

SECTION 1

INTRODUCTION

1.1 Overview and Objectives

The objective of this volume is to provide state, local, and tribal agencies with risk management guidance for developing fish advisories. Fish contamination has been recognized as a potential health hazard in recent years. While most fish provide an excellent source of nutrition, some fish are sufficiently contaminated to cause health problems (e.g., Minamata disease in Japan).

The field of risk management, as it deals with fish advisories, is a relatively new and evolving area. Although a few states have long-standing advisory programs, written evaluations of these programs are generally not available. Consequently, limited information is available from which to draw conclusions or guidance regarding management strategies. Examples of types of advisories were obtained from ongoing advisory programs. Advisory program staff were consulted regarding their experiences with various management approaches. This document therefore provides an overview of risk management rather than detailed and highly specific guidance. EPA will provide more detail on the experiences and recommendations of state and local programs in future editions of this volume.

This risk management volume is part of a series that provides information on:

- identifying and quantifying fish contamination,
- evaluating risks associated with contamination,
- managing those risks, and
- communicating risk information and protective strategies to the public.

Various agencies have responsibility for issuing fish advisories and preventing fish contamination. State, local, and tribal agencies have primary responsibility for safeguarding the public against effects of contaminants in non-commercial fish.¹

¹ State, local, and tribal agencies are referred to as "agencies" in this document and include groups responsible for managing risks associated with fish contamination. These may include departments of environmental protection or health, tribal councils, and other types of regulatory and governing groups.

Federal agencies are responsible for commercial fish and for activities related to preventing fish contamination. The United States Food and Drug Administration (FDA)² is responsible primarily for developing advisories regarding commercial fish. The United States Environmental Protection Agency (EPA), the Department of Energy (DOE), and the United States Fish and Wildlife Service are also involved in managing and monitoring waterbodies, controlling pollutant releases, and clean-up and remediation efforts that impact fish contaminant concentrations (see Section 2.5).

This volume addresses factors to be considered in both the development of advisory programs and the establishment of health-based fish advisories. This process is complex due to the variety of factors involved:

- the type of contamination,
- the level of contamination,
- local fish consumption practices,
- local population characteristics, and
- resources available for an advisory program.

The various options for limiting consumption of contaminated fish can be tailored to fit local characteristics and needs. These options range from approaches that require limited resources and have limited effectiveness (e.g., general advisories), to more resource-intensive and effective approaches (e.g., quantitative advisories). This document presents various options that may be used in fish advisory programs and discusses their strengths and weaknesses. Other relevant characteristics like resources available for program development, risk levels, and economic and cultural impacts, are also discussed. Templates for organizing information on options and characteristics are included.

Agencies currently employ a range of methods to estimate risks to human health from consumption of chemically-contaminated fish. Results of a 1988 survey of such methods, funded by the U.S. Environmental Protection Agency (EPA)³ and conducted by the American Fisheries Society, indicated the need for a more consistent approach to assessing risks from contaminated fish.⁴ The four key components identified as critical in a risk-based approach to developing fish

² See the Glossary for definitions of abbreviations and selected terms.

³ Throughout this document the abbreviation EPA will be used to represent the U.S. Environmental Protection Agency.

⁴ In this document, fish refers to non-commercial fish from estuarine and fresh water sources.

consumption advisories were:

- standard practices for sampling and analyzing fish,
- standardized risk assessment methods,
- standard procedures for making risk management decisions, and
- standardized approaches to risk communication.

To address concerns raised by the survey, EPA is developing a series of four documents to provide guidance to agencies issuing fish advisories for non-commercial fish (i.e., self-caught fresh water and estuarine fish). These four volumes comprise the *Guidance for Assessing Chemical Contamination Data for Use in Fish Advisories*:

Volume I: Fish Sampling and Analysis (EPA, 1993a),

Volume II: Development of Risk-Based Intake Limits (EPA, 1994a),

Volume III: Overview of Risk Management, and

Volume IV: Risk Communication (EPA, 1994c).

