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Agency

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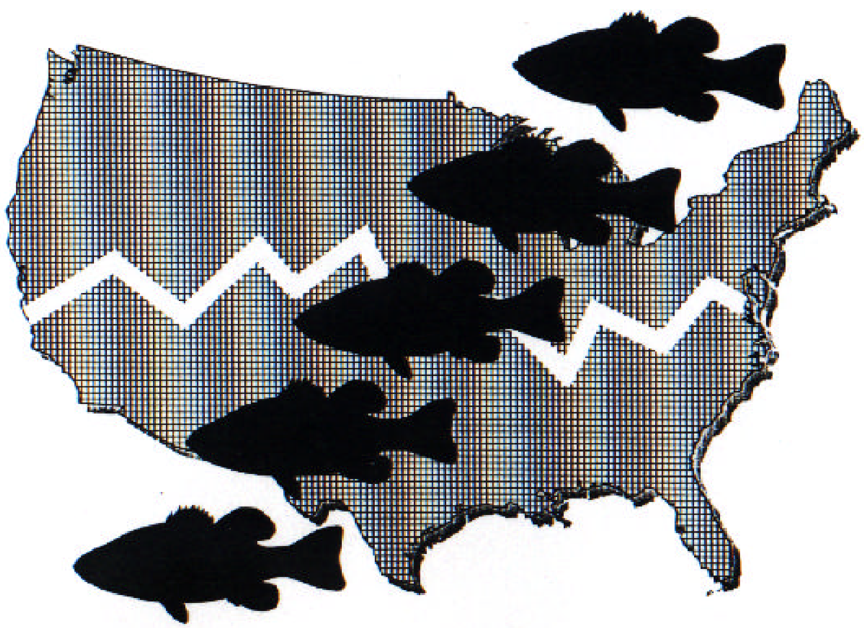
Quality Assurance Project Plan for Sample Collection Activities for a National Study of Chemical Residues in Lake Fish Tissue



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May 2000

Quality Assurance Project Plan

for Sample Collection Activities for a

National Study of Chemical Residues in Lake Fish Tissue

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May 22, 2000
Final

This quality assurance project plan (QAPP) has been prepared according to guidance provided in the document *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5, U.S. Environmental Protection Agency, Quality Assurance Division, Washington, DC, Interim Final, November 1999) to ensure that environmental and related data collected, compiled, and/or generated for this project are complete, accurate, and of the type, quantity, and quality required for their intended use. The work conducted by Tetra Tech will be 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 while collecting samples for the National Study of Chemical Residues in Lake Fish Tissue (hereafter referred to as the National Fish Tissue Study) from 1999 through 2002. The purpose of this document is to present the methods and procedures that will be used for the collection of fish tissue from lakes and reservoirs throughout the United States and the quality assurance procedures that will be employed. This document addresses *only* the sample collection effort of the National 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 1999a). Reference to the QAPP elements described in the guidance document are 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, Second Edition* (USEPA 1995)[or subsequent updates].

The project team organization provides the framework for conducting the sample collection 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 and processing 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 and other participating federal agencies, selected state resource agencies, Native American tribes, and Tetra Tech. 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 oversight for study design, site selection, and adherence to design objectives,
- reviewing and approving the project work plan, QAPP, and other materials developed to support the project, and
- coordinating with contractors, reviewers and USEPA Regions/States/Tribes to ensure technical quality and contract adherence.

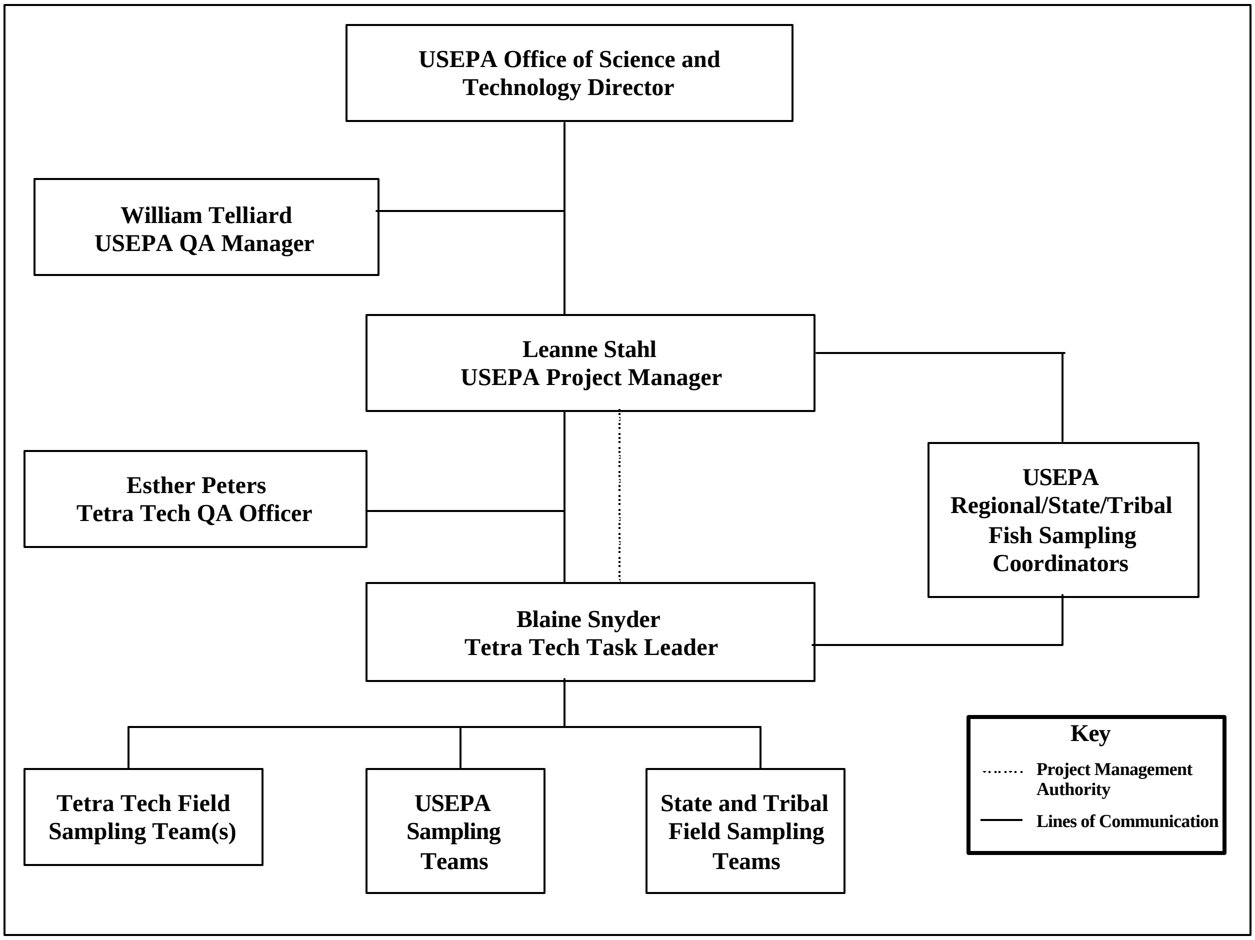

Figure 1. Organizational Diagram for the National Study of Chemical Residues in Lake Fish Tissue.

The **USEPA Quality Assurance Manager** is William Telliard, 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 field procedures,
- conducting external performance and system audits of the procedures, and
- participating in Agency QA reviews of the study.

The **Tetra Tech Task Leader** is Blaine Snyder, who will participate in study design and site selection 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, and
- providing support to USEPA in interacting with the project team (including the sample control center), technical reviewers, and USEPA Regions/States/Tribes to ensure technical quality requirements are met in accordance with project design objectives.

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 **Regional Fish Sampling Coordinators or QA/QC Field Officers** will be responsible for performing evaluations to ensure that QA/QC protocols are maintained throughout the sample collection and preparation processes. The evaluations will include reviewing all required documentation for completeness and seeing that any problems encountered outside normal operating conditions are documented and addressed, and verifying all other QA/QC procedures identified in the QAPP are followed. The USEPA Project Manager and the Tetra Tech Task Leader will coordinate and oversee the orientation of the Regional Fish Sampling Coordinators or QA/QC Field Officers responsible for USEPA Regional/State/Tribal Field Sampling Teams.

Field Sampling Teams will be composed of:

- USEPA field staff, and/or
- State and Tribal field personnel, and/or
- Contractor-affiliated field staff (including subcontracted organizations or universities).

The Task Leader will direct and supervise the contractor-affiliated Field Sampling Teams and provide for their efficient utilization by directing their efforts. Both agency and contractor-affiliated field personnel are responsible for performing the field work, including collection, preparation, and shipment of fish tissue samples and completion of field sampling records. The Field Sampling Teams will include scientific staff with specialization and technical competence in field sampling activities to effectively and efficiently perform the required work. They must perform all work in adherence with the project work plan and QAPP, including maintenance of sample custody and related documentation. Custody procedures are required to ensure the integrity of the samples with respect to prevention of contamination and maintenance of proper sample identification during handling. In this role, Field Sampling Teams are responsible for:

- receiving and inspecting the sample containers,
- completing and signing appropriate field records,
- assigning tracking numbers to each sample,
- verifying the completeness and accuracy of chain-of-custody documentation,
- controlling and monitoring access to samples while in their custody, and
- initiating shipment of the samples to appropriate destinations.

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. Gamefish 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 has initiated work on 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 1999b). 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 coterminous 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 (1999-2002),

- 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 274 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.

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

- are accumulative environments where contamination is detectable,

- provide important sport fisheries nationwide,

- offer other recreational (non-fishing) access and opportunities, and

- occur in agricultural, urban, and less-developed areas, so that associations with each primary use may be determined.

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

- Fish consumption advisories represent 15.8% of the Nation's total lake acres (plus 100% of the Great Lakes), compared to 6.8% of the Nation's total river miles (USEPA 1999c). [**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 and Gulf Coast estuaries, and will include fish contamination in its Year 2000 initiative on West Coast estuaries.

The specific objective of the new National 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 continental United States.*

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

- information to meet objectives of the President's Clean Water Action Plan (CWAP) and to specifically respond to the following action item:
  - — CWAP Key Action #1: USEPA and NOAA will conduct a national survey of mercury and other contaminants in fish and shellfish throughout the country, and will coordinate the effort with states and tribes to maximize geographic coverage. The shellfish survey will be based on the data obtained by NOAA's ongoing Mussel Watch Project.
- information about persistent, bioaccumulative, and toxic chemicals (PBTs) for the Agency's PBT Initiative that addresses the following objective:
  - — The PBT Initiative 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 coterminous 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 task presented and discussed in this document involves only those methods and procedures used to collect and ship fish tissue samples for the National Fish Tissue Study. The Analytical Activities QAPP for the National Fish Tissue Study discusses the following study topics and tasks: sample preparation, compositing and homogenization; target analytes; analytical methods; and sample analysis.

In consultation with the USEPA Office of Science and Technology, Tetra Tech will coordinate with USEPA headquarters and regional staff, state resource agencies, and Native American tribes to collect fish tissue samples from randomly selected lakes and reservoirs in the continental United States. With a combined network of partners and contractors, USEPA anticipates the sampling of approximately 500 lakes across the country (Appendix A) during the four-year sampling duration of the study (1999-2002). The fish tissue samples will be collected based on a probability design to provide information on national distribution of the mean levels of contaminants in fish. This random selection of lakes and reservoirs is important for fulfilling the study design objectives, but adds complexity to field sampling logistics. Sampling Teams will need to be prepared to mobilize and sample fish from lakes in all parts of the country. The following elements will also add to the complexity of the field effort, and must be considered when planning field logistics:

- Field teams should consist of (at a minimum) one experienced fisheries biologist, one field technician, and a quality control specialist, all of whom must have experience with the array of fisheries sampling gear types to be used. In some cases the senior fisheries biologist may serve in dual capacities, assuming responsibility for site quality control (QC).

- The national study will include two groups of target fishes — predator/gamefish and bottom-dwelling fish species (Section 8.1).

- Samples must consist of a composite of fish (e.g., 5 individuals that will collectively provide greater than 560 grams of edible tissue for predators and 560 grams of total body tissue for bottom-dwellers) of the same target species and be the same relative size from each sampling location (Section 8.2).

- The optimum sampling window may be restricted due to biological, physical, and meteorological conditions and factors (Section 7.2).

Each Sampling Team, in the combined network of samplers, will collect, prepare for shipment, and ship all fish tissue samples to a designated location according to the methods and procedures described in this QAPP and approved by the USEPA Project Manager. The USEPA Project Manager will be notified immediately by the Tetra Tech Task Leader and/or the USEPA Regional/State/Tribal Fish Sampling Coordinators of any problems related to successful completion of field efforts.

Field sampling activities began in the fall of 1999, will continue in 2000 and 2001 during the summer and fall, and will conclude in the fall of 2002. Due to the effort required to initiate the study (e.g., project coordination and development of study materials such as the study design document, QAPP, and training materials), fewer lakes were sampled in year one than will be sampled during other sampling years. In addition, some states indicated that they were unable to participate in sampling during the first year, but will have adequate time to prepare for sampling in subsequent years of the study. Data summaries for the four-year period of study and the final study report are scheduled to be completed in 2003. Implementation of the field sampling task will proceed with several milestones, as presented in Table 1.

All activities associated with fish tissue sample collection will be conducted consistent with the requirements and procedures specified in this QAPP as approved by the USEPA Project Manager. Annual sampling activities will conclude with the development of a field collection effort summary (i.e., detailed listing of all sampling participants, sampling locations, and specimens collected) by Tetra Tech and reviewed by the USEPA Project Manager. The summaries will be used to document and report back to USEPA Regional/State/Tribal participants the collective sampling progress for each study year.

Table 1. Project Time Line for Milestones Associated with Fish Tissue Sample Collection Activities.

Activities and Milestones (1999 - 2002)	**1999**						**2000 - 2002**											
	J	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Develop QAPP and project sampling plan for field efforts							[2000 only]											
Conduct orientation for sampling and field QC personnel in EPA Regions							[2000 unless further need arises]											
Sampling of lakes and shipment of samples to analytical laboratory																		
Field collection effort summaries and report-back to regions, states, and tribes																		

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. Data quality objectives (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 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 fish tissue sample collection activities, so the relevant quality objectives are primarily related to sample handling issues. One exception involves the measurement of lake pH. Study DQOs for pH will require that meters are calibrated to a known standard as per manufacturer's specifications (Appendix C). Types of field sampling data needed for this project are listed in Table 2. 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 sample collection and handling procedures, and

- use of trained scientists to perform the sample collection and handling activities.

Table 2. Types of Field Data to Be Collected in Association with Fish Tissue Sample Collection.

Data Type	Measurement Endpoint(s) or Units
Fish specimen	Species-level taxonomic identification
Fish length	Millimeters (mm), total length
Composite classification	Predator or bottom-dwelling species
pH	nearest 0.1 pH units
Estimated maximum lake depth	Meters

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 Section 8.2) will be collected to allow for the assessment of precision during analytical laboratory testing.

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 subset, 10% of the sites, and repeat the lake sampling procedure, compositing and analytical analyses. Sampling teams should plan to obtain duplicate fish samples from 10% of the target lakes and reservoirs in their state during the four-year study period.

Accuracy

Accuracy is defined as the degree of agreement between an observed value and an accepted reference or true value. For example, accuracy of pH meters used for this study will be assured through proper calibration to known standards, i.e., buffer solutions (Appendix C). 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, since analytical testing is beyond the scope of this QAPP, no accuracy criteria are identified here. However, proper sample handling procedures (Section 9.1) will be followed to minimize sample contamination.

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.

Representativeness of the target species (Section 8.1) for this fish tissue sampling effort was established based on:

- the recommendation of USEPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1: Fish Sampling and Analysis, Second Edition* (USEPA 1995),

- the input from federal, state, and tribal scientists on the draft design of the National Study of Chemical Residues in Lake Fish Tissue, obtained primarily during the October 1998 workshop (USEPA 1999b), and

- approval by the USEPA Project Manager.

The representative goal for the sample collection effort will be satisfied by using experienced field biologists to ensure that the sample types and locations specified for the study are the samples actually collected.

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. Accidents during sample transport or lab activities that cause the loss of the original samples will result in irreparable loss of data, which will reduce the ability to perform analyses, integrate results, and prepare reports. Samples will be stored and transported in unbreakable (plastic) containers (i.e., insulated ice chests). All sample processing (i.e., compositing, filleting, homogenization) will occur in a controlled environment within the laboratory, not in the field. The assignment of a set of specific sample numbers (Section 6.0) that have undergone chain-of-custody inspection makes it less likely for the sample preparation laboratory to overlook samples when preparing them for processing.

Percent completeness (%C) for measurement parameters can be defined as follows:

$$\%C = \frac{v}{T} \times 100$$

Where v = the number of measurements judged valid and
T = the total number of measurements.

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%. It should be noted that sample locations and numbers may change over the course of the four-year study, based on local conditions (e.g., accessibility of target lakes) and the availability of target fishes (e.g., natural biological abundance or distribution). Any and all changes must be approved by the USEPA Project Manager, and approved changes must be considered when assessing completeness. 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.

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 fish tissue collection task, comparability of data will be accomplished by standardizing the sampling season, the field sampling methods, and the field training as follows:

- All samples will be collected during the late summer-fall (August-November).

- All samples will be collected and prepared for shipment according to standard operating procedures contained in this QAPP. 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, Second Edition* (USEPA 1995)[or subsequent updates].

- All field personnel involved with sampling will have adequate training and appropriate experience (Section 5.0).

5.0 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

Each Field Sampling Team is required to have the necessary knowledge and experience to perform all field activities. This includes both knowledge and experience in the collection and identification of fishes, in the use of fisheries sampling gear specified for the study and in the operation of small boats. It also includes training in project-specific sample collection and handling procedures. The field sampling crews will be primarily composed of state, tribal, and regional fisheries biologists or contracted biologists with a strong technical background in fisheries sampling activities. Each Field Sampling Team should consist of (at a minimum) one experienced fisheries biologist, one field technician, and a quality control specialist, all of whom must have experience with the array of fisheries sampling gear types to be used. In some cases the senior fisheries biologist may serve in dual capacities, assuming responsibility for site quality control.

This field sampling QAPP, the field sampling plan, and orientation materials will be distributed to all USEPA Regional/State/Tribal Fish Sampling Coordinators, who will, in turn, distribute it to all sampling personnel. Project orientation sessions will be set up by EPA Regions to distribute and discuss training materials. Materials will include detailed instructions for each field procedure (i.e., sampling of target fish, proper handling of the sample, shipping, and chain of custody) and visual training tools based on information from this QAPP. The focus of the orientation will be on sample collection methods, specific details of sample preparation, and strict adherence to the study's protocols. USEPA Regional/State/Tribal Fish Sampling Coordinators and Field Team Leaders will be required to view the training materials, read the QAPP, and verify in writing that they read or viewed the materials and understood the procedures and requirements. If sampling personnel change (i.e., new USEPA Regional/State/Tribal Fish Sampling Coordinators or new Field Team Leaders) during the course of the four-year study, the orientation process will have to be reinitiated for that particular new team.

6.0 DOCUMENTATION AND RECORDS

Thorough documentation of all field sample collection and handling activities is necessary for proper processing in the laboratory and, ultimately, for the interpretation of study results. Field sample collection and handling will be documented in writing (for each sampling site) using the following forms and labels:

- a Field Record Form that contains information about each individual specimen and lake site (Appendix B),

- a Sample Identification Label that accompanies and identifies each sample (Appendix B),

- a Chain-of-Custody Label that seals each sample container (provided by the sample control center), and

- a Chain-of-Custody Form that provides constant tracking information for all samples (Appendix B).

A detailed description of each sample collected by each Field Sampling Team will be recorded on a Field Record Form (Appendix B). The form will document the sampling date, time, sampler's name, sampling site location/description, and sample description (count and length of each specimen). Also, the 10% subset of lakes and reservoirs that are sampled as duplicates will be noted as such on the form. The Field Record Form will also contain a unique tracking code (i.e., composite sample identification code) that will be used to identify each record. The ten-character code will include:

- state of collection (two-character abbreviation),

- year of collection (two-number abbreviation),

- lake identification number (four-digit code from Appendix A),

- composite type (one character -- P = predator species; B = bottom-dwelling species), and

- sample type (one character -- S = standard sample, D = duplicate sample).

The Field Record Form will be produced as a four-page carbonless copy form, with one copy retained by the sampler, and the other three included in the sample shipment to the laboratory (i.e., one for the sample preparation laboratory, one for the sample control center, and one for the Tetra Tech Task Leader). All entries will be made in ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, which is initialed and dated by the sampler/recorder.

A Sample Identification Label will be completed (Appendix B) to accompany each sample throughout the chain of custody. The label will document the project name, sampling site location, sampling date and time, the sampler's name, the ten-character tracking code, and the specimen number (e.g., 01 through 05). All entries will be made in indelible ink and will coincide with specimen and sample information on the Field Record Form. Descriptions and definitions of all field data elements required in the Field Record Form and Sample Identification Label are provided in Appendix D.

Proper chain-of-custody procedures are necessary for tracking sample possession from field to laboratory. Chain-of-Custody Forms (Appendix B) will accompany each shipment of samples and will document sample identity (coinciding with information on the field record), sampler relinquishment date and time, and laboratory receipt date and time. Chain-of-Custody Forms will be produced as five-page carbonless copies, with one copy for the sampler, and four for shipment to the laboratory (i.e., one for the sample preparation laboratory, one for the sample control center, one for the Tetra Tech Task Leader, and one for duplication and distribution to the analytical laboratories). Chain-of-Custody Labels will seal each sample container following packing operations in the field, and will include the signature of the sampler and the date and time sealed. All Chain-of-Custody Label and Form entries will be made in ink. Field sampling teams must notify the sample control center (DynCorp) by telephone (Chris Moore 703/461-2360 or Chris Maynard 703/461-2395) of an incoming shipment.

Samples will be shipped from the field to the sample preparation laboratory via priority, overnight express delivery service. Copies of all shipping airbills will be retained by the sample control center. Specification for retention of field samples by the receiving location are outside the scope of this document. While in storage, it is recommended that samples held for analysis be stored with the original labeling materials.

Annual sampling activities will conclude with the development of a field collection effort summary (i.e., detailed listing of all sampling participants, sampling locations, and specimens collected) by Tetra Tech and review of the summary by the USEPA Project Manager. Following USEPA Project Manager approval, the summaries will be used to document and report back to USEPA Regional/State/Tribal participants the collective sampling progress for each study year. Tetra Tech will maintain a file as a repository for information used in the preparation of the annual field collection summaries throughout the duration of the study. The following information will be included:

- any documents prepared for the study,
- contract and work assignment information,
- project QAPP,
- results of technical reviews, data quality assessments, and audits,
- communications (memoranda; internal notes; telephone conversation records; letters; meeting minutes; and all written correspondence between Tetra Tech, USEPA, and other project team personnel, subcontractors, suppliers, or others),
- maps, photographs, and drawings, and
- studies, reports, and documents pertaining to the project.

If any change(s) in this QAPP is(are) required during the study, a memo will be sent to each person on the distribution list describing the change(s), following approval by the USEPA Project Manager. Any and all memos announcing changes must be attached to the QAPP.

All documents and records prepared for this project will be maintained by USEPA and Tetra Tech during the project, and retained for a period of two years following completion of the project (unless otherwise directed by USEPA).

B. DATA ACQUISITION

7.0 SAMPLING PROCESS DESIGN

The objective of the National 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 continental United States.

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

- information to meet objectives of the President's Clean Water Action Plan (CWAP),
- information about persistent bioaccumulative toxic chemicals (PBTs) for the Agency's PBT Initiative, and
- data to answer important questions concerning the national occurrence of fish tissue contamination.

For the purposes of this study design, the target population will be all lakes and reservoirs within the coterminous 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. Approximately 500 locations will be sampled over the course of four years based on projections of available resources.

7.1 Sample Type

To meet the study objectives, the National Fish Tissue Study will include composite sampling of fish fillets for predator/gamefish species and whole fish for bottom-dwelling species from each sample lake. Five individuals per composite will be collected, all of which will be large enough to provide sufficient tissue for analysis of the group of target analytes. It has been determined that at least 560 grams of edible tissue for predators, and 560 grams of total body tissue for bottom-dwellers will 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, Second Edition* (USEPA 1995), 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 will be conducted during the period when water and weather conditions are 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. 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 will begin in August and last through November (and possibly into December in warmer regions).

