NIAGARA RIVER
TOXICS MANAGEMENT PLAN

PROGRESS REPORT
AND
WORK PLAN

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Niagara River Toxics Management Plan
Progress Report and Work Plan

May 1999

EXECUTIVE SUMMARY

The Niagara River flows 60 kilometres or 37 miles from Lake Erie to Lake Ontario. It serves as a source for drinking water, fishing grounds, and vacation spots. It generates electricity, and provides employment to millions of people. Unfortunately, the River is also the recipient of toxic wastes that pollute its waters and prevent us from fully enjoying its beneficial uses.

Since 1987, the Niagara River has been the focus of attention for four environmental agencies in Canada and the U.S., referred to here as "The Four Parties". In February 1987, Environment Canada, the U.S. Environmental Protection Agency Region II, the Ontario Ministry of the Environment and the New York State Department of Environmental Conservation (the "Four Parties") signed a "Declaration of Intent" (DOI). The purpose of the DOI is to achieve significant reductions of toxic contaminants in the Niagara River.

Eighteen "priority toxics" were specifically targeted for reduction, ten of which, because they were thought to have significant Niagara River sources, were designated for 50% reduction by 1996. The Niagara River Toxics Management Plan (NRTMP) is the program designed to achieve these reductions.

In December 1996, the Four Parties signed a "Letter of Support", pledging their continued commitment to reduce toxic chemical inputs to the Niagara River, to achieve ambient water quality that will protect human health, aquatic life, and wildlife, and while doing so, improve and protect water quality in Lake Ontario as well.

The 1999 Progress Report highlights some of the most significant accomplishments since the NRTMP began, and discusses evidence of continuing concerns due to toxic substance contamination. The 1999 Annual Work Plan describes the actions that the Four Parties and individual agencies are taking or will take to reduce the amount of toxic chemicals going into the Niagara River from various sources, and to monitor progress.

NYSDEC/EPA and MOE have previously presented point source daily load data showing greater than 50% reductions in the "priority toxics". NYSDEC and EPA have also presented information on progress in remediation of hazardous waste sites. This progress report presents corroborative evidence of progress, to gauge the effectiveness of these actions. The key sources of information used in assessing progress are:

- Changes/trends in the eighteen "priority toxics", determined by using a statistical model and data from the Upstream/Downstream Program;
- Biomonitoring Program data (juvenile fish and caged mussels) which show effectiveness of remedial programs in reducing chemical inputs to the Niagara River at various sources; and
- Sediment core data from Niagara River depositional zone cores in Lake Ontario, presented to put the trends of the last eleven years into a longer-term context.

The primary method of assessment is the **Upstream/Downstream Program**. The program collects bi-weekly[1] water and suspended sediment samples from the head and mouth of the river to measure the changes in the concentrations and loads of more than 90 chemicals. An advanced **statistical model** was used to determine trends for the eighteen "priority toxics" for the period 1986/87 to 1996/97, and to determine with more certainty, the effectiveness of reductions of chemical loads to the river.

Results show that there have been statistically significant reductions in the concentrations and loads for most of the eighteen "priority toxics". In many cases the reductions have been greater than 50%. For some chemicals, the reductions observed are due, in part, to the effectiveness of remedial activities at Niagara River sources in reducing chemical inputs to the river.

Results from the **biomonitoring program** were also used to corroborate progress. **Juvenile fish**, including spottail shiners and other species, collected at several sites along the Niagara River, revealed reductions in chlorobenzene and PCB concentrations. Examples presented in the progress report indicate a reduction of contaminants in **caged mussels** located near known sources of pollution. These reductions point to the effectiveness of remedial programs in reducing the inputs of contaminants to the Niagara River. Juvenile fish collected at upstream locations in two Niagara River tributaries suggest additional areas for investigation of contaminant sources.

Many toxic pollutants are principally conveyed through waterways attached to suspended sediments. Dated **sediment core** samples, collected from the Niagara River depositional zone in Lake Ontario, tell the history of toxic chemical loadings from the Niagara River to Lake Ontario. The concentrations of many chemicals in these cores have decreased significantly since the 1960s and 70s. The data show that suspended sediments flowing through the Niagara River are becoming cleaner and cleaner. The older contaminated sediments in this depositional area are being buried by the new, cleaner sediments.

Each of the above monitoring programs supports the conclusion that remedial activities have had an effect in reducing the loads of chemicals to the river. This is the overall goal of the Niagara River Declaration of Intent and the NRTMP.

Despite the successes to date, more work needs to be done. Several chemicals are still at levels that exceed the most stringent government water quality criteria in the River. Advisories to limit consumption of sportfish caught in the Niagara River continue due to toxic contamination. There is evidence of continuing sources of chemical contamination in the River. Inputs from Lake Erie are also important for some chemicals. The activities in the 1999 Work Plan reflect the commitment of the Four Parties to continue to reduce toxic chemical inputs to the River and to monitor the progress. This commitment includes:

- Completing the actions described in prior NRTMP Work Plans;
- Ensuring that these actions have been effective;
- Implementing additional actions to protect and restore the River; and
- Continuing and improving the public reporting of progress.

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[1] Prior to April 1997, sampling was done on a weekly basis.

1. INTRODUCTION

In February, 1987, Environment Canada, the U.S. Environmental Protection Agency Region II, the Ontario Ministry of the Environment and the New York State Department of Environmental Conservation (the "Four Parties") signed a "Declaration of Intent" (DOI). The purpose of this Declaration is to achieve significant reductions of toxic contaminants in the Niagara River. Eighteen "priority toxics" were specifically targeted for reduction (Table 1), ten of which, because they were thought to have significant Niagara River sources, were designated for 50% reduction from Canadian and U.S. point and non-point sources by 1996. The Niagara River Toxics Management Plan (NRTMP) is the program designed to achieve these reductions. The NRTMP Work Plan identifies activities taken by the Four Parties to remediate sources and to monitor progress toward protecting the River.

The Four Parties have used a variety of information to assess progress. For example, NYSDEC/EPA and MOE have presented point source daily load data showing greater than 50% reductions in the "priority toxics". Reductions in point and non-point source loads for certain priority toxic chemicals were also indicated by ambient river and biomonitoring data. NYSDEC and EPA have presented information on progress in remediation of hazardous waste sites. The ambient river data have yielded definitive trend information after application of an advanced statistical model developed specifically for this purpose. The trend information is useful for assessing progress in meeting the 50% reduction goal.

This report presents corroborative evidence of progress. The information presented includes:

1. Changes/trends in the eighteen "priority toxics" determined by using an advanced statistical model completed by Environment Canada in 1998, and data from the Upstream/Downstream Program.
2. Biomonitoring Program data (juvenile fish and caged mussels) which can show the effectiveness of remedial programs in reducing chemical inputs to the Niagara River at various sources;
3. Sediment core data from Niagara River depositional zone cores in Lake Ontario, to put the trends of the last eleven years into a longer-term context.

Detailed reports are available elsewhere (see References).

The Four Parties are committed to continuing the reduction of toxic chemical inputs to the Niagara River, and to assessing the effectiveness of remedial activities at Niagara River sources in reducing the concentrations of these chemicals in water and biota. At a public meeting in December 1996, the Four Parties signed a Letter of Support reaffirming their commitment to the NRTMP.

In the Letter of Support, the Four Parties agreed to make progress toward the following goal:

> *To reduce toxic chemical concentrations in the Niagara River by reducing inputs from sources along the River. The purpose is to achieve ambient water quality that will protect human health, aquatic life, and wildlife, and while doing so, improve and protect water quality in Lake Ontario as well.*

The 1999 Progress Report also presents information on continuing concerns due to toxic contamination in the Niagara River, such as exceedances of water quality criteria and contamination of sportfish. The Work Plan addresses tasks to achieve the Four-Party goal, and to monitor and report progress.

2. THE UPSTREAM/DOWNSTREAM MONITORING PROGRAM

The Upstream/Downstream Program collects both water and suspended sediment samples from the head (Fort Erie = FE), and mouth (Niagara-on-the-Lake = NOTL) of the Niagara River. Data from the Niagara River Upstream/Downstream Program and a statistical model were used to measure progress toward reducing the inputs of the 18 “priority toxics” to the Niagara River.

This program has measured, on a bi-weekly basis[2], the changes in the concentrations and loads of over 90 chemicals in the water entering and leaving the Niagara River. Using state-of-the-art sampling and analytical methodologies, the program has been able to detect chemicals at very low concentrations--much lower than those allowed by the detection limits used in source monitoring programs.

The Upstream/Downstream Program data set is one of the best, if not **the** best, monitoring data set in the Great Lakes Basin. The fact that the program has been designed and operated by a single agency, Environment Canada, has ensured the consistency of field and laboratory work and data management. Four Party audits and peer review of the quality of field and laboratory work are done regularly.

Both seasonal and large, week to week, fluctuations in the Niagara River Upstream/Downstream data made discernment of a trend in the concentration and load data difficult. Compounding this difficulty was the fact that the concentrations of many chemicals, particularly organic chemicals, were so diluted (due to the river’s high rate of flow) that they were often below analytical detection limits. Furthermore detection limits changed during the period of record. A statistical model was needed to determine trends.

[2] Prior to April 1997, sampling was done on a weekly basis.

2.1. The Statistical Model

A model was developed that could determine reliable trends for the 18 Niagara River "priority toxics". Model output would also help answer the fundamental question: "Have remedial programs implemented at Niagara River sources been effective in reducing the loads of these chemicals to the river? ".

Detailed discussion of the development and application of the model is presented elsewhere (El-Shaarawi and Al-Ibrahim 1996). For this report, the model was applied to the eleven years of data for the eighteen "priority toxics" collected between 1986/87 and 1996/97. The same data were then examined on a year-by-year basis and compared with the modelled eleven-year trends to determine possible explanations for the changes observed.

2.2. Results from Application of the Statistical Model

Table 2 presents examples of results for the per cent change in the concentrations and loads of selected chemicals (for which a statistically valid trend could be determined) from the list of eighteen "priority toxics" between 1986/87 and 1996/97. These examples were chosen because they illustrate trends exhibited by many of the other eighteen "priority toxics". Data for both the suspended sediment and water ("dissolved") phases sampled at Fort Erie and Niagara-on-the-Lake are included.

While the numbers have changed from those presented in the last NRTMP progress report (based on comparison between 1986/87 and 1995/96), the overall picture has not. The results show that, with a few exceptions, there have been statistically significant reductions in the concentrations and loads of these chemicals over the eleven-year period in both phases, at both FE and NOTL. In many cases, the reductions have been greater than 50%.

In general, decreases in chemical concentrations result in decreases in chemical loads. There are, however, situations in which a chemical shows an increase in mean concentration, but a decrease in the load (eg., see benzo(a)pyrene). This is most evident for chemicals on suspended solids. Loads are dependent on both the chemical concentration and the river flow; for chemicals on suspended solids, the load is also dependent on the concentration of solids in the water column. Both the suspended solids concentrations and flow in the Niagara River decreased substantially over the period from 1986 to 1997 (Niagara River Data Interpretation Group (NRDIG) 1999). One possible explanation is, therefore, that while the concentration of the chemical increased, this was offset by the decrease in river flow and suspended solids concentrations over the same period. The result was a decrease in the overall load of this chemical.

Figures 1 through 10 are graphs of the actual data and the model output for the concentrations of dieldrin, PCB, hexachlorobenzene (HCB), mirex and octachlorostyrene (OCS).

Decreases in the concentrations and loads of chemicals which are detected only at NOTL (eg., mirex and OCS) serve as the best examples of the effectiveness of remedial activities in reducing the inputs of chemicals from river sources. Many of the eighteen “priority toxics”, however, are detected at both FE and NOTL and exhibited significant decreases in concentrations and loads at both stations.

The question, therefore, was whether the observed decreases at NOTL were due to decreases in Lake Erie inputs or, to remedial programs implemented at sources along the river.

As the loads from sources along the river are reduced at a faster rate than those from Lake Erie, the contribution of the FE inputs to what goes out from the Niagara River into Lake Ontario at NOTL should increase (Williams *et al* 1992); that is, the ratio FE/NOTL for the concentrations/loads should increase. Conversely, as the loads coming in from Lake Erie are reduced at a faster rate than those from Niagara River sources, the contribution of the FE inputs to what goes out from the River at NOTL should decrease; that is, the ratio FE/NOTL should decrease. The ratio, therefore, provides a simplified indication of the effectiveness of remedial programs in controlling the inputs of chemicals to the river.

Table 3 presents estimates of this ratio (expressed as a percent) for 1986/87 and 1996/97 for the water and suspended sediment concentrations and loads of those chemicals noted in Table 2. It can be seen that for HCB and PCB the ratio has increased, while for dieldrin it has decreased. Changes in this ratio (FE/NOTL) for both concentrations and loads based on the annual calculated values from 1986 through 1997 are plotted for dieldrin, HCB, PCB and B(a)P, in the water phase, in Figures 11(a) through (d), respectively. The trend in this ratio is evident. For dieldrin, the ratio is clearly decreasing, indicating that inputs from Lake Erie are being reduced at a faster rate than inputs from Niagara River sources (Williams *et al* 1993). Note however that the inputs of dieldrin along the Niagara River are minor compared to the input at Fort Erie. Although there have been some variations over time in the ratios for HCB and PCB, overall the ratios have increased over the eleven-year period. This suggests that remedial activities at Niagara River sources have probably been the most effective in contributing to the reduction of the inputs of these chemicals to the river. The ratio for B(a)P has also increased, although the data since 1991/92 are more difficult to interpret.

Figure 12 shows the recombined whole water loads (i.e., sum of water + suspended sediments) for PCBs at FE and NOTL, and the differential load (i.e., NOTL - FE, representing the PCB inputs in the Niagara River). The data corroborate what is stated above for the water phase using the ratio approach. Up until 1990/91, the decreasing loads at NOTL are due to decreasing inputs to the river from Lake Erie (note the similarity in the decreasing slopes of the trend lines). After 1990/91, however, the PCB load measured at NOTL decreases faster than the load to the river from Lake Erie as measured at FE (note the slope of the NOTL trend line decreases faster than that for FE). This results in a decrease in the differential load, and is indicative of successes at Niagara River sources in reducing the inputs of PCBs to the river.

