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An Investigation of the Dioxin/Furan Concentrations in the Sediments of Eighteenmile Creek and the Erie Canal Near Lockport, New York

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AN INVESTIGATION OF THE DIOXIN/FURAN CONCENTRATIONS IN THE SEDIMENTS OF EIGHTEENMILE CREEK AND THE ERIE CANAL NEAR LOCKPORT, NEW YORK

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ABSTRACT

Eighteenmile Creek is a small stream in New York State that empties into Lake Ontario 35.5 km east of the Niagara River. Elevated levels of dioxins and furans have been identified in carp, crayfish and sediments of Eighteenmile Creek. An investigation was initiated to identify the source(s) of these contaminants. Sediments were collected from Eighteenmile Creek, the Erie Canal and many other connecting water bodies. They were analyzed for dioxin/furan homologs and 2,3,7,8-substituted congeners. By evaluating the absolute concentrations of the dioxins and furans, their toxic equivalences and percent abundance patterns it has been determined that the bulk of the dioxin/furan levels in the sediments of Eighteenmile Creek migrate from the Erie Canal. There are several potential sources of dioxins and furans in the Lockport vicinity that may have contaminated the canal sediments.

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EXECUTIVE SUMMARY

Eighteenmile Creek is a small stream in Niagara County that headwaters near Lockport, then flows north, emptying into Lake Ontario at Olcott. Much of the flow in Eighteenmile Creek is augmented by Erie Canal water. During the late 1980's and as part of the EPA's National Bioaccumulation Study, two whole body carp samples were submitted from Olcott Harbor for dioxin and furan analyses. The concentrations of 2,3,7,8-TCDD in these composites (32.01 and 33.70 pg/g) were well above NYSDEC's consumption advisory limit (based on filets) of 10 pg/g and the piscivorous protection guidance (based on whole body) of 2.3 pg/g.

These analytical results triggered a four year (1989-1992) study in and around Eighteenmile Creek, the Erie Canal, and Lockport. This investigation was intended to determine if there were concentrations of dioxins and/or furans in these waterbodies that were of environmental or regulatory significance and if so, attempt to identify the source(s) of these contaminants to Eighteenmile Creek.

For this study thirty-four sediment samples, seven fish composites, one macroinvertebrate and one water sample were collected. They were analyzed for dioxin/furan homologs, and 2,3,7,8-substituted congeners. By evaluating the absolute concentrations of the dioxins and furans, their toxic equivalences and percent abundance patterns the following observations were made:

- The highest absolute concentrations of dioxin and furan were found in the Erie Canal in the middle of Lockport. These concentrations are considered "levels of concern" as the toxic equivalents are considerably higher than the sediment guidelines available for comparison. These sediments are a likely source of dioxins and furans to Eighteenmile Creek.

- The majority of the sediment samples demonstrated the OCDD dominated percent abundance pattern which is common in sediments and characteristic of multiple combustion sources.

- Three congeners (OCDD, 1,2,3,4,6,7,8-HpCDD and 1,2,3,4,6,7,8-HpCDF) dominate the toxicity of the dioxins and furans detected in the sediment samples.

- The congener and homolog percent abundance patterns at the Threemile Island sampling site are notably different from any other ambient sediment sample collected for this project. The meaning of this is unknown.

- There are several sites in the Erie Canal at Lockport that demonstrate significant shifts in the dioxin/furan percent abundance patterns. This could indicate several local sources.

- There were lower background levels of dioxin/furan identified in the sediments of other Lake Ontario tributaries that receive a substantial portion of their flow from the Erie Canal.

It is recommended that the source(s) of dioxins and furans to the sediments in the Erie Canal at Lockport be better defined. This effort would be resource intensive, not only due to the substantial analytical cost, but because a study of this nature would require multidiscipline participation.

BACKGROUND

Eighteenmile Creek and its tributaries drain approximately 259 square kilometers of relatively flat terrain in northwestern New York State. This drainage basin is located entirely within Niagara County and includes the city of Lockport and the smaller population centers of Burt, Gasport, Newfane and Olcott. Eighteenmile Creek empties into Lake Ontario about 35.5 km east of the Niagara River. (Figure 1).

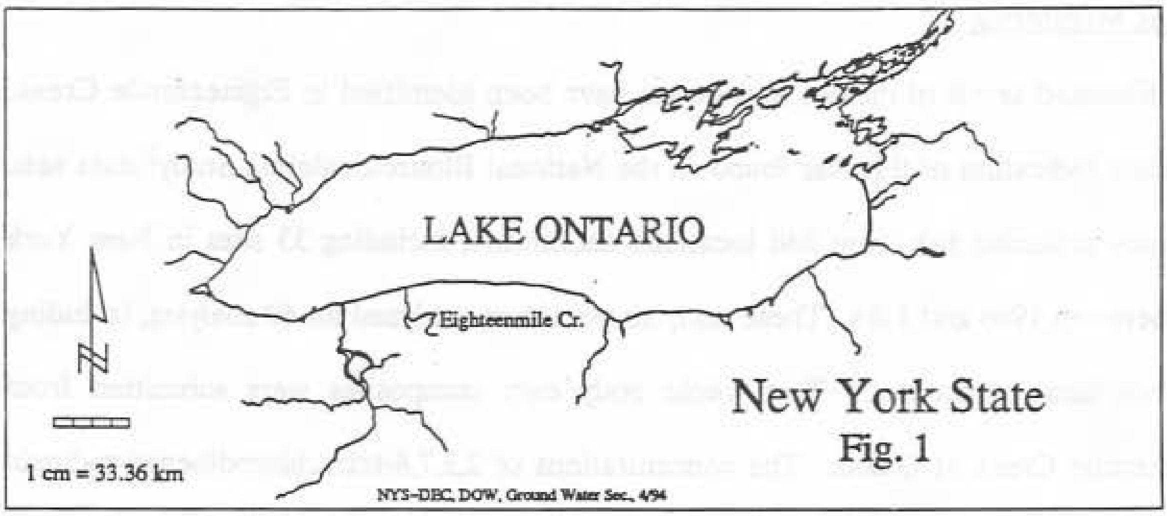


Fig. 1

The natural flow of the main stem of the creek and the East Branch tributary are augmented by water from the Erie Canal. The composition of this canal water can be as much as 90 percent Niagara River water with most of the balance coming from Tonawanda and Ellicott Creeks (personal communication D. Schneeberger, NYSDOT).

The flow of Eighteenmile Creek's main stem is interrupted by three dams. The ones at Lockport and Newfane are old hydromechanical electric generating plants which are now abandoned. The Burt Dam is a newly refurbished run-of-the-river hydro-electric facility (personal communication M. Stankiewicz, NYSDEC).

Several industries are located within the drainage basin. These include Harrison Division of GMC, AKZO Chemicals, Van de Mark Chemicals, Twin Lake Chemical and Milward Alloys. Only one of these (Harrison Division, GMC) currently discharges process wastewater to Eighteenmile Creek in a tributary known as the Gulf. The City of Lockport sewage treatment plant also discharges treated effluent to the main stem of the creek. The Gasport STP discharges to the East Branch tributary[1].

Previous Monitoring

Elevated levels of dioxins and furans have been identified in Eighteenmile Creek. The initial indication of this was found in the National Bioaccumulation Study[2] data sets. This study collected fish from 388 locations nationwide, including 33 sites in New York State, between 1986 and 1989. These samples were then analyzed for 60 analytes, including 15 dioxin/furan congeners. Two whole body carp composites were submitted from Eighteenmile Creek at Olcott. The concentrations of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) in these composites were 32.01 and 33.70 pg/g, the respective EPA toxic equivalents were 39.87 and 56.69 pg/g. (The NYS Department of Health's guidance value for 2,3,7,8-TCDD or toxic equivalents in fish fillets which will trigger a consumption advisory is 10 pg/g. The NYS Department of Environmental Conservation's guidance for the protection of piscivorous wildlife is 2.3 pg/g of 2,3,7,8-TCDD). These concentrations of 2,3,7,8-TCDD represent the two highest values for the New York locations that were monitored for the National Bioaccumulation Study, while the values of the toxic equivalents are two of the three highest. This information indicated that, as far as New York waters were concerned, Eighteenmile Creek was a prime site to further investigate dioxins/furans.

More information came from a 1988 New York State Department of Health Report detailing results from a 1986-1987 sampling survey for dioxins, furans and other priority pollutants at 20 community water systems[3]. Treated drinking water samples were collected and analyzed. The only quantified levels for dioxins or furans came from the City of Lockport, where two polychlorinated dibenzofurans were identified at one part per quadrillion. A follow-up study[4] revealed that tetra- to octa-chlorinated dibenzo dioxins and chlorinated dibenzo furans were detected at parts-per-trillion to parts-per-billion concentrations in the sedimentation basin sludge and in the pump station wet well sediments within the Lockport Water Treatment Plant.

These indications of a potential dioxin/furan problem in Eighteenmile Creek led to ambient monitoring by the Bureau of Monitoring and Assessment. In August of 1989, a water column sample was collected from Eighteenmile Creek near the hamlet of Corwin. The analytical results showed a concentration of total dioxins to be greater than 950 pg/l and the total furans more than 77 pg/l. The 2,3,7,8-TCDD concentration was less than detection (<4.3 pg/l) (unpublished data, Estabrooks, NYSDEC). In July of 1990, a crayfish was collected near the Village of Newfane and submitted for tissue analysis. The results showed over 408 pg/g (dry wt.) of total dioxin, over 610 pg/g (dry wt) of total furan and 6.6 pg/g (dry wt) of 2,3,7,8-TCDD (unpublished data, Bode, Novak, Abele, NYSDEC). During July and October of 1990, bottom sediment samples were collected in Eighteenmile Creek at North Transit Road, Condren Road and from behind the Newfane Dam. (See Figure 2, pg. 10).

The results are listed as follows:

TABLE 1

	Total Dioxins	Total Furans	2,3,7,8-TCDD	EPA TEF[5]
N. Transit Rd.	16,850[11]	3,120	<.67	116.3
Condren Road	26,558[12]	5,403	<1.2	177.3
Newfane Dam	34,793	7,780	<.91	282.1

All values in pg/g (PPT)
(Unpublished data, Bode, Estabrooks, NYSDEC)

This fundamental monitoring reinforced the results of the National Bioaccumulation Study that there are "levels of concern" of dioxins and furans in Eighteenmile Creek.

SAMPLING STRATEGY

Sediments play an important role in the physical movement and biological fate of substances such as dioxin and furan. Because of their low solubility in water, sediments can function as a primary sink for these hydrophobic compounds. Concentrations several orders of magnitude greater than those found in water column can occur in the bottom sediments. Because sediments are also useful in determining the spatial extent of a contaminant and in tracking pathways, they were selected as the sampling medium of choice for this project.

Sampling locations for this project were determined by using a systematic approach to broaden or focus the sampling pattern depending on results of previous sampling. This investigative sequence, hopefully, resulted in a logical step-by-step approach to gather the required information in a manner that economized available analytical and personnel resources.

A drawback of interpreting information from the canal system sediments is that most canal segments are dredged or affected by dredging activities. The lower Tonawanda Creek portion of the Erie Canal flows to the east during the navigation season and to the west during the remainder of the year. The canal near Lockport is isolated by gates during the non-navigation season. These factors complicate the sediment transport and deposition patterns and any evaluation of analytical results.

To augment the sediment data, fish (bass and carp) were collected from the Erie Canal, Eighteenmile Creek and Tonawanda Creek for tissue analysis.

SAMPLING METHODS

The water column sample was collected by directly immersing a 9.3 liter glass bottle through the water column. This container was filled within 3 cm of the top then capped with a stopper. The glass container and stopper were prepared by the New York State Department of Health, Wadsworth Center, Laboratory of Organic Analytical Chemistry.

The macroinvertebrate (crayfish) sample was collected in an aquatic net using the travelling kick method of sampling. The sample was placed into a collection jar with a little stream water then put on ice. Back in the macroinvertebrate laboratory, the sample was frozen then freeze dried for submittal to the analytical laboratory. Further information is documented in the Quality Assurance Work Plan for Biological Stream Monitoring in New York State (NYSDEC, 1991).

The fish samples were collected by electrofishing. Standard fillets were prepared. These were then placed in plastic bags and frozen until processed for delivery to the Analytical Laboratory. For further details, consult the Statewide Toxic Substance Monitoring Program. (NYSDEC 1988).

Several methods were used to collect sediment samples. The Petit Flume sample was collected directly into the sample container (1 pint glass jar prepared by the NYSDOH laboratory) using a stainless steel spoon. The Pendleton Gate sample was collected using a core tube (because of standing water), then transferred to a stainless steel bucket and subsampled into the sample container. The Exchange Street, Main Street Bridge, North Transit Road and Condren Road samples plus the samples from Twelvemile Creek, Johnson Creek, West Branch of Sandy Creek and the Salmon Creek were obtained using a Teflon®-coated scoop to collect a surficial composite into a stainless steel or teflon bucket. This composite was then subsampled into the sample containers. The remaining sediment samples were collected using a Petite Ponar dredge. These samples were then deposited in a stainless steel bucket and subsequently subsampled into the appropriate containers.

In a given area, the highest concentrations of dioxins and furans would tend to accumulate in those sediments with the greatest organic content. To minimize analytical "non-detects" highly organic sediment samples were sought at each site.

All sampling equipment was thoroughly decontaminated prior to use and between sample collections. The following decontamination procedure was used; a soap and water scrub, a deionized water rinse and then a double rinse with acetone.

All pint glass sample containers were prepared by the Laboratory of Organic Analytical Chemistry in the New York State Department of Health.

ANALYTICAL PROTOCOLS

Samples for polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofuran analyses were Soxhelet-extracted with hexane, Kuperna-Danish concentrated followed by alumina cleanup. Identification and quantification was accomplished using high resolution gas chromatograph/high resolution mass spectrometer using isotopically labeled internal standards. Further details are documented in Analytical Protocol for the Determination of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by High Resolution Gas Chromatograph/High Resolution Mass Spectrometry (NYSDOH, 1991).

Total volatile solids were determined by placing the dry residue from the percent dry solids procedure in a muffle furnace at 550 °C for one hour. The procedure and calculations are detailed in Pretreatment and Digestion of Sludge, Sediment and Soil Samples (NYSDOH, not dated).

For the calculation of total organic carbon (low level), the purgeable organics were oxidized with acidified persulfate reagent while the nonpurgeable fraction was subjected to intense ultraviolet illumination. After further treatment, these two factions were integrated to produce a value for total organic carbon. For further details, consult EPA method 415.2.

RESULTS

The results of the initial (1990) sediment sampling effort in Eighteenmile Creek (Table 1, Figure 2) indicated that a significant portion of the dioxin/furan contamination is caused by conditions upstream of North Transit Road. Since the Erie Canal intersection is just upstream and because much of Eighteenmile Creek's flow is augmented from the canal, the next sediment samples were collected (in July 1991) at locations just above and just below the canal's confluence with the main stem and the East Branch of Eighteenmile Creek. The results (Table 2) indicate that the canal is a likely contributor of dioxins and furans.

