NIAGARA RIVER
TOXICS MANAGEMENT PLAN (NRTMP)
PROGRESS REPORT
AND
WORK PLAN

June 2003

Prepared by:

Donald J. Williams, Environment Canada
and
Marie L. O'Shea, USEPA

FOR THE NIAGARA RIVER SECRETARIAT

Environment Canada
Environnement Canada

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Environmental
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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, fish and wildlife habitat and recreation. It generates electricity and provides employment to millions of people. Unfortunately, the River is also the recipient of toxic chemicals that pollute its waters, and prevent us from fully enjoying its beneficial uses.

In February 1987, Environment Canada (EC), the U.S. Environmental Protection Agency Region II (USEPA), the Ontario Ministry of the Environment (MOE) and the New York State Department of Environmental Conservation (NYSDEC)---the "Four Parties"---- signed the Niagara River 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 were designated for 50% reduction by 1996 because they were thought to have significant Niagara River sources. The Niagara River Toxics Management Plan (NRTMP) is the program designed to achieve these reductions.

The Four Parties re-affirmed their commitment to the NRTMP in a "Letter of Support" signed in December, 1996. The revised goal, as stated in that letter, is " 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 format of this Progress Report is the same as past Reports. It presents the most recent results from the Upstream/Downstream and Biomonitoring Programs. Also included are discussions on comparison of ambient water concentrations to the most sensitive, agency water quality standards/criteria, fish consumption advisories, and U.S. trackdown activities to identify sources of "priority toxics" to the Niagara River that may require further attention. The Work Plan, included as part of this Progress Report, outlines the activities to be undertaken by the Four Parties to achieve the goal expressed in the Letter of Support, and to monitor and report progress towards attainment of that goal.

The primary method for assessing progress under the NRTMP is the Upstream/Downstream Program. The most recent results from this Program (up to 2000/01) indicate continuing, statistically significant reductions in the concentrations/loads of most of the "priority toxics" for which there are data. Reductions since 1986/87, when the Program began, have exceeded 70%. The reductions for most chemicals have been due to the effectiveness of remedial activities at Niagara River sources in reducing chemical inputs to the river. For other chemicals (eg., dieldrin) the reductions have been due to reduced inputs to the river from Lake Erie/upstream.

Results from the Biomonitoring Program corroborate the decreasing trends seen in the Upstream/Downstream data reflecting continuing improvement in the Niagara River and its tributaries. Both the YOY (Young-of-Year)-fish, and mussel contaminant data also reflect the effectiveness of remedial activities at hazardous waste sites. However, while the data for most locations indicate decreasing trends, there are some locations (eg., upstream Gill Creek, Cayuga Creek, and downstream of Gratwick Riverside Park) where the data suggest the new or continuing presence of contaminants. Further monitoring will be needed to evaluate these locations. The continuing presence of dioxins and furans in the Pettit Flume cove also needs additional assessment.

Comparison of the upper 90% confidence interval ambient water concentration data for 1999/2000 and 2000/01 with the strictest, agency water quality standards/criteria indicates that these were exceeded for many of the NRTMP "priority toxics" at both Fort Erie (FE) and Niagara-on-the-Lake (NOTL). The Four Parties have traditionally applied the most stringent surface water quality criteria as part of their assessment of water quality in the Niagara River. As noted in the 2001 NRTMP Progress Report, NYSDEC adopted new standards pursuant to the U.S. Great Lakes Initiative in February, 1998. For some chemicals, these new standards, in addition to being the most stringent of the Four-Party water quality criteria, were also more stringent than the NYSDEC standards existing prior to 1998. The exceedences in 1999/2000 and 2000/01 are due, largely, to comparing the data to these more stringent standards, rather than significant increases in the water concentrations of these chemicals in the river.

The 1999/2000 and 2000/01 data also indicate that the loads from Lake Erie to the Niagara River of many of the "priority toxics", particularly the PAHs, may be increasing. Future monitoring will confirm if, indeed, this "trend" continues. This points to the growing importance of Lake Erie as a source of many of these contaminants to the Niagara River, and ultimately Lake Ontario.

No changes to New York State fish consumption advisories for the Niagara River have been issued since 1999. Re-testing of several species of fish from the upper and lower Niagara River in 2002 by Ontario (MOE), however, resulted in the issuance of a mixture of less restrictive and more restrictive fish consumption advisories for some size classes, and species of fish. MOE has prepared a “Guide to the Guide” pamphlet on fish consumption advisories Health Canada translated into 12 languages. The one page explanation helps the various ethnic communities understand how to interpret and use the information in the *Guide to Eating Ontario Sport Fish* (MOE 2003).

NYSDEC trackdown activities in Two Mile Creek and in the Falls Street Tunnel (FST) have verified the presence of PCBs in the Creek and PCBs and polychlorinated dibenzo-dioxins and furans in the FST. Additional trackdown efforts and control measures, respectively, are planned to address these findings.

As stated repeatedly in previous Progress Reports, despite the successes to date, and the continued documented improvements in the Niagara River, more work needs to be done. The adoption of new standards by NYSDEC sets new "goals" to be achieved in terms of river water quality. Biomonitoring Program results provide evidence of the continuing presence of low level chemical contamination in the river. Advisories to limit consumption of sportfish caught in the Niagara River continue due to contamination by toxic substances. And, inputs from Lake Erie might be increasing, and becoming increasingly more important for some chemicals, which will require additional efforts upstream. In the past year, much work has been done to define the actions necessary to assure continued reductions of toxic chemicals in the Niagara River, and there are substantial commitments to address current concerns as indicated in the Work Plan accompanying this Report. Trackdown activities such as those noted above are but one example of these. These commitments include:

- 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 (EC), the U.S. Environmental Protection Agency Region II (USEPA), the Ontario Ministry of the Environment (MOE) and the New York State Department of Environmental Conservation (NYSDEC)---the "Four Parties"--- signed the Niagara River Declaration of Intent (DOI) with the goal "to reduce the concentrations of toxic pollutants in the Niagara River".

Eighteen "priority toxics" were specifically targeted for reduction, ten of which were designated for 50% reduction from Canadian and U.S. point and non-point sources by 1996 because they were thought to have significant Niagara River sources (Table 1). The Niagara River Toxics Management Plan (NRTMP) is the program designed to achieve these reductions, and the context for reporting progress to the public.

In December 1996, the Four Parties re-affirmed their commitment to the DOI in a "Letter of Support". The revised goal, as stated in that letter, is "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".

Detailed Progress Reports on the NRTMP and the Lake Ontario Lakewide Management Plan (LaMP) are now provided in alternate years. 2003 is the year for the detailed Progress Report on the NRTMP.

The format of this 2003 Progress Report is similar to previous NRTMP reports focussing on the results from the Upstream/Downstream and Biomonitoring Programs. Additional concerns related to water quality are also discussed. These include comparison of ambient water concentrations of "priority toxics" to the most stringent agency water quality standards/objectives, fish consumption advisories, and U.S activities to trackdown additional suspected sources of "priority toxics" to the Niagara River that may require further attention.

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

2.0 THE UPSTREAM/DOWNSTREAM MONITORING PROGRAM

Since 1986, the Upstream/Downstream Program has collected 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 about 70 chemicals entering and leaving the river. Annual mean concentrations and loads, with their 90% confidence limits, have been estimated for each of the chemicals, in both phases, at both stations, and the results

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

summarized and released in annual, Four Party Upstream/Downstream reports (e.g., NRDIG 2002). 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 attainable at sources using source monitoring program detection limits.

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. This difficulty was further exacerbated by concentrations of many chemicals, particularly organic chemicals, being below their analytical detection limits (due to dilution by the river's high rate of flow), and the fact that the detection limits for some chemicals changed during the period of record. A statistical procedure (model) that dealt with "censored" (i.e., below detection) and missing data, auto-correlation and seasonality, as well as changing analytical limits of detection was developed to determine reliable trends over time with known confidence for measured chemicals (El-Shaarawi and Al-Ibrahim 1996).

Loads and trends for all chemicals collected as part of the Upstream/Downstream Program over the eleven-year period 1986/87 to 1996/97 have been summarized by Environment Canada (Williams *et al.* 2000). The model was run on each chemical, in each phase (whole water for metals), at both stations for the entire period of record. The ratio of the means for the end year (1996/97) to the base year[2] (expressed as a percent) was used to calculate an index of change over the eleven-year period of record for each chemical. The 2001 Progress Report updated this information to 1998/99 for the NRTMP "priority toxics". This Progress Report updates this information for the fifteen years up to 2000/01.

CHANGES IN THE CONCENTRATIONS/LOADS OVER THE PERIOD 1986/87 TO 2000/01

Table 2 shows the percent change in the annual[3] mean concentrations/loads generated by the model in both phases, at both stations, between the base year and 2000/01 for those NRTMP "priority toxics" for which there are data.[4] 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 ($p<0.001$), and a negative number a significant decrease over this time period. "NS" signifies no significant change. [**NOTE:** PCB estimates for the suspended sediment phase only are presented in the Table because of known laboratory contamination problems with the dissolved phase analyses.] In April, 1998, the analytical protocol for PCBs was changed to measure congeners rather than total-PCBs (i.e., based on Aroclors). The higher PCB concentrations, starting in

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.

4 Loads were calculated using the paired particulate contaminant concentration and the suspended sediment concentration for each individual sample (rather than the annual means), multiplied by the mean annual flow (mean annual flow was used, because the variation in flow is relatively small).

1998/99, are due to this change in analytical methodology. This change in protocol also means that the decrease reported in Table 2 between the base year and 2000/01 is probably slightly less than what would have been reported had the analytical methodology not changed. It is also important to note that the analytical detection limits used in the Upstream/Downstream Program were lowered considerably starting in April 1999. This is true for both the particulate and dissolved phase concentrations of all contaminants. The change in some cases was as much as an order-of-magnitude. For example, the detection limit for the dissolved phase concentration of benzo(a)pyrene [B(a)P] changed from 0.24 ng/L to 0.01ng/L. Similarly, the detection limit for the particulate phase changed from 161 ng/g to 33.7 ng/g. The result of these changes is that many chemicals, which were previously at "less than detection", are now above the detection limit (i.e., "detected"). This has the effect of lowering the tail (right hand end) of the trend graph, making the changes observed between the base year and 2000/01 greater than had use of the old detection limits been continued.

In addition, it should be noted that the mean flow of the Niagara River in 1999/2000 and 2000/01 was the lowest since the Upstream/Downstream Program began in 1986/87 (Figure 1). Since the mean annual flow is used to calculate loads as noted above, the loads in these two years would also be reduced. This means that the change in loads observed between the base year and 2000/01 would be greater.

The effects of the lower detection limits and reduced mean annual flows on trends are evident in the results presented in Table 2. For example, some chemicals (α-chlordane, ppDDT, ppDDE), which were previously reported (in the 2001 Progress Report) as showing no significant trend (NS), now exhibit significant decreases in concentrations and/or loads. Thus, the larger decreases in concentrations/loads reported in Table 2 may be due, in large part, to the use of the much lower detection limits starting in April, 1999. Notwithstanding this, the results presented in this Progress Report still confirm those presented in previous reports. The statistically significant downward trends still continue. Briefly, the results show the following:

Chlorobenzenes (CBs)

The reduction in the dissolved phase concentrations and loads of hexachlorobenzene (HCB) at NOTL over the period 1986/87 to 2000/01 has been greater than 70%. The decrease over this fifteen-year period differs only by a few percent from that estimated up to 1998/99 reported in the 2001 Progress Report. Although the decrease at FE was also significant, the model output was discarded because most of the concentrations were “trace” (i.e., below the detection limit). As noted in previous Progress Reports, these results clearly indicate that the reductions observed at NOTL are due to reducing HCB inputs to the Niagara River from Niagara River sources.

Organochlorine Pesticides (OCs) and PCBs

In general, both the concentrations and loads of nearly all NRTMP OC “priority toxics” (and PCBs) have continued to decrease significantly, in one or both phases, at both FE and NOTL. Decreases in only one phase was most often due to insufficient data in the other phase to determine change. This is probably due to the different partitioning of the chemical between the dissolved and particulate phases. The decreases (in concentrations and/or loads) ranged between 27.6% (mirex) and 92.4% (dieldrin). Decreases at both stations were, generally, of similar magnitude. While the particulate phase concentration of mirex at NOTL has decreased only slightly, the load has decreased by greater than 75%. This is probably because mirex appears only, as intermittent "spikes", in the particulate phase. However, because mirex is only detected at NOTL, this reduction is clearly due to the effectiveness of remedial activities at Niagara River sources. The recent reduction in mirex concentrations in coho (*Onorhynchus kisutch*) and chinook (*O. tshawytscha*) salmon from Lake Ontario have resulted from reduced loads to the lake. These reduced loads were attributed to remedial actions taken at the Occidental Chemical, Buffalo Avenue plant, and at the Hyde Park hazardous waste site (Makarewicz *et al.* 2003).

Polynuclear Aromatic Hydrocarbons (PAHs)

Of all the chemicals analyzed in the Upstream/Downstream Program, results for the PAHs have been the most variable. The concentrations and/or loads between the base year and 2000/01 decreased for some, increased for others, and for yet others, exhibited no significant change. For several of the PAHs, changes were significant at only one of the stations or in only one phase. For example, benzo(a)pyrene [B(a)P] exhibited a significant increase in particulate phase concentrations, but a significant decrease in particulate phase loads at both FE and NOTL over the fifteen-year period. This reduction in B(a)P load is probably due to a decrease in the suspended particulate material (SPM) concentrations, as well as the reduction in flows, that have occurred over this time period as noted above.

Industrial By-Product Chemicals

Octachlorostyrene (OCS) was detected only in the particulate phase at NOTL. Its concentration and load have decreased by greater than 90% over the fifteen-year period up to 2000/01. Again, this clearly indicates success in controlling inputs of OCS from Niagara River sources.

Metals

The concentrations/loads of lead have decreased by greater than 65% at FE and greater than 80% at NOTL between 1986/87 and 2000/01. Arsenic continues to exhibit no significant trend at either station. Analysis of mercury in water was discontinued in 1996/97 pending development of an analytical method with a more sensitive detection limit. Analysis of mercury recommenced in 2001/02.

Trend Graphs

In generating the output for constructing Table 2, the model also generated trend plots for both the dissolved and suspended sediment phases, at both stations, for each of the "priority toxics" shown in the Table**.** Figures 2 to 5 show the trends for HCB, dieldrin, PCB, and OCS respectively, at NOTL over the period 1986/87 to 2000/01. As noted above, the step increase in PCB concentrations in April 1998 is due to the change in the analytical methodology from total-PCBs (i.e., Aroclors) to PCB congeners.

In summary, both the concentrations and loads of most of the NRTMP "priority toxics" shown in Table 2 continue to decrease, indicating continuing improvements in Niagara River water quality.[5] The larger decreases in concentrations/loads reported in this year's Progress Report *vis a vis* those reported in 2001 may be due, in large part, to the effect of lowering the detection limits in April, 1999. The reduced loads may also be due to the significantly reduced flows in 1999/2000 and 2000/01. As stated in previous Progress Reports, the overall rate of change, has slowed considerably in recent years as evidenced by the plots for HCB, PCB and OCS. The trends have flattened out considerably compared to the more rapid changes observed at the beginning of the Upstream/Downstream Program in 1986/87. The notable exception is dieldrin, which continues an almost linear decrease at both stations. Similar decreases have been noted in Lake Erie dieldrin concentrations and are probably due to the "outgassing" of dieldrin from the lake (Williams *et al.* 2001).

3.0 THE BIOMONITORING PROGRAM

Background

Many chemicals that would not otherwise be detected in water because of their low concentrations, concentrate in the tissues of aquatic organisms. In the Niagara River, three long-term biomonitoring efforts have been used to track the concentration of contaminants in aquatic organisms collected from, or deployed within, the Niagara River and its tributaries.

Since 1980, MOE has conducted both routine and specialized biomonitoring of contaminants in the Niagara River using caged mussels (*Elliptio complanata***)**. Mussels (biomonitors) from an uncontaminated (control) site are placed for a specified time to accumulate contaminants in an environment that is known, or suspected, of being contaminated with persistent bioaccumulative substances. They are then removed and analyzed to determine tissue contaminant concentrations. This program has provided information on suspected contaminant sources/source areas in the river between FE and NOTL. The location of sampling stations in the Niagara River have remained fairly consistent, although different stations may have been sampled in different years. Sampling frequency has recently changed from every two years to every three years, with the most recent surveys having been conducted in 1997 and 2000. In July 2000,

[5] The exceptions are benzo(a)pyrene [B(a)P] and benzo(b/k)fluoranthene.

caged mussels were deployed for 21 days at 30 stations on the Canadian and U.S. sides of the Niagara River (Figure 6). Caged mussels were also placed for a period of four months at a station in Two Mile Creek to determine the pattern of PCB uptake over time. Mussels were analyzed for organochlorine pesticides (OCs), total PCBs, chlorinated benzenes (CBs) and industrial compounds. Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDDs, PCDFs) were analyzed in a composite mussel sample (4 mussels) from eight of these sites, and surficial sediments were collected from nine of the sites for PCDD/PCDF analyses (for specific locations see Table 3). The spatial distribution of contaminant concentrations observed in the mussel tissue in the 2000 survey were similar to those observed in previous surveys. Highlights are briefly summarized below. More detail can be found in Richman (2003).

