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A Guide on Remedial Actions at Superfund Sites With PCB Contamination

Office of Emergency and Remedial Response
Hazardous Site Control Division (OS-220)

Quick Reference Fact Sheet

GOALS

This fact sheet summarizes pertinent considerations in the development, evaluation, and selection of remedial actions at Superfund sites with PCB contamination. It provides a general framework for determining cleanup levels, identifying treatment options, and assessing necessary management controls for residuals. It is not a strict "recipe" for taking action at PCB-contaminated sites, but it should be used as a guide for developing remedial actions for PCBs. Site-specific conditions may warrant departures from this basic framework. A more detailed discussion of these issues can be found in the *Guidance on Remedial Actions for Superfund Sites with PCB Contamination*, OSWER Directive No. 9355.4 - 01.

SUPERFUND GOAL AND EXPECTATIONS

The Superfund program goal and expectations for remedial actions (40CFR 300.430 (a)(l)(i) and (iii)(1990)) should be considered during the process of developing remedial alternatives. EPA's goal is to select remedies that are protec-tive of human health and the environment, that maintain protection over time, and that minimize untreated waste. The Agency expects to develop appropriate remedial alternatives that:

- Use treatment to address the principal threats at a site, wherever practicable
- Use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable
- Use a combination of treatment and containment to achieve protection of human health and the environment as appropriate
- Use institutional controls to supplement engineering controls for long-term management and to mitigate short-term impacts
- Consider the use of innovative tech-nology when such technology offers the potential for comparable or superior treatment performance or implementability, fewer or lesser adverse impacts than other available approaches, or lower costs for similar levels of performance than more demonstrated technologies
- Return usable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable, given the particular circumstances of the site

The following sections are organized to follow the Superfund decision process from scoping through preparation of the ROD

DETERMINE DATA NEEDS – Consider Special Characteristics of PCBs

Considerations to note during scoping and when developing potential remedial alternatives for PCBs, include the following:

- Applicable or relevant and appropriate requirements (ARARs) for PCBs are relatively complexbecause PCBs are addressed by both TSCA and RCRA (and in some cases, state regulations). Figure 1 illustrates primary regulatory requirements that address PCBs.
- PCBs encompass a class of chlorin ated compounds that includes up to 209 variations or congeners with different physical and chemical characteristics. PCBs were commonly used as mixtures called Aroclors. The most common Aroclors are Aroclor-1254, Aroclor-1260, and Aroclor-1242.
- PCBs alone are not usually very mobile. However, they are often found with oils, which may carry the PCBs in a separate phase. PCBs may also be carried with sod particulates to which they are sorbed.
- Although most PCBs are not very volatile, they are very toxic in the vapor phase. Consequently, air sampling and analytical methodologies should be selected that will allow for detection of low levels of PCBs.
- Certain remedial technologies will require specific evaluations and/or treatability studies. If biotreatment is considered, the mobility and toxicity of possible by-products should be assessed. If stabilization is considered, the volatilization of PCBs during and after the process should be evaluated. Also, the long-term effectiveness of stabilization should be evaluated carefully. If incineration is considered, the presence of volatile metals should be addressed.

Figure 1 – Primary Regulatory Requirements/Policies Addressing PCBs

RCRA

- Outlines closure requirements for hazardous waste landfills (40 CFR 264.310)
- Establishes land disposal restrictions for liquid hazardous waste that contains PCBs at 50 ppm or greater or nonliquid hazardous waste that contains total HOCs (including PCBs) at concentrations greater than 1,000 ppm (40 CFR 268.32)
- Provides for a treatability variance (40 CFR 268.44) that may be used for PCBs in CERCLA soil and debris. (Under Superfund treatability variance guidance, PCB concentrations should be reduced to .1 - 10 ppm for initial concentrations up to 100 ppm; above100 ppm, treatment should achieve 90-99% reduction of PCBs, consistent with Superfund expectations for treatment.)