2.3. A Perspective on the Yearly Data

Figure 13 shows the concentration of octachlorostyrene (OCS) on suspended sediments at NOTL (measurements of OCS started in 1989). Because this chemical is detected only at NOTL and not at FE, it can be inferred that the major sources are located along the Niagara River rather than Lake Erie. Post-1990, OCS exhibits a reduction in concentrations and in both the number and magnitude of the "spikes". Post-1992, it is generally detected less frequently. Although the levels of OCS are still less than those observed over the period 1989-1990, there is some indication that the number and magnitude of the spikes may be increasing. These observations suggest a reduction of inputs to the river and better control of sources which begin around 1991. However, following this period, the spikes may reflect an increase in the inputs on an intermittent basis.

Concentrations of hexachlorobenzene (HCB) at NOTL have consistently been much higher than concentrations at FE, indicating significant sources along the Niagara River. Figure 14 shows the suspended sediment data for hexachlorobenzene (HCB) at NOTL. The data show much the same pattern as discussed above for OCS. Between 1986 and 1992, there is a reduction in overall concentrations as well as the number and magnitude of the "spikes". Occasional "spike" concentrations again occur in 1993 and 1995, but are not evident in the other years. Once again, these observations suggest a reduction of inputs to the river and better control of sources beginning around 1990 and 1991. However, continued monitoring will be necessary to establish whether the spikes in later years reflect a continuing pattern in contaminant concentrations and inputs.

Figures 15, 16 and 17 show the water concentration data for OCS, HCBD and total chlorobenzenes, respectively, at NOTL. The data clearly show that something happened to cause an increase in the water concentrations of these toxic chemicals at the end of 1989 and extending through 1990/91 similar to that for OCS and HCB on suspended sediments. Subsequent to this period, the water concentrations are again much lower.

2.4. Link to Remedial Activity

Over the last decade, the U.S. has taken various measures to reduce the pollutant flow of untreated **dry weather** discharge (combined sewer overflows and contaminated (groundwater) from the Falls Street Tunnel to the Niagara River. During the period, 1989 to 1993, remedial actions and results determined by DEC and EPA included:

- **Spring 1989**: Implementation of a court order requiring the City of Niagara Falls to pump dry weather flow in the Falls Street Tunnel to the Niagara Falls Waste Water Treatment Plant (NFWWTP) up to the capacity of the pumps that convey the flow from the Tunnel to the treatment plant. Result: Approximately 3 to 4 million gallons a day out of an average of 13 million gallons a day taken for treatment.

- **1990-91**: Tunnel cracks repaired to reduce groundwater leakage at the intersection of the tunnel and the NYPA conduits. Result: Source of heaviest contamination to the tunnel sealed off. Falls Street Tunnel dry weather flow to the River reduced to 2 to 6 million gallons a day.
- **October 1993**: Implementation of a new discharge permit for the Niagara Falls Waste Water Treatment Plant requiring treatment of 100% of the Falls Street Tunnel dry weather flow. Result: All dry weather flow sent to the NFWWTP for treatment.

The Upstream/Downstream Program data support the conclusion that these actions have reduced the inputs of a number of chemicals to the Niagara River.

The reasons for continued occurrence of occasional "spikes" post-1992 have not been determined at this time. Additional monitoring should help establish whether the spikes will continue.

3. THE BIOMONITORING PROGRAM

Many chemicals can concentrate in the tissues of aquatic organisms and reveal the presence of contaminants that cannot otherwise be directly detected in water, because of dilution.

3.1. Caged Mussels

Since 1981, MOE has monitored contaminants in caged mussels (*Elliptio complanata*) at sites along the Niagara River every two years. The cooperative assistance of the NYSDEC has enabled mussels to be placed on the U.S. and Canadian sides of the River. The mussel biomonitoring program has been successful at identifying contaminant sources by providing information on the presence or absence of contaminants in the tissue of deployed mussels. Examples presented here, based on information collected in 1995 and prior, document a reduction of contaminants in caged mussels located in the proximity of known sources of pollution, especially some of the U.S. priority hazardous waste sites (see U.S. EPA and NYSDEC, 1998). At some sites, the reductions point to the effectiveness of remedial programs in reducing the inputs of contaminants to the Niagara River. The results also corroborate those of the Upstream/Downstream program. Detailed discussion of the 1995 survey results are presented elsewhere (Richman 1997).

The most recent mussel data, from caged mussel deployments in 1997, suggest that there may be improvement in some additional areas, and some recurring problems. All these data are currently being reviewed by the Four Parties.

- **Hyde Park - Bloody Run Creek**

Bloody Run Creek and the nearby seeps which run down the face of the Niagara Gorge were historically contaminated from the Hyde Park hazardous waste site. Prior to remediation, the drainage from this site was a major source of dioxin contamination to the Niagara River (Gradient Corporation 1990). Remediation of Bloody Run Creek was completed by the Occidental Chemical Corporation (OCC) in 1994.

Figures 18 and 19 show the dioxin and furan concentrations, respectively, in mussel tissue for the period 1993 to 1995. Concentrations for the last two years were considerably lower than those reported in 1993. These data suggest that sediment removal actions along Bloody Run Creek, action to cover and contain contaminated sediment and soil at the mouth of Bloody Run Creek and on the shoreline of the Niagara River in the vicinity of the creek, together with remedial actions taken at the site, may have reduced the bioavailability of these contaminants to aquatic life in this area.

Water levels fluctuate daily to maintain the operation of the hydro generating stations, thereby, routinely, submerging and then exposing the contaminated shoreline. This site will continue to be monitored in future surveys since the contaminated sediment covered during the remediation along the Niagara River shoreline and at the mouth of the creek may continue to be a source.

- **Occidental Durez - Pettit Flume**

Figure 20 shows the concentrations of chlorobenzenes in mussels placed at the mouth of the Pettit Flume, a storm sewer which was contaminated by groundwater from the Durez hazardous waste site in North Tonawanda. The concentrations of chlorobenzenes typically found in mussels at the Pettit Flume were considerably lower in 1995 than concentrations found in previous years suggesting the positive effects of remedial actions carried out by OCC in 1994.

3.2. Juvenile Fish

Juvenile (young-of-the-year) fish, principally spottail shiners (*Notropis hudsonius*), have also been used in the Biomonitoring Program. These fish have limited home ranges near shore and are of known age, making them useful indicators of local, recent chemical inputs to the aquatic ecosystem.

Both MOE and NYSDEC have collected and analyzed indigenous, young-of-the-year fish. MOE has collected fish from NOTL since 1975, and from several other Canadian and U.S. locations at least every other year since the early 1980s. NYSDEC has collected fish from locations on the U.S. side of the River annually between 1984 and 1987, and about every five years since. The following results are based on MOE data (Hitchin 1998).

In 1996, PCB levels in juvenile fish collected at all sites in the Niagara River (with the exception of common shiners collected at Cayuga Creek) dropped below 200 ng/g for the first time.

Figure 21 shows that the concentrations of PCB in spottail shiners collected at NOTL. have decreased substantially since the 1970s. In particular, concentrations have continued to decline over the last four years (1993-1996). In 1995 and 1996, mean PCB concentrations were below the Great Lakes Water Quality Agreement specific objective of 100 ng/g for the protection of fish-eating wildlife for the first time.

Chlorobenzene concentrations in young-of-the-year fish collected at several sites throughout the Niagara River (Cayuga Creek, 102nd Street, Search and Rescue Station, Lewiston, Queenston, Youngstown and NOTL) in 1996 were considerably less than those measured in 1995. Reasons for the dramatic decline in chlorobenzenes in 1996 are not known at this time.

Decreases in chlorobenzene concentrations in young-of-the-year fish (spottail shiners) are consistent with the declines seen in the Upstream/Downstream and the caged mussel concentrations.

In 1996, as part of a supplemental biomonitoring project in Lake Ontario and the Niagara River (NYSDEC 1998), NYSDEC collected juvenile fish for contaminant monitoring (including PCBs and organochlorine pesticides) from two tributaries in the upper Niagara River (Scajaquada Creek in Buffalo and Two-Mile Creek in Tonawanda). In this project, fish were collected from upstream locations, unaffected by changing lake levels. The stations were chosen based on the potential for having elevated levels of contamination in fish tissue but (in most cases) which had not been examined previously. The intent was to determine whether upstream contaminant sources may be present in significant concentrations, and to indicate areas where further contaminant trackdown efforts may be required. The mean PCB concentration in samples of juvenile bluntnose minnow in Scajaquada Creek was the highest of all the tributaries sampled (approximately 1400 ng/g, wet weight). The sites sampled are not affected by any of the U.S. Niagara River priority hazardous waste sites. Follow-up investigations were recommended to determine the source(s) of the contamination.

4. LONG-TERM TRENDS: SEDIMENT CORES

In the fall of 1995, NYSDEC ,USEPA and Environment Canada collected sediment core samples from the depositional area in Lake Ontario at the mouth of the Niagara River. Analyses of the cores and data interpretation were done by NYSDEC (NYSDEC 1996). Dated cores from this area tell the history of toxic chemical loadings to Lake Ontario from the River, because many toxic pollutants (e.g., pesticides, PCBs) are principally conveyed through waterways attached to suspended sediments. Every few centimeters along the length of the core were analysed separately to determine the concentrations of toxic chemicals on deposits from the particular time frame represented by that segment. Radioisotope dating was used to determine the approximate years during which the sediments were deposited. These sediment cores put the trends of the last ten years into a long-term context.

Results for dioxin (2,3,7,8-TCDD), hexachlorobenzene, benzo(a)pyrene, and mirex are shown in Figures 22 (a) through (d). The depth from the surface is shown on the left of the graph. The corresponding approximate time frame of deposition is also shown. These data indicate that the burden of toxic chemicals associated with suspended sediment coming from the River has declined significantly. The most dramatic declines occurred between 1960 and 1980, with the exception of HCB, which shows mixed results from 1970 to the present, and benzo(a)pyrene, which has exhibited a more steady decline over the period represented in the core. Similar results were observed for all priority toxic chemicals analysed.

The graphs also show a line entitled “Persaud’s LEL (Lowest Effect Level)”, [i.e., formally Ontario’s Provincial Sediment Quality Guideline LEL (Persaud *et al*. 1993)] which is the concentration at which a contaminant can be expected to begin to affect aquatic organisms. This set of guidelines is the most complete, and in most cases the most rigorous, for toxic chemicals in sediment. The sediment concentrations of the priority chemicals in the 1960s and 1970s were above the LELs. However, as the Upstream/Downstream sampling has shown, suspended sediments flowing through the Niagara River are becoming cleaner and cleaner. The older contaminated sediments in this depositional area are being buried by the new, cleaner sediments so that the surface concentrations of all priority chemicals in these cores, with the exception of DDE and PCB congeners, are now less than the LELs.

5. CURRENT CONCERNS DUE TO TOXIC CHEMICALS

Despite the progress in reducing toxic chemical inputs to the Niagara River, there are continuing concerns. For example, some toxic chemicals continue to exceed the most stringent government water quality criteria, and advisories on consumption of sportfish due to toxic chemical contamination continue. While the following discussion may not necessarily address all the current concerns, it suggests the need to continue the program to reduce inputs of toxic chemicals to the River.

Six of the eighteen NRTMP priority toxic chemicals (Table 1) have also been designated as “Critical Pollutants” in the Lake Ontario Lakewide Management Plan (LaMP). That is, they are causing, or likely to cause, lake-wide impairments to “beneficial uses” in the lake (Table 4). Thus, as Niagara River sources of these chemicals continue to be reduced, Lake Ontario will also benefit.

New York State and Ontario issue advice regarding consumption of sportfish caught in their waters. In the Niagara River, New York State has issued advisories on the consumption of certain species of sport fish, based on contamination by PCBs, mirex and dioxin (NYSDOH 1998). The 1998/1999 New York State advisories for the Niagara River are summarized in Table 5. These advisories are unchanged from the 1997/1998 advisories.

The Ontario MOE issues advice contained in a biannual “Guide to Eating Sport Fish”. Consumption advice on a total of 18 species of fish from two locations on the Niagara River is included in the guide. The consumption advice is based on health protection guidelines developed by Health Canada. Table 6 is taken from the 1999/2000 guide (MOE 1999). The 1999 consumption tables show less restrictive consumption advice for chinook salmon, rainbow trout and lake trout than the 1997/1998 guide. Elevated concentrations of mercury, PCBs, and mirex continue to be the major causes of consumption advisories for the sport fish found in the Niagara River.

The 1996/1997 Upstream/Downstream Monitoring Program (NRDIG 1999) identifies a number of NRTMP priority toxic chemicals that are still exceeding the most stringent government water quality criteria in the Niagara River (Table 7). The Upstream/Downstream Monitoring Program has identified some additional chemicals, for example several polycyclic aromatic hydrocarbon (PAH) compounds, that are also exceeding the water quality criteria.

The 1996/1997 Upstream/Downstream Monitoring Program has also identified a number of chemicals for which the loading in 1996/1997 was higher at NOTL than at FE in the water and/or suspended solids phase, indicating that Niagara River sources remain. Several of the NRTMP priority toxic chemicals are among those identified, including all the chemicals in Table 7. Additional indications of continuing sources to the Niagara River may be found through contaminant biomonitoring and source trackdown programs. For example, note the discussion regarding PCB contamination in juvenile fish (pages 8-9).

While Niagara River sources remain, the loadings of some of the chemicals at Fort Erie, representing the input to the Niagara River from upstream sources, including Lake Erie, are significant. For example, as illustrated in the last column of Table 7, the loads at FE are greater than or roughly equivalent to the differential load (i.e. NOTL-FE) for two of the six chemicals (based on recombined whole water). Thus, while a continued focus on Niagara River sources is essential, improving the River may also involve actions beyond its boundaries.

