal fillet), intestine, liver and fatty tissue samples.

Homogenized fish samples (2 g), whole clams (1-2 g) or shredded pieces of macrophytes (2 g) were first digested with 5 mL of TMAH (20%) in a hot water bath at 60 C for 1-2 h or until the tissue was dissolved. After cooling, the mixture was neutralized with 50% HCl to pH of 6-8 and again extracted with 5 mL benzene, 2 g of NaCl and 3 mL of 0.5 M NaDDTC solution. The mixture was centrifuged and 2 mL of the benzene phase was transferred to a vial and tightly sealed. The benzene sample was placed into the freezer. Fish and clam samples required "clean-up" as previously described. Macrophytes did not require "clean-up". Therefore, the 2 mL benzene sample was transferred to a glass-stoppered vial for butylation with 0.2 mL n-butyl Grignard reagent. 3 mL of 1 N H_2SO_4 was added to destroy excess Grignard reagent. The benzene phase was dried in anhydrous sodium sulfate. Suitable aliquots (10-20 uL) were injected into the GC-AAS system for analysis. Sum of total Pb was determined by adding concentrations of individual alkylleads and inorganic Pb. Detection limit for fish, clams and macrophytes was 8 ng/g(wet weight).

h) Determination of alkyllead and Pb species in sediments:

Dried (1-2 g) or wet (5 g) sediment sample was extracted in a capped vial with 3 mL of benzene after adding 10 mL H_2O, 6 g NaCl, 1 g KI, 2 g Na benzoate, 3 mL 0.5 M NaDDTC and 2 g coarse glass beads (20-40 mesh) for 2 hr on a mechanical shaker. After centrifugation, a measured aliquot (1 mL) of the benzene layer was withdrawn for butylation as described. Sum of total Pb was determined by adding concentrations of individual alkylleads and inorganic Pb. Detection limit for sediment was 15 ng/g (wet weight) of sample.

i) Accuracy, precision and interferences:

The recoveries of dialkylleads and trialkylleads from biological (fish, clams and macrophytes), sediment and water samples were evaluated by spiking various levels (1 to 20 ug) of the Pb compounds to the samples and extracted the samples with the above procedures. The average recovery varied from 71% for Me2Pb to 101% for Et2Pb in the biological samples, 94% for Et3Pb to 111% for Me3Pb in sediments and 94% for Et3Pb to 106% for Me3Pb in water. Recoveries were evaluated by comparing values from alkyllead standards with and without spiked into samples. The results indicated that there were no serious sample matrix interferences.
The precision of the method was also evaluated by replicate analysis (n=6) of biological (fillet, clams and macrophytes) and sediment samples spiked with 5 ug of each of the alkylleads. For biological samples the reproducibility varied from 6.5% for Et3Pb to 20% for Et2Pb. Better reproducibility was obtained for sediment analysis. Replicated analysis (n=6) showed an average standard deviation of 4% for Me3Pb and Et3Pb to 15% for the dialkyllead compounds. The precision of the water analyses method was evaluated by determining 10 replicate samples from 100 mL of Lake Ontario water enriched with 10 ug of each of the alkyllead and Pb species. The relative standard deviation for the 4 alkyllead and Pb compounds at this level varied from 5.4% for Me3Pb to 9.5% for Pb.

Alkyllead compounds were identified using the retention times of a synthesized standard mixture containing the ten alkyllead and Pb(II) species. Of all the alkyllead compounds, Me3Pb and Et3Pb were the most stable and since equal quantities of all the alkyllead species gave equal peak areas, Me3Pb and Et3Pb were used as internal standards for other Pb compounds.

All results were reported as ppm (mg/Kg) or ppb (ug/Kg) on a wet weight basis.

RESULTS

a) Alkyllead and Inorganic Lead Species in Fish

Concentrations of individual alkyllead and inorganic Pb species in fish from St. Lawrence and St. Clair Rivers areas from 1981 to 1987 are listed in Appendix C). For presentation of the results and discussion purposes, the data were calculated to give geometric means with their ranges of maximum and minimum.

1981:

Only 3 fish species were collected from Blue Church Bay (downstream from DuPont). However, the fish were found to contain the highest levels of alkylleads and Pb(II) during the 7 years of our studies on alkylleads.

Alkylleads were present in 25 out of 28 samples analysed (Table 1). The highest concentration of alkylleads ever detected was in a carp sample (with intestine removed for separate analysis) with 138,999 ppb. The geometric mean of 12 carp samples was only 4,207 ppb, indicating the wide range of alkyllead levels in the samples. The intestine sample from the same fish also contained very high alkyllead levels with a geometric mean of 2,919 ppb.

White sucker and northern pike contained less alkyllead than did the carp. However, in these fish samples, alkyllead levels were higher in the intestines than in other parts of the fish (Table 1).

Analyses of alkyllead species in the whole fish and in the intestines indicated that the majority of alkyllead was in the form of Et_4Pb and its degradation product Et_3Pb (Tables 2 & 3). Alkyllead levels were correlated to total lead levels in carcass reflecting the high proportion of organolead compounds (unpublished data).

The early indications of lead contamination were confirmed by very strong correlations in carp of the sum of all alkyllead concentrations in carcass to blood lead levels (unpublished data).

1982:

Ten different fish species from the Maitland area were analysed for both alkylleads and total leads.

Alkylleads were detected in 33 out of 45 whole fish samples (with intestines removed for separate analyses). The highest concentration of alkylleads was found in one sample of carp containing 61,713 ppb (Table 4). However, this level was considerably less than 138,999 ppb found in 1981 (Table 1). Again, the ranges of alkylleads were wide. Based on the values of geometric means, yellow perch contained the most alkylleads (1994 ppb) followed by carp (1976), smallmouth bass (1972), white sucker (1747), brown bullhead (1135), redhorse sucker (721), pumpkinseed (567), pike (287) and alewife (244). Rock bass did not contain detectable amounts of the lead compounds (< 8 ppb). Alkyllead compounds were present mainly in the forms of Et_4Pb and Et_3Pb with small amounts in Et_2Pb and $MeEt_3Pb$ (Table 5).

Total Pb which include alkylleads and inorganic Pb was detected in 41 of 45 whole fish samples (Table 6). The pattern of total Pb mirrored the alkyllead levels with yellow perch containing the highest level.

Seven out of ten fish species were analysed for alkylleads in their intestines. Yellow perch, alewife and pumpkinseed with weights less than 120 g were too small to separate the intestines. Alkylleads were present in 24 of 29 intestine samples with white sucker containing the highest geometric mean of 6336 ppb (Table 4). Smallmouth bass, carp and redhorse sucker also contained appreciable amounts of alkylleads with Et_4Pb and Et_3Pb as the major forms (Table 7). Total Pb was found in 26 of 29 intestine samples (Table 6). Smallmouth bass contained 3944 ppb of total Pb followed by carp (3070), white sucker (2700), pike (2010) and brown bullhead (587).

1983:

Various fish species were collected from sites (Maps #1 and #2) along the St. Lawrence River (Maitland, Johnstown, Blue Church Bay, Lily Bay), Lake St. Lawrence, Lake St. Francis and the St. Clair River (Marine City, Algonac, Lake Huron, St. Clair and Walpole Island). As in the previous years, alkylleads were determined in the whole fish samples from certain locations. However, some fish samples were also separated into muscle and carcass portions for analyses.

(1) St. Lawrence River:

a) Maitland area -- Alkylleads and total Pb were determined in 9 different whole fish species from this area (Table 8). Alkylleads were detected in 24 of 26 samples with white sucker containing the highest level (mean of 3725 ppb), followed by yellow perch (1778 ppb), smallmouth bass (1223 ppb), carp (804 ppb), killifish (710 ppb), northern pike (436 ppb), pumpkinseed (413 ppb), red horse sucker (361 ppb) and rock bass

(163 ppb). Et4Pb and Et3Pb were again the major forms of alkylleads (Table 9). Total Pb was present in all of 26 samples (Table 8). White sucker contained the highest geometric mean of total Pb (4920 ppb). The levels of total Pb concentrations followed a similar pattern as in the alkylleads. The ratios of alkylleads to total Pb ranged from a low of 0.25 in rock bass to a high of 0.92 in pumpkinseed.

b) Johnstown -- Thirty-one carcass and 30 muscle samples from 10 different fish species were analysed.

Alkylleads were detected in 29 of 31 carcass samples (Table 10). Yellow perch and carp contained the highest amount of alkylleads. In general, concentrations of alkylleads in the carcass were much lower than the levels in the whole fish samples (Tables 8 & 10). Alkylleads were present mainly in the forms of Et3Pb and Et4Pb (Table 11). Total Pb was present in all 31 carcass samples again with yellow perch (661 ppb) and carp (665 ppb) containing the highest geometric means (Table 12). However, one carcass sample of white sucker contained the highest level of total Pb (4005 ppb).

Alkylleads were present in 28 of 30 muscle samples (Table 13). Concentrations of the lead compounds were generally lower than in the carcass samples with geometric means less than 450 ppb. Yellow perch (450 ppb) and carp (405 ppb) again were the most alkyllead-contaminated species. Interestingly, with the exceptions of carp and northern bass, all other fish species contained alkylleads almost exclusively in the form of Et3Pb (Table 14). Total Pb again followed the same pattern as the alkylleads with carp (615 ppb) and yellow perch (556 ppb) as the most contaminated species (Table 15).

c) Blue Church Bay -- Twenty-eight carcass and 22 muscle samples from 7 fish species were analyzed for alkylleads and total Pb.

Alkylleads were present in 24 of 28 carcass samples with geometric means much higher than the carcass samples from Johnstown. (Table 10). Yellow perch contained 1716 ppb while redhorse sucker had 798 ppb. No sample of carp was available. Et4Pb and Et3Pb were the predominant forms of alkylleads (Table 16). Total Pb was detected in all 28 carcass samples (Table 12). Several samples of three fish species (yellow perch, redhorse sucker and northern pike) contained total Pb at levels above 3000 ppb.

Alkylleads were found in 21 of 22 muscle samples (Table 13). Fish from this area generally contained much higher lead compounds than those from Johnstown. Several fish samples had values over 1000 ppb. In contrast to the carcass samples, alkylleads in muscle were almost exclusively in the form of Et3Pb (Table 17). Total Pb was present in 21 of 22 muscle samples (Table 15) with concentrations generally higher than those from Johnstown. For example, one brown bullhead and 2 yellow perch samples contained 3799, 3505 and 2123 ppb of total Pb respectively.

d) Lily Bay -- Sixteen carcass and 14 muscle samples from 9 fish species were analysed for alkyllead and total Pb levels.

Alkylleads were detected only in 5 out of 16 carcass samples (Table 10). The concentrations of alkylleads in fish from this site were, in general, the lowest compared with other sites. Several species of fish did not contain detectable amounts of alkylleads (<8 ppb). Carp contained the highest amount of alkylleads (321 ppb). Of 3 carp samples analysed, one had 1061 ppb while the others had 97 and < 8 ppb respectively. Composition of alkylleads revealed that carp had been exposed to Et4Pb since 85% of alkylleads were in the form of Et4Pb in this species (Table 18). However, yellow perch and pumpkinseed contained 100% MeEt3Pb, a form not predominant in the previous samples. Total Pb was present in 11 of 16 carcass samples (Table 12). Yellow perch and carp contained the highest levels of total Pb. However, the levels were generally lowered than that from the other areas.

Alkylleads were present in 5 of 14 muscle samples. Again, the levels of alkylleads were very low (Table 13). Only one carp sample had a level higher than 100 ppb. With the exception of carp, yellow perch and small mouth bass had Et3Pb as the predominant form (Table 19). Total Pb was found in 10 of 14 muscle samples with carp containing the highest amount of 260 ppb (Table 15). Similar to the carcass, the muscle samples from this area had much lower total Pb levels.

(2) Lake St. Lawrence and Lake St. Francis:

Two species of whole fish from Lake St. Lawrence and 1 species of whole fish from Lake St. Francis were analyzed.

Alkylleads were detected in low levels (95 ppb) in only 1 of 4 yellow perch samples from Lake St. Lawrence (Table 20). All six carp samples contained less than detectable level. Alkylleads in the yellow perch were present mainly in the forms of Et3Pb and MeEt3Pb (Table 21). Total Pb was found in 4 of 10 samples with carp and yellow perch containing geometric means of 145 and 95 ppb of total Pb respectively (Table 20).

Six samples of carp from Lake St. Francis did not contain detectable level of alkylleads and only low concentrations of total Pb (130 ppb) were detected in 4 of 6 samples (Table 22).

(3) St. Clair River:

a) Marine City -- Two fish species (white sucker and redhorse sucker) were analyzed for alkylleads and total Pb in carcass and muscle samples.

All 3 carcass samples of white sucker contained alkylleads which ranged from 40 to 3188 ppb and total Pb which ranged from 151 to 3188 ppb (Table 23). Only 1 carcass sample of redhorse sucker was determined. Alkylleads were below the detectable level while the total Pb concentration was only 97 ppb.

Muscle samples of white sucker (Table 24) had a higher mean level (753 ppb) of alkyllead compounds than the carcass samples (413 ppb). No muscle sample of redhorse sucker was available for comparison. The predominant forms of alkylleads in white sucker muscle and carcass samples were Et4Pb and Et3Pb (Table 25).

b) Algonac -- Alkylleads were analyzed in carcass samples of 6 fish species (Table 26). Only 1 of 4 carp samples and 1 of 5 white sucker samples contained measureable quantities of alkylleads. Yellow perch, northern pike, bowfin and garpike had no detectable alkylleads. Total Pb was present in more fish samples but with lower geometric means.

More samples of fish muscle contained alkylleads and total Pb but the overall concentrations were very low (Table 27). The highest level was in a carp sample with 1601 and 1843 ppb of alkylleads and total Pb respectively. Alkylleads were present mainly in the forms of Et4Pb and Et3Pb (Table 28). However, one carcass sample of white sucker contained exclusively MeEt3Pb, similar to that observed in yellow perch and pumpkinseed carcass samples from Lily Bay (Table 18).

c) Lake Huron -- Only two fish species (white sucker and carp) were analyzed for alkylleads and total Pb in carcass and muscle samples. The concentrations of these lead compounds in the samples were low. Carcass and muscle samples of carp contained 323 and 627 ppb of alkylleads and 670 and 687 ppb of total Pb respectively (Tables 29 and 30). Alkylleads were present mainly as Et4Pb and Et3Pb with the exception of 1 white sucker muscle sample where 100% of Et2Pb was found (Table 31).

d) St. Clair -- Alkylleads were not detected in carcass and muscle of 4 fish species (Tables 32 and 33). Total Pb was present but in very low levels.

e) Walpole Island -- Carp, yellow perch and catfish contained 34, 17 and 154 ppb of alkylleads in the carcass samples and 121, <8 and 114 ppb of alkylleads in the muscle samples respectively (Tables 34 and 35). Et4Pb and Et3Pb were the major species of alkylleads (Table 36). Total Pb was slightly higher than alkylleads in both carcass and muscle samples. However, the levels were still less than 350 ppb.

1984:

(1) St. Lawrence River:

a) Maitland -- 25 muscle samples from 4 fish species were analyzed for alkylleads and total Pb (Table 37). All samples had alkylleads with carp containing the highest geometric mean of 3333 ppb, followed by brown bullhead (1505 ppb), white sucker (1115 ppb) and yellow perch (622 ppb). One carp muscle sample contained 23143 ppb of alkylleads. However, these levels were still generally lower than those in the previous years of 1981 and 1982 (Tables 1 and 4). Et4Pb and Et3Pb were the major species of alkylleads (Table 38). Total Pb followed the same pattern as the alkylleads (Table 37).

b) Johnstown -- Alkylleads were present in 37 of 67 whole fish samples from Johnstwown (Table 39). White sucker contained the highest geometric mean concentration of 495 ppb, followed by yellow perch (328 ppb), red horse sucker (321 ppb), carp (304 ppb), brown bullhead (171 ppb) and rock bass (165 ppb). Pumpkinseed and small mouth bass did not contain detectable level of alkylleads. Alkylleads were present mainly in the forms of Et4Pb and Et3Pb (Table 40).

Total Pb were detected in 46 of 67 whole fish samples (Table 41). A sample of white sucker had a level of 2553 ppb of total Pb, the highest of all the samples. Other fish species had similar proportions of total Pb and alkylleads.

c) Blue Church Bay -- Six species of whole fish were analyzed. Alkylleads were found in all the species (Table 39). With the exception of white sucker, fish from this area generally contained higher alkyllead levels than those from Johnstown. Only 1 sample of yellow perch was available for analysis but was found to contain 2524 ppb of the lead compounds. Fifteen samples of redhorse sucker had a mean value of 809 ppb and a range of 109 to 5039 ppb. Other fish species had much lower alkyllead levels. Again the predominant forms of alkylleads were Et4Pb and Et3Pb but with significant amount of Et2Pb (Table 42).

One sample of redhorse sucker had the highest total Pb level of 5874 ppb (Table 41). In general, the levels of total Pb mirrored the levels of alkylleads.

d) Lily Bay -- Fish from Lily Bay contained the lowest concentrations of alkylleads and total Pb (Tables 39 and 41). Only 2 fish species (red horse sucker and white sucker) and 9 of 41 whole fish samples from this area had detectable amount of alkylleads and with mean values less than 155 ppb. Et4Pb and Et3Pb were again the major forms of alkylleads (Table 43).

Total Pb was present in more samples (20 of 41). One sample of red horse sucker and 1 sample of white sucker contained high levels of 5461 and 2326 ppb of total Pb respectively (Table 41). However, the geometric means, due to a wide range of concentrations, were only 357 and 171 ppb respectively.

(2) St. Clair River:

a) Stag Island -- Alkylleads were detected in 11 of 16 whole fish samples collected from the south of Stag Island. Only white sucker and walleye contained low levels of alkylleads, 138 and 32 ppb (geometric means) respectively, while yellow perch and brown trout were below detection limit of 8 ppb (Table 44). Et4Pb and Et3Pb were the major species of alkylleads in walleye while Et4Pb and Et2Pb predominated in white sucker (Table 45).

Total Pb were present in all 16 samples (Table 44). One sample of white sucker contained abnormally high level of 2525 ppb of total Pb while the other samples were below 500 ppb.

b) Corunna -- Only 2 carp and 4 northern pike were analyzed as whole fish samples. Alkylleads were detected in 1 carp and all 4 northern pike samples (Table 46). Concentrations were generally low with the highest at 1522 ppb. Carp contained 100% Et3Pb while northern pike had 72% Et4Pb and 21% Et3Pb (Table 47). Total Pb were also low with means less than 443 ppb.

1985:

There was no alkyllead determination on fish in this year. There were caged clam experiments in both St. Lawrence and St. Clair Rivers. Results will be published in separate papers.

1986:

Twenty-five whole fish samples of 4 species of fish (carp, yellow perch, white sucker and brown bullhead) from Blue Church Bay, St. Lawrence River were analyzed.

Alkylleads were found in 11 of 25 whole fish samples (Table 48). With the exception of 1 abnormally high level of 12234 ppb in the carp sample, the levels of alkylleads were generally lower than in the previous years. The geometric means were 988, 230 and 54 ppb for carp, white sucker and brown bullhead respectively. In contrast to the results from the previous years, 5 samples of yellow perch did not contain detectable quantity of alkylleads. The major forms of alkylleads as before were Et4Pb and Et3Pb (Table 49).

Total Pb were present in 24 of 25 samples (Table 48). Similar to the alkylleads, total Pb were generally low as compared to the previous years. However, 1 carp sample still contained 13616 ppb of total Pb.

1987:

(1) St. Lawrence River:

Sixteen whole fish samples of 4 species of fish (carp, brown bullhead, white sucker and yellow perch) from Blue Church Bay were analyzed.

Alkylleads were found in 6 of 16 whole fish samples (Table 50). The alkyllead levels continued to decrease from the previous years. The geometric means were 120, 149 and 50 ppb for carp, brown bullhead and white sucker respectively. The major forms of alkylleads were Et3Pb and Et4Pb (Table 51). Total Pb were present in all 16 samples (Table 50). Similar to the alkylleads total Pb were generally low as compared to previous years.

Four different tissues from 3 carps were dissected and analyzed for alkylleads and total leads (Table 52). Alkylleads were found in all 3 liver and intestine samples with geometric means of 161 and 116 ppb respectively. Alkylleads were present in 1 out of 3 fatty tissue samples (512 ppb) and in 1 out of 3 fillet samples (350 ppb). Alkylleads were present mainly in the forms of Et4Pb and Et3Pb (Table 53). Total leads were present in all samples analyzed (Table 52). The liver had the highest total lead level of 418 ppb followed by the intestines (317 ppb), fatty tissue (154 ppb) and fillet (134 ppb).

(2) St. Clair River:

Alkylleads were detected in 3 out of 11 whole fish samples collected from Stag Island (Table 54). Only carp and white sucker contained alkylleads, 110 and 41 ppb (geometric mean) respectively, while walleye was below detection limit of 8 ppb. Et3Pb and Et4Pb were the major alkyllead species (Table 55). Total lead were present in all 11 samples (Table 54). White sucker contained the highest amount (257 ppb) followed by carp (193 ppb) and walleye (137 ppb).

b. <u>Alkyllead and Inorganic Lead Species in Sediments, Clams, Macrophytes and Water</u>

1981:

There were no alkyllead and inorganic Pb determinations on sediments, clams, macrophytes and water in this year.

1982:

(1) Sediments --

Four sediment samples were collected from Blue Church Bay (2 km downstream from DuPont) and from the vicinity of DuPont (Map #3). Alkylleads were not detected in Blue Church Bay sediments but were 703 ppb in DuPont sediments (Table 56). The levels of total Pb which included alkylleads and inorganic Pb were 4540 in Blue Church Bay and more than 5911 ppb (one sample had so much Pb that it was off-scale in the GC-AAS) in DuPont sediments respectively (Table 57).

Alkylleads were present mainly in the forms of Et_4Pb, followed by Et_3Pb and $MeEt_3Pb$ in DuPont sediments (Table 58).

(2) Clams --

Only one clam was collected near DuPont. Alkylleads were not detected (Table 56). Inorganic Pb level was only 280 ppb (Table 57).

(3) Macrophytes --

Macrophytes from Blue Church Bay did not contain detectable amounts of alkylleads (Table 56) but had 6796 ppb of total Pb (Table 57). Macrophytes from DuPont area contained 2092 ppb of alkylleads and 19169 ppb of total Pb (Tables 56 and 57). Alkylleads were mainly in the form of Et_4Pb (Table 58).

1983:

(1) Sediments --

Sediments were collected from three sites near Blue Church Bay and one site at Lily Bay (Map #4). Site 1 is mid-way between DuPont and Blue Church Bay, Site 2 is off Blue Church Bay or 2 km downstream of DuPont and Site 3 is about 0.5 km downstream of Blue Church Bay. Lily Bay, 18 km upstream of DuPont, was used as a control site.

