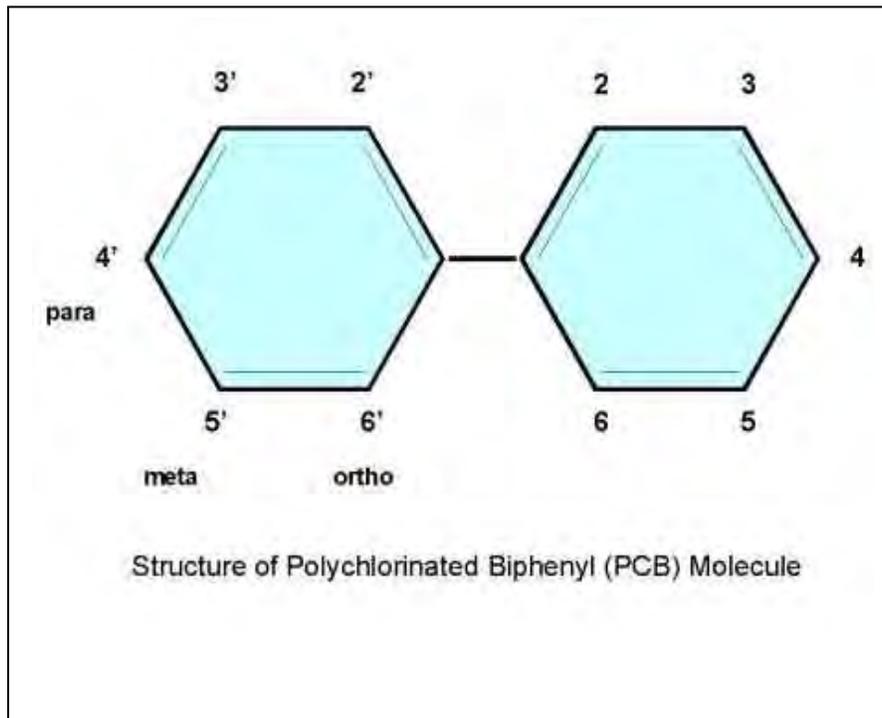


# PCB TMDL Handbook



U.S. Environmental Protection Agency  
Office of Wetlands, Oceans and Watersheds

## DISCLAIMER

*This document provides technical guidance and recommendations to states, authorized tribes, and other authorized jurisdictions to develop Total Maximum Daily Loads (TMDLs) for legacy pollutants like polychlorinated biphenyls (PCBs) under the Clean Water Act (CWA). Under the CWA, states, authorized tribes and US Environmental Protection Agency (USEPA) establish TMDLs to implement water quality standards in impaired waterbodies. State and tribal decision-makers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance when appropriate and scientifically defensible. While this document contains USEPA's recommendations and guidance, it does not substitute for the CWA or USEPA regulations; nor is it a regulation itself. Thus it cannot impose legally binding requirements on USEPA, states, authorized tribes, or the regulated community, and it might not apply to a particular situation or circumstance. USEPA may change this guidance in the future.*

December 2011  
EPA 841-R-11-006



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Polychlorinated Biphenyl (PCB) Total Maximum Daily Load (TMDL) Handbook  
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## UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

OFFICE OF WATER

December 20, 2011

### **MEMORANDUM**

**SUBJECT:** Polychlorinated Biphenyl (PCB) Total Maximum Daily Load (TMDL) Handbook

**FROM:** Tom Wall, Acting Director /s/  
Assessment and Watershed Protection Division

**TO:** Water Division Directors, Regions 1-10

I am pleased to provide the attached document entitled "PCB TMDL Handbook." The purpose of the attached handbook is to provide Regions, states, and other stakeholders with a compendium of updated information for use in developing total maximum daily loads (TMDLs) for waterbodies impaired by polychlorinated biphenyls (PCBs). This handbook identifies various approaches to developing PCB TMDLs and provides examples of them from around the country, complete with Web references.

PCBs rank sixth among the national causes of water quality impairment in the country. Of the 71,000 waterbody-pollutant combinations listed nationally, over 5,000 (eight percent) are PCB-related. However, of the more than 46,000 TMDLs in place nationally, only about 400 (less than one percent) address PCBs as a pollutant. Our intent is that this handbook will aid in the completion of PCB TMDLs, particularly where these TMDLs will address ongoing and significant sources of PCBs.

The handbook opens with background on what PCBs are and some factors to consider in the early stages of TMDL development (e.g., scale, modeling approaches). Next, the handbook identifies the key elements of a TMDL (e.g., "Identification of Waterbodies, Pollutant Sources, Priority Ranking," "Water Quality Standards and TMDL Target," "Wasteload Allocation") and discusses how those elements can be addressed in PCB TMDLs. The handbook also summarizes and provides Web resources for related tools, including databases for PCB sources, references for analytical methods, and regional air monitoring initiatives.

We thank those who provided assistance in the development of this information and provided comments, including States. If you have further questions, please do not hesitate to contact me at 202-564-4179, or have your staff contact Sarah Furtak at 202-566-1167.

Attachment

cc: Alexandra Dunn, ACWA

## I. Overview

### A. What is the purpose of this handbook?

In this handbook, we aim to provide stakeholders with a compendium of updated information for using total maximum daily loads (TMDLs) to address waterbodies impaired by polychlorinated biphenyls (PCBs) consistent with Clean Water Act (CWA) section 303(d) and EPA regulations at 40 CFR §130.7(c)(1).

This handbook will identify different approaches that have been successfully used to develop PCB TMDLs and provide examples. In particular, the handbook will address how to develop PCB TMDLs that account for all sources of PCB contamination (including “passive” sources such as landfills in which PCBs are contaminating the soil). One goal of this handbook is to illustrate how development of PCB TMDLs take into account other program considerations (e.g., Water Quality Standards [WQS]), and how TMDLs may benefit from tools available in other programs (e.g., Superfund).

### B. Which pollutant are we addressing?

The focus of this handbook is on PCBs, one of the most significant legacy pollutants in terms of number of waterbodies impaired. PCBs rank sixth atop national causes of impairment as tracked in the Assessment, TMDL Tracking, and Implementation System (ATTAINS). PCBs represent about eight percent of all causes of impairment nationally on CWA section 303(d) lists.<sup>1</sup>

### C. What are PCBs<sup>2</sup>?

PCBs are a family of chlorinated organic compounds formed by two benzene rings linked by a single carbon-carbon bond. Various degrees of substitution of chlorine atoms for hydrogen are possible on the remaining ten benzene carbons. There are 209 possible arrangements of chlorine atoms on the biphenyl group. Each individual arrangement or compound is called a congener. Thirteen of the 209 congeners are known to show toxic responses similar to those caused by 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD), the most toxic dioxin compound.

Historically, PCBs were produced in very large quantities both within and outside the United States. Although their uses in capacitors and transformers are well known, PCBs were also used in a wide variety of applications including some involving direct contact with the environment (e.g., building materials, paints, sealants). In the United States, commercial PCBs production started in 1929 and continued until

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<sup>1</sup> This estimate is based on current cause of impairment listings in the ATTAINS database ([http://iaspub.epa.gov/waters10/attains\\_nation\\_cy\\_control?p\\_report\\_type=T](http://iaspub.epa.gov/waters10/attains_nation_cy_control?p_report_type=T)) November 18, 2011; this estimate is based on the most recent CWA section 303(d) and 305(b) data reported to EPA by states and available in ATTAINS.

<sup>2</sup> *Total Maximum Daily Load for PCBs in San Francisco Bay Final Staff Report for Proposed Basin Plan Amendment*, February 13, 2008, available at [http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/TMDLs/sfbaypcbs/Staff\\_Report.pdf](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/sfbaypcbs/Staff_Report.pdf).

1977. Importation of PCBs continued after U.S. production was banned until January 1, 1979.

PCB congeners vary markedly in their chemical and physical properties depending on the degree and position of chlorination. Important properties such as non-flammability, low electrical conductivity, high thermal stability, and high boiling point make PCBs highly stable and persistent in the environment. PCBs are also soluble in non-polar organic solvents and biological lipids, hence their tendency to bioaccumulate in living organisms.

## II. Factors to Consider in Early Stages of PCB TMDL Development

With respect to development and establishment of PCB TMDLs, as with TMDLs addressing other pollutants, a variety of factors will determine the appropriate “investment” of time and resources. Motivating factors for prioritizing establishment of PCB TMDLs include the following:

- **Consent decrees** – Legal obligation may drive the establishment of these TMDLs.
- **Stakeholder interest** – National or local environmental or citizen’s groups may have a specific interest in particular legacy pollutant listings or TMDL development decisions.
- **Risk to human health and the environment** – PCB “hot spots” in urban areas (e.g., a Superfund site) may be viewed as high priority for remediation or TMDL development to reduce risks to humans. When developing PCB TMDLs, consider developing targets protective for both human health and wildlife.

Other factors determining “investment” of time and resources with respect to PCB TMDLs, as with TMDLs addressing other pollutants, may include the scale at which PCB TMDLs are developed, pollutant sources, and the modeling approaches available:

- **Scale** -- PCB sources tend to vary in combinations and concentrations from waterbody to waterbody, and hotspots may exist. States should be careful to think about PCB concentrations when selecting the scale at which a PCB TMDL is written. For example, the Delaware River Estuary is a large-scale multijurisdictional waterbody spanning the States of DE, PA, and NJ. A TMDL was established for each of five riverine zones in order to account for the variations in PCB concentrations throughout the estuary.<sup>3</sup> The Delaware River Estuary PCB TMDLs are being revised at the time of this handbook’s development.

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<sup>3</sup> *Total Maximum Daily Loads for Polychlorinated Biphenyls (PCBs) for Zones 2-5 of the Tidal Delaware River*, December 15, 2003, available at [http://www.epa.gov/reg3wapd/tmdl/pa\\_tmdl/DelawareRiver/TMDLreport.pdf](http://www.epa.gov/reg3wapd/tmdl/pa_tmdl/DelawareRiver/TMDLreport.pdf).

- **Sources** -- A PCB TMDL can more quickly guide cleanup if a localized source or sources are determined to be affecting the waterbody (e.g., Superfund site, illegal discharge), and in turn, remediation tools and/or legal authorities are available to control the source(s). On the other hand, if the sources are more diffuse or not amenable to existing controls, environmental outcomes or benefits may manifest more slowly.

Appendix Tables 1 and 2 identify common PCB sources (e.g., incinerators, wastewater treatment plants) and related databases.

