CHICKASAW AND WILLOW LAKES
– DIOXIN STUDY REPORT–

Prepared for:

Louisville Metro Parks Department

Jefferson County, Kentucky

January 2005

Prepared by:

AMEC Earth & Environmental, Inc.
11003 Bluegrass Parkway, Suite 690
Louisville, KY 40299

TABLE OF CONTENTS

SECTION PAGE NO.

1.0 INTRODUCTION 1

1.1 Dioxin Sources 2
1.2 Previous Dioxin Studies in LMP Lakes 2
1.3 Purpose of Current Dioxin Study 4

2.0 METHODS 5

2.1 Field Sample Collection 5
2.2 Laboratory Analysis 5
2.3 Data Validation 6
2.4 Risk Assessment Analysis 6

3.0 RESULTS AND DISCUSSION 7

3.1 Sediment Sample Collection 7
3.2 Fish Sample Collection 9
3.3 Laboratory Analysis and Data Validation 9
3.4 Risk Assessment Analysis 9
3.3.1 Data Evaluation 10
3.3.3.1 Sediment 10
3.3.3.2 Fish Tissue 10
3.3.2 Fish Consumption Evaluation 11
3.3.2.1 Hazard Identification 11
3.3.2.2 Dose Response Assessment 11
3.3.2.3 Exposure Assessment 11
3.3.2.4 Risk Characterization 12

4.0 SUMMARY OF FINDINGS AND CONCLUSIONS 14

5.0 REFERENCES 15

6.0 ACRONYMS 16

TABLES

Fish Samples Collected and Processed for Dioxin Levels ..... Table 1
Summary of Sediment Analytical Results ..... Table 2
Summary of Chickasaw Lake Fish Tissue Analytical Results ..... Table 3
Summary of Willow Lake Fish Tissue Analytical Results ..... Table 4
Fish Consumption Risk Summary: Chickasaw Park Lake ..... Table 5
Fish Consumption Risk Summary: Willow Lake ..... Table 6

FIGURES

Figure 1. Chickasaw Lake 1
Figure 2. Willow Lake at Cherokee Park 1
Figure 3. Randomly Selected Sediment Sample Locations within Chickasaw Lake 7
Figure 4. Randomly Selected Sediment Sample Locations within Willow Lake 8

APPENDIX

Data Validation ..... Appendix A

1.0 INTRODUCTION

Consumption of fish from water bodies with elevated concentrations of "pollutants" has been a concern over the majority of the U.S. In fact, a 25 August 2004 Courier-Journal article reports that one-third of all U.S. lakes, and one-fourth of all rivers were deemed "unsafe" by the U.S. Environmental Protection Agency (USEPA). The Louisville Metro Parks (LMP) has a total of 22 fishing lakes in its jurisdiction, and has been evaluating dioxins for over a decade. Fish tissue and sediment testing for a variety of compounds including dioxins have occurred over the years. Dioxin concentrations in fish within Chickasaw Park Lake (**Figure 1**) and Willow Lake (**Figure 2**) in Cherokee Park is still being evaluated.

Figure 1. Chickasaw Lake

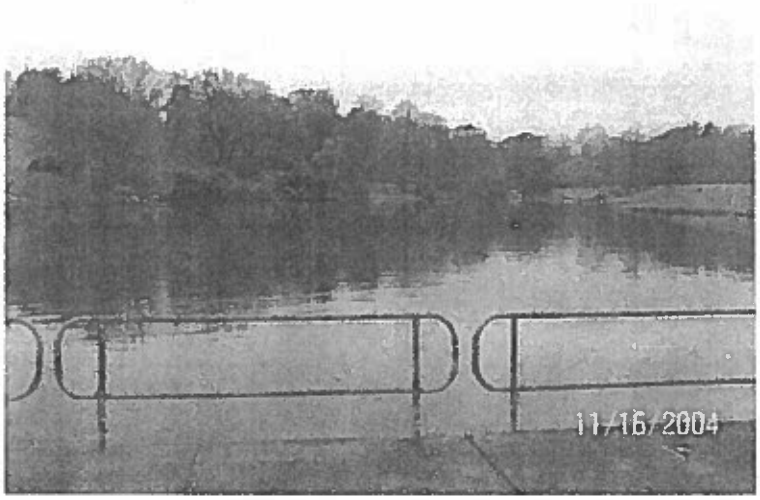

Figure 2. Willow Lake at Cherokee Park

1.1 Dioxin Sources

Dioxins refer to a group of chemical compounds with similar chemical structures and biological characteristics. There are 75 polychlorinated dibenzo-*p*-dioxin (PCDD) congeners and 135 polychlorinated dibenzofuran (PCDF) congeners. These compounds have varying toxicities and do not all pose the same risk. Only 17 congeners with at least four chlorine substitutions (at the 2,3,7, and 8 carbons) are reported to have potential health effects. The most toxic forms of dioxin are 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) and 1,2,3,7,8-pentachlorodibenzo-p-dioxin (PeCDD) (Van den Berg, 1998).

Dioxins form as result of combustion processes containing chlorine atoms including commercial or municipal waste incineration, burning fuels (wood, coal, or oil), burning household trash, natural forest fires, chlorine bleaching of pulp and paper, and cigarette smoke. When dioxins are released in the air, they can travel great distances before settling. Dioxins can settle in soil or sediments or be deposited on plants. Dioxins tend to accumulate in the fat of animals. Accumulation of dioxins through the food chain occurs through incidental ingestion of soils or sediments or consumption of food items containing dioxins.

1.2 Previous Dioxin Studies in LMP Lakes

The following historical information on the LMP lakes is a summary of the information packet provided by the LMP.

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are summarized in these studies using a 2,3,7,8-TCDD Toxic Equivalents (TEQ) approach. In this approach, the concentration for each congener is adjusted based on the Toxic Equivalency Factors (TEFs). The adjusted congeners are then summed by sample to calculate the TEQ for a given sample.

In 1988, two soil samples (one surface and one subsurface) were collected in Chickasaw Park to serve as background samples for comparison to the former Ashland Oil refinery, the adjacent property. Elevated petroleum related organic contaminants, lead, and aluminum levels were detected in the surface sample.

The Kentucky Department for Environmental Protection (KDEP) in 1995 was requested by the Justice Resource Center (JRC) to conduct an environmental investigation on the Ashland Oil refinery property, and to assess it for possible listing as a federal Superfund site. KDEP investigations ranked the site "low" for possible listing; however, groundwater and soil contamination was deemed a concern in the area. However, Chickasaw Park remained a concern due to nearby industry. State officials credit Rev. Louis Coleman, a local activist, for triggering additional tests. Coleman stated in the 19 December 1995 Courier-Journal article that the JRC, which he headed, had been concerned about people consuming fish in the lake and river for awhile. At that time, Kentucky Natural Resources and Environmental Protection Cabinet (KNREPC) agreed to a limited fish tissue analysis for Chickasaw Park Lake because of its close proximity to the old refinery and the 1988 background sediment samples.

In August 1995, a five pound carp and several crappie were collected for tissue analysis by the Kentucky Division of Water (KDOW), Ecological Support Section. Crappie tissue (i.e. composite sample) was tested for metals, polychlorinated biphenyls (PCBs), and pesticides, while the carp tissue was tested for the same constituents and dioxin. Analytical results showed no elevated

levels of metals, PCBs, or pesticides; however, dioxin levels in the carp resulted in a TEQ concentration of 243 parts per trillion (ppt). The Food and Drug Administration (FDA) action level for dioxin is 25 ppt. The dioxin tissue concentration correlates to a 1 in 10,000 risk of an incidence of cancer. KDEP suggests levels greater than 1 in 1,000,000 indicate a significant health concern.

Subsequent to this study, Kentucky Department of Fish and Wildlife Resources (KDFWR) and Kentucky Department of Health Services (KDHS), and KDOW advised fish caught should not be consumed until further information is available. After receiving the laboratory analysis report, KDOW collected sediment samples (December 1995) and planned to collect additional fish the following spring. Warning signs were posted at Chickasaw Park Lake advising citizens to not consume fish. Information was also issued to the public through an article in the Courier-Journal dated 19 December 1995, titled "Toxic Chemical Found in Fish at Chickasaw Park." A public hearing was conducted in early January 1996.

