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EE/CA and RI/FS Support Sampling Plan

Sauget Area 1

Sauget and Cahokia, Illinois

Volume 3

Ecological Sampling

FSP, QAPP and HASP

June 25, 1999

Submitted To:

U.S. Environmental Protection Agency
Chicago, Illinois

Submitted By:

Solutia Inc.
St. Louis, Missouri

Ecological Risk Assessment
Quality Assurance Project Plan
Field Sampling Plan
For Sauget Area 1

Prepared for:
Solutia, Inc.
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Prepared by:
Menzie-Cura and Associates, Inc.

August 11, 1999

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LIST OF ACRONYMS/ABBREVIATIONS

BCOMM	Benthic Community
BSAFs	Biota Sediment Accumulation Factors
CLP	Contract Laboratory Program
COC	Chain-of-Custody
CRDL	Contract Required Detection Limits
CVAA	Cold Vapor Atomic Absorption Spectrometry
DQO	Data Quality Objective
EE/CA	Engineering Evaluation and Cost Analysis
ERA	Ecological Risk Assessment
FSP	Field Sampling Plan
FD	Field Duplicate
GFAA	Graphite Furnace Atomic Absorption Spectroscopy
GPC	Gel Permeation Chromatography
GPS	Geographical Positioning System
HASP	Health and Safety Plan
HHRA	Human Health Risk Assessment
ICP	Indutively Coupled Plasma Spectroscopy
IEPA	Illinois Environmental Protection Agency
LCS	Laboratory Control Sample
LMB	Large Mouth Bass
MD	Matrix Duplicate
MDLs	Method Detection Limits
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NIST	National Institute of Standards and Testing
PRPs	Potentially Responsible Parties
PCBs	Polychlorinated Biphenyl Compounds
PAHs	Polynuclear Aromatic Hydrocarbons
PQLs	Practical Quantitation Limits
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RI/FS	Remedial Investigation/Feasibility Study
RL	Reporting Limit
RPD	Relative Percent Difference
RPM	Remedial Project Manager
SOP	Standard Operating Procedure

LIST OF ACRONYMS/ABBREVIATIONS

SRM	Standard Reference Material
SSP	Support Sampling Plan
Survey	Reconnaissance Survey
SVOCs	Semivolatile Organic Compounds
SW846	Test Methods for Evaluating Solid Waste, USEPA, Third Edition, Final Update, December 1996
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds

1.0 PROJECT DESCRIPTION

This Quality Assurance Project Plan (QAPP)/Field Sampling Plan (FSP) describes the sampling and analysis activities and the quality assurance procedures to generate valid and usable data from biota samples in support of the Ecological Risk Assessment at Sauget Area 1, St. Clair County, Illinois. The Ecological Risk Assessment is a part of the environmental investigations that will be carried out under the EE/CA and RI/FS under the direction of the Illinois Environmental Protection Agency. Further Site details and investigations are described in the Support Sampling Plan (SSP) included in Volume 1.

1.1 Site History and Background Information

The Sauget Area 1 site is located in the Villages of Sauget and Cahokia, St. Clair County, Illinois. For prior environmental investigations, Sauget Area 1 was divided into six creek sectors (CS-A through CS-F) and six-source area sites (Sites G,H, I, L, M and N). Dead Creek is an intermittent stream, which was formerly used, in the early part of the 1900s for waste disposal. Sites G, H, and I are inactive landfills or former disposal areas adjacent to Dead Creek. Site L is a former surface impoundment and sites M and N are former sandpits.

See associated Work Plans in Volume 1 for site's physical features, population and land use, geology and soil, groundwater resources and surface hydrology and drainage.

1.2 Past Data Collection Activity/Current Status

The Sauget Area 1 site has been subject to a number of investigations by Illinois Environmental Protection Agency and individual PRPs. Soil and sediment samples collected from the landfills and Dead Creek contained polychlorinated biphenyl compounds (PCBs), volatile organic compounds (VOCs) including chlorobenzenes and semivolatile organic compounds (SVOCs) including chloroanilines, chlorophenols, and nitroanilines.

Surface waters were found to contain VOCs including chlorinated solvents, PCBs, SVOCs including polynuclear aromatic hydrocarbons (PAHs), chlorophenols, nitroanilines, and metals including cadmium, cobalt, copper, lead, mercury, nickel, and zinc.

Segment A of Dead Creek was remediated by a PRP in 1990 under a Consent Decree with IEPA. Over 22,000 cubic yards of contaminated creek sediment was removed. In 1995, USEPA conducted an investigation of the Site G landfill and surrounding area, after which USEPA consolidated the waste on-site and placed a soil-cap over the landfill. In 1997, USEPA conducted a Preliminary Ecological Risk Assessment on Segment F of Dead Creek.

A description of data already available will be prepared as part of the report for this investigation (see Section 2.0 of Support Sampling Plan). Procedures to generate data usable for the Ecological Risk Assessment are described in the associated Ecological Risk Assessment Work Plan and this

QAPP. Other quality objectives of the EE/CA and RI/FS Work Plans, such as waste characterization, soil gas survey, air, sediment, soil, groundwater, and surface water sampling and analysis activities are described in separate Site documents including QAPPs and FSPs (see Volume 2 of the Support Sampling Plan, SSP).

1.3 Project Objectives and Scope

The purpose of this Remedial Investigation/Feasibility Study (RI/FS) and EE/CA is to gather additional data to fill data gaps and build on the numerous existing data to determine the extent of contamination at the Site. At the conclusion of the investigation, cleanup alternatives and remedial technologies will be evaluated and a final remedy selected. This investigation will provide sufficient information to evaluate risk to public health and the environment (Baseline Risk Assessment) and to develop and evaluate viable remedial alternatives (Feasibility Study at the Site). The objectives of the RI are to determine the nature and extent of contamination at the site in order to support the activities of the FS. The objective of the RI/FS is to develop and evaluate appropriate remedial action alternatives based on the RI/FS data.

This Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) serve to define the sampling and analysis quality assurance objectives to meet the needs of the Ecological Risk Assessment. The chemical measurement from the fish analyses will also be used in the Human Health Risk Assessment.

The Ecological field investigation will include:

- Collection of sediment for toxicity bioassays;
- Benthic organism sampling for community evaluation and chemical analyses;
- Crayfish sampling for chemical analyses;
- Vegetation sampling for chemical analyses; and
- Fish sampling for chemical analyses.

Sediment toxicity tests and evaluation of ecological habitats will be conducted with benthic organisms according to accepted EPA protocols as described in Table 7-1.

Biota samples will be analyzed for chemicals of bioaccumulation importance including semivolatile organic compounds (SVOC), pesticides, polychlorinated biphenyl compounds (PCBs), metals, cyanide, herbicides, and dioxins. Analysis of the biota samples for volatile organic compounds (VOCs) will not be performed since the necessary homogenization of these matrices, in preparation of analysis, will result in the loss of any volatile compounds which may have been present in the biota. Additionally, VOCs are not expected to bioaccumulate. A project-specific list of metals has been developed to include only those metals that bioaccumulate and/or have been previously detected at the Site.

A tiered approach to analysis will be performed for the benthic organisms due to the expectation

of a limited volume of sample being available for analysis. Sample analyses hierarchy for benthic samples with limited sample mass is as follows:

1. PCBs
2. Metals
3. All other parameters including semivolatile organics, dioxins, herbicides, pesticides, and cyanide

Chemical data generated during the sediment, soil, and surface water sampling activities, described in separate Site documents, may also be incorporated into the Ecological Risk Assessment. Quality objectives for these chemical measurements are described in separate Site QAPPs.

1.4 Sampling Plan Design and Rationale

The sampling plan design and rationale for sample locations in support of the Ecological Assessment is described in detail in Section 4, Ecological Assessment Field Sampling Plan. For a detailed Site map showing sampling locations, see Figure 4-1 in Section 4 of this QAPP.

1.5 Parameters to be Tested and Frequency

The chemical data for all biota will be used in the Ecological Risk Assessment. The chemical data from the fish fillets will also be used in the Human Health Risk Assessment. Sample matrices, analytical parameters, and frequencies of sample collection in support of the Ecological Assessment can be found in Tables 1-1 through 1-6 at the end of this section. Project required reporting limits (RL) for biota samples were developed through the USEPA DQO process (see Section 3), and were derived from searches of background concentrations and bioaccumulation information available in the scientific literature to support the Ecological and Human Health Risk Assessment needs. Where this information was not available (e.g., for herbicides in biota), method and practical limits of quantitation (from the laboratories) in tissues formed the basis for the RL. In cases where the laboratory reporting limit does not meet the Ecological and Human Health risk based criteria, a footnote appears in the tables explaining the approach to report below the RLs down to the laboratory method detection limit.

The laboratory will report down to their method detection limits (MDLs) as shown in the laboratories QA Plan included as Volume 3 of the EE/CA and RI/FS Support Sampling Plan. The laboratory reporting limits will be supported by a low-level standard in their calibration curves (for organic compounds), for all compounds for which they cannot achieve the project RLs and specifically for the fish fillets. For those compounds that the laboratory reports down below the RLs down to the MDLs, the results will be flagged with a "J" indicating an estimated value. This approach will generate the lowest level reporting, using the laboratory protocols and EPA methods described, to support the Ecological and Human Health Risk Assessment activities. However, it is anticipated, that even using the approach of reporting down to the laboratory MDLs, the achievable levels of detection in fish tissue may not meet the Human Health Risk Assessment Data Quality Limits as listed in Table 3 of the Human Health Risk Assessment Work Plan.

To meet the needs of this program, field sampling personnel, the analytical laboratory, the data validator and the risk assessors (human health and ecological) will work together on a frequent and regular basis to ensure that the resulting project RLs are as low as feasible for the media being sampled and that sample analytical results will achieve RLs within the limits of the selected analytical methods. The usability of such data with higher RLs will be evaluated during the risk assessment activities. In general, one half of the sample-specific detection levels may be used in risk calculations as a conservative estimate for compounds that do not meet the project RLs. After review of the Ecological and Human Health Risk Assessments, a need may be defined to perform additional sampling and analysis for target compounds that are drivers for the risk assessments if lower levels of detection are required.

Section 4, the Field Sampling Plan (FSP), included in this QAPP defines the types of samples and frequency of collection planned to support the Ecological Assessment activities.

1.6 Data Quality Objectives for Ecological Risk Assessment Sampling and Analysis

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support project decisions. The DQO Process is a series of planning steps based on the Scientific Method that is designed to ensure that the type, quality, and quantity of environmental data used in decision-making are appropriate for the intended application. In this case, the EPA DQO process was followed to establish the project DQOs for the Ecological Risk Assessment sampling and analysis activities. The seven steps of the DQO process, consistent with EPA guidance, are included in this section.

Step 1: State the Problem – a description of the problem(s) and specifications of available resources and relevant deadlines for the study.

1. *Identify the members of the planning team* – Members of the planning team are listed in Section 2 and Figure 2-1 of this QAPP. Planning has benefited from input from Dr. Charles A. Menzie (Menzie-Cura), Susan Chapnick (NEH), Bruce Yare (Solutia), and Mike McAteer (USEPA RPM). In addition, other technical people in these organizations and in supporting consulting firms have provided information and comments that were used in planning the sampling and analysis activities.

2. *Identify the primary decision-maker* – The primary decision-makers are Bruce Yare at Solutia and Michael McAteer at USEPA.

3. *Develop a concise description of the problem* – Chemical contamination has been observed in sediments, soils, and water, within and adjacent to Dead Creek and the Borrow Pit. These contaminants may pose a risk to aquatic and terrestrial biota living within or adjacent to these areas.

4. *Specify available resources and relevant deadlines for the study* – Menzie-Cura and Solutia will provide the resources needed to meet the stated objectives. The project schedule is provided in Section 1.7. The ecological work will consist of a Reconnaissance Survey in early fall 1999, a Main Sampling event either in the fall of 1999 following the Reconnaissance Survey or in May/June 2000, and submittal of a draft ERA report in either February 2001 or August 2001 dependent upon the timing of the Main Sampling Program. The relevant deadlines for the study are dependent upon the requirement of assigning ecological sampling locations to the copper concentrations in the sediments. This requirement will delay the Main Sampling Program for the ERA from fall of 1999 to May/June 2000. The ERA project schedule is consistent with an overall project schedule of 18 months as presented in Volume 1A, Section 16.0 of the SSP.

Step 2: Identify the Decision – a statement of the decision that will use environmental data and the actions that could result from this decision.

1. *Identify the principal study decision* – Do chemical contaminants in sediments, soils, water, or biota pose an unacceptable environmental risk to ecological receptors as represented by Assessment Endpoints?

2. *Define alternative actions that could result from resolution of the principal study question.* Information on ecological risks might be used to: 1) determine if any remedial activities are needed; 2) plan remedial activities for environmental media within and adjacent to Dead Creek and the Borrow Pit; and/or 3) determine the potential risks associated with remediation.

3. *Combine the principle study question and the alternative actions into a decision statement* – Decide if remedial activities are needed to reduce unacceptable risks to ecological receptors. Identify which risks need to be addressed. Decide if remediation would result in net environmental benefits to ecological receptors.

4. *Organize multiple decisions* – Decisions are organized as follows: How will unacceptable risks be determined? Are there unacceptable risks? What receptors and media contribute to risks? What remedial actions would serve to reduce these risks to acceptable levels? What are the risks posed by these remedial steps? Will remediation result in net environmental benefits?

Step 3: Identify Inputs to the Decision – a list of environmental variables or characteristics that will be measured and other information needed to resolve the decision statement.

1. *Identify the information that will be required to resolve the decision statement* – To resolve the decision statement, the following information needs to be collected and/or measured. 1) Measurements of sediment toxicity; 2) community evaluation of benthic

organisms; 3) measurements of chemical contaminants in biota including benthic organisms, crayfish, vegetation, and fish; and 4) measurements of chemical contaminants in sediment, soil, and surface water in Dead Creek and the Borrow Pit.

2. *Determine the sources for each item of the information identified* – Sample media, analytical parameters, and frequencies of sample collection and measurements in support of the Ecological Assessment can be found in Tables 1-1 through 1-6 at the end of this section. Sediment toxicity tests and evaluation of ecological habitats will be conducted with benthic organisms according to accepted EPA protocols as described in Section 7 and Table 7-1 of this QAPP. Chemical measurements in biota (benthic, crayfish, fish, and vegetation) will be performed using standard EPA methods (mainly from SW846) as described in Section 7 and Table 7-1 of this QAPP. Biota samples will be analyzed for chemical of bioaccumulation importance including semivolatile organic compounds (SVOC), pesticides, polychlorinated biphenyl compounds (PCBs), metals, cyanide, herbicides, and dioxins. Sediments, soils, and surface water samples will be analyzed according to standard EPA methods as described in Volume 2 in the QAPP (O'Brien & Gere) for the sampling and analyses of these media in support of the EE/CA and RI/FS.

3. *Identify the information that is needed to establish the action level* – A discrete action level is inappropriate for evaluating ecological risk. Instead, the multiple lines of evidence approach will be used. In accordance with this method, the risk assessor needs the following information: 1) the confidence in each measure of risk (Measurement Endpoint), 2) the response in that measure (based on toxicity or chemical results), and 3) the concordance among measures (variability). This approach is described in the ERA Work Plan. As an initial screening level of risk, and to help establish project-specific reporting limit requirements, risk-based concentrations (RBCs) of the contaminants to be measured in biota were established to help set the DQOs for ecological risk assessment (see Table 1-7a,b, c).

4. *Confirm that appropriate measurement methods exist to provide the necessary data* – Analyses of biota samples will be performed in strict accordance with EPA methods (mainly SW846, December 1996, Third Edition, Final Update) with appropriate modifications for tissue extraction and cleanup procedures as described in the EPA methods included in Section 7 and Table 7-1of this QAPP. Measurements for sediment toxicity will follow EPA protocols as described in Appendix A of this QAPP. Chemical measurement methods must be able to meet sensitivity requirements for ecological risk assessment. Therefore, project-required reporting limits (RL) for biota samples were developed through the USEPA DQO process including searches of background concentrations and bioaccumulation information available in the scientific literature to support the Ecological and Human Health Risk Assessment needs. Where this information was not available (e.g., for herbicides in biota), method and practical limits of quantitation (from the laboratories) in tissues formed the basis for the RL. In cases where the laboratory reporting limit does not meet the Ecological risk based criteria, a footnote appears in the tables (1-1 through 1-6) explaining the approach to report below the RLs

down to the laboratory method detection limit to obtain the necessary data.

Step 4: Define the boundaries of the Study – a detailed description of the spatial and temporal boundaries of the problem, characteristics that define the populations of interest, and any practical considerations of interest.

1. *Specify the characteristics that define the population of interest* – Local populations of ecological resources include those individuals that live within or adjacent to Dead Creek and the Borrow Pit.

2. *Define the spatial boundary of the decision statement*

   a. *Define the geographic area to which the decision statement applies* – For the ecological assessment, the geographic boundaries include Dead Creek (Sections B through F), the Borrow Pit, and the adjacent flood plain. Planned sample locations are given in Table 4-1 and are also included in the FSP for surface soils.

   b. *When appropriate divide the population into strata that have relatively homogeneous characteristics* – The local populations will be considered for the Creek and Borrow Pit as a whole.

3. *Define the temporal boundary of the decision statement* –

   a. *Determine the timeframe to which the decision statement applies* – It will be assumed that samples collected during 1999 and 2000 represent current conditions.

   b. *Determine when to collect the data* – Data collection activities will be performed following one of the two following scenarios. 1) The Reconnaissance Survey and the Main Sampling Program to support the ERA will be conducted concurrently in September and October 1999 and will capture the end of the season when biological activity can be readily observed. Therefore, one ERA sampling event will be performed in the fall of 1999. This schedule will allow for an 18-month project completion from the fall of 1999 for a completed ERA in February 2001. 2) If ecological sampling locations are linked to sediment copper concentrations, as requested by USEPA, then the Main Sampling Program for the ERA must be performed *after* the sediment copper concentrations have been determined (see SSP Volume 2 QAPP and FSP for sediment sampling schedule). Additionally, the Main Sampling Program for the ERA will be successful only if organisms are present. Based on these two constraints, the Main Sampling Program for the ERA will be conducted in May or June 2000 if the sampling locations are tied to copper concentrations in the sediment. This second sampling scheme requires

two ERA sampling events: the Reconnaissance Survey in the fall of 1999 and the Main Sampling in May/June 2000. Following sample analysis and data validation, the ERA would be completed in this second schedule by August 2001. Also see the project schedule presented in Volume 1A, Section 16.0 of the SSP.

4. *Define the scale of decision making* – The assessment will be based on historical data as well as the information gathered during 1999 and 2000. The decision will be made at spatial scales appropriate to the selected Assessment Endpoints.

5. *Identify practical constraints on data collection* – Collection efforts will be influenced by weather conditions (especially rain fall) as well as by the suitability of habitats to support biota such as fish and crayfish. Matrix effects on the accuracy of the chemical measurements for some tissue analyses may pose a practical constraint on the usability of the data for ecological risk calculations. Such effects will be minimized by using cleanup techniques in the laboratory during sample preparation (see Section 7 of this QAPP for further information).

Step 5: Develop a Decision Rule – to define the parameter of interest, specify the action level and integrate previous DQO outputs into a single statement that describes a logical basis for choosing among alternative actions.

1. *Specify the statistical parameter that characterizes the population of interest* – A number of statistical methods will be utilized to evaluate risk. However, chemical concentration data will be expressed as arithmetic means, medians, and 95th confidence intervals on the mean (or maximum values) for risk assessment calculations. The chemical data from the one sampling event (the Main Sampling Event) will characterize the chemical population of interest. The biological populations of interest will be characterized by two sampling events: the Reconnaissance Survey and the Main Sampling Program.

2. *Specify the action level for the study* – There is no single action level for establishing ecological risk. The analyses of risk will depend on integrating multiple lines of evidence that include toxicity benchmarks, community analyses, and toxicity tests. Final remediation goals will be determined when the remedy is selected. Remediation goals will establish acceptable exposure levels that are protective of human health and the environment.

3. *Develop a decision rule* – The multiple lines of evidence approach will be used. In accordance with this method, the risk assessor considers: 1) the confidence in each measure of risk (Measurement Endpoint), 2) the response in that measure, and 3) the concordance among measures. This approach is described in the ERA Work Plan.

Step 6: Specify Tolerable Limits on Decision Errors – the decision-maker's tolerable

decision error rates based on a consideration of the consequences of making a decision error.

1. *Determine the possible range of the parameter of interest* – The measurement methods defined can accommodate a wide range of chemical concentrations for each analyte of interest. The project-specific RLs were developed, using this DQO process, to meet the data input requirements for the ecological risk assessment. For ecological risk assessment, meeting the project sensitivity requirements is most important in usefulness of chemical data. The historical range of chemicals of interest will be reviewed and discussed in the ecological risk assessment report for this project.

2. *Identify the decision errors and choose the main hypothesis* –

   a. *Define both types of decision errors and establish the true state of nature for each decision error*. The two types of decision error are: 1) concluding that there is no risk when there is, and 2) concluding that there is a risk when there is not.

   b. *Specify and evaluate the potential consequences of each decision error.* The first error could result in risks being left unaddressed thereby jeopardizing the health of the environment in Dead Creek and the Borrow Pit. The second error could result in expenditures that do not have a measurable benefit and which could even result in additional ecological harm.

   c. *Establish which decision error has more severe consequences near the action level* – The first error is considered to have more severe consequences to the environment.

3. *Specify the range of possible values of the parameters of interest where the consequences of decision errors are relatively minor (gray region)* – The "gray region" is represented by equivocal results from multiple lines of evidence approach and responses that are considered "small" (e.g., toxicity differences on the order of 30%).

4. *Assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors* – Not applicable.

Step 7: Optimize the Plan

1. *Review the DQO outputs and existing environmental data* – There is no existing data for biota suitable for use in the ecological risk assessment. Historical data for other media, including soil/sediment and water, will be reviewed and incorporated, if acceptable, as part of the ecological risk assessment report for this project. The DQO outputs for this project, based upon this DQO process, are described in detail in Section 3 of this QAPP.

2. *Develop the general data collection design* – The sampling plan design and rationale for sample locations in support of the Ecological Assessment is described in detail in Section 4, Ecological Assessment Field Sampling Plan. For a Site map showing sampling locations, see Figure 4-1 in Section 4 of this QAPP. The Ecological Assessment FSP consists of two separate sampling events: a Reconnaissance Survey and the Main Sampling Event. The Reconnaissance Survey will be used to refine the Main Sampling Program. The field observations made during the Reconnaissance Survey will be used to finalize sampling locations, procedures, and the number of biota samples that can be realistically collected in the Main Sampling Event. Habitat evaluations for biota will also be performed during the Reconnaissance Survey. During the Main Sampling Event biota samples will be collected and analyzed for target compounds and sediment will be collected to assess toxicity using laboratory bioassays. Biota samples collected during the main sampling event, including fish, crayfish, benthic organisms, and vegetation will be analyzed for chemicals of concern (target analytes) listed in Tables 1-1 through 1-6 presented in Section 1.0 of this QAPP. Analyses of chemicals in fish fillets will also be used in the Human Health Risk Assessment to evaluate human exposure due to ingestion. The Human Health Risk Assessment Work Plan (included in Volume 2 of the SSP) describes the details for evaluating this pathway.

   The highest level of data quality is defined for data generated in support of risk assessment. Analyses will be performed in strict accordance with the EPA methods defined in Section 7 of this QAPP. All of the chemical data for use in the ecological risk assessment will be validated using USEPA data validation guidance (*National Functional Guidelines for Organic Data Review*, USEPA 1994 and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, USEPA 1994), the QA/QC requirements described in this QAPP, and the standard operating procedures for data validation as described in the associated Site document "Data Validation Plan for the Sauget Area 1 EE/CA and RI/FS, Sauget, Illinois, April 1999" produced by Environmental Standards, Inc. Specific DQOs for quality assurance and quality control (QA/QC), to support the ecological risk assessment chemical measurements, have been defined for the QA/QC parameters of accuracy, precision, sensitivity, representativeness, completeness, and comparability. These project-specific DQOs are described in Section 3 of this QAPP.

   Data for Ecological Risk Assessment purposes will also be collected as part of the sediment, surface water, and soil-sampling programs described in the FSP for other Site activities included in associated site documents of the SSP.

1.7 Project Schedule

The project schedule for sampling and analysis in support of the ecological risk assessment (ERA) will be one of the two following schedules.

1) If the ERA Sampling locations are not dependent upon sediment copper concentrations, then the Reconnaissance Survey and the Main Sampling Program to support the ERA will be conducted concurrently in September and October 1999 and will capture the end of the season when biological activity can be readily observed. Therefore, one ERA sampling event will be performed in the fall of 1999. This schedule will allow for an 18-month project completion from the fall of 1999 for a completed ERA in February 2001.

2) If the ERA sampling locations are linked to sediment copper concentrations, as requested by USEPA, then the Main Sampling Program for the ERA must be performed *after* the sediment copper concentrations have been determined (see SSP Volume 2 QAPP and FSP for sediment sampling schedule). Additionally, the Main Sampling Program for the ERA will be successful only if organisms are present. Based on these two constraints, the Main Sampling Program for the ERA will be conducted in May or June 2000 if the sampling locations are tied to copper concentrations in the sediment. This second sampling scheme requires two ERA sampling events: the Reconnaissance Survey in the fall of 1999 and the Main Sampling in May/June 2000. Following sample analysis and data validation, the ERA would be completed in this second schedule by August 2001.

The Reconnaissance Survey and the Main Sampling Program sample collection activities will be performed by Menzie-Cura. Four months will be required from the end of sampling to the start of the ERA calculations to account for analysis and data validation time frames. All chemical data used in the ERA will be validation prior to inclusion in risk calculations. An internal draft ERA report will be generated within two to three months of the receipt of the validated data.

The overall project schedule for the SSP activities is presented in Volume 1A, Section 16.0 and will be completed on an 18-month schedule.

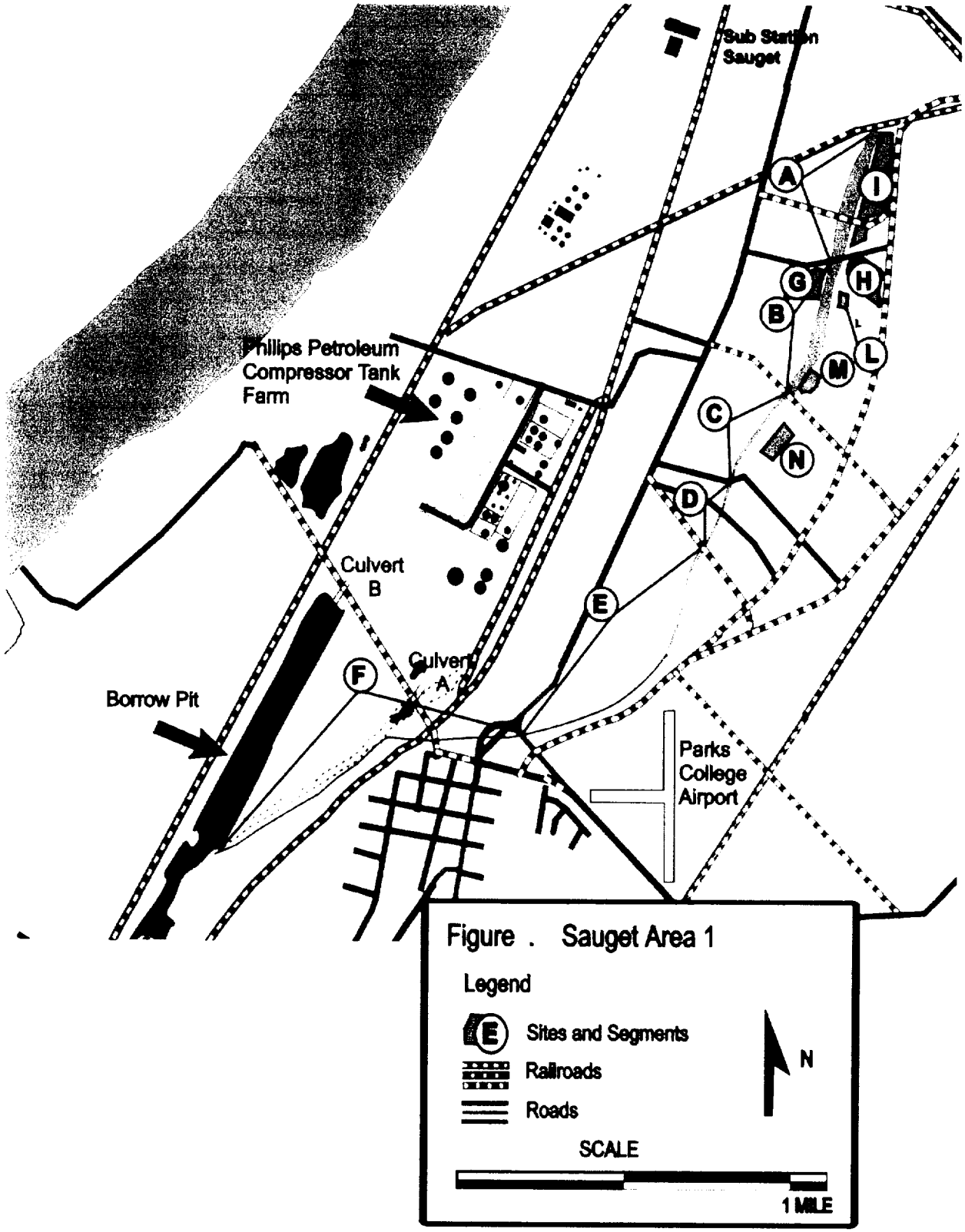


Figure 1-1. Site Location Map for Sauget Area 1

Table 1-1. Semivolatile Organic Analytical Parameters, Reporting Limits, and Sample Matrices

Analyte	CAS Number	Biota RL* wet wt µg/kg	To Be Analyzed in benthic organisms	To Be Analyzed in vegetation, crayfish and fish tissue
Phenol	108-95-2	170	X	X
bis-(2-Chloroethyl)ether *	111-44-4	170	X	X
2-Chlorophenol	95-57-8	170	X	X
1,3-Dichlorobenzene	541-73-1	170	X	X
1,4-Dichlorobenzene	106-46-7	170	X	X
1,2-Dichlorobenzene	95-50-1	170	X	X
2-Methylphenol	95-48-7	170	X	X
2,2'-oxybis(1-chloropropane)	108-60-1	170	X	X
4-Methylphenol	106-44-5	170	X	X
N-Nitroso-di-n-propylamine *	621-64-7	170	X	X
Hexachloroethane	67-72-1	170	X	X
Nitrobenzene	98-95-3	170	X	X
Isophorone	78-59-1	170	X	X
2-Nitrophenol	88-75-5	170	X	X
2,4-Dimethylphenol	105-67-9	170	X	X
bis-(2-Chloroethoxy)methane	111-91-1	170	X	X
2,4-Dichlorophenol	120-83-2	170	X	X
1,2,4-Trichlorobenzene	120-82-1	170	X	X
Naphthalene	91-20-3	170	X	X
4-Chloroaniline	106-47-8	170	X	X
Hexachlorobutadiene	87-68-3	170	X	X
4-Chloro-3-methylphenol	59-50-7	170	X	X
2-Methylnaphthalene	91-57-6	170	X	X
Hexachlorocyclopentadiene	77-47-4	170	X	X
2,4,6-Trichlorophenol	88-06-2	170	X	X
2,4,5-Trichlorophenol	95-95-4	420	X	X
2-Chloronaphthalene	91-58-7	170	X	X
2-Nitroaniline	88-74-4	420	X	X
Dimethylphthalate	131-11-3	170	X	X
Acenaphthylene	208-96-8	170	X	X
2,6-Dinitrotoluene	606-20-2	170	X	X
3-Nitroaniline	99-09-2	420	X	X
Acenaphthene	83-32-9	170	X	X

Table 1-1. Semivolatile Organic Analytical Parameters, Reporting Limits, and Sample Matrices - continued

Analyte	CAS Number	Biota RL* wet wt µg/kg	To Be Analyzed in benthic organisms	To Be Analyzed in vegetation, crayfish and fish tissue
2,4-Dinitrophenol	51-28-5	420	X	X
4-Nitrophenol	100-02-7	420	X	X
Dibenzofuran	132-64-9	170	X	X
2,4-Dinitrotoluene	121-14-2	170	X	X
Diethyl phthalate	84-66-2	170	X	X
4-Chlorophenyl phenyl ether	7005-72-3	170	X	X
Fluorene	86-73-7	170	X	X
4-Nitroaniline	100-01-6	420	X	X
4,6-Dinitro-2-methylphenol	534-52-1	420	X	X
N-Nitrosodiphenylamine	86-30-6	170	X	X
4-Bromophenyl phenyl ether	101-55-3	170	X	X
Hexachlorobenzene *	118-74-1	170	X	X
Pentachlorophenol	87-86-5	420	X	X
Phenanthrene	85-01-8	170	X	X
Anthracene	120-12-7	170	X	X
Carbazole	86-74-8	170	X	X
Di-n-butylphthalate	84-74-2	170	X	X
Fluoranthene	206-44-0	170	X	X
Pyrene	129-00-0	170	X	X
Butylbenzylphthalate	85-68-7	170	X	X
3,3'-Dichlorobenzidine *	91-94-1	170	X	X
Benzo(a)anthracene *	56-55-3	170	X	X
Chrysene	218-01-9	170	X	X
bis-(2-Ethylhexyl)phthalate	117-81-7	170	X	X
Di-n-octylphthalate	117-84-0	170	X	X
Benzo(b)fluoranthene *	205-99-2	170	X	X
Benzo(k)fluoranthene *	207-08-9	170	X	X
Benzo(a)pyrene *	50-32-8	170	X	X
Indeno (1,2,3-cd) pyrene *	193-39-5	170	X	X
Dibenzo(a,h)anthracene *	53-70-3	170	X	X
Benzo(g,h,i)perylene	191-24-2	170	X	X

* The project reporting limits were set as laboratory practical quantitation limits. The lab will report lower than these reporting limits, down to their MDLs using "J" flags, to meet ecological and human health risk-based concentrations (RBCs) as listed in Table 1-7 for ecological RBCs and the Human Health Work Plan. The compounds with "*" are those for which the lab MDL does not meet the ecological or human health RBC. For these compounds, the conservative estimate of ½ the sample reporting limit will be used in risk-based calculations.

Table 1-2. Inorganic Parameters, Reporting Limits, and Sample Matrices

Analyte		CAS Number	Biota RL* wet wt mg/kg	To Be Analyzed in benthic organisms	To Be Analyzed in vegetation, crayfish and fish tissue
Aluminum*	ICP	7429-90-5	3	X	X
Antimony*	GFAA	7440-36-0	0.2	X	X
Arsenic*	GFAA	7440-38-2	0.2	X	X
Beryllium	ICP	7440-41-7	1	X	X
Cadmium	ICP	7440-43-9	0.5	X	X
Chromium*	ICP	7440-47-3	0.5	X	X
Copper	ICP	7440-50-8	2	X	X
Lead	ICP	7439-92-1	0.5	X	X
Mercury	CVAA	7439-97-6	0.02	X	X
Nickel	ICP	7440-02-0	10	X	X
Selenium*	ICP	7782-49-2	0.5	X	X
Silver	GFAA	7440-22-4	0.1	X	X
Zinc	ICP	7440-66-6	2	X	X
Total Cyanide		57-12-5	10	X	X

* The project reporting limits were set to achieve the risk-based concentrations required for the ecological risk assessment (see Table 1-7) and the human health risk assessment (see the work plan). The compounds with "*" are those for which the lab must report down to their MDL to achieve the RBCs. For some metals and pathways, the project RL does not meet the ecological RBC (see Table 1-7). For these metals, if they are non-detected in biota, the conservative estimate of ½ the sample reporting limit will be used in risk-based calculations.

Table 1-3. Pesticide Parameters, Reporting Limits, and Sample Matrices

Analyte	CAS Number	Biota RL* wet wt µg/kg	To Be Analyzed in benthic organisms	To Be Analyzed in vegetation, crayfish and fish tissue
alpha-BHC	319-84-6	1.7	X	X
beta-BHC	319-85-7	1.7	X	X
delta-BHC	319-36-8	1.7	X	X
gamma-BHC (lindane)	58-89-9	1.7	X	X
Heptachlor	76-44-8	1.7	X	X
Aldrin	309-00-2	1.7	X	X
Heptachlor epoxide	1024-57-3	1.7	X	X
Endosulfan I	959-98-8	1.7	X	X
Dieldrin	60-57-1	3.3	X	X
4,4'-DDE	72-55-9	3.3	X	X
Endrin	72-20-8	3.3	X	X
Endosulfan II	33213-65-9	3.3	X	X
4,4'-DDD	72-54-8	3.3	X	X
Endosulfan sulfate	1031-07-8	3.3	X	X
4,4'-DDT	50-29-3	3.3	X	X
Methoxychlor	72-43-5	17	X	X
Endrin Ketone	53494-70-5	3.3	X	X
Endrin Aldehyde	7421-36-3	3.3	X	X
alpha-Chlordane	5103-71-9	1.7	X	X
gamma-Chlordane	5103-74-2	1.7	X	X
Toxaphene *	8001-35-2	90	X	X

* The project reporting limits were set as laboratory practical quantitation limits. The lab will report lower than these reporting limits, down to their MDLs using "J" flags, to meet ecological and human health risk-based concentrations (RBCs) as listed in Table 1-7 for ecological RBCs and the Human Health Work Plan. The compounds with "*" are those for which the lab MDL does not meet the ecological or human health RBC. For these compounds, the conservative estimate of ½ the sample reporting limit will be used in risk-based calculations.

Table 1-4. Herbicide Parameters, Reporting Limits, and Sample Matrices

Analyte	CAS Number	Biota RL wet wt µg/kg	To Be Analyzed in benthic organisms	To Be Analyzed in vegetation, crayfish and fish tissue
2,4-D (herbicide)	94-75-7	10	X	X
2,4-DB	94-82-6	10	X	X
2,4,5-TP (Silvex)	93-72-1	10	X	X
2,4,5-T	93-76-5	10	X	X
Dalapon	75-99-0	2000	X	X
Dicamba	1918-00-9	20	X	X
Dichloroprop	120-36-5	100	X	X
Dinoseb	88-85-7	100	X	X
MCPA	94-74-6	2000	X	X
MCPP	93-65-2	2000	X	X
4-Nitrophenol *	100-02-1	50 **	X	X
Pentachlorophenol *	87-86-5	20**	X	X

* These compounds may also be analyzed by Semivolatile GC/MS.
** Estimated based on Method Estimated Detection Limits

Table 1-5. Dioxin and Dibenzofuran Parameters, Reporting Limits, and Sample Matrices

Analyte	CAS Number	Biota RL* wet wt ppt (ng/kg)	To Be Analyzed in benthic organisms	To Be Analyzed in vegetation, crayfish and fish tissue
2,3,7,8-TCDD	1746-01-6	1	X	X
1,2,3,7,8-PeCDD	40321-76-4	5	X	X
1,2,3,4,7,8-HxCDD	39227-28-6	5	X	X
1,2,3,6,7,8-HxCDD	57653-85-7	5	X	X
1,2,3,7,8,9-HxCDD	19408-74-3	5	X	X
1,2,3,4,6,7,8-HpCDD	35822-46-9	5	X	X
1,2,3,4,5,6,7,8-OCDD	3268-87-9	10	X	X
2,3,7,8-TCDF	51207-31-9	1	X	X
1,2,3,7,8-PeCDF	57117-41-6	5	X	X
2,3,4,7,8-PeCDF	57117-31-4	5	X	X
1,2,3,4,7,8-HxCDF	70648-26-9	5	X	X
1,2,3,6,7,8-HxCDF	57117-44-9	5	X	X
1,2,3,7,8,9-HxCDF	72918-21-9	5	X	X
2,3,4,6,7,8-HxCDF	60851-34-5	5	X	X
1,2,3,4,6,7,8-HpCDF	67562-39-4	5	X	X
1,2,3,4,7,8,9-HpCDF	55673-89-7	5	X	X
1,2,3,4,5,6,7,8-OCDF	39001-02-0	10	X	X
Total TCDD	41903-57-5	1	X	X
Total PeCDD	36088-22-9	5	X	X
Total HxCDD	34465-46-8	5	X	X
Total HpCDD	37871-00-4	5	X	X
Total TCDF	55722-27-5	1	X	X
Total PeCDF	30402-15-4	5	X	X
Total HxCDF	55684-94-1	5	X	X
Total HpCDF	38988-75-3	5	X	X

* The project reporting limits were set as laboratory practical quantitation limits. The lab will report lower than these reporting limits, down to their MDLs using "J" flags, to meet ecological and human health risk-based concentrations (RBCs) as listed in Table 1-7 for ecological RBCs and the Human Health Work Plan. These state-of-the-art methods cannot meet, in all cases, the human health RBCs. For those compounds for which the lab MDL does not meet the ecological or human health RBC, the conservative estimate of ½ the sample reporting limit will be used in risk-based calculations.

Table 1-6. Polychlorinated Biphenyls (PCBs) Reporting Limits, and Sample Matrices

Analyte	CAS Number	Biota RL* wet wt µg/kg	To Be Analyzed in benthic organisms	To Be Analyzed in vegetation, crayfish and fish tissue
Aroclor-1016	12674-11-2	33	X	X
Aroclor-1221	11104-28-2	67	X	X
Aroclor-1232	11141-16-5	33	X	X
Aroclor-1242	53469-21-9	33	X	X
Aroclor-1248	12672-29-6	33	X	X
Aroclor-1254	11097-79-1	33	X	X
Aroclor-1260	11096-82-5	33	X	X

* The project reporting limits were set as laboratory practical quantitation limits. The lab will report lower than these reporting limits, down to their MDLs using "J" flags, to meet ecological and human health risk-based concentrations (RBCs) as listed in Table 1-7 for ecological RBCs and the Human Health Work Plan. These state-of-the-art methods cannot meet, in all cases, the human health RBCs. For those compounds for which the lab MDL does not meet the ecological or human health RBC, the conservative estimate of ½ the sample reporting limit will be used in risk-based calculations.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The project organization and responsibility for all the Site environmental activities is described in the Support Sampling Plan and other Site Work Plans in Volume 1 and Volume 2. For the Ecological Risk Assessment, the following project organization and responsibilities have been defined. Figure 2-1 represents the Project Team Organization Chart.

2.1 USEPA Remedial Project Manager

Michael McAteer, USEPA Region 5 Remedial Project Manager (RPM) has the overall responsibility for all phases of the EE/CA and RI/FS Site activities at Sauget Area 1.

2.2 USEPA Field Service Section

The USEPA Field Services Section may assist the USEPA RPM in technical review of documents, plans, and data, as needed in support of this project.

2.3 Illinois Environmental Protection Agency Project Manager

The IEPA Project Manager, Candy Morin, has the overall responsibility of ensuring that the project meets the IEPA objectives and quality standards.

2.4 Site Program Manager

The Site Program Manager, Bruce Yare of Solutia has the overall responsibility for ensuring that the project meets EPA objectives and quality standards. In addition, he is responsible for the overall technical quality control, project implementation, and oversight. The Site Program Manager will ensure that technical, financial, and scheduling objectives are achieved successfully. The Site Program Manager will report directly to EPA Region 5 RPM and will provide the major point of contact and control for matters concerning the project. The Site Program Manager will be assisted by the Site Project Manager, Kimberly Perry of Solutia. Their responsibilities include the following.