Juvenile (young-of-year; YOY) forage fish, principally spottail shiners (*Notropis hudsonius*), have been collected by both MOE and NYSDEC from several sites in the Niagara River and analyzed for contaminants. YOY-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.

MOE has collected YOY-fish at NOTL since 1975, and from several other Canadian and U.S. locations at least every other year since the early 1980s. The most recent collections were in 1999, 2000 and 2001 (Figure 7). In 2000, MOE collected spottail shiners (*Notropis hudsonius*) from eight locations in the upper and lower Niagara River (see Table 5). Common Shiners (*Notropis cornutus*) were collected as an alternative species at one location in the upper Niagara River, where spottail shiners were not available. In 2001, MOE collected spottail shiners from eleven locations in the upper and lower Niagara River.

NYSDEC has collected YOY-fish as part of its continuing contaminant monitoring program initiated by the Department in the late 1970s. Surveys are now performed on a 5-year basis, as program resources allow. The most recent collection was in 1997. In August and September 1997, composite samples of YOY-fish were collected from 35 near-shore locations in New York’s Great Lakes Basin, including 14 from the Niagara River (between Strawberry Island and the Lewiston Boat Launch) and its U.S. tributaries (Figure 8). Samples were analyzed for PCBs (Aroclor 1016/1248, Aroclor 1254/1260 and PCB congeners), organochlorine pesticides (DDT and metabolites, mirex and photomirex, dieldrin, chlordane, hexachlorobenzene (HCB) and lindane [γ-HCH]) and mercury. Composite samples from eight of the Niagara River locations were also analyzed for 2,3,7,8-tetrachlorodibenzo-p-dioxin and furan congeners. In general, comparison of the 1997 results with those for previous years indicated that the concentrations of nearly all contaminants continued to decrease, or remained stable at low levels. Highlights are briefly summarized below. More detail can be found in Preddice *et al.* (2002).

Results

Results for the Biomonitoring Program are presented below by contaminant/contaminant class. For each of these, findings are presented in chronological order, starting with the NYSDEC YOY-fish monitoring (1997), and proceeding through MOE's mussel biomonitoring program (2000), and then the MOE YOY-fish monitoring results (2000/01). At some commonly monitored areas additional remediation has occurred subsequent to NYSDEC's 1997 monitoring, but prior to MOE's mussel deployment and YOY monitoring. Where possible, findings from these three data sets are compared to examine the success of these remedial activities. (NOTE: all concentrations are expressed on a wet weight basis).

PCBs

Table 4 presents the concentrations of PCBs, and other priority contaminants, found in NYSDEC's YOY-fish at various locations that exceeded protective wildlife criteria in 1997. Of the 14 locations sampled by NYSDEC's YOY monitoring program, PCB concentrations at five locations were either non-detect, or below the Great Lakes Water Quality Agreement (GLWQA) Aquatic Life Guideline of 100 ng/g for the protection of fish consuming wildlife. Exceedences were observed at nine locations, with the most elevated concentrations occurring at lower Gill Creek (2190 ng/g); Bergholtz Creek (594 ng/g); and, Gratwick Riverside Park (259 ng/g). Follow-up monitoring is recommended for Bergholtz Creek, where remedial systems brought on line upstream of the site in the late 1990s may have lowered PCB levels; and, Gratwick-Riverside Park where landfill remediation was completed in 2001, but observed PCB concentrations suggest an upstream source. Similarly, for Gill Creek, contaminated sediment removed upstream of the site in 1998-1999 may result in lower PCBs. Follow-up YOY-fish monitoring is suggested to confirm this. MOE's 2000 mussel data, however, does suggest that removal of the contaminated sediment has, indeed, lowered the PCB concentrations upstream, at least in mussels.

Similar to NYSDEC's findings for YOY-fish collected from lower Gill Creek, just upstream of Buffalo Avenue, previous MOE mussel data for Gill Creek indicated high total PCB concentrations observed in mussels deployed at a MOE's nearby site (i.e., upstream of Buffalo Avenue=Route 384). Note that both sites are upstream of the area of the Creek that was previously remediated in 1992 (from the creek mouth up to Buffalo Avenue). The high PCB concentrations in mussels previously deployed near Buffalo Avenue appear to corroborate NYSDEC's explanation for the high PCB concentrations observed in YOY-fish collected from that area. Namely, that as a result of the daily flow reversals in the Creek, which occur when water is withdrawn from the Niagara River for power generation, contaminated sediment from the lower Creek had been transported upstream and probably settled-out in the deeper, slower moving section of the Creek upstream between Buffalo Avenue and Falls Street. After remediation of this sluggish section of the creek in 1998-1999, the concentrations of PCBs in mussels deployed at MOE's site upstream of Buffalo Avenue in 2000 were similar to those observed in mussels at most sites along the Niagara River (i.e., mean of

80 ng/g). This can be contrasted with pre-sediment remediation mussel PCB concentrations of 157 ng/g (SD 27.7 ng/g), and 200 ng/g (SD 138.5 ng/g) in 1993 and 1995, respectively and suggests that the 1998-99 upstream removal of the contaminated sediment has, indeed, lowered the PCB concentrations in mussels at the this site. A similar decline in total PCB mussel concentrations was previously observed at MOE's site near the mouth of Gill Creek after the 1992 remediation of contaminated sediments upstream of that station [e.g., mean concentrations ranged from a high of 2,623 ng/g (SD 745 ng/g) in 1991 to 50 ng/g (SD 12 ng/g) in 2000]. Additional data collection is recommended to see if similar trends are observed in YOY-fish collected from the Creek.

The presence/absence of PCBs, and other contaminants, in mussels at Canadian and other U.S. sites are shown in Table 3. Trace concentrations of PCBs were detected in Lyons Creek and at NOTL on the Canadian side, and at most stations on the U.S. side. The source of PCBs to Lyons Creek is currently being investigated, as is the feasibility of doing sediment remediation. PCBs detected at NOTL likely reflect concentrations in the lower Niagara River rather than a local point source. Future biomonitoring will verify the presence/trends in PCBs at the NOTL site.

PCB concentrations in mussels at all U.S. sites were generally similar, with the exception of the high concentrations (range 240 to 340 ng/g) at a site located about 15 m downstream of an inactive sewer associated with Occidental's Buffalo Avenue plant. PCB concentrations in mussels deployed at all remaining sewers associated with the Occidental plant tended to fall within the range detected in mussels deployed at other Niagara River stations. High concentrations have previously been detected in mussels deployed at this specific outfall (eg., 322 ng/g and 260 ng/g in 1993 and 1995, respectively). The anomalously elevated concentrations at this location provide strong evidence of increased exposure to PCBs, particularly when viewed in conjunction with 1993 and 1995 data. This data anomaly should be investigated further.

The results of MOE’s YOY monitoring for PCBs from 1975 to 2002 are shown in Figure 9. The more recent results for PCBs as well as other contaminants (total-DDT, mirex, OCS and HCB) over the period 1999-2001 are summarized in Table 5. Figure 9 shows that PCB concentrations at all five MOE YOY sites in the upper Niagara River have decreased since the program began. However, the more recent data suggest that there has been very little change in PCB concentrations over the period 1999-2001. Samples collected at Fort Erie and Frenchman’s Creek, on the Canadian side, remain below the Great Lakes Water Quality Agreement (GLWQA) Aquatic Life Guideline of 100 ng/g. At Wheatfield and 102nd Street, on the U.S. side of the upper river, PCB concentrations remain above the Aquatic Life Guideline, but are below 200 ng/g. PCB concentrations in forage fish at Cayuga Creek still remain over 200 ng/g. In 2001, MOE collected spottail shiners at a new location near the North Grand Island Bridge. In future, this location will replace the Search and Rescue location where forage fish are difficult to collect. PCB concentrations at this new location exceeded the Aquatic Life Guideline, whereas at the Search and Rescue location concentrations were below it.

In general, the PCB mussel and YOY-data for most of the sites are consistent with those obtained from previous sampling efforts. As noted above, data from the Upstream/Downstream Program clearly show that PCB contamination in the river has been reduced, probably in response to the remediation of hazardous waste sites, in addition to other sources. The continuing detection of PCBs in Niagara River biota, however, attests to the pervasiveness of PCB contamination in the river. Given the ubiquitous nature of PCBs, it is likely that this contamination will continue some time into the future.

Organochlorine Pesticides (OCs)

DDT and metabolites, especially DDE (a metabolite of the pesticide DDT), were detected in NYSDEC YOY-fish samples from all 14 locations, but none of the concentrations exceeded protective wildlife criteria. The highest concentration of total DDT (44.0 ng/g) was found in YOY-fish from Gill Creek and may suggest an upstream source (Table 4). This concentration, however, was less than five percent of the GLWQA most protective criterion for total DDT (1000 ng/g). Similarly, MOE mussel data indicated trace concentrations of ppDDE at three of the five stations on the Canadian side of the river, and at almost all stations on the U.S. side (Table 3). The presence of ppDDE in both mussels and fish is probably due to the historical use of DDT in the Lake Erie and the Niagara River watersheds. Concentrations of the DDT found in MOE YOY-fish samples from the upper Niagara River are low and appear to be similar to previous collections (Table 5).

Low concentrations of mirex in NYSDEC YOY-fish samples at nine of the 14 locations exceeded the GLWQA protective wildlife criterion of "less than detection". The highest mirex concentration (97.3 ng/g) was observed in a composite sample from Cayuga Creek, at Porter Road. This concentration, however, was still below the U.S. Food and Drug Administration (USFDA) fish consumption criterion (100 ng/g) designed to protect the human fish consumer (Table 4). No photomirex was detected in any NYSDEC YOY-fish samples from the Niagara River. Mirex was not detected in any of the mussels deployed in the river in 2000 by MOE, or in any of the 2001 MOE YOY-fish from either the upper or lower Niagara River. The absence of mirex in these mussels and fish, however, does not mean that it is no longer entering the river as is clearly shown by the Upstream/Downstream Program data.

Dieldrin was detected at low concentrations (<6 ng/g) only in NYSDEC YOY-fish from upstream Cayuga Creek, at Porter Road. The concentrations were less than one-quarter of the most protective wildlife criterion (22 ng/g dietary criterion for mink).

Similarly, low concentrations of chlordane (<18 ng/g) in YOY-fish were detected only in upstream Cayuga Creek, at Porter Road. These concentrations were an order-of-magnitude less than the most protective wildlife criterion (370 ng/g dietary cancer criterion for mink). However, the YOY-fish data for dieldrin and chlordane (as well as PCBs, DDT, and mirex) suggest a contaminant source upstream from Porter Road.

MOE mussel data for chlordane, like other OCs, was sporadic with concentrations being similar to those seen in previous surveys.

The insecticide γ-HCH (lindane) was found at low levels in NYSDEC YOY-fish only from Gill Creek and Cayuga Creek, at Cayuga Drive (Table 4). Its concentration in fish collected from lower Gill Creek just upstream of Buffalo Avenue (104 ng/g) exceeded the most protective wildlife criterion (100 ng/g for fish consuming wildlife), but was less than the dietary cancer criterion (510 ng/g) for mink. Similarly, MOE mussel data indicate HCH has been consistently detected at Gill Creek since 1987, either at the mouth, or at MOE's upstream station (north of Buffalo Avenue=Route 384) (Table 3). In 2000, the highest concentrations (2 to 26 ng/g,) of all three HCH isomers (α-HCH, β-HCH and γ-HCH) were found in Gill Creek at MOE's upstream station. Although the 2000 mussel data indicate somewhat lower concentrations than the 1997 pre-remediation NYSDEC data, the detection of HCH in both YOY-fish and mussels collected from this creek indicate the need for follow-up monitoring. In contrast, at the 102nd Street site, all three HCH isomers were consistently detected prior to site remediation in 1996 when construction of a coffer dam and slurry wall were completed. The absence of HCH in mussels in 1997 and 2000 suggests that these remedial activities have been effective in reducing the presence and bioavailability of this contaminant.

Chlorinated Benzenes (CBs) and Industrial Compounds

HCB was most commonly detected in NYSDEC YOY-fish from the Pettit Flume, lower Gill Creek, and all three Cayuga Creek locations. As was the case for several of the contaminants noted above, the highest concentration (<8 ng/g) was found in upstream Cayuga Creek, at Porter Road. The concentrations, however, were well below the most protective criterion (200 ng/g dietary cancer criterion for mink). MOE's mussel data for chlorinated benzenes and industrial compounds, indicate the most frequently detected compounds at U.S. sites were HCB, pentachlorobenzene and hexachlorbutadiene (HCBD), with the highest concentrations of HCB, pentachlorbenzene and 1,2,3,4-tetrachlorobenzene, found at the mouth of Bloody Run Creek and at Occidental's Buffalo Avenue Sewer 003 (Table 3). HCB and pentachlorobenzene concentrations at both these sites in 2000 were consistent with those previously observed throughout the 1990s. In contrast, no tri- to hexachlorobenzenes were detected in mussels deployed at the 102nd Street hazardous waste site in 2000. This is similar to the results obtained in 1997. As noted for HCH above, these observations appear to further corroborate that the installation of the slurry wall around the site and removal of contaminated sediment from the river in 1996 have successfully prevented contaminants getting from the site to the river. Similarly, the concentrations of chlorinated benzenes in mussels deployed at the Pettit Flume have been consistently low since the site was remediated in 1995 suggesting that remediation has been successful in reducing the bioavailabilty of chlorinated benzenes to mussels. HCB was detected in YOY-fish collected by MOE at most U.S. sites, but no Canadian sites, in the upper Niagara River. Concentrations in the upper river were low and appeared to be similar to those observed in previous collections. In contrast, HCB was detected at all four sampling locations in the lower

Niagara River at concentrations slightly higher than those in the upper river (Table 5). This is probably due to water in the lower river being well-mixed by the rapids, the Falls, the whirlpool and the power plant inputs. The Upstream/Downstream Program results clearly show that HCB is entering the river from Niagara River sources.

Trace concentrations of octachlorostyrene (OCS) were observed only in mussels deployed between sewer C and sewer 003 at Occidental's Buffalo Avenue Plant. As with HCB, concentrations of OCS in MOE's YOY-fish samples from the upper Niagara River are low and appear to be similar to previous collections. In the lower Niagara River, OCS was detected at low concentrations at all four locations in 2000, but was not detected in 2001. The highest concentrations of HCBD were found in mussels at Occidental sewer 003 (46 ± 5.3 ng/g) and Gill Creek (19 ± 2.1 ng/g). Their presence at these sites was consistent with the observations from previous surveys.

Dioxins and Furans

NYSDEC 1997 YOY-fish data indicated total dioxin and furan congener concentrations (including estimated maximum possible concentration; EMPC) have decreased an average of 41 percent since 1992. The most elevated concentrations occurred at the upstream Little River (132.34 pg/g), Pettit Flume (111.87 pg/g), downstream Little River (88.51 pg/g), and Gratwick-Riverside Park (61.47 pg/g) locations. Concentrations at the upstream and downstream Little River sites in 1997 were 14% and 80% less at these two sites, respectively, than the concentrations observed previously in 1992. A spatial comparison of Niagara River YOY dioxin and furan data indicated the Pettit Flume to be a significant source of dioxins and furans to the Niagara River. The data further suggested a source of dioxins and furans may be present between Gratwick-Riverside Park and the upstream Little River site. However, given the recent remediation of the Gratwick-Riverside and 102nd Street landfills, follow-up post-remediation monitoring is recommended to confirm this.

The concentrations of dioxins and furans in mussels were low (TEQ<1.0 pg/g) at all sites, with the exception of Pettit Flume (TEQ=78.4 pg/g) and in the Niagara River in the vicinity of Bloody Run Creek (TEQ=23.7 pg/g). Figure 10 shows the mussel data for dioxin and furan isomers at the Pettit Flume. The similarity in the isomer patterns seen in the mussels (and sediment, see below) in 1993, 1997 and 2000 suggests a common source. Similarly, dioxin and furan concentrations in sediment were generally low (TEQ<20 pg/g) with the exception of the sites noted below. Note that the concentrations of dioxins and furans in mussels and sediment are expressed in terms of total toxic equivalents (TEQ). Briefly, the TEQ provides an indication of the toxicity of dioxins and furans in the sample relative to 2,3,7,8-TCDD, the most toxic dioxin isomer. The higher the TEQ, the more contaminated the sample. The calculated TEQs can be compared to sediment quality guidelines and tissue sediment guidelines (SQG), where available, to put them into perspective.

