Targeting Toxics: A Characterization Report
A Tool for Directing Management and Monitoring Actions in the Chesapeake Bay's Tidal Rivers

A Technical Workplan

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ABSTRACT

In the Chesapeake Bay region, scientists and managers have been carrying out a multi-step effort to assess the Bay's tidal rivers and identify, or *characterize*, the status of chemical contaminant effects on living resources inhabiting the Bay's tidal rivers. The result of that effort is summarized in a public report: *Targeting Toxics: A Characterization Report - A Tool for Directing Management & Monitoring Actions in the Chesapeake Bay's Tidal Rivers* [1]. This report includes an executive summary, the characterization map, and profiles summarizing the characterization for each river. This technical workplan is a companion document to the characterization report and presents the technical approach used by the Chesapeake Bay Program's Toxics Subcommittee Regional Focus Workgroup (hereafter, the workgroup) to characterize the Bay's tidal rivers. This document serves as an update and expansion to the earlier geographical targeting protocol published in 1995 [2]. This report details the chemical contaminant and biological data used in the characterization, how the workgroup analyzed the data, the thresholds used to interpret the data, and how the workgroup made final decisions. It also addresses limitations to the characterization and recommendations for improving characterizations in the future.

This characterization is the most comprehensive characterization to date of the chemical contaminant-related problems that could affect living resources in the tidal rivers of the Bay. It goes beyond the state's *impaired waters* lists by identifying the areas where living resources may be affected by chemical contamination (*Areas of Emphasis)*, the areas that do not have any known contamination problems (*Areas with Low Probability for Adverse Effects*) and the areas where the data are insufficient or inconclusive (*Areas with Insufficient or Inconclusive Data*). This report enhances the picture of the status of chemical contaminant-related problems in the Bay's tidal rivers.

At the same time the characterization was being conducted, scientists have been working to identify the *sources* of chemical contamination in the Bay's tidal rivers. That study resulted in a related report: the *1999 Chesapeake Bay Basinwide Toxics Loading and Release Inventory* (TLRI) [3]. The information in the characterization and TLRI reports will serve as valuable planning tools to assist the Bay Program in assessing the success of its previous toxics reduction and prevention goals and to formulate new goals for targeting additional chemical contaminant management and monitoring efforts in specific tidal rivers.

I. INTRODUCTION

Background

In 1992-1993 the Chesapeake Bay Program reevaluated the 1989 *Chesapeake Bay Basinwide Toxics Reduction Strategy* to better understand and document the nature, extent, and magnitude of chemical contamination and toxic effects within the Chesapeake Bay. The resultant findings, described in the *Chesapeake Bay Basinwide Toxics Reduction Strategy Reevaluation Report*, revealed that the magnitude and extent of chemical contaminant-related problems in the Bay varied according to geographical region [4]. Findings showed that significant chemical contaminant-related problems do not appear to be baywide, but are localized in areas located near urban centers. The reevaluation process also indicated there are widespread areas with low levels of chemical contaminants below thresholds associated with predictable adverse effects on the Bay's living resources.

At its September 1993 meeting, based on the findings from the reevaluation, the Chesapeake Executive Council designated three *Regions of Concern* where notable chemical contaminant problems have been well documented by Bay scientists and managers: the Anacostia River (DC), Baltimore Harbor/Patapsco River (MD), and the Elizabeth River (VA) [5]. Currently, the jurisdictions are implementing Regional Action Plans, developed through the Bay Program, in these areas to address the chemical contaminant problems. The Executive Council also directed the Chesapeake Bay Program to revise the existing toxics strategy to include a geographical targeting approach for reducing and preventing chemical contamination in the Bay and rivers and for assessing chemical contaminant-related problems. Specifically they directed the signatories to "direct reduction and prevention actions toward regional areas with known toxics problems as well as areas where significant potential exists for toxic impacts on living resources and habitats" and to "establish a process for characterizing and designating additional areas of the Bay as Regions of Concern" [5].

The resulting revised *Chesapeake Bay Basinwide Toxics Reduction and Prevention Strategy,* signed by the Executive Council in October 1994, commits the signatories to:

> "By July 1996, evaluate available data through the Regions of Concern identification protocol, determine whether additional Regions of Concern should be designated, and publish a revised characterization of Bay and tidal tributary habitat status with regard to evidence for the presence of chemical contaminant-related impacts. Every three years, this same evaluation of data will be conducted using data collected since the previous evaluation" [6].

This report describes technical workplan followed to report on the status of chemical contaminant effects on the living resources inhabiting the Bay's tidal rivers. This characterization effort was much more intensive than originally anticipated, requiring five years to complete. Similar geographical targeting efforts have been successfully applied on a regional level in the Great Lakes and Puget Sound [7,8,9] and nationally through the Environmental Protection Agency's National Sediment Quality Survey [10]. The background work from these programs and the experience gained through their implementation provided a firm basis for establishing a geographical targeting component within the 1994 *Chesapeake Bay Basinwide Toxics Reduction and Prevention Strategy*.

Regional Focus Workgroup

In 1994, the Toxics Subcommittee established the Regional Focus Workgroup to implement the regional focus-related commitments in the 1994 basinwide toxics strategy. This workgroup was charged with developing the geographical targeting protocol and conducting the characterization. This five-year effort could not have been accomplished without the commitment of the Regional Focus Workgroup's and the CBPO Characterization Team and their perseverance.

In 1995, the workgroup developed the *Chesapeake Bay Chemical Contaminant Geographical Targeting Protocol* which outlined the general approach for conducting the characterization, including definitions of the classification categories and guidelines for making the characterizations [2]. This protocol was reviewed and approved by the Toxics Subcommittee and the Scientific and Technical Advisory Committee. In 1995 and 1996, the Bay Program held a series of meetings throughout the watershed with key Bay scientists, managers, and citizens to identify all available chemical contaminant and biological data. From 1996-1999, the workgroup continued its extensive data acquisition by identifying additional data sets, acquiring all relevant data, and loading data into a database for use in the characterization. In 1997, they refined the geographical targeting protocol to include decision rules for evaluating the data. These decision rules listed the thresholds and benchmarks to which different types of chemical contaminant concentration and effects data were compared. By 1997, the membership of the workgroup was composed of a consistent and well-balanced representation for conducting the characterization. Workgroup members included representatives from state agencies (Virginia Department of Environmental Quality, Maryland Department of the Environment, Maryland Department of Natural Resources); federal agencies (US Fish and Wildlife Service, US Environmental Protection Agency); interstate agencies (Interstate Commission on the Potomac River Basin); research institutions (Old Dominion University, University of Maryland); and industries (Baltimore Gas & Electric, Potomac Electric Power Company). From the summer 1998 through April 1999, the workgroup engaged in the labor intensive process of using this workplan and their best professional judgement to reach consensus on the characterization of all tidal rivers of the Bay.

II. OVERVIEW OF CHARACTERIZATION

Purpose of the Characterization

The characterization represents the Chesapeake Bay Program's first comprehensive analysis of available chemical and biological data to assess the status of chemical contaminant effects on the living resources in the Bay's tidal rivers. This characterization goes beyond the previously designated *Regions of Concern*, to characterize conditions in other tidal waters. The characterization identifies areas where significant potential exists for chemical contaminant-related effects on living resources and their habitats, areas that show evidence that adverse effects due to chemical contamination are unlikely, and areas where data are lacking or inconclusive and additional study is required. Based on available chemical and biological data, the Regional Focus Workgroup characterized segments of the rivers into one of four categories:

- *Regions of Concern* (hot spots)
- *Areas of Emphasis*
  (significant potential for chemical contaminant problems)
- *Areas with Low Probability for Adverse Effects*
  (no known chemical contaminant problems)
- *Areas with Insufficient or Inconclusive Data*
  (data is too sparse or inconclusive to characterize conditions)

Overall, the characterization report and the 1999 Chesapeake Bay Basinwide Toxics Loading and Release Inventory will serve as valuable planning and targeting tools to assist the Bay Program in assessing the success of its previous toxics reduction and prevention goals and to formulate new goals. More specifically, the Bay Program is committed to take the following actions based on the results of this characterization effort:

- Identify and implement necessary pollution prevention actions in the *Areas of Emphasis* to eventually eliminate the potential for chemical contaminant-related effects.
- Take actions necessary to ensure future protection of the *Areas of Low Probability for Adverse Effects*.
- Initiate necessary assessments in *Areas with Insufficient or Inconclusive Data* to order to characterize these areas.

The Chesapeake Executive Council has directed the Bay Program to reevaluate and revise its 1994 basinwide toxics strategy in 1999. This characterization report and the TLRI report are critical tools that will be used in developing future goals to direct chemical contaminant reduction, prevention, and monitoring activities in the appropriate areas beyond the year 2000.

Types of Data Used for Characterization

Two types of data were considered in the characterization: chemical contaminant concentration data and effects data. Concentration data available for this characterization were chemical contaminant concentrations in water, sediment, and non-migratory, resident finfish tissue and shellfish tissue and information on any current fish consumption advisories. Effects data available for the characterization were sediment and water ambient toxicity data and benthic community structure data (See Section III.A. for more detail).

Human Health

The characterization identifies areas where chemical contaminant effects to the Bay's living resources occur or have the potential to occur. Human health effects from contaminated air, soil and drinking water are not addressed. However, because potential human health effects are an important issue, state agencies have already looked at human health issues in the tidal rivers of the Bay. And, where human health concerns already have been identified, appropriate fish consumption advisories or other warnings have been issued. The characterization should not alter the current recreational or commercial uses of any of the rivers. If swimming, fishing and boating are allowed now, they should continue.

Geographic Focus of Characterization

The mainstem Bay was not characterized because levels of chemical contaminants tend to be very low and effects are unlikely. Techniques for detecting effects at these low levels are under development. Also, the report characterizes the tidal rivers of the Bay, as opposed to non-tidal waters, because tidal waters are the focus of the Bay Program's toxics efforts. The sites of many of the known chemical contaminant problems are in tidal waters, and most of the urban areas and contaminant-related land use activities are adjacent to tidal waters. However, it is important to note that non-tidal waters (above the fall line) are also a source of chemical contaminants to tidal waters.

Since the Chesapeake Executive Council previously designated the Anacostia River, Baltimore Harbor/Patapsco River, and the Elizabeth River as *Regions of Concern* they were not characterized as part of this effort. The workgroup evaluated the data from these regions and verified that these data would have resulted in characterizing the areas as *Regions of Concern*, based on the characterization process. Data from the *Regions of Concern* were used to provide a context for selecting appropriate thresholds for potential or probable effects due to the presence of contaminants and for evaluating the relative severity of contamination in other areas.

Spatial Scale of Characterization

The Chesapeake Bay Program divided the Bay and its tidal rivers into a number of geographic segments based on salinity and other natural features for collecting, analyzing, and reporting data. The Regional Focus Workgroup used this monitoring segmentation scheme to characterize 38 tidal water segments (Figure 1). Most of the major western shore tidal rivers are divided into 3 segments, while most of the Eastern Shore rivers and the smaller western shore rivers are represented by one segment. Some segments may comprise more than one river. The characterization worked well at the spatial scale of these segments given the spatial and temporal limitations of the available data. Also, this scale is appropriate for stakeholder groups who are often organized around a river or watershed.

This effort represents a broad characterization of chemical contaminant conditions in the Chesapeake Bay's tidal rivers. The panel of experts who characterized the rivers weighed all available chemical contaminant data for each river segment and, based on their best professional judgement, developed consensus on the final characterization. All of the available data evaluated had to convey a reasonably consistent record throughout an entire segment, describing the status of chemical contaminant effects on living resources, to make a characterization. If available data were spatially or temporally insufficient to represent the entire segment, or if data were conflicting or inconclusive in describing the entire segment, a segment was characterized as an *Area with Insufficient or Inconclusive Data*. The characterization of a particular river segment does not mean that the entire area has a chemical contaminant-related problem because chemical contaminant conditions are not uniform throughout each segment. For example, even in the *Regions of Concern*, there are areas that have no known problems. When more data are available, future efforts will characterize specific areas within a river segment.

Characterization Categories

The Regional Focus Workgroup evaluated all relevant, available chemical contaminant and biological data for all tidal river segments of the Chesapeake Bay and characterized them in one of the four categories:

Region of Concern - Available data indicate that there is a **probable** chemical contaminant-related problem. Data denote elevated concentrations of chemical contaminants above thresholds associated with adverse effects and observed toxic effects on living resources. In this case, data reveal strong evidence for a linkage between the presence of chemical levels exceeding thresholds and the observed effects on living resources in this region. *Regions of Concern* are formally designated by the Chesapeake Executive Council and targeted for specific chemical contaminant remediation, reduction, and/or prevention actions through jurisdictional development and implementation of Regional Action Plans.

Area of Emphasis - Available data indicate that there is significant **potential** for a chemical contaminant-related problem. In this case, data reveal either elevated concentrations of chemical contaminants above thresholds associated with adverse effects and/or chemical contaminant-related adverse effects on living resources, but limited or no evidence for a relationship between the measured chemical levels and observed effects exists. For these regions, the appropriate jurisdiction(s) will initiate the necessary actions to effectively manage the area. Pollution prevention actions will be targeted towards specific chemical contaminants and sources with the goal of eliminating the potential for chemical contaminated-related effects.

Area with Low Probability for Adverse Effects - Available data indicate that it is unlikely that there is a chemical contaminant-related problem. In this case, data reveal measured chemical contaminant concentrations below thresholds associated with adverse effects and/or no reported or measured chemical contaminant-related adverse effects on living resources. For these regions, the appropriate jurisdiction(s) will take actions necessary to ensure future protection.

Area with Insufficient or Inconclusive Data - Available data are insufficient for characterizing the region into any of the three previous categories. Either the data are too limited temporally and/or spatially, do not provide sufficient mix of concentration and effects data, are inconclusive or conflicting, or are of unknown quality and cannot support the level of confidence required to characterize the region. These regions will be given high priority for future characterization.

Relationship to Other Characterization Efforts

There are several characterization efforts that identify chemical contaminant-related problems in the Bay watershed. National efforts such as the Environmental Protection Agency (EPA) Environmental Monitoring and Assessment Program and National Oceanic and Atmospheric Administration's ongoing sediment characterization effort in the Bay are designed to compare estuarine and coastal conditions on a nationwide scale. The national datasets used in these efforts also were used in the Bay Program's characterization.

There are also several regional programs that characterize chemical contamination in the Bay's rivers. Each state/district is required by section 303(d) of the *Clean Water Act* to develop a list of impaired waterbodies that do not meet their designated uses, such as aquatic life use (including fish/shellfish consumption), recreational use (swimming and boating), and use as a public water supply. The 303(d) list helps focus regulatory efforts to reduce chemical contaminant effects on living resources by reducing chemical contaminant loads into the Bay's rivers. The Bay Program's characterization goes beyond the *Clean Water Act* requirements and not only identifies chemical contaminant-related problem areas, but also identifies areas with potential chemical contaminant problems, areas with no observable chemical contaminant problems, and areas needing more data to assess chemical contamination problems. Such a comprehensive characterization is essential to better target management actions (e.g., voluntary pollution prevention activities) in those areas with known chemical contaminants problems and target more assessments in areas with limited chemical contaminant information. Together, these efforts give the most complete, up-to-date picture possible based on the best available data.

The Bay Program strived to be as consistent as possible with the state/district 303(d) assessments, recognizing differences that may occur with the use of additional data and interpretative tools. The state/district impaired waterbody designations are mainly based on exceedences of EPA-approved water quality criteria and fish consumption advisories, with supporting evidence from any available sediment and biological data (e.g., assessments of benthic community in the sediment). Due to the regulatory nature of the 303(d) lists, sediment and biological data oftentimes do not serve as the sole basis for these characterizations, since there are no EPA-approved criteria. In this characterization, all available chemical contaminant and biological data were evaluated, using the best interpretative tools available, to characterize the probability of adverse effects on living resources due to chemical contamination in the Bay's tidal rivers. Maryland and Virginia state agency representatives were members of the Workgroup and ensured coordination with the state 303(d) efforts.

III. CONDUCTING THE CHARACTERIZATION

This section details the following three steps the Regional Focus Workgroup took to conduct the characterization:

1. Identify, acquire, and compile all relevant, available chemical contaminant and biological data.
2. Analyze and interpret chemical contaminant and biological data.
3. Characterize all tidal rivers into one of the four categories.

A. STEP I: IDENTIFY, ACQUIRE, AND COMPILE ALL RELEVANT, AVAILABLE CHEMICAL CONTAMINANT DATA.

A.1. Types of Data Used in Characterization

The first step in implementing the geographical targeting protocol was to identify and acquire all available ambient chemical contaminant data and other relevant information for all tidal rivers of the Chesapeake Bay. A variety of different types of data is needed to build the weight of evidence necessary in making a characterization. Examples of relevant information the workgroup considered as evidence for the presence/absence of a chemical contaminant-related problem are listed in Table 1.

Chemical Contaminant Concentration Data

"Concentration" data refer to a method-defined value derived from a measurement by an instrument or other direct observations. It does not necessarily express the bioavailable form of the contaminant measured and the pathway by which the contaminant has an effect on an individual organism, population, or community. Concentrations of chemical contaminants can be measured in the water column, the sediment, and in finfish or shellfish tissue. Living resources are exposed to these contaminant levels in their habitat. Data available for this characterization were chemical contaminant concentration data for water, sediment, and non-migratory, resident finfish tissue and shellfish tissue and information on any current fish consumption advisories.

Effects Data

Laboratory toxicity data and benthic community data were considered "effects" data because they indicate the measurable effect chemical contaminants have on living resources. Spatial coverage of effects data was very limited compared to the chemical contaminant concentration data. Effects data available for the characterization were sediment and water ambient toxicity data and benthic community structure data. Data on finfish and shellfish abnormalities were not used due to the difficulty of linking the observed abnormalities to chemical contamination.

Table 1. Chemical Contaminant Data Considered in the Characterization.

CONCENTRATION DATA	***EFFECTS DATA***
! Water column contaminant concentrations	! Water column toxicity
! Sediment contaminant concentrations	! Sediment toxicity
! Edible non-migratory, resident finfish tissue contaminant concentrations	! Impaired benthic community structure
! Shellfish tissue contaminant concentrations	
! Fish consumption advisories	

A.2. Data Acquisition Efforts

Due to the relatively high costs of chemical contaminant assessments, the Chesapeake Bay Program relies heavily on data collected by its partner federal agencies (NOAA, USGS, EPA), state agencies, and research institutions in addition to the Toxics Subcommittee-funded projects such as the Ambient Toxicity Assessment and Fall Line Monitoring programs to use in targeting its chemical contaminant management and monitoring activities.

In 1995, when the Regional Focus Workgroup undertook the characterization endeavor, the Chesapeake Bay Toxics Database was comprised mainly of baywide chemical contaminant concentration data for water, sediment, and finfish/shellfish tissue. In order to characterize toxic conditions in specific segments of the tidal rivers, the Bay Program turned its data acquisition focus towards more regional datasets. In 1995 and 1996 the Bay Program held a series of meetings throughout the watershed with key scientists, managers, and citizens to identify datasets that would help them to characterize chemical contaminant conditions in the tidal rivers. They prioritized the datasets for acquisition and sent out letters requesting the data with specifications for data submission. The Bay Program developed a database to track all identified datasets and its progress in acquiring and loading them into the Chesapeake Bay Toxics Database.

The Bay Program's goal is to make a full range of Bay related data and information directly accessible via the internet in consistent as possible formats. The Chesapeake Bay Toxics Database is a first step towards a more distributed system. In the absence of a comprehensive baywide chemical contaminant monitoring program, the Bay Program is compiling many smaller datasets scattered across many data generators and putting them into a consistent format so that they can be analyzed efficiently. In the future, the Bay Program will move towards a more distributed database where data are maintained in a consistent format by the data generators and shared with the Bay Program via the internet..

A.3. Data Used in the Characterization

The Chesapeake Bay Toxics Database contains the water, sediment, finfish/shellfish tissue chemical contaminant concentration data and the appropriate thresholds to which these chemical contaminant concentration data are compared. Summaries of the effects data, including benthic community structure and most of the ambient toxicity data are stored in spread sheets that are linked to software that geographically displays these data. When necessary, hardcopies of other relevant effects data were evaluated as well. The preponderance of data used in this initial characterization are chemical contaminant concentration data, with effects data from a limited portion of the tidal waters.

Chemical Contaminant Concentration Data

Table 2 summarizes all concentration data in the Chesapeake Bay Toxics Database as of March 31, 1999 for the tidal waters of the Bay. These data date back as far as 1976 and include measurements in the mainstem Bay which was not characterized. The references for all studies in the database are attached [Appendix A]. Table 3 summarizes the subset of relevant data for the tidal rivers considered in the 1999 characterization. In support of the characterization, a total of 53 chemical contaminant concentration datasets were used for water, sediment, and finfish/shellfish tissue, comprised of 124,087 observations (including below detection limit values) collected at 1,062 sampling stations throughout the tidal rivers.

The workgroup evaluated all available data for each segment and made a decision on the date range they should consider for making characterizations. Sometimes the workgroup chose to evaluate older data to assess persistence of a chemical contamination over time, particularly for sediment contaminant data. Of particular concern is the issue of methods for the measurement of metals in water. Older data did not use the "clean techniques" for measuring metals and therefore were used with caution by the workgroup and were customarily used only to confirm suggestions of concentrations in other media (sediments or tissue) that metals were a problem in a segment. The workgroup considered sediment data from the early to mid-1990's to be representative of current conditions in the absence of any dredging, catastrophic freshets that move sediment, or remediation activities. The workgroup would not use these data as representative of current conditions if they had information that indicated that the sediment contaminant levels had changed. An example of this type of information would be if the area was a high depositional area, or management actions were implemented since the data were collected that may have resulted in clean sediments entering the system. Greater weight was given to recent data that were considered more representative of the current conditions in the segment. For all segments combined, sediment data from 1984 - 1998, fish tissue data from 1990-1997, and water data from 1994-1998 were evaluated for the characterization.

Table 2: Chemical Contaminant Concentration Data in the Chesapeake Bay Toxics Database (as of 3/31/1999)

Medium	# datasets	# observations (% total obs.)	# monitoring segments	date range	# (%) of sampling stations
Sediment	30	151,943(49%)	46	1976-1997	1,455 (54%)
Tissue	13	81,385 (27%)	41	1976-1998	770 (28%)
Water	23	73,570 (24%)	36	1976-1998	495 (18%)

Table 3: Chemical Contaminant Concentration Data in the Chesapeake Bay Toxics Database used in Toxics Characterization (as of 3/31/99)

Medium	# studies	# observations % total obs.	# monitoring segments	date range	# (%) of sampling stations
Sediment	27	66,423 (53%)	36	1984-1998*	644 (61%)
Tissue	7	4,378 (4%)	13	1990- 1997*	46 (4%)
Water	19	53,286 (43%)	29	1994-1998*	372 (35%)

* Note: date ranges for data used in the Toxics Characterization were specific to each segment characterized. These ranges represent the earliest and latest dates of data used in any of the 36 segments.

Figures 2-4 illustrate the data density and spatial coverage of the chemical contaminant concentration data used from a variety of different studies. Although water contaminant concentration data comprised approximately 43% of all concentration data considered for the characterization, the spatial coverage of recent water contaminant data was limited in many segments (Figure 2). There was adequate spatial and temporal coverage in most segments for sediment chemical contaminant concentration data and these data comprised approximately 53% of all concentration data considered for the characterization (Figure 3). Recent tissue chemical contaminant concentration data were extremely limited both spatially and temporally (Figure 4). Although there was good spatial coverage of finfish/shellfish tissue contaminant concentration data in the mid 1980's, these data could not be used to represent a current characterization of the tidal rivers. The Bay Program is working with the state monitoring programs to get access to additional fish tissue and water contaminant concentration data for future updates to the characterization. Adequate spatial coverage was an issue that was resolved by visually integrating the distribution of stations within a segment, the complexity of the watershed, and amount of data for each media type (water, sediment, and tissue) and contaminant class (metals, organic compounds). The determination of adequate coverage was treated in a weight of evidence fashion by each member of the workgroup and decided by best professional judgement.

