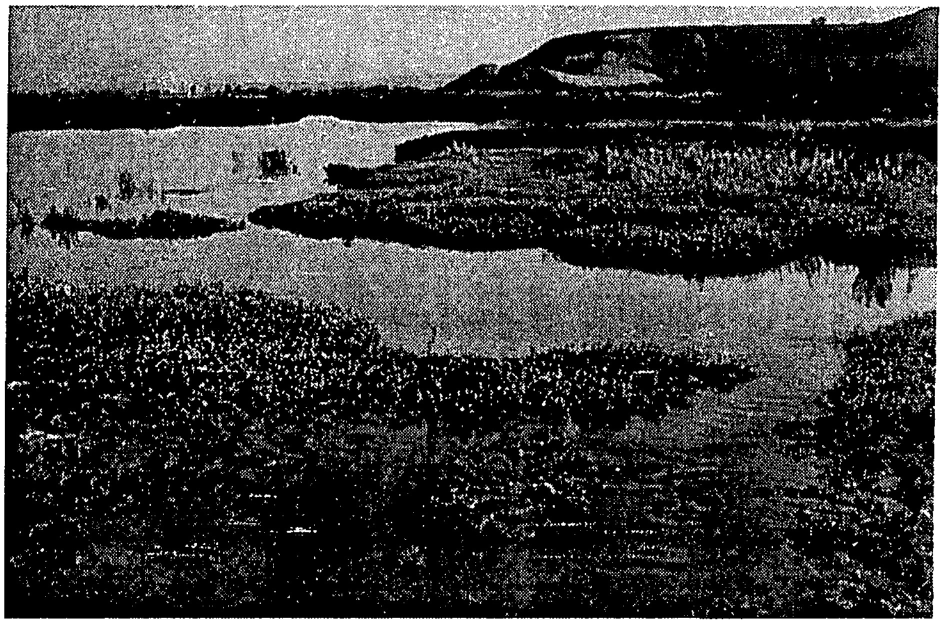
Bay Protection and Toxic Cleanup Program



Guidance on Development of Proposed Regional Toxic Hot Spot Cleanup Plans

October 1997

STATE WATER RESOURCES CONTROL BOARD
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

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STATE WATER RESOURCES CONTROL BOARD

BAY PROTECTION AND TOXIC CLEANUP PROGRAM

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INTRODUCTION

The Bay Protection and Toxic Cleanup Program (BPTCP) is a statewide program legislatively mandated to identify toxic hot spots in the enclosed bays and estuaries of each of the seven coastal regions of the State. The coastal Regional Water Quality Control Boards (RWQCBs) are mandated to develop Regional Toxic Hot Spot Cleanup Plans specifying where and how each identified toxic hot spot will be remediated. The major focus of the Program to date has been monitoring to identify polluted sites. The BPTCP is beginning the process of planning for the cleanup of toxic hot spots.

Purpose of this Report

This report presents suggested guidance on the contents of proposed Regional Toxic Hot Spot Cleanup Plans. The report contains the working definition of a toxic hot spot, general ranking criteria, and the suggested contents of the cleanup plans. The principles contained in this document apply to all enclosed bays, estuaries and coastal waters.

RWQCBs should use this document as a basis for the completion of their proposed regional toxic hot spot cleanup plans.

PLEASE NOTE: This report has not been adopted by the State Water Resources Control Board (SWRCB) and should not be considered to be a Policy or guideline.

CONTENTS OF PROPOSED REGIONAL TOXIC HOT SPOT CLEANUP PLANS

The proposed Regional Toxic Hot Spot Cleanup Plans should contain (at a minimum) the following information:

1. Introduction

The Introduction should contain an identification of the Region. In general terms, the BPTCP goals, authority and requirements to develop cleanup plans (as established in the Water Code) should be presented. This section should also state very clearly that the proposed regional toxic hot spot cleanup plan will be subject to revision as new information on toxic hot spot identification becomes available; that there is an expectation that other sites will be identified as candidate toxic hot spots in the future; potential toxic hot spots will be addressed in future versions of the cleanup plan; cleanup levels for sites may be added to the cleanup plan; and other limitations.

2. Toxic Hot Spot Definition

This section should present the codified definition of a Toxic Hot Spot (THS) as presented in Water Code Section 13391.5. The proposed cleanup plans should then present the specific definition of a Toxic Hot Spot presented in this document.

3. General Criteria For Ranking Toxic Hot Spots

The Water Code requirements for ranking criteria should be presented.

4. Monitoring Approach

The BPTCP has used effects-based measurements of impacts using the sediment quality triad (sediment toxicity, benthic community structure and measures of chemical concentrations in sediments) to identify toxic hot spots in California enclosed bays and estuaries. The BPTCP has used these measures in a two-step process. The first step is to screen sites using toxicity tests, benthic community structure, or measures of chemicals in sediments or tissues. In the second step, the highest priority sites with a response in any of the measures are retested to confirm the observed response.

The description of the monitoring approach should be presented. If there are Region-specific modifications of the approach (such as much of the monitoring in Region 5) the modifications should be briefly described.

5. A priority ranking of all THS (including a description of each THS including a characterization of the pollutants present at the site).

The RWQCBs should use the definition of a candidate and known toxic hot spot listed in this document. The RWQCBs should then rank sites using the Ranking Criteria in this document. The RWQCBs should create one list of candidate toxic hot spots and rank the list using a matrix of the ranking criteria. For the proposed regional toxic hot spot cleanup plans, potential toxic hot spots and other sites where information are unavailable should not be ranked.

For each ranked site listed in the proposed Regional Toxic Hot Spot Cleanup Plan the following information for each toxic hot spot should be presented:

A. Water body name. The name should conform to the water body name in the Regional Basin Plan.

B. Segment Name. The RWQCBs should list a descriptive name in the water body segment where the toxic hot spot is located if the segment name is more descriptive than the water body name.

C. Site Identification. The RWQCBs should list a station or site identifier that can be linked to a monitoring station location (*e.g.*, BPTCP monitoring station, State Mussel Watch station, discharger self monitoring station, or any other appropriate identifier).

D. Reason for Listing. The RWQCBs should list the reason for the site or station to be listed. The value given should be the appropriate trigger value in the definition of a Toxic Hot Spot that is the cause for the listing.

E. Pollutants present at the site. The RWQCBs should also list which chemicals are present at sufficiently high levels to be of concern.

F. Report reference substantiating toxic hot spot listing. All references supporting the designation of the toxic hot spot should be listed with the other information required for designation of a toxic hot spot. The references should include, but not be limited to: author, year of publication, title of report, and other identifying information [*e.g.*, name of journal (including volume and pages), RWQCB file number, agency report, or other identifier that will allow the report to be independently located].

6. Each candidate toxic hot spot with a "High" priority ranking should be listed separately and the following information compiled for the site by the RWQCBs:

A. An assessment of the areal extent of the Toxic Hot Spots.

The RWQCB should characterize the areal extent of the Toxic Hot Spot. For the proposed cleanup plans, the RWQCB should estimate the boundary, size and/or volume of the Toxic Hot Spot. In determining the areal extent the RWQCB should consider a temporal component (*i.e.*, the historic versus ongoing nature of the Toxic Hot Spot), the mix of chemicals present (routinely measured versus other anthropogenic pollutants).

B. An assessment of the most likely sources of pollutants (potential dischargers).

RWQCBs should list potential dischargers that are likely to have discharged or deposited the pollutants identified in the toxic hot spot lists.

