QUALITY ASSURANCE/QUALITY CONTROL

PROJECT PLAN

FOR THE

FISH TISSUE AND SEDIMENT MONITORING PROGRAM

Prepared by

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1.0 Project Description

1.1 Need for Project

It is the policy of the Commonwealth of Virginia to protect existing high quality state waters and restore all other state waters to such condition of quality that any such waters will permit all reasonable public uses and will support the propagation and growth of all aquatic life, including game fish, which might reasonably be expected to inhabit them (Water Control Board Law, Article 1. Section 62.1-44.2). The Virginia Department of Environmental Quality (DEQ) is responsible for enforcing the statutes of the State Water Control Board. The DEQ recognizes that many pollutants discharged into state waters by point and nonpoint sources may impair public uses and/or aquatic life. Specifically, some pollutants accumulate and persist in aquatic sediments and in the tissue of aquatic organisms, including game fish, at potentially toxic concentrations. In addition, pollutants that bioaccumulate tend to magnify in concentration as they pass through aquatic food chains and may cause detrimental effects to consumers, including humans. To address these concerns, the DEQ-Office of Water Quality Standards (WQS) Fish Tissue and Sediment Monitoring Program conducts routine studies of fish tissue and sediment samples in state waters. The program fulfills the Clean Water Act section 106 United States Environmental Protection Agency (EPA) grant requirements and the code of Virginia . 62.1-44.19:5 for the collection of fish tissue and sediment, and implements a multi-phase approach to systematically assess, manage, and communicate the associated risks of contaminants in the aquatic environment.

1.2 Objectives

The primary objectives of the Fish Tissue and Sediment Monitoring Program are as follows:

1. To collect the data to evaluate the human health risks for individuals who may consume fish from state waters using EPA risk based methods.

2. Generate data to be used by the Virginia Department of Health (VDH) to determine the need for fish consumption advisories.

3. Generate data to be used by the DEQ and other state and federal agencies to assess the environmental quality of Virginia's water (e.g. EPA 305B Reports).

4. Support any decision on the need for future studies.

5. Increase the amount of fish tissue and sediment contaminants data in the state and to make this information available electronically and through annual reports.

6. Provide compliance with the code of Virginia . 62.1-44.19:5 regarding routine monitoring of fish tissue in state waters.

1.3 Experimental Design

The objective is met through a cost efficient two tiered sample strategy consistent with federal guidance for fish tissue and sediment contamination monitoring programs (EPA Vol.I, 2nd Ed. 1995, EPA Vol. II 1994). Tier I is a screening study of a relatively large number of sample stations to identify sites where concentrations of contaminants in stream sediments and/or the edible portions of commonly consumed fish indicate potential aquatic ecosystem impairment and/or significant health risks to human consumers.

If Tier I results indicate problems exist, then a second more intensive Tier II study is initiated to determine the magnitude and geographical extent and potential source(s) of contamination in the sediments and/or fish. Established Quality Assurance and Quality Control (QA/QC) protocols are used throughout the program (EPA Vol. I & II, 1994).

Tier I

Tier I sample stations are selected on a rotational river basin approach among the fourteen river basins or subbasins in Virginia. Table 1 lists the basin or subbasin sample schedule. The location of river basins and subbasins are presented in Figure 1. State law requires a minimum of 24 fish tissue and sediment sample stations per year. Approximately 24-35 stations are usually selected among two river basins per year to provide adequate basin coverage. Several criteria are used to select the sample stations and include correspondence with the DEQ-Waste division to identify contaminated waste sites that may impact tissue and sediments in aquatic environments, regional office recommendations, extensive literature searches (e.g. DEQ, 1989-1995, 1994, 1996, Water Control Board, 1990), important recreational and/or commercial fisheries (Department of Game and Inland Fisheries, 1998), close proximity to point source discharges, and spatial distribution between sample stations.

A top level predator (e.g. largemouth bass), a mid-level predator (e.g. bluegill) and a bottom feeder (e.g. catfish species) are usually targeted at Tier I sample stations.

Adult fish are collected because their potential for exposure to environmental contamination has occurred over a longer period of time compared to juvenile fish. Five to ten fish of each species are typically collected by boat or backpack electrofishing equipment, however, other methods have been employed (e.g. trot lines, gill nets, fish traps, etc.). Fish collected are weighed (g), measured (cm - total length), wrapped in aluminum foil, and placed in plastic bags.

Table 1. Fish collection schedule within the basins or sub-basins of Virginia.

BASIN CODE	BASIN NAME	SAMPLE YEAR
1A	POTOMAC RIVER-POTOMAC RIVER SUBBASIN	2001
1B	POTOMAC SHENANDOAH RIVER SUBBASIN	2001
2 JAMES	RIVER	2001
3 RAPPAHANNOCK	RIVER	2001
4A ROANOKE	RIVER	2002
4B YADKIN	RIVER	2002
5A	CHOWAN-CHOWAN RIVER SUBBASIN	2003
5B	CHOWAN-ALBEMARLE SOUND SUBBASIN	2003
6A	TENNESSEE AND BIG SANDY-BIG SANDY RIVER BASIN	2002
6B	TENNESSEE AND BIG SANDY-CLINCH RIVER BASIN	2002
6C	TENNESSEE AND BIG SANDY-HOLSTON RIVER BASIN	2002
7	CHESAPEAKE BAY, ATLANTIC OCEAN AND SMALL COASTAL	2003
8 YORK	RIVER	2003
9 NEW	RIVER	2003

Figure 1. Location of River Basins and Subbasins in Virginia.