7.3 Sample Frame

For the purposes of this study, the target population will be all lakes and reservoirs within the coterminous 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 almost all lakes in the target population for this study. Noted exclusions are newly constructed reservoirs. However, RF3 is the best known national GIS coverage for lakes, so it was used in this study.

To ensure the sample frame included all lakes and reservoirs with an area greater than 5,000 ha, a list from multiple sources of such lakes was constructed. 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 ha 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 3 summarizes the number of lakes in the sample frame used for sample selection.

Table 3. 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 4 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. It is not known yet how well these will apply to other regions of the country. The impact of an incorrect adjustment will be that the number of lakes actually sampled by size category will not be equal.

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 of the study. It is recommended that the lakes be sampled in the year specified. The advantage of adhering to this approach is 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 years (e.g., 1999-2001) results in a legitimate unequal probability sample of all lakes. The expected weights must be adjusted to account for the years not sampled.

Table 4. Number of Lakes Selected for Sampling by Size Category and Year.

Lake area (ha)	1999	2000	2001	2002	All Years	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 Nontarget 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 is not necessary to confirm that the lake meets the definition. In other cases, it may be necessary to actually visit the lake to determine if it meets the definition. Regardless, it is essential that a complete record of this information be reported to the USEPA Project Manager, since this information is required to complete the survey estimation procedures. Two other situations can occur that will result 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 refuses access to a lake selected for the study, then this needs to be recorded. Second, a lake may occasionally be physically inaccessible. If there are logistical or safety constraints that make a lake inaccessible, then the reason why the lake is inaccessible needs to be recorded and reported to the USEPA Project Manager and/or the Tetra Tech Task Leader.

Information that must be determined during pre-sampling reconnaissance of each lake includes 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 sampling period of study? If so, state why.

7.6 Reserve Sample of Lakes

As a contingency, a second sample of lakes has been selected as a reserve. Table 5 summarizes the sample sizes for the reserve sample. This sample could be used if the initial sample is determined to have a larger than expected number of nontarget population lakes, resulting in an insufficient sample size. Alternatively, if additional funding is received to allow a larger sample size, the reserve sample of lakes could be used. Decisions regarding use of the reserve sample of lakes (or subsets of the reserve sample) will be made only by the USEPA Project Manager.

Table 5. Number of Lakes (by Size Category and Year) Selected as a Reserve Sample.

Lake area (ha)	1999	2000	2001	2002	All Years	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**	

8.0 SAMPLING METHODS

8.1 Target Species

Field sampling procedures will follow the recommendations of USEPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume I: Fish Sampling and Analysis, Second Edition* (USEPA 1995) [or subsequent updates]. According to the guidance, the primary criteria for selecting target fishes is that the species:

- are commonly consumed in the study area,
- may potentially accumulate high concentrations of chemicals, and
- have a wide geographic distribution.

Secondarily, the target species should be:

- easy to identify,
- abundant,
- easy to capture, and
- large enough to provide adequate tissue for analysis (i.e., harvestable size adult specimens that as a five-fish composite will provide at least 560 grams of edible tissue for analysis).

Two distinct ecological groups of fish, bottom-dwellers and predators, will be included as target fishes for this study. This permits monitoring of a wide variety of habitats, feeding strategies, and physiological factors that might result in differences in bioaccumulation of contaminants. Suggested target species are listed in Table 6 in order of preference (adapted from USEPA 1995). Additional target species may be added to the list of preferred targets on an as-needed basis, following discussion with the USEPA Project Manager and/or the Tetra Tech Task Leader. For example, additional Salmonid species (such as cutthroat trout or kokanee salmon) and Catostomid species (such as longnose sucker, largescale sucker, or bridgelip sucker) may need to be added to the target species for lakes in the northwestern United States. State personnel, with their knowledge of site-specific fisheries and human consumption patterns, will aid in the determination of the availability of target fishes. The criteria listed above must be considered when selecting target species other than those listed in Table 6. Every effort will be made to collect the desired species and number (Section 8.2) of fish; however, the outcome of field sampling efforts will ultimately depend on the natural diversity and abundance of fish in the study lakes.

8.2 Composite Sampling

The National Fish Tissue Study will involve composite sampling of predator/gamefish species and bottom-dwelling species (to be prepared as fillet composites and whole-body composites, respectively, by the sample preparation laboratory). Composite samples are cost-effective for estimating average tissue concentrations of target analytes in target species populations, and compositing ensures adequate sample mass for analysis of all target analytes.

Table 6. Recommended Target Species for Inland Freshwaters (in Order of Preference).

	Family name	Common name	Scientific name
Predator/Gamefish Species *(in order of preference)*	*Centrarchidae*	Largemouth bass	*Micropterus salmoides*
		Smallmouth bass	*Micropterus dolomieu*
		Black crappie	*Pomoxis nigromaculatus*
		White crappie	*Pomoxis annularis*
	Percidae	Walleye	*Stizostedion vitreum*
		Yellow perch	*Perca flavescens*
	Percichthyidae	White bass	*Morone chrysops*
	Esocidae	Northern pike	*Esox lucius*
	Salmonidae	Lake trout	*Salvelinus namaycush*
		Brown trout	*Salmo trutta*
		Rainbow trout	*Oncorhynchus mykiss*
		Brook trout	*Salvelinus fontinalis*
Bottom-dwelling Species *(in order of preference)*	*Cyprinidae*	Common carp	*Cyprinus carpio*
	Ictaluridae	Channel catfish	*Ictalurus punctatus*
		Blue catfish	*Ictalurus furcatus*
		Brown bullhead	*Ameiurus nebulosus*
		Yellow bullhead	*Ameiurus natalis*
	Catostomidae	White sucker	*Catostomus commersoni*

One predator/gamefish composite and one bottom-dwelling species composite will be collected from each target lake (**Note:** The USEPA Project Manager and/or the Tetra Tech Task Leader need to be notified if one of the ecological groups of fish are not present or available from a target lake). Each composite will consist of five fish of adequate size (i.e., adult specimens that collectively will provide at least 560 grams of edible tissue for predators, and 560 grams of total body tissue for bottom-dwellers) to allow analysis of the target analytes. Fish retained for 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, and

- be collected at the same time, i.e., collected as close to the same time as possible, but no more than one week apart (**Note:** Individual fish may have to be frozen until all fish to be included in the composite are available for delivery to the sample preparation laboratory).

Accurate taxonomic identification is essential in assuring and defining the organisms that have been composited and submitted for analysis. Under no circumstances should individuals from different species be used in a single composite sample. Ideally, the target species composite should focus on the larger individuals commonly harvested by the local population.

8.3 Sample Collection

Fish collection methods can be divided into two major categories, active and passive. Each has advantages and disadvantages. Active collection methods employ a wide variety of sampling devices including electrofishing units, seines, trawls, and angling equipment (hook and line). Although active collection requires greater fishing effort, it is usually more efficient than passive collection for covering a large number of sites and catching the relatively small number of individuals needed from each site for tissue analysis. The active collection methods generally require more field personnel and more expensive equipment than passive collection methods. Passive collection methods employ a wide array of sampling devices, including gill nets, fyke nets, trammel nets, hoop nets, pound nets, and d-traps. Passive collection methods generally require less fishing effort than active methods, but normally yield a much greater catch than would be required for a contaminant monitoring program. They are also time consuming to deploy. Passive collection devices (e.g., gill nets) must be checked frequently (e.g., at least once every 24 hours) to ensure a limited time lag between fish entrapment and sample preparation/preservation.

Sampling Teams dedicated to the National Fish Tissue Study will be equipped with an array of both active and passive gears to ensure the collection of the desired target numbers and species of fish. Selection of the most appropriate gear type(s) for a particular target lake will be at the discretion of the experienced on-site fisheries biologist. USEPA Regional/State/Tribal Sampling Teams and Contractor-affiliated Sampling Teams will be responsible for providing fisheries sampling gear and sampling vessels. The sample control center will provide sample packaging and shipping supplies. A list of equipment and expendable supplies is provided in Table 7. Sample collection, packaging, and shipment methods are presented as Appendix B, Standard Operating Procedure.

Table 7. Equipment and Supply List for Fish Tissue Sampling.

1.	Sampling vessel (including boat, motor, trailer, oars, gas, and all required safety equipment)[a]
2.	Electrofishing equipment - OPTIONAL (including variable voltage pulsator unit, generator, electrodes, wiring cables, dip nets, protective gloves, protective boots, and all necessary safety equipment)[a]
3.	Nets - OPTIONAL (including trawls, seines, gill nets, fyke nets, trammel nets, hoop nets, pound nets, trap nets)[a]
4.	Angling equipment - OPTIONAL (including fishing rods, reels, line, terminal tackle, trot lines)[a]
5.	Coast Guard-approved personal floatation devices
6.	Maps of target lakes and access routes
7.	Global Positioning System (GPS) unit - OPTIONAL [a]
8.	pH meter (including associated calibration supplies) [a]
9.	Livewell and/or buckets
10.	Measuring board (millimeter scale)
11.	Ice chests[b]
12.	Aluminum foil (solvent-rinsed and baked)[b]
13.	Heavy-duty food grade polyethylene tubing[b]
14.	Large plastic (composite) bags [b]
15.	Knife or scissors
16.	Clean nitrile gloves[b]
17.	Field Record Forms[b]
18.	Sample Identification Labels[b]
19.	Chain-of-Custody Forms[b]
20.	Chain-of-Custody Labels[b]
21.	Scientific collection permit
22.	Dry ice[b]
23.	Black ballpoint pens and/or waterproof markers
24.	Clipboard
25.	Packing/strapping tape
26.	Overnight courier airbills[b]
27.	Plastic cable ties[b]
28.	Plastic bubble-wrap[b]
29.	First aid kit and emergency telephone numbers

(a) Selection and exact specifications at the discretion of the experienced on-site fisheries biologist.
(b) Provided by the sample control center.

As soon as fish are obtained via active collection methods, or removed from passive collection devices, they should be identified to species. Species identification should be conducted only by experienced personnel knowledgeable of the taxonomy of species in the waterbodies included in the fish contaminant monitoring program. Nontarget species, collected by the field team should be returned to the water. Individuals of the selected target species will be rinsed in ambient water to remove any foreign material from the external surface, should be handled using clean nitrile gloves (provided by the sample control center), and placed in clean holding containers (livewell, buckets, etc.) to prevent contamination. Each fish of the selected target species should be measured to determine total body length (mm). Maximum body length should be measured, i.e., the length from the anterior-most part of the fish to the tip of the longest caudal finray (when the lobes of the caudal fin are depressed dorsoventrally). When sufficient numbers of the target species have been identified to make up a suitable composite sample (i.e., five individuals meeting the size criteria presented in Section 8.2), the species name, specimen lengths, and all other site and sampling information should be recorded on the Field Record Form (Appendix B).

The field objective is for sampling teams to obtain a representative composite sample for both a predator and a bottom-dwelling species from each lake or reservoir selected for the National Fish Tissue Study. Each composite must consist of all the same species, individual fish must be of similar size (i.e., all within 75% of the length of the largest fish), and the composite must be able to deliver 560 grams of fish tissue (fillets for predators, and whole bodies for bottom-dwellers) for chemical analysis. To obtain a representative sample of the targeted species in lakes and reservoirs (and particularly in large waterbodies), field teams should consider factors such as habitat and presence of contaminant gradients in planning sampling locations for the target lake. Ideally, the habitats suitable for target species would be determined for the lake, and up to three locations of that habitat would be randomly selected for sampling in the lake. If a contamination gradient may be present in the waterbody, then three locations across the gradient should be selected for sampling. For example, in reservoirs, the three locations may be in habitat near the inflow, middle, and outflow of the reservoir. The composite is intended to estimate the mean fish tissue contaminant concentration for the lake or reservoir. Given the diversity of lakes and reservoirs in the study, and given the multiple species that must be used, the study must rely on the local knowledge of the field teams in the selection of the representative composite sample.

9.0 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

9.1 Sample Handling

Clean nitrile gloves (provided by the sample control center) should be worn during the entire sample handling process, beginning with removing the fish from the sampling gear. Individuals of the selected target species should be rinsed in ambient water to remove any foreign material from the external surface. After initial processing to determine species and size, each of the five fish found to be suitable for the composite sample will be individually wrapped in extra heavy-duty aluminum foil (provided by the sample control center as solvent-rinsed, oven-baked sheets). For specimens with sharp fins, spines may be broken (via gloved hands or with the use of a tool covered with the aluminum foil provided by the sample control center) to prevent perforation of the wrapping materials. The broken section of the fins should be included with the fish sample. A Sample Identification Label (Appendix B) will be prepared for each aluminum foil-wrapped specimen. Each foil-wrapped fish will be placed into a waterproof plastic tubing that will be cut to size to fit the specimen (i.e., heavy duty food grade polyethylene tubing provided by the sample control center), and each end of the tubing will be sealed with a plastic cable tie. The completed Sample Identification Label will be affixed to the cable tie, and the entire specimen package will be "double-bagged" (i.e., placed inside a large plastic bag with all the specimens of the same species from that site and sealed with another cable tie). Once packaged, samples should be immediately placed on dry ice for shipment. If samples will be carried back to a laboratory or other facility to be frozen before shipment, wet ice can be used to transport wrapped and bagged fish samples in the coolers to that laboratory or facility. If possible, all of the specimens in a composite sample should be kept together in the same shipping container (ice chest) for transport. Sampling Teams have the option, depending on site logistics, of:

- shipping the samples packed on dry ice (in sufficient quantities to keep samples frozen for up to 48 hours), via priority overnight delivery service (i.e., Federal Express), so that they arrive at the sample preparation laboratory within less than 24 hours from the time of sample collection, or

- freezing the samples within 24 hours of collection (at ≤-20°C), and storing the frozen samples until shipment within 1 week of sample collection (frozen samples will subsequently be packed on dry ice and shipped to the sample preparation laboratory via priority overnight delivery service to arrive within less than 24 hours from time of shipment).

The time of sample collection, relinquishment by the sample team, and time of their arrival at the sample preparation laboratory must be recorded on the Chain-of-Custody Form (Appendix B). Field Sampling Teams should avoid shipping samples for weekend delivery to the sample preparation laboratory unless prior plans for such a delivery have been agreed upon with the sample control center.

9.2 Sample Integrity

A critical requirement of the National Fish Tissue Study is the maintenance of sample integrity from the time of collection to the shipment and arrival at the final destination. Sample integrity is maintained by preventing the loss of contaminants that might be present in the sample and by taking precautions to avoid possible introduction of contaminants during handling. The loss of contaminants can be prevented in the field by ensuring that the sample collected remains intact, i.e., sample collection procedures should be performed with the intention of minimizing the laceration of fish skin. Once a sample is collected, sample integrity is maintained through careful and controlled sample handling, storage, and preservation procedures (Section 9.1).

Preventable sources of extraneous contamination can include the sampling gear, oils and greases on boats, spilled fuel, skin contact, contact with soil or sand, boat motor exhaust, and other potential sources. All potential sources should be identified before the onset and during sample collection, and appropriate measures should be taken to minimize or eliminate them. Examples of preventative measures include the following:

- Collection nets should be free of any potential contaminants.
- The use of tarred collection nets is prohibited.
- Boats should be positioned so that engine exhaust does not fall on the deck area where samples are being handled.
- Ice chests and other sample storage containers should be scrubbed clean with detergent and rinsed with distilled water prior to use (containers originating from the sample control center will be prewashed and rinsed).
- Samples should not be placed directly on dry ice, but should be stored inside foil, plastic tubing (i.e., heavy-duty food grade polyethylene tubing as per Section 9.1), and plastic garbage bags first.
- Proper gloves (clean nitrile gloves) should be used when handling samples.

9.3 Custody Requirements

As soon as possible following collection, the Sampling Team will begin the process of identifying, labeling, packaging, and storing the sample(s). Each sample will be identified and tracked with a unique numbering scheme as described in Section 6.0. This ten-character composite code followed by a two-digit specimen number will identify each sample on all documentation and records including the following:

- Field Record Form,
- Sample Identification Label, and
- Chain-of-Custody Form.

Each sample (i.e., individual fish) will be labeled by affixing a Sample Identification Label (Appendix B) as per the instructions in Section 9.1. All sample label entries will be made with black indelible ink. The sample label will accompany each sample throughout the chain-of-custody. Each sample label will include the following information:

- project name (USEPA National Fish Tissue Study),
- site identification (lake name),

- sample number (01 through 05),
- composite code (ten-digit code as in Section 6.0),
- date of sample (month/day/year),
- time of collection (military time),
- preservative used (dry ice or frozen), and
- collector's name (field team leader).

Detailed documentation of the samples collected in the field (for shipment to the sample preparation laboratory) and information about the collection location will be recorded on a Field Record Form (Appendix B). One form must be completed for each sample composite. One page of the four-page carbonless copy form (Section 6.0) will be retained by the sampler, and the other copies will be included with sample shipment to the sample preparation laboratory. (The sample preparation laboratory will retain one copy, and be responsible for forwarding one copy to the sample control center and one copy to the Tetra Tech Task Leader.) All entries will be made in black ink and no erasures will be made. Each form will have the proper entry requirements, which includes the following information:

- composite code (ten digits as per Section 6.0),
- sampling date (month/day/year),
- time of collection (military time),
- collection method (e.g., gill net),
- collector's name (printed and signed),
- collector's affiliation, address, and telephone number,
- site name (lake name),
- site description (location of lake and area of lake sampled),
- lake type (e.g., natural lake),
- estimated maximum depth (meters),

- fish species (common name),
- length (mm) of each specimen,
- location, date and time of collection for each specimen, and
- a simple sketch of the sampling site and sample collection points.

All samples and composites will be transferred to the receiving laboratory (i.e., sample preparation laboratory) under chain of custody. The Chain-of-Custody Form (Appendix B) acts as a record of sample shipment and a catalog of the contents of each shipment (coinciding with information on the field record). The forms will be produced as five-page carbonless copies with one copy retained by the sampler and four for shipment to the laboratory (i.e., one for the sample preparation laboratory, one for the sample control center, one for the Tetra Tech Task Leader, and one for duplication and distribution to the analytical laboratories). The latter four copies will be placed in a waterproof plastic bag (provided by the sample control center) and sealed inside the shipping container. All Chain-of-Custody Form entries will be made in black ink and will include:

- the USEPA Project Manager's name, address and telephone number (refer to the QAPP cover page),
- sampler's name and telephone number,
- project name (USEPA National Fish Tissue Study),
- page number (e.g., 1 of 1),
- sample location (lake name),
- collection date and time,
- composite code (ten-digit) and sample number (two-digit),
- preservative (dry ice or frozen),
- number of containers,
- type of analysis required (USEPA 274 PBT target analytes [including breakdown products and PCB congeners]),
- sampler's signature, sample date, and time,
- sampler relinquishment date and time,

- laboratory recipient signature, and
- laboratory receipt date and time.

Immediately following the packing of each shipping container (Section 9.1), each container (ice chest) will be secured with packaging tape and sealed with a Chain-of-Custody Label (provided by the laboratory). The Chain-of-Custody Label must contain the signature of the sampler and the date and time written in ink. The seal must be affixed such that the shipping container cannot be opened without breaking the seal (e.g., label adhered across the ice chest latch), so as to protect and document the integrity of the contents from field to laboratory.

10.0 ANALYTICAL METHODS REQUIREMENTS

Samples will be shipped (Section 9.1) under chain of custody to locations designated by the USEPA Project Manager for processing and analytical testing. Sample processing and analytical testing and methods are outside the scope of this QAPP and therefore are not addressed herein, but will be discussed in the Analytical Activities QAPP.

11.0 QUALITY CONTROL REQUIREMENTS

Data quality is addressed, in part, by consistent performance of valid procedures documented in the standard operating procedures (Appendix B). It is enhanced by the training and experience of project staff (Section 5.0) and documentation of project activities (Section 6.0). This QAPP, a field sampling plan, and training materials will be distributed to all USEPA/Regional/State/ Tribal Fish Sampling Coordinators, and, in turn, to sampling personnel. Orientation sessions will be set up by EPA Regions to distribute and discuss project materials (Section 5.0). USEPA Regional/State/Tribal Fish Sampling Coordinators and Field Team Leaders will be required to view the training materials, read the QAPP, and verify in writing that they read or viewed the materials and understood the procedures and requirements.

12.0 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

All field equipment will be inspected prior to sampling activities to ensure that proper use requirements are met (e.g., boats or electrofishers are operating correctly, nets are without defects, pH meter properly calibrated). Inspection of field equipment will occur well in advance of the field operation to allow time for replacement or repair of defective equipment, and the field team will be equipped with proper backup equipment to prevent lost time on site. One member of each field team should gather and inspect all equipment on the equipment and supply list (Table 7) prior to each sampling event.

13.0 INSTRUMENT CALIBRATION AND FREQUENCY

All pH meters used by field teams will be calibrated according to the manufacturer's operating instructions, on a daily basis, while in use (Appendix C).

14.0 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

Careful and thorough planning is necessary to ensure the efficient and effective completion of the field sample collection task. A general checklist of field equipment and supplies is provided in Table 7. Sampling gear will be provided by each field team, and most sample preparation and shipment supplies will be provided by the sample control center. It will be the responsibility of each field team to gather and inspect the necessary sampling gear prior to the sampling event and to inspect the sample packaging and shipping supplies received from the laboratory. Defective packaging and shipping supplies (e.g., torn or damaged polyethylene sample tubing) will be discarded, and, if necessary, the field team will contact the sample control center to obtain replacement supplies.

15.0 DATA ACQUISITION REQUIREMENTS (NONDIRECT MEASUREMENTS)

Nondirect measurements will include identification and/or verification of each sample lake location (i.e., latitude and longitude). Coordinates of the target lakes are provided in Appendix A as decimal degrees and conventional degrees, minutes, and seconds. USEPA Regional/State/ Tribal Fish Sampling Coordinators or Field Sampling Teams having corrections to the Appendix A coordinates for a particular target lake (based on USGS quadrangle, or equivalent, map verification), need to report those corrections to the USEPA Project Manager (telephone 202/260-7055) or Tetra Tech Task Leader (telephone 410/356-8993).

16.0 DATA MANAGEMENT

Samples will be documented and tracked via Sample Identification Labels, Field Record Forms, and Chain-of-Custody Forms (Section 6.0). Since the sampling effort is a cooperative one involving many different partner agencies and groups, the diligence of the Field Sampling Teams in completion of the proper records is essential. Field team leaders will be responsible for reviewing all completed field forms. Any corrections should be noted, initialed, and dated by the reviewer (Section 6.0). As mentioned in Section 6.0, Field Record Forms and Chain-of-Custody Forms will each be prepared and replicated in the field, via multiple page "carbonless copy" forms. The sampler will retain one copy each of the Field Record and Chain-of-Custody Forms, and the remaining copies will be delivered to the sample preparation laboratory with the samples. Shipment of samples to the sample preparation laboratory (Section 9.1) must be conducted by a delivery service that provides constant tracking of shipments (e.g., Federal Express). Laboratory sample log-in and data management procedures are beyond the scope of this QAPP.

The sample preparation laboratory will retain one copy of each Field Record Form and Chain-of-Custody Form, and will forward a copy of each to the Tetra Tech Task Leader. All form copies obtained by Tetra Tech will be maintained in a project file during the active phase of the project, and for a period of 2 years following completion of the project (unless otherwise directed by USEPA).

Upon completion of annual sampling activities, Tetra Tech will develop a field collection effort summary (i.e., a detailed listing of all sampling participants, sampling locations, and specimens collected) based on information recorded by all Sampling Teams on the Field Record Forms. The Field Record Form data will be entered into an Excel® spreadsheet to create the annual summary. All data entries will be checked for errors in transcription and computer input by a minimum of two persons. If there is any indication that requirements for sample integrity or data quality have not been met, the Tetra Tech QA Officer will be notified immediately (with an accompanying explanation of the problems encountered). All computer files associated with the project will be stored in a project subdirectory by Tetra Tech, and will be copied to disk for archive for the two years subsequent to project completion (unless otherwise directed by the USEPA Project Manager).