TSCA

- Regulates PCBs at concentrations of 50 ppm or greater (40 CFR 761)*
  - PCB management options include: incineration (40 CFR 761.70), high- temperature boiler (40 CFR 761.60), alternative technology that achieves a level of performance equivalent to incineration (40 CFR 761.60), and chemical waste landfill (40 CFR 761.75)

  Note: Liquid PCBs at concentrations of 500 ppm or greater can only be incinerated or treated by using an alternative technology equivalent to incineration (40 CFR 761.60). Dredged material may also be disposed of by a method approved by the RA (40 CFR 761.60 (a)(5)).
- Establishes a PCB spill policy (40 CFR 761.120) that defines the level of cleanup for recent small-volume spills. The Superfund approach is consistent with this policy.

CERCLA/NCP

Remedial Actions Must:

- Protect human health and the environment (121[b][1])
- Comply with applicable or relevant and appropriate requirements (ARARs) (121[d][2])
- Be cost-effective (40 CFR 300.430) (121[b][1])
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable (40 CFR 300.430) (121[b][1])

CWA

- Establishes requirements and discharge limits for activities that affect surface water
  - WQC for PCBs, chronic exposure through drinking water and fish ingestion = 7.9×10^{-5} ppb based on incremental increase cancer risk of 10^{-6} over lifetime
  - WQC for PCBs, acute toxicity to freshwater aquatic life = 2 ppb, chronic = .014 ppb
  - WQC for PCBs, acute toxicity to saltwater aquatic life = 10 ppb, chronic = .03 ppb

SDWA

- Establishes MCLs and MCLGs for drinking water (40 CFR 141)
  - Proposed MCL for PCBs = .5 ppb
    MCLG for PCBs = 0 ppb

* Under the TSCA anti-dilution provision (40 CFR 761.1[b]), PCBs disposed of after 1978 are treated as if they were at their original concentration. However, the Agency has clarified that the anti-dilution provision is only applicable to Superfund response actions for disposal that occurs as part of the remedial action. Therefore, PCBs at Superfund sites should be evaluated based on the concentration at which they exist in the environment at the time a response action is determined (July 1990 memorandum from Don Clay and Linda Fisher).

ESTABLISH PRELIMINARY REMEDIATION GOALS

The following guidelines should be considered when establishing preliminary remediation goals (i.e., cleanup levels) for soils, ground water, and sediment. Exceeding the levels indicated does not require that action be taken. These levels should be. used to define the area over which some action should be considered once it has been determined that action is necessary to protect human health and the environment These goals may be refined throughout the RI/FS process; final remediation goals are determined in the remedy selection.

Soils

The concentration of concern for PCBs (that defines the area to be addressed for soils onsite) will depend primarily on the type of exposure that will occur based on land use-current and future residential or industrial. Guidelines based on generic exposure assumptions and characteristics of Aroclor-1254 are provided in Table 1. Other factors that may affect these levels include the potential for PCBs to migrate to ground water and to affect environmental receptors.

Table 1
Recommended Soil Action Levels-Analytical Starting Point

Land Use	Concentration (ppm)
Residential	1
Industrial	10 - 25

The 1 ppm starting point for sites in residential areas reflects a protective quantifiable concentration. (Also, be-cause of the persistence and pervasive-ness of PCBs, PCBs will be present in background samples at many sites.) For sites in industrial areas, action levels generally should be established within the range of 10 to 25 ppm. The appropriate concentration within the range will depend on site-specific factors that affect the exposure assumptions. For example, at sites where exposures will be very limited or where soil is already covered with concrete, PCB concentrations near the high end of the 10-to-25 ppm range may be protective of human health and the environment.