6. SUMMARY AND CONCLUSIONS

The Upstream/Downstream Program and the Biomonitoring Program are important, complementary programs that are key to measuring the success of the NRTMP. The Upstream/Downstream Program measures the input from Lake Erie, output to Lake Ontario, and the difference between the two. It cannot, however, reveal the sources along the river that are responsible for this difference. This is where the Biomonitoring Program is most effective.

Results from applying a statistical model to the Upstream/Downstream Program data show that, with a few exceptions, there have been significant decreases in the concentrations and loads of most of the eighteen “priority toxics” over the eleven-year period between 1986 and 1997. The decreases in both the concentrations and loads for many of the eighteen chemicals exceeds 50%. For some of the eighteen chemicals, the reductions are due to the effectiveness of remedial activities in reducing inputs from Niagara River sources.

This conclusion is corroborated by analysis of the Biomonitoring Program data. For example, PCB concentrations in spottail shiners collected at NOTL continue to decrease since 1993. In 1995 and 1996, concentrations were below the Great Lakes Water Quality Agreement specific objective for the protection of fish eating wildlife for the first time since the Niagara River young-of-the-year fish program began. Also, based on information from 1995 and prior, concentrations of several chemicals in the tissue of mussels placed adjacent to some known sources of contamination to the river are the lowest over the period of record.

Concentrations of priority toxic chemicals in cores collected from the depositional zone of the Niagara River in Lake Ontario have declined significantly. For most chemicals, the most dramatic declines occurred between 1960 and 1980. Concentrations of these chemicals in the 1960s and 1970s were above the Ontario Provincial Sediment Quality Guideline LEL (lowest effect level = LEL). However, with the older contaminated sediments in this depositional area now being buried by cleaner sediments entering the Lake from the river, surface concentrations of all priority chemicals in these cores, with the exception of DDE and PCB congeners, are now less than the LELs.

Each set of data corroborates the other. All results lead to the same conclusion: remedial activities have had an effect in reducing the loads of chemicals to the river and thus, their concentrations in the river. This is the overall goal of the Niagara River Declaration of Intent and the NRTMP.

Despite the successes to date, more work needs to be done. For example, several chemicals still exceed the most stringent government water quality criteria and contaminate sportfish in the River. There is evidence of continuing sources of some of these chemicals in the River. Upstream sources are important for a few of the chemicals. The Four Parties will continue to monitor progress toward reduction of chemical concentrations in the Niagara River, and to define additional actions necessary to reduce toxic chemical inputs, through the activities outlined in the 1999 Work Plan.

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Table 1:

NIAGARA RIVER TOXICS MANAGEMENT PLAN
EIGHTEEN PRIORITY TOXIC CHEMICALS

Chlordane	PCBs*
Mirex/Photomirex*	Dioxin (2,3,7,8-TCDD)*
Dieldrin	Octachlorostyrene
Hexachlorobenzene*	Tetrachloroethylene*
DDT & metabolites	Benz(a)anthracene* Benzo(a)pyrene*
Toxaphene	Benzo(b)fluoranthene*
Mercury*	Benzo(k)fluoranthene*
Arsenic	Chrysene/Triphenylene
Lead	

* Chemicals designated for 50% reduction by 1996.

Table 2. Percent change in the concentration and loads of selected “Priority Toxics” between 1986/87 and 1996/97.

	CONCENTRATIONS				LOADS			
	FE		NOTL		FE		NOTL	
ORGANICS	**Water**	**Susp Sed**	**Water**	**Susp Sed**	**Water**	**Susp Sed**	**Water**	**Susp Sed**
HCB	-38.7	-22.6	-63.6	-69.4	-45.4	-67.4	-67.7	-63.5
PCB	-58.5	-59.5	-59.0	-75.5	-63.1	-82.9	-63.6	-81.8
Mirex/Photomirex	---	---	---	-49.6	---	---	---	-62.5
Dieldrin	-57.6	-38.2	-54.2	-59.1	-62.3	-74.0	-59.3	-69.5
Benzo(a)pyrene	22.4	134.7	3.2	14.6	9.1	-1.1	-8.5	-14.7
Octachlorostyrene	---	---	-98.5	-81.8	---	---	-98.3	-84.0

--- Indicates no significant trend evident; therefore, no calculations. In some cases, this may be because concentrations could not be detected.

Table 3. FE/NOTL ratio for concentrations and loads for selected "Priority Toxics" between 1986/87 and 1996/97, expressed as percent.

		RATIO OF CONC'S [FE/NOTL]		**RATIO OF LOADS [FE/NOTL]**	
ORGANICS		**Water**	**Susp Sed**	**Water**	**Susp Sed**
HCB	1986/87 1996/97	25.5 43.0	7.1 11.2	25.1 42.4	8.4 7.5
PCB	1986/87 1996/97	116.7 117.9	41.9 69.1	114.8 116.5	49.5 46.3
Mirex/Photomirex	1986/87 1996/97	---	---	---	---
Dieldrin	1986/87 1996/97	101.6 94.0	103.5 156.3	100.0 92.8	122.4 104.7
Benzo(a)pyrene	1986/87 1996/97	---	---	---	---
Octachlorostyrene	1986/87 1996/97	---	---	---	---

--- Indicates no significant trend evident; therefore, no calculations. In some cases, this may be because concentrations could not be detected.

Table 4:

LAKE ONTARIO LAKEWIDE MANAGEMENT PLAN
CRITICAL POLLUTANTS

Chemical Name	Causes Lakewide Beneficial Use Impairments[1]	Likely to Cause Lakewide Beneficial Use Impairments[2]	Loading entering Lake from Niagara River[3]
PCBs	●		●
DDT/ metabolites	●		●
Mirex	●		●
Dieldrin		●	●
Dioxins	●		NE
Mercury		●	NE

[1] Based on direct evidence that the chemical is causing lakewide use impairments.
[2] Based on "indirect" evidence that the chemical is causing lakewide beneficial use impairments because the chemical exceeds the most stringent government standard, criteria, or guideline.
[3] Based on Upstream/Downstream Monitoring Program, 1992/1993.
NE = Not estimated, because concentrations were below the analytical detection limit.

Table 5. New York State advisories on the consumption of sportfish for waters of the Niagara River and U.S. tributaries (from NYSDOH, 1998).

Water	Species	Recommendations	Chemicals of Concern
Niagara River, above Niagara Falls	Carp	Eat no more than one meal per month	PCBs
Niagara River, below Niagara Falls	White perch, American eel, channel catfish, carp, lake trout over 25", brown trout over 20", chinook salmon	Eat none	PCBs, Mirex, Dioxin
Tonawanda Creek, Lockport to Niagara River	Carp	Eat no more than one meal per month	PCBs
Buffalo River/Harbor	Carp	Eat none	PCBs
Cayuga Creek	All species	Eat none	Dioxin
Gill Creek, mouth to Hyde Park Lake Dam	All species	Eat none	PCBs, Dioxin

Note the additional general advisories, applicable to the Niagara River and U.S. tributaries, recommended by NYSDOH to minimize potential adverse health impacts:

- Eat no more than one meal (one-half pound) per week of fish from New York State fresh waters.
- Women of childbearing age, infants, and children under the age of 15 should not eat any fish species from the waters listed above.
- Follow trimming and cooking advice described in NYSDOH, 1998.
- Observe the above restrictions from these waters and their tributaries to the first barrier impassable by fish.

Table 6

Ontario Ministry of the Environment:
Selected Excerpts from the 1999/2000 Guide to Eating Ontario Sport Fish

Ontario

CONSUMPTION ADVICE SYMBOLS TABLE

Fish Symbol	Consumption Advice
[fish]	consumption up to eight meals/month*
④	consumption restricted to four meals/month
②	consumption restricted to two meals/month
①	consumption restricted to one meal/month
[black fish]	no consumption advised

*Women of childbearing age and children under 15 are advised to consume only fish from the [fish] category and not to consume more than four meals/month of these fish.

A meal is considered to be 227 grams (8 oz.).

Contaminants analysed

The number beside the fish species name identifies the contaminant or group of contaminants for which the fish was tested:

1 Mercury
2 Mercury, PCBs, mirex/photomirex and pesticides
3 PCBs, mirex/photomirex and pesticides
4 Mercury, PCBs and mirex
5 Mercury, other metals, PCBs, mirex/photomirex and pesticides
6 Mercury and other metals
7 Dioxins and furans
8 Mercury, PCBs, mirex/photomirex, pesticides, chlorinated phenols and chlorinated benzenes
9 Polynuclear aromatic hydrocarbons (PAHs)

LOCATION	SPECIES	FISH SIZE IN CENTIMETRES (INCHES)								
		15-20 (6-8)	20-25 (8-10)	25-30 (10-12)	30-35 (12-14)	35-45 (14-18)	45-55 (18-22)	55-65 (22-26)	65-75 (26-30)	>75 >(30)
Upper Niagara River	Rainbow Trout[5]				[fish]	[fish]	[fish]			
	Northern Pike[2]							[fish]	[fish]	[fish]
	Smallmouth Bass[5,7]	[fish]	[fish]	[fish]	[fish]	④				
	Largemouth Bass[2]	[fish]	[fish]	[fish]	[fish]	[fish]				
	Yellow Perch[5]	[fish]	[fish]	[fish]						
	White Bass[5]	④								
	Rock Bass[5]	[fish]	[fish]							
	Brown Bullhead[2,7]	[fish]	[fish]	[fish]	[fish]					
	Carp[2,7]						②	②	②	
	Freshwater Drum[5,7]		[fish]	[fish]	[fish]	[fish]	[fish]			
	White Sucker[5]	[fish]	[fish]	[fish]	[fish]	[fish]				
	Redhorse Sucker[1]	[fish]	[fish]	[fish]	[fish]	[fish]	[fish]	④		
	Rainbow Smelt[2]	④								
Lower Niagara River	Chinook[5]						②	②	②	①
	Rainbow Trout[5,7,8,9]					[fish]	[fish]	④	④	④
	Lake Trout[5]							①	①	①
	Smallmouth Bass[5,7]		[fish]	④	④	②				
	Largemouth Bass[2]		[fish]	[fish]	[fish]	[fish]				
	Yellow Perch[5,7]	[fish]	[fish]	④	④					
	White Perch[2]		②	①	[black fish]					
	White Bass[5]	[fish]	[fish]	④	②					
	Rock Bass[2,7]	[fish]	[fish]							
	Brown Bullhead[3,7]			[fish]	[fish]	④				
	Channel Catfish[5]				[fish]	④	②	②	②	
	Freshwater Drum[5,7]	[fish]	[fish]	[fish]	[fish]	④				
	Carp[2,7]					[fish]	④	②	①	[black fish]
	White Sucker[5]			[fish]	[fish]	④	④			
	Redhorse Sucker[5]				④	②	②			
	American Eel[5,7]							④	④	④
	Rainbow Smelt[2]	②								

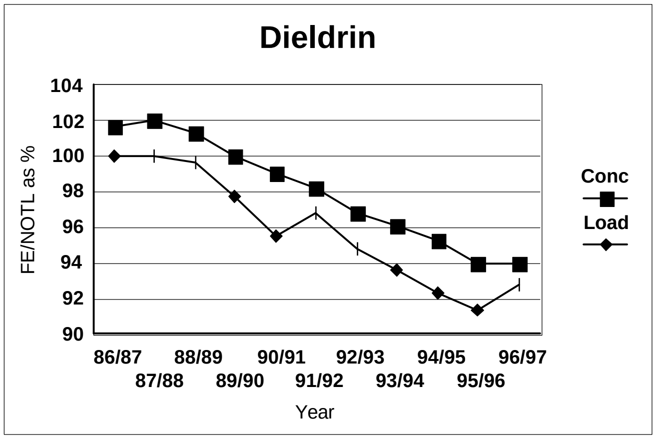
Table 7. NRTMP Priority Toxic Chemicals exceeding the most stringent government water quality criteria in the Niagara River. Based on the 1996/1997 Upstream/Downstream Monitoring Program (NRDIG 1999), and criteria applicable at the time. Table includes exceedances occurring in any phase[1].

Chemical	**Exceeds Criteria in any phase[1] at Fort Erie**	**Exceeds Criteria in any phase[1] at Niagara-on-the-Lake**	**Load at Fort Erie Differential Load[2]**
Chrysene	●	●	
Benz(a)anthracene	●	●	
Benzo(b/k)fluoranthene	●	●	●
Benzo(a)pyrene	●	●	
Hexachlorobenzene		●	
PCBs	●	●	●

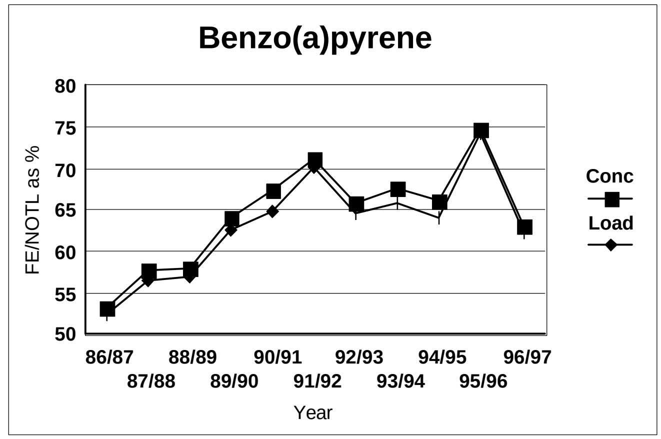
[1] The three phases are the water fraction, suspended solids fraction, and recombined whole water. It is assumed that if a criterion is exceeded in either the water fraction or the suspended solids fraction, it will be exceeded in the whole water.

[2] Based on recombined whole water.

