Quality Assurance
Technical Document 7

Compilation of Sediment & Soil Standards, Criteria & Guidelines

February 1995

Regional Agency State of California Department of Water Resources

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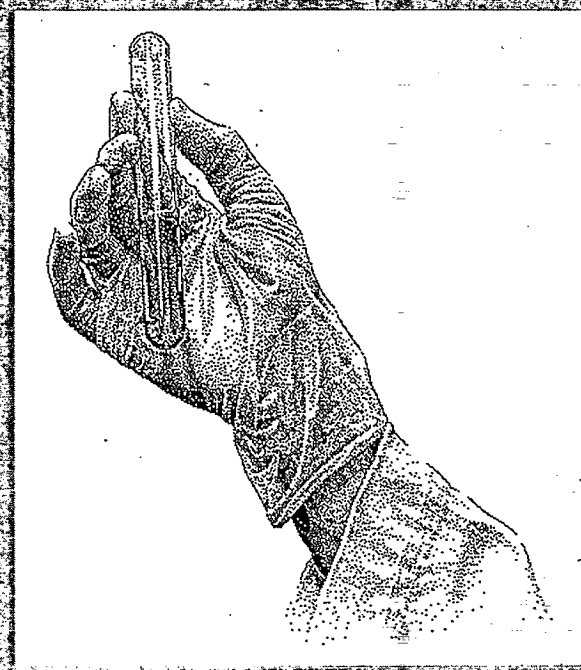
Department of Water Resources
Quality Assurance/Quality Control Program

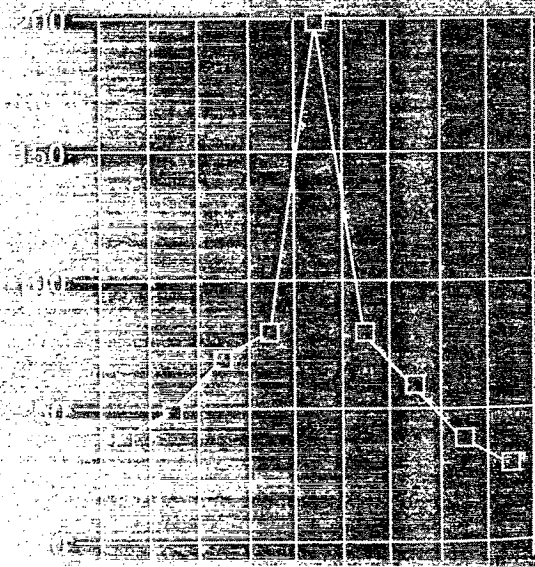
Environmental Assessment

Sampling



Analysis

Data Evaluation



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State of California
The Resources Agency
Department of Water Resources
Division of Local Assistance

Compilation of Sediment & Soil Standards, Criteria & Guidelines

February 1995

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Douglas P. Wheeler
Secretary for Resources
The Resources Agency

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Introduction

Prior to the design of an adequate Quality Control Program Plan for sediment and soil sampling, there must be agreement on the objectives of the sampling program. This document is a compilation of United States and international standards, criteria, and guidelines for assessing acceptable levels of constituents in sediments and soils under specific conditions. These criteria can be used to establish data quality objectives for individual studies, and to compare against data obtained from sediment and soil analyses.

Explanations of the individual criteria and their use are provided at the beginning of each chapter. Each criterion was developed for a different use. Therefore, before using the criteria, it is important to consider the applicability of the particular criterion to the situation. It is recommended that the agencies which developed the criteria be contacted to confirm the appropriate use.

Chapters 1 through 4 provide descriptions of sediment criteria and guidelines developed by various agencies. Tables 1 through 4 list California and other state, federal, and international sediment criteria. Chapter 5 provides descriptions of soil criteria and guidelines listed in Table 5. Chapters 6 through 10 contain information on proposed sediment and soil criteria, and site specific methodologies for evaluating sediment or soil contaminant concentrations. Chapter 11 discusses historical tributyltin sediment concentrations.

This document is one of several Department of Water Resources Quality Assurance/Quality Control Program technical reports. Others include:

- *Quality Assurance Guidelines for Analytical Laboratories—Quality Assurance Technical Document 1* (published in September 1992);

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- *Sampling Manual for Environmental Measurement Projects—Quality Assurance Technical Document 2* (published in April 1994);

- *Compilation of Federal and State Drinking Water Standards and Criteria—Quality Assurance Technical Document 3* (published in July 1993);

- *Compendium of Water Quality Investigations—Quality Assurance Technical Document 4* (published in November 1993);

- *Quality Assurance Program Plan—Quality Assurance Technical Document 5* (due for publication in summer 1995); and

- *Guidelines for Developing Quality Assurance Project Plans—Quality Assurance Technical Document 6* (published in May 1994).

Copies of this report or any of the other technical reports can be obtained from DWR's Bulletins and Reports, Post Office Box 942836, Sacramento, California 94236-0001; phone: (916) 653-1097.

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Chapter 1

California Sediment Criteria

The following is a description of California sediment criteria used in Table 1 starting on page 4.

California Regional Water Quality Control Board San Francisco Bay Region—Disposal Option Sediment Screening Criteria

In December 1993, the California Regional Water Quality Control Board San Francisco Bay Region published *Interim Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse*. The document provides sediment screening criteria and testing requirements for the beneficial reuse of dredged material such as wetlands creation and upland disposal. The document is intended to facilitate creation, enhancement, and restoration of wetlands. The criteria apply to marine and estuarine conditions only and are not applicable for assessment of potential freshwater impacts from sediment reuse or disposal. The screening criteria are not applied without consideration of site-specific factors.

The sediment screening criteria were developed using ER-L and ER-M values from Long et al. (1990) and dredged material values typically found in the Bay Area. The ER-L or tenth percentile value is the chemical concentration below which adverse biological effects may be expected to occur 10 percent of the time. The ER-M is the chemical concentration below which adverse biological effects may be expected 50 percent of the time. ■

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Table 1—California Sediment Criteria

(values in mg/kg, dry weight)

	California Regional Water Quality Control Board San Francisco Bay Region		
	Disposal Option Sediment Screening Criteria		
	Class I	Wetlands Creation Noncover	Wetlands Creation Cover, Levee Restoration, Landfill Daily Cover
CONTAMINANT			
ORGANICS			
Abate	N.A.	N.A.	N.A.
Acenaphthene	N.A.	N.A.	N.A.
Acetaldehyde	N.A.	N.A.	N.A.
Aldrin	N.A.	N.A.	N.A.
Amiben	N.A.	N.A.	N.A.
Anthracene	N.A.	N.A.	N.A.
Atrazine	N.A.	N.A.	N.A.
Benzene	N.A.	N.A.	N.A.
Benzene(a)pyrene	N.A.	N.A.	N.A.
Benzo(a)anthracene	N.A.	N.A.	N.A.
Benzo(a)pyrene	N.A.	N.A.	N.A.
Benzo(g,h,i)perylene	N.A.	N.A.	N.A.
Benzo(k)fluoranthene	N.A.	N.A.	N.A.
BHC	N.A.	N.A.	N.A.
α-BHC	N.A.	N.A.	N.A.
β-BHC	N.A.	N.A.	N.A.
γ-BHC (See Lindane)	N.A.	N.A.	N.A.
Bis(2-ethlyhexyl)phthalate	N.A.	N.A.	N.A.
Bromophos	N.A.	N.A.	N.A.
Butylate	N.A.	N.A.	N.A.
Carbaryl	N.A.	N.A.	N.A.
Chloramp	N.A.	N.A.	N.A.
Chlordane	N.A.	N.A.	N.A.
Chrysene	N.A.	N.A.	N.A.

Table 1—California Sediment Criteria *(continued)*

(values in mg/kg, dry weight)

	California Regional Water Quality Control Board San Francisco Bay Region		
	Disposal Option Sediment Screening Criteria		
	Class I	Wetlands Creation Noncover	Wetlands Creation Cover, Levee Restoration, Landfill Daily Cover
CONTAMINANT			
Cresols	N.A.	N.A.	N.A.
Cumene	N.A.	N.A.	N.A.
Cyanophos (Cyanox)	N.A.	N.A.	N.A.
Cycloate	N.A.	N.A.	N.A.
2,4-D	N.A.	N.A.	N.A.
2,4-D ammonium salt	N.A.	N.A.	N.A.
Dacthal	N.A.	N.A.	N.A.
Dalapon sodium	N.A.	N.A.	N.A.
p,p'-DDD	N.A.	N.A.	N.A.
p,p'-DDE	N.A.	N.A.	N.A.
p,p'-DDT	>2.0	0.1-0.003	<0.003
Desmetryn	N.A.	N.A.	N.A.
Diazinon (Bausdin)	N.A.	N.A.	N.A.
Dibenzo(a,h)anthracene	N.A.	N.A.	N.A.
Dicamba	N.A.	N.A.	N.A.
2,4-Dichlorophenol	N.A.	N.A.	N.A.
2,4-Dichlorophenoxy acetic acid	N.A.	N.A.	N.A.
Dichlorvos	N.A.	N.A.	N.A.
Dicofol (Kelthane)	N.A.	N.A.	N.A.
Dieldrin	N.A.	N.A.	N.A.
Dihydroheptachlor	N.A.	N.A.	N.A.
Dimethoate	N.A.	N.A.	N.A.
Dinobuton	N.A.	N.A.	N.A.
Dioxin	N.A.	N.A.	N.A.
Diuron	N.A.	N.A.	N.A.

Table 1—California Sediment Criteria *(continued)*

(values in mg/kg, dry weight)

	California Regional Water Quality Control Board San Francisco Bay Region		
	Disposal Option Sediment Screening Criteria		
	Class I	Wetlands Creation Noncover	Wetlands Creation Cover, Levee Restoration, Landfill Daily Cover
CONTAMINANT			
Endosulfan	N.A.	N.A.	N.A.
Endrin	N.A.	N.A.	N.A.
EPTC (Eptam)	N.A.	N.A.	N.A.
Etaphos	N.A.	N.A.	N.A.
Ethylenedibromide	N.A.	N.A.	N.A.
Fenuron	N.A.	N.A.	N.A.
Fluoranthene	N.A.	N.A.	N.A.
Fluorene	N.A.	N.A.	N.A.
Folpet	N.A.	N.A.	N.A.
Formaldehyde	N.A.	N.A.	N.A.
Glyphosate	N.A.	N.A.	N.A.
HCB (Hexachlorobenzene)	N.A.	N.A.	N.A.
Heptachlor	N.A.	N.A.	N.A.
Heptachlor epoxide	N.A.	N.A.	N.A.
Herban	N.A.	N.A.	N.A.
Heterophos	N.A.	N.A.	N.A.
Hexachlorobutadiene	N.A.	N.A.	N.A.
Hexachlorocyclohexane	N.A.	N.A.	N.A.
Indeno(1,2,3-cd)pyrene	N.A.	N.A.	N.A.
Kepone	N.A.	N.A.	N.A.
Lead compounds, organic	N.A.	N.A.	N.A.
Lenacil	N.A.	N.A.	N.A.
Lindane	N.A.	N.A.	N.A.
Linuron	N.A.	N.A.	N.A.
Malathion (Carbophos)	N.A.	N.A.	N.A.

Table 1—California Sediment Criteria *(continued)*

(values in mg/kg, dry weight)

	California Regional Water Quality Control Board San Francisco Bay Region		
	Disposal Option Sediment Screening Criteria		
	Class I	Wetlands Creation Noncover	Wetlands Creation Cover, Levee Restoration, Landfill Daily Cover
CONTAMINANT			
Metathione	N.A.	N.A.	N.A.
Methaphos	N.A.	N.A.	N.A.
Methylethylketone	N.A.	N.A.	N.A.
Methoxychlor	N.A.	N.A.	N.A.
Mirex	N.A.	N.A.	N.A.
Monolinuron	N.A.	N.A.	N.A.
Monuron	N.A.	N.A.	N.A.
Naphthalene	N.A.	N.A.	N.A.
Nitrofor	N.A.	N.A.	N.A.
PAH's(total)	N.A.	35-4	<4
PAH's (high molecular wt.)	N.A.	N.A.	N.A.
PAH's (low molecular wt.)	N.A.	N.A.	N.A.
PCB (total)	>100	0.4-0.05	<0.05
Pebulate	N.A.	N.A.	N.A.
Pentachlorophenol	N.A.	N.A.	N.A.
Permethrin	N.A.	N.A.	N.A.
Phenathrene	N.A.	N.A.	N.A.
Phenazon	N.A.	N.A.	N.A.
Phenthoate	N.A.	N.A.	N.A.
Phosalone	N.A.	N.A.	N.A.
Phosphorous Pentoxide	N.A.	N.A.	N.A.
Phthalophos	N.A.	N.A.	N.A.
Picloram	N.A.	N.A.	N.A.
Pirimicarb	N.A.	N.A.	N.A.
Pirimiphos-methyl	N.A.	N.A.	N.A.