Ground Water

If ground water that is, or may be, used for drinking water has been contaminated by PCBs, response actions that return the ground water to drinkable levels should be considered. Non-zero maximum contaminant level goals (MCLG) or maximum contaminant levels (MCL) should be attained in ground water where relevant and appropriate. State drinking water standards may also be potential ARARs. Proposed non-zero MCLGs and proposed MCLs may be considered for contaminated ground water. The pro- posed MCL for PCBs is .5 ppb. Since PCBs are relatively immobile, their presence in the ground water may have been facilitated by solvents (e.g., oils) or by movement on colloidal particles. Thus, the effectiveness of PCB removal from ground water, i.e., ground-water extraction, may be limited. In some cases, an ARAR waiver for the ground water may be supported based on the technical im-practicability of reducing PCB concentrations to health-based levels in the ground water. Access restrictions to prevent the use of contaminated ground water and containment measures to pre- vent contamination of clean ground water should be considered in these cases.

Sediment

The cleanup level established for PCB-contaminated sediment may be based on direct-contact threats (if the surface water is used for swimming) or on exposure as-sumptions specific to the site (e.g., drink- ing water supplies). More often, the impact of PCBs on aquatic life and consumers of aquatic life will determine the cleanup level. Interim sediment quality criteria (SQC) have been developed for several non-ionic organic chemicals, in- cluding PCBs and may be considered in establishing remediation goals for PCB- contaminated sediments. The method used to estimate these values is called the equilibrium partitioning approach. It is based on the assumptions that: (1) the biologically available dissolved concen-tration of a chemical in interstitial water is controlled by partitioning between sediment and water phases that can be estimated based on organic carbon parti- tion coefficients; (2) the toxicity of a chemical to, and bioaccumulation by, benthic organisms is correlated with the bioavailable concentration of the chemi- cal in pore water; and (3) the ambient aquatic life water quality criteria (WQC) concentrations are appropriate for the protection of benthic communities and their uses. Table 2 presents the sediment quality criteria and derived PCB sediment concentrations based on the SQC for freshwater and saltwater environments and two organic carbon (OC) concentrations. These criteria are to be considered in establishing remediation goals for con-taminated sediments.

Table 2 - Sediment Cleanup Levels

	Aquatic Environment	
	Freshwater	Saltwater
Sediment Quality Criteria (SQC)	19	33
(Concentrations expressed as ug/g of sediment)		
OC = 10%	1.90	3.30
OC = 1%	0.19	0.33

DEVELOP REMEDIAL ALTERNATIVES

The potential response options at any site range from cleaning up the site to levels that would allow it to be used without restrictions to closing the site with full containment of the wastes. Figure 2 illustrates the process for developing alternatives for a PCB-contaminated site.

Primary Alternatives

It is the expectation of the Superfund program that the primary alternatives for a site will involve treatment of the principal threats and containment of the remaining low level material. For residential sites, principal threats will generally include soils contaminated at concentrations greater than 100 ppm PCBs. For industrial sites, principal threats will include soils contaminated at concentrations greater than or equal to 500 ppm PCBs.

Treatment Options

Liquid and highly concentrated PCBs constituting the principal threats at the site should be addressed through treatment. Treatment options that are currently available or are being tested include incineration, solvent washing, KPEG (chemical dechlorination), biological treatment, and solidification. Compliance with TSCA ARARs requires that PCBs, at greater than 50ppm, be incinerated, treated by an equivalent method, or disposed of in a chemical waste landfill. Equivalence to incineration is demonstrated when treatment residues contain <2 ppm PCB. If treatment is not equivalent to incineration, compliance with TSCA ARARs must be achieved by implementing long-term management controls consistent with the chemical waste landfill requirements. (Liquid PCBs at concentrations greater than 500 ppm cannot be landfilled under TSCA.)

Containment of Low-Threat Material

Long-term management controls should generally be implemented for treatment residuals and other low level contaminated materials remaining at the site. Example scenarios for the use of long-term management controls appropriate for particular PCB concentrations are shown in Table 3. The substantive requirements of a chemical waste landfill specified in TSCA regulations (761.75

(b)) are indicated, along with the justification that should be provided when a specific requirement is waived under TSCA (761.75 (c)(4) (Under CERCLA on-site actions must meet substantive, but not procedural, requirements of other laws.) TSCA requires that PCBs that are not incinerated or treated by an equiv lent method be disposed of in a chemical waste landfill; it may be appropriate to waive certain landfill requirements, where treatment has reduced the threat posed by the material remaining at the site, as is indicated in Table-3.