Effects Data

The Chesapeake Bay Ambient Toxicity Assessment Program provides water and sediment ambient toxicity data and concurrent water and sediment contaminant concentration data for 46 stations in 16 rivers (Figure 5, [11]). Benthic community data were relatively plentiful, especially in Maryland waters (Figure 6). The random benthic sampling data for Virginia waters from 1996 and 1997 were not available at the time of this characterization but will be evaluated in future characterizations. No finfish/shellfish abnormality data were used in this characterization due to the difficulty in ruling out causes of abnormalities other than chemical contamination.

A.4. Data Quality

There were several points throughout the data acquisition, loading, and evaluation process where the quality of the data was assessed. If data were from studies funded directly by the Chesapeake Bay Program, the Bay Program quality assurance/quality control officer reviewed the quality assurance/quality control project plan to ensure that the study design and data collection and analysis techniques were sound. The Bay Program's Toxics Subcommittee and workgroups reviewed all project deliverables to ensure that they were of good technical quality. If data were from studies not funded by the Bay Program, the Bay Program requested the appropriate documentation on data quality. The Workgroup carefully evaluated all data in making its characterizations, including age of data, detection limits, analytical methods, use of ultra-clean techniques for metals analysis, and adequacy of reference sites. Through careful analysis of the data, they were able to detect data inconsistencies that may indicate quality problems and eliminate questionable datasets from the analysis.

The loading of the data into the Chesapeake Bay Toxics Database was a multi-stepped process. Upon receiving new data for inclusion in the Toxics database, Bay Program Data Center toxics database managers reviewed the submitted data to ensure that it met quality control criteria. At a minimum, data needed to have the following clearly identified: sampling agency; sampling locations and their associated latitudes and longitudes; parameters sampled; dates of sampling; medium sampled (i.e., sediment); sampling units; and an explanation of associated qualifiers. Additionally, if the values were reported as not detected, detection limits were required. Information that enhanced the utility of the data, but was not required for inclusion, included: chemical species; analytical instrumentation; method detection limit; and analytical methodology. After performing an initial review of the data, the database managers referred all problems or questions about the data to the agency or person that submitted the data for resolution. Also, any information that would enhance the utility of the data, but was not captured by the current structure of the Chesapeake Bay Toxics Database, was placed in a "comment" field. Once outstanding issues were resolved, the database managers converted the data to the Chesapeake Bay Toxics Database format. To ensure quality control, parameters and units were standardized. Additionally, before new location values were assigned, the location table in the Chesapeake Bay Toxics Database was queried to identify stations that would duplicate existing stations. Finally, prior to uploading the data, database managers ran a series of quality assurance programs to identify any problems that may have occurred during the data conversion process including duplication of data or unit conversion problems.

A.5. Limitations of Data

It is important to note that there is no baywide monitoring program designed to characterize toxics conditions in the Chesapeake Bay tidal rivers on the scale necessary to perform comparable assessment of all rivers. That is, although the Bay Program has supported an ambient toxicity assessment program since 1990 (the studies usually focus on one or more segments in two basins in any year), it is inadequate for characterizing all tidal rivers at the current funding level. The workgroup was faced with the challenge of piecing together many disparate datasets and developing a consistent set of decision rules for how to interpret this information in making a characterization. Some of the limitations of the data are listed below.

- This initial characterization is based on only those priority data that were available and loaded into the Chesapeake Bay Toxics Database by March 31, 1999. Many more datasets are still being acquired and loaded that will be captured in future updates of the characterization.

- Overall there was a general lack of water and finfish/shellfish chemical contaminant concentration data and effects data throughout the tidal rivers. Data was particularly lacking in most of the Eastern Shore rivers. Very little pesticide data were available.

- The preponderance of available data used in this initial characterization was chemical contaminant concentration data. Sediment chemical contaminant concentration data make up the majority of the concentration data used in the characterization and tend to “drive” most of the characterizations.

- Available water and finfish/shellfish tissue contaminant concentration data for most segments were too old to be representative of current conditions and, therefore, were of limited use in making the characterizations. Even though many of the current fish consumption advisories are based on these older data, if the states/District have an active fish consumption advisory in place, then the Workgroup considered them in its characterizations.

- This characterization is limited to the chemicals for which we have available data. Therefore, chemicals were not considered in the analysis if they were not routinely analyzed for, such as new use pesticides or nonyl phenols, even though they may have a high use, toxicity, or persistence. However, the workgroup considered the absence of ambient chemical contaminant concentration measurements in areas where they would expect to see these chemicals in making its characterizations (e.g., lack of pesticide data in highly agricultural areas would tend to drive a classification towards an *Area with Insufficient or Inconclusive Data*.)

- Studies differed in their objectives, sampling strategies, type of data collected, chemicals measured, analytical methods used, locations and time sampled, etc. The utility of these studies may be limited because they were not conducted with the purpose of characterizing chemical contaminant conditions on the same spatial scale as this effort.

- Many of the datasets are biased towards areas of known or suspected problems resulting in limited data for areas that are thought to be uncontaminated. The workgroup focused on studies that reported data on the ambient environment. The workgroup qualified all studies that were conducted for the purpose of quantifying the chemical contaminant levels or effects in close proximity to a source (i.e., point source discharge pipe) if they decided to use them in the characterization. If no toxicity was observed in these studies targeted to suspected toxics sources, these findings could be used as evidence for the unlikelihood of a chemical contaminant effects on living resources.

- Although benthic community data were relatively plentiful, especially in Maryland waters, these data were of limited use, because of the difficulty in ruling out dissolved oxygen and other non-contaminant-related factors as the principle cause of degradation on the benthic community. For this reason, benthic and fish community data (when available) were used as supporting evidence in making a characterization, but did not drive a characterization.

- No finfish/shellfish abnormality data were collected and used in this characterization due to the difficulty in ruling out causes of abnormalities other than chemical contamination.

- It is important to note that other environmental factors such as low dissolved oxygen and pH may influence the health of living resources in the Bay by affecting the toxicity of substances in the environment. Assessing impacts from "non-anthropogenic" substances that are not chemical contaminants was beyond the workgroup's capacity to evaluate with the available data. The workgroup did consider *in situ* effects measures where low dissolved oxygen levels may have been a causative factor for reduced benthic indices because the data were available.

B. STEP II. ANALYZE AND INTERPRET CHEMICAL CONTAMINANT DATA

B.1. Guidelines for Interpreting Data

In order to characterize a segment into one of the four categories, the chemical contaminant concentration and effects data were initially compared to contaminant thresholds or control conditions, respectively. The thresholds were developed for each media (water, sediment, tissue) and for each effect using the guidelines detailed below and summarized in Table 4. The comparison provided a body of "evidence" for where (spatially), when (temporally), how much (magnitude), and what (concentration or effects) chemical contaminant levels and toxic effects may be occurring.

Water Column Contaminant Concentration - Observed ambient water column chemical contaminant concentrations were compared with relevant chemical contaminant concentrations known to be protective of most aquatic organisms (i.e., EPA aquatic life criteria, respective state water quality standards) or with other relevant thresholds above which adverse effects to aquatic organisms have been observed and documented (i.e., laboratory-based chemical specific toxicity tests) (Appendix B and C).

Bottom Sediment Contaminant Concentration - Observed ambient sediment contaminant concentrations were compared with contaminant threshold concentrations associated with adverse biological effects. Sediment quality threshold values were compiled from peer-reviewed literature and technical reports, summarized in a sediment threshold compendium [12] and stored on the Chesapeake Bay Program Toxics Database. The most appropriate (i.e., higher level of certainty and most applicable to the Bay region estuarine organisms) threshold values were selected for comparison to sediment contaminant data (Appendix B and C)..

Finfish/Shellfish Tissue Contamination - Measurements of the edible portion of finfish tissue contaminant concentrations in resident, non-migratory species and shellfish tissue contaminant concentrations were compared with thresholds associated with the protection of human health. Available human health consumption threshold values were compiled from national and worldwide literature and government documents and summarized in a fish tissue threshold compendium [13] and stored on the Chesapeake Bay Program Toxics Database. The most appropriate (i.e., higher level of certainty) threshold values were selected for comparison to fish tissue contamination data (Appendix B and C).. Existing chemical contaminant-related fish consumption advisories and bans also were used as evidence in making a characterization.

Water Column/Bottom Sediment Toxicity - Observed ambient water column and bottom sediment toxicity data from the Chesapeake Bay Ambient Toxicity Assessment Program have already been interpreted by assigning a “degree of toxicity” to a sampled area [11]. These degrees of toxicity were used in interpreting the data for this characterization. Workgroup members also evaluated the sediment and water toxicity index values which provide a relative measure of toxicity of a given site compared to all other sites sampled to date by this program. Toxicity data collected through other programs were evaluated for statistically significant differences between the observed adverse effects (i.e., survival, growth, reproduction) and reference area or control toxicity test results (Appendix B).

Benthic Community Structure - Benthic community data (i.e., species number, species diversity, and biomass) collected for the Bay Program were summarized into a Benthic Index of Biotic Integrity (B-IBI) that indicates benthic community health [13,14, 16]. A B-IBI of greater than or equal to 3 indicates the benthic community meets or exceeds the restoration goal (a benthic community characteristic of a non-degraded bottom habitat in Chesapeake Bay); an index of 2.6 to 3 indicates a marginal benthic community; an index of 2 to 2.6 indicates a degraded benthic community; and an index of 2 or less indicates a severely degraded benthic community. Only data for regions where low dissolved oxygen conditions could be eliminated as the principle cause of benthic community degradation were used as supportive evidence in making a characterization (Appendix B).

B.2. Decision Rules for Interpreting Data

Through many deliberations, the Regional Focus Workgroup reached consensus on a set of decision rules to provide a uniform and unbiased method for screening chemical contaminant concentration and effects data for each segment (Appendix B). The decision rules list multiple sets of thresholds used to interpret chemical contaminant concentration data. The workgroup chose multiple sets of thresholds for each data type (i.e., water, sediment, fish tissue) because no one set of thresholds covers all chemicals measured and because of the diversity of opinions in the scientific community regarding the confidence and utility of each threshold. The workgroup ranked the thresholds appropriate for each data type based upon the level of confidence in the ability of the threshold to predict effects or protect living resources and on the scientific validity of the approach used to develop the threshold. Appendix C provides a complete listing of the contaminant-specific thresholds used. The decision rules also include uniform methods for interpreting the effects data (benthic community assessments and ambient toxicity test data).

Concentration:Threshold Ratio

The concentration:threshold ratio is the ratio of the measured chemical contaminant concentration in an environmental sample (water, sediment, tissue) divided by a relevant threshold. If the ratio is less than 1.0, it suggests that the condition predicted by the threshold (mortality, reduced growth or reproduction, bioaccumulation, etc.) may not be occurring. If the ratio is greater than 1.0, the threshold has been exceed, suggesting that some level of effect may be occurring. For ratios much greater than 1.0, there is an increasingly greater level of confidence that an effect is occurring. This ratio was used by the workgroup to estimate the confidence in predicting that an effect may be occurring, given the inherent uncertainty in the thresholds and the environmental measurements. Greater weight was given to a ratio of 2.0 or greater, but it was not considered an indicator of the magnitude of the effects. This is, higher ratios do not necessarily indicate greater toxicity because toxicity is not always related to concentration in a linear dose-response fashion.

B.3. Data Analysis Issues

B.3.1. Exposure Data

Below Detection Limit Values

In many cases, chemical contaminants that were measured using a specified detection limit were not detected. Therefore the concentration of these chemicals falls somewhere between zero and the detection limit. In the data analysis, these chemicals were referred to as “below detection limit values” and were not assigned a specific chemical concentration. Data on chemical measurements that were below the detection limit were used as evidence supporting characterizing a segment as an *Area with Low Probability for Adverse Effects*. Sometimes the detection limit for these chemicals was greater than the thresholds. In this case, it is possible that the chemical value may exceed a threshold. If detection limits for a measured chemical were greater than the thresholds used for comparison, these data were flagged in the analysis for the workgroup’s consideration.

Evaluating Contaminants that Exceed Thresholds

Some contaminants reported in the database are not considered toxic in estuarine environments. The workgroup considered this in evaluating data for each segment, placing less weight on metals (e.g., aluminum, manganese, and iron) that are typically non-toxic in estuarine settings. Also, the database contained some compounds that are present in laboratory plastics (e.g., di-(2ethylhexl)phthalate), and these compounds were not considered in the evaluation.

Additionally, in determining its level of confidence in a chemical exceeding a threshold, the Workgroup considered reviews in the scientific literature regarding thresholds and their utility in predicting toxic effects. For example, NOAA ER-L/ER-M sediment threshold values for nickel have not proven to be reliable predictors of sediment quality (Long et al., 1995); hence the workgroup has less confidence in the exceedence of this threshold.

Consistency Issues between EPA Water Quality Criteria and State Standards

For some chemicals Maryland and Virginia used different water quality standards in which to compare their ambient data. The workgroup decided to address this inconsistency on a segment by segment basis if and when characterizations appeared to be driven by the use of a threshold that was not consistently used by both jurisdictions in their individual characterization efforts.

Metals Data

Of particular concern is the issue of methods for the measurement of metals in water. Older data did not use the "clean techniques" for measuring metals. It is believed that historical studies report metals that are bound and freely dissociated in the water column, while it is known that the more toxic form of a metal is the freely dissociated ion. The historical data were used with caution by the workgroup and were customarily used to confirm suggestions of concentrations in other media (sediments or tissue) that metals were a problem in a segment.

Analysis of metals in sediment can be reported as either total or total recoverable, depending on the extraction technique used in the laboratory, where the total value is greater than the total recoverable value. Studies such as the EPA Environmental Monitoring and Assessment Program (EMAP) report total metals, while state programs tend to report total recoverable. It is most appropriate to compare total measurements with the NOAA ER-L and ER-M thresholds, since they are based on total metals measurements. However, the workgroup also compared the lower total recoverable values to the thresholds. If a total recoverable measurement exceeded the threshold, the workgroup's confidence in that exceedence was high.

Polychlorinated Biphenyls (PCBs) in Sediment

Since there are few, if any, sediment thresholds for individual PCB congenors and arochlors, the workgroup compared the sum of the PCB arochlors and the sum of the PCB congenors to "total PCB thresholds" listed in Appendix B. Since the workgroup's confidence in using a total PCB threshold was fairly low, results of this analysis were used only as supporting evidence in making a characterization.

PCBs in Fish Tissue

Since there are few, if any, fish tissue thresholds for individual PCB congenors and arochlors, the workgroup compared the sum of the PCB arochlors and the sum of the PCB congenors to the "total PCB thresholds" listed in Appendix B. Since the workgroup's confidence in using a total PCB threshold was fairly low, results of this analysis were used only as supporting evidence in making a characterization.

B.3.2 Effects Data

Evaluating Benthic Community Structure Data

Dissolved oxygen concentrations of 2 mg/L and below are known to have sublethal and lethal effects on the benthic community. In some parts of the Bay and rivers during the spring and summer months, bottom waters become hypoxic, falling below this 2 mg/L threshold intermittently or persistently. In order to rule out dissolved oxygen as the causative factor for degraded benthic communities, the workgroup worked with the Chesapeake Bay Program Office's GIS and Monitoring team and the principal investigators of Maryland's Chesapeake Bay benthic monitoring program at Versar to make a link between benthic community condition--as expressed by its IBI score--and the degree of exposure of the community to dissolved oxygen concentrations below 2 mg/L.

Although dissolved oxygen measurements are taken when the benthic community is sampled, it represents only one point in time. Because dissolved oxygen concentrations at a given site can vary greatly over a 24-hr period as well as over weeks and months, a single measurement at or near the time the benthic community is sampled may not reflect the longer-term exposure conditions of the community. A better characterization of dissolved oxygen conditions at these sites can be derived from dissolved oxygen measurements collected at stations in the vicinity (i.e., in same segment) as part of the Chesapeake Bay Program Water Quality Monitoring Program. During the spring and summer months, dissolved oxygen samples have been collected twice a month at most stations in the sampling network over the past 14 years.

A method was developed to estimate the depth at which benthic communities at a particular location were exposed to a dissolved oxygen concentration of 2 mg/L or less a significant amount of time ($\geq$10 percent) [17]. The method uses an equation based on the 13 years of monitoring data and the relationship between average monthly or seasonal concentrations and the percent of observations below the selected threshold concentration. The relationships and, thus, the equations are specific to each Bay Program segment and include as variables the specific factors of month (March through October) and depth (meters), in addition to mean dissolved oxygen concentrations. The Chesapeake Bay Program's GIS team used the Bay Program volumetric Mainstem and Tributary Interpolator and the depth values from the Bay Program bathymetry database to map the region of bottom habitat showing the depth where dissolved oxygen concentrations were 2 mg/L or less at least 10 percent of the time.

Figure 7 shows an example of the maps that the workgroup evaluated, showing the benthic IBI scores and the low dissolved oxygen zones within a given segment. Degraded benthic communities that are not in the low dissolved oxygen zone could be caused by other factors such as chemical contamination. Chemical contamination may be a co-stressor for degraded benthic communities in low dissolved oxygen zones, but the relative contributions of these two potential stressors cannot be determined using available data.

B.4. Data Analysis and Interpretation Displays

Through programming the Chesapeake Bay Toxics Database, the Chesapeake Bay Program Office Characterization Team developed data analysis and interpretation displays to aid the workgroup in making its characterization. For every tidal river segment, each workgroup member received a data packet with the following information:

- Map showing all sampling stations sampled for water, sediment, and finfish/shellfish chemical contaminant concentration data; benthic community data; and ambient toxicity data; and a full listing of all of the study references
- Maps showing the level of contamination at each station for water, sediment, and finfish/shellfish contaminant concentration data; ambient toxicity data; and benthic community data based on the decision rules
- Scatter plots showing years and levels of contamination for each chemical measured at each sampling station to indicate magnitude and persistence of chemical contamination problems
- Hardcopy summaries of ambient toxicity test data to supplement maps
- Maps showing benthic community data and dissolved oxygen levels to rule out low dissolved oxygen as causative factor of degraded benthic communities.
- Tables providing both raw and summarized data supporting the maps and scatter plots.
- Table summarizing all references of all datasets used in the analyses

B.5. Factors Considered in Interpreting Data

The Regional Focus Workgroup members considered many different factors in reviewing the available data for each segment. Typical questions they asked themselves as they evaluated the data are the following:

- What exposure and effects studies are available for this segment?
- What is the quality of these data?
- What is the spatial and temporal distribution of the data?
- Was a comprehensive suite of chemicals that we might expect to find in this segment analyzed?
- Are thresholds available for most of the chemicals measured?
- How often were thresholds exceeded?
- How pervasive were these exceedences, spatially?
- How often were chemical contaminant concentrations greater than twice the threshold? (In other words, how confident was the workgroup in the exceedence?).
- Are the chemicals that exceeded thresholds persistent over time?
- Are the chemicals that exceeded thresholds considered to be bioaccumulative or toxic?
- Is there similar evidence of contamination among media sampled (water, sediment, fish tissue) or among stations?
- Do the data indicate any toxic effects on living resources?
- Is there a correlation between elevated chemical levels and toxic effects?
- Is there evidence of a segment-wide chemical contaminant problem, or are problem areas localized to one or a few stations?

The decision rules and data analysis displays provided a standardized output of information for the workgroup to consider as they addressed these questions. Ultimately, the workgroup’s characterizations were based on the weight of evidence and their best professional judgement.

B.6. Limitations in Data Interpretation

The resulting characterization is only as good as the available data and the tools used to interpret these data. Limitations in the data have already been discussed in Section II. Below are some limitations in the interpretative tools:

- Not all chemicals measured have thresholds associated with them. In the absence of thresholds, these data could not be used in the characterization.

- Because there are no EPA-approved sediment criteria, sediment thresholds and benchmarks used for interpreting sediment contaminant concentrations have a lower level of confidence than water quality criteria. This is important to note since sediment data drove most of the characterizations.

- The Benthic Index of Biotic Integrity (B-IBI) is an index used by the Bay Program to address management questions and set new restoration goals. However, interpretation of the data have been largely limited to the known relationship between low dissolved oxygen and degraded benthic communities. Without a way to interpret benthic data in relation to chemical contamination, we are limited in our use of these data, particularly in those areas where low dissolved oxygen cannot be ruled out as a cause for benthic degradation.

- The interpretation of the chemical contaminant data is based on thresholds. The extent to which and how low level chemical contaminant exposure (including the potential for additive and synergistic effects from multiple chemical contaminants) may pose a risk to the Bay's living resources is largely unknown. Such information from the Chesapeake Bay Environmental Effects Committee Toxics Research Program and other research programs could improve the characterization and help the Bay Program better target monitoring in the future.

- Data are lacking for important assessment parameters such as total organic carbon (TOC), acid volatile sulfides (AVS), and simultaneously extractable metals (SEM) that indicate the bioavailability and subsequent toxicity of measured chemical contaminant levels. AVS, SEM, and TOC measurements which are used for assessing sediment toxicity of trace metals were only available for metals data collected concurrently with data collected for the Chesapeake Bay Ambient Toxicity Assessment Program. A TOC content of 2% was assumed in calculating those thresholds dependent on TOC levels since most TOC levels in the Bay fall within a range of 1 - 4%. However, TOC can vary as much as 0.1-10%.

C. STEP III: CHARACTERIZE ALL TIDAL RIVERS OF THE CHESAPEAKE BAY

C.1. Guidelines for Characterizing a Segment

The final step in conducting the characterization was to evaluate the data for each segment and make a characterization. The general characterization guidelines used by the workgroup for characterizing a segment into one of the four categories are listed in Table 4 and detailed below.

Region of Concern

For a segment to be characterized as a *Region of Concern*, the following must be documented:

(1) Multiple measurements of one or more chemical contaminants in the water, bottom sediments, and/or finfish/shellfish tissue at concentrations exceeding the established water column, sediment, or tissue thresholds, respectively;

AND

(2) Multiple observations of one or more adverse effects on living resources exposed to the waters and/or sediments of that area;

AND

(3) Strong evidence for a causal relationship between the measured water column and/or sediment chemical contaminant concentrations and the observed chemical contaminant-related adverse effects on the Bay's living resources, where causes other than chemical contamination (i.e., low dissolved oxygen conditions and disease) can be eliminated.

Area of Emphasis

For a segment to be characterized as an *Area of Emphasis*, the following must be documented:

(1) Multiple measurements of chemical contaminants in the water column, bottom sediments, and/or finfish/shellfish tissue at concentrations exceeding the established water column, sediment, or tissue thresholds, respectively;

AND/OR

(2) Multiple observations of one or more adverse effects on living resources exposed to the waters and/or sediments of that area;

In this case, there is limited or no evidence for a relationship between the measured water column and/or sediment chemical contaminant concentrations and the observed chemical contaminant-related adverse effects on the Bay's living resources, where causes other than chemical contamination (i.e., low dissolved oxygen conditions and disease) can be eliminated. If sufficient data are available for both exposure and effects data, then both conditions (1) and (2) need to be met. If data are only available for exposure data, then only condition (1) needs to be met to characterize an area into this category. If data are only available for effects data, then only condition (2) needs to be met to characterize an area into this category.

There are several cases when a segment can be characterized into this category. If a segment has limited or no effects data, but shows evidence for exposure data that exceed thresholds, it may be characterized as an *Area of Emphasis*. If a segment has limited or no exposure data, but there are observations of adverse effects, it may be characterized as an *Area of Emphasis*. A segment may also be characterized into this category when both effects data and exposure data exceeding thresholds are observed, but there is no relationship between the two.

Area with Low Probability for Adverse Effects

For a segment to be designated as an *Area with Low Probability for Adverse Effects*, the following must be documented:

(1) Multiple measurements of multiple chemical contaminants in the water column, bottom sediments, and/or finfish/shellfish tissue at concentrations below the established water column, sediment, or tissue thresholds, respectively;

AND/OR

(2) Multiple measurements of one or more chemical contaminant-related adverse effects on living resources yield no evidence for adverse effects significantly different from controls or reference areas.