Alkylleads were detected in the sediments in all 4 sites. The sediments in 3 sites downstream from DuPont contained 216-264 ppb of alkylleads and the sediments from Lily Bay also had 219 ppb of the Pb compounds (Tables 59 and 60). In contrast to the previous results (Table 58), these sediments contained more Me3Pb and Me2Et2Pb than Et4Pb (Table 61). Total leads were 2-3 times higher in the sediments from Sites 1 and 3 than in the sediments from Site 2 and Lily Bay (Tables 62 and 63).

(2) Clams --

Only one sample from Site 2 was available for analysis. The levels of alkylleads and total Pb were 335 and 1357 ppb respectively (Tables 59 and 62). Alkylleads were present mainly in the form of Et3Pb followed by Et4Pb (Table 64).

(3) Macrophytes --

Macrophytes were collected from Site 3 and from Lily Bay. Alkylleads were detected in 1 of 4 samples from Site 3 at a concentration of 194 ppb (Table 60) and were present only in the form of Me3Pb (Table 65). Total Pb were found in all 4 samples with a geometric mean of 2515 ppb (Table 63).

While alkylleads were not detectable in any of the 7 samples collected from Lily Bay (Table 60), total Pb were present in all 7 samples in a concentration of 315 ppb (Table 63).

(4) Water --

Alkylleads were determined in surface microlayer and subsurface water samples (1m depth). Table 66 shows alkylleads were below detection limit (<8 ppt) in sample from Lily bay (18 Km upstream from DuPont). The levels were much higher in samples just off from DuPont with geometric means of 0.33 ppb and 0.90 ppb in subsurface and surface microlayer respectively. The levels decreased to 0.09 ppb and 0.08 ppb in samples 2 Km downstream from DuPont (Blue Church Bay).

Compared with alkylleads, the levels of total leads were much higher in all the water samples with one sample from DuPont area as high as 9.39 ppb (Table 66).

Only 1 of 6 water samples collected near Ethyl Corp. in St. Clair River contained detectable levels of alkylleads (Table 67). Surface microlayer had 0.68 ppb while subsurface water sample had 0.42 ppb. All six samples contained high levels of total leads with geometric means of 1.44 ppb and 2.40 ppb for subsurface and surface microlayer samples respectively.

1984:

(1) Sediments--

Sediments were collected from Blue Church Bay (Map # 5). Alkylleads were detected in low levels (geometric mean of 89 ppb) in 13 of 15 samples analyzed (Table 68). Total Pb were found in all the samples and at much higher levels (geometric mean of 7340 ppb). Alkylleads were present mainly in the form of Et4Pb, followed by Et3Pb (Table 69).

(2) Macrophytes--

Macrophytes were collected from the same site as the sediments. Five of 13 macrophyte samples had detectable level of alkylleads with geometric mean of 53 ppb (Table 68). All samples contained total Pb (geometric mean of 1052 ppb). Et4Pb was the predominate form of alkylleads in macrophytes (Table 69).

1985:

There was no sample in 1985.

1986:

Sediment --

Sediment samples were collected from 4 different sites near Blue Church Bay (Map #6)

Alkylleads were detected in very low level (14 ppb) only in one sample in Site 4 near Blue Church Bay (Table 70) and were present completely as Et2Pb (Table 71). Other 7 sediment samples from various sites did not contain detectable amount of alkylleads. Total Pb were detected in all the sediments from each of the 4 sites with Site 2 (DuPont Plant) containing the highest concentration of Pb (510 ppb). Sediments from other sites contained between 156 to 225 ppb of total Pb (Table 72).

TABLE 1:

TOTAL ALKYLLEADS IN FISH
MAITLAND---1981

SPECIES	WHOLE FISH (- INTESTINES) ppb'			INTESTINES ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
CARP	12/12	4207	190-138999	11/12	2919	100-100644
WHITE SUCKER	8/10	218	24- 1221	9/10	1009	236- 3447
NORTHERN PIKE	5/ 6	173	30- 1384	5/6	2248	1360- 4454

' ppb= ug alkyllead per Kg fish (wet weight)

* Number of fish samples with detectable alkyllead levels over number of fish samples analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead.

TABLE 2

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
WHOLE FISH (-INTESTINES)
MAITLAND- 1981

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	ET3	ET2
CARP	12/12	1	4	55	39	1
WHITE SUCKER	8/10	0	2	47	51	0
NORTHERN PIKE	5/ 6	0	21	0	40	39

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 3

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN INTESTINES
MAITLAND- 1981

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
CARP	11/12	1	2	32	54	11
WHITE SUCKER	9/10	1	2	27	52	18
NORTHERN PIKE	5/6	2	8	46	28	16

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 4:

TOTAL ALKYLLEADS IN FISH
MAITLAND---1982

SPECIES	WHOLE FISH (- INTESTINES) ppb'			INTESTINES ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
CARP	5/ 6	1976	102-61713	6/ 6	1606	159-30608
PIKE	4/ 5	287	55- 1324	5/ 5	981	411- 2063
WHITE SUCKER	3/ 5	1747	717- 3187	3/ 5	6336	2767-12085
REDHORSE SUCKER	5/ 5	721	189- 2042	5/ 5	1486	350- 4857
ALEWIFE	2/ 5	244	209- 285	N.S.****		
SMALL MOUTH BASS	4/ 4	1972	890- 3115	3/ 3	3198	1955- 5079
YELLOW PERCH	5/ 5	1994	912- 5415	N.S.		
ROCK BASS	0/ 2	N.D.***		0/ 2	N.D.	
PUMPKIN-SEED	3/ 5	567	89- 1882	N.S.		
BROWN BULLHEAD	2/ 3	1135	553- 2329	2/ 3	587	328- 1052

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead levels over number of fish samples analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead.

*** N.D.= nondetectable (<8 ppb).

**** N.S.= No sample.

TABLE 5:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
WHOLE FISH (-INTESTINES)
MAITLAND- 1982

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
CARP	5/ 6	1	6	87	5	1
PIKE	4/ 5	0	7	90	3	0
WHITE SUCKER	3/ 5	0	1	47	40	12
RED-HORSE SUCKER	5/ 5	0	4	75	21	0
ALEWIFE	2/ 5	0	0	0	85	15
SMALL-MOUTH BASS	4/ 4	5	11	60	17	7
YELLOW PERCH	5/ 5	0	1	14	63	22
PUMPKIN-SEED	3/ 5	0	0	73	23	4
BROWN BULLHEAD	2/ 3	0	0	4	72	24

* Number of fish samples with detectable alkyllead levels over number of fish analysed

TABLE 6:

SUM OF TOTAL LEAD IN FISH
MAITLAND---1982

SPECIES	WHOLE FISH (- INTESTINES) ppb'			INTESTINES ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
CARP	6/ 6	2361	160-66434	6/ 6	3070	385-37909
PIKE	5/ 5	1004	506- 2511	5/ 5	2010	1614- 2595
WHITE SUCKER	4/ 5	1220	167- 5036	5/ 5	2700	236-15562
RED-HORSE SUCKER	5/ 5	721	189- 2042	5/ 5	1486	350- 4857
ALEWIFE	3/ 5	308	209- 491	N.S.****		
SMALL-MOUTH BASS	4/ 4	2162	991- 3397	3/ 3	3944	3293- 5079
YELLOW PERCH	5/ 5	3682	2718- 6759	N.S.		
ROCK BASS	2/ 2	446	312- 638	0/ 2	N.D.***	
PUMPKIN-SEED	5/ 5	812	210- 3321	N.S.		
BROWN BULLHEAD	2/ 3	1135	553- 2329	2/ 3	587	328- 1052

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable total lead levels over number of fish samples analysed.

** The geometric mean is calculated only from those samples containing detectable lead.

*** N.D.= nondetectable (<8 ppb).

**** N.S.= No sample.

TABLE 7:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN INTESTINES
MAITLAND- 1982

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
CARP	6/ 6	1	6	76	9	8
PIKE	5/ 5	1	10	82	2	5
WHITE SUCKER	3/ 5	0	2	38	28	32
RED-HORSE SUCKER	5/ 5	0	4	61	26	9
SMALL-MOUTH BASS	3/ 3	6	10	64	14	6
BROWN BULLHEAD	2/ 3	0	0	8	83	9

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 8:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
WHOLE FISH
MAITLAND- 1983

SPECIES	ALKYLLEAD ppb′			TOTAL LEAD ppb′		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
CARP	2/ 2	804	87- 7429	2/ 2	1812	278-11809
WHITE SUCKER	5/ 5	3725	1245-10553	5/ 5	4920	1668-12785
RED-HORSE SUCKER	1/ 1	361		1/ 1	548	
NORTHERN PIKE	3/ 3	436	154- 1113	3/ 3	822	472- 1315
YELLOW PERCH	5/ 5	1778	1101- 2318	5/ 5	2646	1937- 3430
ROCK BASS	3/ 3	163	124- 428	3/ 3	631	428- 1058
SMALL-MOUTH BASS	1/ 1	1223		1/ 1	1629	
PUMPKIN-SEED	3/ 5	413	220- 609	5/ 5	448	218- 977
KILLIFISH	1/ 1	710		1/ 1	1853	

′ ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

TABLE 9:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
WHOLE FISH
MAITLAND- 1983

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
CARP	2/ 2	0	5	78	13	4
WHITE SUCKER	5/ 5	0	3	53	35	9
REDHORSE SUCKER	1/ 1	0	0	64	28	8
NORTHERN PIKE	3/ 3	0	7	50	34	9
YELLOW PERCH	5/ 5	0	2	18	64	16
ROCK BASS	3/ 3	0	0	19	58	23
SMALLMOUTH BASS	1/ 1	1	6	61	25	7
PUMPKINSEED	3/ 5	0	0	49	40	11
KILLIFISH	1/ 1	0	0	36	58	6

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 10:

TOTAL ALKYLLEADS IN
FISH CARCASS
MAITLAND- 1983

SPECIES	JOHNSTOWN ppb′			BLUE CHURCH BAY ppb′			LILY BAY (CONTROL) ppb′		
	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE
NORTHERN PIKE	10/12	94	34- 524	13/15	279	84- 704	0/ 2	N.D.***	
YELLOW PERCH	1/ 1	379		3/ 3	1716	1714-2223	1/ 1	44	
BROWN BULLHEAD	1/ 1	135		1/ 1	977		0/ 3	N.D.	
WHITE SUCKER	8/ 8	183	46- 798	1/ 3	519		N.S.****		
REDHORSE SUCKER	N.S.			4/ 4	798	237-2724	N.S.		
CARP	2/ 2	354	279- 448	N.S.			2/ 3	321	97-1061
BLACK CRAPPIE	2/ 2	76	44- 132	N.S.			0/ 1	N.D.	
SUNFISH	1/ 1	80		N.S			N.S.		
PUMPKIN-SEED	1/ 1	112		1/ 1	368		1/ 2	247	
LARGE-MOUTH BASS	1/ 1	240		N.S.			N.S.		
SMALL-MOUTH BASS	2/ 2	120	59- 244	N.S.			1/ 2	215	
ROCK BASS	N.S.			N.S.			0/ 1	N.D.	
SPOTTAIL SHINNER	N.S.			1/ 1	120		0/ 1	N.D.	

′ ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable total lead levels over number of fish samples analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead.

*** N.D.= nondetectable (<8 ppb).

**** N.S.= No sample.

TABLE 11:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN FISH CARCASS
MAITLAND (JOHNSTOWN)- 1983

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
NORTHERN PIKE	10/12	0	0	26	42	32
YELLOW PERCH	1/ 1	0	0	0	100	0
BROWN BULLHEAD	1/ 1	0	0	0	100	0
WHITE SUCKER	8/ 8	0	0	28	70	2
PUMPKINSEED	1/ 1	0	0	58	42	0
CARP	2/ 2	0	0	82	18	0
BLACK CRAPPIE	2/ 2	0	0	33	67	0
SUNFISH	1/ 1	0	0	52	48	0
LARGEMOUTH BASS	1/ 1	0	0	82	18	0
SMALLMOUTH BASS	2/ 2	0	0	80	20	0

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 12:

SUM OF TOTAL LEAD IN
FISH CARCASS
MAITLAND- 1983

SPECIES	JOHNSTOWN ppb'			BLUE CHURCH BAY ppb'			LILY BAY (CONTROL) ppb'		
	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE
NORTHERN PIKE	12/12	167	21- 607	15/15	578	57-3500	0/ 2	N.D.***	
YELLOW PERCH	1/ 1	661		3/ 3	2213	1764-3045	1/ 1	750	
BROWN BULLHEAD	1/ 1	384		1/ 1	1504		3/ 3	58	18- 204
WHITE SUCKER	8/ 8	417	52-4005	3/ 3	240	62- 693	N.S.****		
RED-HORSE SUCKER	N.S.			4/ 4	1028	237-3204	N.S.		
CARP	2/ 2	665	518- 854	N.S.			2/ 3	403	139-1167
BLACK CRAPPIE	2/ 2	258	227- 293	N.S.			0/ 1	N.D.***	
SUNFISH	1/ 1	106		N.S.			N.S.		
PUMPKIN-SEED	1/ 1	270		1/ 1	558		1/ 2	299	
LARGE-MOUTH BASS	1/ 1	320		N.S.			N.S.		
SMALL-MOUTH BASS	2/ 2	176	96- 324	N.S.			2/ 2	101	38- 267
ROCK BASS	N.S.			N.S.			1/ 1	390	
SPOTTAIL SHINNER	N.S.			1/ 1	475		1/ 1	370	

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable total lead levels over number of fish samples analysed.

** The geometric mean is calculated only from those samples containing detectable lead.

*** N.D.= nondetectable (<8 ppb).

**** N.S.= No sample.

TABLE 13:

TOTAL ALKYLLEAD IN
FISH MUSCLE
MAITLAND- 1983

SPECIES	JOHNSTOWN ppb′			BLUE CHURCH BAY ppb′			LILY BAY (CONTROL) ppb′		
	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE
NORTHERN PIKE	9/11	79	29- 211	14/15	128	19- 536	0/ 2	N.D.***	
YELLOW PERCH	1/ 1	450		2/ 2	2434	2036-2910	1/ 1	57	
BROWN BULLHEAD	2/ 2	346	270- 440	1/ 1	3585		0/ 3	N.D.	
WHITE SUCKER	8/ 8	303	144- 777	1/ 1	27		N.S.****		
REDHORSE SUCKER	N.S.			3/ 3	482	172-1025	N.S.		
CARP	2/ 2	405	405- 406	N.S.			3/ 3	99	29- 421
BLACK CRAPPIE	2/ 2	226	140- 364	N.S			N.S.		
SUNFISH	1/ 1	48		N.S.			N.S.		
PUMPKIN-SEED	1/ 1	71		N.S.			0/ 2	N.D.	
LARGEMOUTH BASS	1/ 1	50		N.S.			N.S.		
SMALLMOUTH BASS	1/ 1	30		N.S.			1/ 2	19	
ROCK BASS	N.S.			N.S.			0/ 1	N.D.	

′ ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead levels over number of fish samples analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead.

*** N.D.= nondetectable (<8 ppb).

**** N.S.= No sample.

TABLE 14:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN FISH MUSCLE
MAITLAND (JOHNSTOWN)- 1983

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	ET2
NORTHERN PIKE	9/11	0	0	1	91	7
YELLOW PERCH	1/ 1	0	0	0	88	12
BROWN BULLHEAD	2/ 2	0	0	3	82	15
WHITE SUCKER	8/ 8	0	0	5	85	10
CARP	2/ 2	0	12	43	45	0
BLACK CRAPPIE	2/ 2	0	0	8	91	1
SUNFISH	1/ 1	0	0	0	100	0
PUMPKIN-SEED	1/ 1	0	0	0	100	0
LARGEMOUTH BASS	1/ 1	0	0	36	64	0
SMALLMOUTH BASS	1/ 1	0	0	0	100	0

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 15:

SUM OF TOTAL LEAD IN
FISH MUSCLE
MAITLAND- 1983

SPECIES	JOHNSTOWN ppb′			BLUE CHURCH BAY ppb′			LILY BAY (CONTROL) ppb′		
	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE
NORTHERN PIKE	10/11	150	29-4466	14/15	221	49- 612	2/ 2	59	36- 98
YELLOW PERCH	1/ 1	556		2/ 2	2728	2123-3505	1/ 1	158	
BROWN BULLHEAD	2/ 2	396	341- 460	1/ 1	3799		1/ 3	16	
WHITE SUCKER	8/ 8	357	152-1140	1/ 1	180		N.S.****		
REDHORSE SUCKER	N.S			3/ 3	540	226-1080	N.S.		
CARP	2/ 2	615	602- 629	N.S.			3/ 3	260	131-525
BLACK CRAPPIE	2/ 2	269	184- 393	N.S.			N.S.		
SUNFISH	1/ 1	91		N.S.			N.S.		
PUMPKIN-SEED	1/ 1	233		N.S.			2/ 2	24	21- 27
LARGE-MOUTH BASS	1/ 1	180		N.S.			N.S.		
SMALL-MOUTH BASS	1/ 1	30		N.S.			1/ 2	71	
ROCK BASS	N.S.			N.S			0/ 1	N.D.***	

′ ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable total lead levels over number of fish samples analysed.

** The geometric mean is calculated only from those samples containing detectable lead.

*** N.D.= nondetectable (<8 ppb).

**** N.S.= No sample.

TABLE 16:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
FISH CARCASS
MAITLAND (BLUE CHURCH BAY)- 1983

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
NORTHERN PIKE	13/15	0	2	49	45	4
YELLOW PERCH	3/ 3	0	2	16	70	12
BROWN BULLHEAD	1/ 1	0	0	21	63	16
WHITE SUCKER	1/ 3	0	0	51	41	8
REDHORSE SUCKER	4/ 4	0	6	72	21	1
PUMPKIN-SEED	1/ 1	0	0	52	44	4
SPOTTAIL SHINNER	1/ 1	0	0	15	85	0

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 17:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
FISH MUSCLE
MAITLAND (BLUE CHURCH BAY)- 1983

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
NORTHERN PIKE	14/15	0	0	10	83	7
YELLOW PERCH	2/ 2	0	1	1	85	13
BROWN BULLHEAD	1/ 1	0	0	1	84	15
WHITE SUCKER	1/ 1	0	0	0	100	0
REDHORSE SUCKER	3/ 3	0	4	42	48	6

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 18:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN FISH CARCASS
MAITLAND (LILY BAY)- 1983

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
YELLOW PERCH	1/ 1	0	100	0	0	0
PUMPKIN-SEED	1/ 2	0	100	0	0	0
CARP	2/ 3	0	0	85	13	2
SMALL-MOUTH BASS	1/ 2	0	0	6	94	0

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 19:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN FISH MUSCLE
MAITLAND (LILY BAY)- 1983

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
YELLOW PERCH	1/ 1	0	0	0	63	37
CARP	3/ 3	0	5	49	34	12
SMALLMOUTH BASS	1/ 2	0	0	0	100	0

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 20:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
WHOLE FISH
LAKE ST. LAWRENCE- 1983

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
CARP	0/ 6	N.D.***		3/ 6	145	54- 651
YELLOW PERCH	1/ 4	95		1/ 4	95	

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8 ppb).

TABLE 21:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
WHOLE FISH
LAKE ST. LAWRENCE- 1983

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
YELLOW PERCH	1/ 4	0	34	0	66	0

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 22:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
WHOLE FISH
LAKE ST. FRANCIS- 1983

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
CARP	0/ 6	N.D.***		4/ 6	130	30- 368

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8 ppb).

TABLE 23:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
FISH CARCASS
ST. CLAIR RIVER (MARINE CITY)- 1983

SPECIES	ALKYLLEAD ppb′			TOTAL LEAD ppb′		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
WHITE SUCKER	3/ 3	413	40-3188	3/ 3	1153	151-3188
REDHORSE SUCKER	0/ 1	N.D.***		1/ 1	97	

′ ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8 ppb).

TABLE 24:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
FISH MUSCLE
ST. CLAIR RIVER (MARINE CITY)- 1983

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
WHITE SUCKER	3/ 3	753	193-3607	3/ 3	987	151-3758

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

TABLE 25:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
FISH MUSCLE AND CARCASS
ST. CLAIR RIVER (MARINE CITY)- 1983

SPECIES	ALKYLLEAD SPECIES							
	MUSCLE				CARCASS			
	N1/N2*	ET4	ET3	ET2	N1/N2*	ET4	ET3	ET2
WHITE SUCKER	3/ 3	52	40	8	3/ 3	22	70	8

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 26:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
FISH CARCASS
ST. CLAIR RIVER (ALGONAC)- 1983

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
WHITE SUCKER	1/ 5	224		4/ 5	83	20- 233
CARP	1/ 4	2836		4/ 4	264	26-2836
YELLOW PERCH	0/ 1	N.D.***		1/ 1	261	
NORTHERN PIKE	0/ 1	N.D.		0/ 1	N.D.	
BOWFIN	0/ 1	N.D.		1/ 1	45	
GARPIKE	0/ 1	N.D.		0/ 1	N.D.	

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8 ppb).

TABLE 27:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
FISH MUSCLE
ST. CLAIR RIVER (ALGONAC)- 1983

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
WHITE SUCKER	2/ 5	33	31- 36	3/ 5	121	61- 312
CARP	2/ 4	208	27-1601	3/ 4	544	55-1843
YELLOW PERCH	0/ 1	N.D.***		1/ 1	56	
NORTHERN PIKE	0/ 1	N.D.		1/ 1	108	
GARPIKE	1/ 1	79		1/ 1	88	

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8 ppb).

TABLE 28:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
FISH MUSCLE AND CARCASS
ST. CLAIR RIVER (ALGONAC)- 1983

SPECIES	ALKYLLEAD SPECIES									
	CARCASS					MUSCLE				
	N1/N2*	MeEt3	Et4	Et3	Et2	N1/N2*	MeEt3	Et4	Et3	Et2
WHITE SUCKER	1/ 5	100	0	0	0	2/ 5	0	0	80	20
CARP	1/ 4	0	78	22	0	2/ 4	0	32	48	20
GARPIKE	0/ 1	N.D.***				1/ 1	0	61	0	39

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

*** N.D.= nondetectable (<8ppb).

TABLE 29:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
FISH CARCASS
ST. CLAIR RIVER (LAKE HURON)- 1983

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
WHITE SUCKER	1/ 3	210		3/ 3	42	15- 245
CARP	1/ 1	323		1/ 1	670	

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

TABLE 30:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
FISH MUSCLE
ST. CLAIR RIVER (LAKE HURON)- 1983

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
WHITE SUCKER	1/ 3	31		3/ 3	71	46-102
CARP	1/ 1	627		1/ 1	687	

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

TABLE 31:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
FISH MUSCLE AND CARCASS
ST. CLAIR RIVER (LAKE HURON)- 1983

SPECIES	ALKYLLEAD SPECIES									
	CARCASS					MUSCLE				
	N1/N2*	MeEt3	Et4	Et3	ET2	N1/N2*	MeEt3	Et4	Et3	Et2
WHITE SUCKER	1/ 3	0	89	0	11	1/ 3	0	0	0	100
CARP	1/ 1	18	52	23	7	1/ 1	0	43	54	3

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 32:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
FISH CARCASS
ST. CLAIR RIVER (ST. CLAIR)- 1983

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
WHITE SUCKER	0/ 1	N.D.***		1/ 1	212	
CARP	0/ 1	N.D.		0/ 1	N.D.	
YELLOW PERCH	0/ 1	N.D.		1/ 1	25	
ALEWIFE	0/ 1	N.D.		1/ 1	17	

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8 ppb).

