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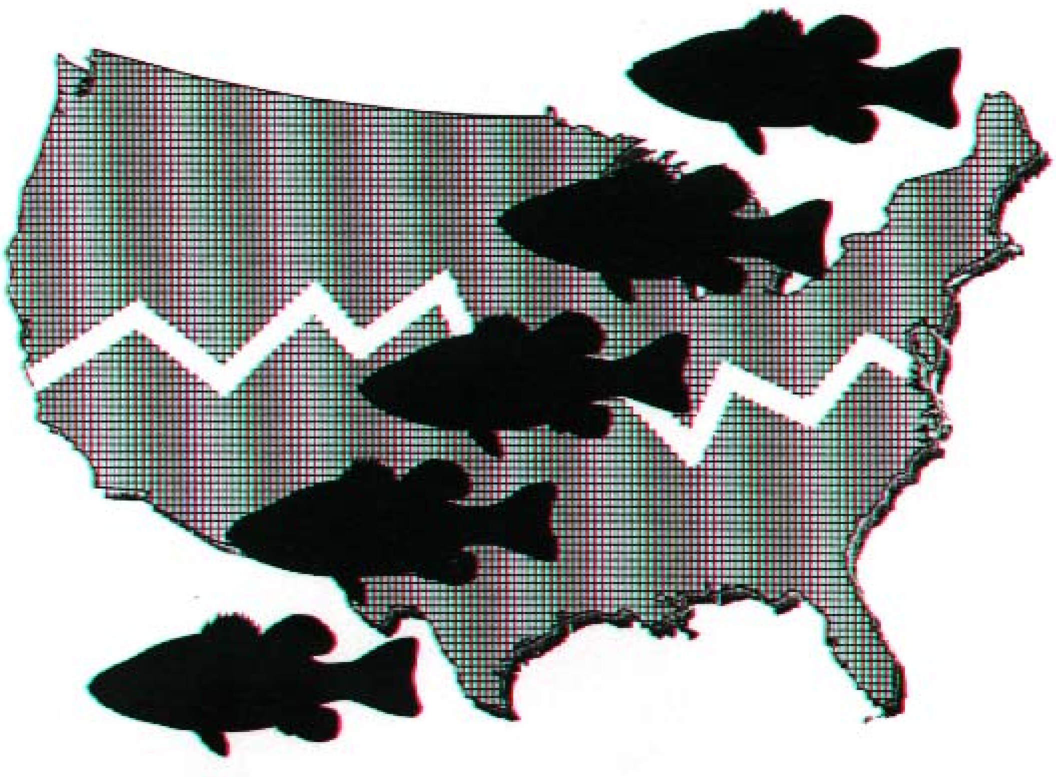
Quality Assurance Project Plan for Data Analysis Activities for the National Study of Chemical Residues in Lake Fish Tissue



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Data Analysis Activities for the National Study of Chemical Residues in Lake Fish Tissue

Contract No. EP-C-04-030
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Prepared for:

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Revision 0

This quality assurance project plan (QAPP) has been prepared according to guidance provided in EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5, EPA/240/B-01/003, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, DC, March 2001) to ensure that environmental and related data are collected, compiled, and/or generated for this project are complete, accurate, and of the type, quantity, and quality required for their intended use. Tetra Tech will conduct work in conformance with the quality assurance program described in the quality management plan for Tetra Tech's Fairfax Group and with the procedures detailed in this QAPP.

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A. PROJECT MANAGEMENT

1.0 PROJECT/TASK ORGANIZATION

This Quality Assurance Project Plan (QAPP) describes the quality assurance (QA) and quality control (QC) activities/procedures that will be used during the data analysis phase of the National Study of Chemical Residues in Lake Fish Tissue (hereafter referred to as the National Lake Fish Tissue Study). The purpose of this document is to present the methods and procedures that will be used for statistical analysis of fish tissue data from lakes and reservoirs throughout the contiguous United States, including the quality assurance procedures that will be employed. This document addresses *only* the data analysis effort of the National Lake Fish Tissue Study.

This QAPP was prepared according to guidance presented in the document *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5 (USEPA 2001). Reference to the QAPP elements described in the guidance document is included herein. The sample collection methods, procedures and protocols follow the guidelines and recommendations of *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume I: Fish Sampling and Analysis, Third Edition* (USEPA 2000a).

The project team organization provides the framework for conducting the data analysis task to meet study objectives. The organizational structure and function also facilitate project performance and adherence to QC procedures and QA requirements. Key roles are filled by those persons responsible for ensuring the collection, processing, and analysis of valid data and for routinely assessing the data for precision and accuracy, as well as the persons responsible for approving and accepting final products and deliverables. The project and QA personnel include staff from USEPA, Computer Sciences Corporation, and Tetra Tech, Inc. The project organizational chart is presented in Figure 1, and includes relationships and lines of communication among key project team members.

The **USEPA Project Manager** is Leanne Stahl, who will supervise the assigned project personnel to provide for their efficient utilization by directing their efforts either directly or indirectly. As Project Manager she will also have the following responsibilities:

- providing programmatic oversight for statistical analysis of fish tissue data,
- coordinating the development of the data analysis plan,
- reviewing and approving the data analysis QAPP and other materials developed to support activities during the data analysis and reporting phase of the project, and
- coordinating with contractors to integrate statistical analysis information into final report development.

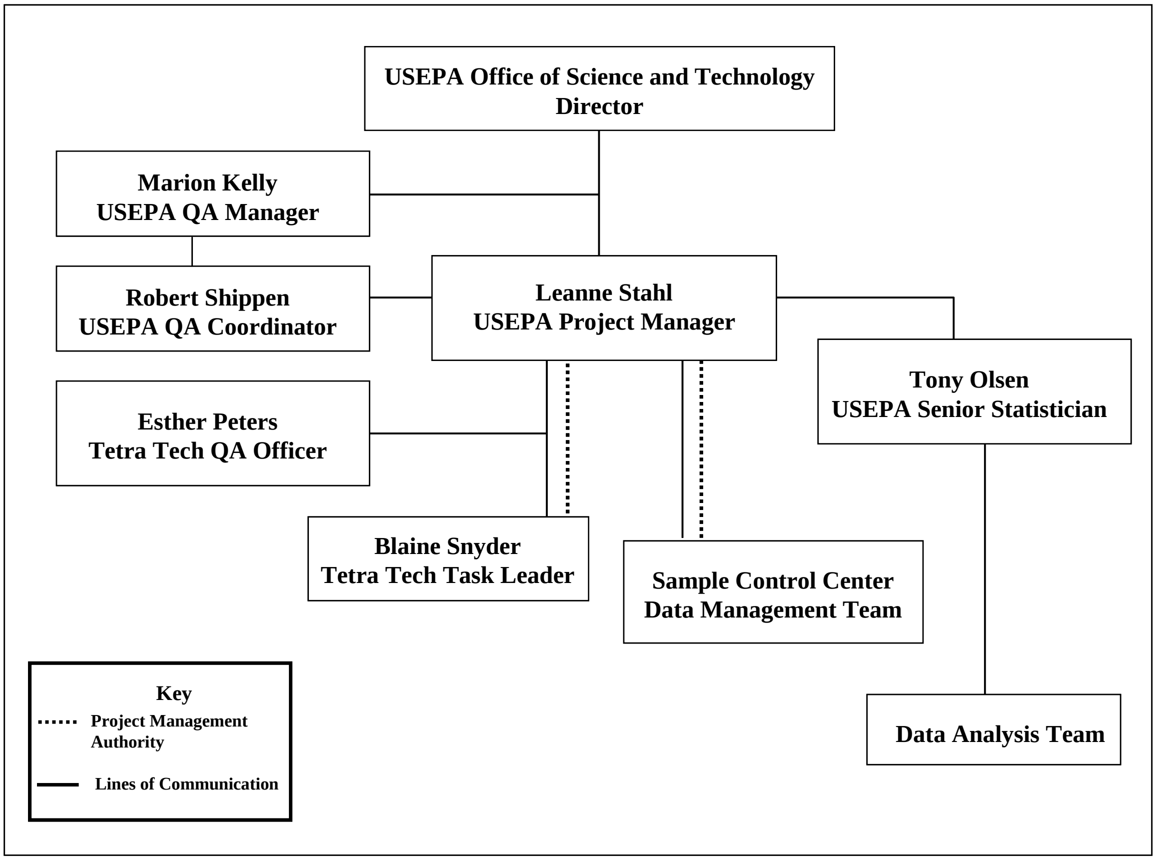

Figure 1. Organizational Diagram for National Lake Fish Tissue Study Data Analysis Tasks.

The **USEPA Quality Assurance Manager** is Marion Kelly, who will be responsible for reviewing and approving all Quality Assurance Project Plans (QAPPs). Additional USEPA QA Manager responsibilities include the following:

- reviewing and evaluating project procedures,
- conducting external performance and system audits of the procedures, and
- participating in Agency QA reviews of the study.

The **USEPA Quality Assurance Coordinator** is Robert Shippen, who will be responsible for reviewing and approving all Quality Assurance Project Plans (QAPPs). Additional USEPA QA Manager responsibilities include the following:

- resolving project QA issues and
- performing internal system audits.

The **Tetra Tech Task Leader** is Blaine Snyder, who will participate in study report preparation and data analysis review processes. Other specific responsibilities of the Task Leader include the following:

- coordinating project assignments in establishing priorities and scheduling,
- ensuring completion of high-quality projects within established budgets and time schedules,
- providing guidance, technical advice, and performance evaluations to those assigned to the project,
- implementing corrective actions and providing professional advice to staff,
- preparing and/or reviewing preparation of project deliverables,
- providing support to USEPA in interacting with the project team (including the sample control center and project statisticians), technical reviewers, and USEPA Regions/States/Tribes to ensure technical quality requirements are met in accordance with project design objectives, and
- coordinating with the USEPA Project Manager and project statisticians to integrate statistical analysis information into final report development.

The **Tetra Tech Quality Assurance (QA) Officer** is Esther Peters, whose primary responsibilities include the following:

- monitoring quality control (QC) activities to determine conformance,
- reviewing the QAPP for completeness and noting inconsistencies,
- providing support to USEPA and the Tetra Tech Task Leader in preparation of the work plan and QAPP and in their distribution, and
- approving the QAPP.

The **USEPA Senior Statistician** is Tony Olsen, whose primary responsibilities include the following:

- developing the data analysis plan in coordination with the USEPA Project Manager,
- performing statistical analysis of fish tissue data and/or providing technical support for data analysis,

- providing oversight for statistical analysis and support activities of other staff statisticians on the Data Analysis Team.
- developing statistical analysis summary information for integration into the final report, and
- developing graphics to display results of statistical analysis of fish tissue data.

The Sample Control Center **Data Management Team** comprises data managers and database specialists from Computer Sciences Corporation, whose primary responsibilities include:

- maintaining the National Lake Fish Tissue Study master database,
- developing data packages for delivery to the USEPA Senior Statistician,
- coordinating with the USEPA Project Manager, USEPA Senior Statistician, and Tetra Tech Task Leader to ensure that technical quality requirements are met for data packages and data transfers, and
- reviewing data inputs and statistical outputs to verify that the appropriate set of data was used for analysis, and that the statistical results are reproducible or can be recreated.

2.0 PROBLEM DEFINITION/BACKGROUND

The USEPA Office of Water conducted a national screening-level investigation in 1987 (USEPA 1992) to determine the prevalence of selected bioaccumulative pollutants in fish and to correlate elevated fish tissue contaminant levels with pollutant sources. Gamefishes and bottom-dwelling fishes were collected from 388 locations across the country thought to be influenced by various point and nonpoint sources. These fish tissue samples were analyzed to determine levels of 60 target analytes, including dioxins and furans, PCBs, pesticides and herbicides, mercury, and several other organic compounds. Results of the 1987 study indicated that target analytes were present in fish tissue at many of the sampling sites, and some of the contaminants (e.g., PCBs, dieldrin, mirex, and combined chlordane) occurred at levels posing potential human health risks.

The Office of Science and Technology (OST) within the Office of Water is conducting a new four-year national study of chemical residues in fish tissue, which is designed to expand the scope of the 1987 study. In October 1998, USEPA convened a two-day workshop of more than 50 scientists from state, federal, and tribal agencies to obtain technical input on sampling design, target analytes, sampling methods and data management. Input from scientists at the workshop and other technical experts that participated in numerous study planning meetings was used to develop a final study design (USEPA 1999). The contemporary study is statistically designed and will provide screening-level data on fish tissue contaminants from a greater number of waterbodies than were sampled in 1987.

This study broadens the scope of the 1987 study (USEPA 1992), which focused on chemical residues in fish tissue near point source discharges. The new study will:

- provide information on the national distribution of selected persistent, bioaccumulative, and toxic (PBT) chemical residues in gamefish and bottom-dwelling fish in lakes and reservoirs of the contiguous United States (excluding the Great Lakes and the Great Salt Lake),
- include lakes and reservoirs selected according to a probability design,
- involve the collection of fish from those randomly selected lakes and reservoirs over a four-year survey period (2000-2003),
- not be used to set fish consumption advisories; however, states and Native American tribes may choose to initiate a detailed fish study in a particular lake based on the screening contaminant concentrations provided by the national study, and
- include the analysis of fish tissue for PBT chemicals selected from USEPA's multimedia candidate PBT list of 451 chemicals and from a list of 130 chemicals from several contemporary fish and bioaccumulation studies. A final target analyte list of 268 PBT chemicals (including breakdown products and PCB congeners) was compiled based on input from study design workshop participants and a review team of analytical experts convened in October 1998 and March 1999, respectively. The final statistical year of fish tissue samples is also being analyzed for polybrominated diphenyl ethers (PBDEs).

Lakes and reservoirs were chosen as the target population because they:

- are accumulative environments where contamination is detectable,
- provide important sport fisheries nationwide, and
- offer other recreational (non-fishing) access and opportunities.

Lakes and reservoirs are the focus of this study rather than other waterbody types because:

- Fish consumption advisories represent 35% of the Nation's total lake acres (plus 100% of the Great Lakes), compared to 24% of the Nation's total river miles (USEPA 2004). [**Note:** The Great Lakes will not be included in this study because substantial fish tissue contaminant information is available and continues to be collected in ongoing Great Lakes monitoring programs.]
- Estuaries are currently being studied by USEPA's Environmental Monitoring and Assessment Program (EMAP). EMAP has sampled fish from East, West, and Gulf Coast estuaries as part of their National Coastal Assessment.

The specific objective of the new National Lake Fish Tissue Study is *to estimate the national distribution of the mean levels of selected persistent, bioaccumulative, and toxic chemical residues in fish tissue from lakes and reservoirs of the contiguous United States.*

In so doing, the study will provide the following types of information:

- information about persistent, bioaccumulative, and toxic chemicals (PBTs) for the Agency's PBT Chemical Program that addresses the following objective:
  - The PBT Chemical Program seeks to identify areas of concern for human and/or ecological health. Study of fish tissue may reveal where PBTs not previously considered a problem are present at levels of concern.
- data to answer important questions concerning the national occurrence of fish tissue contamination, such as the following:
  - What is the national extent of selected chemical contaminants in fish from lakes and reservoirs of the contiguous United States (excluding the Great Lakes)?
  - Are contaminant levels in fish high enough to warrant further investigation?

