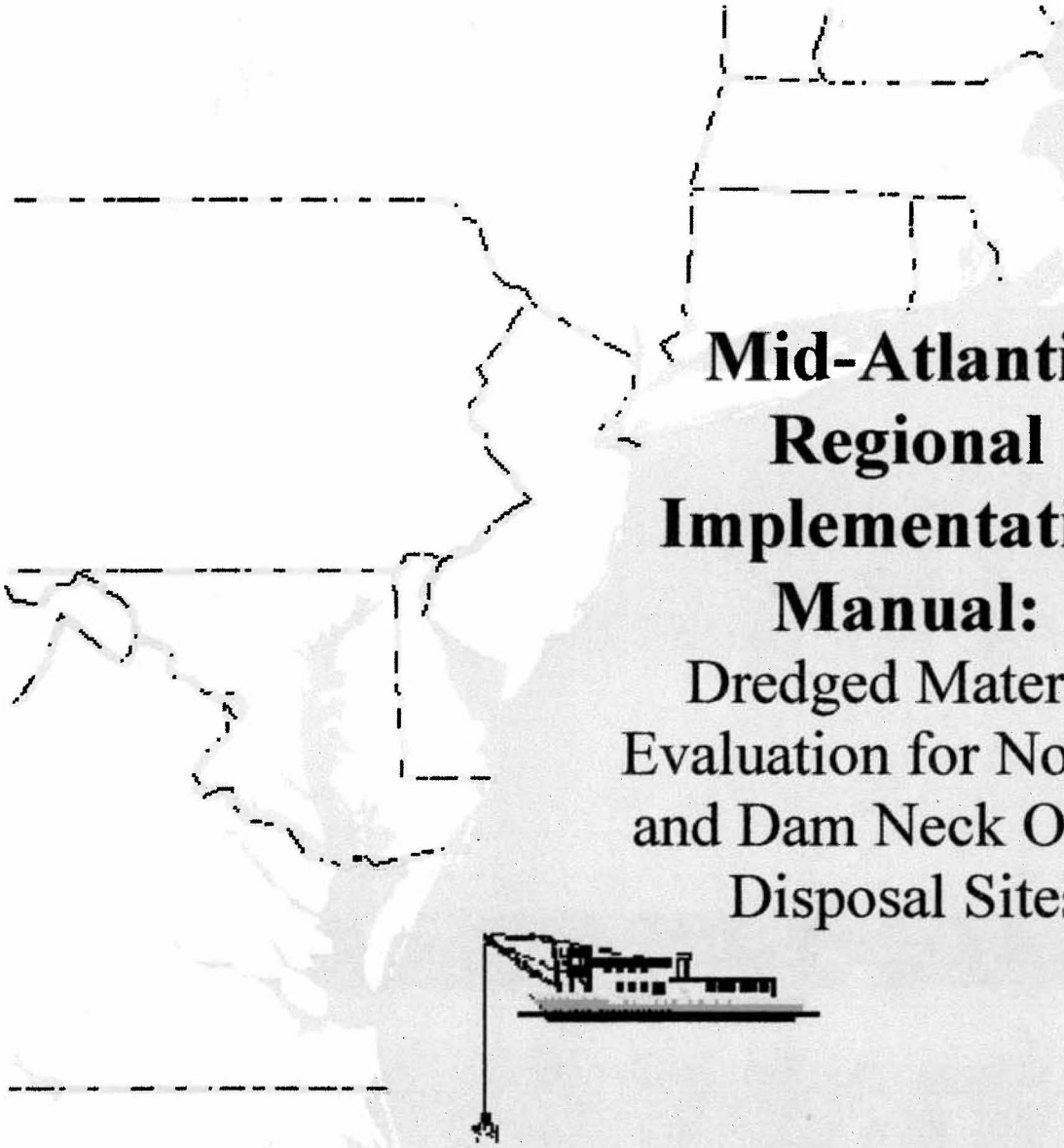

Mid-Atlantic Regional Implementation Manual:

Dredged Material Evaluation for Norfolk and Dam Neck Ocean Disposal Sites

EPA United States Environmental Protection Agency

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Introduction

The dredging of sediment is required to facilitate construction and improvements of ports and channels at various sites within the Mid-Atlantic region. An evaluation of the dredged material is required prior to placement to ensure that the materials are appropriate for ocean disposal regulated under section 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA). The purpose of this manual is to outline the permit review process and the protocol for collecting and analyzing dredged material samples for project sites compared to control and reference sites. This manual will provide the data necessary to document the existing physical, chemical, and biological characteristics of sediment and water in the project area.

This Mid-Atlantic Regional Implementation Manual (MARIM) is designed to specify evaluation procedures for dredged materials proposed for ocean disposal at the Norfolk and Dam Neck Ocean Dump Sites. This MARIM has been developed by the Environmental Protection Agency (EPA) Region III and the U.S. Army Corps of Engineers (Corps) Baltimore and Norfolk Districts, and has undergone review by the Corps Waterways Experiment Station (WES), EPA Office of Wetlands, Oceans, and Watershed Protection, U.S. National Marine Fisheries Service, and U.S. Fish and Wildlife Service.

This document applies to Corps Civil Works projects subject to the criteria defined in the EPA Ocean Dumping Regulations in 40 CFR Parts 220-228 and the Corps regulations on Discharge of Dredged Materials Into Waters of the U.S. or Ocean Water; Operation and Maintenance in 33 CFR Parts 209, 335, 336, 337, and 338. The Corps is subject to the same Federal environmental laws and regulations as the general public even though the Corps does not issue a permit document to authorize its activities.

This document also applies to MPRSA 103 Permit applications. MPRSA 103 applicants must coordinate their sediment testing plans with the Baltimore or Norfolk Districts. Applicants are strongly encouraged to arrange pre-application meeting with the Baltimore or Norfolk Districts and EPA Region III to prepare appropriate sampling plans.

In accordance with Paragraph 227.27(b) of EPA's Ocean Dumping Regulations, national implementation guidance for the MPRSA 103 program was developed jointly by the Corps and EPA to define technical procedures for testing dredged material to assess its compliance with the applicable bioassay based provisions of the EPA regulations. The national guidance manual was first issued in 1977 and an updated version entitled Evaluation of Dredged Materials Proposed for Ocean Disposal was issued in February 1991. Additional guidance is also provided by the Inland Testing Manual issued in 1998 and the QA/QC Guidance Manual for Sampling and Analysis of Sediments dated April 1995. This implementation manual presents detailed procedures for conducting tests required by Federal Statute. Additional guidance is necessary to adapt the procedures to Regional Situations. For instance, Regional Guidance is needed to : specify the frequency of evaluations, select bioassay organisms, define the process for determining contaminants of concern, as well as establish administrative procedures that will be followed by the Corps and EPA.

The methods and technical approach outlined in this scope of work are subject to revisions based upon input from federal and/or state regulatory agencies that may be involved with the final decision process.

Objective

The overall objective of the manual is to design specific evaluation procedures for the issuance of permits for dredged material proposed for ocean disposal and to evaluate physical, chemical, and biological properties of the sediment with respect to the requirements for ocean disposal. The objective of the sampling effort is to obtain and analyze sediment and water samples representative of the areas proposed for dredging to be used in the public notice and by EPA in determining whether proposed dredge material is suitable under criteria defined at 40 CFR Part 227. The results of this investigation will document the existing physical, chemical, and biological characteristics of sediment and water from the project area. In addition, sediments from a reference site near the disposal site and sediments from an agency- specified control site will be characterized. The physical composition of the sediment will be described by grain size and specific gravity. Chemical concentrations of volatile and semivolatile organic compounds, metals, chlorinated and organophosphorus pesticides, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (aroclors and congeners), butyltins, dioxins/furans, ammonia, cyanide, total sulfides, acid volatile sulfides, total Kjeldahl nitrogen (TKN), total organic carbon (TOC), total phosphorus, nitrate + nitrite, biological oxygen demand (BOD), and chemical oxygen demand(COD) will be identified. Biological characterization will include water column bioassays, solid phase bioassays, and bioaccumulation testing. The sediment characterization data will be used to determine if the sediment is appropriate for ocean disposal.

If the data submitted by the applicant are not sufficient to evaluate the proposed dredged material, EPA and the Corps will request additional information {40 CFR 225.2(b)}. After receiving the requested information, EPA and the Corps must make an independent review of the data to determine whether the proposed dredged material is suitable for ocean disposal {40 CFR 225.2(c)}.

New and more advanced testing procedures are continually being developed and refined by the research and development laboratories of the EPA and Corps. Developments in the Ocean Dredge Material Disposal Program such as the issuance of new regulations and guidance are underway. Also the monitoring of the designated disposal sites off the Virginia coast will provide effects-based feedback that will enable the EPA and the Corps to make more refined, environmentally sensitive, and efficient decisions concerning the ocean disposal of dredged materials. For these reason, this MARIM will be periodically reviewed and revised as necessary to incorporate modifications to the testing and reporting requirements. Modifications will be made only upon mutual agreement by the Corps and EPA.

Disputes between the Corps and the EPA regarding the interpretation of this MARIM will be verbal discussion between staff members. If the issue cannot be resolved at the working level, then the issue will be elevated to higher levels. Consultation with the Corps Waterways Experiments Station, the EPA Environmental Research laboratories and Headquarters will be the responsibility of the respective agency.

Question regarding any aspects of this MARIM should be directed to:

U.S. Army Corps of Engineers
Baltimore District
Operations Division
and
Norfolk District
Operations Division

U.S. Environmental Protection Agency
Region III
Environmental Services Division
1650 Arch Street
Philadelphia, PA 19103

Permit Review Process: MPRSA 103 Permit Applications

All applications for MPRSA 103 permits to dredge and dispose of sediment at the Norfolk and Dam Neck ocean disposal sites off the Virginia Coast must be submitted to the Corps' Baltimore or Norfolk Districts. A dredged material permit is defined as any MPRSA 103 permit issued by the Corps' Baltimore and Norfolk Districts reviewed under MPRSA 103(e) {40 CFR 220.2(h)}. In addition to 40 CFR, all permits must comply with the Corps' permitting regulations at 33 CFR Parts 320-330 and Parts 335-338. All information submitted as part of the MPRSA 103 permit application process must comply with EPA's Ocean Dumping Regulations at 40 CFR Parts 220-228.

It is strongly recommended that MPRSA 103 permit applicants consult with EPA Region III, the Corps' Baltimore and Norfolk Districts, and other regulatory agencies on sediment testing plans. Permit applicants should obtain approval on the final sapling plan from EPA Region III and Corps' Baltimore and Norfolk district before any sampling occurs. This will prevent delays in review of testing data and processing of a Public Notice. If necessary, a pre-application meeting can be arranged with EPA Region III and the Corps' Baltimore and Norfolk Districts. The consultation effort should include coordination with State agencies on compliance with the State Water Quality Certification process (Clean water Act 401), and the State Coastal Zone Consistency Determination Process {Coastal Zone Management Act 307(c)}. When applying for a MPRSA 103 permit, the following information should be prepared and submitted:

- Information on the need to dredge, proposed project depth plus any over dredged depth, potential impacts at the dredging site from the dredging operation, and the type of dredging, disposal, and navigation equipment that may be used.

- An estimate of the total amount of dredged material and over-dredge material to be excavated from the proposed site shall be made in cubic yards and cubic meters.

- A disposal alternatives analysis including an examination of potential beneficial uses of the proposed dredged material and a consideration of alternate disposal options before selecting ocean disposal (40 CFR paragraph 227.14 to 2276.16). The applicant must provide written documentation showing an analysis of disposal alternatives, including a rationale for selection or rejection of each potential alternative.

- The applicant should discuss prior dredging activities. If the proposed ocean disposal is covered under an existing Baltimore and Norfolk District MPRSA 103 maintenance dredging permit, the permit number and a written description of the last maintenance work should be provided. In addition, a summary of all previous data on sediment testing (including physical, chemical, and biological test) from the proposed dredging area must be submitted. If a period of more than three years has occurred after the last sediment testing program, EPA Region III and the Corps' Baltimore and Norfolk districts will evaluate the need for a new set of sediment tests. A brief discussion of other dredging projects in the vicinity of the proposed project area should be included. In addition, any NEPA document related to the project

should be cited.

- A dredging site hydrographic condition survey of all areas proposed for dredging. A copy of the hydrographic survey should be submitted as a blueprint copy or other acceptable large format copy of the sounding taken at the proposed dredging site. In addition to the large format copy of the hydrographic survey, a map 8.5 x 11.0" must be provided showing similar information on a reduced scale. The following information should be shown on the blueprint or large format copy of the dredging site condition survey:

    1. A map of the complete area proposed for dredging shall be clearly marked, including all side sloping or relief cuts, U.S. Pierhead Lines, and other important boundaries;

    2. The ratio of the side slope or relief cut shall be defined (i.e., 1:1, 1:2, 1:3, etc.), and the "toe" and "top" of the side slope shall be clearly labeled;

    3. All hydrographic soundings, preferably in meters, shall be corrected for tides and checked for accuracy and precision;

    4. Hydrographic survey control points or reference points at the dredging site shall be plotted;

    5. The company names and model numbers of navigation and sounding instruments used shall be reported (e.g., fathometer, mini ranger, etc.), including accuracy and precision data;

    6. The dredging site condition survey shall also cover an area at least 50 meters outside the boundary of the proposed dredging area, unless navigational obstructions or the shoreline interfere with the survey;
    7. The following specific areas of the proposed project shall be identified on the blueprint or large format copy of the condition survey:

        A. Areas above project depth (grade) that must be dredged shall be shaded in green.

        B. Areas at grade or between grade and over-dredge depth shall be shaded in yellow.

        C. Areas below over-dredge depth shall be shaded in blue.

        D. All soundings shall be clearly legible on the blueprint or large format of the hydrographic survey even if the area is shaded.

        E. The exact point where the sounding was taken shall be defined; and

8. An acceptable coordinate system shall be defined and used in the dredging site condition survey, such as latitude and longitude, state coordinates, or a geographical positioning system;

9. The location of wetlands, submerged vegetation, intertidal mud flats, and shellfish beds (See 40 CFR Part 230 for definitions) in the vicinity of the proposed dredging site shall be identified on the large format copy of the condition survey and the 8.5: x 11.0" map.

- Information on known or suspected contamination of the site, including oil, chemical or waste spills, and other discharges that my cause contamination of the proposed dredging site (e.e., NPDES discharges, RCRA sites, CERCLA sites, landfills, or nonpoint source discharges). The local U.S. Coast Guard office and the Port Authority office should be contacted to obtain additional information on spills or suspected contamination.

- Estimated dates for initiation and completion of the project, and time required for a disposal trip to and from the ocean disposal.

- A report including a full description of any additional test required by the State (e.e, water quality, chemistry tests, or other required tests).

- A complete sampling plan shall be presented according to the guidance defined in Chapters 3-7 of the 1991 Green Book. The sampling plan must be designed to consider: historical data; sediment deteriogeneity; number and distribution of sampling stations based on the volume, acreage and depth of the proposed project; collection, preservation , storage, tracking and analysis of samples; and a quality assurance/quality control (QA/QC) program (U.S. Environmental Protection Agency and U.S. Army Corps of Engineers, 1990). Sampling equipment, such as research vessels, cores, grabs, water samplers, etc., should also be included in the sampling plan.

- A list of key persons or companies associated with the proposed project, their responsibilities, company affiliations, and office telephone numbers.