Similar to the NYSDEC YOY-fish and MOE mussel data, high concentrations of dioxins and furans were also found in sediment at the Pettit Flume inlet cove in 2000 (Figure

11). The sediment TEQ of 30,250 pg/g indicated extremely contaminated sediment. The source of these dioxins and furans is unclear given the recent, extensive remedial activities at the site, which occurred just months prior to mussel deployment. The continuing presence of dioxins and furans in the cove requires further monitoring.

The concentrations of dioxins and furans in sediments (and mussels) from the Niagara River shoreline in the vicinity of Bloody Run Creek were considerably lower in 2000, than those observed in previous surveys. However, the sediment along the shoreline has not been remediated, so the 2000 data likely reflected the variability in local contamination rather than an improvement or decrease in sediment contamination. Concentrations of dioxins and furans in both mussels and sediments still suggest that this site is contaminated (sediment TEQ of 3,732 pg/g) and should continue to be monitored.

Sediment collected from Two Mile Creek, and from the station in Gill Creek upstream of the creek mouth, were contaminated with dioxins and furans. The TEQs for the sediment samples were 81 and 100 pg/g respectively. The sediment collected from Gill Creek is of particular interest, since the area was remediated in 1998. These data suggest a recent source of dioxins and furans.

As noted above, these sediment concentrations can be put into perspective by comparing them with sediment quality guidelines. Ontario does not have a Sediment Quality Guideline (SQG) for dioxins and furans, at present. However, the interim "No Effect Level" guideline for 2,3,7,8-T4CDD has been set at 25.7 pg/g. Similarly, the Canadian Environmental Quality "probable effect level" Guideline has been set at 21.5 pg/g (CCME 2001).

Long Term Mussel Deployment Study

Results from the MOE long-term deployment study of mussels from July to October, 2000 (up to 105 days) showed that mussels rapidly accumulate PCBs over the first 48 hrs, after which time, concentrations level off. Concentrations tend to remain at this level unless the mussels are exposed to an increase in ambient PCB concentrations. If they are, mussel tissue concentrations again rapidly increase and then level off at a new steady state. These results confirm that 21 days is sufficient exposure time for PCB accumulation by *Elliptio complanata* providing there are no changes in the exposure environment.

The staggered deployment and retrieval of mussels in this study provided a better understanding of the patterns of PCB bioaccumulation than the study design in 1997 (Richman 1999). The results from the 1997 study suggested that 21 days may be insufficient to assess maximum PCB accumulation. However, it was not known if mussel tissue concentrations increased over time due to a change in water quality or due to a delay in reaching steady state. However, the results from Two Mile Creek in 2000 suggested that the 21 day survey was sufficient to provide a good indication of the contamination of the area in which the mussels were deployed provided there were no changes in exposure. In addition to physiological changes that may occur and have not been accounted for in this study, the environment is in a constant state of flux due to external forces such as storm events or fluctuations in contaminant loadings from local industries. The data suggest that the mussel tissue concentrations will respond to this dynamic environment. The disadvantage of a short term monitoring program using introduced organisms is that significant contaminant inputs can be missed if they occur outside the designated period of biomonitoring.

Summary

The data from all Biomonitoring Program activities corroborate the decreasing trends seen in the Upstream/Downstream data reflecting continuing improvement in the Niagara River and its U.S. tributaries. Both the YOY-fish, and mussel contaminant data also reflect the effectiveness of remedial activities at hazardous waste sites. However, while the data for most locations indicate decreasing trends, there are some locations (eg., upstream Gill Creek, Cayuga Creek, and downstream of Gratwick Riverside Park) where the data suggest the new or continuing presence of contaminants. Further monitoring will be needed to evaluate these locations. The continuing presence of dioxins and furans in the Pettit Flume cove also need additional assessment.

4.0 STATUS AND TRENDS RELATIVE TO ENVIRONMENTAL OBJECTIVES

The Niagara River contributes 83% of the total tributary inflow to Lake Ontario. Contaminants originating from the upper Great Lakes, Lake Erie, and from sources along the river enter the lake with this inflow. There is a critical link between the water quality of Lake Ontario, and contaminants entering the lake from the river. For example, the six critical pollutants identified in the Lake Ontario Lakewide Management Plan (PCBs, DDT and metabolites, dieldrin, mirex, TCDD and mercury) are also designated as “priority toxics” in the NRTMP. Critical pollutants are chemicals, which are causing beneficial use impairments on a lakewide basis. Similarly, many of the NRTMP "priority toxics" have also been identified in the Lake Erie Lakewide Management Plan as causing beneficial use impairments. Thus, the NRTMP is closely linked to both the Lake Ontario and Lake Erie Lakewide Management Plans (LaMPs).

THE SIGNIFICANCE OF NIAGARA RIVER SOURCES

Chemical inputs to the Niagara River impact both the river and Lake Ontario. For example, these chemicals can contribute to exceedences of water and sediment quality criteria, and/or necessitate the issuance of fish consumption advisories. The Niagara River is a major source of many chemicals to Lake Ontario as indicated by the surficial sediment chemical distribution patterns in the lake (Thomas *et al.* 1988). The depth distributions of chemicals in dated sediment cores collected from Lake Ontario in the vicinity of the Niagara River also show the changes in Niagara River inputs over time. For example, the changes in concentrations of some chemicals along the length of the core mirror their production history at plants located along the river (Durham and Oliver 1983). For other chemicals, the changes relate both to the effectiveness of remediation of sources along the length of the river, and reductions in inputs to the river from Lake Erie/upstream (Mudroch 1983; Swart *et al.* 1996)

The relative significance of Niagara River sources versus those in Lake Erie and upstream *vis a vis* the loads of the "priority toxics" to Lake Ontario can be estimated from the ratio:

$$\frac{(NOTL - FE)}{NOTL}$$

where, NOTL and FE represent the recombined whole water (RWW; dissolved + suspended sediment) loads at Niagara-on-the-Lake and Fort Erie, and (NOTL-FE), called the “differential load”, represents the load from sources along the river (Williams *et al.* 2000). The ratio should vary between zero and one. The higher the value, the greater the relative contribution of Niagara River sources to the load entering Lake Ontario. A ratio of one, for example, indicates that the load to the lake is due primarily to inputs from Niagara River sources. Conversely, a ratio of zero, indicates that most of the load to Lake Ontario comes from Lake Erie and sources upstream.

Table 6 shows the ratio for each of the years from 1986/87 to 2000/01, for each of the chemicals in Table 2 with the exception of PCBs and mercury. The chemicals have been ordered in terms of decreasing overall mean ratio for this period. Excluding the negative results for DDT (see below), the overall mean ratio varies from 1.0 for mirex and OCS to 0.0 for dieldrin and lead. This indicates that the loads of mirex and OCS to Lake Ontario from the river come principally from Niagara River sources, while those for dieldrin and lead, come primarily from sources in Lake Erie and upstream. For the PAHs, about half the load to Lake Ontario appears to come from Niagara River sources, while the other half comes from sources upstream of the river. Similarly, nearly all the arsenic and lead come from sources upstream of the river. The general consistency of this ratio over time for most of the "priority toxics" lends credibility to the usefulness of this approach. For example, Niagara River sources have been implicated since the inception of the Upstream/Downstream Program in terms of the loads of mirex, OCS and HCB to Lake Ontario. Conversely, Lake Erie and upsteam sources have been implicated consistently in terms of DDT + metabolites and dieldrin loads to the lake.

Table 6 clearly points to the growing importance of Lake Erie as a source of many of the NRTMP "priority toxics" to the Niagara River, and ultimately Lake Ontario. For example, the 2000/01 data in Table 6 show that the ratio of the differential load to the load at NOTL is negative for the PAHs and the organochlorine pesticides. This is because the differential load is negative. This means that loads coming into the river from Lake Erie are higher than the loads going from the river into Lake Ontario. Previous Progress Reports have commented on the increases in PAHs entering the river from Lake Erie and speculated on the possible reasons. For example, several principal investigators have documented the increases in bottom sediment PAH concentrations in Lake Erie related to mussel colonization of the eastern basin (Howell *et al.* 1996; Marvin and

Howell 1997). As changes in sediment characteristics (e.g., smaller particle size, higher organic content) are associated with mussel colonization, it is not surprising that the increases in PAH loads occur principally in the particulate fraction where contaminant concentrations are related to the particle's organic content. Regardless of the reasons for these apparent increases, the Four Parties will be carefully monitoring this situation to determine if it is indicative of a continuing "trend".

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). Comparing the Niagara River Upstream/Downstream Program concentration data to available water quality criteria is one way of assessing the threat to aquatic life, and the real, or potential, impairment of beneficial uses. Such a comparison can also serve as an indicator of progress. The approach used by the Four Parties, since the inception of the NRTMP, has been to compare the upper 90% confidence interval recombined whole water (RWW) concentrations (i.e., dissolved + particulate phases) of a chemical to the most stringent agency criterion for that chemical (e.g., see NRDIG 2002). The upper 90% confidence interval concentration provides a more protective estimate of criteria exceedences than the annual mean. This approach is also used in this report. It is important to note, that the increases in exceedences reported below result largely from comparing Upstream/Downstream Program data to more stringent criteria adopted in 1998, rather than significant increases in concentrations.

Table 7 shows the upper 90% confidence interval RWW concentrations from the 1999/2000 and 2000/01 Upstream/Downstream Program data and the 1998 most stringent agency water quality criteria. The pre-1998 criteria are also shown for comparison. Briefly, the Table shows that in both 1999/2000 and 2000/01, the upper 90% confidence interval concentrations for the majority of NRTMP “priority toxics” were exceeded at NOTL. The exceptions were total chlordane, ppTDE, total-DDT, OCS and the metals.[6] HCB, ppTDE, total DDT, mirex, OCS (both only detected at NOTL) and the metals never exceeded criteria at FE. Total chlordane, and B(a)P exceeded criteria in 2000/01, but not in 1999/2000.

For many of the "priority toxics", the NYSDEC standards are the most stringent Four Party water quality criteria. In February 1998, NYSDEC adopted new standards pursuant to the U.S. Great Lakes Initiative. For some chemicals, the new standards were much more stringent than the standards existing prior to 1998. For example, the most stringent pre-1998 criterion for dieldrin was 0.9 ng/L and is now 0.0006 ng/L. Similarly, the most stringent pre-1998 criterion for mirex was 1.0 ng/L and is now 0.001 ng/L. As stated in the 2001 Progress Report, the increase in criteria exceedences subsequent to 1997/98 resulted largely from comparing the data to these more stringent standards, rather than significant increases in chemical concentrations.

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[6] Although RWW concentrations for PCBs were not calculated because of dissolved phase contamination problems, it should be noted that the concentrations in the particulate phase alone are sufficient to exceed the strictest agency criterion.

The most stringent NYSDEC criteria are generally based on human health. The 1999/2000 and 2000/01 upper 90% confidence interval RWW concentrations for many of the NRTMP "priority toxics" exceed these criteria. It is worth noting, however, that the ambient concentrations of these same chemicals are already below many of the most stringent agency criteria for other categories such as the protection of drinking water and the protection of aquatic life (Table 8).

As with Table 6, Table 7 also points to the growing importance of Lake Erie as a source of many of the NRTMP "priority toxics" to the Niagara River, and ultimately Lake Ontario. The Table shows, for example, that the concentrations of a number of the NRTMP "priority toxics", particularly the PAHs, exceed the most stringent agency criteria at FE as well as NOTL.

It is also worth noting that low concentrations of contaminants in the Niagara River, when multiplied by the high flow of the river (>5300 m^3/sec) may still translate into substantial contaminant loads 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 inputs from Niagara River and other Lake Erie/upstream sources for some time to come.

FISH CONSUMPTION ADVISORIES

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

Ontario Advisories

The Ontario Ministry of the Environment issues advice regarding consumption of sport fish caught in their waters in the biennial *Guide to Eating Ontario Sport Fish* (MOE 2003). The 2003-2004 edition of the *Guide to Eating Ontario Sport Fish* provides consumption advice for 14 species of fish in the Upper Niagara River and 19 species in the Lower Niagara River. The current Ontario advisories for fish taken from the Niagara River are summarized in Table 9. The 2003-2004 *Guide* or portions, thereof, are available from http://www.ene.gov.on.ca/envision/guide/index.htm.

Upper Niagara River

In 2002, seven species of fish were collected for testing by the MOE. These included largemouth bass, yellow perch, white perch, rock bass, brown bullhead, carp and freshwater drum. Six of these species provided updated information to the *Guide*. White perch were collected for the first time at this location.

The following changes and additions were made to the *Guide* using the new information collected in 2002. Consumption of largemouth bass between 35 and 45 cm is now restricted to four meals per month. Previously, consumption was not restricted (advisory of up to eight meals per month) in this size range. Consumption of carp 55 cm and larger is now restricted. Previously, carp were restricted at 65 cm and larger. Freshwater drum, which were previously restricted at 35 cm, now do not have any consumption restrictions. Advice for white sucker has been added in the 45-55 cm size range, and consumption is now restricted for white sucker between 45 and 55 cm. Additional advice has been added for smallmouth bass between 45-55 cm in size, with consumption restricted to four meals per month.

As a result, of the 14 species in the Upper Niagara River listed in the 2003-2004 *Guide*, seven have no consumption restrictions. Of the remaining seven species, smallmouth bass, white bass, carp, white sucker and rainbow smelt have consumption restrictions due to PCBs. Largemouth bass and redhorse sucker have consumption restrictions due to mercury.

Lower Niagara River

In 2002, eight species were collected for testing by the MOE. These included smallmouth bass, largemouth bass, white perch, rock bass, brown bullhead, carp, freshwater drum and american eel. Brown trout information was included for the first time.

The additional information resulted in several changes to consumption advisories. Largemouth bass are now restricted at 35 cm due to mercury, whereas previously, they were not restricted. Less restrictive advice is now given for chinook salmon, white perch and carp.

As a result, of the 19 species for the Lower Niagara River listed in the *Guide*, two have no consumption restrictions (bluegill and freshwater drum). Of the remaining species, chinook salmon, brown trout, lake trout, white perch, white bass, brown bullhead, channel catfish, carp, white sucker, redhorse sucker and rainbow smelt have consumption restrictions due to PCBs. Rainbow trout and american eel are restricted due to photomirex. Smallmouth bass, largemouth bass, yellow perch and rock bass have consumption restrictions due to mercury.

MOE has prepared a “Guide to the Guide” pamphlet on fish consumption advisories Health Canada translated into 12 languages. The one page explanation helps the various ethnic communities understand how to interpret and use the information in the *Guide to Eating Ontario Sport Fish.* MOE through the 2002 Canada Ontario Agreement Respecting the Great Lakes Basin Ecosystem is working with the Niagara River Remedial Action Plan Coordinator to distribute the translated “Guide to the Guide” at various community events.

New York State Advisories

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.

In New York State, NYSDEC monitors contaminant levels in fish and game. NYSDOH issues specific advisories (e.g., “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.

The most recent change in health advisories for fish in the Niagara River area was in 1999, when restrictions (all species, “eat none”) were removed for Gill Creek from the Hyde Park Dam downstream to its mouth on the Niagara River. The current advisories for fish taken from the Niagara River and its U.S. tributaries are summarized in Table 10. [**NOTE:** NYSDOH fish advisories for Lake Ontario also apply to the lower Niagara River, below Niagara Falls.] The current 2002-2003 Advisories are also available on the NYSDOH website at: http://www.health.state.ny.us/nysdoh/environ/02fish.pdf.

5.0 U.S. TRACKDOWN INITIATIVES

Two Mile Creek

The NYSDEC sampled Two Mile Creek, in the City and Town of Tonawanda, Erie County, New York, twice at four locations, during dry weather on May 10, 2000, and again at the same stations during a wet weather event on August 29, 2000.

The sampling sites, from upstream to downstream, were:

Twin Cell Site - located immediately downstream of a twin-cell storm sewer discharging to the creek over an impoundment dam face north of Sheridan Drive (Route 324);

Oriskany Site - located at a small bridge over Two Mile Creek on the Sheridan Park Golf Course. The Oriskany Street storm sewer services an area containing the General Electric transformer repair facility and discharges to Two Mile Creek just upstream of this sampling site;

Fire Tower Site - located downstream of both the former wastewater treatment plant (no discharge to Two Mile Creek) and the fire training tower; and,

River Road Site - downstream of River Road and before Two Mile Creek enters the Niagara River (Rattlesnake Creek enters Two Mile Creek upstream of this sampling site).

Analytical results confirmed the presence of PCBs at all locations in both the dry and wet weather flows, with concentrations being higher during wet weather.