Sediment samples are also collected at the tissue sample station in precleaned sample containers using established protocols (Water Control Board, 1991). The fish and sediment samples are stored frozen until they are processed by the contract laboratory. During sample processing, the contract laboratory removes filets (skin on for scaled fish and skin off for scaleless fish) of fish of the same species and combines the filets to make a composite sample. Tissue composite samples for each species are analyzed for organic compounds, trace metals, percent moisture, and percent lipid. The sediment samples are analyzed for organic compounds, trace metals, total organic carbon (TOC), percent moisture, and percent lipid.

Tier I analytical results for fish tissue expressed in wet-weight are compared to contaminant screening values (SVs) that are computed using risk assessment techniques for noncarcinogen and carcinogen effects (EPA Vol. I & II, 1994). Typical SV calculations use a 10^{-5} risk level adopted by the State Water Control Board, a human body weight of 70 kg (average adult body weight), a lifetime fish consumption rate of 6.5 g/day (general U.S. population), (EPA Vol. I, 1995 and EPA Vol. II 1994) and a reference dose (RfD) for noncarcinogen and an oral dose slope for carcinogen effects obtained from the EPA IRIS database system.

Analytical results for contaminants in sediment expressed in dry-weight are compared to effects range-low (ER-L) and effects range-median (ER-M) SVs provided by the National Oceanic and Atmospheric Administration (NOAA, 1991) to assess the potential effects of sediment contamination to aquatic life.

Tier II

If Tier I analytical results indicate SVs have been exceeded and QA/QC measures have been achieved, then an intensive Tier II investigation may be conducted. The unique feature of Tier II investigations are sample replication and multiple station sampling which allows statistical confidence to be placed around the data points and contaminant spatial-distribution characterization, respectively. Hence, Tier II investigations typically involve laboratory analysis of five to ten individual filet samples or multiple composite samples of two or three top or mid-level feeders and one or two bottom level feeders at each station to increase statistical power. As in Tier I data analysis, Tier II analytical results are compared to the risk based SV calculations and appropriate QA/QC procedures are followed (EPA Vol 1, 1994).

1.4 Staff Hours

Of the approximately 24-35 stations monitored each year, 1-2 stations may be completed per day. Three to four employees are involved in the collection of samples at each station, resulting in approximately 96-140 staff days.

1.5 Schedule of Tasks

A time line for assigned tasks is presented in Figure 2. Stations should be selected by March. Fish collections are conducted from April to September. Data are received from the previous sample year in June and the data should be screened within 6 weeks after it is received from the laboratory for quality assurance and quality control problems and compared to current screening values. A summary report should be completed by the end of August and a final report should be completed by March and forwarded to the Regional Offices (RO), VDH, EPA III, etc. for review.

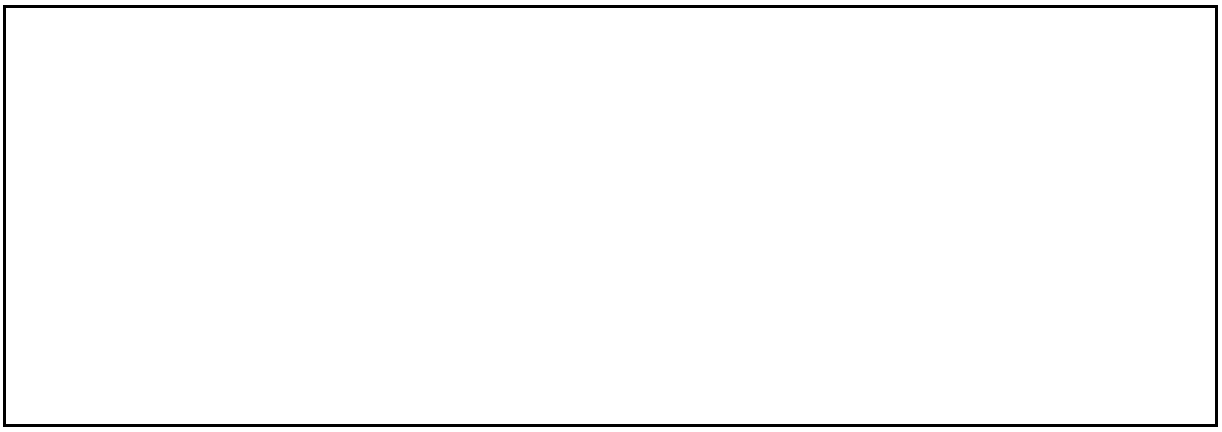

Figure 2. DEQ Fish Tissue and Sediment Monitoring Program Activity Schedule.

1.6 Data Evaluation

The fish tissue data will be evaluated by the Fish Tissue Monitoring Program as described in Section 4.

1.7 Data Usage

The data generated will be used by the Department of Environmental Quality as detailed in Section 4. Annual reports of this data will also be forwarded to the following state and federal agencies:

Appropriate DEQ-Regional Offices
Virginia Department of Health
Department of Game and Inland Fisheries
Virginia Marine Resource Commission if appropriate (i.e. saltwater sites)
EPA Region III
States that border Virginia if appropriate (i.e. impacted waterbody flows into another state).

1.8 Products Produced

A "Notification of Significant Fish Tissue Contamination" memo to the appropriate Regional Director in cases of extremely high levels of contamination for which there is an indication of high human health risks.