C. ASSESSMENT/OVERSIGHT

17.0 ASSESSMENT AND RESPONSE ACTIONS

Assessment activities and corrective response actions have been identified to ensure that sample collection activities are conducted as prescribed and that the measurement quality objectives and data quality objectives established by USEPA are met. The QA program under which this project will operate includes performance and system audits with independent checks of the data obtained from sampling activities. Either type of audit 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.

Immediate corrective actions form part of normal operating procedures and are noted on project Field Record Forms. Problems not solved this way require more formalized, long-term corrective action. In the event that quality problems requiring attention are identified, the Tetra Tech Task Leader and/or Tetra Tech QA Officer will determine whether attainment of acceptable data quality requires either short- or long-term actions. Failure in an analytical system (e.g., performance requirements are not met) and corrective actions for those failures are beyond the scope of this QAPP.

Communication and oversight will proceed from Field Sampling Team Leaders (e.g., senior fisheries biologist) to the Tetra Tech Task Leader and the USEPA Regional/State/Tribal Fish Sampling Coordinators. The Tetra Tech Task Leader will be on-call throughout the entire sampling period (Section 7.2) to address questions and receive communications of sampling status from the Field Sampling Teams. The Tetra Tech Task Leader will communicate the status of the sampling activities to the USEPA Project Manager on a weekly basis (at a minimum). The USEPA Regional/State/Tribal Fish Sampling Coordinators and Tetra Tech Task Leader will immediately consult with the Tetra Tech QA Officer and USEPA Project Manager regarding any difficulties encountered during sample collection activities. The Tetra Tech QA Officer will initiate the corrective action system described above, documenting the nature of the problem and ensuring that the recommended corrective action is carried out.

The USEPA Project Manager and/or the Tetra Tech QA Officer will work with the USEPA Regional/State/Tribal Fish Sampling Coordinators and Tetra Tech Task Leader to determine the best way to rectify the problem and obtain accurate and useable data. When corrective actions have been taken and a sufficient time period has elapsed that allows a response, the response will be compared with project goals by the USEPA Project Manager. The Tetra Tech QA Officer will verify that the corrective action has been appropriately addressed to eliminate the problem. The USEPA QA Manager has the authority to stop work on the project if problems affecting data quality are identified that will require extensive effort to resolve. The USEPA Project Manager will consult with the USEPA QA Manager regarding any and all corrective actions and stop work orders.

Performance audits are qualitative checks on different segments of project activities, and are most appropriate for sampling, analysis, and data processing activities. Field audits will be conducted periodically in accordance with Agency requirements and availability of resources. Performance audit techniques include checks on sampling equipment, measurements, and the analysis of data quality using QC and spiked samples. Analytical performance audits are beyond the scope of this QAPP. The USEPA Regional/State/Tribal Fish Sampling Coordinators and/or the Tetra Tech Task Leader will be responsible for overseeing work as it is performed, and periodically conducting QC checks during the sample collection phase of this project.

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 the QAPP are being implemented. The Tetra Tech QA Officer will conduct one internal system audit during the project and report the results to the USEPA Project Manager on Tetra Tech’s standard Audit Report Form.

18.0 REPORTS TO MANAGEMENT

Following completion of the system audit, the Tetra Tech QA Officer will prepare an Audit Report Form and submit copies to both the USEPA Project Manager and the USEPA QA Officer.

Upon completion of weekly sampling activities, the Tetra Tech Task Leader will contact the USEPA Project Manager to summarize Field Sampling Team progress for the preceding week and submit a weekly progress report detailing the sampling activities. Following completion of annual field sampling activities, Tetra Tech will prepare an annual field collection effort summary (i.e., detailed listing of all sampling participants, sampling locations, and specimens collected) for review by the USEPA Project Manager. Following incorporation of USEPA Project Manager comments and final approval, the summary will be used to report back to USEPA Regional/State/Tribal participants to document collective sampling progress for each study year.

D. DATA VALIDATION AND USABILITY

19.0 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

Data validation and review services provide a method for determining the usability and limitations of data, and provide a standardized data quality assessment. All Field Record Forms and Chain-of-Custody records will be reviewed by the Tetra Tech Task Leader (assisted by the QA Officer, as needed) for completeness and correctness. Tetra Tech will be responsible for reviewing data entries and transmittals for completeness and adherence to QA requirements. Data quality will be assessed by comparing entered data to original data or by comparing results with the measurement performance criteria summarized in Section 4.2 to determine whether to accept, reject, or qualify the data. Results of the review and validation processes will be reported to the USEPA Project Manager.

20.0 VALIDATION AND VERIFICATION METHODS

All Field Record Forms and Chain-of-Custody records will be reviewed by the Tetra Tech Task Leader. The Tetra Tech QA Officer will review a minimum of five percent of the Field Record Forms and Chain-of-Custody records. Any discrepancies in the records will be reconciled with the appropriate associated field personnel and will be reported to the USEPA Project Manager.

Analytical validation and verification methods are outside of the scope of this QAPP. The submission of samples to the sample preparation laboratory will include Field Record Forms and Chain-of-Custody Forms documenting sampling time and date. This information will be checked by the receiving laboratory to ensure that holding times (Section 9.1) have not been exceeded. Violations of holding times will be reported (by the laboratory) to the USEPA Project Manager and the Tetra Tech Task Leader via the USEPA Sample Analysis Manager, and the

USEPA Project Manager will discuss with the USEPA Sample Analysis Manager whether or not to issue a stop work order for analysis of that particular sample.

21.0 RECONCILIATION WITH DATA QUALITY OBJECTIVES

As soon as possible following completion of the sample collection task, precision, accuracy, and completeness measures will be assessed by Tetra Tech and compared with the criteria discussed in Section 4.0. This will represent the final determination of whether the data collected are of the correct type, quantity, and quality to support their intended use for this project. Any problems encountered in meeting the performance criteria (or uncertainties and limitations in the use of the data) will be discussed with the USEPA Project Manager, and will be reconciled, if possible.

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Appendix A

Randomly Selected List of Target Lakes

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
								Deg	Min	Sec	Deg	Min	Sec
OWOW99-0022	-87.3315	33.9487		AL	WALKER	4	1	87	19	53.40	33	56	55.32
OWOW99-0072	-85.0969	31.9344	WALTER F GEORGE RES	AL	BARBOUR	15282	1	85	5	48.84	31	56	3.84
OWOW99-0136	-87.1320	34.0809	Lewis Smith Lake	AL	WINSTON	8793	1	87	7	55.20	34	4	51.24
OWOW99-0147	-86.0285	31.1530		AL	GENEVA	6	1	86	1	42.60	31	9	10.80
OWOW99-0161	-87.0398	34.6639	Wheeler Lake	AL		27143	1	87	2	23.21	34	39	49.93
OWOW99-0197	-87.3823	32.0983		AL	WILCOX	4738	1	87	22	56.28	32	5	53.88
OWOW99-0486	-86.3385	33.3199		AL	TALLADEGA	16	2	86	20	18.60	33	19	11.64
OWOW99-0511	-85.5705	34.0993		AL	CHEROKEE	48	2	85	34	13.80	34	5	57.48
OWOW99-0547	-87.1202	33.3243		AL	JEFFERSON	7	2	87	7	12.72	33	19	27.48
OWOW99-0560	-85.1396	32.4487	Clark's lake	AL	RUSSELL	3	2	85	8	22.56	32	26	55.32
OWOW99-0622	-85.3245	31.1539	Pine Lake	AL	HOUSTON	3	2	85	19	28.20	31	9	14.04
OWOW99-0647	-85.7285	32.4403		AL	MACON	3	2	85	43	42.60	32	26	25.08
OWOW99-0923	-87.2961	31.4475	Kelley Lake	AL	MONROE	2	3	87	17	45.96	31	26	51.00
OWOW99-0947	-87.4428	32.8863	Payne Lake	AL	HALE	46	3	87	26	34.08	32	53	10.68
OWOW99-0961	-86.2978	34.1229		AL	MARSHALL	3	3	86	17	52.08	34	7	22.44
OWOW99-1072	-86.7524	32.3890	Jones Bluff Lake	AL	LOWNDES	5063	3	86	45	8.64	32	23	20.40
OWOW99-1436	-85.9938	33.6132		AL	CALHOUN	7	4	85	59	37.68	33	36	47.52
OWOW99-1472	-86.0533	32.3590		AL	MONTGOMERY	1	4	86	3	11.88	32	21	32.40
OWOW99-1497	-86.3959	33.1694	Candles Lake	AL	TALLADEGA	26	4	86	23	45.24	33	10	9.84
OWOW99-0047	-93.9120	35.2279		AR	LOGAN	6	1	93	54	43.20	35	13	40.44
OWOW99-0097	-91.9745	34.9647		AR	LONOKE	3	1	91	58	28.20	34	57	52.92
OWOW99-0122	-91.3425	35.7756		AR	INDEPENDENCE	2	1	91	20	33.00	35	46	32.16
OWOW99-0143	-92.2420	36.4063	NORFOLK L	AR	BAXTER	7546	1	92	14	31.20	36	24	22.68
OWOW99-0171	-91.7495	34.1479		AR	JEFFERSON	5	1	91	44	58.20	34	8	52.44
OWOW99-0222	-90.3498	34.8895		AR	CRITTENDEN	2	1	90	20	59.28	34	53	22.20
OWOW99-0497	-93.8325	35.5319		AR	FRANKLIN	166	2	93	49	57.00	35	31	54.84

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-0523	-93.7021	33.2410		AR	LAFAYETTE	21	2	93	42	7.56	33	14	27.60
OWOW99-0571	-92.1631	35.5610		AR	CLEBURNE	4803	2	92	9	47.16	35	33	39.60
OWOW99-0623	-93.1037	34.1847		AR	CLARK	152	2	93	6	13.32	34	11	4.92
OWOW99-0922	-91.7543	34.7737		AR	LONOKE	7	3	91	45	15.48	34	46	25.32
OWOW99-0971	-91.0572	34.2542		AR	PHILLIPS	2	3	91	3	25.92	34	15	15.12
OWOW99-1022	-90.7207	34.7570		AR	LEE	1	3	90	43	14.52	34	45	25.20
OWOW99-1046	-92.5217	34.5720		AR	SALINE	4	3	92	31	18.12	34	34	19.20
OWOW99-1371	-93.3895	34.6169	L OUCHITA	AR	GARLAND	15816	4	93	23	22.20	34	37	0.84
OWOW99-1396	-91.3933	34.4663		AR	ARKANSAS	24	4	91	23	35.88	34	27	58.68
OWOW99-1398	-94.0040	33.7506	Millwood Lake	AR	LITTLE RIVER	9668	4	94	0	14.40	33	45	2.16
OWOW99-1447	-91.6630	34.9565		AR	PRAIRIE	6	4	91	39	46.80	34	57	23.40
OWOW99-1449	-93.2374	34.2571	Degray Lake	AR	CLARK	4576	4	93	14	14.64	34	15	25.56
OWOW99-1493	-93.9496	36.3670	BEAVER RES	AR	BENTON	8311	4	93	56	58.56	36	22	1.20
OWOW99-1522	-90.3370	34.9306		AR	CRITTENDEN	872	4	90	20	13.20	34	55	50.16
OWOW99-0045	-111.2923	33.5876	Apache Lake	AZ	MARICOPA	888	1	111	17	32.28	33	35	15.36
OWOW99-0569	-109.5274	34.1152	Carnero Lake	AZ	APACHE	27	2	109	31	38.64	34	6	54.72
OWOW99-0595	-110.0558	34.3240	White Lake	AZ	NAVAJO	10	2	110	3	20.88	34	19	26.40
OWOW99-1020	-114.6362	35.4539	L MOJAVE	AZ	MOHAVE	10446	3	114	38	10.32	35	27	14.04
OWOW99-1044	-109.4212	33.9097	Crescent Lake	AZ	APACHE	64	3	109	25	16.32	33	54	34.92
OWOW99-1520	-114.3657	34.5009	L HAVASU	AZ	MOHAVE	7223	4	114	21	56.52	34	30	3.24
OWOW99-0001	-120.4193	41.9579	Goose Lake	CA		0	1	120	25	9.59	41	57	28.58
OWOW99-0002	-119.2349	36.8747		CA	FRESNO	2337	1	119	14	5.64	36	52	28.92
OWOW99-0018	-114.5414	33.5724		CA	RIVERSIDE	7	1	114	32	29.04	33	34	20.64
OWOW99-0026	-123.7864	40.0640		CA	HUMBOLDT	25	1	123	47	11.04	40	3	50.40
OWOW99-0027	-119.7812	38.1627		CA	TUOLUMNE	3	1	119	46	52.32	38	9	45.72
OWOW99-0051	-122.1163	37.7861		CA	ALAMEDA	309	1	122	6	58.68	37	47	9.96

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-0077	-120.4489	40.5446		CA	LASSEN	11	1	120	26	56.04	40	32	40.56
OWOW99-0118	-116.8157	34.0550		CA	SAN BERNARDINO	74	1	116	48	56.52	34	3	18.00
OWOW99-0126	-122.7705	39.0266	Clear Lake	CA	LAKE	15956	1	122	46	13.80	39	1	35.76
OWOW99-0128	-118.1459	35.0290		CA	KERN	1	1	118	8	45.24	35	1	44.40
OWOW99-0151	-121.3599	39.5799	Lake Oroville	CA	BUTTE	1730	1	121	21	35.64	39	34	47.64
OWOW99-0201	-122.1881	41.4196		CA	SISKIYOU	294	1	122	11	17.16	41	25	10.56
OWOW99-0452	-118.6846	37.1583		CA	FRESNO	2	2	118	41	4.56	37	9	29.88
OWOW99-0468	-116.7810	32.9124		CA	SAN DIEGO	590	2	116	46	51.60	32	54	44.64
OWOW99-0476	-122.3975	40.8253	SHASTA L	CA	SHASTA	5468	2	122	23	51.00	40	49	31.08
OWOW99-0477	-119.0280	38.0050	Mono Lake	CA	MONO	16302	2	119	1	40.80	38	0	18.00
OWOW99-0503	-121.1275	37.0439	San Luis Res	CA	MERCED	5214	2	121	7	39.00	37	2	38.04
OWOW99-0551	-120.5188	40.2272		CA	PLUMAS	2	2	120	31	7.68	40	13	37.92
OWOW99-0577	-120.8588	37.1225		CA	MERCED	6	2	120	51	31.68	37	7	21.00
OWOW99-0601	-121.1105	38.4797		CA	SACRAMENTO	2	2	121	6	37.80	38	28	46.92
OWOW99-0603	-118.1823	34.2971		CA	LOS ANGELES	33	2	118	10	56.28	34	17	49.56
OWOW99-0651	-121.1289	41.5180		CA	MODOC	55	2	121	7	44.04	41	31	4.80
OWOW99-0953	-119.4818	36.0562		CA	TULARE	44	3	119	28	54.48	36	3	22.32
OWOW99-0977	-118.9776	37.3797		CA	FRESNO	755	3	118	58	39.36	37	22	46.92
OWOW99-1002	-120.8496	37.8529		CA	STANISLAUS	719	3	120	50	58.56	37	51	10.44
OWOW99-1026	-120.1551	38.9911		CA	EL DORADO	8	3	120	9	18.36	38	59	27.96
OWOW99-1076	-121.8182	38.0663		CA	SOLANO	476	3	121	49	5.52	38	3	58.68
OWOW99-1118	-115.8314	33.3079	Salton Sea	CA	IMPERIAL	94543	3	115	49	53.04	33	18	28.44
OWOW99-1351	-120.4928	39.4114		CA	NEVADA	89	4	120	29	34.08	39	24	41.04
OWOW99-1378	-120.8460	35.3417		CA	SAN LUIS OBISPO	858	4	120	50	45.60	35	20	30.12
OWOW99-1402	-117.9516	36.1876		CA	INYO	687	4	117	57	5.76	36	11	15.36
OWOW99-1418	-118.0490	33.6996		CA	ORANGE	6	4	118	2	56.40	33	41	58.56

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
								Deg	Min	Sec	Deg	Min	Sec
OWOW99-1426	-122.7696	40.8951	Claire Engle	CA	TRINITY	6757	4	122	46	10.56	40	53	42.36
OWOW99-1427	-119.4148	37.6232		CA	MADERA	4	4	119	24	53.28	37	37	23.52
OWOW99-1502	-121.9981	37.4396		CA	SANTA CLARA	61	4	121	59	53.16	37	26	22.56
OWOW99-1526	-120.7485	38.7982		CA	EL DORADO	9	4	120	44	54.60	38	47	53.52
OWOW99-1528	-120.4040	34.9692		CA	SANTA BARBARA	941	4	120	24	14.40	34	58	9.12
OWOW99-1551	-120.1479	41.7342	Upper Alkali Lake (dry)	CA	MODOC	11196	4	120	8	52.44	41	44	3.12
OWOW99-0019	-102.3823	37.4862		CO	BACA	22	1	102	22	56.28	37	29	10.32
OWOW99-0028	-104.7065	40.0127		CO	WELD	6	1	104	42	23.40	40	0	45.72
OWOW99-0078	-107.3337	39.7020		CO	GARFIELD	9	1	107	20	1.32	39	42	7.20
OWOW99-0176	-108.0405	39.0011		CO	DELTA	6	1	108	2	25.80	39	0	3.96
OWOW99-0469	-102.2763	40.0854		CO	YUMA	7	2	102	16	34.68	40	5	7.44
OWOW99-0478	-105.0226	40.5558		CO	LARIMER	3	2	105	1	21.36	40	33	20.88
OWOW99-0552	-106.2063	40.0177		CO	GRAND	546	2	106	12	22.68	40	1	3.72
OWOW99-0903	-104.4631	40.8024		CO	WELD	1	3	104	27	47.16	40	48	8.64
OWOW99-0969	-106.5172	37.4731		CO	RIO GRANDE	6	3	106	31	1.92	37	28	23.16
OWOW99-0994	-103.7030	38.1887		CO	CROWLEY	2239	3	103	42	10.80	38	11	19.32
OWOW99-1003	-105.0564	40.7888		CO	LARIMER	10	3	105	3	23.04	40	47	19.68
OWOW99-1394	-107.8886	37.8946		CO	SAN MIGUEL	2	4	107	53	18.96	37	53	40.56
OWOW99-1428	-105.3511	40.8820		CO	LARIMER	108	4	105	21	3.96	40	52	55.20
OWOW99-1569	-104.8543	39.6397		CO	ARAPAHOE	347	4	104	51	15.48	39	38	22.92
OWOW99-0117	-71.9430	42.0115	Quinebaug River	CT	WINDHAM	11	1	71	56	34.80	42	0	41.40
OWOW99-0938	-73.4959	41.3409	Rainbow Lake	CT	FAIRFIELD	15	3	73	29	45.24	41	20	27.24
OWOW99-1117	-72.9549	41.9704	Barkhamsted Reservoir	CT	LITCHFIELD	891	3	72	57	17.64	41	58	13.44
OWOW99-1538	-72.7665	41.5074	Foster Lake	CT	NEW HAVEN	4	4	72	45	59.40	41	30	26.64
OWOW99-0025	-81.8469	28.4754		FL	LAKE	78	1	81	50	48.84	28	28	31.44
OWOW99-0050	-81.9264	28.6951		FL	LAKE	10	1	81	55	35.04	28	41	42.36

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-0060	-82.3394	30.0367		FL	UNION	363	1	82	20	21.84	30	2	12.12
OWOW99-0075	-81.5695	24.7544		FL	MONROE	24	1	81	34	10.20	24	45	15.84
OWOW99-0100	-82.3507	28.9242	Tsala Apopka Lake	FL		0	1	82	21	2.52	28	55	27.23
OWOW99-0125	-80.9404	27.9389		FL	OSCEOLA	2	1	80	56	25.44	27	56	20.04
OWOW99-0135	-81.8437	29.1804		FL	MARION	140	1	81	50	37.32	29	10	49.44
OWOW99-0150	-80.7960	27.1752	Lake Okeechobee	FL	OKEECHOBEE	4830	1	80	47	45.60	27	10	30.72
OWOW99-0160	-80.5882	27.7803		FL	INDIAN RIVER	3	1	80	35	17.52	27	46	49.08
OWOW99-0175	-82.2463	27.5928		FL	MANATEE	2	1	82	14	46.68	27	35	34.08
OWOW99-0200	-84.9271	30.6812		FL	JACKSON	3	1	84	55	37.56	30	40	52.32
OWOW99-0225	-82.2637	28.3406		FL	PASCO	62	1	82	15	49.32	28	20	26.16
OWOW99-0475	-81.6036	28.5265		FL	ORANGE	76	2	81	36	12.96	28	31	35.40
OWOW99-0498	-86.3279	30.4826		FL	WALTON	2	2	86	19	40.44	30	28	57.36
OWOW99-0500	-81.6221	28.6191	Lake Apopka	FL	ORANGE	12439	2	81	37	19.56	28	37	8.76
OWOW99-0510	-80.9802	28.2704		FL	OSCEOLA	5	2	80	58	48.72	28	16	13.44
OWOW99-0525	-81.1501	26.4247		FL	HENDRY	24	2	81	9	0.36	26	25	28.92
OWOW99-0535	-81.2028	29.5902		FL	FLAGLER	111	2	81	12	10.08	29	35	24.72
OWOW99-0550	-80.6610	24.9913		FL	MONROE	53	2	80	39	39.60	24	59	28.68
OWOW99-0574	-81.9198	29.0737		FL	MARION	7	2	81	55	11.28	29	4	25.32
OWOW99-0600	-82.2659	27.9661		FL	HILLSBOROUGH	22	2	82	15	57.24	27	57	57.96
OWOW99-0610	-81.6416	29.4031		FL	PUTNAM	3	2	81	38	29.76	29	24	11.16
OWOW99-0625	-80.2610	26.0262		FL	BROWARD	5	2	80	15	39.60	26	1	34.32
OWOW99-0650	-82.5276	29.4948		FL	ALACHUA	7	2	82	31	39.36	29	29	41.28
OWOW99-0675	-81.8420	27.8500		FL	POLK	130	2	81	50	31.20	27	51	0.00
OWOW99-0925	-81.8724	28.9253		FL	LAKE	9	3	81	52	20.64	28	55	31.08
OWOW99-0960	-81.4955	28.6981		FL	ORANGE	23	3	81	29	43.80	28	41	53.16
OWOW99-0972	-85.4548	30.7352		FL	WASHINGTON	5	3	85	27	17.28	30	44	6.72

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-0975	-81.4995	27.7380		FL	POLK	1400	3	81	29	58.20	27	44	16.80
OWOW99-1000	-81.3723	28.2325	L TOHOPEKALIGA	FL	OSCEOLA	7643	3	81	22	20.28	28	13	57.00
OWOW99-1025	-82.6637	28.2997		FL	PASCO	8	3	82	39	49.32	28	17	58.92
OWOW99-1050	-82.3075	27.4795		FL	MANATEE	593	3	82	18	27.00	27	28	46.20
OWOW99-1060	-81.8922	29.6284		FL	PUTNAM	18	3	81	53	31.92	29	37	42.24
OWOW99-1075	-85.7628	30.4994		FL	WASHINGTON	20	3	85	45	46.08	30	29	57.84
OWOW99-1100	-82.3138	26.8617		FL	CHARLOTTE	16	3	82	18	49.68	26	51	42.12
OWOW99-1125	-81.0849	28.1410		FL	OSCEOLA	7	3	81	5	5.64	28	8	27.60
OWOW99-1385	-81.4253	28.9124		FL	LAKE	3	4	81	25	31.08	28	54	44.64
OWOW99-1400	-81.8260	26.8045		FL	CHARLOTTE	6	4	81	49	33.60	26	48	16.20
OWOW99-1425	-81.4320	28.1606		FL	OSCEOLA	57	4	81	25	55.20	28	9	38.16
OWOW99-1450	-81.7713	28.8391		FL	LAKE	2	4	81	46	16.68	28	50	20.76
OWOW99-1475	-83.5613	30.0024		FL	TAYLOR	6	4	83	33	40.68	30	0	8.64
OWOW99-1485	-82.1732	29.4535	Orange Lake	FL		5142	4	82	10	23.66	29	27	12.46
OWOW99-1500	-80.9613	25.3195		FL	MONROE	50	4	80	57	40.68	25	19	10.20
OWOW99-1525	-81.9134	27.7037		FL	POLK	113	4	81	54	48.24	27	42	13.32
OWOW99-1535	-80.8242	28.9187		FL	VOLUSIA	4	4	80	49	27.12	28	55	7.32
OWOW99-1550	-81.8328	26.3086		FL	COLLIER	13	4	81	49	58.08	26	18	30.96
OWOW99-1575	-81.7677	27.9878		FL	POLK	259	4	81	46	3.72	27	59	16.08
OWOW99-0011	-82.0992	32.5078		GA	CANDLER	8	1	82	5	57.12	32	30	28.08
OWOW99-0036	-84.6784	31.9560		GA	STEWART	1	1	84	40	42.24	31	57	21.60
OWOW99-0061	-83.8010	34.6489		GA	WHITE	16	1	83	48	3.60	34	38	56.04
OWOW99-0086	-85.1335	33.0623	West Point Lake	GA	TROUP	9215	1	85	8	0.60	33	3	44.28
OWOW99-0111	-83.2689	31.5345		GA	IRWIN	3	1	83	16	8.04	31	32	4.20
OWOW99-0185	-82.4576	31.0359		GA	WARE	4	1	82	27	27.36	31	2	9.24
OWOW99-0186	-82.7802	34.0842		GA	ELBERT	2	1	82	46	48.72	34	5	3.12