Potential discharger identification should be dependent on factors such as, site location, pollutant type, mix of chemicals found to be present at the site, and identification and location of the potential discharger.

In some cases, after a site is identified as a Toxic Hot Spot, there may not be any identified potential discharger to assume the responsibility of cleanup. In such cases the identified THS would remain reported as a THS in the cleanup Plan lists. The RWQCB and the SWRCB would assume the role of leadership to initiate cleanup through the adoption of the Consolidated Statewide Cleanup Plan.

C. A summary of actions that have been initiated by the RWQCBs to reduce the accumulation of pollutants at existing THSs and to prevent the creation of new THSs.

The summary of actions should contain descriptions of any issued waste discharge requirements, National Pollutant Discharge Elimination System permits, general permits (*e.g.,* construction, industrial stormwater, *etc.*), cleanup and abatement orders, cease and desist orders, actions taken or initiated by other State or Federal agencies (*e.g.,* Department of Defense Base Closure, Damage Assessment activities of the National Oceanic and Atmospheric Administration, etc.), or any other actions.

D. Preliminary Assessment of Actions required to remedy or restore a THS to an unpolluted condition including recommendations for remedial actions.

The RWQCBs should evaluate the alternatives listed in the Cleanup section of this document. After evaluating the cleanup alternatives the RWQCBs should list their assessment of the actions that could be implemented.

E. An estimate of the total cost to implement the cleanup plan.

RWQCBs should estimate costs of cleanup plan implementation using the estimates provided in this document or other referenced source. RWQCBs may deviate from the cost estimate in the document if justified in the cleanup plan. If a potential discharger has been identified the RWQCB should require in the Plan that the discharger prepare a proposal for site remedial actions.

F. An estimate of recoverable costs from potential dischargers.

The costs recoverable from potential dischargers should be developed by the RWQCBs, if possible. The costs should be justified in the cleanup plan.

G. A two-year expenditure schedule identifying funds to implement the plans that are not recoverable from potential dischargers.

The RWQCBs should develop a brief workplan for the implementation of the cleanup plans for sites without potential dischargers identified. The workplan should contain costs and estimated schedule for: finding polluted sediments (monitoring), assessment of areal extent of the toxic hot spot, implementation of remedial actions including, but not limited to, sediment removal and disposal, treatment of removed sediments, or capping of polluted sediments. The expenditure plan should also contain funding for assessing the effectiveness of remediation.

SPECIFIC DEFINITION OF A TOXIC HOT SPOT

Legislative Definition

Section 13391.5 of the Water Code defines toxic hot spots as "...locations in enclosed bays, estuaries, or adjacent waters in the 'contiguous zone' or the 'ocean' as defined in Section 502 of the Clean Water Act (33. U.S.C. Section 1362), the pollution or contamination of which affects the interests of the State, and where hazardous substances have accumulated in the water or sediment to levels which (1) may pose a substantial present or potential hazard to aquatic life, wildlife, fisheries, or human health, or (2) may adversely affect the beneficial uses of the bay, estuary, or ocean waters as defined in the water quality control plans, or (3) exceeds adopted water quality or sediment quality objectives."

Specific Definition of a Toxic Hot Spot

Although the Water Code provides some direction in defining a toxic hot spot, the definition presented in Section 13391.5 is broad and somewhat ambiguous regarding the specific attributes of a toxic hot spot. The following specific definition provides a mechanism for identifying and distinguishing between "candidate" and "known" toxic hot spots. A Candidate Toxic Hot Spot is considered to have enough information to designate a site as a Known Toxic Hot Spot except that the candidate hot spot has not been approved by the RWQCB and the SWRCB. Once a candidate toxic hot spot has been adopted into the consolidated statewide toxic hot spot cleanup plan then the site shall be considered a known toxic hot spot and all the requirements of the Water Code shall apply to that site.

Candidate Toxic Hot Spot:

A site meeting any one or more of the following conditions is considered to be a "candidate" toxic hot spot.

1. The site exceeds water or sediment quality objectives for toxic pollutants that are contained in appropriate water quality control plans or exceeds water quality criteria promulgated by the U.S. Environmental Protection Agency (U.S. EPA).

   This finding requires chemical measurement of water or sediment, or measurement of toxicity using tests and objectives stipulated in water quality control plans. Determination of a toxic hot spot using this finding should rely on recurrent measures over time (at least two separate sampling dates). Suitable time intervals between measurements must be determined.

2. The water or sediment exhibits toxicity associated with toxic pollutants that is significantly different from the toxicity observed at reference sites (*i.e.*, when compared to the lower confidence interval of the reference envelope), based on toxicity tests acceptable to the SWRCB or the RWQCBs.

To determine whether toxicity exists, recurrent measurements (at least two separate sampling dates) should demonstrate an effect. Appropriate reference and control measures must be included in the toxicity testing. The methods acceptable to and used by the BPTCP may include some toxicity test protocols not referenced in water quality control plans (*e.g.*, the Bay Protection and Toxic Cleanup Program Quality Assurance Project Plan). Toxic pollutants should be present in the media at concentrations sufficient to cause or contribute to toxic responses in order to satisfy this condition.

3. The tissue toxic pollutant levels of organisms collected from the site exceed levels established by the United States Food and Drug Administration (FDA) for the protection of human health, or the National Academy of Sciences (NAS) for the protection of human health or wildlife. When a health advisory against the consumption of edible resident non-migratory organisms has been issued by Office of Environmental Health Hazard Assessment (OEHHA) or Department of Health Services (DHS), on a site or water body, the site or water body is automatically classified a "candidate" toxic hot spot if the chemical contaminant is associated with sediment or water at the site or water body.

   Acceptable tissue concentrations are measured either as muscle tissue (preferred) or whole body residues. Residues in liver tissue alone are not considered a suitable measure for known toxic hot spot designation. Animals can either be deployed (if a resident species) or collected from resident populations. Recurrent measurements in tissue are required. Residue levels established for one species for the protection of human health can be applied to any other consumable species.

   <u>Shellfish:</u> Except for existing information, each sampling episode should include a minimum of three replicates. The value of interest is the average value of the three replicates. Each replicate should be comprised of at least 15 individuals. For existing State Mussel Watch information related to organic pollutants, a single composite sample (20-100 individuals), may be used instead of the replicate measures. When recurrent measurements exceed one of the

levels referred to above, the site is considered a candidate toxic hot spot.

Fin-fish: A minimum of three replicates is necessary. The number of individuals needed will depend on the size and availability of the animals collected; although a minimum of five animals per replicate is recommended. The value of interest is the average of the three replicates. Animals of similar age and reproductive stage should be used.

4. Impairment measured in the environment is associated with toxic pollutants found in resident individuals.

Impairment means reduction in growth, reduction in reproductive capacity, abnormal development, histopathological abnormalities. Each of these measures must be made in comparison to a reference condition where the endpoint is measured in the same species and tissue is collected from an unpolluted reference site. Each of the tests shall be acceptable to the SWRCB or the RWQCBs.

Growth Measures: Reductions in growth can be addressed using suitable bioassay acceptable to the State or Regional Boards or through measurements of field populations.

Reproductive Measures: Reproductive measures must clearly indicate reductions in viability of eggs or offspring, or reductions in fecundity. Suitable measures include: pollutant concentrations in tissue, sediment, or water which have been demonstrated in laboratory tests to cause reproductive impairment, or significant differences in viability or development of eggs between reference and test sites.

