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HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT

DECEMBER 1998

For

U.S. Environmental Protection Agency
Region II
and
U.S. Army Corps of Engineers
Kansas City District

Book 1 of 3

TAMS Consultants, Inc.
Limno-Tech, Inc.
TetraTech, Inc.
Menzie-Cura & Associates, Inc.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

DEC 29 1998

To All Interested Parties:

Earlier this year, the U.S. Environmental Protection Agency (EPA) decided to issue responsiveness summaries for the various Hudson River PCB Site Reassessment reports as the study progressed, rather than issuing a single responsiveness summary after the Proposed Plan, as had previously been scheduled. As such, this document is the first of the responsiveness summaries to be prepared on the Phase 2 Reports.

This document contains written comments from various reviewers on the Database Report, the Preliminary Model Calibration Report, and the Data Evaluation and Interpretation Report, and the Agency's response to significant comments on those reports. In addition, the responsiveness summary includes a "Review and Commentary" on a report submitted to EPA by General Electric summarizing the company's analyses of Thompson Island Pool Sediment PCB sources.

A responsiveness summary for the Low Resolution Sediment Coring Report, the Human Health Risk Assessment Scope of Work, the Ecological Risk Assessment Scope of Work, and the Feasibility Study Scope of Work will be issued in Spring 1999.

Public involvement is important to the Agency. I am pleased to provide this response to your concerns about both technical and policy issues.

Sincerely yours,

Richard L. Caspe, Director
Emergency and Remedial Response Division

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DECEMBER 1998

TABLE OF CONTENTS

BOOK 1 OF 3

Page

I. INTRODUCTION AND COMMENT DIRECTORY

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

BOOK 1 OF 3

Page

II. RESPONSES TO COMMENTS

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

BOOK 1 OF 3

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

BOOK 1 OF 3

Page

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

BOOK 1 OF 3

Page

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

BOOK 1 OF 3

Page

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

BOOK 1 OF 3

Page

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

BOOK 1 OF 3

Page

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

BOOK 1 OF 3

Page

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

BOOK 1 OF 3

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

BOOK 1 OF 3

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

BOOK 2 of 3

III. COMMENTS ON THE PHASE 2 REPORTS

A. COMMENTS ON THE DATABASE REPORT AND DATABASE

General Electric (DB-1)

B. COMMENTS ON THE PMCR

Federal (PF-1)
Local (PL-1)
Community Interaction Program (PC-1)
Public Interest Groups and Individuals (PP-1)
General Electric (PG-1)

C. COMMENTS ON THE DEIR

Federal (DF-2)
State (DS-2)
Local (DL-1)
Community Interaction Program (DC-1 through DC-4)
Public Interest Groups and Individuals (DP-1 through DP-5)
General Electric (DG-1)

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

BOOK 3 OF 3

IV. USEPA REVIEW AND COMMENTARY ON THE GENERAL ELECTRIC/QEA REPORT, MARCH 1998

A. REVIEW AND COMMENTARY ON THE GE/QEA REPORT

B. GE/QEA REPORT: THOMPSON ISLAND POOL SEDIMENT PCB SOURCES, MARCH 1998

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

Page

LIST OF CORRECTIONS

Book 1 of 3

LIST OF FIGURES

Book 1 of 3

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY FOR
VOLUME 2A: DATABASE REPORT
VOLUME 2B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME 2C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

TABLE OF CONTENTS

Page

LIST OF TABLES

Book of 1 of 3

Notes: Figures and Tables for the USEPA commentary on the GE/QEA report, March 1998 are listed in the Table of Contents contained in Book 3 of this Responsiveness Summary.

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HUDSON RIVER PCBs REASSESSMENT RI/FS
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DECEMBER 1998

I. INTRODUCTION AND COMMENT DIRECTORY

1. INTRODUCTION

USEPA has prepared this Responsiveness Summary for the first three volumes of the Phase 2 Report, specifically, the Database Report, the Preliminary Model Calibration Report (PMCR), and the Data Evaluation and Interpretation Report (DEIR) for the Hudson River PCB Reassessment Remedial Investigation/Feasibility Study (RI/FS). It addresses comments received during the review of these three reports. This Responsiveness Summary also presents and comments on a free-standing report prepared by General Electric Company.

For the Reassessment, USEPA has established a Community Interaction Program (CIP) to elicit on-going feedback through regular meetings and discussion and to facilitate review of and comment upon work plans and reports prepared during all phases.

The three reports are incorporated by reference and are not reproduced herein. No revised copy of the reports will be published as such. The comment responses and revisions noted herein are considered to amend two of the three reports; *i.e*, the Database Report and the Data Evaluation and Interpretation Report. Although the Preliminary Model Calibration Report (PMCR) will not be republished as such, the PMCR forms the basis for the forthcoming Baseline Modeling Report (BMR); comments on the PMCR will be incorporated as noted into the BMR. For complete coverage, the reports and this Responsiveness Summary must be used together.

The first part of this three-part Responsiveness Summary is entitled "Introduction and Comment Directory." It describes the Report review and commenting process, explains the organization and format of comments and responses and contains a comment index or directory.

The second part, entitled "Responses", contains the USEPA responses to all comments. This section is broken down into three parts; one for each of the three reassessment reports. Responses are grouped first according to the report, and then according to the section number of the report to which they refer, *e.g.*, responses to comments on Section 2.1 of the DEIR are found in DEIR Section 2.1 of the Responsiveness Summary. Additional information about how to locate responses to comments is contained in the Comment Directory.

The third part, entitled "Comments on the Phase 2 Report", contains the copies of the comments submitted to the USEPA on Volumes A, B, and C of the Phase 2 report. The comments are identified by commentor and comment number, as further explained in the Comment Directory.

In addition to specific comments, GE submitted a separate report on the Hudson River (Thompson Island Pool Sediment PCB Sources; QEA, 1998). The USEPA has prepared a critique of the GE report; both GE's report and the USEPA critique are contained in this responsiveness summary as Book 3 of the Responsiveness Summary.

1.1 Recent Developments

Since the issuance of the DEIR, further review of the data and some of the models has revealed errors and corrections that affect these reports, as noted below.

- The Hudson River flow estimate has been revised. The USGS data are now being used for flow estimation. This requires revising the loads below the Thompson Island Dam. This revision will be provided in the response to comments on the Low Resolution Sediment Coring Report.
- General Electric has noted an error in their data, and is correcting their data to reflect a greater presence of the lighter (lower molecular weight) PCB congeners; resulting in about a 40 percent increase to the total PCB concentrations they report.
- Due to the location of the sampling station at the Thompson Island Dam, the PCB load at the TI Dam may be overestimated. The degree of overestimation varies as a function of flow and the PCB load at Rogers Island. The degree of overestimation during low-flow conditions was estimated to be 20 percent (less than 4000 cfs) during the period 1991 - 1995. The degree of overestimation is also less pronounced for trichlorinated and higher congeners relative to total PCBs.

This section documents and explains the commenting process and the organization of comments and responses in this document. Readers interested in finding responses to their comments may skip this section and go directly to the Comment Guide to the Comment Directory following page CD-10.

2. REPORTS COMMENTING PROCESS

2.1 Reports Distribution

The Database Report, the PMCR, and the DEIR, were issued in November, 1995, October, 1996, and February, 1997, respectively, and were distributed to federal and state agencies and officials, participants in the Community Interaction Program (CIP), and General Electric, as shown in Table 1. Distribution was made to approximately 100 agencies, groups, and individuals. Copies of the reports were also made available for public review in 17 information repositories, as shown in Table 2.

2.2 Review Period and Informational Meetings

Official thirty-day comment periods were specifically associated with each report, but comments on all reports, both current and prior, have been welcome throughout the process. USEPA held three Joint Liaison Group meetings that were open to the public to present these reports. The meetings were held in December 1995 (Latham, NY), October 1996 (Albany, NY), and February 1997 (Albany, NY) .

Minutes for these meetings are contained in a binder entitled Project Documents Binder. This binder is part of the project information available for public review at 11 of the 17 information repositories (Table 2). Four of the six repositories that do not currently have a Project Documents Binder (Marist Library, RPI Library, SUNY Albany Library, and USMA Library) are partial repositories maintained primarily for their CD-ROM capability. The other two, Sojourner Truth Library at SUNY New Paltz, and the Sea Grant office in Kingston, will have copies of Project Documents Binders in the near future .

As stated in USEPA's letter transmitting the Reports, all citizens were urged to participate in the Reassessment process and to join one of the Liaison Groups formed as part of the Community Interaction Program. USEPA requested that all comments, including those of Liaison Groups, be sent to USEPA.

2.3 Receipt of Comments

Comments on the reports were received in two ways: letters or other written submissions to USEPA; and written statements as follow-up to statements made during the meetings.

Comments received on the Reports have been recorded and are addressed in this Responsiveness Summary. Comments were received from approximately 17 commentors, for the three reports. Total comments numbered over 320.

2.3.1 Comments on the Database Report and Database

One set of comments was received on the database report (from GE).

2.3.2 Comments on the Preliminary Model Calibration Report

Five sets of comments were received on the PMCR. These included one Federal comment set (from the National Oceanic and Atmospheric Administration (NOAA); identified as PF-1); one set of local government comments (from the Saratoga County Environmental Management Council - PL-1 from Hodgson/Adams); two sets from members of the Science and Technical Committee, a part of the community interaction program (PC-1, G. Putman from SUNY - Albany, and PP-1 from J. Sanders); and one set from General Electric (PG-1).

TABLE 1

DISTRIBUTION OF REPORTS

HUDSON RIVER PCBs OVERSIGHT COMMITTEE MEMBERS

- USEPA ERRD Deputy Division Director (Chair)
- USEPA Project Manager
- USEPA Community Relations Coordinator, Chair of the Steering Committee
- NYSDEC Division of Hazardous Waste Management representative
- NYSDEC Division of Construction Management representative
- National Oceanic and Atmospheric Administration (NOAA) representative
- Agency for Toxic Substances and Disease Registry (ATSDR) representative
- US Army Corps of Engineers representative
- New York State Thruway Authority (Department of Canals) representative
- USDOI (USF&W) representative
- NYSDOH representative
- GE representative
- Liaison Group Chairpeople
- Scientific and Technical Committee representative

SCIENTIFIC AND TECHNICAL COMMITTEE MEMBERS

STEERING COMMITTEE MEMBERS

- USEPA Community Relations Coordinator (Chair)
- Governmental Liaison Group Chair and two Co-chairs
- Citizen Liaison Group Chair and two Co-chairs
- Agricultural Liaison Group Chair and two Co-chairs
- Environmental Liaison Group Chair and two Co-chairs
- USEPA Project Manager
- NYSDEC Technical representative
- NYSDEC Community Affairs representative

FEDERAL AND STATE REPRESENTATIVES

Copies of the reports were sent to relevant federal and state representatives who have been involved with this project. These include, in part, the following:

- The Hon. Daniel P. Moynihan
- The Hon. Alfonse M. D'Amato
- The Hon. Gerald Solomon
- The Hon. Nita Lowey
- The Hon. Maurice Hinchey
- The Hon. Ronald B. Stafford
- The Hon. Michael McNulty
- The Hon. Sue Kelly
- The Hon. Benjamin Gilman
- The Hon. Richard Brodsky
- The Hon. Bobby D'Andrea

17 INFORMATION REPOSITORIES (see Table 2)

TABLE 2
INFORMATION REPOSITORIES

Adriance Memorial Library
93 Market Street
Poughkeepsie, NY 12601

Catskill Public Library
1 Franklin Street
Catskill, NY 12414

^ Cornell Cooperative Extension
Sea Grant Office
74 John Street
Kingston, NY 12401

Crandall Library
City Park
Glens Falls, NY 12801

County Clerk's Office
Washington County Office Building
Upper Broadway
Fort Edward, NY 12828

* ^ Marist College Library
Marist College
290 North Road
Poughkeepsie, NY 12601

* New York State Library
CEC Empire State Plaza
Albany, NY 12230

New York State Department
of Environmental Conservation
Division of Hazardous Waste Remediation
50 Wolf Road, Room 212
Albany, NY 12233

* ^ R. G. Folsom Library
Rensselaer Polytechnic Institute
Troy, NY 12180-3590

Saratoga County EMC
50 West High Street
Ballston Spa, NY 12020

* Saratoga Springs Public Library
49 Henry Street
Saratoga Springs, NY 12866

* ^ SUNY at Albany Library
1400 Washington Avenue
Albany, NY 12222

* ^ Sojourner Truth Library
SUNY at New Paltz
New Paltz, NY 12561

Troy Public Library
100 Second Street
Troy, NY 12180

United States Environmental Protection
Agency
290 Broadway
New York, NY 10007

* ^ United States Military Academy Library
Building 757
West Point, NY 10996

White Plains Public Library
100 Martine Avenue
White Plains, NY 12601

* ***Repositories with Database Report CD-ROM (as of 10/98)***

^ ***Repositories without Project Documents Binder (as of 10/98)***

2.3.3 Comments on the Data Evaluation and Interpretation Report

The most extensive group of comments was received on the Review Copy of the DEIR. A total of 14 comment sets were received, submitted by two federal agencies, one state agency, one local government; four community interaction program participants; five public responders; and General Electric.

Federal agency comments included one set from NOAA (DF-2, 6/3/97).

One set of NY State comments was received from New York State Department of Environmental Conservation (DS-2; from Deputy Commissioner Sternman, 4/25/97).

Local government comments were submitted by the Saratoga Environmental Management Council (DL-1).

Comments were submitted by four members of the community interaction program including T. Borden (chairperson, Agricultural Liason Group; DC-1 4/11/97), M. Pulver (co-chair, Agricultural Liason Group and Fort Edward Town Board; DC-2 4/11/97); S. Ruggi (member, Environmetal Group; DC-3); and George Putman (member, Science and Technical Committee; DC-4 4/11/97).

Five sets of comments from various groups and one individual were received. These comments were submitted by Hudson River Sloop Clearwater (DP-1), Hudson Riverkeeper Fund (on Pace Environmental Litigation Clinic letterhead; DP-4, dated 4/11/97), Scenic Hudson (DP-5), and Sherwood Davies (resident; DP-2 and DP-3, letters dated 11/11/94 and 4/5/97).

General Electric (DG-1) comments constituted virtually a free-standing report, with 63 pages of text plus 22 pages of tables and figures as well as five additional appendices.

2.3.4 General Electric Report: Thompson Island Pool Sediment PCB Sources

A consultant to General Electric, Quantitative Environmental Analysis (QEA), sumbitted a separate, free-standing report entitled "Thompson Island Pool Sediment PCB Sources" dated March 19, 1998. This QEA report has been considered separately. The USEPA response to this report is provided separately in Book 3 of this report. The full text of the QEA report is included in Book 3 as well.

2.4 Distribution of Responsiveness Summary

This Responsiveness Summary, like all other documents prepared for the Reassessment, has been distributed to the members of the Steering Committee, the Hudson River PCB Oversight Committee, the Scientific and Technical Committee, NYSDEC and General Electric. This Responsiveness Summary has also been placed in the 17 Information Repositories and is part of the Administrative Record.

3. ORGANIZATION OF COMMENTS AND RESPONSES TO REPORTS

3.1 Identification of Comments

Each comment submitted for a Report was assigned a dual letter code. The first letter references an individual Report (P for PMCR and D for DEIR) for which the comment was addressed and the second letter was used to denote one of the following:

F - Federal agencies and officials;
S - State agencies and officials;
L - Local agencies and officials;
C - Community Interaction Program Committees and Liaison Groups;
P - Public Interest Groups and Individuals; and
G - General Electric.

It should be noted that the code for Database Report comments (DB) were numbered sequentially, and did not use the second letter code defined above, due to the limited nature of the comments received. The letter codes were assigned for the convenience of readers and to assist in the organization of this document; priority or special treatment was neither intended nor given in the responses to comments.

Once a letter code was assigned, each submission was then assigned a number, in the order that it was received and processed, such as PF-1, PF-2 and so on. Each different comment within a submission was assigned its separate sub-number. Thus, if a federal agency submitted three different comments under the same cover on the DEIR, they are designated as DF-1.1, DF-1.2, DF-1.3.

Written comment submissions have been reprinted following the third tab of this document. In addition, a separate report was provided by a consultant (QEA) to General Electric (GE) entitled "Thompson Island Pool Sediment PCB Sources, Final Report" and is provided in Section IV of this report. USEPA's response to this GE/QEA report is also included in Section IV of the report, found in Book 3.

The alphanumeric code associated with each reprinted written submission is marked at the top right corner of the first page of the comment letter; the sub-numbers designating individual comments are marked in the margin, as shown in the sample letter on the following page. Comment submissions are reprinted in numerical order by letter code in the following order: F, S, L, C, P, and G.

In a few instances, a commentor may have more than one submission listed in the Comment Directory, because he/she made several submissions.

It was not always clear if a commentor intended to represent a CIP Committee or Liaison Group, was representing an interest group or was commenting as an individual. The reader is advised to examine both the C (CIP) category for the name of the CIP Committee or Liaison Group

DF-2

SAMPLE COMMENT LETTER

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Office of Ocean Resources Conservation and Assessment
Hazardous Materials Response and Assessment Division
Coastal Resources Coordination Branch
290 Broadway, Rm 1831
New York, New York 10007

June 3, 1997

Doug Tomchuk
U.S. EPA
Emergency and Remedial Response Division
Sediment Projects/Caribbean Team
290 Broadway
New York, NY 10007

Dear Doug:

Thank you for the opportunity to review the February 1997 Phase 2 Report, Further Site Characterization and Analysis, Volume 2C - Data Evaluation and Interpretation Report (DEIR) for the Hudson River PCB Reassessment Remedial Investigation/Feasibility Study (RI/FS). The following comments are submitted by the National Oceanic and Atmospheric Administration (NOAA).

Summary

The Phase 2 DEIR Report was prepared as part of the overall Phase 2 Reassessment RI/FS activities currently ongoing to provide further characterization and analysis of the Hudson River PCB Site which extends from Hudson Falls, NY to the Battery in New York Harbor. The Reassessment RI/FS Work Plan, completed in September 1992, identified various data collection activities to support the reassessment effort. The February 1997 document presents geochemical analyses of water column and sediment data collected during the Phase 2 assessment and data from other sources including New York State Department of Environmental Conservation (NYSDEC), United States Geological Survey (USGS) and General Electric (GE).

The Phase 2 objectives were as follows: 1) estimate the current and recent PCB source contributions exclusive of the Upper Hudson River sediments 2) characterize the sources, movement and distribution of water column and sediment associated PCBs, and 3) examine PCB distribution and inventory within the Upper Hudson sediments.

General Comments

NOAA commends the authors of this report for a generally well thought-out site characterization and analysis effort. Overall, the report covered appropriate subjects and addressed them in a credible manner. The authors should be complemented for an executive summary which clearly highlights and explains the major conclusions of the Phase 2 reassessment and provides a conceptual model for the factors affecting the fate and transport of PCBs from the Upper Hudson to New York Harbor.. NOAA's more specific concerns with the report are presented below.

Principal Congeners

The DEIR would have benefited from an early identification of congeners that are important for understanding the fate of PCBs in the system, including congeners that are important in fish and that represent the major contribution to each of the primary PCB homologues (i.e., di-hepta). ①
Appendices A and B refer to the 12 principal target congeners as being the major focus of the

and the P (Public Interest Group or Individual) category for the specific name of an interest group or his/her own name.

3.2 Location of Responses to Comments

The Comment Directory, following this text, contains a complete listing of all commentors and comments. This directory allows readers to find responses to comments and provides several items of information. In several cases, the name of the agency or organization of the commentors has been abbreviated, as follows:

- NOAA	National Oceanic and Atmospheric Adiministration
- USGS	United States Geological Survey
- NYSDEC	New York State Department of Environmental Conservation
- SC EMC/GLC	Saratoga County Environmental Management Council/Govermental Liaison Committee
- S&T Committee	Science and Technology Committee
- ALG	Agricultural Liaison Group
- ELG	Environmental Liaison Group
- PELC	Pace Environmental Litigation Clinic, Inc.
- GE	General Electric Corporation

- The first column lists the names of commentors. Comments are grouped first by: F (Federal), S (State), L (Local), C (CIP), P (Public Interest Group or Individual) or G (General Electric) preceded by a P or a D for PMCR or DEIR Report, respectively. Within each of these groups, commentors' names are listed alphabetically.

- The second column identifies the alphanumeric comment code, *e.g.*, DF.1-1, assigned to each comment.

- The third column identifies the location of the response by Report section number. For example, comments raised on Section 3.2 of a Report can be found in the corresponding Section 3.2 of the Responses, following the second tab of this document.

- The fourth, fifth, and sixth columns list key words that describe the subject matter of each comment. Readers will find these key words helpful as a means to identify subjects of interest and related comments.

Responses are grouped and consolidated by section number in order that all responses to related comments appear together to help achieve consistency among the responses and for the convenience of the reader interested in responses to related or similar comments.

In a few instances, several commentors commented on the same or very similar items. These comments are answered by one common response that addresses the common issue being raised. Thus, a comment is not necessarily answered by an individualized response.

In other cases, closely related but somewhat different comments pertaining to the same report section are made. Thus, a section number may contain more than one response.

3.3 Types of Responses

Responses to comments include the types described below.

- General Responses

  In some instances, comments were general and pertained to the Reassessment process or the Report overall rather than to a specific section of it. Responses to these comments are coded as General and appear at the very beginning of the Responses, under the heading General.

- Specific Responses to Comments

  These comments are answered in the Responses, grouped by section number of the Report to which they refer. A common response is provided when commentors question the same or very similar items. In some cases, commentors voiced opposite opinions about the same point, typically a controversial one, but both comments took issue with the same part of the Report. The rationale for the report's findings or resolution of the issue may also be contained in a common response addressing the conflicting nature of the comments and the controversy surrounding the issue.

  No separate section is provided for Responses to Comments on Executive Summary. These comments are answered in one of two ways. When a comment referencing the Executive Summary was specific or technical or dealt with information contained in a specific section of the Report, it is addressed in this document under the appropriate technical section as identified in the Comment Directory. When the comment concerned the wording of the Executive Summary or dealt with the overall nature of either, it is addressed under the heading Executive Summary, as appropriate. In all cases, the Comment Directory refers the reader to the location of the response.

- Additional References

  Full citations are provided only for new references not previously listed in the References Sections of the Reports. These citations are provided at the end of the responses for each report; e.g., new references provided in comment responses to the DEIR appear following the responses to the DEIR, but within the DEIR tab section.

- Corrections

  Corrections to the text are noted in the appropriate report section. No subsequent action will be taken since the reports will not be reissued.

4. COMMENT DIRECTORY

A Comment Guide, a sample comment letter, a diagram illustrating how to find responses to comments, and the Comment Directory follow.

As stated in the preface to this Responsiveness Summary, this document does not reproduce the three reports. Readers are urged to utilize this Responsiveness Summary in conjunction with the three reports for which comments were received.

4.1 GUIDE TO COMMENT DIRECTORY RESPONSIVENESS SUMMARY

Step 1	Step 2	Step 3
Find the commentor or the key words of interest in the Comment Directory. Comments are separated by report and commentor group	Obtain Comment Codes and Report Section. Find coded comments following the COMMENT tab.	Find the responses following the Responses tab. See the table of contents to locate the page of the Responsiveness Summary for the Report Section.
Key to Comment Codes:		
Comment codes are in this format XY-a.b X=Report (DB=Database Report, D=DEIR, P=PMCR) Y=Commentor Group (F=Federal, S=State, L=Local, C=Community Interaction Program, P=Public Interest Group or Individuals, G=General Electric) a=Letter or report containing comments b=Numbered comment		

Example:

COMMENT RESPONSE ASSIGNMENT FOR THE DEIR

AGENCY/ Name	Comment CODE	REPORT SECTION	KEY WORDS		
			1	2	3
NOAA, Rosman	DF-2.1	Appendix A, 5.4	Data	Quality	

Find comment under tab "Federal (DF)".
Find response under tab "Response (DEIR)" page DEIR- 82 where comments relating to Appendix A are discussed.

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Comment Directory

10.0031

4.2 COMMENT DIRECTORY FOR THE DATABASE REPORT AND DATABASE

AGENCY/ Name	COMMENT CODE	REPORT SECTION	KEY WORDS		
			1	2	3
GE, Haggard	DB-1.1	General	Content		
GE, Haggard	DB-1.2	General	Releases		
GE, Haggard	DB-1.3	General	Administrative	Record	

4.3 COMMENT DIRECTORY FOR THE PMCR

AGENCY/ Name	Comment CODE	REPORT SECTION		KEY WORDS	
			1	2	3
NOAA, Rosman	PF- 1.1	1.1	Fish	Bans	Advisories
NOAA, Rosman	PF- 1.2	2.2.1	Model	Segment average	Predicted values
NOAA, Rosman	PF- 1.3	2.2.1	Data	Solids	Flow
NOAA, Rosman	PF- 1.4	2.2.1	Congeners	Values	Total PCBs
NOAA, Rosman	PF- 1.5	2.2.3	Model	Fish	Tissue
NOAA, Rosman	PF- 1.6	2.2.3	Model	Pathways	Bullhead
NOAA, Rosman	PF- 1.7	2.2.3	Data	External Loads	Lower Hudson
NOAA, Rosman	PF- 1.8	2.2.4	Model	Striped Bass	PCB Uptake
NOAA, Rosman	PF- 1.9	2.2.4	Revision	Editorial	
NOAA, Rosman	PF- 1.10	3.7.1	Model	Sediment Cores	Scour
NOAA, Rosman	PF- 1.11	3.8.1	Thomann - model	Food Chain	Revison
NOAA, Rosman	PF- 1.12	4.1	Congeners	Food Chain	Properties
NOAA, Rosman	PF- 1.13	4.1	Sediment	Water Column	Location
NOAA, Rosman	PF- 1.14	4.9, Figure 4.5	Revision	Editorial	
NOAA, Rosman	PF- 1.15	4.3	Model	Data set	Values
NOAA, Rosman	PF- 1.16	4.4.2	Model	Data set	TSS, flow
NOAA, Rosman	PF- 1.17	4.4.2	Data	Loading	USGS
NOAA, Rosman	PF- 1.18	4.4.2	Model	Mass Balance	Averaging
NOAA, Rosman	PF- 1.19	4.4.2 par 1 & Fig 4.46(b)	Revision	Editorial	
NOAA, Rosman	PF- 1.20	4.4.2 par 3	Revision	Editorial	
NOAA, Rosman	PF- 1.21	4.4.2 par 4	Data	Correlation	Coefficients
NOAA, Rosman	PF- 1.22	4.4.2	Data	Outlier	Exclusion
NOAA, Rosman	PF- 1.23	4.4.2	Data	Concentration	Derivation
NOAA, Rosman	PF- 1.24	4.4.2	Load	Sources	Percentages
NOAA, Rosman	PF- 1.25	4.4.3	Model	Data	Atmosphere
NOAA, Rosman	PF- 1.26	4.4.3	Model	Water Column	Stratification
NOAA, Rosman	PF- 1.27	4.4.5	Model	Water Column	Stratification
NOAA, Rosman	PF- 1.28	4.4.5	GE 1991 Data	Sediment	Average
NOAA, Rosman	PF- 1.29	4.4.5	Density	Basis	Dry weight
NOAA, Rosman	PF- 1.30	4.4.5	Model	Sediment	Congener
NOAA, Rosman	PF- 1.31	4.5.2	Model	Parameters	Values
NOAA, Rosman	PF- 1.32	6.5	Model	Scour	Depth
NOAA, Rosman	PF- 1.33	7.1	Lower HR Model	Updated Thomann	

AGENCY/ Name	Comment CODE	REPORT SECTION		KEY WORDS	
			1	2	3
NOAA, Rosman	PF- 1.34	7.2.3	Migration	Striped Bass	References
NOAA, Rosman	PF- 1.35	7.6.2	Revision	Editorial	Sensitivity
NOAA, Rosman	PF- 1.36	7.7	Model	Thomann	Marking
NOAA, Rosman	PF- 1.37	8.5.5	Model	Water Column	Carbon
NOAA, Rosman	PF- 1.38	9.1.5, Table 9-2	Model	Concentration	Weight Basis
NOAA, Rosman	PF- 1.39	9.1.5, Table 9-7	Data	Accuracy	R squared
NOAA, Rosman	PF- 1.40	9.2, Figures 9-11 and 9-12	Revision	Editorial	Axis label
NOAA, Rosman	PF- 1.41	9.3, Figures 9-8 thru 9-13	Revision	Editorial	Regression line
NOAA, Rosman	PF- 1.42	9.3	Model	Fish burden	Outputs
NOAA, Rosman	PF- 1.43	9.3	Revision	Data	
NOAA, Rosman	PF- 1.44	9.4	Reference	Sex	Differences
NOAA, Rosman	PF- 1.45	10.1.3	Data	Water Column	Chironomid
NOAA, Rosman	PF- 1.46	10.2	Tissue	Sediment	Lipid
NOAA, Rosman	PF- 1.47	10.2.2	Data	BSAF	Calculations
NOAA, Rosman	PF- 1.48	10.2.2	Model	Fish	Diet
NOAA, Rosman	PF- 1.49	10.2.3	Model	Percentiles	Clarification
NOAA, Rosman	PF- 1.50	10.2.3	Model	Percentile	Interpretation
NOAA, Rosman	PF- 1.51	10.2.3	Revision	Data	Means error
NOAA, Rosman	PF- 1.52	10.2.3	Chronomids	Feeding	Habits
NOAA, Rosman	PF- 1.53	10.2.3	Data	Sediment	Biota, Format
NOAA, Rosman	PF- 1.54	10.2.3	Data	Organisms	Feeding
NOAA, Rosman	PF- 1.55	10.4.1	Data	Fish	Size
NOAA, Rosman	PF- 1.56	10.4.3	Data	Fish	Diet
NOAA, Rosman	PF- 1.57	10.4.3	Sampling	Fish	Composites
NOAA, Rosman	PF- 1.58	10.4.4	Revision	Editorial	
NOAA, Rosman	PF- 1.59	A- 1.3.2	Revision	Editorial	Units
NOAA, Rosman	PF- 1.60	A- 1.10.4	Revision	Spottail Shiner	Diet
NOAA, Rosman	PF- 1.61	A-1.10.5	Data	Fish	Feeding
NOAA, Rosman	PF- 1.62	A- 1.10.5	Model	BAFs	Water Column
NOAA. Rosman	PF- 1.63	A- 1.10.5	Revision	Forage Fish	Diet
SC EMC/GLC, Adams	PL- 1.1	General	Report	Format	Organization
SC EMC/GLC, Adams	PL- 1.2	General	Report	Content	Concept Summary
SC EMC/GLC. Adams	PL- 1.3	3.5.2	Model	HUDTOX	Relationships
SC EMC/GLC. Adams	PL- 1.4	8.2.1	Model	Congeners	Fish

AGENCY/ Name	Comment CODE	REPORT SECTION		KEY WORDS	
			1	2	3
SC EMC/GLC, Adams	PL- 1.5	8.3	Model	Fish	Burden
SC EMC/GLC, Adams	PL- 1.6	3.5	Model	Appropriateness	Upper Hudson
SC EMC/GLC, Adams	PL- 1.7	3.1, Figure 3-1	Symbols	Explanation	
SC EMC/GLC, Adams	PL- 1.8	3.5	Submodel	Rationale	Carbon
SC EMC/GLC, Adams	PL- 1.9	3.5.2	Submodel	Database	Explanation
SC EMC/GLC, Adams	PL- 1.10	3.5.2	Submodel	Access	Application
SC EMC/GLC, Adams	PL- 1.11	3.71	Model	Scour	Reassessment
SC EMC/GLC, Adams	PL- 1.12	4.4.2	Data	Air	Volatilization
SC EMC/GLC, Adams	PL- 1.13	4.4.2	Tables	Sediment	Concentration
SC EMC/GLC, Adams	PL- 1.14	4.7	Data	Explanation	Settling velocity
SC EMC/GLC, Adams	PL- 1.15	4.7	Data	Explanation	Average velocity
SC EMC/GLC, Adams	PL- 1.16	4.5, Table 4.10	Data	Explanation	Ux
SC EMC/GLC, Adams	PL- 1.17	Chapter 4 Tables, Tables 4-13 thru 4-17	Data	Variance	Statistics
SC EMC/GLC, Adams	PL- 1.18	7.2	Data	Dispersion	Coefficient
SC EMC/GLC, Adams	PL- 1.19	10.4.4	Data	FFBAF	Equations
STC/Putman	PC- 1.1	4.0	Solids	TSS	Resusupension
STC/Putman	PC- 1.2	4.7	Model	Loading	Resuspension
STC/Putman	PC- 1.3	4.2	Model	Transport	Movement
STC/Putman	PC- 1.4	4.4	Model	Flow	Concentration
STC/Putman	PC- 1.5	4.4	Data	References	Mass
STC/Putman	PC- 1.6	6.2	Model	Scour	Resuspension
Sanders, John	PP- 1.A	4.0	Model	Time	Date
Sanders, John	PP- 1.B	4.0	Data	Time	Date
Sanders, John	PP- 1.C	General	Data	Sediment	Sampling
Sanders, John	PP- 1.1	General	Revision	Editorial	Hyphen

AGENCY/ Name	Comment CODE	REPORT SECTION		KEY WORDS	
			1	2	3
Sanders. John	PP- 1.2	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.3	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.4	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.5	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.6	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.7	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.8	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.9	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.10	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.11	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.12	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.13	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.14	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.15	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.16	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.17	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.18	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.19	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.20	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.21	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.22	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.23	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.24	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.25	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.26	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.27	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.28	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.29	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.30	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.31	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.32	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.33	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.34	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.35	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.36	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.37	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.38	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.39	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.40	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.41	General	Revision	Editorial	Hyphen

AGENCY/ Name	Comment CODE	REPORT SECTION		KEY WORDS	
			1	2	3
Sanders, John	PP- 1.42	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.43	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.44	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.45	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.46	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.47	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.48	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.49	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.50	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.51	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.52	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.53	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.54	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.55	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.56	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.57	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.58	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.59	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.60	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.61	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.62	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.63	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.64	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.65	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.66	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.67	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.68	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.69	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.70	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.71	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.72	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.73	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.74	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.75	General	Revision	Editorial	Comma
Sanders, John	PP- 1.76	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.77	General	Revision	Editorial	Comma
Sanders, John	PP- 1.78	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.79	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.80	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.81	General	Revision	Editorial	Comma

AGENCY/ Name	Comment CODE	REPORT SECTION		KEY WORDS	
			1	2	3
Sanders, John	PP- 1.82	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.83	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.84	General	Revision	Editorial	Comma
Sanders, John	PP- 1.85	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.86	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.87	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.88	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.89	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.90	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.91	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.92	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.93	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.94	General	Aroclors	Homologues	PCBs
Sanders, John	PP- 1.95	General	Revision	Editorial	Style
Sanders, John	PP- 1.96	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.97	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.97A	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.97B	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.97C	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.98	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.99	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.100	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.101	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.102	General	Revision	Editorial	Comma
Sanders, John	PP- 1.103	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.104	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.105	General	Revision	Editorial	Style
Sanders, John	PP- 1.106	General	Revision	Editorial	Style
Sanders, John	PP- 1.107	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.108	General	Revision	Editorial	Comma
Sanders, John	PP- 1.109	Executive Summary	Model	HUDTOX	Allens Mill
Sanders, John	PP- 1.110	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.111	General	Revision	Editorial	Style
Sanders, John	PP- 1.112	Executive Summary	Sediment	Congener	Finger print
Sanders, John	PP- 1.113	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.114A	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.114B	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.115	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.116	General	Revision	Editorial	Hyphen

AGENCY/ Name	Comment CODE	REPORT SECTION		KEY WORDS	
			1	2	3
Sanders, John	PP- 1.117	General	Revision	Editorial	Style
Sanders, John	PP- 1.118	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.119	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.120	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.121	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.122	General	Revision	Editorial	Style
Sanders, John	PP- 1.123	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.124	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.125	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.126	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.127	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.128	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.129	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.130	General	Revision	Editorial	Comma
Sanders, John	PP- 1.131	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.132	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.133	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.134	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.135	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.136	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.137	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.138	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.139	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.140	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.141	General	Revision	Editorial	Comma
Sanders, John	PP- 1.142	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.143	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.144	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.145	1.1	Survey	NYSDEC	1984 FS
Sanders, John	PP- 1.146	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.147	General	PCBs	Homologues	Aroclors
Sanders, John	PP- 1.148	General	PCBs	Homologues	Aroclors
Sanders, John	PP- 1.149	General	Revision	Editorial	Hyphen
Sanders, John	PP- 1.150	General	Revision	Editorial	Style
Sanders, John	PP- 1.151	General	Revision	Editorial	Hyphen
Sanders, John	PP -1.152	General	Revision	Editorial	Style
Sanders, John	PP- 1.153	General	Revision	Editorial	Style
Sanders, John	PP- 1.154	General	Revision	Editorial	Style

AGENCY/ Name	Comment CODE	REPORT SECTION		KEY WORDS	
			1	2	3
Sanders. John	PP- 1.155	General	Revision	Editorial	Style
Sanders. John	PP- 1.156	General	Revision	Editorial	Style
Sanders. John	PP- 1.157	General	Revision	Editorial	Hyphen
Sanders. John	PP- 1.158	General	Revision	Editorial	Spelling
Sanders, John	PP- 1.159	General	Revision	Editorial	Spelling
GE	PG- 1.1	4.6	Fate	Transport	Solids balance
GE	PG- 1.2	3.5	Mass Balance	Transfer	PCB balance
GE	PG- 1.3	3.5	PCB Balance	Conditions	Model
GE	PG- 1.4	4.7.2	Mechanisms	Groundwater	TIP
GE	PG- 1.5	3.1	Data	Calibration	Model
GE	PG- 1.6	8.1	Steady State	Predictions	Model
GE	PG- 1.7	3.7	Scour	100 year flood	Lick equation
GE	PG- 1.8	General	Data	Predictions	Testing
GE	PG- 1.9	7.1	Thomann	Update	Use
Additional GE Material posing no direct questions but for which responses are appropriate.					
GE	PG- 1.10	6.1	Model	Evaluation	Criteria
GE	PG- 1.11A	4.3	PCB	Mass	Balance
GE	PG- 1.11B	4.7, 4.7.2	Model	Calibration	Groundwater
GE	PG- 1.11C	4.7	Model	Calibration	Solids
GE	PG- 1.11D	4.7	Model	Calibration	Sediment
GE	PG- 1.11E	4.7, 4.7.2	Model	Calibration	Resuspension
GE	PG- 1.11F	4.7	Model	Calibration	Variation
GE	PG- 1.11G	4.7	Model	Calibration	Data
GE	PG- 1.11H	4.7	Model	Dechlorination	Biodegradation
GE	PG- 1.11I	4.7	Model	Calibration	Results
GE	PG- 1.12	8.1			
GE	PG- 1.13B	5.9.1	Shear stress	Hydrodynamic	RMA-2V
GE	PG- 1.13C	6.3	Lick Equation	Resuspension	Densities
GE	PG- 1.13D	6.3	Scour Model	Transport Model	Inconsistency
GE	PG- 1.13E	6.5	Scour Model	Sediment	Non-cohesive
GE	PG- 1.13F	6.5	Scour Model	Non-cohesive	Erosion
GE	PG- 1.14	7.7	Model	Predictive	Validation
GE	PG- 1.15	7.0	Upper Hudson	Remediation	Impacts
GE	PG- 1.16	7.7	Model	Limitations	

4.4 COMMENT DIRECTORY FOR THE DEIR

AGENCY/ Name	Comment CODE	REPORT SECTION		KEY WORDS	
			1	2	3
NOAA, Rosman	DF-2.1	Appendix A, 5.4	Data	Quality	
NOAA, Rosman	DF-2.2A	Appendix A	Data	Quality	Compositions
NOAA, Rosman	DF-2.2B	Appendix A	Data	Quality	BZ#44
NOAA, Rosman	DF-2.2C	Appendix A	Data	Quality	Risks
NOAA, Rosman	DF-2.3A	3	Discussion	Congener	Loading
NOAA, Rosman	DF-2.3B	3	Discussion	Congener	BZ#118
NOAA, Rosman	DF-2.4	3.3.3	Analyses	Congener	Concentration
NOAA, Rosman	DF-2.5	3.4.3	Discussion	Congener	Weathering
NOAA, Rosman	DF-2.6	4	Data	Interpretation	Use
NOAA, Rosman	DF-2.7	2.2.2	Analysis	Independence	Sources
NOAA, Rosman	DF-2.8	2.3	Patterns	Summer	Load
NOAA, Rosman	DF-2.9	2.3	Collections	Dynamics	Deposits
USGS, Pearsall	DF-3.1	3.3	Data	Bias	
USGS, Pearsall	DF-3.2	3.4	Revision	Editorial	
USGS, Pearsall	DF-3.3	3.3.5	Data	Homologue	Water column
USGS, Pearsall	DF-3.4	3.2.3	Definition	Transition	Flow
USGS, Pearsall	DF-3.5	3.2.3	Data	Source	
USGS, Pearsall	DF-3.6	3.2.3	Data	Collection	Time
USGS, Pearsall	DF-3.7	3.2.3	Figures	Information	
USGS, Pearsall	DF-3.8	3.4.3	Load	Time	
USGS, Pearsall	DF-3.9	3.4.6	Model	Thomann	Water column
NYSDEC, Sterman	DS-2.1	2.2.1	Sediments	Fish	Site
NYSDEC, Sterman	DS-2.2	2.2.1	Seepage	Rate	Usage
NYSDEC, Sterman	DS-2.3	2.2.1	Dump	Listing	Existing
NYSDEC, Sterman	DS-2.4	2.2.2	Remediation	Consideration	Feasibility Study
NYSDEC, Sterman	DS-2.5	3.2.6	Process	Load	Water column
NYSDEC, Sterman	DS-2.6	3.2.6	Loads	Water column	Flow
NYSDEC, Sterman	DS-2.7	3.2.6	Load	Prediction	Fate
NYSDEC, Sterman	DS-2.8	3.2.6	Processes	Exchange	Load
NYSDEC, Sterman	DS-2.9	3.2.6	Load	Sediments	Influence
NYSDEC, Sterman	DS-2.10	3.2.7	Sediments	Scour	Hoosic River
NYSDEC, Sterman	DS-2.11	3.2.7	Load	Increase	Spring
NYSDEC, Sterman	DS-2.12	3.3.1	Sediments	Cores	Chronology
NYSDEC, Sterman	DS-2.13	3.4.1	Data	Water column	Representative
NYSDEC, Sterman	DS-2.14	3.4.3	Load	Storage	TIP

AGENCY/ Name	Comment CODE	REPORT SECTION	KEY WORDS 1	KEY WORDS 2	KEY WORDS 3
NYSDEC, Sterman	DS-2.15	3.4.4	Sewer overflow	Problem	Allen Mill
NYSDEC, Sterman	DS-2.16	3.4.4	Loading	Interpretation	Relation
NYSDEC, Sterman	DS-2.17	3.4.4	Sediments	Source	Water column
NYSDEC, Sterman	DS-2.18	3.4.4	Comparison	Load	Basis
NYSDEC, Sterman	DS-2.19	3.6	Sediments	Age	
NYSDEC, Sterman	DS-2.20	3.6	Sediments	Load	Dechlorination
NYSDEC, Sterman	DS-2.21	4.4	Sediment	Water column	Exchange
NYSDEC, Sterman	DS-2.22	4.4	Loads	Quantify	
NYSDEC, Sterman	DS-2.23	4.4	Loads	Sources	Alteration
NYSDEC, Sterman	DS-2.24	4.4	Load	Duration	Stability
NYSDEC, Sterman	DS-2.25	4.4	Load	Porewater	Exchange
NYSDEC, Sterman	DS-2.26	4.4	Remediation	Remedy	Controls
NYSDEC, Sterman	DS-2.27	General	Data	Model	Verify
NYSDEC, Sterman	DS-2.28	General	Data	Monitoring	Long term
NYSDEC, Sterman	DS-2.29	General	Data	Core	Incorporation
NYSDEC, Sterman	DS-2.30	General	Data	Sediments	Impact
SCEMC&GLC, Balet	DL-1.1	3.4.3	Data	Loading	Suspect
SCEMC&GLC, Balet	DL-1.2	3.4.5	Data	Sediment	Hot spots
SCEMC&GLC, Balet	DL-1.3	3.2.3	Sediments	Time	Hot spots
SCEMC&GLC, Balet	DL-1.4	4.5	Scenario	Sediment	Transport
SCEMC&GLC, Balet	DL-1.5	General	Data	Water column	Concentrations
SCEMC&GLC, Balet	DL-1.6	4.5	Evaluate	Inputs	Source
SCEMC&GLC, Balet	DL-1.7	4.3.1	Significance	Chlorine	Health Risk
SCEMC&GLC, Balet	DL-1.8	3.3.3	Input	Congener	Fingerprinting
Agriculture Liaison Group, Borden	DC-1.1	General	Participation	Public meetings	
Agriculture Liaison Group, Borden	DC-1.2	General	Conclusions	Reports	Schedule
Agriculture Liaison Group, Borden	DC-1.3	General	Comments	Opinions	Parties
Agriculture Liaison Group, Borden	DC-1.4	3.4.2	Sources	Ignored	
Agriculture Liaison Group, Borden	DC-1.5	1.3	Data	Reference	Time
Agriculture Liaison Group, Pulver	DC-2.1	General	Dredging	Objection	Dairy

AGENCY/ Name	Comment CODE	REPORT SECTION	KEY WORDS		
			1	2	3
Environmental Liason Group, Ruggi	DC-3.1	4.5	Sediments	Dechlorination	Quantification
Environmental Liason Group, Ruggi	DC-3.2	4.5	Theory	Flux	Groundwater
S&T Committee, Putman	DC-4.1	3.3.2	Concentrations	Flow	Cores
S&T Committee, Putman	DC-4.2	3.2.3	Sedimentation	Rate	Scour
S&T Committee, Putman	DC-4.3	3.2.3	Loading	Groundwater	Discharge
S&T Committee, Putman	DC-4.4	Executive Summary	Loading	Increase	Hot spots
S&T Committee, Putman	DC-4.5	3.2.7	Data	Concentrations	Water samples
S&T Committee, Putman	DC-4.6	1.4.2	Data	Sampling	Unreliable
S&T Committee, Putman	DC-4.7	3.2.4	Discharge	Calibration	Error
Clearwater, Mele	DP-1.1	Executive Summary	Inventory	Depletion	Time
Davies, Sherwood	DP-2.1	General	Exposure	Transport	Water source
Davies, Sherwood	DP-2.2	General	Ozone	By-products	Toxicity
Davies, Sherwood	DP-2.3	General	Risk	Infiltration	Water source
Davies, Sherwood	DP-3.1	Executive Summary	Sediments	Porewater	Migration
Pace Environ. Litigation Clinic, Boehlje	DP-4	General			
Scenic Hudson, Lee	DP-5	General			
GE	DG-1.1	Executive Summary, p. 2	Water Column	TI Dam	Pipeline
GE	DG-1.2	Executive Summary, p. 3	Load	Homologue	Water column
GE	DG-1.3	Executive Summary, p. 4	Load	Source	Vague
GE	DG-1.4	Executive Summary, pp. 5-8	Sediment	Dechlorination	Toxicity

10.0043

AGENCY/ Name	Comment CODE	REPORT SECTION		KEY WORDS	
			1	2	3
GE	DG-1.4A	3.2.7	PCB	Fate	Low flow
GE	DG-1.4B	3.2.7	Fate	Volatilization	Deposition
GE	DG-1.4C	3.2.7	Inconsistency	Reaches	Treatment
GE	DG-1.4D	3.2.7	1993 Conditions	Allens Mill	Loading
GE	DG-1.4E	General	PCB	Behavior	Upper Hudson
GE	DG-1.5	4.4	Diffusion	Load	Increase
GE	DG-1.6	4.4	Resuspension	Sediments	pre-1984
GE	DG-1.7	4.4	Resuspension	Dechlorination	Low flow
GE	DG-1.8	4.4	Fingerprint	Dechlorination	Source
GE	DG-1.9	3.2.6, p. 3-76	Discharge	Load	Undechlorination
GE	DG-1.10	3.2.6	Source	Reduction	Control
GE	DG-1.10A	3.2.6	Source	High Flow	
GE	DG-1.11	3.2.6	Load	Balance	Calculation
GE	DG-1.12	3.3.4	Fingerprint	Load	Undechlorination
GE	DG-1.13	General	Fingerprint	Fish	Consistency
GE	DG-1.14	3.3.4	Load	Unaccounted	Allen Mill
GE	DG-1.15	3.2.6	Load	Understated	
GE	DG-1.15A	3.2.6			
GE	DG-1.15B	3.2.6			
GE	DG-1.15C	3.2.6			
GE	DG-1.15D	3.2.6			
GE	DG-1.16	3.2.6	Volatization	Deposition	Decrease
GE	DG-1.17	3.3.3	Load	Sources	External
GE	DG-1.18	4.3	Mechanism	Dechlorination	Reduction
GE	DG-1.19	4.3	Report	Dechlorination	Indices
GE	DG-1.20	4.3.2, p. 4-69	Dechlorination	Concentration	
GE	DG-1.21	4.3	Dechlorination	Cessation	
GE	DG-1.22	3.3.3, p. 3-119	Dechlorination	Pattern	H/H'
GE	DG-1.23	3.1	Partitioning	Kp	Temperature
GE	DG-1.24	3.2.3, p. 3-55	Volatilization	Low Flow	Seasonal
GE	DG-1.25A	Appendix A, 5.4	Analytical Issues	Congeners	
GE	DG-1.25B	Appendix A, 5.4	Analytical Issues	Congeners	
GE	DG-1.25C	Appendix A, 5.2	Analytical Issues	Extraction	Gas flow
GE	DG-1.26A	4.3, p. 4-49	Remobilization	Resuspension	Sediment

AGENCY/ Name	Comment CODE	REPORT SECTION		KEY WORDS	
			1	2	3
GE	DG-1.26B	4.3.1, p. 4-50	Microorganisms	Degradation	High mol wt
GE	DG-1.26C	4.3.1, p. 5-50	Anoxic	Biotransformation	Dechlorination
GE	DG-1.26D	4.3.1, p. 4-51	Dechlorination	ortho-chlorine	High mol wt
GE	DG-1.26E	4.3.1, p. 4-51	PCB molecule	Destruction	Total
GE	DG-1.26F	4.3.1, p. 4-51	Carcinogenic	Neurological	Congeners
GE	DG-1.26G	4.3.1, p. 4-51	Anerobic	Degradation	Sediments
GE	DG-1.26H	4.3.1, p. 4-52	Biodegradation	Prodcucts	Sediments
GE	DG-1.26I	4.5, p. 4-88	Concentration	Dependence	Dechlorination
GE	DG-1.26J	4.3.2, p. 4-52	Dechlorination	Sources	Basis
GE	DG-1.26J1	4.3.2, p.4-56			
GE	DG-1.26K	4.3.2, p. 4-56	BZ#8	Indicator	MDPR
GE	DG-1.26L	4.3.2, p. 4-57	ortho-chlorine	Dechlorination	Limits
GE	DG-1.26M	4.3.2, p. 4-59	Dechlorination	Processes	H/H'
GE	DG-1.26N	4.3.2, p. 4-60	MDPR	Sensitivity	Congeners
GE	DG-1.26O	4.3.2, p. 4-62	MDPR	Partitioning	Degradation
GE	DG-1.26P	4.3.2, p. 4-65	Dechlorination	Maximum	Decrease
GE	DG-1.26Q	4.3.2, p. 4-69	delta-MW	Concentration	Dependence
GE	DG-1.26R	4.3.2, p. 4-70	Sediments	Age	Dechlorination

Responses (DATABASE)

10.0046

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY
VOLUME A: DATABASE REPORT
DECEMBER 1998

A. DATABASE REPORT AND DATABASE:

RESPONSES TO COMMENTS ON THE DATABASE REPORT

No comments were received on the Database Report *per se*. However, General Electric did provide comments on the database itself, as issued in the April 1996 CD-ROM version, in their letter dated May 29, 1996.