Exceptions
Treatment of low-threat material may be warranted at sites involving:

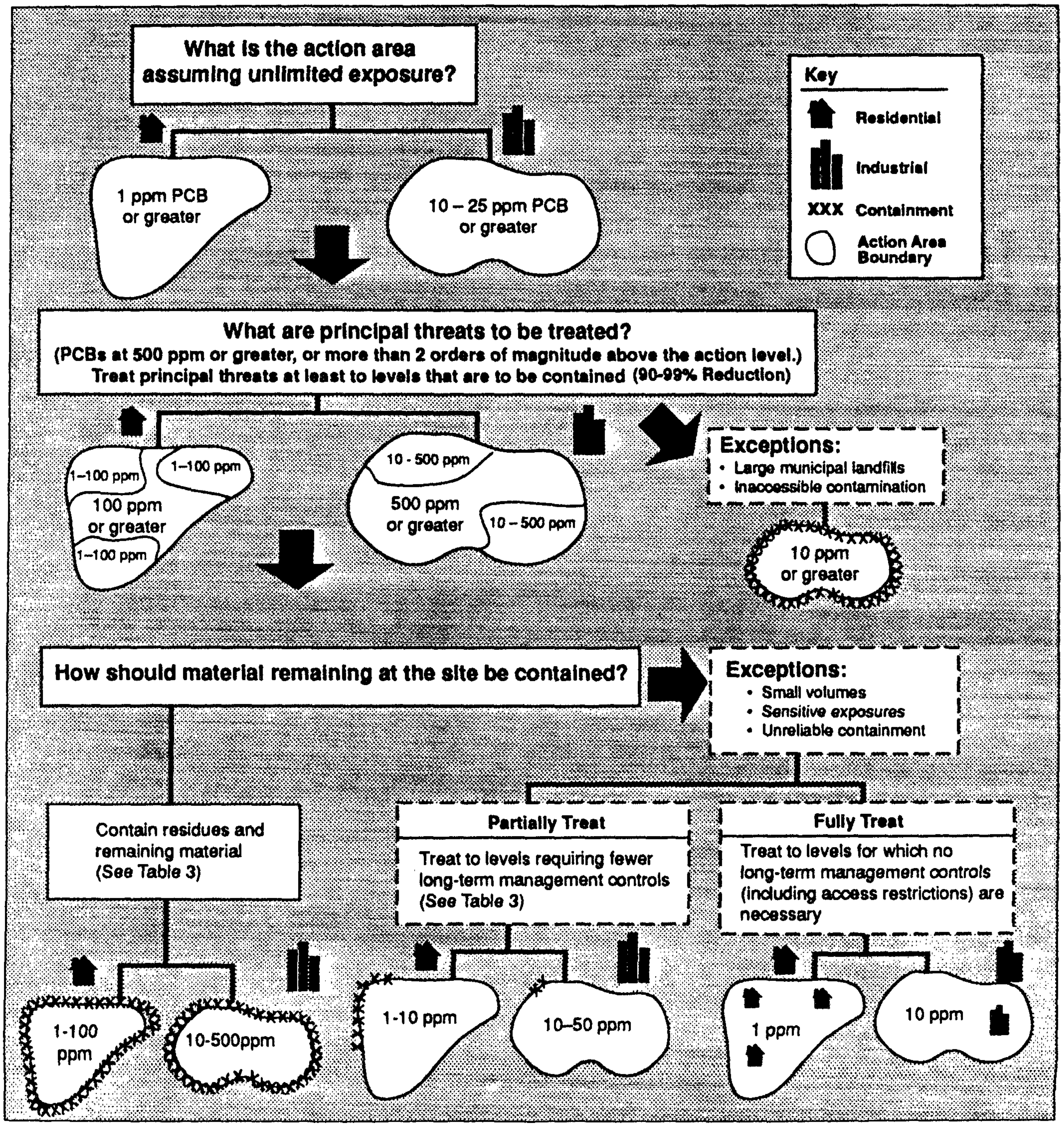
- Relatively small volumes of contaminated material
- Sensitive environments (e.g., wetlands)
- Floodplains or other conditions that make containment unreliable.