One copy of the items above should be sent to the EPA Region III Ocean Disposal Coordinator and the Corps' Baltimore and Norfolk District prior to any sampling at the proposed dredging site. Any written comments or requirements identified by EPA Region III and the Corps' Baltimore and Norfolk Districts must be incorporated into the revised sampling plan or addressed.

The date and time of all field sampling and laboratory analytical work must be communicated in writing to EPA Region III and the Corps' Baltimore and Norfolk Districts one week prior to sampling. EPA Region III or Corps Baltimore and Norfolk District's inspectors may be present during any phase of the program to evaluate field or laboratory QA/QC procedures. Accommodations on board vessels or in the laboratory for such inspectors shall be made available at the request of EPA Region III or the Corps' Baltimore and Norfolk Districts.

Determination of Compliance

The information provided by the applicant for the Public Notice will be used by EPA Region III and The Corps' Baltimore and Norfolk Districts to determine whether the proposed dredged material is suitable for ocean disposal under the criteria defined at 40 CFR Part 227. The applicable sections of the Part 227 Criteria for the Evaluation of Permit Applications for Ocean Dumping of Materials are: paragraph 227.4, 227.5, 227.9, 227.10, 227.13, and Sub-parts C, D, E, and G {40 CFR paragraph 227.1(b)}.

EPA Region III will inform the Corps' Baltimore and Norfolk District Engineers in writing whether the material complies with EPA's Ocean Dumping Criteria. If EPA Region III determines that the material does not comply with the criteria then the Corps' Baltimore and Norfolk Districts may not issue a permit unless procedures for invoking economic impact are initiated by the Corps' Baltimore and Norfolk District Engineers {40 CFR 225.2(3), 225.3 AND 225.4}

Testing Protocol

Tiered Testing Approach

EPA and The Corps will implement a tiered testing approach to evaluate dredged material proposed for ocean disposal It is necessary to proceed through the tiers only until information sufficient to determine compliance or noncompliance with paragraph 227.5 and 225.13 has been obtained. After any of the first three tiers is completed, one of three decisions can be made: (1) information is sufficient to determine that the LPC is met, (2) information is sufficient to determine that the LPC is not met, or (3)information is insufficient to make a determination. In the rare case that a compliance decision cannot be made after completion of the first three tiers, further testing in tier IV may be appropriate. Please refer to Figure 1-1, 1-2, 1-3 for an overview of the Tiered Approach.

Tier I -Exclusions

Tier 1 evaluations include an evaluation of exclusion criteria, a comprehensive analysis of existing and readily available information on the proposed dredged material, and a determination of compliance with the limiting permissible concentration (LPC) of the dredged material.

1. Tier 1 analyses begin with a comparison of existing physical and chemical information of the proposed dredged material to the exclusion criteria of 40 CFR 227.13(b). If the dredged material meets at least one of these criteria, no more testing is required. Conclusive written information must be presented to show that the proposed dredged material meets one of the EPA's exclusion criteria. These criteria are:

"(1) The dredged material is composed predominantly of sand, grave, rock, or any other naturally occurring bottom material with particle sizes larger than silt, and

Figure 1-1. Overview of Tiered Approach to Evaluating Potential Impact of Ocean Disposal of Dredged Material. Sections in which applicable discussions begin in the manual are indicated by the numbers within the parenthesis.

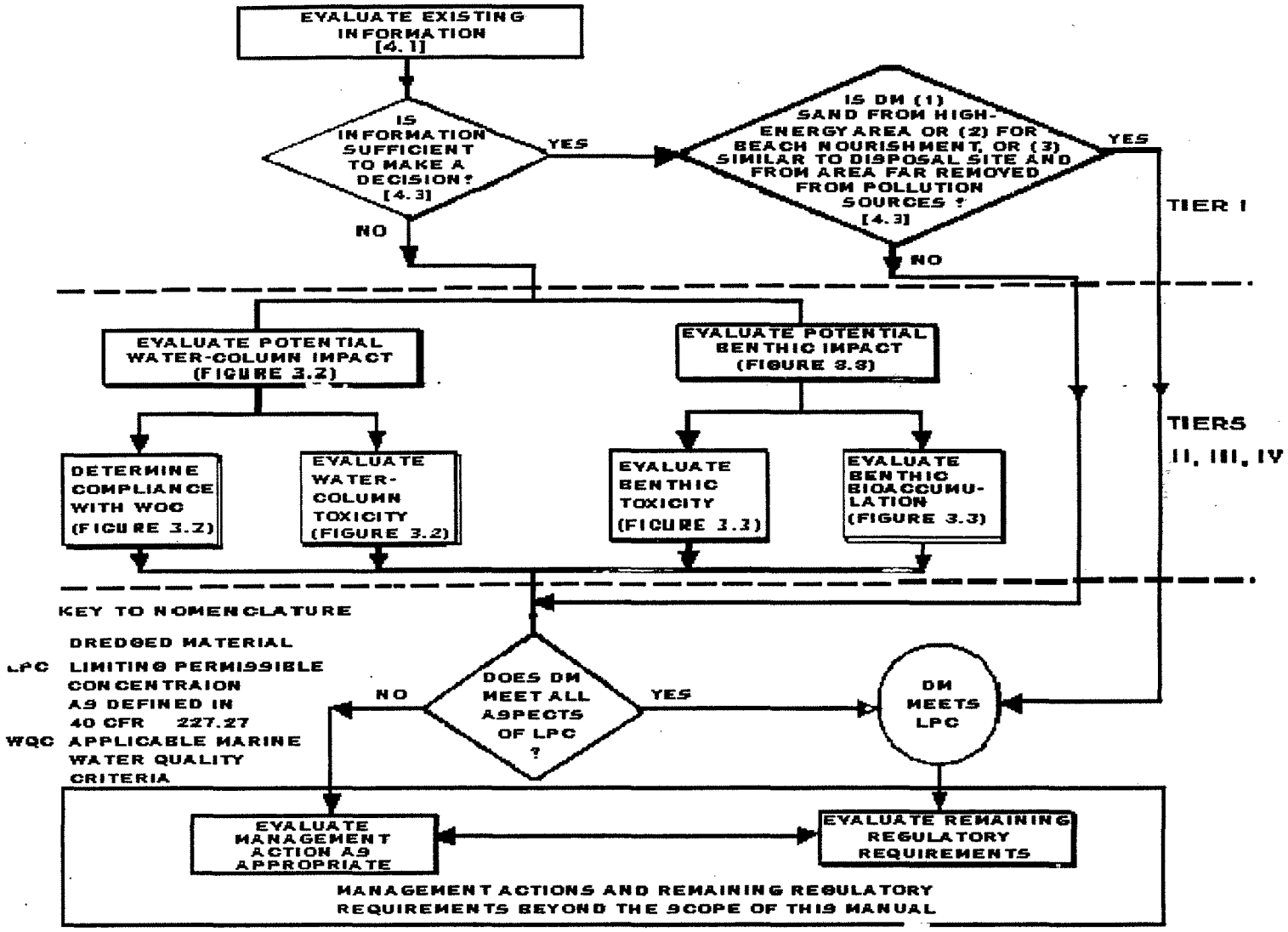


Figure 1-2. Overview of Tiered Approach to Evaluating Potential WATER-COLUMN IMPACT of Dredged Material. Sections in which applicable discussions in the manual are indicated by the numbers within the parentheses.

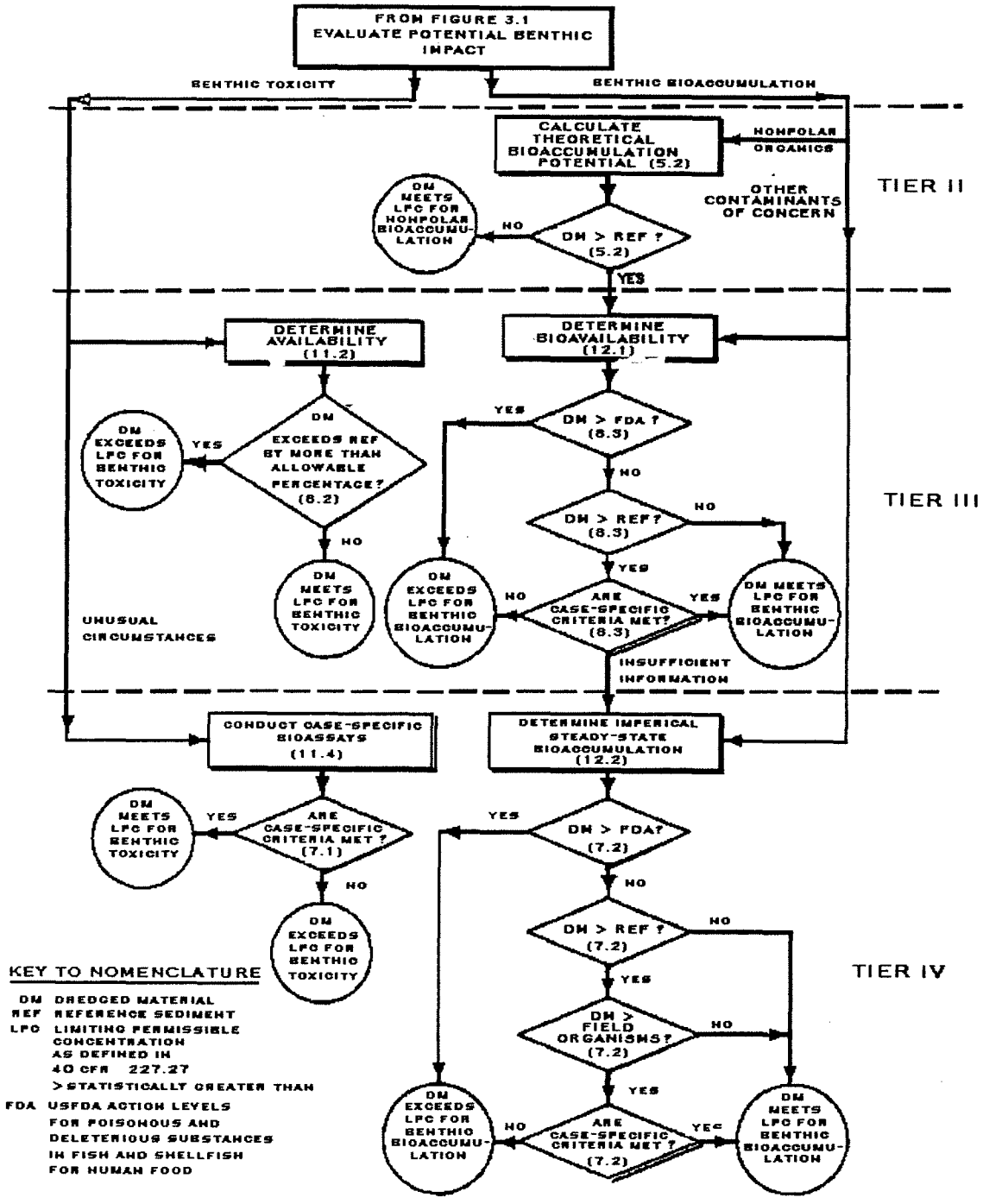
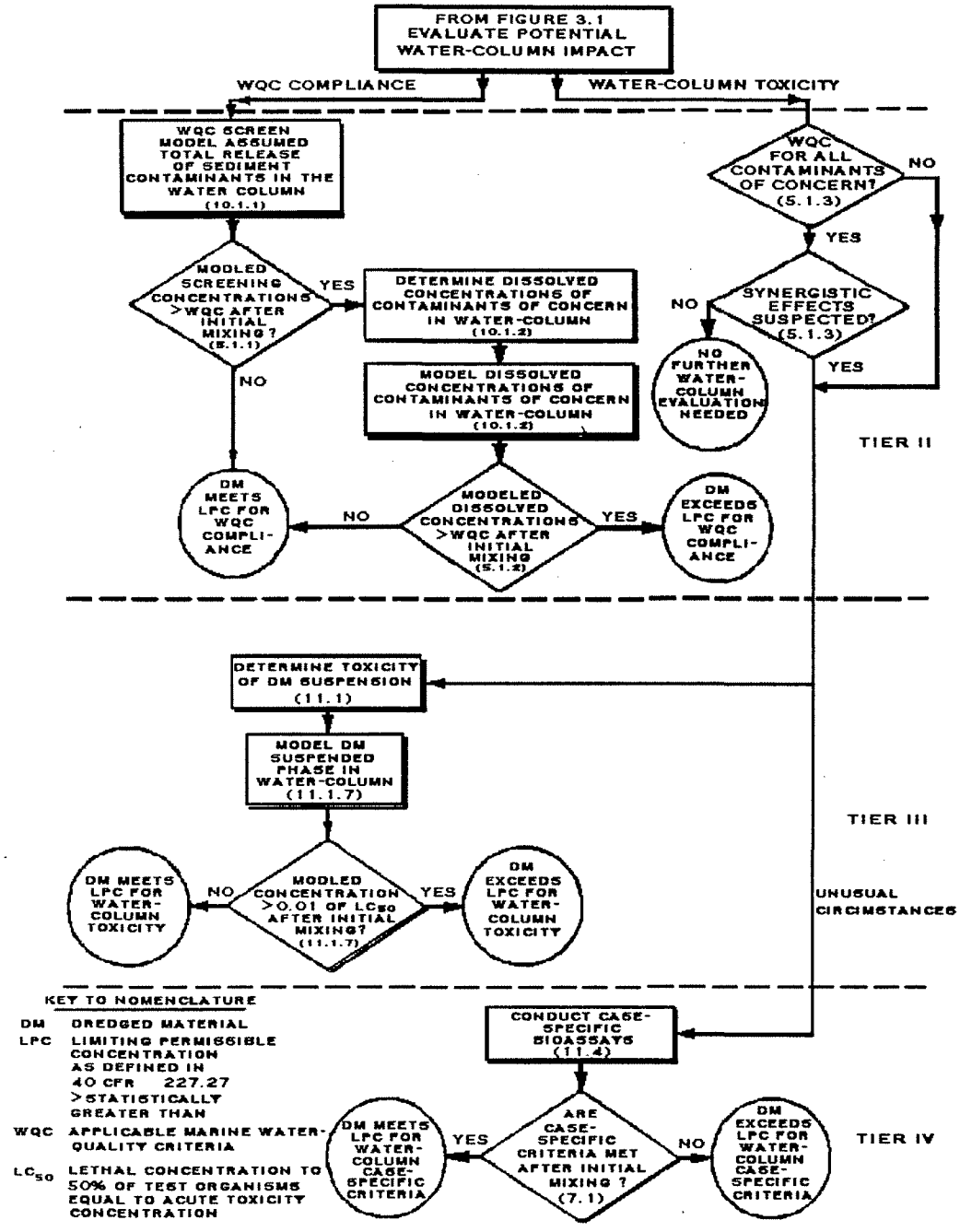


Figure 1-3. Tiered Approach to Evaluating Potential BENTHIC IMPACT of Deoposited Dredged material. Sections in which applicable discussions in the manual are indicated by the numbers within the parentheses.



the material is found in areas of high current or wave energy such as streams with large bed loads or coast areas with shifting bars and channels; or

(2) The dredged material is for beach nourishment or restoration and is composed predominantly of sand, gravel, or shell with particle sizes compatible with material on the receiving beaches; or

(3) When :

(i) The material proposed for disposal is substantially the same as the substrate at the proposed dump site; and

(ii) the site from which the material proposed for dumping is to be taken is far removed from known sources of pollution so as to provide reasonable assurance that such material has not been contaminated by such pollution."