Supplements to Volume II have also recently been released. These provide information regarding exposure assessment, including fish consumption patterns, risk characterization, and mapping. The four volumes and the supplements should be used together, since no one volume provides all the necessary information to evaluate and make decisions regarding the issuance of fish consumption advisories. While these volumes are designed to provide guidance to agencies developing fish advisory programs, **they do not constitute a regulatory requirement**. To provide further information, EPA recently developed the National Listing of Fish Consumption Advisories data base, available from the Office of Water on five disks in a PC format.

1.2 Series Summary

To provide guidance on using a human health risk-based approach to determine both the level of the advisory and the most appropriate type of advisory, this series presents the following features:

- methods to assess contaminant levels in fish tissues,
- methods to evaluate population risks for specific groups, waterbodies, and geographic areas;

- discussion on identifying target populations, with information on especially susceptible subpopulations;
- descriptions of various risk management options for fish advisory programs, with the experiences of agencies that have utilized the options;
- factors that may be considered in selecting program options and protection levels, including organizational factors such as feasibility and efficacy, and the impacts of various options on target populations (e.g., on nutrition, economics, traditional activities, communities, and risk);
and
- methods for organizing information on risk, options impacts, and target populations' characteristics.
- methods of risk communication

Table 1.1 provides more specific information on the major activities covered in the documents in this series. All the activities carried out in the process of developing fish advisories and managing risks associated with contaminated fish are listed in the table. Volume I provides guidance on developing a sampling and analysis program to characterize the nature of the fish contamination distribution in waterbodies throughout an area. Volume II provides an overview of risk assessment, chemical-specific risk values, and methods for calculating meal intake limits. It also provides the groundwork for a population risk evaluation. Volume III, this document, provides information on selecting and implementing various options for reducing risks associated with contaminated fish consumption. This document focuses on fish advisories, although other related activities are discussed. Volume IV provides guidance on methods for communicating risk information and for evaluating the target audience for risk advisories to determine the best approach for communicating risk.

Table 1.1. Activities Related to the Development of Fish Advisories and Risk Management and Volumes in the Series Containing Discussions of These Activities					
ACTIVITY	Sampling and Analysis	Risk Assessment	Calculate Health-Based Intake Limits	Evaluate Options	Select Appropriate Risk Management Options ⁵
DATA GENERATE D	1.concentration in fish tissue (V. 1) 2.geographic distribution of contaminant (V. 1)	1. individual risks (V. 2) 2. population and subgroup risks (V. 3) 3. identify groups at highest risk (V. 3)	1. health-based consumption limits (V. 2 & 3) 2. maximum acceptable contamination levels (V. 2 & 3)	1. potential options and administrative requirements (V. 3) 2. benefits and adverse impacts of options (V. 3) 3. other mechanisms for reducing contamination and risk (V. 3)	1. identify options that are optimal for a specific locality (V. 3)
RELATED ACTIVITIES NOT COVERED IN THIS SERIES	evaluate sources of contamination and transit pathways	determine if medical monitoring or intervention is warranted (primarily relevant to high exposures)	determine what actions are needed to lower contamination to minimal risk levels	work with remediation and enforcement agencies to reduce contamination	integrate programs with relevant local activities ongoing through other agencies or groups

⁵ Risk communication activities related to fish advisories are discussed in Volume IV of this series.

Major functions are listed in the first row. The data or conclusions generated by each step are listed below the activities, along with the volume in which the activities are discussed. Some related activities relevant to fish advisories but beyond the scope of this series are listed in the final row. As Table 1.1 shows, the development of advisories depends on the collection of appropriate data in the early stages of program development and proceeds through analysis (risk assessment) to decision-making (risk management).

1.3 Volume III Contents

Figure 1.1 shows how Volume III fits into the overall series and lists the major categories of information provided. This volume covers topics necessary for decision-making to manage risks related to chemically contaminated fish. The sequential order of the sections follow the anticipated sequence of activities to be carried out in developing a risk management program.

Section 2 contains a discussion of various options for limiting contaminated fish consumption. Federal roles and activities are identified. Regulatory and other options for state, local, and tribal governments are presented with discussions of the organizational features of each option. Some anecdotal information is provided on the experiences of various agencies in implementing different program options.

Section 3 provides information on the potential impacts of limiting consumption, including social, economic, cultural, and nutritional impacts, costs, feasibility, legislative and political constraints, and other factors. The impacts vary depending on the specific circumstances of an area and the population of concern.