In February 1996, analysis of the sediment sample collected in December 1995 and a second test on the white crappie and carp tissue were completed. Risk analysis regarding consumption of these fish determined the reanalyzed carp to have an increased cancer risk of 8 in 100,000, while the white crappie had a 1 in 100,000 excess lifetime cancer risk. Sediment samples were 4.62 ppt, which is slightly above typical residential soil dioxin concentrations (3.91 ppt) (KDEP, 1996). Sediment and fish tissue dioxin congeners reported were not the same. For example, 2,3,7,8-TCDD was detected in fish tissue, while it was not in found in sediments. This inconsistency resulted in a concern for the source of these fish dioxin concentrations.

Through informal interviews with park staff and the general fishing public, the city determined all the lakes in the park system are subject to illegal stocking. Signs were immediately posted to advise the public of KRS 150.180(7) (that states: No person may at any time stock any species of fish secured from any source into the public waters of the Commonwealth without first securing a permit from the commissioner). In order to ascertain the source of the fish dioxins, Ohio River Valley Water Sanitation Commission (ORSANCO) was contacted to see if their Ohio River studies could shed some light on the issue. The type and concentration of dioxin congeners found in the ORSANCO study correlated with what was found in the Chickasaw Lake fish, which indicated illegal stocking. Based on these findings, a fish kill in Chickasaw Park Lake was instituted to remove all contaminated fish. Two weeks later, minnows were introduced to control mosquitoes. The lake was restocked (no records of species stocked were available), and fish were not tested for dioxin levels prior to their introduction into Chickasaw Park Lake.

ADVENT Environmental, Inc. (ADVENT) was contracted to develop an Environmental Management Plan and to sample sediment and fish in Chickasaw Park Lake. Six sediment samples were collected in March 1997. Five of the six samples did not indicate an elevated human health risk greater than 1 in 1, 000,000 (KDEP established risk level). The sixth sample was just slightly greater than the KDEP established risk level 1.09 in 1,000,000. No significant cancer risk was identified with fish consumption exposures related to sediment samples (ADVENT, 1997).

In June 1998, ADVENT collected one bass, one bluegill, and one carp from Chickasaw Park Lake for dioxin tissue analysis. Carp had a toxic equivalency (TEQ) concentration of 0.074 picograms of dioxin per gram (pg/g). Dioxins were not detected in the bass or bluegill. Carp were not restocked in Chickasaw Park Lake after the fish kill, thus the dioxin source is still unknown. The risk- based concentration is 0.0691 pg dioxin TEQ/g fish tissues, therefore fish

consumption was found to pose no significant health risk. However, carp consumption was of a concern due to a lack of source knowledge (ADVENT, 1998).

Since illegal stocking was believed to be occurring in all LMP lakes, fish sampling of ten city lakes was employed by ADVENT, with the aid of KDFWR, in August 1999. The lakes sampled included: Long Run Park, Cherokee Park (Willow Lake), Fisherman's Park, Chickasaw Park, Watterson Park, Tom Wallace Park, McNeely Park, Vettiner Golf Course, Waverly Park (Bobby Nichols Golf Course) and Iroquois Park. A variety of fish species were obtained including bass, bluegill, catfish, crappie, carp, and goldfish (ADVENT, 1999).

Post analysis recommendations from ADVENT suggested fish consumption postings could be removed, however carp may still be a problem in Cherokee Park, Watterson Park, Long Run Park, and McNeely Park. ADVENT suggested additional fish and sediment analyses at the conclusion of their study (ADVENT, 1999).

1.3 Purpose of Current Dioxin Study

LMP wanted to reinstitute fish and sediment sampling for dioxin to monitor human health risks associated with fish consumption. The objectives of this study were (1) to evaluate the level of dioxins present in the Chickasaw and Willow Lake fish tissue and sediment and (2) to determine if this level may result in an elevated human health risk.

2.0 METHODS

Detailed methods for field sample collection, data validation, and risk assessment analysis were provided in the *Chickasaw and Willow Lake Dioxin Lake Study Work Plan* (AMEC, 2004). A summary of these methods is provided below.

2.1 Field Sample Collection

Fish sampling procedures were consistent with the following protocols:

- *Chapter 9 and 10* of the Kentucky Department for Environmental Protection (KYDEP), Division of Water, Methods for Assessing Biological Integrity of Surface Waters in Kentucky (2002);
- *Volume 1* of the USEPA, Guidance for Assessing Chemical Contamination Data for use in Fish Advisories, 3rd Edition (2000); and
- *Chapter 8* of the US Environmental Protection Agency (USEPA), Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, 2nd Edition (1999).

Sample collection was conducted on 16 November 2004 with the aid of KDOW. Fish were collected by electroshocking, weighed and measured, wrapped in aluminum foil, placed into labeled freezer bags, and finally preserved in a cooler with dry ice. Individual sediment grab samples were obtained using a hand auger. Two composite sediment (shallow and deep) samples were formed from the respective grab samples. Sediment grabs were placed in a decontaminated stainless steel bowl and mixed prior to placing sediment into a 1 liter glass sample bottle. Bottles were stored in a cooler with ice.

Sample coolers were shipped within 24 hours to Pace Analytical Services, Inc. (Pace), Minneapolis, Minnesota under chain of custody (COC) procedures. Copies of the field records and relevant instructions for preparation of fish composites were sent to the laboratory with the samples.

2.2 Laboratory Analysis

Fish samples were prepared and analyzed in accordance with USEPA (2000) guidance. Sample processing (filleting, homogenizing, compositing) was done in an appropriate laboratory area free of organic contaminants. A portion of the homogenized sample was taken for lipid analysis by extraction with methylene chloride (NOAA, 1993). Results were reported on a wet-weight basis.

Fish samples were extracted and analyzed by high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS) for PCDDs/PCDFs. USEPA Method 8290 (USEPA, 1994) procedures for tissue sample preparation and extract clean up were followed and requirements for quality assurance/quality control (QA/QC) were implemented. Sediment samples were prepared and analyzed for PCDDs/PCDFs in accordance with Method 8290 (USEPA, 1994) procedures for sediments.

Pace provided a full report for all samples. This included results and reporting limits for field samples and associated QA measurements, both in an electronic and hard copy form. Hard

copies of sample preparation records, instrument run logs and records for percent lipid and moisture determination were provided along with raw data for the analyses of standards, QA samples and field samples.

2.3 Data Validation

Laboratory data were validated in accordance with USEPA (2002) guidance. During this process, results and records were reviewed to assess the laboratory's compliance with method requirements and the overall quality and usability of the data. QA/QC procedures required by the method (USEPA, 2002) were followed and results indicated acceptable precision and accuracy (Appendix A).

2.4 Risk Assessment Analysis

Validated tissue data was used in calculating potential risk to humans from consumption of fish in both Chickasaw and Willow Lakes. Risk calculations were performed using the methods described in USEPA (2000) that provides guidance for developing risk-based consumption limits. Fish tissue PCDD/PCDF concentrations were summarized by lake and by fish species. Percent lipids for each sample were used to develop lipid-adjusted concentrations.

As described above, a TEQ was calculated for fish and sediment samples using individual congener results and the current World Health Organization TEFs (Van den Berg et al., 1998). Concentrations of TEQ in sediments were qualitatively compared to tissue concentrations in fish in each lake to evaluate the possibility of site related sources of PCDDs/PCDFs.

3.0 RESULTS AND DISCUSSION

3.1 Sediment Sample Collection

Two surface sediment samples (e.g., a shallow and deep sediment sample) were collected in both Chickasaw and Willow lakes. Sediment composite samples were comprised of 4-5 grab samples. A sediment model was used to determine the locations of sediment grabs within Chickasaw (**Figure 3**) and Willow (**Figure 4**) lakes needed for a representative sediment sample. Locations randomly selected by the sediment model often overlapped in the same general area. In these areas, one sediment grab sample was obtained. Sediment from both lakes consisted of mucky, gleyed, unconsolidated clay material.