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
								Deg	Min	Sec	Deg	Min	Sec
OWOW99-0461	-82.2751	32.5185		GA	EMANUEL	6	2	82	16	30.36	32	31	6.60
OWOW99-0586	-83.1705	31.6930		GA	BEN HILL	3	2	83	10	13.80	31	41	34.80
OWOW99-0636	-83.2274	34.0646		GA	MADISON	33	2	83	13	38.64	34	3	52.56
OWOW99-0661	-82.7082	32.8112		GA	WASHINGTON	13	2	82	42	29.52	32	48	40.32
OWOW99-0911	-83.4105	33.0359		GA	JONES	1	3	83	24	37.80	33	2	9.24
OWOW99-0950	-84.3761	30.6983		GA	GRADY	13	3	84	22	33.96	30	41	53.88
OWOW99-0986	-81.6357	32.9502		GA	SCREVEN	2	3	81	38	8.52	32	57	0.72
OWOW99-1011	-84.6197	32.3871		GA	MARION	10	3	84	37	10.92	32	23	13.56
OWOW99-1035	-84.6319	34.1368		GA	CHEROKEE	4661	3	84	37	54.84	34	8	12.48
OWOW99-1085	-82.5690	31.0989		GA	WARE	3	3	82	34	8.40	31	5	56.04
OWOW99-1097	-83.8326	30.8728		GA	THOMAS	5	3	83	49	57.36	30	52	22.08
OWOW99-1111	-82.7243	31.2453		GA	ATKINSON	3	3	82	43	27.48	31	14	43.08
OWOW99-1360	-84.9227	33.6541		GA	CARROLL	6	4	84	55	21.72	33	39	14.76
OWOW99-1386	-85.2008	34.2992		GA	FLOYD	12	4	85	12	2.88	34	17	57.12
OWOW99-1411	-83.8231	31.1853		GA	COLQUITT	4	4	83	49	23.16	31	11	7.08
OWOW99-1461	-82.3983	33.6589	J Strom Thurmond Res	GA	COLUMBIA	10307	4	82	23	53.88	33	39	32.04
OWOW99-1511	-83.2477	31.8803		GA	WILCOX	40	4	83	14	51.72	31	52	49.08
OWOW99-1547	-84.9136	30.7852	L SEMINOLE	GA	SEMINOLE	5138	4	84	54	48.96	30	47	6.72
OWOW99-1561	-83.2858	33.2307	Lake Sinclair	GA	PUTNAM	2071	4	83	17	8.88	33	13	50.52
OWOW99-0082	-95.7467	43.3695		IA	OSCEOLA	6	1	95	44	48.12	43	22	10.20
OWOW99-0165	-93.6948	42.8389	Morse Lake	IA	WRIGHT	41	1	93	41	41.28	42	50	20.04
OWOW99-0540	-93.7902	40.8780	Unnamed lake	IA	DECATUR	3	2	93	47	24.72	40	52	40.80
OWOW99-0615	-95.8102	40.7771	Percival Lake	IA	FREMONT	6	2	95	48	36.72	40	46	37.56
OWOW99-0907	-94.8276	43.4883	Eagle Lake	IA	EMMET	82	3	94	49	39.36	43	29	17.88
OWOW99-0965	-92.3738	40.9740	Sand pit	IA	WAPELLO	13	3	92	22	25.68	40	58	26.40
OWOW99-1040	-93.7316	41.7532	Saylorville Lake	IA	POLK	2041	3	93	43	53.76	41	45	11.52

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-1090	-94.2594	41.5498	Diamondhead Lake	IA	GUTHRIE	40	3	94	15	33.84	41	32	59.28
OWOW99-1432	-94.8721	42.9460	Rush Lake	IA	PALO ALTO	178	4	94	52	19.56	42	56	45.60
OWOW99-0079	-117.0784	44.6758	Brownlee Reservoir	ID	WASHINGTON	6071	1	117	4	42.35	44	40	32.74
OWOW99-0127	-111.1113	43.2436	PALISADES RES	ID	BONNEVILLE	6062	1	111	6	40.68	43	14	36.96
OWOW99-0177	-112.9475	42.7355		ID	POWER	6	1	112	56	50.86	42	44	7.94
OWOW99-0553	-114.6393	43.7787		ID	BLAINE	8	2	114	38	21.44	43	46	43.39
OWOW99-0554	-116.8576	48.5679	Priest Lake	ID	BONNER	9454	2	116	51	27.50	48	34	4.37
OWOW99-0627	-111.3329	42.0037	Bear Lake	ID		28329	2	111	19	58.48	42	0	13.32
OWOW99-0904	-115.9208	45.0938		ID	VALLEY	3	3	115	55	14.81	45	5	37.50
OWOW99-1028	-115.8469	45.0996		ID	VALLEY	3	3	115	50	48.88	45	5	58.45
OWOW99-1452	-111.5860	42.9042	Blackfoot Reservoir	ID	CARIBOU	6475	4	111	35	9.67	42	54	15.01
OWOW99-0015	-88.7835	37.7733	Unnamed lake	IL	WILLIAMSON	6	1	88	47	0.60	37	46	23.88
OWOW99-0041	-88.6600	41.6475	Buck Lake	IL	DE KALB	4	1	88	39	36.00	41	38	51.00
OWOW99-0091	-89.2082	41.0500	Unnamed lake	IL	MARSHALL	2	1	89	12	29.52	41	2	60.00
OWOW99-0115	-89.8931	39.4512	Otter Lake	IL	MACOUPIN	126	1	89	53	35.16	39	27	4.32
OWOW99-0140	-90.6031	41.4549	Unnamed lake	IL	ROCK ISLAND	2	1	90	36	11.16	41	27	17.64
OWOW99-0190	-89.3736	38.5090	Unnamed lake	IL	CLINTON	7	1	89	22	24.96	38	30	32.40
OWOW99-0491	-87.5327	41.6645	Wolf Lake	IL	COOK	323	2	87	31	57.72	41	39	52.20
OWOW99-0515	-89.5855	40.5838	Unnamed lake	IL	TAZEWELL	17	2	89	35	7.80	40	35	1.68
OWOW99-0916	-89.3615	41.2039	Unnamed lake	IL	PUTNAM	31	3	89	21	41.40	41	12	14.04
OWOW99-0990	-89.8377	38.2833	Unnamed lake	IL	ST CLAIR	4	3	89	50	15.72	38	16	59.88
OWOW99-1065	-88.9741	38.0812	Rend Lake	IL	FRANKLIN	833	3	88	58	26.76	38	4	52.32
OWOW99-1115	-90.2936	40.1154	Crane Lake	IL	MASON	73	3	90	17	36.96	40	6	55.44
OWOW99-1390	-89.9905	40.3401	McHarry Pond	IL	MASON	6	4	89	59	25.80	40	20	24.36
OWOW99-1415	-90.0621	38.9224	Unnamed lake	IL	MADISON	5	4	90	3	43.56	38	55	20.64
OWOW99-1441	-88.2174	41.2945	Unnamed lake	IL	WILL	25	4	88	13	2.64	41	17	40.20

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
								Deg	Min	Sec	Deg	Min	Sec
OWOW99-1465	-88.5078	37.7370	Unnamed lake	IL	SALINE	8	4	88	30	28.08	37	44	13.20
OWOW99-1565	-89.4784	37.8187	Kinkaid Lake	IL	JACKSON	972	4	89	28	42.24	37	49	7.32
OWOW99-0141	-86.7549	39.7330	Baire Lake	IN	PUTNAM	3	1	86	45	17.64	39	43	58.80
OWOW99-0191	-85.5530	40.7298		IN	HUNTINGTON	102	1	85	33	10.80	40	43	47.28
OWOW99-0216	-86.3262	39.0996		IN	BROWN	59	1	86	19	34.32	39	5	58.56
OWOW99-0466	-85.8336	41.2229	Winona Lake	IN	KOSCIUSKO	216	2	85	50	0.96	41	13	22.44
OWOW99-0590	-87.5286	39.0672	Turtle Creek Reservoir	IN	SULLIVAN	606	2	87	31	42.96	39	4	1.92
OWOW99-0616	-85.9425	39.9282	Geist Reservoir	IN	HAMILTON	683	2	85	56	33.00	39	55	41.52
OWOW99-0940	-87.2352	39.0350	Round Lake	IN	GREENE	8	3	87	14	6.72	39	2	6.00
OWOW99-0941	-85.6889	38.7726	Hardy Lake	IN	SCOTT	316	3	85	41	20.04	38	46	21.36
OWOW99-1416	-86.3382	41.6112	(gravel pit)	IN	ST JOSEPH	18	4	86	20	17.52	41	36	40.32
OWOW99-1516	-85.0236	41.6268	Fox Lake	IN	STEUBEN	53	4	85	1	24.96	41	37	36.48
OWOW99-1541	-86.9530	40.0349	Unnamed lake	IN	MONTGOMERY	5	4	86	57	10.80	40	2	5.64
OWOW99-0044	-97.7495	38.4030		KS	MCPHERSON	12	1	97	44	58.20	38	24	10.80
OWOW99-0119	-96.7013	39.4570	Tuttle Creek Lake	KS	POTTAWATOMIE	2153	1	96	42	4.68	39	27	25.20
OWOW99-0168	-94.7718	38.0787		KS	LINN	2	1	94	46	18.48	38	4	43.32
OWOW99-0218	-95.8411	38.2688		KS	COFFEY	3	1	95	50	27.96	38	16	7.68
OWOW99-0568	-95.9745	38.5312		KS	LYON	2	2	95	58	28.20	38	31	52.32
OWOW99-0619	-98.4462	37.9214		KS	RENO	6	2	98	26	46.32	37	55	17.04
OWOW99-0668	-96.2702	38.4313		KS	LYON	1	2	96	16	12.72	38	25	52.68
OWOW99-0943	-96.5009	37.3790		KS	ELK	2	3	96	30	3.24	37	22	44.40
OWOW99-0993	-98.0562	37.9161		KS	RENO	2	3	98	3	22.32	37	54	57.96
OWOW99-1019	-99.2180	39.5027		KS	ROOKS	2	3	99	13	4.80	39	30	9.72
OWOW99-1119	-95.6010	39.5024		KS	JACKSON	5	3	95	36	3.60	39	30	8.64
OWOW99-1368	-95.1619	38.5113		KS	FRANKLIN	10	4	95	9	42.84	38	30	40.68
OWOW99-1519	-98.2340	39.1122		KS	LINCOLN	3	4	98	14	2.40	39	6	43.92

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
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OWOW99-1568	-95.6120	37.8871		KS	WOODSON	2	4	95	36	43.20	37	53	13.56
OWOW99-0037	-86.1933	37.3077		KY	EDMONSON	808	1	86	11	35.88	37	18	27.72
OWOW99-0465	-88.4942	37.2822		KY	LIVINGSTON	13	2	88	29	39.12	37	16	55.92
OWOW99-0640	-85.6473	37.7978		KY	NELSON	3	2	85	38	50.28	37	47	52.08
OWOW99-0641	-84.7146	37.6850		KY	BOYLE	1084	2	84	42	52.56	37	41	6.00
OWOW99-1012	-85.2710	37.2335		KY	ADAIR	3191	3	85	16	15.60	37	14	0.60
OWOW99-1062	-84.7791	36.9740		KY	PULASKI	231	3	84	46	44.76	36	58	26.40
OWOW99-1361	-88.1218	37.0234		KY	LYON	8	4	88	7	18.48	37	1	24.24
OWOW99-0024	-89.8980	29.6683	Unknown	LA	PLAQUEMINES	4	1	89	53	52.80	29	40	5.88
OWOW99-0074	-92.3439	31.5566	Unknown	LA	GRANT	11	1	92	20	38.04	31	33	23.76
OWOW99-0124	-90.1274	30.1925	Lake Ponchartrain	LA		#####	1	90	7	38.46	30	11	33.14
OWOW99-0149	-93.4958	32.1731	Unknown	LA	RED RIVER	8	1	93	29	44.88	32	10	23.16
OWOW99-0173	-93.3868	32.4381	Lake Bisteneau	LA	WEBSTER	6283	1	93	23	12.48	32	26	17.16
OWOW99-0174	-93.4135	30.8376	Unknown	LA	BEAUREGARD	5	1	93	24	48.60	30	50	15.36
OWOW99-0199	-93.0480	29.9418	Unknown	LA	CAMERON	602	1	93	2	52.80	29	56	30.48
OWOW99-0224	-89.8645	30.6719	Unknown	LA	WASHINGTON	34	1	89	51	52.20	30	40	18.84
OWOW99-0474	-89.7188	30.1291	Lake St. Catherine?	LA	ORLEANS	3109	2	89	43	7.68	30	7	44.76
OWOW99-0549	-91.9919	31.6677	Unknown	LA	CATAHOULA	19	2	91	59	30.84	31	40	3.72
OWOW99-0575	-89.5451	29.4416	Allen Bay	LA	PLAQUEMINES	16	2	89	32	42.36	29	26	29.76
OWOW99-0599	-91.6058	30.7783	Unknown	LA	POINTE COUPEE	55	2	91	36	20.88	30	46	41.88
OWOW99-0649	-91.5507	29.9396	Unknown	LA	ST MARY	10	2	91	33	2.52	29	56	22.56
OWOW99-0674	-89.2912	29.9980	Indian Mound Bay?	LA	ST BERNARD	82	2	89	17	28.32	29	59	52.80
OWOW99-0999	-90.5717	29.9208	Lac des Allemands	LA		5957	3	90	34	18.05	29	55	14.95
OWOW99-1048	-93.7341	32.3496	Unknown	LA	CADDO	8	3	93	44	2.76	32	20	58.56
OWOW99-1074	-93.4158	30.2565	Unknown	LA	CALCASIEU	64	3	93	24	56.88	30	15	23.40
OWOW99-1099	-92.0605	32.5879	Unknown	LA	OUACHITA	6	3	92	3	37.80	32	35	16.44

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
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OWOW99-1124	-89.3347	29.8557	Christmas Camp Lake?	LA	ST BERNARD	21	3	89	20	4.92	29	51	20.52
OWOW99-1374	-92.3550	30.7519	Miller's Lake	LA	EVANGELINE	1246	4	92	21	18.00	30	45	6.84
OWOW99-1375	-89.6034	29.5372	California Bay?	LA	PLAQUEMINES	1302	4	89	36	12.24	29	32	13.92
OWOW99-1424	-89.8663	29.6994	Unknown	LA	PLAQUEMINES	6	4	89	51	58.68	29	41	57.84
OWOW99-1474	-91.7324	30.7120	Unknown	LA	POINTE COUPEE	16	4	91	43	56.64	30	42	43.20
OWOW99-1499	-91.5497	31.4483	Old River	LA	CONCORDIA	3	4	91	32	58.92	31	26	53.88
OWOW99-1548	-91.9289	32.8645	Lake Bussy Brake	LA	MOREHOUSE	848	4	91	55	44.04	32	51	52.20
OWOW99-1549	-91.2212	32.0874	Lake Bruin	LA	TENSAS	7	4	91	13	16.32	32	5	14.64
OWOW99-0017	-71.1075	41.7031	North Watuppa Pond	MA	BRISTOL	674	1	71	6	27.00	41	42	11.16
OWOW99-0043	-71.0101	42.6178	Prichards Pond	MA	ESSEX	5	1	71	0	36.36	42	37	4.08
OWOW99-0467	-70.0928	41.7239	Seymour Pond	MA	BARNSTABLE	69	2	70	5	34.08	41	43	26.04
OWOW99-0493	-71.9988	42.5272	Bents Pond	MA	WORCESTER	9	2	71	59	55.68	42	31	37.92
OWOW99-0567	-72.3087	42.4015	QUABBIN RES	MA	WORCESTER	9536	2	72	18	31.32	42	24	5.40
OWOW99-0592	-71.8687	42.1353	Carbuncle Pond	MA	WORCESTER	4	2	71	52	7.32	42	8	7.08
OWOW99-0992	-71.6047	42.2435	Westboro Reservoir	MA	WORCESTER	1	3	71	36	16.92	42	14	36.60
OWOW99-1017	-70.6276	41.3523	Big Homer Pond	MA	DUKES	13	3	70	37	39.36	41	21	8.28
OWOW99-1443	-71.7692	42.5272	Rockwell Pond	MA	WORCESTER	4	4	71	46	9.12	42	31	37.92
OWOW99-0563	-76.3694	38.8416	Holligans Snooze Inlet	MD	QUEEN ANNES	10	2	76	22	9.84	38	50	29.76
OWOW99-0564	-75.8240	38.0482	Annemessex River	MD	SOMERSET	1710	2	75	49	26.40	38	2	53.52
OWOW99-1439	-79.3215	39.5043	Deep Creek Lake	MD	GARRETT	1449	4	79	19	17.40	39	30	15.48
OWOW99-0042	-69.8635	45.1845	Heald Ponds	ME	SOMERSET	9	1	69	51	48.60	45	11	4.20
OWOW99-0092	-68.2270	44.8762	Lower Middle Branch Pond	ME	HANCOCK	104	1	68	13	37.20	44	52	34.32
OWOW99-0166	-68.0095	44.9731	Stiles Lake	ME	HANCOCK	17	1	68	0	34.20	44	58	23.16
OWOW99-0192	-70.5879	44.1533	Little Pond	ME	OXFORD	11	1	70	35	16.44	44	9	11.88
OWOW99-0210	-69.3678	45.8203	Ragged Lake	ME	PISCATAQUIS	1047	1	69	22	4.08	45	49	13.08
OWOW99-0217	-70.8049	44.0539	Moose Pond	ME	CUMBERLAND	679	1	70	48	17.64	44	3	14.04

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OWOW99-0492	-69.7220	45.6786	Moosehead Lake	ME		30308	2	69	43	19.09	45	40	43.10
OWOW99-0516	-67.8207	45.1594	Little River Lake	ME	WASHINGTON	29	2	67	49	14.52	45	9	33.84
OWOW99-0566	-68.4982	44.6483	Green Lake	ME	HANCOCK	1267	2	68	29	53.52	44	38	53.88
OWOW99-0617	-70.3992	44.0212	Middle Range Pond	ME	ANDROSCOGGIN	15	2	70	23	57.12	44	1	16.32
OWOW99-0635	-68.7143	47.1056	Wallagrass Lakes	ME	AROOSTOOK	100	2	68	42	51.48	47	6	20.16
OWOW99-0642	-69.4533	44.0098	McCurdy Pond	ME	LINCOLN	80	2	69	27	11.88	44	0	35.28
OWOW99-0660	-69.2984	46.1063	Cuxabexis Lake	ME	PISCATAQUIS	247	2	69	17	54.24	46	6	22.68
OWOW99-0667	-70.8288	44.8868	Mooselookmeguntic Lake	ME	OXFORD	6597	2	70	49	43.68	44	53	12.48
OWOW99-0917	-67.4489	44.7863	Hadley Lake	ME	WASHINGTON	680	3	67	26	56.04	44	47	10.68
OWOW99-0935	-69.0874	46.5076	Peaked Mountain Pond	ME	PISCATAQUIS	5	3	69	5	14.64	46	30	27.36
OWOW99-0966	-67.6423	45.6216	Spednik Lake	ME	WASHINGTON	5571	3	67	38	32.28	45	37	17.76
OWOW99-0967	-70.8544	43.9330	Unnamed	ME	OXFORD	7	3	70	51	15.84	43	55	58.80
OWOW99-1041	-68.9015	45.6875	Pemadumcook Lake	ME	PISCATAQUIS	7453	3	68	54	5.40	45	41	15.00
OWOW99-1067	-70.0304	44.4858	Parker Pond	ME	KENNEBEC	611	3	70	1	49.44	44	29	8.88
OWOW99-1366	-69.1132	44.2628	Megunticook Lake	ME	WALDO	574	4	69	6	47.52	44	15	46.08
OWOW99-1391	-68.3404	45.6371	Unnamed	ME	AROOSTOOK	5	4	68	20	25.44	45	38	13.56
OWOW99-1392	-70.8790	43.6124	Mud Pond	ME	YORK	8	4	70	52	44.40	43	36	44.64
OWOW99-1442	-70.2829	45.6192	Wood Pond	ME	SOMERSET	819	4	70	16	58.44	45	37	9.12
OWOW99-1460	-69.0628	46.3064	Chandler Pond	ME	PISCATAQUIS	52	4	69	3	46.08	46	18	23.04
OWOW99-1560	-69.8704	45.9150	Seboomook Lake	ME	SOMERSET	2571	4	69	52	13.44	45	54	54.00
OWOW99-0009	-85.0115	45.3005	Walloon Lake	MI	EMMET	1832	1	85	0	41.40	45	18	1.80
OWOW99-0014	-83.4149	43.0991	West Lake #1	MI	LAPEER	1	1	83	24	53.64	43	5	56.76
OWOW99-0016	-86.3480	41.9271	Lake Chapin	MI	BERRIEN	220	1	86	20	52.80	41	55	37.56
OWOW99-0116	-85.3849	42.3976	Torch Lake	MI	KALAMAZOO	13	1	85	23	5.64	42	23	51.36
OWOW99-0159	-87.0669	46.3338	Dorsey Lake	MI	ALGER	16	1	87	4	0.84	46	20	1.68

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-0184	-85.5683	44.5887	Hackman Lake	MI	GRAND TRAVERSE	7	1	85	34	5.88	44	35	19.32
OWOW99-0189	-85.3889	44.0069	Boot Lake	MI	OSCEOLA	3	1	85	23	20.04	44	0	24.84
OWOW99-0209	-85.9940	46.2242	T Pool	MI	SCHOOLCRAFT	95	1	85	59	38.40	46	13	27.12
OWOW99-0214	-84.7831	42.5946	Unnamed	MI	EATON	6	1	84	46	59.16	42	35	40.56
OWOW99-0459	-84.6654	45.4599	Burt Lake	MI	CHEBOYGAN	0	2	84	39	55.58	45	27	35.78
OWOW99-0464	-83.5643	42.6691	White Lake	MI	OAKLAND	198	2	83	33	51.48	42	40	8.76
OWOW99-0509	-88.0520	46.5487	Mud Lake	MI	MARQUETTE	2	2	88	3	7.20	46	32	55.32
OWOW99-0534	-88.8515	46.8884	Lake Roland	MI	HOUGHTON	107	2	88	51	5.40	46	53	18.24
OWOW99-0539	-85.2538	43.3313	Spring Lake	MI	MONTCALM	22	2	85	15	13.68	43	19	52.68
OWOW99-0589	-84.2805	44.4161	Horseshoe Lake	MI	OGEMAW	14	2	84	16	49.80	44	24	57.96
OWOW99-0591	-86.1248	42.2524	Dyer Lake	MI	VAN BUREN	12	2	86	7	29.28	42	15	8.64
OWOW99-0609	-89.1549	46.1527	Birch Lake	MI	GOGEBIC	84	2	89	9	17.64	46	9	9.72
OWOW99-0634	-85.3152	44.9782	Torch Lake	MI	ANTRIM	7503	2	85	18	54.72	44	58	41.52
OWOW99-0639	-84.7165	44.3499	Houghton Lake	MI	ROSCOMMON	8068	2	84	42	59.40	44	20	59.64
OWOW99-0659	-84.7507	45.6852	Lake Paradise	MI	EMMET	767	2	84	45	2.52	45	41	6.72
OWOW99-0664	-84.2082	42.1467	Norvell Lake	MI	JACKSON	12	2	84	12	29.52	42	8	48.12
OWOW99-0934	-86.0872	46.5590	Cloverleaf Lake	MI	ALGER	5	3	86	5	13.92	46	33	32.40
OWOW99-0939	-86.1309	44.0559	Mud Lake	MI	MASON	2	3	86	7	51.24	44	3	21.24
OWOW99-0984	-83.5097	45.0968	Seven Mile Pond	MI	ALPENA	556	3	83	30	34.92	45	5	48.48
OWOW99-0989	-83.5418	42.6689	Grass Lake	MI	OAKLAND	15	3	83	32	30.48	42	40	8.04
OWOW99-1016	-85.5184	41.8123	Tamarack Lake	MI	ST JOSEPH	52	3	85	31	6.24	41	48	44.28
OWOW99-1064	-85.3592	43.1538	Little Wabasis Lake	MI	KENT	14	3	85	21	33.12	43	9	13.68
OWOW99-1116	-85.5206	42.1948	Long Lake	MI	KALAMAZOO	198	3	85	31	14.16	42	11	41.28
OWOW99-1384	-87.9626	46.6857	Lake Margaret	MI	MARQUETTE	52	4	87	57	45.36	46	41	8.52
OWOW99-1414	-84.2279	41.7327		MI	LENAWEE	6	4	84	13	40.44	41	43	57.72
OWOW99-1459	-86.0181	44.8708	Glen Lake	MI	LEELANAU	560	4	86	1	5.16	44	52	14.88