Response to DB-1.1

GE identified the data sets identified below as missing from the database (copied from GE Attachment 1).

LOCATION/ PROGRAM	ORIGIN	MEDIA	PARAMETER	CURRENT FORM	STATUS
Lower River, New York Harbor, Long Island Sound	GE/Harza 1988 - 1991	Sediment Biota	PCBs Pesticides lipids	dBase IV files	Partially included
TIP TSS Survey	GE/OBG 1991	Water	TSS	report, dBase IV files	Included
Polygon (3)	GE/OBG 1990	Sediment	PCB	dBase IV	Not included
EPA Lower River Helicopter Survey	EPA 1976	Sediment	PCB	EPA Report	Not included
EPA Lower River Survey	EPA 1981	Sediment	PCB	EPA Report	Not included
NYU Lower River Biota	NYU pre-1982	Biota	PCB	NYU Report	Not included

General Electric data updates received from O'Brien and Gere (OBG) are regularly incorporated into the Hudson River Database. The data structure is modified to conform to a relational database structure, but data points are not omitted. The latest release of the database (Release 4.1, dated August 1998) included the data received on 7/28/98 from O'Brien and Gere. As stated in OBG's transmittal letter, GE/Harza data from 1988-1991 have only been partially provided to USEPA. All GE/Harza data provided in the recent GE database transmittal have been included in the USEPA database. Sediment and fish data from this sampling event are expected in upcoming deliverables from OBG. Pesticide data have not been included in the data received from GE/OBG. There are 651 TSS samples from the 1991 Hudson River PCB Water Survey. Although not specifically labeled TIP TSS Survey data, this is believed to be the data referred to in the table. Polygon (3) data were not specifically identified in the data files supplied by GE. However, if these data were included in the recent GE database transmittal then they are included in the TAMS' Hudson River database. The missing data including GE/Harza sediment and biota data, pesticide data, and Polygon (3) sample data, will be added to the Hudson River Database once received from General Electric.

The data from last three programs listed in the table are not available in electronic format. These programs focus on the Lower Hudson River in 1976, 1981 and pre-1982. To date these data have not been needed to perform the Hudson River PCBs Reassessment. Only if these data are required for the Reassessment will they be added to the database.

Response to DB-1.2

The Hudson River Database is released whenever significant additions of data or modifications to data are made. This includes addition of data from General Electric and NYSDEC as well as other sources.

Response to DB-1.3

The status of each data set identified by GE as missing from the Hudson River Database is listed in the table on page DB-1. Two of the six data sets have been added to the database in the form provided by GE. An incomplete set of sediment PCB data from the lower river New York Harbor and Long Island Sound data is included, but GE did not provided the pesticide data. The TIP TSS survey data are included in the database and this data set appears to be complete. The Polygon (3) program data was not provided by GE. Sediment data in the database from 1990 was collected by Harza Engineering, but the Polygon (3) study was performed by O'Brien and Gere.

The EPA's lower river surveys (1976 and 1981) and NYU's lower river biota study have not been included in the database. The data from these programs was not required to perform the Hudson River PCBs Reassessment. These programs focus on the Lower Hudson River in 1976, 1981 and pre-1982. Only if these data are required for the Reassessment will they be added to the database.

Responses (PMCR)

10.0049

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY
VOLUME B: PRELIMINARY MODEL CALIBRATION REPORT
DECEMBER 1998

B: PMCR REPORT

RESPONSES TO GENERAL COMMENTS ON THE PMCR REPORT

Response to PL-1.2:

The Executive Summary included at the front of each Reassessment report is intended to summarize the information presented in the report in a manner that can be understood by less technically-trained citizens. It is noted, however, that there is a limit to the extent to which this rather complex topic can be made non-technical without oversimplifying, and perhaps distorting, the issues.

Response to PL-1.1:

The format of the report, which provides the tables and figures as a second book, allows the reader to have both the text and tables/figures open at the same time, rather than continually having to leaf back and forth within a single volume. Such a format is standard for all Reassessment reports.

Response to PP-1.1 through PP-1.159:

PP-1 are comments from John E. Sanders. Mr. Sanders provided 159 numbered comments in an attachment, plus three additional comments in the cover/transmittal letter. For convenience, Mr. Sanders' numbering has been retained (*e.g.*, his comment 08 is identified herein as "PP-1.8"); with comments in the cover letter identified by letter (*e.g.*, PP-1.A). A large number of the comments are editorial, reflecting use of hyphens, commas, or wording. These editorial comments (for which no response is provided) are identified immediately below; technical comments are provided with a specific response in the appropriate section of this Responsiveness Summary.

Comments on hyphen use: PP-1.1 - 1.63; 1.65 - 1.74; 1.76; 1.78 - 1.80; 1.85 - 1.93; 1.96 - 1.101; 1.103; 1.104; 1.107; 1.113 - 1.116; 1.118 - 1.121; 1.123 - 1.140; 1.142 - 1.144; 1.146; 1.151; and 1.157.

Comments on comma use: PP-1.75, 1.77, 1.81, 1.84, 1.102, 1.1.108, and 1.141.

Comments on spelling, wording, or word use: PP-1.64; 1.95; 1.105; 1.106; 1.111; 1.117; 1.122; 1.150; 1.152 - 1.156; 1.158; and 1.159.

Response to PG-1.8:

The scope of work for the Baseline Modeling and Ecological Modeling efforts will include consideration of the model validation tests suggested by the reviewer.

RESPONSES TO SPECIFIC COMMENTS ON THE PMCR REPORT

EXECUTIVE SUMMARY

Response to PP-1.109:

The additional PCB DNAPL seepage from the Allen Mill site was discovered after the PMCR was completed; the HUDTOX simulation predates its cleanup.

The Allen Mill gate structure failed in September, 1991. The period of simulation for the modeling results in the PMCR corresponded only to the 1993 EPA Phase 2 sampling period. It is possible that loads from this failure event and from DNAPL seepage influenced PCB dynamics in Thompson Island Pool during 1993. The Baseline Modeling effort will include a hindcasting simulation for the period 1977-1997 to gain a better understanding of the impacts of long-term changes in PCB loads.

Response to PP-1.112:

USEPA is continuing to evaluate existing water column and sediment data for potential congener "fingerprints" which may help constrain the importance of pore-water flux for PCB loading from sediments to the Hudson River.

The PCB modeling effort includes several individual PCB congeners to assess differences in physicochemical properties (*e.g.*, partition coefficients) which can result in differential transport and exchange between sediments and the water column. The Baseline Modeling effort will continue to examine individual PCB congeners.

1. INTRODUCTION

1.1 Background

Response to PP-1.145:

The work described in the PMCR was not intended to assess the historical data; *e.g.*, the 1984 NYSDEC Survey. The focus of the PMCR was on development and preliminary calibration of a PCB transport and fate model for the 1993 EPA Phase 2 sampling period. Problems with representation of PCBs among different historical data sets were still unresolved at the time of the PMCR. More detailed descriptions and analyses of earlier NYSDEC investigations can be found in the Phase I report (USEPA, 1991), the Data Evaluation and Interpretation Report (USEPA, 1997), and the Low Resolution Sediment Coring Report (USEPA, 1998). The Baseline Modeling effort will include historical data from 1977 through 1997, including data from the 1984 NYSDEC Survey.

Response to PF-1.1:

Although this information (*e.g.*. a more detailed listing of commercial fishing bans and advisories for the Hudson River) would be useful. the topic is not germane to the specific subject matter of the PMCR. These items were included in the Phase I report and will be updated and revisited in the forthcoming Human Health Risk Assessment.

1.2 Purpose of Report

1.3 Report Format and Organization

No significant comments were received on Sections 1.2 and 1.3.

2. SUMMARY AND PRELIMINARY CONCLUSIONS

2.1 Summary

2.1.1 Overall Approach

2.1.2 Water Column and Sediment Models

2.1.3 Fish Body Burden Models

2.2 Preliminary Conclusions

No significant comments were received on Sections 2.1 through 2.2.

2.2.1 Upper Hudson River PCB Mass Balance

Response to PF-1.2:

The reviewer is referred to Table 4-15. The three cases where segment-average values for the model output were significantly different than observed values represent conditions for model segments downstream of the Thompson Island Pool and for three different PCB congeners. No consistent pattern of significant under- or over-prediction is apparent. The t-tests were applied to a relatively sparse set of matched predicted and observed conditions for the 1993 EPA Phase 2 sampling period; the reader is cautioned against over-interpretation of the preliminary results.

Response to PF-1.3:

The solids gain (across Thompson Island Pool) during the high flow period may have been under-represented due to incomplete information on suspended solids loads for the Moses and Snook Kill tributaries. The Spring 1994 high flow solids monitoring data were not available for the PMCR. The Baseline Modeling effort will incorporate these data, as well as other estimation methods, to more accurately determine flows and solids loads for the 1977-1997 hindcasting period.

Response to PF-1.4:

There is an error in the PMCR. The last sentence of "Item 13" in Section 2.2.1 (page 2-5) should be re-stated as: "The principal factor responsible for differences between total PCBs and lower-chlorinated congeners appears to be that sediments in Thompson Island Pool are relatively more contaminated with lower-chlorinated congeners than with higher-chlorinated congeners."

This sentence should have appeared as a separate item, since it refers to findings presented in several preceding "Items".

2.2.2 Thompson Island Pool Hydrodynamics and Sediment Erosion

No significant comments were received on Sections 2.2.2.

2.2.3 Upper Hudson River Fish Body Burdens

Response to PF-1.5

Differences in PCB tissue residues by fish sex, age, and/or season have been qualitatively evaluated, but it is not currently planned to conduct an extensive quantitative evaluation. There are not enough data to provide a robust statistical evaluation of differences by age, sex, or season. The 1993 Phase II data set provided fish collections at one point in time (August), and the NYSDEC data sets, for the most part, tend to collect species once per season. Insofar as differences in PCB uptake by sex reflect endpoints of interest (*e.g.*, females *vs.* males in terms of reproductive endpoints), these will be explored.

Response to PF-1.6:

The model structure is dominated by the feeding preferences of the particular fish species. These feeding preferences are based on life history studies of the species (preferentially from the Hudson River), anecdotal evidence from analyses of fish stomach contents using preserved samples provided by NYSDEC, and studies from the 1970s and 1980s by environmental engineers evaluating the impacts of power plant effluent on fish populations. The model structure does allow feeding preferences to be changed and/or expressed as distributions, and a sensitivity analysis provides information on the relative impact of feeding preference assumptions on predicted body burdens.

Response to PF-1.7:

The statement that "...the estuarine portion of the Lower Hudson River is influenced primarily by direct external loadings and loadings from the vicinity of NY City" (Preliminary Conclusions, Section 2.2; pg. 2-9) was based on preliminary results from the Upper Hudson River model and results from the original version of the Lower Hudson River model. A more accurate assessment must await results from the Baseline Modeling effort and the updated Lower Hudson River model.

2.2.4 Lower Hudson PCB Mass Balance and Striped Bass Bioaccumulation

Response to PF-1.8:

The point made by the reviewer (*i.e.*, the conclusion that striped bass net PCB uptake occurs primarily between RM 18.5 and 78.5 is an artifact of the model, since the model did not consider the distribution of striped bass in the river above RM 80) is discussed in Section 7.7 of the PMCR. The summary of findings from the Lower Hudson River bioaccumulation model results should have qualified the statement regarding striped bass PCB uptake to reflect the discrepancy between the assumed migration patterns in the existing model and more recent observations which indicate the presence of both adults and juveniles above RM 80.

Response to PF-1.9

Editorial; correction noted.

3. MODELING APPROACH: TRANSPORT AND FATE

3.1 Introduction

Response to PL-1.7:

Figure 3-1 was meant to provide a general overview of the principal components (water, solids and PCBs) of the WASP model mass balance framework. Separate diagrams representing the conceptual model framework for the solids and PCB mass balances were provided in Figures 3-2 and 3-4, respectively. The presentation of this material will be clarified (*e.g,* explanation of the symbols used) in the Baseline Modeling Report.

Response to PG-1.5:

The inclusion of groundwater advection was simply a numerical experiment designed to determine the degree to which this process might influence water column PCB concentrations in Thompson Island Pool. USEPA does not advocate inclusion (or exclusion) of groundwater advection within the HUDTOX model. This process will be further assessed in the Baseline Modeling effort. A model hindcast calibration to historic data will help verify that the model does not misrepresent either PCB flux from sediments or the rate of depletion of PCBs in sediment.

3.2 Modeling Goals and Objectives

3.3 Conceptual Approach

3.4 Hudson River Database

No significant comments were received on Sections 3.2 through 3.4.

3.5 Upper Hudson River Mass Balance Model

Response to PG-1.2:

The HUDTOX model as presented in the PMCR was not intended to be used as a predictive tool to assess remedial action scenarios. The technical concerns raised by the reviewer (*i.e.*, by overestimating resuspension and deposition, underestimating tributary solids loadings, and decoupling sedimentation from the other solids parameters, the model overstates the transfer of PCBs from sediment to water) are recognized and are being addressed in the ongoing Baseline Modeling effort, as outlined in Appendix B, (revised July 1998).

Response to PG-1.3:

The Baseline Modeling effort will include simulation of the historical period from 1977 through 1997. The GE database was acknowledged, subsequent to preparation of the PMCR, to contain significant analytical biases. USEPA's previous efforts to "correct" the GE PCB data have been superseded by GE's own efforts to make appropriate corrections to these data. These newly-corrected data have been provided to USEPA and are being used in the ongoing Baseline Modeling effort. It is not true that the USEPA model fails to consider the effects of PCB dechlorination; it is precisely to capture dechlorination effects that selected individual congeners, as well as total PCBs, will be modeled.

Response to PL-1.8:

A constant is assigned to the fraction of TSS consisting of organic carbon (Section 3.5.2, Solids Submodel, last paragraph). Representation of spatial-temporal variability in fraction organic carbon (f_{oc}) requires either direct field measurements or a separate model of organic carbon dynamics. The available data are not sufficient to support development and application of a separate mass balance model for organic carbon dynamics. Furthermore, in USEPA's judgment, the organic carbon dynamics in the Upper Hudson River do not warrant the level of process resolution that would be included in such a model. In the Baseline Modeling effort, spatial-temporal variability in foc will be examined using available direct field measurements and included in the model if appropriate.

Tables 4-10 and 4-14 contain f_{oc} as a PCB model process-related parameter.

The rationale for estimating biotic solids loads due to primary production is presented in Section 4.4.2. The data used represent the only available information on primary production within the freshwater portion of the Hudson River.

Response to PL-1.6:

A discussion of why it was felt necessary to develop a new model for the Upper Hudson instead of applying the existing Lower Hudson model will be included in the Baseline Modeling Report.

The available version of the Lower Hudson River model was not directly applicable to the study questions in the Upper Hudson River. The Lower Hudson model represented PCB homologues and was intended to represent temporal scales on the order of years to decades. The Upper Hudson River model was designed to represent individual PCB congeners and event-scale processes.

Work on the Lower Hudson River model has been suspended, because the Lower Hudson River model is currently being updated by Drs. Robert Thomann and Kevin Farley as part of a separate project. Upon completion of this work, USEPA will review the updated model and decide how it should be used to assess the impacts of PCB loads from the Upper Hudson River on the lower river and estuary.

3.5.1 Introduction

No significant comments were received on Section 3.5.1.

3.5.2 State Variables and Process Kinetics

Response to PL-1.3:

Additional documentation of the HUDTOX mathematical modeling framework should have been incorporated within the report for completeness. Relevant equations, expressing the relationships between various model state variables, will be included in the Baseline Modeling Report. The reader will still be referred to official USEPA documentation and other sources (*e.g.*, Ambrose, *et al.*) for specific details insofar as HUDTOX and WASP5 share common features.

Response to PL-1.9:

The inclusion of both truly dissolved phase PCBs and DOC-bound PCBs is important and thus both of these PCB forms have been included in the HUDTOX model. Unfortunately, it is very difficult to achieve accurate separation of the DOC-bound phase in environmental samples, for which reason the DOC-bound phase was not directly quantified in either the EPA Phase 2 work or GE's sampling effort. The Data Evaluation and Interpretation Report (1997) provides an extensive discussion of PCB partitioning to DOC, together with an analysis of available evidence on partition coefficients to DOC for individual PCB congeners. The lack of inclusion of DOC-bound PCBs in the database precludes direct calibration of DOC-bound PCB concentrations computed by the HUDTOX model. Both the estimated values developed in the Data Evaluation and Interpretation Report and literature values for partition coefficients between PCBs and DOC will be used in the model to verify that results for DOC-bound PCB concentrations are reasonable.

Response to PL-1.10:

More complete information on model enhancements (referenced in the last paragraph of section 3.5.3) will be provided in the Baseline Modeling Report.

3.5.3 Spatial-Temporal Scales

3.5.4 Application Framework

3.6 Thompson Island Pool Hydrodynamic Model

3.6.1 Introduction

3.6.2 State Variables and Process Mechanisms

3.6.3 Spatial-Temporal Scales

3.6.4 Application Framework

No significant comments were received on Sections 3.5.3 through 3.6.4.

3.7 Thompson Island Pool Depth of Scour Model

3.7.1 Introduction

Response to PF-1.10:

The Depth of Scour Model in the Baseline Modeling effort has been expanded to include representation of both cohesive and non-cohesive sediment types.

Response to PL-1.11:

The different models in this Reassessment RI/FS were designed to answer different questions. The Depth of Scour Model was designed to estimate masses of solids and PCBs resuspended, and corresponding depth of sediment scour, for large flood events at fine spatial scales. The HUDTOX model was designed to estimate transport, fate and redistribution of solids and PCBs over a range of river flows at coarser spatial scales. When used in a complementary fashion, these two models will adequately address the transport and redistribution of eroded sediments.

Response to PG 1.7:

The application of the Lick equation to the dynamics of cohesive sediment resuspension in the Depth of Scour Model will be reviewed. If any errors are discovered they will be corrected. The USEPA will consider use of a modified van Rijn model for resuspension properties of non-cohesive sediments.

3.7.2 Process Representation

3.7.3 Spatial-Temporal Scales

3.7.4 Applications Framework

No significant comments were received on Sections 3.7.2 through 3.7.4.

3.8 Lower Hudson River PCB Transport and Fate Model

3.8.1 Introduction

Response to PF-1.11:

The Baseline Modeling Report will state that the Lower Hudson River model is currently being updated by Drs. Robert Thomann and Kevin Farley as part of a separate project. Upon completion of this work, USEPA will review the updated model and decide how it should be used to assess the impacts of PCB loads from the Upper Hudson River on the lower river and estuary. At the present time it is not known how results from the updated model may differ from those in the original model.

3.8.2 State Variables and Process Kinetics

3.8.3 Spatial-Temporal Scales

3.8.4 Applications Framework

No significant comments were received on Sections 3.8.2 through 3.8.4.

4. CALIBRATION OF UPPER HUDSON RIVER PCB MODEL

Response to PP-1.A:

There are some inconsistencies between displayed results and corresponding labels (dates). Results and labels will be consistent in the Baseline Modeling Report.

Response to PP-1.B:

The USGS data for flow at Green Island has been obtained in electronic form from the USGS, therefore the offer of the electronic file is appreciated but not needed. Since the Lower Hudson will not be modeled by the USEPA as part of the Reassessment, the suspended matter data are not required for this effort. Again the offer is appreciated by the USEPA.

Response to PC-1.1:

The Baseline Modeling effort will include investigation of more comprehensive data sets for solids (TSS) and river discharge. For example, the Spring 1994 high flow solids survey conducted by Dr. Richard Bopp included daily measurements in the main stem and principal tributaries. After completion of the PMCR, 5000 additional USGS TSS measurements were discovered and incorporated within the USEPA/TAMS database. The solids mass balance in the PMCR will be extended to include the historical period from 1977 to 1997.

4.1 Introduction

Response to PF-1.12:

This information (a description of the physico-chemical properties for the five selected PCB congeners and the relevancy of the five selected congeners to the food chain model and ecological risk assessment) will be presented in the Baseline Modeling Report.

Response to PF-1.13:

Matched pairs of sediment and water column PCBs are not available to directly assess whether there is such a concomitant increase. There is not yet a full understanding of processes controlling PCB dynamics between Fort Edward and Thompson Island Dam. The Data Evaluation and Interpretation Report (USEPA, 1997) provides a detailed discussion and analyses of available data from all sources on changes in water column load across the Thompson Island Pool. The recently released Low Resolution Coring Report provides an analysis of changes in sediment inventory of PCBs over time. General Electric has recently (OBG, 1997) conducted float studies in the Thompson Island Pool designed to sample PCB concentrations in discrete parcels of water as they traverse the pool. Results from these studies will be evaluated as part of the Baseline Modeling effort.

4.2 Historical Trends in Water Quality Observations

Response to PC-1.3:

There are uncertainties and temporal variability in PCB loadings to the Upper Hudson River from the vicinity of Hudson Falls due to failure of the Allen Mill gate structure in September 1991, and to the recently-documented seepage of PCB in DNAPL form. These phenomena complicate efforts to develop an accurate picture of historical PCB loading. Analysis of the available data on water column loads of PCBs is contained in the Data Evaluation and Interpretation Report (USEPA, 1997).

4.3 Overview of Preliminary Calibration Data Set

Response to PF-1.15:

The impact of these zero values for BZ#138 in water and sediment will be investigated more thoroughly in the Baseline Modeling effort. It should be noted that the GE PCB data set has also been revised. Consequently, many of the data values used in the PMCR will be revised in the Baseline Modeling Report.

Response to PG-1.11A:

The 1991 GE sediment data were the most appropriate available data for specification of sediment initial conditions for the modeling effort in the PMCR. The USEPA/TAMS Phase 2 low resolution sediment coring data (1994) were unavailable when the PMCR modeling effort was conducted. The ongoing Baseline Modeling effort will include all available sediment data for the historical period from 1977 through 1997.

4.4 Model Input Data .

Response to PC-1.4:

Please refer to the following comment (PC 1.5) and response. They are both a continuation of the same technical issue.

Response to PC-1.4 and PC-1.5:

The development of PCB loads at Fort Edward is necessary for applying the PCB model within Thompson Island Pool. The uncertainty in these loads is acknowledged, but applying PCB loads developed using the data at the downstream end of the pool to the upstream boundary at Fort Edward would be inappropriate for simulating PCB transport through the pool. It should be noted that GE has collected new and relevant information during 1997 that pertains to representativeness of the Fort Edward PCB data. This information will be assessed in the Baseline Modeling effort.

With regard to the PCB "spikes" during high flow events, please refer to the response to PC-1.3. No mass balance model can correct bias that is inherent in a field sampling program. Such a model can only reconcile external loadings and system responses within the uncertainties in the available field data. In response to concerns that potential bias may exist in the TIP data, GE has recently (1996 and 1997) conducted additional water column sampling to better represent the PCB concentrations in the vicinities of Rogers Island and the Thompson Island Dam. These data will be utilized in the Baseline Modeling effort. Finally, PCB loadings in the Baseline Modeling effort will be investigated using flow-weighted average, regression, and ratio estimator methods in order to best represent the influence of PCB concentration "spikes" during high flow events.

4.4.1 System-Specific Physical Data

No significant comments were received on Section 4.4.1.

4.4.2 External Loadings

Response to PL-1.12:

The specification of atmospheric PCB concentrations (*e.g.*, use of the Green Bay data) will be re-assessed in the Baseline Modeling effort.

Response to PL-1.13:

USEPA elected not to present the sediment PCB initial concentrations in these deeper layers (5-10 and 10-25 cm) in the PMCR because they have no influence on model results for the nine-month simulation period. Furthermore, the 1994 low resolution sediment coring data were unavailable for the PMCR and there were numerous unresolved technical issues with representation of PCBs in the historical data.

Response to PF-1.16 and PF-1.17:

Solids loads for the modeling effort in the PMCR were required for only a nine-month period in 1993. These loads were estimated using data from only 1993 to avoid complications due to historical differences in sampling protocols and sampling locations.

After completion of the PMCR, 5000 additional USGS TSS measurements were discovered and incorporated within the USEPA/TAMS database. In the Baseline Modeling effort, solids loads will be extended to include measurements for the historical period from 1977 to 1997. Any differences in sampling protocols or sampling locations will be addressed and resolved.

Response to PF-1.18:

Preliminary modeling efforts were conducted with Batten Kill and Fish Creek solids being treated in similar fashion to the direct drainage (ungaged) flows. The text (p. 4-7, par. 4) should have made this clear. In the Baseline Modeling effort, solids loads from these and other tributaries will assessed in greater detail, especially since more extensive solids data are now available.

Response to PF-1.19:

Text should state "as can be inferred from Figure 4-6(b), the principal external . . ."

10.0062

Response to PF-1.20:

The "other tributaries" are the Mohawk and Hoosic Rivers.

Response to PF-1.21:

These correlations (PCBs *vs* TSS and flow, and difference in correlation between higher and lower chlorinated congeners) will be reviewed as part of the Baseline Modeling effort and results will be included in the Baseline Modeling Report.

Response to PF-1.22:

The reviewer is referred to the Data Evaluation and Interpretation Report (DEIR) which became available in February, 1997 with regard to the exclusion of a high PCB measurement in January 1993 . Page 3-127 of the DEIR states with regard to the GE PCB data that "a high estimated load at RM 194.6 (Rogers Island) in January 1993 is due to a single observation of 1086 ng/L total PCBs on January 15. Sampling did not capture this concentration slug at RM 188.5, and it is possible that this sample could also represent disturbance of contaminated sediment in the sampling procedure, although it is not annotated as having been collected from shore." This data point may not be an analytical outlier; however, it does not appear to represent upstream PCB loads at Rogers Island.

Response to PF-1.23:

This value (10 ng/L PCBs) was estimated based on an assessment of the lowest reported tributary PCB concentrations. The Baseline Modeling Report will contain more specific information. It should be noted that PCB loads from these tributaries are relatively insignificant.

Response to PF-1.24:

The reviewer is correct. The PMCR (pg 4-9) should state that BZ#4 from upstream sources accounts for 49% (not 27%) of the load during spring high flow, and that 76% (not 68%) of the total PCB external load to the Upper Hudson occurs during spring high flow.

4.4.3 Forcing Functions

Response to PF-1.25:

The need to better support specification of atmospheric PCB inputs to the Upper Hudson River (pg 4-10) is acknowledged. USEPA thanks the reviewer for offering to provide information that was unavailable for the modeling effort in the PMCR.

Response to PF-1.26:

The exact depth for the temperature measurements is not available in the database, but will be investigated as part of the Baseline Modeling effort. Although some temperature variation with depth is possible within deeper reaches of the Upper Hudson River (especially behind dams) it is unlikely that these conditions are significant. The HUDTOX model is vertically averaged and does not explicitly represent water column stratification.

4.4.4 Boundary Conditions

No significant comments were received on Section 4.4.4.

4.4.5 Initial Condition

Response to PF-1.27:

Please refer to the response to comment PF-1.25, above (section 4.4.4). USEPA acknowledges the potential utility of these data for the Baseline Modeling effort.

Response to PF-1.28:

The GE 1991 sediment data were composited horizontally by groupings of individual coring locations, but an attempt to reflect vertical PCB gradients in the sediments was made by forming these composite samples within distinct layers. These data cannot be characterized simply as being vertically averaged, except perhaps within the context of each vertical layer that was sampled.

Response to PF-1.29:

The sediment bulk densities quoted in the report are dry weight-based concentrations.

Response to PF-1.30:

The GE PCB data have been substantially revised and incorporated into the USEPA/TAMS Phase 2 database (Release 4.1, August 1998). These revisions will improve the comparability between the GE and USEPA/TAMS data sets. No correction factors should be necessary in order to use the GE data in the Baseline Modeling effort.

Results for sensitivity analyses of model outputs to changes of plus and minus 30 percent in initial sediment PCB concentrations are presented in the PMCR (Section 4.9).

Specification of deep sediment layer PCB concentrations was not important for the nine month simulation period in the PMCR. It will be important for the longer-term simulations in the Baseline Modeling effort and will receive due attention using all of the available field data.

4.5 Internal Model Parameters

Response to PL-1.16:

The reviewer is referred to the Data Evaluation and Interpretation Report (DEIR) of February, 1997. An analysis of sources of variability in PCB partition coefficients provided in the DEIR indicated that the particle concentration effect, which would be represented by U_x, is not significant for Upper Hudson River PCBs. The DEIR was in draft form at the time the PMCR was produced and therefore was not referenced. Such inconsistencies will be eliminated in the Baseline Modeling Report.

4.5.1 Solids Model Parameters

No significant comments were received on Section 4.5.1.

4.5.2 PCB Model Parameters

Response to PF-1.31:

This question (the effect of median [*vs.* mean *vs.* maximum] parameter values for total PCBs has on the output) will be addressed in more detail in the Baseline Modeling Report.

4.6 Calibration Approach

Response to PG-1.1:

The three "significant shortcomings" listed in the comment are addressed below.

1. The PMCR solids loads from Snook and Moses Kills are likely underestimated for the 1993 high-flow period, but not necessarily for the lower flow periods. Flow and solids data were unavailable for Snook and Moses Kills at the time of the modeling work in the PMCR. Spring 1994 high flow solids data are now available and will be used, along with other new solids data, in the Baseline Modeling effort. These additional data will improve estimates of solids loads for the main stem and tributaries in the Upper Hudson River.

2. Concerns regarding solids deposition and resuspension rates will be addressed in the Baseline Modeling effort through calibration to high flow events and a long-term (1977-1997) historical calibration. Solids resuspension rates should be reduced during low flow periods.

3. Sedimentation and water column solids dynamics were de-coupled in the preliminary model because of the short (nine months) calibration period and the lack of solids data with which to test the model during high-flow events. The Baseline Modeling effort will determine sedimentation rates as the net of deposition and resuspension. This is more appropriate for long-term simulation of both historical conditions and remedial scenarios.

4.6.1 Transport Model (Water Balance) Specification

4.6.2 Solids Model

4.6.3 PCB Model

No significant comments were received on Sections 4.6.1 through 4.6.3.

4.7 Calibration Results

Response to PC-1.2:

The concerns expressed in this comment are addressed in the response to comments PG-1.11C, PG-1.11D, PG-1.11E and PG-1.11F.

Response to PG-1.11E:

Gross hydrodynamic resuspension of solids is significantly reduced and possibly negligible at low flows. However, this rate should not be arbitrarily set to zero at low flows. Even a small gross resuspension of solids (whether from hydrodynamic or other causes) is likely to have an impact on sediment-water column PCB exchange in areas with high levels of sediment PCB contamination. USEPA also believes it is appropriate in a "box model" to allow simultaneous gross resuspension and settling. USEPA does agree that there is no net resuspension, but most likely net settling, of solids during low flow conditions.

Response to PG-1.11F:

Although incorporation of the variation in solids load and deposition velocity with river flow would be useful, currently available site-specific data are insufficient to accurately characterize changes in the solids load composition with respect to particle sizes as a function of flow. If additional information becomes available during the Baseline Modeling effort, then this suggestion will be considered.

Response to PG-1.11G:

The 1991 GE sediment data were the most appropriate available data for specification of sediment initial conditions for the modeling effort in the PMCR. The USEPA/TAMS Phase 2 low resolution sediment coring data (1994) were unavailable when the PMCR modeling effort was conducted. The ongoing Baseline Modeling effort will include all available sediment data for the historical period from 1977 through 1997.

The relationship between fish body burden and its food web components will be evaluated in the ecological components of the modeling effort.

Response to PG-1.11H:

The conceptual framework (Figure 3-4 in the PMCR) does explicitly acknowledge possible degradation/dechlorination of PCBs in the sediments. This potential loss mechanism should be addressed in long-term forecasting simulations. This technical issue (*i.e.*, the rate of dechlorination and its variation over time) is unresolved at the present time.

Most of the references suggested by General Electric for estimating degradation rates post-date publication of the PMCR. Furthermore, General Electric states (page 24 of their 11/21/96 comment) "Although recently conducted laboratory experiments (Fish, 1996) indicate that dechlorination can occur at a rate sufficient to contribute to the excess loading as described above, extrapolation of these results to the field is not yet complete."

Accordingly, USEPA plans to address these loss mechanisms using sensitivity analyses for the calibration and forecasting simulations unless sufficient information to estimate *in situ* degradation rates becomes available within a usable time frame.

Response to PL-1.14:

The specified settling velocity (V_s of 2.0 m/day) was a model calibration parameter. The typical ranges provided in the PMCR (V_s ranging from 0.25 to 3.05) represent calibrated settling rates from model applications to other similar water bodies. A value of 2.0 m/day is consistent with settling velocities used for PCBs in the Upper Hudson River (Hydroscience, 1978) and in Green Bay (Bierman *et al.*, 1992).

There is no single correct, constant value for gross settling velocity in the Hudson River. A more refined approach to specifying gross settling as a function of variations in flow and solids concentrations is being developed as part of the Baseline Modeling effort.

Response to PL-1.15:

A reference should have been included to a General Electric report (prepared by HydroQual) examining sedimentation in the Upper Hudson River. The report entitled "Quantification of Sedimentation in the Upper Hudson River", October 31, 1995, examined several methods of estimating long-term sedimentation rates. The analysis in this report suggested that sedimentation rates (V_b) in Thompson Island Pool ranged between 0.24 to 0.57 cm/year, and averaged approximately 0.21 cm/year between Fort Edward and Stillwater.

Sedimentation rate will be fully coupled with solids settling and resuspension dynamics in the Baseline Modeling effort. Consequently, sedimentation rate will no longer be an independent model parameter, but will instead be determined by the balance between dynamic settling and resuspension processes.

Response to PG-1.11B:

The inclusion of groundwater influx was simply a numerical experiment designed to determine the degree to which this process might influence water column PCB concentrations in Thompson Island Pool. The experiment was also conducted to demonstrate the significance of this potential influx on the lower-chlorinated, less hydrophobic PCB congeners that constitute most of the observed gain in PCB mass across Thompson Island Pool. The specified groundwater inflow was based on an assessment of USGS flow data and a simplified application of Darcy's Law. The PMCR did not advocate inclusion (or exclusion) of groundwater influx within the HUDTOX model. This process will be further assessed in the Baseline Modeling effort.

The possible influx of groundwater to sections of the river downstream of Thompson Island Pool was not evaluated in the PMCR. This or any other hypothesis employed to explain the observed increase in PCB concentrations across Thompson Island Pool should be validated to the extent possible through the evaluation of appropriate field data.

Response to PG-1.11C:

The preliminary model calibration was for only a nine-month period (January through September 1993) and excluded three months during 1993 that may have been net depositional for solids. Over an annual cycle the preliminary model may still have predicted net erosion, but to a significantly lesser degree than suggested by the results from the limited nine-month simulation period.

It should be noted that a prediction of net solids erosion, by itself, does not imply that external solids loads were underestimated. External solids loads and sediment-water exchanges can only be accurately constrained by conducting a long-term hindcasting simulation in which solids and PCB mass are balanced simultaneously.

Response to PG-1.11D:

The bulleted actions suggested by General Electric to "improve the accuracy of its PCB fate model" are being addressed as part of the Baseline Modeling effort. Both the long-term historical record and high-flow event periods will be simulated as part of the PCB model validation process.

Response to PG-1.11I:

Results from the preliminary model can not be used to judge its utility for conducting long-term simulations. The preliminary PCB model was intended to represent conditions during the 1993 USEPA Phase 2 sampling period. Due to its preliminary nature and acknowledged data limitations, this model was not intended to simulate long-term changes in transport and fate of sediment PCBs. The Baseline Modeling effort will include a long-term hindcasting calibration for the period 1977 through 1997.

4.7.1 Solids Model

No significant comments were received on Section 4.7.1.

4.7.2 PCB Model

Response to PG-1.4, PG-1.11B and PG-1.11E:

The governing equations in the HUDTOX model are inherently mass-conserving. The model does balance PCB mass across Thompson Island Pool. The model was not able to exactly match increases in PCB concentrations across the pool, especially for lower-chlorinated congeners. This problem will receive continued emphasis during the Baseline Modeling effort.

GE's interpretations of a potential mass imbalance across the Thompson Island Pool were rendered invalid by subsequent corrections for analytical bias in the GE data set. A "mass imbalance" is not evident in the USEPA Phase 2 data. Since release of the PMCR, both USEPA and

GE have been pursuing a variety of analyses on mechanisms and explanations for observed PCB mass transport across the Thompson Island Pool, including examination of the various hypotheses proposed by GE in comment PG 1.11. The results of these additional analyses will be incorporated into the Baseline Modeling Report.

4.8 Mass Balance Component Analysis

4.9 PCB Model Calibration Sensitivity Analysis

No significant comments were received on Sections 4.8 and 4.9.

CHAPTER 4 TABLES

Response to PL-1.17:

As part of the Baseline Modeling effort, both parametric and non-parametric statistical methods will be used to compare model output with observed data (*e.g.*, Tables 4-13 through 4-17). This will be done in recognition of the large variances that sometimes occur in both model output and field observations.

CHAPTER 4 FIGURES

Response to PF-1.14:

Suggested text should have been added to Figure 4-5 for clarity.

5. CALIBRATION OF THOMPSON ISLAND POOL HYDRODYNAMIC MODEL

5.1 Introduction

5.2 Model Input Data

5.2.1 System-Specific Physical Data

5.2.2 Forcing Functions

5.2.3 Boundary Conditions

5.3 Internal Model Parameters

5.4 Calibration Approach

5.5 Calibration Results

5.6 Model Validation

5.6.1 Rating Curve Velocity Measurements

5.6.2 FEMA Flood Studies

5.7 100 Year Flood Model Results

5.8 Sensitivity Analyses

5.8.1 Manning's 'n'

5.8.2 Turbulent Exchange Coefficient

No significant comments were received on Sections 5.1 through 5.8.2.

5.9 Conversion of Flow Velocity to Shear Stress

5.9.1 Results

Response to PG-1.13B:

The Depth of Scour Model for the Baseline Modeling effort has been modified to use the predicted RMA-2V bottom shear stress.

5.10 Discussion

No significant comments were received on Section 5.10.

6. APPLICATION OF THOMPSON ISLAND POOL DEPTH OF SCOUR MODEL

6.1 Introduction

Response to PG-1.10:

Neither the PMCR nor the Baseline Modeling Report were intended to include forecasting simulations to compare system responses to different potential remedial scenarios. Forecasting simulations are expected to be conducted as part of the Feasibility Study.

6.2 Available Data

Response to PC-1.6:

Data from the TIP Depth of Scour Model (Section 6.2.2) Resuspension Experiments must be interpreted within the context of the assumptions and uncertainties inherent in collecting and testing sediment samples. These assumptions and uncertainties are discussed in the primary references cited in Section 6 of the PMCR.

6.2.1 Bottom Sediment Distribution

6.2.2 Resuspension Experiments

No significant comments were received on Sections 6.2.1 or 6.2.2

6.3 Model Parameterization and Uncertainty

Response to PG-1.13C:

The application of the Depth of Scour Model in the Baseline Modeling effort has been modified to use localized data representing dry bulk density.

Response to PG-1.13D:

The Depth of Scour Model in the Baseline Modeling effort will incorporate armoring in the cohesive sediment areas. The HUDTOX fate and transport model will be consistent with the Depth of Scour Model to the maximum extent possible.

In the Baseline Modeling effort, both settling and resuspension will be flow-dependent in two dimensions within Thompson Island Pool. The RMA-2V hydrodynamic model will be used to generate 2-D velocity distributions for both the Depth of Scour and HUDTOX models. Resuspension results from HUDTOX will be compared to results from the Depth of Scour Model for high flow events.

6.3.1 Rearrangement of Erosion Equation

6.3.2 Parameter Estimation

6.3.3 Prediction Limits

6.4 Depth of Scour Predictions at Selected Locations in Cohesive Sediment Areas

No significant comments were received on Sections 6.3.1 through 6.4.

6.5 Global Results for Cohesive Sediment Areas

Response to PG-1.13E:

An approach for applying the Depth of Scour Model to non-cohesive sediments has been developed and was presented at a meeting between USEPA/TAMS and General Electric in March, 1997.

Response to PG-1.13F:

The limitations of the Depth of Scour Model with regard to non-cohesive sediments are acknowledged. The application of the Depth of Scour Model to non-cohesive sediments produces only an "upper bound" estimate for depth of scour.

Response to PF-1.32:

The conclusion (that flood events will not erode PCB contaminated cohesive sediments to any large degree) is valid and reasonable for the cohesive sediment areas characterized by the high resolution sediment cores and the resuspension experiments. This conclusion will be independently assessed by comparing sediment PCB distributions from the 1984 NYSDEC survey with those from the 1994 Phase 2 low resolution sediment cores. It should also be noted that the HUDTOX mass balance model represents the entire sediment area of Thompson Island Pool. Results from the Depth of Scour Model and HUDTOX models will be compared to verify reasonableness and consistency.