- **Modeling approaches** -- Various modeling approaches are available for developing PCB TMDLs. Level one, level two, and level three techniques for TMDL development are briefly contrasted below:
  - **Level one approaches** for PCB TMDLs include non-modeling approaches, such as assuming a proportional one-to-one relationship between PCB loadings and fish tissue, and using a bioconcentration factor to calculate a water column value. A level one approach may also involve back-calculating from the sediment targets and sediment data to determine the loading capacity. Examples of TMDLs that have used a level one approach include the Kawkawlin River in Michigan<sup>4</sup>, Lower Okanogan River Basin in Washington<sup>5</sup>, and TMDLs in California (San Diego Creek and Newport Bay<sup>6</sup>, and Calleguas Creek<sup>7</sup>).
  - **Level two approaches** may involve mass balance modeling, which estimate PCB concentrations in the water column, fish tissue and sediment using sampling data. An example of an intermediate modeling approach is the Shenandoah PCB TMDL<sup>8</sup>.
  - **Level three approaches** may involve linking a hydrodynamic sediment transport model with a PCB fate and transport model, and may also be linked with a watershed model. Examples of such complex models applicable to PCBs include a modified WASP-DYNHD hydrodynamic

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<sup>4</sup> Total Maximum Daily Load for Polychlorinated Biphenyls for the Kawkawlin River, Bay County, Michigan, August 2002, available at [http://www.epa.gov/waters/tmdl/docs/3843\\_tmdl-kawkawlin.pdf](http://www.epa.gov/waters/tmdl/docs/3843_tmdl-kawkawlin.pdf).

<sup>5</sup> Lower Okanogan River Basin DDT and PCBs Total Maximum Daily Load, October 2004, available at <http://www.ecy.wa.gov/pubs/0410043.pdf>.

<sup>6</sup> Total Maximum Daily Loads For Toxic Pollutants San Diego Creek and Newport Bay, California, June 14, 2002, available at [http://www.waterboards.ca.gov/santaana/water\\_issues/programs/tmdl/docs/sd\\_crk\\_nb\\_toxics\\_tmdl/summary0602.pdf](http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/docs/sd_crk_nb_toxics_tmdl/summary0602.pdf).

<sup>7</sup> Calleguas Creek Watershed OC Pesticides and PCBs TMDL Technical Report, June 20, 2005, available at [http://www.waterboards.ca.gov/losangeles/board\\_decisions/basin\\_plan\\_amendments/technical\\_documents/2005-010/05\\_0426/OC\\_6\\_TechnicalReport.pdf](http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/2005-010/05_0426/OC_6_TechnicalReport.pdf).

<sup>8</sup> "Shenandoah River PCB TMDL," available at [http://www.epa.gov/reg3wapd/tmdl/VA\\_TMDLs/Shenandoah/index.htm](http://www.epa.gov/reg3wapd/tmdl/VA_TMDLs/Shenandoah/index.htm).

model (used in the Delaware River Estuary PCB TMDLs<sup>9</sup> and the Tidal Portions of the Potomac and Anacostia Rivers TMDLs<sup>10</sup>).

### III. Identification of Waterbodies, Pollutant Sources, Priority Ranking

As described in existing EPA guidance, TMDLs, including PCB TMDLs, should include the following<sup>11</sup>:

- Identification of specific waterbody and pollutant (PCBs) addressed by the TMDL.
- Identification of the pollutant sources, including quantity and location(s) of National Pollutant Discharge Elimination System (NPDES)-permitted sources within the waterbody (including regulated stormwater sources) and nonpoint sources (including non-regulated stormwater sources) (also see section VI of this handbook identifying point source loadings).
- Source assessment, including amount of PCBs from air deposition, and contribution from point and legacy sources (e.g., sediments; also see section VII on nonpoint source loadings). Although a comprehensive source assessment can be challenging, states are encouraged to consider the best available data in identifying PCB sources, and to describe how PCB sources were identified. Commensurate with historic data and information on PCB presence, budget, and other priorities, conducting a good source assessment as part of a TMDL can help ensure that all sources are accounted for, and in turn, ensure that the TMDL can be better designed to address those sources. *Method 1668C: Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS* guidance describes the PCB analysis method the EPA developed for use in CWA programs and for wastewater, surface water, soil, sediment, biosolids, and tissue matrices.<sup>12</sup>
- Linkage to 303(d) list/Integrated Report (i.e., identify waterbody and impairment as it appears on the 303(d) list, the listing cycle, and priority ranking of the waterbody).
- Identification of other factors within the waterbody or watershed that may affect PCB loadings (e.g., watershed area, land use/land cover, population, future growth, distribution of sources and loadings, including air deposition, etc.).

<sup>9</sup> *Total Maximum Daily Loads for Polychlorinated Biphenyls (PCBs) for Zones 2-5 of the Tidal Delaware River*, December 15, 2003, available at [http://www.epa.gov/reg3wapd/tmdl/pa\\_tmdl/DelawareRiver/TMDLreport.pdf](http://www.epa.gov/reg3wapd/tmdl/pa_tmdl/DelawareRiver/TMDLreport.pdf). Note that these TMDLs are being revised at the time of this handbook's development.

<sup>10</sup> *Total Maximum Daily Loads of Polychlorinated Biphenyls (PCBs) for Tidal Portions of the Potomac and Anacostia Rivers in the District of Columbia, Maryland, and Virginia*, October 31, 2007, available at [http://www.potomacriver.org/cms/index.php?option=com\\_content&view=article&id=136:tidal-pcb-tmdl&catid=41:pollution&Itemid=1](http://www.potomacriver.org/cms/index.php?option=com_content&view=article&id=136:tidal-pcb-tmdl&catid=41:pollution&Itemid=1).

<sup>11</sup> Unless otherwise noted, "existing guidance" in this handbook refers primarily to EPA's guidance for TMDL approvals, *Guidelines for Reviewing TMDLs under Existing Regulations* issued in 1992, available at <http://www.epa.gov/owow/tmdl/guidance/final52002.pdf>. Although some information is repeated from the 1992 guidance, this handbook does not replace that guidance.

<sup>12</sup> *Method 1668C: Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS* guidance, April 2010, is available at <http://water.epa.gov/scitech/methods/cwa/other.cfm>. The EPA proposed this method in a September 23, 2010 Federal Register notice and is currently reviewing comments on the proposed rule. A decision has not been made on the promulgation of this method. Additional background on PCB analysis includes: Muir, Derek and Ed Sverko, 2006. *Analytical methods for PCBs and organochlorine pesticides in environmental monitoring and surveillance: a critical appraisal*. Anal Bioanal Chem. 386: 769-789, available at [http://www.inweh.unu.edu/Coastal/CCPP/2009\\_Merida/Reports/Muir&Sverko\\_AnalBioanalChem2006.pdf](http://www.inweh.unu.edu/Coastal/CCPP/2009_Merida/Reports/Muir&Sverko_AnalBioanalChem2006.pdf).

Maryland and Virginia have recently published a source tracking study and point source guidance, respectively, that may be informative to other states. The “2005 Caged Clam Study to Characterize PCB Bioavailability in the Impaired Watersheds throughout the State of Maryland” aimed to characterize Maryland subwatersheds draining into the PCB-impaired tidal waters as (i) those with no apparent sources and (ii) those with relatively significant sources of PCB runoff.<sup>13</sup> Virginia Department of Environmental Quality personnel refer to a “Guidance for Monitoring of Point Sources for TMDL Development Using Low-Level PCB Method 1668” when selecting the types of facilities that should be targeted for PCB monitoring (within PCB fish impaired waterbodies) and for its standard operating procedures for sample collection, Method 1668 analysis of the samples, and submittal of PCB data to VADEQ by permitted dischargers.<sup>14</sup>

Pursuant to CWA section 308, the EPA may enter and inspect the facilities and records of current NPDES permit holders. Inspections ascertain the degree of compliance with requirements of the NPDES permit. During such an inspection, representatives may observe process operations, inspect monitoring equipment and lab methods, collect samples, and examine appropriate records.<sup>15</sup> The opportunity to observe or collect samples may help identify point sources of PCBs that otherwise would have escaped detection.

#### IV. Water Quality Standards and TMDL Target

TMDLs are established at a level that attains and maintains the applicable WQS, including designated uses, numeric and narrative criteria, and antidegradation policy [40 CFR §130.7(c)(1)]:

- Depending on the impairment being addressed by the TMDL, existing criteria may include human health, aquatic life, and wildlife criteria.
- The state’s existing numeric PCB criterion may be a water column concentration or fish tissue value.
- TMDLs identify a numeric TMDL target or WQS criterion, a quantitative value used to attain and maintain applicable WQS, including designated uses. A TMDL also includes, as necessary depending on the nature of the sources, load allocations (LAs) and wasteload allocations (WLAs) [40 CFR § 130.2(i)].

Where a fish tissue target is used for the TMDL, appropriate justification for using a fish tissue target should be included, considering existing numeric and narrative criteria as well as designated uses.<sup>16</sup> For example, where a state has a narrative criterion such as

<sup>13</sup> Available at [http://www.mde.state.md.us/assets/document/2005\\_Corbicula\\_Study\\_final.pdf](http://www.mde.state.md.us/assets/document/2005_Corbicula_Study_final.pdf).

<sup>14</sup> *Guidance for Monitoring of Point Sources for TMDL Development Using Low-Level PCB Method 1668*, March 6, 2009, available at <http://www.deq.virginia.gov/waterguidance/pdf/092001.pdf>. Additional background on PCB analysis includes: Muir, Derek and Ed Sverko, 2006. *Analytical methods for PCBs and organochlorine pesticides in environmental monitoring and surveillance: a critical appraisal*. *Anal Bioanal Chem.* 386: 769-789, available at [http://www.inweh.unu.edu/Coastal/CCPP/2009\\_Merida/Reports/Muir&Sverko\\_AnalBioanalChem2006.pdf](http://www.inweh.unu.edu/Coastal/CCPP/2009_Merida/Reports/Muir&Sverko_AnalBioanalChem2006.pdf).

<sup>15</sup> *NPDES Compliance Inspection Manual-- Appendix E: Sample Section 308 Letter*, available at <http://www.epa.gov/oecaerth/resources/publications/monitoring/cwa/inspections/npdesinspect/npdesinspect.pdf>.

<sup>16</sup> As described in the *Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act* (“2006 IR Guidance”), when deciding whether to identify a segment as impaired, states should determine whether there are impairments of designated uses and narrative criteria, as well as the numeric criteria. The guidance notes that, while numeric human health criteria for ambient water column concentrations of pollutants are a basis for determining

“no toxics in toxic amounts,” and where a state considers there to be an impairment of a designated use due to presence of a fish consumption advisory, it may be appropriate to use a fish tissue target to interpret a narrative standard. Reliance on advisories may decrease as PCB detection levels become more precise/sensitive. The TMDL should include a demonstration of how meeting the fish tissue target will achieve WQS [40 CFR §130.7(c)].

In the San Francisco Bay PCB TMDL, the numeric target is a fish tissue concentration as fish tissue PCB concentrations are the direct cause of impairment of the designated uses. In the Palouse River Chlorinated Pesticide and PCB TMDL, numeric targets are based on fish tissue; the determination as to whether WQS have been achieved is based on fish tissue criteria.<sup>17</sup>

### Multi-state scale

For a TMDL established for a multi-jurisdictional waterbody, in addition to the above elements, TMDLs identify WQS for each applicable state and established at a level to attain and maintain the WQS in each state. The TMDL should demonstrate that it is set at a level to achieve the WQS in each state; where the state standards are different, the TMDL should include a separate TMDL calculation to meet each standard.