Table 2

	Total Dioxins	Total Furans	2,3,7,8-TCDD	EPA TEF
Main Stem Upstream of Canal (Remick Pkwy)	560/388*	64/44*	<5.8	3.76/2.60*
Main Stem Downstream of Canal (Clinton Street)	10,705	2,396	<5.3	103.16
East Branch Upstream of Canal (Gasport Rd)	766/406*	117/62	<7.5	4.13/2.19*
East Branch Downstream of Canal	1787	514	<4.2	20.63

All values pg/g (PPT)
*Result normalized to Total Volatile Solids of 9%

The analytical results for the bottom sediments from Clinton Street, North Transit Road, Condren Road and Newfane Dam show increasing concentrations of dioxins and furans in the downstream stations (Figure 3). This could indicate several circumstances, for example, sources between the sampling sites, preferential depositional areas caused by hydraulic conditions or variability of organic matter in the bottom sediment.

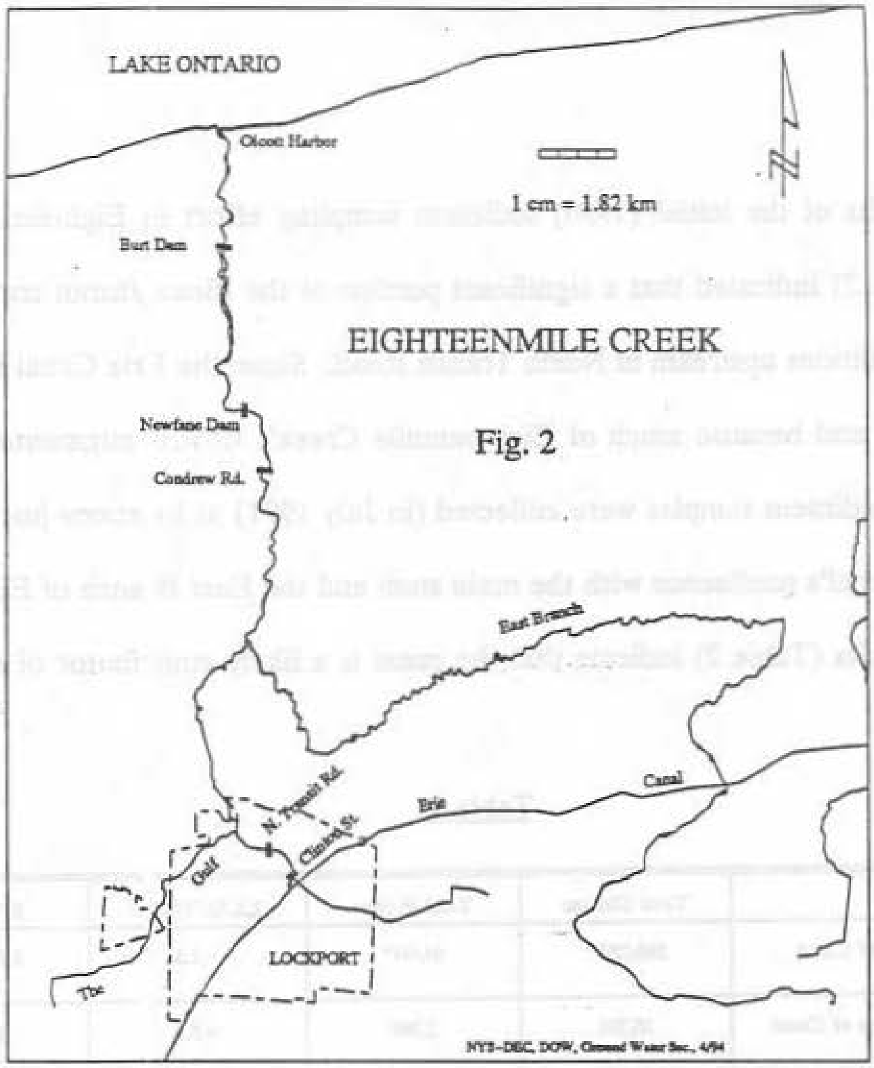
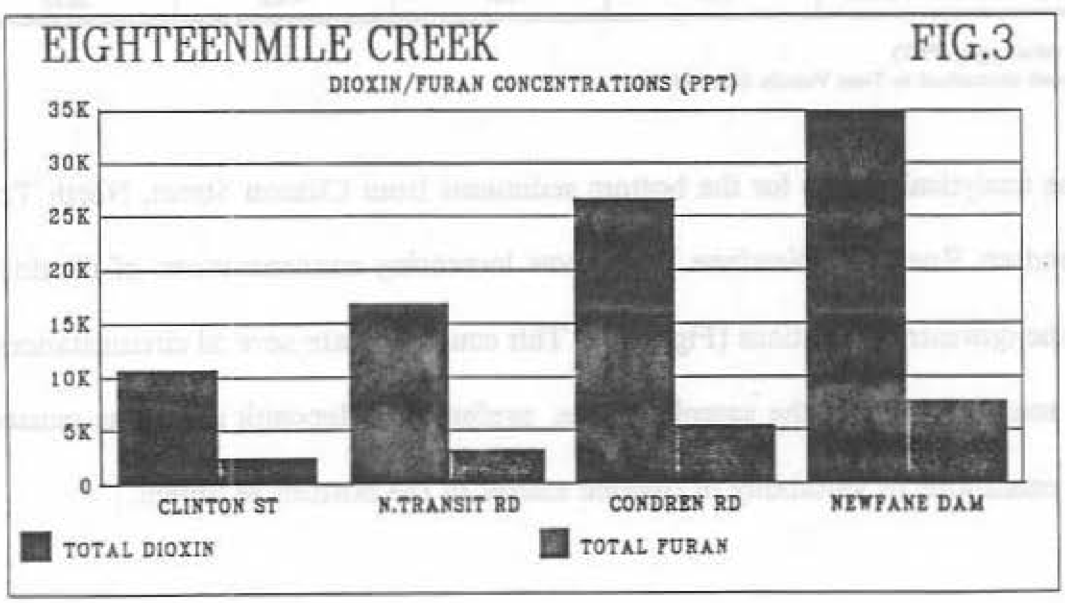
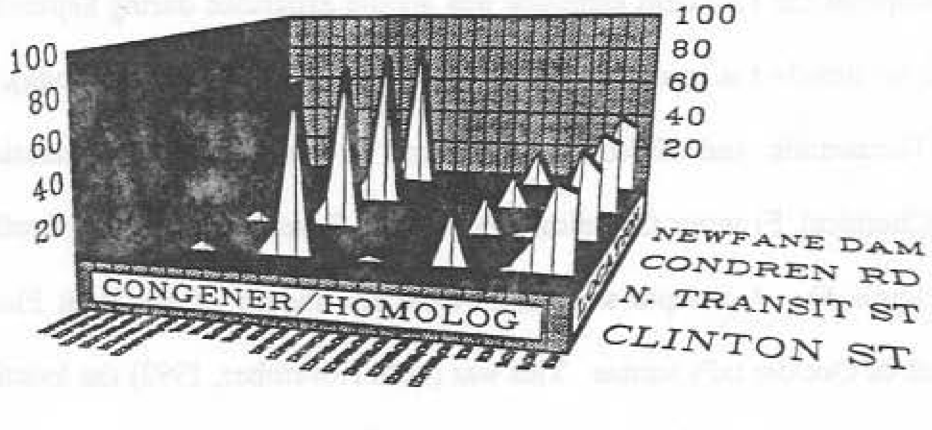

LAKE ONTARIO
Olcott Harbor
1 cm = 1.82 km
N
Burt Dam
EIGHTEENMILE CREEK
Newfane Dam
Condrew Rd.
East Branch
N. Transit Rd.
Erie
Canal
Clinton St.
Gulf
LOCKPORT
NYS-DEC, DOW, Ground Water Sec., 4/94

Fig. 2


EIGHTEENMILE CREEK
FIG.3
DIOXIN/FURAN CONCENTRATIONS (PPT)
35K
30K
25K
20K
15K
10K
5K
0
CLINTON ST
N.TRANSIT RD
CONDREN RD
NEWFANE DAM
TOTAL DIOXIN
TOTAL FURAN

Normalizing the results from Clinton Street, North Transit and Condren Roads (no characterization data are available for the Newfane Dam site) using the total volatile solids and total organic carbon results decreases or eliminates the increasing concentrations at the downstream sites (Appendix B). The percent abundance patterns of the dioxin and furan congeners and homologs for all the Eighteenmile Creek bottom sediment samples appear very similar (Figure 4).



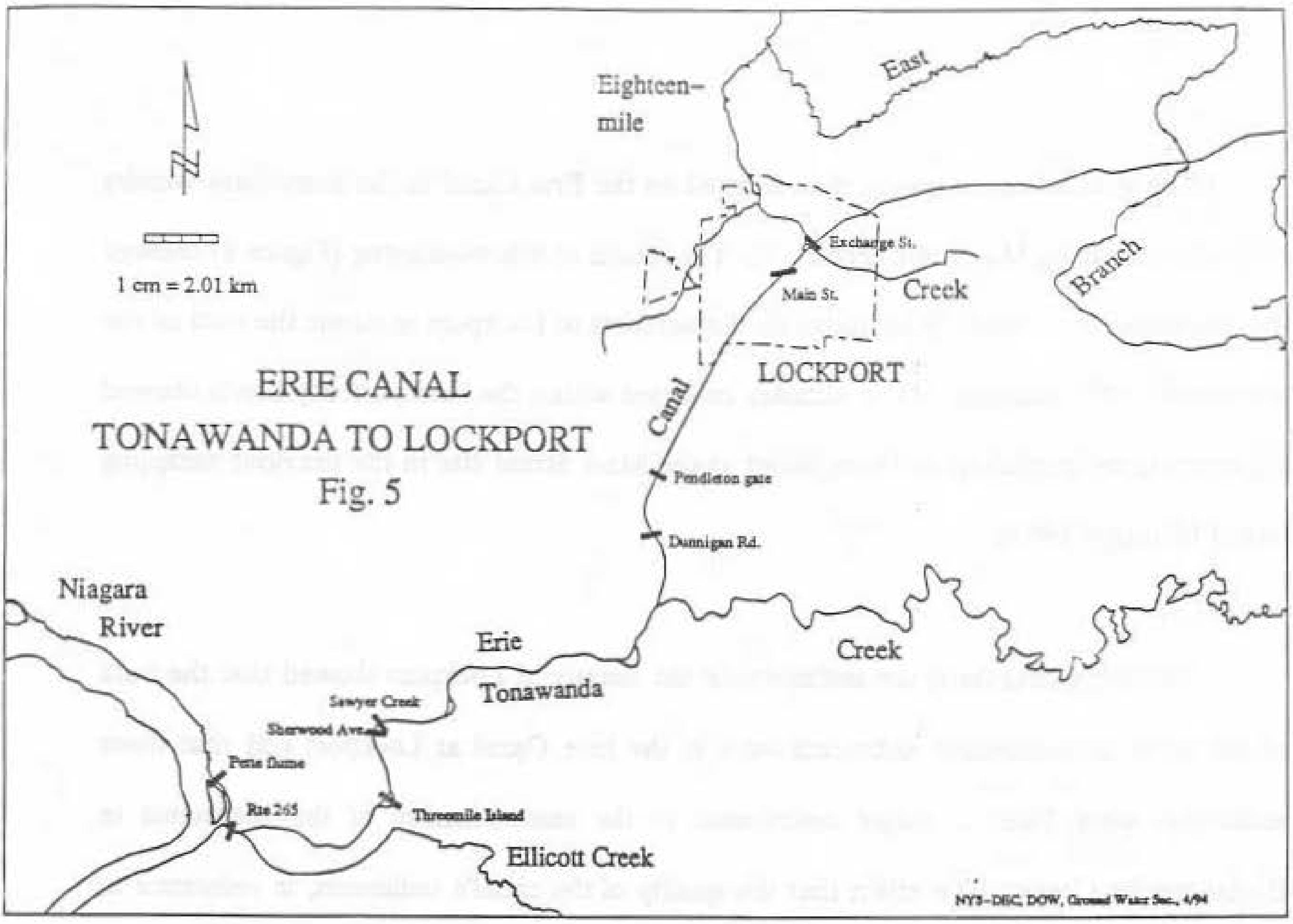
EIGHTEENMILE CREEK FIG.4
PERCENT ABUNDANCE BASED TO TOTAL DIOXIN OR TOTAL FURAN

These two factors led us to proceed with the trackdown process with the assumption that the dioxin and furan concentration gradients in Eighteenmile Creek were caused by the process of dewatering the Erie Canal (for dredging purposes) into the Creek. This process significantly increases the flow rate and would tend to flush most of the contaminated sediment (suspended and that scoured from the bottom) material in the canal to the first major flow obstruction in Eighteenmile Creek, which would be the Newfane Dam.

Since there was some certainty that the major source or sources of dioxins/furans to Eighteenmile Creek are via the Erie Canal, potential sources were immediately considered. These included the Occidental Chemical (Hooker) Durez facility in North Tonawanda, some of the many satellite dump sites of various industries located along the Canal, Tonawanda and Ellicott Creeks or some yet unknown facility or activity in or around Lockport (see Appendix D).

The scope of the sediment sampling was greatly expanded during September 1991 - January 1992 to include the upstream length of the Erie Canal (to Tonawanda), the major tributaries (Tonawanda and Ellicott Creeks) and to bracket known potential sources (Occidental Chemical, Frontier Chemical - Pendleton, Creekside and Pfohl Brothers waste sites) (see Figure 5). A sample was taken from the mouth of the Petit Flume which received much of Occidental's wastes. This was (until November, 1992) the location of City of Lockport's water intake pipe. Samples were collected in the vicinity of the City of Lockport when the canal was dewatered for winter. Two of these samples were just upcanal (Main Street) and downcanal (Exchange Street) from the location where the canal overflows into Eighteenmile Creek. Analytical results for dioxins and furans were available from other DEC investigative units working on the DiMatteo Drive, Creekside and Pfohl Brothers waste sites.

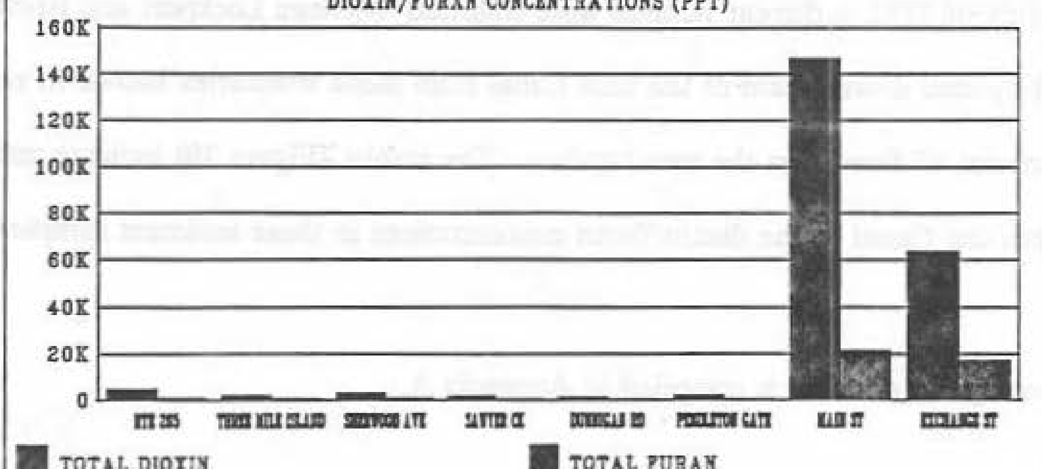
The analytical results (see Figure 6) from these samples show a definite increase in the total dioxin and furan concentrations for the two samples (Main Street and Exchange St.) collected in Lockport.