7. APPLICATION OF LOWER HUDSON RIVER PCB TRANSPORT AND FATE MODEL

Response to PG-1.15:

USEPA has suspended work relating to the Lower Hudson River model, due to the fact is that the Lower Hudson River model is currently being updated by Drs. Robert Thomann and Kevin Farley as part of a separate project. Upon completion of their work, USEPA will review the updated model and decide how it should be used to assess the impacts of PCB loads from the Upper Hudson River on the lower river and estuary.

7.1 Introduction

Response to PF-1.33 and PG-1.9

See the above response to comment PG-1.15.

7.2 Model Input Data

Response to PL-1.18:

The rationale and justification for these decisions is presented in Thomann *et al.* (1989; 1991).

7.2.1 System-Specific Physical Data

7.2.2 External Loadings

No significant comments were received on Sections 7.2.1 or 7.2.2.

7.2.3 Forcing Functions

Response to PF-1.34:

It is expected that the most current knowledge about striped bass migration patterns will be incorporated into the updated Lower Hudson River model currently being developed by Drs. Robert Thomann and Kevin Farley. It is not known whether the reference cited is the most current information.

7.2.4 Boundary Conditions

7.2.5 Initial Conditions

7.3 Internal Model Parameters

7.4 Application Approach

7.5 Application Results

7.6 Diagnostic Analyses

7.6.1 Component Analysis

No significant comments were received on Sections 7.5 through 7.6.1.

7.6.2 Sensitivity Analysis

Response to PF-1.35

The reader is correct in noting that model segment 2 is not sensitive to loading or volatilization. The reader is also correct in noting that PCB concentrations were quite or very sensitive to the various processes listed.

7.7 Discussion

Response to PF-1.36:

Figure 7-7 was not meant to contain the original Thomann model. It was meant to contain comparative results with the original Thomann model for two different assumptions on PCB loads. Figure 7-7 does contain this information. The labeling should have been more clear, and will be corrected in the BMR.

Response to PG-1.14 and PG-1.16:

The limitations of the preliminary Hudson River PCB model calibration were acknowledged within the PMCR. The PMCR represents the status of the preliminary PCB modeling effort as of Fall, 1995. Datasets, database corrections and other pertinent information which became available after October 1995 were not incorporated within the fate and transport modeling presented in the PMCR. The ongoing PCB modeling effort will result in a model that is both scientifically credible and useful to EPA for evaluating remedial assessment alternatives. Results from this ongoing effort will be presented in the BMR.

8. MODELING APPROACH: FISH BODY BURDENS

8.1 Modeling Goals and Objectives

Response to PG-1.6 and PG-1.12

General Electric contends that neither the Bivariate BAF model nor the Probabilistic Food Chain Model should be used to make predictions because they ignore the short and long-term variability in the relationships among PCB levels in the water column, sediment, and fish and do not attempt to describe or respond to the mechanisms by which fish bioaccumulate PCBs. Instead, GE recommends using a time-variable, mechanistic food web model, such as the Gobas model.

In response, it should first be noted that USEPA has already proposed use of the Gobas model (PMCR, p. 8-2), although results were not ready for the PMCR, and has actively worked with GE/QEA since release of the PMCR on the development of modeling approaches to address PCB bioaccumulation in fish. In addition, since the completion of the Modeling Approach Peer Review, USEPA has decided to also use the mechanistic Gobas model, as per the recommendation of that panel. The PMCR provides only preliminary results on bioaccumulation modeling for the Hudson River, which will be expanded and further developed in the Baseline Modeling Report.

It is also not the intention of USEPA to use any single bioaccumulation modeling approach to make predictions; rather, using a weight-of-evidence approach which draws upon all three modeling tools is proposed. The state-of-the-science is not sufficiently advanced that a mechanistic food web model alone can be relied upon for predictions, and that sufficient data are not available for all food chain compartments to fully constrain a mechanistic food web model for the Hudson.

8.2 Background

No significant comments were received on Sections 8.2.

8.2.1 PCB Compounds

Response to PL-1.4:

Fish PCB body burdens will mirror sediment and water concentrations. In terms of the management objectives for the Hudson River, the endpoint of interest is total PCBs. To the extent that the bioaccumulation models adequately and accurately predict the uptake of total PCBs, this will achieve the stated goal. As to the potential risks of individual PCB congeners, data are inadequate to determine human effects while ecological toxicity benchmarks are available for several PCB congeners.

8.2.2 PCB Accumulation Routes

No significant comments were received on Section 8.2.2.

8.3 Theory for Models of PCB Bioaccumulation

Response to PL-1.5

Under the steady-state assumption incorporated in the BAF or 'transfer factor' approach, PCB removal processes are implicitly included by representing net accumulation (*i.e.*, steady-state balance between uptake and depuration). This approach does not assume a "one-to-one" relationship, but rather a liner equilibrium relationship. Use of Aroclors to some extent accounts for differential accumulation with chlorination level. In addition, the use of time-varying or bioenergetic models is being explored.

8.4 Bivariate Statistical Model for Fish Body Burdens

8.4.1 Rationale and Limitations for Bivariate Statistical Model

8.4.2 Theory for Bivariate Statistical Models of PCB Bioaccumulation

8.5 Probabilistic Bioaccumulation Food Chain Model

8.5.1 Rationale and Limitations

8.5.2 Model Structure

8.5.3 Spatial Scale for Model Application

8.5.4 Temporal Scales for Estimating Exposure to Fish

No significant comments were received on Sections 8.4 through 8.5.4.

8.5.5 Characterizing Model Compartments

Response to PF-1.37:

In the discussion presented on page 8-18, the discussion is focused on the more chlorinated congeners, as opposed to the total PCB concentrations which is the focus of the DEIR. In viewing total PCBs, the data presented in the DEIR demonstrate the considerably higher dissolved phase concentrations relative to those of the suspended matter phase. However, the importance of the dissolved phase decreases with increasing degree of chlorination. The assumption that most of the higher chlorinated congeners are present as suspended matter is not a perfect one since the importance of the dissolved phase varies across the suite of congeners found in fish. Nonetheless, this assumption is a useful place to begin the modeling analysis. Subsequent modeling analysis will examine this assumption in greater detail. It is anticipated that subsequent bioaccumulation modeling will be driven with estimated concentrations of both dissolved and suspended PCB concentrations.

9. CALIBRATION OF BIVARIATE STATISTICAL MODEL FOR FISH BODY BURDENS

9.1 Data used for Development of Bivariate BAF Models

9.1.1 Fish Data

9.1.2 Standardization of PCB Results for NYSDEC Fish Analyses

9.1.3 Water Column Data

9.1.4 Sediment Data

No significant comments were received on Sections 9.1 through 9.1.4.

9.1.5 Functional Grouping of Sample Locations for Analyses

Response to PF-1.38:

Table 9-2 lipid and PCB concentration values are on a wet-weight basis.

Response to PF-1.39:

Table 9-7 gave R^2 values as percentages, as is commonly done. The column label should have included "%".

9.2 Results of Bivariate BAF Analysis

Response to PF-1.40:

Figures 9-11 and 9-12 would be improved by the inclusion of zero on the y axis, and this change will be made in the Baseline Modeling Report.

9.3 Discussion of Bivariate BAF Results

Response to PF-1.41:

Figures 9-8 through 9-13 would be improved by the inclusion of a 1:1 line of perfect agreement, and this change will be made in the Baseline Modeling Report.

Response to PF-1.42:

The reviewer provided a variety of suggestions for improving the interpretation of the bivariate regression model results for predicted fish body burden. The bivariate regression analysis will be re-done for the Baseline Modeling Report, and these suggestions will be taken into advisement for that effort. Results of the bivariate BAF model approach presented in the PMCR will undergo revisions to reflect a variety of modifications to the data on which the regressions are based. These data revisions include:

1. Updating of the NYSDEC database and additional research on interpretation of historic NYSDEC PCB quantitations.

2. Thorough review, reconciliation, and quality assurance checks of the USGS water column PCB data, completed in April 1997.

3. New information and analyses on the interpretation of historic USGS water column PCB quantitations.

4. Availability of low resolution coring results.

The data revisions can be expected to result in some modifications to the regression results. In addition, the planned work for updating the bivariate BAF work will include investigation of using fate and transport model-generated time series of surface sediment concentrations as an independent variable.

Response to PF-1.43:

The statement in question refers to "about 42 percent" and "about 58 percent". The value of 58 percent was chosen, rather than the exact rounded value of 59 percent, so that the two values would sum to 100 percent.

9.4 Summary

Response to PF-1.44:

Potential differences by sex should have been mentioned in the summary on pg. 9-16. Potential differences by sex were discussed earlier in this chapter.

10.0078

10. CALIBRATION OF PROBABILISTIC BIOACCUMULATION FOOD CHAIN MODEL

10.1 Overview of Data Used to Derive BAFs

10.1.1 Benthic Invertebrates

10.1.2 Water Column Invertebrates

No significant comments were received on Sections 10.1 through 10.1.2.

10.1.3 Fish

Response to PF-1.45:

No, the data from the chironomid short-term study is not presented in this document. The short-term chironomid study provides information on short-term uptake kinetics of several PCB congeners to chironomid. These data have been evaluated in terms of the information provided relative to the time it takes to achieve steady-state concentrations in water-column invertebrates. These data cannot be directly used in the modeling but have been and continue to be used to provide information generally on the kinetics of PCB uptake of specific congeners to water-column invertebrates.

10.1.4 Literature Values

No significant comments were received on Section 10.1.4.

10.2 Benthic Invertebrate: Sediment Accumulation Factors (BSAF)

Response to PF-1.46:

Tissue is lipid normalized and sediment is organic carbon normalized.

10.2.1 Sediment Concentrations

No significant comments were received on Section 10.2.1

10.2.2 Approach

Response to PF-1.47:

The objective of the modeling exercise is to estimate the population distribution of concentrations for a given fish species following changes in the PCB concentrations of its prey, which result from changes in the sediment and/or water PCB levels. Because the available data on predator concentrations are approximately lognormally distributed, the parameters of interest are the geometric mean concentration and the geometric standard deviation. From these parameters, the distribution of expected PCB concentrations in a particular species can be estimated. However, in response to this comment, the analysis is being redone using arithmetic means instead of geometric-means for the denominator(s) of the BAF estimates. Preliminary results suggest that there is no difference in the estimated geometric standard deviation, and that there is a non-significant difference in the mean accumulation factor(s).

Response to PF-1.48:

Benthic invertebrate samples were identified down to the class level (in terms of PCB analyses) and no biomass information was available. There are not enough data to evaluate differences in a statistically robust manner. For example, although the mean chironomid BSAF is higher than for other benthic species, and the observed variance far greater, there are only three samples. Significant effort has been spent on determining fish consumption preferences at the lowest practicable taxonomic level specifically to evaluate this question. It is difficult to evaluate species differences given that data are only available to a class level.

10.2.3 Calculations of BSAF Values for Benthic Invertebrates

Response to PF-1.49:

The figures presenting goodness-of-fit results do differ by the individual congeners. From a management perspective, the endpoint of interest is total PCBs. This comment will be evaluated further in the context of the Baseline Modeling Report.

Response to PF-1.50:

The 75th percentile will be included in the figure in the BMR.

Response to PF-1.51:

Figure 10-13 shows the means do range from 0.2 to about 1.6; with four of the means between 0.2 and 0.5; two means approximately equal to 0.5; and four means between about 0.7 and 1.6.

Response to PF-1.52:

There are not enough data to adequately characterize congener profiles in chironomid species. First, chironomid were not identified to the species level; and second, there are only three samples identified as chironomid (at three different stations). The short-term uptake studies may be of some help in this regard, but used the same chironomid species for all studies and only focused on a few PCB congeners.

Response to PF-1.53

Due to a document assembly error, not all goodness-of-fit plots were presented in the same format. The BMR will address consistency of format; however, it is noted that the referenced figures (10-16 and 10-20) will not be present in the PMCR form in the BMR, as a more formal algorithm for goodness-of-fit will be used.

Response to PF-1.54:

The data are not detailed enough to be able to evaluate this question (*i.e.*, if the greater differences in BSAF at certain locations due to the differences in benthic organisms and their feeding habits). However, this issue is currently being explored and results presented in the context of the baseline modeling report.

10.3 Water Column Invertebrate: Water Accumulation Factors (BAFs)

10.3.1 Approach

10.3.2 Calculation of BAF_{water} for Water Column Invertebrates

10.3.3 Alternative Approaches

No significant comments were received on Sections 10.3 through 10.3.3.

10.4 Forage Fish: Diet Accumulation Factors (FFBAFs)

10.4.1 Approach

Response to PF-1.55:

At most stations, forage fish are typically represented by spottail shiners less than 10 cm. For those stations at which a composite forage fish concentration was estimated, the feeding preference leading to that concentration was accordingly adjusted by the number of fish of each species represented by the composite. Considerable effort is being expended on refining the feeding preferences for particular species and sizes of fish. It is acknowledged that the feeding preferences of the young-of-year of any species will differ from adult fish, hence using only those fish less than 10 cm.

10.4.2 Water Column Concentrations Used to Derive FFBAF Values

No significant comments were received on Section 10.4.2.

10.4.3 Forage Fish Body Burdens Used to Derive FFBAF Values

Response to PF-1.56:

The largemouth bass and white and yellow perch collected in the 1993 Phase II effort were young-of-year. Consequently, these data were not used in modeling adult body burdens. Sediment and water concentrations at collocated tessellated darter and spottail shiner stations show high variances: in other words, any given fish could have been exposed to a higher concentration than any other fish. The observed variability in all media (more so in the upper Hudson) is very high, so an observed individual high body burden in any one fish may or may not be attributable to a correspondingly high concentration in either sediment or water.

Response to PF-1.57:

Most of the fish samples collected in 1993 represented composites of multiple (typically five to ten) individual fish.

10.4.4 Calculation of FFBAF Values for Forage Fish

Response to PL-1.19:

The equations defining FFBAF, calculations of FFBAF, and FFBAF tables should have been included; this will be corrected in the BMR.

Response to PF-1.58:

Editorial; acknowledged.

10.4.5 Calculation of FFBAFs for Small Pumpkinseed Sunfish

10.5 Piscivorous Fish: Diet Accumulation Factors (PFBAF)

10.5.1 Approach Used for Yellow Perch

10.5.2 Approach Used for Largemouth Bass

10.5.3 Approach Used for White Perch

10.6 Demersal Fish: Sediment Relationships

10.6.1 Approach and Calculations of BAF Values

10.7 Summary of Probabilistic Food Chain Models

10.8 Illustration of Food Chain Model Application

10.9 Comparison of Bivariate Statistical and Chain Models

No significant comments were received on Sections 10.5.4 through 10.9.

REFERENCES

No significant comments were received on the References section.

GLOSSARY

No significant comments were received on the Glossary section.

APPENDIX A - FISH PROFILES

A-1.3.2 [White Perch] Range, Movement and Habitat within the Hudson River

Response to PF-1.59:

In the discussion about water depths, the units should be feet instead of meters.

A-1.10.4 Estimating Feeding Habits of Forage Fish

Response to PF-1.60:

The spottail shiner diet in this size range is 50% water column sources and 50% benthic sources. Table A-15 will be corrected.

A-1.10.5 Estimating Composite Fish Feeding Habits

Response to PF-1.61:

The data available are in fact only reported for the area between Lock 7 and Troy Dam. These data were extrapolated to the remainder of the river based on the stomach contents analyses from other reports. This will be clarified in the Baseline Modeling Report.

Response to PF-1.62:

The preliminary modeling calibration report presents several alternative approaches to evaluating the water column invertebrate box. In addition, efforts are currently underway to evaluate the role of direct water uptake. This question (*i.e.*, what can be done to reduce the uncertainty in the water column invertebrate compartment, which impacts all subsequent compartments) is currently being evaluated.

Response to PF-1.63:

Table A-16 will be corrected to show that the forage fish diet is 33% benthic to 67% water column invertebrates.

APPENDIX B - MATHEMATICAL MODELING, TECHNICAL SCOPE OF WORK

No significant comments were received on Appendix B.

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY
VOLUME C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

C. DEIR REPORT

RESPONSES TO GENERAL COMMENTS ON THE DEIR REPORT

Response to DG-1.4E

The writer describes some of the features of the modeling efforts being undertaken by GE and its consultants. Since the submittal of the DEIR and the receipt of responses from GE, GE has prepared a second modeling report (QEA, 1998) with somewhat different interpretations of the data, including newer results obtained in the vicinity of the TI Dam. Comments on the GE report are included in a separate section of this responsiveness summary. However, it should be noted that the DEIR is an interpretation of the Phase 2 and other data sets, an interpretation which will be subsequently analyzed in a more quantitative fashion in the Baseline Modeling Report. Thus, the interpretation provided in the DEIR is meant to integrate and describe the net effect of all inputs, while noting the most important components, such as the TI Pool load, which are readily discernable from the data.

The writer's contention that a portion of the TI Pool load cannot be explained by the sources cited is based on a model of the Upper Hudson developed by GE and its consultants. For the reasons stated in USEPA's critique of the QEA report (Book 3 of this Responsiveness Summary), however, USEPA does not accept the results of the QEA model. Subsequent modeling efforts by the USEPA will examine this load in detail.

Response to DG-1.13

The DEIR is focused exclusively on the geochemical interpretation of the PCB contamination of the Hudson River. Discussions on the uptake of PCBs by fish and the congener pattern of their subsequent body burdens will be included as part of the ecological assessment and ecological modeling work to be completed in 1999. The information presented by the writer will be considered during these efforts. Results of any food web modeling efforts (the writer's figures 18 through 21) cannot be reviewed thoroughly without a complete report explaining those efforts in detail. The discussions presented on congener ratios in fish may have some potential in tracing the pathways of fish exposure. The USEPA anticipates examining these ratios in detail in the subsequent ecological assessment and modeling efforts.

Response to DP-4:

This letter "supports the major conclusions in the DEIR" and presents no critiques of the report requiring a response.

Response to DP-5:

This letter (comment DP-5.1) acknowledges the depth, scope, and scientific rigor of the DEIR. No critiques of the DEIR requiring a response were presented in this letter.

Response to DS-2.27

Although additional data is always of some value, it would be difficult to collect and analyze additional data without delaying the program schedule. In addition, the type of data required to clarify the mechanisms for release is not easily obtained and may require an extended study period to obtain sufficient information to significantly improve the understanding of these mechanisms. Given these constraints, USEPA believes that the available data, in conjunction with that regularly acquired by GE, will provide an adequate basis for the ultimate conclusions which will need to be made for the Hudson River.

It should be noted that USEPA will not delay the issuance of any Reassessment reports in order to accommodate data collected after December 1997. However, USEPA will address changes in Hudson River conditions that are reflected in data collected between December 1997 and when USEPA issues a Record of Decision (ROD) for the site in 2001 in the Final Responsiveness Summary to be issued with the ROD.

Response to DS-2.28

USEPA concurs that long-term monitoring will be required within the river regardless of the alternative selected. USEPA will evaluate whether there is any type of monitoring program that should begin prior to issuing the Record of Decision.

Response to DS-2.29

Interpretation of the low resolution coring data has been included in the July 1998 Phase 2 Low Resolution Coring Report (USEPA, 1998). The ecological data will be included in the forthcoming Ecological Risk Assessment Report, currently scheduled for August 1999.

Response to DS-2.30

Bioturbation is considered a potentially important mechanism explaining PCB measurements in the TI Pool. See, for example, response to comment DG-1.3, below.

Since issuance of this letter, NYSDEC and USEPA have met on a regular basis to discuss elements of the Hudson River PCBs RRI/FS.

Response to DC-1.1

Public participation has always been an important part of the Hudson River PCBs Reassessment RI/FS. In fact, the Community Interaction Program (CIP) developed and implemented in 1990 is entirely unique to USEPA, and was designed specifically to meet the particular needs of this project.

Major reports are distributed according to a pre-determined schedule. A meeting is scheduled at the time of the report's publication to provide an overview of what is in the document so that interested parties who read it are acquainted with the contents and aware of the major points. After a period of a few weeks, follow-up meetings or availability sessions are held so that people who have read the report may meet with USEPA representatives to discuss it, ask questions, or offer comments.

All members of the public receive the reports at the same time; therefore, the initial public presentation would be confined to USEPA's introduction of the material. Different perspectives would logically only be available for presentation after other parties have the opportunity to read the report.

Response to DC-1.2

Each of the various reports presents findings and conclusions. The DEIR, for example, presents data and conclusions relating to the fate and transport of PCBs in the Hudson River. Human health and ecological risks will be addressed in forthcoming Phase 2 reports scheduled for 1999, and remedial options for the Hudson will be addressed in the Phase 3 Feasibility Study Report, scheduled for 2000. These results are typical of a Supefund remedial investigation and feasibility study. Only here they have been broken up into many individual components because of the size of the effort involved on this project.

While the analysis detailed in the DEIR found that the PCB water column load at Rogers Island had dropped to undetectable levels as a result of the remedial actions performed at Allen Mills Site, the PCB loading between the Rogers Island and the TI Dam has remained relatively constant from 1993 to 1996. This indicates that the TI Pool is a constant source of PCBs to the water column. The source appears to be PCBs stored within the sediments. There also are significant gains to the water column between the TI Dam and Waterford, NY, again with PCBs stored within the sediments being the main contributor.

Response to DC-1.3

Since the beginning of the Reassessment, EPA has made a particular point of soliciting input and opinions from any and all interested parties, and will continue to do so until the project is complete. All input provided is reviewed and considered. The CIP especially was designed to provide opportunities for direct participation on multiple levels. Further, in addition to running multiple meetings over the last eight years where comment is always solicited, EPA has hosted Availability Sessions on particular reports to answer questions and receive comments. Finally, on a number of occasions EPA has extended standard comment periods to accommodate the public.

The official comment period for the DEIR Report was through April 11, 1997. The Scientific and Technical Committee (S.T.C.) meeting for the DEIR was on March 25, 1997, within the comment period for that report. USEPA assumes therefore that the writer's concern about the comment period's being closed prior to the Scientific and Technical Committee meeting referred not to the DEIR but to the Preliminary Model Calibration Report (PMCR), released in October of 1996. The S.T.C. meeting for that was held on March 26, 1997. To address the writer's concern, we refer first to the cover letter of the DEIR, which states:

> "EPA will be accepting comments on the Data Evaluation and Interpretation Report until April 11, 1997. The comment period is longer than we have provided for previous Reassessment reports because of the extensive analyses that are included and the complexity of those analyses. In addition, there are several findings discussed in this report which were utilized in the Preliminary Model Calibration Report (released in October 1996). Therefore, during this comment period, EPA will also accept comments on the Preliminary Model Calibration Report as they pertain to findings from the Data Evaluation and Interpretation Report."

Further, because these reports are a series and in essence build upon each other, USEPA remains willing to entertain questions from members of the public on prior reports.

Response to DC-2.1

This report does not present or evaluate remedial options. A variety of options, including "No Action" and Natural Attenuation as well as dredging, will be considered during the Feasibility Study (FS) process.

Response to DL-1.5

This comment explicitly repeats comments made on the Hudson River models. As such, it is addressed as part of the PMCR. This issue will be further addressed in the Baseline Modeling Report (to be released in May 1999).

Response to DP-2.1 and DP-2.3

The safety of the drinking water supplied from an infiltration gallery located near the Hudson River is under the jurisdiction of local and/or State Departments of Health. Risk from such intakes depend on a variety of design specifications that need to be reviewed on a location-specific basis. Risk from direct intakes of Hudson River water (*i.e.*, not from an infiltration gallery) will be included in the Human Health Risk Assessment.

Response to DP-2.2

This comment cannot be addressed by the Hudson River PCBs Reassessment. This question should be addressed by the designers of the water supply system.

Chapter 1 - Introduction

1.1 Purpose of Report

1.2 Report Format and Organization

No significant comments were received on Sections 1.1 and 1.2.

1.3 Technical Approach of the Data Evaluation and Interpretation Report

Response to DC-1.5

Water column data spanning over two decades, not just 1993 data, were examined in the DEIR in various analyses. The 1993 sediment and water column data collected for the Phase 2 reassessment is used in the DEIR to analyze the geochemical principals of the system (such as gaining an understanding of the mechanisms of PCB transport). In addition, General Electric's water column monitoring program data, which began in 1990 and continues to date on a bi-monthly basis, are used to quantify the PCB loadings above the TI Pool and in the TI Pool over time. USGS water column data were also used for this purpose in the river below the TI Dam. Data from the 1984 NYSDEC Sediment Survey are used to estimate the total mass contained in the TI Pool by using polygonal declustering and geostatistical techniques. An emphasis may have been placed on the 1993 data collected by USEPA for the detailed understanding of the system this data provided, but these are clearly not the only data explored in the DEIR.

1.4 Review of the Phase 2 Investigations

No significant comments were received on Section 1.4.

1.4.1 Review of PCB Sources

No significant comments were received on Section 1.4.1.

1.4.2 Water Column Transport Investigation

Response to DC-4.6

Each of the three sources of variance mentioned (variance shown in analyses from the site; variance caused by sampling methods; and known physical sources of variance including cross channel and vertical inhomogeneity in the PCB distribution in the river) are examined separately below. The Phase 2 data were generated in such a way as to minimize unwanted sources of variability so that the actual trends in the data would not be obscured.

For variability shown in analyses from Rogers Island, Phase 2 data are compared to General Electric data for the same period. Figure 3-105 of the DEIR shows monthly PCB loads from above Bakers Falls, Bakers Falls to Rogers Island, and Rogers Island to the TI Dam. The Phase 2 flow-averaged estimates agree well with the General Electric estimates in both total load and distribution for July through September 1993 (post construction at the Bakers Falls area).

The precision in the Phase 2 sampling methods is determined by comparing the split sample data. Figure DC-4.6 shows the relative fractional differences of the ten split samples analyzed for total PCBs taken during the flow-averaged and transect events. Although the distributions are right skewed, the median values are low at 0.10, 0.13, and 0.13 for the dissolved, suspended and whole water samples, respectively. Each sample required a large volume of water in order to achieve the low quantitation limits for PCBs, which in turn necessitated a long sampling period. This may be the cause of the occasional high relative fractional difference.

The impact of physical sources of variance due to cross channel and vertical inhomogeneity in PCB distribution in the Hudson River is shown in Figure 4-22 of QEA's March 1998 report, Thompson Island Pool Sediment PCB Sources. General Electric's routine composite sample of east and west channels at Rogers Island is compared to shallow and deep samples taken at six stations in a river cross section just upstream of Rogers Island. This was performed on 2 separate occasions. While there are differences among the samples, it is clear that the routine sample provides a reasonable estimate of the Hudson River PCB concentration at this station. The routine sample is comparable to the Phase 2 sample at Rogers Island which was stationed before the river splits into east and west channels.

1.4.3 Assessment of Sediment PCB Inventory and Fate

No significant comments were received on Section 1.4.3.

1.4.4 Analytical Chemistry Program

No significant comments were received on Section 1.4.4.

RESPONSES TO SPECIFIC COMMENTS ON THE DEIR

Executive Summary

Response to DP-1.1

The time of depletion of the PCB inventory from the Thompson Island Pool will be more rigorously examined in the forthcoming Baseline Modeling Report.

However, the last sentence of the Executive Summary, "[t]he time for depletion appears to be on the scale of a decade or more and will be investigated further through the planned computer simulations," is not in contradiction to the suggestion that the residence time of PCBs in the Thompson Island Pool could be a several decades in duration.

Response to DP-3.1

This comment addresses potential contamination of the Town of Bethlehem water supply drawn from a horizontal well or infiltration gallery on the west side of the Hudson River opposite the Village of Castleton and determined to be ground water under the influence of surface water. This well is south of Albany, and no direct evidence on pore water concentrations in this area has been collected. However, total PCB concentrations in sediment in the Albany Turning Basin do suggest the possibility that pore water concentrations in this area might exceed MCLs.

While the issue raised is a valid one, it is outside the scope of the DEIR. This issue will be addressed in the Human Health Risk Assessment to the extent possible although without specific monitoring data any risk analysis is likely to be highly uncertain. The commenter should also consider raising these issues to the designers of the of the water supply system.

Response to DC-4.4 and DG-1.1

The analogy of a pipeline transport process mentioned in the executive summary has been withdrawn in light of the revision to Upper Hudson flows noted elsewhere in this report. (See corrections to DEIR Section 3.2.2, below.) However, the results as they are currently understood do not suggest extensive loadings entering the water column in the region below the TI Dam, with the possible exception of the region between the TI Dam and Schuylerville. To place the regions in perspective, the TI Pool, a distance of only six miles, produces a water column inventory gain of 1 to 2 pounds per day during low periods. The 25-mile stretch between Schuylerville and Waterford showed no measurable net load gain and is expected to show a substantive PCB loss when the load calculations are revised. Thus, while downstream sediments undoubtedly make some contribution to the water column PCB inventory, it is clear that they do not contribute at the same level as those of the TI Pool. Data recently collected by GE appears to confirm the suggestion made in the DEIR that additional loads may be generated between the TI Dam and Schuylerville.

However, this does not change the fact that the region above Schuylerville has been and continues to be the primary source of PCBs to the fresh water Hudson. Water column congener patterns support this contention as does the sediment PCB inventory which is concentrated above

Schuylerville (35 of the 40 *hot spots* are found in this region representing roughly 85 percent of the fine-grained sediment PCB inventory). Essentially all of the sediment PCB contamination in the Upper Hudson is attributable to GE so that if some of the water column load is generated below the TI Dam, it is merely the re-release of PCBs which originated above the TI Dam. The possibility that a small portion of the sediment PCB inventory at Albany (reported as 22 percent on page 3-138 of the DEIR) may be generated external to the GE-related loads still does not change the fact that the GE-related loads to Albany represent 78 percent of the load at Albany, which can arguably be considered the "primary" source. It is also important to note that the congener pattern analysis in the cores did not consider weathering during transport, a process which would serve to shift the congener pattern toward heavier mixtures and incorrectly suggest the input of another source. Note that the water column load analysis as well as the PCB/^{137}Cs analysis were characterized as having an uncertainty of 25 percent. This does not implicitly mean that local additions at 25 percent of the Upper Hudson load were present. Thus the conclusion is correct as written.

<u>Response to DG-1.2</u>

The data analyzed in the report covers nearly three years (1993 - 1996) after the initial controls at the Allen Mills were in place. These data, as well as subsequent data collected, show that water column loads during low flow periods, particularly those from May through November, are produced within the TI Pool as a result of sediment release. The latter years of sampling have shown further reduction in the load originating above Rogers Island, to the point where its annual contribution has become negligible relative to that of the TI Pool. Also notable in the GE data is the consistency of summertime loads produced by the TI Pool despite the abatement of the loads produced upstream. Thus the conclusion correctly characterizes conditions in the river. In addition, the statement correctly places the emphasis on the TI Pool and recognizes that river PCB loads will be controlled almost exclusively by the sediments in the foreseeable future. Thus, while understanding the impacts of GE's ongoing remedial activities is certainly useful, their importance has waned relative to the demonstrably larger loads now originating from the TI Pool.

<u>Response to DG-1.3</u>

The conclusion (*i.e.*, the PCB load from the Thompson Island Pool originates from the sediments within the Pool) is distinctly important in that it places the responsibility for the TI Pool load squarely on the sediments of the Pool and <u>not</u> on any other load source. While the analysis did not permit the resolution of the exact mechanism or sediment type responsible for the load, the analysis very clearly showed that the loads from the sediments were distinct from those originating upstream of the Pool. While the GE releases are undoubtedly the original source of the PCBs in the TI Pool sediments, it is now these sediments themselves, and not the upstream inputs, which are responsible for the water column loads throughout much of the year.

As far as the mechanism responsible for the release of PCBs from the sediments, there are several possibilities, including resuspension, porewater diffusion, groundwater movement, biological activity (*see*, for example, Templer *et al.*, 1997) as well as any combination of the above. The purpose of the DEIR was to provide an interpretation of the data, in part, as a guide for the subsequent modeling analysis. GE's contention that no realistic mechanism exists to resuspend fine-grained sediments is based largely on modeling arguments, not measurements, and it ignores processes such as biologically-driven resuspension and recreational water craft use. Recent water column data show the TI Pool load to be largely constrained to the period May to November, the principal period of both biological activity and recreational boat use. Additionally, given that the TI Pool sediments represent a broad range of sediment contamination with a similarly wide range of dechlorination, it is most likely that a combination of mechanisms and sediment types are responsible for this load.

GE's contention that a portion of the TI Pool load originates with undetected oil droplets is unfounded. Despite GE's many attempts to find such droplets, none have been detected. In fact, some of their most recent results from a sampling cross section of the river just above Roger Island (QEA, March 1998) shows the water column PCB concentration to be relatively homogeneous, suggesting the absence of oil droplets. (Presumably, oil droplets near the bottom would cause the deeper samples to yield markedly higher PCB levels.) Even if such droplets were to exist, it is unclear how long it would take for these PCBs to leave the sediments and re-enter the water column. Clearly, nearly all the PCBs present in the bottom sediments were once released as oil droplets in GE's discharges. As discussed in the Low Resolution Sediment Coring Report (USEPA, 1998), much of the sediment burden, though clearly not all of it is still in place, some at depth, most within 9 inches of the surface. The sediments of the TI Pool are clearly not stagnant, lake-like deposits but rather a dynamic environment subject to resuspension and burial as well as diffusive and biological processes. Thus, the simple addition of more PCBs during the period from September 1991 to 1996 serves to worsen the pre-existing problem but certainly does not define it. The strongest evidence for this fact comes from the GE data itself, which demonstrates a measurable TI Pool input prior to the September 1991 event as well as the consistency of the size of the TI Pool load each year from 1993 to the present despite the major reductions in the loads from upstream of the pool. Lastly, the congener patterns of the TI Pool load are not consistent over time, as might be expected from a single source type (*i.e.*, oil droplets on sediments) but rather they vary as might be expected given a variable mixture of sediments and processes. Thus the need for this conclusion, *i.e.*, that the sediments, and not any other phenomenon, are responsible for the TI Pool load.

Response to DG-1.4

The issue of the effect of dechlorination on PCB toxicity will be discussed in the Ecological and Human Health Risk Assessments and is not appropriate for this report as it deals with PCB geochemistry. As to the effect of dechlorination on PCB bioaccumulation, it is true that the dechlorination products tend to bioaccumulate less, consistent with the decrease in the partition coefficient. However, the lower partition coefficient also yields greater mobility for the partly dechlorinated molecule, thereby increasing the potential for migration from the sediments to the water column and possible biological exposure. Thus it is unclear as to the net effect of dechlorination on bioaccumulation. This issue will be examined in greater detail in the ecological risk assessment and associated modeling. The writer is reminded, however, that most sediment PCBs mixtures do not experience extensive degrees of dechlorination due to their relatively low concentration.

General Electric has consistently argued that the Upper Hudson acts essentially like a lake, gradually and steadily burying older sediments with newer ones. This is simply not the case. The Upper Hudson, while not a free-flowing river, is still a dynamic system, with sediment scour and resuspension occurring on a regular basis. Thus there is no guarantee of burial as a means to sequester contaminated sediments. This was demonstrated in the Low Resolution Coring Report, which showed sediment inventory losses in a large number of historical study areas.

The following are responses to the writer's interpretations of the four 'central positions' of the DEIR:

1. During periods of low flow, a portion of the PCBs entering the TIP from above Rogers Island may be stored in the sediments of the TI Pool. This is based on the apparent loss of several congeners from the Rogers Island load relative to the load at the TI Dam. In light of current results obtained from the TI Dam, this phenomenon may also be caused by incomplete mixing of the main channel and near-shore flows within the river, wherein the upstream load is not completely detected at the TI Dam.

2. As stated in the DEIR on page 3-148, the TI Pool load may be produced by a number of sediment sources, including relatively-less dechlorinated, low PCB level sediments (regardless of age) as well as highly dechlorinated sediments, with concentrations of roughly at least 30 mg/kg or higher, typical of sediments deposited prior to 1984. Some combination of these sources is also plausible.

3. PCBs from the Upper Hudson clearly represent the major source of PCBs to the entire freshwater Hudson. During low flow conditions, PCBs derived from Upper Hudson sediments, particularly those of the TI Pool, represent the dominant source of PCBs to the Upper Hudson and therefore to the Lower Hudson as well. Lower Hudson sediments (much of whose contamination is also derived from the Upper Hudson) may add to the water column PCB load borne by the water column but the Upper Hudson load still represents the main external load to the Lower Hudson, regardless of flow conditions.

4. The writer has correctly summarized the USEPA's interpretation.

5. The writer has correctly summarized the USEPA's interpretation.

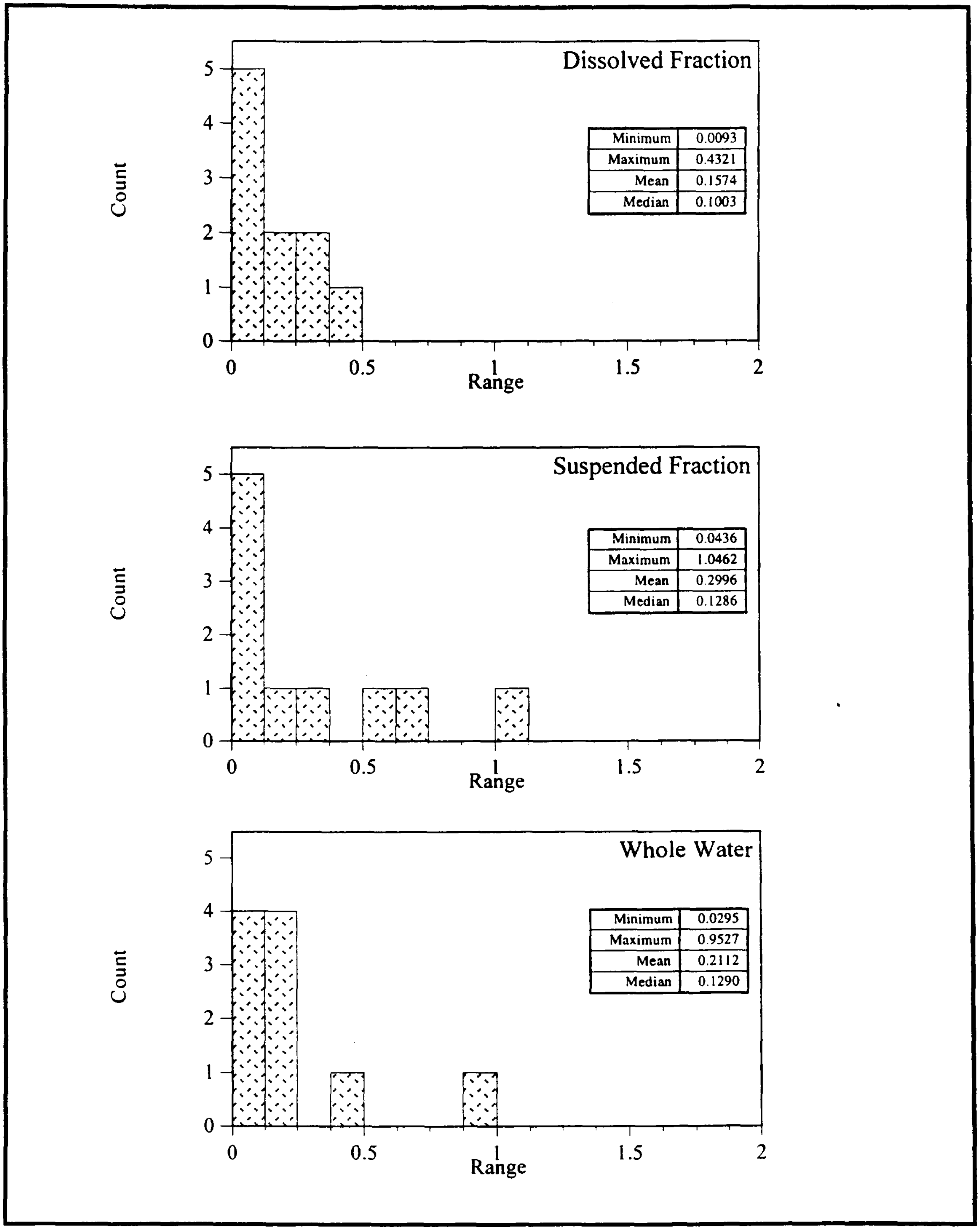


Figure DC-4.6
Relative Fractional Difference for Phase II
Water Column Split Samples (Total PCBs)

Chapter 2- PCB Sources to The Upper and Lower Hudson River

2.1 Background

No significant comments were received on Section 2.1.

2.2 Upper Hudson River Sources

No significant comments were received on Section 2.2.

2.2.1 NYSDEC Registered Inactive Hazardous Waste Disposal Sites

Response to DS-2.1

The second to last sentence on page 2-3 should be changed to: "The significance of the contaminated site is clearly evident in the NMPC Phase II fish tissue data. . ." The commentor noted that "remediation of the shoreline has been completed and preliminary fish monitoring data indicates improvement."

Response to DS-2.2

For the first paragraph on page 2-14, the commentor suggested that the mean monthly maximum flow (174 gpm, December 1991 through April 1994) cited on page 2-15 should be used to estimate the seepage loading. Thus, at a total PCB concentration of 20 μg/L, this flow (174 gpm or 0.4 cfs) would result in a loading of 0.02 kg/day (0.04 lb/day) or 7 kg/year (15 lb/year).

Response to DS-2.3

The commentor noted that although the GE Fort Edward Plant Site is listed as a "dump" in NYSDEC's Registry of Inactive Hazardous Waste Sites, the plant is currently an operational capacitor manufacturing facility.

2.2.2 Remnant Deposits

Response to DS-2.4

As indicated in the 1984 Record of Decision for the site, USEPA will evaluate whether further remedial action is appropriate for Remnant Deposits 2-5 if the Agency decides to take additional remedial action with respect to sediments in the river.

Response to DF-2.7

Oversight of the activities and documentation associated with the GE facilities has been performed by NYSDEC. Chapter 2 of the DEIR provides a summary of those activities and documents. USEPA's assessment of the significance of the GE facilities and the Remnant Deposits in relation to the sediments of the Upper Hudson River is presented in Chapter 3 of the DEIR. As part of the Phase 2 geochemical and modeling efforts, the data have been and will continue to be critically reviewed in determining the current and projected PCB loading from all of the sources above the Thompson Island Pool (*i.e.*, above Rogers Island).

Figure DF-2.7 provides a comparison of the PCB homologue distribution in both the non-aqueous phase liquid and water phases of seepage samples collected in May 1993 from the eastern raceway area adjacent to the GE Hudson Falls facility with the USEPA Phase 2 Aroclor 1242 standard as well as the whole water sample collected at Rogers Island during the spring runoff event of 1993. As can be seen, the sample patterns closely resemble the standard, suggesting that the mixture is primarily Aroclor 1242. However, as shown by the H, H' congeners in Figure DG-1.20B (in Section 4.3.2), there are still significant differences between the Rogers Island station and pure Aroclor 1242. The results shown in Figure DG-1.20B show substantially higher levels of three of the four congeners presented, indicating the presence of a heavier Aroclor mixture (*e.g.*, Aroclor 1254) in the GE releases.

2.2.3 Dredge Spoil Sites

No significant comments were received on Section 2.2.3.

2.2.4 Other Upper Hudson Sources

No significant comments were received on Section 2.2.4.

2.3 Lower Hudson River Sources

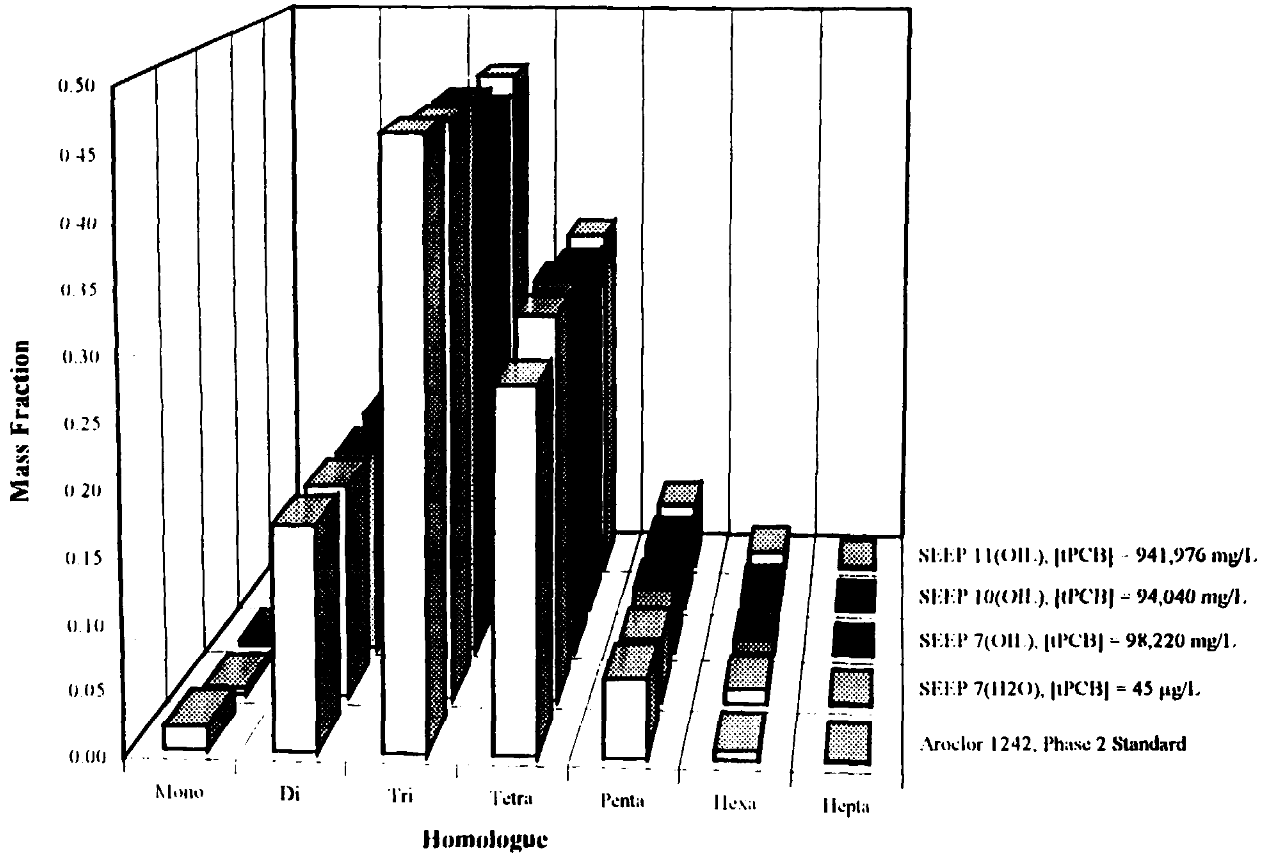
Response to DF-2.8

Sediments downstream of the Thompson Island Pool (TI Pool) represent a potentially important source for PCB release to the water column. In fact, based on additional data collected by GE after the release of the DEIR, it appears that the sediments between the TI Dam and Schuylerville produce an additional PCB load roughly equal to about one half of that generated by the TI Pool (QEA, 1998). This is based on the apparent load gain between the TI Dam and Schuylerville documented by the GE samples.