3.0 PROJECT/TASK DESCRIPTION

The study design reflects the study goal and objectives defined by USEPA. The study goal can be stated simply — to determine the extent to which fish in waters of the United States are contaminated with persistent, bioaccumulative, and toxic chemicals (PBTs). The project field sampling tasks, methods, and procedures are presented and discussed in the Sample Collection Activities QAPP for the National Lake Fish Tissue Study (USEPA 2000b). The Analytical Activities QAPP (USEPA 2000c) discusses the following study topics and tasks: sample preparation, compositing, and homogenization; target analytes; analytical methods; and chemical analysis of fish tissue samples. Sample collection and analytical activities have been completed, and subsequent data analysis tasks are presented in this document.

Full implementation of the study (i.e., sample collection) began in 2000 and ended in the winter of 2003 (Table 1). Review of fish tissue analysis results was completed in April 2005. Statistical analysis activities began in mid-2005, as the complete cumulative data set (i.e., all years of validated fish tissue data) was released from the analytical laboratories and Sample Control Center. Results of the statistical analysis of the fish tissue data will be presented in the final study report, which is scheduled to be released in September 2007.

Table 1. Time Line of Project Milestones and Associated Data Analysis Activities.

Activities and Milestones (1999 - 2007)	1999						2000 - 2007											
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Sample Collection Activities QAPP and Field Sampling Plan development							[2000 only]											
Orientation for sampling and field QC personnel in EPA Regions							[2000 only]											
Sample collection from target lakes							[2000 through 2003]											
Fish tissue analysis and data validation							[2001 through April 2005]											
Statistical analysis of fish tissue data							[May 2005 through February 2007]											
Final report preparation							[November 2006 through September 2007]											

EPA began analyzing fish study data once the full 4-year analytical data set was available. The data analysis plan focuses on the following core components:

- calculation of national ranges, medians, and percentiles for target PBT chemicals in fish tissue,
- preparation of cumulative distribution function plots for chemicals and composite types with sufficient data, and
- calculation of estimates of sampling variability based on replicate sample data.

4.0 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

4.1 Project Quality Objectives

Data of known and documented quality are essential to the success of any monitoring or sampling program. USEPA recommends the development of Data Quality Objectives for all environmental data collection activities. DQOs are qualitative and quantitative statements that clarify the intended use of the data, define the type of data needed to support the decision, identify the conditions under which the data should be collected, and specify tolerable limits on the probability of making a decision error due to uncertainty in the data. DQOs are developed by data users to specify the data quality needed to support specific decisions. Sources of error or uncertainty for the sampling phase of the program include the following:

- *Sampling error*: The difference between sample values and *in situ* true values from unknown biases due to collection methods and sampling design,

- *Measurement error*: The difference between sample values and *in situ* true values associated with the measurement process,

- *Natural variation*: Natural spatial heterogeneity and temporal variability in population abundance and distribution, and

- *Error sources or biases*: Associated with compositing, sample handling, storage, and preservation.

This QAPP addresses only data analysis activities, so the relevant quality objectives are primarily related to data summary and statistical analysis issues. The DQOs established for the National Lake Fish Tissue Study can be expressed as a program level goal to *estimate the status (i.e., the proportion of the population that is above or below some level of concern for a particular chemical) of the population of lakes and reservoirs within the contiguous United States with 95% confidence.* Discussion of conventional data quality indicators, i.e., precision, accuracy, completeness, representativeness, and comparability, follows in this section. Methods and procedures described in this document are intended to reduce the magnitude of the sources of uncertainty (and their frequency of occurrence) by applying the following approaches:

- use of standardized, accepted, and published statistical methods and treatments,

- use of tested, peer reviewed, and published statistical analysis software, and

- use of experienced statisticians to perform the statistical analysis activities.

4.2 Measurement Performance Criteria

Measurement performance criteria are quantitative statistics that are used to interpret the degree of acceptability or utility of the data to the user. These criteria, also known as data quality indicators (DQIs), include the following:

- precision,
- accuracy,
- representativeness,
- completeness, and
- comparability.

Precision

Precision is a measure of internal method consistency. It is demonstrated by the degree of agreement between individual measurements (or values) of the same property of a sample, measured under similar conditions. As the analytical testing is beyond the scope of this QAPP, no specific criteria are required for this parameter. However, sufficient sample volumes (i.e., the five-fish composites described in USEPA 2000b) will be collected to allow for the assessment of precision during analytical laboratory testing (USEPA 2000c).

For this study, all fish in a lake cannot be sampled, and the laboratory analytical process is not perfect. The combined variability introduced by the sampling at a lake, the compositing of fish, the subsampling of the composite for analysis, and the chemical analysis itself can be considered the "index" variability. The detection limits and analytical precision are one part of the analytical process that can be specified ahead of time (however, analytical processes are not part of this QAPP). The orientation and training of sampling crews, and the process that they use to collect fish from a lake, can also be standardized. Besides standardizing training, this dimension of variability cannot be reduced. The general rule of thumb is that if the combined index variability is less than 10% of the total variability, it will have little impact on the ability to estimate status. For this study, the best way to develop an estimate of index variability is to simply revisit a randomly selected subset, 10% of the sites, and repeat the lake sampling procedure, compositing, and analytical analyses. Sampling teams will obtain replicate fish samples from 10% of the target lakes and reservoirs during the four-year sampling period, according to random selection results provided by the USEPA Project Manager.

Accuracy

Accuracy is defined as the degree of agreement between an observed value and an accepted reference or true value. Accuracy is a combination of random error (precision) and systematic error (bias), introduced during sampling and analytical operations. Bias is the systematic distortion of a measurement process that causes errors in one direction, so that the expected sample measurement is always greater or lesser to the same degree than the sample's true value. As mentioned previously, analytical testing is beyond the scope of this QAPP. Accuracy criteria are presented in the QAPP for Analytical Control and Assessment Activities (USEPA 2000c).

Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter, variations at a sampling point, a process condition, or an environmental condition.

The National Lake Fish Tissue Study probability survey design selects a set of lake objects from the sample frame (see Section 7.3) to meet the survey design requirements, in particular the desired sample size. Lake objects may not be sampled in the field for several reasons. First, the lake object in the sample frame may not meet the definition of a lake given for the National Lake Fish Tissue Study. For example, it may be a wetland or a saline lake, or it may be a lake but not have a permanent fish population. These lake objects are classified as "non-target" or NT. A landowner may not give permission to access the lake. These are classified as "landowner denial" or LD. In some cases, it may be unsafe or extremely difficult to obtain access to or travel to the lake. These lakes are classified as "physical barrier" or PB. Both LD and PB lakes are assumed to be lakes that meet the National Lake Fish Tissue Study lake definition. The evaluation status is compiled based on information gathered during office evaluation of each lake and, if necessary, a field visit.

The evaluation status provides the data necessary to estimate the number of lakes in the contiguous United States that meet the National Lake Fish Tissue Study lake definition. It is also used to estimate the number of lakes that one would expect to be unavailable due to landowners denying access or no physical access.

The survey design assigns a weight to each lake object. These weights must be used in the statistical analyses to estimate mean concentrations for all lakes in the contiguous United States. The weights are in units of numbers of lakes, e.g., a weight of 2.28 means that the concentration data from the sampled lake represents the concentration that would be observed in 2.28 lakes. The weights differ by lake area classes used in the survey design. The weight assignments assume that the survey will be implemented as planned, i.e., that 900 lakes would be evaluated for potential field sampling. A design is rarely implemented as planned. For example, if 1000 lakes have to be evaluated to identify 500 lakes that meet the National Lake Fish Tissue Study lake definition, are available to sample due to permission from landowners, and are physically accessible, then the design is not implemented as planned. Consequently, the weights must be re-calculated, i.e., adjusted to account for the evaluation of 1000 lakes.

The study plan states that when an additional lake is required, the next lake in the oversample list of lakes will be used (Section 7.6). Under this provision, a single national weight adjustment is required. In addition, the total number of lake objects for each of the six lake area categories used in the design can be summarized from the sample frame. This information, along with the actual number of lake objects evaluated in each lake area category, is used to adjust the weights. The adjusted weight for a lake area category is the number of lakes in the sample frame divided by the number of lakes evaluated. The result is then assigned to each lake evaluated within that area category. The sum of the weights for all lakes evaluated will equal the total number of lake objects in the sample frame.

The representativeness goal will be satisfied by using qualified and experienced statisticians for designing the probability survey, assigning weights to each lake object, and adjusting weights (as needed). The USEPA Project Manager will ensure that the data are collected, reviewed, validated, and verified as specified for the study (USEPA 1999, USEPA 2000b, and USEPA 2000c) and that the complete four-year analytical dataset is delivered to the USEPA Senior Statistician.

Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid according to specific criteria and entered into the data management system. To optimize completeness, every effort is made to avoid sample and/or data loss. Refer to USEPA (2000b) for a complete description of completeness objectives for the National Lake Fish Tissue Study. Completeness, in the case of this project, is the number of valid samples collected relative to the number of samples that are planned to be collected. The completeness goal for this project is 90%. The completeness goal is achieved when 90% or more of the available samples from the final list of target lakes found to contain target fishes are collected and shipped with no errors in documentation or sample handling procedures. All 1,003 samples collected and shipped throughout the four years were received frozen and in good condition by the sample preparation laboratory.

Comparability

Comparability is an expression of the confidence with which one data set can be compared with another. Comparability is dependent on the proper design of the sampling program and on adherence to accepted sampling techniques, standard operating procedures, and quality assurance guidelines. For the National Lake Fish Tissue Study, comparability of data will be accomplished by standardizing the sample collection and handling methods, training field participants, providing consistent sampling materials, using approved analytical methods, using consistent laboratories for analyses for the duration of the study, and applying a tested and reproducible statistical design:

- All samples were collected and prepared for shipment using consistent sampling methods and materials for all field teams across the country, according to standard operating procedures contained in the *Quality Assurance Project Plan for Sample Collection Activities for a National Study of Chemical Residues in Lake Fish Tissue* (USEPA 2000b). These procedures are consistent with the recommendations of USEPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1: Fish Sampling and Analysis, Third Edition* (USEPA 2000a).

- All field personnel involved with sampling had adequate training and appropriate experience, and project orientation workshops were conducted in 10 EPA Regions for all participating state partners.

- All chemical analyses were based on published, EPA-approved analytical methods (detailed in USEPA 2000c). A single set of methods was used for each target chemical, and was applied consistently throughout the four years of study. Additionally, laboratories were assigned a specific group of chemicals for analysis, and those laboratories, chemicals, and methods remained consistent for the duration of the study.

- The probability-based sample design is similar to that of EPA's Environmental Monitoring and Assessment Program (EMAP). The statistical procedure used to estimate the total from an unequal probability sample of lakes is described explicitly in Diaz-Ramos et al. (1996), and the associated variance estimates follow Stevens and Olsen (2003). Standard, fundamental statistical procedures will be used to calculate a population range, mean (where appropriate), median, variance, and percentiles for all target chemicals, and to construct cumulative distribution function (CDF) plots.

5.0 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

Training and project orientation aspects of the National Lake Fish Tissue Study are discussed in USEPA (2000b). Statisticians participating in the data analysis elements of this study will have experience with national probabilistic study designs (e.g., EMAP experience), associated variance estimates, and applicable statistical analysis software (e.g., R, S-Plus, or S-Plus Professional).

6.0 DOCUMENTATION AND RECORDS

Thorough documentation of all sample collection and handling activities is necessary for proper processing in the laboratory and, ultimately, for the interpretation of study results. A complete description of National Lake Fish Tissue Study documentation and record keeping is included as part of the Sample Collection Activity QAPP (USEPA 2000b), and the Analytical Control and Assessment Activity QAPP (USEPA 2000c). Once analytical data has passed all internal review procedures at each laboratory, data are proofed and verified by the Sample Control Center. At the direction of the USEPA Project Manger, Sample Control Center data managers maintain a project database, and they prepare and transfer data submission packages (Appendix B) to the USEPA Senior Statistician. Additional information on data transfer and acquisition and an Electronic Data Deliverable Data Dictionary are provided in Section 15.0 and Appendix C, respectively. Field data files will be retained by Tetra Tech (the Field Support Contractor) (USEPA 2000b) and analytical data files will be retained by Computer Sciences Corporation (the Sample Control Center) (USEPA 2000c) after all data are uploaded to EPA's STORET Data Warehouse. All documents, records, and data files associated with data analysis activities are to be retained and archived by the statistical analysis team (USEPA Office of Research and Development, Corvallis, Oregon) following completion of the project, as directed by the USEPA Project Manager. Tetra Tech, CSC, and ORD will provide copies of all critical program and data files to the USEPA Project Manager at the end of the project.

B. DATA ACQUISITION

7.0 SAMPLING PROCESS DESIGN

The objective of the National Lake Fish Tissue Study is *to estimate the national distribution of the mean levels of selected persistent, bioaccumulative, and toxic chemical residues in fish tissue from lakes and reservoirs of the contiguous United States.*

In so doing, the study will provide the following types of information:

- information about persistent bioaccumulative toxic chemicals (PBTs) for the Agency's PBT Chemical Program, and

- data to answer important questions concerning the national occurrence of fish tissue contamination.

An unequal probability sample design was applied to address the study objectives. Probability sampling provides the basis for estimating resource extent and condition, for characterizing trends in extent or condition, and for representing spatial pattern, all with known certainty. A probability sample has some inherent characteristics that distinguish it from other samples: first, the population being sampled is explicitly described; second, every element in the population has the opportunity to be sampled with known probability; and third, the selection is carried out by a process that includes an explicit random element. A probability sample from an explicitly defined resource population is a means to certify that the data collected are free from any selection bias, conscious or not. This probability sample is an essential requirement for a program such as the National Lake Fish Tissue Study that aims to describe the condition of national resources.

For the purposes of this study design, the target population is all lakes and reservoirs within the contiguous United States, excluding the Laurentian Great Lakes and the Great Salt Lake. This study defines a lake as a permanent body of water of at least one hectare (2.47 acres) in surface area with a minimum of 1,000 m^2 of open (unvegetated) water and a minimum depth of one meter. The lakes in this study must also have a permanent fish population. A total of 500 locations were sampled over the course of four years.

7.1 Sample Type

To meet the study objectives, the National Lake Fish Tissue Study includes composite sampling of fish fillets for predator/gamefish species and whole fish for bottom-dwelling species from each sample lake. Five individuals per composite were targeted, all of which had to be large enough to provide sufficient tissue for analysis of the group of target analytes. It was determined that at least 560 grams of edible tissue for predators, and 560 grams of total body tissue for bottom dwellers, would be required from the composites to allow for analysis of all target analytes. Based on the recommendations of USEPA’s *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1: Fish Sampling and Analysis, Third Edition* (USEPA 2000a), fish used in a composite sample must meet the following criteria:

- all be of the same species,

- satisfy any legal requirements of harvestable size or weight, or at least be of consumable size if no legal harvest requirements are in effect,

- be of similar size so that the smallest individual in a composite is no less than 75% of the total length of the largest individual,

- be collected at the same time (i.e., collected as close to the same time as possible but no more than 1 week apart) [**Note:** This assumes that a sampling crew was unable to collect all fish needed to prepare the composite sample on the same day. If organisms used in the same composite are collected on different days (no more than 1 week apart), individual fish will be frozen until all the fish to be included in the composite are available for delivery to the laboratory.], and

- be collected in sufficient numbers (five per composite) and of adequate size (five harvestable size adult specimens that collectively will provide greater than 560 grams of edible tissue for predators, and 560 grams of total body tissue for bottom-dwellers) to allow analysis of recommended target analytes.