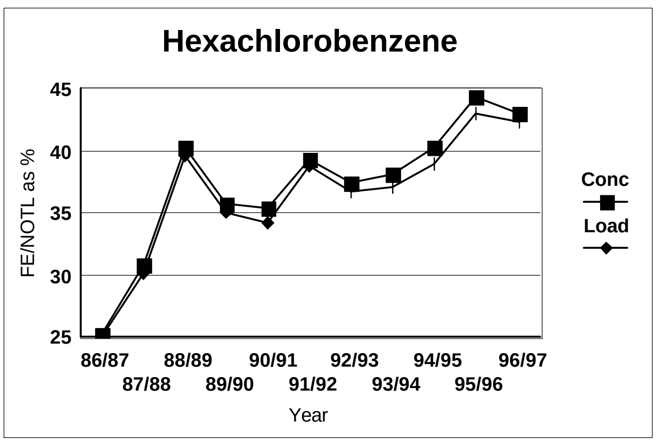
Figures 11 a-d. Time Series of Ratio of FE/NOTL in Water Phase for Dieldrin, Hexachlorobenzene, Benzo(a)pyrene, and PCB.



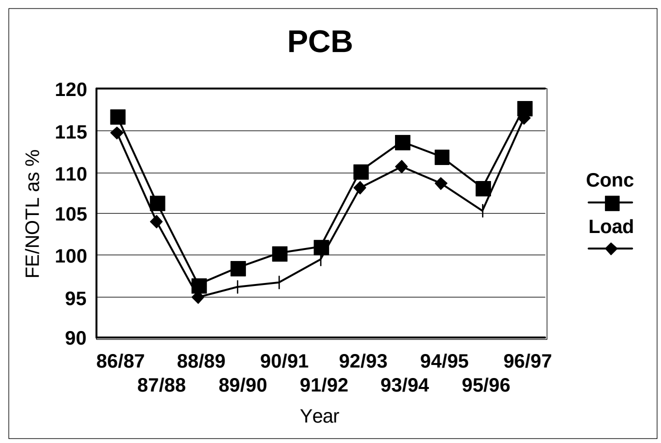
(a)



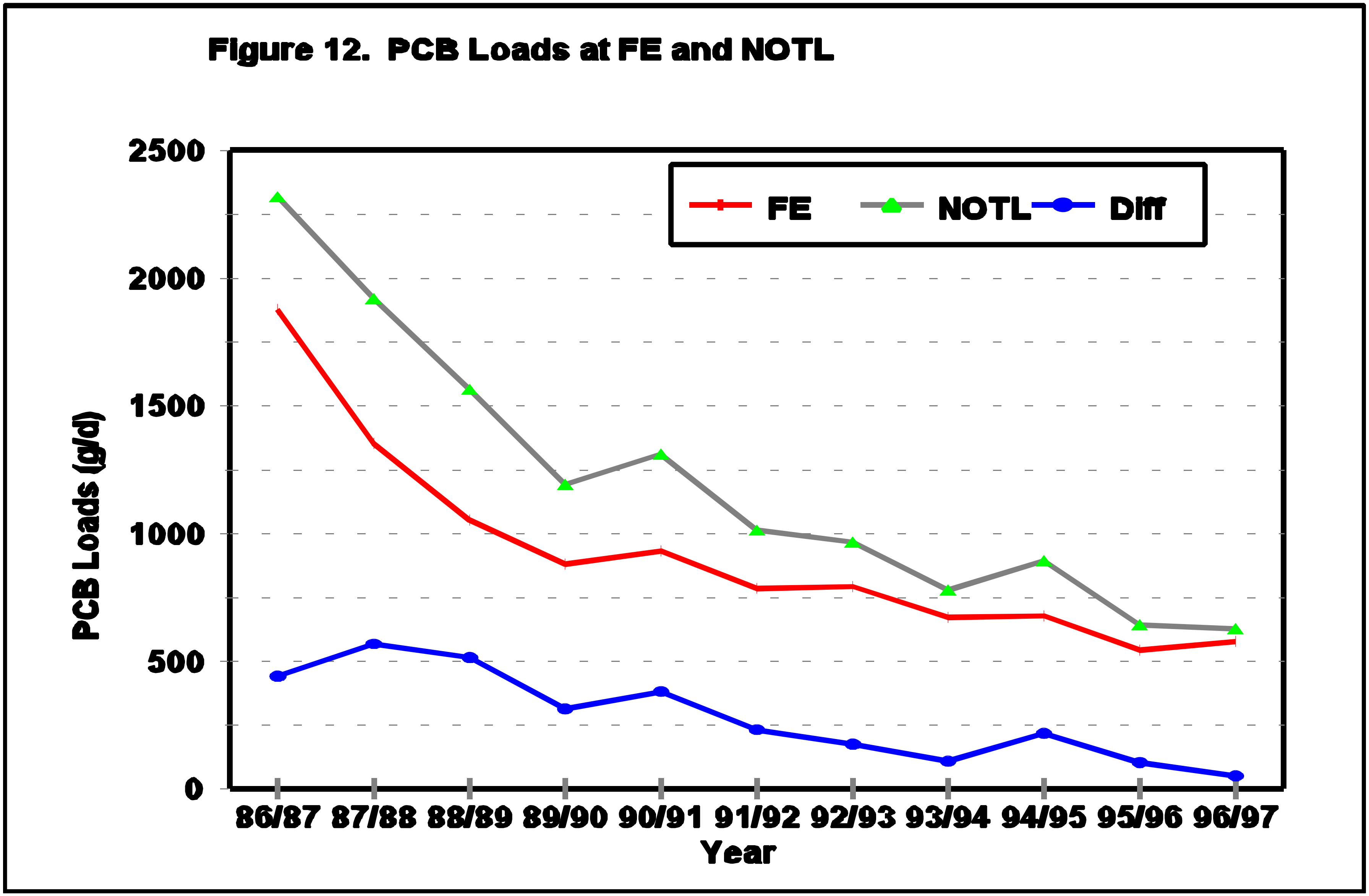
(b)



(c)



(d)



Note: Load based on recombined whole water

Figure 13. OCS on Suspended Sediments at NOTL, Apr 1986 - Apr 1997.

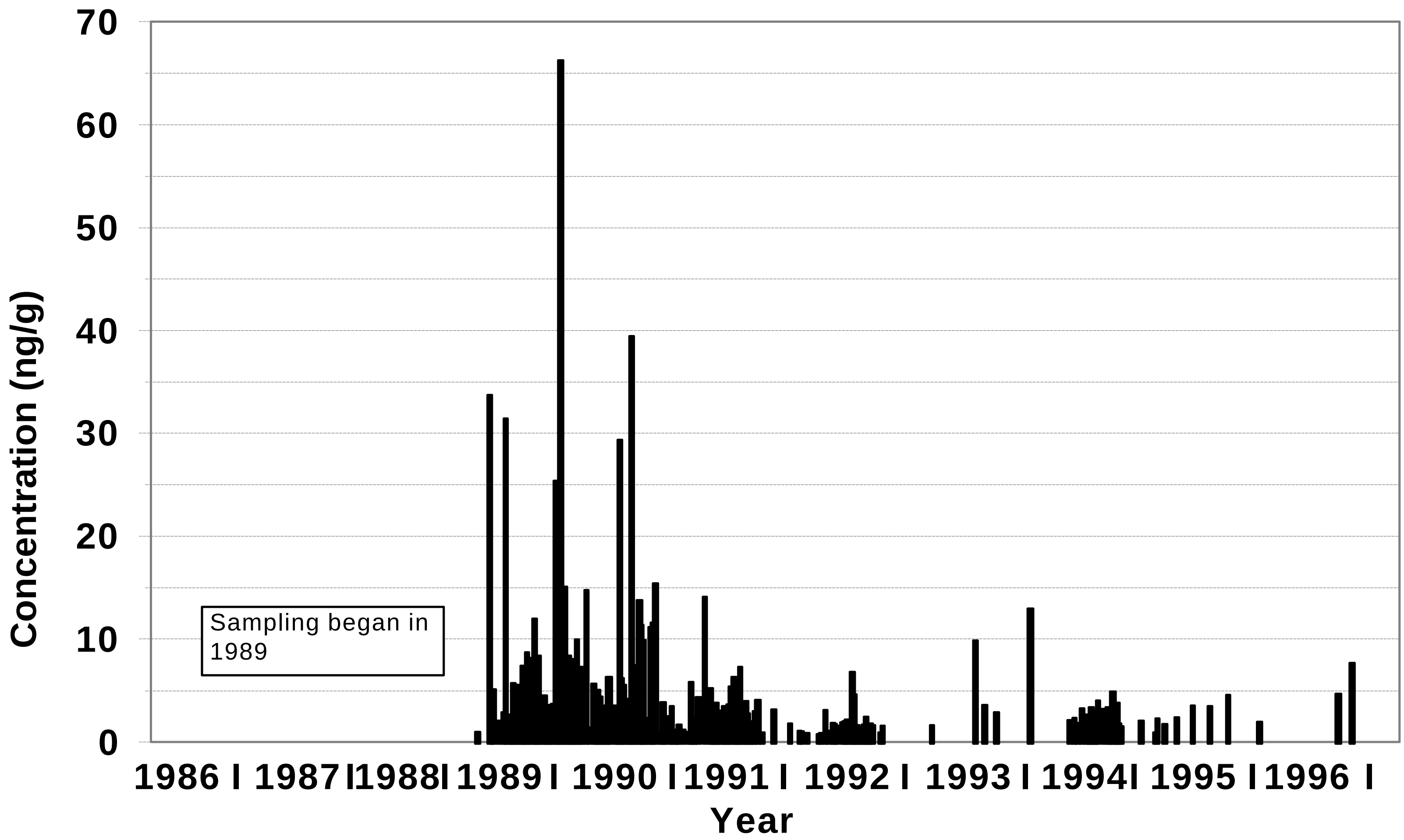
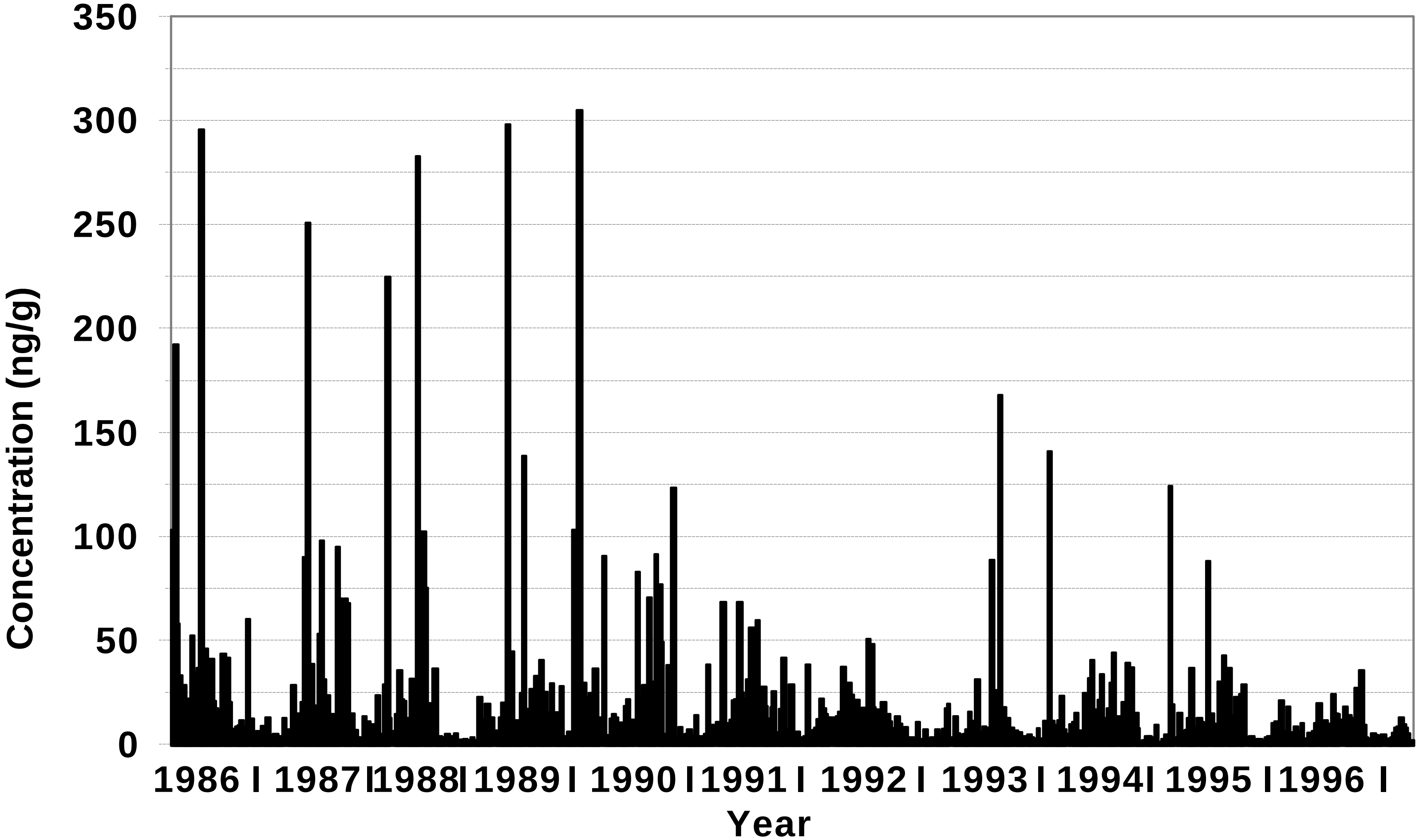


Figure 14. HCB on Suspended Sediments at NOTL, Apr 1986 - Apr 1997.