A "Fish Tissue and Sediment Monitoring Program Annual Summary" document which summarizes the previous year's fish tissue monitoring program's findings.

A summary description of the Fish Tissue Monitoring Program and its findings in the biennial 305 B report to EPA and Congress.

A final detailed report.

2.0 Project Organization and Responsibility

Project design-Fish tissue and sediment monitoring project plan design and study preparation.	Rick Browder Gabriel Darkwah
Sampling Team-Conduct all office and field related	Rick Browder

duties directly affecting sample collection and handling.	Gabriel Darkwah Lou Seivard Seasonal, Central Office, and Regional Office Staff
Project Manager-Manages day to day operation of the program. Manages contract with the laboratory Supervises conductance of the program in accordance with this quality assurance project plan and DEQ Water Quality Assessments Operating Procedures (WQAOP) Manual.	Lou Seivard
Laboratory QA/QC Officer-Evaluates contract laboratory methods and QA/QC procedures makes recommendations for corrective action.	Roger Stewart
Project Quality Assurance Officers-Evaluates QA/QC procedures in the field and makes recommendations for corrective action.	Rick Browder Gabriel Darkwah
Laboratory Liaison Officers- Coordinates activities between the DEQ and the contract laboratory. This includes scheduling sample collection and delivery based on laboratory capabilities. Delivers samples to the laboratory	Rick Browder Gabriel Darkwah
Data Review and Reporting-Reviews data and writes summary and annual reports.	Rick Browder Gabriel Darkwah

Project Organization and Responsibility of VDH

Human Health Impacts- Advises on the adequacy of samples for human health concerns. Reviews and	P.C. Sherertz

forwards data to appropriate VDH personnel. Issues
fish consumption advisories.

Project Organization and Responsibility of the Contract Laboratory (Virginia Institute of Marine Science, VIMS)

Laboratory Project Manager-	Rob Hale
Laboratory Data Validation and Data Manager-	Craig Smith
Organics Laboratory-	Rob Hale
Metals Laboratory (William and Mary Campus)-	Gary Rice
Sample Receiving-	Rob Hale

3.0 Quality Assurance Objectives

The representative and comparability of the samples cannot be completely assured for fish collections since the size and species of fish which could be caught for consumption may vary. Every effort will be made to collect representative, comparable samples. Composite or replicate samples should include fish of the same species and the total length of the shortest individual should be within 75% of the total length of the largest individual using equation 1.

Equation 1

$$\text{Percent difference (length) of the smallest fish in the composite sample compared the largest.} = \frac{\text{Length of Smallest Fish}}{\text{Length of Largest Fish}} \times 100$$

Five to 10 percent of the samples submitted to VIMS may be replicate or duplicate samples of fish or sediment to test laboratory precision.

Accuracy, precision, detection limits, and completeness for the studies are addressed in established technical procedures utilized by VIMS (Appendix A).

Preventive maintenance and calibration should be performed on all sampling equipment. Maintenance and calibration procedures should be implemented as per manufacturer's instructions.

4.0 Program Operating Procedures

The Fish Tissue and Sediment Monitoring Program has adopted the EPA Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories Volume 1 and 2 (Appendix B). The Guidance manual address specific project requirements for:

- survey planning
- target analytes
- sampling containers, preservation and holding times
- field sampling
- laboratory QA/QC procedures
- data reduction and evaluation

4.1 Experimental design

Several criteria are used to select the sample stations and include;

1) Correspondence with the DEQ-Waste division to identify contaminated waste sites that may impact tissue and sediments in aquatic environments.

2) Regional office recommendations.

3) Extensive literature searches (e.g. DEQ, 1989-1995, 1994, 1996)

4) Important recreational and/or commercial fisheries (Department of Game and Inland Fisheries, 1996),

5) Close proximity to point source discharges, and spatial distribution between sample stations.

The type of samples collected for analysis are based on USEPA Guidelines (Appendix B). The fish and sediment samples are stored frozen until they are processed by the contract laboratory. During sample processing, the contract laboratory removes filets of fish of the same species and combines the filets to make a composite sample. The parameters analyzed by the contract laboratory include wide spectrum analyses of aromatic and halogenated compounds including PCB congeners, DDT and chlordane metabolites and thirteen metals (silver, aluminum, arsenic, cadmium, chromium, copper, mercury, nickel, lead, antimony, selenium, thallium, zinc), percent lipid, and percent moisture in tissue and sediments, and total organic carbon (TOC) in sediments. Appendix A presents the organics laboratory list of compounds that can be detected as well as detection limits.

4.2 Safety Plan

Safety concerns are top priority during all field operations and are the underlying foundations upon from which field operations are based. There are a number of potential health and safety considerations specific to the Fish Tissue and Sediment Monitoring Program. A number of these hazards are common to all sample sites, while others may be site- or region-specific. This section lists several hazards likely to be encountered during fish tissue and sediment sampling, as well as measures to minimize the health and safety risks associated with them. The following section was modified from the Maryland Department of Natural Resources (MBSS, 1995) and the U.S. Fish and Wildlife Service published occupational safety and health procedures.

To minimize any potential health and safety risks related to field sampling, personnel need to be physically able to conduct field work under demanding conditions and be well prepared to handle contingencies or emergencies. The following are suggested requirements for all field personnel:

1) Recent (within 1 year) physician's approval to conduct field work

2) Recent (within 1 year) CPR certification.