In these cases, long-term management controls may be reduced, as shown in Table 3, since the concentrations are lower.

Containment of principal threats may be warranted at sites involving:

- Large volumes of contaminated material for which treatment may not be practicable
- PCBs mixed with other contaminants that make treatment impracticable
- Highly concentrated PCBs that are difficult to treat because of their inaccessibility (i.e.,buried in a landfill)

Figure 2 - Key Steps In the Development of Remedial Alternatives for PCB-Contaminated Superfund Sites*



***These numbers are guidance only and should not be treated as regulations.**

SELECTION OF REMEDY

Criteria and Balancing

The analysis of remedial alternatives for PCB-contaminated Superfund sites is developed on the basis of the following nine evaluation criteria provided in the NCP (300.430[e][a][iii];300.430[f][i][i]). Considerations unique to PCBs are noted

Threshold Criteria

• **Overall protection of human health and the environment.** Are all pertinent exposure pathways being addressed? Are highly concentrated PCBs being treated? Are remaining PCBs and treatment residuals being properly contained, as outlined in Table 3?

• **Compliance with ARARs.** Does the action involve disposal of PCBs at concentrations greater than or equal to 50 ppm? Is the action consistent with TSCA treatment requirements? Is the action consistent with chemical waste landfill requirements, with appropriate TSCA waivers specified for landfilling of material that does not meet treatment requirements? Is a RCRA hazardous waste present? Do California List land disposal restrictions (LDRs) apply? Is the action consistent with LDRs or treat-ability variance levels where appropriate? Is contaminated ground water that is potentially drinkable being returned to drinkable levels or is support for a technical impracticability waiver provided?

Balancing Criteria

• **Long-term effectiveness and permanence.** Are highly concentrated PCBs being treated? Are low-concentration PCBs being properly contained, as outlined in Table 3? Is the site in a location that geographically limits the long-term reliablility of containment (e.g., high water table, floodplain)?

• **Reduction of toxicity, mobility, or volume through treatment.** Is there a high degree of certainty that the treatment methods selected will achieve at least a 90 percent reduction of PCBs? Does treatment increase the volume of PCB-contaminated material that must be addressed either directly (e.g., solidification) or through the creation of additional waste streams (e.g., solvent washing)?

• **Short-term effectiveness.** Is the short-term inhalation risk resulting from volatilization of the PCBs properly addressed? What is the relative timing of the different remedial alternatives?

• **Implementability.** Does the treatment selected require construction of a system onsite (e.g., KPEG, solvent washing)? Does the action require extensive study to determine effectiveness (e.g., bioremediation)? Are permitted facilities available for Alternatives involving off-site treatment or disposal?

• **Cost.**

Modifying Criteria

• **State acceptance**

• **Community acceptance**

Likely Tradeoffs Among Alternatives

Primary tradeoffs for PCB-contaminated sites will derive from the type of treatment selected for the principal threats and the determination of what material can be reliably contained. Alternatives that require minimal long-term management will often provide less short-term effectiveness and implementability because large volumes of contaminated material must be excavated and treated. They will generally be more costly but will provide high long-term effective-ness and permanence and achieve significant reductions in toxicity and volume through treatment. Alternatives that involve containment of large portions of the contaminated site will generally have lower long-term effectiveness and permanence and achieve less toxicity or volume reduction through treatment. However, they will generally be less costly, more easily implemented, and have higher short-term effectiveness.