In the original geographical targeting protocol [2], a segment could not be characterized into this category unless both exposure <u>and</u> effects data provided enough evidence that there was not a chemical contaminant-related problem. As the workgroup evaluated data, they quickly realized that there are very few cases where sufficient exposure and effects data are available in a segment. Good spatial coverage of effects data are limited in the tidal rivers. The workgroup found that, in the absence of effects data, exposure data may be sufficient for assigning a segment to this category. If sufficient data are available for both exposure and effects data, then both conditions (1) and (2) need to be met to characterize an area into this category. If data are only available for exposure data, then only condition (1) needs to be met to characterize an area into this category. If data are only available for effects data, then only condition (2) needs to be met to characterize an area into this category.

Area with Insufficient or Inconclusive Data

For an area to be designated as an *Area with Insufficient or Inconclusive Data*, the following must be documented:

(1) Either the measurements of chemical contaminants in water, sediment, or finfish/shellfish tissue are too limited temporally and/or spatially, are inconclusive or conflicting, or are of unknown quality and cannot support the level of confidence required to characterize the region into one of the other three categories;

AND/OR

(2) Either the measurements of the potential adverse effects on living resources are too limited temporally and/or spatially, are inconclusive or conflicting, or are of unknown quality and cannot support the level of confidence required to characterize the region into one of the other three categories;

An area can be characterized into this category if either condition (1) or condition (2) is met, or if both conditions (1) and (2) are met.

C.2. Making a Characterization

Using these guidelines and the available data, each workgroup member weighed the evidence for each segment and, using their best professional judgement, they made their characterizations. The process for evaluating and integrating data was designed to standardize the characterization process as much as possible and the workgroup sought to be as consistent in its judgements as possible. It is important to note that making a characterization is not a standardized process where anyone looking at a set of data and applying the general characterization criteria and decision rules would come up with the same characterization. Each workgroup member had to evaluate the data, recognizing certain realities such as:

- the overall paucity of chemical contaminant data in the tidal rivers,
- the paucity of effects data in many segments,
- a database weighted heavily towards sediment data,
- the different mixes of data in different rivers of the Bay,
- the quality of data, and
- the inherent uncertainties in different thresholds.

Each workgroup member evaluated the data independently and filled out a report card that justified their characterization of the segment. The workgroup met 6 times from August 1998 through April 1999 to come to consensus on each characterization. In most cases, the initial votes were not unanimous. Those with the minority vote were given the choice of either presenting their justification to the workgroup, or allowing the majority to present their case. After this discussion, workgroup members placed a final vote. The majority vote became the final characterization and the minority members were allowed to caveat the characterization with a narrative description. This process for finalizing characterizations was very effective in building workgroup consensus and comfort with the final decisions. The strength of this characterization is represented by the workgroup's technical knowledge of chemical contaminant data, its diversity of interests, and its ability to discuss the data and reach a consensus on all characterizations.

C.3. Insights Into Making Characterizations

There were some general "rules of thumb" that emerged in the characterization process that are worth noting:

- **Exposure data alone can drive a characterization.** The Workgroup discovered, in the absence of effects data, that chemistry data could be compelling enough to indicate the presence or absence of a chemical contaminant problem if the data were widespread, recent, and pertained to persistent, bioaccumulative, and toxic chemicals. The workgroup found cases where the chemistry data were compelling enough to characterize an entire segment as an *Area with Low Probability for Adverse Effects* or an *Area of Emphasis* on the basis of sediment chemistry data alone. The workgroup's confidence in these characterization could be bolstered in the future with effects data.

- **Confidence in effects data can drive a characterization.** Concurrently collected exposure and effects data from the Chesapeake Bay Ambient Toxicity Assessment Program was compelling evidence for characterizing a segment as an *Area of Emphasis* or an *Area with Low Probability for Adverse Effects* even if it was somewhat spatially or temporally limited, due to the workgroup's high level of confidence in the data. Additional assessments to increase spatial coverage of the data is necessary to confirm these initial characterizations.

- **Benthic community data cannot drive a characterization.** Because interpretative tools have not been developed to distinguish chemical contaminant-related benthic community degradation from degradation caused by other stressors such as low dissolved oxygen, benthic community data cannot drive a characterization, but can be used in support of making a characterization.

- **Information such as landuse and loadings data can be helpful in making characterizations.** The workgroup let the ambient data drive their characterization and tried not to let their personal knowledge of a given area influence their characterizations. However, they found that sometimes considering information about landuse, loadings, and historical sources sometimes helped them to finalize a characterization. For example, if an area has known kepone problems from historical sources, but the ambient data do not include kepone measurements, then data may be insufficient in making a characterization. Another example is if a segment was lacking data in one area and the landuse around the entire segment was thought to be similar, the workgroup may infer that similar ambient contaminant conditions exist in the unsampled area.

- **Several segments have localized problems.** Several segments had specific localized contamination problems that weren't reflective of the overall condition of the segment, but should be addressed in future management and monitoring efforts. These localized problem areas were noted in the workgroup's characterization, but most often did not drive the characterization.

- **In some cases, the workgroup chose to characterize a segment as an** *Area with Insufficient or Inconclusive Data* **until all available data have been collected.** In some cases, where data were currently being collected for a particular segment and would be available in 1999 or early 2000, the workgroup decided to characterize it as an *Area with Insufficient or Inconclusive Data*, pending the new data.

IV. REVIEW OF CHARACTERIZATION WORKPLAN AND RESULTS

The Chesapeake Bay Program's Scientific and Technical Advisory Committee (STAC) technical reviewed a final draft of the technical workplan and the public report and provided a very favorable and constructive review, indicating that this initial assessment of the Bay's tidal rivers "provides a good model for other estuary programs to utilize". Appendix D includes the STAC review and the Toxics Subcommittee's response to the review. STAC reviewed the 1995 *Chesapeake Bay Chemical Contaminant Geographical Targeting Protocol* [2], which is the foundation for this effort. The STAC has received progress reports throughout the characterization process, either through presentations to STAC or the Implementation Committee. The Regional Focus Workgroup Chair presented a final briefing to the STAC on March 25, 1999.   The STAC members' reaction was very positive and they raised no concerns about the technical merit of the effort.

The technical workplan also was reviewed by the Toxics Subcommittee, Regional Focus Workgroup, and two technical reviewers from the US Environmental Protection Agency. The Implementation Committee was briefed on the characterization process throughout the effort. Additionally, a presentation was developed to aid workgroup members in communicating the process and results to the managers on the Implementation Committee to ensure buy-in from each of the participating agencies and institutions. Managers and communicators from Maryland and Virginia state agencies were further briefed on this effort and the results in 1999.

The results of the characterization are summarized in a public report [1]. The Bay Program signatory jurisdictional representatives on the Implementation Committee and the key Principals' Staff Committee liaisons reviewed this report. Additionally, a community expert panel and the Chesapeake Bay Program Office's Communications Team reviewed the public report and results to ensure that the information presented was useful and relevant to stakeholders.

V. IMPLICATIONS OF THE CHARACTERIZATION

Through the characterization process, the Bay's tidal rivers were classified into one of four categories based on the severity of chemical contaminant-related problems and the resulting need for chemical contaminant reduction, prevention, and/or assessment actions. In the 1994 basinwide toxics strategy, the CBP signatories have committed to take the following actions based on the characterization results:

- Develop, adopt, and begin implementation of Regional Action Plans within two years of designation of additional *Regions of Concern*.
- Identify and implement necessary pollution prevention actions in the identified *Areas of Emphasis* to eventually eliminate the potential for chemical contaminant-related effects.
- Take actions necessary to ensure future protection of *Areas with Low Probability for Adverse Effects*.
- Initiate necessary assessments in *Areas with Insufficient or Inconclusive Data*.

Within six months of each subsequent review of available data, management and assessment actions will be identified and implemented in specific regions of the Bay. The primary value and utility of the characterization is in identifying areas that need additional monitoring and assessment to better characterize the status of toxic effects on living resources inhabiting those areas. This characterization can also serve as a planning tool to help the Chesapeake Bay Program determine the areas in which to focus its voluntary pollution prevention and reduction efforts and the areas in which to focus its voluntary preservation/conservation efforts. The Bay Program will also use the characterization to inform the public, local communities, and watershed associations about the chemical contaminant conditions in their rivers so that they can take additional actions to protect or restore their rivers. The characterization gives the State/District partners base information to allow them to conduct the more detailed risk assessment analysis, site specific analysis, and source assessment studies which may be necessary before regulatory actions can be taken.

The Chesapeake Executive Council directed the Bay Program to reevaluate and revise the 1994 basinwide toxics strategy in 1999. This characterization, coupled with the *1999 Toxics Loadings and Release Inventory*, will be used to set new toxics reduction and prevention goals for beyond the year 2000.

VI. UPDATES TO CHARACTERIZATION

The characterization of each segment will be reevaluated every three years using data collected since the previous evaluation, as committed to within the *1994 Chesapeake Bay Basinwide Toxics Reduction and Prevention Strategy*. To prepare for future updates to the characterization, the Bay Program will continue to acquire and load any existing, recent, relevant chemical contaminant and biological data. Additionally, the Bay Program will direct further assessments in the *Areas with Insufficient or Inconclusive Data* and those areas where data are needed to strengthen the initial characterization. Triennial updates to the characterization will allow the Bay Program to assess progress in reducing the number of *Regions of Concern* and *Areas of Emphasis*, increasing the number of *Areas with Low Probability for Adverse Effects*, and eliminating all *Areas with Insufficient or Inconclusive Data*.

Recommendations for Future Updates to Characterization

Specific recommendations for improving subsequent characterizations are based on the data and interpretative tool limitations highlighted in this report. To address data limitations, the Bay Program will continue its data acquisition efforts to acquire all relevant, recent, available information and direct assessments in particular areas to address any remaining data gaps. In addition to improving coverage of data, the Bay Program will work to encourage improving the interpretative tools (i.e., thresholds) for evaluating the data. The following are specific recommendations for future updates to the characterization:

- **Improve spatial and temporal coverage of exposure and effects data through data acquisition efforts.**
  - Through implementation of the Chesapeake Information Management System (CIMS) and building partnerships with state agencies and research institutions, continue to acquire existing and future chemical contaminant exposure and effects data for future characterization updates. Acquisition of currently available data will be focused on filling in data gaps in the *Areas with Insufficient or Inconclusive Data* and other areas where characterizations need to be strengthened with additional data.
  - Work with communities, local governments, and watershed associations to acquire additional data to strengthen characterization in the future.
  - Consider the feasibility of acquiring and interpreting fish abnormality data and waterfowl/wading bird contaminant concentrations data in future characterizations.

- **Conduct monitoring, assessments, and research to support future updates.** Only through increased funding, intensified coordination with all Federal and State toxics monitoring and research efforts, and intentional collaboration between the Signatory states at the governmental and academic level to address Bay-wide issues, will the gaps in data coverage and gaps in our knowledge of the distribution and extent of toxic effects be filled.
  - If all available chemical data are not sufficient to characterize a segment, then implement monitoring priorities defined in the *Chesapeake Bay Toxics Monitoring Strategy* [18] to fill in data gaps, reduce the number of *Areas with Insufficient or Inconclusive Data,* and strengthen the other characterizations.
  - Increase spatial coverage of ambient toxicity testing through the enhancement of state monitoring programs.
  - Consider using a random sampling design for gathering data so that data from particular sites are more likely to be representative of the entire segment sampled.
  - Require the collection and reporting of acid volatile sulfides, simultaneously extractable metals, and total organic carbon in conjunction with metals sediment analysis and total organic carbon in conjunction with organic contaminant sediment analysis.
  - Identify those chemicals which may be problematic to the Bay due to their use, toxicity or persistence but are not included in our current monitoring because they have not been measured. These chemicals can be targeted for additional monitoring to provide enough data to assess whether they are causing effects in the Bay.
  - Encourage more speciation measurements to determine the "free" form of a contaminant that is bioavailable so that toxicity can be better predicted.
  - Encourage research through the Chesapeake Bay Environmental Effects Committee Toxics Research Program and other research programs to determine the extent to which and how low level chemical contaminant exposure (including the potential for additive and synergistic effects from multiple chemical contaminants) poses a risk to the Bay's living resources. The characterization is based on the best available thresholds. We do not know what, if any, the effect is from long term exposure at chemical contaminant levels that are below these thresholds.

- **Update and improve tools for interpreting exposure and effects data.**
  - Continually update water quality, sediment, and fish tissue thresholds as new thresholds become available, including the application of guidelines that consider additive effects of contaminants with similar modes of action.
  - Explore the utility of using site-specific or Bay Program segment-specific total organic carbon data for sediment thresholds that are dependent on total organic carbon. Work with MD Geological Survey, Chesapeake Bay benthic monitoring investigators, and the US Army Corps of Engineers to acquire total organic carbon data. This may be difficult, given the fine scale spatial variability in sediment type.

S Explore the AQUIRE database and other sources of empirically-based bioconcentration factors and quantitative structure activity relationship (QSAR) predicted bioconcentration factors for relevant thresholds to use in future characterization updates for those chemical contaminants without thresholds listed in Appendices B and C.

S Refine the decision rules for how to include a diversity of toxicity data from national and state programs.

S Develop interpretative tools to determine chemical contaminant-related benthic degradation.

S Explore interpretative tools that link fish community data and finfish/shellfish abnormality data to chemical contaminants for use in characterization updates.

- **Develop additional characterization rules and guidelines based on the 1999 characterization.**

  S Conduct quantitative analysis of characterization results to determine the feasibility of developing quantitative guidelines for making future characterizations. For example, determine if a certain density of data or number of threshold exceedences was needed to characterize an area into a particular category.

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3. Chesapeake Bay Program (1999) *1999 Chesapeake Bay Basinwide Toxics Loading and Release Inventory*. US EPA CBPO, Annapolis, Maryland.

4. Chesapeake Bay Program (1994) *Chesapeake Bay Basinwide Toxics Reduction Strategy Reevaluation Report.* US EPA CBPO, Annapolis, Maryland.

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13. Chesapeake Bay Program (1998), *Fish Tissue Threshold Compendium*, *Draft Report*, US EPA CBPO, Annapolis, Maryland.

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TABLE 4. GUIDELINES FOR INTERPRETING CHEMICAL CONTAMINANT DATA AND MAKING TOXICS CHARACTERIZATION (refer to Sections III of technical workplan for more information)

		REGION OF CONCERN	AREA OF EMPHASIS	AREA WITH LOW PROBABILITY FOR ADVERSE EFFECTS	AREA WITH INSUFFICIENT OR INCONCLUSIVE DATA
Exposure	Water Column Contaminant Concentration	Water column concentrations exceed current acute or chronic EPA aquatic life criteria or Bay states' water quality standards for protection of aquatic life or are above laboratory concentrations observed to cause acute or chronic toxicity in aquatic organisms.	Water column concentrations exceed current acute or chronic EPA aquatic life criteria or Bay states' water quality standards for protection of aquatic life or are above laboratory concentrations observed to cause acute or chronic toxicity in aquatic organisms.	Water column concentrations do not exceed current acute or chronic EPA aquatic life criteria or Bay states' water quality standards for protection of aquatic life or are not above laboratory concentrations observed to cause acute or chronic toxicity in aquatic organisms.	Either no quality water column concentration data are available or data are too limited or inconclusive to characterize area.
		AND/OR	***AND/OR***	***AND/OR***	***AND/OR***
	Bottom Sediment Contaminant Concentration	Sediment contaminant concentrations are above thresholds associated with probable or potential adverse effects.	Sediment contaminant concentrations are above thresholds associated with probable or potential adverse effects.	Sediment contaminant concentrations are below thresholds associated with probable or potential adverse effects.	Either no quality sediment contaminant concentration data are available or data are too limited or inconclusive to characterize area.
		AND/OR	***AND/OR***	***AND/OR***	***AND/OR***
	Finfish Tissue Contamination	Edible portion of finfish tissue contaminant concentrations in resident, non-migratory species exceed levels required for protection of human health or restrictions on harvest/consumption are in place.	Edible portion of finfish tissue contaminant concentrations in resident, non-migratory species exceed levels required for protection of human health or restrictions on harvest/consumption are in place.	Edible portion of finfish tissue contaminant concentrations in resident, non-migratory species do not exceed levels required for protection of human health and there are no restrictions on harvest/consumption in place.	Either no edible portion of finfish tissue contaminant data are available or data are too limited or inconclusive to characterize area.
		AND/OR	***AND/OR***	***AND/OR***	***AND/OR***
	Shellfish Tissue Contamination	Shellfish tissue contaminant concentrations exceed levels required for protection of human health or restrictions on harvest/consumption are in place.	Shellfish tissue contaminant concentrations exceed levels required for protection of human health or restrictions on harvest/consumption are in place.	Shellfish tissue contaminant concentrations do not exceed levels required for protection of human health; there are no restrictions on harvest or consumption.	Either no shellfish tissue contaminant data are available or data are too limited or inconclusive to characterize area.
		=====AND=====	**===AND/OR===**	**===AND/OR===**	**===AND/OR===**
Effects	Water Column Toxicity	Percent of ambient acute or chronic effects differ significantly from reference areas/controls.	Percent of ambient acute or chronic effects differ significantly from reference areas/controls.	Percent of ambient acute or chronic effects do not differ significantly from reference areas/controls.	Either no water column toxicity data are available or data are too limited or inconclusive to characterize area.
		AND/OR	***AND/OR***	***AND/OR***	***AND/OR***
	Bottom Sediment Toxicity	Percent of ambient acute or chronic effects differ significantly from reference areas/controls.	Percent of ambient acute or chronic effects differ significantly from reference areas/controls.	Percent of ambient acute or chronic effects do not differ significantly from reference areas/controls.	Either no sediment toxicity data are available or data are too limited or inconclusive to characterize area.
		AND/OR	***AND/OR***	***AND/OR***	***AND/OR***
	Benthic Community Structure	Chesapeake Bay benthic restoration goal index of 3 or less, where dissolved oxygen can be eliminated as the principal cause of impact on the benthic community.	Chesapeake Bay benthic restoration goal index of 3 or less, where dissolved oxygen can be eliminated as the principal cause of impact on the benthic community.	Chesapeake Bay benthic restoration goal index of greater than 3, or index less than 3 where dissolved oxygen is identified as the principal cause of impact on the benthic community.	Either no data are available on benthic community structure or data are too limited or inconclusive to characterize area.

Figure 1 - coming soon

Figure 2: Water Chemical Concentration Sampling Stations 1994 - 1998 Data Used in 1999 Toxics Characterization

Figure 3: Sediment Chemical Concentration Sampling Stations 1984 - 1998 Data Used in 1999 Toxics Characterization

Figure 4: Finfish/Shellfish Tissue Chemical Concentration Sampling Stations 1990 - 1997 Data Used in 1999 Toxics Characterization

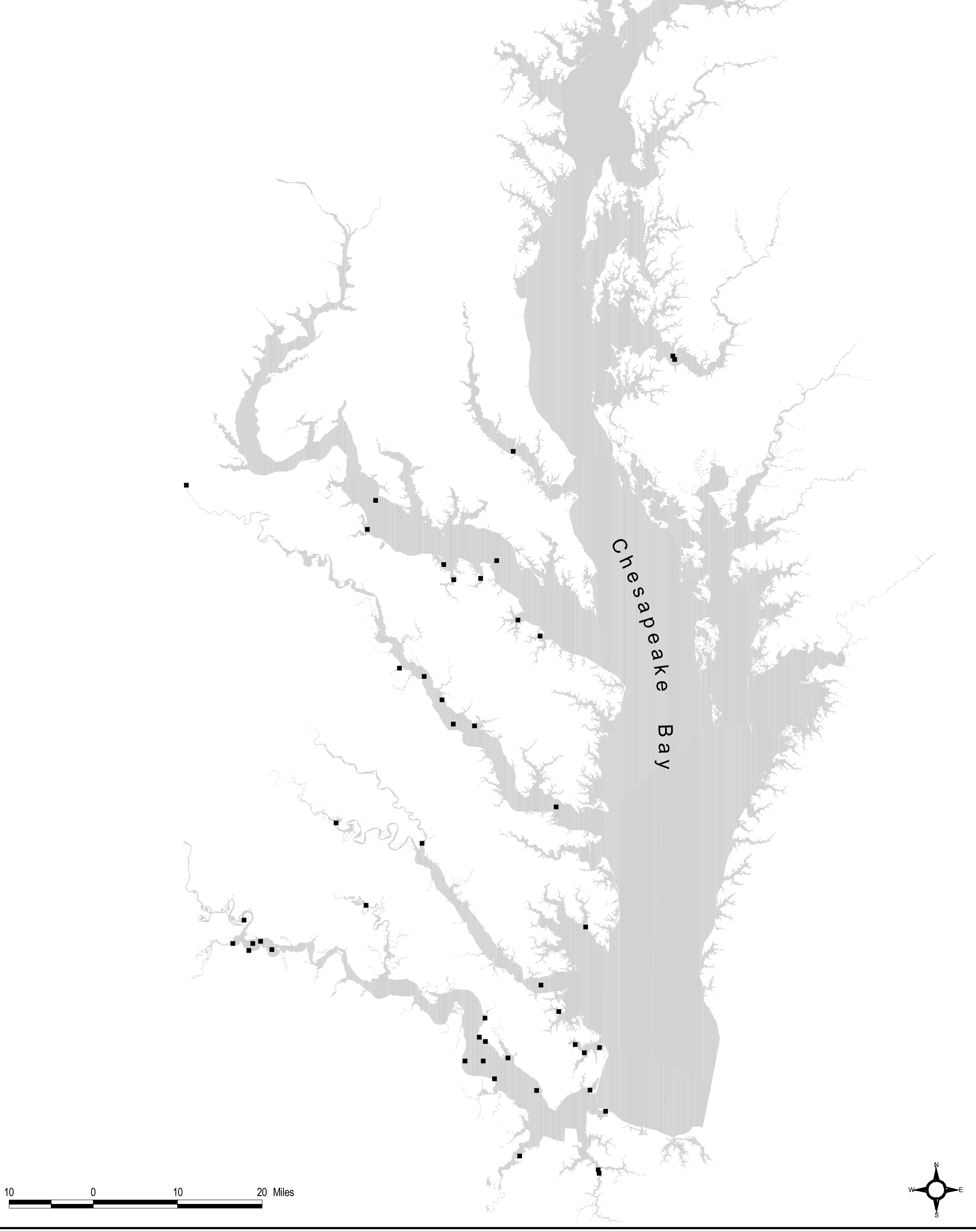
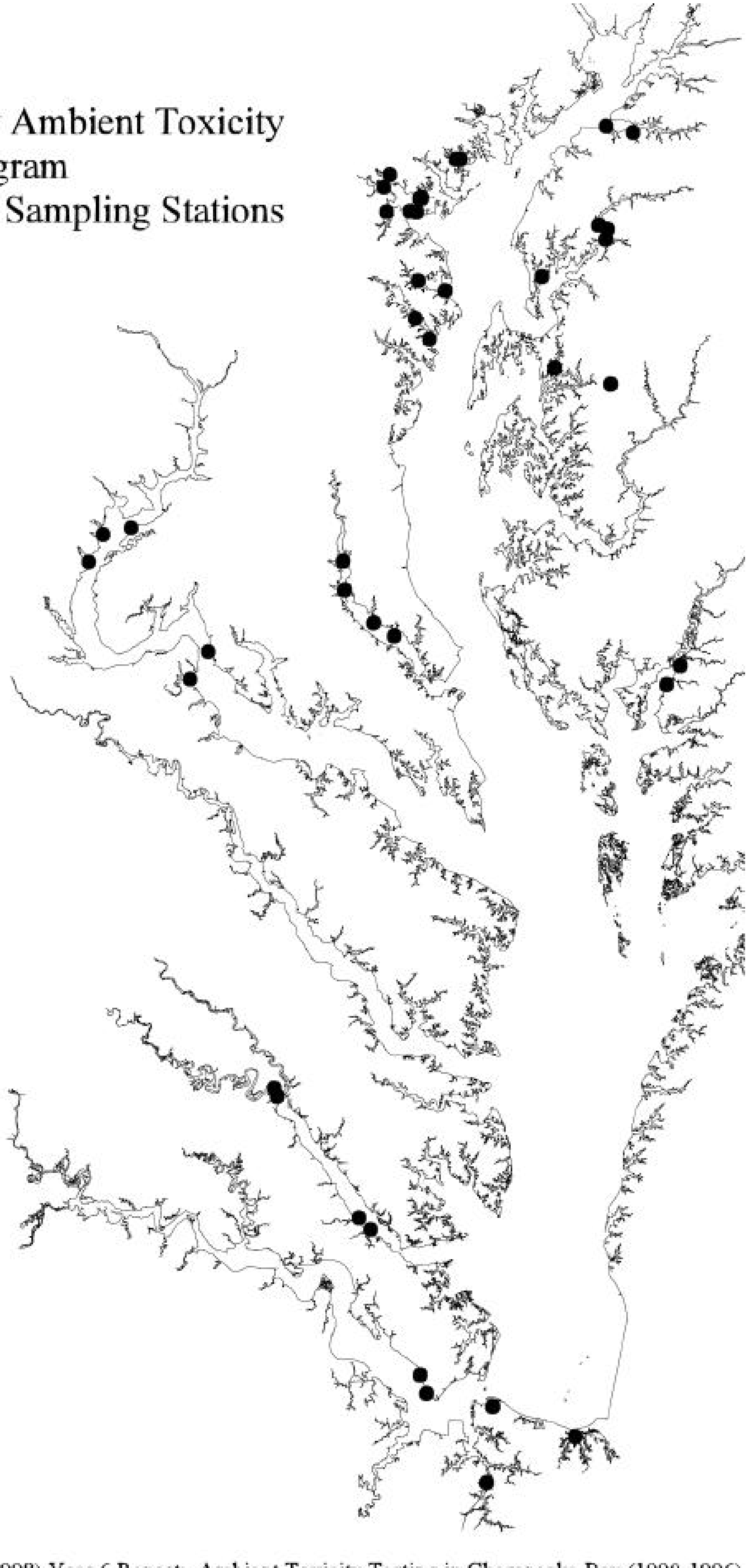