3) Recent (within 1 year) Red Cross First Aid Training.

Note: At least two crew members should have CPR and First Aid training.

Crew Leader

Crew leaders should have adequate field sampling experience under rigorous conditions. Field Crew Leaders are responsible for ensuring that day to day activities of the field crew are conducted in a safe manner as possible. Crew Leaders make decisions on actions and enforces safety policy. Recommended health and safety responsibilities of the Field Crew Leaders include;

1) Instruction and supervision of the survey team such that travel to and from sample stations are done in a manner that minimizes health and safety risks.

2) Reporting to the Project Manager any unusual health and safety conditions, emergencies, or accidents by phone as soon as time permits.

3) Ensure that vehicles and sampling equipment are in safe operating condition prior to and during operation.

4) Ensure that all field sample crew members are aware of potentially hazardous conditions or materials during sampling.

5) Determine if sampling conditions are safe and appropriate.

6) Cancel sampling trip if unsafe conditions are observed.

Field Crew Members

All personnel involved in field sampling should be aware of the risks involved with field sampling. Several of these are outlined below. Individual crew members have the right to decline participation if he or she feels concerned that there is an undue safety risk (without fear of recrimination from the supervisor or other crew members). When unsafe or hazardous conditions are observed, crew members should inform the Crew Leader as soon as possible. In addition, Crew Members should notify the Crew Leader if, for any reason, they cannot perform an assigned task in a safe manner. Examples include sickness, fatigue, physical limitations, or a lack of confidence in operating the sample equipment.

Vehicle Accident-Automobile or Boat

As with nearly all field sampling programs there is a risk of vehicular accident. To minimize

this risk, the following measures should be taken:

1) An inspection of the sampling vehicle should be performed by the Crew Leader or a designee prior to departure. The inspection should include tire condition and operability of wipers, turn signals, lights, horn, etc..

2) During sampling, any potential unsafe vehicle condition should be reported to the Crew Leader and corrected as soon as possible.

3) If, in the judgement of the crew leader, the sampling vehicle is not safe to operate, the vehicle should not be operated until the condition is rectified.

4) Vehicles should not be operated by crew members who are incapable of safely operating them. No sampling vehicle should be operated by a person not holding a valid drivers license.

5) Auto collisions should be immediately reported to the State Police and the Project Manager. Consult the instruction located on the milage sheet clip board in case of an accident. Boat collisions involving injury, death, or property damage over $500 should be reported to the Department of Game and Inland Fisheries and the project manager as soon as possible.

Electric Shock

Failure to observe appropriate safety precautions when using backpack or boat mounted electrofishing gear could result in electric shock. Under worst conditions, this shock could result in cardiac arrest and loss of life. To minimize risks associated with electrofishing during sampling, the following measures should be taken:

1) Only personnel who have been trained and informed of the risks and proper operation of electrofishing equipment may participate in boat or backpack electrofishing sampling.

2) Heavy duty water-tight rubber gloves and boots should be continuously warn during all electrofishing operations. Gloves should not be taken off to remove fish from the water.

3) To minimize the amount of body surface area potentially exposed to electric shock, normal wading gear should be chest waders. When deemed appropriate by the crew leader, hip boots may be warn in lieu of chest waders. Hip or chest waders must be worn by all crew members working on electrofishing boats.

4) Only non-leaking gear should be used during electrofishing.

5) Electrofishing should only be conducted when a minimum of three persons are present at the site. In the event of electric shock, this provides for one person to administer CPR while the other seeks medical assistance. Use of a portable phone is also recommended as an effective means to summon emergency medical care.

6) If the Crew Leader determines that stream conditions at the time of the site visit present an abnormal risk of electric shock, then the Crew Leader will determine that the sample site cannot be sampled and sampling will be conducted on an alternate date.

7) Prior to each use, electrofishing gear should be verified to be in safe working condition by the Crew Leader. This verification should include an examination of external wiring and electrical connections.

8) In cases where two backpack electrofishing units are used at a segment, extra care should be taken to ensure that unit operators maintain an awareness of all personnel in the water. In addition, unit operators should maintain adequate spacing between units to minimize the risks of shock from both electric fields in the event a crew member slips or falls in the water.

9) U.S. Coast Guard approved Life jackets and throwable float should always be handy and life jackets should be worn as deemed appropriate on electrofishing vessels.

Fast or Deep water

Some sample locations may have fast or deep water. Sampling in locations which have

fast or deep water could result in injury or drowning. Backpack electrofishing in fast or deep water also increase the chance of electrical shock; thus a high degree of caution is imperative for safe operations. To minimize health and safety risks associated with sampling in fast and/or deep waters, the following steps should be taken:

1) Prior to sampling, the Crew Leader should ensure that all crew members who are to enter the stream are physically able to do so and are aware of any specific sampling risks at the site.

2) Prior to sampling, the Crew Leader should make a determination as to whether the site can be sampled by wading or by boat without undue risks. If a negative determination is reached, the site should be resampled another time.

Dangerous Plants and Animals

Sampling at some sites includes risks associated with dangerous plants and animals. Poison ivy is commonly encountered in Virginia. Poison ivy vines on tree trunks offer particular risks since they are often unnoticed. Poison sumac is another plant that may be encountered in Virginia. Faunal risks include poisonous snakes, free ranging domestic dogs, bees, ticks, and rabid mammals of any species. To minimize the risks associated with dangerous plants and animals, the following measures are recommended:

1) All survey personnel should receive training in field identification, avoidance of, and first aid for dangerous plants and animals which may be encountered.

