NIAGARA RIVER TOXICS MANAGEMENT PLAN

PROGRESS REPORT AND WORK PLAN

June 2000

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Progress Report and Work Plan

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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 the 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 reduce the concentrations of toxic pollutants 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.

This year’s Progress Report, in addition to presenting results from the Upstream/Downstream and Biomonitoring Programs, also presents information on the comparison of ambient water concentrations to water quality objectives, fish consumption advisories, and trends of contaminants in fish.

The Work Plan, also included as part of this Progress Report, outlines the activities to be undertaken by the Four Parties to achieve the goals expressed in the Letter of Support, and to monitor and report progress towards attainment of these goals.

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 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), indicating contaminant bioavailability, one of the tools which can help us gauge the effectiveness of remedial programs in reducing chemical inputs to the Niagara River at various sources;
- Comparison with the most stringent agency water quality criteria available in 1996/97; and,
- Fish consumption advisories.

The primary method of assessment is the **Upstream/Downstream Program**. The program collects water and suspended sediment samples once every two weeks 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.

In 1996/97, concentrations of most of the “priority toxics” were below their 1996/97 most stringent agency criteria. The exceptions were hexachlorobenzene (HCB) and the polynuclear aromatic hydrocarbons (PAHs). This is a positive indicator of progress. Recently, the New York State Department of Health has made some fish consumption advisories in the Niagara River and Lake Ontario less restrictive. Biomonitoring Program results, using caged mussels, continue to show that remedial activities at specific hazardous waste sites have been successful in reducing inputs of chemicals to the Niagara River. Where the data show there might be some residual contamination, both EPA and DEC have taken steps to ensure that appropriate follow-up action is taken.

Each of the above results 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 DOI and the NRTMP.

Despite the successes to date, more work needs to be done. Some chemicals are still at levels that exceed the most stringent agency water quality criteria in the River. Advisories to limit consumption of sportfish caught in the Niagara River continue due to contamination by toxic substances. 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 2000 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.

1.0 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”. NYSDEC and EPA have presented information on progress in remediation of hazardous waste sites. Reductions in inputs of certain priority toxic chemicals to the river from Niagara River sources have also been shown by ambient river and biomonitoring data.

In particular, past NRTMP Progress Reports have focused on the corroborative evidence from the Upstream/Downstream and Biomonitoring programs, along with sediment core data from the Niagara River depositional zone in Lake Ontario.
The information has been useful for assessing progress in meeting the 50% reduction goal and in documenting successes in “cleaning-up” the Niagara River. These reports have presented at least two consistent messages as follows:

- Concentrations of many of the 18 NRTMP “priority toxics” in the Niagara River have decreased and the river is getting “cleaner”; and,

- Decreases in the concentrations/loads of many of these “priority toxics” have exceeded 50%.

Past reports have also stated that, notwithstanding the work and successes to date, more work still needs to be done. Several examples of current concerns were noted in last year’s report. These included exceedences of water quality criteria in the river; fish consumption advisories for fish from the river; and biomonitoring program results indicating the continuing presence of particular priority toxics in areas where remediations have occurred. Current trackdown efforts will determine if there are sources of priority toxics to the Niagara River that may require attention.

The Four Parties are committed to further reducing 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. In December, 1996, the

Four Parties signed a Letter of Support to re-affirm their commitment to the NRTMP. The revised goal statement in that Letter reads as follows:

> *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.*

In addition to presenting results from the Upstream/Downstream and Biomonitoring Programs, this year's Progress Report presents additional information on the comparison of ambient water concentrations to water quality objectives, fish consumption advisories, and trends of contaminants in fish.

The Work Plan, also included as part of this Progress Report, outlines the activities to be undertaken by the Four Parties to achieve the above goal, and to monitor and report progress.

2.0 THE UPSTREAM/DOWNSTREAM MONITORING PROGRAM

Since 1986, the Upstream/Downstream Program has been used to estimate the annual mean concentrations and loads with their 90% confidence limits for each of the chemicals, in both phases, at both stations. Results have been summarized and released in annual, Four Party Upstream/Downstream reports (e.g., NRDIG 1999).

The 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, once every two weeks[1], to measure the changes in the concentrations and loads of over 90 chemicals in the water entering and leaving the 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.

Both seasonal and large, week to week, fluctuations in the Niagara River Upstream/Downstream data made discernment of trends in the concentrations and loads 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. To determine reliable trends over time with known confidence for measured chemicals, a statistical procedure was developed that dealt with "censored" and missing data, auto-correlation and seasonality, as well as changing analytical limits of detection (El-Shaarawi and Al-Ibrahim 1996).

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

A detailed analysis of the Upstream/Downstream Program data collected over the eleven-year period 1986/87 to 1996/97 to determine trends was recently completed by Williams *et al* (2000). The model was run on each of the chemicals, in each phase individually [whole water for metals], at both stations *for the entire period of record*. The ratio of the means (expressed as a percent) for the end year (1996/97) to the base year[2] was used to calculate an index of change over the eleven-year period of record· Table 2 shows the percent change in the annual[3] mean concentrations/loads for the 18 NRTMP "priority toxics", in both phases, at both stations, between the base year and end year (1996/97) *generated by the model*. A dashed line in the Table indicates that the chemical either had too few data to run the model (e.g., most values below detection), or insufficient data to have confidence in the model output. A positive number indicates a significant increase, and a negative number a significant decrease, in the model estimates of annual mean concentrations/loads between the base year and 1996/97. "NS" signifies no significant change in the model estimates over the period of record.

Briefly, the results for the 18 NRTMP "priority toxics" show the following.

Chlorobenzenes (CBs)

The reduction in both the dissolved and particulate phase concentrations and loads of hexachlorobenzene at NOTL exceeded 50%. At FE, the output from the model was discarded because significance was based almost entirely on "trace" (i.e., below the detection limit) values. This clearly suggests that reductions at NOTL are due to reductions in the inputs of hexachlorobenzene to the Niagara River from Niagara River sources.

Organochlorines (OCs) and PCBs

In general, both the concentrations and loads of nearly all the NRMTP "priority toxics" OCs decreased significantly in one or both phases at both FE and NOTL. Decreases were often observed only in one phase because there were insufficient data in the other phase to determine change. This may be related to the partitioning of the chemical between the dissolved and particulate phases. The decreases (in concentrations or loads) ranged between 23% (p,p'-DDE) and 83% (PCB) and were, generally, of similar magnitude at both stations. Exceptions to these generalities were γ-chlordane, for which the trend was not significant, and mirex which was detected only at NOTL.

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[2] The base year varies for different chemicals; while the program was initiated in 1986 (identified base year in the NRTMP), additional chemicals were added to the Niagara River protocol as analytical methods became available.

[3] Note that "annual" refers to April 1 to March 31, rather than calendar year.

Polynuclear Aromatic Hydrocarbons (PAHs)

Of all the chemicals analyzed in the Upstream/Downstream Program, the PAHs exhibited the most varied results. For those chemicals having sufficient data to run the model, the concentrations and/or loads between the base year and 1996/97 decreased for some, increased for others, and for yet others, exhibited no significant change. Depending on the PAH, these changes occurred only in the dissolved phase, only in the particulate phase, or in both. Furthermore, changes for some PAHs were significant at only one of the stations. For example, benzo(a)pyrene B(a)P exhibited a significant increase in both concentration and load only at FE over the eleven-year period. Benzo(b/k)fluoranthene showed no significant change in either phase at either station.

Industrial By-Product Chemicals

Octachlorostyrene (OCS) was detected only at NOTL. The concentrations and loads of OCS decreased significantly (>80%) in the particulate phase. There were insufficient data in the other phase to determine change. As noted for the OCs, this may be related to the different partitioning of these chemicals between the dissolved and particulate phases. The results clearly suggest success in controlling inputs from Niagara River sources.

Metals

The concentrations and/or loads of the three NRTMP “priority toxics” metals at both FE and NOTL decreased significantly ranging from 3.1% (arsenic) to >86% (lead).

Trend Graphs

In generating the output for Table 2, the model also generated time series plots (i.e., trends) of the dissolved and suspended particulate phase concentrations at both NOTL and FE for each of the “priority toxics” shown in the Table. The plots for most of the chemicals showed a statistically significant decrease. The pattern of change, however, was not the same for all chemicals. In contrast, the plot for B(a)P showed an increasing trend, while that for γ-chlordane showed no significant change/trend. Figures 1 to 4 are examples of the results for hexachlorobenzene, PCBs, dieldrin and octachlorostyrene, respectively, which exhibited a statistically significant trend over the 1986/87 to 1996/97 time period.

3.0 STATUS AND TRENDS RELATIVE TO ENVIRONMENTAL OBJECTIVES

The Niagara River is the largest tributary to Lake Ontario, providing over 80% of all the water that flows into the lake. Along with the contribution of water, the Niagara River also transports contaminants from the waters of the upper Great Lakes and from sources along the river from Lake Erie to Lake Ontario. Therefore, there is a critical link between the inputs to the Niagara River from the upper Great Lakes, inputs from sources along the river, and the water quality of Lake Ontario. Improvements in both the Niagara River and Lake Ontario are related to completion of site specific remediations, control of point source discharges and encouragement of the implementation of pollution prevention techniques. These improvements are evidenced by the results of the Upstream/Downstream program, analysis of contaminant levels in the tissues of fish or mussels and collection and analysis of sediments.

Inputs of chemicals to the Niagara River can impact both the river and Lake Ontario including, for example, contributing to the exceedences of water and sediment quality criteria, and issuance of fish consumption advisories. Surficial sediment chemical distribution patterns in Lake Ontario point to the Niagara as a major source of many chemicals to the lake (Thomas *et al* 1988). Similarly, depth distributions of chemicals in dated cores collected from Lake Ontario in the vicinity of the Niagara River mirror the production history of the chemicals (Durham and Oliver 1983) and the reduction of Niagara River inputs, either as a result of better control of sources along the length of the river, or reductions in inputs from Lake Erie/upstream (Mudroch 1983; Stewart *et al* 1996). The six critical pollutants for the Lake Ontario Lakewide Management Plan (LaMP) are also NRTMP "priority toxics" (Table 3). Critical pollutants for Lake Ontario are chemicals which are causing beneficial use impairments on a lakewide basis. The threat to aquatic life and the real or potential impairment of beneficial uses such as restrictions on fish consumption can be assessed by comparing the Niagara River Upstream/Downstream Program data to available water quality criteria.

COMPARISON WITH WATER QUALITY CRITERIA

The 18 NRTMP "priority toxics" were selected based on their exceedence of water, fish or sediment criteria in the Niagara River or Lake Ontario (Categorization Committee 1990). It is appropriate, therefore, to compare the current concentrations of these "priority toxics" in the river to their criteria as an indicator of progress. Since its inception, the NRTMP has used the most stringent agency criteria[4] of either Canada, the United States, Ontario, or New York State (see below).

The approach used by the Four Parties in their annual Niagara River Upstream/Downstream Reports (e.g., see NRDIG 1999) has been to compare the upper 90th percentile recombined whole water (**RWW)** concentrations (i.e., dissolved + particulate phases) of a chemical to the most stringent agency criterion for that chemical. Using the upper 90th percentile, rather than the annual mean, provides a more protective estimate of criteria exceedences. This approach has also been used in this report.

[4] Although criteria have changed over the period of record of the NRTMP, in this report, all data were compared to the most stringent agency criteria available in 1996/97.

Figures 5 and 6 show the results for the organochlorine (OCs) and polynuclear aromatic hydrocarbon (PAHs) “priority toxics” at Niagara-on-the-Lake (NOTL) and Fort Erie (FE), respectively. The most stringent agency criterion concentration is noted for each chemical and is plotted as a solid line on the graph when its concentration is reasonably close to the observed chemical concentrations. Plotting NOTL and FE data on the same graph facilitates comparison of the results at the two stations simultaneously. Because none of the metals exceeded their criteria at either station the data were not plotted. Briefly, the results show the following.

Of the OCs (Figure 5), only hexachlorobenzene (HCB) still exceeds its criterion at NOTL. over the eleven years of sampling (1986/87 to 1996/97), the magnitude of the exceedences has declined. PCB concentrations have decreased since 1986/87 with concentrations in 1996/97 being below the criterion for the first time over the eleven-year period.

For the PAHs (Figure 6), both benzo(b,k)fluoranthene and chrysene/triphenylene exceeded the most stringent agency criteria at both FE and NOTL. Benzo(a)pyrene has been above its criterion at NOTL for the past three years and benz(a)anthracene has been slightly below its criterion for the past six years.

The higher concentrations for some of these chemicals (e.g., HCB, chlordane) at NOTL infer the presence of inputs from Niagara River sources. The similar concentrations of others (e.g., dieldrin, PCBs) at both stations, and the higher concentrations of DDT and metabolites at FE, suggest that Lake Erie/upstream is the major source. This is consistent with the conclusions reached in past NRTMP Progress Reports.