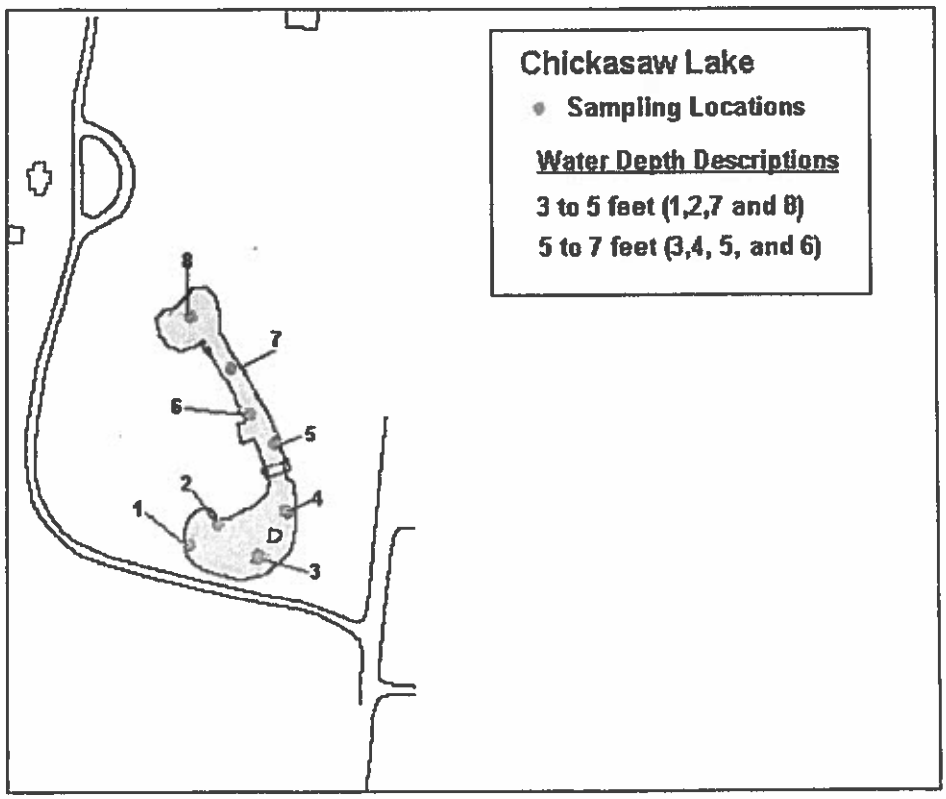

Figure 3. Randomly Selected Sediment Sample Locations within Chickasaw Lake

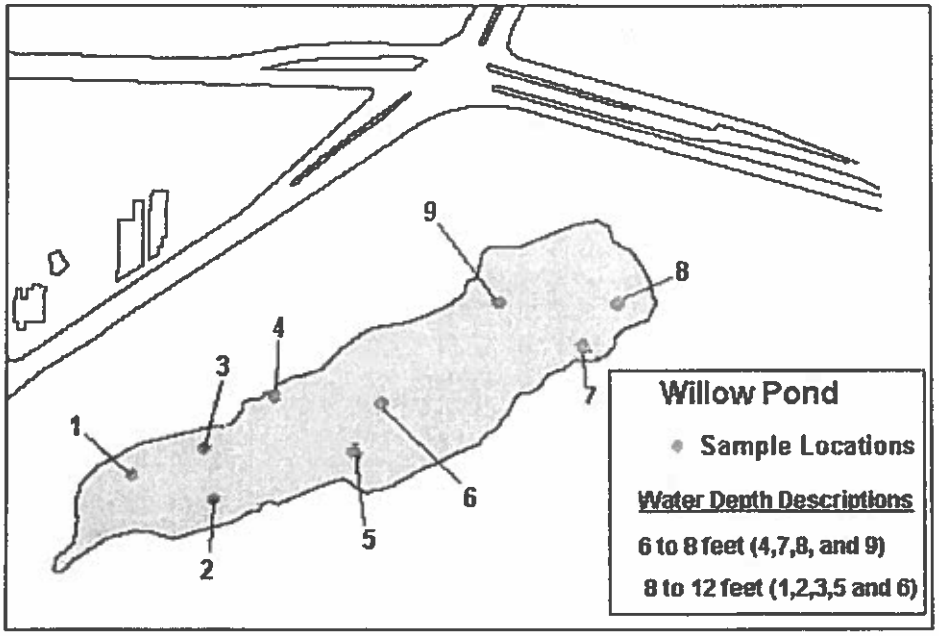

Figure 4. Randomly Selected Sediment Sample Locations within Willow Lake

3.2 Fish Sample Collection

Samples of three different fish species were obtained for both Chickasaw and Willow lakes. Composite samples were obtained when individuals were of the same species and met the following requirement: minimum size fish/maximum size fish *100 > 75% (KDEP, 2000). The goal was to obtain a species in each of the three trophic classes (a bottom feeder, a mid-level predator, and top-level predator). A mid-level predator could not be obtained in Willow Lake; thus two top-level predator composite samples were collected. Fish species and sample descriptions are found in **Table 1**.

3.3 Laboratory Analysis and Data Validation

Results for PCDDs and PCDFs were validated in accordance with the U.S. EPA Draft National Functional Guidelines for Dioxin/Furan Data Validation (1996) and the U. S. EPA Region IV Data Validation Standard Operating Procedure for PCDDs/PCDFs. QA/QC procedures required by the method were followed and results indicated acceptable precision and accuracy. Findings of the validation focus on three review elements: method blank detection, compound quantification and reported detection limits, and target compound identification.

The low level method blank results reported for OCDD in the fish are potentially attributable to background levels in the laboratory and have been qualified as non-detected with slightly elevated reporting limits. Results as qualified are acceptable for use in risk assessments for the sediments and fish.

Pace reports PCDDs and PCDFs with default reporting limits rather than sample specific, analyte specific detection limits based on signal to noise as specified by the method. As a result, there is in limited instances evidence of the presence of a non-reported PCDD or PCDF at levels below the default reporting limit used. It should also be noted that use of reporting limits rather than sample detection limits for risk assessments might result in an overestimate of potential risks. Reporting limits are conservatively used in risk analysis.

In the Chickasaw Lake largemouth bass composite (C2), 2,3,7,8-TCDF is reported as an estimated maximum possible concentration (EMPC) value. The peak did not meet criteria for positive identification of TCDF because of interferences, but it is possible that some TCDF is present. The EMPC value should be used with the understanding that it is biased high to an unknown degree. This may also result in an overestimate of potential risks. Refer to Appendix A for additional information pertaining to the data validation.

3.4 Risk Assessment Analysis

Validated tissue data were used in calculating potential risk to humans from consumption of fish in both Chickasaw Park and Willow Lakes. Risk calculations were performed using the methods described in USEPA (2000) that provides guidance for developing risk-based consumption limits. Both concentration of 2,3,7,8-TCDD toxicity equivalent (TEQ) in fish and estimated fish consumption risks will be evaluated using two methods for assessing non-detects in the data. The first applies one-half the reporting limit (RL) for non-detect congeners. This method is conservative for two reasons: 1) since the congeners may not be present at all in the sediment, using the RL may potentially overestimate risks and, 2) in this evaluation, RLs are used instead of detection limits (DLs) and RLs are typically greater than DLs. The second method is less conservative, using zero to represent non-detect congeners in a given sample. Both are summarized in the results.

3.3.1 Data Evaluation

Results are summarized by medium and by lake. To compare results from one fish species to another, or within one species in different lakes, percent lipids for each fish sample was used to develop lipid-adjusted concentrations. A summary of the sediment dioxin results is provided in **Table 2.** Dioxin results for fish tissue from Chickasaw and Willow Lakes are provided in **Table 3** and **Table 4.**

3.3.3.1 Sediment

Three congeners (1,2,3,4,7,8-HxCDD, 1,2,3,7,8-PeCDD, and, 1,2,3,7,8,9-HxCDF) were not detected in any of the samples in sediment from either lake (Table 2). Generally, PCDDs were detected more frequently across shallow and deep samples from both lakes, however all TEQ results were fairly consistent across lakes.