ERIE CANAL
TONAWANDA TO LOCKPORT
Fig. 5

ERIE CANAL–TONAWANDA TO LOCKPORT FIG.6

DIOXIN/FURAN CONCENTRATIONS (PPT)

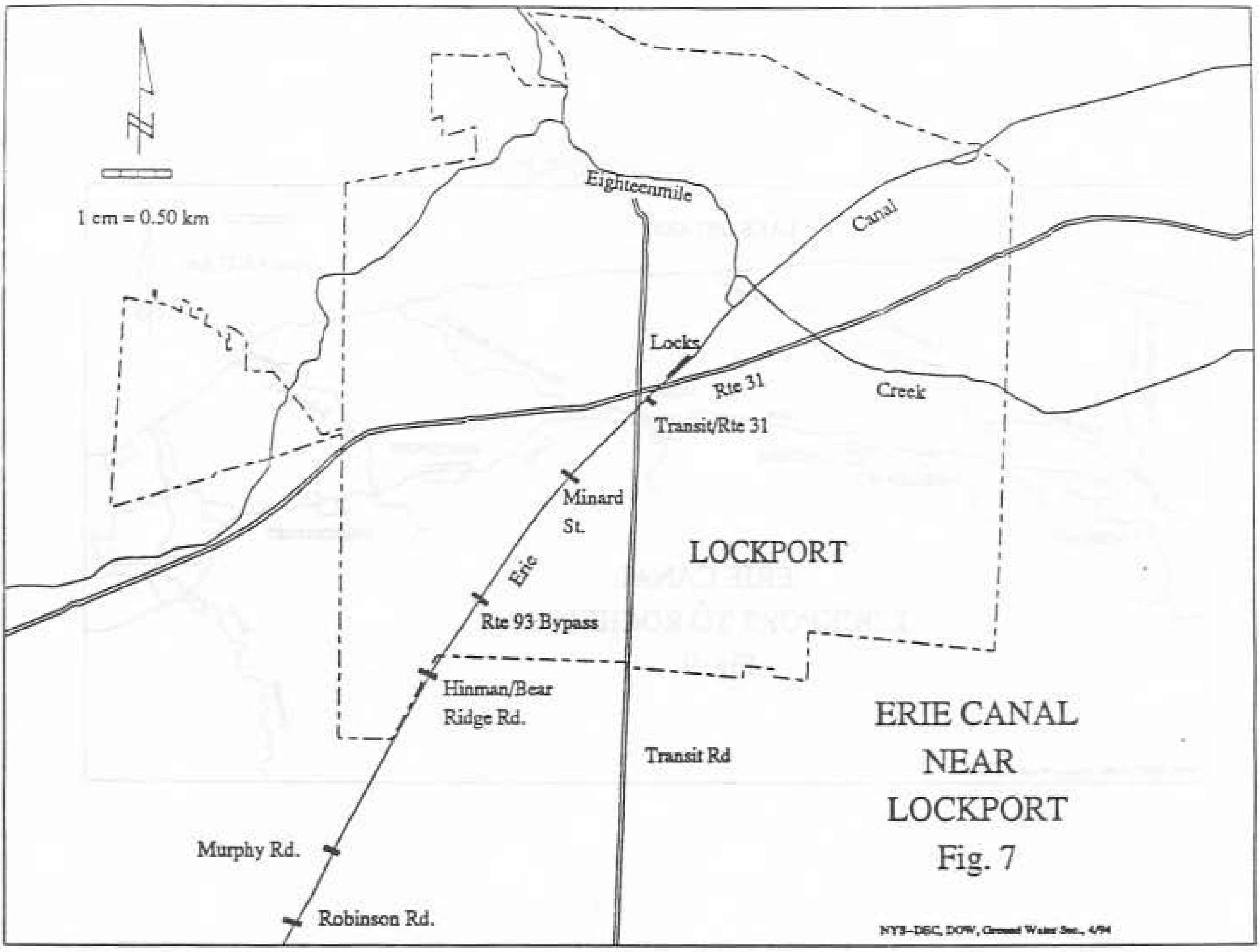


The area of investigation then focused on the Erie Canal in the immediate vicinity of Lockport during May, 1992 (Figure 7). The results of this monitoring (Figure 8) showed the downstream or westerly locations on the outskirts of Lockport to mimic the data of the September 1991 sampling. The samples collected within the Lockport city limits showed concentrations increasing to those found at the Main Street site in the previous sampling round (January 1992).

Sampling data from the sediments in the vicinity of Lockport showed that the bulk of the most contaminated sediments were in the Erie Canal at Lockport and that these sediments were likely a major contributor to the contamination of the sediments in Eighteenmile Creek. The effect that the quality of the canal's sediments, in reference to dioxin and furan, might be having on other tributaries to Lake Ontario that intersect with the canal was investigated.

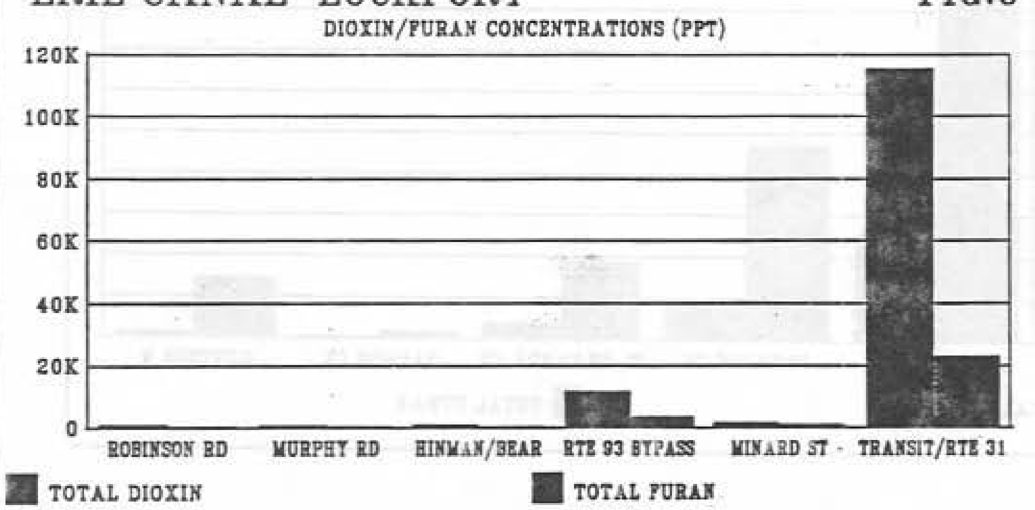
In July of 1992, sediment samples were collected between Lockport and Rochester (Figure 9) up and downstream of the Erie Canal from those tributaries known to receive a large amount of flow from the canal system. The results (Figure 10) indicate minimal impact from the Canal to the dioxin/furan concentrations in these sediment samples.

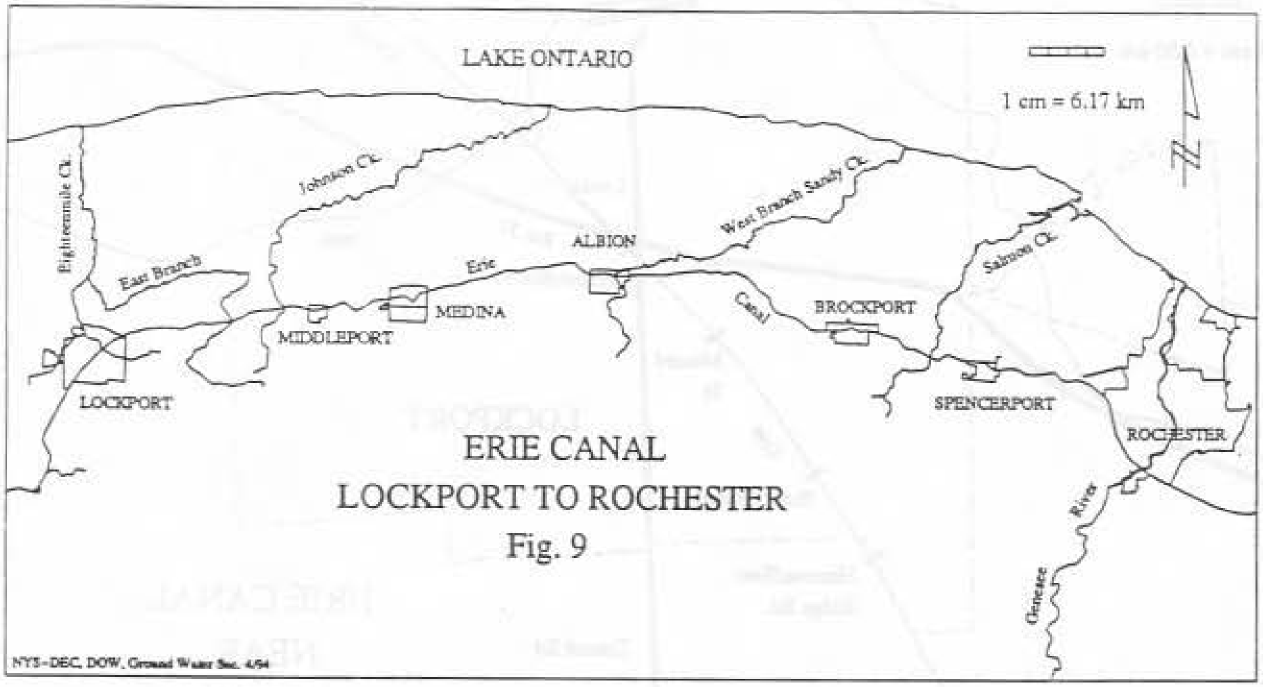
A complete data set is compiled in Appendix A.



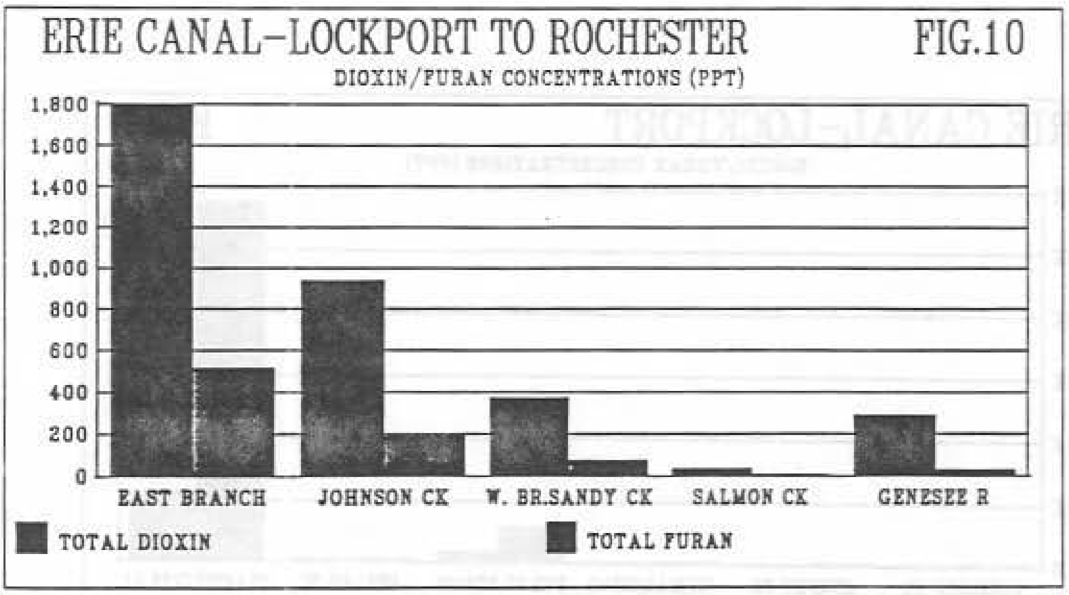
ERIE CANAL NEAR LOCKPORT Fig. 7

ERIE CANAL–LOCKPORT FIG.8





ERIE CANAL
LOCKPORT TO ROCHESTER
Fig. 9



ERIE CANAL–LOCKPORT TO ROCHESTER FIG.10

OBSERVATIONS

Total Concentration of Dioxin and Furan

The designation of a total concentration of dioxins and furans, in this report, is a conservative estimate of the actual total, as all "less than" results were treated as zeros. Only the tetra- through octa- homologs were summed as the mono- through tri- are not reported because the analytical methodology is not presently available to NYSDEC. To produce this data would require the broadening of the chromatograph window which would necessitate a more difficult cleanup of the sample, but interference problems, especially with PCBs, would not be eliminated. One could reason though, that with samples dominated by the hepta- and octa- homologs, the mono-, di- and tri- factions may be of little significance.

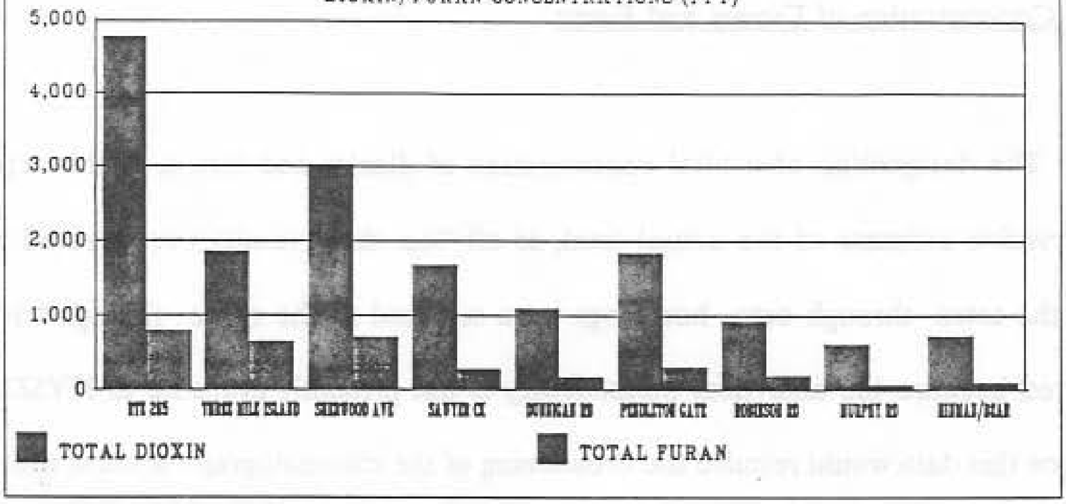
An evaluation of the total concentrations of dioxin and furan in the bottom sediments collected for this project (Appendix B) indicate:

- A substantial portion of the dioxin/furan concentrations in the sediments of Eighteenmile Creek apparently comes from the Erie Canal.

- There are generally decreasing concentrations of dioxin/furan from the Route 265 site to Hinman/Bear Ridge Road (Figure 11).

ERIE CANAL–TONAWANDA TO LOCKPORT FIG.11

DIOXIN/FURAN CONCENTRATIONS (PPT)



- A moderate elevation of the dioxin and furans concentrations at the Rte. 93 bypass, then dramatic increases at the sampling sites in downtown Lockport (Figures 6 & 8).

- Increasing concentrations of dioxin/furan in downstream Eighteenmile Creek sampling locations (Figure 3). These increases are tempered somewhat when the data are normalized to total volatile solids and total organic carbon.

- Decreasing concentrations of dioxin/furan in the sediments of the tributaries to Lake Ontario furthest from Lockport (Figure 10). These tributaries are down canal of Lockport and receive substantial flow augmentation of canal water.

- All these observations (except for the previous) are also valid using the dioxin/furan data normalized for the total volatile solids and total organic carbon content of the sediments (Pages B-3 through B-5).