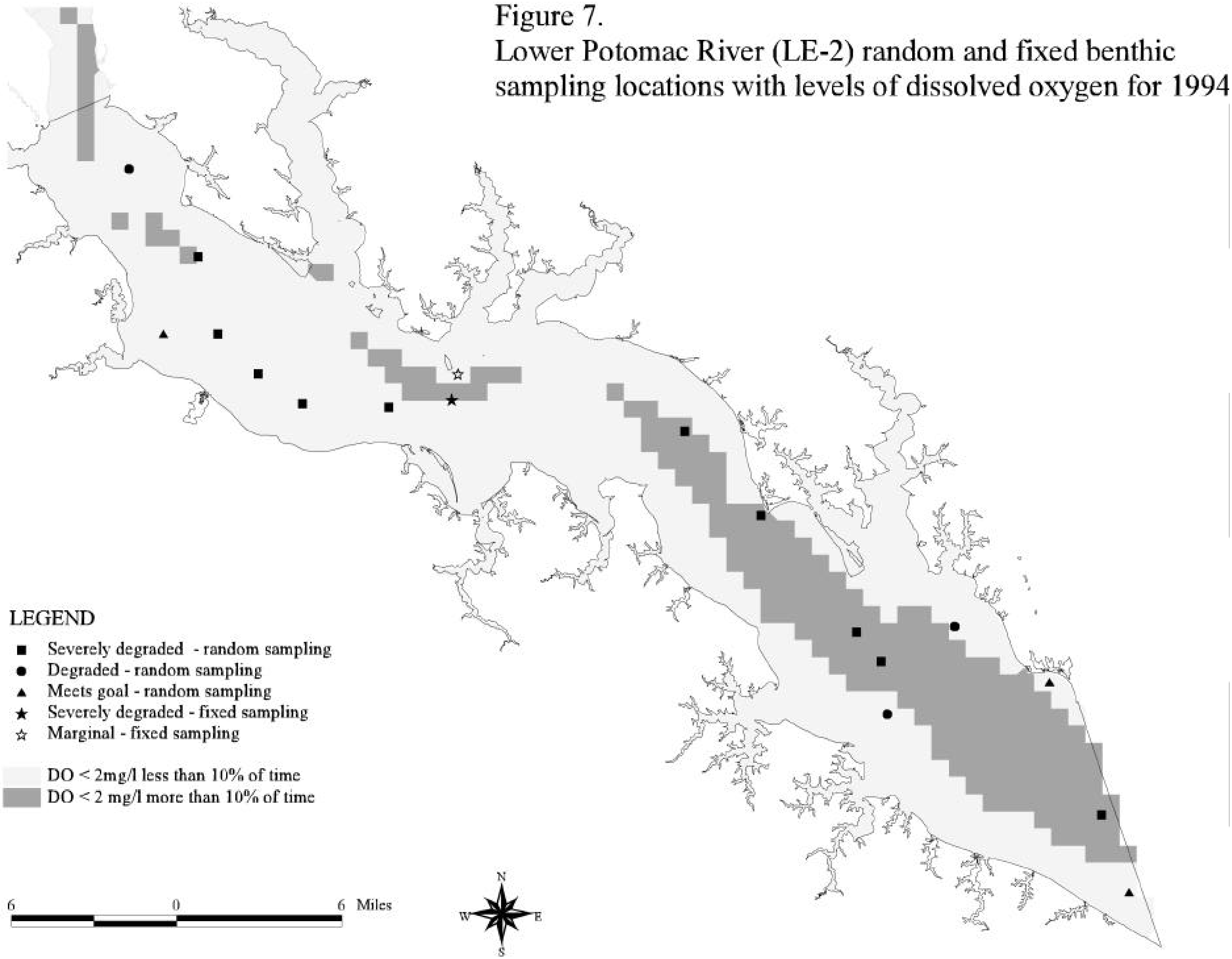
Figure 5.
Chesapeake Bay Ambient Toxicity
Assessment Program
Water/Sediment Sampling Stations
1990-1996



Source: Hall et al. (1998) Year 6 Report: Ambient Toxicity Testing in Chesapeake Bay (1990-1996)

Figure 6 - coming soon

Figure 7.
Lower Potomac River (LE-2) random and fixed benthic sampling locations with levels of dissolved oxygen for 1994



APPENDIX A: SUMMARY OF REFERENCES IN TOXICS DATABASE

R0000187
Sediment Survey of Priority Pollutants in the District of Columbia
Waters:Prepared for the Interstate Commission on the Potomac River
Basin, March 5, 1990
PREPARED FOR:Interstate Commission on the Potomac River Basin Rockville, MD
PREPARED BY:LTI, Limno-Tech Inc.
LTI, Limno-Tech Inc.
2395 Huron Pkwy

R0000209
1983 Crab Survey
Mary Jo Garreis, Deidre Murphy
Maryland Department of the Environment/Water Management Administration
Standards & Certification Division

R0000211
Shellstock Contaminant Monitoring Program
Mary Jo Garreis, Deidre Murphy, P.Distefano
Maryland Department of the Environment/Water Management Administration
Standards & Certification Division

R0000212
Basic Water Monitoring Program Fish Tissue Network
Mary Jo Garreis, Deidre Murphy
Maryland Department of the Environment/Water Management Administration
Standards & Certification Division

R0000238
Toxic Substances in Submerged Aquatic Vegetation Beds
January 1990
Jeffrey C. Cornwell and J. Court Stevenson
Horn Point Environmental Laboratories, University of Maryland
Center for Environmental and Estuatine Studies

R0000241
Maryland Chesapeake Bay Sediment Toxicant Monitoring Program
Robert Magnien
Maryland Department of the Environment/Water Management Adminstration
Chesapeake Bay and Special Projects Program

R0000242
National Status & Trends Program for Marine Environmental Quality
Second Summary of Data on Chemical Contaminants in Sediment
from the Nationl Status and Trends Program
Dr. Thomas P. O'Connor, Manager
National Status and Trends Program
NOAA/National Ocean Service
U.S. Department of Commerce

R0000245
A Pilot Study for Ambient Toxicity Testing in Chesapeake Bay
Volume I Year I Report April, 1991.
Lenwood W. Hall Jr.; Michael C. Ziegenfuss; Steven A. Fisher; Raymond W.
Alden, III; Emily Deaver; Jay Gooch; Nikki Debert-Hastings.
CBP/TRS 64/91

R0000246
A Pilot Study for Ambient Toxicity Testing in Chesapeake Bay,
Volume II Year II Report November, 1992.
Lenwood W. Hall Jr.; Michael C. Ziegenfuss; Steven A. Fisher; Raymond W.
Alden, III; Emily Deaver; Jay Gooch; Nikki Debert-Hastings.
CBP/TRS 82/92

R0003605
ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM (EMAP),
VIRGINIA PROVINCE 1991 SEDIMENT CHEMISTRY DATA

R0003606
ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM (EMAP),
VIRGINIA PROVINCE 1990 SEDIMENT CHEMISTRY DATA

R0003607
ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM (EMAP),
VIRGINIA PROVINCE 1992 SEDIMENT CHEMISTRY DATA

R0003608
DEQ/EPA, Chesapeake Bay and Tributaries Study, '84

R0003609
DEQ/EPA, Chesapeake Bay and Tributaries Study, '85

R0003610
DEQ/EPA, Chesapeake Bay and Tributaries Study, '86

R0003611
DEQ/EPA, Chesapeake Bay and Tributaries Study, '91

R0003612
DEQ, Elizabeth River Extra Study, '86

R0003613
DEQ, Elizabeth R. Long-Term Monitoring Program, '89

R0003614
DEQ, Virginia Tributary Study, '83

R0003615
DEQ, Water Division General, '85-

R0003616
A Pilot Study for Ambient Toxicity Testing in Chesapeake Bay,
Year 3 Report, May 1994.
Lenwood W. Hall, Jr.; Michael C. Ziegenfuss; Ronald D. Anderson;
William D. Killen; Raymond W. Alden III; Peter Adolphson
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R0003617
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U.S. EPA Chespeake Bay Program, CBP/TRS 98/93, August 1993

R0003618
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GMU (Dept. of Chemistry); MDE; USGS (Water Res. Div.); Metropolitan
Washington Council of Governments; Occoquan Watershed Monitoring Lab.
U.S. EPA Chespeake Bay Program, CBP/TRS 131/95, April 1994

R0003619
Inventory of Chemical Concentrations in Coastal and Estuatine
Sediments
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U.S. Department of Commerce, National Oceanic and Atmospheric Admin.,
National Ocean Service, Office of Ocean Resources Conservation and

R0003620
Field assessment of striped bass, morone saxatilis, larval survival
as related to contaminants and changes in water quality parameters
Hall, L.W. 1984.
Johns Hopkins University, Applied Physics Laboratory, Aquatic
Ecology Section, Shady Side, Maryland

R0003621
In-situ investigations for assessing striped bass, morone saxatilis
larval and yearling survival as related to conaminants and changes in
water quality parameters-contaminants and water quality evaluations
Hall, L.W. 1985.
Johns Hopkins University, Applied Physics Laboratory, Aquatic
Ecology Section, Shady Side, Maryland

R0003622
In-situ investigations for assessing striped bass, morone saxatilis, prolarval and yearling survival as related to contaminants and water quality parameters in the Potomac River-contaminant and water quality
Hall, L.W., W.S. Hall, S.J. Bushong. 1986
Johns Hopkins University, Applied Physics Laboratory, Aquatic Ecology Section, Shady Side, Maryland

R0003623
Mobile on-site and in-situ striped bass contaminant studies in the Choptank River and Upper Chesapeake Bay-annual contaminant and water quality evaluations in east coast striped bass habitats
Hall, L.W., S.J. Bushong, M.C. Ziegenfuss, W.S. Hall. 1987.
Johns Hopkins University, Applied Physics Laboratory, Aquatic Ecology Section, Shady Side, Maryland

R0003624
Striped bass contaminant and water quality studies in the Potomac River and Upper Chesapeake Bay-annual contaminant and water quality evaluations in east coast striped bass habitats
Hall, L.W. M.C. Zeigenfuss, S.J. Bushong, M.A. Unger. 1988.
Johns Hopkins University, Applied Physics Laboratory, Aquatic Ecology Section, Shady Side, Maryland

R0003625
Striped bass contaminant and water quality studies in the Potomac River and Upper Chesapeake Bay in 1989: Annual contaminant and water quality evaluations in east coast striped bass habitats
Hall, L.W., M.C. Ziegenfuss, S.J. Bushong, J.A. Sullivan, M.A. Unger. 1991.
University of Maryland System, Agricultural Experiment Station, Wye Research and Education Center, Queenstown, MD

R0003626
In-situ striped bass contaminant and water quality studies in the Potomac River and Upper Chesapeake Bay in 1990
quality evaluations in east coast striped bass habitats
Hall, L.W., M.C. Zeigenfuss, S.A. Fischer, J.A. Sullivan, D.M. Palmer. 1992.
University of Maryland, Agricultural Experiment Station, Wye Research and Education Center, Queenstown, MD.

R0003627
PESTICIDE MONITORING OF OYSTERS, 1974-1995
VIRGINIA DIVISION OF SHELLFISH SANITATION

R0003628
sys$rdb:[tables.saic.nst95.raw]bslivmet. asscii file.

R0003629
sys$rdb:[tables.saic.nst95.raw]bslivorg. asscii file.
Dolvin, Scott. NOAA, National Status and Trends Program

R0003630
sys$rdb:[tables.saic.nst95.raw]bssed. asscii file.
Dolvin, Scott. NOAA, National Status and Trends Program

R0003631
sys$rdb:[tables.saic.nst95.raw]mwsed. asscii file.
Dolvin, Scott. NOAA, National Status and Trends Program

R0003632
sys$rdb:[tables.saic.nst95.raw]mwtis. asscii file.
Dolvin, Scott. NOAA, National Status and Trends Program

R0003635
Fate and Transport of Agricultural Pesticides in the Patuxent River
A SUB-ESTUARY OF THE CHESAPEAKE BAY
J.A. Harman-Fetcho
University of Maryland, Graduate School

R0003636
Agricultural Pesticide Residues in Oysters and Water From Two Chesapeake
BAY TRIBUTARIES
S.J. Lehotay
J.A. Harman-Fetcho
USDA, Agricultural Research Services
Beltsville Agric. Res. Center

R0003638
Ambient Toxicity Testing in Chesapeake Bay
Year 6 Report
7/1/98
Lenwood W. Hall, Jr.
Ronald D. Anderson
Univ. of Maryland System
Agricultural Experiment Station

R0003639
Ambient Toxicity Testing in Chesapeake Bay
Year 5 Report
2/1/98
Lenwood W. Hall, Jr.
Ronald D. Anderson
Chesapeake Bay Program

R0003640
A Pilot Study for Ambient Toxicity Testing in Chesapeake Bay
Year 4 Report
4/1/97
Lenwood W. Hall, Jr.
Ronald D. Anderson
Chesapeake Bay Program

R0003643
MAIA 1997 Chesapeake Bay Sediment Data

R0003644
EMAP- Estuaries Program Level Database
1993 Virginian Province
Sediment Chemistry Data
Charles Strobel, US EPA NHEERL-AED
Melissa Hughes
Mary 25, 1996

R0003645
VA Ambient Monitoring Network, 1992- 1998.
STORET Retrieval
Retreival Date 12/10/98

R0003646
Sediment Contamination & Toxicity Assessments in support of the development of Benthic Restoration Goals & Sediment Quality Criteria. Final Report to VDEQ. 29.pgs. 1998.
Dauer, D.M.

R0003647
1995 Tissue and Sediment Monitoring Prog
Virginia Department of Environmental Q

R0003648
Nitrate and Pesticide Data for Waters of the Mid-Atlantic
U.S. Geological Survey Open-File Report 98-
Data download from usgs.gov/maia/swdata
Matthew J. Ferrai
Scott W. Ator
U.S. Department of the Interior, U
USEPA

R0003650
Virginia Toxics Database
Data: 1979-1993
Virginia Department of Environmental Quality
Water Division - Office of Environmental Research and Standards

R0003737
Paxtuxent River Trace Element Data
Dr. Gerhardt F. Reidel
Academy of Natural Sciences
Estuarine Research Center

APPENDIX B: Characterization Decision Rules

Overview

Through many deliberations, the Regional Focus Workgroup reached consensus on a set of decision rules to provide a uniform and unbiased method for screening data for each segment. The decision rules and data analysis displays provided a standardized output of information for the Workgroup to consider as they made the characterizations. Ultimately, the Workgroup's characterizations were based on the weight of evidence and their best professional judgement.

In order to characterize a segment into one of the four categories, the exposure and effects data were compared to contaminant thresholds or control conditions, respectively. These decision rules list the threshold sets used for interpreting the exposure and effects data. For each exposure data type (i.e., water, sediment, or tissue chemical contaminant concentration data), the Workgroup chose multiple sets of thresholds because no one set of thresholds covers all chemicals measured and because of the diversity of opinions in the scientific community regarding the utility of each threshold set. The workgroup ranked the thresholds appropriate for each data type based upon the level of confidence in the ability of the threshold to predict effects or protect living resources and on the scientific validity of the approach used to develop the threshold. Appendix C provides a complete listing of all thresholds used by chemical. The decision rules also include uniform methods for interpreting the benthic and ambient toxicity effects data.

In addition to identifying which thresholds to use, the decision rules also serve as a screening tool for electronically sorting data into four "levels of contamination" to make it easier for the workgroup members to integrate the data in a given area. Levels of contamination were assigned to each sampling station and data type based on which thresholds were exceeded and the magnitude of the exceedence. The four levels of contamination represent evidence for characterizing a segment as a *Region of Concern* (Level 1), *Area of Emphasis* (Level 2), *Area with Low Probability for Adverse Effects* (Level 3), and *Area with Insufficient or Inconclusive Data* (Level 4). Sub-levels are included for some media to facilitate the characterization. It is important to note that classifying a station for one or more media at a particular level will not necessarily result in characterizing the entire segment into a particular category. The final characterization will be based on the integration of all data from all stations in the segment.

Levels of Contamination

- Level 1
  - Indicates <u>probable</u> contaminant effects.
  - Primarily supports characterizing segment as *Regions of Concern* or *Areas of Emphasis*.
  - Rules designed to make this group exclusive, so that only stations with the possibility of probable effects would be classified into this level.

- Level 2
  - Indicates <u>potential</u> contaminant effects.

- S Primarily supports characterizing segment as *Areas of Emphasis*.
- S Rules designed to make this group inclusive, so that any station with the potential of having potential effects would be listed in this level.

- Level 3
- S Indicates low probability for contaminant effects.
- S Rules designed to make this group exclusive, so that only stations with evidence of a low probability for effects would be classified into this level.
- S Primarily supports characterizing segment as *Areas With Low Probability of Adverse Effects*.

- Level 4
- S Indicates data are insufficient or inconclusive to place the station into one of the other levels, due to the absence of any data, the absence of appropriate thresholds for data that have been collected, conflicting or inconclusive data, or data of unknown quality.
- S Primarily supports characterizing segment as *Areas with Insufficient or Inconclusive Data*.

Water Column Contaminant Concentration Data

Observed ambient water column chemical contaminant concentrations were compared with relevant chemical contaminant concentrations known to be protective of most aquatic organisms (i.e., EPA aquatic life criteria, respective state water quality standards) or with other relevant thresholds above which adverse effects to aquatic organisms have been observed and documented (i.e., laboratory-based chemical specific toxicity tests). In the event where EPA criteria differed from state standards or standards differed among states, the Workgroup decided on which threshold was most appropriate to use. The threshold sets used for interpreting the water chemistry data are listed below with the thresholds having typically higher values listed first. Sub-level designations were given based on the Workgroup's judgement of the severity of exceedences of different thresholds. For example, an exceedence of an acute criterion (Level 1.A.) was considered more serious than an exceedence of the lower chronic criterion value (Level 1.B.).

Thresholds

- Set 1: EPA Acute Water Quality Criteria or State Standard
- Set 2: EPA Chronic Water Quality Criteria or State Standard

Decision Rules

Level 1

A. Exceedence of Set 1 threshold for any chemical.
B. Exceedence of Set 2 threshold for any chemical.

Level 2

Exceedences of threshold Sets 1 and 2 can provide evidence for either probable or potential contaminant effects. No additional appropriate thresholds were available for a Level 2 designation. In the absence of EPA criteria for measured chemicals, data were compared to benchmarks in the AQUIRE database (a source of empirically-based bioconcentration factors and quantitative structure activity relationship (QSAR) predicted bioconcentration factors [19,20]). Oftentimes these benchmarks were not appropriate for estuarine environments and exceedences of these benchmarks did not drive any characterizations. Therefore, these thresholds were removed from the analysis until more appropriate and relevant thresholds are determined.

Level 3

A. No exceedences of any Set 1 or Set 2 thresholds for any chemical.

Level 4

A. Above detection limit data without thresholds for comparison.
B. Below detection limit data without thresholds for comparison.
C. No water contaminant concentration data collected at station.

Note:

Anytime a freshwater threshold was used, in the absence of a saltwater/estuarine threshold, the results were "flagged" in the data analysis tables.

Sediment Contaminant Concentration Data

Observed ambient sediment contaminant concentrations were compared with contaminant threshold concentrations associated with adverse biological effects. Sediment quality threshold values were compiled from peer-reviewed literature and technical reports, summarized in a sediment threshold compendium [12] and stored on the Chesapeake Bay Program Toxics Database. The most appropriate (i.e., higher level of certainty and most applicable to the Bay region estuarine organisms) threshold values were selected for comparison to sediment contaminant data.

The threshold sets used for interpreting the sediment chemistry data are listed below with the thresholds having typically higher values listed first. Sub-level designations were given based on the Workgroup's level of confidence in the ability of the threshold to predict effects or protect living resources. For example, an exceedence of a NOAA ER-M would be given a higher level designation (2.A.) than an exceedence of the lower value NOAA ER-L (2.B.). A "concentration:threshold" ratio (hereafter Ratio) was used as a measure of the magnitude of an exceedence and was calculated by dividing the measured concentration by the threshold value. If the concentration was greater than or equal to two, the workgroup's confidence that the threshold was actually exceeded was higher. Since the Workgroup's confidence in an exceedence of threshold Set 1, Set 1a, and Set 2 (where Ratio ≥ 2) was the same and they could not distinguish between the severity of the exceedences, an exceedence of these thresholds was given the same Level 1.A. designation. See Appendix C for actual threshold values.

Thresholds

- Set 1: EPA Equilibrium Partitioning-based Sediment Quality Criteria (EqP based SQC) [21]
- Set 1a: EPA Equilibrium Partitioning-based Sediment Quality Advisory Level (EqP-based SQAL) [22]
- Set 2: Lowest of the NOAA Effects Range-Median (ER-M), Environment Canada Probable Effects Level (PEL), and MacDonald PEL [23,24,25]
- Set 3: Lowest of the NOAA Effects Range-Low (ER-L), Environment Canada Threshold Effects Level (TEL), and the MacDonald TEL [23,24,25].

Decision Rules

Level 1

A.1 Exceedence of Set 1 threshold for any chemical.
A.2 Exceedence of Set 1a threshold for any chemical.
A.3 Exceedence of Set 2 threshold for any chemical, Ratio ≥ 2.

Level 2

A. Exceedence of Set 2 threshold for any chemical, Ratio < 2.
B. Exceedence of Set 3 threshold for any chemical, Ratio ≥ 2.
C. Exceedence of Set 3 threshold for any chemical, Ratio < 2.