Large, multi-state PCB TMDL examples include the Delaware River Estuary, Ohio River, and the Potomac River and Anacostia River TMDLs. The Delaware River Estuary TMDL – being revised at the time of this guidance - addresses impairments listed in DE, NJ, and PA. The Ohio River TMDL considered WV, OH, and PA WQS; the WV standard, being most protective of human health, was used to establish TMDL endpoints within the TMDL segment. The Potomac River and Anacostia River TMDLs address impairments listed in DC, MD, and VA and are written with allocations to achieve water column concentrations less than or equal to jurisdiction-specific water quality criteria and water column and sediment concentrations less than or equal to jurisdictional fish tissue thresholds.

### Total PCBs

For San Francisco Bay in California, the EPA established the PCBs water quality criterion for the protection of aquatic life based on the sum of Aroclors (i.e., the trade name given to different types of PCB mixtures) and for the protection of human health based on total PCBs (e.g., the sum of all congeners, or isomers or homologs or Aroclor analyses).<sup>18</sup>

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impairment, the attainment of such criteria does not always mean that designated uses are being protected. For example, a segment can be meeting numeric ambient water quality criteria, but not attaining the designated uses because fish or shellfish tissue concentrations exceed levels that are protective of human health or levels used as the basis for fish consumption advisories. See the 2006 IR Guidance for additional information on listing waters with fish or shellfish consumption advisories at <http://www.epa.gov/owow/tmdl/2006IRG>.

<sup>17</sup> *Palouse River Chlorinated Pesticide and PCB Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan*, July 2007, available at <http://www.ecy.wa.gov/pubs/0703018.pdf>.

<sup>18</sup> *Total Maximum Daily Load for PCBs in San Francisco Bay Final Staff Report for Proposed Basin Plan Amendment*, February 13, 2008, available at [http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/TMDLs/sfbaypcbs/Staff\\_Report.pdf](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/sfbaypcbs/Staff_Report.pdf) and “Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. 40 CFR Part 131.38.”

In San Francisco Bay and Calleguas Creek PCB TMDLs<sup>19</sup>, the pollutant ‘total PCBs’, has been defined as:

- Sum of Aroclors;
- Sum of the individual congeners routinely quantified by the Regional Monitoring Program (RMP) or a similar congener sum; or
- Sum of the National Oceanic and Atmospheric Administration (NOAA) 18 congeners converted to total Aroclors. A comparison of the sum of 18 NOAA congeners converted to Aroclor with quantified sums of Aroclors shows relatively good correlation in one study<sup>20</sup>.

### **Sediment concentrations**

Desorption of sediment-bound PCBs may contribute significantly to the concentrations detected in water. PCBs, particularly the highly chlorinated congeners, adsorb strongly to sediment and soil where they tend to persist with half-lives on the order of months to years. Specific examples of PCB contamination in sediment follow:

#### ***Calleguas Creek***<sup>21</sup>

The applicable water quality criteria for protection of aquatic life in the Calleguas Creek Watershed are 0.014 µg/L [ppb] (freshwater) and 0.130 µg/L [ppb] (marine). Multiple numeric targets (including fish, sediment, and water) are considered in this TMDL as there is uncertainty that a single numeric target is sufficient to ensure protection of designated beneficial uses. In order to address impaired waters listings for PCBs in the water column, fish tissue, and sediment, multiple targets are used to protect organisms, wildlife, and human health from the potentially harmful effects of PCBs.

Sediment quality guidelines endorsed by NOAA and contained in NOAA's Screening Quick Reference Tables are selected as numeric targets for PCB sediment concentrations. Use of threshold effect level (TEL) values and effect range low (EFL) values for marine sediment represents a conservative (i.e., more protective) choice. Since these sediment guidelines are not EPA-approved sediment quality criteria, they are used as numeric targets only for reaches with sediment listings. The TMDL is calculated as a reduction in sediment concentration, which is based upon fish tissue and water concentrations (and consideration of sediment guidelines for reaches with sediment listings. In order to translate required reductions in fish tissue and water column concentrations into sediment concentration reductions, it is assumed that bioaccumulation factors for fish tissue to sediment and partition coefficients for water to sediment

<sup>19</sup> *Total Maximum Daily Load for PCBs in San Francisco Bay Final Staff Report for Proposed Basin Plan Amendment*, February 13, 2008, available at [http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/TMDLs/sfbaypcbs/Staff\\_Report.pdf](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/sfbaypcbs/Staff_Report.pdf). *Calleguas Creek Watershed OC Pesticides and PCBs TMDL Technical Report*, June 20, 2005, available at [http://www.waterboards.ca.gov/losangeles/board\\_decisions/basin\\_plan\\_amendments/technical\\_documents/2005-010/05\\_0426/OC\\_6\\_TechnicalReport.pdf](http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/2005-010/05_0426/OC_6_TechnicalReport.pdf)

<sup>20</sup> NOAA. 1993. Sampling and Analytical Methods of the National Status and Trends Program-National Benthic Surveillance and Mussel Watch Projects 1984-1992. NOAA Technical Memorandum NOS ORCA 71, Volume 1. July, 1993. pp.1-34-39.

<sup>21</sup> *Calleguas Creek Watershed OC Pesticides and PCBs TMDL Technical Report*, June 20, 2005, available at [http://www.waterboards.ca.gov/losangeles/board\\_decisions/basin\\_plan\\_amendments/technical\\_documents/2005-010/05\\_0426/OC\\_6\\_TechnicalReport.pdf](http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/2005-010/05_0426/OC_6_TechnicalReport.pdf).

are linear, and that a given percent reduction in fish tissue or water concentration results in an equal percent reduction in sediment concentration.

### **Ohio River<sup>22</sup>**

Although the operating WQS of 0.044 ng/L [0.000044 µg/L or ppb] for the water column was used to establish TMDL endpoints, WV and OH conducted a sediment survey to address water column PCB loads resulting in part from resuspension of contaminated sediments and to identify “hot spots.” Specific sediment quality criteria for total PCBs have not been standardized for the Ohio River; however, *The Incidence and Severity of Sediment Contamination In Surface Waters of the United States* (EPA 823-R-97-006), also known as The National Sediment Inventory, includes multiple PCB screening levels for the protection of consumers. These values are based upon theoretic bioaccumulation potential and cancer risk levels from the primary route of human exposure to contaminated sediment: consumption of fish. Screening levels are guidelines for analysis of sediment quality data; they are not regulatory criteria.

### **San Francisco Bay<sup>23</sup>**

The mass of PCBs in sediments is much greater than in the water column. However, it is important to note that a numeric PCB criterion exists in California for the water column but not for sediments.

PCB uptake by biota from sediment is well documented in the scientific literature. In a shallow bay with a large sediment PCB reservoir, such as San Francisco Bay, this is the most important pathway for PCB bioaccumulation in fish. Therefore, reducing PCB concentrations in Bay sediments is the most effective means of reducing fish tissue PCB concentrations. This TMDL uses a food web model to translate the fish tissue numeric target to a corresponding sediment concentration. It then uses a waterbody (mass budget) model to predict the long-term fate of PCBs in the Bay and determine the external load of PCBs that will attain the sediment concentration goal resulting in attainment of the fish tissue numeric target.

Starting with the numeric fish tissue target of 10 ng/g [0.01 µg/g or 10 ppb], the food web model yields a corresponding concentration of 1 µg/kg [0.001 µg/g, 1 ng/g, or 1 ppb] PCBs in sediment. This human consumption-based sediment PCB concentration goal is much lower than the sediment concentration California has deemed protective of wildlife of 160 µg/kg [0.160 µg/g, 160 ng/g, or 160 ppb] total PCBs, and is therefore considered to result in attainment of all beneficial uses currently impaired by PCBs.<sup>24</sup>

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<sup>22</sup> *Ohio River Total Maximum Daily Load (TMDL) for PCBs*, September 2002, available at [http://www.epa.gov/reg3wapd/tmdl/wv\\_tmdl/Ohio/OhioReport.pdf](http://www.epa.gov/reg3wapd/tmdl/wv_tmdl/Ohio/OhioReport.pdf).

<sup>23</sup> *Total Maximum Daily Load for PCBs in San Francisco Bay Final Staff Report for Proposed Basin Plan Amendment*, February 13, 2008, available at [http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/TMDLs/sfbaypcbs/Staff\\_Report.pdf](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/sfbaypcbs/Staff_Report.pdf).

<sup>24</sup> Water quality unit conversions available at US Geological Survey “Conversion Factors and Abbreviated Water-Quality Units,” <http://pubs.usgs.gov/circ/circ1133/conversion-factors.html>.

## V. Loading Capacity – Linking Water Quality and Pollutant Sources

TMDLs identify loading capacity and reductions needed to meet WQS [40 CFR §130.2(f)].

As described in existing EPA guidance, TMDLs should provide documentation of the approach used to establish a linkage between the numeric PCB target and PCB sources, factors within the waterbody or watershed that may affect PCB loadings, the strengths and weaknesses of the approach, and the results of any modeling. As described earlier, however, factors such as likelihood of controlling the PCB source, existence of consent decrees, and risk to human health and the environment will influence level of investment devoted to modeling and analysis (see section II).

Examples of PCB fate-and-transport assumptions that may influence the calculations in an approved TMDL include ocean influence treated as background and net burial of PCBs into sediments that result in removal of PCBs from the system. Below are additional considerations to bear in mind in conducting a linkage analysis:

- A linkage analysis may include water quality modeling or other analytical approaches, although modeling is not required.
- Selecting an analytical approach depends on the type of questions to be answered and may include simple, non-modeling approaches, mass balance approaches, and more complex modeling approaches. Types of models that may be used to calculate PCB TMDLs include steady-state, hydrodynamic, and food web models. Results of air deposition modeling, as well as runoff models, may also be used as input to water quality models in a linked approach (see section II, “Factors to Consider...”).
- Data on which the linkage analysis is based (e.g., waterbody characteristics, sources, fish tissue data) should be included in the TMDL.

Where a fish tissue target is used to establish a TMDL, states are encouraged to include the following items as part of the linkage analysis documentation. Unless otherwise noted, examples of each item below can be found in the San Francisco Bay PCB TMDL:

- A description of the fish tissue data (number of samples, concentration, locations, etc.)
- Identification of the specific fish species, or multiple species, and
- Identification of statistic used to calculate the baseline PCB concentration and the TMDL target (e.g., which percentile), and the rationale for the target level and fish species used.

## VI. Linking Water Quality and Pollutant Sources – Point Source Loadings

As described in existing TMDL guidance, the TMDL should, to the extent data allow, identify specific point sources covered by the TMDL, and the total point source loadings. Point sources may include wastewater treatment plants, combined sewer overflows

(CSOs), municipal separate storm sewer systems (MS4), rail yards, landfills, or other locations where capacitors, transformers, or other PCB-laden products have been used.

The EPA encourages states to consider the following in determining the total point source loading of PCBs:

- States are encouraged to use data on point source loadings most representative of current conditions where relevant information is available.
- Where facility or category-specific PCB discharge data are available and of appropriate quality, states are encouraged to consider such data, and develop estimates of PCB loadings applicable to each category of sources (e.g., wastewater treatment, power plants, stormwater, and other potential PCB dischargers), rather than calculating a single average for all types of dischargers.
- Where source-specific data are not available, states are encouraged to develop representative estimates for loadings for each source category or land use.
- States should indicate how they have accounted for PCB contributions from NPDES-permitted stormwater sources in the estimate of total PCB loadings. Contributions from NPDES-permitted sources should be included in the point source estimate, and contributions from non-NPDES permitted stormwater sources may be included in the estimate of nonpoint source loadings<sup>25</sup>. States are encouraged to estimate contributions from specific NPDES-permitted sources such as MS4s.
- Maps showing location of key sources, land-use, and other waterbody characteristics are encouraged.