TABLE 33:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
FISH MUSCLE
ST. CLAIR RIVER (ST. CLAIR)- 1983

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
CARP	0/ 1	N.D.***		1/ 1	36	

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8 ppb).

TABLE 34:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
FISH CARCASS
ST. CLAIR RIVER (WALPOLE ISLAND)- 1983

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
CARP	1/ 1	34		1/ 1	162	
YELLOW PERCH	1/ 1	17		1/ 1	119	
CATFISH	1/ 1	154		1/ 1	332	

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geommetric mean is calculated only from those samples containing detectable alkyllead or total lead.

TABLE 35:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
FISH MUSCLE
ST. CLAIR RIVER (WALPOLE ISLAND)- 1983

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
CARP	1/ 1	121		1/ 1	292	
YELLOW PERCH	0/ 1	N.D.***		1/ 1	178	
CATFISH	1/ 1	114		1/ 1	153	

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8 ppb).

TABLE 36:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
FISH MUSCLE AND CARCASS
ST. CLAIR RIVER (WALPOLE ISLAND)- 1983

SPECIES	ALKYLLEAD SPECIES									
	CARCASS					MUSCLE				
	N1/N2*	MeEt3	Et4	Et3	Et2	N1/N2*	MeEt3	Et4	Et3	Et2
CARP	1/ 1	0	0	100	0	1/ 1	0	0	100	0
YELLOW PERCH	1/ 1	0	25	75	0	0/ 1	N.D.***			
CATFISH	1/ 1	0	78	22	0	1/ 1	0	23	62	13

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

*** N.D.= nondetectable (<8 ppb).

TABLE 37:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
FISH MUSCLE
MAITLAND- 1984

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
WHITE SUCKER	7/ 7	1115	728- 1774	7/ 7	1429	1061- 1991
YELLOW PERCH	5/ 5	622	374- 1499	5/ 5	1056	507- 1923
CARP	5/ 5	3333	1138-23143	5/ 5	3412	1138-23576
BROWN BULLHEAD	8/ 8	1505	632- 2172	8/ 8	1730	632- 2533

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

TABLE 38:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
FISH MUSCLE
MAITLAND- 1984

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
WHITE SUCKER	7/ 7	0	0	9	74	17
YELLOW PERCH	5/ 5	0	0	4	81	15
CARP	5/ 5	0	14	69	13	4
BROWN BULLHEAD	8/ 8	0	0	1	71	28

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 39:

SUM OF ALKYLLEAD IN
WHOLE FISH
MAITLAND- 1984

SPECIES	JOHNSTOWN ppb′			BLUE CHURCH BAY ppb′			LILY BAY (CONTROL) ppb′		
	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE
WHITE SUCKER	16/19	495	58-1300	9/ 9	411	80-2019	8/15	150	24-2326
REDHORSE SUCKER	7/10	321	106- 825	15/15	809	109-5039	1/ 8	155	
YELLOW PERCH	1/ 1	328		1/ 1	2524		0/ 3	N.D.***	
PUMPKIN-SEED	0/12	N.D.		7/11	150	53- 647	0/ 2	N.D.	
BROWN BULLHEAD	6/ 8	171	103- 398	2/ 2	294	233- 371	0/ 6	N.D.	
SMALL-MOUTH BASS	0/ 2	N.D.		N.S.****			0/ 7	N.D.	
ROCK BASS	2/ 6	165	75- 363	3/ 4	332	64-1057	N.S.		
CARP	5/ 6	304	134- 794	N.S.			N.S.		
BOWFIN	0/ 3	N.D.		N.S.			N.S.		

′ ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead levels over number of fish samples analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead.

*** N.D.= nondetectable (<8 ppb).

**** N.S.= No sample.

TABLE 40:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
WHOLE FISH
MAITLAND (JOHNSTOWN)- 1984

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
WHITE SUCKER	16/19	10	0	31	47	12
REDHORSE SUCKER	7/10	4	0	66	21	9
YELLOW PERCH	1/ 1	0	0	66	34	0
BROWN BULLHEAD	6/ 8	15	0	10	75	0
ROCK BASS	2/ 6	17	0	83	0	0
CARP	5/ 6	0	0	46	45	9

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 41:

SUM OF TOTAL LEAD IN
WHOLE FISH
MAITLAND- 1984

SPECIES	JOHNSTOWN ppb′			BLUE CHURCH BAY ppb′			LILY BAY (CONTROL) ppb′		
	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE
WHITE SUCKER	19/19	622	58-2553	9/ 9	582	80-2364	10/15	171	24-2326
REDHORSE SUCKER	9/10	338	127- 945	15/15	1195	330-5874	4/ 8	357	34-5461
YELLOW PERCH	1/ 1	1406		1/ 1	3570		1/ 3	192	
PUMPKIN-SEED	2/12	174	104- 292	7/11	241	89- 758	1/ 2	108	
BROWN BULLHEAD	7/ 8	161	60- 577	2/ 2	352	335- 371	3/ 6	225	160- 292
SMALL-MOUTH BASS	0/ 2	N.D.***		N.S.****			1/ 7	976	
ROCK BASS	2/ 6	427	363- 502	4/ 4	456	64-1147	N.S.		
CARP	5/ 6	374	134- 794	N.S.			N.S.		
BOWFIN	1/ 3	84		N.S.			N.S.		

′ ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable total lead levels over number of fish samples analysed.

** The geometric mean is calculated only from those samples containing detectable lead.

*** N.D.= nondetectable (<8 ppb).

**** N.S.= No sample.

TABLE 42:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN WHOLE FISH
MAITLAND (BLUE CHURCH BAY)- 1984

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
WHITE SUCKER	9/ 9	0	2	40	48	10
REDHORSE SUCKER	15/15	0	10	65	22	3
YELLOW PERCH	1/ 1	0	0	10	61	29
ROCK BASS	3/ 4	0	5	49	31	15
PUMPKIN-SEED	7/11	0	12	54	20	14
BROWN BULLHEAD	2/ 2	0	0	0	87	13

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 43:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
WHOLE FISH
MAITLAND (LILY BAY)- 1984

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
WHITE SUCKER	8/15	0	0	42	38	20
REDHORSE SUCKER	1/ 8	0	0	69	31	0

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 44:

TOTAL ALKYLLEAD AND SUM OF TOTAL LEAD IN
WHOLE FISH
ST. CLAIR RIVER (SOUTH OF STAG ISLAND)- 1984

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
WHITE SUCKER	8/ 8	138	18-1042	8/ 8	851	273-2525
YELLOW PERCH	0/ 1	N.D.***		1/ 1	256	
BROWN TROUT	0/ 1	N.D.		1/ 1	116	
WALLEYE	3/ 6	32	11- 174	6/ 6	73	38- 466

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8 ppb).

TABLE 45:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
WHOLE FISH
ST. CLAIR RIVER (SOUTH OF STAG ISLAND)- 1984

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
WHITE SUCKER	8/ 8	0	8	45	17	30
WALLEYE	3/ 6	0	0	73	27	0

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 46:

TOTAL ALKYLLEAD AND SUM OF TOTAL LEAD IN
WHOLE FISH
ST. CLAIR RIVER (ST. CLAIR RIVER AT CORUNNA)- 1984

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
CARP	1/ 2	283		2/ 2	162	70- 377
NORTHERN PIKE	4/ 4	158	25-1522	4/ 4	443	83-2885

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

TABLE 47:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
WHOLE FISH
ST. CLAIR RIVER (ST. CLAIR RIVER AT CORUNNA)- 1984

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
CARP	1/ 2	0	0	0	100	0
NORTHERN PIKE	4/ 4	0	0	72	21	7

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 48:

TOTAL ALKYLLEADS AND SUM OF TOTAL LEAD IN
WHOLE FISH
MAITLAND (BLUE CHURCH BAY)- 1986

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
CARP	5/10	988	201-12234	10/10	243	25-13616
YELLOW PERCH	0/ 5	N.D.***		5/ 5	72	45- 91
WHITE SUCKER	3/ 5	230	108- 491	4/ 5	423	76- 1025
BROWN BULLHEAD	3/ 5	54	19- 385	5/ 5	314	135- 975

' ppb= ug alkyllead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8 ppb).

TABLE 49:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
WHOLE FISH
MAITLAND (BLUE CHURCH BAY)- 1986

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
CARP	5/10	0	18	68	13	1
WHITE SUCKER	3/ 5	0	0	25	61	14
BROWN BULLHEAD	3/ 5	0	0	16	72	12

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 50:

CONCENTRATIONS OF ALKYLLEADS AND TOTAL LEAD
IN WHOLE FISH
MAITLAND (BLUE CHURCH BAY)-- 1987

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
CARP	4/6	120	24-4263	6/6	406	76-6599
BROWN BULLHEAD	1/3	149		3/3	630	319-1075
WHITE SUCKER	1/4	50		4/4	513	358- 812
YELLOW PERCH	0/3	N.D.***		3/3	445	232-1449

' ppb= ug alkyllead or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8ppb).

TABLE 51:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN WHOLE FISH
MAITLAND (BLUE CHURCH BAY)- 1987

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
CARP	4/6	0	5	76	13	6
BROWN BULLHEAD	1/3	0	0	0	66	34
WHITE SUCKER	1/4	0	0	0	100	0
YELLOW PERCH	0/3	0	0	0	0	0

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 52:

CONCENTRATIONS OF ALKYLLEAD AND TOTAL LEAD
IN CARP TISSUE
MAITLAND (BLUE CHURCH BAY)-- 1987

TISSUE	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
FATTY TISSUE	1/3	512		3/3	154	58- 635
INTESTINES	3/3	116	63-300	3/3	317	186- 739
FILLET	1/3	350		3/3	134	62- 503
LIVER	3/3	161	44-867	3/3	418	187-1463

' ppb= ug alkyllead or total lead per Kg (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

TABLE 53:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
CARP TISSUE
MAITLAND (BLUE CHURCH BAY)- 1987

TISSUE	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
FATTY TISSUE	1/3	0	0	92	4	4
INTESTINES	3/3	0	0	42	36	22
FILLET	1/3	0	0	54	37	9
LIVER	3/3	0	0	53	28	19

* Number of tissue samples with detectable alkyllead levels over number of fish analysed.

TABLE 54:

CONCENTRATIONS OF ALKYLLEAD AND TOTAL LEAD
IN WHOLE FISH
ST. CLAIR RIVER (STAG ISLAND)- 1987

SPECIES	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
CARP	2/7	110	51-236	7/7	193	73-499
WHITE SUCKER	1/2	41		2/2	257	192-345
WALLEYE	0/2	N.D.***		2/2	137	124-152

' ppb= ug alkyllead or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8ppb).

TABLE 55:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
WHOLE FISH
ST. CLAIR RIVER (STAG ISLAND)- 1987

SPECIES	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	MeEt3	Et4	Et3	Et2
CARP	2/7	0	0	41	50	9
WHITE SUCKER	1/2	0	0	0	100	0
WALLEYE	0/2	0	0	0	0	0

* Number of fish samples with detectable alkyllead levels over number of fish analysed.

TABLE 56:

CONCENTRATIONS OF TOTAL ALKYLLEADS
IN SEDIMENT, CLAMS AND MACROPHYTES
MAITLAND- 1982

SAMPLE	BLUE CHURCH BAY ppb'			DUPONT CHEMICAL PLANT ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRCIC MEAN**	RANGE
SEDIMENT	0/2	N.D.***		2/2	703	329- 1503
CLAMS	N.S.****			0/1	N.D.	
MACROPHYTES	0/1	N.D.		2/2	2092	200-21888

NOTE site locations are indicated on map # 3.

' ppb= ug alkyllead per Kg sample weight (wet weight).

* Number of samples with detectable alkyllead levels over number of samples analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead.

*** N.D.= nondetectable.

**** N.S.= No sample.

TABLE 57:

CONCENTRATIONS OF TOTAL LEADS
IN SEDIMENT, CLAMS AND MACROPHYTES
MAITLAND- 1982

SAMPLE	BLUE CHURCH BAY ppb'			DUPONT CHEMICAL PLANT ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
SEDIMENT	2/2	4540	3808-5414	2/2	>5911	5911- ?
CLAMS	N.S.***			1/1	280	
MACROPHYTES	1/1	6796		2/2	19169	4527-81170

NOTE site locations are indicated on map # 3.

' ppb= ug (alkyllead + inorganic lead) per Kg sample weight (wet weight).

* Number of samples with detectable total lead levels over number of samples analysed.

** The geometric mean is calculated only from those samples containing detectable total lead.

*** N.S.= No sample.

? Level to high (off scale).

TABLE 58:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
SEDIMENT AND MACROPHYTES
MAITLAND (DUPONT CHEMICAL PLANT)- 1982

SAMPLE	N1/N2*	ALKYLLEAD SPECIES					
		Me3Et	Me2Et2	MeEt3	Et4	Et3	Et2
SEDIMENT	2/2	0	0	8	81	10	1
MACROPHYTES	2/2	0	5	16	75	3	1

NOTE site locations are indicated on map # 3.

* Number of samples with detectable alkyllead levels over number of samples analysed.

TABLE 59:

CONCENTRATIONS OF TOTAL ALKYLLEADS
IN SEDIMENT, CLAMS AND MACROPHYTES
MAITLAND- 1983

SAMPLE	BLUE CHURCH BAY					
	SITE #1 ppb′			SITE #2 ppb′		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
SEDIMENT	4/4	220	152-376	4/4	216	76-706
CLAMS	N.S.***			1/1	335	
MACRO-PHYTES	N.S.			N.S.		

NOTE site locations are indicated on map # 4.

′ ppb= ug alkyllead per Kg sample weight (wet weight).

* Number of samples with detectable alkyllead levels over number of samples analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead.

*** N.S.= No sample.

TABLE 60:

CONCENTRATIONS OF TOTAL ALKYLLEADS
IN SEDIMENT, CLAMS AND MACROPHYTES
MAITLAND- 1983

SAMPLE	BLUE CHURCH BAY SITE #3 ppb′			LILY BAY (CONTROL) ppb′		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
SEDIMENT	4/4	264	49-665	4/4	219	131-428
CLAMS	N.S.****			N.S.****		
MACRO-PHYTES	1/4	194		0/7	N.D.***	

NOTE site locations are indicated on map # 4.

′ ppb= ug alkyllead per Kg sample weight (wet weight).

* Number of samples with detectable alkyllead levels over number of samples analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead.

*** N.D.= nondetectable.

**** N.S.= No sample.

TABLE 61:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN SEDIMENT
MAITLAND- 1983

LOCATION	N1/N2*	ALKYLLEAD SPECIES			
		Me2Et2	Me3	MeEt3	Et4
BLUE CHURCH BAY -SITE #1	4/4	27	30	16	27
BLUE CHURCH BAY -SITE #2	4/4	42	34	24	0
BLUE CHURCH BAY -SITE #3	4/4	44	35	9	12
LILY BAY -CONTROL	4/4	45	37	18	0

NOTE site locations are indicated on map # 4.

* Number of samples with detectable alkyllead levels over number of samples analysed.

TABLE 62:

CONCENTRATION OF TOTAL LEADS
IN SEDIMENT, CLAMS AND MACROPHYTES
MAITLAND- 1983

SAMPLE	BLUE CHURCH BAY					
	SITE #1 ppb'			SITE #2 ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
SEDIMENT	4/4	629	421-923	4/4	237	76-706
CLAMS	N.S.***			1/1	1357	
MACRO-PHYTES	N.S.			N.S.		

NOTE site locations are indicated on map # 4.

' ppb= ug (alkyllead + inorganic lead) per Kg sample weight (wet weight).

* Number of samples with detectable total lead levels over number of samples analysed.

** The geometric mean is calculated only from those samples containing detectable total lead.

*** N.S.= No sample.

TABLE 63:

CONCENTRATION OF TOTAL LEADS
IN SEDIMENT, CLAMS AND MACROPHYTES
MAITLAND- 1983

SAMPLE	BLUE CHURCH BAY			LILY BAY		
	SITE #3 ppb'			CONTROL ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
SEDIMENT	4/4	811	448-1332	4/4	237	161-428
CLAMS	N.S.***			N.S.		
MACRO-PHYTES	4/4	2515	1932-3393	7/7	315	181-855

NOTE site locations are indicated on map # 4.

' ppb= ug (alkyllead + inorganic lead) per Kg sample weight (wet weight).

* Number of samples with detectable total lead levels over number of samples analysed.

** The geometric mean is calculataed only from those samples containing detectable total lead.

*** N.S.= No sample.

TABLE 64:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
CLAMS
MAITLAND- 1983

LOCATION	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	Me3	MeEt3	Et4	Et3
BLUE CHURCH BAY -SITE # 2	1/1	0	0	0	16	84

NOTE site locations are indicated on map # 4.

* Number of samples with detectable alkyllead levels over number of samples analysed.

TABLE 65:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN MACROPHYTES
MAITLAND- 1983

LOCATION	N1/N2*	ALKYLLEAD SPECIES				
		Me2Et2	Me3	MeEt3	Et4	Et3
BLUE CHURCH BAY -SITE # 3	1/4	0	100	0	0	0

NOTE site locations are indicated on map # 4.

* Number of samples with detectable alkyllead levels over number of samples analysed.

TABLE 66:

CONCENTRATIONS OF ALKYLLEAD AND TOTAL LEAD
IN WATER
IN ST. LAWRENCE RIVER--- 1983

LOCATION	SAMPLE	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
		N1/N2*	GEOM. RANGE**	RANGE	N1/N2*	GEOM. RANGE**	RANGE
LILY BAY	SUBSURFACE	0/1	N.D.***		1/1	1.74	
DUPONT	SUBSURFACE	3/3	0.33	0.20-0.47	3/3	2.33	1.76-2.95
	SURFACE MICROLAYER	3/3	0.90	0.43-1.91	3/3	6.77	3.79-9.39
BLLUE CHURCH BAY	SUBSURFACE	3/3	0.09	0.08-0.12	3/3	1.82	1.38-3.14
	SURFACE MICROLAYER	1/1	0.08		1/1	3.55	

' ppb= ug alkyllead per L of water.

* Number of water samples with detectable alkyllead or total lead levels over number of water samples analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable.

TABLE 67:

CONCENTRATIONS OF ALKYLLEAD AND TOTAL LEAD
IN WATER
ST. CLAIR RIVER--- 1983

WATER SAMPLE	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
SUBSURFACE (1m down)	1/6	0.42		6/6	1.44	1.02-2.67
SURFACE MICROLAYER	1/6	0.68		6/6	2.40	0.84-9.22

' ppb= ug alkyllead per L of water.

* Number of water samples with detectable alkyllead or total lead levels over number of water samples analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

TABLE 68:

CONCENTRATIONS OF TOTAL ALKYLLEADS AND TOTAL LEADS
IN SEDIMENT AND MACROPHYTES
BLUE CHURCH BAY- 1984

SAMPLE	ALKYLLEADS ppb'			TOTAL LEADS ppb		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2	GEOMETRIC MEAN	RANGE
SEDIMENT	13/15	89	10-245	15/15	7340	1869-15700
MACROPHYTES	5/13	53	6-429	13/13	1052	71- 4778

' ppb= ug alkyllead per Kg sample weight (wet weight).

* Number of samples with detectable alkyllead levels over number of samples analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead.

TABLE 69:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN SEDIMENT AND MACROPHYTES BLUE CHURCH BAY- 1984

SAMPLE	N1/N2*	ALKYLLEAD SPECIES			
		Me3	Et4	Et3	Et2
SEDIMENT	13/15	0	55	43	2
MACROPHYTES	5/13	17	39	6	38

* Number of samples with detectable alkyllead levels over number of samples analysed.

TABLE 70:

CONCENTRATIONS OF TOTAL ALKYKLLEADS
IN SEDIMENT
MAITLAND (BLUE CHURCH BAY)- 1986

SITE #1 ppb′			SITE #2 ppb′			SITE #3 ppb′			SITE #4 ppb′		
N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE
0/2	N.D.***		0/2	N.D.		0/3	N.D.		1/2	14	

NOTE site locations are indicated on map # 6.
SITE #1= WELLS CREEK
SITE #2= DUPONT PLANT
SITE #3= BLUE CHURCH BAY
SITE #4= BLUE CHURCH BAY (EAST END ACROSS FROM CHURCH)

′ ppb= ug alkyllead per Kg sample weight (wet weight).

* Number of samples with detectable alkyllead levels over number of samples analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead.

*** N.D.= nondetectable.

TABLE 71:

PERCENTAGE OF ALKYLLEAD SPECIES DISTRIBUTION IN
SEDIMENT
MAITLAND- 1986

LOCATION	N1/N2	ALKYLLEAD SPECIES		
		Et4	Et3	Et2
BLUE CHURCH BAY- east end across from church	1/2	0	0	100

NOTE site locations are indicated on map # 6.

* Number of samples with detectable alkyllead levels over number of samples analysed.

TABLE 72:

CONCENTRATIONS OF TOTAL LEADS
IN SEDIMENT
MAITLAND (BLUE CHURCH BAY)- 1986

SITE #1 ppb′			SITE #2 ppb′			SITE #3 ppb′			SITE #4 ppb′		
N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE	N1/N2*	GEO. MEAN**	RANGE
2/2	156	136-180	2/2	510	425-612	3/3	195	177-221	2/2	225	214-305

NOTE site locations are indicated on map # 6.
SITE #1= WELLS CREEK
SITE #2= DUPONT PLANT
SITE #3= BLUE CHURCH BAY
SITE #4= BLUE CHURCH BAY (EAST END ACROSS FROM CHURCH)

′ ppb= ug (alkyllead + inorganic lead) per Kg sample weight (wet weight).

* Number of samples with detectable total lead levels over number of samples analysed.

** The geometric mean is calculated only from those samples containing detectable total lead.

SUMMARY

Alkylleads were analyzed in fish samples from Maitland area from 1981 to 1987 and were summarized in Tables 73-81.

1. The levels of alkylleads fell from 1981 to 1987. For example, the levels in carp declined from 4207 ppb in 1981 to 1976 ppb in 1982 and finally to 120 ppb in 1987.

2. The most contaminated fish species were carp, yellow perch, white sucker and brown bullhead while bass, pike, redhorse sucker and pumkinseed were the least contaminated.

3. Alkylleads represented 0-100% of total lead, depending on the location and species sampled. However most fish in the contaminated area contained 50-75% of total lead as alkylleads.

4. The most common alkyllead species in fish were tetra- and triethyllead forms.

5. There was a clear upstream and downstream distribution of alkyllead residues when mean levels were compared. Higher levels were found in fish near or downstream from the alkyllead manufacturer than in fish from upstream.

6. Alkyllead levels were consistently lower in muscle and carcass samples but were higher in fatty tissues and intestines when compared to the whole fish.

7. Alkyllead compounds could be measured in clams, macrophytes, sediment and water only from area downstream from the alkyllead manufacturer.