Table 1—California Sediment Criteria *(continued)*

(values in mg/kg, dry weight)

	California Regional Water Quality Control Board San Francisco Bay Region		
	Disposal Option Sediment Screening Criteria		
	Class I	Wetlands Creation Noncover	Wetlands Creation Cover, Levee Restoration, Landfill Daily Cover
CONTAMINANT			
Polychloropinewe	N.A.	N.A.	N.A.
Polytriazin	N.A.	N.A.	N.A.
Prometrin	N.A.	N.A.	N.A.
Propanid	N.A.	N.A.	N.A.
Pyrene	N.A.	N.A.	N.A.
Simazine	N.A.	N.A.	N.A.
Solan	N.A.	N.A.	N.A.
2,3,7,8 TCDD	N.A.	N.A.	N.A.
2,3,7,8 TCDF	N.A.	N.A.	N.A.
Tenoran	N.A.	N.A.	N.A.
Terbacil	N.A.	N.A.	N.A.
Tetrachlorvinphos (Gardona)	N.A.	N.A.	N.A.
Trichloroethylene	N.A.	N.A.	N.A.
Toluene	N.A.	N.A.	N.A.
Toxaphene	N.A.	N.A.	N.A.
Trichlorfon (Chlorophos)	N.A.	N.A.	N.A.
Trifluralin (Treflan)	N.A.	N.A.	N.A.
2,4,5-Trichlorophenoxy-propionic acid	N.A.	N.A.	N.A.
Yalan	N.A.	N.A.	N.A.
Zineb	N.A.	N.A.	N.A.
INORGANICS			
Antimony	N.A.	N.A.	N.A.
Arsenic	>1,000	85-33	<33
Asbestos	N.A.	N.A.	N.A.

Table 1—California Sediment Criteria *(continued)*

(values in mg/kg, dry weight)

	California Regional Water Quality Control Board San Francisco Bay Region		
	Disposal Option Sediment Screening Criteria		
	Class I	Wetlands Creation Noncover	Wetlands Creation Cover, Levee Restoration, Landfill Daily Cover
CONTAMINANT			
Barium	N.A.	N.A.	N.A.
Beryllium	N.A.	N.A.	N.A.
Cadmium	>200	9-5	<5
Chromium Total	>1,000	300-220	<220
Chromium III	N.A.	N.A.	N.A.
Chromium VI	N.A.	N.A.	N.A.
Cobalt	N.A.	N.A.	N.A.
Copper	>5,000	390-90	<90
Fluoride salt	N.A.	N.A.	N.A.
Iron	N.A.	N.A.	N.A.
Lead	>2,000	110-50	<50
Manganese	N.A.	N.A.	N.A.
Mercury	>40	1.3-0.35	<0.35
Molybdenum	N.A.	N.A.	N.A.
Nickel	>4,000	200-140	<140
Nitrates	N.A.	N.A.	N.A.
Selenium	>200	1.4-0.7	<0.7
Silver	>1,000	2.2-1.0	<1.0
Thallium	N.A.	N.A.	N.A.
Vanadium	N.A.	N.A.	N.A.
Zinc	>10,000	270-160	<160

Legend:

N.A. — Not Available

Chapter 2

Other State Sediment Criteria

The following is a description of state (excluding California) sediment criteria used in Table 2 starting on page 14.

Florida Department of Environmental Protection—Preliminary Sediment Quality Assessment Guidelines

The preliminary Sediment Quality Assessment Guidelines (SQAGs) are taken from a publication prepared for the Florida Department of Environmental Regulation entitled ***Development of an Approach to the Assessment of Sediment Quality in Florida Coastal Waters***. The SQAGs were developed to evaluate the potential for biological effects associated with sediment-sorbed contaminants and to provide assistance in managing coastal resources. They are intended to assist in sediment quality assessment applications, such as identifying priority nonpoint source management actions, designing wetlands restoration projects, and monitoring trends in environmental contamination. The SQAGs are not intended to be used as sediment quality criteria. They do not supersede formal regulatory assessment protocols such as those implemented under the federal Marine Protection, Research, and Sanctuaries Act.

The effects-based SQAGs were derived using a modified version of the National Oceanic and Atmospheric Association National Status and Trends Program Approach. The SQAGs apply to marine and estuarine conditions only. The numerical SQAGs define three ranges of concentrations for the contaminants: a no effects range, a possible effects range, and a probable effects range. Two values are used to define these

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ranges: a no observed effect level (NOEL) and a probable effects level (PEL). NOEL defines the upper limit of the no effects range and the lower limit of the possible effects range. PEL defines the upper limit of the possible effects range and the lower limit of the probable effects range.

For a copy of the guidelines, contact Thomas L. Seal, Florida Department of Environmental Protection, 3900 Commonwealth Boulevard, Mail Stop #46, Tallahassee, Florida 32399-3000; phone: (904) 488-0784.

Washington Department of Ecology—Sediment Management Standards

The Washington State Sediment Management Standards are found in Chapter 173-204 of the *Washington Administrative Code*. The purpose of the standards is to reduce and ultimately eliminate adverse effects on biological resources and significant health threats to humans from surface sediment contamination. The following standards are for the protection of aquatic biota and apply to Puget Sound marine sediment only:

Marine Sediment Quality Standards—Chemical Criteria: These sediment quality standards correspond to a sediment quality that will result in no adverse effects, including no acute or chronic adverse effects on biological resources. The criteria are used to initially designate a sample as passing or failing the sediment quality standards. Additional tests may be used to confirm the designation of a sediment.

Puget Sound Marine Sediment Impact Zone Maximum Chemical Criteria: These criteria are the maximum chemical concentration levels that may be allowed within an authorized sediment impact zone due to a permitted or otherwise authorized discharge. These chemical concentrations correspond to a minor adverse effects level.

Puget Sound Marine Sediment Cleanup Screening Levels and Minimum Cleanup Levels—Chemical Criteria: These criteria establish minor adverse effects as the level used to identify contiguous sediment sampling stations of low concern and stations of potential concern. They are identical to the above criteria. Contiguous stations whose average contaminant concentrations exceed the screening levels are considered stations of potential concern. Stations whose concentrations are at or below the screening levels are defined as stations of low concern. The criteria also represent the maximum allowed chemical concentration permissible at a cleanup site, to be achieved by year 10 after completion of an active cleanup action.

The Department of Ecology is currently in the process of developing chemical criteria for freshwater sediment and criteria for the protection of human health.

For a copy of the Standards, contact Brenden McFarland, Washington Department of Ecology, Post Office Box 47600, Olympia, Washington 98504-7600; phone: (206) 407-6000. ■

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Table 2—Other State Sediment Criteria

	Florida Dept. of Environmental Protection		Washington Department of Ecology	
	Sediment Quality Guidelines **Marine & Estuarine Sediments** (µg/kg, dry weight)[a]		Sediment Management Standards for **Marine Sediment** (mg/kg_{oc})[b]	
	NOEL	PEL	Quality Standards	Impact Zones Maximum and Cleaning Screening Levels
CONTAMINANT				
ORGANICS				
Abate	N.A.	N.A.	N.A.	N.A.
Acenaphthene	22	450	16	57
Acenaphthylene	N.A.	N.A.	66	66
Acetaldehyde	N.A.	N.A.	N.A.	N.A.
Aldrin	N.A.	N.A.	N.A.	N.A.
Amiben	N.A.	N.A.	N.A.	N.A.
Anthracene	85	740	220	1200
Atrazine	N.A.	N.A.	N.A.	N.A.
Benzene	N.A.	N.A.	N.A.	N.A.
Benzene(a)pyrene	N.A.	N.A.	N.A.	N.A.
Benzo(a)anthracene	160	1,300	110	270
Benzo(a)pyrene	230	1,700	99	210
Benzo(g,h,i)perylene	N.A.	N.A.	31	78
Benzo(k)fluoranthene	N.A.	N.A.	N.A.	N.A.
Benzofluoranthenes(total)[c]	N.A.	N.A.	230	450
Benzoic acid	N.A.	N.A.	650[d]	650[d]
Benzyl alcohol	N.A.	N.A.	57[d]	73[d]
BHC	N.A.	N.A.	N.A.	N.A.
α-BHC	N.A.	N.A.	N.A.	N.A.
β-BHC	N.A.	N.A.	N.A.	N.A.
γ-BHC (See Lindane)	N.A.	N.A.	N.A.	N.A.
Bis(2-ethlyhexyl)phthalate	N.A.	N.A.	47	78
Bromophos	N.A.	N.A.	N.A.	N.A.

Table 2—Other State Sediment Criteria *(continued)*

	Florida Dept. of Environmental Protection		Washington Department of Ecology	
	Sediment Quality Guidelines Marine & Estuarine Sediments (µg/kg, dry weight)[a]		Sediment Management Standards for Marine Sediment (mg/kg_{oc})[b]	
	NOEL	PEL	Quality Standards	Impact Zones Maximum and Cleaning Screening Levels
CONTAMINANT				
Butyl benzyl phthalate	N.A.	N.A.	4.9	64
Butylate	N.A.	N.A.	N.A.	N.A.
Carbaryl	N.A.	N.A.	N.A.	N.A.
Chloramp	N.A.	N.A.	N.A.	N.A.
Chlordane	N.A.	N.A.	N.A.	N.A.
Chrysene	220	1,700	110	460
Cresols	N.A.	N.A.	N.A.	N.A.
Cumene	N.A.	N.A.	N.A.	N.A.
Cyanophos (Cyanox)	N.A.	N.A.	N.A.	N.A.
Cycloate	N.A.	N.A.	N.A.	N.A.
2,4-D	N.A.	N.A.	N.A.	N.A.
2,4-D ammonium salt	N.A.	N.A.	N.A.	N.A.
Dacthal	N.A.	N.A.	N.A.	N.A.
Dalapon sodium	N.A.	N.A.	N.A.	N.A.
p,p'-DDD	N.A.	N.A.	N.A.	N.A.
p,p'-DDE	1.7	130	N.A.	N.A.
p,p'-DDT	4.5	270	N.A.	N.A.
Desmetryn	N.A.	N.A.	N.A.	N.A.
Diazinon (Bausdin)	N.A.	N.A.	N.A.	N.A.
Dibenzo(a,h)anthracene	31	320	12	33
Dibenzofuran	N.A.	N.A.	15	58
Dicamba	N.A.	N.A.	N.A.	N.A.
1,2-Dichlorobenzene	N.A.	N.A.	2.3	2.3
1,4-Dichlorobenzene	N.A.	N.A.	3.1	9
2,4-Dichlorophenol	N.A.	N.A.	N.A.	N.A.

Table 2—Other State Sediment Criteria *(continued)*

	Florida Dept. of Environmental Protection		Washington Department of Ecology	
	Sediment Quality Guidelines **Marine & Estuarine Sediments** (µg/kg, dry weight)[a]		Sediment Management Standards for **Marine Sediment** (mg/kg_{oc})[b]	
	NOEL	PEL	Quality Standards	Impact Zones Maximum and Cleaning Screening Levels
CONTAMINANT				
2,4-Dichlorophenoxy acetic acid	N.A.	N.A.	N.A.	N.A.
Dichlorvos	N.A.	N.A.	N.A.	N.A.
Dicofol (Kelthane)	N.A.	N.A.	N.A.	N.A.
Dieldrin	N.A.	N.A.	N.A.	N.A.
Diethyl phthalate	N.A.	N.A.	61	110
Dihydroheptachlor	N.A.	N.A.	N.A.	N.A.
Dimethoate	N.A.	N.A.	N.A.	N.A.
2,4-Dimethyl phenol	N.A.	N.A.	29[d]	29[d]
Dimethyl phthalate	N.A.	N.A.	53	53
Di-n-butyl phthalate	N.A.	N.A.	220	1700
Dinobuton	N.A.	N.A.	N.A.	N.A.
Di-n-octyl phthalate	N.A.	N.A.	58	4500
Dioxin	N.A.	N.A.	N.A.	N.A.
Diuron	N.A.	N.A.	N.A.	N.A.
Endosulfan	N.A.	N.A.	N.A.	N.A.
Endrin	N.A.	N.A.	N.A.	N.A.
EPTC (Eptam)	N.A.	N.A.	N.A.	N.A.
Etaphos	N.A.	N.A.	N.A.	N.A.
Ethylenedibromide	N.A.	N.A.	N.A.	N.A.
Fenuron	N.A.	N.A.	N.A.	N.A.
Fluoranthene	380	3,200	160	1200
Fluorene	18	460	23	79
Folpet	N.A.	N.A.	N.A.	N.A.
Formaldehyde	N.A.	N.A.	N.A.	N.A.