Chickasaw Park Lake Sediments. A TEQ of 2.47 ppt was estimated from sediment results in the *shallow* area of Chickasaw Park Lake using ½ RL for non-detects. This estimate is below the National Background level of 5.3 ppt (USEPA 2003), which was also estimated using a similar approach for non-detects. The resulting TEQ when assuming zero for non-detect results is 1.28 ppt, based on the 4 detected congeners.

The TEQ estimate (3.69 ppt) for the *deep* sediment sample is slightly higher than for the *shallow*, using ½ RL for non-detects, however the estimated TEQ is still below the National Background value. When calculating the TEQ using only the seven detected congeners, the resulting TEQ is 2.57 ppt.

Willow Lake Sediments. Using ½ RL for non-detects, a TEQ of 5.2 ppt was estimated using sediment results from the *shallow* area of Willow Lake. This estimate is just below the National Background level of 5.3 ppt (USEPA 2003). As only three congeners were non-detect, the resulting TEQ when assuming zero for non-detect results is similar (4.61 ppt).

The TEQ estimate (1.37 ppt) for the *deep* sediment sample, using ½ RL for non-detects, is lower than for the *shallow*. The estimated TEQ for the four detected congeners is 0.14 ppt.

3.3.3.2 Fish Tissue

The only congener detected in any fish in either lake was 2,3,7,8-TCDF (Table 3 and Table 4). Results for each sample are discussed below. The catfish results (C1 and W1) are consistent between the lakes, while the largemouth bass had detected TEQ in Chickasaw Park Lake but not in Willow Lake. These results suggest that PCDD/PCDF concentrations in the two lake systems are not present at levels of concern for human health.

Chickasaw Park Lake Fish. The TEQ for the catfish sample in Chickasaw Park Lake (C1) was estimated at 0.52 ppt using ½ RL for non-detects (Table 3). The TEQ for the only detected congener for the same sample is 0.02 ppt. Both estimates are well below the National Finfish Background value of 1.3 ppt (USEPA, 2003). The percent lipid for C1 is reported at 3.9%. As such, the resulting lipid-normalized TEQ for the detected congener is 0.62 ppt.

Using ½ RL for non-detected congeners, the resulting TEQ for largemouth bass (C2) is 0.50 ppt. A TEQ of 0.01 ppt was calculated for the only detected congener. The lipid normalized TEQ for the detected congener is 4.33 ppt, using the percent lipid reported for C2 of 0.3%.

The bluegill (C3) were analyzed and the resulting TEQ (using ½ RL for non-detects) is 0.51 (0.01 ppt when using zero for non-detects). A lipid-normalized TEQ of 0.25 ppt was estimated by applying the percent lipid reported for the sample of 4%.

Willow Lake Fish. Although the sediment TEQ concentrations are reportedly higher in Willow Lake than in Chickasaw Park Lake, all fish tissue results were reported as non-detects for the warmouth and largemouth bass samples (W2 and W3, respectively) (Table 4).

Laboratory analysis of catfish (W1) collected from Willow Lake results in an estimated TEQ of 0.50 ppt (using ½ RL for non-detects) and 0.01 ppt (using only the detected congener). Again, these TEQ estimates are below the National Finfish Background value. Lipid-normalizing the detected congener with the reported percent lipid for the sample (2%) yields a TEQ of 0.42 ppt.

3.3.2 Fish Consumption Evaluation

The recently collected tissue concentrations were used to estimate the potential cancer risks to humans from consuming fish from either lake. These methods follow the four general components outlined in USEPA (2000) for the development of risk-based fish consumption limits.

1. Hazard Identification
2. Dose Response Assessment
3. Exposure Assessment
4. Risk Characterization

Application of each of these risk assessment steps is described in the subsequent sections.

3.3.2.1 Hazard Identification

In the Hazard Identification step, available analytical data are evaluated and constituents of potential concern (COPC) are selected for quantitative risk evaluation. PCDDs and PCDFs have been designated COPCs based on results of historical fish testing in both Chickasaw Park and Willow Lakes.

3.3.2.2 Dose Response Assessment

Dose response assessment evaluates possible correlation between exposure to COPCs (in this case PCDDs/PCDFs) and potential health effects in the population. For the purposes of this assessment, potential carcinogenic effects were estimated for potential exposure to dioxin/furan TEQ. In accordance with USEPA (2000), a cancer slope factor (CSF) of $1.56X10^5$ was used in risk estimates.

3.3.2.3 Exposure Assessment

Human exposure to TEQ via fish consumption in each lake were calculated using the following general equation, as recommended in USEPA (2000):

$$Em = \frac{[CmXCR]}{BW}$$

Where:

E*m* = estimated TEQ dose from ingestion of fish fillets (mg TEQ/kg body weight/day)
C*m* = concentration of TEQ in fish fillet (mg TEQ/kg fish
CR = average daily consumption rate of fish (kg fish / day)
BW = body weight of receptor

And Where:

CR = (Meal Size (kg) X Meals per Month) / Days per Month (30.44 days)

Exposure estimates were calculated for each fish species per lake. Since exposure is related to the amount of fish consumed and frequency of consumption, a range of exposure estimates are provided as a function of meals per unit time and the concentrations that are found in the sampled fish. An adult body weight of 70 kg and an average meal size of 8 ounces will be used in calculations, as recommended in USEPA (2000). Average daily consumption rates were calculated using eight "per month" frequency estimates (0.5, 1, 2, 3, 4, 8, 12, 16) and an average days per month value of 30.44 days.

3.3.2.4 Risk Characterization

According to USEPA (2000), the risk characterization step combines the dose response and exposure pieces of the assessment to evaluate the nature and extent of potential risks.

Potential risks will be calculated using the following equation.

$$Risk = EmXCSF$$

Where:

Risk = Estimated potential carcinogenic risk
E*m* = estimated TEQ dose from ingestion of fish fillets (mg TEQ/kg body weight/day)
CSF = Cancer Slope Factor (mg TEQ/kg body weight/day)$^{-1}$

As previously mentioned, individual fish consumption rates are variable in the general population, and therefore it is best to look at the range of potential risks as a function of the number of fish meals per unit time. This summary method is comparable to the logic applied in the USEPA (2000) guidance. The ranges of allowable TEQ concentrations in fish tissue in the Monthly Fish Consumption Limit Table are provided to cover these variable consumption rates (USEPA, 2000). Risk estimates are provided in **Tables 5** and **Table 6** for Chickasaw Park Lake and Willow Lake, respectively. They were compared to the risk level of 1 in 100,000 ($1X10^{-5}$) applied in setting fish consumption limits in USEPA (2000).

Since both sediments and fish tissue concentrations are below National Background levels, a strong link between potential sediment contamination and bioaccumulative effects in fish tissue is not apparent. In comparing lipid-normalized tissue results across species, catfish TEQ results were estimated at a lower concentration than the TEQ for largemouth bass and bluegill in Chickasaw Lake. As catfish are bottom feeders, they are expected to be in closer contact with the sediment than other mid- or top-level predators. If the source of the PCDDs/PCDFs found in the fish tissue was the lake sediment, the catfish would be expected to have a greater

concentration of TEQ in their tissue. This may suggest that the source of the dioxin in the fish may not be sediment-related.

Chickasaw Park Lake Fish Consumption. Based on measured data and the risk evaluation in this report, the consumption of bluegill from Chickasaw Park Lake will not result in a potential risk at a consumption rate of 16 meals per week (Table 5). Potential risks from consumption of Chickasaw Park Lake catfish and largemouth bass were estimated above the target level for consumption rates of two meals per month or more. However, as previously mentioned, using ½ the RL for non-detect results could potentially overestimate risks, to a greater degree than using the method detection limit (typically lower than the RL). Pace did not provide the complete method detection limits for every sample with the data reports. An even more conservative estimate was made regarding dietary fraction in fish consumption. Potential risks were estimated assuming that the entire fish diet (up to 16 meals per month for seventy years in one scenario) is from the lake in question. This is highly conservative, as it is unlikely that all meals of fish will come from one lake. Considering 2,3,7,8-TCDF was the only detected congener at all in the fish tissue samples, the method of applying zero for non-detects may be the appropriate estimate of risk in this evaluation. Using this method for potential risk estimates, consumption of catfish or largemouth bass at any of the consumption frequencies would not yield significant risks.