When material proposed for ocean disposal is compared to the "substrate at the dump site, the reference site material as defined in this MARIM will be the comparison material, not the designated disposal site material.

2. It may be necessary to develop or supplement available information with new physical and chemical analyses of the proposed dredged material. Tests may be performed for chemicals of concern including compounds known or suspected of contaminating the dredging site. The list of compounds identified as contaminants of concern are in Table 1. Table 1 is a general list of metals and organics of concern. When no sediment data exists and there is no reason to believe that exotic contamination might exist, analysis of the complete list in Table 1 is requested. Where sediment data exists and contaminants of concern are known, the basic list will typically be reduced or supplemented by mutual agreement of the Corps' Baltimore and Norfolk Districts and EPA Region III. For example, if a pulp and paper mill discharges to a channel proposed for dredging, dioxin will be added to the list of compound in Table 1.

To further ensure that toxic compounds not included in Table 1 are not over looked in the chemical characterization of the dredged material, the analytical results should also be scrutinized by trained personnel for additional analytes that are not on the target list. The presence of persistent major so called unknown analytes on gas chromatograms or reconstructed ion chromatograms should be noted. In such a case, methods involving GC/MS techniques for organic compounds are recommended for the identification of unknown chemicals.

3. The conventional parameters listed in Table 2 are not considered contaminants of concern. Collection and reporting of these data may be necessary to further characterize the sediment and to assist interpretation of chemical and biological test (if done).

Table 1 Potential Contaminants of Concern Listed According to Structural Compound Class

Structural Compound Class	Contaminant
Phenols	phenol 2,4-dimethylphenol 2-methylphenol 4-methylphenol
Substituted Phenols	2,4,6-trichlorophenol para-chloro-meta-cresol 2-chlorophenol 2,4-dichlorophenol 2-nitrophenol 4-nitrophenol 2,4-dinitrophenol 4,6-dinitro-o-cresol pentachlorophenol
Organonitrogen Compounds	benzidine 3,3'-dichlorobenzidine 2,4-dinitrotoluene 2,6-dinitrotoluene 1,2-diphenylhydrazine nitrobenzene N-nitrosodimethylamine N-nitrosodiphenylamine N-nitrosodipropylamine
Low Molecular Weight Polynuclear Aromatic Hydrocarbons (PAH)	acenaphthene naphthalene acenaphthylene anthracene phenanthrene fluorene 1-methylnapthalene 2-methylnapthalene

High Molecular Weight Polynuclear Aromatic Hydrocarbons (PAH)	fluoranthene benzo(a)anthracene benzo(a)pyrene benzo(b)fluoranthene benzo(k)fluoranthene chrysene benzo(ghi)perylene dibenzo(a,h)anthracene ideno(1,2,3-cd)pyrene pyrene
Chlorinated Aromatic Hydrocarbons	1,2,4-trichlorobenzene hexachlorobenzene 2-chloronaphthalene 1,2-dichlorobenzene 1,3-dichlorobenzene 1,4-dichlorobenzene
Chlorinate Aliphatic Hydrocarbons	hexachlorobutadiene hexachloroethane hexachlorocyclopentadiene
Halogenated Ethers	bis(2-chloroethyl)ether 4-chlorophenyl ether 4-bromophenyl ether bis(2-chloroisopropyl) ether bis(2-chlorethoxy)methane
Phthalates	bis(2-ethylhexyl)phthalate butyl benzyl phthalate di-n-butyl phthalate di-n-octyl phthalate diethyl phthalate dimethyl phthalate
Polychlorinated Biphenyls (PCB) as Aroclors[a]	PCB-1242 PCB-1254 PCB-1221 PCB-1232 PCB-1248 PCB-1260 PCB-1016
Miscellaneous Oxygenated Compounds	TCDD (dioxin)[b] PCDF (furan) isophorone

Pesticides	aldrin dieldrin chlordane chlorbenside dacthal DDT[c] endosulfan[d] endrin endrin aldehyde heptachlor heptachlor epoxide alpha-hexachlorocyclohexane -hexachlorocyclohexane ?-hexachlorocyclohexane ?-hexachlorocyclohexane toxaphene mirex methoxychlor parathion malathion guthion demeton
Volatile Halogenated Alkanes	tetrachloromethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1-dichloroethane 1,1,2-trichloroethane 1,1,2,2-tetrachloroethane chloroethane chloroform 1,2-dichloropropane dichloromethane chloromethane bromomethane bromoform dichlorobromoethane fluorotrichloromethane dichlorodifluoromethane chlorodibromomethane

Volatile Halogenated Alkenes	1,1-dichlorethylene 1,2-trans-dichlorethylene trans-1,3-dichloropropene cis-1,3-dichloropropene tetrachlorethene trichlorethene vinyl chloride
Volatile Aromatic Hydrocarbons	benzene ethylbenzene toluene
Chlorinated Benzenes	1,3-dichlorobenzene 1,4-dichlorobenzene 1,2-dichlorobenzene 1,2,4-trichlorobenzene hexachlorobenzene
Volatile Unsaturated Carbonyl Compounds	acrolein acrylonitrile
Volatile Ethers	2-chlorethylvinylether bis(chloromethyl)ether
Metals	aluminum antimony arsenic beryllium butyltins cadmium chromium (hexavalent) cobalt copper iron lead manganese mercury nickel selenium silver thallium tin zinc

Miscellaneous	ammonia[e] asbestos benzoic acid cyanide guaiacols methylethyl ketone resin acids

a -- It is recommended that PCB analyses use congener-specific methods. The sum of the concentrations of specific congeners is an appropriate measure of total PCBs (see Table 9-3).
b -- Additional dioxin and furan (e.g., TCDF) compounds are listed in Table 9-2.
c -- Includes DDT, DDD, and DDE
d -- Includes gamma-endosulfan, beta-endosulfan, and endosulfan sulfate.
e -- Ammonia may not be a contaminant of concern at certain open-water dredged material disposal sites (e.g., dispersive situations and situations with well-oxygenated overlying water).

Table 2: Conventional Parameters
Chemical Oxygen Demand (COD)
Biological Oxygen Demand (BOD)
Total Organic Carbon (TOC)
Nutrients: NO_2, NO_3, PO_4
Grain Size
Specific Gravity
Atterburg Limits
Moisture Content

4. If the proposed dredged material does not meet any of the exclusion criteria, new or historical sediment characterization data can be used to show that the LPC of the sediment can be met. Sources of historical information are listed in section 4.1 of the 1991 Green Book. If the Corps determines that existing data is adequate to make a Tier 1 compliance decision, a re-evaluation of the historical data should accompany the compliance decision. The re-evaluation should include a reassessment of previously evaluated physical and chemical data relative to any regulatory changes, changes in sediment composition or deposition, and improvements in analytical methods and contaminant detect ability. The Corps should also review available data of spills since the sediment characterization was generated and determine the impact the spill may have on the dredging and disposal operation.

5. Chemical and biological data greater than 5 years old may not be adequate to conduct evaluations. Best professional judgement will be exercised by the Corps' Baltimore and Norfolk Districts as well as EPA Region III in deciding when new chemical and biological data are needed. Factors that will be considered will include: frequency of dredging, proximity to existing and historical pollution sources, and age of historical data results. It is recommended that upon the effective date of this MARIM, all areas proposed for dredging that have data older than 3 years be sampled and evaluated according to this MARIM and the 1991 Green Book. Once all areas have been tested according to the 1991 Green Book, the 5 year rule of thumb will apply.

Tier II- Regional Requirements

1. Water Column Impact Analyses
If a WQC LPC decision cannot be made in Tier I, a Tier II evaluation is mandatory even if subsequent evaluations are to be conducted in Tiers III and IV. Under no circumstances

can the disposal of dredged material cause the applicable marine WQC to be exceeded outside the disposal site boundaries at any time or within the disposal site boundaries after 4 hours of initial mixing. The EPA WQC are listed on EPA's web site (www.epa.gov/ost/standards/, National Recommended Water Quality Criteria). The EPA WQC are periodically revised to reflect new data and information on toxicity effects to aquatic life. The most recent WQC should be utilized. EPA Region III will use the acute (Criterion Maximum Concentration) WQC when running the model to determine water column impacts. If an acute WQC is not available, then the chronic (Criterion Continuous Concentration) WQC will be used.

The Tier II water-column evaluation for WQC is a two-step process, using the numerical model provided in Appendix B of the 1991 Green Book. The first step uses the model as a screen and assumes that all of the contaminants in the dredged material are released into the water column during the disposal process. If the results from Step 1 predict WQC will be exceeded then Step 2 is conducted. The second step applies the same model with results from chemical analyses of the elutriate test.

According to 40 CFR paragraph 227.13(2) (ii), if WQC have not been established for all contaminants of concern or if synergistic effects are expected, further testing in Tier III is required to determine water-column LPC compliance.

Along the Virginia coast ambient concentrations of compounds such as copper occasionally exceed WQC. This renders the Tier II model inappropriate. In those cases where ambient water quality is already exceeding EPA acute WQC, the compounds already exceeding WQC are unusually high (e.g. exceeding historic sediment concentrations by an order of magnitude), then Tier II elutriate analyses will be conducted and the results will be compared to the ambient water column values. If the elutriate values are exceeding the ambient values, then Tier III water column bio-assays will be conducted using disposal site water. This will enable the Corps and EPA to evaluate the impact the dredged material proposed for ocean disposal will have on water quality.

Table 1 contains a general list of metals and organics of concern that will be analyzed for when ambient water and elutriate quality are being evaluated for use in the model. In the absence of any sediment data and with no reason to believe that exotic contamination might exist, analysis for the complete list in Table 1 is requested. Where sediment data exist, the list in Table 1 will typically be reduced or supplemented by mutual agreement of the Corps' Baltimore and Norfolk Districts and EPA Region III. It is not always necessary to generate new ambient water quality data. If ambient water quality data exists for the disposal area that is less than five years old, it may be used when conducting Tier II water column impact analyses.

2. Theoretical Benthic Impact Evaluations

When technically sound sediment quality guidelines (SQC) are developed and the corresponding Final Notice of Availability is published in the Federal Register by EPA, these criteria will be incorporated into Tier II benthic-impact evaluations. The

incorporation of these criteria into Tier II will be implemented by the insertion of a new Section into the Green Book and this RIA. The new Sections will be developed by both the Corps and EPA and will provide guidance on how to use the SQC to determine compliance with the LPC.

At present, only potential bio-accumulation impacts of non-polar organic chemicals, such as polychlorinated biphenyls and pesticides, can be evaluated from dredged material samples in Tier II. The calculation of theoretical bio-accumulation potential (TBP) is based on the concentration of the non-polar organic chemical, the total organic carbon (TOC) in the sediment, and the lipid concentration in a benthic organism. The TBP predicts the magnitude of bio-accumulation likely to be associated with the non-polar organic chemical in the proposed dredged material.

A. Guidance for calculating the TBP of non-polar organic chemicals is provided in Chapter 10 of the 1991 Green Book. The lipid concentration used by the Corps when calculating the TBP of non-polar organic chemicals will be reported to EPA.

B. If polar organic chemicals, organometals, or trace metals are considered to be contaminants of concern in the dredged material, further evaluation is required in Tier III and/or Tier IV.

Tier III - Regional Protocol

Tier III testing is an assessment of the effects of dredged material contaminants on appropriate sensitive marine organisms. The procedures include bioassay and bio-accumulation tests on water column and/or benthic test species. Bioassay tests must be conducted on all reference site, control site, and proposed dredging site samples according to protocols defined in the 1991 Green Book. When Conducting benthic toxicity bioassays with amphipods, the methods specified in ASTM E-1367-90 must be followed. Any proposed variation from the 1991 Green book procedures or ASTM methodologies must be technically valid and mutually agreed upon by EPA Region II and the Baltimore and Norfolk Districts before the bioassay test are started

1. Water Column Toxicity Tests

Bioassay test on the liquid phase {40 CFR paragraph 227.32 (b) (1)} may not routinely be required. However, when LPC determinations cannot be made for the reasons discussed earlier in Tier II portion of the RIA, biological tests on the suspended particulate phase will be required.

Paragraph 227.27(C) of the regulations defines appropriate sensitive water-column marine organism to mean at least one species each representative of phytoplankton or zooplankton, crustacean or mollusk, and fish. Water column bioassays for the dredging operation in the Baltimore and Norfolk Districts must be conducted using those organisms listed below in the Section: Ecotoxicology Testing. An alternative is to use at least three organisms selected from the list of test of test species in Table 11.1 of the Green Book.

The Tier III water column effects evaluation involves running a numerical model to determine compliance with the LPC. The LPC is defined in 40 CFR 227.27 (a) (2) as:

> "That concentration of waste or dredged material in the receiving water which after allowance for initial mixing, as specified in 227.29, will not exceed a toxicity threshold defined as 0.01 of a concentration shown to be acutely toxic to appropriate sensitive marine organisms in a bioassay carried out in accordance with approved EPA procedures."

The modeled concentrations of the dredged material are compared to the LPC, as determined by 0.01 of the 48-or 96- hour LC 50, depending on the test duration. The LC 50 is the concentration lethal to 50% of the organisms. Both the maximum concentration outside the disposal boundary during the first 4 hours and the maximum concentration at any point in the marine environment after 4 hours are compared to 0.01 of the LC 50. If both modeled concentrations are less than 0.01 of the LC 50, the discharge meets the LPC. If either of the modeled concentrations exceeds 0.01 of the LC 50, the discharge does not meet the LPC.

This MARIM recommends that if mortality is greater than 10% (30% mortality/abnormality for zooplankton) in the control treatment or in the dilution-water treatment for a particular test species, the test should be rejected and the bioassay repeated. This will be determined by the Corp sand EPA on a case by case basis.

2. Benthic Toxicity Test

Solid phase bioassays are conducted to evaluate potential benthic impact and regulatory compliance. The regulations {40 CFR 227.27 (d)} require that benthic bioassays be conducted with filter-feeding, deposit-feeding, and burrowing species. These categories of species are broad and overlapping. Minimally, the two different species should be used from the listed in the Section below: Ecotoxicology Testing. The Green Book Table 11.2 also covers the three species characteristics identified in the regulations and can be used to evaluate a disposal project.

Dredged material does not meet the LPC for benthic toxicity when bioassay organism mortality (1) is statistically greater than in the reference sediment and (2) exceeds mortality in the reference sediment by at least 10% or exceeds the reference mortality by at least 20% when amphipods are used.

This MARIM recommends that if greater than 10% mean mortality occurs in the control sediment, the test should be repeated. This will be determined by the Corps and EPA on a case by case basis.

3. Benthic Bioaccumulation Test.

Bio-accumulation tests are conducted to evaluate benthic impact and regulatory compliance. Paragraph 227.27(d) of the regulations also applies to benthic bio-accumulation analyses. The organisms selected for the bio-accumulation evaluations must be of sufficient biomass to run analyses on the tissue. A minimum of two species listed in the Section: Ecotoxicology Testing, below, satisfy the requirements specified in Paragraph 227.72(d) and will be used to evaluate the bio-accumulation potential. Additional organisms are provided in Table 12-1 of the Green Book.