Individual organisms used in composite samples must be of the same species because of notable differences in the species-specific bioaccumulation potential. Accurate taxonomic identification is essential in preventing the mixing of closely related species with the target species. Under no circumstance should individuals from different species be used in a composite sample.

7.2 Sampling Period

Field sampling was conducted during the period when water and weather conditions were conducive to safe and efficient field sampling, and when the target species are most frequently harvested by anglers. For most inland freshwaters, the most desirable sampling period is from late summer to early fall, since lipid content is usually highest and water levels are usually lowest at that time. Where possible, sampling should not occur during the spawning period of the particular target species being sought. With these recommendations in mind, and considering the geographic extent of the study area (i.e., range of latitudes and longitudes) the field sampling period was scheduled to begin in August and last through November (and possibly into January or February in warmer regions). Any adjustments to this schedule had to be approved by the USEPA Project Manager.

7.3 Sample Frame

For the purposes of this study, the target population is all lakes and reservoirs within the contiguous United States, excluding the Laurentian Great Lakes and the Great Salt Lake. For this study, a lake is defined as a permanent body of water of at least one hectare (2.47 acres) in surface area with a minimum of 1,000 m^2 of open (unvegetated) water, and a minimum depth of one meter. The lakes in this study must also have a permanent fish population. Examples of nonpermanent fish populations are lakes that are subject to annual fish winterkill, or are recently stocked with fingerlings. Stocked lakes with adult fish are defined as having a permanent fish population.

The River Reach File Version 3 (RF3) was used to generate the list of lakes in the target population. RF3 constitutes the sample frame, and includes GIS coverage for almost all lakes in the target population for this study. Noted exclusions are newly constructed reservoirs.

To ensure the sample frame included all lakes and reservoirs with an area greater than 5,000 hectares, a list of such lakes was constructed from multiple sources. The list was sent to USEPA Regional Offices, and subsequently to each state, to verify that each lake on the list was greater than 5,000 ha and to add any lakes greater than 5,000 hectares that were not on the list. The corrected list of lakes was integrated into the RF3 list of lakes before sample selection was initiated. Table 2 summarizes the number of lakes in the sample frame used for sample selection.

Table 2. Numbers of Lakes by Size Category in Sample Frame (Based on RF3).

Lake area (ha)	Number of Lakes	Frequency (%)	Cumulative Number of Lakes	Cumulative Frequency (%)
>1-5	172,747	63.8	172,747	63.8
>5-10	44,996	16.6	217,743	80.4
>10-50	40,016	14.8	257,759	95.2
>50-500	11,228	4.1	268,987	99.3
>500-5000	1,500	0.6	270,387	99.9
>5000	274	0.1	270,761	100.0

7.4 Selection of Lakes for Sampling

The procedures described by Olsen et al. (1998) were used to select an unequal probability sample of lakes. The probability of selection for a lake depends on its area as given by RF3. In Table 3, the expected weight is the reciprocal of the probability of selection (inclusion probability). The inclusion probability was determined by the goal of obtaining approximately an equal number of lakes to sample in each size category. A higher percentage of the lakes in the smaller size categories would include lakes not meeting the target population definition of a lake. The probability of selection was adjusted so that the smaller size categories had a greater sample size. No adjustment was required for size categories 50-500 hectares, 500-5000 hectares, or > 5000 hectares. The adjustments for the remaining size categories were as follows: for 1-5 hectares, increase by 40%; for 5-10 hectares, increase by 30%; and for 10-50 hectares, increase by 20%. These adjustments were based on limited information from the EMAP northeastern lake survey.

Although it was not a requirement for the statistical survey design, study planners decided to select the sample by allocating the lakes to be sampled in each year, or "Panel," of the study. Lakes were assigned to a particular Panel (1 through 4) to maintain the unequal probability across all sampling years. Each Panel number coincides with the same sampling year. Thus, Panel 1 lakes should be sampled during sampling Year 1 (1999-2000), Panel 2 lakes should be sampled in sampling Year 2 (2001), etc. It was recommended that the lakes should be sampled in the year specified. The advantage of adhering to this approach was that if any year-to-year differences exist in fish tissue contaminants, then the sample will be balanced across years. In the event that the study must be stopped before all lakes can be sampled, sampling all lakes from a subset of the Panels is a legitimate unequal probability sample of all lakes. The expected weights must be adjusted to account for the Panels not sampled.

Table 3. Number of Lakes Selected for Sampling by Size Category and Panel.

Lake area (ha)	Panel 1	Panel 2	Panel 3	Panel 4	All Panels	Expected Weight
>1-5	39	41	47	47	174	938.84
>5-10	44	40	47	46	177	261.61
>10-50	32	47	46	25	150	256.51
>50-500	34	37	29	34	134	85.06
>500-5000	36	30	31	41	138	11.36
>5000	40	30	25	32	127	2.21
Total	**225**	**225**	**225**	**225**	**900**	

7.5 Non-target Population, Inaccessible Lakes, and Lakes for Which Access Is Denied

A critical element of the statistical survey design is the determination of the status of each lake in the sample. This means that each lake is checked to determine if it meets the definition of a lake for the study (Section 7.3). In many cases, a field visit was not necessary to confirm that the lake met the definition. In other cases, it was necessary to actually visit the lake to determine if it met the definition. Regardless, it was essential that a complete record of this information was reported to the USEPA Project Manager, since this information is required to complete the survey estimation procedures. Two other situations sometimes occurred that resulted in a lake not being sampled. First, the lake may be on private land and require landowner permission to visit the lake. If a landowner refused access to a lake selected for the study, that situation was documented in reconnaissance files. Second, occasionally a lake may have been physically inaccessible. If there were logistical or safety constraints that made a lake inaccessible, then the reason for inaccessiblility was recorded and reported to the USEPA Project Manager and/or the Tetra Tech Task Leader.

Information that was determined during pre-sampling reconnaissance of each lake included the following:

- Does the lake meet the definition of the target population (Section 7.3)? If the lake does not meet the definition, what are the reasons? For example:
  - — lake < 1 ha in surface area
  - — lake < 1 m depth
  - — lake < 1000 m^2 of open water (unvegetated)
  - — saline lake with no fish population
  - — lake has no annual fish population (winterkill lake)
  - — other (list specific reasons)

- Has the landowner denied access to lake? (Record landowner information)

- Is the lake physically inaccessible during the sampling period of study? If so, state why.

7.6 Reserve Sample of Lakes

As a contingency, a second sample of lakes was selected as a reserve. Table 4 summarizes the sample sizes for the reserve sample. This sample could be used if the initial sample was determined to have a larger than expected number of non-target population lakes, resulting in an insufficient sample size. Decisions regarding use of the reserve sample of lakes (or subsets of the reserve sample) were made only by the USEPA Project Manager.

Table 4. Number of Lakes (by Size Category and Panel) Selected as a Reserve Sample.

Lake area (ha)	Panel 1	Panel 2	Panel 3	Panel 4	All Panels	Expected Weight
>1-5	47	48	48	49	192	938.84
>5-10	45	52	40	42	179	261.61
>10-50	36	39	42	41	158	256.51
>50-500	36	26	40	22	124	85.06
>500-5000	38	29	30	37	134	11.36
>5000	23	31	25	34	113	2.21
Total	**225**	**225**	**225**	**225**	**900**	

7.7 Estimates of Uncertainty

The study will allow the USEPA Office of Water to report on the extent of PBTs in fish tissue in lakes with known confidence. Therefore, study results should allow statements such as: 35% of the sampled population of lakes in the U.S. have PBT levels in fish that exceed the criteria of concern. If the estimate of uncertainty is ± 5%, results would suggest that the proportion of lakes that are of concern might be as low as 30% or as high as 40%. This estimate of uncertainty is derived from the fact that a probability sample was used to select the sites to visit. It is this estimate of uncertainty that should be considered the project level data quality objective (DQO). Ideally, the required DQO should be determined by those who will use the results, and this DQO then should be used to drive the details of the study design. However, determination of a DQO is usually more complex. Frequently, the data users will request a best estimate and some measure of uncertainty, i.e., loosely translated as an unbiased estimate with reasonable confidence. From experience, many data users are comfortable with the results when the uncertainty estimate ranges from ± 2 - 10%.

It is important to consider the basis on which estimates of uncertainty are made. Assume for a moment that every fish in every lake in the country could be sampled with absolute truth. If that were possible, an absolute result (concentration) could be developed with no associated uncertainty. Now assume PBT levels could be measured in every fish with absolute truth, but not every lake could be visited. Some uncertainty exists in the results because inferences are made about all lakes from a sample of lakes. The uncertainty results from the statistical sampling process, i.e., fish are analyzed from a sample of lakes rather than all lakes. The uncertainty associated with this process can be roughly estimated by the binomial distribution equation:

$$SE = \sqrt{\frac{p(1-p)}{n}}$$

where:

SE is the standard error,
p is the proportion of population in exceedance,
and n is the sample size.

For example, if an uncertainty estimate of ± 5% is desired with 95% confidence and it is likely that the proportion of the population in exceedance is on the order of 0.2, then a sample size of roughly 256 lakes would be necessary.

To reduce the uncertainty to ± 2% would require a sample size of about 1,600 lakes. In this study, the budget has set a fixed sample size of 500 lakes, which would result in an uncertainty of roughly ± 3.6% with 95% confidence for the national estimate. As the sample size decreases for subpopulation estimates, the uncertainty in the subpopulation estimates will increase. For example, if the sample size for a subpopulation of lakes is 150, then the uncertainty would be ± 6.5%.

7.8 Statistical Analysis of Study Data

The National Lake Fish Tissue Study uses a probability survey design with unequal probability of selection based on lake area. The study objectives require estimates for *the national distribution of the mean levels of 268 persistent, bioaccumulative, and toxic (PBT) chemicals in fish tissue from lakes and reservoirs of the contiguous United States.* To calculate these estimates, the statistical analysis must incorporate survey design elements as well as information from the field and laboratory operations.

The following steps are essential to the statistical analysis process: (1) compiling evaluation status for each lake in the study (Section 4.2), (2) adjusting the survey design (sample) weights based on lake status (Section 4.2), (3) estimating the number of lakes within the contiguous United States that meet the project definition of a lake (Section 7.0), (4) estimating the number and proportion of lakes in the sampled population, and (5) estimating the cumulative distribution and percentile concentrations of the PBT chemicals in fish tissue.

7.8.1 Estimating the Number of National Lake Fish Tissue Study Lakes

The data necessary for estimating the number of lakes are the evaluation status results recorded for all lake objects evaluated for potential field sampling. Diaz-Ramos et al. (1996) describe the statistical procedure to use in estimating a total from an unequal probability sample. An associated variance estimate, termed a local neighborhood variance estimate, is described by

Stevens and Olsen (2003). Both procedures are available at http://www.epa.gov/NHEERL/arm/analysispages/software in the R library for probability survey population estimation (psurvey.library) (Version 2.6) maintained by the USEPA/ORD National Health and Environmental Effects Research Laboratories (NHEERL), Corvallis, Oregon. In addition to national estimates, an option exists to complete the same estimates for sub-regions of the contiguous United States. Although an estimate can be made for any sub-region, unless the sample size is sufficiently large, the confidence intervals for the estimates may be so large that the estimate provides little information. Estimates for sub-regions are not planned as part of this study because of insufficient sample size to develop estimates with reasonable confidence intervals.

7.8.2 Estimating the Number of Lakes in the Sampled Population

As described earlier, a lake may meet the definition of a National Lake Fish Tissue Study lake, but it may not be sampled due to landowner denial or physical inaccessibility. In either case, it is important to estimate the number of lakes meeting the National Lake Fish Tissue Study lake definition that could be sampled, i.e., the "sampled population." Alternatively, an estimate can be derived for the number of lakes expected to have landowner access denials and the number of lakes expected to be physically inaccessible. These estimates use the same procedures referred to above in Section 7.8.1.

7.8.3 Estimating Fish Tissue Concentrations

If available, both a predator fish composite and a bottom-dweller fish composite were collected from each lake. Chemical analyses provided tissue concentration data for each composite and all target chemicals. Each chemical and fish composite type constitutes a data set to be used for estimating the fish tissue concentration for the sampled population of lakes. Each lake also has an associated adjusted weight calculation. This information will be used to estimate percentile concentrations for each target chemical, and to estimate the cumulative distribution of tissue concentrations for the sampled population of lakes. This procedure has been described by Diaz-Ramos et al. (1996) (Estimation Method 1: Cumulative Distribution Function for Proportion of a Discrete or an Extensive Resource). Variance estimates will be derived using the local neighborhood variance estimator described by Stevens and Olsen (2003 and 2004). These statistical analyses will utilize the R statistical software (R Development Core Team 2004) and an R contributed library for probability survey population estimation (psurvey.analysis) (Version 2.6) (http://www.epa.gov/NHEERL/arm/analysispages/software). This statistical package was selected for tissue data analysis because it is readily available, it has robust capabilities, and statisticians in ORD have extensive experience using this software for analysis of unequal probability survey data.

8.0 SAMPLING METHODS

Field sampling activities and standard operating procedures for sample collection are outside the scope of this QAPP. See USEPA (2000b) for sample collection activity details.

9.0 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Sample handling and custody procedures are outside the scope of this QAPP. See USEPA (2000b and 2000c) for description of sample handling and custody requirements.

10.0 ANALYTICAL METHODS REQUIREMENTS

Samples were shipped under chain of custody to locations designated by the USEPA Project Manager for processing and analytical testing. Sample processing and analytical methods are outside the scope of this QAPP; they are discussed in the Analytical Control and Assessment Activities QAPP (USEPA 2000c).

11.0 QUALITY CONTROL REQUIREMENTS

Data quality is addressed, in part, by consistent performance of valid procedures documented in standard operating procedures. It is enhanced by the training and experience of project staff and documentation of project activities. The National Lake Fish Tissue Study Sample Collection Activities QAPP (USEPA 2000b) and Analytical Control and Assessment Activities QAPP (USEPA 2000c) were distributed to all USEPA Regional/State/Tribal Fish Sampling Coordinators, and other project personnel. This QAPP addresses data analysis activities, and will be distributed to core project team members and project statisticians. The data analysis team will be required to read this QAPP, and the USEPA Senior Statistician will verify that each team member read the QAPP and understood the procedures and requirements.

12.0 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

Instrumentation descriptions and associated testing/inspection/maintenance requirements are outside the scope of this QAPP. See the National Lake Fish Tissue Study Sample Collection Activities QAPP and the Analytical Control and Assessment Activities QAPP (USEPA 2000b and 2000c, respectively) for instrumentation details.