## **VII. Linking Water Quality and Pollutant Sources – Nonpoint Source Loadings**

EPA regulations say that LAs “may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading” [40 CFR §130.2(g)]. The EPA encourages states to consider the most recent and best available data.

As described in existing TMDL guidance, the TMDL should include estimates of nonpoint source loadings (e.g., atmospheric deposition, contaminated sediment, runoff from contaminated sites, groundwater). The EPA encourages states to consider the following in developing such estimates:

- As with point sources, maps showing the location of key sources or source areas are encouraged.
- Loading estimates should account for air deposition and nonpoint sources other than those nonpoint sources containing loadings from air deposition (e.g., runoff from waste sites, legacy sources). States may wish to use runoff models to estimate PCB loadings to the waterbody from the watershed.
- While not necessary for developing the load allocation (LA), parsing out the contributions to the air deposition loading may be helpful in developing an implementation plan. Parsing out contributions to the air deposition loading is

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<sup>25</sup> “Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs,” November 22, 2002, available at <http://www.epa.gov/npdcs/pubs/final-wwtmdl.pdf>.

contingent upon decisions regarding the appropriate level of analysis; if contribution from air is small, environmental outcomes or benefits may not be commensurate with the amount of effort spent on this analysis. For example, in contrasting two water quality impairment scenarios -- a rural Kansas scenario vs. a downtown Chicago scenario -- industry codes in the latter may be able to help identify PCB release information.

- Studies have also shown that PCB flux from water to air is significant; according to the San Francisco Bay TMDL, PCBs escape to the atmosphere from the Bay at a greater rate than they are deposited from the atmosphere, resulting in a net loss of PCBs.<sup>26</sup> Similarly, a Lake Michigan Mass Balance Study publication concluded from the concentration and distribution of PCB congeners collected from vapor over water, over land, and dissolved in the water, that volatilization of PCBs from contaminated waters is a major source of PCBs to the local atmosphere.<sup>27</sup>
- Developing a detailed source identification plan may be especially important in a highly populated urban area for protection of human health.
- Where possible, the TMDL should include estimates of the contributions from air deposition to permitted stormwater sources and account for such loadings in the point source load estimate, rather than the nonpoint source load estimate. Contributions from nonpermitted stormwater sources may be included in the nonpoint source loading estimate.<sup>28</sup>

Examples of PCB TMDLs that quantify nonpoint source loadings include State of Washington PCB TMDLs. In the Lower Okanogan River Basin DDT and PCB TMDL and the Palouse River Chlorinated Pesticide and PCB TMDL, sediment, runoff from waste sites, and legacy sources are considered to be nonpoint sources of focus.<sup>29</sup>

<sup>30</sup>The Lower Okanogan River Basin DDT and PCB TMDL examines the relationship between contamination of fish tissue and bottom sediments.<sup>31</sup> Also, the Palouse River Chlorinated Pesticide and PCB TMDL evaluates total suspended solids levels from nonpoint source drainages and legacy hazardous waste sites.<sup>32</sup>

As mentioned earlier in this section VII, the nonpoint source loading portion of the TMDL may include, as appropriate, LAs for contaminated sites. The Delaware River Estuary PCB TMDLs, for example, acknowledge that reducing NPDES permitted point source discharges alone will not be sufficient to achieve estuary WQS. Runoff from

<sup>26</sup> *Total Maximum Daily Load for PCBs in San Francisco Bay Final Staff Report for Proposed Basin Plan Amendment*, February 13, 2008, available at [http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/TMDLs/sfbaypcbs/Staff\\_Report.pdf](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/sfbaypcbs/Staff_Report.pdf).

<sup>27</sup> Hornbuckle, K.C. et al, 1993. Over-Water and Over-Land Polychlorinated Biphenyls in Green Bay, Lake Michigan. *Environ. Sci. Technol.* 27(1): 87-98, abstract available at <http://www.epa.gov/glnpo/lmmb/results/pubs.html>.

<sup>28</sup> "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs," November 22, 2002, available at <http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf>.

<sup>29</sup> *Lower Okanogan River Basin DDT and PCBs Total Maximum Daily Load*, October 2004, available at <http://www.ecy.wa.gov/pubs/0410043.pdf>.

<sup>30</sup> *Palouse River Chlorinated Pesticide and PCB Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan*, July 2007, available at <http://www.ecy.wa.gov/pubs/0703018.pdf>.

<sup>31</sup> *Lower Okanogan River Basin DDT and PCBs Total Maximum Daily Load*, October 2004, available at <http://www.ecy.wa.gov/pubs/0410043.pdf>.

<sup>32</sup> *Palouse River Chlorinated Pesticide and PCB Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan*, July 2007, available at <http://www.ecy.wa.gov/pubs/0703018.pdf>.

contaminated sites is a significant source of PCBs: the combined load from these 49 sites in the Delaware watershed comprises about 57% of the loading from Zone 3, 38% of the loading from Zone 4, and about 46% of the loading from Zone 5.<sup>33</sup>

### **Regional air monitoring initiatives**

There may be air deposition data that can be used in TMDL development as a result of various air monitoring efforts. Air monitoring efforts include the following:

#### ***Great Lakes***

Since 1990, the EPA's Great Lakes National Program Office (GLNPO) has utilized the Integrated Atmospheric Deposition Network (IADN)<sup>34</sup>, a joint project with Canada, to determine atmospheric PCB loadings, look at trends in PCB concentrations, and use data to measure progress. IADN consists of 15 monitoring sites around the Great Lakes, five of which are US sites.

IADN also works with an EPA transformer database covering the Great Lakes States, New York, Pennsylvania and New Jersey. IADN data indicate no correlation between transformers and concentrations of PCBs (i.e., transformers are fairly closed systems); however, it is likely that data are missing (e.g., there may be discrepancies as industries have been phased out of the database). GLNPO still recommends phasing out transformers associated with PCBs as a means of restoring water quality within the Great Lakes system.

#### ***Western Airborne Contaminants Assessment Project (WACAP)***

This project was initiated to determine risk to ecosystems and food webs in eight core national parks -- in the western US and Alaska -- from long-range transport of airborne contaminants. From 2002 to 2007, analysis of the concentration and biological effects of contaminants in air, snow, water, sediment, lichen, conifer needles, and fish was conducted in the national parks. Partners include the National Park Service, the EPA, US Geologic Survey, US Forest Service, Oregon State University, and University of Washington.<sup>35</sup>

#### ***New Jersey Atmospheric Deposition Network (NJADN)***

NJ Department of Environmental Protection and Rutgers University partnered to measure concentrations of PCBs in air (gas phase), aerosol (particle phase), and precipitation at ten NJ sites representing an array of land-use regimes at regular intervals between 1997 and 2003. Based on the measured gas, particle, and precipitation phase concentrations, NJADN researchers estimated the atmospheric deposition flux, or flow, of total PCBs at the different sites.<sup>36</sup>

<sup>33</sup> Total Maximum Daily Loads for Polychlorinated Biphenyls (PCBs) for Zones 2-5 of the Tidal Delaware River, December 15, 2003, available at [http://www.epa.gov/reg3wapd/tmdl/pa\\_tmdl/DelawareRiver/TMDLreport.pdf](http://www.epa.gov/reg3wapd/tmdl/pa_tmdl/DelawareRiver/TMDLreport.pdf).

<sup>34</sup> USEPA IADN website is available at <http://www.epa.gov/glnpo/monitoring/air2/index.html>.

<sup>35</sup> National Park Service and USEPA "Western Airborne Contaminants Assessment Project" available at [http://www.nature.nps.gov/air/Studies/air\\_toxics/wacap.cfm](http://www.nature.nps.gov/air/Studies/air_toxics/wacap.cfm) and <http://www.epa.gov/nheerl/wacap/>, respectively.

<sup>36</sup> NJ Dept. of Environmental Protection "New Jersey Atmospheric Deposition Network" available at <http://www.state.nj.us/dep/dsr/njadn/> and Atmospheric Deposition: PCBs, PAHs, organochlorine pesticides, and Heavy Metals available at <http://www.nj.gov/dep/dsr/trends2005/pdfs/atmospheric-dep-pcbs.pdf>.

***San Francisco Estuary Institutes' Regional Monitoring Program for Trace Substances (RMP) and Watersheds Science Program***

The RMP is made up of a group of representatives from wastewater treatment plants, stormwater agencies, industrial dischargers, and the San Francisco Bay Water Board. The RMP works to support the development of TMDLs and other water quality attainment strategies for the San Francisco Bay.

The Watersheds Science Program provides Bay area environmental managers with quality science information in the context of the whole system (watersheds, the airshed, wetlands, and the Bay).<sup>37</sup>

***Chesapeake Bay Atmospheric Deposition Network Nutrient-Toxics Deposition Monitoring Program (CBAD-NT)***

The CBAD-NT was conducted at urban and non-urban sites along the shoreline of the Chesapeake Bay during 1995-1999. The primary objective of the CBAD-NT study was to provide the best possible estimates of total, annual atmospheric loadings of nitrogen-based nutrients and organic contaminants, including PCBs, directly to the surface waters of the Chesapeake Bay, and to conduct a study of a series of key processes for estimating reductions in deposition to the watershed and delivered loads to the tidal bay.<sup>38</sup>

## VIII. Wasteload Allocation (WLA)

TMDLs include WLAs which identify the portion of the loading capacity allocated to individual existing and future point sources [40 CFR §130.2(h), 40 CFR §130.2(i)].

Consistent with the 2006 decision by the D.C. Circuit Court of Appeals in *Friends of the Earth v. EPA*, the EPA has recommended that TMDL allocations be expressed as a daily load<sup>39</sup>. Because PCB levels in fish represent bioaccumulation over longer periods of time, it may be appropriate to express allocations in PCB TMDLs as both an annual and daily load. If appropriate, states may also express allocations using other averaging periods, such as seasonal, in addition to a daily load.

### Stormwater

NPDES-permitted stormwater discharges are included in a TMDL's WLA [40 CFR §130.2(h)<sup>40</sup>].

Here are three examples of TMDLs that address stormwater within their WLA:

<sup>37</sup> San Francisco Estuarine Institute, "Programs" website, available at <http://www.sfei.org/programs>.

<sup>38</sup> Maryland Power Plant Research Program, "Chesapeake Bay Atmospheric Deposition Network Nutrient-Toxics Deposition Monitoring Program" available at [http://www.esm.versar.com/pprp/features/Atmosdep/regional\\_sites/cbadsnt/cbadnt\\_prog.html](http://www.esm.versar.com/pprp/features/Atmosdep/regional_sites/cbadsnt/cbadnt_prog.html).

<sup>39</sup> See Establishing TMDL "Daily" Loads in Light of the Decision by the US Court of Appeals for the DC Circuit in *Friends of the Earth, Inc. v. EPA, et al.*, No. 05-5015, (April 25, 2006) and Implications for NPDES Permits at <http://www.epa.gov/owow/tmdl/dailyloadsguidance.html>. Note that, as described in the latter memo, the Court decision regarding daily loads does not imply that NPDES permit limits must be expressed in daily terms.