2) Crew members should inform their crew leader of any known allergies and keep appropriate medical relief kits.

3) The Crew Leader should make all crew members aware of site- or situation specific dangers as they are noted. Similarly, field crew members should inform the Crew Leader as soon as they are discovered.

High Bacterial Levels

When sampling downstream from sewage or other organic waste inputs, potentially dangerous bacterial levels may exist. In urban areas, the presence of such inputs may be evident by smell, observation of solids, and/or the presence of sewage fungus on bottom sediments. However, in some areas, potentially dangerous bacterial levels could be present in a stream without direct evidence. To minimize the health risks associated with high bacterial levels in streams, the following measures should be incorporated into sampling operations:

1) All field personnel may be exposed to water known or suspected to contain human waste. Therefore, it is recommended that all crew members be immunized for tetanus, hepatitis, and other infectious diseases.

2) Water Quality Standards maps should be consulted to check for any discharges that occur upstream from the site. This information is used to determine if special safety precautions are necessary.

3) Prior to sampling, the Crew Leader should make note of any evidence of high bacterial counts.

4) The use of gloves should be maximized during the sampling process.

5) Open wounds should not be exposed to contact with stream water.

6) After exposure to stream water, all crew members should wash their hands in isopropyl alcohol or anti-bacterial soap with clean water prior to consuming food.

Hazardous Waste

Because of historical disposal practices, hazardous wastes may be present at an unknown number of stream sample sites. Risks of exposure to hazardous waste are likely to be low, but precautions still need to be taken to minimize exposure possibilities. These include:

1) Prior to commencement of field sampling near a hazardous waste site, the Field Crew Leader or his/her designee should review existing information (through DEQ-Waste and EPA) about known or probable hazardous waste. After review of hazardous site information, the field crew leader should inform the Project Supervisor. Any such areas identified as containing hazardous waste should only be sampled by a crew that has OSHA hazardous waste safety training (as specified in 29 CFR 1910.120).

2) All sampling at hazardous waste sites will be conducted in accordance with site health and safety plans and only after proper advance notice has been given to authorities at the site.

3) Personnel who participate in sampling at hazardous waste sites should participate in a Medical Monitoring Plan. Medical monitoring should include baseline, yearly, and exit examinations.

4) Food should not be consumed at hazardous waste sites.

Exposure To Solar Radiation and Extreme Heat and Cold Temperatures

Many of the sites sampled will be in remote locations. At these locations, the potential for prolonged exposure to solar radiation, and extremely hot or cold weather conditions is of concern.

Field Crew members should protect there skin and eyes from solar radiation by wearing proper clothing, and UV absorption sunglasses rated at least 90 percent. Exposed skin should be protected with a commercial sunscreen with a 15 or higher rated sun protection factor (SPF).

While working in the heat, heat cramps, heat exhaustion, and heat stroke are serious conditions caused by over exposure. Recommended precautions to reduce the possibility of heat related illness include:

1) Field crew members should drink plenty of water before and during work activities.

2) Field crew members should stop working, drink water, and rest in a cool place if feeling severely fatigued or if exhibiting signs of heat exhaustion.

There is also the potential for prolonged exposure to cold air and water temperatures while working in the field. Recommended precautions to reduce the possibility of hyperthermia or related illness include:

1) Field crew should ensure that they have appropriate clothing for field sampling, and bring a set of dry clothing in case they get wet.

2) Crew leaders should be responsible for monitoring the weather conditions and for postponing sampling plans as appropriate.

Additional information regarding heat exhaustion and hypothermia is presented in Appendix C.

Lightning Strike

During the sampling season, exposure to electrical storms is likely. To minimize the risk associated with electrical storms the following measures should be taken:

1) Crew leaders should be responsible for monitoring weather conditions and adjusting the sample schedule as appropriate to minimize the chance of the field crew being exposed to an electrical storm while in a remote location.

2) In the event of an electrical storm sampling activities should be halted and the Crew Leader should determine whether to return to the vehicle or seek local shelter.

Additional information regarding lightning storms and severe weather is presented in Appendix D.

First Aid

In the event of a medical emergency, the Crew Leader or senior technician should take all appropriate immediate actions and should send for appropriate assistance using the fastest available means. In the event the emergency occurs in a remote location, all necessary information to guide assistance personnel should be provided, including map coordinates if known. As soon as practicable thereafter, the Project Manager and Program Supervisor should be notified.

Field Sampling-Sample Preparation

Prior to departure the Crew Leader must ensure that all equipment needed for fish tissue and sediment sampling are present and in working order, including nets and electrofishing gear. A list of necessary equipment is provided in Appendix E). In addition, the DGIF fish collection permit requires that the local Game Warden be notified at least four days before the sample event. Furthermore, the DGIF permit package contains a list of aquatic threatened and endangered species occurring in Virginia waters. The list should be checked, and the sample team should avoid collecting threatened and endangered species.

4.3 Sample Procedure-Fish

At each Tier I station, three composite samples with a minimum of five fish of the same species per sample should be collected. The length of the smallest fish should be within 75% of the length of the largest fish in each composite sample (see section 3.0). Two of the composites should be a top level predator and a mid-level predator of harvestable size that are typically consumed by humans, respectively. The third composite should be a fish species associated with the bottom sediments (e.g. catfish). At Tier II stations, the species of fish collected, sample type (e.g. composite or individuals), and the number of samples, will depend on Tier I results.