- Define project objectives and develop a detailed workplans and schedule with the project team;
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;
- Acquire and apply technical and corporate resources as needed to ensure performance within budget and schedule constraints;
- Orient all field leaders and project team staff concerning the project's special considerations;
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;

Table 1-7a
Ecological Risk-Based Concentrations for Food
Sauget Area I, Illinois

Analyte	CAS #	Analyte class	Project Reporting Limit for Biota (mg/kg or ug/kg wet weight)	Ecological Receptor Food RBC * (mg/kg or ug/kg wet weight)	Ecological Receptor *
RBC = Risk-Based Concentration					
Inorganic Analytes			**mg/kg**	**mg/kg**	
Aluminum	7429-90-5	Metal	3	4.245	River Otter
Antimony	7440-36-0	Metal	0.2	0.275	River Otter
Arsenic	7440-38-2	Metal	0.2	0.277	River Otter
Beryllium	7440-41-7	Metal	1	2.68	River Otter
Cadmium	7440-43-9	Metal	0.5	8.25	Great Blue Heron
Chromium (total)	7440-47-3	Metal	0.5		
(Chromium (III))		Metal	NA	5.69	Great Blue Heron
Copper	7440-50-8	Metal	2	61.8	River Otter
Lead	7439-92-1	Metal	0.5	6.43	Great Blue Heron
Mercury	7439-97-6	Metal	0.02	0.036	Great Blue Heron
Nickel	7440-02-0	Metal	10	162.61	River Otter
Selenium	7782-49-2	Metal	0.5	0.813	River Otter
Silver	7440-22-4	Metal	0.1		
Zinc	7440-66-6	Metal	2	82.5	Great Blue Heron
Cyanide	57-12-5	WetChem	10	262.5	River Otter
Semivolatile Organic Analytes			**ug/kg**	**ug/kg**	
Phenol	108-95-2	SVOC	170		
bis(2-Chloroethyl)ether	111-44-4	SVOC	170		
2-Chlorophenol	95-57-8	SVOC	170		
1,3-Dichlorobenzene	541-73-1	SVOC	170		
1,4-Dichlorobenzene	106-46-7	SVOC	170		
1,2-Dichlorobenzene	95-50-1	SVOC	170		
2-Methylphenol	95-48-7	SVOC	170	1158600	River Otter
2,2-oxybis(1-Chloropropane)	108-60-1	SVOC	170		
4-Methylphenol	106-44-5	SVOC	170		
N-Nitroso-di-n-propylamine	621-64-7	SVOC	170		
Hexachloroethane	67-72-1	SVOC	170		
Nitrobenzene	98-95-3	SVOC	170		
Isophorone	78-59-1	SVOC	170		
2-Nitrophenol	88-75-5	SVOC	170		
2,4-Dimethylphenol	105-67-9	SVOC	170		
bis(2-Chloroethoxy)methane	111-91-1	SVOC	170		
2,4-Dichlorophenol	120-83-2	SVOC	170		
1,2,4-Trichlorobenzene	120-82-1	SVOC	170		
Naphthalene	91-20-3	SVOC	170		
4-Chloroaniline	106-47-8	SVOC	170		
Hexachlorobutadiene	87-68-3	SVOC	170		
4-Chloro-3-methylphenol	59-50-7	SVOC	170		
2-Methylnaphthalene	91-57-6	SVOC	170		
Hexachlorocyclopentadiene	77-47-4	SVOC	170		
2,4,6-Trichlorophenol	88-06-2	SVOC	170		
2,4,5-Trichlorophenol	95-95-4	SVOC	420		
2-Chloronaphthalene	91-58-7	SVOC	170		

Table 1-7a
Ecological Risk-Based Concentrations for Food
Sauget Area I, Illinois

Analyte	CAS #	Analyte class	Project Reporting Limit for Biota (mg/kg or ug/kg wet weight)	Ecological Receptor Food RBC[a] (mg/kg or ug/kg wet weight)	Ecological Receptor [a]
2-Nitroaniline	88-74-4	SVOC	420		
Dimethylphthalate	131-11-3	SVOC	170		
Acenaphthylene	208-96-8	SVOC	170		
2,6-Dinitrotoluene	606-20-2	SVOC	170		
3-Nitroaniline	99-09-2	SVOC	170		
Acenaphthene	83-32-9	SVOC	170		
2,4-Dinitrophenol	51-28-5	SVOC	420		
4-Nitrophenol	100-02-7	SVOC	420		
Dibenzofuran	132-64-9	SVOC	170		
2,4-Dinitrotoluene	121-14-2	SVOC	170		
Diethylphthalate	84-66-2	SVOC	170	10081000	River Otter
4-Chlorophenyl-phenylether	7005-72-3	SVOC	170		
Fluorene	86-73-7	SVOC	170		
4-Nitroaniline	100-01-6	SVOC	420		
4,6-Dinitro-2-methylphenol	534-52-1	SVOC	420		
N-Nitrosodiphenylamine [b]	86-30-6	SVOC	170		
4-Bromophenyl-phenylether	101-55-3	SVOC	170		
Hexachlorobenzene (HCB)	118-74-1	SVOC	170		
Pentachlorophenol	87-86-5	SVOC	420	976	River Otter
Phenanthrene	85-01-8	SVOC	170		
Anthracene	120-12-7	SVOC	170		
Carbazole	86-74-8	SVOC	170		
Di-n-butylphthalate	84-74-2	SVOC	170	630	Great Blue Heron
Fluoranthene	206-44-0	SVOC	170		
Pyrene	129-00-0	SVOC	170		
Butylbenzylphthalate	85-68-7	SVOC	170		
3,3'-Dichlorobenzidine	91-94-1	SVOC	170		
Benzo(a)anthracene	56-55-3	SVOC	170		
Chrysene	218-01-9	SVOC	170		
bis(2-Ethylhexyl)phthalate	117-81-7	SVOC	170	6260	Great Blue Heron
Di-n-octylphthalate	117-84-0	SVOC	170		
Benzo(b)fluoranthene	205-99-2	SVOC	170		
Benzo(k)fluoranthene	207-08-9	SVOC	170		
Benzo(a)pyrene	50-32-8	SVOC	170	2200	River Otter
Indeno(1,2,3-cd)pyrene	193-39-5	SVOC	170		
Dibenz(a,h)anthracene	53-70-3	SVOC	170		
Benzo(g,h,i)perylene	191-24-2	SVOC	170		
Pesticides			**ug/kg**	**ug/kg**	
α-BHC	319-84-6	PEST	1.7		
β-BHC	319-85-7	PEST	1.7	1630	River Otter
δ-BHC	319-86-8	PEST	1.7		
γ-BHC (Lindane)	58-89-9	PEST	1.7	11380	Great Blue Heron
BHC mixed isomers			NA	70	River Otter
Heptachlor	76-44-8	PEST	1.7	529	River Otter
Aldrin	309-00-2	PEST	1.7	813	River Otter
Heptachlor epoxide	1024-57-3	PEST	1.7		
Endosulfan I	959-98-8	PEST	1.7		

Table 1-7a
Ecological Risk-Based Concentrations for Food
Sauget Area I, Illinois

Analyte	CAS #	Analyte class	Project Reporting Limit for Biota (mg/kg or ug/kg wet weight)	Ecological Receptor Food RBC * (mg/kg or ug/kg wet weight)	Ecological Receptor *
Dieldrin	60-57-1	PEST	3.3	81	River Otter
4,4'-DDE	72-55-9	PEST	3.3		
Endrin	72-20-8	PEST	3.3	57	Great Blue Heron
Endosulfan II	33213-65-9	PEST	3.3		
4,4'-DDD	72-54-8	PEST	3.3		
Endosulfan sulfate	1031-07-8	PEST	3.3		
Endosulfan			NA	610	River Otter
4,4'-DDT	50-29-3	PEST	3.3		
DDT and metabolites			NA	16	Great Blue Heron
Methoxychlor	72-43-5	PEST	17	16300	River Otter
Endrin ketone	53494-70-5	PEST	3.3		
Endrin aldehyde	7421-36-3	PEST	3.3		
α-Chlordane	5103-71-9	PEST	1.7		
γ-Chlordane	5103-74-2	PEST	1.7		
Chlordane			NA	10100	River Otter
Toxaphene	8001-35-2	PEST	90	32500	River Otter
Herbicides			**ug/kg**	**ug/kg**	
2,4 - D	94-75-7	HERB	10		
2,4 - DB	94-82-6	HERB	10		
2.4.5 - TP (Silvex)	93-72-1	HERB	10		
2.4.5. - T	93-76-5	HERB	10		
Dalapon	75-99-0	HERB	2000		
Dicamba	1918-00-9	HERB	20		
Dichloroprop	120-36-5	HERB	100		
Dinoseb	88-85-7	HERB	100		
MCPA	94-74-6	HERB	2000		
MCPP	93-65-2	HERB	2000		
4-Nitrophenol (see semivoa list)	100-02-1	HERB	50		
Pentachlorophenol (see semivoa)	87-86-5	HERB	20	976	River Otter
PCBs			**ug/kg**	**ug/kg**	
Total PCBs			NA		
Aroclor-1016	12674-11-2	PCB	10	7240	River Otter
Aroclor-1221	11104-28-2	PCB	10		
Aroclor-1232	11141-16-5	PCB	10		
Aroclor-1242	53469-21-9	PCB	10	365	River Otter
Aroclor-1248	12672-29-6	PCB	10	79	River Otter
Aroclor-1254	11097-79-1	PCB	10	740	Great Blue Heron
Aroclor-1260	11096-82-5	PCB	10		
Dioxins and Dibenzofurans			**ng/kg**	**ng/kg**	
2,3,7,8 - TCDD	1746-01-6	DIOXIN	1	4.1	River Otter
1,2,3,7,8 - PeCDD	40321-76-4	DIOXIN	5		
1,2,3,4,7,8 - HxCDD	39227-28-6	DIOXIN	5		
1,2,3,6,7,8 - HxCDD	57653-85-7	DIOXIN	5		

Table 1-7a
Ecological Risk-Based Concentrations for Food
Sauget Area I, Illinois

Analyte	CAS #	Analyte class	Project Reporting Limit for Biota (mg/kg or ug/kg wet weight)	Ecological Receptor Food RBC[a] (mg/kg or ug/kg wet weight)	Ecological Receptor[a]
1,2,3,7,8,9 - HxCDD	19408-74-3	DIOXIN	5		
1,2,3,4,6,7,8 - HpCDD	35822-46-9	DIOXIN	5		
1,2,3,4,5,6,7,8 - OCDD	3268-87-9	DIOXIN	10		
2,3,7,8 - TCDF	51207-31-9	DIOXIN	1	5.7	Great Blue Heron
1,2,3,7,8 - PeCDF	57117-41-6	DIOXIN	5	650	River Otter
2,3,4,7,8 - PeCDD	57117-31-4	DIOXIN	5	70	River Otter
1,2,3,4,7,8 - HxCDF	70648-26-9	DIOXIN	5		
1,2,3,6,7,8 - HxCDF	57117-44-9	DIOXIN	5	650	River Otter
1,2,3,7,8,9 - HxCDF	72918-21-9	DIOXIN	5		
2,3,4,6,7,8 - HxCDF	60851-34-5	DIOXIN	5		
1,2,3,4,6,7,8 - HpCDF	67562-39-4	DIOXIN	5		
1,2,3,4,7,8,9 - HpCDF	55673-89-7	DIOXIN	5		
1,2,3,4,5,6,7,8 - OCDF	39001-02-0	DIOXIN	10		
Total TCDD	41903-57-5	DIOXIN	1		
Total PeCDD	36088-22-9	DIOXIN	5		
Total HxCDD	34465-46-8	DIOXIN	5		
Total HpCDD	37871-00-4	DIOXIN	5		
Total TCDF	55722-27-5	DIOXIN	1		
Total PeCDF	30401-15-4	DIOXIN	5		
Total HxCDF	55684-94-1	DIOXIN	5		
Total HpCDF	38988-75-3	DIOXIN	5		

NOTES:

[a] ORNL: Toxicological Benchmarks for Wildlife: 1996 Revision (EPA, 1996). Selected figures are for river otter or great blue heron (the receptors for which RBCs existed); if more than one RBC existed, the lower one was used.

[b] Cannot be separated from Diphenylamine

Table 1-7b
Ecological Risk-Based Concentrations (RBCs) for Fish Tissue
Sauget Area 1, Illinois

Analyte	CAS #	Analyte class	Project Reporting Limit for tissue (mg/kg or ug/kg wet weight)	Fish RBC * (mg/kg or ug/kg wet weight)	Common Name of Fish	Latin Name of Fish	Does the study have a LOAEL?	Endpoint, Miscellaneous Notes
RBC = Risk-Based Concentration								
Inorganic Analytes			mg/kg	mg/kg	Common Name			
Aluminum	7429-90-5	Metal	3	1.0	Atlantic salmon	*Salmo salar*	Y	
Antimony	7440-36-0	Metal	0.2	5.0	Rainbow trout	*Oncorhynchus mykiss*	Y	
Arsenic	7440-38-2	Metal	0.2	1.8	Bluegill	*Lepomis macrochirus*	Y	
Beryllium	7440-41-7	Metal	1					
Cadmium	7440-43-9	Metal	0.5	0.036	Bluegill	*Lepomis macrochirus*	Y	
Chromium (total)	7440-47-3	Metal	0.5	0.58	Rainbow trout	*Oncorhynchus mykiss*	N	
(Chromium (III))		Metal	NA					
Copper	7440-50-8	Metal	2	7.4	Carp	*Cyprinus carpio*	Y	survival of larvae
Lead	7439-92-1	Metal	0.5	0.34	Brook Trout	*Salvelinus fontinalis*	Y	survival/hatchability of larvae
Mercury	7439-97-6	Metal	0.02	0.8	Fathead Minnow	*Pimephales promelas*	Y	growth of fish (larvae to adult)
Nickel	7440-02-0	Metal	10	58.0	Carp	*Cyprinus carpio*	Y	in white muscle--survival
Selenium	7782-49-2	Metal	0.5	0.8	Bluegill	*Lepomis macrochirus*	Y	survival of juvenile
Silver	7440-22-4	Metal	0.1	0.06	Bluegill	*Lepomis macrochirus*	N	survival, growth of "young of year"
Zinc	7440-66-6	Metal	2	34	Flagfish	*Jordanella floridae*	Y	growth of fish (larvae to adult)
Cyanide	57-12-5	WetChem	10					
Semivolatile Organic Analytes			ug/kg	ug/kg				
Phenol	108-95-2	SVOC	170	25000	Goldfish	*Carassius auratus*	Y	survival
bis(2-Chloroethyl)ether	111-44-4	SVOC	170					
2-Chlorophenol	95-57-8	SVOC	170	50000	Goldfish	*Carassius auratus*	Y	survival
1,3-Dichlorobenzene	541-73-1	SVOC	170	120000	Fathead minnow	*Pimephales promelas*	Y	survival, growth of embryo/juvenile
1,4-Dichlorobenzene	106-46-7	SVOC	170	69500	Fathead minnow	*Pimephales promelas*	Y	survival, growth of embryo/juvenile
1,2-Dichlorobenzene	95-50-1	SVOC	170	670	Rainbow trout	*Oncorhynchus mykiss*	N	survival of subadults a similar study presents LOAEL of 138.2
2-Methylphenol	95-48-7	SVOC	170					
2,2-oxybis(1-Chloropropane)	108-60-1	SVOC	170					
4-Methylphenol	106-44-5	SVOC	170					
N-Nitroso-di-n-propylamine	621-64-7	SVOC	170					
Hexachloroethane	67-72-1	SVOC	170					
Nitrobenzene	98-95-3	SVOC	170	29100	Guppy	*Poecilia reticulata*	N	survival
Isophorone	78-59-1	SVOC	170					
2-Nitrophenol	88-75-5	SVOC	170					
2,4-Dimethylphenol	105-67-9	SVOC	170					
bis(2-Chloroethoxy)methane	111-91-1	SVOC	170					
2,4-Dichlorophenol	120-83-2	SVOC	170	98000	Goldfish	*Carassius auratus*	Y	survival
1,2,4-Trichlorobenzene	120-82-1	SVOC	170	355000	Fathead minnow	*Pimephales promelas*	Y	survival, growth of embryo/juvenile
Naphthalene	91-20-3	SVOC	170					
4-Chloroaniline	106-47-8	SVOC	170	357300	Guppy	*Poecilia reticulata*	N	survival (showed mild behavior effects)
Hexachlorobutadiene	87-68-3	SVOC	170					
4-Chloro-3-methylphenol	59-50-7	SVOC	170					
2-Methylnaphthalene	91-57-6	SVOC	170					
Hexachlorocyclopentadiene	77-47-4	SVOC	170					
2,4,6-Trichlorophenol	88-06-2	SVOC	170	40000	Goldfish	*Carassius auratus*	Y	survival
2,4,5-Trichlorophenol	95-95-4	SVOC	420	38000	Goldfish	*Carassius auratus*	Y	survival
2-Chloronaphthalene	91-58-7	SVOC	170					
2-Nitroaniline	88-74-4	SVOC	420					
Dimethylphthalate	131-11-3	SVOC	170					
Acenaphthylene	208-96-8	SVOC	170					

Table 1-7b
Ecological Risk-Based Concentrations (RBCs) for Fish Tissue
Sauget Area 1, Illinois

Analyte	CAS #	Analyte class	Project Reporting Limit for tissue (mg/kg or ug/kg wet weight)	Fish RBC[a] (mg/kg or ug/kg wet weight)	Common Name of Fish	Latin Name of Fish	Does the study have a LOAEL?	Endpoint, Miscellaneous Notes
2,6-Dinitrotoluene	606-20-2	SVOC	170					
3-Nitroaniline	99-09-2	SVOC	170					
Acenaphthene	83-32-9	SVOC	170					
2,4-Dinitrophenol	51-28-5	SVOC	420					
4-Nitrophenol	100-02-7	SVOC	420	25100	Fathead minnow	*Pimephales promelas*	N	survival, growth
Dibenzofuran	132-64-9	SVOC	170					
2,4-Dinitrotoluene	121-14-2	SVOC	170					
Diethylphthalate	84-66-2	SVOC	170					
4-Chlorophenyl-phenylether	7005-72-3	SVOC	170					
Fluorene	86-73-7	SVOC	170					
4-Nitroaniline	100-01-6	SVOC	420					
4,6-Dinitro-2-methylphenol	534-52-1	SVOC	420					
N-Nitrosodiphenylamine[b]	86-30-6	SVOC	170					
4-Bromophenyl-phenylether	101-55-3	SVOC	170					
Hexachlorobenzene (HCB)	118-74-1	SVOC	170	468000	Fathead minnow	*Pimephales promelas*	N	
Pentachlorophenol	87-86-5	SVOC	420	12600	Fathead minnow	*Pimephales promelas*	Y	growth
Phenanthrene	85-01-8	SVOC	170					
Anthracene	120-12-7	SVOC	170					
Carbazole	86-74-8	SVOC	170					
Di-n-butylphthalate	84-74-2	SVOC	170					
Fluoranthene	206-44-0	SVOC	170					
Pyrene	129-00-0	SVOC	170					
Butylbenzylphthalate	85-68-7	SVOC	170					
3,3'-Dichlorobenzidine	91-94-1	SVOC	170					
Benzo(a)anthracene	56-55-3	SVOC	170					
Chrysene	218-01-9	SVOC	170					
bis(2-Ethylhexyl)phthalate	117-81-7	SVOC	170					
Di-n-octylphthalate	117-84-0	SVOC	170					
Benzo(b)fluoranthene	205-99-2	SVOC	170					
Benzo(k)fluoranthene	207-08-9	SVOC	170					
Benzo(a)pyrene	50-32-8	SVOC	170	10200	Rainbow trout	*Oncorhynchus mykiss*	Y	Survival, growth of egg/alevin
Indeno(1,2,3-cd)pyrene	193-39-5	SVOC	170					
Dibenz(a,h)anthracene	53-70-3	SVOC	170					
Benzo(g,h,i)perylene	191-24-2	SVOC	170					
Pesticides			ug/kg	ug/kg				
α-BHC (Hexachlorocyclohexane, HCH)	319-84-6	PEST	1.7	25000	Guppy	*Poecilia reticulata*	Y	survival (saltwater fish)
β-BHC	319-85-7	PEST	1.7					
δ-BHC	319-86-8	PEST	1.7					
γ-BHC (Lindane)	58-89-9	PEST	1.7	770	Brook trout	*Salvelinus fontinalis*	Y	growth
Total BHC (mixed isomers)			NA					
Heptachlor	76-44-8	PEST	1.7	5300	Spot	*Leiostomus xanthurus*	Y	survival (saltwater fish)
Aldrin	309-00-2	PEST	1.7					
Heptachlor epoxide	1024-57-3	PEST	1.7					
Endosulfan I	959-98-8	PEST	1.7					
Dieldrin	60-57-1	PEST	3.3	548	Rainbow trout	*Oncorhynchus mykiss*	Y	survival of juvenile
4,4'-DDE	72-55-9	PEST	3.3	5000	Brook trout	*Salvelinus fontinalis*	N	survival, growth of juvenile
Endrin	72-20-8	PEST	3.3	80	Bluegill	*Lepomis macrochirus*	Y	survival
Endosulfan II	33213-65-9	PEST	3.3					
4,4'-DDD	72-54-8	PEST	3.3	5000	Brook trout	*Salvelinus fontinalis*	N	survival, growth of juvenile
Endosulfan sulfate	1031-07-8	PEST	3.3					
Endosulfan			NA	200	Pinfish	*Lagodon rhomboides*	Y	survival (saltwater fish)
4,4'-DDT	50-29-3	PEST	3.3					
DDT and metabolites			NA	40000	Fathead minnow	*Pimephales promelas*	Y	survival of juvenile to adult
Methoxychlor	72-43-5	PEST	17	200	Striped mullet	*Mugil cephalus*	Y	survival of adult, juvenile (saltwater fish)
Endrin ketone	53494-70-5	PEST	3.3					
Endrin aldehyde	7421-36-3	PEST	3.3					

Table 1-7b
Ecological Risk-Based Concentrations (RBCs) for Fish Tissue
Sauget Area 1, Illinois

Analyte	CAS #	Analyte class	Project Reporting Limit for tissue (mg/kg or ug/kg wet weight)	Fish RBC* (mg/kg or ug/kg wet weight)	Common Name of Fish	Latin Name of Fish	Does the study have a LOAEL?	Endpoint, Miscellaneous Notes
α-Chlordane	5103-71-9	PEST	1.7					
γ-Chlordane	5103-74-2	PEST	1.7					
Chlordane			NA					
Toxaphene	8001-35-2	PEST	90	1200	Channel catfish	*Ictalurus punctatus*	Y	growth of fingerling (5 g)
Herbicides			ug/kg	ug/kg				
2,4 - D	94-75-7	HERB	10					
2,4 - DB	94-82-6	HERB	10					
2,4,5 - TP (Silvex)	93-72-1	HERB	10					
2,4,5, - T	93-76-5	HERB	10					
Dalapon	75-99-0	HERB	2000					
Dicamba	1918-00-9	HERB	20					
Dichloroprop	120-36-5	HERB	100					
Dinoseb	88-85-7	HERB	100	910	Fathead minnow	*Pimephales promelas*	Y	survival, growth
MCPA	94-74-6	HERB	2000					
MCPP	93-65-2	HERB	2000					
4-Nitrophenol (see SVOCs)	100-02-1	HERB	50	25100	Fathead minnow	*Pimephales promelas*	N	survival, growth
Pentachlorophenol (see SVOCs)	87-86-5	HERB	20	12600	Fathead minnow	*Pimephales promelas*	Y	growth
PCBs			ug/kg	ug/kg				
Total PCBs			NA					
Aroclor-1016	12674-11-2	PCB	10	77000	Sheepshead minnow	*Cyprinodon variegatus*	Y	suvival of egg (saltwater fish)
Aroclor-1221	11104-28-2	PCB	10					
Aroclor-1232	11141-16-5	PCB	10	14000	Channel catfish	*Ictalurus punctatus*	N	survival, growth
Aroclor-1242	53469-21-9	PCB	10	278000	Fathead minnow	*Pimephales promelas*	N	survival, growth
Aroclor-1248	12672-29-6	PCB	10	2800	Fathead minnow	*Pimephales promelas*	Y	growth of embryo-adult
Aroclor-1254	11097-79-1	PCB	10	741000	Fathead minnow	*Pimephales promelas*	Y	survival, growth
Aroclor-1260	11096-82-5	PCB	10	350000	Fathead minnow	*Pimephales promelas*	N	survival, growth, reproduction
Dioxins and Dibenzofurans			ng/kg	ng/kg				
2,3,7,8 - TCDD	1746-01-6	DIOXIN	1	143	Yellow perch	*Perca flavescens*	Y	survival, growth of fingerling
1,2,3,7,8 - PeCDD	40321-76-4	DIOXIN	5					
1,2,3,4,7,8 - HxCDD	39227-28-6	DIOXIN	5					
1,2,3,6,7,8 - HxCDD	57653-85-7	DIOXIN	5					
1,2,3,7,8,9 - HxCDD	19408-74-3	DIOXIN	5					
1,2,3,4,6,7,8 - HpCDD	35822-46-9	DIOXIN	5					
1,2,3,4,5,6,7,8 - OCDD	3268-87-9	DIOXIN	10					
2,3,7,8 - TCDF	51207-31-9	DIOXIN	1	2500	Rainbow trout	*Oncorhynchus mykiss*	Y	survival, growth of fry
1,2,3,7,8 - PeCDF	57117-41-6	DIOXIN	5					
2,3,4,7,8 - PeCDD	57117-31-4	DIOXIN	5					
1,2,3,4,7,8 - HxCDF	70648-26-9	DIOXIN	5					
1,2,3,6,7,8 - HxCDF	57117-44-9	DIOXIN	5					
1,2,3,7,8,9 - HxCDF	72918-21-9	DIOXIN	5					
2,3,4,6,7,8 - HxCDF	60851-34-5	DIOXIN	5					
1,2,3,4,6,7,8 - HpCDF	67562-39-4	DIOXIN	5					
1,2,3,4,7,8,9 - HpCDF	55673-89-7	DIOXIN	5					
1,2,3,4,5,6,7,8 - OCDF	39001-02-0	DIOXIN	10					
Total TCDD	41903-57-5	DIOXIN	1					
Total PeCDD	36088-22-9	DIOXIN	5					
Total HxCDD	34465-46-8	DIOXIN	5					
Total HpCDD	37871-00-4	DIOXIN	5					
Total TCDF	55722-27-5	DIOXIN	1					
Total PeCDF	30401-15-4	DIOXIN	5					
Total HxCDF	55684-94-1	DIOXIN	5					
Total HpCDF	38988-75-3	DIOXIN	5					

NOTES:

* Jarvinen and Ankley (1999). Database for Aquatic Organisms Exposed to Inorganic and Organic Chemicals. All RBCs are whole body burdens.

Table 1-7b
Ecological Risk-Based Concentrations (RBCs) for Fish Tissue
Sauget Area 1, Illinois

Analyte	CAS #	Analyte class	Project Reporting Limit for tissue (mg/kg or ug/kg wet weight)	Fish RBC[a] (mg/kg or ug/kg wet weight)	Common Name of Fish	Latin Name of Fish	Does the study have a LOAEL?	Endpoint, Miscellaneous Notes

A study using both a NOAEL and LOAEL was chosen when whenever possible. A receptor fish or a closely related one was used whenever possible.
Saltwater fish and salmonids were not used unless necessary. Priorities were as follows: whole body, NOAEL and LOAEL; freshwater; similar fish/nonsalmonid.
[b] Cannot be separated from Diphenylamine

Table 1-7c
Ecological Risk-Based Concentrations (RBCs) for Crustacean Tissue
Sauget Area 1, Illinois

Analyte	CAS #	Analyte class	Project Reporting Limit for Tissue (mg/kg or ug/Kg) wet weight	Crustacean RBC a (mg/kg or ug/kg wet weight)	Common Name of Crustacean	Latin Name of Crustacean	Does the study have a LOAEL?	Endpoint, Miscellaneous Notes
RBC = Risk-Based Concentration								
Inorganic Analytes			mg/kg	mg/kg				
Aluminum	7429-90-5	Metal	3					
Antimony	7440-36-0	Metal	0.2					
Arsenic	7440-38-2	Metal	0.2	1.28	Grass shrimp	*Palaemonetes pugio*	N	growth (saltwater)
Beryllium	7440-41-7	Metal	1					
Cadmium	7440-43-9	Metal	0.5	0.9	Crayfish	*Orconectes virilis*	Y	survival
Chromium (total)	7440-47-3	Metal	0.5	1.0	Sand crab	*Portunus pelagicus*	Y	growth of juvenile (saltwater)
(Chromium (III))		Metal	NA					
Copper	7440-50-8	Metal	2	50	Crayfish	*Orconectes rusticus*	N	survival
Lead	7439-92-1	Metal	0.5					
Mercury	7439-97-6	Metal	0.02					
Nickel	7440-02-0	Metal	10					
Selenium	7782-49-2	Metal	0.5					
Silver	7440-22-4	Metal	0.1					
Zinc	7440-66-6	Metal	2	12.7	Crayfish	*Orconectes virilis*	Y	survival; may have been adapted to low conc's
Cyanide	57-12-5	WetChem	10					
Semivolatile Organic Analytes			ug/kg	ug/kg				
Phenol	108-95-2	SVOC	170	701000	Crustacean	*Asellus aquaticus*	see Endpoint	recovery (?): higher conc. of 1050 leads to immobilization
bis(2-Chloroethyl)ether	111-44-4	SVOC	170					
2-Chlorophenol	95-57-8	SVOC	170					
1,3-Dichlorobenzene	541-73-1	SVOC	170					
1,4-Dichlorobenzene	106-46-7	SVOC	170					
1,2-Dichlorobenzene	95-50-1	SVOC	170					
2-Methylphenol	95-48-7	SVOC	170					
2,2-oxybis(1-Chloropropane)	108-60-1	SVOC	170					
4-Methylphenol	106-44-5	SVOC	170					
N-Nitroso-di-n-propylamine	621-64-7	SVOC	170					
Hexachloroethane	67-72-1	SVOC	170					
Nitrobenzene	98-95-3	SVOC	170					
Isophorone	78-59-1	SVOC	170					
2-Nitrophenol	88-75-5	SVOC	170					
2,4-Dimethylphenol	105-67-9	SVOC	170					
bis(2-Chloroethoxy)methane	111-91-1	SVOC	170					
2,4-Dichlorophenol	120-83-2	SVOC	170					
1,2,4-Trichlorobenzene	120-82-1	SVOC	170					
Naphthalene	91-20-3	SVOC	170					
4-Chloroaniline	106-47-8	SVOC	170					
Hexachlorobutadiene	87-68-3	SVOC	170					
4-Chloro-3-methylphenol	59-50-7	SVOC	170					
2-Methylnaphthalene	91-57-6	SVOC	170					
Hexachlorocyclopentadiene	77-47-4	SVOC	170					
2,4,6-Trichlorophenol	88-06-2	SVOC	170					
2,4,5-Trichlorophenol	95-95-4	SVOC	420					
2-Chloronaphthalene	91-58-7	SVOC	170					
2-Nitroaniline	88-74-4	SVOC	420					
Dimethylphthalate	131-11-3	SVOC	170					
Acenaphthylene	208-96-8	SVOC	170					
2,6-Dinitrotoluene	606-20-2	SVOC	170					
3-Nitroaniline	99-09-2	SVOC	170					
Acenaphthene	83-32-9	SVOC	170					
2,4-Dinitrophenol	51-28-5	SVOC	420					
4-Nitrophenol	100-02-7	SVOC	420					
Dibenzofuran	132-64-9	SVOC	170					
2,4-Dinitrotoluene	121-14-2	SVOC	170					
Diethylphthalate	84-66-2	SVOC	170					
4-Chlorophenyl-phenylether	7005-72-3	SVOC	170					
Fluorene	86-73-7	SVOC	170					
4-Nitroaniline	100-01-6	SVOC	420					
4,6-Dinitro-2-methylphenol	534-52-1	SVOC	420					
N-Nitrosodiphenylamine [b]	86-30-6	SVOC	170					
4-Bromophenyl-phenylether	101-55-3	SVOC	170					
Hexachlorobenzene (HCB)	118-74-1	SVOC	170					
Pentachlorophenol	87-86-5	SVOC	420					
Phenanthrene	85-01-8	SVOC	170					

Table 1-7c
Ecological Risk-Based Concentrations (RBCs) for Crustacean Tissue
Sauget Area 1, Illinois

Analyte	CAS #	Analyte class	Project Reporting Limit for Tissue (mg/kg or ug/kg) wet weight	Crustacean RBC * (mg/kg or ug/kg wet weight)	Common Name of Crustacean	Latin Name of Crustacean	Does the study have a LOAEL?	Endpoint, Miscellaneous Notes
Anthracene	120-12-7	SVOC	170					
Carbazole	86-74-8	SVOC	170					
Di-n-butylphthalate	84-74-2	SVOC	170					
Fluoranthene	206-44-0	SVOC	170					
Pyrene	129-00-0	SVOC	170					
Butylbenzylphthalate	85-68-7	SVOC	170					
3,3'-Dichlorobenzidine	91-94-1	SVOC	170					
Benzo(a)anthracene	56-55-3	SVOC	170					
Chrysene	218-01-9	SVOC	170					
bis(2-Ethylhexyl)phthalate	117-81-7	SVOC	170					
Di-n-octylphthalate	117-84-0	SVOC	170					
Benzo(b)fluoranthene	205-99-2	SVOC	170					
Benzo(k)fluoranthene	207-08-9	SVOC	170					
Benzo(a)pyrene	50-32-8	SVOC	170					
Indeno(1,2,3-cd)pyrene	193-39-5	SVOC	170					
Dibenz(a,h)anthracene	53-70-3	SVOC	170					
Benzo(g,h,i)perylene	191-24-2	SVOC	170					
Pesticides			ug/kg	ug/kg				
α-BHC (Hexachlorocyclohexane, HCH)	319-84-6	PEST	1.7	4500	Brine shrimp	*Artemia saline*	Y	survival (saltwater)
β-BHC	319-85-7	PEST	1.7					
δ-BHC	319-86-8	PEST	1.7					
γ-BHC (Lindane)	58-89-9	PEST	1.7					
Total BHC (mixed isomers)			NA					
Heptachlor	76-44-8	PEST	1.7					
Aldrin	309-00-2	PEST	1.7					
Heptachlor epoxide	1024-57-3	PEST	1.7					
Endosulfan I	959-98-8	PEST	1.7					
Dieldrin	60-57-1	PEST	3.3					
4,4'-DDE	72-55-9	PEST	3.3					
Endrin	72-20-8	PEST	3.3	50	Grass shrimp	*Palaemonetes pugio*	Y	Growth, survival (saltwater)
Endosulfan II	33213-65-9	PEST	3.3					
4,4'-DDD	72-54-8	PEST	3.3					
Endosulfan sulfate	1031-07-8	PEST	3.3					
Endosulfan			NA	70	Grass shrimp	*Palaemonetes pugio*	Y	survival of juvenile-adult (saltwater)
4,4'-DDT	50-29-3	PEST	3.3	130	Blue crab	*Callinectes sepidus*	Y	survival (saltwater)
DDT and metabolites			NA	60	Pink shrimp	*Panaeus duorarum*	Y	survival of juveniles (saltwater)
Methoxychlor	72-43-5	PEST	17	170	Dungeness crab	*Cancer magister*	Y	survival (saltwater)
Endrin ketone	53494-70-5	PEST	3.3					
Endrin aldehyde	7421-36-3	PEST	3.3					
α-Chlordane	5103-71-9	PEST	1.7					
γ-Chlordane	5103-74-2	PEST	1.7					
Chlordane			NA					
Toxaphene	8001-35-2	PEST	90	54	Pink shrimp	*Panaeus duorarum*	see Endpoint	**survival reduced by 20%** = divided by ten, LD50 = 0.83

Table 1-7c
Ecological Risk-Based Concentrations (RBCs) for Crustacean Tissue
Sauget Area 1, Illinois

Analyte	CAS #	Analyte class	Project Reporting Limit for Tissue (mg/kg or ug/kg) wet weight	Crustacean RBC [a] (mg/kg or ug/kg wet weight)	Common Name of Crustacean	Latin Name of Crustacean	Does the study have a LOAEL?	Endpoint, Miscellaneous Notes
Herbicides			ug/kg	ug/kg				
2,4 - D	94-75-7	HERB	10					
2,4 - DB	94-82-6	HERB	10					
2,4,5 - TP (Silvex)	93-72-1	HERB	10					
2,4,5 - T	93-76-5	HERB	10					
Dalapon	75-99-0	HERB	2000					
Dicamba	1918-00-9	HERB	20					
Dichloroprop	120-36-5	HERB	100					
Dinoseb	88-85-7	HERB	100					
MCPA	94-74-6	HERB	2000					
MCPP	93-85-2	HERB	2000					
4-Nitrophenol (see semivos list)	100-02-1	HERB	50					
Pentachlorophenol (see semivos)	87-86-5	HERB	20					
PCBs			ug/kg	ug/kg				
Total PCBs			NA					
Aroclor-1016	12674-11-2	PCB	10					
Aroclor-1221	11104-28-2	PCB	10					
Aroclor-1232	11141-16-5	PCB	10					
Aroclor-1242	53469-21-9	PCB	10					
Aroclor-1248	12672-29-6	PCB	10					
Aroclor-1254	11097-79-1	PCB	10		Pink shrimp	*Peneaeus duorarum*	Y	survival of juvenile (saltwater)
Aroclor-1260	11096-82-5	PCB	10		Horseshoe crab	*Limulus polyphemus*	Y	survival, growth of juvenile (saltwater)
Dioxins and Dibenzofurans			ng/kg	ng/kg				
2,3,7,8 - TCDD	1746-01-6	DIOXON	1					
1,2,3,7,8 - PeCDD	40321-76-4	DIOXON	5					
1,2,3,4,7,8 - HxCDD	39227-28-6	DIOXON	5					
1,2,3,6,7,8 - HxCDD	57653-85-7	DIOXON	5					
1,2,3,7,8,9 - HxCDD	19408-74-3	DIOXON	5					
1,2,3,4,6,7,8 - HpCDD	35822-46-9	DIOXON	5					
1,2,3,4,5,6,7,8 - OCDD	3268-87-9	DIOXON	10					
2,3,7,8 - TCDF	51207-31-9	DIOXON	1					
1,2,3,7,8 - PeCDF	57117-41-6	DIOXON	5					
2,3,4,7,8 - PeCDD	57117-31-4	DIOXON	5					
1,2,3,4,7,8 - HxCDF	70648-26-9	DIOXON	5					
1,2,3,6,7,8 - HxCDF	57117-44-9	DIOXON	5					
1,2,3,7,8,9 - HxCDF	72918-21-9	DIOXON	5					
2,3,4,6,7,8 - HxCDF	60851-34-5	DIOXON	5					
1,2,3,4,6,7,8 - HpCDF	67562-39-4	DIOXON	5					
1,2,3,4,7,8,9 - HpCDF	55673-89-7	DIOXON	5					
1,2,3,4,5,6,7,8 - OCDF	39001-02-0	DIOXON	10					
Total TCDD	41903-57-5	DIOXON	1					
Total PeCDD	36088-22-9	DIOXON	5					
Total HxCDD	34465-46-8	DIOXON	5					
Total HpCDD	37871-00-4	DIOXON	5					
Total TCDF	55722-27-5	DIOXON	1					
Total PeCDF	30401-15-4	DIOXON	5					
Total HxCDF	55684-94-1	DIOXON	5					
Total HpCDF	38998-75-3	DIOXON	5					

NOTES:

[a] Jarvinen and Ankley (1999). Database for Aquatic Organisms Exposed to Inorganic and Organic Chemicals. All RBCs are whole body burdens

A study using both a NOAEL and LOAEL was chosen when whenever possible. Crayfish or a closely related crustacean was used whenever possible.

Saltwater crustaceans were not used unless necessary. Priorities were as follows: whole body, NOAEL and LOAEL; freshwater; similar crustacean.

[b] Cannot be separated from Diphenylamine

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The project organization and responsibility for all the Site environmental activities is described in the Support Sampling Plan and other Site Work Plans in Volume 1 and Volume 2. For the Ecological Risk Assessment, the following project organization and responsibilities have been defined. Figure 2-1 represents the Project Team Organization Chart.

2.1 USEPA Remedial Project Manager

Michael McAteer, USEPA Region 5 Remedial Project Manager (RPM) has the overall responsibility for all phases of the EE/CA and RI/FS Site activities at Sauget Area 1.

2.2 USEPA Field Service Section

The USEPA Field Services Section may assist the USEPA RPM in technical review of documents, plans, and data, as needed in support of this project.

2.3 Illinois Environmental Protection Agency Project Manager

The IEPA Project Manager, Candy Morin, has the overall responsibility of ensuring that the project meets the IEPA objectives and quality standards.

2.4 Site Program Manager

The Site Program Manager, Bruce Yare of Solutia has the overall responsibility for ensuring that the project meets EPA objectives and quality standards. In addition, he is responsible for the overall technical quality control, project implementation, and oversight. The Site Program Manager will ensure that technical, financial, and scheduling objectives are achieved successfully. The Site Program Manager will report directly to EPA Region 5 RPM and will provide the major point of contact and control for matters concerning the project. The Site Program Manager will be assisted by the Site Project Manager, Kimberly Perry of Solutia. Their responsibilities include the following.

- Define project objectives and develop a detailed workplans and schedule with the project team;
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;
- Acquire and apply technical and corporate resources as needed to ensure performance within budget and schedule constraints;
- Orient all field leaders and project team staff concerning the project's special considerations;
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;

- Review the work performed on each task to ensure its quality, responsiveness, and timeliness;
- Review and analyze overall task performance with respect to planned requirements;
- Approve all external reports (deliverables) before their submission to EPA Region 5;
- Ultimately be responsible for the preparation and quality of interim and final reports; and
- Represent the project team at meetings and public hearings.

2.5 Ecological Project Manager and Field Leader for Ecological Risk Assessment

The site manager will be supported by the Ecological Project Manger and Field Leader for the Ecological Risk Assessment. Menzie-Cura and Associates, Inc. of Chelmsford, MA will perform the sampling and analysis activities to support the Ecological Risk Assessment evaluation at Sauget Area 1. The Menzie-Cura principals, Jerome Cura, PhD and Charles Menzie, PhD will provide the high-level technical direction for the ecological risk assessment. These principals are responsible for leading and coordinating the day-to-day activities of the various resource specialists under their supervision in support of the Ecological Risk Assessment activities. These Project Managers/Field Leaders are highly experienced environmental professionals and will report directly to the Site Program Manager. Specific Project Managers/Field Leaders responsibilities include the following.

- Provision of day-to-day coordination with the Site Program Manager on technical issues concerning the sampling and analysis of biota for Ecological Risk Assessment;
- Development and implementation of the Ecological Risk Assessment Work Plan, this QAPP/FSP;
- Coordination and management of field staff for the collection of biota and documentation of field observations important for the Ecological Risk Assessment evaluation;
- Implementation of QAPP procedures for the collection and analysis of biota data;
- Adherence to work schedules provided by the Site Program Manager;
- Identification of problems at the field team level, discussion of resolutions and implementation of corrective actions, as necessary; and
- Authorship, review, and approval of Ecological Risk Assessment Report for Sauget Area 1 including coordination and oversight of technical efforts of subcontractors assisting the ecological risk assessment team.

2.6 Ecological Chemistry QA Team

Quality Assurance (QA) oversight for the Ecological Risk Assessment sampling and analysis activities described in this QAPP/FSP will be provided by the team of Nancy C. Rothman, Ph.D. and Susan D. Chapnick, MS, associates of Menzie-Cura. Dr. Rothman will provide chemistry QA oversight and technical assistance for all organic analyses and Ms. Chapnick will provide chemistry QA oversight and technical assistance for all inorganic analyses planned in support of the Ecological Risk Assessment. Responsibilities include:

- Preparation of the QAPP/FSP in support of the Ecological Risk Assessment;
- Development of project DQOs to support the Ecological and Human Health Assessment activities;
- Coordination with the analytical laboratory and field teams, as necessary, to ensure proper implementation of QAPP/FSP procedures;
- Coordination with the Data Validator, as necessary, to determine usability of the data for evaluation of ecological risk;
- Technical assistance to the Ecological Project Manager and the Site Program Manager, as necessary, for chemistry and QA-related issues.