<sup>40</sup> See "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs," November 22, 2002, available at <http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf>.

**San Francisco Bay<sup>41</sup>**

The TMDL identifies the two major sources of PCB loadings to the Bay as Delta inflow from the Central Valley watershed and urban stormwater discharges. Sediments from the Central Valley watershed carry a large mass of PCBs but are lower in concentration than in-Bay sediments, potentially helping to reduce current impacts of PCBs on the Bay by burying more contaminated sediments. Implementation of the TMDL is thus focused on reducing sediment PCB concentrations by controlling PCB sources in urban stormwater discharges.

A potential means to reduce urban stormwater discharge of PCB loads might be to strategically intercept and route stormwater to municipal wastewater treatment facilities. The TMDL designates a separate WLA for discharges associated with urban stormwater treatment via municipal wastewater treatment facilities, since such actions will result in increased PCBs loads from municipal wastewater dischargers. The individual WLAs for municipal wastewater treatment works dischargers reflect current performance levels.

The TMDL also includes WLAs for stormwater discharges for each county. These WLAs apply to all NPDES permitted municipal stormwater discharges. These WLAs implicitly include all current and future permitted discharges within the geographic boundaries of municipalities and unincorporated areas within each county. Examples of sources of PCBs in stormwater discharges include, but are not limited to, California Department of Transportation (Caltrans) roadways and non-roadway facilities, atmospheric deposition, public facilities, properties proximate to stream banks, industrial facilities, and construction sites.

**Delaware River Estuary<sup>42</sup>**

In the 2003 Stage 1 PCB TMDL for the tidal Delaware River, point sources include all municipal and industrial discharges subject to regulation by the NPDES permit program, including CSOs and stormwater discharges. This Stage 1 TMDL explicitly assigns a portion of each of the different estuary zone WLAs to storm water discharges.

In developing the Stage 1 TMDLs, the WLAs were calculated for traditional point source discharges based upon effluent concentrations and the actual effluent flows during a one-year model cycling period.

**Calleguas Creek<sup>43</sup>**

An aggregate concentration-based WLA was developed for MS4s. The aggregate allocation will apply to all NPDES-regulated municipal stormwater

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<sup>41</sup> *Total Maximum Daily Load for PCBs in San Francisco Bay Final Staff Report for Proposed Basin Plan Amendment*, February 13, 2008, available at [http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/TMDLs/sfbaypcbs/Staff\\_Report.pdf](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/sfbaypcbs/Staff_Report.pdf).

<sup>42</sup> *Total Maximum Daily Loads for Polychlorinated Biphenyls (PCBs) for Zones 2-5 of the Tidal Delaware River*, December 15, 2003, available at [http://www.epa.gov/reg3wapd/tmdl/pa\\_tmdl/DelawareRiver/TMDLreport.pdf](http://www.epa.gov/reg3wapd/tmdl/pa_tmdl/DelawareRiver/TMDLreport.pdf).

<sup>43</sup> *Calleguas Creek Watershed OC Pesticides and PCBs TMDL Technical Report*, June 20, 2005, available at [http://www.waterboards.ca.gov/losangeles/board\\_decisions/basin\\_plan\\_amendments/technical\\_documents/2005-010/05\\_0426/OC\\_6\\_TechnicalReport.pdf](http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/2005-010/05_0426/OC_6_TechnicalReport.pdf).

discharges in the watershed. Stormwater WLAs will be translated into the NPDES permits as ambient receiving water PCB concentration limits measured at instream discharge points for each subwatershed. They will be achieved through the implementation of best management practices (BMPs) as outlined in the implementation plan. Compliance will be determined through the measurement of in-stream water quality, sediment, and fish tissue measurements at the base of each subwatershed. To facilitate stormwater co-permittees measuring compliance in all six subwatersheds, additional monitoring stations will be needed in four of the subwatersheds mentioned within the TMDL.

### **Reserve capacity and WLA**

A portion of a TMDL's loading capacity may be set aside as a "reserve" to allow for future increases in pollutant loading. Use of a reserve may be relevant to PCB TMDLs in particular, as there may be unexpected discharges of PCBs not identified in the initial TMDL. The concept of reserving loading capacity for "future" sources of pollutants is expressly included in the definitions of "wasteload" and "load" allocations [40 CFR § 130.2(g), 40 CFR § 130.2(h)]. Thus, a TMDL may assign a WLA or LA to a particular source that is larger than its current pollutant contribution to allow room for future loading increases by that source (in other words, using design capacity of a facility in setting its WLA). A TMDL may also set aside a gross, unallocated "reserve" (as part of the overall WLA, the overall LA, or the overall total loading capacity) to account for increased future pollutant contributions from a variety of existing or future sources. In all cases, the sum of the WLAs, LAs, the margin of safety (if an explicit load has been defined), and any reserve capacity must be equal to or less than the loading capacity ( $TMDL = \Sigma WLA + \Sigma LA + MOS + Reserve$ ). The EPA does not support trading of pollutants considered by the EPA to be persistent bioaccumulative toxics (PBTs).<sup>44</sup>

In the case of PCB TMDLs for waterbodies where there are no permitted or unpermitted point source dischargers at the time the TMDL is established, inclusion of a reserve capacity in a TMDL's WLA could allow for permits for newly identified sources.

A reserve for future pollutant contributions from point sources may be included in the TMDL as a WLA. The EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to the individual existing and future point source(s) [40 CFR §130.2(h), 40 CFR §130.2(i)]. Reserve capacity may be incorporated into the individual WLA of each individual point source. One method is to allocate a WLA at design flow of a facility when the facility is currently permitted under capacity. Individual WLA reserves may also be expressed as a percentage of the initial WLA as calculated in the Delaware River Estuary Volatile Organics and Toxicity TMDLs.<sup>45</sup>

It may be reasonable to express allocations from multiple point sources as a single categorical WLA when data and information are insufficient to assign each source or

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<sup>44</sup> USEPA "Final Water Quality Trading Policy," January 2003, available at <http://www.epa.gov/owow/watershed/trading/finalpolicy2003.html>.

<sup>45</sup> *Wasteload Allocations for Volatile Organics and Toxicity: Phase I TMDLs for Toxic Pollutants in the Delaware River Estuary*, December 1998, available at <http://www.state.nj.us/drbc/reqs/wlareport.pdf>.

outfall individual WLAs.<sup>46</sup> In a PCB TMDL, it may thus be reasonable to set aside a gross WLA reserve to account for the following PCB point source loadings: (a) post-TMDL identified discharges from existing NPDES permittees that were not captured in a specific WLA (in other words, newly identified discharges from NPDES permittees that did not have PCB limits previously); and (b) newly identified dischargers (those not holding any NPDES permits previously).

### **Protecting Local Water Quality**

Where a TMDL includes an aggregate allocation, states are strongly encouraged to include specific information on how NPDES permits, including stormwater permits, will be implemented. It is recommended that the TMDL specifically state that, at the time of permit issuance, an analysis will be conducted to determine that there will be no localized exceedances of the WQS. For example, three stormwater outfalls are located in hypothetical Smith Creek watershed with an aggregate allocation of 30 units per day. One outfall is considerably closer to Smith Creek than the other two and wants a larger allocation of 12 units per day. The two remaining outfalls would then have an allocation of 9 units per day each. These allocations may be appropriate as long as they will not be contributing to localized exceedances of the WQS or designated uses at any of the three outfalls. Another option, using the same three stormwater outfalls, would be to assign a smaller allocation to the closer outfall to Smith Creek if necessary to implement WQS and designated uses due to the proximity of the outfall to the impaired waterbody.

### **IX. Load Allocation (LA)**

TMDLs include a LA, which identifies the portion of the loading capacity attributed to existing and future nonpoint sources and natural background. LAs may range from reasonably accurate estimates to gross allotments [40 CFR §130.2(g)].

As described in VIII above, contributions from NPDES-permitted stormwater sources that include contributions from air deposition should be included in the WLA. Contributions from air deposition in stormwater discharges not currently subject to NPDES regulation may be included in the LA.<sup>47</sup>

As with WLAs, the LAs should be expressed as a daily load; however, given bioaccumulative properties of PCBs, TMDL writers may wish to express allocations as both an annual and daily load.

### **X. Margin of Safety (MOS)**

TMDLs include an MOS to account for uncertainty in relationship between pollutant loads and quality of receiving water [CWA §303(d)(1)(C), 40 CFR §130.7(c)(1)]. As described in existing guidance, the MOS may be implicit (conservative assumptions in

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<sup>46</sup> "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs," November 22, 2002, available at <http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf>.

<sup>47</sup> See "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs," November 22, 2002, available at <http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf>.

the calculations or overall approach) or explicit (e.g., build in additional percent load reduction). For an implicit MOS, the TMDL should describe the assumptions used to account for the MOS. The MOS in a TMDL is distinct from the conservative assumptions that may be incorporated into a WQS.

### Implicit MOS

Examples of implicit MOS in PCB TMDLs include, but are not limited to, the following:

- Conservative approach to derive fish tissue target<sup>48</sup>
- Conservative assumptions of (1) mass assumed to be completely conserved as it passes through the study area and (2) existing OH River tributary loadings estimated using conservative approach<sup>49</sup>
- Combination of several conservative assumptions, including (1) selecting the greater percent reduction required of water or fish tissue concentrations as the basis for determining the percent reduction required in sediment, (2) ensuring protection of downstream subwatersheds from upstream inputs by reducing the allowable concentration for upstream subwatersheds where downstream allowable concentrations are lower, (3) decision to use the lower of the allowable concentration or the numeric target for sediment as the WLA and LA for all reaches with 303(d) listings for sediment.<sup>50</sup>

### Explicit MOS

A range of explicit MOS values from five percent to 20% of the total loading were observed in the sample of TMDLs below. The choice of a specific, explicit MOS will depend on the facts of each particular TMDL. States are encouraged to document and explain the basis for the particular MOS value they choose.

The Palouse River Chlorinated Pesticide and PCB TMDL<sup>51</sup> recognizes the uncertainties associated with stormwater and WWTP loading of PCBs and dieldrin, and includes a safety margin of 20% of the loading capacities of the South Fork and mainstem Palouse River.

Within the Newport Bay and San Diego Creek TMDLs for toxic pollutants<sup>52</sup>, a 10% explicit MOS was applied to account for uncertainties in the analysis. A 10% MOS was subtracted from the loading capacity or existing load, whichever was the smaller value. An explicit MOS was deemed appropriate because of significant uncertainty in the analysis of pollutant effects, loads, fate (i.e., chemical transformations and degradation following discharge), and transport in the watershed. The data supporting the TMDLs

<sup>48</sup> *Total Maximum Daily Load for PCBs in San Francisco Bay Final Staff Report for Proposed Basin Plan Amendment*, February 13, 2008, available at [http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/TMDLs/sfbaypcbs/Staff\\_Report.pdf](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/sfbaypcbs/Staff_Report.pdf).