Abnormal Development: Abnormal development can be determined using measures of physical or behavioral disorders or aberrations. Evidence that the disorder can be caused by toxic pollutants, in whole or in part, must be available.

Histopathology: Abnormalities representing distinct adverse effects, such as carcinomas or tissue necrosis, must be evident. Evidence that toxic pollutants are capable of causing or contributing to the disease condition must also be available.

5. Significant degradation in biological populations and/or communities associated with the presence of elevated levels of toxic pollutants.

   This condition requires that the diminished numbers of species or individuals of a single species (when compared to a reference site) are associated with concentrations of toxic pollutants. The analysis should rely on measurements from multiple stations. Care should be taken to ensure that at least one site is not degraded so that a suitable comparison can be made.

In summary, sites are designated as "candidate" hot spots after generating information which satisfies any one of the five conditions constituting the definition.

Known Toxic Hot Spot:

A site meeting any one or more of the conditions necessary for the designation of a "candidate" toxic hot spot that has gone through a full SWRCB and RWQCB hearing process, is considered to be a "known" toxic hot spot. A site will be considered a "candidate" toxic hot spot until approved as a known toxic hot spot in a Regional Toxic Hot Spot Cleanup Plan by the RWQCB and approved by the SWRCB.

RANKING CRITERIA

A value for each criterion described below should be developed provided appropriate information exists or estimates can be made. Any criterion for which no information exists should be assigned a value of "No Action". The RWQCB should create a matrix of the scores of the ranking criteria. If the majority of ranking criteria are "High" then the site should be listed in the "High" priority list of Toxic Hot Spots. The ranking criteria follow:

Human Health Impacts

Human Health Advisory issued for consumption of non-migratory aquatic life from the site (assign a "High"); Tissue residues in aquatic organisms exceed FDA/DHS action level and U.S. EPA screening levels ("Moderate").

Aquatic Life Impacts

For aquatic life , site ranking should be based on an analysis of the preponderance of information available (*i.e.,* weight-of-evidence). The measures that should be considered are: the sediment quality triad (sediment chemistry, toxicity, and benthic community analysis), water toxicity, toxicity identification evaluations (TIEs), and bioaccumulation.

Stations with hits in any two of the measures if associated with high chemistry, assign a "High" priority. A hit in one of the measures associated with high chemistry is assigned "moderate", and high sediment or water chemistry only should be assigned "low".

Water Quality Objectives[1]:

Any chemistry data used for ranking under this section should be no more than 10 years old, and should have been analyzed with appropriate analytical methods and quality assurance.

Water quality objective or water quality criterion: Exceeded regularly (assign a "High" priority), occasionally exceeded ("Moderate"), infrequently exceeded ("Low").

Areal Extent of Toxic Hot Spot

Select one of the following values: More than 10 acres, 1 to 10 acres, less than 1 acre.

Pollutant Source

Select one of the following values: Source(s) of pollution identified (assign a "High" priority), Source(s) partially known ("Moderate"), Source is unknown ("Low").

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1. Water quality objectives to be used are found in Regional Water Quality Control Board Basin Plans or the California Ocean Plan (depending on which plan applies to the water body being addressed). Where a Basin Plan contains a more stringent value than the statewide plan, the regional water quality objective will be used.

TABLE 1
NAS, FDA, and U.S. EPA Limits Relevant to the BPTCP
Marine Organisms
(ng/g or ppb wet weight)

Chemical	NAS Recommended Guideline[3] (whole fish)	FDA Action Level or Tolerance[4] (edible portion)	USEPA Screening Values[2] (edible portion)
Total PCB	500	2000**	10
Total DDT	50	5000	300
aldrin	*	300**,***	-
dieldrin	*	300**,***	7
endrin	*	300**,***	3000
heptachlor	*	300**,***	-
heptachlor epoxide	*	300**,***	10
lindane	50	-	80
chlordane	50	300	80
endosulfan	50	-	20,000
methoxychlor	50	-	-
mirex 50	-	2000	
toxaphene	50	5000	100
hexachlorobenzene	50	-	70
any other chlorinated hydrocarbon pesticide	50	-	
dicofol	-	-	10,000
oxyfluorfen	-	-	800
dioxins/dibenzofurans	-	-	7×10^{-4}
terbufos	-	-	1000
ethion	-	-	5000
disulfoton	-	-	500
diazinon	-	-	900
chlorpyrifos	-	-	30,000
carbophenothion	-	-	1000
cadmium	-	-	10,000
selenium	-	-	50,000
mercury	-	1000** (as methyl mercury)	600

* Limit is 5 ng/g wet weight. Singly or in combination with other substances noted by an asterisk.
** Fish and shellfish.
*** Singly or in combination for shellfish

2 Use U.S. EPA values and references.

3 National Academy of Sciences. 1973. Water Quality Criteria, 1972 (Blue Book). The recommendation applies to any sample consisting of a homogeneity of 25 or more fish of any species that is consumed by fish-eating birds and mammals, within the same size range as the fish consumed by any bird or mammal. No NAS recommended guidelines exist for marine shellfish.

4 U.S. Food and Drug Administration. 1984. Shellfish Sanitation Interpretation: Action Levels for Chemical and Poisonous Substances. A tolerance, rather than an action level, has been established for PCB.

Natural Remediation Potential

Select one of the following values: Site is unlikely to improve without intervention ("High"), site may or may not improve without intervention ("Moderate"), site is likely to improve without intervention ("Low").

SEDIMENT CLEANUP METHODS

Each known and candidate toxic hot spot should be evaluated to determine which technique or techniques would best remediate the toxic hot spot. In determining the remedial action(s), each RWQCB should identify remediation techniques that are technically feasible and reasonably cost-effective. Selection of the alternatives involves choosing the remediation option that is appropriate for the site (*i.e.*, protective of its beneficial uses).

The use of remediation technologies and controls is still emerging. Generally, the field has been dominated by tools developed for navigation dredging, and few full scale treatment systems have been implemented.[5] No one option should be selected in the cleanup plans especially if a discharger is identified as being responsible for the site (in order to comply with Water Code Section 13360).

Tables 2 through 12 list many of the types of remediation that should be considered by the RWQCBs in developing the regional toxic hot spot cleanup plans. For each type of remediation technology, the Table presents: (1) the state of the practice, (2) advantages and effectiveness, (3) limitations of the methods, and (4) any identified research needs.

Each RWQCB should provide an analysis of a range of treatment technologies or alternatives for comparison of the cost effectiveness. The minimum list of alternatives to be considered follow.

[5] National Research Council. 1997. Contaminated sediments in ports and waterways: Cleanup strategies and technologies. Committee on Contaminated Marine Sediments, Marine Board, Commission on Engineering and Technical Systems, National Research Council. National Academy Press, Washington, D.C. 295 pp.

1. Treatment of the site sediments only.

Site treatment involves the physical or chemical alteration of material. The treatment must reduce or eliminate the toxicity, mobility, or volume of polluted material. Treatment may be either (a) *in situ*, or (b) *ex situ*. In situ treatment requires uniform treatment and confirmation of effectiveness; however, *in situ* methods generally have not been considered effective in marine sediments.

Ex situ treatment requires a treatment area, or a dedicated site to assure effectiveness.