In 1998, New York State completed the adoption of water quality standards under the U.S. Great Lakes Initiative. For some chemicals, these new standards are now the most stringent of the Four-Party water quality criteria. For example, the most stringent criterion for dieldrin was 0.9 ng/L and is now 0.0006 ng/L. Similarly, the most stringent criterion for PCB was 1.0 ng/L and is now 0.001 ng/L. New York State Water Quality Standards are shown in BOLD in Table 4. Future NRTMP Progress Reports will compare the data collected beginning in 1998 to these new criteria.

It is also worth noting that ambient “priority toxics” concentrations already are below many of the most stringent agency criteria for other categories such as the protection of drinking water, protection of aquatic life, etc. (Table 4).

Notwithstanding the above, two additional points should be noted. First, despite the low concentrations of contaminants in the Niagara River, the high flow of the river (>5300 m^3/sec) means that it may still be contributing substantial loads of contaminants to Lake Ontario (Mudroch and Williams 1989). Given the persistence of many of these chemicals, this means that there may still be the potential for problems in Lake Ontario related to Niagara River inputs and other upstream sources for some time to come.

Lastly, it was mentioned briefly in last year's report that some chemicals (particularly the PAHs), not currently considered "priority toxics", also exceeded their strictest agency criteria in the river. For example, Figure 7 shows that fluoranthene and benzo(ghi)perylene have consistently exceeded their criteria at both NOTL and FE since they were first measured. Anthracene also exceeded its criterion about half the time over the last eleven years. As noted above (Section 2.0), the river data on PAHs is particularly complex. The NRS will be reporting further on these chemicals in 2001.

Comparison of the ambient concentrations of "priority toxics" in water to the strictest agency criteria in use in 1996/97 clearly indicates progress. As noted, however, the criteria for a number of chemicals were made even more stringent in 1998. Continuing work will need to be done to ensure that concentrations of these chemicals in the river are eventually below these new agency criteria.

FISH CONSUMPTION ADVISORIES

New York State and Ontario issue advice regarding consumption of sport fish caught in their waters.

The New York State Department of Health (NYSDOH) issues an annual booklet titled *Health Advisories: Chemicals in Game and Sportfish*. This booklet provides advisories on eating sportfish and game since some of these foods contain chemicals at levels that may be harmful to human health. The health advisories provide general advice on sportfish taken from the waters in New York State and on game species. The information is presented so that it is easy to understand the guidance for a particular species from a specific waterbody. The advisories explain how to minimize exposure to contaminants from sportfish and game and reduce whatever health risks are associated with them.

NYSDOH has a general advisory to eat no more than one (half-pound) meal per week of sportfish from all New York State fresh waters (and some marine waters at the mouth of the Hudson River). The United States federal government sets standards for chemicals in food that is sold commercially, including fish. In New York State, the Department of Environmental Conservation (NYSDEC) monitors contaminant levels in fish and game. NYSDOH issues specific advisories (i.e., "eat none" or "eat no more than one meal per month") when sportfish have contaminant levels greater than federal standards. NYSDOH also advises women of childbearing age, infants and children under the age of 15 to eat no fish from waters that have specific advisories for any fish species.

For the Niagara River and Lake Ontario system, specific sportfish advisories have seen some important changes in the past several years. In 1999, the previous advisory (all species, "eat none") for Gill Creek from the Hyde Park Dam downstream to its mouth on the Niagara River was removed based on new data showing lower PCB levels in black crappie, largemouth bass, white perch, brown bullhead and bluegill. Contaminated sediment was removed from Gill Creek before the fish were sampled. The current advisory for the upper Niagara River and tributaries of "eat no more than one meal per month of carp" now also applies to Gill Creek In 1998, NYSDOH made advisories for certain sizes of rainbow trout, lake trout and coho salmon from Lake Ontario and the lower Niagara River less restrictive because of lower concentrations of PCB and mirex in more recent collections of these fish. The 1998/1999 New York State advisories for the Niagara River are summarized in Table 5.

NYSDEC staff will be analyzing data to evaluate temporal trends in contaminant concentrations in fish from the Niagara River. It is known, however, that between 1993 and 1996 most contaminant concentrations in sportfish from Lake Ontario (central and eastern sections) have generally declined, especially PCBs and mirex. Several factors are probably responsible for these changes. First, management actions implemented in the late 1970s and the 1980s (e.g., chemical production bans, use restrictions, improvements in waste water treatment, and the remediation of hazardous waste sites) have reduced PCB and mirex inputs to the lake. Also, the biotic community continues to undergo dramatic changes based, at least in part, on the introduction of exotic species. These community changes may be changing the dynamics of contaminant uptake by fish through alterations in the food web.

Similarly, the Ontario Ministry of the Environment issues advice contained in the biennial *Guide to Eating Ontario 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 5 is taken from the 1999-2000 Guide (MOE 1999). The consumption table shows less restrictive consumption advice for chinook salmon, rainbow trout and lake trout in the lower Niagara River than the 1997-1998 *Guide*. Elevated concentrations of mercury, PCBs, and mirex/photomirex continue to be the major contaminants causing Ontario consumption advisories for the sport fish found in the Niagara River.

In 1999, northern pike and smallmouth bass were collected in the upper Niagara and walleye and smallmouth bass in the lower Niagara River. In 2000, a broad range of species will be collected from both the upper and lower Niagara River. The results will be available for the 2001 NRTMP Progress Report and for the 2001/02 *Guide to Eating Ontario Sport Fish*.

Historical data from the MOE Sport Fish Contaminant Monitoring Program are currently being analyzed to evaluate temporal trends in contaminant concentrations in sport fish from the upper and lower Niagara River and western Lake Ontario. Sport fish from western Lake Ontario have been included because their contaminant concentrations appear to reflect the concentrations found in lower Niagara River sport fish.

Temporal trends for PCB concentrations in the edible portion of lake trout and chinook salmon from western Lake Ontario are shown in Figures 8 and 9, respectively. PCB concentrations in both species declined substantially between the 1970s and mid-1980s. Reductions in PCBs after 1983 appear to be modest.

Trends of PCB in Lake Ontario Fish

The statement above for trends of PCB in edible portion of lake trout can be compared with the trends for whole fish shown in Figure 10 based on several data sets and the estimated trend based on the LOTOX (Lake Ontario Toxics) model. Despite the differences among the data sets, a continuing trend of PCBs in fish is indicated. For example, Huestis *et al* (1996) using a data set which is internally consistent, concluded that from 1977 to 1993, most measured contaminants showed significant decreasing trends. The LOTOX model simulation for PCB concentrations in lake trout based on estimates of the PCB loads to the lake reinforces this conclusion.

4.0 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. Since 1980 the Ontario Ministry of Environment (MOE) has conducted both routine and specialized biomonitoring of contaminants in the Niagara River using caged mussels (*Elliptio complanata*) as part of Ontario's commitment to the NRTMP. The principle behind the mussel biomonitoring program is to take mussels (biomonitors) from an uncontaminated site and place them in an environment that is known or suspected of being contaminated with persistent bioaccumulative substances. The biomonitors are left for a specified time to accumulate contaminants and are then analysed to determine tissue contaminant concentrations. The Biomonitoring Program has provided information on suspected contaminant sources and source areas in the river between Fort Erie and Niagara-on-the-Lake.

In 1997 mussels were deployed at 32 stations on the American as well as Canadian side of the river. In general, results indicated spatial distributions of contaminant concentrations in mussel tissue similar to those observed since 1980. On the Canadian side of the river, mussels had no detectable concentrations of chlorinated benzene compounds, PCBs or organochlorine pesticides, with the exception of trace concentrations of p,p'-DDE (a metabolite of the pesticide DDT).

On the U.S. side of the river, organochlorine pesticides were detected sporadically at several stations at concentrations similar to those in past surveys. Mirex was detected in mussels deployed at sites associated with the Occidental Chemical Corporation. PCBs and chlorinated benzene compounds were detected at almost all stations. Hexachlorobenzene, pentachlorobenzene and 1,2,3,4-tetrachlorobenzene were the most frequently detected chlorinated benzenes.

After completion of remedial activities at the 102nd Street hazardous waste site in December, 1998, mussel tissue concentrations of almost all parameters were below the detection limit. This was in contrast to high tissue concentrations of these compounds observed prior to site remediation. In particular, dioxin and furan concentrations in mussels deployed at 102nd Street Landfill were low and reflect the success of the site remediation and removal of contaminated sediment. Figure 11 shows the dioxin data for the period 1987-97. No dioxins and furans were detected in the sediment sample collected from the site.

Concentrations of dioxins and furans in exposed sediment at the Niagara River shoreline at the mouth of Bloody Run Creek, which runs through the Hyde Park hazardous waste site, although lower than pre-remediation concentrations, were still high relative to sediment concentrations observed throughout the Great Lakes basin. Characteristic of the congener/isomer patterns for Bloody Run Creek all the tetra-dioxin was in the form of 2,3,7,8-tetrachlorodibenzo-p-dioxin which is the most toxic form of dioxin (45,000 pg/g). The presence of dioxins and furans in mussels at this site suggest that these compounds were bioavailable to aquatic life at this location (Figure 12). The TEQ (concentration of toxicity equivalents) for Bloody Run Creek sediment was 58,543 pg/g. Toxicity Equivalency Factors (TEQs) are used as a measure to express the toxicity of different dioxins and furans on a common basis. TEQs are assigned to individual dioxins and furans on the basis of how toxic they are in comparison with the toxicity of 2,3,7,8-tetrachloro-dibenzodioxin, which is assigned the value of 1.0. 2,3,7,8-TCDF is one tenth as toxic and has a toxic equivalent of 0.1. This site is under further investigation by EPA. It should be noted that follow up sediment sampling by EPA in 1999 at the mouth of Bloody Run Creek also indicated possible continuing concerns due to dioxin contamination. EPA will assess the human health risk of the contamination. A more detailed characterization of the area will be performed.

It is also important to note that the monitoring at the base (mouth) of Bloody Run does not adequately reflect the effectiveness of the Hyde Park Landfill remedial systems. The remedial plan for the Niagara gorge face was based on human-health exposure scenarios. The remedial systems in place to date have been successful in drying up the gorge-face seeps and have substantially reduced chemical loadings from the site into the river. However, the area of the Bloody Run within the gorge was not remediated and residual contamination exists. The Hyde Park settlement agreement recognized that there would be residual contamination. To limit human exposure, access to the area is restricted.

Concentrations of chlorinated benzenes in mussels deployed at the Pettit Flume inlet cove were low relative to previous years of sampling before the remediation of the cove in 1994 (Figure 13). By removing contaminated sediment from the cove, an important non point source of chlorinated benzenes and phenols to the Niagara River was eliminated. However, high concentrations of dioxins and furans were detected in mussels and sediment. Given the recent extensive remedial activities at this site, the source of the dioxins and furans is unclear. The congener patterns in the sediment and mussel sample were consistent with samples from 1993 before remedial activities suggesting a common source. Figure 14 shows the dioxin and furan isomer patterns in caged mussels from the Pettit Flume for 1993 and 1997. NYSDEC is presently investigating possible sources and the extent of contamination in the cove. The high concentrations in mussel tissue showed that these compounds were still bioavailable in this cove. Fish, other aquatic biota and waterfowl move freely in and out of the cove to feed and sediment is transported from the cove to the Little Niagara River. All these factors suggest that dioxins and furans in this cove were bioavailable to the Niagara River. Concentrations of 2,3,7,8 T4CDD in sediment from the Pettit Flume site were 350 pg/g and the TEQ for the Pettit Flume cove sediment was 20,073 pg/g.

Recent sampling of sediment in the Pettit Cove has confirmed the presence of dioxin and furans indicative of Occidental Chemical, Durez. However, due to the absence of volatile organic chemicals (VOCs) within the recently deposited sediment, it is hypothesized that the contamination is an historical remnant of past sewer cleaning operations within the Pettit Flume and not a new source. In response, Occidental Chemical has mobilized a remedial contractor to conduct maintenance dredging of the Pettit Cove. Approximately, 200 cubic yards of sediment will be hydraulically dredged out of the cove in spring 2000.

Dioxins and furans were not detected in mussels deployed at Fort Erie on the Canadian side of the river. Sediment concentrations of dioxins and furans at the Fort Erie site were low and similar to concentrations measured in sediment in 1995 from Fort Erie. The TEQ for Fort Erie was 11.3 pg/g.

The mussel monitoring program will be repeated in July 2000.

5.0 SUMMARY

The messages in this Progress Report reiterate the consistent messages of the past few Progress Reports. Specifically, these are that:

- Concentrations of many of the 18 NRTMP "priority toxics" in the Niagara River have decreased and the river is getting "cleaner"; and,

- Decreases in the concentrations/loads of many of these "priority toxics" have exceeded 50%.