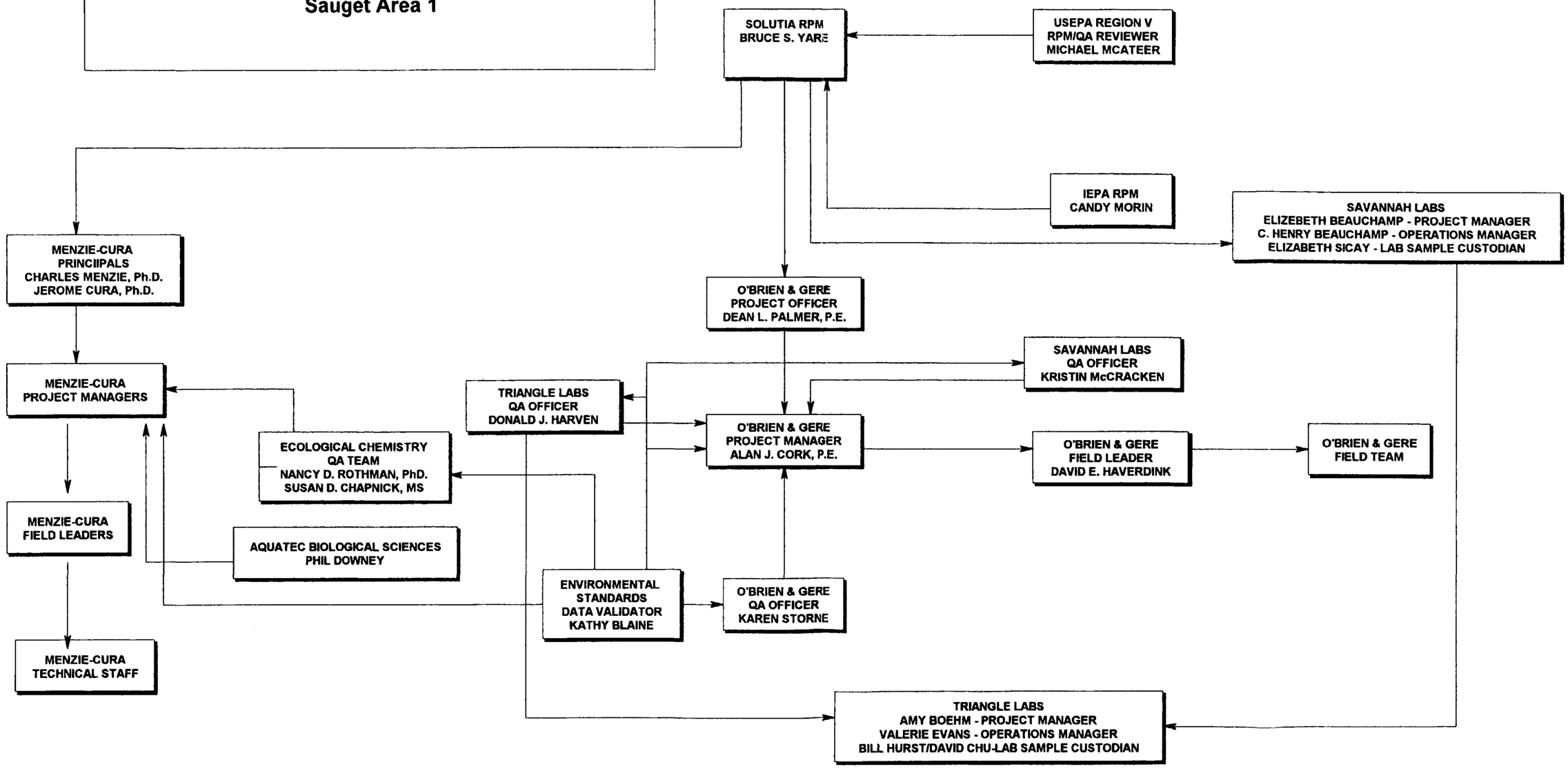
2.7 Technical Staff for the Ecological Risk Assessment Activities

The technical staff (team members) for this Ecological Risk Assessment will be assembled from Menzie-Cura staff. The technical team staff will be utilized to gather and analyze data, and to prepare various task reports and support materials. All of the designated technical team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the Ecological Risk Assessment required work. The technical staff includes field observation and biota collection staff, ecological risk assessors, quality assurance professionals, and regulatory experts.

2.8 Laboratory Project Manager and Quality Assurance

Responsibilities of the analytical laboratory, Savannah River Laboratory, are described in the associated Site QAPP documents for Soil, Groundwater, Surface Water, Sediment, and Air Sampling (Volume 2) and in the laboratory SOPs and QAPP included in Volume 3 of the Site documents. Betsy Beauchamp, (912-354-7858) is the contact for this project at Savannah Lab. The Laboratory Manager is Henry Beauchamp and the QA Manager is Kirstin McCracken. The dioxin analyses will be sub-contracted by Savannah River Laboratory to Triangle Laboratories, Inc. in North Carolina. The contact at Triangle Laboratory for this work is John Gunther, (919-544-5729). The Lab President is J. Ronald Hass, Ph.D. and the QA Officer is Don Harvan. The toxicity testing and benthic community analysis will be performed by Aquatec Biological Sciences, Inc. with Phil Downey as the project contact. Volume 3 of the SSP contains organizational charts for

Figure 2-1. Project Team Organization Chart
Sauget Area 1



Savannah River Laboratory and Triangle Laboratories indicating the organizational structure of these facilities (as part of the lab's Quality Assurance Plans).

2.9 Data Validation Contractor

Data Validation will be performed by Environmental Standards, Inc., Valley Forge, PA. Kathy Blaine is the contact for this project at Environmental Standards. Description of Data Validation responsibilities is included in Volume 4, Data Validation Plan of the SSP.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The Data Quality Objective (DQO) Process is a series of planning steps based on the Scientific Method that is designed to ensure that the type, quantity, and quality of environmental data used in decision making are appropriate for the intended application. The DQO process is presented in *Guidance for the Data Quality Objectives Process, USEPA QA/G-4 (USEPA 1994a).* DQOs are quantitative and qualitative statements derived from outputs of each step of the DQO process that:

- Clarify the study objective;
- Define the most appropriate type of data to collect; and
- Determine the most appropriate conditions from which to collect the data.

The DQO process is developed through a multi-step process that includes the following:

Step 1. State the problem to be resolved.
Step 2. Identify the decision to be made.
Step 3. Identify the inputs to the decision.
Step 4. Define the boundaries of the study.
Step 5. Develop a decision rule.
Step 6. Specify the tolerable limits on decision errors.
Step 7. Optimize the design for obtaining the data.

The overall QA objective for this project is to develop and implement procedures for field sampling, laboratory analysis, chain-of-custody, and reporting for biota samples that will provide results which are technically valid for use in the Ecological Risk Assessment. A secondary objective is to generate valid data for the fish fillets for use in the Human Health Risk Assessment. This section provides in greater detail specific project DQOs and intended data usages mentioned in Section 1 of this QAPP that were developed through the DQO process. The specific risk-based criteria data quality levels in support of the Human Health Risk Assessment can be found in Table 3 of the appendices in the Human Health Risk Assessment Work Plan. The risk-based criteria levels for Ecological Risk Assessment were developed through the DQO process to be consistent with the requirements of the Ecological Risk Assessment Work Plan and are presented in Table 1-7. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance, and corrective action are described in other sections of this QAPP.

Tables 3-1 through 3-6 define the project-specific DQOs that were developed for chemical data collected from biota samples in support of the Ecological Risk Assessment.

3.1 Level of Quality Control Effort

The following specific quality control (QC) parameters will be collected, prepared and analyzed to evaluate the quality of the data generated to support the Ecological Risk Assessment. Tables 3-1 through 3-6 define the level of the quality for the ecological assessment activities through setting project criteria for acceptance of QC sample results. Table 3.7 summarizes the type and frequency of QC samples in support of this QAPP.

Field blanks, laboratory method blanks, field duplicates, laboratory matrix duplicates and matrix spike duplicates, matrix spikes, laboratory control samples, surrogates, laboratory calibration QC, and tissue standard reference materials (SRM) will be analyzed to assess the quality of the data resulting from the field sampling and analysis of the biota samples. For the sediment toxicity studies, see Appendix A for QA/QC procedures and statistical evaluations specific for these evaluations.

3.1.1 Field Blanks

Field blanks for this project will be equipment rinsate blanks consisting of distilled interference-free water, preserved with appropriate preservative (see Tables in Section 4) which will be provided by the laboratory. The field rinsate blanks will be carried to the sampling site, exposed to sampling conditions through rinsing of sampling equipment, and returned to the laboratory to provide the means to assess the quality of the data resulting from the field sampling program. Field blank samples are analyzed to check for procedural contamination that may have occurred during sample collection or handling prior to analysis.

Field rinsate blanks should be collected following the collection of a field sample, after decontamination procedures. EPA Region 5 requires the collection of one field blank for every 10 investigative samples of a given matrix. Therefore, one field rinsate blank will be collected for each of the biota types (fish, benthic, vegetation) and for each of 10 field samples collected (see Table 3-7).

Trip blanks will not be collected because volatile organic compounds are not of interest as bioaccumulation compounds for the Ecological Risk Assessment.

3.1.2 Field Duplicates

Field duplicates (FD) provide a measure of the reproducibility (precision) of the sampling procedures and the representativeness of the samples to Site conditions. Two collocated/separate samples from a single sample location are obtained in the field and prepared and analyzed by the laboratory. Each sample is labeled with a unique sample number, and both are submitted to the laboratory for the appropriate analyses. The target frequency for field duplicate collection is one for every set of 10 samples and for each matrix collected by the same procedure for laboratory analysis. Criteria for FD precision are defined in Tables 3-1 thorough 3-7.

3.1.3 Method Blanks

Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures. Results of method blanks provide an estimate of the within-batch variability of the blank response and an indication of bias introduced by the preparation and analytical procedures. They must be performed for each extraction or digestion batch at a minimum frequency of 1 method blank per 20 field samples. Criteria for method blank acceptance for all compounds of interest in biota are listed in Tables 3-1 through 3-7.

3.1.4 Laboratory or Matrix Duplicates

Duplicate samples are two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. In the laboratory, duplicate samples or matrix duplicates (MD) are analyzed to check for sampling and analytical reproducibility as a measure of precision and representativeness. The duplicate sample is a separate aliquot of a sample that the laboratory prepares and analyzes identical to the original sample. The relative percent difference between the duplicate results is a measure of precision and representativeness. Criteria for laboratory matrix duplicates for all compounds of interest in biota are listed in Tables 3-1 through 3-7. Note that for organic analysis (Table 3-1, 3-3 through 3-6), the matrix duplicate precision requirements are equivalent to those indicated for the field duplicate precision.

3.1.5 Matrix Spikes and Matrix Spike Duplicates

Matrix spikes (MS) and Matrix Spike Duplicates (MSD) provide information about the effect of the sample matrix (media) on the digestion and measurement methodologies. One MS/MSD pair, spiked with the compounds of interest, must be generated for every 20 or fewer biota samples for organic analyses. For inorganic analyses, one MS/MD pair is required for every 20 or fewer biota samples. Criteria for acceptance are based upon percent recoveries of the MS or MSD and are defined for this project in Tables 3-1 through 3-7 based upon those acceptance limits given in the USEPA Contract Laboratory Program; however, as required by SW-846, each laboratory must routinely update the accuracy limits based upon their experience with real-world samples. Therefore, the limits achieved by the laboratories for accuracy may be different than those indicated in these tables.

The relative percent difference of the MS/MSD results also gives a measure of the precision and representativeness of the organic data (see above). Tables 3-1, 3-3, 3-4, 3-5, and 3-6 list the criteria for MS/MSD precision for this QAPP.

3.1.6 Laboratory Control Sample/Standard Reference Material

A laboratory control sample (LCS) and/or standard reference material (SRM) will be prepared and analyzed with each batch of field biota samples or at a minimum frequency of one LCS or SRM per 20 biota samples. The LCS or SRM will contain the compounds of interest, for organics and inorganics, in an appropriate tissue matrix as available from a reliable, verifiable

source (e.g., NIST, certified vendor). The results of the LCS or SRM must meet vendor's limits for acceptance and measures the accuracy of the method. See Table 3-2 for project criteria for inorganic compounds (metals and cyanide).

For organics, standard reference material will be obtained for tissues (biota), as available, for the compounds of interest. Vendor-generated 95% confidence limits will be the acceptance criteria for the SRMs. For organics, SRMs should be analyzed at a frequency of 1 per 20 samples or per laboratory sample batch.

3.1.7 Surrogate Spikes

A surrogate spike contains pure substances not usually found in nature, with properties that mimic the compounds of interest. This spike is added to all organic samples prior to extraction to assess the accuracy of the method in the sample matrix. Criteria for surrogate spike recoveries are listed in Tables 3-1, 3-3, 3-4, 3-5, and 3-6 based upon those acceptance limits given in the USEPA Contract Laboratory Program; however, as required by SW-846, each laboratory must routinely update the accuracy limits based upon their experience with real-world samples. Therefore, the limits achieved by the laboratories for accuracy may be different than those indicated in these tables.

3.1.8 Laboratory Calibration Check Samples

A variety of QC samples are analyzed for separate analytical methods to assess the accuracy of the analysis on a day-to-day basis. These QC checks, include but are not limited to the following: criteria for initial calibration, continuing calibration, baseline drift and, contamination, and are performed per method requirements by the laboratory. The details of these QC checks are available in the methods referenced in Section 7 of this QAPP and the laboratory specific SOPs for analysis. A summary is presented in Table 3-7.

3.2 Precision

Precision is a measure of the degree to which two or more measurements are in agreement. Field and laboratory precision QC requirements for this project are listed in Tables 3-1 through 3-7. Field and laboratory precision will be assessed through the calculation of relative percent differences (RPD) of the field duplicate results, matrix spike duplicate results, and matrix duplicate results. The equations to be used for calculation of precision criteria in this project can be found in Section 12 of this QAPP.

3.2.1 Field Precision Objectives

Field precision will be assessed through the collection and measurement of field duplicates as described in Section 3.1.2.

3.2.2 Laboratory Precision Objectives

Laboratory precision will be assessed through the preparation and analysis of matrix spike duplicate samples (for organic compounds) and matrix duplicate samples (for metals and organic compounds) results as described in Section 3.1.2.

3.3 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference or true value. Accuracy will be assessed through the evaluation of recoveries of spiked compounds of interest into biota samples, as well as the evaluation of standard reference materials (SRM) for tissues, and through the evaluation of field and laboratory blanks. Tables 3-1 through 3-6 provide accuracy criteria for matrix spike (MS) and matrix spike duplicate (MSD) samples, laboratory control samples, and blanks for this program. The limits in Tables 3-1 through 3-6 are those which have been established through the USEPA Contract Laboratory Program; however, as required by SW-846, each laboratory must routinely update the accuracy limits based upon their experience with real-world samples. Therefore, the limits achieved by the laboratories for accuracy may be different than those indicated in these tables. The equations to be used for accuracy in this project can be found in Section 12 of this QAPP.

3.3.1 Field Accuracy Objectives

Accuracy in the field will be assessed through the use of field blanks (equipment rinsate blanks) as described in Section 3.1.1. and through the strict adherence to all sample handling, preservation, and holding times to maintain the integrity of the biota sample

3.3.2 Laboratory Accuracy Objectives

Laboratory accuracy will be assessed through the analysis of Method Blanks (as described in Section 3.1.3), MS/MSD (as described in Section 3.1.5), standard reference materials (SRM) and laboratory control samples (LCS) (as described in Section 3.1.6), surrogate compound spikes (as described in Section 3.1.7), laboratory calibration checks (as described in Section 3.1.8), and the determination of percent recoveries of these QC samples. Accuracy control limits are given in Table 3.1-3.6 and also in the applicable SOPs as referenced in Section 7 of this QAPP. Note that all chemicals of concern included in Tables 1-1 through 1-6 of this QAPP must be included in method spiking solutions for the LCS and MS/MSD samples.

3.4 Sensitivity - Reporting Limit Requirements

The sensitivity or reporting limit requirements for this project were defined to meet Ecological Risk Assessment requirements. Tables 1-1 through 1-6 list the compounds of concern, the media (biota) to be sampled and analyzed, and the ecological project-required reporting limits for the level of detection.

These reporting limits will be achieved in tissue samples through following the procedures as specified in this QAPP in Section 7. Note that the achievable reporting limits in tissue samples may be affected by matrix interferences. Sample cleanups, such as GPC and silica gel, may be performed by the laboratory to minimize matrix effects and to obtain project reporting limits.

Additionally, see Section 1.5 for the rationale for the project reporting limits and discussion of approach to report down to the MDLs when necessary to achieve risk-based levels of detection. If the laboratory reports down to the MDL for any compound, they will flag the data with a "J" as an estimated value (reported below their PQL).

3.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. The equation for completeness is presented in Section 12 of this QAPP.

3.5.1 Field Completeness Objectives

Field completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The field completeness objective for this project is greater than or equal to 90 percent.

Note that to support the ecological risk assessment, field completeness refers to the collection of biota samples and the documentation of ecological observations on site. No field measurements are planned in support of the ecological risk assessment. QC objectives for field measurements planned for other Site activities can be found in the associated QAPP and FSP documents in Volume 2.

3.5.2 Laboratory Completeness Objectives

Laboratory completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The laboratory completeness objective for this project, with respect to the chemical data being generated for biota in support of the Ecological Risk Assessment (see Tables 1-1 through 1-6 of this QAPP) is greater than or equal to 90 percent.

3.6 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 within a defined spatial and/or temporal boundary. Representativeness is dependent upon the proper design of the sampling program. The field sampling rationale, as presented in the Ecological Risk Assessment Work Plan in Volume 1 and the Ecological Assessment Field Sampling Plan in Section 4 of this QAPP, has been developed to collect representative samples of biota to assess ecological impacts at Sauget Area 1.

3.6.1 Measures to Ensure Representativeness of Field Data

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the procedures described in the Ecological Risk Assessment Work Plan in Volume 1 and the Ecological Assessment Field Sampling Plan in Section 4 of this QAPP are followed. The media of concern for sampling in this QAPP are biota including fish, vegetation, and benthic invertebrates. One measure of the representativeness of the samples to the site includes the precision of the field duplicate measurements (as described in Section 3.1.2).

3.6.2 Measures to Ensure Representativeness of Laboratory Data

Representativeness in the laboratory is ensured by using the analytical procedures defined in this QAPP (see Section 7), maintaining proper preservation and meeting sample holding times to maintain sample integrity, performing appropriate homogenization and aliquoting procedures to ensure representative samples for analysis, and analyzing and assessing field and laboratory duplicate samples (as described in Section 3.1.4).

3.7 Comparability

Comparability is an expression of the confidence with which one data set can be compared to another. Comparability is dependent upon the proper design of the field sampling and analytical measurement program.

3.7.1 Measures to Ensure Comparability of Field Data

Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the Ecological Assessment Field Sampling Plan (Section 4 of this QAPP) is followed.

3.7.2 Measures to Ensure Comparability of Laboratory Data

Planned analytical data will be comparable when similar sampling and analytical methods are used and documented as required by this QAPP. Comparability is also dependent on consistent QA objectives. As such, comparability of data for the biota to be sampled and analyzed in support of the Ecological Risk Assessment will be achieved by following the sampling procedures for collection of biota as described in Section 4 of this QAPP, by using standard EPA methods for analysis of tissues with modifications for tissue extraction as described in Section 7 of this QAPP, and by evaluating the validity and usability of the data generated for the risk assessment using standard EPA procedures and QA/QC criteria defined in this QAPP as described in Section 9 of this QAPP and the Data Validation Plan (Volume 4).

Table 3-1. Analytical Laboratory Data Quality Objectives for Precision and Accuracy for Semivolatile Organic Compound Analyses of Biota Samples in Support of the Ecological Assessment

PARAMETER	QC COMPOUNDS	FIELD/MATRIX DUPLICATE PRECISION [c] (RPD)	MS/MSD PRECISION (RPD)	BLANKS	MS/MSD [ab] ACCURACY (% RECOVERY)	SURROGATE [ab] ACCURACY (% RECOVERY)
Semivolatile Analysis	All analytes	≤50		≤ 5x RL for phthalates ≤ RL for all others		
	phenol		≤ 35		17-103	
	2-chlorophenol		≤ 50		23-114	
	1,4-dichlorobenzene		≤ 40		10-125	
	N-nitroso-di-n-propylamine		≤ 38		11-117	
	1,2,4-trichlorobenzene		≤ 28		17-105	
	p-chloro-m-cresol		≤ 33		25-107	
	acenaphthene		≤ 25		31-137	
	4-nitrophenol		≤ 50		10-117	
	2,4-dinitrotoluene		≤ 47		26-107	
	pentachlorophenol		≤ 47		10-120	
	pyrene		≤36		18-136	
	nitrobenzene-d_5					12-125
	2-fluorobiphenyl					24-118
	terphenyl-d_{14}					18-153
	phenol-d_5					10-142
	2-fluorophenol					10-118
	2,4,6-tribromophenol					14-121
	2-chlorophenol-d_4					20-130 *
	1,2-dichlorobenzene-d_4					20-130 *

NOTES:

General: All method requirements for QC frequency and criteria for acceptance, as defined in the EPA methods for this program (SW846 Method 8270C), must be followed.

* Advisory Limits Only

[a] Provision for wider acceptance limits near the RL may be based on professional judgment during data review/validation.

[b] As required by EPA SW846 Method 8270C, these QC limits represent the laboratory-specific limits for accuracy and precision based on analysis of biota samples.

[c] Field duplicate precision based on technical judgment and USEPA National Functional Guidelines for duplicate precision.

Table 3-2. Analytical Laboratory Data Quality Objectives for Precision and Accuracy for Inorganic Compound Analyses of Biota Samples in Support of the Ecological Assessment

Parameter	QC Compounds	FIELD DUPLICATE PRECISION [c] (RPD)	Sample/MD Precision[a] (RPD)	MS Accuracy (% Recovery)	Blanks	LCS/SRM Accuracy (% Recovery)
Inorganic Analysis (metals and cyanide)	All analytes	≤50	<35% RPD for results >5x RL; difference <± RL for results <5x RL	75-125 [b]	< ± RL	Manufacturer's Control Limits

NOTES:

General: All method requirements for QC frequency and criteria for acceptance, as defined in the EPA methods for this program (SW846 Methods 6010B, 7000 series, 9010B), must be followed.

[a] Provision for wider acceptance limits near the RL may be based on professional judgment during data review/validation.

[b] Unless the sample concentration exceeds the spike added concentration by a factor of 4 or more.

[c] Field duplicate precision based on technical judgment and USEPA National Functional Guidelines for duplicate precision.

Table 3-3. Analytical Laboratory Data Quality Objectives for Precision and Accuracy for Pesticide Analyses of Biota Samples in Support of the Ecological Assessment

PARAMETER	QC COMPOUNDS	FIELD/MATRIX DUPLICATE PRECISION [c] (RPD)	MS/MSD PRECISION (RPD)	BLANKS	MS/MSD [ab] ACCURACY (% RECOVERY)	SURROGATE [ab] ACCURACY (% RECOVERY)
Pesticide Analysis	All analytes	≤50		< RL		
	gamma-BHC (linden)		≤ 50		12-138	
	heptachlor		≤ 38		17-138	
	aldrin		≤ 43		10-144	
	dieldrin		≤ 38		28-137	
	endrin		≤ 45		33-149	
	4,4'-DDT		≤ 50		29-134	
	tetrachloro-m-xylene					10-114
	decachlorobiphenyl					27-128

NOTES:

General: All method requirements for QC frequency and criteria for acceptance, as defined in the EPA methods for this program (SW846 Method 8081A), must be followed.

* Advisory Limits Only

[a] Provision for wider acceptance limits near the RL may be based on professional judgment during data review/validation.

[b] As required by EPA SW846 Methods 8000B and 8081A, these QC limits represent the laboratory-specific limits for accuracy and precision based on analysis of biota samples.

[c] Field duplicate precision based on technical judgment and USEPA National Functional Guidelines for duplicate precision.

Table 3-4. Analytical Laboratory Data Quality Objectives for Precision and Accuracy for Herbicide Analyses of Biota Samples in Support of the Ecological Assessment

PARAMETER	QC COMPOUNDS	FIELD/MATRIX DUPLICATE PRECISION[c] (RPD)	MS/MSD PRECISION (RPD)	BLANKS	MS/MSD [ab] ACCURACY (% RECOVERY)	SURROGATE [ab] ACCURACY (% RECOVERY)
Herbicide Analysis	All analytes	≤50		< RL		
	2,4-D		≤ 50		19-153	
	2,4-DB		≤ 50		20-160	
	2,4,5-TP (silvex)		≤ 50		27-120	
	dalapon		≤ 50		10-170	
	dicamba		≤ 50		20-160	
	2,4-dichlorophenyl acetic acid (DCAA)					30-189

NOTES:

General: All method requirements for QC frequency and criteria for acceptance, as defined in the EPA methods for this program (SW846 Method 8151A), must be followed.

[a] Provision for wider acceptance limits near the RL may be based on professional judgment during data review/validation.

[b] As required by EPA SW846 Methods 8000B and 8151A, these QC limits represent the laboratory-specific limits for accuracy and precision based on analysis of biota samples.

[c] Field duplicate precision based on technical judgment and USEPA National Functional Guidelines for duplicate precision.

Table 3-5. Analytical Laboratory Data Quality Objectives for Precision and Accuracy for Dioxin and Dibenzofuran Analyses of Biota Samples in Support of the Ecological Assessment

PARAMETER	QC COMPOUNDS	FIELD/MATRIX DUPLICATE PRECISION (RPD)	MS/MSD PRECISION (RPD)	BLANKS	INTERNAL [a] STANDARD ACCURACY (% RECOVERY)	RECOVERY STANDARD ACCURACY
Dioxin and Dibenzo-furan Analysis	All analytes	≤ 25		< RL		
	2,3,7,8-TCDD		≤ 20			
	1 2,3,7,8-TCDF		≤ 20			
	1,2,3,7,8-PeCDD		≤ 20			
	1,2,3,7,8-PeCDF		≤ 20			
	2,3,4,7,8-PeCDF		≤ 20			
	1,2,3,4,7,8-HxCDD		≤ 20			
	1,2,3,6,7,8-HxCDD		≤ 20			
	1,2,3,7,8,9-HxCDD		≤ 20			
	1,2,3,4,7,8-HxCDF		≤ 20			
	1,2,3,6,7,8-HxCDF		≤ 20			
	1,2,3,7,8,9-HxCDF		≤ 20			
	2,3,4,6,7,8-HxCDF		≤ 20			
	1,2,3,4,6,7,8-HpCDD		≤ 20			
	1,2,3,4,6,7,8-HpCDF		≤ 20			
	1,2,3,4,7,8,9-HpCDF		≤ 20			
	OCDD		≤ 20			
	OCDF		≤ 20			
	$^{13}C_{12}$-2,3,7,8-TCDD				40-135	
	$^{13}C_{12}$-2,3,7,8-TCDF				40-135	
	$^{13}C_{12}$-1,2,3,7,8-PeCDD				40-135	
	$^{13}C_{12}$-1,2,3,7,8-PeCDF				40-135	
	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD				40-135	
	$^{13}C_{12}$-1,2,3,4,7,8-HxCDF				40-135	
	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD				40-135	
	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF				40-135	
	$^{13}C_{12}$-OCDD					Method LCL and UCL Criteria Met
	$^{13}C_{12}$-1,2,3,4-TCDD					
	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD					

NOTES:

General: All method requirements for QC frequency and criteria for acceptance, as defined in the EPA methods for this program (SW846 Method 8290), must be followed.

[a] Provision for wider acceptance limits near the RL may be based on professional judgment during data review/validation.

Table 3-6. Analytical Laboratory Data Quality Objectives for Precision and Accuracy for PCB Analyses of Biota Samples in Support of the Ecological Assessment

PARAMETER	QC COMPOUNDS	FIELD/MATRIX DUPLICATE PRECISION (RPD)	MS/MSD PRECISION (RPD)	BLANKS	MS/MSD [ab] ACCURACY (% RECOVERY)	SURROGATE [ab] ACCURACY (% RECOVERY)
PCB Analysis	All analytes	≤50		< RL		
	Aroclor 1016		≤ 44		34-137	
	Aroclor 1254		≤ 50		40-122	
	Tetrachloro-m-xylene					10-114
	Decachlorobiphenyl					27-128

NOTES:

General: All method requirements for QC frequency and criteria for acceptance, as defined in the EPA methods for this program (SW846 Method 8082), must be followed.

[a] Provisions for wider acceptance limits near the RL may be based on professional judgment during data review/validation.

[b] As required by EPA SW846 Methods 8000B and 8082, these QC limits represent the laboratory-specific limits for accuracy and precision based on analysis of biota samples. The MS/MSD should contain the most representative PCBs for the site.

[c] Field duplicate precision based on technical judgment and USEPA National Functional Guidelines for duplicate precision.

Table 3-7. Summary of QC Sample Types, Criteria, and Corrective Action

Field Generated QC Samples

TYPE	PURPOSE	FREQUENCY	CRITERIA	CORRECTIVE ACTION
Field Blank (Equipment Rinsate Blanks)	Evaluate cleanliness of sample containers and sample handling and collection procedures	1 per media per 10 field samples collected	all compounds of interest ≤ RL	Qualify data
Field Duplicate	Evaluate precision and representativeness taking into account variability of sample matrix	1 per media per 10 field samples	±50% RPD with provisions for wider acceptance limits near the detection limits	Compare to matrix duplicates, check for possible matrix interferences or improper sample collection procedure, qualify data
Laboratory Generated QC Samples				
Laboratory Control Sample (LCS) and Standard Reference Material (SRM)	Evaluate laboratory performance (accuracy) using verified standards from an outside source	1 per media per 20 field samples or per laboratory sample batch, whichever is more frequent	Vendor-supplied: Within the 95% confidence interval/ vendor supplied limits	Re-prepare and re-analyze associated samples to obtain acceptable LCS/SRM. Check if MS/MSD acceptable to compare for matrix effects
Calibration Check Sample	Verifies calibration curve	Minimum of 1 per analytical batch per day	90-110% recovery for inorganics; as specified in EPA methods for organics listed in Table 7-1	Recalibrate; check system
Method Blank	Verifies clean reagents, instrument systems, and lab procedures	Minimum of 1 per analytical batch or per 20 field samples; whichever is more frequent	All compounds of interest < RL	Reanalyze; if second blank exceeds criteria, clean and recalibrate system; document corrective action

Table 3-7. Summary of QC Sample Types, Criteria, and Corrective Action

Field Generated QC Samples

TYPE	PURPOSE	FREQUENCY	CRITERIA	CORRECTIVE ACTION
Matrix Spikes and Matrix Duplicates (MS/MSD/MD)	Evaluate precision and accuracy taking into account variability of sample matrix	1 set per media per 20 field samples	Recoveries for MS/MSD specified in Tables 3-1 through 3-6 and in laboratory SOPs. RPD for sample/MD in Tables 3-1 through 3-6	Qualify data for matrix effect if LCS/SRM is acceptable. Qualify sample/MD if precision is not acceptable. If LCS/SRM is not acceptable, see above
Surrogate Standards	Measures recoveries in actual sample matrices	All GC/MS and all GC samples for organic analyses	Recoveries as specified in Tables 3-1, 3-3, 3-4, 3-5, 3-6 and in laboratory SOPs	Reanalyze samples; qualify data
Internal Standards	Provides standard for calculating analyte response and concentrations	All GC/MS and GC samples for organic analyses	Recoveries as specified in the EPA methods listed in Table 7-1.	Reanalyze samples; qualify data

RL = Reporting Limit
MS = Matrix Spike Sample
MSD = Matrix Spike Duplicate Sample
MD = Matrix Duplicate Sample
SRM = Standard Reference Material
LCS = Laboratory Control Sample
RPD = Relative Percent Difference (between duplicate results)
GC = Gas Chromatography
GC/MS = Gas Chromatography/Mass Spectrometry

NOTE:

Qualification criteria and qualifier for each QC parameter are given in SSP, Volume 4, Data Validation Plan.

All additional EPA method QC, including initial and continuing calibration requirements and criteria for acceptance, must be followed. Laboratories will follow the method-specific corrective actions for these QC criteria, as defined in the EPA methods listed in Section 7 of this QAPP and the internal quality control checks defined in Section 8 of this QAPP.

4.0 ECOLOGICAL ASSESSMENT FIELD SAMPLING PLAN

This section is the Field Sampling Plan (FSP) for the Ecological Risk Assessment. It describes the conceptual approach for a Reconnaissance Survey and a Main Sampling Event, locations for collection of biota and sediment, collection procedures, number of samples to be collected, labeling and chain-of-custody requirements, container and preservation requirements, and holding times. This FSP supports the activities for the Ecological Risk Assessment Work Plan (included in Volume 2 of the SSP). Field sampling personnel will follow the procedures documented in this section, the associated field sampling SOPs included in Appendix B, and the Ecological Risk Assessment Health and Safety Plan (HSP) included in Appendix C.

4.1 Study Area

The ecological assessment focuses on Dead Creek (Creek) and a Borrow Pit to which the Creek drains. The Site map of the study area is presented in Section 1, Figure 1-1 of this QAPP. For a Site map showing proposed sample locations for the ERA, see Figure 4-1 at the end of this section. This aquatic and wetland system will be sampled along with two reference areas to provide data in support of the Ecological Risk Assessment (ERA). Samples will be collected to evaluate risks to biota within the system as well as wildlife that are dependent on wetland and aquatic environments for food or habitat. Much of the land bordering the system is developed for residential and/or commercial use. Therefore, exposure to terrestrial ecological receptors is considered to be secondary to exposure to aquatic biota. The assessment considers exposure to those terrestrial receptors that utilize the shorelines for habitat and rely on aquatic biota (e.g., plants, crayfish, or fish) as a source of food. Data on chemical body burdens in fish will also be used to support the Human Health Risk Assessment (HHRA).

Sampling for ERA purposes will be carried out in Dead Creek Segments B through F which form the creek-like portion of the water body. Segment F extends into the Borrow Pit Pond. Site M is connected to Dead Creek within Sector B.

Dead Creek begins south of an industrial zone adjacent to the Cerro property and flows slowly south through residential neighborhoods. The stream is bordered by a dense, narrow band of riparian trees and shrubs, including cottonwood, willow, mulberry, and box elder. Homeowners have cleared to the Creek's edge and have established lawns along several sections. Within the residential area the stream is crossed, via culverts, by seven roads. At the Judith Lane road crossing, the road culvert has been set approximately one foot higher than the observed water level, apparently to allow drainage of the channel only during high-water events. The pooled channel behind this road is connected to a small pond located at the end of Walnut Street where herons, painted turtle, wood duck, fish, and evidence of beaver (chewed trees) were observed.

Downstream of the impounded channel Dead Creek segments C and D flow south through bordering wetlands. For a short section, adjacent to Parks College, the Creek is routed through a culvert under a parking area. Throughout the rest of the Creek's length it is bordered by either riparian vegetation or lawn. Emergent and aquatic vegetation occurs along the Creek's shores.

West of Route 3 the Creek flows south and west through the American Bottoms floodplain. This area contains active and abandoned agricultural land divided by levees and railroad right-of-ways. After crossing Route 3 Dead Creek flows under a railroad right-of-way and is joined by a stream draining land from the north. North of the confluence of these two waterways is a road that cuts SE to NW across the floodplain, connecting Cahokia to Fox Terminal. To the north (upstream) of this road is a gas tank farm and fields. The stream was observed to flow south under the Fox Terminal road and into Dead Creek. A second dry culvert was observed west of the stream crossing in the vicinity of the north end of the Dead Creek Borrow Pit Pond. This culvert appeared to drain the land north of the Fox Terminal road during high-water events when water from the tank farm and surrounding area becomes impounded behind the roadway.

Creek Sector B (CS-B) includes 1,800 feet of an intermittent portion of Dead Creek which lies between Queeny Avenue to the north and Judith Lane to the south. The banks of the Creek are heavily vegetated, and debris is scattered throughout the northern portion of CS-B. The entire length of CS-B was fenced by USEPA in 1982. Near the southern portion of CS-B, Dead Creek is connected to Site M by an 8-foot wide cut-through.

Creek Sectors C through F (CS-C, CS-D, and CS-F) include the entire length of Dead Creek south of Judith Lane. This portion of the Creek flows south-southwest through the village of Cahokia prior to discharging into the Prairie Du Pont Creek. CS-C through CS-F are delineated as follows: CS-C extends from Judith Lane at the north end to Cahokia Street to the south; CS-D extends from Cahokia Street to Jerome Street; CS-E extends from Jerome Street to the intersection of Illinois Routes 3 and 157; and CS-F which includes the Borrow Pit Pond extends from this intersection to the discharge point at Prairie Dupont Creek.

Sectors C, D, and E are dominated by intermittent flow. Sectors C and D are located adjacent to residential areas. Sector E runs through mostly commercial developments. Access to Dead Creek Sectors C through F is unrestricted. In the southern portion of CS-E near Parks College, Dead Creek temporarily passes through corrugated pipe, and downstream of this point the Creek passes through a series of culverts prior to draining into a large wetland area (part of CS-F) west of Illinois Route 3. Dead Creek is wider in sector CS-F than in the upgradient sectors. Creek Sector-F is approximately 6,500 feet long and extends from Route 157 to the Old Prairie du Pont Creek. CS-F is the widest sector of Dead Creek and a large wetland area extends several hundred feet out from both sides of the Creek.

The Borrow Pit Pond that forms part of Creek Sector F appears to have been excavated during the construction of the local levee system. The United States Geological Survey (USGS) map of the area (Cahokia) indicates that the Pond was dug to its current shape sometime after 1954. The Pond is the largest non-flowing waterbody in the area. Its shore is surrounded with mature riparian trees and emergent wetland vegetation. Ducks, herons, and fish have been observed in the Pond.

The outlet of the Pond is also considered part of Dead Creek. It drains south through a pump station under the levee and into the ditched section of Prairie du Pont Creek[1]. At the confluence and above it the ditch shore is vegetated with grasses, herbs, and small shrubs. The channel flows northwest to Arsenal Island on the Mississippi River.

4.2 Overview of Survey Plans

The Ecological Assessment FSP consists of two separate sampling events: a Reconnaissance Survey and the Main Sampling Event. Biota samples collected during the main sampling event, including fish, crayfish, benthic organisms, and vegetation will be analyzed for chemicals of concern (target analytes) listed in Tables 1-1 through 1-6 presented in Section 1.0 of this QAPP. Analyses of chemicals in fish fillets will also be used in the Human Health Risk Assessment to evaluate human exposure due to ingestion. The Human Health Risk Assessment Work Plan (included in Volume 1B of the SSP) describes the details for evaluating this pathway.

4.2.1 Reconnaissance Survey

A Reconnaissance Survey, (Survey) will be used to refine the Field Sampling Program to be performed during the Main Sampling Program. This Survey will be most useful if agency personnel can participate and assist the project team in finalizing the sample locations. The field observations made during the Survey will be used to finalize sampling locations, procedures, and the number of biota samples that can be realistically collected in the Main Sampling Program. The objectives and justification for the Survey activities are described below.

- **Finalize sampling locations for the Main Sampling Program,** based on the locations identified in Table 4-1 and Figure 4-1. Tentative sampling locations for use in the Main Sampling Program will be reviewed with USEPA or its designee. This will either be done after input from the Reconnaissance Survey in the fall of 1999 or after overlaying Survey

[1] The actual name of this section of stream is not specified in any maps of the region. SE of Cahokia, Harding Ditch joins Prairie du Pont Creek. The ditch continues west and then northwest around the south side of Cahokia. Sections of Old Prairie du Pont occur south of the ditch. Once the ditch reaches Arsenal Island the USGS map calls the channel Cahokia Chute.

results and maps of sediment copper concentrations in the spring of 2000 (as requested by EPA to base ERA sample locations on sediment copper concentrations).

- **Finalize the list of the selected representative receptor species** that are using the Dead Creek habitats and represent assessment endpoints for the baseline ecological risk assessment. Assessment endpoints are described in the Ecological Risk Assessment Workplan (Volume 1C of the SSP). The selected species will represent different feeding groups such as fish-eating birds and herbivorous mammals.
- **Conduct a fish and crayfish habitat evaluation** for Creek Sectors B through F (including Borrow Pit Pond). The purpose of this evaluation will be to determine if Sectors B through E support fish and/or crayfish and to provide preliminary information on the types of fish that are present in Sector F. A fish habitat evaluation form is presented in Appendix B.
- **Select the two reference areas.** The selected reference areas will be either in the Dead Creek watershed or in a watershed that includes industrial, commercial, residential and farming land uses. The areas will be comparable to those found in the Dead Creek watershed in order to provide a basis for comparison with the Dead Creek. Other criteria that will be used to select a reference area will be taken from biological criteria for Streams and Small Rivers provided by EPA, 1996. In addition, parameters pertinent to the assessment of benthic habitat will be considered when selecting a reference area. Tentative locations for reference areas include Old Prairie DuPont Creek and Harding Ditch. The appropriateness of these potential reference areas will be evaluated during the reconnaissance survey.
- **Perform a habitat assessment for benthic invertebrates.** A habitat assessment will be used to document the physical and environmental conditions for each of the creek sectors (see Appendix B for fish habitation evaluation form). Observations of the bottom substrate, available cover, estimation of embeddedness, estimation of the flow or velocity and depth regime, channel morphology, and riparian and bank structure (such as bank stability, bank vegetation, and streamside cover) sill be documented to evaluate the benthic habitat. The observations will be recorded on habitat field data sheets. As an example, the habitat assessment field data sheet for low gradient streams (USEPA, 1989) is presented in Appendix B.
- **Determine the most appropriate sampling techniques** for sediment and biota based on Survey observations.

The Reconnaissance Survey will also include qualitative observations of:

- **Benthic invertebrate organisms in Creek sediments**. These observations will be used to determine the sampling strategy for these organisms with respect to taxa, sample size requirements, and the labor-effort associated with obtaining sufficient tissue for chemical

analyses.

- **Aquatic vegetation in the water bodies.** Observations will be made along the banks of Creek Sectors C to F. The types of submergent, emergent, and floating aquatic vegetation will be documented. This information will be used to select plant types for tissue analyses. Criteria for selection include the abundance of various plant species and whether they are considered potential food for wildlife.

All modifications of the Field Sampling Program that occur as a result of the Survey will be documented in an Appendum to this QAPP. Photographs will be taken at all locations selected for sampling prior to collecting any biota from Dead Creek.

4.2.2 Main Sampling Program

During the Main Sampling Program biota samples will be collected and analyzed for target compounds and sediment will be collected to assess toxicity using laboratory bioassays. Data for Ecological Risk Assessment purposes will also be collected as part of the sediment, surface water, and soil-sampling programs described in the FSP for other Site activities included in Volume 2 of the SSP.

The objectives of the Main Sampling Program activities are as follows.

- **Collect vegetation, benthic organisms, and crayfish** from Creek Sectors B through F, the Borrow Pit, Site M, and Reference Locations for analyses of chemicals in tissues. Same volume of tissues will be collected in each segment in areas with high concentration of bioaccumulating chemicals. Concentrations of target analytes in biota tissue will be used in dietary exposure models for the selected representative receptor species (see the Ecological Risk Assessment Work Plan, Volume 1C of the SSP). Exposures associated with food items from Dead Creek will be quantified for the selected representative wildlife species. Predicted risks attributed to the dietary-related exposures will be quantified for these wildlife species.
    - Benthic invertebrates will be collected for tissue analyses of chemicals and to evaluate the composition and abundance of the benthic community. Information on tissue analyses will be used to evaluate potential effects on benthic invertebrate communities and to support food-chain modeling. Information on the composition and abundance of benthic invertebrates will be used to evaluate potential effects on the benthic invertebrate community.