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Table 2—Other State Sediment Criteria *(continued)*

	Florida Dept. of Environmental Protection		Washington Department of Ecology	
	Sediment Quality Guidelines **Marine & Estuarine Sediments** (µg/kg, dry weight)[a]		Sediment Management Standards for **Marine Sediment** (mg/kg_{oc})[b]	
	NOEL	PEL	Quality Standards	Impact Zones Maximum and Cleaning Screening Levels
CONTAMINANT				
Glyphosate	N.A.	N.A.	N.A.	N.A.
HCB (Hexachlorobenzene)	N.A.	N.A.	0.38	2.3
Heptachlor	N.A.	N.A.	N.A.	N.A.
Heptachlor epoxide	N.A.	N.A.	N.A.	N.A.
Herban	N.A.	N.A.	N.A.	N.A.
Heterophos	N.A.	N.A.	N.A.	N.A.
Hexachlorobutadiene	N.A.	N.A.	3.9	6.2
Hexachlorocyclohexane	N.A.	N.A.	N.A.	N.A.
Indeno(1,2,3-cd)pyrene	N.A.	N.A.	34	88
Kepone	N.A.	N.A.	N.A.	N.A.
Lead compounds, organic	N.A.	N.A.	N.A.	N.A.
Lenacil	N.A.	N.A.	N.A.	N.A.
Lindane	N.A.	N.A.	N.A.	N.A.
Linuron	N.A.	N.A.	N.A.	N.A.
Malathion (Carbophos)	N.A.	N.A.	N.A.	N.A.
Metathione	N.A.	N.A.	N.A.	N.A.
Methaphos	N.A.	N.A.	N.A.	N.A.
Methylethylketone	N.A.	N.A.	N.A.	N.A.
2-Methylnaphthalene	N.A.	N.A.	38	64
2-Methylphenol	N.A.	N.A.	63[d]	63[d]
4-Methylphenol	N.A.	N.A.	670[d]	670[d]
Methoxychlor	N.A.	N.A.	N.A.	N.A.
Mirex	N.A.	N.A.	N.A.	N.A.
Monolinuron	N.A.	N.A.	N.A.	N.A.
Monuron	N.A.	N.A.	N.A.	N.A.

Table 2—Other State Sediment Criteria *(continued)*

	Florida Dept. of Environmental Protection		Washington Department of Ecology	
	Sediment Quality Guidelines **Marine & Estuarine Sediments** (µg/kg, dry weight)[a]		Sediment Management Standards for **Marine Sediment** (mg/kg$_{oc}$)[b]	
	NOEL	PEL	Quality Standards	Impact Zones Maximum and Cleaning Screening Levels
CONTAMINANT				
Naphthalene	130	1,100	99	170
Nitrofor	N.A.	N.A.	N.A.	N.A.
N-nitrosodiphenylamine	N.A.	N.A.	11	11
PAH's(total)	2,900	28,000	N.A.	N.A.
PAH's (high molecular wt.)	N.A.	N.A.	960	5300
PAH's (low molecular wt.)	250	2,400	370	780
PCB (total)	24	260	12	65
Pebulate	N.A.	N.A.	N.A.	N.A.
Pentachlorophenol	N.A.	N.A.	360[d]	690[d]
Permethrin	N.A.	N.A.	N.A.	N.A.
Phenathrene	140	1,200	100	480
Phenazon	N.A.	N.A.	N.A.	N.A.
Phenol	N.A.	N.A.	420[d]	1200[d]
Phenthoate	N.A.	N.A.	N.A.	N.A.
Phosalone	N.A.	N.A.	N.A.	N.A.
Phosphorous Pentoxide	N.A.	N.A.	N.A.	N.A.
Phthalophos	N.A.	N.A.	N.A.	N.A.
Picloram	N.A.	N.A.	N.A.	N.A.
Pirimicarb	N.A.	N.A.	N.A.	N.A.
Pirimiphos-methyl	N.A.	N.A.	N.A.	N.A.
Polychloropinewe	N.A.	N.A.	N.A.	N.A.
Polytriazin	N.A.	N.A.	N.A.	N.A.
Prometrin	N.A.	N.A.	N.A.	N.A.
Propanid	N.A.	N.A.	N.A.	N.A.
Pyrene	290	1,900	1000	1400

Table 2—Other State Sediment Criteria *(continued)*

	Florida Dept. of Environmental Protection		Washington Department of Ecology	
	Sediment Quality Guidelines Marine & Estuarine Sediments (µg/kg, dry weight)[a]		Sediment Management Standards for Marine Sediment (mg/kg_{oc})[b]	
	NOEL	PEL	Quality Standards	Impact Zones Maximum and Cleaning Screening Levels
CONTAMINANT				
Simazine	N.A.	N.A.	N.A.	N.A.
Solan	N.A.	N.A.	N.A.	N.A.
2,3,7,8 TCDD	N.A.	N.A.	N.A.	N.A.
2,3,7,8 TCDF	N.A.	N.A.	N.A.	N.A.
Tenoran	N.A.	N.A.	N.A.	N.A.
Terbacil	N.A.	N.A.	N.A.	N.A.
Tetrachlorvinphos (Gardona)	N.A.	N.A.	N.A.	N.A.
Trichloroethylene	N.A.	N.A.	N.A.	N.A.
Toluene	N.A.	N.A.	N.A.	N.A.
Toxaphene	N.A.	N.A.	N.A.	N.A.
Trichlorfon (Chlorophos)	N.A.	N.A.	N.A.	N.A.
1,2,4-Trichlorobenzene	N.A.	N.A.	0.81	1.8
Trifluralin (Treflan)	N.A.	N.A.	N.A.	N.A.
2,4,5-Trichlorophenoxy-propionic acid	N.A.	N.A.	N.A.	N.A.
Yalan	N.A.	N.A.	N.A.	N.A.
Zineb	N.A.	N.A.	N.A.	N.A.
INORGANICS				
Antimony	N.A.	N.A.	N.A.	N.A.
Arsenic	8	64	57	93
Asbestos	N.A.	N.A.	N.A.	N.A.
Barium	N.A.	N.A.	N.A.	N.A.
Beryllium	N.A.	N.A.	N.A.	N.A.
Cadmium	1	7.5	5.1	6.7
Chromium Total	33	240	260	270

Table 2—Other State Sediment Criteria *(continued)*

	Florida Dept. of Environmental Protection		Washington Department of Ecology	
	Sediment Quality Guidelines Marine & Estuarine Sediments (µg/kg, dry weight)[a]		Sediment Management Standards for Marine Sediment (mg/kg_{oc})[b]	
	NOEL	PEL	Quality Standards	Impact Zones Maximum and Cleaning Screening Levels
CONTAMINANT				
Chromium III	N.A.	N.A.	N.A.	N.A.
Chromium VI	N.A.	N.A.	N.A.	N.A.
Cobalt	N.A.	N.A.	N.A.	N.A.
Copper	28	170	390	390
Fluoride salt	N.A.	N.A.	N.A.	N.A.
Iron	N.A.	N.A.	N.A.	N.A.
Lead	21	160	450	530
Manganese	N.A.	N.A.	N.A.	N.A.
Mercury	0.1	1.4	0.41	0.59
Molybdenum	N.A.	N.A.	N.A.	N.A.
Nickel	N.A.	N.A.	N.A.	N.A.
Nitrates	N.A.	N.A.	N.A.	N.A.
Selenium	N.A.	N.A.	N.A.	N.A.
Silver	0.5	2.5	6.1	6.1
Thallium	N.A.	N.A.	N.A.	N.A.
Vanadium	N.A.	N.A.	N.A.	N.A.
Zinc	68	300	410	960

Legend:

a units for inorganics are mg/kg (ppm), dry weight
b units for inorganics are mg/kg, dry weight
c the total benzofluoranthenes criterion represents the sum of the concentrations of the "B," "J," and "K" isomers
d units are in µg/kg dry weight
e picograms per gram (pg/g)

NOEL = No Observable Effects Level
PEL = Probable Effects Level
N.A. = Not Available

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Chapter 3

Federal Sediment Criteria

The following is a description of the federal sediment guidelines found in Table 3 starting on page 29.

U.S. Environmental Protection Agency, Region V—*Guidelines for Classifying Sediments of Great Lakes Harbors*

The guidelines for the evaluation of Great Lakes harbor sediments were developed as interim guidelines to aid in decisions regarding disposal of dredged material. Sediments are classified as nonpolluted, moderately polluted, or heavily polluted. The overall classification of the sample is based on the most predominant classification of the individual parameters, with the exception of mercury and polychlorinated biphenyls. Because of the known bioaccumulation of mercury and PCBs, if the guideline values for either are exceeded, the sediments are classified as polluted and unacceptable for open lake disposal, regardless of the concentrations of other parameters. The guidelines apply to sediments in the Great Lakes harbors only.

U.S. Environmental Protection Agency—Proposed Sediment Quality Criteria

The Sediment Quality Criteria are taken from the U.S. EPA's *Proposed Sediment Quality Criteria for the Protection of Benthic Organisms*. SQC are proposed to provide protection to benthic organisms from chemicals associated with sediments. They are EPA's best recommendation of the concentrations of a substance in sediment that will not unacceptably affect benthic organisms. The criteria were established for both freshwater and marine sediments and are based on the biologically available concentration of the

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substance in sediments. These criteria do not protect against additive, synergistic, antagonistic, or bioaccumulative effects of contaminants to aquatic life or human health.

SQC were developed for nonionic organic chemicals using an equilibrium partitioning method. The SQC are expressed as micrograms per gram of organic carbon (µg/goc). SQC are intended to apply to sediments permanently inundated with water, intertidal sediments, and sediments inundated periodically for durations sufficient to permit development of benthic assemblages.

Until final SQC are developed, these criteria should only be used to support site specific assessments for sediments that are consistent with assumptions on which these SQC are developed. ■

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Table 3—Federal Sediment Criteria

	U.S. Environmental Protection Agency, Region V			U. S. Environmental Protection Agency	
	Guidelines for Classifying Sediments of Great Lakes Harbors (µg/kg, dry weight)			Sediment Quality Criteria ($\mu g/g_{oc}$)[a]	
	Nonpolluted	Mod. Polluted	Heavily Polluted	Freshwater	Marine
CONTAMINANT					
ORGANICS					
Abate	N.A.	N.A.	N.A.	N.A.	N.A.
Acenaphthene	N.A.	N.A.	N.A.	130	230
Acenaphthylene	N.A.	N.A.	N.A.	N.A.	N.A.
Acetaldehyde	N.A.	N.A.	N.A.	N.A.	N.A.
Aldrin	N.A.	N.A.	N.A.	N.A.	N.A.
Amiben	N.A.	N.A.	N.A.	N.A.	N.A.
Anthracene	N.A.	N.A.	N.A.	N.A.	N.A.
Atrazine	N.A.	N.A.	N.A.	N.A.	N.A.
Benzene	N.A.	N.A.	N.A.	N.A.	N.A.
Benzene(a)pyrene	N.A.	N.A.	N.A.	N.A.	N.A.
Benzo(a)anthracene	N.A.	N.A.	N.A.	N.A.	N.A.
Benzo(a)pyrene	N.A.	N.A.	N.A.	N.A.	N.A.
Benzo(g,h,i)perylene	N.A.	N.A.	N.A.	N.A.	N.A.
Benzo(k)fluoranthene	N.A.	N.A.	N.A.	N.A.	N.A.
Benzofluoranthenes(total)[b]	N.A.	N.A.	N.A.	N.A.	N.A.
Benzoic acid	N.A.	N.A.	N.A.	N.A.	N.A.
Benzyl alcohol	N.A.	N.A.	N.A.	N.A.	N.A.
BHC	N.A.	N.A.	N.A.	N.A.	N.A.
α-BHC	N.A.	N.A.	N.A.	N.A.	N.A.
β-BHC	N.A.	N.A.	N.A.	N.A.	N.A.
γ-BHC (See Lindane)	N.A.	N.A.	N.A.	N.A.	N.A.
Bis(2-ethlyhexyl)phthalate	N.A.	N.A.	N.A.	N.A.	N.A.
Bromophos	N.A.	N.A.	N.A.	N.A.	N.A.
Butyl benzyl phthalate	N.A.	N.A.	N.A.	N.A.	N.A.
Butylate	N.A.	N.A.	N.A.	N.A.	N.A.

Table 3—Federal Sediment Criteria *(continued)*

	U.S. Environmental Protection Agency, Region V			U. S. Environmental Protection Agency	
	Guidelines for Classifying Sediments of Great Lakes Harbors (µg/kg, dry weight)			Sediment Quality Criteria ($\mu g/g_{oc}$)[a]	
	Nonpolluted	Mod. Polluted	Heavily Polluted	Freshwater	Marine
CONTAMINANT					
Carbaryl	N.A.	N.A.	N.A.	N.A.	N.A.
Chloramp	N.A.	N.A.	N.A.	N.A.	N.A.
Chlordane	N.A.	N.A.	N.A.	N.A.	N.A.
Chrysene	N.A.	N.A.	N.A.	N.A.	N.A.
Cresols	N.A.	N.A.	N.A.	N.A.	N.A.
Cumene	N.A.	N.A.	N.A.	N.A.	N.A.
Cyanophos (Cyanox)	N.A.	N.A.	N.A.	N.A.	N.A.
Cycloate	N.A.	N.A.	N.A.	N.A.	N.A.
2,4-D	N.A.	N.A.	N.A.	N.A.	N.A.
2,4-D ammonium salt	N.A.	N.A.	N.A.	N.A.	N.A.
Dacthal	N.A.	N.A.	N.A.	N.A.	N.A.
Dalapon sodium	N.A.	N.A.	N.A.	N.A.	N.A.
p,p′-DDD	N.A.	N.A.	N.A.	N.A.	N.A.
p,p′-DDE	N.A.	N.A.	N.A.	N.A.	N.A.
p,p′-DDT	N.A.	N.A.	N.A.	N.A.	N.A.
DDT (total)	N.A.	N.A.	N.A.	N.A.	N.A.
Desmetryn	N.A.	N.A.	N.A.	N.A.	N.A.
Diazinon (Bausdin)	N.A.	N.A.	N.A.	N.A.	N.A.
Dibenzo(a,h)anthracene	N.A.	N.A.	N.A.	N.A.	N.A.
Dibenzofuran	N.A.	N.A.	N.A.	N.A.	N.A.
Dicamba	N.A.	N.A.	N.A.	N.A.	N.A.
1,2-Dichlorobenzene	N.A.	N.A.	N.A.	N.A.	N.A.
1,4-Dichlorobenzene	N.A.	N.A.	N.A.	N.A.	N.A.
2,4-Dichlorophenol	N.A.	N.A.	N.A.	N.A.	N.A.
2,4-Dichlorophenoxy acetic acid	N.A.	N.A.	N.A.	N.A.	N.A.
Dichlorvos	N.A.	N.A.	N.A.	N.A.	N.A.