Types of treatment include:

- ex situ bioremediation (Table 2),
- soil washing and physical separation (Table 3),
- chemical separation and thermal desorption (Table 4),
- immobilization (Table 5),
- thermal and chemical destruction (Table 6), and
- ex situ bioremediation (Table 7).

The treatment choice should be pollutant specific. The choice depends upon the chemical characteristics of the pollutants, as well as physical and chemical characteristics of the sediments; for example, clay content, organic carbon content, salinity, and water content. Some treatment options produce by-products which require further handling. Although these technologies are currently being employed for soils, their effectiveness for use in marine sediments should be thoroughly evaluated. If the safety and effectiveness of treatment options are not well known, bench tests and pilot projects should be performed prior to authorization of the use of such treatment methods.

Table 2: In-Situ Bioremediation

State of Practice (system maturity, known pilot studies, etc.)	Applicability	Advantages/Effectiveness	Limitations	Research Needs
(a) None documented for marine sediments; (b) examples from freshwater sediment are limited to special cases on pilot scale, e.g., chemical stimulation of dehalogenation (but no degradation) of PCBs in the Houseatonic River, Connecticut; (c) stimulation of degradation with addition of active microbes in Hudson River, New York.	(a) Pollutant is biologically available; (b) concentration of pollutant appropriate for bioactivity, e.g., sufficiently high to serve as substrate or not high enough to be toxic; (c) limited number or classes of pollutants that are biodegradable; less known for complex mixtures; (d) site is reasonably accessible for management and monitoring; (e) rapid solution is not required.	Based on experience from soil systems, it offers the potential for (a) complete degradation and elimination of organic pollutants; (b) reduced toxicity of sediment from partial biotransformation; (c) less materials handling, which can result in substantially lower costs; (d) no need for placement sites; (e) favorable public response and acceptability.	(a) Not a proven technology for sediments (freshwater or marine); (b) likely to require manipulation and disturbance of sediment; (c) can require containment which limits volume that is treatable; (d) can require long time periods, especially in temperate waters; (e) ineffective for low level pollution; (f) not applicable to areas of high turbulence or sheer; (g) not applicable for high molecular weight polyaromatic hydrocarbons.	(a) Fundamental understanding of biodegradation principles in marine environments; (b) bioavailability of sorbed pollutants and the effect of aging; (c) exploration of anaerobic degradation processes for the largely impacted near-shore anoxic sediments; (d) laboratory, pilot, and field demonstration of effectiveness for marine sediments; (e) interaction of physical, chemical, and microbiological processes on biodegradation, e.g., sediment composition, hydrodynamics; (f) analysis of cost-effectiveness; (g) exploration of combining in-situ bioremediation with capping.

Table 3: Soil Washing and Physical Separation

State of Practice (system maturity, known pilot studies, etc.)	Applicability	Advantages/Effectiveness	Limitations	Research Needs
Well developed by mining industry and frequently used for sediments.	Where pollutant is predominantly associated with fine-grained material that is a small fraction of the total solids.	(a) Mature technology that can reduce volumes of polluted material requiring subsequent treatment; (b) soil washing can be used to recover Confined Disposal Facility space for later reuse.	Original sediments must have a significant proportion of sand for the process to be cost effective.	None identified.

Table 4: Chemical Separation and Thermal Desorption

State of Practice (system maturity, known pilot studies, etc.)	Applicability	Advantages/Effectiveness	Limitations	Research Needs
(a) Pilot plant studies conducted on metal desorption by acid-leaching solutions and at least one full-scale implementation; (b) pilot and full-scale application of organics separation by liquid solvents and supercritical fluids; (c) organic chemical thermal desorption also has had full-scale demonstration; (d) thermal desorption used at Waukegan Harbor.	Suitable for weakly bound organics and metals.	Pollutant is removed and concentrated.	(a) Batch extraction during separation requires multiple cycles to achieve high removal; (b) fluid-solid separation is difficult for fine-grained materials; (c) a separate reactor is needed to remove the pollutant from the extracting fluid so that the extracting fluid can be reused; (d) thermal desorption requires temperatures that will vaporize water, and sediment particles must be eliminated from gaseous discharge; (e) pollutant removal from the gas phase following thermal desorption is another treatment process that is required.	Systems integration for complete pollutant isolation or destruction.

Table 5: Immobilization

State of Practice (system maturity, known pilot studies, etc.)	Applicability	Advantages/Effectiveness	Limitations	Research Needs
Extensive knowledge based on inorganic immobilization within solid wastes and dry soils.	Chemical fixation and immobilization of trace metals.	(a) Chemical isolation from biologically accessible environment; (b) process is simple and there is a history of use for sludge.	(a) Sediment should have moisture content of less than 50 percent, and solidified volumes can be 30 percent greater than starting material; (b) limited applicability to organic pollutants; (c) high organic pollutant levels may interfere with treatment for metals immobilization; (d) need for placement of solidified sediments.	(a)Studies of long-term effectiveness for pollutant isolation; (b) develop sediment placement options, especially for beneficial uses.

Table 6: Thermal and Chemical Destruction

State of Practice (system maturity, known pilot studies, etc.)	Applicability	Advantages/Effectiveness	Limitations	Research Needs
Thermal oxidation in flame and thermal reduction in nonflame reactors have been extensively tested and demonstrated.	Process destroys organic pollutants in sediment samples at efficiencies of greater than 99.99 percent but at very high costs.	Very effective.	(a) Very expensive; (b) metals mobilized into the gas phase require gas phase scrubbing; (c) water content of sediment increases energy costs.	(a) process control to prevent upsets and effluent gas treatment for metals containment; (b) facility design to control the destruction process.

Table 7: Ex Situ Bioremediation

State of Practice (system maturity, known pilot studies, etc.)	Applicability	Advantages/Effectiveness	Limitations	Research Needs
(a) Limited experience; (b) transfer of soil-based technologies to marine sediments is not proved and may not be directly applicable because of the different biogeochemistry of marine sediments; (c) but general trends should translate; (d) examples from freshwater sediment have been carried out at the pilot scale in the assessment and remediation of polluted sediments program, as well as in Europe; (e) PCBs were treated ex situ at a Sheboygan River site.	(a) Pollutant is biologically available; (b) concentration of pollutant appropriate for bioactivity (e.g., sufficiently high to serve as substrate, not high enough to be toxic); (c) limited number or classes of pollutants are biodegradable; less known for complex mixtures; (d) site is reasonable accessible for management and monitoring; (e) rapid solution is not required.	Based on experience from freshwater systems, it offers the potential for (a) degradation (as opposed to mass transfer) of some organic pollutants; (b) possible reduction of toxicity from biotransformation in those cases in which complete mineralization does not occur; (c) containment of polluted material allowing for an engineered system and enhanced rates, when compared to in situ biotransformations; (d) public acceptability.	(a) Far from a proven technology--all work with marine sediments is at the bench-scale; (b) requires handling of polluted sediment; (c) slow compared to chemical treatment; (d) ineffective for low levels of pollution, and does not remove 100 percent of pollutants; (e) not applicable for very complex organics, such as high-molecular-weight compounds; (f) susceptible to matrix effects on bioavailability.	(a) Fundamental understanding of biodegradation principles in engineered systems; (b) exploration of aerobic/anaerobic combinations or comparisons; (c) laboratory, pilot, and field demonstrations; (d) analysis of cost effectiveness; (e) exploration of bioremediation as part of more extensive treatment trains.