13.0 INSTRUMENT CALIBRATION AND FREQUENCY

Instrument calibration requirements are outside the scope of this QAPP. See USEPA (2000b and 2000c) for calibration details.

14.0 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

Inspection requirements are outside the scope of this QAPP. See USEPA (2000b and 2000c) for acceptance requirements for supplies and consumables.

15.0 DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

An analytical data package was prepared by the Sample Control Center and delivered to the USEPA Senior Statistician. Example pages from the data package are provided in Appendix B. Data types are discussed in USEPA (2000b) (i.e., supporting field sampling data) and USEPA (2000c) (i.e., analytical data), and data elements and terms are defined in the Electronic Data Deliverable Data Dictionary (Appendix C).

16.0 DATA MANAGEMENT

At the direction of the USEPA Project Manager, validated data will be transferred from the Sample Control Center to the USEPA Senior Statistician. The USEPA Senior Statistician will serve as the point of contact for data management activities conducted by the Data Analysis Team at the USEPA/ORD NHEERL, Corvallis, Oregon. The NHEERL information management system includes both hard copy and electronic means of storing and archiving data. The central repository for the incoming data is an alpha server system located in Corvallis. The information management staff are responsible for maintaining the security and integrity of both the data and the system. National Lake Fish Tissue Study data may be released externally from the system only with the permission of the USEPA Project Manager.

All data files in the information management system are protected from corruption by computer viruses, unauthorized access, and hardware or software failures. Data files are accessible only to information management staff and the Data Analysis Team, and are marked read-only to prevent corruption by inadvertent editing, additions, or deletions. All data will be stored (and archived) on redundant systems. This ensures that if one system is destroyed or incapacitated, information management staff will be able to reconstruct the database. Data files will be retained and archived by USEPA/ORD NHEERL for storage on a long-term basis after project completion. Copies of the data files will also be forward to the USEPA Project Manager at the end of the project for retention with other program and data files.

All data analysis activities (e.g., statistical outputs) will be prepared and reviewed by the USEPA Senior Statistician before submittal to the USEPA Project Manager (see Sections 19.0 and 20.0). Subsequent reviews will be conducted by the USEPA Project Manager, the Sample Control Center Data Management Team, and Tetra Tech. If there is any indication that requirements for data quality and integrity have not been met, the USEPA Project Manager, Sample Control Center Data Management Team, and the OST QA Coordinator will work with the USEPA Senior Statistician to determine the best way to rectify the problem and obtain accurate and useable output data.

C. ASSESSMENT/OVERSIGHT

17.0 ASSESSMENT AND RESPONSE ACTIONS

Assessment activities and corrective response actions have been identified to ensure that data analysis activities are conducted as prescribed. The QA program under which this project operates includes performance and system audits with independent checks of the statistical analysis of the original data. These audits could indicate the need for corrective action. The essential steps in the program are as follows:

- identify and define the problem,
- assign responsibility for investigating the problem,
- investigate and determine the cause of the problem,
- assign and accept responsibility for implementing appropriate corrective action,
- establish effectiveness of and implement the corrective action, and
- verify that the corrective action has eliminated the problem.

Performance audit techniques include checks on the appropriateness of the statistical inputs, the reproducibility of the results, and sensitivity of the statistical methods. System audits are qualitative reviews of project activity to check that the overall quality program is functioning and that the appropriate QC measures identified in this QAPP are being implemented. The OST QA Coordinator will conduct one internal system audit during the data analysis phase of the project and report the results to the USEPA Project Manager.

18.0 REPORTS TO MANAGEMENT

The Sample Control Center data managers will provide a statistical QA/QC report to the USEPA Project Manager following their review of the statistical inputs and outputs (see Section 20.0). Copies of this report will be submitted to the USEPA Project Manager, the USEPA Senior Statistician, and the Tetra Tech Task Leader. This Sample Control Center review and report will be considered as part of the internal system audit. Following completion of the system audit, the OST QA Coordinator will prepare an Audit Report Form and submit copies to both the USEPA Project Manager and the USEPA QA Officer.

D. DATA VALIDATION AND USABILITY

19.0 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

The data validation and verification phase will involve a secondary data QA/QC review, as the raw data will have already been thoroughly reviewed and validated as described in the *Quality Assurance Project Plan for Analytical Control and Assessment Activities in the National Study of Chemical Residues in Lake Fish Tissue* (USEPA 2000c). The data review, validation, and verification checks associated with this Data Analysis QAPP will occur in two steps, one on the data inputs and one on the statistical outputs. The first step will be to verify that the statistical input (raw data) is correct, and that the appropriate set of data is being used for each analysis. The second step is to perform QA/QC checks on the statistical output. Sample Control Center data managers will conduct both steps of review, using input files and output results provided by the USEPA Senior Statistician. The Sample Control Center will document instances of agreement and disagreement between the analysis reviews and the original analyses. Additional data review, validation, and verification procedures may be considered necessary as this phase of the project evolves. Any additional procedures will be approved by the USEPA Project Manager and thoroughly documented by the Sample Control Center. The results of the review will be reported to the USEPA Project Manager, the USEPA Senior Statistician, and the Tetra Tech Task Leader. Areas of disagreement between the review and the original analyses will be discussed among, and resolved by, the Sample Control Center, the USEPA Senior Statistician, and the USEPA Project Manager. The USEPA Project Manager will authorize and direct all resolved action activities. A report of all review activities and all resolved actions will be submitted to the USEPA Project Manager (see Section 18.0).

20.0 VALIDATION AND VERIFICATION METHODS

The Sample Control Center will review the data sets used as statistical input to verify that the correct data set is used for each type of analysis. There are several methods that can be used to verify that the correct set of data is being applied for each analysis. One option is to count the number of observations going into the analysis, and then calculate the average of the observations. This number is then compared to the same counts in the original database.

After this initial check, the Sample Control Center data managers will employ a multi-tiered approach to verify the statistical analyses that have been performed on the study data set and to demonstrate the reproducibility of the results. The first step will be to verify that the methodologies employed are sound and will allow for re-creation of the final results. The data managers will:

- attempt to re-create the original results (e.g., number of responses, percentiles, confidence limits, etc.)

- verify the appropriate application of results for comparison with thresholds and screening values (e.g., summed values were used for applicable chemicals, such as DDT and chlordane)

A second phase will be undertaken if the initial methodology assessment finds alternative approaches that are more or equally appropriate. This phase will incorporate a sensitivity analysis to determine the extent that the choice of methodology affects the final results. The Sample Control Center data managers will ensure that the new methodology is fully documented and that the final results can be re-created. This may require interaction with the USEPA Project Statistician and USEPA Project Manager if questions arise that need to be resolved. All actions requiring resolution will be reported to the USEPA Project Manager (see Section 18.0), and the USEPA Project Manager will authorize and direct all resolved action activities.

21.0 RECONCILIATION WITH DATA QUALITY OBJECTIVES

Final reconciliation with Data Quality Objectives (DQOs) is outside the scope of this QAPP. Precision, accuracy, and completeness measures were assessed and compared to performance criteria immediately following completion of the sample collection and sample analysis phases of this project. That process represented the final determination of whether the data were of the correct type and quality to support their intended use for this project. Data Quality Assessment results are detailed in the *Quality Assurance Report for the National Study of Chemical Residues in Lake Fish Tissue: Year 1 through Year 4 Analytical Data* (USEPA 2005).

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Appendix A

Target Lakes

State	Lake Name	County	Lake ID	Statistical Year	Sampling Year	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
ALABAMA: 16 Lakes												
AL	Bankhead Reservoir	Walker	0272	R	2003	33	37	17.76	87	12	11.52	1346.43
AL	Candles Lake	Talladega	1497	4	2003	33	10	9.84	86	23	45.24	25.75
AL	Choccolocco Lake	Calhoun	1436	4	2003	33	36	47.52	85	59	37.68	6.97
AL	Clark's Lake	Russell	0560	2	2001	32	26	55.32	85	8	22.56	2.68
AL	Jones Bluff Lake	Lowndes	1072	3	2002	32	23	20.4	86	45	8.64	5063
AL	Lake Martin	Tallapoosa	0236	R	2003	33	26	27.96	85	34	42.456	15783
AL	Lewis Smith Lake	Cullman/Walker/Winston	0136	1	2000	34	4	51.24	87	7	55.2	8793.13
AL	Payne Lake	Hale	0947	3	2002	32	53	10.68	87	26	34.08	46.02
AL	Pine Lake	Houston	0622	2	2001	31	9	14.04	85	19	28.2	3.25
AL	Unnamed lake	Walker	0022	1	2000	33	56	55.32	87	19	53.4	4.37
AL	Unnamed lake	Monroe	0923	3	2002	31	26	51	87	17	45.96	1.87
AL	Unnamed lake	Marshall	0961	3	2002	34	7	22.44	86	17	52.08	3.37
AL	Walter F. George Reservoir	Henry/Barbour	0072	1	2000	31	56	3.84	85	5	48.84	15281.91
AL	Wheeler Lake	Lauderdale	0161	1	2000	34	39	49.932	87	2	23.208	27143
AL	William "Bill" Dannelly Reservoir	Wilcox	0197	1	2000	32	5	53.88	87	22	56.28	4738.41
AL	Wilson Reservoir	Colbert	0311	R	2003	34	49	27.084	87	30	14.328	6272.6
ARIZONA: 3 Lakes												
AZ	Apache Lake	Maricopa	0045	1	2000	33	35	15.36	111	17	32.28	888.11
AZ	Lake Havasu	Mohave	1520	4	2002	34	30	3.24	114	21	56.52	7223
AZ	Lake Mohave	Mohave	1020	3	2001	35	27	14.04	114	38	10.32	10446.12
ARKANSAS: 11 Lakes												
AR	Beaver Reservoir	Benton	1493	4	2002	36	22	1.20	93	56	58.56	8310.84
AR	Greers Ferry Lake	Cleburne	0571	2	2000	35	33	39.60	92	9	47.16	4803
AR	Horseshoe Lake	Crittenden	1522	4	2001	34	55	50.16	90	20	13.20	872.26
AR	Lake Dardanelle	Logan	0247	R	2003	35	21	7.92	93	24	21.6	12640.98
AR	Lake DeGray	Clark	1449	4	2002	34	15	25.56	93	14	14.64	4575.86
AR	Lake Ouachita	Garland	1371	4	2002	34	37	0.84	93	23	22.20	15815.64
AR	Lake Terkington	Arkansas	1396	4	2002	34	27	58.68	91	23	35.88	23.57
AR	Millwood Lake	Little River	1398	4	2002	33	45	2.16	94	0	14.40	9667.69
AR	Norfolk Lake	Baxter	0143	1	1999	36	24	22.68	92	14	31.20	7546.18

State	Lake Name	County	Lake ID	Statistical Year	Sampling Year	Latitude			Longitude			Lake Area (ha)
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AR	Ozark City Lake	Franklin	0497	2	2000	35	31	54.84	93	49	57.00	166.23
AR	ReReg Lake	Clark	0623	2	2000	34	11	4.92	93	6	13.32	151.71
CALIFORNIA: 18 Lakes												
CA	Claire Engle Reservoir	Trinity	1426	4	2003	40	53	42.36	122	46	10.56	6757.19
CA	Clear Lake	Lake	0126	1	2000	39	1	35.76	122	46	13.8	15956.2
CA	Crag Lake	El Dorado	1026	3	2002	38	59	27.96	120	9	18.36	8.38
CA	El Capitan Reservoir	San Diego	0468	2	2002	32	54	44.64	116	46	51.6	589.97
CA	Finnon Reservoir	El Dorado	1526	4	2003	38	47	53.52	120	44	54.6	8.58
CA	Guadalupe Reservoir	Santa Clara	0303	R	2003	37	11	33	121	52	21.72	25.64
CA	Jewelry Lake	Tuolumne	0027	1	2001	38	9	45.72	119	46	52.32	2.61
CA	Lake Oroville	Butte	0151	1	2001	39	34	47.64	121	21	35.64	1730.03
CA	Lake Thomas Edison	Fresno	0977	3	2003	37	22	46.92	118	58	39.36	755.47
CA	Little Grass Valley Reservoir	Plumas	0301	R	2003	39	43	44.4	120	59	36.6	564.03
CA	Meadow Lake	Nevada	1351	4	2003	39	24	41.04	120	29	34.08	89.41
CA	New Melones Reservoir	Calaveras	0227	R	2003	37	59	30.84	120	30	26.64	726.39
CA	Pete's Valley Reservoir	Lassen	0077	1	2003	40	32	40.56	120	26	56.04	10.86
CA	Pine Flat Reservoir	Fresno	0002	1	2001	36	52	28.92	119	14	5.64	2336.88
CA	San Leandro Reservoir	Alameda	0051	1	2002	37	47	9.96	122	6	58.68	309.21
CA	San Luis Reservoir	Merced	0503	2	2002	37	2	38.04	121	7	39	5214.08
CA	Shasta Lake	Shasta	0476	2	2002	40	49	31.08	122	23	51	5467.73
CA	Woodward Reservoir	Stanislaus	1002	3	2002	37	51	10.44	120	50	58.56	718.84
COLORADO: 8 Lakes												
CO	Cherry Creek Reservoir	Arapahoe	1569	4	2000	39	38	22.92	104	51	15.48	347.28
CO	Fuchs Reservoir	Rio Grande	0969	3	2001	37	28	23.16	106	31	1.92	6.1
CO	Left Hand Valley	Boulder	0228	R	2003	40	5	49.92	105	15	56.88	45.82
CO	Stalker Lake	Yuma	0469	2	2001	40	5	7.44	102	16	34.68	6.63
CO	Trujillo Meadows Reservoir	Conejos	0319	R	2003	37	3	2.88	106	27	9	29.16
CO	Turk's Pond	Baca	0019	1	2000	37	29	10.32	102	22	56.28	22.13
CO	Williams Fork Reservoir	Grand	0552	2	2001	40	1	3.72	106	12	22.68	546.12
CO	Willow Creek Reservoir	Weld	0903	3	2000	40	48	8.64	104	27	47.16	1.21