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-1464	-83.5503	43.1634	Unnamed	MI	GENESEE	2	4	83	33	1.08	43	9	48.24
OWOW99-1489	-84.5111	43.1184		MI	GRATIOT	1375	4	84	30	39.96	43	7	6.24
OWOW99-1534	-89.5863	46.5082	Gogebic Lake	MI		5170	4	89	35	10.50	46	30	29.56
OWOW99-1559	-83.6934	46.0584		MI	CHIPPEWA	29	4	83	41	36.24	46	3	30.24
OWOW99-1564	-83.8948	42.5038	Chenango Lake (Lime Lake)	MI	LIVINGSTON	12	4	83	53	41.28	42	30	13.68
OWOW99-0005	-95.1647	47.3415	LaSalle	MN	HUBBARD	90	1	95	9	52.92	47	20	29.40
OWOW99-0010	-90.9426	48.0215	Mora	MN	COOK	94	1	90	56	33.36	48	1	17.40
OWOW99-0031	-94.9994	46.8863	Long	MN	HUBBARD	784	1	94	59	57.84	46	53	10.68
OWOW99-0032	-96.3941	45.5205	Unnamed	MN	BIG STONE	6	1	96	23	38.76	45	31	13.80
OWOW99-0033	-93.5870	45.4859	Cantlin	MN	SHERBURNE	41	1	93	35	13.20	45	29	9.24
OWOW99-0035	-91.1740	48.0688	Kekekabic	MN	LAKE	691	1	91	10	26.40	48	4	7.68
OWOW99-0055	-93.5770	47.1810	Pokegama Lake	MN	ITASCA	6313	1	93	34	37.20	47	10	51.60
OWOW99-0057	-95.6236	45.7808	Unnamed	MN	DOUGLAS	8	1	95	37	24.96	45	46	50.88
OWOW99-0081	-95.9084	46.7805	Fox	MN	BECKER	56	1	95	54	30.24	46	46	49.80
OWOW99-0083	-94.2868	46.3518	White Sand	MN	CROW WING	159	1	94	17	12.48	46	21	6.48
OWOW99-0085	-90.4943	47.8652	Dick	MN	COOK	53	1	90	29	39.48	47	51	54.72
OWOW99-0106	-95.4026	47.1965	Glanders	MN	CLEARWATER	20	1	95	24	9.36	47	11	47.40
OWOW99-0110	-92.8239	48.5579	Namakan Lake	MN		5686	1	92	49	25.93	48	33	28.51
OWOW99-0130	-92.1057	47.3197	Linwood Lake??	MN	ST LOUIS	3	1	92	6	20.52	47	19	10.92
OWOW99-0132	-95.8216	45.6412	Unnamed	MN	STEVENS	8	1	95	49	17.76	45	38	28.32
OWOW99-0155	-94.2687	46.4872	Hubert	MN	CROW WING	511	1	94	16	7.32	46	29	13.92
OWOW99-0157	-94.6157	45.3749	Rice	MN	STEARNS	618	1	94	36	56.52	45	22	29.64
OWOW99-0180	-94.2727	46.9586	Woman	MN	CASS	2396	1	94	16	21.72	46	57	30.96
OWOW99-0182	-93.5168	44.7412	O'Dowd	MN	SCOTT	118	1	93	31	0.48	44	44	28.32
OWOW99-0183	-92.7562	46.3802	Sturgeon	MN	PINE	666	1	92	45	22.32	46	22	48.72
OWOW99-0205	-94.5317	47.4232	Cass Lake	MN		12050	1	94	31	53.94	47	25	23.48

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
								Deg	Min	Sec	Deg	Min	Sec
OWOW99-0207	-93.2741	43.7920	Geneva	MN	FREEBORN	694	1	93	16	26.76	43	47	31.20
OWOW99-0455	-93.5638	47.5288	Pickerel	MN	ITASCA	16	2	93	33	49.68	47	31	43.68
OWOW99-0460	-91.5581	47.6143	South McDougal	MN	LAKE	113	2	91	33	29.16	47	36	51.48
OWOW99-0481	-95.5381	47.0775	Many Point	MN	BECKER	677	2	95	32	17.16	47	4	39.00
OWOW99-0482	-96.0942	45.3626	Unnamed	MN	SWIFT	11	2	96	5	39.12	45	21	45.36
OWOW99-0483	-94.0019	45.5746	Unnamed	MN	BENTON	2	2	94	0	6.84	45	34	28.56
OWOW99-0485	-92.0778	48.2927	LAC LA CROIX	MN	ST LOUIS	5769	2	92	4	40.08	48	17	33.72
OWOW99-0505	-96.0091	46.3972	Wolf	MN	OTTER TAIL	16	2	96	0	32.76	46	23	49.92
OWOW99-0507	-94.1022	45.3217	Bass	MN	WRIGHT	86	2	94	6	7.92	45	19	18.12
OWOW99-0530	-92.9112	46.8136	Moberg	MN	ST LOUIS	14	2	92	54	40.32	46	48	48.96
OWOW99-0532	-94.5663	45.5608	Lauer	MN	STEARNS	5	2	94	33	58.68	45	33	38.88
OWOW99-0555	-95.8735	46.6991	Unnamed	MN	OTTER TAIL	5	2	95	52	24.60	46	41	56.76
OWOW99-0556	-94.4671	43.6875	Buffalo	MN	MARTIN	103	2	94	28	1.56	43	41	15.00
OWOW99-0557	-95.3693	46.0890	Unnamed	MN	DOUGLAS	7	2	95	22	9.48	46	5	20.40
OWOW99-0559	-90.6578	47.9947	Trump	MN	COOK	14	2	90	39	28.08	47	59	40.92
OWOW99-0581	-95.7940	47.4786	Unnamed	MN	MAHNOMEN	8	2	95	47	38.40	47	28	42.96
OWOW99-0583	-92.8785	45.2609	Unnamed	MN	WASHINGTON	21	2	92	52	42.60	45	15	39.24
OWOW99-0585	-93.1006	48.2787	Unnamed	MN	KOOCHICHING	1	2	93	6	2.16	48	16	43.32
OWOW99-0605	-92.2737	46.9391	Fish Lake Reservoir	MN	ST LOUIS	1214	2	92	16	25.32	46	56	20.76
OWOW99-0607	-95.3151	45.5396	Swenoda	MN	POPE	117	2	95	18	54.36	45	32	22.56
OWOW99-0630	-93.9130	46.4961	Agate	MN	CROW WING	66	2	93	54	46.80	46	29	45.96
OWOW99-0632	-93.1093	44.8687	Unnamed	MN	DAKOTA	2	2	93	6	33.48	44	52	7.32
OWOW99-0633	-92.8199	46.3146	First	MN	PINE	31	2	92	49	11.64	46	18	52.56
OWOW99-0655	-94.8418	47.6093	Fox	MN	BELTRAMI	64	2	94	50	30.48	47	36	33.48
OWOW99-0905	-95.9718	48.3293	Mud Lake	MN		9591	3	95	58	18.48	48	19	45.55
OWOW99-0906	-95.4222	46.3986	East Leaf	MN	OTTER TAIL	170	3	95	25	19.92	46	23	54.96

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
								Deg	Min	Sec	Deg	Min	Sec
OWOW99-0908	-94.6005	46.2537	Shamineau	MN	MORRISON	548	3	94	36	1.80	46	15	13.32
OWOW99-0910	-90.9841	48.0774	Howard Lake	MN	COOK	69	3	90	59	2.76	48	4	38.64
OWOW99-0930	-95.5579	47.6234	Unnamed	MN	POLK	13	3	95	33	28.44	47	37	24.24
OWOW99-0932	-91.6562	44.0415	Winona	MN	WINONA	32	3	91	39	22.32	44	2	29.40
OWOW99-0933	-93.6431	46.2381	Miles Lacs	MN	MILLE LACS	51700	3	93	38	35.16	46	14	17.16
OWOW99-0955	-95.9853	46.0809	Four Mile	MN	GRANT	79	3	95	59	7.08	46	4	51.24
OWOW99-0957	-95.0638	45.2362	Florida	MN	KANDIYOHI	211	3	95	3	49.68	45	14	10.32
OWOW99-0980	-95.0251	47.9620	Lower Red Lake	MN		0	3	95	1	30.29	47	57	43.02
OWOW99-0985	-91.2914	47.8110	Isabella	MN	LAKE	667	3	91	17	29.04	47	48	39.60
OWOW99-1006	-96.1832	47.6754	Unnamed	MN	POLK	7	3	96	10	59.52	47	40	31.44
OWOW99-1008	-93.0521	45.1318	Amelia	MN	ANOKA	50	3	93	3	7.56	45	7	54.48
OWOW99-1010	-91.7537	47.8983	White Iron	MN	LAKE	2404	3	91	45	13.32	47	53	53.88
OWOW99-1030	-96.2475	46.8293	Unnamed	MN	CLAY	12	3	96	14	51.00	46	49	45.48
OWOW99-1032	-93.6363	44.9095	Minnetonka	MN	HENNEPIN	1700	3	93	38	10.68	44	54	34.20
OWOW99-1034	-93.0806	48.5981		MN	ST LOUIS	1	3	93	4	50.16	48	35	53.16
OWOW99-1055	-94.3916	47.1557	Leech Lake	MN		44280	3	94	23	29.69	47	9	20.48
OWOW99-1057	-93.8774	44.2542	Washington	MN	LE SUEUR	582	3	93	52	38.64	44	15	15.12
OWOW99-1080	-93.4365	47.2130	Unnamed	MN	ITASCA	7	3	93	26	11.40	47	12	46.80
OWOW99-1082	-95.6831	45.8481	Unnamed	MN	DOUGLAS	14	3	95	40	59.16	45	50	53.16
OWOW99-1110	-92.3073	47.8681	Vermilion Lake	MN		19875	3	92	18	26.17	47	52	5.20
OWOW99-1355	-95.8561	46.5908	McCollume	MN	OTTER TAIL	6	4	95	51	21.96	46	35	26.88
OWOW99-1357	-94.4259	44.9814	Belle	MN	MEEKER	362	4	94	25	33.24	44	58	53.04
OWOW99-1359	-94.9752	49.3608		MN	LAKE OF THE WOODS	114	4	94	58	30.72	49	21	38.88
OWOW99-1380	-95.7993	46.3063	North Turtle	MN	OTTER TAIL	601	4	95	47	57.48	46	18	22.68
OWOW99-1382	-94.8427	45.1832	Diamond	MN	KANDIYOHI	626	4	94	50	33.72	45	10	59.52
OWOW99-1410	-91.9695	48.0107	Slim	MN	ST LOUIS	131	4	91	58	10.20	48	0	38.52

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Min	Sec	Latitude Deg	Min	Sec
OWOW99-1430	-95.2037	48.9700	Lake of the Woods	MN		#####	4	95	12	13.25	48	58	12.07
OWOW99-1431	-95.7495	46.4793	Dead	MN	OTTER TAIL	2988	4	95	44	58.20	46	28	45.48
OWOW99-1435	-91.0591	48.1618	Unnamed	MN	LAKE	2	4	91	3	32.76	48	9	42.48
OWOW99-1455	-93.7461	46.6502	Blind	MN	AITKIN	120	4	93	44	45.96	46	39	0.72
OWOW99-1457	-92.3071	44.5155	Lake Pepin	MN	GOODHUE	5075	4	92	18	25.56	44	30	55.80
OWOW99-1458	-92.5169	46.2546	Unnamed	MN	PINE	10	4	92	31	0.84	46	15	16.56
OWOW99-1480	-94.7573	47.1668	Kabekona	MN	HUBBARD	975	4	94	45	26.28	47	10	0.48
OWOW99-1482	-93.7620	44.4942	Thomas	MN	LE SUEUR	48	4	93	45	43.20	44	29	39.12
OWOW99-1506	-95.6548	46.9790	Flat	MN	BECKER	741	4	95	39	17.28	46	58	44.40
OWOW99-1508	-93.7467	45.1509	Charlotte	MN	WRIGHT	94	4	93	44	48.12	45	9	3.24
OWOW99-1510	-91.4933	47.9748	Ennis	MN	LAKE	9	4	91	29	35.88	47	58	29.28
OWOW99-1530	-93.5769	47.4910	Spider	MN	ITASCA	546	4	93	34	36.84	47	29	27.60
OWOW99-1532	-95.3562	45.9641	Carlos	MN	DOUGLAS	1040	4	95	21	22.32	45	57	50.76
OWOW99-1555	-95.1158	47.7441	Unnamed	MN	BELTRAMI	6	4	95	6	56.88	47	44	38.76
OWOW99-0040	-91.0894	38.8129		MO	WARREN	10	1	91	5	21.84	38	48	46.44
OWOW99-0215	-89.6157	37.2404		MO	CAPE GIRARDEAU	128	1	89	36	56.52	37	14	25.44
OWOW99-0490	-92.1693	38.9230		MO	BOONE	9	2	92	10	9.48	38	55	22.80
OWOW99-0518	-92.9303	38.5295		MO	MORGAN	4	2	92	55	49.08	38	31	46.20
OWOW99-0543	-93.3961	36.5590	TABLE ROCK L	MO	STONE	12410	2	93	23	45.96	36	33	32.40
OWOW99-0618	-93.6900	37.3760		MO	DADE	3	2	93	41	24.00	37	22	33.60
OWOW99-0665	-91.3675	38.0854		MO	CRAWFORD	2	2	91	22	3.00	38	5	7.44
OWOW99-0912	-89.1714	36.7866		MO	MISSISSIPPI	8	3	89	10	17.04	36	47	11.76
OWOW99-0915	-91.6021	39.2285		MO	AUDRAIN	8	3	91	36	7.56	39	13	42.60
OWOW99-0968	-91.5418	37.7095		MO	DENT	2	3	91	32	30.48	37	42	34.20
OWOW99-1015	-90.4555	38.7693		MO	ST LOUIS	2	3	90	27	19.80	38	46	9.48
OWOW99-1043	-94.3974	38.7750		MO	CASS	12	3	94	23	50.64	38	46	30.00

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
								Deg	Min	Sec	Deg	Min	Sec
OWOW99-1068	-94.5328	37.2897		MO	JASPER	14	3	94	31	58.08	37	17	22.92
OWOW99-1393	-93.5719	38.1700	TRUMAN RES	MO	ST CLAIR	9246	4	93	34	18.84	38	10	12.00
OWOW99-1437	-89.4497	36.5535		MO	NEW MADRID	10	4	89	26	58.92	36	33	12.60
OWOW99-1440	-91.7100	39.5129	Mark Twain Lake	MO	RALLS	3551	4	91	42	36.00	39	30	46.44
OWOW99-1490	-92.0686	40.0317		MO	KNOX	4	4	92	4	6.96	40	1	54.12
OWOW99-1515	-91.9827	38.9651		MO	CALLAWAY	9	4	91	58	57.72	38	57	54.36
OWOW99-0071	-91.1601	33.5082		MS	WASHINGTON	47	1	91	9	36.36	33	30	29.52
OWOW99-0098	-88.5441	32.5750		MS	LAUDERDALE	12	1	88	32	38.76	32	34	30.00
OWOW99-0146	-89.8375	33.4770		MS	CARROLL	50	1	89	50	15.00	33	28	37.20
OWOW99-0172	-90.8814	32.7220		MS	SHARKEY	10	1	90	52	53.04	32	43	19.20
OWOW99-0472	-88.1104	34.8551		MS	TISHOMINGO	636	2	88	6	37.44	34	51	18.36
OWOW99-0521	-90.4070	34.0076		MS	TALLAHATCHIE	75	2	90	24	25.20	34	0	27.36
OWOW99-0522	-90.1623	32.2687		MS	RANKIN	4	2	90	9	44.28	32	16	7.32
OWOW99-0546	-90.9335	33.2578		MS	WASHINGTON	6	2	90	56	0.60	33	15	28.08
OWOW99-0572	-89.5842	31.6186		MS	COVINGTON	3	2	89	35	3.12	31	37	6.96
OWOW99-0621	-90.2024	33.5276		MS	LEFLORE	1016	2	90	12	8.64	33	31	39.36
OWOW99-0624	-90.7826	32.0304		MS	CLAIBORNE	37	2	90	46	57.36	32	1	49.44
OWOW99-0672	-89.7129	34.4486	Sardis Lake	MS		23684	2	89	42	46.48	34	26	55.03
OWOW99-0949	-89.0588	30.8977		MS	STONE	1	3	89	3	31.68	30	53	51.72
OWOW99-0997	-89.8621	34.1474	Enid Lake	MS		11230	3	89	51	43.45	34	8	50.68
OWOW99-1047	-88.9294	32.8226		MS	NESHOBA	4	3	88	55	45.84	32	49	21.36
OWOW99-1096	-89.7340	33.8319	Grenada Lake	MS		26154	3	89	44	2.36	33	49	54.80
OWOW99-1122	-88.7112	33.7215		MS	MONROE	5	3	88	42	40.32	33	43	17.40
OWOW99-1372	-90.3281	32.2211		MS	HINDS	2	4	90	19	41.16	32	13	15.96
OWOW99-1397	-90.1054	32.5856		MS	MADISON	19	4	90	6	19.44	32	35	8.16
OWOW99-1422	-89.7740	34.0039		MS	YALOBUSHA	6	4	89	46	26.40	34	0	14.04

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-1448	-89.3108	31.3542		MS	FORREST	30	4	89	18	38.88	31	21	15.12
OWOW99-1546	-90.0304	33.5995		MS	CARROLL	8	4	90	1	49.44	33	35	58.20
OWOW99-1572	-90.0714	34.7557		MS	DE SOTO	3249	4	90	4	17.04	34	45	20.52
OWOW99-1574	-89.5315	30.3291		MS	HANCOCK	2	4	89	31	53.40	30	19	44.76
OWOW99-0029	-111.2044	48.3775		MT	LIBERTY	1076	1	111	12	15.84	48	22	39.00
OWOW99-0053	-108.1039	45.1706	BIGHORN L	MT	BIG HORN	6943	1	108	6	14.04	45	10	14.16
OWOW99-0054	-113.7489	48.6154		MT	GLACIER	1	1	113	44	56.04	48	36	55.44
OWOW99-0084	-106.7435	47.7335	FORT PECK RES	MT	VALLEY	98766	1	106	44	36.60	47	44	0.60
OWOW99-0104	-107.4776	47.1298		MT	GARFIELD	6	1	107	28	39.36	47	7	47.28
OWOW99-0129	-113.3498	48.8880		MT	GLACIER	6	1	113	20	59.28	48	53	16.80
OWOW99-0153	-113.1950	44.9973		MT	BEAVERHEAD	10	1	113	11	42.00	44	59	50.28
OWOW99-0178	-104.6747	45.6234		MT	CARTER	8	1	104	40	28.92	45	37	24.24
OWOW99-0181	-104.5234	47.2791		MT	DAWSON	2055	1	104	31	24.24	47	16	44.76
OWOW99-0454	-113.9012	47.5570		MT	MISSOULA	23	2	113	54	4.32	47	33	25.20
OWOW99-0479	-111.5479	47.4160		MT	CASCADE	20	2	111	32	52.44	47	24	57.60
OWOW99-0558	-106.4908	47.6953		MT	GARFIELD	2	2	106	29	26.88	47	41	43.08
OWOW99-0579	-111.5445	46.3699		MT	BROADWATER	196	2	111	32	40.20	46	22	11.64
OWOW99-0604	-115.2348	48.5864	L KOOCANUSA	MT	LINCOLN	11463	2	115	14	5.28	48	35	11.04
OWOW99-0909	-108.5948	48.3476		MT	BLAINE	59	3	108	35	41.28	48	20	51.36
OWOW99-0952	-111.2497	44.7870	Hebgen Lake	MT		0	3	111	14	58.74	44	47	13.02
OWOW99-1004	-111.9909	48.0219		MT	TETON	9	3	111	59	27.24	48	1	18.84
OWOW99-1029	-115.6653	48.2210		MT	LINCOLN	52	3	115	39	55.08	48	13	15.60
OWOW99-1079	-113.8897	48.1628		MT	FLATHEAD	9	3	113	53	22.92	48	9	46.08
OWOW99-1104	-115.4069	47.2692		MT	MINERAL	3	3	115	24	24.84	47	16	9.12
OWOW99-1358	-106.0834	47.8205		MT	MCCONE	5	4	106	5	0.24	47	49	13.80
OWOW99-1404	-113.2146	47.0855		MT	POWELL	2	4	113	12	52.56	47	5	7.80

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-1429	-112.4335	47.9460		MT	TETON	1296	4	112	26	0.60	47	56	45.60
OWOW99-1434	-107.2259	48.7055		MT	PHILLIPS	231	4	107	13	33.24	48	42	19.80
OWOW99-1504	-111.6821	45.4309		MT	MADISON	1491	4	111	40	55.56	45	25	51.24
OWOW99-1529	-114.0767	48.8717		MT	FLATHEAD	1	4	114	4	36.12	48	52	18.12
OWOW99-0062	-81.4559	35.3010	Kings Mt. Reservoir	NC	CLEVELAND	552	1	81	27	21.24	35	18	3.60
OWOW99-0137	-80.4275	35.7108	Impoundment/Grants Creek	NC	ROWAN	6	1	80	25	39.00	35	42	38.88
OWOW99-0139	-76.4601	35.7687	Phelps Lake	NC		6718	1	76	27	36.18	35	46	7.36
OWOW99-0162	-79.0165	35.7732	B Everett Jordan Lake	NC	CHATHAM	5787	1	79	0	59.40	35	46	23.52
OWOW99-0164	-78.0190	36.5410	Lake Gaston	NC	WARREN	7951	1	78	1	8.40	36	32	27.60
OWOW99-0537	-80.9698	35.3508	Mt. Island Lake	NC	MECKLENBURG	1404	2	80	58	11.28	35	21	2.88
OWOW99-0611	-83.3703	35.4456	Impoundment/Oconoluftee River	NC	SWAIN	7	2	83	22	13.08	35	26	44.16
OWOW99-0612	-78.9274	35.1360	Smith Lake	NC	CUMBERLAND	34	2	78	55	38.64	35	8	9.60
OWOW99-0962	-79.8803	35.7551	Unnamed	NC	RANDOLPH	1	3	79	52	49.08	35	45	18.36
OWOW99-1037	-78.4574	35.2586	Unnamed	NC	SAMPSON	24	3	78	27	26.64	35	15	30.96
OWOW99-1112	-77.2761	34.7116	Unnamed	NC	ONSLOW	6	3	77	16	33.96	34	42	41.76
OWOW99-1387	-78.6858	36.0778	Unnamed	NC	GRANVILLE	1	4	78	41	8.88	36	4	40.08
OWOW99-1389	-77.2762	36.1907	Unnamed	NC	BERTIE	6	4	77	16	34.32	36	11	26.52
OWOW99-0006	-100.0630	46.7390	Long Lake	ND	KIDDER	1300	1	100	3	46.80	46	44	20.40
OWOW99-0030	-98.8053	48.2210	Devils Lake	ND	RAMSEY	7120	1	98	48	19.08	48	13	15.60
OWOW99-0034	-103.9666	48.6934		ND	DIVIDE	9	1	103	57	59.76	48	41	36.24
OWOW99-0105	-98.9742	48.2524		ND	RAMSEY	2196	1	98	58	27.12	48	15	8.64
OWOW99-0109	-100.2730	48.8584		ND	BOTTINEAU	5	1	100	16	22.80	48	51	30.24
OWOW99-0131	-100.9038	46.9226		ND	BURLEIGH	20	1	100	54	13.68	46	55	21.36
OWOW99-0156	-99.9637	47.4209		ND	WELLS	37	1	99	57	49.32	47	25	15.24
OWOW99-0456	-99.0408	47.1242		ND	STUTSMAN	3	2	99	2	26.88	47	7	27.12