PCB concentrations increased at each subsequent downstream site during both wet and dry weather sampling. While the homolog distribution pattern of PCBs at each of the stations were closely correlated during the wet weather sampling, there was little similarity in the homolog distribution in the dry weather samples.

Any attempt to explain the reasons for the differences between the wet and dry weather sampling results would be speculative. It would also be further complicated because sampling was conducted at the same time the General Electric transformer repair facility was undergoing site investigation and remediation under the Resource Conservation and Recovery Act (RCRA). This facility is served by the Oriskany Street storm sewer, which is tributary to Two Mile Creek just upstream of the Oriskany Site sampling location.

While the General Electric transformer repair facility is a possible source of contaminants to the downstream portion of Two Mile Creek, the presence of PCBs at the Twin Cell sampling site, at a wet weather concentration of 89.9 ng/L, is significant. This finding indicates the likely existence of an unidentified source that flows to the twin cell storm sewer.

Remediation of the General Electric transformer repair facility site has now been completed. DEC is planning to conduct post-remediation sampling of Two Mile Creek in 2003 to assess the effectiveness of the remediation, identify the source of the wet weather PCBs in the twin cell storm sewer, and determine if future remedial work or other action is necessary.

Falls Street Tunnel

The Falls Street Tunnel (FST), a major unlined interceptor sewer cut into the bedrock under the City of Niagara Falls, receives combined sewer overflows primarily from residential and commercial areas within the City, in addition to the infiltration of potentially contaminated groundwater. Early comparative studies of pollutant point sources discharging into the Niagara River identified the FST as a significant source of toxic pollutants. In the early 1990s, EPA and DEC required the City of Niagara Falls to treat all of the FST flow during dry weather. As a result, flow of up to 10 million gallons per day (mgd) from the FST is being diverted to the City of Niagara Falls wastewater treatment plant (NFWWTP) to preclude dry weather discharges, and to reduce wet weather overflows. In addition, recent grouting undertaken by the City, has reduced daily dry weather flow in the tunnel from 6 to 8 mgd to about 3 to 4 mgd. Although grouting and the diversion and treatment of dry weather flows have significantly reduced both the frequency and volume of wet weather overflows from the FST, occasional wet weather overflows are likely to occur during significant rainfall or snowmelt.

As part of a continuing effort to evaluate the effectiveness of these and other improvements, the FST was sampled twice at four locations, during dry weather on December 5, 2001, and again at the same stations during a wet weather event, on May 13, 2002. Samples were analyzed for PCBs and chlorinated dibenzo dioxins and chlorinated dibenzo furans. The analytical results (using congener-specific methods) confirmed the presence of these chemicals at all locations in both the dry and wet weather flows. The concentrations of these compounds were significantly higher during wet weather. The sampling data suggest that PCBs and chlorinated dibenzodioxins/dibenzofurans are ubiquitous within the FST, while the data provide no suggestion of the source or sources of these compounds.

In early 2003, NYSDEC substantively modified the State Pollutant Discharge Elimination System (SPDES) permit for the Niagara Falls Sewage Treatment Plant. Included in the permit renewal were new requirements to control discharges from the sewage treatment plant outfall, the storm sewer outfalls, and the combined sewer overflows (CSOs) within the sewer system, including the Falls Street Tunnel.

Permit requirements for CSOs were updated to include all of NYSDEC's fifteen best management practices (BMPs), as well as the requirement to develop and implement a Long Term Control Plan (LTCP) to mitigate impacts from CSOs. As part of the LTCP, the permittee will be required to comprehensively characterize the combined sewer system; develop, evaluate, and select a range of CSO control alternatives; and, for selected measures, provide an implementation and construction schedule. Special monitoring and interceptor requirements are also included to prevent dry weather wastewater discharges from the Falls Street Tunnel outfall.

The permit also establishes water quality-based effluent limits (WQBELs) for pollutants for which the sewage treatment plant discharge has been determined to have reasonable potential to exceed water quality standards. In the case of mirex, mercury, total-DDT, PCBs, and HCB, for which calculated WQBELs were below the practical quantification level for the analytical methods specified for compliance monitoring, the permittee is required to implement a pollutant minimization program (PMP) to reduce the potential for discharge of these pollutants. The PMP requirements included additional effluent monitoring using highly sensitive analytical methods, source identification, evaluation, and prioritization, and a control strategy that includes BMPs to reduce discharges through cost-effective control measures. Finally, the permit also requires periodic whole effluent toxicity (WET) testing to assess the synergistic effect of pollutants with toxic characteristics. Based on the WET results, the State may require a Toxicity Reduction Evaluation to identify and reduce the discharge of these toxics.

6.0 SUMMARY

The principal messages in this Progress Report further emphasize the consistent messages of past Progress Reports.

- The concentrations/loads of many of the 18 NRTMP “priority toxics” in the Niagara River have decreased significantly substantiating that the river is getting “cleaner”; and,

- The decreases in nearly all cases have exceeded 70% since 1986/87.

The 2001 NRTMP Progress Report indicated that comparison of the upper 90% confidence interval ambient concentrations of NRTMP “priority toxics” to the 1998 most stringent agency criteria resulted in these criteria being exceeded for many of the "priority toxics" at both FE and NOTL. It was also stated that these exceedences were due to the much more stringent standards adopted by NYSDEC in 1998, rather than increases in the concentrations of these chemicals in the river. The same is true for the 1999/2000 and 2000/01 data presented in this report. In counterpoint, comparing the 2000/01 data to those from 1986/87 shows that the downward trends in concentrations/loads over the fifteen-year continues. For a number of chemicals, decreases are greater than 70%.

Biomonitoring has proven to be an effective tool to measure progress in the reduction of toxic substances in the Niagara River and its tributaries. In general, the spatial distributions of contaminant concentrations in mussel tissue during the three-week exposure of mussels in July 2000 were similar to those observed in previous surveys. High concentrations of dioxins and furans continued to be bound in mussels and sediment at the Pettit Flume site, despite recent remediation activities. The source of these dioxins and furans is unclear given the recent, extensive remedial activities at the site and requires further monitoring. Similarly, the concentrations of dioxins and furans in mussels and sediments from the Niagara River shoreline in the vicinity of Bloody Run Creek, while considerably lower in 2000, than in previous surveys, still suggest that this site is contaminated and should continue to be monitored.

Results from a 1997 DEC survey of juvenile fish indicated that, while there were criteria exceedences for some chemicals, at some locations in the Niagara River, overall, contaminant concentrations for nearly all contaminants sampled between 1997 and previous years continued to show a decreasing, or low stable, trend. Similarly, surveys of juvenile fish in 2000 and 2001 by MOE showed that PCB concentrations in the lower Niagara River are declining, and that concentrations at a number of sites in the river now meet or are very close to the Great Lakes Water Quality Agreement’s aquatic life guideline of 100ng/g. Furthermore, concentrations have decreased at most of these sites since monitoring first started in about 1980.

Re-testing of sport fish in 2002 by Ontario has resulted in both more restrictive and less restrictive consumption advisories for several species from the upper and lower River. There were no new consumption advisories for New York State.

NYSDEC trackdown activities in Two Mile Creek in 2000, confirmed the presence of PCBs at all locations in both the dry and wet weather flows, with concentrations being higher during wet weather. In particular, the presence of PCBs at the Twin Cell sampling site indicated the likely existence of an unidentified source within the drainage area of the twin cell storm sewer. Sampling of Two Mile Creek is planned for 2003 to identify the source of the wet weather PCBs in the twin cell storm sewer, and determine if future remedial work or other action is necessary. Similarly, NYSDEC sampling of the Falls Street Tunnel indicated that PCBs and chlorinated dibenzodioxins/dibenzofurans are ubiquitous within the tunnel, although the data provide no suggestion of the source or sources of these compounds. NYSDEC has recently renewed the City of Niagara Falls' State Pollutant Discharge Elimination System (SPDES) permit and has included several terms and conditions to address discharges from this outfall.

The improvements in the Niagara River are due, at least in part, to the beneficial remedial efforts at Niagara River sources. As has been consistently stated in previous Progress Reports, despite the successes to date and the continued improvements now being reported, more work still needs to be done, and is being done. The actions necessary to assure continued reductions of toxic chemicals in the Niagara River have been defined, and there are substantial new action commitments to address current concerns. These are outlined in the 2003 NRTMP Work Plan.

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Figure 1. Mean Flow (±σ) at NOTL, 1986/87 to 2000/01 (m^3/sec).

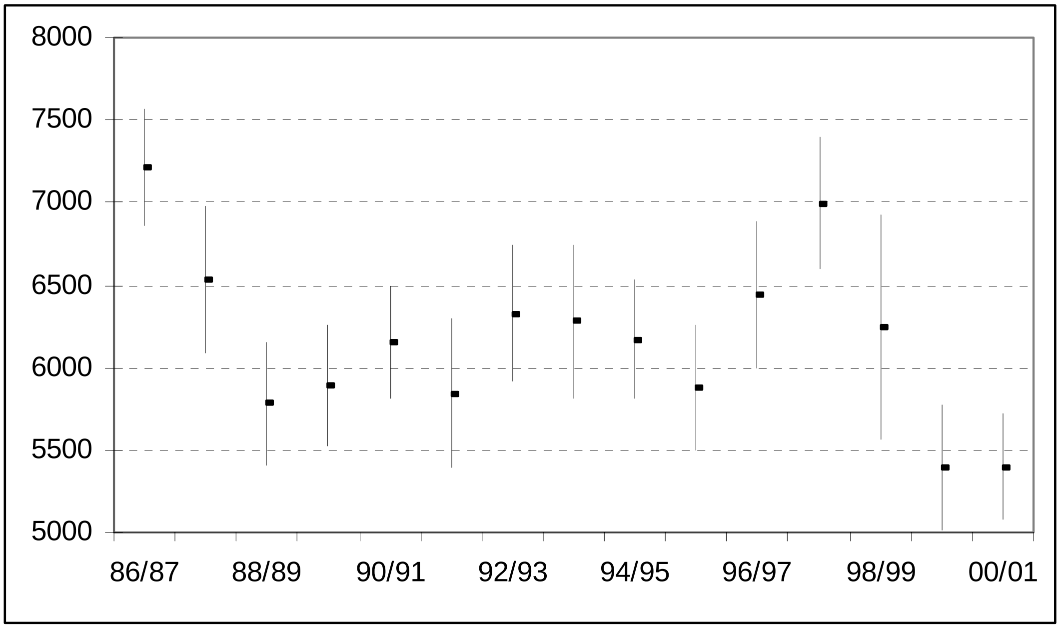


Figure 2. Modelled Trend of Hexachlorobenzene (HCB) in Water at NOTL, 1986/87 to 2000/01 (ng/L).

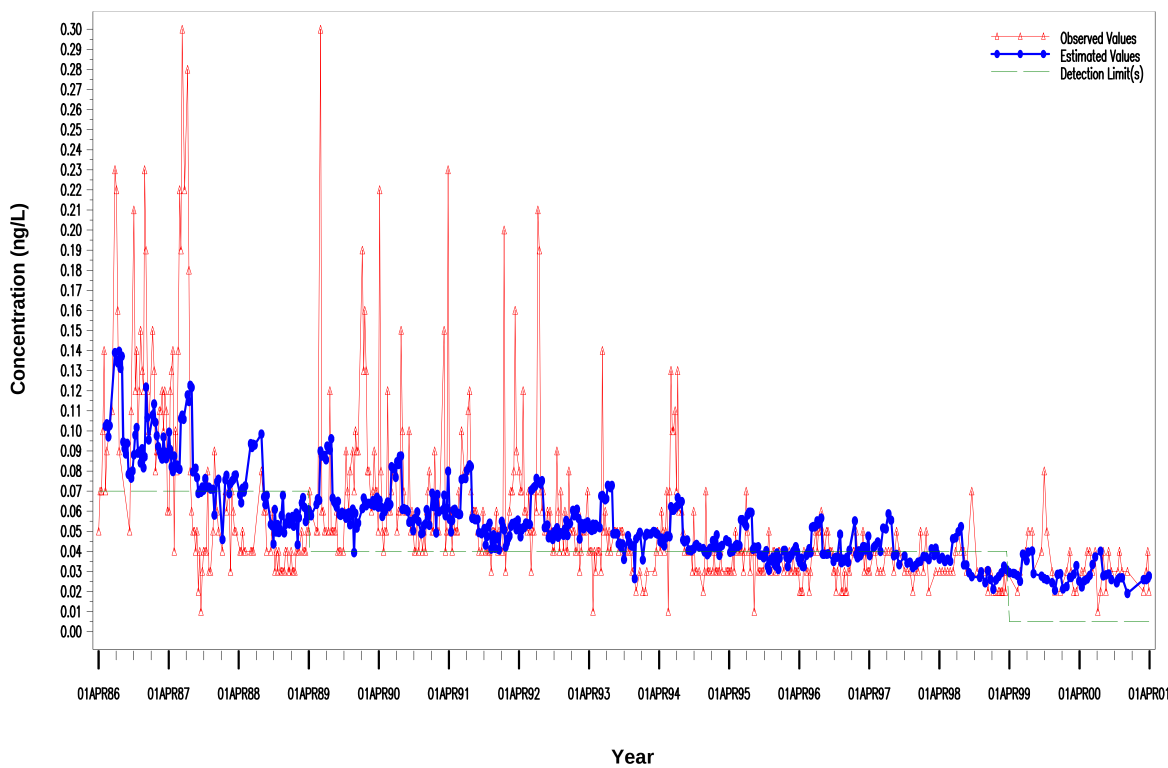


Figure 3. Modelled Trend of Dieldrin in Water at NOTL, 1986/87 to 2000/01 (ng/L).

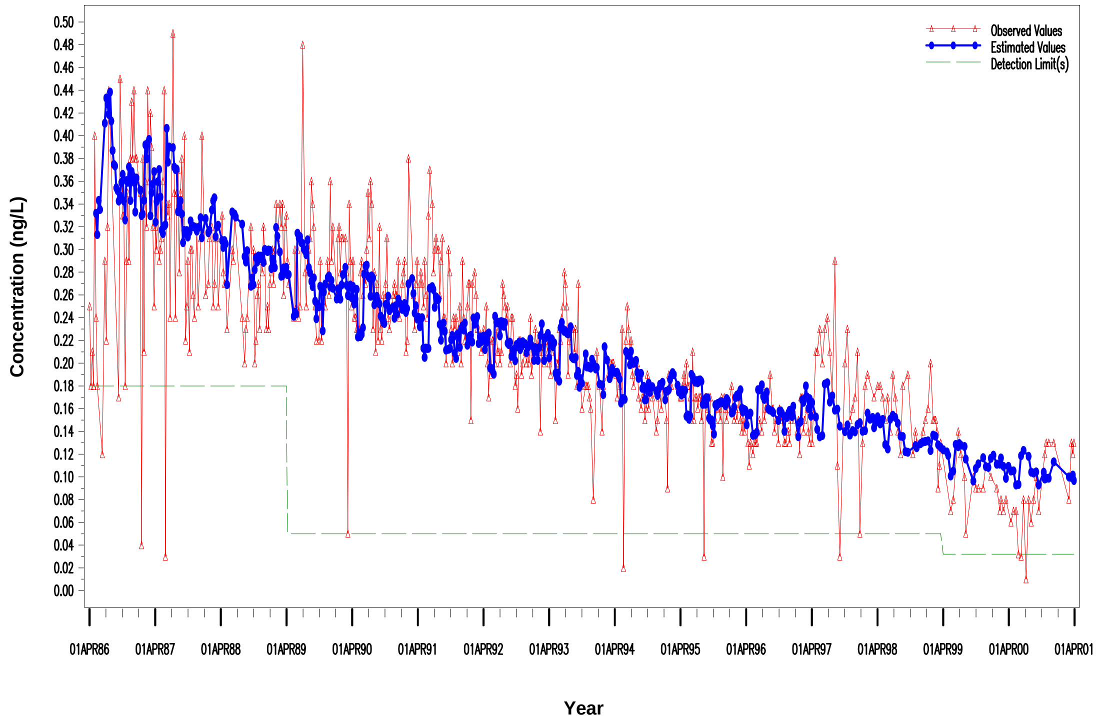


Figure 4. Modelled Trend of PCBs on Suspended Sediments at NOTL, 1986/87 to 2000/01 (ng/g).