Section 4 contains a discussion of methods for comparing health risks associated with consumption to impacts of limiting consumption. It provides schematics for organizing information on a site-specific basis regarding various risk management options, their applicability to an area, and attributes and requirements for their implementation. A tiered approach to developing fish advisories is discussed. Templates are included to help risk managers organize their information to evaluate needs and to identify the optimal group of options and consumption limits.

Section 5 contains a list of references consulted and cited.

**Figure 1.1 Series Summary: Guidance for Assessing Chemical Contamination
Data for Use in Fish Advisories**

1.4 Methods and Sources

This document was developed using information from a variety of sources:

- State documents related to the development and implementation of fish advisories were consulted. These sources provided data on existing programs and, in some cases, comments on their efficacy.
- Staff members of some agencies and tribal groups with long-standing programs were consulted regarding their experiences and recommendations. Due to the recent development in many states of extensive advisory programs, limited information on management strategies exists. Future editions of this volume are expected to contain additional information on program development processes and strategies.
- Government publications and journal articles were consulted for information on scientific issues including nutrition and economics.
- Government documents and programs were consulted for information on mapping methods (e.g., GIS mapping), regulatory roles of various agencies, and information on existing programs designed to address pollution prevention and waterbody remediation.
- Workgroup members⁶ and other experts from state, local, tribal, and federal governments, academic institutions, and advocacy groups were contacted by phone, and provided both information about their current programs and experiences and ideas for future activities.

1.5 Underlying Assumptions

Risk management for any environmental program requires numerous staff and management decisions. The decision-making process is aided by comprehensive information on both the nature of the problem to be addressed and the

⁶ Work on this document was guided by a workgroup of experts on fish contamination issues. Their names and affiliations are listed in the Acknowledgements section in the front of this volume. This group reviewed the outline and drafts of the document, and made numerous comments and recommendations on the content.

characteristics and implications of options for remediation. The approach to risk management described in this volume is based upon underlying assumptions regarding decision-making in the public sector:

Chemical contamination of fish may pose health risks. These risks are dependent on the nature and severity of the contamination and the characteristics of the exposed population. Risk estimation is a developing science that cannot predict precise effects in individuals or populations. Consequently, uncertainty exists regarding the type and extent of health risks. Risk estimates can be used, however, with other relevant information, to make decisions regarding fish advisory programs.

The goal of developing fish advisories is to minimize the health risks to fish consumers as well as minimize any negative effects of restricting consumption. When fish contamination levels pose sufficiently elevated health risks (determined on a local basis), agencies may elect to take restrictive action to protect public health. Because many risk reduction options are associated with some negative impacts, decision-makers must also consider potential impacts on all affected parties.⁷ These impacts include social, cultural, economic, health, and any other impacts associated with options for reducing risks.

Most options for reducing risks will require trade-offs between risk reduction and social, economic, and other costs. Decision-making to select options is primarily a policy activity rather than a scientific one. Consequently, it is beneficial to make such decisions with input from all affected parties.

Each agency and exposed population has unique characteristics, resources, strengths, goals, and constraints. Consequently, there is no one best approach to developing and implementing fish advisory programs. Each agency should design a program based upon the unique characteristics of its contamination problem, populations at risk, and affected parties. EPA does not recommend specific target intake limits or risk levels for contaminants. It also does not recommend using FDA action levels for site-specific fish consumption advisories.

*The **ultimate** goal of a fish contamination risk reduction program is to return waterbodies to a condition in which fish are no longer contaminated at a level that will pose unacceptable risks to human health.* While remediation of contaminated water is beyond the scope of this document, it is briefly discussed

⁷ Affected parties may include fish consumers, individuals whose livelihood or lifestyle are dependent on non-commercial fishing, and individuals whose land use or value are related to non-commercial fishing.

in Section 2.5, which contains a listing of federal programs that may provide assistance.