The importance of the sediments below the TI Dam will be further evaluated as part of the fate and transport modeling analysis currently ongoing. The model has been configured to represent geochemical PCB transport from Rogers Island in the TI Pool to Waterford.

Response to DF-2.9

Ongoing sample collection efforts by GE and NYSDEC serve to provide much of the information requested by the writer, specifically water column and fish data, respectively. Data to clarify the nature of the PCB release processes are more difficult to obtain. Specifically, it is difficult to collect samples which can integrate the individual micro- to macro-scale processes currently responsible for the release of PCBs from the sediments. Without data to individually constrain these processes, it is difficult to estimate their magnitudes. In their stead, the low resolution coring program examined the integration of all these processes on the sediment inventory and demonstrated a statistically significant loss from the most contaminated sediments. Additional data



Rogers Island Transect 4 Whole Water

Source: GE Bakers Falls Investigation Data in TAMS/Gradient Database

TAMS/LTI/TetraTech/MCA

Figure DF-2.7

General Electric Hudson Falls Source - Seepage Homologue Distribution, May 1993 may be helpful but studies of the individual processes have the potential of requiring very long investigations and monitoring periods before useful results are obtained.

2.3.1 Review of Phase 1 Analysis

2.3.2 Sampling of Point Sources in New York/New Jersey (NY/NJ) Harbor

2.3.3 Other Downstream External Sources

No significant comments were received on Sections 2.3.1 through 2.3.3.

Chapter 3 - Water Column PCB Fate And Transport in The Hudson River

Response to Comment DF-2.3A

Further resolution of the sample data into congener-specific loads would provide greater clarification on some aspects of PCB transport in the Upper Hudson. However, USEPA recognizes that for the purposes of the DEIR, the homologue patterns presented in the report are sufficient to support the conclusions drawn. Subsequent analysis anticipated as part of the fate and transport modeling effort will also advance this issue further since it will deal specifically with five individual congeners, representing a range of PCB characteristics. Additional congener-specific interpretation may also be completed during the Ecological and Human Health Risk Assessments if deemed necessary.

Response to Comment DF-2.3B

The writer is correct in noting that BZ#118 alone was not used to identify the presence of Aroclor 1254. Although not explicitly stated in the text, the presence of Aroclor 1254 was inferred based on the ratio of BZ#118/BZ#52. The presence of Aroclor 1254 was indicated when this ratio was well beyond that found in Aroclor 1242. Thus, unlike the eight unique congeners identified for Aroclor 1260, no unique congeners specific to Aroclor 1254 could be discerned which could indicate the presence of this Aroclor unequivocally. The amount of Aroclor 1254 in a sample was estimated based on the degree to which this ratio exceeded that found in Aroclor 1242. The writer is also correct in noting that for a mixture of 85 percent Aroclor 1242 and 10 to 15 percent Aroclor 1254, each Aroclor would contribute roughly equally to the total amount of BZ#118. Nevertheless, the fact that the BZ#118/BZ#52 ratio was well beyond that which could be attributed to Aroclor 1242 is fairly clear proof of the presence of Aroclor 1254 in the sample. This indication is further supported by the reported history of GE's PCB usage (Brown *et al.*, 1984). GE usage of Aroclor 1254 began in 1945 at Ft. Edward and continued at both plants until 1971. (This information is summarized in Figure B.2-1 of the Phase 1 Report (USEPA, 1991).) Thus the presence of Aroclor 1254 in the PCB contamination of the Hudson is highly likely.

3.1 PCB Equilibrium Partitioning

Response to DG-1.23

The comment noted that there appeared to be a difference in partitioning behavior for samples in the Remnant Deposit and Rogers Island data compared to stations downstream and stated, "it is incorrect to include Remnant and Rogers Island data in the determination of equilibrium partition coefficients. Estimates including this data [sic] will yield partition coefficients well above equilibrium".

USEPA is in full agreement that some samples from the Rogers Island station show higher estimated partition coefficients than samples collected downstream, but disagrees with the conclusions stated in this comment. While it now appears likely that some partition coefficient estimates at Rogers Island are biased high, this fact was not known *a priori*. Indeed, because field partitioning is often observed to differ systematically from laboratory K_{OW} estimates, there is no clear baseline against which to determine if a given estimate is biased high or low. It was USEPA's judgement that any pre-selection of the data to eliminate undesirable sample observations would subject the work to a criticism of bias. Therefore, the full set of data was used. However, because it was judged likely that some samples were out of equilibrium, central tendency of the estimates was summarized by the median (50th percentile), rather than the mean. The median is relatively insensitive to the presence of biased outlying values, particularly in this case where only one out of eight stations used for the analysis deviates strongly from the central tendency. The approach USEPA has taken therefore does not yield partition coefficients well above equilibrium, because the median from samples at eight stations is used, yet avoids an arbitrary prejudgement of the data.

GE's discussion also neglects the effect of changing POC concentrations between stations. GE's Figure E-1 displays variation in K_P with station, implying a large upward bias at all stations upstream of Thompson Island Dam. In fact, a part of the variability is due to variations in POC concentrations, and corrections must be made for POC concentration. Figure 3-16 in the DEIR shows that it is only samples from the Rogers Island station which exhibit a strong upward bias relative to mean $K_{POC,a}$ estimates for higher-chlorinated homologues. GE's Figure E-1 lumps partition coefficient estimates across all congeners. As there is significant variability in partitioning among individual congeners, the position of the bars in this figure is determined as much by what congeners happen to have been quantitated in both dissolved and particulate phases at a given station as by variability between stations. Finally, GE's Figure E-1 also misleadingly includes estimates from Stations 1 and 2 (upstream of the PCB source area, with concentrations generally too low for accurate determination of partition coefficients) and from Station 10 (Lock 7), which does not reflect conditions within the river.

GE (p. E-3) raised several issues regarding temperature correction of partition coefficients. GE first questioned why the data of Warren *et al.* (1987) was used to determine the temperature dependence of partition coefficients when the Phase 2 data collected covers a sufficient range in temperature to determine temperature dependence directly. The reasons for this choice should be evident from the discussion in the DEIR: Because some samples were believed to be out of equilibrium (including, but not necessarily limited to, samples from the Rogers Island station), while estimates from other samples may be affected by analytical uncertainty, it was highly desirable to use estimates of the temperature correction factor derived from the independent controlled laboratory experiments (using Hudson River sediment) conducted by Warren *et al.* If only the Phase 2 data were used for this calculation, it would not be possible to isolate the effect of temperature from other sources of variability in partition coefficient estimates.

GE also stated that the temperatures used by EPA are not ambient, and over estimate actual *in situ* temperatures (Figure E-5). In fact, the Phase 2 temperatures plotted by GE in Figure E-5 are not those used for establishing partition coefficient temperature correction factors. Temperatures which were used in the DEIR also appear to be higher than *in situ* temperatures, but were selected intentionally, as described below.

True *in situ* water temperatures were not recorded during the Phase 2 data collection effort, and water temperatures reported in connection with the various physical parameter measurements had adjusted to some degree toward ambient air temperature. Release 4.1 of the Hudson River RRI/FS Database now contains best estimates of *in situ* water temperatures based on examination of sampling logs and determination of which of the reported temperatures were recorded closest to time of sampling, which were not available in time for the DEIR. Filtration of samples in the field occurred up to four hours after sample collection, however, allowing some potential re-equilibration between phases in response to temperature changes in the sample. The temperatures used for calculation of partition coefficients in the DEIR were an estimate of temperature at time of filtration, derived from temperatures recorded during measurement of conductivity. Some refinements to these temperature estimates may be possible based on review of the sampling logs. Additional investigations of this issue are ongoing.

3.1.1 Two-Phase Models of Equilibrium Partitioning

3.1.2 Three-Phase Models of Equilibrium Partitioning

3.1.3 Sediment Equilibrium Partition Coefficients

3.1.4 Summary

No significant comments were received on Sections 3.1.1 through 3.1.4.

3.2 Water Column Mass Loading

Correction to Section 3.2 - Water Column Mass Transport

Since the completion of the DEIR, several additional analyses as well as new or revised data sets have been reviewed which indicate the need to revisit the water column PCB mass loading estimates derived in the DEIR. Specifically, additional data analysis on Upper Hudson flows along with two reports produced by GE have led to the following observations:

- Upper Hudson flows at Stillwater and Waterford for low flow conditions estimated for the Phase 2 analysis may be 15 to 40 percent too high.
- GE PCB data obtained on water column concentrations through 1996 under reported PCB concentrations by roughly 40 percent. Revised data are now available.
- GE sampling in the vicinity of the TI Dam suggests that some TI Dam samples collected at low flow conditions in the absence of loadings above Rogers Island may overestimate the water column load at the dam. For the five-year period of GE data collection prior to 1996, the results suggest the values may be too high by 20 percent. During 1996 and 1997, the low-flow estimates may be 36 percent too high. No corrections are required for flows higher than 4000 cfs prior to 1996. These corrections account for both flow and Rogers Island load which are shown to affect the sampling bias. (See the discussion in Section 1 of the USEPA review of the GE/QEA model in book 3 of this responsiveness summary.)

As a result of these observations, the conclusions concerning the water column transport need to be reviewed for their accuracy. The main conclusion for the water column transport were given in the executive summary of the DEIR as follows:

1. The area of the site upstream of the Thompson Island Dam represents the primary source of PCBs to the freshwater Hudson. This includes the GE Hudson Falls and Ft. Edward facilities, the Remnant Deposit area and the sediments of the Thompson Island Pool. Analysis of the water column data showed no substantive water column load increases (i.e., load changes were less than ten percent) from the Thompson Island Dam to the Federal Dam at Troy during ten out of twelve monitoring events. These results indicate the absence of substantive external (e.g., tributary) loads downstream of the Thompson Island Dam as well as minimal losses from the water column in this portion of the Upper Hudson. These results also indicate that PCB transport can be considered conservative over this area, with the river acting basically as a pipeline (i.e., most of the PCBs generated upstream are delivered to the Lower Hudson). Some PCB load gains were noted during spring runoff and summer conditions, which were readily attributed to Hudson River sediment resuspension or exchange by the nature of their homologue patterns. These load gains were notable in that they represent sediment-derived loads which originate outside the Thompson Island Pool, indicating the presence of substantive sediment inventories outside the Pool. The Mohawk and Hoosic Rivers were each found to contribute to the total PCB load measured at Troy. The loading from each of these rivers during the 1993 Spring runoff event could be calculated to be as high as 20 percent of the total load at Troy. However, these loads represent unusually large sediment transport events by these tributaries since both rivers were near or at 100-year flood conditions.

This conclusion is based on a number of lines of reasoning but it is clear that the downward-revised flows at Stillwater and Waterford will yield lower PCB fluxes at these locations. Thus the statement above that "PCB transport can be considered conservative over this area" does not apply at low flow conditions in the sense that a net loss of PCB transport will be apparent during these conditions. The finding that the PCB load generated above the TI Dam is essentially equal to that delivered by the Upper Hudson to Waterford will only apply at high flow conditions. Thus, while it is likely that most of the PCBs which cross the dam at Waterford at low flow will have been released from the area above the dam, a substantial portion of the PCBs released will not be transported to Waterford. Presumably this loss is attributable to processes like settling, gas exchange and aerobic degradation. This result will not change the finding that the region above the TI Dam is the primary PCB source to the fresh water Hudson since, even with these reduced loads, this region will still easily present the largest load. In addition, the dated core evidence shows this region to be the dominant PCB source to the fresh water Hudson as well.

The revised GE data more than compensate for the potential overestimation of PCB loading by the TI Dam station since the corrections to the TI Dam loads are dependent on other factors such as the total flow and the Rogers Island load. Thus the overall result will be to yield higher loads from the TI Pool based on the GE data than previously estimated. An important finding becomes evident from analysis of the GE data. That is, the sediments between TI Dam and Schuylerville may also contribute significantly to the water column PCB load. The revised quantitation of these loads will be completed in the near future.

3.2.1 Phase 2 Water and Sediment Characterization

No significant comments were received on Section 3.2.1.

3.2.2 Flow Estimation

Correction to Section 3.2.2 - Flow Estimation

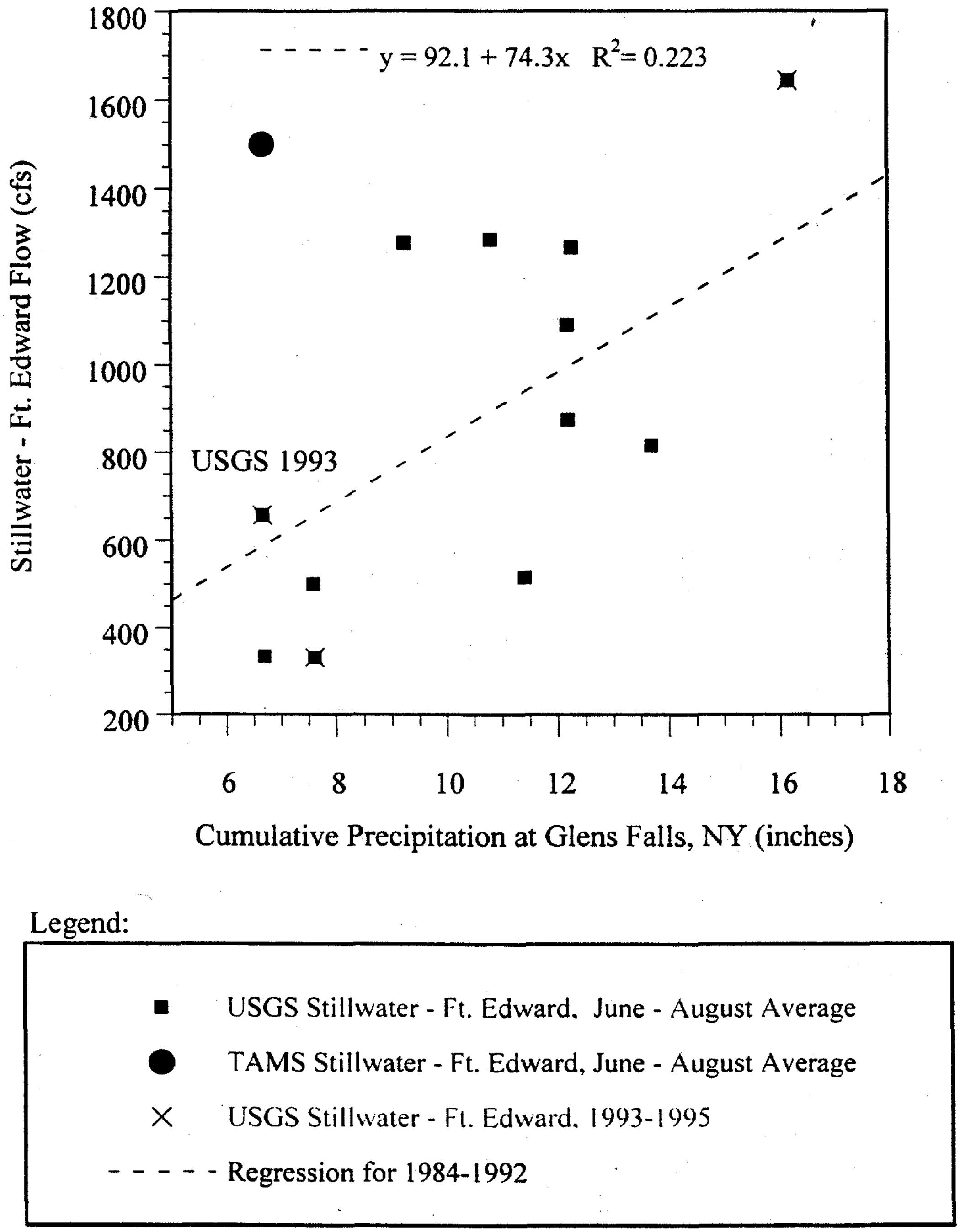
As part of the original data analysis, estimates of flow in the Upper Hudson between Schuylerville and Waterford were required due to the loss of USGS discharge stations at Stillwater and Waterford. These stations were lost due to construction activities in the corresponding areas of the river. In order to obtain flow estimates, staff gauge data from the NYS Champlain Barge Canal system were analyzed and used to estimate flow, as reported in the DEIR.

Since the original preparation of the DEIR, additional information concerning Hudson River flows between Schuylerville and Waterford during 1993 have become available. Specifically, USGS estimates of water flow based on other data for the region have been published as well as additional information on the nature of the modifications made to the dams in this region of the river. Additional information concerning the barge canal staff gauge data was also obtained which suggested that several of the staff gauges used in the flow analysis may have been affected by the construction as well.

A thorough review of this information has shown that some of the original Phase 2 flow estimates reported in the DEIR for the Hudson between Schuylerville and Waterford are probably incorrect, representing overestimates of the actual flow. In general, it was found that the USGS and Phase 2 flow estimates agreed at high flow conditions but that the Phase 2 results were 15 to 40 percent higher than those derived by the USGS at low flow conditions.

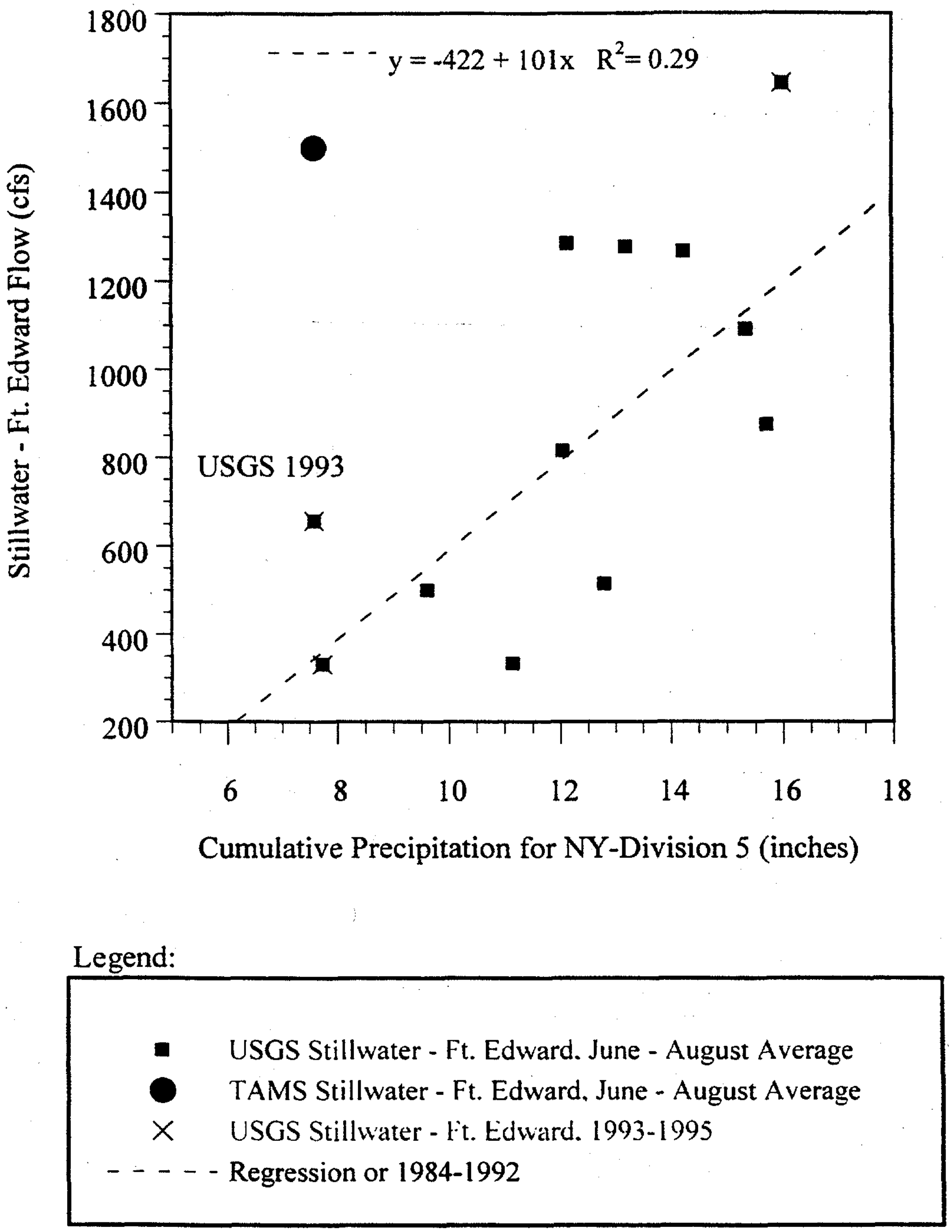
The subsequent choice of the "correct" flow records was based on the precipitation records for the Upper Hudson area. A comparison of the flow and precipitation data was prepared which established the relationship between flow and precipitation for the historical data prior to the construction begun in 1993. This result is shown in DEIR Figures 3.2.2 A and B. These figures compare the incremental flow gain between the USGS measurement stations at Fort Edward and Stillwater with two different records of precipitation in the Upper Hudson area. The vertical axis in each graph represents the mean June-to-September flow gain between Fort Edward and Stillwater. Also shown on these graphs are the estimates for 1993 based on the Phase 2 and USGS analyses. It is clear from these diagrams that the USGS estimates are in closer agreement with the historical relationship than is the Phase 2 estimate. In light of this finding as well as the information concerning the dam construction work in the region, the USGS estimates of flow at Stillwater and Waterford will be used in subsequent Reassessment analyses in place of the Phase 2 flow estimates reported in the DEIR.

As a result of this finding, the PCB fluxes calculated in the DEIR must be revised to reflect the lower flow rates in the lower portion of the Upper Hudson. These calculations will be presented as an appendix to the Responsiveness Summary for the Low Resolution Coring Report, as mentioned previously.



Note:
Data retrieved from NOAA's National Climatic Data Center (NCDC) web site (http://www.ncdc.noaa.gov/ncdc.html).

Figure 3.2.2A
Fort Edward to Stillwater Incremental Summer Average Flow vs.
Total Precipitation for Glens Falls



Note:
Data retrieved from NOAA's National Climatic Data Center (NCDC) web site (http://www.ncdc.noaa.gov/ncdc.html).

Figure 3.2.2B
Fort Edward to Stillwater Incremental Summer Average Flow vs.
Total Precipitation for NCDC-Division 5 (Hudson River Valley)

3.2.3 Fate Mechanisms

Response to DL-1.3

The source of the TI Pool load appears to be PCBs stored within the sediments. This source may consist of partially dechlorinated sediments which release PCBs via porewater. These sediments are probably older but need not be buried. As shown in the Low Resolution Sediment Coring Report (USEPA., 1998), burial occurs, but is not continuous throughout the river bottom. Also in this subsequent report, PCB mass loss in fine-grained sediments was identified based on collocated sampling points taken in 1984 and 1994. In gross terms, this mass loss from the sediments agrees with the estimated water column loading across the TI Pool for that time period. Irregularly lineated zones, often occurring in regions of fine grained sediment, were identified in the side scan sonar analysis (Flood, 1993). These areas appear to have a large potential for erosion. Wood chips which may have eroded out of these areas are found in some areas. These findings demonstrate that burial is not occurring universally in the river, but that regions in the river are eroding, making more contaminated and dechlorinated sediments available to the water column.

Response to DC-4.2

Two dated cores showing an annual sedimentation rate of about 1 cm/yr do not establish that the entire TI Pool river bed is continuously undergoing burial. The river appears to be in a dynamic state with some areas exhibiting scour and other areas exhibiting burial. This is extensively discussed in the Low Resolution Sediment Coring Report. (See the response to comment DL-1.3.) As shown in this report, a median value of PCB mass loss has occurred in many fine-grained areas of the TI Pool of which only a small portion can be explained by dechlorination. Given that there is evidence of scour and PCBs have been lost to the water column, this transfer of mass may be partially explained by resuspension of contaminated sediments. Plausible mechanisms which are consistent with the data are discussed in the DEIR, but no attempt was made to establish the mechanism or set of mechanisms under every condition.

Response to DC-4.3

The presence of PCB contaminated porewater in the water column is suggested by the distribution of congeners found in the water column samples. The high levels of mono- and dichlorobiphenyls can be generated by partitioning the PCBs between dechlorinated PCB contaminated sediments and porewater. The mechanism of transport is not clearly defined but there are several possibilities including bioturbation, diffusion, groundwater flux and sediment scour. One study estimates that certain rooted macrophytes turn over the porewater from three to eight times per growing season (Templer, 1997). The contribution from exposed high concentration sediments might be significant, with the exposure caused by scour or water craft activities. Finally, there is evidence that the TI Pool fine-grained sediments have lost 40 percent of the PCB mass between 1984 and 1994 (USEPA, 1998). Only 11 percent of this mass lost is explainable by dechlorination. The remainder is lost to the water column by some combination of mechanisms.

Response to DG-1.24

The writer asserts that a wind-driven gas exchange equation is not appropriate for use in the Upper Hudson during low flow conditions. This is based on the assertion that the energy for water surface renewal stems from the downstream flow of the river and not wind. Alternatively, the writer contends that O'Connor and Dobbins (1958), which is based on water flow, is a better model of the gas exchange phenomena. The writer also points out that for gases such as PCBs, gas-phase diffusion as well as liquid-phase diffusion can be rate limiting for gas exchange.

The purpose of the discussion in Section 3.2.3 was to briefly examine the various processes affecting PCB transport in the Hudson River. Among these was the process of gas exchange, potentially an important means for PCB loss from the water column. The prediction of gas exchange rates has been extensively studied via a large number of techniques (Hartmond and Hammond, 1984, Clark *et al.*, 1994; Clark *et al.*, 1996; O'Connor and Dobbins, 1958). In the Upper Hudson, gas exchange processes have not been explicitly studied. However, it is still possible to surmise some of the importance of the three models described in the DEIR.

In the context of the O'Connor and Dobbins model, gas exchange is roughly proportional to the square root of the ratio of the bulk water velocity to the mean water depth. At low flow this ratio can range from 0.015 to 0.081 sec^{-1} at flows of 1,000 to 8,000 cfs. However, as noted in O'Connor and Dobbins, this model typically does not apply where water velocities are controlled by dams and not by the simple process of flowing downhill. Thus the applicability of this model to the Upper Hudson with its eight dams between Fort Edward and Troy is uncertain at best. Alternatively, in the Lower Hudson, the flow to depth ratio is comparable to that of the Upper Hudson at low flow (0.05 sec^{-1}) based on information from Deck, 1981, and Garvey, 1990. Yet in this area of the river the gas exchange rate has been extensively documented to be well predicted by wind-driven gas exchange models (Clark *et al.*, 1994, Clark *et al.*, 1996). Although the fetch of the Upper Hudson is substantially less than that of the Lower Hudson, the similarity of the flow-to-depth ratios and the predominance of wind-driven gas exchange in the Lower Hudson as well as the observation that the Upper Hudson at low flow more closely resembles a series of dammed lakes than a river would together suggest that wind-driven gas exchange may be an important factor under low flow conditions. At this point in the investigation, it would appear inappropriate to simply rule out either mechanism for gas exchange in the large, relatively quiescent pools of the Upper Hudson during low-flow conditions.

Regardless of which of these mechanisms govern the quiescent areas of the Upper Hudson, they pale in comparison to the gas exchange which occurs at each of the dams. The eight dams of the Upper Hudson represent a total vertical drop of about 122 feet. At each of the dams, energy is rapidly dissipated as the river flow cascades down the downstream surface of the dam. This process serves to generate a great deal of turbulence, incorporating fine air bubbles. This serves to greatly enhance the air-to-water exchange of gas since it will occur across the individual bubbles as well as the river's upper surface. Simulation of this process will be included in the modeling analysis.

The USEPA agrees with the concern over the gas-phase diffusion raised by the writer. This will be examined for its importance during the modeling analysis.

3.2.4 Conceptual Model of PCB Transport in the Upper Hudson

Response to DC-4.7

This comment (problems with relating TSS to discharge) will be addressed after further analysis in the Baseline Modeling Report. Data relating TSS and flow was explicitly obtained for this purpose and will be incorporated in the Baseline Modeling Report. Additionally, GE collected similar TSS and flow data which will be examined in this context as well. Nonetheless, the USEPA disagrees with the notion that sediment resuspension and PCB load cannot be inferred in some instances, since subsequent changes in congener pattern and PCB load would be readily recognizable as was seen at Waterford in Transect 3 (which occurred in March of 1993).

3.2.5 River Characterization

No significant comments were received on Section 2.3.5.

3.2.6 Mass Load Assessment

Response to DS-2.5

The statement should read as follows: "Water column processes such as gas exchange and *in situ* degradation may also serve to remove a portion of the PCB load originating above Rogers Island. However, this appears unlikely in view of the apparent absence of their effects below TI Dam and the near-conservative PCB transport observed from the TI Dam to Waterford during these transects."

Response to DS-2.6

USEPA agrees with the writer's observation. Subsequent to the release of the DEIR, additional data have been obtained by GE which support the suggestion that the region from the TI Dam to Schuylerville also yields a substantive PCB load. These results also suggest that the TI Dam stations used by both the USEPA and GE may overestimate the total load over the TI Dam during warm weather, low flow conditions when loads at Rogers Island are largely nondetect (see Section 1 of USEPA comments on the GE/QEA model in book 3 of this responsiveness summary). The end result of the analysis of these data indicates that the TI Dam station yielded may occasionally overestimate PCB loads depending upon other conditions The degree of overestimation varies from about 0 to 36 percent but it is negligible at flows over 4000 cfs under most conditions seen during the past 8 years. Only when loads at Rogers Island drop to negligible levels does the overestimation approach 36 percent. The writer is referred to Section 1 of the USEPA review of the GE/QEA model presented in book 3 of this responsiveness summary. The implications of these observations will be fully explored as part of the modeling effort. Regardless of the outcome of this analysis, the four major findings of the report will still apply. If, after a more thorough analysis of the new data, the areas below the TI Dam are shown to yield a significant load, the indications are that these loads still represent only about 20 percent of the total load during low flow conditions. Even with new information, the conclusions of the DEIR concerning the overall importance of the TI Pool sediments to PCB water column loads in the freshwater Hudson remains valid.

Response to DS-2.7

To date, there are no data which are capable of specifically identifying the fate of the newest PCB contributions to the TI Pool from above Rogers Island. Undoubtedly, these newer contributions are subject to the same sorts of processes which affect the older PCBs but it is difficult to trace the newest contributions short of an extensive program of high resolution cores. Even then there would be no guarantee that the most recent releases would be readily discernable from reworked PCBs.

Response to DS-2.8

USEPA agrees that the processes affecting PCB transport in the TI Pool are unlikely to be unique to the Pool. As noted, the scale of these processes would be expected to vary from pool to pool in the Upper Hudson, dependent on the physical characteristics of each pool.

Response to DS-2.9

The phenomena noted, *i.e.,* the consistency of the total load but the change in congener distribution, is observed only during warm water, low flow conditions. Evidence for consistency in total load and in congener pattern is noted for cold water and high flow conditions, suggesting that the degree of "conservative" transport is probably dependent on several factors including temperature as well as water residence time in the Upper Hudson. This issue of quasi-conservative transport is less important than assessing the overall magnitude of the load emanating from the Upper Hudson sediments. Indeed it is quite conceivable that sediments downstream of the TI Dam (or Schuylerville) may be in a quasi-equilibrium or steady-state with the historical water column loads and concentrations produced in the upstream areas. This issue remains to be explored further during the modeling effort. It should be noted, however, that the calculations demonstrating "conservative" behavior using summer months are being revised. "Conservative" behavior is not expected during summer months, as noted in the corrections in Section 3.2.

Response to DG-1.9

The concerns over the accurate representation of the PCB loads during the April 1993 high flow event are valid. However, the transect 4 sample was collected at Rogers Island as the flow peaked in the river and not after the peak as contended. It does not appear that the loading of PCBs during this transect was directly attributable to scour since no change in suspended matter concentration (and therefore load) occurred between Bakers Falls and Rogers Island (18.4 *vs* 17.5 mg/L, respectively). Thus, the concern over sampling during the period of rising river flow may not be valid. Specifically, it is unclear as to the nature of the PCB release process in the Bakers Falls area. Given that the PCB oils apparently enter the river via rock fissures and man-made pipes, it would appear likely that the greater displacement of water through these conduits during high flow is a more likely mechanism rather than a scouring of the river bottom. The displacing water could originate as groundwater or as a result of higher water levels in the river channel. On this basis it is unclear when the peak flushing of these PCB oils would occur.

Nonetheless, it is important to note that the majority of the load delivered to Rogers Island during this transect is carried through the Upper Hudson to the Lower River. This is not to suggest that the PCB inputs upstream of Rogers Island do not contaminate the sediments of the Upper

Hudson, but simply that the Upper Hudson is not an efficient filter for these loads and that the majority of their mass is delivered downstream.

Lastly, as made evident by the GE monitoring data, the importance of the Bakers Falls releases during the spring, as well as for the rest of the year, has greatly decreased. This is attributed to the remedial work conducted by GE at the Hudson Falls facility. Thus the issue of how and how much of the water column load is generated above Rogers Island has become largely moot. The sediments of the Upper Hudson, particularly those of the TI Pool, have become the major source of PCBs to the Hudson. While it is undoubtedly true that the sediment contamination of the Upper Hudson originated above Rogers Island, it is also true that the current surficial sediment contamination is the integration of resuspension, settling, and biological activity as well as fresh introductions of PCBs from the GE facilities.

Response to DG-1.10

The remedial efforts undertaken by GE have produced a marked decline in the loads originating above Rogers Island since September 1991. In particular, the peak loads of the September 1991-June 1993 period were substantially reduced in the ensuing months as recorded by the GE monitoring program. Typical water column concentrations at Rogers Island were reduced from levels as high as 1,000 ng/L during high flow levels to nondetect levels throughout much of the year. This is shown in Figure 3-82 of the DEIR as well as in subsequent GE reports. The GE contention that PCB transport into the TI Pool occurs as oil droplets has never been substantiated despite sampling by GE to demonstrate its existence. Given the absence of evidence for this phenomenon and the markedly reduced PCB loads originating above Rogers Island, it is unlikely that fresh releases remain a major issue to PCB transport. GE's remedial efforts have sufficiently reduced the loads from the Hudson Falls facilities so as to permit the unobstructed observation of the TI Pool sediment load during both 1997 and 1998. As demonstrated in subsequent reports by GE (*e.g.*, QEA, March 1998), the loads upstream have become minor relative to that of the TI Pool on an annual basis. Thus, while the mechanisms for PCB release from the Hudson Falls facilities remain unknown, their importance to the Hudson River PCB problem has greatly diminished. In this context, it appears that the degree of control attained by GE readily permits the study and interpretation of the loads produced by downstream sediments.

Response to DG-1.10A

The contention that higher loads of unaltered PCBs appear to enter the TI Pool at higher flows is supported by the USEPA and GE data. However, the comment fails to note that these loads appear to be swept unmitigated to the Lower Hudson, with relatively little loss as a percentage of total transport to the sediments of the Upper Hudson. While it is undoubtedly true that freshly contaminated sediments are produced and deposited during these events, it is apparent that these sediments represent just a small fraction of the PCBs released. These same conditions presumably serve to resuspend, deposit, uncover and bury older and newer contaminated sediments, yielding a surface sediment patchwork of PCB contamination. The contention that large portions of the PCB load originating upstream of Rogers Island enter the TI Pool undetected and remain undetected despite nearly eight years of monitoring as well as specific sampling techniques employed by GE to demonstrate their occurrence is unsubstantiated.

Response to DG-1.11

The writer contends that the PCB loads which occur during the passage of the river through the TI Pool cannot be explained by the combination of the load at Rogers Island and a diffusive flux from the river sediments. This calculation is based in part on the very limited data set obtained prior to the September 1991 failure of the Allen Mill structure and the large ensuing PCB releases related to the GE Hudson Falls facilities. The calculation is of questionable value for a number of reasons. First, it is not clear that porewater exchange in the TI Pool would be exclusively limited to diffusive exchange. Groundwater migration and biological processes may serve to greatly enhance the exchange of porewater with the overlying river. Second, the partition coefficients developed by the USEPA may not have the precision assigned to them by the writer. As a result, there may be greater uncertainty in the congener pattern of the truly dissolved PCBs in porewater than ascribed by the writer. Thirdly, the assignment of a partition coefficient for DOC-bound PCBs at one-tenth of the value developed by the USEPA is not defensible and appears without support. The values developed in this manner are quite different from those developed from three-phase calculations in the DEIR. Additionally, the DOC content of the porewater is not well defined and its concentration may vary significantly. This variation would directly affect the congener pattern carried by the porewater. The DOC measurements themselves are based on frozen samples collected in 1991. The effect of the freezing process is unclear, adding further uncertainty to the calculation presented. Based on these issues, the USEPA does not accept the calculation nor the conclusions based on it.

Response to DG-1.15

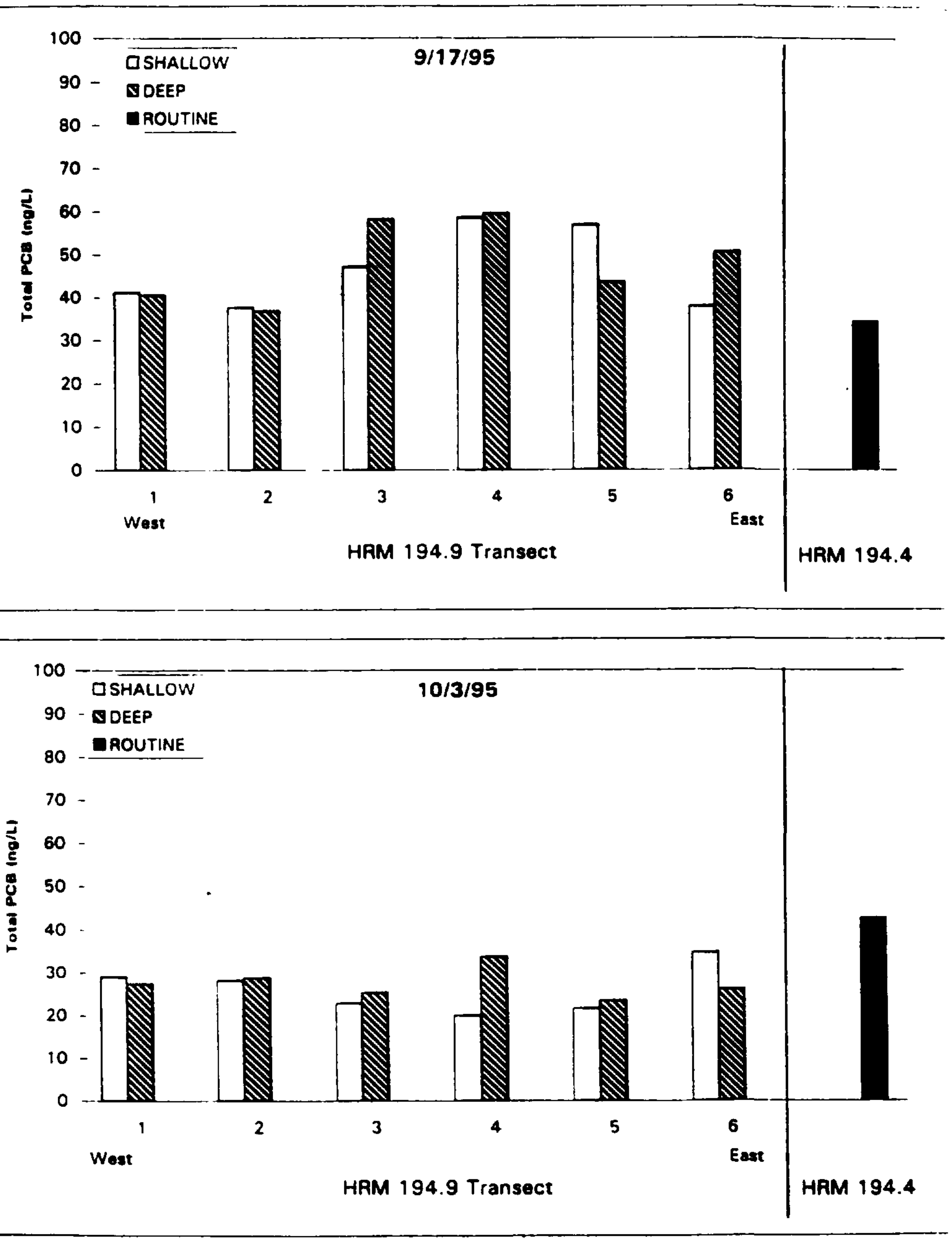
The writer raises four issues:

1. Transient PCB transport events are not captured by GE's monitoring efforts. (Responded to as DG-1.15A)
2. The USEPA sampling program missed the peak loading event in 1993. (Responded to as DG-1.15B)
3. PCB oils are the likely source of the spring peak PCB transport. (Responded to as DG-1.15C)
4. Flushing activities conducted by the hydroelectric plant at Bakers Falls serve to flush PCBs out of the plunge pool on an irregular basis. (Responded to as DG1.15D)

Response to DG-1.15A

The capture of transient transport events will always remain a concern to some degree. However, the length of weekly to biweekly sampling at the GE monitoring points, as required by the USEPA, now covers more than eight years or over 400 samples at Rogers Island alone. The size of this data set is sufficient to characterize the general rate of PCB loads originating above Rogers Island. In fact, the data set clearly documents the decline in PCB loads at Rogers Island, largely attributed to the remedial efforts at Hudson Falls conducted by GE. Current levels are frequently nondetect, indicating reductions of more than two orders of magnitude in the Rogers Island load since 1993.

In a subsequent report to USEPA (QEA, March 1998), GE demonstrated the homogeneity of the water column load above Rogers Island on two separate occasions by collecting shallow and deep samples at several locations in a river cross-section (see Figure DG-1.15A). Water column concentrations both horizontally and vertically rarely varied more than 25 percent and typically



From QEA. March 1998

Figure DG-1.15A
Water Column PCB Concentrations Within the Vicinity of Fort Edward
from the 1995 River Monitoring Test

agreed to within 10 percent. The data also showed that the normal Rogers Island monitoring station agreed with these cross sections within reasonable bound, falling 25 percent lower and 58 percent higher on the two sampling events. The close vertical agreement of the water column samples is strong evidence for the absence of the oil droplets at the river bottom, since they would presumably raise the concentration of the deeper water relative to the shallower water. Additionally, the data show that the water column load originating in the Hudson Falls area has been thoroughly homogenized in the water column by the time the load reaches Rogers Island. This is further evidence of the accuracy of the Rogers Island monitoring station.

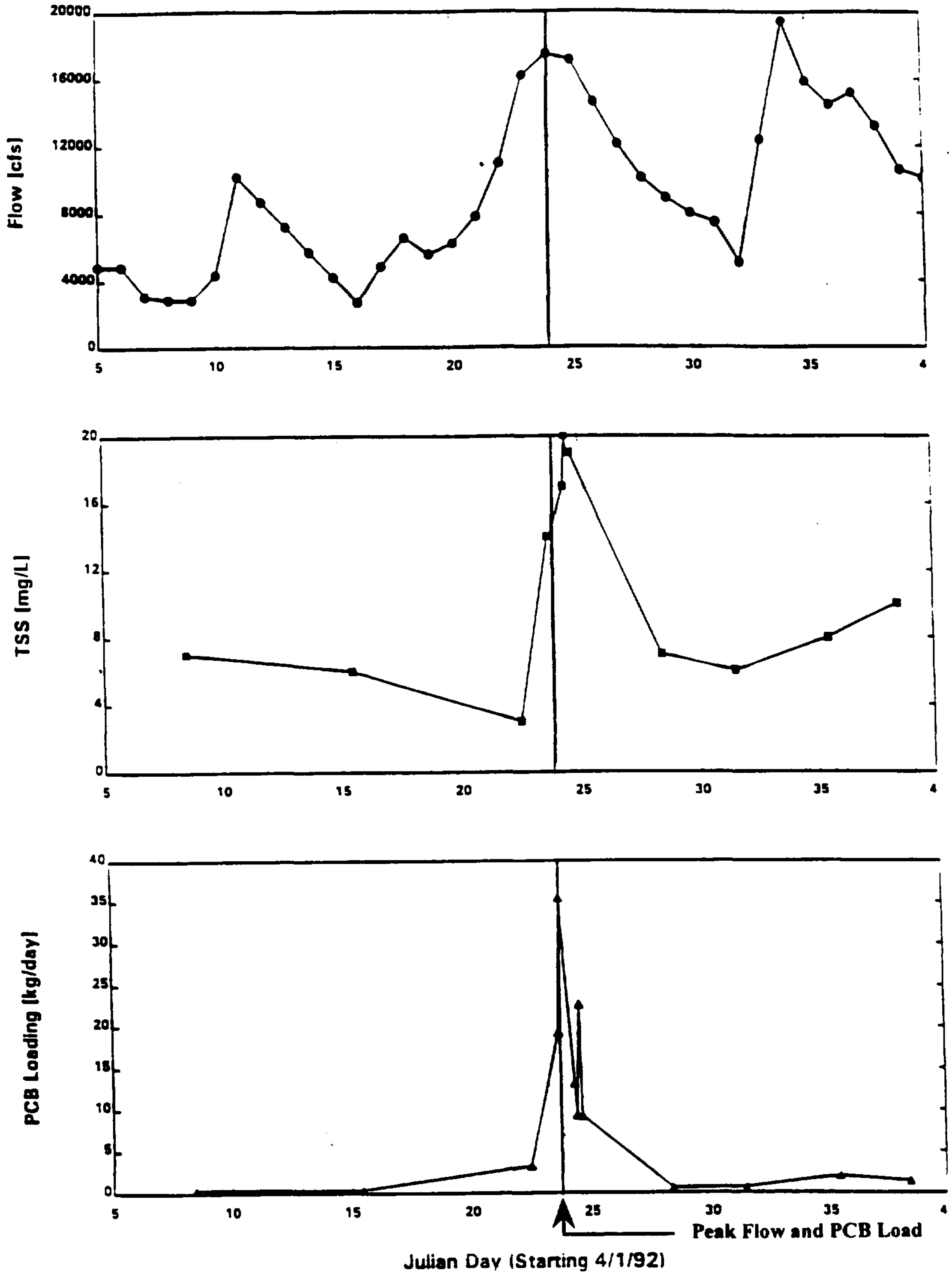
In view of this, it appears likely that the Rogers Island monitoring results will on average accurately represent the loads entering the TI Pool.