Level 3

A. No exceedences of any threshold for any chemicals.

Level 4

A. Above detection limit data without thresholds for comparison.
B. Below detection limit data without thresholds for comparison.
C. No sediment contaminant concentration data collected at station.

Evaluating Polychlorinated Biphenyls (PCBs) in Sediment

The sum of the PCB arochlors and the sum of the PCB congenors were compared to the total PCB thresholds listed below. In the cases where multiple concentration values were reported for the same PCB arochlor or congenor for the same study, date, and location (i.e., replicates or split samples), the geometric mean of these values was calculated first, and then the concentrations for all PCB arochlors or congenors were summed and compared to the thresholds. This analysis was conducted for three different scenarios where any below detection limit values were (1) set to zero, (2) set to one-half the detection limit, and (3) set to the detection limit.

Thresholds

- NOAA ER-M for total PCBs (180 ppb)
- NOAA ER-L for total PCBs (22.7 ppb)

Decision Rules

Level 1

- Exceedence of NOAA ER-M for total PCBs.

Level 2

- Exceedence of NOAA ER-L for total PCBs.

Level 3

- No exceedence of NOAA ER-L or ER-M for total PCBs..

Finfish/Shellfish Tissue Chemical Contaminant Concentration Data

Measurements of the edible portion of finfish tissue contaminant concentrations in resident, non-migratory species and shellfish tissue contaminant concentrations were compared with thresholds associated with the protection of human health. Available human health consumption threshold values were compiled from national and worldwide literature and government documents and summarized in a fish tissue threshold compendium [13] and stored on the Chesapeake Bay Program Toxics Data Base. The most appropriate (i.e., higher level of certainty) threshold values were selected for comparison to fish tissue contamination data. Existing chemical contaminant-related fish consumption advisories and bans were also used as evidence in making a characterization.

The threshold sets used for interpreting the finfish/shellfish tissue data are listed below with the thresholds having typically higher values listed first. Sub-level designations were given based on the Workgroup's level of confidence in the ability of the threshold to predict effects or protect living resources. When the Workgroup's confidence in an exceedence of threshold was indistinguishable (as in the case of an exceedence of a Set 2 and Set 3 threshold), the same sub-level designation was used (Level 2.A.). See Appendix C for actual threshold values.

Thresholds

- Set 1: Food and Drug Administration (FDA) Action Levels [13][1]
- Set 2: Food and Drug Administration (FDA) Levels of Concern [13][1]
- Set 3: Environmental Protection Agency (EPA) Screening Levels [26][2]

Decision Rules

Level 1

A.1 Exceedence of FDA Action Level for any chemical

Level 2

A.1 Exceedence of FDA Level of Concern for any chemical.
A.2 EPA Screening Level for any chemical.

Level 3

A. No exceedences of any FDA or EPA thresholds for any chemical.

Level 4

A. Above detection limit data without thresholds for comparison.
B. Below detection limit data without thresholds for comparison.
C. No finfish/shellfish chemical contaminant data collected at station.

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1 See reference [13] for assumptions made in calculating threshold.

2 Assumes adult population weight of 70 kg, 70 year life time, mean daily consumption rate of 6.5 g/day.

Note: If a given chemicals has a 90th percentile FDA levels of concern and a mean FDA levels of concern, the 90th percentile level was used. For those chemicals that have more than one threshold for different ages of finfish/shellfish, the lowest threshold was used. Unless the threshold specifies, the threshold was applied to all tissue types (finfish and shellfish).

Evaluating Polychlorinated Biphenyls (PCBs) in Fish Tissue

The sum of the PCB arochlors and the sum of the PCB congenors were compared to the total PCB thresholds listed below. In the cases where multiple concentration values were reported for the same PCB arochlor or congenor for the same study, date, and location (i.e., replicates or split samples), the geometric mean of these values was calculated first, and then the concentrations for all PCB arochlors or congenors were summed and compared to the thresholds. This analysis was conducted for three different scenarios where any below detection limit values were (1) set to zero, (2) set to one-half the detection limit, and (3) set to the detection limit.

Thresholds

- FDA Action Level for total PCBs (2.0 ppm)
- EPA Screening Level for total PCBs (0.01 ppm)

Decision Rules

Level 1

- Exceedence of FDA Action Level for total PCBs.

Level 2

- Exceedence of EPA Screening Level for total PCBs.

Level 3

- No exceedence of FDA Action Level or EPA Screening Level for total PCBs.

Benthic Community Data

Benthic community data (i.e., species number, species diversity, and biomass) collected for the Bay Program were summarized into a Benthic Index of Biotic Integrity (B-IBI) that indicates benthic community health [14,15,16]. A B-IBI of greater than 3 indicates the benthic community meets or exceeds the restoration goal (a benthic community characteristic of a non-degraded bottom habitat in Chesapeake Bay); an index of 2 to 3 indicates a degraded benthic community; and an index of less than 2 indicates a severely degraded benthic community. Only data for regions where low dissolved oxygen conditions could be eliminated as the principle cause of benthic community degradation were used as supportive evidence in making a characterization. Sub-level designations were given based on the B-IBI score. For example, a B-IBI score indicating a degraded community was given a sub-level of 2.A. while a B-IBI score indicating a marginal community was given a sub-level of 2.B.

Thresholds

- Benthic Index of Biotic Integrity (B-IBI) Restoration Goals

Decision Rules

Level 1

A. Severely Degraded (B-IBI <=2), sufficient dissolved oxygen.

Level 2

A. Degraded (B-IBI: 2-<2.6), sufficient dissolved oxygen.

B. Marginal (B-IBI: 2.6-<3), sufficient dissolved oxygen.

Level 3

- Meets Goal (B-IBI: $\geq$ 3)

Level 4

- No benthic data available at station.

Ambient Toxicity Test Data

Ambient water column and bottom sediment toxicity data from the Chesapeake Bay Ambient Toxicity Assessment Program have already been interpreted by assigning a "degree of toxicity" to a sampled area. These degrees of toxicity are used in interpreting the data. Workgroup members also evaluated the sediment and water toxicity index values which provide a relative measure of toxicity of a given site compared to all other sites sample during the program. Toxicity data collected through other programs were evaluated for statistically significant differences between the observed adverse effects (i.e., survival, growth, reproduction) and reference area or control toxicity test results.

Degrees of Toxicity

The "degree of toxicity" of water and sediment for the Chesapeake Bay Ambient Toxicity Assessment Program was determined by a "weight of evidence" approach based on the toxicity index value, the percentage of significant toxic impairments observed (i.e., endpoints such as survival, growth, and reproduction that were significantly different from the control), and whether or not chemical contaminants measured were above certain thresholds.

Great toxicity: Those areas with "great" toxicity have the highest toxicity index values, roughly a quarter of the endpoints are significantly different from controls, and chemical contaminants that exceed thresholds.

Low to Moderate toxicity: Those areas with low to moderate toxicity have lower toxic index values than areas with great toxicity, but still show a substantial percentage of endpoints that are significantly different from controls, and oftentimes some of the chemical contaminant measured exceed thresholds.

Low but Significant toxicity: Those areas that exhibit toxicity that is statistically significant, but are not thought to be ecologically significant.

No Significant toxicity: Those areas where chemical contamination does not appear to be a problem.

Thresholds

- For the Chesapeake Bay Ambient Toxicity Assessment Program (ATP) results: reported "degree of toxicity."
- For other available toxicity test results: percentages of endpoints significantly different from reference, or statistical comparison of toxicity test results with control/reference test.

Decision Rules

Level 1

A. "Great" sediment AND water column toxicity (ATP) or at least 2 significant sediment and water tests each (non-ATP).

B. "Great" sediment OR water column toxicity (ATP) or at least 2 significant sediment or water tests (non-ATP).

Level 2

A. "Low to Moderate" sediment AND water column toxicity (ATP) or any one significant sediment and water test each (non-ATP).

B. "Low to Moderate" sediment OR water column toxicity (ATP) or any one significant sediment or water test each (non-ATP).

C. "Low but Significant" sediment AND water column toxicity (ATP).

D. "Low but Significant" sediment OR water column toxicity (ATP).

Level 3

A. "No Significant" sediment AND water column toxicity observed.

B. "No Significant" sediment OR water column toxicity observed.

Level 4

- No toxicity data available at station.

APPENDIX C: Chemical Thresholds Used to Interpret Data for Characterization

The Regional Focus Workgroup used a number of different threshold sets against which to compare the exposure data to in conducting the characterization, as described in the decision rules (Appendix B). This appendix includes the comprehensive list of all available thresholds listed in Appendix B for water, sediment, and fish tissue data. These threshold lists include all available thresholds, regardless of whether there are corresponding data in the Chesapeake Bay Toxics Database for each of the chemicals.

There are 2 sets of water column thresholds:
- Set 1 - EPA/State acute water quality criteria
- Set 2 - EPA/State chronic water quality criteria

There are 4 sets of sediment thresholds:
- Set 1 - SQCs - EqP based thresholds
- Set 1a - SQALs - EqP based thresholds
- Set 2 - ERMs/PELs
- Set 3 - ERLs/TELs

There are 4 sets of fish tissue thresholds:
- Set 1 - FDA action levels
- Set 2a - FDA levels of concern - 90^{th} percentile
- Set 2b - FDA levels of concern - mean
- Set 3 - EPA Screening levels

The threshold sets listed above are included in this appendix as a separate table. Each of the tables are presented in a similar manner:
- The chemical is identified by chemical name and then by Chemical Abstract Service number (CAS Number).
- The threshold is then listed, followed by the units. It should be noted that the thresholds are not all expressed in the same units.
- The type of water for which the threshold was derived is identified as freshwater, saltwater, estuarine. A footnote appears at the bottom of each table explaining all valid entries for this column.
- Water column thresholds only - please note that where available, saltwater water quality criteria were selected over freshwater water quality criteria for comparison against water column data in the Chesapeake Bay rivers. In the absence of a saltwater water quality criteria, a freshwater water quality criteria was chosen and the value was flagged.
- Fish tissue threshold only - the species for which the threshold is considered valid is presented (e.g., Crustacea, Finfish, Mollusca).
- The source of threshold is identified.

Water Thresholds, Set 1: EPA/State Acute Water Quality Criteria

Thresholds selected for saltwater

Chemical Name	CAS Number	Threshold Value	Units	Water Type (1)	Flag (2)	Threshold Source
Acenaphthene	000083329	970	UG/L	S		EPA Acute Water Quality Criteria
Acrolein	000107028	55	UG/L	S		EPA Acute Water Quality Criteria
Acrylonitrile	000107131	7550	UG/L	F	1	EPA Acute Water Quality Criteria
Aldrin	000309002	1.3	UG/L	S		EPA Acute Water Quality Criteria
Antimony	007440360	1500	UG/L	S		EPA Acute Water Quality Criteria
Arsenic III	022569728	69	UG/L	S		EPA Acute Water Quality Criteria
Arsenic V	017428410	2319	UG/L	S		EPA Acute Water Quality Criteria
BHC	000680731	0.34	UG/L	S		EPA Acute Water Quality Criteria
Benzene	000071432	5100	UG/L	S		EPA Acute Water Quality Criteria
Benzidine	000092875	2500	UG/L	F	1	EPA Acute Water Quality Criteria
Beryllium	007440417	130	UG/L	F	1	EPA Acute Water Quality Criteria
Cadmium	007440439	43	UG/L	S		EPA Acute Water Quality Criteria
Carbon Tetrachloride	000056235	50000	UG/L	S		EPA Acute Water Quality Criteria
Chlordane	000057749	0.09	UG/L	S		EPA Acute Water Quality Criteria
Chloride	CAS000337	860000	UG/L	F	1	EPA Acute Water Quality Criteria
Chlorinated Benzenes		160	UG/L	S		EPA Acute Water Quality Criteria
Chlorine	007782505	13	UG/L	S		EPA Acute Water Quality Criteria
Chloroform	000067663	28900	UG/L	F	1	EPA Acute Water Quality Criteria
Chlorophenol 2-	000095578	4380	UG/L	F	1	EPA Acute Water Quality Criteria
Chlorophenol 4-	000106489	29700	UG/L	S		EPA Acute Water Quality Criteria
Chlorophenol 4-Methyl-3-	000059507	30	UG/L	F	1	EPA Acute Water Quality Criteria
Chlorpyrifos	002921882	0.01	UG/L	S		EPA Acute Water Quality Criteria
Chromium (III)	016065831	10300	UG/L	S		EPA Acute Water Quality Criteria
Chromium (VI)	007440473	1100	UG/L	S		EPA Acute Water Quality Criteria
Copper	007440508	6.1	UG/L	S		MD Acute State Water Quality Criteria
Cyanide	000057125	1	UG/L	S		EPA Acute Water Quality Criteria
DDD 4,4-	000072548	3.6	UG/L	S		EPA Acute Water Quality Criteria
DDE	000072559	14	UG/L	S		EPA Acute Water Quality Criteria
DDT	000050293	0.13	UG/L	S		EPA Acute Water Quality Criteria
Di-2-Ethylhexyl phthalate	000117817	400	UG/L	S		EPA Acute Water Quality Criteria
Dichlorobenzenes	025321226	1970	UG/L	S		EPA Acute Water Quality Criteria
Dichloroethane 1,2-	000107062	113000	UG/L	S		EPA Acute Water Quality Criteria
Dichloroethylenes	025323303	224000	UG/L	S		EPA Acute Water Quality Criteria
Dichlorophenol 2,4-	000120832	2020	UG/L	F	1	EPA Acute Water Quality Criteria
Dichloropropane	026638197	10300	UG/L	S		EPA Acute Water Quality Criteria
Dichloropropene	026952238	790	UG/L	S		EPA Acute Water Quality Criteria
Dieldrin	000060571	0.71	UG/L	S		EPA Acute Water Quality Criteria
Dimethylphenol 2,4-	000105679	2120	UG/L	F	1	EPA Acute Water Quality Criteria
Dinitrophenol	025550587	7	UG/L	F	1	EPA Acute Water Quality Criteria
Dinitrophenol 2,4	000051285	7	UG/L	F	1	EPA Acute Water Quality Criteria
Dinitrotoluene	025321146	590	UG/L	S		EPA Acute Water Quality Criteria
Dinitrotoluene 2,4-	000121142	330	UG/L	F	1	EPA Acute Water Quality Criteria
Diphenylhydrazine 1,2-	000122667	270	UG/L	F	1	EPA Acute Water Quality Criteria
Endosulfan	000115297	0.03	UG/L	S		EPA Acute Water Quality Criteria
Endosulfan a-	000959988	0.03	UG/L	S		EPA Acute Water Quality Criteria
Endosulfan b-	033213659	0.03	UG/L	S		EPA Acute Water Quality Criteria
Endrin	000072208	0.03	UG/L	S		EPA Acute Water Quality Criteria
Ethylbenzene	000100414	430	UG/L	S		EPA Acute Water Quality Criteria
Fluoranthene	000206440	40	UG/L	S		EPA Acute Water Quality Criteria

1 - Water type values include: freshwater (F) and saltwater (S)

2 - Freshwater criterion was used in the absence of a saltwater criterion

Water Thresholds, Set 1: EPA/State Acute Water Quality Criteria
Thresholds selected for saltwater

Chemical Name	CAS Number	Threshold Value	Units	Water Type (1)	Flag (2)	Threshold Source
HEXACHLOROCYCLOHEXANE - BETA	000319857	0.16	UG/L	S		EPA Acute Water Quality Criteria
HEXACHLOROCYCLOHEXANE - GAMMA	000058899	0.16	UG/L	S		EPA Acute Water Quality Criteria
HEXACHLOROCYCLOHEXANE - TECHNI	000319868	0.16	UG/L	S		EPA Acute Water Quality Criteria
Haloethers	CAS000409	360	UG/L	F	1	EPA Acute Water Quality Criteria
Heptachlor	000076448	0.05	UG/L	S		EPA Acute Water Quality Criteria
Heptachlor epoxide	001024573	0.05	UG/L	S		EPA Acute Water Quality Criteria
Hexachlorobenzene	000118741	6	UG/L	F	1	EPA Acute Water Quality Criteria
Hexachlorobutadiene	000087683	32	UG/L	S		EPA Acute Water Quality Criteria
Hexachlorocyclopentadiene	000077474	7	UG/L	S		EPA Acute Water Quality Criteria
Hexachloroethane	000067721	940	UG/L	S		EPA Acute Water Quality Criteria
Isophorone	000078591	12900	UG/L	S		EPA Acute Water Quality Criteria
Lead	007439921	220	UG/L	S		EPA Acute Water Quality Criteria
Mercury	007439976	2.1	UG/L	S		EPA Acute Water Quality Criteria
Naphthalene	000091203	2350	UG/L	S		EPA Acute Water Quality Criteria
Nickel	007440020	75	UG/L	S		EPA Acute Water Quality Criteria
Nitrate	014797558	8	UG/L	F	1	EPA Acute Water Quality Criteria
Nitrobenzene	000098953	6680	UG/L	S		EPA Acute Water Quality Criteria
Nitrosamines	035576911	3300000	UG/L	S		EPA Acute Water Quality Criteria
PCB-1016 (PCB)	012674112	2	UG/L	F	1	EPA Acute Water Quality Criteria
PCB-1221 (PCB)	011104282	2	UG/L	F	1	EPA Acute Water Quality Criteria
PCB-1232 (PCB)	011141165	5	UG/L	F	1	EPA Acute Water Quality Criteria
PCB-1248 (PCB)	012672296	6	UG/L	F	1	EPA Acute Water Quality Criteria
PCB-1254 (PCB)	011097691	1	UG/L	F	1	EPA Acute Water Quality Criteria
PCB-1260 (PCB)	011096825	5	UG/L	F	1	EPA Acute Water Quality Criteria
PCBs	001336363	10	UG/L	S		EPA Acute Water Quality Criteria
Parathion	000056382	0.06	UG/L	F	1	EPA Acute Water Quality Criteria
Pentachloroethane	000076017	390	UG/L	S		EPA Acute Water Quality Criteria
Pentachlorophenol	000087865	13	UG/L	S		EPA Acute Water Quality Criteria
Phenanthrene	000085018	7.7	UG/L	S		EPA Acute Water Quality Criteria
Phenol	000108952	5800	UG/L	S		EPA Acute Water Quality Criteria
Phthalate esters	CAS000407	2944	UG/L	S		EPA Acute Water Quality Criteria
Polynuclear aromatic hydrocarb	CAS000340	300	UG/L	S		EPA Acute Water Quality Criteria
Selenium	007782492	300	UG/L	S		EPA Acute Water Quality Criteria
Silver	007440224	2.3	UG/L	S		EPA Acute Water Quality Criteria
TCDD 2,3,7,8- (dioxin)	001746016	0.01	UG/L	F	1	EPA Acute Water Quality Criteria
TRICHLOROPHENOL, 2,4,5-	000095954	240	UG/L	S		EPA Acute Water Quality Criteria
Tetrachloroethane 1,1,2,2-	000079345	9020	UG/L	S		EPA Acute Water Quality Criteria
Tetrachloroethanes	025322207	9320	UG/L	F	1	EPA Acute Water Quality Criteria
Tetrachloroethylene	000127184	10200	UG/L	S		EPA Acute Water Quality Criteria
Tetrachlorophenol 2,3,5,6-	000935955	440	UG/L	S		EPA Acute Water Quality Criteria
Thallium	007440280	2130	UG/L	S		EPA Acute Water Quality Criteria
Toluene	000108883	6300	UG/L	S		EPA Acute Water Quality Criteria
Toxaphene	008001352	0.21	UG/L	S		EPA Acute Water Quality Criteria
Trichloroethane 1,1,1-	000071556	31200	UG/L	S		EPA Acute Water Quality Criteria
Trichloroethanes	025323891	18000	UG/L	F	1	EPA Acute Water Quality Criteria
Trichloroethylene	000079016	2000	UG/L	S		EPA Acute Water Quality Criteria
Zinc	007440666	95	UG/L	S		EPA Acute Water Quality Criteria

1 - Water type values include: freshwater (F) and saltwater (S)
2 - Freshwater criterion was used in the absence of a saltwater criterion

Water Thresholds, Set 2: EPA/State Chronic Water Quality Criteria
Thresholds selected for saltwater

Chemical Name	CAS Number	Threshold Value	Units	Water Type (1)	Flag (2))	Threshold Source
Acenaphthene	000083329	710	UG/L	S		EPA Chronic Water Quality Criteria
Acrolein	000107028	21	UG/L	F	1	EPA Chronic Water Quality Criteria
Acrylonitrile	000107131	2600	UG/L	F	1	EPA Chronic Water Quality Criteria
Antimony	007440360	500	UG/L	S		EPA Chronic Water Quality Criteria
Arsenic III	022569728	36	UG/L	S		EPA Chronic Water Quality Criteria
Benzene	000071432	700	UG/L	S		EPA Chronic Water Quality Criteria
Beryllium	007440417	5.3	UG/L	F	1	EPA Chronic Water Quality Criteria
Cadmium	007440439	9.3	UG/L	S		EPA Chronic Water Quality Criteria
Chlordane	000057749	0.004	UG/L	S		EPA Chronic Water Quality Criteria
Chloride	CAS000337	230000	UG/L	F	1	EPA Chronic Water Quality Criteria
Chlorinated Benzenes		129	UG/L	S		EPA Chronic Water Quality Criteria
Chlorine	007782505	7.5	UG/L	S		EPA Chronic Water Quality Criteria
Chloroform	000067663	1240	UG/L	F	1	EPA Chronic Water Quality Criteria
Chlorpyrifos	002921882	0.0056	UG/L	S		EPA Chronic Water Quality Criteria
Chromium (III)	016065831	210	UG/L	F	1	EPA Chronic Water Quality Criteria
Chromium (VI)	007440473	50	UG/L	S		EPA Chronic Water Quality Criteria
Copper	007440508	12	UG/L	F	1	EPA Chronic Water Quality Criteria
Cyanide	000057125	5.2	UG/L	F	1	EPA Chronic Water Quality Criteria
DDT	000050293	0.001	UG/L	S		EPA Chronic Water Quality Criteria
Demeton	008065483	0.1	UG/L	S		EPA Chronic Water Quality Criteria
Di-2-Ethylhexyl phthalate	000117817	360	UG/L	S		EPA Chronic Water Quality Criteria
Dichlorobenzenes	025321226	763	UG/L	F	1	EPA Chronic Water Quality Criteria
Dichloroethane 1,2-	000107062	20000	UG/L	F	1	EPA Chronic Water Quality Criteria
Dichlorophenol 2,4-	000120832	365	UG/L	F	1	EPA Chronic Water Quality Criteria
Dichloropropane	026638197	3040	UG/L	S		EPA Chronic Water Quality Criteria
Dichloropropene	026952238	244	UG/L	F	1	EPA Chronic Water Quality Criteria
Dieldrin	000060571	0.0019	UG/L	S		EPA Chronic Water Quality Criteria
Dinitrotoluene	025321146	370	UG/L	S		EPA Chronic Water Quality Criteria
Dinitrotoluene 2,4-	000121142	230	UG/L	F	1	EPA Chronic Water Quality Criteria
Endosulfan	000115297	0.0087	UG/L	S		EPA Chronic Water Quality Criteria
Endosulfan a-	000959988	0.0087	UG/L	S		EPA Chronic Water Quality Criteria
Endosulfan b-	033213659	0.0087	UG/L	S		EPA Chronic Water Quality Criteria
Endrin	000072208	0.0023	UG/L	S		EPA Chronic Water Quality Criteria
Fluoranthene	000206440	16	UG/L	S		EPA Chronic Water Quality Criteria
Guthion	000086500	0.01	UG/L	S		EPA Chronic Water Quality Criteria
HEXACHLOROCYCLOHEXANE - BETA	000319857	0.08	UG/L	F	1	EPA Chronic Water Quality Criteria
HEXACHLOROCYCLOHEXANE - GAMMA	000058899	0.08	UG/L	F	1	EPA Chronic Water Quality Criteria
HEXACHLOROCYCLOHEXANE - TECHNI	000319868	0.08	UG/L	F	1	EPA Chronic Water Quality Criteria
Haloethers	CAS000409	122	UG/L	F	1	EPA Chronic Water Quality Criteria
Heptachlor	000076448	0.0036	UG/L	S		EPA Chronic Water Quality Criteria
Heptachlor epoxide	001024573	0.0036	UG/L	S		EPA Chronic Water Quality Criteria
Hexachlorobenzene	000118741	3.68	UG/L	F	1	EPA Chronic Water Quality Criteria
Hexachlorobutadiene	000087683	9.3	UG/L	F	1	EPA Chronic Water Quality Criteria
Hexachlorocyclopentadiene	000077474	5.2	UG/L	F	1	EPA Chronic Water Quality Criteria
Hexachloroethane	000067721	540	UG/L	F	1	EPA Chronic Water Quality Criteria
Hydrogen sulfide	007783064	2	UG/L	S		EPA Chronic Water Quality Criteria
Iron	007439896	1000	UG/L	F	1	EPA Chronic Water Quality Criteria
Lead	007439921	8.5	UG/L	S		EPA Chronic Water Quality Criteria
Malathion	000121755	0.1	UG/L	S		EPA Chronic Water Quality Criteria