The above observations support the conclusion that for the waterbodies studied (except for the Petit Flume) the Erie Canal in Lockport is the geographical locus of the highest total ambient concentrations of dioxins and furans.

- There were no immediately observable correlations between the sediment dioxin/furan levels and the locations of known hazardous waste sites (Pfohl Brothers, DiMatteo Drive, Creekside Golf Course and Frontier Chemical).

- The results of the analytical work on the four composites of bass and the three of carp, collected and analyzed for this project, contrast somewhat with the results of the crayfish and the Olcott Harbor carp (National Bioaccumulation Study) analysis. Concentrations in the bass filets (see page A-7) of 2,3,7,8-TCDD were well below the National (25 ppt) and State (10 ppt) guidelines for human consumption and the State piscivorous guideline (2.3 ppt). The carp samples from the Erie Canal at Lockport (2.6 ppt) and from Tonawanda Creek (3.5 ppt) at Pendleton exceed the State piscivorous guideline. In contrast, the levels in the crayfish (6.6 ppt) and in the Olcott Harbor carp (35.07 ppt) were substantially higher. It must be noted that the

Olcott carp and the crayfish were submitted as whole body samples while the other bass and carp composites were from filets.

- It is of interest to note that the levels of dioxins and furans in the fish composites tend to correlate positively with the sediment concentrations in the vicinity of their collection.

Toxic Equivalency

Toxic equivalency quantifies the toxicity of selected 2,3,7,8 substituted dioxin and furan congeners by proportionalizing their toxicities to 2,3,7,8-TCDD. These values can then be summed and the total will represent the aggrerate toxicity of the dioxin and furan concentrations relative to 2,3,7,8-TCDD. This protocol was developed by the USEPA[5]. The methodology for the routine regulatory use of toxic equivalence is currently under development, but has already found some utility as an adjunct measure in the determination of natural resource impacts in remedial investigations at hazardous waste sites (NYSDEC) and in determining health advisories on fish consumption (NYSDOH). Toxic equivalence is used in this report as an evaluation tool.

To facilitate an evaluation of relative congener toxicity, those sediment results with toxic equivalencies less than 10 pg/g were excluded due to the possibility of limited analytical results skewing the assessment. The analytical results were also grouped into three different stream segment data sets. These sets correspond with the investigative sequence: Eighteenmile Creek (excluding Remick Parkway), the Erie Canal from Tonawanda to Pendleton Gate (excluding Dunnigan Road) and the Erie Canal at Lockport (excluding Robinson, Murphy and Hinman Roads). By evaluating the components of the toxic equivalents several observations are made:

- Three congeners tend to dominate the toxicity, these include OCDD, 1,2,3,4,6,7,8-HpCDD and 1,2,3,4,6,7,8-HpCDF. For the data sets studied the furan congener represents from 46 to almost 63 percent of the toxicity of the furans. The two dioxin congeners represent from almost 67 to over 83 percent of the dioxin toxicity. Together these three congeners represent 65 to 83 percent of the dioxin/furan toxicity (Table 3).

- The toxicity percents (Table 3) for the Eighteenmile Creek and the Erie Canal at Lockport data sets are very similar while those for the canal between Tonawanda and Pendleton Gate are markedly different. This supports the observation that the dioxin/furan contamination in the canal at Lockport impacts Eighteenmile Creek.

TABLE 3

	OCDD plus 1234678 HpCDD Relative to Dioxin Toxicity	1234678HpCDF Relative to Furan Toxicity	OCDD plus 1234678HpCDD plus 1234678HpCDF Relative to Dioxin plus Furan Toxicity
Eighteenmile Creek	82.68%	58.02%	78.12%
Canal at Lockport	83.38%	62.70%	83.03%
Canal Tonawanda to Pendleton Gate	66.82%	45.96%	65.79%

- By comparing the toxic equivalences of 2,3,7,8-TCDD on page B-2 to the guidance/criteria values in Table 4, it is evident that the sediments in the Erie Canal at Lockport and in Eighteenmile Creek contain levels that should be of concern.

Guidelines/Criteria for Assessing 2,3,7,8-TCDD Levels in Bottom Sediments

TABLE 4

Source	Affected Organisms	Concentration or Range (pg/g)	
NYSDEC[A]	Human Health Wildlife	10-100 3-30	
NYSDEC[B]	Human Health Wildlife	.08 8	Organic Carbon of 4%
State of Wisconsin[C]	Unknown	1.0	
USEPA[D] Low Risk	Fish Mammals Avian Wildlife	60 2.5 21	
USEPA[E] High Risk	Fish Mammals Avian Wildlife	100 25 210	

[A]Sediment criteria derived by the sediment-to-fish bioaccumulation method by Division of Fish and Wildlife. [6]

[B]Sediment criteria and guidelines used by Divisions of Fish and Wildlife and Marine Resources as guidance. [7]

[C]Maximum allowable concentrations for beach nourishment and in water disposal State of Wisconsin. [8]

[D]Low risk concentrations derived from no-effects thresholds for reproductive effects in sensitive species (USEPA). [9]

[E]High risk concentrations derived from TCDD doses expected to cause 50 to 100% mortality in embroyos and young of sensitive species (USEPA). [9]

- From the perspective of toxic equivalents, the fish composites from the Erie Canal at Lockport (9.7 ppt), Middleport (4.3 ppt) and North Tonawanda (4.3 ppt) and from Tonawanda Creek at Pendleton (6.8 ppt), all exceed the State's piscivorous guideline. It should be noted that the carp composite from the canal at Lockport is approaching the State's human consumption guideline.

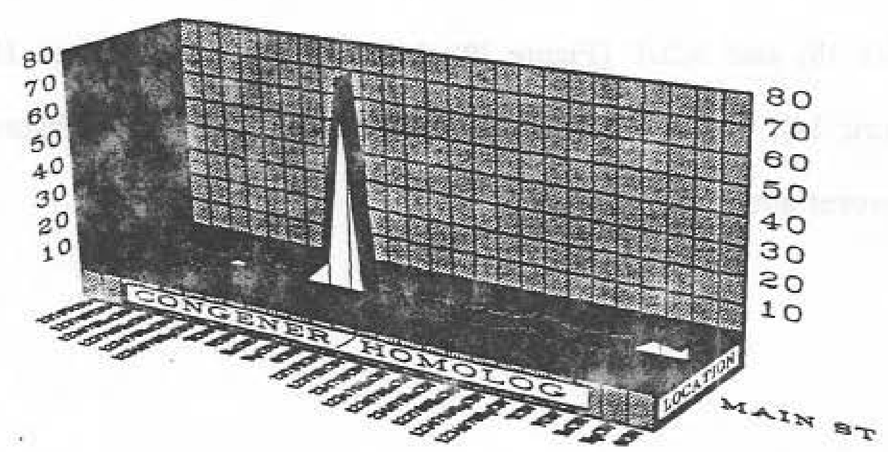
Percent Abundance Patterns

Percent abundance patterns are useful in characterizing the composition of complex compounds, such as dioxins, furans and PCBs. Percent abundances are calculated by dividing each individual congener and/or homolog concentration by their respective totals. The percent abundance values for each congener and homolog are then arranged in a fixed sequence, which establishes a pattern. This pattern can then be used to compare the similarity or divergence of the analytical results of multiple samples.

For each 2,3,7,8-substituted congener, percent abundance was calculated once using the total homolog concentration and then a second time using the total of the tetra- through octa- homologs of the dioxins for the dioxin congeners and the tetra- through octa- homologs of the furans for the furan congeners. The first percent abundance calculated to the homolog concentration shows a congener's relative concentration compared to the total of its isomers. The second percent abundance characterizes each congener's concentration with respect to the relative total of its respective compound.

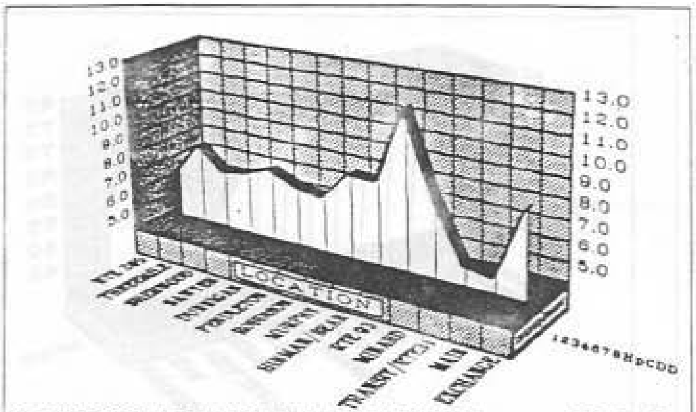
Each homolog total also had a percent abundance calculated using the relative total of its respective compound and a second calculated using the overall total of the dioxin plus furan homologs. While the first percent abundance calculations will characterize each homolog's relationship to the total of its respective compound, the second will identify changes in the relationship between the overall concentrations of dioxins to furans. These three denominators were used in the percent abundance calculations to afford several perspectives which should provide a more complete evaluation of the congener/homolog patterns. In each variation of the percent abundance calculations, all "less than" results were treated as zeros.

The percent abundance pattern found to be typical for the sediments collected for this project (Figure 12) shows an OCDD domination. This pattern is commonly found in this medium and is indicative of multiple combustion sources (11-18).

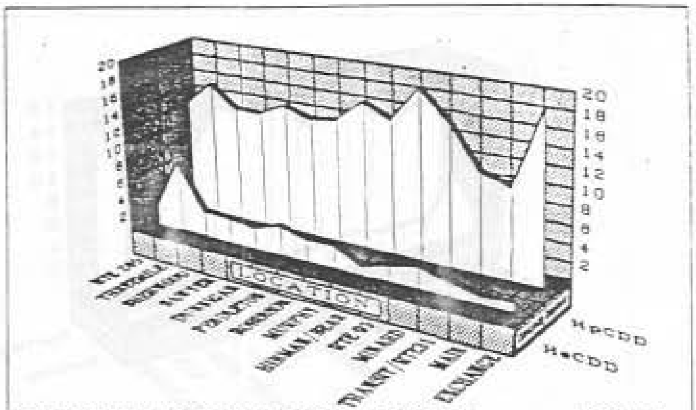


TYPICAL SEDIMENT PERCENT ABUNDANCE PATTERN FIG.12
BASED TO TOTAL DIOXIN PLUS FURAN

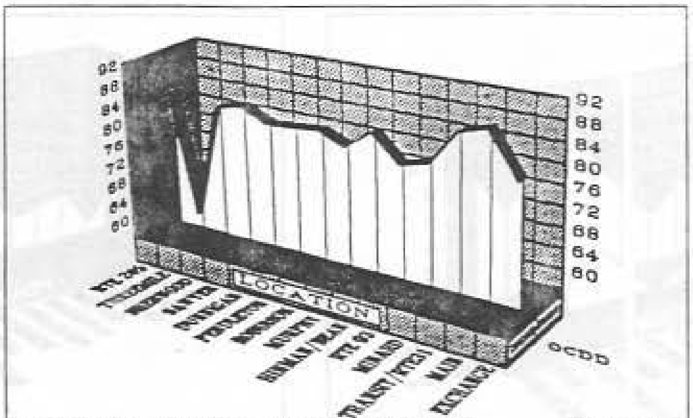
By graphically displaying and then comparing the percent abundance patterns, marked changes, if they exist, can be identified. Only the congeners and homologs with relatively complete percent abundance data sets were graphed. The data were sequenced in a spatial order proceeding from Tonawanda through Lockport. The results are displayed in Figures 13 through 26 . An evaluation of the data, based to total dioxin or total furan, show evident pattern deviations at Threemile Island for HeCDD (Figure 14), OCDD (Figure 15), 1,2,3,4,6,7,8-HeCDF (Figure 16) and OCDF (Figure 19). Less prominent changes for TCDD and PCDD were noted in the incomplete data sets at this sampling location. At Hinman/Bear Ridge changes occurred in the HeCDD (Figure 14), HpCDF (Figure 18) and OCDF (Figure 19) homologs. At Rte. 93 Bypass, the 1,2,3,4,6,7,8-HpCDD (Figure 13), 1,2,3,4,7,8-HeCDF (Figure 16) and 1,2,3,4,7,8-HpCDF (Figure 17) congeners along with the HpCDD (Figure 14), HeCDF (Figure 18) and OCDF (Figure 19) homologs demonstrated notable shifts. At Minard Street, the two furan congeners 1,2,3,4,7,8-HeCDF (Figure 16) and 1,2,3,4,6,7,8-HpCDF (Figure 17)) show changes; at Transit Road/Rte. 31, HpCDF (Figure 18) and OCDF (Figure 19) show change; at Main Street, HeCDD and HpCDD (Figure 14); and at Exchange Street, 1,2,3,4,6,7,8-HpCDF (Figure 17) show evidence of percent abundance pattern shifts.