1.6 Critical Decisions

Both science and policy are components of a fish advisory program. In the policy arena, decisions are required to establish and achieve policies and goals. Decisions are also required to conduct risk assessments and determine how science will be used in establishing policies. Many elements of risk assessment involve significant uncertainty (e.g., animal to human extrapolations, differences in susceptibility over a lifespan, the effects of exposure to a mixture of contaminants). Although some scientific data on these topics exist, they are rarely definitive. Under these circumstances, the decisions that transcend current scientific knowledge may be considered policy decisions, and both policy and scientific experts should participate in the decision-making process to arrive at the best choice. Scientists may be able to best describe the uncertainties and some alternatives, while policy makers may bring non-scientific issues to bear and consider potential impacts of decisions on a broader level.

In this document (and in others in the series) many issues that are decision points can be found in phrases like "readers may wish to...," where the reader may determine the best course of action. Minor decisions may be related to the use of specific resources (e.g., a particular laboratory method, a set of toxicological information sources). These decisions are expected to have a relatively minor impact on overall program activities and efficacy. Alternatively, critical decisions (or groups of decisions) are those that may have a significant impact on the target population, their level of risk or protection, and program efficacy.

Table 1-2 lists critical decisions in risk management for a fish advisory program, along with the section in which they are addressed. As stated above, the four volumes in the series *Guidance for Assessing Chemical Contamination Data for Use in Fish Advisories* are designed to be used together, although they address different topics regarding fish advisory development. Volume III, addressing risk management, provides an overview of the critical decisions made throughout the fish advisory development process. Relevant discussions also appear in other volumes in the series (e.g., decisions regarding sampling and analysis [Volume I], risk assessment [Volume II], and risk communication [Volume IV]). The critical decisions listed in Table 1-2 are discussed briefly in this section, and in more depth in subsequent sections of this volume.

Table 1-2. Critical Decisions	
Nature of Decision (Category)	Section of Volume III or Volume Number
1. sampling and analysis	Vol. I
2. population risk estimation (risk assessment) including: consumption rates - subpopulation selection non-fish exposure - air, water, soil, occupational, non-fish food sources risk values - RfDs, cancer potency values, other values	Vol.II Supplement A
3. selection of target populations or risk levels	Vol.II Supplement A
4. risk management options under consideration	2.2
5. consideration of positive and negative impacts	3, 4.2
6. selection of most appropriate risk management options	4.3
7. level of protection afforded by advisories including: carcinogenic effects - acceptable risk level non-cancer effects - value selected as benchmark	4.4 and Vol. II Supplement A
8. level of program effort and funding	4.5
9. program evaluation and modification	4.6

Category 1. Sampling and Analysis

Decisions regarding sampling and analysis are discussed in Volume I. These decisions include sampling location, frequency, the chemicals analyzed, and those levels and frequency of occurrence that trigger the decisions to issue advisories. In most cases, it is neither economically feasible nor necessary to sample and analyze all waterbodies. When sampling has not been conducted previously, no scientific information is available on which to base sampling decisions. Consequently, sampling and analysis decisions may be based on policy or on the likelihood of contamination (e.g., using TRI data, the presence of Superfund sites, or clusters of environmentally-related disease).

Category 2. Population Risk Estimation.

Methods for calculating population risk require risk assessors to combine information on consumption patterns, contaminant levels, and risk values (e.g., RfDs) to obtain an overall estimate of risk for various population subgroups.⁸ These methods are described in Supplements A and B to Volume II. Risk assessment used to establish risk-based fish advisories incorporates many decisions that involve policy considerations because they transcend current scientific knowledge. Examples of these decisions include choosing a health endpoint among many credible endpoints, and the degree of safety incorporated in risk values and subsequent risk estimates.

A range of values for the inputs used in risk calculations are discussed in Volume II. The exposure and toxicity values used affect the outcome of risk estimates. Risk estimates, in turn, are often used to determine the appropriate course of action, the population groups or geographic areas requiring action, and the fish advisory levels.

Critical decisions include the type of consumption data used (e.g., survey data collected locally, "average" consumption values from various studies, "high-end" estimates from studies), the location and nature of contaminant sampling (which may depend on available resources), the sources of concurrent exposure to the same contaminants considered, the risk values used to estimate risk, and the level of protection afforded by the advisory. Decisions on these factors involve policy rather than science and should be considered by risk managers in developing an overall fish advisory program.