Response to DG-1.15B

The writer also contends that the 1993 high flow sampling event missed the peak flow and therefore did not capture the maximum PCB load. This is incorrect. The sampling was conducted on the day of peak flow and not after the peak. The previous day's flow was 17,200 cfs and the subsequent day's flow was 18,100 cfs. Subsequent flows later in the month exceeded the levels seen on 4/12/93 but the 4/12/93 event represented the first high flow event that year. The representativeness of this event was further supported by sampling performed in 1992 and 1997 by GE. In both events, sampling was performed during the rising and falling flow periods of the spring runoff event. During the 1992 event the peak PCB load of 35 kg/day was produced at the maximum flow for the period, representing the first major flow event of the year. The coincidence of the peak flow and peak load are shown in Figure DG-1.15B, a modified version of Figure 26 supplied by GE. During the 1997 sampling, the peak load generated was only 2 lb/day in 1997 *vs* 18 in 1993. Nonetheless the data clearly show the coincidence of the peak flow (ca. 17,000 cfs) and peak PCB load (see Figure DG-1.15C). Subsequent high flows later in the month in 1992 and 1997 did not yield such a substantive PCB load. While this does not constitute proof that the 1993 USEPA sampling event represents the peak load for the year, it does suggest that the sampling event did capture the maximum load carried by the river up to that point in the year and probably for the whole year. Thus it is unlikely that the load underestimates the true PCB loading.

Response to DG-1.15C

The USEPA agrees with the assessment that high flow events are generally associated with high PCB transport events, although the timing of these events seems to affect the amount of PCBs they deliver. Since little or no increase in TSS occurs during these events between the upstream station at Bakers Falls and the downstream station at Rogers Island, it would appear that either highly contaminated sediments (percent levels) or PCB oils are mobilized during these events. Either source would have no effect on the TSS but would greatly increase the PCB load. However, the writer contends that this process would serve to deliver oil droplets undetected by the monitoring station at Rogers Island. As stated previously, the USEPA rejects this contention for the following reasons. First, no evidence has ever been found for their transport past Rogers Island despite GE's efforts to discover them. Second, the region of the river between Bakers Falls and Rogers Island probably represents one of the best areas for the homogenization of PCBs introduced to the river. Specifically, the very large quantity of energy added to the river as turbulence from the 70 foot Bakers Falls plus the large section of rapids at Remnant Deposit 1 and the former Fort Edward Dam

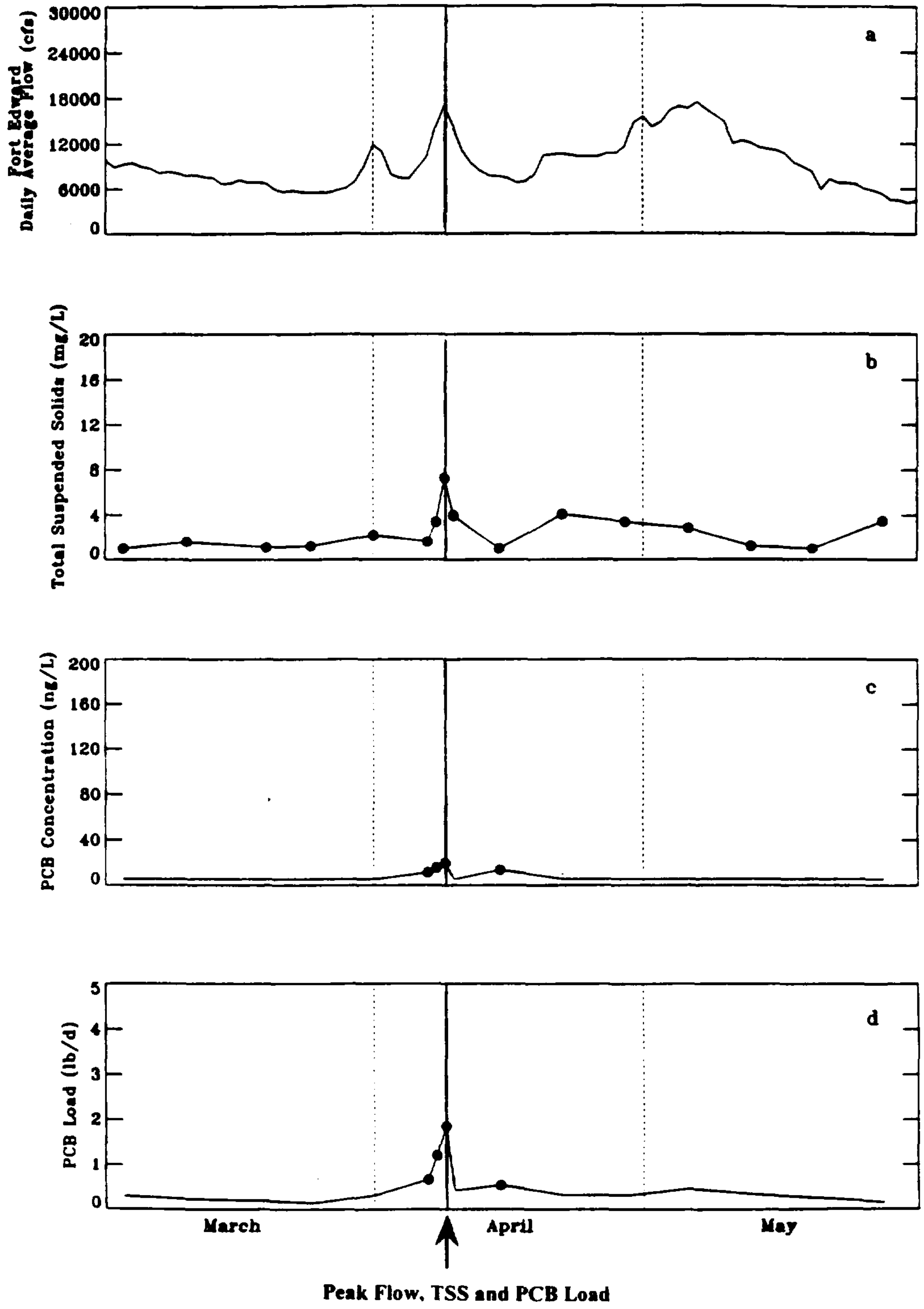


PCB data are corrected for analytical bias

From GE Comments, April 1997

TAMS/LTI/TetraTech/MCA

Figure DG-1.15B
PCB and Solids Transport During 1992 Spring High Flow



Note: Daily averages plotted: Non-detect PCBs plotted as open symbols at one-half MDL.

From QEA, March 1998

TAMS/LTI/TetraTech/MCA

Figure DG-1.15C
Temporal Trends in TSS and PCB Concentration and Loading
During the 1997 Spring High Flow Period

site (now essentially a small falls) plus the two sharp river bends all serve to blend the water column load both horizontally and vertically (see Figure DG-1.15A). This energetic system would be expected to dissolve any oil droplets as well. Thus, as stated above, it is highly unlikely that any significant PCB load passes Rogers Island that is not reflected in the regular monitoring done by GE.

A second issue needs to be raised here as well. During the high transport event monitored by USEPA, there was little evidence for decreases in PCB load downstream of Rogers Island, implying that the vast majority of the PCB load released upstream was translated down to the Lower Hudson, with relatively little storage in the sediments as compared to the amount translated. Other sampling events clearly showed a net gain across the TI Pool. Thus even if an individual large PCB transport event is missed by the monitoring station, its impact on the overall inventory of the TI Pool and other sediments of the Upper Hudson is likely to be relatively small. Rather, the sediment inventory of the Upper Hudson has been built up over many years, with the largest gains occurring during the mid-1970s. Events from 1991 to 1993 undoubtedly added to this inventory. Resuspension, groundwater migration, diffusion and biological activity all serve to rework the contaminated sediments, replenishing the upper sediment layer. As a result, the release of PCBs from the sediments has probably been occurring for many years and will continue to do so for many more to come. There is no evidence in the data collected to date that this source is diminishing.

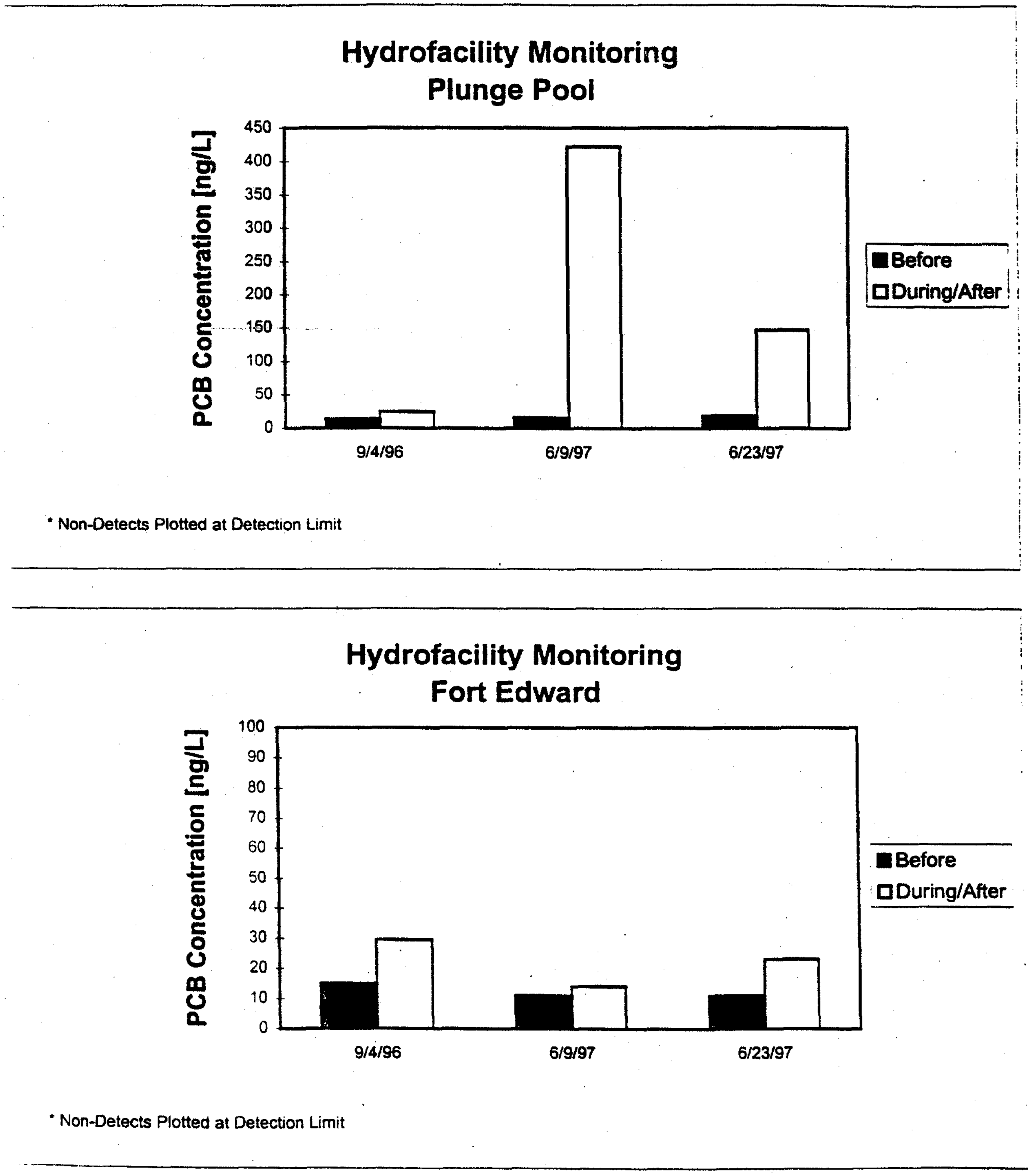
Response to DG-1.15D

The hydro plant flushing activities were studied by GE and reported to USEPA (QEA, March 1998). These studies show small increases in the PCB loads delivered to Rogers Island as a result of these activities. Some results are shown in Figure DG-1.15D. These events serve to create highly concentrations near the plunge pool which are subsequently homogenized by the transit to Rogers Island. Thus, although these events do add to the PCB loads of the Upper Hudson, they do not represent major loads unaccounted for by the Rogers Island monitoring.

Response to DG-1.16

As noted in the corrections to Chapter 3.2, the PCB transport estimates presented in the DEIR will require revision. Based on the knowledge that the flow estimates at Stillwater and Waterford used in the DEIR were probably 15 to 40 percent too high, it is expected that the low flow sampling events completed by the USEPA will not show constant PCB loads from Schuylerville to Waterford. In addition, evidence collected by GE at the TI Dam monitoring station suggest that this station may overestimate loads at low flow, summer time conditions. Rather, the reanalysis using revised flows will likely yield declining PCB load downstream of Schuylerville. This reanalysis will be submitted as an appendix to the responsiveness summary for the Low Resolution Sediment Coring Report. However, it is likely that the analogy of a pipeline to describe PCB transport will no longer be appropriate.

The writer indicates that the DEIR did not consider the effects of various geochemical processes below the TI Dam. In fact, these are mentioned and discussed at length in the report. However, evidence for their occurrence and magnitude is far less obvious in the region below the TI Dam than within the Pool itself. Downstream of the TI Dam loads change gradually under low flow conditions (perhaps 40 percent in light of the revised flow data) while the load gain across the



From QEA, March 1998

TAMS/LTI/TetraTech/M

Figure DG-1.15D
Vater Column PCB Concentrations at Bakers Falls Plunge Pool and
Fort Edward from Hydrofacility Monitoring Program

TI Pool typically increased by 300 to 500 percent. Thus the focus on the TI Pool was not inappropriate in the context of the DEIR. Further analysis in the context of a mass balance model was anticipated prior to the preparation of the DEIR. The mass balance model results will be described in the upcoming Baseline Modeling Report.

The estimates of gas exchange and settling losses described by the writer cannot be examined without the support of a complete report. A report describing part of this work was submitted to USEPA and is critiqued elsewhere in this responsiveness summary.

3.2.7 Source Loading Quantitation

Response to DS-2.10

The data recently collected by the NYS Canal Corporation should provide insight into the scour events that occurred in the area of the Hoosic River confluence. USEPA agrees that Transect 3, like Transect 6, provides clear evidence for PCB contributions from the sediments below the TI Dam. Nonetheless, it is still concluded that the sediments of the TI Pool still represent the major sediment source of PCBs to the water column of the Upper Hudson.

Response to DS-2.11

The TI Pool load of 0.65 kg/day measured during low flow conditions is small relative to the spring runoff event load of 20 kg/day generated above Rogers Island. The ability to measure the TI Pool load is limited by the relative difference. Estimated flux errors were of the scale of 20 to 25 percent, thus precluding resolution of a TI Pool flux of this magnitude. It would also be difficult to resolve the presence of a TI Pool load based on congeners alone as was done for some lower Hudson high resolution core samples in Chapter 3 of the DEIR. Both of the proposed conditions would yield the measured results for the spring high flow transect and thus neither hypothesis can be ruled out at this time. Modeling analysis may clarify this issue to some degree.

Response to DC-4.5

USEPA agrees that there are many challenges in estimating PCB loads, and trends in loads, across the Thompson Island Pool and between Thompson Island Dam and Waterford. Comparisons on the basis of concentration alone must be pursued with considerable caution, due to the presence of short-term variability in concentrations and the fact that few samples, with the exception of the Phase 2 transect samples and a few of the USGS samples, have been timed to attempt to sample the same "parcel" of water at consecutive downstream stations. Although there are shortcomings in terms of sample representativeness relative to flow rate, the best load estimates possible from available data have been produced.

USEPA concurs that load across the Thompson Island Pool is most evident at low flow conditions, and not obvious during high flow conditions. Indeed, during spring high-flow sampling (Transect 4 and Flow-Averaged Event 1), a net loss of total PCBs was estimated across the Thompson Island Pool, although this is believed to be due, at least in part, to a different protocol for sampling and compositing during this sampling. These results are discussed in Section 3.2.6 of the DEIR. Recent GE data suggest that the greatest load gain across the Thompson Island Pool occurs during spring-summer low flow conditions, which is consistent with biologically-mediated mobilization of PCBs from the sediment, but may also reflect temperature effects on PCB partitioning and seasonal changes in pore water movement.

The commentor states, as an example of "a basic weakness in estimating annual loadings", the following characterization of USGS load estimates: "For example in Table 3-23, note that estimated annual PCB loadings at Schuylerville (below TID) are greater than Fort Edward 1977-85, and then abruptly reverse 1986-1993 (1990-93 relative to Waterford)." It should first be pointed out that the change is not necessarily abrupt, as the load estimates at Fort Edward do not show a statistically significant difference from those at Schuylerville for the period 1984–1988. Further, a shift in the relative importance of sources above and below Fort Edward is fully consistent with our understanding of historical PCB transport processes in the Upper Hudson River. During the earlier years, large, unstable deposits of contaminated sediment derived from the former Fort Edward Dam pool were present within the Thompson Island Pool, and can be expected to have contributed a significant, but generally declining load of PCBs to the water column. In contrast, loading above Fort Edward appears to have always contained a component derived from PCB DNAPL flux in the Bakers Falls area, which has remained more constant over time. Thus, a gradual shift in importance from sources below Fort Edward to sources above Fort Edward is expected over time as readily mobilizable contaminated material in the Thompson Island Pool was buried or depleted. (It should also be recalled that the USGS quantitation methods significantly under-represent the mono- and dichlorobiphenyl fractions of total PCB load, and thus do not show much of the dechlorination product flux from the Thompson Island Pool.)

USEPA disagrees with the characterization that "all too often high values have been discarded as anomalous". In fact, only two data points were rejected for the calculation of historical loads: one from GE data, and one from USGS data. The GE observation at Rogers Island on January 19, 1994 was not included due to concerns over sampling protocol and abnormally high TSS concentrations. This sample was flagged by GE as having been collected from shore due to ice cover, and the high TSS concentrations suggest that the sample was contaminated by disturbance of near-shore sediment during sample collection. For the analysis of the USGS data, one anomalous observation was omitted. This sample was taken on December 15, 1983 in the navigation canal (east channel) at Rogers Island, and showed a reported PCB concentration of 77 μg/l, far greater than any other reported water column concentration. On the same date the concentration in the main channel at Rogers Island was only 0.01 μg/l.

Response to DG - 1.4A

The DEIR suggests that a portion of this load may be stored in the sediments of the TI Pool. However, although this is a possibility, nearly all other analyses concerning the TI Pool load examine net gain, effectively assuming that the entire Rogers Island load is passed through the pool at all flow conditions. This provides a minimum estimate of the amount of PCBs produced by the sediments of the TI Pool.

Response to DG-1.4B and DG-1.4C

The report does not ignore these mechanisms at all and in fact notes them directly (see DEIR page 3-60, for example). However, the existence of these mechanisms does not change the nature of the loading in the Upper Hudson, *i.e.*, that most of the Upper Hudson's PCB load is generated above the TI Dam and that this load is similar in size and congener makeup to that delivered to Waterford. Given the larger inventories of PCBs within the TI Pool as compared to those below Schuylerville, it is reasonable to conclude that most of the load delivered to Waterford originated above the TI Dam.

Response to DG-1.4D

The report examines data obtained by the USEPA sampling program as well as that collected by the USGS and GE, representing more than 18 years of data collection. Thus it is not solely focused on the conditions of 1993. However, the detailed sampling and analysis performed during 1993 can be used to increase the understanding of PCB geochemistry throughout the entire data collection period as was done in the report. The conclusions made on the basis of the 1993 studies were compared with the results obtained by other studies so as to confirm their applicability. For example, note that the conclusion concerning the importance of the TI Pool loads was based not only on the Phase 2 results but also on the three years of sampling by GE completed after the Phase 2 water column program.

3.3 Historical Water Column Transport of PCBs

No significant comments were received on Section 3.3.

3.3.1 Establishing Sediment Core Chronologies

Response to DS-2.12

The difficulty in obtaining a datable core from the TI Pool as well as elsewhere in the river indicates that the majority of locations do not yield useful core chronologies. USEPA agrees with the statement that "there are times when either there is no sedimentation, or events that result in the removal of part of the sediment column." The Low Resolution Sediment Coring Report provides further evidence for the transient nature of sediment deposition and removal.

3.3.2 Surface Sediment Characterization

Response to DC-4.1

The water column transect suspended solids total PCB concentrations at Rogers Island (median value 17.3 ppm) is higher than at the TI Dam (median value 5.3 ppm). As shown in DEIR Figure 3-8, the partition coefficients derived for the Rogers Island station vary greatly from the coefficients derived for the other stations. This indicates that the PCBs in the water column are not in equilibrium at this station, which may be a result of the fresh source of PCBs input from above Fort Edward. Thus, a disproportionate amount of PCBs is detected on the suspended fraction as compared to the dissolved fraction in the water column at Rogers Island. This difference may also result from sediment/water exchange during transit through the pool wherein suspended matter originating above Rogers Island may be partially exchanged or removed from the water column.

3.3.3 Water Column Transport of PCBs Shown by Sediment Deposited After 1975

Response to Comment DF-2.4

Further congener-specific load analysis will be completed for five congeners as part of the fate and transport modeling effort. To the extent necessary, other congeners may be examined individually as well. Nonetheless, the level of analysis in the DEIR provides a sufficient basis for the conclusions drawn in the DEIR. Further analysis always has the potential to yield greater insights and the option to continue the analysis of data may be pursued.

The writer is correct in noting the inconsistency on p. 3-122. The intention of the original statement was to note the greater proportion of more chlorinated congeners in the sediments at RM -1.9 relative to RM 177.8, and not an absolute increase in the concentration. In fact, as noted by the writer, sediment concentrations for nearly all congeners are lower at RM -1.9 *vs* RM 177.8. The trend to lower PCB concentrations downstream from RM 177.8 is the premise behind the PCB/^{137}Cs analysis presented in Section 3.3.3 of the report.

Response to DL-1.8

Fingerprinting of congener patterns is discussed extensively in Section 3.3.3 of the DEIR. This analysis compares water column and sediment samples from both the Lower and Upper Hudson River and establishes a strong link between the sediments of the lower river and input from the Upper Hudson. Congener patterns in the fish samples will be examined in the Ecological Risk Assessment. However, as noted in the text, congener fingerprinting is not the only basis available to establish the contribution of PCBs from the Upper Hudson River to the Lower Hudson River and New York/New Jersey harbor. Other evidence is considered as well. The data presented in the DEIR are sufficient to attribute freshwater Hudson River PCB contamination to the Upper Hudson River.

Response to DG-1.17

In this response the writer asserts that the PCB/^{137}Cs analysis presented in the DEIR is invalid for the reasons listed below.

1. The simple dilution model used to estimate the PCB loading with respect to ^{137}Cs fails to account for changes in the suspended solids yield downstream of Ft. Edward.
2. Different deposition rates yield different ^{137}Cs levels in the 0-2 cm layer.
3. The addition of Aroclor 1242 by other external sources is not accounted for by this analysis and the Albany core top is biased toward the Upper River because of the high loads produced by the 1991-1992 events at Allen Mills.

1. The writer cites the work of Phillips and Hanchar (1996) to contend that the suspended solids load greatly increases between Fort Edward and Waterford and therefore the assumption that all tributaries contribute suspended solids in proportion to their drainage areas is invalid. Furthermore, the writer contends that the fact that the simple dilution model could not be applied to the area between the TI Dam and Stillwater is further evidence for its rejection.

The data provided by Phillips and Hanchar actually support the assumption of constant suspended solids yield per unit area of basin as well as demonstrating why the model could not be applied above Stillwater. Table DG-1.17 summarizes the information provided by Phillips and Hanchar. Also shown in the table is the incremental increase in yield between the three USGS suspended solids monitoring stations of the Upper Hudson.

Of particular note are the four yield values shown in bold. The yield of suspended solids for the Upper Hudson increases steadily from 0.044 tons/day/sq.mi. at Fort Edward to 0.097 tons/day/sq.mi. at Waterford. To accomplish this, the tributaries downstream of Fort Edward must yield substantially higher suspended solids loads relative to the region above Fort Edward. This is reflected in the incremental yield column. Note that the incremental yield between Stillwater and Waterford (0.235 tons/day/sq.mi.), principally reflecting the Hoosic River, is much higher than the Upper Hudson. Thus, the model fails to explain the change in the PCB/^{137}Cs ratio to this point in the river, as was noted in the DEIR, because the suspended solids yield is changing so rapidly. However, the suspended solids yield of the Hoosic watershed is essentially equal to that of the Mohawk (0.25 tons/day/sq.mi.), the next major watershed along the Hudson. Thus, the dilution model would be expected to work in this region as in fact it was shown to. PCB concentrations in the Albany core are predicted by those in the Stillwater core because the two intervening rivers introduce suspended solids at essentially the same rate, thus achieving a dilution of the PCB/^{137}Cs ratio between Stillwater and Albany which is proportional to the increase in drainage area.

The introduction of the Hoosic and Mohawk Rivers serves to increase the drainage area from 3773 sq.mi. at Stillwater to 8,090 at Albany, more than doubling the total area and halving the concentration as predicted by the model. This result matches the measured trend quite well as shown in Figures 3-66 to 3-68 of the DEIR Report. From Albany to Kingston the drainage area increases by another 30 percent to 11,300 sq.mi. and the PCB/^{137}Cs ratio decreases according for both the model and the measurements. Unfortunately, there are no suspended solids data to further support the model but its success to Kingston and to Lents Cove would suggest that the suspended solids yields of the Lower Hudson are comparable to those of the Mohawk and Hoosic Rivers. Thus the data provided by Phillips and Hanchar provide the explanation as to why the model does not work above Stillwater relative to the region between Stillwater and Lents Cove.

2. The writer's premise that the 0-2 cm layer does not consistently reflect the same time horizon among the coring locations and therefore the ^{137}Cs levels do not represent the same years of deposition is incorrect. First, nearly all of the cores represented in DEIR Figure 3-63, which displays the ^{137}Cs levels in 0-2 cm slices in the Hudson, were shown to contain ^{7}Be and therefore represented recent deposition, even when the core sequence could not be dated. Secondly, as shown in Figures 3-53 to 3-54, ^{137}Cs levels have not varied substantially during the most recent five years. Thus, as long as the 0-2 cm core slice represented materials deposited sometime over the last five years, the ^{137}Cs levels could be expected to reflect differences in local deposition rates and not differences in ^{137}Cs deposition over time. On this basis, the information presented in Figure 3-63 reflects the consistency of recent ^{137}Cs deposition in the Hudson and shows the assumptions used by the simple dilution model to be appropriate.

3. The addition of any Aroclor to the Hudson River by an external source will be reflected in the PCB/^{137}Cs ratio by an increase in the ratio relative to that predicted by the dilution model. In this regard, it does not matter which Aroclor is added to the mixture. The fact that the model is predictive

Table DG-1.17
Suspended Solids Yields for the Hudson River to Albany [1]

USGS Monitoring Location	River Mile	Suspended Solids Yield (tons/day/sq.mi.)	Drainage Area (sq.mi.)	Incremental Drainage Area (sq.mi.)	Incremental Suspended Solids Yield (tons/day/sq.mi.)	
Ft Ed	194.6	**0.044**	2,817	956	**0.131**	(Ft. Edward to Stillwater)
Stillwater	168.3	0.066	3,773	847	**0.235**	(Stillwater to Waterford)
Waterford	156.5	0.097	4,620			
Mohawk	156.2 [2]	**0.250**	3,456			
Green Island	151.7	0.220	8,090			
Waterford+Mohawk [3]	151.7	0.163	8,076			

Notes:

1. From Phillips and Hanchar, 1996
2. River mile at confluence with Hudson
3. Area-weighted average yield of the two watersheds

over a 17-year period indicates how long the GE releases have dominated the Hudson's PCB contamination problem.

In considering the congener patterns of the sediments, it is true that a mixture identical to that of GE's input will not be discernable. However, in order to reflect the congener patterns identified in the sediments, PCBs from other sources would need to contain the exact proportions of 1242, 1016 and 1254 seen in the GE releases, an unlikely occurrence. As further evidence of the absence of significant external inputs downstream of Stillwater, Figure DG-1.17 shows the decline in four congener ratios in high resolution core tops (*i.e.*, recently deposited sediment) as a function of river mile. In each instance the ratio declines steadily, without any indication of additional input, which would increase the ratio back to conditions seen at River Mile 195. These ratios serve to track the absence of a GE-like input which might not be discerned using the overall congener pattern analysis presented in the DEIR. In this manner, the combination of the PCB/^{137}Cs ratio, the congener pattern analysis, and the H, H' congener ratios all serve to identify the region above the TI Dam as the principal source of PCBs to the freshwater Hudson.

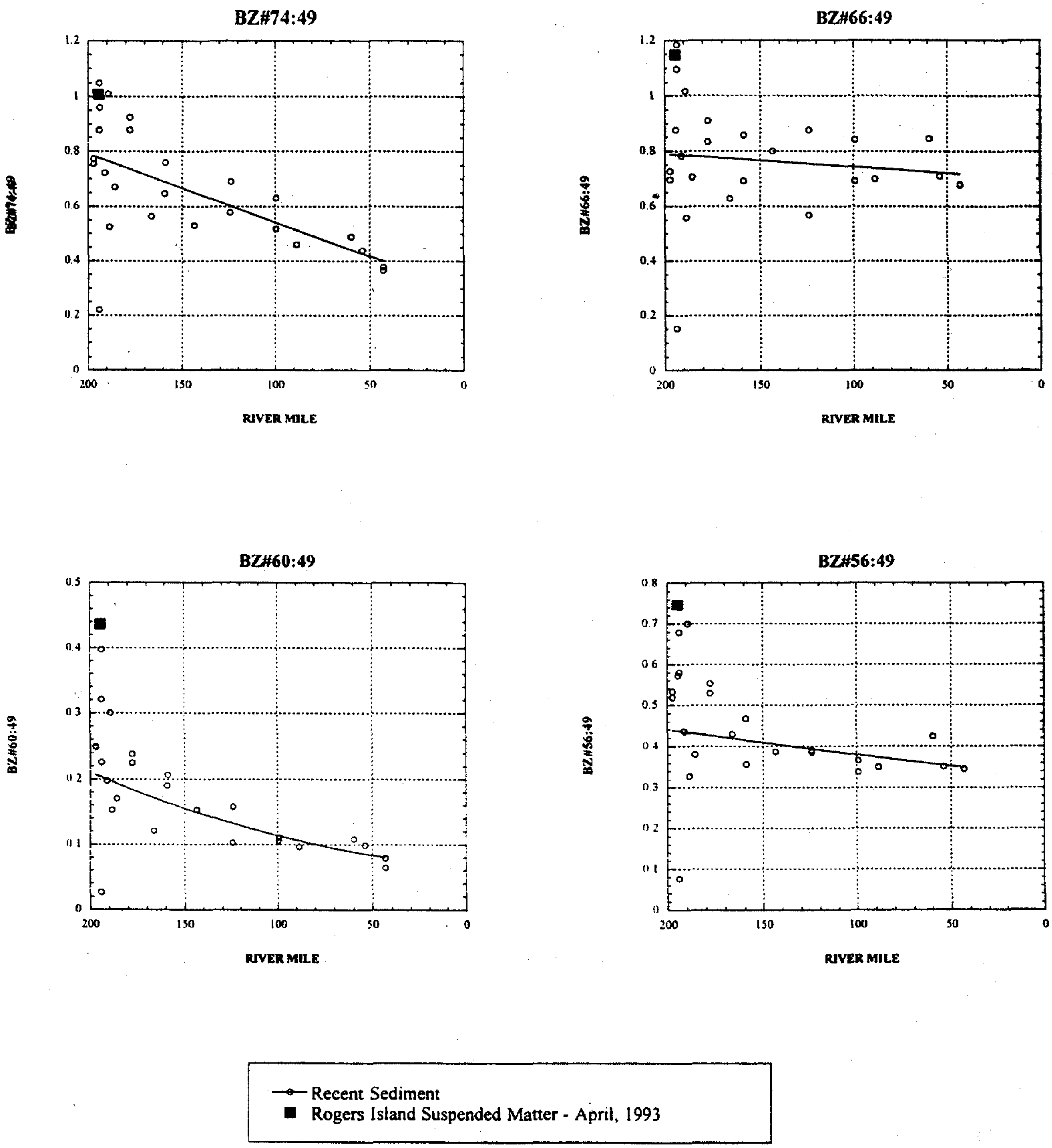
The concern that the core top comparison is biased because of the large GE-related release events of the 1991-1992 period is unfounded. The fact that additional PCBs are transported downstream from the Upper Hudson simply adds to the PCB inventory at each coring site. The cores simply integrate the total loadings. If the Upper Hudson PCB load was greater during 1991-1992, then this load constituted an even greater proportion of the total sediment concentration as would be expected.

Response to DG-1.22

The writer contends that the H, H' dechlorination process occurs extensively throughout the Hudson and that this represents a significant reduction in the PCB exposure, toxicity and carcinogenicity.

The issues of toxicity and carcinogenicity are left for subsequent discussion in the upcoming Human Health and Ecological Risk Assessment Reports. However, it should be noted that it is not clear that the dechlorination processes render the congeners less toxic. As to exposure, the result of dechlorination is less clear. Although the tendency for bioaccumulation decreases as a molecule is dechlorinated, the mobility of the congener tends to increase since the sediment-water partition coefficient also decreases as the molecule is dechlorinated.

Finally, although the H, H' patterns may be common in the Lower Hudson, their occurrence does not indicate that substantive dechlorination of the PCB contamination will be found there. Therefore, in the context of examining the dechlorination as a potential means to ameliorate the PCB contamination of the Hudson, it is misleading to focus on the few congeners which may be affected when the vast majority of the congeners in the Lower Hudson are unaltered by this process.



Note:
Trend lines are for visual reference only.

Figure DG-1.17
Trend of Various H, H' Markers in Recent Sediments (0-2 cm) as a Function of River Mile

3.3.4 Estimation of the PCB Load and Concentration across the Thompson Island Pool based on GE Capillary Column Data

Response to DG-1.12

As discussed above, the analysis of congener patterns developed by the writer is not based on defensible assumptions and as such cannot be used to develop a fingerprint for the "missing" source. Given the range of possible release mechanisms and the uncertainties in their possible impact on the water column load, it is not possible to definitively describe the PCB sources from the TI Pool. Undoubtedly, the TI Pool load is generated by a blend of older, relatively unaltered PCBs, older, highly altered PCBs, and recently released, unaltered PCBs.

Response to DG-1.14

The analysis presented in the comment is used to suggest that the load differential between Rogers Island and the TI Dam (*i.e.*, the TI Pool load) has greatly increased as a result of the 1991 Allen Mills event. The writer ascribes an increase in the TI Pool load from 1 to 2 lb/day as the result of temporary storage of PCBs in the TI Pool sediments stemming from the Allen Mills event as well as recently discovered PCB oil seeps. This storage of PCB oils is part of the writer's assertion of undocumented oil droplets transferring PCBs to the TI Pool while undetected at the Rogers Island monitoring station, a theory rejected by USEPA (see response to DG-1.3 and DG-1.10). This analysis cites the USGS data as a further basis for defining this differential load gain.

This analysis suffers from several flaws. First, as discussed extensively in Section 3.3.5 of the DEIR, the USGS PCB data does not reflect the lightest congeners in the water column due the nature of the measurement scheme used. These congeners represent a large portion of the water column load generated from the TI Pool; thus, the USGS data cannot be used to accurately characterize the entire flux, as noted in the DEIR. Most likely, the USGS data can be used to reflect the transport of trichlorinated and higher molecular weight congeners (Tri+) although its application here is still limited due to detection limit and sample timing issues. Conversely, the GE data reflect the total PCB load gain although the data presented with these comments are not accurate and were subsequently revised and resubmitted by GE. The revised data, typically yielding higher PCB concentrations at the TI Dam than those used for the estimates shown by the writer, reflect a large increase in the water column load as the result of passage through the TI Pool during the period 1991 to 1998, based on the most current GE data submittals. (The USEPA does acknowledge that the TI Dam monitoring station used for both GE and USEPA sampling programs may overestimate the actual load gain across the TI Pool under some conditions, based on recent work performed by GE. Nonetheless, the degree of uncertainty in these estimates does not diminsh the importance of the TI Pool as a source to the water column.)

On this basis, it is inappropriate to compare the estimated gains of the tri+ congeners based on the USGS data with those of the entire PCB spectrum reflected in the GE data. The result of this exclusion is that the writer's presentation now has but a single data point prior to the Allen Mills event. This point, suggesting a TI Pool loading of 1 lb/day is less than that seen in some, but not all, of the subsequent years of monitoring. This suggests that the annual loads from the TI Pool have an intrinsic variability of about ±1 lb/day. Thus it is unclear whether 1991 represented a truly different condition relative to later years. While the USEPA does not dispute that the 1991 Allen Mills event added to the existing sediment inventory, it is not clear that this additional contamination had a major impact on the rate of sediment loading to the water column. It is not inconceivable that similar load gains of about 2 lb/day were seen throughout the 10-year period prior to 1991. Thus, the additional 1 lb/day load gains seen in the 1992 to 1996 period cannot directly ascribed to the Allen Mills failure. The contention that the 1995 to 1996 rise in the TI Pool load is ascribed to additional, undetected loads from upstream of Rogers Island is rejected by USEPA as well since it is again ascribed to an undemonstrated phenomenon (undetected oil droplets) and because it is not clear that the TI Pool load changed as a result of the Allen Mills event and subsequent leakages.

3.3.5 Estimated Historical Water Column Loadings Based on USGS Measurements

No significant comments were received on Section 3.3.5.

3.3.6 Conclusions Concerning Historical Water Column Transport

No significant comments were received on Section 3.3.6.

3.4 Integration of Water Column Monitoring Results

3.4.1 Monitoring Techniques and PCB Equilibrium

Response to DS-2.13

The USEPA data alone are not sufficient to rule out the possibility of occasional PCB oil droplet transport. However, when the more-than-seven years of biweekly GE monitoring data and the unsuccessful attempts by GE to measure an oil droplet flux are considered, it appears very unlikely that PCB oil transport represents a substantive portion of the Rogers Island load. It is our opinion that during the transit of water from Bakers Falls to Rogers Island, there is sufficient turbulence (due to the falls itself as well as the rapids area near the former dam site) to disperse any oil droplets into a relatively homogeneous water column concentration which is subsequently monitored at Rogers Island. The only possible exception to this scenario may have occurred during the failure of the Allen Mills structure when much greater quantities of PCB oils and contaminated sediments were released.

3.4.2 Loadings Upstream of the Thompson Island Pool

Response to DC-1.4

Fresh sources of PCB contamination were extensively examined in the DEIR by using General Electric's water column monitoring data collected at Rogers Island from 1990 through 1996. These data provided a means of quantitating the load and fingerprinting the contaminant as unaltered PCBs from above Rogers Island. Since the inception of the Phase 2 water column program, data collected by the USEPA and GE have documented the significant decline in fresh loadings to the Hudson originating above Rogers Island. This has left the sediments of the Upper Hudson, particularly those of the TI Pool, as the major PCB source.

3.4.3 Loading from the Thompson Island Pool During 1993

Response to Comment DF-2.5

The writer is correct in noting that extensive weathering of the congener pattern seen at RM 177.8 would serve to yield an underestimate of Upper Hudson PCB load to NYC harbor. However, the degree of weathering is difficult to assess independent of the other processes affecting PCBs and so the degree of underestimation is difficult to determine. The possibility that the PCB contribution from the Upper Hudson could exceed 50 percent of the total PCB load to the harbor is considered to be well within the uncertainty of the estimate contained in the report.

Response to DS-2.14

The fate of recent PCB releases from the GE facilities is expected to be the same as the historical releases from the facilities, *i.e.*, processes such as sediment-to-water partitioning, gas exchange, dechlorination, biological uptake, deposition and scour will slowly disperse the recently released PCBs throughout the Hudson. The more difficult question is "What is the average residence time for PCBs in the biogeochemically active portion of the sediments and how long will it take before the PCBs in these sediments are purged from the sediments or deposited in areas of long term burial?" The issues pertaining to the resolution of this question continue to be examined as part of the Phase 2 modeling effort.

Response to DL-1.1

The contention, also claimed by GE, that a portion of the TI Pool load originates with undetected oil droplets is unfounded. Despite GE's many attempts to find such droplets, none have been detected. In fact, some of their most recent results from a sampling cross section of the river just above Roger Island (QEA, 1998) shows the water column PCB concentration to be relatively homogeneous, suggesting the absence of oil droplets. (Presumably, oil droplets near the bottom would cause the deeper samples to yield markedly higher PCB levels.) Even if such droplets were to exist, it is unclear how long it would take for these PCBs to leave the sediments and re-enter the water column. Nearly all the PCBs present in the bottom sediments were once released as oil droplets in GE's discharges. Much of the sediment burden, though clearly not all of it (USEPA, 1998) is still in place, some at depth, most within 9 inches of the surface. As discussed in USEPA, 1998, the sediments of the TI Pool are clearly not static, lake-like deposits but rather a dynamic environment subject to resuspension and burial as well as diffusive and biological processes. Thus, the simple addition of more PCBs during the period from September 1991 to 1996 serves to worsen the pre-existing problem but certainly does not define it. The strongest evidence for this fact comes from the GE data, which demonstrates a measurable TI Pool input prior to the September 1991 event as well as the consistency of the size of the TI Pool load each year from 1993 to the present despite the major reductions in the loads from upstream of the Pool. Lastly, the congener patterns of the TI Pool load are consistent with a sediment-derived source which has been subject to a moderate degree of dechlorination and not a fresh Aroclor mixture as might be derived from oil droplets. Thus the need for this conclusion, *i.e.*, that the sediments, and not any other phenomenon, are responsible for the TI Pool load.

3.4.4 Loading at the Thompson Island Dam - 1991 to 1996

Response to DS-2.15

Acknowledged. "The CSO was repaired in May 1993; water from the CSO still flowing through the Allen Mill and discharging out the Tailrace tunnel until it was fixed"; this helps explain the observed extensive PCB loadings which continued until June, 1993.

Response to DS-2.16

USEPA believes that the loads produced from the GE facilities from Sepember 1991 to June 1994 impacted the sediment-related PCB loads originating within the TI Pool. The data set collected by GE prior to the Allen Mills failure represents only a few months of sample collection and is not a sufficient basis on which to assess the change in the TI Pool sediment load to the water column. The fact that sediment-related loads are still in evidence in 1998 and have not yet appeared to have changed over time (GE post construction monitoring, 1998), despite the substantial reduction in loads originating above Rogers Island, suggests that the TI Pool load has existed prior to September 1991 and will continue to exist for some time.

Response to DS-2.17

Yes (*i.e.*, the TIP sediments, both those contaminated years ago combined with those recently contaminated, are the primary source of PCBs to the river), with a lesser fraction of additional PCB load from sediments downstream of the TI Dam.

Response to DS-2.18

This issue has been addressed in Section 3.4.4 and in Figure 3-106. In particular, this figure shows that the PCB loads in the Upper Hudson were originally dominated by sediment-related releases prior to 1991. Subsequently, the PCB releases from the Allen Mills dominated the Upper Hudson and the total PCB loading to the water column increased five-fold. Nonetheless, sediment-related releases were still in evidence. In the period June 1993 to June 1994, the sediments again became the dominant source to the water column, perhaps at twice the loading rate seen in 1991. At the same time the overall loading rate declined to one third of that observed for Sept. 1991 to May 1993. In later years, the sediment-related loads and the overall loading rate appear to have returned to the levels seen in 1991. Data collected subsequently by GE shows that further reduction in the load from the GE facilities has further declined while that from the TI Pool has remained relatively constant. The change in these loads will be examined in detail as part of the "hindcasting" analysis to be completed during the modeling analysis.

3.4.5 PCB Loadings to Waterford

Response to DL-1.2

The original presentation in the DEIR indicated that PCB loads at the TI Dam were essentially equal to those at Waterford under many different conditions, despite the 30 miles of river separating the two monitoring stations. As discussed in the corrections to Section 3.2, the USEPA is currently revising its assessment of PCB loads in the Upper Hudson. This analysis is expected to show a substantial decline in the loads at Waterford and Stillwater relative to those at the TI Dam under low flow cionditions based on revisions to the water flow rates at the time of sampling. The analysis is also expected to show that the sediments between the TI Dam and Schuylerville may also contribute to the water column load as was noted in the DEIR. Nonetheless, the analysis presented in the DEIR did not indicate that the sediments below the TI Dam were subject to a different set of processes than those of the TI Pool, as purported by the writer. Rather the text states that the PCB losses and gains between the TI Dam and Waterford must balance each other such that the total loads delivered to Waterford were the same as those generated from the Pool. The anticipated results from the re-analysis of the Phase 2 transect data will not change the finding that the TI Pool is the dominant source of PCBs to the freshwater Hudson under low flow. In fact, since PCB loads will be shown to decrease below Schuylerville, the results will indicate an even smaller contribution from the river sediments between Schuylerville and Waterford to the water column load at Waterford. While it may be interesting to speculate why the region below Schuylerville contributes little to the water column load (for example, 20 of the 40 hot spots are found in the TI Pool and 35 of the 40 hot spots are located upstream of Schuylerville), the data show no significant increase in PCB load to the water column from sediments below Schylerville.

3.4.6 PCB Loadings to the Lower Hudson

No significant comments were received on Section 3.4.6.

3.5 Integration of PCB Loadings to Lower Hudson River and New York/New Jersey Harbor

No significant comments were received on Section 3.5.

3.5.1 Review of Lower Hudson PCB Mathematical Model

3.5.2 Estimate of 1993 PCB Loading from the Upper Hudson River

3.5.3 Revised PCB Loading Estimates

No significant comments were received on Sections 3.5.1 through 3.5.3.

3.6 Water Column Conclusion Summary

Response to DS-2.19

It is highly unlikely that either PCB type (*i.e.*, old or recently-contaminated sediments) is solely responsible for the water column load generated by the sediments. Most likely, the PCB load is a combination of both recently deposited and older PCBs. Further resolution of this issue will be completed during the modeling analysis.