Fish samples obtained at freshwater stations will be collected by standard elecrofishing techniques. The Fish Tissue and Sediment Monitoring Program has
adopted the U.S Fish and Wildlife Service Safety Guidelines for electrofishing operations (Appendix F). Basic electrofishing procedures are highlighted below.

Water temperature, conductivity, and any other pertinent information should be recorded on the back of the sample sheet (Appendix G).

In waters where conductivity is between 100 to 400 umho/cm, a voltage setting of 300 or 400 volts should be used. In lower conductivity water, increase the output voltage, and in high conductivity water decrease the output voltage. In waters where conductivity is greater than 1000 umho/cm, the lowest voltage and frequency should be used. At stations where the conductivity of the water is too high to permit electrofishing, fish samples will be collected by passive techniques (e.g. trot-lines, fish traps, gill nets, etc.)

Remember gasoline is extremely flammable, and vapors readily ignite on contact with heat, spark or flame. Always allow the generator to cool before refueling. Keep gasoline out of direct sunlight and store only in approved containers.

The Crew Leader coordinates start-up procedures with the entire crew.
When starting electrofishing equipment, all crew members should have protective gear on, output switches should be turned off, booms should be deployed or arrays should be away from crew members, and all crew members should indicate they are ready.

Bystanders and livestock should be well away from electrofishing operations. If bystanders or live stock get with 100 feet of the electrofishing operation, the crew should probably stop electrofishing, however, the Crew Leader should use his or her best judgement as to when to stop electrofishing.

After electrofishing, effort (seconds) should be read from the electrofishing unit and recorded on the back of the sample sheet. Standard operating procedures for using the backpack electrofishers and the electrofishing vessels are included in Appendix H.

Information regarding passive fish collection techniques (i.e. gill nets, crab pots, fish traps, etc.) is included in Appendix I.

Fish should be handled with clean hands. Fish samples should be checked for external anomalies, weighed (g) and measured (cm-total length), wrapped in aluminum foil (dull side in), placed in plastic bags, and placed in ice. Fish of the same species in composite samples may be wrapped together in the same piece of foil. Sample bags should be labeled with a wire tag that contains five fields of information;

1) Date sampled
2) Basin #
3) Stream code
4) Stream mile
5) Species code

Sample information should be recorded on data sheets provided in Appendix G. Once back from the field, the samples should be immediately removed from ice and stored in the freezer until ready for shipment to the contract laboratory. The contract laboratory (VIMS) processes the samples for lab analysis. Directions to VIMS and a map of the VIMS campus is presented in Appendix J.

4.4 Sample Procedure-Sediment

Sediment samples are also collected at each fish tissue collection site.
The Fish Tissue and Sediment Monitoring Program follows the Water Quality Assessment Procedure Manual for the collection of sediment samples (DEQ-WQA-SOP 1991). Basic sediment collection procedures are highlighted below; however, field crew should refer to Water Quality Assessment Operating Procedures Manual for more details.

Sediment sample jars must be precertified clean and stored with there lids secure prior to use. Cases of jars should be dated and the oldest cases used first. Sediment samples should be collected with equipment that will not introduce contaminants into the sample. Acceptable equipment include clean sample jars, teflon or stainless steel scoop or spoons, stainless steel buckets, and Eckman/Ponar dredges. Equipment should be washed with 10% HCL, acetone, and rinsed with deionized water. Sample equipment should be wrapped in aluminum foil and stored in a clean area. A total of three jars are required for each sample site; two 16 oz. precleaned glass jars with teflon lids are used for organics analysis and as a historical sample. One 8-16 oz. precertified clean glass or high density polyethylene plastic jar is used for metals analysis.

When collecting a sample from a wadable stream, the person collecting the sample should face upstream to avoid contamination from hands or boots. The sample should be collected from a single depositional area of the stream and from the stream bed, not from the river bank or flood plan. The sample location should be representative of the stream. Avoid sampling downstream of boat ramps, bridge abutments, etc.

When sampling from a boat or bridge abutment the Ponar dredge may be required. The sample collector should sample on the upstream side of the bridge or boat to collect a representative sample and to avoid contamination. Open the jaws on the dredge and latch so the dredge remains open. Secure the end of the rope attached to the dredge to the boat or structure. Hold the dredge over the boat or bridge and lower it straight into the water. Do not let the dredge "free fall". Once the dredge is lowered to the sediment, slack the rope then pull the rope to close the dredge. Pull the dredge to the surface and carefully dump the sediment into sample jars or into stainless steel buckets.

Sediment samples should include the top three centimeters of sediment and precautions to not lose fine sediments should be taken. Large stones, plant material, and other debris should not be included in the sample. Sample jars should only be filled half full of sediment to avoid breakage when the sample is frozen. The sample should be labeled with a sample tag, lab sheets completed, and stored on ice until the sample can be frozen.

Criteria for acceptable sediment samples include:

1) Sample container is not leaking.

2) Desired penetration depth is achieved.

3) Overlying water is present.

4) Anthropogenic material (debris such as cans, bottles, lead shot) is not present.