Willow Lake Fish Consumption. Potential risk from consumption of warmouth or largemouth bass was not estimated as no PCDDs/PCDFs were detected in their tissue (Table 6). Based on the measured data and the risk evaluation performed, consumption of catfish from Willow Lake would not result in a potential risk greater than the target level used to set consumption limits (USEPA, 2000) when evaluating the only detected congener in the tissue (2,3,7,8-TCDF). Even applying ½ the RL for non-detected congeners would result in elevated potential risks (in an order of magnitude greater than the target level) only for the highest consumption frequency evaluated.

Although a detailed comparison with previous results was not performed, AMEC noted that the methodology of calculating the TEQ using only detected congeners was applied in the 1999 and 1997 evaluations. TEQ estimates using this detect-only approach from fish tissue collected from both Chickasaw Park and Willow Lake are below the target risk level of $1X10^{-5}$, which is typically used in setting fish consumption limits (USEPA, 2000). In fact, the majority of the risk estimates were below the risk level of $1X10^{-6}$.

5.0 REFERENCES

ADVENT Environmental, Inc. June 1997. Environmental Management Report Chickasaw Lake. City of Louisville Office of Health and Environment and Louisville & Jefferson County Metropolitan Parks Department, Louisville, Kentucky.

ADVENT Environmental, Inc. September 1998. Memorandum. Report of Fish Tissue Sampling and Analysis, Chickasaw Park Lake, Louisville, Kentucky.

ADVENT Environmental, Inc. September 1999. Fish Tissue Sampling and Analysis: Jefferson County Metro Park Lakes. City of Louisville, Department of Health and Environment, Louisville, Kentucky.

AMEC, Earth & Environmental. October 2004. Chickasaw and Willow Lake: Dioxin Lake Study Work Plan. Louisville Metro Parks Department, Jefferson County, Kentucky.

Kentucky Department for Environmental Protection (KDEP). 7 March 1996. Office of Health and Environment Report on Chickasaw Neighborhood Health Issues to Environmental Policy/Culture & Historic Development Committee, Board of Alderman.

Kentucky Department for Environmental Protection (KDEP). July 2002. Methods for Assessing Biological Integrity of Surface Waters in Kentucky. Ecological Support Section, Division of Water, Frankfort, Kentucky.

Interagency Working Group on Dioxin (IWG). Updated 29 October 2004. Questions and Answers about Dioxins. Accessed 2 January 2005. http://www.cfsan.fda.gov/~lrd/dioxinqa.html

National Oceanic & Atmospheric Administration (NOAA). 1993. Sampling and Analytical Methods of the National Status and Trends Program. National Benthic Surveillance and Mussel Watch Projects. 1984-1992: Overview and Summary of Methods, Volume I. Technical Memorandum NOS ORCA 71.

United States Environmental Protection Agency (USEPA). 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, 2nd Edition. EPA 841-B-99-002.

United States Environmental Protection Agency (USEPA). 1994. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. SW-846 3rd Edition. Office of Solid Waste.

United States Environmental Protection Agency (USEPA). 2000. Guidance for Assessing Chemical Contaminant Data for Use In Fish Advisories, Volume 1: Fish Sampling and Analysis - Third Edition. EPA 823-B-00-007. November, 2000.

United States Environmental Protection Agency (USEPA). 2002. National Functional Guidelines for Chlorinated Dioxin/Furan Data Review. (EPA 540-R-02-003). March, 2002.

Van den Berg, M., L. Birnbaum, A.T.C. Bosveld, B. Brunstrom, P. Cook, M. Feeley, J. P. Giesy, A. Hanberg, R. Hasegawa, S.W. Kennedy, T. Kubiak, J.C. Larsen, F.X.R. van Leeuwen, A.K. D. Liem, C. Nolt, R.E. Peterson, L. Poellinger, S. Safe, D. Schrenk, D. Tillitt, M. Tysklind, M. Younes, F. Waern, and T. Zacharewski. 1998. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. Environ. Health Perspec. 106:775-792.

6.0 ACRONYMS

ADVENT	ADVENT Environmental, Inc.
COC	Chain of Custody
CSF	Cancer Slope Factor
FDA	Food and Drug Administration
HRGC/HRMS	High resolution gas chromatography/high resolution mass spectrometry
IWG	Interagency Working Group on Dioxin
JRC	Justice Resource Council
KDEP	Kentucky Department of Environmental Protection
KDFWR	Kentucky Department of Fish and Wildlife Resources
KDHS	Kentucky Department of Health Services
KDOW	Kentucky Division of Water
KNREPC	Kentucky Natural Resources and Environmental Protection Cabinet
KRS	Kentucky Revised Statutes
LMP	Louisville Metro Parks
NOAA	National Oceanic and Atmospheric Administration
ORSANCO	Ohio River Valley Water Sanitation Commission
Pace	Pace Analytical Services, Inc.
PCB	Polychlorinated biphenyls
PCDD	Polychlorinated dibenzo-*p*-dioxin
PCDF	Polychlorinated dibenzofuran
PeCDD	Pentachlorodibenzo-p-dioxin
ppt	Parts per trillion
QA/QC	Quality assurance/Quality control
TCDD	Tetrachlorodibenzo-p-dioxin
TEF	Toxic Equivalency Factors
TEQ	Toxicity equivalent
USEPA	United States Environmental Protection Agency

Table 1
Fish Samples Collected and Processed for Dioxin Levels
Chickasaw Park and Willow Lakes Project
Louisville, Kentucky

Species		Composite ID	Length (inches)	Weight (ounces)	Trophic Level
Common Name	Scientific Name				
Chickasaw Park Lake					
Channel Catfish	*Ictalurus punctatus*	C1	22	61	Bottom Feeder
			18.2	32	
Largemouth Bass	*Micropterus salmoides*	C2	10.4	8	Top-Level Predator
			11.9	14	
			10.5	6	
Bluegill	*Lepomis macrochirus*	C3	6.8	4	Mid-Level Predator
			6.3	3.5	
			6.3	3	
Willow Lake					
Blue Catfish	*Ictalurus furcatus*	W1	25.9	84	Bottom Feeder
Warmouth	*Lepomis gulosus*	W2	7.9	6	Top-Level Predator
			8	7	
			7.3	6	
Largemouth Bass	*Micropterus salmoides*	W3	15.9	32	Top-Level Predator
			13.1	17	
			13.5	19	

Table 2
Summary of Sediment Analytical Results
Chickasaw Park and Willow Lakes Project
Louisville, Kentucky