2. Dredging: Sediment Removal and Disposal or Reuse

Dredging may be combined with containment or offsite disposal (Table 8). Selection of the method depends upon the amount of resuspension of sediments caused by the dredge at the removal site and at the disposal site. To reduce the transport of polluted sediment to other areas, silt curtains constructed of geotextile fabrics may be utilized to minimize migration of the resuspended sediments beyond the area of removal. Consideration must also be given to temporary loss of benthic organisms at the removal site and at the disposal site.

Selection of the dredging method should take into account the physical characteristics of the sediments, the sediment containment capability of the methods employed, the volume and thickness of sediments to be removed, the water depth, access to the site, currents, and waves. Consideration should also be given to placement site of the material once it is removed.

Typical dredging methods include mechanical or hydraulic dredging. Mechanical dredging often employs clamshell buckets and dislodges sediments by direct force. Sediments can be resuspended by the impact of the bucket, by the removal of the bucket, and by leakage of the bucket. Mechanical dredging generally produces sediments low in water content.

Table 8: Confined Disposal Facility

State of Practice (system maturity, known pilot studies, etc.)	Applicability	Advantages/Effectiveness	Limitations	Research Needs
(a) The most commonly used placement alternative for polluted sediments; (b) hundreds of sites nationwide for navigation dredging projects; (c) often used for pretreatment prior to final placement or as final sediment placement site for remediation projects.	Applicable to a wide variety of sediment types and project conditions.	(a) Low cost compared to ex situ treatment; (b) compatible with a variety of dredging techniques, especially direct placement by hydraulic pipeline; (c) proper design results in high retention of suspended sediments and associated pollutants; (d) engineering for basic containment normally involves conventional technology; (e) controls for pollutant pathways usually can be incorporated into site design and management; (f) conventional monitoring approaches can be used; (g) site can be used for beneficial purposes following closure, with proper safeguards.	(a) Does not destroy or detoxify pollutants unless combined with treatment; (b) control of some pollutant loss pathways may be expensive.	(a) Design approaches, such as covers and liners, needed for low cost pollutant controls; (b) design criteria for treatment of releases or control strategies for high profile contaminates; (c) methods for site management to allow restoration of site capacity and potential use of treated materials.

Hydraulic dredging uses centrifugal pumps to remove sediments in the form of a slurry. Although less sediment may be resuspended at the removal site, sediment slurries contain a very high percentage of water at the end of the pipe.

Removal and consolidation often involves a diked structure which retains the dredged material (Tables 9 and 10). Considerations include:

A. construction of the dike or containment structure to assure that pollutants do not migrate,

B. the period of time for consolidation of the sediments,

C. disturbance or burying of benthic organisms,

D. Disposal to an offsite location, either upland (landfill), in-bay, or ocean. Considerations once the material has been dredged should be (1) staging or holding structures or settling ponds, (2) de-watering issues, including treatment and discharge of wastewater, (3) transportation of dredged material, (*i.e.*, pipeline, barge, rail, truck), or (4) regulatory constraints.

3. Containment of Polluted Sediments

Containment can prevent human or ecological exposure, or prevent migration of pollutants. Containment can be either in-place capping, or removal and consolidation at a disposal structure (Tables 9 and 11). Containment options such as capping clearly reduce the short-term exposure, but require long-term monitoring to track their effectiveness.

Table 9: Contained Aquatic Disposal

State of Practice (system maturity, known pilot studies, etc.)	Applicability	Advantages/Effectiveness	Limitations	Research Needs
Limited application. Reviews exist concerning (a) necessary data, equipment, and procedures; (b) engineering considerations; (c) guidelines for cap armoring design; (d) predicting chemical containment effectiveness.	(a) Costs and environmental effects of relocation are factors; (b) suitable types and quantities of cap material are available; (c) hydrologic conditions will not compromise the cap; (d) cap can be supported by original bed; (e) appropriate for sites where excavation is problematic or removal efficiency is low; (f) cap material is compatible with existing aquatic environment.	(a) Eliminates need to remove polluted sediments; (b) cost effective for sites with large surface areas; (c) effective in containing pollutants by reducing bioaccessibility; (d) promotes in situ chemical or biological degradation; (e) maintains stable geochemical and geohydraulic conditions, minimizing pollutant release to surface water, groundwater, and air.	(a) Laboratory and field validation of capping procedures and tools; (b) analysis of data from existing and ongoing field demonstrations to support capping effectiveness; (c) test for chemical release during bed placement and consolidation; (d) tests to evaluate and simulate the effects of cap penetration by deep burrowing organisms; (e) simulate and evaluate consequences of mixing; (f) potential loss of pollutants to the water column may require controls during placement.	(a) Design criteria for treatment of releases or control strategies for high-profile pollutants; (b) improved methods for evaluation of potential pollutant release pathways; (c) develop reliable cost estimates.

Table 10: Landfills

State of Practice (system maturity, known pilot studies, etc.)	Applicability	Advantages/Effectiveness	Limitations	Research Needs
Used for several dredged material and Superfund projects involving polluted sediments.	(a) Small volumes; (b) where no other alternatives or sites are available.	(a) Does not require acquisition of permanent placement site; (b) may be most cost effective for small volumes; (c) effectiveness is inherent in the site license.	(a) Lack of landfill capacity in most regions of the country; (b) requires handling and transport to the landfill; (c) restriction on free liquids requires dewatering as a pretreatment step.	Improved methods for rehandling, dewatering, and transporting dredged sediments.

The process for stabilization of sites using sub-aqueous capping to contain toxic waste at a site would be to follow the basic three-step approach and apply the criteria shown in USEPA Report No. 893-B-93-001, Selection of Remediation Techniques for Contaminated Sediment. This federal remediation document provides a list of performance considerations to test whether clean sediments consisting of sands and silts can be used to effectively contain the waste, either at the present location or at some other location. The list includes, in part:

A. Capping provides adequate coverage of polluted sediments and capping materials can be easily placed.

B. The integrity of the cap must be assured to prevent burrowing organisms from mixing of polluted sediments (bioturbation).

C. The ability of the polluted sediment to support the cap, *i.e.*, causing settlement or loading.

D. The bottom topography causing sloping or slumping of the capped material during seismic events.

E. Cap erosion or disruption by currents, waves, bioturbation, propeller wash, or ship hulls.

F. Future use of capped area, *i.e.*, shipping channel.

Another consideration is presented in the U.S. EPA document concerning whether the no-action alternative would accomplish the same end as capping the site; however, this option should be considered as the last alternative.

Table 11: In-Place Capping

State of Practice (system maturity, known pilot studies, etc.)	Applicability	Advantages/Effectiveness	Limitations	Research Needs
Less than 10 major in situ capping projects in North America have been competed (more than 20 worldwide). Reviews exist concerning (a) necessary data, equipment, and procedures; (b) engineering considerations; (c) guidelines for design of cap armor; and (d) predicting effectiveness of chemical containment.	(a) Pollutant sources have been substantially abated; (b) natural recovery is too slow; (c) costs and environmental effectiveness of relocation are too high; (d) suitable types and quantities of cap material are available; (e) hydrologic conditions will not compromise the cap; (f) cap can be supported by original bed; (g) appropriate for sites where excavation is problematic or removal efficiency is low.	(a) Eliminates need to remove polluted sediments; (b) effective in containing pollutants by reducing bioaccessibility; (c) promotes in situ chemical or biological degradation; (d) maintains stable geochemical and geohydraulic conditions, minimizing pollutant release to surface water, groundwater, and air; (e) relatively easy to implement; (f) eliminates bioturbation and resuspension; (g) reduces pollutant release to water column; (h) easily replaced or repaired; (i) in shallow water, creates wetlands, dry lands, or reduces water column depth.	(a) Cap incompatible with bottom material can alter benthic community; (b) subject to erosion by strong currents and wave action; (c) subject to penetration/destruction by deep burrowing organisms; (d) destroys/changes benthic communities/ecological niches; (e) requires ongoing monitoring for cap integrity; (f) dilutes pollutants in original bed if subsequent removal/remediation is required.	(a) Analysis of data from existing and ongoing field demonstrations to support capping effectiveness; (b) controls for chemical release during bed placement and consolidation; (c) test to simulate and evaluate consequences of episodic mixing, such as anchor penetration, propeller wash, and/or mechanical penetration.