8. Macrophytes also showed gradual decline in alkylleads from 2092 ppb in 1982 to 53 ppb in 1984. Similarly the levels in sediments decreased from 703 ppb in 1982 to below detection (<15 ppt) in 1986.

9. Surface microlayer and subsurface water samples were analyzed only in 1983. Alkylleads were detected in subsurface water at 0.33 ppb and 0.09 ppb in samples collected near the alkyllead manufacturer and 2 Km downstsream respectively. Surface microlayer samples were about 3X higher in alkylleads than the subsurface water samples near the manufacturer.

10. Fish from St. Clair River area in 1983, 84 and 87 were determined (Tables 82-84). The levels of alkylleads were much lower than the same fish species from Maitland area.

11. Carp, sucker and northern pike had higher levels of alkylleads than yellow perch, walleye, bowfin and garpike. In general, carcass samples contained higher alkyllead levels than muscle samples.

12. Only 1 of 6 subsuface water samples from St. Clair River in 1983 contained detectable alkyllead level (0.42 ppb). Surface microlayer had a slightly higher level (0.68 ppb).

13. Fish from Lake St. Lawrence and Lake St. Francis contained very little alkylleads. Only 1 of 4 yellow perch had 95 ppb alkylleads while 12 carp samples had nondectable level.

TABLE 73:

CONCENTRATIONS OF ALKYLLEADS AND TOTAL LEAD
IN CARP FROM MAITLAND AREA (1981-1987)

YEAR	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN **	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
1981	12/12	4207	190-138999	N.S.****		
1982	5/ 6	1976	102- 61713	6/ 6	2361	160-66434
1983	2/ 2	804	87- 7429	2/ 2	1812	278-11809
1984	5/ 6	304	134- 794	5/ 6	374	134- 794
1986	5/10	988	201- 12234	10/10	243	25-13616
1987	4/ 6	120	24- 4263	6/ 6	406	76- 6599

NOTE--1981 AND 1982---(WHOLE FISH - INTESTINES)
1983, 1984, 1986 AND 1987---(WHOLE FISH)

' ppb= ug alkyllead and/or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated from those samples containing detectable alkyllead or total lead.

*** N.S.= No sample.

TABLE 74:

CONCENTRATIONS OF ALKYLLEADS AND TOTAL LEAD
IN YELLOW PERCH FROM MAITLAND AREA (1981-1987)

YEAR	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
1981	N.S.****			N.S.		
1982	5/ 5	1994	912-5415	5/ 5	3682	2718-6759
1983	5/ 5	1778	1101-2318	5/ 5	2646	1937-3430
1984	2/ 5	910	328-2524	3/ 5	988	192-3570
1986	0/ 5	N.D.***		5/ 5	72	45- 91
1987	0/ 3	N.D.		3/ 3	445	232-1449

NOTE---1981 AND 1982---(WHOLE FISH - INTESTINES)
1983, 1984, 1986 AND 1987---(WHOLE FISH)

' ppb= ug alkyllead and/or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8 ppb).

**** N.S.= No sample.

TABLE 75

CONCENTRATIONS OF ALKYLLEAD AND TOTAL LEAD
IN WHITE SUCKERS FROM MAITLAND AREA (1981-1987)

YEAR	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN **	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
1981	8/10	216	24- 1221	N.S.***		
1982	3/ 5	1747	717- 3187	4/ 5	1220	167- 5036
1983	5/ 5	3725	1245-10553	5/ 5	4920	1668-12785
1984	33/43	352	24- 2326	38/43	436	24- 2553
1986	3/ 5	230	108- 491	4/ 5	423	76- 1025
1987	1/ 4	50		4/ 4	513	358- 812

NOTE---1981 AND 1982---(WHOLE FISH - INTESTINES)
1983, 1984, 1986 AND 1987---(WHOLE FISH)

' ppb= ug alkyllead and/or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

**** N.S.= No sample.

TABLE 76:

CONCENTRATIONS OF ALKYLLEAD AND TOTAL LEAD
IN BROWN BULLHEAD FROM MAITLAND AREA (1981-1987)

YEAR	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
1981	N.S.****			N.S.		
1982	2/ 3	1135	553-2329	2/ 3	1135	553-2329
1983	N.S.			N.S.		
1984	8/16	196	103- 398	12/16	199	60- 577
1986	3/ 5	54	19- 385	5/ 5	314	135- 975
1987	1/ 3	149		3/ 3	630	319-1075

NOTE--1981 AND 1982---(WHOLE FISH - INTESTINES)
1983, 1984, 1986 AND 1987---(WHOLE FISH)

' ppb= ug alkyllead and/or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

**** N.S.= No sample

TABLE 77

CONCENTRATIONS OF ALKYLLEADS AND TOTAL LEAD
IN SMALL MOUTH BASS FROM MAITLAND AREA (1981-1987)

YEAR	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
1981	N.S.****			N.S.		
1982	4/ 4	1972	890-3115	4/ 4	2162	991-3397
1983	1/ 1	1223		1/ 1	1629	
1984	0/ 9	N.D.***		1/ 9	976	
1986	N.S.			N.S.		
1987	N.S.			N.S.		

NOTE--1981 AND 1982---(WHOLE FSIH - INTESTINES)
1983, 1984 AND 1987---(WHOLE FISH)

' ppb= ug alkyllead and/or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8 ppb).

**** N.S.= No sample.

TABLE 78

CONCENTRATIONS OF ALKYLLEADS AND TOTAL LEAD
IN ROCK BASS FROM MAITLAND AREA (1981-1987)

YEAR	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
1981	N.S.****			N.S.		
1982	0/ 2	N.D.***		2/ 2	446	312- 638
1983	3/ 3	163	82- 428	3/ 3	631	428-1058
1984	5/10	251	64-1057	6/10	446	64-1147
1986	N.S.			N.S.		
1987	N.S.			N.S.		

NOTE--1981 AND 1982---(WHOLE FISH-INTESTINES)
1983, 1984, 1986 AND 1987---(WHOLE FISH)

' ppb= ug alkyllead and/or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

*** N.D.= nondetectable (<8 ppb).

**** N.S.= No sample.

TABLE 79:

CONCENTRATIONS OF ALKYLLEADS AND TOTAL LEAD
IN NORTHERN PIKE FROM MAITLAND AREA (1981-1987)

YEAR	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
1981	5/ 6	173	30- 1384	N.S.****		
1982	4/ 5	287	55- 1324	5/ 5	1004	506-2511
1983	3/ 3	436	154- 1113	3/ 3	822	472-1315
1984	N.S.			N.S.		
1986	N.S			N.S.		
1987	N.S.			N.S.		

NOTE---1981 AND 1982---(WHOLE FISH-INTESTINES)
1983, 1984, 1986 AND 1987---(WHOLE FISH)

' ppb= ug alkyllead and/or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

**** N.S.= No sample.

TABLE 80

CONCENTRATIONS OF ALKYLLEADS AND TOTAL LEAD
IN RED HORSE SUCKER FROM MAITLAND AREA (1981-1987)

YEAR	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
1981	N.S.****			N.S.		
1982	5/ 5	721	189-2042	5/ 5	721	189-2042
1983	1/ 1	361		1/ 1	548	
1984	23/33	587	106-5039	28/33	670	34-5874
1986	N.S.			N.S.		
1987	N.S.			N.S.		

NOTE--1981 AND 1982---(WHOLE FISH-INTESTINES)
1983, 1984, 1986 AND 1987---(WHOLE FISH)

' ppb= ug alkyllead and/or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkyllead or total lead.

**** N.S.= No sample.

TABLE 81

CONCENTRATIONS OF ALKYLLEADS AND TOTAL LEAD
IN PUMPKINSEED FROM MAITLAND AREA (1981-1987)

YEAR	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
1981	N.S.***			N.S.		
1982	3/ 5	567	89-1882	5/ 5	812	210-3321
1983	3/ 5	413	220- 609	5/ 5	448	218- 977
1984	7/25	150	53- 647	10/25	209	89- 758
1986	N.S			N.S.		
1987	N.S.			N.S.		

NOTE---1981 AND 1982---(WHOLE FISH-INTESTINES)
1983, 1984 1986 AND 1987---(WHOLE FISH)

' ppb=ug alkyllead and/or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated only from those samples containing detectable alkylead or total lead.

*** N.S.= No sample.

TABLE 82:

CONCENTRATIONS OF ALKYLLEADS AND TOTAL LEAD
IN CARP FROM ST. CLAIR RIVER AREA (1983-1987)

YEAR	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
1983-MUSCLE	4/7	239	27-1601	6/7	324	36-1843
1983-CARCASS	3/7	315	34-2836	6/7	285	26-2836
1984-WHOLE FISH	1/2	283		2/2	162	70- 377
1987-WHOLE FISH	2/7	110	51- 236	7/7	193	73- 499

' ppb= ug alkyllead and/or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated from those samples containing detectable alkyllead or total leads.

TABLE 83:

CONCENTRATIONS OF ALKYLLEADS AND TOTAL LEAD
IN WHITE SUCKERS FROM ST. CLAIR RIVER AREA (1983-1987)

YEAR	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
1983-MUSCLE	6/11	157	31-3607	9/11	203	46-3758
1983-CARCASS	5/12	319	40-3188	11/12	154	15-3188
1984-WHOLE FISH	8/ 8	138	18-1042	8/ 8	851	273-2528
1987-WHOLE FISH	1/ 2	41		2/ 2	263	200- 345

' ppb= ug alkyllead and/or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated from those samples containing detectable alkyllead or total leads.

TABLE 84

CONCENTRATIONS OF ALKYLLEADS AND TOTAL LEAD
IN WALLEYE FROM ST. CLAIR RIVER AREA (1983-1987)

YEAR	ALKYLLEAD ppb'			TOTAL LEAD ppb'		
	N1/N2*	GEOMETRIC MEAN**	RANGE	N1/N2*	GEOMETRIC MEAN**	RANGE
1983-MUSCLE	N.S.****			N.S.		
1983-CARCASS	N.S.			N.S.		
1984-WHOLE FISH	3/6	33	11-174	6/6	73	38-466
1987-WHOLE FISH	0/2	N.D.***		2/2	137	124-152

' ppb= ug alkyllead and/or total lead per Kg fish (wet weight).

* Number of fish samples with detectable alkyllead or total lead levels over number of fish analysed.

** The geometric mean is calculated from those samples containing detectable alkyllead or total leads.

*** N.D.= nondetectable (<8ppb).

**** N.S.= No sample.

REFERENCES

Chau, Y.K., and P.T.S. Wong. 1984. Organic lead in the aquatic environment. In Biological Effects of Organolead Compounds. P. Grandjean (Ed.), Chapter 4, p 21-31. CRC Press.

Chau, Y.K., P.T.S. Wong, O. Kramar, G.A. Bengert, R.B. Cruz, J.O. Kinrade, J. Lye and J.C. Van Loon. 1980. Occurrence of tetraalkyllead compounds in the aquatic environment. Bull. Environ. Contam. Toxicol. 24: 265-269.

Chau, Y.K., P.T.S. Wong, G.A. Bengert, J.L. Dunn and B. Glen. 1985. Occurrence of alkyllead compounds in the Detroit and St. Clair Rivers. J. Great Lakes Res. 11: 313-319.

De Jonghe, W.R.A., W.E. Van Mol and F.C. Adams. 1983. Determination of trialkyllead compounds in water by extraction and graphite furnace atomic absorption spectrometry. Anal. Chem. 55: 1050-1054.

Harrison, R.M., and D.P.H. Laxen. 1978. Sink processes for tetraalkyllead compounds in the atmosphere. Environ. Sci. Technol. 12: 1384-1391.

Hewitt, C.N., and R.M. Harrison. 1986. Organolead compounds in the enviornment. In Organometallic Compounds in the Environment. P.J. Craig (Ed), Chapter 4, p 160-197. Longman, England.

Hodson, P.V. 1986. The effects on aquatic biota of exposure to lead. Pathways, Cycling and Transformation of Lead in the Enviromnent. P.M. Stoke (Ed.), p 203-224, Royal Society of Canada.

Hodson, P.V., B.R. Blunt and D.M. Whittle. 1983. Suitability of a biochemical method for assessing the exposure of feral fish to lead. In Aquatic Toxicology and Hazard Assessment. Sixth Symposium ASTM STP 902, W.E. Bishop, R.D. Cardwell and B.B. Heidolph (Eds), p 389-405. American Society for Testing and Materials, Philadelphia.

Jarvie, A.W.P., R.N. Markall and H.R. Potter. 1981. Decomposition of organolead compounds in aqueous systems. Environ. Res. 25: 241-249.

Mor, E.D., and A.M. Beccaria. 1977. A dehydration method to avoid loss of trace elements in biological samples. In Proc. Int. Experts Discussion on Lead- Occurrence, Fate and Pollution in the Marine Environment. Rovinj, Yugoslavia.

Royal Society of Canada. 1986. Lead in the Canadian Environment: Science and Regulation. The Commission on Lead in the Environment. 374 pages. Ottawa.

Shapiro, H., and F.W. Frey. 1968. The Organic Compounds of Lead, p 407-426, Wiley, N.Y.

Sirota, G.R., and J.F. Uthe. 1977. Detection of tetraalkyllead compounds in biological materials. Anal. Chem. 49: 823-825.

Wong, P.T.S., Y.K. Chau and P.L. Luxon. 1975. Methylation of lead in the environment. Nature 253: 263-264.

ACKNOWLEDGEMENT

We thank G.A. Bengert (Dept. Environment, National Water Research Institute) for analyses of water samples and advice and assistance in laboratory techniques; W. H. Hyatt, M. J. Kier, O. Kramar, B. Blunt, K. Ralph (Dept. Fisheries and Oceans, Burlington) and G. Shum (Dept. Fisheries and Oceans, Inspection Services Branch, Toronto) for collecting and preparing the fish samples.

APPENDIX=

a) Maps of sampling sites-

1) St. Lawrence River sampling sites (fish)

2) St. Clair River sampling sites (fish)

3) 1982--St. Lawrence River sampling sites (sediments, clams and macrophytes)

4) 1983--St. Lawrence River sampling sites (sediments, clams, macrophytes and water)

5) 1984--St. Lawrence River sampling sites (sediments and macrophytes)

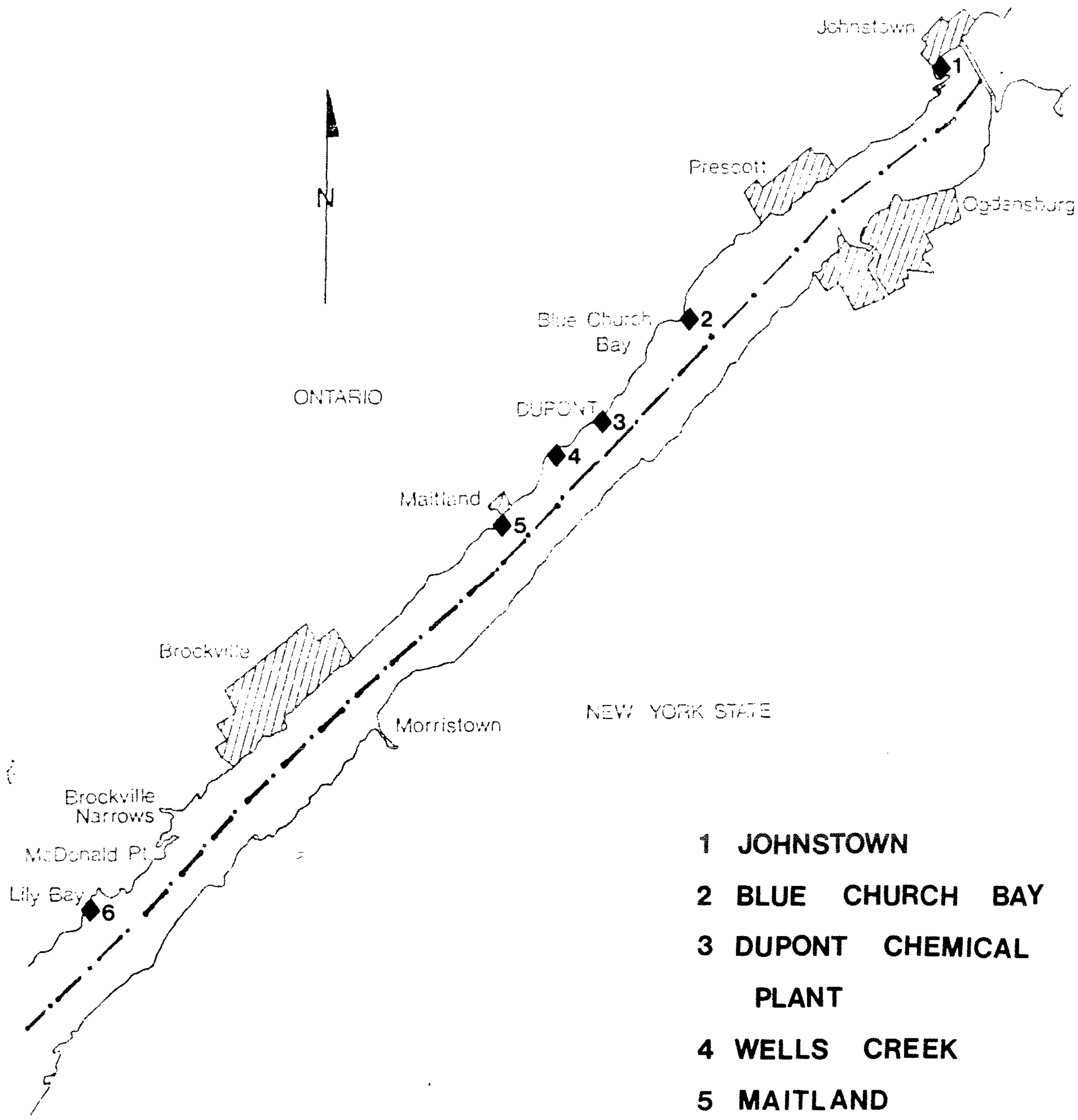
6) 1986--St. Lawrence River sampling sites (sediments)

b) Summary of alkyllead sampling= year, location, type of samples and agency collecting the samples

c) Computer codes and detailed alkyllead data in fish samples

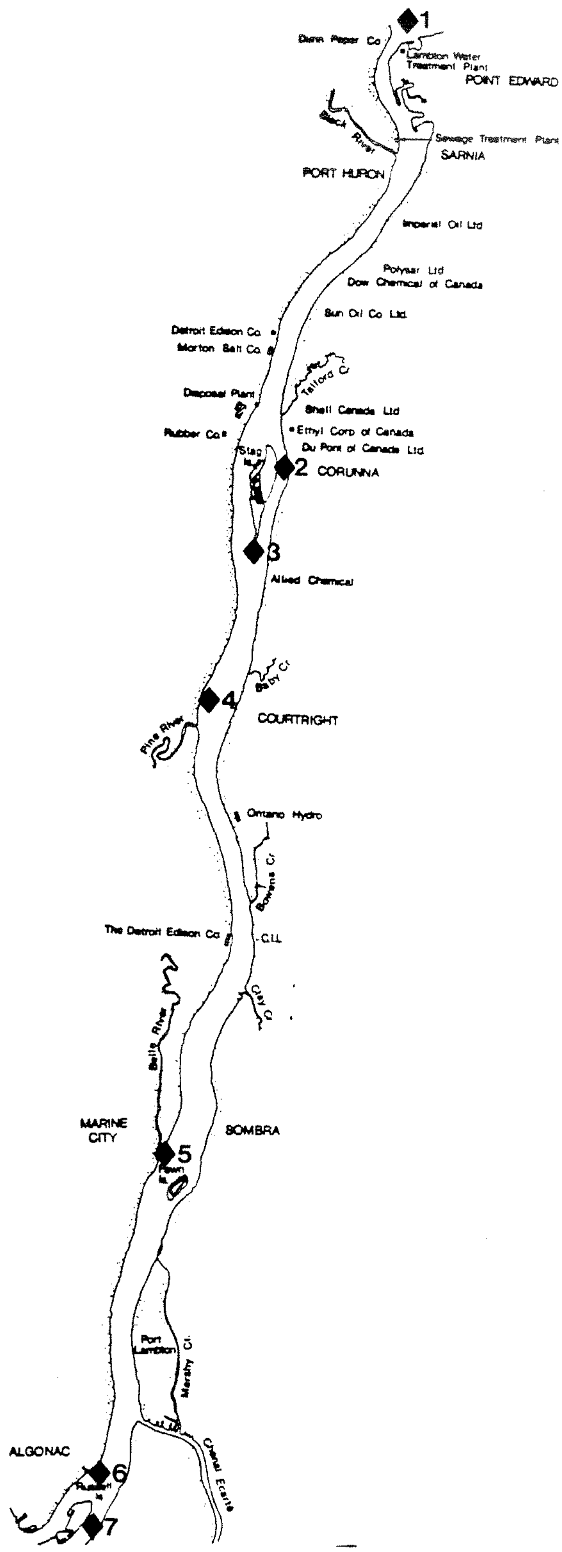
d) Computer codes and detailed alkyllead data in clams, macrophytes, sediment and water samples

MAP 1– ST. LAWRENCE RIVER: SAMPLING SITES (FISH)