		Chickasaw ParkiLake						Willow Lake					
		Shallow			Deep			Shallow			Deep		
PCDD/PCDF (ng/kg)	TEF	Lab Result	Final TEC Result - Half RL	Final TEC Result - 0 RL	Lab Result	Final TEC Result - Half RL	Final TEC Result - 0 RL	Lab Result	Final TEC Result - Half RL	Final TEC Result - 0 RL	Lab Result	Final TEC Result - Half RL	Final TEC Result - 0 RL
PCDDs													
1,2,3,4,6,7,8-HpCDD	0.01	57	0.57	0.57	82	0.82	0.82	53	0.53	0.53	7.8	0.078	0.078
1,2,3,4,7,8-HxCDD	0.1	ND	0.05	0	ND	0.05	0	ND	0.05	0	ND	0.05	0
1,2,3,6,7,8-HxCDD	0.1	ND	0.05	0	1.4	0.14	0.14	1.9	0.19	0.19	ND	0.05	0
1,2,3,7,8,9-HxCDD	0.1	1.6	0.16	0.16	2.2	0.22	0.22	1.7	0.17	0.17	ND	0.05	0
1,2,3,7,8-PeCDD	1	ND	0.50	0	ND	0.50	0	ND	0.50	0	ND	0.50	0
2,3,7,8-TCDD	1	ND	0.11	0	ND	0.10	0	0.28	0.28	0.28	ND	0.10	0
OCDD	0.0001	5300	0.53	0.53	13000	1.3	1.3	2300	0.23	0.23	330	0.033	0.033
PCDFs													
1,2,3,4,6,7,8-HpCDF	0.01	ND	0.005	0	4.2	0.04	0.042	28	0.28	0.28	2.8	0.03	0.028
1,2,3,4,7,8,9-HpCDF	0.01	ND	0.005	0	ND	0.005	0	1.4	0.01	0.014	ND	0.005	0
1,2,3,4,7,8-HxCDF	0.1	ND	0.05	0	ND	0.05	0	7.1*	0.71	0.71	ND	0.05	0
1,2,3,6,7,8-HxCDF	0.1	ND	0.05	0	ND	0.05	0	4.8	0.48	0.48	ND	0.05	0
1,2,3,7,8,9-HxCDF	0.1	ND	0.05	0	ND	0.05	0	ND	0.05	0	ND	0.05	0
1,2,3,7,8-PeCDF	0.05	ND	0.02	0	ND	0.02	0	1.9	0.10	0.095	ND	0.02	0
2,3,4,6,7,8-HxCDF	0.1	ND	0.05	0	ND	0.05	0	1.8	0.18	0.18	ND	0.05	0
2,3,4,7,8-PeCDF	0.5	ND	0.25	0	ND	0.25	0	2.6	1.30	1.3	ND	0.25	0
2,3,7,8-TCDF	0.1	0.22	0.02	0.022	0.44	0.04	0.044	1.5	0.15	0.15	ND	0.01	0
OCDF	0.0001	ND	0.0001	0	6.2	0.0006	0.00062	37	0.0037	0.0037	4	0.0004	0.0004
TEQ			2.47	1.28		3.69	2.57		5.21	4.61		1.37	0.14

Notes:
Sediment concentrations are reported in dry weight.
TEF: Toxic Equivalency Factor; World Health Organization TEF form mammals (Van den Berg et al., 1998)
TEC: Toxic Equivalents Concentration (Lab Result * TEF)
TEQ: Toxic Equivalents (Sum of TECs)
Half RL - Concentration represents one-half the reporting limit
0 RL - Only detected congeners are used in summary calculations
* Value is Estimated Maximum Possible Concentration (EMPC). Validated as potentially biased high.

Table 3
Summary of Chickasaw Lake Fish Tissue Analytical Results
Chickasaw Park and Willow Lakes Project
Louisville, Kentucky

		C1: Catfish				C2: Largemouth Bas				C3: Bluegill			
		Bottom Feeder				Top-Level Predator				Mid-Level Predator			
		% Lipids: 3.9				% Lipids: 0.3				% Lipids: 4			
PCDD/PCDF (ng/kg)	TEF	Lab Result	Final TEC Result - Half RL	Final TEC Result - 0 RL	Final TEC Result Lipid Adj. - 0 RL	Lab Result	Final TEC Result - Half RL	Final TEC Result - 0 RL	Final TEC Result Lipid Adj. - 0 RL	Lab Result	Final TEC Result - Half RL	Final TEC Result - 0 RL	Final TEC Result Lipid Adj. - 0 RL
PCDDs													
1,2,3,4,6,7,8-HpCDD	0.01	ND	0.002	0	0.00	ND	0.00195	0	0	ND	0.002	0	0
1,2,3,4,7,8-HxCDD	0.1	ND	0.02	0	0.00	ND	0.0195	0	0	ND	0.02	0	0
1,2,3,6,7,8-HxCDD	0.1	ND	0.02	0	0.00	ND	0.0195	0	0	ND	0.02	0	0
1,2,3,7,8,9-HxCDD	0.1	ND	0.02	0	0.00	ND	0.0195	0	0	ND	0.02	0	0
1,2,3,7,8-PeCDD	1	ND	0.2	0	0.00	ND	0.195	0	0	ND	0.2	0	0
2,3,7,8-TCDD	1	ND	0.04	0	0.00	ND	0.0395	0	0	ND	0.04	0	0
OCDD	0.0001	ND*	0.00014	0	0.00	ND	4E-05	0	0	ND*	0.00009	0	0
PCDFs													
1,2,3,4,6,7,8-HpCDF	0.01	ND	0.002	0	0.00	ND	0.00195	0	0	ND	0.002	0	0
1,2,3,4,7,8,9-HpCDF	0.01	ND	0.002	0	0.00	ND	0.00195	0	0	ND	0.002	0	0
1,2,3,4,7,8-HxCDF	0.1	ND	0.02	0	0.00	ND	0.0195	0	0	ND	0.02	0	0
1,2,3,6,7,8-HxCDF	0.1	ND	0.02	0	0.00	ND	0.0195	0	0	ND	0.02	0	0
1,2,3,7,8,9-HxCDF	0.1	ND	0.02	0	0.00	ND	0.0195	0	0	ND	0.02	0	0
1,2,3,7,8-PeCDF	0.05	ND	0.01	0	0.00	ND	0.00975	0	0	ND	0.01	0	0
2,3,4,6,7,8-HxCDF	0.1	ND	0.02	0	0.00	ND	0.0195	0	0	ND	0.02	0	0
2,3,4,7,8-PeCDF	0.5	ND	0.1	0	0.00	ND	0.0975	0	0	ND	0.1	0	0
2,3,7,8-TCDF	0.1	0.24	0.024	0.024	0.62	0.13**	0.013	0.013	4.33	0.098	0.0098	0.0098	0.245
OCDF	0.0001	ND	0.00004	0	0.00	ND	0.00004	0	0	ND	0.00004	0	0
TEQ			0.52	0.02	0.62		0.50	0.01	4.33		0.51	0.01	0.25

Notes:
Tissue concentrations are reported in wet weight.
TEF: Toxic Equivalency Factor; World Health Organization TEF form mammals (Van den Berg et al., 1998)
TEC: Toxic Equivalents Concentration (Lab Result * TEF)
TEQ: Toxic Equivalents (Sum of TECs)
Half RL - Concentration represents one-half the reporting limit
0 RL - Only detected congeners are used in summary calculations

* OCDD was detected in the method blank. These results are used as non-detects with elevated reporting limits.
** Value is Estimated Maximum Possible Concentration (EMPC). Validated as potentially biased high.

Table 4
Summary of Willow Pond Fish Tissue Analytical Results
Chickasaw Park and Willow Lakes Project
Louisville, Kentucky

		W1: Catfish				W2: Warmouth Bass				W3: Largemouth Bass			
		Bottom Feeder				Top-Level Predator				Top-Level Predator			
		% Lipids: 2				% Lipids: 0.3				% Lipids: 0.4			
PCDD/PCDF (ng/kg)	TEF	Lab Result	Final TEC Result - Half RL	Final TEC Result - 0 RL	Final TEC Result Lipid Adj. - 0 RL	Lab Result	Final TEC Result - Half RL	Final TEC Result - 0 RL	Final TEC Result Lipid Adj. - 0 RL	Lab Result	Final TEC Result - Half RL	Final TEC Result - 0 RL	Final TEC Result Lipid Adj. - 0 RL
PCDDs													
1,2,3,4,6,7,8-HpCDD	0.01	ND	0.002	0	0.00	ND	0.002	0	0	ND	0.002	0	0
1,2,3,4,7,8-HxCDD	0.1	ND	0.02	0	0.00	ND	0.02	0	0	ND	0.02	0	0
1,2,3,6,7,8-HxCDD	0.1	ND	0.02	0	0.00	ND	0.02	0	0	ND	0.02	0	0
1,2,3,7,8,9-HxCDD	0.1	ND	0.02	0	0.00	ND	0.02	0	0	ND	0.02	0	0
1,2,3,7,8-PeCDD	1	ND	0.2	0	0.00	ND	0.2	0	0	ND	0.2	0	0
2,3,7,8-TCDD	1	ND	0.0395	0	0.00	ND	0.0395	0	0	ND	0.04	0	0
OCDD	0.0001	ND*	0.00005	0	0.00	ND	0.00004	0	0	ND*	0.00006	0	0
PCDFs													
1,2,3,4,6,7,8-HpCDF	0.01	ND	0.002	0	0.00	ND	0.002	0	0	ND	0.002	0	0
1,2,3,4,7,8,9-HpCDF	0.01	ND	0.002	0	0.00	ND	0.002	0	0	ND	0.002	0	0
1,2,3,4,7,8-HxCDF	0.1	ND	0.02	0	0.00	ND	0.02	0	0	ND	0.02	0	0
1,2,3,6,7,8-HxCDF	0.1	ND	0.02	0	0.00	ND	0.02	0	0	ND	0.02	0	0
1,2,3,7,8,9-HxCDF	0.1	ND	0.02	0	0.00	ND	0.02	0	0	ND	0.02	0	0
1,2,3,7,8-PeCDF	0.05	ND	0.01	0	0.00	ND	0.01	0	0	ND	0.01	0	0
2,3,4,6,7,8-HxCDF	0.1	ND	0.02	0	0.00	ND	0.02	0	0	ND	0.02	0	0
2,3,4,7,8-PeCDF	0.5	ND	0.1	0	0.00	ND	0.1	0	0	ND	0.1	0	0
2,3,7,8-TCDF	0.1	0.084	0.0084	0.0084	0.42	ND	0.004	0	0	ND	0.004	0	0
OCDF	0.0001	ND	0.00004	0	0.00	ND	0.00004	0	0	ND	0.00004	0	0
TEQ			0.50	0.01	0.42		0.50	0.00	0.00		0.49	0	0.00