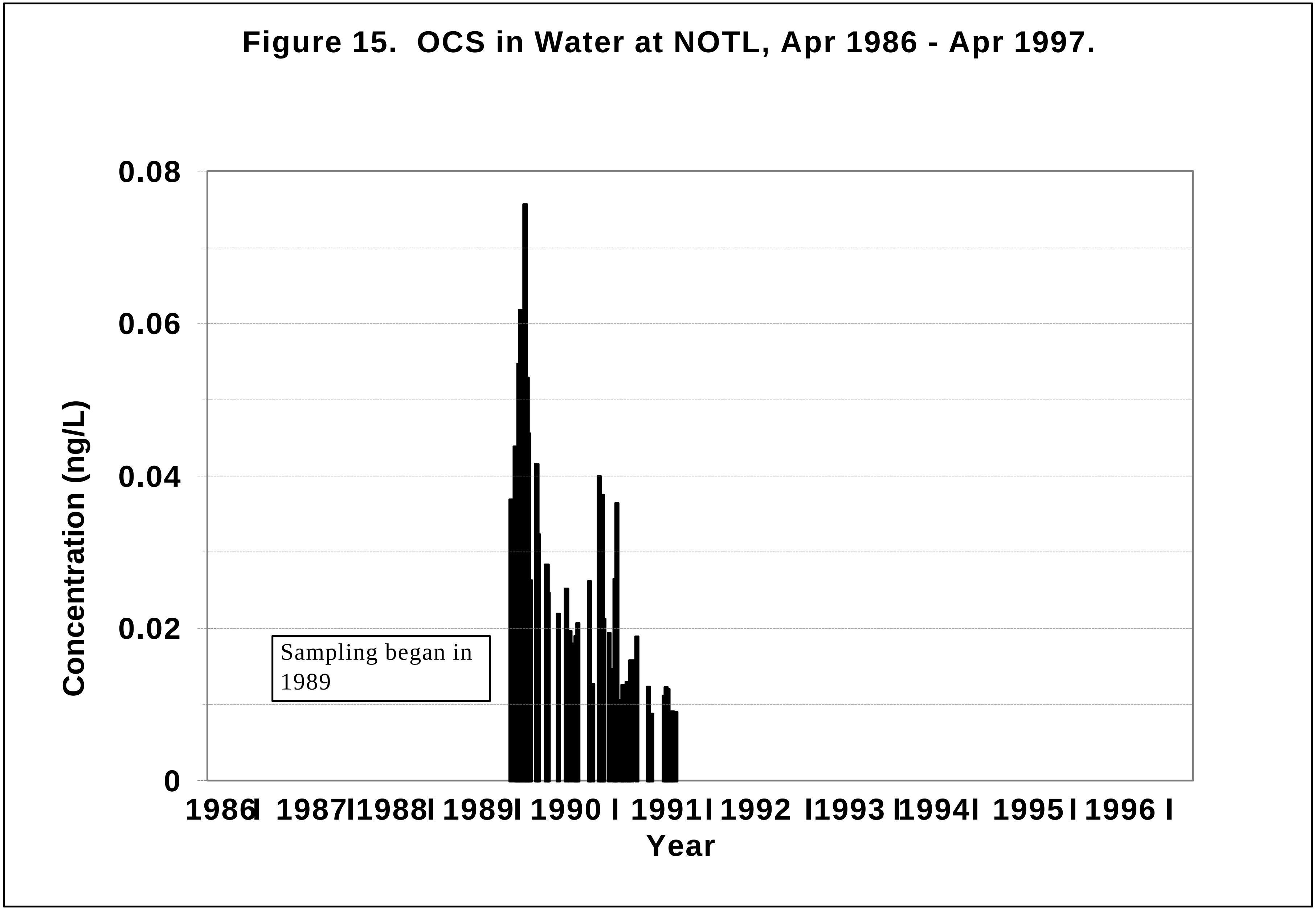


Figure 15. OCS in Water at NOTL, Apr 1986 - Apr 1997.
0.08
0.06
0.04
0.02
0
Concentration (ng/L)
Sampling began in 1989
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
Year

Figure 16. HCBD in Water at NOTL, Apr 1986 - Apr 1997.

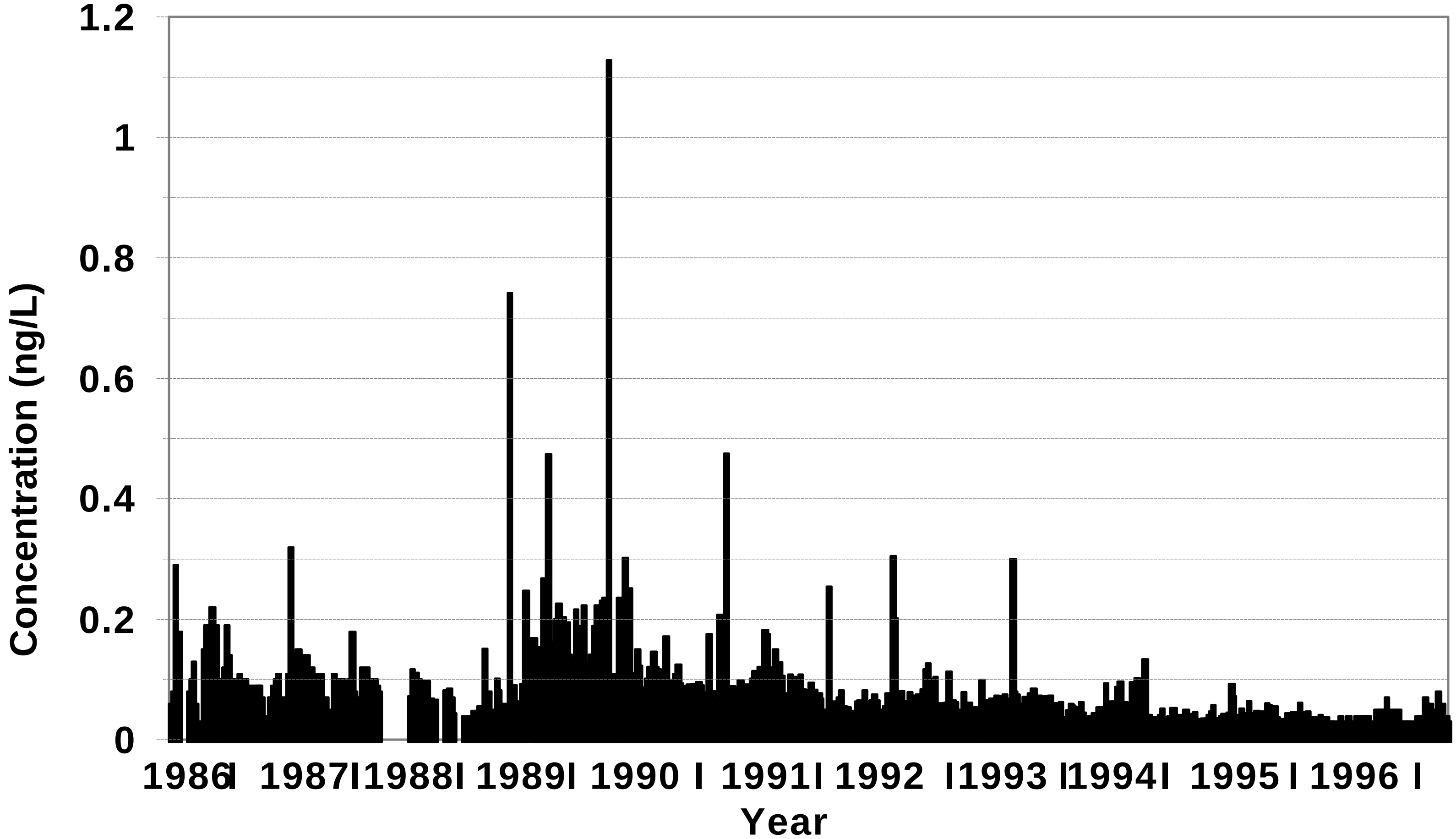


Figure 17. Total Chlorobenzenes in Water at NOTL, Apr 86 - Apr 97.