The "priority toxics" were selected based on their exceedence of water, fish or sediment criteria in the Niagara River or Lake Ontario (Categorization Committee 1990). Comparing the current concentrations of these "priority toxics" in the river to the 1996/97 most stringent agency criteria as an indicator of progress shows that only hexachlorobenzene and some of the PAHs still exceed their criteria at NOTL. Decreasing concentrations over the last eleven years, however, has resulted in the magnitude of the exceedences in 1996/97 being less than what they were in 1986/87. Furthermore, decreasing PCB concentrations since 1986/87 have resulted in concentrations in 1996/97 being below the criterion for the first time over the eleven-year period. These are positive indicators of progress. Data from the New York State Department of Health shows that some of the recent fish health advisories in the Niagara River and Lake Ontario have become less stringent. This is due, at least in part, to the beneficial remedial efforts at Niagara River and Lake Ontario sources. Data from the Biomonitoring Program, using caged mussels, continue to show that remedial activities at specific hazardous waste sites have been successful in reducing inputs of chemicals to the Niagara River. Where the data show there might be residual contamination occurring, both EPA and DEC have taken steps to ensure appropriate follow-up action is taken.

There have clearly been successes under the Niagara River Toxics Management Plan and progress continues to be made. This is the overall purpose of the NRTMP and the Letter of Support signed by the Four Parties in December, 1996, to re-affirm their commitment to the NRTMP.

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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*
Toxaphene	Benzo(a)pyrene*
Mercury*	Benzo(b)fluoranthene*
Arsenic	Benzo(k)fluoranthene*
Lead	Chrysene/Triphenylene

** Chemicals designated for 50% reduction by 1996.*

Table 2. Percent Change in Concentrations and Loads of Upstream/Downstream Program Chemicals between the Base Year and 1996/97.

Chemical	Period of record	Fort Erie Concentration % change Dissolved	Fort Erie Concentration % change Susp. Part.	Fort Erie Load % change Dissolved	Fort Erie Load % change Susp. Part.	Niagara-on-the-Lake Concentration % change Dissolved	Niagara-on-the-Lake Concentration % change Susp. Part.	Niagara-on-the-Lake Load % change Dissolved	Niagara-on-the-Lake Load % change Susp. Part.
Chlorobenzenes									
Hexachlorobenzene	1986-1997	--	--	--	--	-69.6	-51.0	-67.3	-63.5
Chlorinated Pesticides & PCBS									
a-chlordane	1986-1997	--	NS	--	NS	NS	NS	NS	NS
g-chlordane	1986-1997	--	--	--	--	--	--	--	--
p,p'-DDT	1986-1997	--	-42.1	--	-75.6	--	-35.2	--	-51.8
o,p'-DDT	1986-1997	--	--	--	--	--	--	--	--
p,p'-TDE	1986-1997	-25.5	NS	-33.6	NS	NS	-29.1	NS	-47.3
p,p'-DDE	1986-1997	NS	-25.3	NS	-68.5	NS	-23.2	NS	-42.8
Dieldrin	1986-1997	-58.6	-38.2	-63.1	-74.0	-56.5	-60.1	-61.5	-70.3
Mirex	1986-1997	--	--	--	--	--	-49.6	--	-62.5
PCBs	1986-1997	-58.5	-59.5	-63.1	-82.9	-59.0	-75.5	-63.6	-81.8
PAHs									
Benz(a)anthracene	1986-1997	-59.1	-17.7	-63.6	-65.3	-40.8	-33.8	-47.5	-50.7
Benzo(a)pyrene	1988-1997	--	+81.1	--	+7.1	--	NS	--	NS
Benzo(b/k)fluoranthene	1986-1997	NS	NS	NS	NS	NS	NS	NS	NS
Chrysene-triphenylene	1986-1997	-30.6	NS	-38.2	NS	NS	-22.0	NS	-41.9
Industrial By-products									
Octachlorostyrene	1989-1997	--	--	--	--	--	-89.6	--	-84.0

Trace Metals in Whole Water	Period of record	Fort Erie Whole Water Concentration % Change	Fort Erie Whole Water Load % Change	Niagara-on-the-Lake Whole Water Concentration % Change	Niagara-on-the-Lake Whole Water Load % Change
Lead	1986-1997	-84.4	-86.2	-68.9	-72.4
Arsenic	1986-1997	-3.1	-14.3	NS	NS
Mercury	1986-1997	-83.6*	-85.5*	--	--

Notes:

* Raw data shows a decreasing trend, although caution must be exercised since early mercury data considered unreliable due to the likelihood of contamination.

NS No significant trend was detected by the model for the period of record.

-- Too few values above the detection limit to run the model.

Table 3. 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 4 Surface Water Quality Criteria for Niagara River Toxics Management Plan "Priority Toxics and Lake Ontario LaMP Critical Pollutants (ppb)

Substance[a]	Protection of Human Health for Consumption of Fish			Protection of Aquatic Life (Acute Values)		Protection of Aquatic Life (Chronic Values)[b]				Protection of Human Health for Drinking Water Source			Protection of Piscivorous Wildlife
	NYS	EPA[c]	HC	NYS	EPA	NYS	EPA	OMOE[b]	IJC	NYS	HC	IJC	NYS
Arsenic		0.018		**340[d]**	340[d]	**150[d]**	150[d]	5(p)		**50**	50	50	
Benz(a)anthracene		0.0044		0.23		0.03		0.0004(p)		0.002			
Benzo(a)pyrene	0.0012	0.0044								0.002			
Benzo(b)fluoranthene		0.0044								0.002			
Benzo(k)fluoranthene		0.0044						0.0002(p)		0.002			
Chrysene		0.0044						0.0001(p)		0.002			
Chlordane	**2E-5**	2.1E-3	0.006		2.4		0.0043	0.06	0.06	**0.05**			
p,p'-DDD	**8E-5**	8.3E-4	see DDT					see DDT	see DDT	**0.3**			see DDT
p,p'-DDE	**7E-6**	5.9E-4	see DDT					see DDT	see DDT	**0.2**			see DDT
p,p'-DDT	**1E-5**	5.9E-4	0.001[e]		1.1		0.001	0.003[e]	0.003[e]	**0.2**			**1.1E-5[e]**
Dieldrin	**6E-7[f]**	1.4E-4	0.004[f]	**0.24**	0.24	**0.056**	0.056	0.001[f]	0.001[f]	**0.004**			
Dioxins/dibenzofurans	**6E-10[g]**	1.3E-8[h]						2E-8(p)[g]		**7E-7[g]**			**3.1E-9[h]**
Hexachlorobenzene	**3E-5**	7.5E-4	0.0065					0.0065		**0.04**			
Lead				**see below[i,d]**	65[j,d]	**see below[i,d]**	2.5[j,d]	5(p)[j]	25	**50**	2		
Mercury	**7E-4[d]**	0.050		**1.4[d]**	1.4[d]	**0.77[d]**	0.77[d]	0.2[d]	0.2[d]	**0.7**	0.1[k]		**0.0026[d]**
Mirex	**1E-6**			**0.001**		**0.001**	0.001	0.001		**0.03**			
Octachlorostyrene	**6E-6**									**0.2**			
PCBs[l]	**1E-6**	1.7E-4	0.001				0.014	0.001		**0.09**			**1.2E-4**

Table 4 Surface Water Quality Criteria for Niagara River Toxics Management Plan "Priority Toxics and Lake Ontario LaMP Critical Pollutants (ppb)

Substance[a]	Protection of Human Health for Consumption of Fish			Protection of Aquatic Life (Acute Values)		Protection of Aquatic Life (Chronic Values)[b]				Protection of Human Health for Drinking Water Source			Protection of Piscivorous Wildlife
	NYS	EPA[c]	HC	NYS	EPA	NYS	EPA	OMOE[b]	IJC	NYS	HC	IJC	NYS
Tetrachloroethylene	1	0.8						50		0.7			
Toxaphene	**6E-6**	7.3E-4		**1.6**	0.73	**0.005**	0.0002	0.008	0.008	**0.06**			

(New York State Standards are shown in boldface type)

Sources:

NY State: Division of Water Technical and Operational Guidance Series (1.1.1), June 1998. New York State Department of Environmental Conservation, Albany, NY.
U.S. EPA: National Recommended Water Quality Criteria. Office of Science and Technology, Washington, DC. May 21, 1999.
Ontario MOE: (1) Water Management Policies, Guidelines, Provincial Water Quality Objectives. July 1994. (2) Joint Evaluation of the Upstream/Downstream Monitoring Program, 1996-1997.
Health Canada: Joint Evaluation of the Upstream/Downstream Monitoring Program, 1996-1997.
IJC: (1) Specific Objectives. Annex 1 of the Great Lakes Water Quality Agreement of 1978, as amended 1987.

Footnotes:

- **a.** All substances shown are NRTMP "priority toxics". Those in italics are also Lake Ontario LaMP critical pollutants.
- **b.** Concentrations designed to be protective of all aquatic life in situations of long-term exposure. For Ontario, values shown are Provincial Water Quality Obectives, or proposed PWQOs, denoted with (p).
- **c.** Values for protection of human health for consumption of water + organisms.
- **d.** Apples to dissolved form.
- **e.** Applies to sum of pp-TDE, ppDDE and ppDDT.
- **f.** NY State Standard shown applies to dieldrin only. In addition, a NY State standard of 0.001 ppb applies to the sum of aldrin + dieldrin. Ontario PWQO, Health Canada, and IJC objectives apply to the sum of aldrin + dieldrin.
- **g.** Value is for total dioxins/furans as 2,3,7,8 equivalents.
- **h.** Applies only to 2,3,7,8-TCDD.
- **i.** Chronic value in ppb = {1.46203 - [ln (hardenss in ppm) (0.145712)]} exp (1.273[ln(hardness in ppm)] - 4.297). Acute value in ppb = {1.46203 - [ln (hardness in ppm) (0.145712]} exp 1.273[ln(hardness in ppm)] - 1.052).
- **j.** Hardness based criteria. For EPA criterion, 100 mg/L used. Ontario criteria apply at hardness > 80 mg/L.
- **k.** Applies to inorganic mercury.
- **l.** Values apply to sum of PCBs.

Table 5 New York State Advisories on the Consumption of Sportfish for Waters of the Niagara River and U.S. Tributaries (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.

Figure 1. Modelled Trend of Hexachlorobenzene in Water at NOTL, 1986/87 to 1996/97