Notes:
Tissue concentrations are reported in wet weight.
TEF: Toxic Equivalency Factor; World Health Organization TEF form mammals (Van den Berg et al., 1998)
TEC: Toxic Equivalents Concentration (Lab Result * TEF)
TEQ: Toxic Equivalents (Sum of TECs)
Half RL - Concentration represents one-half the reporting limit
0 RL - Only detected congeners are used in summary calculations

* OCDD was detected in the method blank. These results are used as non-detects with elevated reporting limits.
** Value is Estimated Maximum Possible Concentration (EMPC). Validated as potentially biased high.

Table 5
Fish Consumption Risk Summary
Chickasaw Park Lake
Chickasaw Park and Willow Lakes Project
Louisville, Kentucky

	Exposure Parameters						Catfish (C1)						Largemouth Bass (C2)					
							ND=1/2 RL			Detects Only			ND=1/2 RL			Detects Only		
Fish Meals per month	CSF (mg/kg-d)$^{-1}$	Body Weight (kg)	Meal Size (kg)	Days per Month	CF	CR (kg fish/d)	Cm (ng/kg)	Em (mg/kg-d)	Risk	Cm (ng/kg)	Em (mg/kg-d)	Risk	Cm (ng/kg)	Em (mg/kg-d)	Risk	Cm (ng/kg)	Em (mg/kg-d)	Risk
16	1.56E+05	70	0.227	30.44	1.00E-06	0.119	0.52	8.86E-10	1.4E-04	0.02	3.41E-11	5.3E-06	0.5	8.52E-10	1.3E-04	0.01	1.70E-11	2.7E-06
12	1.56E+05	70	0.227	30.44	1.00E-06	0.089	0.52	6.65E-10	1.0E-04	0.02	2.56E-11	4.0E-06	0.5	6.39E-10	1.0E-04	0.01	1.28E-11	2.0E-06
8	1.56E+05	70	0.227	30.44	1.00E-06	0.060	0.52	4.43E-10	6.9E-05	0.02	1.70E-11	2.7E-06	0.5	4.26E-10	6.6E-05	0.01	8.52E-12	1.3E-06
4	1.56E+05	70	0.227	30.44	1.00E-06	0.030	0.52	2.22E-10	3.5E-05	0.02	8.52E-12	1.3E-06	0.5	2.13E-10	3.3E-05	0.01	4.26E-12	6.6E-07
3	1.56E+05	70	0.227	30.44	1.00E-06	0.022	0.52	1.66E-10	2.6E-05	0.02	6.39E-12	1.0E-06	0.5	1.60E-10	2.5E-05	0.01	3.20E-12	5.0E-07
2	1.56E+05	70	0.227	30.44	1.00E-06	0.015	0.52	1.11E-10	1.7E-05	0.02	4.26E-12	6.6E-07	0.5	1.07E-10	1.7E-05	0.01	2.13E-12	3.3E-07
1	1.56E+05	70	0.227	30.44	1.00E-06	0.007	0.52	5.54E-11	8.6E-06	0.02	2.13E-12	3.3E-07	0.5	5.33E-11	8.3E-06	0.01	1.07E-12	1.7E-07
0.5	1.56E+05	70	0.227	30.44	1.00E-06	0.004	0.52	2.77E-11	4.3E-06	0.02	1.07E-12	1.7E-07	0.5	2.66E-11	4.2E-06	0.01	5.33E-13	8.3E-08

Notes:
CSF: Cancer Slope Factor
CF: Unit Conversion Factor. Converts fish ppt to fish ppm.
CR: Average daily fish consumption rate per day (kg fish/d) = (Meal Size X Meals/month)/Days/month
Cm: TEQ estimate using 1/2 RL for non-detect congeners
Em: Exposure Dose

Problem - they assume no accumulation (cancer - Life time exposure 30 years at least)

2.5E-06

15X

Table 5
Fish Consumption Risk Summary
Chickasaw Park Lake
Chickasaw Park and Willow Lakes Project
Louisville, Kentucky

	Exposure Parameters						Bluegill (C3)					
							ND=1/2 RL			Detects Only		
Fish Meals per month	CSF $(mg/kg\text{-}d)^{-1}$	Body Weight (kg)	Meal Size (kg)	Days per Month	CF	CR (kg fish/d)	Cm (ng/kg)	Em (mg/kg-d)	Risk	Cm (ng/kg)	Em (mg/kg-d)	Risk
16	1.56E+05	70	0.227	30.44	1.00E-06	0.119	0.51	8.69E-10	1.4E-04	0.01	1.70E-11	2.7E-06
12	1.56E+05	70	0.227	30.44	1.00E-06	0.089	0.51	6.52E-10	1.0E-04	0.01	1.28E-11	2.0E-06
8	1.56E+05	70	0.227	30.44	1.00E-06	0.060	0.51	4.35E-10	6.8E-05	0.01	8.52E-12	1.3E-06
4	1.56E+05	70	0.227	30.44	1.00E-06	0.030	0.51	2.17E-10	3.4E-05	0.01	4.26E-12	6.8E-07
3	1.56E+05	70	0.227	30.44	1.00E-06	0.022	0.51	1.63E-10	2.5E-05	0.01	3.20E-12	5.0E-07
2	1.56E+05	70	0.227	30.44	1.00E-06	0.015	0.51	1.09E-10	1.7E-05	0.01	2.13E-12	3.3E-07
1	1.56E+05	70	0.227	30.44	1.00E-06	0.007	0.51	5.43E-11	8.5E-06	0.01	1.07E-12	1.7E-07
0.5	1.56E+05	70	0.227	30.44	1.00E-06	0.004	0.51	2.72E-11	4.2E-06	0.01	5.33E-13	8.3E-08

Notes:
CSF: Cancer Slope Factor
CF: Unit Conversion Factor. Converts fish ppt to fish ppm.
CR: Average daily fish consumption rate per day (kg fish/d) = (Meal Size)
Cm: TEQ estimate using 1/2 RL for non-detect congeners
Em: Exposure Dose

Table 6
Fish Consumption Risk Summary
Willow Lake
Chickasaw Park and Willow Lakes Project
Louisville, Kentucky