State	Lake Name	County	Lake ID	Statistical Year	Sampling Year	Latitude			Longitude			Lake Area (ha)
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CONNECTICUT: 2 Lakes												
CT	Barkhamsted Reservoir	Litchfield	1117	3	2001	41	58	13.44	72	57	17.64	890.54
CT	Rainbow Lake	Fairfield	0938	3	2001	41	20	27.24	73	29	45.24	15.25
FLORIDA: 16 Lakes												
FL	Brown Lake	Osceola	1425	4	2003	28	9	38.16	81	25	55.2	57.37
FL	Chipco Lake	Putnam	1060	3	2002	29	37	42.24	81	53	31.92	18.28
FL	Crescent Lake	Putnam/Flagler	0260	R	2003	29	27	11.628	81	29	34.296	6459
FL	Eagle Lake	Polk	1575	4	2002	27	59	16.08	81	46	3.72	259.22
FL	Lake Apopka	Orange	0500	2	2001	28	37	8.76	81	37	19.56	12439.41
FL	Lake Butler	Union	0060	1	2000	30	2	12.12	82	20	21.84	362.69
FL	Lake Manatee	Manatee	1050	3	2002	27	28	46.2	82	18	27	593.3
FL	Lake Okeechobee	Palm Beach/Hendry	0150	1	2001	27	10	30.72	80	47	45.6	4830.28
FL	Lake Reedy	Polk	0975	3	2002	27	44	16.8	81	29	58.2	1399.66
FL	Lake Tohopekaliga	Osceola	1000	3	2002	28	13	57	81	22	20.28	7642.87
FL	Lake Tsala Apopka	Citrus	0100	1	2000	28	55	27.228	82	21	2.52	7733.98
FL	Long Pond	Hillsborough	0600	2	2001	27	57	57.96	82	15	57.24	22.39
FL	Mill Dam Lake	Marion	0135	1	2000	29	10	49.44	81	50	37.32	140.03
FL	Unnamed lake	Walton	0498	2	2001	30	28	57.36	86	19	40.44	1.53
FL	Unnamed lake	Broward	0625	2	2001	26	1	34.32	80	15	39.6	5.43
FL	Unnamed lake	Palm Beach	0325	R	2003	26	35	5.64	80	11	10.68	2.32
GEORGIA: 15 Lakes												
GA	Allatoona Lake	Bartow/Cherokee	1035	3	2000	34	8	12.48	84	37	54.84	4661.32
GA	Boatright Lake	Washington	0661	2	2000	32	48	40.32	82	42	29.52	12.58
GA	Demott Lake	Colquitt	1411	4	2003	31	11	7.08	83	49	23.16	4
GA	J. Strom Thurmond Reservoir	Columbia	1461	4	2000	33	39	32.04	82	23	53.88	10306.7
GA	Johnson's Lake	Warren	0286	R	2003	33	21	54.72	82	38	8.52	25.72
GA	Lake Ashley ("Fishing Lake")	Carroll	1360	4	2003	33	39	14.76	84	55	21.72	6.2
GA	Lake Blue Ridge	Fannin	0261	R	2003	34	50	29.04	84	15	57.6	1339.82
GA	Lake Seminole	Seminole	1547	4	2003	30	47	6.72	84	54	48.96	5137.63
GA	Lake Sinclair	Putnam	1561	4	2001	33	13	50.52	83	17	8.88	2070.71

State	Lake Name	County	Lake ID	Statistical Year	Sampling Year	Latitude			Longitude			Lake Area (ha)
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GA	Qualatchee Lake	White	0061	1	2002	34	38	56.04	83	48	3.6	15.64
GA	Reservoir 29	Madison	0636	2	2001	34	3	52.56	83	13	38.64	32.62
GA	Unnamed lake	Elbert	0186	1	2000	34	5	3.12	82	46	48.72	1.94
GA	Unnamed lake	Stewart	0036	1	2003	31	57	21.6	84	40	42.24	1.39
GA	Unnamed lake	Thomas	1097	3	2003	30	52	22.08	83	49	57.36	4.77
GA	West Point Lake	Troup	0086	1	2002	33	3	44.28	85	8	0.6	9215.38
IDAHO: 7 Lakes												
ID	Bear Lake	Bear Lake	0627	2	2000	42	0	13.32	111	19	58.476	28329
ID	Blackfoot Reservoir	Caribou	1452	4	2002	42	54	15.012	111	35	9.672	6475.2
ID	Brownlee Reservoir	Washington	0079	1	2000	44	40	32.736	117	4	42.348	6070.5
ID	Enos Lake #1	Valley	1028	3	2002	45	5	58.452	115	50	48.876	3.01
ID	Loon Creek Lake #2	Valley	0904	3	2002	45	5	37.5	115	55	14.808	2.62
ID	Palisades Reservoir	Bonneville	0127	1	2000	43	14	36.96	111	6	40.68	6061.57
ID	Priest Lake	Bonner	0554	2	2000	48	34	4.368	116	51	27.504	9453.8
ILLINOIS: 10 Lakes												
IL	Buck Lake	De Kalb	0041	1	2000	41	38	51	88	39	36	3.56
IL	Kincaid Lake	Jackson	1565	4	2002	37	49	7.32	89	28	42.24	972.39
IL	Lake Inverness	Cook	0241	R	2003	42	5	39.48	88	5	3.12	6.57
IL	Otter Lake	Macoupin	0115	1	2001	39	27	4.32	89	53	35.16	126.16
IL	Rend Lake	Franklin	1065	3	2001	38	4	52.32	88	58	26.76	832.64
IL	Shook's Pond	Rock Island	0140	1	2000	41	27	17.64	90	36	11.16	1.67
IL	Unnamed lake	Williamson	0015	1	2000	37	46	23.88	88	47	0.6	6.2
IL	Unnamed lake	Tazewell	0515	2	2000	40	35	1.68	89	35	7.8	17.48
IL	Unnamed lake	Saline	1465	4	2002	37	44	13.2	88	30	28.08	7.87
IL	Wolf Lake	Cook	0491	2	2001	41	39	52.2	87	31	57.72	323
INDIANA: 7 Lakes												
IN	Baire Lake	Putnam	0141	1	2000	39	43	58.8	86	45	17.64	3.03
IN	Fox Lake	Steuben	1516	4	2003	41	37	36.48	85	1	24.96	53.2
IN	Geist Reservoir	Hamilton	0616	2	2001	39	55	41.52	85	56	33	683.06
IN	Hardy Lake	Scott	0941	3	2002	38	46	21.36	85	41	20.04	315.77
IN	Turtle Creek Reservoir	Sullivan	0590	2	2001	39	4	1.92	87	31	42.96	605.95

State	Lake Name	County	Lake ID	Statistical Year	Sampling Year	Latitude Deg	Latitude Min	Latitude Sec	Longitude Deg	Longitude Min	Longitude Sec	Lake Area (ha)
IN	Unnamed lake	Montgomery	1541	4	2003	40	2	5.64	86	57	10.8	5.24
IN	Winona Lake	Kosciusko	0466	2	2001	41	13	22.44	85	50	0.96	216.43
IOWA: 5 Lakes												
IA	Diamondhead Lake	Guthrie	1090	3	2002	41	32	59.28	94	15	33.84	40.03
IA	Morse Lake	Wright	0165	1	2000	42	50	20.04	93	41	41.28	41.11
IA	Percival Lake	Fremont	0615	2	2001	40	46	37.56	95	48	36.72	6.39
IA	Saylorville Lake	Polk	1040	3	2002	41	45	11.52	93	43	53.76	2041.2
IA	Unnamed lake	Wapello	0965	3	2002	40	58	26.4	92	22	25.68	12.99
KANSAS: 4 Lakes												
KS	Tuttle Creek Lake	Pottawatomie	0119	1	2000	39	27	25.2	96	42	4.68	2152.55
KS	Unnamed lake	Jackson	1119	3	2002	39	30	8.64	95	36	3.6	5.43
KS	Unnamed lake	Greenwood	0293	R	2003	37	56	5.28	96	10	45.84	1.53
KS	Unnamed lake	Woodson	1568	4	2003	37	53	13.56	95	36	43.2	1.81
KENTUCKY: 7 Lakes												
KY	Barkley Lake	Lyon	1361	4	2003	37	1	24.24	88	7	18.48	7.75
KY	Green River Lake	Adair	1012	3	2002	37	14	0.6	85	16	15.6	3190.89
KY	Herrington Lake	Boyle	0641	2	2001	37	41	6	84	42	52.56	1084.43
KY	Lake Cumberland	Pulaski	1062	3	2003	36	58	26.4	84	46	44.76	231.04
KY	Unnamed lake	Livingston	0465	2	2001	37	16	55.92	88	29	39.12	13.42
KY	Unnamed lake	Nelson	0640	2	2001	37	47	52.08	85	38	50.28	2.56
KY	Unnamed lake	Fleming	0266	R	2003	38	23	12.84	83	31	20.64	7.11
LOUISIANA: 7 Lakes												
LA	Catahoula Lake	LaSalle	0274	R	2002	31	30	20.34	92	7	30.72	10846
LA	Lac des Allemands	St. John the Baptist	0999	3	2000	29	55	14.95	90	34	18.05	5957.2
LA	Lake Bistineau	Webster	0173	1	1999	32	26	17.16	93	23	12.48	6282.91
LA	Lake Bussey Brake	Morehouse	1548	4	2002	32	51	52.20	91	55	44.04	848.31
LA	Miller's Lake	Evangeline	1374	4	2002	30	45	6.84	92	21	18.00	1245.69
LA	Salt Lake	Calcasieu	1074	3	2001	30	15	23.40	93	24	56.88	63.59
LA	Unnamed lake	Pointe Coupee	1474	4	2003	30	42	43.20	91	43	56.64	16.31
MAINE: 25 Lakes												
ME	Chandler Pond	Piscataquis	1460	4	2003	46	18	23.04	69	3	46.08	51.83
ME	Cuxabexis Lake	Piscataquis	0660	2	2001	46	6	22.68	69	17	54.24	247.09

State	Lake Name	County	Lake ID	Statistical Year	Sampling Year	Latitude			Longitude			Lake Area (ha)
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ME	Green Lake	Hancock	0566	2	2001	44	38	53.88	68	29	53.52	1267.24
ME	Hadley Lake	Washington	0917	3	2002	44	47	10.68	67	26	56.04	680.2
ME	Hale Pond	Piscataquis	0285	R	2003	45	48	36	68	58	35.76	64.84
ME	Heald Ponds	Somerset	0042	1	2000	45	11	4.2	69	51	48.6	8.72
ME	Little Pond	Oxford	0192	1	2000	44	9	11.88	70	35	16.44	10.67
ME	Little River Lake	Washington	0516	2	2001	45	9	33.84	67	49	14.52	29.41
ME	McCurdy Pond	Lincoln	0642	2	2001	44	0	35.28	69	27	11.88	79.6
ME	Megunticook Pond	Waldo	1366	4	2003	44	15	46.08	69	6	47.52	573.61
ME	Middle Range Pond	Androscoggin	0617	2	2001	44	1	16.32	70	23	57.12	14.61
ME	Moose Pond	Cumberland	0217	1	2000	44	3	14.04	70	48	17.64	679.43
ME	Moosehead Lake	Piscataquis	0492	2	2001	45	40	43.104	69	43	19.092	30308
ME	Mooselookmeguntic Lake	Oxford	0667	2	2001	44	53	12.48	70	49	43.68	6597
ME	Parker Pond	Kennebec	1067	3	2002	44	29	8.88	70	1	49.44	611.44
ME	Peaked Mountain Pond	Piscataquis	0935	3	2002	46	30	27.36	69	5	14.64	5.01
ME	Pemadumcook Lake	Piscataquis	1041	3	2002	45	41	15	68	54	5.4	7453.06
ME	Puffer's Pond	Penobscot	0242	R	2003	45	0	56.88	69	15	37.08	46.36
ME	Ragged Lake	Piscataquis	0210	1	2000	45	49	13.08	69	22	4.08	1046.61
ME	Seboomook Lake	Somerset	1560	4	2003	45	54	54	69	52	13.44	2571.1
ME	Spednik Lake	Washington	0966	3	2002	45	37	17.76	67	38	32.28	5570.94
ME	Stiles Lake	Hancock	0166	1	2000	44	58	23.16	68	0	34.2	16.99
ME	Upper Middle Branch Pond	Hancock	0092	1	2000	44	52	34.32	68	13	37.2	103.76
ME	Wallagrass Lakes	Aroostook	0635	2	2001	47	6	20.16	68	42	51.48	100.43
ME	Wood Pond	Somerset	1442	4	2003	45	37	9.12	70	16	58.44	819.41
MARYLAND: 1 Lake												
MD	Deep Creek Lake	Garrett	1439	4	2002	39	30	15.48	79	19	17.4	1449.35
MASSACHUSETTS: 7 Lakes												
MA	Bent's Pond	Worcester	0493	2	2001	42	31	37.92	71	59	55.68	8.72
MA	Carbuncle Pond	Worcester	0592	2	2001	42	8	7.08	71	52	7.32	3.94
MA	North Watuppa Pond	Bristol	0017	1	2000	41	42	11.16	71	6	27	673.72

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MA	Quabbin Reservoir	Worcester	0567	2	2001	42	24	5.4	72	18	31.32	9535.65
MA	Rockwell Pond	Worcester	1443	4	2003	42	31	37.92	71	46	9.12	3.68
MA	Seymour Pond	Barnstable	0467	2	2001	41	43	26.04	70	5	34.08	68.75
MA	Westboro Reservoir	Worcester	0992	3	2002	42	14	36.6	71	36	16.92	1.33
MICHIGAN: 21 Lakes												
MI	Burt Lake	Cheboygan	0459	2	2001	45	27	35.784	84	39	55.584	6928.25
MI	Chenango Lake	Livingston	1564	4	2003	42	30	13.68	83	53	41.28	12.35
MI	Cloverleaf Lake	Alger	0934	3	2002	46	33	32.4	86	5	13.92	4.79
MI	Fire Lake	Baraga	0309	R	2003	46	29	57.12	88	11	29.76	10.83
MI	Glen Lake	Leelanau	1459	4	2003	44	52	14.88	86	1	5.16	559.97
MI	Gogebic Lake	Gogebic	1534	4	2003	46	30	29.556	89	35	10.5	5170
MI	Haney Lake	Van Buren	0591	2	2003	42	15	8.64	86	7	29.28	11.9
MI	Horseshoe Lake	Ogemaw	0589	2	2001	44	24	57.96	84	16	49.8	14.45
MI	Houghton Lake	Roscommon	0639	2	2001	44	20	59.64	84	42	59.4	8067.91
MI	Lake Chapin	Berrien	0016	1	2000	41	55	37.56	86	20	52.8	220.36
MI	Lake Paradise	Emmet	0659	2	2001	45	41	6.72	84	45	2.52	767.18
MI	Lake Roland	Houghton	0534	2	2001	46	53	18.24	88	51	5.4	107.27
MI	Long Lake	Kalamazoo	1116	3	2002	42	11	41.28	85	31	14.16	198.23
MI	Miner's Lake	Alger	0284	R	2003	46	28	50.52	86	32	16.8	6.01
MI	Norvell Lake	Jackson	0664	2	2001	42	8	48.12	84	12	29.52	12.38
MI	Seven Mile Pond	Alpena	0984	3	2002	45	5	48.48	83	30	34.92	555.78
MI	Torch Lake	Antrim	0634	2	2001	44	58	41.52	85	18	54.72	7503.08
MI	Walloon Lake	Emmet	0009	1	2000	45	18	1.8	85	0	41.4	1832.12
MI	West Lake	Lapeer	0014	1	2000	43	5	56.76	83	24	53.64	1.12
MI	White Lake	Oakland	0464	2	2001	42	40	8.76	83	33	51.48	198.12
MI	Wintergreen Lake	Kalamazoo	0116	1	2000	42	23	51.36	85	23	5.64	13.49
MINNESOTA: 58 Lakes												
MN	Agate Lake	Crow Wing	0630	2	2001	46	29	45.96	93	54	46.8	65.74
MN	Bass Lake	Wright	0507	2	2001	45	19	18.12	94	6	7.92	86.47
MN	Belle Lake	Meeker	1357	4	2003	44	58	53.04	94	25	33.24	361.91
MN	Blind Lake	Aitkin	1455	4	2000	46	39	0.72	93	44	45.96	119.92