Response to DS-2.20

The importance of PCB loads from the sediments below the TI Dam will be further examined during the modeling effort. As noted in the corrections to Section 3.2, total loads downstream of

Schuylerville are expected to be markedly lower relative to the original DEIR estimates. See the corrections to Section 3.2 for more detail.

Chapter 4 - Inventory And Fate of PCBs in The Sediment of The Hudson River

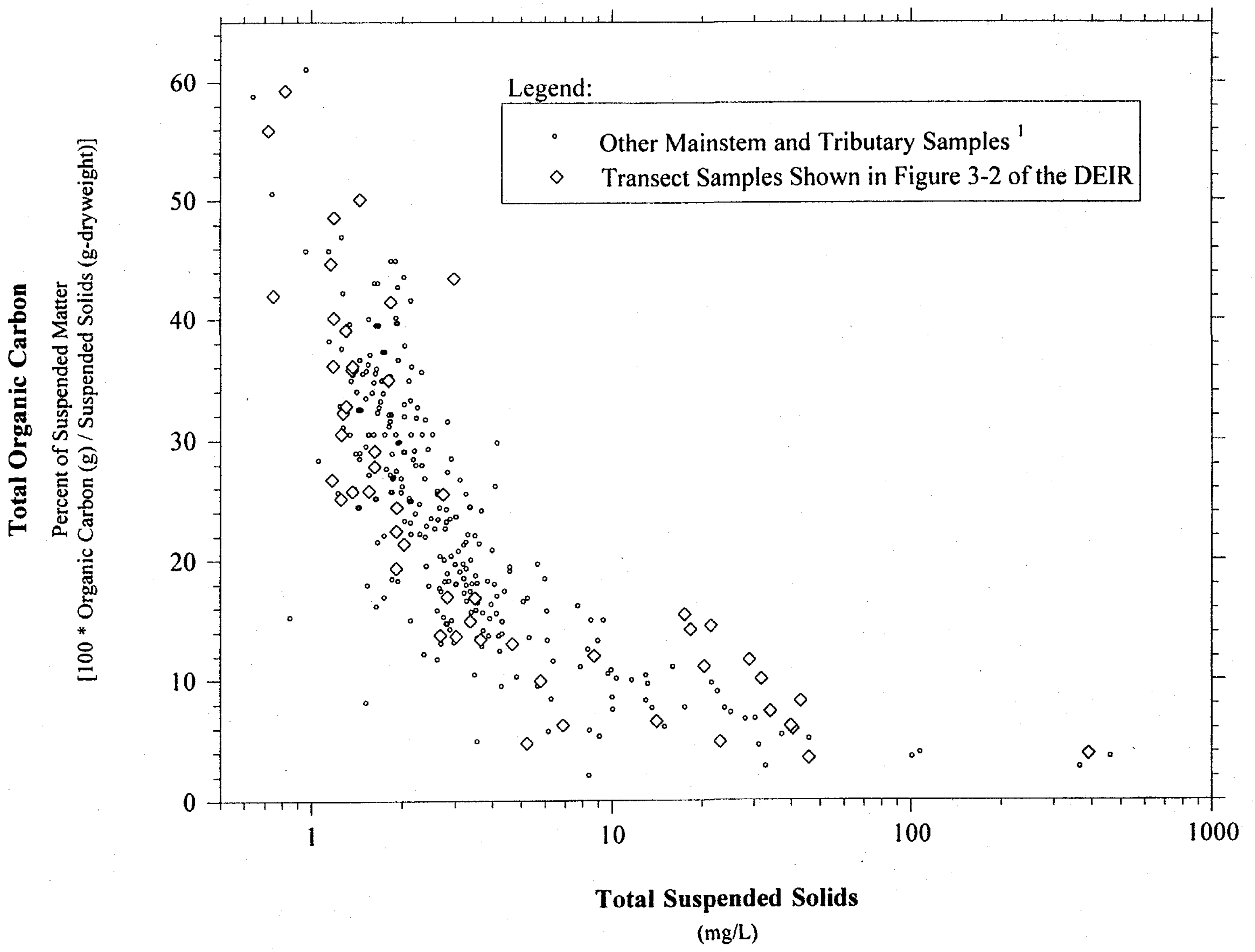
Response to DF-2.6

Although the text does not discuss the analyses, the physical data collected as a part of the sediment coring efforts were examined in detail. Little correlation among PCB mass, sediment texture, and other physical parameters was found. This is believed to stem from the fact that the high resolution cores themselves showed relatively little variation in their physical properties, both vertically within a core as well as among cores. The lack of variability is attributed to the careful coring site selection process, which focused on finding depositional environments consisting exclusively of fine sands and silts where little evidence of episodic sediment emplacement could be seen. As a result, the high resolution cores are physically very similar and thus the correlations between the PCB inventory and the physical sediment parameters was relatively weak. As was demonstrated in the Low Resolution Sediment Coring Report (USEPA, 1998), when samples are collected from a range of environments, yielding a range of physical properties, correlations among PCBs and other sample characteristics can be seen.

The POC values developed for the water column samples were in the range of 0.3 to 3.4 mg-organic carbon/L, excluding the high flow conditions occurring around Transect 3. As to the correctness of this data, a graph of total organic carbon (TOC) *vs* total suspended solids (TSS) is provided in this response summary. TOC represents the fraction of organic matter in the suspended matter. TOC is calculated from the weight-loss-on-ignition (WLOI) results for the suspended matter and the relationship between TOC and WLOI developed for the high resolution sediment cores, as described in the DEIR. The fraction of organic matter would be expected to vary inversely with suspended solids in this system, since higher suspended solids loads are associated with high flows and subsequently little *in situ* production of organic carbon. Conversely, at the low flow conditions typical of summer, TOC would be expected to be high relative to TSS due to *in situ* organic carbon production via photosynthesis coupled with little resuspension or erosion.

Figure DF-2.6 shows the relationship between TOC and TSS, supporting this general relationship and indicating the validity of the data. This figure represents both transect and flow-averaged samples for all mainstem Hudson stations as well as the tributary data collected. The high TOC values are generally attributed to water column photosynthesis, which will yield substantially higher TOC fractions as compared to high flow conditions or the sediments of the river itself. The high flow/high TSS results are more commensurate with the TOC levels found in the high resolution core sediments (0.3 - 12% TOC) as would be expected from scour of river sediment as well as erosion of soils, both of which will contribute suspended matter with this level of TOC. The high TOC levels seen in low flow conditions would not be expected in the sediments of the river since biological reworking of suspended matter and surficial sediment efficiently extracts much of the TOC from the particles. It should be noted that the calculated POC values discussed in the report and shown on Figure 3-2 are simply the product of the TSS and TOC results for each of the mainstem transect samples.

The writer is referred to the Low Resolution Sediment Coring Report (USEPA, 1998) for further information concerning the relationships among PCBs and the physical parameters.



Note: 1. Includes all flow-averaged samples as well as transect tributary samples.

TAMS/LTI/TetraTech/MCA

Figure DF-2.6
Relationship Between Total Suspended Solids and Total Organic Carbon
For 1993 Phase 2 Transect and Flow-Averaged Samples

4.1 Characterization of Upper Hudson Sediments by Acoustic Techniques

4.1.1 Geophysical Data Collection and Interpretation Techniques

4.1.2 Correlation of Sonar Image Data and Sediment Characteristics

4.1.3 Delineation of PCB-Bearing and Erodible Sediments

4.2 Geostatistical Analysis of PCB Mass in the Thompson Island Pool, 1984

4.2.1 Data Preparation for PCB Mass Estimation

4.2.2 Geostatistical Techniques for PCB Mass Estimation

4.2.3 Polygonal Declustering Estimate of Total PCB Mass

4.2.4 Geostatistical Analysis of Total PCB Mass

4.2.5 Kriging Total PCB Mass

4.2.6 Kriged Total Mass Estimate

4.2.7 Surface Sediment PCB Concentrations

4.2.8 Summary

No significant comments were received on Sections 4.1 through 4.2.8.

4.3 PCB Fate in Sediments of the Hudson River

Response to DG-1.18

The writer's concerns focus on the effects of anaerobic dechlorination on PCB toxicity and bioaccumulation. Issues concerning PCB toxicity will be covered in the Ecological and Human Health Risk Assessments. The USEPA will consider comments related to these issues at the time of their preparation. The issue of bioaccumulation will examined at that time as well. However, two considerations can be discussed here in this context. First, while dechlorination does reduce the tendency for bioaccumulation by converting heavier molecules to lighter ones, typically with lower octanol-water partition coefficients (K_{ow}), it has a second, related effect. In decreasing the partition coefficient, the process also increases the tendency of the PCB molecule to dissolve in the porewater and subsequently migrate, thus increasing the probability for biological exposure. In this manner, greater exposure occurs to congeners of lower molecular weight. This result may or may not be offset by the decrease in the tendency for bioaccumulation.

The second and more important issue concerns the lack of extensive dechlorination in most sediments of the Hudson. Most sediments have not seen extensive dechlorination simply because they lack the concentrations sufficient to support extensive dechlorination (hence the relationship between the MDPR or ΔMW and PCB concentration). Because extensive dechlorination of PCBs in the Hudson River is largely limited to the TI Pool and the areas immediately downstream, the impact of dechlorination on bioaccumulation and toxicity is not as important as the writer contends.

<u>Response to DG-1.19</u>

The writer contends that the measures used to identify and quantify the dechlorination process are insensitive and inappropriate to characterize the conditions in the Hudson River. In particular the writer focuses on the extraction of a pure PCB oil as a possible means to enhance the concentration of the congeners included in the molar dechlorination product ratio (MDPR). Also the writer contends that by focusing on the final or near final end products, the MDPR does not reflect the intermediate steps. Also the measure does not account for the final transformation from BZ#8 to BZ#1.

There are any number of possible ways to reflect the degree of dechlorination in a sample. The DEIR presents two, the MDPR and the change in molecular weight with respect to Aroclor 1242 (ΔMW). GE has offered several additional suggestions in its comments, *e.g.*, the ratios of 56:49, 60:49, 66:49, 74:49 and the number of chlorines per biphenyl. Since the dechlorination process is the process of cleaving chlorines from a mixture, it is then appropriate to examine the average number of chlorine atoms per molecule as a measure of the dechlorination. As it turns out, the term ΔMW is algebraically linked to the number of chlorines per biphenyl (Cl/BP) as shown below. Thus the two measures are equivalent and directly reflect the chlorine content of the congener mixture.

ΔMW is defined as:

$$\Delta MW = \frac{MW_{A1242} - MW_{sample}}{MW_{A1242}}$$

Solving for the molecular weight of the sample:

$$MW_{sample} = (1 - \Delta MW) MW_{A1242}$$

Number of chlorine atoms per biphenyl (Cl/BP) is defined as:

$$\frac{No\ of\ Cl\ atoms}{Biphenyl} = \frac{\dfrac{Mass\ Cl}{molecule}}{Atomic\ Weight_{Cl}}$$

where the mass of chlorine per biphenyl molecule is given as:

$$\frac{Mass\ Cl}{molecule} = MW_{sample} - \left(MW_{Biphenyl} - \frac{Cl}{BP} * Atomic\ Weight_{H} \right)$$

Substituting:

$$\frac{Cl}{BP} = \frac{MW_{sample} - MW_{BP} + \dfrac{Cl}{BP}}{Atomic\ Weight_{Cl}}$$

Substituting for the molecular weight of the sample:

$$\frac{Cl}{BP} = \frac{(1-\Delta MW)MW_{A1242} - MW_{BP} + \frac{Cl}{BP}}{Atomic\ Weight_{Cl}}$$

Solving for $\frac{Cl}{BP}$

$$= \frac{(1-\Delta MW)(265.7) - 154}{35.45}\left(\frac{35.45}{35.45-1}\right)$$

Yields a simple algebraic relationship between Cl/BP and ΔMW:

$$\frac{Cl}{BP} = 3.24 - 7.70\ \Delta MW$$

where:

MW_{A1242} = molecular weight of Aroclor 1242 (265.7 g/mole) based on the Phase 2 analysis
MW_{sample} = molecular weight of sample
Atomic $Weight_{Cl}$ = atomic weight of chlorine (35.5 g/mole)
Atomic $Weight_{H}$ = atomic weight of hydrogen (1 g/mole)

The MDPR is simply the proportion of congeners which have been converted to final dechlorination products in a given congener mixture. As it turns out, the MDPR correlates very strongly with ΔMW as shown in Figure 4-21 of the report. This is no coincidence, since in order for the two parameters to correlate, the change in ΔMW must be accomplished by the conversion to the final dechlorination products. This does not mean that every molecule converted must go to completion immediately once it begins to dechlorinate but rather that the amount of conversion to the final products is simply proportional to the overall degree of dechlorination of the entire suite of molecules. Ultimately it is the conversion of the molecules to lighter congeners that is the focus of the dechlorination process. That some minor components rapidly convert relative to the vast bulk of the sediment PCBs is of only marginal interest and certainly does not substantively modify the nature of the mixture.

GE proposes several ratios as other measures of various processes occurring in the sediments. The ratios given above (*i.e.*, 56:49, 60:49, 66:49, and 74:49) are said to be related to H, H' dechlorination as defined by GE. These ratios can be compared to the Cl/BP ratio as is shown in Figure DG-1.19A. These ratios are plotted using a linear scale as opposed to the log scale used by GE to better clarify the degree of variability; also, all data are shown. (The GE representation shows only the mean and two standard errors on the mean.) While each ratio declines with decreasing Cl/BP, they are clearly not linear relationships as reflected by the poor R^2 values. Even if the data are fit with a logarithmic curve, the R^2 improves only marginally. These curves can be compared with the relationship between MDPR and Cl/BP shown in Figure DG-1.19B. In this instance, the R^2 is markedly better at 0.94 (the same as that for ΔMW as would be expected). Thus the MDPR is a very strong predictor of the degree of dechlorination as reflected in the number of chlorines per

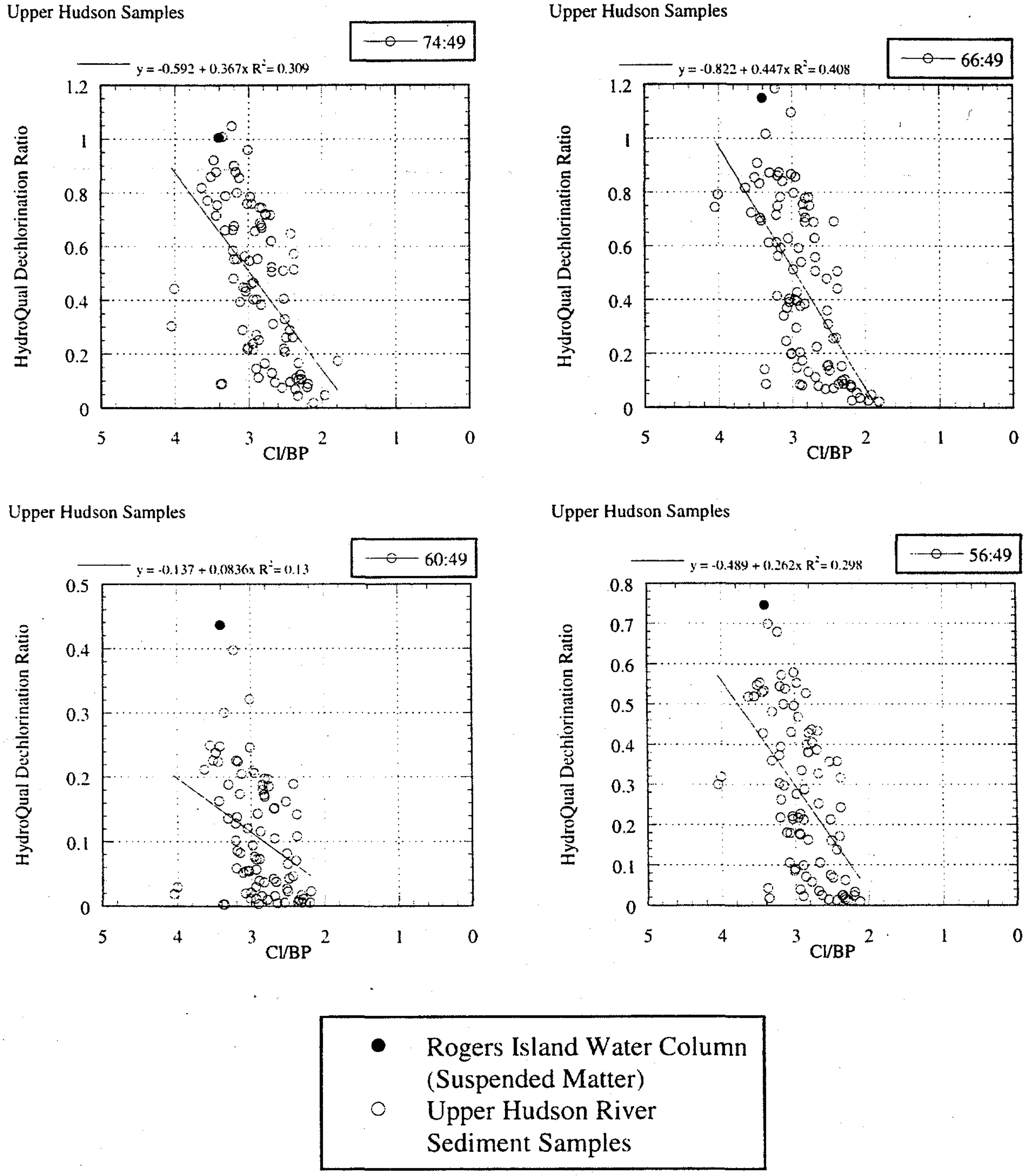
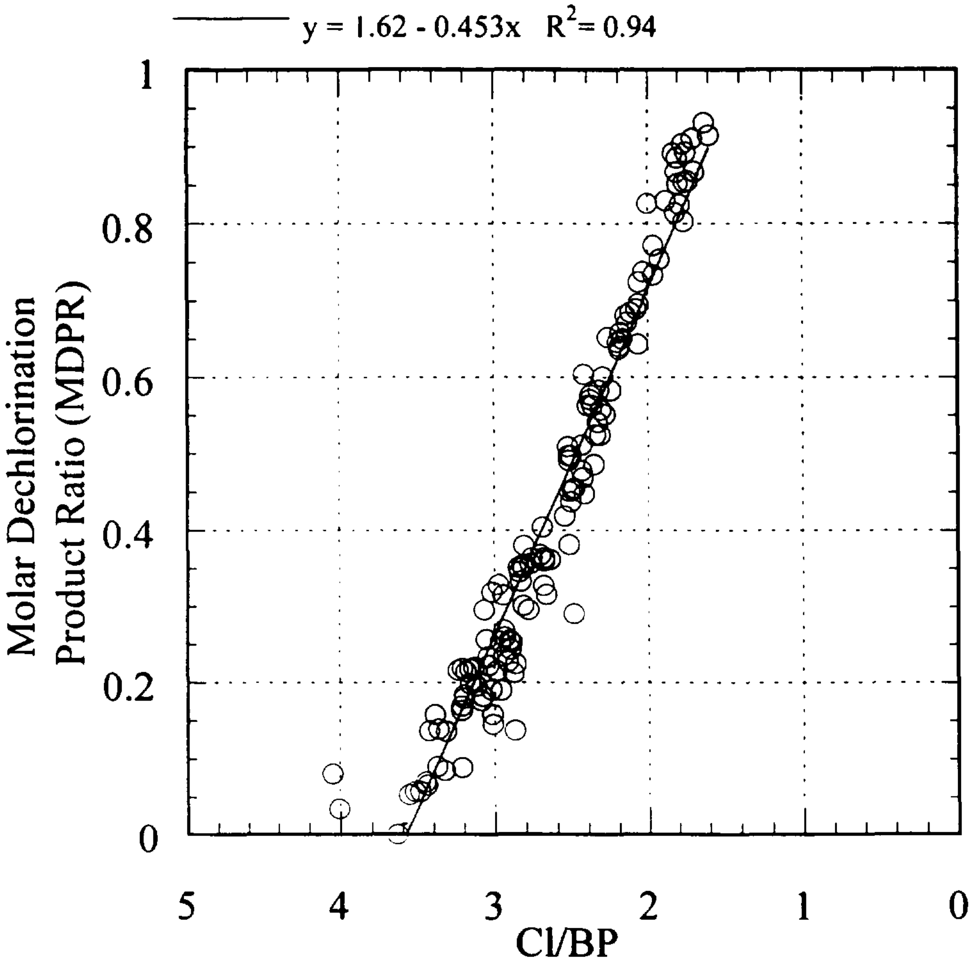


Figure DG-1.19A
The Number of Chlorines per Biphenyl vs. the GE/HydroQual Dechlorination Ratios for the High Resolution Core Data



Note:
Data from Phase II Upper Hudson samples shown.

10.0138

Figure DG-1.19B

The Relationship Between the Number of Chlorines per Biphenyl
and the Molar Dechlorination Product Ratio for the High Resolution Core Data

biphenyl and is far better than the individual congener ratios given above. While there may be better ratios to be discovered within the data, the MDPR is certainly a useful measure of the degree of dechlorination seen by a mixture.

In particular, for the sediments of the high resolution cores, where isolation from active exchange with the water column is likely, the MDPR presents an excellent measure of dechlorination on what is effectively a closed system. As to the enhancement of ratios by extraction of PCB oils, the USEPA does not accept the premise that extensive amounts of PCB oils pass the Rogers Island monitoring station. Rather, by the time PCBs released from the Hudson Falls area reach Rogers Island they have been largely homogenized in the water column (see response to DG-1.15) and thus there is no issue of relative extraction. The whole of any PCB oils have been incorporated in the dissolved and suspended matter phases of the water column. Thus the effect of any oil extraction process on the MDPR is moot. As further proof of this, note how the Rogers Island water column stations fall along the MDPR/ΔMW relationship, quite close to the point representing Aroclor 1242 (see Figure 4-29 of the DEIR). Thus, in the only environment where PCB oils have been shown to exist, the water column mixture has already incorporated the entire congener mixture present in the oil. If preferential extraction were occurring, the mixture would have a higher MDPR. Clearly the values at Rogers Island tend to fall to lower, not higher values of MDPR relative to Aroclor 1242, perhaps indicative of small amounts of Aroclor 1254 or 1260 in the congener mixture entering the river. No preferential dissolution of the mixtures entering the river at Hudson Falls is evident. Based on these observations, it is clear that the measures used by the USEPA in the DEIR are appropriate and accurate reflectors of dechlorination.

Response to DG-1.21

The writer contends that dechlorination is still occurring in Hudson sediments. Specifically, sediments less than 30 mg/kg still exhibit changes in several indices used by GE to identify dechlorination processes. The writer also contends that recently deposited sediments will undergo dechlorination as well.

The USEPA's assessment of dechlorination has focused on the "big picture" in terms of dechlorination, *i.e.*, can dechlorination be expected to substantively reduce the inventories of PCBs in the sediments of the Hudson. After review of the writer's contentions, the USEPA's conclusion remains the same. Dechlorination represents only a minor process in reducing PCB mass and then only in the most contaminated sediments. Dechlorination can affect a large number of molecules in these instances but for the vast majority of sediment contamination in the Upper Hudson, with anticipated concentrations less than 100 mg/kg, dechlorination is largely unimportant.

The USEPA acknowledges the writer's observation that minor components in the congener mixture may continue to dechlorinate over time, and these are in fact noted in the DEIR in both sections 3.3.3 and 4.3. However, as shown in Figure DG-1.19A, these ratios are not good predictors for the degree of dechlorination. In preparing Figure 32 of the GE comments, the writer has selected sediments less than 30 mg/kg in showing the relationship of dechlorination with depth. These results show that dechlorination of these individual congener pairs does not approach a final value until perhaps 25 cm of depth. At deposition rates typical of the high resolution cores depicted in this figure, this would suggest roughly 25 years before these ratios had reached their final values. Thus for these congeners at least, the dechlorination process is a very slow one. These results need to be compared with Figure 4-28b of the DEIR. This figure depicts the absence of a time dependence for dechlorination when all sediments are examined. From this it can be concluded that more massive samples reach their final or near final level of dechlorination quite rapidly while sediments at low levels of contamination may take decades to reach their final level of dechlorination. Regardless of the time taken to reach these final levels, it is also clear that for sediments of low contamination (<100 mg/kg), the final level of dechlorination represents only a minor change in sediment PCB mass and modifications to a limited number of congeners.

The USEPA also agrees that recent deposition will be subject to some degree of dechlorination. However, since recent deposition is substantially lower in PCB contamination relative to the peak historical levels (35 mg/kg *vs* 2,000 mg/kg in the TI Pool), the dechlorination process will probably take over 25 years to complete and therefore will have only a minor impact on the recent sediments and can largely be ignored as an important mechanism to reduce or modify the PCB mass in these sediments.

Thus, while dechlorination may still occur in the sediments of the Upper Hudson, it remains only a minor process for sediments of relatively low (<100 mg/kg) contamination and will not have a major impact on the PCB inventories beyond that already measured. In this context, it is clear that dechlorination in the sediments of the lower Hudson is negligible.

Response to DG-1.26A

Resuspension of sediment and porewater displacement are mechanisms suggested for transport of PCB contamination from sediments at depth to the water column in the DEIR. Additional transport mechanisms include sediment displacement due to water craft activities and bioturbation. These mechanisms correspond well with the seasonal nature of the TI Pool loading. It is clear that PCBs are transported from TI Pool sediments to the water column based on the PCB mass loss between 1984 and 1994 documented in the Low Resolution Sediment Coring Report (USEPA, 1998) of which only 11 percent can be attributed to dechlorination.

USEPA intends to examine the information available to estimate the depth of the sediment inventory responsible for the TI Pool load. However, given the dynamic nature of the sediments of the Pool, it is clear that no single depth can accurately describe the exchange process.

4.3.1 Anaerobic Dechlorination and Aerobic Degradation

Response to DL-1.7

Changes in PCB toxicity due to dechlorination are unclear. While heavier congeners are associated with carcinogenicity, the lighter ones are associated with neurological impacts. Thus it is unclear as to net effect of dechlorination on toxicity. The amount of bioaccumulation by fish and the carcinogenic and noncarcinogenic risks to human health associated with the levels of PCB contamination detected in the Hudson River will be studied in the Ecological and Human Health Risk Assessments (ERA and HHRA, expected in 1999). The health effects of these contaminants cannot be dismissed in light of the scientific literature. PCBs have been shown to cause metabolic, neurological, developmental or reproductive affects on various species. A more complete review of the toxicological literature will be presented in the HHRA.

Response to DG-1.26B

The statement is made in the DEIR (page 4-50) that, "In general, these aerobic processes affect only the lightest congeners, monochloro- to trichlorobiphenyls, and are ineffective at altering heavy congeners (those with four or more chlorine atoms) under environmental conditions." This statement was based upon review of literature which reported the occurrence and mechanisms of PCB destruction under aerobic conditions (*e.g.*, Furukawa, 1982; Bedard *et al.*, 1987; Bedard, 1990; Abramowicz and Brennan, 1991). While the presence of microorganisms which are capable of degrading PCBs containing as many as six chlorines may have been established, the effectiveness of these organisms in degrading significant amounts of PCB contamination has not been established particularly in sediments under anaerobic conditions. The high resolution core results of the DEIR as well as the results of the Low Resolution Sediment Coring Report demonstrate the continued presence of high PCB concentrations in many areas of the Hudson. The fact that these areas of PCB contamination still exist decades after their deposition indicates that aerobic degradation has not reduced PCB contamination in sediments of the Hudson River to a significant degree.

Aerobic degradation and loss due to gas exchange are mechanisms proposed to explain the loss of mono- and di-chlorobiphenyls from the water column found in lower river samples.

Response to DG-1.26C

On page 4-50 of the DEIR the statement is made that, "Reductive dechlorination of PCBs by microorganisms from the Hudson River occurs anaerobically, *i.e.*, in the absence of oxygen, primarily through the removal of the meta-chlorines and, to a lesser extent, the para-chlorines in PCBs bound to subsurface sediments (Rhee *et al.,* 1993b; Quensen *et al.,* 1990)." This sentence explains that reductive dechlorination is an anaerobic process involving the removal of meta- and para-chlorines which acts on subsurface sediment contamination. It is implied that reductive dechlorination is the primary biotransformation acting on the subsurface anaerobic sediments. Biodegradation of PCBs may occur in anaerobic sediments, but this primarily results from complete dechlorination of the approximately three mole percent of congeners without ortho-chlorines which can be transformed to biphenyls.

This statement does not rule out the possibility that aerobic and anaerobic biotransformations may occur in surface sediments, but the impact of these processes is unlikely to be substantial, given the close agreement of the PCB concentrations of recent sediment and Hudson River suspended matter. It is incorrect to simply state that the source of PCB contamination to fish is PCBs in the surface sediment and only the newest releases of PCBs (presumably from the Bakers Falls area). The source of PCB contamination to fish will be examined in the Ecological Risk Assessment to be released in 1999.

Response to DG-1.26D

As stated in the DEIR (page 4-51), "[t]he dechlorination process is more effective on the heavier PCB homologues, in which meta- and para-chlorines occur frequently." The statement indicates the PCB congeners with more meta- and para- chlorines can be altered more by reductive dechlorination than congeners with less meta- and para- chlorines. For example, a congener with nine chlorines might lose at least five meta- and para- chlorines through dechlorination while a congener with three chlorines could lose at most three meta- and para- chlorines. No mechanistic or rate of reaction concepts are implied by this statement.

Response to DG-1.26E

"The process of dechlorination has the net effect of reducing the mass of PCBs within the sediments without reducing the total molecular PCB concentration unless the process removes all chlorine atoms." This sentence from the DEIR implies that the molar PCB concentration will decrease by the amount of congeners with only meta- or para- chlorines which can be removed by reductive dechlorination. As stated in comment DG-1.26E, there are only approximately three mole percent of congeners which can be degraded by reductive dechlorination, so the molar concentration is not greatly lowered by this process, even if all congeners with meta- and para-chlorines are degraded. Table 4-8 of the DEIR lists all congeners used in the report with final dechlorination products.

The toxicity of the sediments contaminated with PCBs will be quantitated in the Ecological and Human Health Risk Assessments due in 1999. The level of risk associated with any congener cannot be inferred *a priori* by deductive reasoning.

Response to DG-1.26F

The toxicological affects of PCB congeners will be assessed in accordance with the USEPA guidelines in the Ecological and Human Health Risk Assessments due in 1999.

Response to DG-1.26G

The primary biotransformation process affecting PCB contamination in anaerobic sediments is reductive dechlorination. Aerobic degradation may occur in low oxygen levels, but the importance of this process relative to dechlorination is small if only some low, unquantified level of degradation occurs. Ultimately, it is the continued presence of identifiable Aroclor 1242-like mixtures in sediments as old as 40 years which indicates that these degradative processes are largely unimportant in substantively reducing the sediment PCB inventory.

Response to DG-1.26H

The Low Resolution Sediment Coring Report (USEPA, 1998) contains the analysis of anaerobic dechlorination in the high and low resolution cores. The dechlorination indices used in this report (molar dechlorination product ratio and fractional change in mean molecular weight relative to Aroclor 1242) are sufficient for the purposes of the report. As noted in the responses to DG-1.19 and DG-1.20, other indices do not appear to be as sensitive or useful in assessing the overall degree of dechlorination.

4.3.2 Anaerobic Dechlorination as Documented in Phase 2 High-Resolution Sediment Cores

Response to DG-1.26J

The MDPR is an estimate of the amount of dechlorination found in the Hudson River sediments. It is an estimate based the assumptions outlined in the text, such as the PCB contamination in the river is primarily Aroclor 1242. In regions were these assumptions do not hold, the text discusses the consequences. From the DEIR, page 4-62, "The Lower Hudson sample MDPRs tend to cluster just below the Aroclor 1242 value of 0.14. The mean MDPR for the Lower Hudson is 0.11, suggesting the presence of a minor contribution by heavier Aroclors or, more likely, possible loss of BZ#1, 4, 8, 10, and 19 prior to deposition due to their generally greater solubility and degradability. The congener pattern comparisons made in Chapter 3 (Subsection 3.3.3), suggest that both processes probably occur to some degree."

The power of the relationship between MDPR and total PCB is evident in the correlation and range of values spanned. This relationship cannot be dismissed by argument, particularly when alternative dechlorination ratios developed by GE/QEA are weakly predictive at best (see response to comment DG-1.20).

Response to DG-1.26J1

The congener BZ#8 was included in the MDPR as a dechlorination product even though it is the third most abundant congener in Aroclor 1242 by mass (approximately 7.3% of the mixture, according to the Phase II analysis of standards). Inclusion of this congener is justified by the fact that it is a significant intermediate dechlorination product with 14% of the high resolution core samples containing more than 7.3% of BZ#8 and up to 25% by mass. The correlation between MDPR and total PCBs was improved by including this congener. Finally, it is unimportant that the MDPR is unchanged whether BZ#8 is dechlorinated to BZ#1 or not, because the MDPR is a measure of dechlorination as shown by end products and a significant intermediate. The MDPR is not a direct measure of all the chemical activity undergone by the sample as a result of dechlorination. However, as discussed in DG-1.19, the MDPR does correlate strongly with the number of chlorines per biphenyl, indicating singly that the MDPR changes in direct relation to the extent of dechlorination.

Response to DG-1.26K

The MDPR is an estimate of the number of affected PCB molecules. This estimate allows insights on the nature and degree of dechlorination in the Hudson River sediments to be gained. As discussed in the text, the MDPR is an underestimate of the number of affected PCB molecules because the intermediates are not accounted for and lighter molecules being more soluble and more susceptible to degradation processes may be lost from the sediments. Nevertheless, this measure provides a relationship between the degree of dechlorination and the PCB concentration which is far stronger than the GE/QEA dechlorination products which are designed to account for dechlorination of specific congeners (see the Response to DG-1.20). Since the MDPR increases directly with the decline in Cl/BP, and represents a sum of dechlorinated molecules, it is in fact a measure of the molecules affected although not all affected molecules are directly represented in its sum.

Response to DG-1.26L

The text of the DEIR on page 4-57 is a discussion of reductive dechlorination in sediments subject to an anaerobic environment and the MDPR as a measure of this process. Other processes, such as aerobic degradation and photo-destruction in the water column are discussed in other portions of the document, where appropriate. On page 4-61, the fact that the MDPR and ΔMW cannot account for mass loss by degradation is noted. Although degradative loss may occur in the sediments, these losses have not be demonstrated by be significant in the Hudson River sediments (page 4-65). The potential to bioaccumulate and the risks associated with the contaminants detected in the sediments and water column of the Hudson River will be examined in the Ecological and Human Health Risk Assessments.

Response to DG-1.26M

As stated in the text on page 4-62, "The Lower Hudson sample MDPRs tend to cluster just below the Aroclor 1242 value of 0.14. The mean MDPR for the Lower Hudson is 0.11, suggesting the presence of a minor contribution by heavier Aroclors or, more likely, possible loss of BZ#1, 4, 8, 10, and 19 prior to deposition due to their generally greater solubility and degradability. The congener pattern comparisons made in Chapter 3 (Subsection 3.3.3), suggest that both processes probably occur to some degree." Loss of lighter congeners through partitioning into the water column or degradation is acknowledged to be a plausible explanation of the samples with low concentrations of dechlorination products and MDPRs close to the initial Aroclor 1242 MDPR.

Response to DG-1.26N

The DEIR on page 4-60 states that "the MDPR has a larger range [than the ΔMW], roughly 0.86 (1.0 - 0.14), and thus is more sensitive to changes in the PCB congener composition. However, the latter parameter represents only the final dechlorination products and ignores intermediates other than BZ#8." The type of sensitivity discussed in this paragraph concerns the range of dechlorination measures vs. the range of total PCBs and the correlation coefficients associated with these relationships. Figures 4-22 and 4-25 provide graphical representations of these relationships.

There is greater analytical uncertainty associated with these lighter congeners due to the lower response factors, but this uncertainty is a factor in both measures of dechlorination used in the DEIR. This uncertainty may account for some of the scatter seen in Figures 4-22 and 4-25. It is important to note, however, that despite the analytical uncertainty the MDPR provides the strongest correlations with other dechlorination measures, much stronger than the H, H' ratios proposed by GE.

Response to DG-1.26O

The text of the DEIR on page 4-62, suggests that the MDPRs calculated from Lower Hudson samples are generally lower than the MDPRs calculated from Upper Hudson sediment samples because of the greater solubility and degradability of the congeners BZ #1, 4, 8, 10, and 19. While it is unquestionable that these lighter congeners will exhibit greater solubility and degradability than other congeners whether in the Upper or Lower Hudson, it is possible that the cumulative affect of these factors will differ in these regions. In particular, PCBs found in the sediments of the Lower

Hudson have traveled far more miles and have descended over one hundred feet at the various dam spillways of the Upper Hudson. There is then more time for re-partitioning from suspended matter into the water column and exposure to gas-exchange aerobic degradation and photo-degradation.

Response to DG-1.26P

From the DEIR, page 4-65:

> The fact that meta- and para-dechlorination can only decrease the PCB mass by a maximum of 26 percent implies that sediment PCB inventories sequestered over the previous 40 years (1954 to 1994) will remain in place unless subject to scour, extensive purging by porewater, or remediation. Although some authors have demonstrated degradative PCB losses from the sediments (*e.g.*, Rhee *et al.*, 1993b), these losses do not appear significant for the mix of PCB congeners present in the Hudson.

As stated in the text, the theoretical maximum PCB mass loss due to dechlorination is 26 percent as measured by the described endpoints. Although, the existence of degradative processes have been demonstrated, the amount of mass loss due to these processes has not been quantified and appears to be relatively insignificant given the large quantity of PCBs still stored in the Hudson River sediments (USEPA, 1998).

Response to DG-1.26Q

From the DEIR, page 4-69:

> Given the correspondence of ΔMW and mass loss, it is important to note that sediments with PCB concentrations less than the 30,000 μg/kg threshold, on average, experienced little, if any, mass loss via dechlorination. Mass loss greater than 10 percent is generally restricted to sediments of 30,000 μg/kg or higher, which in turn are still subject to the maximum loss of 26 percent.

The value of 30 ppm occurs at the intersection of the initial ΔMW value of Aroclor 1242 and the lower 95 percent confidence interval about the data. Below 30 ppm, the occurrence of dechlorination is not predictable using ΔMW as a measure, because data fall above and below the initial ΔMW value of Aroclor 1242. It is possible that samples with ΔMW values less than that of an Aroclor 1242 have undergone dechlorination and preferentially lost the mono- and dichlorobiphenyls.

While it is possible that some combination of dechlorination plus porewater migration could yield the MDPR and ΔMW results seen for the sediments of the Lower Hudson, this would subsequently require that this not occur in the sediments of the Upper Hudson where dechlorination end products clearly build up in the sediments, yielding high MDPR values for the most concentrated samples. If porewater migration or some other removal or degradative process were occurring, these sediments would be the most likely candidates since they are so concentrated. The possibility suggested by the writer is also contradicted by the congener evidence, which shows strong similarities in congener patterns among sediments throughout the Hudson. Presumably if the processes suggested by the writer were occurring, these similarities would not exist. The more dechlorinated but depleted sediments would no longer resemble the original mixture since the more dechlorination sensitive congeners would be depleted relative to other mixtures. Furthermore, the PCB/^{137}Cs relationship demonstrated for the Hudson from Stillwater to Lents Cove would no longer apply since the downstream dechlorinated plus purged sediments would exhibit lower concentrations than those predicted from upstream.

Response to DG-1.26R

From the DEIR at page 4-70:

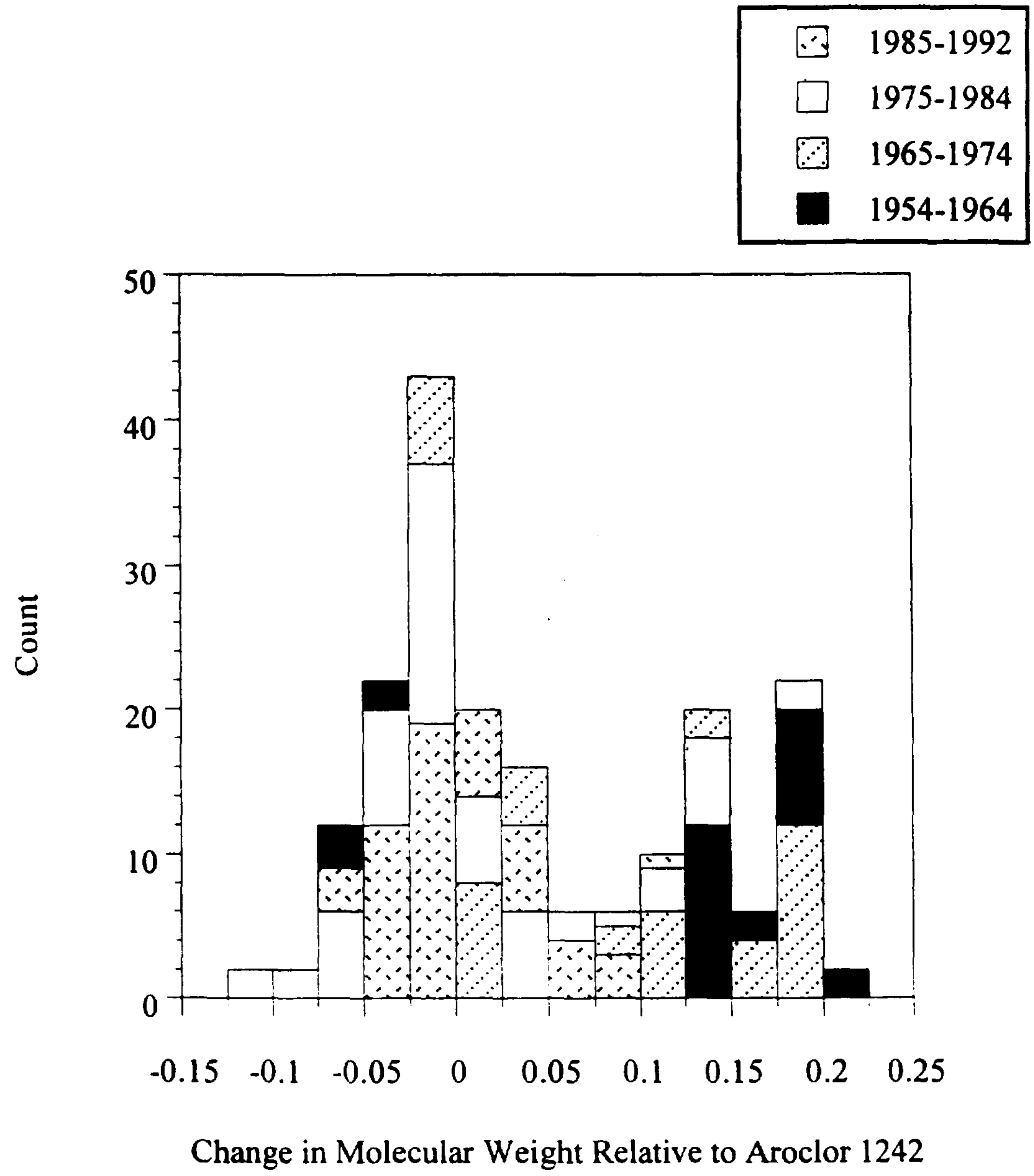
> The absence of a correlation with time can be seen more clearly in a subset of the samples represented above. Using only dated sediment cores from the freshwater main stem Hudson, the degree of dechlorination as measured by the ΔMW is plotted in a histogram as a function of time of deposition (see Figure 4-28a). The data are grouped into approximately ten year intervals beginning in 1954. Evident in the diagram is the clustering of the values around a ΔMW value of 0. More important for this discussion, however, is the fact that a wide range of mass loss (*i.e.*, ΔMW) can be seen for any time period, indicating the lack of time dependence for this process. The samples with the greatest degree of dechlorination are from the period 1965 to 1974. However, this period also contains samples with essentially no measurable dechlorination. Similar ranges can be seen for the periods 1955 to 1964 and 1975 to 1984. Only the most recent period presented, 1985 to 1992, has a lesser range. However, its results are still consistent with those of the previous time periods. The limitation here is simply that water column PCB loads during this most recent period were less than those of the earlier periods, resulting in lower sediment PCB levels. (Historical water column transport is discussed in detail in Section 3.3.)

As stated in the text, all datable cores from the freshwater mainstem Hudson are represented in Figure 4-28a. The upstream source and low-level recent contamination are represented by the 1985-1992 period (more recent deposition). Because the top segments of the cores were more finely sliced (2 cm), the more recent deposition is overweighted. In Figure DG-1.26R, this is corrected by double counting the deeper samples which were sliced at 4 cm intervals. This correction does not affect the main conclusion drawn from this analysis, namely that all time periods display a wide range of mass loss. Additionally, the statement in the comment response that "there are >2x the number of "new sediment samples" than "old sediments" used to construct Figure 4-28a is not factual because there are 44 samples from the 1985-1992 period and 68 from the 1954-1984 period. Approximately 40% of the samples shown are from the 1985-1992 period.

The discussion of concentration effects on dechlorination center on the extent of dechlorination not the type of dechlorination. As discussed in the response to comment DG-1.20, the indices of dechlorination developed by GE/HydroQual are much less sensitive than either the MDPR or ΔMW. See also the response to DG-1.20Q.

Response to DG-1.20

The MDPR is used as an estimate of the extent of dechlorination found in the Hudson River sediment samples contaminated with PCBs. As discussed in Section 4.3.2, this ratio is strongly



Notes:
Data represented is the same as in Figure 4-28a of the DEIR, except that samples which are 4 cm in length are represented twice and samples which are 2 cm in length are counted once.
This step elimates the overweighting of the more finely sliced surface samples.

Figure DG-1.26R
Histogram of the Change in Molecular Weight as a Function of Time of Deposition in Post-1954 Dated Sediments from the Hudson River

correlated with the total PCBs mass detected in the mainstem Hudson samples ($R^2 = 0.75$). This demonstrates the strong relationship between PCB concentration and the degree of dechlorination.

The value of 30,000 ppb total PCBs is the intersection between MDPR equal to the initial MDPR of Aroclor 1242 (0.14) and the lower 95% confidence limit of the data. For samples with total PCB mass less than 30,000 ppb the occurrence of dechlorination from the initial Aroclor 1242 mixture is not predictable. Some samples have MDPRs greater than 0.14 and some have MDPRS less than 0.14. This does not imply that dechlorination has not taken place, merely that the occurrence of dechlorination is not predictable using this measure.