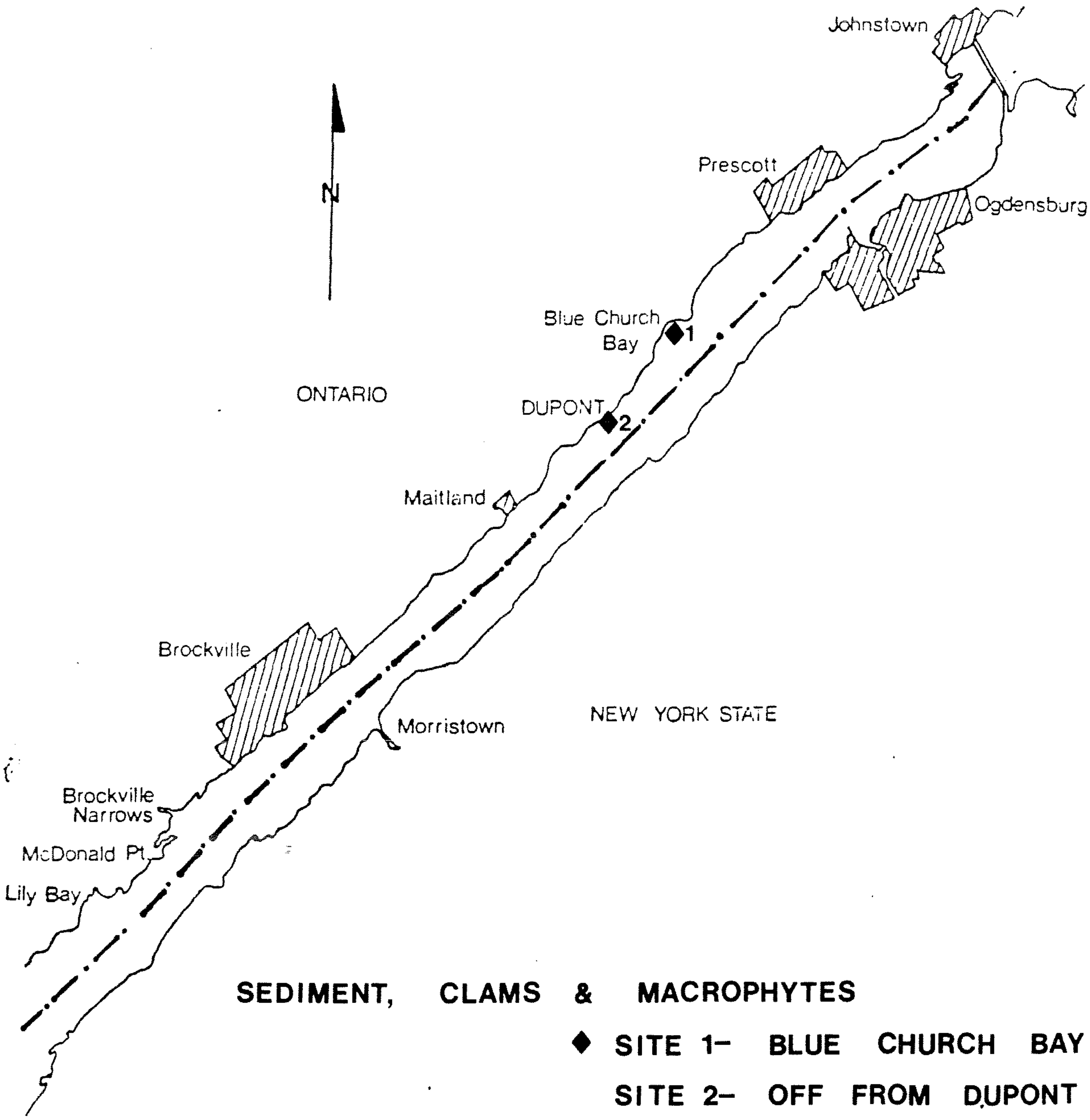
1 JOHNSTOWN
2 BLUE CHURCH BAY
3 DUPONT CHEMICAL PLANT
4 WELLS CREEK
5 MAITLAND
6 LILY BAY

MAP 2— ST. CLAIR RIVER: SAMPLING SITES (FISH)



1 LAKE HURON
2 CORUNNA
3 SOUTH OF STAG IS.
4 ST. CLAIR
5 MARINE CITY
6 ALGONAC
7 WALPOLE IS.

MAP 3– 1982 ST. LAWRENCE RIVER: SAMPLING SITES

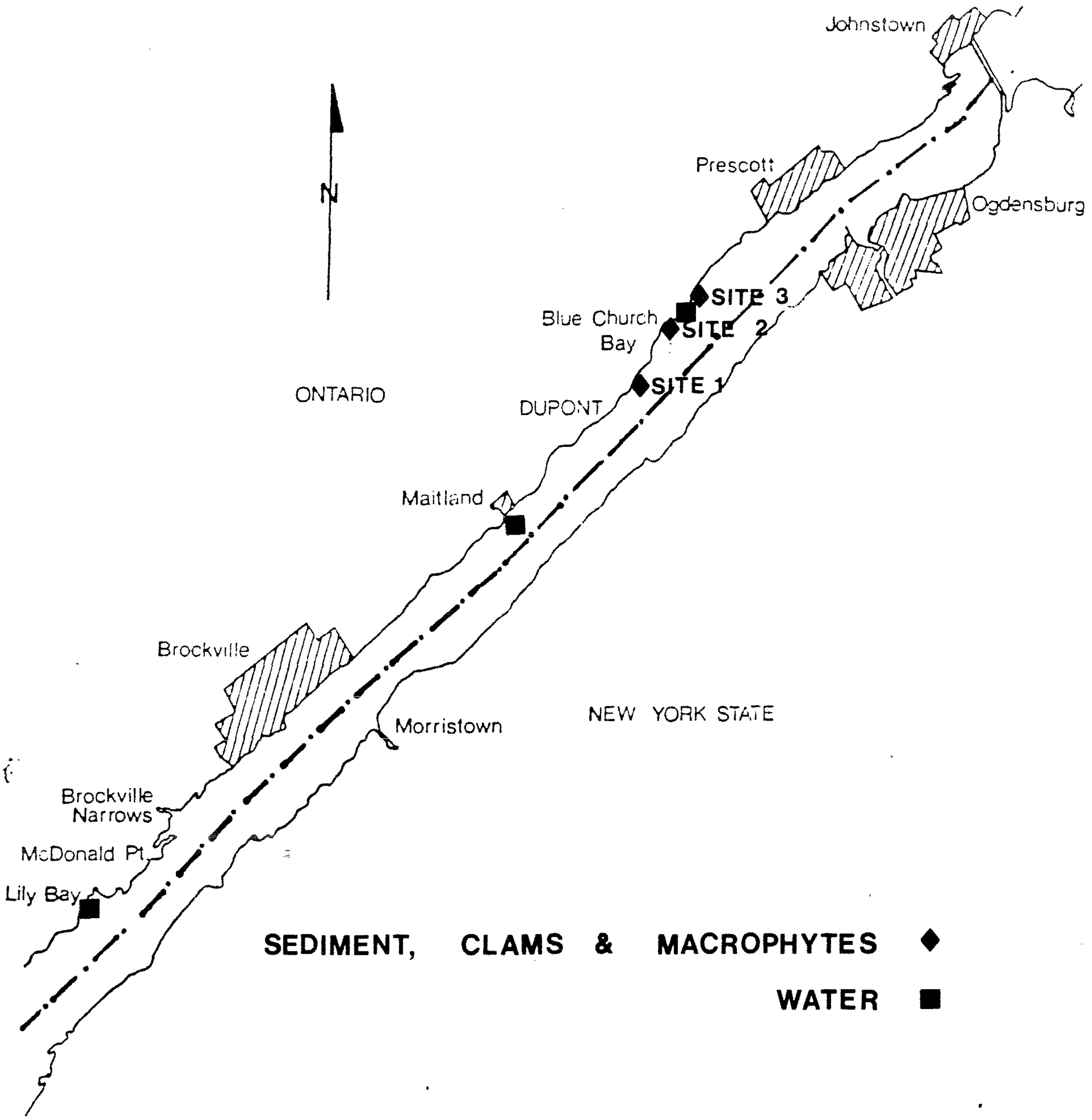


SEDIMENT, CLAMS & MACROPHYTES

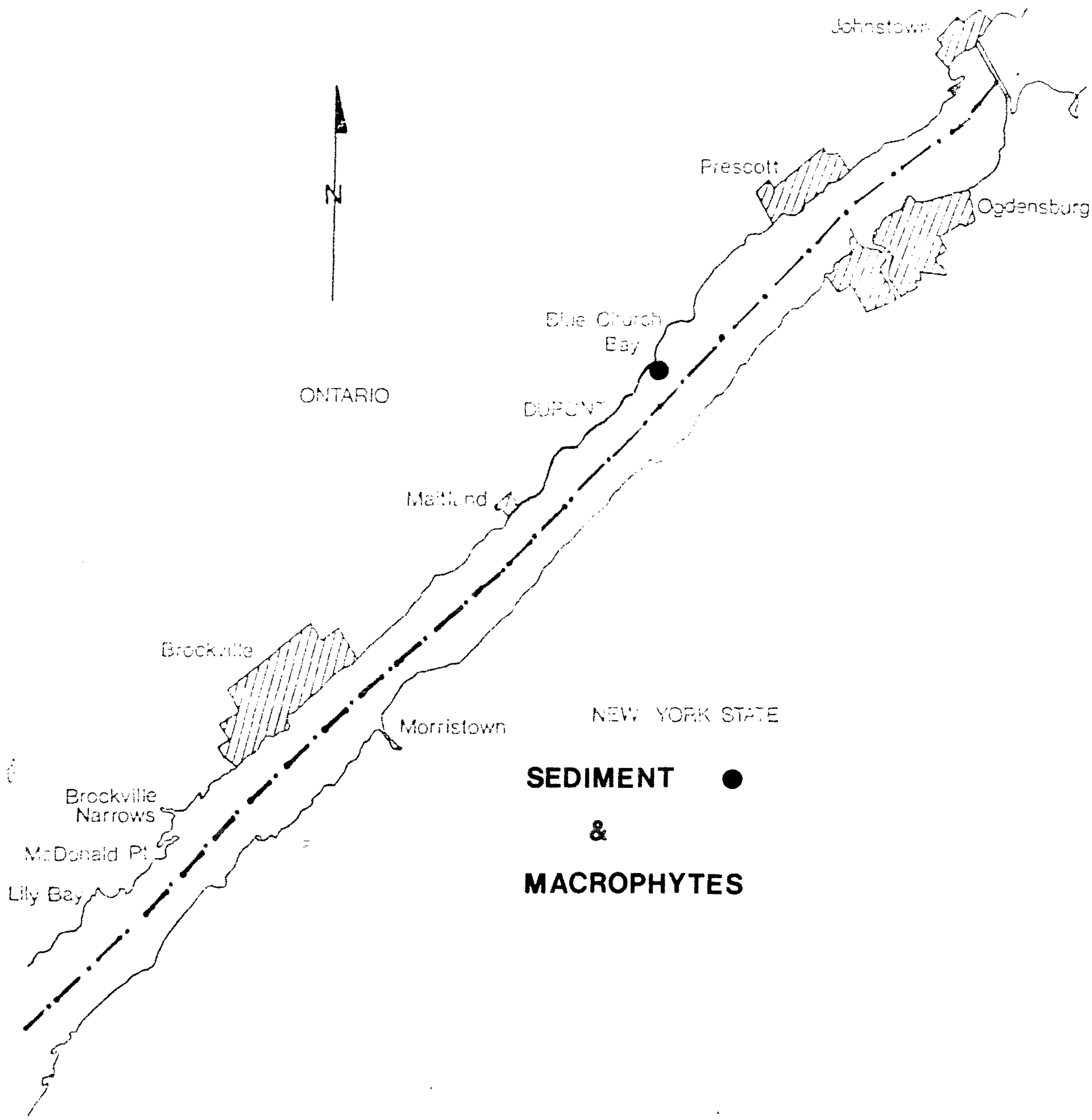
◆ **SITE 1– BLUE CHURCH BAY**

SITE 2– OFF FROM DUPONT

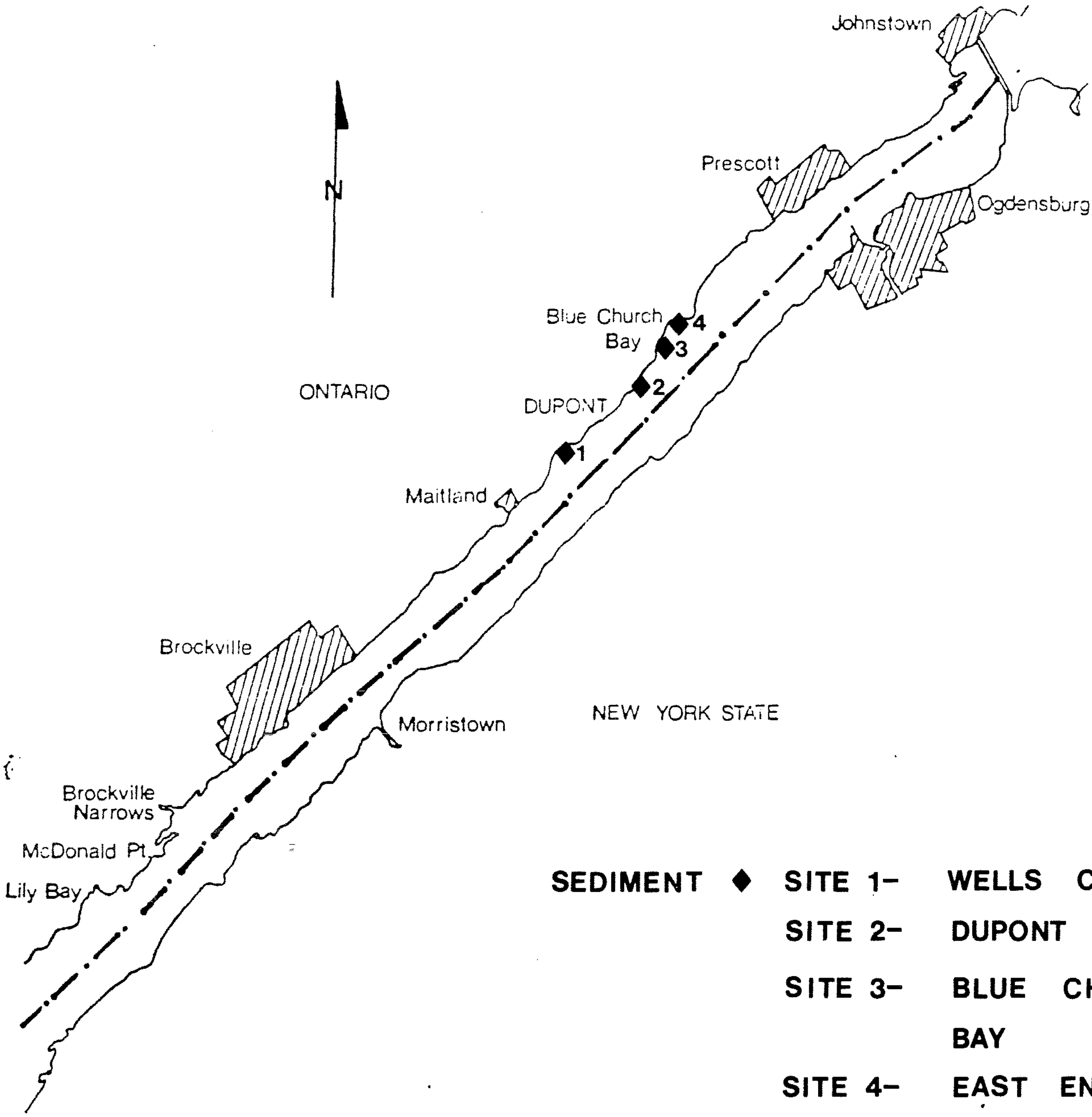
MAP 4— 1983 ST. LAWRENCE RIVER: SAMPLING SITES



MAP 5– 1984 ST. LAWRENCE RIVER: SAMPLING SITE



MAP 6– 1986 ST. LAWRENCE RIVER: SAMPLING SITES



SEDIMENT ◆

SITE 1–	**WELLS CREEK**
SITE 2–	**DUPONT PLANT**
SITE 3–	**BLUE CHURCH BAY**
SITE 4–	**EAST END ACROSS FROM CHURCH**

APPENDIX b=

PART I: SUMMARY OF ALKYLLEAD SAMPLING= YEAR, LOCATION, TYPE OF SAMPLES AND AGENCY COLLECTING THE SAMPLES

YEAR	1981	1982
LOCATION	ST. LAWRENCE RIVER	ST. LAWRENCE RIVER
	1. MAITLAND	2. BLUE CHURCH BAY 3. OFF FROM DUPONT
SAMPLES AND SAMPLE-COLLECTING AGENCIES		
FISH-		
whole		
gutted	1.(28)GLLFAS*	2.(45)GLLFAS
intestines	1.(28)GLLFAS	2.(29)GLLFAS
muscle		
carcass		
WATER-		
SEDIMENT-		2.(2)GLLFAS 3.(2)GLLFAS
CLAMS-		3.(1)GLLFAS
MACROPHYTES-		2.(1)GLLFAS 3.(2)GLLFAS

Continued

*1.= identifies location eg. MAITLAND
(25)= identifies number of samples collected eg. 25
GLLFAS/FIS= identifies who collected the samples eg. GREAT LAKES LABORATORY FOR FISHERIES AND AQUATIC SCIENCES/ FISHING AND INDUSTRIAL SERVICES

APPENDIX b=

PART II: SUMMARY OF ALKYLLEAD SAMPLING= YEAR, LOCATION, TYPE OF SAMPLES AND AGENCY COLLECTING THE SAMPLES

YEAR	1983		1984	
LOCATION	ST. LAWRENCE R.	ST. CLAIR R.	ST. LAWRENCE R.	ST. CLAIR R.
	1. MAITLAND 2. BLUE CHURCH BAY 3. JOHNSTOWN 4. LILY BAY 5. DUPONT PLNT PROCESS EFFL. TO RIVER 6. L.ST.LAWRENCE 7. L.ST.FRANCES	8. MARINE CITY 9. ALGOMAC 10. LAKE HURON 11. ST. CLAIR 12. WALPOLE ISLAND	1. MAITLAND 2. BLUE CHURCH BAY 3. JOHNSTOWN 4. LILY BAY	5. SOUTH OF STAG IS. 6. CORUNNA

SAMPLES AND SAMPLE-COLLECTING AGENCIES

	1983 ST. LAWRENCE R.	1983 ST. CLAIR R.	1984 ST. LAWRENCE R.	1984 ST. CLAIR R.
FISH-				
whole	1.(26)GLLFAS* 6.(10)GLLFAS 7.(6)FIS		2.(42)GLLFAS 3.(67)GLLFAS 4.(41)GLLFAS	5.(16)FIS 6.(6)FIS
gutted				
intestines				
muscle	2.(22)FIS 3.(30)FIS 4.(14)FIS	8.(3)FIS 9.(12)FIS 10.(4)FIS 11.(1)FIS 12.(3)FIS	1.(25)FIS	
carcass	2.(28)FIS 3.(31)FIS 4.(16)FIS	8.(4)FIS 9.(13)FIS 10.(4)FIS 11.(4)FIS 12.(3)FIS		
WATER-	1.(6)GLLFAS 2.(4)GLLFAS 4.(1)GLLFAS	11.(12)GLLFAS		
SEDIMENT-	2.(12)GLLFAS 4.(4)GLLFAS		2.(15)GLLFAS	
CLAMS-	2.(1)GLLFAS			
MACROPHYTES-	2.(4)GLLFAS 4.(7)GLLFAS		2.(13)GLLFAS	

Continued

APPENDIX b=

PART III: SUMMARY OF ALKYLLEAD SAMPLING= YEAR, LOCATION, TYPE OF SAMPLES AND AGENCY COLLECTING THE SAMPLES

YEAR	1986	1987	
LOCATION	ST. LAWRENCE RIVER	ST.LAWRENCE R.	ST CLAIR R.
	1. MAITLAND 2. BLUE CHURCH BAY 3. OFF FROM DUPONT 4. BLUE CHURCH BAY- EAST END ACROSS FROM CHURCH 5. WELLS CREEK	1. BLUE CHURCH BAY	2. STAG IS.
SAMPLES AND SAMPLE-COLLECTING AGENCIES			
FISH-			
whole	1.(25)GLLFAS*	1.(16)GLLFAS	2.(11)GLLFAS
gutted			
intestines		1.(3)GLLFAS	
muscle			
carcass			
liver		1.(3)GLLFAS	
fatty tissue		1.(3)GLLFAS	
fillet		1.(3)GLLFAS	
WATER-			
SEDIMENT-	2.(3)GLLFAS 3.(2)GLLFAS 4.(2)GLLFAS 5.(2)GLLFAS		
CLAMS-			
MACROPHYTES-			

APPENDIX c=

THE FOLLOWING IS A DEFINITION OF THE CODES USED IN THE FISH ALKYLLEAD DATA:

I. SITE= The site where the sample was colleced.

SITE-
1.0 = St. Clair river system
1.1 = Corunna
1.2 = St. Clair
1.3 = Marine City
1.4 = Algonac
1.5 = Lake St. Clair
1.6 = Lake Huron
1.7 = Walpole Is.
1.8 = Sout of Stag Is.
1.9 = Stag Island

2.0 = Maitland river system
2.1 = Johnstown
2.2 = Blue Church Bay
2.3 = Lily Bay
2.4 = Maitland

3.0 = Lake St. Lawrence

4.0 = Lake St. Francis

II. SP. = The species of the fish

SPECIES-
41 = Garpike
51 = Bowfin
61 = Alewife
78 = Brown Trout
131 = Northern Pike
163 = White Sucker
177 = Red Horse Sucker
186 = Carp
201 = Spottail Shinner
233 = Brown Bullhead
234 = Catfish
261 = Killifish
311 = Rock Bass
313 = Pumpkinseed
316 = Small Mouth Bass
317 = Large Mouth Bass
319 = Black Crappie
320 = Sunfish
331 = Yellow Perch
334 = Walleye

III. L.(CM)= Total length in centimeters

IV. WT(G) = Total weight in grams

V. SEX = The sex of the fish

SEX-
1 = Male
2 = Female
3 = Immature
4 = Unknown

VI. TIS = Tissue type being examined

TIS-
1 = Whole fish
2 = Intestines
3 = Muscle
4 = Carcass
5 = Whole fish-Intestines
6 = Liver
7 = fatty tissue
8 = fillet

VII.	-99	= If this appears in any catagory it means that no data was available
VIII.	S.ALK	= Total sum of alkylleads
IX.	S.TBP	= Total sum of all leads--- S.ALK + PB
X.	PERC.	= Percentage of Total lead that is alkyllead---S.ALK/S.TPB X 100