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MN	Cantlin Lake	Sherburne	0033	1	2000	45	29	9.24	93	35	13.2	41.26
MN	Cass Lake	Beltrami	0205	1	1999	47	25	23.484	94	31	53.94	12050
MN	Charlotte	Wright	1508	4	2000	45	9	3.24	93	44	48.12	94.11
MN	Cork Lake	Douglas	0257	R	2003	45	52	25.68	95	29	2.76	41.04
MN	Dead Lake	Otter Tail	1431	4	2000	46	28	45.48	95	44	58.2	2987.93
MN	Diamond Lake	Kandiyohi	1382	4	2003	45	10	59.52	94	50	33.72	626.23
MN	Dick Lake	Cook	0085	1	2001	47	51	54.72	90	29	39.48	52.8
MN	East Leaf Lake	Otter Tail	0906	3	1999	46	23	54.96	95	25	19.92	170.1
MN	First Lake	Pine	0633	2	2001	46	18	52.56	92	49	11.64	31.02
MN	Fish Lake Reservoir	St. Louis	0605	2	1999	46	56	20.76	92	16	25.32	1214.34
MN	Flat Lake	Becker	1506	4	2003	46	58	44.4	95	39	17.28	741.28
MN	Florida Lake	Kandiyohi	0957	3	2001	45	14	10.32	95	3	49.68	210.53
MN	Fox Lake	Becker	0081	1	1999	46	46	49.8	95	54	30.24	55.54
MN	Fox Lake	Beltrami	0655	2	2001	47	36	33.48	94	50	30.48	63.87
MN	Hendricks Lake	Lincoln	0457	2	2000	44	29	43.8	96	27	44.64	616
MN	Hubert Lake	Crow Wing	0155	1	2000	46	29	13.92	94	16	7.32	510.95
MN	Isabella Lake	Lake	0985	3	2003	47	48	39.6	91	17	29.04	666.76
MN	Kabekona Lake	Hubbard	1480	4	2003	47	10	0.48	94	45	26.28	974.89
MN	Kekekabic Lake	Lake	0035	1	2002	48	4	7.68	91	10	26.4	690.72
MN	La Salle Lake	Hubbard	0005	1	2000	47	20	29.4	95	9	52.92	90.11
MN	Lac La Croix	St. Louis	0485	2	1999	48	17	33.72	92	4	40.08	5768.93
MN	Lake Carlos	Douglas	1532	4	2000	45	57	50.76	95	21	22.32	1039.76
MN	Lake Geneva	Freeborn	0207	1	2000	43	47	31.2	93	16	26.76	693.82
MN	Lake Minnetonka	Hennepin	1032	3	2002	44	54	34.2	93	38	10.68	1699.75
MN	Lake of the Woods	Lake of the Woods	1430	4	2003	48	58	12.072	95	12	13.248	384622
MN	Lake Pepin	Goodhue	1457	4	2003	44	30	55.8	92	18	25.56	5075
MN	Lake Washington	Le Sueur	1057	3	2002	44	15	15.12	93	52	38.64	582.48
MN	Lake Washington	Meeker	0307	R	2003	45	4	15.6	94	22	20.64	979.68
MN	Lake Winona	Winona	0932	3	2003	44	2	29.4	91	39	22.32	32.22
MN	Leech Lake	Cass	1055	3	2002	47	9	20.484	94	23	29.688	44280
MN	Linwood Lake	St. Louis	0130	1	2000	47	19	10.92	92	6	20.52	2.5
MN	Long Lake	Hubbard	0031	1	2000	46	53	10.68	94	59	57.84	783.5

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MN	Many Point Lake	Becker	0481	2	2001	47	4	39	95	32	17.16	676.86
MN	Mille Lacs	Mille Lacs	0933	3	2003	46	14	17.16	93	38	35.16	51699.73
MN	Moberg Lake	St. Louis	0530	2	2001	46	48	48.96	92	54	40.32	13.94
MN	Mora Lake	Cook	0010	1	2001	48	1	17.4	90	56	33.36	94.49
MN	Mud Lake	Traverse	0905	3	2002	48	19	45.552	95	58	18.48	9591
MN	Namakan Lake	St. Louis	0110	1	1999	48	33	28.512	92	49	25.932	5686
MN	North Turtle Lake	Otter Tail	1380	4	2001	46	18	22.68	95	47	57.48	600.51
MN	O'Dowd Lake	Scott	0182	1	2000	44	44	28.32	93	31	0.48	118.14
MN	Pokegama Lake	Itasca	0055	1	2000	47	10	51.6	93	34	37.2	6313
MN	Portage Lake	Cass	0280	R	2003	47	20	35.16	94	18	42.12	605.98
MN	Red Lake	Beltrami	0980	3	2002	47	57	43.02	95	1	30.288	61512.47
MN	Rice Lake	Stearns	0157	1	2000	45	22	29.64	94	36	56.52	617.62
MN	Rice Lake	Itasca	0255	R	2003	47	12	48.24	93	40	56.64	276.63
MN	Shamineau Lake	Morrison	0908	3	2002	46	15	13.32	94	36	1.8	547.87
MN	Snowbank Lake	Lake	0235	R	2003	47	59	3.48	91	25	9.12	1889.88
MN	South McDougal Lake	Lake	0460	2	2000	47	36	51.48	91	33	29.16	112.64
MN	Spider Lake	Itasca	1530	4	2003	47	29	27.6	93	34	36.84	546.03
MN	Sturgeon Lake	Pine	0183	1	2000	46	22	48.72	92	45	22.32	666.38
MN	Vermilion Lake	St. Louis	1110	3	2002	47	52	5.196	92	18	26.172	19875
MN	White Iron Lake	St. Louis/Lake	1010	3	2001	47	53	53.88	91	45	13.32	2404.36
MN	White Sand Lake	Crow Wing	0083	1	2000	46	21	6.48	94	17	12.48	158.52
MN	Woman Lake	Cass	0180	1	2000	46	57	30.96	94	16	21.72	2395.76
MISSISSIPPI: 9 Lakes												
MS	Bailey Lake	Carroll	0146	1	2000	33	28	37.2	89	50	15	50.29
MS	Ben Lilly Pond	Monroe	1122	3	2002	33	43	17.4	88	42	40.32	4.76
MS	Enid Lake	Yalobusha	0997	3	2002	34	8	50.676	89	51	43.452	11230
MS	Grenada Lake	Grenada	1096	3	2002	33	49	54.804	89	44	2.364	26154
MS	H Johnson Pond	Yazoo	0322	R	2003	32	37	41.16	90	28	49.8	5.53
MS	Hollis Lee's Lake	Claiborne	0624	2	2001	32	1	49.44	90	46	57.36	37
MS	Lake Lucille	Lauderdale	0098	1	2000	32	34	30	88	32	38.76	12
MS	Sardis Reservoir	Panola	0672	2	2001	34	26	55.032	89	42	46.476	23684
MS	Unnamed lake	Carroll	1546	4	2003	33	35	58.2	90	1	49.44	8.1

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MISSOURI: 11 Lakes												
MO	Lake Wapapello	Wayne	0290	R	2003	36	58	3.72	90	21	15.12	2523.23
MO	Mark Twain Lake	Ralls	1440	4	2003	39	30	46.44	91	42	36	3551.37
MO	Table Rock Lake	Stone	0543	2	2003	36	33	32.4	93	23	45.96	12409.59
MO	Tressle Hole	New Madrid	1437	4	2003	36	33	12.6	89	26	58.92	9.93
MO	Truman Reservoir	St Clair	1393	4	2003	38	10	12	93	34	18.84	9246.25
MO	Unnamed lake	Dade	0618	2	2002	37	22	33.6	93	41	24	3
MO	Unnamed lake	Jasper	1068	3	2002	37	17	22.92	94	31	58.08	14.27
MO	Unnamed lake	Cooper	0240	R	2003	38	54	46.44	92	47	36.96	4.83
MO	Unnamed lake	Polk	0318	R	2003	37	46	16.32	93	33	17.28	5.54
MO	Unnamed lake	Knox	1490	4	2003	40	1	54.12	92	4	6.96	4.27
MO	Unnamed lake	Callaway	1515	4	2003	38	57	54.36	91	58	57.72	9.35
MONTANA: 16 Lakes												
MT	Bighorn Lake	Big Horn	0053	1	2001	45	10	14.16	108	6	14.04	6942.75
MT	Bynum Reservoir	Teton	1429	4	2003	47	56	45.6	112	26	0.6	1295.69
MT	Clear Lake	Mineral	1104	3	2001	47	16	9.12	115	24	24.84	3.09
MT	Cliff Lake	Flathead	1079	3	2002	48	9	46.08	113	53	22.92	9.3
MT	Ennis Lake	Madison	1504	4	2003	45	25	51.24	111	40	55.56	1490.89
MT	Fort Peck Reservoir	Valley	0084	1	2000	47	44	0.6	106	44	36.6	98766.25
MT	Frenchman Pond	Phillips	1434	4	2003	48	42	19.8	107	13	33.24	231.25
MT	Hebgen Lake	Gallatin	0952	3	2002	44	47	13.02	111	14	58.74	4856.25
MT	Krieder's Pond	Garfield	0104	1	2000	47	7	47.28	107	28	39.36	5.88
MT	Laird Pond	Carter	0178	1	2000	45	37	24.24	104	40	28.92	7.75
MT	Lake Elwell	Liberty	0029	1	2000	48	22	39	111	12	15.84	1075.54
MT	Lake Koocanusa	Lincoln	0604	2	2002	48	35	11.04	115	14	5.28	11462.51
MT	Leigh Lake	Lincoln	1029	3	2002	48	13	15.6	115	39	55.08	52
MT	Rape Creek Reservoir	Beaverhead	0153	1	2000	44	59	50.28	113	11	42	9.64
MT	Upper Cold Lake	Missoula	0454	2	2001	47	33	25.2	113	54	4.32	22.84
MT	Upper Two Medicine Lake	Glacier	0254	R	2003	48	27	54.72	113	27	27	61.42

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NEBRASKA: 5 Lakes												
NE	Enders Reservoir	Chase	1444	4	2002	40	25	55.92	101	33	14.04	652.43
NE	Harlan County Reservoir	Harlan	0244	R	2003	40	3	30.6	99	18	12.96	5185.54
NE	Jeffrey Reservoir	Lincoln	0494	2	2000	40	56	27.6	100	24	34.2	226.1
NE	Lake McConaughy	Keith	1403	4	2002	41	15	1.08	101	50	53.16	11464.25
NE	Lake Minatare	Scotts Bluff	0453	2	2000	41	56	1.32	103	29	42	784.3
NEVADA: 4 Lakes												
NV	Chimney Reservoir	Humboldt	1451	4	2002	41	24	52.56	117	9	11.88	880.93
NV	Lake Mead	Clark	0652	2	2000	36	16	57.36	114	22	23.16	39372.55
NV	Pyramid Lake	Washoe	0902	3	2003	40	1	19.2	119	33	11.88	44232.8
NV	Ruby Lake	Elko	0926	3	2001	40	10	20.64	115	28	10.2	38.43
NEW HAMPSHIRE: 5 Lakes												
NH	Big Diamond Pond	Coos	0292	R	2003	44	57	11.16	71	18	44.28	67.92
NH	Horn Pond	Carroll	0317	R	2003	43	33	39.6	70	57	41.4	91.56
NH	Lake Winnipesaukee	Carroll/Belknap	0167	1	2000	43	36	9.36	71	20	27.6	18545.11
NH	Little Island Pond	Hillsborough	0243	R	2003	42	43	39.72	71	17	16.08	64.89
NH	Newfound Lake	Grafton	0517	2	2001	43	39	34.2	71	46	2.64	1717.53
NEW JERSEY: 2 Lakes												
NJ	Unnamed lake	Camden	0013	1	2000	39	47	5.28	74	51	45.72	4
NJ	Verona Lake	Essex	1063	3	2002	40	49	36.84	74	14	50.28	5.47
NEW MEXICO: 2 Lakes												
NM	Brantley Reservoir	Eddy	1369	4	2001	32	36	46.19	104	21	3.46	8498
NM	Navajo Reservoir	Rio Arriba	0169	1	2000	36	31	4.08	107	36	37.80	1892.41
NEW YORK: 17 Lakes												
NY	Brant Lake	Warren	0593	2	2000	43	42	55.44	73	42	25.2	571.85
NY	Chautauqua Lake	Chautauqua	0114	1	1999	42	7	59.196	79	22	40.116	5438
NY	Colgate Lake	Greene	0488	2	2000	42	14	8.16	74	7	8.4	10.67
NY	Copake Lake	Columbia	0138	1	2000	42	8	38.76	73	35	47.4	157.5
NY	Goldfish Pond	Suffolk	1463	4	2003	40	56	31.2	72	19	45.12	1.34
NY	Grizzle Ocean	Essex	1518	4	2002	43	49	13.8	73	35	42.72	7.6
NY	Jamesville Reservoir	Onondaga	0238	R	2003	42	58	23.52	76	4	9.12	87.71

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NY	Lake DeForest	Rockland	1488	4	2002	41	9	42.12	73	57	31.32	93.52
NY	Little Wolf Pond	Franklin	0542	2	2000	44	15	13.32	74	28	47.64	65.08
NY	Moose Lake	Herkimer	1513	4	2003	43	50	0.96	74	50	41.64	507.45
NY	Mud Pond	Clinton	1542	4	2002	44	33	42.12	73	55	21.36	45.43
NY	Northville Pond	Fulton	1013	3	2001	43	13	44.76	74	10	13.44	7.6
NY	Seneca Lake	Yates	0088	1	2003	42	37	39.72	76	55	6.96	17413.27
NY	Southern South Lake	Putnam	0613	2	2001	41	30	9.36	73	42	14.76	4.26
NY	Sylvia Lake	St. Lawrence	0113	1	1999	44	15	9.72	75	24	50.04	124.86
NY	Tupper Lake	Franklin	0067	1	2001	44	11	29.04	74	30	0.72	2583.95
NY	Whitney Pond	Oswego	0913	3	2001	43	26	0.96	75	59	23.28	32.07
NORTH CAROLINA: 8 Lakes												
NC	B. Everett Jordan Lake	Chatham	0162	1	2000	35	46	23.52	79	0	59.4	5787
NC	Kings Mountain Reservoir	Cleveland	0062	1	2000	35	18	3.6	81	27	21.24	551.51
NC	Lake Gaston	Warren	0164	1	2000	36	32	27.6	78	1	8.4	7951
NC	Lake Norman	Catawba	0262	R	2003	35	37	35.4	80	56	40.2	13211.68
NC	Lake Phelps	Washington	0139	1	2000	35	46	7.356	76	27	36.18	6718
NC	Mountain Island Reservoir	Gaston/Mecklenburg	0537	2	2001	35	21	2.88	80	58	11.28	1403.92
NC	San-Lee Park Lake	Lee	0312	R	2003	35	28	53.04	79	7	31.08	7.29
NC	Smith Lake	Cumberland	0612	2	2002	35	8	9.6	78	55	38.64	34.07
NORTH DAKOTA: 8 Lakes												
ND	Devils Lake	Ramsey	0030	1	2001	48	13	15.6	98	48	19.08	7119.61
ND	Dry Lake	Mcintosh	1456	4	2000	46	7	5.88	99	28	20.28	203.78
ND	Dry Lake	Ramsey	0105	1	2001	48	15	8.64	98	58	27.12	2196.46
ND	Epping - Springbrook Dam	Williams	0484	2	2001	48	15	43.92	103	25	0.48	59.85
ND	Homme Lake	Walsh	0230	R	2003	48	24	24.84	97	48	4.68	75.74
ND	Horsehead Lake	Kidder	0956	3	2001	47	2	34.8	99	47	2.76	1355.91
ND	Long Lake	Kidder	0006	1	2000	46	44	20.4	100	3	46.8	1299.72
ND	Twin Lakes South	La Moure	0281	R	2003	46	24	8.28	98	15	45.72	108.46
OHIO: 7 Lakes												
OH	Clouse Lake	Perry	1491	4	2003	39	46	1.56	82	17	56.4	13.14
OH	Darrell Rose's Pond	Marion	0541	2	2001	40	37	20.28	83	7	39.36	2.16
OH	Lake Rupert	Vinton	0066	1	2000	39	11	23.28	82	31	19.56	133.07