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Table 3—Federal Sediment Criteria *(continued)*

	U.S. Environmental Protection Agency, Region V			U. S. Environmental Protection Agency	
	Guidelines for Classifying Sediments of Great Lakes Harbors (µg/kg, dry weight)			Sediment Quality Criteria (µg/g$_{oc}$)[a]	
	Nonpolluted	Mod. Polluted	Heavily Polluted	Freshwater	Marine
CONTAMINANT					
Dicofol (Kelthane)	N.A.	N.A.	N.A.	N.A.	N.A.
Dieldrin	N.A.	N.A.	N.A.	11	20
Diethyl phthalate	N.A.	N.A.	N.A.	N.A.	N.A.
Dihydroheptachlor	N.A.	N.A.	N.A.	N.A.	N.A.
Dimethoate	N.A.	N.A.	N.A.	N.A.	N.A.
2,4-Dimethyl phenol	N.A.	N.A.	N.A.	N.A.	N.A.
Dimethyl phthalate	N.A.	N.A.	N.A.	N.A.	N.A.
Di-n-butyl phthalate	N.A.	N.A.	N.A.	N.A.	N.A.
Dinobuton	N.A.	N.A.	N.A.	N.A.	N.A.
Di-n-octyl phthalate	N.A.	N.A.	N.A.	N.A.	N.A.
Dioxin	N.A.	N.A.	N.A.	N.A.	N.A.
Diuron	N.A.	N.A.	N.A.	N.A.	N.A.
Endosulfan	N.A.	N.A.	N.A.	N.A.	N.A.
Endrin	N.A.	N.A.	N.A.	4.2	0.76
EPTC (Eptam)	N.A.	N.A.	N.A.	N.A.	N.A.
Etaphos	N.A.	N.A.	N.A.	N.A.	N.A.
Ethylenedibromide	N.A.	N.A.	N.A.	N.A.	N.A.
Fenuron	N.A.	N.A.	N.A.	N.A.	N.A.
Fluoranthene	N.A.	N.A.	N.A.	620	300
Fluorene	N.A.	N.A.	N.A.	N.A.	N.A.
Folpet	N.A.	N.A.	N.A.	N.A.	N.A.
Formaldehyde	N.A.	N.A.	N.A.	N.A.	N.A.
Glyphosate	N.A.	N.A.	N.A.	N.A.	N.A.
HCB (Hexachlorobenzene)	N.A.	N.A.	N.A.	N.A.	N.A.
Heptachlor	N.A.	N.A.	N.A.	N.A.	N.A.
Heptachlor epoxide	N.A.	N.A.	N.A.	N.A.	N.A.
Herban	N.A.	N.A.	N.A.	N.A.	N.A.

Table 3—Federal Sediment Criteria *(continued)*

	U.S. Environmental Protection Agency, Region V			U. S. Environmental Protection Agency	
	Guidelines for Classifying Sediments of Great Lakes Harbors (µg/kg, dry weight)			Sediment Quality Criteria (µg/g$_{oc}$)[a]	
	Nonpolluted	Mod. Polluted	Heavily Polluted	Freshwater	Marine
CONTAMINANT					
Heterophos	N.A.	N.A.	N.A.	N.A.	N.A.
Hexachlorobutadiene	N.A.	N.A.	N.A.	N.A.	N.A.
Hexachlorocyclohexane	N.A.	N.A.	N.A.	N.A.	N.A.
Indeno(1,2,3-cd)pyrene	N.A.	N.A.	N.A.	N.A.	N.A.
Kepone	N.A.	N.A.	N.A.	N.A.	N.A.
Lead compounds, organic	N.A.	N.A.	N.A.	N.A.	N.A.
Lenacil	N.A.	N.A.	N.A.	N.A.	N.A.
Lindane	N.A.	N.A.	N.A.	N.A.	N.A.
Linuron	N.A.	N.A.	N.A.	N.A.	N.A.
Malathion (Carbophos)	N.A.	N.A.	N.A.	N.A.	N.A.
Metathione	N.A.	N.A.	N.A.	N.A.	N.A.
Methaphos	N.A.	N.A.	N.A.	N.A.	N.A.
Methylethylketone	N.A.	N.A.	N.A.	N.A.	N.A.
2-Methylnaphthalene	N.A.	N.A.	N.A.	N.A.	N.A.
2-Methylphenol	N.A.	N.A.	N.A.	N.A.	N.A.
4-Methylphenol	N.A.	N.A.	N.A.	N.A.	N.A.
Methoxychlor	N.A.	N.A.	N.A.	N.A.	N.A.
Mirex	N.A.	N.A.	N.A.	N.A.	N.A.
Monolinuron	N.A.	N.A.	N.A.	N.A.	N.A.
Monuron	N.A.	N.A.	N.A.	N.A.	N.A.
Naphthalene	N.A.	N.A.	N.A.	N.A.	N.A.
Nitrofor	N.A.	N.A.	N.A.	N.A.	N.A.
N-nitrosodiphenylamine	N.A.	N.A.	N.A.	N.A.	N.A.
PAH's(total)	N.A.	N.A.	N.A.	N.A.	N.A.
PAH's (high molecular wt.)	N.A.	N.A.	N.A.	N.A.	N.A.
PAH's (low molecular wt.)	N.A.	N.A.	N.A.	N.A.	N.A.
PCB (total)	N.A.	N.A.	N.A.	N.A.	N.A.

Table 3—Federal Sediment Criteria *(continued)*

	U.S. Environmental Protection Agency, Region V			U. S. Environmental Protection Agency	
	Guidelines for Classifying Sediments of Great Lakes Harbors (µg/kg, dry weight)			Sediment Quality Criteria ($\mu g/g_{oc}$)[a]	
	Nonpolluted	Mod. Polluted	Heavily Polluted	Freshwater	Marine
CONTAMINANT					
Pebulate	N.A.	N.A.	N.A.	N.A.	N.A.
Pentachlorophenol	N.A.	N.A.	N.A.	N.A.	N.A.
Permethrin	N.A.	N.A.	N.A.	N.A.	N.A.
Phenathrene	N.A.	N.A.	N.A.	180	240
Phenazon	N.A.	N.A.	N.A.	N.A.	N.A.
Phenol	N.A.	N.A.	N.A.	N.A.	N.A.
Phenthoate	N.A.	N.A.	N.A.	N.A.	N.A.
Phosalone	N.A.	N.A.	N.A.	N.A.	N.A.
Phosphorous Pentoxide	N.A.	N.A.	N.A.	N.A.	N.A.
Phthalophos	N.A.	N.A.	N.A.	N.A.	N.A.
Picloram	N.A.	N.A.	N.A.	N.A.	N.A.
Pirimicarb	N.A.	N.A.	N.A.	N.A.	N.A.
Pirimiphos-methyl	N.A.	N.A.	N.A.	N.A.	N.A.
Polychloropinewe	N.A.	N.A.	N.A.	N.A.	N.A.
Polytriazin	N.A.	N.A.	N.A.	N.A.	N.A.
Prometrin	N.A.	N.A.	N.A.	N.A.	N.A.
Propanid	N.A.	N.A.	N.A.	N.A.	N.A.
Pyrene	N.A.	N.A.	N.A.	N.A.	N.A.
Simazine	N.A.	N.A.	N.A.	N.A.	N.A.
Solan	N.A.	N.A.	N.A.	N.A.	N.A.
2,3,7,8 TCDD	N.A.	N.A.	N.A.	N.A.	N.A.
2,3,7,8 TCDF	N.A.	N.A.	N.A.	N.A.	N.A.
Tenoran	N.A.	N.A.	N.A.	N.A.	N.A.
Terbacil	N.A.	N.A.	N.A.	N.A.	N.A.
Tetrachlorvinphos (Gardona)	N.A.	N.A.	N.A.	N.A.	N.A.
Trichloroethylene	N.A.	N.A.	N.A.	N.A.	N.A.
Toluene	N.A.	N.A.	N.A.	N.A.	N.A.

Table 3—Federal Sediment Criteria *(continued)*

	U.S. Environmental Protection Agency, Region V			U. S. Environmental Protection Agency	
	Guidelines for Classifying Sediments of Great Lakes Harbors (µg/kg, dry weight)			Sediment Quality Criteria ($\mu g/g_{oc}$)[a]	
	Nonpolluted	Mod. Polluted	Heavily Polluted	Freshwater	Marine
CONTAMINANT					
Toxaphene	N.A.	N.A.	N.A.	N.A.	N.A.
Trichlorfon (Chlorophos)	N.A.	N.A.	N.A.	N.A.	N.A.
1,2,4-Trichlorobenzene	N.A.	N.A.	N.A.	N.A.	N.A.
Trifluralin (Treflan)	N.A.	N.A.	N.A.	N.A.	N.A.
2,4,5-Trichlorophenoxy-propionic acid	N.A.	N.A.	N.A.	N.A.	N.A.
Yalan	N.A.	N.A.	N.A.	N.A.	N.A.
Zineb	N.A.	N.A.	N.A.	N.A.	N.A.
INORGANICS	N.A.	N.A.	N.A.	N.A.	N.A.
Ammonia	<75	75-200	>200	N.A.	N.A.
Antimony	N.A.	N.A.	N.A.	N.A.	N.A.
Arsenic	<3	3-8	>8	N.A.	N.A.
Asbestos	N.A.	N.A.	N.A.	N.A.	N.A.
Barium	<20	20-60	>60	N.A.	N.A.
Beryllium	N.A.	N.A.	N.A.	N.A.	N.A.
Cadmium	N.A.	N.A.	>6	N.A.	N.A.
Chromium Total	<25	25-75	>75	N.A.	N.A.
Chromium III	N.A.	N.A.	N.A.	N.A.	N.A.
Chromium VI	N.A.	N.A.	N.A.	N.A.	N.A.
Cobalt	N.A.	N.A.	N.A.	N.A.	N.A.
COD	<40,000	40,000-80,000	>80,000	N.A.	N.A.
Copper	<25	25-50	>50	N.A.	N.A.
Cyanide	<0.10	0.10-0.25	>0.25	N.A.	N.A.
Fluoride salt	N.A.	N.A.	N.A.	N.A.	N.A.
Iron	<17,000	17,000-25,000	>25,000	N.A.	N.A.
Lead	<40	40-60	>60	N.A.	N.A.
Manganese	<300	300-500	>500	N.A.	N.A.

Table 3—Federal Sediment Criteria *(continued)*

	U.S. Environmental Protection Agency, Region V			U. S. Environmental Protection Agency	
	Guidelines for Classifying Sediments of Great Lakes Harbors (µg/kg, dry weight)			Sediment Quality Criteria ($\mu g/g_{oc}$)[a]	
	Nonpolluted	Mod. Polluted	Heavily Polluted	Freshwater	Marine
CONTAMINANT					
Mercury	<1.0	N.A.	>1.0	N.A.	N.A.
Molybdenum	N.A.	N.A.	N.A.	N.A.	N.A.
Nickel	<20	20-50	>50	N.A.	N.A.
Nitrates	N.A.	N.A.	N.A.	N.A.	N.A.
Nitrogen, Total Kjeldahl	<1,000	1,000-2,000	>2,000	N.A.	N.A.
Oil and Grease	<1,000	1,000-2,000	>2,000	N.A.	N.A.
Selenium	N.A.	N.A.	N.A.	N.A.	N.A.
Silver	N.A.	N.A.	N.A.	N.A.	N.A.
Thallium	N.A.	N.A.	N.A.	N.A.	N.A.
Vanadium	N.A.	N.A.	N.A.	N.A.	N.A.
Volatile Solids	<5%	5-8%	>8%	N.A.	N.A.
Zinc	<90	90-200	>200	N.A.	N.A.

Legend:

[a] micrograms per gram organic carbon ($\mu g/g_{oc}$)

[b] the total benzofluoranthenes criterion represents the sum of the concentrations of the "B," "J," and "K" isomers.

N.A. — Not Available

Chapter 4

International Sediment Criteria

The following is a description of the international guidelines found in Table 4 starting on page 39.