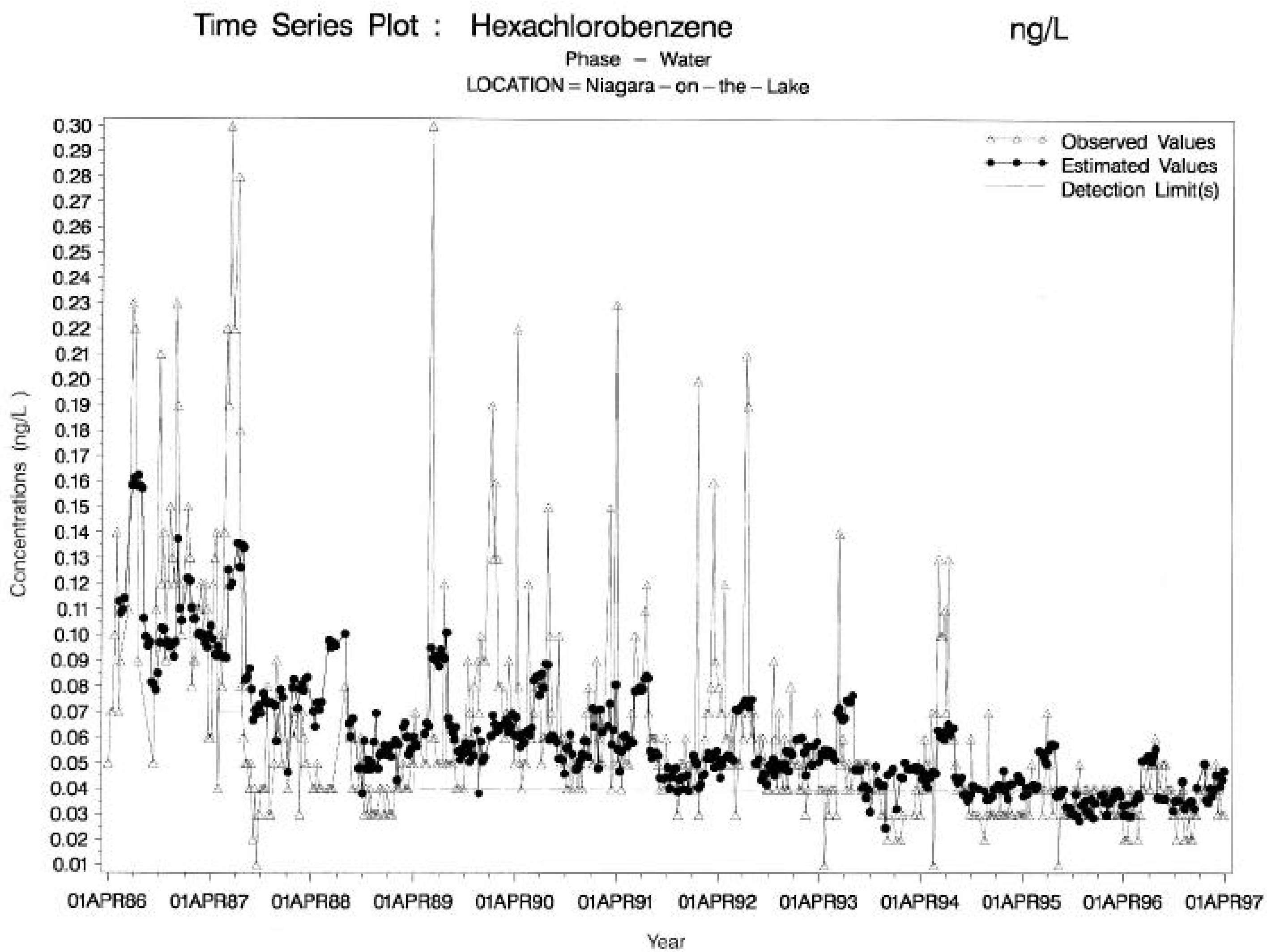


Figure 2. Modelled Trend of PCB in Water at NOTL, 1986/87 to 1996/97

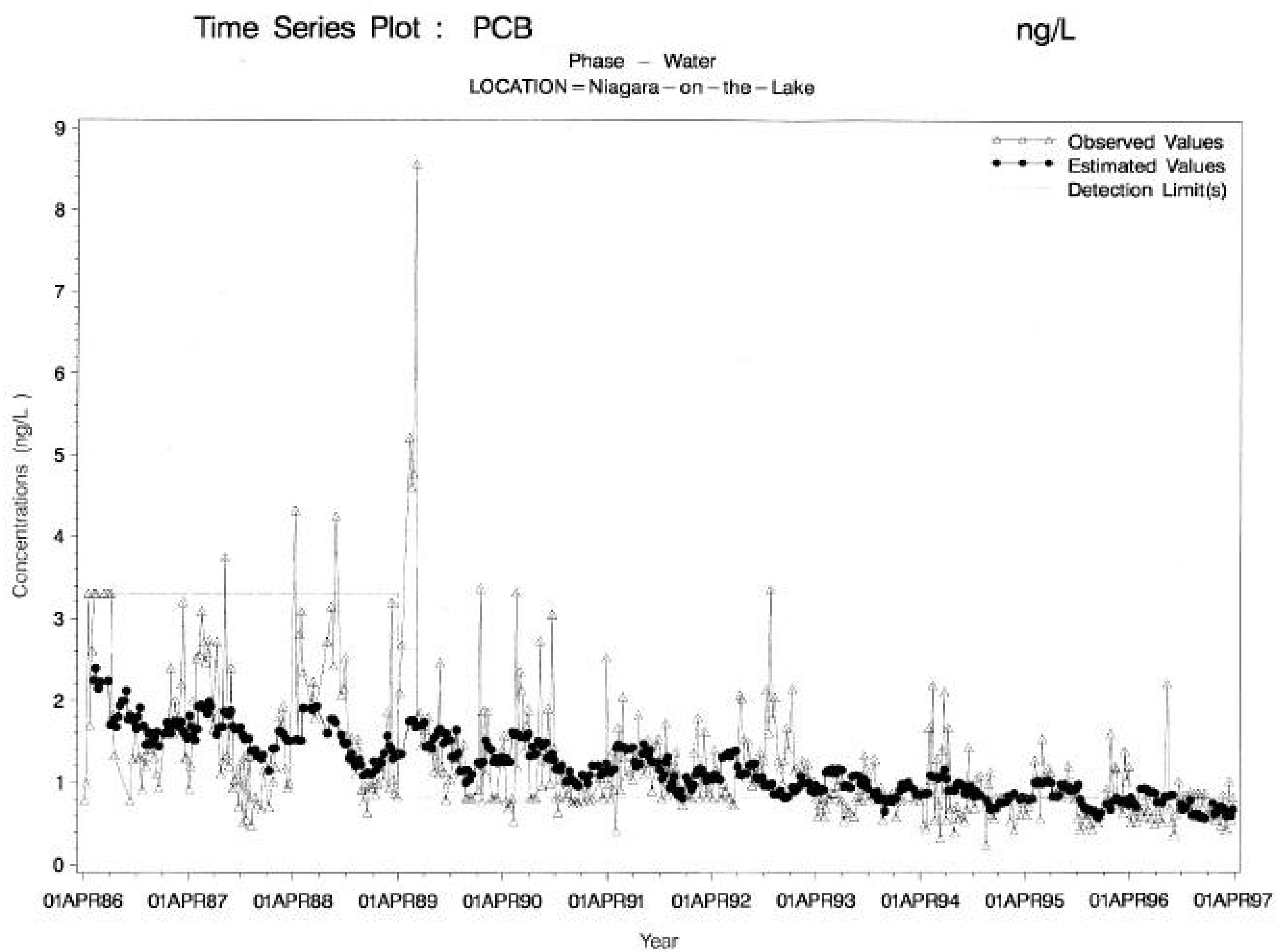


Figure 3. Modelled Trend of Dieldrin in Water at NOTL, 1986/87 to 1996/97

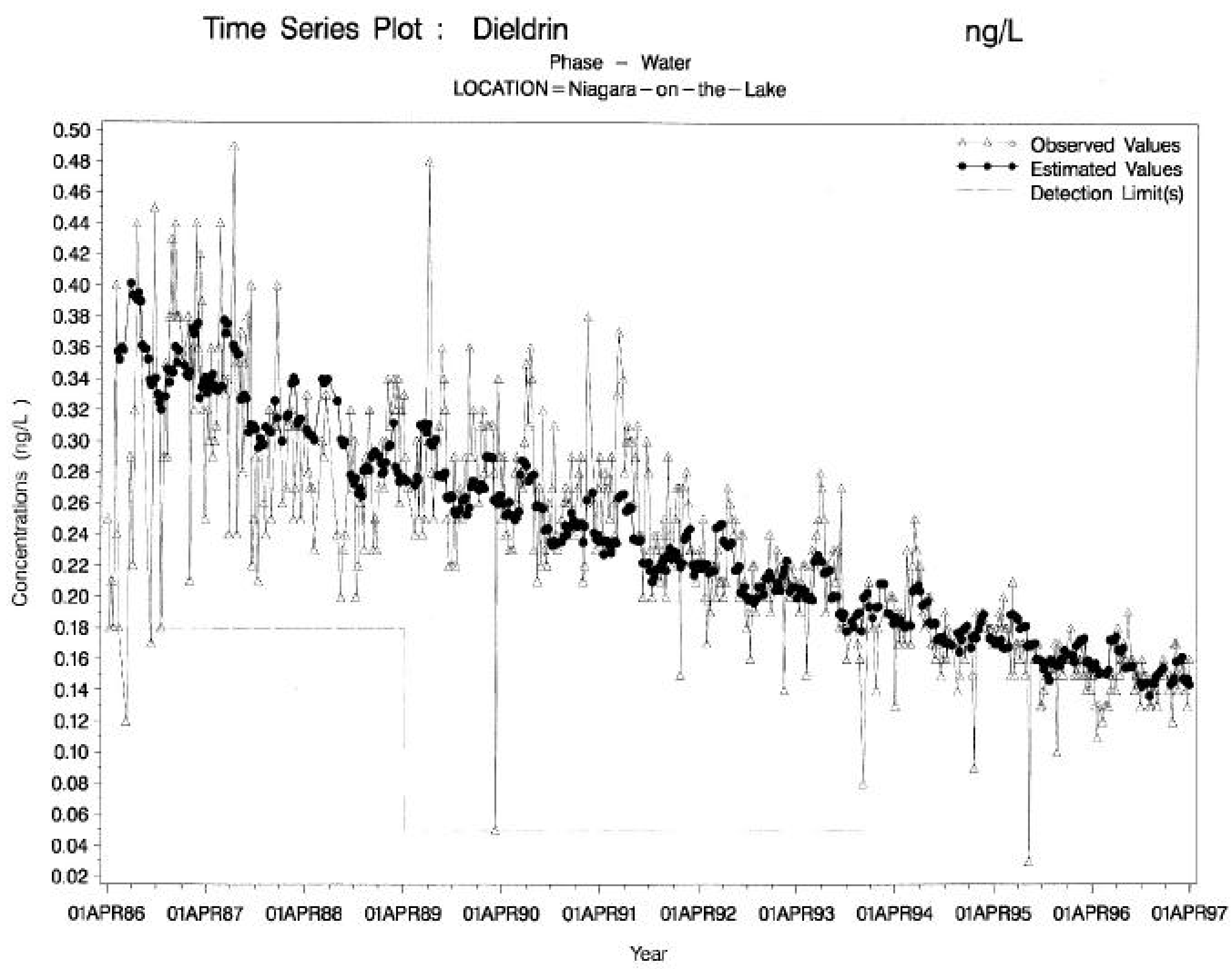


Figure 4. Modelled Trend of Octachlorostyrene (OCS) on Suspended Solids at NOTL, 1986/87 to 1996/97

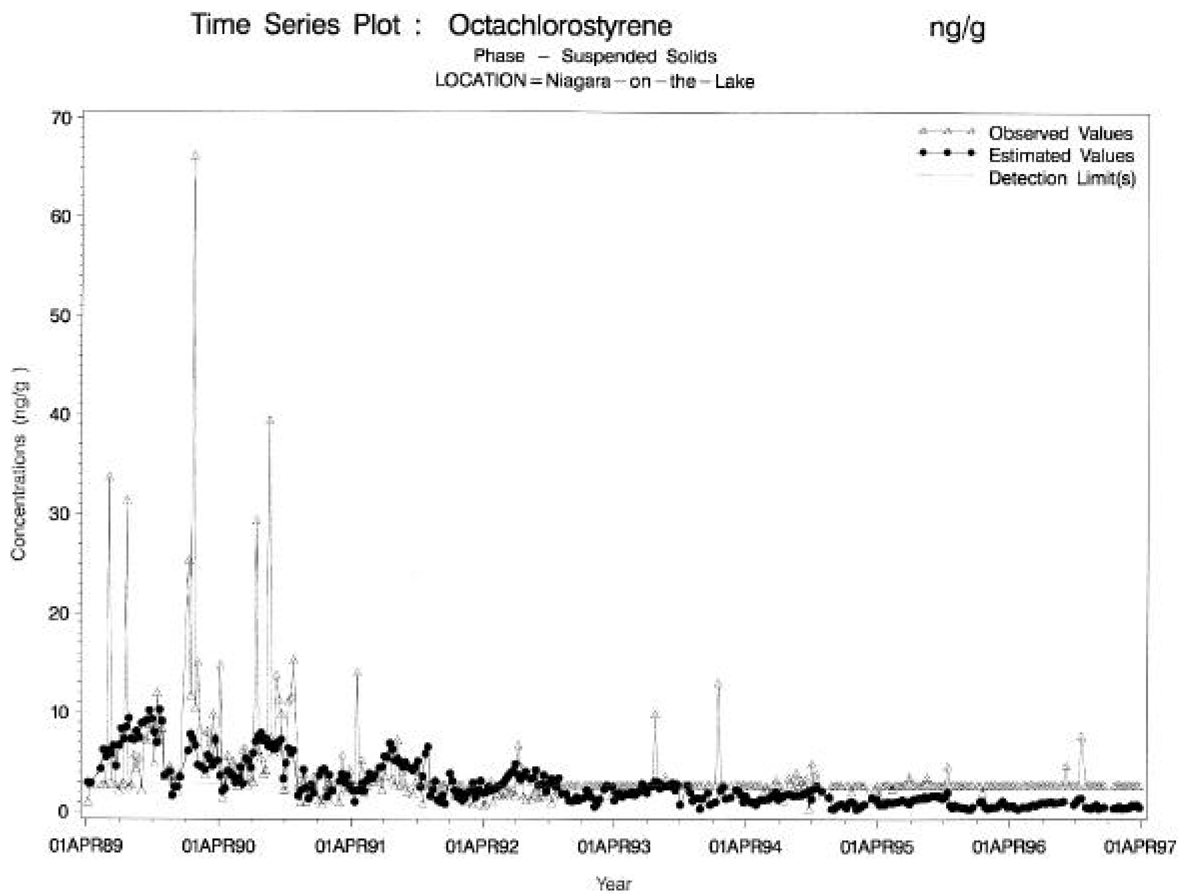
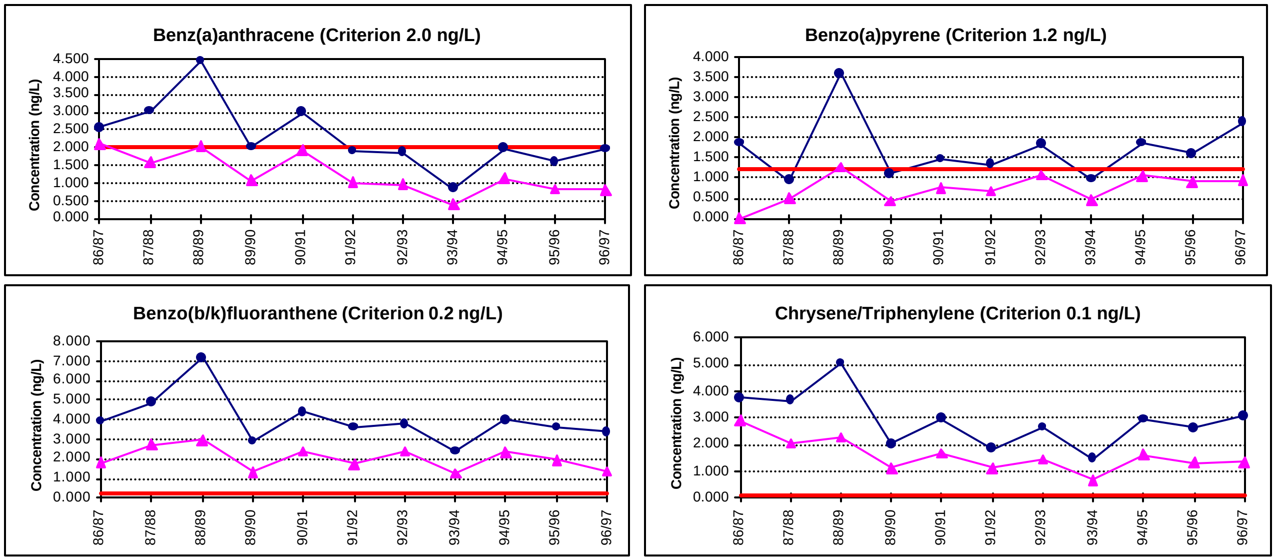