As with the fish samples, sediment samples should be labeled with wire tags containing five fields of information:

1) Date sampled
2) Basin #
3) Stream code
4) Stream mile
5) Sediment code

4.5 Data Evaluation

Human Health Risk Assessment of Edible Fish Tissue

Analytical results for fish tissue are compared to human health contaminant screening values (SVs) that are computed using risk assessment techniques for carcinogen and chronic toxicity or noncarcinogen effects (EPA, 1994). The SVs calculate concentrations in edible fish tissue that are of potential public health concern and are used to identify sites where more intensive investigation and evaluation may be needed.

Carcinogen Screening values (SV_c) in parts per billion (ppb) are calculated using the following formula:

equation 2

$$SV_c \text{ (ppb)} = \frac{[(RL/SF) \times BW] \times 1000}{CR}$$

Chronic toxicity or noncarcinogen Screening values (SV_n) in parts per billion (ppb) are calculated using the following formula;

equation 3

$$SV_n \text{ (ppb)} = \frac{RfD \times BW \times 1000}{CR}$$

Where:
SV_c = screening value for carcinogen effects (ppb)
SV_n = screening value for noncarcinogen effects (ppb)
RfD = oral reference dose (mg/kg/day)
SF = slope factor $(mg/kg/day)^{-1}$
BW = body weight (kg)
CR = mean daily consumption rate by the population of concern averaged over a 70 year lifetime (kg/d).
RL = acceptable risk level

EPA standard default values for the protection of the general adult population are typically used for body weight (BW), 70 kg, and for lifetime consumption rate (CR), 6.5 g/day over a 70 year lifetime. Screening value calculations use a 10^{-5} risk level (RL) adopted by the State Water Control Board for the protection of human health when deriving Virginia's water quality standards. SVs are not available for several contaminants since SF and RfD values are not available from the IRIS database.

For those contaminants for which EPA or FDA SVs have not been established, professional judgement will be used to flag unusually high values, including previous data, existing criteria, and current literature values.

The analytical results for organic compounds detected in tissue and sediment are typically reported by VIMS as dry mass concentrations. Tissue concentrations are converted to wet mass concentrations using the formula below to compare to EPA-IRIS SVs.

equation 4

Wet Mass Concentration = Dry Mass Concentration x 1-(% moisture/100)

Metal concentrations in tissue are typically expressed by VIMS as wet weight concentrations and metal concentrations in sediment are typically expressed as dry weight concentrations.

Ecological Risk Assessment

It will be assumed ecological impacts are occurring if analytical results for tissue exceed human health SVs. In addition, analytical results for sediments are compared to effects range-low (ER-L) and effects range-median (ER-M) concentration SVs provided by the National Oceanic and Atmospheric Administration (NOAA 1991) to assess the potential effects of sediment contamination to aquatic life. Furthermore, tissue and sediment analytical data are used together in 305(b) report process to help determine if the waterbody meets aquatic life support goals. Finally, wildlife occurring within a two mile radius of the locations that exceeded the NOAA ER-L and ER-M values and/or sites that contain elevated levels of contaminants in tissue may be searched using the Virginia Department of Game and Inland Fisheries-Fish and Wildlife Information System (VDGIF-FWIS) database to identify federal and or state

threatened and endangered species that have been confirmed to occur in the areas containing contaminants.

4.7 Data Usage

The data generated will be used by the DEQ to determine what contaminants are present in fish tissue at each station. The data will be used to identify areas of concern due to tissue and/or sediment contamination. The data collected may establish the need for special studies, based on the findings.

The assessment reports and data will be forwarded to the VDH for determination of human health risk.

Reports (as detailed in section 6) will be produced by the Fish Tissue Monitoring Program Analyst using the data collected.

Annual reports will be forwarded to the following state and federal agencies for their use:

- DEQ Regional Office 305 (b) Coordinators, Technical Services Supervisors
- Virginia Department of Health
- Department of Game and Inland Fisheries
- Virginia Marine Resource Commission
- EPA Region III
- Adjacent states

4.8 Schedule of Tasks and Products	Completion Date
Preliminary station selection	March 15, Annually
Schedule station sampling	April 1, Annually
Field sampling begins	April 1, Annually
Notification to regional DGIF Game Warden	4 days prior to sampling
Receive data from previous year	June 01, Annually
Complete initial data review and summary report	July 15, Annually
DGIF Permit report	July 31, Annually
Sample season ends	Sept. 1, Annually
Deliver samples to laboratory	As soon as the lab can accept them.
Complete data report for previous year	Jan. 15, Annually
Submit data report to regional offices state agencies, and EPA region III	Feb. 15, Annually

5.0 Sample Custody

The use of legal "chain-of-custody" procedures will not normally be required for this program. Sample custody procedures to ensure the integrity of the samples received at VIMS will be utilized including: proper procedures for packing and storing the tissue and sediment samples, completion of the field sheets and sample tags, and sample tracking.

6.0 Data Reduction, Validation and Reporting

Data reduction and validation steps will be taken by VIMS to ensure that only accurate information is used. The program analysts will note any irregular conditions during sample collection and handling which might have affected the data. Field audits may be performed by the QA officer if desired. A portion of each sample, if available, will be reserved (historical sample) for additional analytical work. The data reported for each parameter will be reviewed and another analysis will be requested of VIMS if deemed necessary.

Reports Produced

The reports produced include but are not limited to the following:

A summary report of the data

A "Notification of Significant Fish Tissue Contamination" memo to the appropriate regional director and VDH Director of the Bureau of Toxic Substances in cases of extremely high levels of fish tissue contamination for which there is an indication of high human health risk.