    - The analysis of benthic community structure (*e.g.* diversity and abundance of benthic invertebrates) will be used to support the assessment of possible effects on benthic invertebrates. The data will be analyzed for taxa richness, abundance, percent dominant taxon/taxa, and community composition (see Section 7 and Appendix B of this QAPP).

- The principal objective of vegetation sampling is to determine concentrations of target analytes for use in exposure models for the representative herbivorous wildlife species that will be selected based on field observations made during the Survey.

- The objective of the crayfish sampling is to evaluate bioaccumulation of target analytes and potential subsequent food chain transfer to predatory fish, crayfish-eating birds or mammals such as herons or raccoons. Crayfish was selected as the target prey for predatory fish, crayfish-eating birds or mammals such as herons or raccoons.

- Following collection, all biota tissue samples for chemical analysis will be stored on dry ice for shipment to the analytical laboratory. At the laboratory, biota samples will be stored frozen prior to analysis. Frozen storage (<10 °C) of tissue samples can be maintained for a maximum of 1 year, consistent with USEPA guidance on solid and tissue sample preservation (40CFR, Part 136.3, July 1, 1998). The method-specified holding times for extraction and analyses begin when the samples are thawed for preparation and analysis. Tables 4-2 through 4-7 list preservation and holding times for all samples to be collected in support of the ERA.

- **Collect fish** from the Borrow Pit portion of Creek Sector F (and other sectors if fish are found to be present) and measure target analytes. Concentrations of target analytes (Tables 1-1 to 1-6) in fish will be used in dietary exposure models for wildlife species. Target analyte concentrations in fish fillets will also be used in the Human Health Risk Assessment (see Human Health Risk Assessment Work Plan, Volume 1B of the SSP).

  - The goals of the fish sampling program are to:

    1. identify the composition and general abundance of fish in the water bodies;
    2. examine weight and length relationships for species collected;
    3. evaluate the habitat quality of the water bodies for supporting different fish species;
    4. determine the potential of the water bodies ponds for supporting recreational fishing;
    5. measure body burdens of chemicals in fish tissues for use in ERA and HHRA; and,
    6. examine fish for gross histopathological anomalies.

  - Data developed on tissue levels and sediment levels of chemicals can be used to estimate Biota Sediment Accumulation Factors (BSAFs). These may be useful for estimating body burdens for areas where sediment data exist but where fish have not been collected.

  - Preservation of fish samples for shipment from the field and storage at the laboratory are as described, above, for biota samples and as listed Table 4-6.

- **Collect sediments for laboratory sediment toxicity bioassays** at designated sediment triad locations in Creek Sectors B to F, the Borrow Pit, Site M, and the reference locations. Collected sediment samples will be shipped to the laboratory (Aquatec Biological Sciences) and used in sediment toxicity bioassays with indicator laboratory benthic invertebrates, as described in Appendix A. These tests will be used to evaluate whether chemicals in the sediments are toxic to benthic invertebrates. The sediment triad approach will be used to evaluate the sustainability of benthic macroinvertebrate communities in Dead Creek.

4.2.3 Sample Locations

Sample locations for the Main Sampling Program are listed in Table 4-1. Sampling sites will be selected in one of two ways. 1) The suggested primary approach is to locate the stations so that they give the greatest coverage and that they are placed in depositional areas. This approach involves placing stations in the middle and at either end of each creek segment or other sample area. Within each area, we will select a location with depositional sediments in order to provide a common basis of comparison for all areas. 2) The alternative method is to place stations in areas of high, average, and low concentrations of copper, as recommended by US EPA. In the selection of sampling sites, we will also consider whether the sites are representative of the specified habitat.

Tentative locations will be selected during the Reconnaissance Survey and confirmed immediately after the Survey with input from the project team, in the fall of 1999, if the primary approach (as described above) is used to define the ERA sampling locations. If the secondary approach is used, then the ERA sampling locations will be confirmed after measuring sediment concentrations for copper. Sediment sampling and analysis is described in associated SSP documents in Volume 2. ERA sample locations dependent on the copper concentrations will be confirmed in the spring of 2000 with input from the project team. Navigational coordinates for all sampling locations will be established in the field using a Geographical Positioning System (GPS) as well as by line of sight.

4.3 Sediment and Surface Water Sampling

Chemical data from sediment and surface water sampling performed at the site will be used in the ecological risk assessment. The associated site documents including the EE/CA and RI/FS FSP and QAPP describe procedures for sampling sediments and surface water. Surficial sediment collections (upper 5 cm) will be made coincident with the collection of sediment for toxicity testing and the collection of benthic macroinvertebrates. This will allow the sediment locations to be evaluated using an appropriate multiple lines of evidence approach (e.g., triad approach). Surface sediment and sediment for toxicity testing are taken from the same composite sample made for each sampling location. The method by which this composite is made is discussed in the associated FSP and QAPP documents (Volume 2 of the SSP) that

include surface water and sediment sampling.

4.4 Sampling Benthic Macroinvertebrates

Benthic organisms will be collected using techniques appropriate for the objective and as required by the type of substrate (i.e., soft versus cobble/gravel). The type of sampling equipment will be determined during the Survey. For instance, soft sediments are expected in Borrow Pit Pond and therefore, a Petite Ponar Grab sampler or Eckman Grab would be used. A Standard Operating Procedure (SOP) for the Collection of Benthic Macroinvertebrates with a Grab Sampler is provided in Appendix B.

For riffle run areas in Dead Creek, benthic macroinvertebrates will be collected using a Turtox D-frame dip net (0.800 x 0.900 mm mesh). The D-frame net is held in a vertical position, with the collection net pointing downstream. Approximately one square foot of substrate is repeatedly lofted into the water column in front of the net, causing macroinvertebrates to drift into the mesh. Organisms are rubbed free from large gravel and cobbles, which are visually inspected and removed from the sample. Organisms are rinsed from the mesh into a shallow pan, then individually picked from the pan and placed in a sampler container.

4.4.1 Benthic Invertebrate Collection for Tissue Analysis

The goal of the sampling effort will be to obtain sufficient benthic invertebrate biomass for tissue analyses of chemicals at each of the sampling locations listed in Table 4-1. It is recognized that this goal may be difficult to achieve; therefore an approach has been developed to guide these sampling efforts. The approach and collection procedures are described in this section.

Benthic organisms will be collected for tissue analyses from each Creek Sector (B through F), the Borrow Pit (part of F), Site M, and the two Reference Locations. This will yield a total of eight composite samples of benthic invertebrate tissue. These composites will be formed from the sample locations within the particular sector, site, or reference water body. Concentrations measured in tissue will be used to evaluate the risks to the representative species that feed on benthic organisms in Dead Creek. Proposed representative species are identified in the Ecological Risk Assessment Work Plan (included in Volume 1C of the SSP).

If possible, sampling will focus on the collection of larger benthic organisms (e.g., clams or dragonfly larvae). The composite would consist of either clams or insects but these organisms will not be combined into a single composite. However, these organisms may not be present or readily available. In this case, it will be necessary to sample smaller invertebrates such as worms and chironomid insect larvae.

It may be difficult to obtain sufficient sample sizes of these organisms for tissue analysis. It

should be noted that EPA observed that there was a lack of riffle areas and therefore, a potential for low dissolved oxygen levels (U.S. EPA, 1997). Benthic invertebrates may not be abundant in certain Creek Sectors. If the findings from the Survey indicate that benthic organism collection for tissue analysis is not feasible or practical at a particular location, benthic organisms will be collected throughout various locations within a Creek Sector and samples will be composited. By compositing the collected benthic organisms within a Creek Sector, the sampling design mimics the foraging behavior of representative species.

The field sampling team dedicated to the field processing of sediment to obtain invertebrates for tissue analysis will consist of at least three to four people per sample location. A special sediment-sieving device with an extra-large screen and running water will be used to support this sampling effort. The laboratory requires 1-2 g per sample for metals, 3-4 g for each organic fraction. Additional sample would be needed to perform project-defined matrix QC including matrix spike and duplicate analyses (see section 3 and 8 of this QAPP). On this basis, a minimum of 5-g wet weight of benthic invertebrates and up to 10-g wet weight will be collected per location if adequate tissue can be obtained. The number of organisms required to achieve sufficient sample size will depend on the size of the organisms. The SOP "Collection Of Benthic And Epiphytic Invertebrates For Chemical Analysis" (included in Appendix B) describes a procedure for calculating sample size requirements based on field observations of general body size and form. These estimates will be used by the field collection team to estimate sample size requirements. This method will be simpler to implement than in-field weighing because a considerable amount of water as well as debris adheres to the animals when they are picked and sorted from the sample.

The following scheme will be used to achieve benthic invertebrate sample size requirements within a "reasonable period of time" during the Main Sampling Program.

- Judgments concerning the abundance of invertebrates at a location will initially be made using grab samples and/or kick net samples. A minimum of five grabs and/or kick net samples will be collected at each location and an effort of 45 minutes to an hour will be expended. This allocation of time is for sampling and sorting and does not include travel and set up time.
- If this initial sampling effort yields less than 1 g (based on sizes and numbers of animals), sampling for benthic invertebrates will cease because the location would be unlikely to yield the sample-size requirement of at least 5-g of organisms within a "reasonable period of time." For these locations, the invertebrate sampling effort will be extended to the other locations within the Sector or reallocated to epiphytic invertebrates.
- If this initial sampling effort yields 1 g or more organisms, then the collection will continue for an additional two hours and/or until an estimated 10 g of organisms are collected, which ever occurs first.

- The decision to reallocate sampling effort or to consider a sampling location complete will be made in the field. At this time a decision will also be made concerning the taxa to use for tissue analysis.
- After the collection is complete at a location, the samples will be washed and rinsed with site surface water to help remove debris. The sample will be stored on ice in surface water and washed again at the end of the day's sampling effort.
- At locations where the collection of adequate sample sizes of benthic invertebrates is judged to take longer than three hours, the sampling effort will be reallocated to provide information on collection of epiphytic invertebrates. These invertebrates include dragonfly nymphs, chironomid insect larvae and amphipods that live on plants as well as on the surface of sediments and other substrates. These animals are typically exposed to the water column as well as re-suspended surface sediments.

In addition to the collection of benthic macroinvertebrates, sampling will also be conducted for crayfish as described in a later task. These animals are larger than the other benthic invertebrates and should provide sufficient tissue amounts for chemical analyses in the event that the amounts obtained for other invertebrates are limited (see Section 4.8 for crayfish sample collection activities).

4.4.1.1 Benthic Invertebrate Sample Documentation

Samples of benthic or epiphytic invertebrates for tissue analysis will be placed in glass jars and stored on ice for overnight courier shipment to the analytical laboratory.

Samples will be labeled using the sample field identification scheme in associated Site documents in Volume 2 of the SSP. The type of sample is benthic tissue, BTISS. Sample locations, time and date of collection, and initials of the collector will be on each sample label (Figure 5-4) and the chain of custody form (Figure 5-1). This information will also be documented in a field note book or log sheet. Observations of sediment type, vegetation, oxidation-reduction status, or any unusual matter will also be recorded on the notebook or log sheet.

Information on sample containers, preservation, and holding times are provided in Table 4-2. Analytical methods and detection limits for tissue analyses are presented in Sections 1 and 7 of this QAPP. Collection locations are listed in Table 4-1.

4.4.1.2 Benthic Invertebrate Sample Priority for Chemical Testing

If limited sample amounts are obtained for benthic invertebrates, the priority for analysis will be:

1) PCBs
2) Metals
3) All other parameters including SVOCs, Pesticides, Herbicides, Dioxins, and Cyanide.

4.4.2 Benthic Invertebrate Collection for Community Evaluation

At each of the 23 locations listed in Table 4-1, benthic invertebrates will be collected with an Eckman or petite ponar grab using techniques described in the standard operating procedure, *Collection of Benthic Invertebrates with a Grab Sampler* (Appendix B). Three samples will be collected from each location and analyzed separately to provide a measure of within-station variability. This will yield 23 locations x 3 grabs/location = 69 samples.

Each invertebrate benthic sample will be washed in the field through a 0.5-mm mesh sieve, placed into 1-liter plastic jars, and preserved with isopropyl alcohol (Table 4-3).

Samples will be labeled using the sample field identification scheme in associated Site documents. The type of sample is benthic community, BCOMM. Sample locations, time and date of collection, and initials of the collector will be on each sample label (Figure 5-4) and the chain of custody form (Figure 5-1). This information will also be documented in a field note book or log sheet. Observations of sediment type, vegetation, oxidation-reduction status, or any unusual matter will also be recorded on the notebook or log sheet. A labeled tongue depressor is placed into the jar with the sample to ensure the integrity of the chain-of-custody through unique sample identifications. Preservative is added to cover the sample. Number of samples, container types, and preservative are listed in Table 4-3.

4.5 Sediment Toxicity Bioassays

Sediments samples from the 0 to 2 inch (upper 5 cm) depth interval will be collected at each of the 23 sediment triad locations in Creek Sectors B – F, Borrow Pit Pond, Site M, and the Reference Locations to evaluate the toxicity associated with site-related chemicals to benthic organisms. These samples will be taken from the composite surface sediment sample made for each location to support the analyses of chemicals in surficial sediments (see Surface Water and Sediment protocols in the associated Site FSP and QAPP documents, Volume 2 of the SSP). Samples will be stored on ice and shipped to the bioassay laboratory on the day of sample collection. Approximately 4 liters of sediment will be collected from each location for the sediment toxicity testing.

The sediment toxicity tests will be used to evaluate whether chemicals in sediments are toxic to benthic invertebrates. Acute toxicity tests will be conducted at all 23 sampling locations with the amphipod *Hyallela* and the insect larvae *Chironomus* in accordance with analytical methods presented in Section 7 of this QAPP and Appendix B. For stations where the results of acute toxicity tests indicate that survival does not significantly differ from that in Reference Locations and the control sediments, chronic tests will also be conducted for these two species. The sequential testing (acute followed by chronic) will eliminate the need to set up and run long-term tests for sediments in which acute toxicity has already been demonstrated. The chronic test methods are described in Section 7 and Appendix B. Numbers, preservation, and containers are summarized in Table 4-4.

4.6 Aquatic Vegetation Sample Collection for Tissue Analysis

Aquatic plants will be collected for analysis of chemicals in tissues. The analysis will be used to estimate exposure to animals – such as the muskrat – that feed on plants. In order to minimize variability associated with differential uptake by plant species, an effort will be made to analyze the same or similar plant species in all locations. However, because of habitat differences among water bodies, it may not be possible to find a single common species. Therefore, there may be a few different species represented in the sampling effort. The selection of species will be guided by observations made during the Survey.

Plants may include an emergent or submergent species depending on what is present within and among sampling areas. Samples will consist of: 1) the upper portion of the selected plants including leaves, stems, and fruiting bodies with seeds, and 2) root systems. Each of these parts of plants is used as food by a variety of wildlife species.

Three composite samples of 1) stems/leaves/seeds and 2) roots will be made within each of the Creek sectors (B through F), Borrow Pit Pond, and the two reference areas. Each composite sample will consist of five plants. Collections will be made by digging up the plant, washing the plant free of sediments, and cutting the plant above the roots to obtain 2 sub-samples for each plant specimen. Table 7-1 provides analytical methods for tissue. Tables 1-1 to 1-6 provide target analyte reporting limits for tissue. A summary of collections for vegetation is given in Table 4-5.

Samples will be labeled using the sample field identification scheme in associated Site documents. The type of sample is plant tissue, PTISS. Sample locations, time and date of collection, and initials of the collector will be on each sample label (Figure 5-4) and the chain of custody form (Figure 5-1).

4.7 Fish Sample Collection

Fish will be collected using standard fish collection techniques such as gill nets, leaded lines, trot lines, rod and reel, traps and electroshocking by boat or portable electroshock packs. Once fish are identified, length, weight, species, gross abnormalities (e.g., lesions, tumors, and deformities) will be recorded on a fish log (example included in Figure 5-2). For species that are difficult to identify in the fields representative individuals will be sent to a taxonomic expert.

Grossly deformed specimens will be photographed, preserved, labeled, and a few representative individuals will be retained at the Menzie-Cura facility.

Fish samples for tissue analyses will be placed in Zip-lock bags and stored on dry ice for overnight courier shipment to the analytical laboratory. Fish samples will be stored frozen until analysis by the laboratory. The SOP for filleting fishes is presented in Appendix B. Table 7-1 provides the analytical methods for tissue. Tables 1-1 to 1-6 present target analytes for tissue and corresponding reporting limits. The lipid content of each sample will be determined to provide a basis for normalizing tissue concentrations for organic constituents.

Fish sampling will focus on the Borrow Pit Pond. Limited sampling will be conducted in other Creek sectors if the Survey reveals the presence of fish. Sampling will also be conducted in the Reference Areas.

4.7.1 Fish Sampling in the Borrow Pit and Reference Locations

Fish samples will be collected at three locations in the Borrow Pit Pond (part of CS F). Fish sampling will focus on CS F because the Borrow Pit Pond appears to be the best habitat area for fish and wildlife. It is most likely to be the primary depositional area for sediments transported from the upper reaches of Dead Creek and recreational fishing is most likely to occur at this location. Three composite samples each comprised of 3 to 5 individuals will be collected for each of the following: (SOP) Collection and Treatment of Fish Field Data

Fillets of pisciverous fish (e.g., largemouth bass)
Whole body pisciverous fish (e.g., largemouth bass)
Whole body of bottom-feeding fish (e.g., catfish)
Whole body of forage fish (e.g., shiners or sunfish)

If composites of a single fish species are not feasible, different species representing the same trophic level will be used. Two composites of each of the three fish species will be obtained in each of the two Reference Areas.

These data will be used to support both the Ecological Risk Assessment and Human Health Risk Assessment.

4.7 Fish Sample Collection

Fish will be collected using standard fish collection techniques such as gill nets, leaded lines, trot lines, rod and reel, traps and electroshocking by boat or portable electroshock packs. Once fish are identified, length, weight, species, gross abnormalities (e.g., lesions, tumors, and deformities) will be recorded on a fish log (example included in Figure 5-2).

Grossly deformed specimens will be photographed, preserved, labeled, and retained in a voucher collection as archived specimen. If necessary, duplicates of the voucher specimens will be collected and sent to recognized fish biology expert(s) for taxonomic confirmation.

Fish samples for tissue analyses will be placed in Zip-lock bags and stored on dry ice for overnight courier shipment to the analytical laboratory. Fish samples will be stored frozen until analysis by the laboratory. The SOP for filleting fishes is presented in Appendix B. Table 7-1 provides the analytical methods for tissue. Tables 1-1 to 1-6 present target analytes for tissue and corresponding reporting limits. The lipid content of each sample will be determined to provide a basis for normalizing tissue concentrations for organic constituents.

Fish sampling will focus on the Borrow Pit Pond. Limited sampling will be conducted in other Creek sectors if the Survey reveals the presence of fish. Sampling will also be conducted in the Reference Areas.

4.7.1 Fish Sampling in the Borrow Pit and Reference Locations

Fish samples will be collected at three locations in the Borrow Pit Pond (part of CS F). Fish sampling will focus on CS F because the Borrow Pit Pond appears to be the best habitat area for fish and wildlife. It is most likely to be the primary depositional area for sediments transported from the upper reaches of Dead Creek and recreational fishing is most likely to occur at this location. Three composite samples each comprised of 3 to 5 individuals will be collected for each of the following: (SOP) Collection and Treatment of Fish Field Data

Fillets of piscivorous fish (e.g., largemouth bass)
Whole body piscivorous fish (e.g., largemouth bass)
Whole body of bottom-feeding fish (e.g., catfish)
Whole body of forage fish (e.g., shiners or sunfish)

If composites of a single fish species are not feasible, different species representing the same trophic level will be used. Two composites of each of the three fish species will be obtained in each of the two Reference Areas.

These data will be used to support both the Ecological Risk Assessment and Human Health Risk Assessment.

4.7.2 Fish Sampling in Other Creek Sectors

It is possible that smaller forage fish occur in other Creek sectors. These could be a source of food for wildlife and therefore a possible source of exposure to chemicals present in the Creek. If the Survey reveals the presence of fish in a Creek sector, a single composite sample will be made of a forage fish species for that sector. This composite will be comprised of whole fish and will be analyzed for the project-specific list of chemicals tabulated in Section 1 of this QAPP.

4.7.3 Documentation for Fish Sample Collection

Samples will be labeled using the sample field identification scheme in associated Site documents. The type of sample for pisciverous fish for fillets is, FILLET and initials of the fish species such as large mouth bass, LMB. For example: FILLET-LMB. For the composite forage fish samples collected, the field identifier will be FORAGE. For the whole body pisciverous fish, the field identifier will be PISC. Sample locations, time and date of collection, and initials of the collector will be on each sample label (Figure 5-4) and the chain of custody form (Figure 5-1). Additionally, a Fish Collection Log (Figure5-2) will be completed in the field. A Sample Processing Record for Fish Compositing (Figure 5-3), or equivalent, will be completed by the laboratory prior to preparation and analysis. A summary of fish to be collected is provided in Table 4-6.

4.8 Crayfish Sample Collection

Three composite samples (each containing approximately 5 crayfish) will be collected for the Borrow Pit Pond. Two composite samples will also be collected in each of the two Reference water bodies. Additionally, if the Survey reveals the presence of crayfish in a Creek sector, a single composite will be collected for that sector.

4.8.1 Sampling Protocols

The type of sampling equipment for collecting crayfish will be determined in the field during the Survey. Collection methods may include using baited traps, seining, kick nets, hand collection, and dip netting.

Baited traps will most likely be deployed in the Creek stations. In the Borrow Pit Pond, seining will most likely preformed if water is less than chest-high. Baited traps will be used if water is more than chest high. Kick-nets will be used as a last resort. The target number of crayfish from each Creek location will be three because stream populations of crayfish are expected to be less dense than pond and lake populations of crayfish.

4.8.2 Documentation of Crayfish Collection

Crayfish samples will be placed in Zip-lock bags or glass jars and stored on dry ice for overnight courier shipment to the analytical laboratory. Tables 1-1 to 1-6 provide analytical methods and for tissue analysis. Table 7-1 presents target analytes to be analyzed in tissue and reporting limits for tissue.

Samples will be labeled using the sample field identification scheme in associated Site documents. The type of sample is crayfish, CRAY. Sample locations, time and date of collection, and initials of the collector will be on each sample label (Figure 5-4) and the chain of custody record (Figure 5-1). A summary of sampling is given in Table 4-7.

Table 4-1. Locations of the Sampling Stations for Biota and Sediment to Support the Ecological Risk Assessment

Station Designation	Description
B-1	Located in portion of creek sector B in accordance with selection criteria (see text)
B-2	Located in portion of creek sector B in accordance with selection criteria (see text)
B-3	Located in portion of creek sector B in accordance with selection criteria (see text)
C-1	Located in portion of creek sector C in accordance with selection criteria (see text)
C-2	Located in portion of creek sector C in accordance with selection criteria (see text)
C-3	Located in portion of creek sector C in accordance with selection criteria (see text)
D-1	Located in portion of creek sector D in accordance with selection criteria (see text)
D-2	Located in portion of creek sector D in accordance with selection criteria (see text)
D-3	Located in portion of creek sector D in accordance with selection criteria (see text)
E-1	Located in portion of creek sector E in accordance with selection criteria (see text)
E-2	Located in portion of creek sector E in accordance with selection criteria (see text)
E-2	Located in portion of creek sector E in accordance with selection criteria (see text)
F-1	Located in portion of creek sector F in accordance with selection criteria (see text)
F-2	Located in portion of creek sector F in accordance with selection criteria (see text)
F-3	Located in portion of creek sector F in accordance with selection criteria (see text)

Table 4-1. Locations of the Sampling Stations for Biota and Sediment to Support the Ecological Risk Assessment - continued

Station Designation	Description
BP-1	Located in portion of creek sector BP in accordance with selection criteria (see text)
BP-2	Located in portion of creek sector BP in accordance with selection criteria (see text)
BP-3	Located in portion of creek sector BP in accordance with selection criteria (see text)
M-1	Located in portion of creek sector M in accordance with selection criteria (see text)
Ref 1-1	Located in reference area 1 in accordance with selection criteria (see text)
Ref 1-2	Located in reference area 1 in accordance with selection criteria (see text)
Ref 2-1	Located in reference area 2 in accordance with selection criteria (see text)
Ref 2-2	Located in reference area 2 in accordance with selection criteria (see text)

Note: Some locations may be changed based on the results of the Reconnaissance Survey.

Table 4-2. Benthic Samples for Tissue Analysis: Number, Sample Preservation, Container Specification, and Holding Time Requirements

Parameter	Number of Samples	Sample Container(s)	Preservative	Holding Time*
Metals	8 benthic or epiphytic	4 or 8 oz Amber Glass jars	Cool, 4°C, protected from light; store frozen < -10°C	180 days – All metals except mercury Mercury: 28 days
Semivolatile Organics	8 benthic or epiphytic (if sufficient biomass is collected)	Same as above for delivery to the lab	Cool, 4°C, protected from light; store frozen < -10°C	Extraction: within 14 days of collection Analysis: within 40 days of extraction
Herbicides	8 benthic or epiphytic (held for possible future analysis)	Same as above for delivery to the lab	Cool, 4°C, protected from light; store frozen < -10°C	Extraction: within 14 days of collection Analysis: within 40 days of extraction
Pesticides	8 benthic or epiphytic (held for possible future analysis)	Same as above for delivery to the lab	Cool, 4°C, protected from light; store frozen < -10°C	Extraction: within 14 days of collection Analysis: within 40 days of extraction
Dioxins	8 benthic or epiphytic (held for possible future analysis)	Same as above for delivery to the lab	Cool, 4°C, protected from light; store frozen < -10°C	1 year frozen - Extraction: within 14 days of collection Analysis: within 40 days of extraction
PCBs	8 benthic or epiphytic (held for possible future analysis)	Same as above for delivery to the lab	Cool, 4°C, protected from light; store frozen < -10°C	1 year frozen - Extraction: within 14 days of collection Analysis: within 40 days of extraction

* All holding times start from when the samples are thawed, if initially frozen.

Table 4-2. Benthic Samples for Tissue Analysis: Number, Sample Preservation, Container Specification, and Holding Time Requirements

Parameter	Number of Samples	Sample Container(s)	Preservative	Holding Time*
Metals	8 benthic or epiphytic	4 or 8 oz Amber Glass jars	Cool, 4°C, protected from light; store frozen < -10°C	180 days – All metals except mercury Mercury: 28 days
Semivolatile Organics	8 benthic or epiphytic (if sufficient biomass is collected)	Same as above for delivery to the lab	Cool, 4°C, protected from light; store frozen < -10°C	Extraction: within 14 days of collection Analysis: within 40 days of extraction
Herbicides	8 benthic or epiphytic (held for possible future analysis)	Same as above for delivery to the lab	Cool, 4°C, protected from light; store frozen < -10°C	Extraction: within 14 days of collection Analysis: within 40 days of extraction
Pesticides	8 benthic or epiphytic (held for possible future analysis)	Same as above for delivery to the lab	Cool, 4°C, protected from light; store frozen < -10°C	Extraction: within 14 days of collection Analysis: within 40 days of extraction
Dioxins	8 benthic or epiphytic (held for possible future analysis)	Same as above for delivery to the lab	Cool, 4°C, protected from light; store frozen < -10°C	1 year frozen - Extraction: within 14 days of collection Analysis: within 40 days of extraction
PCBs	8 benthic or epiphytic (held for possible future analysis)	Same as above for delivery to the lab	Cool, 4°C, protected from light; store frozen < -10°C	1 year frozen - Extraction: within 14 days of collection Analysis: within 40 days of extraction

* All holding times start from when the samples are thawed, if initially frozen.
* Number of Samples does not include planned QC Sample

Table 4-3. Biota Samples for Analysis of Benthic Invertebrate Composition and Abundance: Number, Sample Preservation, Container Specification, and Holding Time Requirements

Parameter	Number of Samples	Sample Container(s)	Preservative	Holding Time
Benthic invertebrates	69 (23 stations x 3 samples)	1 liter plastic jars	Isopropyl alcohol 70% to cover specimen	NA

* Number of Samples does not include planned QC Sample

Table 4-4. Samples for Sediment Toxicity Tests: Number, Sample Preservation, Container Specification, and Holding Time Requirements

Parameter	Number of Samples	Sample Container(s)	Preservative	Holding Time
Chironomus acute test	23	(1) wide-mouth polyethylene jar, pre-cleaned, capacity of 4 L of sediment	Cool, 4°C	14 days
Chironomus chronic test	23	Same jar as above	Cool, 4°C	14 days
Amphipod acute test	23	Same jar as above	Cool, 4°C	14 days
Amphipod chronic test	23	Same jar as above	Cool, 4°C	14 days

* Number of Samples does not include planned QC Sample

Table 4-5. Plant Samples for Tissue Analysis: Number, Sample Preservation, Container Specification, and Holding Time Requirements

Plants	Number of Samples	Sample Container(s)	Preservative	Holding Time
Stems, leaves, seeds	24 8 areas x 3 composites	Clean Ziplock Bags	Cool, 4°C, protected from light; store frozen < -10°C	Analyte dependent (see Table 4-2)
Roots	24 8 areas x 3 composites	Clean Ziplock Bags	Cool, 4°C, protected from light; store frozen < -10°C	Analyte dependent (see Table 4-2)

* Number of Samples does not include planned QC Sample

Table 4-6. Fish Samples for Tissue Analysis: Number, Sample Preservation, Container Specification, and Holding Time Requirements

Parameter [a]	Number of Samples	Sample Container(s)	Preservative	Holding Time*
Metals/ Cyanide	7 composite fillets of piscivore fish (e.g., bass) 7 composite whole piscivore fish (e.g., bass)	Clean Ziplock Bags or glass jars	Cool, 4°C, protected from light; store frozen < -10°C	180 days – All metals except mercury, cyanide Mercury: 28 days Cyanide: 14 days
Metals/ Cyanide	7 composite of whole bottom-feeding fish (e.g., bullheads)	Clean Ziplock Bags or glass jars	Cool, 4°C, protected from light; store frozen < -10°C	180 days – All metals except mercury, cyanide Mercury: 28 days Cyanide: 14 days
Metals/ Cyanide	7 composites of forager fish (e.g., golden shiners) [possible 5 additional composites in Creek sectors]	Clean Ziplock Bags or glass jars	Cool, 4°C, protected from light; store frozen < -10°C	180 days – All metals except mercury, cyanide Mercury: 28 days Cyanide: 14 days
Pesticides Herbicides Dioxins PCBs SVOCs	7 composite fillets of piscivore fish (e.g., bass) 7 composite whole piscivore fish (e.g., bass)	Sub-sample from metals sample composite	Cool, 4°C shipment, stored at < -10°C, protected from light	1 year frozen – then: Extraction: within 14 days Analysis: within 40 days of extraction
Pesticides Herbicides Dioxins PCBs SVOCs	7 composite of whole bottom-feeding fish (e.g., bullheads)	Sub-sample from metals sample composite	Cool, 4°C shipment, stored at < -10°C, protected from light	1 year frozen – then: Extraction: within 14 days Analysis: within 40 days of extraction
Pesticides Herbicides Dioxins PCBs SVOCs	7 composites of forager fish (e.g., golden shiners) [possible 5 additional composites in Creek sectors]	Sub-sample from metals sample composite	Cool, 4°C shipment, stored at < -10°C, protected from light	1 year frozen – then: Extraction: within 14 days Analysis: within 40 days of extraction

[a] Percent Lipid concentrations will be analyzed for all fish tissues.

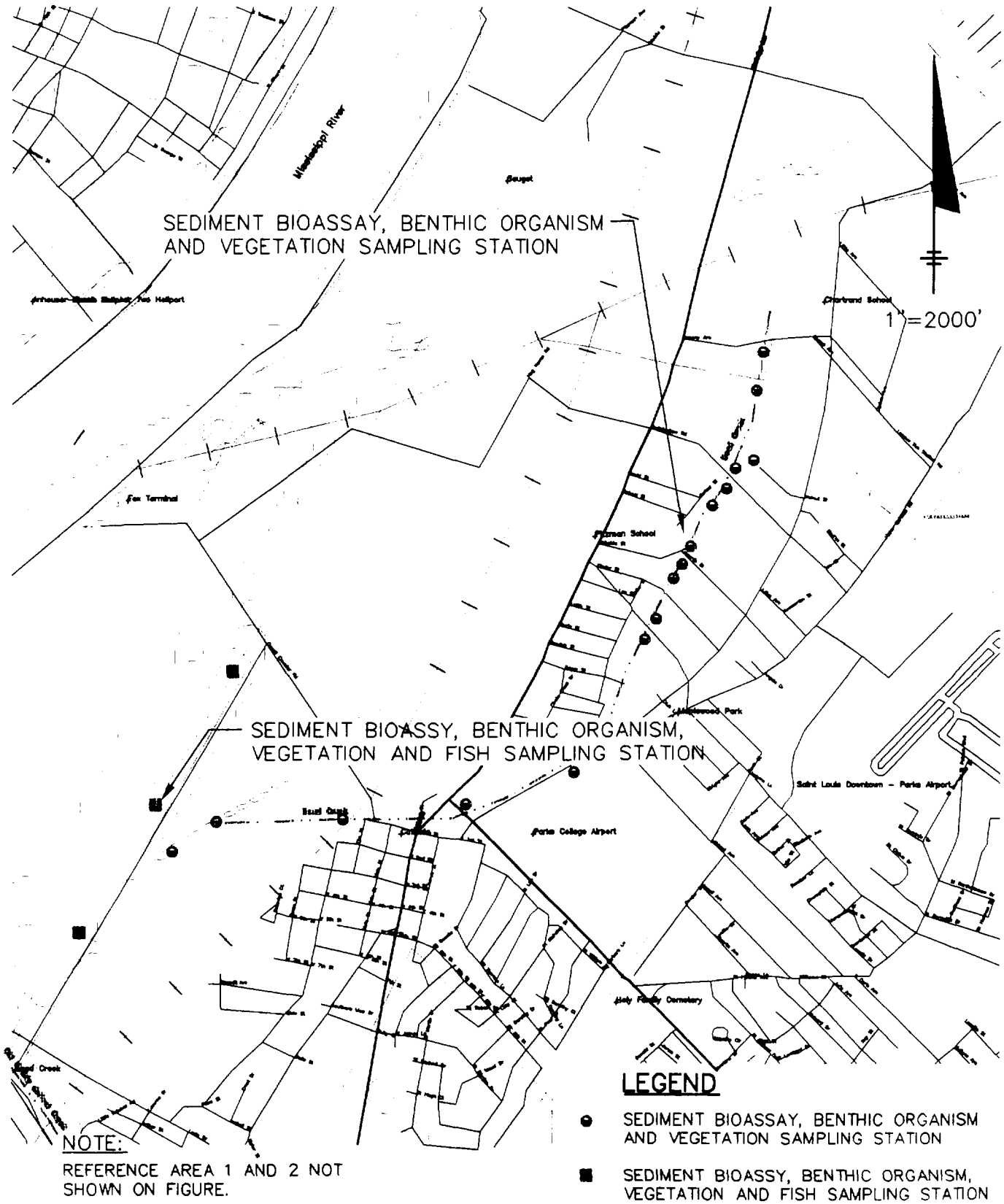
* Holding times begin from when the sample is thawed, if frozen.

* Number of Samples does not include planned QC Sample

Table 4-7. Crayfish Samples for Tissue Analysis: Number, Sample Preservation, Container Specification, and Holding Time Requirements

Parameter [a]	Number of Samples	Sample Container(s)	Preservative	Holding Time*
Metals	7 composites [possible 5 additional composites in Creek sectors]	Clean Ziplock Bags or 4 oz or 8 oz glass jars	Cool, 4°C, protected from light; store frozen < -10°C	All metals except Mercury 180 days Mercury: 28d
Pesticides Herbicides Dioxins PCBs SVOCs	Sub-sample from metals composite	Sub-sample from metals composite	Cool, 4°C shipment, stored at < -10°C, protected from light	1 year frozen – then: Extraction: within 14 days Analysis: within 40 days of extraction

[a] Percent Lipid concentrations will be analyzed for all crayfish tissues.
* Holding times begin from when the sample is thawed, if frozen.
* Number of Samples does not include planned QC Sample



NOTE:
REFERENCE AREA 1 AND 2 NOT SHOWN ON FIGURE.

FIGURE 4-1. REPRESENTATIVE ECOLOGICAL SAMPLE LOCATIONS

SAUGET AREA I SUPPORT SAMPLING PLAN
SAUGET AND CAHOKIA, IL

23548.010.01
3/29/99

O'BRIEN & GERE ENGINEERS INC.

DWG PATH: I:\10040\23548\DWG\01.DWG 1=2000

PLOT DATE: 3/29/99

5.0 SAMPLE CUSTODY

Chain-of-Custody (COC) procedures for the collection of biota in support of the Ecological Risk Assessment will follow custody protocols as described in "NEIC Policies and Procedures", EPA-330/9-78DDI-R, Revised June 1985. This custody is compliant with EPA Region 5 requirements for sample custody and is divided into three parts: field-specific sample collection, laboratory custody, and final evidence files.

A sample or evidence file is under your custody if:

- the item is in your possession;
- the item is in your view, after being in your possession;
- the item is in your possession and you place it in a secured location; or
- the item is in a designated secure area.

5.1 Field Chain of Custody Procedures

The sample packaging and shipment procedures summarized below will insure that the samples will arrive at the laboratory with the chain of custody intact. The protocol for specific sample numbering is described in Section 4 of this QAPP.

5.1.1 Field Procedures

(a) The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. To preserve the integrity of the samples, as few people as possible should handle the samples.

(b) All bottles will be identified with unique sample numbers and locations on secure bottle labels. The labels will include the sample identification number, location, date of collection, time of collection, and type of analysis required.

(c) Sample labels are to be completed for each sample using waterproof ink.

(d) Samples will be accompanied by a properly completed COC form (Figure 5-1a,b,c). The sample numbers and locations will be listed on the COC. See Section 5.1.2 and 5.1.3 for further field custody documentation and transfer procedures.

5.1.2 Field Logbooks/Documentation

Field logbook will provide the means of recording data collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could re-construct a particular situation without reliance on memory.

Field logbooks will be bound, field survey books or notebooks. Logbooks will be assigned to field personnel, but will stored in the document control center when not in use. Each logbook will be identified by the project-specific document number.

The title page of each logbook will contain the following:

- Person to whom the logbook is assigned.
- Logbook number.
- Project name.
- Project start date, and
- End date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. 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. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the station, which includes compass and distance measurements, shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in the Ecological Assessment Field Sample Plan, Section 4.0 of this QAPP. The procedure and equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected (if applicable), amount and number of containers. Sample identification number will be assigned prior to

sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

Figures 5-1a, 5-1b and 5-1c are examples of COCs that will be completed in the field during sample collection of biota samples. Figure 5-2 is an example Fish Log to be completed in the field for the collection of fish samples. Figure 5-3 is an example of a Sample Processing Record for Fish Compositing that will be used in the laboratory in this form or an equivalent. Figure 5-4a. 5-4b and 5-4c are examples of the Sample Identification Labels that will be used on all sample containers to identify the samples collected for the Ecological Risk Assessment.

5.1.3 Transfer of Custody and Shipment Procedures

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the COC intact. The protocol for sample identification is included in Section 4, FSP, of this QAPP. Examples of field custody documents are in Figures 5-1a, 5-1b, 5-1c and 5-2. An example of the fish compositing form is included in Figure 5-3.

(a) Samples are accompanied by a properly completed chain of custody form. The sample numbers and locations will be listed on the chain of custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

(b) Samples will be properly packaged for shipment, including ice to preserve the biota samples at $\leq$ 4 C and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in each sample box or cooler. Shipping containers will be locked and secured with strapping tape and custody seals for shipment to the laboratory.

(c) All shipments will be accompanied by the Chain of Custody Record identifying the contents. The original record will accompany the shipment, and copies of the COC will be retained by the field sampler for documentation. It is recommended that a copy of the COC be faxed to the laboratory on the date of collection to give the laboratory forewarning of the shipment and analytical requirements.

(d) If the samples are sent by common carrier, a bill of lading should be used. Receipts of bills of lading will be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the custody

form as long as the custody forms are sealed inside the sample cooler and the custody seals remain intact.

5.2 Laboratory Chain of Custody Procedures

Laboratory custody procedures for sample receiving and log-in; sample storage; tracking during sample preparation and analysis; and storage of data are described in the laboratory SOP and laboratory QAPP (included in Volume 3).

5.3 Final Evidence Files Custody Procedures

The final evidence files for the data supporting the Ecological Risk Assessment will be maintained by the Site Program Manager at Solutia. The content of the evidence file will include, at a minimum, all relevant records, reports, correspondence, logs, field logbooks, laboratory sample preparation and analysis raw data, original laboratory data packages, pictures, subcontractor's reports including data validation reports, assessment reports, progress reports, and chain of custody records/forms. The evidence file will be under custody of the Site Program Manager in a locked, secured area.