Figure 5. Comparison of Upper 90% Confidence Level Whole Water Organochlorine Concentrations at FE (▲) and NOTL (●) to the Most Stringent Agency Water Quality Criteria, 1986/87 - 1996/97 (ng/L).*

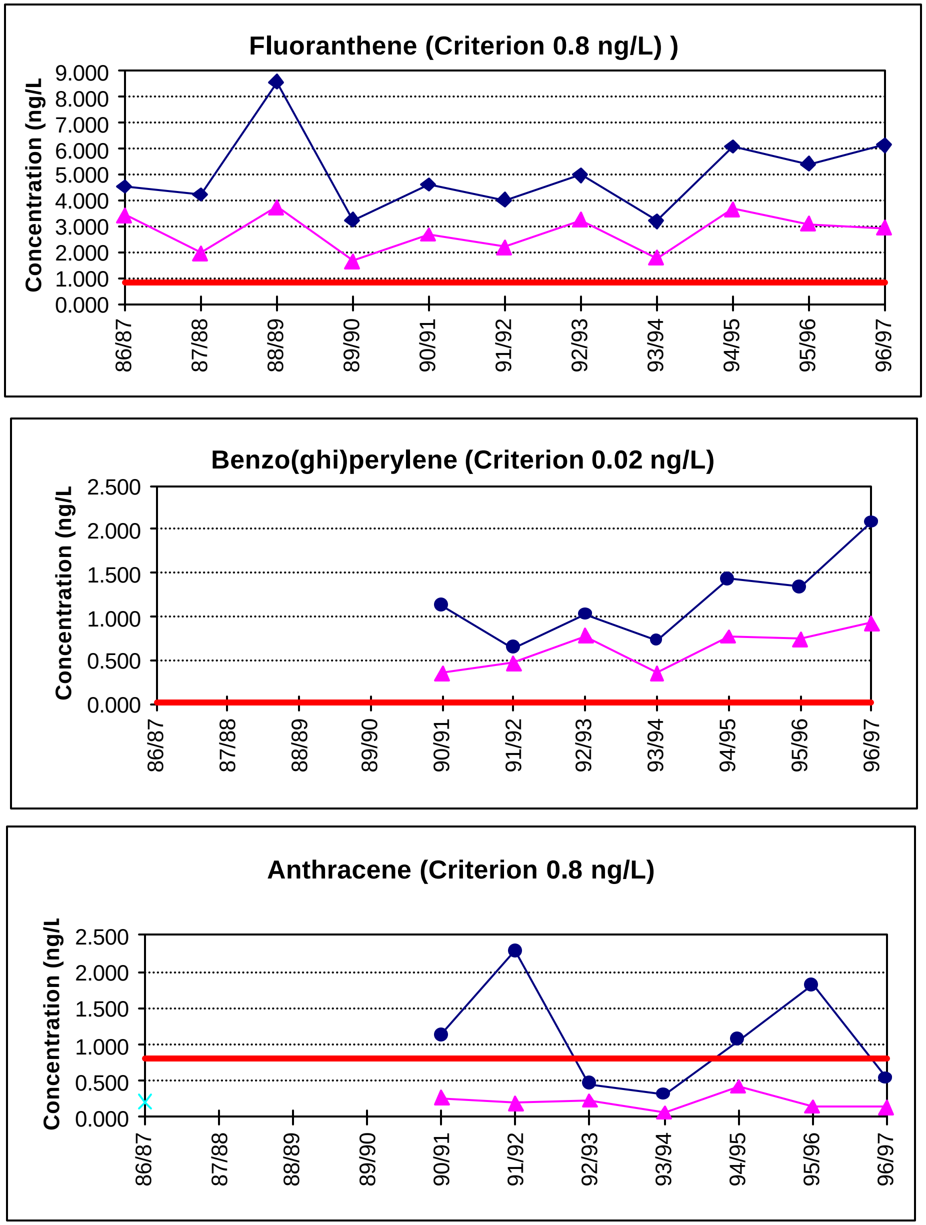
** Solid line where shown represents criterion*

Figure 6. Comparison of Upper 90% Confidence Level Whole Water PAH Concentrations at FE (▲) and NOTL (●) to the Most Stringent Agency Water Quality Criteria, 1986/87 - 1996/97 (ng/L).*



* *Solid line where shown represents criterion*

Figure 7. Comparison of Upper 90% Confidence Level Whole Water PAH Concentrations at FE (▲) and NOTL (●) to the Most Stringent Agency Water Quality Criteria, 1986/87 - 1996/97 (ng/L).*



** Solid line where shown represents criterion*

Figure 8. PCB Concentrations (mg/kg) in Edible Portion of Western Lake Ontario Lake Trout (65cm).

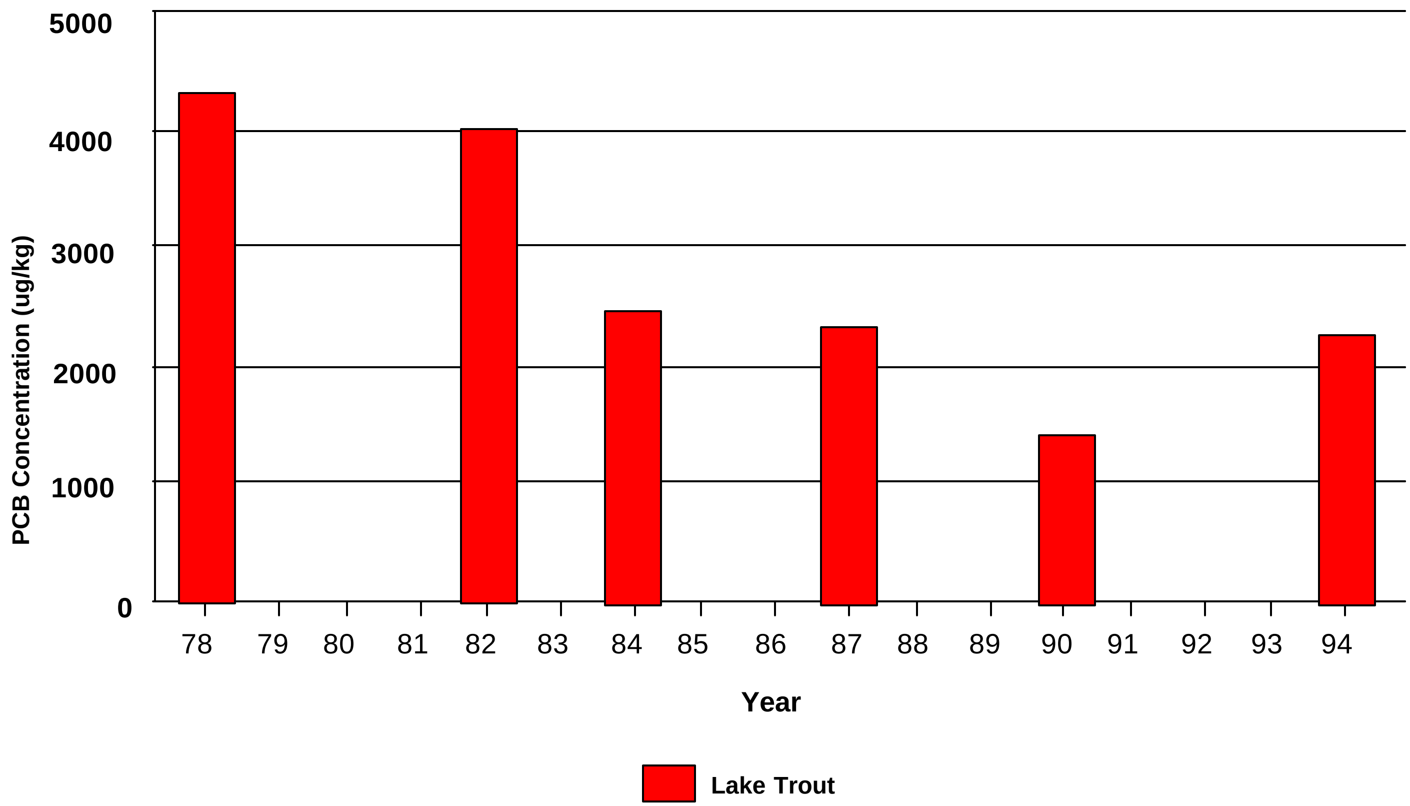


Figure 9. PCB Concentrations (mg/kg) in Edible Portion of Western Lake Ontario Chinook Salmon (70cm).