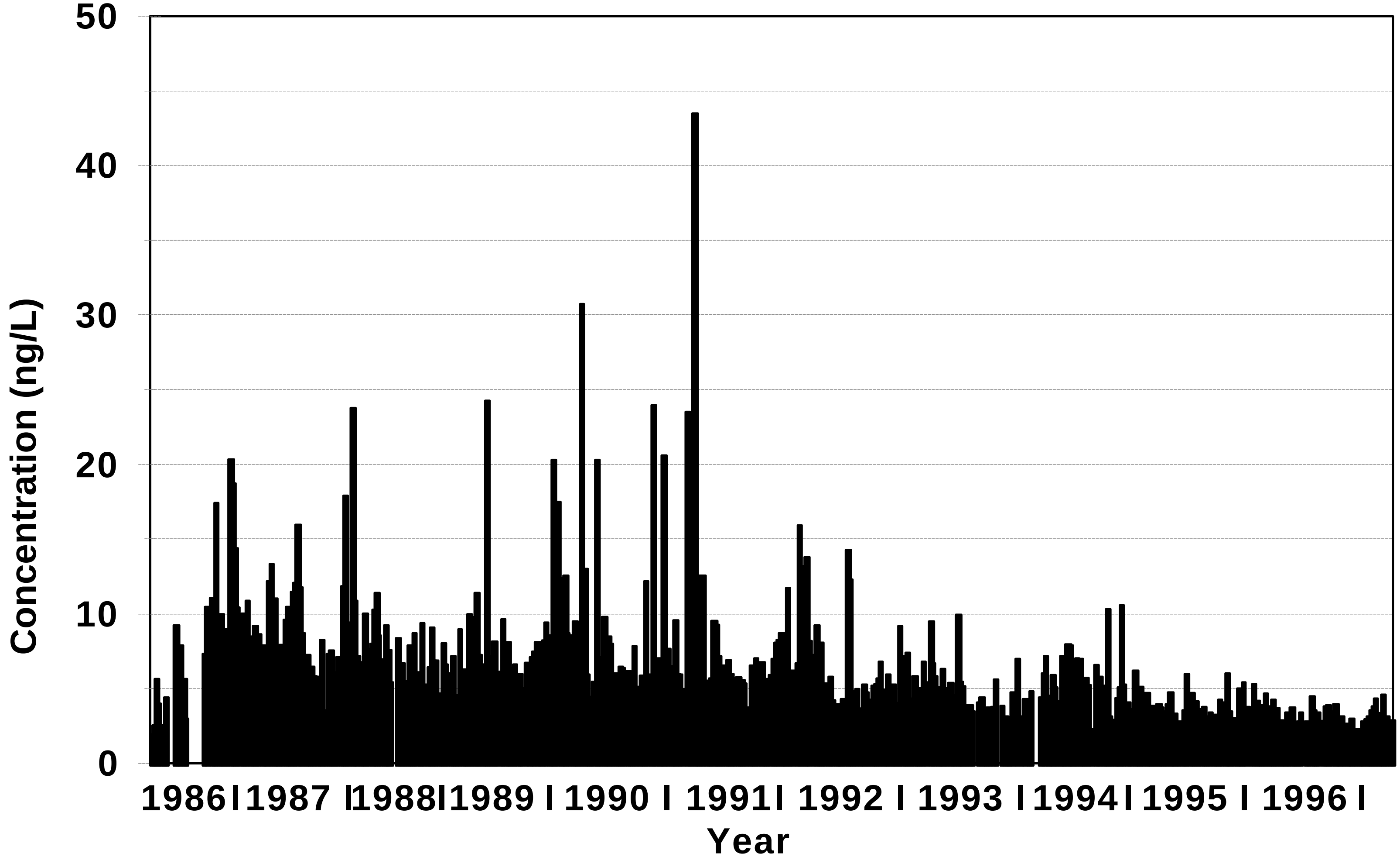


Figure 18

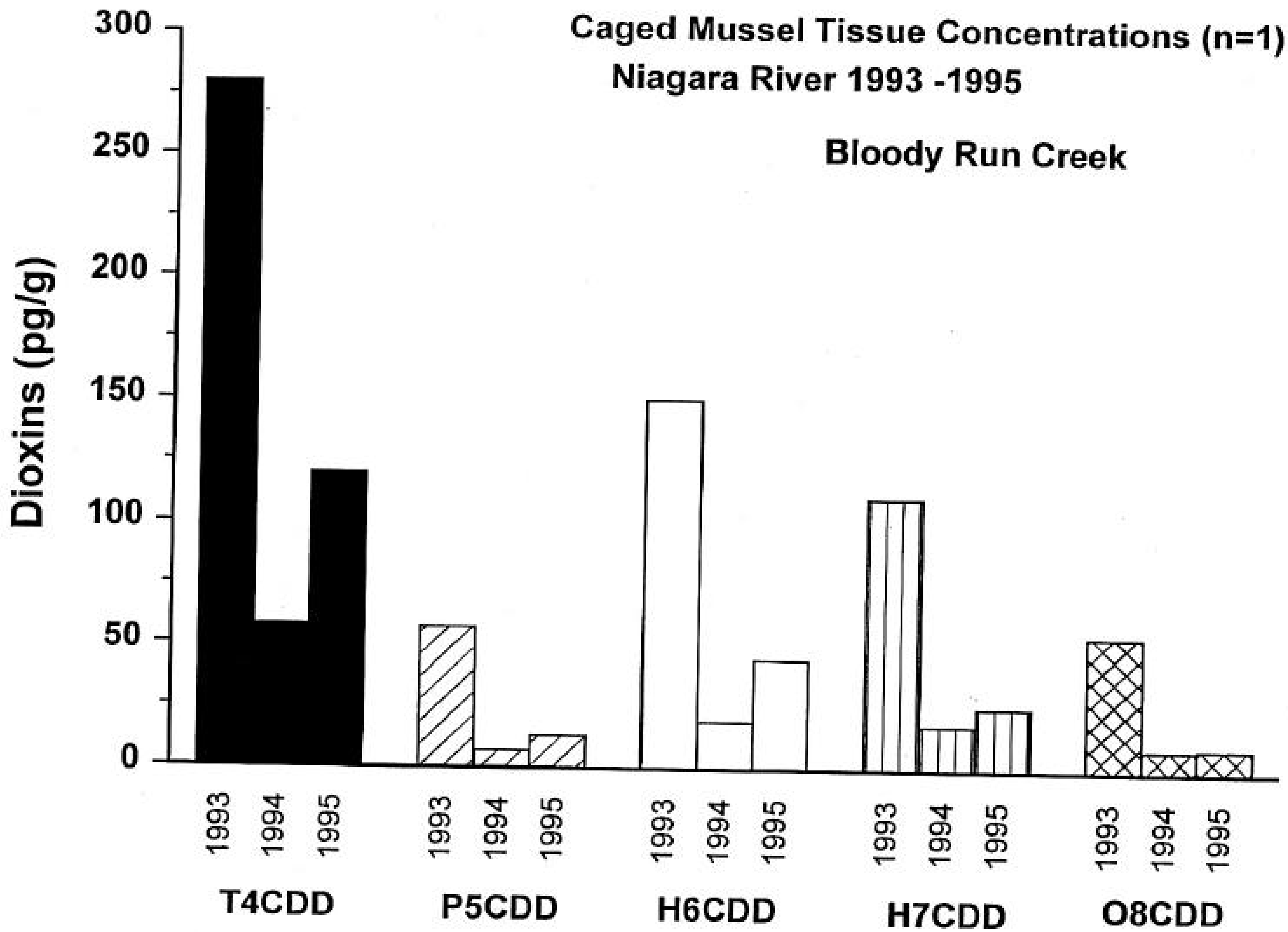
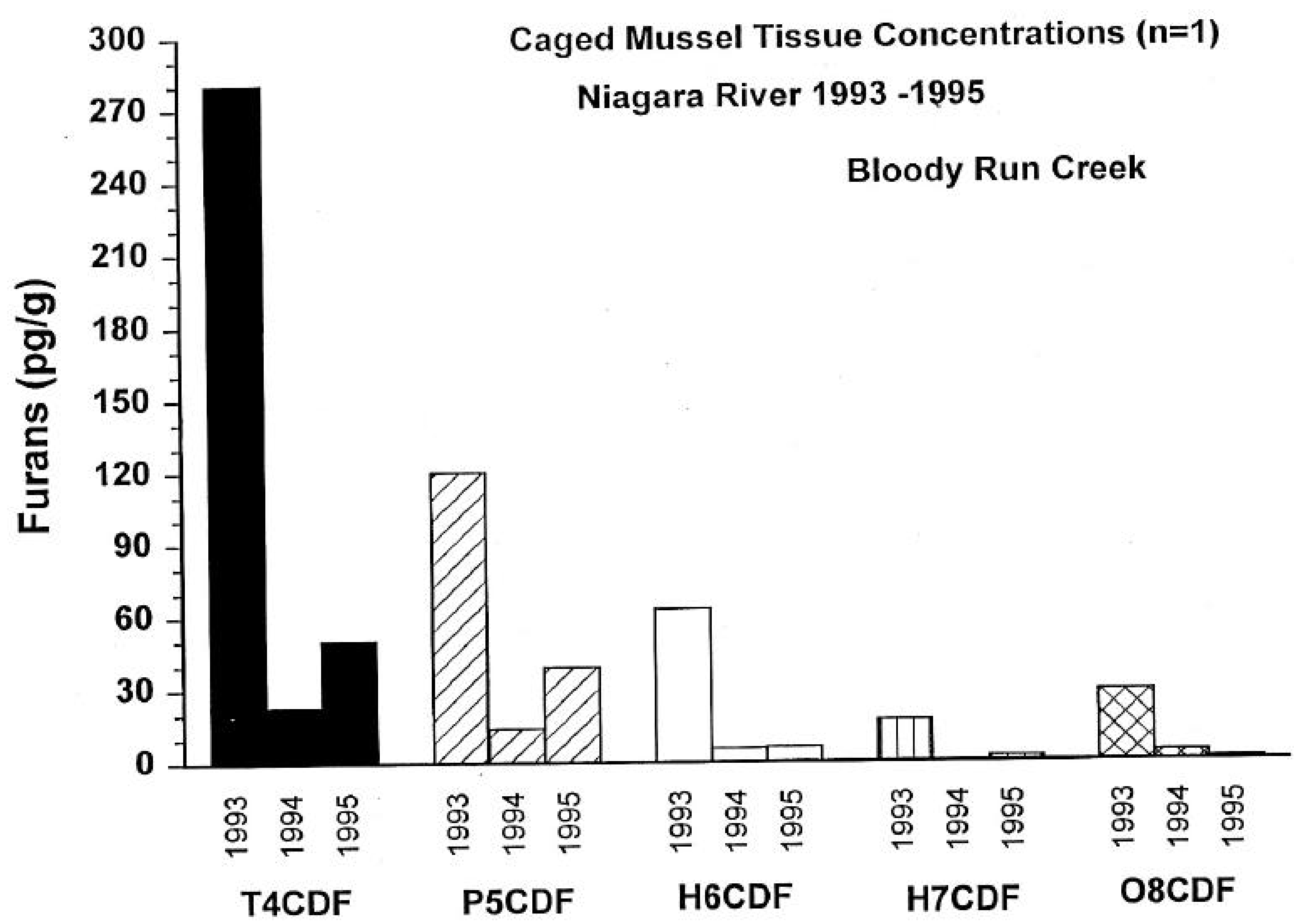
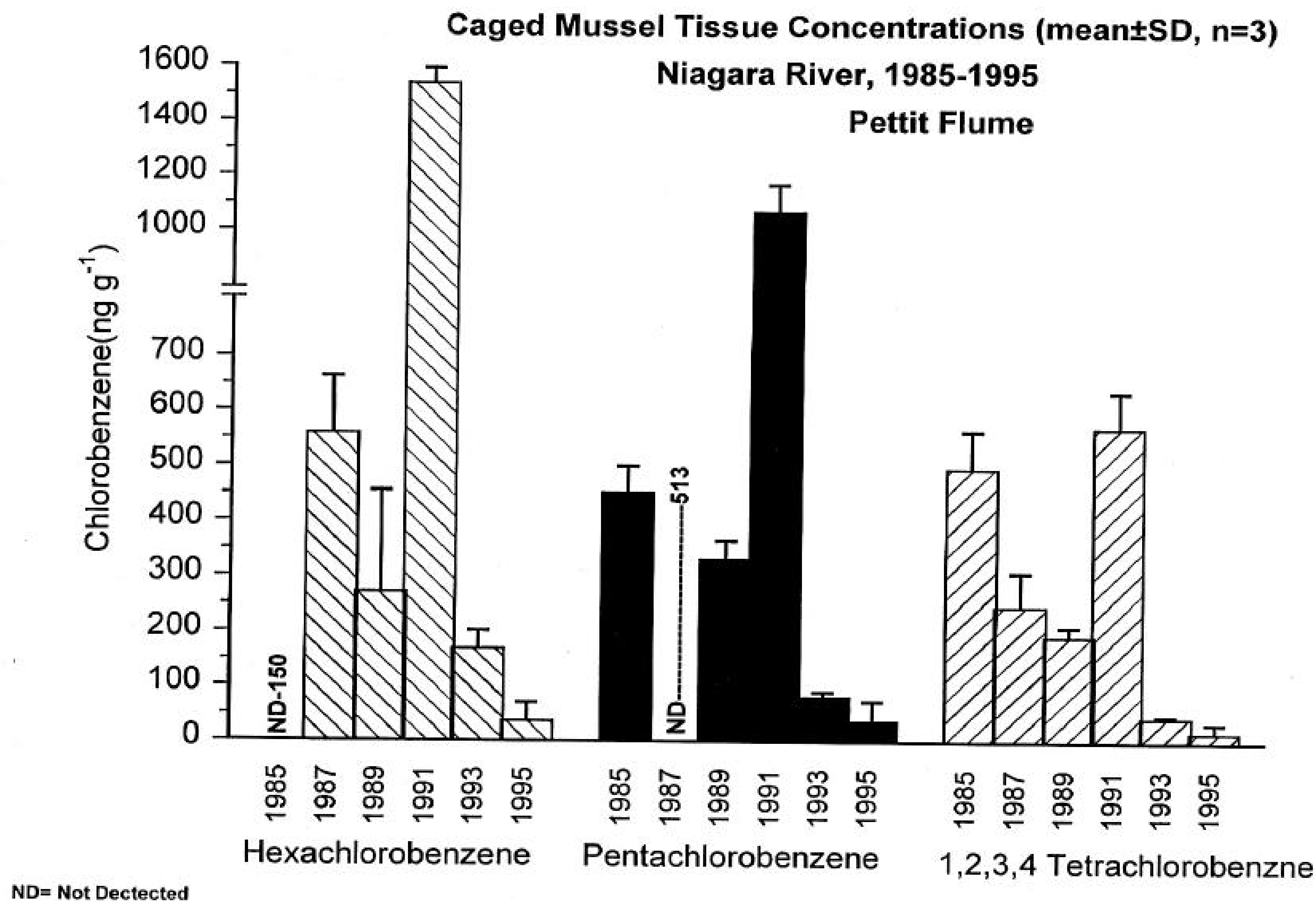

Caged Mussel Tissue Concentrations (n=1)
Niagara River 1993 -1995
Bloody Run Creek
Dioxins (pg/g)
300
250
200
150
100
50
0
1993
1994
1995
T4CDD
P5CDD
H6CDD
H7CDD
O8CDD

Figure 19



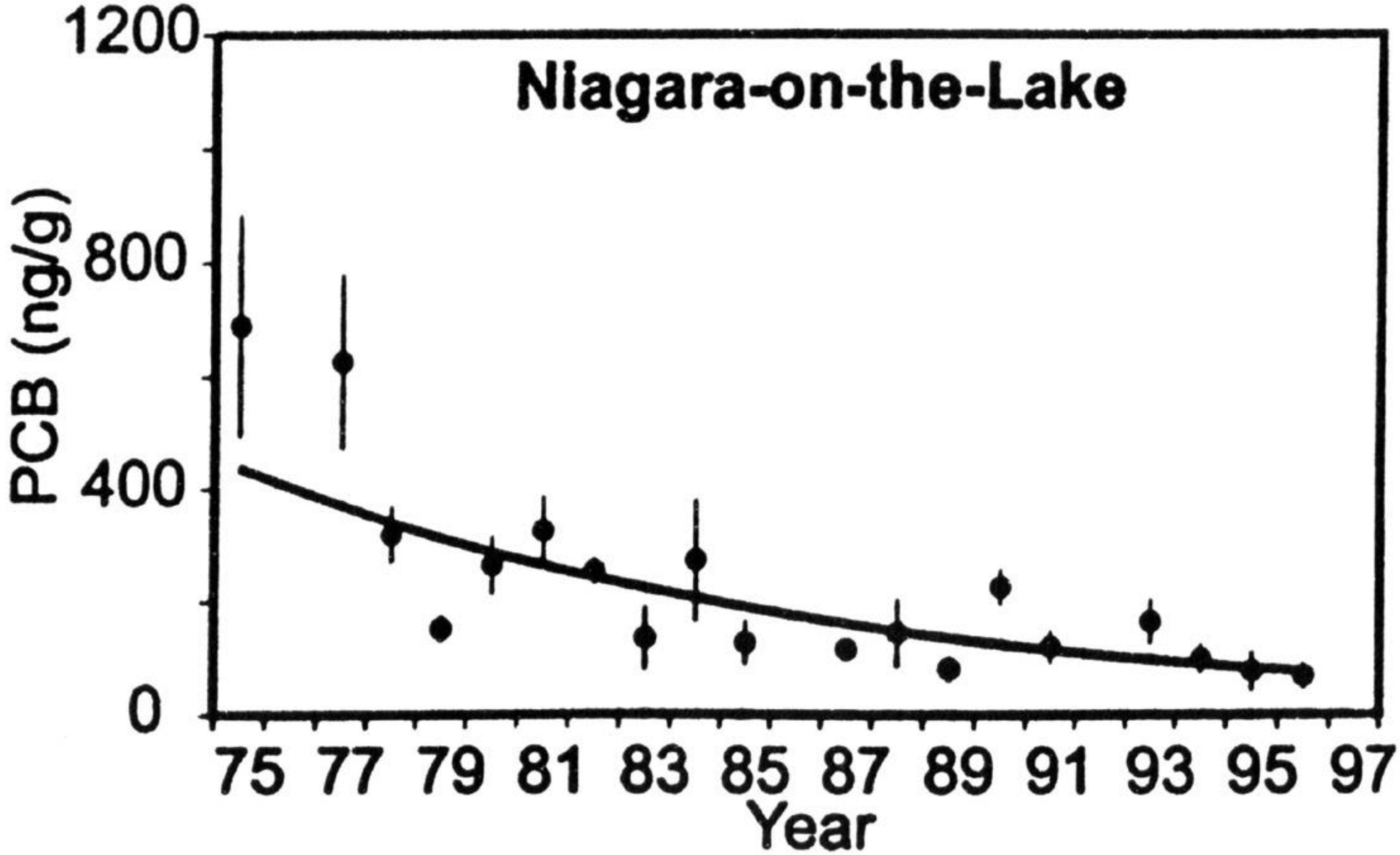
Caged Mussel Tissue Concentrations (n=1)
Niagara River 1993 -1995
Bloody Run Creek
Furans (pg/g)
300
270
240
210
180
150
120
90
60
30
0
1993
1994
1995
T4CDF
P5CDF
H6CDF
H7CDF
O8CDF

Figure 20



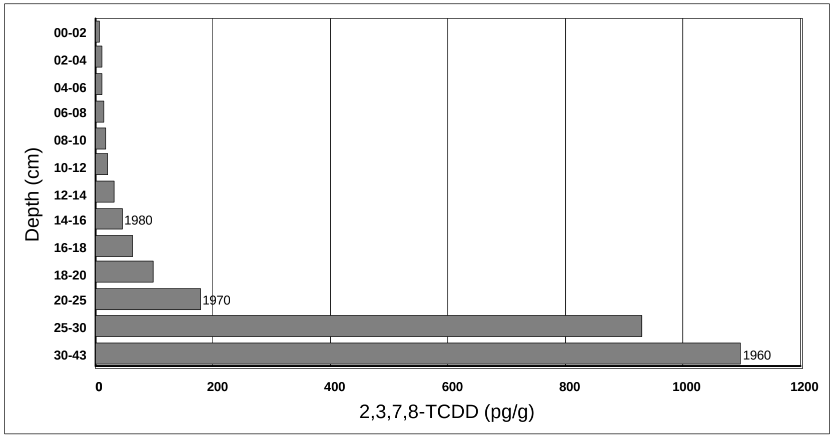
Caged Mussel Tissue Concentrations (mean±SD, n=3)
Niagara River, 1985-1995
Pettit Flume
Chlorobenzene(ng g-1)
1600
1400
1200
1000
700
600
500
400
300
200
100
0
ND-150
ND
513
1985
1987
1989
1991
1993
1995
Hexachlorobenzene
Pentachlorobenzene
1,2,3,4 Tetrachlorobenzne
ND= Not Dectected

Figure 21. Temporal trend of total PCB concentrations in young-of-the-year spottail shiners at Niagara-On-The-Lake from 1975 to 1996. Values are means ± 95% confidence limits. Regression line r = -0.85, p<0,01.