<sup>49</sup> *Ohio River Total Maximum Daily Load (TMDL) for PCBs*, September 2002, available at [http://www.epa.gov/reg3wapd/tmdl/wv\\_tmdl/Ohio/OhioReport.pdf](http://www.epa.gov/reg3wapd/tmdl/wv_tmdl/Ohio/OhioReport.pdf).

<sup>50</sup> *Calleguas Creek Watershed OC Pesticides and PCBs TMDL Technical Report*, June 20, 2005, available at [http://www.waterboards.ca.gov/losangeles/board\\_decisions/basin\\_plan\\_amendments/technical\\_documents/2005-010/05\\_0426/OC\\_6\\_TechnicalReport.pdf](http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/2005-010/05_0426/OC_6_TechnicalReport.pdf).

<sup>51</sup> *Palouse River Chlorinated Pesticide and PCB Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan*, July 2007, available at <http://www.ecy.wa.gov/pubs/0703018.pdf>.

<sup>52</sup> *Total Maximum Daily Loads For Toxic Pollutants San Diego Creek and Newport Bay, California*, June 14, 2002, available at [http://www.waterboards.ca.gov/santaana/water\\_issues/programs/tmdl/docs/sd\\_crk\\_nb\\_toxics\\_tmdl/summary0602.pdf](http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/docs/sd_crk_nb_toxics_tmdl/summary0602.pdf).

were somewhat limited. Additionally, for all pollutants the TMDLs also incorporate an implicit MOS because numerous conservative assumptions were made to ensure that the analytical methods applied are environmentally protective.

The Delaware River Basin Commission's (DRBC's) Toxic Advisory Committee recommended use of an explicit MOS of five percent within the Stage 1 PCB TMDLs. This recommendation, which was adopted in the TMDLs, was based upon the use of a one-year cycling period for the hydrodynamic and water quality model. Since the conditions under which the TMDL is determined, like tributary flows, are related to the long-term conditions and not to design conditions associated with human health WQS for carcinogens (such as the harmonic mean flow of tributaries), expression of the MOS as an explicit percentage of each zone TMDL was considered more appropriate than an implicit MOS.

## **XI. Critical Conditions and Seasonal Variation**

TMDL calculations take into account critical conditions for stream flow, loading and water quality parameters [40 CFR §130.7(c)(1)]. For PCBs, critical conditions might be based upon freshwater flow rates due to precipitation regardless of season. Thus, the applicable allocation for a given source does not depend on time of year, but on actual stream flow (or associated sediment disposition rate for organochlorine compounds) at time of discharge. Wet weather events, which may occur at any time of the year, produce extensive sediment redistribution and transport downstream. This would be considered the critical condition for loading; however, the effects of organochlorine compounds are manifested over long time periods in response to bioaccumulation in the food chain. Therefore, short term loading variations (within the time scale of wet and dry seasons each year) are not likely to cause significant variations in beneficial use effects. The Newport Bay and San Diego Creek TMDLs<sup>53</sup>, for example, consider seasonal variations in loads and flows but are established in a manner that accounts for the longer time horizon in which ecological effects may occur.

As PCBs bioaccumulate over time, annual variations may be considered more important than seasonal variations, particularly if a fish tissue target is used. States are encouraged to indicate how, when, and where fish tissue data were collected.

## **XII. Reasonable Assurance**

When a TMDL is developed for waters impaired by point sources only, the issuance of an NPDES permit provides the reasonable assurance that the WLAs contained in the TMDL will be achieved. This is because 40 CFR 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with "the assumptions and requirements of any available wasteload allocation" in an approved TMDL.<sup>54</sup>

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<sup>53</sup> *Total Maximum Daily Loads For Toxic Pollutants San Diego Creek and Newport Bay, California*, June 14, 2002, available at [http://www.waterboards.ca.gov/santaana/water\\_issues/programs/tmdl/docs/sd\\_crk\\_nb\\_toxics\\_tmdl/summary0602.pdf](http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/docs/sd_crk_nb_toxics_tmdl/summary0602.pdf).

<sup>54</sup> May 2002 "Guidelines for Reviewing TMDLs Under Existing Regulations Issued in 1992," available at <http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/final52002.cfm>.

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, the EPA's 1991 TMDL Guidance states that the TMDLs should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for the EPA to determine that the TMDL, including the LAs and WLAs, has been established at a level necessary to implement WQS. The EPA's August 1997 TMDL Guidance also directs Regions to work with states to achieve TMDL LAs in waters impaired only by nonpoint sources.<sup>55</sup>

For TMDLs for PCB-impaired waters, the reasonable assurance demonstration is challenging because of the nature of the sources and the inability to trade allocations among nonpoint and point sources. Each TMDL's demonstration of reasonable assurance is, of necessity, case-specific and therefore states are encouraged to contact their EPA Region.

### **XIII. Post-TMDL Monitoring**

States are encouraged to implement a multi-media monitoring program, commensurate with prevalence and availability of PCBs, budget, and other priorities, to track progress in reducing emissions and loadings from PCB source categories and, in turn, to track progress toward the TMDL target.

Where discharge data on particular sources or source categories is not available when developing the TMDL, follow-up monitoring by those sources is encouraged. Further monitoring can assist in refining the loading estimates and allocations using an adaptive management approach. States are encouraged to implement as many elements of a multi-media program as possible to reduce PCB loadings, depending on resources.

A monitoring plan should identify which parameters will be monitored and the frequency of monitoring. States may also wish to identify a baseline against which to measure progress.

#### **Delaware River Estuary**

The 2003 Stage 1 TMDLs for PCBs within the tidal Delaware River Estuary anticipate that facilities that discharge to the river, including its tributary streams, will develop and implement a pollutant minimization plan (PMP)<sup>56</sup>. This PMP is expected to include a list of all known and suspected point and nonpoint sources of PCBs, a description of studies used to track down PCBs (i.e., evaluate the most appropriate sampling and analytical techniques for identifying PCB contamination to the municipal utility authority

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<sup>55</sup> May 2002 "Guidelines for Reviewing TMDLs Under Existing Regulations Issued in 1992," available at <http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/final52002.cfm>.

<sup>56</sup> *Total Maximum Daily Loads for Polychlorinated Biphenyls (PCBs) for Zones 2-5 of the Tidal Delaware River*, December 15, 2003, available at [http://www.epa.gov/reg3wapd/tmdl/pa\\_tmdl/DelawareRiver/TMDLreport.pdf](http://www.epa.gov/reg3wapd/tmdl/pa_tmdl/DelawareRiver/TMDLreport.pdf). *PCB TMDLs, Pollution Minimization Plans, and Source Trackdown in Camden City*, August 2008, available at <http://www.state.nj.us/dep/dsr/health/trackdown-rps.pdf>.

(MUA) collection system and identifying upland sources), a description of actions to minimize the discharge of PCBs, and a proposed time frame for PCB load reductions.

Innovative methods explored in this study included the use of PCB analytical Method 1668a to attain high sensitivity in sampling, including quantification of 124 separate PCB congeners as a means to identify unique source signatures, the use of passive in-situ continuous extraction samplers (PISCES) for sample integration over long time periods (14 days), the use of inexpensive immunoassay techniques for sampling PCBs in street soils, and the use of NJ Department of Environmental Protection's hazardous waste site's electronic data collection system in conjunction with a geographic information system (GIS) to screen and isolate potential upland sources for further investigation.<sup>57</sup> The pilot study was carried out in two phases. Phase 1 involved only in-sewer sampling of wastewater to identify sewersheds with PCB hotspots. Phase 2 followed up on this sampling with additional in-sewer sampling but also with more detailed street soil sampling for PCBs in front of suspect facilities.

### **Ohio River**

The Ohio River PCB TMDL<sup>58</sup> states that initial actions were to be focused on addressing current point sources of PCBs. Limited sampling identified publicly owned treatment works (POTWs) as possible point sources. Additional monitoring was deemed necessary to better quantify the loadings from these facilities. Once loadings are established possible control strategies can be considered.

Limited high-volume water sampling conducted on the effluent at two municipal wastewater treatment plants within the TMDL study area revealed the presence of PCBs. Similar results were found at another POTW downstream of the study area. Considering the large number of POTWs within the entire Ohio River Basin, the potential loadings from these facilities may be significant. The TMDL recommended additional monitoring be conducted to more accurately quantify the PCB loads discharged from POTWs and to determine the amount of PCBs attributable to source water loadings.

## **XIV. Implementation**

An implementation plan is not a federally-required element of a TMDL that is subject to EPA approval. However, a TMDL implementation plan is required in some states as a matter of state law. The EPA encourages states to develop an implementation plan for PCB TMDLs even where one is not required. In addition to implementing PCB TMDLs through NPDES permits, a number of additional implementation authorities, sources, and approaches, which could be involved in development of implementation plans for PCB TMDLs, are provided here.

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<sup>57</sup> Note Method 1668C: Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS guidance, April 2010, available at <http://water.epa.gov/scitech/methods/cwa/other.cfm>, describes the updated analytical method version (1668C).

<sup>58</sup> Ohio River Total Maximum Daily Load (TMDL) for PCBs, September 2002, available at [http://www.epa.gov/reg3wapd/tmdl/ww\\_tmdl/Ohio/OhioReport.pdf](http://www.epa.gov/reg3wapd/tmdl/ww_tmdl/Ohio/OhioReport.pdf).

### **Superfund and Toxic Substances Control Act**

In implementing a PCB TMDL, the EPA recommends coordinating with the Superfund Program. TMDLs established by states, territories or authorized Indian tribes may or may not be promulgated as rules. Therefore, TMDLs established by states, territories, or authorized Indian tribes, should be evaluated on a regulation-specific and site-specific basis. EPA-established TMDLs are not promulgated as rules, are not enforceable, and, therefore, are not appropriate or relevant and appropriate requirements (ARARs). Even if a TMDL is not an ARAR, it may aid in setting protective cleanup levels and may be appropriately a TBC ["to be considered"]. Project managers should work closely with regional EPA Water program and state personnel to coordinate matters relating to TMDLs. The project manager should remember that even when a TMDL or wasteload allocation is not enforceable, the water quality standards on which they are based may be ARARs. TMDLs can also be useful in helping project managers evaluate the impacts of continuing sources, contaminant transport, and fate and effects. Similarly, Superfund's remedial investigation and feasibility study may provide useful information and analysis to the federal and state water programs charged with developing TMDLs.<sup>59</sup>

The principal federal law regulating PCBs is the Toxic Substances Control Act (TSCA) and its implementing regulations, including regulations at 40 CFR 761<sup>60</sup>. EPA regulations under TSCA allow discharge of water to a treatment works or navigable waters if the PCB concentration is less than 3 ug/L (parts per billion), or if the concentration complies with a PCB water discharge limit in the discharger's CWA permit [40 CFR 761(b)(1)(ii)].

Although PCBs were banned in 1979, the EPA's regulations under TSCA allow the inadvertent manufacture of PCBs as the result of some manufacturing processes. Under the regulations, a manufacturer can have up to 50 ppm PCBs in products leaving the manufacturing site (except components of detergent bars can only have less than 5 ppm), so long as the annual average concentration in those products is less than 25 ppm, and so long as the manufacturer complies with other restrictions, including proper disposal of any PCB wastes produced [40 CFR 761.20(b), 761.3]. EPA regulations also allow the continued use of PCBs in various electrical and other applications, under certain conditions [40 CFR 761.30].