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OH	Tom Porter's Pond	Licking	0513	2	2001	39	57	9.36	82	14	1.68	1.52
OH	Unnamed lake	Lucas	1114	3	2002	41	36	25.92	83	40	48.72	5.3
OH	Unnamed lake	Trumbull	1514	4	2003	41	18	24.84	80	34	16.68	2.38
OH	Unnamed lake	Hancock	0963	3	2002	41	3	4.32	83	34	28.56	1.18
OKLAHOMA: 21 Lakes												
OK	Broken Bow Lake	Mccurtain	0499	2	2000	34	16	49.08	94	40	46.92	5342.04
OK	Camp Simpson Lake	Johnston	1123	3	2001	34	25	7.32	96	32	49.20	41.33
OK	Coalgate City Lake	Coal	0924	3	2001	34	34	40.80	96	14	16.80	159.1
OK	Fort Cobb Lake	Caddo	0069	1	1999	35	11	53.52	98	29	27.24	1654.07
OK	Great Salt Plains Lake	Alfalfa	1544	4	2002	36	44	1.32	98	10	39.36	4041.26
OK	Hugo Lake	Choctaw	0099	1	2000	34	5	8.52	95	25	26.04	4950.45
OK	Keystone Lake	Creek/Pawnee	0219	1	1999	36	14	53.16	96	22	4.80	5454.54
OK	Lake Altus-Lugert	Kiowa	1494	4	2002	34	55	32.52	99	18	42.12	1810.44
OK	Lake El Reno	Canadian	0944	3	2001	35	31	19.56	97	59	31.56	62.72
OK	Lake Hudson	Mayes	1093	3	2001	36	26	2.04	95	11	30.12	8.22
OK	Lake Lawtonka	Comanche	0269	R	2003	34	45	28.44	98	30	50.04	959.22
OK	Lake Ponca	Kay	0294	R	2003	36	44	19.68	97	2	4.56	184.84
OK	Oologah Lake	Rogers	0068	1	2000	36	34	55.56	95	35	31.92	6099.87
OK	Sardis Lake	Latimer	0249	R	2003	34	46	21	95	4	9.84	63.2
OK	Tenkiller Ferry Lake	Cherokee	1468	4	2002	35	42	41.76	94	57	21.24	5350.48
OK	Unnamed lake	Mcclain	0544	2	2000	34	59	12.48	97	31	44.76	12.21
OK	Unnamed lake	Osage	0669	2	2000	36	36	48.60	96	47	36.60	2.18
OK	Unnamed lake	Stephens	1423	4	2002	34	35	12.12	97	38	8.52	14.67
OK	Unnamed lake	Le Flore	1524	4	2002	35	16	8.76	94	48	20.52	1.18
OK	Unnamed lake	Rogers	1543	4	2002	36	32	46.32	95	38	43.80	99.47
OK	Wewoka Lake	Seminole	1469	4	2002	35	11	49.20	96	31	1.92	144.51
OREGON: 9 Lakes												
OR	Barney Reservoir	Washington	1454	4	2003	45	26	42.612	123	23	19.968	81.14
OR	Crater Lake	Klamath	0451	2	2001	42	56	57.84	122	5	41.1	5318.03
OR	Denley Reservoir	Douglas	1001	3	2002	43	22	22.476	123	14	38.724	5.91
OR	Elk Lake	Marion	0901	3	2002	44	49	22.872	122	7	7.968	25.95
OR	Lake Owyhee	Malheur	1353	4	2003	43	29	57.084	117	21	3.672	4576.85

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OR	Lake Umatilla	Klickitat	0629	2	2002	45	43	32.916	120	31	53.544	11697.92
OR	Malheur Lake	Harney	0326	R	2003	43	18	35.24	118	47	32.03	5961.67
OR	Unnamed lake	Linn	0076	1	2002	44	33	9.54	123	14	20.112	7.23
OR	Wickiup Reservoir	Deschutes	1501	4	2003	43	41	29.868	121	43	19.668	4110.44
PENNSYLVANIA: 9 Lakes												
PA	Crooked Creek Lake	Armstrong	0489	2	2000	40	40	55.92	79	29	8.52	151.44
PA	Francis Slocum State Park Lake	Luzerne	0288	R	2003	41	20	12.48	75	53	40.56	66.62
PA	Keystone Lake	Westmoreland	0239	R	2003	40	22	24.96	79	22	58.08	23.52
PA	Lake Sabula	Clearfield	0039	1	2002	41	9	29.16	78	39	57.24	13.36
PA	Pike Lake #3	Pike	0188	1	1999	41	15	1.44	74	57	5.04	5.61
PA	Shenango River Lake	Mercer	1014	3	2001	41	17	34.08	80	25	28.92	1490.57
PA	Unnamed lake	Franklin	0089	1	1999	39	56	42.36	77	48	43.56	1.6
PA	Unnamed lake	Bradford	0213	1	2000	41	56	39.48	76	23	19.68	9.65
PA	Whitney Lake	Wayne	1088	3	2001	41	28	9.12	75	15	0.72	46.01
RHODE ISLAND: 2 Lakes												
RI	Arnold Mills Reservoir	Providence	1567	4	2003	41	59	2.04	71	24	23.4	6.44
RI	Gorton Pond	Kent	1517	4	2003	41	42	18.72	71	27	33.84	21.82
SOUTH CAROLINA: 3 Lakes												
SC	Hartwell Reservoir	Oconee	1486	4	2001	34	34	42.24	83	6	6.12	6881.09
SC	Lake Murray	Newberry	0987	3	2000	34	5	15.72	81	28	0.12	19601.57
SC	Lake Wateree	Kershaw	1562	4	2001	34	25	9.48	80	48	32.04	5548.26
SOUTH DAKOTA: 9 Lakes												
SD	Angostura Reservoir	Fall River	1553	4	2002	43	18	28.08	103	25	4.44	1741.5
SD	Corsica Lake	Douglas	1031	3	2001	43	24	53.64	98	17	31.2	37.99
SD	Hayes Lake	Stanley	0982	3	2000	44	21	57.6	101	0	44.64	24.6
SD	Lake Mitchell	Davison	0007	1	2000	43	45	23.04	98	3	21.6	283.62
SD	Lake Oahe	Dewey	1056	3	2002	44	52	26.76	100	31	59.16	61520.39
SD	Mud Lake	Kingsbury	1107	3	2001	44	28	44.76	97	35	33	119.08
SD	Pelican Lake	Codington	0107	1	2001	44	52	4.08	97	10	48.36	1124.44
SD	Shadehill Reservoir	Perkins	0056	1	2000	45	46	11.64	102	15	16.92	958.83
SD	South Waubay Lake	Day	1507	4	2002	45	22	49.08	97	27	5.04	940.18

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TENNESSEE: 8 Lakes												
TN	Dale Hollow Lake	Clay	0487	2	2001	36	33	54.36	85	16	29.28	10725.65
TN	Douglas Reservoir	Jefferson	1487	4	2003	35	59	50.28	83	21	54.36	11138.56
TN	J. Percy Priest Lake	Davidson	0087	1	2000	36	5	56.76	86	33	37.08	5369.73
TN	Kentucky Lake	Henry/Stewart	1036	3	2002	36	25	53.76	88	4	45.12	46342.27
TN	Norris Lake	Union	0187	1	2000	36	18	40.68	83	49	58.8	3749.23
TN	Pine Lake	Henderson	0561	2	2001	35	33	29.16	88	24	54	184.41
TN	Ridgetop Lake	Robertson	0587	2	2001	36	24	46.08	86	45	51.84	5.41
TN	Tellico Lake	Monroe	1536	4	2003	35	36	30.96	84	13	4.8	6638.63
TEXAS: 41 Lakes												
TX	Arnold Lake	Houston	0220	1	1999	31	10	9.84	95	41	0.24	23.46
TX	ASCS Lake Riser 638	Collin	0598	2	2002	33	18	28.08	96	40	9.48	6.77
TX	B.A. Steinhagen Lake	Tyler/Jasper	0524	2	2000	30	50	56.29	94	11	30.59	5549
TX	Bardwell Reservoir	Ellis	0246	R	2003	32	17	11.04	96	40	10.92	1125.31
TX	Caddo Lake	Marion	1373	4	2003	32	44	56.76	94	7	32.16	10794
TX	E.V. Spence Reservoir	Coke	0021	1	2000	31	56	13.56	100	34	39.72	6055
TX	Hubbard Creek Reservoir	Stephens	0596	2	2000	32	46	31.08	99	0	24.48	5960.07
TX	Lake Arrowhead	Clay	0048	1	2000	33	42	37.08	98	22	44.40	6561
TX	Lake Belton	Bell	0921	3	2001	31	9	59.40	97	34	25.68	1052.24
TX	Lake Caballo	Zavala	0196	1	2000	28	54	23.40	99	38	57.84	4.95
TX	Lake Childress	Childress	0495	2	2000	34	27	40.68	100	20	57.12	120.72
TX	Lake Coleman	Coleman	0471	2	2000	32	2	13.20	99	30	50.40	705.13
TX	Lake Conroe	Montgomery	1570	4	2002	30	28	4.08	95	35	8.52	8029.64
TX	Lake Corpus Christi	Live Oak	0221	1	1999	28	12	4.68	97	55	42.24	7831
TX	Lake Falcon	Zapata	1571	4	2003	26	55	17.76	99	19	7.68	15801.88
TX	Lake Lavon	Collin	0948	3	2001	33	7	49.44	96	32	39.84	80.66
TX	Lake Lewisville	Denton	1473	4	2002	33	8	57.84	96	59	12.48	8589.78
TX	Lake Logan	Navarro	0496	2	2000	32	0	52.20	96	49	37.92	12.44
TX	Lake Palestine	Henderson	0673	2	2000	32	11	9.60	95	29	17.16	9533.34
TX	Lake Pat Mayse	Lamar	0573	2	2001	33	49	37.20	95	35	54.24	2389.57
TX	Lake Proctor	Comanche	1045	3	2001	32	1	8.04	98	30	18.36	1913.14

State	Lake Name	County	Lake ID	Statistical Year	Sampling Year	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
TX	Lake Sam Rayburn	Nacogdoches	0324	R	2003	31	7	0.516	94	9	37.332	46336.7
TX	Lake Tawakoni	Hunt	0223	1	2000	32	56	57.12	96	0	38.52	15333.32
TX	Lake Texoma	Grayson	0473	2	2001	33	51	21.96	96	47	23.64	23548.87
TX	Lake Travis	Travis	0070	1	2000	30	24	55.44	98	1	32.88	7239.69
TX	Richland Reservoir	Navarro/Freestone	1446	4	2003	31	58	47.14	96	13	1.92	18124
TX	Rogers Lake	Montgomery	0020	1	1999	30	11	6.36	95	23	14.64	9.31
TX	Stillhouse Hollow Reservoir	Bell	0645	2	2000	31	0	22.32	97	36	31.32	2663.76
TX	Toledo Bend Reservoir	Panola	0974	3	2002	32	1	39.72	94	9	57.24	4.96
TX	Toledo Bend Reservoir	Sabine	1399	4	2002	31	31	22.80	93	46	16.32	67141.13
TX	Unnamed lake	Young	1021	3	2001	33	23	43.80	98	40	37.56	8.72
TX	Unnamed lake	Smith	1098	3	2001	32	34	5.52	95	30	57.96	6.07
TX	Unnamed lake	Henderson	0998	3	2002	32	4	54.48	96	2	20.40	10.27
TX	Unnamed lake	Nacogdoches	1049	3	2002	31	33	15.12	94	33	7.92	3.24
TX	Unnamed lake	Hopkins	1073	3	2002	33	6	4.32	95	31	55.20	5.18
TX	Unnamed lake	Karnes	1395	4	2002	28	56	11.40	98	0	58.32	8.01
TX	Unnamed lake	Mcculloch	1421	4	2002	31	18	57.24	99	14	0.60	5.97
TX	Unnamed lake	Collin	1498	4	2002	33	11	22.56	96	21	46.08	8.58
TX	Unnamed lake	Ellis	1370	4	2003	32	14	28.32	96	49	17.40	9.12
TX	Unnamed lake	Montague	1523	4	2003	33	29	19.32	97	36	39.60	5.38
TX	Wright Patman Lake	Bowie	0973	3	2003	33	17	3.84	94	19	55.56	11360.46
UTAH: 5 Lakes												
UT	Gunlock Reservoir	Washington	0102	1	2000	37	15	42.48	113	46	31.8	100.83
UT	Olsen Slough	Sanpete	0526	2	2003	39	4	14.52	111	50	15.72	14.5
UT	Strawberry Reservoir	Wasatch	1051	3	2002	40	11	13.56	111	8	41.64	3171.67
UT	Unnamed lake	Cache	0927	3	2003	41	49	53.4	111	53	17.88	6.96
UT	Utah Lake	Utah	1476	4	2002	40	12	8.856	111	48	26.208	39231
VERMONT: 2 Lakes												
VT	Lake Whitingham	Windham	0093	1	2000	42	49	41.52	72	53	29.4	1564.85
VT	Lake Willoughby	Orleans	0942	3	2002	44	44	52.8	72	3	33.12	670.01