Tissue concentrations may be measured prior to exposure to control, reference, or test sediment. This will add perspective to the magnitude of uptake during the exposure period, and in some cases may show elevated body burdens were not due to exposure to dredged material or reference sediment but were already present in the organisms at the start of the test. If tissue concentrations are not measured prior to the initiation of the tests, some of the organisms must be archived (frozen). If test results are suspect, then the archived organisms should be analyzed.

The contaminants of concern identified in Tier II will be analyzed when conducting bio-accumulation evaluations. The methods and detection limits listed in Table 8 will be used when conducting bio-accumulation evaluations.

The contaminant concentrations in the tissue of the test species are first compared with Food and Drug Administration (FDA) Action Levels for Poisonous and Deleterious substances in Fish and Shellfish for Human Food (see Table 3). If the concentrations of one or more contaminants of concern are statistically greater than the FDA action levels, the dredged material exceeds the LPC for bio-accumulation and does not comply with the bio-accumulation aspects of 227.13(c)(3). FDA Action levels do not consider ecological impact; however, for the purposes of the Green Book and this MARIM, they serve as an upper limit of acceptability.

If the contaminant concentrations in the test species are not greater than he FDA limits, the contaminant concentrations in the tissue of the test species are then compared to the contaminant concentrations in the tissue of the reference species. A statistically greater tissue residue in test sediment compared to reference sediment does not necessarily indicate an environmental or human health problem. Conversely, the lack of statistically greater tissue residues in test sediment compared to reference sediment would be strong evidence that the test sediment would not result in an environmental or human health problem for the pollutants tested. Therefore, the following factors will be assessed to evaluate LPC compliance when the bio-accumulation of contaminants in dredged-material statistically exceed that in the reference material. The factors and their order of evaluation are as follows:

Factors 1-3 will be evaluated first by the Corps and EPA.

1. Magnitude by which bio-accumulation from the dredged material exceeds bio-accumulation from the reference material.

Table 3: Food and Drug Administration (FDA) Action Levels for Poisonous and Deleterious Substances in Fish and Shellfish for Human Food[a]

Substance	Action Level[b]
Metals	
Methyl Mercury	1.0 ppm
Pesticides	
Benzene Hexachloride (BHC)	0.3 ppm
Chlordane	0.3 ppm
Chlordecone Kepone	0.3 ppm
DDT + DDE	5.0 ppm
Dichlrophenoxyacetic acid	1.0 ppm
Dieldrin + Aldrin	0.3 ppm
Heptachlor + Heptachlor Epoxide	0.3 ppm
Hexachlorobenzene (HBC)	0.3 ppm
Mirex	0.1 ppm
Simazine	12.0 ppm
Toxaphene	5.0 ppm
Industrial chemicals	
PCBs	2.0 ppm
Dioxin	25.0 ppt

a -- Action levels are established, revised, and revoked through notices published in the Federal Register. It is the responsibility of the users of the list to keep up to date on any amendments to this list. For further information on current action levels, users may contact the Food and Drug Administration, Center for Food Safety and Applied Nutrition, Industry Programs Branch [HFF-326, 200 C Street, S.W.,Washington, DC 10204; (202) 205-5251]

b -- Action levels are reported in wet weight.

2. Number of contaminants for which bio-accumulation from the dredged material is statistically greater than bio-accumulation from the reference material.

3. Number of species in which -bio-accumulation from the dredged material is statistically greater than bio-accumulation from the reference material.

If a compliance decision cannot be agreed to after reviewing factors 1-3, factors 4-7 will be evaluated.

4. Toxicological importance of the contaminants whose bio-accumulation from the dredged material statistically exceeds that from the reference material.

5. Phylogenetic diversity of the species in which bio-accumulation from the dredged material statistically exceeds bio-accumulation from the reference material.

6. Propensity for the contaminants with statistically significant bio-accumulation to bio-magnify within aquatic food webs.

7. Magnitude of toxicity and number of phylogenetic diversity of species exhibiting greater mortality in the dredged material than in the reference material.

If a compliance decision still cannot be reached, a sampling plan will be developed and agreed upon by both the EPA and the Corps to Evaluate factor 8.

8. Magnitude by which contaminants whose bio-accumulation from dredged material exceeds that from the reference material also exceed the concentrations found in comparable species living in the vicinity of the proposed disposal site.

Tier IV - Case Specific Testing

Where a decision regarding toxicity or bio-accumulation has not been reached at earlier tiers or where circumstances warrant, Tier IV evaluations are used to determine compliance with paragraph 227.13(c). Tier IV tests consist of bioassays and bio-accumulation tests to determine the long-term effects of exposure to dredged material. Tier IV tests will be carefully selected to address the specific issues relevant to the case in question. Whatever the Tier IV tests, the case-specific evaluative criteria for these tests have to be determined beforehand and agreed upon by EPA Region III and the Corps' Baltimore and Norfolk Districts, and have to be adequate to determine compliance with the requirements of paragraph 227.13(c).

Sampling

If the proposed dredged material does not meet testing exclusion criteria defined at 40 CFR paragraph 227.13(b), physical, chemical, and biological test may be required depending on the specific tier.

Specific objective of the dredged material evaluation are:

- Collect the required volume of sediment and site water for physical, chemical, and biological analyses, and elutriate preparation
- Collect samples from specific locations within positioning accuracy appropriate for the project objectives.
- Collect and transfer sediment to appropriate, laboratory-prepared containers and preserve/hold samples for analysis according to protocols that ensure sample integrity.
- Test and characterize sediment with regard to physical characteristics, chemical contamination, biological toxicity, and potential for bioaccumulation.
- Test site water, elutriate, and reference/disposal site water with regard to potential chemical contamination.
- Evaluate the results of data with regard to the requirements for ocean placement.

The technical approach for sampling, analysis, and data evaluation follows the tiered testing approach for inland and ocean disposal of dredged material outlined above. The tiered approach is designed to aid in generating necessary toxicity and bio-accumulation information, but not more information than is necessary. This allows optimal use of resources by focusing the least effort on dredging operations where impacts are clear, and expending the most effort on operations requiring more extensive investigations to determine the potential (or lack thereof) for impact.

The proposed dredged material evaluation will consist of collecting sediment and water from the proposed dredging locations in the project site, from an ocean reference site, and from a control site to characterize physical, chemical, and biological attributes of sediments within each area.

Reference sediment is defined as substantially free of contaminates, that is as similar as practicable to the grain size of the dredged material and at the disposal site and that reflects the conditions that would exist in the vicinity of the disposal site had dredged disposal not taken place, but assuming all other influences on sediment condition occurred naturally (Green Book 1991). Reference sediment serves as a point of comparison to identify potential effects of contaminants in dredged material.

This MARIM requires that the reference area approach be used rather than the reference location is viewed not as a single station or point, but as the entire area in the environs of the disposal site, excluding the disposal site itself. Rather than characterize the reference area by sampling at a single point, it is characterized by a number of samples taken throughout the reference area and composited according to methods described in the 1991 Green Book.

Appendix A contains maps of the Norfolk and Dam Neck ODMDS's and their respective reference areas to be used in comparative evaluations for ocean dredged material disposal in the Baltimore and Norfolk Districts. Reference sediments must be comprised of a minimum of three composites. The location by latitude and longitude of the reference sampling stations must be submitted with test results.

Control sediment is distinguished from reference sediment because it is from an area known to be free of contaminates and is used to determine the health of test species and evaluate test protocols. Control sediment must be used for all bioassay and bio-accumulation tests. Control sediment is distinguished from the reference sediment because it is collected from the site where the test species were collected, or an area known to be free of contaminates. The control samples are used to determine the health of the test species during bioassay and bioaccumulation tests, and to evaluate test protocols as part of the laboratory QA/QC program. EPA's QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluation provides a complete quality control evaluation.

The project plan consists of the following tasks:

- Work plan development
- Sample collection and processing
- Analytical testing of bulk sediments
- Ecotoxicological testing (water column, solid phase, and bioaccumulation studies)
- Data evaluation and report preparation

A work plan for any project will be developed and will include the following components:

- Overview of the project objectives and personnel assigned to the project
- Field Sampling Plan (FSP)
- Analytical Chemistry Quality Assurance Project Plan (QAPP)
- Ecotoxicology Quality Assurance Project Plan (QAPP)

- Site Safety and Health Plan (SSHP)

The components of the work plan may be reduced or expanded based upon consultation with regulatory agencies. The minimum components for the Work Plan will include a FSP and QAPPs for analytical chemistry and ecotoxicological testing.

Sample Locations

Sampling stations in the project site will be located in areas proposed for dredging. The reference site and control site will be selected based on consultation and recommendations from applicable federal and state regulatory agencies (EPA, USFWS, MDE, VADEQ). Stations will be located in the field using a differential Global Positioning System (DGPS).

The location of each sampling station should be based directly on the amount and extent of dredging proposed. The number of sampling stations will depend on the proposed project. In general, the sampling stations should be located within areas of proposed dredging where the largest amounts of sediments are planned for dredging or in areas of known or suspected contamination.

Sediment Sampling

Sediment samples in the Project site will be collected using a vibracoring system capable of collecting sediment cores to project depth. Core depth will be representative of the material to be removed and will be dependent upon the proposed dredging depth. Cellulose Acetate Butyrate (CAB) core liners will be used within the coring device. The core liners will be fitted with a one-way valve at the top and a stainless steel catcher at the bottom to retain sediment during retrieval. The core barrel will be fitted with a steel cutter head to facilitate sediment penetration. Sampling equipment coming into direct contact with the sediment will be decontaminated prior to sampling. Coring operations will be conducted from a vessel outfitted with lifting equipment and electrical hook-ups to facilitate coring operations.

Surficial sediment will be collected from the ocean reference site and control site using a stainless steel Van Veen grab sampler. The ocean reference sediment will be collected from a research vessel. Grabs will be collected and composited to obtain the necessary sample volume for physical, chemical, and biological analysis.

Sediment Volume Requirements

Approximately 20-25 gallons of sediment will be required per sampling station for the toxicity testing, bioaccumulation studies, sediment chemistry, and elutriate preparation. The total of required cores will be dependent upon the sampling depth, the sediment recover, and the diameter of the core barrel. The number of grabs required at the reference or control site will be dependent upon the composition of the bottom substrate and the penetration depth of the

sampler.

Labeling and Storage

In the field, cores will be capped at both ends, sealed, labeled, and bagged on the work platform. Cores will be stored and chilled on the work vessel during the work day. Cores will be hand delivered each evening to the contracting facility where they will be stored at 4 C until processing. Surficial sediments that require chemical analysis will be composited and homogenized on the work vessel using pre-cleaned stainless steel bowls and spoons. These samples will be placed in appropriate holding containers, labeled, chilled on ice, and hand-delivered to the analytical laboratory for testing as soon as possible after collection. In addition sediment for ecotoxicology testing will be archived in pre-cleaned, 5-gallon polyethylene buckets with lids. This material will be transported to the contract ecotoxicological facility, stored at 4 C, and later composited for ecotoxicological testing.

Water Sampling

Approximately 16-gallons of site water will be collected from each sampling location for site water, elutriate, and bioassay testing. Water will be collected from mid-depth of the water column using a peristaltic pump with Tygon tubing. Water for the analytical testing and the elutriate preparation will be stored at 4 C in 1-gallon pre-cleaned, amber glass bottles. Water for the bioassay testing will be stored at 4 C in 5-gallon, pre-cleaned, high-density polyethylene containers.

Sample Containers, Preservation Techniques, and Holding Time Requirements

Holding times for the core samples will begin when the sediment is removed from the core liner, composited, homogenized, and placed in the appropriate sample containers. Holding time for the surficial sediment will begin with the sediment is collected. Holding times for the site water will begin when the samples are collected and placed into the appropriate sample containers.

The sample containers, preservatives, and holding time requirement for sediment samples are provided in Table 4. The sample containers, preservatives, and holding time requirements for aqueous samples are provided in Table 5. The sample containers, preservatives, and holding time requirements of sediment and site water for toxicity and bioaccumulation testing are provided in Table 6.

Field Documentation

Station coordinates, approximate water depth, weather conditions, sea state, and tidal cycle at each sampling location will be recorded in the field. In addition, water temperature, salinity, and dissolved oxygen profiles (2 meter increments) will be recorded at each station.

Detailed methods for determining station locations in the field, sample collection protocols,

sample volume requirements, equipment decontamination procedures, chain-of-custody documentation, sample packaging, core processing, investigation derived wastes, and corrective actions will be described explicitly in a project FSP.

Sample Processing

After completion of coring activities, cores will be processed in a designated area at the contracted laboratory facility. Sediments will be extracted from each core using a stainless-steel extrusion rod and will be homogenized using pre-cleaned stainless-steel spoons in stainless-steel bowls. The composites will be homogenized in a 55-gal fiberglass holding container using large stainless-steel spoons. A 1-gallon sub-sample of composited mater from each station will be submitted for analytical testing. Sample processing equipment that comes into direct contact with sediment will be decontaminated according to the protocols specified in the FSP.

A 20-gallon composite from each station will be used for ecotoxicological testing. Sediment to be used for ecotoxicological testing will be sieved through a 1 mm-mesh screen to remove plant debris, predators, and shell and rock fragments. Compositing the homogenization procedures are fully described in the FSP.

Table 4: Required Containers, Preservation Technique, and Holding Times for Sediment Samples[a]

Parameter	Mass Required (g)	Container[b]	Preservative	Holding Time
Inorganics				
Mercury	5	P	4 C	28 days
Other Metals	5	P	4 C	6 months
Cyanide	50	P, G	4 C	14 days
Sulfide	10	P, G	4 C	7 days
Acid Volatile Sulfides (AVS)	25	P, G	4 C	14 days
Ammonia	10	G	4 C	28 days
Biological Oxygen Demand	10	G	4 C	48 hours
Chemical Oxygen Demand	50	P, G	4 C	28 days
Nitrogen (Ammonia, Total Kjeldahl Nitrate+Nitrite, Total Phosphorus)	150	P, G	4 C	28 days
Physical Parameters				
Elutriate Preparation	1500	G	4 C	14 days until elutriate prep. Follow aqueous hold times after prep.
Total Moisture, Grain Size, Atterberg Limits, Specifric Gravity	1000	P,G	4 C	6 months
Organics				
Total Organic Carbon	5	Heat treated glass vial with Teflon-lined lid	4 C	14 days
Organotins	100	G	4 C	14 days until extraction, 7 days from extraction to derivatization, 40 days after extraction
Dioxins/Furans	40	G		30 days until extraction, 40 days after extraction
Pesticides (Organochlorine and Organophosphate), PCB, Congeners, Semivolatile Organics, Polynuclear Aromatic Hydorcarbons	400	G	4 C	14 days until extraction, 40 days after extraction

(a) From time of sample collection.
(b) P = plastic; G = glass

Table 5: Required Containers, Preservation Technique, and Holding Times for Aqueous Samples[a]

Parameter	Volume Required (mL)	Container[b]	Preservative	Holding Time
Inorganics				
Mercury	100	P	pH<2 with HNO_3: Cool, 4 C	28 days
Other Metals	100	P	pH<2 with HNO_3; Cool, 4 C	6 months
Cyanide	500	P, G	NaOH to pH>12 Ascorbic Acid; Cool, 4 C	14 days
Sulfide	500	P, G	NaOH to pH>12 Ascorbic Acid; Cool, 4 C	7 days
Ammonia	500	P, G	H_2SO_4 to pH<2 Cool, 4 C	28 days
Biological Oxygen Demand	1000	P, G	Cool, 4 C	48 hours
Chemical Oxygen Demand	50	P, G	H_2SO_4 to pH<2 Cool, 4 C	28 days
Nitrogen (Ammonia, Total Kjeldahl Nitrate+Nitrite, Total Phosphorus)	1050	P, G	H_2SO_4 to pH<2 Cool, 4 C	28 days
Organics				
Total Organic Carbon	50	P, G	H_2SO_4 or Hcl to pH<2; Cool, 4 C	28 days
Organotins	1000	G, teflon-lined cap	Cool, 4 C	7 days until extraction, 7 days from extraction to derivatization, 40 days after extraction
Dioxins/Furans	1000	G, teflon-lined cap	Cool, 4 C	30 days until extraction, 40 days after extraction
Pesticides (Organochlorine and Organophosphate), PCB, Congeners, Semivolatile Organics, Polynuclear Aromatic Hydorcarbons	5000	G, teflon-lined cap	Cool, 4 C	7 days until extraction, 40 days after extraction

(a) From time of sample collection.
(b) P = plastic; G = glass

Table 6: Required Containers, Preservation Technique, and Holding Times for Toxicity and Bioaccumulation Testing(a)

Parameter	Mass Required (g)	Container[b]	Preservative	Holding Times
Toxicity and Bioaccumulation Testing				
Whole Sediment	30 L	P	</= 4 C/dark	Optimum 14 days, maximum 6 weeks
Water Column	10 L	P	</= 4 C/dark	Elutriate from sediment prepared with 24 hours of test initiation

(a) From time of sample collection per USEPA 1991, *The Green Book*, and USEPA 1995, *QA/QC Guidance for Sampling and Analysis of sediments, Water, and Tissues for Dredged Material Evaluations.*
(b) Polyethylene (P) or glass (G)

Analytical Testing of Bulk Sediment, Water, and Tissue

Analytical testing of the bulk sediments, site water, elutriate, and tissue will be conducted by the contract laboratory. Target analyte fractions, analytical methods, and target detection limits for sediment, water, and tissue samples are provided in Tables 7, 8, and 9 respectively.