Long and Others—Sediment Quality Guidelines

Long, et al. have developed sediment quality guidelines for 9 trace metals, total polychlorinated biphenyls (PCBs), 2 pesticides, 13 polynuclear aromatic hydrocarbons (PAHs), and 3 classes of PAHs. These values are published in *Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments*. These guidelines were developed using an updated and refined version of a sediment chemistry/biological effects database compiled by Long and Morgan (1990).

For development of the new guidelines, the database used by Long and Morgan (1990) was refined by excluding data from freshwater studies and including data from additional sites, biological test end points, and contaminants. Numerous reports were reviewed and screened; a total of 89 reports were included in the database. The studies included were conducted throughout North America, including California, Washington, and British Columbia.

The approach to developing the guidelines involved three steps: (1) assemble, evaluate, and collate all available information in which measures of adverse biological effects and chemical concentrations in sediments were reported; (2) identify the ranges in chemical concentrations that were rarely, occasionally, or frequently associated with effects; and (3) determine the

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incidence of biological effects within each of the ranges in concentrations for each chemical as an estimate of guideline accuracy.

Two values were developed for each chemical or chemical group. The lower tenth percentile of the effects data for each chemical was identified and referred to as the effects range-low (ERL). The median, or fiftieth percentile, of the effects data was identified and referred to as the effects range-median (ERM). The concentrations below the ERL value represent a minimal-effects range, a range intended to estimate conditions in which effects would be rarely observed. Concentrations equal to and above the ERL but below the ERM represent a possible-effects range within which effects would occasionally occur. Finally, the concentrations equivalent to and above the ERM value represent a probable-effects range within which effects would frequently occur.

This method is currently being used as a basis for developing national sediment quality guidelines for Canada and informal sediment quality guidelines for Florida.

For more information, contact Edward Long at the Coastal Monitoring and Bioeffects Assessment Division, National Oceanic and Atmospheric Administration, Bin C15700, 7600 Sand Point Way Northeast, Seattle, Washington 98115; phone: (206)526-6338.

Ontario, Canada's Ministry of the Environment—Ontario Provincial Sediment Quality Guidelines

The Provincial Sediment Quality Guidelines were taken from *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*. The guidelines were developed for protection of aquatic biological resources. The biologically based guidelines have been derived to protect those organisms that are directly impacted by contaminated sediment, namely the benthic species. They are intended to provide guidance during decision-making in relation to sediment issues, ranging from prevention to remedial action. ■

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Table 4—International Sediment Criteria

	Long et al.		Ontario Canada's Ministry of the Environment		
	Sediment Quality Guidelines (ppb, dry weight)[a]		Ontario Provincial Sediment Quality Guidelines (ppm dry weight)		
	ERL	ERM	No Effect Level[b]	Lowest Effect Level[c]	Severe Effect Level[d]
CONTAMINANT					
ORGANICS					
Abate	N.A.	N.A.	N.A.	N.A.	N.A.
Acenaphthene	16	500	N.A.	N.A.	N.A.
Acenaphthylene	44	640	N.A.	N.A.	N.A.
Acetaldehyde	N.A.	N.A.	N.A.	N.A.	N.A.
Aldrin	N.A.	N.A.	N.A.	0.002	8
Amiben	N.A.	N.A.	N.A.	N.A.	N.A.
Anthracene	85.3	1,100	N.A.	0.220	370
Atrazine	N.A.	N.A.	N.A.	N.A.	N.A.
Benzene	N.A.	N.A.	N.A.	N.A.	N.A.
Benzene(a)pyrene	N.A.	N.A.	N.A.	N.A.	N.A.
Benzo(a)anthracene	261	1,600	N.A.	0.320	1,480
Benzo(a)pyrene	430	1,600	N.A.	0.370	1,440
Benzo(g,h,i)perylene	N.A.	N.A.	N.A.	0.170	320
Benzo(k)fluoranthene	N.A.	N.A.	N.A.	0.240	1,340
BHC	N.A.	N.A.	N.A.	0.003	12
α-BHC	N.A.	N.A.	N.A.	0.006	10
β-BHC	N.A.	N.A.	N.A.	0.005	21
γ-BHC (See Lindane)	N.A.	N.A.	N.A.	N.A.	N.A.
Bis(2-ethlyhexyl)phthalate	N.A.	N.A.	N.A.	N.A.	N.A.
Bromophos	N.A.	N.A.	N.A.	N.A.	N.A.
Butylate	N.A.	N.A.	N.A.	N.A.	N.A.
Carbaryl	N.A.	N.A.	N.A.	N.A.	N.A.
Chloramp	N.A.	N.A.	N.A.	N.A.	N.A.
Chlordane	N.A.	N.A.	0.005	0.007	6

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Table 4—International Sediment Criteria *(continued)*

	Long et al.		Ontario Canada's Ministry of the Environment		
	Sediment Quality Guidelines (ppb, dry weight)[a]		Ontario Provincial Sediment Quality Guidelines (ppm dry weight)		
	ERL	ERM	No Effect Level[b]	Lowest Effect Level[c]	Severe Effect Level[d]
CONTAMINANT					
Chrysene	384	2,800	N.A.	0.340	460
Cresols	N.A.	N.A.	N.A.	N.A.	N.A.
Cumene	N.A.	N.A.	N.A.	N.A.	N.A.
Cyanophos (Cyanox)	N.A.	N.A.	N.A.	N.A.	N.A.
Cycloate	N.A.	N.A.	N.A.	N.A.	N.A.
2,4-D	N.A.	N.A.	N.A.	N.A.	N.A.
2,4-D ammonium salt	N.A.	N.A.	N.A.	N.A.	N.A.
Dacthal	N.A.	N.A.	N.A.	N.A.	N.A.
Dalapon sodium	N.A.	N.A.	N.A.	N.A.	N.A.
p,p'-DDD	N.A.	N.A.	N.A.	0.008	6
p,p' -DDE	2.2	27	N.A.	0.005	19
p,p'-DDT	N.A.	N.A.	N.A.	0.007	12
DDT (total)	1.58	46.1	N.A.	N.A.	N.A.
Desmetryn	N.A.	N.A.	N.A.	N.A.	N.A.
Diazinon (Bausdin)	N.A.	N.A.	N.A.	N.A.	N.A.
Dibenzo(a,h)anthracene	63.4	260	N.A.	0.060	130
Dicamba	N.A.	N.A.	N.A.	N.A.	N.A.
Dicofol (Kelthane)	N.A.	N.A.	N.A.	N.A.	N.A.
2,4-Dichlorophenol	N.A.	N.A.	N.A.	N.A.	N.A.
2,4-Dichlorophenoxy acetic acid	N.A.	N.A.	N.A.	N.A.	N.A.
Dichlorvos	N.A.	N.A.	N.A.	N.A.	N.A.
Dieldrin	N.A.	N.A.	0.0006	0.002	91
1,4-Dioxane	N.A.	N.A.	N.A.	N.A.	N.A.
Dihydroheptachlor	N.A.	N.A.	N.A.	N.A.	N.A.

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Table 4—International Sediment Criteria *(continued)*

	Long et al.		Ontario Canada's Ministry of the Environment		
	Sediment Quality Guidelines (ppb, dry weight)[a]		Ontario Provincial Sediment Quality Guidelines (ppm dry weight)		
	ERL	ERM	No Effect Level[b]	Lowest Effect Level[c]	Severe Effect Level[d]
CONTAMINANT					
Dimethoate	N.A.	N.A.	N.A.	N.A.	N.A.
Dinobuton	N.A.	N.A.	N.A.	N.A.	N.A.
Dioxin	N.A.	N.A.	N.A.	N.A.	N.A.
Diuron	N.A.	N.A.	N.A.	N.A.	N.A.
Endosulfan	N.A.	N.A.	N.A.	N.A.	N.A.
Endrin	N.A.	N.A.	0.0005	0.003	130
EPTC (Eptam)	N.A.	N.A.	N.A.	N.A.	N.A.
Etaphos	N.A.	N.A.	N.A.	N.A.	N.A.
Ethylenedibromide	N.A.	N.A.	N.A.	N.A.	N.A.
Fenuron	N.A.	N.A.	N.A.	N.A.	N.A.
Fluoranthene	600	5,100	N.A.	0.750	1,020
Fluorene	19	540	N.A.	0.190	160
Folpet	N.A.	N.A.	N.A.	N.A.	N.A.
Formaldehyde	N.A.	N.A.	N.A.	N.A.	N.A.
Glyphosate	N.A.	N.A.	N.A.	N.A.	N.A.
HCB (Hexachlorobenzene)	N.A.	N.A.	0.01	0.02	24
Heptachlor	N.A.	N.A.	0.0003	N.A.	N.A.
Heptachlor Epoxide	N.A.	N.A.	N.A.	0.005	5
Herban	N.A.	N.A.	N.A.	N.A.	N.A.
Hterophos	N.A.	N.A.	N.A.	N.A.	N.A.
Hexachlorobutadiene	N.A.	N.A.	N.A.	N.A.	N.A.
Hexachlorocyclohexane	N.A.	N.A.	N.A.	N.A.	N.A.
Indeno(1,2,3-cd)pyrene	N.A.	N.A.	N.A.	0.200	320
Kepone	N.A.	N.A.	N.A.	N.A.	N.A.
Lead compounds, organic	N.A.	N.A.	N.A.	N.A.	N.A.

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Table 4—International Sediment Criteria *(continued)*

	Long et al.		Ontario Canada's Ministry of the Environment		
	Sediment Quality Guidelines (ppb, dry weight)[a]		Ontario Provincial Sediment Quality Guidelines (ppm dry weight)		
	ERL	ERM	No Effect Level[b]	Lowest Effect Level[c]	Severe Effect Level[d]
CONTAMINANT					
Lenacil	N.A.	N.A.	N.A.	N.A.	N.A.
Lindane	N.A.	N.A.	0.0002	0.003[e]	1[e]
Linuron	N.A.	N.A.	N.A.	N.A.	N.A.
Malathion (Carbophos)	N.A.	N.A.	N.A.	N.A.	N.A.
Metathione	N.A.	N.A.	N.A.	N.A.	N.A.
Methaphos	N.A.	N.A.	N.A.	N.A.	N.A.
Methylethylketone	N.A.	N.A.	N.A.	N.A.	N.A.
2-Methyl naphthalene	70	670	N.A	N.A	N.A
Methoxychlor	N.A.	N.A.	N.A.	N.A.	N.A.
Mirex	N.A.	N.A.	N.A.	0.007	130
Monolinuron	N.A.	N.A.	N.A.	N.A.	N.A.
Monuron	N.A.	N.A.	N.A.	N.A.	N.A.
Naphthalene	160	2,100	N.A.	N.A.	N.A.
Nitrofor	N.A.	N.A.	N.A.	N.A.	N.A.
PAH's(total)	4,022	44,792	N.A.	4	10,000
PAH's (high molecular wt.)	1,700	9,600	N.A.	N.A.	N.A.
PAH's (low molecular wt.)	552	3,160	N.A.	N.A.	N.A.
PCB (total)	22.7	180	0.01	0.07	530
PCB 1254[e]	N.A.	N.A.	N.A.	0.06	34
PCB 1248[e]	N.A.	N.A.	N.A.	0.03	150
PCB 1016[e]	N.A.	N.A.	N.A.	0.007	53
PCB 1260[e]	N.A.	N.A.	N.A.	0.005	24
Pebulate	N.A.	N.A.	N.A.	N.A.	N.A.
Pentachlorophenol	N.A.	N.A.	N.A.	N.A.	N.A.
Permethrin	N.A.	N.A.	N.A.	N.A.	N.A.

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Table 4—International Sediment Criteria *(continued)*

	Long et al.		Ontario Canada's Ministry of the Environment		
	Sediment Quality Guidelines (ppb, dry weight)[a]		Ontario Provincial Sediment Quality Guidelines (ppm dry weight)		
	ERL	ERM	No Effect Level[b]	Lowest Effect Level[c]	Severe Effect Level[d]
CONTAMINANT					
Phenathrene	240	1,500	N.A.	0.560	950
Phenazon	N.A.	N.A.	N.A.	N.A.	N.A.
Phenthoate	N.A.	N.A.	N.A.	N.A.	N.A.
Phosalone	N.A.	N.A.	N.A.	N.A.	N.A.
Phosphorous Pentoxide	N.A.	N.A.	N.A.	N.A.	N.A.
Phthalophos	N.A.	N.A.	N.A.	N.A.	N.A.
Picloram	N.A.	N.A.	N.A.	N.A.	N.A.
Pirimicarb	N.A.	N.A.	N.A.	N.A.	N.A.
Pirimiphos-methyl	N.A.	N.A.	N.A.	N.A.	N.A.
Polychloropinewe	N.A.	N.A.	N.A.	N.A.	N.A.
Polytriazin	N.A.	N.A.	N.A.	N.A.	N.A.
Prometrin	N.A.	N.A.	N.A.	N.A.	N.A.
Propanid	N.A.	N.A.	N.A.	N.A.	N.A.
Pyrene	665	2,600	N.A.	0.490	850
Simazine	N.A.	N.A.	N.A.	N.A.	N.A.
Solan	N.A.	N.A.	N.A.	N.A.	N.A.
2,3,7,8 TCDD	N.A.	N.A.	N.A.	N.A.	N.A.
2,3,7,8 TCDF	N.A.	N.A.	N.A.	N.A.	N.A.
Tenoran	N.A.	N.A.	N.A.	N.A.	N.A.
Terbacil	N.A.	N.A.	N.A.	N.A.	N.A.
Tetrachlorvinphos (Gardona)	N.A.	N.A.	N.A.	N.A.	N.A.
Trichloroethylene	N.A.	N.A.	N.A.	N.A.	N.A.
Toluene	N.A.	N.A.	N.A.	N.A.	N.A.
Toxaphene	N.A.	N.A.	N.A.	N.A.	N.A.
Trichlorfon (Chlorophos)	N.A.	N.A.	N.A.	N.A.	N.A.