It should also be noted that for each of the congener ratios shown in Figure DG-1.20A, the sediments typically fall well below the ratios seen in the Rogers Island water column station, suggesting that much of the alteration occurs prior to deposition or just after deposition. That is the ratios are reduced during water column transport or very soon after deposition. Additionally, this phenomenon is shown in Figure DG-1.17, which shows these same ratios to decline in surface sediment as a function of river mile. This shows that the further the PCBs have been transported, the greater the change in ratio. Again this suggests that much of this alteration takes place during transport, most likely in aerobic conditions, representing a degradation process which is unrelated to anaerobic dechlorination.

There are several possible explanations for the low level MDPR values found in samples with total PCB mass less than 30,000 ppb of which the majority of the samples are from the Lower Hudson. From the DEIR, page 4-62, "The Lower Hudson sample MDPRs tend to cluster just below the Aroclor 1242 value of 0.14. The mean MDPR for the Lower Hudson is 0.11, suggesting the presence of a minor contribution by heavier Aroclors or, more likely, possible loss of BZ#1, 4, 8, 10, and 19 prior to deposition due to their generally greater solubility and degradability. The congener pattern comparisons made in Chapter 3 (Subsection 3.3.3), suggest that both processes probably occur to some degree."

The GE/HydroQual dechlorination ratios do show that the majority of the Hudson River sediment samples have undergone some degree of dechlorination, although in most instances there has been little reduction in mass or the number of chlorines per biphenyl. These ratios are shown in Figures 1.20A and 1.20B. The majority of Upper and Lower Hudson samples fall below the values of the ratios for unaltered Aroclor 1242. However, the correlations for these relations range from 0.0557 to 0.465, far weaker than the relationship between the MDPR and total PCB mass. There is much less ability to predict the degree of dechlorination at a given concentration due to this scatter. For the BZ#74:49 ratio applied to the Upper Hudson samples for a concentration of 10,000 ppb, the dechlorination ratio ranges from 0.1 to 0.9. Samples with BZ#74:49 ratios greater than 0.65 (the unaltered Aroclor 1242 BZ#74:49 value) do not appear to have undergone dechlorination. These ratios serve to gain further insights into the nature and extent of dechlorination, but are not free of limitations.

The fact that these ratios change within the sediment does not necessarily imply that the sediment was subject to substantive levels of dechlorination (*i.e.*, a large decline in the number of chlorines per biphenyl). The diagrams shown in Figures DG-1.20A and B demonstrate the weak correspondence between the dechlorination ratios proposed by the writer and the PCB mass of the sediments. This is in sharp contrast to the relationship between MDPR and Cl/BP vs. total PCB mass

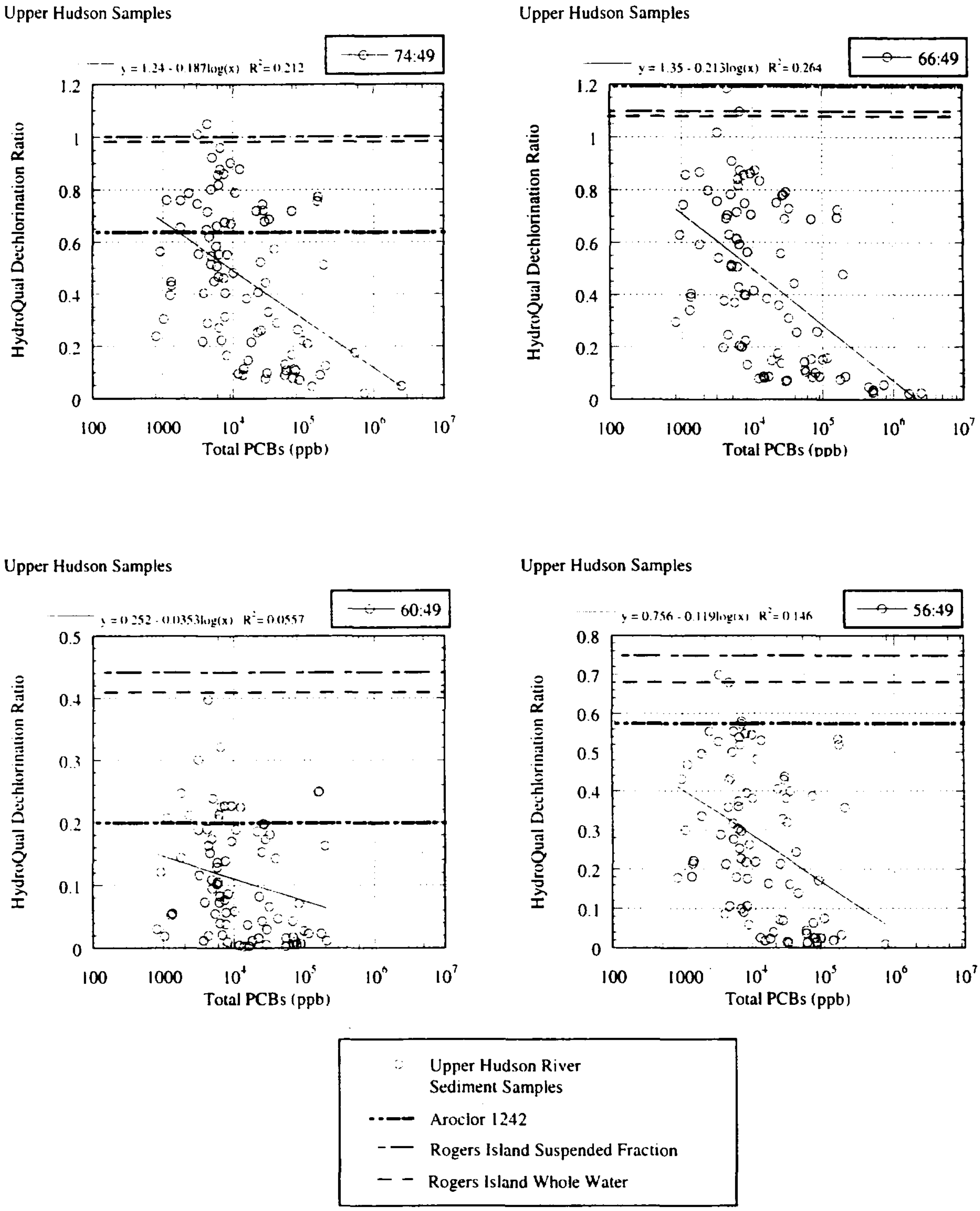


Figure DG-1.20A
Total PCBs vs. the GE/HydroQual Dechlorination Ratios
for the High Resolution Core Data (Upper Hudson)

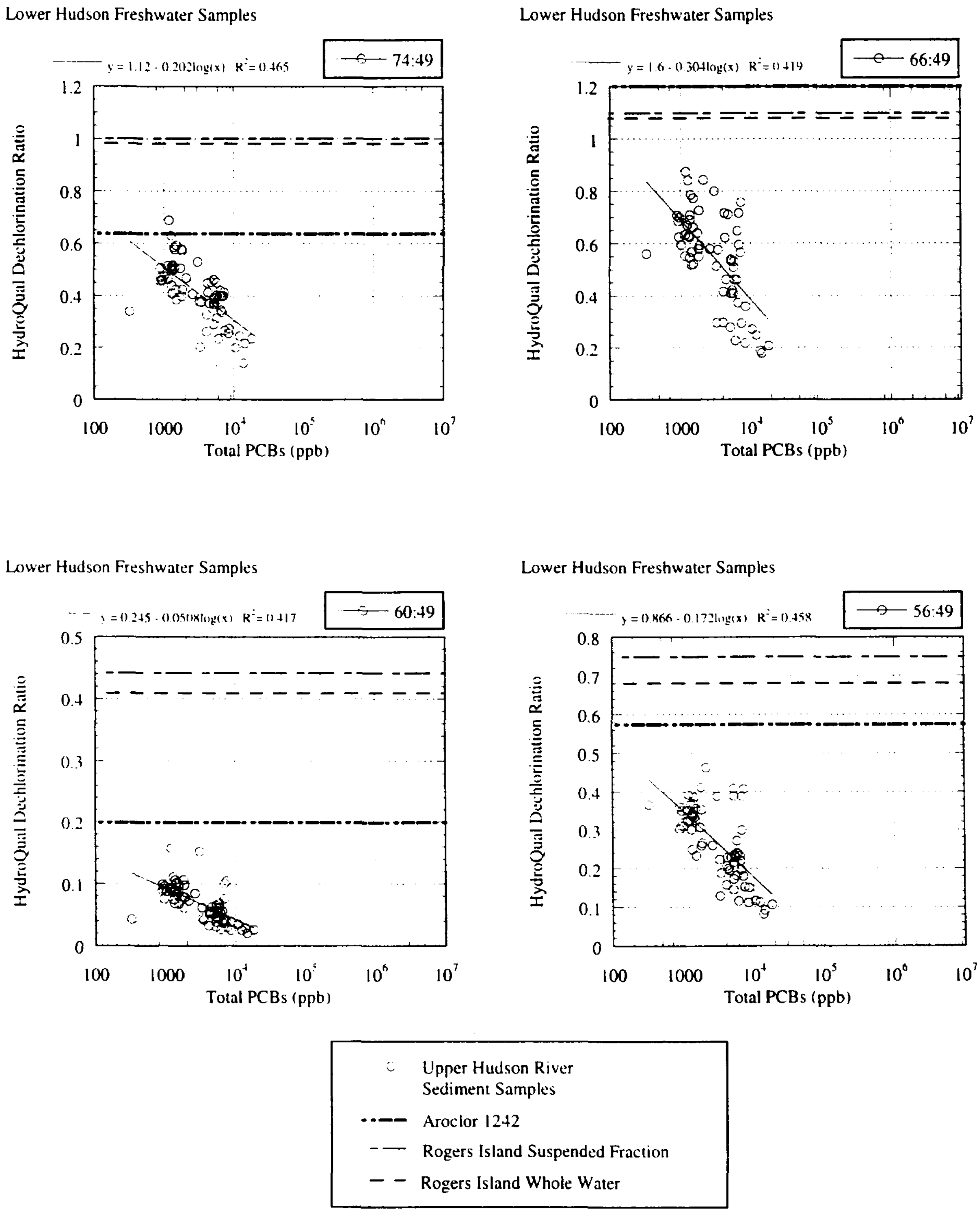


Figure DG-1.20B
Total PCBs vs. the GE/HydroQual Dechlorination Ratios
for the High Resolution Core Data (Lower Hudson Freshwater)

as shown in Figure DG-1.20C. In this figure, both MDPR and Cl/BP correlate strongly with total PCB mass ($R^2 = 0.635$ and 0.597, respectively). Note that this figure uses only the Upper Hudson sediment results. If Lower Hudson sediment results are included (as in Figure 4-22 of the DEIR), then the R^2 for MDPR vs. total PCB mass improves to 0.75, indicating that the Lower Hudson sediments belong in this analysis. This information, coupled with the congener pattern analysis and the PCB/^{137}Cs analysis, indicates the dominance of freshwater PCB contamination by the GE facilities and therefore supports their analysis as a single data set in this context. The USEPA rejects the premise posed by the writer that the Lower Hudson samples do not belong in this analysis.

The H, H' ratios of the Lower Hudson sediments show a weak decline with total PCB mass. However, this decline does not correspond to a substantive change in the number of chlorines per biphenyl, as shown in Figure DG-1.20D. This is also evident in Figure DG-1.19A which shows only a weak correlation between Cl/BP and these ratios for the Upper Hudson

Ultimately, it appears that while these ratios weakly correlate with the degree of dechlorination, they are not useful in predicting the overall level of modification to the sample and instead simply track the changes in the congeners themselves (*i.e.*, BZ#56, 60, 66 and 74). They may offer some insights to some limited processes perhaps involving dechlorination but they do not reflect the overall alteration of the mixture. The fact that the ratio changes occur at low concentrations is indicative of the instability of these particular congeners. However, the demonstrated presence of Aroclor 1242-like mixtures in sediments 30 to 40 years old shows that the dechlorination process cannot be relied on to substantively reduce the PCB mass or toxicity of low level sediment contamination.

4.4 Implication of the PCB Fate in the Sediments for Water Column Transport

Response to DS-2.21

The USEPA acknowledges the importance of the exchange between the water column and the sediments throughout the river, not just in the TIP.

Response to DS-2.22

As part of the modeling analysis, congener patterns of the various potential PCB sources to the TI Pool water column will be compared with the patterns measured within the water column. This analysis should provide further clarification as to the nature of the sources responsible for the load. It is unclear what sort of study could precisely define the PCB sources and release mechanisms short of a very extensive, open-ended study where many water column and sediment samples would be required over long periods of time.

Response to DS-2.23

The degree of dechlorination required to match the water column pattern is fairly high. Recently deposited PCBs would not be expected to attain the same degree of dechlorination as older sediments due to their generally lower concentrations. Thus some contribution by older sediments

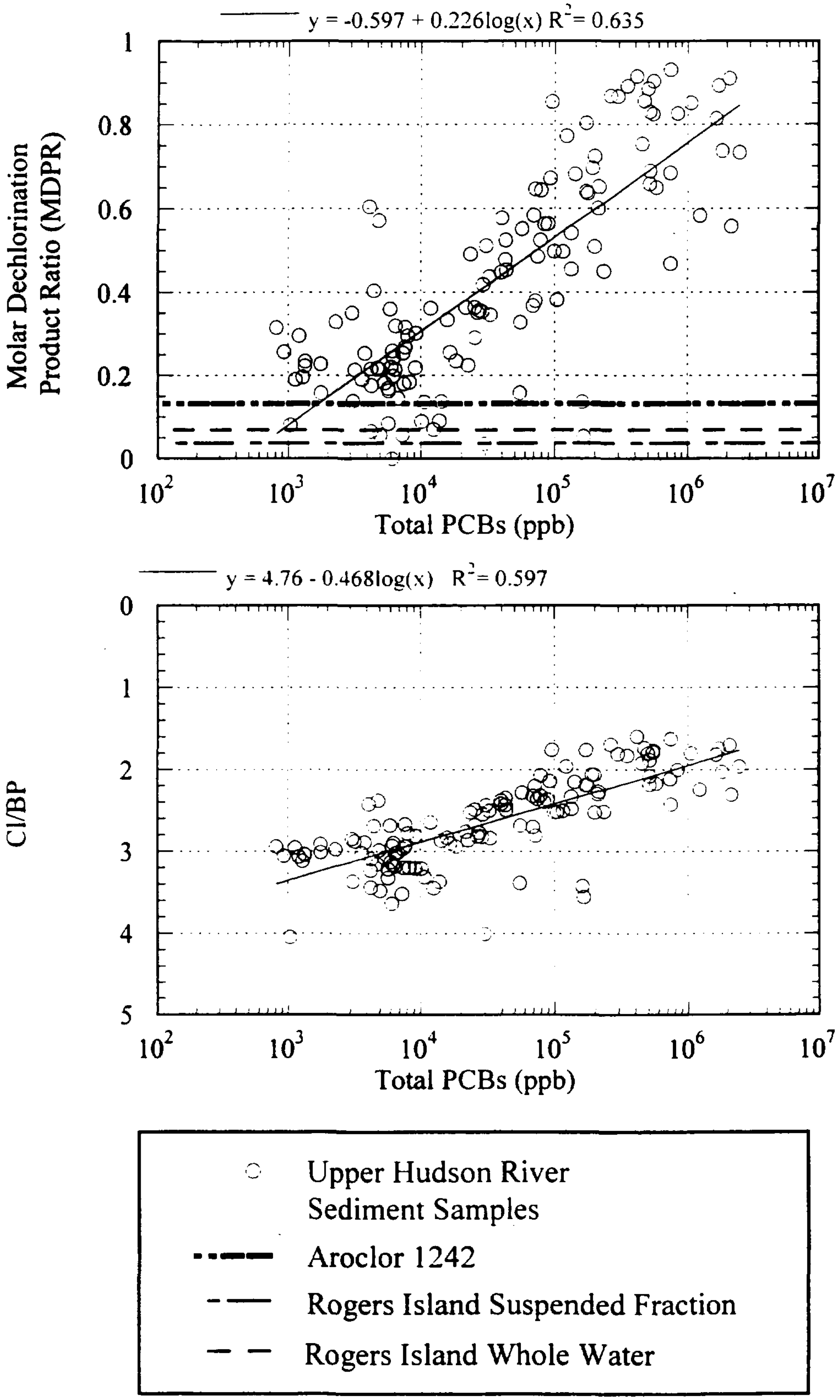


Figure DG-1.20C
Relationships Between the Number of Chlorines per Biphenyl,
Molar Dechlorination Product Ratio and Total PCBs for the High Resolution Core Data

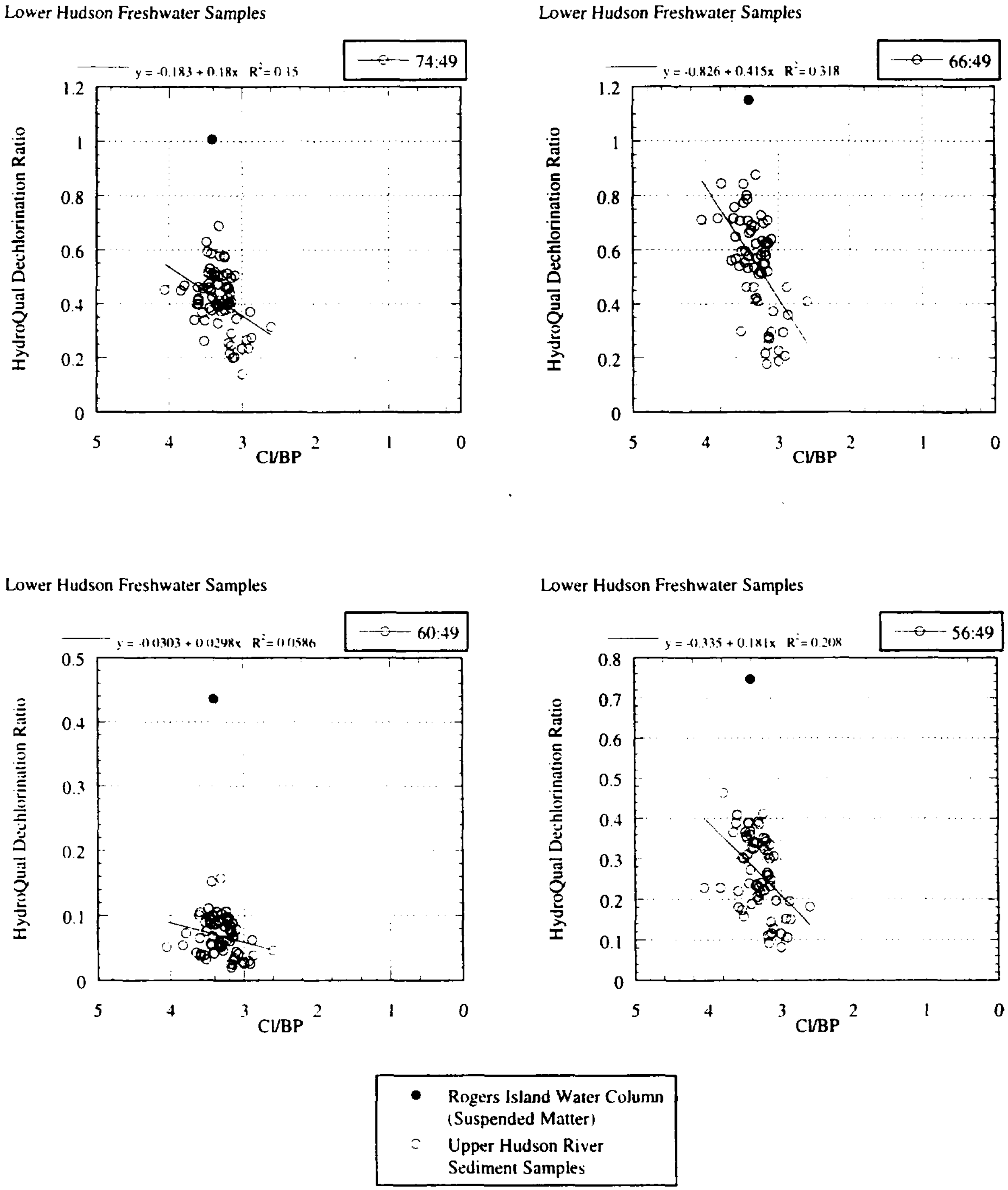


Figure DG-1.20D
The Number of Chlorines per Biphenyl vs. the GE/HydroQual Dechlorination Ratios
for the High Resolution Core Data (Lower Hudson)

would be needed to replicate the congener pattern seen in the water column. Rapid dechlorination of recently deposited PCBs would serve only to decrease the degree of dechlorination required for the older sediments contribution.

Response to DS-2.24

The intent of this statement was to confer the notion that simply because the upstream loads have been greatly reduced does not mean that the sediment loads will now quickly dissipate. USEPA agrees with the writer in that the sediment-derived loads are unlikely to disappear for a long period of time without intervention.

Response to DS-2.25

USEPA agrees that the exchange mechanisms operating within the TI Pool should also occur downstream.

Response to DS-2.26

Although the remedial measures at the GE facilities have not yet been completed, it is still clearly evident in the water column monitoring data collected by USEPA and GE that the PCB releases from the GE facilities have been greatly reduced since 1991. Data collected subsequent to the completion shows still further reduction in the loads originating around the GE facilities, thus leaving the TI Pool sediments as the major source to the water column. USEPA acknowledges the fact that the efforts toward remediation at the GE facilities are not final and that the possibility of further releases from the GE facilities remains.

Response to DG-1.5

The contention that the sediments cannot provide a source for a diffusive flux of PCBs to the water column is incorrectly based on an assumption of continuous deposition throughout the TI Pool. The TI Pool represents a dynamic system characterized by periodic sediment resuspension and settling. Thus the surficial sediments of the pool at any given moment in time represent an integration of all the PCBs deposited there with subsequent reworking by various hydrological and biological processes. These processes effectively serve to renew the active sediment layer so that sediment-to-water fluxes are not limited by burial. Deeper, more contaminated sediments can be brought to the surface and redistributed throughout the pool by sediment resuspension and settling. Evidence for this kind of reworking was demonstrated by the Low Resolution Sediment Coring Program which showed extensive loss of PCBs from the sediments at many locations throughout the Upper Hudson. Sediment mass losses based on this investigation are commensurate with mass loads based on the water column monitoring data obtained by USEPA, USGS and GE.

The writer incorrectly uses the high resolution cores as a basis to infer the fate of sediment PCBs with respect to resuspension or scouring. High Resolution core locations for which the sediment deposition can be determined have not had any significant resuspension or scour. These locations are difficult to find, as evidenced by the number of high resolution cores which did not provide date-able sequences. Thus, these locations do not provide a basis to assess the extent of sediment resuspension. Because the writer's mass balance is based on the incorrect assumption of consistent burial throughout the TI Pool, citing the relatively unique high resolution cores as support, the USEPA rejects the mass balance calculation presented in the comment.

Response to DG-1.6

USEPA does not accept the premise that the resuspension of sediments containing dechlorinated PCBs is implausible. The analysis of the homologue pattern of the water column and sediments suggests a strong similarity. As support for its position, GE contends that the congener patterns of the water column PCBs and dechlorinated sediment PCBs do not match. A similar analysis conducted by USEPA is found in Book 3 of 3. However, it should be noted even if the congener patterns do not match exactly, this does not rule out this mechanism or source since, as noted in the DEIR, the water column load may be the combination of several PCB release processes, so that the resulting pattern is the integration of the various processes. In addition, the congener pattern of the water column load is itself variable, suggesting multiple sources and/or mechanisms. As mentioned in response DG-1.5, the sediment inventories of PCBs are dynamically renewed by the processes which affect the river bottom. For this reason, the writer's contention that the reservoir of PCBs for this release process is inherently limited is incorrect. In fact, as described in the Low Resolution Sediment Coring Report (USEPA, 1998), the sediment PCB inventories have seen a substantial reduction that would be consistent with a substantial release to the water column as well as a resuspension mechanism.

The analysis presented by the writer concerning the areas of the TI Pool with PCB concentrations greater than 100 mg/kg is based on the surface sediment kriging analysis presented in the DEIR. However, the samples represented in this analysis constitute roughly 12 inch intervals whose mean concentration is 100 mg/kg. Thus, the selection presented by the writer does not find all areas with sediments greater than 100 mg/kg. Indeed, it likely that sediments greater than 100 mg/kg can be found throughout much of the TI Pool, given that the peak concentration in some cores from the TI Pool is over 1,500 mg/kg. On this basis, the depth-of-scour analysis presented by the writer does not apply since the areas selected by the writer are unlikely to be the only areas responsible for the TI Pool load if resuspension is the main release mechanism. (Note that the USEPA expects its modeling analysis, which is currently underway, to better resolve the actual mechanism(s) responsible for PCB release from the sediments.) It should be noted as well that the low resolution coring program found most of the sediment PCB inventory to occur in the top 9 inches (23 cm). Scouring to this depth in the sediments would be largely undetectable given the current and historical bathymetric data. Thus the argument that the scour necessary to yield the measured loads would generate measurable changes in bathymetry is incorrect. Higher PCB concentrations are more pervasive and the depth of contamination is typically shallower than suggested by the writer.

Response to DG-1.7

The writer's concern that the degree of resuspension and settling of sediments in the TI Pool may not be sufficient to yield the water column loads emanating from the Pool has also concerned the USEPA. Currently the USEPA is investigating the scale of these fluxes with its own modeling efforts. However, there are two issues concerning this flux. First, as indicated in the report, it may be that resuspension is responsible for only a portion of the TI Pool load; thus, the rate of sediment resuspension and settling may not be limiting. Second, other processes unrelated to river flow, such as biological activity and recreational boat use, may be responsible for sediment resuspension. The seasonal variability of the last three to four years of monitoring data collected by GE is in fact strongly indicative of the absence of a flow dependence in the TI Pool's PCB loads. The absence of a flow dependence would suggest that resuspension resulting from flow is unlikely to be the cause of the PCB loading from the TI Pool. Nonetheless, this does not rule out resuspension via biological activity and recreational boat use.

Response to DG-1.8

The writer contends that the congener pattern of the water column load at the TI Dam is very different from that of dechlorinated sediments as characterized by samples greater than 100 mg/kg in the high resolution coring data set. The analysis considers "averaged" PCB samples from the high resolution core data set, although the method of averaging is not explained. Using the "average" congener pattern from these cores, the writer then presents a series of graphs comparing the percent mass (mass fraction x 100) of the six transects to the "average" dechlorinated sediment. There are several concerns in this presentation which undermine its conclusions. First, the mass percent comparisons are made on log scale plots, thus the degree of disagreement among the congener pairs is partially masked. In addition, undue emphasis is placed on the congeners present at low to trace levels, where presence and quantitation are least certain. In the comparisons themselves, the data as presented show a better regression to the surface sediments then to the dechlorinated sediments. However, as mentioned above, it is unclear how the "average" congener patterns were obtained. It is also uncertain whether the dechlorination pattern obtained from the average of the high resolution cores would be the same as that of the average dechlorinated sediment source. Accepting the presentation at face value, it is also clear that the surface sediments fail to predict the correct mass percent for the two most prevalent congeners and consistently underestimate their percentages by a large margin. Thus, although the surface sediments provide better regressions, they cannot represent the most massive congeners in the mixture. In light of this evidence, the more dechlorinated sediments cannot be ruled out as a major source at this time.

4.5 Summary and Conclusions

Response to DC-3.1

As stated in the DEIR, the data gathered for the Phase 2 Hudson River PCBs RI/FS (high resolution cores and water column samples) are not sufficient to determine the exact mechanisms for sediment to water column transfer, but are sufficient to both suggest and rule out mechanisms, qualitatively. Water column data collected by USEPA and General Electric at Rogers Island are a monitor of the affect of the Allen Mill input in two ways. First, PCB concentrations in the water column have dropped to undetectable levels at the Rogers Island station since remedial actions were taken in 1993 and after peaking in 1991. Second, the unaltered contribution is easily distinguished from altered (dechlorinated) contribution by the absence of high levels of mono- and di-chlorinated congeners. The amount of PCBs released above Rogers Island has been quantified using General Electric's Water Column monitoring data which began in 1990 and continues to date. See Section 3.4.2 of the DEIR, Loadings Upstream of the TI Pool.

Response to DC-3.2

Groundwater flux is a well defined phenomenon. A thorough treatment of the topic can be found in the following reference: Freeze, R. Allan, and John A. Cherry. *Groundwater*. Prentice-Hall Inc., 1979.

Diffusion of PCBs from the sediment to the water column via porewater is a mechanism suggested by comparing the water column homologue patterns with the porewater homologue patterns derived from the sediment concentrations. These patterns closely match in some, but not all, instances.

Response to DG-1.26I

From page 4-70 of the DEIR:

> *The absence of a correlation with time can be seen more clearly in a subset of the samples represented above. Using only dated sediment cores from the freshwater main stem Hudson, the degree of dechlorination as measured by the* ΔMW *is plotted in a histogram as a function of time of deposition (see Figure 4-28a). The data are grouped into approximately ten year intervals beginning in 1954. Evident in the diagram is the clustering of the values around a* ΔMW *value of 0. More important for this discussion, however, is the fact that a wide range of mass loss (i.e.,* ΔMW*) can be seen for any time period, indicating the lack of time dependence for this process. The samples with the greatest degree of dechlorination are from the period 1965 to 1974. However, this period also contains samples with essentially no measurable dechlorination. Similar ranges can be seen for the periods 1955 to 1964 and 1975 to 1984. Only the most recent period presented, 1985 to 1992, has a lesser range. However, its results are still consistent with those of the previous time periods.*

The conclusion that the degree of *in situ* PCB dechlorination is dependent on total PCB concentration and not dependent on time is based on the comparison of dated core samples and the ΔMW. This relationship is apparent from the field results, not the tenets of dechlorination biochemistry. It is not disputed that dechlorination reactions are time dependent, but as discussed in the comment, the time scale is on the order of months, since many of these samples have been *in situ* for more than 20 years and still do not show extensive dechlorination, it is clear that time is not a major component in determining the ultimate degree of dechlorination. See also the responses to comments DG-1.19 and DG-1.20.

Response to DL-1.4

Due to the remedial actions performed by General Electric in the Bakers Falls area, the concentration of PCBs has dropped to undetectable levels at the Rogers Island station. Still, PCBs are detected at the TI Dam. This indicates that the TI Pool sediments are a source of PCBs to the water column. The presence of oil droplets in the TI Pool is unproven (see the response to comment DL-1.1), but even so, the levels of mono- and di-chlorobiphenyls in the water column could not be generated by the partitioning of an unaltered Aroclor 1242 mixture. (See Sections 4.3 and 4.4 of the DEIR.) The concentrations of lighter congeners found in the water column can be generated by partitioning of a dechlorinated Aroclor mixture such as is found in the sediments of the TI Pool.

Further, substantial mass has been lost from the hot spots of the TI Pool between 1984 and 1994 (USEPA, 1998). Thus, the sediment of the TI Pool are not acting as a sink for PCBs, but rather as a source of PCBs to the water column. The USEPA does not contend that sediments below the TI Dam do not contribute PCBs to the water column. Rather, it is apparent from the data that the contributions below the dam are substantially less than those from the TI Pool. This is particularly evident for the area of the Upper Hudson below Schuylerville.

Response to DL-1.6

PCBs are currently detectable in water column samples taken from the Thompson Island Dam stations (O'Brien & Gere, 1998) while samples from Rogers Island have dropped to undetectable levels. Additionally, peak summer time concentrations have shown no sign of decreasing, despite major reductions in the loads at Rogers Island since 1993. Thus the source of the contamination must originate in the TI Pool. Examination of co-located sample pairs from 1984 and 1994 indicates loss of PCB mass in fine-grained TI Pool sediments over these ten years. At most only 11% can be accounted for by dechlorination (USEPA, 1998). According to this evidence, the source of PCBs to the water column at the TI Dam is the PCBs resident in the sediments of the TI Pool. Various remediation strategies, including "No Action" and Natural Attenuation, as well as dredging and capping of affected areas, and the accompanying ramifications, will be explored in the Feasibility Study.

References

No significant comments were received on References.

Volume 2C (Book 2 of 3)

Figures, Tables, and Plates

Comments mentioning figures and tables were addressed in the Book 1 text section in which they were referenced.

Volume 2C (Book 3 of 3)

Appendix A: DATA USABILITY REPORT FOR PCB CONGENERS HIGH RESOLUTION SEDIMENT CORING STUDY

Response to DF-2.2A

Data quality issues relating to total PCB and homologue sums for the data used in the DEIR were treated as follows:

A. In the creation of total PCB and homologue sums, non-detect and rejected congener results were treated as null (or zero) values, *i.e,* they did not contribute to the sum in any way. In this manner, each sum represents only what was measured and is therefore a minimum estimate of the true PCB mass in the sample since presumably some congeners are present at below the detection limit. This summation technique is different from that usually employed to deal with nondetect values wherein nondetects are assigned a value at one half the detection limit. In general, this approach is believed to yield little difference from the true value since most samples were quantitated over two orders of magnitude and therefore the PCB mass present below the detection limit would represent less than a few percent of the total mass of the sample.

B. In the examination of congener patterns and congener ratios, the interpretation followed the same convention as described immediately above in A. Thus, nondetect values appear as zero values on the diagrams showing ratios with respect to BZ#52. In this fashion, matching points in a comparison of samples represent measured values only. Following this convention, it is clear that all samples represented in the congener pattern plots had measurable levels of BZ#52.

C. No sample was excluded from analysis based solely on the occurrence of non-detect results for individual congeners. In most instances, non-detects were constrained to minor components of the PCB levels found in most samples and therefore did not greatly affect the homologue patterns seen. The individual non-detect congener results were examined only when a sample deviated from an expected geochemical trend or congener pattern. In these instances, a sample might be excluded from the analysis if the non-detect issues warranted it. Several samples in Transect 2 in particular suggested this kind of concern.

Overall this treatment minimized the impact of non-detect results on the analyses presented. Total PCB and homologue sums were not greatly impacted unless a major congener was affected. These instances were typically obvious when the data were examined in a geochemical context. Individual congeners were only compared to other measured values, thus avoiding the issue of a possible but unconfirmed match between a measured level and a high detection limit non-detect result. The following discussion provides a detailed discussion of the effect of the converted results.

A summary of the detected results negated (*i.e.*, changed to undetected or "U" values) because of blank contamination is provided in the Appendices A and B of the DEIR. Table A-6 summarizes the instances for the High Resolution Sediment Cores; Tables B-3 and B-4 provide a similar summary for the Water Column Particulate Data and Dissolved PCBs, respectively. Based on the reviewer's selection of congeners, the concern was focussed on the dissolved data (review of Table B-4 shows that 22 to 62 percent of all sample results for the four cited congeners were negated to non-detects based on blank contamination).

In order to assess, and enable others to assess, the effect and relative significance of the negated congeners in the context of the total PCBs detected in any particular sample, USEPA has prepared three tables, one for each matrix (Table DF-2.2A - Water Column-Dissolved PCBs; Table DF-2.2B - Water Column-Particulate Data; and Table DF-2.2C - High Resolution Coring Study - Sediment Core Sample Data). These tables list each sample for the respective matrix in which one or more of 15 different congeners was negated (the 15 congeners consist of the 12 "principal" congeners along with three other congeners - BZ #44, 77, and 153 - which were explicitly mentioned in this or other review comments); the congener-specific negated concentration; the total (valid) PCB concentration in the sample (column header "Total PCBs"); the total (sum) negated concentration of the 15 congeners (header "Sum of Negated Values"); and the fraction of these negated values relative to the total valid concentration (header "Fraction"; consisting of "Sum of Negated Values" divided by "Total PCBs", expressed in percent).

Table D[illegible].A
Water Column Study - Dissolved PCBs

Units: ng/L

	Negated Values (Changed to Undetect Because of Blank Contamination)																	
Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
FW-409-0005															0.022	205.407	0.022	0%
TW-005-0005													0.198		0.072	226.113	0.270	0%
FW-309-0005													0.155		0.058	176.659	0.213	0%
FW-309-0004													0.100		0.034	91.721	0.134	0%
FW-209-0008										0.105					0.059	86.515	0.164	0%
TW-004-0006										0.159					0.020	93.602	0.179	0%
TW-005-0008M										0.051				0.067	0.018	68.995	0.136	0%
FW-209-0005M										0.101			0.108	0.081	0.029	156.769	0.318	0%
TW-005-0004												0.194	0.166		0.099	198.438	0.459	0%
TW-006-0005										0.132			0.154		0.018	107.524	0.304	0%
TW-001-0006										0.056			0.043		0.007	36.349	0.105	0%
TW-004-0007										0.089				0.079	0.032	65.365	0.200	0%
TW-003-0006										0.038		0.094	0.052	0.033	0.008	62.826	0.225	0%
TW-004-0004										0.084			0.048	0.037	0.012	48.061	0.180	0%
FW-309-0008M												0.172	0.105		0.037	77.349	0.314	0%
TW-003-0005										0.050	0.314		0.063		0.014	98.444	0.441	0%
TW-001-0005										0.102		0.075	0.040		0.006	46.565	0.223	0%
TW-003-0008												0.080				15.114	0.080	1%
TW-006-0008			0.153							0.089					0.019	48.523	0.261	1%
FW-109-0004M										0.098		0.209			0.021	53.653	0.328	1%
FW-109-0005										0.077		0.188	0.086	0.060	0.021	65.885	0.432	1%
TW-003-0007M										0.028		0.082	0.060	0.046	0.010	33.346	0.226	1%
FW-109-0008A1										0.116		0.245	0.128	0.104	0.042	75.235	0.635	1%
FW-109-0008A2										0.097		0.209	0.106	0.086	0.026	53.938	0.525	1%
TW-008-0005											0.500	0.220	0.110	0.084	0.040	84.991	0.954	1%
TW-004-0015M										0.022	0.248	0.071				25.285	0.341	1%
TW-004-0012										0.027						1.963	0.027	1%
FW-409-0008			0.656							0.172				0.094	0.008	68.056	0.929	1%
TW-004-0008										0.106	0.497	0.236	0.099	0.077	0.019	74.987	1.034	1%
TW-004-0014										0.065	0.379	0.163	0.119	0.065	0.018	53.466	0.809	2%
TW-008-0004										0.172	0.733	0.317	0.150	0.111	0.043	99.280	1.526	2%
TW-006-0014			0.216							0.054			0.114	0.093	0.024	28.920	0.500	2%
TW-001-0003						2.670						1.950			0.141	252.231	4.761	2%
TW-006-0004										0.065	0.320		0.085	0.071	0.012	27.694	0.553	2%
TW-006-0015			0.287								0.266	0.096	0.083	0.075	0.020	27.706	0.826	3%
TW-001-0008									0.833	0.072		0.079	0.046	0.030		31.159	1.059	3%
TW-006-0017			0.137								0.271	0.085	0.096	0.088	0.020	19.347	0.697	4%
FW-409-0004M			0.849							0.093		0.107	0.059	0.053		29.145	1.162	4%

10.0161

Table DF-2.2A
Water Column Study - Dissolved PCBs

Negated Values (Changed to Undetect Because of Blank Contamination)

Units: ng/L

Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/ 90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
FW-609-0008M			0.747							0.158	0.466	0.188	0.118	0.094	0.027	39.889	1.797	5%
TW-008-0008									2.320		0.391	0.196	0.124	0.097	0.064	46.617	3.192	7%
FW-609-0004			0.688							0.040	0.200	0.100	0.064	0.046	0.019	16.575	1.156	7%
TW-004-0011										0.082		0.241	0.121	0.112	0.039	7.163	0.594	8%
TW-003-0003		1.000		0.071						0.033	0.139		0.036	0.021	0.005	14.960	1.305	9%
TW-002-0004						0.297						0.032				3.724	0.329	9%
TW-003-0004		1.240		0.099						0.039	0.133		0.029	0.017		15.545	1.556	10%
TW-001-0004				0.050		0.247			0.307	0.201	0.051		0.018			7.024	0.874	12%
TW-004-0003		1.600								0.049	0.091		0.038	0.031	0.022	14.641	1.830	13%
TW-002-0005M			1.540		1.690	2.250	1.480			0.030		0.077	0.036	0.017		44.084	7.120	16%
TW-005-0013							0.066				0.066		0.033	0.019	0.011	1.071	0.195	18%
TW-002-0006		0.407	0.869	1.120		1.330				0.047					0.029	20.227	3.802	19%
TW-004-0017		1.250									0.121	0.031	0.037	0.035	0.011	7.217	1.484	21%
TW-005-0003	0.191	0.805				0.343				0.040	0.114	0.073	0.042	0.034	0.011	7.861	1.653	21%
TW-003-0012		0.791		0.058		0.212				0.019					0.022	4.844	1.103	23%
TW-001-0002					0.025		0.011	0.011			0.007		0.005			0.251	0.059	23%
TW-006-0003M	0.293	0.573	0.577	0.573						0.049	0.197	0.081	0.040	0.028		10.109	2.411	24%
TW-002-0007		1.020	0.825	1.140		1.310				0.040		0.084	0.056		0.030	17.824	4.506	25%
TW-005-0010		0.679				0.135					0.107	0.054	0.054	0.048	0.015	4.319	1.092	25%
TW-004-0001			0.011				0.009	0.017	0.042	0.077	0.028			0.016	0.008	0.781	0.208	27%
TW-006-0010		0.264		0.264			0.271				0.087	0.040	0.035	0.025		2.776	0.986	36%
TW-005-0012		0.477	0.030			0.047					0.077	0.054	0.050	0.038	0.020	1.978	0.792	40%
TW-002-0011	0.037				0.049				0.030	0.013	0.027		0.040	0.020	0.011	0.556	0.228	41%
TW-001-0011					0.104					0.044	0.007				0.006	0.324	0.160	49%
TW-003-0011					0.017		0.007	0.020	0.048	0.024	0.042		0.048	0.040	0.032	0.506	0.277	55%
TW-005-0011		0.186			0.010			0.011	0.017	0.024	0.026	0.018	0.023	0.020	0.014	0.549	0.350	64%
TW-006-0012		0.092		0.092			0.117		0.263		0.126	0.081	0.086	0.064	0.018	1.448	0.940	65%
TW-002-0013	0.069						0.034	0.039	0.122	0.018	0.069		0.033	0.026	0.008	0.596	0.417	70%
TW-003-0013			0.109		0.160		0.114	0.137	0.252		0.219		0.087	0.094	0.023	1.464	1.195	82%
TW-004-0013	0.033		0.135				0.078	0.157	0.358		0.167	0.043	0.072	0.063	0.017	1.359	1.123	83%
FW-109-0002			0.013	0.012	0.021		0.021	0.047	0.104		0.087		0.033	0.027	0.010	0.446	0.376	84%
TW-001-0001			0.020		0.044		0.021	0.012		0.093	0.011					0.224	0.199	89%
TW-002-0001		0.103			0.036		0.007	0.008	0.019	0.005	0.013					0.210	0.191	91%
TW-003-0001		0.550		0.007			0.006	0.027	0.085	0.013	0.032		0.020	0.010		0.812	0.751	92%
TW-001-0013			0.024		0.077		0.033	0.038	0.071	0.029	0.039		0.019			0.355	0.330	93%
TW-001-0012			0.186		0.343	0.259	0.126		0.126		0.049	0.029	0.027			1.182	1.144	97%
TW-001-0016		4.490	0.455	0.857	0.870	0.978			0.831				0.044	0.040	0.007	8.623	8.573	99%
TW-006-0013								0.063	0.133		0.096	0.028	0.047	0.039	0.019	0.413	0.425	103%

Table D .2A

Water Column Study - Dissolved PCBs

Negated Values (Changed to Undetect Because of Blank Contamination)

Units: ng/L

Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/ 90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
TW-005-0002	0.173	0.096			0.033		0.047	0.024	0.030		0.015	0.012	0.012	0.009	0.007	0.420	0.458	109%
TW-002-0003	0.174	1.060	0.326		0.527		0.496			0.020	0.047		0.032	0.016		2.377	2.699	114%
TW-006-0001					0.014			0.012	0.017		0.011	0.011	0.017			0.073	0.083	114%
TW-004-0002			0.010		0.008		0.019	0.016	0.029	0.024	0.023	0.015	0.019	0.015	0.011	0.163	0.188	115%
TW-002-0012		1.050	0.265	0.203		0.399	0.168		0.171	0.014	0.068	0.038	0.041		0.008	1.979	2.426	123%
TW-005-0001		0.094			0.021		0.037	0.019	0.021		0.018		0.015	0.013	0.007	0.196	0.245	125%
FW-409-0002					0.019		0.054	0.072	0.071	0.033	0.094	0.111		0.095	0.043	0.465	0.592	127%
FW-309-0002		0.349					0.064	0.041	0.066	0.028	0.052	0.025	0.031	0.025	0.016	0.492	0.696	141%
TW-003-0002		0.461	0.009	0.007			0.011	0.028	0.071	0.013	0.029					0.420	0.628	149%
TW-002-0002		0.170			0.033					0.005						0.115	0.208	182%
FW-209-0002		0.167	0.013		0.023		0.031	0.022	0.032	0.020	0.030	0.020	0.021	0.015	0.016	0.195	0.409	210%
TW-002-0008	2.910	2.620	0.816	0.924	1.560	1.050	1.620	0.620	0.888	0.035	0.153	0.085	0.046	0.028	0.007	4.451	13.363	300%
TW-006-0002					0.031			0.042	0.052		0.101	0.034	0.053	0.053	0.036	0.116	0.401	345%
FW-609-0002								0.036	0.089		0.134	0.040	0.046	0.040	0.047	0.084	0.431	516%
TW-006-0011		0.051		0.051													0.102	--