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-0480	-98.1807	47.8124		ND	NELSON	13	2	98	10	50.52	47	48	44.64
OWOW99-0484	-103.4168	48.2622		ND	WILLIAMS	60	2	103	25	0.48	48	15	43.92
OWOW99-0506	-99.1740	47.1297		ND	STUTSMAN	11	2	99	10	26.40	47	7	46.92
OWOW99-0580	-100.2759	47.8418		ND	SHERIDAN	24	2	100	16	33.24	47	50	30.48
OWOW99-0584	-102.3091	48.5432		ND	MOUNTRAIL	6	2	102	18	32.76	48	32	35.52
OWOW99-0606	-100.3287	47.7739		ND	SHERIDAN	8	2	100	19	43.32	47	46	26.04
OWOW99-0656	-98.9907	46.0214		ND	DICKEY	12	2	98	59	26.52	46	1	17.04
OWOW99-0956	-99.7841	47.0430		ND	KIDDER	1356	3	99	47	2.76	47	2	34.80
OWOW99-0981	-99.2248	46.6055		ND	LOGAN	4	3	99	13	29.28	46	36	19.80
OWOW99-1005	-99.8568	48.5667		ND	ROLETTE	49	3	99	51	24.48	48	34	0.12
OWOW99-1009	-102.0806	48.3434		ND	MOUNTRAIL	4	3	102	4	50.16	48	20	36.24
OWOW99-1081	-101.4909	47.9278		ND	WARD	52	3	101	29	27.24	47	55	40.08
OWOW99-1105	-97.8659	47.5268		ND	STEELE	5	3	97	51	57.24	47	31	36.48
OWOW99-1106	-97.8346	46.7275		ND	BARNES	13	3	97	50	4.56	46	43	39.00
OWOW99-1109	-100.2276	48.9943		ND	BOTTINEAU	20	3	100	13	39.36	48	59	39.48
OWOW99-1381	-99.5410	47.2677		ND	KIDDER	64	4	99	32	27.60	47	16	3.72
OWOW99-1405	-99.0504	47.6458		ND	EDDY	16	4	99	3	1.44	47	38	44.88
OWOW99-1406	-99.1631	46.9102		ND	STUTSMAN	12	4	99	9	47.16	46	54	36.72
OWOW99-1409	-99.9233	48.8529		ND	ROLETTE	5	4	99	55	23.88	48	51	10.44
OWOW99-1456	-99.4723	46.1183		ND	MCINTOSH	204	4	99	28	20.28	46	7	5.88
OWOW99-1505	-100.1783	48.1937		ND	PIERCE	10	4	100	10	41.88	48	11	37.32
OWOW99-1509	-101.9556	48.2697		ND	MOUNTRAIL	55	4	101	57	20.16	48	16	10.92
OWOW99-1531	-102.4403	47.9289		ND	MOUNTRAIL	2	4	102	26	25.08	47	55	44.04
OWOW99-0003	-99.1880	42.2988		NE	HOLT	37	1	99	11	16.80	42	17	55.68
OWOW99-0065	-96.3294	42.2335		NE	THURSTON	6	1	96	19	45.84	42	14	0.60
OWOW99-0094	-96.7822	41.2891		NE	SAUNDERS	3	1	96	46	55.92	41	17	20.76

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-0103	-102.7355	42.0064		NE	BOX BUTTE	8	1	102	44	7.80	42	0	23.04
OWOW99-0453	-103.4950	41.9337		NE	SCOTTS BLUFF	784	2	103	29	42.00	41	56	1.32
OWOW99-0494	-100.4095	40.9410		NE	LINCOLN	226	2	100	24	34.20	40	56	27.60
OWOW99-0578	-102.3409	42.0069		NE	GARDEN	10	2	102	20	27.24	42	0	24.84
OWOW99-0594	-98.1846	40.0087		NE	NUCKOLLS	7	2	98	11	4.56	40	0	31.32
OWOW99-0919	-96.9633	41.4518		NE	COLFAX	5	3	96	57	47.88	41	27	6.48
OWOW99-0978	-101.7811	42.4001		NE	CHERRY	10	3	101	46	51.96	42	24	0.36
OWOW99-1103	-102.5531	42.2118		NE	SHERIDAN	7	3	102	33	11.16	42	12	42.48
OWOW99-1356	-98.1129	42.7988		NE	KNOX	28	4	98	6	46.44	42	47	55.68
OWOW99-1403	-101.8481	41.2503	L MCCONAUGHY	NE	KEITH	11464	4	101	50	53.16	41	15	1.08
OWOW99-1419	-95.6776	40.3263		NE	NEMAHA	2	4	95	40	39.36	40	19	34.68
OWOW99-1444	-101.5539	40.4322		NE	CHASE	652	4	101	33	14.04	40	25	55.92
OWOW99-1540	-96.3740	41.3094		NE	DOUGLAS	9	4	96	22	26.40	41	18	33.84
OWOW99-0142	-71.1640	43.0991	Unnamed	NH	ROCKINGHAM	5	1	71	9	50.40	43	5	56.76
OWOW99-0167	-71.3410	43.6026	Lake Winnepesaukee	NH	BELKNAP	18545	1	71	20	27.60	43	36	9.36
OWOW99-0517	-71.7674	43.6595	Newfound Lake	NH	GRAFTON	1718	2	71	46	2.64	43	39	34.20
OWOW99-0918	-71.7401	43.0228	Unnamed	NH	HILLSBOROUGH	8	3	71	44	24.36	43	1	22.08
OWOW99-1367	-71.9652	43.3070	Loch Lyndon Reservoir	NH	MERRIMACK	47	4	71	57	54.72	43	18	25.20
OWOW99-0013	-74.8627	39.7848		NJ	CAMDEN	4	1	74	51	45.72	39	47	5.28
OWOW99-0463	-74.2645	39.7364		NJ	OCEAN	18	2	74	15	52.20	39	44	11.04
OWOW99-0638	-74.2684	41.1211		NJ	PASSAIC	23	2	74	16	6.24	41	7	15.96
OWOW99-1063	-74.2473	40.8269		NJ	ESSEX	5	3	74	14	50.28	40	49	36.84
OWOW99-1413	-75.2780	39.3922		NJ	CUMBERLAND	3	4	75	16	40.80	39	23	31.92
OWOW99-1563	-74.9980	40.9226		NJ	WARREN	6	4	74	59	52.80	40	55	21.36
OWOW99-0095	-103.6595	35.0939	Arch Hurly Conservency Lake	NM	QUAY	39	1	103	39	34.20	35	5	38.04
OWOW99-0169	-107.6105	36.5178	Mavajo Reservoir	NM	RIO ARRIBA	1892	1	107	36	37.80	36	31	4.08

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
								Deg	Min	Sec	Deg	Min	Sec
OWOW99-0519	-105.0750	36.8757	No name playa lake	NM	COLFAX	6	2	105	4	30.00	36	52	32.52
OWOW99-1369	-104.3510	32.6128	Brantley Reservoir	NM		8498	4	104	21	3.46	32	36	46.19
OWOW99-1445	-103.9262	33.0108	No name playa lake	NM	CHAVES	1	4	103	55	34.32	33	0	38.88
OWOW99-0501	-118.3701	38.5316		NV	MINERAL	82	2	118	22	12.36	38	31	53.76
OWOW99-0652	-114.3731	36.2826	LAKE MEAD	NV	CLARK	39373	2	114	22	23.16	36	16	57.36
OWOW99-0902	-119.5533	40.0220	Pyramid Lake	NV	WASHOE	44233	3	119	33	11.88	40	1	19.20
OWOW99-0926	-115.4695	40.1724	Ruby Lake	NV	ELKO	38	3	115	28	10.20	40	10	20.64
OWOW99-0951	-118.3443	38.9805		NV	MINERAL	84	3	118	20	39.48	38	58	49.80
OWOW99-1102	-116.0292	38.9549		NV	NYE	269	3	116	1	45.12	38	57	17.64
OWOW99-1376	-118.3889	38.8915		NV	MINERAL	277	4	118	23	20.04	38	53	29.40
OWOW99-1451	-117.1533	41.4146	Chimney Reservoir	NV	HUMBOLDT	881	4	117	9	11.88	41	24	52.56
OWOW99-1552	-116.2257	36.3573		NV	NYE	138	4	116	13	32.52	36	21	26.28
OWOW99-0038	-75.5268	42.5710	Mead Pond	NY	CHENANGO	5	1	75	31	36.48	42	34	15.60
OWOW99-0063	-74.7667	41.7675	Lake Barnabee	NY	SULLIVAN	2	1	74	46	0.12	41	46	3.00
OWOW99-0067	-74.5002	44.1914	Tupper Lake	NY	FRANKLIN	2584	1	74	30	0.72	44	11	29.04
OWOW99-0088	-76.9186	42.6277	Seneca Lake	NY	YATES	17413	1	76	55	6.96	42	37	39.72
OWOW99-0113	-75.4139	44.2527	Sylvia Lake	NY	ST LAWRENCE	125	1	75	24	50.04	44	15	9.72
OWOW99-0114	-79.3778	42.1331	Chatauqua Lake	NY		5438	1	79	22	40.12	42	7	59.20
OWOW99-0138	-73.5965	42.1441	Copake Lake	NY	COLUMBIA	158	1	73	35	47.40	42	8	38.76
OWOW99-0488	-74.1190	42.2356	Colgate Lake	NY	GREENE	11	2	74	7	8.40	42	14	8.16
OWOW99-0538	-74.5199	41.6999	Unnamed	NY	SULLIVAN	7	2	74	31	11.64	41	41	59.64
OWOW99-0542	-74.4799	44.2537	Little Wolf Pond	NY	FRANKLIN	65	2	74	28	47.64	44	15	13.32
OWOW99-0562	-78.8773	42.6172	Unnamed	NY	ERIE	2	2	78	52	38.28	42	37	1.92
OWOW99-0588	-75.2920	44.1313	Unnamed	NY	LEWIS	1	2	75	17	31.20	44	7	52.68
OWOW99-0593	-73.7070	43.7154	Brant Lake	NY	WARREN	572	2	73	42	25.20	43	42	55.44
OWOW99-0613	-73.7041	41.5026	Southern South Lake	NY	PUTNAM	4	2	73	42	14.76	41	30	9.36

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-0913	-75.9898	43.4336	Whitney Pond	NY	OSWEGO	32	3	75	59	23.28	43	26	0.96
OWOW99-1013	-74.1704	43.2291	Northville Lake	NY	FULTON	8	3	74	10	13.44	43	13	44.76
OWOW99-1018	-73.6822	43.3046	Unnamed	NY	WARREN	7	3	73	40	55.92	43	18	16.56
OWOW99-1362	-77.1845	43.2367	Unnamed	NY	WAYNE	1	4	77	11	4.20	43	14	12.12
OWOW99-1438	-76.2675	43.2846	Pennellville Pond	NY	OSWEGO	7	4	76	16	3.00	43	17	4.56
OWOW99-1463	-72.3292	40.9420	Goldfish Pond	NY	SUFFOLK	1	4	72	19	45.12	40	56	31.20
OWOW99-1488	-73.9587	41.1617	DeForest Lake	NY	ROCKLAND	94	4	73	57	31.32	41	9	42.12
OWOW99-1492	-74.5445	44.3974	Little Rock Pond	NY	FRANKLIN	7	4	74	32	40.20	44	23	50.64
OWOW99-1513	-74.8449	43.8336	Moose Lake	NY	HERKIMER	507	4	74	50	41.64	43	50	0.96
OWOW99-1518	-73.5952	43.8205	Grizzle Ocean	NY	ESSEX	8	4	73	35	42.72	43	49	13.80
OWOW99-1542	-73.9226	44.5617	Mud Pond	NY	CLINTON	45	4	73	55	21.36	44	33	42.12
OWOW99-0066	-82.5221	39.1898	Lake Rupert	OH	VINTON	133	1	82	31	19.56	39	11	23.28
OWOW99-0163	-81.7622	40.1524		OH	MUSKINGUM	1542	1	81	45	43.92	40	9	8.64
OWOW99-0513	-82.2338	39.9526	Unnamed	OH	LICKING	2	2	82	14	1.68	39	57	9.36
OWOW99-0541	-83.1276	40.6223	Unnamed	OH	MARION	2	2	83	7	39.36	40	37	20.28
OWOW99-0963	-83.5746	41.0512	Unnamed	OH	HANCOCK	1	3	83	34	28.56	41	3	4.32
OWOW99-1038	-81.6191	41.0094	Branch Lake #1	OH	SUMMIT	3	3	81	37	8.76	41	0	33.84
OWOW99-1066	-84.0402	39.8466	Unnamed	OH	GREENE	9	3	84	2	24.72	39	50	47.76
OWOW99-1091	-84.1174	39.5665	Unnamed	OH	WARREN	4	3	84	7	2.64	39	33	59.40
OWOW99-1114	-83.6802	41.6072	Unnamed	OH	LUCAS	5	3	83	40	48.72	41	36	25.92
OWOW99-1363	-81.2526	41.3496	Unnamed Lake	OH	GEAUGA	2	4	81	15	9.36	41	20	58.56
OWOW99-1388	-81.1403	40.7884	Hidden Valley Lake	OH	STARK	2	4	81	8	25.08	40	47	18.24
OWOW99-1466	-84.7258	39.2000	Unnamed Lake	OH	HAMILTON	5	4	84	43	32.88	39	12	0.00
OWOW99-1491	-82.2990	39.7671	Clouse Lake	OH	PERRY	13	4	82	17	56.40	39	46	1.56
OWOW99-1514	-80.5713	41.3069	Unnamed Lake	OH	TRUMBULL	2	4	80	34	16.68	41	18	24.84
OWOW99-0023	-96.3983	33.9319		OK	BRYAN	5	1	96	23	53.88	33	55	54.84

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-0049	-94.8975	34.9442		OK	LE FLORE	1	1	94	53	51.00	34	56	39.12
OWOW99-0068	-95.5922	36.5821	OOLOGAH L	OK	ROGERS	6100	1	95	35	31.92	36	34	55.56
OWOW99-0069	-98.4909	35.1982		OK	CADDO	1654	1	98	29	27.24	35	11	53.52
OWOW99-0099	-95.4239	34.0857	Hugo Lake	OK	CHOCTAW	4950	1	95	25	26.04	34	5	8.52
OWOW99-0193	-95.3515	35.9778		OK	WAGONER	634	1	95	21	5.40	35	58	40.08
OWOW99-0194	-95.8195	35.3984		OK	MCINTOSH	590	1	95	49	10.20	35	23	54.24
OWOW99-0219	-96.3680	36.2481	KEYSTONE L	OK	PAWNEE	5455	1	96	22	4.80	36	14	53.16
OWOW99-0499	-94.6797	34.2803	BROKEN BOW L	OK	MCCURTAIN	5342	2	94	40	46.92	34	16	49.08
OWOW99-0544	-97.5291	34.9868		OK	MCCLAIN	12	2	97	31	44.76	34	59	12.48
OWOW99-0643	-95.3119	36.0564		OK	WAGONER	799	2	95	18	42.84	36	3	23.04
OWOW99-0644	-95.2973	35.4847		OK	MUSKOGEE	1	2	95	17	50.28	35	29	4.92
OWOW99-0669	-96.7935	36.6135		OK	OSAGE	2	2	96	47	36.60	36	36	48.60
OWOW99-0924	-96.2380	34.5780		OK	COAL	159	3	96	14	16.80	34	34	40.80
OWOW99-0944	-97.9921	35.5221		OK	CANADIAN	63	3	97	59	31.56	35	31	19.56
OWOW99-1023	-98.0545	34.3044		OK	STEPHENS	2076	3	98	3	16.20	34	18	15.84
OWOW99-1024	-95.1480	35.2651		OK	HASKELL	6	3	95	8	52.80	35	15	54.36
OWOW99-1069	-98.6438	35.4976		OK	CUSTER	4	3	98	38	37.68	35	29	51.36
OWOW99-1093	-95.1917	36.4339		OK	MAYES	8	3	95	11	30.12	36	26	2.04
OWOW99-1123	-96.5470	34.4187		OK	JOHNSTON	41	3	96	32	49.20	34	25	7.32
OWOW99-1423	-97.6357	34.5867		OK	STEPHENS	15	4	97	38	8.52	34	35	12.12
OWOW99-1468	-94.9559	35.7116	TENKILLER FERRY L	OK	CHEROKEE	5350	4	94	57	21.24	35	42	41.76
OWOW99-1469	-96.5172	35.1970		OK	SEMINOLE	145	4	96	31	1.92	35	11	49.20
OWOW99-1494	-99.3117	34.9257		OK	KIOWA	1810	4	99	18	42.12	34	55	32.52
OWOW99-1524	-94.8057	35.2691		OK	LE FLORE	1	4	94	48	20.52	35	16	8.76
OWOW99-1543	-95.6455	36.5462		OK	ROGERS	99	4	95	38	43.80	36	32	46.32
OWOW99-1544	-98.1776	36.7337		OK	ALFALFA	4041	4	98	10	39.36	36	44	1.32

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-0076	-123.2389	44.5527		OR	LINN	7	1	123	14	20.11	44	33	9.54
OWOW99-0101	-119.2216	43.4362		OR	HARNEY	57	1	119	13	17.87	43	26	10.28
OWOW99-0451	-122.0948	42.9494	Crater Lake	OR	KLAMATH	5318	2	122	5	41.10	42	56	57.84
OWOW99-0576	-119.1225	43.2360	Harney Lake	OR		9844	2	119	7	21.14	43	14	9.67
OWOW99-0629	-120.5315	45.7258	Lake Umatilla	OR	KLICKITAT	11698	2	120	31	53.54	45	43	32.92
OWOW99-0901	-122.1189	44.8230		OR	MARION	26	3	122	7	7.97	44	49	22.87
OWOW99-0929	-123.8054	46.1084		OR	CLATSOP	10	3	123	48	19.33	46	6	30.06
OWOW99-0976	-120.0245	42.1399		OR	LAKE	767	3	120	1	28.20	42	8	23.64
OWOW99-1001	-123.2441	43.3729		OR	DOUGLAS	6	3	123	14	38.72	43	22	22.48
OWOW99-1101	-120.2574	42.6017	Lake Abert	OR	LAKE	16397	3	120	15	26.60	42	36	6.08
OWOW99-1353	-117.3510	43.4992		OR	MALHEUR	4577	4	117	21	3.67	43	29	57.08
OWOW99-1401	-122.0095	42.2938		OR	KLAMATH	1498	4	122	0	34.13	42	17	37.82
OWOW99-1454	-123.3889	45.4452		OR	WASHINGTON	81	4	123	23	19.97	45	26	42.61
OWOW99-1501	-121.7221	43.6916		OR	DESCHUTES	4110	4	121	43	19.67	43	41	29.87
OWOW99-0039	-78.6659	41.1581	Lake Sabula	PA	CLEARFIELD	13	1	78	39	57.24	41	9	29.16
OWOW99-0089	-77.8121	39.9451	unnamed pond	PA	FRANKLIN	2	1	77	48	43.56	39	56	42.36
OWOW99-0188	-74.9514	41.2504	Pike Lake #3	PA	PIKE	6	1	74	57	5.04	41	15	1.44
OWOW99-0213	-76.3888	41.9443	unnamed pond	PA	BRADFORD	10	1	76	23	19.68	41	56	39.48
OWOW99-0489	-79.4857	40.6822	Crooked Creek Lake	PA	ARMSTRONG	151	2	79	29	8.52	40	40	55.92
OWOW99-0663	-76.2884	41.2899	Luzerne Lake #6	PA	LUZERNE	18	2	76	17	18.24	41	17	23.64
OWOW99-0988	-75.6005	40.5611	Lehigh Lake #7	PA	LEHIGH	2	3	75	36	1.80	40	33	39.96
OWOW99-1014	-80.4247	41.2928	Shenango River Reservoir	PA	MERCER	1491	3	80	25	28.92	41	17	34.08
OWOW99-1088	-75.2502	41.4692	Wayne-Whitney Lake	PA	WAYNE	46	3	75	15	0.72	41	28	9.12
OWOW99-1113	-76.7346	40.1593	York Haven Dam	PA	DAUPHIN	1596	3	76	44	4.56	40	9	33.48
OWOW99-1417	-71.5789	41.1687	Fresh Pond	RI	WASHINGTON	2526	4	71	34	44.04	41	10	7.32
OWOW99-1517	-71.4594	41.7052	Gorton Pond?	RI	KENT	22	4	71	27	33.84	41	42	18.72

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
								Deg	Min	Sec	Deg	Min	Sec
OWOW99-1567	-71.4065	41.9839	Arnolds Mills Reservoir	RI	PROVIDENCE	6	4	71	24	23.40	41	59	2.04
OWOW99-0012	-80.1384	34.5133		SC	CHESTERFIELD	3	1	80	8	18.24	34	30	47.88
OWOW99-0112	-79.1741	34.3024		SC	DILLON	159	1	79	10	26.76	34	18	8.64
OWOW99-0211	-80.9912	33.2641		SC	BAMBERG	37	1	80	59	28.32	33	15	50.76
OWOW99-0212	-80.9015	33.6414		SC	CALHOUN	18	1	80	54	5.40	33	38	29.04
OWOW99-0462	-80.1292	34.3049		SC	DARLINGTON	36	2	80	7	45.12	34	18	17.64
OWOW99-0536	-82.5805	34.6606		SC	ANDERSON	3	2	82	34	49.80	34	39	38.16
OWOW99-0662	-80.7032	34.3094		SC	KERSHAW	2	2	80	42	11.52	34	18	33.84
OWOW99-0936	-81.3848	33.6076		SC	AIKEN	18	3	81	23	5.28	33	36	27.36
OWOW99-0937	-80.2755	33.5042		SC	CLARENDON	3	3	80	16	31.80	33	30	15.12
OWOW99-0987	-81.4667	34.0877	L MURRAY	SC	NEWBERRY	19602	3	81	28	0.12	34	5	15.72
OWOW99-1061	-81.6083	33.8239		SC	AIKEN	6	3	81	36	29.88	33	49	26.04
OWOW99-1087	-81.6246	34.8750		SC	CHEROKEE	6	3	81	37	28.56	34	52	30.00
OWOW99-1412	-79.2482	33.3649		SC	GEORGETOWN	4	4	79	14	53.52	33	21	53.64
OWOW99-1486	-83.1017	34.5784	HARTWELL RES	SC	OCONEE	6881	4	83	6	6.12	34	34	42.24
OWOW99-1537	-81.9264	34.8039		SC	SPARTANBURG	3	4	81	55	35.04	34	48	14.04
OWOW99-1562	-80.8089	34.4193	Lake Wateree	SC	KERSHAW	5548	4	80	48	32.04	34	25	9.48
OWOW99-0007	-98.0560	43.7564		SD	DAVISON	284	1	98	3	21.60	43	45	23.04
OWOW99-0056	-102.2547	45.7699		SD	PERKINS	959	1	102	15	16.92	45	46	11.64
OWOW99-0107	-97.1801	44.8678		SD	CODINGTON	1124	1	97	10	48.36	44	52	4.08
OWOW99-0203	-101.3716	44.1562		SD	HAAKON	5	1	101	22	17.76	44	9	22.32
OWOW99-0206	-99.8458	45.7071		SD	CAMPBELL	6	1	99	50	44.88	45	42	25.56
OWOW99-0457	-96.4624	44.4955		SD	BROOKINGS	616	2	96	27	44.64	44	29	43.80
OWOW99-0531	-103.2273	45.1155		SD	BUTTE	4	2	103	13	38.28	45	6	55.80
OWOW99-0582	-97.5077	45.6993		SD	MARSHALL	83	2	97	30	27.72	45	41	57.48
OWOW99-0628	-103.8945	44.2735		SD	LAWRENCE	681	2	103	53	40.20	44	16	24.60