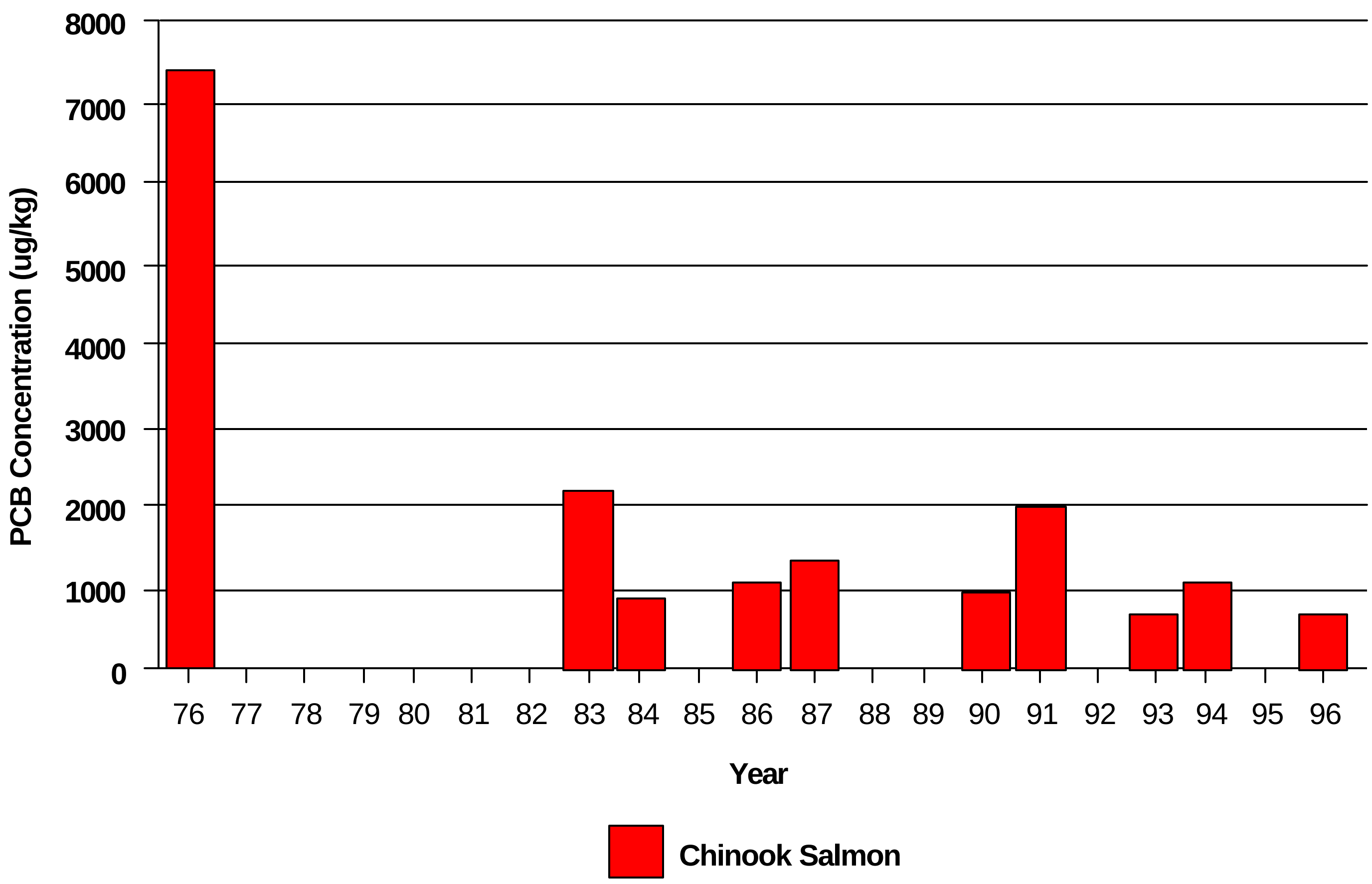
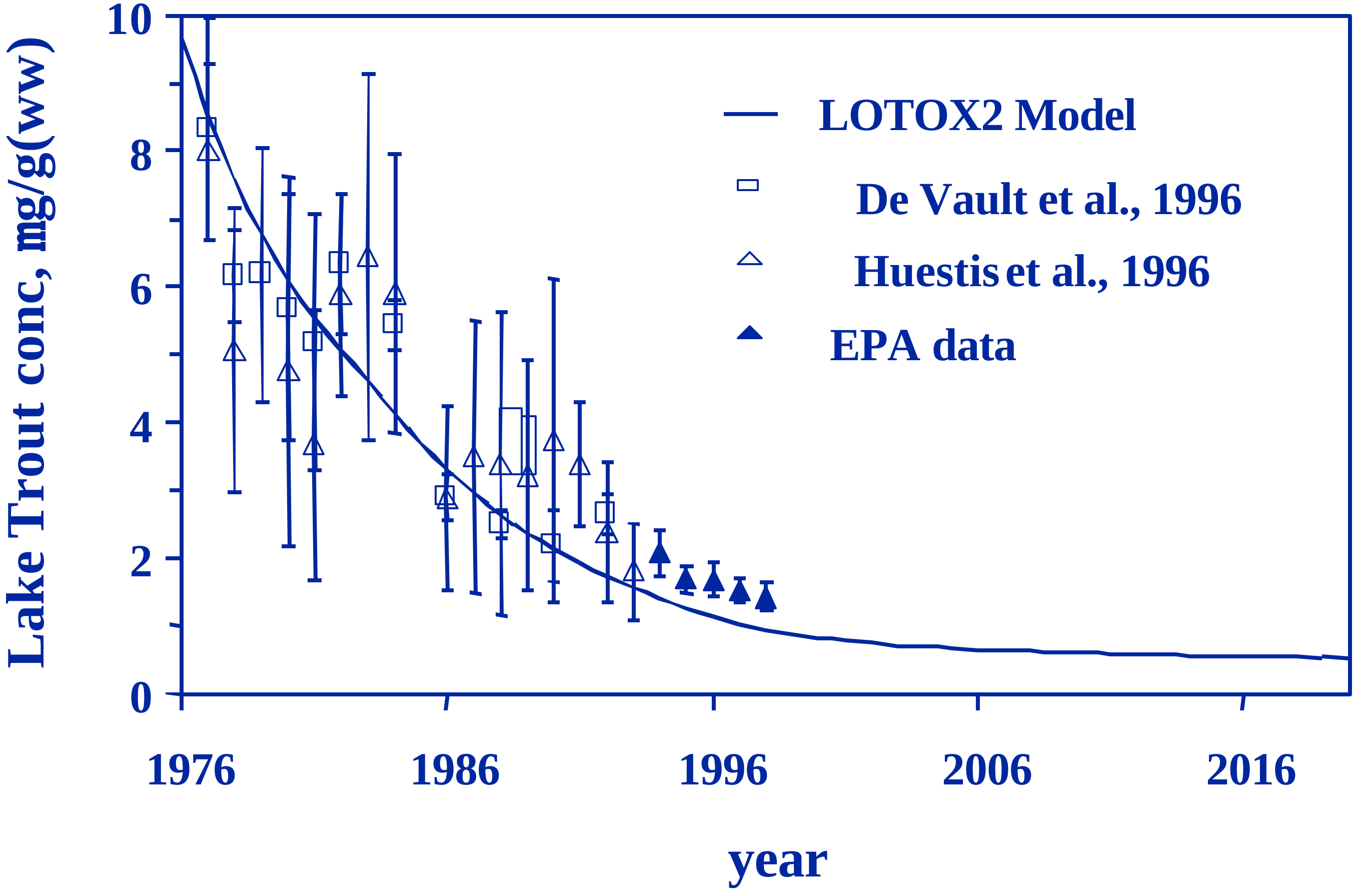


Figure 10. Trend in the Concentration of PCB in Lake Ontario Lake Trout



Temporal profile of total PCB concentration in Lake Ontario adult lake trout. Solid line is LOTOX2 simulation of lakewide average PCB concentrations in lake trout with revised estimates of historical PCB loadings. Average PCB concentrations measured in lake trout are shown for comparison with LOTOX simulation. This "base" forecast assumes no PCB load reduction after 1995. (from DePinto et al 2000)

EPA data (pers. com. Sandra Hillman, USEPA, Great Lakes National Program Office, Chicago, Ill.)

Figure 11. Concentrations of Dioxins in Caged Mussels at 102nd Street Landfill, 1987-97

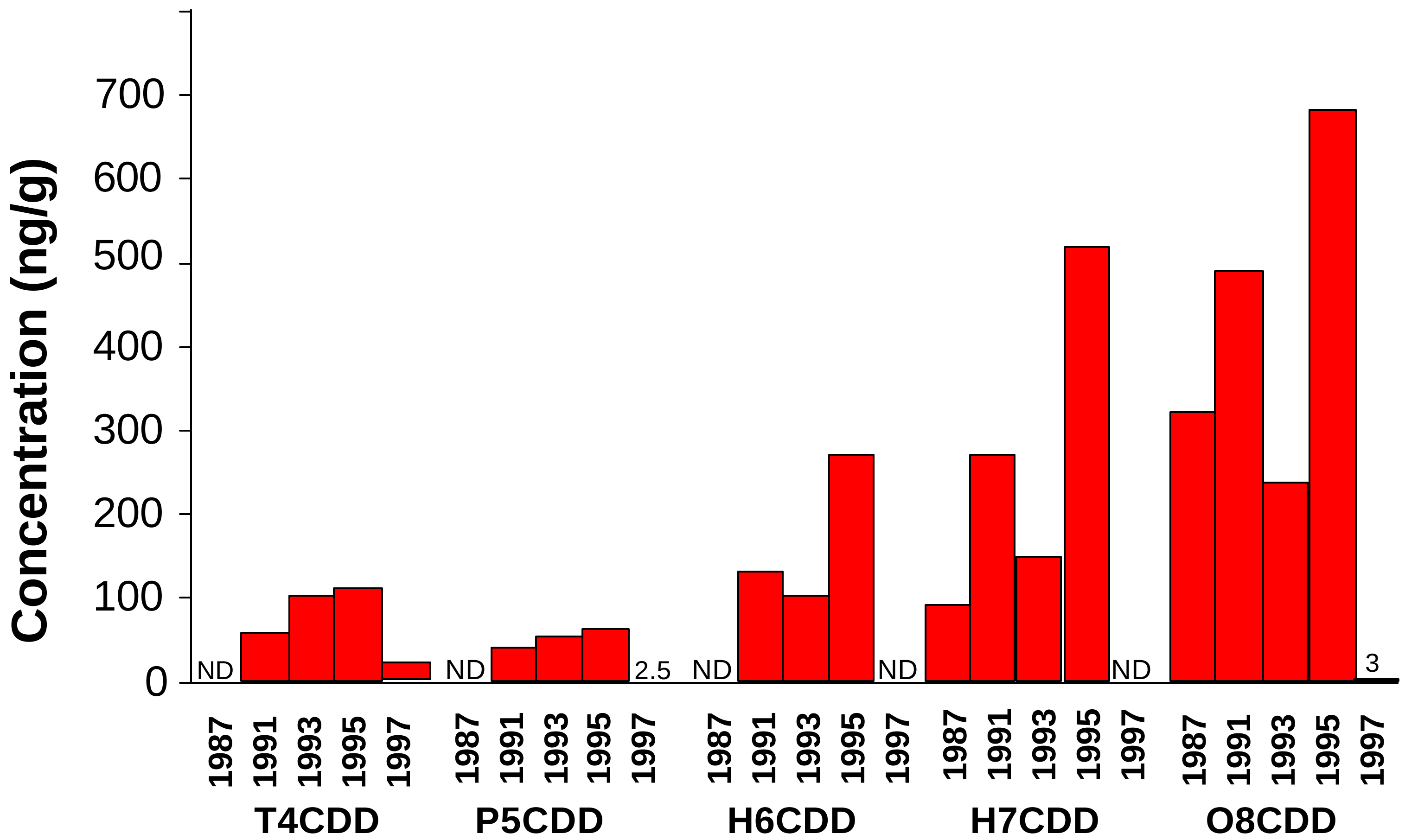


Figure 12. Dioxin and Furan Isomer Patterns in Caged Mussels from Bloody Run Creek, 1997

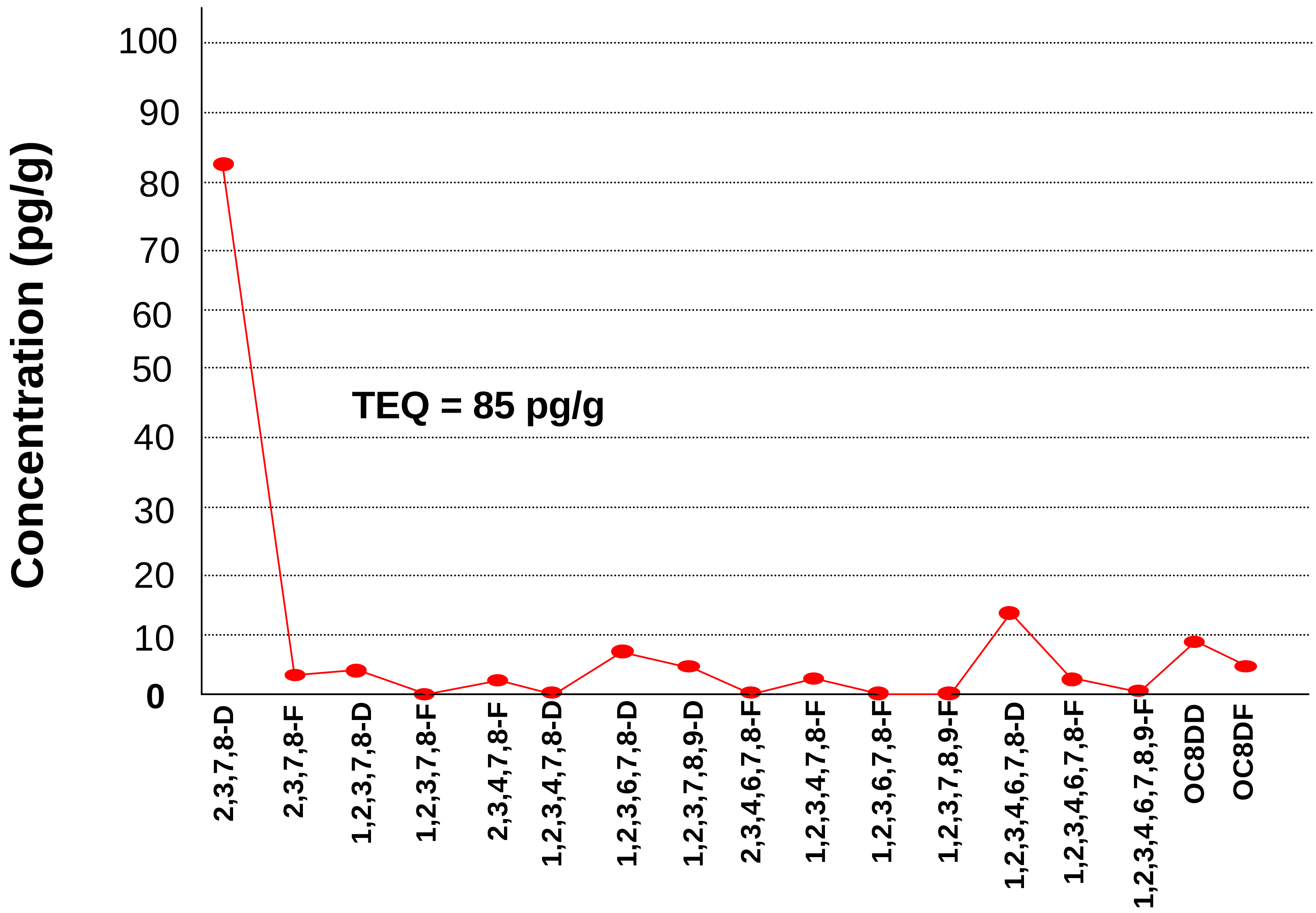


Figure 13. Concentrations of Chlorobenzenes in Caged Mussels from the Pettit Flume, 1995-97