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4. No Remediation

This alternative consists of two elements: (a) institutional or access controls (or "natural remediation") and (b) the no action alternative. The first element, institutional controls could include, but is not limited to, posting of warning signs, or monitoring of water, sediments, or organisms. This element would be protective of human health by providing warning signs for fishing, etc., but not protective of aquatic life.

The second element is the "no-action alternative". If by no action, the toxic hot spot is to be left in place, because to move it, or to disturb it in any way would be detrimental, then "no action" should be considered. This would have to be proven beyond any doubt, and would not be "an easy way out" of dealing with a toxic hot spot.

The no-remediation/no-action alternative should be considered only after all other alternatives have been studied (Table 12). State Board Resolution 92-49 (as amended) requires that regional boards compel dischargers to clean up wastes to protect beneficial uses (III.G.). Resolution 92-49 also requires regional boards to consider "Minimizing the likelihood of imposing a burden on the people of the state with the expense of cleanup and abatement..." (IV.D.).

If the no-remediation/no-action alternative is to be implemented, the RWQCB should determine the following: (a) Point source discharges have been controlled, (b) The costs and environmental effects of moving and treating polluted sediment are too great, (c) Hydrologic conditions will not disturb the site, (d) The sediment will not be remobilized by human or natural activities, such as by shipping activity or bioturbation, (e) Notices to abandon the site have been issued to appropriate federal, state, and local agencies and to the public, (f) The exact location of the site and a list of chemicals causing the toxic hot spot and their quantities are noted on deeds, maps, and navigational charts, and (g) A monitoring program is established to measure changes in discharge rates from the site.

If a no-remediation alternative is considered, RWQCBs should provide an assessment of the geographic extent of the pollution, the depth of the pollution in the sediment, compelling evidence that no treatment technologies should be applied and that only the no-remediation alternative is feasible at the site, and a cleanup cost comparison of all other treatment technologies versus the no-remediation alternative.

If a no-remediation alternative is considered, the following information shall be provided in the proposed cleanup plan:

A. Sources of pollution which caused the toxic hot spot to exist.

B. A monitoring program description, specifying the duration of the monitoring, and all organizations which will carry it out.

C. Monitoring program which will show whether rates of pollutant release and the area of influence of the pollutants are not accelerating.

D. Detailed assessment containing proof that all of the following statements are true:

  (1) Pollutant discharge has been controlled.

  (2) Burial or dilution processes are rapid.

  (3) Sediment will not be remobilized by human or natural activities.

  (4) Environmental effects of cleanup are more damaging than leaving the sediment in place.

  (5) Unpolluted sediments from the drainage basin will integrate with polluted sediments through a combination of dispersion, mixing, burial, and/or biological degradation.

(6) Polluted sediments at the site will not spread.

(7) The site will be noted on appropriate maps, charts, and deeds to document the exact location of the site.

For no-remediation alternatives, a map of the area should be required to be provided by potential discharger(s) to the US Army Corps of Engineers, US Coast Guard, National Oceanographic and Atmospheric Administration, Coastal Commission, State Lands Commission, and harbor authorities to be included on official navigational charts and other maps to document the exact location of the site and the depth of the site and the pollutants encountered.

Table 12: Natural Recovery

State of Practice (system maturity, known pilot studies, etc.)	Applicability	advantages/Effectiveness	Limitations	Research Needs
Selected for James River, New York Kepone pollution and considered at Port of Tacoma, Washington site.	(a) Bed is stable or depositional; (b) chemical release rates are low; (c) interim controls can maintain safety to health and environment; (d) pollution level at active surface is low, but areal extent is large; (e) most of the pollution is below the bioturbed zone; (f) pollutants are underlain by low permeability strata; (g) site is not subject to dredging or other disturbance; (h) source of pollution has been abated.	(a) There may be less environmental risk to await natural capping than to attempt sediment removal; (b) removal may cause physical harm to bottom communities as well as suspend and disperse pollutants; (c) cleanup cost may be prohibitive because of large area and low level of pollution; (d) low cost.	(a) Effectiveness of in-bed processes that govern chemical containment and/or destruction is poorly known; (b) bed remains subject to resuspension by storms or anthropogenic processes; (c) should only rarely be used in beds of flowing streams; (d) not appropriate if dredging is required or bulk quantities of chemicals, such as non-aqueous liquids or solids, are present.	(a) Develop scientific principles to describe the process of natural recovery; (b) based on a literature survey, document the success, failure, effectiveness, *etc.*, of sites that have undergone natural recovery either by design or default; (c) develop accepted measuring protocols to determine in situ chemical flux from bed sediment to the overlying water column; (d) develop protocols for assessing the relative contribution of the five or more mechanisms for chemical release or movement from bed sediments.

SEDIMENT CLEANUP COSTS

Total costs for various remedial technologies is dependent upon many factors, some of the most important being pollutant concentration, cleanup level, physical characteristics of the sediment, and the volume of material to be remediated. In addition, overall costs of remediation should also include monitoring to evaluate the effectiveness of cleanup. Due to the large number of variables associated with remedial actions and availability of disposal sites, the costs for any cleanup will be project specific.

Tables 13 and 14 provide a qualitative assessment of the various categories of technology. Table 15 contains estimates of the various costs associated with several cleanup methods. The costs listed should not be considered as absolute for specific remediation methods.

RWQCBs should use either the estimates in Table 13, Table 14, Table 15 or obtain new, project-specific estimates of cleanup costs. The RWQCBs may obtain outside estimates of costs, if necessary. Obtaining new estimates will allow a more realistic comparison of the cost-effectiveness benefit of the selected alternative.

Table 13: Qualitative Comparison of the State of the Art in Remediation Technologies

Feature technology	State of Design Guidance	Number of Times Used	Scale of Application	Cost (per cubic yard)	Limitations
Natural recovery	Nonexistent	2	Full scale.	Low.	Source control Sedimentation Storms.
In place containment	Developing rapidly	<10	Full scale.	<$20.	Limited technical guidance. Legal/regulation uncertainty.
In place treatment	Nonexistent	~2	Pilot scale.	Unknown.	Technical problems Few proponents Need to treat entire volume.
Excavation and containment.	Substantial and well developed	Several hundred	Full scale.	$20 to $100.	Site availability Public assistance.
Excavation and treatment	Limited and extrapolated from soil	<10	Full scale.	$50 to $1,000.	High cost Inefficient for low concentration Residue toxic Need for treatment train.