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-0631	-103.4072	45.8542		SD	HARDING	9	2	103	24	25.92	45	51	15.12
OWOW99-0653	-100.0315	43.3437		SD	TRIPP	3	2	100	1	53.40	43	20	37.32
OWOW99-0657	-99.3955	44.6185		SD	HYDE	3	2	99	23	43.80	44	37	6.60
OWOW99-0928	-103.4528	44.8720		SD	BUTTE	5	3	103	27	10.08	44	52	19.20
OWOW99-0931	-99.1439	45.9093		SD	MCPHERSON	129	3	99	8	38.04	45	54	33.48
OWOW99-0982	-101.0124	44.3660		SD	STANLEY	25	3	101	0	44.64	44	21	57.60
OWOW99-1007	-97.2311	45.1795		SD	DAY	83	3	97	13	51.96	45	10	46.20
OWOW99-1031	-98.2920	43.4149		SD	DOUGLAS	38	3	98	17	31.20	43	24	53.64
OWOW99-1056	-100.5331	44.8741	OAHE RES	SD	DEWEY	61520	3	100	31	59.16	44	52	26.76
OWOW99-1107	-97.5925	44.4791		SD	KINGSBURY	119	3	97	35	33.00	44	28	44.76
OWOW99-1407	-97.1505	44.1469		SD	LAKE	95	4	97	9	1.80	44	8	48.84
OWOW99-1453	-103.7237	45.0254		SD	BUTTE	7	4	103	43	25.32	45	1	31.44
OWOW99-1481	-102.1920	45.2425		SD	PERKINS	43	4	102	11	31.20	45	14	33.00
OWOW99-1507	-97.4514	45.3803		SD	DAY	940	4	97	27	5.04	45	22	49.08
OWOW99-1553	-103.4179	43.3078		SD	FALL RIVER	1742	4	103	25	4.44	43	18	28.08
OWOW99-1556	-97.2857	45.7157		SD	MARSHALL	54	4	97	17	8.52	45	42	56.52
OWOW99-1557	-99.7300	43.9121		SD	LYMAN	3	4	99	43	48.00	43	54	43.56
OWOW99-0087	-86.5603	36.0991	J PERCY PRIEST L	TN	DAVIDSON	5370	1	86	33	37.08	36	5	56.76
OWOW99-0187	-83.8330	36.3113	Norris Lake	TN	UNION	3749	1	83	49	58.80	36	18	40.68
OWOW99-0487	-85.2748	36.5651	Dale Hollow Lake	TN	CLAY	10726	2	85	16	29.28	36	33	54.36
OWOW99-0561	-88.4150	35.5581		TN	HENDERSON	184	2	88	24	54.00	35	33	29.16
OWOW99-0587	-86.7644	36.4128		TN	ROBERTSON	5	2	86	45	51.84	36	24	46.08
OWOW99-0597	-89.3677	35.2595		TN	FAYETTE	5	2	89	22	3.72	35	15	34.20
OWOW99-1036	-88.0792	36.4316	KENTUCKY L	TN	HENRY	46342	3	88	4	45.12	36	25	53.76
OWOW99-1086	-84.7785	35.6188		TN	MEIGS	2	3	84	46	42.60	35	37	7.68
OWOW99-1487	-83.3651	35.9973	DOUGLAS L	TN	JEFFERSON	11139	4	83	21	54.36	35	59	50.28

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
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OWOW99-1512	-86.4277	36.0389		TN	RUTHERFORD	714	4	86	25	39.72	36	2	20.04
OWOW99-1536	-84.2180	35.6086	Tellico Lake	TN	MONROE	6639	4	84	13	4.80	35	36	30.96
OWOW99-0020	-95.3874	30.1851	Rogers Lake	TX	MONTGOMERY	9	1	95	23	14.64	30	11	6.36
OWOW99-0021	-100.5777	31.9371	E V Spence Reservoir	TX	COKE	6055	1	100	34	39.72	31	56	13.56
OWOW99-0046	-97.4428	31.9740		TX	BOSQUE	2208	1	97	26	34.08	31	58	26.40
OWOW99-0048	-98.3790	33.7103	Lake Arrowhead	TX	CLAY	6561	1	98	22	44.40	33	42	37.08
OWOW99-0070	-98.0258	30.4154	Lake Travis	TX	TRAVIS	7240	1	98	1	32.88	30	24	55.44
OWOW99-0073	-94.6013	32.8300		TX	MARION	557	1	94	36	4.68	32	49	48.00
OWOW99-0096	-97.8593	32.0622	Flag Branch Lake	TX	BOSQUE	11	1	97	51	33.48	32	3	43.92
OWOW99-0120	-97.3485	26.2842	Unnamed lake	TX	CAMERON	35	1	97	20	54.60	26	17	3.12
OWOW99-0121	-99.2766	33.9259	Santa Rosa Lake	TX	WILBARGER	660	1	99	16	35.76	33	55	33.24
OWOW99-0123	-97.1985	33.0425		TX	DENTON	380	1	97	11	54.60	33	2	33.00
OWOW99-0145	-96.2522	29.4629		TX	WHARTON	2	1	96	15	7.92	29	27	46.44
OWOW99-0148	-94.7224	33.2888		TX	MORRIS	1239	1	94	43	20.64	33	17	19.68
OWOW99-0170	-100.9665	32.4319	Bullock Lake	TX	MITCHELL	2	1	100	57	59.40	32	25	54.84
OWOW99-0195	-94.9041	29.8449		TX	CHAMBERS	4	1	94	54	14.76	29	50	41.64
OWOW99-0196	-99.6494	28.9065		TX	ZAVALA	5	1	99	38	57.84	28	54	23.40
OWOW99-0198	-95.6121	33.4843		TX	LAMAR	6	1	95	36	43.56	33	29	3.48
OWOW99-0220	-95.6834	31.1694		TX	HOUSTON	23	1	95	41	0.24	31	10	9.84
OWOW99-0221	-97.9284	28.2013	Lake Corpus Christi	TX	LIVE OAK	7831	1	97	55	42.24	28	12	4.68
OWOW99-0223	-96.0107	32.9492	Lake Tawakoni	TX	HUNT	15333	1	96	0	38.52	32	56	57.12
OWOW99-0470	-98.1155	26.1452		TX	HIDALGO	8	2	98	6	55.80	26	8	42.72
OWOW99-0471	-99.5140	32.0370	Lake Coleman	TX	COLEMAN	705	2	99	30	50.40	32	2	13.20
OWOW99-0473	-96.7899	33.8561	L TEXOMA	TX	GRAYSON	23549	2	96	47	23.64	33	51	21.96
OWOW99-0495	-100.3492	34.4613	Lake Childress	TX	CHILDRESS	121	2	100	20	57.12	34	27	40.68
OWOW99-0496	-96.8272	32.0145	Unnamed lake	TX	NAVARRO	12	2	96	49	37.92	32	0	52.20

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
								Deg	Min	Sec	Deg	Min	Sec
OWOW99-0520	-96.0261	28.7684		TX	MATAGORDA	18	2	96	1	33.96	28	46	6.24
OWOW99-0524	-94.1918	30.8490	B A Steinhagen Lake	TX		5549	2	94	11	30.59	30	50	56.29
OWOW99-0545	-95.0674	29.5604	Clear Lake	TX	HARRIS	812	2	95	4	2.64	29	33	37.44
OWOW99-0548	-94.3946	32.2129	Shelby Lake	TX	PANOLA	5	2	94	23	40.56	32	12	46.44
OWOW99-0570	-98.2822	32.6120		TX	PALO PINTO	7	2	98	16	55.92	32	36	43.20
OWOW99-0573	-95.5984	33.8270	Lake Pat Mayse	TX	LAMAR	2390	2	95	35	54.24	33	49	37.20
OWOW99-0596	-99.0068	32.7753	HUBBARD CR RES	TX	STEPHENS	5960	2	99	0	24.48	32	46	31.08
OWOW99-0598	-96.6693	33.3078	ASCS Lake Riser 638	TX	COLLIN	7	2	96	40	9.48	33	18	28.08
OWOW99-0620	-98.3474	29.8943		TX	COMAL	19	2	98	20	50.64	29	53	39.48
OWOW99-0645	-97.6087	31.0062	Stillhouse Hollow Lake	TX	BELL	2664	2	97	36	31.32	31	0	22.32
OWOW99-0646	-98.4200	28.3815		TX	MCMULLEN	6	2	98	25	12.00	28	22	53.40
OWOW99-0648	-96.6480	32.6450		TX	DALLAS	6	2	96	38	52.80	32	38	42.00
OWOW99-0670	-94.8510	30.4974		TX	POLK	6	2	94	51	3.60	30	29	50.64
OWOW99-0671	-97.8103	28.1089		TX	SAN PATRICIO	7	2	97	48	37.08	28	6	32.04
OWOW99-0673	-95.4881	32.1860	L PALESTINE	TX	HENDERSON	9533	2	95	29	17.16	32	11	9.60
OWOW99-0920	-101.8108	35.4638		TX	POTTER	655	3	101	48	38.88	35	27	49.68
OWOW99-0921	-97.5738	31.1665	Lake Belton	TX	BELL	1052	3	97	34	25.68	31	9	59.40
OWOW99-0945	-95.9137	31.2285	Unnamed lake	TX	LEON	2	3	95	54	49.32	31	13	42.60
OWOW99-0946	-99.1748	27.9740		TX	WEBB	20	3	99	10	29.28	27	58	26.40
OWOW99-0948	-96.5444	33.1304	Lake Lavon	TX	COLLIN	81	3	96	32	39.84	33	7	49.44
OWOW99-0970	-96.6798	28.3294		TX	CALHOUN	2	3	96	40	47.28	28	19	45.84
OWOW99-0973	-94.3321	33.2844	Wright Patman Lake	TX	BOWIE	11360	3	94	19	55.56	33	17	3.84
OWOW99-0974	-94.1659	32.0277	Sabine River overflow	TX	PANOLA	5	3	94	9	57.24	32	1	39.72
OWOW99-0995	-96.2954	30.1495		TX	WASHINGTON	2	3	96	17	43.44	30	8	58.20
OWOW99-0996	-101.1158	30.1436		TX	VAL VERDE	51	3	101	6	56.88	30	8	36.96
OWOW99-0998	-96.0390	32.0818		TX	HENDERSON	10	3	96	2	20.40	32	4	54.48

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
								Deg	Min	Sec	Deg	Min	Sec
OWOW99-1021	-98.6771	33.3955		TX	YOUNG	9	3	98	40	37.56	33	23	43.80
OWOW99-1045	-98.5051	32.0189	Lake Proctor	TX	COMANCHE	1913	3	98	30	18.36	32	1	8.04
OWOW99-1049	-94.5522	31.5542		TX	NACOGDOCHES	3	3	94	33	7.92	31	33	15.12
OWOW99-1070	-95.3163	28.9617		TX	BRAZORIA	2	3	95	18	58.68	28	57	42.12
OWOW99-1071	-100.9560	29.6535		TX	VAL VERDE	588	3	100	57	21.60	29	39	12.60
OWOW99-1073	-95.5320	33.1012		TX	HOPKINS	5	3	95	31	55.20	33	6	4.32
OWOW99-1094	-101.6812	35.6553		TX	MOORE	593	3	101	40	52.32	35	39	19.08
OWOW99-1095	-98.0244	30.3621		TX	TRAVIS	225	3	98	1	27.84	30	21	43.56
OWOW99-1098	-95.5161	32.5682		TX	SMITH	6	3	95	30	57.96	32	34	5.52
OWOW99-1120	-97.8470	27.1988		TX	KENEDY	5	3	97	50	49.20	27	11	55.68
OWOW99-1121	-98.9015	33.7473		TX	ARCHER	3	3	98	54	5.40	33	44	50.28
OWOW99-1370	-96.8215	32.2412		TX	ELLIS	9	4	96	49	17.40	32	14	28.32
OWOW99-1373	-94.1256	32.7491	CADDO L	TX	MARION	10794	4	94	7	32.16	32	44	56.76
OWOW99-1395	-98.0162	28.9365		TX	KARNES	8	4	98	0	58.32	28	56	11.40
OWOW99-1399	-93.7712	31.5230	Toledo Bend Reservoir	TX	SABINE	67141	4	93	46	16.32	31	31	22.80
OWOW99-1420	-99.2401	26.8182		TX	ZAPATA	116	4	99	14	24.36	26	49	5.52
OWOW99-1421	-99.2335	31.3159		TX	MCCULLOCH	6	4	99	14	0.60	31	18	57.24
OWOW99-1446	-96.2172	31.9798	Richland Reservoir	TX		18124	4	96	13	1.92	31	58	47.14
OWOW99-1470	-96.5598	30.7472		TX	ROBERTSON	2	4	96	33	35.28	30	44	49.92
OWOW99-1471	-98.6921	28.6395		TX	ATASCOSA	1	4	98	41	31.56	28	38	22.20
OWOW99-1473	-96.9868	33.1494	Lake Lewisville	TX	DENTON	8590	4	96	59	12.48	33	8	57.84
OWOW99-1495	-95.5053	29.6160	What Is It Pond	TX	FORT BEND	1	4	95	30	19.08	29	36	57.60
OWOW99-1496	-100.1961	28.5733		TX	MAVERICK	3	4	100	11	45.96	28	34	23.88
OWOW99-1498	-96.3628	33.1896		TX	COLLIN	9	4	96	21	46.08	33	11	22.56
OWOW99-1521	-100.3713	33.0911		TX	STONEWALL	7	4	100	22	16.68	33	5	27.96
OWOW99-1523	-97.6110	33.4887		TX	MONTAGUE	5	4	97	36	39.60	33	29	19.32

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Min	Sec	Latitude Deg	Min	Sec
OWOW99-1545	-97.3344	30.0141		TX	BASTROP	4	4	97	20	3.84	30	0	50.76
OWOW99-1570	-95.5857	30.4678	Lake Conroe	TX	MONTGOMERY	8030	4	95	35	8.52	30	28	4.08
OWOW99-1571	-99.3188	26.9216	I N T E R N A T I O N A L FALCON RES	TX	ZAPATA	15802	4	99	19	7.68	26	55	17.76
OWOW99-1573	-95.5930	32.6230		TX	SMITH	3	4	95	35	34.80	32	37	22.80
OWOW99-0102	-113.7755	37.2618		UT	WASHINGTON	101	1	113	46	31.80	37	15	42.48
OWOW99-0144	-110.8572	37.3143		UT	KANE	912	1	110	51	25.92	37	18	51.48
OWOW99-0152	-110.2791	40.6966		UT	DUCHESNE	4	1	110	16	44.76	40	41	47.76
OWOW99-0526	-111.8377	39.0707		UT	SANPETE	15	2	111	50	15.72	39	4	14.52
OWOW99-0626	-112.6432	40.8812		UT	TOOELE	921	2	112	38	35.52	40	52	52.32
OWOW99-0927	-111.8883	41.8315		UT	CACHE	7	3	111	53	17.88	41	49	53.40
OWOW99-1027	-110.1109	40.7634		UT	DUCHESNE	10	3	110	6	39.24	40	45	48.24
OWOW99-1051	-111.1449	40.1871	Strawberry Reservoir	UT	WASATCH	3172	3	111	8	41.64	40	11	13.56
OWOW99-1352	-110.1033	40.3998		UT	DUCHESNE	2	4	110	6	11.88	40	23	59.28
OWOW99-1476	-111.8073	40.2025	Utah Lake	UT		0	4	111	48	26.21	40	12	8.86
OWOW99-0064	-77.8438	38.0644	Lake Anna	VA	LOUISA	5254	1	77	50	37.68	38	3	51.84
OWOW99-0090	-77.3122	37.9672	unnamed	VA	CAROLINE	11	1	77	18	43.92	37	58	1.92
OWOW99-0512	-79.0903	36.6820	Big Lake	VA	HALIFAX	10	2	79	5	25.08	36	40	55.20
OWOW99-0514	-78.5318	36.5703		VA	MECKLENBURG	10	2	78	31	54.48	36	34	13.08
OWOW99-0614	-77.3104	37.4233	Griggs Pond	VA	HENRICO	6	2	77	18	37.44	37	25	23.88
OWOW99-0914	-77.7039	38.8207	unnamed	VA	PRINCE WILLIAM	3	3	77	42	14.04	38	49	14.52
OWOW99-0964	-76.5704	36.8671	Lone Star Lake	VA	SUFFOLK	13	3	76	34	13.44	36	52	1.56
OWOW99-1039	-75.9664	37.4214		VA	NORTHAMPTON	628	3	75	57	59.04	37	25	17.04
OWOW99-1089	-78.9541	36.7873	Banister Lake	VA	HALIFAX	154	3	78	57	14.76	36	47	14.28
OWOW99-1364	-76.3460	37.0230		VA	HAMPTON	170	4	76	20	45.60	37	1	22.80
OWOW99-1462	-79.4531	36.7772	unnamed pond	VA	PITTSYLVANIA	1	4	79	27	11.16	36	46	37.92
OWOW99-1539	-77.6024	37.2620	Lake Chesdin	VA	CHESTERFIELD	1316	4	77	36	8.64	37	15	43.20

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
								Deg	Min	Sec	Deg	Min	Sec
OWOW99-0093	-72.8915	42.8282	Lake Whitingham	VT	WINDHAM	1565	1	72	53	29.40	42	49	41.52
OWOW99-0942	-72.0592	44.7480	Lake Willoughby	VT	ORLEANS	670	3	72	3	33.12	44	44	52.80
OWOW99-1042	-72.4259	43.6486	Lake Pinneo	VT	WINDSOR	7	3	72	25	33.24	43	38	54.96
OWOW99-1092	-73.2782	44.8277		VT	GRAND ISLE	3406	3	73	16	41.52	44	49	39.72
OWOW99-1467	-72.3081	44.8707	Kidder Pond	VT	ORLEANS	6	4	72	18	29.16	44	52	14.52
OWOW99-0004	-121.3595	47.3342	Keechelus Lake	WA	KITTITAS	955	1	121	21	34.06	47	20	2.94
OWOW99-0080	-117.5813	47.7677	Dry Lake	WA	SPOKANE	5	1	117	34	52.61	47	46	3.58
OWOW99-0154	-120.9586	48.5632	Unnamed/Vulcan	WA	SKAGIT	3	1	120	57	30.82	48	33	47.63
OWOW99-0179	-119.5883	46.9819	Frenchman Hills Lake	WA	GRANT	138	1	119	35	17.77	46	58	54.88
OWOW99-0202	-123.7674	48.0848	Cresent Lake	WA	CLALLAM	1995	1	123	46	2.71	48	5	5.32
OWOW99-0204	-122.8397	46.9928	unnamed	WA	THURSTON	6	1	122	50	22.88	46	59	34.19
OWOW99-0504	-120.3321	48.0261	Lake Chelan	WA	CHELAN	13091	2	120	19	55.38	48	1	33.96
OWOW99-0529	-121.1618	46.6403	Rimrock Lake	WA	YAKIMA	952	2	121	9	42.44	46	38	25.08
OWOW99-0654	-121.3833	47.5843	Lake Dorothy	WA	KING	102	2	121	22	59.88	47	35	3.41
OWOW99-0954	-119.4764	48.9145	Mud Lake	WA	OKANOGAN	4	3	119	28	34.97	48	54	52.24
OWOW99-0979	-122.4597	48.0215	Lone Lake	WA	ISLAND	34	3	122	27	34.81	48	1	17.47
OWOW99-1054	-119.3222	46.9868	Potholes Reservoir	WA	GRANT	11333	3	119	19	19.99	46	59	12.48
OWOW99-1354	-117.2925	48.4300		WA	PEND_OREILLE	936	4	117	17	33.07	48	25	48.00
OWOW99-1379	-118.8874	48.0631	Buffalo Lake	WA	OKANOGAN	226	4	118	53	14.50	48	3	47.02
OWOW99-1479	-118.9817	46.0048	Lake Wallula	WA	BENTON	12961	4	118	58	54.16	46	0	17.21
OWOW99-1554	-121.6659	47.6052	Calligan Lake	WA	KING	117	4	121	39	57.17	47	36	18.54
OWOW99-0008	-89.2323	44.0659	Irogami (Fish) Lake	WI	WAUSHARA	116	1	89	13	56.28	44	3	57.24
OWOW99-0058	-92.2221	45.7970	Warner Lake	WI	BURNETT	71	1	92	13	19.56	45	47	49.20
OWOW99-0059	-89.0859	46.0610	Noseeum Lake	WI	VILAS	5	1	89	5	9.24	46	3	39.60
OWOW99-0108	-92.6510	45.2943	Osceola Lake	WI	POLK	17	1	92	39	3.60	45	17	39.48
OWOW99-0133	-90.9843	45.8117	Lake Winter	WI	SAWYER	110	1	90	59	3.48	45	48	42.12

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude Deg	Longitude Min	Longitude Sec	Latitude Deg	Latitude Min	Latitude Sec
OWOW99-0134	-89.5894	45.8619	Sweeney Lake	WI	ONEIDA	78	1	89	35	21.84	45	51	42.84
OWOW99-0158	-90.5273	46.2912	Maki Lake	WI	IRON	17	1	90	31	38.28	46	17	28.32
OWOW99-0208	-89.6991	44.8103	L DUBAY/Big Eau Pleine Res	WI	MARATHON	5356	1	89	41	56.76	44	48	37.08
OWOW99-0458	-89.9860	43.9352	Castle Lake	WI	JUNEAU	5010	2	89	59	9.60	43	56	6.72
OWOW99-0508	-89.5351	45.6967	Bob's Lake	WI	ONEIDA	8	2	89	32	6.36	45	41	48.12
OWOW99-0533	-91.5771	45.7591	unnamed	WI	WASHBURN	4	2	91	34	37.56	45	45	32.76
OWOW99-0565	-91.1565	43.3500		WI	CRAWFORD	59	2	91	9	23.40	43	21	0.00
OWOW99-0608	-90.1691	46.0857	Turtle Flambeau Flowage	WI		0	2	90	10	8.72	46	5	8.52
OWOW99-0658	-89.6562	45.2854	Black Alder Lake	WI	LINCOLN	5	2	89	39	22.32	45	17	7.44
OWOW99-0666	-88.4157	44.0020	Lake Winnebago	WI	WINNEBAGO	53757	2	88	24	56.52	44	0	7.20
OWOW99-0958	-91.3394	46.1505	Pacwawong Lake	WI	SAWYER	76	3	91	20	21.84	46	9	1.80
OWOW99-0959	-89.3112	45.8418	Bog Lake	WI	ONEIDA	20	3	89	18	40.32	45	50	30.48
OWOW99-0983	-89.1146	44.5307	Hatch Lake	WI	WAUPACA	46	3	89	6	52.56	44	31	50.52
OWOW99-0991	-89.0375	43.9647	unnamed	WI	GREEN LAKE	7	3	89	2	15.00	43	57	52.92
OWOW99-1033	-91.2826	46.3544	Flynn Lake	WI	BAYFIELD	27	3	91	16	57.36	46	21	15.84
OWOW99-1058	-91.8659	45.4135	Yellow River Reservoir	WI	BARRON	21	3	91	51	57.24	45	24	48.60
OWOW99-1059	-89.1653	45.5817	Mars (Sequilla) Lake	WI	ONEIDA	16	3	89	9	55.08	45	34	54.12
OWOW99-1083	-92.3092	45.6438	Crooked Lake	WI	POLK	8	3	92	18	33.12	45	38	37.68
OWOW99-1084	-89.5527	46.1376	Big Gibson Lake	WI	VILAS	48	3	89	33	9.72	46	8	15.36
OWOW99-1108	-91.3828	45.2325	Calkins North Lake	WI	CHIPPEWA	5	3	91	22	58.08	45	13	57.00
OWOW99-1365	-90.8791	43.1321	unnamed	WI	CRAWFORD	5	4	90	52	44.76	43	7	55.56
OWOW99-1383	-89.8021	45.9586	Bolton Lake	WI	VILAS	57	4	89	48	7.56	45	57	30.96
OWOW99-1408	-90.4251	44.1284	Unnamed l	WI	MONROE	6	4	90	25	30.36	44	7	42.24
OWOW99-1433	-92.6653	45.4906	Beede Lake	WI	POLK	2	4	92	39	55.08	45	29	26.16

OWOW99 Site-ID	Long. DD	Lat. DD	Lake Name	St.	County	Lake Area (ha)	Yr.	Longitude			Latitude		
								Deg	Min	Sec	Deg	Min	Sec
OWOW99-1483	-92.2409	45.9427	Upper Loon Lake (Phernetton)	WI	BURNETT	24	4	92	14	27.24	45	56	33.72
OWOW99-1484	-88.2877	45.2655	Mirror Lake	WI	MARINETTE	4	4	88	17	15.72	45	15	55.80
OWOW99-1533	-91.2291	45.5345		WI	RUSK	1617	4	91	13	44.76	45	32	4.20
OWOW99-1558	-88.8840	45.1419	McGee Lake	WI	LANGLADE	8	4	88	53	2.40	45	8	30.84
OWOW99-1566	-88.3072	43.0729	Pewaukee Lake	WI	WAUKESHA	985	4	88	18	25.92	43	4	22.44
OWOW99-0637	-80.8542	38.2409	Summersville Lake	WV	NICHOLAS	844	2	80	51	15.12	38	14	27.24
OWOW99-0052	-109.3330	43.0084		WY	FREMONT	4	1	109	19	58.80	43	0	30.24
OWOW99-0502	-106.9291	42.6746		WY	NATRONA	1	2	106	55	44.76	42	40	28.56
OWOW99-0527	-109.3050	42.8726		WY	FREMONT	73	2	109	18	18.00	42	52	21.36
OWOW99-0528	-109.2586	44.4925		WY	PARK	1385	2	109	15	30.96	44	29	33.00
OWOW99-0602	-110.6277	44.2998		WY	TETON	1116	2	110	37	39.72	44	17	59.28
OWOW99-1052	-110.3633	43.4642		WY	TETON	35	3	110	21	47.88	43	27	51.12
OWOW99-1053	-106.2468	43.1947		WY	NATRONA	24	3	106	14	48.48	43	11	40.92
OWOW99-1077	-109.6685	43.3312		WY	FREMONT	40	3	109	40	6.60	43	19	52.32
OWOW99-1078	-110.3662	44.4549	Yellowstone Lake	WY		0	3	110	21	58.43	44	27	17.53
OWOW99-1377	-106.2790	41.3601		WY	ALBANY	5	4	106	16	44.40	41	21	36.36
OWOW99-1477	-109.3615	42.8049		WY	SUBLETTE	3	4	109	21	41.40	42	48	17.64
OWOW99-1478	-106.7534	44.4843		WY	JOHNSON	821	4	106	45	12.24	44	29	3.48
OWOW99-1503	-106.1244	42.7497		WY	NATRONA	8	4	106	7	27.84	42	44	58.92
OWOW99-1527	-110.8467	43.8054		WY	TETON	4	4	110	50	48.12	43	48	19.44

Appendix B

Standard Operating Procedure:
Fish Tissue Sample Collection Procedures for a National Study of Chemical Residues in Lake Fish Tissue

Standard Operating Procedure

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Fish Tissue Sample Collection Procedures for a National Study of Chemical Residues in Lake Fish Tissue

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Scope and Applicability: This Standard Operating Procedure (SOP) must be followed by all Field Sample Collection Teams involved with the USEPA Office of Water's National Study of Chemical Residues in Lake Fish Tissue. Adherence to the SOP will ensure that field sampling activities will be performed the same way every time, i.e., are standardized, for all sampling participants.