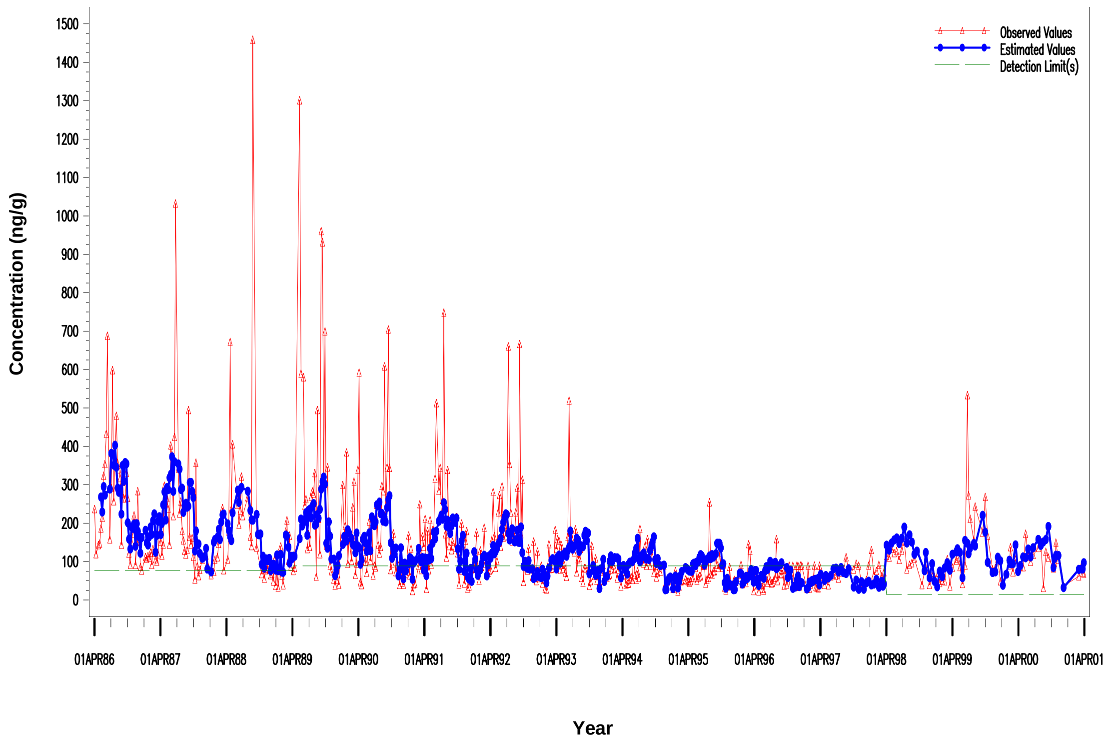


Figure 5. Modelled Trend of Octachlorostyrene (OCS) on Suspended Sediments at NOTL, 1986/87 to 2000/01 (ng/g).

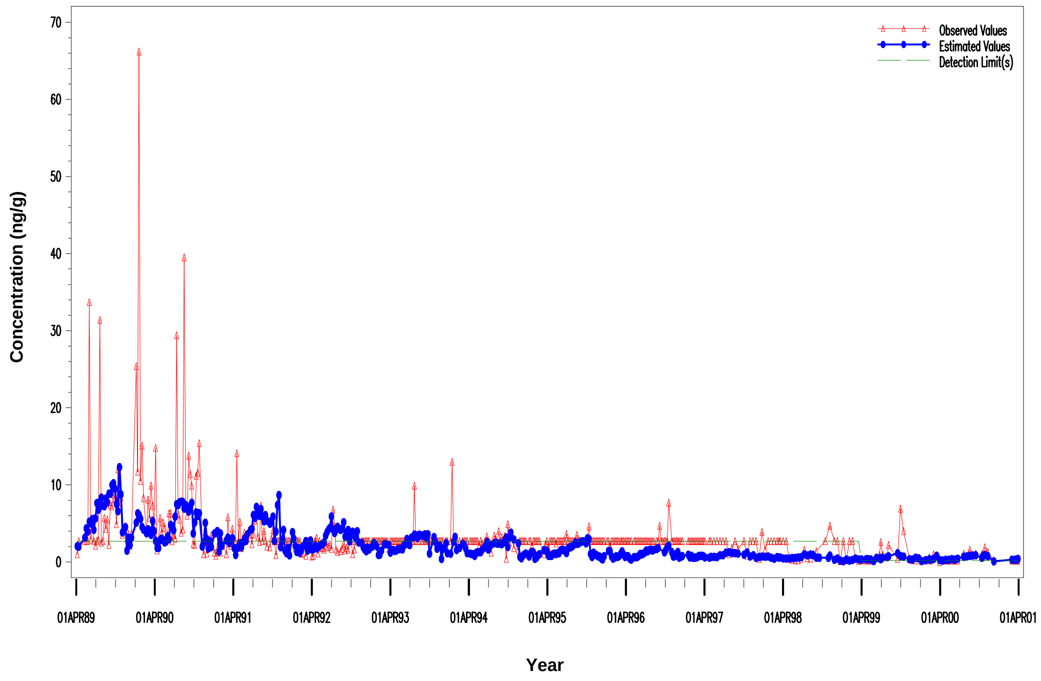


Figure 6. Station Locations for MOE Niagara River Mussel Biomonitoring Survey 2000.

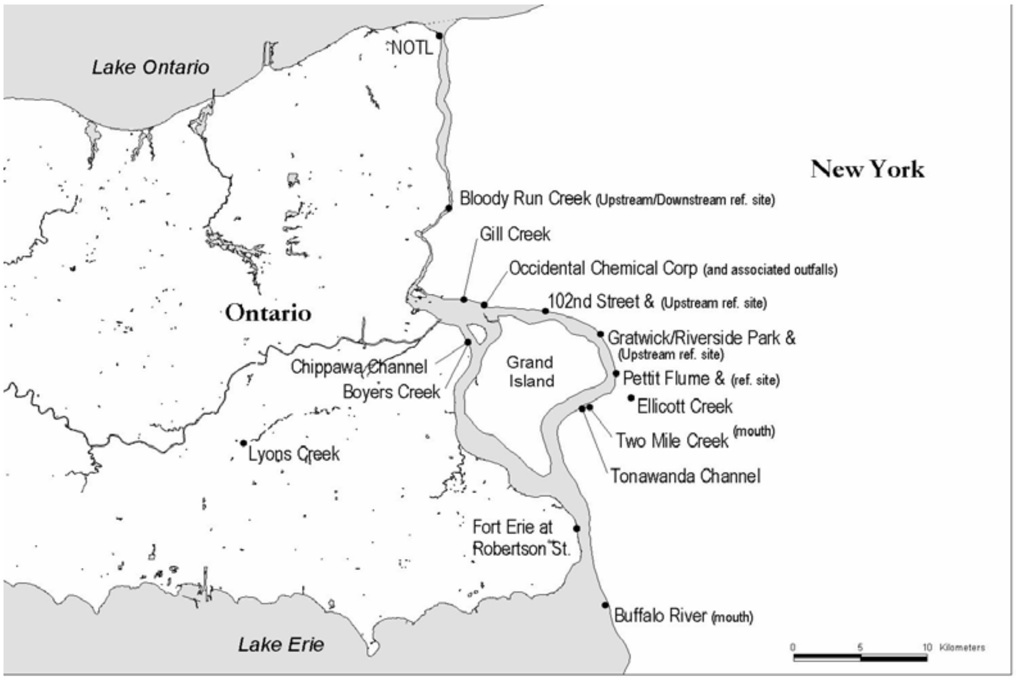


Figure 7. MOE YOY-Fish Collection Sites in the Niagara River (1999-2001)

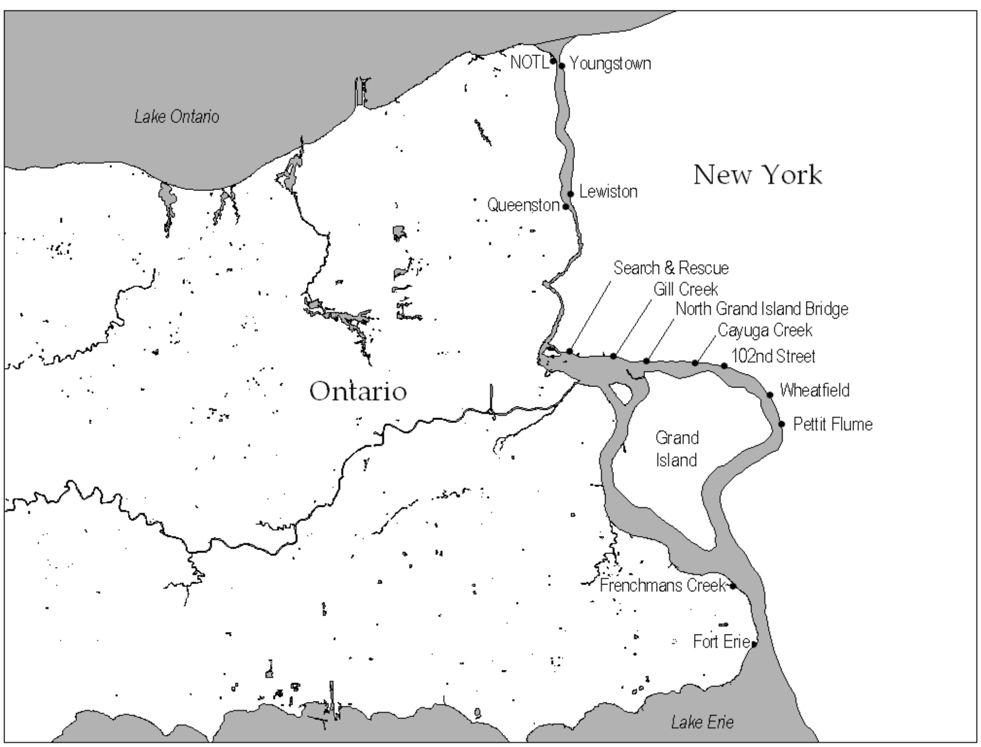
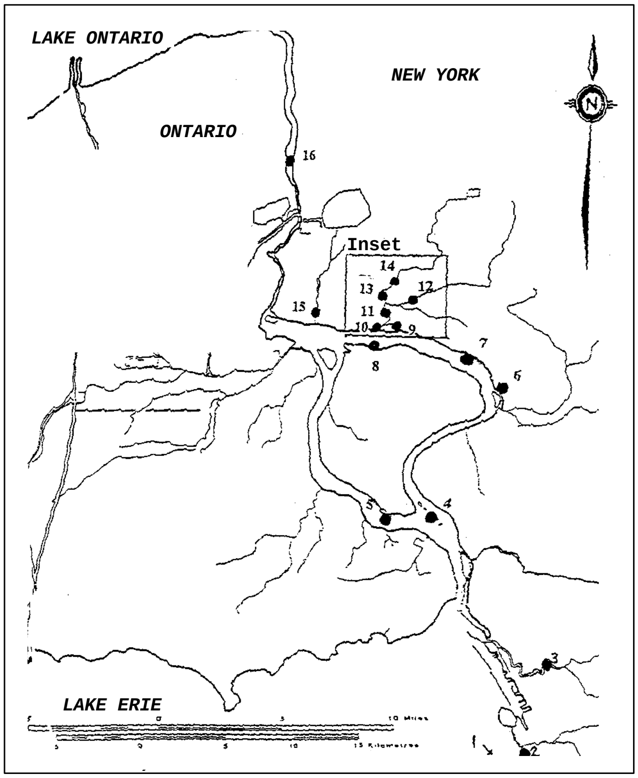


Figure 8. NYSDEC YOY-Fish Sampling Locations in the Niagara River, 1997.



Number and Location

1. Lake Erie, Dunkirk
2. Lake Erie, Smokes Creek
3. Buffalo River
4. Nia. Riv., Strawberry Is.
5. Nia. Riv., Beaver Is. State Park
6. Pettit Flume
7. Nia. Riv., Gratwick-Riverside Park
8. Nia. Riv., N. Grand Is. Bridge
9. Little Riv., upstream of Cayuga Creek
10. Little Riv., downstream of Cayuga Creek
11. Cayuga Creek, Lindberg Ave. Bridge
12. Bergholtz Creek
13. Cayuga Creek, Cayuga Dr. Bridge
14. Cayuga Creek, Porter Rd. Bridge
15. Gill Creek
16. Nia. Riv., Lewiston

(Inset – Cayuga Creek YOY-Fish Sampling Locations)

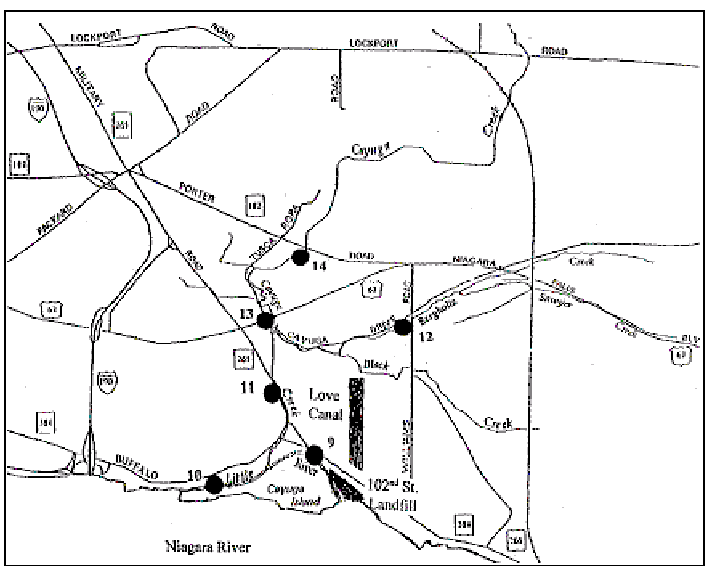


Figure 9. Temporal Trends in Total PCB Concentrations in YOY Spottail Shiners from the Niagara River, 1975 to 2002 [Mean (±σ), ng/g, wet weight].

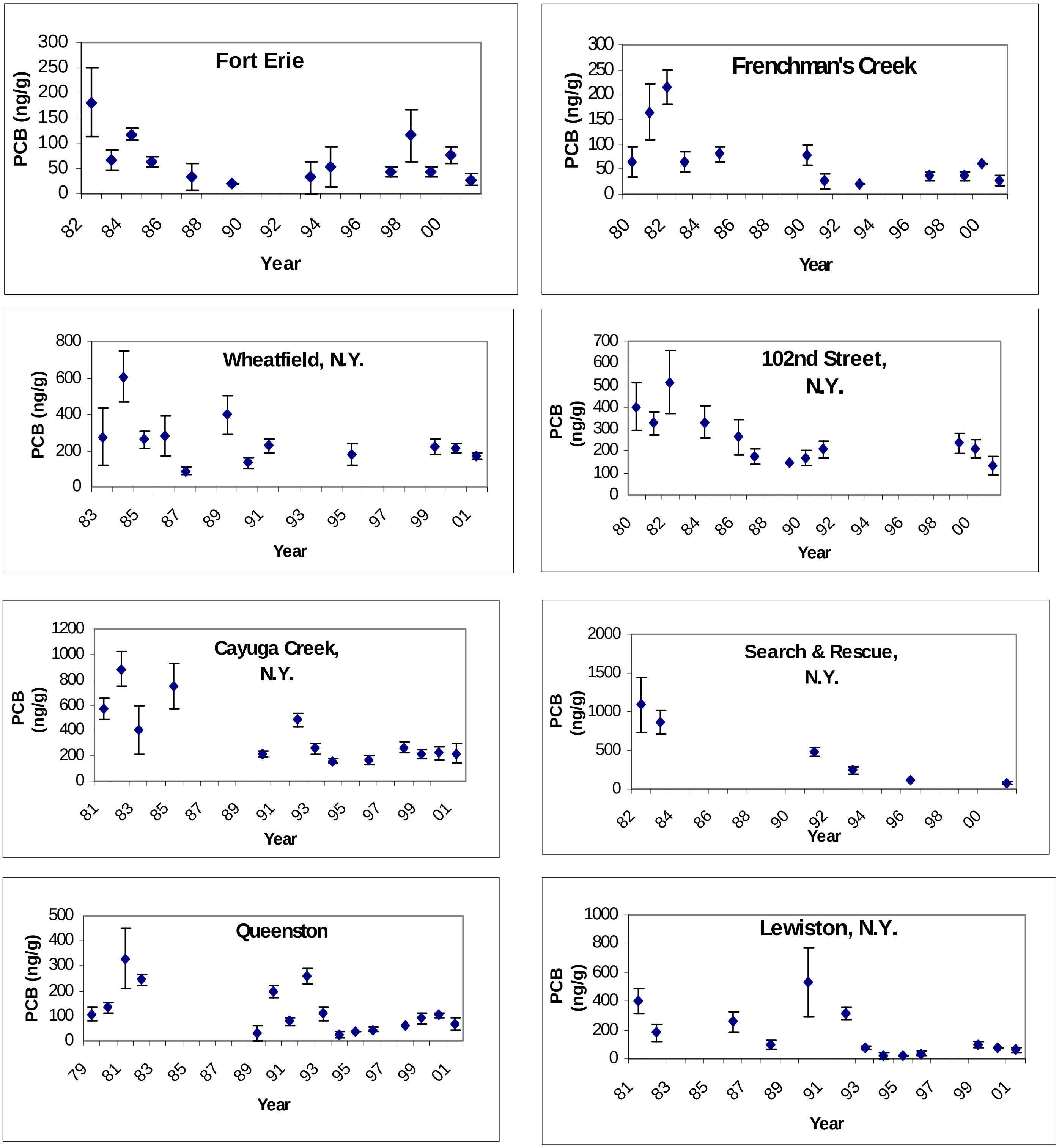


Figure 9 (cont'd). Temporal Trends in Total PCB Concentrations in YOY Spottail Shiners from the Niagara River, 1975 to 2002 (ng/g, wet weight).