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Table 4—International Sediment Criteria *(continued)*

	Long et al.		Ontario Canada's Ministry of the Environment		
	Sediment Quality Guidelines (ppb, dry weight)[a]		Ontario Provincial Sediment Quality Guidelines (ppm dry weight)		
	ERL	ERM	No Effect Level[b]	Lowest Effect Level[c]	Severe Effect Level[d]
CONTAMINANT					
2,4,5-Trichlorophenoxy-propionic acid	N.A.	N.A.	N.A.	N.A.	N.A.
Trifluralin (Treflan)	N.A.	N.A.	N.A.	N.A.	N.A.
Yalan	N.A.	N.A.	N.A.	N.A.	N.A.
Zineb	N.A.	N.A.	N.A.	N.A.	N.A.
INORGANICS	N.A.	N.A.	N.A.	N.A.	N.A.
Antimony	N.A.	N.A.	N.A.	N.A.	N.A.
Arsenic	8.2	70	N.A.	6	33
Asbestos	N.A.	N.A.	N.A.	N.A.	N.A.
Barium	N.A.	N.A.	N.A.	N.A.	N.A.
Beryllium	N.A.	N.A.	N.A.	N.A.	N.A.
Cadmium	1.2	9.6	N.A.	0.6	10
Chromium	81	370	N.A.	26	110
Cobalt	N.A.	N.A.	N.A.	N.A.	N.A.
Copper	34	270	N.A.	16	110
Fluorene	N.A.	N.A.	N.A.	N.A.	N.A.
Fluoride salt	N.A.	N.A.	N.A.	N.A.	N.A.
Iron	N.A.	N.A.	N.A.	21,200	43,766
Lead	46.7	218	N.A.	31	250
Manganese	N.A.	N.A.	N.A.	460	1,100
Mercury	0.15	0.71	N.A.	0.2	2.0
Molybdenum	N.A.	N.A.	N.A.	N.A.	N.A.
Nickel	20.9	51.6	N.A.	16	75
Nitrates	N.A.	N.A.	N.A.	N.A.	N.A.
Selenium	N.A.	N.A.	N.A.	N.A.	N.A.

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Table 4—International Sediment Criteria *(continued)*

	Long et al.		Ontario Canada's Ministry of the Environment		
	Sediment Quality Guidelines (ppb, dry weight)[a]		Ontario Provincial Sediment Quality Guidelines (ppm dry weight)		
	ERL	ERM	No Effect Level[b]	Lowest Effect Level[c]	Severe Effect Level[d]
CONTAMINANT					
Silver	1.0	3.7	N.A.	N.A.	N.A.
Thallium	N.A.	N.A.	N.A.	N.A.	N.A.
Vanadium	N.A.	N.A.	N.A.	N.A.	N.A.
Zinc	150	410	N.A.	120	820

Legend:

[a] Units for inorganics are mg/kg (ppm) dry weight.

[b] A No Effect Level (NEL µg/g) at which no toxic effects have been observed in aquatic organisms. This is the level at which all biological resources will be protected. This level meets other water quality and use guidelines. Values represent Ontario, Canada's Sediment Quality Guidelines.

[c] A Lowest Effect Level (LEL µg/g) indicating a level of sediment contamination at which the majority of benthic organisms are unaffected. Values represent Ontario, Canada's Provincial Sediment Quality Guidelines.

[d] A Severe Effect Level (SEL $\mu g/g_{oc}$) indicating the level at which pronounced disturbance of the sediment dwelling community can be expected. Values represent Ontario, Canada's Provincial Sediment Quality Guidelines.

[e] Tentative guidelines.

N.A. — Not Available

Chapter 5

Soil Criteria

The following is a description of the soil guidelines found in Table 5 starting on page 43. The previous chapters discussed the sediment criteria.

California Department of Toxic Substances and Control—Characteristics of Hazardous Waste

Total Threshold Limit Concentrations: The Total Threshold Limit Concentrations (TTLCs) are standards listed in the *California Code of Regulations* (CCR), Title 22, Chapter 11 "Identification and Listing of Hazardous Waste." The standards are for use in classifying a waste as hazardous. The TTLCs are enforceable; any waste exceeding a TTLC is classified as a hazardous or extremely hazardous waste in the State of California.

Soluble Threshold Limit Concentrations: As with the TTLCs, the Soluble Threshold Limit Concentrations (STLCs) are listed in the CCR, Title 22, Chapter 11, and are for use in classifying a waste as hazardous. However, STLC is for the concentration of the constituent in the waste extract, as determined using the Waste Extraction Test (WET). WET is described in CCR, Title 22, Chapter 11, Appendix II. This test measures the amount of extractable substance in a waste or other material. Any waste extract with concentrations exceeding the STLC is classified as a hazardous waste in the State of California.

New Jersey Department of Environmental Protection—Guidelines for Drinking Water Protection

The guidelines are from the New Jersey Department of Environmental Protection's *Summary of Approaches to Soil Cleanup Levels*. They are

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nonenforceable guidelines designed to identify potential contamination problems. The guidelines were derived by considering background concentrations and selecting a multiple of the background concentrations, thought to ensure that concentrations in ground water would not violate drinking water standards.

Ontario, Canada's Ministry of the Environment—Criteria for Protection of Human Health

These criteria are taken from an unpublished report *Inventory of Cleanup Criteria and Methods to Select Criteria*. They are intended to protect human health during the dismantling of industrial sites. The criteria were set to ensure that human intake through inhalation of dust and other exposures would not exceed daily intake levels. The criteria were based on an exposure model for human health.

USSR State Committee for Science and Technology—Allowable Soil Concentrations in the Former Soviet Union

The allowable soil concentrations are taken from *Maximum Allowable Concentrations and Tentative Safe Exposure Levels of Harmful Substances in the Environmental Media*. The concentrations in soil were set to protect plants, water, and air from contamination by harmful substances in the soil, as well as to protect the soil's composition and biological properties. ■

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Table 5—Soil Criteria

(values in mg/kg unless otherwise noted)

	California Department of Toxic Substances Control[a]		New Jersey Dept. of Environmental Protection	Ontario, Canada's Ministry of the Environment	USSR State Committee for Science and Technology	
	TTLCs (wet weight)	STLCs (mg/L)	Guidelines for Drinking Water Protection	Criteria for Protection of Human Health	Allowable Soil Concentrations in the Former Soviet Union	
					Maximum Allowable Concentrations	Tentative Allowable Concentrations
CONTAMINANT						
ORGANICS						
Abate	N.A.	N.A.	N.A.	N.A.	N.A.	0.6
Acenaphthene	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Acetaldehyde	N.A.	N.A.	N.A.	N.A.	10	N.A.
Aldrin	1.4	0.14	N.A.	N.A.	N.A.	N.A.
Amiben	N.A.	N.A.	N.A.	N.A.	N.A.	0.05
Anthracene	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Atrazine	N.A.	N.A.	N.A.	N.A.	0.5	N.A.
Benzene	N.A.	N.A.	N.A.	0.040-0.13	0.3	N.A.
Benzene(a)pyrene	N.A.	N.A.	N.A.	0.004-0.005	N.A.	N.A.
Benzo(a)anthracene	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Benzo(a)pyrene	N.A.	N.A.	N.A.	N.A.	0.02	N.A.
Benzo(g,h,i)perylene	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

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Table 5—Soil Criteria *(continued)*

(values in mg/kg unless otherwise noted)

	California Department of Toxic Substances Control[a]		New Jersey Dept. of Environmental Protection	Ontario, Canada's Ministry of the Environment	USSR State Committee for Science and Technology	
	TTLCs (wet weight)	STLCs (mg/L)	Guidelines for Drinking Water Protection	Criteria for Protection of Human Health	Allowable Soil Concentrations in the Former Soviet Union	
					Maximum Allowable Concentrations	Tentative Allowable Concentrations
CONTAMINANT						
Benzo(k)fluoranthene	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
BHC	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
α-BHC	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
β-BHC	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
γ-BHC (See Lindane)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Bis(2-ethlyhexyl)phthalate	N.A.	N.A.	N.A.	70-5,000	N.A.	N.A.
Bromophos	N.A.	N.A.	N.A.	N.A.	N.A.	0.4
Butylate	N.A.	N.A.	N.A.	N.A.	N.A.	0.6
Carbaryl	N.A.	N.A.	N.A.	N.A.	0.05	N.A.
Chloramp	N.A.	N.A.	N.A.	N.A.	0.05	N.A.
Chlordane	2.5	0.25	N.A.	N.A.	N.A.	N.A.
Chrysene	N.A.	N.A.	N.A.	470	N.A.	N.A.
Cresols	N.A.	N.A.	N.A.	700	N.A.	N.A.
Cumene	N.A.	N.A.	N.A.	N.A.	0.5	N.A.

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Table 5—Soil Criteria *(continued)*

(values in mg/kg unless otherwise noted)

	California Department of Toxic Substances Control[a]		New Jersey Dept. of Environmental Protection	Ontario, Canada's Ministry of the Environment	USSR State Committee for Science and Technology	
	TTLCs (wet weight)	STLCs (mg/L)	Guidelines for Drinking Water Protection	Criteria for Protection of Human Health	Allowable Soil Concentrations in the Former Soviet Union	
					Maximum Allowable Concentrations	Tentative Allowable Concentrations
CONTAMINANT						
Cyanophos (Cyanox)	N.A.	N.A.	N.A.	N.A.	N.A.	0.4
Cycloate	N.A.	N.A.	N.A.	N.A.	0.8	N.A.
2,4-D	N.A.	N.A.	N.A.	N.A.	0.1	N.A.
2,4-D ammonium salt	N.A.	N.A.	N.A.	N.A.	0.25	N.A.
Dacthal	N.A.	N.A.	N.A.	N.A.	N.A.	0.1
Dalapon sodium	N.A.	N.A.	N.A.	N.A.	0.5	N.A.
p,p′-DDD	1.0	0.1	N.A.	N.A.	N.A.	N.A.
p,p′-DDE	1.0	0.1	N.A.	N.A.	N.A.	N.A.
p,p′-DDE	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
p,p′-DDT	1.0	0.1	N.A.	N.A.	0.1	N.A.
Desmetryn	N.A.	N.A.	N.A.	N.A.	N.A.	0.6
Diazinon (Bausdin)	N.A.	N.A.	N.A.	N.A.	0.2	N.A.
Dibenzo(a,h)anthracene	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Dicamba	N.A.	N.A.	N.A.	N.A.	0.25	N.A.

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Table 5—Soil Criteria *(continued)*

(values in mg/kg unless otherwise noted)

	California Department of Toxic Substances Control[a]		New Jersey Dept. of Environmental Protection	Ontario, Canada's Ministry of the Environment	USSR State Committee for Science and Technology	
	TTLCs (wet weight)	STLCs (mg/L)	Guidelines for Drinking Water Protection	Criteria for Protection of Human Health	Allowable Soil Concentrations in the Former Soviet Union	
					Maximum Allowable Concentrations	Tentative Allowable Concentrations
CONTAMINANT						
Dicofol (Kelthane)	N.A.	N.A.	N.A.	N.A.	1.0	N.A.
2,4-Dichlorophenol	N.A.	N.A.	N.A.	N.A.	0.05	N.A.
2,4-Dichlorophenoxy acetic acid	100	10	N.A.	N.A.	N.A.	N.A.
Dichlorvos	N.A.	N.A.	N.A.	N.A.	N.A.	0.1
Dieldrin	8.0	0.8	N.A.	N.A.	N.A.	N.A.
1,4-Dioxane	N.A.	N.A.	N.A.	5.80-12.2	N.A.	N.A.
Dihydroheptachlor	N.A.	N.A.	N.A.	N.A.	0.5	N.A.
Dimethoate	N.A.	N.A.	N.A.	N.A.	0.3	N.A.
Dinobuton	N.A.	N.A.	N.A.	N.A.	1.0	N.A.
Dioxin	0.01	0.001	N.A.	N.A.	N.A.	N.A.
Diuron	N.A.	N.A.	N.A.	N.A.	N.A.	0.6
Endosulfan	N.A.	N.A.	N.A.	N.A.	N.A.	0.1
Endrin	0.2	0.02	N.A.	N.A.	N.A.	N.A.
EPTC (Eptam)	N.A.	N.A.	N.A.	N.A.	0.9	N.A.