A detailed report

A report for the 305B process

7.0 Internal Quality Control

Internal quality control measures are discussed in sections 3.0 and 4.0.

8.0 Audit Procedures

Formal laboratory audits and field audits will not be performed for this program unless so desired by the QA Officer. SOP's will be followed.

9.0 Preventive Maintenance

Preventive maintenance will be performed on sampling equipment at least one week prior to the scheduled sample collection. A final inspection will be conducted the day before sampling. SOP manuals (Appendix H) should be consulted for detail information.

Vehicles and boats should be maintained according to the following schedule.

DATE	EQUIPMENT	ACTIVITY
END OF SAMPLE SEASON	BOAT AND GENERATOR FUEL TANKS	ADD FUEL STABILIZER TO RESIDUAL FUEL
END OF SAMPLE SEASON	BOAT MOTORS	BURN FUEL OUT OF CARBS
END OF SAMPLE SEASON	BOAT MOTORS	OIL CYLINDERS
NOV.-MAR.	BOAT MOTORS	CHANGE LOWER UNIT OIL
NOV.-MAR.	BOAT TRAILERS	CHECK WHEEL BEARINGS
NOV.-MAR.	GENERATORS	CHANGE OIL
JAN	#120 VEHICLE	INSPECTION DUE
MAY	#156 VEHICLE	INSPECTION DUE
AUGUST	#143 VEHICLE	INSPECTION DUE

NOTE: OIL SHOULD BE CHANGED IN TRUCKS EVERY 3000-4000 MILES. TRUCKS SHOULD BE WINTERIZED IN EARLY OCTOBER.

AUGUST	BOSTON WHALER TRAILER	INSPECTION DUE

NOTE: INSPECTION IS REQUIRED BY STATE LAW FOR THE BOSTON WHALER TRAILER. INSPECTION FOR THE OTHER BOAT TRAILERS IS OPTIONAL, BUT RECOMMENDED.

In the fall (field equipment should be checked and replaced as necessary (e.g. waders, landing nets, gill nets, crab pots, meters, motor props, etc). In addition, field gear (i.e. sample jars, aluminum foil, plastic bags, etc.) should be procured.

In the spring check all electrofishing hardware for loose or worn connections. Also check fuel and oil level in motors, test run equipment and make sure trailer lights are operational.

10.0 Procedures Used to Develop Accuracy and Precision Data

At least two replicate samples (split samples) per year will be analyzed for QA/QC purposes. Laboratory QA/QC results should be checked closely and compared to EPA recommended results. Additional QA/QC procedures may be employed as deemed appropriate.

11.0 Corrective Action Plan

Any deficiencies or unacceptable activities that occur during sampling will be reported immediately to the project manager (Section 2). The project manager or his representative will be on site to determine the need and extent of corrective action.

12.0 Reports To Management

The reports to management are listed in section 6 under "Reports Produced".
The two types of reports are detailed below.

1) An annual summary report with appropriate quality assurance review will summarize each year's study. The report will provide analytical results and tabulations for locations that exceeded available SVs. The report will include fish species collected, parameter concentrations, and recommendations for further action. Follow-up activities could include additional fish, sediment, and or water sampling, source identification, and abatement measures. The annual summary report will be distributed as described in section 6. The report will also be available upon request from interested parties.

2) After the sampling season a more comprehensive report will be produced in the winter that includes risk assessment calculations for samples that exceeded SVs.

References

Code of Virginia ¸ 62.1-44.2 relating to Water Quality Monitoring, Information and Restoration Act.

Department of Environmental Quality. 1996 Draft-Report Virginia 303 (d) TMDL Priority List, April 1996. Richmond, Virginia.

Department of Environmental Quality. 1994. Virginia Water Quality Assessment, 1994--305 (b) Report to EPA and Congress for the period July 1, 1991 to June 30, 1993. Richmond, Virginia.

Department of Environmental Quality. Core Data. 1989-1996. Richmond, Virginia.

Department of Game and Inland Fisheries. 1998. Virginia Freshwater Fishing Guide. Richmond, Virginia.

Maryland Department of Natural Resources. 1996. Maryland Biological Stream Survey Sampling Manual. Annapolis Maryland.

National Oceanic and Atmospheric Administration. 1991. NOAA Technical Memorandum NOS OMA 52. Seattle, Washington.

Virginia Water Control Board. 1991. Water Quality Assessment Operating Procedures Manual. Richmond, Virginia.

Virginia Water Control Board. 1990. Comprehensive Review of Selected Toxic Substances- Environmental Samples In Virginia- Bulletin 583. Richmond, Virginia.

U.S. Environmental Protection Agency. 1995. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol. I. Fish Sampling and Analysis. Washington, DC.

U.S. Environmental Protection Agency. 1994. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol. II. Risk Assessment and Fish Consumption Limits. Washington, DC.

Appendix A

Virginia Institute of Marine Science Laboratory Protocols

Appendix B

EPA Guidance For Assessing Chemical Data For Use In Fish Advisories

Appendix C

Heat and Cold Temperature Survival

Appendix D

Lightning Storms and Severe Weather

Appendix E

Field Equipment List

Appendix F

U.S. Fish and Wildlife Service Safety Guidelines

Appendix G

Field Sample Sheets

Appendix H

Operating Procedures for Backpack Electrofishers and Electrofishing Vessels

Appendix I

Passive Fish Collection Techniques

Appendix J

Directions and Map to VIMS Campus