Figure 5-1a. CHAIN OF CUSTODY RECORD

Project No.	Project Name:	Project Location:

MENZIE-CURA & ASSOCIATES, INC.
1 COURTHOUSE LANE, SUITE 2
CHELMSFORD, MA 01824
TEL: 978/453-4300 FAX: 978/453-7260

DATE:

SAMPLERS

Analyses Required

SAMPLE ID	Date	Comp.	Grab	Station Locations	No. of Containers						NOTES

Relinquished By: (Signature)	Date	Time	Received By: (Signature)	Date	Time
Relinquished By: (Signature)	Date	Time	Received By: (Signature)	Date	Time
Relinquished By: (Signature)	Date	Time	Received By: (Signature)	Date	Time

Laboratory:

Phone:

Contact Person:

Remarks:

PAGE ____ OF ____

Figure 5-1b. Example of Chain-of-Custody from Savannah Laboratories

SL *SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.*

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

☐ 5102 LaRoche Avenue, Savannah, GA 31404	Phone: (912) 354-7858	Fax: (912) 352-0165
☐ 2846 Industrial Plaza Drive, Tallahassee, FL 32301	Phone: (904) 878-3994	Fax: (904) 878-9504
☐ 414 SW 12th Avenue, Deerfield Beach, FL 33442	Phone: (954) 421-7400	Fax: (954) 421-2584
☐ 900 Lakeside Drive, Mobile, AL 36693	Phone: (334) 666-6633	Fax: (334) 666-6696
☐ 6712 Benjamin Road, Suite 100, Tampa, FL 33634	Phone: (813) 885-7427	Fax: (813) 885-7049
☐ 100 Alpha Drive, Suite 110, Destrehan, LA 70047	Phone: (504) 764-1100	Fax: (504) 725-1163

PROJECT REFERENCE	PROJECT NO.	P.O. NUMBER	MATRIX TYPE	REQUIRED ANALYSES	PAGE	OF
PROJECT LOC. (State)	SAMPLER(s) NAME	PHONE / FAX				
CLIENT NAME	CLIENT PROJECT MANAGER					
CLIENT ADDRESS (CITY, STATE, ZIP)						

☐ STANDARD REPORT DELIVERY

☐ EXPEDITED REPORT DELIVERY (surcharge)

Date Due: _____

SAMPLE DATE	SAMPLE TIME	SL NO.	SAMPLE IDENTIFICATION	AQUEOUS (WATER)	SOLID OR SEMI/SOLID	AIR	NONAQUEOUS LIQUID (oil, solvent, etc)	NUMBER OF CONTAINERS SUBMITTED										REMARKS

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SL LOG NO.	LABORATORY REMARKS:
			☐ YES ☐ NO			

Figure 5-1c. Example of Chain-of-(:ody from Aquatec Biological Laboratory

Page _____ of _____

COMPANY INFORMATION	COMPANY'S PROJECT INFORMATION	SHIPPING INFORMATION	VOLUME/CONTAINER TYPE/ PRESERVATIVE (NOTE 4)
Name: _____	Project Name: _____	Carrier: _____	
Address: _____	_____		
_____	Project Number: _____	Airbill Number: _____	
_____	Sampler Name(s): _____		
Telephone: _____	_____	Date Shipped: _____	
Facsimile: _____	_____		
Contact Name: _____	Quote #: _____ Client Code: _____	Hand Delivered: ☐ Yes ☐ No	

SAMPLE IDENTIFICATION (NOTE1)	COLLECTION DATE	COLLECTION TIME	GRAB	COMPOSITE	MATRIX	ANALYSIS/REMARKS (NOTE 2,3)	NUMBER OF CONTAINERS					

Relinquished by: *(signature)*	DATE	TIME	Received by: *(signature)*
Relinquished by: *(signature)*	DATE	TIME	Received by: *(signature)*
Relinquished by: *(signature)*	DATE	TIME	Received by: *(signature)*

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 30 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.:MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.: 40 ml/glass/H_2SO_4

Notes to Lab:

_____

_____

_____

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

Figure 5-2 Fish Log

Menzie-Cura & Associates, Inc. **Fish Collection Log**		
Project #	**Client:**	
Date:	**Time:**	
Species Identification (genus and species):		
Total Length (cm):	**Weight (g):**	**Sex:**
Method Collection:	**Tag Number: (each specimen to be individually tagged with jaw tag):**	
Sample Location (nearest prominent landmark, loran, distance from shore):		
Observations of any External Pathology		

Menzie-Cura & Associates, Inc.
One Courthouse Lane, Suite Two
Chelmsford, MA 0182
Tel: 508/453-4300 Fax: 508/453-726

Page ____of ____

Figure 5-3 Sampling Processing Record for Fish Fillet Composites

Project Number: _____ Sampling Date and Time: _____

STUDY PHASE: Screening Study ☐; Intensive Study: Phase I ☐ Phase II ☐

SITE LOCATION

Site Name/Number: _____

County/Parish: _____ Lat./Long.: _____

Waterbody Name/Segment Number: _____ Waterbody Type: _____

Sample Type (bottom feeder, predator, etc.) _____ Species Name: _____

Composite Sample #: _____ Replicate Number: _____ Number of Individuals: _____

					First Fillet (F1) or Combined Fillets (C)			Second Fillet (F2)		
Fish #	Weight (g)	Scales/Otoliths Removed (✓)	Sex (M,F)	Resection Performed (✓)	Weight (g)	Homogenate Prepared (✓)	Wt. of Homog. for Composite (g)	Weight (g)	Homogenate Prepared (✓)	Wt. of Homog. for Composite (g)
001										
002										
003										
004										
005										
006										
007										
008										
009										
010										
Analyst										
Date										

Total Composite Weight (g) (F1 or C) _____ (F2) _____

Notes: _____

Figure 5-4a Example of a Custody Label for Menzie-Cura & Associates, Inc.

Menzie-Cura & Associates, Inc.	
Field Samplers Initials	Type of Analyses
Sample ID Number	Sample Location
Sample Date (d/mo/yr)	Time (24-h clock)

Figure 5-4b: Example of Custody Labels from Savannah Laboratory

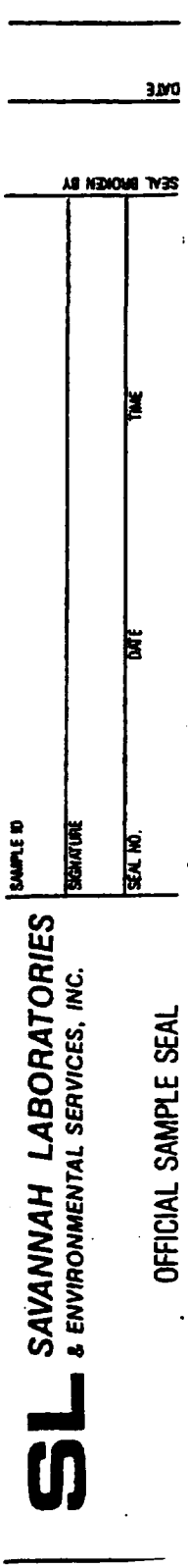
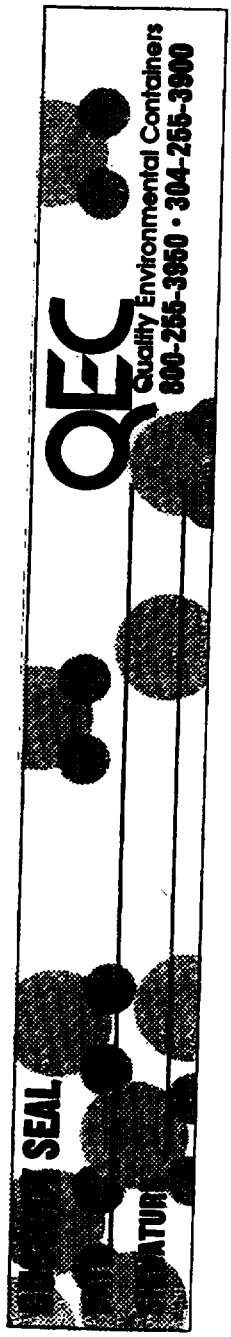
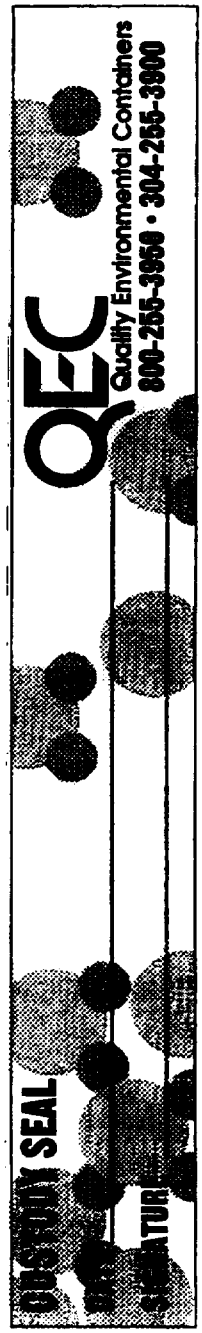


Figure 5-4c: Example of Custody Labels from Aquatec Biological Sciences





6.0 CALIBRATION PROCEDURES AND FREQUENCY

All instruments used to perform chemical measurements must be properly calibrated prior and during use to ensure acceptable and valid results. This section describes the procedures necessary for maintaining the accuracy of all the instrumentation used in the field tests and the laboratory analyses. The accuracy and traceability of all calibration standards used must be properly documented. The procedures described herein are to be used in conjunction with specific instrument manufacturer's instructions, applicable analytical methodology requirements, and specific laboratory/field procedures for instrument operation.

6.1 Field Instruments/Equipment

Field measurements are not planned for the ERA sampling activities described in this QAPP. Field measurements of pH, conductivity, temperature, and dissolved oxygen of the surface waters will be performed during surface water collection as described in Volume 2 of the SSP. Field measurement information from the surface water investigation may be used in the ERA.

6.2 Laboratory Instruments

The methodologies selected for use in this investigation specify the types and frequency of calibrations. For all analytical procedures, the lowest calibration standard analyzed must be at or below the project required reporting limit for the specific media being tested to ensure accurate reporting limit determinations. The specific methods to be used are provided in Section 7.0. Volume 2, Appendix A and Appendix B of the SSP contain the laboratories' Quality Assurance Manuals detailing specifics on instrumentation and calibration procedures.

Accessory analytical equipment such as refrigerators, balances and ovens required for the storage and preparation of samples must be calibrated using manufacturer's instruction with the following guidelines:

- Calibrations of equipment must be checked daily and these records kept in a logbook or calibration-specific log
- The laboratory must document clearly the acceptance criteria for all such equipment (e.g., refrigerator temperature must be $4 \pm 2^{o}C$) and corrective actions must be taken for any out-of-control situation as described in the laboratory's quality assurance plan or manual
- The equipment must not be used after corrective action until it has been recalibrated or verified through the successful analysis of a check standard
- Calibrations of other miscellaneous analytical equipment (e.g., automatic pipettes) must be performed according to manufacturer's recommendations

Implementation of the laboratory calibrations will be the responsibility of the Laboratory Director and the analysts performing the procedures.

7.0 ANALYTICAL PROCEDURES

This section describes a brief overview of the analytical methodologies to be used during the Sauget Area 1 Ecological Risk Assessment.

7.1 Field Analytical Procedures

Field measurements are not being performed during this assessment.

7.2 Laboratory Analytical Procedures

Laboratory analyses in support of biota data will be performed by Savannah River Laboratory, Georgia with the dioxin analysis sub-contracted to Triangle Laboratories, North Carolina. Sediment bioassay toxicity testing and community composition will be performed by Aquatec Biological Sciences, Vermont. Details on laboratory analyses and QA procedures can be found in Volume 3 of the SSP which includes the laboratories' Quality Assurance Plans.

7.2.1 Sediment and Surface Water Methods

Sediment and surface water analyses are being performed as part of the EE/CA and RI/FS activities. Methods can be found in the associated Site QAPP for "Soil, Groundwater, Surface Water, Sediment, and Air Sampling," in Volume 2.

7.2.2 Biota Methods

Analysis of benthic organisms, vegetation, crayfish, and fish will be conducted by the off-site laboratories, Savannah River Laboratory and Triangle Laboratories, in accordance with the EPA methods summarized in Table 7-1. The corresponding analytical parameters are listed in Tables 1-1 through 1-6. The project required reporting limits are provided in the specific parameter tables. Additional guidance is provided as follows.

- Parameters will be analyzed according to analytical procedures set forth in the EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition, Final Update, December 1996.

- Sample preparation for biota samples (benthic invertebrates, crayfish, vegetation, and fish) prior to solvent extraction or digestion will include homogenization of each sample using a tissuemizer or blender at the laboratory. This procedure will ensure a uniform sample aliquot for analysis.

- Samples that have significant matrix interferences may require specialized cleanup procedures and/or reanalysis in order to eliminate interferences and to permit analysis to proceed with a reporting limit at or closer to the project required reporting limits. Any matrix interferences that result in elevated reporting limits without positive results for target analytes must be reported by the laboratory. Cleanup protocols will be anticipated for the biota sample analyses. Gel-Permeation Chromatography (GPC EPA SW-846 Method 3640A) will be used on solvent extracts for organic compounds prior to analysis to remove high molecular weight fatty acids and lipids. Additional cleanup procedures may be required and, if needed, will be drawn from the procedures given in EPA SW-846, 3rd Edition.

The laboratory will maintain current SOPs for extraction, cleanup and analysis of biota material and must have on file current Method Detection Limit (MDL) studies, as shown in their QA Plans (included in Volume 3) to demonstrate their ability to meet the project required reporting limits. The MDLs must be performed by the laboratory on a yearly basis to ensure their ongoing ability to perform the methods as specified. The MDLs will be performed in accordance with EPA guidance described in 40 CFR 136, 1986, Appendix B, "Definition and Procure for the Determination of the Method Detection Limit - Revision 1.11".

7.2.3 Biota Methods – Benthic Invertebrate Community Composition

The field-preserved benthic grab samples will be sorted at the laboratory using techniques described in the SOP for processing of benthic invertebrate samples for taxonomic identification and community evaluation (Appendix A). Benthic invertebrates will be identified to the lowest practical taxonomic level and counted. A voucher collection of the identified animals will be maintained. The data will be analyzed for taxa richness, abundance, percent dominant taxon/taxa, and community composition.

7.2.4 Biota Methods – Fish Processing and Filleting

Forager fish, bottom fish, and piscivorous fish will be processed as whole fish in the laboratory. In addition, some piscivorous fish (large mouth bass) will be filleted using procedures described in Appendix B. Fillets and whole fish samples will be analyzed for organic and inorganic compounds (Table 1-1 through 1-7). Fish samples that will undergo organic analysis will also be analyzed for lipid content, since there is a documented correlation between bioaccumulation of certain organic contaminants (*e.g.*, PCBs) and the lipid content of fish.

7.2.5 Sediment Toxicity Methods

Sediment toxicity testing will be performed using Site sediments as described in Section 4. Acute and chronic toxicity testing will be performed on *Hyalella azteca* and *Chironomus tentans*. Acute toxicity tests will include EPA Test Method 100.1 Hyallella azteca 10-d

survival and growth test for sediments and EPA Test Method, *Chironomus tetans* 10-d survival and growth test for sediments. Chronic toxicity tests will include draft EPA Test Method 100.4 *Hyallela azteca* 42-d growth and reproduction test and draft EPA Test Method 100.5 *Chironomus tentans* test for measuring chronic survival, growth, emergence, and reproduction. Aquatic Biological Sciences, Inc.'s laboratory SOPs for the sediment toxicity tests are presented in Appendix A. Eight laboratory replicates will be conducted for each acute test. Twelve laboratory replicates will be conducted for the chronic test with *Hyalella azteca*. Sixteen laboratory replicates including 4 auxiliary male replicates will conducted for the chronic test with *Chironomus tetans*.

When whole sediment samples are removed from storage, test sediment will be prepared following procedures cited in the laboratory SOP (Appendix A). Indigenous organisms removed from the test sediment will be identified and recorded. Control sediment (artificial sediment) will be hydrated before distribution into test chambers. The sediments will be then distributed to individual replicate test chambers, overlying water will be added, and the automated overlying water renewal system will be activated. In addition to measurements of initial overlying water chemistry cited in the sediment toxicity SOP (Appendix A), ammonia and hydrogen sulfide will be measured in sediment pore water.

Table 7-1. Laboratory Methods of Analysis of Biota in Support of the Ecological Assessment

Parameter Type	Method of Analysis
Semivolatile Organic Analytes	8270C, SW-846, 3rd Edition, December 1996
Inorganic Analytes	Metals: 6010B, (ICP) and 7000 Series Methods (GFAA) SW-846, 3rd Edition, December 1996 Mercury: 7471A, SW-846, 3rd Edition, December 1996 Cyanide: 9010B/9014, SW-846, 3rd Edition, December 1996
Pesticide Analytes	8081A, SW-846, 3rd Edition, December 1996
Herbicide Analytes	8151A, SW-846, 3rd Edition, December 1996
Dioxin and Dibenzofuran Analytes	8290, SW-846, 3rd Edition, September 1994 method included in December 1996 update
PCBs	8082, SW-846, 3rd Edition, December 1996
Percent Lipids	EPA-600/4-81-055
Sediment Bioassay Toxicity Testing	See Appendix A for Sediment Bioassay Protocols and references

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 Field Measurements

On-site field measurements are not being performed in support of the Ecological Risk Assessment. The type and frequency of field collected Quality Control samples in support of the Ecological Risk Assessment are described in Section 3.0.

8.2 Laboratory Analysis

Laboratory QC checks include the analysis of initial and continuing calibration checks, blanks, spiked samples (matrix spikes and matrix spike duplicates, laboratory control samples and/or Standard Reference Material (SRM) analysis, cleanup check samples), surrogates (organic analyses only), laboratory duplicate samples (matrix duplicates), and retention time window determination (applicable organic methods). A brief description of these check samples are given below. Criteria that the laboratory must meet for these are based on the specific analytical methods used and are summarized in Tables 3-1 through 3-7. Laboratory QC will be checked against the analytical methods and data usability criteria during the data generation and review process.

8.2.1 *Calibration Criteria*

Calibration checks will be performed according to the method-specific requirements as summarized below. The specifics for the calibrations are detailed in the individual analytical methods.

Organic Analyses

- Multilevel initial calibrations (usually 5-level) will be performed to establish the instrument's response to the targets of interest across a range of concentrations (calibration curves). The lowest level calibration standard must be at or below the project required reporting limit

- Calibration verification will be performed at least once every 12 hours of gas chromatograph/mass spectrometer (GC/MS) analysis. For gas chromatographic (GC) analyses, verification will occur every 10 samples of GC instrument analysis to ensure continued accurate quantitation.

- Instrument tuning of GC/MS systems will be performed every 12 hours using the method-appropriate tuning standard and acceptance criteria.

Inorganic Analyses

- Multilevel calibration curves generated by analyses of individual or mixed standards
- Initial calibration verification at the beginning of each run and continuing calibration verification at a minimum of 1every 10 samples to verify ongoing instrument performance
- Inductively coupled plasma (ICP) interference check standards after initial calibration and after sample analysis (within 8-hours) to verify interelement and background corrections

8.2.2 *Blanks*

Method blanks are generated by the laboratory as they are processing field samples. These method or preparation blanks are analyte-free matrices that are processed using all of the reagents and procedures that are used on the field samples to evaluate whether or not contamination occurred during sample preparation and analysis. Method blanks will be analyzed at a minimum of 1 per 20 field samples per matrix per preparation batch. Contamination found in the method blank and similarly in the field samples may be an indication of cross-contamination and may not be indicative of the samples taken from the field. Additional method blanks, such as cleanup method blanks, may be generated to independently verify the cleanup technique, if used. Criteria for acceptance of method blanks is method-specific and is included in Tables 3-1 through 3-6.

Analytical blanks are required for inorganic analyses during initial and continuing calibration verification. These blanks are analyzed at the beginning, during, and at the end of the analytical sequence to assess contamination and instrument drift. The initial calibration blank (ICB) is run after the initial calibration verification (ICV) and prior to sample analysis. The continuing calibration blank (CCB) is analyzed every 10 samples, following the ICB, throughout the analytical run and at the end of the sequence. These blanks are prepared by acidifying reagent water to the same concentrations of acids found in the samples and standards. Criteria for acceptance of the analytical blanks are the same as for method blanks and are included in Table 3-2.

8.2.3 *Matrix Spikes and Matrix Spike Duplicates*

Matrix Spike (MS) samples are prepared by spiking known concentrations of target analytes into an aliquot of field sample. The MS is processed in exactly the same manner as all other field samples. The percent recovery of a target spike compound is an indication of the ability of the methods of analysis and of the laboratory to accurately quantitate the target analyte in the sample that was spiked. The recovery of the MS may aid the analyst in determining whether a matrix

effect or interference exists in the analysis of the unspiked sample. For organic analyses in particular, the recovery of the MS does not necessarily reflect the ability to accurately determine the target analyte, or analytes of similar chemical nature, in other field samples. MS target compounds and criteria are method specific and are summarized in Tables 3-1 through 3-6.

Matrix Spike Duplicates (MSD) are prepared for organic analyses and are handled in the same exact manner as the MS. The relative percent difference (RPD) is a measure of comparability between the MS and MSD and provides a measure of analytical precision (whereas inorganics uses matrix duplicate results to evaluate precision). For all organic analyses, an MS/MSD pair will be prepared and analyzed at a frequency of 1 per 20 samples per matrix per analytical batch. RPD acceptance criteria for the MS/MSD are analyte and method specific and are summarized in Tables 3-1 and 3-3 through 3-6.

8.2.4 *Surrogate Spikes*

All samples, including field and QC samples, analyzed for organic components will have surrogates (termed "sample fortification mixture" for dioxin analysis) added to the samples during the preparation procedures. The surrogates used are method-specific and are similar in chemical nature to the targets of interest; however, they are not normally found in environmental samples. The recoveries of the surrogate compounds assist the analyst and data user in the determination of the accuracy of the measurements for the target compounds of interest. Tables 3-1 and through 3-3 through 3-6 summarize the surrogate identities and criteria by method.

8.2.5 *Laboratory Control Samples and Standard Reference Material*

Laboratory Control Samples (LCS) are prepared by spiking known concentrations of target analytes into analyte-free matrices (blank matrices). Standard Reference Material (SRM) contain the analytes of interest in a matrix of interest and are purchased from a standard's vendor. LCS and SRM are prepared and analyzed concurrently with the field samples. The recovery of the targets from the LCS or SRM is a measure of the ability of the preparation and analysis methods to accurately quantitate target analytes in the absence of matrix effects or interferences. LCS will be analyzed at a minimum of 1 per 20 field samples per matrix per preparation batch. LCS criteria are analyte and method specific and are summarized in Tables 3-1 through 3-6. The SRM criteria are based on the manufacturer's accuracy limits. The laboratory will obtain appropriate SRM for analysis with biota samples. If an SRM is used as a measure of method accuracy for target analytes in biota, then an LCS is not required.

8.2.6 *Cleanup Check Samples*

Whenever a cleanup technique (e.g., gel permeation chromatography (GPC), alumina column cleanup, etc.) is employed to eliminate interferences which may prevent accurate determination of the targets of interest at the project required reporting limit, the cleanup procedure must be

verified through the analysis of check standards. A standard containing some or all of the target analytes must be processed through the cleanup procedure and analyzed. The recovery of the target analytes in this check will indicate if the cleanup procedure was effective in elimination of interferences without undo elimination of the targets of interest.

8.2.7 *Laboratory Duplicates*

A laboratory matrix duplicate (MD) is a separate aliquot of sample taken from the same sample container as a field sample which is prepared and analyzed independently. Comparison of all positive results between the sample and MD, through determination of the RPD, provides a measure of the analytical precision and accuracy of the quantitation. A sample/MD pair will be prepared and analyzed at a frequency of 1 per 20 samples per matrix per analytical batch. RPD acceptance criteria for the sample/MD are analyte and method specific and are summarized in Tables 3-1 through 3-6. Note that for organic analyses, the precision criteria for Field Duplicates given in Tables 3-1, and 3-3 through 3-6 are equivalent to those for the sample/MD precision.

8.2.8 *Retention Time Window Determination*

For organic analyses, determination of the target analyte retention time window will be made based on the procedure specified in the method of analysis. Positive identification of an analyte will be made when it's retention time falls within the window established during calibration.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

All data generated by the laboratories shall be reduced, reviewed, and validated prior to use in the Ecological Risk Assessment using the following procedures.

9.1 Data Reduction

9.1.1 Field Data Reduction Procedures

Field measurements are not a part of the field activities described in this QAPP in support of the Ecological Risk Assessment. Field activities include observations and sample collection only. For field data reduction procedures for other measurements, see associated FSPs for the EE/CA and RI/FS in Volume 2.

9.1.2 Laboratory Data Reduction Procedures

Laboratory data reduction procedures will be performed according to the following general protocols and laboratory-specific protocols as described in the laboratories' QA Plans (Volume 3). All raw analytical data will be recorded and documented using laboratory standard procedures. Laboratory data will include, at a minimum, the unique sample identification number, analytical method used, name of analyst, the date of analysis, matrix sampled, reagent and standard concentrations, instrument settings, final results, units, and sample-specific reporting limits. Periodic review of laboratory notebooks (logbooks) and data reports shall be performed by the Lab QA Manager as described in the laboratory QAPP.

For this project, analytical results for all biota samples will be calculated and reported on a wet-weight basis. QC data (e.g. laboratory duplicates, surrogates, MS/MSDs) will be compared to the acceptance criteria defined in this QAPP in Section 3 and 7. Laboratory case narratives will be prepared which will include information concerning data that fell outside acceptance limits, and any other anomalous conditions encountered during sample analysis. After the laboratory submits the laboratory data package to the Site Program Manager, the data are considered approved by the laboratory and ready for third party data validation.

9.2 Data Validation

Formal data validation, using standard EPA protocols for evaluating the technical and regulatory validity of environmental data (based on the procedures in Volume 4, Data Validation Plan), shall be performed for the laboratory generated chemical data. For field activities, informal data review of observations and documentation will be performed.

9.2.1 Procedures Used to Validate Field Data.

The procedures to evaluate field information for the Ecological Risk Assessment include checking for transcription errors and review of field logbooks. These reviews will be performed by the site field team leader of Menzie-Cura. Procedures to validate field

measurements to be performed for other Site investigations are described in associated Site QAPPs in Volume 2.

9.2.2 Procedures Used to Validate Laboratory Data

Procedures to validate laboratory data will be derived from the USEPA's *National Functional Guidelines for Organic Data Review* (February 1994) and *Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review* (February 1994). The third-party validator, Environmental Standards, Inc., will modify these protocols to include the criteria in this project QAPP as listed in Sections 3 and 8.

Briefly, the validation includes a review of all technical holding times, instrument performance check sample results, initial and continuing calibration results, and all batch and matrix QC including field blanks, field duplicates, MS/MSD, matrix duplicates, surrogate recoveries, method blanks, laboratory control samples, standard reference material results, and the identification and quantitation of specific compounds of interest. One hundred percent of the analytical data shall be validated in support of using the data in the Ecological Risk Assessment.

Additionally, method detection limit studies (MDL) for all chemicals of concern in tissues will be performed by the analytical laboratory. These MDLs will support the project reporting limit requirements and have been performed within one year of the analysis of samples collected for the Ecological Risk Assessment. The laboratory shall follow the MDL procedures as outlined in the Federal Register, Vol. 49, no. 209, October 26, 1984, pp.198-199 and associated laboratory QAPP SOPs. Appendix D contains current MDLs for the analytes and matrices of interest from the laboratories.

In addition to the precision, accuracy, and sensitivity criteria as defined in Section 3 and 8 of this QAPP, the overall completeness of the data package will also be evaluated by the Data Validator. Completeness checks will be administered on all data to determine whether deliverables specified in the QAPP Section 9.3, below, are present. The reviewer will determine whether all required items are present and request copies of missing deliverables using resubmittal request documentation via facsimile or email. Such documentation will be included in the data validation reports.

9.3 Data Reporting

9.3.1 Field Data Reporting

No field measurements are planned in this QAPP/FSP for Ecological Risk Assessment.

9.3.2 Laboratory Data Reporting

The Laboratory will provide at least two hard-copies of each laboratory data report, an original and a copy for data validation, to the Site Program Manager. Electronic deliverables will be

required for the project database. Specific formats for electronic deliverables shall be determined by the Site Program Manager, the Ecological Risk Assessors at Menzie-Cura, the Data Validation Contractor, and the analytical laboratory prior to the start of the program.

The laboratory data reports shall consist of the following, at a minimum:

1. Case Narrative

- Date of issuance
- Laboratory analysis performed
- Any deviations from intended analytical strategy
- Laboratory batch number
- Numbers of samples and respective matrices
- QC procedures utilized and also references to the acceptance criteria
- Laboratory report contents
- Project name and number
- Condition of samples 'as-received'
- Discussion of whether or not sample holding times were met
- Discussion of technical problems or other observations which may have
- created analytical difficulties
- Discussion of any laboratory QC checks which failed to meet project criteria
- Signature of the Laboratory QA Manager and/or Laboratory Director or designee

2. Chemistry Data Package

- Summary page indicating dates of analyses for samples and laboratory QC checks
- Cross referencing of laboratory sample identification numbers to project sample identification numbers
- Description of laboratory data qualifiers used
- Sample preparation and analyses dates and methods used for samples
- Sample results in wet weight with units clearly labeled
- Sample-specific reporting limits
- Raw data for sample results and laboratory QC samples
- Results of (dated) initial and continuing calibration checks, and GC/MS tuning
- MS/MSD recoveries and relative percent difference (RPD), MD results and Sample/MD RPD, laboratory control samples/standard reference recoveries, method blank results
- Calibration check compounds, system performance check results, surrogate recoveries
- Chromatograms/spectra or other raw data of sample results and QC checks
- Example result calculations

The data package submitted will be a "CLP-like" data package consisting of all the information presented in a CLP data package, including CLP-like reporting forms to facilitate data validation. Tentatively Identified Compounds, (TICs) will not be reported for this project.

9.4 Data Reconciliation with Ecological Risk Assessment Requirements for Usability

The goal of this project is to produce an Ecological Risk Assessment. As such, the data generated must meet the risk assessor's needs as defined in Section 3 of this QAPP. In summary from Section 3, the primary objectives for assessing the usablity of the biota data for Ecological Risk Assessment are (1) to collect data that is representative of site conditions and comparable with prior data; (2) to produce data that meets the project reporting limit requirements for Ecological Risk Assessment; (3) to produce data of the highest quality possible in order to accurately and precisely characterize the Site ecological conditions.

The Data Validator will apply the standard data validation qualifiers to data to indicate the level of uncertainty in the associated result. In general, for the purposes of the Ecological Risk Assessment, data that are left unqualified, data qualified "U" (non-detected), data qualified "J" (detected as an estimated result), and data qualified "UJ" (non-detected at an estimated detection reporting limit) are considered valid and usable for project objectives. Data that are qualified "R" (rejected), due to severe exceedances of QC requirements, will be considered invalid and unusable for the Ecological Risk Assessment.

The goal of this QAPP/FSP program is to generate valid, usable data for the Ecological Risk Assessment. However, in environmental sampling and analysis, some data may be lost due to sampling location logistics, field or laboratory errors, or matrix effects that may cause the rejection of results for some compounds. The overall completeness of collection of valid data, as defined in Section 3 of this QAPP, is 90%. The Data Validator will assess the completeness of the overall data generation against the project goal of producing 90% of the planned data as valid and usable results for the Ecological Risk Assessment. If this goal is not met, data gaps may exist that may compromise the risk assessment.

10.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of both field and laboratory activities may be conducted to verify that sampling and analysis are performed in accordance with the procedures established in this QAPP/FSP and the Ecological Risk Assessment Work Plan. The audits of field and laboratory activities will include two independent parts: internal and external audits.

10.1 Field Performance and System Audits

10.1.1 Internal Field Audit Responsibilities, Frequency, and Procedures

Internal audits of field activities including sampling and field observations will be conducted by the Ecological Project Manager/Field Team Leader. These audits will verify that all established procedures are being followed.

Internal field audits should be conducted at least once at the beginning of the site sample collection activities and potentially during the course of sampling activities if problems in the field are encountered.

Internal field audits will include examination of field sampling records, field observation records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures, chain of custody, adherance to the health and safety procedures, included in the Ecological Risk Assessment Project Health & Safety Plan (Appendix C) and any other procedures defined in this QAPP/FSP Sections 4 and 5. These audits will occur at the onset of the project to verify that all established procedures are followed. Follow-up audits may be conducted to correct deficiencies, and to verify that QA procedures are maintained throughout the project.

10.1.2 External Field Audit Responsibilities, Frequency, and Procedures

An external audit may be conducted as required, by appropriate QA staff of U.S. EPA Region 5 and/or contractor.

External field audits may be conducted any time during the field operations. These audits may or may not be announced and are at the discretion of U.S. EPA Region 5.

External field audits, if performed, will be conducted according to the field activity information presented in this QAPP/FSP in Sections 4 and 5 and field activities described in the Ecological Risk Assessment Work Plan. The external field audit process may include (but not be limited to): sampling equipment decontamination procedures, sample bottle preparation procedures, sampling procedures, examination of field sampling and safety plans, sample vessel cleanliness and QA procedures, procedures for verification of field duplicates, sample preservation and preparation for shipment, and chain-of-custody procedures.

10.2 Laboratory Performance and System Audits

10.2.1 Internal Laboratory Audit Responsibilities, Frequency, and Procedures

The internal laboratory audit will be conducted by the Laboratory QA Officer. The internal system audits will be done on an annual basis while the internal performance audits may be conducted on a quarterly basis according to the laboratory QA procedures (see Volume 3, Laboratory QA Plans).

The internal system audits will include an examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedures, sample preparation and analysis, instrument operating records, etc. The auditor should ensure that all Standard Operating Procedures (SOPs) and Method Detection Limits (MDL) are current and appropriate for the matrices and analyses being conducted for the project. The laboratory internal auditor will follow procedures described in the laboratory QA Plan for internal system audits.

The performance audits may involve preparing blind QC samples and submitting them along with project samples to the laboratory for analysis throughout the project. The laboratory QA Officer will evaluate the analytical results of these blind performance samples to ensure the laboratory maintains acceptable QC performance. The laboratory auditor will follow procedures for the performance audits as described in the laboratory QA Plan.

Data package review, as discussed in Section 10.2.2, below, may also be performed.

10.2.2 External Laboratory Audit Responsibilities, Frequency, and Procedures

An external laboratory audit may be conducted as required, by appropriate QA staff of U.S. EPA Region 5 and/or contractor. Menzie-Cura does not plan to perform an external performance evaluation of the analytical laboratories because these laboratories have been pre-qualified to perform chemical analysis for this project based on prior successful performance on other projects for Solutia, and by maintaining appropriate QA/QC procedures as evidenced by their Quality Assurance Manuals, SOPs, and MDLs. Additionally, 100% of the chemical data generated to support the Ecological Risk Assessment will be validated by Environmental Standards. This validation will uncover any QA/QC issues that may affect the use of the results for the ERA. Procedures for the data validation, criteria for acceptance and qualification, are presented in the SSP Volume 4, "Data Validation Plan for the Sauget Area 1 EE/CA and RI/FS." Note, however, that USEPA and the project team reserve the option of performing an external audit of the laboratories during this project, if deemed necessary to the success of the project.

External laboratory audits may be conducted any time during the analytical operations. These audits may or may not be announced and are at the discretion of U.S. EPA Region 5 and/or the project team.

External audits may include: review of laboratory analytical procedures; laboratory on-site visits; and results of performance evaluation samples submitted to the laboratory for analysis. Failure of any or all audit procedures chosen can lead to laboratory disqualification, and the requirement that another suitable laboratory be chosen.

An external on-site review can consist of: sample receipt procedures, custody and sample security and log in procedures, sample storage procedures, review of instrument calibration records, instrument logs and statistics (number and type), review of QA procedures, log books, sample preparation procedures, analytical Standard Operating Procedure (SOP) review, Method Detection Limit (MDL) review, instrument reviews, personnel interviews, review of glassware preparation procedures, and corrective action protocols.

It is common practice when conducting an external laboratory audit to review one or more data packages from sample lots recently analyzed by the laboratory. This review will most likely include but not be limited to:

- Comparison of resulting data to the SOP or method, including deviations.
- Verification of initial and continuing calibrations within control limits.
- Verification of surrogate recoveries and instrument timing results, where applicable.
- Review of extended quantitation reports for comparisons of library spectra to instrument spectra, where applicable.
- Recoveries on laboratory control samples and/or SRM analyses.
- Review of run logs with run times, ensuring proper order of runs.
- Review of spike recoveries/QC sample data.
- Review of suspected manually integrated GC data and its cause, where applicable.
- Review of GC peak retention times and resolution for compounds as compared to reference spectra, where applicable.
- Assurance that samples are run within holding times.

Ideally, the data should be reviewed while on the premises, so that any data called into question can be discussed with the staff.

11.0 PREVENTIVE MAINTENANCE

11.1 Field Instrument Preventative Maintenance

Field measurements are not planned specifically for the Ecological Risk Assessment. Specific preventative maintenance procedures to be followed for field equipment are described in associated Site documents (QAPPs and FSPs) in Volume 2 and are, in general, based on those recommended by the manufacturer.

11.2 Laboratory Instrument Preventative Maintenance

As part of the laboratories' QA Manuals, a routine preventative maintenance program is conducted by the laboratory to minimize the occurrence of instrument failure and other system malfunctions (see Laboratory QA Manuals included in Volume 2, Appendices A and B of the SSP). Designated laboratory employees regularly perform routine scheduled maintenance and repair of (or coordinate with the vendor for the repair of) all instruments. All laboratory instruments are maintained in accordance with manufacturer's specifications. The details of the preventative maintenance procedures are included in the laboratories' QA Manuals and are not reiterated herein. In general terms, the preventive maintenance program includes the following steps.

- An inventory of replacement and spare parts for instruments that are maintained.
- Maintenance logbooks for each instrument will be kept along with information on routine and non-routine procedures. The logbook records must include the instrument number, date of maintenance activity, and the type of activity performed.
- Training of laboratory staff in the maintenance requirements of the instruments used in this project. Preventive maintenance schedules and activities will be outlined in the laboratory's SOPs and will be adhered to.

The following sections describe the general preventative maintenance procedures for major pieced of analytical equipment. The specific laboratory QA Manuals should be consulted for specific procedures for each laboratory (Volume 2, Appendices A and B, SSP).

11.2.1 Inductively Coupled Plasma Spectroscopy

The Inductively Coupled Plasma (ICP) Spectrometer should be maintained under service contract with the manufacturer. Routine preventive maintenance should include:

- Checking pump tubing and replacing when necessary.
- Checking nebulizer for even "spray" and cleaning as necessary.
- Checking the torch for plasma height and shape and cleaning as necessary.
- Checking sensitivity of photomultiplier and replacing as necessary.

11.2.2 Gas Chromatograph Instruments

The GC and GC/MS systems will be maintained on a service contract or undergo in-house maintenance to provide routine preventive maintenance. Spare parts for the GC and GC/MS systems should include: filaments, electron multiplier, source parts, o-rings, ferrules, septa, injection port liners, and columns. Routine preventive maintenance for the systems should include:

- Checking the data systems (disk drives, tape readers, etc.) and servicing, as necessary.
- Changing oil and traps on mechanical and turbo pumps.
- Servicing the MS source through cleaning, replacement of filaments and other source parts, as necessary.
- Replacement of Injection port septa and liners, as necessary.
- Clipping front end of GC column or replacement of GC column, as necessary.

11.2.3 Thermometers

Thermometers for refrigerators and ovens are calibrated yearly against National Institute of Standards and Technology (NIST) certified thermometers. The laboratory QA manager will be responsible for the safekeeping of the NIST thermometers and for the documentation asserting the accuracy of their measurements.

11.2.4 Analytical Balances

Virtually every analytical procedure requires the use of side-loading and/or top-loading balances. Many of these requirements involve standards preparation and are, therefore, crucial to accurate determination. Balances should be maintained on a service contract. A calibration status label is affixed to each balance after calibration during servicing.

12.0 SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The purpose of this section is to indicate the methods by which it will be ensured that the data collected for this investigation falls in line with the data quality objectives (DQOs) as described in Section 3 of this QAPP. To meet these DQOs, a combination of statistical procedures and qualitative evaluations will be used to check the quality of the data. These procedures will be used by the laboratory, in generating the data, and by the Data Validator, in the validation of the biota results for ultimate use in the Ecological Risk Assessment.

Results for QC samples, including field and laboratory blanks, spikes, and duplicates as previously described in Sections 3, 6, and 8 of this QAPP, will be evaluated using the equations described below to determine the validity and usability of the data. In addition, the data will be reviewed for indications of interferences to results caused by sample matrices, contamination during sampling, contamination in the laboratory, and sample preservation and storage anomalies (i.e., samples holding time or analytical instrument problems).

As no field measurements are planned in this QAPP, the following procedures refer to laboratory-generated chemical data in biota samples.

12.1 Precision Assessment

The relative percent difference (RPD), as a measure of variability, between the matrix spike and matrix spike duplicate for organics, or sample and matrix duplicate in the case of inorganics, and field duplicate pair will be calculated to compare to precision and representativeness DQOs. The RPD of duplicate measurements is calculated according to the following formula.

$$RPD = \frac{\text{(Result in Sample 1 - Result in Sample 2)}}{\frac{\text{(Result in Sample 1 - Result in Sample 2)}}{2}} \times 100$$

where:
Sample 1 = Initial Sample or spiked sample result
Sample 2 = Duplicate sample or duplicate spiked sample result

12.2 Accuracy Assessment

Accuracy, as a measure of bias, will be evaluated based on the percent recoveries of the matrix spike sample (organics and inorganics), matrix spike duplicate sample (organics), surrogates (organics), internal standards (organics), laboratory control samples and/or standard reference materials (organics and inorganics), initial and continuing calibration check samples (organics and inorganics). These QC results will be compared to the project DQOs for accuracy.

The increase in concentration of the analyte observed in the spiked sample, due to the addition of a known quantity of the analyte, compared to the reported value of the same analyte in the unspiked sample determines the percent recovery. Percent recoveries for spiked samples and QC are determined using the following equation.

$$\% R = \frac{\text{(Result in Spiked Sample - Result in original/unspiked Sample)}}{\text{Known amount of spike added}} \times 100$$

Percent recoveries for LCS and SRM are determined using the following equation:

$$\% R = \frac{\text{Result for compound in LCS or SRM}}{\text{Verified amount of compound in LCS or SRM from vendor information}} \times 100$$

Additionally, field and laboratory blanks will be used to evaluate whether field or laboratory procedures represent a possible source of contamination in the biota samples. Unmonitored contamination can allow false positive results to be reported and treated as true sample components when, in fact, they are not. This type of error will adversely affect the accuracy of the reported results. Several types of blanks, including field blanks, method blanks, and instrument blanks, will be used in this project as described in Sections 3, 6, and 8.

Specific DQOs for blanks have been defined for this program in Sections 3, 6, and 8. In general, the procedure for assessing blank samples for potential contamination is as follows.

1. Tabulate blank compound results.
2. Identify blank samples for which compounds are reported above the project-required reporting limits.
3. If no compounds are detected above the reporting limits in any blanks, the associated data are reported unqualified and no blank actions are taken.
4. If compounds are detected above the reporting limits in the blanks, the associated sample compounds will be qualified during data validation. This qualification may result in the negation of results at raised reporting limits due to blank actions.

Further details on blank actions that may be taken during data validation can be found in the Data Validation Plan, Volume 4.

12.3 Completeness Assessment

Completeness is the ratio of the number of valid sample results to the total number of results planned for collection. Following completion of the sampling, analysis, and data validation,

the percent completeness will be calculated and compared to the project DQO of ≥ 90% (Section 3 of this QAPP) using the following equation.

$$\% \text{ Completeness} = \frac{\text{number of valid/usable results obtained}}{\text{number of valid/usable results planned}} \times 100$$

12.4 Overall Assessment of Ecological Data

Data assessment will involve Data Validation and usability to determine if the data collected are of the appropriate quality, quantity and representativeness to support the Ecological Risk Assessment. The affect of the loss of data deemed unacceptable for use, for whatever reason, will be discussed and decisions made on corrective action for potential data gaps. The QC results associated with each analytical parameter for each biota type will be compared to the objectives presented in Sections 3, 6, and 8 of this QAPP. Only data generated in association with QC results meeting these objectives and the data validation criteria will be considered usable for the Ecological Risk Assessment.

Factors to be considered in the overall data assessment based on the DQOs in this QAPP and the data validation by the third-party validator will include, but not necessarily be limited to, the following.

- Were all samples obtained using the methodologies and SOPs proposed in the QAPP?
- Were all proposed analyses performed according to the SOPs provided in the QAPP?
- Were samples obtained from all proposed sampling locations planned?
- Do any analytical results exhibit elevated reporting limits due to matrix interferences or contaminants present at high concentrations?
- Were all laboratory data validated according to the validation protocols, including project-specific QC objectives as defined in this QAPP?
- Which data sets were found to be unusable (qualified as "R") based on the data validation results?
- Which data sets were found to be usable as estimated data, (qualified as "J" or "UJ") based on the data validation results?
- Has sufficient data of appropriate quality been generated to support the Ecological Risk Assessment?
- Were all issues requiring corrective action, if any, fully resolved?
- Have any remaining data gaps been identified and summarized in the final report?

13.0 CORRECTIVE ACTIONS

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out of QC performance which can affect data quality and usability. Corrective actions may be required for two classes of problems: analytical and equipment problems and noncompliance problems. Analytical and equipment problems may occur during sampling and sample handling, sample preparation, laboratory instrumental analysis, and data review.

For noncompliance problems, for example, non-compliance with EPA methods or QC defined in this QAPP, a formal corrective action will be implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the Site Project Manager. A description of the problem and the corrective action implemented will be confirmed in writing via email, facsimile, or technical memorandum.

Any nonconformance with the established quality control procedures in this QAPP will be identified and corrected. Corrective actions in the field will be implemented and documented in the field record book.

13.1 Field Sample Collection

Technical staff and field project personnel will be responsible for reporting all suspected technical or QA nonconformance or suspected deficiencies of any field collection or observation activity by reporting the situation to the Ecological Project Manager/Field Leader. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, then a nonconformance report will be initiated by the field personnel and a copy forwarded to the Site Program Manager.