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Table 5—Soil Criteria *(continued)*

(values in mg/kg unless otherwise noted)

	California Department of Toxic Substances Control[a]		New Jersey Dept. of Environmental Protection	Ontario, Canada's Ministry of the Environment	USSR State Committee for Science and Technology	
	TTLCs (wet weight)	STLCs (mg/L)	Guidelines for Drinking Water Protection	Criteria for Protection of Human Health	Allowable Soil Concentrations in the Former Soviet Union	
					Maximum Allowable Concentrations	Tentative Allowable Concentrations
CONTAMINANT						
Etaphos	N.A.	N.A.	N.A.	N.A.	N.A.	0.1
Ethylenedibromide	N.A.	N.A.	N.A.	0.00006	N.A.	N.A.
Fenuron	N.A.	N.A.	N.A.	N.A.	1.8	N.A.
Fluoranthene	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Fluorene	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Folpet	N.A.	N.A.	N.A.	N.A.	N.A.	0.3
Formaldehyde	N.A.	N.A.	N.A.	N.A.	7.0	N.A.
Glyphosate	N.A.	N.A.	N.A.	N.A.	0.5	N.A.
HCB (Hexachlorobenzene)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Heptachlor	4.7	0.47	N.A.	N.A.	0.05	N.A.
Heptachlor Epoxide	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Herban	N.A.	N.A.	N.A.	N.A.	N.A.	0.7
Heterophos	N.A.	N.A.	N.A.	N.A.	0.05	N.A.
Hexachlorobutadiene	N.A.	N.A.	N.A.	N.A.	0.5	N.A.

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Table 5—Soil Criteria *(continued)*

(values in mg/kg unless otherwise noted)

	California Department of Toxic Substances Control[a]		New Jersey Dept. of Environmental Protection	Ontario, Canada's Ministry of the Environment	USSR State Committee for Science and Technology	
	TTLCs (wet weight)	STLCs (mg/L)	Guidelines for Drinking Water Protection	Criteria for Protection of Human Health	Allowable Soil Concentrations in the Former Soviet Union	
					Maximum Allowable Concentrations	Tentative Allowable Concentrations
CONTAMINANT						
Hexachlorocyclohexane	N.A.	N.A.	N.A.	N.A.	0.1	N.A.
Indeno(1,2,3-cd)pyrene	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Kepone	21	2.1	N.A.	N.A.	N.A.	N.A.
Lead compounds, organic	13	N.A.	N.A.	N.A.	N.A.	N.A.
Lenacil	N.A.	N.A.	N.A.	N.A.	N.A.	0.1
Lindane	4.0	0.4	N.A.	N.A.	0.1	N.A.
Linuron	N.A.	N.A.	N.A.	N.A.	1.0	N.A.
Malathion (Carbophos)	N.A.	N.A.	N.A.	N.A.	2	N.A.
Metathione	N.A.	N.A.	N.A.	N.A.	1.0	N.A.
Methaphos	N.A.	N.A.	N.A.	N.A.	0.1	N.A.
Methylethylketone	N.A.	N.A.	N.A.	52	N.A.	N.A.
Methoxychlor	100	10	N.A.	N.A.	N.A.	N.A.
Mirex	21	2.1	N.A.	N.A.	N.A.	N.A.
Monolinuron	N.A.	N.A.	N.A.	N.A.	N.A.	0.7

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Table 5—Soil Criteria *(continued)*

(values in mg/kg unless otherwise noted)

	California Department of Toxic Substances Control[a]		New Jersey Dept. of Environmental Protection	Ontario, Canada's Ministry of the Environment	USSR State Committee for Science and Technology	
	TTLCs (wet weight)	STLCs (mg/L)	Guidelines for Drinking Water Protection	Criteria for Protection of Human Health	Allowable Soil Concentrations in the Former Soviet Union	
					Maximum Allowable Concentrations	Tentative Allowable Concentrations
CONTAMINANT						
Monuron	N.A.	N.A.	N.A.	N.A.	N.A.	0.6
Naphthalene	N.A.	N.A.	N.A.	5,400	N.A.	N.A.
Nitrofor	N.A.	N.A.	N.A.	N.A.	N.A.	0.2
PAH's(total)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PAH's (high molecular wt.)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PAH's (low molecular wt.)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PCB (total)	50	5.0	N.A.	N.A.	N.A.	N.A.
Pebulate	N.A.	N.A.	N.A.	N.A.	N.A.	0.6
Pentachlorophenol	17	1.7	N.A.	N.A.	N.A.	N.A.
Permethrin	N.A.	N.A.	N.A.	N.A.	N.A.	0.05
Phenathrene	N.A.	N.A.	N.A.	1,870	N.A.	N.A.
Phenazon	N.A.	N.A.	N.A.	N.A.	N.A.	0.7
Phenthoate	N.A.	N.A.	N.A.	N.A.	N.A.	0.4
Phosalone	N.A.	N.A.	N.A.	N.A.	0.5	N.A.

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Table 5—Soil Criteria *(continued)*

(values in mg/kg unless otherwise noted)

	California Department of Toxic Substances Control[a]		New Jersey Dept. of Environmental Protection	Ontario, Canada's Ministry of the Environment	USSR State Committee for Science and Technology	
	TTLCs (wet weight)	STLCs (mg/L)	Guidelines for Drinking Water Protection	Criteria for Protection of Human Health	Allowable Soil Concentrations in the Former Soviet Union	
					Maximum Allowable Concentrations	Tentative Allowable Concentrations
CONTAMINANT						
Phosphorous Pentoxide	N.A.	N.A.	N.A.	N.A.	200	N.A.
Phthalophos	N.A.	N.A.	N.A.	N.A.	0.1	N.A.
Picloram	N.A.	N.A.	N.A.	N.A.	0.05	N.A.
Pirimicarb	N.A.	N.A.	N.A.	N.A.	0.3	N.A.
Pirimiphos-methyl	N.A.	N.A.	N.A.	N.A.	0.5	N.A.
Polychloropinewe	N.A.	N.A.	N.A.	N.A.	0.5	N.A.
Polytriazin	N.A.	N.A.	N.A.	N.A.	0.01	N.A.
Prometrin	N.A.	N.A.	N.A.	N.A.	0.5	N.A.
Propanid	N.A.	N.A.	N.A.	N.A.	1.5	N.A.
Pyrene	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Simazine	N.A.	N.A.	N.A.	N.A.	0.2	N.A.
Solan	N.A.	N.A.	N.A.	N.A.	N.A.	0.6
2,3,7,8 TCDD	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
2,3,7,8 TCDF	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

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Table 5—Soil Criteria *(continued)*

(values in mg/kg unless otherwise noted)

	California Department of Toxic Substances Control[a]		New Jersey Dept. of Environmental Protection	Ontario, Canada's Ministry of the Environment	USSR State Committee for Science and Technology	
	TTLCs (wet weight)	STLCs (mg/L)	Guidelines for Drinking Water Protection	Criteria for Protection of Human Health	Allowable Soil Concentrations in the Former Soviet Union	
					Maximum Allowable Concentrations	Tentative Allowable Concentrations
CONTAMINANT						
Tenoran	N.A.	N.A.	N.A.	N.A.	N.A.	0.4
Terbacil	N.A.	N.A.	N.A.	N.A.	N.A.	0.4
Tetrachlorvinphos (Gardona)	N.A.	N.A.	N.A.	N.A.	1.4	N.A.
Toluene	N.A.	N.A.	N.A.	N.A.	0.3	N.A.
Toxaphene	5	0.5	N.A.	N.A.	0.5	N.A.
Trichlorfon (Chlorophos)	N.A.	N.A.	N.A.	N.A.	0.5	N.A.
Trichloroethylene	2,040	204	N.A.	N.A.	N.A.	N.A.
2,4,5-Trichlorophenoxy-propionic acid	10	1.0	N.A.	N.A.	N.A.	N.A.
Trifluralin (Treflan)	N.A.	N.A.	N.A.	N.A.	N.A.	0.1
Yalan	N.A.	N.A.	N.A.	N.A.	N.A.	0.9
Zineb	N.A.	N.A.	N.A.	N.A.	1.8	N.A.
INORGANICS						
Antimony	500	15	N.A.	N.A.	4.5	N.A.
Arsenic	500	5.0	20	N.A.	2.0	N.A.

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Table 5—Soil Criteria *(continued)*

(values in mg/kg unless otherwise noted)

	California Department of Toxic Substances Control[a]		New Jersey Dept. of Environmental Protection	Ontario, Canada's Ministry of the Environment	USSR State Committee for Science and Technology	
	TTLCs (wet weight)	STLCs (mg/L)	Guidelines for Drinking Water Protection	Criteria for Protection of Human Health	Allowable Soil Concentrations in the Former Soviet Union	
					Maximum Allowable Concentrations	Tentative Allowable Concentrations
CONTAMINANT						
Asbestos	1.0(as %)	N.A.	N.A.	N.A.	N.A.	N.A.
Barium	10,000[b]	100	400	N.A.	N.A.	N.A.
Beryllium	75	0.75	1	N.A.	N.A.	N.A.
Cadmium	100	1.0	3	N.A.	N.A.	N.A.
Chromium Total	N.A.	N.A.	100	N.A.	N.A.	N.A.
Chromium III	2,500	5	N.A.	N.A.	0.05	N.A.
Chromium VI	500	5	N.A.	N.A.	N.A.	N.A.
Cobalt	8,000	80	N.A.	N.A.	N.A.	N.A.
Copper	2,500	25	170	N.A.	3.0	N.A.
Fluoride salt	18,000	180	N.A.	N.A.	N.A.	N.A.
Iron	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Lead	1,000	5.0	250-1,000	N.A.	20.0	N.A.
Manganese	N.A.	N.A.	N.A.	N.A.	1,500	N.A.
Mercury	20	0.2	1	N.A.	2.1	N.A.

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Table 5—Soil Criteria *(continued)*

(values in mg/kg unless otherwise noted)

	California Department of Toxic Substances Control[a]		New Jersey Dept. of Environmental Protection	Ontario, Canada's Ministry of the Environment	USSR State Committee for Science and Technology	
	TTLCs (wet weight)	STLCs (mg/L)	Guidelines for Drinking Water Protection	Criteria for Protection of Human Health	Allowable Soil Concentrations in the Former Soviet Union	
					Maximum Allowable Concentrations	Tentative Allowable Concentrations
CONTAMINANT						
Molybdenum	3,500	350	N.A.	N.A.	N.A.	N.A.
Nickel	2,000	20	100	N.A.	4.0	N.A.
Nitrates	N.A.	N.A.	N.A.	N.A.	130	N.A.
Selenium	100	1.0	4	N.A.	N.A.	N.A.
Silver	500	5	5	N.A.	N.A.	N.A.
Thallium	700	7.0	N.A.	N.A.	N.A.	N.A.
Vanadium	2,400	24	N.A.	N.A.	150	N.A.
Zinc	5,000	250	350	N.A.	N.A.	N.A.

Legend:

a TTLC and STLC values are calculated on the concentrations of the elements—not the compounds.
b Excluding barium sulfates.
N.A. — Not Available

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Chapter 6

California State Water Resources Control Board Leaking Underground Fuel Tank Field Manual

The ***Leaking Underground Fuel Tank Field Manual*** was prepared by the State Water Resources Control Board in conjunction with the California Department of Health Services in an effort to establish procedures for determining whether an underground storage fuel tank site is clean and safe, so as to protect public health and the environment. It deals with gasoline and diesel fuel products only, including: benzene, toluene, xylene, ethylene (BTX&E), and total petroleum hydrocarbons (TPH). The manual provides a guideline for determining site specific soil cleanup levels for the protection of ground water.

The soil cleanup levels were developed using environmental fate and chemistry data for BTX&E. The site-specific cleanup levels are based on several site features: depth to ground water, subsurface fractures, precipitation, man-made conduits, and unique site-specific features such as recharge area, coarse soil, nearby wells, etc. The guidelines are valid for soil concentrations below 100, 80, and 40 ppb for benzene, toluene, and xylene and ethylene, respectively. If soil concentrations exceed these values, an alternative risk appraisal should be considered.

In addition to soil cleanup guidelines, the LUFT field manual also provides criteria for hazardous waste classification of contaminated soil. In the

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past, DHS has set a TPH concentration of 1,000 mg/kg in soil as a hazardous waste classification criterion. At this time, DHS is researching the issue with the objective of reassessing this threshold value. Until this issue is resolved, the LUFT Task Force recommends that a value of 1,000 mg/kg TPH be used to classify soil as a hazardous waste until new criteria are set. ■

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Chapter 7

California State Water Resources Control Board Sediment Quality Objectives for Enclosed Bays and Estuaries of California

The California State Water Resources Control Board is currently developing sediment quality objectives for enclosed bays and estuaries in the State of California. Information regarding the objectives is in ***Workplan for the Development of Sediment Quality Objectives for Enclosed Bays and Estuaries of California.*** The purpose of the sediment quality objectives will be to protect the beneficial uses of bays and estuaries from the adverse affects of toxic substances.