10.0162

Table DF-2.2B
Water Column Study - Particulate Data

	Negated Values (Changed to Undetect Because of Blank Contamination)															Units: µg/kg		
Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/ 90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
FS-109-0005															4.97	5765.15	4.97	0%
FS-109-0004M															12.16	12198.10	12.16	0%
FS-109-0008A1															2.80	2037.70	2.80	0%
TS-008-0005															12.32	5228.40	12.32	0%
TS-004-0013										0.89						379.12	0.89	0%
TS-002-0008															10.29	2628.96	10.29	0%
TS-001-0004					150.70					110.78			29.19	16.57		53456.23	307.24	1%
TS-002-0011									9.57							1449.71	9.57	1%
FS-609-0004														41.78	48.69	5900.82	90.47	2%
TS-004-0017										4.48					2.76	446.62	7.25	2%
TS-004-0006		119.58														7300.25	119.58	2%
TS-004-0014		62.02														3627.42	62.02	2%
TS-001-0003		751.02		66.91		860.26								445.15		118720.65	2123.35	2%
TS-004-0008		85.18														4698.15	85.18	2%
FS-409-0008			71.19													3843.47	71.19	2%
FS-109-0008A2												61.70			11.34	3816.72	73.04	2%
TS-004-0004		223.25				139.61										17853.09	362.86	2%
FS-309-0008M	31.82									24.41					16.56	3159.98	72.79	2%
TS-005-0008M	47.49														11.41	2358.00	58.90	2%
TS-004-0007		127.33														4709.38	127.33	3%
TS-003-0013										0.45					1.14	53.50	1.59	3%
TS-002-0004						514.83										16676.60	514.83	3%
TS-004-0003		49.58													3.50	1605.18	53.08	3%
TS-004-0012										1.06					1.58	78.76	2.64	3%
FS-409-0004M			149.04													4310.93	149.04	3%
FS-409-0005			275.20													6989.50	275.20	4%
FS-309-0005	293.35									67.23					36.18	8659.63	396.76	5%
FS-609-0008M			114.54											47.43	27.51	3543.88	189.47	5%
TS-002-0006					202.09					95.52					33.87	5853.73	331.48	6%
TS-005-0010													4.27	3.08	0.89	138.51	8.23	6%
TS-003-0004											169.29	135.62	76.57	61.35	33.67	7609.70	476.50	6%
TS-006-0017		16.53	59.33	16.53												1468.79	92.38	6%
TS-002-0003					110.60				129.80	42.07					6.77	4562.59	289.24	6%
FS-109-0002							1.65			2.44		5.06			1.48	166.23	10.62	6%
TS-001-0005						169.17				72.25		88.99			19.12	5432.34	349.54	6%
TS-003-0003											111.62	94.94		48.54	24.16	4324.15	279.27	6%
TS-004-0001							0.50			1.07					2.37	58.04	3.95	7%
FS-609-0002												4.53				65.44	4.53	7%

Table D 2B

Water Column Study - Particulate Data

Units: µg/kg

	Negated Values (Changed to Undetect Because of Blank Contamination)																	
Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/ 90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
TS-003-0006										8.31	24.79	17.53		9.80	5.36	927.14	65.79	7%
TS-002-0007			55.72		82.33					29.91					15.03	2355.97	182.99	8%
TS-005-0003	31.26									16.95			36.86	29.71	14.42	1637.25	129.20	8%
TS-005-0011													2.02	1.22	3.15	71.45	6.38	9%
TS-001-0006					152.63	203.93				73.29		99.59			22.64	6116.59	552.08	9%
TS-001-0016			16.65									18.50	18.16	13.92	8.64	820.15	75.88	9%
TS-006-0008		71.34	94.07	71.34												2538.33	236.76	9%
TS-006-0015		38.26	71.20	38.26										24.86		1781.22	172.59	10%
TS-002-0005M					231.17	332.58				54.47					23.87	6484.95	642.09	10%
TS-005-0005	453.75					177.14				44.50				68.64	31.12	7141.24	775.16	11%
TS-006-0010							10.13							3.70	1.17	137.20	14.99	11%
TS-001-0002					59.49				135.39					53.33	17.59	2179.30	265.80	12%
FS-209-0005M	367.28						492.75			63.01					33.44	7530.30	956.48	13%
TS-008-0004		19.96	221.08				2504.31									18781.22	2745.35	15%
TS-002-0013					11.22					20.59		24.35			10.56	434.27	66.72	15%
TS-002-0002					32.37											210.66	32.37	15%
TS-004-0011										3.66		12.10	7.51	6.57	3.14	207.84	32.98	16%
TS-003-0005		360.15		73.10						22.94		42.59			14.08	3216.97	512.86	16%
TS-008-0008		2.26	39.74				88.93								2.79	821.54	133.72	16%
TS-005-0001													13.11		9.52	134.99	22.63	17%
TS-001-0013			9.45		6.03		2.54	8.37					5.91			189.16	32.29	17%
TS-001-0011							3.18		47.73	156.27			4.43			1220.29	211.62	17%
TS-006-0013			14.61				37.41			8.94				24.63		486.33	85.60	18%
TS-003-0012							6.28	6.19	8.14	2.93				9.35	4.01	208.48	36.90	18%
TS-003-0007M		42.34		4.78						3.42	9.02	6.60		3.49	1.62	402.71	71.28	18%
TS-004-0002										1.56		2.83			5.92	56.01	10.31	18%
TS-006-0003M			96.19				77.86					42.47	112.84	144.90		2394.95	474.27	20%
TS-006-0005		194.23	221.33	194.23			242.91							49.59	20.38	4393.62	922.66	21%
TS-001-0008			47.52		74.49				120.78	34.95		46.60			10.30	1575.77	334.63	21%
TS-006-0004		43.72	71.47	43.72			183.63						42.96	27.56	8.33	1852.12	421.39	23%
TS-003-0002							20.38	18.73	35.81	21.23	35.33	19.05	24.41	20.87	21.19	913.75	217.01	24%
TS-003-0011					0.89		1.13	2.40	4.29	2.37	4.33		2.52	2.16	1.85	91.10	21.94	24%
TS-005-0013	9.48						12.10					14.92		14.07	6.55	235.91	57.11	24%
TS-006-0014		26.24	60.31	26.24			111.22			16.06			41.71	31.53		1241.21	313.31	25%
TS-001-0012					17.49		5.39	9.80					12.31		2.78	177.98	47.77	27%
TS-003-0001							10.57	11.59	25.32	12.55	18.92	9.15	13.64	10.84	12.33	450.45	124.90	28%
TS-002-0012					6.40				5.88	6.70		9.67	12.75		3.29	152.35	44.67	29%
TS-002-0001					5.04	53.69				7.73					5.14	212.65	71.60	34%

Table DF-2.2B
Water Column Study - Particulate Data

Units: µg/kg

Sample ID	Negated Values (Changed to Undetect Because of Blank Contamination) BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
TS-005-0012	5.78						5.22					8.25	9.45	6.72	2.76	111.52	38.18	34%
FS-209-0008	70.87						195.92	108.10	146.28	26.49	72.31	63.48	45.10	31.98	14.77	2040.01	775.31	38%
FS-309-0002													16.19		11.93	73.76	28.12	38%
TS-006-0012											6.99	6.40	8.35	6.31		39.17	28.05	72%
TS-006-0001		19.71		19.71			30.26						31.84	33.72	25.21	163.74	160.44	98%
FS-209-0002										11.49	5.43	10.03	12.70	6.88	8.82	49.53	55.35	112%
TS-006-0011													4.57		2.70	5.91	7.27	123%
TS-001-0001									29.87	120.49				13.80	8.42	137.02	172.58	126%
TS-005-0002	68.87										3.90		8.88	4.96	7.48	66.08	94.08	142%
TS-006-0002		40.57		40.57			15.44					3.22	9.24	8.49	2.76		120.30	--

10.0165

Table D(:C
High Resolution Coring Study - Sediment Core Sample Data

Negated Values (Changed to Undetect Because of Blank Contamination)

Units: µg/kg

Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/ 90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
HR-005-4449P				2										0.262		7456	2	0%
HR-020-2024P								175								548656	175	0%
HR-023-4045P								77								170587	77	0%
HR-018-1216P										1270						2483363	1270	0%
HR-038-0002A				0.484												687	0.484	0%
HR-036-0002A				0.467												632	0.467	0%
HR-018-0816G										1820						2350128	1820	0%
HR-026-3240P										60						73202	60	0%
HR-018-1620P										1370						1653208	1370	0%
HR-026-0408P															143	158247	143	0%
HR-019-0812P														105	75	197452	180	0%
HR-019-0816G								273						173		437362	446	0%
HR-037-0002A				1												974	1	0%
HR-026-0816G															132	112588	132	0%
HR-026-0002P															120	99474	120	0%
HR-022-4852P										628						515651	628	0%
HR-039-0002A				1												1074	1	0%
HR-023-4549P							0.318	0.519	1							1625	2	0%
HR-002-3640P						9										5356	9	0%
HR-002-4448P						6										3574	6	0%
HR-030-0002A				2												1273	2	0%
HR-020-1620P								166								88844	166	0%
HR-020-0816G								329					657			462795	986	0%
HR-026-1624P										648		199		595	368	840055	1810	0%
HR-026-2432P										318		119			282	330862	719	0%
HR-019-0608P														109	67	69211	176	0%
HR-012-4852P						4										1685	4	0%
HR-002-4851P						8										3122	8	0%
HR-019-1620P							2800	382						1130	559	1719639	4871	0%
HR-002-2832P						5										1612	5	0%
HR-019-2832P								170		601				380	397	500219	1548	0%
HR-019-0002P														78		25128	78	0%
HR-026-1216P								252		233		183	548	370	195	515745	1781	0%
HR-003-4043P						5										1323	5	0%
HR-009-1214P						8										2388	8	0%
HR-026-0204P														274	135	115690	409	0%
HR-003-2024P						3										913	3	0%
HR-031-0002A				4												1188	4	0%

Table DF-2.2C
High Resolution Coring Study - Sediment Core Sample Data

Units: µg/kg

	Negated Values (Changed to Undetect Because of Blank Contamination)																	
Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
HR-023-2832P					6930											1830882	6930	0%
HR-003-2832P						4										1103	4	0%
HR-023-3236P					2830			440								838036	3270	0%
HR-003-0816G						4										1011	4	0%
HR-012-4448P						3										801	3	0%
HR-008-5660P						15										3624	15	0%
HR-007-0608P						7										1632	7	0%
HR-028-0608P										177			131		45	83601	353	0%
HR-007-0406P						6										1359	6	0%
HR-013-3236P						23										5202	23	0%
HR-007-0204P						5										1226	5	0%
HR-008-2024P															13	2906	13	0%
HR-001-1216P						5										1082	5	0%
HR-007-0002P						6										1146	6	0%
HR-035-0002A				21												4284	21	0%
HR-006-0816G						7										1502	7	0%
HR-007-1216P						8										1626	8	1%
HR-008-2428P						25										4861	25	1%
HR-028-2024P										78			65	53	23	43134	220	1%
HR-001-1620P						6										1265	6	1%
HR-025-0002P														33		6481	33	1%
HR-007-0812P						7										1357	7	1%
HR-008-4448P						31										5957	31	1%
HR-025-0408P														32		6028	32	1%
HR-007-0816G						9										1689	9	1%
HR-007-1620P						13										2377	13	1%
HR-028-0204P										405			459	290		212267	1154	1%
HR-003-1216P						5										996	5	1%
HR-004-2428P						5										897	5	1%
HR-025-0812P														26		4764	26	1%
HR-007-2024P						29										5321	29	1%
HR-003-0812P						5										864	5	1%
HR-007-2428P						36										6497	36	1%
HR-003-0406P						6										1079	6	1%
HR-013-2428P						20									12	5732	32	1%
HR-008-0816G						7									8	2681	15	1%
HR-028-0812P										229		274	274	207	122	189840	1106	1%
HR-003-0204P						6										1045	6	1%

Table D 2C
High Resolution Coring Study - Sediment Core Sample Data

Units: µg/kg

	Negated Values (Changed to Undetect Because of Blank Contamination)																	
Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/ 90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
HR-003-3236P						7										1223	7	1%
HR-007-2832P						44										7292	44	1%
HR-016-4044P				5		82										13783	87	1%
HR-008-1620P						7									12	2919	18	1%
HR-014-0812P						8										1337	8	1%
HR-012-0816G			1													167	1	1%
HR-012-2024P			0.964													153	0.964	1%
HR-014-1216P						53										8357	53	1%
HR-023-3640P					832			74								141060	906	1%
HR-003-2428P						6										926	6	1%
HR-028-0406P										110			78	49	27	39458	264	1%
HR-010-1216P						9										1302	9	1%
HR-003-3640P						8										1148	8	1%
HR-013-2832P						70									14	12107	84	1%
HR-010-0002P				2		5										958	7	1%
HR-004-0812P		7								3						1450	10	1%
HR-014-0608P						10										1439	10	1%
HR-003-1620P						6										832	6	1%
HR-010-0812P						7										948	7	1%
HR-010-0608P						9										1161	9	1%
HR-006-3236P						52										6692	52	1%
HR-017-2428P			1									3				531	4	1%
HR-010-0406P				2		6										933	7	1%
HR-004-0002P		11														1389	11	1%
HR-006-2832P				17		54										8590	71	1%
HR-003-0608P						7										888	7	1%
HR-006-2428P				12		45										6918	57	1%
HR-005-3640P				0.321				0.270								71	0.591	1%
HR-006-3640P						41										4806	41	1%
HR-008-6064P		14				34										5399	48	1%
HR-016-4448P	7			3		26										4017	36	1%
HR-010-1620P						16										1806	16	1%
HR-005-0816G		7		0.659						3						1189	11	1%
HR-028-3236P				119						161			140	157	47	68800	624	1%
HR-013-0608P		13		5		12									6	4019	37	1%
HR-010-0204P				3		11										1492	14	1%
HR-010-4448P						98										10511	98	1%
HR-022-2832P				171												18226	171	1%

Table DF-2.2C
High Resolution Coring Study - Sediment Core Sample Data

Units: µg/kg

	Negated Values (Changed to Undetect Because of Blank Contamination)																	
Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/ 90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
HR-010-2832P						17										1828	17	1%
HR-015-0204P						17										1777	17	1%
HR-018-2832P						526										54742	526	1%
HR-006-2024P				13		53										6795	65	1%
HR-034-0002A				63												6520	63	1%
HR-010-2428P						17										1730	17	1%
HR-005-1620P		10														984	10	1%
HR-015-4853P				5		61										6791	66	1%
HR-008-6468P		8				18										2632	26	1%
HR-004-0608P		9								3						1222	12	1%
HR-004-0204P		13														1316	13	1%
HR-015-0002P						12										1129	12	1%
HR-008-1216P				10											11	2031	21	1%
HR-004-0406P		14														1340	14	1%
HR-013-4044P		13				10										2109	22	1%
HR-023-0002P						34										3139	34	1%
HR-017-3640P			5	6	12		7	4	5	12	4					4978	54	1%
HR-013-3640P		42				14										5202	57	1%
HR-028-2428P										134				652		72074	786	1%
HR-008-0002P						6									8	1241	14	1%
HR-008-4852P		22				28										4397	50	1%
HR-011-4852P						60										5164	60	1%
HR-017-3236P				4	20		8	5	6	9	3	4				5105	59	1%
HR-005-1216P		8				7										1221	15	1%
HR-007-5962P						6										448	6	1%
HR-015-4448P				23		256										22454	279	1%
HR-003-0002P		6				3										717	9	1%
HR-016-4852P	5					8										1037	13	1%
HR-012-3640P			3			3										409	5	1%
HR-001-0816G		27														2088	27	1%
HR-005-0204P		6		0.818		6										959	12	1%
HR-015-0406P						42										3234	42	1%
HR-011-4044P						45										3403	45	1%
HR-008-5256P		30		3		27										4432	60	1%
HR-009-0506P						26								46		5282	72	1%
HR-012-6064P			2		1	2										397	5	1%
HR-028-0002P						2270										164451	2270	1%
HR-017-2832P	1		5							6		6				1364	19	1%

Table D-2C
High Resolution Coring Study - Sediment Core Sample Data

Negated Values (Changed to Undetect Because of Blank Contamination)

Units: μg/kg

Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
HR-008-0204P		17				6									8	2143	30	1%
HR-013-2024P	10					11										1506	22	1%
HR-015-0608P						26										1764	26	1%
HR-001-0002P						5										367	5	1%
HR-010-3640P						48										3306	48	1%
HR-012-3236P			2			2										281	4	1%
HR-008-0406P		22				6									8	2378	35	1%
HR-013-1620P	10					11										1407	21	1%
HR-005-0002P		9				11										1349	20	2%
HR-002-3236P		69				25										6178	94	2%
HR-012-2428P			2			3										334	5	2%
HR-011-2024P						50										3244	50	2%
HR-010-3236P						63										4105	63	2%
HR-009-0607P						29								54		5372	83	2%
HR-022-4044P					4290					352						295629	4642	2%
HR-009-0405P						23								39		3961	63	2%
HR-013-0812P	12					9										1325	21	2%
HR-005-0406P		6		0.913		7										823	13	2%
HR-014-2024P						5				1						361	6	2%
HR-010-4044P						221										13654	221	2%
HR-012-5660P			2		2	2										400	6	2%
HR-015-1216P						80										4928	80	2%
HR-004-4043P		7														426	7	2%
HR-017-4852P			0.206				0.116								0.088	25	0.410	2%
HR-007-4448P						55								24	10	5285	88	2%
HR-008-0608P		23				6									8	2157	37	2%
HR-008-0812P		26				6									9	2412	41	2%
HR-015-2024P						93										5425	93	2%
HR-022-1216P				132												7717	132	2%
HR-013-0002P	10					13										1354	23	2%
HR-004-2024P		9		0.142												547	9	2%
HR-018-3236P		402				107										29589	509	2%
HR-004-0816G		16		1												1022	18	2%
HR-004-2832P		8		0.259												465	8	2%
HR-004-1216P		11		0.345		3										784	14	2%
HR-004-1620P		12														680	12	2%
HR-016-7680P			3								0.639	0.603				242	4	2%
HR-006-0608P		10		7		8										1342	25	2%

Table DF-2.2C
High Resolution Coring Study - Sediment Core Sample Data

Negated Values (Changed to Undetect Because of Blank Contamination)

Units: µg/kg

Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/ 90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
HR-016-1620P						70										3677	70	2%
HR-004-3640P		11														571	11	2%
HR-016-8084P			1				0.425		1		0.453	0.502				206	4	2%
HR-019-3640P						181				12					7	10290	199	2%
HR-016-0002P						18										925	18	2%
HR-011-0812P						37										1850	37	2%
HR-004-3236P		14		0.273												695	14	2%
HR-010-5256P		106				39										7270	145	2%
HR-013-0816G	12					11										1127	23	2%
HR-005-2832P				2	5			0.265								347	7	2%
HR-015-2428P						157										7686	157	2%
HR-011-0608P						31										1522	31	2%
HR-009-0304P														13	7	972	20	2%
HR-009-0810P						16								64		3699	79	2%
HR-013-0406P	12					8										903	19	2%
HR-006-0002P		16		4												948	21	2%
HR-006-0812P		10		5												702	15	2%
HR-007-3236P		41				18									9	3041	68	2%
HR-014-1620P		275				50										14429	325	2%
HR-009-0102P														13	7	885	20	2%
HR-010-5659P		113				44										6822	157	2%
HR-009-0001P														13	6	819	19	2%
HR-006-1216P		12		4												699	16	2%
HR-009-0708P						28								69		4128	97	2%
HR-002-2024P					21											869	21	2%
HR-006-1620P		27		9		7										1820	43	2%
HR-010-4852P		119				42										6733	161	2%
HR-028-0002A						3880										160763	3880	2%
HR-015-0812P						94										3856	94	2%
HR-001-0812P						4						16				780	20	3%
HR-001-0406P						4						16				769	20	3%
HR-007-4044P						23				11				12	5	1990	51	3%
HR-018-4852P							0.766			1			0.484			88	2	3%
HR-005-2428P				0.340	5											198	5	3%
HR-001-0204P						5						17				792	21	3%
HR-016-5256P	1		2	4		4										402	11	3%
HR-015-3236P						390										14206	390	3%
HR-006-0204P		19		5		7										1097	30	3%

Table D 2C
High Resolution Coring Study - Sediment Core Sample Data

Negated Values (Changed to Undetect Because of Blank Contamination)

Units: µg/kg

Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
HR-012-0812P			0.989		3											161	4	3%
HR-006-0406P		16		7		7										1052	30	3%
HR-016-7276P			2					1		0.349	0.529	0.535				173	5	3%
HR-001-0608P						7						16				790	23	3%
HR-012-0608P			0.962		3											147	4	3%
HR-028-7679P						17700				907		1430	657	551	242	740021	21487	3%
HR-008-3640P		226				124										11824	350	3%
HR-011-5660P		146				70										7083	216	3%
HR-018-0608P						1300										42515	1300	3%
HR-011-5256P		102				44										4731	146	3%
HR-015-4044P						3640		65		257	203					133477	4165	3%
HR-008-2832P		152		4		98										8035	253	3%
HR-020-3236P						1660		63	94							56967	1817	3%
HR-008-3236P		212				106										9509	318	3%
HR-009-1618P		11	1			0.912				0.829				4	4	636	21	3%
HR-021-2428P				2270				105		119				63		74743	2557	3%
HR-022-4448P						15600				424						449287	16024	4%
HR-011-0002P		80				28										3017	108	4%
HR-009-0203P		13				1								15	7	963	36	4%
HR-009-0816G														10	6	432	16	4%
HR-013-0204P	8	18				9									4	1022	38	4%
HR-017-4044P			3							3		3				231	9	4%
HR-019-0406P						1580								84	42	42557	1706	4%
HR-013-4447P		7				5									1	328	13	4%
HR-028-4448P						8210				674			386		117	232042	9387	4%
HR-023-0204P			27			22										1210	49	4%
HR-005-0608P		25	10	5						5						1100	45	4%
HR-011-7680P		274														6330	274	4%
HR-016-8488P	2			2				1						0.520		135	6	4%
HR-006-4044P			2							0.797		0.846	0.765	0.508	0.178	120	5	4%
HR-011-4448P		115				49				22						4221	186	4%
HR-022-0204P	340			133												10678	473	4%
HR-028-1216P						3700				436			230	193	80	104499	4639	4%
HR-011-6872P		263														5914	263	4%
HR-028-3640P						3800		545	671	221	132	147				122199	5516	5%
HR-015-3640P						4100		45		167						92070	4312	5%
HR-028-2832P						1720				98			74	53	22	39373	1967	5%
HR-017-0812P	1		1		2		3	2	2	0.640						235	12	5%

Table DF-2.2C
High Resolution Coring Study - Sediment Core Sample Data

Negated Values (Changed to Undetect Because of Blank Contamination)

Units: µg/kg

Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/ 90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
HR-012-6870P							0.601								3	71	4	5%
HR-018-3640P			6			7	3									313	16	5%
HR-021-1216P				115		229								39		7411	383	5%
HR-011-8488P		212				86										5712	298	5%
HR-011-9610P		270														5114	270	5%
HR-022-0816G	305			119												7943	424	5%
HR-018-4448P						25	2									491	27	5%
HR-024-1224P			1		5					1						124	7	6%
HR-028-6064P					9760	41700		5820	7810		1810	1710	1060	704	501	1234175	70875	6%
HR-011-7276P		226				91										5494	317	6%
HR-017-0608P	0.932		1		2		1	0.729	1	0.226						121	7	6%
HR-011-6468P		219				88										5209	307	6%
HR-022-1620P	354			141												8284	495	6%
HR-022-0406P	318			133												7547	451	6%
HR-022-0812P	250			97												5750	347	6%
HR-019-2428P					2630	18000	2990			918				206		409447	24744	6%
HR-012-0002P			0.762		3										3	108	7	6%
HR-012-0406P			0.904		4										4	143	9	6%
HR-022-0608P	266			88												5794	354	6%
HR-018-4044P			2			4										101	6	6%
HR-028-5256P					15100	74000		12200	14600	3030		7530	3910	3130	1310	2159623	134810	6%
HR-020-2428P						42400	4290	471					981			735977	48142	7%
HR-012-0204P			1		4										5	146	10	7%
HR-021-2832P				11200				182	4740	299	284	55	220	73	69	259705	17122	7%
HR-016-5660P			3	7		4		1								232	15	7%
HR-009-1416P		10	1			0.889				2				7	5	386	26	7%
HR-028-6872P					5610	21500		3960	5120		1040	962	777	415		575881	39384	7%
HR-021-3236P				3860		7050		103		361	181	33		124	101	171137	11813	7%
HR-017-0406P	2						0.886	0.538	0.643			0.457	1			77	5	7%
HR-026-4048P	4	16	2													319	22	7%
HR-019-1216P					4930	23800	3650	373								468857	32753	7%
HR-016-6064P			4	7		3		1								227	16	7%
HR-017-2024P	3		10		6	4	6			3		2				467	35	7%
HR-016-6468P			2	5			1	0.489				1				129	10	7%
HR-001-2024P			0.755				5					1	2			112	9	8%
HR-028-0816G					1540	39400	2650	1750	2350		1290	991	1070	837	484	643552	52362	8%
HR-014-2428P			3					2		0.539		0.383	0.262			73	6	8%
HR-027-0002P			1					2	1							49	4	8%

Table D 2C

High Resolution Coring Study - Sediment Core Sample Data

Units: µg/kg

	Negated Values (Changed to Undetect Because of Blank Contamination)																	
Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
HR-017-0204P			0.799				0.779	0.360	0.265	0.574		0.311	0.665			42	4	9%
HR-014-0816G	2	13	3				7	3		0.735		0.950				308	29	9%
HR-022-0002P	429	660		143												12483	1232	10%
HR-011-0816G		120				35										1504	155	10%
HR-014-0406P	20	44		7	54	9										1154	133	12%
HR-021-0002P	207	258		45		79										4998	589	12%
HR-021-0608P	174	221		40		80										4272	514	12%
HR-021-0406P	291	387		63		147										7323	888	12%
HR-017-4448P			1				3	1	2	1		1				76	10	12%
HR-017-0002P	3		5				1	0.504	2			0.507				86	12	13%
HR-021-4044P	118	184	77	15		32										3109	426	14%
HR-009-1820P		12	0.897		0.897	0.897		0.897		0.897				0.314	0.471	124	17	14%
HR-017-0816G			0.778		6		3	2	2	1	0.933	0.846				120	17	14%
HR-017-1620P	2		3		6	4	5			3		1				163	24	15%
HR-021-0812P	256	404		60		128										5751	848	15%
HR-021-0204P	218	302	239	64		131										6114	954	16%
HR-026-4856P	1		1		2			0.981					1			43	7	16%
HR-016-8890P			1					0.223	0.747							13	2	16%
HR-014-3640P			0.249				1	0.074	0.315	0.358			0.081			15	2	16%
HR-009-2224P		3	0.988		0.988	0.988		0.988		0.988				0.988	0.988	61	10	17%
HR-024-0412P	9	18	16	3						2						287	48	17%
HR-024-0816G	3	11	7	2	7					2						179	33	18%
HR-019-3236P				6130	1140	8220	1900	140								95446	17530	18%
HR-021-1620P	615	839		121		312										10188	1887	19%
HR-024-0204P	6	9	4	2	7					2						151	29	19%
HR-021-0816G		498	306			143								26		4555	973	21%
HR-024-0002P	1	9	3	2	6			5	6	1						148	34	23%
HR-033-0002A		101		52												638	153	24%
HR-020-5660P			8		2	9	2	0.214	2	0.731			0.486			90	24	27%
HR-001-4044P							0.370				0.222			0.088		3	0.680	27%
HR-009-2022P		9	0.979		0.979	0.979		0.979		0.979				0.211	0.107	48	15	31%
HR-021-3640P			16200	1020	2650	4190		238			246	103		211	110	78762	24968	32%
HR-019-5661P	0.611		0.841		2		0.451		0.268	0.835						15	5	34%
HR-009-2628P			0.323					2								6	2	37%
HR-006-4852P					0.563										0.193	2	0.756	41%
HR-019-4448P	7		4			2	2		1	1				0.247	0.180	38	18	46%
HR-019-4044P	6		4			1	4		2	0.852				0.243	0.101	40	18	46%
HR-024-2434P		3	2	2	1		2	1	1	0.234						25	12	46%

10.0175

Table DF-2.2C
High Resolution Coring Study - Sediment Core Sample Data

Negated Values (Changed to Undetect Because of Blank Contamination)

Units: µg/kg

Sample ID	BZ#1	BZ#4	BZ#8	BZ#10	BZ#18	BZ#19	BZ#28	BZ#44	BZ#52	BZ#77	BZ101/ 90	BZ#118	BZ#138	BZ#153	BZ#180	Total PCBs	Sum of Negated Values	Fraction
HR-021-4449P	54	51	4	9	13	8	2	2	3							269	145	54%
HR-019-5256P	6		2			0.318	0.954	1	0.694					0.270		21	12	54%
HR-009-3032P								0.402				0.130		0.103	0.136	1	0.771	69%
HR-019-4852P	4		2		3	0.593	0.872	1	0.603					0.118	0.075	13	11	89%
HR-017-5256P					2		0.569									3	3	92%
HR-017-6063P					2		0.468	0.186	0.144				0.123		0.104	3	3	99%
HR-001-2428P								0.177		0.190						0.361	0.367	102%
HR-026-5664P	13	12	1		0.896		0.368		0.154	0.112				0.276		15	28	186%
HR-009-2426P		3	0.357		1	1		0.540		1		0.150		0.266	1	3	8	266%
HR-006-5256P		0.606			0.465		0.121									0.443	1	269%
HR-014-2832P			0.246		4		0.679	0.140	0.354							2	6	274%
HR-026-6468P	4	13	2		0.755	5	0.423		0.322	0.131	0.186		0.212	0.160		9	26	295%
HR-020-4852P	2		0.456		0.438				0.190							1	3	320%
HR-020-4448P	2		0.359		0.377				0.097	0.172						0.783	3	361%
HR-020-4044P	1		0.251		0.356				0.098							0.515	2	392%
HR-006-4448P		0.627			0.980											0.339	2	474%
HR-020-3640P	3		0.362		0.446				0.102							0.658	4	578%
HR-020-5256P	10		2		0.974	4			0.276	0.203						2	17	972%

Due to the differences among matrices, they will be examined individually, beginning with the water column study dissolved PCB data, as summarized in Table DF-2.2A. Subsequently the particulate data (Table DF-2.2B) and high resolution sediment core data (Table DF-2.2C) will be reviewed.

Of the 102 samples analyzed (5 blanks taken from Saratoga Springs groundwater are not included in this total), 96 had at least one congener (of the 15) negated due to blank contamination (see Table DF-2.2A). For the most part, the effect of the negated congeners on the total PCB concentration was low. Only one mainstem sample downstream of the GE facility exceeded a fraction of 25 percent. The other samples exceeding 25 percent were considered background stations and unaffected tributaries whose absolute concentrations are quite low relative to the Hudson River. As described previously, the fraction on Tables DF-2.2A , DF-2.2B, and DF-2.2C is defined as the ratio of the sum of negated values to Total PCBs. Serious understatement of the total PCBs, defined as those samples where the mass of negated congeners were greater than or equal to the reported PCBs, are shown in the "Fraction" column as values of 100 percent or more. This occurred in 16 samples, including one in which the total PCBs were reported as not detected but two congeners were detected but negated due to presence in blanks.

Even in these 16 samples, the overall effect on total PCBs is not great in most of them, as the total of detected and negated PCBs was less than, or just slightly greater than, 1.0 ng/L, representing background levels for the river. (The one sample in which PCBs were reported as not detected, TW-006-0011, had a total of only about 0.1 ng/L negated congeners.) The four samples which the effect was greatest were TW-002-0008, in which reported total PCBs were about 4.5 ng/L but negated PCB congeners totaled over 13 ng/L (including over 1 ng/L each of BZ#1, #4, #18, #19, and #28); TW-002-0012 (reported PCBs about 2.0 ng/L, negated congeners about 2.4 ng/L); TW-002-0003 (reported PCBs about 2.4 ng/L, negated PCB congeners about 2.7 ng/L); and TW-001-0016 (reported and negated congeners each about 8.6 ng/L). Most of these samples are from water column Stations 0001, 0002, 0011, or 0012, which were collected from background Hudson (stations 0001 and 0002) and tributaries free of GE contamination (Batten Kill, station 0011, and Hoosic River, station 0012), or from Transect 2 (TW-002) which was problematic for other reasons. (In fact, Transect 2 was not analyzed in detail because of the inconsistencies in congener patterns among samples.) Thus, even large errors in the samples from background or tributary locations represent small total mass errors as compared to the main stem Hudson River stations 0003 through 0008.

In the dissolved PCB data, the effect tended to be greatest in an absolute sense in the lower molecular weight congeners. Although some of the higher molecular weight congeners such as BZ#77, BZ#101/90, BZ#138, BZ#153, and BZ#138 were negated frequently (each in more than half of the 102 samples), the absolute concentration of these congeners negated was always less than 1 ng/L, and with a few isolated exceptions (primarily BZ#101/90) consistently less than 0.1 ng/L. Therefore, despite the high number of data points assigned non-detected values due to blank contamination, the effect in general is not great. The effect on sample data was greater for some of the lower molecular weight congeners such as BZ#4 and BZ#19. Although these congeners were negated less often, the negated concentrations were greater in both an absolute sense (e.g., negations of concentrations of 1 ng/L or higher) and in terms of the fraction of these congeners negated relative to the total valid PCB concentration reported.

Of the 101 suspended solids samples analyzed, 86 (85 percent) had at least one congener (of the 15) negated due to blank contamination (see Table DF-2.2B). For the most part, the effect of the negated congeners on the total PCB concentration was low. Again, only one mainstem sample downstream of the GE facility exceeded a fraction of 25 percent, with the remainder over 25 percent representing background and unaffected tributaries. Serious understatement of the total PCBs, defined as above (*i.e.*, the sum of negated values were greater than or equal to the reported PCBs), are shown in the "Fraction" column as values of 100 percent or more. This occurred in five samples, including one (TS-006-0002) in which the total PCBs were reported as not detected but seven congeners were detected but negated due to presence in blanks.

In these five samples, the overall effect on total PCBs varies. These samples, and one other sample potentially affected, are listed below. All of these samples are from water column Stations 0001, 0002, 0011, or 0012, which were collected from background Hudson (stations 0001 and 0002) and tributaries free of GE contamination (Batten Kill, station 0011, and Hoosic River, station 0012) and therefore likely to be quite low in concentration. Thus, even large errors in these samples represent small total mass errors as compared to the main stem Hudson River stations 0003 through 0008. The Maximum Low Bias (MLB) shown is the percent of the worst-case maximum value of total PCBs, assuming the that all the negated PCBs were actually present, represented by the reported total PCB concentration. The MLB is calculated as:

$$\text{MLB} = [(\text{total PCBs})/(\text{total PCBs} + \text{sum UB})] * 100\%$$

Sample ID	Total PCBs (ug/kg)	Negated PCBs (ug/kg)	Maximum Low Bias
TS-006-0001	163.74	160.44	50.5%
FS-209-0002	49.53	55.35	47.2%
TS-006-0011	49.53	7.27	44.8%
TS-001-0001	137.02	172.58	44.3%
TS-005-0002	66.08	94.08	41.3%
TS-006-0002	0.00	120.30	Not Defined

In the water column particulate PCB data, the effect tended to be greatest in an absolute sense in the lower molecular weight congeners, although the effect is not as pronounced as for the dissolved PCBs. Only BZ#180 was negated in more than half the samples (62 of 101, or 61 percent); however, the absolute concentrations were relatively low (less than 50 µg/kg [ppb] in all cases), and never representing more than about 15 percent of the total valid PCBs (with the exception of TS-006-0011, in which the negated concentration of BZ#180 [2.7 µg/kg] was about 45 percent of the total valid PCB concentration [about 5.9 µg/kg]).

Due to the relatively high concentrations of PCBs in the particulate matter, the absolute concentrations negated were higher than for the dissolved PCBs. However, as a fraction of the total PCBs, the negated concentrations in the particulate matter were lower than in the dissolved phase.

For example, the highest negated congener concentration in the particulate matter, about 2500 µg/kg BZ#28 in TS-008-0004, represented less than 15% of the total valid PCB concentration (about 18,800 µg/kg) in that sample. The 2500 µg/kg negation was by far the highest negated congener concentration; although congener concentrations 100 µg/kg or greater were negated in 45 other instances, only two of these negated values were greater than 500 µg/kg, with the next highest negated value being about 860 µg/kg (BZ#19 in TS-001-0003).

There were 467 high resolution sediment core samples. Of these, 360 (77 percent) had at least one congener (of the 15) negated due to blank contamination (see Table DF-2.2C). For the most part, the effect of the negated congeners on the total PCB concentration was low. Only 28 of the 467 samples had fraction values greater than 25 percent. This represents less than 6 percent of the total samples analyzed. Serious understatement of the total PCBs, defined as above, occurred in only 12 samples (2.6 percent of the total high resolution sediment core samples analyzed), including no samples in which the total PCBs were reported as not detected but congeners were detected but negated due to presence in blanks.

As with the particulate phase samples, due to the relatively high concentrations of PCBs in the sediment samples, the absolute concentrations negated were higher than for the dissolved PCBs. However, as a fraction of the total PCBs (and considering the nearly five-fold greater number of samples), the negated concentrations in the sediment samples overall were lower than both the particulate matter and the dissolved phase. Even in the 12 samples in which the "Fraction" exceeded 100 percent, the overall effect on total PCBs is not great in most of them, as the total of detected and negated PCBs was less than 35 µg/kg. There is only one sample (HR-021-4449P) in which the fraction negated was greater than 50 percent of the valid detection and the sum of the negated concentrations was greater than 100 µg/kg; and only one sample (HR-021-3640P) in which the fraction negated was greater than 25 percent and the sum of negated congener concentrations was greater than 1000 µg/kg.

With the exception of sample HR-21-3640P, the high resolution core samples with fractions greater than 25 percent represent the deepest slices within the cores, with concentrations less than 270 µg/kg. That is, they represent older sediments, which in most cases reflect conditions near the onset or prior to the GE discharges to the Hudson River. As such their levels are expected to be quite low. In these cases, the presence of a large proportion of blank contamination has little impact on their interpretation.

Response to DF-2.2B

BZ#44 was similar to BZ#52 with respect to data quality issues. In fact, BZ#44 had a lower frequency of blank contamination than BZ#52 for the water column samples and a slightly higher frequency for the sediment samples (see Tables A-6, B-3 and B-4). Although it was not reviewed at the same quality control level as BZ#52, it is expected that the data quality conclusions drawn for BZ#52 would also apply to BZ#44.

Response to DF-2.2C

To the extent that these congeners become important in the assessment of human health and ecological risks, USEPA agrees that it will be important to consider their suggested concentration as inferred from the presence of other similar congeners. At this point in the geochemical analysis, further interpretation of these specific congeners was not expected to greatly benefit the overall understanding of PCB fate and transport in the Hudson and so was not pursued.

A.1 Introduction
A.2 Field Sampling Program
A.3 Analytical Chemistry Program
A.3.1 Laboratory Selection and Oversight
A.3.2 Analytical Protocols for PCB Congeners
A.4 Data Validation
A.5 Data Usability
A.5.1 Approach

No significant comments were received on Sections A.1 through A.5.1.

A.5.2 Usability - General Issues

Response to DG-1.25C

Internal consistency in the analytical procedure was maintained as much as possible and was kept within specifications. USEPA data validation considers such issues to a limited degree so that this concern was monitored. However, the issue of response factor changes in response to changes in operating conditions only becomes important if one congener is more significantly affected relative to another and not on an absolute basis. This comes about because both the original analyses and the subsequent congener standard based correction were performed on a ratio basis, that with respect to BZ#52. Thus as long as the response factor of the congener in question and that of BZ#52 responded in the same manner to operational changes, then there was no impact on the calibration correction. Undoubtedly some congeners were more sensitive and some less sensitive to these factors, but it is deemed unlikely that the differences in relative sensitivity would be very large. Since the primary purpose of the nontarget congener analysis was to improve the overall estimate of total PCBs by simply including these additional congeners in the sum, it is unlikely that this sensitivity would introduce a substantive error.

Sample drying was conducted in low temperature incubators at roughly 36°C. Samples pairs of wet and dried analyses did not show substantive differences in congener pattern and quantitation.

Samples were extracted using a hexane-acetone mixture. The statement on page A-4 is in error.

A.5.3 Usability - Accuracy, Precision, Representativeness and Sensitivity

No significant comments were received on Section A.5.3.

A.5.4 Usability - Principal Congeners

Response to DF-2.1

In the report, PCB data are examined in several ways, including total PCBs, homologue sums, individual congener concentrations and congener ratios. No one way of examining the data provided the key to all understandings gained during the preparation of the report. In each analysis, the level of PCB data resolution (*i.e.,* total PCBs, homologues or congeners) was advanced as needed to address the specific question. While further resolution of the PCB data could provide additional information, it was not deemed necessary for the purposes of the questions being addressed.

In preparing the report, the focus was inherently limited to the fate of PCBs in the Hudson River without considering the importance of a particular congener to fish or human health. This focus was necessary since in this phase of the investigation it is unclear which congeners will be of greatest importance in the subsequent analyses relating to fish or human health. It was also important to understand the variability of PCB transport across the spectrum of congeners, since many of the factors affecting transport will vary with increasing number of chlorines. The most concentrated congeners provide the best basis to estimate this variability since these congeners were most likely to be present in all media measured (*i.e.,* sediments, water, and biota) and thus provide information on the transport or exchange among media. This information can then be applied to less concentrated congeners which may be of equal or even greater interest from a toxicological perspective.

It should be noted here that although Appendices A and B focus on only 12 congeners, all congener data was submitted to a rigorous, USEPA Region 2-approved, data validation procedure. The discussion of 12 specific congeners in the appendices was focused on those congeners expected to be of greatest importance to the ensuing data interpretation. This portion of the report was prepared prior to the completion of the interpretive sections of the report when it was unclear exactly which congeners would be incorporated in the report discussion. As a result, the appendices discuss several congeners which are not specifically discussed in the report. Several of them were discussed at length in the DEIR (*e.g.,* BZ#1, 4, 8, 10, 19, and 52) while others will be utilized in the upcoming modeling work (*e.g.,* BZ#4, 28, 52, 101, and 138). The latter set was reviewed in the DEIR in anticipation of the data quality needs of the fate and transport models to be discussed in the Baseline Modeling Report. The remaining three (BZ#18, 118, and 180) were selected because they were selected as representative of Aroclors 1242, 1254, and 1260, respectively.

Ultimately, further congener analysis would almost certainly provide additional insights to PCB fate and transport. However, for the purposes of the DEIR, the analyses presented provide a sufficient level of understanding of PCB transport. Further interpretation may be completed during the fate and transport modeling or during the ecological and human health assessments as needed. As far as identification of problem samples is concerned, this was largely done during the data interpretation process by examining the congener spectra associated with outliers.

Response to DG-1.25A

This congener ("PCB [sic] 12") was detected in the four lower molecular weight Aroclor standards (1016, 1221, 1232, and 1242) at concentrations ranging from 0.083% to 0.436% of the total mass of the Aroclor. BZ#126 was detected only in the standard for 1248 as 0.053% of that Aroclor's mass.

USEPA concurs that the congeners listed by GE as "trace" are generally such; analysis of Aroclor standards (Aquatec, 1992) showed that BZ#58, 69, 140, 143, and 169 were not detected in any of the standards analyzed for this project. BZ#184 was detected only in the Aroclor 1260 standard (0.087% of its mass); BZ#23 was detected in all Aroclors except 1260 at concentrations consistently of about 0.06%; and BZ#96 was detected in five of seven Aroclors at concentrations of 0.043% to 0.136%. The USEPA will take the writer's interpretation into consideration if any of these congeners are considered individually.

Response to DG-1.25B

Congener-specific comments are presented which amplify some of the concerns and analytical problems encountered in some of the analyses. These comments are for the most part acknowledged and do not significantly impact the quality or usability of the data. Certain congener-specific comments are addressed below however.

BZ#18. Data were not rejected for discrepancies up to a factor of five between the ECD and ITD results because the ITD data were never intended to be quantitative. The purpose of the ITD analysis was to generate confirmational data for the congener *identificatio*n, not quantitation.

PCB #138. While USEPA has no knowledge that BZ#138 coelutes with #163, a fact which "was not recognized" in the DEIR, this fact is not considered significant (regardless of whether or not it is true). BZ#163 is not reported to be present in Aroclors 1242 or 1016. BZ#138 is present, but at low concentrations (about 0.5% or less) in these Aroclors (Frame, 1997).

BZ#46 - The congeners reported represented the "state-of-the-art" at the time the analyses were conducted; coupled with the necessity that the congener could be unequivocally and accurately identified. It is noted that BZ#46 is reported to occur in only low concentrations (less than 1% of the total mass) in Aroclors 1242 and 1016 (Frame, 1997), and only a very few of the limited number of pentachlorobiphenyls in these Aroclors could even theoretically generate BZ#46 as a degradation byproduct. Although consideration will be given to adding BZ#46 to any future analysis performed, its omission from the Phase 2 analyses is not significant.

Volume 2C (Book 3 of 3)
Appendix B: DATA USABILITY REPORT FOR PCB CONGENERS WATER COLUMN MONITORING PROGRAM

B.1 Introduction
B.2 Field Sampling Program
B.3 Analytical Chemistry Program
B.3.1 Laboratory Selection and Oversight
B.3.2 Analytical Protocols for PCB Congeners
B.4 Data Validation
B.5 Data Usability
B.5.1 Approach
B.5.2 Usability - General Issues
B.5.3 Usability - Accuracy, Precision, Representativeness and Sensitivity
B.5.4 Usability - Principal Congeners

B.6 Conclusions

No significant comments were received on Appendix B (note that some Appendix A comments and responses also apply to Appendix B).

Volume 2C (Book 3 of 3)
Appendix C: DATA USABILITY REPORT FOR NON-PCB CHEMICAL AND PHYSICAL DATA

C.1 Introduction
C.2 High Resolution Coring Study and Confirmatory Sediment Sample Data
C.2.1 Grain Size Distribution Data
C.2.2 Total Organic Nitrogen (TON) Data
C.2.3 Total Carbon/Total Nitrogen (TC/TN) Data
C.2.4 Total Inorganic Carbon (TIC) Data
C.2.5 Calculated Total Organic Carbon (TOC) Data
C.2.6 Weight-Loss-on-Ignition Data
C.2.7 Radionuclide Data
C.2.8 Percent Solids
C.2.9 Field Measurements
C.3 Water Column Monitoring Program and Flow-Averaged Sampling Programs
C.3.1 Dissolved Organic Carbon (DOC) Data
C.3.2 Total Suspended Solids and Weight-Loss-on-Ignition (TSS/WLOI) Data
C.3.3 Chlorophyll-*a*

No significant comments were received on Appendix C.

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References

HUDSON RIVER PCBs REASSESSMENT RI/FS
RESPONSIVENESS SUMMARY
VOLUME A: DATABASE REPORT
VOLUME B: PRELIMINARY MODEL CALIBRATION REPORT
VOLUME C: DATA EVALUATION AND INTERPRETATION REPORT
DECEMBER 1998

D. ADDITIONAL REFERENCES FOR THE RESPONSIVENESS SUMMARY

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