NOTE: ALL LEAD VALUES IN FISH ARE EXPRESSED IN ngPb/g WET WEIGHT OF FISH

File: LEAD
Report: VIEW REPORT

YEAR	SITE	SP.	L.(CM)	WT(G)	SEX	TIS	ME2ET2	MEET3	ET4	ET3	ET2	S.ALK.	PB	S.TPB.	PERC
1981	2.4	186	57.7	4930	1	5	151	1759	11294	5262	44	18510	-99	-99	-99
1981	2.4	186	63.9	6930	1	5	257	5528	64560	68135	519	138999	-99	-99	-99
1981	2.4	186	67.8	9100	2	5	0	621	18	55	0	694	-99	-99	-99
1981	2.4	186	64.0	7340	2	5	0	508	8360	23306	346	32520	-99	-99	-99
1981	2.4	186	61.7	6300	2	5	0	38	264	820	0	1122	-99	-99	-99
1981	2.4	186	60.8	5690	2	5	0	110	2506	1207	0	3823	-99	-99	-99
1981	2.4	186	68.2	8120	2	5	0	0	129	164	0	293	-99	-99	-99
1981	2.4	186	63.8	5910	1	5	0	22	94	103	0	219	-99	-99	-99
1981	2.4	186	57.7	6850	1	5	43	760	9614	3251	21	13689	-99	-99	-99
1981	2.4	186	68.1	8480	2	5	0	0	76	114	0	190	-99	-99	-99
1981	2.4	186	60.4	5820	1	5	213	4218	68661	16398	124	89614	-99	-99	-99
1981	2.4	186	51.7	5340	2	5	46	472	4955	2759	0	8232	-99	-99	-99
1981	2.4	163	37.2	800	2	5	0	0	0	24	0	24	-99	-99	-99
1981	2.4	163	35.3	900	2	5	0	7	147	281	0	435	-99	-99	-99
1981	2.4	163	36.2	980	2	5	0	27	584	610	0	1221	-99	-99	-99
1981	2.4	163	39.0	820	2	5	0	0	19	77	0	96	-99	-99	-99
1981	2.4	163	-99	-99	4	5	0	0	0	0	0	0	-99	-99	-99
1981	2.4	163	37.9	1040	1	5	0	0	40	84	0	124	-99	-99	-99
1981	2.4	163	43.3	1160	4	5	0	0	169	97	0	266	-99	-99	-99
1981	2.4	163	39.0	960	1	5	0	0	442	240	0	682	-99	-99	-99
1981	2.4	163	37.1	870	1	5	0	0	31	138	0	169	-99	-99	-99
1981	2.4	163	37.1	880	2	5	0	0	0	0	0	0	-99	-99	-99
1981	2.4	131	50.7	1040	2	5	0	0	0	78	0	78	-99	-99	-99
1981	2.4	131	53.2	1430	1	5	0	0	51	119	0	170	-99	-99	-99
1981	2.4	131	52.2	1310	2	5	0	0	117	168	0	285	-99	-99	-99
1981	2.4	131	58.0	1840	2	5	0	0	206	413	765	1384	-99	-99	-99
1981	2.4	131	47.0	960	2	5	0	0	0	0	0	0	-99	-99	-99
1981	2.4	131	47.2	910	1	5	0	0	30	0	0	30	-99	-99	-99
1981	2.4	186	57.7	4930	1	2	0	0	0	22934	8925	31859	-99	-99	-99
1981	2.4	186	63.9	6930	1	2	0	77	69	84197	16301	100644	-99	-99	-99
1981	2.4	186	67.8	9100	2	2	0	0	0	0	0	0	-99	-99	-99
1981	2.4	186	64.0	7340	2	2	273	1581	29173	4505	30	35562	-99	-99	-99
1981	2.4	186	61.7	6300	2	2	11	62	438	877	0	1388	-99	-99	-99
1981	2.4	186	60.8	5690	2	2	0	0	76	24	0	100	-99	-99	-99
1981	2.4	186	68.2	8120	2	2	0	0	189	178	0	367	-99	-99	-99
1981	2.4	186	63.8	5910	1	2	14	62	210	115	0	401	-99	-99	-99
1981	2.4	186	57.7	6850	1	2	0	0	0	3862	6341	10203	-99	-99	-99
1981	2.4	186	68.1	8480	2	2	0	0	43	59	0	102	-99	-99	-99
1981	2.4	186	60.4	5820	1	2	228	3542	59147	35806	333	99056	-99	-99	-99
1981	2.4	186	51.7	5340	2	2	0	0	477	70	0	547	-99	-99	-99
1981	2.4	163	37.2	800	2	2	0	0	66	170	0	236	-99	-99	-99
1981	2.4	163	35.3	900	2	2	31	121	1342	1534	0	3028	-99	-99	-99
1981	2.4	163	36.2	980	2	2	30	112	1201	1672	432	3447	-99	-99	-99
1981	2.4	163	39	820	2	2	0	0	78	478	0	556	-99	-99	-99
1981	2.4	163	-99	-99	4	2	0	0	78	132	0	210	-99	-99	-99
1981	2.4	163	37.9	1040	1	2	0	22	421	1028	45	1516	-99	-99	-99
1981	2.4	163	43.3	1160	2	2	0	10	462	380	0	852	-99	-99	-99
1981	2.4	163	39.0	960	1	2	0	0	0	1089	1563	2652	-99	-99	-99
1981	2.4	163	37.1	870	1	2	0	0	0	672	429	1101	-99	-99	-99
1981	2.4	163	37.1	880	2	2	0	0	0	0	0	0	-99	-99	-99
1981	2.4	131	50.7	1040	2	2	17	84	859	490	16	1466	-99	-99	-99
1981	2.4	131	53.2	1430	1	2	76	303	1174	902	1999	4454	-99	-99	-99
1981	2.4	131	52.2	1310	2	2	61	274	1276	845	0	2456	-99	-99	-99
1981	2.4	131	58.0	1840	2	2	49	205	1673	707	0	2634	-99	-99	-99
1981	2.4	131	47.0	960	2	2	0	0	0	0	0	0	-99	-99	-99

File: LEAD Page
Report: VIEW REPORT

YEAR	SITE	SP.	L.(CM)	WT(G)	SEX	TIS	ME2ET2	MEET3	ET4	ET3	ET2	S.ALK.	PB	S.TPB.	PERC
1981	2.4	131	47.2	919	4	2	20	118	667	555	0	1360	-99	-99	-99
1982	2.2	186	79.4	6840	1	2	0	0	0	159	0	159	1536	1695	9
1982	2.2	186	76.1	6220	1	2	0	0	261	124	0	385	0	385	100
1982	2.2	186	78.1	6280	1	2	96	1142	7475	1215	1310	11238	4133	15371	73
1982	2.2	186	74.4	5980	1	2	0	0	170	99	72	341	375	716	48
1982	2.2	186	70	4400	1	2	0	0	780	906	707	2393	1282	3075	65
1982	2.2	186	77	7000	2	2	91	1474	25535	1764	1744	30608	7301	37909	81
1982	2.2	131	59	1080	1	2	0	0	449	0	0	449	1165	1614	28
1982	2.2	131	65.7	1340	2	2	0	169	1018	0	0	1187	1040	2227	53
1982	2.2	131	57.2	1120	1	2	0	179	1813	0	71	2063	532	2595	79
1982	2.2	131	54	1000	1	2	44	205	1765	0	0	2014	0	2014	100
1982	2.2	131	87	4300	2	2	0	83	0	99	229	411	1338	1749	23
1982	2.2	163	40	440	1	2	0	0	0	0	0	0	522	522	0
1982	2.2	163	55	2040	2	2	0	0	0	0	0	0	236	236	0
1982	2.2	163	41.1	700	1	2	0	64	1318	695	690	2767	3905	6672	41
1982	2.2	163	44.7	740	2	2	0	0	4384	3433	4268	12085	3477	15562	78
1982	2.2	163	42.4	700	2	2	0	293	2948	2171	2196	7608	3610	11218	68
1982	2.2	177	59.4	2220	2	2	0	104	1739	566	249	2658	0	2658	100
1982	2.2	177	58.7	2100	1	2	0	86	1228	469	0	1783	0	1783	100
1982	2.2	177	64.6	3300	1	2	0	0	188	162	0	350	0	350	100
1982	2.2	177	64	2520	1	2	0	268	2627	1309	653	4857	0	4857	100
1982	2.2	177	60	2580	1	2	0	0	665	233	0	898	0	898	100
1982	2.2	316	33.1	440	2	2	154	286	2193	468	192	3293	0	3293	100
1982	2.2	316	34.4	580	2	2	106	215	1493	141	0	1955	1712	3667	55
1982	2.2	316	31.1	449	2	2	372	555	2890	805	457	5079	0	5079	100
1982	2.2	311	21.9	248	4	2	0	0	0	0	0	0	0	0	0
1982	2.2	311	23.3	247	2	2	0	0	0	0	0	0	0	0	0
1982	2.2	233	32	400	4	2	0	0	105	223	0	328	0	328	100
1982	2.2	233	29	300	2	2	0	0	0	928	124	1052	0	1052	100
1982	2.2	233	31.2	446	2	2	0	0	0	0	0	0	0	0	0
1982	2.2	186	79.4	6840	1	1	0	0	0	126	265	391	156	547	71
1982	2.2	186	76.1	6220	1	1	0	0	102	0	0	102	1574	1676	6
1982	2.2	186	78.1	6280	1	1	0	875	6630	672	94	8271	1211	9482	87
1982	2.2	186	74.4	5980	1	1	0	0	0	0	0	0	160	160	0
1982	2.2	186	70.0	4400	1	1	0	109	967	403	0	1479	396	1875	79
1982	2.2	186	77.0	7000	2	1	203	3548	54812	2622	528	61713	4721	66434	93
1982	2.2	131	59.0	1080	1	1	0	0	0	0	0	0	770	770	0
1982	2.2	131	65.7	1340	2	1	0	0	298	0	0	298	1146	1444	21
1982	2.2	131	57.2	1120	1	1	0	0	55	0	0	55	669	724	8
1982	2.2	131	54.0	1000	1	1	0	0	313	0	0	313	193	506	62
1982	2.2	131	87.0	4300	2	1	0	146	1125	53	0	1324	1187	2511	53
1982	2.2	163	40.0	440	1	1	0	0	0	0	0	0	0	0	0
1982	2.2	163	55.0	2040	2	1	0	0	0	0	0	0	167	167	0
1982	2.2	163	41.1	700	1	1	0	79	405	233	0	717	142	859	83
1982	2.2	163	44.7	740	2	1	0	0	1437	1189	561	3187	1849	5036	63
1982	2.2	163	42.4	700	2	1	0	0	1098	1076	160	2334	736	3070	76
1982	2.2	177	59.4	2220	2	1	0	68	654	322	0	1044	0	1044	100
1982	2.2	177	58.7	2100	1	1	0	0	788	227	0	1015	0	1015	100
1982	2.2	177	64.6	3300	1	1	0	0	189	0	0	189	0	189	100
1982	2.2	177	64.0	2520	1	1	0	133	1590	319	0	2042	0	2042	100
1982	2.2	177	60.0	2580	1	1	0	0	341	137	0	478	0	478	100
1982	2.2	61	17.5	28	2	1	0	0	0	0	0	0	0	0	0
1982	2.2	61	18.2	30	2	1	0	0	0	0	0	0	491	491	0
1982	2.2	61	18.0	30	2	1	0	0	0	209	0	209	0	209	100
1982	2.2	61	16.2	30	2	1	0	0	0	0	0	0	0	0	0

File: LEAD Page
Report: VIEW REPORT

YEAR	SITE	SP.	L.(CM)	WT(G)	SEX	TIS	ME2ET2	MEET3	ET4	ET3	ET2	S.ALK.	PB	S.TPB.	PERC
1982	2.2	61	17.1	31	2	1	0	0	0	212	73	285	0	285	100
1982	2.2	316	32.2	503	2	1	71	252	1834	660	275	3092	305	3397	91
1982	2.2	316	33.1	440	2	1	57	187	1204	223	92	1763	254	2017	87
1982	2.2	316	34.4	580	2	1	69	97	724	0	0	890	101	991	90
1982	2.2	316	31.1	449	2	1	251	446	1529	654	235	3115	100	3215	97
1982	2.2	331	16.0	45	4	1	0	0	115	1017	371	1503	845	2348	64
1982	2.2	331	17.5	56	4	1	0	0	0	1608	415	2023	2100	4123	49
1982	2.2	331	17.7	57	4	1	0	0	460	1197	444	2101	1704	3805	55
1982	2.2	331	14.5	41	4	1	0	58	1023	3128	1206	5415	1344	6759	80
1982	2.2	331	18.5	74	4	1	0	0	108	603	201	912	1806	2718	34
1982	2.2	311	21.9	248	4	1	0	0	0	0	0	0	638	638	0
1982	2.2	311	23.3	247	2	1	0	0	0	0	0	0	312	312	0
1982	2.2	313	17.5	144	4	1	0	0	0	0	0	0	210	210	0
1982	2.2	313	16.4	118	4	1	0	0	1447	435	0	1882	1439	3321	57
1982	2.2	313	16.8	131	4	1	0	0	698	279	111	1088	782	1870	58
1982	2.2	313	17.3	126	4	1	0	0	89	0	0	89	363	452	20
1982	2.2	313	18.0	131	4	1	0	0	0	0	0	0	598	598	0
1982	2.2	233	32.0	400	4	1	0	0	105	448	0	553	0	553	100
1982	2.2	233	29.0	300	2	1	0	0	0	1622	707	2329	0	2329	100
1982	2.2	233	31.2	446	2	1	0	0	0	0	0	0	0	0	0
1983	2.2	186	68.4	4730	2	1	0	373	5776	995	285	7429	4380	11809	63
1983	2.2	186	78.7	8960	2	1	0	0	65	22	0	87	191	278	31
1983	2.2	163	45	1445	1	1	0	103	1431	386	147	2067	1143	3210	64
1983	2.2	163	48	1331	1	1	28	233	5086	4146	1060	10553	2232	12785	83
1983	2.2	163	47.2	1106	2	1	0	110	2013	2378	600	5101	1056	6157	83
1983	2.2	163	52.8	1530	2	1	69	200	3452	1053	405	5179	1658	6837	76
1983	2.2	163	55.6	1800	2	1	0	36	752	389	68	1245	423	1668	75
1983	2.2	177	55.3	1650	1	1	0	0	231	100	30	361	187	548	66
1983	2.2	131	60.2	1320	2	1	0	31	215	183	55	484	411	895	54
1983	2.2	131	68.9	1700	4	1	0	91	629	306	87	1113	202	1315	85
1983	2.2	131	67.5	1540	4	1	0	0	33	109	12	154	318	472	33
1983	2.2	331	20.4	87	3	1	0	0	104	1490	265	1859	1402	3261	57
1983	2.2	331	22	127	3	1	0	108	829	1014	367	2318	1112	3430	68
1983	2.2	331	20.1	95	3	1	36	13	108	1571	430	2158	759	2917	74
1983	2.2	331	18.4	60	3	1	0	0	61	1426	249	1736	316	2052	85
1983	2.2	331	21	120	3	1	0	61	571	351	118	1101	836	1937	57
1983	2.2	311	18.7	110	1	1	0	0	0	66	16	82	473	555	15
1983	2.2	311	13.1	43	3	1	0	0	100	221	107	428	630	1058	40
1983	2.2	311	16.7	87	3	1	0	0	21	82	21	124	304	428	29
1983	2.2	316	42.5	957	2	1	17	72	735	309	90	1223	406	1629	75
1983	2.2	313	20.5	201	2	1	0	0	258	219	50	527	122	649	81
1983	2.2	313	19.8	204	2	1	0	0	0	0	0	0	284	284	0
1983	2.2	313	19	191	2	1	0	0	0	0	0	0	218	218	0
1983	2.2	313	19.1	171	4	1	0	0	156	42	22	220	240	460	48
1983	2.2	313	20.5	195	2	1	0	0	251	286	72	609	368	977	62
1983	2.2	261	8.2	6	2	1	0	0	252	414	44	710	1143	1853	38
1983	3.0	186	-99	6300	4	1	0	0	0	0	0	0	651	651	0
1983	3.0	186	-99	7250	4	1	0	0	0	0	0	0	0	0	0
1983	3.0	186	-99	6000	4	1	0	0	0	0	0	0	0	0	0
1983	3.0	186	-99	5950	4	1	0	0	0	0	0	0	86	86	0
1983	3.0	186	-99	5800	4	1	0	0	0	0	0	0	0	0	0
1983	3.0	186	-99	5600	4	1	0	0	0	0	0	0	54	54	0
1983	4.0	186	-99	5850	4	1	0	0	0	0	0	0	129	129	0
1983	4.0	186	-99	7650	4	1	0	0	0	0	0	0	368	368	0
1983	4.0	186	-99	8100	4	1	0	0	0	0	0	0	0	0	0

File: LEAD Page
Report: VIEW REPORT

YEAR	SITE	SP.	L.(CM)	WT(G)	SEX	TIS	ME2ET2	MEET3	ET4	ET3	ET2	S.ALK.	PB	S.TPB.	PERC
1983	4.0	186	-99	6900	4	1	0	0	0	0	0	0	0	0	0
1983	4.0	186	-99	5000	4	1	0	0	0	0	0	0	30	30	0
1983	4.0	186	-99	7100	4	1	0	0	0	0	0	0	202	202	0
1983	3.0	331	-99	85	4	1	0	32	0	63	0	95	0	95	100
1983	3.0	331	-99	95	4	1	0	0	0	0	0	0	0	0	0
1983	3.0	331	-99	90	4	1	0	0	0	0	0	0	0	0	0
1983	3.0	331	-99	65	4	1	0	0	0	0	0	0	0	0	0
1983	1.3	163	40	865	4	3	0	0	949	2397	260	3607	151	3758	96
1983	1.3	163	40	865	4	4	0	0	1944	1044	199	3188	0	3188	100
1983	1.3	163	42	900	4	3	0	0	35	158	0	193	114	308	63
1983	1.3	163	42	900	4	4	0	0	20	20	0	40	110	151	27
1983	1.3	163	47	1025	4	3	0	0	0	533	80	613	217	830	74
1983	1.3	163	47	1025	4	4	0	0	11	434	106	552	2634	3187	17
1983	1.4	163	41	883	4	3	0	0	0	0	0	0	0	0	0
1983	1.4	163	41	883	4	4	0	0	0	0	0	0	20	20	0
1983	1.4	163	47	1275	4	3	0	0	0	0	0	0	93	93	0
1983	1.4	163	47	1275	4	4	0	0	0	0	0	0	133	133	0
1983	1.4	163	50.5	1575	4	3	0	0	0	0	0	0	0	0	0
1983	1.4	163	50.5	1575	4	4	0	0	0	0	0	0	78	78	0
1983	1.6	163	47	1225	4	3	0	0	0	0	0	0	102	102	0
1983	1.6	163	47	1225	4	4	0	0	0	0	0	0	20	20	0
1983	1.6	163	38	670	4	3	0	0	0	0	31	31	15	46	67
1983	1.6	163	38	670	4	4	0	0	187	0	23	210	35	245	86
1983	1.6	163	40	660	4	3	0	0	0	0	0	0	75	75	0
1983	1.6	163	40	660	4	4	0	0	0	0	0	0	15	15	0
1983	1.4	186	54	2400	4	3	0	0	0	0	0	0	0	0	0
1983	1.4	186	54	2400	4	4	0	0	0	0	0	0	26	26	0
1983	1.4	186	46	1600	4	3	0	0	0	0	0	0	55	55	0
1983	1.4	186	46	1600	4	4	0	0	0	0	0	0	244	244	0
1983	1.4	186	53	2100	4	3	0	0	0	27	0	27	1561	1589	0.01
1983	1.4	186	53	2100	4	4	0	0	0	0	0	0	272	272	0
1983	1.4	186	67	3900	4	3	0	0	522	747	331	1601	242	1843	87
1983	1.4	186	67	3900	4	4	0	0	2222	614	0	2836	0	2836	100
1983	1.2	186	58	2700	4	3	0	0	0	0	0	0	36	36	0
1983	1.2	186	58	2700	4	4	0	0	0	0	0	0	0	0	0
1983	1.7	186	56	3500	4	3	0	0	0	121	0	121	171	292	41
1983	1.7	186	56	3500	4	4	0	0	0	34	0	34	128	162	21
1983	1.6	186	59	3050	4	4	0	57	168	74	22	323	346	670	48
1983	1.6	186	59	3050	4	3	0	0	271	337	19	627	60	687	91
1983	1.4	331	16	65	4	3	0	0	0	0	0	0	56	56	0
1983	1.4	331	16	65	4	4	0	0	0	0	0	0	261	261	0
1983	1.2	331	19	136	4	4	0	0	0	0	0	0	25	25	0
1983	1.7	331	20	135	4	3	0	0	0	0	0	0	178	178	0
1983	1.7	331	20	135	4	4	0	0	4	12	0	17	101	118	14
1983	1.4	131	75	2600	4	3	0	0	0	0	0	0	108	108	0
1983	1.4	131	75	2600	4	4	0	0	0	0	0	0	0	0	0
1983	1.3	311	13	67	4	4	0	0	0	0	0	0	97	97	0
1983	1.4	051	55	1600	4	4	0	0	0	0	0	0	45	45	0
1983	1.4	041	78	675	4	3	0	0	48	0	31	79	8	88	90
1983	1.4	041	78	675	4	4	0	0	0	0	0	0	0	0	0
1983	1.2	061	7.6	37	4	4	0	0	0	0	0	0	17	17	0
1983	1.7	234	68	4000	4	3	0	0	26	71	15	114	39	153	74
1983	1.7	234	68	4000	4	4	0	0	119	34	0	154	177	331	46
1983	1.4	163	46	975	4	3	0	0	0	31	0	31	281	312	10
1983	1.4	163	46	975	4	4	0	224	0	0	0	224	9	233	96

File: LEAD Page
Report: VIEW REPORT

YEAR	SITE	SP.	L.(CM)	WT(G)	SEX	TIS	ME2ET2	MEET3	ET4	ET3	ET2	S.ALK.	PB	S.TPB.	PERC
1983	1.4	163	43	817	4	3	0	0	0	22	13	36	45	61	44
1983	1.4	163	43	817	4	4	0	0	0	0	0	0	0	0	0
1983	1.2	163	45	850	4	4	0	0	0	0	0	0	212	212	0
1983	2.2	131	-99	-99	4	3	0	0	0	0	0	0	0	0	0
1983	2.2	131	-99	-99	4	3	0	0	0	19	0	19	65	84	23
1983	2.2	131	-99	-99	4	3	0	0	22	464	50	536	76	612	88
1983	2.2	131	-99	-99	4	3	0	0	0	117	35	153	43	196	78
1983	2.2	131	-99	-99	4	3	0	0	18	113	17	149	108	257	58
1983	2.2	131	-99	-99	4	3	0	0	21	424	22	467	46	513	91
1983	2.2	131	-99	-99	4	3	0	0	12	153	0	165	213	378	44
1983	2.2	131	-99	-99	4	3	0	0	41	71	30	143	132	275	52
1983	2.2	131	-99	-99	4	3	0	0	0	22	0	22	27	49	45
1983	2.2	131	-99	-99	4	3	0	0	0	67	0	67	40	107	63
1983	2.2	131	-99	-99	4	3	0	0	17	131	0	148	183	331	45
1983	2.2	131	-99	-99	4	3	0	0	0	193	9	203	113	316	64
1983	2.2	131	-99	-99	4	3	0	0	46	75	0	121	38	159	76
1983	2.2	131	-99	-99	4	3	0	0	28	81	8	117	54	171	68
1983	2.2	131	-99	-99	4	3	0	0	38	161	0	200	122	322	62
1983	2.2	331	-99	-99	4	3	0	0	31	2741	137	2910	595	3505	83
1983	2.2	331	-99	-99	4	3	0	53	21	1459	501	2036	86	2123	96
1983	2.2	233	-99	-99	4	3	0	0	50	3018	517	3585	214	3799	94
1983	2.2	163	-99	-99	4	3	0	0	0	27	0	27	153	180	15
1983	2.2	177	-99	-99	4	3	0	35	379	196	25	635	9	644	99
1983	2.2	177	-99	-99	4	3	0	28	313	607	76	1025	55	1080	95
1983	2.2	177	-99	-99	4	3	0	0	78	83	10	172	54	226	76
1983	2.1	131	-99	-99	4	3	0	0	0	32	55	87	97	184	47
1983	2.1	131	-99	-99	4	3	0	0	0	153	0	153	58	211	73
1983	2.1	131	-99	-99	4	3	0	0	0	29	0	29	0	29	100
1983	2.1	131	-99	-99	4	3	0	0	0	38	0	38	4428	4466	1
1983	2.1	131	-99	-99	4	3	0	0	0	65	0	65	29	95	69
1983	2.1	131	-99	-99	4	3	0	0	0	84	0	84	4	88	95
1983	2.1	131	-99	-99	4	3	0	0	0	0	0	0	41	41	0
1983	2.1	131	-99	-99	4	3	0	0	0	32	0	32	71	104	31
1983	2.1	131	-99	-99	4	3	0	0	0	73	0	73	21	94	78
1983	2.1	131	-99	-99	4	3	0	0	0	0	0	0	0	0	0
1983	2.1	131	-99	-99	4	3	0	0	11	200	0	211	127	338	62
1983	2.1	186	-99	-99	4	3	0	101	168	136	0	405	224	629	64
1983	2.1	186	-99	-99	4	3	0	0	180	226	0	406	196	602	67
1983	2.1	320	-99	-99	4	3	0	0	0	48	0	48	42	91	54
1983	2.1	319	-99	-99	4	3	0	0	40	100	0	140	44	184	76
1983	2.1	319	-99	-99	4	3	0	0	0	358	5	364	28	393	93
1983	2.1	163	-99	-99	4	3	0	0	0	144	0	144	77	221	65
1983	2.1	163	-99	-99	4	3	0	0	0	71	81	152	0	152	100
1983	2.1	163	-99	-99	4	3	0	0	53	424	17	494	30	524	94
1983	2.1	163	-99	-99	4	3	0	0	0	450	78	529	81	610	87
1983	2.1	163	-99	-99	4	3	0	0	27	676	73	777	362	1140	68
1983	2.1	163	-99	-99	4	3	0	0	0	194	12	207	12	220	94
1983	2.1	163	-99	-99	4	3	0	0	39	309	21	370	93	463	80
1983	2.1	163	-99	-99	4	3	0	0	22	182	4	209	4	214	98
1983	2.1	313	-99	-99	4	3	0	0	0	71	0	71	152	223	32
1983	2.1	331	-99	-99	4	3	0	0	0	397	52	450	106	556	81
1983	2.1	317	-99	-99	4	3	0	0	12	21	0	33	128	161	20
1983	2.1	316	-99	-99	4	3	0	0	0	30	0	30	0	30	100
1983	2.1	233	-99	-99	4	3	0	0	2	231	37	270	71	341	79
1983	2.1	233	-99	-99	4	3	0	0	17	353	70	440	20	460	96