Table 14: Comparative Analysis of Technology Categories

Approach	Feasibility	Effective	Practicality	Cost
INTERIM CONTROL				
Administrative	0	4	2	4
Technological	1	3	1	3
LONG-TERM CONTROL				
In Situ				
Natural recovery	0	4	1	4
Capping	2	3	3	3
Treatment	1	1	2	2
Sediment Removal and Transport	2	4	3	2
Ex Situ Treatment				
Physical	1	4	4	1
Chemical	1	2	4	1
Thermal	4	4	3	0
Biological	0	1	4	1
Ex Situ Containment	2	4	2	2

SCORING	**Feasibility**	**Effective**	**Practicality**	**Cost**
0	<90%	Concept	Not acceptable, very uncertain	\$1,000/yd
1	90%	Bench		\$100/yd
2	99%	Pilot		\$10/yd
3	99.9%	Field		\$1/yd
4	99.99%	Commercial	Acceptable, certain	<\$1/yd

Table 15

Estimated Cost Ranges for Sediment Remediation

			Alternatives	Volume	Cost/cy
I.	Removal				
		A. mechanical			
		1.	dipper[4]	1 cy	$1 - 25
		2.	bucket ladder[4]	1 cy	$1 - 25
		3.	dragline[4]	1 cy	$1 - 25
		4.	clamshell[2]	1 cy	$10 labor
		B. hydraulic			
			silt screen[3]	10,000 sf	$30,000 mat/labor
		1.	plain suction[2,3]	1 cy	$7 - 10 labor
		2.	cutterhead[4]	1 cy	$7 - 10
		3.	dustpan		
		C.	pneumatic[4]	1 cy	>$10
II.	Transport (may depend upon if hazardous waste, and will affected by dredge and treatment selection)				
		A.	pipeline	TBD*	TBD
		B.	barge[4]	TBD	TBD
		C.	rail[3]	1 Ton	$53 (includes 1500 miles of transportation and upland disposal of non-hazardous pollutants)
		D.	truck[2]	1 cy	$200

TBD = to be determined

Table 15
(Continued)
Estimated Cost Ranges for Sediment Remediation

		Alternatives	Volume	Cost
III.	Pre-Treatment			
		A. dewatering pumping[3]	1 cy	$0.05 labor
		1. air drying		
		a. construct upland drying area	(size dependent)[2]	$5,000 labor
		wick drains, subdrain blanket[3]	1 sf or lf	$1 materials
		b. condition dredged sediment[3]	1 cy	$4 - 7 mat/labor
		2. mechanical		
		a. filtration[5b]	1 cm	$6
		b. centrifuge[7]	1 cm	<$6
		c. gravity thickening[7]	1 cm	<$6
		B. particle classification: for #2, 3, 4, and 5 below[5b] (sorting and separating)	1 cy	$6 - 100
		1. impoundment basins	1 cy	$6 - 100
		2. hydraulic classifiers	1 cy	$6 - 100
		3. hydrocyclones	1 cy	$6 - 100
		4. grizzlies	1 cy	$6 - 100
		5. screens	1 cy	$6 - 100

Table 15
(Continued)
Estimated Cost Ranges for Sediment Remediation

Alternatives	Volume	Cost
C. slurry injections (may overlap with other treatment technologies)		
1. chemicals	TBD	TBD
2. nutrients	TBD	TBD
3. microorganisms	TBD	TBD

IV. Treatment (in some cases, costs associated with any particular treatment will be dependent upon pollutant concentration and cleanup levels required. Some of these technologies have been performed on sediments at the bench or pilot scale only, and are not proven for full scale.)

Alternatives	Volume	Cost
A. biological		
1. biodegradation/bioremediation[5b]	1 ton	\$25 - 100
B. physical		
1. solidification/stabilization[5]	1 cy	< \$100
C. chemical		
1. chelation, chemical hydrolysis, detoxification[5a]	1 cy	\$200-300
2. solvent extraction[5b]	1 ton	\$50 -150
3. electrokinetic soil washing[5b]	1 cy	\$100-300

Table 15
(Continued)
Estimated Cost Ranges for Sediment Remediation

	Alternatives	Volume	Cost
	D. thermal		
	1. rotary kiln incineration[1]	< 6,700 cy	$675 - 2,025
		6,750 - 20,250 cy	$405 - 1,215
		20,250 - 40,500 cy	$270 - 810
		> 40,500 cy	$135 - 540
	2. cyclone furnace vitrification[5b]	1 ton	$450 - 530
	3. fluid bed incineration[5b]	1 ton	$50 - 175
V. Disposal			
	A. onsite upland[6] (includes unspecified dredging method **and** disposal)	1 cy	$3 - 4
	B. offsite land		
	wetlands creation[6]	1 cy	$10 - 20
	class I disposal facility[5] (does not include hazardous waste generator fees)	1 ton	$200 - 300
	class II disposal facility[5]	1 ton	$55 - 65
	class III disposal facility[5]	1 cy	$30 - 40
	C. aquatic		
	1. confined	TBD	TBD

Table 15
(Continued)
Estimated Cost Ranges for Sediment Remediation

	Alternatives	Volume	Cost
2.	unconfined		
	a. in-bay[6] (includes unspecified dredging method and disposal)	1 cy	$2 - 3
	b. in-bay[6] (includes clamshell dredging and disposal)	1 cy	$1 - 8
	c. ocean[6] (includes unspecified dredging method and disposal)	1 cy	$5 - 9
VI.	Effluent/Leachate Treatment		
1.	set up carbon absorption system[2,3] (for organics)	1 system	$25,000 -30,000 mat/labor (does not include O&M)

Table 15
(Continued)
Estimated Cost Ranges for Sediment Remediation

References:

[1] US EPA Office of Research and Development, *Contaminated Sediments Seminar* CERI-91-19, May 1991

[2] *Feasibility Study for the United Heckathorn Site, Richmond, California,* prepared by Levine Fricke - Emeryville, California, January 11, 1991

[3] *Feasibility Study for the United Heckathorn Superfund Site, Richmond, California,* prepared by Batelle/Marine Sciences Laboratory, Sequim, Washington, July 1994

[4] US EPA Office of Water, *Selecting Remediation Techniques for Contaminated Sediment* EPA-823-B93-001, June 1993

[5] Draft Report - Long-Term Management Strategy, *Analysis of Remediation Technologies for Contaminated Dredged Material,* prepared by Gahagan & Bryant Associates, Inc., Novato California in association with ENTRIX, Inc. Walnut Creek, California, October 25, 1993 (includes review and analysis of other documents:

[a] Texas A & M *Proceedings of 25th Annual Dredging Seminar* ;

[b] *Sediment Treatment Technologies Database (SEDTEC),* 2nd edition; Site Remediation Division, Wastewater Technology Centre, operated by Rockcliffe Research Management, Inc.) - submitted by technology developers and vendors from around the world;

[6] Long-Term Management Strategy Dredging Costs Survey for San Francisco Bay, Tom Gandesbery, RWQCB Region 2, personal communication June 1994

[7] US EPA Office of Research and Development, Handbook/Remediation of Contaminated Sediments, EPA/625/6-91/028, April 1991.

PREVENTION OF TOXIC HOT SPOTS

In the process of developing strategies to prevent toxic hot spots, the RWQCBs should focus on designs that accomplish the following:

1. Consider use of any established prevention tools such as (a) voluntary programs, (b) interactive cooperative programs, and (c) regulatory programs, individually or in any combination that will result in an effective THS prevention strategy.