The Ecological Project Manager/Field Leader will be responsible for ensuring that corrective action for nonconformance are initiated by:

- evaluating all reported nonconformance;
- controlling additional work on nonconforming items;
- determining disposition or action to be taken;
- maintaining a log of nonconformances;
- reviewing nonconformance reports and corrective actions taken;
- ensuring nonconformance reports are forwarded to the Site Program Manager to be included in the final site documentation in project files.

If appropriate, the Site Program Manager will ensure that no additional work that is dependent on the nonconforming activity is performed until the corrective actions are completed.

If a corrective action warrants a change in the program protocols, this change will be documented and signed by the Menzie-Cura Field Team Leader for the Ecological Risk Assessment, the Site Program Manager and the EPA RPM.

13.2 Laboratory Analysis

The laboratories participating in this program is required to have a written SOPs specifying corrective actions to be taken when an analytical error is discovered or the analytical system is determined to be out of control. The SOP requires documentation of the corrective action and notification by the analyst about the errors and corrective procedures. Additionally, corrective action procedures are included in the laboratories' QA Plans (Volume 3).

Corrective actions are required whenever an out-of-control event or potential out-of-control event is noted. The investigative action taken is dependent on the analysis and the event. Laboratory corrective actions may be necessary if:

- QC data are outside the warning or acceptable windows for precision and accuracy;
- Blanks contain compounds of interest, as listed in tables in Section 1 of this QAPP, above the project reporting limits;
- Undesirable trends are detected in spike recoveries or RPD between duplicates;
- There are unusual changes in detection limits;
- Deficiencies are detected by the Laboratory QA Department during internal or external audits or from the results of performance evaluation samples; or
- Inquiries concerning data quality are received.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor, manager and/or QA department for further investigation. Once resolved, full documentation of the corrective action procedure is filed with the QA department.

Corrective action may include:

- Re-analyzing the samples, if holding time criteria permits;
- Resampling and analyzing;

- Evaluating and amending analytical procedures;
- Accepting data and acknowledging the level of uncertainty as documented in the laboratory data package case narrative.

If resampling is deemed necessary due to laboratory problems, the Site Program Manager must identify the necessary approach including cost recovery for the additional sampling effort.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The deliverables associated with the tasks identified in the Ecological Risk Assessment Work Plan will contain QA sections in which data quality information collected during the task is summarized. The Ecological Risk Assessment report will include the results of the Data Validation of the biota samples as a documentation of the quality of the data collected for assessing ecological risk.

The QA section of the Ecological Risk Assessment report will contain information generated during the project on the achievement of project-specific DQOs, uncertainties in the biota data used and their affect on the risk assessment, and a summary of corrective actions implemented, as necessary, as it may have affected the evaluation of ecological risk.

Associated Site Documents, as included in Volumes 1 and 2, contain procedures and requirements for overall program QA reports to management and are not included herein.

15.0 REFERENCES

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Appendix A

Sediment Toxicity Bioassy and Reference Toxicant Control Chart

A-1 *Hyalella azteca* in Potassium chloride (mg/L)
A-2 *Chironomus tentans* in Potassium chloride (g/L)

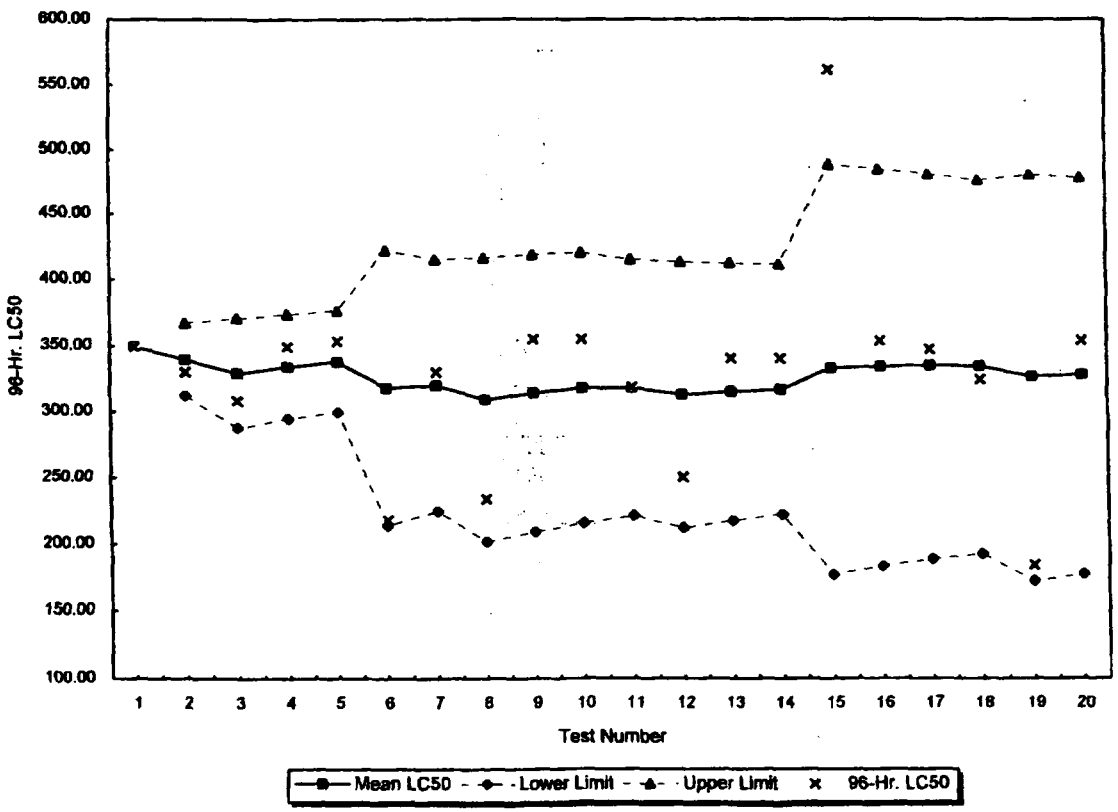
Standard Operating Procedure

A-3 Amphipod, *Hyalella azteca*, 10-day Survival and Growth Toxicity Test for Sediments
A-4 Amphipod, *Hyalella azteca*, 42-day Survival and Growth Toxicity Test for Sediments
A-5 Midge, *Chironomus tentans*, 10-day Survival and Growth Toxicity Test for Sediments
A-6 Midge, *Chironomus tentans*, Chronic Whole Sediment Toxicity Test

A-1 *Hyalella azteca* in Potassium chloride (mg/L)

Reference Toxicant Control Chart
Hyalella azteca
in Potassium chloride (mg/L)

Test Number	Test Date	Organism Age (Days)	96-Hr. LC50	Mean LC50	Lower Limit	Upper Limit	Organism Source
1	07/03/96	8	349.35	349.35			Env. Consult & Testing
2	07/12/96	8	329.88	339.62	312.08	367.15	Env. Consult & Testing
3	07/16/96	11	307.79	329.01	287.42	370.59	Env. Consult & Testing
4	07/25/96	8	349.35	334.09	294.51	373.68	Env. Consult & Testing
5	09/06/96	8	353.55	337.98	299.54	376.43	Env. Consult & Testing
6	09/27/96	10	217.64	317.93	213.82	422.03	Env. Consult & Testing
7	10/11/96	12	329.90	319.64	224.17	415.10	Env. Consult & Testing
8	02/14/97	10	233.26	308.84	201.41	416.27	Env. Consult & Testing
9	08/19/97	15	355.00	313.97	208.87	419.07	Env. Consult & Testing
10	08/19/97	15	355.00	318.07	215.64	420.50	Env. Consult & Testing
11	09/26/97	11	318.64	318.12	220.95	415.30	Env. Consult & Testing
12	12/20/97	10	250.00	312.45	211.79	413.10	Env. Consult & Testing
13	04/15/98	8	340.20	314.58	216.99	412.17	Env. Consult & Testing
14	04/17/98	10	340.20	316.41	221.65	411.17	Env. Consult & Testing
15	08/04/98	14	561.23	332.73	176.78	488.68	Env. Consult & Testing
16	08/22/98	10	353.55	334.03	183.01	485.06	Env. Consult & Testing
17	09/13/98	11	347.16	334.81	188.44	481.17	Env. Consult & Testing
18	10/26/98	12	324.21	334.22	192.13	476.30	Env. Consult & Testing
19	11/13/98	10	183.72	326.30	171.91	480.68	Env. Consult & Testing
20	02/19/99	9	353.55	327.66	176.90	478.42	Env. Consult & Testing



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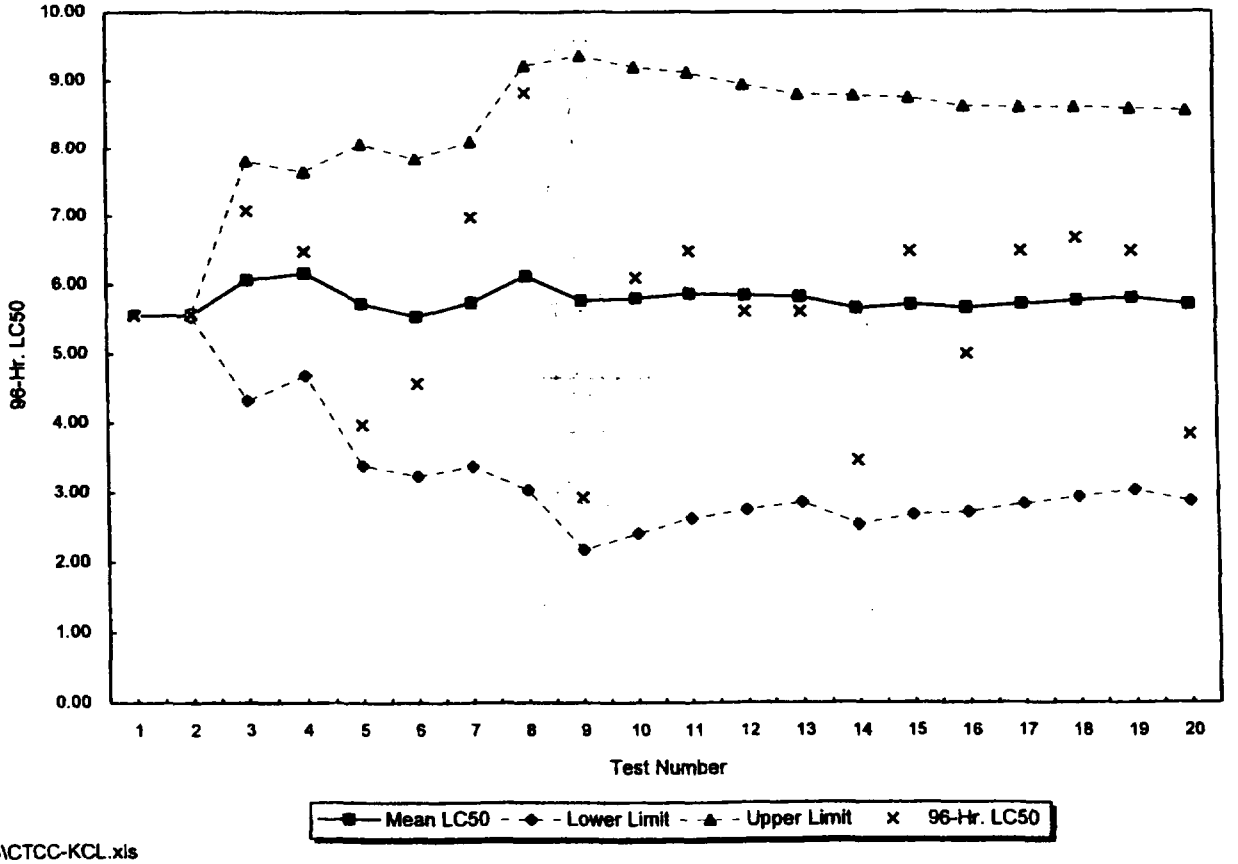
A-2

Chironomus tentans in Potassium chloride (g/L)

Reference Toxicant Control Chart
Chironomus tentans
in Potassium chloride (g/L)

Test Number	Test Date	Organism Age (Days)	96-Hr. LC50	Mean LC50	Lower Limit	Upper Limit	Organism Source
1	10/19/96	10	5.55	5.55			Inchcape
2	08/19/97	9	5.57	5.56	5.53	5.59	Env. Consulting & Testing
3	09/17/97	12	7.07	6.06	4.32	7.81	Env. Consulting & Testing
4	09/26/97	10	6.48	6.17	4.68	7.65	Env. Consulting & Testing
5	10/01/97	9	3.98	5.73	3.39	8.07	Aquatec Biological Sciences
6	10/03/97	8	4.56	5.53	3.23	7.84	Aquatec Biological Sciences
7	10/08/97	11	6.98	5.74	3.37	8.11	Aquatec Biological Sciences
8	10/10/97	11	8.82	6.13	3.04	9.21	Aquatec Biological Sciences
9	10/14/97	11	2.93	5.77	2.18	9.36	Aquatec Biological Sciences
10	10/20/97	11	6.10	5.80	2.41	9.19	Aquatec Biological Sciences
11	10/21/97	11	6.48	5.86	2.62	9.11	Aquatec Biological Sciences
12	10/28/97	10	5.61	5.84	2.75	8.94	Aquatec Biological Sciences
13	10/31/97	9	5.61	5.83	2.86	8.79	Aquatec Biological Sciences
14	11/02/97	9	3.47	5.66	2.54	8.77	Aquatec Biological Sciences
15	11/09/97	10	6.48	5.71	2.68	8.75	Aquatec Biological Sciences
16	11/10/97	9	5.00	5.67	2.72	8.62	Aquatec Biological Sciences
17	08/23/98	11	6.48	5.72	2.83	8.60	Aquatec Biological Sciences
18	09/15/98	9	6.67	5.77	2.93	8.60	Aquatec Biological Sciences
19	10/23/98	10	6.48	5.81	3.03	8.58	Aquatec Biological Sciences
20	11/10/98	9	3.83	5.71	2.87	8.55	Aquatec Biological Sciences



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A-3

Amphipod, *Hyalella azteca*, 10-day Survival and Growth Toxicity Test for Sediments

Standard Operating Procedure for Amphipod, *Hyalella azteca*, 10-day Survival and Growth Toxicity Test for Sediments

1.0 OBJECTIVE

This SOP describes procedures for performing a ten-day whole sediment survival and growth toxicity test. This test is used to estimate the toxicity of whole sediment samples to the freshwater amphipod, *Hyalella azteca*. When required, toxicity is estimated by statistical comparisons to the control sediment and/or refernce sediment. This procedure is based on the guidelines of EPA/600/R-94/024: *Methods for Assessing the Toxicity of and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates*, Method 100.

WARNING:Samples acquired for toxicity testing may contain unknown toxicants or health hazards. Lab coats and protective gloves should be worn when handling samples.

2.0 PREPARATION

2.1 Equipment and Apparatus

Calibrated Instrumentation and Water Quality Apparatus:
- pH meter
- Dissolved Oxygen (DO) meter
- Thermometer (accurate to 0.1°C)
- Alkalinity and hardness titration apparatus
- Ammonia selective electrode and meter
- Mettler M3 Microbalance
- VWR 1320 drying oven

Additional Equipment:
- Test chambers (300-ml beakers, 8 per sample)
- Aeration manifold, tubing, manifold, and pipets
- Automated water-delivery system
- Disposable polyethylene transfer pipets
- Light tables
- Waste collection bucket
- Carolina bowls (assorted sizes)
- Nitex mesh sieves (0.3 mm)

Reagents:
- Reconstituted moderately hardwater (EPA/600/R-94/024)
- Deionized water

70 percent Ethanol

Forms and Paperwork:
- Amphipod (*Hyalella azteca*) Water Chemistry Data
- Amphipod (*Hyalella azteca*) Daily Biological Monitoring
- Amphipod (*Hyalella azteca*) 10-Day Survival and Growth Data
- Sediment Characterization Data
- Organism Holding and Acclimation
- Daily Checklist for Automated Delivery System
- Project Documentation Forms

2.2 Test System and Conditions

The test system and environmental conditions for the 10-day survival and growth test are summarized in Figure 1.

2.3 Test Organisms

2.3.1 Procurement and Documentation

Amphipods are obtained from a commercial supplier or from in-house cultures. If possible, schedule delivery of amphipods at least 48 hours prior to test initiation. They are acclimated to the exposure water used in testing during the the period prior to test initiation. Sources of amphipods include:

Environmental Consulting and Testing: (800) 377-3657
Aquatic BioSystems: (800) 331-6916

Prior to the testing, order sufficient organisms for 10 amphipods per replicate test chamber (80 per test sample) and a surplus for reference toxicant testing. Request that the supplier provide information regarding the age and environmental conditions for the test organisms.

Amphipods are shipped by next-day carrier and delivered to Aquatec Biological Sciences. The amphipods are typically shipped in 500-mL plastic container. Upon receipt , examine the organisms and document their apparent condition, as well as the dissolved oxygen (D.O.), pH, temperature and conductivity of the shipping water. Record the observations on the Organism Data Sheet provided by the supplier. Place a copy of this sheet in the project data package.

2.3.2 Evaluation of Amphipod Condition

If, during examination, it appears that more than 5% of the organisms have died during transport, or if the temperature or other environmental conditions are different from test

requirements (e.g., dissolved oxygen <4 mg/L, temperature <15°C), notify the Toxicity Laboratory Manager immediately. A decision will be made regarding the possibility of obtaining a new stock of organisms for testing. If the test is to be delayed, document the reason on the Project Documentation form. Also, it may be necessary to notify the client.

2.3.3 Acclimation and Holding

Transfer the amphipods to a 2-L plastic storage container. Add incremental amounts of laboratory reconstituted water and acclimate to test temperature (23°C). Provide aeration to the holding container. Overlying water temperature should not be changed more than 3°C per day. Monitor organism mortality, temperature, pH, and D.O. during the holding period. Record monitoring data on the Organism Holding and Acclimation form. If more than five percent of the organisms die, contact the Laboratory Manager and arrange for a replacement order.

2.3.4 Food

Feed daily with sufficient *Selenastrum* and YCT to maintain a monolayer of food on the bottom of the container.

2.4 Exposure Water

Reconstituted moderately hardwater prepared following the procedure outlined in Section 7.1.3 of EPA/600/R-94/024 will be used as exposure water (overlying water) during the test. Age the exposure water with vigorous aeration for at least one day prior to use in toxicity testing.

3.0 PROCEDURES

3.1 Control Sediment Preparation

Control sediment is formulated sediment prepared according to the procedure outlined in EPA/600/R-94/024 (Section 7.2.3.2) and consists of 77% fine and medium sand, 17% kaolinite clay, 5% ground peat, and 1% calcium carbonate. The formulated sediment is stored dry and is hydrated by addition of reconstituted moderately hardwater prior to distribution to test chambers.

3.2 Test Sediment Preparation

1. Remove sediment samples from Sample Management refrigerators.
2. Transfer the sample to the ventilation hood in the Sample Preparation Laboratory;
3. Homogenize the sediment with a clean plastic "spaghetti fork-it" spatula or other suitable utensil;

4. Transfer aliquots of the homogenized sediment to a glass tray and examine for indigenous organisms;
5. If no indigenous organisms are apparent (check very carefully for amphipods), transfer approximately 100 mL aliquots to each of the replicate test chambers;
6. If indigenous organisms (especially predacious insects or amphipods) are present, remove them with forceps or press sieve sediment through a 0.5 or 1.0 mm Nitex mesh sieve, re-homogenize, then distribute 100-mL aliquots to each of the test replicates. Notify the Laboratory Manager before making a decision to sieve sediments. Sieving of sediments should be avoided if possible;
7. Record the visual characteristics of each sediment sample on the Sediment Characterization Data form;
8. Add overlying water to a final volume of approximately 275 mL;
9. Return the unused sediment sample to Sample Management for storage;
10. Transfer the test chambers to the automated water delivery system and begin the water renewal cycles (noon and midnight). The test replicates remain in the test system overnight without addition of test organisms.

3.2.1 Measuring Initial Overlying Water Chemistry

On the day of test initiation remove an aliquot of overlying water from replicates of each test sample. Measure the following parameters: pH, DO, temperature, and conductivity. Record the data directly on the Monitoring Data Form for Day 0. Aliquots of overlying water are also stored and preserved for Day 0 alkalinity, hardness, and ammonia analyses. The temperature of the exposure water must be within the range of 23 ± 1°C. Dissolved oxygen should be ≥40% saturation (3.4 mg/L). Additional water exchanges or aeration may be required if dissolved oxygen levels do not remain above 40% saturation.

3.2.2 Test Initiation: Preparation and Distribution of Test Organisms

1. Place the amphipod holding container over a light table and use a disposable polyethylene transfer pipet to transfer amphipods to 1-oz. (30 mL) disposable cups (Dixie condiment cups) until each cup contains 10 amphipods. Prepare sufficient cups for one per test replicate plus several spares. Sufficient amphipods (60) should be reserved for a standard reference toxicant test and to archive a representative subsample (10-20) of the amphipod test population.
2. Randomly select a cup containing 10 amphipods. Examine them over a light table and replace any apparently unhealthy or injured amphipods.
3. Using a transfer pipet, gently rinse the 10 amphipods into a test replicate with clean exposure water. Check to be sure that all amphipods have been removed from the cup and swim to the sediment in the test replicate. A drop of exposure water can be used to submerge any amphipods that get trapped on the surface. **WARNING: Do not dip condiment cups into the exposure water.**

4. Record the date and time of test initiation when amphipods have been distributed to all test chambers. The test replicates are positioned randomly within the testing system.
5. After one hour, check all test replicates and replace any amphipods which are floating or are dead.
6. Preserve a representative sample of 10-20 amphipods with 70% ethanol for archiving. After measurement of initial lengths, the amphipods should be stored six months as a reference stock identified by testing group (BTR) and date.

3.3 Daily Monitoring

3.3.1 Environmental Conditions

The environmental conditions monitoring schedule is outlined in Table 1. On Days 0 and 10 preserve a portion of the overlying water sample used for water quality determinations (approximately 100 mL) with 0.3 mL of concentrated H_2SO_4 for ammonia-N analysis. These samples should be properly labeled and stored in a refrigerator at 4°C for subsequent analysis.

3.3.2 Biological Monitoring

Test organism observations are made daily for all test replicates. Position lighting to illuminate the overlying water column and the sediment surface for each replicate. Examine and record observations such as amphipods not buried or dead amphipods (not removed). Replace the test chamber to its assigned position.

3.3.3 Feeding

Provide 1.5 mL of YCT to each test replicate daily.

3.3.4 Automated Water Delivery System

Complete the System Checklist during the noon delivery cycle daily. Ensure that all components of the delivery system are functioning properly.

3.4 Termination of the Whole Sediment Toxicity Test

3.4.1 Final Chemistry

Decant an aliquot of exposure water from several test replicates and pool to obtain sufficient water for the Day 10 water chemistry analyses. Measure and record the final chemistry parameters as specified in Figure 1.

3.4.2 Day 10 Survival

1. Transfer a test replicate to a light table equipped with side lighting. Search for amphipods and remove any alive or dead amphipods with a transfer pipet. Decant the overlying water through a 0.3 mm sieve. Rinse the sediment through a 0.3 mm sieve. Pool all amphipods found from a single replicate into a lableled 30-mL disposable cup. Count and record the total number of amphipods surviving on the Survival Data Form. If organisms appear to be dead, examine them under a dissecting microscope. If any movement is detected, the amphipod is considered to be alive.
2. If fewer than 10 amphipods are recovered, transfer all sediment and undieved material back into the test chamber and hold for a possible reexamination. The test material may be preserved with sugar formalin solution and Rose-Bengal Stain for a supsequent re-pick. Stained amphipods found on the repick will be assumed to have been alive when the test was ended if the body tissue is not significantly degraded. The total number surviving will then be corrected.

3.4.2 Day 10 Growth

Growth is based upon the mean dry weight of surviving amphipods, by replicate. Transfer surviving amphipods to pre-weighed weighing boats (data recorded on the Amphipod (*Hyalella azteca*) 10-Day Survival and Growth Data form) and dry overnight in the drying oven at 60°C. Weigh the boats and the dried amphipods to the nearest 0.01 mg. The Mettler M3 microbalance is used for all dry weight determinations.

4.0 QUALITY ASSURANCE

4.1 Blind Sample Analysis

Each sample, including the Control, will be assigned a unique sample number which will be used throughout the test.

4.2 Test Acceptability

Test acceptability criteria are based upon the guidelines of EPA/600/R-94/024, Table 11.1. Specifically, a test is judged to be acceptable if the average survival of control amphipods is equal to or greater than 80% at the end of the test. The environmental conditions must be within the tolerance limits of *Hyallela azteca*.

4.3 Protocol Deviations

Any deviations from this SOP should be noted on a project documentation form and the Laboratory Manager and/or the Project Director should be immediately notified. The Project Director will determine the appropriate corrective action and will communicate protocol deviations to the client.

4.4 Reference Toxicant Testing

A water-only 96-hour exposure of amphipods to potassium chloride (KCl) will be conducted concurrently with the sediment exposures and with the same batch of amphipods. The 96-hour LC50 from this standard reference toxicant test is used to assess the sensitivity of the test organisms and to develop a control chart of LC50 values for this species when exposed to potassium chloride.

5.0 SAFETY

Samples acquired for toxicity testing may contain unknown toxicants or health hazards. Lab coats and protective gloves should be worn when handling these samples.

6.0 TRAINING

To be qualified for the overall procedure outlined in this SOP, the analyst must:

Read this SOP.
Receive verbal and visual instruction.
Demonstrate 90% recovery of 10 amphipods in trial sediments.
Be trained on pertinent associated SOPs.

Figure 1. Test conditions for the amphipod *(Hyalella azteca)* 10-day whole sediment survival toxicity test.

ASSOCIATED PROTOCOLS: EPA 1994. *Methods for Assessing the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* (EPA/600/R-94/024) Method 100.1.

1. Test type:	Whole-sediment toxicity (static)
2. Temperature:	23 ± 1 °C
3. Light quality:	Wide-spectrum fluorescent lights
4. Light illuminance:	500 to 1000 lux
5. Photoperiod:	16 hr. light, 8 hr. dark
6. Test chamber size:	300 mL beaker
7. Sediment volume:	100 mL
8. Overlying water volume:	175 mL
9. Renewal of overlying water:	Every 12 hours
10. Age of test organism:	7 - 14 days at the start of the test
11. Number of organisms / test chamber:	10
12. Number of replicate test chambers / treatment:	8
13. Feeding regime:	YCT, 1.5 mL daily per test chamber
14. Aeration:	None, unless D.O. drops below 40% saturation 3.4 mg/L. Additional renewals are preferred to aeration to maintain acceptable D.O. levels
15. Overlying water:	Reconstituted moderately hard water
16. Control sediment	Formulated sediment
17. Test chamber cleaning:	Drainage screens as needed
18. Monitoring:	
Temperature	Daily (overlying water)
Dissolved oxygen	Daily (overlying water)
pH	Daily (overlying water)
Conductivity	Days 0, 5, and 10 (overlying water)
Alkalinity and hardness	Days 0 and 10 (overlying water)
Ammonia	Days 0 and 10 (overlying water)
Organism behavior	Daily
19. Test duration:	10 days
20. End points:	Survival and growth (organism dry weight) by replicate on Day 10
21. Reference toxicant:	Potassium chloride 96-h acute, water only
22. Test acceptability:	Minimum mean control survival of 80%
23. Data analysis:	Hypothesis tests versus the control or the reference site responses

A-4

Amphipod, *Hyalella azteca*, 42-day Survival and Growth Toxicity Test for Sediments

Standard Operating Procedure for Amphipod, *Hyalella azteca*, 42-day Survival, Growth and Reproduction Toxicity Test for Sediments

1.0 OBJECTIVE

This SOP describes procedures for performing a 42-day whole sediment survival, growth, and reproduction toxicity test. This test is used to estimate the chronic toxicity of whole sediment samples to the freshwater amphipod, *Hyalella azteca*. End points measured include survival (Days 28, 35, and 42); growth (Days 28 and 42), and reproduction (number of neonates produced from Day 28 to 42, assessed on Days 35 and 42). When required, toxicity is estimated by statistical comparisons of survival, growth (dry weight), and reproduction to the organism responses in the control or reference site sediment. This procedure is based on the draft guidelines of EPA/600/R-98/XXX (New number pending): *Methods for Assessing the Toxicity of and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* Second Edition, Mehod 100.4.

WARNING: Samples acquired for toxicity testing may contain unknown toxicants or health hazards. Lab coats and protective gloves should be worn when handling these samples.

2.0 PREPARATION

2.1 Equipment and Apparatus

Calibrated Instrumentation and Water Quality Apparatus:
- pH meter
- Dissolved Oxygen (DO) meter
- Thermometer (accurate to 0.1°C)
- Alkalinity and hardness titration apparatus
- Ammonia selective electrode and meter
- Mettler M3 Microbalance
- VWR 1320 drying oven

Additional Equipment:
- Test chambers (300-ml beakers, 8 per sample)
- 0.5 mm Nitex mesh substrate (2 cm x 2 cm) for water-only exposure
- Aeration manifold, tubing, manifold, and pipets
- Automated water-delivery system
- Disposable polyethylene transfer pipets
- Light tables
- Waste collection bucket
- Carolina bowls

Nitex mesh sieves (0.3 mm)

Reagents:
Reconstituted moderately hardwater (EPA/600/R-94/024)
Deionized water
70 percent Ethanol

Forms and Paperwork:
Amphipod (*Hyalella azteca*) Water Chemistry Data
Amphipod (*Hyalella azteca*) Daily Biological Monitoring
Amphipod (*Hyalella azteca*) Day 28 Survival and Growth Data
Amphipod (*Hyalella azteca*) Days 35 Survival and Reproduction Data
Sediment Characterization Data
Organism Holding and Acclimation
Daily Checklist for Automated Delivery System
Project Documentation Forms

2.2 Test System and Conditions

The test system and environmental conditions for the 42-day survival, growth, and reproduction test are summarized in Figure 1.

2.3 Test Organisms

2.3.1 Procurement and Documentation

Amphipods are obtained from a commercial supplier or from in-house cultures. If possible, schedule delivery of amphipods at least 48 hours prior to test initiation. They are acclimated to the exposure water used in testing during the the period prior to test initiation. Sources of amphipods include:

Environmental Consulting and Testing: (800) 377-3657
Aquatic BioSystems: (800) 331-6916

Prior to the testing, order sufficient organisms for 10 amphipods per replicate test chamber (120 per test sample) and a surplus for reference toxicant testing. Request that the supplier provide information regarding the age and environmental conditions for the test organisms.

Amphipods are shipped by next-day carrier and delivered to Aquatec Biological Sciences. The amphipods are typically shipped in 500-mL plastic container. Upon receipt, examine the organisims and document their apparent condition and the dissolved oxygen (D.O.), pH, temperature and conductivity of the shipping water. Record the observations on the Organism Data Sheet provided by the supplier. Place a copy of this sheet in the project data package.

2.3.2 Evaluation of Amphipod Condition

If, during examination, it appears that more than 5% of the organisms have died during transport, or if the temperature or other environmental conditions are different from test requirements (e.g., dissolved oxygen <4 mg/L, temperature <15°C), notify the Toxicity Laboratory Manager immediately. A decision will be made regarding the possibility of obtaining a new stock of organisms for testing. If the test is to be delayed, document the reason on the Project Documentation form. Also, it may be necessary to notify the client.

2.3.3 Acclimation and Holding

Transfer the amphipods to a 2-L plastic storage container. Add incremental amounts of laboratory reconstituted water and acclimate to test temperature (23°C). Provide aeration to the holding container. Overlying water temperature should not be changed more than 3°C per day. Monitor organism mortality, temperature, pH, D.O. during the holding period and record the monitoring data on the Organism Holding and Acclimation form. Amphipods should be 7-8 days old when the test is started. If more than five percent of the organisms die during the holding period, contact the Laboratory Manager and arrange for a replacement order.

2.3.4 Food

Feed daily sufficient *Selenastrum* and YCT to maintain a monolayer of food on the bottom of the container.

2.4 Exposure Water

Reconstituted moderately hardwater prepared following the procedure outlined in Section 7.1.3 of EPA/600/R-94/024 mixed 1:1 with natural river water (Lamoille River, Vermont) is used as exposure water (overlying water) during the test. Age the exposure water with vigorous aeration for at least one day prior to use in toxicity testing.

3.0 PROCEDURES

3.1 Control Sediment Preparation

Control sediment is formulated sediment prepared according to the procedure outlined in EPA/600/R-94/024 (Section 7.2.3.2) and consists of 77% fine and medium sand, 17% kaolinite clay, 5% ground peat, and 1% calcium carbonate. The formulated sediment is stored dry and is hydrated by addition of reconstituted moderately hardwater prior to distribution to test chambers.

3.2 Test Sediment Preparation

1. Remove sediment samples from Sample Management refrigerators.
2. Transfer the sample to the ventilation hood in the Sample Preparation Laboratory;
3. Homogenize the sediment with a clean plastic "spaghetti fork-it" spatula;
4. Transfer aliquots of the homogenized sediment to a glass tray and examine for indigenous organisms;
5. If no indigenous organisms are apparent (check very carefully for amphipods), transfer approximately 100 mL aliquots to each of the replicate test chambers;
6. If indigenous organisms (especially predacious insects or amphipods) are present, remove them with forceps or press sieve sediment through a 0.5 or 1.0 mm Nitex mesh sieve, re-homogenize, and then distribute 100-mL aliquots to each of the test replicates. Notify the Laboratory Manager before making a decision to sieve sediments. Sieving of sediments should be avoided if possible;
7. Record the visual characteristics of each sediment sample on the Sediment Characterization Data form;
8. Add overlying water to a final volume of approximately 275 mL;
9. Return the unused sediment sample to Sample Management for storage;
10. Transfer the test chambers to the automated water delivery system and begin the water renewal cycles (noon and midnight). The test replicates remain in the test system overnight without addition of test organisms.

3.2.1 Measuring Initial Overlying Water Chemistry

On the day of test initiation, remove an aliquot of overlying water from at least one replicate of each test sample. Measure the following parameters: pH, DO, temperature, and conductivity. Record the data directly on the Monitoring Data Form for Day 0. Aliquots of overlying water are also stored and preserved for Day 0 alkalinity, hardness, and ammonia analyses. The temperature of the exposure water must be within the range of 23 ± 1°C. D. O. should be ≥40% saturation (3.4 mg/L). Additional water exchanges or aeration may be required if D.O. levels do not remain above 40% saturation.

3.2.2 Test Initiation: Preparation and Distribution of Test Organisms

1. Place the amphipod holding container over a light table and use a disposable polyethylene transfer pipet to transfer amphipods to 1-oz. (30 mL) disposable cups (Dixie condiment cups) until each cup contains 10 amphipods. Prepare sufficient cups for one per test replicate plus several spares. Sufficient amphipods (60) should be reserved for a standard reference toxicant test and to archive a representative subsample of the amphipod test population (10-20).
2. Randomly select a cup containing 10 amphipods. Examine them over a light table and replace any apparently unhealthy or injured amphipods.

3. Gently rinse the 10 amphipods into a test replicate with clean exposure water using a transfer pipet. Check to be sure that all amphipods have been removed from the cup and swim to the sediment in the test replicate. A drop of exposure water can be used to submerge any amphipods that get trapped on the water surface. **WARNING: Do not dip condiment cups into the exposure water.**
4. Record the date and time of test initiation when amphipods have been distributed to all test chambers. The test replicates are positioned randomly within the testing system.
5. After one hour, check all test replicates and replace any amphipods which are floating or are dead.
6. Preserve a representative sample of 10-20 amphipods with 70% ethanol for archiving. After measurement of initial lengths, the amphipods should be stored six months as a reference stock identified by testing group (BTR) and date.

3.3 Daily Monitoring

3.3.1 Environmental Conditions

The environmental conditions monitoring schedule and list of parameters is outlined in Table 1. On Days 0, 28, 35, and 41 preserve a portion of the overlying water sample used for water quality determinations (approximately 100 mL) with 0.3 mL of concentrated H_2SO_4 for ammonia-N analysis and collect subsamples of overlying water for alkalinity and hardness analyses. These samples should be properly labeled and stored in a refrigerator at 4°C for subsequent analysis.

3.3.2 Biological Monitoring

Test organism observations are made daily for all test replicates. Position lighting to illuminate the overlying water column and the sediment surface for each replicate. Examine and record observations such as amphipods not buried or dead (not removed). Replace the test chamber to its assigned position.

3.3.3 Feeding

Provide 1.0 mL of YCT to each test replicate daily. If the D.O. drops below 40% saturation due to the accumulation of uneaten food, feeding may be suspended for 1-2 days. Document these events and increase the water renewal frequency (or aerate), if needed, to maintain acceptable D.O levels.

3.3.4 Automated Water Delivery System

Complete the System Checklist during the noon delivery cycle daily. Ensure that all components of the delivery system are functioning properly.

3.4 End-point Determination and Water-only Exposure

3.4.1 Day 28 Survival

1. Transfer each test replicate to a light table equipped with side lighting. Search for amphipods and remove both live or dead amphipods with a transfer pipet. Decant the overlying water through a 0.3 mm sieve. Rinse the sediment through a 0.3 mm sieve. Pool all surviving amphipods from a single replicate into a 30-mL disposable cup. Count and record the total number of survivng amphipods observed on the Survival Data Form. If organisms appear to be dead, examine them under a dissecting microscope. If any movement is detected, the amphipod is considered to be alive.
2. If fewer than 10 amphipods are recovered, transfer all sediment and material that has not passed through the 0.3 mm sieve back into the test chamber and hold the replicates for a possible reexamination. The test material may be preserved the with sugar formalin solution and Rose-Bengal Stain for a supsequent re-pick. Stained amphipods found during the repick will be assumed to have been alive on Day 28 if the body tissue is not significantly degraded. The total number surviving will then be corrected.

3.4.2 Day 28 Growth (4 Replicates)

Select four of the 12 replicate cups containing surviving amphipods (e.g., Replicates I, J, K, L) for Day 28 growth analysis. Growth is based upon the mean dry weight of pooled surviving amphipods, for the selected replicates. Transfer surviving amphipods to pre-weighed weighing boats (boat weights recorded on the Amphipod (*Hyalella azteca*) Day 28 Survival and Growth Data form) and dry overnight in the drying oven at 60°C. Weigh the dried amphipods to the nearest 0.01 mg. The Mettler M3 microbalance is used for all dry weight determinations.

3.4.3 Water-only Exposure (8 Replicates)

Decant all sediment and overlying water from the test beakers. Select test replicate beakers A, B, C, D, E, F, G, and H. Rinse them with deionized water, fill with exposure water, and add two squares of Nitex mesh substrate. Transfer the surviving amphipods, replicates A, B, C, D, E, F, G, and H, back into the appropriate replicate test chamber. Daily monitoring activities continue as described (Figure 1).

3.4.4 Day 35 Survival and Reproduction (8 Replicates)

On Day 35 of the test, remove each test replicate to a light table. Count and record the number of surviving adult amphipods, the number of amplexes pairs, and the number of neonates (hatched young). Record data on the Day 35 Survival and Reproduction form. The surviving adult amphipods remain in the test replicate while the neonates are removed. Return the test replicates to the testing system.

3.4.5 Day 42 Survival, Reproduction, and Growth (8 Replicates)

On Day 42 of the test, remove each test replicate to a light table. Count and record the number of surviving adult amphipods, the number of amplexes pairs, number of adult females, and number of adult males, and the number of neonates (hatched young). Record data on the Day 42 Survival, Reproduction, and Growth form.

Growth for Replicates A, B, C, D, E, F, G, and H is based upon the mean dry weight of pooled surviving amphipods, for the selected replicates. Transfer surviving amphipods to pre-weighed weighing boats (boat weights recorded on the Amphipod (*Hyalella azteca*) Day 42 Survival, Reproduction, and Growth Data form) and dry overnight in the drying oven at 60°C. Weigh the dried amphipods to the nearest 0.01 mg using the Mettler M3 microbalance.

4.0 QUALITY ASSURANCE

4.1 Blind Sample Analysis

Each sample, including the Control, will be assigned a unique sample number which will be used throughout the test.

4.2 Test Acceptability

Test acceptability criteria are based upon the guidelines of EPA/600/R-98/XXX, Table 14.3. Specifically, a test is judged to be acceptable if the average survival of control amphipods is equal to or greater than 80% on Day 28. The environmental conditions must be within the tolerance limits of *Hyallela azteca*.

4.3 Protocol Deviations

Any deviations from this SOP should be noted on a project documentation form and the Laboratory Manager and/or the Project Director should be immediately notified. The Project Director will determine the appropriate corrective action and will communicate protocol deviations to the client.

4.4 Reference Toxicant Testing

A water-only 96-hour exposure of amphipods to potassium chloride (KCl) will be conducted concurrently with the sediment exposures and with the same batch of amphipods. The 96-hour LC50 from this standard reference toxicant test is used to assess the sensitivity of the test organisms and to develop a control chart of LC50 values for this species when exposed to potassium chloride.

5.0 SAFETY

Samples acquired for toxicity testing may contain unknown toxicants or health hazards. Lab coats and protective gloves should be worn when handling these samples.

6.0 TRAINING

To be qualified for the overall procedure outlined in this SOP, the analyst must:

Read this SOP.
Receive verbal and visual instruction.
Demonstrate 90% recovery of 10 amphipods in trial sediments.
Be trained on pertinent associated SOPs.

Figure 1. Test conditions for the amphipod *(Hyalella azteca)* 42-day whole sediment chronic toxicity test.

ASSOCIATED PROTOCOLS: EPA 1998. *Methods for Assessing the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates*, Second Ed. (EPA/600/R-94/024) Method 100.4.

1. Test type:	Whole-sediment toxicity (static)
2. Temperature:	23 ± 1 °C
3. Light quality:	Wide-spectrum fluorescent lights
4. Light illuminance:	500 to 1000 lux
5. Photoperiod:	16 hr. light, 8 hr. dark
6. Test chamber size:	300 mL beaker
7. Sediment volume:	100 mL (Days 0-28). Water-only exposure Days 28-42
8. Overlying water volume:	175 mL (Days 0-28), 275 mL (Days 28-42)
9. Renewal of overlying water:	Every 12 hours
10. Age of test organism:	7 - 8 days
11. Number of organisms / test chamber:	10
12. Number of replicate test chambers / treatment:	12 (4 for 28-day survival and growth, 8 for days 28-42 survival, reproduction, and growth)
13. Feeding regime:	1.0 mL YCT daily per replicate test chamber
14. Aeration:	None, unless D.O. drops below 40% saturation
15. Overlying water:	Reconstituted moderately hard water and natural river water (1:1)
16. Control sediment	Formulated sediment
17. Test chamber cleaning:	Drainage screens daily as needed
18. Monitoring:	
Temperature	Daily, Days 0-42 (overlying water)
Dissolved oxygen	Daily Days 0-28, 3 times weekly Days 29-41 (overlying water)
pH	3 times weekly Days 0-41 (overlying water)
Conductivity	Weekly Days 0-41 (overlying water)
Alkalinity and hardness	Days 0, 28, 25, and 41 (overlying water)
Ammonia	Days 0, 28, 25, and 41 (overlying water)
Organism behavior	Daily
19. Test duration:	42 days
20. End points:	Survival and growth (Day 28); Survival (Day 35), Survival, Reproduction, and Growth (Day 42)
21. Reference toxicant:	Potassium chloride 96-h acute, water only
22. Test acceptability:	Minimum mean control survival of 80% on Day 28
23. Data analysis:	Hypothesis tests versus the control or the reference site responses

A-5

Midge, *Chironomus tentans*, 10-day Survival and Growth Toxicity Test for Sediments

Standard Operating Procedure for Midge, *Chironomus tentans*, 10-day Survival and Growth Toxicity Test for Sediments

1.0 OBJECTIVE

This SOP describes procedures for performing a ten-day whole sediment survival and growth toxicity test. This test is used to estimate the toxicity of whole sediment samples to the freshwater midge, *Chironomus tentans*. When required, toxicity is estimated by statistical comparisons to the control sediment or reference sediment. This procedure is based on the guidelines of EPA/600/R-94/024: *Methods for Assessing the Toxicity of and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* Method 100.2.