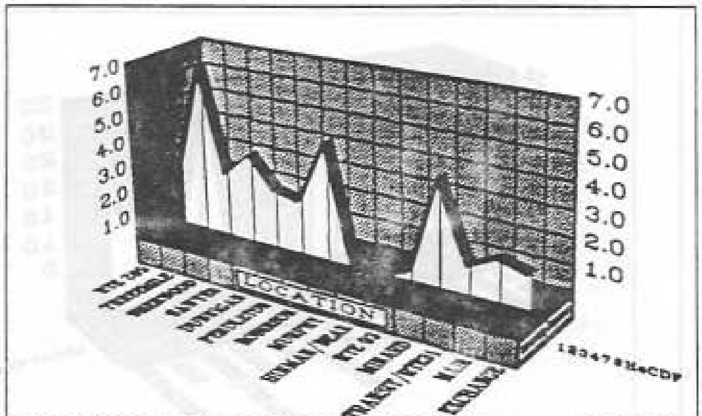
PERCENT ABUNDANCE PATTERN FIG.13
BASED TO TOTAL DIOXIN



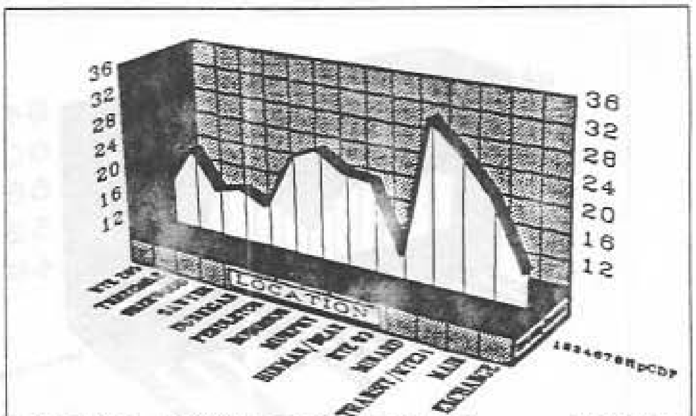
PERCENT ABUNDANCE PATTERN FIG.14
BASED TO TOTAL DIOXIN



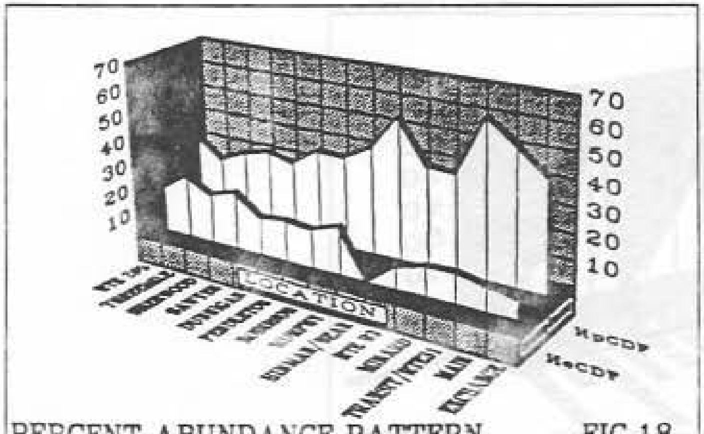
PERCENT ABUNDANCE PATTERN FIG.15
BASED TO TOTAL DIOXIN



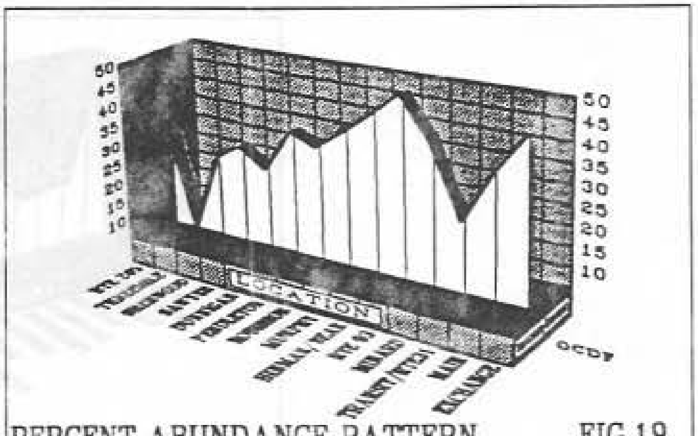
PERCENT ABUNDANCE PATTERN FIG.16
BASED TO TOTAL FURAN



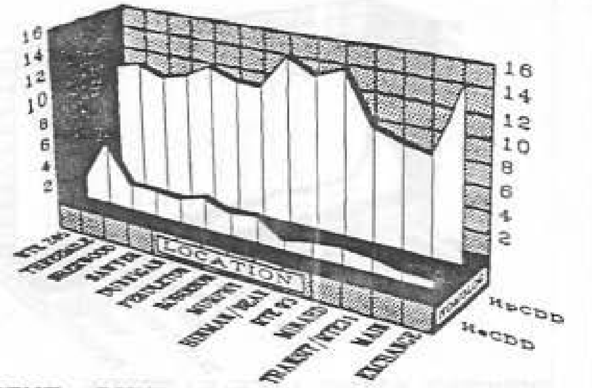
PERCENT ABUNDANCE PATTERN FIG.17
BASED TO TOTAL FURAN



PERCENT ABUNDANCE PATTERN FIG.18
BASED TO TOTAL FURAN

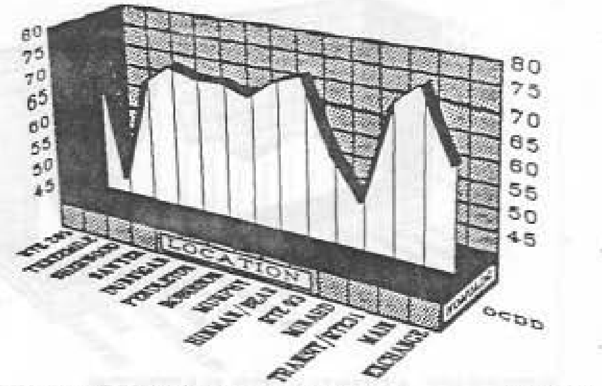


PERCENT ABUNDANCE PATTERN FIG.19
BASED TO TOTAL FURAN



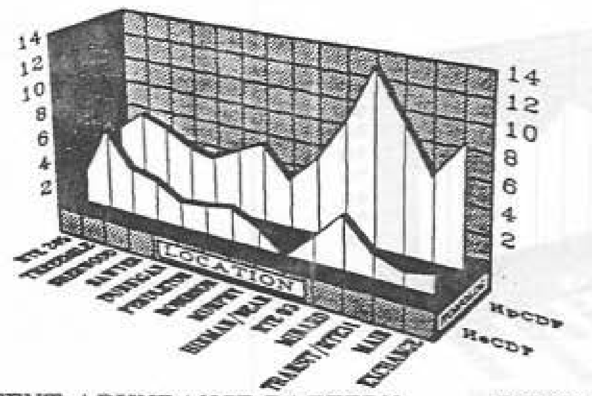
PERCENT ABUNDANCE PATTERN FIG.20

BASED TO TOTAL DIOXIN PLUS TOTAL FURAN



PERCENT ABUNDANCE PATTERN FIG.21

BASED TO TOTAL DIOXIN PLUS TOTAL FURAN

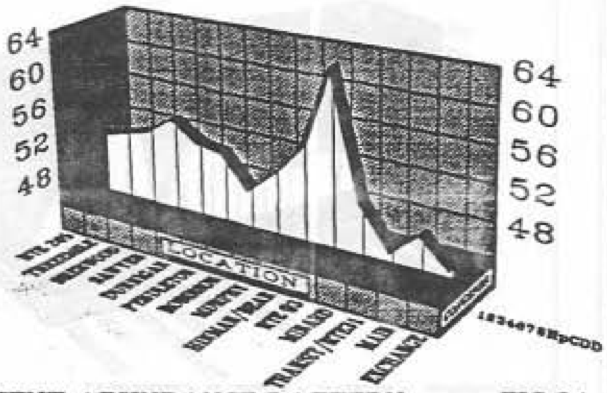


PERCENT ABUNDANCE PATTERN FIG.22

BASED TO TOTAL DIOXIN PLUS TOTAL FURAN

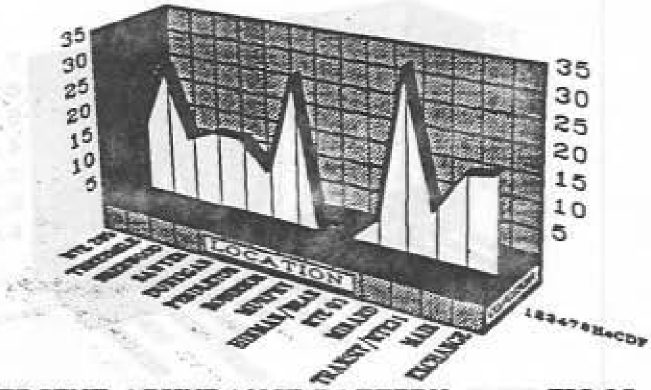
PERCENT ABUNDANCE PATTERN FIG.23

BASED TO TOTAL DIOXIN PLUS TOTAL FURAN



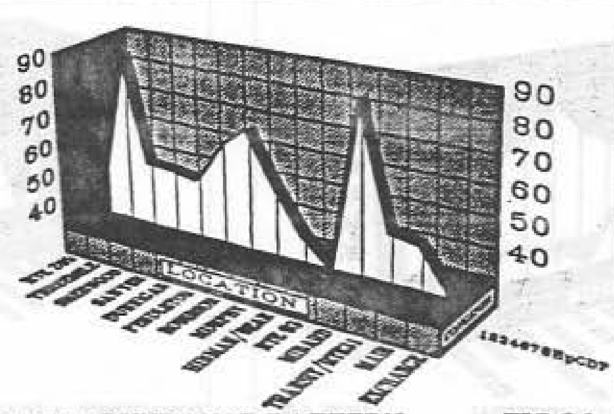
PERCENT ABUNDANCE PATTERN FIG.24

BASED TO RESPECTIVE HOMOLOG TOTAL



PERCENT ABUNDANCE PATTERN FIG.25

BASED TO RESPECTIVE HOMOLOG TOTAL



PERCENT ABUNDANCE PATTERN FIG.26

BASED TO RESPECTIVE HOMOLOG TOTAL

These percent abundance patterns tell us that there are marked changes in the makeup of the dioxins and furans in the bottom sediments at Threemile Island and at several locations in the Erie Canal in Lockport. This may indicate inputs (sources) at these locations. The graphs characterizing the percent abundance patterns based to the respective homolog total and to the total of the dioxin plus furan homologs generally support this assessment.

Although not displayed, the percent abundance patterns for the five Eighteenmile Creek sites show dioxin and furan patterns at the four sites, downstream from the canal, are very similar to each other and appreciably different from the upstream site (Remick Parkway).

Euclidian Distance

By using these percent abundance patterns, changes in the proportional makeup of the dioxin and furan congeners and/or homologs can be detected and then assessed by statistical tests. This information, along with the absolute concentrations and toxic equivalences can be used to identify locations where sediments have likely been impacted by sources.

One method to quantify differences in percent abundance patterns is called Euclidian distance[10]. In this procedure, each sample result is described as occupying points within a multi-dimensional space where each dimension is a fraction of the total dioxin and/or furan mass contributed by each of the 2,3,7,8-substituted congeners and homologs. The distance between any two sample results (A and B) can be computed as:

$$D_{(A-B)} = [(X_A - X_B)^2 + (Y_A - Y_B)^2 + ...(Z_A - Z_B)^2]^{0.5}$$

Where variables X, Y...and Z are the congener or homolog percent abundances for each sample.

Minimum distances are between like sample results and likewise, maximum distances are between those sample results that are most dissimilar. Only congeners and homologs with relatively complete data sets (i.e. all or most analytical results above quantification level) were included in the Euclidian calculations.

Euclidian distance calculations (Page C-1) were completed for each of the three percent abundance data sets (based to homolog totals, total dioxin or furan and total dioxin plus furan). The ranking of the resultant Euclidian distances shows the greatest magnitude of change in Erie Canal sediment dioxin abundance patterns occurs between Rte. 265 and Threemile Island. The second greatest change shows up between Threemile Island and Sherwood Avenue. The next greatest dioxin pattern changes are between Minard Street and the Transit/Rte. 31 site and again between Main Street and Exchange Street.

For Erie Canal sediment furans, the greatest percent abundance pattern change occurs between Minard Street and the Transit/Rte. 31 site. The second greatest change occurs between Hinman Road/Bear Ridge and the Rte. 93 Bypass. The next greatest changes for furans occur between Rte. 93 Bypass and Minard and between Rte. 265 and Threemile Island.

For the overall dioxin/furan congener and homolog patterns, the greatest change occurs at Threemile Island. The next greatest between Minard Street and the Transit/Rte. 31 site and again between the Rte. 93 Bypass and Minard Street.

In comparison, changes occurring for all sampling sites between Sherwood Avenue to Hinman Road/Bear Ridge are ranked very low for change for all congener and homolog variations.

To show statistical significance ($P < .05$), the t statistic was applied to the Euclidian data sets (Page C-3) using the maximum likelihood unbiased estimator as the standard deviation factor. The results of this analysis on each of the percent abundance data sets are in general agreement with one another.

Findings

- The dioxin/furan analytical results from the four downstream Eighteenmile Creek sediment samples are very similar.

- The dioxin/furan analytical results from Threemile Island sediments are very different from any other sediment sample collected for this study.

- There are significant ($P<.05$) changes in the dioxin pattern between the Rte. 93 Bypass and Minard Street.

- There are significant ($P<.05$) changes in the furan pattern between Minard Street and Transit/Rte. 31 site and again between Transit/Rte. 31 and Main Street.

- There is a significant ($P<.05$) change in the dioxin pattern between Main Street on the canal and the Clinton Street site on Eighteenmile Creek. (The riparian area between these two sites is covered with cinders and other combustion debris).

- There is a significant change ($P<.05$) of the overall dioxin and furan percent abundance patterns at Threemile Island, between the Rte. 93 Bypass and Minard Streets and between Minard Street and the Transit/Rte. 31 site.

SUMMARY

- The majority of the sediment samples demonstrated the OCDD dominated percent abundance pattern which is common in sediments and characteristic of multiple combustion sources.

- The highest absolute concentrations of dioxin and furan were found in the Erie Canal in the middle of Lockport. These concentrations are considered "levels of concern" as the toxic equivalents are considerably higher than the sediment guidelines available for comparison.

- Three congeners (OCDD, 1,2,3,4,6,7,8-HpCDD and 1,2,3,4,6,7,8-HpCDF) dominate the toxicity of the dioxins and furans detected in the sediment samples.

- The congener and homolog percent abundance patterns at Threemile Island are notably different from any other ambient sediment sample collected for this project. The meaning of this is unknown.

- There are several sites in the Erie Canal at Lockport that demonstrate significant shifts in the dioxin/furan percent abundance patterns. This could indicate local sources. The list of potential sources in the vicinity is substantial (See Appendix D).

- There were lower (background) levels of dioxin/furan identified in the sediments of other Lake Ontario tributaries that receive a substantial portion of their flow from the Erie Canal.

It is yet to be determined if the levels of dioxin and furan in the canal are of environmental and regulatory importance. If they are, the sources of the dioxins/furans to the sediments in the Erie Canal at Lockport should be identified. The source(s) of the unusual patterns to the Threemile Island site should also be investigated.

QUALITY CONTROL

Quality Control for this project included five surrogate spikes (native CDD and CDF) and 17 method blanks. The control limits in the analytical laboratory for the percent recoveries of the surrogate spikes at concentrations greater than ten times the reporting level are $\pm$ 20%. These control limits are a generally accepted standard for dioxin analysis. The surrogate results are calculated by isotope dilution mass spectrometry, as are the sample results. For method blanks, it was expected to have all analytes below the limit of detection. But by using a GC/MS system capable of detecting as little as 0.1 pg of material, reportable amounts of analytes will occasionally be found. OCDD, in particular, was recurrently detectable in method blanks, while detection of other analytes was rare. To be considered reportable, the analytical laboratory requires that the signal in the sample be at least three times that found in the method blank. Otherwise, both the sample and blank were rerun.

Surrogate Spikes

Of the five spikes, four were run with sediment samples and one with the fish tissue samples. For the 120 spike analyte results associated with these five surrogate spikes, the average percent recovery was 100.6% with a standard deviation of 11.4%.

Method Blanks

No analytes were detected in the method blank for the water sample.

Six blanks were run with the fish and crayfish samples. Of the three method blanks with the fish samples, two showed reportable levels of OCDD (4.2 and 12 pg/g). The corresponding sample results had OCDD results less than reporting level. One method blank was originally run with the crayfish sample and had an OCDD level of 67 pg/g. Two subsequent blanks were less than the reporting level for all analytes. The crayfish tissue showed 260 pg/g of OCDD.

Ten method blanks were analyzed with seven sediment sample groupings. Only two showed levels of any dioxin or furan analyte. One of these blanks had 47.5 pg/g of OCDD. Two additional blanks were run with this sediment grouping and they were both less than the reporting level for all analytes. The minimum value of OCDD for the sediments run with these blanks was 430 pg/g. The second of the original method blanks showed OCDD at 31.5 pg/g and 1,2,3,4,6,7,8-HpCDF at the minimum reporting level of 2.6 pg/g. Two sediment samples associated with this method blank had levels of OCDD (33.9 and 75 pg/g) and 1,2,3,4,6,7,8-HpCDF (7.7 and 3.8 pg/g) that were within three times the method blank value. Because these sediment samples were of secondary importance, intended to measure low level background conditions, the method blank problem with these samples had no effect on the evaluation of the dioxin and furan concentrations in the primary samples.

The analytical laboratory reports that all established laboratory methods and procedures were followed and all quality control samples, other than the one just discussed, met established guidelines. The quality control samples strongly indicate useful data of high quality.