⁸ EPA is currently reviewing risk assessment methods for carcinogens and non-carcinogens. Information will be provided on any new recommended approaches (e.g., the benchmark dose approach, non-linear cancer extrapolation, categorical regression) in future editions of this series.

Category 3. Target Populations and Risk Levels.

Identifying target populations is a critical decision, because it may determine which groups will be the focus of risk reduction activities. This decision may be linked to those regarding sampling locations and groups to be considered in selecting consumption data (either through surveys or based on previous studies in the literature). If a risk-based approach is taken to population selection, targeted populations will be those groups identified following a risk assessment as having unacceptably high risk levels.

Decisions are also required to determine the breadth of the population to protect through advisories. Choosing members of the fish consuming population who eat an average (50th percentile) amount of fish versus those who consume larger amounts (i.e., at the 80, 90, or 99th percentiles) is a policy rather than a scientific decision.

The selection of unacceptable and acceptable risk levels are significant policy decisions and may involve evaluating various assumptions underlying the risk estimates. Risk managers may choose to focus on a particular risk level for carcinogens (e.g., one in one million) or specific types of risks (e.g., developmental, cancer, organ-specific toxicity to susceptible subpopulations) as being of critical importance. Others may focus on particular communities or population groups at risk. These decisions are very important because they may determine levels of protection, who is protected, and the scope and nature of fish advisory programs.

Considerable trade-offs exist in many cases between maximizing public protection and minimizing an advisory's negative impacts. If the goal is to protect 99% of the population, including the highest consuming individuals in a high-consumption population group, advisories will be much more prevalent (and any negative impacts more pronounced) than if a program were to target the average consumer's behavior. However, focusing on average exposure and risk levels may not protect the high-risk populations who need to obtain information that they can use to protect their health.

Category 4. Options Under Consideration

Risk managers determine which program options are under consideration in a fish advisory program (e.g., posting notices, catch and release, restricting waterbody access). From this set of options a subset is usually identified that will actually be employed. The decision to consider all possible strategies for risk reduction is important because it provides wide latitude in addressing the needs of target populations. Very restrictive options, such as restricting

waterbody access, are rarely employed in practice.

In many areas, risk managers may choose options to reduce fish-related risks under a specific set of constraints. For example, agencies responsible for tracking contaminant levels in fish may not have the regulatory authority to restrict fishing access. In most areas, however, the health department has authority to restrict access in cases where a clear and present danger to the public exists. In many cases, budgetary constraints may curtail significantly the number and types of risk management options available. Because the options have differing potentials for reducing risk, limiting the types of available program options may affect the risk reduction potential of a program significantly.

Category 5. Consideration of Positive and Negative Impacts

Recommending limitations in fish consumption involves tradeoffs with respect to health, recreation, economics, community and traditional activities, personal interests, and other perceived benefits of fish consumption. Although risk managers are encouraged to consider all risks and impacts in some way, managers may elect to focus on one or a few of the potential risks or impacts. The types of options and the strength of the advisories recommended will depend on how various population groups and their risks are evaluated and upon the impacts that are considered most important. Deciding how to prioritize and balance the risks and impacts involved will have a pronounced effect on fish advisory programs.

Category 6. Selection of Most Appropriate Options

Selecting appropriate fish advisory program options from those that have been considered is obviously a critical decision in developing a program. Although this decision appears to be the most important one, it generally corresponds to individual or community risk levels and characteristics. The various decisions that have been made up to this point regarding consumption rates, sampling and analysis, selection of risk values, treatment of non-fish exposures, and consideration of impacts, all contribute significantly to the basis for selection and the ultimate choice of appropriate options, target populations, and protection levels.

Category 7. Level of Protection

Risk managers may choose from various risk values (RfDs and cancer potencies) to establish consumption limits. These values may generate consumption limits that vary by orders of magnitude for a single contaminant, especially when cancer-based and non-cancer-based values are compared. In

addition, targeted acceptable risk levels are used in setting limits for carcinogens. Decisions regarding risk values can have a substantial impact on consumption advisories and on potential risks to the population.