The list of target analytes, target detection limits, methodologies, elutriate preparation procedures, and sample holding times were derived from the following guidance documents:

> USEPA/USACE, 1991. Evaluation of Dredged Material Proposed for Ocean Disposal, Testing Manual (commonly called "The Green Book").
>
> USEPA/USACE, 1998 (EPA-823-B-98-004). Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.- Testing Manual (inland Testing Manual-ITM).
>
> USEPA, 1995 (EPA-823-B-95-001). QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations.

In addition to sediment, water, and elutriate samples, quality control (QC) samples will be submitted to the laboratory. Equipment blanks and matrix spike/ matrix spike duplicate (MS/MSD), duplicates, and standard reference material (SRM) samples will be analyzed with the samples. Analytical methods, target analyte, holding times, reporting limits, and laboratory QA/QC protocols will be detailed and addressed in a project specific Analytic Chemistry Quality Assurance Project Plan (QAPP).

Water column bioassays, whole-sediment bioassays, and bioaccumulation studies will be conducted on homogenized sediment composites from each station , from the reference location, and from a control site.

Table 7: Method Detection Limits (MDLS) for Sediment Samples

Parameter	Units	Laboratory MDL[a]	Recommended TDL[b]
Organiochlorine Pesticides - GC/ECD - (SW846 3540C/8081A)			
Aldrin	ug/kg	0.52	10
alpha-BHC	ug/kg	0.38	-
beta-BHC	ug/kg	0.49	-
- BHC	ug/kg	0.49	-
- BHC (Lindane)	ug/kg	0.45	10
Chlorbenzide	ug/kg	3.3[c]	2
Chlordane (Technical)	ug/kg	1.6	10
Dacthal	ug/kg	10[c]	2
4,4' - DDD	ug/kg	0.42	10
4,4' - DDE	ug/kg	0.40	10
4,4' - DDT	ug/kg	0.66	10
Dieldrin	ug/kg	0.43	10
Endosulfan I	ug/kg	0.72	10
Endosulfan II	ug/kg	0.36	10
Endosulfan Sulfate	ug/kg	0.84	10
Endrin	ug/kg	1.5	5
Endrin aldehyde	ug/kg	0.94	5
Heptachlor	ug/kg	0.60	10
Heptachlor epoxide	ug/kg	0.81	10
Mirex	ug/kg	3.3[C]	-
Methoxychlor	ug/kg	2.6	10
Toxaphene	ug/kg	14	50
PCB Congeners - GC/ECD - (SW846 3540C/8082)			
2,4'- Dichlorobiphenyl (BZ # 8)	ug/kg	0.10	1
2,2',5- Trichlorobiphenyl (BZ # 18)	ug/kg	0.10	1
2,4,4'- Trichlorobiphenyl (BZ # 28)	ug/kg	0.037	1
2,2',3,5'- Trichlorobiphenyl (BZ # 44)	ug/kg	0.11	1
2,2',4,5'- Trichlorobiphenyl (BZ # 49)	ug/kg	0.17	1
2,2',5,5'- Trichlorobiphenyl (BZ # 52)	ug/kg	0.10	1
2,3',4,4'- Trichlorobiphenyl (BZ # 66)	ug/kg	0.056	1
3,3',4,4'- Trichlorobiphenyl (BZ # 77)	ug/kg	0.082	1
2,2',3,4,5'- Pentachlorobiphenyl (BZ # 87)	ug/kg	0.042	1
2,2',4,5,5'- Pentachlorobiphenyl (BZ # 101)	ug/kg	0.058	1
2,3,3',4,4'- Pentachlorobiphenyl (BZ # 105)	ug/kg	0.18	1
2,3',4,4',5- Pentachlorobiphenyl (BZ # 118)	ug/kg	0.069	1
3,3',4,4',5- Pentachlorobiphenyl (BZ # 126)	ug/kg	0.049	1
2,2,3,3',4,4'- Hexachlorobiphenyl (BZ # 128)	ug/kg	0.048	1
2,2,3,4,4',5'- Hexachlorobiphenyl (BZ # 138)	ug/kg	0.043	1
2,2,4,4',5,5'- Hexachlorobiphenyl (BZ # 153)	ug/kg	0.037	1
2,3,3',4,4',5- Hexachlorobiphenyl (BZ # 156)	ug/kg	0.080	1
3,3',4,4',5,5'- Hexachlorobiphenyl (BZ # 169)	ug/kg	0.095	1
2,2',3,3',4,4',5- Heptachlorobiphenyl (BZ #170)	ug/kg	0.071	1
2,2',3,4,4',5,5'- Heptachlorobiphenyl (BZ #180)	ug/kg	0.087	1
2,2',3,4,4',5',6- Heptachlorobiphenyl (BZ #183)	ug/kg	0.051	1
2,2',3,4,4',6,6'- Heptachlorobiphenyl (BZ #184)	ug/kg	0.056	1
2,2',3,4',5,5',6- Heptachlorobiphenyl (BZ #187)	ug/kg	0.060	1
2,2',3,3',4,4',5,6- Octachlorobiphenyl (BZ #195)	ug/kg	0.087	1
2,2',3,3',4,4',5,5',6- Nonachlorobiphenyl (BZ # 206)	ug/kg	0.13	1
2,2',3,3',4,4',5,5',6,6'- Decachlorobiphenyl (BZ #209)	ug/kg	0.16	1
Organophosphorus Pesticides GC/NPD - (SW 3540C/8141A)			
Demeton	ug/kg	21	-
Ethyl parathion (Parathion)	ug/kg	33[C]	6
Guthion (Azinphos methyl)	ug/kg	22	-
Malathion	ug/kg	16	5
Methyl parathion	ug/kg	17	6

Table 7: Method Detection Limits (MDLS) for Sediment Samples

Semivolatile organics GC/MS - (SW846 3540C/8270C)			
Benzoic acid	ug/kg	1600	100
Benzyl alcohol	ug/kg	58	50
Bis(2-chloroethyl) ether	ug/kg	63	-
Bis(2-chloroethoxy) ether	ug/kg	69	-
Bis(2-ethylhexyl) phthalate	ug/kg	53	50
4- Bromophenyl phenyl ether	ug/kg	61	-
Butylbenzylphthalate	ug/kg	56	50
4-Chloro-3-methylphenol	ug/kg	70	-
2-Chloronaphthalene	ug/kg	74	-
2-Chlorophenol	ug/kg	64	-
4-Chlorophenyl phenyl ether	ug/kg	71	-
Dibenzofuran	ug/kg	73	50
Di-n-butyl phthalate	ug/kg	46	50
1,2- Dichlorobenzene	ug/kg	54	20
1,3- Dichlorobenzene	ug/kg	72	20
1,4- Dichlorobenzene	ug/kg	73	20
3,3'- Dichlorobenzidine	ug/kg	47	-
2,4- Dichlorophenol	ug/kg	68	-
Diethyl phthalate	ug/kg	47	50
4,6- Dinitro-2-Methylphenol	ug/kg	64	-
2,4- Dimethylphenol	ug/kg	130	20
Dimethyl phthalate	ug/kg	55	50
2,4- Dinitrophenol	ug/kg	630	-
2,4- Dinitrotoluene	ug/kg	51	-
2,6- Dinitrotoluene	ug/kg	58	-
1,2- Diphenylhydrazine	ug/kg	55	-
Di-n-oxtyl phthalate	ug/kg	64	50
Hexachlorobenzene	ug/kg	59	10
Hexachlorobutadiene	ug/kg	67	20
Hexachloroethane	ug/kg	130	100
Hexachlorocycleopentadiene	ug/kg	61	-
Isophorone	ug/kg	81	-
2- Methylphenol	ug/kg	77	50
4- Methylphenol	ug/kg	160	100
Nitrobenzene	ug/kg	72	-
2- Nitrophenol	ug/kg	55	-
4- Nitrophenol	ug/kg	52	-
N-Nitrosodiphenylamine	ug/kg	57	20
N-Nitrosodimethylamine	ug/kg	57	-
N-Nitroso-di-n-propylamine	ug/kg	86	-
2,2'-Oxybis(1-chloropropane)	ug/kg	83	-
Pentachlorophenol	ug/kg	310	100
Phenol	ug/kg	66	100
1,2,4-Trichlorobenzene	ug/kg	75	10
2,4,6-Trichlorophenol	ug/kg	77	-

Table 7: Method Detection Limits (MDLS) for Sediment Samples

Polynuclear Aromatic Hydrocarbons (Pahs) - HPLC (SW846 3540C/8310)			
Acenaphthene	ug/kg	9.6	20
Acenaphthylene	ug/kg	20	20
Anthracene	ug/kg	0.73	20
Benzo[a]anthracene	ug/kg	0.85	20
Benzo[b]fluoranthene	ug/kg	1.8	20
Benzo[k]fluoranthene	ug/kg	2.1	20
Benzo[a]pyrene	ug/kg	1.1	20
Benzo[ghi]perylene	ug/kg	2.1	20
Chrysene	ug/kg	1.3	20
Dibenzo[a,h]anthraqcene	ug/kg	3.4	20
Fluoranthene	ug/kg	2.6	20
Fluorene ug/kg	1.3	20	
Inden[1,2,3-cd]pyrene	ug/kg	1.1	20
1-Methylnaphthalene	ug/kg	12	20
2-Methylnaphthalene	ug/kg	7.8	20
Naphthalene	ug/kg	7.4	20
Phenanthrene	ug/kg	1.3	20
Pyrene ug/kg	0.63	20	
Dioxins/Furans-HRGC/HRMS (SW846 3545/8290)			
2,3,7,8-TCDF	ug/kg	0.36	1
2,3,7,8-TCDD	ug/kg	0.29	1
1,2,3,7,8-PeCDF	ug/kg	0.52	2.5
2,3,4,7,8-PeCDF	ug/kg	0.78	2.5
1,2,3,7,8-PeCDD	ug/kg	0.87	2.5
1,2,3,4,7,8-HxCDF	ug/kg	0.90	5
1,2,3,6,7,8-HxCDF	ug/kg	1.19	5
2,3,4,6,7,8-HxCDF	ug/kg	1.07	5
1,2,3,4,7,8-HxCDD	ug/kg	1.26	5
1,2,3,6,7,8-HxCDD	ug/kg	0.93	5
1,2,3,7,8,9-HxCDD	ug/kg	1.64	5
1,2,3,7,8,9-HxCDF	ug/kg	0.70	5
1,2,3,4,6,7,8-HpCDF	ug/kg	1.37	5
1,2,3,4,6,7,8-HpCDD	ug/kg	1.29	5
1,2,3,4,7,8,9-HpCDF	ug/kg	1.38	5
OCDD ug/kg	10.48	10	
OCDF ug/kg	2.16	10	
Organotins by GC/FPD (STL-Burlington SOP)			
Monobutyltins	ug/kg	10. (C)	10
Dibutyltins	ug/kg	1.3 (C)	10
Tributylins	ug/kg	1.5 (C)	10
Inorganic Nonmetals/General Organics			
Cyanide (SW846 9012A)	mg/kg	0.065	2.0
Nitrogen, ammonia (EPA350.1)	mg/kg	1.4	0.1
Nitrogen, nitrate (SW846 9056)	mg/kg	0.055	-
Fitrogen, nitrate (SW846 9056)	mg/kg	0.048	-
Nitrogen, total Kjeldahl (EPA 351.2)	mg/kg	43.2	-
Sulfide (SW846 9030B/9034)	mg/kg	30.7	0.1
TOC (SW846 9060)	mg/kg	547	1000
Metals - Cold Vapor (SW846 7471A)			
Mercury mg/kg	0.027	0.2	
Metals - Furnace (SW846 3050B/7841)			
Thallium mg/kg	0.027	0.2	

Table 7: Method Detection Limits (MDLS) for Sediment Samples

Metals - ICP (SW846 3050B/6010B)			
Aluminum	mg/kg	3.7	50
Phosphorus	mg/kg	2.0	-
Zinc	mg/kg	0.79	15
Metals - TRACE ICP (SW846 3050B-6010B)			
Antimony	mg/kg	0.22	2.5
Arsenic	mg/kg	0.093	5.0
Beryllium	mg/kg	0.0080	2.5
Cadmium	mg/kg	0.022	0.3
Chromium	mg/kg	0.091	5.0
Copper	mg/kg	0.17	5.0
Lead	mg/kg	0.093	5.0
Nickel	mg/kg	0.25	5.0
Selenium	mg/kg	0.13	1.0
Silver	mg/kg	0.28	0.2

(a). Method Detection Limit (MDL) for standard solid matrix determined according to the procedure in 40 CFR 136 Appendix B
(b). Target Detection Limit
(c). For these compounds, no laboratory MDL has been determined. A Reporting Limit is used based upon the low calibration standard concentration (Organotins are lab reporting limits).