Table 3 - Selection of Long-Term Management Controls To Be Considered for PCB-Contaminated Sites

PCB - Concentration (ppm)	Approximate Depth to Ground Water	Access	RCRA Corollary	Long-Term Management Controls Reccomended: Cover System 1	Leachate Collection	Leak Detection	Bottom Liner	Ground Water Monitoring	Surface Water Monitoring	Surface Water Management	Chemical Waste Landfill Requirements: Bottom Liner	Depth to Ground Water	Ground Water Monitoring	Leachate Collection	Surface Water Monitoring	Fence	Potential Basis for TSCA Waiver (761.75(c)(4)) of Indicated Chemical Waste Landfill Requirements
≤ 1	All Depths	Nonrestricted Access	Clean Closure														No waivers required; clean closure
1 10	All Depths	Nonrestricted Access	Hybrid Closure	2							X	3	X	X	X	X	Low PCB concentration Design and installation of a protective cover system Evaluation of PCB migration in GW and SW
10-25	All Depths	Limited Access Deed Notice	Hybrid Closure	2							X	3	X	X	X	X'	Low PCB concentration Design and installation of a protective cover system Evaluation of PCB migration to GW and SW
25-100	All Depths	Restricted Access Fence Deed Notice	Landfill Closure	X				X		4	X	3		X	X		Releatively low PCB concentration Implementation of a GW monitoring program Evaluation of PCB migration to GW and SW Design and installation of a protective cover system
100-500	3-50 Feet	Restricted Access Fence Deed Notice	Landfill Closure	X				X	X	4	X	X		X			Implementation of GW monitoring program Design and installation of a protective cover system Evaluation of PCB migration to GW and SW
	> 50 Feet	Restricted Access Fence Deed Notice	Landfill Closure	X				5	X	4	X		X	X			Design and installation of a protective cover system Demonstrate sufficient depth to GW to protect human health and the environment Evaluation of PCB migration to GW and SW
> 500	3-50 Feet	Restricted Access Fence Deed Notice	Landfill Closure Maximum Technology	X	X	X	X	X	X	4		X					Demonstrate other long-term management controls to provide adequate protection of GW
	> 50 Feet	Restricted Access Fence Deed Notice	Landfill Closure Maximum Technology	X	X	X	X	X	X	4	X			X			Demonstrates sufficient depth to GW and long-term managment controls to protect human health and the environment Implementation of GW monitoring program Evaluation of PCB migration to GW and SW

GW = ground water; SW = surface water

1 Cover system may range from 12" soil cap for low concentrations to a full RCRA cap for concentrations exceeding 500 ppm.

2 The need for a cover system will depend on the land use (i.e., residential or individual).

3 40 CFR 761.75(b)(4) requires that landfills be located at least 50 feet above the high water table.

4 In accordance with 40 CFR 761.75(b)(4), if the site is located below the 100-year floodwater elevation, diversion dikes shall be constructed around the perimeter of the landfill with a minimum height equal to 2 feet above the 100-year floodplain elevation. Flood protection for landfills above the 100-year floodwater elevation is not applivable to closed landfill units.

5 When the site is located in a permeable formation, incorporation of this long-term management control should be evaluated.

DOCUMENTATION

A ROD for a PCB-contaminated Superfund site should include the following components under the *Description of Alternatives* section:

• Remediation goals defined in the FS for each alternative, i.e., concentrations above which PCB-contaminated mate rial will be addressed and concentrations above which material will be treated.

• Treatment levels to which the selected action will reduce PCBs before redepositing residuals. The consistency of these levels with TSCA requirements and other ARARs should be indicated.

•Long-term management controls that will be implemented to contain or limit access to PCBs remaining onsite. The consistency with RCRA closure and TSCA chemical waste landfill requirements (and justification for appropriate TSCA waivers) should be indicated.

NOTICE

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