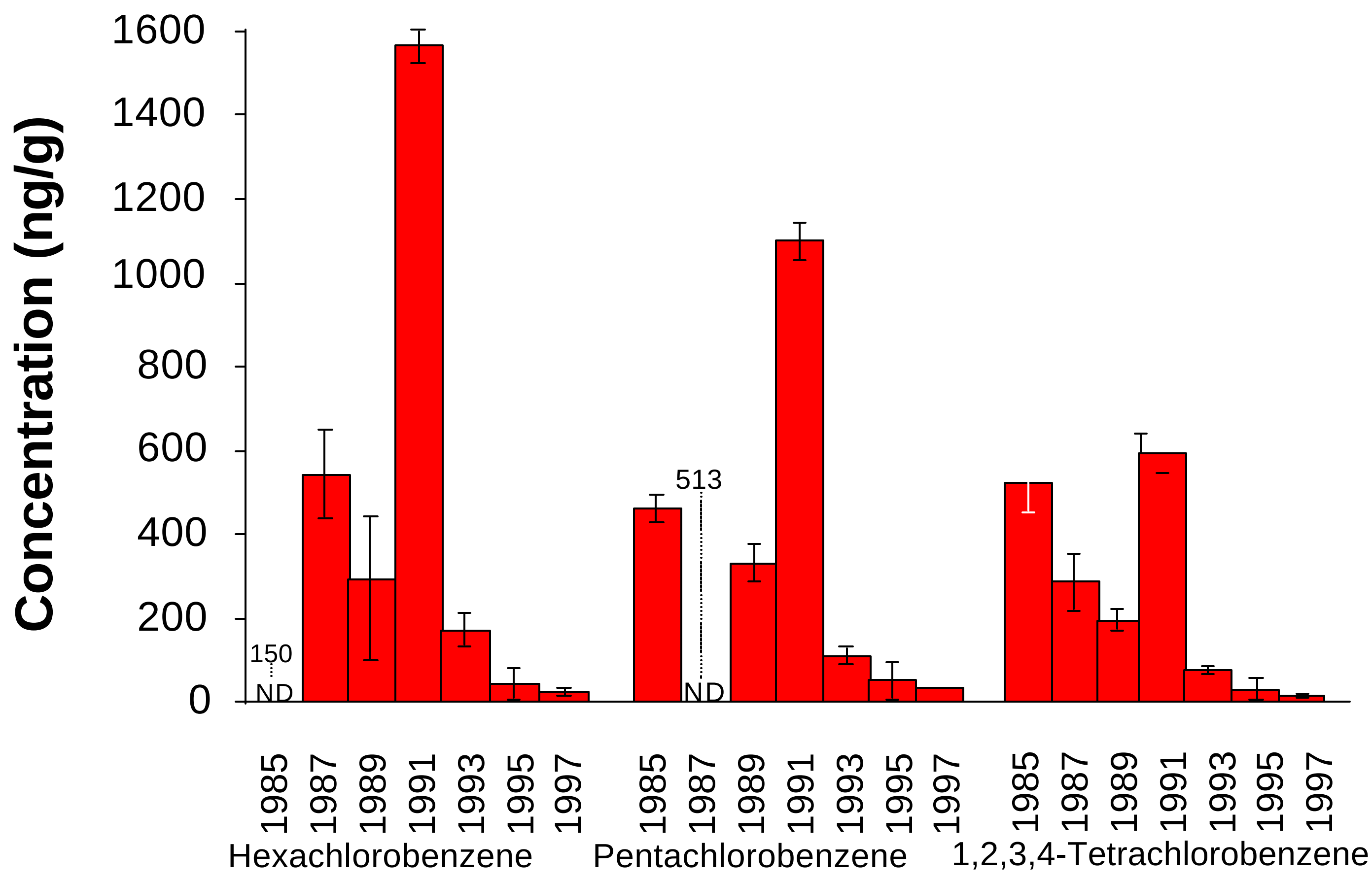
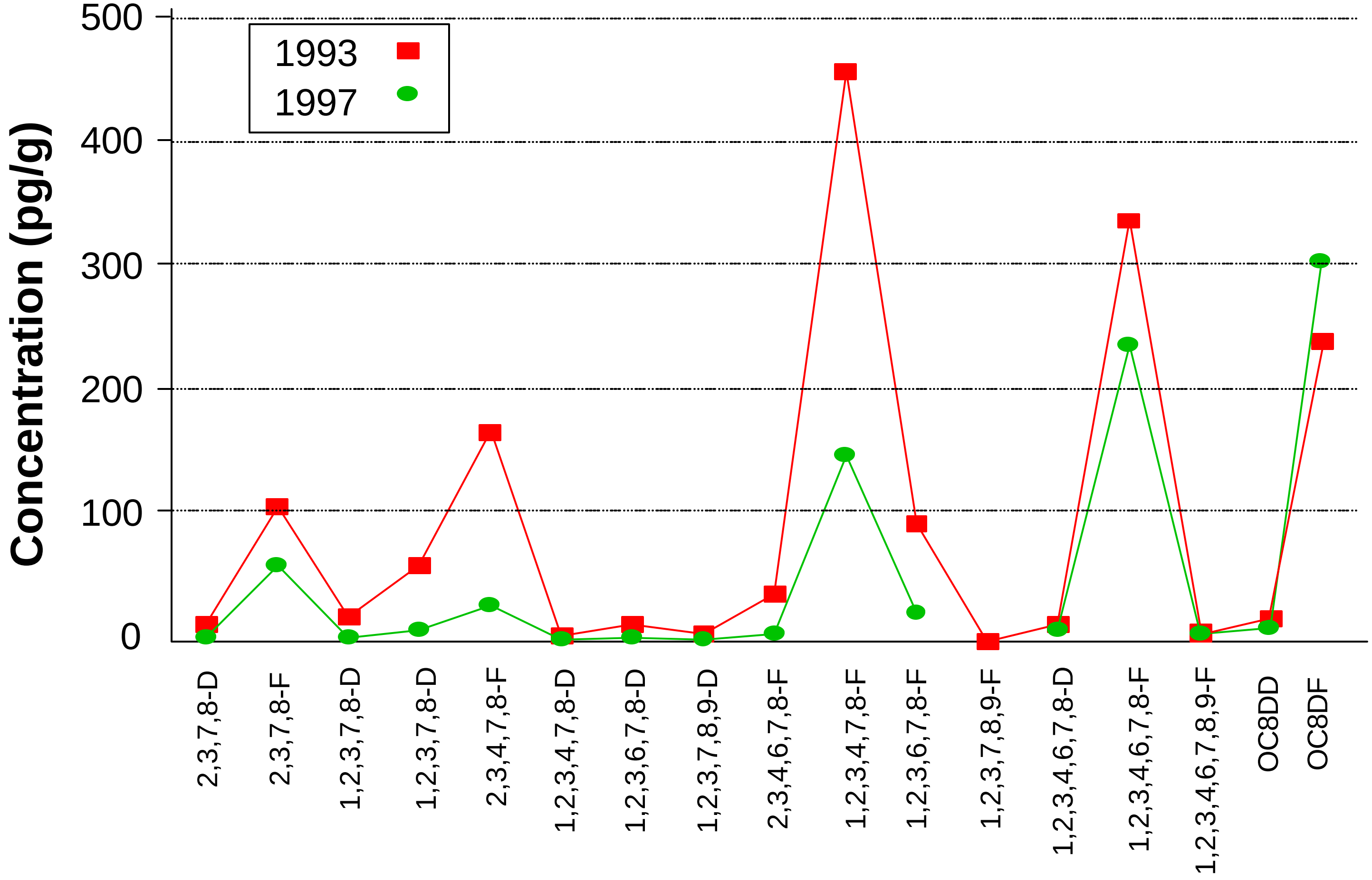


Figure 14. **Dioxin and Furan Isomer Patterns in Caged Mussels from the Pettit Flume, 1993 and 1997**



NIAGARA RIVER TOXICS MANAGEMENT PLAN (NRTMP) ANNUAL WORK PLAN [2000]

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	1999 Commitment	Status/Comments	2000 Commitment	Status/Comments
I.	**Controlling Point Sources**								
A.	Report on U.S. Point Sources		*			Periodically		Periodically	See *Note A*
B.	Report on Canadian Point Sources (1994/95)				*	- -	Completed Nov 96 See *Note B*		
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.]	*	*			Oct 99	Completed Oct 99	Oct 00	See "Public Involvement" section (V.B).
2.	Remediate Occidental Chemical-Buffalo Ave site								
a.	Complete overburden groundwater collection system.		*			----	Completed Dec 98	----	See *Note C*
b.	Enhance bedrock groundwater collection system.		*			----	Completed Dec 98	----	See *Note C*
c.	Complete remediation of contaminated soils and off-site groundwater		*			----	------------------------>	----	See *Note C*
d.	Issue Corrective Measures Implementation (CMI) Permit		*			Apr 99	Completed. Draft permit issued Sep 99.	----	See *Note C*
e.	Biomonitor effectiveness of remediation using caged mussels				*	June 1999	Completed report issued in September 1999.	2000	Next field survey.

ACTIVITY		EPA	DEC	EC	MOE	1999 Commitment	Status/Comments	2000 Commitment	Status/Comments
3.	Remediate Niagara County Refuse Disposal								
a.	Complete construction of site remedy.	*				Sep 00	On schedule	Sep 00	Installation of the leachate collection system and its tie-in to the municipal sanitary sewer system has been completed and the system is operational. Construction of the landfill cap is 95% complete.
4.	Remediate DuPont, Necco Park site								
a.	Start construction of final site remedy	*				Dec 99	Delayed--------------->	Jun 00	The completion date will allow time to address any complications that may arise in achieving effective hydraulic containment in the fractured bedrock beneath the site, and to allow the remedial systems to be tested and optimized.
c.	Complete final remedy	*				Sep 01	Delayed--------------->	Mar 03	
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	Completed Dec 99	----	See *Note D*
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.	*				Sep 00	Delayed -------------->	Dec 00	

ACTIVITY		EPA	DEC	EC	MOE	1999 Commitment	Status/Comments	2000 Commitment	Status/Comments
d.	Conduct annual survey of gorge-face seeps.	*				Jul 99	Completed	Jul 00	See *Note D*
e.	Sample groundwater seeps coming from Niagara River Gorge face and analyze for toxic chemicals.	*				Dec 98	Completed. Sampling conducted annually since 1997. Results indicate no need for additional control or remediation of the seep areas.	Dec 00	Results of 2000 sampling. See *Note D*
f.	Assess contamination at Bloody Run Creek mouth	*				----		2000	*See Note D*
g.	Biomonitor effectiveness of remediation using caged mussels				*	June 1999	Completed report issued in September 1999.	2000	Next field survey.
6.	Remediate 102nd Street								
a.	Complete containment system, including barrier wall, drainage system, landfill cap.	*				----	Completed	----	
b.	Complete leachate pumping system.	*				----	Completed Dec 98	----	Eliminates potential off-site loadings
c.	Complete site landscaping and optimization of the pump-and-treat system.	*				Jul 99	Completed Mar 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				*	June 1999	Completed report issued in September 1999.	2000	Next field survey.