Table 8: Method Detection Limits (MDLS) for Water and Elutriate Samples

Parameter	Units	Laboratory MDL[a]	Recommended TDL[b]
Pesticide and PCBs GC/ECD - organochlorine compounds (SW846 3520C8081A)			
Aldrin	ug/L	0.023	0.04
alpha-BHC	ug/L	0.010	-
beta-BHC	ug/L	0.011	-
- BHC	ug/L	0.012	-
- BHC (Lindane)	ug/L	0.0081	0.1
Chlorbenzide	ug/L	0.10[C]	0.002
Chlordane (Technical)	ug/L	0.10	0.14
Dacthal	ug/L	0.30[C]	0.01
4,4' - DDD	ug/L	0.018	0.1
4,4' - DDE	ug/L	0.024	0.1
4,4' - DDT	ug/L	0.020	0.1
Dieldrin	ug/L	0.010	0.02
Endosulfan I	ug/L	0.019	0.1
Endosulfan II	ug/L	0.024	0.1
Endosulfan Sulfate	ug/L	0.029	0.1
Endrin	ug/L	0.033	0.1
Endrin aldehyde	ug/L	0.032	0.1
Heptachlor	ug/L	0.023	0.1
Heptachlor epoxide	ug/L	0.019	0.1
Mirex	ug/L	0.085	0.5
Methoxychlor	ug/L	0.10[C]	-
Toxaphene	ug/L	0.49	0.5
PCB Congeners - GC/ECD - (SW846 3520C/8082)			
2,4'- Dichlorobiphenyl (BZ # 8)	ug/L	0.0030	0.01
2,2',5- Trichlorobiphenyl (BZ # 18)	ug/L	0.0064	0.01
2,4,4'- Trichlorobiphenyl (BZ # 28)	ug/L	0.0065	0.01
2,2',3,5'- Trichlorobiphenyl (BZ # 44)	ug/L	0.0055	0.01
2,2',4,5'- Trichlorobiphenyl (BZ # 49)	ug/L	0.0030	0.01
2,2',5,5'- Trichlorobiphenyl (BZ # 52)	ug/L	0.0022	0.01
2,3',4,4'- Trichlorobiphenyl (BZ # 66)	ug/L	0.00045	0.01
3,3',4,4'- Trichlorobiphenyl (BZ # 77)	ug/L	0.0025	0.01
2,2',3,4,5'- Pentachlorobiphenyl (BZ # 87)	ug/L	0.0012	0.01
2,2',4,5,5'- Pentachlorobiphenyl (BZ # 101)	ug/L	0.0026	0.01
2,3,3',4,4'- Pentachlorobiphenyl (BZ # 105)	ug/L	0.0034	0.01
2,3',4,4',5- Pentachlorobiphenyl (BZ # 118)	ug/L	0.0018	0.01
3,3',4,4',5- Pentachlorobiphenyl (BZ # 126)	ug/L	0.0022	0.01
2,2,3,3',4,4'- Hexachlorobiphenyl (BZ # 128)	ug/L	0.0013	0.01
2,2,3,4,4',5'- Hexachlorobiphenyl (BZ # 138)	ug/L	0.0013	0.01
2,2,4,4',5,5'- Hexachlorobiphenyl (BZ # 153)	ug/L	0.0030	0.01
2,3,3',4,4',5- Hexachlorobiphenyl (BZ # 156)	ug/L	0.0012	0.01
3,3',4,4',5,5'- Hexachlorobiphenyl (BZ # 169)	ug/L	0.0022	0.01
2,2',3,3',4,4',5- Heptachlorobiphenyl (BZ #170)	ug/L	0.0014	0.01
2,2',3,4,4',5,5'- Heptachlorobiphenyl (BZ #180)	ug/L	0.0015	0.01
2,2',3,4,4',5',6- Heptachlorobiphenyl (BZ #183)	ug/L	0.0017	0.01
2,2',3,4,4',6,6'- Heptachlorobiphenyl (BZ #184)	ug/L	0.00099	0.01
2,2',3,4',5,5',6- Heptachlorobiphenyl (BZ #187)	ug/L	0.0053	0.01
2,2',3,3',4,4',5,6- Octachlorobiphenyl (BZ #197)	ug/L	0.0017	0.01
2,2',3,3',4,4',5,5',6- Nonachlorobiphenyl (BZ # 206)	ug/L	0.0024	0.01
2,2',3,3',4,4',5,5',6,6'- Decachlorobiphenyl (BZ #209)	ug/L	0.0026	0.01
Organophosphorus Pesticides GC/NPD/FPD - (SW 3520C/8141A)			
Demeton	ug/L	2.0	-
Ethyl parathion (Parathion)	ug/L	1[C]	0.8
Guthion (Azinphos methyl)	ug/L	0.58	-
Malathion	ug/L	0.22	0.8
Methyl parathion	ug/L	0.24	0.8

Table 8: Method Detection Limits (MDLS) for Water and Elutriate Samples

Semivolatile organics GC/MS - (SW846 3520C/8270C)			
Benzoic acid	ug/L	34	50
Benzyl alcohol	ug/L	2	50
Bis(2-chloroethyl) ether	ug/L	2	-
Bis(2-chloroethoxy) ether	ug/L	2	-
Bis(2-ethylhexyl) phthalate	ug/L	2	10
4- Bromophenyl phenyl ether	ug/L	3	-
Butylbenzylphthalate	ug/L	2	10
4-Chloro-3-methylphenol	ug/L	1	-
2-Chloronaphthalene	ug/L	2	-
2-Chlorophenol	ug/L	1	-
4-Chlorophenyl phenyl ether	ug/L	2	-
Dibenzofuran	ug/L	2	10
Di-n-butyl phthalate	ug/L	4	10
1,2- Dichlorobenzene	ug/L	2	10
1,3- Dichlorobenzene	ug/L	2	10
1,4- Dichlorobenzene	ug/L	2	10
3,3'- Dichlorobenzidine	ug/L	7	-
2,4- Dichlorophenol	ug/L	2	-
Diethyl phthalate	ug/L	3	10
4,6- Dinitro-2-Methylphenol	ug/L	5	-
2,4- Dimethylphenol	ug/L	4	10
Dimethyl phthalate	ug/L	3	10
2,4- Dinitrophenol	ug/L	23	-
2,4- Dinitrotoluene	ug/L	2	-
2,6- Dinitrotoluene	ug/L	2	-
1,2- Diphenylhydrazine	ug/L	3	-
Di-n-oxtyl phthalate	ug/L	3	10
Hexachlorobenzene	ug/L	3	10
Hexachlorobutadiene	ug/L	2	50
Hexachloroethane	ug/L	2	50
Hexachlorocycleopentadiene	ug/L	4	-
Isophorone	ug/L	2	-
2- Methylphenol	ug/L	2	-
4- Methylphenol	ug/L	2	-
Nitrobenzene	ug/L	3	-
2- Nitrophenol	ug/L	3	10
4- Nitrophenol	ug/L	4	10
N-Nitrosodiphenylamine	ug/L	4	50
N-Nitrosodimethylamine	ug/L	3	-
N-Nitroso-di-n-propylamine	ug/L	4	-
2,2'-Oxybis(1-chloropropane)	ug/L	1	-
Pentachlorophenol	ug/L	2	50
Phenol	ug/L	2	10
1,2,4-Trichlorobenzene	ug/L	2	10
2,4,6-Trichlorophenol	ug/L	2	-

Table 8: Method Detection Limits (MDLS) for Water and Elutriate Samples

Polynuclear Aromatic Hydrocarbons (Pahs) - HPLC (SW846 3520C/8310)			
Acenaphthene	ug/L	0.39	10
Acenaphthylene	ug/L	0.38	10
Anthracene	ug/L	0.034	10
Benzo[a]anthracene	ug/kg	0.031	10
Benzo[b]fluoranthene	ug/kg	0.034	10
Benzo[k]fluoranthene	ug/kg	0.053	10
Benzo[a]pyrene	ug/kg	0.047	10
Benzo[ghi]perylene	ug/kg	0.066	10
Chrysene	ug/kg	0.024	10
Dibenzo[a,h]anthraqcene	ug/kg	0.065	10
Fluoranthene	ug/kg	0.047	10
Fluorene	ug/kg	0.064	10
Inden[1,2,3-cd]pyrene	ug/kg	0.035	10
1-Methylnaphthalene	ug/kg	.31	10
2-Methylnaphthalene	ug/kg	0.21	10
Naphthalene	ug/kg	0.32	10
Phenanthrene	ug/kg	0.034	10
Pyrene	ug/kg	0.063	10
Dioxins/Furans-HRGC/HRMS (SW846 3520/8290)			
2,3,7,8-TCDF	ng/L	0.0023	0.01
2,3,7,8-TCDD	ng/L	0.0038	0.01
1,2,3,7,8-PeCDF	ng/L	0.0080	0.025
2,3,4,7,8-PeCDF	ng/L	0.0122	0.025
1,2,3,7,8-PeCDD	ng/L	0.0064	0.025
1,2,3,4,7,8-HxCDF	ng/L	0.0095	0.05
1,2,3,6,7,8-HxCDF	ng/L	0.0043	0.05
2,3,4,6,7,8-HxCDF	ng/L	0.0085	0.05
1,2,3,4,7,8-HxCDD	ng/L	0.096	0.05
1,2,3,6,7,8-HxCDD	ng/L	0.0083	0.05
1,2,3,7,8,9-HxCDD	ng/L	0.0093	0.05
1,2,3,7,8,9-HxCDF	ng/L	0.0135	0.05
1,2,3,4,6,7,8-HpCDF	ng/L	0.0102	0.05
1,2,3,4,6,7,8-HpCDD	ng/L	0.0108	0.05
1,2,3,4,7,8,9-HpCDF	ng/L	0.0124	0.05
OCDD	ng/L	0.341	0.1
OCDF	ng/L	0.0383	0.1
Organotins by GC/FPD (STL-Burlington SOP)			
Monobutyltins	ug/kg	0.031 (C)	0.01
Dibutyltins	ug/kg	0.038 (C)	0.01
Tributylins	ug/kg	0.044 (C)	0.01
Inorganic Nonmetals/General Organics			
Cyanide (SW846 9012A)	mg/kg	0.0050	5
Nitrogen, ammonia (EPA350.1)	mg/kg	0.028	0.03
Nitrogen, nitrate (SW846 9056)	mg/kg	0.010	-
Fitrogen, nitrate (SW846 9056)	mg/kg	0.0050	-
Nitrogen, total Kjeldahl (EPA 351.2)	mg/kg	0.19	-
Sulfide (SW846 9030B/9034)	mg/kg	0.35	0.1
TOC (SW846 9060)	mg/kg	0.080	1000
Metals - Cold Vapor (SW846 7470A)			
Mercury	mg/kg	0.039	0.2
Metals - Furnace (SW846 3020A/7841)			
Thallium	mg/kg	2.4	1.0

Table 8: Method Detection Limits (MDLS) for Water and Elutriate Samples

Metals - ICP (SW846 3010A/6010B)			
Aluminum	mg/kg	57.6	40
Phosphorus	mg/kg	19.7	-
Zinc	mg/kg	2.3	1.0
Metals - TRACE ICP (SW846 3010A-6010B)			
Antimony	mg/kg	3.0	3.0
Arsenic	mg/kg	1.7	1.0
Beryllium	mg/kg	0.083	0.2
Cadmium	mg/kg	0.24	1.0
Chromium	mg/kg	0.74	1.0
Copper	mg/kg	1.9	1.0
Lead	mg/kg	2.4	1.0
Nickel	mg/kg	1.1	1.0
Selenium	mg/kg	1.8	2.0
Silver	mg/kg	3.2	1.0

(a). Method Detection Limit (MDL) for standard solid matrix determined according to the procedure in 40 CFR 136 Appendix B
(b). Target Detection Limit
(c). For these compounds, no laboratory MDL has been determined. A Reporting Limit is used based upon the low calibration standard concentration (Organotins are lab reporting limits).

Table 9: Method Detection Limits (MDLS) for Tissue Samples

Parameter	Units	Laboratory MDL[a]	Recommended TDL[b]
Pesticide and PCBs GC/ECD - organochlorine compounds (SW846 3540C8081A)			
Aldrin	ug/kg	0.53	10
alpha-BHC	ug/kg	0.72	-
beta-BHC	ug/kg	0.77	-
- BHC	ug/kg	0.69	-
- BHC (Lindane)	ug/kg	0.82	10
Chlorbenzide	ug/kg	3.39[C]	2
Chlordane (Technical)	ug/kg	3.3	10
Dacthal	ug/kg	10[C]	2
4,4' - DDD	ug/kg	1.5	10
4,4' - DDE	ug/kg	1.3	10
4,4' - DDT	ug/kg	1.2	10
Dieldrin	ug/kg	0.77	10
Endosulfan I	ug/kg	0.61	10
Endosulfan II	ug/kg	0.86	10
Endosulfan Sulfate	ug/kg	0.95	10
Endrin	ug/kg	0.98	10
Endrin aldehyde	ug/kg	1.2	10
Heptachlor	ug/kg	0.68	10
Heptachlor epoxide	ug/kg	0.73	10
Mirex	ug/kg	3.3[C]	-
Methoxychlor	ug/kg	5.0	10
Toxaphene	ug/kg	13	50
PCB Congeners - GC/ECD - (SW846 3540C/8082)			
2,4'- Dichlorobiphenyl (BZ # 8)	ug/kg	0.24	2
2,2',5- Trichlorobiphenyl (BZ # 18)	ug/kg	0.12	2
2,4,4'- Trichlorobiphenyl (BZ # 28)	ug/kg	0.12	2
2,2',3,5'- Trichlorobiphenyl (BZ # 44)	ug/kg	0.11	2
2,2',4,5'- Trichlorobiphenyl (BZ # 49)	ug/kg	0.26	2
2,2',5,5'- Trichlorobiphenyl (BZ # 52)	ug/kg	0.14	2
2,3',4,4'- Trichlorobiphenyl (BZ # 66)	ug/kg	0.33	2
3,3',4,4'- Trichlorobiphenyl (BZ # 77)	ug/kg	0.21	2
2,2',3,4,5'- Pentachlorobiphenyl (BZ # 87)	ug/kg	0.13	2
2,2',4,5,5'- Pentachlorobiphenyl (BZ # 101)	ug/kg	0.18	2
2,3,3',4,4'- Pentachlorobiphenyl (BZ # 105)	ug/kg	0.16	2
2,3',4,4',5- Pentachlorobiphenyl (BZ # 118)	ug/kg	0.21	2
3,3',4,4',5- Pentachlorobiphenyl (BZ # 126)	ug/kg	0.20	2
2,2,3,3',4,4'- Hexachlorobiphenyl (BZ # 128)	ug/kg	0.14	2
2,2,3,4,4',5'- Hexachlorobiphenyl (BZ # 138)	ug/kg	0.20	2
2,2,4,4',5,5'- Hexachlorobiphenyl (BZ # 153)	ug/kg	0.12	2
2,3,3',4,4',5- Hexachlorobiphenyl (BZ # 156)	ug/kg	0.088	2
3,3',4,4',5,5'- Hexachlorobiphenyl (BZ # 169)	ug/kg	0.11	2
2,2',3,3',4,4',5- Heptachlorobiphenyl (BZ #170)	ug/kg	0.075	2
2,2',3,4,4',5,5'- Heptachlorobiphenyl (BZ #180)	ug/kg	0.085	2
2,2',3,4,4',5',6- Heptachlorobiphenyl (BZ #183)	ug/kg	0.076	2
2,2',3,4,4',6,6'- Heptachlorobiphenyl (BZ #184)	ug/kg	0.10	2
2,2',3,4',5,5',6- Heptachlorobiphenyl (BZ #187)	ug/kg	0.088	2
2,2',3,3',4,4',5,6- Octachlorobiphenyl (BZ #197)	ug/kg	0.13	2
2,2',3,3',4,4',5,5',6- Nonachlorobiphenyl (BZ # 206)	ug/kg	0.11	2
2,2',3,3',4,4',5,5',6,6'- Decachlorobiphenyl (BZ #209)	ug/kg	0.15	2
Organophosphorus Pesticides GC/NPD - (SW 3540C/8141A)			
Demeton	ug/kg	33[C]	-
Ethyl parathion (Parathion)	ug/kg	33[C]	6
Guthion (Azinphos methyl)	ug/kg	33[C]	-
Malathion	ug/kg	33[C]	5
Methyl parathion	ug/kg	33[C]	6