1 - Water type values include: freshwater (F) and saltwater (S)
2 - Freshwater criterion was used in the absence of a saltwater criterion

Water Thresholds, Set 2: EPA/State Chronic Water Quality Criteria
Thresholds selected for saltwater

Chemical Name	CAS Number	Threshold Value	Units	Water Type (1)	Flag (2))	Threshold Source
Mercury	007439976	0.02	UG/L	S		EPA Chronic Water Quality Criteria
Methoxychlor	000072435	0.03	UG/L	S		EPA Chronic Water Quality Criteria
Mirex	002385855	0.001	UG/L	S		EPA Chronic Water Quality Criteria
Naphthalene	000091203	620	UG/L	F	1	EPA Chronic Water Quality Criteria
Nickel	007440020	8.3	UG/L	S		EPA Chronic Water Quality Criteria
PCBs	001336363	0.03	UG/L	S		EPA Chronic Water Quality Criteria
Parathion	000056382	0.01	UG/L	F	1	EPA Chronic Water Quality Criteria
Pentachloroethane	000076017	281	UG/L	S		EPA Chronic Water Quality Criteria
Pentachlorophenol	000087865	7.9	UG/L	S		EPA Chronic Water Quality Criteria
Phenanthrene	000085018	4.6	UG/L	S		EPA Chronic Water Quality Criteria
Phenol	000108952	2560	UG/L	F	1	EPA Chronic Water Quality Criteria
Phosphorus (elemental)	007723140	0.1	UG/L	S		EPA Chronic Water Quality Criteria
Phthalate esters	CAS000407	3.4	UG/L	S		EPA Chronic Water Quality Criteria
Selenium	007782492	71	UG/L	S		EPA Chronic Water Quality Criteria
Silver	007440224	0.92	UG/L	S		EPA Chronic Water Quality Criteria
TCDD 2,3,7,8- (dioxin)	001746016	0.00001	UG/L	F	1	EPA Chronic Water Quality Criteria
TRICHLOROPHENOL, 2,4,5-	000095954	11	UG/L	S		EPA Chronic Water Quality Criteria
Tetrachloroethane 1,1,2,2-	000079345	2400	UG/L	F	1	EPA Chronic Water Quality Criteria
Tetrachloroethylene	000127184	450	UG/L	S		EPA Chronic Water Quality Criteria
Thallium	007440280	40	UG/L	F	1	EPA Chronic Water Quality Criteria
Toluene	000108883	5000	UG/L	S		EPA Chronic Water Quality Criteria
Toxaphene	008001352	0.0002	UG/L	S		EPA Chronic Water Quality Criteria
Trichloroethane 1,1,2-	000079005	9400	UG/L	F	1	EPA Chronic Water Quality Criteria
Trichloroethylene	000079016	21900	UG/L	F	1	EPA Chronic Water Quality Criteria
Trichlorophenol 2,4,6-	000088062	970	UG/L	F	1	EPA Chronic Water Quality Criteria
Zinc	007440666	86	UG/L	S		EPA Chronic Water Quality Criteria

1 - Water type values include: freshwater (F) and saltwater (S)
2 - Freshwater criterion was used in the absence of a saltwater criterion

Sediment Thresholds, Set 1: SQCs - EqP based thresholds

Chemical Name	CAS Number	Threshold Value	QUAL	Units (1)	Water Type (2)	TOCFLAG	Threshold Source
ACENAPHTHENE	000083329	230	<=	UG/GOC	SW		EPA (1993), EqP, ACEN.
DIELDRIN	000060571	20	<=	UG/GOC	SW		EPA (1993), EqP, DIELDRIN
ENDRIN	000072208	0.76	<=	UG/GOC	SW		EPA (1993), EqP, ENDRIN
FLUORANTHENE	000206440	300	<=	UG/GOC	SW		EPA (1993), EqP, FLUOR.
PHENANTHRENE	000085018	240	<=	UG/GOC	SW		EPA (1993), EqP, PHEN.

1 - When necessary, thresholds have been converted to PPB assuming 2% total organic carbon

2 - Water type values include: freshwater (FW), saltwater (SW), estuarine (E), fresh and saltwater (FS), fresh and estuarine (FE), and estuarine and salt (ES).

Sediment Thresholds, Set 1A: SQALs - EqP based thresholds

Chemical Name	CAS Number	Threshold Value	Units (1)	Water Type (2)	Threshold Source
1,1,1-TRICHLOROETHANE	000071556	17	UG/GOC	FS	EPA (1996), SQALs
1,1,2,2-TETRACHLOROETHANE	000079345	160	UG/GOC	FS	EPA (1996), SQALs
1,2,4-TRICHLOROBENZENE	000120821	920	UG/GOC	FS	EPA (1996), SQALs
1,2-DICHLOROBENZENE	000095501	34	UG/GOC	FS	EPA (1996), SQALs
1,3-DICHLOROBENZENE	000541731	170	UG/GOC	FS	EPA (1996), SQALs
1,4-DICHLOROBENZENE	000106467	35	UG/GOC	FS	EPA (1996), SQALs
4-BROMOPHENYL PHENYL ETHER	000101553	130	UG/GOC	FS	EPA (1996), SQALs
BENZENE	000071432	5.7	UG/GOC	FS	EPA (1996), SQALs
BHC, DELTA	000319868	13	UG/GOC	FS	EPA (1996), SQALs
BHC, GAMMA (LINDANE)	000058899	0.37	UG/GOC	FS	EPA (1996), SQALs
BIPHENYL	000092524	110	UG/GOC	FS	EPA (1996), SQALs
BUTYL BENZYL PHTHALATE	000085687	1100	UG/GOC	FS	EPA (1996), SQALs
CHLOROBENZENE	000108907	82	UG/GOC	FS	EPA (1996), SQALs
DI-N-BUTYL PHTHALATE	000084742	1100	UG/GOC	FS	EPA (1996), SQALs
DIAZINON	000333415	0.19	UG/GOC	FS	EPA (1996), SQALs
DIBENZOFURAN	000132649	200	UG/GOC	FS	EPA (1996), SQALs
DIETHYL PHTHALATE	000084662	63	UG/GOC	FS	EPA (1996), SQALs
ENDOSULFAN MIXED ISOMERS	000115297	0.54	UG/GOC	FS	EPA (1996), SQALs
ENDOSULFAN-ALPHA	000959988	0.29	UG/GOC	FS	EPA (1996), SQALs
ENDOSULFAN-BETA	033213659	1.4	UG/GOC	FS	EPA (1996), SQALs
ETHYLBENZENE	000100414	480	UG/GOC	FS	EPA (1996), SQALs
FLUORENE	000086737	54	UG/GOC	FS	EPA (1996), SQALs
HEXACHLOROETHANE	000067721	100	UG/GOC	FS	EPA (1996), SQALs
MALATHION	000121755	0.067	UG/GOC	FS	EPA (1996), SQALs
METHOXYCHLOR	000072435	1.9	UG/GOC	FS	EPA (1996), SQALs
NAPHTHALENE	000091203	47	UG/GOC	FS	EPA (1996), SQALs
PENTACHLOROBENZENE	000608935	69	UG/GOC	FS	EPA (1996), SQALs
TETRACHLOROETHENE	000127184	53	UG/GOC	FS	EPA (1996), SQALs
TETRACHLOROMETHANE	000056235	120	UG/GOC	FS	EPA (1996), SQALs
TOLUENE	000108883	89	UG/GOC	FS	EPA (1996), SQALs
TOXAPHENE	008001352	10	UG/GOC	FS	EPA (1996), SQALs
TRIBROMOMETHANE	000075252	65	UG/GOC	FS	EPA (1996), SQALs
TRICHLOROETHENE	000079016	210	UG/GOC	FS	EPA (1996), SQALs
XYLENE, M	000108383	2.5	UG/GOC	FS	EPA (1996), SQALs

1 - When necessary, thresholds have been converted to PPB assuming 2% total organic carbon
2 - Water type values include: freshwater (FW), saltwater (SW), estuarine (E), fresh and saltwater (FS), fresh and estuarine (FE), and estuarine and salt (ES).

Sediment Thresholds, Set 2: ERM/PELs

Chemical Name	CAS Number	Threshold Value	Units (1)	Water Type (2)	Threshold Source
2-METHYLNAPHTHALENE	000091576	201	NG/G	FS	MACDONALD (1994), PEL
ACENAPHTHENE	000083329	88.9	NG/G	FS	MACDONALD (1994), PEL
ACENAPHTHYLENE	000208968	128	NG/G	FS	MACDONALD (1994), PEL
ANTHRACENE	000120127	245	NG/G	FS	MACDONALD (1994), PEL
ARSENIC	007440382	41.6	UG/G	FS	MACDONALD (1994), PEL
BENZO(A)ANTHRACENE	000056553	693	NG/G	FS	MACDONALD (1994), PEL
BENZO(A)PYRENE	000050328	763	NG/G	FS	MACDONALD (1994), PEL
BHC, GAMMA (LINDANE)	000058899	0.99	NG/G	FS	MACDONALD (1994), PEL
BIS(2-ETHYLHEXYL) PHTHALATE	000117817	2647	NG/G	FS	MACDONALD (1994), PEL
CADMIUM	007440439	4.21	UG/G	FS	MACDONALD (1994), PEL
CHLORDANE	000057749	4.79	NG/G	FS	MACDONALD (1994), PEL
CHROMIUM	007440473	160	UG/G	FS	MACDONALD (1994), PEL
CHRYSENE	000218019	846	NG/G	FS	MACDONALD (1994), PEL
COPPER	007440508	108	UG/G	FS	MACDONALD (1994), PEL
DDD-P,P	000072548	7.81	NG/G	FS	MACDONALD (1994), PEL
DDE-P,P	000072559	27	NG/G	SE	NOAA (1995), ERM
DDT, TOTAL	CAS000111	46.1	NG/G	SE	NOAA (1995), ERM
DDT-P,P	000050293	4.77	NG/G	FS	MACDONALD (1994), PEL
DIBENZ(A,H)ANTHRACENE	000053703	135	NG/G	FS	MACDONALD (1994), PEL
DIELDRIN	000060571	4.3	NG/G	FS	MACDONALD (1994), PEL
ENDRIN	000072208	62.4	NG/G	FW	ENVIRONMENT CANADA (1996) PEL
FLUORANTHENE	000206440	1494	NG/G	FS	MACDONALD (1994), PEL
FLUORENE	000086737	144	NG/G	FS	MACDONALD (1994), PEL
HEPTACHLOR EPOXIDE	001024573	2.74	NG/G	FW	ENVIRONMENT CANADA (1996) PEL
LEAD	007439921	112	UG/G	FS	MACDONALD (1994), PEL
MERCURY	007439976	0.69	UG/G	FS	MACDONALD (1994), PEL
NAPHTHALENE	000091203	391	NG/G	FS	MACDONALD (1994), PEL
NICKEL	007440020	42.8	UG/G	FS	MACDONALD (1994), PEL
PAH, HIGH MOLECULAR WEIGHT	CAS000460	6676	NG/G	FS	MACDONALD (1994), PEL
PAH, LOW MOLECULAR WEIGHT	CAS000461	1442	NG/G	FS	MACDONALD (1994), PEL
PAHS, TOTAL	000061789	16770	NG/G	FS	MACDONALD (1994), PEL
PCBS, TOTAL	001336363	180	NG/G	SE	NOAA (1995), ERM
PHENANTHRENE	000085018	544	NG/G	FS	MACDONALD (1994), PEL
PYRENE	000129000	1398	NG/G	FS	MACDONALD (1994), PEL
SILVER	007440224	1.77	UG/G	FS	MACDONALD (1994), PEL
ZINC	007440666	271	UG/G	FS	MACDONALD (1994), PEL

1 - When necessary, thresholds have been converted to PPB assuming 2% total organic carbon

2 - Water type values include: freshwater (FW), saltwater (SW), estuarine (E), fresh and saltwater (FS), fresh and estuarine (FE), and estuarine and salt (ES).

Sediment Thresholds, Set 3: ERL/TELs

Chemical Name	CAS Number	Threshold Value	Units (1)	Water Type (2)	Threshold Source
2-METHYLNAPHTHALENE	000091576	20.2	NG/G	FS	MACDONALD (1994), TEL
ACENAPHTHENE	000083329	6.71	NG/G	FS	MACDONALD (1994), TEL
ACENAPHTHYLENE	000208968	5.87	NG/G	FS	MACDONALD (1994), TEL
ANTHRACENE	000120127	46.9	NG/G	FS	MACDONALD (1994), TEL
ARSENIC	007440382	7.24	UG/G	FS	MACDONALD (1994), TEL
BENZO(A)ANTHRACENE	000056553	74.8	NG/G	FS	MACDONALD (1994), TEL
BENZO(A)PYRENE	000050328	88.8	NG/G	FS	MACDONALD (1994), TEL
BHC, GAMMA (LINDANE)	000058899	0.32	NG/G	FS	MACDONALD (1994), TEL
BIS(2-ETHYLHEXYL) PHTHALATE	000117817	182	NG/G	FS	MACDONALD (1994), TEL
CADMIUM	007440439	0.676	UG/G	FS	MACDONALD (1994), TEL
CHLORDANE	000057749	2.26	NG/G	FS	MACDONALD (1994), TEL
CHROMIUM	007440473	52.3	UG/G	FS	MACDONALD (1994), TEL
CHRYSENE	000218019	108	NG/G	FS	MACDONALD (1994), TEL
COPPER	007440508	18.7	UG/G	FS	MACDONALD (1994), TEL
DDD-P,P	000072548	1.22	NG/G	FS	MACDONALD (1994), TEL
DDE-P,P	000072559	2.07	NG/G	FS	MACDONALD (1994), TEL
DDT, TOTAL	CAS000111	1.58	NG/G	SE	NOAA (1995), ERL
DDT-P,P	000050293	1.19	NG/G	FS	MACDONALD (1994), TEL
DIBENZ(A,H)ANTHRACENE	000053703	6.22	NG/G	FS	MACDONALD (1994), TEL
DIELDRIN	000060571	0.715	NG/G	FS	MACDONALD (1994), TEL
ENDRIN	000072208	2.67	NG/G	FW	ENVIRONMENT CANADA (1996) TEL
FLUORANTHENE	000206440	113	NG/G	FS	MACDONALD (1994), TEL
FLUORENE	000086737	19	NG/G	SE	NOAA (1995), ERL
HEPTACHLOR EPOXIDE	001024573	0.6	NG/G	FW	ENVIRONMENT CANADA (1996) TEL
LEAD	007439921	30.2	UG/G	FS	MACDONALD (1994), TEL
MERCURY	007439976	0.13	UG/G	FS	MACDONALD (1994), TEL
NAPHTHALENE	000091203	34.6	NG/G	FS	MACDONALD (1994), TEL
NICKEL	007440020	15.9	UG/G	FS	MACDONALD (1994), TEL
PAH, HIGH MOLECULAR WEIGHT	CAS000460	655	NG/G	FS	MACDONALD (1994), TEL
PAH, LOW MOLECULAR WEIGHT	CAS000461	312	NG/G	FS	MACDONALD (1994), TEL
PAHS, TOTAL	000061789	1684	NG/G	FS	MACDONALD (1994), TEL
PCBS, TOTAL	001336363	21.5	NG/G	SW	ENVIRONMENT CANADA (1996) TEL
PHENANTHRENE	000085018	86.7	NG/G	FS	MACDONALD (1994), TEL
PYRENE	000129000	153	NG/G	FS	MACDONALD (1994), TEL
SILVER	007440224	0.73	UG/G	SW	ENVIRONMENT CANADA (1996) TEL
ZINC	007440666	124	UG/G	FS	MACDONALD (1994), TEL

1 - When necessary, thresholds have been converted to PPB assuming 2% total organic carbon

2 - Water type values include: freshwater (FW), saltwater (SW), estuarine (E), fresh and saltwater (FS), fresh and estuarine (FE), and estuarine and salt (ES).

Tissue Thresholds, Set 1: FDA Action Levels

Chemical Name	CAS Number	Threshold Value	Units	Water Type (1)	Species Type	Threshold Source
ALDRIN	000309002	300	NG/G (PPB)	FS	CRUSTACEA	USFDA, ACTION LEVELS
ALDRIN	000309002	300	NG/G (PPB)	FS	FINFISH	USFDA, ACTION LEVELS
ALDRIN	000309002	300	NG/G (PPB)	FS	MOLLUSCA	USFDA, ACTION LEVELS
CHLORDANE	000057749	300	NG/G (PPB)	FS	CRUSTACEA	USFDA, ACTION LEVELS
CHLORDANE	000057749	300	NG/G (PPB)	FS	FINFISH	USFDA, ACTION LEVELS
CHLORDANE	000057749	300	NG/G (PPB)	FS	MOLLUSCA	USFDA, ACTION LEVELS
CHLORDECONE (KEPONE)	000143500	300	NG/G (PPB)	FS	CRUSTACEA	USFDA, ACTION LEVELS
CHLORDECONE (KEPONE)	000143500	300	NG/G (PPB)	FS	FINFISH	USFDA, ACTION LEVELS
CHLORDECONE (KEPONE)	000143500	300	NG/G (PPB)	FS	MOLLUSCA	USFDA, ACTION LEVELS
DDE	000072559	5000	NG/G (PPB)	FS	CRUSTACEA	USFDA, ACTION LEVELS
DDE	000072559	5000	NG/G (PPB)	FS	FINFISH	USFDA, ACTION LEVELS
DDE	000072559	5000	NG/G (PPB)	FS	MOLLUSCA	USFDA, ACTION LEVELS
DDT	000050293	5000	NG/G (PPB)	FS	CRUSTACEA	USFDA, ACTION LEVELS
DDT	000050293	5000	NG/G (PPB)	FS	FINFISH	USFDA, ACTION LEVELS
DDT	000050293	5000	NG/G (PPB)	FS	MOLLUSCA	USFDA, ACTION LEVELS
DIELDRIN	000060571	300	NG/G (PPB)	FS	CRUSTACEA	USFDA, ACTION LEVELS
DIELDRIN	000060571	300	NG/G (PPB)	FS	FINFISH	USFDA, ACTION LEVELS
DIELDRIN	000060571	300	NG/G (PPB)	FS	MOLLUSCA	USFDA, ACTION LEVELS
HEPTACHLOR	000076448	300	NG/G (PPB)	FS	CRUSTACEA	USFDA, ACTION LEVELS
HEPTACHLOR	000076448	300	NG/G (PPB)	FS	FINFISH	USFDA, ACTION LEVELS
HEPTACHLOR	000076448	300	NG/G (PPB)	FS	MOLLUSCA	USFDA, ACTION LEVELS
HEPTACHLOR EPOXIDE	001024573	300	NG/G (PPB)	FS	CRUSTACEA	USFDA, ACTION LEVELS
HEPTACHLOR EPOXIDE	001024573	300	NG/G (PPB)	FS	FINFISH	USFDA, ACTION LEVELS
HEPTACHLOR EPOXIDE	001024573	300	NG/G (PPB)	FS	MOLLUSCA	USFDA, ACTION LEVELS
MERCURY	007439976	1	UG/G (PPM)	FS	CRUSTACEA	USFDA, ACTION LEVELS
MERCURY	007439976	1	UG/G (PPM)	FS	FINFISH	USFDA, ACTION LEVELS
MERCURY	007439976	1	UG/G (PPM)	FS	MOLLUSCA	USFDA, ACTION LEVELS
MIREX	002385855	100	NG/G (PPB)	FS	CRUSTACEA	USFDA, ACTION LEVELS
MIREX	002385855	100	NG/G (PPB)	FS	FINFISH	USFDA, ACTION LEVELS
MIREX	002385855	100	NG/G (PPB)	FS	MOLLUSCA	USFDA, ACTION LEVELS
TDE	000072548	5000	NG/G (PPB)	FS	CRUSTACEA	USFDA, ACTION LEVELS
TDE	000072548	5000	NG/G (PPB)	FS	FINFISH	USFDA, ACTION LEVELS
TDE	000072548	5000	NG/G (PPB)	FS	MOLLUSCA	USFDA, ACTION LEVELS

1 - Water type values include: freshwater (FW), saltwater (SW), estuarine (E), fresh and saltwater (FS), fresh and estuarine (FE), and estuarine and salt (ES).

Tissue Thresholds, Set 2A: FDA Levels of Concern - 90th Percentile

Chemical Name	CAS Number	Threshold Value	Units	Water Type (1)	Species Type	Threshold Source
ARSENIC	007440382	43.0	UG/G (PPM)	FS	CRUSTACEA	USFDA, 90TH, ARSENIC
ARSENIC	007440382	55.0	UG/G (PPM)	FS	MOLLUSCA	USFDA, 90TH, ARSENIC
CADMIUM	007440439	3.0	UG/G (PPM)	FS	CRUSTACEA	USFDA, 90TH, CADMIUM
CADMIUM	007440439	3.0	UG/G (PPM)	FS	MOLLUSCA	USFDA, 90TH, CADMIUM
CHROMIUM III, TOTAL	016065831	11.0	UG/G (PPM)	FS	CRUSTACEA	USFDA, 90TH, CHROMIUM
CHROMIUM III, TOTAL	016065831	11.0	UG/G (PPM)	FS	MOLLUSCA	USFDA, 90TH, CHROMIUM
LEAD	007439921	0.6	UG/G (PPM)	FS	CRUSTACEA	USFDA, 90TH, LEAD
LEAD	007439921	0.8	UG/G (PPM)	FS	MOLLUSCA	USFDA, 90TH, LEAD
NICKEL	007440020	70.0	UG/G (PPM)	FS	CRUSTACEA	USFDA, 90TH, NICKEL
NICKEL	007440020	80.0	UG/G (PPM)	FS	MOLLUSCA	USFDA, 90TH, NICKEL

1 - Water type values include: freshwater (FW), saltwater (SW), estuarine (E), fresh and saltwater (FS), fresh and estuarine (FE), and estuarine and salt (ES).

Tissue Thresholds, Set 2B: FDA Levels of Concern - Mean

Chemical Name	CAS Number	Threshold Value	Units	Water Type (1)	Species Type	Threshold Source
ARSENIC	007440382	86.0	UG/G (PPM)	FS	CRUSTACEA	USFDA, MEAN, ARSENIC
ARSENIC	007440382	110.0	UG/G (PPM)	FS	MOLLUSCA	USFDA, MEAN, ARSENIC
CADMIUM	007440439	6.0	UG/G (PPM)	FS	CRUSTACEA	USFDA, MEAN, CADMIUM
CADMIUM	007440439	5.0	UG/G (PPM)	FS	MOLLUSCA	USFDA, MEAN, CADMIUM
CHROMIUM III, TOTAL	016065831	22.0	UG/G (PPM)	FS	CRUSTACEA	USFDA, MEAN, CHROMIUM
CHROMIUM III, TOTAL	016065831	17.0	UG/G (PPM)	FS	MOLLUSCA	USFDA, MEAN, CHROMIUM
LEAD	007439921	1.2	UG/G (PPM)	FS	CRUSTACEA	USFDA, MEAN, LEAD
LEAD	007439921	1.5	UG/G (PPM)	FS	MOLLUSCA	USFDA, MEAN, LEAD
NICKEL	007440020	130.0	UG/G (PPM)	FS	CRUSTACEA	USFDA, MEAN, NICKEL
NICKEL	007440020	120.0	UG/G (PPM)	FS	MOLLUSCA	USFDA, MEAN, NICKEL

1 - Water type values include: freshwater (FW), saltwater (SW), estuarine (E), fresh and saltwater (FS), fresh and estuarine (FE), and estuarine and salt (ES).