State	Lake Name	County	Lake ID	Statistical Year	Sampling Year	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
VIRGINIA: 10 Lakes												
VA	Banister Lake	Halifax	1089	3	2001	36	47	14.28	78	57	14.76	154.42
VA	Big Lake	Halifax	0512	2	2000	36	40	55.2	79	5	25.08	10.42
VA	Griggs Pond	Henrico	0614	2	2000	37	25	23.88	77	18	37.44	5.81
VA	John H. Kerr Reservoir	Mecklenburg	0314	R	2003	36	33	54.72	78	28	36.48	16907.08
VA	Lake Anna	Louisa	0064	1	1999	38	3	51.84	77	50	37.68	5254.27
VA	Lake Caroline	Caroline	0264	R	2003	37	59	23.28	77	31	35.4	111.22
VA	Lake Chesdin	Chesterfield	1539	4	2002	37	15	43.2	77	36	8.64	1315.57
VA	Lone Star Lake	Suffolk	0964	3	2001	36	52	1.56	76	34	13.44	13.14
VA	Unnamed lake	Caroline	0090	1	2001	37	58	1.92	77	18	43.92	10.88
VA	Unnamed lake	Prince William	0914	3	2001	38	49	14.52	77	42	14.04	2.99
WASHINGTON: 14 Lakes												
WA	Buffalo Lake	Okanogan	1379	4	2002	48	3	47.016	118	53	14.496	226.24
WA	Calligan Lake	King	1554	4	2002	47	36	18.54	121	39	57.168	116.96
WA	Crescent Lake	Clallam	0202	1	1999	48	5	5.316	123	46	2.712	1995.24
WA	Dorothy Lake	King	0654	2	2000	47	35	3.408	121	22	59.88	101.93
WA	Frenchman Hills Lake	Grant	0179	1	1999	46	58	54.876	119	35	17.772	138.34
WA	Keechelus Lake	Kittitas	0004	1	2001	47	20	2.94	121	21	34.056	955.35
WA	Lake Chelan	Chelan	0504	2	2000	48	1	33.96	120	19	55.38	13091
WA	Lake Nahwatzel	Mason	0279	R	2003	47	14	35.34	123	19	56.532	111.16
WA	Lake Wallula	Benton	1479	4	2003	46	0	17.208	118	58	54.156	12960.93
WA	Lone Lake	Island	0979	3	2001	48	1	17.472	122	27	34.812	34.21
WA	Patterson Lake	Okanogan	0304	R	2003	48	27	31.896	120	14	40.308	51.6
WA	Pend Oreille River	Pend Oreille	1354	4	2002	48	25	48	117	17	33.072	935.8
WA	Potholes Reservoir	Grant	1054	3	2001	46	59	12.48	119	19	19.992	11333
WA	Rimrock Lake	Yakima	0529	2	2000	46	38	25.08	121	9	42.444	951.97
WEST VIRGINIA: 1 Lake												
WV	Summersville Lake	Nicholas	0637	2	2003	38	14	27.24	80	51	15.12	843.74

State	Lake Name	County	Lake ID	Statistical Year	Sampling Year	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
WISCONSIN: 18 Lakes												
WI	Big Gibson Lake	Vilas	1084	3	2002	46	8	15.36	89	33	9.72	48.45
WI	Castle Rock Lake	Adams/Juneau	0458	2	2001	43	56	6.72	89	59	9.6	5010.01
WI	Hatch Lake	Waupaca	0983	3	2003	44	31	50.52	89	6	52.56	46.13
WI	Irogami (Fish) Lake	Waushara	0008	1	2001	44	3	57.24	89	13	56.28	116.45
WI	Keyes Lake	Florence	0259	R	2003	45	53	58.2	88	18	23.76	76.26
WI	Lake DuBay/Big Eau Pleine Reservoir	Marathon	0208	1	2002	44	42	0	89	40	48	5356.14
WI	Lake Winnebago	Winnebago	0666	2	2003	44	0	7.2	88	24	56.52	53756.72
WI	Lake Winter	Sawyer	0133	1	2001	45	48	42.12	90	59	3.48	110.43
WI	Pacwawong Lake	Sawyer	0958	3	2002	46	9	1.8	91	20	21.84	76.05
WI	Pewaukee Lake	Waukesha	1566	4	2003	43	4	22.44	88	18	25.92	984.62
WI	Rainbow Flowage	Oneida	0308	R	2003	45	51	32.4	89	30	51.84	1291.37
WI	Spirit River Flowage	Lincoln	0283	R	2003	45	26	38.76	89	49	24.24	640.24
WI	Sweeney Lake	Oneida	0134	1	2003	45	51	42.84	89	35	21.84	77.73
WI	Turtle Flambeau Flowage	Iron	0608	2	2001	46	5	8.52	90	10	8.724	7648.59
WI	Warner Lake	Burnett	0058	1	2002	45	47	49.2	92	13	19.56	71.36
WI	Whitefish Lake	Sawyer	0258	R	2003	45	51	47.52	91	26	36.24	322.36
WI	Wolf Lake	Fond Du Lac	0291	R	2003	43	51	51.48	88	12	28.44	33.84
WI	Yellow River Barron Flowage #3	Barron	1058	3	2002	45	24	48.6	91	51	57.24	20.56
WYOMING: 6 Lakes												
WY	Baptiste Lake	Fremont	0527	2	2001	42	52	21.36	109	18	18	73.34
WY	Buffalo Bill Reservoir	Park	0528	2	2000	44	29	33	109	15	30.96	1384.63
WY	Lake 79	Fremont	0052	1	2001	43	0	30.24	109	19	58.8	4.04
WY	Lake DeSmet	Johnson	1478	4	2001	44	29	3.48	106	45	12.24	821.12
WY	Lewis Lake	Teton	0602	2	2003	44	17	59.28	110	37	39.72	1115.92
WY	Yellowstone Lake	Teton	1078	3	2003	44	27	17.532	110	21	58.428	35223.98

Appendix B

Input Data File Example
(A Portion of Year 4 Data from Rhode Island)

State	County	Site_Name	Latitude	Longitude	Lake_ID_Number	Water_Body_Type	Surface_Area (ha)	Composite_Sample_ID
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS
Rhode Island	Kent	Gorton Pond	41.7052	-71.4594	1517	Lake	21.82	RI031517PS

Composite_ Type	Preparation	EPA_Sample_ Number	Analyte	CAS_Number	Amount
Predator	Filleted Prior to Homogenization	63252	1,2,3,4,6,7,8-HPCDD	35822469	
Predator	Filleted Prior to Homogenization	63252	1,2,3,4,6,7,8-HPCDF	67562394	
Predator	Filleted Prior to Homogenization	63252	1,2,3,4,7,8,9-HPCDF	55673897	
Predator	Filleted Prior to Homogenization	63252	1,2,3,4,7,8-HXCDD	39227286	
Predator	Filleted Prior to Homogenization	63252	1,2,3,4,7,8-HXCDF	70648269	
Predator	Filleted Prior to Homogenization	63252	1,2,3,6,7,8-HXCDD	57653857	
Predator	Filleted Prior to Homogenization	63252	1,2,3,6,7,8-HXCDF	57117449	
Predator	Filleted Prior to Homogenization	63252	1,2,3,7,8,9-HXCDD	19408743	
Predator	Filleted Prior to Homogenization	63252	1,2,3,7,8,9-HXCDF	72918219	
Predator	Filleted Prior to Homogenization	63252	1,2,3,7,8-PECDD	40321764	
Predator	Filleted Prior to Homogenization	63252	1,2,3,7,8-PECDF	57117416	
Predator	Filleted Prior to Homogenization	63252	2,3,4,6,7,8-HXCDF	60851345	
Predator	Filleted Prior to Homogenization	63252	2,3,4,7,8-PECDF	57117314	
Predator	Filleted Prior to Homogenization	63252	2,3,7,8-TCDD	1746016	0.07
Predator	Filleted Prior to Homogenization	63252	2,3,7,8-TCDF	51207319	0.03
Predator	Filleted Prior to Homogenization	63252	OCDD	3268879	
Predator	Filleted Prior to Homogenization	63252	OCDF	39001020	
Predator	Filleted Prior to Homogenization	63252	1,2,3-TRICHLOROBENZENE	87616	
Predator	Filleted Prior to Homogenization	63252	1,2,4,5-TETRACHLOROBENZENE	95943	
Predator	Filleted Prior to Homogenization	63252	1,2,4-TRICHLOROBENZENE	120821	
Predator	Filleted Prior to Homogenization	63252	1,2-DICHLOROBENZENE	95501	
Predator	Filleted Prior to Homogenization	63252	1,2-DIPHENYLHYDRAZINE	122667	
Predator	Filleted Prior to Homogenization	63252	1,3-DICHLOROBENZENE	541731	
Predator	Filleted Prior to Homogenization	63252	1,4-DICHLOROBENZENE	106467	
Predator	Filleted Prior to Homogenization	63252	2,3,6-TRICHLOROPHENOL	933755	
Predator	Filleted Prior to Homogenization	63252	2,4,5-TRICHLOROPHENOL	95954	
Predator	Filleted Prior to Homogenization	63252	2,4,6-TRICHLOROPHENOL	88062	
Predator	Filleted Prior to Homogenization	63252	2,4,6-TRIS(1,1-DIMETHYLETHYL)PHENOL	732263	
Predator	Filleted Prior to Homogenization	63252	2,4-DICHLOROPHENOL	120832	
Predator	Filleted Prior to Homogenization	63252	2,4-DIMETHYLPHENOL	105679	
Predator	Filleted Prior to Homogenization	63252	2,4-DINITROPHENOL	51285	
Predator	Filleted Prior to Homogenization	63252	2,4-DINITROTOLUENE	121142	
Predator	Filleted Prior to Homogenization	63252	2,6-DINITROTOLUENE	606202	
Predator	Filleted Prior to Homogenization	63252	2-CHLORONAPHTHALENE	91587	
Predator	Filleted Prior to Homogenization	63252	2-CHLOROPHENOL	95578	

Replimit	Unit	SCC_Code	Comments	Method_ Number	Analysis	Percent_ Lipids	Sampling_ Year
0.5	NG/KG (ppt)	B, RNON	BLANK CONTAMINATION	1613B	Dioxins and Furans	0.28	2003
0.5	NG/KG (ppt)			1613B	Dioxins and Furans	0.28	2003
0.5	NG/KG (ppt)			1613B	Dioxins and Furans	0.28	2003
0.5	NG/KG (ppt)			1613B	Dioxins and Furans	0.28	2003
0.5	NG/KG (ppt)			1613B	Dioxins and Furans	0.28	2003
0.5	NG/KG (ppt)			1613B	Dioxins and Furans	0.28	2003
0.5	NG/KG (ppt)			1613B	Dioxins and Furans	0.28	2003
0.5	NG/KG (ppt)			1613B	Dioxins and Furans	0.28	2003
0.5	NG/KG (ppt)			1613B	Dioxins and Furans	0.28	2003
0.5	NG/KG (ppt)			1613B	Dioxins and Furans	0.28	2003
0.5	NG/KG (ppt)			1613B	Dioxins and Furans	0.28	2003
0.5	NG/KG (ppt)			1613B	Dioxins and Furans	0.28	2003
0.5	NG/KG (ppt)			1613B	Dioxins and Furans	0.28	2003
	NG/KG (ppt)	J	ESTIMATED VALUE	1613B	Dioxins and Furans	0.28	2003
	NG/KG (ppt)	J	ESTIMATED VALUE	1613B	Dioxins and Furans	0.28	2003
1	NG/KG (ppt)	B, RNAF	BLANK CONTAMINATION	1613B	Dioxins and Furans	0.28	2003
1	NG/KG (ppt)			1613B	Dioxins and Furans	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
666	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
1665	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003
333	UG/KG (ppb)			1625C	Semi-volatile Organic Cmpds.	0.28	2003

Appendix C

Electronic Data Deliverable Data Dictionary

National Lake Fish Tissue Study – Year Three (2002) and Year Four (2003) Electronic Data Deliverable (EDD) Data Dictionary

Worksheet Name: –RESULTS(A-M) and RESULTS(N-Z)
Worksheet Description: – These worksheets store the analytical results for all of the composite samples.
Worksheet Organization: – These worksheets are sorted by the *State*, *Method*, and then *Analyte* fields.

Column Name	Description
State	The full name of the state in which the sample was collected. An example of a record found in this field would be Alabama.
County	The county where the sampling site is located. An example is Becker (MN).
Site_Name	The name of the water body where the samples were collected. An example of an entry in this field is Flat Lake. Sampling locations without an official name were identified as "Unnamed lake."
Latitude	The latitude (represented as a decimal value) associated with the sampling location. An example is "46.9790".
Longitude	The longitude (represented as a decimal value) associated with the sampling location. An example is "-95.6548".
Lake_ID_Number	The unique 4-digit code assigned to individual lakes or reservoirs by EPA; this number uniquely identifies a particular site. An example of a record found in this field is 1506.
Water_Body_Type	The type of water body from which the individual fish specimens were collected. Records found in this field include Lake and Reservoir.
Surface_Area(ha)	The total area covered by a water body in hectares (ha); a hectare is about 2.5 acres.
Composite_Sample_ID	This is the alpha-numeric code (ten characters in length) used to describe a sample. The first two characters of the code are the state abbreviation; the third and fourth characters are the last two digits of the year in which the sample was collected; the fifth through eighth characters represent the lake ID number designated by EPA; the ninth character represents the composite type ("B" for bottom dweller and "P" for predator); and the tenth, and final, character represents the sample type ("S" for standard and "D" for duplicate). Examples of records found in this field would be AL030236BS or AL030236BD.

Worksheet Name: –RESULTS(A-M) and RESULTS(N-Z) (cont.)

Column Name	Description
Composite_Type	This field describes the type of fish species sampled. This field contains the designations “Bottom-dweller” or “Predator.”
Preparation	A description of how the sample was prepared. The only two entries found in this field are “Homogenized Whole” for the bottom dwellers and “Filleted Prior to Homogenization” for the predators.
EPA_Sample_Number	The unique 5-digit EPA sample number assigned by the sample prep laboratory to distinguish samples from one another. Examples are 63287 and 63289.
Analyte	The chemical compound analyzed by the laboratory.
CAS_Number	The unique Chemical Abstract Services (CAS) Number assigned to each analyte. Please note that for those PCB congeners that co-elute, the CAS Number was left blank. Also, since Total Inorganic Arsenic does not have a CAS Number associated with it, this field was left blank for this analyte.
Amount	The concentration of a particular analyte (chemical) for which the data are being reported. Please note that a blank field indicates that the analyte was not detected above the Method Detection Limit (MDL).
Replimit	The minimum level of quantitation (ML), adjusted for dilution or concentration, if necessary.
Unit	Unit of measure. Examples include NG/KG (ppt), UG/KG (ppb), and UG/G (ppm).
SCC_Code	This column is used to represent Sample Control Center’s (SCC’s) data considerations or “qualifiers.” Examples of records found in this field include “B, RNON” and “HLBL.” Please note that a Data Qualifier Key is provided with the results and this key describes all of the SCC Codes that are applied to the results.
Comments	A brief explanation or description of the SCC Code. Examples of records found in this field include Blank Contamination and Estimated Value.
Method_Number	The EPA method number used by the laboratory to analyze the samples for a particular analyte of interest. This field is limited to the following method numbers: 1613B, 1625C, 1631B, 1632A, 1656A, 1657A, and 1668A.

Worksheet Name: –RESULTS(A-M) and RESULTS(N-Z) (cont.)

Column Name	Description
Analysis	The full text description of the analysis performed on the sample. This field is limited to the following: "Metals (Hg + As Species)", "Polychlorinated Biphenyls", "Dioxins and Furans", "Pesticides", and "Semi-volatile Organic Cmpds."
Percent_Lipids	Measure of the amount of lipid content of a fish composite sample; represented as a percentage of total sample weight, rounded to two decimal places.
Sampling_Year	The year that the sample was collected.