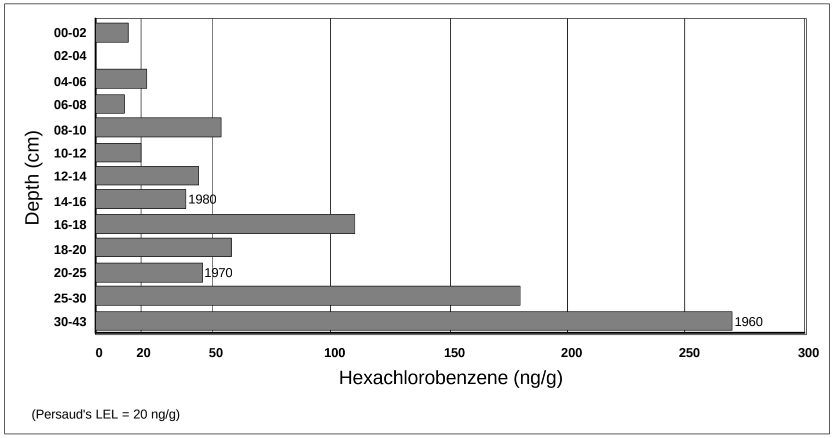


Figures 22a-d. Concentrations of dioxin (2,3,7,8 TCDD), hexachlorobenzene, benzo(a)pyrene, and mirex in a sediment core collected from the depositional area in Lake Ontario at the mouth of the Niagara River, September 28, 1995. Approximate years of deposition are shown (1980, 1970, 1960). Persaud's LEL shown where applicable.

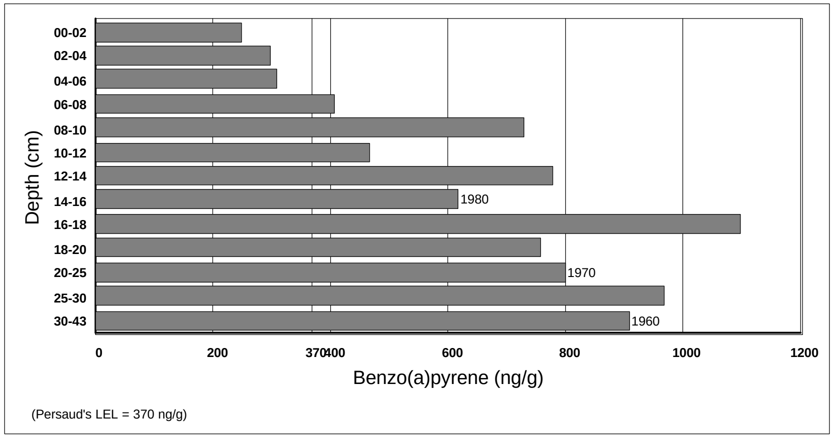
(a)



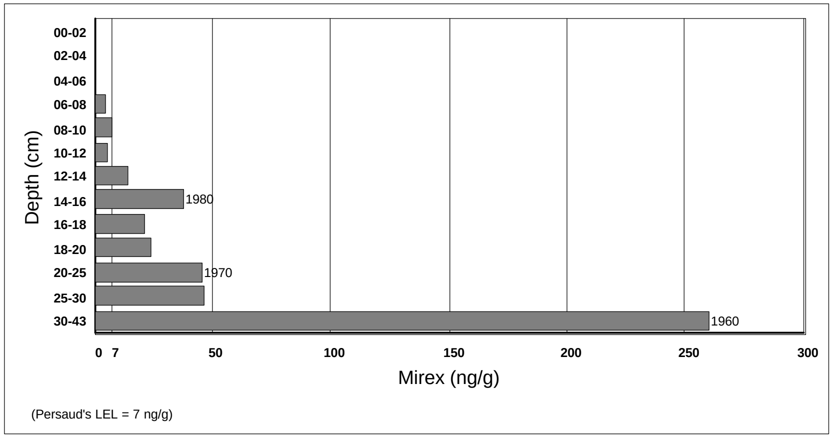
(b)



(c)



(d)



NIAGARA RIVER TOXICS MANAGEMENT PLAN (NRTMP) ANNUAL WORK PLAN [1999]

The "Four Parties":
EPA = U.S. Environmental Protection Agency
DEC = New York State Department of Environmental Conservation
EC = Environment Canada
MOE = Ontario Ministry of the Environment

ACTIVITY	EPA	DEC	EC	MOE	1997-98 Commitment	Status/Comments	1999 Commitment	Status/Comments
I. Controlling Point Sources								
A. Report on U.S. Point Sources		*			Periodically		Periodically	See *Note A* (p. W-14)
B. Report on Canadian Point Sources (1994/95)				*	- -	Completed Nov 96 See *Note B* (p. W-14)		

ACTIVITY	EPA	DEC	EC	MOE	1997-98 Commit-ment	Status/Comments	1999 Commit-ment	Status/Comments
II. Controlling Non-Point Sources								
A. Waste sites/landfills								
1. Update progress report on remediation of U.S. hazardous waste sites. [Progress at most significant sites summarized below.]	*	*			May 98	Completed Nov 98	Oct 99	See "Public Involvement" section (V.B).
2. Remediate Occidental Chemical-Buffalo Ave site								
a. Complete overburden groundwater collection system.		*			Jun 98	Completed Dec 98	----	See *Note C* (p. W-14)
b. Enhance bedrock groundwater collection system.		*			Jun 98	Completed Dec 98	----	See *Note C* (p. W-14)
c. Complete remediation of contaminated soils and off-site groundwater		*			Apr 99	------------------------>	----	See *Note C* (p. W-14)
d. Issue Corrective Measures Implementation (CMI) Permit		*			----		Apr 99	See *Note C* (p. W-14)
e. Biomonitor effectiveness of remediation using caged mussels				*	Jun 99	Final technical summary from the 1997 study.	2000	Next field survey

ACTIVITY	EPA	DEC	EC	MOE	1997-98 Commit-ment	Status/Comments	1999 Commit-ment	Status/Comments
3. Remediate Niagara County Refuse Disposal								
a. Approve design of remedial actions	*				----	Completed	----	
b. Start construction of site remedy	*				----	Construction began in fall 98 following completion of requirements for state assistance.	----	
c. Complete construction of site remedy.	*				Dec 98	Delayed -------------->	Sep 00	
4. Remediate DuPont, Necco Park site								
a. Start designing site remediation	*				1998	Began Oct 98 following Sep 98 ROD	----	EPA amended the Record of Decision (ROD) in response to extensive public comment.
b. Start construction of final site remedy	*				1998	Delayed--------------->	Dec 99	
c. Complete final remedy	*				----		Sep 01	

ACTIVITY	EPA	DEC	EC	MOE	1997-98 Commit-ment	Status/Comments	1999 Commit-ment	Status/Comments
5. Remediate Hyde Park site								
a. Complete construction of additional remedial systems (includes installing 3 additional pumping wells and force main, and additional measures as necessary).	*				----		Sep 99	See *Note D* (p. W-15)
b. Optimize well pumping rates and evaluate the containment of contaminated groundwater. Monitor groundwater level and conduct chemical sampling	*				On-going		On-going	
c. Complete all remedial systems, including optimization.	*				----		Sep 00	
d. Conduct annual survey of gorge-face seeps.	*				Jul 98	Completed	Jul 99	
e. Biomonitor effectiveness of remediation using caged mussels				*	Jun 99	Final technical summary from the 1997 study.	2000	Next field survey
6. Remediate 102nd Street site								
a. Complete containment system, including barrier wall, drainage system, landfill cap.	*				----	Completed	----	

ACTIVITY	EPA	DEC	EC	MOE	1997-98 Commit-ment	Status/Comments	1999 Commit-ment	Status/Comments
b. Complete leachate pumping system.	*				May 98	Completed Dec 98	----	Eliminates potential off-site loadings
c. Complete site landscaping and optimization of the pump-and-treat system.	*				----		Jul 99	
d. Monitor groundwater level and conduct chemical sampling.	*				On-going		On-going	To ensure effectiveness of remedial systems.
e. Biomonitor effectiveness of remediation using caged mussels				*	Jun 99	Final technical summary from the 1997 study.	2000	Next field survey
7. Remediate Occidental Chemical, S-Area site								
a. Finish building new City of Niagara Falls Drinking Water Treatment Plant (DWTP)	*				----	Completed Mar 97	----	
b. Demolish existing City of Niagara Falls DWTP	*				----	Completed winter 98	----	
c. Construct eastern barrier wall	*				Jul 98	Completed May 98	----	Other 3 sides of site already enclosed by barrier walls.
d. Complete cap and overburden drain collection system for the old DWTP property.	*				----		Dec 98	Completed.
e. Grout DWTP raw water intake.	*				----		2000	

ACTIVITY	EPA	DEC	EC	MOE	1997-98 Commit-ment	Status/Comments	1999 Commit-ment	Status/Comments
f. Install final landfill cap.	*				Sept 99	Delayed--------------->	2000	See *Note E* (p. W-15)
g. Optimize well pumping rates and make sure that contaminated groundwater is no longer flowing off site.	*				Dec 99	Delayed--------------->	2000	See *Note E* (p. W-15)
h. Biomonitor effectiveness of remediation using caged mussels				*	Jun 99	Final technical summary from the 1997 study.	2000	Next field survey
8. Remediate Solvent Chemical site								
a. Complete remedial design		*			----	Underway since 1997	Sep 99	Design for asbestos removal & demolition completed in 1998. Design for off-site hot spot and 18" sewer removal nearly complete. Design completion for on-site remedial systems anticipated Sep. 99.
b. Construct site remedy		*			Dec 98	Construction began early 1998	On-going	Asbestos removal and site demolition complete. Remedial system to include cap and groundwater pump-and-treat.

ACTIVITY	EPA	DEC	EC	MOE	1997-98 Commit-ment	Status/Comments	1999 Commit-ment	Status/Comments
c. Complete remedial action		*			----		Sep 00	
9. Remediate Olin plant site								
a. Monitor effectiveness of remedial systems.	*	*			On-going		On-going	Remedial system completed Oct 97
b. Biomonitor effectiveness of remediation using caged mussels				*	Jun 99	Final technical summary from the 1997 study.	2000	Next field survey
10. Remediate Buffalo Color Corporation site								
a. Complete site investigation		*			----		Mar 99	See *Note F* (p. W-15)
b. Select site remedy		*			Jun 99	Delayed -------------->	Aug 00	See *Note F* (p. W-15).
c. Implement site remedy.		*			Dec 99	Delayed -------------->	Jul 01	
11. Finish implementing site remedy at Buffalo Color, Area D		*			Dec 98	Completed Sep 98	----	Remedy included removal of river sediments, cap, groundwater collection and treatment system, barrier wall.
a. Complete wetland restoration		*			----	On-going	Sep 99	
b. Site monitoring		*			----	On-going	----	

ACTIVITY	EPA	DEC	EC	MOE	1997-98 Commit-ment	Status/Comments	1999 Commit-ment	Status/Comments
12. Remediate Bethlehem Steel site								
a. Complete site investigation	*	*			Dec 98	Delayed -------------->	Apr 00	See *Note G* (p. W-15)
b. Select site remedy	*	*			Mar 00	Delayed -------------->	Oct 01	
c. Begin implementation of site remedy.	*	*			Dec 00	Delayed -------------->	Dec 02	
13. Remediate River Road and Niagara Mohawk Cherry Farm sites								
a. Complete construction of on-site remedy (includes capping the site with clean soil, and stabilizing the shoreline).		*			Sept 98	Completed		See *Note H* (p. W-15)
b. Remove contaminated sediment from Niagara River.		*			Nov 98	Completed		
c. Complete capping of sediment disposal area and landscaping.		*			Dec 98	Underway	Jun 99	
14. Remediate Gratwick Riverside Park site								
a. Start construction of site remedy.		*			----		mid 99	Bids due 3/31/99. See *Note J* (p. W-16)
b. Complete construction of site remedy		*			----		Dec 00	
c. Biomonitor effectiveness of remediation using caged mussels				*	Jun 99	Final technical summary from the 1997 study.	2000	Next field survey.

ACTIVITY	EPA	DEC	EC	MOE	1997-98 Commit-ment	Status/Comments	1999 Commit-ment	Status/Comments
15. Remediate Occidental Chemical Durez - North Tonawanda site		✶						
a. Complete construction of site remedy		✶			----	Completed 1994. See *Note K* (p. W-16).		
b. Biomonitor effectiveness of remediation using caged mussels				✶	Jun 99	Final technical summary from the 1997 study.	2000	Next field survey.
16. Determine whether trace amounts of contaminants of concern found at 5 landfills are moving to groundwater off-site.			*	*	----	Completed. See *Note L* (p. W-16)	----	
B. Contaminated sediments								
1. Update NY Great Lakes Contaminated Sediments Inventory		*			Every 2 years	Data update completed Feb 98 and submitted to national database.	Annually	Inventory of data on contaminated sediments is used to prioritize sampling and remediation actions.