Tissue Thresholds Set 3: EPA Screening Levels

Chemical Name	CAS Number	Threshold Value	Units	Water Type (1)	Species Type	Threshold Source
CADMIUM	007440439	10.0	UG/G (PPM)	FS	CRUSTACEA	USEPA, SCREENING VALUES
CADMIUM	007440439	10.0	UG/G (PPM)	FS	FINFISH	USEPA, SCREENING VALUES
CADMIUM	007440439	10.0	UG/G (PPM)	FS	MOLLUSCA	USEPA, SCREENING VALUES
CARBOPHENOTHION	000786196	1000.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
CARBOPHENOTHION	000786196	1000.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
CARBOPHENOTHION	000786196	1000.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
CHLORDANE	000057749	80.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
CHLORDANE	000057749	80.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
CHLORDANE	000057749	80.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
CHLORPYRIFOS	002921882	30000.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
CHLORPYRIFOS	002921882	30000.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
CHLORPYRIFOS	002921882	30000.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
DDT (TOTAL)	CAS000111	300.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
DDT (TOTAL)	CAS000111	300.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
DDT (TOTAL)	CAS000111	300.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
DIAZINON	000333415	900.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
DIAZINON	000333415	900.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
DIAZINON	000333415	900.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
DICOFOL	000115322	10000.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
DICOFOL	000115322	10000.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
DICOFOL	000115322	10000.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
DIELDRIN	000060571	7.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
DIELDRIN	000060571	7.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
DIELDRIN	000060571	7.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
DIOXINS	001746016	700.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
DIOXINS	001746016	700.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
DIOXINS	001746016	700.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
DISULFOTON	000298044	500.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
DISULFOTON	000298044	500.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
DISULFOTON	000298044	500.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
ENDOSULFAN	000115297	20000.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
ENDOSULFAN	000115297	20000.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
ENDOSULFAN	000115297	20000.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
ENDRIN	000072208	3000.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
ENDRIN	000072208	3000.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
ENDRIN	000072208	3000.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
ETHION	000563122	5000.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
ETHION	000563122	5000.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
ETHION	000563122	5000.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
HEPTACHLOR EPOXIDE	001024573	10.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
HEPTACHLOR EPOXIDE	001024573	10.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
HEPTACHLOR EPOXIDE	001024573	10.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
HEXACHLORBENZENE	000118741	70.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
HEXACHLORBENZENE	000118741	70.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
HEXACHLORBENZENE	000118741	70.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
LINDANE	000058899	80.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
LINDANE	000058899	80.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
LINDANE	000058899	80.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
MERCURY	007439976	0.6	UG/G (PPM)	FS	CRUSTACEA	USEPA, SCREENING VALUES
MERCURY	007439976	0.6	UG/G (PPM)	FS	FINFISH	USEPA, SCREENING VALUES

1 - Water type values include: freshwater (FW), saltwater (SW), estuarine (E), fresh and saltwater (FS), fresh and estuarine (FE), and estuarine and salt (ES).

Tissue Thresholds Set 3: EPA Screening Levels

Chemical Name	CAS Number	Threshold Value	Units	Water Type (1)	Species Type	Threshold Source
MERCURY	007439976	0.6	UG/G (PPM)	FS	MOLLUSCA	USEPA, SCREENING VALUES
MIREX	002385855	2000.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
MIREX	002385855	2000.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
MIREX	002385855	2000.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
OXYFLUORFEN	042874033	800.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
OXYFLUORFEN	042874033	800.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
OXYFLUORFEN	042874033	800.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
PCBS (TOTAL POLYCHLORINATED BI	001336363	10.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
PCBS (TOTAL POLYCHLORINATED BI	001336363	10.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
PCBS (TOTAL POLYCHLORINATED BI	001336363	10.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
SELENIUM	007782492	50.0	UG/G (PPM)	FS	CRUSTACEA	USEPA, SCREENING VALUES
SELENIUM	007782492	50.0	UG/G (PPM)	FS	FINFISH	USEPA, SCREENING VALUES
SELENIUM	007782492	50.0	UG/G (PPM)	FS	MOLLUSCA	USEPA, SCREENING VALUES
TERBUFOS	013071799	1000.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
TERBUFOS	013071799	1000.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
TERBUFOS	013071799	1000.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES
TOXAPHENE	008001352	100.0	NG/G (PPB)	FS	CRUSTACEA	USEPA, SCREENING VALUES
TOXAPHENE	008001352	100.0	NG/G (PPB)	FS	FINFISH	USEPA, SCREENING VALUES
TOXAPHENE	008001352	100.0	NG/G (PPB)	FS	MOLLUSCA	USEPA, SCREENING VALUES

1 - Water type values include: freshwater (FW), saltwater (SW), estuarine (E), fresh and saltwater (FS), fresh and estuarine (FE), and estuarine and salt (ES).

APPENDIX D: Scientific and Technical Advisory Committee Review of Characterization

June 1, 1999

Mr. Robert Summers
Chair, Toxics Subcommittee
Maryland Department of the Environment
2500 Broening Highway
Baltimore, MD 21224

Dear Mr. Summers:

In response to the request from the Implementation Committee, the Scientific and Technical Advisory Committee (STAC) conducted an expedited, independent technical review of the Toxics Subcommittee's publication *Targeting Toxics: A Characterization Report* **-** *A Tool for Directing Management and Monitoring Actions in the Chesapeake Bay's Tidal Rivers*, and its *Technical Workplan*. The results of this review process are described in the attached report.

The review panel for this effort, chaired by Dr. Jonathan Phinney from the Center for Marine Conservation, was charged with three tasks: (1) evaluate the protocol used for the characterization, and its utility as a management tool, (2) determine of the protocol was properly implemented, and (3) recommend how this information can be more effectively communicated in the future. Each of these charges are addressed in detail in the attached report. A presentation and discussion with the subcommittee of the findings of the review panel can be arranged, if requested.

In general, the review panel found the protocol used for this toxics characterization, and its implementation given the available data sets, to be appropriate. They commended the Toxics Subcommittee for pulling together so many disparate datasets to be effectively used for a single purpose. However, despite the large number of data sets used in the characterization, significant information gaps exist for the Bay's tidal rivers. As such, the reviewers recommend that the results of this characterization be used primarily to direct future toxics research and monitoring efforts.

The attached report recommends some specific changes to the characterization report and its technical workplan. STAC requests that the Toxics Subcommittee respond to those recommendations, identifying how they were implemented or clarifying why such changes were not feasible and/or appropriate, by June 18, 1999. After the responses are received, STAC will submit the technical review report to the Implementation Committee.

STAC appreciates the opportunity to participate in the review of the toxics characterization report. If you have any questions or need further information, please feel free to contact myself or Caryn Boscoe, STAC Coordinator.

Sincerely,

Richard L. Jachowski
Chair, Scientific & Technical Advisory Committee

CC: Kelly Eisenman, TSC Coordinator
Carrie McDaniel, TSC Fellow
Joe Winfield, Regional Focus Workgroup Chair

Technical Review

of

Targeting Toxics: A Tool for Directing Management and Monitoring Actions in the Chesapeake Bay's Tidal Rivers

Public Report & Technical Workplan

June 1, 1999

Conducted by the Scientific and Technical Advisory Committee to the Chesapeake Bay Program

Review Panel Members

Jonathan Phinney (chair); Center for Marine Conservation
Richard Coffin; Naval Research Laboratory
Dan Dauer; Old Dominion University
Dennis Suszkowski; Hudson River Foundation
Caryn Boscoe (coordinator); Chesapeake Research Consortium

Introduction

In April 1999, the Chesapeake Bay Program's Implementation Committee requested that the Scientific and Technical Advisory Committee establish a review panel to conduct an expedited, independent, technical review of two publications produced by the Toxics Subcommittee: *Targeting Toxics: A Characterization Report - A Tool for Directing Management & Monitoring Actions in the Chesapeake Bay's Tidal Rivers* and the characterization's *Technical Workplan*. The ad hoc review panel was charged with the following three tasks:

1. Evaluate the scientific merit of the protocol and criteria used in the characterization of any designated region of the tidal Chesapeake, as detailed in the 1999 Technical Workplan. Address the suitability of this protocol as a management tool.

2. Provide an assessment of whether the protocol was properly used to categorize tributary segments described in the workplan and the report.

3. Recommend how future reports on characterization of contaminant-related impacts can most effectively and accurately communicate information about habitat status.

Foremost, the Toxics Subcommittee and its Regional Focus Workgroup is to be commended for weaving together the many databases used in the characterization into a centralized, useable system. Formatting so many disparate sources such that they can be used to address a single problem is a significant challenge. In addition, the successful coordination of the many agencies and individuals involved in the Workgroup's development of the protocol and the characterizations is a major accomplishment in itself.

The data available for use in the development of this characterization posed a considerable challenge to the Regional Focus Workgroup. Information was collected from a wide variety of research and monitoring efforts which tested for different compounds at different time scales, using a range of sampling protocols. The result of this collection is a dataset with *uncoordinated and* incomplete spatial and temporal (historic and seasonal) coverage. As such, this toxics characterization has limitations in the level of detail at which it can classify toxicity, as well as identify sources and primary contaminants in a system. This paucity of data should be emphasized in the report, both for an accurate understanding of the limitations and to encourage further, coordinated monitoring efforts. The review panel makes some specific recommendations about future research and monitoring later in this report.

Review Process

Reviewers were chosen to represent expertise in a range of toxicological disciplines. Following the review of the two documents and the datasets used by the Regional Focus Workgroup to characterize the Chester River segment, the review panel submitted written comments to Caryn Boscoe, who drafted the initial report. Based on three group discussions of the pertinent issues, reviewers made revisions to two subsequent redrafts before completion of the final report.

1. Scientific Merit of the Protocol and Criteria

In general, the review panel found the protocol used in the Technical Workplan to be suitable for the limited dataset presently available, and should be considered a first attempt to characterize the toxicity in the Bay's tidal rivers and to direct future monitoring efforts. The characterization protocol presented a logical series of steps that involved identifying and compiling relevant data, interpreting the data in light of established endpoints, and then characterizing river segments into qualitative categories.

> *Categories*: Given the present level of data and information, the four categories used in the characterization are appropriate: (1) Region of Concern, (2) Area of Emphasis, (3) Area with Low Probability for Adverse Effects, and (4) Area with Insufficient or Inconclusive Data. The review panel recommends that descriptions and figures (particularly Figure 3) for each of the segments in Category 4 specify whether the data available were insufficient or inconclusive. Insufficient data requires more general monitoring, while inconclusive data calls for focused research and/or monitoring.
>
> *Endpoints*: The endpoints, or thresholds, used to characterize the level of contamination in each segment were generally appropriate. Those used to evaluate water quality were found to be conservative and appropriate guidelines. The thresholds for sediment analyses are currently a subject of scientific debate, but appropriately based on current information.
>
> *Management Tool*: As a management tool, the protocol is useful as an initial assessment of the Bay's tidal tributaries and provides a good model for other estuary programs to utilize. It summarizes existing data and sets up priority segments for future analysis. The greatest strength of the characterization may be its role as a scientifically sound means to identify future sites and issues for study and monitoring, and should be used to direct upcoming efforts.
>
> The current characterization presents two potential problems related to management actions and public interpretation of the results: (a) it may overstate problems because the relationships between cause and effect in the segments are not well established, or (b) they may understate problems because data are limited or lacking altogether. These information gaps limit the ability of the characterization to identify specific locations and/or contaminants which require regulation or management. This qualification should be considered when using the characterization as a management tool.

2. Protocol Implementation

The reviewers examined the datasets available from the Chester River as a case study for the implementation of the characterization protocol. Based on this information, the reviewers felt that the consensus process utilized by the Workgroup successfully implemented the criteria and decision rules described in the technical workplan. The panel would like to reemphasize a point made in the workplan, that making a characterization is not a standardized or reproducible process. Rather, the Workgroup members had to apply their best professional judgement and group consensus in the characterization of each of the segments.

The review panel recommends the following revisions to the Technical Workplan and Public Report:

- The segment profiles in the public report make statements about the toxicity levels in the tributaries which are inappropriate and/or misleading, particularly when based on a limited number of presumably uncoordinated toxicity tests. For example, the Chester River profiles states "The sediment in the upper portions of the Chester River was found to be **highly** toxic...to Chesapeake Bay organisms..." The panel recommends that descriptors such as "highly toxic" be changed to more neutral language (e.g. "adverse effects") unless detailed definitions are included for such classifications.
- Areas with Low Probability for Adverse Effects: the report should emphasize that just because there is not a chemical contaminant-related problem does not mean that the tributary is healthy, requiring no further management or restoration efforts. Other environmental factors, such as low dissolved oxygen, may impact chemical fates and transport times, having future implications for the segment. A notation of this caveat could also be included in the figures (especially Figure 3).
- Include more information about the datasets used in the characterization. For example: (1) Discuss the temporal coverage of the water column data. Were samples collected seasonally? Monthly? Coordinated with precipitation events? (2) What does the toxicity data consist of? What species are used? What are the degrees of toxicity?
- The public report mentions the "Workgroup's confidence" or "level of confidence." From a scientific perspective, the report should clarify the level of uncertainty, where possible, in making a decision about the potential toxic effects in a segment, thus illustrating the possibility of an incorrect (either positive or negative) classification.
- The major purpose of the characterization is to prompt action when problems are found - or yet to be found. There is very little detail about the types of actions that might be taken. Though it may be premature to describe detailed remedies, it is likely that ongoing inputs will be problematic in areas of concern. What will be done to investigate the sources of the pollutants? If multiple sources are discovered, then some relative significance will have to attached to the various sources. If this is the case, loadings will have to quantified and models may be necessary to link the loads with observed conditions in water, sediment and biota. Is modeling planned? Will sources be quantified? Will the existing data support model development?
- Pollution Prevention is stated as an option, however, this form of contaminant reduction may not be appropriate to deal with problematic compounds like PCBs and DDT -- chemicals that were banned years ago. What about TMDLs or other regulatory tools?

3. Future Research and Monitoring

As stated earlier, the greatest utility of the toxics characterization is to direct and influence future chemical contaminant research and monitoring programs. It is clear from the inconsistencies in the present dataset that a focused, coordinated monitoring program would allow a much more detailed, comprehensive analysis of the toxicity problems in the Chesapeake Bay ecosystem. The following are a few specific recommendations for consideration in future monitoring and research programs, in anticipation of an updated characterization project.

- Identifying those contaminants which have significant adverse effects on living resources would allow the prioritization of monitoring and restoration efforts. Genetic and tissue toxicity assays can demonstrate the contaminant effects at multiple levels of the food web and be beneficial in setting priorities. (See References)
- Continuing studies on the impact of low level, long-term exposure to ambient toxicity should be encouraged.
- Future work for assessing habitats in the segments would benefit from a more thorough analysis of spatial and seasonal variations in contaminant concentrations and the contaminant turnover time. For example, sampling should be coordinated with pesticide applications in the spring.
- Repeated measurement of chemicals which are no longer in use (e.g. DDT) may be of limited utility for regulation and prevention, particularly in areas where new introductions are unlikely. If initial surveys demonstrate that these chemicals are not present or in harmless amounts, monitoring should be shifted to incorporate chemicals and pesticides currently used in the watershed.
- As data availability improves, the guidelines and criteria used for the characterizations should also be updated. For example, EPA's Acute and Chronic Water Quality Guidelines are outdated and do not take into account advances in toxicity assessment such as AVS measurement of sediment toxicity, speciation measurements, and synergism between toxicants. The Guidelines should be used as a first assessment of a potential problem that could require follow-up speciation and toxicity tests.
- Public health implications of chemical contaminants would seem to be of paramount importance, and should have greater emphasis in future characterizations. Specifically, (1) highlight fish tissue data and associated health advisories in future reports, (2) in conjunction with state organizations, conduct a Bay-wide assessment of contaminants in edible species, with an emphasis on organics, (3) considering the movement of contaminants in fish, reassess the characterization of the mainstem Bay as free of toxics impacts.

Textual Comments

Reviewers identified specific questions and comments about the text of the documents, detailed below.

Overview comments / questions

- Throughout the report, the distinction between "exposure" and "effects" is unclear. Recommend changing to "concentration" and "toxicity" (or other appropriate terms).

- How will PCBs be quantified? The Workplan states that arochlors and congeners will be summed. Will the 18 or so congeners be combined to obtain a measure of total PCBs? If so, this total will likely be a factor of 2 too low. Why was the Workgroup's confidence in using a total PCB threshold...fairly low?
- Are there other endpoints that have management implications that could be used in the characterizations? For instance, is dredged material analyzed in relationship to any toxics endpoints? If so, these endpoints would be useful to include. The more endpoints that have specific management implications, the better.

<u>Page-specific comments / questions</u>

- Pg 2 para 2 bullet 1. Change sentence to read *Better* identify and *conduct risk assessment analysis* in the Areas of Emphasis. As written, "implement necessary pollution prevention action" is premature given that there is little data available in some areas of emphasis. More direct field studies would be the logical next step.
- Pg 4: the mainstem of the Bay is not characterized because contaminant levels are low. The sentence about technique development implies that there are possible effects in the mainstem (or also in the tributaries) which can not be detected. Is this statement based upon caution or suspected cases in the data set where toxicity effects were found but no measured levels of contamination?
- Pg 4, bottom: "... spatially or temporally insufficient.... inconclusive... data.." A bit vague and never resolved. Possibly this is an outcome of the shear size and complexity of the task at hand.
- Pg 5: "... limited or no evidence for a relationship..." "... Strong evidence for a linkage..." Vague.
- Pg 5 para 4: drop "pollution prevention actions" replace with better characterization of toxicity using speciation, risk assessment, other tools. See explanation first bullet.
- Pg 6 para 1: "Chemical contaminants entering the tidal rivers tend to get trapped...." This indicates that a mass balance of input relative to dilution from river and tidal energy has been accomplished. If this has not been done this needs to be restated.
- Pg 7 para 1: Table 1 need to have sources embedded in a legend, so the reader doesn't have to interpret Appendix B. For instanced, water column contaminant data concentrations could include EPA's Acute and Chronic Toxicity Guidelines.
- Pg 8 para 4, line 2: What was the QA/QC on data going back to 1976? For trace metals, "clean techniques" were developed during that period and not implemented for another10 years or so. There should be added emphasis on screening of data sets.
- Pg 9 para 2, line 2: "water exposure" should be changed to "water concentration." Exposure is a nebulous term and the data are generally reported in concentration units.
- Pg 9 para 2 line 4: Define "adequate spatial coverage": 50 % of tributary? other?
- Pg 10 para 2 line 5: "no random benthic sampling data were available for Virginia waters.." A benthic monitoring program has been in place in Virginia since 1996. Statement in the report needs to clarify that the data from this program were just not used in the characterization.
- Pg 11, bottom: Last sentence about "absence of data" and inference from expectations is troublesome.

- Pgs 12-13: List the actual data sets used in the guidelines. It is done in some sections such as water Column Concentration-(e.g. EPA aquatic life criteria) ,but not Bottom Sediment or Finfish/Shellfish. Just listing the Chesapeake Bay Program Toxic Databases is not enough; list NOAA's ER-L/ER-M threshold document and others.
- Pg 13: benthic B-IBI criteria conflict with those in Appendix B, page 10.
- Figure 6 shows locations of benthic community samples used in the report. There were hundreds of EMAP locations that are not indicated here. Were EMAP data used? In 1996 the Virginia Benthic Monitoring Program began random sampling at 100 locations each year. There are 200 random Virginian locations that were available for the period 1996-1997. Were these data used?

References

Ray, S., Dunn, B.P., Payne, J.F., Fancey, L. and Belands, P. 1991. Aromatic DNA-carcinogen adducts in Beluga whales from the Canadian Arctic and Gulf of Lawrence. Mar. Pollut. Bull. 22: 392-396.

Stein, J., Collier, T.K., Reichert, E., Casillas, T., Hom, T. and Varanasi, U. 1992. Bioindicators of contaminant exposure and sublethal effects: studies with benthic fish in Puget Sound, Washington. Environ. Toxicol. Chem. 11: 701-714.

Reichert, W.L. and French, B. 1994. 32P-Postlabeling protocols for assaying levels of hydrophobic DNA adducts in fish. NOAA-NWFCS Tech Memo-14.

Chesapeake Bay Program

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June 15, 1999

Richard L. Jachowski
Chair, Scientific and Technical Advisory Committee
U.S. Geological Survey
11410 American Holly Drive
Laurel, MD 20708-4015

On behalf of the Toxic Subcommittee, I would like to thank you for coordinating such a comprehensive STAC technical review of the toxics characterization effort. The review panel's in depth review of the scientific merit of the protocol and criteria used in the characterization, the application of the protocol, and communication of the results has helped us to strengthen this initial characterization and will provide insight on how to improve the characterization in future updates.

Attached is our response to the STAC review which details how we have responded to the recommendations and issues that were raised. We would be happy to meet with the STAC review panel and the entire Committee to discuss the review in more detail if desired. You will note throughout our response, that we highlight several areas where follow up discussions and further coordination with STAC would be beneficial, particularly in acting on the review panel's recommendations for future research and monitoring. We would like to continue this dialogue with the broader scientific community as we undergo reevaluating and revising the 1994 toxics strategy this year, particularly at the upcoming "science forum" in September.

The reviews that the STAC has conducted over the years on key Toxics Subcommittee products and budget proposals have been invaluable. We look forward to continuing these discussions and interactions with the STAC and the broader scientific community as we plot our course for the year 2000 and beyond.

Sincerely,

Bob Summers
Chair, Toxics Subcommittee
Maryland Department of the Environment

Attachment
cc: Jonathan Phinney, Chair of Review Panel/Caryn Boscoe, STAC

Toxics Subcommittee Response to the STAC Technical Review of Targeting Toxics: ***A Tool for Directing Management and Monitoring Actions in the Chesapeake Bay's Tidal Rivers***
Public Report & Technical Workplan

This report represents the formal response from the Toxics Subcommittee to the Scientific and Technical Advisory Committee (STAC) review report of the characterization (Attachment A). The STAC recommendations are listed under heading topics used in the STAC review report in the order they appear in the review report. The Toxics Subcommittee's response follows each recommendation and includes a combination of actions (in bold text) and further explanations. The "workgroup" refers to the Toxics Subcommittee's Regional Focus Workgroup which was charged with conducting the toxics characterization.