File: LEAD
Report: VIEW REPORT

YEAR	SITE	SP.	L.(CM)	WT(G)	SEX	TIS	ME2ET2	MEET3	ET4	ET3	ET2	S.ALK.	PB	S.TPB.	PERC
1983	2.3	186	-99	-99	4	3	0	25	182	148	65	421	103	525	80
1983	2.3	186	-99	-99	4	3	0	0	0	29	0	29	225	255	12
1983	2.3	186	-99	-99	4	3	0	0	78	0	0	78	53	131	59
1983	2.3	313	-99	-99	4	3	0	0	0	0	0	0	21	21	0
1983	2.3	313	-99	-99	4	3	0	0	0	0	0	0	27	27	0
1983	2.3	316	-99	-99	4	3	0	0	0	0	0	0	0	0	0
1983	2.3	316	-99	-99	4	3	0	0	0	19	0	19	51	71	27
1983	2.3	331	-99	-99	4	3	0	0	0	36	21	57	101	158	36
1983	2.3	311	-99	-99	4	3	0	0	0	0	0	0	0	0	0
1983	2.3	131	-99	-99	4	3	0	0	0	0	0	0	98	98	0
1983	2.3	131	-99	-99	4	3	0	0	0	0	0	0	36	36	0
1983	2.3	233	-99	-99	4	3	0	0	0	0	0	0	0	0	0
1983	2.3	233	-99	-99	4	3	0	0	0	0	0	0	0	0	0
1983	2.3	233	-99	-99	4	3	0	0	0	0	0	0	16	16	0
1983	2.2	131	-99	-99	4	4	0	0	0	0	0	0	57	57	0
1983	2.2	131	-99	-99	4	4	0	0	61	31	0	93	784	877	11
1983	2.2	131	-99	-99	4	4	0	18	177	403	106	704	215	920	77
1983	2.2	131	-99	-99	4	4	0	15	41	27	0	84	86	170	49
1983	2.2	131	-99	-99	4	4	0	0	138	134	16	288	271	560	51
1983	2.2	131	-99	-99	4	4	0	30	358	270	25	683	558	1241	55
1983	2.2	131	-99	-99	4	4	0	0	165	92	23	280	172	452	62
1983	2.2	131	-99	-99	4	4	0	0	200	146	0	346	721	1067	32
1983	2.2	131	-99	-99	4	4	0	0	0	0	0	0	109	109	0
1983	2.2	131	-99	-99	4	4	0	5	188	135	0	329	808	1137	29
1983	2.2	131	-99	-99	4	4	0	0	72	111	0	183	339	523	35
1983	2.2	131	-99	-99	4	4	0	22	283	244	13	562	2938	3500	16
1983	2.2	131	-99	-99	4	4	0	0	45	58	0	103	377	481	22
1983	2.2	131	-99	-99	4	4	0	16	321	185	0	522	634	1156	45
1983	2.2	131	-99	-99	4	4	0	0	120	189	18	327	491	819	40
1983	2.2	331	-99	-99	4	4	0	61	472	983	198	1714	305	2019	85
1983	2.2	331	-99	-99	4	4	0	23	162	1042	100	1327	437	1764	75
1983	2.2	331	-99	-99	4	4	0	0	197	1683	343	2223	822	3045	73
1983	2.2	233	-99	-99	4	4	0	0	202	620	155	977	527	1504	65
1983	2.2	163	-99	-99	4	4	0	0	0	0	0	0	62	62	0
1983	2.2	163	-99	-99	4	4	0	0	0	0	0	0	321	321	0
1983	2.2	163	-99	-99	4	4	0	0	264	211	43	519	174	693	75
1983	2.2	177	-99	-99	4	4	0	39	588	115	0	743	565	1309	57
1983	2.2	177	-99	-99	4	4	0	0	135	102	0	237	0	237	100
1983	2.2	177	-99	-99	4	4	0	156	2004	529	35	2724	480	3204	85
1983	2.2	177	-99	-99	4	4	0	69	567	212	0	849	277	1126	75
1983	2.2	313	-99	-99	4	4	0	0	189	162	16	368	190	558	66
1983	2.2	201	-99	-99	4	4	0	0	18	102	0	120	355	475	25
1983	2.1	131	-99	-99	4	4	0	0	166	0	236	402	28	430	93
1983	2.1	131	-99	-99	4	4	0	0	126	144	254	524	83	607	86
1983	2.1	131	-99	-99	4	4	0	0	0	34	0	34	144	179	19
1983	2.1	131	-99	-99	4	4	0	0	0	86	0	86	184	270	32
1983	2.1	131	-99	-99	4	4	0	0	84	64	0	148	44	192	77
1983	2.1	131	-99	-99	4	4	0	0	5	36	0	41	25	66	62
1983	2.1	131	-99	-99	4	4	0	0	0	0	0	0	78	78	0
1983	2.1	131	-99	-99	4	4	0	0	0	37	0	37	96	133	28
1983	2.1	131	-99	-99	4	4	0	0	0	52	0	52	99	151	34
1983	2.1	131	-99	-99	4	4	0	0	0	0	0	0	21	21	0
1983	2.1	131	-99	-99	4	4	0	0	14	150	0	164	205	369	44
1983	2.1	131	-99	-99	4	4	0	0	0	46	0	46	191	237	19
1983	2.1	186	-99	-99	4	4	0	0	279	0	0	279	239	518	54

File: LEAD
Report: VIEW REPORT

YEAR	SITE	SP.	L.(CM)	WT(G)	SEX	TIS	ME2ET2	MEET3	ET4	ET3	ET2	S.ALK.	PB	S.TPB.	PERC
1983	2.1	186	-99	-99	4	4	0	0	314	134	0	448	406	854	52
1983	2.1	320	-99	-99	4	4	0	0	41	38	0	80	25	106	76
1983	2.1	319	-99	-99	4	4	0	0	58	74	0	132	95	227	58
1983	2.1	319	-99	-99	4	4	0	0	0	44	0	44	248	293	15
1983	2.1	163	-99	-99	4	4	0	0	0	46	0	46	558	604	8
1983	2.1	163	-99	-99	4	4	0	0	0	52	0	52	0	52	100
1983	2.1	163	-99	-99	4	4	0	0	206	390	46	642	271	913	70
1983	2.1	163	-99	-99	4	4	0	0	129	327	0	456	3549	4005	11
1983	2.1	163	-99	-99	4	4	0	0	225	573	0	798	274	1073	74
1983	2.1	163	-99	-99	4	4	0	0	0	75	0	75	0	75	100
1983	2.1	163	-99	-99	4	4	0	0	49	146	0	195	279	474	41
1983	2.1	163	-99	-99	4	4	0	0	71	84	0	156	53	209	75
1983	2.1	313	-99	-99	4	4	0	0	65	47	0	112	157	270	42
1983	2.1	331	-99	-99	4	4	0	0	0	379	0	379	282	661	57
1983	2.1	316	-99	-99	4	4	0	0	200	43	0	244	79	324	75
1983	2.1	316	-99	-99	4	4	0	0	43	16	0	59	36	96	62
1983	2.1	233	-99	-99	4	4	0	0	0	135	0	135	249	384	35
1983	2.3	186	-99	-99	4	4	0	0	887	147	26	1061	105	1167	91
1983	2.3	186	-99	-99	4	4	0	0	0	0	0	0	0	0	0
1983	2.3	186	-99	-99	4	4	0	0	97	0	0	97	41	139	70
1983	2.3	319	-99	-99	4	4	0	0	0	0	0	0	0	0	0
1983	2.3	313	-99	-99	4	4	0	0	0	0	0	0	0	0	0
1983	2.3	313	-99	-99	4	4	0	247	0	0	0	247	52	299	82
1983	2.3	331	-99	-99	4	4	0	44	0	0	0	44	31	75	58
1983	2.3	316	-99	-99	4	4	0	0	0	0	0	0	38	38	0
1983	2.3	316	-99	-99	4	4	0	0	13	202	0	215	52	267	80
1983	2.3	311	-99	-99	4	4	0	0	0	0	0	0	39	39	0
1983	2.3	131	-99	-99	4	4	0	0	0	0	0	0	0	0	0
1983	2.3	131	-99	-99	4	4	0	0	0	0	0	0	0	0	0
1983	2.3	233	-99	-99	4	4	0	0	0	0	0	0	204	204	0
1983	2.3	233	-99	-99	4	4	0	0	0	0	0	0	18	18	0
1983	2.3	233	-99	-99	4	4	0	0	0	0	0	0	54	54	0
1983	2.3	201	-99	-99	4	4	0	0	0	0	0	0	37	37	0
1984	1.8	163	42.5	942	2	1	0	72	182	0	348	602	1004	1666	36
1984	1.8	163	45	945	1	1	0	0	215	41	252	508	2017	2525	20
1984	1.8	163	41	762	3	1	0	0	0	0	134	134	1747	1881	7
1984	1.8	163	45	995	2	1	0	115	648	279	0	1042	995	2037	51
1984	1.8	163	42.5	891	2	1	0	0	0	18	0	18	255	273	6
1984	1.8	163	40	831	1	1	0	0	16	20	4	40	316	356	11
1984	1.8	163	47	1275	2	1	0	0	20	26	0	46	405	451	10
1984	1.8	163	46	1447	2	1	0	22	28	42	0	92	297	389	24
1984	1.1	186	56	2488	1	1	0	0	0	283	0	283	94	377	75
1984	1.1	186	67.5	5062	2	1	0	0	0	0	0	0	70	70	0
1984	1.8	331	31.5	389	1	1	0	0	0	0	0	0	256	256	0
1984	1.8	78	40.5	951	1	1	0	0	0	0	0	0	116	116	0
1984	1.8	334	41	583	1	1	0	0	0	0	0	0	67	67	0
1984	1.8	334	47	877	1	1	0	0	120	54	0	174	292	466	37
1984	1.8	334	43	786	1	1	0	0	0	0	0	0	38	38	0
1984	1.8	334	42	714	1	1	0	0	0	0	0	0	40	40	0
1984	1.8	334	41.5	619	1	1	0	0	11	0	0	11	44	55	20
1984	1.8	334	42	701	1	1	0	0	18	0	0	18	38	56	32
1984	1.1	131	57	1015	1	1	0	0	25	0	0	25	58	83	30
1984	1.1	131	72.5	2550	1	1	0	0	1134	312	76	1522	1363	2885	53
1984	1.1	131	82.2	4153	2	1	0	0	31	0	25	56	117	173	32
1984	1.1	131	73	2913	2	1	0	0	184	83	24	291	637	928	31

File: LEAD Page
Report: VIEW REPORT

YEAR	SITE	SP.	L.(CM)	WT(G)	SEX	TIS	ME2ET2	MEET3	ET4	ET3	ET2	S.ALK.	PB	S.TPB.	PERC
1984	2.2	163	37	689	2	1	0	0	405	131	35	571	51	622	91
1984	2.2	163	52	1894	2	1	0	0	42	38	0	80	0	80	100
1984	2.2	163	50	1595	2	1	0	0	149	173	0	322	576	898	36
1984	2.2	163	49	1326	2	1	0	0	312	1340	366	2019	344	2364	85
1984	2.2	163	52	1603	2	1	0	0	0	156	0	156	0	156	100
1984	2.2	163	48	1453	2	1	0	0	0	126	113	239	345	584	41
1984	2.2	163	51	1695	2	1	0	114	960	190	99	1363	694	2057	66
1984	2.2	163	47	1575	2	1	0	0	425	244	0	669	0	669	100
1984	2.2	163	50	1365	2	1	0	0	0	335	0	335	243	579	58
1984	2.2	177	57	2755	1	1	0	102	378	211	0	691	1270	1961	35
1984	2.2	177	57	2683	1	1	0	0	34	75	0	109	490	599	18
1984	2.2	177	45.5	1337	1	1	0	178	1129	232	0	1539	0	1539	100
1984	2.2	177	60	2555	1	1	0	147	873	285	81	1386	665	2051	68
1984	2.2	177	44	1363	2	1	0	174	1622	149	20	1965	78	2043	96
1984	2.2	177	57.5	-99	2	1	53	593	3213	931	249	5039	835	5874	86
1984	2.2	177	51	2156	2	1	0	56	642	141	27	867	132	999	87
1984	2.2	177	55	2577	2	1	0	77	582	245	51	956	594	1550	62
1984	2.2	177	55	2392	2	1	0	0	471	241	0	712	559	1271	56
1984	2.2	177	53	-99	2	1	0	75	336	172	0	584	80	665	88
1984	2.2	177	60	2889	1	1	0	0	528	276	41	845	129	975	87
1984	2.2	177	62	2850	2	1	0	99	505	261	0	866	81	948	91
1984	2.2	177	57	2174	2	1	0	0	0	346	0	346	305	651	53
1984	2.2	177	60	2989	2	1	0	0	161	99	0	261	68	330	79
1984	2.2	177	59	2742	2	1	0	181	735	195	46	1159	90	1249	93
1984	2.2	331	32	389	3	1	0	0	260	1546	717	2524	1046	3570	71
1984	2.2	311	23.5	305	1	1	0	86	272	459	240	1057	90	1147	92
1984	2.2	311	20	195	1	1	0	0	0	64	0	64	0	64	100
1984	2.2	311	-99	-99	1	1	0	0	542	0	0	542	0	542	100
1984	2.2	311	22.5	223	1	1	0	0	0	0	0	0	1088	1088	0
1984	2.2	313	17	121	3	1	0	0	0	0	0	0	0	0	0
1984	2.2	313	18.5	140	2	1	0	0	106	0	0	106	0	106	100
1984	2.2	313	17.5	120	2	1	0	0	0	0	0	0	0	0	0
1984	2.2	313	17.5	150	2	1	0	0	28	24	0	53	151	205	26
1984	2.2	313	18.5	162	1	1	0	191	140	99	217	647	111	758	85
1984	2.2	313	19	158	2	1	0	0	0	0	0	0	0	0	0
1984	2.2	313	18	141	2	1	0	0	0	89	0	89	0	89	100
1984	2.2	313	17	130	1	1	0	0	0	0	0	0	0	0	0
1984	2.2	313	20	215	1	1	0	0	128	0	0	128	166	294	44
1984	2.2	313	20	216	1	1	0	0	418	54	0	473	89	563	84
1984	2.2	313	19.5	183	2	1	0	0	30	59	0	89	107	197	46
1984	2.2	233	27.5	262	2	1	0	0	0	290	80	371	0	371	100
1984	2.2	233	29	396	2	1	0	0	0	233	0	233	102	335	69
1984	2.1	163	38	681	1	1	98	0	0	128	0	226	0	226	100
1984	2.1	163	42.8	1098	2	1	287	0	0	132	0	420	58	478	88
1984	2.1	163	41	919	2	1	0	0	477	82	273	832	254	1086	77
1984	2.1	163	43.5	1050	2	1	0	0	303	165	201	670	549	1220	55
1984	2.1	163	47	1264	2	1	0	0	0	0	0	0	1080	1080	0
1984	2.1	163	46	1549	2	1	0	0	0	0	0	0	2553	2553	0
1984	2.1	163	38	782	2	1	175	0	0	191	208	575	377	953	60
1984	2.1	163	39	967	2	1	275	0	175	247	250	948	92	1041	91
1984	2.1	163	38	682	2	1	0	0	474	474	0	948	190	1138	83
1984	2.1	163	48	1469	2	1	0	0	0	334	0	334	0	334	100
1984	2.1	163	59.5	2658	2	1	0	0	432	867	0	1300	0	1300	100
1984	2.1	163	45	1363	2	1	0	0	162	386	146	694	37	731	95
1984	2.1	163	34	614	2	1	0	0	269	81	0	351	0	351	100

File: LEAD | Page
Report: VIEW REPORT

YEAR	SITE	SP.	L.(CM)	WT(G)	SEX	TIS	ME2ET2	MEET3	ET4	ET3	ET2	S.ALK.	PB	S.TPB.	PERC
1984	2.1	163	51.5	1527	1	1	0	0	195	589	0	784	235	1020	77
1984	2.1	163	46	1594	1	1	0	0	186	150	0	336	0	336	100
1984	2.1	163	49	1565	2	1	73	0	223	303	0	599	132	731	82
1984	2.1	163	41	823	1	1	0	0	0	0	0	0	334	334	0
1984	2.1	163	47	1215	2	1	0	0	0	58	0	58	0	58	100
1984	2.1	163	43	1013	2	1	35	0	60	278	123	496	0	496	100
1984	2.1	177	56	1997	2	1	0	0	0	153	0	153	0	153	100
1984	2.1	177	49	1627	2	1	0	0	0	0	0	0	245	245	0
1984	2.1	177	57	2483	2	1	0	0	234	0	0	234	68	302	78
1984	2.1	177	50	1902	2	1	0	0	0	0	0	0	148	148	0
1984	2.1	177	62	3422	1	1	0	0	106	0	0	106	21	127	83
1984	2.1	177	58.5	2457	2	1	0	0	134	0	261	396	549	945	42
1984	2.1	177	58	3034	2	1	113	0	411	0	0	524	110	634	83
1984	2.1	177	66	2967	2	1	0	0	0	0	0	0	0	0	0
1984	2.1	177	56.2	2373	2	1	0	0	389	155	0	544	0	544	100
1984	2.1	177	51.5	2324	2	1	0	0	553	271	0	825	0	825	100
1984	2.1	331	26	280	2	1	0	0	217	110	0	328	1078	1406	23
1984	2.1	311	23	262	2	1	0	0	0	0	0	0	0	0	0
1984	2.1	311	21	204	2	1	75	0	0	0	0	75	426	502	15
1984	2.1	311	20	183	3	1	0	0	0	0	0	0	0	0	0
1984	2.1	311	21	204	2	1	0	0	363	0	0	363	0	363	100
1984	2.1	311	25	174	1	1	0	0	0	0	0	0	0	0	0
1984	2.1	311	20.5	199	2	1	0	0	0	0	0	0	0	0	0
1984	2.1	316	26	361	2	1	0	0	0	0	0	0	0	0	0
1984	2.1	316	31	441	2	1	0	0	0	0	0	0	0	0	0
1984	2.1	186	51	1958	2	1	0	0	0	0	186	186	335	521	36
1984	2.1	186	64	3653	1	1	0	0	0	0	0	0	0	0	0
1984	2.1	186	69.5	5036	1	1	0	0	467	327	0	794	0	794	100
1984	2.1	186	77	8296	2	1	0	0	0	183	0	183	0	183	100
1984	2.1	186	58	2942	2	1	0	0	0	134	0	134	0	134	100
1984	2.1	186	69.5	4470	2	1	0	0	465	258	0	723	0	723	100
1984	2.1	313	16	136	3	1	0	0	0	0	0	0	0	0	0
1984	2.1	313	16	120	3	1	0	0	0	0	0	0	0	0	0
1984	2.1	313	17.5	121	3	1	0	0	0	0	0	0	0	0	0
1984	2.1	313	18	159	3	1	0	0	0	0	0	0	292	292	0
1984	2.1	313	19.5	120	2	1	0	0	0	0	0	0	104	104	0
1984	2.1	313	19	172	2	1	0	0	0	0	0	0	0	0	0
1984	2.1	313	18	150	2	1	0	0	0	0	0	0	0	0	0
1984	2.1	313	17	145	2	1	0	0	0	0	0	0	0	0	0
1984	2.1	313	17	119	2	1	0	0	0	0	0	0	0	0	0
1984	2.1	313	16.5	110	2	1	0	0	0	0	0	0	0	0	0
1984	2.1	313	19	152	1	1	0	0	0	0	0	0	0	0	0
1984	2.1	313	17	154	2	1	0	0	0	0	0	0	0	0	0
1984	2.1	233	35	544	3	1	0	0	0	0	0	0	60	60	0
1984	2.1	233	29.5	472	2	1	181	0	0	216	0	398	179	577	69
1984	2.1	233	30.5	442	1	1	0	0	0	104	0	104	0	104	100
1984	2.1	233	34	616	2	1	0	0	117	174	0	291	79	370	79
1984	2.1	233	30	415	2	1	0	0	0	0	0	0	0	0	0
1984	2.1	233	31	466	2	1	0	0	0	103	0	103	0	103	100
1984	2.1	233	28	424	2	1	0	0	0	164	0	164	0	164	100
1984	2.1	233	32.5	423	2	1	0	0	0	123	0	123	0	123	100
1984	2.1	051	53.5	1600	1	1	0	0	0	0	0	0	84	84	0
1984	2.1	051	66	3692	2	1	0	0	0	0	0	0	0	0	0
1984	2.1	051	57	2266	1	1	0	0	0	0	0	0	0	0	0
1984	2.3	163	49	1289	2	1	0	0	0	0	0	0	0	0	0