WARNING: Samples acquired for toxicity testing may contain unknown toxicants or health hazards. Lab coats and protective gloves should be worn when handling samples.

2.0 PREPARATION

2.1 Equipment and Apparatus

Calibrated Instrumentation and Water Quality Apparatus:
- pH meter
- Dissolved Oxygen (DO) meter
- Thermometer (accurate to 0.1°C)
- Alkalinity and hardness titration apparatus
- Ammonia-selective electrode and meter
- Mettler M3 Microbalance
- VWR 1320 drying oven

Additional Equipment:
- Test chambers (300-ml beakers, 8 per sample)
- Aeration manifold, tubing, manifold, and pipets
- Automated water-delivery system
- Disposable polyehtylene transfer pipets
- Light tables
- Waste collection bucket
- Carolina bowls
- Nitex mesh sieves (0.5 mm)

Reagents:
- Reconstituted moderately hardwater (EPA/600/R-94/024)
- Deionized water

70 percent Ethanol

Forms and Paperwork:
- Midge (*Chironomus tentans*) Water Chemistry Data
- Midge (*Chironomus tentans*) Daily Biological Monitoring
- Midge (*Chironomus tentans*) 10-Day Survival and Growth Data
- Sediment Characterization Data
- Organism Holding and Acclimation
- Daily Checklist for Automated Delivery System
- Project Documentation Forms

2.2 Test System and Conditions

The test system and environmental conditions for the 10-day survival and growth test are summarized in Figure 1.

2.3 Test Organisms

2.3.1 Procurement and Documentation

Midges are obtained from in-house cultures. Approximately 12 days before testing, adult male and female midges are isolated in mating flasks overnight. The next morning, freshly deposited egg cases are transferred to a petri dish containing culture water. After two days (at 23°C) larvae should begin to hatch from the egg case. Transfer egg cases with hatching larvae to a culture box containing culture water and a monolayer of culture substrate (fine and medium sand). Maintain the culture approximately 8-9 days (post-hatch) until the larvae reach third instar. They are acclimated to the exposure water used in testing during the period prior to test initiation.

Sufficient egg cases should be harvested to obtain 10 midge larvae per replicate test chamber (80 per test sample) and a surplus for reference toxicant testing. Plan on a yield of approximately 200 larvae per egg case. Record culture conditions in the *Chironomus tentans* Culture Log.

2.3.2 Evaluation of Midge Condition

Examine the condition of the organisms to be used in testing, if it appears that more than 5% of the organisms have died or if the temperature or other environmental conditions are different from test requirements (e.g., dissolved oxygen <4 mg/L, temperature <15°C), notify the Toxicity Laboratory Manager immediately. A decision will be made regarding the possibility of obtaining a new stock of organisms for testing. If the test is to be delayed, document the reason on the Project Documentation form. Also, it may be necessary to notify the client.

2.3.3 Acclimation and Holding

Midge larvae are held in a 2-L plastic storage container. Provide aeration to the holding container. Overlying water temperature should not be changed more than 3°C per day. Monitor organism mortality, temperature, pH, and dissolved oxygen during the growout/acclimation period. Record monitoring data on the *Chironomus tentans* Culture form.

2.3.4 Food

Feed daily *Selenastrum* for Days 0-1 after larvae begin to hatch. Shift to a 1:1 slurry of Cerophyll and YCT on Day 2 (post-hatch) with increasing amounts (e.g., 1-3 mL) as the larvae grow (evident from increases in the size of the substrate tubes).

2.4 Exposure Water

Reconstituted moderately hardwater prepared following the procedure outlined in Section 7.1.3 of EPA/600/R-94/024 will be used as exposure water (overlying water) during the test. Age the exposure water with vigorous aeration for at least one day prior to use in toxicity testing.

3.0 PROCEDURES

3.1 Control Sediment Preparation

Control sediment is formulated sediment prepared according to the procedure outlined in EPA/600/R-94/024 (Section 7.2.3.2) and consists of 77% fine and medium sand, 17% kaolinite clay, 5% ground peat, and 1% calcium carbonate. The formulated sediment is stored dry and is hydrated by addition of reconstituted moderately hardwater prior to distribution to test chambers.

3.2 Test Sediment Preparation

1. Remove sediment samples from Sample Management refrigerators.
2. Transfer the sample to the ventilation hood in the Sample Preparation Laboratory;
3. Homogenize the sediment with a clean plastic "spaghetti fork-it" spatula or other suitable utensil;
4. Transfer aliquots of the homogenized sediment to a glass tray and examine for indigenous organisms;
5. If no indigenous organisms are apparent (check very carefully for midges), transfer approximately 100 mL aliquots to each of the replicate test chambers;
6. If indigenous organisms (especially predacious insects or midges) are present, remove them with forceps or press sieve sediment through a 0.5 or 1.0 mm Nitex mesh sieve, re-homogenize, and then distribute 100-mL aliquots to each

of the test replicates. Notify the Laboratory Manager before making a decision to sieve sediments. Sieving of sediments should be avoided if possible;

7. Record the visual characteristics of each sediment sample on the Sediment Characterization Data form;
8. Add overlying water to a final volume of approximately 275 mL;
9. Return the unused sediment sample to Sample Management for storage;
10. Transfer the test chambers to the automated water delivery system and begin the water renewal cycles (noon and midnight). The test replicates remain in the test system overnight without addition of test organisms.

3.2.1 Measuring Initial Overlying Water Chemistry

On the day of test initiation, remove an aliquot of overlying water from replicates of each test sample. Measure the following parameters: pH, dissolved oxygen (D.O.), temperature, and conductivity. Record the data directly on the Monitoring Data Form for Day 0. Aliquots of overlying water are also preserved and stored for Day 0 alkalinity, hardness, and ammonia analyses. The temperature of the exposure water must be within the range of 23 ± 1°C. Dissolved oxygen should be ≥40% saturation (3.4 mg/L). Additional water exchanges may be required if D.O. levels do not remain above 40% saturation.

3.2.2 Test Initiation: Preparation and Distribution of Test Organisms

1. Place the midge holding container over a light table and use a disposable polyethylene transfer pipet to transfer 10 midge larvae directly to each test replicate. Sufficient midges (60) should be reserved for a standard reference toxicant test and to archive a representative subsample (10-20) of the midge test population.
2. Check to be sure that all midges swim to the sediment in the test replicate. A drop of exposure water can be used to submerge any midges that get trapped on the surface.
3. Record the date and time of test initiation when midges have been distributed to all test chambers. The test replicates are positioned randomly within the testing system.
4. After one hour, check all test replicates and replace any midges which are floating or have not borrowed or are dead.
5. Preserve a representative sample of 10-20 midges with 70% ethanol for determination of instar stage by head capsule measurement.

3.3 Daily Monitoring

3.3.1 Environmental Conditions

The environmental conditions monitoring schedule and list of parameters is outlined in Table 1. On Days 0 and 10 preserve a portion of the overlying water sample used for

water quality determinations (approximately 100 mL) with 0.3 mL of concentrated H_2SO_4 for ammonia-N analysis. These samples should be properly labeled and stored in a refrigerator at 4°C for subsequent analysis.

3.3.2 Biological Monitoring

Test organism observations are made daily for all test replicates. Position lighting to illuminate the overlying water column and the sediment surface for each replicate. Examine and record observations such as midges not buried or dead midges (not removed). Replace the test chamber to its assigned position.

3.3.3 Feeding

Provide 1.5 mL of Tetrafin slurry (4.0 mg/mL) to each test replicate daily

3.3.4 Automated Water Delivery System

Complete the System Checklist during the noon delivery cycle daily. Ensure that all components of the delivery system are functioning properly.

3.4 Termination of the Whole Sediment Toxicity Test

3.4.1 Final Chemistry

Decant an aliquot of exposure water from several test replicates and pool to obtain sufficient water for the Day 10 water chemistry analyses. Measure and record the final chemistry parameters as specified in Figure 1.

3.4.2 Day 10 Survival

1. Decant the overlying water and sediment into a 0.5 mm sieve. Rinse the sediment through the sieve. Pool all midges from a single replicate into a labeled 30-mL disposable cup. Count and record the total number of midges surviving on the Survival and Growth Data Form. If organisms appear to be immobile and discolored, they are considered to be dead and are not included in the growth analysis. If any movement is detected, the midge is considered to be alive.
2. If fewer than 10 midges are recovered, transfer all sediment and material that has not passed through the 0.5 mm sieve back into the test chamber and hold the replicates for a possible reexamination. The test material may be repicked. If additional surviving midges are found, the total number surviving will then be corrected.

3.4.2 Day 10 Growth

Growth is based upon the mean dry weight of pooled surviving midges, by replicate. Transfer surviving midges to pre-weighed weighing boats (data recorded on the Midge (*Chironomus tentans*) 10-Day Survival and Growth Data form) and dry overnight in the drying oven at 60°C. Weigh the dried midges to the nearest 0.01 mg. The Mettler M3 microbalance is used for all dry weight determinations.

4.0 QUALITY ASSURANCE

4.1 Blind Sample Analysis

Each sample, including the Control, will be assigned a unique sample number which will be used throughout the test.

4.2 Test Acceptability

Test acceptability criteria are based upon the guidelines of EPA/600/R-94/024, Table 11.1. Specifically, a test is judged to be acceptable if the average survival of control midges is equal to or greater than 70% and the mean weight of the control organisms is >0.6mg/organism at the end of the test. The environmental conditions must be within the tolerance limits of *Chironomus tentans*.

4.3 Protocol Deviations

Any deviations from this SOP should be noted on a project documentation form and the Laboratory Manager and/or the Project Director should be immediately notified. The Project Director will determine the appropriate corrective action and will communicate protocol deviations to the client.

4.4 Reference Toxicant Testing

A water-only 96-hour exposure of midges to potassium chloride (KCl) will be conducted concurrently with the sediment exposures and with the same batch of midges. The 96-hour LC50 from this standard reference toxicant test is used to assess the sensitivity of the test organisms and to develop a control chart of LC50 values for this species when exposed to potassium chloride.

5.0 SAFETY

Samples acquired for toxicity testing may contain unknown toxicants or health hazards. Lab coats and protective gloves should be worn when handling these samples.

6.0 TRAINING

To be qualified for the overall procedure outlined in this SOP, the analyst must:

Read this SOP.
Receive verbal and visual instruction.
Demonstrate 90% recovery of 10 midges in trial sediments.
Be trained on pertinent associated SOPs.

Figure 1. Test conditions for the midge *(Chironomus tentans)* 10-day whole sediment toxicity test

ASSOCIATED PROTOCOLS: EPA 1994. *Methods for Assessing the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* (EPA/600/R-94/024) Method 100.2

1. Test type:	Whole-sediment toxicity (static)
2. Temperature:	23 ± 1 °C
3. Light quality:	Wide-spectrum fluorescent lights
4. Light illuminance:	500 to 1000 lux
5. Photoperiod:	16 hr. light, 8 hr. dark
6. Test chamber size:	300 mL beaker
7. Sediment volume:	100 mL
8. Overlying water volume:	175 mL
9. Renewal of overlying water:	Every 12 hours
10. Age of test organism:	Third instar or younger (50% or more in third instar)
11. Number of organisms / test chamber:	10
12. Number of replicate test chambers / treatment:	8
13. Feeding regime:	Tetrafin slurry (1 mg/mL), 1.5 mL daily
14. Aeration:	None, unless D.O. drops below 40% saturation (3.4 mg/L). Additional renewals are preferred to aeration to maintain acceptable D.O. levels
15. Overlying water:	Reconstituted moderately hard water
16. Control sediment	Formulated sediment
17. Test chamber cleaning:	Drainage screens daily as needed
18. Monitoring:	
Temperature	Daily (overlying water)
Dissolved oxygen	Daily (overlying water)
pH	Daily (overlying water)
Conductivity	Days 0, 5, and 10 (overlying water)
Alkalinity and hardness	Days 0 and 10 (overlying water)
Ammonia	Days 0 and 10 (overlying water)
Organism behavior	Daily
19. Test duration:	10 days
20. End points:	Survival and growth (organism dry weight) by replicate on Day 10
21. Reference toxicant:	Potassium chloride 96-h acute, water only
22. Test acceptability:	Minimum mean control survival of 70% and mean control weights must be >0.6mg/organisms
23. Data analysis:	Hypothesis tests versus the control or the reference site responses

A-6

Midge, *Chironomus tentans*, Chronic Whole Sediment Toxicity Test

Standard Operating Procedure
for
Midge *Chironomus tentans* Chronic Whole Sediment Toxicity Test

1.0 OBJECTIVE

This SOP describes procedures for performing a chronic whole sediment survival and growth toxicity test. This test is used to estimate the toxicity of whole sediment samples to the freshwater midge, *Chironomus tentans*. Organisms are exposed, for forty or more days, to a whole sediment sample. Endpoint measurements include Day 20 survival and ash-free dry weight, cumulative emergence during the test, adult mortality, and reproduction (which may include number of egg cases deposited, number of eggs per egg case, and number of hatched larvae per egg case). When required, toxicity is estimated by statistical comparisons to the control sediment or reference sediment. This procedure is based on the draft guidelines of EPA/600/R-98/XXX (New number pending): *Methods for Assessing the Toxicity of and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* Second Edition, Method 100.5.

WARNING: Samples acquired for toxicity testing may contain unknown toxicants or health hazards. Lab coats and protective gloves should be worn when handling samples.

2.0 PREPARATION

2.1 Equipment and Apparatus

Calibrated Instrumentation and Water Quality Apparatus:
- pH meter
- Dissolved Oxygen (DO) meter
- Thermometer (accurate to 0.1°C)
- Alkalinity and hardness titration apparatus
- Ammonia-selective electrode and meter

Additional Equipment:
- Test chambers (300-ml beakers, 16 per sample)
- Screened emergence traps
- Aeration manifold, tubing, manifold, and pipettes
- Automated water-delivery system
- Disposable polyethylene transfer pipettes
- Light tables
- Waste collection bucket
- Carolina bowls
- Nitex mesh sieves (0.5 mm)
- Mettler M3 Microbalance

Drying oven
Muffle furnace
Compound and dissecting microscopes

Reagents:
Reconstituted moderately hardwater (EPA/600/R-94/024)
Deionized water

Forms and Paperwork:
Midge (*Chironomus tentans*) Water Chemistry Data
Midge (*Chironomus tentans*) Daily Biological Monitoring
Midge (*Chironomus tentans*) 20-Day Survival and Growth Data
Midge (*Chironomus tentans*) Daily Emergence Data
Midge (*Chironomus tentans*) Adult Mortality Data
Midge (*Chironomus tentans*) Egg Case Deposition and Hatching Data
Midge (*Chironomus tentans*) 20-Day Survival and Growth Data
Midge (*Chironomus tentans*) End-of-test Larval Survival Data
Sediment Characterization Data
Chironomus tentans Culture Log
Daily Checklist for Automated Delivery System
Project Documentation Forms

2.2 Test System and Conditions

The test system and environmental conditions for the *Chironomus tentans* chronic toxicity test are summarized in Figure 1.

2.3 Test Organisms

2.3.1 Procurement and Documentation

Midges are obtained from in-house cultures. Approximately 3-4 days before testing, adult male and female midges are isolated in mating flasks overnight. The next morning transfer freshly deposited egg cases to a petri dish containing culture water. After two days (at 23°C) larvae should begin to hatch from the egg cases. Feed each petri dish with approximately 1 ml of a *Selenastrum* food stock. Larvae less than 24-hours old are used for testing. They are acclimated to the exposure water used in testing during the 2 to 3 day period prior to test initiation.

Sufficient egg cases are needed to obtain 12 midge larvae per replicate test chamber (144 per test sample). Additional larvae should be grown out to provide a surplus for reference toxicant testing. Plan on a yield of approximately 200 larvae per egg cases. Record culture conditions in the *Chironomus tentans* Culture Log.

2.3.2 Evaluation of Midge Condition

Examine the egg cases daily prior to testing; to be sure that sufficient larvae are likely to hatch on the day the tests are started. If there is to be a delay in initiating the tests, it may be necessary to notify the client.

2.3.3 Acclimation and Holding

Egg cases are incubated in a Petri dish containing reconstituted moderately hard water during the pre-hatch and pre-test period. The temperature of the culture water should be maintained at 23°C ± 1°C.

2.3.4 Food

Provide a monolayer of *Selenastrum* when the larvae begin to hatch and move from the egg case.

2.4 Exposure Water

Reconstituted moderately hardwater prepared following the procedure outlined in Section 7.1.3 of EPA/600/R-94/024 will be used as exposure water (overlying water) during the test. Age the exposure water with vigorous aeration for at least one day prior to use in toxicity testing.

3.0 PROCEDURES

3.1 Control Sediment Preparation

Control sediment is formulated sediment prepared according to the procedure outlined in EPA/600/R-94/024 (Section 7.2.3.2) and consists of 77% fine and medium sand, 17% kaolinite clay, 5% ground peat, and 1% calcium carbonate. The formulated sediment is stored dry and is hydrated by addition of reconstituted moderately hardwater prior to distribution to test chambers.

3.2 Test Sediment Preparation

1. Remove sediment samples from Sample Management refrigerators.
2. Transfer the sample to the ventilation hood in the Sample Preparation Laboratory;
3. Homogenize the sediment with a clean plastic "spaghetti fork-it" spatula;
4. Transfer aliquots of the homogenized sediment to a glass tray and examine for indigenous organisms;
5. If no indigenous organisms are apparent (check very carefully for midges), transfer approximately 100 ml aliquots to each of the replicate test chambers;

6. If indigenous organisms (especially predacious insects or midges) are present, remove them with forceps or press sieve sediment through a 0.5 or 1.0 mm Nitex mesh sieve, re-homogenize, and then distribute 100-mL aliquots to each of the test replicates. Notify the Laboratory Manager before making a decision to sieve sediments. Sieving of sediments should be avoided if possible;
7. Record the visual characteristics of each sediment sample on the Sediment Characterization Data form;
8. Add overlying water to a final volume of approximately 275 ml;
9. Return the unused sediment sample to Sample Management for storage;
10. Transfer the test chambers to the automated water delivery system and begin the water renewal cycles (noon and midnight). The test replicates remain in the test system overnight without addition of test organisms.

3.2.1 Measuring Initial Overlying Water Chemistry

On the day of test initiation, remove an aliquot of overlying water from replicates of each test sample. Measure the following parameters: pH, dissolved oxygen (D.O.), temperature, and conductivity. Record the data directly on the Monitoring Data Form for Day 0. Aliquots of overlying water are also preserved and stored for Day 0 alkalinity, hardness, and ammonia analyses The temperature of the exposure water must be within the range of 23 ± 1°C. Dissolved oxygen should be ≥2.5 mg/L). Additional water exchanges may be required if D.O. levels do not remain above 2.5 mg/L.

3.2.2 Test Initiation: Preparation and Distribution of Test Organisms

1. Place the Petri dishes holding egg cases with hatching larvae on the stage of a dissecting microscope. Larvae that are actively swimming from the egg case are transferred using a Pasteur pipette directly to a test replicate. Twelve larvae are distributed to each replicate. Sufficient midges should be reserved for a standard reference toxicant test (these will be grown out to third instar) and to archive a representative subsample (10-20) of the midge test population.
2. Check to be sure that all midges swim to the sediment in the test replicate. A drop of exposure water can be used to submerge any midges that get trapped at the water surface.
3. Record the date and time of test initiation when midges have been distributed to all test chambers. The test replicates are positioned randomly within the testing system.
4. After one hour, check all test replicates and replace any midges that are floating.
5. Preserve a representative sample of 10-20 midges with 70% ethanol for archival.

3.3 Daily Monitoring

3.3.1 Environmental Conditions

The environmental conditions monitoring schedule and list of parameters are outlined in Table 1. On Days 0, 20, and end of test, preserve a portion of the overlying water sample used for water quality determinations (approximately 100 ml) with 0.3 ml of concentrated H_2S0_4 for ammonia-N analysis. Samples for alkalinity and hardness determinations are collected at the same time intervals. These samples should be properly labeled and stored in a refrigerator at 4°C for subsequent analysis.

3.3.2 Biological Monitoring

Test organism observations are made daily for all test replicates. Position lighting to illuminate the overlying water column and the sediment surface for each replicate. Examine and record observations such as midges not buried or dead midges (not removed) or pupating larvae. Replace the test chamber to its assigned position.

3.3.3 Feeding

Provide 1.0 ml of Tetrafin slurry (4.0 mg/ml) to each test replicate daily. If the D.O. drops below 3.0 mg/L due to accumulation of uneaten food, feeding may be suspended for 1-2 days to stabilize the dissolved oxygen. The frequency of water renewals may also be increased to help maintain acceptable dissolved oxygen concentrations.

3.3.4 Automated Water Delivery System

Complete the System Checklist during the noon delivery cycle daily. Ensure that all components of the delivery system are functioning properly.

3.4 Auxiliary Male Production

On Day 9 of the test, an additional four replicates of each test sample are set up. On Day 10 these are inoculated with <24-hour old larvae, 12 per replicate. Egg cases collected from cultures on Days 6 or 7 are used as a source of larvae on Day 10. The auxiliary test beakers will be used as a source of male adults (emerged flies) for continued pairings, by test sample, near the end of the test. Auxiliary males are required because males tend to emerge earlier than females.

3.5 End Point Determinations

3.5.1 Day 20 Survival and Growth

Select Replicates I, J, K, L from each treatment and sieve the sediment to recover the larvae for survival and growth determinations. Record the number of surviving larvae

on the Midge (*Chironomus tentans*) 20-Day Survival and Growth Data form. Surviving midges in these replicates will be used to determine ash-free dry weights. Combine the larvae from each replicate on ashed weighing pans and dry the larvae at 60°C for 24 hours. Weigh each replicate weigh pan to 0.01 mg. Ash the replicate pans at 550°C for 2 hours. Re-weigh the ashed larvae. The tissue mass is the difference between the weight of the dried larvae (plus pan) and the weight of the ashed larvae (plus pan).

3.5.2 Emergence

Larvae will begin pupating and emerge as adult flies after Day 20. Install emergence traps on each of the remaining test replicates (Replicates A, B, C, D, E, F, G, and H) on Day 20. Record the number of larvae pupating and the number of males and females emerged each day on the Midge (*Chironomus tentans*) Daily Emergence Data form.

3.5.3 Reproduction and Adult Mortality

Transfer emerged adults daily from individual replicates (of the same sample) to a Reproduction/Oviposit (R/O) chamber using the transfer syringe. Males from a different replicate may be paired with females of replicates where no males have emerged. After Day 33, males collected from the auxiliary male replicates may be needed to create mating pairs. For each emerged female (from any replicate of a sediment sample), at least one male (obtained from the same replicate, or another replicate of the same sample, or from an auxiliary male replicate of the same sample) is transferred to the R/O chamber. Tabulate the number of egg cases deposited daily, and record adult mortality on the Midge (*Chironomus tentans*) Adult Mortality Data form.

3.5.4 Egg Counts and Egg Hatching

Transfer primary egg cases (the first egg case hatched by a female) from the R/O chamber to a petri dish. Estimate the number of eggs per egg case by the "ring method" using a dissecting or compound microscope. Incubate the egg cases from each treatment separately for 6 days. Determine hatching success (proportion hatched) by counting the unhatched eggs and subtracting that value from the original egg count.

3.5.5 Ending the Test

The test is ended after seven consecutive days of no emergence in a given treatment. When no emergence is recorded in a treatment at any time during the test, that treatment can be ended once emergence in the control sediment has stopped (using the 7-day criterion). End the test by sieving to recover surviving larvae or pupae that have not emerged. These data are recorded on the Midge (*Chironomus tentans*) End-of-test Larval Survival Data form.

4.0 QUALITY ASSURANCE

4.1 Blind Sample Analysis

Each sample, including the Control, will be assigned a unique sample number that will be used throughout the test.

4.2 Test Acceptability

Test acceptability criteria are based upon the guidelines of EPA/600/R-98/XXX, Table 15.3. Specifically, a test is judged to be acceptable if the average survival of control midges (cumulative total of successfully emerged larvae and surviving larvae which do not emerge) is equal to or greater than 70% at the end of the test. The average size of larvae on Day 20 in the Control must be at least 0.6 mg/surviving larva (as dry weight). The environmental conditions must be within the tolerance limits of *Chironomus tentans*.

4.3 Protocol Deviations

Any deviations from this SOP should be noted on a project documentation form and the Laboratory Manager and/or the Project Director should be immediately notified. The Project Director will determine the appropriate corrective action and will communicate protocol deviations to the client.

4.4 Reference Toxicant Testing

A water-only 96-hour exposure of midges to potassium chloride (KCl) will be conducted concurrently with the sediment exposures and with the same batch of midges. The 96-hour LC50 from this standard reference toxicant test is used to assess the sensitivity of the test organisms and to develop a control chart of LC50 values for this species when exposed to potassium chloride.

5.0 SAFETY

Samples acquired for toxicity testing may contain unknown toxicants or health hazards. Lab coats and protective gloves should be worn when handling these samples.

6.0 TRAINING

To be qualified for the overall procedure outlined in this SOP, the analyst must:

Read this SOP.
Receive verbal and visual instruction.
Demonstrate 90% recovery of 10 midges in trial sediments.
Be trained on pertinent associated SOPs.

Figure 1. Test conditions for the midge *(Chironomus tentans)* chronic whole sediment survival toxicity test.

ASSOCIATED PROTOCOLS: EPA 1998. *Methods for Assessing the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* (EPA/600/R-94/024) Second Edition, Method 100.5

1. Test type:	Whole-sediment toxicity (static)
2. Temperature:	23 ± 1 °C
3. Light quality:	Wide-spectrum fluorescent lights
4. Light illuminance:	500 to 1000 lux
5. Photoperiod:	16 hr. light, 8 hr. dark
6. Test chamber size:	300 ml beaker
7. Sediment volume:	100 ml
8. Overlying water volume:	175 ml
9. Renewal of overlying water:	Every 12 hours
10. Age of test organism:	Larvae, less than 24 hours
11. Number of organisms / test chamber:	12
12. Number of replicate test chambers / treatment:	12
13. Feeding regime:	Tetrafin slurry (1 mg/ml), 1.0 ml daily. Suspended if food accumulates.
14. Aeration:	None, unless D.O. drops below 2.5 mg/L). Additional renewals if needed
15. Overlying water:	Reconstituted moderately hard water
16. Control sediment	Formulated sediment
17. Test chamber cleaning:	Drainage screens daily as needed
18. Monitoring:	
Temperature	Daily (overlying water)
Dissolved oxygen	Daily (overlying water), may be reduced to 3 times weekly after Day 20
pH	3 times weekly (overlying water)
Conductivity	Weekly (overlying water)
Alkalinity and hardness	Days 0, 20 and end of test (overlying water)
Ammonia	Days 0, 20 and end of test (overlying water)
Organism behavior	Daily
19. Test duration:	Until no emergence occurs for 7days in control or test sediment
20. End points:	Survival and growth (Day 20), and end-of-test emergence, adult mortality, and reproduction
21. Reference toxicant:	Potassium chloride 96-h acute, water only
22. Test acceptability:	Day 20 mean control survival ≥70% and dry weight ≥0.6 mg/larvae
23. Data analysis:	Hypothesis tests versus the control or the reference site responses

Appendix B Ecological Assessment Field Sampling Standard Operating Procedures

B-1 Collection of Crayfish Using Traps
B-2 Collection of Crayfish Using Aquatic Nets
B-3 Collection of Benthic Macroinvertebrates with a Grab Sampler
B-4 Fish Collection and Processing
B-5 Laboratory Processing of Benthic Macroinvertebrate Samples for Taxonomic Identification
B-6 Macrophyte Sampling
B-7 Field Data Sheets

B-1 Collection of Crayfish Using Traps

STANDARD OPERATING PROCEDURE

COLLECTION OF CRAYFISH USING TRAPS

1.0 GENERAL APPLICABILITY

Crayfish will be collected using a variety of methods including hand collection and dip-netting, as well as the use of baited crayfish traps. Deployment of traps will be contingent on field conditions and trapping success.

2.0 EQUIPMENT

Equipment required for kick sampling with an aquatic net consists of the following:

- Hip boots or chest waders
- aquatic net with a mesh opening size less than 0.9 square mm (i.e., kick net).
- sample collection pan or bucket
- Analytical balance
- Measuring board
- 8-ounce glass jars
- coolers with ice
- adhesive labels
- tie tags
- space pen and field collection logs

An individual sample will consist of a composite of crayfish sufficient to achieve 150 g of tissue, approximately 5 to 10 crayfish per sample. Following collection, crayfish will be rinsed with distilled, deionized water to remove any loose debris on the specimens. The sample will be weighed to ensure a minimum wet with of 150 g. Where possible, several specimens from each set will be set aside and preserved for subsequent taxonomic identification. Crayfish to be used for tissue analysis will be placed in a sample collection jar or put in Zip-lock bags and immediately placed on ice to avoid decomposition. All samples will be labeled immediately upon retrieval at each sample location. Date and time of specimen retrieved, collector, location of retrieval, general condition, and other pertinent information will be recorded in the field notebook. In addition, as each sample is processed, a data sheet will be completed that will include at a minimum:

- Location of Collection
- Method of Collection
- Name of Collector
- Date and time of collection
- Weight and Length
- Sex

- Age class
- Tissue preserved

In addition, any other information deemed pertinent will also be included.

3.0 SAMPLE PRESERVATION, HANDLING, AND STORAGE

All samples will be placed in either decontaminated glass jars or zip-lock bags and stored in a freezer where they will be maintained at or below –10oC until shipped to the laboratory for analysis.

B-2 Collection of Crayfish Using Aquatic Nets

STANDARD OPERATING PROCEDURE

COLLECTION OF CRAYFISH USING AQUATIC NETS

1.0 GENERAL APPLICABILITY

This SOP discusses the sampling of crayfish for bioaccumulation analysis using an aquatic net (i.e., kick net). Kick sampling will be used to collect crayfish in the streams possessing a substrate of rock, rubble, gravel and sand (i.e., riffle/run areas). The depths in the stream are less than one meter and the current speed is at least 0.4 meters per second. Kick sampling is a method of sampling benthic organisms by kicking or disturbing bottom sediments and catching the dislodged organisms downstream with an aquatic net.

2.0 EQUIPMENT

Equipment required for kick sampling with an aquatic net consists of the following:

- Hip boots or chest waders
- Aquatic net with a mesh opening size less than 0.9 square mm (i.e., kick net).
- sample collection pan or bucket
- Analytical balance
- Measuring board
- 8-ounce glass jars
- coolers with ice
- adhesive labels
- tie tags
- space pen and field collection logs

3.0 PROCEDURES

Collection of crayfish using an aquatic net will proceed as follows:

1. The kick net is positioned in the water about 0.5 m downstream
2. The stream bottom is disturbed by foot so that the dislodged organisms are carried into the net.
3. Sampling is continued for a specified time and for a specified distance in the stream.
4. The preferred line of sampling is a diagonal transect of the stream.
5. The net contents are emptied into a pan of stream water.
6. Crayfish are removed from the net and washed with water from the pond or the creek being sampled then placed in collection bucket Other benthic macroinvertebrates are removed from the net and discarded.
7. The net is thoroughly cleaned before further sampling by vigorous rinsing in the stream.

4.0 LENGTH AND WEIGHT MEASUREMENTS

1. Place each crayfish on the measuring board.
2. Place the balance tray on the analytical and press TARE. Wait for a reading of 0.0g.
3. Place the crayfish in the balance tray.
4. Allow the weight reading to stabilize, and record the weight to the specified accuracy (e.g. 1.0g)
5. Record measurements on a field collection log.
6. Place crayfish in hexane-washed 8 ounce glass jars containing water from the pond or the creek being sampled.
7. Label jars with adhesive label and tie-tag.
8. Keep jars ice in a cooler until they are shipped to the laboratory.

B-3 Collection of Benthic Macroinvertebrates with a Grab Sampler

STANDARD OPERATING PROCEDURE

COLLECTION OF BENTHIC MACROINVERTEBRATES WITH A GRAB SAMPLER

1.0 GENERAL APPLICABILITY

This method is used to collect quantitative samples of benthic macrofauna from soft –bottomed environments for benthic community evaluation and chemical analysis. Menzie-Cura maintains a videotape of how to conduct this sampling. The tape is reviewed by all members of the sampling group associated with Menzie-Cura.

2.0 EQUIPMENT AND REAGENTS

The equipment used in benthic invertebrate sampling in soft sediments consists of: a grab sampler either a petite ponar grab or tall Eckman, and 0.5-mm mesh sieve, surface water in plastic squirt bottles is used to rinse the sample through the sieve. Plastic and/or glass sample jars, (see Table Section 4.0 of QAPP) and sample labels are provided by the laboratory. A preservative and rose bengal stain may be added to the samples collected for benthic community evaluation, according to the laboratory SOP.

The selection of a grab sampler is based on the depth, current, and sediment type present at the location. A sampler that opens from the top is more convenient to observe the top few inches of the sample for oxidation- reduction conditions, presence of vegetation, or other conditions.

3.0 PROCEDURES

Grab samplers are usually deployed over the side of a boat. They may also be used while wading in a small stream. A small sampler such as a petite ponar may be pulled by hand from a small, stable v-hulled or flat-bottomed boat.

Samples may be emptied into a sieve and sieved on board or emptied into clean buckets for sieving on the shore, depending on the room on board to hold unsieved samples and the proximity to the shore. Samples are rinsed through the 0.5-mm sieve using surface water. The sediment and organisms retained on the sieve are carefully transferred by hand into a labeled sample jar. A labeled tongue depressor is placed into the jar with the sample as well. Preservative and stain (as required by the analytical laboratory) is added to cover the sample for benthic community evaluation.

Samples are transferred to the analytical laboratory under chain of custody. Care is required in packing samples that contain preservative for shipping. Jar lids should be securely taped with electrical tape. Preserved samples should be packed in an absorbent, non-flammable material such as vermiculite.

4.0 DOCUMENTATION

Sample locations, time and date of collection, and initials of the collector will be on each sample label and on the COC. This information will also be documented in a field note book or log sheet. Observations of sediment type, vegetation, oxidation-reduction status, or any unusual matter will also be recorded in field log.

B-4 Fish Collection and Processing

STANDARD OPERATING PROCEDURE

FISH COLLECTION AND PROCESSING

1.0 FISH PREPARATION

Fish will be collected by location and retained in live wells containing location-specific water until sample processing is initiated. Fish containers (e.g., live wells) will be labeled with capture location information and aerated to minimize fish mortality before fish processing. All fish retained for potential sample analysis will be enumerated and separated by species and size class. This information will subsequently be used to determine the number of samples and associated IDs. Fish will be sacrificed by cervical separation or sharp blow to the head with a stunning rod. All fish not retained for analysis will be released unharmed after processing to their respective locations.

The following metrics will be recorded for each individual fish included in any sample.

- Total Length (cm) — The greatest of a fish from its anterior most extremity to the end of the tail fin. For fish with a forked tail, the two lobes should be pressed together, and length of the longest lobe should be recorded.
- Total Weight (g) — Fish will be placed in a pre-weighted decontaminated tray and weighed to the nearest gram.
- Sex (M/F) — When possible (i.e., bass), fish sex will be identified by external morphological characteristics or internal reproductive examination.
- Physical Exam — Gross pathological examination of all fish will be conducted and documented. Special consideration will be given to gross pathological conditions on largemouth bass.

Upon completion of collection of metrics, fish samples will be either submitted for whole body. Fillet and offal samples will be prepared in the Laboratory.

2.0 WHOLE BODY SAMPLE PROCESSING

Fish samples for whole body analysis will be rinsed of all debris with deionized water and placed in zip-lock bags. The sample ID labels will be placed on the outside of the zip-lock bag and secured with clear tape. If more than one fish is used for a sample (composite), all fish used for the sample will be placed in zip-lock freezer bags, and labeled with the appropriate sample ID. To preserve sample integrity, samples will be placed in double ziplock freezer bags with a second ID label and placed in either a cooler with dry ice or a suitable freezer until analyzed.

3.0 FILLET AND OFFAL SAMPLE PROCESSING IN THE LABORATORY

- Fillet Weight (g) — For appropriate samples (same procedures as total weight).
- Offal Weight (g) — For appropriate samples (same procedures as total weight
- Age — Otoloths and scales samples will be collected to determine the age of largemouth bass. Ages will be determined in a laboratory setting

Procedures for filleting fish are described below.

An initial cut should be made from the dorsal fin to the pelvic fin, just behind the opercular flap. Run the tip of the knife along the dorsal side of the fish, from the initial cut to the caudal fin. Continue making successively deeper cuts, running the knife blade as close to the neural spines and ribs as possible. After the fillet is obtained, remove the skin. Place the skin side of the fillet down on the dissecting tray, hold on to the tail portion of the fillet, and run the knife between the skin and the muscle tissue. Remove any debris from the skinless fillet by rinsing with deionized water.

After a fillet is cleaned, place the sample in a pre-weighted decontaminated tray and record the weight to the nearest gram. For composite samples, obtain all the fillets for the composite and weigh to the nearest gram. Fillet samples will be placed in freezer zip-lock bags. Offal samples (fish tissue remaining after fillets have been removed) will also be placed freezer zip-lock bags in the same manner. The sample ID label will be placed on the outside of freezer-zip lock bag and secured with clear tape. Place the samples in double ziplock freezer bags with a second ID label and store on dry ice or suitable freezer until submitted to a designated laboratory.

4.0 SAMPLE SIZE

Individual and composite fish samples will be collected for the aforementioned sample reaches and impoundments.

- Both sides of the fish will be filleted to obtain the minimum sample weight of 150 grams. All fillet samples will have the skin removed.
- For all species, composite samples of fish each, of forage size (5 to 9 cm), will be submitted. Each composite will contain fish within 75% of the total length between the largest and smallest fish of each composite.
- Largemouth bass of all size ranges (excluding forage sized fish 5 to 9 cm) observed will be submitted for analysis. Bass will be broken up into three size ranges:
    1. Bass Illinois legal limit
    2. Bass between 8 to 12 inches (20 to 28.5 cm)

3. Bass between 4 to 12 inches (10 to 20 cm).

Bass (Illinois legal limit) will be submitted as fillet samples with the skin removed. Bass less than legal limit will be submitted as whole body samples. No mixing of fillets or composites of whole bodies from different fish will occur.

5.0 DOCUMENTATION

All sample documentation will follow project specific SOPs for field sample ID, data sheet, chain-of-custody, and custody seal procedures.

6.0 DECONTAMINATION

All dissection equipment will be decontaminated following the project-specific SOP for equipment decontamination including detergent/water wash, potable water rinse, hexane rinse, isopropyl alcohol rinse, and deionized water rinse. All zip-lock bags will be hexane rinsed prior to use.

7.0 SAMPLE SHIPPING

Samples should be sent by overnight delivery service (next morning delivery) or had delivered. Samples sent to the USFWS should be shipped to:

United States Fish & Wildlife Service

Shippers will notify the receiving laboratory or the USWS and notify that samples are being sent for next-day delivery. Samples should not be sent to USFW if the authorized persons are unavailable. Samples need to be sent for arrival on a weekday only. Therefore, Thursday is the last day of the week to ship samples. Shippers should also call the receiving laboratory of USFWS the day of delivery to verify the receipt of samples.

STANDARD OPERATING PROCEDURES

COLLECTION AND TREATMENT OF FISH FIELD DATA

1.0 PURPOSE AND APPLICABILITY

This procedure describes the efficient collecting and recording of fish field data.

2.0 DEFINITIONS

Total length – total length is the maximum length from the tip of the anterior-most portion of the fish with the jaws closed to the posterior-most portion of the caudal fin with the labels appressed.

Fork length – fork length is the distance from the anterior-most portion of the fish with the jaws closed to the deepest incision of the fork of the tail.

3.0 HEALTH AND SAFETY CONSIDERATIONS

Health and Safety considerations are dependent on site l logistics and the possible presence of hazardous chemicals or wildlife. All field personnel must wear proper clothing for the environmental conditions present. At least one member of the field team must be trained for basic first aid techniques such as heat stress prevention and CPR. A first aid kit must be provided as standard equipment for all field trips.

4.0 QUALITY ASSURANCE PLANNING CONSIDERATIONS

The appropriate equipment and methods will be selected for each project on the basis of circumstances, objectives, and requirements of that project. The provisions of this SOP will be adapted to these project specific requirements in the project QA plan.

5.0 RESPONSIBILITIES

One or more members of the field team are assigned responsibility for collecting and recording field data. Responsibilities include assuring that proper gear and supplies are in working order and ready for transport to the field and performing the tasks indicated in this SOP.

6.0 TRAINING/QUALIFICATIONS

Each MCA employee who collects and handles fish data will have previous experience with the procedures or be trained by an experienced MCA ecologist in the specific procedure used. Training and experience includes cognizance of the literature covering methods, limitations for each species, and knowledge of results, which can be expected.

7.0 MATERIALS

Weighing scales
Scale envelopes
10 percent formalin
Scaler
Forceps
Scalpel
Scissors
Measuring board
Screw-top jars with polypropylene lids
Labels
Taxonomic fish keys
Pencils
Data sheets
First aid kit

8.0 METHODS

8.1. Recording Data

All particulars of field sampling are recorded on data forms (Attachment 1). All non-applicable spaces must be left blank. This is accomplished by drawing a horizontal line through the non-applicable block when the entire element is not applicable or by leaving unused spaces blank when only some of the spaces in a data element are used. Data are recorded in pencil to minimize the possibility of water causing illegibility. If no fish are taken in a given sample, a blank data sheet is filled in the notation "NO FISH CAPTURED' entered for "species."

All data sheets for each sampling effort (e.g., each gill net, each shocking run, each seine haul, etc.) are securely fastened together for transport to the laboratory.

If a mixed collection of small fish or fish of doubtful identification are taken for laboratory analysis, an additional data sheet is made up with a description of the sample in the comments section. This sheet is included with the fish data sheets. Another label with all pertinent data and the sample identification is inserted into the sample container.

When project requirements do not necessitate individual length-weight measurements, fish are tallied by species in length groups. Tallies by length groups are tallied by species in length-groups. Tallies by length groups are recorded in the section "Length Classed Fish." When counts only are required, a data sheet with the same headings as Attachment 1 but with columns for species and numbers in the body are prepared.

8.2. Weight and Length Measurements

For each species, all fish are weighed and measured and the data are recorded on data sheets (Attachment 1). If more than one sheet is used, the sheets are identified as sheet 1 of x, sheet 2 of x, etc. Measuring board and scales used in the field are calibrated according to manufacturer's instructions and other appropriate methods. All lengths are taken as total lengths in millimeters except sturgeon, which are measured in fork length.

Weights are recorded in grams or kilograms. If fish have been covered with sand or other foreign materials in the process of capture, this foreign material is removed before weighing the fish.

8.3. Unusual Specimens

Anomalies (e.g., tail or tail-fin deformed, parasitized, part of a fish protruding from the mouth of a slightly larger fish, emaciated condition, etc.), are noted on the data sheet.

8.4. Uncertain Field Identifications

Any specimen that cannot be clearly identified to project specified taxonomic level is returned to the laboratory for identification or confirmation.

8.5. Numerous Small Fishes

When small fish are captured and project requirements permit, these individuals are counted and released as rapidly as possible.

If lengths and weights are required, at least 25 individuals of each species representing the complete range of lengths are preserved for analyses in the laboratory.