Introduction

RE: Data Limitations: "This paucity of data should be emphasized in the report, both for an accurate understanding of the limitations and to encourage further, coordinated monitoring efforts.*"*

Agreed. We appreciate that the review panel recognized one of the more important limitations to our efforts. It is important to emphasize that the database used in this characterization is from a wide range of research and monitoring programs [sic: uncoordinated efforts] that provide inadequate descriptions of the presence of contaminants and their potential or actual impacts for much of the Bay [sic: incomplete spatial and temporal (historic and seasonal) coverage]. This characterization is limited in the level of detail at which it can classify problems related to contamination [sic: toxicity]. It should be apparent that a better understanding and more clear picture of the problems can only be provided by enhanced and coordinated monitoring efforts at all levels within the Chesapeake Bay Program. This limitation is clearly stated in the technical workplan (Section III.A.5. Data Limitations and Section VI. Recommendations for Future Updates). **We have added the following section in the public report "Limitations of Data" (Section II) to ensure that this limitation is clearly stated:** *"Limitations of Data*: It is important to note that, to date, there is no Baywide monitoring program designed to characterize toxics conditions in the Chesapeake Bay's tidal rivers on the scale necessary to perform comparable assessments of all rivers. Information used for this characterization was collected for a wide variety of studies that were conducted for different purposes. The result of this collection is a dataset with uncoordinated and incomplete spatial and temporal coverage. The workgroup was faced with the challenge of piecing together these different datasets and developing a consistent set of decision rules for how to interpret this information in making a characterization. As such, this characterization has limitations in the level of detail at which it can characterize toxic effects on the Bay's living resources. Through increased funding, intensified coordination with federal and state toxics monitoring and research efforts, and intentional collaboration between Bay Program signatory states at the governmental and academic level to address Bay-wide issues, the gaps in data coverage will be filled." **We have also added the following sentence in Section VI Recommendations:** "Only through increased funding, intensified coordination with all Federal and State toxics monitoring and research efforts, <u>and</u> intentional collaboration between the Signatory states at the governmental and academic level to address Bay-wide issues, will the gaps in data coverage and gaps in our knowledge of the distribution and extent of toxic effects be filled."

1. Scientific Merit of the Protocol and Criteria

RE: "... should be considered a first attempt to characterize toxicity in the Bay's tidal rivers and to direct future monitoring efforts."

Agreed. Prior to future updates to the characterization, an accounting of the "lessons learned" would be useful for future refinements and the next characterization to be performed in 3 years (see *1994 Chesapeake Bay Basinwide Toxics Reduction and Prevention Strategy*) or for periodic updates as new data become available (an alternative strategy to triennial updates).

RE: "The review panel recommends that descriptions and figures ... for each of the segments in Category 4 specify whether the data available were insufficient or inconclusive."

We agree that distinguishing between areas with insufficient data versus areas with inconclusive data is important. Initially, the Regional Focus Workgroup (hereafter, workgroup) was working with only the category of "insufficient" and found that in some cases it was difficult to classify a segment because the data, although of adequate spatial/temporal coverage, were considered "inconclusive" or conflicting for one or more reasons. "Insufficient" was considered just too little data to interpret for the spatial scale of the segment. In developing a consensus, the workgroup "lumped" these two categories together because the best professional judgement was that any additional monitoring or research in these areas would have to be directed at answering one question: what is the level of impairment due to toxics, if any? The workgroup has not developed specific definitions or decision rules to distinguish segments with insufficient data from segments with inconclusive data and therefore cannot provide extra detail on the map. **We have clearly indicated when data were spatially or temporally insufficient versus inconclusive in the summary section of each segment profile in the public report.**

It is obvious that the two strategies suggested by STAC ("more general monitoring" vs. "focused research and/or monitoring") are good approaches for resolving the classification uncertainties. **The Toxics Subcommittee will continue to use the more detailed information in the segment profiles and the data used to make the characterizations to set its characterization priorities in the *Areas with Insufficient or Inconclusive Data*.** It may be appropriate for STAC and the Toxics Subcommittee to work together in the process of setting specific objectives for the research and monitoring programs. That is, the Toxics Subcommittee should recognize the differences among the *Areas with Insufficient or Inconclusive Data* and decide the appropriate monitoring strategy with STAC review so that the uncertainties can be resolved at a management and scientific level, respectively.

RE: *Endpoints*

Concur.

RE: *Management Tool*

1st ¶ RE: "model for other estuary programs" and "greatest strength of the characterization may be its role as a scientifically sound means to identify future sites and issues for study and monitoring."

Concur.

2nd ¶ (a) "two potential problems related to management actions"

We agree that the "greatest strength of the characterization may be its role as a scientifically sound means to identify future sites and issues for study and monitoring, ...". We also agree that there are limitations in how this characterization can be used for targeting management activities. We believe that this initial characterization can serve as a valuable planning tool to help the Bay Program to better target its voluntary management actions in the watershed. We have always pursued two goals: to improve our understanding of toxic impacts in the Bay, while concurrently acting with the knowledge we have now to ensure that we are reducing and preventing chemical contamination in the Bay. As our understanding increases, we will be able to better target our management actions. This characterization will allow the Chesapeake Bay Program to determine the areas in which to focus its voluntary pollution prevention and reduction efforts and the areas in which to focus its preservation/conservation efforts. For example, in the *Areas of Emphasis* where point source loadings of chemicals of concern are substantial (based on the recently published *1999 Chesapeake Bay Basinwide Toxics Loading and Release Inventory*) we could target businesses in those watersheds for further voluntary chemical reductions through the voluntary pollution prevention program, Businesses for the Bay. The characterization gives the State/District partners base information to allow them to conduct the more site specific analysis and source assessment studies necessary for implementing regulatory programs called for in the *Clean Water Act.*

We agree that we need to clearly state the utility of this characterization, highlighting its primary value as a tool for targeting monitoring and carefully describing how it can be used for targeting voluntary management activities. **To clarify the utility of the characterization, we have added the following paragraph into the public report (Section III: What will be done with this characterization effort) and in Technical Workplan (Section V. Implications of the Characterization):** "The primary value and utility of the characterization is in identifying areas that need additional monitoring and assessment to better characterize the status of toxic effects on living resources inhabiting those areas. This characterization can also serve as a planning tool to help the Chesapeake Bay Program determine the areas in which to focus its voluntary pollution prevention and reduction efforts and the areas in which to focus its voluntary preservation/conservation efforts. The characterization gives the State/District partners base information to allow them to conduct site specific analysis and source assessment studies which may be necessary before regulatory actions can be taken."

2nd ¶ (b) RE: "overstate problems"

The workgroup made every effort to be conservative in characterizing an area as an *Area of Emphasis*. However, due to the limitations of the data, it is possible that some problems may be overstated either in degree or extent of contamination. Uncertainty in the characterizations has been detailed in the caveats in the segment profiles in the public report. It is important to note that the burden of proof for an *Area of Emphasis* does not require a demonstrated cause and effect relationship. It may be argued that, with few exceptions, direct cause and effect relationships are impossible to define when working with ambient exposure and effects data. Only where there are site-, contaminant- or effects-specific studies with the objective to identify causative agents <u>and</u> to confirm their actions against target species, populations or communities is there a chance for some level of confidence in defining causality. We intentionally restricted our efforts to looking at ambient data and not data from known "hot spots" for contaminants or effects to ensure that we were characterizing an entire segment rather than letting a known problem (hopefully under responsible management attention such as the implementation of TMDLs or remediation efforts) drive the classification for a segment. Also, we "raised the bar" for our use of the "disputed" thresholds or benchmarks to reduce the likelihood of overstating problems because of the concern for unwarranted alarm or management action.

2nd¶ (c) RE: "understate the problem"

Agree. This is an issue that the workgroup struggled to address. We are highly concerned about overlooking a problem where current data "suggest" that there is no problem and giving the managers and public a false sense that the entire segment is clean or safe from either a natural resources, habitat, or human health perspective. **We have addressed any limitations or caveats in the characterizations in the segment profiles in Section IV of the public report.**

2. Protocol Implementation

RE: CASE STUDY: Chester River "...the reviewers felt that the consensus process utilized by the Workgroup successfully implemented the criteria and decision rules described in the technical workplan."

Concur.

Bullet 1: "The panel recommends that descriptors such as 'highly toxic' be changed to more neutral language (e.g. 'adverse effects') unless detailed definitions are included for such classifications."

Agree that a more globally understood term or terms be used throughout the report to describe results of toxicity tests. The author of the source document for these data used words such as "highly toxic" and "low to moderately toxic" to indicate the severity of toxicity observed based on the number of toxicity tests and endpoints showing toxic effects. **Since these words are not in and of themselves descriptive, we have replaced them with text which describes that an adverse effect occurred and gives an indication of the severity of toxicity.** An example of the change in wording is: "the [sediment/water] was found to cause adverse effects on Chesapeake Bay organisms exposed to the [sediment/water] in the laboratory. In laboratory studies, sediment from [location] was more toxic to animals that live in the sediments than almost all other sediments tested in the Bay (ranking third [for example] out of 46 stations sampled in 16 rivers Baywide)." Where the author provided inferences regarding what chemical contaminants may be contributing to the toxicity, we have provided that information as well. **For those people wanting more detail on the toxicity test results, the number of endpoints significantly different from the controls, the toxicity index, etc. we have included the following reference in Section IV. For More Information of the public report:** "For electronic copies of the data evaluated by the workgroup, please refer to the Bay Program Home Page at http://www.chesapeakebay.net or contact the Bay Program Office at 1-800 YOUR BAY. Note that where feasible, links are made to the actual datasets or summary reports/abstracts."

Bullet 2: "... the report should emphasize that just because there is not a chemical contaminant-related problem does not meant that the tributary is healthy..."

Agreed, but assessing impacts due to non-anthropogenic substances was beyond our charge-of-duties and beyond our capacity to evaluate with the available data. We did take into consideration *in situ* effects measures where low dissolved oxygen levels may have been a causative factor for reduced benthic indices because the data were available. It is, however, very important to describe other factors that can influence the survival of living resources by affecting the toxicity of substances in the environment. **We have mentioned this in the Section III.A.5 of the Technical Workplan.**

Bullet 3: "Include more information about the datasets used in the characterization..."

Agree that the more detailed information regarding the purpose of the study, the sample design, the species used in toxicity tests, etc. is necessary to fully evaluate the characterization. It was beyond the Regional Focus Workgroup's charge to develop a narrative summary of the numerous datasets it evaluated in conducting the characterization. However, we understand that many users of the characterization are not as familiar with the data as the workgroup is and need background information. The characterization reports, supporting data, and references for all data evaluated will be published on the Chesapeake Bay Program homepage. **Where feasible, we will provide links from the reference table to the actual studies to ensure that the more detailed information about the study can be accessed. We have indicated this in Section IV. For More Information of the public report.** We are hopeful that we will have the cooperation of the scientific community in making their datasets, reports, and abstracts available via the web.

Bullet 4: "The report should clarify the level of uncertainty, where possible, in making a decision about the potential toxic effects in a segment,..."

Agree that the level of uncertainty in making a characterization is important to stress in the report. The level of confidence by the workgroup is an expression of the magnitude, frequency and extent (or distribution) of the contaminants or effects measured. The level of confidence cannot be numerically quantified in the sense of a quantitative risk assessment process for ambient concentration gradients about a source, but it can be expressed in terms of how convincing or compelling the data were when carefully weighed and subjected to the best professional judgement by the individuals and confirmed through a consensus process. The Regional Focus Workgroup has clearly indicated the overall uncertainty in the characterization effort in the technical workplan (Section A.5. Limitations of Data, B.6. Limitations in Data Interpretation, VI. Recommendations for Future Updates to Characterization) and in the way the decision rules were set up to account for uncertainty in the data and thresholds used (see Section B.2. Decision Rules for Interpreting Data and Appendix B.). The workgroup's level of uncertainty in individual characterizations is stated in the limitations and caveats section of each of the segment profiles. **To ensure that uncertainty is more directly addressed in the public report, we added a statement in the first paragraph of Section IV to point the reader to the caveat/limitations section of each of the segment profiles for more description on the level of uncertainty for each characterization.**

Bullet 5: "What will be done to investigate the sources of pollutants?"

Agree in concept, however, identifying sources and recommending actions to take in certain areas is beyond the workgroup's charge-of-duties and greatly exceeds the level of effort available for this report. Actions can be taken on two fronts; 1) regulatory and 2) voluntary. To recommend regulatory actions may overstep our relationships with the States.   Voluntary programs underway can benefit from some of the information in the characterization and more detailed segment profiles. For example, for voluntary programs in an area classified as an *Area with Low Probability for Adverse Effects*, the participants can encourage preservation and good stewardship of an impacted resource. Point and nonpoint source chemical contaminant loads to the Bay and its major tidal rivers have been quantified in the *1999 Chesapeake Bay Basinwide Toxics Loading and Release Inventory*. The characterization, coupled with the loadings inventory, will provide initial information to enable managers, scientists, and stakeholders to target their toxics reduction and prevention activities towards specific source categories and chemicals.   Further assessments may be necessary to elucidate the problems and sources, before regulatory actions can be taken. With respect to the data supporting model development, only the modelers will know if the data meet their assumptions and needs (See related responses in Section 1. Scientific Merit re: management tool, Bullet 6 of this section, Section IV. Page Specific Textual Comments, Bullet 1).

Bullet 6: "What about TMDLs or other regulatory tools?"

It was beyond the scope of the Regional Focus Workgroup to determine the specific activities and remedies that should be taken in each of the characterized segments. The report outlines general actions that the Chesapeake Bay Program can take in each of the four categories which originated from the *1994 Chesapeake Bay Basinwide Toxics Reduction and Prevention Strategy*. We agree that pollution prevention activities will not address contamination problems that are due to historically used chemicals that are banned, yet persistent. Regulatory programs at both the federal and state level are necessary to address the intractable problems of sediment contaminated with historically used persistent bioaccumulative chemicals. The Chesapeake Bay Program's role in toxics management is to supplement the regulatory programs with voluntary actions where necessary. We believe it will take a combination of both regulatory and voluntary actions to effectively address chemical contaminant impacts in the Bay. It is up to the Chesapeake Bay Program and its partners to determine the next steps that need to be taken to prevent and reduce chemical contaminant impacts in the Bay and to protect and conserve areas in the Bay from future harm.

3. Future Research and Monitoring

Many of the recommendations for future research and monitoring were incorporated into the FY2000 Request for Proposal for Toxics Subcommittee funding for chemical contaminant characterization efforts. As part of the Toxics Strategy Reevaluation and Revision, the Bay Program will hold a forum in September with the scientific community to discuss many of these issues and recommendations. We are working with STAC to ensure that this dialogue with the scientific community continues so that we can develop actions to deal with these information gaps in order to better target our management actions.

Bullet 1: "Genetic and tissue toxicity assays can demonstrate the contaminant effects..."

The endpoints suggested must be shown to be important and relevant to the stakeholders. That is, resource managers and the public should fully understand the meaning of the endpoints for genetic and tissue toxicity assays. For resource managers, these endpoints must relate to some decision point in their regulatory programs.

Bullet 2: "Continuing studies on the impact of the low level, long term exposure to ambient toxicity should be encouraged."

Concur. The Toxics Subcommittee is working closely with the NOAA Chesapeake Bay Environmental Effects Committee's Toxics Research Program to ensure that the funded research addresses management questions. Although the focus of the research program for the next 5 years is on contaminated sediment in the three Regions of Concern, impacts from low levels will also be addressed. It may be necessary for STAC and the Toxics Subcommittee to partner with other such research programs to leverage additional funds to more thoroughly address this issue.

Bullet 3: "...more thorough analysis of spatial and seasonal variations..."

Concur. Although resource limited, a subset of this problem is addressed in the FY2000 Request for Proposals for Toxics Subcommittee funding which solicit projects to assess the effects of pesticides in the Eastern Shore rivers by coordinating sampling with pesticide applications in the spring.

Bullet 4: "Repeated measurements of chemicals which are no longer in use...may be of limited utility..."

Concur. However, it is important to note that some of these banned chemicals (i.e., PCBs and chlordane) are continuing to have an impact and accumulate in aquatic life, resulting in fish consumption advisories and potentially other problems.

Bullet 5: "As data availability improves, the guidelines and criteria used for characterizations should also be updated."

Concur. However, if we do not use the US EPA Acute and Chronic Water Quality Criteria for surface waters (or the States' standards) what does STAC recommend? Updating existing criteria and developing criteria for additional chemicals and media (i.e., sediment) is a long standing issue. We cannot expect to improve our characterization unless our interpretative tools improve. We will address this issue as part of the Toxics Reevaluation and Revision with STAC and the broader scientific community and other stakeholders in our Toxics Revaluation and Revision "science forum" that will be held in September.

Bullet 6: "...(1) highlight fish tissue data and associated health advisories in future reports, (2) in conjunction with state organizations, conduct a Bay-wide assessment of contaminants in edible species... and (3) reassess characterization of the mainstem of Bay..."

Concur with all 3 items listed. However, each and every endpoint must be matched to a regulatory decision framework or decision endpoint to ensure that something will be done if a problem is discovered. We will need to rely on the States and EPA to declare human health advisories from fish consumption to use in future characterizations. It is important to note that this characterization is not a human health assessment. Where human health concerns already have been identified by the states, appropriate fish consumption advisories or other warnings have been issued. Please note: The Toxics Characterization did not assess the mainstem as free of toxic impacts. The mainstem was not characterized due to historically low levels of chemical contaminants. We are considering formally characterizing the mainstem of the Bay in subsequent updates.

4. Textual Comments
Overview Comments/Questions

Bullet 1: "...the distinction between 'exposure' and 'effects' is unclear."

We will clarify the distinction between "exposure" and "effects" in the report. We will replace "exposure" with "concentration" when describing the data that was used in the characterization and will provide the definition stated below. We will continue to use the word "effects" for the reason stated below. "Concentration" data refer to a method-defined value derived from a measurement by an instrument or other direct observations. It does not necessarily express the bioavailable form of the contaminant measured and the pathway by which the contaminant has an effect on an individual organism, population, or community. "Effects" covers all potential and actual impacts to living resources as opposed to "toxicity" which suggests that we can attribute the impairment to a substance, eliminating all other potential and real causes.

Bullet 2: "How will PCBs be quantified? ... Why was the Workgroup's confidence in using a total PCB threshold fairly low?"

The Workgroup's confidence in using a total PCB benchmark was fairly low because the confidence of the authors who developed the total PCB benchmark was low (Long et al., 1995). The process for how PCB levels in sediment and fish tissue were evaluated is described in the Decision Rules (Technical Workplan, Appendix B, pages B-6 and B-9). Because the confidence of this approach was fairly low, PCB data were used to support a characterization and did not drive a characterization unless they were the cause of an existing fish consumption advisory. The reviewers mention that the sum of the congenors "will likely be a factor of 2 too low" but did not provide a reference for us to review so we cannot respond directly to that statement.

Bullet 3: "...is dredged material analyzed in relationship to any toxics endpoints?"

Data for or from site-specific problems or biased study areas (e.g., dredge material assessments, investigations at "hot spots") were not evaluated since we were attempting to characterize large areas (segments). Information or data concerning dredge material was not used since the material was probably targeted for removal and the problems, if any, may be resolved or will be resolved in the near future at the test site (don't know what will happen at the location where contaminated sediments will be placed). Also, we choose to use the most relevant and important management and characterization endpoints that we could find and that had some level of quality control and had passed some form of quality assurance. The workgroup felt that relevant endpoints were important since neither management or the public will listen to any description of a problem unless it is relevant and important to their respective interests.

Page-Specific Comments/Questions

Bullet 1:

It is important to note that the verbiage used in the technical workplan and the public report regarding actions that the Bay Program will take in the four different areas comes directly from the *1994 Chesapeake Bay Basinwide Toxics Reduction and Prevention Strategy*. By classifying a segment as an *Area of Emphasis* we have determined by weighing the evidence and applying best professional judgement that there is sufficient data to say there is a problem and that actions are necessary now. The Bay Program can use this characterization to act now to target <u>voluntary</u> actions in these areas. Further studies may be necessary to better elucidate the problem and its sources before regulatory actions such as developing TMDLs are implemented by the States/District.

As mentioned in section 1 of this response, we have added the following paragraph to both the public report and technical workplan to explain the limited utility of the characterization for guiding management actions: "The primary value and utility of the characterization is in identifying areas that need additional monitoring and assessment to better characterize the status of toxic effects on living resources inhabiting those areas. This characterization can also serve as a planning tool to help the Chesapeake Bay Program determine the areas in which to focus its voluntary pollution prevention and reduction efforts and the areas in which to focus its voluntary preservation/conservation efforts. The characterization gives the State/District partners base information to allow them to conduct the more detailed risk assessment analysis, site specific analysis, and source assessment studies which may be necessary before regulatory actions can be taken."

Bullet 2:

The statement is based upon our lack of knowledge of the potential for low levels of contaminants in the mainstem to have subtle yet important impacts on living resources throughout the Bay and tributaries. Our current arsenal of toxicity assessment tests do not allow us to adequately assess the impacts of the low levels of contaminants on living resources. Endocrine disruptors alone at extremely low concentrations have the potential for affecting population dynamics and community assemblages in the plankton found in the mainstem.

Bullet 3:

The Regional Focus Workgroup did not develop set rules for defining how much data is enough to make a characterization because the size and attributes of each segment and the available data for each segment varied a great deal. Adequate spatial coverage was an issue that was resolved by visually integrating the distribution of stations within a segment, the complexity of the watershed, and amount of data for each media type (water, sediment, and tissue) and contaminant class (metals, organic compounds). The determination of adequate coverage was treated in a weight of evidence fashion by each member of the workgroup and decided by best professional judgement. Reading through the segment profiles and the supporting data is a good way to get a feel for how much data was enough to make a characterization, when data were insufficient, and when data were inconclusive.

Bullet 4:

It is unclear why the review panel thinks these terms are vague. A good way to illustrate the difference between "strong evidence for a linkage" and "limited or no evidence for a relationship" is to compare data from a *Region of Concern* with an *Area of Emphasis*.

Bullet 5:

See explanation in Bullet 1.

Bullet 6:

The reference provided for this statement in the public report is the *1999 Chesapeake Bay Basinwide Toxics Loading and Release Inventory* which summarizes a preliminary mass balance conducted by Dr. David Velinsky, ANS, and Dr. Joel Baker, UMD-CBL.

Bullet 7:

We are describing the data we used and not the thresholds. Thresholds are referenced in Appendix B of the Technical Workplan.

Bullet 8:

Table 2 refers to the dates for which the Chesapeake Bay Program has data stored in its toxics database. Only a subset of these data were evaluated for the toxics characterization as described in Table 3. **We clarified this in the Technical Workplan (Sections III.A.3 and III.B.3.1) with the following text:** "Of particular concern is the issue of methods for the measurement of metals in water. Older data did not use the "clean techniques" for measuring metals. It is believed that historical studies report metals that are bound and freely dissociated in the water column, while it is known that the more toxic form of a metal is the freely dissociated ion. The historical data were used with caution by the workgroup and were customarily used to confirm suggestions of concentrations in other media (sediments or tissue) that metals were a problem in a segment."

Bullet 9:

Agree. We replaced the term "exposure" with "chemical contaminant concentration".

Bullet 10:

We will include the following definition of "adequate spatial coverage": "Adequate spatial coverage was an issue that was resolved by visually integrating the distribution of stations within a segment, the complexity of the watershed, and amount of data for each media type (water, sediment, and tissue) and contaminant class (metals, organic compounds). The determination of adequate coverage was treated in a weight of evidence fashion by each member of the workgroup and decided by best professional judgement."

Bullet 11:

You are correct that additional data are available for the Virginia waters that, unfortunately, were not considered in the characterization. The 1996 and 1997 benthic data from random sites in Virginia waters were not provided to the workgroup for use in the initial characterization. **We will ensure that we acquire these data and evaluate them in future updates to the characterization.**

Bullet 12:

To clarify this sentence we added the following text: "(e.g., lack of pesticide data in highly agricultural areas would tend to drive a classification towards an *Area with Insufficient or Inconclusive Data*.)"

Bullet 13:

Appendix B provides the complete set of decision rules and outlines the thresholds used and how they were interpreted. By listing the thresholds in a summary paragraph in the workplan as suggested, we run the risk of the reader assuming that we took these thresholds at face value. **Therefore, we continued to list them only in the decision rules in Appendix B.** It is important to note that although our characterization approach will stay more or less the same, it is likely that we will update the list of thresholds in future characterizations as our interpretative tools improve.

Bullet 14:

We edited the text in section B.1. to be consistent with the correct text in the decision rules in Appendix B.

Bullet 15:

See Bullet 11 for response.

Additional Actions:

We have included a copy of the STAC review and the Toxics Subcommittee response as an Appendix to the characterization report.