Table 9: Method Detection Limits (MDLS) for Tissue Samples

Semivolatile organics GC/MS - (SW846 3540C/8270C)			
Benzoic acid	ug/kg	250	100
Benzyl alcohol	ug/kg	100	100
Bis(2-chloroethyl) ether	ug/kg	110	-
Bis(2-chloroethoxy) ether	ug/kg	130	-
Bis(2-ethylhexyl) phthalate	ug/kg	180	20
4- Bromophenyl phenyl ether	ug/kg	120	-
Butylbenzylphthalate	ug/kg	150	20
4-Chloro-3-methylphenol	ug/kg	77	-
2-Chloronaphthalene	ug/kg	100	-
2-Chlorophenol	ug/kg	91	-
4-Chlorophenyl phenyl ether	ug/kg	94	-
Dibenzofuran	ug/kg	100	20
Di-n-butyl phthalate	ug/kg	110	20
1,2- Dichlorobenzene	ug/kg	140	20
1,3- Dichlorobenzene	ug/kg	140	20
1,4- Dichlorobenzene	ug/kg	140	20
3,3'- Dichlorobenzidine	ug/kg	280	-
2,4- Dichlorophenol	ug/kg	100	-
Diethyl phthalate	ug/kg	110	20
4,6- Dinitro-2-Methylphenol	ug/kg	100	-
2,4- Dimethylphenol	ug/kg	84	20
Dimethyl phthalate	ug/kg	64	20
2,4- Dinitrophenol	ug/kg	190	-
2,4- Dinitrotoluene	ug/kg	57	-
2,6- Dinitrotoluene	ug/kg	67	-
1,2- Diphenylhydrazine	ug/kg	69	-
Di-n-oxtyl phthalate	ug/kg	370	20
Hexachlorobenzene	ug/kg	89	20
Hexachlorobutadiene	ug/kg	120	40
Hexachloroethane	ug/kg	110	40
Hexachlorocycleopentadiene	ug/kg	59	-
Isophorone	ug/kg	120	-
2- Methylphenol	ug/kg	87	20
4- Methylphenol	ug/kg	67	20
Nitrobenzene	ug/kg	110	-
2- Nitrophenol	ug/kg	120	-
4- Nitrophenol	ug/kg	140	-
N-Nitrosodiphenylamine	ug/kg	110	20
N-Nitrosodimethylamine	ug/kg	120	-
N-Nitroso-di-n-propylamine	ug/kg	120	-
2,2'-Oxybis(1-chloropropane)	ug/kg	150	-
Pentachlorophenol	ug/kg	210	100
Phenol	ug/kg	98	20
1,2,4-Trichlorobenzene	ug/kg	120	20
2,4,6-Trichlorophenol	ug/kg	83	-

Table 9: Method Detection Limits (MDLS) for Tissue Samples

Polynuclear Aromatic Hydrocarbons (Pahs) - HPLC (SW846 3540C/8310)			
Acenaphthene	ug/kg	2.8	20
Acenaphthylene	ug/kg	21	20
Anthracene	ug/kg	0.54	20
Benzo[a]anthracene	ug/kg	0.76	20
Benzo[b]fluoranthene	ug/kg	0.78	20
Benzo[k]fluoranthene	ug/kg	0.44	20
Benzo[a]pyrene	ug/kg	0.41	20
Benzo[ghi]perylene	ug/kg	0.92	20
Chrysene	ug/kg	0.24	20
Dibenzo[a,h]anthraqcene	ug/kg	0.91	20
Fluoranthene	ug/kg	0.78	20
Fluorene	ug/kg	1.0	20
Inden[1,2,3-cd]pyrene	ug/kg	0.80	20
1-Methylnaphthalene	ug/kg	4.8	20
2-Methylnaphthalene	ug/kg	4.7	20
Naphthalene	ug/kg	3.6	20
Phenanthrene	ug/kg	1.0	20
Pyrene	ug/kg	0.44	20
Dioxins/Furans-HRGC/HRMS (SW846 3545/8290)			
2,3,7,8-TCDF	ng/L	0.07	1
2,3,7,8-TCDD	ng/L	0.10	1
1,2,3,7,8-PeCDF	ng/L	0.20	2.5
2,3,4,7,8-PeCDF	ng/L	0.33	2.5
1,2,3,7,8-PeCDD	ng/L	0.25	2.5
1,2,3,4,7,8-HxCDF	ng/L	0.37	5
1,2,3,6,7,8-HxCDF	ng/L	0.24	5
2,3,4,6,7,8-HxCDF	ng/L	0.30	5
1,2,3,4,7,8-HxCDD	ng/L	0.27	5
1,2,3,6,7,8-HxCDD	ng/L	0.54	5
1,2,3,7,8,9-HxCDD	ng/L	0.40	5
1,2,3,7,8,9-HxCDF	ng/L	0.39	5
1,2,3,4,6,7,8-HpCDF	ng/L	0.25	5
1,2,3,4,6,7,8-HpCDD	ng/L	0.95	5
1,2,3,4,7,8,9-HpCDF	ng/L	0.67	5
OCDD	ng/L	5[C]	10
OCDF	ng/L	0.75	10
Organotins by GC/FPD (STL-Burlington SOP)			
Monobutyltins	ug/kg	1.0[C]	10
D©tyltins	ug/kg	1.3[C]	10
Tributylins	ug/kg	1.5[C]	10
Metals - Cold Vapor (SW846 7471A)			
Mercury	mg/kg	0.14	0.01
Metals - Furnace (SW846 3020B/7000)			
Thallium	mg/kg	0.30	0.1
Metals - ICP (SW846 3050B/6010B)			
Aluminum	mg/kg	11	1.0
Zinc	mg/kg	9.1	2.0

Table 9: Method Detection Limits (MDLS) for Tissue Samples

Metals - TRACE ICP (SW846 3050B-6010B)			
Antimony	mg/kg	0.90	0.1
Arsenic	mg/kg	0.42	0.1
Beryllium	mg/kg	0.30	0.1
Cadmium	mg/kg	0.045	0.1
Chromium	mg/kg	0.27	0.1
Copper	mg/kg	0.42	0.1
Lead	mg/kg	0.23	0.1
Nickel	mg/kg	0.22	0.1
Selenium	mg/kg	0.27	0.1
Silver	mg/kg	0.16	0.2

(a). Method Detection Limit (MDL) for standard solid matrix determined according to the procedure in 40 CFR 136 Appendix B
(b). Target Detection Limit
(c). For these compounds, no laboratory MDL has been determined. A Reporting Limit is used based upon the low calibration standard concentration (Organotins are lab reporting limits).

Ecotoxicology Testing

The ecotoxicological testing program for this project follows protocols provided by the following guidance documents:

> USEPA/USACE, 1998 (EPA-823-B-98-004). Evaluation of Dredged material Proposed for Discharge in Waters of the U.S. -Testing Manual (Inland Testing Manual).
>
> USEPA/USACE, 1991. Evaluation of Dredged material Proposed for Ocean Disposal, Testing Manual (commonly called "The Green Book").
>
> USACESAD/USEPA Region IV, 1993. Regional Implementation Manual, Requirements and Procedure for Evaluation of the Ocean Disposal of Dredged Material in Southeastern Atlantic and Gulf Coastal Waters.
>
> USEPA, 1995 (EPA-823-B-95-001). QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations.

The ecotoxicological testing program proposed for this project includes the following tasks:

- 96-hours water column bioassay with *Mysidopsis bahia* (opossum shrimp), *Cyprinodon variegatus* (sheepshead minnow) and 48-hour test with *Arebacia punctulata* (purple sea urchin).
- 10-day whole sediment bioassay with *Leptocheirus plumulosus* (estuarine amphipod) and *Neanthes areneceodentata* (marine polychaete).
- 28-day whole sediment bioaccumulation studies with *Nereis virens* (sand worm) and *Macoma nasuta* (blunt-nose clam). Tissues will be analyzed for lipids, total water content, and for contaminants of concern.

Biological tests and selected species will be approved by appropriate regulatory agencies prior to test initiation. Detailed information regarding test preparation and protocols will be described and addressed in an Ecotoxicology Quality Assurance Project Plan (Ecotox-QAPP). Tissue analysis information will be provided in an Analytical Chemistry- Quality Assurance Project Plan. The sample containers, preservatives, and holding time requirements for tissue samples are provided in Table 10. Target fractions for tissue analysis will be selected based on the results of Theoretical Bioaccumulation Potential (TBP) calculations and the sediment chemistry results.

Table 10: Required Containers, Preservation Technique, and Holding Times for Tissue Samples[a]

Parameter	Mass Required (g)	Container [b]	Preservative	Holding Times
Inorganics				
Mercury	5	G	Frozen, < -20 C	28 days
Other Metals	5	G	Frozen, < -20 C	6 months
Organics				
Lipids	5	G	Frozen, < -20 C	Up to 1 year if frozen (14 days after thaw) to analysis
Organotins	10	G	Frozen, < -20 C	Up to 1 year if frozen (14 days after thaw) to extraction, 7 days from extraction to derivatization, 40days after extraction
Dioxins/Furans	10	G	Frozen, < -20 C	Up to 1 year if frozen (30 days after thaw) to extraction, 40 days after extraction
Pesticides (Organochlorine and Organophosphate), PCB, Congeners, Semivolatile Organics, Polynuclear Aromatic Hydrocarbons	110	G	Frozen, < -20 C	Up to 1 year if rozen (14 days after thaw) to extraction, 40 days after extraction

(a) From time of sample collection.
(b) P = Plastic; G = Glass.

Modeling and Data Analysis

Bulk Sediment and Elutriate Data

The bulk sediment data will be used to model compliance with marine water quality criteria (WQC) and to calculate TBP. The STFATE model will be used to determine water quality compliance and to model the concentration of the contaminant that requires the greatest dilution. The model identifies the concentration of the contaminant in the water column inside and outside the boundary of the disposal site during a specific mixing period. If the Limiting Permissible Concentration (LPC) is not met, elutriate data (which are more representative of true disposal conditions) will be run thorough the STFATE model to determine if the contaminant still exceeds the LPC. TBP results will be used to compare potential bioaccumulation of contaminants in organisms exposed to the dredged material and organisms exposed to the reference material. The TBP results will be used to determine which analytical fractions should be tested in the tissues.

Bioassay and Bioaccumulation Data

Survival data from the water column bioassays will be statistically compared against control survival to determine if there is a significant effect of the elutriate on the survival of test organisms. In addition, median lethal concentrations (LC50) will be calculated. Statistical analyses will also be conducted on the survival data from the whole sediment bioassays to determine if the proposed dredged material is more toxic to organisms than the material from the reference location. Tissue data from the bioaccumulation test will be statistically compared to determine if contaminants of concern are more concentrated in organisms exposed to dredged material than in organisms exposed to the reference material. In addition, contaminant concentrations detected in tissues will be compared to the U.S. Food and Drug Administration (USFDA) Action Levels.

Quality Assurance/Quality Control

The purpose of the quality-assurance program in a dredging study is to ensure that the data produced by the study are of known and documented quality. This is accomplished by ensuring that proper quality control procedures are built into the study at the beginning and by verifying that the procedures are followed during the study. A complete QA effort in a dredging study has two components: QA program implemented by the responsible governmental agency (the data user) and QA programs implemented by the laboratories performing the tests (the data generators).

The function of the government QA program is to ensure that laboratories contracted for the dredging studies comply with the procedures in the 1991 Green Book. This responsibility is carried out three ways by interlaboratory comparisons, and routine inspections are conducted during the studies.

Every laboratory participating in a dredged-material study must have a written QA program Plan that has been approved by the District.

The District will consult with EPA when negotiating contracts for dredged material studies to assure all QA measures are addressed.

Report Preparation

The bulk sediment and elutriate data should be organized in tabular format, compile a data report, and evaluate the results of the data. The report should include:

- Overview of sampling activities and copies of the field logbook(s)
- Quantities and concentrations of potential contaminants at each station
- Results of site water and elutriate tests
- Results of toxicity testing, and bioaccumulation studies
- Evaluation of data with regard to ocean disposal requirements.

Glossary

The following definitions of words and terms are specific to the use of this manual and, where applicable, are quoted verbatim from the Guidelines (cf. Definitions at 40 CFR 230.3 and/or other parts; such definitions are starred*). Thorough familiarization with the following definitions is required prior to use of this manual.

Accuracy:
The ability to obtain a true value; determined by the degree of agreement between an observed value and an accepted reference value.

Acid volatile sulfide (AVS):
The sulfides removed from sediment by cold acid extraction, consisting mainly of H2S and FeS. AVS is a possible predictive tool for divalent metal sediment toxicity.

Acute:
Having a sudden onset, lasting a short time.

Acute toxicity:
Short-term toxicity to organism(s) that have been affected by the properties of a substance, such as contaminated sediment. The acute toxicity of a sediment is generally determined by quantifying the mortality of appropriately sensitive organisms that are put into contact with the sediment, under either field or laboratory conditions, for a specified period.

*Adjacent:
Bordering, contiguous or neighboring. Wetlands separated from other waters of the United States by man-made dikes or barriers, natural river berms, beach dunes and the like are "adjacent wetlands".

Application factor (AF):
A numerical, unitless value, calculated as the threshold chronically toxic concentration of a test substance divided by its acutely toxic concentration. The AF is usually reported as a range and is multiplied by the median lethal concentration as determined in a short-term (acute) toxicity test to estimate an expected no- effect concentration under chronic exposure.

Benchmark organism:
Test organism designated by USACE and EPA as appropriately sensitive and useful for determining biological data applicable to the real world. Test protocols with such organisms are published, reproducible and standardized.

Bioaccumulation:
The accumulation of contaminants in the tissue of organisms through any route, including respiration, ingestion, or direct contact with contaminated water, sediment, pore water or dredged material. [The regulations require that bioaccumulation be considered as part of the environmental evaluation of dredged material proposed for disposal. This consideration involves predicting whether there will be a cause-and-effect relationship between an organism's presence in the area influenced by the dredged material and an environmentally important elevation of its tissue content or body burden of contaminants above that in similar animals not influenced by the disposal of the dredged material].

Bioaccumulation factor:
The degree to which an organism accumulates a chemical compared to the source. It is a dimensionless number or factor derived by dividing the concentration in the organism by that in the source.

Bioassay:
A bioassay is a test using a biological system. It involves exposing an organism to a test material and determining a response. There are two major types of bioassays differentiated by response: toxicity tests which measure an effect (e.g., acute toxicity, sublethal/chronic toxicity) and bioaccumulation tests which measure a phenomenon (e.g., the uptake of contaminants into tissues).

Bioavailable:
Can affect organisms.

Bioconcentration:
Uptake of a substance from water.

Biomagnification:
Bioaccumulation up the food chain, e.g., the route of accumulation is solely through food. Organisms at higher trophic levels will have higher body burdens than those at lower trophic levels.