Fish Meals per month	Exposure Parameters						Catfish (W1)					
							ND=1/2 RL			Detects Only		
	CSF $(mg/kg\text{-}d)^{-1}$	Body Weight (kg)	Meal Size (kg)	Days per Month	CF	CR (kg fish/d)	Cm (ng/kg)	Em (mg/kg-d)	Risk	Cm (ng/kg)	Em (mg/kg-d)	Risk
16	1.56E+05	70	0.227	30.44	1.00E-06	0.119	0.5	8.52E-10	1.33E-04	0.01	1.70E-11	2.66E-06
12	1.56E+05	70	0.227	30.44	1.00E-06	0.089	0.5	6.39E-10	9.97E-05	0.01	1.28E-11	1.99E-06
8	1.56E+05	70	0.227	30.44	1.00E-06	0.060	0.5	4.26E-10	6.65E-05	0.01	8.52E-12	1.33E-06
4	1.56E+05	70	0.227	30.44	1.00E-06	0.030	0.5	2.13E-10	3.32E-05	0.01	4.26E-12	6.65E-07
3	1.56E+05	70	0.227	30.44	1.00E-06	0.022	0.5	1.60E-10	2.49E-05	0.01	3.20E-12	4.99E-07
2	1.56E+05	70	0.227	30.44	1.00E-06	0.015	0.5	1.07E-10	1.66E-05	0.01	2.13E-12	3.32E-07
1	1.56E+05	70	0.227	30.44	1.00E-06	0.007	0.5	5.33E-11	8.31E-06	0.01	1.07E-12	1.66E-07
0.5	1.56E+05	70	0.227	30.44	1.00E-06	0.004	0.5	2.66E-11	4.15E-06	0.01	5.33E-13	8.31E-08

Notes:
Risks are only calculated for W1 (catfish) as PCDDs/PCDFs for W2 and W3 were all non-detect

CF: Unit Conversion Factor. Converts fish ppt to fish ppm.
CR: Average daily fish consumption rate per day (kg fish/d) = (Meal Size X Meals/month)/Days/month
Cm: TEQ estimate using 1/2 RL for non-detect congeners
Em: Exposure Dose

SUMMARY

Results for the analyses of fish and sediment samples for polychlorinated dibenzodiozins (PCDDs) and polychlorinated dibenzofurans (PCDFs) have been validated. These samples were collected by AMEC on 16 November 2004 and were submitted to Pace Analytical, Minneapolis, MN for compositing and analyses. A total of 4 sediment and 6 composite fish samples were prepared, with 2 sediments each from the Chicksaw Lake and Willow Lake and 3 composite fish samples from each. Pace processed and reported these samples under their Project Number 04-103367.

Results for PCDDs/PCDFs have been validated in accordance with the U.S. EPA *Final Draft of National Functional Guidelines for Dioxin/Furan Data Validation* (2003) and the U. S. EPA Region IV Data Validation Standard Operating Procedure for PCDDs/PCDFs. QA/QC procedures required by the method were followed and results indicated acceptable precision and accuracy.

The low level results reported for OCDD in the fish are potentially attributable to background levels in the laboratory and have been qualified as non-detected with slightly elevated reporting limits. Data for Total PCDFs in several samples have been qualified as estimated due to ether interferences. Results as qualified are acceptable for use in risk assessments for the sediments and fish.

SAMPLES

Sediment and composite fish samples included in this data set are listed below:

Willow		Chickasaw	
Sediments	**Fish**	**Sediments**	**Fish**
Willow Shallow	W1 (blue catfish)	Chickasaw Shallow	C1 (catfish)
Willow Deep	W2 (warmouth bass)	Chickasaw Deep	C2 (largemouth bass)
	W3 (largemouth bass)		C3 (bluegill)

REVIEW ELEMENTS

The following analytical elements were reviewed:

- Holding times
- Mass resolution check
- Initial Calibration
- Continuing Calibration
- Method Blank Analyses
- Matrix spike/matrix spike duplicate
- Target Compound Identification Criteria
- Compound quantification and reported detection limits
- Second column confirmation
- Interferences

Summary of Data Qualifications

Sample	Analytes / Qualified Result	Reason
Chicksaw Deep	Total HpCDF 7.00J	Results may be biased low by peaks attributed to ethers
Willow Deep	Total TCDF 0.52 J Total PeCDF 1.70 J	Results may be biased low by peaks attributed to ethers
Willow Shallow	Total TCDF 19 J Total PeCDF 32 J Total HxCDF 28 J Total HpCDF 43 J	Results may be biased low by peaks attributed to ethers
C1	Total TCDF 0.24 J Total PeCDF 0.4 UJ Total HxCDF 0.4 UJ Total HpCDF 0.4 UJ	Results and reporting limits may be biased low by peaks attributed to ethers
C2	Total TCDF 0.79 UJ Total PeCDF 0.39 UJ Total HxCDF 0.39 UJ Total HpCDF 0.39 UJ	Reporting limits may be biased low by peaks attributed to ethers
C2	Total TCDF 0.98 J Total PeCDF 0.4 UJ Total HxCDF 0.4 UJ Total HpCDF 0.4 UJ OCDD 1.8 UB	Results and reporting limits for totals may be biased low by peaks attributed to ethers. OCDD in method blank; presence in sample potentially attributable to laboratory background.
W1	Total TCDF 0.84 J Total PeCDF 0.4 UJ Total HxCDF 0.4 UJ Total HpCDF 0.4 UJ OCDD 1.0 UB	Results and reporting limits for totals may be biased low by peaks attributed to ethers. OCDD in method blank; presence in sample potentially attributable to laboratory background.
W2	Total TCDF 0.79 UJ	Reporting limits for totals may be biased low by peaks attributed to ethers
W3	Total TCDF 0.79 UJ Total PeCDF 0.39 UJ Total HxCDF 0.39 UJ Total HpCDF 0.39 UJ OCDD 1.2 UB	Reporting limits for totals may be biased low by peaks attributed to ethers. OCDD in method blank; presence in sample potentially attributable to laboratory background.

DISCUSSION

The following elements were in compliance with method requirements and are not discussed further:

- Holding times
- Mass resolution check
- Initial Calibration
- Continuing Calibration
- Internal standard recoveries
- Matrix spike/matrix spike duplicate

Method Blanks

OCDD was detected at a low level in the laboratory method blank for fish analyses, and results reported for this compound in 4 of the fish are potentially attributable to laboratory background. Data have been qualified by raising the reporting limit for OCDD in these samples to the amount of OCDD initially reported in the fish analysis. These results should be used as non-detects with elevated reporting limits.

Compound quantification and reported detection limits

It is noted that Pace reports PCDDs and PCDFs with default reporting limits rather than sample specific, analyte specific detection limits based on signal to noise as specified by the method. Although there were a limited number of instances where the nominal reporting limits were adjusted upwards to reflect the actual signal to noise, Pace's default reporting limits were higher for almost all analytes in all samples than the detection limits would be based on signal to noise ratios. As a result, there is in limited instances evidence of the presence of a non-reported PCDD or PCDF at levels below the default reporting limit used.

Target Compound Identification / Interferences

Polychlorinated ethers were present in some sediment and all fish samples, and these compounds interfere with accurate identification and quantitation of PCDFs. When an ether coeluted with a 2,3,7,8-substituted PCDF, Pace noted this on the report sheet by the flag "E", but when there was no coelution with one of the 2,3,7,8-substituted PCDFs, their presence was not noted on the reporting forms. Totals for the congener levels (e.g. total TCDFs) do not include any ether measurements. This may bias results for the Totals low, since it is possible that other PCDFs were also present but not recognized under the ether peaks. These data have been qualified as estimated with potential low bias. Totals for the congener levels are not used in risk assessment.

2,3,7,8-TCDF in C2 is reported as an estimated maximum possible value. The peak did not meet criteria for positive identification as TCDF due to interferences, but it is possible that some TCDF is present. The EMPC value should be used with the understanding that it is biased high to an unknown degree.

REFERENCES

USEPA, October 1998. Data Validation Standard Operating Procedures for Polychlorinated Dibenzodioxin and Polychlorinated Dibenzofurana Analysis by High Resolution Gas Chromatography/High Resolution Mass Spectrometry; United States Environmental Protection Agency, Region IV Science and Ecosystem Support Division, Office of Quality Assurance, Athens, Georgia
Revision 2.0.

USEPA. March 2003. National Functional Guidelines for Chlorinated Dioxin/Furan Data Review, Final Draft OSWER 9240.1-37. EPA 540-R-02-003.