2. Promote a watershed management protection approach focused on hydrologically defined areas (watersheds) rather than areas defined by political boundaries (counties, districts, municipalities), that take into account all waters, surface, ground, inland, and coastal and address point and nonpoint sources of pollution that may have influence or has been identified to have influenced the identified Toxic Hot Spots. Link the cleanup plan to implementation of the Watershed Management Initiative and the SWRCB Strategic Plan.

3. Encourages the participation and input of, interdisciplinary groups of interested parties (including all potential dischargers) able to cross over geographical and political boundaries to develop effective solutions for preventing Toxic Hot Spots.

4. Prevention strategies should provide enough flexibility to be used as watershed protection plans where there are none established or have the ability to join with a watershed protection plan that is already being implemented to address the THS. Solutions developed should also be developed for, and applied at sites where it will do the most prevention and where it will be the most cost-effective at mitigating and preventing toxic hot spots at a watershed level.

SITE-SPECIFIC VARIANCES

A site-specific variance to the guidance document allows an alternate approach for developing a cleanup plan for one or more sites within the jurisdiction of a RWQCB. RWQCBs should vary the methods in this guidance document depending on the specific conditions at the toxic hot spot. In any case, when a RWQCB takes an alternate approach the RWQCB should provide the following in the proposed regional toxic hot spot cleanup plan:

1. A description of the provision not followed.
2. A description of the new approach used. The proposed alternative program, method, or process should be clearly identified.
3. Any specific circumstances on which the RWQCB relied to justify the finding necessary for the variance.
4. Clear evidence that the alternative approach will better protect beneficial uses.

TEMPLATE FOR PROPOSED REGIONAL TOXIC HOT SPOT CLEANUP PLANS

The template for the development of a proposed regional toxic hot spot cleanup plan is presented in the appendix.

APPENDIX 1

TEMPLATE FOR PROPOSED REGIONAL TOXIC HOT SPOT CLEANUP PLANS

PROPOSED REGIONAL TOXIC HOT SPOT CLEANUP PLAN

REGIONAL WATER QUALITY CONTROL BOARD

< > REGION

Part I

I. Introduction

- Region Description
- Legislative Authority
- Limitations

II. Toxic Hot Spot Definition

- Codified Definition of A Toxic Hot Spot
- Specific Definition of A Toxic Hot Spot

III. Monitoring Approach

IV. Criteria For Ranking Toxic Hot Spots

- Human Health
- Aquatic Life
- Water Quality Objectives
- Other Factors

V. Future Needs

Part II

IV. Candidate Toxic Hot Spot List

Water body name	Segment Name	Site Identification	Reason for Listing	Pollutants present at the site.	Report reference

Reference list

V. Ranking Matrix

Waterbody Name	Site Identification	Human Health Impacts	Aquatic Life Impacts	Water Quality Objectives	Areal Extent	Pollutant Source	Remediation Potential

Part III

V. High Priority Candidate Toxic Hot Spot Characterization

For each high priority Candidate Toxic Hot Spots, the following information should be presented:

A. An assessment of the areal extent of the THS.

B. An assessment of the most likely sources of pollutants (potential discharger).

C. A summary of actions that have been initiated by the Regional Boards to reduce the accumulation of pollutants at existing THSs and to prevent the creation of new THSs.

D. Preliminary Assessment of Actions required to remedy or restore a THS to an unpolluted condition including recommendations for remedial actions.

E. An estimate of the total cost to implement the cleanup plan.

F. An estimate of recoverable costs from potential dischargers.

G. A two-year expenditure schedule identifying funds to implement the plans that are not recoverable from potential dischargers.

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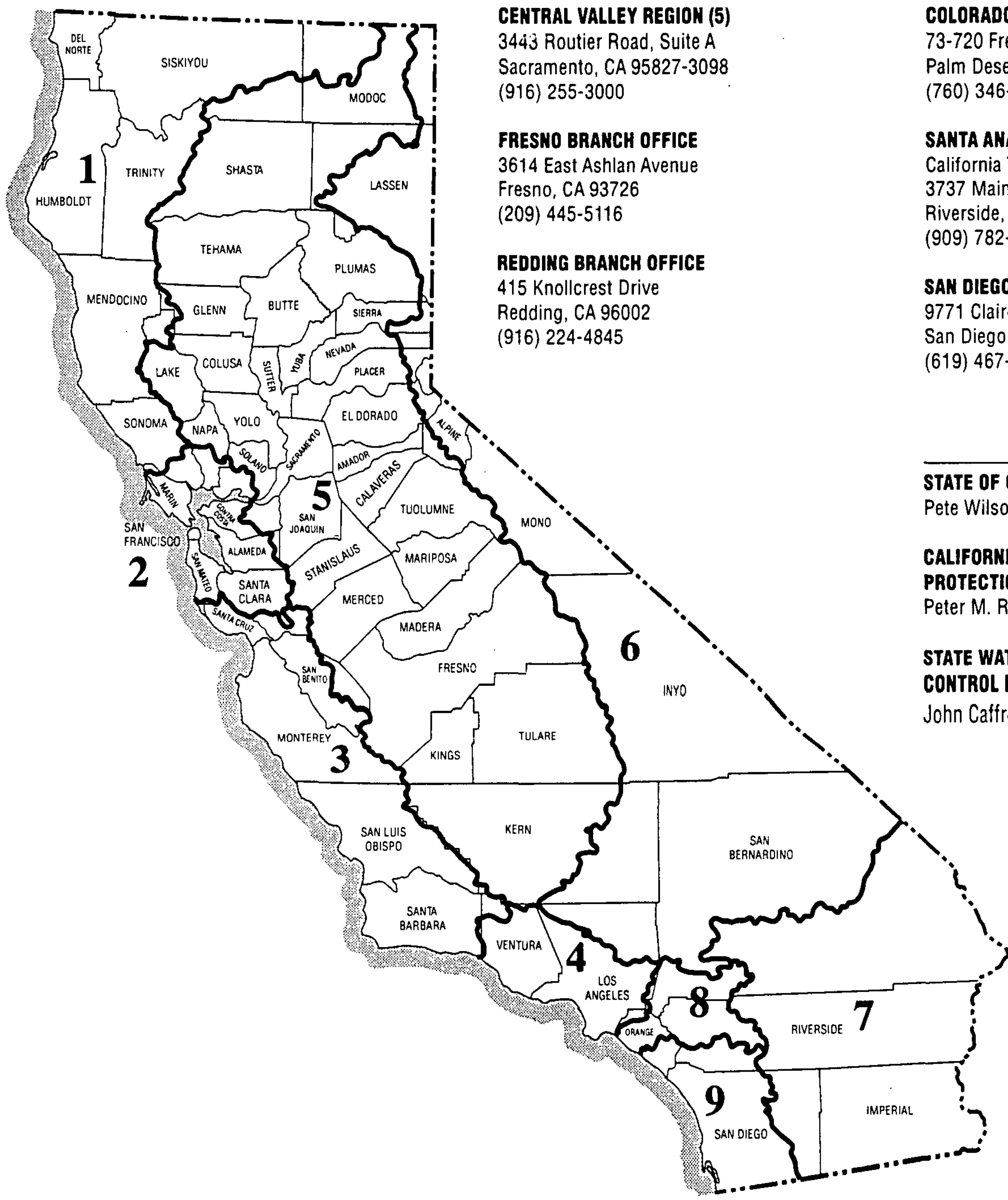

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