ACTIVITY		EPA	DEC	EC	MOE	1999 Commitment	Status/Comments	2000 Commitment	Status/Comments
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 three sides of site already enclosed by barrier walls.
d.	Complete cap and overburden drain collection system for the old DWTP property.	*				Dec 98	Completed Sep 99	----	See *Note E*
e.	Grout DWTP raw water intake.	*				2000		July 00	
f.	Install final landfill cap.	*				2000		Dec 00	See *Note E*
g.	Optimize well pumping rates and make sure that contaminated groundwater is no longer flowing off site.	*				2000	Delayed -------------->	Apr 01	See *Note E*
h.	Biomonitor effectiveness of remediation using caged mussels				*	June 1999	Completed report issued in September 1999.	2000	Next field survey.

ACTIVITY	EPA	DEC	EC	MOE	1999 Commitment	Status/Comments	2000 Commitment	Status/Comments
8. Remediate Solvent Chemical site								
a. Complete remedial design		*			Sep 99	Completed	----	
b. Construct site remedy		*			On-going	Construction began early 1998	-----	Construction of the groundwater remedial systems began in 1999 and will continue throughout 2000. Pump tests on installed portions of the groundwater systems will allow design of the groundwater pre-treatment system to be completed by mid-2000. Final cover is anticipated to be installed by fall 2000, and the pre-treatment system is scheduled to go on-line in Jan 2001.
c. Complete remedial action	*				Sep 00	Delayed -------------->	Jan 01	
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				*	June 1999	Completed report issued in September 1999.	**2000**	Next field survey.

ACTIVITY		EPA	DEC	EC	MOE	1999 Commitment	Status/Comments	2000 Commitment	Status/Comments
10.	Remediate Buffalo Color Corporation site								
a.	Complete site investigation		*			Mar 99	Completed Apr 99	----	See *Note F*
b.	Select site remedy		*			Aug 00	On schedule	Aug 00	See *Note F*
c.	Implement site remedy.		*			Jul 01	On schedule	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		*			Sep 99	Completed	----	
b.	Site monitoring		*			----	On-going	----	
12.	Remediate Bethlehem Steel site								
a.	Complete site investigation	*	*			Apr 00	Delayed -------------->	Apr 01	See *Note G*
b.	Select site remedy	*	*			Oct 01	Delayed -------------->	Oct 02	
c.	Begin implementation of site remedy	*	*			Dec 02	Delayed ------------->	Dec 03	
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*
b.	Remove contaminated sediment from Niagara River.		*			Nov 98	Completed		

ACTIVITY		EPA	DEC	EC	MOE	1999 Commitment	Status/Comments	2000 Commitment	Status/Comments
14	Remediate Gratwick Riverside Park site								See *Note J*
a.	Start construction of site remedy.		*			mid 99	Began Jun 99	----	
b.	Complete construction of site remedy		*			Dec 00	Delayed ------------->	Apr 01	Final technical summary from the 1997 study completed Jun 99.
c.	Biomonitor effectiveness of remediation using caged mussels				*	June 1999	Completed report issued in September 1999.	2000	Next field survey.
15.	Remediate Occidental Chemical Durez - North Tonawanda Site								
a.	Complete construction of site remedy		*			----	Completed 1994. See *Note K.*		
b.	Assess contamination in Pettit Flume Cove		*			----			
c.	Biomonitor effectiveness of remediation using caged mussels				*	June 1999	Completed report issued in September 1999.	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*	----	
B.	**Contaminated sediments**								
1.	Update NY Great Lakes Contaminated Sediments Inventory		*			Every 2 years	Data update completed Feb 99 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	1999 Commitment	Status/Comments	2000 Commitment	Status/Comments
III. Monitoring								
A. Complete report on results of Upstream/Downstream sampling	*	*	*	*	Dec 98 (for 96-97 report)	Final report completed and distributed.	Dec 00	**97-98 report. (Revised Format)**
B. Collect juvenile spottail shiners or other juvenile fish and analyze for toxic chemicals, according to Monitoring Plan. See *Note M*		*		*	MOE: Dec 99 Dec 99 DEC: May 2000	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. Spottail shiners were collected at 9 locations on the Niagara River in 1999. DEC: Final report on 1996 collections completed May 2000.	MOE Dec 2000 Dec 00 DEC: May 2000	Technical summary on 1999 collections. MOE to collect fish in 2000. Technical summary of 1999 collection. Draft report on 1997 collections. Collections to follow on a five-year basis (next in 2002)
C. Track down toxic chemicals in tributaries and sewer systems to identify sources.	*	*			Dec 99	Assess existing information and plan for next step. *See Note N.*	Spring-Fall, 2000	Complete PCB trackdown in Two Mile Creek. See *Note N*
D. Biomonitor using caged mussels and analyze for toxic chemicals, according to Monitoring Plan. See *Note O*				*	Every 3 years	Completed report issued in September 1999.	Every 3 years	Next field survey in 2000.

ACTIVITY		EPA	DEC	EC	MOE	1999 Commitment	Status/Comments	2000 Commitment	Status/Comments
E.	Study use of zebra and quagga mussels as biomonitors				*	Dec 98	------------------------>	Dec 00	Sampling and analysis completed. Abstract paper due in 2000.
F.	Assess sport fishery in Niagara River, with contaminant analysis.			*	*	MOE: Apr 99	Sport fish collected in Niagara River in 1997-1998. Sport fish collected in Niagara River in 1999. Collect sport fish from the Niagara River in 2000.	MOE: Apr 99 MOE Apr 00 Apr 01	"1999-2000 Guide to Eating Ontario Sport Fish" completed. Complete the review of sport fish contaminant trends in the Niagara River/Western Lake Ontario from 1970-2000. Release 2001-2002 "A Guide to Eating Ontario Sport Fish".
G.	Collect sample of Falls Street Tunnel wet weather discharge and analyze for NRTMP priority chemicals using techniques to achieve low detection levels.		*			----		Jun 00	Sample collected fall 1999. Analysis and report expected June 2000.
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	Materials included in 2000 report	May 01	See *Note P*

ACTIVITY	EPA	DEC	EC	MOE	1999 Commitment	Status/Comments	2000 Commitment	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.	*	*	*	*	Jun 99	Completed Feb 00	----	
B. Present progress made in the remediation of U.S. hazardous waste sites at a public meeting in Niagara Falls.	*	*			Nov 99	Completed	Nov 00	See "Controlling Non-Point Sources" section (II.A.1).
C. 1. Make NRTMP information and reports available on the Internet.	*	*	*	*	As available	On-going. See *Note Q*	As available	
2. Develop a NRTMP web page	*	*	*	*	Sep 99	Delayed ------------->	Sep 00	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.	*	*	*	*	May 99 May 00	Completed.	May 01	Annually.
E. Hold a public meeting to present above progress report and updated annual work plan.	*	*	*	*	Jun 99 Jun 00	Jun 99 completed; Jun 00 scheduled.	Jun 00 Jun 01	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

The groundwater stabilization programs were completed in December 1998. Occidental enhanced its treatment plant for contaminated bedrock groundwater, and then increased the groundwater extraction rates. The overburden groundwater collection system was augmented by installation of a tile drain collection system. On December 27, 1999 New York State issued a final permit that incorporates these and other corrective measures currently in place as part of the Final Corrective Measures for the site. The effective date of the permit is February 10, 2000.

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. A total of six additional pumping wells were installed in 1998 and 1999.

EPA has evaluated current groundwater contour maps and determined that hydraulic containment is not being achieved in the north-west corner of the site. The NAPL plume will be redefined in the north-west corner and additional groundwater pumping wells will be installed in the 2000 construction season. Drilling commenced 3/27/00.

Completion of construction is scheduled for September 2000, with Remedial Action completion by December 2000.

To ensure that remediation of the groundwater seeps in the Niagara River Gorge face has been effective, survey of the gorge face, and sampling of the seeps, is conducted annually. The survey is a physical inspection of the area, for example, to document whether any seepage is evident and ensure that physical barriers are sound. The seep sampling includes analysis of aqueous phase chemical contaminants. Results continue to indicate no need for additional control or remediation of the area.

Sediment sampling conducted by MOE in 1997 and EPA in 1999 at the mouth of Bloody Run Creek indicates possible continuing concerns due to dioxin contamination. EPA will assess the human health risk of the contamination. A more detailed characterization of the area will be performed.

Note E. Remediate Occidental Chemical S-Area Site

The installation of the final cap for the old Niagara Falls Drinking Water Treatment Plant property was completed in September 1999. Restoration work for portions of the cap that were disturbed for replacement of the drain collection system (DCS; see below), and around portions of the DWTP intake system will begin in spring 2000 and be completed in fall 2000. Part of the DCS for the landfill portion of the S-area site where the drain pipe collapsed is being replaced. Completion is expected in April 2000. The completion of the S-Area Remedial Action is expected in spring 2001. The DCS work is delaying the start of construction of the final landfill cap until spring 2000. Also, it is anticipated that modifications to the final bedrock pump and treat system will be needed. Installation of all systems for bedrock monitoring programs will be completed by early 2001.

Note F. Remediate Buffalo Color Corporation Site

The site RFI has been completed. A supplemental investigation was conducted during summer 1998. A revised RFI report was submitted in December 1998 and approved in April 1999. A Corrective Measures Work Plan was submitted in May 1999 and approved in July 1999. During July 1999, a pump test was performed to aid in the design of an Interim Corrective Measure for Plant Area A, to prevent the discharge of contaminated groundwater to the Buffalo River. Completion of the CMS Report is expected in May 2000.

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 2001. BSC completed limited remedial technology studies for two areas that appear to be the primary sources of groundwater contamination at the facility (the Acid Tar Pits and Coke Oven Areas). EPA and DEC found the studies to be technically flawed and of limited value. BSC has submitted a Pre-design Investigation Report for the remediation of the Benzol Plant Area (i.e., coke oven area), which is currently under agency review. Any future CMS or CMI activities will require a new order, permit or other agreement.

Note H. Remediate River Road and Niagara Mohawk Cherry Farm Site

Sediment removal and final capping of the sediment disposal area was completed in July 1999. Recent diver inspection of the dredged areas shows good revegetation and recolonization by fish. The remedial action also included fish and wildlife habitat enhancements.

Note J. Remediate Gratwick Riverside Park Site

Remedial construction began in June 1999. The action involves a cap over the site, a slurry wall barrier between site and river, collection of contaminated groundwater, and shoreline stabilization with enhancements for improved habitat value.

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.

Recent sampling of sediment in the Pettit Cove has confirmed the presence of dioxin and furans indicative of Occidental Chemical, Durez. However, due to the absence of volatile organic chemicals (VOCs) within the recently deposited sediment, it is hypothesized that the contamination is an historical remnant of past sewer cleaning operations within the Pettit Flume and not a new source. In response, Occidental Chemical has mobilized a remedial contractor to conduct maintenance dredging of the Pettit Cove. Approximately, 200 cubic yards of sediment will be hydraulically dredged out of the cove in spring 2000.

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 nine 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 working cooperatively to oversee the implementation of New York State Great Lakes basin source trackdown work, including Lake Ontario, the Niagara River and Lake Erie. DEC and EPA are currently implementing certain plans for trackdown in the Great Lakes waters including the Niagara River. Trackdown work is planned for Two-mile Creek for this year. Additional U.S. plans are being developed in consideration of the needs and available resources. Much relevant information has been collected over the past several years in the Niagara River and tributaries that is helping us determine priorities for further efforts to identify point and non-point sources impacting the river. To develop these plans, the available information is currently under review and will be summarized in the 2001 and future NRTMP Progress Reports.

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 remediation in reducing contaminants in the River between Fort Erie and Niagara-on-the-Lake.

In 1997, two complementary studies were initiated by the MOE (a) the routine deployment of caged mussels at 32 stations on the Canadian and American sides of the river for 21 days of exposure, and (b) a long term deployment of mussels up to four months at four stations. Mussels were retrieved after the designated period of deployment and the tissues were analysed for organochlorine pesticides, total polychlorinated biphenyls (PCBs), chlorinated benzenes, polycyclic aromatic hydrocarbons (PAH) and polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/PCDF). The report, Niagara River Mussel Biomonitoring Program, 1997, was released in September 1999 and is available through the Ministry of the Environment. During the summer of 2000, mussels will be deployed at 34 sites in the Niagara River.

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. Some information is incorporated into the NRTMP 2000 Progress Report and Work Plan (e.g., fish advisory information, data comparison to water quality criteria). Additional information is currently under review (eg., contaminant trackdown in U.S. tributaries, point sources). This effort will continue in 2001.

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

The Four Party Upstream/Downstream Reports for 1991/92, 1993/94, 1995/96, and 1996 /97 can be found on the GLIMR web site at http://www.cciw.ca/glimr/search.html (search "joint evaluation"). The November 1998 and October 1999 U.S. waste site remediation reports are at http://www.epa.gov/grtlakes/lakeont/nrtmp. Additional reports will be added as they become available.