Examples of Superfund Program response actions that have been initiated to help clean up waterways and sediments contaminated with PCBs include the Lower Duwamish Waterway Site Washington and the Hudson River Site in New York (see "Sediment Sources: Dredging and Excavation" further below).

### **Air Sources**

When developing PCB TMDLs, states are not required to identify contributions from individual air sources or air source categories; however, identifying such contributions

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<sup>59</sup> EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*, December 2005, available at <http://www.epa.gov/superfund/health/conmedia/sediment/pdfs/guidance.pdf> .

<sup>60</sup> [http://www.access.gpo.gov/nara/cfr/waisidx\\_08/40cfr761\\_08.html](http://www.access.gpo.gov/nara/cfr/waisidx_08/40cfr761_08.html)

can assist in developing a targeted implementation plan. PCBs may be released to the air from equipment or materials that are still in use, such as transformers and fluorescent light ballasts; disposal sites containing transformers, capacitors, and other PCB waste; incineration of PCB-containing wastes, particularly PCB-containing oils; and redistribution and transport of PCBs already present in the environment.<sup>61</sup> For PCB air sources over which a state has control, particularly the most significant sources, TMDL implementation may be based on existing delegated and/or approved federal air program requirements. States are encouraged to address air sources not already covered by federal requirements. States should also evaluate cumulative emissions from air sources other than the most prominent (i.e., secondary, tertiary) and adopt controls as appropriate.

### **Water Pollutant Minimization Plans (PMPs)**

The EPA's existing regulations require NPDES permits to include WQBELs to control all pollutants or pollutant parameters that the permitting authority determines are or may be discharged at a level which will cause, have a reasonable potential to cause, or contribute to an excursion above any state WQS, including state numeric and narrative criteria for water quality [40 CFR §122.44(d)(1)(i)]. In the case of waters impaired by PCBs, states may consider implementing compliance schedules and cost-effective pollutant minimization plans (PMPs) for wastewater treatment plants and industrial discharges [see "Pollutant Minimization Plans (PMPs)," below]. For implementation of the WLA by permitted sources, also see discussion under previous sections VIII ["Wasteload Allocation (WLA)"] and XII ("Reasonable Assurance").

### **Sediment Sources**

TMDL implementation plans might discuss anticipated remediation measures. Remediation approaches for PCBs include capping and dredging. Descriptions of these measures and examples within PCB TMDL implementation plans or discussions follow:

#### ***Capping***

In-situ capping refers to the placement of a subaqueous covering or cap of clean material over contaminated sediment that remains in place. Caps are generally constructed of clean sediment, sand, or gravel, but can also include geotextiles, liners, or the addition of material, such as organic carbon, to attenuate the flux of contaminants into the overlying water.<sup>62</sup> The San Francisco Bay TMDL discusses cost estimates and potential implications of capping in-bay sediments for area noise and cultural resources.<sup>63</sup>

#### ***Dredging and excavation***

Dredging and excavation are the two most common means of removing contaminated sediment from a waterbody, either while it is submerged (dredging) or after water has been diverted or drained (excavation). Both methods typically

<sup>61</sup> "Polychlorinated Biphenyls (PCBs) (Arochlors)," January 2000, available at <http://www.epa.gov/ttn/uatw/hlthef/polychlo.html>.

<sup>62</sup> More details on in-situ capping can be found in EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*, December 2005, available at <http://www.epa.gov/superfund/health/conmedia/sediment/pdfs/guidance.pdf>.

<sup>63</sup> *Total Maximum Daily Load for PCBs in San Francisco Bay Final Staff Report for Proposed Basin Plan Amendment*, February 13, 2008, available at [http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/TMDLs/sfbaypcbs/Staff\\_Report.pdf](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/sfbaypcbs/Staff_Report.pdf).

necessitate transporting the sediment to a location for treatment and/or disposal. They also frequently include treatment of water from dewatered sediment prior to discharge to an appropriate receiving waterbody.<sup>64</sup> One of the principal advantages of dredging and excavation is often that, if they achieve cleanup levels for the site, they may result in the least uncertainty regarding future environmental exposure to contaminants because the contaminants are removed from the aquatic ecosystem and disposed in a controlled environment.<sup>65</sup> The San Francisco Bay PCB TMDL discusses the cost of dredging and disposal of in-bay sediments.<sup>66</sup> The challenges of dredging, including high cost and risks of habitat destruction and resuspension of contaminants are recognized in the Ohio River TMDL.<sup>67</sup>

A collection of technical reports on PCB treatment technologies, including sediment capping, in-situ thermal desorption-destruction of PCBs, and phytoremediation of persistent organic compounds is available through the EPA's Technology and Innovation Program<sup>68</sup>. The EPA, United Nations Environment Programme, and US Army Engineer Research and Development Center are among the developers of these resources.

Examples of Superfund contaminated sediment cleanups include the Lower Duwamish Waterway in Washington and the Hudson River in New York.

The Lower Duwamish Waterway Cleanup Site covers a 5.5 mile waterway that empties into Elliot Bay in Seattle as well as the 32 square mile basin that discharges into the Duwamish. Past and present activities have left a legacy of chemical pollution in the waterway and in the sediment. Pollutants include PCBs, dioxins, furans, and other chemicals. In 2001-2002, the EPA and Washington Department of Ecology listed the Lower Duwamish Waterway under the federal Superfund law and Washington's Model Toxic Substances Control Act because of the health risks to people and animals exposed to contaminated sediments. Currently, the EPA is overseeing development of a Feasibility Study and is developing a recommendation for the cleanup. The Proposed Plan will be available for public comment in early 2012. Meanwhile, PCBs have driven several of the "Early Action" cleanup areas' sediment investigation and removal plans.<sup>69</sup>

The Hudson River PCBs Site encompasses a nearly 200-mile stretch of the Hudson River in eastern New York State from Hudson Falls, New York to the Battery in New York City. The EPA named this a Superfund site, contaminated by PCBs, in 1984.

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<sup>64</sup> More details on in-situ capping can be found in EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*, December 2005, available at <http://www.epa.gov/superfund/health/conmedia/sediment/pdfs/guidance.pdf>.

<sup>65</sup> EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*, December 2005, available at <http://www.epa.gov/superfund/health/conmedia/sediment/pdfs/guidance.pdf>.

<sup>66</sup> *Total Maximum Daily Load for PCBs in San Francisco Bay Final Staff Report for Proposed Basin Plan Amendment*, February 13, 2008, available at [http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/TMDLs/sfbaypcbs/Staff\\_Report.pdf](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/sfbaypcbs/Staff_Report.pdf).

<sup>67</sup> *Ohio River Total Maximum Daily Load (TMDL) for PCBs*, September 2002, available at [http://www.epa.gov/reg3wapd/tmdl/wv\\_tmdl/Ohio/OhioReport.pdf](http://www.epa.gov/reg3wapd/tmdl/wv_tmdl/Ohio/OhioReport.pdf).

<sup>68</sup> "Contaminant Focus: Polychlorinated Biphenyls (PCBs) – Treatment Technologies," available at [http://www.clu-in.org/contaminantfocus/default.focus/sec/Polychlorinated\\_Biphenyls\\_\(PCBs\)/cat/Treatment\\_Technologies/](http://www.clu-in.org/contaminantfocus/default.focus/sec/Polychlorinated_Biphenyls_(PCBs)/cat/Treatment_Technologies/).

<sup>69</sup> USEPA, "Lower Duwamish Waterway Superfund Site" website, available at <http://yosemite.epa.gov/r10/cleanup.nsf/sites/lduwamish>.

From approximately 1947 to 1977, the General Electric Company (GE) discharged as much as 1.3 million pounds of PCBs from its capacitor manufacturing plants into the Hudson River. Since 1976, high levels of PCBs in fish have led New York State to close various recreational and commercial fisheries and to issue fish consumption advisories,

Phase 1 dredging for Hudson River cleanup took place between May and November 2009 in a six-mile stretch of the Upper Hudson River near Fort Edward in New York. Phase 1 was designed to address approximately 10 percent of the material to be dredged over the six-year project timeframe. At the end of Phase 1, an estimated 283,000 cubic yards of PCB-contaminated sediment had been removed from the river. Phase 2 (final phase) dredging began in June 2011. During this phase of dredging, GE will remove about 2.4 million cubic yards of sediment from a forty-mile section of the Upper Hudson River.<sup>70</sup>

### **Multi-media Sources**

PCBs can be released from disposal of products discarded as solid waste, ongoing use of PCB-containing equipment and materials, industrial processes, and other sources. These releases may have cross-media impacts. Examples of approaches to address these sources include monitored natural recovery and PMPs (below), as well as working with industry, local governments, and the general public through outreach and communication regarding proper disposal of PCB-containing products.

#### ***Monitored Natural Recovery (MNR)***

Although burial by clean sediment is often the dominant process relied upon for natural recovery, multiple physical, biological, and chemical mechanisms frequently act together to reduce risk. Evaluation of MNR should usually be based on site-specific data, including multiple lines of evidence such as decreasing trends of contaminant levels in fish, in surface water, and in sediment. Project managers should evaluate the long-term stability of the sediment bed and the mobility of contaminants within it. Contingency measures should be included as part of a MNR remedy when there is significant uncertainty that the remedial action objectives will be achieved within the predicted time frame. Generally, MNR should be used either in conjunction with source control or active sediment remediation.

While this approach to PCB contamination has a relatively low financial cost, these natural processes act very slowly on persistent, bioaccumulative pollutants such as PCBs (estimates from Indiana University<sup>71</sup> calculate the half-life of PCBs at between 13 and 17 years and another estimate in the Central Valley puts half-life at 56 years<sup>72</sup>).<sup>73</sup> MNR involves analyzing the processes that will result in

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<sup>70</sup> USEPA, "Hudson River PCBs" website, available at <http://www.epa.gov/hudson/>.

<sup>71</sup> Venier, M. and Hites, R.A. Time Trend Analysis of Atmospheric POPs Concentrations in the Great Lakes Region Since 1990, *Environ. Sci. Technol.*, 2010, 44 (21), pp 8050–8055. Venier, M. and Hites, R.A. Regression Model of Partial Pressures of PCBs, PAHs, and Organochlorine Pesticides in the Great Lakes' Atmosphere, *Environ. Sci. Technol.*, 2010, 44 (2), pp 618–623.

<sup>72</sup> *Total Maximum Daily Load for PCBs in San Francisco Bay Final Staff Report for Proposed Basin Plan Amendment*, February 13, 2008, available at [http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/TMDLs/sfbaypcbs/Staff\\_Report.pdf](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/sfbaypcbs/Staff_Report.pdf).

achieving cleanup objectives and monitoring the recovery to ensure that cleanup is proceeding as expected. MNR has been selected as a component of the remedy for contaminated sediment at over one dozen Superfund sites. Historically, at many sites MNR is combined with dredging or in-situ capping of other areas of a site. Although reduced contamination in sediments following effective source control has been observed at some of these sites, long-term monitoring data on fish tissue are not yet available at most sites to document continued risk reduction.<sup>74</sup>

When considering MNR versus a more aggressive remedy, Superfund cleanup levels are based on regulatory standards that constitute ARARs such as WQS, or where not available or sufficiently protective, based on risk to human health and the environment. For human health carcinogenic cleanup levels are based on a  $10^{-4}$  to  $10^{-6}$  excess cancer risk range (i.e., 1/10,000 - 1/1,000,000 risk range) with  $10^{-6}$  as the point of departure. For toxicity endpoint, the cleanup level is based on a Hazardous Index of one or less. Cleanup levels are set to protect ecological receptors.