ACTIVITY	EPA	DEC	EC	MOE	1997-98 Commit-ment	Status/Comments	1999 Commit-ment	Status/Comments
III. Monitoring								
A. Complete report on results of Upstream/Downstream sampling	*	*	*	*	Dec 98 (for 96-97 report)	Draft report completed and reviewed. Final report in preparation	Dec 99	For 97-98 report.
B. Determine if Fort Erie sampling station is representative of toxic chemical concentrations coming from Lake Erie	*	*	*	*	----	Preliminary analysis completed by EC.	Sep 99	Statistical analysis and final report to be prepared by DEC.
C. Collect juvenile spottail shiners or other juvenile fish and analyze for toxic chemicals, according to Monitoring Plan. See *Note M* (p. W-16)		*		*	MOE: Dec 98 DEC: Dec 98	MOE: No spottail shiners collected in 1997. Collected emerald shiners at three locations instead. Collected spottail, common and emerald shiners at various locations in 1998. DEC: Final report on 1996 collections completed Dec 98.	MOE Dec 99 DEC: Jun 99	Technical summary on 1997 and 1998 collections. Draft report on 1997 collections. Collections to follow on a five-year basis (next in 2002)

ACTIVITY	EPA	DEC	EC	MOE	1997-98 Commit-ment	Status/Comments	1999 Commit-ment	Status/Comments
D. Track down toxic chemicals in tributaries and sewer systems to identify sources.		*			Perio-dically		Dec 99	Assessment of existing information and plan for next steps. See *Note N* (p. W-17)
E. Sample groundwater seeps coming from Niagara River Gorge face and analyze for toxic chemicals.	*				Dec 98	Completed. Sampling was conducted in 1997. Results indicated no need for additional control or remediation of the seep areas.	----	
F. Biomonitor using caged mussels and analyze for toxic chemicals, according to Monitoring Plan. See *Note O* (p. W-17)				*	Every 3 years	1997 field work and analysis complete. Technical summary June 99.	Every 3 years	Next field survey in 2000. 1997 summary to be completed June 1999.
G. Study use of zebra and quagga mussels as biomonitors				*	Dec 98	------------------------>	Dec 99	Sampling and analysis completed. Report due Dec 99.
H. Assess sport fishery in Niagara River, with contaminant analysis.			*	*	----	Sport fish collected in Niagara River in 1997-1998.	MOE: Apr 99	1997-98 analyses and "Guide to Eating Ontario Fish".

ACTIVITY	EPA	DEC	EC	MOE	1997-98 Commit-ment	Status/Comments	1999 Commit-ment	Status/Comments
IV. Define additional actions to reduce toxic chemical inputs to the Niagara River								
A. Develop additional materials relating information on Niagara River contamination and contaminant sources, and incorporate into NRTMP Progress Report and Work Plan.	*	*	*	*	----		Beginning May 00	See *Note P* (p. W-17)

ACTIVITY	EPA	DEC	EC	MOE	1997-98 Commit-ment	Status/Comments	1999 Commit-ment	Status/Comments
V. Public Involvement								
A. Develop a reader-friendly brochure that gives an overview of the NRTMP and summarizes progress made on restoring the Niagara River.	*	*	*	*	Dec 98	In preparation-------->	Jun 99	
B. Present progress made in the remediation of U.S. hazardous waste sites at a public meeting in Niagara Falls.	*	*			Jun 98	Public meeting held Dec 98	Nov 99	See "Controlling Non-Point Sources" section (II.A.1).
C. 1. Make NRTMP information and reports available on the Internet.	*	*	*	*	Dec 98	On-going. See *Note Q* (p. W-18)	As available	
2. Develop a NRTMP web page	*	*	*	*	----		Sep 99	NRTMP web page to be developed on EPA/GLNPO web site
D. Produce a progress report on the condition of the Niagara River and NRTMP efforts to restore the river. Update annual work plan for future actions.	*	*	*	*	Feb 98	Completed.	May 99 May 00	Annually.
E. Hold a public meeting to present above progress report and updated annual work plan.	*	*	*	*	Mar 98	Completed	Jun 99 Jun 00	Annually.

WORK PLAN NOTES

Note A. Report on U.S. Point Sources

DEC regularly monitors a suite of EPA priority pollutants in point sources as part of its State Permit Discharge Elimination System (SPDES) requirements. Of the 29 most significant point sources of toxic pollutants existing in 1986, 26 dischargers are still operating. New York reported an 80% drop in priority pollutants from its 29 significant point sources between 1981 and 1985. New York also reported a drop of 25% in the remaining load of "priority pollutants" between 1985 and 1994.

Note B. Report on Canadian Point Sources

In November 1996, MOE released a final report on NRTMP-specific monitoring of its point sources on the Niagara River.

From 1986 to 1995, MOE has seen an estimated 99% reduction in loadings of the 18 chemicals of concern (COC).

Provincial Water Quality Objectives (PWQO) have been set for 14 of the 18 COCs. Since 1993, effluent quality from these point sources has met all 14 PWQOs. This means that end-of-pipe concentrations are acceptable against the Standards that Ontario has set for all surface waters in the Province. As a result, MOE has discontinued NRTMP-specific monitoring of the Niagara River and focused resources towards Ontario's biomonitoring program on the River.

Regulatory monitoring and reporting of Ontario point sources required by Certificates of Approval and Clean Water regulations will continue.

Note C. Remediate Occidental Chemical-Buffalo Ave site

Additional enhancements to the overburden groundwater collection system, including a tile drain, were completed by December 1998. Additional enhancements to the bedrock groundwater collection system (enhancement of the treatment plant) were also completed in December 1998. These enhancements are discussed in the November 1998 EPA/DEC Hazardous Waste Site Remediation Progress Report (see References). Full operation of the collection systems has begun, effectively eliminating future off-site loadings.

A site-wide Corrective Measures Study (CMS), addressing all on-site and off-site remedial measures, was submitted in November 1998 and approved in March 1999. Additional measures beyond the continued operation of the existing interim corrective measures (ICMs) are not indicated in the CMS report. Public notice of the Draft Permit is expected in April 1999.

Note D: Remediate Hyde Park site.

Most site construction is complete. All of the overburden groundwater is being contained, and in the three bedrock groundwater zones, at least 80% of contaminated groundwater is being contained. Remedial work to achieve full containment is continuing.

Note E: Remediate Occidental Chemical S-area site.

Operation of the drain collection system for the landfill portion of the site began in 1996. However, a portion of the system is not functioning as designed due to collapse of the drain pipe in several areas. EPA and DEC have determined that the damaged system must be replaced and are assessing what actions are necessary to do so. EPA anticipates that this problem will delay completion of the Remedial Action by approximately one year, until 2000. The final landfill cap is scheduled for construction in 1999, but will be delayed to correct the damaged drain collection system.

Note F: Remediate Buffalo Color Corporation site.

A supplemental investigation involving the collection of six additional soil samples was conducted and a Revised RFI Report was submitted in November 1997. A second supplemental investigation was conducted during the summer of 1998 in response to NYSDEC comments on the Revised RFI Report. The investigation included eight new wells, ten additional soil samples and other work. A Revised RFI Report was submitted December 1998 and was approved in March 1999. A site-wide CMS Work Plan will be submitted in May 1999. A Draft Interim Corrective Measures Study for Plant Area A is to be submitted in April 1999. The objective of the ICM is to establish hydraulic control of groundwater in this area and prevent any discharge of contaminated groundwater to the Buffalo River.

Note G: Remediate Bethlehem Steel site

BSC has completed the field work for the site investigation, and is preparing RFI and human health risk assessment reports. These have been delayed due to negotiations over the scope. Approval is anticipated by April 2000. BSC completed limited remedial technology studies for two areas that are the primary sources of groundwater contamination at the facility (the Acid Tar Pits and Coke Oven Areas). However, EPA and DEC found the studies to have major technical flaws. A comprehensive Corrective Measures Study will commence after RFI approval. All CMS and Corrective Measure Implementation will be performed pursuant to a subsequent order or permit. A two-year delay is anticipated for CMI start-up (December 2002).

Note H: Remediate River Road and Niagara Mohawk Cherry Farm site

Removal of sediment from the Niagara River was completed in late 1998. All remedial work is complete except for final capping of the sediment disposal area. Also note that the remedy was revised to include fish and wildlife habitat enhancements through the creation of shoreline wetland embayments in the river.

Note J: Remediate Gratwick Riverside Park site

Remedial Design (RD) started in early 1996. The design includes shoreline protection, hydraulic barrier between site and river, a cap over the site to allow it to be used as a park, and collection of contaminated groundwater. During design, some site-related contamination was found in river sediments. It was also determined that steps should be taken to improve the habitat value of the shoreline area. Design changes to address these issues were submitted for approval in a proposed ROD amendment, released in September 1998. Remedial construction is expected to begin in mid-1999.

Note K: Remediate Occidental Chemical Durez - North Tonawanda site

The remediation of this site was completed in 1994. The remedial action included construction of a ground water interceptor trench around the plant perimeter to collect groundwater for treatment at an on-site carbon treatment system; removal of contaminated sediments in 22,000 linear feet of sewers off site; and remediation of Pettit Creek Cove, including sediment and soil removal at the cove, pumping of DNAPL; and dredging of the Little Niagara River.

Note L: Determine whether trace amounts of contaminants of concern found at 5 landfills are moving to groundwater off-site.

During the Niagara River Toxics Committee Study (1981-84), four industrial and one municipal landfills were identified as having the potential to contribute contaminants to the River. Studies conducted in 1991 and 1993 showed that the landfills have minimal to no impact on the River. Groundwater monitoring at these sites has shown that contaminants are not moving to the groundwater and off-site. Further assessment is not required at this time.

Regulatory monitoring and reporting of these non-point sources as required by certificates of approval will continue.

Note M: Collect juvenile spottail shiners or other juvenile fish and analyze for toxic chemicals according to Monitoring Plan

In 1997 and 1998, spottail shiner capture in the Niagara River was poor despite efforts of MOE and DEC on the Canadian and U.S. sides of the River. MOE collected emerald shiners as an alternate species at three locations in 1997 including Queenston, Lewiston, and Niagara-on-the-Lake. Technical summaries are currently in preparation. MOE collected juvenile fish from eight locations on both the Canadian and U.S. side of the Niagara River in 1998. The Canadian locations included Fort Erie (spottail shiners), Queenston (common shiners), and Niagara-on-the-Lake (spottail shiners). The U.S. locations included Wheatfield (common shiners), 102nd Street (common shiners), Cayuga Creek (common and spottail shiners), Search and Rescue (emerald shiners) and Lewiston (emerald shiners). In 1997, DEC completed collections of spottail shiners and other young-of-the-year fish at

35 stations throughout the Great Lakes basin in New York State, including 14 stations in the Niagara River basin. Analysis was expanded to include PCB congeners and dioxin and furans at several stations. A report is in preparation.

Note N: Track down toxic chemicals in tributaries and sewer systems to identify sources

There is evidence of continuing sources of some of the NRTMP priority toxic chemicals in the Niagara River and its tributaries. Trackdown is a key program to identify the sources. DEC and EPA are forming a work group to oversee the implementation of New York State Great Lakes basin source trackdown work, including Lake Ontario, the Niagara River and Lake Erie. Much relevant information has been collected over the past several years. The assessment is to assemble the existing trackdown related information, describe the source contol actions completed to date or on-going, and describe the next steps, including additional source control actions and monitoring. Additional follow-up actions in the Niagara River and tributaries will start in 2000 upon completion of the assessment, or sooner as priorities are identified.

Note O: Biomonitor using caged mussels and analyze for toxic chemicals, according to Monitoring Plan

Since 1981, MOE, with the cooperation of DEC, has conducted routine and specialized biomonitoring of contaminants in the Niagara River using caged mussels. Studies have been conducted on both the Canadian and U.S. sides of the River. These studies have provided information on suspected contaminant sources and source areas, as well as information on the effectiveness of site remediations in reducing contaminants in the River between Fort Erie and Niagara-on-the-Lake.

In 1995, two complementary studies were initiated by MOE: (1) the routine deployment of caged mussels at 21 stations on the Canadian and U.S. sides of the river for 21 days of exposure; and (2) a long term deployment, for up to four months, at two stations. Mussels were retrieved after the designated period of deployment and the tissues were analyzed for pesticides, PCBs, chlorinated benzenes, PAHs, dioxins, and furans. The results of the studies are discussed in the Progress Report, and the full report is available through the MOE, Richman, L. 1998. Niagara River Mussel Biomonitoring Program, 1995.

In 1997, Mussels were deployed at 32 stations for 21 days and at four stations for up to four months. Mussel tissue has been analyzed for chlorobenzenes, total PCBs, and organochlorine pesticides and PAHs. A technical summary was recently completed.

Note P: Develop additional materials relating information on Niagara River contamination and contaminant sources.

The goal of the December 1996 NRTMP Letter of Support is

> To reduce toxic chemical concentrations in the Niagara River by reducing inputs from sources along the river. The purpose is to achieve ambient water quality that will protect human health, aquatic life, and wildlife, and while doing so, improve and protect water quality in Lake Ontario as well.

Though NRTMP has made much progress toward this goal, more work is needed to determine what additional actions are necessary to improve water quality and reduce contamination of sediments, fish and wildlife. The task is to examine a variety of information sources on toxic contamination in the River water, biota, and sediments, toward the following objectives:

- Develop an improved description of contaminant status and trends in the Niagara River, and the relationship to the NRTMP;
- Determine the toxic chemicals that continue to exceed criteria or standards for the protection of human health, aquatic life, and wildlife in the Niagara River;
- Determine and describe the sources and loads of those chemicals;
- Where the above objectives cannot be fully achieved, describe the actions necessary to achieve them.

Key sources of information for the synthesis include: (1) Upstream/Downstream monitoring; (2) contaminant biomonitoring; (2) sportfish advisories and contamination; (5) contaminant source trackdown monitoring; (5) sediment quality data; (6) waste site contaminant loadings; (7) point source contaminant loadings. The effort to develop the synthesis is underway. Additional information will be incorporated into the NRTMP Progress Report and Work Plan beginning in 2000.

Note Q: Make NRTMP information and reports available on the Internet.

Upstream/Downstream Reports for 1992/93 and 1993/94 are on GLIMR Internet site (*http://glimr.cciw.ca/*). The November 1998 U.S. Niagara River hazardous waste site remediation progress report is at *http://www.epa.gov/grtlakes/lakeont/nrtmp/report.html*. Additional reports will be added as they are available.