Carcinogenic Effects - Acceptable Risk Levels

Cancer risks are evaluated based upon an assumed relationship between exposure and lifetime risk as defined in the cancer potency values for each target analyte. Risk managers determine the level of risk (e.g., one in one million) that is acceptable. This decision enables them to select appropriate exposure level. The acceptable level of risk can be determined by the needs and goals of the target population, the decision-makers, or, under ideal circumstances, by joint discussions between the two groups. Meal consumption limits provided for the carcinogenic target analytes in Volume II are listed for three cancer risk levels: one in ten thousand, one in one hundred thousand, and one in one million. The method used to calculate the values is presented in Volume II so that alternative risk levels can be calculated.

Non-cancer Effects - Value Selected as Benchmark

The potential for non-carcinogenic effects can be evaluated by comparing exposures to a Reference Dose (RfD) or some other benchmark of a "safe" exposure level. Volume II presents the RfDs developed by EPA, along with a summary of toxicological information for the 23 target analytes. In the summary data, recent study results are presented for some analytes regarding developmental, neurological, and other types of toxicity. Risk managers may choose which benchmark value they consider most appropriate for their target population of concern. In some cases, more than one value may be selected for various population subgroups (e.g., children, women of reproductive age).

Category 8. Level of Program Effort and Funding

As noted above under Section 4 (Selection of Most Appropriate Options), financial constraints may affect the choice of options for developing a fish advisory program. Financial and other resource factors (e.g., staff, materials, access to information) also affect the methods used to implement options, how extensively they are implemented throughout an area, and ultimately how effective the programs are.

Category 9. Program Evaluation and Modification.

Program evaluation and modification are important activities to be considered even in the initial planning of a program. Reviews of a program's design are

necessary to determine how effective it is: who it is reaching, whether their behavior has changed, and whether the target population requires additional information. Program evaluation also enables the risk manager to determine how the program might be altered to better address its goals. Accordingly, flexibility is vital so that necessary modifications can be made both in the initial design and over time as needs change. The decision to include these elements in a program design will help provide for the long-range success of a fish advisory program.

This document provides an overview of a wide variety of risk management options and their potential utility and impacts. State, local, and tribal risk managers are urged to review the various options and to include all interested parties in the decision-making process in order to develop the best possible programs for their areas.

1.7 Environmental Justice

This document reflects EPA's policy regarding environmental equity and justice. The President's Executive Order (Feb 11, 1994), *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, specifically directs federal agencies to identify and address disproportionately high adverse human health or environmental effects on minority and low-income populations and workers.⁹

Environmental justice is particularly relevant to the work discussed in this document because contaminated fish may be consumed in greater quantities by minorities and low-income populations in many areas of the United States. These groups often comprise subsistence fishers and may be simultaneously exposed to the same or similar acting contaminants in air, water, and other foods. This exposure may occur both in an urban environment, where high pollution levels often have obvious industrial or other sources, and in less developed areas, where water or soil contamination may occur via long-range transport or from non-point sources.

Many specific recommendations of the executive order address program coordination and activities tracking at the federal level. Additional recommendations may be useful to state, local, and tribal governments for better addressing environmental justice issues. These include the following:

- promote the enforcement of all health and environmental statutes in areas with

⁹ Readers are encouraged to review Executive Order 12898 in its entirety.

- minority populations and low-income populations;
- ensure greater public participation;
- improve research and data collection relating to the health and environment of minority populations and low-income populations;
- identify differential patterns of natural resources consumption among minority populations and low-income populations; and
- identify multiple and cumulative exposures.

The executive order contains some specific recommendations regarding subsistence consumption of fish and wildlife that may also be relevant for state, local, and tribal governments:

- collect, maintain, and analyze information on the consumption patterns of populations who rely principally on fish and/or wildlife for subsistence (urban and rural);
- communicate to the public the risks of those consumption patterns;
- provide guidance reflecting the latest scientific information available concerning methods for evaluating the human health risks associated with consuming pollutant-bearing fish or wildlife. Consider such guidance in developing policies and rules;
- translate crucial public documents, notices, and hearings relating to human health or the environment for limited English-speaking populations; and
- ensure that public documents, notices, and hearings relating to human health or the environment are concise, understandable, and readily accessible to the public.