Fish tissue sample collection procedures are presented below as sequential steps, and include specific equipment, materials, and methods required to perform field sampling activities only.

Responsibility and Personnel Qualifications: This procedure may be used by any Field Sampling Teams that have been authorized by the USEPA Project Manager or the USEPA Regional/State/ Tribal Fish Sampling Coordinators to collect fish for the National Study of Chemical Residues in Lake Fish Tissue.

References:

U.S. Environmental Protection Agency (USEPA). 1995. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 1: Fish Sampling and Analysis. Second Edition. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA 823-R-95-007.

U.S. Environmental Protection Agency (USEPA). 1997. Quality Assurance Project Plan for the Cook Inlet Contaminant Study Sampling. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D.C.

U.S. Environmental Protection Agency (USEPA). 1997. Sampling Plan for Conducting Field Sampling and Chemical Analysis for the Cook Inlet Contaminant Study. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D.C.

U.S. Environmental Protection Agency (USEPA). 1999a. EPA Requirements for Quality Assurance Project Plans. U.S. Environmental Protection Agency, Quality Assurance Division, Washington, D.C. Interim Final. EPA QA/R-5.

U.S. Environmental Protection Agency (USEPA). 1999b. National Study of Chemical Residues in Lake Fish Tissue: Study Design. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D.C.

Precautions: Follow usual safety precautions for working in the field. Boats and/or electrofishing equipment should only be operated by qualified, experienced operators trained in their proper use. Each vessel must be equipped with the appropriate Coast Guard-required safety equipment (including personal floatation devices for each field team member). If electrofishing equipment is used for sample collection, each team member must be insulated from the water, boat, and electrodes via rubber boots and gloves.

Equipment/Materials:

Sampling vessel (including boat, motor, trailer, oars, gas, and all required safety equipment)[a]

Electrofishing equipment - OPTIONAL (including variable voltage pulsator unit, generator, electrodes, wiring cables, dip nets, protective gloves, protective boots, and all necessary safety equipment)[a]

Nets - OPTIONAL (including trawls, seines, gill nets, fyke nets, trammel nets, hoop nets, pound nets, trap nets)[a]

Angling equipment - OPTIONAL (including fishing rods, reels, line, terminal tackle, trot lines)[a]

Coast Guard-approved personal floatation devices

Maps of target lakes and access routes

Global Positioning System (GPS) unit - OPTIONAL [a]

pH meter (including associated calibration supplies) [a]

Livewell and/or buckets

Measuring board (millimeter scale)

Ice chests[b]

Aluminum foil (solvent-rinsed and baked)[b]

Heavy-duty food grade polyethylene tubing[b]

Large plastic (composite) bags[b]

Knife or scissors

Clean nitrile gloves[b]

Field Record Forms[b]

Sample Identification Labels[b]

Chain-of-Custody Forms[b]

Chain-of-Custody Labels[b]

Scientific collection permit

Dry Ice[b]

Black ballpoint pens and/or waterproof markers

Clipboard

Packing/strapping tape

Overnight courier airbills[b]

Plastic cable ties[b]

Plastic bubble-wrap[b]

First aid kit and emergency telephone numbers

[a] Selection and exact specifications at the discretion of the experienced on-site fisheries biologist.

[b] Provided by the sample control center.

Procedures:

1. Identify the target lake to be sampled using the USEPA Office of Water's Target Lake List. Locate the target lake via the coordinates provided in the Target Lake List and USGS topographic maps (or equivalent maps).

2. Based on site reconnaissance, determine whether the target lake meets the definition of a suitable lake for sampling for the purposes of this study, i.e., each lake must:

   - be a permanent body of water of at least one hectare in surface area,
   - have a minimum of 1,000 m^2 of open (unvegetated) water,
   - be greater than 1 meter deep, and
   - have a permanent fish population (e.g., no annual winterkill, not recently stocked with young fish).

   If the target lake meets all of the above criteria, and if in the case of private property, the landowner allows access/permission to sample the lake, proceed with Step 3. If the lake does not meet the definition of a lake and/or if a private landowner denies access, record the problem and contact the USEPA Project Manager and/or the Tetra Tech Task Leader.

3. Assemble an array of both active and passive gear types, to ensure the collection of the desired target numbers and species of fish. Selection of the most appropriate gear type(s) for a particular target lake will be at the discretion of the experienced on-site fisheries biologist. Detailed procedures for use or deployment of all possible gear types are not included here. However, if passive collection devices (e.g., gill nets) are used, they must be checked frequently (e.g., several times daily if possible, but at least every 24 hours) to ensure a limited time lag between fish entrapment and sample preparation. Sampling Teams must be qualified, experienced, and/or trained on the safe and effective use of each gear type selected.

4. Sampling gear will be selected and deployed to obtain samples of both predator species and bottom-dwelling species. Suggested target species, listed in order of preference, are as follows:

	Family name	Common name	Scientific name
Predator/Gamefish Species ***(in order of preference)***	*Centrarchidae*	Largemouth bass	*Micropterus salmoides*
		Smallmouth bass	*Micropterus dolomieu*
		Black crappie	*Pomoxis nigromaculatus*
		White crappie	*Pomoxis annularis*
	Percidae	Walleye	*Stizostedion vitreum*
		Yellow perch	*Perca flavescens*
	Percichthyidae	White bass	*Morone chrysops*
	Esocidae	Northern pike	*Esox lucius*
	Salmonidae	Lake trout	*Salvelinus namaycush*
		Brown trout	*Salmo trutta*
		Rainbow trout	*Oncorhynchus mykiss*
		Brook trout	*Salvelinus fontinalis*
Bottom-dwelling Species ***(in order of preference)***	*Cyprinidae*	Common carp	*Cyprinus carpio*
	Ictaluridae	Channel catfish	*Ictalurus punctatus*
		Blue catfish	*Ictalurus furcatus*
		Brown bullhead	*Ameiurus nebulosus*
		Yellow bullhead	*Ameiurus natalis*
	Catostomidae	White sucker	*Catostomus commersoni*

5. As soon as fish have been obtained via active collection methods (or removed from passive collection devices) they must be identified to species. Clean nitrile gloves must be worn during the sample handling process. Potential target species/individuals will be rinsed in ambient water to remove any foreign material from the external surface and placed in clean holding containers (e.g., livewells, buckets). Nontarget fishes or small specimens are returned to the lake.

6. One predator and one bottom-dwelling species composite will be retained from each target lake. Each composite must consist of five fish of adequate size (i.e., 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) for analysis. Select fish for each composite based on the following criteria:

   - all are of the same species,
   - all satisfy legal requirements of harvestable size (or weight), or at least be of consumable size if no legal harvest requirements are in effect,
   - all are of similar size, so that the smallest individual in a composite is no less than 75% of the total length of the largest individual, and

- all are collected at the same time, i.e., collected as close to the same time as possible, but no more than one week apart (Note: Individual fish may have to be frozen until all fish to be included in the composite are available for delivery to the sample preparation laboratory).

Accurate taxonomic identification is essential in assuring and defining the organisms that have been composited and submitted for analysis. Under no circumstances should individuals from different species be used in a single composite sample.

7. Following selection of five fish for each of the two composites that meet the above-listed criteria for compositing, measure each to determine total body length. Measure total length of each specimen in millimeters, from the anterior-most part of the fish to the tip of the longest caudal finray (when the lobes of the caudal fin are depressed dorsoventrally).

8. Record species retained, specimen length, location collected and sampling date and time on the Field Record Form (Figure 1) in black ink. Complete site location description portions of the form, and draw a simple sketch of the sampling area in the space provided. One Field Record Form will be completed for each composite collected from the target lake.

9. Assign the unique ten-character composite sample ID number to each composite as directed on the Field Record Form (Figure 1):

   - state of collection (two-character abbreviation),
   - year of collection (two-number abbreviation),
   - lake identification number (four-digit code from Appendix A),
   - composite type (one character -- P = predator species; B = bottom-dwelling species), and
   - sample type (one character -- S = standard sample; D = duplicate sample).

10. Sign and date the Field Record Form.

11. Remove each fish retained for analysis from the clean holding container(s) (e.g., livewell) using clean nitrile gloves. Dispatch each fish using a clean wooden bat (or equivalent wooden device).

12. Wrap each fish in extra heavy-duty aluminum foil (provided by the sample control center as solvent-rinsed, oven-baked sheets).

13. Prepare a Sample Identification Label (Figure 2) (in black ink) for each sample, ensuring that the label information matches the information recorded on the Field Record Form.

14. Cut a length of food grade tubing (provided by sample control center) that is long enough to

contain each individual fish and to allow extra length on each end to secure with cable ties. Place each foil-wrapped specimen into the appropriate length of tubing. Seal each end of the tubing with a plastic cable tie, and attach the appropriate Sample Identification Label.

15. Double-bag each entire specimen package, that is, place inside a large plastic bag with all specimens of the same species from that site and seal with another cable tie.

16. As soon as each sample is packaged, place it immediately on dry ice for shipment. If samples will be carried back to a laboratory or other facility to be frozen before shipment, wet ice can be used to transport wrapped and bagged fish samples in the coolers to a laboratory or other interim facility.

17. If possible, keep all (five) specimens designated for a particular composite in the same shipping container (ice chest) for transport.

18. Samples may be stored on dry ice for a maximum of 24 hours. Sampling teams have the option, depending on site logistics, of:

    - shipping the samples packed on dry ice in sufficient quantities to keep samples frozen for up to 48 hours, via priority overnight delivery service (e.g., Federal Express), so that they arrive at the sample preparation laboratory within less than 24 hours from the time of sample collection, or

    - freezing the samples within 24 hours of collection at ≤-20°C, and storing the frozen samples until shipment within 1 week of sample collection (frozen samples will subsequently be packed on dry ice and shipped to the sample preparation laboratory via priority overnight delivery service).

19. Complete a Chain-of-Custody Form (Figure 3). All entries must be in black ink and coincide with specimen/sample information on the Sample Identification Labels and Field Record Forms.

20. Retain one copy of the Chain-of-Custody Form and Field Record Form, place and seal all other copies in a waterproof bag, and enclose the sealed forms in the shipping container (ice chest).

21. Pack each shipping container (completely) with dry ice, secure each container with packaging tape, and seal it (e.g., across the latch of the ice chest) with a Chain-of-Custody Label (provided by the sample control center). Include the signature of the sampler and the date/time sealed (in black ink) on each Chain-of-Custody Label.

22. Ship each container to the laboratory via priority overnight express delivery service, as directed by the USEPA Project Manager or Tetra Tech Task Leader. Monitor sample holding time, and factor time required for shipment/delivery to ensure that the preservation and holding criteria described in Step 18 have been met.

Figure 1. Field record for fish samples

Field Record for National Study of Chemical Residues in Lake Fish Tissue

Composite Sample ID: ___ ___ (State) ___ ___ (Year) ___ ___ ___ ___ (Lake ID Number) ___ (Composite type P=predator or B=bottom-dweller) ___ (Sample type S=standard or D=duplicate)

Sampling Date : ______________________

Collection Method(s): ______________________

Collector Name (print and sign): ______________________

Affiliation: ______________________ Phone: ______________

Address: ______________________

Site Location County: ______________

Latitude: ______________ Longitude: ______________

Site Name: ______________________

Site Description: ______________________

Circle one: natural lake, modified natural lake, human-made reservoir, other ______________

Estimated maximum lake depth ______ meters

pH surface ______ mid (optional) ______ bottom (optional) ______

Sample Description

Fish Species: ______________________ Total Number of Individuals: ______________

Specimen #	Length (mm)*	Location	Date/Time	Notes
01				
02				
03				
04				
05				

Additional Comments:

*minimum individual size should be no less than 75% maximum individual size

Sampling Site Diagram

FORM DISTRIBUTION: White -- Tetra Tech Task Leader Yellow & Pink -- Sample Prep Lab Gold -- Sampler

EPA Sample Number (*to be assigned by Prep Lab*): ___ ___ ___ ___ ___

Figure 2. Sample identification label[a].

Project Name	Date
Site Identification	Time
Specimen #	Preservative
Composite Sample ID #	Collected by

[a] See Appendix D for key to complete Sample Identification Label.

Figure 3. Chain-of-Custody Form.

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CHAIN-OF-CUSTODY RECORD

Project Manager or Client Contact:

Address/Phone:

Contact Name/Phone:

Project Number: Project Name:

Page of Sample Location:

Type of Analyses Requested

Shaded area for Tt use only:

Sample check-in:
DO ______
T ______
pH ______
Cond/Salinity ______
Chlorine ______
Appearance ______
____
____

Date	Time	Sample Identification/Station	Preservative (Y/N)	Number of Containers									Collection Method	Log Number

Sampled by: *(signature)*	Date/Time:	Relinquished by: *(signature)*	Date/Time:	Received by: *(signature)*	Date/Time:
Received by: *(signature)*	Date/Time:	Received by: *(signature)*	Date/Time:	Received by: *(signature)*	Date/Time:

FORM DISTRIBUTION: White - Tt BRF Yellow - Report Pink - Sampler

reproduced electronically

Appendix C

Standard Operating Procedure: pH Measurements

Standard Operating Procedure

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pH Measurement Procedures for a National Study of Chemical Residues in Lake Fish Tissue

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Scope and Applicability: This Standard Operating Procedure (SOP) must be followed by all Field Sample Collection Teams involved with the USEPA Office of Water's National Study of Chemical Residues in Lake Fish Tissue. Adherence to the SOP will ensure that field pH measurements will be performed the same way every time, i.e., are standardized, for all sampling participants.

Procedures for field pH measurement are presented as sequential steps in the SOP to follow, and include equipment, materials, and methods required to perform field measurements only.

Responsibility and Personnel Qualifications: This procedure may be used by any Field Sampling Teams that have been authorized by the USEPA Project Manager or the USEPA Regional/State/ Tribal Fish Sampling Coordinators to collect fish for the National Study of Chemical Residues in Lake Fish Tissue.

References: American Public Health Association (APHA). 1995. Part 4500 — H^+: pH Value. Pages 4-65 - 4-69 in APHA. Standard Methods for the Examination of Water and Wastewater. APHA, Washington, D.C.

Precautions: Follow usual safety precautions for working in the field. Boats should only be operated by qualified, experienced operators trained in their proper use. Each vessel must be equipped with the appropriate Coast Guard-required safety equipment (including personal floatation devices for each field team member). Caution must be used when deploying pH probes overboard, and deployment should only occur when vessels are stable and not under power.

Equipment/Materials:

Sampling vessel (including boat, motor, trailer, oars, gas, and all required safety equipment)[a]

Coast Guard-approved personal floatation devices

Maps of target lakes and access routes

Field Record Forms[b]

Clipboard

pH meter with pH electrode/probe[a]

Standard buffer solutions (pH 4, 7, and 10)

Calibration cup or beaker

Distilled water

Calibration log book[a]

(a) Selection and exact specifications at the discretion of the experienced on-site fisheries biologist.

(b) Provided by the sample control center.

Procedures:

GENERAL

Procedures provided herein focus on pH probe deployment and pH measurement, not specific component assembly or operation since selection of a particular meter for use is at the discretion of the individual field teams. Field teams are urged to read, understand, and follow the manufacturer's instructions for their pH meter of choice for this study.

CALIBRATION

1. Prior to deployment (i.e., at a minimum once daily during field use), the pH meter must be calibrated as per manufacturer's specifications. Calibration procedures presented here are generalized and are not water-specific.

2. Rinse the calibration cup (or beaker) and pH sensor with distilled, deionized water.

3. Pour off the deionized water and fill the calibration cup with pH 4.0 buffer solution, making sure that the pH sensor is completely immersed in buffer solution.

4. Turn the meter display on and monitor pH. When the pH reading has stabilized to a consistent value, note the reading in a calibration log book or field notebook.

5. If the displayed value is different from the buffer/standard, adjust the meter (e.g., via a calibration setting) to match the buffer value. Record the final calibrated pH reading (which must match the buffer value) in the calibration log book.

6. Decant the 4.0 buffer solution from the calibration cup, and rinse the pH sensor and calibration cup with distilled water.

7. Fill the calibration cup with 7.0 buffer solution and repeat Steps 4 through 5.

8. Decant the pH 7.0 buffer solution and rinse the pH sensor and calibration cup with distilled water. Fill the calibration cup with pH 10.0 buffer solution and repeat Steps 4 through 5.

9. Decant the buffer solution and rinse the pH sensor with distilled water.

10. Once the meter is successfully calibrated, lake pH can be measured. Water sample temperature must be similar in temperature to that of the calibration standards (or use and adjust the temperature compensation feature of the meter).

DEPLOYMENT AND SAMPLE MEASUREMENT

11. Deploy the pH sensor by gently lowering the probe into the water. Be sure that the sensor is completely immersed.

    Specific deployment and measurement instructions for the National Fish Tissue Study requires only one measurement location (with an optional vertical profile) per target lake, and are as follows:

    a. In waters < 2 meters deep, measure pH at approximately 30 cm (approximately 1 ft) below the surface.

    b. In waters ≥ 2 meters deep, measure pH at approximately 30 cm below the surface, at mid-depth, and at 30 cm above lake bottom substrates; ***however*** if multiple measurements or vertical profiles are not feasible (e.g., due to lake depth, meter probe cord length, etc.), record a single measurement at 30 cm below the surface.

12. When the pH reading has stabilized to a consistent value, record the reading on the Field Record Form (provided by the sample control center) to the nearest 0.1 unit.

13. Repeat Step 12 for mid-depth and near bottom measurements, as appropriate and if feasible (refer to Step 11).

14. Follow manufacturer's instructions for pH meter and electrode storage and maintenance.

Appendix D

Field Data Element Dictionary

Field Data Element Definitions and Instructions
Associated with Field Sample Collection Activities for the National Study of Chemical Residues in Lake Fish Tissue

Element

Affiliation: The **Affiliation** field (on the Field Record Form) contains the agency, group, or company name of those persons conducting the field effort.

Collected by: The **Collected by** field on the Sample Identification Label is synonymous with the **Collector Name** field on the Field Record Form, and contains the name of the Field Team Leader.

Collection Method: The **Collection Method** field on the Field Record Form contains the listing of sampling gear types used to collect samples.

Collector Name: The **Collector Name** field on the Field Record Form is synonymous with the **Collected by** field on the Sample Identification Label, and contains the name of the Field Team Leader.

Composite Sample ID: The **Composite Sample ID** field on the Field Record Form and the Sample Identification Label is composed of a ten-character code including state of collection (two-character abbreviation), year of collection (two-number abbreviation), lake identification number (four-digit USEPA code), composite type (one character -- P = predator species, B = bottom-dwelling species), and qualifier for standard or duplicate composite samples (one character -- S = standard sample, D = duplicate sample).

EPA Sample Number: Please leave this space blank on the Field Record Form. The **EPA Sample Number** is an analytical tracking number that will be assigned by the sample preparation laboratory to each individual aliquot of fish tissue prepared for analysis.

Estimated Maximum Lake Depth: The **Estimated Maximum Lake Depth** field on the Field Record Form stores a depth estimate in meters for the deepest portion of the target lake. Estimates will be made by the Field Team and may be based on sources such as lake maps, depth sounder readings, anchor line lengths, etc.

Fish Species: The **Fish Species** field on the Field Record Form stores the common name of the fish retained for analysis. Scientific name entries are optional.

Length: The **Length** field on the Field Record Form contains the individual Total Length (in millimeters) of each fish retained for analysis. Total length of each specimen is measured from the anterior-most part of the fish to the tip of the longest caudal finray (when the lobes of the caudal fin are depressed dorsoventrally) and recorded to the nearest mm.

Location: The **Location** field on the Field Record Form stores a brief description of the area in the lake where each fish was collected.

Preservative: The **Preservative** field on the Sample Identification Label stores information on how the samples were preserved for shipment, i.e., either on dry ice or frozen.

Project Name: The **Project Name** field on the Sample Identification Label contains the designation "USEPA National Fish Tissue Study".

Sampling Date: The **Sampling Date** field on the Field Record Form and Sample Identification Label stores the numerical month/date/year (e.g., 10/02/99) of sample collection.

Site Description: The **Site Description** field on the Field Record Form contains a brief written description of the location of the lake (e.g., road or town landmarks) and area of lake sampled (e.g., east portion of the lake).

Site Identification: The **Site Identification** field on the Sample Identification Label is synonymous with the **Site Name** field on the Field Record Form, and contains the lake name.

Site Name: The **Site Name** field on the Field Record Form is synonymous with the **Site Identification** field on the Sample Identification Label and contains the lake name.

Specimen #: The **Specimen #** field on the Field Record Form and the Sample Identification Label consists of a two-digit number from 01 through 05.

Time: The **Time** field on the Sample Identification Label and Field Record Form stores time of sample collection recorded in military time (i.e., four digits). Time fields on the Field Record Form include collection times for each individual specimen.