Factors to take into account when considering MNR versus other remedies include an analysis of the processes that are contributing to achieving the cleanup levels through MNR, the expected time frame to achieve the protective levels, and how this compares against other more active remedies. General factors for evaluation of MNR need to be evaluated on a case-by-case basis. Examples of site conditions that might support use of MNR may include such factors as the sediment bed is reasonably stable and likely to remain so, and sediment is resistant to resuspension (e.g., cohesive or well-armored sediment).

Several PCB TMDLs consider natural recovery within their implementation sections. For example, the Ohio River TMDL looks toward addressing PCB contamination present in sediments; options include natural attenuation.<sup>75</sup> An ongoing annual fish tissue monitoring program makes data and information available to assess and define current and future long-term trends in PCBs in the Ohio River system.<sup>76</sup> Fish tissue monitoring measures trends and natural attenuation progress; it provides information on impacts from sediment concentration (atmospheric deposition may also affect fish tissue concentration).

### ***Pollutant minimization plans (PMPs)***

In the case of waters impaired by PCBs, states may consider implementing cost-effective PMPs.

For PCB control, a PMP might include identification of all known and suspected point and nonpoint sources of PCBs, a description of studies used to identify

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<sup>73</sup> Ohio River Total Maximum Daily Load (TMDL) for PCBs, September 2002, available at [http://www.epa.gov/reg3wapd/tmdl/wv\\_tmdl/Ohio/OhioReport.pdf](http://www.epa.gov/reg3wapd/tmdl/wv_tmdl/Ohio/OhioReport.pdf).

<sup>74</sup> Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, December 2005, available at <http://www.epa.gov/superfund/health/conmedia/sediment/pdfs/guidance.pdf>.

<sup>75</sup> Ohio River Total Maximum Daily Load (TMDL) for PCBs, September 2002, available at [http://www.epa.gov/reg3wapd/tmdl/wv\\_tmdl/Ohio/OhioReport.pdf](http://www.epa.gov/reg3wapd/tmdl/wv_tmdl/Ohio/OhioReport.pdf).

<sup>76</sup> These data can be found on Ohio River Valley Water Sanitation Commission's website at <http://www.orsanco.org/fish-tissue/193>.

PCB sources, a description of actions to minimize prospective discharge of PCBs, a proposed time frame for PCB load reductions, a method to demonstrate progress, and ongoing PCB monitoring. As an example, PMP elements for PCBs were identified in a DRBC resolution and guidance manual<sup>77</sup>. DRBC has aggregated resources for completing and implementing PMPs -- including a handbook on PCBs in electrical equipment, a report on technological feasibility for proposed water quality criteria for NJ, and a NJ pilot “trackdown” program for PCBs in the sewer system -- on its website<sup>78</sup>.

The primary objective of a recent Camden PCB trackdown study was to identify PCB sources entering storm drains and CSOs in order to abate PCB transport to the Delaware River, thereby decreasing bioaccumulation in foodfish and decreasing risk to human consumers. To that end, the State of New Jersey narrowed down the universe of potential PCB sources in Camden County MUA’s collection system from a county-wide range of potential sources and municipalities to just a few specific neighborhoods, industry types and streets in Camden City (77% of PCB load). Methods used included soil collection, enzyme-linked immunosorbent assays (ELISA), and high resolution gas chromatography/high resolution mass spectrometry.<sup>79</sup>

DRBC’s<sup>80</sup>, recommended actions to minimize known and probable on-site PCB sources include the following:

- Removal;
- Engineering controls (such as caps and containment dikes);
- Fluid changeout;
- Substitutions / modifications of raw or finished materials used in the treatment process;
- Modifications to material handling including transport; and
- Remedial activities for spills and leaks (current or legacy).

Recommended minimization activities for probable collection system sources include the following<sup>81 82</sup>:

- Indirect Discharge Permit review and amendment;
- Recommendations for improved and upgraded industrial pre-treatment;
- Remedial activities for spills and leaks (current or legacy);
- Recommendations for remediation by other agencies under other regulatory programs; and
- Hydraulic controls to minimize PCB mass loads through CSOs.

<sup>77</sup> *Pollution Minimization Plans, and Source Trackdown in Camden City*, August 2008, available at <http://www.state.nj.us/dep/dsr/health/trackdown-finalreport.pdf>.

<sup>78</sup> Available at [http://www.state.nj.us/drbc/PMP\\_Resources/index.htm](http://www.state.nj.us/drbc/PMP_Resources/index.htm).

<sup>79</sup> *PCB TMDLs, Pollution Minimization Plans, and Source Trackdown in Camden City*, August 2008, available at <http://www.state.nj.us/dep/dsr/health/trackdown-rps.pdf>.

<sup>80</sup> *Recommended Outline for Pollution Minimization Plans for Polychlorinated Biphenyls in the Delaware Estuary*, January 26, 2006, available at <http://www.state.nj.us/drbc/PMP-POTW-012606.pdf>

<sup>81</sup> *Recommended Outline for Pollution Minimization Plans for Polychlorinated Biphenyls in the Delaware Estuary*, January 26, 2006, available at <http://www.state.nj.us/drbc/PMP-POTW-012606.pdf>.

<sup>82</sup> Also see 40 CFR Part 403; these regulations set forth requirements for publicly owned treatment works (POTWs) to control discharges into the collection system and POTW treatment plant, as well as requirements for industries that discharge to the POTW.

Where appropriate, states may wish to use “adaptive implementation,” which is “an iterative implementation process that makes progress toward achieving water quality goals while using any new data and information to reduce uncertainty and adjust implementation activities.”<sup>83</sup> In implementing a TMDL, states may wish to modify implementation activities as new information on assumptions in the TMDL, such as previously uncharacterized dischargers as described in section V, becomes available. PCB TMDLs have also used a “staged” implementation approach, in which implementation is staged over a period of time, with reduction goals to be met in several phases.<sup>84</sup>

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<sup>83</sup> See “Clarification Regarding “Phased” Total Maximum Daily Loads,” August 2, 2006, at [http://www.epa.gov/owow/tmdl/tmdl\\_clarification\\_letter.html](http://www.epa.gov/owow/tmdl/tmdl_clarification_letter.html) and *Adaptive Implementation of Water Quality Improvement Plans: Opportunities and Challenges*, September 2007, at <http://nicholasinstitute.duke.edu/water/quality/adaptive-implementation-of-water-quality-improvement-plans-opportunities-and-challenges>.

<sup>84</sup> See *Total Maximum Daily Loads for Polychlorinated Biphenyls (PCBs) for Zones 2-5 of the Tidal Delaware River*, December 15, 2003, available at [http://www.epa.gov/reg3wapd/tmdl/pa\\_tmdl/DelawareRiver/TMDLreport.pdf](http://www.epa.gov/reg3wapd/tmdl/pa_tmdl/DelawareRiver/TMDLreport.pdf).

## Appendix: PCB Sources

<b>Table 1. Databases for PCB Sources</b>			
<b>Database</b>	<b>Description</b>	<b>Location</b>	<b>Comments</b>
Toxic Release Inventory (TRI)	Contains information on releases of nearly 650 chemicals and chemical categories from industries, including manufacturing, metal and coal mining, electric utilities, commercial hazardous waste treatment, among others.	<a href="http://www.epa.gov/tri">www.epa.gov/tri</a>	Other sources for information on toxic chemical site releases: <a href="http://www.epa.gov/triexplorer">www.epa.gov/triexplorer</a> -- <a href="http://www.epa.gov/enviro">www.epa.gov/enviro</a> -- <a href="http://www.scorecard.org">www.scorecard.org</a> -- <a href="http://www.rtk.net">www.rtk.net</a>
Permit Compliance System (PCS)	Provides information on companies which have been issued permits to discharge waste water into rivers. You can review information on when a permit was issued and expires, how much the company is permitted to discharge, and the actual monitoring data showing what the company has discharged.	<a href="http://www.epa.gov/enviro/html/pcs/">http://www.epa.gov/enviro/html/pcs/</a>	
National Priority List (NPL)	Lists national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation.	<a href="http://www.epa.gov/superfund/sites/query/basic.htm">http://www.epa.gov/superfund/sites/query/basic.htm</a> (Basic Query)	--Locate NPL sites, check their cleanup progress, and get information on new and proposed NPL sites. --Query parameters include contaminant of concern (e.g., PCBs)
Envirofacts Warehouse Database	Provides access to several EPA databases (e.g., PCS, TRI) to provide information about environmental activities that may affect air, water, and land anywhere in the United States.	<a href="http://www.epa.gov/envirofw/">http://www.epa.gov/envirofw/</a>	Learn more about environmental activities in your area or generate maps of environmental information here.
EPA Transformer Registration and PCB Activity Databases	Provides information on companies or people who have PCB transformers, are conducting business involving the disposal of PCBs, or are conducting research and development involving PCBs.	<a href="http://www.epa.gov/epawaste/hazard/tsd/pcbs/pubs/data.htm">http://www.epa.gov/epawaste/hazard/tsd/pcbs/pubs/data.htm</a>	

<b>Table 2. General PCB Sources</b>		
<b>General Source</b>	<b>Description</b>	<b>Related Databases (reference Table 1, above)</b>
Items intentionally containing PCBs	Transformers, capacitors, hydraulic and heat transfer fluids	EPA Transformer Registration and PCB Activity Databases
Industry	Steel manufacturing, power plants, electric lamps, plastic materials and resins, motors, carbon and graphite products, wiring devices, communication equipment, rubber, aluminum foundries	TRI, NPL, EPA Transformer Registration and PCB Activity Databases
Combustion of PCB-laden materials	Incinerators of municipal, medical, and hazardous wastes; sewage sludge, scrap tires, industrial and utility boilers	TRI
Environmental sinks	Contaminated sediments	NPL
Inadvertent generation of PCBs	--Combination of carbon, chlorine, and high temperatures can result in PCB generation --Up to 200 chemical processes may create PCB byproducts --Products inadvertently containing PCBs include paint, inks, ag chemicals, plastics, detergent bars	
Storage and disposal facilities	Storage facilities, wastewater treatment plants, incinerators, landfills, decontamination facilities, hazardous waste sites (old products include dust control agents, adhesives, construction materials, gaskets, sound deafening felt)	TRI, NPL, EPA Transformer Registration and PCB Activity Databases
<i>Ohio River Total Maximum Daily Load (TMDL) for PCBs, September 2002, available at <a href="http://www.epa.gov/reg3wapd/tmdl/wv_tmdl/Ohio/OhioReport.pdf">http://www.epa.gov/reg3wapd/tmdl/wv_tmdl/Ohio/OhioReport.pdf</a>.</i>		