ACCOUNTS

Analytical
34 Bottom Sediments

Dioxin/furan Analyses (34 samples)($1744/sample)	$59,300
TVS and TOC Analysis (34 samples)($101/sample)	3,440

8 Biota Samples (7 fish composites, 1 macroinvertebrate (crayfish))

Dioxin/furan Analyses (8 samples)($1744/sample)	13,950

1 Water Sample (phase separated)

Dioxin/furan Analyses (2 samples)($1744/sample)	3,490
Total Analytical Cost	*$80,180

*Cost per sample includes laboratory QA/QC. The analytical cost was supplemented with a $20,000 grant (x995237-01) from the USEPA Great Lakes National Program Office through the USEPA Region II Niagara Frontier Program Office.

Personnel (Salaries)
Two principal investigators.
14 days in field sampling.
80 days in office doing research, data analysis and report preparation.
94 days ($180/day)(1.4 overhead)(1.28 benefits) = $30,320

One technician
8 days in field sampling.
10 days in office doing research and report preparation.
18 days ($100/day)(1.4 overhead)(1.28 benefits) = 3,226

Total Personnel (Salaries) $33,546

Travel and Miscellaneous Expenses

Travel	
~700 miles/trip (7 trips)($.28/mile)	$1,370
Room	
7 nights (~$40/night)	280
Per diem	
14 days ($26/day)	364
Total Travel and Miscellaneous	$2,014
Total Project Cost	$115,740

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APPENDIX A

ANALYTICAL RESULTS (pg/g)
SEDIMENTS FROM EIGHTEENMILE CREEK

Congener or Homolog	Remick Pky	Clinton St.	N.Transit Rd.	Condren Rd.	Newfane Dam			
2378-TCDD	<5.8	<5.3	<.67	<1.2	<.91			
12378-PCDD	<6.3	<5.3	<1.6	<3.0	12			
123678-HxCDD	<14	25	46	68	90			
123789-HxCDD	<14	<9.8	<2.2	13	27			
123478-HxCDD	<16	<12	<2.8	<5.2	<4.0			
1234678-HpCDD	73	740	1300	1900	2400			
TCDD	<5.8	18	13	15	29			
PCDD	<6.3	6.7	17	33	84			
HxCDD	<14	180	220	410	580			
HpCDD	130	1500	2600	4100	5100			
OCDD	430	9000	14000	22000	29000			
2378-TCDF	<5.9	15	31	<2.2	<1.4			
12378-PCDF	<4.8	6.1	9.8	12	20			
23478-PCDF	<6.5	11	15	21	34			
123478-HxCDF	<6.7	100	62	110	190			
123678-HxCDF	<7.3	27	18	35	51			
234678-HxCDF	<8.9	<6.6	<1.6	<3.6	20			
123789-HxCDF	<8.7	<6.4	<1.5	<3.3	<2.3			
1234678-HpCDF	26	650	640	1039	1634			
1234789-HpCDF	NA	NA	15	26	40			
TCDF	<5.9	22	120	200	360			
PCDF	<4.8	94	150	190	320			
HxCDF	17	370	350	670	900			
HpCDF	47	1000	1400	2300	3300			
OCDF	<100	910	1100	2043	2900			

ANALYTICAL RESULTS (pg/g)
SEDIMENTS FROM ERIE CANAL (TONAWANDA TO LOCKPORT)

Congener or Homolog	Rte 265	Threemile Is.	Sherwood Ave.	Sawyer Cr.	Dunnigan Rd.	Pendleton Gte	Main St.	Exchange St.
2378-TCDD	<6.2	5.1	<5.6	<6.1	<4.8	<4.5	9.5	<5.7
12378-PCDD	<5.3	11	<4.6	<5.5	<4.3	<6.0	10	<7.1
123678-HeCDD	18	17	15	9.4	<5.0	12	190	<13
123789-HeCDD	<6.2	19	12	<6.5	<5.0	<9.0	27	<11
123478-HeCDD	<7.3	9.5	<7.6	<7.5	<5.8	<11	17	180
1234678-HpCDD	310	150	210	120	84	130	7200	5400
TCDD	26	190	17	<6.1	15	21	82	47
PCDD	18	120	5.2	<5.5	<4.3	<6.0	150	31
HeCDD	110	150	93	49	29	65	1600	710
HpCDD	610	290	400	220	160	250	15,000	12,000
OCDD	4000	1100	2500	1400	890	1500	130,000	51,000
2378-TCDF	20	59	26	<5.9	<4.7	<3.7	13	13
2378-PCDF	<4.3	17	3.8	<4.4	<3.3	<3.8	22	18
23478-PCDF	<5.2	7.2	6.4	<5.5	<4.1	<4.8	55	69
123478-HeCDF	19	43	18	9.8	4.1	6.4	370	240
123678-HeCDF	8.4	31	9.7	4.4	<3.3	<5.2	100	66
234678-HeCDF	9.6	7.8	9.7	<5.1	<3.9	<5.9	39	36
123789-HeCDF	<4.5	<3.9	<5.0	<4.9	<3.7	<5.4	11	15
1234678-HpCDF	120	140	110	46	26	70	5000	2300
1234789-HpCDF	NA	NA	NA	NA	NA	<13	110	130
TCDF	89	180	85	<5.9	29	9.1	310	270
PCDF	57	110	96	41	23	21	460	390
HeCDF	140	160	140	64	27	50	2100	1300
HpCDF	260	160	210	89	52	110	11,000	7500
OCDF	250	39	180	84	45	110	7400	7800

ANALYTICAL RESULTS (pg/g)
SEDIMENTS FROM ERIE CANAL (NEAR LOCKPORT)

Congener or Homolog	Robinson Rd.	Murphy Rd.	Hinman/Bear Ridge Rd.	Rte 93 Bypass	Minard St.	Transit/Rte 31		
2378-TCDD	<13	<12	<11	<17	<11	4.5		
12378-PCDD	<17	<14	<16	<24	<15	<21		
123678-HeCDD	<29	<23	<41	43	5.6	250		
123789-HeCDD	<28	<22	<37	<45	<27	35		
[illegible]78-HeCDD	<32	<25	<44	<52	<31	20		
1234678-HpCDD	63	51	60	1400	120	5900		
TCDD	9.8	5.5	<11	14	15	51		
PCDD	<17	<14	<16	21	7.1	140		
HeCDD	25	17	8.2	230	39	2000		
HpCDD	130	100	110	2200	240	13,000		
OCDD	760	490	610	9100	1200	100,000		
[illegible]	<11	<9.6	<9.3	4.9	<9.2	21		
[illegible]	<11	<9.3	<11	<15	3.9	33		
[illegible]	<14	<12	<14	<20	<13	92		
123478-HeCDF	8.9	<12	<21	16	35	270		
123678-HeCDF	<16	<13	<22	<25	9.0	110		
234678-HeCDF	<19	<16	<26	<29	5.5	49		
123789-HeCDF	<18	<15	<25	<27	<16	15		
1234678-HpCDF	49	14	19	430	280	6600		
1234789-HpCDF	<42	<32	<83	<82	<44	110		
TCDF	13	<9.6	<9.3	30	40	280		
PCDF	15	<9.3	<11	63	39	500		
HeCDF	30	12	<21	310	100	2800		
HpCDF	69	26	48	1400	320	14,000		
OCDF	65	24	38	1800	340	5200		

ANALYTICAL RESULTS (pg/g)
SEDIMENTS FROM OTHER ERIE CANAL TRIBUTARIES

Congener or Homolog	East Branch Upstream	East Branch Downstream	Johnson Creek Upstream	Johnson Creek Downstream	W.Branch Sandy Cr. Upstream	W.Branch Sandy Cr. Downstream	Salmon Creek Upstream	Salmon Creek Downstream
2378-TCDD	<7.5	<4.2	<.34	<.32	.49	<.14	<1.7	<.157
12378-PCDD	<6.9	<4.0	.25	<.34	<.32	<.11	<2.1	<.087
123678-HeCDD	<11	<6.5	<.246	2.29	1.06	1.45	3.1	<.058
123789-HeCDD	<11	<6.5	<.54	<1.43	1.24	.55	<2.8	<.054
123478-HeCDD	<12	<7.6	<.27	<.65	.62	<.28	<3.3	<.65
1234678-HpCDD	88	120	7.96	59.27	18.41	28.70	82	3.08
TCDD	<7.5	<4.2	<.44	<.32	.49	<.14	1.7	<.157
PCDD	<6.9	<4.0	1.80	<2.02	<.58	<.21	<2.1	<.087
HeCDD	26	37	<4.43	<18.45	6.96	<4.82	23	<.065
HpCDD	140	250	7.96	103.14	32.85	50.67	170	<4.95
OCDD	600	1500	74.95	833.45	201.90	321.35	1090	33.86
2378-TCDF	<7.6	7.6	1.82	<1.68	<1.42	<1.02	<1.5	<.41
12378-PCDF	<5.6	<3.2	.37	.62	<.48	.21	<1.4	.07
23478-PCDF	<7.5	<4.3	.66	1.19	.80	<.33	2.9	<.20
123478-HeCDF	<5.9	22	1.23	5.18	.99	1.91	6.2	<.19
123678-HeCDF	<6.5	7.8	<.52	1.41	<.62	<.47	1.8	.15
234678-HeCDF	<7.9	<4.6	<.49	1.16	<.47	<.056	1.2	<.091
123789-HeCDF	<7.7	<4.5	<.21	<.092	<.206	<.058	<1.8	<.095
1234678-HpCDF	26	140	3.83	35.61	7.70	14.59	53	<.70
1234789-HpCDF	NA	NA	<.179	<.048	<.44	.34	<3.8	<.129
TCDF	<7.6	29	7.71	<7.92	<3.65	<1.02	19	<1.70
PCDF	14	26	8.58	15.89	<2.88	<4.11	22	<.27
HeCDF	12	79	<3.95	24.02	<8.52	<9.46	29	.51
HpCDF	45	190	10.26	76.68	<18.12	34.66	85	<1.55
OCDF	46	190	12.14	70.06	25.09	38.65	66	3.85

ANALYTICAL RESULTS (pg/g)
SEDIMENTS FROM OTHER ERIE CANAL TRIBUTARIES

Congener or Homolog	Genesee River Upstream	Genesee River Downstream	Twelvemile Cr. (Background Site)					
2378-TCDD	<.029	<.046	<2.2					
12378-PCDD	<.011	<.22	<2.6					
123678-HeCDD	<.085	<.78	<3.9					
123789-HeCDD	<.078	<.47	<3.4					
123478-HeCDD	<.089	.26	<4.0					
1234678-HpCDD	<3.86	20.24	8.1					
TCDD	<.029	<.046	<2.2					
PCDD	<.011	<.48	<2.6					
HeCDD	.27	<4.46	<3.9					
HpCDD	<6.91	42.75	20.21					
OCDD	67.40	243.19	153					
2378-TCDF	.22	<1.15	<2.0					
12378-PCDF	<.007	<.083	<1.8					
23478-PCDF	<.008	<.33	<2.3					
123478-HeCDF	<.18	<1.50	<2.1					
123678-HeCDF	<.047	.50	<3.9					
234678-HeCDF	<.053	<.079	<2.5					
123789-HeCDF	<.055	<.081	<2.3					
1234678-HpCDF	.55	9.35	<3.3					
1234789-HpCDF	<.102	.42	<4.6					
TCDF	.98	<6.04	<2.0					
PCDF	.28	<3.89	<1.8					
HeCDF	<.44	<.601	<2.1					
HpCDF	<.70	18.16	<3.3					
OCDF	<2.36	11.38	<7.2					

ANALYTICAL RESULTS (pg/g)
SEDIMENTS FROM MISCELLANEOUS LOCATIONS

Congener or Homolog	Petit Plume	Tonawanda Cr. Upstream	Ellicott Cr. Downstream	Ellicott Cr. Upstream				
2378-TCDD	2400	<6.7	<7.1	<6.7				
12378-PCDD	6400	<5.1	<6.9	<6.9				
123678-HeCDD	16,000	<5.9	<9.2	<15				
123789-HeCDD	9400	<5.9	<9.7	<15				
123478-HeCDD	9000	<6.9	<11	<18				
1234678-HpCDD	77,000	8.4	180	180				
TCDD	110,000	<6.7	<7.1	<6.7				
PCDD	120,000	<5.1	<6.9	<6.9				
HeCDD	220,000	<5.9	40	<15				
HpCDD	140,000	13	350	280				
OCDD	170,000	120	2100	2100				
2378-TCDF	<1900	14	14	<7.2				
12378-PCDF	32,000	<4.2	<5.2	<5.7				
23478-PCDF	150,000	<5.1	<6.8	<7.1				
123478-HeCDF	1,500,000	<3.8	18	<14				
123678-HeCDF	230,000	<4.0	8.6	<15				
234678-HeCDF	77,000	<4.8	<6.7	<17				
123789-HeCDF	<2000	<4.6	<6.2	<16				
1234678-HpCDF	4,300,000	9.8	110	37				
1234789-HpCDF	NA	NA	NA	NA				
TCDF	520,000	14	77	<7.2				
PCDF	1,200,000	<4.2	84	<5.7				
HeCDF	2,800,000	<3.8	130	<14				
HpCDF	4,700,000	9.8	210	89				
OCDF	5,700,000	20	200	97				

ANALYTICAL RESULTS (pg/g)

BIOTA

Congener or Homolog	Erie Canal N.Tonawanda (Carp)	Erie Canal Lockport (Carp)	Erie Canal Lockport (Bass)	Erie Canal Middleport (Bass)	Eighteenmile Corwin (Bass)	Eighteenmile Jacques Rd. (Bass)	Tonawanda Ck. Pendleton (Carp)	Eighteenmile Newfane (Crayfish)
2378-TCDD	1.5	2.6	1.1	1.6	.61	.53	3.5	6.6
12378-PCDD	1.3	1.7	<7.2	1.4	.14	<.40	1.3	<3.2
123678-HeCDD	1.9	3.6	<1.0	<1.4	<.51	<.69	2.8	24
123789-HeCDD	.41	.64	<.98	<1.3	<.46	<.63	.49	<.46
123478-HeCDD	.54	1.1	<1.1	<1.5	<.56	<.76	.59	<5.5
1234678-HpCDD	4.9	9.6	<1.6	<2.6	.20	<1.2	4.0	43
TCDD	1.5	2.6	1.1	1.6	.61	.53	3.5	14
PCDD	1.3	1.7	<.72	1.4	.14	<.40	1.3	<3.2
HeCDD	2.9	5.3	<1.0	<1.4	<.51	<.69	3.9	48
HpCDD	4.9	9.6	<1.6	<2.6	.20	<1.2	4.0	86
OCDD	7.8	13.0	<3.4	<5.9	3.4	2.4	5.8	260
2378-TCDF	1.4	2.8	<.66	1.7	1.0	.51	3.8	110
12378-PCDF	.39	1.1	<.52	<.57	.16	<.28	<.26	11
23478-PCDF	2.7	7.5	1.3	3.4	.41	.23	3.1	18
123478-HeCDF	1.1	6.2	.64	.70	<.27	<.35	1.6	29
123678-HeCDF	.63	2.2	<.60	<.79	.17	<.37	.59	<3.0
234678-HeCDF	<.29	1.2	<.71	<.96	.16	<.41	<.28	<3.5
123789-HeCDF	<.28	<.31	<.67	<.97	<.29	<.38	<.26	<3.3
1234678-HpCDF	1.0	4.4	<.95	<1.3	.29	.35	.71	45
1234789-HpCDF	NA	NA	NA	NA	<.70	<.96	NA	NA
TCDF	1.4	2.8	<.66	1.7	1.0	.51	3.8	340
PCDF	3.1	8.1	1.8	2.6	.50	.19	3.2	95
HeCDF	2.4	11.0	2.0	.70	.44	<.35	2.1	130
HpCDF	1.0	4.4	<.95	<1.3	.71	.74	.71	45
OCDF	1.2	2.6	<2.1	<3.6	1.4	.95	<.42	<8.9
Toxic Equivalents	4.3	9.7	1.9	4.3	1.0	.7	6.8	38.2