Biota sediment accumulation factor:
Relative concentration of a substance in the tissues of an organism compared to the concentration of the same substance in the sediment.

Bulk sediment chemistry:
Results of chemical analyses of whole sediments (in terms of wet or dry weight), without normalization (e.g., to organic carbon, grain-size, acid volatile sulfide).

Can:
Is used to mean "is able to".

Chronic:
Involving a stimulus that is lingering or which continues for a long time.

Chronic toxicity:
See sublethal/chronic toxicity.

Comparability:
The confidence with which one data set can be compared to others and the expression of results consistent with other organizations reporting similar data. Comparability of procedures also implies using methodologies that produce results comparable in terms of precision and bias.

Completeness:
A measure of the amount of valid data obtained versus the amount of data originally intended to be collected.

Confined disposal:
A disposal method that isolates the dredged material from the environment. Confined disposal is placement of dredged material within diked confined disposal facilities via pipeline or other means.

Confined disposal facility (CDF):
A diked area, either in-water or upland, used to contain dredged material. The terms confined disposal facility (CDF), dredged material containment area, diked disposal facility, and confined disposal area are used interchangeably.

Constituents:
Chemical substances, solids, liquids, organic matter, and organisms associated with or contained in or on dredged material.

*Contaminant:
A chemical or biological substance in a form that can be incorporated into, onto or be ingested by and that harms aquatic organisms, consumers of aquatic organisms, or users of the aquatic environment, and includes but is not limited to the substances on the 307(a)(1) list of toxic pollutants promulgated on January 31, 1978 (43 FR 4109). [Note: A contaminant that causes actual harm is technically referred to as a pollutant, but the regulatory definition of a "pollutant" in the Guidelines is different, reflecting the intent of the CWA.]

Contaminant of concern:
A contaminant present in a given sediment thought to have the potential for unacceptable adverse environmental impact due to a proposed discharge.

Control sediment:
A sediment essentially free of contaminants and which is used routinely to assess the acceptability of a test. Control sediment may be the sediment from which the test organisms are collected or a laboratory sediment, provided the organisms meet control standards. Test procedures are conducted with the control sediment in the same way as the reference sediment and dredged material. The purpose of the control sediment is to confirm the biological acceptability of the test conditions and to help verify the health of the organisms during the test. Excessive mortality in the control sediment indicates a problem with the test conditions or organisms, and can invalidate the results of the corresponding dredged material test.

Data quality indicators:
Quantitative statistics and qualitative descriptors which are used to interpret the degree of acceptability or utility of data to the user; include bias (systematic error), precision, accuracy, comparability, completeness, representativeness, detectability and statistical confidence.

Data quality objectives (DQOs):
Qualitative and quantitative statements of the overall uncertainty that a decision maker is willing to accept in results or decisions derived from environmental data. DQOs provide the framework for planning environmental data operations consistent with the data user's needs.

Discharge of dredged material:
Any addition of dredged material into waters of the United States. [Dredged material discharges include: open water discharges; discharges resulting from unconfined disposal operations (such as beach nourishment or other beneficial uses); discharges from confined disposal facilities which enter waters of the United States (such as effluent, surface runoff, or leachate); and, overflow from dredge hoppers, scows, or other transport vessels]. Material resuspended during normal dredging operations is considered "de minimus" and is not regulated under Section 404 as a dredged material discharge. See 33 CFR 323.2 for a detailed definition. The potential impact of resuspension due to dredging can be addressed under NEPA.

*Disposal site:
That portion of the "waters of the United States" where specific disposal activities are permitted and consist of a bottom surface area and any overlying volume of water. In the case of wetlands on which surface water is not present, the disposal site consists of the wetland surface area. [Note: upland locations, although not mentioned in this definition in the Regulations, can also be disposal sites].

District:
A USACE administrative area.

*Dredged material:
Material that is excavated or dredged from waters of the United States. [A general discussion of the nature of dredged material is provided by Engler et al. (1991a)].

EC50:
The median effective concentration. The concentration of a substance that causes a specified effect (generally sublethal rather than acutely lethal) in 50% of the organisms tested in a laboratory toxicity test of specified duration.

Elutriate:
Material prepared from the sediment dilution water and used for chemical analyses and toxicity testing. Different types of elutriates are prepared for two different procedures as noted in this manual.

Evaluation:
The process of judging data in order to reach a decision.

*Factual determination:
A determination in writing of the potential short-term or long-term effects of a proposed discharge of dredged or fill material on the physical, chemical and biological components of the aquatic environment in light of Subparts C-F of the Guidelines.

Federal Standard:
The dredged material disposal alternative(s) identified by the U.S. Army Corps of Engineers that represent the least costly, environmentally acceptable alternative(s) consistent with sound engineering practices and which meet the environmental standards established by the 404(b)(1) evaluation process. [See Engler et al. (1988) and 33 CFR 335-338].

*Fill material:
Any material used for the primary purpose of replacing an aquatic area with dry land or changing the bottom elevation of a water body for any purpose. The term does not include any pollutant discharged into the water primarily to dispose of waste, as that activity is regulated under Section 402 of the Clean Water Act. [Note: dredged material can be used as fill material].

Grain-size effects:
Mortality or other effects in laboratory toxicity tests due to sediment granulometry, not chemical toxicity. [It is clearly best to use test organisms which are not likely to react to grain-size but, if this is not reasonably possible, then testing must account for any grain-size effects.]

Guidelines:
Substantive environmental criteria by which proposed discharges of dredged material are evaluated. CWA Section 404(b)(1) final rule (40 CFR 230) promulgated December 24, 1980.

LC50:
The median lethal concentration. The concentration of a substance that kills 50% of the organisms tested in a laboratory toxicity test of specified duration.

Leachate:
Water or any other liquid that may contain dissolved (leached) soluble materials, such as organic salts and mineral salts, derived from a solid material.

Lethal:
Causing death.

Loading density:
The ratio of organism biomass or numbers to the volume of test solution in an exposure chamber.

Management actions:
Those actions considered necessary to rapidly render harmless the material proposed for discharge (e.g., non-toxic, non-bioaccumulative) and which may include containment in or out of the waters of the U.S. (see 40 CFR Subpart H). Management actions are employed to reduce adverse impacts of proposed discharges of dredged material.

Management unit:
A manageable, dredgeable unit of sediment which can be differentiated by sampling and which can be separately dredged and disposed within a larger dredging area. Management units are not differentiated solely on physical or other measures or tests but are also based on site- and project-specific considerations.

May:
Is used to mean "is allowed to".

Method detection limit (MDL):
The minimum concentration of a substance which can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero.

Might:
Is used to mean "could possibly."

*Mixing zone:
A limited volume of water serving as a zone of initial dilution in the immediate vicinity of a discharge point where receiving water quality may not meet quality standards or other requirements otherwise applicable to the receiving water. [The mixing zone may be defined by the volume and/or the surface area of the disposal site or specific mixing zone definitions in State water quality standards].

Must:
In this manual refers to requirements that have to be addressed in the context of compliance with the Guidelines.

Open water disposal:
Placement of dredged material in rivers, lakes or estuaries via pipeline or surface release from hopper dredges or barges.

Pathway:
In the case of bioavailable contaminants, the route of exposure (e.g., water, food).

*Pollution:
The man-made or man-induced alteration of the chemical, physical, biological or radiological integrity of an aquatic ecosystem. [See definition of contaminant].

*Practicable:
Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Practical quantitation limit (PQL):
The lowest concentration that can be reliably quantified with specified limits of precision and accuracy during routine laboratory operating conditions.

Precision:
The ability to replicate a value; the degree to which observations or measurements of the same property, usually obtained under similar conditions, conform to themselves. Usually expressed as standard deviation, variance or range.

QA:
Quality assurance, the total integrated program for assuring the reliability of data. A system for integrating the quality planning, quality control, quality assessment, and quality improvement efforts to meet user requirements and defined standards of quality with a stated level of confidence.

QC:
Quality control, the overall system of technical activities for obtaining prescribed standards of performance in the monitoring and measurement process to meet user requirements.

Reason to believe:
Subpart G of the 404(b) (1) guidelines requires the use of available information to make a preliminary determination concerning the need for testing of the material proposed for dredging. This principle is commonly known as "reason to believe", and is contained in Tier I of the tiered testing framework. The decision to not perform additional testing based on prior information must be documented, in order to provide a "reasonable assurance that the proposed discharge material is not a carrier of contaminants" (230.60(b)).

Reference sediment:
Point of comparison for evaluating test sediment. Testing requirements in the Section 404(b)(1) Guidelines regarding the point of comparison for evaluating proposed discharges of dredged material are being updated to provide for comparison to a "reference sediment" as opposed to sediment from the disposal site. Because subsequent discharges at a disposal site could adversely impact the point of comparison, adoption of a reference sediment that is unimpacted by previous discharges of dredged material will result in a more scientifically sound evaluation of potential individual and cumulative contaminant-related impacts. This change to the Guidelines was proposed in the Federal Register in January 1995, public comments have been received, and a final rule Notice is being prepared. It is expected that the final rule will be published prior to July 1, 1998, and as a result the reference sediment approach will be implemented in the ITM.

Reference site:
The location from which reference sediment is obtained.

Region:
An EPA administrative area.

region:
A geographical area.

Regulations:
Procedures and concepts published in the Code of Federal Regulations for evaluating the discharge of dredged material into waters of the United States.

Representativeness:
The degree to which sample data depict an existing environmental condition; a measure of the total variability associated with sampling and measuring that includes the two major error components: systematic error (bias) and random error. Sampling representativeness is accomplished through proper selection of sampling locations and sampling techniques, collection of sufficient number of samples, and use of appropriate subsampling and handling techniques.

Sediment:
Material, such as sand, silt, or clay, suspended in or settled on the bottom of a water body.

Should:
Is used to state that the specified condition is recommended and ought to be met unless there are clear and definite reasons not to do so.

Standard operating procedure (SOP):
A written document which details an operation, analysis, or action whose mechanisms are thoroughly prescribed and which is commonly accepted as the method for performing certain routine or repetitive tasks.

Standardized:
In the case of methodology, a published procedure which has been peer reviewed (e.g., journal, technical report), and generally accepted by the relevant technical community of experts.

Sublethal:
Not directly causing death; producing less obvious effects on behavior, biochemical and/or physiological function, histology of organisms.

Sublethal/chronic toxicity:
Biological tests which use such factors as abnormal development, growth and reproduction, rather than solely lethality, as end-points. These tests involve all or at least an important, sensitive portion of an organism's life-history. A sublethal endpoint may result either from short-term or long-term (chronic) exposures.

Target detection limit:
A performance goal set by consensus between the lowest, technically feasible, detection limit for routine analytical methods and available regulatory criteria or guidelines for evaluating dredged material. The target detection limit is, therefore, equal to or greater than the lowest amount of a chemical that can be reliably detected based on the variability of the blank response of routine analytical methods. However, the reliability of a chemical measurement generally increases as the concentration increases. Analytical costs may also be lower at higher detection limits. For these reasons, a target detection limit is typically set at not less than 10 times lower than available dredged material guidelines.

Tests/testing:
Specific procedures which generate biological, chemical, and/or physical data to be used in evaluations. The data are usually quantitative but may be qualitative (e.g., taste, odor, organism behavior). Testing for discharges of dredged material in waters of the United States is specified at 40 CFR 230.60 and 230.61 and is implemented through the procedures in this manual.

Tiered approach:
A structured, hierarchical procedure for determining data needs relative to decision-making, which involves a series of tiers or levels of intensity of investigation. Typically, tiered testing involves decreased uncertainty and increased available information with increasing tiers. This approach is intended to ensure the maintenance and protection of environmental quality, as well as the optimal use of resources. Specifically, least effort is required in situations where clear determinations can be made of whether (or not) unacceptable adverse impacts are likely to occur based on available information. Most effort is required where clear determinations cannot be made with available information.

Toxicity:
See Acute toxicity; Sublethal/chronic toxicity, Toxicity test.

Toxicity test:
A bioassay which measures an effect (e.g., acute toxicity, sublethal/chronic toxicity). Not a bioaccumulation test (see definition of bioassay).

Water quality certification:
A state certification, pursuant to Section 401 of the Clean Water Act, that the proposed discharge of dredged material will comply with the applicable provisions of Sections 301, 303, 306 and 307 of the Clean Water Act and relevant State laws. Typically this certification is provided by the affected State. In instances where the State lacks jurisdiction (e.g., Tribal Lands), such certification is provided by EPA or the Tribe (with an approved certification program).

Water quality standard:
A law or regulation that consists of the beneficial designated use or uses of a water body, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular water body, and an anti- degradation statement.

Waters of the U.S.:
In general, all waters landward of the baseline of the territorial sea and the territorial sea. Specifically, all waters defined in Section 230.3 (s) of the Guidelines. [See Appendix A].

Whole sediment:
The sediment and interstitial waters of the proposed dredged material or reference sediment that have had minimal manipulation. For purposes of this manual, press-sieving to remove organisms from test sediments, homogenization of test sediments, compositing of sediment samples, and additions of small amounts of water to facilitate homogenizing or compositing sediments may be necessary to conducting bioassay tests. These procedures are considered unlikely to substantially alter chemical or toxicological properties of the respective whole sediments except in the case of AVS (acid volatile sulfide) measurements (EPA, 1991a) which are not presently required. Alternatively, wet sieving, elutriation, or freezing and thawing of sediments may alter chemical and/or toxicological properties, and sediment so processed should not be considered as whole sediment for bioassay purposes.

LIST OF ACRONYMS

AAS - Atomic Absorption Spectrometry

AF - Application Factor

AVS - Acid Volatile Sulfide

BAF - Bioaccumulation Factor

BCF - Bioconcentration Factor

BSAF - Biota Sediment Accumulation Factor

CDF - Confined Disposal Facility

CFR - Code of Federal Regulations

CLP - Contract Laboratory Program

CWA - Clean Water Act

ECD - Electron Capture Detection

EO - Executive Orders

EPA - Environmental Protection Agency

FDA - Food and Drug Administration

FR - Federal Register

GC - Gas Chromatography

GFAAS - Graphite Furnace Atomic Absorption Spectrometry

IAEA - International Atomic Energy Agency

ICP - Inductively Coupled Plasma

ITM - Inland Testing Manual

LBP - Lipid Bioaccumulation Potential

MPRSA - Marine Protection, Research and Sanctuaries Act

MS - Mass Spectrometry

NBS - National Bureau of Standards

NEPA - National Environmental Policy Act

NIST - National Institute for Standards and Technology

NOAA - National Oceanic Atmospheric Administration

NPDES - National Pollutant Discharge Elimination System

NRC - National Research Council of Canada

PAH - Polynuclear Aromatic Hydrocarbons

PCB - Polychlorinated Biphenyl

QA - Quality Assurance

QC - Quality Control

QSAR - Quantitative Structure Activity Relationship

RHA - Rivers and Harbors Act of 1899

SAB - Science Advisory Board

SIM - Selected Ion Monitoring

SOP - Standard Operating Procedure

SQC - Sediment Quality Criteria

SQS - Sediment Quality Standards

SRM - Standard Reference Material

TBP - Theoretical Bioaccumulation Potential

TDL - Target Detection Limit

TEF - Toxicity Equivalency Factor

TOC - Total Organic Carbon

TIE - Toxicity Identification Evaluation

USACE - U.S. Army Corps of Engineers

USCS - Unified Soil Classification System

WQC - Water Quality Criteria WQS - Water Quality Standards

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