These recommendations to federal offices are generally covered by the caveat that such activities should be carried out whenever practicable and appropriate. While these are potentially useful and necessary activities, this information does not constitute a requirement for state, local, and tribal governments, although the values espoused are useful for consideration. If additional assistance is needed on environmental justice issues and strategies, readers may wish to contact:

U.S. EPA Office of Environmental Justice
401 M. St. S.W.

Washington, D.C.
20460
phone: (202) 260-6357

This guidance document addresses concerns regarding environmental justice through the variety of mechanisms discussed below. A major focus of risk management is to evaluate and reduce risks to the most highly exposed individuals or population groups. With respect to fish contaminants, these people are often subsistence fishers, although in some areas they may be primarily sport fishers.

Highest consuming **or** most susceptible subgroups of concern include subsistence fishers, pregnant women, children, groups with poor nutritional status, and individuals with certain pre-existing health problems. Volume II provides substantial toxicological information regarding susceptible subgroups on a chemical-specific and chemical class-specific basis. Information is also provided on characteristics of population subgroups that may cause them to be generally more susceptible to chemical exposures. These subgroups, such as women of reproductive age and children, may be targeted for special efforts in advisory programs (discussed in this volume). Specific methods for calculating advisories tailored to children of various ages and other subgroups are presented in Volume II and discussed further in this document.

The discussions of exposure assessment in Volume II and its Supplements include information regarding fish consumption patterns of highly exposed minority groups such as Asian and Native American communities. The results of numerous recently completed studies show higher consumption rates among these groups than among the general fisher population.

Studies have indicated that highly polluted areas contain disproportionate numbers of minority and low-income populations. To avoid an unsafe exposure level, groups exposed to the same or similar-acting contaminants in media other than fish may require lower consumption limits than if their exposure occurred only through fish. To address this concern, this volume contains information regarding methods for estimating total exposure including air, water, soil, food, and workplace exposures. This information, important for any groups exposed through multiple media, is particularly relevant for groups who reside in highly polluted areas, such as industrialized urban areas and near hazardous waste sites.

Throughout this text, readers are reminded of aspects of the risk management process that may involve public participation. Encouraging participation by traditionally-disenfranchised groups may improve fish advisory program implementation and efficacy. Decisions on the type of risk reduction programs to be established in a community, the pursuit of remediation efforts, and the level of

acceptable risk for a community requires community participation to be the most effective. Discussions of critical decisions in this volume emphasize the value of community member participation and the need for information regarding affected communities.

The potential community, societal, and economic impacts of risk management fish advisory options are discussed in this volume. Subsistence fishers and some other fisher groups consume higher quantities of non-commercial fish; Consequently, they are at greater risk of negative nutritional, economic, or community impacts if their fish consumption is reduced. The negative impacts of consumption reductions are discussed in Section 3. Numerous representatives of Native American, Asian American, urban fishers, rural fishers, and other groups were contacted to obtain their ideas regarding the various options for reducing risks associated with contaminated fish consumption (see the expert source list under Acknowledgements in the front of this document).

Many individuals consulted from community and tribal groups requested information regarding environmental remediation and pollution prevention be included in this volume. These groups frequently expressed the sentiment that the ultimate goal should be to improve environmental quality so that fish advisories are no longer necessary. This has been EPA's goal since its inception and has been shared by many state, local, and tribal programs. In response to these requests, information was collected from a variety of federal, state, tribal, and other sources regarding rights and responsibilities in environmental remediation and pollution prevention. The information summarized in Section 2 provides a road map through various offices at the federal level responsible for remedial action and pollution prevention. Information on federal activities and responsibilities may provide both risk managers and affected groups with the ability to evaluate ongoing efforts, obtain additional information, and participate in determining future activities where necessary. Because state, regional, local, and tribal programs vary considerably, a summary of their activities was beyond the scope of this document.

The environmental justice activities at the federal level are being accelerated as the need to evaluate and address inequities in environmental contamination and health risks is recognized. The approach outlined in this series is designed to assist state, local, and tribal governments in evaluating risks for both the general population and subgroups, allocating resources based on risk levels, and providing more healthful alternatives for all their citizens. EPA welcomes recommendations regarding these issues and approaches to addressing environmental justice.