ANALYTICAL RESULTS (pg/l)
WATER COLUMN EIGHTEENMILE CREEK AT JACQUES ROAD BRIDGE

Congener or Homolog	Water	Particulate							
2378-TCDD	<3.2	<4.3							
12378-PCDD	<3.5	<4.5							
123678-HeCDD	<5.0	<4.8							
123789-HeCDD	<4.7	<4.1							
123478-HeCDD	<5.4	<5.2							
1234678-HpCDD	12	72							
TCDD	<3.2	<4.3							
PCDD	<3.5	<4.5							
HeCDD	<5.0	12							
HpCDD	20	110							
OCDD	140	670							
2378-TCDF	<3.0	<4.6							
12378-PCDF	<3.6	<4.3							
23478-PCDF	<3.9	<4.3							
123478-HeCDF	<2.6	2.0							
123678-HeCDF	<2.7	<3.4							
234678-HeCDF	<3.2	<4.0							
123789-HeCDF	<3.5	<3.9							
1234678-HpCDF	<4.9	18							
1234789-HpCDF	NA	NA							
TCDF	<3.0	<4.6							
PCDF	<3.6	<4.3							
HeCDF	<2.6	8.0							
HpCDF	<4.9	37							
OCDF	<16	32							

APPENDIX B

RESULTS OF SEDIMENT CHARACTERIZATION ANALYSES

	TVS	TOC_{comb}	TOC_{uv-ox}
Remick Parkway	13	8.3	.15
Clinton Street	9	2.2	1.1
N. Transit Road	11	5.0	.3
Condren Road	12	6.8	1.0
Newfane Dam	NA	NA	NA
Rte. 265	7	3.4	.17
Threemile Island	5	2.6	.39
Sherwood Avenue	6	2.2	.38
Sawyer Creek	4	2.6	.64
Dunnigan Road	5	1.2	.22
Pendleton Gate	5	2.4	.54
Main Street	6	4.6	.95
Exchange Street	6	6.4	.96
Robinson Road	4	1.3	.32
Murphy Road	2	1.8	.25
Hinman/Bear Ridge Rd.	3	3.6	.18
Rte. 93 Bypass	6	2.1	.84
Minard Street	5	2.8	.56
Transit/Rte. 31	11	3.6	.67
East Branch			
Upstream	17	8.4	.78
Downstream	9	3.1	.50
Johnson Creek			
Upstream	12	5.4	1.49
Downstream	4	1.9	.45
W. Branch Sandy Creek			
Upstream	11	6.8	1.08
Downstream	2	2.0	.11
Salmon River			
Upstream	4	3.2	.85
Downstream	6	5.0	.59
Genesee River			
Upstream	2	.7	.24
Downstream	3	.9	.25
Twelve-Mile Creek	2	1.3	.45
Petit Flume	NA	NA	NA
Tonawanda Creek			
Upstream	4	1.8	.19
Ellicott Creek			
Upstream	5	3.6	.31
Downstream	5	7.4	.78

All results in percent (%)
NA - Not analyzed

TVS - Total Volatile Solids
TOC_{comb} - Total Organic Carbon Combustion Method
TOC_{uv-ox} - Total Organic Carbon UV - Oxidation Method

RESULTS OF SEDIMENT ANALYSES

	TOT. DIOXIN	TOT. FURAN	TEF
Remick Parkway	560	64	3.8
Clinton Street	10,705	2,396	103.2
N. Transit Road	16,850	3,120	116.3
Condren Road	26,558	5,403	177.3
Newfane Dam	34,793	7,780	282.1
Rte. 265	4,764	796	16.1
Threemile Island	1,850	649	51.2
Sherwood Avenue	3,015	711	18.5
Sawyer Creek	1,669	278	9.6
Dunnigan Road	1,094	176	4.8
Pendleton Gate	1,836	300	11.8
Main Street	146,832	20,810	841.3
Exchange Street	63,788	17,260	447.1
Robinson Road	925	192	7.2
Murphy Road	613	62	2.4
Hinman/Bear Ridge Rd.	728	86	3.1
Rte. 93 Bypass	11,565	3,603	74.3
Minard Street	1,501	839	36.6
Transit/Rte. 31	115,191	22,780	966.0
East Branch			
Upstream	766	117	4.1
Downstream	1,787	514	20.6
Johnson Creek			
Upstream	85	39	2.5
Downstream	936	187	6.7
W. Branch Sandy Creek			
Upstream	242	25	2.5
Downstream	372	74	2.6
Salmon River			
Upstream	1,285	221	10.0
Downstream	34	5	.1
Genesee River			
Upstream	67	1	.2
Downstream	286	29	1.3
Twelve-Mile Creek	173	ND	.2
Petit Flume	760,000	14,920,000	704,580
Tonawanda Creek			
Upstream	133	44	2.6
Ellicott Creek			
Upstream	2,380	186	7.7
Downstream	2,490	701	19.2

TEF - Toxic Equivalency Factor
All results in pg/g (PPT)
ND - None detected

RESULTS OF SEDIMENT ANALYSES
NORMALIZED TO TOTAL VOLATILE SOLIDS (9%)

	TOT. DIOXIN	TOT. FURAN	TEF
Remick Parkway	388	44	2.6
Clinton Street	10,705	2,396	103.2
N. Transit Road	13,786	2,553	95.2
Condren Road	19,919	4,052	133.0
Newfane Dam	NA	NA	NA
Rte. 265	6,125	1,023	20.7
Threemile Island	3,330	1,168	92.2
Sherwood Avenue	4,523	1,067	27.8
Sawyer Creek	3,755	626	21.6
Dunnigan Road	1,969	317	8.6
Pendleton Gate	3,305	540	21.2
Main Street	220,248	31,215	1,262.0
Exchange Street	95,682	25,890	670.7
Robinson Road	2,081	432	16.2
Murphy Road	2,759	279	10.8
Hinman/Bear Ridge Rd.	2,184	258	9.3
Rte. 93 Bypass	17,348	5,405	111.5
Minard Street	2,702	1,510	65.9
Transit/Rte. 31	94,247	18,638	790.4
East Branch			
Upstream	406	62	2.2
Downstream	1,787	514	20.6
Johnson Creek			
Upstream	64	29	1.9
Downstream	2,106	421	15.1
W. Branch Sandy Creek			
Upstream	198	20	2.0
Downstream	1,674	333	11.7
Salmon River			
Upstream	2,891	497	22.5
Downstream	51	8	.2
Genesee River			
Upstream	302	5	.9
Downstream	858	87	3.9
Twelve-Mile Creek	779	ND	.9
Petit Flume	NA	NA	NA
Tonawanda Creek			
Upstream	299	99	5.9
Ellicott Creek			
Upstream	4,284	335	13.9
Downstream	4,482	1,262	34.6

RESULTS OF SEDIMENT ANALYSES
NORMALIZED TO TOTAL ORGANIC CARBON COMBUSTION METHOD (4%)

	TOT. DIOXIN	TOT. FURAN	TEF
Remick Parkway	187	31	1.8
Clinton Street	19,464	4,356	187.6
N.Transit Road	13,480	2,496	93.0
Condren Road	15,622	3,178	104.3
Newfane Dam	NA	NA	NA
Rte. 265	5,605	939	18.9
Threemile Island	2,846	998	78.8
Sherwood Avenue	5,482	1,293	33.6
Sawyer Creek	2,568	428	14.8
Dunnigan Road	3,647	587	16.0
Pendleton Gate	3,060	500	19.7
Main Street	127,680	18,096	731.6
Exchange Street	39,868	10,788	279.4
Robinson Road	2,846	591	22.2
Murphy Road	1,362	138	5.3
Hinman/Bear Ridge Rd.	809	96	3.4
Rte. 93 Bypass	22,029	6,863	141.5
Minard Street	2,144	1,199	52.3
Transit/Rte. 31	127,990	25,311	1,073.3
East Branch			
Upstream	365	56	2.0
Downstream	2,306	663	26.6
Johnson Creek			
Upstream	63	29	1.9
Downstream	1,971	394	14.1
W. Branch Sandy Creek			
Upstream	142	15	1.5
Downstream	744	148	5.2
Salmon River			
Upstream	1,606	276	12.5
Downstream	27	4	.1
Genesee River			
Upstream	393	6	1.1
Downstream	1,271	129	5.8
Twelve-Mile Creek	532	ND	.6
Petit Flume	NA	NA	NA
Tonawanda Creek			
Upstream	296	98	5.8
Ellicott Creek			
Upstream	2,644	207	8.6
Downstream	1,346	379	10.4

All Results in pg/g (ppt)

RESULTS OF SEDIMENT ANALYSES
NORMALIZED TO TOTAL ORGANIC CARBON-UV-OXIDATION METHOD (5%)

	TOT. DIOXIN	TOT. FURAN	TEF
Remick Parkway	1,867	213	12.7
Clinton Street	4,866	1,089	46.9
N. Transit Road	28,083	5,200	193.8
Condren Road	13,279	2,702	88.7
Newfane Dam	NA	NA	NA
Rte. 265	14,012	2,341	47.4
Threemile Island	2,372	832	65.6
Sherwood Avenue	3,967	936	24.3
Sawyer Creek	1,304	217	7.5
Dunnigan Road	2,486	400	10.9
Pendleton Gate	1,700	278	10.9
Main Street	77,280	10,953	442.8
Exchange Street	33,223	8,990	232.9
Robinson Road	1,445	300	11.3
Murphy Road	1,226	124	4.8
Hinman/Bear Ridge Rd.	2,022	239	8.6
Rte. 93 Bypass	4,857	2,145	44.2
Minard Street	1,340	749	32.7
Transit/Rte. 31	85,963	17,000	720.9
East Branch			
Upstream	491	75	2.6
Downstream	1,787	514	20.6
Johnson Creek			
Upstream	29	13	.8
Downstream	1,040	208	7.4
W. Branch Sandy Creek			
Upstream	112	12	1.2
Downstream	1,691	336	11.8
Salmon River			
Upstream	756	130	5.9
Downstream	29	4	.1
Genesee River			
Upstream	140	2	.4
Downstream	572	58	2.6
Twelve-Mile Creek	192	ND	.2
Petit Flume	NA	NA	NA
Tonawanda Creek			
Upstream	350	116	6.8
Ellicott Creek			
Upstream	3,839	300	12.4
Downstream	1,596	449	12.3

All results in pg/g (ppt)

APPENDIX C

EUCLIDIAN DISTANCE MEASUREMENT

COMPARISON OF SITES	TOTAL DIOXIN OR FURAN			TOTAL DIOXIN PLUS TOTAL FURAN			HOMOLOG TOTAL
	DIOXIN & FURAN	DIOXIN	FURAN	DIOXIN & FURAN	DIOXIN	FURAN	DIOXIN & FURAN
Rte. 265/Threemile Is.	38.2623	25.3918	28.6227	28.6834	28.215	5.16298	43.4487
Threemile Is./Sherwood	32.5226	24.1311	21.8039	23.7469	23.3597	4.27084	37.8231
Sherwood/Sawyer	6.66207	1.00846	6.5853	5.00862	4.84253	1.27914	3.2682
Sawyer/Dunnigan	10.0046	2.97113	9.55327	2.69544	2.25754	1.47272	2.65951
Dunnigan/Pendleton	15.828	1.51483	15.7554	2.2731	1.18625	1.93902	14.6566
Pendleton/Robinson	4.67501	1.09659	4.54458	2.65109	2.32293	1.27761	21.4402
Robinson/Murphy	10.0374	3.69785	9.33141	6.49572	5.55246	3.37114	23.2231
Murphy/Hinman-Bear Ridge	15.5594	4.38793	14.9279	4.04243	3.09582	2.59944	14.7049
Hinman-Bear Ridge/Rte 93 Bypass	24.3318	7.53731	23.1349	16.9851	14.9925	7.98254	15.6067
Rte 93 Bypass/Minard	24.5424	5.29999	23.9633	11.2123	9.68835	5.64367	65.5864
Minard/Transit-Rte.31	31.0387	8.84666	29.7512	24.1547	21.2178	11.5437	47.8895
Transit-Rte.31/Main	16.6005	2.14679	16.4611	6.16927	4.90128	3.74665	8.56743
Main/Exchange	21.2583	12.6618	17.0761	16.6365	15.5582	5.89194	15.1048
Main/Clinton	14.7003	6.2236	13.3178	9.55038	9.00301	3.18677	21.7375
Clinton/N.Transit	9.34949	1.9416	9.14567	2.85111	2.12742	1.89813	21.434
N.Transit/Condren	3.9072	.663626	3.85043	1.62478	1.30648	.965919	3.91807
Condren/Newfane	2.1876	.973602	2.07007	1.30843	1.11041	.682098	6.43716