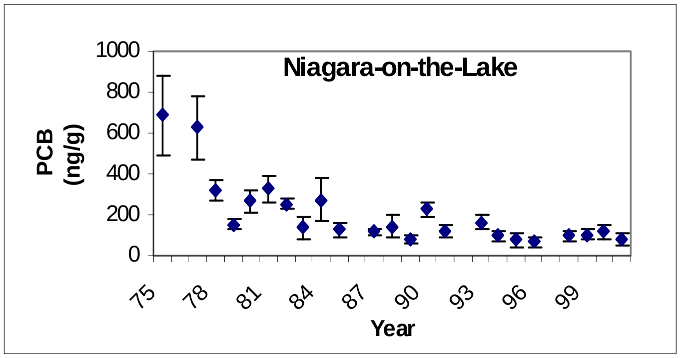


Figure 10. Mussel Concentrations of Dioxin and Furan Isomers at the Pettit Flume, 2000 (pg/g, wet weight).

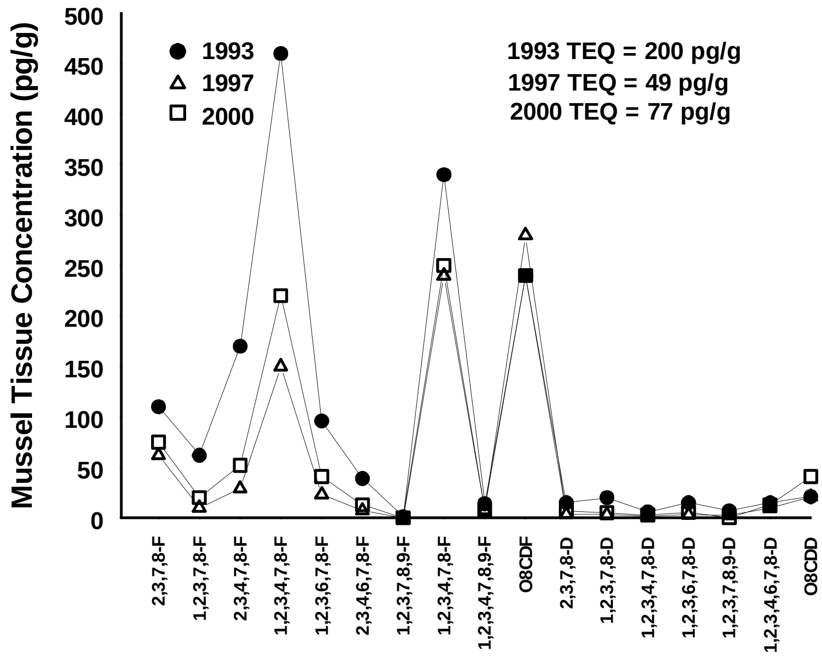


Figure 11. Sediment Concentrations of Dioxin and Furan Isomers at the Pettit Flume, 2000 (pg/g).

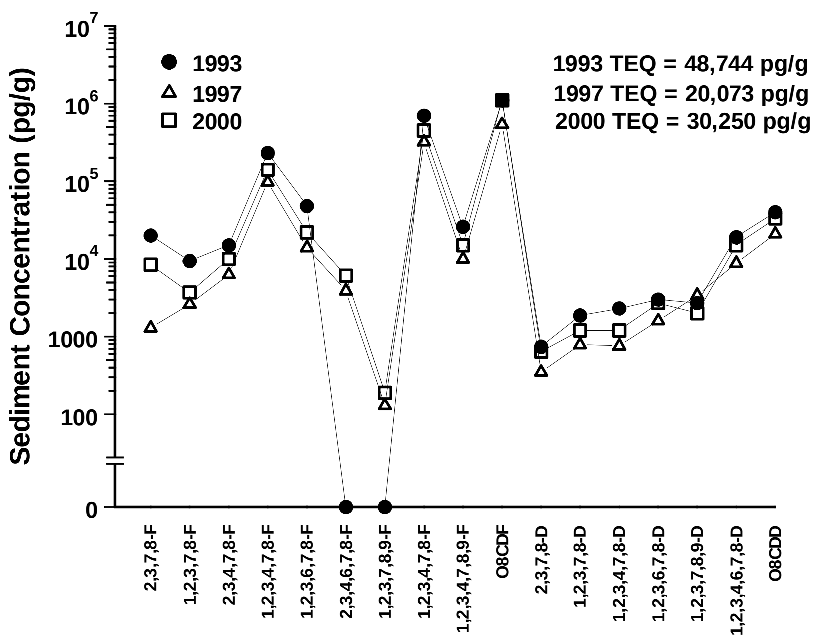


Table 1. Eighteen "Priority Toxics" Identified in the Niagara River Toxics Management Plan (NRTMP).

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 2000/01.

		Fort Erie				Niagara-on-the-Lake			
Chemical	Period of record	Concentration % change		Load % change		Concentration % change		Load % change	
		Dissolved	Susp. Part.	Dissolved	Susp. Part.	Dissolved	Susp. Part.	Dissolved	Susp. Part.
Chlorobenzenes (CBs)									
Hexachlorobenzene	1986-2001	--	--	--	--	-72.2	-41.2	-79.1	-80.7
Organochlorine Pesticides (OCs) & PCBS									
a-chlordane	1986-2001	--	-70.2	--	-87.2	-53.9	-58.0	-66.8	-86.3
g-chlordane	1986-2001	--	--	--	--	--	--	--	--
p,p'-DDT	1986-2001	--	-80.5	--	-89.7	--	-62.7	--	-87.8
o,p'-DDT	1986-2001	--	--	--	--	--	--	--	--
p,p'-TDE	1986-2001	-71.7	-54.1	-78.4	-75.7	-74.7	-54.8	-81.0	-85.2
p,p'-DDE	1986-2001	-67.6	-66.7	-72.5	-82.4	-58.9	-42.1	-69.1	-81.1
Dieldrin	1986-2001	-70.4	-76.1	-77.4	-87.3	-71.6	-76.8	-78.6	-92.4
Mirex	1986-2001	--	--	--	--	--	-27.6	--	-76.3
PCBs	1986-2001	NC	-51.2	NC	-74.2	NC	-51.2	NC	-84.0
Polynuclear Aromatic Hydrocarbons (PAHs)									
Benz(a)anthracene	1986-2001	-79.3	-23.1	-84.2	-59.4	-65.1	-25.1	-73.7	-75.5
Benzo(a)pyrene	1986-2001	--	+129.6	--	-21.4	-77.8	+55.2	-83.3	-49.2
Benzo(b/k)fluoranthene	1986-2001	-50.8	+86.8	-62.4	-1.22	NS	NS	NS	NS
Chrysene-triphenylene	1986-2001	-57.9	NS	-67.8	NS	-33.6	NS	-50.0	NS
Industrial By-products									
Octachlorostyrene	1989-2001	--	--	--	--	--	-91.3	--	-94.1
Trace Metals in Whole Water		Whole Water Concentration % Change		Whole Water Load % Change		Whole Water Concentration % Change		Whole Water Load % Change	
Lead	1986-2001	-65.9		-74.3		-80.3		-85.2	
Arsenic	1986-2001	NS		NS		NS		NS	
Mercury	1986-1997	*		*		*		*	

Notes:

NC Dissolved phase concentrations and loads not calculated because of known contamination problems with dissolved phase data.
NS No significant ($p<0.001$) trend was detected by the model for the period of record.
-- Too few values above the detection limit to run the model.
* Analysis of mercury in water was discontinued in 1996/97 pending achievement of more sensitive detection limit.

Table 3. Summary of the Presence/Absence of Organochlorine Pesticides, PCBs, Industrial Compounds and Chlorinated Benzenes in Caged Mussels in the Niagara River.

Canadian Sites	***Contaminant*** ($_{(t)}$ - Trace concentrations, interpret with caution)
Fort Erie at Robertson Street[1, 2]	pp'-DDE$_{(t)}$, pentachlorobenzene$_{(t)}$[3]
Boyers Creek (mouth)	
Chippawa Channel[1, 2]	
Niagara-on-the-Lake[1]	PCBs$_{(t)}$, pp'-DDE$_{(t)}$
Lyons Creek	PCBs$_{(t)}$, pp'-DDE$_{(t)}$, pentachlorobenzene$_{(t)}$[3]
US Sites	***Contaminant*** ($_{(t)}$ - Trace concentrations, interpret with caution)
Buffalo River	pp'-DDE$_{(t)}$, PCBs$_{(t)}$
Tonawanda Channel	pp'-DDE$_{(t)}$, PCBs$_{(t)}$ pentachlorobenzene$_{(t)}$
Tonawanda Channel (upstream of Two Mile Ck)	pp'-DDE$_{(t)}$, PCBs$_{(t),}$ pentachlorobenzene$_{(t)}$
Two Mile Creek (mouth)[2]	pp'-DDE$_{(t)}$,PCBs$_{(t)}$
Pettit Flume (upstream)[1, 2]	pp'-DDE$_{(t)}$, PCBs$_{(t)}$
Pettit Flume (site B)[1, 2]	pp'-DDE$_{(t)}$, PCBs$_{(t)}$, HCB$_{(t)}$, **pentachlorobenzene**, 1,2,3,4-tetrachlorobenzene$_{(t)}$, 1,2,3,5-tetrachlorobenzene$_{(t)}$, 2,3,6-trichlorotoluene$_{(t).}$
Pettit Flume (downstream)[1, 2]	pp'-DDE$_{(t)}$, PCBs$_{(t)}$
Gratwick/Riverside Park (upstream)	pp'-DDE$_{(t)}$, PCBs$_{(t)}$
Gratwick/Riverside Park	pp'-DDE$_{(t)}$, PCBs$_{(t)}$
102nd Street Landfill (upstream)	pp'-DDE$_{(t)}$, PCBs$_{(t)}$
102nd Street Landfill	pp'-DDE$_{(t)}$, PCBs$_{(t)}$
Upstream (Occidental) Sewer A	pp'-DDE$_{(t)}$, PCBs$_{(t)}$
(Occidental) Sewer A	PCBs$_{(t)}$, HCB$_{(t)}$
(Occidental) Sewer B	PCBs$_{(t)}$, HCB$_{(t)}$
(Occidental) - between Sewer B and Sewer C	PCBs$_{(t)}$, HCB$_{(t)}$
(Occidental) Sewer C	PCBs$_{(t)}$, **HCB**
(Occidental) - (between Sewer C and Sewer 003)	b-BHC$_{(t)}$, g-chlordane$_{(t)}$, **PCBs**, pp'-DDE$_{(t)}$, hexachlorobutadiene$_{(t)}$, **HCB**, octachlorostyrene$_{(t)}$, pentachlorobenzene$_{(t)}$, 1,2,3,4-tetrachlorobenzene$_{(t)}$, 1,2,4,5-tetrachlorobenzene$_{(t)}$
Occidental Sewer 003	g-chlordane$_{(t)}$, **pp'-DDE**, PCBs$_{(t)}$, **hexachlorobutadiene, HCB, pentachlorobenzene, 1,2,3,4-tetrachlorobenzene**,1,2,4,5-tetrachlorobenzene$_{(t)}$,1,2,3,5-tetrachlorobenzene$_{(t,}$, 1,3,5-trichlorobenzene$_{(t)}$, 2,3,6-trichlorotoluene$_{(t)}$, 2,4,5-trichlorotoluene$_{(t)}$

Table 3 (cont'd). Summary of the Presence/Absence of Organochlorine Pesticides, PCBs, Industrial Compounds and Chlorinated Benzenes in Caged Mussels in the Niagara River.

Occidental - Storm Sewer	pp'-DDE$_{(t)}$, PCBs$_{(t)}$, hexachlorobutadiene$_{(t)}$, HCB$_{(t)}$ pentachlorobenzene$_{(t)}$, 2,3,6-trichlorotoluene$_{(t)}$, 2,4,5-trichlorotoluene$_{(t)}$, 1,2,3,4-tetrachlorobenzene$_{(t)}$
Gill Creek (upstream)[2]	α-**BHC**, β-BHC$_{(t)}$, γ-BHC$_{(t)}$, PCBs$_{(t)}$, pp'-DDE$_{(t)}$,
Gill Creek (mouth)	α-BHC$_{(t)}$, pp'-DDE$_{(t)}$, PCBs$_{(t)}$, **hexachlorobutadiene**, 1,3,5-trichlorobenzene$_{(t)}$
Bloody Run Creek (upstream)[1, 2]	pp'-DDE$_{(t)}$, pentachlorobenzene$_{(t)}$, 2,3,6-trichlorotoluene$_{(t)}$,
Bloody Run Creek[1, 2]	β-BHC$_{(t)}$, pp'-DDE$_{(t)}$, PCBs$_{(t)}$, **hexachlorobutadiene**, **HCB, pentachlorobenzene**, **2,3,6-trichlorotoluene**, 2,4,5-trichlorotoluene$_{(t)}$, 1,2,3,4-tetrachlorobenzene$_{(t)}$, 1,2,3,5-tetrachlorobenzene$_{(t)}$, 1,2,4,5-tetrachlorobenzene$_{(t)}$, 1,3,5-trichlorobenzene$_{(t)}$,dichlorobenzly chloride$_{(t)}$
Bloody Run Creek (downstream)	pp'-DDE$_{(t)}$, PCBs$_{(t)}$, HCB$_{(t)}$ pentachlorobenzene$_{(t)}$, 2,3,6-trichlorotoluene$_{(t)}$

Bolded Values > trace.
[1] Composite mussel sample (4 mussels) for dioxins and furan analysis.
[2] Sediment samples collected for dioxin and furan analysis.
[3] Detected in only one mussel (out of six or more caged mussels) at this site.

Table 4. Contaminant Concentrations (wet weight) Exceeding Protective Wildlife Criteria in Young-of-Year Fish from the Niagara River and U.S. Tributaries, 1997.

Locations	Criteria	PCB 100 [2], 110 [4]	Mirex 100 [5], 330 [3], 373 [4] < detect. limit [2]	HCH[11] 100 [3], 510 [4]	2,3,7,8-TCDD 3.0 [3], 2.3 [4]	2,3,7,8-chloro Dioxin & Furan Congener TEQ 3.0 [3], 2.3 [4] **(pg/g)**	Total TEQ [6] 2.3[4] **(pg/g)**
	Contaminant	PCB Aroclors **(ng/g)**	Mirex **(ng/g)**	HCH **(ng/g)**	2,3,7,8-TCDD **(pg/g)**		
	Species [1]						
Niagara River - Strawberry Island	BN, ST, ES	-	-	-	-	-	-
- Beaver Island State Park	ST, ES	-	3.2	-	-	-	-
- North Grand Island Bridge	ST	-	-	-	-	-	-
- Lewiston	BN, ST	-	-	-	-	-	-
-**Pettit Flume**	ST	-	0.29	-	-	4.07[4.31][7]	5.81[6.05]
-Gratwick-Riverside Park	BN	259(22.3)[8]	-	-	-	3.39[3.64]	4.62[4.87]
Little River - > Cayuga Creek	BN	105(20.7)	1.7	-	-	5.41[5.47]	5.82[5.88]
- < Cayuga Creek	BN	193(20.9)	9.3	-	4.1, 2.7 [9]	6.87	7.43[7.56]
Cayuga Creek, Porter Rd.	BN	191(46.6)	97.3(5.3)	-	-	-	-
- Cayuga Drive	BN	126(28.7)	9.2	-	2.7 [9, 10]	2.53	3.75[3.76]
- **Bergholtz Creek**	BN	594(22.4)	-	-	-	-	30.35[30.83]
Cayuga Creek, - Lindberg Avenue	BN	184(28.3)	12.3	-	5.9, 5.4[9]	5.77[5.80]	7.35[7.38]
	BN	226	2.0	-	-	-	

Locations	Criteria	PCB 100 [2], 110 [4]	Mirex 100 [5], 330 [3], 373 [4] < detect. limit [2]	HCH[11] 100 [3], 510 [4]	2,3,7,8-TCDD 3.0 [3], 2.3 [4]	2,3,7,8-chloro Dioxin & Furan Congener TEQ 3.0 [3], 2.3 [4] **(pg/g)**	Total TEQ [6] 2.3[4] **(pg/g)**
	Contaminant	PCB Aroclors **(ng/g)**	Mirex **(ng/g)**	HCH **(ng/g)**	2,3,7,8-TCDD **(pg/g)**		
	Species [1]						
-**Gill Creek** 15A							**-**
-**Gill Creek** 15B	BN	2190(981)	2.5	104 [295]	-	-	**-**

[1] Species: ST - spottail shiner, BN - bluntnose minnow, ES - emerald shiner
[2] Level in fish suggested to protect piscivorous wildlife (GLWQA 1987) – not a regulatory standard
[3] NYS DEC non-carcinogenic criterion for the protection of fish-consuming wildlife (Newell *et al.* 1987)
[4] NYS DEC 1:100 dietary cancer risk criterion for mink (Newell *et al.* 1987)
[5] FDA level suggested to protect people who consume fish
[6] Total TEQ = sum PCB TEQ and 2,3,7,8-dibenzo-p-dioxin and furan congeners TEQ
[7] [ ] -includes Estimated Maximum Possible Concentration (EMPC) values
[8] (SD) - standard deviation
[9] One outlier value omitted
[10] Two other composites from this site had values of <1.4 and 2.1, both less than the 2.3 pg/g criterion
[11] Values are not mean but represent individual composites

Table 5. Concentrations of Selected Organochlorine Contaminants in Spottail Shiners (*Notropis hudsonius*) from Canadian and U.S. Sites in the Upper and Lower Niagara River, 1999, 2000 and 2001 (ng/g, wet weight).