File: LEAD Page
Report: VIEW REPORT

YEAR	SITE	SP.	L.(CM)	WT(G)	SEX	TIS	ME2ET2	MEET3	ET4	ET3	ET2	S.ALK.	PB	S.TPB.	PERC
1984	2.3	163	45	1156	2	1	0	0	177	0	0	177	81	258	69
1984	2.3	163	51	1481	1	1	0	0	0	248	0	248	450	698	36
1984	2.3	163	48	1263	2	1	0	0	0	0	0	0	0	0	0
1984	2.3	163	48	1302	2	1	0	0	128	0	0	128	0	128	100
1984	2.3	163	50	1627	2	1	0	0	0	0	0	0	0	0	0
1984	2.3	163	41	986	1	1	0	0	930	811	585	2326	0	2326	100
1984	2.3	163	41.5	950	2	1	0	0	0	48	0	48	0	48	100
1984	2.3	163	48.5	1217	2	1	0	0	24	0	0	24	0	24	100
1984	2.3	163	49	1574	1	1	0	0	0	0	0	0	0	0	0
1984	2.3	163	45	1276	1	1	0	0	0	0	0	0	90	90	0
1984	2.3	163	50	1708	1	1	0	0	113	86	79	278	0	278	100
1984	2.3	163	44	1103	1	1	0	0	0	0	0	0	0	0	0
1984	2.3	163	43	1027	2	1	0	0	0	61	0	61	0	61	100
1984	2.3	163	43	889	1	1	0	0	0	0	0	0	232	232	0
1984	2.3	177	23	163	2	1	0	0	0	0	0	0	5461	5461	0
1984	2.3	177	53	2181	2	1	0	0	0	0	0	0	345	345	0
1984	2.3	177	53.5	2300	2	1	0	0	0	0	0	0	0	0	0
1984	2.3	177	51	1625	1	1	0	0	106	48	0	155	98	253	61
1984	2.3	177	53	1826	2	1	0	0	0	0	0	0	0	0	0
1984	2.3	177	52	1481	2	1	0	0	0	0	0	0	0	0	0
1984	2.3	177	51	1389	2	1	0	0	0	0	0	0	34	34	0
1984	2.3	177	50.5	-99	2	1	0	0	0	0	0	0	0	0	0
1984	2.3	331	20.5	104	3	1	0	0	0	0	0	0	192	192	0
1984	2.3	331	18	157	2	1	0	0	0	0	0	0	0	0	0
1984	2.3	331	22.5	144	3	1	0	0	0	0	0	0	0	0	0
1984	2.3	316	23	174	2	1	0	0	0	0	0	0	0	0	0
1984	2.3	316	28	282	1	1	0	0	0	0	0	0	0	0	0
1984	2.3	316	38	865	1	1	0	0	0	0	0	0	0	0	0
1984	2.3	316	27	259	2	1	0	0	0	0	0	0	0	0	0
1984	2.3	316	25	209	3	1	0	0	0	0	0	0	976	976	0
1984	2.3	316	37.5	734	2	1	0	0	0	0	0	0	0	0	0
1984	2.3	316	32.5	514	2	1	0	0	0	0	0	0	0	0	0
1984	2.3	313	15	88	2	1	0	0	0	0	0	0	0	0	0
1984	2.3	313	14.6	78	2	1	0	0	0	0	0	0	108	108	0
1984	2.3	233	27.5	299	2	1	0	0	0	0	0	0	292	292	0
1984	2.3	233	24	232	2	1	0	0	0	0	0	0	160	160	0
1984	2.3	233	23	228	1	1	0	0	0	0	0	0	0	0	0
1984	2.3	233	25.5	213	3	1	0	0	0	0	0	0	0	0	0
1984	2.3	233	24	233	2	1	0	0	0	0	0	0	243	243	0
1984	2.3	233	26	256	2	1	0	0	0	0	0	0	0	0	0
1984	2.4	163	54.2	1600	4	3	0	0	159	1335	280	1774	217	1991	89
1984	2.4	163	49.1	1200	4	3	0	0	0	1025	288	1313	211	1524	86
1984	2.4	163	47.3	1150	2	3	0	0	112	644	193	949	558	1507	63
1984	2.4	163	48.1	1100	2	3	0	0	116	662	132	910	265	1175	77
1984	2.4	163	48.8	1375	2	3	0	0	87	1123	245	1455	358	1813	80
1984	2.4	163	42.8	975	1	3	0	0	0	592	136	728	333	1061	69
1984	2.4	163	41.4	950	1	3	0	0	216	654	135	1005	175	1180	85
1984	2.4	331	27.4	150	2	3	0	0	106	374	80	560	302	862	65
1984	2.4	331	26.8	150	2	3	0	0	0	1314	184	1499	424	1923	78
1984	2.4	331	26.4	150	2	3	0	0	47	286	41	374	133	507	74
1984	2.4	331	24.3	200	2	3	0	0	0	461	135	596	462	1058	56
1984	2.4	331	25.1	175	2	3	0	0	0	404	94	498	981	1479	34
1984	2.4	186	84	11200	2	3	0	0	2489	836	475	3801	0	3801	100
1984	2.4	186	67.4	7250	2	3	0	0	2848	273	73	3194	90	3284	97
1984	2.4	186	72.9	5000	2	3	0	0	971	166	0	1138	0	1138	100

File: LEAD

Report: VIEW REPORT

YEAR	SITE	SP.	L.(CM)	WT(G)	SEX	TIS	ME2ET2	MEET3	ET4	ET3	ET2	S.ALK.	PB	S.TPB.	PERC
1984	2.4	186	67.8	5100	1	3	39	4402	15458	2587	657	23143	433	23576	98
1984	2.4	186	87.1	10600	2	3	0	144	819	242	81	1286	94	1380	93
1984	2.4	233	31.7	500	1	3	0	0	0	1504	668	2172	183	2355	92
1984	2.4	233	27.2	300	1	3	0	0	0	1365	519	1885	138	2023	93
1984	2.4	233	27.9	250	1	3	0	0	61	757	358	1176	375	1551	76
1984	2.4	233	30.3	375	2	3	0	0	0	1292	553	1845	360	2205	84
1984	2.4	233	27.6	300	2	3	0	0	0	1342	746	2088	445	2533	82
1984	2.4	233	28.2	375	1	3	0	0	0	1000	359	1359	251	1610	84
1984	2.4	233	27.2	300	2	3	0	0	32	1369	250	1651	262	1913	86
1984	2.4	233	26.8	300	2	3	0	0	87	400	144	632	0	632	100
1986	2.4	186	73.5	5949	1	1	0	0	114	93	0	207	171	378	55
1986	2.4	186	74	6090	1	1	0	0	0	0	0	0	72	72	0
1986	2.4	186	70.5	5060	1	1	0	0	0	0	0	0	32	32	0
1986	2.4	186	70.0	5103	1	1	0	0	0	0	0	0	42	42	0
1986	2.4	186	81.0	7708	2	1	0	0	0	0	0	0	25	25	0
1986	2.4	186	73.0	6222	1	1	0	0	718	173	0	891	161	1052	85
1986	2.4	186	68.8	4701	1	1	0	0	1883	197	0	2080	137	2217	94
1986	2.4	186	78.0	7797	1	1	0	0	0	0	0	0	61	61	0
1986	2.4	186	69.0	5511	1	1	0	2757	7731	1552	194	12234	1382	13616	90
1986	2.4	186	77.5	6685	2	1	0	0	201	0	0	201	198	399	50
1986	2.4	331	-99	-99	4	1	0	0	0	0	0	0	79	79	0
1986	2.4	331	-99	-99	4	1	0	0	0	0	0	0	67	67	0
1986	2.4	331	-99	-99	4	1	0	0	0	0	0	0	88	88	0
1986	2.4	331	-99	-99	4	1	0	0	0	0	0	0	45	45	0
1986	2.4	331	-99	-99	4	1	0	0	0	0	0	0	91	91	0
1986	2.4	163	50.0	1550	3	1	0	0	47	61	0	108	428	536	20
1986	2.4	163	52.0	1542	2	1	0	0	125	84	21	230	538	768	30
1986	2.4	163	48.0	1285	3	1	0	0	0	0	0	0	76	76	0
1986	2.4	163	47.5	1104	3	1	0	0	34	361	96	491	534	1025	50
1986	2.4	331	47.8	1274	3	1	0	0	0	0	0	0	0	0	0
1986	2.4	233	33.0	671	3	1	0	0	0	22	0	22	408	430	5
1986	2.4	233	34	689	2	1	0	0	0	0	0	0	242	242	0
1986	2.4	233	29.0	336	2	1	0	0	67	268	50	385	590	975	39
1986	2.4	233	28.5	346	2	1	0	0	0	0	0	0	135	135	0
1986	2.4	233	26	287	2	1	0	0	0	19	0	19	204	223	6
1987	2.2	233	29.5	361	2	1	0	0	0	99	50	149	926	1075	14
1987	2.2	233	32.5	446	2	1	0	0	0	0	0	0	730	730	0
1987	2.2	233	27.5	301	2	1	0	0	0	0	0	0	319	319	0
1987	2.2	331	28.0	275	3	1	0	0	0	0	0	0	232	232	0
1987	2.2	331	25.0	244	3	1	0	0	0	0	0	0	262	262	0
1987	2.2	331	28.0	288	3	1	0	0	0	0	0	0	1449	1449	0
1987	2.2	163	51.0	1675	2	1	0	0	0	0	0	0	812	812	0
1987	2.2	163	51.5	1512	1	1	0	0	0	0	0	0	358	358	0
1987	2.2	163	50.0	1598	1	1	0	0	0	50	0	50	593	643	8
1987	2.2	163	52.5	1769	2	1	0	0	0	0	0	0	371	371	0
1987	2.2	186	68.5	4781	1	1	0	0	0	24	0	24	1074	1098	2
1987	2.2	186	71.0	7938	2	1	0	263	3290	492	245	4290	2336	6626	65
1987	2.2	186	81.2	7625	2	1	0	0	0	0	0	0	76	76	0
1987	2.2	186	68.6	5514	1	1	0	0	0	0	0	0	128	128	0
1987	2.2	186	84.0	8630	2	1	0	0	35	28	0	63	146	209	30
1987	2.2	186	76.5	7184	1	1	0	0	8	24	0	32	270	302	10
1987	2.2	186	67.2	4116	1	7	0	0	0	0	0	0	58	58	0
1987	2.2	186	67.2	4116	1	2	0	0	29	43	11	83	149	232	36
1987	2.2	186	67.2	4116	1	8	0	0	0	0	0	0	62	62	0
1987	2.2	186	67.2	4116	1	6	0	0	27	54	28	109	158	267	41

File: LEAD Page
Report: VIEW REPORT

YEAR	SITE	SP.	L.(CM)	WT(G)	SEX	TIS	ME2ET2	MEET3	ET4	ET3	ET2	S.ALK.	PB	S.TPB.	PERC
1987	2.2	186	75.0	6800	2	7	0	0	0	0	0	0	99	99	0
1987	2.2	186	75.0	6800	2	2	0	0	30	14	19	63	123	186	34
1987	2.2	186	75.0	6800	2	8	0	0	0	0	0	0	77	77	0
1987	2.2	186	75.0	6800	2	6	0	0	18	16	10	44	143	187	24
1987	2.2	186	70.5	4864	1	7	0	0	470	22	20	512	123	635	81
1987	2.2	186	70.5	4864	1	2	0	0	127	105	68	300	439	739	41
1987	2.2	186	70.5	4864	1	8	0	0	188	129	33	350	153	503	70
1987	2.2	186	70.5	4864	1	6	0	0	492	217	158	867	596	1463	59
1987	1.9	186	48.0	1478	1	1	0	0	0	0	0	0	159	159	0
1987	1.9	186	51.5	1801	1	1	0	0	0	0	0	0	73	73	0
1987	1.9	186	52.0	1826	1	1	0	0	0	51	0	51	159	210	24
1987	1.9	186	49.0	1961	1	1	0	0	0	0	0	0	398	398	0
1987	1.9	186	48.0	1919	2	1	0	0	118	91	27	236	263	499	47
1987	1.9	186	62.0	3160	2	1	0	0	0	0	0	0	127	127	0
1987	1.9	186	51.0	2025	2	1	0	0	0	0	0	0	162	162	0
1987	1.9	163	34.0	420	2	1	0	0	0	41	0	41	159	200	20
1987	1.9	163	31.5	367	2	1	0	0	0	0	0	0	345	345	0
1987	1.9	334	39.0	575	2	1	0	0	0	0	0	0	152	152	0
1987	1.9	334	38.0	560	1	1	0	0	0	0	0	0	124	124	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX d=

THE FOLLOWING IS A DEFINITION OF THE CODES USED IN THE CLAM, MACROPHYTE, SEDIMENT AND WATER ALKYLLEAD DATA:

I. SITE= The site where the sample was collected.

SITE- 1.0 = St. Clair river system

2.0 = Maitland river system
2.1 = Off from DuPont
2.2 = Blue Church Bay
2.3 = Lily Bay
2.4 = Wells Creek

II. SP. = Type of specimen that was collected

SPECIMENT-
1 = Clam
2 = Macrophytes
3 = Sediment
4 = Subsurface water
5 = Surface microlayer water

III. TIS = Tissue type being examined. This value pertains only to clams in the file.

TISSUE-
1 = Whole Organism

IV. -99 = If this appears in any catagory it means that no data was available.

V. S.ALK = Total sum of alkylleads

VI. S.TPB = Total sum of all leads----S.ALK + PB

NOTE: ALL LEAD VALUES IN CLAMS, MACROPHYTES AND SEDIMENT ARE MEASURED IN ng/g. ALL LEAD VALUES IN WATER ug/L.
DETECTION LIMIT FOR CLAMS, MACROPHYTES, SEDIMENT AND WATER IS 8ng/g and 8ng/L.

File: CLAM ETC. LEAD Page
Report: VIEW REPORT

YEAR	SITE	SP.	FROM	N	TIS	ME2ET2	ME3	MEET3	ET4	ME2	ET3	ET2	S.ALK.	PB	S.TPB	PER
1982	2.1	1	1	1	1	0	0	0	0	0	0	0	0	280	280	0
1982	2.1	2	1	1	-99	0	0	0	68	0	132	0	200	4327	4527	4
1982	2.1	2	1	1	-99	1051	0	3613	16515	0	558	113	21850	59282	81132	27
1982	2.2	2	1	1	-99	0	0	0	0	0	0	0	0	6796	6796	0
1982	2.2	3	1	1	-99	0	0	0	0	0	0	0	0	5414	5414	0
1982	2.2	3	1	1	-99	0	0	0	0	0	0	0	0	3808	3808	0
1982	2.1	3	1	1	-99	0	0	0	329	0	0	0	329	5582	5911	6
1982	2.1	3	1	1	-99	0	0	142	1152	0	187	22	1503	-99	-99	-99
1983	2.2	1	1	1	1	0	0	0	53	0	282	0	335	1022	1357	25
1983	2.2	2	1	1	-99	0	0	0	0	0	0	0	0	2747	2747	0
1983	2.2	2	1	1	-99	0	194	0	0	0	0	0	194	2028	2222	9
1983	2.2	2	1	1	-99	0	0	0	0	0	0	0	0	3393	3393	0
1983	2.2	2	1	1	-99	0	0	0	0	0	0	0	0	1932	1932	0
1983	2.3	2	1	1	-99	0	0	0	0	0	0	0	0	855	855	0
1983	2.3	2	1	1	-99	0	0	0		0	0	0	0	676	676	0
1983	2.3	2	1	1	-99	0	0	0	0	0	0	0	0	438	438	0
1983	2.3	2	1	1	-99	0	0	0	0	0	0	0	0	184	184	0
1983	2.3	2	1	1	-99	0	0	0	0	0	0	0	0	186	186	0
1983	2.3	2	1	1	-99	0	0	0	0	0	0	0	0	181	181	0
1983	2.3	2	1	1	-99	0	0	0	0	0	0	0	0	196	196	0
1983	2.2	3	1	1	-99	0	0	0	184	0	0	0	184	739	923	20
1983	2.2	3	1	1	-99	104	136	65	71	0	0	0	376	382	758	50
1983	2.2	3	1	1	-99	57	69	26	0	0	0	0	152	269	421	36
1983	2.2	3	1	1	-99	87	73	61	0	0	0	0	221	312	533	42
1983	2.2	3	1	1	-99	263	275	168	0	0	0	0	706	0	706	100
1983	2.2	3	1	1	-99	96	76	116	0	0	0	0	288	0	288	100
1983	2.2	3	1	1	-99	77	64	0	0	0	0	0	141	64	205	69
1983	2.2	3	1	1	-99	76	0	0	0	0	0	0	76	0	76	100
1983	2.2	3	1	1	-99	29	20	0	0	0	0	0	49	399	448	11
1983	2.2	3	1	1	-99	254	192	47	0	0	0	0	493	438	931	53
1983	2.2	3	1	1	-99	140	132	33	0	0	0	0	305	474	779	39
1983	2.2	3	1	1	-99	237	185	52	91	0	0	0	665	667	1332	50
1983	2.3	3	1	1	-99	183	151	94	0	0	0		428	0	428	100
1983	2.3	3	1	1	-99	76	55	0	0	0	0	0	131	30	161	81
1983	2.3	3	1	1	-99	94	96	46	0	0	0	0	236	27	263	90
1983	2.3	3	1	1	-99	80	58	36	0	0	0	0	174	0	174	100
1983	2.2	4	1	1	-99	0	0	0	0	0	0.12	0	0.12	3.02	3.14	4
1983	2.2	5	1	1	-99	0	0	0	0	0	0.08	0	0.08	3.47	3.55	2
1983	2.1	4A	1	1	-99	0	0	0	0	0	0.34	0.06	0.40	1.36	1.76	23
1983	2.1	5A	1	1	-99	0	0	0	0	0	0.74	0.15	0.89	7.83	8.72	10
1983	2.1	4B	1	1	-99	0	0	0	0	0	0.40	0.07	0.47	2.48	2.95	16
1983	2.1	5B	1	1	-99	0	0	0	0	0	0.37	0.06	0.43	3.36	3.79	11
1983	2.1	4C	1	1	-99	0	0	0	0	0	0.16	0.04	0.20	2.23	2.43	8
1983	2.1	5C	1	1	-99	0	0	0	0	0	1.76	0.15	1.91	7.48	9.39	20
1983	2.2	4	2	1	-99	0	0	0	0	0	0.06	0.02	0.08	1.31	1.39	6
1983	2.2	4	2	1	-99	0	0	0	0	0	0.07	0.01	0.08	1.30	1.38	6
1983	2.3	4	1	1	-99	0	0	0	0	0	0	0	0	1.74	1.74	0
1983	1.0	4	1	1	-99	0	0	0	0	0	0	0	0	1.53	1.53	0
1983	1.0	5	1	1	-99	0	0	0	0	0	0	0	0	0.84	0.84	0
1983	1.0	4	1	1	-99	0	0	0	0	0	0	0	0	1.43	1.43	0

File: CLAM ETC. LEAD Page

Report: VIEW REPORT

YEAR	SITE	SP.	FROM	N	TIS	ME2ET2	ME3	MEET3	ET4	ME2	ET3	ET2	S.ALK.	PB	S.TPB	PER
1983	1.0	5	1	1	-99	0	0	0	0	0	0	0	0	1.96	1.96	0
1983	1.0	4	1	1	-99	0	0	0	0	0	0	0	0	1.02	1.02	0
1983	1.0	5	1	1	-99	0	0	0	0	0	0	0	0	1.37	1.37	0
1983	1.0	4	1	1	-99	0	0	0	0	0	0	0	0	1.13	1.13	0
1983	1.0	5	1	1	-99	0	0	0	0	0	0	0	0	7.23	7.23	0
1983	1.0	4	1	1	-99	0	0	0	0	0	0.34	0.08	0.42	2.25	2.67	16
1983	1.0	5	1	1	-99	0	0	0	0	0	0.54	0.14	0.68	8.54	9.22	7
1983	1.0	4	1	1	-99	0	0	0	0	0	0	0	0	1.32	1.32	0
1983	1.0	5	1	1	-99	0	0	0	0	0	0	0	0	1.28	1.28	0
1984	2.2	3	1	1	-99	0	0	0	154	0	79	0	233	5047	5280	4
1984	2.2	3	1	1	-99	0	0	0	72	0	80	0	152	5668	5820	3
1984	2.2	3	1	1	-99	0	0	0	37	0	83	0	120	5572	5692	2
1984	2.2	3	1	1	-99	0	0	0	38	0	82	0	120	9314	9434	1
1984	2.2	3	1	1	-99	0	0	0	100	0	93	16	209	2699	2908	7
1984	2.2	3	1	1	-99	0	0	0	123	0	107	15	245	2972	3217	8
1984	2.2	3	1	1	-99	0	0	0	101	0	48	0	149	15551	15700	1
1984	2.2	3	1	1	-99	0	0	0	86	0	52	0	138	15233	15371	1
1984	2.2	3	1	1	-99	0	0	0	97	0	51	0	148	1721	1869	8
1984	2.2	3	1	1	-99	0	0	0	0	0	0	0	0	11259	11259	0
1984	2.2	3	1	1	-99	0	0	0	25	0	18	0	43	10687	10730	0.4
1984	2.2	3	1	1	-99	0	0	0	40	0	12	0	52	11895	11947	0.4
1984	2.2	3	1	1	-99	0	0	0	10	0	0	0	10	9402	9412	0.1
1984	2.2	3	1	1	-99	0	0	0	12	0	0	0	12	9828	9840	0.1
1984	2.2	3	1	1	-99	0	0	0	0	0	0	0	0	10387	10387	0
1984	2.2	2	1	1	-99	0	59	0	187	0	0	183	429	984	1413	30
1984	2.2	2	1	1	-99	0	46	0	101	0	0	101	248	647	895	28
1984	2.2	2	1	1	-99	0	0	0	0	0	0	0	0	4596	4596	0
1984	2.2	2	1	1	-99	0	0	0	0	0	0	0	0	4778	4778	0
1984	2.2	2	1	1	-99	0	0	0	0	0	38	0	38	2840	2878	1
1984	2.2	2	1	1	-99	0	0	0	0	0	0	0	0	1926	1926	0
1984	2.2	2	1	1	-99	0	0	0	0	0	0	0	0	550	550	0
1984	2.2	2	1	1	-99	0	0	0	0	0	0	0	0	3000	3000	0
1984	2.2	2	1	1	-99	0	0	0	0	0	0	0	0	1064	1064	0
1984	2.2	2	1	1	-99	0	0	0	0	0	0	0	0	1281	1281	0
1984	2.2	2	1	1	-99	0	6	0	0	0	0	0	6	187	193	3
1984	2.2	2	1	1	-99	0	18	0	0	0	0	0	18	392	410	4
1984	2.2	2	1	1	-99	0	0	0	0	0	0	0	0	71	71	0
1986	2.2	3	1	1	-99	0	0	0	0	0	0	0	0	177	177	0
1986	2.2	3	1	1	-99	0	0	0	0	0	0	0	0	189	189	0
1986	2.2	3	1	1	-99	0	0	0	0	0	0	0	0	221	221	0
1986	2.2	3	1	1	-99	0	0	0	0	0	0	14	14	200	214	6
1986	2.2	3	1	1	-99	0	0	0	0	0	0	0	0	305	305	0
1986	2.1	3	1	1	-99	0	0	0	0	0	0	0	0	425	425	0
1986	2.1	3	1	1	-99	0	0	0	0	0	0	0	0	612	612	0
1986	2.4	3	1	1	-99	0	0	0	0	0	0	0	0	180	180	0
1986	2.4	3	1	1	-99	0	0	0	0	0	0	0	0	136	136	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0