The remainder of each species are counted and released. Both the number counted and the notation of specimens collected are recorded on the same sheet.

8.6. Threatened and Endangered Species

Special effort is made to return threatened or endangered species to the water in an uninjured condition after weighing and measuring. Unless voucher specimens are required and special permission is obtained, threatened and endangered species are not retained.

8.7. Field Preservation

All fish to be returned to the laboratory are preserved in formalin or frozen on dry ice. Preservation with formalin is as follows. Small fish are preserved in formalin of a concentration such that after absorption by the specimens the concentration is about 10 percent. This can be done simply by filling container 9/10 full of fish and water; then filling to top with full strength formaldehyde.

Specimens larger that 6 inches should be slit open along the venter to the fish's right of the midline to allow entry of preservative into the body cavity. When slitting, avoid damage to the internal organs. Properly label container of fish.

8.8. Collection of Scale Samples

The currently accepted method for collecting scale samples utilized two different locations of collection, depending on whether the fish is soft-rayed or spiny-rayed. On soft-rayed fish, the scale sample is collected above the lateral line directly below the origin of the dorsal fin. On spiny-rayed fish, the scale sample is collected below the lateral line at the end of the appressed pectoral fin. In each case, 10 to 20 scales should be collected unless very large fish are encountered.

If scales are obviously regenerated (as evidenced by a pebbled center area under 10% magnification), additional scales should be collected from an adjacent area. Scales from very large fish are examined in the field under 10% magnification to eliminate regenerated scale; 3 or 4 scales are collected.
Scale samples are not collected from ganoid-scaled fishes (gars) or fishes not having a regular scale pattern (e.g., sturgeons or leather and mirror carp), since these scales generally do not provide useful information.
Scales are collected by puling them from their pockets with a front to back movement of a knife, scalpel, or similar instrument.
Insert the collected scales into a prepared scale envelope upon which the following are recorded on a label: species, location, collection number, length, weight, and fish number from the data sheet.
If scales are taken from all fish or none of the fish recorded on a data sheet, this fact should be recorded in the comment section. If scales are taken from some fish listed on the data sheet but not others, an asterisk or the letter "S" is placed in the box on the data sheet containing the fish number.
The envelopes are always checked for correct data prior to releasing the fish. As soon as possible after collection (enerally the same day), scale envelopes are spread to dry.

9.0 QUALITY CONTROL CHECKS

Quality control checks will consist of the following:

The appropriate taxonomic key is being used,
The correct fish sampling equipment is used,
Data sheets and labels are correctly filled out,
Field equipment is working properly,
Formalin is fresh and not deteriorated,
Lengths and weights of fish are taken, and
Scale samples are properly taken.

10.0 DOCUMENTATION

Documentation of activities will be completed by an ecologist or biologist conducting the activities. The documentation will be kept on field data forms and a field notebook. At a minimum, the documentation will include the date , field crew names, methods used, and sample identification numbers.

The documentation will be peer reviewed, signed off by the task manager, and dated.

All documentation will be retained in the project files following completion of the project.

B-5 Laboratory Processing of Benthic Macroinvertebrate Samples for Taxonomic Identification

STANDARD OPERATING PROCEDURE

LABORATORY PROCESSING OF BENTHIC MACROINVERTEBRATE SAMPLES FOR TAXONOMIC IDENTIFICATION

1.0 GENERAL APPLICABILITY

This Standard Operating Procedure describes how benthic macroinvertebrates samples received by laboratory will be processed, and identified.

2.0 EQUIPMENT DESCRIPTIONS

The following compound microscopes will be used: a Leitz Laborlux 12 with magnification changer, a drawing tube, a research quality objectives, and phase contrast objectives to 100X; a Leitz Laborlux 11 with objectives to 100X; an Olympus BH2 with drawing tube and objectives to 100X, and BHTU with 100X objectives. Ten dissecting microscopes are available for processing.

3.0 PROCEDURE

The preservative will be removed from the sample to prevent exposure of volatile fumes to the sorter. This will be done by pouring the sample through a 250um mesh screen. Large debris (rocks, leaves, twigs etc.) will be rinsed and discarded from the sample.

The procedure provided in EPA, 1998 will be followed. Subsampling will be done to obtain a minimum of 200 organisms from the sample. The sample will be divided into eight aliquots using a specially designed subsampler. Each aliquot will be placed into a separate container and examined until a minimum of 200 organisms is reached. An aliquot that has been started will be completed regardless of the number of organisms, to enable a total number to be calculated. Contents will be examined in gridded petri dishes using a dissecting microscope, and all organisms removed, counted and placed in labelled vials containing 70% ethyl alcohol. The remainder of the sample (i.e., the portion from which no subsamples have been taken) will be re-preserved with 10% buffered formalin. Before preservation, one subsample will be kept separate, in case the identifiers need more material (e.g., some of the oligochaetes worms are fragments and more individuals are then needed to comprise the 200 specimen count).

3.1 Quality Control Checks

Quality control checks will be performed on 10 percent of the samples for each sorter. If less than10 percent of the total number of organisms is found in the QC check, no more samples will be checked. If greater than 10 percent of the total number of organisms is found in any sample, then another 10 percent will be checked. The results of the QC checks will be presented with other data.

3.2 Identification

After the organisms have been removed according to the procedures outlined above, all of the organisms will be identified. The dissecting microscope is used for all identifications except for chironomid larvae and oligochaetes, or when specific parts of an organism have to be checked (e.g., water mite palps, plecopteran lacinia). Chironomids and oligochaetes will be identified using compound microscopes. These organisms will be mounted under a coverslip with two coverslips per slide, and five oligochaetes under a coverslip with two coverslips per slide. Separate data sheets are used for the identification of oligochaetes and chironomid larvae. These sheets are designed so that a specimen can be located with a minimum of effort.

The following taxonomic groups will be identified to the genera/species level: Oligochaeta, Isopoda, Decapoda, Hydrachnida, Ephemeroptera, Odonata, Plecoptera, Hemiptera, Megaloptera, Neuroptera, Trichoptera, Coleoptera, Diptera (including Chironomidae), Gastropoda and Bivalvia.

4.0 DOCUMENTATION

4.1 Voucher Collection

A voucher collection will be provided. For each taxon encountered, one to three individuals are removed per taxon for the collection.

4.2 Data Analysis

All data will be entered into Excel and provided in the prescribed format (Excel, Lotus, ASCII). The data will be analyzed for taxa richness, abundance, percent dominant taxon/taxa, and community composition.

5.0 REFERENCES:

EPA, 1998. Lake and Reservoir Bioassessment and Biocriteria: Technical Guidance Document, EPA Office of Water, EPA 841-B-98-007

B-6 Macrophyte Sampling

Microclimatic differences on a site such as shade, soil factors, nutrients, and topographic variation will affect plant growth and possibly mask the effects of contaminants.

This is a destructive method and may be undesirable at some sites.

This procedure can only be carried out during the growth season. Also, differences in the times when various species germinate and become dominant within the growing season may bias the results.

Results may also be biased if the root portions of plants of different species vary greatly in their portion of the total biomass. Roots may also be sampled, but this is a tedious process requiring that all root material be extracted from the soil and sediment and all soil and sediment be removed from the roots.

B-7 Field Data Sheets

PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

SAMPLING LOCATION: _____

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Surrounding Lead Use:

Forest Field/Pasture Agricultural Residential Commercial Industrial Other _____

Local Watershed Erosion: None Moderate Heavy

Local Watershed HPS Pollution: No evidence Some potential sources Obvious sources

Estimated Stream Width _____ Estimated Stream Depth: _____ Riffle _____ Run _____ Pool _____

High Water Mark _____ Velocity _____ Dam Present: Yes ____ No ____ Channelized: Yes ____ No ____

Canopy Cover: Open Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal Sewage Petroleum Chemical Anaerobic None Other _____

Sediment Oils: Absent Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Select Shells Other _____

Are the undersides of stones which are not deeply embedded black? Yes No

Inorganic Substrate Components		
Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	> 256 mm (10 in.)	
Cobble	64 - 256 mm (2.5-10 in.)	
Gravel	2 - 64 mm (0.1-2.5 in.)	
Sand	0.06 - 2.00 mm (gritty)	
Silt	.0004 - .06 mm	
Clay	< .004 mm (slick)	

Organic Substrate Compounds		
Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Weed, Coarse Plant Materials (CPOM)	
Muck Mud	Black, Very Fine Organic (FPOM)	
Marl	Grey, Shell Fragments	

WATER QUALITY

Temperature _____ c Dissolved oxygen _____ pH _____ Conductivity _____ Other _____

Instrument(s) Used _____

Stream Type: Coldwater Warmwater

Water Odors: Normal Sewage Petroleum Chemical None Other _____

Water Surface Oils: Slick Sheen Globe Flecks None

Turbidity: Clear Slightly Turbid Turbid Opaque Water Color _____

WEATHER CONDITIONS

PHOTOGRAPH NUMBER

OBSERVATIONS AND/OR SKETCH

RELATIVE ABUNDANCE OF AQUATIC BIOTA

Periphyton	0	1	2	3	4	Simes	0	1	2	3	4
Filamentous Algae	0	1	2	3	4	Macroinvertebrates	0	1	2	3	4
Macrophytes	0	1	2	3	4	Fish	0	1	2	3	4

0 = Absent/Not Observed 1 = Rare 2 = Common 3 = Abdundant 4 = Dominant

PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Surrounding Land Use:

Forest Field/Pasture Agricultural Residential Commercial Industrial Other _____

Local Watershed Erosion: None Moderate Heavy

Local Watershed NPS Pollution: No evidence Some Potential Sources Obvious Sources

Estimated Stream Width _____ m Estimated Stream Depth: Riffle _____ m Run _____ m Pool _____ m

High Water Mark _____ m Velocity _____ Dam Present: Yes ___ No ___ Channelized: Yes ___ No ___

Canopy Cover: Open Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal Sewage Petroleum Chemical Anaerobic None Other _____

Sediment Oils: Absent Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Relict Shells Other _____

Are the undersides of stones which are not deeply embedded black? Yes No

Inorganic Substrate Components			Organic Substrate Components		
Substrate Type	Diameter	Percent Composition in Sampling Area	Substrate Type	Characteristic	Percent Composition in Sampling Area
Bedrock			Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	
Boulder	>256-mm (10 in.)		Muck-Mud	Black, Very Fine Organic (FPOM)	
Cobble	64-256-mm (2.5-10 in.)		Marl	Grey, Shell Fragments	
Gravel	2-64-mm (0.1-2.5 in.)				
Sand	0.06-2.00-mm (gritty)				
Silt	.004-.06-mm				
Clay	<.004-mm (slick)				

WATER QUALITY

Temperature _____ C Dissolved Oxygen _____ pH _____ Conductivity _____ Other _____

Instrument(s) Used _____

Stream Type: Coldwater Warmwater

Water Odors: Normal Sewage Petroleum Chemical None Other _____

Water Surface Oils: Slick Sheen Globs Flocks None

Turbidity: Clear Slightly Turbid Turbid Opaque Water Color _____

WEATHER CONDITIONS

PHOTOGRAPH NUMBER

OBSERVATIONS AND/OR SKETCH

Figure 5.1-1. Physical Characterization/Water Quality Field Data Sheet for use with all Rapid Bioassessment Protocols.

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVERMILE_____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ AM PM	REASON FOR SURVEY

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% <20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score _____

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Appendix C Ecological Risk Assessment Health and Safety Plan

ECOLOGICAL RISK ASSESSMENT HEALTH AND SAFETY PLAN
SAUGET AREA I SAMPLING PLANS

Sauget and Cahokia, Illinois

APPENDIX C

SITE-SPECIFIC HEALTH AND SAFETY PLAN

SITE: Sauget Area 1

LOCATION: Sauget and Cahokia, Illinois

DATE PREPARED: April 5, 1999

PREPARED BY: Menzie-Cura & Associates, INC.

PLANNED SITE DATE(s): To-Be-Determined

- Menzie-Cura & Associates, Inc. and Menzie-Cura & Associates, Inc. subcontractors, and the United States Environmental Protection Agency cannot guarantee the health or safety of any person entering a contaminated site or hazardous waste site. Strict adherence to the Health and Safety Guidelines set forth herein will reduce, but not eliminate, the potential for injury.

2.0 GENERAL

2.1 *Introduction*

This plan has addressed all sampling activities associated with work performed for the Sauget Area 1s Site in Sauget and Cahokia Illinois.

The content of this HSP may be altered or revised as additional information becomes available and/or as monitoring surveillance or the technical scope of work changes.

The HSP shall apply to all Menzie-Cura & Associates, Inc. field personnel as well as to Menzie-Cura & Associates, Inc. subcontractors on-site.

The Menzie-Cura & Associates, Inc. team will conduct activities relative to the performance of a preliminary risk assessment of the Sauget Area 1 Site in Sauget and Cahokia Illinois. The purpose of the investigation is to determine if historical contamination of the Sauget Area 1 Site presents health risks to wildlife and human receptors. During the investigation, samples will be collected from surface water, sediment, and biological material (fish and plants). Samples will be collected using hand augers; sediment-sampling locations will be facilitated by the use of a boat.

2.2 *Emergency Phone Numbers*

Emergency Services	Sauget Phone Number	Cahokia Phone Number
Police	618 322-6507 or 6997	618 337-9505
Fire	618 332-6700	618 337-5080
St. Mary's Hospital of East St. Louis, IL.	618 274-1900 Louis, IL.	618 274-1900 Louis, IL.
National Response Center	1-800-424-8802	1-800-424-8802
Industrial Medical Associates (James Rozier)	1-315-478-1977	1-315-478-1977
Poison Control Center	1-800-942-5969	1-800-942-5969

2.3 *Contacts*

Name	Affiliation	Phone Number
Jerome Cura (Corporate Health & Safety Officer)	Menzie-Cura & Associates	978-453-4300 ext. 17
Charles A. Menzie (Project Manager)	Menzie-Cura & Associates	978-970-2620 or 978-453-4300
Michael McAteer	USEPA Region 5 Chicago, IL	312 353-2000
Bruce Yare	Solutia Inc. Chicago, IL.	312 674-6370

Directions to St. Mary's Hospital from the site are as follows:

From the Sauget Area 1 Site, drive west on Queeny Avenue to Illinois State Route 3, North (IL 3N). Drive north on IL 3 N. Take the I 70 east/I 64 East/I 55 North exit toward Chicago /Inidanpolis. Take the 4th St. Exit toward Business District/East St. Louis. Merge onto south 4th Street , turn right onto east Broadway/IL 15. Turn left onto north 8th Street. St. Mary's Hospital is located at 129 North 18th Street. The distance from the site to the hospital is approximately three miles. The estimated driving time is seven minutes.

A copy of this HSP will be provided through U.S.EPA's community relations staff for this site, to St. Mary's Hospital and to the Cahokia and Sauget Fire and Police departments by the SSHC.

3.0 HEALTH AND SAFETY PERSONNEL

The following section briefly describes the personnel and their health and safety responsibilities for the Sauget Area 1 Site in Sauget and Cahokia Illinois

3.1 *Project Manager*

The Project Manager has the responsibility for the safe conduct of operations and use of equipment during fieldwork. She has direct responsibility for the safety of Menzie-Cura & Associates, Inc. personnel on-site and for the safe conduct of Menzie-Cura & Associates, Inc. sub-contractors. The Project Manager shall ensure that a Project Health and Safety Officer or a Designated Health and Safety Officer (DHSO) is on-site whenever Menzie-Cura & Associates, Inc. personnel or subcontractors are on-site.

3.2 *Health and Safety Officer*

The Project Health and Safety Officer (PHSO) has responsibility for development of this HSP and is responsible for implementing this site-specific Health and Safety Plan. The PHSO shall conduct initial site-specific health and safety training for all on-site personnel, subcontractors, and visitors. The Project Health and Safety Officer will accompany all U.S. Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), and other government agency personnel who visit the site or who respond to health and safety issues. All persons shall complete medical forms at the time of site-specific training and these forms will be kept on file. The Project Health and Safety Officer shall also identify communication procedures and provide for briefings to be held before site activity is initiated.

3.3 *All Site Personnel*

All on-site personnel are responsible for knowing, understanding, and abiding by the HSP. While on site, all personnel shall follow the directions of the Project Health and Safety Officer regarding health and safety issues.

4.0 SITE DESCRIPTION AND HISTORY

The Sauget Area 1 site is located in the Villages of Sauget and Cahokia, St. Clair County, Illinois. For environmental investigations, Sauget Area 1 has been divided into segments or Sites including Sites A through F of Dead Creek and adjacent Sites G through N (see Site Location Map Figure 1-1 of Ecological Risk Assessment QAPP). Dead Creek is an intermittent creek which was formerly used in the early part of the 1900s for waste disposal. Sites G, H, and I are inactive landfills or former disposal areas adjacent to Dead Creek. Site L is a former surface impoundment and sites M and N are former sand pits.

See associated Work Plans in Volume 1 for site's physical features, population and land use, geology and soil, groundwater resources and surface hydrology and drainage.

5.0 HAZARD ASSESSMENT

Potential hazards at the site could include chemical, physical and biological hazards. This section will identify those hazards and discuss by task the likelihood of and risk of exposure to the hazards identified.

The list of chemicals of concern that have been identified from previous field sampling is provided in Table 1.

Table 1. Maximum Constituent Concentrations in Dead Creek

Constituent	Matrix	Segment of Dead Creek (CS)					
		CS-A	CS-B	CS-C	CS-D	CS-E	CS-F
VOCs	soil/sediment						
1,1,1-trichloroethane							
1,1,2,2-tetrachloroethane		3.30E-01					
1,2-dichloroethane			2.70E-02				
1,1-dichloroethane		1.60E+00					
trans-1,2-dichloroethene		1.50E+01					
methyl ethyl ketone		[illegible]	1.40E+01				
acetone		2.40E-01	8.20E-01		1.30E-01	4.10E-01	2.20E-02
benzene		[illegible]	8.70E-02				
bromomethane		5.80E-01					
carbon disulfide			[illegible]				
carbon tetrachloride			3.50E-02				
chlorobenzene		3.10E+01	5.20E+00		[illegible]	1.20E-01	
chloroform							
dichlorodifluoromethane		6.90E+00					
ethyl benzene		8.00E+01	3.60E+00				
iodomethane		[illegible]					
methylene chloride		2.10E-01	1.00E+01			[illegible]	
tetrachloroethene		1.10E+01	[illegible]				
toluene		[illegible]	8.10E-01				2.90E-02
total xylenes		5.00E+02	5.40E+02				
trichloroethene		1.00E+02	3.70E+00				
SVOCs	soil/sediment						
1,2,4,5-tetrachlorobenzene		2.80E+01					
1,2,4-trichlorobenzene		4.70E+01	1.20E+01	2.60E-01			
1,2-dichlorobenzene		7.40E+01	1.70E+01			3.20E-01	
1,3-dichlorobenzene		1.70E+01	2.00E+00	1.10E-01			
1,4-dichlorobenzene		6.40E+01	2.20E+02	6.90E-01		[illegible]	
2,4,5-trichlorophenol			9.67E-02				
2,4,6-trichlorophenol			[illegible]				

Table 1. Maximum Constituent Concentrations in Dead Creek

Segment of Dead Creek (CS)

Constituent	Matrix	CS-A	CS-B	CS-C	CS-D	CS-E	CS-F
2,4-dichlorophenol			3.40E-01				
2,4-dimethylphenol		5.50E-01	1.40E-01				
2,4-dinitrophenol							
2-chlorophenol			1.50E-01				
2-methylnaphthalene		6.00E-01	3.40E+00	1.00E-01			
2-methylphenol		6.00E-01					
2-nitroaniline							
3,3-dichlorobenzidine							
4-chloroaniline		1.70E+01					
4-methyl phenol		1.20E-01	1.70E-01				1.10E+00
4-methyl-2-pentanone			2.20E-01	1.20E+00	1.20E+00		
4-nitroaniline							
4-nitrophenol			2.60E+00				
acenaphthene		1.70E-01	2.60E+00	1.30E-01			
acenapthylene							
acetophenone		2.40E+01					
aniline		3.60E+00					
anthracene			2.70E+00	2.40E-01			
benzo (a) anthracene			2.30E+00	3.30E+00			
benzo (a) pyrene		5.40E-01	1.00E+01	9.40E+02			
benzo (b) fluoranthene		1.80E+00	3.00E+01	7.50E+00	5.00E-01	2.40E+00	
benzo (g,h,i) perylene			1.30E+01	1.50E+00			
benzo (k) fluoranthene			1.50E+01	9.20E-01			
benzoic acid		2.80E+00					
benzyl alcohol		8.20E-01					
bis (2-ethylhexyl) phthalate		2.60E+01	1.30E+00	7.40E-01	7.20E-02		
butyl benzyl phthalate		2.40E+00	1.30E+00				
chloronitrobenzene			2.40E+02				
chrysene		8.00E-01	9.40E+00	4.40E+00	5.30E-02	2.80E+00	
cresol (m,p)							
di-n-butyl phthalate		4.40E-01	3.50E-01	4.40E-01	1.30E-01		
di-n-octyl phthalate		1.10E+01	2.60E+00	1.50E-01	1.20E-01		
dibenzo (a,h) anthracene		0.60E-01	1.80E+00	4.00E+00	3.60E-03		

Table 1. Maximum Constituent Concentrations in Dead Creek

Constituent	Matrix	Segment of Dead Creek (CS)					
		CS-A	CS-B	CS-C	CS-D	CS-E	CS-F
dibenzofuran			2.00E+00				
dichlorobenzene		1.70E+00	1.20E+04				
dichlorophenol			1.70E+02				
diethylphthalate							
dimethyl phenanthrene							
diphenylamine		[illegible]					
fluoranthene		[illegible]	1.10E+01	4.60E+00	5.10E-01		3.10E-01
fluorene		[illegible]	4.60E+00	[illegible]		[illegible]	
hexachlorobenzene		[illegible]	1.90E+00				
hexachloroethane							
hexachlorobutadiene		[illegible]					
indeno (1,2,3-cd) pyrene		[illegible]	9.00E+00	4.30E+00	[illegible]		
isophorone			[illegible]				
n-nitrosodiphenylamine		[illegible]					
naphthalene		[illegible]	[illegible]	2.10E+00			
pentachlorobenzene		3.70E+01					
pentachlorophenol		[illegible]	1.60E+00				
phenanthrene		1.40E+01	1.50E+01	[illegible]	2.20E-01	3.20E-01	
phenol		3.80E-01		5.80E-01			
phenyl indene							
pyrene		1.00E+01	1.30E+01	4.50E+00	4.80E-01	5.30E+00	3.40E-01
sulfide			1.60E+01				
trimethyl phenanthrene							
Pesticides	soil/sediment						
4,4-DDD							
4,4-DDE						[illegible]	9.70E-02
4,4-DDT							
endosulfan II					2.10E-01		2.03E-01
endrin					1.51E-01	9.75E-01	6.60E-02
methoxychlor							8.00E-03
toxaphene							

Table 1. Maximum Constituent Concentrations in Dead Creek

Segment of Dead Creek (CS)

Constituent	Matrix	CS-A	CS-B	CS-C	CS-D	CS-E	CS-F
PCBs	soil/sediment						
arochlor 1221		7.80E+02					
arochlor 1232		1.60E+03					
arochlor 1242		1.30E+01					
arochlor 1248		1.50E+02	4.80E+02	8.70E+03			
arochlor 1254		5.30E+02	1.41E+02	1.10E+04	7.50E+00	4.57E+01	4.49E+00
arochlor 1260		7.20E+01	6.60E+01	[illegible]	4.50E+00	1.43E+01	8.62E-01
total PCBs			1.70E+04	2.75E+01	1.20E+01	5.99E+01	5.35E+00
PCB Precursors							
biphenyl		[illegible]	9.00E+03				
chlorobiphenyl		[illegible]					
dichlorobiphenyl		[illegible]					
trichlorobiphenyl		[illegible]					
tetrachlorobiphenyl		[illegible]					
pentachlorobiphenyl		[illegible]					
hexachlorobiphenyl		[illegible]					
decachlorobiphenyl		3.00E+00					
Dioxin	soil/sediment						2.11E-19
Metals	soil/sediment						
aluminum		1.03E+04	2.15E+04	1.26E+04	1.48E+04	1.56E+04	2.17E+04
antimony		3.56E+02	2.40E+02				1.08E+01
arsenic		1.94E+02	6.00E+03	3.30E+01	1.12E+01	3.03E+01	2.76E+02
barium		5.20E+03	1.73E+04	4.70E+03	6.22E+02	3.69E+03	4.75E+02
beryllium		4.41E+01	3.00E+00	3.00E+00			2.00E+00
cadmium		5.32E+02	4.00E+02	5.00E+01	4.20E+01	2.31E+01	2.35E+01
chromium		6.95E+02	4.00E+02	6.80E+01	4.80E+01	1.05E+02	5.00E+01
cobalt		3.84E+01	1.80E+02	3.20E+01	1.20E+01	6.00E+00	1.88E+01
copper		9.18E+04	4.48E+04	1.72E+04	1.63E+03	8.54E+03	1.80E+03
cyanide			3.80E+00				
iron		3.12E+05	3.65E+05	1.10E+05	4.02E+04	3.99E+04	3.53E+04

Table 1. Maximum Constituent Concentrations in Dead Creek

Constituent	Matrix	Segment of Dead Creek (CS)					
		CS-A	CS-B	CS-C	CS-D	CS-E	CS-F
lead		3.24E+04	2.40E+04	1.30E+03	4.80E+02	1.27E+03	2.50E+02
manganese		8.71E+02	5.10E+02	1.84E+04	4.12E+02	1.36E+03	8.96E+02
mercury		1.24E+02	3.00E+01	4.67E+02	1.00E+00	1.53E+00	5.50E-01
molybdenum			9.20E+01				
nickel		6.94E+03	3.50E+03	2.30E+03	6.65E+02	2.13E+03	7.72E+02
selenium		4.16E+01	4.10E+00	2.50E+00			
silicon			1.50E+02				
silver		3.48E+02	1.00E+02	1.16E+02		8.30E+00	
strontium			4.30E+02	1.40E+02		2.10E+02	4.70E+01
thallium			4.00E+00				
tin			2.60E+02				
titanium			1.10E+02				
vanadium		4.30E+01	1.50E+02	5.00E+01	4.12E+01	5.33E+01	5.43E+01
zinc		2.68E+04	7.10E+04	2.10E+04	6.59E+03	9.97E+03	5.60E+03

Notes:

1. Highlighted blocks are estimated concentrations.

Through the hands-on contact with sediment, surface water, or biota collection, the most likely route of exposure is skin absorption.

5.1 *Physical Hazards*

Physical hazards that may be encountered on site include slip, trip, and fall hazards due to rugged terrain, holes, ditches, and slippery or muddy surfaces. Individuals working in these areas should walk cautiously and restrict the weight load they carry. During hot or even mild weather, a potential for heat stress will exist.

5.2 *Heat Stress*

Heat stress is a significant potential hazard associated with the use of protective equipment in hot weather environments.

Heat cramps are brought about by long exposure to heat. As an individual sweat, water and salts are lost by the body resulting in painful muscle cramps. The signs and symptoms of heat cramps are as follows:

- Severe muscle cramps, usually in the legs and the abdomen
- Exhaustion, often to the point of collapse
- Dizziness or periods of faintness.

First aid treatment includes shade, rest, and fluid replacement. Normally, the individual should recover within one-half hour. If the individual is not better within 30 minutes, the individual should be transported to a hospital for medical attention. Figure 1 shows a map of the hospital route.

Heat exhaustion usually occurs in a healthy individual who has been exposed to excessive heat while working or exercising. The circulatory system of the individual begins to fail as blood collects near the skin in an effort to rid the body of excess heat. The signs and symptoms of heat exhaustion are as follows:

- Rapid and shallow breathing
- Weak pulse
- Cold and clammy skin with heavy perspiration
- Skin appears pale
- Fatigue and weakness
- Dizziness
- Elevated body temperature

First aid treatment includes cooling the victim, elevating the feet, and replacing fluids. If the individual is not better within 30 minutes, the individual should be transported to the hospital for medical attention.

Heat stroke occurs when an individual is exposed to excessive heat and stops sweating. This condition is classified as a ***medical emergency***, requiring immediate cooling of the patient and transport to a medical facility. The signs and symptoms of heat stroke are as follows:

- Dry, hot, red skin
- Body temperature approaching or above 105° F
- Large (dilated) pupils
- Loss of consciousness-the individual may go into a coma.

First aid treatment includes collecting the patient and transporting to a medical facility immediately.

Heat stress is a significant hazard associated with using protective equipment in hot weather environments.

Proper training on signs and symptoms of heat stress, adequate hydration, and self-regulated work/rest cycles should help prevent heat-related illnesses from occurring.

5.3 *Task-Specific Hazard Analysis*

5.3.1 Sediment Sampling

Sediment samples will be collected from locations within the Sauget Area I (Figure 4-1 located in the Ecological Risk Assessment QAPP). The samples will be collected using simple grab methods or a dredge device, and will be collected from a boat. The likelihood of chemical exposure through skin contact is low. The risk of skin contact will be further reduced with the use of PPE including chemical chemical-resistant gloves (nitrile), butyl rubber aprons (as necessary), and long-sleeve coveralls. In addition, once sealed, the exterior of sample containers will be decontaminated using a mild detergent water mixture. The risk of contaminant inhalation is low, since contaminant volatilization is unlikely. Physical hazards can be expected during the approach to sampling locations during sampling activities conducted from a boat. Refer to Table 2 for specific Activity Hazard Analyses (AHAs).

Table 2. Activity Hazard Analysis

Project Identification Sauget Area 1	**Location** Sauget and Cahokia Illinois	**Estimated Start Date** April, 1998
Task	**Potential Hazards**	**Control Measures**
Sediment sampling for Sediment Bioassays	**Exposure to Chemical Hazards**	• Wear appropriate PPE per HSP • Practice contamination avoidance • Follow proper personal and sample decontamination procedures • Wash hands/face immediately as part of decontamination. • Wear chemical safety goggles when handling chemical sample preservatives and samples • Avoid splashing. If inevitable, personnel should stay out of splash radius • Hazard communication training
	Manual Lifting, Material Handling, and Hand Auger Usage	• Use proper lifting techniques • Team lifting will be used for heavy loads (>60lbs.)
	Heat Stress	• Personnel must be aware of signs/symptoms of heat stress. • Personnel will drink plenty of fluids. • Practice heat stress prevention per HSP
	Splashing	• Use safety glasses or goggles • All personnel should stay out of the splash radius
	Slip/Trip/Falls	• Work areas and means of access shall be maintained neat and orderly • Even terrain will be utilized as unloading areas
	Boating Operations	• Individuals operating boats must be experienced and qualified • Boats are to be occupied during use by not less than one qualified operator plus one additional person. • The designated boat operator will provide a safety briefing to all boat occupants prior to disembarking • Maximum weight load for a boat will not exceed manufacturer's specified capacity. • All persons on board will remain seated except when sampling • All gear will be stowed securely against unexpected shifts.

Table 2. Activity Hazard Analysis

Project Identification Sauget Area 1	**Location** Sauget and Cahokia Illinois	**Estimated Start Date** April, 1998
Task	**Potential Hazards**	**Control Measures**
Biota Sampling	**Exposure to Chemical Hazards**	• Wear appropriate PPE • Practice contamination avoidance • Follow proper personal and sample decontamination procedures. • Wash hands/face immediately as part of decontamination • Wear chemical safety goggles when handling chemical sample preservatives and samples • Avoid splashing. If inevitable, personnel should stay out of splash radius. • Wear chemical protective gloves (nitrile).
	Manual Lifting and Material Handling	• Use proper lifting techniques • Team lifting will be used for heavy loads (>60 lbs.)
	Heat Stress	• Personnel must be aware of signs/symptoms • Personnel must drink plenty of fluids • Practice heat stress prevention per HSP
	Splashing	• Use safety glasses or goggles; and • All personnel should stay out of the splash radius.
	Slip/Trip/Falls	• Work areas and means of access shall be maintained neat and orderly • Even terrain will be utilized as unloading areas
	Boating Operations	• Individuals operating boats must be experienced and qualified • Boats are to be occupied during use by not less than one qualified operator plus one additional person • The designated boat operator will provide a safety briefing to all boat occupants prior to disembarking • Maximum weight load for a boat will not exceed manufacturer's specified capacity. • All persons on board will remain seated except when sampling • All gear will be stowed securely against unexpected shifts. • All personnel on board will wear a Coast Guard approved Type III personal flotation devices. • On-board personnel must be able to contact shore either by cellular phone or radio

5.3.2 Biological Hazards

The potential for exposure to biological hazards during the investigation is low. This includes ticks; insects such as mosquitoes, black flies, and horseflies. Exposure to insects can be reduced through the use of clothing to cover exposed body parts, and insect repellents. Careful consideration to the use of insect repellents should be made. Some repellents contain the compound diethyl-meta-toluamide (DEET), the health effects of which have not been thoroughly investigated. The wearing of light-colored clothing will facilitate the observation of ticks, should they be on a person. Before leaving the site, each person shall conduct a body check for ticks. If ticks are found, they should be retained for identification. If a tick has become embedded, mineral oil should be applied, and the tick carefully removed with tweezers after suffocating. All incidents involving ticks will be reported.

5.3.3 Boating Hazards

This work will take place in a small boat using a gasoline run outboard motor. All personnel will wear a United States Coast Guard approved personal flotation device (PFD) whenever working from the boat. No smoking is allowed at any time in the boat or within 50 feet of it during refueling. The Captain will be named at a later date. At the Captain's discretion, he can modify or cancel any on-board operation for safety reasons. Such reasons may include, but are not limited to, sea, state, weather, condition of boat or motor, condition of sampling equipment, or preparedness of personnel. All personnel working on board will follow his orders.

We will follow small boat safety procedures. The boat's transom or seats will contain a plate, which describes the total weight capacity and other limitations of the particular boat used. We will not exceed these. The boat's equipment will include: motor, full spare gasoline tank, oars, installed oar locks, Danforth anchor, 50 feet of half inch nylon anchor line terminated in three feet of half inch galvanized chain, a metered and weighted line to estimate depth, PFDs for everyone on board, a two quart canteen of drinking water (otherwise, there should be no food on-board), and a cell phone.

Personnel on board will each carry a belted and sheathed jack knife or rigging knife. On-board personnel will be aware of the position of their bodies relative to coiled or faired lines or lines under tension. Especially do not put hands or feet in any basket containing a faired line or sit upon a coiled deck line. Always position yourself to one side of a line under tension. Never position yourself behind a line under tension or between such a line and the gunnel of the boat or any other immovable object. During over the side operations, lower all lines. **Never let a weighted line free fall.** The most common way to drown is to go over the side with a free falling anchor or equipment line tangled around a leg, arm, or neck. Grab samplers are not intended to free fall, they are designed to be lowered. It may be necessary to let certain samplers free fall a short distance (i.e. several feet) from above the bottom. Lower them to that height above bottom. Always know the depth to bottom before deploying equipment.

Generally stay seated in the boat. It is sometimes necessary to stand when deploying equipment. Do this keeping your center of gravity as low as possible, and as near the center

line of the boat as possible. Before standing or changing your position in the boat, announce your intentions to all on-board.

5.3.4 Biota Sampling

During the project, samples of various biological materials will be collected. The biota samples will be collected in a similar manner as described for sediment and surface water sampling above. The likelihood of contaminant exposure through inhalation or skin contact is low.

6.0 TRAINING AND MEDICAL REQUIREMENTS

6.1 *Required Health and Safety Training*

Completion of a 40-Hour Health and Safety Training or an approved equivalent is required for all personnel who expect to perform work on hazardous waste sites. This training must comply with the training provisions of OSHA" standard on hazardous waste operations, 29 CFR 1910.120.

6.2 *Refresher Training*

Eight hours of refresher training will be required annually of all personnel who have completed the necessary 40-Hour Health and Safety Training for Hazardous Waste Operations and who work on hazardous waste sites.

6.3 *Site-Specific Training*

On-site, initial site-specific training will be provided for all personnel, contractors, subcontractors, and visitors and will specifically address site history, planned activities, procedures, monitoring techniques, emergency response procedures, and specific equipment necessary for all field operations. It shall also include site and facility layout potential chemical and physical hazards and emergency procedures contained within this HSP. In addition, this training will ensure clarification and understanding by personnel of all potential on-site hazards and personal responsibility regarding safety during on going field operations.

6.4 *Safety Briefings*

Site personnel will be afforded briefings daily or on an as-needed basis in order to ensure continuance of a safe and secured site during field operations. Briefings will also serve to clarify new operations or implementation of changes in work practices due to additional site information or changing environmental conditions.

7.0 SAFETY CONSIDERATIONS

In this section, safety-related procedures are described for each site task.

7.1 *Safety/ Emergency Equipment*

The Project Health and Safety Officer shall determine the types of emergency equipment needed for the various tasks at the site. This equipment may include a fire extinguisher, emergency eyewash, and first aid kit kits.

7.2 *Sample Handling*

Personnel responsible for the handling of samples should wear the prescribed level of protection. Samples should be identified as to there hazard and packaged as to prevent spillage or breakage in accordance with Department of Transportation (DOT) regulations. Any unusual sample conditions should be noted. Laboratory personnel should be advised of sample hazard level and the potential contaminants present. This can be accomplished by a phone call to the laboratory coordinator and/or including a written statement with the samples reviewing laboratory safety procedures in handling in order to ensure that the practices are appropriate for the suspected contaminants in the sample.

Chemicals that may be utilized on site for sample preservation and equipment decontamination include hydrochloric acid, nitric acid and methanol. Personnel using these chemicals shall be instructed in the proper use, hazards, PPE requirements, emergency response procedures, and the hazard communication standard.

8.0 STANDARD SAFE WORK PRACTICES

Consult the HSP regarding all health and safety concerns and planned activities prior to and during on going field operations.

- Plan activities ahead of time
- Practice contamination avoidance at all times
- Be alert to your own physical condition and be cognizant of other personnel for signs of fatigue and/or heat/cold stress.
- No site operations will be conducted without sufficient natural light or adequate artificial illumination (29 CFR 1910.120) and appropriate supervision.
- Apply immediate first aid to any cuts, scratches, or abrasions and report all accidents and incidents to the HSP as soon as possible
- Do not jump or climb over or under obstacles.
- Avoid unsafe or potentially unsafe areas such as those with old equipment, broken pallets, fresh fill, flattened drums, marshy, or wet areas.

9.0 DECONTAMINATION PROCEDURES

Personal decontamination shall consist of personnel hand washing prior to eating and breaks.

10.0 DISPOSAL PROCEDURES

All discarded materials, waste materials, and other objects shall be handled in such a way as to exclude the potential for the spread of contamination, creating a sanitary hazard or causing litter to be left on-site. All potentially contaminated disposable will be bagged or drummed as necessary and segregated for disposal. All non-contaminated materials shall be collected and bagged for proper disposal as normal domestic waste.

11.0 EMERGENCY RESPONSE PLAN

As a result of the hazards on site and the conditions under which operations are conducted, the possibility of an emergency situation (personal injury, fire, and explosion) exists. An emergency plan is included below.

11.1 *Onsite Emergency Coordinator*

Menzie-Cura & Associates, Inc. has assigned responsibility for implementation of this emergency plan to the Project Health and Safety Officer. The Project Health and Safety Officer shall make contact with the emergency response units (fire, police, and medical) prior to beginning work on site. In these contacts, the Project Health and Safety Officer shall inform the emergency units about the nature and duration of work expected on the site, the location of the work, and the type of contaminants and possible health or safety effects of emergencies involving these contaminants.

The Site emergency Coordinator shall implement this emergency plan whenever conditions at the site warrant such action. The coordinator will be responsible for ensuring the evacuation, emergency treatment, emergency transport of site personnel as necessary, and notification of emergency response units and the appropriate Menzie-Cura & Associates, Inc. management staff as described below.

11.2 *Evacuation*

During a site emergency (fire, explosion, or significant spill), Menzie-Cura & Associates, Inc. and its subcontractors will evacuate their employees from the danger area when as emergency occurs and will not permit any of their employees to assist in handling the emergency beyond the incipient stage.

In the event of an emergency situation, such as a fire, explosion, significant release of contaminants, etc., the Site Emergency Coordinator shall immediately:

- Solicit the aid of the other site personnel as appropriate.
- Direct all personnel in the affected area to evacuate and assemble upwind in a designated safe area
- Establish the safety of all personnel and direct the administration of first aid as appropriate.
- Shut down all combustion equipment.
- Notify emergency response (dial 911). Give the exact location of the evacuated area (nearest building or street).
- Prohibit outside personnel from entering the evacuated area until the Fire Department arrives.
- Provide emergency equipment as appropriate
- Notify the Menzie-Cura & Associates, Inc. Project Manager and the Project Health and Safety Officer.

11.3 *Environmental Incident (Spill)*

In the event of a spill of hazardous materials on site, the Site Emergency Coordinator shall control the spill and proceed to absorb or containerize the material.

11.4 *Personnel Injury*

In the event of serious personnel injury (patient unconscious, possibility of broken bones, severe bleeding, burns, blood loss, shock or trauma), the first responder shall immediately:

- Administer first aid if qualified; if not qualified, immediately seek out a person qualified to administer first aid.
- Notify the Site Emergency coordinator of the name of the individual involved their location, and the nature of the injury.

The Site emergency Coordinator, upon receipt of notification of the injury, shall immediately:

- Notify emergency response (911) and give the appropriate patient information and their location.
- Assist the injured party as deemed appropriate
- Designate someone to accompany the injured party to the hospital
- Notify the Menzie-Cura & Associates, Inc. Project Manager and the Project Health and Safety Officer.
- Complete the Menzie-Cura & Associates, Inc. Incident/Accident Report.

If the Site Emergency Coordinator determines that emergency response is not necessary (minor injury such as sprain or abrasion, patient is conscious and can be moved), he or she may direct someone to decontaminate and transport the patient by vehicle to the closest hospital. The Site Emergency Coordinator shall then fill out the Menzie-Cura & Associates, Inc. Incident/Accident Report.

11.5 *Overt Personnel Exposure*

If an overt exposure to toxic materials should occur, the first responder to the victim shall immediately:

- **SKIN CONTACT**: Wash/rinse the affected area thoroughly with copious amounts of soap and water, then provide appropriate medical attention. If the eyes are involved, they should be rinsed for at least 15 minutes using the eyewash provided in the support zone.
- **INALATION**: Move to fresh air and provide medical attention.
- **INGESTION**: Provide medical attention
- **PUNCTURE WOUND OR LACERATION**: Provide medical attention.

11.6 *Adverse Weather*

In the event of adverse weather, the Project Health and Safety Officer will determine if work can continue without sacrificing the health and safety of field workers. Some of the items to be considered prior to determining if work should continue are:

- Heavy rainfall
- Potential for heat or cold stress,

- Limited visibility,
- Electrical storms, and
- Potential for accidents.

12.0 MEDICAL DATA SHEET

This brief Medical Data Sheet will be completed by all on-site personnel and will be kept in the support zone by the Project Health and Safety Officer during the conduct of site operations. Completion of this form is required in addition to compliance with the Medical Surveillance Program requirements. This data sheet will accompany any personnel when medical assistance is needed or if transport to a hospital facility is required.

Project: _____

_____

Name: _____ **Home Telephone:** _____

_____

Address: _____

_____

Age: _____ **Height:** _____ **Weight:** _____

Blood Type: _____

Emergency Contact: _____

_____

Drug or Other Allergies: _____

_____

Particular Sensitivities: _____

_____

Do you wear contacts? _____

Provide a checklist of previous illnesses: _____

_____

_____

_____

Exposures to Hazardous Chemicals: _____

_____

_____

_____

What Medications are you presently using? _____

_____

_____

Do you have any medical restrictions? _____

_____

Name, Address, and Phone Number of Personal Physician

_____

_____

_____