Sampling Site	Year	n	Total Length (mm)	Lipid (%)	PCB (ng/g)	DDT (ng/g)	Mirex (ng/g)	OCS (ng/g)	HCB (ng/g)
<u>Upper Niagara River</u>									
Canada									
Fort Erie	1999	5	54-5	1.1-0.5	44-9	8-3	ND	ND	ND
	2000	5	52-4	2.1-0.6	76-17	8-2	ND	ND	ND
	2001	5		2.5-0.4	28-11	10-3	ND	ND	ND
Frenchman's Creek	1999	5	55-6	0.9-0.2	36-9	8-5	ND	ND	ND
	2000	4	56-7	2.7-0.7	60-0	7-2	ND	ND	ND
	2001	5		2.3-0.4	28-11	7-2	ND	ND	ND
U. S.									
Wheatfield	1999	5	64-2	2.2-0.6	220-42	4-1	ND	ND	ND
	2000	5	57-2	2.9-0.4	212-23	2-3	ND	2-1	2-0
	2001	5		3.2-0.4	168-18	9-2	ND	ND	2-0
102nd Street	1999	5	66-5	3.3-0.6	236-46	6-3	ND	2-0	2-0
	2000	3	65-4	4.5-0.7	207-42	6-2	ND	3-1	3-1
	2001	5		3.7-0.4	132-41	7-2	ND	ND	2-1
Cayuga Creek	1999	5	57-5	2.7-0.6	216-36	8-3	ND	1-0	3-2
	2000	5 *	49-3	2.8-0.1	220-58	8-3	ND	2-1	2-0
	2001	5		2.8-0.9	216-79	11-4	ND	ND	3-1
Grand Island Bridge	2001	5	63-3	3.9-0.3	116-26	6-2	ND	ND	2-1
Search and Rescue	2001	5		2.8-0.8	84-17	4-1	ND	ND	ND
<u>Lower Niagara River</u>									
Canada									
Queenston	1999	5	61-4	1.6-0.2	92-22	10-5	ND	ND	ND
	2000	5	58-4	3.5-0.2	104-9	16-5	ND	1-0	3-1
	2001	5		3.6-0.9	68-23	16-13	ND	ND	1-0
Niagara-on-the-Lake	1999	5	61-6	1.6-0.2	104-26	12-6	ND	ND	ND
	2000	5	61-3	5.3-0.5	116-33	23-8	ND	3-1	5-1
	2001	5		2.5-0.4	84-30	18-6	ND	ND	1-1
U. S.									
Lewiston	1999	5	60-6	1.7-0.6	100-20	6-3	ND	ND	ND
	2000	1	58-0	4.4-0	80-0	10-0	ND	2-0	4-0
	2001	5		3.4-0.9	60-14	10-3	ND	ND	1-1
Youngstown	1999	5	57-5	2.4-0.5	112-17	16-5	ND	ND	ND
	2000	3	64-7	4.4-0.2	153-70	32-18	ND	2-0	7-6
	2001	5		2.9-0.2	72-18	13-5	ND	ND	2-1

*Common Shiner

Table 6. Ratio of the "Differential Load" to the Load to Lake Ontario for NRTMP "Priority Toxics".

	86-87	87-88	88-89	89-90	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	Mean
Organics[1]																
Mirex	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	1.0	1.0	1.0	**1.0**
Octachlorostyrene (OCS)				1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	**1.0**
Hexachlorobenzene (HCB)	0.9	0.9	0.8	0.9	0.8	0.8	0.8	0.6	0.8	0.8	0.8	0.8	0.8	0.7	0.7	**0.8**
Benzo(a)pyrene [B(a)P]	1.0	0.5	0.7	0.7	0.5	0.5	0.4	0.6	0.4	0.4	0.6	0.6	0.7	0.5	-0.8	**0.5**
Benzo(b/k)fluoranthene	0.6	0.5	0.6	0.6	0.5	0.5	0.4	0.5	0.4	0.5	0.6	0.7	0.7	0.5	-0.7	**0.5**
Benz(a)anthracene	0.2	0.5	0.6	0.6	0.4	0.5	0.5	0.6	0.4	0.5	0.6	0.6	0.8	0.6	-0.8	**0.4**
Chrysene/Triphenylene	0.2	0.4	0.6	0.5	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.7	0.7	0.5	-0.7	**0.4**
Total Chlordane (a- + g-)	0.0	0.5	0.9	0.3	0.0	0.3	0.4	0.4	0.4	1.0	0.8	0.4	-0.1		-0.2	**0.4**
Dieldrin	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.2	-0.1	-0.3	**0.0**
ppDDE	-3.8	-2.0	-0.4	-0.3	-0.4	-0.6	-0.8	-1.3	-0.4	-0.6	-0.2	-1.2	-0.7	-0.6	-1.7	**-1.0**
ppDDT	-2.2	-1.1	0.3	-5.5	-2.3	0.0	-0.4	-0.2	-0.6	-0.6	-3.4	-0.1	-0.3	0.1	-1.2	**-1.2**
ppTDE	-1.9	-1.3	-2.9	-0.9	-0.6	-1.0	-1.1	-1.0	-0.7	-0.3	-3.1	-2.0	-0.6	-0.7	-0.6	**-1.2**
PCBs	**not calculated[3]**															
Metals[2]																
Arsenic	0.20	0.12	0.12	0.20	0.13	0.17	0.06	0.04	0.07	0.11	0.08	0.09	0.02	-0.04	0.00	**0.1**
Pb	0.16	0.12	-0.41	0.28	0.42	-0.78	0.38	0.09	-0.40	0.24	0.20	0.33	-0.50	-0.26	0.61	**0.0**
Hg		**NA[4]**														

1 RWW Concentrations
2 Whole water concentrations
3 No dissolved phase PCB data due to contamination problems
4 Not Available

Table 7. Comparison of the 1999/2000 and 2000/01 Upstream/Downstream Program Upper 90% Confidence Interval Data to the Most Stringent Agency Water Quality Criteria (ng/L).

Parameter	Pre-1998 Criteria	1998 Criteria	Agency	Upper 90% CI (RWW Concentrations - ng/L) 1999/2000 FE	1999/2000 NOTL	2000/01 FE	2000/01 NOTL
Total Chlordane	2	0.02	NYSDEC	0.009	0.017	**0.028**	0.019
Mirex	1.0	0.001	NYSDEC	ND	**0.015**	ND	**0.007**
Dieldrin	1	0.0006	NYSDEC	**0.110**	**0.100**	**0.131**	**0.120**
HCB	20	0.03	NYSDEC	0.024	**0.091**	0.022	**0.061**
ppDDT		0.01	NYSDEC	**0.020**	**0.040**	**0.098**	**0.027**
ppTDE		0.08	NYSDEC	0.061	0.035	0.059	0.031
ppDDE		0.007	NYSDEC	**0.061**	**0.039**	**0.097**	**0.029**
Total DDT	1.0	0.011	NYSDEC	0.143	0.127	0.258	0.090
PCBs*	0.0006	0.001	NYSDEC	NC	NC	NC	NC
OCS		0.006	NYSDEC	ND	0.006	ND	0.002
Benz(a)anthracene	0.4	0.4	MOE (proposed)	**0.583**	**1.361**	**3.467**	**1.325**
Benzo(b/k)fluoranthene[1]	0.2	0.2	MOE (proposed)	**1.883**	**3.856**	**11.077**	**4.496**
Chrysene/Triphenylene[2]	0.1	0.1	MOE (proposed)	**0.964**	**1.987**	**4.704**	**1.786**
B(a)P	1.2	1.2	NYSDEC	0.774	**1.727**	**4.894**	**1.860**
As (ug/L)	5	5	MOE (proposed)	0.693	0.672	0.784	0.668
Hg (ug/L)	20	0.7	NYSDEC	NA	NA	NA	NA
Pb (ug/L)	2.5	2.5	USEPA	1.548	1.041	0.721	1.412

RWW = Recombinded Whole Water
ND = not detected
NC = not calculated bcause of dissolved phase contamination problems
NA = not analyzed
bolded values represent Water Quality Criteria exceedences
[1] Criterion is for benzo(k)fluoranthene
[2] Criterion is for Chrysene

Table 8. Surface Water Quality Criteria for Niagara River Toxics Management Plan "Priority Toxics and Lake Ontario LaMP Critical Pollutants (ug/L).

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		0.0038		0.23		0.03		0.0004(p)		0.002			
Benzo(a)pyrene	0.0012	0.0038								0.002			
Benzo(b)fluoranthene		0.0038								0.002			
Benzo(k)fluoranthene		0.0038						0.0002(p)		0.002			
Chrysene		0.0038						0.0001(p)		0.002			
Chlordane	**2E-5**	8.0E-4	0.006		2.4		0.0043	0.06	0.06	**0.05**			
p,p'-DDD	**8E-5**	3.1E-4	see DDT					see DDT	see DDT	**0.3**			see DDT
p,p'-DDE	**7E-6**	2.2E-4	see DDT					see DDT	see DDT	**0.2**			see DDT
p,p'-DDT	**1E-5**	2.2E-4	0.001[e]		1.1		0.001	0.003[e]	0.003[e]	**0.2**			**1.1E-5**[e]
Dieldrin	**6E-7**[f]	5.2E-5	0.004[f]	**0.24**	0.24	**0.056**	0.056	0.001[f]	0.001[f]	**0.004**			
Dioxins/dibenzofurans	**6E-10**[g]	5.0E-9[h]						2E-8(p)[g]		**7E-7**[g]			**3.1E-9**[h]
Hexachlorobenzene	**3E-5**	2.8E-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]			**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**	6.4E-5	0.001				0.014	0.001		**0.09**			**1.2E-4**	
Tetrachloroethylene	1	0.69						50		0.7				
Toxaphene	**6E-6**	2.8E-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: 2002. Office of Science and Technology, Washington, DC. November, 2002 (http://www.epa.gov/waterscience/pc/revcom.pdf).
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. Applies 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 ng/g 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 ng/g = {1.46203 - [ln (hardenss in ppm) (0.145712)]} exp (1.273[ln(hardness in ppm)] - 4.297).
Acute value in ng/g = {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 9. Sport Fish Consumption Advisories for the Upper and Lower Niagara Rivers from the 2003-2004 Guide to Eating Ontario Sport Fish.

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)
Lake Ontario										
Upper Niagara River	Rainbow Trout[5]			X	X	X	X			
	Northern Pike[2]			X	X	X	X	X	X	X
	Smallmouth Bass[5,7]	X	X	X	X	4	4			
	Largemouth Bass[2]	X	X	X	X	4				
	Yellow Perch[5]	X	X	X	X					
	White Perch[5]	X								
	White Bass[5]	4								
	Rock Bass[5]	X	X							
	Brown Bullhead[2,7]	X	X	X	X					
	Carp[2,7]			X	X	X	X	4	2	2
	Freshwater Drum[5,7]		X	X	X	X	X			
	White Sucker[5]	X	X	X	X	X	4			
	Redhorse Sucker[1]	X	X	X	X	X	X	4		
	Rainbow Smelt[2]	4								
Lower Niagara River	Chinnook[5]								4	2
	Rainbow Trout[5,7,8,9]				X	X	X	4	4	4
	Brown Trout[2]						X	X	4	
	Lake Trout[5]						1	1	1	1
	Smallmouth Bass[5,7]	X	X	X	X	4	4			
	Largemouth Bass[2]		X	X	X	4				
	Yellow Perch[5,7]	X	X	4	4					
	White Perch[2]	X	X	1	Y					
	White Bass[5]	X	X	X	X	1				
	Rock Bass[2,7]	X	X	4						
	Bluegill[2]	X								
	Brown Bullhead[3,7]		X	X	X	4				
	Channel Catfish[5]							X	4	4
	Freshwater Drum[5,7]	X	X	X	X	X	X			
	Carp[2,7]					X	X	X	4	2
	White Sucker[5]			X	X	4	4			
	Redhorse Sucker[5]			X	4	2	2			
	American Eel[5,7]							4	4	4
	Rainbow Smelt[2]	2								

X = Consumption of no more than eight meals per month for the general population. Women of childbearing age and children under 15 are advised to consume only the fish represented by this symbol and to consume no more than four meals per month

Y = None of these fish should be consumed in any amount by anyone.

1 - 4 = Number of advised meals per month. Women of child bearing age and children under 15 are advised not to consume these fish in any amount.

NOTE: A meal is considered to be 227 grams (8 ounces).

Contaminants Analyzed (Superscripts)

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 mtals
7 Dioxins and furans
8 Mercury, PCBs, mirex/photomirex, pesticides chlorinated phenols and chlorinated benzen
9 Polynuclear aromatic hydrocarbons (PAHs)

Table 10. New York State Advisories on the Consumption of Sportfish for Waters of the Niagara River and its U. S. tributaries (NYSDOH 2002).

Water	Species	Recommendation*	Chemical of Concern
Niagara River, above Niagara Falls	Carp	Eat no more than one meal per month	PCBs
Niagara River, below Niagara Falls	American eel, channel catfish, carp, lake trout over 25", brown trout over 20", chinook salmon, white perch	Eat none	PCBs, mirex, dioxin
	Smallmouth bass, rainbow trout, white sucker, lake trout less than 25", brown trout less than 20", coho salmon over 25"	Eat no more than one meal per month	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

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

- Eat no more than one meal (one-half pound) per week of fish from any New York fresh water.
- Women of childbearing age, infants and children under age 15 years should not eat any fish species from the waters listed above.
- Observe the above restrictions in tributaries of the above waters to the first impassable barrier impassable by fish.

Follow trimming and cooking advice described in NYSDOH (2002).