The approach is to bring several estimators of sediment quality together into a single sediment quality objective. The estimators of sediment quality which will be used include the "Equilibrium Partitioning Approach" from the U.S. Environmental Protection Agency, the "Apparent Effects Threshold Approach" developed for use in Puget Sound, and the "Spiked Bioassay Approach" used for general characterization of toxicity responses. An uncertainty factor will be incorporated to account for any disagreement of the data. The combination of these three methods balances the uncertainties and limitations of any one method by incorporating the strengths of the other two methods to produce a single value.

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For more information, contact Craig Wilson at the State Water Resources Control Board, Post Office Box 100, Sacramento, California 95812-0100; phone: (916) 657-1108. ■

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Chapter 8

California Regional Water Quality Control Board San Francisco Bay Region Testing Requirements for Wetland Creation and Upland Beneficial Reuse

The California Regional Water Quality Control Board San Francisco Bay Region's document ***Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse*** provides testing requirements for different dredge material disposal options. Each disposal option has specific dredged material testing requirements. Some testing requirements are common to all disposal options. All dredging projects are required to complete the testing requirements contained in Public Notice 92-7, "Interim Testing Procedures for Evaluating Dredged Material Disposal in San Francisco Bay" (USACOE/USEPA/SFBRWQCB/BCDC, 1992), except for the biological testing. Additional testing requirements for each disposal option are discussed below.

Wetlands Creation Cover

In addition to the standard requirements, the following tests shall be part of the dredging projects for Wetlands Creation Cover material:

- 10-day solid phase bioassay test (ASTM Method E1367-90)

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- Modified Waste Extraction Test (WET) procedure Title 22, Division 4.5, Chapter 11, Appendix II

Wetlands Creation Noncover

A leach test on the dredged material shall also be part of the dredging projects proposed for Wetlands Creation Noncover material. The leach test employed should include procedures for leachate extraction under reduced as well as oxidized conditions.

Class III Landfill

Dredged material for disposal at a Class III landfill has to meet the testing requirements and sediment screening criteria of the individual landfill. One acceptable testing procedure is the Regional Water Control Board's Designated Level Methodology. This methodology takes into consideration the WET extractable concentration from the material and an attenuation factor. The procedure is site and material specific (see Chapter 9).

Class II Landfill

Dredged material proposed for disposal at a Class II landfill has to meet the testing requirements of the individual landfill. In general, if a material fails to be accepted at a Class III landfill and is below the concentrations of a hazardous waste, it is acceptable for disposal at a Class II landfill.

Class I Landfill

Dredged material proposed for disposal at a Class I landfill has to meet the testing requirements of the individual landfill. In general, if a material contains concentrations greater than those listed in Title 22, Section 66699(a), then the material is hazardous and must be disposed of at a Class I facility.

Definition of Dredged Material as Inert Waste

Dredged material will be considered inert waste if the following criteria are met:

1. It has contaminant concentrations less than those listed for Wetlands Creation Cover material and it passes the 10-day solid-phase bioassay test;

   or

2. It is within the concentrations for the Wetlands Creation Noncover material, and it passes the leach test.

Definitions relating to Class I, II, and III landfills, and inert waste are found in the California Code of Regulations, Title 23, Division 3, Chapter 15.

For more information contact Karen Taberski, Regional Water Quality Control Board, San Francisco Bay Region, 2101 Webster Street, Suite 500, Oakland, California 94612; phone (510) 286-1346.

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Chapter 9

California Regional Water Quality Control Board Central Valley Region Designated Level Methodology

The Regional Water Quality Control Board Central Valley Region's ***Designated Level Methodology for Waste Classification and Cleanup Level Determination*** establishes a method for classifying wastes and determining the degree to which a contaminated site should be cleaned or to which remedial action is necessary. The methodology defines the lower boundary of the "designated waste" classification (Title 23, ***California Code of Regulations,*** Division 3, Chapter 15 "Discharges of Waste to Land") by establishing "Designated Levels." These levels are concentrations of waste constituents above which a waste is presumed to pose a threat to water quality at the site being considered. Wastes classified as "designated waste" are required to have Class II containment. The Designated Levels can also be used to determine the necessity of cleanup or mitigative measures for water quality protection at sites with soil contamination.

Designated Levels are "measures of the minimum concentrations of waste constituents which, upon accounting for environmental attenuation at the proposed site of discharge, have the potential to cause the water quality goals for the constituents to be equalled or exceeded in ground and/or surface waters" (Marshack, 1989). The designated levels are based on water quality goals and environmental

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attenuation factors. Water quality goals are numerical parameters indicating the mandated water quality for the proposed site. In many cases, the background water quality is appropriate for water quality goals. In other cases, several water quality criteria and standards exist that are designed to protect a number of beneficial uses.

Environmental attenuation factors approximate the degree of expected attenuation under reasonable worst-case conditions at the site. Several characteristics influence the environmental fate of a constituent: Depth to ground water, net recharge, characteristics of the vadose zone, pollutant characteristics, topography, etc. Attenuation factors are derived using site and constituent specific information. However, in cases where resources may not permit a detailed environmental fate analysis, a "generic" environmental attenuation factor should be used. The "generic" environmental attenuation factor is based on the degree of natural water quality protection, as seen in the following:

Degree of Water Quality Protection	Attenuation Factor
Very Low	1
Less than Average	1-10
Average	100
Very High*	1000

* also for constituents that are known to have a much greater than average degree of environmental attenuation.

Two types of Designated Levels exist, the Soluble Designated Level and the Total Designated Level. The Soluble Designated Level is compared with extractable concentrations of contaminants in the solid waste. The extractable concentrations are determined using the WET procedure from Title 22, Division 4.5, Chapter 11, Appendix II of the CCR. The Total Designated Level is calculated for comparison with total constituent concentrations at the site. The methods for determining Soluble Designated Levels and Total Designated Levels are given below:

Soluble Designated Levels

Soluble Designated Level for a Constituent of a Solid Waste (mg/L of WET extract)	=	Water Quality Goal (mg/L)	x	Environmental Attenuation/10 Factor

NOTE: The factor of 10 represents the dilutions caused by the WET procedure.

Total Designated Level

In addition to the water quality goal and environmental attenuation factor, the Total Designated Level takes another factor into consideration, the leachability factor. The leachability factor is equal to the total constituent concentration divided by the leachable constituent concentration.

$$\text{Leachability Factor} = \frac{\text{Total Constituent Concentration}}{\text{Leachable Constituent Concentration}}$$

NOTE: The Leachable Constituent Concentration must be converted into mg/kg by multiplying by the dilution of the WET procedure.

In cases when information on the leachable fraction is unavailable, the leachability factor must be approximated. The recommended "generic" leachability factors are:

- Volatile Organics—1 fold Leachability Factor

- Organics—10 fold Leachability Factor
- Inorganics—100 fold Leachability Factor

The Total Designated Level for a constituent is:

Total Designated Level (mg/kg)	=	Soluble Designated Level (mg/L of WET extract)	x	Leachability Factor	x	10

or

Total Designated Level (mg/kg)	=	Water Quality Goal	x	Environmental Attenuation Factor	x	Leachability Factor

The Regional Water Quality Control Board provides the following guidelines for comparing Soluble Designated Level and Total Designated Level Results:

- If the total concentration of a constituent of a solid waste equals or exceeds the Total Designated Level but the extractable concentration of the constituent does not exceed the Soluble Designated Level, the waste should not be classified as a "designated waste," since it is the extractable or soluble constituent concentration that has the potential to adversely impact water quality.

- If the total concentration of a constituent in a solid waste is less than ten times the Soluble Designated Level for the constituent, it would be unlikely for the extractable constituent concentration from the WET to equal or exceed the Soluble Designated Level, assuming sample homogeneity. Therefore, extraction testing would be unnecessary and the waste would not be considered a "designated waste."

The threat to water quality posed by constituents of a contaminated soil is similar to the threat posed by constituents of a solid waste in an unlined landfill or waste pile. Therefore, by deriving site-specific Designated Levels for constituents of contaminated soils, the necessity for cleanup or mitigative measures for water quality protection can be assessed.

For more information on the Designated Level Methodology, contact Jon Marshack at the Central Valley Regional Water Quality Control Board, 3443 Routier Road, Suite A, Rancho Cordova, California 95827-3098; phone: (916) 255-3123. ■

Chapter 10

U.S. Environmental Protection Agency Acid Volatile Sulfide Methodology

The U.S. Environmental Protection Agency is currently developing a methodology for determining sediment criteria for divalent cationic metal contaminants in anoxic sediments. The method focuses on the role solid phase sulfides play in controlling the bioavailability of toxic metals.

EPA's Acid Volatile Sulfide (AVS) method measures the amount of reactive solid phase sulfides. These sulfides are available to bind with metals such as nickel, zinc, cadmium, lead, copper, and mercury. Cold hydrochloric acid is added to the sample causing the reactive solid phase sulfides to volatilize and form hydrogen sulfide gas (H_2S). The H_2S is trapped and the amount of sulfide is measured. The sulfides that volatilize are called Acid Volatile Sulfides (AVS).

The addition of acid to the sample also results in the solubilization of metals from less soluble sulfides. These metals are defined as Simultaneously Extracted Metals (SEM).

The relative amounts of AVS and SEM are important in the prediction of potential metal bioavailability. If SEMs are found in excess of the AVSs, the toxic metals in the sample are potentially bioavailable. On the other hand, if AVSs are greater than SEMs, the toxic metal is bound to sulfide and is not bioavailable. Most freshwater and marine sediments contain high enough AVS concentrations to have a significant

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effect on the bioavailability of toxic metals.

It is anticipated that the methodology will be used to define contaminated sediment according to the following ratios:

SEM/AVS < 1	Sediment Not Contaminated
SEM/AVS > 1	Sediment Potentially Contaminated (other binding factors may apply if toxicity is not observed)

If sediment is determined to be contaminated, an appropriate program strategy for contaminated sediments must be followed. It should be noted that this method does not yet account for bioaccumulation.

The AVS methodology is anticipated to be presented to the Science Advisory Board (SAB) in the fall of 1994. SAB is a senior scientific panel of nationally recognized experts EPA employs to review new scientific approaches. In addition to the current AVS methodology, a secondary factor relating to the organic carbon concentration in sediment is being incorporated.

For more information, contact Mary Reiley at the Environmental Protection Agency, Office of Science and Technology, 400 M Street, S.W., #4304, Washington, DC 20460; phone: (202) 260-9456. ■

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Chapter 11

Historical Tributyltin Data

Tributyltin (TBT), an anti-fouling paint for boats, is a widespread contaminant of marine and fresh water habitats in California. Once TBT enters the water, it has been found to accumulate in sediments. Once in the sediments, TBT degrades to dibutyltin (DBT) and monobutyltin (MBT). Currently no sediment criteria exist for TBT. However, some accumulated data can be used to assess ranges of concentrations. These data are listed in Table 6 (on page 74) and are explained below.

In 1986, the State Water Resources Control Board's Priority Chemical program conducted a water and sediment sampling project. Samples were collected from San Diego Bay to as far north as Crescent City, California and in the Sacramento-San Joaquin Delta. Sites were selected both within and away from high-density pleasure and fishing craft areas in order to show a potential gradient of TBT use.

In 1986-87, the U.S. Navy studied total butyl tin concentrations in 15 harbors. The sample sites were separated into naval, commercial, and ecological habitat.

In 1992, the U.S. Army Corps of Engineers sampled sediments near Alcatraz, California in an attempt to determine reference or background concentrations of several constituents in the area. Five separate sample sites were selected.

Canada is the only country outside of the U.S. known to have reported data on TBT concentrations in sediment. In 1982, a study of TBT concentrations in the water and sediment of lakes, rivers, and harbors of Ontario was conducted. Samples were collected from 24 sites. ■

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Table 6—Butyltin Historical Sediment Data

Study	Sample Site	TBT	DBT	MBT	Total BT
		(ppb, dry weight)			
SWRCB	CA Coastal and Delta Waters	0.23-23	0.26-27	0.36-60	N.A.
U.S. Navy	Mare Island	N.A.	N.A.	N.A.	N.A.
	Naval	N.A.	N.A.	N.A.	4.6
	Commercial	N.A.	N.A.	N.A.	4.7
	Ecological Habitat	N.A.	N.A.	N.A.	3.5
	San Diego	N.A.	N.A.	N.A.	N.A.
	Naval	N.A.	N.A.	N.A.	87
	Commercial	N.A.	N.A.	N.A.	178
	Ecological Habitat	N.A.	N.A.	N.A.	9.1
U.S. Army Corps of Engineers	Battelle, Jan 92	N.D.	0.6	1.0	N.A.
	Battelle, Jun 92	N.D.	N.D.	1.1	N.A.
	Battelle, Sept 92	N.D.	N.D.	N.D.	N.A.
	Oakland berths 7, 8, 9 & 25	<1.1	<1.1	<1.1	N.A.
	Port of SF Berth 35E	<1.3	<1.3	<1.3	N.A.
Canada	Ontario	30-540	9-350	14-580	N.A.

Legend:

N.A. — Not Available
N.D. — Not Detected

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