RANKING OF THE GREATEST EUCLIDIAN DISTANCE

COMPARISON OF SITES	TOTAL DIOXIN OR FURAN			TOTAL DIOXIN PLUS TOTAL FURAN			HOMOLOG TOTAL
	DIOXIN & FURAN	DIOXIN	FURAN	DIOXIN & FURAN	DIOXIN	FURAN	DIOXIN & FURAN
Rte. 265/Threemile Is.	1	1	2	1	1	5	3
Threemile Is./Sherwood	2	2	5	3	2	6	4
Sherwood/Sawyer	12	13	12	9	9	12	12
Sawyer/Dunnigan	11	9	10	11	12	11	13
Dunnigan/Pendleton	8	11	8	13	13	10	10
Pendleton/Robinson	13	12	13	12	11	13	6
Robinson/Murphy	10	8	11	7	7	8	5
Murphy/Hinman-Bear Ridge	9	7	9	10	10	9	9
Hinman-Bear Ridge/Rte 93 Bypass	5	5	4	4	5	2	7
Rte 93 Bypass/Minard	4	6	3	6	6	4	1
Minard/Transit-Rte.31	3	4	1	2	3	1	2
Transit-Rte.31/Main	7	10	7	8	8	7	11
Main/Exchange	6	3	6	5	4	3	8
Main/Clinton	1	1	1	1	1	1	1
Clinton/N.Transit	2	2	2	2	2	2	2
N.Transit/Condren	3	4	3	3	3	3	4
Condren/Newfane	4	3	4	4	4	4	3

t-VALUES

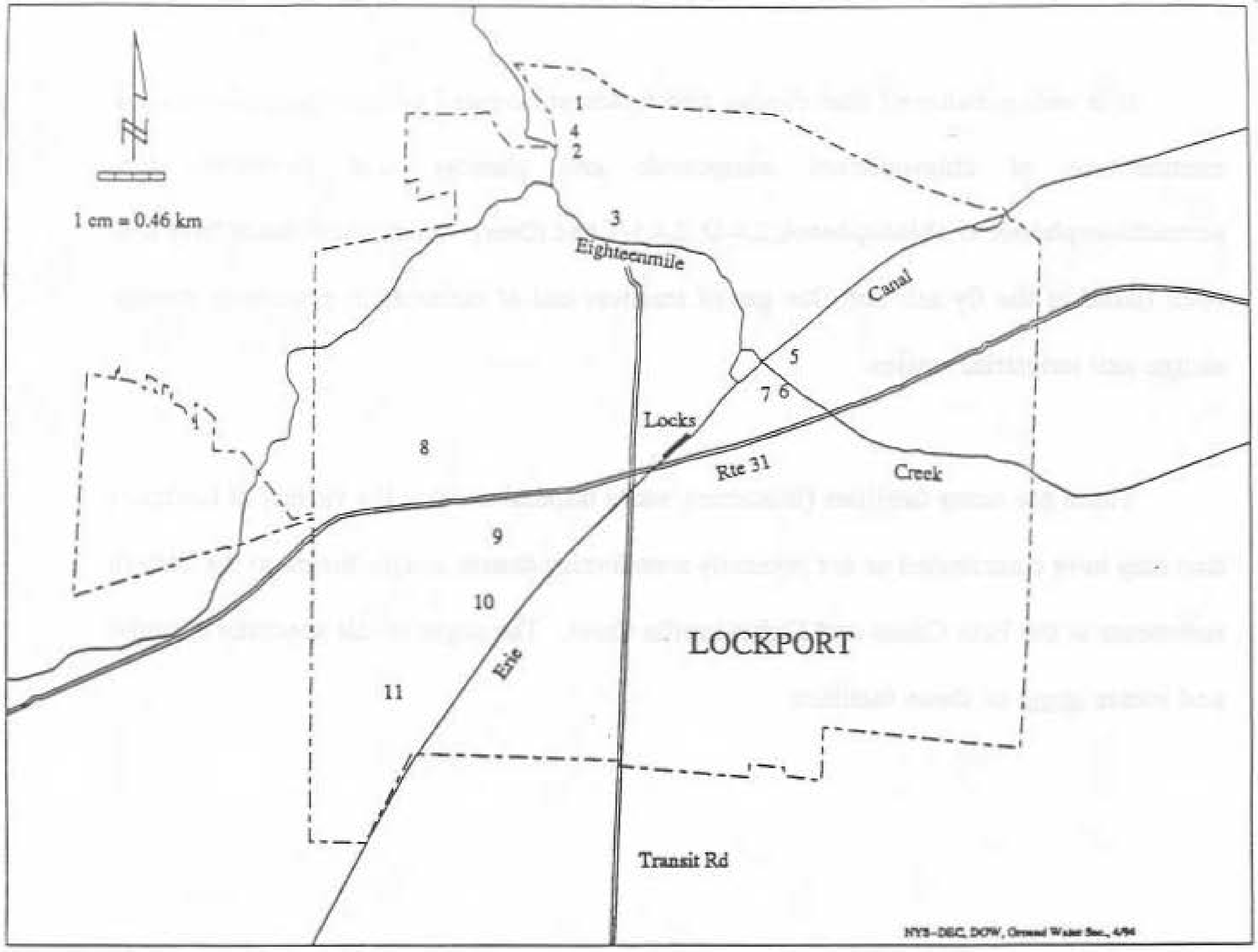
COMPARISON OF SITES	TOTAL DIOXIN OR FURAN			TOTAL DIOXIN PLUS TOTAL FURAN			HOMOLOG TOTAL
	DIOXIN & FURAN	DIOXIN	FURAN	DIOXIN & FURAN	DIOXIN	FURAN	DIOXIN & FURAN
Rte. 265/Threemile Is.	8.97097	12.2006	6.75626	8.33277	7.820765	2.70349	4.82224
Threemile Is./Sherwood	7.67906	12.8802	5.3053	10.24	9.10156	3.00831	5.17356
Sherwood/Sawyer	.522029	.10271	.59328	.06984	.01551	.287	.01148
Sawyer/Dunnigan	.432863	.15413	.520966	.04255	.26861	.415159	.1687
Dunnigan/Pendleton	1.769345	.14448	1.973299	.2399	.07333	.840245	1.81018
Pendleton/Robinson	.231843	.21549	.306913	.08796	.05275	.1899	1.80131
Robinson/Murphy	.03676	.67728	.095748	.92287	.783	1.25891	3.167185
Murphy/Hinman-Bear Ridge	2.280953	.39922	2.67814	.12628	.430378	1.12828	.972526
Hinman-Bear Ridge/Rte 93 Bypass	.36186	2.34314	.09271	1.57623	.93942	4.27717	2.5041
Rte 93 Bypass/Minard	1.26762	2.29707	1.09401	5.47375	4.771272	5.118978	1.769556
Minard/Transit-Rte.31	3.34037	1.2064	3.67709	5.703412	4.828889	7.730707	4.849115
Transit-Rte.31/Main	2.85812	.87377	3.81287	.893847	1.444147	1.94541	.51777
Main/Exchange	.04918	1.342863	.33292	.50318	1.025198	2.35814	2.32369
Main/Clinton	1.61077	2.300212	1.335235	1.858571	2.181504	2.81313	1.77139
Clinton/N.Transit	.18678	.05349	.19406	.01218	.094783	.401337	1.85649
N.Transit/Condren	1.72343	.048547	1.86327	.05432	.068687	.057223	.18147
Condren/Newfane	.02464	.03339	.03524	.074885	.00078	.31802	.006809

Fractional point for $P < .05$ and 32 degrees of freedom is 1.697
The t-Values in bolder print indicate values greater than 1.697

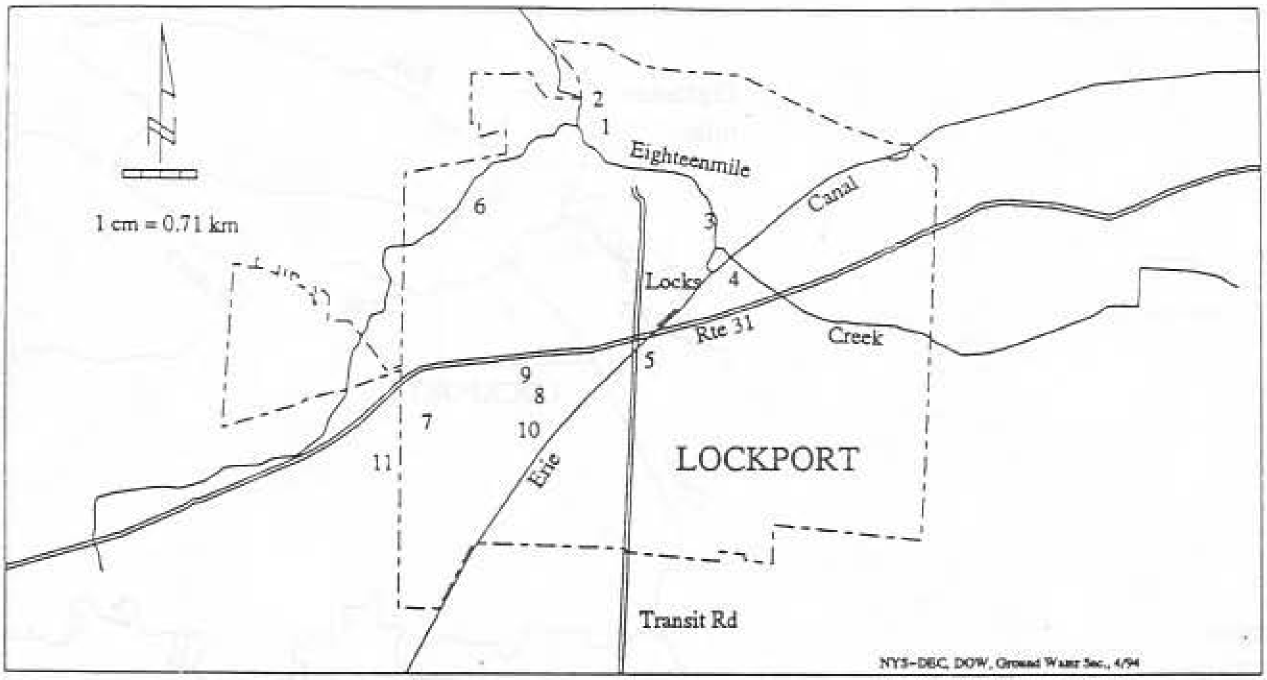
APPENDIX D

It is widely believed that dioxins and furans are created as trace impurities in the manufacture of chlorophenol compounds and phenoxy acid herbicides (i.e. pentachlorophenol, trichlorophenol, 2,4-D, 2,4,5-T and silvex). Dioxins and furans have also been found in the fly ash and flue gas of smelters and of incinerators processing sewage sludge and industrial wastes.

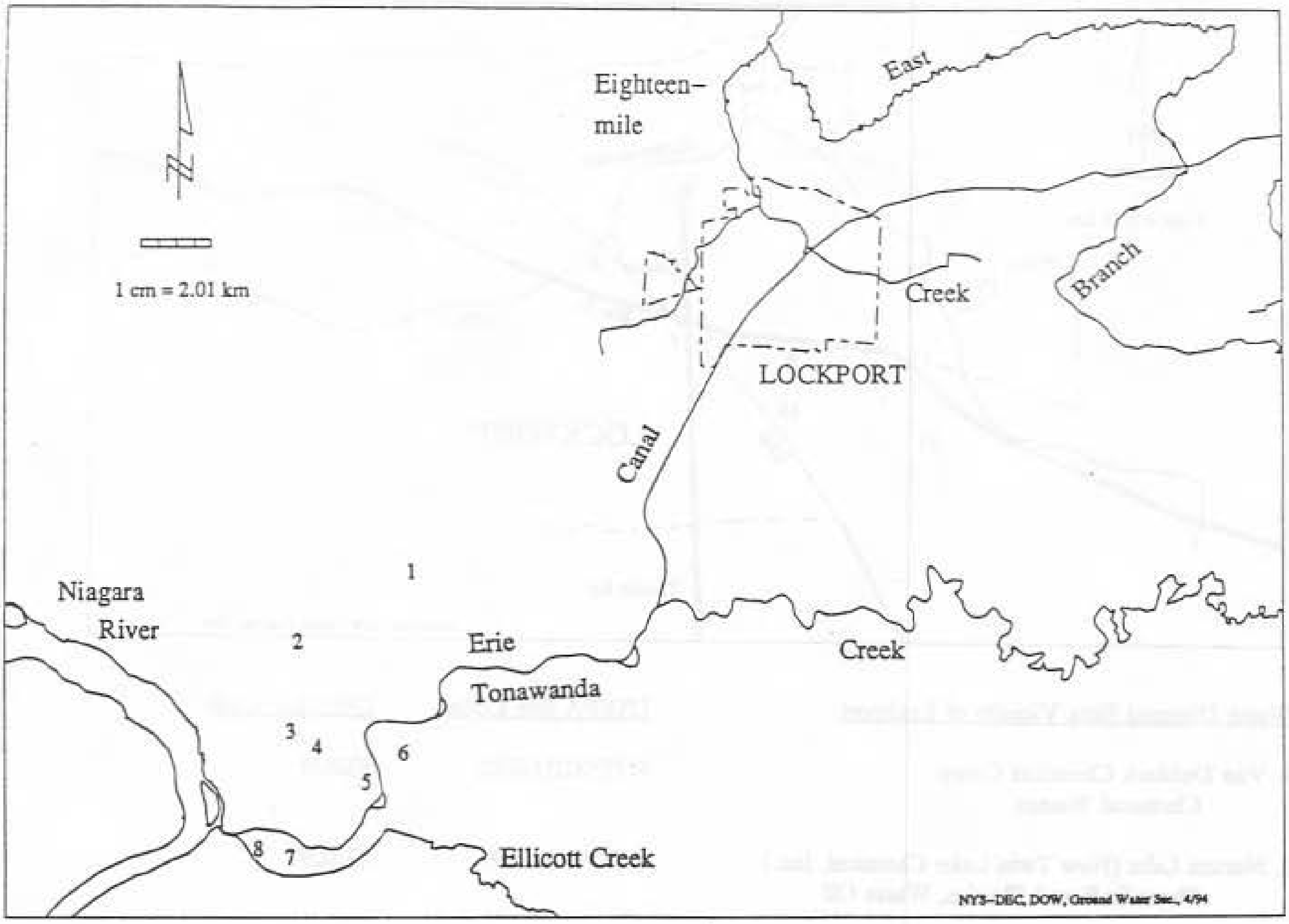
There are many facilities (industries, waste disposal sites) in the vicinity of Lockport that may have contributed or are presently contributing dioxins and/or furans to the bottom sediments in the Erie Canal and Eighteenmile Creek. The pages in this appendix describe and locate some of these facilities.



Industries of Interest Vicinity of Lockport	Production
1. Van DeMark Chemical Comp.	Industrial Chemicals
2. J.H. Products (Twin Lake Chemical)	Organic Chemicals (Bakelite Specialties)
3. Milward Alloys	Smelting and refining copper
4. Vanchem, Inc.	Industrial organic chemicals
5. Lyon Research	Moldmaking, lost wax process
6. Converdis U.S. Inc.	Recycling paper
7. Dussault Foundry Corp.	Iron foundry
8. B & B Plastics	Applied industrial coatings, phenolics
9. Buffalo Paperboard Corp.	Repulping
10.Allegheny Ludlum Corp.	Speciality steel
11.Frontier Stone Products	Petroleum and coal products



Waste Disposal Sites Vicinity of Lockport	USEPA Site Code	DEC Site Code
1. Van DeMark Chemical Comp. Chemical Wastes	NYD002116192	932039
2. Norton Labs (Now Twin Lake Chemical, Inc.) Phenolic Based Plastics, Waste Oil	NYD030212799	932029
3. Flintkote Comp. Transformer Oil Allegedly Dumped	NYD039107107	932072
4. Dussault Foundry Foundry Sand, Drums of Unknown Materials	NYD002115301	932012
5. Lockport NYSEG Substation Coal Tar	NYD980531289	932098
6. Lockport City Landfill Industrial Waste	NYD000514216	932010
7. Niagara Materials Comp. Phenolics, Halogenated Organics	NYD980654438	932073
8. Diversified Manufacturing Waste Oil, Solvents	NYD002114742	932011
9. Diamond Shamrock (Now Occidental Chem. Corp) Unknown, Surface Runoff Drains to Erie Canal	NYD002123388	932071
10.Guterl Speciality Steel Corp (Now Allegheny Ludlum) Slag, Foundry Sand; Waste Oil	NYD094174554	932032
11.Niagara County Refuse Disposal District Phenol Resin Solids, Molding Compounds	NYD980532436	932024



Waste Disposal Sites Vicinity of Tonawanda	USEPA Site Code	DEC Site Code
1. Frontier Chemical - Pendleton Waste Oil, Halogenated Organics, PCBs	NYD000514133	932043
2. Niagara Sanitation Comp. Material From Love Canal	NYD980534812	932054
3. Occidental Chemical Corp. Durez Division Phenolic Wastes	NYD002106938	932018
4. Holiday Park Phenolic Resins, Phenolic Molding Compounds	NYD980531834	932033
5. Botanical Gardens Phenolic Resins and Molding Compounds	NYD980528277	932068
6. Creekside Golf Course Phenolic Tars and Residues		915123
7. Tonawanda City Landfill Unknown	NYD980509251	915079
8. Columbus McKinnon Cutting Oils Contaminated with PCBs	NYD002105534	915016