NIAGARA RIVER TOXICS MANAGEMENT PLAN (NRTMP) ANNUAL WORK PLAN [2003]

The Four Parties: EPA =United States Environmental Protection Agency
DEC =New York State Department of Environmental Conservation
EC =Environment Canada
MOE =Ontario Ministry of the Environment

	ACTIVITY AND COMMENTS	EPA	DEC	EC	MOE	COMMITMENTS 2002	COMMITMENTS 2003	STATUS
Controlling Point Sources								
A.	Report on U.S. Point Sources		X			Periodically	Periodically	Ongoing; see comments
	Comments: As of 2003 all regulated facilities in the Niagara River basin are in substantial compliance with State Pollutant Discharge Elimination System (SPDES) permits.							
B.	Report on Canadian Point Sources				X	-	-	Ongoing; see comments
	Comments: Regulatory monitoring and reporting of Ontario point sources as required by Certificates of Approval and Clean Water regulations will continue.							
C.	Report on actions to further address U.S. point sources discharging NRTMP Priority Toxics.	X	X			Beginning 2002	Update in 2003	Ongoing
	Comments: In 2000-2001, DEC/EPA conducted an assessment of information on NRTMP Priority Toxic Chemical discharges to help prioritize further actions. Among the priorities identified were: the regulatory review and revision, as necessary, of existing permits, the investigation of contaminants associated with wet-weather overflows from the Falls Street Tunnel (FST); and, nonregulatory or voluntary pollution prevention programs to further reduce contamination. Permit reviews and revision occur routinely according to programmatic schedules. See ***Monitoring****, item G, for details. Nonregulatory and innovative voluntary pollution prevention activities have been implemented locally by DEC, Erie and Niagara counties, and various non-governmental organizations.*							
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]	X	X			May 2002	June 2003	Completed

ACTIVITY AND COMMENTS	EPA	DEC	EC	MOE	COMMITMENTS 2002	2003	STATUS
2. Remediate Occidental Chemical-Buffalo Ave							Completed
a. Complete overburden groundwater collection system		X			-	-	
b. Enhance bedrock groundwater collection system		X			-	-	Completed
c. Complete remediation of contaminated soils and off-site groundwater		X			-	See comments	
d. Issue Corrective Measures Implementation (CMI) Permit		X			-	-	Completed
e. Biomonitor effectiveness of remediation using caged mussels				X	2003	2003	Completed 2000 mussel biomonitoring report. Next field survey scheduled for 2003
Comments: 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. After a public comment period, the final permit became effective February 10, 2000. The field survey to biomonitor effectiveness of remediation using caged mussels was completed by MOE in August 2000. The next survey is scheduled for 2003.							
3. Remediate Niagara County Refuse Disposal							Completed; operation and maintenance ongoing
a. Complete construction of site remedy	X				-	-	
4. Remediate DuPont, Necco Park site							
a. Start construction of final site remedy	X				Nov 2001	-	Ongoing
b. Complete Final Remedy	X				Nov 2005	Nov 2005	See comments
Comments: Remedial design is underway including the installation of additional groundwater wells, which began September 2000. However, recent progress on the design and construction of the remedy has been delayed due to disagreements between EPA and Dupont over technical aspects of the design. EPA and Dupont are working to resolve the issue. See EPA/DEC's ***Reduction of Toxics Loadings to the Niagara River from Hazardous Waste Sites in the United States: June 2003,*** *Appendix A, for details.*							

ACTIVITY AND COMMENTS	EPA	DEC	EC	MOE	COMMITMENTS 2002	2003	STATUS
5. Remediate Hyde Park Site							
a. Complete additional remedial measures as necessary to achieve hydraulic containment	X				-	June 2003	See comments
b. Optimize well pumping rates and evaluate the containment of contaminated groundwater. Monitor groundwater level and conduct chemical sampling	X				Ongoing	Ongoing	See comments
c. Complete all remedial systems	X				-	June 2003	See comments
d. Conduct annual survey of gorge-face seeps	X				-	July 2003	See comments
e. Sample groundwater seeps coming from Niagara River Gorge face and analyze for toxic chemicals.	X				-	June 2002	See comments
f. Conduct ecological risk screening of contamination at mouth of Bloody Run Creek	X				-	Dec 2003	See comments
g. Biomonitor effectiveness of remediation using caged mussels				X	2003	2003	Completed 2000 mussel biomonitoring report. Next field survey scheduled for 2003

Comments: Most site construction is complete with all overburden groundwater being contained, and in the three bedrock groundwater zones, approximately 96% of contaminated groundwater being contained. Remedial work to achieve full containment is continuing. Pumping wells installed in 1998-2000 did not achieve all required inward hydraulic gradients, and a groundwater model was used to locate five additional extraction wells, installed in 2001. Annual gorge face surveying and seep sampling 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 indicated possible continuing concerns due to dioxin contamination. Biomonitoring data from 2000 showed that concentrations of dioxins and furans in mussels at the mouth of Bloody Run Creek were lower than concentrations detected in 1994, 1995 and 1997. However, calculated TEQs were still considered high based on samples collected at uncontaminated sites. Risk screening of this contamination by EPA indicated human health risk to be within its acceptable risk range. EPA will complete an ecological risk screening by December 2003. See EPA/DEC's ***Reduction of Toxics Loadings to the Niagara River from Hazardous Waste Sites in the United States: June 2003,*** *for further details.*

ACTIVITY AND COMMENTS	EPA	DEC	EC	MOE	COMMITMENTS 2002	2003	STATUS
6. Remediate 102nd Street							
a. Complete containment system, including barrier wall, drainage system, landfill cap	X				-	-	Completed
b. Complete leachate pumping system	X				-	-	Completed Dec 1998
c. Complete site landscaping and optimization of the pump-and-treat system	X				-	-	Completed Mar 1999
d. Monitor groundwater level to ensure effectiveness of remedial systems	X				Ongoing	Ongoing	Ongoing
e. Biomonitor effectiveness of remediation using caged mussels				X	2003	2003	Completed 2000 mussel biomonitoring report. Next field survey scheduled for 2003
7. Remediate Occidental Chemical, S-Area	X				-	-	
a. Finish building new City of Niagara Falls Drinking Water Treatment Plant (DWTP)							Fully operational
b. Demolish existing DWTP	X				-	-	Completed
c. Construct eastern barrier wall	X				-	-	Completed
d. Complete cap and overburden drain collection system for the old DWTP property	X				-	-	Completed
e. Secure DWTP intake structures, including grouting raw water intake	X				-	-	Completed
f. Install final landfill cap	X				May 2002	-	Completed
g. Optimize well pumping rates to prevent contaminated groundwater from leaving site.	X				2002	2004	See comments
h. Biomonitor effectiveness of remediation using caged mussels				X	2003	2003	Completed 2000 report. Next field survey scheduled for 2003

ACTIVITY AND COMMENTS	EPA	DEC	EC	MOE	COMMITMENTS 2002	2003	STATUS
Comments: Completion of the Remedial Action has been delayed due to the improper installation of a portion of the drain collection system. The system was replaced in 1999-2000 and construction of the final landfill cap was completed in August 2002. Securement of the raw water intake structure from the old DWTP, including the grouting of the 5,000-foot long bedrock tunnel was completed in August 2002. Construction activities for the site are completed. Evaluation and adjustments of the remedial systems are currently being performed.							
8. Remediate Solvent Chemical Site							
a. Complete remedial design		X			-	-	Completed
b. Construct site remedy		X			-	-	Completed
c. Complete remedial action		X			Dec 2002	-	Completed; see comments
d. Begin performance monitoring		X				2003	See comments
Comments: Construction of the groundwater extraction and treatment systems were completed in 2001, but treatment system modifications were required in early 2002. The remedial system became fully operational in December 2002. A performance monitoring program will begin in 2003.							
9. Remediate Olin plant site							
a. Monitor effectiveness of remedial systems	X	X			Ongoing	Ongoing	Ongoing
b. Biomonitor effectiveness of remediation using caged mussels				X	2003	2003	Completed 2000 mussel biomonitoring report. Next field survey scheduled for 2003
10. Remediate Buffalo Color Corporation site		X			-	-	Completed
a. Complete site investigation							
b. Select site remedy		X			Apr 2002	Aug 2003	See comments
c. Implement site remedy		X			delayed	July 2004	See comments
Comments:. Public notice and implementation of the final remedy has been delayed due to BCC's Chapter 11 Bankruptcy filing in Oct 2002. Buffalo Color and Honeywell, a PRP, have recently come to an agreement regarding financial arrangements for implementation of the remedial measures. However, this agreement requires the approval of the Bankruptcy Court and the issuance of a Consent Order by the NYSDEC. The overall schedule for corrective action is dependant on these actions as well as on field conditions required. See EPA/DEC's ***Reduction of Toxics Loadings to the Niagara River from Hazardous Waste Sites in the United States: June 2003,*** *Appendix A, for more information.*							

ACTIVITY AND COMMENTS	EPA	DEC	EC	MOE	COMMITMENTS 2002	2003	STATUS
11. Remediate Bethlehem Steel site	X	X					See comments
a. Complete site investigation					July 2002	Dec 2003	
b. Select site remedy	X	X			Oct 2003	Oct 2005	See comments
c. Begin implementation of site remedy	X	X			Dec 2004	Mar 2007	See comments
Comments: Due to delays caused by several problems (see EPA/DEC's ***Reduction of Toxics Loadings to the Niagara River from Hazardous Waste Sites in the United States: June 2003,*** *Appendix A, for more information), the proposed schedule, and all target dates, were extended. EPA has removed approximately 102 acres of the facility from the RFI Order to facilitate brownfields type redevelopment. This acreage is not believed to be significantly contaminated and may be suitable for redevelopment. BSC and DEC are negotiating a Work Plan for the investigation of the 102 acre parcel.*							
12. Remediate Gratwick Riverside Park site		X			-	-	Completed Dec 2000
a. Complete construction of site remedy							
b. Biomonitor effectiveness of remediation using caged mussels				X	2003	2003	Completed 2000 mussel biomonitoring report. Next field survey scheduled for 2003
13. Remediate Occidental Chemical Durez - North Tonawanda site		X			-	-	Completed
a. Complete construction of site remedy							
b. Assess contamination in Pettit Flume Cove		X			-	-	See comments
c. Biomonitor effectiveness of remediation using caged mussels				X	2003	2003	Completed 2000 mussel biomonitoring report. Next field survey scheduled in 2003
Comments: The July 2000 mussel biomonitoring study again detected high concentrations of dioxins and furans in deployed mussels and sediment collected from Pettit Flume. Additional assessment of Pettit Flume Cove will be done in conjunction with OCC's long-term operation, maintenance and monitoring plan, as well as MOE's ongoing biomonitoring program.							

	ACTIVITY AND COMMENTS	EPA	DEC	EC	MOE	COMMITMENTS 2002	2003	STATUS
	14. Determine whether trace amounts of contaminants of concern found at 5 landfills are moving to groundwater off-site			X	X	Ongoing	Ongoing	Ongoing; see comments
	Comments: 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; however, regulatory monitoring and reporting of these non-point sources as required by certificates of approval will continue.							
B.	Contaminated Sediments							
	Update NY Great Lake Contaminated Sediment Inventory		X			Annually	Annually	Update completed Mar 2001
Monitoring								
A.	Complete report on results of Upstream/Downstream sampling	X	X	X	X	-	-	1999/00 and 2000/01 report in preparation
B.	Collect juvenile spottail shiners or other juvenile fish and analyze for toxic chemicals, according to Monitoring Plan		X		X	See comments	2003	Next MOE and DEC surveys scheduled for 2003; MOE technical summary of 2000 and 2001 data completed
	*Comments: In the fall of 2000, 2001 and 2002 MOE collected juvenile fish on both the Canadian and US sides of the Niagara River. Technical summaries. A technical summary of the 2000 and 2001 sampling is completed and presented in the **2003 NRTMP Progress Report**. In August 2002, DEC published its summary of its 1997 sampling of YOY fish in near shore areas of New York's Great Lake Basin.*							
C.	Track down toxic chemicals in tributaries and sewer systems to identify sources	X	X			Update in 2003	Annual updates	See comments
	1. Perform post-remediation sediment sampling of Gill Creek		X				2003	See comments
	2. Perform follow-up trackdown-related sampling in Two-Mile Creek		X				2003	See comments
	3. Perform sediment sampling in Cayuga Creek and Little Niagara River		X				2003	See comments

	ACTIVITY AND COMMENTS	EPA	DEC	EC	MOE	COMMITMENTS 2002	2003	STATUS
	Comments: DEC and EPA are working cooperatively to oversee the implementation of New York State Great Lakes basin source trackdown work, including Lake Ontario, Lake Erie, and the Niagara River. Through DEC/EPA's assessment of past data collected in the Niagara River and U.S. tributaries, several priority areas were identified for follow-up monitoring and are scheduled for track-down and/or post-remediation sampling in 2003 by DEC. Additional trackdown-related sampling may be funded through the Great Lakes National Program Office's FY 2003-2004 Request for Proposals. Trackdown related proposals received in response to this Request are currently being reviewed.							
D.	Biomonitor using caged mussels and analyze for toxic chemicals, according to Monitoring Plan.				X	2003	2003	Completed 2000 mussel biomonitoring report. Next survey scheduled for 2003
E.	Study use of zebra and quagga mussels as biomonitors.				X	2002	2003	Study completed; journal article to be submitted for review and publication.
F.	Assess sport fishery in Niagara River, with contaminant analysis.		X		X	2002	2003	Ongoing. 2003-2004 *Guide to Eating Ontario Sport Fish* released in March 2003. NYS DOH's *Health Advisories: Chemicals in Game and Sportfish* issued annually.
	Comments: MOE collections from the upper and lower Niagara River completed in fall of 2002; next field collection scheduled for 2003. Contaminant trend analysis (1970-2000) in preparation, with results anticipated to be reported in the 2004 NRTMP Progress Report. The next NYS Niagara River sampling has yet to be determined.							
G.	Collect sample of Falls Street Tunnel (FST) wet weather discharge and analyze for NRTMP priority chemicals using techniques to achieve low detection levels.		X			2002	-	Completed. See comments
	Comments: Wet and dry weather sampling conducted by DEC indicate the presence of certain NRTMP toxics (PCBs and dioxin/furans). Since all flows <10 mgd are being routed through the City of Niagara Falls' Wastewater Treatment Plant, only extreme wet weather flows currently discharge into the Niagara River. In early 2003, the SPDES permit for the Plant was modified to include new requirements to control discharges from its outfalls, including the FST (see also the 2003 ***NRTMP Progress Report****, Section 5.0: US Trackdown Initiatives).*							

	ACTIVITY AND COMMENTS	EPA	DEC	EC	MOE	COMMITMENTS 2002	2003	STATUS
H	Develop plans for additional assessment of low-level contaminant discharges from Niagara River point sources.	X	X			Update in 2003	Annual updates	See comments
	Comments: DEC/EPA's 1999 assessment of recent available information on toxic contaminant discharges from Niagara River point sources indicate the need for additional assessment of low-level contaminant discharges from point sources in the Niagara River. The purpose would be to help determine additional priorities for control of contaminant discharges from point sources. DEC/EPA are evaluating approaches for such an assessment and will provide an update in 2004.							
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	X	X	X	X	Update in 2003	Annual updates as necessary	See comments
	Comments: DEC/EPA have completed three synthesis assessments, utilizing a variety of data sources to address: ambient toxic concentrations, and the significance of Niagara River sources; point sources of toxics; and characterization of toxic contaminants in sediments, biota and water of the Niagara River and its tributaries. Information and recommended actions from this synthesis effort were included in the 2001 Progress Report. In the following years, DEC/EPA will update and report on synthesis related efforts as necessary. Additional information and plans are under development, including a Four-Party technical interpretive report on the US/DS Program and Biomonitoring Program, and a DEC report summarizing the results of tributary trackdown activities.							
B.	Develop plans addressing water-quality limiting chemicals.	X	X			Beginning 2002	-	See comments
	Comments: A DEC/EPA assessment of water quality in the Niagara River indicates exceedences of New York water quality standards for some NRTMP Priority Toxic Chemicals. Niagara River waters and tributaries have previously appeared on New York's annual list of water quality-impaired waters (i.e. the Clean Water Act Section 303(d) list) due to water quality standard exceedences of PCBs, dioxin, and mirex. In 2002, the Niagara River was additionally listed under Part 3 the 303(d) list (Waters Previously Listed But Requiring Re-Assessment Based on New Methodology) due to potential exceedences of most stringent applicable NYS standards for the following PAHs: benzo(a)pyrene, chrysene, benzo(b/k)fluoranthene, and indeno(123-cd)pyrene. Total Maximum Daily Loads/Wasteload Allocations/Load Allocations (TMDLs/WLAs/LAs) must be developed for waters on the 303(d) list. Since monitoring data suggest several of these exceedences can be attributed to Lake Erie sources, DEC and EPA have communicated their priorities to the Lake Erie Lakewide Management Plan committee to ensure that their future strategy to address toxic contamination in Lake Erie be consistent with, and incorporate NRTMP concerns.							

ACTIVITY AND COMMENTS		EPA	DEC	EC	MOE	COMMITMENTS 2002	2003	STATUS
Public Involvement								
A.	Develop a reader-friendly brochure that gives an overview of the NRTMP and summarizes progress made on restoring the Niagara River.	X	X	X	X	-	-	Completed
B.	Present remediation progress for U.S. hazardous waste sites at a public meeting in Niagara Falls.	X	X	X	X	2003	2004	See comments
	Comments: In June 2003 recent progress in the remediation of the U.S. hazardous waste sites will be summarized in the NRTMP/LO LaMP annual public meeting. See also ***Controlling Non-Point Sources****, item A1.*							
C.	Make NRTMP information and reports available on the Internet. Develop a NRTMP web page.	X	X	X	X	As available	As available	See comments
	*Comments: Summaries of recent Four Party Upstream/Downstream Reports can be found on the GLIMR web site at http://www.on.ec.gc.ca/glimr/search.html (search "joint evaluation"). U.S. wastesite reports (****Reduction of Toxics Loadings to the Niagara River from Hazardous Waste Sites in the United States****) from 1998 and NRTMP progress reports are at http://www.epa.gov/grtlakes/lakeont/nrtmp. Additional reports will be added as they become available.*							
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	X	X	X	X	2003	June 2003	Interim report released in June 2002. Next full report scheduled for 2003
E.	Hold a public meeting to present above progress and updated annual work plan	X	X	X	X	2003	June 2003	See comments
	Comments: In recent years, NRTMP and LO LaMP public meetings have been jointly held. In June 2003, the meeting will primarily focus on the NRTMP with the LO LaMP being the secondary component of the meeting. LO LaMP will be the primary focus in 2004 with the NRTMP being the secondary component of this meeting.							